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Engineering and Contracting for 1913.

With this issue Engineering and Contracting begins its eighth year. It is a journal of 50 pages, 30 of which contain civil engineering articles and discussion and 20 of which contain news of civil engineering construction which is being planned and prosecuted. During the coming year changes will be made in classification and manner of presentation which we believe will make the journal a more complete and convenient source of civil engineering information. A brief explanation of these changes seems desirable.

The articles and discussion contained in the 30 pages allotted to them will be classified under ten headings as follows: (1) Editorial, (2) General Articles, (3) Roads and Streets, (4) Water Works, (5) Sewerage and Sanitation, (6) Drainage and Irrigation, (7) Power Plants, (8) Buildings, (9) Bridges, and (10) Railways. At least six and not over seven of these classifications will be represented in each issue, all articles of any classification appearing under that classification heading and forming an individual section of the journal. Obviously some of the classes of articles or "sections" must alternate in the successive issues. The following periodicity will be maintained as closely as possible: Sections 1 to 4 will appear in each issue; sections 5 and 6 will appear every fortnight, and sections 7 to 10 will appear every three weeks. Stated in different form, four sections will appear 52 times, two sections will appear 26 times and four sections will appear at least 17 times in each twelve months.

The news of construction work in the 20 pages allotted to them will be classified and published under headings or in "sections" corresponding exactly to those employed in the part of the journal devoted to technical articles. Every news "section" will however appear each week when news of engineering importance and of authenticity are available for a "section."

With this classified arrangement of technical articles and news items it is apparent that the civil engineer or contractor interested in any one or more than one class of engineering and construction will be able to locate immediately and precisely the articles and news items which he is chiefly concerned in locating. To facilitate his search still more there will be published as a part of the table of contents of each issue, an index of works and products dealt with in that issue. The items in this index will be arranged under the following headings: Earth Excavation; Rock Excavation; Concrete Construction; Steel Construction; Foundry Products; Bituminous Products; Clay Products; Timber Products, and Machinery.

The utility of this index comes from the fact that any of the classes of work or products named may be included in any of the constructions described or discussed under any of the ten main "section" headings previously listed. By consulting this index the civil engineer or contractor is referred precisely by page number to each place in all "sections" where considerable mention is made of or data are given relating to, for example, earth excavation. In similar manner he is referred by the index to places where each of the other listed classes of work or of products is mentioned.

The articles and news items furnished by Engineering and Contracting are confined to works and products involved in the practice of the civil engineer. This limitation does not mean that nothing of the engineering of mining or of power development and transmission or of other construction involving the work of mechanical, or electrical, or mining engineers will be published, but that the civil engineer's part only of such engineering work will be considered. At its least this is a broad field of activity and it is only by confining effort to it alone that one can approach the completeness of presentation in written records which it deserves.

In conclusion it is right that we should express thanks to the subscribers and to the purchasers of advertising space who have made it possible for the publishers to bring Engineering and Contracting to its present position as a journal for civil engineers and contractors.

A New Alloy of Iron That Is Rustless.

Chemically pure iron—that is, *Fe* without carbon or other alloy—is quite free from oxidization; but it lacks the strength of steel and will not resist abrasion well. For certain purposes, however, like corrugated metal culverts, fence wire, etc., pure iron has been used with great economic advantage. If reports are correct, a rustless alloy of iron has been recently made in France.

Professor Borcheris of Aix-la-Chapelle, a well known metallurgist, is credited with having produced an iron alloy which resists even boiling nitric acid. The alloy consists of ferro-chrome (having very little carbon) and molybdenum. Titanium and vanadium give results not quite as favorable as molybdenum. The important question of cost is, as yet, unanswered, as is the question of strength. Nevertheless we have in this announcement a finger post that may point the way to securing a commercial, rustless iron alloy for use in engineering structures and machines.

A Notable Series of Articles on Interstate Swamp Drainage.

There are in the United States a number of great swamp areas, like the St. Frances, the Red River, the Dismal, the Kankakee, the Okefinokee and the Savannah River Bottoms, which lie across the boundaries of two or more states. The reclamation of any one of these swamp areas is one problem as far as its engineering is concerned. It is not, however, so far, being considered as one problem in any instance. The work that is being done in one State is being done with no consideration of its effect on the work that is being done or that may be done in the neighboring State in which lies another part of the same swamp. In fact reclamation of different portions of that part of the swamp within one State is seldom conducted as a part of a common plan; each fractional area is drained and leveed as a separate and independent work. The faulty engineering of these procedures is evident, and it is also evident that some time in the work of reclaiming these great swamps some one will pay heavily for these engineering faults. It should be the part of engineers to urge these facts and to aid in developing a more logical and comprehensive plan of interstate swamp reclamation.

It is as an aid toward this end that Engineering and Contracting has undertaken, through the able pen and special knowledge of Mr. M. O. Leighton, Chief Hydrographer, U. S. Geological Survey, to place before engineers a competent account of the characteristics of various interstate swamps and of the nature of the engineering problems involved in their reclamation. The first of these articles was published in our issue of Nov. 11, 1912, and the second is published in another section of this issue. Other articles on other interstate swamp areas will follow and the series will close with discussions of legislation, regulation, methods, crop possibilities, etc. We shall not anticipate further the arguments and facts which Mr. Leighton will set forth to elucidate the problem of interstate swamp drainage; we urge here merely that engineers interested in this problem shall study carefully these facts and arguments and lend their aid by criticism and approval, to the work to promote which the articles have been written.

GENERAL ARTICLES

Unit Costs of Construction on the Panama Canal for the Fiscal Year Ending June 30, 1912.

(Staff Article.)

The following are the detailed costs per unit of work for the construction of the Panama Canal for the year ending June 30, 1912, as taken from the annual report of Col. Goethals, Chairman and Chief Engineer of the Isthmian Canal Commission. The work considered includes dry excavation, dredging excavation, hydraulic excavation, masonry, dry filling, hydraulic filling, piles for foundations, breakwater, stone and sand production, concrete pile manufacture, and cost of power plant operation.

The cost of securing and preparing the detailed cost data is of interest. The expenses of this department for the month of June, 1912, were $5,093.35, or about $60,000 for the year. Considering the savings which have resulted from securing detailed costs promptly, this is a very small expense. The expense of keeping records of costs is about 0.04 per cent of the total of construction expenditures.

DRY EXCAVATION.

In the last annual report of the low cost of excavation in the Central Division was commented on and it was stated that the division cost of $0.588 per cu. yd., was not likely to be so low again, because fewer shovels could be operated and on account of the confined space for handling trains, etc. The cost for this year is $0.5101, a decrease of $0.0779.

Owing to the large increase in the estimated yardage due to slides, etc., the average arbitrary plant charge during the year was reduced by $0.0606, so that the division cost, exclusive of arbitrary, was $0.4865 last year as against $0.4753 this year, an actual decrease of $0.0112. This decrease is entirely against the item "tracks," which shows a decrease of about $360,000, due principally to the excessive dry season, decrease in track mileage, and to recovery of second hand material from tracks in the completed portions of the canal. Other items show but small change from the figures of the previous year. The figures for this year are as follows:

TABLE 1.—DRY EXCAVATION

Atlantic Division.

Dry excavation, canal prism, cu. yds.	424,872
Drilling	$0.0174
Blasting	0.0494
Loading	0.0564
Tracks	0.0487
Transportation	0.1280
Pumps	0.0202
Maintenance of equipment	0.0754
Plant, arbitrary	0.1814
Division expense	0.0183
Total division cost	$0.5952
Administration and general expense	0.0406
Total cost	$0.6358

Gatun Spillway.

Excavation, cu. yds.	7,133
Blasting	$0.0004
Loading by power	0.2031
Loading by hand	1.3354
Transportation	0.0052
Tracks	0.0223
Cofferdams	0.7606
Maintenance of equipment	0.0471
Plant arbitrary	0.1081
Division expense	0.1578
Total division cost	$2.6400
Administrative and general expense	0.2643
Total cost	$2.9043
Gatun locks, excavation, cu. yds.	8,888
Drilling	$0.3157
Blasting	0.1900
Loading by power	0.0479
Loading by hand	1.2150
Transportation	0.2139
Tracks	0.0203
Pumps	0.1397
Maintenance of equipment	0.4388
Plant arbitrary	0.2000
Division expense	0.1785
Total division cost	$2.9598
Administrative and general expense	0.2484
Total cost	$3.2082
Gatun power house—excavation, cu. yds.	72,119
Clearing	$0.0046
Drilling	0.0048
Blasting	0.0004
Loading	0.0342
Tracks	0.0655
Transportation	0.0864
Maintenance of equipment	0.0638
Plant arbitrary	0.1024
Division expense	0.0146
Total division cost	$0.3767
Administrative and general expense	0.0221
Total cost	$0.3988

Central Division.

Prism excavation, cu. yds.	16,917,662
Clearing	$0.0001
Drilling	0.0535
Blasting	0.0622
Loading	0.0492
Tracks	0.0885
Transportation	0.0734
Dumps	0.0423
Pumps	0.0041
Maintenance of equipment	0.0843
Plant arbitrary	0.0394
Division expense	0.0145
Total division cost	$0.5115
Administrative and general expense	0.0364
Total cost	$0.5479

Pacific Division.

Prism excavation, cu. yds.	864,475
Clearing	$0.0027
Drilling	0.0825
Blasting	0.0413
Loading	0.1116
Tracks	0.1359
Transportation	0.0637
Dumps	0.0043
Pumps	0.0377
Maintenance of equipment	0.0740
Plant arbitrary	0.1762
Division expense	0.0228
Total division cost	$0.7527
Administrative and general expense	0.0432
Total cost	$0.7959
Pedro Miguel locks—dry excav., cu. yds.	95,156
Drilling	$0.0001
Loading by power	0.0943
Tracks	0.0650
Transportation	0.0451
Dumps	0.0008
Pumps	0.0204
Maintenance of equipment	0.0633
Plant arbitrary	0.0002
Division expense	0.0126
Total division cost	$0.3018
Administrative and general expense	0.0283
Total cost	$0.3301
Preparing foundatinos, cu. yds.	38,826
Drilling	$0.4002
Blasting	0.1252
Loading by power	0.0948
Loading by hand	0.8446
Transportation	0.0981
Tracks	0.2821
Dumps	0.0092
Pumps	0.0340
Maintenance of equipment	0.1684
Plant arbitrary	0.0016
Division expense	0.1133
Total division cost	$2.1715
Administrative and general expense	0.2142
Total cost	$2.3857
Pedro Miguel dam—excavation, cu. yds.	3,937
Excavation by hand	$1.3739
Maintenance of equipment	0.0575
Division expense	0.0712
Total division cost	$1.5026
Administrative and general expense	0.1132
Total cost	$1.6158
Miraflores locks—dry excavation, cu. yds.	624,747
Drilling	$0.1012
Blasting	0.0637
Loading by power	0.1186
Tracks	0.1210
Transportation	0.0699
Dumps	0.0120
Pumps	0.0235
Maintenance of equipment	0.0769
Plant arbitrary	0.0436
Division expense	0.0265
Total division cost	$0.6566
Administrative and general expense	0.0508
Total cost	$0.7074
Preparing foundations, cu. yds.	165,145
Drilling	$0.0905
Blasting	0.0495
Loading by power	0.0615
Loading by hand	0.7859
Transportation	0.0742
Tracks	0.1434
Dumps	0.0272
Pumps	0.0941
Maintenance of equipment	0.1138
Plant arbitrary	0.0520
Division expense	0.0756
Total division cost	$1.5677
Administrative and general expense	0.1444
Total cost	$1.7121

DREDGING EXCAVATION.

The operation of dredges is confined, except in minor instances, to the excavation of the sea level channels from the Gatun Locks to the Atlantic on the north and from the Miraflores Locks to the Pacific on the south. In the Atlantic division the average cost per cubic yard for pipe lines in connection with the pipe-line suction dredges was $0.0127 for dredging in prism and $0.0121 for dredging in locks, as against $0.0074 for dredging in prism last year. The charge to retaining dikes amounted to $0.0125 per cubic yard of material excavated from prism and to $0.0323 per cubic yard of material excavated from Gatun Locks, as against $0.0729 per cubic yard of material excavated from prism last year. This reduction is largely fictitious, as the larger proportion of cost of the retaining dike, which will be used to hold this class of excavation, was included in the accounts of last year; and the average cost should be based on the quantity dredged to date, both in the prism and in the lock site, a total of 2,236,274 yards, or a cost for the dike per cubic yard of $0.0429. These

TABLE II—DREDGING, ATLANTIC DIVISION.

Prism.	Cu. Yds.	Unit Cost.
Clearing	4,870,827	$0.0006
Seagoing suction dredge:		
Operation	2,755,255	0.0378
Repairs	2,755,255	0.0259
Small ladder dredges:		
Operation	1,004,118	0.0772
Repairs	1,004,118	0.0790
Dipper dredges:		
Operation	595,667	0.1111
Repairs	595,667	0.1437
Pipe-line dredges:		
Operation	515,787	0.0424
Repairs	515,787	0.0705
Pipe lines	515,787	0.0127
Dikes	515,787	0.0125
Tugs, clapets and scows:		
Operation	1,599,785	0.0811
Repairs	1,599,785	0.0698
Drilling	574,837	0.0897
Blasting	574,837	0.1321
Small boats	4,870,827	0.0024
Repairs, miscellan's equipment	4,870,827	0.0018
Plant arbitrary	4,870,827	0.0458
Division expense	4,870,827	0.0077
Total division cost	4,870,827	$0.2481
Administrative and general exp.	4,870,827	0.0207
Total cost	4,870,827	$0.2688
Earth excavation, per cent	4,295,990	88.20
Rock excavation, do	574,837	11.80
Gatun Locks.		
Dredging excavation	883,918	.....
Suction dredges:		
Operation	......	0.1377
Repairs	......	0.0372
Pipe lines	......	0.0121
Cofferdams	......	[1]0.0034
Dikes	......	0.0323
Drilling	......	0.0013
Blasting	......	0.0027
Plant arbitrary	......	0.0880
Division expense	......	0.0050
Total division cost	......	$0.3129
Administrative and general exp.	......	0.0131
Total cost	......	$0.3260

[1] Indicates credit.

costs represent the expenses for disposing of material excavated by pipe-line suction dredges.

The cost of disposing of material excavated by ladder and dipper dredges was: Atlantic division, $0.1509 per cubic yard, as against $0.1355 last year; Pacific division, $0.0907 per cubic yard, as against $0.0917 last year. In the Atlantic division 574,837 cu. yds. of rock were dredged from prism, being 11.80 per cent of total prism excavation. The cost of breaking this rock for the dredges was $0.2218 per cubic yard. Last year there was excavated 487,038 cu. yds. of rock, being 8.36 per cent of total excavation, with a cost of $0.1588 per cubic yard for breaking. In the Pacific division 410,216 cu. yds. of rock were dredged from prism, being 10.56 per cent of total. The cost of breaking this rock for the dredges was $0.3300 per cubic yard, as against 301,112 cubic yards, being 5.43 per cent of total, and cost of $0.5776 per cubic yard for breaking last year.

The total excavation in prism in the Atlantic division was 4,870,827 cu. yds., as against 5,828,345 cu. yds. last year. The cost per cubic yard was $0.2481 for 1912 and $0.2215 for last year. In the Pacific division, the average cost

TABLE III.—DREDGING, PACIFIC DIVISION.

Prism.	Cu. Yds.	Unit Cost.
Seagoing suction dredge:		
Operation	2,376,505	$0.0485
Repairs	2,376,505	0.0247
Small ladder dredges:		
Operation	991,992	0.0788
Repairs	991,992	0.0315
Five-yard ladder dredge:		
Operation	153,626	0.0932
Repairs	153,626	0.1340
Dipper dredges:		
Operation	362,164	0.1160
Repairs	362,164	0.0983
Tugs, clapets and scows:		
Operation	1,507,782	0.0675
Repairs	1,507,782	0.0232
Drilling	410,216	0.0010
Blasting	410,216	0.0040
Operation, drill barges	410,216	0.2869
Operation, rock breakers	410,216	0.0381
Small boats	3,884,287	0.0040
Repairs, miscellan's equipment	3,884,287	0.0085
Division expense	3,884,287	0.0056
Total division cost	3,884,287	$0.1900
Administrative and general exp.	3,884,287	0.0176
Total cost	3,884,287	$0.2076
Earth excavation, per cent	3,474,071	89.44
Rock excavation, do	410,216	10.56

TABLE IV.—HYDRAULIC EXCAVATION, ATLANTIC DIVISION.

Prism, cu. yds	1,000
Dredging pumps	$2.4430
Division expense	0.1546
Total division cost	$2.5976
Administrative and general expense	0.2090
Total cost	$2.8066
PACIFIC DIVISION.	
Prism, cu. yds	900,596
Clearing	$0.0004
Drilling	0.0043
Blasting	0.0058
Pumping station	0.0840
Pipe lines and monitors	0.0513
Dredging pumps	0.0634
Dikes	0.0198
Maintenance of equipment	0.0893
Power	0.1223
Plant arbitrary	0.1027
Division expense	0.0131
Total division cost	$0.5564
Administrative and general expense	0.0284
Total cost	$0.5848

TABLE V.—COST OF PLAIN CONCRETE.

	Gatun Spillway.	Gatun Locks.	Pedro Miguel Locks.	Miraflores Locks.
Large rock	$0.0079	$0.0211	.....	.....
Forms	0.5007	0.5204	$0.5511	$0.3166
Mixing	0.4543	0.1600	0.2833	0.2011
Placing	0 2913	0.4285	0.4731	0.1717
Reinforcements	0.0127	0.0158	0.0009	0.0002
Pumping	0.0030	0.0580	0.0237	0.0170
Cofferdams	0.0204	.....	.....	.....
Maintenance of eq'p.	0.1438	0.0936	0.0546	0.0837
Division expense	0.1084	0.0866	0.0866	0.0491
Total cost., cu. yd.	$1.5425	$1.3840	$1.4733	$0.8394

The cost of reinforced concrete is given in Table VI.

TABLE VI.—COST OF REINFORCED CONCRETE.

Gatun Spillway.	
Concrete, cu. yds	57,894
Cement	$1.6559
Stone	1.8964
Sand	0.9245
Mixing	0.2820
Total cost	$4.7588
Large rock, cu. yds	154
Large rock, cost	$3.5606
Masonry, cu. yds	58,048
Concrete	$4.7461
Large rock	0.0094
Forms, wood	0.7360
Forms, steel	.....
Placing	0.6287
Reinforcements	0.0439
Pumps	0.0041
Power	.....
Cofferdams	0.0311
Maintenance of equipment	0.2856
Plant arbitrary	0.4200
Division expense	0.1084
Total division cost	$7.0133
Administrative and general expense	0.4105
Total cost	$7.4238
Masonry, reinforced, cu. yds	618
Cement	$1.7444
Stone	1.8974
Sand	0.8871
Mixing	0.3726
Wood forms	5.6367
Steel forms	.....
Power	.....
Placing	1.0513
Reinforcements	2.3782
Pumps	.....
Maintenance of equipment	0.4523
Plant arbitrary	0.4013
Division expense	0.3418
Total division cost	$15.1631
Administrative and general expense	1.1396
Total cost	$16.3027
Total masonry, cu. yds	58,666
Total cost	$7.5173
Gatun Locks.	
Concrete, cu. yds	376,417
Cement	$1.5332
Stone	1.9946
Sand	1.0128
Mixing	0.1798
Total cost	$4.7204
Large rock, cu. yds	1.4194
Cost	$1.3283
Masonry, cu. yds	390,611
Concrete	$4.5478
Large rock	0.0483
Wood forms	0.5077
Steel forms	0.1502
Placing	0.4788
Reinforcements	0.0173
Pumps	0.0878
Power	0.0834
Cofferdams	.....
Maintenance of equipment	0.2109
Plant arbitrary	0.8980
Division expense	0.1015
Total division cost	$7.1317
Administrative and general expense	0.2643
Total cost	$7.3960
Masonry, reinforced, cu. yds	59,883
Cement	$2.2111
Stone	1.9930
Sand	1.0381
Mixing	0.5855
Wood forms	2.8307
Steel forms	0.1281
Power	0.0324
Placing	0.7385
Reinforcements	0.8623
Pumps	0.0014
Maintenance of equipment	0.2033
Plant arbitrary	0.9281
Division expense	0.2703
Total division cost	$11.8228
Administrative and general expense	0.8367
Total cost	$12.6595
Total masonry, cu. yds	450,494
Total cost	$8.0956
Pedro Miguel Locks.	
Concrete, cu. yds	134,193
Cement	$1.6564
Stone	0.7619
Sand	0.3823
Mixing	0.3562
Total cost	$3.1568
Masonry, cu. yds	134,193
Concrete	$3.1568
Wood forms	0.7596
Steel forms	0.0041
Placing	0.5619
Reinforcements	0.0074
Pumps	0.0331
Power	0.0199
Maintenance of equipment	0.1511
Plant arbitrary	0.9101
Division expense	0.1143
Total division cost	$5.7183
Administrative and general expense	0.3085
Total cost	$6.0268
Masonry, reinforced, cu. yds	48,677
Cement	$2.2715
Stone	0.7133
Sand	0.3282
Mixing	0.4112
Wood forms	1.6959
Power	0.0085
Placing	0.7087
Reinforcements	1.3263
Pumps	0.0197
Maintenance of equipment	0.1198
Plant arbitrary	0.6923
Division expense	0.2241
Total division cost	$8.5195
Administrative and general expense	0.6443
Total cost	$9.1638
Total masonry, cu. yds	182,870
Total cost	$6.8618
Miraflores Locks.	
Concrete, cu. yds	729,096
Cement	$1.7920
Stone	0.7464
Sand	0.3564
Mixing	0.2258
Total cost	$3.1206
Concrete	$3.1206
Wood forms	0.4030
Steel forms	0.0364
Placing	0.2014
Reinforcements	0.0012
Pumps	0.0327
Power	0.0289
Maintenance of equipment	0.1545
Plant arbitrary	0.5420
Division expense	0.0660
Total division cost	$4.5867
Administrative and general expense	0.2240
Total cost	$4.8107
Masonry, reinforced, cu. yds	22,444
Cement	$2.0051
Stone	0.7222
Sand	0.3236
Mixing	0.8380
Wood forms	2.2615
Steel forms	0.7138
Power	0.0080
Placing	0.8883
Reinforcements	1.7997
Pumps	0.1257
Maintenance of equipment	0.0931
Plant arbitrary	0.5487
Division expense	0.3111
Total division cost	$10.6388
Administrative and general expense	0.8172
Total cost	$11.4560
Total masonry, cu. yds	751,540
Total cost	$5.0091

per cubic yard was $0.19, 3,884,287 cu. yds. being excavated, as against $0.2519 per cubic yard last year, with 5,549,642 cu. yds. of excavation. The figures for the Pacific division do not include any arbitrary for plant, the total cost of the plant having been absorbed prior to this fiscal year. The arbitrary in the Atlantic division was $0.458 for excavation in prism and $0.0880 for excavation in Gatun locks this year. The arbitrary charged in Pacific division accounts in 1911 was $0.0759 per cubic yard.

Only two French dipper dredges were operated in the Atlantic division this year, one having been lost in June, 1911. In the Pacific division the 5-yard dipper dredge was put in commission on April 11. The high cost per cubic yard of excavation by this dredge was largely due to the depth at which it worked and the quality of material handled rock and hard clay. In general, all costs show an actual increase, due to increased depth of the excavation and a longer haul to the dumps. Tables II and III give the detailed unit costs of the dredging excavation in the Atlantic and Pacific divisions.

HYDRAULIC EXCAVATION.

In the Atlantic division 1,000 cu. yds. of material were sluiced from prism at Mindi, at a division cost of $2.5976 per cubic yard, completing the work described in last annual report. In all, 29605 cu. yds. were removed by this method at a division cost of $0.3185 per cubic yard. In the Pacific division 900,596 cu. yds. were excavated from the prism at an average division cost of $0.5564 per cubic yard, as against 332,703 cu. yds. from Miraflores Lock site and 197,677 cu. yds. from the prism last year at an average cost of $0.5486 and $0.6106 per cubic yard, respectively.

MASONRY.

A total of 1,443,570 cu. yds. of masonry was laid in the locks and spillways this year, as against 1,741,908 cu. yds. laid last year. The cost of plain concrete at Gatun spillway, with approximately the same quantity placed this year as last, shows an increase of $0.3089 over last year. The increases are principally in the items sand, mixing, forms, placing reinforcements, pumping, and maintenance of equipment. Decreases in the cost of cement, stone, and plant arbitrary amounting to $0.3507, partially offset the increases. Owing to the difference in ratio of the large rock used in the two years, the cost of mixed concrete per cubic yard of masonry laid, shows further increase of $0.0725, while large rock shows a decrease of $0.0283 per cubic yard.

What is said of the increases and decreases in the cost of concrete per cubic yard for the Gatun spillway is also true for most items for the Gatun locks, the Pedro Miguel locks, and the Miraflores locks. Table V shows the division labor cost of plain concrete at the various locks and spillways.

DRY FILLING.

Based on the quantities reported each month the cost of the dry filling in Gatun dam shows an increase of $0.1361 per cubic yard over that for last year. These figures are, however, largely theoretical. The method of ascertaining the quantity placed each month is to cross-section the areas worked over during the month and deduct an arbitrary of 40,000 cu. yds. to allow for slow consolidation in the areas not cross-sectioned. Complete cross-sections made in June, 1911, and June, 1912, indicate that the dry fill was increased during the year 1911 by 2,060,186 cu. yds. and during the year 1912, by 2,982,859 cu. yds., instead of by 2,653,908 cu. yds. and 2,608,073 cu. yds., respectively.

If the quantities ascertained by the complete cross-sections be used, the average cost per cubic yard for the fiscal year 1911 is $0.4912. Included in the cross-section yardage for 1912 are 438,333 cu. yds. previously wasted from excavation from spillway, all cost being charged to that work, but now included in the area of the dam owing to change of plans. The quantity placed by actual measurement was, therefore, 2,544,526 cu. yds., and the division cost $0.5303 per cubic yard, an increase over 1911 of $0.0391 per cubic yard.

The quantity of dry fill in place, as ascertained by complete cross-section on June 30, 1912, was 9,863,901 cu. yds.; the division cost $4,046,486.38, an average cost of $0.4102 per cubic yard.

The average cost per cubic yard for back filling Gatun Lock walls shows a decrease of $0.0692, principally in "tracks," the original cost of installation having been included in the accounts for the fiscal year 1911. The work of filling the center wall of Gatun locks was commenced in June, 1911, and preparatory work, charged in that month, explains the decrease of $0.3027 per cubic yard compared with the fiscal year 1912.

Fluctuations in average costs in Pacific division are too small to require explanation. Table VII, which follows, gives the details of the cost of dry filling.

TABLE VII.—DRY FILLING.

Gatun Dam—	
Dry fill, cu. yds.	2,608,073
Clearing site	$0.0007
Excavation	0.0721
Tracks	0.0852
Trestles	0.0038
Transportation	0.1209
Filling	0.1010
Maintenance of equipment	0.0457
Plant arbitrary	0.0690
Division expense	0.0187
Total division cost	$0.5174
Administrative and general expense	0.0359
Total cost	$0.5533
Gatun Spillway—	
Back filling, cu. yds.	10,062
Loading	$0.0038
Tracks	0.2220
Transportation	0.0482
Filling	0.0739
Maintenance of equipment	0.0109
Plant arbitrary	0.0055
Division expense	0.0255
Total division cost	$0.3898
Administrative and general expense	0.0438
Total cost	$0.4336
Gatun Locks—	
Dry fill—approach wall, cu. yds.	7,072
Filling	$0.2884
Tracks	0.0799
Maintenance of equipment	0.0652
Plant arbitrary	0.0600
Division expense	0.0157
Total division cost	$0.5092
Administrative and general expense	0.0250
Total cost	$0.5342
Back filling, cu. yds.	922,215
Drilling	$0.0152
Blasting	0.0239
Loading	0.0239
Tracks	0.1031
Transportation	0.0695
Filling	0.1068
Maintenance of equipment	0.0408
Plant arbitrary	0.0576
Division expense	0.1207
Total division cost	$0.4615
Administrative and general expense	0.0399
Total cost	$0.5014
Filling center wall, cu. yds.	94,574
Loading	$0.0584
Tracks	0.0476
Transportation	0.0896
Filling	0.1884
Power	.....
Maintenance of equipment	0.0749
Plant arbitrary	0.2831
Division expense	0.0184
Total division cost	$0.7607
Administrative and general expense	0.0297
Total cost	0.7904
Pedro Miguel Dam—	
Dry fill, cu. yds.	349,275
Tracks	$0.0638
Trestles	0.0381
Transportation	0.1094
Filling	0.0306
Maintenance of equipment	0.0996
Plant arbitrary	0.0120
Total division cost	$0.3535
Administrative and general expense	0.0227
Total cost	$0.3762
Filling center wall, cu. yds.	21,937
Tracks	$0.1681
Transportation	0.0550
Filling	0.4824
Power	0.0120
Maintenance of equipment	0.0831
Plant arbitrary	0.1160
Division expense	0.0467
Total division cost	$0.9633
Administrative and general expense	0.0765
Total cost	$1.0398
Miraflores Locks—	
Back filling, cu. yds.	442,774
Tracks	$0.1096
Transportation	0.0649
Filling	0.0717
Maintenance of equipment	0.0418
Plant arbitrary	0.1160
Division expense	0.0134
Total division cost	$0.4174
Administrative and general expense	0.0261
Total cost	$0.4435
Filling center wall, cu. yds.	7,912
Transportation	$0.1318
Filling	0.6766
Power	0.0126
Maintenance of equipment	0.0456
Plant arbitrary	0.1200
Division expense	0.0266
Total division cost	$1.0126
Administrative and general expense	0.0509
Total cost	$1.0635
Miraflores Dam—	
Dry fill, cu. yds.	425,125
Tracks	$0.0768
Transportation	0.0629
Filling	0.0681
Maintenance of equipment	0.0416
Plant arbitrary	0.1437
Division expense	0.0113
Total division expense	$0.4044
Administrative and general expense	0.0195
Total cost	$0.4239

HYDRAULIC FILLING.

The quantity of hydraulic fill placed in Gatun dam this year, as reported monthly, aggregates 2,604,632 cu. yds., at an average division cost of $0.3844 per cubic yard, as against 4,256,393 cu. yds., at an average cost of $0.2289 per cubic yard last year—an increase of $0.1555 per cubic yard. For reasons given under "Dry filling," these figures are largely theoretical as the complete cross-sections indicate that during the fiscal year 1911, 3,758,870 cu. yds. of hydraulic filling were added to the dam, and during the fiscal year 1912, 2,543,086 cu. yds. Using these quantities, the average division cost per cubic yard is $0.2592 for the year 1911, and $0.3938 for the year 1912, an increased most per cubic yard of $0.1346. This increase is general to all items, principally in operation of dredges, $0.0464; power, $0.0480; maintenance of equipment, $0.0174; and plant arbitrary, $0.0186 per cubic yard. Longer pipe lines and a higher lift account for the first two items of increase, while the increase in "Maintenance of equipment" is due to the harder usage to which the dredges were put, and that in "Plant arbitrary" to decreased estimates of quantities.

Based on actual measurement, the amount of hydraulic fill in place on June 30, 1912, was 9,955,078, and the average division cost $0.2938 per cubic yard, instead of $0.2782, which is based on total of monthly quantities reported.

Hydraulic fill around the south approach wall of Gatun locks aggregated 594,495 cu. yds., at a division cost of $0.1545 per cubic yard. The dredge worked in close proximity to the spot where the material was placed with short pipe lines without lift, which explains the low cost per cubic yard as compared with that of the fill placed in the dam.

TABLE VIII.—HYDRAULIC FILLING.

Gatun Dam—	
Hydraulic fill, cu. yds.	2,604,632
Clearing site	$0.0007
Clearing for dredge	0.0117
Dredging	0.1241
Relay pumps	0.0132
Pipe lines	0.0257
Wood flumes	0.0028
Power	0.0762
Small boats	0.0028
Maintenance of equipment	0.0469
Plant arbitrary	0.0725
Division expense	0.0075
Total division cost	$0.3844
Administrative and general expense	0.0201
Total cost	$0.4045
Gatun Locks—	
Hydraulic fill, approach wall, cu. yds.	594,495
Operation, dredges	$0.0627
Repairs to dredges	0.0062
Pipe lines	0.0036
Plant arbitrary	0.0799
Division expenses	0.0021
Total division cost	$0.1545
Administrative and general expense	$0.0038
Total cost	$0.1583

BREAKWATERS.

During the year 460,040 cu. yds. of material from Toro Point were placed in the Colon breakwater at an average cost of $1.38 per cubic yard, against 359,890 cu. yds. last year, at an average division cost of $1.45 per cubic yard. The cost of securing the fill decreased $0.4258 per cubic yard as compared with last year, while the expense of placing in breakwater, including cost of trestle, increased $0.2316, and the charge for plant, $0.1509 per cubic yard.

In addition to the fill from Toro Point, there were also secured 65,133 cu. yds. of large stone from Porto Bello, which were placed in the Colon breakwater at an average cost of $4.3064 per cubic yard.

The Naos Island breakwater on the Pacific side is being filled with material hauled from Culebra Cut and other parts of the Central division. The charge made to this account represents the difference between the cost of dumping at the breakwater, including the cost of trestles, and the cost of disposing of material on dumps at the Pacific entrance to the canal. At the end of the year, 782,021 cu. yds. of material had been placed at a cost of $0.2467 per cubic yard.

TABLE IX.—BREAKWATER.

Colon Breakwater—	
Toro Point fill:	
Excavation, cu. yds	460,040
Surveys	$0.0001
Drilling	0.0167
Blasting	0.0731
Loading by power	0.0854
Tracks	0.0323
Transportation	0.0787
Maintenance of equipment	0.0502
Total	$0.3365
Filling, cu. yds	460,040
Trestles	$0.6095
Dumping	0.0100
Maintenance of equipment	0.0142
Total	$0.6337
Plant arbitrary	$0.3024
Division expense	0.0284
Tug service	0.0822
Total division cost	$1.3832
Administrative and general expense	0.1299
Total cost filling	$1.5131
Porto Bello large rock:	
Quarrying, cu. yds	65,133
Stripping	$0.4331
Drilling	0.2119
Blasting	0.3152
Loading	0.2993
Transportation	0.2099
Tracks	0.2603
Loading on barges	0.1344
Power	0.0989
Maintenance and equipment	0.5039
Plant arbitrary	0.2432
Total	$2.7092
Towing, cu. yds	65,133
Operation, tugs and barges	$0.3461
Maintenance of equipment	0.1096
Plant arbitrary	0.4274
Total	$0.8831
Placing, cu. yds	65,133
Operation of floating derricks	$0.0185
Operation, cranes	0.1724
Operation, trains	0.0785
Dumping	0.0209
Maintenance and equipment	0.1160
Plant arbitrary	0.1319
Total	$0.5382
Division expense	0.1759
Total division cost	$4.3064
Administrative and general expense	0.3381
Total cost, large rock	$4.6445
Total material placed, cu. yds	525,173
Total cost	$1.9014

SAND PRODUCTION.

Operations for securing sand at Nombre de Dios were discontinued in November, 1911, so that the average monthly production this year was 32,027 cu. yds., as compared with 36,827 cu. yds. last year. The cost per cubic yard delivered in storage increased $0.3849 per cubic yard, due to increase in plant arbitrary of $0.4435 per cubic yard, owing to overestimation of quantities of sand required, partially offset by decrease of $0.0534 in cost of production, due to high cost of securing sand by excavation last year.

Sand was procured at Chame throughout the year in increased quantities. There is a decrease in cost delivered in storage of $0.1259 per cubic yard, $0.1024 being due to decreased arbitraries owing to increased estimate of quantities required, and to decreased cost of water transportation, due to increased output.

There is an excess this year of $1.5389 per cubic yard in the cost of sand in storage from Nombre de Dios compared with that from Chame. The difference in "Plant arbitrary" is $1.1039 per cubic yard, leaving a difference in operating cost of $0.4350 per cubic yard, as follows: Production $0.1873, towing $0.2117, and unloading $0.0751; offset by excess cost of transportation by rail of Chame sand (if 83,629 cu. yds. produced at Nombre de Dios, but not transported by rail, be considered) of $0.0391 per cubic yard. The operating cost for rail transportation, based on the actual number of cubic yards transported, shows excess in favor of Chame of $0.0633.

From May 15 to June 30, 1912, one of the dredges pumped into Gatun Dam, 40,531 cu. yds. of sand, at an average cost of $1.2850 per cubic yard. Detailed costs of dredging appear in Table X.

TABLE X.—SAND PRODUCTION.

Nombre de Dios—	
Dredging, cu. yds	144,123
Operation, dredges	$0.1912
Maintenance of equipment	0.1309
Total	$0.3222
Plant arbitrary	0.7890
Total cost of production	$1.1112
Towing, cu. yds	144,123
Operation, tugs and barges	$0.2235
Maintenance of equipment	0.1311
Plant arbitrary	0.2820
Total	$0.6366
Unloading, cu. yds	144,123
Operation, cableways and cranes	$0.1027
Power	0.0189
Maintenance of equipment	0.0712
Plant arbitrary	0.2170
Total	$0.4098
Rail transportation to storage, cu. yds	60,494
Operation of trains	$0.0993
Repairs to tracks	0.0096
Dumping in storage	.....
Maintenance of equipment	0.0677
Plant arbitrary	.....
Total	$0.1766
Division expense	0.0096
Total lost in storage	$2.2411
Gatun—	
Dredging, cu. yds	40,531
Operation, dredges	$0.1915
Maintenance of equipment	0.0436
Total	$0.2351
Plant arbitrary	0.7671
Total cost of production	$1.0022
Towing, cu. yds	38,760
Operation, tugs and barges	$0.0684
Maintenance of equipment	0.0222
Total	$0.0906
Unloading, cu. yds	38,760
Operation, cableways and cranes	$0.0541
Power	0.0157
Maintenance of equipment	0.0480
Total	$0.1178
Transportation to storage, cu. yds	1,771
Operation of cranes	$0.2174
Operation of trains	0.0604
Repairs to tracks	0.9094
Maintenance of equipment	0.2795
Total	$1.4667
Division expense	0.0194
Total cost in storage	$1.2850
Chame—	
Dredging, cu. yds	564,837
Operation, dredges	$0.0905
Maintenance of equipment	0.0403
Total	$0.1308
Plant arbitrary	0.0202
Total cost of production	$0.1510
Towing, cu. yds	564,837
Operation, tugs and barges	$0.0936
Maintenance of equipment	0.0493
Plant arbitrary	0.0309
Total	$0.1738
Unloading, cu. yds	564,837
Operation, cableways and cranes	$0.0646
Power	0.0196
Maintenance of equipment	0.0335
Plant arbitrary	0.0545
Total	$0.1722
Transportation to storage, cu. yds	564,837
Operation of trains	$0.0403
Repairs to tracks	0.0369
Dumping in storage	0.0120
Maintenance of equipment	0.0241
Plant arbitrary	0.0785
Total	$0.1918
Division expense	0.0137
Total cost in storage	$0.7025

TABLE XI.—STONE PRODUCTION.

Porto Bello Quarry—	
Quarrying, cu. yds	440,413
Stripping	$0.0040
Drilling	0.0431
Blasting	0.1622
Loading	0.0774
Transportation	0.0669
Tracks	0.0340
Power	0.0353
Maintenance of equipment	0.0621
Plant arbitrary	0.4897
Total	$0.9747
Crushing, cu. yds	440,413
Operation, crushers	$0.0283
Stone bins and conveyors	0.0168
Power	0.0462
Maintenance of equipment	0.0827
Plant arbitrary	0.2524
Total	$0.4264
Total cost of production	$1.4011
Towing, cu. yds	440,413
Operation, tugs and barges	$0.1557
Maintenance of equipment	0.1267
Plant arbitrary	0.1794
Total	$0.4618
Unloading, cu. yds	440,413
Operation, cableways and cranes	$0.0987
Power	0.0608
Maintenance of equipment	0.0224
Plant arbitrary	0.3441
Total	$0.5260
Transportation to storage, cu. yds	139,167
Operation of trains	$0.1297
Repairs to tracks	0.0194
Dumping in storage	.....
Maintenance of equipment	0.1022
Plant arbitrary	.....
Total	$0.2513
Division expense	0.0269
Total cost in storage	$2.4952
Ancon Quarry—	
Quarrying, cu. yds	839,279
Stripping	$0.0423
Drilling	0.0552
Blasting	0.0465
Loading	0.0356
Transportation	0.0576
Tracks	0.0379
Power	.....
Maintenance of equipment	0.0568
Plant arbitrary	0.1903
Total	$0.5222
Crushing, cu. yds	839,279
Operation, crushers	$0.0179
Stone bins and conveyors	0.0045
Power	0.0187
Maintenance of equipment	0.0311
Plant arbitrary	0.0592
Total	$0.1314
Total cost of production	$0.6536
Transportation to storage, cu. yds	839,279
Operation of trains	$0.0366
Repairs to tracks	0.0004
Dumping in storage	0.0110
Maintenance of equipment	0.0206
Plant arbitrary	0.0590
Total	$0.1276
Division expense	0.0184
Total cost in storage	$0.7996

STONE PRODUCTION.

With approximately the same output in both years, the cost in storage of rock from Ancon quarry is less by $0.0447 per cubic yard than last year. This is partly due to lower arbitraries for plant, owing to increased estimates of quantities and to decreased cost of transportation to storage.

The Porto Bello crushing plant was closed on April 30, 1912, so that the average output per month for the year was 44,041 cu. yds. compared with 68,760 cu. yds. for last year.

The actual production cost was decreased. however, by $0.0331 per cu. yd. Table XI shows the detailed cost of stone production.

Under "Total quantities" 1,371 cu. yds. have been added to adjust the difference between cross-section measurements of stock pile and book balance. For the Ancon quarry this amount was not added to monthly quantities

PILING FOR FOUNDATIONS.

The manufacture of concrete piles ceased in November, 1911, up to which time 104,755 lin. ft. had been produced, at an average cost of $1.2358.

In 1911, 8,196 lin. ft. of piles were driven for the foundations of the south approach wall for the Gatun locks and in 1912, 75,474 lin. ft. were driven. The total cost for this work in 1911 was $2.212 per lineal foot and in 1912, $1.5032 per lineal foot. This work was completed in March, 1912, when a total of 83,670 lin. ft. had been driven at an average division cost of $1.5719 per linear foot.

In addition to the concrete piling, there were driven for the foundations of the south approach wall, during the fiscal year 1912, 51,450 lin. ft. of wooden piles, at an average division cost of $0.6516 per linear foot.

In the Pacific division 6,580 lin. ft. of wooden piles were driven for the foundations of the northeast wing wall of locks at Miraflores, at an average division cost of $7.6390 per linear foot. This high cost is apparent only, as there were 57,375 lin. ft. of piling which had been charged to the work, but had not been driven. Deducting the value of this piling from the total charge, the cost for piling in place was $2.32 per linear foot. Table XII shows the detailed cost of piling.

TABLE XII.—COST OF PILES FOR FOUNDATIONS.

Gatun Locks—	
Preparing foundations, concrete piling, lin. ft.	75,474
Concrete piles in place	$1.4849
Maintenance of equipment	0.0078
Division expense	0.0105
Total division cost	$1.5032
Administrative and general expense	0.0320
Total cost	$1.5352
Preparing foundations, wooden piling, lin. ft.	51,450
Wooden piles in place	$0.6440
Maintenance of equipment	0.0024
Division expense	0.0052
Total division cost	$0.6516
Administrative and general expense	0.0845
Total cost	$0.7361
Miraflores Locks—	
Preparing foundations, wooden piling, lin. ft.	6,580
Wooden piles in place	$7.5527
Division expense	0.0863
Total division cost	$7.6390
Administrative and general expense	0.5444
Total cost	$8.1834

Table XIII shows the detailed cost of manufacturing the concrete piling.

TABLE XIII.—MANUFACTURING CONCRETE PILES.

Concrete piles, lin. ft.	73,695
Cement	$0.0837
Stone	0.0645
Sand	0.0088
Mixing	0.0482
Placing	0.0438
Reinforcements	0.7152
Forms	0.0547
Maintenance of equipment	0.0026
Plant arbitrary	0.1810
Division expense	0.0131
Total cost	$1.2156

POWER PLANTS.

The power plant at Gatun generated this year 16,263,510 kw. hrs., at an average division cost of $0.022 per kw. hr., as against 12,962,247 kw. hrs. and a cost of $0.0227 last year. The power plant at Miraflores generated this year 9,522,400 kw. hrs. at an average division cost of $0.0229 per kilowatt hour, as against 6,797,714 kw. hrs. and a cost of $0.0274 per kilowatt hour last year. Included in the average cost are arbitraries sufficient to absorb the total cost of these plants during the construction of the canal. The costs represent general costs only and do not include the expenses of pipe lines, or other installations outside of the power houses. Table XIV shows the unit costs of operation and the arbitrary depreciation charges per unit of output.

TABLE XIV.—OPERATION OF POWER PLANTS.

Gatun Power Plant—	
Output, kw. hrs.	16,263,510
Operation	$0.0018
Fuel	0.0083
Repairs to equipment	0.0014
Plant arbitrary	0.0103
Division expense	0.0002
Total	$0.0220
Miraflores Power Plant—	
Output, kw. hours	9,522,400
Operation	$0.0031
Fuel	0.0081
Repairs to equipment	0.0014
Plant arbitrary	0.0100
Division expense	0.0003
Total	$0.0229

HYDRAULIC FILLING IN CITY OF COLON.

During the year, 129,939 cu. yds. of material, borrow-pit measurement, were deposited in this fill, at an average division cost of $0.3533 per cubic yard, exclusive of charge for plant; as against 698,644 cu. yds. last year at an average division cost of $0.2108 per cubic yard, a total for the project of 828,583 cu. yds., borrow-pit measurement, at a division cost, exclusive of charge for plant, of $0.2119 per cubic yard. Owing to waste and consolidation, the fill actually in place amounts to 585,527 cu. yds., a loss of 243,056 cu. yds., or 29.33 per cent, making an average division cost, exclusive of charge for plant, for fill in place of $0.2999 per cubic yard. The dredge placing this fill ceased operation in August, 1911.

ROADS AND STREETS

Methods and Cost of Constructing a Combination Corrugated Pipe and Concrete Culvert With Some Data on Corrugated Pipe Culverts With Concrete End Walls.

Contributed by John N. Edy, Assistant City Engineer, Billings, Mont.

During the past summer the city of Billings, Montana, installed two 60-in. corrugated iron pipe culverts and one combination concrete and iron culvert, all with concrete end walls of the same general design. The two views, Figs. 1 and 2, illustrate the "before and after" of the improvement described. As is too often the case, the old wooden structure remained in use long after it was a positive menace to the traveling public. Not only was the bridge dangerous, but its extreme narrowness presented a serious obstacle to the traffic of the well built up residence district which it was supposed to serve. The culvert installed not only permits the use of the entire width of street (80 ft.), but is an improvement in every sense of the word. Its appearance is pleasing, and it adds to the attractiveness of the surroundings by breaking the monotony of the bare lines of the drainage ditch which it spans.

Design.—In considering the kind of structure most desirable and economical for the two crossings first ordered, estimates were prepared on culverts of concrete and of corrugated pipe, and on beam bridges. The bridge proposed had a span of 14 ft. and a 20 ft. reinforced concrete roadway, on a substructure of reinforced concrete. It was at once apparent that the cost of the bridges would exceed the appropriation for the work; and it has developed that each completed culvert, as built by force acount, actually cost less by several hundred dollars than was estimated for the bridge for that particular crossing.

It was originally intended to built the culverts entirely of concrete. The council committee, however, favored the use of corrugated iron pipe for the barrel of the structure. Their objection to concrete was based upon the failure of certain local concrete structures. due, apparently, to the action of alkali. Inasmuch as the water to be carried was known

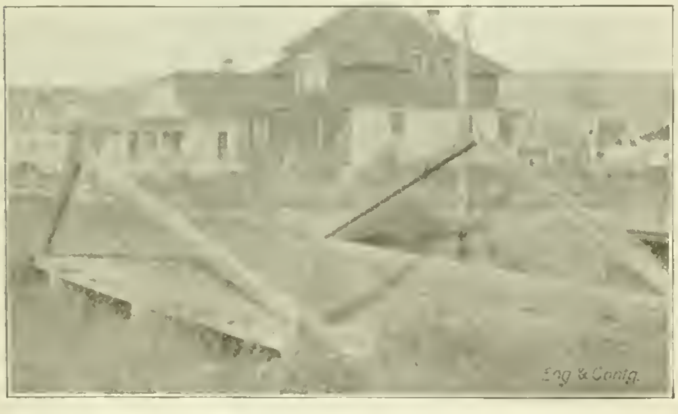


Fig. 1—Old Timber Bridge Replaced by Corrugated Pipe and Concrete Wing Walls Culvert.

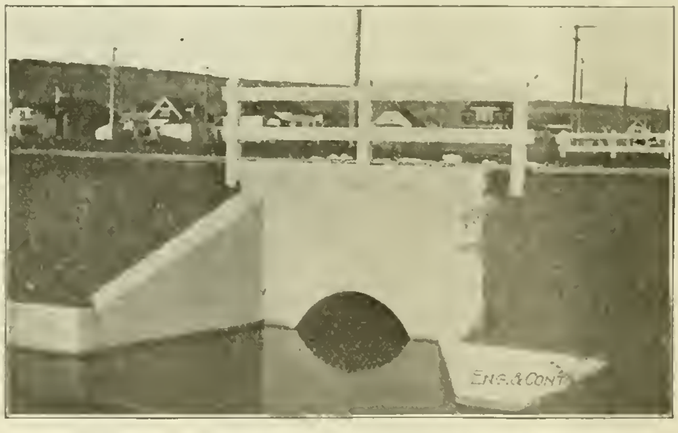


Fig. 2—Corrugated Pipe Culvert With Concrete Wing Walls.

to be strongly alkaline, the committee's recommendation was adopted and the pipe used.

This of course greatly simplified the plans for the work, leaving only the end walls to be designed. The view Fig. 2 shows an end view of the walls; an end elevation and sections of the wing walls are shown by Fig. 3.

The wings were assumed to act as retaining walls and the base thickness made one-fourth the height above the footing at that point. The head walls, being partly supported by the wings, were made slightly lighter, the base thickness being one-fifth the height. Footings were made uniformly 6 ins. wider than the wall base, and were set well into hard gravel. The cut-off wall was built as shown. Top thickness, coping, etc., were made as shown by the drawings.

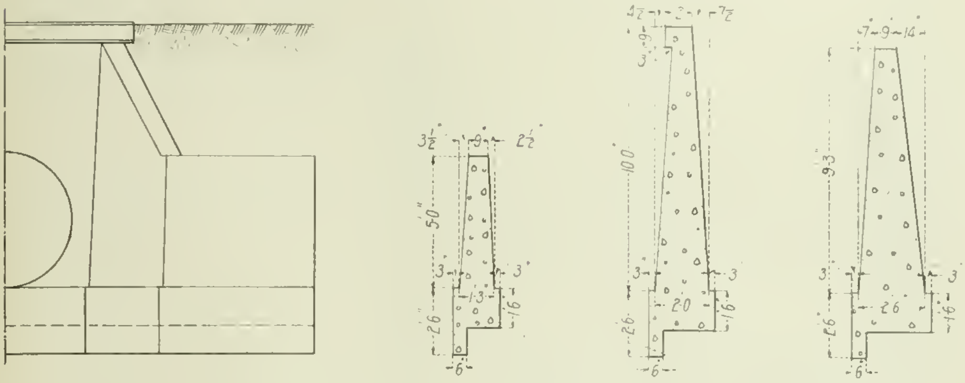


Fig. 3—Details of Concrete Wing Walls for Corrugated Pipe Culvert.

Construction.—The first item of construction involved turning the water from the old channel. This was a matter of some consequence, owing to the volume of water and the height and steepness of the ditch banks. The problem was solved as follows: Several sections of culvert pipe were placed in the ditch, above and below the end wall locations, and bolted together so as to form the arched cores of two earth dams. The flow of water having been determined, a wood flume was designed and built along one bank of the ditch in such a manner as to least interfere with the placing of the culvert barrel. With this arrangement one hand pump kept the ditch sufficiently free from water to permit the workmen to perform their duties.

Immediately upon the completion of the flume the footings for both end walls were concreted, after which the corrugated iron pipe was placed. This pipe, laid on a 1 per cent grade, was set on 6x8-in. mudsills spaced 10 ft. on centers. The semi-circular pipe sections as shipped by the manufacturer were joined together on the bank into 10-ft. lengths, when they were lowered onto the sills. In this manner the lower half of the culvert barrel for the entire 80 ft. was securely bolted in place before the upper half was set. A string of oakum was laid between the flanges of the top and bottom sections to prevent leakage at that point.

As the culvert pipe projected about half way through the head wall, the wall forms were built so as to fit the pipe at its end, and permit of concreting the entire wall at one operation. Forms were made of 1-in. dressed lumber nailed to 2x4-in. studding spaced about 15 ins. on centers and thoroughly wired. All corners and edges were chamfered 1½ ins. by means of suitable strips nailed inside the forms.

All concrete was machine-mixed, and proportioned one part cement to five parts natural bank gravel. A wet mixture was used and the mass was well spaded. Face forms were removed after 36 hours and exposed surfaces floated and brushed.

After the concrete had hardened sufficiently the street was filled in and graded, and the temporary walks laid.

The rail used was built of dressed 2x6-in. timbers and slightly ornamental 6x6-in. wood posts, painted white with a sand finish.

It was necessary to provide an inlet into the culvert for surface water from the street gutter. This was accomplished by cutting a hole in the top of the 60-in. pipe and connecting a 15-in. corrugated pipe of the same manufacture, which received the water from an inlet properly placed directly above. No-co-ro pipe was used exclusively.

Combination Culvert.—Figure 4 represents a section of a 40-ft. combination iron pipe and concrete culvert built after the completion of those described above. This design assumes the use of a half-section of corrugated pipe for the arch only, which rests on side walls of concrete as shown. While it was found that the concrete portion cost approximately the same as a half-section of pipe, it was possible to secure slightly greater culvert area. The plan was adopted primarily as an experiment, and seems to have possibilities worthy of consideration. The figure showing the details of this design is self-explanatory.

In constructing the combination culvert, the side wall footings were placed first, after which the reinforced concrete floor was laid on a gravel base. Wall forms were then built and concrete poured. The setting and bolting of the iron arch completed the work with the exception of the end walls, which were built similar to those described above. The cost of this culvert was as follows:

20 lin. ft. of 60-in. No-co-ro culvert pipe, at $5.44 per lin. ft.	$108.80
Cement, 62 bbls., at $2.10, net	130.20
Gravel, 37.5 cu. yds., at $1.25 per cu. yd.	46.90
Lumber, 1,024 ft. B. M.	28.70
Reinforcement, 183 lbs., at 5 cts. per lb.	9.15
Backfilling, 248.5 cu. yds., at 17 cts. per cu. yd.	42.25
Foreman, $4 per day of 8 hrs. Labor, $3 per day of 8 hrs.	401.30
Miscellaneous (hardware, power and wiring for pump, drayage, etc.)	27.00
Total cost	$794.30

All the work described in this paper was built by force account for the City of Billings under the general supervision of Mr. C. E. Durland, City Engineer.

A New High-Temperature Cement.—The H. W. Johns-Manville Co. has recently put on the market what they term "J.-M. High-Temperature Cement No. 31," which it is said can be practically used instead of fire clay, whenever working temperatures range between 1500° and 3100° F. This material is a dry powder mixture composed of asbestos and other materials of secret preparation. It is mixed with water to the proper consistency for working like mortar or tamping around molds. When air-dried it will withstand a crushing strain of 883.5 lbs. per square inch. It vitrifies at 1418° F. and has a high melting point, 3182° F. As it is semi-acid in character, it can be used with chrome, silica or fire-clay bricks. It is claimed that this cement can be successfully used in building doors of angle iron framework without backing, or for making one-piece lining for gas or oil burning crucible furnaces.

Street Cleaning in Chicago, and Suggested Standards for Increasing the Efficiency.

The Efficiency Division of the Civil Service Commission of the city of Chicago has completed recently a comprehensive study of street cleaning methods. The investigation was conducted under the direction of Mr. J. L. Jacobs, Engineer in Charge of the Efficiency Division, and was made primarily for the purpose of fixing equitable bases and percentages for the distribution of funds in the various wards of Chicago for the cleaning and repair of streets and alleys, the collection and removal of ashes and refuse and the removal of pure garbage. The investigation included a study of the following: Cleaning of streets and alleys and removal of street dirt; collection and removal of garbage; collection and disposal of ashes and rubbish; special snow removal in the business district of the city; care of sidewalks, unimproved streets and alleys and other emergency needs; repairs of improved streets and alleys and distribution of vehicle tax fund. In making the inquiry the following methods were pursued in the office and field studies: By search and analysis of available information and statistical data in municipal reports, in scientific publications and in reports of experts on these subjects; through the service of written inquiries directed to private and public officials and larger municipalities in this country and in Europe; by personal inquiry made by the Commission's technical staff and the special corps of investigators and assistants into conditions and methods obtaining in the office and in the field. The Efficiency Division began its study last summer, and on Nov. 15 submitted its report. This report has just been made public, and from it the matter in this article has been abstracted.

CLEANING OF STREETS AND ALLEYS.

Methods of Street Cleaning in Chicago.—Street cleaning work, as performed in the various sections of the city of Chicago, is intended to cover all paved streets and alleys, and consists of (a) cleaning of streets by hand with brooms, (b) patrolling the streets with boulevard scrapers, (c) cleaning of streets and alleys by gangs of men equipped with necessary tools, (d) flushing of streets with machine flushers and (e) cleaning of streets with machine sweepers. The area of paved streets and alleys cleaned in various wards has depended entirely on the amount of funds available for this purpose, as this branch of the service has been made secondary, and if retrenchment was effected in the bureau this activity suffered first.

The methods employed by the various wards were generally the same, varying somewhat with the character of pavement. In most cases, the streets are cleaned by hand under the block or patrol system; the street dirt is collected by the sweeper in push carts of 12 cu. ft. capacity and dumped into vacant lots, or into unused alleys, where it is picked up by dirt wagons and hauled to the dumps.

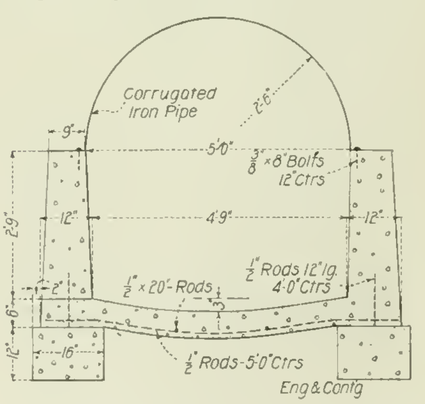


Fig. 4—Combination Corrugated Pipe Arch and Reinforced Concrete Invert Culvert.

Sources and Volume of Street Dirt.—The dirt which collects upon the streets of a city is derived from a number of different sources, the principal ones of which are as follows: 1, Excrement of animals; 2, material lost by passing vehicles; 3, dirt swept from sidewalks and thrown from buildings onto the street; 4, dirt from unpaved streets and alleys; 5, falling leaves; 6, building construction; 7, soot and dust from the air; 8, material originating from the wear of pavements.

The amount of dirt which is directly attributed to horse-drawn vehicle traffic is readily appreciated when it is realized that on an average 1,000 horses will excrete 500 gals. of urine and 10 tons of dung during a working day of eight hours. This is by far the most important source of street dirt, and has been given the greatest weight in the preparation of the schedules and standards used as a basis for the estimates of future expenditures.

The loss of sand, coal, crushed stone, hay, manure and other loose material from poorly constructed wagons, or from overloaded wagons, adds greatly to the quantity of street dirt to be removed. In many cases, street dirt carts and wagons contribute their share by allowing wet street dirt to ooze out upon the streets through poorly constructed boxes.

The common opinion that the streets and alleys should be the repository for all dirt and filth of the householders does much towards adding to the amount of dirt to be removed. Failure to collect house refuse, according to a fixed schedule of frequency often causes cans to be overturned and contents scattered about the pavements.

Another source which is important during wet seasons is the dirt that is carried by moving vehicles from streets and alleys onto hard pavements. This is principally done by peddler wagons, push carts and delivery wagons, whose drivers are forced to travel these streets and alleys to sell and deliver their wares. However, the amount of street dirt actually attributable to this source is considerably less than is usually believed.

The removal of street dirt proper from the pavement of a street is a very necessary and important function, both from an aesthetic and a sanitary standpoint. There is, however, considerable refuse in the form of leaves and grass which accumulates in residential streets and along parks and boulevards, which is not objectionable as far as sanitation is concerned, except that it has a tendency to lodge in catch basin inlets and stop the free flow of storm water. The amount of leaves accumulating in the short "leaf season" on streets far exceeds that which naturally drops onto the surface of streets alone, because of the additional cleaning from the lawns and parkway spaces. This requires constant attention during this season, and always must be kept in mind by street cleaning superintendents.

An activity which is entirely separate from the street cleaning, yet which must be performed carefully in the outlying wards, is the cutting of weeds along parkway places and vacant lots. The need of this is apparent, because during the autumn season obnoxious weeds are seeding and burs are caught by clothing, and during the season of heavy dews and rains the weeds protrude over the sidewalks and wet the clothing of pedestrians. The heavy growth of weeds on either side of the street, which keeps the ground moist and conceals decaying vegetable and animal matter, does not promote sanitation, and is a feature which should require careful attention of the superintendent in charge of street cleaning, as well as the inspectors of the Sanitary Bureau of the Health Department. Leaves and weeds constitute great nuisances in the outlying wards, and problems connected therewith can best be solved in co-operation with residents and with owners of vacant property.

The carelessness with which contractors allow the different materials used in building construction to be scattered about the streets is not only a great annoyance to the street cleaners, but is a prolific source of street dirt, and is a condition which constantly demands the attention of superintendents. This annoyance, together with that caused by the overloading of vehicles and the losing of dirt from overloaded wagons upon the streets, is a matter which can be eliminated by properly enforcing the ordinances relating to these matters.

Soot and dust settling upon the streets from the air will be heavier in some districts than in others, and will be of more importance in the congested residential or manufacturing districts, and in most cases it will constitute only a very small percentage of the whole.

The constant abrasion of hard pavements under different kinds of traffic has a tendency gradually to wear out the surface of the pavement, which must be removed by the street sweepers. This source is of special importance in macadam pavements, as it is this material that forms practically all of the dirt which is removed from pavements of this class.

It is believed that when a fixed standard is established of basing street cleaning schedules carefully on density of traffic, condition of pavements, character of frontage and kind of pavements, a definite relation will be found between the amount of street sweepings collected and the number of sweepers employed. At present it is found that different street sweepers will average daily collections of quantities varying from ¾ cu. yd. to 3 cu. yds. It has also been noted that street sweepings collected by regular "block" sweepers average about .0045 cu. ft. per square yard. The weight of sweepings will, under ordinary conditions, approximate 36 lbs. per cubic foot.

From records available there appear to have been collected from the streets of Chicago during each of the past five years the following amounts of street dirt:

	Cu. yds.
1907	681,707
1908	892,751
1909	815,703
1910	892,912
1911	735,334

An analysis was made of the character and per cent of waste thrown about by pedestrians in the streets and by business houses in the densely populated sections. It was found that a great portion of street dirt collected by street cleaners consisted of waste paper and other litter. The ordinance regarding the litter of streets and alleys and the ordinance pertaining to the construction of manure vaults are those which probably are the most flagrantly violated.

Relative Costs of Cleaning Streets.—The present lack of uniformity in standards and records maintained in the different cities of the country makes it difficult to compare the relative costs of the cleaning of streets of the various cities. Investigation conducted by the United States Census Bureau into the cost of cleaning streets throughout the country indicated that the unit cost of street cleaning for cities having less than 300,000 inhabitants is less than that in cities having over 300,000.

The following summary taken from the report of the Commission on Street Cleaning and Waste Removal of the city of New York indicates the comparative costs of cleaning streets by the four most used methods:

Type.	Cost per 1,000 sq. yds.
Hand sweeping	$0.28
Machine sweeping	.317
Hose flushing	.319
Machine flushing	.721

In Chicago the average cost of cleaning 1,000 sq. yds. was 42 cts during the year 1910, and during the year 1911 the cost was 36 cts. per 1,000 sq. yds. This includes the cost of all the different methods of street cleaning and the cost of removal of street dirt to dumps. The cost of street flushing, including the cost of labor, teams and water, averages approximately 21 cts. per 1,000 sq. yds. About ¾ gal. of water is used per square yard of surface flushed. This does not represent the total cost of street cleaning by machine flushing, as a considerable quantity of the dirt which is washed from the pavement settles in the gutter and must be swept into piles by hand and hauled away to dumps.

Classification of Pavements.—The main pavements in the city of Chicago which control the street cleaning and street repair are asphalt, brick, granite, macadam and creosote block. Cedar block is not now adopted for new pavements, but there still remain several miles of old cedar block within the city. This generally is in poor condition, and streets paved with it have been considered as unimproved.

For the purpose of cleaning streets by "block" men, the different pavements of the city have been classified according to characteristics, as follows: Improved—Permanent—(a) Smooth pavements, including asphalt, creosote block and bitulithic; (b) rough pavements, including brick, granite, cobble and rubble, and such other pavements as require that the dirt be picked out from between bricks, where the work of block men is much greater than cleaning of smooth pavements for the same area.

Under the classification Improved—Not Permanent are included all macadam pavements and country roads. Under the classification Unimproved Pavements are included all streets that have not been paved, as well as those having old cedar block pavement, which, as noted above, is in such poor condition as to be considered unimproved.

Uniform Standards and Schedules.—In order to obtain the best results and the most efficient service, it is necessary that the responsibility of each workman be fixed definitely. In the matter of street cleaning this principle is no better illustrated than by the so-called block system, which was introduced into New York by Colonel Waring some 17 years ago, and is now effectively used in the larger cities in this country and in Europe. By this system each man is alloted a definite area of pavement to clean, which will vary in extent, depending upon the local conditions as to traffic, pavement, physical condition of pavement and frontage on street. The work now done in the Borough of Richmond, New York, and in Washington and Boston, under this system, deserves special mention.

This system has been quite largely used in Chicago of late, although the lack of funds in many wards, together with the character of pavement, has made the cleaning of streets by the gang system necessary. The apportionment of area to be cleaned is a matter which demands a detailed study of all conditions existing as to traffic, frontage and physical conditions of pavements. These are the prime conditions which affect street cleaning, and fix the frequency with which a certain pavement should be cleaned to give uniform cleanliness on an equivalent standard throughout the city.

Time Studies.—The Commission has directed a series of time studies of methods, operations and movements of street cleaners and teamsters employed by the Bureau of Streets, with a view to obtaining definite data as to present methods and efficiency of employes, and of ascertaining standards and uniform schedules for the effective and economical cleaning of streets and alleys and collection of the city's wastes.

As a result of these time studies made during this investigation, the Commission was enabled to obtain definite data and work out standards of the work of street cleaners under various conditions and on different kinds of pavements. The final standard indicated under the heading of "Standards of Street Cleaning" upon which the 1913 estimates are based, was obtained from these sources. The analysis of the records supplied by the Bureau of Streets indicated that able street cleaners who were working regularly and under instructions in proper methods were able to do more than the final adopted standard. The average street cleaner now working in the Bureau of Streets does not return in productive service more than 50 per cent of a fair amount, and very often it is as low as 33 per cent. A change which should result in all employes giving service approaching the 100 per cent attainable standard cannot possibly be expected within one year. For that reason, the Commission has assumed that the employes will average 63 per cent of the standard of work.

Standards for Street Cleaning.—It devolved upon the Commission to make an analysis of all the conditions and factors which control street cleaning, and obtain definite units and schedules upon which future estimates could be based and street cleaning be done. It was found that the amount and frequency of cleaning which any pavement requires, other conditions remaining the same, vary according to the following factors:

1. Density of horse-drawn vehicles and other traffic.
2. Kind and condition of pavement.
3. Location of district.
4. Street car lines.
5. Width of streets.
6. Character of district and population.
7. Location of public buildings.

The principal factor in determining the number of cleanings per week that any street requires is the density of horse traffic, which is the total number of horse-drawn vehicles for a given street divided by the width of the street. A census of traffic made by the Commission indicates that the number of 3 and 4-horse vehicles is negligible in comparison with the number of 1 and 2-horse vehicles; that the ratio of 1 and 2-horse vehicles throughout the city is practically constant, and that the total number of horse-drawn vehicles for any street in the city will be comparable with those of any other street.

The importance of the traffic factor in affecting the amount of cleaning necessary for the various pavements of the city is readily appreciated when the amount of excrement of animals on the streets is considered. With these conditions in mind, a traffic census was conducted over practically all streets of the city, and all sources of information which gave reliable figures in this respect were consulted.

A more or less erroneous opinion is generally current that width of street greatly affects the cost of cleaning per cubic yard of dirt removed. Motion and time study of street cleaners has clearly disclosed the fact that the only effect width of street has upon conditions is to determine the density of traffic per foot width of street; also that the time lost by efficient sweepers due to dodging traffic on heavy traffic streets outside of the congested loop district seldom exceeds 2 per cent. The density of traffic per foot width of street increases the amount of street dirt to be removed, and forms the basis of estimating the number of cleanings per week which a street requires in order to maintain a definite standard of cleanliness. The effect of motor traffic and street car traffic on street cleaning is merely that of determining the minimum cleanings which a street requires, as no definite amount of dirt can be attributed directly to either of these sources.

It has been found that where a comparative standard of cleanliness obtains in the various wards, the traffic density of any street bears a certain ratio to the number of cleanings per week; and that the standard of cleanliness of streets varies to a considerable extent with the distance from the center of the city, and that the wards on this account may be divided as follows:

Inlying wards—1, 2, 3, 4, 5, 10, 16, 17, 18, 19, 20, 21, 22.

Outlying wards—6, 7, 8, 9, 11, 12, 13, 14, 15, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35.

After tabulating various representative wards where reliable figures had been secured as to the amount of traffic upon the various streets, the following street cleaning constants were obtained for different wards and districts:

Ward.	Position.	Constant of cleaning. Average residence.	Constant of cleaning. Average business or manf.
5	Inlying	.9	3.0
4	Inlying	1.6	1.5
22	Inlying	4.3	3.8
2	Inlying	1.9	2.3
13	Inlying	2.1	2.9
21	Inlying	1.8	2.6
	Average	2.1	2.6
31	Outlying	2.3	1.9
6	Outlying	1.2	1.0
16	Outlying	2.7	3.5
13	Outlying	3.8	3.5
28	Outlying	2.4	4.3
	Average	2.5	2.8

While the ratio between teams and width of street and the frequency of cleaning does not bring about an exact constant in any one ward, investigation has disclosed that for all main thoroughfares where conditions are practically the same in any ward, these ratios are practically constant. The ratios determined in many of the wards could not be included here on account of abnormal conditions, due either to reduction of street cleaning forces, or to too large an appropriation of funds for the work at hand. The average constants gave average conditions as they exist in the city. Upon this basis the number of cleanings per week which any street paved with hard pavements will receive is expressed by the equation:

$$N = \frac{E}{C \quad W}$$

where N = number of cleanings per week.
E = total number of horse-drawn vehicles per 8-hour day.
W = width of roadway in feet.
C = constant of cleaning.

For many residence and street railway streets or streets on which churches, schools, hospitals, playgrounds and general public institutions are located, the application of these constants to traffic conditions does not give the best results. The minimum number of cleanings for streets having these characteristics has, therefore, been determined by a separate study as follows:

MINIMUM CLEANINGS PER WEEK ON HARD PAVEMENTS.

	Cleanings per week.
Inlying wards (indicated above)	0.7
Outlying wards (indicated above)	0.5

MINIMUM CLEANINGS ON CAR TRACK STREETS.

	Cleanings per wk. X (head room). Up to 3 min.	Cleanings per wk. Y (head room). 3 to 10 min.	Cleanings per wk. 10 min or more. Z (head room).
Inlying wards (indicated above)	5	4	3
Outlying wards (indicated above)	4	3	2

MINIMUM CLEANINGS WHERE THERE ARE PUBLIC BUILDINGS.

Churches.		Schools.		Hospitals and general public institutions.	
L	3	L	6	L	6
M	2	M	5	M	4
S	1	S	4	S	2

L = Large; M = Medium; S = Small.

In cases where the pavement of streets surrounding the foregoing is macadam, the minimum number of cleanings should be at least one-twelfth of that for hard pavements.

From an analysis of the findings of time and motion studies of street cleaners, Table 1 has been deduced, upon which are based the relative difficulty of cleaning different pavements under varying conditions, and the standards and equivalent areas to be cleaned by one man in one 8-hour day.

The foregoing data and conditions, as existing in Chicago, indicate that the presence of street car tracks in a street considerably increases the difficulty of cleaning the street, and that if all conditions are equal, these difficulties indicate that the street car right of way is 30 per cent harder to clean than the same pavements outside of the car tracks. In instances where the pavement of the right of way is different from the pavement of the balance of street, the area of the right of way has been increased by 30 per cent and the paving factors applied.

Where alleys are paved with hard pavement and where conditions exist similar to those on streets, the same standards and equivalents as given for the cleaning of streets having similar factors are used, the resulting number of cleanings per week being divided by six. In some instances, the number of cleanings per week that an alley would receive, based upon traffic conditions alone, would give absurd results, and, therefore, a minimum of one cleaning in ten days has been fixed, which will insure some attention for all paved alleys, irrespective of traffic. As the standard of alley cleanliness is considerably lower than street cleanliness, and considerably more dirt accumulates in the alleys, which must be removed, the area of pavement which one man can clean per 8-hour day has been taken as 54.4 per cent of the area of similar pavement of streets.

In the matter of cleaning macadam pavements, it was discovered that there were various standards in different parts of the city for cleaning macadam pavements, the number of times a macadam pavement was cleaned varying from twice per year in the outlying wards to four times per year in the inlying wards. In determining the number of cleanings per year required for macadam pavements, the following classification of wards has been made:

Inlying (indicated above)—

Intermediate—6, 7, 11, 12, 13, 14, 15, 23, 24, 25, 28, 30, 31.

Outlying—26, 27, 29, 32, 33, 34, 35.

Several of the wards which had more than ample appropriations gave much better service on macadam pavements, but on an average the following cleanings per year were given and are so assumed here:

Position of ward.	Cleanings per yr.
Inlying wards (indicated above)	4
Intermediate wards (indicated above)	3
Outlying wards (indicated above)	2

These standards of cleaning the streets of the city of Chicago will not give perfect results, but they will be uniform throughout the city, and such as the finances of the city will permit at the present time.

In order to obtain street cleaning appropriations according to these standards, every street in the city of Chicago has been classified according to wards, pavement, condition of pavement, car tracks, head room, subways, percentage of business and residence, length, width and traffic, and from these tabulations the appropriations have been determined.

One hundred feet has been taken as the standard unit for determining the cost of the spring cleanup of macadam streets. As traffic and pavement conditions are both determining factors in the amount of dirt to be removed from this pavement, the following subdivisions have been made, assuming that heavy traffic for macadam pavement shall consist of 400 vehicles or more per 8-hour day. The following unit costs have been applied.

TABLE I.—STANDARDS AND EQUIVALENT AREAS.

Pavement.	Condition of pavement.	Standards.	Equivalent sq. yds.
Asphalt	Good	100% average efficiency standard	34,000
Asphalt	Good	63% of standard assumed	21,500
Asphalt	Fair	90% of good asphalt	19,300
Asphalt	Bad	80% of good asphalt	17.200
Creosote block	Good	Good asphalt	21,500
Brick	Good	Good asphalt ÷ 1.35	16,000
Brick	Fair	90% of good brick	14,400
Brick	Poor	80% of good brick	12,800
Granite	Good	Good asphalt ÷ 1.60	13,400
Granite	Fair	90% of good granite	12,100
Granite	Poor	80% of good granite	10,700

based upon conditions existing during the past year:

Good condition.		Fair condition.		Poor condition.	
Light traffic.	Heavy traffic.	Light traffic.	Heavy traffic.	Light traffic.	Heavy traffic.
$0.80	$1.05	$1.30	$1.75	$1.50	$2.00

The cost of macadam and cedar block, other than the spring cleanup, has been found to be approximately one-half of the spring cleanup, which has been used as a standard.

The average cost of making the spring cleanup of hard pavements has been found to be 2.95 times the cost of block cleaning for one week on such pavements.

COLLECTION AND REMOVAL OF GARBAGE.

The house collection is made by wagons equipped with steel tanks having a capacity of about 2½ tons of garbage. Each ward is divided into garbage districts and collections are made from each district by one driver according to the density and character of population. A study has been made of this system of collection and it is found that under ordinary conditions it requires an average of approximately 3 hrs. 55 mins. to collect a full load. Usually the greater number of garbage collectors collect one load per day and the remaining time, over the 3 hrs. 55 mins., is spent either in going to and from the loading station or disposal plant, in waiting at the loading stations or loafing on the way.

The collection of garbage is a branch of the service which most affects the sanitation and well being of a community and it is necessary that this activity receive constant attention. During the winter months the collection is a minimum and during the summer months, especially during the month of September, the maximum quantity to be collected is reached. This necessitates that the organization maintained must be such as to be flexible and easily adapted to the ever changing conditions. Records of garbage collection in the city for the past five years further indicate that the quantity to be collected from the several districts for different years is not a constant quantity, but is continually increasing or decreasing, depending upon the local conditions, such as change of character of population, the growth of residence, business and manufacturing.

All garbage which is collected from the north and west parts of the city is delivered either to the Chicago avenue loading station or to the Oakley avenue loading station, each of which is located on the north branch of the Chicago River. The garbage is transported by barge to the reduction plant at 39th and Iron Sts. The garbage delivered to these two stations in 1911 constituted 56 per cent of the total garbage collected. The Royal Lighterage Co. has the contract for the transportation of garbage from these two stations to the reduction plant. The present contract is made on the basis of working days and calls for a sum of $81.45 to be paid to the lighterage company for each day of service.

For the eight months of 1912 the cost of operation, maintenance and lighterage of garbage delivered to Oakley Ave. station has averaged about 75 cts. per ton. The cost of operation, maintenance and lighterage chargeable against the garbage delivered at the Chicago Ave. loading station averaged about 64 cts. per ton.

Standard for Garbage Collection.—The tendencies and natural laws which determine the amount of rubbish which is collected from different sections of the city obtain also in connection with garbage collection. It has been found that wards lying the same distance from the center of the city, which have the same character and density of population, and having other similar conditions, give about the same tonnage of garbage per load.

Field study of the average time required by drivers to collect a load of garbage indicates that it takes about 3 hrs. 55 mins. to collect a full load of garbage in summer and 4 hrs. 41 mins. to collect a full load of garbage in the winter months. These units have been taken as standards and represent service which can be secured and maintained by practically every efficient teamster in the city. The average rate of haul has been found to be approximately 3 miles per hour during the summer months and 2 7/10 miles per hour during the winter months. These have been used in calculating the time spent and cost of hauling garbage.

RUBBISH COLLECTION AND DISPOSAL.

The matter of collection and hauling is the most important phase of the disposal of rubbish. Collection, haul and disposal are so correlated that no final solution or plan can be adopted for one without careful study of the conditions and methods used in the other two. In order to determine the costs of collection and the factors affecting it, study has been made as to time of collection, number of collections made each day by various teamsters, the service rendered, the rate of haul in miles per hour, location of dumps and the co-operation given the city's employes by the people served.

In estimating the cost of rubbish collection and disposal, the following tendencies have been found to control the expenditure necessary to care for this activity: (a) Character of district, (b) population, (c) distribution of population, (d) location of dumps, (e) time required to collect, (f) time required to haul, (g) length of hauls.

Careful analysis of the conditions in the city of Chicago for several years past indicates that a natural law has been followed throughout the entire city in the matter of growth, and that certain set cycles of growth have obtained. The controlling tendencies do not change materially, while the cycles change at a known rate, this rate being determined by the general conditions existing in each section of the city. Not only does the total amount of rubbish gathered from year to year vary according to a definite law, but the percentage of the rubbish gathered during the year from each month in the year varies accordingly. Tabulating the percentage of rubbish collected for each month of the year, based on January collections as 100 per cent for a period of five years for each ward in the city, the law of change for each ward has been determined, as well as an estimate of probable percentages to be expected for each month of the ensuing year. As the tendencies of various sections do not follow ward lines, the characteristics of each ward have been determined from those of the section surrounding that ward, and where ward lines have been changed entirely, the characteristics of the new ward have been determined from those of the old ward which occupied the same territory before the change.

Loading stations for rubbish and street dirt are being put into operation to a limited extent to reduce the length of haul for rubbish and street dirt, and thereby serve to lessen the unproductive work in connection with rubbish removal. A station for this purpose has been built at 15th Pl. and Loomis St., which consists of an elevated platform about 28 ft. x 460 ft. x 8 ft. high with 60-ft. approaches, a spur track being built on each side of the platform from the street railway tracks on Blue Island Ave. All hauling is done from the platform to the rubbish dump by the street railway company, which also furnishes the motor dump cars for this purpose.

The city of Chicago owns the trailing dump cars, and the cost of maintaining and repairing all cars, together with the cost of traffic and maintaining tracks at the dump and the loading station are charged against it. During the year 1911 the loading station at 15th Pl. and Loomis St. was operated for approximately 10 months at an average cost of 26½ cts. per cubic yard of rubbish handled. For the first eight months of 1912, the average cost per cubic yard of rubbish handled has been 24½ cts. These unit costs include the cost of operation at the dump, the cost of maintenance at the dump, the cost of train service and the cost of maintenance and repairs of equipment and track.

A second loading station is maintained in the Illinois Central Ry. yards at the foot of S. Water St., for the prime purpose of removing the street sweeping and catch basin cleanings collected in parts of the First and Eighteenth Wards.

The various dumps now in use and those available are so situated that the average total length of haul in many cases is five miles, and in some reaches seven miles.

Standard for Rubbish Removal.—During the course of investigation it was found that the platform at 15th Pl. and Loomis St. was out of order a considerable part of the time, because of insufficient equipment and undefined methods.

This matter has been considered in estimating the cost of removal of rubbish for 1913, an assumption having been made that the platform would be out of commission 33 per cent of the time and thus necessitate that wards using this platform must haul to the dumps indicated in the above table. It has also been assumed that an average of 25 min. for dumping is required and an average rate of haul of 3 miles per hour during the summer months and 2½ miles per hour during the winter months can be attained.

Investigation has revealed the average time of collection of one load of rubbish to be 2.19 hrs. in summer and 1.7 hrs. in winter. In the 8th and 9th wards these conditions do not obtain, on account of long collection routes and bad roads, but the units as given above are liberal and cover conditions in general. Estimates for the appropriations for rubbish and ash service in different wards have been prepared on two assumptions—viz., that each team will be required to work 8 hrs. each day irrespective of number of loads which can be collected in such time, and second, that the cost of removal per load of rubbish in 1913 will be the same as the cost in 1912. Estimates for ward appropriations, based upon the standard 8-hr. working day and upon the actual working conditions as obtain at present are included in Table III.

Paper burners, or hand-cart incinerators have been in use in the city for more than a year. These are usually assigned to definite routes in the dirtiest sections of a ward and cover their districts periodically, burning all the paper there is at hand.

The records of the weather bureau show that it has rained at least once each month during the past four or five years. The time required for these burners was therefore estimated only on a 25-day month. The wage of the man handling the burner is $2 per day. Paper burners are used between the months of May and October inclusive.

STANDARD OF SPECIAL SNOW REMOVAL.

Probably no activity of the Bureau of Streets calls for more rapid action and better organization to accomplish the desired result in the least possible time, and hence prevent a congestion or tie-up of traffic in the most congested portions of the city, than the removal of snow. In the performance of this function, the Bureau of Streets exerts all its efforts in giving proper attention to the loop district first. The loop district has been subdivided into sections and the removal of the snow from these sections is under the direct supervision of separate ward superintendents of the city, who are required to send a specified number of men and drivers upon call from the office. The ward superintendent of the 1st ward is responsible for the direction of all the laborers who shovel and pile up the snow. It is not known what the exact result is of this dual responsibility.

The necessity for special appropriations for the removal of snow occurs only on those streets having heavy pedestrian or team and street railway traffic, and also where the congestion due to these greatly hampers business and disrupts the services if the snow is not removed.

In the course of the study of the traffic conditions in the different parts of the city, the Commission also collected data as to the methods now used in the removal and disposition of snow. From these data, a standard has been prepared upon which special appropriations for snow removal have been based. The cost of snow removal per cubic yard becomes greater with the decrease in depth of snowfall. Investigation of the cost of snow removal in different sections of the city shows that it costs about $1.05 per cubic yard to remove a snowfall 1 in. deep, 89 cts. per cubic yard to remove a snowfall 2 ins. deep and 41 cts. per cubic yard to remove a snowfall 3½ ins. or greater in depth.

In determining the amount of snow to be removed, the area between building lines has been used, as the snow from the sidewalks is shoveled into the streets and must be included in the amount to be removed. This area has been multiplied by the estimated depth of snow to obtain the gross number of cubic yards which have fallen. Due to the compression of snow, either under traffic or its own weight, and to its melting, it has been found that the volume of snow to be removed is only 18 per cent of the total volume as it falls to the ground. It has been assumed that where the depth of snowfall is less than 3 ins., special removal will be made in no part of the city, except that portion of the 1st ward north of 12th St.; also a snowfall of 1 in. or less in depth will not be removed in any part of the city by special snow forces, but shall be cared for by the ordinary street cleaning organization.

WATER WORKS

An Argument for Water Meters in Chicago from the Standpoint of the Individual Householder.

Contributed by T. C. Phillips, Engineer of Water Surveys, Chicago.

During the year 1911 the pumping stations of the city of Chicago pumped 156,125,000,000 gals. of water into the city water mains. This is an average daily supply for the entire city of 427,740,000 gals., after deducting for slip of pumps, or an average daily supply of 190 gals. per capita, based upon a population of 2,259,000 for 1911.

Comparing the per capita consumption with that of other large cities, Chicago stands in a class by herself as a lavish waster of water. A daily consumption of 190 gals. for each man, woman and child is far more than is necessary for any city with reasonable precaution against waste and leakage.

We naturally inquire, what becomes of the water? The answer is given as follows:

(1) 37.0 gals. per capita is consumption by frontage consumers.
(2) 44.0 gals. per capita is consumption by meter consumers.
(3) 9.5 gals. per capita is consumption by free service consumers.
(4) 4.5 gals. per capita is slippage of or loss by meters.
(5) 38.0 gals. per capita is plumbing leakage.
(6) 57.0 gals. per capita is willful wastage and underground leakage.

190.0 gals. per capita is total consumption for entire city.

Items 1, 2 and 3, amounting to 90 gals. per capita, show the water that is actually used and items 4, 5 and 6, amounting to 100 gals. per capita, show the water that is lost through wastage and leakage.

Items 1 and 2, amounting to 81 gals. per capita, produce all the revenue, and items 3, 4, 5, 6, amounting to 109 gals. per capita, produce no revenue. In other words, 42.6 per cent of the water delivered to the mains produced all of the $5,993,771.32 revenue for 1911 and 57.4 per cent of the same produced no revenue.

A good deal may be said about the large unnecessary waste of water, but when all is boiled down some one has to "pay the freight" or, in other words, pay for the losses of supply through wastage and leakage.

The freight, so to speak, is paid for by the consumer who pays for water. He pays for the 90 gals. daily per capita that are used and also the 100 gals. daily per capita that are lost through leakage and waste.

THE FRONTAGE VS. THE METERED CONSUMER.

There are three classes of water consumers, the frontage, the metered and the free service consumer. The first two are paying consumers and the third pays no revenue.

The 1911 Annual Report of the City of Chicago shows that the frontage consumer used 30,655,000,000 gals. and paid $3,134,700.02, which is 10.23 cts. for 1,000 gals. for the water he used; and in the same report we find that the metered consumer paid $2,556,594.32 for 40,175,000,000 gals., which is 6.3 cts. per 1,000 gals. for the water that passed through his meters.

The frontage consumer pays 56.7 per cent and the metered consumer pays 43.3 per cent of the total revenue. The frontage consumer received 39.48 per cent of the total pumpage or 75 gals. per capita per day and wastes 20 per cent or 38 gals. per capita per day through leaky plumbing. For the 19.48 per cent or 37 gals. per capita that the frontage consumer actually uses he pays 10.23 cts. per 1,000 gals.

The meter consumer pays only about 6.3 cts. per 1,000 gals. for the water he received through meters.

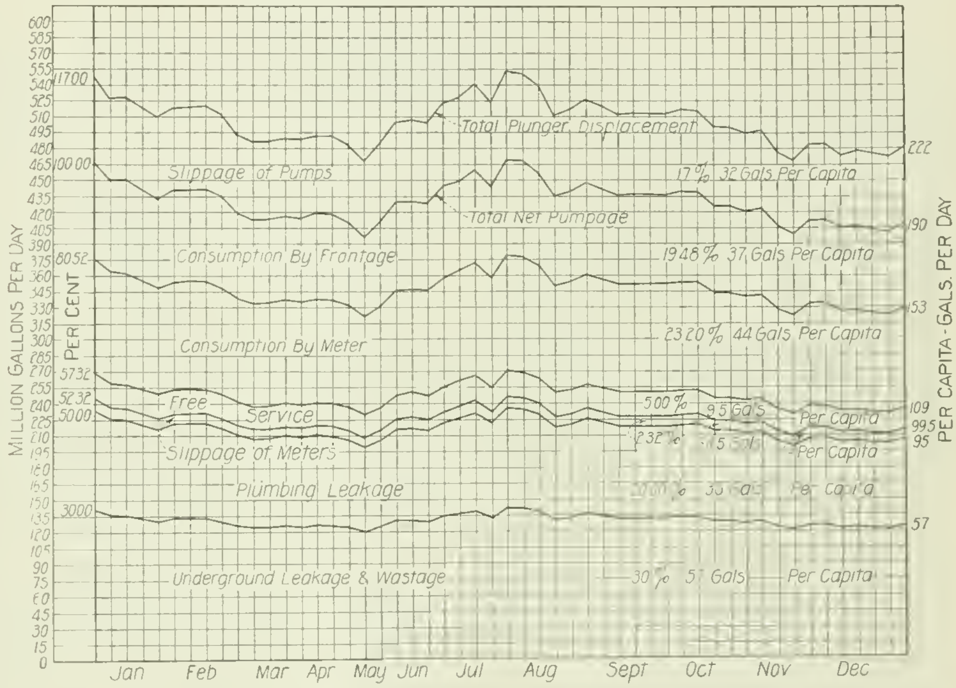


Fig. 1—Diagram Showing the Distribution of Water Consumption in Chicago During 1911.

THE CONSUMER WHO BEARS THE BURDEN.

We are mostly concerned in the two paying consumers for they must be charged enough for water to make up for the water used by the free service consumer, and also make up for the 100 gals. daily per capita that wastes and leaks away. This last item amounts to over 200,000,000 gals. of water per day.

The frontage consumer as a class is under no restrictions in the use of water and therefore is a lavish user and waster of water. He pays for his extravagance as shown above. Some of the extra burden of expense caused by waste is borne by the metered consumer for he would, no doubt, be given a better rate if there was no additional expense for losses to be met.

Since the burden of the waste and the burden of the revenue is placed upon the frontage consumer, let us see who he is. The frontage consumer is the paying consumer who does not pay for water by meter measurement, and who generally believes that a meter on his service pipe is an ill omen. The water ordinances of the City of Chicago say that frontage consumer is the consumer whose frontage is $100 or less. He is useful and necessary in making up the balance of the revenue, but cannot enjoy the privilege of paying only for what he needs for his family or his business. If he wishes to escape paying for his neighbors' carelessness and wastefulness, he must build a building high and wide enough, regardless of its length, so that his frontage charge for water exceeds $100 per annum and the city will then install a meter and charge him at the rate of 7 cts. per 1,000 gals.

THE SMALL FRONTAGE CONSUMER OR HOUSEHOLDER.

There are about 250,000 frontage consumers in the city of Chicago. They include private residences and flat buildings, rooming and lodging houses, saloons, restaurants, stables and miscellaneous other consumers. The great majority of this number are private residences and the smaller flat buildings. They pay for the water they use and the water they waste, and in addition thereto bear a considerable part of the extra burden, due to the excessive use and lavish waste of the large frontage consumer, due to the careless waste by the small consumer with hopper closets, and due to the useless and negligent waste by the consumer with cheap fixtures. The large frontage consumer, who happens to have a bakery, a bottling establishment, milk depot, restaurant, photograph gallery, saloon, laundry, foundry, fish packing establishment, hotel, fountain or barber shop, etc., enjoys lower rates per 1,000 gals. of water delivered than the consumer who pays for water by meter, or the small frontage consumer, namely, the householder.

The consumer with a hopper closet, as a class, is the most wasteful consumer. It is doubtful if the revenue derived from this class is sufficient to pay for the coal burned to pump water for them.

The small frontage consumer, or householder, generally speaking, has smaller facilities for using water. It is difficult to state what he pays per 1,000 gals. of water used, but from the above it is safe to conclude he pays more for water per 1,000 gals. used than the metered consumer or large frontage consumer. He should be permitted to enjoy the privilege of paying only for what he gets the same as the metered consumer. He should not be charged for water on the same basis as the large frontage consumer who has large facilities for using water. Naturally the large frontage consumer uses his influences against meters and the little frontage consumer innocently follows to his own disadvantage. The result is the little frontage consumer pays the bulk of the freight.

EACH SHOULD PAY HIS FAIR SHARE.

Each consumer should pay his fair share of the "freight" or expense of delivering water. He should pay for the water by measurement. It is estimated that this would produce a daily saving of about 75 gals. per capita, or a daily saving of about 170,000,000 gals.

WHAT THE GREAT WASTE MEANS.

The city of Chicago has nine large pumping stations. In 1911 these nine stations actually delivered an average of 427,000,000 gals. of water per day. This is less than an average of 50,000,000 gals. per day per station for the nine large stations. One hundred and seventy million gallons per day is more than the actual average output or delivery of the two large pumping stations, or more than the actual delivery of 14th Street, 22d Street, Harrison Street and Lake View Pumping Stations collectively based upon the pumpage figures given in the 1911 annual report and allowing 15 per cent for slippage.

As the city grows, extending its center of population, more of these pumping stations will be required to meet the demand for supply. They represent an enormous investment, about $1,000,000 per station, and cost additional large sums for operation and maintenance. Curtailment of these expenditures cannot be made immediately, but steps should be taken now to stop the enormous waste and leakage so that the future expense of operation and maintenance of pumping stations and also the cost of and the future expense of operation and maintenance of water mains and water tunnels will be reduced to a minimum.

The City of Chicago cannot afford to build, maintain and operate a water works to provide water to waste when there are so many public improvements in great need of appropriations.

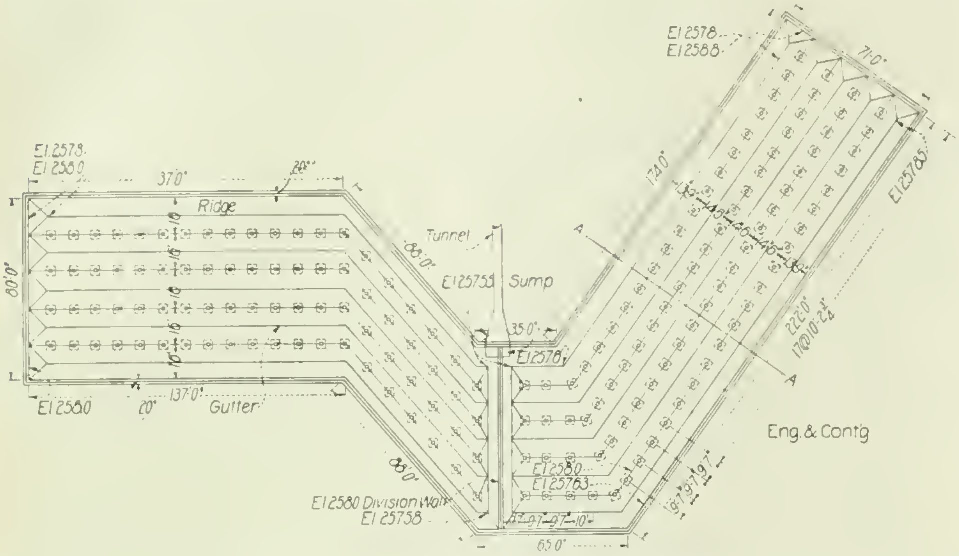


Fig. 1—Plan of 5,000,000-Gal. High Service Water Works Reservoir for La Crosse, Wis.

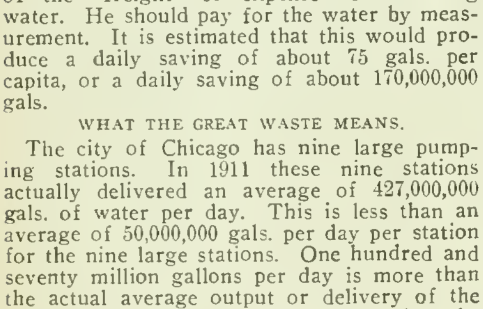


Fig. 2—Section A-A of Fig. 1.

The Design of the 5,000,000-Gal. Reinforced Concrete Water Works Reservoir for La Crosse, Wis.

(STAFF ARTICLE.)

An important structural feature of the new water supply system for La Crosse, Wis., is the 5,000,000-gal. reinforced concrete, high service reservoir. The present article will describe and illustrate the principal features of the design of this reservoir, in addition to presenting a summary of the discussion of the economics of water storage as given in the original report of the consulting engineers, Messrs. Alvord and Burdick of Chicago.

ECONOMICS OF WATER STORAGE.

The load upon a water works pumping station can be made approximately uniform by the utilization of water storage. Storage is particularly economical where land at the proper elevation, within a reasonable distance of the pipe system, is available for the construction of storage reservoirs. The city of La Crosse is particularly fortunate in this respect in that good reservoir sites exist at any elevation that may be desired closely adjoining the city.

In cities where such reservoir sites are lacking resort is usually made to storage reservoirs on the ground level at the water works plant. Such reservoirs, while they have no effect upon the installation in boilers or pumping engines, permit the capacity of the water source to be based upon average rates. At La Crosse, however, it is practicable by the utilization of elevated storage to base the entire plant capacity on the 24-hour rate, and, in addition, to reduce to some extent the reserve capacity in water supply and machinery required for fire protection.

Water Required for Fire Protection.—The experience of the past 30 years has demonstrated that where fire protection is good serious conflagrations are extremely rare. It was the conclusion of the engineers that the La Crosse water works should be able at all times to furnish water at the rate of not less than 5,500,000 gals. per day in excess of the domestic consumption rate.

Capacity of Storage.—Knowing the hourly rate of pumpage, it is practicable to compute quite accurately the required volume of water in storage that will be needed to make good the inequalities in the consumption rate and permit the pumps and water supply to operate at uniform or more nearly uniform rates. The volume in storage that is required to reduce the present maximum pumpage rate of 16,000,000 gals. per 24 hours to various other smaller rates, including the present average rate of 6,740,000 gals. per 24 hrs., is as follows:

Gallons in storage.	Max. pumpage rate mil. gals. per 24 hrs.
0 (as at present)	14
197,000	12
508,000	10
924,000	8
1,190,000	6.74

A volume of water, therefore, of about 1,000,000 gals. in the summer of 1910 would have been effective in reducing the pumpage rate from the maximum of about 14,000,000 to the average water consumption for the 24 hours of about 6,700,000 gals. In providing storage at this time it will be wise to provide for some future increase in consumption, and possibly some further increase in variation in the daily consumption. The indications at present, however, are that no large allowance for the future will be required.

In situations where the topography is unfavorable, storage is sometimes so costly that it is better finance to provide additional machinery and enlarge the water supply sources, but this is not true at La Crosse, where elevated storage can be secured at an expenditure, in round numbers, of $12,000 to $15,000 per 1,000,000 gals. stored, that will reduce the capacity in machinery by the amount of the difference between the maximum hourly rate and the average 24-hour rate, the differ-7,000,000 gals. The figures for an 8,000,000-gal. 7,000,000 gals. The figures for 8,000,000-gal. development, including water supply and pumping machinery, approximate $22,000 per 1,000,000 of capacity—a sum considerably in excess of the cost of water storage, and, furthermore, an expenditure in a permanent masonry reservoir is not subject to the relatively high maintenance and depreciation charges incident to wells, pumps and boilers.

It can be shown by the same process of figures that a large part of the water supply and station reserve capacity needed for fire protection can be most economically provided by materially increasing the volumes of water stored. In connection with the various projects suggested by the engineers for the development of the ground water supply, they recommended the construction of an elevated reservoir of from 5,000,000 to 8,000,000 gals. storage volume.

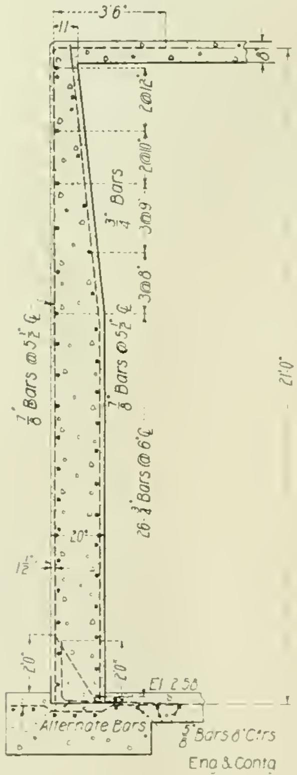


Fig. 3—Section of Outside Wall.

Elevation of Reservoir.—If the elevated storage reservoir is to be available for fire protection, it must be placed at such an elevation as to produce sufficient pressure for the fighting of fire, viz., from 80 to 90 lbs. in the business district, and if such a reservoir is constructed it follows that all of the water pumped must be delivered against this increased pressure as compared to 60 lbs. at the present time. It was the opinion of the engineer, however, that although such increased pressure will result in larger coal bills, this increase in the operating expenses will be more than offset by the saving in fixed charges in the otherwise necessary additional water supply and machinery. The figures bearing upon the matter are as follows:

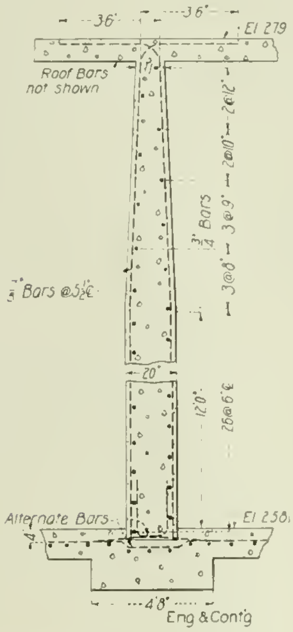


Fig. 4—Section of Division Wall.

Interest and depreciation on $121,000 invested in 5,500,000 water supply capacity, at 9 per cent		$10,900
Interest and depreciation on $93,000 invested in 5,000,000-gal. reservoir and pipe line, at 6 per cent	$5,600	
Increased coal bill, not to exceed	3,300	
		8,900
Net annual saving through elevated storage not less than		$ 2,000

It was the opinion of the engineers that elevated storage will pay at La Crosse from the standpoint not only of domestic consumption, but from the standpoint of fire protection as well, and they contemplated the use of elevated storage in all of the alternate propositions considered for the supply of the city.

It is practicable to make use of a storage reservoir at the domestic pressure level, say at an elevation equivalent to 60 lbs. above the pumping station, by the installation of pumping machinery at the reservoir that would permit water to be drawn therefrom and repumped into the distribution system against fire pressure. This plan is followed in a number of cities, especially where there is a high pressure domestic service district, notably at Dubuque and at Davenport, but at La Crosse, where the entire city lies upon low ground, it was the opinion of the engineers that it is the better to build the reservoir at the fire pressure level. This plan is followed at Quincy.

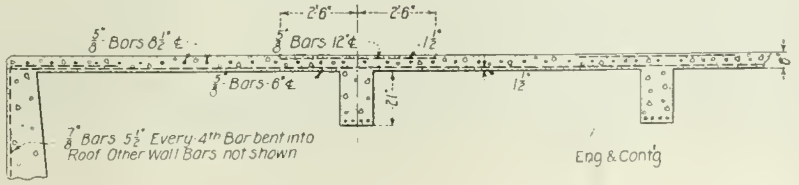


Fig. 5—Detail of Typical Roof Slab.

DESIGN OF RESERVOIR.

The principal features of the design of the reservoir which is to be constructed during the coming season are shown herewith in Figs. 1 to 10. The reservoir is to be constructed of reinforced concrete throughout. The specifications for excavation, concrete, and reinforcement are substantially the same as given for the reinforced concrete pump houses which were presented in the article entitled The Development of a Ground Water Supply at La Crosse, Wis., which was published in Engineering & Contracting of Dec. 18, 1912.

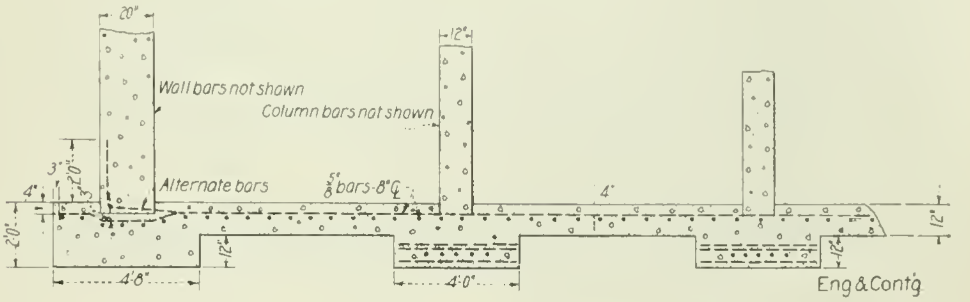


Fig. 6—Section of Floor.

The reservoir will be located on a bluff east of the city. The storage capacity is to be 5,000,000 gals. A general plan view of the proposed structure is shown in Fig. 1. The irregular outlines of the structure were made so to conform in a general way to the natural topography of the site. It will be noted that the reservoir is divided into two approximately equal parts by means of the division wall. The roof slab is supported by means of reinforced concrete beams, extending transversely across the reservoir, supported on the columns which rest upon the reservoir floor. Suitable square pedestal slabs are placed beneath the floor at the base of all columns.

Fig. 2 shows a typical transverse section through the reservoir. The section shown is taken at *A-A* of Fig. 1. The depth of water shown is 20 ft. The floor of the reservoir is given a transverse pitch of 2 ins. in half the distance between columns. This, of course, is to facilitate drainage in emptying the reservoir for inspection, cleaning, or repairs. The minimum distance between columns at any point of the reservoir, measured parallel to the long axis, is 9 ft. 7 ins., and the corresponding maximum distance is 10 ft. 2¾ ins. The distance between the side walls and the adjacent column is either 13 ft. 9 ins. or 16 ft. The distance between columns, measuring transversely across the reservoir, is either 14 ft. 6 ins. or 16 ft.

Figs. 3 and 4 show a typical section of the outside walls of the reservoir and of the division wall, respectively. All vertical bars in the walls are ⅞ in. square in section. All horizontal bars in the walls are ¾ in. square The spacing of the vertical bars is either 11 ins. or 22 ins. in the walls. The spacing of the horizontal wall bars ranges from 6 to 12 ins. The total amount of reinforcing in the walls is 331,829 lbs. The alternate vertical rods in the outside of the outside walls are bent into the roof and floor slabs. The alternate vertical rods in both the faces of the division wall are bent into the roof and floor slabs.

A typical section of the roof slab is shown in Fig. 5. All reinforcing bars in the roof are ⅝ in. square. The spacing of these bars ranges from 5 to 12 ins. The particular section shown is the design which will be used in the four panels on the downhill side of the reservoir. As shown in Fig. 2 the thickness of the roof slab is 8 ins. in the fifth or uphill panel. The total amount of reinforcing in the roof is 209,150 lbs. After the roof of the reservoir has been completed and thoroughly set, an earth fill of 12 ins. in depth will be placed upon it.

A section through the floor is shown in Fig. 6. All the reinforcing bars in the floor are ⅝ in. square in section and are spaced 8 ins. on centers. The total weight of the floor bars is 157,000 lbs. As shown in Fig. 6 the pedestals beneath the floor at the base of the columns is 12 ins. thick and 4 ft. square. A similar strip of concrete 12 ins. thick and 4 ft. 8 ins. wide underlies the floor for the full length of the outside and division walls.

The floor of the reservoir will be given a plaster coat consisting of one part of Portland cement and two parts of clean sharp sand. This coat will be at least ¾ in. thick, and will be placed within one hour after the concrete floor is laid. The finish coat will be rounded into the angles between the bottom and side walls, and will be carried up a distance of 6 ins. along the walls. The cement plaster will be applied and finished as in placing the wearing coat on cement sidewalks.

Sections of the columns and a typical section of one panel of a beam are shown in Figs. 7 and 8, respectively. All the reinforcing rods in the beams and columns are ⅞ in. square bars with the exception of the stirrups in the beams which are ⅜ in. square The total weight of bars in the beams and columns is 109,580 lbs. The section of the beam shown is in the uphill panel where the depth of beam is 25 ins. In the four lower panels the depth of beam is 20 ins. A 4-in. circular air vent is left open at the center of each beam just below the under surface of the roof slab.

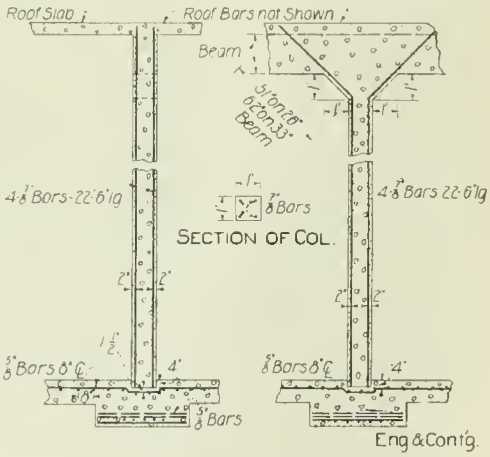


Fig. 7—Vertical Sections of Columns.

In building the columns care will be taken to make them symmetrical, truly vertical, and free from bulging. A special long-handled tool will be used for compacting the concrete by thoroughly cutting it into the form. The beams and slabs for the roof will be constructed simultaneously with the top of the side walls and the tops of the columns, so as to tie the whole work together as thoroughly as possible. The surface of the roof will be trowelled smooth as soon as the concrete is placed.

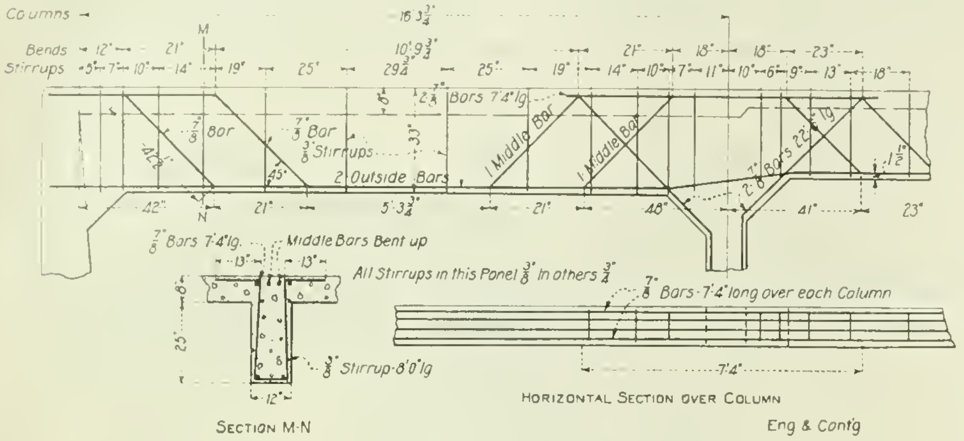


Fig. 8—Details of One Panel of a Typical Beam Supporting Reservoir Roof.

A stone gutter will be built to care for the drainage from the side of the bluff. The cross section of the gutter is a segment of a circle. The gutter will be 4 ft. wide, 8 ins. deep, and of stones not less than 6x6x8 ins. The stones will be placed by hand so as to produce a smooth surface in the finished gutter. After the stone has been placed the joints will be completely filled with Portland cement mortar consisting of one part cement and three parts of sand. The mortar will be brushed into the joints with a broom.

Each of the two main compartments of the reservoir will be provided with two ventilator manholes. These manholes will be placed at diagonally opposite corners of the two main compartments. Cast iron manhole frames and covers will be placed upon these manholes. The walls of the manholes, which are 6 ins. thick, will be carried up 3 ft. above the top of the concrete roof slab. In one wall a grated opening 12 ins. deep and 24 ins. wide will be made. The top of this opening will be 6 ins. below the top of the manhole wall.

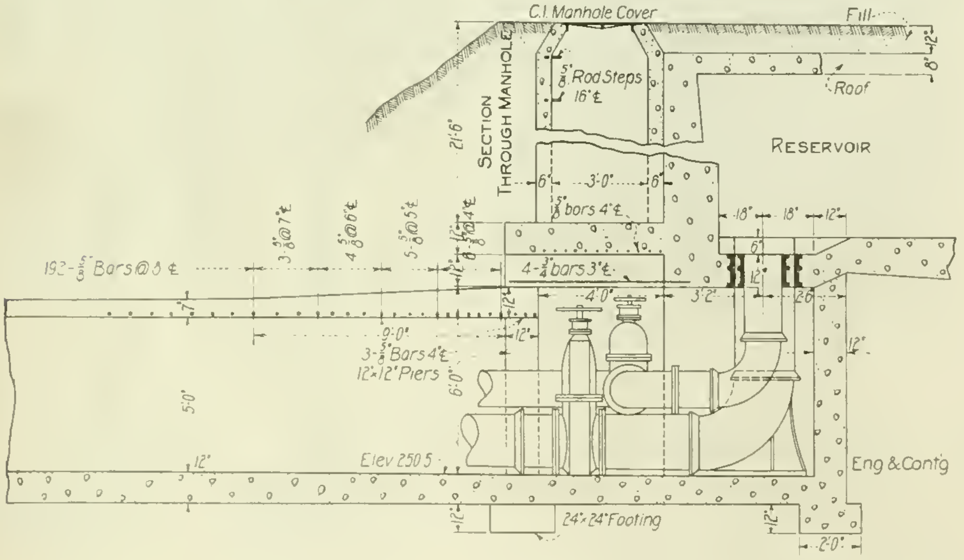


Fig. 9—Longitudinal Section Through Tunnel.

Fig. 9 shows a partial longitudinal section of the tunnel, the general position of which is shown in the plan, Fig. 1. The inlet and blow off pipes are also shown in this figure. The inside dimensions of the tunnel section are 3 ft. 6 ins. by 5 ft. The roof slab is 7 ins. thick, the floor 12 ins. thick, and the side walls are also 12 ins. thick. The 20-in. pipe is placed on concrete supports on the tunnel bottom. The 12-in. pipe rests upon a reinforced concrete saddle which is supported on the top of the 20-in. pipe. The total weight of reinforcing bars in the tunnel is 2,053 lbs. Elevations of the overflow are shown in Fig. 10.

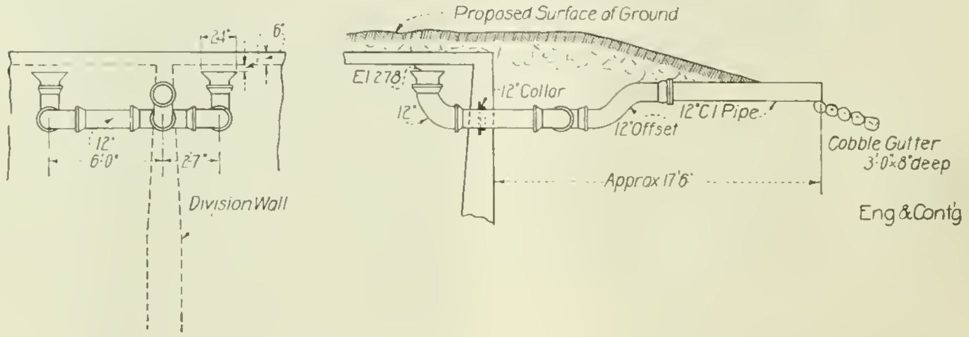


Fig. 10—Elevations of the Reservoir Overflow.

The reservoir is to be constructed in such a manner that when completed and filled there shall be no appreciable loss of water, and no wet spots shall show on the outside of the reservoir. The reservoir will not be accepted until it passes the engineer's test for watertightness.

The contract for the construction of this reservoir was let to the J. W. Turner Improvement Co. of Des Moines, Ia., for $74,461. Alvord and Burdick of Chicago are the consulting engineers.

The Proposed Extensive Improvements to the Water Works System of the City of Akron, O.

The water works system of Akron, Ohio, a city of 85,000 population, has not been developed to keep pace with the growth of the city during recent years, and so became inadequate. Fire service has been unreliable and there have been entire failures of the domestic supply on the higher levels. The city at length voted to buy the privately owned plant, and subsequently planned extensive improvements, including a new source of supply. The proposed improvements were discussed by H. H. Frost, Superintendent of the Akron City Water Works, in a paper before the Central States Water Works Association. The following matter is taken from Mr. Frost's paper.

The consulting engineers employed to design a new water works system for the city, Messrs. F. A. Barbour of Boston, and E. G. Bradbury of Columbus, realized that the attribute of any new supply which in the mind of the average citizen will finally justify the expense involved in securing the supply, is attractive appearance as well as proper hygienic qualities.

With these ideas in view, the Cuyahoga River was chosen as a source of supply. It is proposed to go a short way above the village of Kent, or about nine miles northeast of Akron, and build a dam across the Cuyahoga River valley which will be high enough to store up enough water to take care of Akron for years to come, even during the dryest year, or a series of dry years. This storage reservoir can be further enlarged by raising the dam, should the consumption of water so demand. This dam will probably be of the hollow-reinforced gravity type. The water will be diverted from this reservoir through a 60-in. reinforced concrete conduit, about 2,500 ft. long, to the purification works and pumping station.

Although the Cuyahoga River flows within a mile of Akron, it was deemed safer and more economical to choose the site decided upon for the new pumping station, because the water is not liable to so much contamination at that point, and the head against which the pump must work would be very much less.

The water will pass from the 60-in. conduit into coagulating basins; will then be sterilized and passed through rapid sand-filters under which is located the clear-water well. From here the water will pass to the suction wells, and will then be pumped through a 36-in. force main about 10 miles in length to a 20,000,000-gal. distributing reservoir near the eastern part of the city.

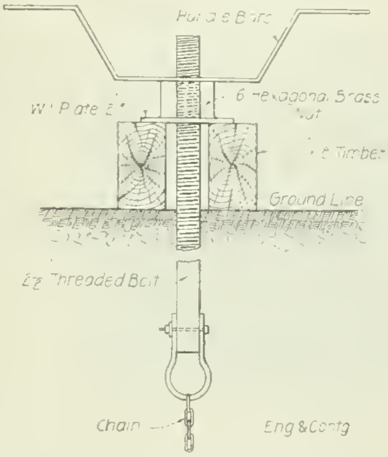
The elevation of the purification works in relation to the dam is such that double pumping will be practically avoided and still ample drainage will be allowed from the works to the river. Aluminum sulphate will probably be used as a coagulant, and hypochlorite of lime as a sterilizing agent.

The pumping station provides for the installation of high and low lift pumping apparatus, boilers, machine shop, coal sheds, etc. It is proposed to install two 15,000,000-gal. high duty vertical, triple expansion pumping engines, low lift centrifugal pump, electrical generating apparatus, and water-tube boilers of capacity necessary for the operation of the plant and auxiliaries when pumping at the rate of 15,000,000 gals. per day.

The question arose as to whether cast iron or steel should be used for the 36-in. force main, and steel lock-bar was finally decided upon for the reason that steel has the greater reliability in the matter of breakage tending to interrupt the service, and will cost only about three-fourths as much as would a cast-iron line. Its life, however, would perhaps not be as long as cast iron, but there being but one supply line, the risk of constructing the same of cast iron was considered too great.

The total estimated cost of the storage reservoir, dam, intake pipe to the purification plant, purification plant, pumping plant and 36-in. force main, including $450,000 for land and water rights, is $1,650,000.

The old distributing system is now being reinforced by 30-in., 24-in., 20-in., 16-in., 10-in. and 8-in. mains, with the expectation that the works will then be able to furnish, in addition to the ordinary consumption, 25 fire streams of 250 gals. per minute each in the down-town district, and at the same time 10 fire streams at any point in the residential district. At present there are about 600 hydrants, but these will be increased to about 950 in the near future, the old 4-inch hydrants in the down-town district being removed to the outskirts, and 6-in. hydrants put in their places. All hydrant runs will be provided with gate valves.



Sketch of Jack for Raising Cast Iron Pipe Line While in Service.

The cost of the distributing reservoir, mains from reservoir to the city limits, and reinforcement of present pipe system, will be about $750,000.

In addition to this the city has already purchased the old system for $815,000. Although one of the pumps in the present plant will likely be used in the new plant, the cost of the whole water works system when completed will probably be about $3,250,000.

Method of Raising 48-in. Cast Iron Water Mains While in Service.

(STAFF ARTICLE.)

In constructing a subway passing under three 48-in. water mains in Brooklyn, N. Y., the mains were required to be elevated for a distance between 18 joints, or about 204 ft., so as to rise over the subway roof. The maximum change in elevation at joints directly over the subway was about 2 ft., and decreased gradually to zero at joints 1 and 18 on opposite sides of the subway. The difficulty of the work came from the necessity of keeping the pipes in service under a pressure of 40 lbs. per square inch during raising. The lengths of pipes between joints were 12 ft., and each length weighed 4 tons empty or 9 tons filled with water. One main was raised at a time by means of twelve service jacks arranged as indicated by the accompanying sketch. The 12x18 in. timbers were long enough to give a good distribution of the lifting pull, and the chain shown was passed around the mains near the bell end of the joint. Turns were taken on the jacks so as to raise the main gradually, and as the raising progressed the main was carefully blocked underneath. A number of caulkers were kept in attendance to repair any rupture that occurred in the joint caulking. The jacks were capable of lifting 25 tons each.

SEWERAGE AND SANITATION

Operating Results of the Sewage Disposal Works at Bordentown New Jersey.

Contributed by C. M. Hartley, Civil Engineer, South River, New Jersey.

Among the recent installations of sewage disposal plants in New Jersey is that at Bordentown, a city of 5,000 inhabitants. This plant was placed in operation in June, 1911, and has been operated continuously since that time with results eminently satisfactory to the State Board of Health, and to all others concerned. The following brief description of the plant is appended to aid in the better interpretation of the operating results described later on.

DESIGN.

These works embrace screen chambers, sedimentation tanks, contact beds, settling basins, sand filters, and sludge pit. With the exception of the sludge pit, the several parts are in duplicate, and comprise a plant designed to produce an effluent of exceptional purity.

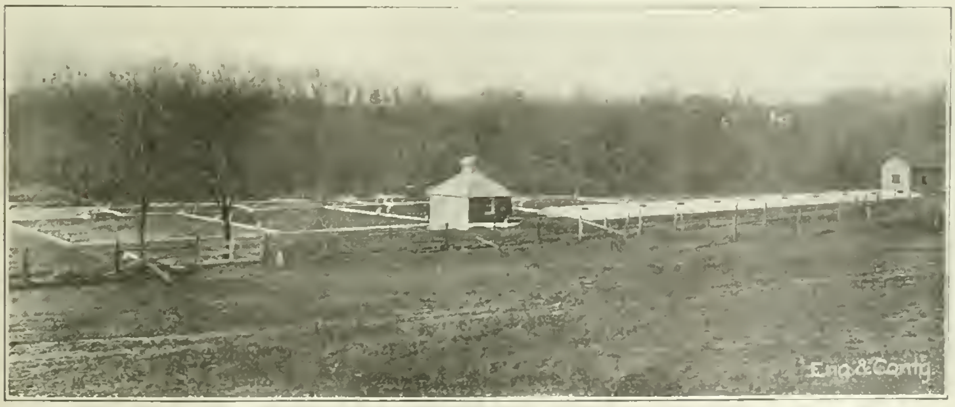


Fig. 1—General View of the Sewage Purification Works at Bordentown, New Jersey.

(Dosing chamber in the center, screen chamber at the extreme right.)

It will be seen at a glance that this design provides for a plant capable of much more complete treatment than is obtained by the majority of plants designed and built at present for towns of this size, and it may seem unnecessarily large, complicated and costly. However, at the time this plant was designed, in the year 1908, the regulations and requirements of the New Jersey State Board of Health as well as those of other nearby states, were much more exacting, and called for a greater degree of purification, and more stages of treatment, than is the case at present. At that time the alleviation of the pollution of the Delaware River was being most violently agitated, and it was necessary to build a plant capable of producing results that were the best known to the sanitary engineer.

There have been designed and built within the last two years, in this state a number of plants consisting of treatment of the sewage by chemicals, and settling tanks. These plants are simple in design, operation and maintenance, and low in cost, and as a general rule are designed to meet the same conditions encountered at Bordentown.

Four years ago the Imhoff tank had not reached the high state of development and efficiency in this country, nor was this method of treatment so widely used or well thought of, as is the case now. Whereas a tank together with chemical treatment and a filter will satisfy all requirements in the majority of cases now, such was not the case a few years ago. For this reason we have a plant at Bordentown which may seem more complete than the majority but which was required, in its entirety, by the state. A general view of the plant is shown in Fig. 1.

The sewage is delivered by gravity to the screen chamber through a 15-in. terra cotta sewer, and the design is such that the screen chamber may be by-passed and the sewage thus delivered directly to the sedimentation tanks. The screens, which are in two sets, are constructed of flat wrought iron bars ⅛ by 2 ins. The bars are spaced 1¼ ins. apart in the first, and ⅝ ins. apart in the second screen. Any finer particles which may pass through the screens are collected in two hopper-bottomed tanks, and drained out from the bottom of each by gates which lead to a 12-in. drain leading from the outlets under each structure to the outlet of the plant.

The two sedimentation tanks of reinforced concrete, see Fig. 2, are built as one structure, together with the screen chamber, and are 150 ft. long, 17 ft. high, and 12 ft. in width. The bottom 6 ft. of each side of each tank is built on a 1 on 1 slope, and thus form a long, narrow trough. The sides forming the gallery between the tanks are 12 ins. thick, while those sides built against the excavation are 9 ins. in thickness. The center partition wall of the tanks is 12 ins. thick, and the outside walls 9 ins. These walls are carried up 6 ft. from the tops of the troughs, to the normal flow line of the tanks. The end walls are 15 ins. in thickness. Each tank is covered with a 12-in. arched roof.

The intakes from the screen chamber are located 6 ft. below the flow line, and baffles are placed at this point to insure an even distribution of the flow across the full width of the tanks. A concrete weir, equipped with scum board, is placed at the outlet end and rests on a shelf extending 2 ft. into the tanks from the end wall. A 12-in. sludge drain is located in the gallery between the tanks, formed by the inverted V-shaped tank bottoms. At 25 ft.

intervals, 6-in. pipes extend at right angles into the tanks, the drainage of the sludge being controlled by gate valves. Access to this gallery is obtained through a manhole in the screen chamber, and to the tanks themselves, through ten standard manhole frames and covers, placed along the crown of each arched roof, at intervals of 15 ft. These tanks are designed for a detention period of 8 hours, for a 250,000 gal. flow per day for each tank.

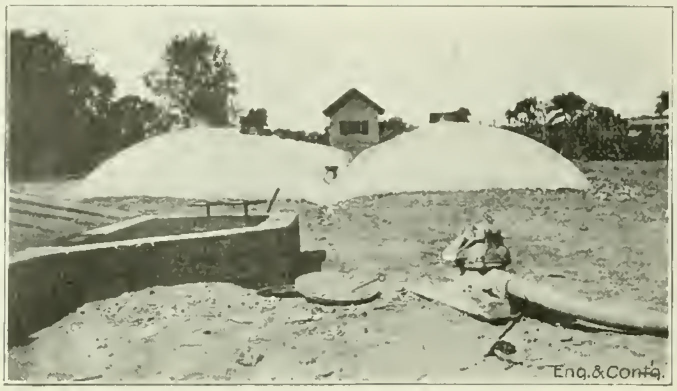


Fig. 2—End View of Sedimentation Tanks.

By means of an automatic dosing device, installed by the Pacific Flush Tank Co., the sewage from the sedimentation tanks is fed in rotation to the contact beds. The arrangement is such that the order of dosing may be changed at will, and any two beds may be cut out indefinitely. The operation of this device is accomplished entirely by air pressure developed by the sewage, through four "Adam's Feeds" with their attendant domes and syphons.

The contact beds, consisting of a primary series, see Fig. 3, and a secondary series, each of four beds, are of identical construction with the exception of the filtering media which, in the secondary beds, is a finer material. They are so designed that either series may be by-passed when desired and are of the underfed type. Each series covers a rectangular area 80 ft. by 200 ft., divided into four beds by walls 4½ ft. high, 3 ft. thick at the bottom, and 9 ins. thick at the top. The floors are 4½ ins. thick, reinforced with expanded metal reinforcement. The floors all drain to the center of each bed where a gutter runs from end to end longitudinally. The underdrainage is taken care of by U-tiles of a special design, 5½ ins. wide by 6½ ins. high, which cover the floors in transverse rows, laid close together and cemented. Two beds of each series are filled with crushed trap rock, and the other two with selected washed gravel, to within 6 ins. of the tops of the walls. Each bed is ventilated by six 10-in. ventilating pipes, three on a side, and fitted with swiveled hoods.

As stated before the sewage enters the beds on the floor line. It then fills the bed to within 6 ins. of the top, is held for a predetermined and regulated period of contact by an air-locked syphon installed by the Pacific Flush Tank Co., and is then automatically discharged either on to the secondary bed or into the main drain. Valves are so arranged that the beds may be operated entirely by hand, if so desired, and any primary bed may be discharged into either of the two secondary beds below it.

A settling basin 300 ft. long, 3 ft. deep, and 15 ft. wide at the bottom receives the effluent from the secondary contact beds, see Fig. 4. It is divided into two parts by a partition wall, and in this wall is a manhole providing access to the main drain. In the center of each half of the basin is an inlet from the adjacent contact beds, the outlets to the sand filters being at the ends. Either half of the basin can be cut out, and all of the beds can be emptied into either half. Concrete weirs and baffles are provided at the outlet side.

The final stage of treatment is afforded by sand filters, in two sets of two each, and the effluent from the settling basin is delivered to these filters through 12-in. terra cotta drains. These filters are of the customary earth bank construction and are drained by tile underdrains. They are filled with 2½ ft. of fine sand and are fed by risers which discharge on circular concrete distributing tables 3 ft. in diameter, placed flush with the surface of the sand.

The main drain is carried between the two sets of filters, and is provided with four manholes into which, through their underdrains, the filters discharge. The effluent flows from here into a small stream known as Black's Creek, which is tributary to the Delaware River.

OPERATING RESULTS.

At the present time there are 400 connections to the sewer system, which totals approximately nine miles of terra cotta sewer, with the number being increased daily. The average daily flow of sewage, as recorded at the works, is 220,000 gals., so it is seen that the plant is operated at considerably below its rated capacity, which is not conducive, theoretically, to the best results. However, in actual operation, this does not seem to have such an effect. The results, as far as the purification of the sewage is concerned, are all that could be desired, the only trouble caused being in the regulation and timing of the dosing devices.

The sewage handled is all domestic, and arrives at the works, through an outfall sewer ½ mile long, in a fairly fresh condition. The screens have been cleaned; and the deposit of "sludge," if it may be called such, in the hopper bottoms of the screen chamber, has been drawn off twice since the plant was placed in operation; in June, 1912, and September, 1912. This accumulation was spread over the sludge pit to dry, and now represents a total of about 22 cu. yds. Its appearance is not unlike that of the black spongy material, full of decomposed vegetable matter and grass, composing the subsoil of the salt meadows in this state. The screens were examined by the writer on November 4, and were in such condition as will necessitate cleaning before long. This seems to indicate that with the amount of sewage now being treated, they will have to be cleaned every two or three months.

It is the intention, now, to construct other sludge pits when the present one is filled to the level of the incoming drain. However, it may be found better policy, and more economical, to dispose of the dried sludge by some other means, and continue to use the same pit.

An inspection of the plant was made by the writer on November 9, in company with Mr. Shipp, the superintendent, at which time the sedimentation tanks were examined. The tanks have been in active operation for one year. The floating mat on the sewage is 2 ins. thick at the inlet end, and about 1½ ins. thick at the outlet. This sludge mat is of unusual density, and, while bacterial action is decidedly active, very little gas forces its way through. By making an opening in the mat, it was seen that gas was being formed rapidly. The greater part of it, however, escapes in the dosing device, being carried along under the sludge mat until access to the air is freely obtained.

There are some small floating particles of humus matter in the dosing chamber, and a more perceptible odor than in any other part of the works, with the exception of the screen chamber house. There is a commendable absence of objectionable odor about the whole plant, however, even in the summer time.

Returning to the sedimentation tanks, it is stated by the superintendent that, so far, no sludge has been drawn off. It was found, by examination, that the sludge deposit is so liquid as to be hardly distinguishable from the sewage, but, as near as can be measured, seems to be about 2 ft. in depth and similar to the sludge deposit found in all sedimentation tanks, though perhaps not quite so dense as in some.

The contact beds have not, of course, been cleaned as yet, and will not need to be for some time. The effluent from the contact beds, as exposed in the settling basin, is generally quite clear and odorless. At times there may be noted some finely divided particles of humus matter, which are settled out in the

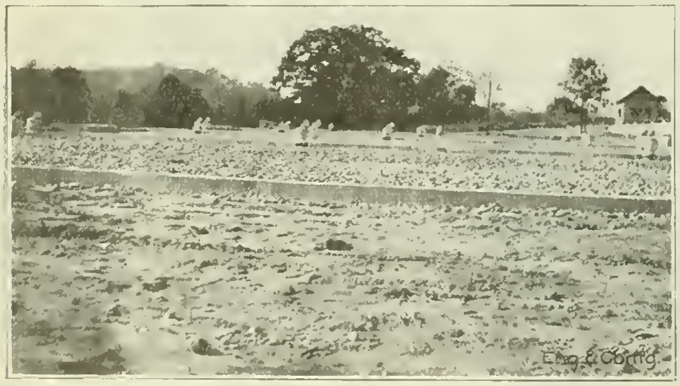


Fig. 3—View of Primary Contact Beds.

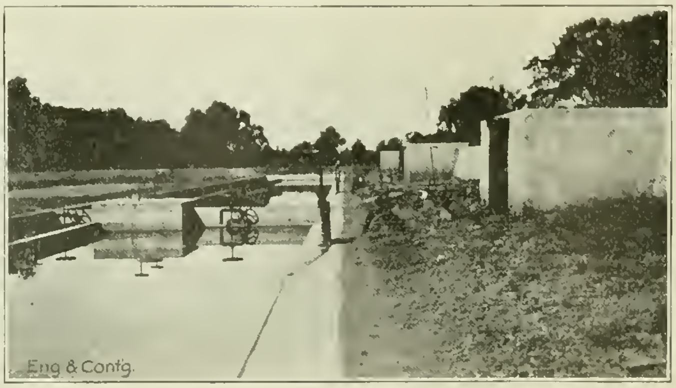


Fig. 4.—View of Settling Basin.

basin, or removed in passage through the sand filters.

Owing to certain topographical conditions, it was impossible to obtain more than about 3 ins. fall from the settling basin to the sand filters, and for this reason there has been caused some trouble by pooling of the filters. As stated before the filters are fed by risers, which discharge on circular concrete tables. With the loss of velocity due to friction, and the small working head, the effluent from the settling basin is discharged at such a low velocity that the greater part remains near the center of the filter. The filters work slowly, owing to the fine composition of the filtering media. It is now apparent that a coarser sand on the bottom, with a layer of fine sand on top, would have been better in view of the low head under which the filters operate.

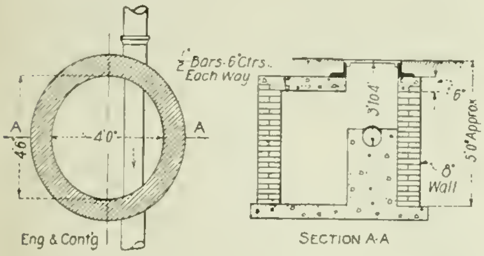


Fig. 1—Plan and Section of Shallow Manhole With Wide Chamber for Use of Sewer Rod Operator.

It has been stated before that the sewage treated is all domestic, but in the fall, during the month of September, there was an additional flow of about 20,000 gals. per day of cannery waste from a pumpkin canning factory. The superintendent states that this waste caused considerable trouble, "souring" the whole plant, retarding bacterial action to some extent in the tanks, and giving a disagreeable odor to the effluent.

On the occasions of all visits to the works, made by the writer, the effluent was found to be clear, colorless, odorless, and non-putrescible. It has satisfactorily passed the monthly tests of the New Jersey State Board of Health.

Aside from the purely utilitarian purposes of a disposal works, a point which may well be borne in mind is that of the external appearance of the plant. One that is well kept up, and pleasing to the eye, may do much towards overcoming the prejudice against such municipal works which still exists among many persons, especially if the works be located close to the town. These works are very attractive in appearance, with well-kept grass and walks, and a general air of having their importance well appreciated.

Great credit must be given Mr. Shipp, the superintendent, for his interest in and intelligent operation of these works, which furnish an admirable example of a well-designed and well-built plant, successfully operated.

Opening of the Sand Patch Tunnel.—The first train passed through the Sand Patch tunnel of the Baltimore & Ohio R. R. at noon, Dec. 24. The opening of this tunnel marks the completion of the reconstruction work begun by President Daniel Willard three years ago, which included the building of a third track across the Alleghany mountains. The tunnel is between Sand Patch and Manilla, Pa., 30 miles west of Cumberland. Its cost was approximately $1,250,000, and about 700,000 cu. yds. of earth were excavated at the rate of about 600 cu. yds. per day. The tunnel is 4,000 ft. long, with a width of 31 ft. and height of 28 ft. An account of the methods of construction and a description of the tunnel appeared in Engineering & Contracting, June 26, 1912.

Some Features of the Design and Operation of the Sewer System and Sewage Disposal Plant at Belton, Texas.

Some of the interesting features of the design, operation, and operating results of the sewer system and sewage disposal plant at Belton, Texas., with special reference to structural changes found desirable after the plant was put in operation, were described by Thomas L. Fountain of the Fountain-Shaw Engineering Co., in the December issue of The Cornell Civil Engineer. The information here presented is taken from Mr. Fountains description:

The present population of Belton is about 4,000, of which probably 1,500 are now connected with the sewer system. Most of the area within the city limits is situated upon the water shed at Nolan Creek which flows in an easterly direction through the center of the town. As this water shed has in general a rather steep slope, little difficulty was experienced in securing satisfactory grades for most of the lateral sewers. The outlet sewer, which is 12 ins. in diameter, was laid on a grade of 0.15 ft. per 100 in order to keep the outlet at the disposal site at a sufficient height above the normal water level in Nolan Creek to secure a gravity flow through the disposal plant and into the creek.

Solid rock of varying degrees of hardness was encountered on all streets in which the sewers were laid, and ranged in thickness from 18 ins. in the bottom of the trench to 13 ft. on a portion of the outlet sewer. Where the houses on each side of the sewer lines were at a sufficient elevation to give a good fall in the house sewer even when the street sewers were laid very shallow, the type of manhole shown in Fig. 1 was utilized and a considerable reduction in rock excavation thus secured. The invert trough through the manhole is of such depth that the sewer would have to flow full before discharging into the pocket built at the side to be occupied by a man using the sewer rods. Water leaking through the manhole cover into the pocket would have to be pumped or bailed out. As the sewer grades at Belton are sharp, little cleaning is required, so the manholes will be rarely used. The system has now been in service for about 18 months without a single stop.

The combined flush tank and manhole construction shown in Fig. 2, to Mr. Fountain's knowledge, has not been used on other work. The vitrified pipe wye, into the leg of which the siphon discharges is ordinarily plugged as shown, the plug being lightly cemented into place. In case of a stop in the sewer, the plug can be broken out, thus converting the flush tank into a manhole. This construction was used at permanent dead ends and also at the ends of sewers which will eventually be extended, at which time the plug will be removed and the siphon abandoned.

Domestic sewage constitutes the greater portion of the flow, two laundries and a creamery furnishing wastes of a different character.

SEWAGE DISPOSAL PLANT.

The sewage disposal plant is located at a point on the bank of Nolan Creek, about 1 mile from the business district. The surface of the ground at the site is about 23 ft. above the bottom of the creek bed, a height sufficient to prevent all danger from overflow. The bottom of the outlet sewer at the entrance to the grit chamber is 2½ ft. below the surface of the ground.

Nolan Creek, which received the treated sewage from the plant, is practically a dry bed during from four to six months of each year. This necessitated the adoption of a type of plant which would give as nearly as possible a uniform, stable, clarified effluent. Sufficient head being available for the installation of a sprinkling filter, this method of treating the sewage was adopted, the sewage being first subjected to sedimentation in clarification tanks, followed by passage through sprinkling filters, and final subsidence in a settling basin.

The entire plant is built on the unit plan, two of the clarification tanks, two of the sprinkling filters, and one of the settling basins having been constructed. When the entire plant is built, it will have a normal capacity of 300,000 gals. in 24 hours, based on a flowing through time of 2 hours for the clarification tanks, a rate of 2,000,000 gals. per acre per 24 hours for the sprinkling filters, and a subsidence in the settling basin of 3 hours. The present units constituting one-third of the entire plant, have a normal capacity of 100,000 gals. in 24 hours. While this rate is at present exceeded for from two to three hours on certain days in each week, the flow at other times is very much less. As all of the larger water users are at present connected with the sewers, the increase in connections will not produce a corresponding increase in the sewage flow. There is no ground water in the sewers.

Clarification Tanks.—The sewage discharges from the outlet sewer into the grit chamber, from which it is passed through a submerged inverted bend to the clarification tanks, which are of the two-story variety. Whenever high water in Nolan Creek prevents the operation of the sprinkling filters, a stop gate is dropped in a slot in the grit chamber wall. The sewage then overflows the sides of the concrete channel which spans the manhole and flows to the creek through a 12-in. bypass sewer.

A 3-in. pipe laid longitudinally under the center of each clarification tank, provided with three openings into the tank bottom, and controlled by a gate valve was originally intended to be used for drawing off the sludge periodically from the bottom, the outlet end of the pipe being 4 ft. below normal water level in the tank. This did not work well, the sludge being too stiff to flow freely. After a small quantity of sludge had been forced out, the supernatant sewage would break through the sludge and come out through the sludge pipe.

The tanks are cleaned about every six months at a time when the creek is on a rise by opening the gate on the 8-in. sludge pipe, which passes transversely beneath the tank bottoms and allowing all sludge, scum and sewage in each tank to discharge into and through the settling basin, which has previously been drained by opening the gate in its bottom. This method of sludge and sum disposal has proven very satisfactory. Each semi-annual cleaning requires the services of two laborers for two days and costs less than $8.

The sedimentation chamber of each clarification tank has a capacity of 556 cu. ft., the decomposing chamber a capacity below the slots of 900 cu. ft. Each 1,000,000 gals. of sewage was estimated to furnish 12 cu. ft. of wet sludge.

The central longitudinal triangular beam in each clarification tank overhangs the slots about 4 ins., yet a large amount of gas from the decomposing chamber rises through the slots. This was thought to be due to clogging of the slots at the bottom of the clarification chamber, but no sign of clogging was evident when the sewage was drawn down below the slots. A beam construction was used to carry

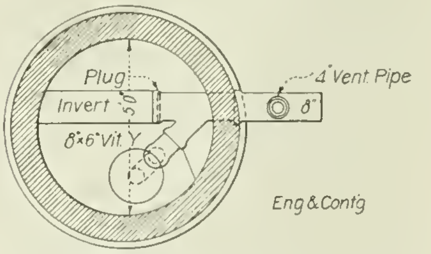


Fig. 2—Plan of Flush Tank Which Is Convertible to Manhole.

the wall thrust, as no concrete cover was placed over the tanks.

Sprinkling Filters.—The sewage passes from the clarification tanks to the control chamber through an 8-in. wood pipe laid on the filter floor. Shear gates control its discharge through 6-in. wood pipes laid on reinforced concrete brackets, the center of the wood pipe being 5 ft. 10 ins. above the top of the broken stone in the filter bed. Cast iron crosses, made for use with wood pipe, are set so that tangent circles struck from their centers have radii of 5 ft. 6 ins. The columns supporting the brackets are so placed that they interfere very little with the operation of the sprays. The lateral underdrains are 6-in. vitrified half pipe set below the surface of the floor, the distance between centers being 4 ft. 6 ins. The main underdrain is 8-in. vitrified half pipe. The concrete filter floor has a crown between underdrains of about ¾ in. The main underdrain has a fall of 6 ins. in about 43 ft., that of the lateral drains is somewhat less. A 4-in. vitrified ventilating pipe extends from the end of each underdrain next the filter wall to the top of the broken stone. The bottom foot of filtering material is composed of 4 to 6-in. stone, the next 3 ft. 6 ins. of 1½ to 2-in. stone, and the top 18 ins. of ¼ to ¾-in. stone. Fairly hard, tough local limestone was used. When the entire filter bed is constructed, it will form a complete hexagon with the control chamber at the center. Two of the equilateral triangles have been built.

Brass tubes of ¾-in. interior diameter and 6 ins. long, threaded on the outside, are screwed into plugs in the cast iron crosses. Through these sewage is discharged upon the brass spattering disks set directly below at a height of about 2 ft. above the top of the broken stone. Each tube can be screwed up or down with a small Stillson wrench until the proper flow is secured. The normal discharge upon each disk is 3½ gals. per minute. The original shape of spattering disk tried is that shown by dotted lines in Fig. 3. Operating tests showed that most of the sewage clung to the beaded outer portion of the disk proper, flowed to the outer secondary disk, and struck the broken stone in a narrow ring with mean radius of about 3 ft. Trimming the disks on a lathe to the shape shown in full lines obviated this. The outer disk is added to catch and break into spray the falling stream of sewage when blown off the center disk. In practice this has worked well, there being only a short time even on very windy days when the stream does not at least strike at the outer disk.

After trickling through the filter beds, the sewage returns through the underdrains to the control chamber and flows through a vitrified pipe to the settling basin. Distribution across one end of the basin is effected by vitrified tees turned down, collection at the other end by vertical pipes surrounded with concrete and set with their tops level and with their bottoms in tees in a horizontal pipe laid on the bottom of the settling basin. By opening the shear gate the entire settling basin may be emptied. A vitrified outlet pipe carries the settled effluent from the manhole in the corner of the settling basin to Nolan Creek. The settling basin is 21 ft. 8 ins. wide, 30 ft. long, and 3 ft. deep measured from the normal water level.

The entire cost of the disposal plant, exclusive of the site, was approximately $6,000.

OPERATION OF DISPOSAL PLANT.

After the plant had been in service for several months, Mr. Fountain operated it for a week to become familiar with its workings.

The grit chamber has been a source of trouble on account of the collection of floating solids which give off odors as they undergo decomposition. These solids are gradually broken up by the flow of the incoming sewage and are carried to the clarification tanks. Floating decomposable matter collects in the clarification chamber and causes odors. The gases escaping from the decomposing chambers are somewhat objectionable, though not so disagreeable as those from a septic tank

Scum forms rapidly in the clarified sewage, as it flows slowly through the wood pipe distributors. Small patches frequently break away from the main masses and lodge on the discharge tubes, greatly interfering with the flow through them and often stopping one or more of the tubes entirely. This clogging can be prevented by inserting a perforated dipper in the cross opening above each discharge tube and removing the large masses of scum once daily.

As this system of overhead distribution with spattering disks can be constructed as cheaply as the pressure system with spray nozzles, it should be more satisfactory for use in the South where there is no danger of the sewage freezing in the exposed pipes. In the pressure system, only small bits of scum can be removed as they reach the tips of the spray nozzles, leaving the large masses undisturbed in the main distributing pipes to furnish an indefinite number of small pieces to clog the nozzles shortly after they have been cleaned. The spattering disks, when once properly set, require very little attention, as there are no projecting arms to catch scum or solids.

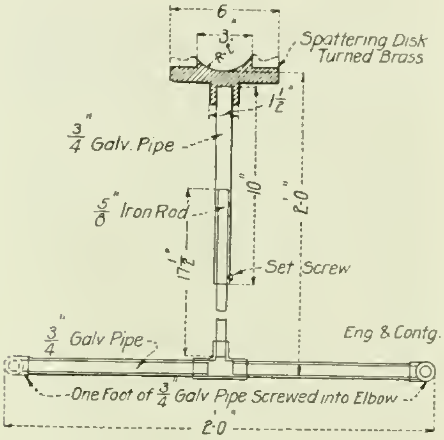


Fig. 3—Detail of Spattering Disk for Sprinkling Filters.
(Dotted lines show shape of disk first used.)

The shape and dimensions of the disks were determined upon after a study of the results obtained in experiments carried on by the Sanitary Research Laboratory at the Massachusetts Institute of Technology. A disk of these dimensions when tested there under approximately the head used at Belton gave a better effective distribution than did any other type of fixed distributor tested by the laboratory up to that time.

The ¾-in. brass discharge tubes were found to be too large, as sufficient depth of water could not be secured in the wood distributing pipe to produce a uniform discharge through all the tubes. This was corrected by slipping tubes with an interior diameter of ½ in. into the brass tubes and sealing them to the sides.

Scum formed in the clarification tanks and 8-in. wood pipe gave trouble until held back by a ⅜-in. mesh galvanized wire circular screen set over the inlet opening in the control chamber. Sliding wire screens, composed of 14 meshes to the inch, were set up in the control chamber between the coarse screen and the inlets to the overhead distributing pipe for the purpose of retaining various stringy growths which form in great numbers in the 8-in. wood pipe bringing the clarified sewage to the control chamber. These fine screens require cleaning once in two days, which is readily done by propping them up and dashing a few buckets of sewage against them.

The filter beds pooled badly after being in operation a short time. This was thought to be due to the stone dust in the top course of filtering material, to the fineness of the upper 18 ins. of filtering material, and to lack of screening of the clarified sewage. In an effort to prevent this, the screens described above were inserted, and the fine material removed from a portion of the bed. A considerable quantity of dust remained with the fine stone when it was placed in the beds, although precautions were taken to prevent this. This dust was evidently largely responsible for the clogging of the beds, as the clogging has become much less troublesome since the stone dust has been carried away by the sewage, although the coarse screen is constantly neglected and the fine screens have long ago been destroyed by the sewage. Stirring the beds vigorously with a rake has been the method of temporarily preventing pooling.

The company of which Mr. Fountain is a member now has under construction in another town a clarification tank which will be covered with an air-tight reinforced concrete roof. The screen chamber, taking the place of the grit chamber in the Belton plant, will also be covered in the same manner. A 6-in pipe will carry all gases 60 ft. into the air. If this attempt at reducing the odors from the tank is unsuccessful, the same scheme will be used at Belton.

The effluent from the plant was for a time clear and odorless, as some effort was made by those having it in charge to operate it properly. During many months of the first year of operating this effluent formed about four-fifths of the flow in Nolan Creek, yet there was no complaint from any property owner below the outlet and no evidence of destruction of fish life. The effluent at present has a slight odor and is not so clear as formerly. This is very probably due to lack of proper operation of the plant, as it receives very little attention, the discharge tubes being allowed to clog and no attempt being made to secure uniform distribution over the filter beds.

A Diagram for Determining the Hydraulic Properties of the Larger Sizes of Pipe Sewers.

Contributed by Benjamin L. Parker, Civil Engineer, Sikeston, Mo.

Most of the published diagrams and tables for sewer design with which the writer is familiar, limit the use of sewer pipe to sizes of about 24 ins. internal diameter. It is also claimed by some authors that brick will furnish the most economical section when this diameter is exceeded, owing to the relative ease in turning arches of this size. It is not the purpose of the present article to argue the relative advantages of either brick or vitrified sewer pipe. The item of initial cost and maintenance should be the ruling consideration in the choice of the material.

The principal reason that larger sewer pipe have not been adopted for sewer construction appears to be that their cost was excessive and also that the cost of transportation was high. We still have the transportation problem to contend with and it is an important factor in the determination of which material to use, but with later and improved methods of manufacture the first cost has been materially reduced. As regards strength, it would seem that there should be no hesitancy in using the larger sizes as now manufactured.

The section which will afford the most economical construction will depend upon the relative prices of materials, the distance from the source of supply, the labor problem and the natural conditions bearing upon the problem in hand. These are obviously different for each particular locality, and about the only way of determining which is the more economical is to make a comparison from accurate estimates of each construction. As an aid in determining this the accompanying diagram is given.

The diagram is based on Kutter's formula using the value of 0.013 as the coefficient of roughness—and embraces the commercial sizes of pipe from 20 to 48 inches internal diameter.

The advantages in having the information in this form rather than having it tabulated are that any necessary degree of refinement is possible by interpolation by the eye, and that the relation of the essential elements of the problem is quickly and easily determined. This is facilitated by employing the logarithmic scale so that the lines will be straight rather than in curves.

The use of this diagram enables the designer to select the most efficient section; to balance his grades so that the liability of choking and the deposition of sediment will be reduced to a minimum, and enables him to see at a glance the effect that a certain change in one of the elements will have on the others, or the necessary changes that will have to be made in order to accomplish a desired result. It also eliminates the question of doubt in the mind of the designer as to whether he has the most efficient section or not.

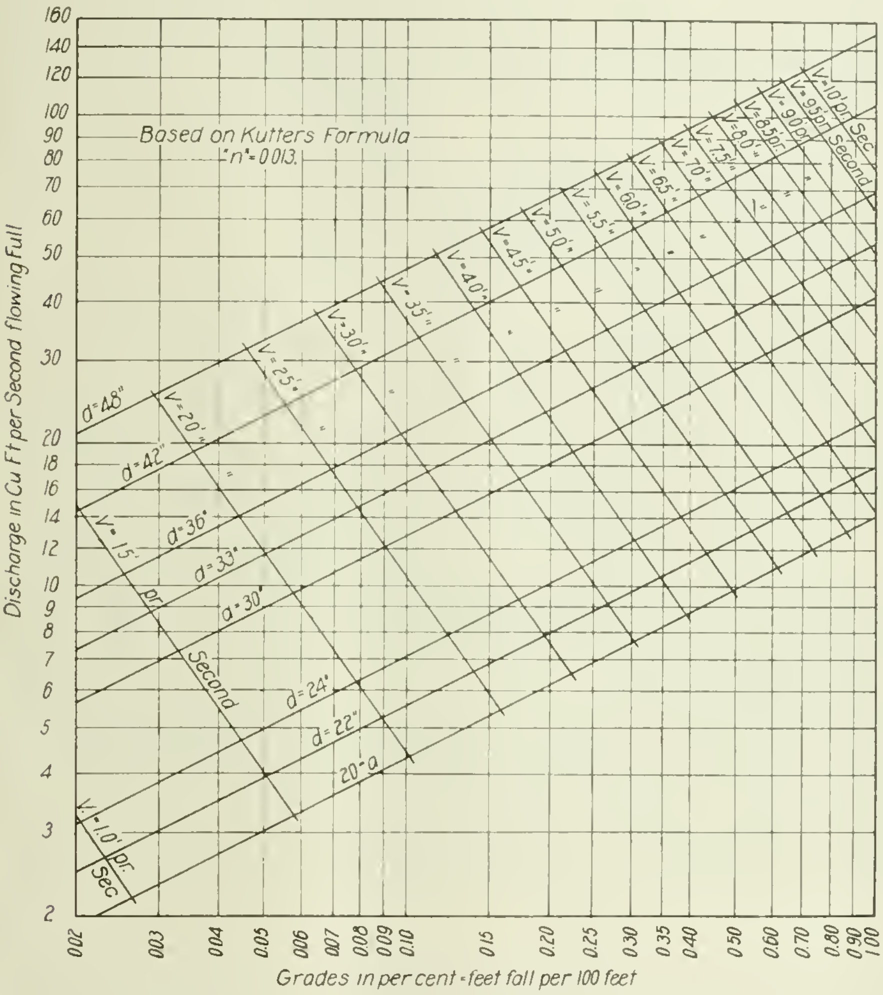


Diagram for Determining Hydraulic Properties of the Larger Sizes of Pipe Sewers.

USE OF THE DIAGRAM.

Having given the discharge in cubic feet per second and the percent grade, to find the size of the pipe and the velocity of flow.

First find the discharge in the left hand margin and follow the line drawn through the same horizontally to the right to its intersection with a line drawn vertically through the grade in percent as shown on the bottom margin. Then read the size from the lines ascending to the right and the velocity from those ascending to the left.

For example, given the discharge equal to 20 cubic feet per sec., grade equals 0.1 per cent., to find the velocity of flow and size of the pipe. Follow the line through 20 on the left-hand margin to the intersection with the vertical drawn through 0.1 on the bottom margin.

The size nearest this intersection is seen to be "d" equals 36 ins. Then find the intersection of the line showing size and the line showing discharge. Interpolating by eye the velocity is found to be 2.8 ft. per sec. approximately.

Further Comment on the Value of the Main Trap in House Connections of Sewers—Suggested Procedure When Trap is Omitted.

The conclusions reached in a British inquiry into the value of the main or intercepting trap, commonly placed in the house connections of sewers, were published in Engineering & Contracting of Sept. 25, 1912. The article referred to also presented the more important passages of the report. As stated in that article the committee worked for five years upon its report, and in collecting evidence upon which to base its conclusions, examined over 5,000 traps in service. Since the publication of the committee's report municipal engineers in England have read and very fully discussed several papers bearing upon this subject before their various national and local organizations. A good example of the character of papers, which have been brought out by the discussion of the report, is that of Mr. Edward Willis before the Lower Thames Valley District Surveyors' Association on December 7, 1912. The following matter is taken from Mr. Willis' paper as reported in The Surveyor of London.

The origin of the intercepting trap in house drains may be considered to be largely due to the conditions which were found to exist in sewers laid prior to or about the middle of the last century. Undoubtedly at such time many sewers in use were practically elongated cesspools, and defective both in construction and gradient, the result of such defects being that offensive and often dangerous gases were considered to be given off.

Some of these gases, being lighter than air, traveled along the several house drain connections, and rose to the highest available position in such drains or soil pipes. It was at this point that serious trouble apparently arose therefrom, since it is known to every municipal engineer that ventilating pipes to waterclosets, sinks, lavatories or baths were practically unknown prior to the above date, and when the traps became unsealed the alleged dangerous gases were driven into the houses.

Even the heavier gases, such as carbonmonoxide, together with deleterious microorganisms, often obtained access to the house, thus lowering the vitality of residents and creating a predisposition to disease.

It is evident that such conditions, even assuming the whole of the house drainage to have been comparatively good, except for the old-fashioned "D" trap then in use, would tend to result in disease or delicate health, and when some of the early sanitary reformers first evolved the idea of the intercepting trap, it was hailed as a panacea for many drainage evils.

Undoubtedly, assuming the conditions which then existed, the intercepting trap may have served a useful purpose, but the time has come (in fact, for many years such time has been present in the opinion of many engineers) when it is a moot point if this appliance is still always desirable. Assuming the previous remarks are correct, the principal object of the intercepting trap has passed away, as sewers and house drains, such as those described above, are practically unknown in the modern development of towns and cities.

From the recent report, it seems certainly probable that the Local Government Board will approve of by-laws omitting the use of this appliance, or will make the use of the interceptor optional at the discretion of the local authority, now that sewers and house drains are laid under efficient supervision and tested hydraulically by capable and trustworthy officials.

The subject is so essentially a practical one, with which every engineer of a municipality must have had a greater or less degree of experience, that no excuse is needed again to debate upon the many experiments of results deduced therefrom, which are detailed in the report itself or in the appendices.

The author, while engaged as a building engineer, personally examined upwards of 1,000 interceptors, both in house drains during construction and after these were in actual use, and in many instances his observations agreed with those mentioned in the report, though in a few his experience does not entirely coincide therewith, as will be mentioned hereinafter.

DISADVANTAGES OF THE INTERCEPTING TRAP.

Upon examination of intercepting traps, both during the construction and testing of house drainage and in many instances subsequently to the occupation of the premises, the author had the advantage of testing their effectiveness with actual paper and fæces, instead of adopting artificial fæces, as appeared necessary in the very useful experiments carried out by Mr. Patten Barber.

His experience agrees to some extent with that of the last-named engineer, but not entirely, since he found that no 2-gal. flush would clear any type of interceptor experimented with, and the 3-gal. flush only occasionally was successful in removing fæces and paper. A full bath of water emptied in the orthodox method through the waste pipe was also never successful in entirely removing the paper and fæces from many of the traps tested, but a single large pail of slops or water on a reasonably short house drain was in every case successful where the other above-mentioned means of flushing were unsuccessful.

This points to one necessary alteration in the present regulations and design of sanitary fittings, namely, improvements in the method of flushing house drains.

His experience of the blockage of intercepting traps has been extensive, and the causes have been found to include stoppers, paper, fæces, dusters, brushes, and the usual miscellaneous assortment of minor articles, while cement has also been found to be the cause, in some instances, by unduly restricting the effective area of the trap.

The actual setting of the interceptor does not appear to have received sufficient consideration. The best depth of water seal and cascade may also be included in the same category.

In the experiments carried out by him many years ago, before there was any thought of a commission or departmental committee's report upon this subject, he deduced the following: That with a normal house drain and watercloset flush, cascades of less than 2 ins., or from 4 ins. to 6 ins. in depth in an ordinary interceptor were seldom self-cleansing, but that when approximately between 2 ins. and 4 ins. in depth the interceptor tended to be self-cleansing after one or two flushes.

His experiments did not include consideration of the actual capacity of the trap, and he therefore does not propose to deal further with this item or with the other more general matters mentioned in this section of the report, as these are already well known.

ADVANTAGES OF THE INTERCEPTING TRAP.

The opinion that traps of small water seal act as permanent barriers to the passage of rats through drains has now been clearly demonstrated as fallacious. In one case the author was personally examining an ordinary disconnecting chamber, when a rat came up through a trap (the cleaning arm being properly sealed), and was running along the channel, but upon seeing him turned and dived through the trap again. On another occasion, when accompanied by a witness, a similar thing happened, thus adding proof to the above contention that the intercepting trap does not entirely prevent the excursions of rats into the house drainage system. If, then, the intercepting trap is not ratproof, the ordinary ground floor or basement watercloset, with small water seal, is also not ratproof. Therefore, should the intercepting trap become obsolete, some special provision must be made to eliminate the risk of rats entering into the basement or ground floor premises through the watercloset.

In connection with this matter the author would strongly emphasize the importance of using syphonic or valve closets, primarily because of the effective double seal, which is given by both these appliances, and, secondly, owing to the advantages that would accrue from the more efficient flush obtained by each, and specially refered to above as being urgently required to cleanse both drain and trap.

CHEMISTRY OF SEWER AIR.

In connection with this portion of the report, it is both impossible and inadvisable for an engineer to discuss it in detail, but the author differs with the observation of one of the witnesses where he implied that sewer air is only harmful when accompanied by offensive odor.

His experience proves that such is not the case, and this could probably be further proved by many other engineers. Carbon-monoxide, which is highly dangerous, and carbon-dioxide are both odorless gases, and he has no doubt from the occasional effect of sewer air on lamps, that both these or similar harmful gases are at times generated in sewers and drains.

He once had a most unpleasant experience of an assistant being practically overcome, probably through carbon-monoxide, and it was with great difficulty he forced him through the sewer into fresh air. The sewer in question was only 580 ft. in length and 3 ft. in diameter, and there was actually no fæces, but only clean water running at the time of inspection, and no odor whatever was noticeable therein, but flocculent matter was visible in the bottom and at the sides.

The currents of air in sewers and the condition of the latter should therefore always be the subject of careful examination prior to the entry of any men, or work by them therein.

BACTERIOLOGY OF SEWER AIR.

The evidence under this heading is somewhat extraordinary after the usual preconceived ideas respecting it, but certain points are very instructive, namely, that the ordinary flowing sewage apparently gives off practically no bacteria until the water is subjected to agitation and splashing.

It seems particularly strange that the external air should in some instances contain more pathogenic micro-organisms than the sewers, and the only solution that occurs to the author in regard thereto is that in unventilated sewers the deleterious gases that may be given off have also a germicidal action upon micro-organisms, while those that reach the atmosphere or surface of the street are benefited or nourished by the purer air obtainable. In any case, the results obtained by the witnesses have astonished the majority of sanitarians.

BACTERIOLOGY OF DRAIN AIR.

Briefly, the substance of the report is that drain air is infinitely worse bacteriologically than sewer air. If this is actually true, then undoubtedly from a bacteriological point of view it would seem advantageous to dilute drain air with sewer air; but in any case, from the observations and experiments, there appears to be no serious objection to sewer air mixing with drain air.

One general point in connection with the evidence under this heading is that, if some contrivance can be evolved for efficiently flushing with disinfecting media the soil pipes and all exposed portions of the drain and its contents, the danger of drain air would be removed. It is probable that some such arrangement may eventually be found beneficial.

GENERAL EVIDENCE.

This is somewhat on the lines which one might expect from the other portions of the report. Sewer men, as a rule, do not certainly appear to suffer from illnesses more than other municipal employes.

The experiments in connection with animals are not quite unanimous, but the consensus of opinion appears to point to ordinary sewer air being not unduly harmful to them.

One of the most important pieces of general evidence that the report advances appears to be the general health in Germany, where intercepting traps are absolutely tabooed. In Cologne they were tried for a time, but the disadvantages so far outweighed the advantages that they were removed.

VENTILATION OF SEWERS.

The report seems to imply that the ventilation of sewers is not so important as has been considered in the past, and the author does not entirely agree with the findings of the committee in regard thereto. He cannot help stating that he would not risk the lives of any of the men under him in sewers which were solely unventilated, unless it were first possible to circulate a current of air through, and a lamp requiring oxygen for combustion burnt satisfactorily in them. He is, therefore, particularly keen upon the advantages which would accrue to the ventilation of sewers if the intercepting trap is omitted. Primarily he considers "house drainage" is part of the sewerage system of a district, and as such each house should share the burden of efficient ventilation.

The suggestions that have been made in various quarters to root out all existing traps are, of course, absurd, since no sanitary expert would advise the wholesale destruction of an appliance which although not perfect, has in many cases, and may even still in some cases, prove of benefit, but it does seem most important that in the development of new property where sewers are laid under efficient supervision, and where drains should be equally efficient, the trap should be omitted, and each house take its normal share in the ventilation of sewers.

CONCLUSION.

In concluding the above notes the author would like to express his appreciation of a report so full of information, a great deal of which would have been unobtainable by the ordinary observer. The experiments appear to have been carried out in a most careful, systematic, and thorough manner, and the results obtained therefrom must undoubtedly be treated with the utmost deference by all thoughtful sanitary experts.

Personally, he is of opinion that the death-blow of the intercepting trap has fallen. It may take a long while to entirely disappear, but a strong case has been made out for its future omission. What, then, will take its place? He suggests the following points for consideration:

(1) Improved flushing arrangements whereby rapid discharge of large volumes of water are obtained daily through every portion of the house drainage system, which would prevent stagnation or retention of paper and fæeces in the pipes.

(2) Effective double seals on all water-closets, slop-closets, sinks, lavatories, and baths.

(3) Effective ventilating pipes clear of the second water seal, recommended above, and ventilating or puff pipes between the first and second seal.

(4) Entire abolition of fresh-air inlets at or near the ground level.

(5) The erection of all ventilating pipes above the ridge of the highest roof immediately adjoining, and as far removed as possible from any window.

(6) An efficient ventilating pipe of the height before described, at each end of any drain which necessarily passes under the building.

(7) The provision of iron drains whenever passing underneath domestic or public buildings.

(8) The provision of at least one trap of shallow water seal, say not less than ½ in. and not more than 1½ ins., with provision, by drip tap or otherwise, for always keeping same sealed, and with vent pipe therefrom if the ordinary ventilating pipes were omitted on any branches from internal drains.

(9) All waste pipes to be treated similarly to soil pipes as regards double seal traps and ventilation, and the abolition of open heads.

(10) Means of efficiently flushing all ventilating and soil pipes.

(11) Statutory regulations requiring the examination of house drains not less than once in every six months, with lesser intervals when special conditions render same desirable.

Wood Block Paving in Liverpool.—A small proportion of Liverpool's paving, about 150,000 sq. yds., is of creosoted wood blocks. The woods used are Australian hard woods, and Canadian or Baltic redwood. The cost of paving on a laid concrete foundation is about $2.07 per square yard; if the foundation is to be laid, about 73 cts. per square yard extra. Traffic is rather heavy, and the estimated life of the pavement is 15 years. The cost of maintenance is practically nothing. In Birkenhead, a suburb of Liverpool, where the traffic is light, there is a much larger proportion of wood-block paving. Baltic redwood blocks are preferred. The cost here is about $3.65 per square yard, and the life of the pavement about 15 or 20 years. Some pavements of Baltic redwood have been down over 30 years. The maintenance cost is said to be little.

Use of Steel Belts for Power Transmission.—Steel belts have been used during the past year in some of the large manufacturing plants at Huddersfield, England, and have proved satisfactory. It is found that a 7⅞-in. steel belt, weighing 119 lbs., does the work formerly done by a leather belt 22 ins. wide, weighing 814 lbs., driving 300 hp. In another mill a 3½-in. steel belt, weighing 12 lbs., does the work of a leather belt 12 ins. wide, weighing 64 lbs., driving 40 hp. The steel belt saves space, does not slip or stretch, and gives greater efficiency of power delivery. Tests have shown a saving of 61 hp. on a drive of 640 hp.

BUILDINGS

A Time Saving Chart for Solving Problems in Reinforced Concrete Beam Design.

Contributed by Donald P. Maxwell, Draftsman, Pittsburg & Lake Erie R. R., Pittsburg, Pa.

In Engineering & Contracting for March 22, 1911, and May 3, 1911, were published two valuable articles by Mr. Melvin D. Casler, Assistant Engineer, Designer Board of Water Supply, New York, in which he developed simple formulas for the design of reinforced concrete beams, and showed special slide rules designed by him to solve these formulas.

This solution of these formulas by the alinement chart method is offered as a time saver as compared with solutions by ordinary slide rule, and a money saver as compared with special slide rules. The formulas used are:

$$(1)\quad D=\frac{RC}{S}$$

$$(2)\quad T=Rp$$

$$(3)\quad Y=\frac{M}{C(bh^2)}$$

$$(4)\quad Z=\frac{RM}{S(bh^2)}$$

Where the following notation is employed:

C = Stress in concrete (inch-pounds per square inch);

S = Stress in steel (inch-pounds per square inch);

M = Bending Moment in inch-pounds;

b = Width of beam in inches;

h = Depth of beam in inches to center line of steel;

(bh^2 is regarded as one variable)

p = percentage of steel in area, $b \times h$;

$$R=\frac{\text{Modulus Elasticity of Steel}}{\text{Modulus Elasticity of Concrete}}$$

D, T, Y and Z are functions of X where X is the coefficient of h, such that xh = distance from center line of steel to neutral axis.

Their values in terms of one another are found from the "Conversion Table."

In constructing this chart, only one assumption is made: $R = 15$.

The formulas then become:

$$(1')\quad D=\frac{15C}{S}$$

$$(2')\quad T=15p$$

$$(3')\quad Y=\frac{M}{C(bh^2)}$$

$$(4')\quad Z=\frac{15M}{S(bh^2)}$$

Referring to the chart it will be noticed that the axes of M and bh^2 (marked I), Z and S (marked II), and Y and C (marked III) are respectively equally spaced from, and are parallel with the "Support" line and are plotted *lagarithmically* by the *same scale.*

The graduations for any three variables in equations (3′) or (4′) can be placed in any position along their proper axes, but the position of the graduations of the 4th variable is best found by making a trial solution of each formula. The quantities M and bh^2 being common to equations (3′) and (4′), the same axes are used in solving either formula.

From (2), $p=\frac{T}{15}$; so p is plotted directly and T is omitted.

The axes of D and S marked *"A"* are equidistant from and parallel with the *"C"* scale marked *"A"* and are plotted to double the scale of *"C."* The graduations of the *"C"* scale are fixed in position from its use in formula (3′). Either of *"D"* or *"S"* scale graduations being assumed in position, the other becomes fixed.

The following four examples illustrate the use of the chart:

(1) Data: M = 60,000 in. lbs.; S = 16,000 lbs. per sq. in.; C = 500 lbs. per sq. in. Required h. b. and pbh.

Solution:—On "A" scales placed straight edge across between S = 16,000 lbs. per sq. in. and C = 500 lbs. per sq. in. Read D = 0.47 at intersection of straight edge with "D" axis. From Conversion Table for D = 0.47 read p = .0048; Y = 0.142; Z = .065.

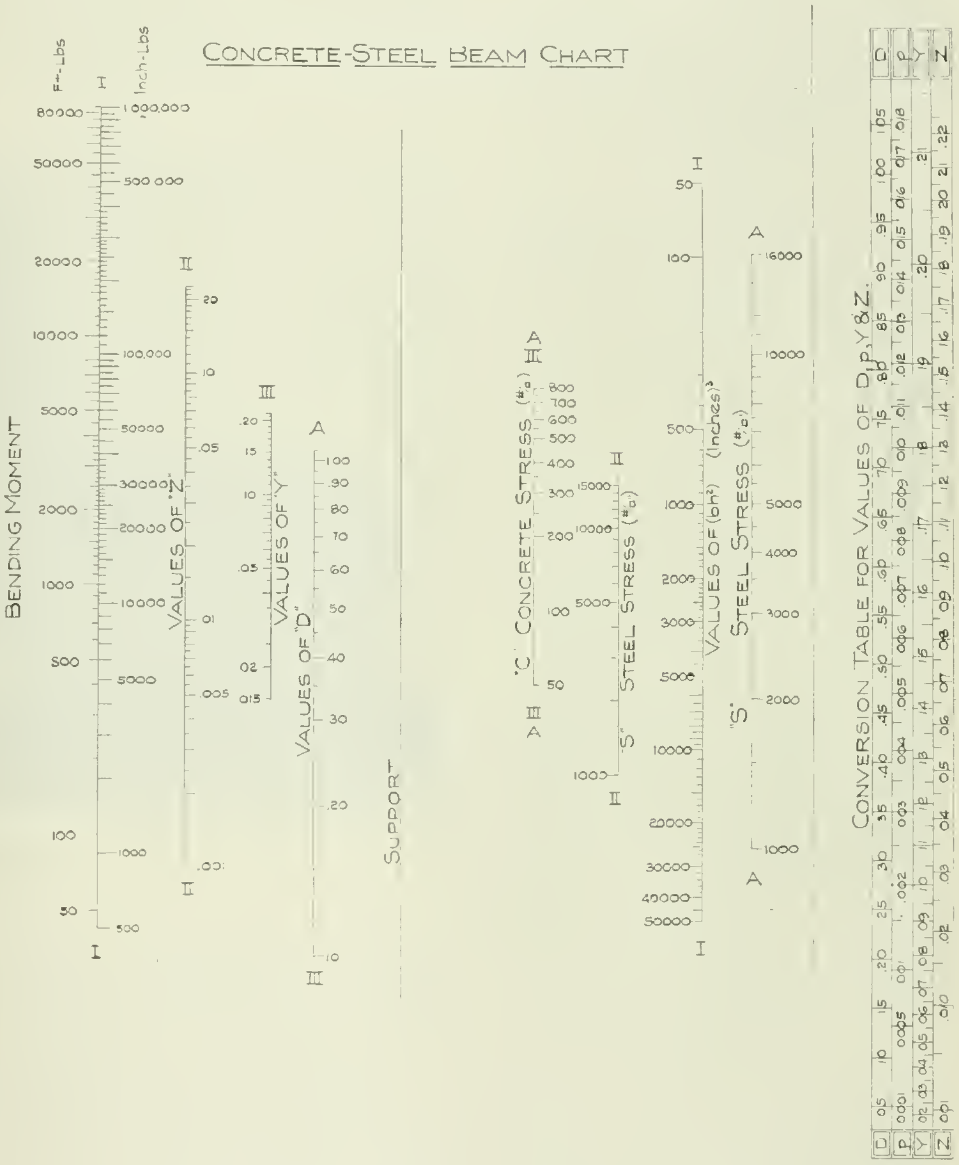


Fig. 1—Chart for Solving Problems in Reinforced Concrete Beam Design.

Set off Y = 0.142 and C = 500 lbs. per sq. in. (Scales III); place a pencil point of the intersection of a line joining these points with "Support," rotate line about this point to M = 60,000 in. lbs. (Scale I), and read bh^2 = 850 (Scale I); whence by trial b = 6, h = 2 (±) pbh = .0048x 6x12 = 0.36 sq. in.

(2) Data: M = 100,000 in. lbs., b = 8 ins., h = 12 ins., S is not to exceed 16,000 lbs. per sq. in., C is not to exceed 500 lbs. per sq. in. Required p.

Solution:—bh^2 = 1152 (in.³). Set off M = 100,000 lbs. and bh^2 = 1,152 (Scale I). Locate intersection point on "Support." Use this intersection point with S = 16,000 (on II). Read Z = 0.082 on II from Conversion Table; for Z = 0.082, Y = 0.154, p. = 0.0062 and D = 0.53. For D = 0.53 and S = S = 16,000 lbs. per sq. in. Read C = 580 lbs. per sq. in., which is too high for the limit imposed upon C, indicating that C should be used in place of S and Y determined.

Using some "support" point as before with C = 500 lbs. per sq. in. (III) read Y = 0.174 (III). For Y = 0.174; read Z = 0.118, p = 0.0091, D = 0.67. Now see what stress is occasioned in steel for C = 500 lbs. per sq. in. On "A" scales for C = 500 lbs. per sq. in. and D = 0.67 read S = 11,000 lbs. per sq. in. (O. K.). Therefore p = 0.0091 = .91 per cent.

(3) Data: M = 80,000 in. lbs.; b = 10 ins.; h = 12 ins. Area of steel reinforcement = pbh = 1 in.²

Required stress in steel and in concrete.

Solution:—bh^2 = 1,440, $p=\frac{1}{120}$ = 0.0083.

From Conversion Table for p = 0.0083, Y = 0.17, Z = 0.109, D = 0.64. Locate "support" point from M = 80,000 in. lbs. and bh^2 = 1,440 (Scales I). Set off Y = 0.17 (III); read C = 330 lbs. per sq. in. (III). Keeping same "support" point; set off Z = 0.109 (II); read S = 7,700 lbs. per sq. in. (II).

(4) Data: b = 10 ins., h = 12 ins. Area of steel = pbh = 1 sq. in. Required—One M to make C = 500 lbs. per sq. in.; two M to make S = 16,000 lbs. per sq. in.

Solution:—$p=\frac{1}{120}$ = 0.0083.

From Conversion Table, $Y = 0.17$, $Z = 0.109$, $D = 0.64$. Locate "support" point for $C = 500$ lbs. per sq. in. and $Y = 0.17$ (Scales III). Turn to bh^3 (I) and read $M = 120,000$ in. lbs. (I). Locate "support" point for $S = 16,000$ lbs. per sq. in. and $Z = 0.109$ (II), turn to $bh^2 = 1,440$ (II) and read $M = 165,000$ in. lbs. on I.

While neither the formulas used nor the principles applied are original, the writer has never seen the alinement chart used in this manner. The chart has been tested on the work of the Pittsburgh & Lake Erie R. R., and the ease and rapidity with which accurate results are obtained make it preferred to other methods of computation.

Moving Forms for Concrete Grain Elevator Construction, With Some Notes on Materials and Methods of Work.

The moving form is the unique contribution to concrete engineering by American builders of reinforced concrete grain elevators. This type of form is used in building the cylindrical storage bins which are arranged in rows as indicated by Fig. 1, and which form the storage receptacles for the grain, all other parts of the elevator being normally occupied by the machinery for receiving and delivering the grain. In two papers on concrete elevator construction contributed to the transactions of the National Association of Cement Users, moving bin forms are discussed by Mr. R. B. Durham, Vice-President John S. Metcalf Co., Ltd., Montreal, Canada, and by Mr. B. T. Weller, Purchasing Agent James Stewart & Co., Chicago, Ill. These discussions, with the drawing furnished us by Mr. Durham, give a very clear idea of moving form design and operation.

BY R. B. DURHAM.

The building of elevator bin walls has developed a method of construction not used as far as I am aware in connection with other buildings. This arises from the great height of bin wall of the same thickness, which early suggested that a short form which could be moved up continuously would be the most economical means to be used.

The earliest concrete bins were built by means of fixed or shutter forms. As far as I can learn, the first set of bins on which the moving bin form was used was the cluster of nine cylindrical bins built for the Canadian Pacific Ry. at Port Arthur, Ontario, in the latter part of 1903.

All moving bin forms have certain characteristics in common, the variations between those used by different contractors, or by the same contractor at different times and on different work, being more in method than in principle. The form consists of horizontal framing pieces to which vertical sheeting is attached. The form may vary in height from 3 ft. to perhaps as much as 5 ft., measuring by the length of the vertical sheeting, but is always a comparatively short form. It must, of course, extend along both sides of each wall, the forms on the two sides of the wall being connected by vertical timber or steel yokes which are usually attached to the horizontal framing of the form. The sheeting is generally of wood dressed on the side in contact with the concrete. Galvanized sheet steel on a wood framework has also been used and in some cases the wood sheeting itself has been covered with steel, either on only the forms for the outside walls exposed to view or on all of the forms throughout the work. The purpose of covering the wood sheeting or lagging with sheet steel has been to make smoother walls, which would thus have a more presentable appearance and would also require less pointing up or patching. It has been found that the use of steel is not necessary if the raising of the form is carried on rapidly and continuously and a gang of pointers follows closely after the moving forms. In such cases the wooden sheeting has produced workmanship which is all that can be desired and in some ways is superior to that produced by stationary forms.

The principal difference in methods of building bin walls with moving forms is difference in the procedure followed for raising the forms. It is necessary, in order to obtain walls which are smooth and results which are economical, that the forms be raised continuously and that the movement be at a steady rate. The concrete at any particular point must have a reasonable length of time to harden before the bottom edge of the sheeting gets above it. This means that the progress in any one day is limited to a maximum of approximately twice the depth of the form, which insures that there will never be any exposed concrete which is less than twelve hours old. Assuming a 4-ft. form, this means that the movement must not exceed 4 ft. in twelve hours and it is generally less than that; so that a very slow, but at the same time a very steady, upward movement is desirable. It will probably be asked, why not build forms with longer sheeting and jack faster. The answers are, first, that it is not desirable to put a much greater load on green concrete; and, second, that 6 ft. to 8 ft. of concrete a day on a large building has been found to be the maximum which can be gotten into the forms, when the placing of reinforcing and other items tending to delay have been considered.

The Canadian Pacific Elevator at Port Arthur, built in 1903, was, as stated above, the first elevator, so far as I am aware, on which moving bin forms were used. The jacking was done by means of, I think, ordinary locomotive jack screws. Brackets were fastened to the lower horizontal members of the forms and the jacks were set on vertical posts with the top of the jacks bearing against these brackets. As the forms were raised to the limit of each jack, another section of post was added below the jack and the entire form structure thus gradually raised from bottom to top by increasing the length of the post. The jack posts were probably of varying length so that all jacks would not have to be released simultaneously.

Another method of raising moving forms, and that used by our company at the Missouri Pacific Elevator, Kansas City, and on one or two other contracts, was somewhat similar except that the jack was placed at the bottom of the bin instead of at the top next to the form. Locomotive jack screws were placed below the posts and the entire form structure and scaffolding gradually raised, the new sections of post being put in at the bottom from time to time as the limit of travel of any jack was reached.

After this time, with the increased number of concrete elevators being constructed and the increased number of engineers working on schemes for raising the forms, the method of jacking becomes more diversified. The style of jacks may, however, be divided into two general classes, the screw jack and the pump jack. The former depends on the travel of a nut on some form of threaded rod, either in the jack or in the bin wall; the latter depends on a toggle arangement operated by a lever with pump handle motion and working on a plain rod. Practically all builders now support the forms, not on a scaffolding between the bottom of the bin and the form, but on steel rods which are embedded in the bin wall. The jack travels upward on these rods, the jack itself generally being attached to the yoke, to the lower end of which the bin forms on either side of the wall are secured.

The question as to whether the pump jack or the screw jack is the better style is one on which experts disagree. Some who have used both kinds are very much in favor of the pump jack; others who have had experience with both kinds stick to the screw jack. We have experimented with the pump style but have never seen fit to adopt it in actual construction work. We have used two or three different styles of screw jacks and have built about 10,000,000 bushels capacity of storage bins with the jack we are now using. In this case the vertical rod which is embedded in the wall, and on which the jack operates, Fig. 2, is threaded the entire length with a double "V" thread about 3½ pitch. The jack casting is attached to the yoke and consists of one supporting casting and a revolving casting with apertures for the jack levers. The revolving casting is set over a square nut on the threaded jack rod. As the revolving casting is turned the nut climbs the jack rod and the yoke and forms are raised. This jack enables us to make steady progress, is capable of exerting great power in case of the forms sticking, and is sufficiently fast. On two different sections of the Montreal Harbor Commissioners Elevator, each section being about 150 ft. by 100 ft. in plan, we have run up 86 ft. of bin walls in less than 14 days, or better than 6 ft. per day. This is, of course, working night and day; for if a moving form is stopped after it is once

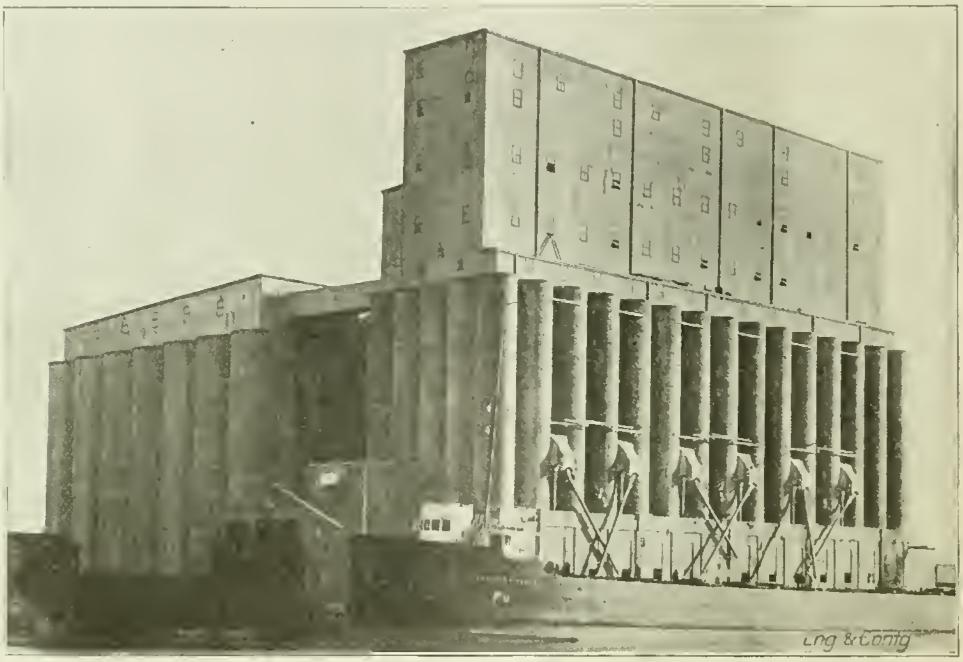


Fig. 1—Grand Trunk Pacific Terminal Elevator of Reinforced Concrete at Fort William, Ontario.

started a joint in the work is sure to show, and generally a small offset or shelf is left at the joint.

One company uses another type of screw jack; in their case the vertical rod in the wall is a plain rod. The jack is, briefly, an extra heavy pipe about 2 ft. long and threaded on the outside. The jack rod runs through this pipe, which is provided with a clutch at the lower end. The traveling nut operates on the pipe and when the limit of travel has been reached the clutch is released, the threaded pipe runs to the other end of the travel and the operation repeated. They have secured good results with this jack. The Macdonald Engineering Co. of Chicago, on the other hand, after trying various styles of jacks, has abandoned screw jacks altogether and uses only a pump jack. Another contractor has used both of these styles, but of late has leaned to the pump jack.

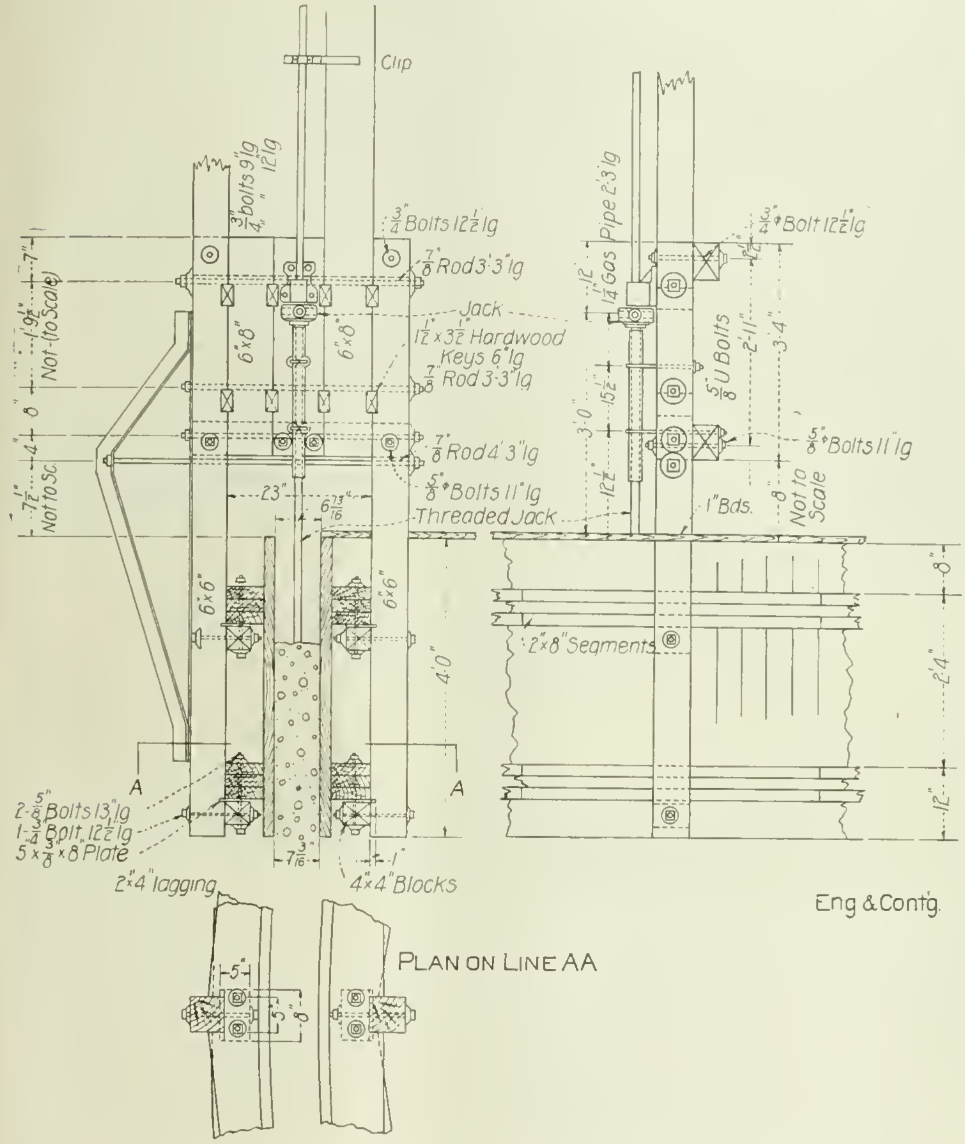

Clip
$\frac{3}{4}$" bolts 9" lg
" " 12" lg
$\frac{3}{4}$ Bolts $12\frac{1}{2}$ lg
$\frac{7}{8}$" Rod 3'3" lg
Jack
$1\frac{1}{2}$" x $3\frac{1}{2}$" Hardwood Keys 6" lg
$\frac{7}{8}$" Rod 3'3" lg
$\frac{7}{8}$" Rod 4'3" lg
$\frac{5}{8}$" Bolts 11" lg
Threaded Jack
6"x8"
6"x8"
6"x6"
6"x6"
7"
$1'9\frac{1}{2}$"
Not (to Scale)
8"
4"
$7\frac{1}{2}$"
Not to Sc.
23"
$6\frac{13}{16}$"
4'0"
A
A
2-$\frac{5}{8}$" Bolts 13" lg
1-$\frac{3}{4}$" Bolt $12\frac{1}{2}$" lg
5 x $\frac{3}{8}$ x 8 Plate
2"x4" lagging
$7\frac{3}{16}$"
1"
4"x4" Blocks
5"
5"
8"
PLAN ON LINE AA
$1\frac{1}{4}$" Gas Pipe 2'3" lg
$\frac{3}{4}$" Bolt $12\frac{1}{2}$" lg
12"
$15\frac{1}{2}$"
3'0"
$12\frac{1}{2}$"
$\frac{5}{8}$" U Bolts
2'11"
3'4"
$\frac{5}{8}$" Bolts 11" lg
1" Bds.
8"
Not to Scale
2"x8" Segments
8"
2'4"
12"
Eng & Contg.

Fig. 2—Moving Form for Constructing Reinforced Concrete Elevator Bins.

The rate of progress of which I have spoken is possible only with a comparatively quick setting cement such as is used in the United States and Canada. The standard British cement sets very slowly and the use of moving forms is unknown in Great Britain. Thus far, as the Brtish engineers are slow to allow innovation, they have not been willing to permit the use of a quick-setting cement and a moving form.

From what I have said in regard to the speed at which bin walls can be built, it may be thought that there are no troubles in this business, but I can assure you that every builder of concrete elevators who has used moving bin forms has also had his griefs; even when the forms themselves are practically perfect, there are other considerations which sometimes cause trouble. It is not possible to build a very thin wall with a moving form, the determining factor being the relation between the weight of concrete in the form and the friction of the concrete against the sides of the form. The area of form exposed to the concrete is the same no matter what the thickness of the wall, while the weight, of course, varies in direct proportion to the thickness. I think it is entirely practicable to build a 6-in. wall with moving forms but that it is dangerous to go much below this unless very special precautions are taken to prevent lifting of the concrete. We have built concrete elevator legs 2 ins. thick with moving forms and gotten good work, but in that case we lifted the forms with chain blocks and went with comparative slowness.

The speed of the work and the freedom from trouble will also depend somewhat on the aggregate used and, it would seem in some cases, on the cement. Three elevator builders have had trouble with one particular brand of cement in moving forms and decline to use it further. A fourth has used it with success and is not afraid of it. Whether the trouble arises from this particular cement having properties which cause it to stick to the forms more than other cements, or whether it sets before the forms have been moved and thus causes the top of the wall to break away from the portion below it, is a question no one, not even the cement people themselves, have been able to satisfactorily explain.

The question of aggregates seems to be a comparatively unimportant one. We have had good results with crushed stone concrete and with gravel concrete. The crushed stone concrete has, perhaps, less tendency to lift in the forms but, on the other hand, on account of the likelihood of sharp corners of the stones catching in the wood of the sheeting when tamped and thus being displaced as the form is raised, smoother walls are generally obtained with gravel concrete. We have successfully run bin walls with sand and cement alone, though in general we should consider this taking a chance because of the tendency of a cement mortar to stick to forms.

BY B. T. WELLER.

The equipment for handling concrete in the modern elevator differs very little from the methods used in placing concrete in any other building, with the exception of the forms, in which great advancement has been made in the last few years. These forms are made of 2-in. plank, surfaced on one side and two edges, and the form over all is about 4 ft. 6 ins. in height. After the foundation has been completed these forms are set over the whole area and filled with concrete in layers of about 8-in. thickness. The raising of these forms is accomplished by a series of jacks in which there are from 6 to 8 on each tank, or if they are used on straight walls they are placed about 5 or 6 ft. apart. These jacks are set in a yoke which is a framework of steel and is connected to the wooden forms. Through each jack there is a jacking rod about 1 in. in diameter running vertically. To operate the jacks a bar is placed in the socket causing a screw to turn, which if turned to the right lifts the forms and if turned to the left, the jack itself climbs the jacking rod while the forms remain stationary, being supported by the two adjacent jacks. By reason of the rod passing through the jack the load is applied concentrically and leaves no tendency for the forms to bind. These jacking rods are placed directly on top of each other and no dismantling of the forms is required when additional rods are added. These yokes are connected by means of trusses and this in turn supports the temporary floor for the convenience of the workmen and permits easier handling of material. This continual moving of forms does away with the horizontal rings and discolorations so often to be seen in the first concrete elevators. This type of form also has greatly reduced the cost over the stationary forms used originally or the primitive jacking system first adopted, which was accomplished by jacking from the ground all the way to the top of the elevator.

Silo Construction of Special Vitrified Clay Hollow Blocks and Steel Reinforcing Bars.

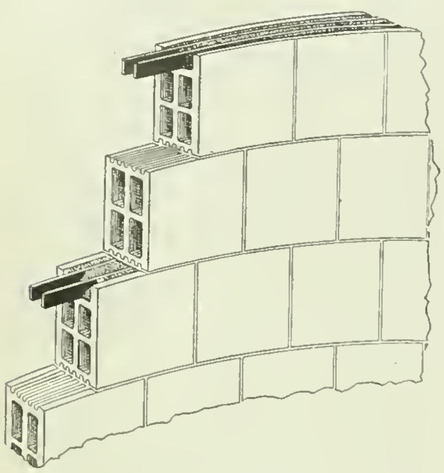
(STAFF ARTICLE.)

In earlier silos built of burnt clay hollow blocks, use was made of regular trade block shapes and when reinforcement was used it consisted of ordinary wire laid around the silo in the mortar joints or of outside steel hoops. Improved methods have followed the growing use of clay tile for silo construction and the accompanying sketch shows a form of special silo block and of circular reinforcement or hooping which is being used with success by the National Fireproofing Co., Pittsburg, Pa.

Referring to the sketch it will be observed that two forms of hollow blocks are used, the difference between them being that in one block the top edge is molded with a channel giving space for the reinforcing hoops. Both blocks have 12x12-in. faces and are 6 ins. thick, and both have four compartments. In construction the channel blocks form alternate courses around the silo, so that the reinforcing hoops are spaced 2 ft. apart the full height of the silo wall. The channel in which the hoops are set is about 1½ ins. deep and 4 ins. wide, and the hoop is really two concentric hoops of flat steel bar set on edge; the channel is filled with mortar which completely embeds the hoops. At the door opening the hoops loop over heavy steel rods which cross the opening and serve for attachments for the wooden doors. A concrete bottom and footing are used with these tile block silos, and the doors and roof are of wood.

Principles of Design of a New Type of Girderless Floor Construction of Reinforced Concrete.

In our issue of Dec. 22, 1909, we described the application in the Studebaker Building in Chicago of girderless reinforced concrete floor construction which differed essentially from floors of this general type previously designed. Since that date the new design has been employed for a number of structures and tests have been made to determine its efficiency. These tests and a general discussion of the principles of design are outlined in a paper by Mr. T. L. Condron, President Condron Co., Structural Engineers, Chicago, Ill., before the National Association of Cement Users. An abstract follows of that portion of the paper which explains the methods of computation:



Vitrified Clay Hollow Block Silo Wall Construction.

The method of reinforcing these floors consists of rectangular belts of bars in *two directions only* and is patented. Fig. 4 shows the finished appearance of the construction. The main belts of reinforcement pass over the column heads and surround an enclosed space at the center of the panel which is reinforced with secondary belts of bars parallel to the main belts and extending across the latter. A feature of this construction that is entirely novel and is an important claim of the inventor, is the transverse reinforcement of the main belts of reinforcement, so that these belts become wide, shallow girders reinforced longitudinally to resist longitudinal tension and transversely to resist the transverse tension, due to being loaded along the edges and supported only on part of their widths. The following is an analysis of the stresses:

Fig. 1a is a diagram of a portion of such a floor supported upon six columns and Fig. 1b is a longitudinal section across the same, while Fig. 1c is a diagram of certain moment curves. If a longitudinal element of the floor, in line with the column centers, be considered as uniformly loaded and the width of the column heads be reduced to knife edges, then the bending moments along this element of the floor will be represented by the dotted curve, in Fig. 1c, and the negative moment over each support, will be equal to $\frac{WL}{12}$, where L is the distance between knife-edge supports. At the center of the span, the positive moment will be $\frac{WL}{24}$, or one-half the moment over the support. If the supports are wide column heads instead of knife edges, the moment curve will be changed, because the clear span will be shortened and this element of the floor will become a beam with fixed ends and a span equal the clear distance between column caps. The moment at the edge of the column cap will be qual to $\frac{WS}{12}$ where S equals the clear span, and the moment at the center of the span will be $\frac{WS}{24}$, or one-half the moment at the edge of the cap. If one panel only is loaded, the moment will presumably be greater at the center of the span, than if several adjacent panels are loaded, and to meet this condition of loading, we assume a moment at the center of the span equal to the moment at the edge of the column cap.

If the columns are placed in the usual manner, as indicated in Fig. 1a, each column will support a section of floor, C_1, C_2, C_3, C_4; and if the column heads are rectangular, there will be supported on each edge of the column head an area of the floor equal to A, C, C_1, A_1.

Two simple ways are suggested for analyzing the stresses in such a slab supported upon rectangular column heads and with rectangular reinforcement, either of which follows the ordinary methods of beam analysis, does not involve abstruse reasoning, and may be relied upon to give safe and sane results, nearly enough correct for all practical considerations.

The first method is to consider the loaded area $A\ C\ B\ B_1\ C_1\ A_1$, carried by the broad girder AA_1-B_1B having the clear span AB and having its ends fixed. Considering this girder uniformly loaded, the moment at the edge of the column plate will be $\frac{WS}{12}$. Since W equals the load on one-half the panel (exclusive of the area of the column plate) it is equal to $\frac{w}{2}(L^2-P^2)$. Therefore, the moment at the edge of the cap is equal to $\frac{w}{24}(L^2-P^2)\ S$, or $\frac{w}{24}(L^2-P^2)\ (L-P)$. If $P=L/4$, the moment becomes equal to $wL^3/34$.

The other method of analysis is to consider that the slab supported by the several column caps is in negative bending over the columns, within the lines of inflection $R_1\ R_2$ — $R_2\ R_3$ — $R_3\ R_4$ and $R_4\ \ R_1$, and in positive bending between these lines and corresponding lines about the adjacent heads. We then assume that these lines of inflection are located at a distance from the column centers, which is a mean between $.2L$ and $.2S+P/2$. Since $S=L-P$, this distance is equal $.2L+.15P$. If $P=L/4$, then the distance from column center to the lines of inflexion becomes $.2375L$.

By this method, the moment at the edge of the cap, when the width of the column is $L/4$, becomes $wL^3/33$, or practically the same as by the first method. The calculations by this method are somewhat complicated for the general case, but are simple for specific dimensions.

After the moment at the edge of the cap is determined and if the same moment is arbitrarily assumed at the mid-span for each belt of bars, the slab will be over reinforced at mid-span between columns for all panels loaded, which introduces an extra degree of safety. The reinforcement of the region enclosed by the four main belts is readily determined, this portion being a slab reinforced in two directions. The moment between the lines of inflection will be $\frac{wl^2}{8}$ or $\frac{wl^2}{16}$ for each direction where l is the distance between lines of inflection.

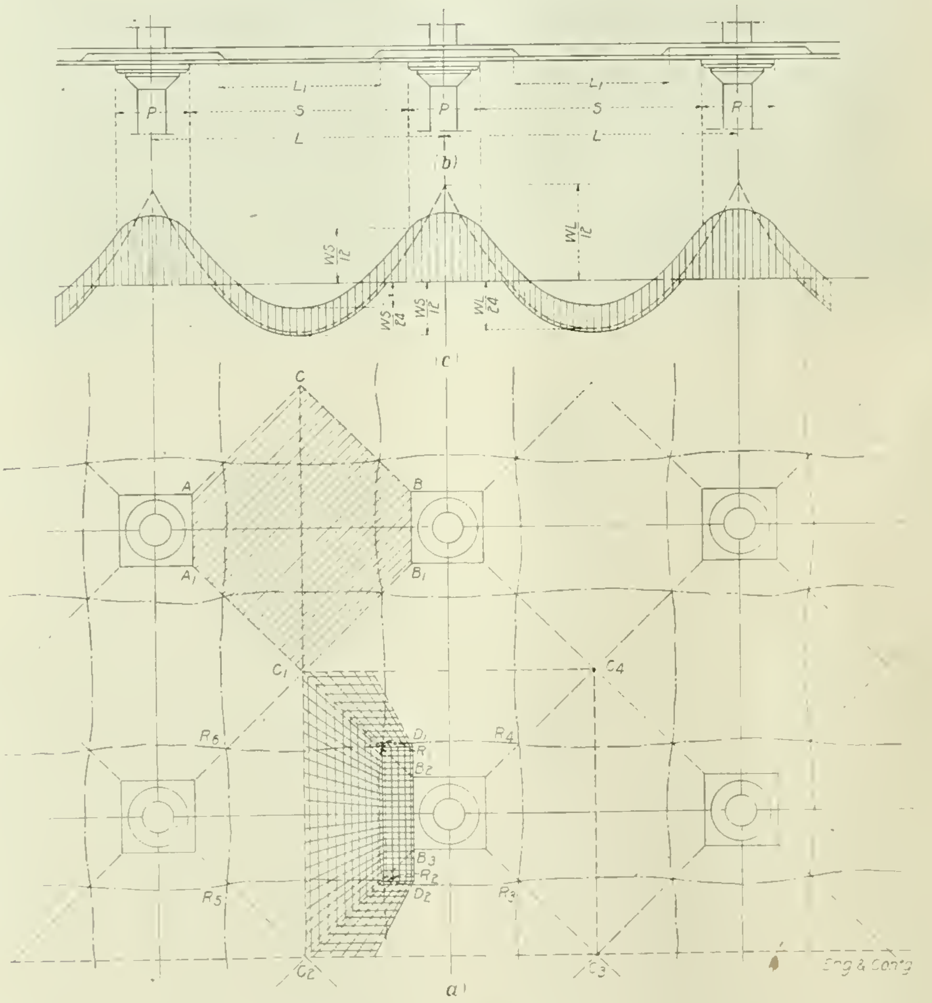


Fig. 1—Diagram Illustrating Method of Computing Girderless Reinforced Concrete Floor.

The importance of transversely reinforcing the top of the slab, across the main belts of bars, has already been mentioned and too much emphasis cannot be laid upon this feature.

The proper width of the belts of reinforcement is a matter of judgment based upon experience and deflections under tests, but these belts will be wider than the caps, but not wider than the distance between the lines of inflection. We determine the thickness of the slab by limiting the shear at the plane of contraflexture about the column to less than 40 lbs. per square inch on the effective section.

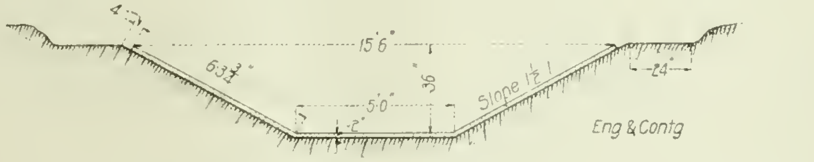
We also determine the area of steel required, under the allowed unit stress, for each of the two layers of bars over the column plate, as the difference of the resisting arms for the two layers should, in our opinion, be taken account of. We provide efficient supports for the upper reinforcement, which we believe in maintaining in a truly horizontal position, where it is needed to resist tension. Therefore, our designs call for the accurate bending and placing of the bars.

DRAINAGE AND IRRIGATION

Cost of Concrete Lining 7,050 Ft. of Irrigation Canal.

(STAFF ARTICLE.)

A length of 7,050 ft. of irrigation canal of the cross-section and dimensions shown by the accompanying drawing was lined with 2 ins. of concrete at the costs given in the succeeding tabulations. The volumes of concrete in lining were 13,502 sq. yds., and 766 cu. yds., the mixture being a 1:6 cement and sand. All mixing was done by hand on 4½x10 ft. mixing boards set on the ditch bottom and moved by hand. Sand, water and cement were delivered on the upper side of the canal; the sand was measured in boxes containing 1 cu. ft. and dumped in trough to mixing board. Water was hauled in 650-gal. tanks an average distance of 2¾ miles, and was delivered in barrels to each mixing gang. Each batch was turned over twice dry, water was added and the wetted mixture was turned twice. A mixing gang consisted of 7 men as follows: 4 mixers, 1 top man to deliver sand and water, 1 assistant trowel man, and 1 trowel man, who also acted as foreman. The wages paid for labor were as follows, the rates per hour being for a ten-hour day:



Section of Cement Lined Canal, Hanford Irrigation & Power Co., Washington.

Inspector, per day	$ 5.00
Foreman, per month	125.00
Timekeeper, per month	75.00
Cook, per month	98.00
Carpenter, per hour	35 cts.
Sub-foreman, per hour	27½ cts.
Trowel man, per hour	30 cts.
Team and driver, per hour	50 cts.
Common labor, per hour	22½ cts.

The number of men employed was 75 and they lined on an average 80 ft. of canal per ten-hour day.

The concrete materials required were 1,054 bbls. of cement, 771 cu. yds. of sand and 82,850 gals. of water. The costs of these materials distributed on the work were as follows:

Cement.—Two brands of cement were used, Golden Gate, 654 bbls., and Red Devil, 400 bbls., and the costs distributed on the work were as follows:

Item.	Golden Gate.	Red Devil.
Cost, f. o. b. Kennewick	$2.75	$2.60
Drayage at 40 cts. per ton	0.076	0.076
Boat to Hanford at $3 per ton	0.57	0.570
Hauling to job, $1.50 per ton	0.285	0.285
Distribution	0.037	0.037
Total	$3.718	$3.568
Credit, 4 sacks at 10 cts.	0.40	0.40
Net cost per barrel	$3.318	$3.168

The total cost for cement distributed on the job was therefore:

654 bbls. at $3.318	$2,170.20
400 bbls. at $3.168	1,267.44
Total	$3,437.64

Water.—The cost of water was the cost of handling 82,850 gals., which was $693.04, or slightly less than 0.85 cts. per gallon.

Sand.—Sand was secured on the company's property and its only cost was for hauling an average distance of 0.85 miles in loads of 1 cu. yd. This cost was $1,079.62. A total of 771 cu. yds. were hauled and 766 cu. yds. were actually used; the corresponding cubic yard costs were $1.40 and $1.41.

Lining.—The cost of lining, including materials as listed above and labor of all kinds, was as follows:

	Total.	Per lin. ft.
Excavation.		
2,230 cu. yds. earth at 33 cts.	$ 735.34	$0.104
400 cu. yds. gravel and loose rock at $1.39	556.71	0.079
660 cu. yds. solid rock at $1.62	1,070.72	0.152
Total	$2,362.78	$0.335
Concrete.		
1,054 bbls. cement at $3.262	$3,437.64	$0.488
771 cu. yds. sand at $1.40	1,079.62	0.153
62,850 gals. water	693.04	0.098
Mixing and placing 766 cu. yds. at $3.33	2,547.46	0.361
Total	$7,757.76	$1.100
7,050 ft. forming and tamping	1,595.40	0.226
14,192 ft. fence at 4½ cts.	633.13	0.089
Totals	$12,349.07	$1.75

Fencing.—The itemized cost of the 14,192 lin. ft. of four-strand barbed wire fencing with posts 20 ft. apart was as follows:

Barbed wire, 3,168 lbs. at $2.85, f. o. b. Portland	$ 90.29
Freight, Portland to Hanford	21.72
Posts, 705 at 8 cts., f. o. b. Coyote (720 ft. B. M. at $22)	15.84
Timber for braces, 4x4 ins. (1,295 ft. B. M. at $23)	29.80
Staples, 210 lbs. at 10 cts.	21.00
Miscellaneous material	3.58
Handling and hauling	85.67
Labor (common)	140.29
Surveying and proportionate camp charge	190.26
Total	$633.13
Cost per lin. ft. of fence	$0.045
Cost per lin. ft. of canal	0.089

Concrete in Place.—The cost per cubic yard and per square yard of concrete lining in place was from the above costs as follows:

	Total cost.	Cost per cu. yd.	Cost per sq. yd.
Cement	$3,437.64	$ 4.49	$0.249
Sand	1,079.62	1.41	0.078
Water	693.04	0.90	0.050
Mixing and placing	$2,547.46	3.33	0.185
Total cost	$7,757.76	$10.13	$0.562

We are indebted for the costs and other data given in this article to Mr. T. P. Beeman, District Engineer, Chicago, Milwaukee & Puget Sound R. R., Beverly, Wash., through whom they were forwarded by Mr. A. T. Petheram, Engineer, Hanford Irrigation & Power Co., who was in charge of the work.

The Problem of Interstate Swamp Drainage; The Red River of the North.

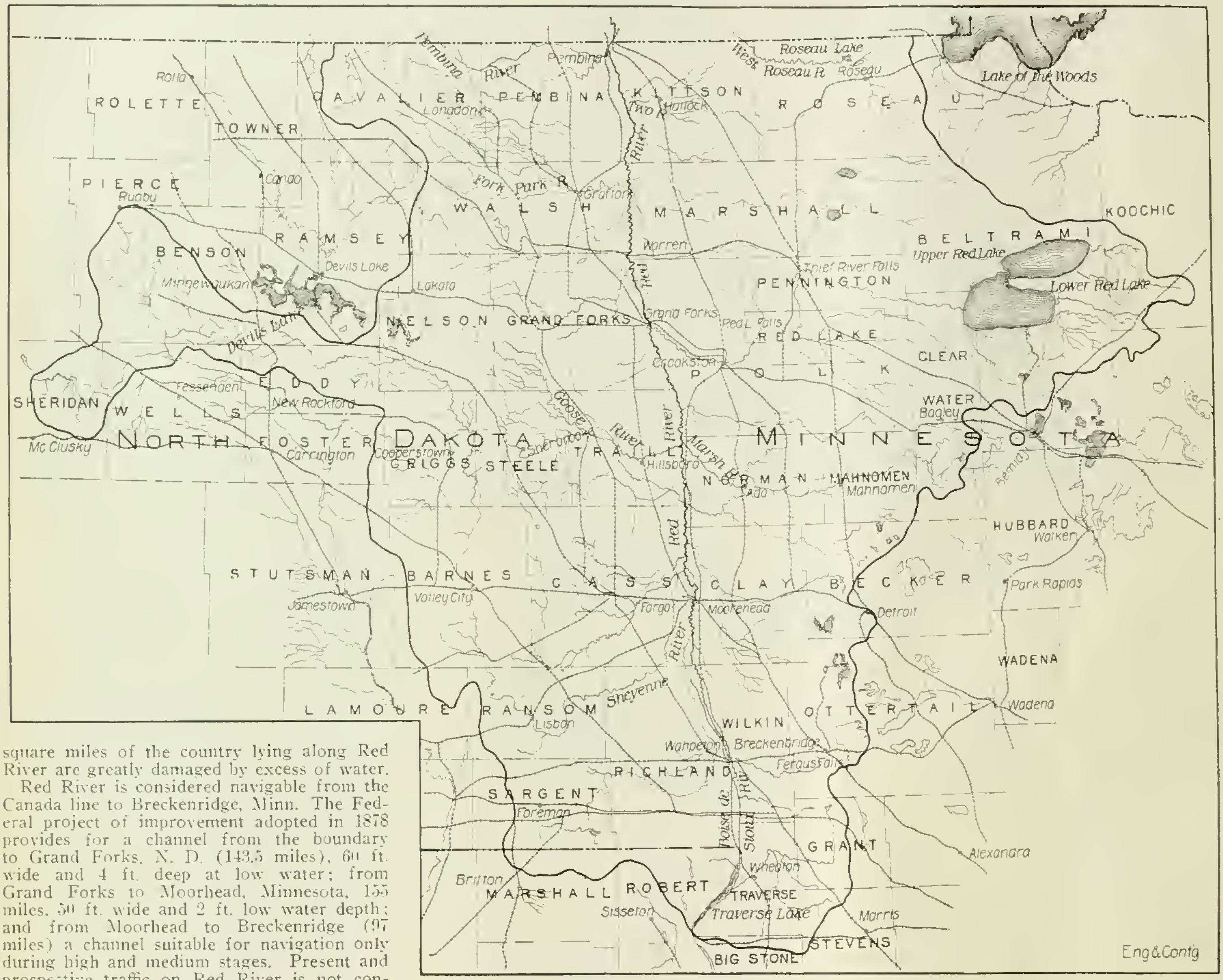
Contributed by M. O. Leighton, Chief Hydrographer, U. S. Geological Survey.

This basin differs in many ways from that of the St. Francis which was discussed in the previous paper (Eng. & Contg., Dec. 11, 1912). The former, though not precisely defined as to area and divide, is essentially independent of the neighboring watersheds; the latter, in its natural state, i. e., previous to the construction of the Mississippi levees, was in large part a great flood plain of that river, possessing its own individuality only during the periods when the stage of the great river had been lowered to a certain elevation. The interstate complication in the St. Francis is caused by a transverse State boundary crossing which places the upper portion in one State and the lower portion in another. The complications in the Red River basin are both interstate and international. South of the Canada line the river channel forms a State boundary. It is a common artery for drainage from Minnesota on the east, and from North Dakota and a small part of South Dakota on the west. The international boundary is transverse and the run-off complications are similar to those in the St. Francis. The relations are shown in the accompanying map. Other differences are numerous, the important ones being largely climatic. The Red River basin is subject to wide extremes of temperature, ranging from above +100° F. to more than —50° F. During the winter the area is covered with a heavy mantle of snow. In the St. Francis the temperature only seldom descends below zero, rises at times above 100° F., and the light snows remain only a few days. Drained lands in the Red River basin produce abundant crops, especially of hard wheat and oats and are believed to be very favorable for flax.

The Red River valley is the bed of Lake Agassiz, a preglacial body of water which drained through the present Minnesota River. The drainage area within the United States is about 35,000 square miles in extent, of which 16,100 lie in Minnesota and 18,900 in the Dakotas. The land gradients are generally low, and lakes and swamps are the predominant physiographic feature on the Minnesota side. In the Dakotas, the western edge of the basin is considerably higher and dryer than the country nearer the river. Along the eastern margin, which marks the western boundary of Upper Mississippi River basin, the divide is indefinite, the country being largely occupied by a system of small and relatively shallow lakes and ponds, the drainage from which sometimes takes both directions. Traverse Lake, one of the sources of Red River, is separated from Big Stone Lake, the source of Minnesota River, by a divide only 4 miles wide, lying at a maximum elevation of only 3 ft. above high-water mark in the former. From Breckenridge, Minn., where the Ottertail and the Bois de Sioux unite to form Red River, to the Canada line is 395.5 miles, though the direct line distance is only 194 miles. Certain physical features at various points along the stream are as given in Table I.

The principal tributaries of Red River are shown on the accompanying map. Their general grade exceeds that of the main stream, especially where for short distances low falls or rapids are developed. Red Lake River, the most important tributary, is the best example of such a case. At Thief River Falls, the river drops 13 ft. The two northernmost tributaries do not lie wholly within the United States. Roseau River occupies a considerable area in Minnesota but does not join the Red until it has traversed for some distance beyond the Canadian boundary. Pembina River, on the other hand, rises in Manitoba but dips southward, drains a large area in North Dakota and joins the Red a short distance south of the international boundary. The general flatness of the country indicates a general swampy condition of the basin. Much of it is too wet for cultivation without artificial drainage and indeed there is little land on the Minnesota side that would not be agriculturally benefited by such improvements. In North Dakota about 2,500 square miles of the country lying along Red River are greatly damaged by excess of water.

Red River is considered navigable from the Canada line to Breckenridge, Minn. The Federal project of improvement adopted in 1878 provides for a channel from the boundary to Grand Forks, N. D. (143.5 miles), 60 ft. wide and 4 ft. deep at low water; from Grand Forks to Moorhead, Minnesota, 155 miles, 50 ft. wide and 2 ft. low water depth; and from Moorhead to Breckenridge (97 miles) a channel suitable for navigation only during high and medium stages. Present and prospective traffic on Red River is not considered by the War Department of sufficient importance to warrant any large expenditures for improvement. The grounds for this belief are discussed at some length in House Document No. 616, 62nd Congress, 2nd Session, which is a report by Major Francis R. Shunk, Corps of Engineers, U. S. Army, on the necessity of construction, in aid of navigation, of certain reservoirs on the principal tributaries of the river. The report concedes the practicability of certain sites, for power and flood prevention purposes, but is unfavorable to the project because "neither present nor prospective commerce is sufficient to justify further expenditures than are required under the existing project."



Map of the Red River of the North Drainage Basin.

TABLE I.—PHYSICAL FEATURES OF RED RIVER OF THE NORTH,* BY SECTIONS.

From—	To—	Distance by river.	Distance by direct line.	Total fall.	Average fall per mile	Width of channel.	Height of bank.	Range between high and low water.
Wahpeton	Abercrombie	26.0	14.0	35.5	1.36	125	12	16
Abercrombie	Fargo	71.0	30.0	38.2	.54	95	37	33
Fargo	Goose Rapids	98.1	41.0	50.6	.51	100	38	33
Goose Rapids	Belmont	21.9	11.0	21.2	.97	160	61	40
Belmont	Grand Forks	35.0	22.0	12.8	.36	100-200	60	50
Grand Forks	Turtle River	25.0	18.0	6.2	.40	...	45	45
Turtle River	Salt River	30.5	13.0	18.8	.29	250-300	40	40
Salt River	Pelican River	40.0	17.0	11.9	.29	...	45	40
Pelican River	Boundary line	48.0	28.0	9.3	.19	...	50	38
Total		395.5	194.0	194.5	.49	...	..	..

*Bulletin 189, Office of Experiment Stations. Report on the drainage of the eastern parts of Cass, Traill, Grand Forks, Walsh and Pembina Counties, North Dakota, by John T. Stewart.

The lakes in the basin, especially Traverse, Ottertail and Red, offer certain advantages for storage. The problem of drainage will involve a more or less considerate examination of these possibilities and their intimate effects on floods in the main stream. The construction of Red Lake Reservoir would markedly reduce flood effects in Red Lake River and have a beneficial effect on those in Red River. It may be that the other sites are so near the headwaters and control so small a portion of the total basin, that they would have comparatively little effect in flood abatement under present conditions. The evidence should, however, not be accepted dogmatically. As drainage operations become more intensive, the run-off characteristics of this basin will be greatly altered. It may prove that a comparatively small storage will reduce flood crests at a time when and to a point at which they would otherwise overflow the banks of the main stream. The time element is important in such a case and until more hydrometric data are available, no generalization concerning reservoir ineffectiveness is safe.

Spring flood conditions are greatly intensified in Red River because of the fact that the flow is northward. The warm spring weather usually first invades the upper end of the valley, while the lower end may still be locked in ice. Thus the free passage northward of drift ice and melted snow is prevented. Ice jams are of frequent occurrence in the spring.

Of the area, 10,304,000 acres, drained by Red River in Minnesota, 3,428,600, or about one-third, are classed as swamp land. This, however, is a somewhat relative term. In Minnesota it is used to describe land that is perennially wet and which at no time is suitable for agriculture. In other parts of the country the term would also be applied to land which is wet for a large part of the year and which will produce a crop only in seasons of scanty rainfall. Probably 90 per cent of the Minnesota land in Red River basin would be agriculturally benefited by drainage. The condition is well illustrated by the area statements in the report of the State Drainage Commission for the two years ending Aug. 1, 1910. The area designated as swamp land is that above given, while the area for which benefits are claimed as a result of state, county and judicial ditch construction is 4,185,238 acres or 756,638 in excess of the total area classified as swamp. The foregoing statement of area benefited by existing ditches does not mean to imply that the land has actually been drained in the intensive sense in which that term is properly used. It means that main canals have been excavated or existing stream channels have been straightened so that a measure of relief more or less complete has been secured. The completion of the drainage in a manner finally necessary to agriculture requires small lateral drains or tiling. A very small proportion of the land in the Minnesota portion of the basin has been treated in this way. When all, or the greater part, of it has been drained, the maximum effects on the run-off characteristics of Red River will be apparent.

That portion of the Red River valley in North Dakota is about 12,100,000 acres in extent. Of this about 1,600,000 acres comprise the so-called bottom lands which adjoin the channel of the river and its tributaries. The remainder is higher country, lying to the west. Here the principal tributaries rise and, as they proceed eastward, traverse deep channels and finally emerge upon the bottom lands. In this portion the channel banks lie somewhat higher than the main body of land, the water that overflows the banks and is spread abroad on the land cannot return to the streams after the floods have passed. It escapes only by evaporation and slow percolation during subsequent low-water periods. The result, from an agricultural point of view, is well illustrated in a report of Mr. A. L. Fellows, former State Engineer, who, in 1905, made an investigation in certain North Dakota counties, representing an aggregate area of 3,000,000 acres:

Acres too wet to be seeded	89,234
Acres too wet to be summer fallowed	70,187
Acres seeded but not worth harvesting	87,035
Acres too wet for fall plowing	166,625
Acres which grew a crop but were too wet for harvesting	171,493

This represents a crop loss total on the parts seeded but not harvested of 253,600 acres which, at a wheat production of 15 bushels per acre and at $.70 per bushel, represents a gross loss of $2,663,407 for that single year.

The foregoing somewhat extensive description of the valley is necessary to an appreciation of the drainage requirements. Heretofore drainage districts on each side of the main river have been projected independently of each other and the main canal of each has been led into the channel of Red River or one of its tributaries. The depth of Red River channel below the abutting lands gives a more favorable prospect than is found in the St. Francis basin, but whether the banks are sufficiently high to pass prospective floods is a matter of grave doubt. The next task will be to determine from available stream flow data what are the prospects of increasing overflow tendencies of the river as a result of the increased rate of flood run-off that will follow artificial drainage.

A fair amount of run-off data, suitable for general purposes, is available for the Red River basin. For present purposes that at three places is all that can be purposefully used, viz.: Red River at Fargo and Grand Forks and Red Lake River at Crookston. At each of these places, flow observations have been maintained from 1901 to date, the yearly period usually extending from the spring break-up to the onset of the frozen period. Especially during the later years have sufficient flow measurements been made under ice to afford some idea of winter discharge. This is the period of lowest flow.

During the entire period of record, the flow at Fargo, above which there is an area of 6,020 square miles, has varied from 30 second feet in October, 1910, to 5,220 second feet in April, 1904. Inspection of the records appears to indicate that drainage has already changed the regimen to some extent, though a longer period of observation will be necessary before a final determination of this point can be made. The present low-high ratio is 1 to 173. Considering the whole period of observation, the usual low-water flow is in excess of 200 second feet while in only one year of the entire record has high-water exceeded 4,700 second feet. At Grand Forks, the drainage area above which is 25,000 square miles, the lowest observed flow was 313 second feet, occurring in September, 1910. The highest flood occurred in the spring break-up of 1904, when on April 27 the flow was 32,900 second feet. The ratio is 1 to 105. At Crookston on Red Lake River, above which there are 5,320 square miles of drainage area, the flow within the period of record has varied from 170 second feet in August, 1910, to 13,600 second feet on April 24, 1904. The ratio is 1 to 80. The foregoing figures indicate a remarkable uniformity of flow, equalled or exceeded by few rivers in the country. Attention is called to the exceedingly low run-off per square mile, the highest at Grand Forks being only 1.32 second feet. This fact, together with the long periods of well-sustained flow and the very slow subsidence to the minimum, give stronger testimony than can any single observation to the remarkable water-holding qualities of the drainage area. Flow characteristics of some of the principal rivers of the United States are given in Table II for purposes of comparison.

Red River of the North has, during many centuries, adapted the capacity of its channel to meet all except the extraordinary demands. An increase in those demands may result in frequent overflow. It is possible, with the hydrometric data available, to determine with reasonable accuracy whether bank overflow is to be expected. The work has not, however, been sufficiently intensive to determine just how large a channel will be required to pass the floods without overflow. The drainage area above Fargo will first be considered.

The highest run-off at Fargo, within the period of record, is equivalent to a depth of .032 in. on the drainage area and is represented by a stage of 21.3 ft. on the Fargo gage. At this elevation there is some overflow at points along Red River where the banks are low, though the total area thus submerged is not great. The danger line at Fargo is at 26.5 ft. on the gage, equivalent to a flow, under open channel conditions, of about 7,300 second feet. Above such a stage great areas of land are submerged. There is no reason to believe that a flood higher than that of April 20, 1904, did not occur previous to the beginning of the record nor that a higher one will not occur in the future, even if no drainage work were performed in this country. It will satisfy present purposes, however, to consider this the high point.

Many difficulties arise in determining the flow characteristics that will prevail under intensive conditions of ditching and tiling above Fargo. That the rate of flood run-off will be increased considerably is apparent, but as there are available no gagings of flood flow from drained lands in this basin, the remainder of the present problem must be discussed from data derived in another place. It is admitted that such a practice is uncertain. The present problem is, however, to determine whether the present channel of Red River in the region of Fargo is or is not of sufficient capacity to carry the increased run-off from drained land. If, therefore, all the assumptions be conservatively made, i. e., if every doubt be determined in favor of the present river channel, there can be little uncertainty as to the accuracy of the final conclusions if they indicate that more channel capacity than is now available must eventually be provided.

Of the 6,020 square miles of basin above Fargo, the portion requiring drainage for maximum agricultural production is probably in excess of 70 per cent. This does not mean that all of this proportion is sodden swamp but that it contains an excess of water for so long a period during the growing season that crops are not as abundant as they would be under artificial drainage. To be very conservative, it will here be assumed that only 25 per cent or about 1,500 square miles would, under drainage improvement, affect the run-off habits of the river.

Observations made of flood run-off from drained lands in the Upper Mississippi Valley, and particularly from Vermillion River Drainage District, a level piece of wet land in Illinois 128,000 acres in extent, have afforded data that can be used very well. To properly apply Vermillion River District run-off values to the basin of Red River, several variable correction factors must be applied. These factors have not been determined precisely and it will, therefore, be necessary to approximate in a conservative way. The apparent corrections include those for slope and rainfall.

Both areas are comparatively flat, as shown by the general grade of the streams. Certain river profile surveys and a general inspection of the elevations determined at many points, show that the fall in the Red River tributaries is considerably greater than that in the Vermillion country. Those portions of the Red River basin beyond the confines of the old Lake Agassiz bed are undulating and afford many steep slopes. Nevertheless, it will here be assumed that the two basins have the same slope.

The annual rainfall in the Vermillion district and indeed throughout that portion of the United States, varies widely from 25 to 50 ins. per year, with an average of about 35 ins. Storms have occurred amounting to 2.3 ins. per day. The mean rainfall for the Red River basin above Fargo is about 23 ins., or 66 per cent of that of the Vermillion. Attention should, however, be directed to the fact that the winter precipitation in the Red River basin, equivalent to from 3 to 6 ins. of water, is in the form of snow which is largely stored until spring when it is, under some circumstances, quickly melted and a large flood run-off results.

Mr. Chas. G. Elliott, M. Am. Soc. C. E., has derived, with the data in the Vermillion and other areas in that region, a run-off curve which he has carried up to 200 square miles and which is defined by the formula $C^{20} = \sqrt{M} + 3.63$, in which C equals run-off in second feet per square mile and M equals drainage area in square miles. If this formula be extended to cover 1,500 square miles a run-off of 4.15 second feet per square mile is derived. The haz-

TABLE II.

River.	Point of measurement.	Drainage area, sq. mi.	Length of record, years.	Lowest observed sec. ft.	Highest observed sec. ft.	Ratio.
Red of North	Grand Forks	25,000	11	313	32,900	1-105
Republican	Bostwick, Neb.	23,300	9	25	24,500	1-980
Colorado	Austin, Tex.	37,000	18	40	123,000	1-3075
Minnesota	Mankato, Minn.	14,600	10	89	38,700	1-435
Susquehanna	Harrisburg, Pa.	24,000	22	2,000	543,500	1-272
Potomac	Pt. of Rocks, Md.	9,650	18	680	218,700	1-320

ards involved in this broad extrapolation are fully recognized. Nevertheless, the result may be confidently accepted as a low factor in view of the small proportionate area assumed as being susceptible of drainage improvement above Fargo, and in view of other conservative assumptions made farther on. A run-off of 4.15 second feet per square mile is equivalent to .154 in. per day. If now, in view of all the doubts, a further conservative action be taken, viz., to use the factor of 0.1 in. instead of 0.154 per day, the findings will be well within the bounds of probability; 0.1 in. per day is equivalent to 2.69 second feet per square mile.

Returning now to the flood run-off of April 20, 1904, 0.032 in. per day or a little less than one-third of that above expressed: The assumption of 1,500 square miles as being affected by drainage improvements reduces the area above Fargo, which will discharge in the natural way, to 4,520 square miles. By reducing the observed flood flow accordingly and by increasing the run-off from the 1,500 according to the factor above derived, the following statement results:

Flow from 4,520 square miles at old rate..	3,920
Flow from 1,500 square miles at new rate.	4,035
Indicated flood flow at Fargo...............	7,950

The foregoing result is equivalent to 28 ft. on the Fargo gage or 1.5 ft. above the danger point at that place and assuring submergence of great areas of bordering farm lands. The author is not unmindful of the fact that there would be a flattening of the flood wave in transit to Fargo. It is not possible to determine how much this would be but, in view of the fact that the greater part of the swamp land lies toward the center of the valley, and fairly close to the main channel, and considering the liberal safety allowances that have been made in all previous assumptions, it does not appear doubtful that the channel of Red River in the Fargo region will be greatly overtaxed in the day when the rich prairie lands of Minnesota and the Dakotas are drained in the way that they deserve. Future hydrometric work in the Red River basin is necessary to determine the required capacity of channel. Until such data are available, we must stand on the apparent fact above shown.

The basin of Red Lake River, above Crookston, will now be considered. In this drainage area of 5,320 square miles, there are over 1,200,000 acres of sodden swamp lands. The greater part of the basin would be benefited agriculturally by drainage. Nevertheless, the same conservative assumption will be made for this as for that above Fargo, viz., 1,500 square miles, which, when drained and tiled, will discharge into the Red Lake River and be effective at Crookston to the extent of 0.1 in. per day or 2.69 second feet per square mile. How conservative this may be is shown by the fact that on April 15, 1906, Red Lake River at Crookston had a flood of 15,200 second feet, equivalent to 2.67 second feet per square mile. As this flood was not general over the Red River basin (the flow at Fargo reached only 2,840 second feet on April 28), the flood that crested on April 24, 1904, amounting to 13,600 second feet or 2.6 second feet per square mile, will be used in the following calculations. This corresponds to a gage height at Crookston of 20 ft. Estimating the run-off at the assumed rates, we have:

	Sq. ft.
From 3,730 square miles at 2.6 seconds feet per square mile..........................	9,700
From 1,500 square miles at 2.69 seconds feet per square mile..........................	4,035
Total	13,735

This is equivalent to a little more than 20 ft. on the Crookston gage and not greatly in excess of the actual occurrence. In order to anticipate a probable event in the Red Lake River basin, and place another unavoidable error on the safe side, it will here be assumed that swamp drainage in this basin above Crookston will not affect the regimen of the stream. Red Lake, having a surface area of 486 square miles, and a drainage area of 1,950 square miles, is an ideal reservoir site. The practicable capacity is sufficient to control all the discharge from the basin above the outlet, and a uniform flow of about 890 second feet could be maintained throughout the year. This steadying effect on the flow at Crookston will be set off against the increased flood tendencies that will arise from the uncontrolled area both above and below that point. It is readily apparent that such a reservoir at the head of Red Lake River basin could not be entirely compensatory but this fact only gives assurance to the conclusions hereinafter drawn.

The flood of April, 1904, was general all over the basin. The records at the three points above mentioned were as given in Table III.

TABLE III.

Date.	Fargo.	Crookston.	Grand Forks.
April 15..........	3,820	......	......
April 16..........	4,300	......	......
April 17........ ..	4,580	......	......
April 18..........	4,900	......	......
April 19..........	5,180	......	......
April 20..........	5,220	......	......
April 21..........	5,060	7,600	27,050
April 22..........	4,780	9,140	27,880
April 23..........	4,500	12,600	29,280
April 24..........	4,100	13,600	30,700
April 25..........	3,780	12,900	32,020
April 26..........	3,380	11,900	32,780
April 27..........	3,100	10,200	32,920

The interval between crests at Fargo and Grand Forks is seven days and between Crookston and Grand Forks is three days. The distances are 155 and 53 miles, while the slopes are 0.55 ft. and 1.1 ft. per mile, respectively.

It is evident that the Fargo crest reached Grand Forks before that from Crookston. Had they reached Grand Forks at the same time, the flood at this place would have been higher than it actually was. Therefore, if it be considered that the crests were coincident, the following calculations will err well on the side of safety.

The drainage area of Red River basin, above Grand Forks, is 25,000 square miles. Excluding Red Lake River, the artificial drainage of whose basin will, as above stated, be considered as having no effect on the flood flow at Grand Forks, the drainage area is 19,240 square miles. The basin between Fargo and Grand Forks, excluding Red Lake basin, is 13,200 square miles. How much of this area is wet and would be benefited by drainage can be determined approximately. The report of John T. Stewart above referred to, indicates that there are about 1,140 square miles on the Dakota side. Buffalo, Wild Rice and Sand Hill basins, and that portion of Red Lake basin below Crookston, have an aggregate area of 3,815 square miles, the greater part of which will ultimately be tiled drained. We have, therefore, 4,955 square miles of such land, or about 38 per cent of that lying in the basin between Fargo and the mouth of Red Lake River. It is, therefore, safe to conclude that the percentage increase in flood flow estimated for Fargo will at least obtain at Grand Forks.

The calculated increase at Fargo was from 5,220 to 7,950 or 52 per cent. High-water at Grand Forks on April 27, 1904, was 32,900 second feet, equivalent to a stage of a little more than 40 ft. on the gage. The estimate works out as follows:

Flood flow at Grand Forks........	32,900	
Less flow at Crookston............	13,600	
Flow from remainder of basin....	19,300	19,300
Add 52 per cent increase.................		10,000
Restore Crookston flow..................		13,609
Total flood at Grand Forks............		42,900

The channel of Red River at Grand Forks has not been rated to a height above 40 ft. and it is not known with certainty what would be the stage corresponding to 42,900 second feet. A fair estimate of the probabilities places the equivalent stage at 48 or 49 ft. The banks at Grand Forks are 45 ft. above the gage zero and it is apparent that a flood of the volume of that above estimated would destructively inundate great areas of country.

The country tributary to Red River below Grand Forks is similar to that above. On the North Dakota side the wet land area is 1,187 square miles. On the Minnesota side the Snake, Tamerack, and Two Rivers drain 2,638 square miles of very wet, level prairie land. The run-off from all of this country will be hastened by intensive drainage.

In the foregoing statements, the estimates have, in every case, been reduced to a figure which must, of necessity, represent a lower flood level than is likely to arise in the Red River channel as a result of final and intensive drainage. The author believes that much more serious conditions will occur than are here indicated. It is safe to assert that the richness of the Red River Valley lands will eventually insure their final drainage reclamation. It is apparent that when that day arrives Red River must be a straightened and probably a leveled stream. It will also be a stream the channel of which will be difficult of maintenance to its full capacity. Those who are familiar with the valley, and especially the engineers of the Army who, during past years have endeavored to maintain the river in a navigable condition, know that annual dredging is necessary in order to remove bar obstructions. These bars are not sedimentary but they rise from the bottom because of pressure on the banks The whole Red River valley is underlaid by a semi-fluid clay which flows under pressure. The banks of the river readily slide into the stream and if this is to be prevented, an extensive system of training walls will be necessary.

Drainage of wet lands in the Red River basin means more than the mere excavation of ditches which discharge water into the main channel. Eventually the capacity of the channel must be increased. Different state jurisdictions exist on either side of the stream and, moreover, the channel is included among the navigable waterways of the Federal Government. These conditions point inevitably to the necessity for intervention of a common authority and an apportionment of expenses for the outlet improvements to the States and to the lands finally benefited. The swamp lands in the basin of Red River of the North must finally be treated as though no State boundary were in existence.

The channel of Red River north of the Canadian boundary must eventually be included in the improvement and thus arises an international difficulty. The results will be either that, owing to constricted channel in Canada, much land south of the boundary will be deprived of suitable drainage outlets or that, if the grade is such that the United States lands can be drained, the valley north of the boundary will be grievously inundated. There can be no question that such matter must be the subject of international adjustment and because any adjustment of this kind must take into consideration all of the lands contributing to the flood conditions, the Federal Government will logically be obliged to intervene in State matters.

All that has been attempted in this article is to show that the present channel of Red River will be overtaxed under future conditions of intensive drainage. To determine the necessary capacity, hydrometric studies of unusual intensiveness will be necessary and these must cover a period of years.

Use of Wood Block for Paving in Paris.—The use of wood block paving in Paris is steadily increasing and most of the leading avenues and public places on both sides of the Seine are now paved with that material. The blocks are of pine from southwestern France, or from Norway or Sweden, or of teak, oak or beech. It is all preserved by the creosote treatment. The cost of this paving in Paris is about 23 francs ($4.44) per square meter, including the work of tearing up the old pavement. The cost of repairs averages about 40 to 60 cts. per square meter a year.

Sewage System in South Africa.—The municipality of Maritzburg is considering a project for the construction of a general system of water-bourne sewage, and for other sanitary improvements.

NEWS SECTION

Editorial Comment—Personals—Society Meetings—Trade Notes—Catalog Reviews—Contract News, Embracing Bids Asked, Work Projected, Contracts Let and Contract Prices on All Classes of Civil Engineering Construction Work.

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The Doings of the Week.

Little of importance has developed during the past week regarding prospective railroad construction. To be sure, numerous rumors have cropped out regarding important work to be undertaken this year by the larger lines. Most of these rumors, however, may be set down as "shanty house" talk. The Southern Pacific is reported to be planning to begin work in the near future on a low grade line over the Tchachap Mountain between Mojari and Kern City, Cal. The line will cost about $10,000,000 and the last right of way for it was acquired about two weeks ago. There is also a report that the directors of the Chicago, Milwaukee & St. Paul Ry. are preparing to authorize a large bond issue, the proceeds of which are to be used gradually for extensions and branch lines to the Chicago, Milwaukee & Puget Sound Ry. Something like 2,000 miles of new lines have already been surveyed in Washington and Montana.

Construction contracts let during the past few days have been few. The Boston Transit Commission has awarded the contract to the Hugh Nawn Contracting Co., 82 Savin St., Boston, for the construction of Section 4 of the Boylston St. subway. The contract price was $743,700. The Pennsylvania R. R. has let a fair sized contract for work on its C. & C. division in Cambria County, A. L. Anderson & Bros., Altoona, Pa., being the successful contractors. The Fred A. Jones Co., Dallas, Tex., has been awarded a contract for tracklaying and ballasting 125 miles of line for the Southern Traction Co. of Dallas.

A number of good sized bridge contracts have been let recently. The city of Cleveland, O., has awarded the work of constructing the land part of the substructure of the Clark Ave. viaduct to the C. H. Fath Construction Co., Citizens' Bldg., Cleveland, at $223,450; the Phee Construction & Engineering Co., Peoples Gas Bldg., Chicago, Ill., secured the contract for the river pier at $109,378. In New York City bids have been opened for a large piece of work in connection with the improvement of the Manhattan Plaza of the Manhattan bridge. William P. Seaver, 322 Fifth Ave., New York City, a new entrant into the heavy construction field, was the low bidder, at $817,380.

In the way of drainage construction the largest contract which has come up for bids appears to be the work for the Central Clay Drainage District of Piggott, Ark. The district is calling for bids until Jan. 22 for the construction of ditches and levees approximating 6,160,000 cu. yds. ditch excavation and 480,000 cu. yds. of levee embankment.

There are good prospects for a considerable amount of navigation canal construction the present year. The Commissioners of the Illinois and Michigan Canal, Lockport, Ill., are to ask the State Legislature for an appropriation of at least $500,000 for cleaning out the canal from Lockport to the mouth of the Hennepin Canal, and for other improvements. In Canada it is expected that the coming session of parliament will appropriate $3,000,000 for Georgian Bay Canal construction. This first appropriation will be sufficient to permit of the preparation of contract plans and the beginning of preliminary construction work.

Bids have been opened by the U. S. Engineer at Rock Island, Ill., on about $175,000 worth of work, for the construction and repair of dams and shore protection. The low bidders were as follows: Work between Clayton, Ia., and Cassville, Wis., $57,000 to be expended, Kirchner Contracting Co., Dubuque, Ia.; between Rock River and Fairport, Ia., $57,000 to be expended, Builders' Sand & Gravel Co., Davenport, Ia.; between Keokuk, Ia., and Canton, Mo., $61,750 to be expended, A. W. Fetter, Quincy, Ill.

Considerable interest is being manifested in the bill introduced in Congress by Senator Borah for continuing government reclamation work. The bill authorizes an additional loan of $30,000,000 to the reclamation fund on terms similar to those under which a $20,000,000 loan was made two years ago, except that this $30,000,000 may be applied either to extensions of existing projects or to eitirely new projects.

An eastern contractor, the Snare & Triest Co., 143 Liberty St., New York City, secured the contract from the city of Los Angeles, Cal., for the construction of the reinforced concrete wharf at Huntington Fill. The contract price was $444,777. A large dry dock job at Boston, Mass., is likely to come up some time this spring. The Directors of the Port of Boston have appropriated $3,000,000 for the construction of a dry dock at South Boston, capable of accommodating a ship 1,000 ft. in length and 120 ft. in breadth.

At a recent conference with Governor Wilson, the Attorney General and the State Water Supply Commission of New Jersey decided to proceed with the arrangements for the purchase of the Wharton tract for the establishment of a water supply for South Jersey municipalities. Bonds to the amount of $1,000,000 will be issued.

Road Work in 1913.

No class of construction work will offer more opportunities for contractors this year than the building of improved highways. The New York state highway commission will begin the expenditure of the additional $50,000,000 bond issue authorized last fall; California will continue the construction of its system of improved highways under the $18,000,000 bond issue; the highway authorities of Maine will have the spending of a $2,000,000 bond issue, to be provided by automobile fees, and the legislature of Pennsylvania will probably take favorable action on the proposition to issue $50,000,000 of bonds for road purposes. States such as Massachusetts, New Jersey, Connecticut, and Maryland, will continue extending their highway systems, and increased state appropriations will doubtless be allowed for the work. In the smaller political units, towns, counties and road districts, large sums of money will be expended this year for the construction of improved highways. In other states which heretofore have not taken a very active part in road building, there is much agitation for good roads bond issues. The legislature of Arizona will be petitioned to submit to the voters a proposition to issue $5,000,000 of bonds; the General Assembly of Missouri will be called upon to submit a constitutional amendment providing for a tax for permanently improved highways; and the legislature of Washington will probably be petitioned to provide $15,000,000 or $20,000,000 for improved roads throughout the state. It is safe to say that the expenditures this year on the construction of improved highways will exceed even the high water mark of 1912.

Last Year and This Year.

A pretty good little old year has been 1912. Some people call it the most prosperous 12 months this country has ever known. Business conditions have been good, crops have been more than the average, and industry has not marked time for a single moment. The steel and iron industry, the "barometer of trade," broke all records in 1912, the production of pig iron reaching 30,000,000 tons, against less than 24,000,000 tons in previous years. Foreign trade in the past year exceeds all previous records. Imports approximated $1,800,000,000 against $1,500,000,000 in 1910, the former banner year; while exports aggregate $2,400,000,000, compared with $2,093,000,000 in 1911, the former high record year. As to crops the production of wheat is estimated at 720,391,000 bu., oats at 1,417,000,000 bu., corn above 3,169,132,000 bu., and the crop of small grains at more than any previous year. In addition the cotton crop was the second largest in the history of cotton growing in the Southern States; the crops of hay and potatoes were remarkable, and the fruit crop was very satisfactory. As another proof of the good business conditions prevailing in 1912 it may be added that there were more jobs than there were laborers to fill them. Periods of hard times are not the growth of a day; their causes extend back to previous years. Even the most pessimistic of calamity howlers will admit that business was good last year. The present year has the prosperity of 1912 behind it, and there is no reason to doubt that it will not break the good time record of all previous years.

Versatility.

For a number of years F. Hopkinson Smith, engineer, contractor, author, lecturer and painter, has held undisputed title to the blue ribbon for versatility. A new claimant, however, has now entered the field. This is Frederick Arnold Kummer, a native of Baltimore, author of books worth reading, writer of plays worth seeing, and painter of pictures worth looking at. In addition Mr. Kummer is an engineer of note and something of an authority on street paving. He has written three or four books, a volume of poems, a play in which Blanche Bates starred for an entire season, and has had his paintings exhibited in the Pennsylvania Academy of Fine Arts.

PERSONAL

Mr. Edward Schildhauer, electrical engineer at the Panama Canal, sailed December 8 for the United States.

Mr. H. F. Tucker, formerly designing engineer at the Panama Canal, has opened offices in the Pioneer building, Seattle, Wash., as consulting engineer.

Mr. A. C. Janni, formerly bridge engineer of the board of public improvements of St. Louis, Mo., has opened an office in that city for consulting engineering practice.

Mr. B. A. Brackenbury has resigned as sewer engineer in the city engineer's office, Portland, Ore., and will become associated with the firm of Carstens & Earles, Lowman building, Seattle.

Mr. Richard E. Schmidt has been made architect for Cook County, Ill., succeeding Paul Gerhardt. Mr. Schmidt was the architect for the Michael Reese, Alexian Brothers and St. Anne's hospitals in Chicago.

Mr. Edward N. Hines of Detroit, Mich., will deliver an address before the Hydraulic, Sanitary and Municipal Section of the Western Society of Enginueers, Monday, Jan. 30. His topic will be "Concrete Roadways."

Mr. R. A. Polglaze, formerly connected with the water department at Tuscaloosa, Ala., was elected superintendent of the water works department at Gadsden, Ala., to succeed Major M. E. Jones who recently resigned.

Professor H. W. Riley of Cornell University, president of the American Society of Agricultural Engineers, delivered the opening address at the sixth annual meeting of the society, which began at the Great Northern Hotel, Chicago, December 26.

Mr. Francis P. Smith, chemical and consulting paving engineer of New York City, on December 20 delivered an illustrated lecture on "The Mining and Refining of Asphaltic Oils," before the graduate students in highway engineering at Columbia University.

Mr. Frank W. Black, who was city engineer of Butte, Mont., 18 years ago, and has since been engaged in railroad construction work in various parts of the United States, is now engaged by the United Fruit Co. of Guatemala to build a railroad in that country.

Mr. Archie Stanton Buyers has resigned as instructor in mechanical engineering at the University of Illinois to accept the appointment as Second Lieutenant in the Coast Artillery Corps of the United States Army, and will enter upon the duties of that office January 7.

Mr. Frank P. Shepard of the firm of Morris, Shepard & Dougherty, railway contractors, 801 Globe building, St. Paul, Minn., died at his home in St. Paul, December 24, of pneumonia. Mr. Shepard's firm is now engaged in double tracking the Pacific coast end of the Chicago, Milwaukee & St. Paul R. R.

Mr. J. H. Warder, secretary of the Western Society of Engineers, announces the annual meeting of that society, to be held January 8 and 9, 1913. The program includes an excursion to the new Northwest Station of the Commonwealth Edison Co., and a visit to the plant of the Corn Products Refining Co.'s plant at Argo, Ill.

Mr. W. D. Barclay, general manager of the eastern lines of the Canadian Northern R. R., died at Riverside, Cal., December 13. Mr. Barclay was 60 years of age, and a native of New Brunswick. He was a civil engineer and formerly general manager of the Galt road between Medicine Hat and Lethbridge, Alta. Later he became a partner in the firm of Foley Brothers, railroad contractors.

INDUSTRIAL

The American Well Works, of Aurora, Ill., have appointed Mr. J. H. Dousman, who has handled their line of material for the past four years with the Builders' Material Supply Co., as the manager of their Kansas City sales office. His territory will cover parts of Missouri, Kansas, Oklahoma and Nebraska. The branch office of the company will be located at 206 Reliance Bldg., Kansas City, Mo.

The Universal Crusher Co. of Cedar Rapids, Ia., manufacturers and patentees of the original Velten Universal Crusher, on Jan. 1 took over the entire sale and control of the line of crushers heretofore manufactured and sold by the Eureka Stone & Ore Crusher Co. of Cedar Rapids, Ia. The Universal company will continue manufacturing both lines at the Eureka plant.

CATALOGUES

Ugite.—Paper, 6x9 ins., 12 pp. The United Gas Improvement Co., Philadelphia, Pa.

This catalogue shows a number of illustrations of roads treated with Ugite. A description of the material is given.

Big-An-Little Concrete Mixer. — Paper, 20x13 ins., Folder. Jaeger Machine Co., Columbus, O.

This illustrates and describes a concrete mixer weighing 1,300 pounds, complete, with 2¼ h. p. gasoline engine. The mixer is said to make "a mix a minute."

U. S. Standard Concrete Machinery.—Paper, 6¾x9¼ ins., 12 pp. Ashland Steel Range & Manufacturing Co., Ashland, O.

Bulletin No. 21 gives complete information and illustrations describing the U. S. Standard Concrete Mixer, a continuous mixer with an automatic measuring device.

Blocks, Sheaves & Wire Rope.—Paper, 4½x9¾ ins., 40 pp. Clyde Iron Works, Duluth, Minn.

This catalogue contains illustrations with brief descriptions and tables of dimensions, weights, etc., for each type of block and sheave, and for other fittings for derricks and hoists.

Pillsbury Sprayer.—Paper, 6¼x3½ ins., 20 pp. Walter Cressy, Gloucester, Mass.

This is a "no-pump" pressure cart for spraying asphalts, tar or oil on road surfaces. Illustrations with descriptions of the machine and its operation are given. Letters from users and illustrations of work done are given.

McCoy Silo Forms.—Paper, 3½x6 ins., 8 pp. McCoy Silo Form Company, 1301 Berger Bldg., Pittsburgh, Pa.

This pamphlet shows illustrations of the construction of a silo 12 feet in diameter and 40 feet high, which was built beside a barn and was not destroyed by the fire which razed the barn. A table of prices for forms is given.

Contractors' Equipment.—Paper, 8½x5½ ins., 16 pp. The Albany Belting & Supply Co., 372 Broadway, Albany, N. Y.

This is Catalogue No. 10. It contains illustrations, specifications and prices of portable heating tanks, pouring pots, mixers for street work, portable pumps, wheelbarrows, shovels, saw mills, etc.

American Vanadium Facts.—Paper, 8x 10½ ins., 12 pp. The American Vanadium Co., 341 Vanadium Bldg., Pittsburgh, Pa.

The December number of this booklet contains an article on Heat Treated Chrome-Vanadium Steel Tires, with service records, drop tests and specifications, and other articles and information on steel springs of vanadium and of carbon steel. The articles are illustrated.

Reinforced Concrete Water Tanks.—Paper, 6x9 ins., 12 pp. Steel Concrete Construction Co., 1301 Berger Bldg., Pittsburgh, Pa.

This catalogue illustrates and describes water tanks built for railway purposes. The tank built at Sir John's Run, W. Va., is illustrated by views and drawings.

Blystone Batch Mixer.—Paper, 6x9 ins., 24 pp. Blystone Machinery Co., Cambridge Springs, Pa.

This catalogue illustrates and describes a one-bag batch mixer operated by a two-horsepower gasoline engine. The details of the machine are completely illustrated, and specifications are given.

Watson Wagons.—Paper, 6x9 ins., 8 pp. Watson Wagon Co., Canastota, N. Y.

This catalogue deals particularly with the stub pole coupling attachment for hauling Watson bottom dump wagons in trains. Descriptions of several jobs are given with illustrations showing economical methods of hauling.

Amiesite.—Paper, 7¼x8¼ ins., 28 pp. Amies Road Company, Drake Bldg., Easton, Pa.

This catalogue contains a description of a bituminous binder and shows illustrations of various roads which have been treated. Cross-sections of road construction are also shown.

Concrete Stone Manufacture.—Paper, 8x 11 ins., 16 pp. Jaeger Machine Co., Columbus, O.

This catalogue describes a method of concrete stone manufacture by the Jaeger-Keny Hydraulic System. Illustrations of building construction are given, with views of stone work showing the effects of various finishes. The catalogue shows and explains the machine and the company's plan of installation.

Pumps.—Paper, 9¼x6¼ ins., 48 pp. Advance Pump & Compressor Co., Battle Creek, Mich.

This catalogue comprises a set of bulletins giving illustrations, descriptions and tables of sizes, weights, etc., for pumps of various purposes.

An accompanying bulletin gives complete descriptions and illustrations of centrifugal pumps of various types for irrigation work and for contractors' use.

Coltrin Concrete Mixer.—Paper, 6x9 ins., 48 pp. The Knickerbocker Co., Jackson, Mich.

The new catalogue which illustrates and describes the 1913 Coltrin Mixer shows practically the same construction of mixer that characterizes the 1912 machine, but with a number of refinements such as strengthened or improved parts. Complete illustrations of the details of the machine, which has an automatic feeding device, are shown. A number of views of construction and letters from contractors are given.

Trus-Con Handbook.—Paper, 5¼x7¾ ins., 96 pp. Trussed Concrete Steel Co., Detroit, Mich.

This is a revised edition of the complete handbook issued by this company. It contains many important additions and improvements. A number of new specifications treating of special conditions, many illustrations of important installations and applications have been added. The subject matter on Trus-Con Water Proofing Concentrated is practically all new and contains comparative absorption tests on this product. A section has been added on the texture of cement floors, illustrated with photographs taken through microscopes showing various conditions of floors. A description of Trus-Con Ironite Flooring is also given. Tables of water pressure and on concrete and mortar mixtures are included.

RAILWAYS

Alabama.

The Seaboard Air Line Ry. is considering a proposition for building an extension from Wellington to Gadsden.

Good progress has been made toward the financing and preparations for the construction of the projected road of the Peoples R. R. Co. This company proposes a line from Fairhope on Mobile Bay, through Silverhill to Robertsdale on the Bay Minette & Fort Morgan branch of the Louisville & Nashville R. R. The estimated cost of the road, including equipment, is $119,000. E. B. Gaston, Fairhope, Ala., is President; T. W. Nicol, Mobile, Ala., is Consulting Engineer.

Arkansas.

The Pine Bluff, Sheridan & Southern R. R., now completing a 16-mile extension out of Sheridan, is reported to be considering building a further extension from Sheridan to Little Rock, a distance of 27 miles. E. S. McCarty, New Madrid, Mo., is President.

John H. Page, Commissioner of Mines, Little Rock, Ark., is to present a resolution to the Penitentiary Board this month, asking for the use of convicts for the construction of a 4-mile railroad from the State farm to Varner.

California

Extensive improvements on the Southern Pacific branch line between Folsom and Placerville, Calif., are contemplated this year. According to the report received, 90-lb. steel will be installed.

The Southern Pacific R. R., W. Hood, Chief Engineer, San Francisco, Cal., is stated to have acquired the last right of way for a low grade line over the Tehachapi Mountain between Mojari and Kern City, and it is said that construction work on the line, which will cost about $10,000,000, will be begun in the near future.

The Clear Lake R. R. Co., projecting a 44-mile line via Highland Springs, Big Valley and Kelseyville, has completed surveys and disposed of $150,000 of stock. Seven miles of the line have been completed by company forces, and contract for the remainder will be let soon. L. H. Baggs, Lakeport, Cal., is President, and C. R. Rankin, Hopland, Cal., is Chief Engineer.

The Calaveras Copper Co., J. H. Trerise, Superintendent, Copperopolis, Cal., proposes the construction of an electric railway connecting its mines with another road into Stockton. The line will be about 16 miles long and will cost about $200,000. It is to be in operation by next August. Charles M. Hayden, Boston, Mass., is President of the copper company.

The San Pedro, Los Angeles & Salt Lake R. R., E. G. Tilton, Chief Engineer, Los Angeles, Cal., is to make a survey for a line from Daggett to Riverside. The company at present uses the tracks of the Santa Fe system between these two points.

Colorado.

The Denver, Colorado Springs & Pueblo R. R. Co. has been incorporated to construct a line between the cities named.

Connecticut.

The Connecticut Co., New Haven, Conn., is contemplating the following work on its electric railway system: An extension through Camp St. in Stamford from the company's terminus to the west side of the New Haven Co.'s New Canaan branch; an extension in Torrington to the Driving park; a line from Plainfield to Almyville; a series of extensions and loops at Yale field, New Haven, and a line in Hamden to Pine Rock.

The Connecticut Railway & Lighting Co., Bridgeport, Conn., a subsidiary of the Connecticut Co., is planning a number of extensions in Norwalk, South Norwalk, New Britain, Berlin and Arsonia and a line from Bridgeport to the village of Nichols. The company will also ask the State legislature for revival of rights to build northward from Milford to the tracks of the New Haven & Derby trolley line.

Application is to be made to the State Legislature for a charter for a street railway to extend from Danbury to New Milford. Saunders & Jones, controlling the Danbury & Bethel Street Ry. Co., of Danbury, and the proposed Bridgeport & Danbury Electric Ry., are reported to be interested in the new line.

Florida.

The Pinellas Way Co., of St. Petersburg, Fla., has secured the rails and will commence work in the near future on the construction of its line.

Application has been made to the City Council of St. Augustine, Fla., for a franchise to construct and operate a new electric railway into and through certain streets of the city. It is proposed to construct the line from Jacksonville to St. Augustine, and to erect the power station in the latter city. T. R. Osmond, St. Augustine, Secretary and General Manager of the St. Johns Light & Power Co., operating 10 miles of electric railway at St. Augustine, is interested.

Georgia.

The Central of Georgia Railway, according to information received from Macon, Ga., has purchased two acres of land on the Waterville road to be used as switching yards. This, it is said, is the first step toward the construction of the proposed $1,500,000 depot to be erected at that place by the C. of G. Ry.

Preliminary surveys are under way for the projected line of the Americus, Tifton & Atlantic R. R. The survey has been completed to Milltown, the present southern terminal. The distance from Tifton to Nashville, the county seat of Berrien, by the survey is 23 miles. The distance from Nashville to Milltown will be about 15 miles, making the total distance from Tifton to Milltown about 38 miles. John W. Greer, Tifton, Ga., is secretary.

Illinois.

The Springfield & Central Illinois Traction Co., of Springfield, Ill., has been incorporated with a capital stock of $20,000, and proposes to operate electric lines connecting Springfield, Nashville, Carlyle, Centralia, Coffeen, Mount Carmel and East St. Louis. The incorporators are Isaac A. Smith, St. Louis, Mo.; George W. White, A. C. Skillman, Arthur H. Cox, Noble E. McMillian and Alfred L. Lynch.

The Chicago, Milwaukee & St. Paul Ry. is understood to be preparing to authorize a large bond issue, the proceeds of which are to be used gradually for extensions and branch lines to the Chicago, Milwaukee & Puget Sound Ry. Something like 2,000 miles of new lines have already been surveyed in Washington and Montana and within a few years portions of the Puget Sound line must be double tracked to meet the demands of the movement of forest products by rail now getting started. The proposed large bond issue can be more advantageously marketed if it covers the entire St. Paul system, especially since the old road must guarantee any bond issue covering coast extensions alone.

Indiana.

It is reported at Evansville that the Tennessee Central R. R., L. F. Lonnbladth, Chief Engineer, Nashville, Tenn., will soon apply to the City Council for a franchise to enter the city. The Tennessee Central is understood to be planning to build from Hopkinsville, Ky., through Providence to Owensboro, Ky., and it is now stated that it is the intention of the company to extend the line from Owensboro to Evansville The plan proposes bridging the Ohio River nine miles above Evansville, where the Illinois Central railroad for several years operated a transfer boat.

Kansas.

The Anthony & Northern Ry. Co., which, as mentioned in our issue of Dec. 18, was incorporated in Kansas to construct a line through Harper, Pratt and Stafford Counties, has received authority from the State Board of Railway Commissioners to issue stocks and bonds. R. A. Cox, Hutchinson, Kan., is one of the promoters.

A movement has been started at Dodge City, Kan., to revive the projected Omaha, Dodge City & Southern Ry., surveys for which were made about 30 years ago.

Louisiana.

Residents in the eastern parts of Allen and Jefferson Davis Parishes, La., are interested in the proposition to construct a railroad connecting Oberlin and Jennings, La.

It is reported at Lake Charles that the St. Louis & San Francisco R. R. will enter that city over its own tracks by building from Kinder, 25 miles north.

Massachusetts.

⦿Bids as follows were received Dec. 24 by the Boston Transit Commission, 15 Beacon St., Boston, Mass., for constructing Sec. 4 of the Boylston St. subway: Hugh Nawn Contracting Co., 82 Savin St., Boston, $743,700 (awarded contract); Patrick McGovern, $750,050; Coleman Bros., $751,100; Coughlan & Sheils Co., $761,275; W. H. Keyes & Co., $927,945. The contract embraces a section about 1,790 ft. long, and extends easterly under Boylston St. from the end of section three, or to about 85 ft. east of Berkeley St. Along Boylston St. the average depth of the roof of the subway below the surface of the street is about 7 ft.

The Bristol & Norfolk Street Ry. Co., Henry A. Belcher, President, Randolph, Mass., is reported to be planning to build a street car line from Postoffice Sq., Holbrook, to the railroad station.

Bids will be asked soon by the Boston Transit Commission, B. Leighton Beal, Secretary, 15 Beacon St., Boston, Mass., for constructing Sec. 3 of the Dorchester subway. This will include a station in Summer St. extending from near Washington St. to Arch St. Passageways will connect each platform of this station with both the Summer and Winter stations of the present Washington St. tunnel. The portion of this tunnel under Fort Point channel will necessarily be constructed by means of a shield and compressed air.

Michigan.

It has been suggested by Mayor Joseph Zief, Ludington, Mich., that $42,000 raised to be given as bonuses to factories be transferred to a bonus fund for the Butters R. R. which is building through Ludington to Grand Rapids.

The Thumb Survey Co. has been incorporated in Michigan for the purpose of doing the preliminary work in connection with the proposed railroad from Detroit to Bad Axe. William Tait and Dudley W. Abbott, Detroit, Mich., are officers. The company is capitalized at $10,000 of which $5,000 has already been paid in. According to statements in the application the line will run through Grosse Pointe, Mt. Clemens, Armada, Berville, Capac, Brown City, Stover, Argyle and Ubly.

Local committees have been appointed in each of the nine cities and villages and the 24 townships along the western route of the proposed Muskegon & Manistee Interurban Ry., and the soliciting of subscriptions for the $280,000 bonus will be started next week. It is expected that the full amount will be pledged by March 1, and that construction work can be started in the spring. Sidney M. Wiel, Chicago, Ill., is the promoter.

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

Minnesota.

The Interstate Transfer Ry., the belt line which will connect the steel plant with the dock sites of Allouez Bay, will commence shortly the improvement of its yard site at Pokegama Junction. The size of the yards has not yet been definitely determined, as this will depend entirely on the amount of traffic to be handled. If the yards are not large enough they will be enlarged as more space is required. The location of the roundhouse, shops and terminal buildings of the belt line system has not yet been decided. It has been generally understood that they would be located at Pokegama Junction, but according to H. L. Dresser, Duluth, Minn., Chief Engineer of the Belt Line, a site at Allouez Bay is also under serious consideration. Each site has its advantages and these will all be taken into consideration before the location of the terminal buildings is finally decided upon.

The Chicago, Milwaukee & St. Paul Ry. has announced that it is willing to proceed at once with the elevation of its tracks from the passenger station on Third Ave., S., to the shops in South Minneapolis, Minn., providing the City Council of Mineapolis, Minn., orders the improvement. A. D. Emery, Minneapolis, is Assistant District Engineer of the Milwaukee R. R.

Missouri.

It is reported that $90,000 of bonds were subscribed for the proposed Leonard branch of the Shelby County R. R., and that prospects are good for the beginning of construction work in the spring. J. C. Houck, Shelbyville, Mo., is General Manager.

Montana.

Guthrie & Co., St. Paul, Minn., who were recently awarded the contract for the construction of the first 32 miles of the Great Northern line east of Lewistown, Mont., as mentioned in ENGINEERING & CONTRACTING, Dec. 11, are organizing forces and expect to start work immediately on the tunnels included in the contract.

It is rumored that the Great Northern Ry. Co. contemplates the operation of its new line—the Montana & Eastern Ry.—from Lewistown, Mont., to New Rockford, N. Dak., by electricity. A portion of this new road is to be constructed shortly, the contract having been let to A. Guthrie & Co., St. Paul, Minn.

Nebraska.

Three surveys have been made by engineers of the Union Pacific Ry. for the construction of the proposed Holmesville cutoff and it is expected that actual construction work will be completed this winter. The new cutoff will avoid the Rock Cut along the Blue River, near Holmesville, Neb. R. L. Huntley, Omaha, Neb., is Chief Engineer and Assistant General Manager.

The Midland Continental R. R. Co. of Nebraska has been incorporated with a capital stock of $250,000 and proposes a line from Boyd County to Smith Center, Kan. The new company is a part of the plan for building a railroad from Canada to the Gulf. The Midland Continental R. R. Co. of North Dakota, which will form a link of the line, already has 50 miles of road in operation, and recently let contracts for additional construction. The incorporators of the Midland Continental R. R. of Nebraska are: Herbert S. Duncombe, Chicago, Ill.; James D. Small, Chicago; W. E. Jenkins, Chicago; E. J. Moline, Chicago; Edmund G. McGilton and Frank H. Gaines, Omaha.

Nevada.

The Southern Pacific Ry. has been running preliminary surveys for a branch line north from Basalt over the Cortez Mountain and down Smokey Valley to a connection with the main line at a point just west of Palisade.

New Jersey.

The New York & Long Branch R. R., G. V. Sneden, Engineer Maintenance of Way, Long Branch, N. J., has secured right of way in Sayreville and is understood to be planning to build a spur into that township.

The Monmouth County Electric Co., Red Bank, N. J., has signified its willingness to extend its present trolley system from Rumson to Seabright, provided the residents of Seabright would obtain the necessary rights of way through the streets. The extension would be about one mile long.

New York.

The Belt Line Ry. Co., a new company organized for the purpose of taking over the property of the Central Park, North & East River R. R. Co., New York City, purchased at foreclosure sale last month by Edward Cornell, as noted previously in this column, has applied to the Public Service Commission for permission to issue its first mortgage 5 per cent gold bonds, maturing in forty years, in the sum of $2,200,000 par value, and also $200,000 par value in capital stock. Edward Cornell, New York City, is President of the new company.

The Public Service Commission for the First District has been holding conferences with representatives of the Interborough Rapid Transit Co. and those of the Brooklyn Rapid Transit Co. for the purpose of completing the contracts for the operation of the dual system of rapid transit in New York City, so that the statutory hearing on the forms of contracts may be held as soon as possible. These contracts were prepared by counsel to the commission last September, and since that time the representatives of the companies concerned and the commission have been carefully going over details of the instruments and harmonizing points of difference between the city and the corporations. It is expected that the contracts will be so far perfected that the commission this week can adopt a resolution calling for a public hearing. Two weeks' notice by advertisement must be given of such hearing, after which the contracts will be put in permanent form and forwarded to the Board of Estimate and Apportionment for its approval. The contracts will involve the expenditure by the city and the companies for the construction and equipment of the new lines amounting to more than $300,000,000.

North Carolina.

The Virginia & Eastern Carolina Ry. has about completed surveys for a 64-mile line from Henderson, N. C., to Wilson, N. C., and possibly will let construction contracts in about 60 days. J. C. Cruikshank, Spring Hope, N. C., is Chief Engineer, and J. M. Turner, Raleigh, N. C., is President.

North Dakota.

Engineers of the Great Northern have been working in the vicinity of Marmarth, N. Dak., on the surveys for the proposed Wadena cutoff through that vicinity. A. H. Hogeland, St. Paul, Minn., is Chief Engineer.

Ohio.

Advices from Coshocton, O., state that engineers are at work on surveys and maps of the route for the proposed railroad from Birds Run to Morgan Run. The new line is to carry coal from the Cambridge field, and it is expected it will be ready for operation next summer.

Oklahoma.

The Missouri, Kansas & Texas R. R. is reported to be planning to take over the Clinton & Oklahoma & Western R. R., a 50-mile line running from Clinton to Strong City, Okla. An extension from the latter place to Cheyenne is now being built under the name of Cheyenne Short Line.

Oregon.

The Oregon Pacific & Eastern Ry., projecting a 100-mile line from Cottage Grove, Ore., to Winchester Bay, has made part of its survey. No decision has been reached as to when construction contracts will be placed. The engineering work is being done under the direction of A. B. Wood, General Manager, Cottage Grove, Ore. G. B. Hengen, Chicago, Ill., is President.

The citizens of Grants Pass, Ore., have voted a bond issue of $200,000 toward the construction of the first section of the Pacific Interior R. R., a 100-mile line projected to connect Grants Pass with Crescent City, Cal. It is stated that $750,000 has already been subscribed and that construction work will be started early this year. Dr. J. F. Reddy, Medford, Ore., is interested.

Steps are being taken for uniting the interests of a number of lumber companies operating in Clatsop County. One of the results will be the construction of a 21-mile logging railroad extending from a point on the Columbia River about one mile below Wood's Landing, between that place and Westport, over the ridge and to the Nehalem River. Surveys for this road have been completed and it is possible that construction work will be started this month. The proposed road is to be of first-class construction, with a maximum grade of 2 per cent. In order to secure this grade the line will be nine miles long before reaching the crest of the divide. A. S. Kerry, Seattle, Wash., is interested.

Pennsylvania.

⊙A. L. Anderson & Bros., Altoona, Pa., have been awarded a contract by the Pennsylvania R. R. for improvements in Cambria County, which will probably call for the expenditure of about $140,000. The work includes the relocation of about two miles of line between Ebensburg and Winterset on the C. & C. Division.

The Pottstown & Reading Street Ry. Co., Pottstown, Pa., is planning three extensions in Phoenixville, as follows: Beginning at intersection of Main St. and Nutt's Ave. to Buchanan St. to Bridge St. Beginning at Bridge and Church St., to Star St. to Fifth St., to B St., to Fourth St., to Gay St., to Washington Ave. Beginning at Nutt's Ave. and Bridge St. to First Ave., to Lincoln Ave., to Second Ave., to Ellis Ave., to Washington Ave.

It is rumored that the Northern Central Ry. (Pennsylvania Lines), J. W. Nichol, Williamsport, Pa., Assistant Engineer, is planning to construct a low-grade freight line from Selinsgrove, Snyder County, Pa., to Aqueduct, Perry County, along the west shore of the Susquehanna River, following the old Pennsylvania Canal bed. A company known as the Northern Central Connecting Co. was chartered in 1906 to construct and operate a line over the above route but nothing further was ever done.

Plans are under way by engineers of the Pittsburgh & Lake Erie R. R. for the railroad shops and power house to be built at Dickerson Run, Pa., by the company. The power house will measure 60x70 ft., the roundhouse 100x600 ft. and the machine shops 60x130 ft. A storage building may also be erected. Details of the work will be ready in the spring.

South Dakota.

The Commercial Club of Sioux City, Ia., and Rapid City, S. Dak., have under consideration a plank to have the Chicago, Milwaukee & Puget Sound Ry. extend its line north from Rapid City to Marmount, N. Dak., giving Sioux City an outlet to the Pacific Coast.

The Fairmount & Veblen Ry. Co. has been incorporated with a capital stock of $25,000 and headquarters at Veblen, S. Dak. The company proposes the construction of a railway 50 miles in length from Fairmount, N. Dak., to Veblen, S. D., at a cost of $500,000, through the counties of Richland, Roberts, and Marshall. The incorporators are Julius Rosholt, L. R. Rosholt, C. A. Paulson, Minneapolis, Minn.; George H. Anderson and P. J. Hanson, Veblen, S. Dak.

Tennessee.

Advices from Nashville state that the Tennessee, Kentucky & Northern R. R., H. Adkins, Chief Engineer, Livingston, Tenn., will extend its line so as to secure an entrance to Nashville. The line will connect the Tennessee Central with the Cincinnati, New Orleans & Texas Pacific at Stearns, Ky., and with the Nashville, Chattanooga & St. Louis at Sparta, Tenn.

Texas.

⊙Southern Engineering & Construction Co., Luther Dean, Chief Engineer, Dallas, Tex., has awarded a subcontract to The Fred A. Jones Co., Dallas, Tex., for laying and ballasting about 120 miles of track for the Southern Traction Co. The contract is for track between Dallas and Corsicana, Tex., and between Waxahachie and Waco, Tex.

Citizens of San Antonio have raised the $50,000 bonus necessary to secure the construction of a railroad connecting that city with Fredericksburg.

The Kansas City, Mexico & Orient Ry. is pushing construction work west of San Angelo, Tex., and the line is now operating into Fort Stockton. The company will extend from Alpine into Mexico to connect with its Mexico line to Topolobambo. N. J. O'Brien, San Angelo, Tex., is General Manager of the lines in Texas.

It is reported that the El Paso & Southwestern R. R. is planning the construction of a new line from Tyrone to White Water, where it will connect with the Atchison, Topeka, Santa Fe. A line may be extended to the Phelps-Dodge operations at Fierro and Hanover. H. S. Stansbury, Tucumcari, N. Mex., is Assistant Engineer.

Track material is being received at Texas City for the proposed street railway to be built at that place by the Texas City Street Ry. Co., incorporated recently with a capital stock of $60,090.

The Missouri, Kansas & Texas Ry., A. M. Acheson, Chief Engineer, Dallas, Tex., is understood to be planning to have work started early this year on the 12-mile cut-off from Hillsboro to Whitney, where a connection will be made with the Texas Central Ry.

The construction of an interurban line out of San Benito for a distance of 30 miles is contemplated by Sam. A. Robertson, San Benito, President of the San Benito & Rio Grande R. R.

The Southwestern Ry., A. C. Parks, General Manager, Henrietta, Tex., contemplates holding an extension northwest from Arden City. Nothing in the way of a definite route or plans will be announced before May or June, 1913.

The Commissioners of Jefferson County have granted a franchise to the Jefferson County Traction Co. for an electric interurban connecting Beaumont and Port Arthur. This company, as noted in our last issue, is a Stone & Webster project. C. W. Kellogg, Jr., Dallas, Tex., represented Stone & Webster in the franchise application.

The Alderson-Stille-Force Co., real estate dealers, Houston, Tex., will start work shortly on an electric car line to the Houston Harbor Addition of Houston. The Houston Electric Co. will operate the line.

The Missouri, Kansas & Texas Ry., A. M. Acheson, Chief Engineer, Dallas, Tex., will probably have work started in the near future on the enlargement of its freight yards in and near Houston.

Utah.

The City Commission of Provo has granted a franchise for a right of way over certain streets to John McGinnis, Thaddeus S. Lane, W. C. Alexander and C. W. Hamer, for the construction and operation of an interurban electric railroad. The franchise is for 50 years and 25 miles of the road is to be built and in operation within 18 months.

Virginia.

The Interstate R. R., A. H. Reeder, General Manager, Big Stone Gap, Va., is reported to be planning an extension to tap coal lands in Wise County, Va. It is probable that if this extension is built the Pound River Coal Corp., T. J. Crumley, Secretary, Gate City, Va., will begin development work on its coal lands, eight miles from Glamorgan.

Washington.

The Oregon-Washington Railroad & Navigation Co., J. R. Holman, Assistant General Manager, Seattle, Wash., will probably expend about $1,000,000 for improvements in Spokane in the district from Monroe to Center Sts., and between Front Ave. and the Spokane River. The improvements include a $350,000 union depot.

Grant Smith & Co., Spokane, Wash., who, as mentioned some time ago in ENGINEERING & CONTRACTING, were awarded the contract for grading the new line of the Kettle Valley, report that good progress is being made. The grading is unusually heavy and warehouses have been established all along the right of way by the contractors.

The North Yakima & Valley Ry., J. C. Roth, Superintendent, North Yakima, is to extend its line this summer 10 miles to the Village of Tieton in the Yakima Reclamation Project.

The Chicago, Milwaukee & Puget Sound Ry., E. O. Reeder, Chief Engineer, Seattle, Wash., has plans under way and construction work will probably be started in March on the switching and storage yards to be built on the tide flats at Toerma. About 35 tracks are to be laid and the work will call for about 300,000 cu. yds. of fill. It is probable that suction dredges will be used for making the fill.

The Walla Walla Valley Ry. Co., C. S. Walters, General Manager, Walla Walla, is to expend about $150,000 for improvements this year in the Walla Walla Valley. These include the construction of tracks in Walla Walla and Milton, new cars, paving of the right of way over Clinton and Whitman Sts. and College Ave., Walla Walla; new freight locomotive sheds, reconstruction of substation, new passenger station at Freewater and a mile extension of the Prospect Heights line as the first step to building a loop through the foothill and Russell creek districts, connecting with the East Walla Walla line. In addition the company may build the 10-mile Vincent extensions at a cost of $220,000.

Executive instruction has been issued to prepare right of way maps for a branch line from the Yakima Division of the Oregon-Washington Railroad & Navigation Co. through Hanford and White Bluffs. The company plans to immediately acquire the right of way for this branch, embracing about 28 miles. It has not yet been decided when construction will begin.

Track laying upon that part of the Spokane-Ayer Junction Cut-off of the Oregon-Washington R. R. & N. Co., between Spokane and the crossing of Snake River, embracing about 97 miles, is just now being finished and ballasting is well under way. Laying of track from Snake River crossing to Ayer Junction, about 7 miles, will be delayed until the Snake River crossing structure is completed. The material of the structure is steel with concrete foundations; its length is 4,070 ft. and maximum height above the river 285 ft. In design it consists of deck spans supported by towers with viaduct approaches. In round figures 8,000 tons of steel are required for the bridge. It is expected that the bridge will be completed about May 15, 1913.

Wisconsin.

Citizens of Bloomington, Wis., will vote soon on accepting proposition of Chicago Short Line Ry. Co. for constructing a line through the town. This company proposes the construction of an electric belt line railway in Western Grant County, and also plans to build from Lancaster, Wis., to Stockton, Ill. Joseph T. Bennett, Lancaster, Wis., is President.

Canada.

The Alberta Interurban Ry. Co., projecting 1,200 miles of line radiating out of Calgary, Alberta, has completed surveys for 100 miles of the road, and has let contracts for 70 miles of this to Land Traction Co., Calgary. W. C. Ferguson, 28 Elm Block, Calgary, is Chief Engineer, and K. J. C. Finck, Box 394, Calgary, is Vice President and General Manager.

The Northern Ontario Ry. Co. is to apply to parliament for an act increasing the bonding power of the company.

According to the annual report of the Chief Engineer of the Grand Trunk Pacific Ry., issued under date of Dec. 20, construction in 1912 was undertaken on 568 miles of main line and on 683 miles on branch lines, making a total of 1,251 miles of line on which clearing, grading and tracklaying was done. Track was laid on 128 miles of main line and 331 miles of branch lines, making a total of 459 miles of railway completed exclusive of second tracks and sidings. The status of some of the sections of the road is as follows: On the section known as "Main Line Winnipeg West," grade is now completed to Mile 1,124 (Rau Shuswap Crossing, and track should be laid to that point before the close of the year. The line is in operation from Winnipeg to Tete Jaune Cache, Mile 1,095. From the Rau Shuswap Crossing at Mile 1,124, westerly to Mile 1,403 (Endako River Crossing), the right of way is being cleared and at those points where clearing has been completed, active grading operations are under way. For instance, the grade from Rau Shuswap Crossing to the second crossing of the Fraser River at Mile 1,190, should permit of tracklaying in the space of a month or two. From Prince Rupert easterly the track is laid to Mile 189, being held up at that point owing to the erection of steel bridges. Eighty-nine miles of this track were laid during 1912, and the line is in operation to Hazelton. From Mile 189 to the Endako River Crossing (Mile 341 Prince Rupert, or Mile 1,403 Winnipeg), active grading operations are in progress. The report of the Chief Engineer on the progress of the branch lines of the Grand Trunk Pacific includes the following: Harte to Brandon—Grading is under way on this branch and although 10.8 miles are ready for track no steel has yet been laid. The total length of this branch is 25 miles. Regina to International boundary—Only the last 19 miles of this line require to be graded. The track is laid for 106 miles and was all put down this season. Prince Albert Branch—This line extends from Young on the main line, and is in operation from that point to Wakaw, a distance of 67 miles. No track was laid in 1912. A large steel bridge has yet to be erected over the South Saskatchewan River, but with the exception of the entrance into Prince Albert the grade is practically completed. Tofied to Calgary—This line is 202 miles long. A few steel bridges have yet to be erected, but grading is almost completed. During 1912 steel was laid from Mile 107 to Mile 165.3, and the track will be continued to Calgary in the early spring of 1913. The line is in operation to Mile 162. Other branch lines reported upon are the Talmage-Weyburn line, 15 miles in length, of which 39 per cent of the grade is completed; and the Regina-Moose Jaw connection of 49 miles, which is now completed, and its terminals at Moose Jaw in course of construction. Grading is completed, and Moose Jaw Northwest branch, but no steel has been laid. All the track on the Oban-Battleford branch was laid during 1912, and the line, 48.5 miles in length, is now complete. The Cut Knife branch, from Battleford westerly toward Wainwright, is finished so far as grading is concerned, and 4 miles of track are laid. Steel will be laid throughout its length in the early spring of 1913. A branch line is surveyed from Biggar to Calgary, but it is stated by the Chief Engineer that for the present this line is only being constructed as far as the Saskatchewan-Alberta boundary, a distance of 104 miles from Biggar. Grading on this portion was completed in 1912, and steel is laid to Mile 37. The Alberta coal branch, which extends 56 miles southerly from Bickerdike on the main line, is graded for the whole of its present length.

ROADS AND STREETS

Alabama.

The City Commission of Birmingham, Ala., has passed street pavement improvement ordinances representing an expenditure of about $75,000. The improvements call for 50,000 sq. yds. of pavement for various sections of the city. Bids will be asked shortly.

Arizona.

✣Bids will be received until 5 p. m., Jan. 13, by Frank Thomas, City Recorder, Phoenix, Ariz., for 24,000 sq. yds. of bitulithic pavement, 9,000 lin. ft. of curb and gutter and a syphon flume across Central Ave. at the Salt River Canal. Plans and specifications may be had on application to F. N. Holmquist, City Engineer, at $5 per set. All proposals must be accompanied by a bond of not less than 10 per cent of the aggregate proposals, payable to Lloyd B. Christy, Mayor. Six per cent ten-year serial bonds will be issued in payment for the above street work. V. A. Thompson, Supt. of Streets of the City of Phoenix.

California.

⊙The city of Pasadena, Calif., has awarded the contract for improving a part of Walnut St. to J. E. Haddock at $7,080, and a contract for improving Pleasant St. to The Baldwin Construction Co., at $1,020.

⊙The Board of Public Works of Los Angeles, Calif., has awarded to the Barber Asphalt Paving Co. the contract for the paving and storm drain in Sunset Blvd. from Normandie Ave. to Hollywood Blvd., at $74,564. The work is to be completed in 180 days.

⊙The California State Highway Commission, Sacramento, has awarded a contract for furnishing and delivering crushed rock to be used in the construction of the state highway to the Natomas Consolidated of California. The contract calls for 500,000 tons of rock from the company's plants at Oroville, Natoma and Fair Oaks.

⊙John Hannafin of Fresno, Calif., has been awarded the contract for the grading of 19½ miles of streets of the new town of Biola, near Fresno, at about $60,000.

City Engineer Homer Hamlin of Los Angeles, Calif., has recommended to the Board of Public Works that an 8-ft. cement walk be constructed along each side of Sunset Blvd. between Main St. and Marion Ave., except in the following cases: That a 13½-ft. walk be constructed on each side of the boulevard from Main to New High Sts. and from Centennial to Beaudry the walks be 6 ft. in width. This improvement is to be carried on in connection with the proceedings to change the grade from Hill to Marion Ave.

The City Trustees of Visalia, Calif., have ordered the paving, curbing, oiling and grading of West Center and South Garden Sts. The former will be graded and oiled, while South Garden will be paved with Acequia to the south line of the Washington grammar school.

At a recent meeting of the Sonoma County Development Association at the courthouse in Santa Rosa, Calif., it was decided to ask the Board of Supervisors at the January meeting to appoint a highway commission to investigate the feasibility of bonding the county for building good roads.

The Town Trustees of Mayfield, Calif., have approved the plans and specifications for paving Main St.

F. G. Wrightson, Superintendent of Streets and Deputy City Engineer, Sacramento, Calif., is working out the plan called for by the commission, by which it will know what sort of pavement will be built upon certain streets.

Engineer H. A. Kuchmsted of National City, Cal., has prepared plans for the construction of 40 blocks of asphalt and decomposed granite wearing surfaces at an estimated cost of $81,000. The pavement will be laid on a 5-in. concrete foundation and will require 6,000 cu. yds. of excavation. No curb required. Contracts will be let in March or April. H. I. Atwater is Superintendent of Streets.

City Engineer Karl F. Tuttle of San Bernardino, Cal., is preparing plans for the construction of three miles of oiled macadam pavement on a 5-in. lime rock foundation, at an estimated cost of $45,000. No. 1 filler will be used—⅜-in. to dust lime rock. About 5,000 cu. yds. of excavation will be required. Contracts will be let about April.

Colorado.

The Board of Public Works of Denver, Colo., the Tramway Co., and the Union Pacific railroad have approved plans for the paving of Wynkoop St., from Cherry Creek to 19th St. with sandstone blocks.

Florida.

The city of St. Petersburg, Fla., is having plans made to annex to the city a strip of land one mile wide and 6 miles long, so that a brick road can be built extending from Tampa Bay on the east to Boca Ceiga Bay on the west.

The citizens of Pinellas County, Fla., recently voted the issuance of bonds to the amount of $370,000 for the construction of good roads. Clearwater is the county seat.

Georgia.

The Finance Committee of the City Council, Atlanta, Ga., will be asked at its January meeting to recommend the extension of Spring St., from 14th St. to Peachtree St., and the regrading of West Peachtree St.

Illinois.

The Board of Local Improvements of East St. Louis, Ill., has announced that the improvement of State St., from 34th to 89th Sts., will start by Jan. 15. City Engineer Ed. F. Harper has estimated the cost at $320,000.

The Board of Local Improvements of Waukegan, Ill., has passed resolutions for improvements in the way of paving to the extent of $93,800. The proposed improvements are as follows: Washington St., from West St. to the city limits with brick, at about $47,400; a system of streets, Ash St., from Grand Ave. to Seward; Julian, from North St. to Ash St.; Hickory St., from Grand Ave. to Julian; Seward, from Ash St. to Williams, to be paved with asphaltic concrete at about $35,800. Second system of streets, St. James St., from Glen Rock to Clayton, to be paved with creosoted wood blocks at an estimated cost of $10,600.

The Board of Local Improvements of Galesburg, Ill., has been petitioned to pave Lincoln St.

The city of Bloomington, Ill., has ordered the construction of brick pavement on East Washington St., from Main St. east. Poston block, concrete foundation and concrete curb will be used.

The Board of Local Improvements of Peoria, Ill., has ordered an ordinance prepared for the paving of College St., between South Garfield and University Sts., at an estimated cost of $9,857.

The Board of Local Improvements of Macomb, Ill., has passed a resolution providing for the continuance of the pavement on Lafayette St. to the cemetery. The length of the pavement will be about 1,000 ft., and it will be 24 ft. wide. The estimated cost is $5,900.

The Board of Local Improvements of Rock Island, Ill., has instructed City Engineer Wallace Treichler to prepare property lists for the purpose of drawing estimates for paving 20th St., from Seventh to 12th Ave., with asphalt; Second Ave., from 14th St. west to the plow shops, and Fourth Ave., from 16th St. west.

Plans have been prepared by City Engineer L. D. Jeffries of Peoria, Ill., for the construction of 4,975 sq. yds. of brick pavement on a concrete foundation at an estimated cost of $9,857. The proposed work includes cement grout filler, 3,320 cu. yds. of excavation and stone curb (already in). S. W. Eckley is official in charge.

Indiana.

✣Bids will be received until noon, Jan. 7, by Board of Pulaski County Commissioners at Winamac, Ind., for the construction of a gravel road known as the William Moyer road. Jacob Nice is County Commissioner.

✣Bids will be received until noon, Jan. 9, by Board of Morgan and Johnson Counties' Commissioners at Martinsville, Ind., for the construction of a gravel road known as the Elburn Brown et al, road. J. S. Whitaker is County Auditor.

✣Bids will be received until Jan. 6 by Town Board of Shelburn, Ind., for the paving and improving of approximately 7,000 sq. yds. of street.

⊙Jacob Ackerman of LaPorte, Ind., has been awarded the contract by the County Commissioners, Michigan City, Ind., for the construction of the George Bull macadam road at $53,000.

Iowa.

⊙The McCarthy Construction Co. of Davenport, Ia., has been awarded the contract by the Board of Local Improvements of Rock Island, Ill., H. M. Schriver, president for the improvement of 38th St. from the south line of 7th Ave. to south line of 18th Ave. by paving with brick, at $1.63 per sq. yd., for paving and $0.37 per cu. yd. for grading about 70,000 cu. yds. Bids were opened Dec. 21.

The City Council of Corning, Ia., has passed resolutions providing for the paving of portions of the following streets: Adams St., Davis Ave., Benton Ave., Nodaway St., Grove Ave., Washington St., Loomis Ave., 5th St., 7th St., 8th St., 9th St. and 10th St. Preliminary estimates as prepared by City Engineer Theo. S. Delay show the work will include the following: 22,469 sq. yds. of street paving, 815 sq. yds. of concrete alley paving and 16,127 lin. ft. of combined curb and gutter. It is intended to let the work early in 1913 and begin work as soon as frost is out.

The City Council of Des Moines, Ia., will advertise for new bids for finishing the paving on Euclid Ave., between Sixth Ave. and 12th St. The work is about half completed. Brick will be used.

A resolution has been introduced in the City Council of Grundy Center, Ia., calling for the paving of the two business blocks of Main St. Part of the pavement would be 60 ft. wide, part 40 ft. wide and part 30 ft. wide. Several kinds of material are under consideration.

Kentucky.

Working specifications based on the new asphalt ordinance of the city of Louisville, Ky., are being printed and will be ready for use by Jan. 15. Shortly after that date City Engineer David R. Lyman will arrange to advertise for bids on the bulk of the spring and summer asphalt paving.

Maryland.

⊙The Board of Awards of Baltimore, Md., has awarded the contract for paving the following streets with granite blocks, at $35,687: Madison St., from the Fallsway to Greenmount Ave.; Cheapside, from Pratt St. to Water St., and German St., from Paca St. to Penn St.

⊙J. R. Francis of Oakland, Md., has been awarded the contract by the State Road Commission, Baltimore, for the building of 4½ miles of macadam from McHenry toward Accident in Garrett County. Work will begin at once. It is understood that if the contract is completed by August next the work will be continued on to the village of Accident.

The Paving Commission of Baltimore, Md., has selected the material to be laid on 20 streets to be improved next year as follows: Vitrified block, Granby St., from Exeter St. to

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Central Ave.; Low St., from East to Front; Watson St., from High St. to Central Ave.; Custom House Ave., from Water St. to Lombard; Commerce St., from Water to Lombard; West St., from Light to Riverside Ave. Granite block, with bituminous filler, Commerce St., from Lombard to Pratt; Lombard St., from South to Gay. Granite block, in competition with hassan block, with bituminous filler, Saratoga St., from Calvert to Gay; Frederick St., from Gay to Lexington; Pleasant St., from Calvert to Guilford Ave. Granite blocks, with ordinary cement filler, Exeter St., from Fayette to Baltimore. Sheet asphalt, Fort Ave., from Lawrence to Fort McHenry gate; Calvert St., from Saratoga to Pleasant; William St., from West to Clement; Maryland Ave., from the bridge over the Pennsylvania R. R. tracks to North Ave.; Biddle St., from Cathedral to Maryland Ave.; Preston St., from Cathedral to Guilford Ave.; Maryland Ave., from Chase to Preston. Bituminous concrete, Division St., from Lafayette Ave. to Mosher; Biddle St., from Maryland Ave. to St. Paul.

Michigan.

⊙The Gogebic County Road Commissioners, Bessemer, Mich., have awarded a contract to Oxman & Sutherland for graveling the county trunk road between Dunham and Marenisco.

⊙Odber & Conner of Kenton, Mich., has been awarded the contract for the construction of the first section of the Kenton-Sidnaw highway in Duncan Township.

Minnesota.

✣Bids will be received until 11 a. m., Jan. 13, by Board of County Commissioners, at the office of A. P. Erickson, Hennepin County Auditor, Minneapolis, Minn., for graveling 6,080 lin. ft. more or less of road No. 83 and road connecting road No. 83 and road No. 133, being contract No. 1, running between sections 1 and 12 in the town of Minnetrista, commencing on road No. 83 at station 117 and 30, being northerly end of bridge No. 339. Proposals must be made on blank forms furnished by the County Surveyor and accompanied by a certified check payable to the order of the County Treasurer for 5 per cent of the amount of the bid as a guaranty for the execution of a contract if awarded.

Residents south of Milwaukee railway tracks in the city of Winona, Minn., plan to ask the City Council to pave Main St. with brick.

At a recent meeting of the industrial, municipal and state and county committees at the Commercial Club, Duluth, Minn., City Engineer John Wilson outlined a comprehensive plan of street paving for the city of Duluth. It is proposed to have plans and specifications prepared for this work and submit them to a competent consulting engineer for approval.

The Minnesota State Highway Commission, St. Paul, on Dec. 27 held a meeting to consider the petitions from various parts of the state relative to the Federal government's offer to establish a 50-mile stretch of road anywhere in the state designated by the government.

Petitions are being circulated among the property owners on Superior, First, Third and Fifth Sts., 20th, 22nd, 23d, 30 Aves., and Vernon St., between 30th Ave. and Third St., in the city of Duluth, Minn., asking for street paving.

The City Councils of Big Stone and Ortonville, Minn., are working out plans to build a wagon road between the two towns. This road would require 134,000 yds. of dirt to fill the flat for the roadway.

Mississippi.

✣Bids will be received until Jan. 6 by Board of Road Commissioners, District 3, Covington County, Collins, Miss., for the maintenance of all unlet roads for two years.

⊙Garretson Brewer Co., Jackson, Miss., has been awarded the contract by the Adams County Commissioners, Natchez, Miss., for the building of good roads in that county for which bids were opened Dec. 19, at $99,684. The work includes culverts not to exceed 4-ft. span, grading, widening and graveling. John F. Jenkins is Clerk of the Board.

The citizens of Supervisors' District No. 4, Covington County, Miss., at a recent election voted against the issuance of bonds for the construction of good roads. Collins is the county seat.

Missouri.

⊙Lloyd Burrers of Joplin, Mo., has been awarded the contract for the construction of 9,799 sq. yds. of liquid bituminous pavement in that city, for which bids were opened on Dec. 17. C. B. Anderson is City Engineer.

Nebraska.

A petition has been presented to the City Council of Fremont, Nebr., providing for the paving of Main St. as far as Irving St. A number of new districts are to be paved the coming year.

New York.

✣Bids will be received until 10 a. m., Jan. 27, by Capt. F. E. Smith, Quartermaster, Fort Slocum, N. Y., for the construction of roads, walks, gutters, etc., at Fort Slocum, N. Y.

✣Bids will be received until 11 a. m., Jan. 2, by Department of Public Works, Francis G. Ward, Commissioner, Buffalo, N. Y., for the improvement of streets. Plans and specifications and estimate of quantities can be seen, and printed froms of proposals, and any desired information can be had on application at the Bureau of Engineering on and after this date. This department reserves the right to reject any and all bids, and waive any informalities. A separate proposal must be made for each job. For repaving Jackson St., 25 ft. wide, from northwest curb line of Genesee St. to the southeast curb line of Court place, with each kind of pavement for laying, of which specifications have been filed by the Commissioner of Public Works. For repaving Washington St., 32 ft. wide, from the north curb line of Virginia St. to a point about 262 ft. northerly with each kind of pavement for laying, of which specifications have been filed by the Commissioner of Public Works. For repaving Mortimer St., 26 ft. wide, from the northwest curb line of Sycamore St. to the southeast curb line of Genesee St., with each kind of pavement for laying, of which specifications have been filed by the Commissioner of Public Works. For repaving Elk St., 42 ft. wide, from 326 ft. west of Bailey Ave. to 543 ft. west of Bailey Ave., except the space occupied by the street railway tracks and 2 ft. outside the same with each kind of pavement for laying of which specifications have been filed by the Commissioner of Public Works. For repaving Delavan Ave., its present width, from the east curb line of Delaware Ave. to the west curb line of Main St., except the space occupied by the street railway tracks and 2 ft. outside the same; and to pave 3 ft. wider on the north side from Delaware to Main and 3 ft. wider on the south side from Linwood to Main with each kind of pavement for laying, of which specifications have been filed by the Commissioner of Public Works.

✣Bids will be received until 1 p. m., Jan. 4, by Rank E. Bogardus, Onondaga County Superintendent of Highways, Syracuse, N. Y., for the construction of three county roads as follows: Peru-Jordan-Seneca River road, 5.09 miles long; Onondaga-Dewitt road, 7.27 miles long; Salina Clay, Sec. 2 road, 5.37 miles long. Specifications are on file with the Superintendent.

✣Bids will be received until 11 a. m., Jan. 21, by Board of Water Supply, 165 Broadway, New York City, for contract 134 for surfacing with vitrified brick brock highways around the Ashokan reservoir in the towns of Olive, Marbletown, Hurley, Woodstock and Kingston, Ulster County, New York. At the above place and time the bids will be publicly opened and read. Pamphlets containing information for bidders and contract drawings can be obtained by depositing the sum of $10 for each pamphlet. Joseph P. Morrissey is Secretary.

✣Bids will be received until 11 a. m., Jan. 8, by Alfred E. Steers, President of the Borough of Brooklyn, New York City, for the construction of pavements under 18 contracts, the largest being as follows: No. 11, for regulating and paving with permanent wood block pavement on a 6-in. concrete foundation the roadway of 48th St. from 12th Ave. to 17th Ave. The Engineer's estimate is as follows: 12,390 sq. yds. wood block pavement, 5 years maintenance, 2,065 cu. yds. concrete, 60 lin. ft. bluestone heading stones set in concrete, 3,440 cu. yds. excavation to subgrade. Time allowed, 40 working days. Security required, $14,500.

✣Bids will be received until 2 p. m., Jan. 6, by George McAneny, President, Borough of Manhattan, New York City, for furnishing the following road and street materials: 40,000 gals. asphalt road oil, 7,500 cu. yds. washed gravel, repairing tools, 2,000 tons of paving pitch, 1,800 barrels of Portland cement, 6,000 cu. yds. of paving sand, 250 cords of pine wood, 650 cu. yds. of broken stone and screenings. Specifications may be had at the office of Commissioner of Public Works, 13-21 Park Row, Bureau of Highways, Room 1611, Borough of Manhattan, New York City.

Petitions are being circulated in Olean, N. Y., for the paving of North Seventh St., from State to Washington and North Eighth St., from the intersection of Buffalo St. to Town Line alley. It is also proposed to pave Buffalo St., from Washington to the intersection of Eighth St.

The Common Council of Syracuse, N. Y., has ordered the paving of Stolp Ave., between Dudley St. and Reed Ave., at a cost not to exceed $60,000.

According to advices from Watkins, N. Y., surveyors are now working on Franklin St. to make a complete survey from the lake to the south end of the fair ground preparatory to the paving which is expected to be started by March 1.

President George McAneny of the Borough of Manhattan has asked the Board of Estimate for an issue of $1,000,000 in corporate stock for repaving the streets of Manhattan in 1913.

The good road committee of the Board of Supervisors, Troy, N. Y., has authorized the building of a new highway from the village of Nassau south to the borders of Columbia County.

F. J. Baker of Syracuse, N. Y., is the probable contractor for furnishing materials and paving N. Franklin St., from Noxon St. to the Erie Canal in that city, at $10,056 on asphalt. Bids were opened Dec. 23 by the Board of Contract and Supply.

F. J. Baker of Syracuse, N. Y., is the probable contractor for furnishing materials and paving Almond St., from Jefferson to Cedar St., in the city of Syracuse, for which bids were opened on Dec. 23 by the Board of Contract and Supply of that city. The bid was $2,336.

Ohio.

✣Bids will be received until 11 a. m., Jan. 15, by Board of Cuyahoga County Commissioners, Cleveland, O., for the improvement of Usher road, from Irish road to the village line in Olmsted Township, in accordance with the form of contract and specifications to be furnished by Frank R. Lander, County Surveyor. A certified check for $500 must be filed with each bid. J. F. Goldenbogen is Clerk of the Board.

⊙C. W. Comer of Sharonville, O., has been awarded the contract by the Board of Hamilton County Commissioners, Cincinnati, O., for construction under Specifications No. 411, concrete retaining wall on Springfield pike at the north end of Wyoming, in Springfield Township, at $2,464. Bids were opened Dec. 24.

⊙Tripper & Son of Peru, Ind., have been awarded the contract by State Highway Commissioner James R. Marker, Columbus, O., for grading and paving with brick for heavy traffic the Bridgetown and Ferguson road in Green Township, Hamilton County, O., at $27,680. The road is 7,458 ft. long and 16 ft. wide. Bids were opened Dec. 23.

✣ indicates work now open for bids. ⊙ indicates a contract let recently

⊙The National Lime & Stone Co. of Carey, O., has been awarded the contract by State Highway Commissioner James R. Marker, Columbus, for grading and paving with waterbound macadam the Upper Sandusky and Findlay road in Wyandot County, Crawford Township, at $12,499. The road is 14,002 ft. long and 16 ft. wide. Bids were opened Dec. 23.

⊙Lewis Pickering of Bellefountaine, O., has been awarded the contract by State Highway Commissioner James R. Marker, Columbus, for grading and paving with waterbound macadam the Wapakoneta and St. Johns road in Duchoquet, Pusheta, Union and Clay Townships, Auglaize County, at $13,500. The road is 23,500 ft. long and 12 ft. wide. Bids were opened Dec. 23.

The City Council of Ashtabula, O., has adopted a resolution providing for the paving of Lake St.

The City Council of Canal Dover, O., has passed favorably on the proposed paving of East Front St., from Wooster Ave. to the corporation line, on Reeves Heights from the railroad track to the corporation line, and on Tuscarawas Ave., from the rolling mill to the corporation line.

The Village Council of Jefferson, O., has decided to pave Satin St., from Chestnut to Elm, a distance of about a quarter of a mile. A tar-top concrete pavement will be laid.

Engineers Cumings & Downer, Painesville, O., have prepared plans for the construction of 15,888 sq. yds. of brick and concrete pavement in Geneva, O., on a concrete foundation. The work will include stone and concrete curb, grout filler and 6,000 cu. yds. of excavation. Contracts will be let in about 60 days.

Petitions have been circulated in Madison Township, Lake County, O., for the construction of about nine miles of concrete pavement with cement curb. Plans will be prepared by H. P. Cumings, Engineer for the County Commissioners, Painesville, O. W. Albert Davis is County Auditor.

Oklahoma.

The Federal Government has offered the state of Oklahoma or any county or organization in the state the sum of $10,000 for the building of 50 miles of highway, if the organization accepting the offer will raise an additional $20,000 for the work. Sidney Suggs is State Highway Commissioner.

Consulting Engineers M. A. Earl & Co., Muskogee, Okla., will prepare plans for the construction of 18,000 sq. yds. of paving on a concrete foundation in Rogers, Ark. This work will require very little excavation. Lee Harris of Rogers is official in charge.

Oregon.

⊙The city of Lebanon, Ore., has let the contract for the paving of 12 blocks of streets to the California Construction Co.

Pennsylvania.

✣Bids will be received until 10 a. m., Jan. 10, at the office of the City Controller, Pittsburgh, Pa., for public improvements as follows: Grading, curbing and paving with blockstone, B St., from Kirkbridge St. to Columbus Ave.; Kirkpatrick St., from Bedford Ave. to Grant Blvd.; Reynolds St., from Linden St. to Hastings St. Grading, curbing and paving with asphalt, Antietam St., from Java Av. to east line of Greenwood St.; Lloyd St., from Reynolds St. to north line of Robinson and Dickie Plan. Grading, curbing and paving with brick, Decision Av., from Graham St. to Rebecca St.; Cowley St., from Ley St. to Wickline's Lane; Jordan Ave., from Millvale Ave. to Winebiddle St. Grading, curbing and paving with wood block, Mary St., from South 20th St. to South 21st St. Grading, curbing and paving with blockstone and brick, Rockland Ave., from Hampshire Ave. to the alley north of Sebring St. Grading and paving with brick, Anton Av., from Grant Blvd. to Webster Ave.; Hurd Av., from O'Neil Av. to Dante Av.; O'Neil Av., from Strawberry Way to Dante Av. Repaving with blockstone, South 11th St., South 12th St., Sarah St. and Bradish St. Grading, curbing and paving with asphalt and brick, Lilac St., from Welfer's Line to Wm. Pitt Blvd.

✣Bids will be received until 10 a. m., Jan. 10, at the office of the City Controller, Pittsburgh, Pa., for the construction of a concrete retaining wall on Brownsville Ave., opposite Williams St. J. G. Armstrong is Director of the Department of Public Works.

✣Bids will be received until 10 a. m., Jan. 10, by City Controller, Pittsburgh, Pa., for the grading, curbing and paving with blockstone of Kirkpatrick St. from Bedford Ave. to Grand Blvd. Bids shall be made from plans and specifications and on the printed forms to be obtained at the office of Jos. G. Armstrong, Director of the Department of Public Works, 452 Oliver Bldg. Proposals must be accompanied by a bond in the amount of $25,000, secured by a surety or trust company which shall have complied with city ordinances relating thereto.

The City Councils of Lebanon, Pa., on Dec. 17 appointed a committee to consider and recommend ways and means for paving the streets of Lebanon. It is possible that the committee will also recommend the kind of paving to be used and what streets should be paved. Nine months have been allowed for this investigation. T. R. Crowell is City Engineer.

The city of Lebanon, Pa., contemplates raising its city tax by April 1 one mill for street paving.

Tennessee.

The citizens of Cheatham County, Tenn., recently voted the issuance of bonds to the amount of $100,000 for the improvement of roads. Ashland City is the county seat.

The city of Lookout Mountain, Tenn., plans the construction of about one-half mile of street paving and 2,000 ft. of concrete curb. An engineer will be employed to prepare plans. Contracts will be let early in the spring. Jno. H. Wheelock is Commissioner and Treasurer.

Texas.

✣Bids will be received until noon, Jan. 13, by Dan C. Smith, Jr., City Secretary, Houston, Tex., for grading and paving Louisiana St. in accordance with specifications adopted by the City Council, as follows: From its intersection with the south line of Congress Ave. to its intersection with the south line of Capitol Ave. with creosoted wood block pavement; from its intersection with the south line of Capitol Ave. to its intersection with the north line of Pease Ave. with Texaco asphalt pavement, and from its intersection with the north line of Pease Ave. to its intersection with the north line of Berry Ave. with bitulithic pavement. Each bid must be accompanied by a certified check on any bank in the city of Houston for 10 per cent of the cost of constructing said pavement, said check being made payable to H. B. Rice, Mayor. Specifications and all necessary information can be obtained upon application at the office of F. L. Dormant, City Engineer.

⊙The City Commission of Dallas, Tex., has awarded the contracts for paving Pacific Ave., from Bryan to Akard Sts., and Preston St., from Main to Commerce, to the Creosoted Wood Block Paving Co. Pacific Ave. is to

Consulting Engineer J. Gibbons Browne, Houston, Tex., is making preliminary surveys for the construction of macadam roads on clay foundation in Navasota Road District, Grimes County, Texas, for which $126,000 is available. The contracts for this work will be let sometime in the spring. E. H. Terrell, Navasota, Tex., is official in charge.

be paved with 3⅓-in. blocks and Preston St. with 4-in. wood blocks. The contract prices are $4,752 and $1,927, respectively.

⊙The City Council of El Paso, Tex., has awarded the contract for the paving of Tularosa St., in the Alta Vista section, to the Southwestern Paving Co., at $1.20 per square yard for asphalt macadam.

⊙The City Council of Houston, Tex., on Dec. 23 awarded the contracts for street paving as follows: Creosoted Wood Block Paving Co., paving of Fannin St., from Leeland to McGowen Aves., with creosoted wood blocks at $2.60 per square yard; also for the paving of LaBranch St., from Leeland to McGowen with the same material, at the same price. Ockander Bros., Waco, Tex., paving of Leeland Ave., from Crawford St. to the San Antonio & Aransas Pass railroad, with Hassam concrete, at $1.90 per square yard.

The Robertson County Commissioners, Franklin, Tex., have ordered new elections held in Franklin and Hearne commissioners' precincts to determine the issuance of road improvement bonds in the sum of $150,000 for each precinct. Both elections are to be held Jan. 21.

The Harris County Commissioners, Houston, Tex., have agreed to appropriate $9,000 as its share of the expense of paving with asphalt Harrisburg Road between Milby St. and the eastern limits of Houston. The estimated cost of this road is $34,000.

The Commissioners' Court, Pleasanton, Tex., has ordered a good roads bond issue for $25,000 for Commissioners' Precinct No. 3 on Jan. 25.

Palacios Precinct of Matagorda County, Tex., recently voted bonds to the amount of $100,000 for the improvement of public highways. Work is expected to commence at an early date. Bay City is the county seat.

It is reported that the citizens of El Paso County, Tex., on Dec. 27 voted the issuance of bonds to the amount of $40,000 to construct macadam, gravel and paved roads in Road District No. 3 and to the amount of $350,000 for good roads in other parts of the county. El Paso is the county seat.

City Engineer A. B. Carson of Bryan, Tex., is agitating the paving of the main street of the city on the co-operation plan.

The city of Jefferson, Tex., has plans under way for the construction of eight blocks of city pavement. Creosoted blocks will be used. Work is expected to start in the spring.

Prominent citizens of Corpus Christi, Tex., will petition the County Commissioners Court asking that an election be held some time during the early part of the new year for the purpose of voting on the proposition of issuing bonds to the amount of $400,000 for the building of 150 miles of modern roads in Nueces County.

The citizens of Conroe District No. 1, Montgomery County, Tex., on Dec. 23 voted bonds to the amount of $250,000 for the building of good roads. Conroe is the county seat.

The Limestone County Commissioners, Groesbeck, Tex., have sold the $150,000 bond issue for good roads construction in Mexia precinct. It is expected the contracts for the crushed rock roads will be let in the near future.

Virginia.

⊙The Continental Public Works Co., of New York City, has been awarded the contract by the Board of Control of Norfolk, Va., for the laying of 55,500 sq. yds. of asphalt paving in the old Fifth, Ninth and Tenth Wards at $1.48 per square yard; also for 18,000 ft. of curbing at $0.49 a foot.

Advices from Richmond, Va., state that the Town Council of Barton Heights, Va., has decided to grade and improve four blocks of Robert St.

Washington.

⊙The city of Wenatchee, Wash., has let the contract for the construction of wood block pavement on Wenatchee Ave. et al., to J. J. McNerney of that city, at $112,965. A list of the bids received on this work was given in our last issue.

⊙August Wallin of Aberdeen, Wash., has been awarded the contract by the County Commissioners, Montesano, Wash., R. G. Trask, Auditor, for the construction of the uncompleted portion of Aloha County road in Chehalis County at $7,000. The work includes cleaning and grading. Bids were opened Dec. 16.

The Commissioners of Tacoma, Wash., on Dec. 23 took up for approval the matter of grading in District 660, the estimated cost of which is $50,000. The work involves 119,000 cu. yds. of excavation; 369 M ft. of lumber; grading of North 31st St. in District 789, the estimated cost of which is $11,000, involving 29,000 cu. yds. of excavation, 59 M ft. of lumber, etc. Plans for this work have been completed.

Wisconsin.

Paving requests have been submitted by the aldermen of Milwaukee, Wis., for 1913 as follows: 257 blocks of asphalt paving; 16 blocks of brick or asphalt; 115 blocks of brick; 115 blocks of stone (granite or sandstone), 7½ blocks of sandstone, 19½ blocks of macadam, and 35½ blocks of creosoted block. F. G. Simmons is Commissioner of Public Works.

Freeholders of the city of Racine, Wis., have petitioned the Common Council to have Michigan St., between Third and Fourth Sts., widened by increasing the width 5 ft. along the west line of said street.

BRIDGES

Alabama.

✣Bids will be received, it is reported, until Jan. 6, for the construction of the proposed reinforced concrete viaduct over the tracks of the Southern Ry., Illinois Central and Frisco R. Rs. Specifications may be obtained of E. M. Durham, Asst. Engineer of the Southern Ry., Birmingham, Ala.

California.

The Chamber of Commerce, Redding, Calif., has appointed a committee to confer with the City Trustees and the Board of County Supervisors in regard to the construction of the proposed bridge over the Sacramento River at the north end of Market St.

The City Council of Long Beach, Calif., has decided to construct a bridge over Cerritos Slough. E. P. Dewey is City Engineer.

The Board of Fresno County Supervisors, Fresno, Calif., has decided to postpone the construction of the proposed reinforced concrete bridge over Dry Creek at Kearney Blvd. for some time. B. M. Barnwell is Clerk.

Colorado.

J. A. Beeler, Manager of the Tramway Co., and the Board of Public Works, Denver, Colo., have reached an agreement in regard to the construction of the West Colfax Ave. viaduct. The city will pay one-third of the cost, the Tramway company one-third and the other third will be paid by the Colorado & Southern, Denver & Rio Grande and Burlington railroads, over whose tracks the viaduct will extend.

Connecticut.

A bill which is now in process of preparation will be presented to the coming session of the General Assembly authorizing the construction of a new concrete bridge over the Housatonic River between Derby and Shelton, Conn. The cost of the new structure will be divided as follows: One third to the state; one third to the counties of New Haven and Fairfield and one-third to the Connecticut Co. The railway company will construct a double track on the new bridge.

Delaware.

Committees of the City Council, Wilmington, Dela., the Levy Court and the Board of Park Commissioners recently met for the purpose of transferring the old Baltimore & Ohio R. R. over Brandywine Creek from the city to the Levy Court. It will cost about $20,000 to convert the bridge into a highway structure and about $4,000 to build approaches.

Illinois.

A petition was presented to the city council of Rockford, Ill., at a recent meeting, asking that a new bridge be erected across the Rock River at Morgan St. A bond issue will probably be voted on to provide funds for the improvement if the petition is granted. Edwin Main is City Engineer.

The City Council of Edwardsville, Ill., has called a special meeting for the purpose of taking up for consideration the plans proposed for the construction of a bridge over the Alton and Springfield roads, eliminating two grade crossings.

The Commissioners of Wabash and Edwards counties recently met to discuss the matter of building a new bridge to replace the Bonpas bridge at Browns. Mt. Carmel, Ill., is county seat of Wabash County.

An ordinance was recently presented to the City Council of Peoria, Ill., calling for the immediate construction of the viaduct at the end of S. Adams St. Fred B. Tracy is City Clerk.

Following are the lowest bids submitted to L. E. McGann, Commissioner of Public Works, Chicago, Ill., for constructing the superstructure of the highway bridge over the north branch of the Chicago River at Wilson avenue: National Contracting Co., 180 W. Madison St., $20,700. The contract has not been awarded.

Citizens of South Homer Township and Vance Township have petitioned the boards of supervisors of Vermilion and Champaign counties, Ill., for the construction of a bridge over the creek on the county line road 3 miles northeast of the town of Homer.

Plans have been decided upon by the Board of La Salle County Supervisors for the construction of the proposed bridge over the Vermilion River at Deer Park Road near LaSalle, Ill. Figures will be taken on both steel and concrete structures. The cost of the structure will be borne by the county and the Burlington railroad.

Indiana.

✣Bids will be received until 11 a. m., Jan. 14, by Board of Park Commissioners, Indianapolis, Ind., for furnishing of materials for and the construction of a reinforced concrete, arch bridge with stone trimmings, across Crooked Creek on the west side of Riverside Park; along the Myer's road; the contract for said bridge, or certain units of said bridge, to be let in conjunction with the letting of certain units designated in the specifications by the board of commissioners of Marion County. Bidders must accompany their proposals for said improvement with a certified check for an amount not less than 2½ per cent of the engineer's estimate of the cost of said work, but in no case shall any such check be less than the sum of $650. Henry Jameson is Chairman of the Board.

✣Bids will be received until 10 a. m., Jan. 8, by Board of Noble County Commissioners, Albion, Ind., for the construction of a 90-ft. concrete bridge at Ligonier, Ind. J. C. Kimmell is County Auditor.

✣Bids will be received until 10 a. m., Jan. 14, by Board of Marion County Commissioners, Indianapolis, Ind., for the construction of a reinforced concrete bridge with Bedford or native limestone facing over Crooked Creek, Riverside Park, Indianapolis, Ind. W. T. Patten is County Auditor.

Iowa.

✣Bids will be received until noon, Jan. 2, by Board of Bremer County Supervisors at the office of W. H. Pochels, County Auditor, Waverly, Ia., it is reported, for the construction of all truss, concrete and iron bridges erected in the county during 1913.

⊙The Board of Allamakee County Commissioners, Waukon, Ia., has awarded the contracts for the construction of two steel bridges, one 120 ft. long and the other 42 ft. long, to the Clinton Bridge Co., Clinton, Ia., at $3,490 and $749, respectively. Bids were opened Dec. 20.

Preliminary surveys are under way by engineers of the Eastern Iowa Ry. Co., Cedar Rapids, Ia., for the construction of the proposed steel span bridge over the Iowa River at Iowa City. Nothing definite in regard to the work has as yet been arranged. J. D. Wardle is Superintendent of the company.

Louisiana.

The Baton Rouge Bridge & Terminal Co., of which Job Hedges, New York City, is President, has negotiations under way for the construction at an early date of the proposed bridge over the river above Baton Rouge, La. The cost of the structure is estimated at about $7,000,000. The engineers propose as the site on the east bank Scott's Bluffs, 6 miles from Baton Rouge, on the west bank the approaches would have to extend for miles back from the river.

Kansas.

✣Bids will be received up to noon, Jan. 10, 1913, at the office of the County Clerk in the Court House at Great Bend, Kans., for the construction of a bridge over the Arkansas River in Barton County. A deposit of $50 must accompany each bid. Great Bend Bridge—Composed of ten 45-ft. reinforced concrete girder spans, 24 ft. roadway and concrete piers and abutments. Estimated quantities, 725 cu. yds. reinforced concrete, 646.1 cu. yds. plain concrete, 213,940 lbs. of steel reinforcement and 5,725 ft. of wood piles. Excavations will be in sand, footings are to be carried about 7.5 below bed stream. Sand available in river near bridge site, also some gravel which could probably be used if carefully selected. Crushed rock available at Augusta, Eldorado and Florence. Bridge is located over the Arkansas River about 1,000 ft. from A. T. & St. F. switch at Great Bend, Kans. Plans and specifications are on file with the County Clerk, and copies of the same may be obtained by mailing $2 to the State Engineer, Manhattan, Kans.

✣Bids will be received up to 12 o'clock noon, Jan. 7, 1913, at the office of the County Clerk in the Court House at Eldorado, Kans., for the construction of a concrete bridge, in Butler County. A deposit of $50 must accompany each bid. Weidlein Bridge—Composed of two reinforced concrete girders, each having a 50 ft. clear space, 16 ft. roadway, supported on two concrete abutments and one pier. Estimated quantities, 153.8 cu. yds. reinforced concrete, 700 cu. yds. plain concrete and 35,000 lbs. of steel reinforcement. Foundations are on solid rock in about 6 ft. of water. Crushed rock can be obtained at Augusta for $1 to $1.15 per cubic yard. Rubble stone delivered at bridge site for about 35 cts. per cubic yard. The bridge is located over the Walnut River on the highway between sections 23 and 26, Augusta Township, Butler County, about ½ mile east of the city of Augusta. More detailed information relative to price and location of suitable stone may be had from Hon. Ed. Weidlein, Mayor of Augusta. Plans and specifications are on file with the County Clerk, and copies of the same may be obtained by mailing $1 to the State Engineer, Manhattan, Kans.

✣Bids will be received up to 12 o'clock noon, Jan. 8, 1913, at the office of the County Clerk in the Court House, Council Grove, Kans., for the construction of a bridge over the Neosho River in Morris County. A deposit of $50 must accompany each bid. Main Street Bridge—Composed of two 90-ft. reinforced concrete arches, 24-ft. roadway and two 5-ft. sidewalks. Foundations will be in rock and gravel; footings to be carried 5 ft. below bed of stream. Ordinary depth of water about 2 ft. Total height of structure about 34 ft. Crushed stone can be had for 50 cts. per cubic yard f. o. b. cars at Helmick on the Missouri Pacific, 7 miles west of Council Grove. Sand must be shipped in; cost about $2 per cubic yard. Gravel can be had at bridge site free, but must be washed. Bridge is located over Neosho River ¼ mile from the M., K. & T. station at Council Grove, Kans. Plans and specifications are on file with the County Clerk, and copies of the same may be obtained by mailing $2 to the State Engineer, Manhattan, Kans.

✣Bids will be received until noon, Jan. 14, by Board of Fillmore County Supervisors at the office of Bert A. Lynn, County Clerk, Geneva, Nebr., for the erection of all county bridges, both bent and pile, steel and wooden, required by the county during the 12 months beginning from Jan. 14, 1913.

✣Bids will be received until noon, Jan. 10, by Mitchell County Board of Commissioners, Beloit, Kan., for the construction and repair of the following bridges: Bridge No. 67141 near Morris Moore's, new wood floor; bridge No. 67261, near Nelson's, new wood floor; bridge No. 67191, near Birt's, steel I beam span with concrete floor, stone and concrete abutments; bridge No. 9671, near Thompson's, stone arch, 10 ft. span, 16 ft. roadway; bridge No. 89352, near Freeman's, concrete and stone abutments and wings, steel span, concrete floor, 30 ft. span by 18 ft. roadway; bridge No. 89281, near Gaston's, concrete and stone abutments and wings, steel span, concrete floor, 30 ft. span by 18 ft. roadway; bridge No. 76191, near Pagett's, reinforced concrete, 14 ft. span by 18 ft. roadway; bridge No. 76101, near Grau's, reinforced concrete, 16 ft. span by 18 ft. roadway; bridge No. 96241, near Sale's, reinforced concrete, 14 ft. span by 18 ft. roadway; bridge No. 810201, near Leonhart's, new stone wings and spandrel walls and steel railings; bridge No. 810341, on Eresch's place, reinforced concrete, 10 ft. span, 18 ft. roadway; bridge No. 810261, near Beck's, reinforced concrete, 10 ft. span by 18 ft. roadway. All in accordance with the respective plans and specifications for said respective bridges now on file in the office of H. L. Petterson, County Clerk of said county and state. Each proposal must be accompanied by a certified check for the sum of $50, payable to the county treasurer of Mitchell County, Kansas.

All bids received Dec. 17 by Charles Nayler, Dawes County Clerk, Chadron, Nebr., for the construction of two wagon bridges over the White River have been rejected and the matter is postponed for some time.

Maryland.

✣Bids will be received until 11 a. m., Jan. 25, by H. R. Stanford, Bureau of Yards & Docks, U. S. Navy Department, Washington, D. C., for a highway bridge over Dorsey Creek at the Naval Academy, Annapolis, Md. Amount available, $50,000. Plans and specifications can be obtained on application to the bureau upon receipt of $10 deposit. This deposit to be returned upon return of plans and specifications.

Massachusetts.

The Board of Bristol County Commissioners, Taunton, Mass., on Dec. 17 received the following bids, the lowest of which was about $6,500 above the amount available for the new bridge over the Acushnet River between Taunton and New Bedford: W. H. Ellis of Boston, for bridge and approaches, $33,647; Beattie & Wilcox, Fall River, $34,056; Beattie & O'Connell, Fall River, $36,874; New England Construction Co., Springfield, $37,291.95; William H. Miller, Boston, $43,496.25, and Frank C. Taylor, New Bedford, $44,827.50.

Minnesota.

Among the projects under consideration by the city of Minneapolis, Minn., is the construction of the proposed 19th Ave. bridge, estimated to cost $200,000. Andrew Rinker is City Engineer.

M. J. Cleveland, Engineer, St. Cloud, Minn., is making surveys for the construction of the proposed bridge over the Mississippi River at Sartell. The cost of the structure will amount to about $20,000. The expense will be borne by the village, the county and the state.

Plans are being prepared by F. D. McKellip, City Engineer, Faribault, Minn., for the construction of the proposed viaduct over the Rock Island and the Great Western tracks.

Mississippi.

✣Bids will be received until 1 p. m., Jan. 7, by Board of Montgomery County Supervisors, Winona, Miss., for the construction of a pile bridge over Jackson Creek on Winona and Grenada Road. J. T. Parks is Clerk.

✣Bids will be received until Jan. 6 by Board of Hinds County Supervisors, Jackson, Miss., it is reported, for the construction of a number of small bridges.

Missouri.

✣Bids will be received until 1:30 p. m., Jan. 7, by Board of Gentry County Commissioners, Albany, Mo., for the construction of a steel span bridge 100 ft. long with a 30-ft. wooden approach on each end. The roadway will be 14 ft. wide. The substructure will consist of steel tubes 36 ins. by 26 ft. John B. H. Ray, Albany, Mo., is Engineer.

⊙The Buchanon County Court, St. Joseph, Mo., awarded the following contracts for the construction of concrete culverts: C. H. Belcher, the culvert at the Radecke place, $3,185; the Campbell farm $1,780, and the Maget farm $2,720. The DuBois Construction Co., Hamilton culvert at $850, and that at the Stafford farm for $2,050.

The Committee of Public Improvements, St. Louis, Mo., has set Jan. 3 as the date for holding a public hearing on the bill providing for the construction of a Union Ave. viaduct by the Terminal Railroad Association.

Nebraska.

It has been decided to replace the old bridge which spans the north channel of the Platte River south of Grand Island, Nebr., on the Sand Krong Road with a new steel structure estimated to cost $7,500.

New Jersey.

✣Bids will be received until 2 p. m., Jan. 13, by Board of Chose Freeholders, County Record Bldg., New Brunswick, N. J., for the construction of a concrete and steel bridge over Noes Creek, on the Blazing Star Road. According to plans and specifications on file at the office of Alvin B. Fox, Perth Amboy, N. J., and at the office of Thomas H. Hagerty, New Brunswick, N. J. Each bid must be accompanied by a certified check in the amount of $200, payable to the order of Thomas H. Hagerty.

⊙Barrows-Stewart Co., Whitehall Bldg., 17 Battery Pl., New York City, has been awarded the contract by Sperry & Hutchinson for the construction of a reinforced concrete highway bridge across the Rahway River at Cranford, N. J., also reinforced concrete arch dam and concrete gate house and complete gate equipment at the same point, to be used for water storage and power purposes. Work will be started at once, to be completed by spring. Oakley & Son, Elizabeth, N. J., are the Consulting Engineers for this work.

Plans have been prepared by the engineers of the Pennsylvania Railroad for the construction of the bridges at Perry and State Sts., Trenton, N. J. New designs will probably be prepared by City Engineer Abram Swan for lift bridges with underground structure.

New York.

✣Bids will be received until 8 p. m., Jan. 15, by Purchasing Agent, Bureau of Supply, Manila, P. I., at the office of the Insular Purchasing Agent, Bureau of Insular Affairs, 1530, 17 Battery Pl., New York City, for furnishing all the fabricated steel and field rivets for two spans at 90 ft., one span at 100 ft., one span at 130 ft. for Nueva Ecija bridges, seven spans at 160 ft. for the Laoag bridge, Ilocos Norte; one span at 160 ft. for the Rugao bridge, Isabela, for the Government of the Philippine Islands.

✣Bids will be received until 1 p. m., Jan. 13, by State Commission on Highways, Albany, N. Y., for the construction of the South Bay bridge west of Whitehall, Washington County, N. Y. Plans and specifications may be had at the office of the Commission in Albany, N. Y.

⊙The New York Central R. R. has awarded the contract for the construction of the new bridge over the river at Oswego, N. Y., to the Phoenix Building Co., at $152,366. The new structure will be of concrete. The Bosser Engineering and Construction Co. secured the contract for the foundation at $50,000.

The lowest bid opened by Arthur J. O'Keefe, Commissioner of Bridges, New York City, Dec. 19, for the improvement of the Manhattan Plaza of the Manhattan Bridge was that of William P. Seaver, 322 Fifth Ave., Manhattan, New York City, $817,380. The principal features will be a great arch and elliptical colonnades, the arch being similar to the Porte of St. Denis, in Paris, and the colonnade similar to that of St. Peter's in Rome. The work is to be completed in four hundred consecutive working days. The other bidders were: The Snare & Triest Co., $914,300; Frawley-Kaufman Co., $922,000; P. J. Carlin Construction Co., $954,000; Cooper & Evans Co., $959,000; the Marble Arch Co., $961,000; John T. Brady & Co., $994,132; Oscar Daniels Co., $994,700; Northeastern Construction Co., $1,010,217; A. L. Guidone Co., $1,049,400; Rodgers & Haggerty, $1,076,275; Thomas Crimmins Construction Company, $1,086,000.

It has been announced that bids for the construction of the proposed Ballantyne bridge in Monroe County, N. Y., will not be asked for several months. J. Y. McClintock is County Superintendent, Rochester, N. Y.

Ohio.

✣Bids will be received until noon, Jan. 17, by Board of Hamilton County Commissioners, Cincinnati, O., for repairing the floor of iron bridge over the Great Miami River at Elizabethtown in Whitewater Township under Specifications No. 415. A certified check for $500 must be filed with each bid. Albert Reinhardt is Clerk.

✣Bids will be received until 2 p. m., Jan. 25, by Board of Clark County Commissioners, Springfield, O., for the necessary labor and material for the construction of a new county bridge over Donnels Creek on the New Carlisle pike in Bethel Township. Bidders may bid on either the sub-structure or superstructure, or both, but each bidder on the superstructure of said bridge must furnish his own plans and specifications therefor, which must show and set forth the number of spans, the length of each, the nature, quality and size of the materials to be used in the erection of said superstructure, the strength of said superstructure when completed and also whether there is any patent right on the proposed plan, and if any, on what part thereof.

✣The Board of Clark County Commissioners, Springfield, O., has passed resolutions for the issuance of $10,500 worth of bonds for the construction of two bridges. It was voted to issue $5,000 worth of bonds to build a bridge over Beaver Creek, east of the city, on a new road petitioned for by George E. McKaig and others. An issue of $5,500 worth of bonds has been authorized to build a new bridge over Donnel's Creek, west of the city on the Carlisle pike. The bonds will be sold on Jan. 15 and the contracts for the building of the new bridges will be let on Jan. 23.

⊙The contract for the construction of the portion of the substructure of the Clark Ave. viaduct over the land was awarded on Dec. 24 to Fath & Son Construction Co., low bidders, at $223,450. The substructure for the river span went to the Phee Construction & Engineering Co., Peoples Gas Bldg., Chicago, Ill., at $109,378. This work was mentioned in our last issue. Bids were opened by W. J. Springborn, Director of Public Service, Cleveland, O., Dec. 19.

Representatives of civic, business and labor organizations met at the office of the Cuyahoga County Commissioners, Cleveland, O., for the purpose of discussing tentative plans for the construction of the proposed new

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Brooklyn-Brighton bridge. The plan, Route C. was favored and Commissioner Eirick moved that the commissioners adopt a resolution at the regular meeting instructing County Engineer F. R. Lander to prepare additional blue prints and data for "Route C" and that in accordance with the statutes a meeting be held thirty days later to ratify the adoption of plans for that route. This plan will make imperative the removal of the Gates elevator, one of the landmarks of the West Side. The structure which will be practically a level bridge across Big Creek will cost $595,000.

Representatives of the Lake Shore & Michigan Southern (New York Central Lines) and the Pennsylvania Lines recently met with Director of Public Service W. J. Springborn, Cleveland, O., to discuss the matter of replacing the bridges over the river with elevator structures costing about $500,000. The new bridges will each have a span of 200 ft. and the entire floor will be raised to the height of two tall towers, in elevator fashion, to permit tall masted boats to pass beneath. The Lake Shore bridge will be south of its present location and when closed will be considerable higher than its present elevation to meet the new union depot grade. The new Pennsylvania bridge will be on the present site of the Lake Shore bridge and at a lower level to meet the grade of the Pennsylvania ore docks.

The Board of Harrison County Commissioners contemplates the construction of a bridge over Stillwater Creek on the Tippecanoe Road in Washington Township. O. C. Gray is County Auditor, Cadiz, O.

Engineers representing the railroads operating through Dayton, O., have conferred with the City Engineer, G. C. Cummins, in regard to the newly drawn plans for the elevation of tracks and the elimination of grade crossings throughout the city. It is believed that no radical changes will be made.

Oklahoma.

⊙E. G. Fike, Tulsa, Okla., has been awarded a contract by the St. Louis-San Francisco Ry. for the reconstruction of the bridge over the Arkansas River at Tulsa at his bid of $100,000. Nine additional concrete piers will be placed under the bridge and on these piers will be built a modern steel girder bridge. The bridge is to be constructed in such a way as to keep an open track for the passage of trains. It has also been announced the building of the immense West Tulsa yards and 24-stall roundhouse for the Frisco for use of the California service will very soon be under way. Frisco improvements in Tulsa during the coming years will approximate $500,000 in cost.

The Board of Commissioners, Oklahoma City, Okla., has adopted the plans and specifications for the proposed new bridge over Lightning Creek at the A St. crossing.

Oregon.

The contract for the construction of the proposed bridge over the Willamette River between Marion and Yamhill Counties, Ore., has been held up bv injunction proceedings. G. W. Jones, McMinnville, Ore., is Yamhill County Clerk.

Pennsylvania.

The Bridge Committee of the Town Council, Warren, Pa., has submitted a report on the proposed new bridge to be erected over the mill race at Liberty St. The cost of a cement bridge is estimated at $7,500, while a steel bridge will necessitate an expenditure of $13,000. D. F. A. Wheelock is City Engineer.

South Carolina.

The Isle of Palms Traction Co., which recently closed a contract with the Charleston Consolidated Railway Co., for the purchase of the Seashore Division of the latter road, plans the construction of a bridge over the Cooper River from Charleston, S. C., to the opposite shore. A bill has been introduced into the senate authorizing James Sottle, who is at the head of the Isle of Palms Traction Co., to proceed with the improvement.

Tennessee.

The Board of City Commissioners, Memphis, Tenn., has been petitioned for the construction of a viaduct over the tracks of the Illinois Central and Yazoo & Mississippi Railways at McLemore Ave.

The Tennessee Central Railroad Co. proposes in connection with an extension from Hopkinsville, Ky., to Owensboro and Providence, Ky., thence to Evansville, Ind., the construction of a bridge over the Ohio River at a point 9 miles above Evansville. L. F. Lonnblach, Nashville, Tenn., is Chief Engineer.

Texas.

✣Bids will be received until 11 a. m., Jan. 4, by George L. Fearn, County Auditor, Dallas, Tex., for one steel bridge, 50-ft. span, 16-ft. roadway, 10-ton capacity, in place; flooring and stringers to be of 3x12 heart pine. Contractor will furnish all material except piling. Plans and specifications on file with County Engineer.

Utah.

✣Bids will be received until Jan. 12 by Board of Snohomish County Commissioners, Everett, Wash., for the construction of a bridge over Ebey Slough at Iver Johnson's farm.

⊙The contract for the construction of the Eighth Street bridges over Tumwater and Dailey Gulches, Port Angeles, Wash., has been awarded to Young & Denio, Auburn, Wash., at their bid, of $26,500.

⊙The contract for the construction of the concrete footings for the Rio Grande viaduct on Fourth South St., Salt Lake City, Utah, mentioned in our last issue, has been awarded by the Denver & Rio Grande Ry. to Zerbe & Walker.

Simon Bamberger, President, Salt Lake & Ogden Ry. Co., recently conferred with the Board of City Commissioners, Ogden, Utah, with a view of reaching an agreement for the erection of a joint steel bridge over Weber River in the vicinity of 33d St. H. J. Craven is City Engineer.

It is reported that Joseph A. West, Chief Engineer of the Ogden & Logan Rapid Transit Co., Ogden, Utah, will let contracts at once for the construction of buildings and steel bridges on the extension of both lines. On the Hermitage-Huntsville extension of the Ogden Rapid Transit Co. there will be five steel bridges, the same as the first one in the mouth of the Ogden canyon. There will be one bridge built in Cache valley.

The Commissioners of Pierce County, Tacoma, Wash., have awarded the contracts for the construction of three bridges to G. A. Marsh, Tacoma Bldg., Tacoma, Wash., as follows: (a) Bridge No. 95, 140 ft. long; (b) No. 96, 525 ft. long; (c) No. 97, 275 ft. long. The contract prices were $666, $5,569 and $2,207, respectively. Other bids were as follows: W. A. Chamberlain, (a) $1,115; (b) $6,884; (c) $3,999. W. G. Hiatt, (a) $987; (b) $9,000. Knoell Bros., (a) $1,362; (b) $8,442; (c) $4,125. Brainard & Englebrecht, (a) $995; (b) $6,000; (c) $3,000. P. Munson, (a) $900; (c) $3,700. C. L. Creelman, (a) $1,157; (b) $8,857; (c) $3,937. W. H. Davis, (a) $1,153.

Wisconsin.

✣Bids will be received until noon, Jan. 29, by Board of Public Works, Oshkosh, Wis., for the construction of a new bridge to replace the present structure over the Fox River at West Algoma St. Separate bids will be received on the following items: (1) Substructure, including the removal of the existing bridge, construction of a temporary bridge and removing same later, construction of the piers, fenders, abutments, retaining walls and filling for new bridge; (2) superstructure, including erection complete ready for operation of a plate girder deck highway and electric railway bridge having 6 approach spans and one Scherzer Rolling Lift Span, total length of 602 ft. and width of 42 ft. Scherzer Rolling Lift Bridge Co. are Engineers. Official advertisement will be found elsewhere in this issue.

The city of Manitowoc, Wis., has under consideration the expenditure of about $25,000 for the lengthening of the Eighth Street bridge. The channel will be made 72 ft. wide, allowing all boats to pass through. L. K. Pitz is City Engineer.

A hearing was recently held at Eau Claire, Wis., on the proposition to build a bridge over the Chippewa River from the West to the East Side. No definite location has been decided upon. A. R. Gomock is City Engineer.

Wyoming.

The bill providing for the construction of a bridge across the Snake River in Jackson Hole country, Wyoming, has been amended to limit the expenditure to $36,000 for the bridge and approaches, one-half of which is to be paid by the U. S. Reclamation Service.

Canada.

✣Bids will be received until Jan. 13, it is reported, by City Council, Vancouver, B. C., for the construction of the proposed Georgia-Harris St. steel or concrete bridge. The cost is estimated at about $400,000. Wm. McQueen, City Clerk.

⊙The contract for the construction of the sub-structure of the new bridge over the reversible falls at St. John, N. B., has been awarded by John Morrissy, Chief Commissioner of Public Works, to Joseph McVay and Son, at $50,000. Bids for the construction of the superstructure will be asked shortly.

The Canadian Northern Ry. Co. has applied to parliament for authority to construct a bridge over the St. Lawrence River at Montreal in order that the line may be extended to Point Levis. H. K. Wicksteed, Toronto, Ont., is Chief Engineer.

DRAINAGE AND IRRIGATION

Arkansas.

✣Bids will be received until noon, Jan. 22, by Board of Directors, Central Clay Drainage District, J. T. Campbell, Secretary, Piggott, Ark., for the construction of ditches and levees approximating 6,160,000 cu. yds. ditch excavation and 480,000 cu. yds. of levee embankment. A certified check for $2,500 must be filed with each bid. J. R. Rhyne, Corning, Ark., is Engineer.

✣Bids will be received until 2 p. m., Jan. 9, by Fourche Drainage District, W. M. Kavanaugh, President, at the Chamber of Commerce, Little Rock, Ark., for furnishing the main pumping station of the district requiring all labor and equipment in accordance with plans and specifications on file with Lund & Hill, Engineers, 201 W. Second St., Little Rock, Ark. A certified check or bond for 10 per cent the amount of bid must accompany each bid. Official advertisement will be found elsewhere in this issue.

California.

✣Bids will be received until 2 p. m., Jan. 2, by U. S. Reclamation Service, Los Angeles, Calif., for furnishing steel tower tops and structural material for the Roosevelt-Mesa transmission line, Salt River project, Arizona. For particulars address U. S. Reclamation Service, 605 Federal Bldg., Los Angeles Cal. O. H. Ensign, Consulting Engineer.

✣Plans were to be ready about Jan. 1 for the construction of a reinforced concrete res-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ervoir in Altadena for the Rubio Canyon Land & Water Co. It is expected that bids on the work will be in by Jan. 10. Allin Bros., 65 North Raymonds Ave., Pasadena, Cal., are the engineers.

Colorado.

⊙Advices from Grand Junction, Colo., state that William Milne and M. W. Blakeslee have been awarded the contract at about $6,000 for the drainage of a 160-acre tract near Grand Junction.

Idaho.

A bill has been introduced in Congress by Senator Borah, of Idaho, authorizing an additional loan of $30,000,000 to the reclamation fund on terms similar to those under which a $20,000,000 loan was made two years ago, except that this $30,000,000 may be applied either to extensions of existing projects or to entirely new projects.

Indiana.

✣Bids will be received until 1 p. m., Jan. 8, by Board of Shelby County Commissioners, Shelbyville, Ind., for the construction of the Franklin P. Crosby et al. public tile drain. F. T. Hack is commissioner for construction.

Bids were opened Dec. 15 by the Ogle Land Co., K. L. Ogle, Manager, Linton, Ind., for the construction of 50 miles of tile ditches. The bids were considered too high and the contract was not let.

Fred Morgan, Vincennes, Ind., at about $6,500, was low bidder Dec. 17 for cleaning out the Four Mile ditch in Washington and Fairplay Townships.

Iowa.

✣Bids will be received at 3 p. m., Jan. 14, by Board of Buena Vista County Supervisors, at the office of W. W. Bennett, County Auditor, Storm Lake, Iowa, for the construction of the drains in Drainage District No. 45 of said county. Bids will be received as follows: For the furnishing of the tile delivered along the line of ditch which bids must include the tile and sewer pipe for the catch basins. For the doing of all construction work and the furnishing of all material except tile necessary for the completion of the drainage system as recommended in the report of the engineer. All bids must be based on the plans and specifications on file in the office of the county auditor of Buena Vista County. The approximate amount of work to be done is as follows: Main—1,800 ft. of 30-in. tile, av. cut 5.80 ft.; 1,200 ft. of 26-in. tile, av. cut 6.70 ft.; 2,250 ft. of 24-in. tile, av. cut 6.10 ft.; 2,350 ft. of 28-in. tile, av. cut 7.30 ft.; 2,450 ft. of 26-in. tile, av. cut 8.30 ft.; 950 ft. of 22-in. tile, av. cut 7 ft.; 1,000 ft. of 18-in. tile, av. cut 6.90 ft.; 800 ft. of 16-in. tile, av. cut 7.60 ft.; 1,100 ft. of 14-in. tile, av. cut 7.60 ft.; 850 ft. of 12-in. tile, av. cut 7.70 ft.; 950 ft. of 14-in. tile, av. cut 7.30 ft.; 700 ft. of 12-in. tile, av. cut 5.90 ft.; 577 ft. of 10-in. tile, av. cut 4.80 ft. One concrete bulkhead and five catch basins. Lateral No. 1—854 ft. of 7-in. tile, av. cut 6.10 ft. and 1 catch basin. Lateral No. 2—800 ft. of 12-in. tile, av. cut 5.20 ft.; 700 ft. of 10-in. tile, av. cut 6.20 ft.; Branch 1 of Lateral No. 2—577 ft. of 8-in. tile, av. cut 5.70 ft. and 1 catch basin. Lateral No. 3—1,000 ft. of 16-in. tile, av. cut 5.30 ft.; 294 ft. of 10-in. tile, av. cut 4.80 ft. Branch 1 of Lateral No. 3—345 ft. of 6-in. tile, av. cut 4.30 ft. Lateral No. 4—1,500 ft. of 14-in. tile, av. cut 6.50 ft.; 696 ft. of 12-in. tile, av. cut 5.50 ft. Branch 1 of Lateral No. 4—600 ft. of 8-in. tile, av. cut 4.60 ft.; 688 ft. of 7-in. tile, av. cut 4.60 ft. and 1 catch basin. Lateral No. 5—536 ft. of 6-in. tile, av. cut 4.90 ft.

✣All bids received Dec. 20 by W. J. Freeman, Johnson County Auditor, Iowa City, Ia., for constructing a tile drain in Drainage District No. 2, were rejected, and new bids are asked for Jan. 3. The work will include: 2,975 lin. ft. of 24-in. tile, average depth 3 ft.; 3,000 lin. ft. of 18-in. tile, average depth 3 ft.; 1,400 lin. ft. of 14-in. tile, average depth 3 ft.; 1,275 lin. ft. of 12-in. t[illegible] average depth 3 ft.

The contract for the furnishing of tile for the Drainage District No. 83, Greene county, Ia., was let to the Jefferson Tile Co., at Jefferson, and the labor to Bert John of Rippey, Ia.

Louisiana.

✣Bids will be received until noon, Jan. 8, by Board of Commissioners, Caddo Levee District, Shreveport, La., for the construction of the following new levee in Caddo Parish, Red River, right bank: Brown Place Levee—Approximate contents, 95,000 cu. yds.; deposit required, $310; bond required, $4,800. Cash or certified check to the amount named as deposit must accompany each proposal. Terms of payment, cash. The right to reject any or all proposals is reserved. Other information as to location, character of work, manner of submitting proposals, execution of contract and bond, and time of beginning and completing of work, as well as blank forms for submitting proposals, may be had on application to the Board of State Engineers, Rooms 213-215 New Orleans Court Bldg., New Orleans, La., or to J. M. Sentell, President. W. A. Kerley is Secretary.

⊙The Vermillion Bay Co. has awarded the contract for the construction of the dock at Avery Island, to C. S. Jackson & Co., of New Iberia, La.

Michigan.

✣Bids will be received at 9 a. m., Jan. 8, by A. H. Reid, Genesee County Drain Commissioner, Flint, Mich., at the residence of Earl Eckley, 2½ miles east of Flint on Lapeer Road, Section 16, Burton township, for the construction of the McAllister Drain. The work will include about 5,082 ft. of 8, 10 and 12-in. tile, digging and refilling the ditch.

Minnesota.

✣Bids will be received until Jan. 16 by A. P. Erickson, Hennepin County Auditor, Minneapolis, Minn., for the construction of Judicial Ditch No. 20 and two branches, requiring about 30,000 cu. yds. of excavation. A certified check for 10 per cent the amount bid must be filed with each bid.

✣Bids will be received until 11 a. m., Jan. 14, by Jesse L. Herring, Faribault County Auditor, Blue Earth, Minn., for the construction of Judicial Ditch No. 5. The approximate amount of work and material to be furnished in the construction of such ditch is as follows: 10,250 ft. 6-in. tile, max. cut 4.5 ft., min. cut 2.5 ft., av. cut 3.26 ft.; 1,200 ft. 7-in. tile, max. cut 8.6 ft., min. cut 2.2 ft., av. cut 4 ft.; 5,100 ft. 8-in. tile, max. cut 6.1 ft., min. cut 3.4 ft., av. cut 4.62 ft.; 11,900 ft. 10-in. tile, max. cut 6.7 ft., min. cut 2.8 ft., av. cut 5.03 ft.; 16,500 ft. 12-in. tile, max. cut 7.2 ft., min. cut 3 ft., av. cut 4.87 ft.; 4,500 ft. 14-in. tile, max. cut 6.8 ft., min. cut 3 ft., av. cut 5.1 ft.; 4,500 ft. 18-in. tile, max. cut 13.8 ft., min. cut 3.4 ft., av. cut 8.23 ft. All tile or closed work requiring 231 Y's for the connecting of laterals, concrete abutment and apron at outlet. The soil black loam with clay sub-soil; no timber. Nearest railroad station, Winnebago, on the C., M. & St. P. and St. P. M. & O. Average haul 4 miles. Time one year from date of sale. First quality hard burned clay tile specified. All bids must be accompanied by certified check for 10 per cent of the amount of each bid, payable to Jesse L. Herring, county auditor. H. W. Holley is Engineer, Winnebago, Minn.

⊙C. D. Anderson and M. Sandeen, St. Paul, Minn., were awarded the contract on Dec. 21, for reconstructing Ditch No. 3, bids for which were opened Nov. 30 at St. Paul, Minn. The work calls for 89,523 cu. yds. of excavation. The contract price was $14,090.

Commissioners of Douglas County have taken favorable action on the reports for cleaning County Ditch No. 1. E. J. Brandt, Alexandria, Minn., is County Auditor.

Petition has been presented to the County Board of Renville County asking for the repair of County Ditch No. 4. J. L. Johnson, Olivia, Minn., is County Auditor.

Hearing will be held on Jan. 9 on County Ditch No. 24 of Hennepin County, petitioned for by Simon Gelle and others. A. P. Erickson, Minneapolis, Minn., is County Auditor.

J. F. Parrish has been appointed engineer of County Ditch No. 51 by the County Board of Rertville County.

Hearing will be held Jan. 3 on Judicial Ditch No. 3 of Cottonwood County. P. G. Neufeld, Windom, Minn., is County Clerk.

Ohio.

⊙Bids will be received until Feb. 12, Surveyors of Wood, Henry, Hancock and Putnam counties, at Deshler, O., it is reported, for the construction of the I. W. Butler Joint County ditch. The work proposed will include 40 miles of open ditch 2 to 16 ft. wide at bottom. The cost of the improvement is estimated at $75,000.

The Commissioners of Huron, Crawford and Seneca Counties have decided to have the county surveyors make a survey and estimate of cost by the proposed Paige Joint County ditch. Report is to be made at a joint meeting of the County Board to be held at Bucyrus, O., next June.

Petitions have been presented to the Joint Board of Commissioners of Wayne and Summit Counties, George W. Plasterer, President, Wooster, O., for a joint county ditch.

Oregon.

Work is to be started early this year on two large irrigation projects in Umatilla County. These two developments are the Paradise Project and the Tell Irrigated District. Offices for both of these are at Echo, Ore. The first mentioned will reclaim 50,000 acres of land north of Echo, a part of which is now classed as wheat land. The main canal to carry water to this tract will tap the Umatilla River east of Pendleton and follow the hills north of that city until it empties into two reservoirs near the land. The Tell District is east of the Butter Creek alfalfa region. Its supply of water will come from Camas Creek, in the extreme southern end of Umatilla County. This system will require a long tunnel through the dividing hills that form a watershed of the Umatilla and John Day Rivers. It will reclaim an area of 20,000 acres.

Texas.

✣Bids will be received until Jan. 6 by H. M. Farrell, Chairman Brazoria County Drainage District No. 9, and opened at the office of Judge H. Grass, Alvin, Tex., for the construction of ditches, including approximately 336,700 cu. yds. of excavation.

⊙Ray McDonald, Austin, Tex., has been awarded the contract at 12¾ cts. per cu. yd. for the construction of 25 miles of open ditches calling for 214,000 cu. yds. of excavation, for Wharton County Drainage District No. 2. Bids were opened Dec. 17 at Glen Flora, Tex.

The Santo Domingo Land & Irrigation Co. has work under way on its irrigation project near Garcias, east of Rio Grande City, Tex. About $75,000 will be expended for machinery and improvements. Knox Jones is General Manager.

Virginia.

✣Bids will be received until Jan. 13 at the office of the County Treasurer, Portsmouth, Va., for the construction of a drainage canal and branch ditches in District No. 1. The work contemplated will include about 60,000 cu. yds. of excavation.

Washington.

Application for right of way for an irrigation system at Wahluke, Wash., has been filed by J. R. Anderson, Pioneer Bldg., Seattle, Wash.

Wisconsin.

✣Bids will be received at 10 a. m., Jan. 14, by Commissioners of the Trempealeau Drainage District, Trempealeau, Wis., for the construction of the drainage work in said district in accordance with plans and specifications on file with Henry Roettiger, Secretary of the Commission, Fountain City, Wis.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

WATER WORKS

Arkansas.

⊙T C. Brooks & Son of Jackson, Mich., have been awarded the contract for the construction of a water works and an electric light plant in McGehee, Ark., at $23,681, exclusive of engine, which was purchased by the town. The Missouri Valley Engineering Co., Western Nat. Bank Bldg., Mitchell, S. Dak., are engineers.

California.

⊙The city of Pasadena, Calif., has let contracts for the furnishing of water pipe to the American Pipe Co. and the U. S. Cast Iron Pipe & Foundry Co., of San Francisco, Calif. Burdette Moody, City Hall, is engineer.

The Common Council of Riverside, Calif., H. C. Cree, City Clerk, has called an election for Jan. 14 for the purpose of voting on the issuance of bonds to the amount of $1,160,000 to acquire the present holdings of the Riverside Water Co., the Riverside Artesia Water Co., and a water system owned by H. P. Kyes. Of the total amount $785,000 will be spent to purchase the present systems and the remainder for betterments and extensions to the same. Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., are engineers.

The Whittier Water Co., 205 North Greenleaf Ave., Whittier. Calif., is considering the construction of a pipe line along the Workman Mill road. The matter as to style and size of pipe is still indefinite. J. B. Chaffry is general manager.

The Redlands Water Commission, Redlands, Calif., has recommended that the City Trustees advertise for bids for material for the construction of the new Redlands municipal water system. Plans have been completed by Engineers Trask & Hinckley. The Commission also recommended the purchase of the present plant of the Redlands Water Co., at $70,000.

The City Council of Santa Monica, Calif., recently decided to get accurate cost of the several water systems that have been offered the city to become part of the municipal water service, and two engineers have been selected to investigate and make a report. It is probable that $500,000 will be expended for water betterments.

J. A. Whitehead and associates have filed water right notices on the Russian and Eel Rivers with a view to presenting a proposition to San Francisco for furnishing water. They propose to put a dam across the lower end of Potter Valley to store approximately 330,000,000-gals. of water.

Colorado.

✣Bids will be received until about Jan. 27, it is reported, by City of Fountain, Colo., for the construction of a water works system in accordance with plans and specifications on file with A. W. Payne, Jr., engineer, Century Bldg., Denver, Colo.

District of Columbia.

✣Bids will be received until 2 p. m., Jan. 8, by Commissioners of the District of Columbia, Washington, D. C., for furnishing, delivering and erecting two electrically-driven traveling yard cranes for use in the water department, this city. Specifications and form of proposal may be obtained from the purchasing officer.

Georgia.

Mayor L. H. Chappell of Columbus, Ga., advocates the purchase of the present water works system. W. C. Campbell is City Engineer.

The City Council of Girard, Ga. (population 227), has had a resolution drawn up to provide for the election and sale of bonds for the purpose of purchasing a water works and lighting system for the city.

Illinois.

The citizens of the town of Grafton, Ill., contemplate the installation of a water works system. W. H. Journey is Mayor.

L. E. McGann, Commissioner of Public Works, Chicago, Ill., has awarded to Allis-Chalmers Co., Milwaukee, Wis., the contract for designing, erecting and constructing at the 14th St. pumping station, 1354 Indiana Ave.; Harrison St. pumping station, 135 W. Harrison St.; Central Park Ave. pumping station, 1015 S. Central Park Ave., and Springfield Ave. pumping station, 1747 W. Springfield Ave., a horizontal centrifugal pump driven by direct connected horizontal condensing steam turbine, with auxiliaries, accessories, etc.; contract price, $83,500.

The contract for furnishing and erecting a 16-in. lathe at the water works shops, 2354 S. Ashland Ave., has been awarded to Pratt Whitney, 12 N. Jefferson St., by L. E. McGann, Commissioner of Public Works, Chicago, Ill.; contract price, $1,228.

L. E. McGann, Commissioner of Public Works, Chicago, Ill., has awarded to the Bethlehem Steel Co., South Bethlehem, Pa., the contract for designing, constructing and erecting in Lake View pumping station, at the corner of Montrose Ave. and Clarendon Ave., 2 pumping units, each consisting of a horizontal shaft centrifugal pump driven by condensing steam turbines, each having a capacity of 20,000,000 gallons per 24 hours against a head of 120 ft., when turbine is supplied with saturated steam at 145 lbs. per sq. in.; contract price, $118,000.

Bids for constructing 7 steel coal hoppers at the 68th St. pumping station were received as follows by L. E. McGann, Commissioner of Public Works, Chicago, Ill.: Kenwood Bridge Co., 1st Natl. Bank Bldg., Chicago, $1,687.

Indiana.

The Board of Public Works of Richmond, Ind., B. A. Bescher, City Clerk, on Jan. 16 will sell a franchise for the furnishing of water to the city for a period of 25 years.

The Town Board of West Terre Haute, Ind., has appointed a committee of three to investigate the possibility of getting financiers to build the water works plant.

Iowa.

The citizens of the town of Pisgah, Ia. (population 212), at a recent election voted the issuance of bonds to the amount of $7,000 for the installation of a water works.

An election is to be held in Waverly, Ia., on Jan. 7 for the purpose of voting on the proposition of issuing bonds to the amount of $6,000 for a water works system.

The city of Valley Junction, Ia., has ordered plans for a municipal water and light plant, Charles P. Chase, Clinton, Ia., is consulting engineer.

Kansas.

A mass meeting of citizens of Jewell, Kans. (population, 839), was recently held to consider the issuance of bonds to the amount of $40,000 for the installation of a water works system.

The city of Holton, Kans., proposes to construct a dam in Banner Creek and purify the water to divert it into the city mains.

The citizens of Kingman, Kans., have voted bonds to the amount of $45,000 for the construction of a water works and an electric light plant.

Kentucky.

⊙The City Council of Jackson, Ky., has awarded the contract for the erection of a water works system to T. G. Stuart of Winchester, Ky. Preliminary surveys will be made early in the new year.

The City Council of Winchester, Ky., is having plans formulated for the making of extensions to the water works system. It is proposed to extend the pipes to the river, four miles distant.

Maryland.

The Board of Trade and Civic Club of Frederick, Md., have recommended to the City Council the purchase of the watershed to protect the city's water supply and build a storage reservoir. It is proposed that bonds to the amount of $60,000 be issued for this work.

Michigan.

✣Bids will be received until 5 p. m., Jan. 6, by C. L. Miller, City Clerk, Kalamazoo, Mich., for furnishing 500 tons, more or less, of 4, 6, 8, 10 and 12-in. cast iron water pipe.

Following bids were received by the Special Water Committee, Ann Arbor, Mich., on Dec. 20, for pumping five 8-in. artesian wells having an aggregate flow of 750,000 gals. in 24 hours: Hill Tripp Pump Co., Anderson, Ind., $8,400; W. J. Harper, Wauseon, O., $7,350.

Minnesota.

⊙A. J. Hanson of Moorhead, Minn., has been awarded the contract by that city, R. G. Price, City Clerk, for the drilling of a 10-in. well at $5 per ft. The work also includes galvanized casing and 12 ft. screen. Bids were opened Dec. 14.

The citizens of Virginia, Minn., at a recent election voted the issuance of bonds to the amount of $492,000 for the purpose of purchasing the present water and light plant in operation in that city. Recent improvements made will probably increase the value of the plant to $550,000.

The village of Excelsior, Minn. (population, 1,015), contemplates installing a water works system.

Mississippi.

The City Commissioners of Jackson, Miss., have decided to investigate the feasibility of securing an artesian well water supply for that city. It is thought that a system of this kind can be installed for about $45,000, while the construction of a filtration plant would entail a cost of about $130,000.

Nebraska.

The citizens of the village of Diller, Nebr. (population 506), at a recent election voted the issuance of bonds to the amount of $5,000 for a water works system. J. Smith Diller is village clerk.

The plant of the York Water Co., York, Nebr., is reported to have been sold to eastern capitalists. Improvements are contemplated.

The town of South Sioux City, Nebr., at a recent election voted the issuance of bonds to the amount of $25,000 for the construction of a standpipe and water works system.

New Jersey.

⊙Rogers Bros. of Moorestown, N. J., have been awarded the contract for the construction of the water filtration plant for Trenton, N. J., at about $340,000. J. R. Fell is Commissioner of Public Improvements.

New York.

⊙Wm. Horne Co., 37-39 E. 28th St., New York City, has been awarded the contract by the Board of Water Supply of that city, 165 Broadway, for the removal of chestnut growth around the site of Kensico reservoir, in the towns of Mt. Pleasant, North Castle and Harrison, Westchester County, N. Y., at $20,900. Bids were opened Dec. 23. Other contracts which this firm has under way are: Repairs to the Old Crotan Aqueduct, Department Water Supply, Gas & Electricity, amount, $115,000. Laying 12-in. pipe line at Ottisville, N. Y., Department Health, amount, $27,000. Constructing Sewerage Disposal Plant at Westfield, N. J., amount, $15,000.

⊙A. T. Essery has been awarded the contract by the State Hospital Commission, Albany, N. Y., for the improvement of water

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

supply and extension of water main at Hudson River, State Hospital, Poughkeepsie, N. Y., at $1,200. Bids were opened Dec. 18.

✣Bids will be received until 11 a. m., Jan. 8, by Alfred E. Steers, President of the Borough of Brooklyn, New York City, for the construction of sewers under four contracts. One of the largest is as follows: No. 1—For furnishing all the labor and materials required for constructing a sewer in 9th Ave., between 47th and 49th Sts. The Engineer's preliminary estimate of the quantities is as follows. 440 lin. ft. of 12-in. pipe sewer, laid complete, including all incidentals and appurtenances; 920 lin. ft. of 6-in. house connection drain, laid complete, including all incidentals and appurtenances; 6 manholes complete, with iron heads and covers, including all incidentals and appurtenances; 3 sewer basins complete, of either standard design, with iron pans or gratings, iron basin hoods and connecting culverts, including all incidentals and appurtenances.

North Carolina.

The city of Farmville, N. C., will introduce a bill in the next legislature for authority to hold an election to vote on the proposition of issuing bonds for a water works system. T. C. Turnage is mayor.

North Dakota.

⊙Bowers Bros. of Fargo, N. Dak., were awarded the contract by that city for the sinking of the 30-ft. dump pit at the site of the new artesian wells.

Oklahoma.

⊙The Halsted Construction Co., Phoenix, Ariz., has been awarded the contract by the city of Ponca, Okla., W. M. Rawlins, City Clerk, for furnishing the labor and material necessary for the construction of a power house for the water works system, and for installing machinery at $5,997. Bids were opened Dec. 19. Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., are engineers.

The Board of Public Works of Hornell, N. Y., has acquired a farm near Fremont on which it is proposed to construct a reservoir for the water works.

The Conservation Commission has granted the petition of the village of Brockport, Monroe County, N. Y. (population, 3,579), for the approval of plans to acquire a new source of water supply and to construct a new waterworks system with certain modifications of plans as designated by the Commission. The project is for the installation of a municipally owned water supply system, source Lake Ontario, 14 miles distant from the village, water to be led into a slow sand filter and thence pumped to the village by two pumping units of 750,000 gals. per day capacity each. From the pumps a 14-in. cast iron force main will be laid. South of the village there will be constructed a distribution reservoir of 1,500,000 gals. capacity, the flow line of which will be 160 ft. above the center of the village. The estimated cost is $275,000. H. C. Perry is City Engineer.

The stockholders of the Suburban Water Co., on Dec. 31 held a meeting at the company's office in Slingerlands, N. Y., for the purpose of increasing the capital stock from $30,000 to $40,000 for improvements. G. W. Slingerland is President.

It is reported that Hon. John D. Moore, State Conservation Commissioner, has granted the application of the village of West Winfield, N. Y., for approval of its plans for a municipal water supply for that village. Civil Engineer W. G. Stone of Whitesboro is Engineer for the village.

Ohio.

⊙The City Council of Kenmore, O., has let the contract for the erection of the water and sewage disposal systems. The Payne Engineering Co., of Akron, O., and the Central Engineering Bureau of Chicago, Ill., received the contracts jointly. Bonds to the amount of $100,000 and $70,000 were sold on Dec. 21 by City Clerk E. J. Shook.

Oklahoma.

⊙The Bailey Prospecting Co., of Kansas City, Mo., has been awarded the contract for the drilling of a deep well at Bokoshe, Okla.

Oregon.

The citizens of Milwaukee, Ore., at a recent election voted the issuance of bonds to the amount of $20,000 for the installation of a water works system.

The Oregon State Board of Health has adopted the report of Consulting Engineer Louis C. Kelsey, Portland, Ore., for a pure water plan from Clear Lake to provide water for all of the cities and towns of the Willamette Valley. The estimate cost of this scheme is $4,000,000. The pipe line would be 116 miles long and from 44 to 36-ins. in diameter.

Pennsylvania.

✣Bids will be received until 2 p. m., Jan. 20 by Capt. H. F. Dalton, Quartermaster, Gettysburg, Pa., for drilling three or more 8-in. tubular wells at Gettysburg.

The Elverson Water & Light Co., Elverson, Pa., has purchased a site for a water plant.

The Kyle Water Co., Washington Township, Jefferson County, Pa., has been incorporated by P. M. Marling, J. E. Morris and J. F. Sprankle, Dubois, Pa.; J. F. Dinkey, Rochester, Treasurer.

South Dakota.

✣Bids will be received until Jan. 29 (extension of date from Dec. 16) it is reported, by J. W. Summers, City Auditor, Yankton, S. Dak., for the construction of a new water works system at that city. Edmunds & Norgren, Yankton, S. Dak., are engineers.

The City Council of Beresford, S. Dak., has let a contract to J. H. Janssen of Woonsocket, S. Dak., to sink a well to the artesian stratum which is believed to underlie the surface there at a depth of 500 to 600 ft. The well will be 8 ins. in diameter to a depth of 300 ft. and 6 ins. in diameter the rest of the way.

Texas.

The Water Co., Sweetwater, Tex., Ben Anthony, Mgr., has acquired 1,280 acres of land for a reservoir site on Sweetwater Creek, seven miles southwest, and will build a reservoir which will have a watershed of over 50 square miles to store water 80 ft. deep.

A new complete system of filtering is being planned for the water works of Brownwood, Tex., and will be installed nearly next year in connection with the 2,000,000-gal. reservoir. The settling basin will probably be used. Mark E. Ragsdale is City Engineer.

W. C. Teter of New York City has applied to the Jefferson County Commissioners, Beaumont, Tex., for a franchise for a term of 50 years to lay and install water lines, pipes and mains and maintain and operate a water works system outside the city limits of Beaumont and within a radius of 10 miles from the court house.

The City Council of Beaumont, Tex., has passed a resolution whereby the city will take steps toward building and operating a municipal water works system. C. L. Scherer is City Engineer.

An election will shortly be held in Granbury, Tex. (population, 1,336), for the purpose of voting on the issuance of bonds for the construction of a water works and electric light plant.

The citizens of Marlin, Tex., at a recent election voted the issuance of bonds to the amount of $25,000 for the purpose of purchasing the remaining interest in the water works system held by A. R. Wright.

The Board of Trade of Cooper, Tex., is endeavoring to interest capital in building a waterworks system at Cooper. It is reported that a good supply of water is located near the surface.

Virginia.

The Chincoteague Gas & Water Co., Chincoteague Island, Va., has been incorporated with a capital stock of $50,000. The incorporators are: William H. Bookhammer, President; H. M. Joseph, Vice-President; J. R. Baylis, Treasurer, all of Lewes, Del.

Plans are being prepared by Consulting Engineer Harry Stevens of Washington, D. C., for the construction of from five to six miles of water mains with valves, hydrants, etc., pumping station, water tower, etc., for the city of Manassas, Va. A municipal electric light plant will also be constructed. No estimate has as yet been prepared.

Washington.

⊙The city of Tacoma, Wash., has let the contract for furnishing 4,500 ft. of riveted steel pipe for use on the third unit of the Green River gravity water system to Albert Kelly of Seattle, Wash., at $3,161.

The citizens of Friday Harbor, Wash. (population, 400), have voted bonds to the amount of $14,000 for the construction of a water works system.

The citizens of Centralia, Wash., recently voted the issuance of bonds to the amount of $300,000 to purchase the local water plant of the Washington-Oregon Corporation, and to construct a municipal gravity water system from the head waters of the Newaukum River.

West Virginia.

✣Bids will be received until Jan. 3, it is reported, by H. E. Jackson, City Recorder, Milton, W. Va., for the construction of a water works system in accordance with plans prepared by Leete-Maupin Engineering Co., Huntington, W. Va.

Wisconsin.

A special election will be held on Jan. 14 in Prairie du Sac, Wis., for the purpose of voting on the issuance of bonds to the amount of $30,000 for a water works system.

W. E. Miller of the engineering department of the Wisconsin Railroad Commission is ascertaining the tentative valuation of the plant of the Oshkosh Water Works Co., Oshkosh, Wis., with a view to its purchase by that city. A valuation of $546,437 was placed on the property two years ago.

The water works committee of the City Council, Milwaukee, Wis., has recommended that the proposed new intake be 12 ft. in diameter. The estimated cost is $100,000. Thomas McMillan is Chief Engineer.

Canada.

⊙The Canada Foundry Co., Winnipeg, Man., has been awarded the contract by the Board of Control of that city, M. Peterson, Secy., for furnishing and delivering f. o. b. City Yards, one McKiernan Terry well drilling machine at $4,230. Bids were opened Dec. 2.

⊙The Canada Foundry Co., Winnipeg, Man., has been awarded the contract by the Board of Control of that city, M. Peterson, Secy., for the supply and installation or turbine pumps and motors required for the extension of the Artesian Well Water Supply System of the city at $6,801.

The City Council of Vancouver, B. C., has awarded a contract for supplying 6, 8 and 12-in. water pipe, to Wilkinson & Co., at $43,818. For the supply of pipe, for which the estimated cost was $100,000 and $150,000, respectively, no award was made. The bids will be held up until the by-laws providing the necessary funds are passed.

The City Council of Toronto, Ont., has appropriated $27,000 for a water main along the Lakeshore road from the terminus of Queen St. to the West Toronto pumping station to increase the supply for that portion of the town.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

SEWERAGE AND SANITATION

California.

The Board of Public Works of Wilmington, Calif., has been requested by City Council for permission to advertise for bids for the construction of a sanitary and storm sewer in Fries St. The estimated cost is $10,000.

The city of Alhambra, Calif., is taking preliminary steps toward installing a municipal sanitary sewer system at an estimated cost of $125,000. Olmstead & Gilellen of Los Angeles, Calif., are Engineers.

The Board of City Trustees of Colfax, Calif., has appointed a committee to envestigate septic tanks for the sewer system. Bids will not be called for the building of the tanks until the committee has filed its report.

City Engineer S. J. VanOrnum of Pasadena, Calif., has submitted to the City Council plans for a sewer system in the S. Grand Ave. district. The estimated cost of the proposed new sewer is $17,000.

The Board of City Trustees of Hanford, Calif., has offered bonds in the sum of $105,000 for sale. The proceeds will be used in the construction of a sewer system, for which bids will be asked at once.

Delaware.

The Sewer Committee of the city of Newark, Del., has retained Consulting Engineer T. Chalkley Hatton of Wilmington, Del., to prepare plans and a skeleton bill for a sewer system for Newark. Joseph H. Hossinger is Mayor.

Idaho.

City Engineer C. C. Stevenson of Boise, Ida., has submitted an estimate of the cost of a storm sewer district, including Idaho, 13th, O'Farrell Sts. and Harrison Blvd., to the City Council. The cost of the proposed district is placed at $100,000.

⊙The Jas. Kennedy Construction Co., Fargo, N. Dak., has been awarded the contract by the city of Pocatello, Ida., F. H. Berg, City Clerk, for the construction of 22,630 ft. of lateral sewers, 51 manholes, six combination manholes and flush tanks, and septic tank. The estimated cost of the entire work is $58,619. Bids were opened Dec. 19.

Illinois.

The Board of Local Improvements of De Kalb, Ill., has adopted a resolution providing for the construction of a sewerage system. According to the estimate of City Engineer A. R. Russell the improvement will cost about $150,000. Bids will be asked shortly.

Residents on Silver and B Sts. have filed a petition with the City Council of Belleville, Ill., asking that a sewer be installed in those streets.

Chief Engineer C. D. Hill of the Board of Local Improvements of Chicago, Ill., has prepared tentative plans for the new Indiana sewer system. There will be a new pumping station at Wildwood, which will eliminate the stations at Pullman and Kensington. It is probable that it will be a year before the work can be started.

The City Council of Marshall, Ill., has voted against the proposition to construct a sewer in the north part of town.

The Board of Local Improvements of Centralia, Ill., has passed a resolution adhering to the original plans and estimates for the making of extensions to the sewer system.

The City Council of Watseka, Ill., contemplates installing a sewerage system in Watseka. Chas. L. Blake is City Engineer.

Bids for constructing sewers in the following streets were received as follows by the Board of Local Improvements, Chicago, Ill., Edward J. Glackin, Secretary: N. 56th Ave., Fullerton Ave. to Wrightwood Ave., 1,330 lin. ft. 2-ft. single ring brick, 12-ft. cut, $2.85; 8 manholes and 14 catchbasins; total, $3,790; the Ryan Co., 10 S. La Salle St. E. 106th St., Ave. H to Ave. F, 670 lin. ft., 3- ft. double ring brick, 7½-ft. cut, $4.15; Ave. F. to Ave. C, 690 lin. ft. 2½-ft. double ring, 6½-ft. cut, $4.15; Ave. C to Indianapolis Ave., 850 lin. ft. 2-ft. double ring brick, 5½ ft. cut. $3.15; Ave. G, 300 ft. N. of E. 105th to 105th St., 340 lin. ft. 12-in. tile pipe, 4½-ft. cut, $1; Ave. G, E. 105th St. to E. 107th St., 1,320 lin. ft. 18-in. tile pipe 4½ ft. cut, $1.20; E. 107th St. to E. 108th St., 640 lin. ft. 12-in tile pipe, 4 ft. cut, $1; wing sewers, 80 lin. ft. 15-in. tile pipe, 4 ft. cut, $1.20; 60 lin. ft. 30-in. cast iron pipe, 6 ft. cut, $7; 36 manholes and 31 catch basins; Cleary Bros., 55, 36 Winthrop Ave. Bryn Mawr Ave., North Shore channel to 2,620 ft. W. of Kedzie Ave., 3,160 lin. ft. 5½ ft. brick, 17 ft. cut, $7.10; 2,660 lin. ft. 5 ft., 17½ ft. cut, $6.55; 2,690 lin. ft. 4½ ft., 20 ft. cut; N. 40th Ave., 700 lin. ft. 2 ft., 14 ft. cut; 680 lin. ft. 2½ ft., 14 ft. cut; 1,330 lin. ft. 3 ft., 19 ft. cut; 670 lin. ft. 2½ ft., 17½ ft. cut; 660 lin. ft. 2 ft., 12 ft. cut; 51 manholes, 69 catch basins and 1 concrete bulk head; $74,094; H. J. McNichols, The Rookery, Chicago, Ill.

Indiana.

⊙J. H. Watson Co. has been awarded the contract by the Board of Public Works of Kokomo, Ind., Ben Havens, City Clerk, for the construction of a local sewer composed of 12-in. vitrified tile, beginning in Prairie Creek sewer at the intersection of the alley running east and west between Taylor and Jackson Sts., and running thence west in said alley to the east line of Purdum St., at $1,575. Bids were opened Dec. 23.

Iowa.

⊙Thos. Carey & Sons of Clinton, Ia., have been awarded the contract by the City Council of that city, C. J. Reusche, Clerk, for the construction of sewer in District No. 9, at $20,396. The work includes 500 lin. ft. of 24-in. pipe, 700 ft. of 18-in. pipe, 1,400 ft. of 15-in. pipe, 700 ft. of 12-in. pipe, 3,000 ft. of 10-in. pipe, 3,600 ft. of 8-in. pipe, 24 manholes, 4 flush tanks, 3,000 cu. yds. of rock excavation. Bids were opened Dec. 23.

Kansas.

Residents of Auburndale, a suburb of Topeka, Kans., have petitioned the City Commissioners to give them a new sewer service. The proposed new sewer would be approximately 3 miles in length. City Engineer A. R. Young has estimated that the following quantities would be required: 11,515 ft. of 6-in. pipe, 2,008 ft. of 10-in. pipe and 2,157 ft. of 12-in. pipe, making a total of 15,680 ft. of pipe. The entire cost of the sewer probably will range from $12,000 to $14,000.

Kentucky.

The City Trustees of Fort Thomas, Ky., have decided to have a survey made of the Highlands District with a view of ascertaining the probable cost of the most feasible scheme of installing a septic sewer system. An expert engineer will be retained.

Louisiana.

The election which was to have been held in Mansfield, La., on Dec. 27, to vote on the proposition of installing a sewerage system, was withdrawn on account of informality in the ordinance.

Maryland.

⊙The Board of Awards of Baltimore, Md., on Dec. 23 awarded contracts for nearly $500,000 worth of sewers, as follows: James Ferry & Sons, Inc., Baltimore; Section 25 of the storm-water system, $279,990; B. F. Sweeten & Son, Camden, N. J., Section 24 of the storm-water system, $166,194; William McCarthy & Co., Baltimore, Sanitary Contract No. 106, $37,834.

Massachusetts.

✣Bids will be received until noon, Jan. 14, by Commissioner of Public Works L. K. Rourke, Boston, Mass., for furnishing and erecting, in Summer St., opposite E St., South Boston, an automatic electric sewage pumping plant, and giving bond therefor of a surety company approved by the Commissioner in the sum of $1,500, to secure the due performance of the contract and the full protection of the city. Forms of proposal may be obtained at Room 49, City Hall. A certified check for $500 must be filed with each bid.

⊙Following bids were opened on Dec. 18 by the city of New Bedford, Mass., W. F. Williams, City Engineer, for the construction of a sewage screen station and connecting concrete sewer of the intercepting sewer system: (1) Stands for bid of Frank Gammino, 233 Federal St., Providence, R. I., (awarded contract); (2) J. W. Bishop Co., 417 Butler Ex., Providence, R. I.; (3) C. E. Trumbull & Co., 1121 Tremont Bldg., Boston, and (4) Jos. Long & Co., 29 Blossom St., Leominster, Mass.

	(1)	(2)	(3)	(4)
Earth excavation, 39,000 cu. yds.	$ 1.50	$ 3.41	$ 1.75	$ 2.90
Rock excavation, 250 cu. yds.	4.00	2.50	5.00	7.00
Concrete masonry in screen house, 2,100 cu. yds.	9.00	9.60	10.00	13.80
Concrete masonry in sewer, manholes, overflow, 1,142 cu. yds.	5.50	9.00	10.00	10.80
Steel reinforcing in sewer and screen house, 129,000 lbs.	.025	.03	.05	.045
Steel beams, angles, channels, Z-bars, 12,000 lbs.	.07	.05	.08	.07
Lumber left in place, 40,000 ft.	20.00	20.00	20.00	20.00
Rubble masonry in sea wall, 575 cu. yds.	11.00	10.70	9.00	10.50
Brick lining in boiler room, 1,300 sq. ft.	.30	.42	.30	.60

Michigan.

The City Council of Escanaba, Mich., recently adopted plans prepared by Consulting Engineer T. Chalkley Hatton of Wilmington, Del., for a complete modern sewage disposal system.

The W. J. Sherman Co., The Nasby, Toledo, O., has prepared plans for the construction of 3,292 ft. of 10 to 18-in. storm water sewer in Reese, Mich. The estimated cost is $3,665. The date for letting contract has not been decided.

Minnesota.

A special committee of the City Council, Minneapolis, Minn., has recommended that the next legislature be asked for authority to issue bonds to the amount of $500,000 for the construction of trunk sewers.

Missouri.

✣Bids will be received until noon, Jan. 7, by Board of Public Improvements, St. Louis, Mo., for the construction of sewers in Northwestern Sewer District No. 30, including sewers of materials, lengths and sizes as follows: Vitrified clay pipe sewers—108 ft. of 18-in. inside diameter, 360 ft. of 15-in. inside diameter, 1,164 ft. of 12-in. inside diameter, with sewer inlets, manholes, and all other appurtenances; deposit required, $230. Maxime Reber is President of the Board.

✣Bids will be received until noon, Jan. 7, as mentioned in our last issue, by Board of Public Improvements, St. Louis, Mo., for the construction of Rocky Branch Joint District Sewer in Rocky Branch Joint Sewer District, as authorized by Ordinance No. 26713, embracing 725 ft. of reinforced concrete sewer, 27 ft. by 8 ft. inside dimensions (a double conduit, each compartment 13 ft. by 8 ft. with 1-ft. division wall); 4,675 ft. of 14 ft. inside diameter brick and Portland cement

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

mortar sewer; 314 ft. of 10 ft. inside diameter brick and Portland cement mortar sewer, with inlets, manholes, junctions and all other appurtenances. Deposit required, $9,450. W. T. Findly is Secretary.

The City Council of Hannibal, Mo., has approved plans and specifications of City Engineer B. F. Smiley for Sewer District No. 100.

Nebraska.

Plans have been prepared by Consulting Engineers W. K. Palmer Co., 919 Baltimore Ave., Kansas City, Mo., for the construction of trunk sewers in Madison, Nebr., at an estimated cost of $16,000. Contracts for this work will be let in about 60 days.

New Jersey.

✣Bids will be received until 2 p. m., Feb. 4, by the Passaic Valley Sewerage Commissioners, Essex Bldg., Clinton St., Newark, N. J., for the construction of Section 7 of the Main Intercepting Sewer in compressed air tunnel. The work will include 4,930 ft. of 135-in. circular concrete sewer; 8,800 lin. ft. of 141-in. concrete sewer; 30,000 cu. yds. of concrete masonry; 300 cu. yds. of brick masonry. Drawings, etc., may be obtained at the commissioners' office from William M. Brown, Chief Engineer. J. S. Gibson is Clerk. Official advertisement will be found elsewhere in this issue.

Chief Engineer C. A. Van Keuren of the Street and Water Commissioners, Jersey City, N. J., has not as yet completed plans and specifications for the Mill Creek sewerage system.

New York.

✣Bids will be received until 8:30 p. m., Jan. 15, by Board of Trustees, Larchmont, N. Y., for the construction of sewers. Conditions under which all said proposals shall be made, the specifications, plans and detail drawings for the construction of said sewers and the form of contract under which said sewers are proposed to be constructed may be obtained at the office of L. E. Van Etten, Esq., Engineer, at Nos. 12 and 14 Lawton St., New Rochelle, N. Y. Eugene D. Wakeman is Clerk of the Board.

✣Bids will be received until 10:30 a. m., Jan. 15, by Cyrus C. Miller, President of the Borough of The Bronx, New York City, for constructing sewers and appurtenances in Lacombe Ave., between Bronx River and Bronx River Ave.; and in Bronx River Ave., between Lacombe Ave. and Metcalf Ave.; and in Metcalf Ave., between Bronx River Ave. and E. 177th St., together with all the work incidental thereto. The amount of security required is $250,000. Specifications may be had at the office of the President.

The Common Council of Oswego, N. Y., contemplates asking for bids about Feb. 15 on the construction of new sewers throughout the city. The Council has accepted the plans prepared by City Engineer Chas. H. Snyder for this work.

North Carolina.

Plans for an intercepting sewer system for Winston (P. O., Winston-Salem), N. C., have been accepted and are now ready for bids. This system will be 3 miles in length and built of 12 and 24-in. piping. It will take up the various lines now emptying into Peter's Creek and convey the city sewerage beyond the present city limits. G. F. Hinshaw is City Engineer.

Ohio.

A resolution has been passed by the City Council of Kent, O., providing that the Village Engineer be instructed to prepare an estimate of the cost of a general sewerage system, and a disposal plant for the town. Plans and specifications have already been prepared.

The City Council of Norwalk, O., has instructed City Engineer John Laylin to prepare plans for a sewer on Elm St., from Benedict Ave. to the creek, and on Whittlesey Ave., from Bouscay St. to Grand Ave.

The City Council of Geneva, O., has passed an ordinance providing for the construction of the E. Main St. sewer. New plans have been prepared by Engineer Cummings. W. E. Morgan is City Clerk.

The State Board of Health has approved plans and specifications for the construction of a small sewer system in West Toledo, Toledo, O.

Property owners of Wildwood, between Glendale Ave. and Delaware Creek, Toledo, O., have submitted plans for a new sewer system to the State Board of Health.

No bids were received on Dec. 19 by W. J. Springborn, Director of Public Service, Cleveland, O., for dry tankage, the product of the Cleveland Garbage Disposal Plant.

Oklahoma.

⊙The City Commissioners of Tulsa, Okla., have awarded the contract for building sanitary sewers in Sewer District Nos. 73 and 74 to the Wells-Franklin Construction Co., Surety Bldg., Muskogee, Okla., at $5,258.

Pennsylvania.

✣Bids will be received until 7:30 p. m., Jan. 20, by Borough of Washington, Pa., John Griffiths, Clerk, for the construction of a 20-ton garbage incinerating plant. General specifications can be obtained at the office of the Borough Engineer. Each proposal shall be accompanied by a certified check for $500.

✣Bids will be received until 10 a. m., Jan. 10, at the office of the City Controller, Pittsburgh, Pa., for the construction of sewers in the following streets: Album St., from a point about 20 ft. southwest of Dunmere St. to present sewer on Anneta St., 15-in. pipe; Bradish St., from a point about 60 ft. east of S. 11th to present sewer on S. 12th St., 9-in. and 15-in. pipe; Clemesha St. and Midland St., from a point about 85 ft. south of Aidyl Ave. to the present sewer on Midland St., 8-in. pipe; Graphic St., from a point above 20 ft. south of Prescott St. to present sewer on Kilbourne St., 15-in. pipe; Grandview Ave. (south sidewalk), from a point about 75 ft. east of Kearsarge St. to present sewer on Maple Terrace, 15-in. pipe; Grandview Ave., from a point about 5 ft. west of Amabell St. to present sewer on Merrimac St., 15-in. pipe; Kendall and Kent St., from the crown on Kendall St. south of Kent St. to present sewer on 54th St., 15-in. pipe; Flemington Ave., and private property of Harry Blair, et al., from present sewer and from the property line of the Dupont Land Co. to the present sewer on Wm. Pitt Blvd., 15-in. pipe; Merritt St., from a point about 15 ft. south of Hawkins St. to present sewer on Taggart St., 9-in. and 15-in. pipe; Novelty St. (east sidewalk), from a point about 20 ft. north of Susquehanna St. to present sewer on Hamilton Ave., 15-in. pipe; Merriman St. (south sidewalk), from a point about 40 ft. west of S. 18th St., to present sewer on S. 17th St., 12-in. pipe; Palm Beach Ave., private property of Mary A. Ward and Shiras Ave., from the present sewer on Palm Beach Ave. to present sewer on Pauline Ave., 8-in. pipe; Winterton St., from a point about 20 ft. south of Bryant St. to present sewer on Stewart St., 15-in. pipe; Liverpool St. (south sidewalk), from a point about 40 ft. west of Allegheny Ave. to present sewer on Bidwell St., 12-in. pipe; private property of the City of Pittsburgh, C. W. Jones and the Pennsylvania R. R. Co., from Grant Blvd. to the south track of the Pennsylvania R. R., 24-in. pipe.

✣Bids will be received until 3 p. m., Jan. 3, by Borough of North Braddock (P. O. Pittsburgh), Pa., for the construction of a 15-in. terra cotta sewer on Verona St., about 700 ft. of 15-in., 600 ft. of 6-in., 3 man holes, 2 receiving basins, 1 lamp hole. Plans, specifications and bidding blanks at Borough Engineer's office, Spring and Jones Aves., North Braddock, Pa. George F. Siefers is Borough Engineer.

The City Council of Chambersburg, Pa., has adopted an ordinance authorizing the extension of the sewerage system to the Chambersburg silk mills.

The Town Council of Towanda, Pa., has approved the plans and specifications for a sewage disposal plant and system as recommended by the Engineer. The system as outlined will cost $96,510.

The citizens of Jenkintown, Pa., on Dec. 27 voted on the proposition of making a loan of $75,000 for the purpose of installing a modern sewerage system. Engineers have estimated that there will be 70,000 ft. of sewer frontage to pay for with the system, and that the aggregate to be paid for by the bonds will be about $66,000.

South Dakota.

The City Commissioners of Sioux Falls, S. Dak., have passed resolutions declaring it necessary to construct sewers in Districts 1, 2 and 3. Plans and specifications have been approved.

Texas.

✣Bids will be received until noon, Jan. 20, by Dan C. Smith, Jr., City Secretary, Houston, Tex., for furnishing the necessary labor and material for the construction of the First and Sixth Ward storm sewers. The work will approximately consist of: 1,600 ft. of 4-ft. sewer, 1,173 ft. of 5-ft. sewer, 1,833 ft. of 6-ft. sewer, 16 manholes, 50 catch basins, 1,600 lin. ft. of catch basin connections. Plans and specifications can be obtained on application at the office of F. L. Dormant, City Engineer, City Hall, Houston, Tex. Each bid must be accompanied by a certified check for $3,500 on any bank in Houston, Tex., payable to the order of H. B. Rice, Mayor.

The recent election in Plainview, Tex., to vote bonds to the amount of $12,000 for street improvements and $10,000 for sewer extensions, has been declared null and void by the Attorney General at Austin, Tex. The City Council will order another election at once.

The city of San Antonio, Tex., it is reported, has retained Consulting Engineer Alexander Potter of New York City, to prepare a general plan for a comprehensive sewer system for that city. It is proposed to issue bonds for this work.

Plans are being prepared for the further extension of the sewerage system of Wharton, Tex. It is proposed to submit the proposition of levying a tax for the improvement to the voters.

The Luflin Sanitary Sewer Co., of Luflin, Tex., has been incorporated with a capital stock of $15,000. The incorporators are: G. A. Kelley, W. M. Glenn, W. R. McMullen, all of Luflin.

A survey of the city of Jacksonville, Tex., is being made with a view of installing a sewerage system during the early part of next year. It is proposed to bond the city to the amount of $35,000 or $40,000 for this work. Frank Devereaux is City Clerk.

The City Council of West, Tex., has ordered an election held Feb. 11 for the purpose of voting on the question of issuing bonds for a sewerage system.

Consulting Engineers Burns & McDonald, Scarritt Bldg., Kansas City, Mo., submitted the lowest bid to the City Council of Temple, Tex., for the work of appraising the value of the plant of the Temple Sanitary Sewer Co., and also for making estimates of the cost of a new sewer system. Six firms submitted bids and the work will not be let until the January meeting of the Council.

Virginia.

Consulting Engineer Harry Stevens, Union Trust Bldg., Washington, D. C., is preparing plans for the installation of a complete system of sewerage for the city of Manassas, Va. The work will include from five to six miles of sewers, sewage ejection or pumps, and a complete disposal plant. Contracts will probably be awarded in the spring. No estimate has as yet been prepared.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

BUILDINGS

Arkansas.

✣Bids will be received until 4 p. m., Jan. 8, by Westbrook, Grain & Commission Co., Pinebluff, Ark., for the construction of a warehouse and grain elevator.

Connecticut.

✣Bids will be received until noon, Jan. 14, by Board of Contract and Supply, Hartford, Conn., for the construction and completion of a proposed Municipal Building Extension at Hartford, Conn., in accordance with the drawings and specification prepared by Davis & Brooks, Architects, 49 Pearl St., Hartford, Conn.

✣Bids will be received until noon, Jan. 14, by Board of Contract & Supply, Hartford, Conn., for the furnishing and setting of all Bethel White Granite Stone Work on the exterior of the proposed Municipal Building Extension at Hartford, Conn., in accordance with the drawings and specification prepared by Davis & Brooks, Architects, 49 Pearl St., Hartford, Conn.

Georgia.

✣Bids will be received until 3 p. m., Jan. 31, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction, complete (including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures, and approaches) of the United States post office at Cedartown, Ga. The building is of one story and basement, and has a ground area of approximately 3,940 sq. ft. First floor only fireproof, stone and brick facing, and tin roof. Drawings and specifications may be obtained from the custodian of site at Cedartown, Ga., or at the discretion of the Supervising Architect.

⊙Algernon Blair, Montgomery, Ala., has been awarded the contract by the Southern Ry. for the construction of a fertilizer warehouse to be built at the company's terminals in Brunswick, Ga. The building will be 300 ft. in length and 100 ft. wide and will be equipped with two movable hoisting towers and an automatic railway for handling bulk freight from shore to ship.

Illinois.

✣Bids will be received until 10 a. m., Jan. 21, by the Armory Commission, Great Northern Hotel, Chicago, Ill., for the construction of an Armory for the Second Infantry, Illinois National Guard at West Madison St., near Washtenaw Ave., Chicago, Ill. W. Carbys Zimmerman, Architect, 1101 Steinway Hall, Van Buren St., Chicago, Ill.

✣Bids will be received until noon, Jan. 20, by J. C. Aydelott, Chairman Board of Education, at the office of Smith-Hippen Co., Pekin, Ill., for the construction of a high school building and of a 12-room grade school building. Bids are desired on each building separately and for both buildings together. The heating and ventilating and plumbing contracts will be let separate from the general contracts. Plans can be obtained by addressing Hewitt & Emerson, archts., 321 Main st. Peoria Ill. Each applicant for plans and specifications for the general contracts must send with his application a certified check for $15 for each of the two buildings made out in favor of the architects. Each applicant for plans and specifications on the heating and ventilating and on the plumbing shall send with their application a certified check for the sum of $10.00 for each of the two buildings made out in favor of the architects.

✣Bids will be received until noon Jan. 7, by E. E. Fitch County Clerk Cambridge Ill., for general construction of the proposed Henry County Infirmary buildings to be located near Cambridge Ill. The buildings are to be of fireproof, stone and brick construction, two stories and basement. Drawings and specifications may be obtained at the office of the Architect, J. Grant Beadle, Galesburg, Ill., after November 30th, 1912.

Maine.

✣Bids will be received until 3 p. m., Jan. 30, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures, and approaches, of the United States post office at Biddeford, Me. The building is of one story and basement, and has a ground area of approximately 5,200 sq. ft.; fireproof construction throughout; stone and brick facing; and tin roof. Drawings and specifications may be obtained from the custodian of site at Biddeford, Me., or at the discretion of the Supervising Architect.

Maryland.

✣Bids will be received until noon, Jan. 9, by the city of Annapolis Armory and Convention Hall Commission for State of Maryland, Annapolis, Md., for the erection of an armory and convention hall building in the city of Annapolis. A certified check for $500 must be filed with each bid. Baldwin & Pennington, 330 N. Charles St., Baltimore, Md., are Architects.

Massachusetts.

⊙Charles G. Wetter, Philadelphia, Pa., has been awarded the contract for the erection of the Harry Elkins Widener Memorial Library at Harvard University, Cambridge, Mass. The building will cost $1,400,000; will be of brick and marble, 3-story, 210 by 275 ft., and will have a specially fireproofed section. Horace Trumbauer, Philadelphia, Pa., is the architect.

Michigan.

✣Bids will be received until 1 p. m., Jan. 2, by Martin Voetsch, County Clerk, Baraga County, L'Anse, Mich., for the construction of a building of a jail and sheriff's residence at L'Anse, Mich. Charlton & Kuenzli, Marquette, Mich., are architects.

New Jersey.

✣Bids will be received until 11 a. m., Jan. 18, by H. R. Stanford, Chief of Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., for steel roof trusses, braces, etc., at the United States naval magazine, Dover, N. J. Estimated cost, $500. Plans and specification can be obtained on application to the bureau.

New York.

✣Bids will be received until 3 p. m., Jan. 25, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for three electric passenger elevators in connection with the reconstruction of the U. S. Barge Office, New York City, in accordance with drawing and specification on file at the office of the Architect.

⊙The Crucible Steel Company of America has awarded to the McClintic-Marshall Construction Co., of Pittsburgh, Pa., the contract for the construction of the steel work of the $1,000,000 plant to be erected in Syracuse as an enlargement of the Sanderson Brothers' plant. Approximately 3,500 tons of structural steel will be used. About 12 buildings will be erected on the 19-acre site which has been purchased by the Crucible Steel Co. for the new plant. These buildings will include a melting plant, a rolling mill, wire mill, machine shops, annealing and warehouse building, office and chemical laboratory, power house and several smaller structures. All the buildings will be of skeleton steel construction, while brick and concrete will be the other principal building materials.

Ohio.

✣Bids will be received until 10 a. m., Jan. 7, by Board of County Commissioners, Huron County, Norwalk, O., for the construction and erection of a Childrens' Home. Proposals will be for the excavation, concrete and cement work, stone work, brick and tile work, carpenter work, and lumber, hardware, glass and iron work, painting and glazing, plastering and roofing and sheet metal work, and generally, for the letting of a contract for the construction and erection of said children's home and the performance of the necessary work and labor and furnishing of the necessary materials therefor. Plans and specifications for said improvement will be on file with J. E. Smith, County Auditor at Norwalk, Ohio.

Vrydaugh & Wolf, Architects, 347 Fifth Ave., Pittsburg, Pa., are preparing plans for a 2-story brick and stone church building to cost $80,000 to be erected for the Westminster Presbyterian Congregation, Steubenville, O.

Bids have been taken by Architects Albert Pretzinger and Edward Musselman, 1125 Reibold Bldg., Dayton, O., on the construction of an 11-story concrete and steel fireproof office building at Main and Fourth Sts., Dayton, for the Louis Reibold estate. The cost will be $400,000.

Plans have been filed at the Building Inspection Office, Cincinnati, for a new telephone building to be erected at 4th Ave. and Hammond St. It is to be of steel construction, 10 stories in height, and will cost about $250,000. Harry Hake, Prov. Bank Bldg., Cincinnati, is the Architect.

Oregon.

⊙The Dinwiddie Construction Co., Yeon Bldg., Portland, Ore., has been awarded the contract for the erection of a 12-story building on Morrison St., Portland, for the Northwestern Fidelity Co. Building will be of steel and reinforced concrete construction, 60x200 ft., and will cost about $750,000. Doyle, Patterson & Beach, Worcester Bldg., Portland, are the Architects.

The Directors of the Portland School District, Portland, have recomended that they be authorized to issue $1,000,000 in bonds with which to purchase sites for new school buildings and erect the necessary structures. Among the buildings proposed is a new home for the School of Trades on the half block recently purchased on 7th St. opposite the new Lincoln High School and a new high school for Southeast Portland.

Pennsylvania.

✣Bids will be received until Jan. 6, by officials of Sharon, Pa., for the erection of an $85,000 electric lighting plant in accordance with plans prepared by G. Nicolls, Architect, Sharon, Pa. The building will be 50x80 ft. and of brick construction.

⊙The General Electric Co. is planning the expenditure of about $1,000,000 this year for additions and extensions. Henry Shenk Co., Erie, Pa., have the contracts for a considerable part of the work.

⊙W. B. Bennett, 742 North Negley Ave., Pittsburg, Pa., has been awarded the contract by H. E. Kennedy Co., Architects, Home Trust Bldg., Pittsburg, for constructing a brick and steel fireproof vaudeville theater at Center avenue and Sheridan St., Pittsburg, for T. B. Moreland, 6104 Penn Ave. The Harris Amusement Co. is the lessee. The building will cost $150,000.

The committee on Charities of the Council of Pittsburgh, Pa., has sent a communication to the mayor and director of the Department of Charities, authorizing them to select an architect ot draw plans for new buildings to be erected at Marshalsea, the city home, and to supervise their erection. The city solicitor is to insert a clause in the resolution making the selection of the architect subject to the confirmation of council.

Dean & Stoplet, Architects, Fitzsimmons Bldg., Pittsburgh, will prepare plans for the alterations to be made to the Bakewell Bldg., Grant and Diamond Sts., Pittsburgh, for Gilbert T. Rafferty. The improvement will cost $80,000.

Texas.

✣Bids will be received until Jan. 6 by J. W. Butler, Clifton, Tex., for the erection and completion of a brick bank building. Plans and specifications will be found at the office of Milton W. Scott, Architect, Waco, and First Guaranty State Bank, Clifton, Tex.

✣Bids will be received until 3 p. m., Jan. 24, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the electric passenger elevator in the United States courthouse, Texarkana, Tex., in accordance with the drawing and specification, copies of which may be had at the discretion of the Supervising Architect.

⊙City Council of Houston, Tex., has awarded contracts as follows for the North Side Junior High School Building: General work, McKee Contracting Co., $72,589; heating and ventilating, Collins Plumbing Co., $9,429; plumbing, gas piping and sewering, Collins Plumbing Co., $5,942; electric wiring, Barden Electric Manufacturing Co., $1,950; vacuum cleaning, C. A. Cleaver, $775; steel lockers, R. B. Everett, $1,661.

Washington.

The State Board of Control, Olympia, Wash., is to ask the following appropriations for state buildings during the present year: Eastern Hospital for Insane, constructions, repairs, equipment, replacements and betterments, $456,350; Western Hospital for Insane, maintenance, construction, repairs, replacements and betterments, equipment, $577,960; Northern Hospital for Insane, construction, repairs, replacements and betterments, purchase and betterments, purchase and clearing of land, $563,625. Institution for Feeble-Minded, construction, equipment, purchase of land, $421,400; State Soldiers' Home, construction, repairs, equipment, $146,200; Washington Veterans' Home, construction, repairs, replacements, equipment, $368,259; School for Deaf, construction, repairs, replacements and betterments, equipment; State Penitentiary, construction, repairs, equipment, $367,550; State Training School, $303,670; State Reformatory, $474,000.

About $350,000 is to be expended this year for the erection of two new buildings at the University of Washington, Seattle. One of the buildings will be used for recitation rooms; it will be 2 stories, of concrete and brick construction. The other will be used for dormitory purposes, and will be 2 stories, of reinforced concrete and fireproof. Prof. Condon, of the University, is in charge of the plans.

The Trustee Co., Central Bldg., Seattle, Wash., is considering the erection of an 18 to 20-story addition to the Bailey Bldg., at Seattle. Tentative plans call for a 125-ft. by 60-ft. steel and concrete fireproof addition, costing about $400,000.

Canada.

✣Bids will be received until 4 p. m., Jan. 13, by R. C. Desrochers, Secretary Department of Public Works, Ottawa, Ont., for the construction of additions and alterations to Public Building, Oshawa, Ont. Plans and specifications and form of contract can be seen and forms of tender obtained at the office of Mr. Thos. Hastings, Clerk of Works, Postal Station F, Younge St., Toronto, at the Post Office, Oshawa, Ont., and at the Department of Public Works.

✣Bids will be received until 4 p. m., Jan. 13, by R. C. Desrochers, Secretary Department of Public Works, Ottawa, Ont., for the construction of a post office building at Eganville, Ont. Plans, specification and form of contract can be seen and forms of tender obtained at the office of Messrs. Morris & Moore, architects and civil engineers, Pembroke, Ont., at the Post Office, Eganville, Ont., and at the Department of Public Works.

John Atchison & Co., Winnipeg, Man., were the winners in the competition for preparing the plans for the city hall at Moose Jaw, Sask. The building is to cost about $225,000.

The Canadian Government proposes to erect a new federal building at Berlin, Ont., to cost $200,000. Robert Rogers, Ottawa, Ont., is Minister of Public Works.

A 5-story business block, costing $175,000, is to be erected early this year on Central Ave., Prince Albert, Sask., by Ald. J. S. Woodward of that city and the Bradshaw agencies.

RIVERS AND HARBORS

California.

⊙The Snare & Triest Co., 143 Liberty St., New York City, has been awarded the contract at $444,777 for constructing the reinforced concrete wharf at Huntington Fill for the City of Los Angeles, Cal. The work includes the construction of about 2,520 lin. ft. of reinforced concrete wharf complete, including 580 ft. of railroad track, sheet pile bulkhead, anchorage, riprap protection, steel cylinders, pavements, fenders, foundation piles for warehouses, etc. Bids were opened Dec. 16.

District of Columbia.

✣Bids will be received until 10:30 a. m., Jan. 20, by Maj. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under Canal Circular 753, steel reinforcing bars, journal bearings, steel wire, pipe fittings, hammers, reamers, taps, wrench parts, hinges, vises, cotters, rivets and burrs, chain blocks, tackle blocks, coal baskets, hose valves, cocks, steam gages, engine gongs, oars, lantern globes, window glass, packing, twine, towels, water coolers, spoons, dishes, cheesecloth, silica wash, silica grit and lumber.

Florida.

✣Bids will be received until noon, Jan. 23, by Capt. J. B. Slattery, U. S. Engineer, Jacksonville, Fla., for furnishing material and raising jetty at entrance to St. John's River, Fla.

Illinois.

Bids were opened Dec. 17 at the U. S. Engineer's Office, Rock Island, Ill., for the construction and repair of dams and shore protections, the low bidders being as follows: Work between Clayton, Ia., and Cassville, Wis., $57,000 to be expended, Kirchner Contracting Co., Dubuque, Ia.; between Rock River and Fairport, Ia., $57,000 to be expended, Builders' Sand & Gravel Co., Davenport, Ia.; between Keokuk, Ia., and Canton, Mo., $61,750 to be expended, A. W. Fetter, Quincy, Ill.

The Commissioners of the Illinois and Michigan Canal, Lockport, Ill., are to ask the State Legislature for an appropriation of at least $500,000 for cleaning out the canal from Lockport to the mouth of the Hennepin Canal, and for other improvements.

Massachusetts.

The Directors of the Port of Boston, 40 Central St., Boston, Mass., have appropriated $3,000,000 for the construction of a dry dock at South Boston, capable of accommodating a ship 1,000 ft. in length and 120 ft. in breadth. Frank W. Hodgdon is Chief Engineer of the directors.

Michigan.

Business men of Battle Creek, Mich., are making arrangements to investigate the possibilities of cutting and straightening the Kalamazoo River, forming a commercial waterway from Battle Creek to Saugatuck at the mouth of the stream on Lake Michigan

Promoters of the proposed hydro-electric development on the Sturgeon River in the Upper Peninsula have been in conference with the State National Commission. Attorney Wm. P. Belden, Ishpeming, Mich., is interested.

Citizens' committee at Ludington, Mich., has decided to incorporate a company capitalized at $25,000 and to be known as the Lake Hamlin Resort Association, for the purpose of rebuilding the dam at Hamlin Lake. Plans for the dam estimated to cost $17,000 have been submitted by Prof. A. E. Phillips, Armour Institute, Chicago, Ill. George W. Clarke, City Engineer, Ludington, has also submitted a plan for a dam estimated to cost $14,000.

Pennsylvania.

Bids were opened Dec. 19 by Lt. Col. Francis R. S. Runk, U. S. Engineer, Pittsburgh, Pa., for furnishing movable parts of 7, 9 and 19, Ohio River. The probable contractors are as follows: Lot A, 705,970 lbs. wicket wire, Pittsburgh Trolley & Forge Co., Pittsburgh, Pa., at 2.9975 cts. per lb.; Lot B, 727,416 lbs. horses, Penn Bridge Co., Beaver Falls, Pa., at 5.45 cts.; Lot C, 648,728 lbs. props, C. Heppenstall Forge & Knife Co., Pittsburgh, Pa., at 3.95 cts.; Lot D, 570,450 lbs. service bridges and Poiree trestles, Penn Bridge Co., at 3.8 cts.

Texas.

Bids were opened Dec. 18 by Lt.-Col. C. E. Ritchie, U. S. Engineer, Galveston, for dredging 578,000 cu. yds. of material from the Texas City Channel, to receive a 30-ft. depth. The Bowers Southern Dredging Co., Galveston, at 13½ cts. per cu. yd., was the low bidder.

Washington.

✣Bids will be received until 11 a. m., Jan. 20, by Depot Quartermaster, Seattle, Wash., for furnishing at Seattle or Tacoma, Wash. (or other Puget Sound ports), Portland, Ore., or other Pacific Coast ports accessible to vessels of deep draft, or Manila, P. I., 3,317,737 ft. B. M. lumber for the Philippine Islands. For further information address the Depot Quartermaster, Seattle, Wash.

Canada.

✣Bids will be received until 4 p. m., Jan. 7, by R. C. Desrochers, Secy., Department of Public Works, Ottawa, Ont., for the construction of six steel hopper scows, 300-yd. capacity each. Plans, specification and form of contract can be seen and forms of tender obtained at this department and at the offices of T. H. Schwitzer, Esq., Mech. Superintendent, Birks Bldg., Ottawa, Ont.; J. G. Sing, Esq., District Engineer, Confederation Life Bldg., Toronto, Ont.; C. E. W. Dodwell, Esq., District Engineer, Halifax, N. S., and H. H. Donnelly, Esq., Supt. of Dredges, St. John, N. B.

✣Bids will be received until 4 p. m., Jan. 7, by R. C. Desrochers, Secy., Department of Public Works, Ottawa, Ont., for the construction of an extension to the wharf at Providence Bay, Manitoulin Island, Algoma District, Ont. Plans, specification and form of contract can be seen and forms of tender obtained at the Department and at the offices of J. G. Sing, Esq., District Engineer, Confederation Life Building, Toronto, Ont.; H. J. Lamb, Esq., District Engineer, Windsor, Ont., and on application to the Postmaster at Providence Bay, Ont.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ENGINEERING AND CONTRACTING

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and to Methods and Cost of Construction

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Plant Performance Records at Panama.

The records of performance of construction plant and machines working at Panama provide an interesting feature in the accounts of the canal work published by the engineers in charge. A summary of these performance records for the construction year ending last June is made in another section of this issue. Obviously, too precise conclusions may not wisely be drawn from the limited data presented, but there are two bits of evidence which stand out so prominently and are so consistent throughout the records that they may be accepted as good bases for broad conclusions. These are the excesive loss of time by all working plant in waiting upon co-ordinate operations, and the exceedingly small delay to operations caused by repair work.

A glance at the tabulations of delays which we have arranged from the canal engineers' reports shows that of their total operating time from 7 to 66 per cent was time idle waiting for material to be delivered or taken away or for other operations necessary for continuance of work to be performed. Indeed of the 13 items of plant for which performance records are given only one exhibited less than 14 per cent time idle for the causes named, nine items exhibited over 20 per cent time idle, four items exhibited over 30 per cent time idle and two items exhibited 57 per cent and 66 per cent time idle. These percentages, be it noted again, do not represent total delays but only delays waiting on co-ordinate operations. The greatest of these delays, moreover, are not exhibited by plant whose operations are necessarily complex but by the stone crushers and concrete mixers, almost the simplest of all machines employed on the canal.

Turning now to the percentages of time idle due to repairs we find it running from zero to 7¼ per cent of the total time in operation. The highest percentage of delays for repairs are naturally exhibited by the larger and more complex machines like the concrete handling cranes. The greatest delay for repairs to mixers was less than 1 per cent of the total operating time and the same is true of the large crushers at the Porto Bello quarries. Other figures may be gleaned by those interested from the tabulations which we publish. They are all surprisingly small, and indicate that excellent care was taken by the canal engineers in the up-keep of the plant being worked. What, on the other hand, should be said of the co-ordination of work which permitted losses of 20, 30, 40, 50 and to 66 per cent of time in operation because of delays waiting for other operations?

Let us consider for example the crushing plant at Porto Bello. This plant lost by delays 50.16 per cent of its total time in operation and those delays were made up as follows:

Item—	Per cent.
Repairs to machinery....................	1.66
Crusher choked	0.56
Waiting for stone.......................	30.60
Waiting for barges (bins full)..........	13.63
Other causes	3.71
Total	50.16

With perfect co-ordination with the crushing plant of the operations for supplying stone to the crushers and of removing the crushed stone from the crusher bins, the crushing plant would have needed to be run only about half the time that it was run. We have not presented these figures patricularly in criticism of the Porto Bello quarry management, but for the sake of the general lesson they teach. There are few more common defects in managing work than failure so to co-ordinate different operations that none will have to wait on another.

The law of coordination as given by a well known treatise on management engineering is: "So schedule the performance of each gang of men that they will work in perfect coordination with other gangs, either adjacent or remote." There is no new idea in this law. It is of as ancient invention perhaps as is the working in concert of men. Every manager unconsciously applies the law. The scientific manager is one who consciously applies it.

Perfect coordination is seldom possible, but also it is seldom in construction work that more perfect coordination than exists is not possible if attempts to secure it are earnestly made. Generally adjacent operations are more nearly coordinated than those which are performed at points remote from each other. This is because the eye of the manager is always on adjacent operations, and ever observes where one is lagging and thus delaying another. Whenever concrete operations are progressing at points remote from each other the manager has to substitute a plan of indirect observation for the direct observation possible with adjacent operations. No better plan of indirect observation has been devised than the time table. There are few better examples of the coordination of widely remote operations than train operations on a well managed railway. The means to this perfection is the time table. Trains do not invariably keep to the time scheduled in the time table, nor can constructive operations be made to do it, but without the time table neither sort of operations will adhere to any kind of time. In direct observations of adjacent operations the manager may carry his time table in his mind but he nevertheless has one and employs it. For remote operations he must devise other means and the written time table is a successful means.

Albert Ferdinand Reichmann, President Western Society of Engineers.

Albert F. Reichmann, the newly elected President of the Western Society of Engineers, exemplifies the engineer as a specialist more completely than is common in his profession. Since his first engagement in 1890 as draftsman with the Lassig Bridge & Iron Co., now the Lassig Plant of the American Bridge Co., Mr. Reichmann has been employed almost exclusively in steel bridge and building design and construction. From draftsman and computer at Lassig's the young engineer went to the Bridge and Building Department of the Chicago, Milwaukee & St. Paul Ry. Mr. Onward Bates, Past President of the Western Society of Engineers and of the American Society of Civil Engineers, was then engineer and superintendent of bridges and buildings for the Chicago, Milwaukee & St. Paul Ry., and under his direction Mr. Reichmann assumed charge of the designing office. This was in November, 1894. Early in 1900 Mr. Reichmann took a position as structural designer with Sargent & Lundy, Consulting Engineers of Chicago, but remained there only three months, when he was appointed resident engineer in Chicago of the American Bridge Co. He has held this position since July, 1900.

During the approximately six years of his connection with the Chicago, Milwaukee & St. Paul Ry. that company built some 360 steel bridges and 260 masonry culverts, the design of which came under Mr. Reichmann's direction as head of the designing office. An account of these six hundred and more structures would exhibit all the variety of conditions to be met and problems to be solved that the bridge work of a great railway system has to present, but there is space here for particular mention of only those structures that have become, because of size or character, most familiar to engineers. They are the Mississippi River bridge at Minneapolis, the viaducts for the company's track elevation in Chicago, the company's ore dock at Escanaba, Mich., and the 400-ft. pontoon built to carry railway temporarily across the Mississippi River.

As resident engineer in Chicago of the American Bridge Co., Mr. Reichmann assumed charge of all the company's engineering work in the territory lying west of Chicago to the Pacific coast and between Duluth and New Orleans. Here again the number and variety of structures that have come under his direction make individual mention impossible. They have called for two kinds of work, complete designing and detailing of the whole structure and detailing of structures for which general designs had been prepared by other engineers.

Of the more important structures well known to bridge engineers, the complete designing of which have come under Mr. Reichmann's direction, two were the pioneer structures in steel of their kind. These were the two steel ore docks built at Two Harbors, Minn., for the Duluth & Iron Range R. R. One of these docks had a height of 73 ft. above the water and a width of 52 ft.; it contained 148 ore pockets with an aggregate capacity of 37,000 tons of ore. This was the first of the Great Lakes ore docks to be constructed entirely of steel, and, since these docks are unique to ore shipments on the Great Lakes, it was necessarily the first steel ore dock ever built. The second steel dock at Two Harbors was of a still greater capacity of 52,000 tons stored in 208 pockets.

The more important bridges completely designed under Mr. Reichmann's direction include the somewhat celebrated double deck, double track 300-ft. space over the St. Louis River at Duluth, Minn., for the Interstate Transfer Railway. This bridge was designed for a train load on its upper deck of 6,800 lbs. per lineal foot and for a lower deck interurban electric car loading and was at the time of its completion the heaviest single bearing bridge span ever built. Other large bridges designed in Mr. Reichmann's office were: The Snake River viaduct, 3,920 ft. long, including five 226-ft. riveted truss deck spans erected as cantilevers because of their great height of 185 ft. above the river; the Spokane River and Hangman Creek viaduct, 2,520 ft. long and 160 ft. high, and the Missouri River bridge at St. Joseph, Mo., consisting of three 300-ft. fixed spans one 360 ft. swing span and plate girder approaches. The erection of this swing span had to be accomplished around an old span still in service and without falsework for one arm and called for unusual detailing.

Albert Reichmann

The building work designed by Mr. Reichmann's office comprises the notable structures of the Indiana Steel Co. and the American Bridge Co. at Gary, Ind.; the buildings of the Minnesota Steel Co. at Duluth, and the 1,000 tons per day concentrating plant of the Oliver Iron Mining Co. at Taconite, Minn.

Besides the complete design of many steel structures which have been completed in Mr. Reichmann's office, it has done the shop detailing for numerous bridges and buildings, the general designs for which were made in other offices. One of the largest bridges for which shop details were prepared was the Thebes cantilever bridge, a double track structure 2,750 ft. long crossing the Mississippi River with two 512-ft. fixed spans, three 366-ft. suspended spans, and four 152½-ft. cantilevers. The Willamette River Lift bridge at Portland, Ore., is another structure deserving of mention because of its vertical lift span of 220 ft., the largest of its type ever built. In addition to its lift span this bridge had two fixed spans of 287 ft. All spans were double-deck, the lower deck carrying two railway tracks and the upper deck, a street railway and street traffic. The similar but smaller lift bridge constructed later at Tacoma, Wash., and known as the City Waterway Lift, was also detailed under Mr. Reichmann's direction.

Three other railway bridges of exceptional size which were detailed in Mr. Reichmann's office are: The Columbia River bridge of the Portland & Seattle Ry.; the Willamette River bridge for the same road, and the Missouri River bridge for the Atchison, Topeka & Santa Fe Ry. The Columbia River Bridge and the Willamette River Bridge were both double track structures; the first named consisted of about 465-ft. swing span of six 265-ft. one 371-ft. and one 185-ft. fixed spans, and the second named consisted of a 521 ft. swing span and four 265-ft. fixed spans. The Missouri River Bridge had four 400-ft., one 247-ft. and two 172-ft. fixed spans and a steel viaduct approach 2,000 ft. long.

Among the more recent bridge and building work for the detailing of which M. Reichmann's office has been responsible are: The Illinois Central R. R. track elevation viaducts in Chicago; several viaducts for the Chicago & Eastern Illinois Ry.; two four-track skew spans for the Metropolitan West Side Elevated Ry. in Chicago; the steel viaduct approaches and other steel work for the La Salle St. and Chicago & Northwestern terminals in Chicago, and the tall buildings for the Commercial National Bank, the Marshall Field estate, the Rothschild store, the North American, the Chicago Telephone Company and the Chicago, Burlington & Quincy R. R. office buildings, all in Chicago; the Northwestern Mutual Life Insurance office building in Milwaukee, Wis., and the Dime Savings Bank office building in Detroit, Mich.

Mr. Reichmann was born in Dubuque, Ia., in 1868, and completed his technical schooling at the Grossherzoglich Badische Technische Hochschule at Karlsruhe, Germany. He became a member of the Western Society of Engineers in December, 1897, and was elected treasurer of the society in January, 1906. Mr. Reichmann is a member of the American Society of Civil Engineers, of the American Railway Engineering Association and of the Engineers' Club of Chicago.

Exhibit of Bureau of Standards.—An interesting exhibit of testing apparatus was made by the United States Bureau of Standards at the recent cement show in Pittsburgh. The same exhibit will be used by the bureau at the coming cement show to be held in Chicago Jan. 16-23. The following will give an idea of the exhibit: Varieties of cement test pieces, machinery and appliances used for making cement tests, apparatus for standardizing sieves and specific gravity bottles, an exhibit of a concrete electrolysis test piece, a chemical exhibit showing the standard method of analyzing cement, a strain gage with diagrams showing the value of strain measurements to the engineer, and an interfometer mounted on a concrete test beam showing the possibilities of precise measurements.

GENERAL ARTICLES

Tabulations of Energy of Explosives and Toughness of Rock for Use in Selecting Explosives.

If one knows the total energy of two explosives, and the percentage of this energy available as percussive force, and if one knows further the toughness of the material to be blasted, one can say which of the two explosives will be best suited to the work. Even cost factors can be brought in when this stage of the calculation has been reached. In a paper before the Engineers' Society of Western Pennsylvania, Dr. Walter O. Snelling, Consulting Chemical Engineer, Pittsburgh, Pa., presents tabulations of total energy of explosives, of percussive and propellent force, and toughness of rocks which may be used for selecting explosives. The data on toughness of rocks are quite unique and are arranged from results of tests of rock for road material which have been conducted during several years by the U. S. Office of Public Roads. We abstract Dr. Snelling's paper as follows:

All commercial explosives are alike in that their effects are due solely to the large volumes of gas suddenly set free, but these explosives differ from one another greatly in regard to the rate at which this evolution of gas takes place. Nitro-glycerin, blasting gelatine, and certain grades of dynamite, evolve great volumes of gas in a period of time that must be measured by thousandths, or even ten-thousandths of a second, while other explosives, notably black powder, evolve similarly large volumes of gas in a much slower manner. The more rapid explosives are wholly shattering in their action, and are used in breaking up the harder kinds of rock. The slower acting explosives have but little shattering action, and the manner in which they produce large volumes of gas in a regular manner make them well suited for such uses as that of propellent in guns, for example. As we will have to consider the total energy of all explosives as being represented by different intensities of these two factors, the propellent factor and the percussive factor, we can consider that the total energy of any explosives can be divided between these two quantities. The forces which produce a shattering effect are what we will call the percussive factor, and the continued pressure produced by a slower evolution of gas we will call the propellent factor.

Table I gives the total energy of a number of explosives as determined by well known energy test methods.

In order to obtain practical results from the energy data of explosives, it is necessary to know the percussive and propellent factors of the explosive. An explosive having a high percussive ratio may be several times as efficient in breaking rock as another explosive of equal energy, but which has a lower percussive value, and accordingly the methods for determining the percussion and propellent factors of explosives are important.

It will probably have already been made clear that by the selection of suitable units for percussive and propellent factors, these could be mathematically related to total energy. Up to the present time no units have been selected which make such mathematical relationship possible, but carefully conducted experiments have convinced me that to bring about this result is not in any way difficult, and I hope that we will soon be able to discuss these factors in a definite way. It must, of course, be admitted that the division of the energy might have different values, depending upon the nature of the units selected for percussive and propellent force, respectively, but by taking suitable units, probably based upon the results of suspended Trauzl blocks, this matter will admit of ready solution.

TABLE I.—TOTAL ENERGY OF EXPLOSIVES.

Explosive.	Energy in foot tons from 1 pound.	Energy in calories from 1 kg.	Energy in kilogrammeters from 1 kg.
Blasting gelatine[1]	1,148.9	1,640,000	700,587
Blasting gelatine[4] (7% nitrocellulose)	1,075.3	1,535,000	655,732
Blasting gelatine[5] (7.29% nitrocellulose)	1,085.6	1,551,000	662,568
Blasting gelatine[3]	996.3	1,422,000	607,460
Nitroglycerine[1]	1,107.0	1,580,000	674,955
Nitroglycerine[4]	1,029.8	1,469,800	627,879
Nitroglycerine[6]	1,157.3	1,652,000	705,713
Nitroglycerine[7]	1,099.9	1,570,000	670,684
Dinitroglycerine[5]	859.9	942,000	402,410
Dynamite, 75%[1]	903.8	1,290,000	551,071
Dynamite, 75%[1]	819.7	1,170,000	499,809
Gelatine dynamite, 65%[3]	925.5	1,321,000	564,314
Gelatine dynamite, 65%[4]	879.6	1,267,000	541,246
Dynamite, 40% active dope[1]	903.8	1,290,000	551,071
Dynamite, 40% active dope[6]	864.6	1,221,400	527,166
Dynamite, 30% active dope[4]	721.6	1,030,000	440,003
Picric acid[1]	567.4	810,000	346,021
Picric acid[4]	611.7	873,200	373,020
Carbonite No. 1[3]	421.1	601,000	256,739
Donarite[3]	585.7	836,000	357,128
Aetna coal powder A[2]	517.2	738,300	315,392
Aetna coal powder B[2]	532.8	760,500	324,876
Carbonite No. 1[2]	539.5	770,100	328,977
Carbonite No. 2[2]	498.6	711,700	304,029
Carbonite No. 3[2]	494.4	705,700	301,466
Carbonite No. 1, L. F.[2]	481.1	686,700	293,349
Carbonite No. 2, L. F.[2]	465.7	688,200	283,990
Coal special No. 1[2]	563.9	805,000	343,885
Coal special No. 2[2]	524.8	772,500	320,002
Coalite No. 1[2]	502.6	717,400	306,464
Coalite No. 2 D[2]	553.1	789,600	337,307
Collier powder No. 2[2]	388.2	696,900	297,707
Collier powder No. 4[2]	533.8	762,000	325,516
Collier powder No. 5[2]	603.5	861,400	367,979
Masurite M. L. F.[2]	695.5	992,800	424,111
Meteor A X X O[2]	427.8	610,600	260,840
Monobel[2]	796.6	1,137,100	485,754
Black powder[1]	479.9	685,000	292,623
Black powder[3]	402.1	574,000	245,205
Black powder, F. F. F.[2]	553.0	789,400	337,221
Mercury fulminate[1]	287.2	410,000	175,147
Mercury fulminate[4]	288.1	411,200	175,659
Nitrocellulose (13.30% N_2)[6]	743.2	1,061,000	453,245
Nitrocellulose (13% N_2)[1]	770.6	1,100,000	469,906
Nitrocellulose (13.47% N_2)[4]	728.1	1,039,300	443,975
"Pyrocellulose" powder (12.75% N_2)	671.7	958,830	409,600
Nitrocellulose (12% N_2)[1]	511.4	730,000	311,847
Nitrocellulose (11.11% N_2)[4]	557.1	795,100	339,657
E. C. powder[6]	560.4	800,000	341,750
S. S. powder (English)[6]	559.7	799,000	341,322
Troisdorf (German)[6]	660.6	943,000	402,837
Rifleite (English)[6]	605.3	864,000	369,090
B. N. (French)[6]	583.5	833,000	355,847
Ballistite (German)[6]	904.5	1,291,000	551,498
Cordite (English)[6]	877.9	1,253,000	535,265
Ballistite (Italian and Spanish)[6]	922.7	1,317,000	562,605

References:
[1] = Brunswig.
[2] = Bureau of Mines.
[3] = Bichel.
[4] = Heise.
[5] = Gody.
[6] = Jupnter.

TABLE II. — COMMON EXPLOSIVES ARRANGED IN THE ORDER OF DECREASING PERCUSSIVE FORCE AND INCREASING PROPELLENT FORCE.

High Percussive Force.
Nitroglycerine.
Blasting gelatine.
65% gelatine dynamite.
60% dynamite, active dope.
50% dynamite, active dope.
40% dynamite, active dope.
30% dynamite, active dope.
"40%" ammonia dynamite.
"40%" gelatine dynamite.
Granular nitroglycerine powder.
Black powder (fine grained).
Black powder (coarse grained).
High Propellent Force.

In view of the number of unsatisfactory units already in use, and to the further fact that the energy relationship between these different units has not been worked out, it has seemed to me to be best, instead of giving tables of these different factors, to present instead a list of some of the more important explosives, arranged in a column in the order of decreasing percussive force and increasing propellent force. To prepare this table I have reduced the results of lead block tests, rate of detonation tests, etc., to common standards, and have then arranged the explosives so as to represent equal energy. Any explosive in the list given has higher percussive force than the explosive next below it, and lower propellent force.

If an explosive is being used for any particular work, and is not proving to be sufficiently shattering in its work, the explosive which for equal energy would produce an increase in percussive force is found in the next explosive above in the table. In the same way, if in any blasting operation where 30 per cent dynamite is now used need is felt for less percussive force and higher propellent force, the table shows that the "40 per cent" ammonia and "40 per cent" gelatine dynamite will supply this need. This will probably be plain when considered in relation to Table III, showing relative toughness of rock, since in that table all the common types of rock are graded in a table, in the order of their decreasing toughness, which is the same as the order in which they require increasing propellent and decreasing percussive force.

In blasting we call upon explosives to do two different kinds of work. First, solid rock must be fissured and broken; second, the pieces of rock thus separated by fissures must be set in motion, or "shaken up," as the quarryman says. An explosive that would produce cracks and fissures through a mass of tough rock but would not move the separated pieces, would be of but little help in mining or quarrying, since the mass would be very difficult to remove by either pick or steam shovel, and but little help would be gained from the blast. In addition to being fissured, a rock mass must be "shaken up" or "tumbled about," and the broken pieces must be removed from the interlocking hold of surrounding pieces.

It is the percussive force of an explosive that produces in any rock mass the ramifying cracks and fissures that form the first essential of blasting, but it is the heaving or propellent force of the explosive that sets these pieces in motion, and shakes up the whole mass so that its removal becomes possible. Clearly, the ideal explosive is the one that combines in proper proportion these two factors of heaving and propellent force.

It is interesting to note that an excess of either heaving or propellent force is of no advantage in blasting and may even prove a

TABLE III.—TOUGHNESS OF ROCKS.

Kind of rock.	Relative toughness. (Limestone = 1).	Foot pounds per sq. foot of fracture.	Kgm. per square meter of fracture.
Fresh diabase	3.0	624.9	930
Pyroxene quartzite	2.7	562.4	837
Sandstone	2.6	541.6	806
Altered diabase	2.4	499.9	744
Fresh basalt	2.3	479.1	713
Hornblende-schist	2.1	437.4	651
Diorite	2.1	437.4	651
Hornblende granite	2.1	437.4	651
Rhyolite	2.0	416.6	620
Quartzite	1.9	395.7	589
Biotite gneiss	1.9	395.7	589
Augite-diorite	1.9	395.7	589
Altered basalt	1.7	354.1	527
Feldspathic sandstone	1.7	354.1	527
Gabbro	1.6	333.2	496
Chert	1.5	312.4	465
Calcareous sandstone	1.5	312.4	465
Granite	1.5	312.4	465
Slate	1.2	249.9	372
Peridotite	1.2	249.9	372
Granite-gneiss	1.2	249.9	372
Andesite	1.1	229.1	341
Limestone	1.0	208.3	310
Mica-schist	1.0	208.3	310
Amphibolite	1.0	208.3	310
Dolomite	1.0	208.3	310
Biotite-granite	1.0	208.3	310
Augite-syenite	1.0	208.3	310
Hornblende-gneiss	1.0	208.3	310

decided disadvantage. An excess of percussive force breaks the rock too fine, and tends to pack these fine fragments together; while an excess of propellent or heaving force tends to throw the pieces of rock to great distances, frequently with serious results. An ideal blast produces but little noise, fissures the rock to the proper extent, and lifts the whole mass blasted to a slight extent, allowing it to fall back in re-arranged position, ready to be easily removed by hand labor or by steam shovel.

For a very tough rock we require an explosive of high percussive force and low propellent force, and for a soft rock we require particularly a high propellent force, even the absence of a notable amount of percussive force being but little disadvantage. In clay, for example, the use of explosives of even medium percussive force results, not in breaking the material, but in further compacting it, and so for excavation in earth and soft clay gun powder and low-grade granular nitroglycerine powders are used exclusively.

Remembering that a very tough rock requires an explosive of high percussive force, the value of tables showing the relative toughness of different rock becomes evident, and I have prepared from the data given by E. C. C. Lord in Bulletin 31 of the Office of Public Roads, Department of Agriculture, a table giving the toughness of the common rock types, together with the energy required to produce fracture. In tabulating the energy required to produce definite areas of fracture, I have taken the weight and height of fall of the test hammer, and have then compared this with the area over which fracture has occurred in the test specimen.

Convention of American Society of Agricultural Engineers.

(STAFF ARTICLE.)

The sixth annual convention of the American Society of Agricultural Engineers was held at the Great Northern Hotel, Chicago, Dec. 26, 27 and 28, 1912. The first session, Thursday afternoon, was devoted largely to general agricultural machinery interests, and included papers on "Tests of Corn Planters," "Draft of the Plow," and "Isolated Gas Lighting Plants." The paper on this last subject by Mr. Eugene Becker of the Atlantic Blau-Gas Co., brought out the advantages and disadvantages of the different systems using gasoline gas, acetylene and Blaugas, the explosive range of each and the quality of light given, etc.

Friday was devoted to the tractor and standardization questions. Mr. L. W. Chase of the University of Nebraska, in his paper, "Testing of Gas Tractors," reviewed briefly the results secured through the Winnipeg motor contests, and pointed out the desirability of having a similar contest held in the United States. He said that it should be devoted principally to the general purpose tractor, and the necessary facilities and the proper methods of handling the scoring end of such a contest were outlined. A point which he made emphatic was the immediate posting of all data and scores, and in such a form as to be intelligible to the general public. He also offered a new system of classification, three new score cards and a new system of penalties. After general discussion the Society declared its readiness to undertake the scoring of a general purpose tractor contest in the United States upon the receipt of an invitation from the Winnipeg authorities to participate and from a repsonsible organization which would agree to take care of the financial and business part.

Other papers were: "Principles of Fuel Oil Engines," by C. F. Hirshfeld of Cornell University; "The Standardization Work of the Society of Automobile Engineers"; "Standards in Agricultural Machinery." Mr. W. J. Brandon of the Avery Co., in his paper on "Standards in Gas Tractor Construction," took up the question of standardization as applied to the gas tractor industry, especially as to the matter of horse power rating, magneto dimensions, spark plugs, screw threads, bolt and nut fits, wheel tires, carburetor fittings, etc., but made no specific recommendations.

Saturday was devoted to papers along the teaching phase of the work. Those discussed were: "Laboratory Exercises in Farm Machinery," and "The Design of an Agricultural Engineering Building." The latter paper took up the design of a proposed building for the Ohio State University.

General Method and Cost of Driving an 11x5-ft. Inclined Shaft or Raise.

Useful data of costs and progress of driving a 11x5-ft. raise 930 ft. on an angle of 45° to 60° is given by Mr. H. Y. Russell in "Engineering & Mining Journal" for Dec. 14, 1912. The work was done for the Treasury Tunnel Co., Red Mountain, Colo. A 40-ft. drift was driven off one side and at right angle to the main tunnel and the raise was begun from this drift, which gave room for hoists, spoil cars, and other fixtures required and thus left the main tunnel unobstructed. The 11x5-ft. section was divided by stulls and lagging into two compartments, one 5x5 ft. for a rock chute and the other for a bucket hoist, ladders, etc. In timbering, particular care was taken to ensure the stability of the stulls by cutting good deep hitches in the foot and hanging walls and to keep the line of the rock chute straight and its dimensions uniform. Lagging of 2-in. plank was spiked to the stulls on the side next the rock chute, but the chute was not otherwise lined. In driving the blasted rock fell into the top of the rock chute and slid down it and was drawn off at the bottom. All other transportation proceeded in this bucket compartment of the raise.

The raise was put up 450 ft. without any break in the chute and for this distance the chute was always full after the round had been blasted, the rock was then gradually drawn off until it was 20 or 25 ft. below the top of the lining, leaving room for the next round. At 450 ft. a break was made in the chute and a door was put in and the lower chute was gradually emptied until there was only about 50 ft. of rock left in it, which protected the door of the lower chute from the rock coming down from the upper chute. The break in the chute was made necessary by continued choking by fine dirt. The upper chute was carried to 900 ft. and was kept full except before blasting, when 20 to 25 ft. of rock was drawn off to leave room for the round.

The method of driving was in brief as follows: Two Waugh stoping machines were used, two machine men being kept on each shift so that drilling could be started at any time. Eight or nine 5½-ft. holes were a round and the drilling time averaged about 2½ hours. When the drilling was finished the machine men assisted the timbermen to cut hitches, put in the stulls, and raise the lugging. The air pressure in the compressor room was kept between 100 and 105 lbs., giving the hoist and drills from 90 to 95 lbs. pressure.

Seventeen men were employed altogether on the work. This included a foreman and also a cook and waiter in the boarding house, but did not include the clerk nor the engineer in charge. The latter took care of other company interests, but one-half of his salary, as well as the clerk's whole salary was charged to the raise. The inside crew consisted of two shifts; two machine men and two timbermen on each shift. As the raise got above 250 ft., one, and at times two extra men, were put on the day shift to look after repair work, etc. The principal reason for employing these men was to have men to replace machine men and timbermen when they quit and they were a good investment for this reason alone.

The rock was taken out of the tunnel by mules. One man on the day shift loaded the cars from the chute and drove the mule, 25 to 30 cars taking out a round. A second mule took the night shift in and out and was driven by one of the shift men. No tramming was done at night except in an emergency. No shift bosses were necessary, the foreman usually coming out early in the afternoon and going in with the night shift to see it properly started. Outside there were the blacksmith and helper and two compressor men and the cook and waiter.

Sixty per cent 1⅛-in. gelatin powder was used and a "nihilte" cap. This was rather a departure from the regular custom, but was found to work most successfully. The powder was given out by the foreman after he had examined the ground, so that no more than necessary was used. The cap was between

TABLE I.—COST BY MONTHS OF DRIVING AN INCLINED SHAFT THROUGH ROCK.

(All costs except fire insurance and taxes are included.)

Labor and Supplies.	May. Drove 100 ft. 448-548 ft. Total cost.	May. Cost per ft.	June. Drove 105 ft. 548-653 ft. Total cost.	June. Cost per ft.	July. Drove 92.5 ft. 653-745.5 ft. Total cost.	July. Cost per ft.	August. Drove 107.5 ft. 745.5-853 ft. Total cost.	August. Cost per ft.
Machine men	$ 465.50	$ 4.65	$ 471.30	$ 4.49	$ 468.80	$ 5.06	$ 478.68	$ 4.45
Timbermen and helpers	618.70	6.19	539.79	5.14	434.01	4.70	561.87	5.24
Tramming	113.50	1.14	102.81	0.98	87.30	0.94	110.17	1.02
Explosives	118.42	1.18	142.27	1.35	76.95	0.83	83.42	0.78
Candles and oil	23.61	0.23	21.40	0.20	20.05	0.21	23.39	0.21
Timber, lumber and timber supplies	128.74	1.29	147.02	1.40	171.28	1.85	169.07	1.57
Hauling expenses	23.72	0.24	40.45	0.39	36.14	0.40	36.19	0.33
	$1,492.19	$14.92	$1,465.13	$13.95	$1,294.53	$13.99	$1,462.79	$13.60
Salaries and office expenses	$ 213.72	$ 2.14	$ 216.87	$ 2.06	$ 222.31	$ 2.40	$ 205.00	$ 1.91
Foreman	158.00	1.58	154.50	1.47	159.20	1.72	162.80	1.51
Compressor men	254.00	2.54	249.00	2.38	261.40	2.83	262.60	2.44
Blacksmith and helper	121.00	1.21	169.80	1.61	217.77	2.34	129.01	1.20
Coal	1,066.13	10.66	951.75	9.06	584.19	6.32	441.15	4.10
Compressor supplies	22.30	0.22	21.43	0.21	24.24	0.26	23.94	0.22
Tools and shop supplies	5.70	0.05	4.73	0.04	3.38	0.04	4.35	0.05
Maintenance or repairs	4.58	0.05	8.83	0.08	20.18	0.22	147.19	1.37
	$1,845.43	$18.45	$1,776.91	$16.91	$1,492.67	$16.13	$1,376.02	$12.80
Employer's liability	....	......	....	......	....	......	$ 273.71	$ 2.55
Cost of board	$ 40.37	$ 0.40	$ 77.14	$ 0.73	$ 142.03	$ 1.54	125.93	1.17
Total cost	$3,377.99	$33.78	$3,319.18	$31.61	$2,929.23	$31.66	$3,238.45	$30.12

two and three times as strong as a 6 X, gave complete combustion and little gas. The rock was broken up into small fragments, which was an important matter. The ground was easily soft enough to be broken by 40 per cent powder, but it was owing to the 60 per cent and the strong cap that so little trouble with ventilation was had. The smaller amount of powder used and the smaller holes drilled made the cost practically the same, if not less, than if 40 per cent had been used. The fuses were cut long enough to allow the men to get to the bottom of the raise before blasting occurred.

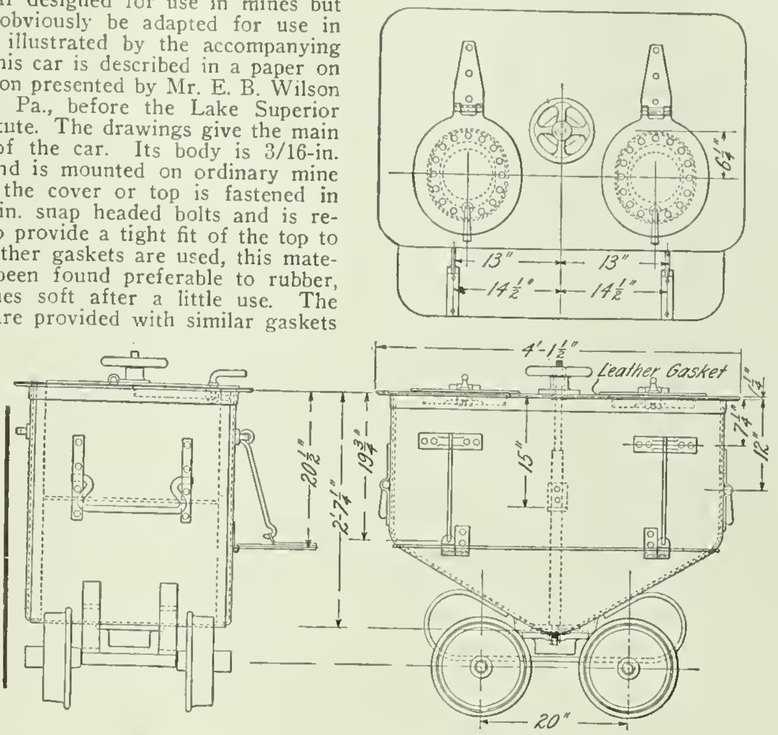
The average speed for the 930 ft. was 100 ft. per month. The greatest monthly progress was 107 ft., which was driven between 746 and 853 ft. In fact just as good speed was made in the last 400 ft. as in the first 500 ft. The costs were practically the same.

In considering the accompanying cost data, Table 1, it must be borne in mind that there was no work other than the raise going on; that with the same outside expense about three times as much work could have been done, and that the compressor had to run all the time for ventilation. The company's other interests made the employement of a supervising engineer necessary, and part of his salary was charged to the raise. The company also ran its own boarding house, which usually lost money, owing to the small number of men employed, and a clerk was necessary to do the ordering and check supplies in and out.

Two items in the cost sheet might be explained. The coal consumption in May and June included heating several buildings; this was cut out in July and August. Maintenance includes only supplies, except for August, when the cable was twice spliced at a cost of $15 per splice, and about $75 was spent on the boiler plant. Cost of board is the boarding-house deficit each month.

A Convenient Toilet Car for Underground Workings.

A toilet car designed for use in mines but which may obviously be adapted for use in tunneling is illustrated by the accompanying drawing. This car is described in a paper on mine sanitation presented by Mr. E. B. Wilson of Scranton, Pa., before the Lake Superior Mining Institute. The drawings give the main dimensions of the car. Its body is 3/16-in. steel plate and is mounted on ordinary mine car wheels; the cover or top is fastened in place by ¾-in. snap headed bolts and is removable. To provide a tight fit of the top to the body, leather gaskets are used, this material having been found preferable to rubber, which becomes soft after a little use. The seat covers are provided with similar gaskets and are firmly latched. A hand wheel provides for the bottom discharge of the contents of the car, which can also be washed out with a hose. Water and a little chloride of lime are placed in the car before it is returned underground for use. This car is fitted not only to travel on the tunnel tracks but also to be hoisted and lowered through the shafts.



Toilet Car for Underground Workings.

ROADS AND STREETS

Methods of Repairing Cement Concrete Pavements.

The extended use of concrete as a wearing surface for pavements is a comparatively recent development. For this reason very little information is available as to the methods of repairing this type of construction. In Engineering and Contracting of June 19, 1912, Mr. Geo. A. Dingman, Engineer of the Wayne County Road Commission, described a method of patching concrete roads. Mr. A. N. Johnson, State Engineer of Illinois, in a paper* presented at this year's American Road Congress, also discusses briefly the maintenance and repair of concrete surfaced highways. These are about the only descriptions of the work that have appeared in print. A paper, "Methods of Repairing Cement Concrete Pavements," presented on January 3 before Section D of the American Association for the Advancement of Science, by Mr. Frank F. Rogers, Deputy Commissioner of the Michigan State Highway Department, should therefore be of particular interest. In this paper, which is given in abstract below, Mr. Rogers presents a considerable amount of information regarding repair methods on concrete pavements in Michigan.

The concrete pavement in Bellefontaine, O., built in 1893 and 1894, contains 4,400 sq. yds. It was constructed of a local cement manufactured by the Buckeye Portland Cement Co. a leaner mix being used in the base than in the top. The approximate total cost for repairs has been $200. This is at the rate of 4.54 cts. per square yard in 18 years, or 0.252 ct. per yard year.

When laid, the pavement was cut into squares, similar to those commonly seen in cement concrete sidewalks, and the principal part of the wear has been along the longitudinal joints thus formed. The wheels of vehicles form grooves at these places, which they have a tendency to follow.

Repairs have usually been made with cement mortar or concrete, which has been placed in the grooves after they have been chiseled out. Sometimes this patch has been dove-tailed in, that is, the sides of the notch incline towards the axis of the groove, rather than outwards.

In some places paving bricks, laid crosswise, have been cemented into the prepared notch, instead of making the entire patch of concrete. This has been done when it was impracticable to keep traffic off the street long enough for a concrete patch to harden.

Bad Axe, Mich., a town of 2,500 population, paved its main street for a distance of ½ mile with cement concrete in 1908. Gravel taken from beneath the subgrade of the pavement was used for the aggregate. The pavement was laid as 2-course work, the base being a 1:6 mix, 5 ins. thick, with a wearing surface of a 1:2 mix, 2 ins. thick. The contractor guaranteed this street for five years, hence the city has made no repairs up to this time. Transverse joints were placed every 12 ft. There are no longitudinal joints, except at the gutter lines, though the pavement is from 30 to 50 ft. in width.

The contractor has patched a few places by chiseling out the old pavement to the subgrade and filling the excavation with 2-course concrete of the same mix used in the original construction.

The transverse joints now show considerable wear, the groove, due to chipping off the edges of the adjoining slabs, being in many places 2 ins. deep, and very perceptible when riding over the pavement in an iron tired vehicle even at a slow speed. Similar wear is visible around the edges of some of the patches. There are also some holes which need repairing.

Pavements at Grand Ledge and Scottsville, Mich., were laid in 1910. Some limestone was used for the course aggregate in these pavements. Both were 2-course work and were in need of some repairs the second year, but mostly at the joints. In neither town have the repairs received the attention that should have been given them.

The first concrete pavements in Ann Arbor were laid in 1909, but in Alpena, Lansing, Coldwater and Charlotte they were laid one and two years later and have needed but slight repairs.

The pavements at Ann Arbor and Lansing were top dressed with tar and sand, refined tar being used on all the later work. This top dressing wears off annually, particularly in the central portion of the roadway, and has to be wholly or partially renewed at a cost of from 5 cts. to 6 cts. per square yard.

Kalamazoo, Marquette and Red Jacket each have considerable cement concrete pavement, built under the R. S. Blome patents. Regarding repairs at Kalamazoo, the City Engineer states that the surface is carefully watched and all holes repaired when they are small. The holes have been thoroughly cleaned, washed with cement and filled with a 3 to 1 mixture of good bank gravel and Portland cement. These repairs have given good results.

The pavement now shows a large number of long surface cracks with the edges wearing rapidly. The percentage of surface thus far repaired is small, but a larger percentage will have to be repaired in the next five years. This pavement was laid five years ago last summer at a cost of $1.74 per square yard. It has a 5-in. base and 2-in. top.

Some concrete has been laid on the rural highways in the counties of Berrien, Huron, Saginaw and Wayne, but in the two former counties the roads were built in 1912 and have needed no repairs. On these roads sand and gravel were used for the aggregate in a 1:2:4 mix.

Saginaw county built its concrete road in

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*Engineering & Contracting, Nov. 13, 1912.

1910. Sand and crushed limestone were used for the aggregate. Each of the two layers is 3 ins. thick. The bottom is a 1:2:5 mix and the top a 1:2:4 mix. The pavement has had quite extensive repairs. The portions that have been found defective were due to a leaner mix or to a less depth than was specified. Repairs have been made by cutting out the defective places to the corrected subgrade and filling with concrete as above specified for the top layer. No extra refinements were used in these repairs, and, so far, no trouble has been had with the places repaired. This pavement was only 9 ft. in the central portion of a 24-ft. roadway. It carries a rather heavy mixed traffic, consisting of heavily loaded farm and trucking wagons, throughout the season, and a heavy sugar beet traffic (loads 2 to 5 tons) during the months of October and November. Repairs have been very small on the better built portions of this road.

Wayne county began building concrete roadways in the summer of 1909, and has built a larger mileage each succeeding year. The first two years 2-layer concrete was built, the bottom 4½ ins. being a 1:2½:5 mix and the top 2 ins. being a 1:2:3 mix, using crushed cobblestones for the coarse aggregate in the surface layer. Since then, 1-layer concrete 7 ins. thick, with a 1:2:4 and a 1:2:3 mix, has been adopted, using washed pebbles and sand for the aggregate. The richer mix was used last summer.

On Nov. 23rd, last, an inspection was made of the Woodward Ave. concrete roadway, one mile of which was laid previous to July 1st, 1909, and 1 1/5 miles of which was laid in the early part of the season of 1910. Both of these pieces are the 2-course work above referred to. These pavements are 18 ft. wide and have transverse expansion joints every 25 ft., making 211 sections to the mile. The oldest mile has had nearly four seasons' wear and has passed through three winters. On the first mile, 9 sections show one or more pit holes, 17 sections show transverse cracks, a very few of which reach entirely across the roadway, and 61 sections show longitudinal cracks, many of which reach the whole length of the section. In fact, most of these longitudinal cracks are grouped, several contiguous sections showing cracks where there were any at all. Isolated sections showing longitudinal cracks are the exception and not the rule.

The 1 1/5 mile stretch, which has had nearly three seasons' wear and has passed through two winters, shows defects as follows: Pit holes, 8 sections; transverse cracks, 7 sections, and longitudinal cracks, 13 sections. For better comparison, it may be stated that 29 per cent of the sections showed longitudinal cracks on the first mile, while only 5 per cent of the sections showed longitudinal cracks on the second 1 1/5 miles. Roads of more recent construction show proportionately less defects.

Repairs to the Wayne county concrete roadways have mostly been confined to expansion joints, where the edges of the concrete have chipped off, and to the defects above described, which are subject to the same action.

In making repairs, the cracks, whether at expansion joints or other places, are broomed out clean, preferably when the weather is warm and dry, and poured full of hot refined tar. A portable heating kettle is moved along on the pavement and the tar is poured from long-nozzled cans, which are fitted with long wooden handles. When filling a joint the workman backs up, dragging the nozzle of the can along the crack, which is filled about as rapidly as a man can work. As fast as the joints are filled, another laborer follows up and spreads a layer of dry sharp sand over the tar to a depth of from ¼ to ½ in. Pit holes, unless large, are filled with tar and sand in the same manner. It might be added that the tars are found to adhere to concrete better than the asphalts.

Repairs of this kind cost about $50 a mile, and have to be repeated each year. They present further deterioration of the pavement, both at the transverse joints and at the cracks which nature has formed. In fact, so far, the cracks do not seem to menace the life of the pavement.

In a few places where holes have formed, due to defective mixing or to some foreign substance accidentally getting into the concrete, repairs have been made by chiseling out the concrete down to the subgrade, brooming off the sides and filling the excavation with concrete of the same kind as used in the original construction. The cost of this kind of repairs has been a negligible quantity, as compared with the others.

The transverse joints on the early construction were formed by placing three strips of tar paper between the 25-ft. sections. Later, sheared steel plates, separated by strips of tar paper, and having prongs which are bedded in the concrete of the adjoining sections, have been used. So far, there has been little or no chipping of the edges of the concrete next to the steel plates. However, the joints are all kept filled and covered with tar and sand to prevent possible wear.

On two roads which were completed late in the fall, short sections of the surface became thickly pitted to the depth of ¼ to ½ in., due to opening the road to traffic before the concrete was thoroughly hard. These defects have also been repaired by covering the entire surface of the pavement with refined tar and coating with sand, as in the case of the joints and cracks. This coating has to be renewed when it wears away.

A few sections of the Michigan Ave. road, not in need of repair, were tarred and sanded in 1911 to watch results. Only a small part of this was worn off during the first year, but so far, the kind of repairs already described are all that the Wayne County Road Commissioners have found necessary or advisable.

Cost of Object Lesson Sand-Clay Roads Constructed in 1911-12 by the U. S. Office of Public Roads.

During the fiscal year ending June 30, 1912, the U. S. Office of Public Roads constructed 103,876 sq. yds. of object lesson sand-clay roads. Some of the details of these roads are given in the recently issued report of Logan Waller Page, Director U. S. Office of Public Roads, from which the matter in this article has been taken. Table I shows the cost of 15 of these roads, and Table II contains further detail of the cost on some of the roads in the first mentioned table.

Work was started on the road at Demopolis, Ala., on May 18, 1911, and completed on July 20, 1911. The length was 4,400 ft., the width of sand-clay surface 16 ft., and the width from ditch to ditch 24 ft. The crown was made 1⅜ ins. to the foot. The natural soil for 1,300 ft. was a sand-clay mixture, for the next 800 ft. sand, and for the remaining distance of 2,300 ft. clay. The surface was plowed, moved with a slip scraper, and spread with shovels. The average cut was 1½ ft. and the average fill 1 ft. The total area graded was 11,733 sq. yds., amounting to 2,190 cu. yds. of excavation. The maximum grade of 8 per cent was reduced to 4.5 per cent. The average haul for excavated material was 300 ft. and for surfacing material from pit 2,600 ft. Both slat-bottom and dump wagons were used. The sand was fine grained, and spreading was done by shoveling from the wagons. The surface was shaped with a road machine; 970 cu. yds. of surfacing material was spread from 6 to 9 ins. in depth on a subgrade of 7,822 sq. yds. The foreman was paid $0.20 per hour, men $0.10 per hour, and the teams $0.35 per hour.

The work on the road at Monticello, Fla., was started on Aug. 21, 1911, and completed on Oct. 14, 1911. The country is hilly, with a natural soil of sand and clay. The sand is usually found in the bottom lands and the clay half way up the hill slopes or in ridges across the road. The outfit used consisted of a grading machine, 4 plows, 9 wheel scrapers, 4 wagons, 23 mules, and various hand tools. The average haul for excavation was 275 ft. and the maximum, 400 ft. The foundation was made of sandy clay and surfaced with a natural mixture of sand and clay having good wearing qualities. The spreading was done with hoes and finished with the grader. The total length graded was 9,990 ft.; the width was 30 ft. in cuts and 24 ft. in fills; and the area graded, 27,931 sq. yds. The length surfaced was 8,150 ft. and the width 16 ft., making an area of 14,489 sq. yds. The finished roadway was from 20 ft. to 30 ft. wide. The depth of surfacing material when compacted was 6 ins., and the crown ¾ in. to the foot. Earth excavation amounted to 5,260 cu. yds. and the surfacing material is included in this amount. Labor cost $1 per day, and the teams without driver, $2.50 per day.

Two sections of sand-clay demonstration road were built at Palatka, Fla. Section 1, called the Palatka-Hastings Road, running north from East Palatka toward Jacksonville, was started on Feb. 15, 1912, and completed on Feb. 17, 1912. The work consisted of reshaping the surface, covering it with sand and clay, and thoroughly mixing these materials. The adjacent land is level, the natural soil black loamy sand, and the grade of the road 0.4 per cent. Slat-bottom wagons were used in hauling sand ¾ mile and clay ½ mile. The sand is fine grained, and the clay has good binding properties. The total length graded was 500 ft., the width 16 ft., and the area 889 sq. yds. The length surfaced was 500 ft., the width 8 ft., and the area 444 sq. yds. The bottom course consisted of 4 ins. of loose sand, the second course 3 ins. of clay, and the top course 2 ins. of sand, making the total compacted depth 7 ins. The crown was made 1 in. to the foot; 100 cu. yds. of sand and 30 cu. yds. of clay were used. Labor cost $1.25 per day and teams $4.50 per day. Section 2 was started on Feb. 19, 1912, and completed on Feb. 24, 1912. The natural soil is sandy. Road machines, a heavy disk harrow, and slat-bottom wagons were used. Similar materials were used and the same methods followed as in

TABLE I.—COST AND DETAILS OF CONSTRUCTION OF 15 SAND-CLAY ROADS.

Place.	Length, Surfaced. Ft.	Width, Surfaced. Ft.	Depth Compacted, Surfacing. Ins.	Cost per Sq. Yd. Surfaced, Including Excavation.	Cost per Mile, Including Grading.	Excavation. Cu. Yds.	Surfacing Material. Cu. Yds.	Average Haul, Surfacing Material. Ft.
Demapolis, Ala	4,400	16	6[1]	$0.135	$1,275	2,190	970	2,600
Monticello, Fla	8,150	16	6	.0966	906	....	....	....
Palatka, Fla	500	8	7	.10	465	....	130	....
Palatka, Fla	3,000	12	..	.025	180	....	....	....
Liberty, Miss	2,500	15	6	.052	396	590	191	2,100
Brady Island, Neb	5,280	16	5[2]	.1266	1,188	2,440	1,746	2,640
Columbus, Neb	3,282	16	6[3]	.244	2,287	1,035	1,750	5,280
Black Mountain, N. C.	525	12	..	.166	1,172	265	65	10,560
Goldsboro, N. C	5,800	24	..	.077	1,199	5,246	....	....
Hickory, N. C	1,050	16	6	.106	995	135	395	3,300
Kingston, N. C	3,000	16	6	.107	865	699	1,185	3,168
Moyock, N. C	1,800	20	..	.0284	333	352	....	....
Warsaw, N. C	5,280	14	8[*]	.133	1,020	1,914	1,200	....
Mineola, Tex	4,150	16	9[4]	.115	1,597	3,820	1,840	[4]1,150
Orange, Tex	5,120	16	4½[5]	.111	1,042	....	11	....

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[*] Probable depth uncompleted.

[1] Spread 6-in. to 9-in. depth. [2] 5 in. at center, 4 in. at side. [3] 6 in. at center, 5 in. at side. [4] 1,150 ft. for 1,630 cu. yds. clay; 2,400 ft. for 210 cu. yds. sand. [5] 4½ in. for 3,720 ft.; 7 in. for 1,400 ft.

building section 1. The total length was 3,000 ft. This section was originally built by contract in 1910, but, on account of an excess of unmixed clay, the road had become badly rutted and the object of this work was to demonstrate the necessity of thoroughly mixing the sand and clay, which had not been done when the road was built. The length of section rebuilt was 3,000 ft., the width 12 ft., the total width of the roadway 20 ft., and the total area surfaced 4,000 sq. yds. The crown was made 1 in. to the foot. Labor cost $1.25 per day and teams, $4.50 per day.

Work was begun on November 15, 1911, on a sand-clay road at Talbotton, Ga., but was discontinued on Jan. 6, 1912, before completion, with the understanding that it would be resumed early in 1912. The material is red clay, containing pipe clay and a small percentage of sand. The foundation was made of nonslaking clay containing some pipe clay, and the surface was of fine, loamy sand. The maximum cut was 4.5 ft., the maximum fill 4 ft., and the grade was reduced from 9 to 4½ per cent. For carrying out the work picks, plows, wheel scrapers, slat-bottom wagons, a disk harrow, and a split-log drag were used. The total length graded was 3,525 ft., the width 30 ft., and the area 11,750 sq. yds. The length surfaced was 1,950 ft., the width 14 ft., and the area 3,030 sq. yds. The bottom course was 4 ins. of clay and the top course 8 ins. of sand. The materials were mixed by continued plowing and harrowing. The crown was made ¾ in. to the foot. The earth excavation amounted to 3,290 cu. yds. and the surfacing material to 675 cu. yds. The average haul from the pit was 985 ft., and the material was spread with shovels. The gang on this work consisted of a superintendent, 3 guards, 17 convicts, and 15 mules, and the value of the equipment was carefully estimated to be $6,000. The cost of the work to the county per month was estimated as follows: Superintendent, $75; 2 guards, $60; 1 guard, $37.50; provisions, $115.90; miscellaneous supplies, $11.97; incidentals, $7.79; hay, at $28 per ton, $56; oats, at $0.635 per bushel, $161.92; ground feed, $34; transportation, freight, etc., at $10.19; depreciation on $6,000 at 10 per cent, $60; and interest on the equipment at 6 per cent, $30, making a total estimated monthly cost of $650.27, or, for 25 workings days, an average cost of $26 per day.

The sand-clay surface at Liberty, Miss., was built on the upper Gloster Road. Work was begun on Aug 18, 1911, and completed on Sept 6, 1911, with 4 days' delay on account of unfavorable weather The natural soil from station 0 to station 5 is sand; from station 5 to station 12, clay; and from station 12 to station 25, sand-clay The total length graded was 2,500 ft., the width in cuts being 18 ft. and in fills 20 ft., making the area graded 5,122 sq. yds. The length surfaced was the same, the width surfaced 15 ft., and the area 3,611 sq. yds. The finished roadway was made 20 ft. wide from station 0 to station 5 and 18 ft. wide from station 6 to station 25. The compacted depth of surfacing material was 6 ins., and the crown 1⅛ ins. to the foot. A road machine and 4 slip scrapers were used. The surfacing material was sand of good wearing quality, containing 10 per cent of gravel. Labor cost $0.50 for convicts, $1 for hired men, $1 for county teams, and $3 for hired teams. About 50 per cent of the work was done by county and convict labor.

One mile of sand-clay road was built from Brady Island southeast toward Gothenburg between Oct. 27 and Dec. 11, 1911, with 6½ days' delay on account of bad weather. The country is hilly and the soil sandy. The surfacing was built of a good natural mixture of top soil. The average cut was 2.5 ft. and the maximum cut 4.4 ft. The average fill was 1.5 ft. and the maximum fill 2.6 ft. The maximum grade was reduced from 8 per cent to 2 per cent. Plows, slipscrapers, fresno scraper, plank drag, grader, concrete roller, disk, harrow, and spike and tooth harrow formed the equipment. Slat-bottom wagons were used for hauling. The road was graded for a distance of 5,280 ft., 32 ft. wide in cuts and 24 ft. wide in fills, making a total area graded of 18,080 sq. yds. The same length was surfaced 16 ft. wide, making an area of 9,387 sq. yds. The surfacing material when compacted was 5 ins. deep in the center and 4 ins. on the sides. The crown was 0.5 in. to the foot. Labor cost $1.75 per day, teams $3, and foreman $2.50.

The gumbo-sand road at Columbus, Neb., was started on Sept. 18, 1911, and discontinued for the season on Oct. 20, 1911. The first work consisted of excavation and stripping of gumbo pits. The earth was plowed and loaded on wagons, and was also moved with slips, and wheel and fresno scrapers, and spread with shovels or a grader. The natural soil was sandy loam. The maximum cut was 3½ ft., the maximum fill 1 ft., and the maximum grade of 2.24 per cent was reduced to 1 per cent. The equipment consisted of 2 road graders, 1 steel road drag, 1 concrete road roller, 1 disk harrow, and 1 spike-tooth harrow, besides plows and scrapers. The material used for surfacing was gumbo silt and Platte River sand. The road was graded 32 ft. wide. The total area graded was 11,669 sq. yds. The length surfaced was 3,282 ft., and the width surfaced 16 ft., making a total of 5,835 sq. yds. The width of the finished road was 24 ft. The surfacing was spread in two courses, making a compacted depth of 6 ins. in the center and 5 ins. at the sides. The crown was made ¾ in. to the foot. Labor cost $1.75 per day; foremen, $4 per day; and teams, with driver, $3.50 per day.

The work at Goldsboro, N. C., was done between Aug. 2, 1911, and Sept. 18, 1911. The material from station 0 to station 15 was a hard gray top soil with a black loam subsoil; from station 15 to station 23, sandy top soil and clay subsoil; from station 23 to station 46, a natural sand-clay mixture; from station 46 to station 57, clay; from station 57 to station 59, sand; and from station 59 to station 73, sand with clay subsoil. At station 52, 1,000 ft. of road was relocated to improve the alignment. The maximum cut was 18 ft., the maximum fill 6.5 ft., the average cut 0.5 ft., and the average fill 0.6 ft. The grade was reduced from 7.5 per cent to 4.95 per cent. The total length graded was 7,300 ft., the width 30 ft., and the area 24,333 sq. yds. The surfacing material consisted of natural sand or gravel clay. The length surfaced was 5,800 ft., the width 24 ft., and the area 15,466 sq. yds., of which 2,133 sq. yds. was surfaced with clay from a pit, and 13,333 sq. yds. with clay taken from the side ditches. The crown was made 0.75 in. to the foot. The excavated material amounted to 5,426 cu. yds., and the following equipment was used: 1 road machine, 4 wheel scrapers, 11 single-horse dump carts, 4 slip scrapers, 1 rooter plow, 1 turning plow, and hand tools. A 30-ft. span wooden bridge 20 ft. wide was built. Labor was performed by convicts estimated at $0.50 per day, county mules at $0.50 each, and hired mules at $1 each.

The sand-clay road at Hickory, N. C., was started on Nov. 14, 1911, and completed on Dec. 2, 1911. The country is hilly and the soil clay. Excavation was made by plowing, and the material was moved with single-mule slip scrapers and spread with shovels. The grading required no appreciable cuts or fills, and the maximum grade was 5.6 per cent. A plank drag was built for the work. The sand used for surfacing was hauled ⅝ mile. The total length regraded was 1,050 ft., with a width of 24 ft. The same length was surfaced 16 ft. wide, making the area surfaced 1,867 sq. yds. The surfacing was 6 ins. thick when compacted, and the crown 1¼ ins. to the foot. Labor cost $1 per day, and teams $2.50 per day.

TABLE II.—SOME DETAILS OF COST OF SAND-CLAY ROADS.

Place.	Surfacing. Material. Cu. Yds.	Average Haul. Ft.	Cost of Hauling. per Cu. Yd.	Cost of Spreading, per Cu. Yd.	Cost of Mixing, per Cu. Yd.
Liberty, Miss..........	191	2,100	$0.18	$0.033	$0.023
Brady Island, Neb....	1,746	2,640	.36	.037	.021[1]
Hickory, N. C........	395	3,168	.26	.045	.014
Warsaw, N. C........	1,200	500	.115[2]	.020	...
Mineola, Tex.........	1,630[3]	1,150	.138	.022	...
Mineola, Tex.........	210[4]	2,400	.271	.529	...

[1] This includes rolling, $4.13; shaping surface, $28.12; mixing. $4.50. [2] Loosening and loading clay cost 3½ cts., which is not included in the cost of hauling given above. [3] For the clay; cost of loosening and loading clay was 11 cts. per cu. yd. [4] For the sand, cost of loading was 5 cts. per cu. yd.

The work at Kinston, N. C., was performed by convict labor. It was started on Aug. 24, 1912, and completed on Sept. 28, 1912. The road was first plowed, and the material was transported in wheel scrapers and wagons, and spread with shovels. The average cut was 0.6 ft., and the maximum grade 1 per cent. The natural soil was black sandy loam unsuitable for mixing with clay. The equipment consisted of a road machine, 2 wheel scrapers, 3 slat-bottom wagons, and 1 plow. The road was graded 30 ft. wide, and the area was 13,666 sq. yds. The width surfaced was 16 ft., and the area 5,333 sq. yds. The surfacing material was compacted to a depth of 6 ins., and the crown of the roadway made 0.75 in. to the foot. The superintendent was paid $2 per day; hired teams, $3; and guards, $1. Convicts were figured at $0.40, and county teams at $1 per day.

The work of building a sand-clay road northwest from Moyock, N. C., was started on Oct. 19, 1911, and continued until Nov. 17, 1911. The soil from station 0 to station 1 is sand-clay with an excess of sand; from station 1 to station 2, clay; from station 2 to station 10, sand-clay containing an excess of sand; from station 10 to station 15 the mixture of sand and clay is well proportioned; and from station 15 to station 18 there is a slight excess of sand. The equipment consisted of one 4-horse road plow, 1 disk cutter, 1 disk riding plow, 1 harrow, and a road grader. Some of the material was handled in carts, then dumped and spread by hand, although most of the grading was done with slip scrapers. The average haul was 50 ft. and the maximum haul 1,700 ft. The subsoil was used for a foundation and a sand-clay mixture for the surfacing. The total length built was 1,800 ft. with a width of 20 ft., and the crown was made 1.8 ins. to the foot. Labor cost $1.25 per day, and team, with driver, $3.25 per day. It was very difficult to obtain men and teams.

The work of building a sand-clay road from Warsaw, N. C., was begun on Nov. 4, 1911, but discontinued on Dec. 22, 1911, after 1 mile of road had been built. The soil is sandy, with a light red subsoil of clay and white sand. The proportion of sand in the subsoil is from ⅔ to ¾, making a good mixture. The surface was first plowed, thereby turning the sand under and bringing the subsoil to the surface. It was then mixed with a disk harrow, shaped with grader and drag, and leveled with slip scrapers where necessary, and material was added from the ditches or nearest clay pits. The maximum cut was 1 ft., the maximum fill 3.1 ft., and the maximum grade of 3 per cent was reduced to 2½ per cent. The maximum haul was 1,000 ft., the average haul, 200 ft., and the average haul from the pit, 500 ft. The total length of road built was 5,280 ft.; the width of grading, 20 ft., and the area graded, 11,703 sq. yds. The surfacing material was spread 14 ft. wide, making the area surfaced 8,213 sq. yds. The surfacing was 8 ins. in depth, and the crown 1½ ins. to the foot. Labor per 10-hour day cost $1.25; foremen per day, $2.50; and mules per day, $1.50.

The sand-clay road at Mineola, Tex., was begun on Nov. 27, 1911, and completed on Jan. 17, 1912; 19½ days were lost on account of cold weather and holidays. The earth was loosened with plows and rooters or with drag and wheel scrapers and spreads with shovels. The maximum cut was 2 ft., the maximum fill 4½ ft., and the maximum grade of 5½ per cent was reduced to 3 per cent. From station 0 to station 21 the natural soil is sandy with a clay subsoil; from station 21 to station 32, the soil is sandy clay; from station 32 to station 41+50, sand; and from station 41+50 to station 58, clay loam. One road machine, 6 wheel scrapers, 12 drag scrapers, slat-bottom wagons, plows and small tools formed the equipment. The average haul for excavation was 250 ft. and the maximum 800 ft. The average haul from the clay pit was 1,150 and from the sand pit 2,400 ft. The foundation of the road was made with sandy loam and the surface with a sand-clay mixture containing an excess of clay with fairly good binding qualities. The clay and sand were loosened with a rooter plow and loaded into wheel scrapers. The material was then hauled 700 ft., dumped, reloaded with shovels into carts and hauled the remaining distance to the road. The surfacing material was spread with shovels. The total length graded was 5,800 ft., the width 24 ft., and the area 15,467 sq. yds. The length surfaced was 4,150 ft. The width of surfacing was 16 ft. and the area of surfacing 7,377 sq. yds. The finished roadway was made 20 ft. wide. The depth of clay was 8 ins. and of sand 1 in. The crown of the road was made 1 in. to the foot. The amount of earth excavation was 3,820 cu. yds., the amount of clay for surfacing 1,630 cu. yds., and of sand 210 cu. yds. Labor per 9-hour day cost $1.50. Labor for shovelers and wheel-scraper work cost $2; foremen, $3; teams for scrapers, $3.50; and teams for hauling, $3. The working force was organized with a foreman in general charge. Local labor and teams were used throughout the work. The clearing and grubbing on about 2,000 ft. was very heavy.

The building of the section of sand-clay road 5,120 ft. long in Orange, Tex., was started on May 1, 1912, and completed on May 20, 1912. Three and two-thirds days' work was lost during that time on account of rain. The top soil is black sand and silt, and the subsoil is a stratum of clay varying from reddish to gumbo colored. Below this stratum is a quicksand. The surface of the road before improvement was covered with very fine sand. In certain sections the clay used for surfacing was taken from the side ditches by means of two-mule slip scrapers, after having been loosened by plowing. The clay so taken amounted to 322 cu. yds. For other sections of the road slat-bottom wagons were used for hauling from the clay pit. The amount of clay hauled from the unit was 989 cu. yds. The grade of the road is very flat. The equipment consisted of a road grader, a disk harrow, a split-log drag, 1 large plow, and 2 small plows. The average haul from pit to road was 2,777 ft. The material was spread with shovels. The total length of the road graded was 7,870 ft., the width 36 ft., and the area 31,476 sq. yds. The length surfaced was 5,120 ft., the width 16 ft., and the area 9,102 sq. yds. The depth of surfacing material was 7 ins. for 1,400 ft. and 4½ ins. for the remaining 3,720 ft. The crown was made ¾ in. to the foot.

Hours of Labor in Mines and Quarries.—According to a table prepared by the United States Census Bureau, the 8-hour day has been adopted by about one-half of the mines and quarries operated in the United States. The other half are mostly operated on a 9 or 10-hour basis, with a few still maintaining the 11 or 12-hour shift. It is found that the prevailing hours are 8 or less in more than nine-tenths of the deep gold and silver mines, five-sixths of the copper mines, about three-fourths of the lead and zinc mines, more than two-thirds of the bituminous coal mines, about three-fifths of the placer mines, and slightly less than one-half of the granite quarries. The 9-hour shift predominates in anthracite coal mines, and the 10-hour day in iron mines, limestone quarries and the phosphate rock industry. In about one-fourth of the phosphate-rock enterprises 11 or 12 hours per shift constitute the prevailing hours of labor.

Harbor Work at Valencia, Spain.—The Spanish government will award contracts in January for the construction of outer breakwaters and wharves in Valencia harbor, Spain. The estimated cost of these improvements is about $3,500,000.

A Method of Preparing Plans and Cross Sections for Road Grading.

In making surveys and plans for the proposed construction of earth roads, the engineer in many cases is handicapped by the small allowance made for the engineering work. To accurately determine the yardage to be moved, the position from which it is to be taken and the position in which it is to be placed, so that the contractor in making his bid may know what the character of the grading is to be, requires a considerable amount of work on the part of the engineer, which must be done at a minimum of expense. An interesting method for the preparation at small expense of plans and cross sections of a road preparatory to letting grading contracts, is used by the Dakota Engineering Co. of Mitchell, S. Dak. The method was described by Mr. Edward K. Mather, Managing Engineer of the above company, in a paper presented before the South Dakota Engineering Society. We are indebted to Mr. Mather for the following description of the manner in which the survey work is handled.

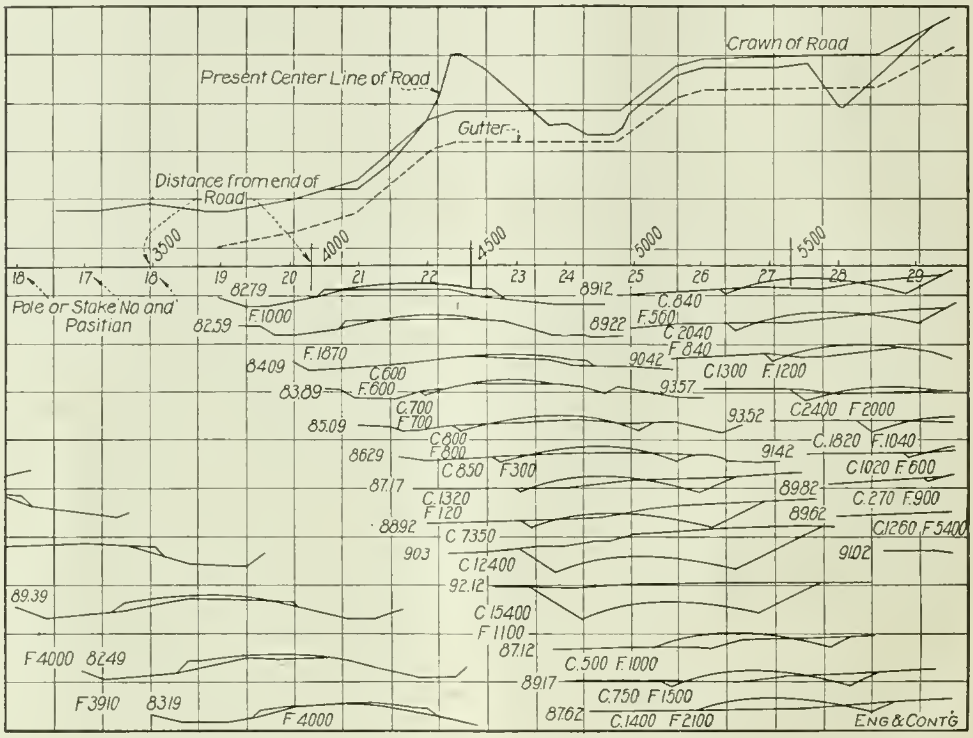

Fig. 1—Profile and Cross Sections of Road.

In making the survey if telephone poles were located along the highway, these were numbered consecutively from one end of the line to the other and distances taped from pole to pole. The number of the pole was kieled onto the pole, so it was easily readable for a number of months. If no poles were available, stakes were set along the edge of the highway and numbered. As the pole or stake line becomes a base line to which practically all of the construction work is referred, it is important that the poles or stakes should be placed along the edge of the right of way, rather than along the edge of the grading, so they will not be disturbed during the construction. The number of these poles or stakes is shown on the plans. In the illustration, Fig. 1, poles numbered from 16 to 29 are given. Their location is platted on the paper to a scale of 200 equals 1 in., and the distance in feet of points along the line, located 500 ft. apart, is shown; this distance is from the point in question to the end of the road.

The profile of the center line of the highway as it is before grading and as it will be after grading is platted directly above the pole numbers to the same horizontal scale, the vertical scale being 4 ft. equals 1 in.

Cross section of the road across the right of way were taken at each pole and at intermediate points where grade or cross section changed materially. This made the cross sections average about 100 ft. apart. These cross sections are platted to a scale of 10 ft. to the inch, both horizontally and vertically, below the pole numbers. The position of the cross section with respect to the profile or to the highway is determined by the position of the left hand end of the cross section on the plat, it being placed directly under the pole number, or position between poles at which the cross section was taken. For instance, in the cross sections shown near the center of the illustration (Fig. 1) the upper one was taken at pole No. 19, the one below this between poles Nos. 19 and 20 and 25 ft. from pole No. 19, the next is at pole No. 20, the next 100 ft. beyond pole No. 20, the next at pole No. 21, etc. The distance from the pole to these intermediate readings is readily determined by remembering that it is, according to the scale on the profile, 50 ft. between the vertical lines. The location of old grades, their height and the extent to which they may be utilized is readily shown by the cross sections at poles Nos. 16, 17, 18 and 19. Side hill work where more dirt is to be removed from one gutter than from the other is readily shown as at pole No. 22. Work entirely in excavation is shown between poles Nos. 22 and 23, and that partially in cut and partially embankment being shown between poles 21 and 22.

According to the scale of the cross sections, the space between any two horizontal lines represents 6 ins. For instance, at pole No. 22 the left hand gutter will be 12 ins. deep, the fill at the center of the road nothing, the cut in the right hand gutter 3 ft. 6 ins. A slight fill not exceeding 6 ins. is required to round out the grade between the center of the road and left gutter. With this method of showing the cross sections it is possible for a contractor to determine very accurately where and how much grading to do without the expense of setting grade stakes being required.

After the cross sections were platted the area of the cut or fill on each cross section was determined, and by the method of end areas the number of cubic feet of both cut and fill between adjacent sections figured. The number of cubic feet of the cut or fill was then marked on the plat between the sections to which it applied, the cut footage being preceded by a C and fill by F. From this it is possible to determine whether the cut and fill will balance or whether it will be necessary to move dirt forward or backward along the line of the highway. With a proper understanding of the method of interpreting the profiles and cross sections a contractor can determine with great accuracy the proper place to commence cutting or filling, or the amount of such cut or fill without the necessity of grade stakes being set. This is a material saving in the cost of the engineering work without detracting from the quality of the construction work materially.

Spikes are driven into each pole along the road, and the elevation of the head of the spike determined at the levels for the cross sections are being taken. These serve as bench marks, which may be used by the engineer in testing completed work, or may be used by the contractor in determining accurately the elevation of the center of the road opposite the bench mark, a carpenter's level or an F-frame level being used to carry the elevation from the B. M. to the center of the road. The elevation of the B. M. is given on the profile above the cross section taken opposite the B. M. in question.

Experience has shown that it is a comparatively easy matter to lay a grade line which will care for drainage, grades, etc., in a slightly rolling country, which will require an expenditure of from $300 to $500 per mile. After this has been done the grades may then be revised so that the cost is reduced from $225 to $125 per mile, without sacrificing anything essential to the proper construction of the earth road. The above contemplates roads in which the water is entirely drained away from the roadway, not a road in which a slight grade is thrown across a wet place, which perhaps may be submerged at some seasons of the year, and throughout most of the year wet and soft. Cost of bridges and culverts is not included.

Distillation of Tar: Methods of Determination and Value in Specifications.

The methods in use and proposed for the distillation of tars and refined tars in road work are so varied and give such varied results that there is evident need for their standardization. This fact is well brought out by Mr. Philip P. Sharples, Chief Chemist, Barrett Manufacturing Co., in a paper presented last week before Section D of the American Association for the Advancement of Science. In his paper, which is reprinted below, practically in full, Mr. Sharples, states that there are 14 sources of variations in methods of distilling, and gives tables showing the variation in results obtained by different observers. He summarizes his conclusion as follows:

The distilaltion test in a specification should be so drawn as to show, in conjunction with the free carbon, specific gravity and viscosity —(1) absence of water; (2) character of tars used; (3) method of refining. It is important that in addition to the amount of distillate, its specific gravity and the melting point of the residue be required. Mr. Sharples' paper follows:

TABLE I.—DISTILLATION OF CREOSOTE, SP. GR. 1,057 AT 15° C. (8-OZ. RETORT).

	Ther.: In liquid bulb ⅜ in. from bottom of retort.	Ther.: In vapour bulb just below neck of retort and 1 in. from liquid at commencement.	Ther.: Bulb ⅜ in. from bottom of retort. Retort bulb covered with tin hood packed with asbestos.	Ther.: In vapour 1 in. above liquid. Bulb of retort covered with tin hood packed with asbestos.	Wurtz Flask "A"—100 cc.	Wurtz Flask "C"—200 cc.
	%	%	%	%	%	%
Below 140° C....	0.85	1.20	0.20	0.50	0.80	1.10
140-270° C.......	41.00	63.00	45.00	60.00	58.00	56.00
270-300° C.......	21.00	12.00	22.00	15.00	15.00	14.00
Total distillate	62.85	76.20	67.20	75.50	73.80	71.10

TABLE II.—SAMPLE MADE FROM WATER GAS TAR; SP. GR. 1.1137; FREE CARBON 1.34.

Time, minutes.	90	90	75	120	150	139	64	45	46	64	45	42
Per cent by weight:												
Start to 110° C.	0.00	0.20	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
110° to 170° C..	0.23	0.85	1.44	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
170° to 235° C..	21.50	16.21	14.61	0.80	0.60	0.00	1.63	0.40	0.35	0.07	0.08	0.37
235° to 270° C..	20.80	8.36	24.06	10.70	6.83	4.09	10.93	4.50	4.35	11.90	11.56	7.62
270° to 315° C..	*	16.22	15.73	42.80	34.30	27.59	25.50	24.00	25.67	26.97	28.66	26.41
Residue	57.13	58.16†	43.31	43.50	58.37†	67.35	61.80	71.10†	69.45	60.87	59.11†	65.22
Total	99.69	100.00	99.24	97.85	100.00	99.03	99.86	100.00	99.62	99.81	100.00	99.62

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*Distillation carried to 270° C. only.
†Residue determined by difference.

The wide adoption of refined tar in road work has led to much study of the material both from a manufacturer's and a consumer's standpoint. The manufacturer is interested in the manufacture of the best possible product from the raw materials available, while the consumer is interested both in getting the best material and in holding the manufacturer up to his highest level.

Many different tests have been proposed to define refined tar, but the only essential points to be defined in order to secure uniformity are the specific gravity, viscosity or melting point, free carbon, and a distillation test. Of these tests, the specific gravity, viscosity or melting point, and free carbon have been very well understood through the discussion which has raged around them, and the tests themselves are comparatively simple, using simple apparatus.

On the other hand, with the distillation test so many variations are possible, each of them having a direct and important bearing on the result, that the standardization of a method of testing has been fraught with great difficulty. Each laboratory which has attacked the problem has chosen a form of apparatus of its own, or even where the apparatus was the same, it was used in such different ways that radically different results have been obtained with the same apparatus. It is hardly to be wondered that the manufacturer who came in contact with all these different methods had difficulties of his own in attempting to fill even a specification based on the analysis of his own material.

The sources of variation in the methods of distilling may be enumerated as follows:

1. Shape of still.
2. Size of still.
3. Position of outlet.
4. Material of still and weight.
5. Method of heating.
6. Method of protecting still and outlets from drafts.
7. Size of charge.
8. Rate of distillation.
9. Position of thermometer.
10. Accuracy of thermometer.
11. Size and shape of thermometer.
12. Cutting points on fractions.
13. Personal equation.
14. Method of reporting results (by volume or by weight).

It is not necessary to go into detail in regard to the causes of variation in the different cases enumerated, but that they are serious is shown by Tables I, II and III. Table I shows results obtained by Messrs. Arthur R. Warnes and W. B. Southerton, of the Midland Junior Gas Association, February, 1912.

Tables II and III are taken from "Proceedings of the American Society for Testing Materials," Vol. XI, 1911, the report of the sub-committee on Distillation of Committee D-4. The three series of tests, "A," "B," and "C," were made by three different observers in three independent laboratories on the same sample, and are especially important, since they bring out not only variations due to the method, but also variations due to the personal equation.

In the case of creosote oil where a similar distillation is made, it was early recognized that every detail of the method of distillation must be clearly stated, in order that the results might have any weight. As small variations in the distillate might lead to the rejection of thousands of gallons of oil, it was important that the chemists of the buyer and of the seller should agree.

In the United States, the specification of the Maintenance of Way Association has been generally adopted for creosote oil. This specification recognized and provided for all the points enumerated above, except the size and shape of the thermometer. Some recent work on thermometers has shown that manufacturers of the instruments vary widely in their method of calibration and in the size of the different parts of the thermometer. These differences are of small account in ordinary thermometric work, but in distillation, where the range is wide and where the temperature is not stationary but advancing, it is important to define the size of the thermometer, its amount of mersion and its sensitiveness to change in temperature. If this is not done, the cutting points recorded will not be the same, since a thermometer which is lacking in sensitiveness will not arrive at the true temperature until long after that temperature has actually been reached in the distillation.

Out of the general chaos of methods proposed for road work have emerged four which are now in somewhat general use. These methods are as follows:

DISTILLATION TEST: OFFICE OF PUBLIC ROADS.

This test is made upon tars and tar products, as follows: From the specific gravity of the tar, taken at 25° C., the weight of 250 c. c. is calculated, and this amount poured into a tarred glass retort of 750 c. c. capacity. A cork stopper, carrying a thermometer, is then inserted into the tubulature so that the bulb is on a level with the bottom of the juncture of stem and body of the retort.

The tar should be heated gradually by means of a Bunsen burner, and the first fraction to 100° C. caught in a graduated glass cylinder. A cold, wet towel wrapped about the stem of the retort serves to condense the distillate. If the tar is a crude one, containing much water, great care must be taken to prevent it from boiling over. After the first fraction is collected, however, distillation proceeds without trouble.

At this point the receiver is changed for another graduated glass cylinder, and an asbestos paper cover placed over the retort for the purpose of obtaining a uniform temperature. The flame of the burner should be so regulated that not over two drops of distillate per second are collected. At 170° C. the receiver is again changed and a third fraction to 270° C. collected.

Distillation is then stopped, and any material which may have solidified in the stem of the

TABLE III.—SAMPLE MADE FROM COAL TAR; SP. GR. 1.2082; FREE CARBON 18.53.

Time, minutes.	96	105	84	100	210	102	93	50	35	58	50	38
Per cent by weight:												
Start to 110° C.	0.03	0.00	0.52	0.10	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
110° to 170° C..	1.36	0.07	3.06	0.25	0.20	0.15	0.18	0.00	0.00	0.01	0.00	0.00
170° to 235° C..	17.54	14.80	13.39	5.75	3.54	2.84	5.90	3.40	2.84	6.40	6.65	5.04
235° to 270° C..	9.80	6.64	12.78	11.65	11.70	11.41	10.33	9.40	9.16	9.07	9.06	9.87
270° to 315° C..	*	10.47	10.57	11.60	12.42	12.66	10.37	9.60	11.40	10.10	9.14	10.25
Residue	70.80	68.02	58.92	70.10	72.14†	72.00	73.07	77.60	76.45	74.10	75.15†	74.62
Total	99.42	100.00	99.24	99.45	100.00	99.06	99.85	100.00	99.85	99.69	100.00	99.78

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*Distillation carried to 270° C. only.
†Residue determined by difference.

TABLE IV.—COMPARISON OF REFINED TARS.

	No. 5.	No. 7.	No. 9.	No. 11.
Penetration (Schutte)	5 sec. @ 40° F.	77 sec. @ 40° F.	70 sec. @ 60° F.	M. P. 113° F.
Distillation, 0 to 170° C.	0%	0%	0%	0%
Do, 170 to 315.5° C.	26.67%	21.75%	15.99%	9.12%
Specific gr. of distillate at 15.5° C.	1.0345	1.0433	1.0481	Not determined.
Melting point of residue	72.7 C.	73.8 C.	72.2 C.	74.4 C.

retort is liquefied by the application of heat and caught in the last receiver.

When the maximum temperature is reached for each fraction, the flame should be removed from under the retort until the thermometer shows drop of about 5°. The temperature is then changed for the next fraction.

DISTILLATION TEST: AMERICAN SOCIETY OF CIVIL ENGINEERS.

Seven hundred grams of the compound are weighed into a retort (E. & A. 4-pint iron retort No. 4521) whose top is fitted with a tee as close as possible to the retort, and a condenser pipe, 24 ins. to 36 ins. long. The upper branch of the tee is used for the insertion of a thermometer, the top of whose bulb is placed immediately below the main outlet of the tee. The distillation shall proceed at the rate of two drops per second.

DISTILLATION TEST: AMERICAN RAILWAY ENGINEERING & MAINTENANCE OF WAY ASSOCIATION.[1]

Apparatus: The apparatus for distilling the tar oil or creosote must consist of a stoppered glass retort similar to that shown in diagram, having a capacity, as nearly as can be obtained, of 8 oz. up to the bend of the neck, when the bottom of the retort and the mouth of the offtake are in the same plane.

A nitrogen-filled mercury thermometer of good, standard make, divided into full degrees Centrigrade, must be used in connection therewith. The bulb of the retort and at least 2 ins. of the neck must be and remain covered with a shield of heavy asbestos paper, shaped as shown in diagram, during the entire process of distillation, so as to prevent heat radiation, and between the bottom of the retort and the flame of the lamp or burner two sheets of wire gauze, each 20-mesh fine and at least 6 ins. square, must be placed.

It is also recommended that the flame be protected against air currents. An ordinary tin can, from which a portion of the bottom and all of the top have been removed, placed on a support attached to the burner, as shown on diagram, has been found to answer the purpose.

Distillation: Before beginning the distillation the retort should be carefully weighed, and exactly 100 grams of the oil placed therein, the same being weighed in the retort. The thermometer should be inserted in the retort with the lower end of the bulb ½ in. from the surface of the oil, and the condensing tube attached to the retort by a tight cork joint. The distance between the bulb of the thermometer and the end of the condensing tube should not be less than 20 nor more than 24 ins., and during the progress of the distillation the thermometer must remain in the position originally placed.

The distillate should be collected in weighed bottles and all fractions determined by weight.

The distillation should be a continuous one and should take about 45 min.

PROPOSED TENTATIVE METHOD OF DISTILLATION: AMERICAN SOCIETY FOR TESTING MATERIALS.[2]

Apparatus: The apparatus shall consist of the following standard parts:

(a) Flask: The distillation flask shall be a 250-c. c. Engler distilling flask, having the following dimensions:

	Cm.
Diameter of bulb	8.0
Length of neck	15.0
Diameter of neck	1.7
Surface of material to lower side of tubulature	11.0
Length of tubulature	15.0
Diameter of tubulature	0.9
Angle of tubulature	75°

A variation of 3 per cent from the above measurements will be allowed.

(b) Thermometer: The thermometer shall be of hardened glass, filled with carbon dioxide under pressure, and provided with an expansion chamber at the top; it shall read to 450° C., and shall be graduated in single degrees Centrigrade, and shall have the following dimensions:

	Mm.		Mm.
Diameter of stem	6.75	to	7.25
Length of thermometer	335	to	350
Length from 0° to 450° marks	285	to	300
Length of bulb	20	to	22
Diameter of bulb	5.25	to	6.50

It shall rise from 15° to 95° in not less than 3 secs. or more than 5 secs. when plunged into boiling water.

The thermometer shall be set up as for the distillation test, using water, naphthalene and dimethylamine as distilling liquids. The correctness of the thermometer shall be checked at 0° C. and 100° C. after each third distillation until seasoned.

(c) Condenser: The condenser shall have the following dimensions:

	Mm.
Length of tube	500
Width of tube	12 to 15
Width of adaptor end of tube	20 to 25

(d) Stands: Two iron stands shall be provided, one with a universal clamp for holding the condenser and one with a light grip arm with a cork-lined clamp for holding the flask.

(e) Burner and Shield: A Bunsen burner shall be provided, with a tin shield 20 cm. long by 9 cm. in diameter. The shield shall have a small hole for observing the flame.

(f) Cylinders: The cylinders used in collecting the distillate shall have a capacity of 25 cc., and shall be graduated in tenths of a cubic centimeter.

4. Setting up the Apparatus: The apparatus shall be set up as shown in Fig. 1, the thermometer being placed so that the top of the bulb is opposite the middle of the tubulature. All connections should be tight.

5. Method: One hundred cubic centimeters of the dehydrated material to be tested shall be placed in a tarred flask and weighed. After adjusting the thermometer, shield, condenser, etc., the distillation is commenced, the rate being so regulated that 1 cc. passes over every minute. The receiver is changed as the mercury column just passes the fractionating point.

The following fractions should be reported:

Start of distillation to 110° C.
110 to 170° C.
170 to 235° C.
235 to 270° C.
270 to 300° C.
Residue.

To determine the amount of residue, the flask is weighed again when distillation is complete. During the distillation the condenser tube shall be warmed when necessary to prevent the deposition of any sublimate. The percentages of fractions should be reported both by weight and by volume.

The results of a long series of distillations made by members of the sub-committee on distillation, of the American Society for Testing Materials, given in Table No. 1, show very clearly the marked difference in the results given by these methods, and also the difference that may be expected from different observers using the same methods.

If these different specifications are examined, it will be noted that the specification of the American Railway Engineering & Maintenance of Way Association provides for nearly all the possible sources of error noted on page 2. The personal equation, however, seems to enter less into the results obtained by the Tentative Method of the American Society for Testing Materials. It would seem therefore that this method warrants a much wider acceptance than has been accorded it at the present time. The method, in addition to its accuracy, has the distinct advantages over all the other methods (except that of the American Railway Engineering & Maintenance of Way Association method) of requiring apparatus easily obtainable; of requiring a minimum amount of material for the distillation; and of requiring a minimum amount of time. All of these are important considerations in a commercial laboratory.

A distillation clause in specifications for road tar was originally introduced with the idea of governing the consistency. Methods for determining consistency have, however, been so well worked out in recent years that the distillation test is not required for this purpose, and the mistake has often been made of calling for a distillation test not in accordance with the viscosity test. The two are closely related, as is shown by Table IV, showing the total distillate of four refined road tars of differing viscosities, made from the same raw tars, as determined by the American Railway Engineering & Maintenance of Way Association method.

The real value of the distillation test is that when properly worded it defines to a certain extent the tars from which the product may be produced and the method of distilling them. The results should always be interpreted with reference to the other constants determined.

The distillation specification may be made to show:

1. The detection of water. Water will be shown in the first fraction and may be determined quantitatively.

2. The kind of tar. For this purpose the specific gravity of the oils distilled is indispensable and should be required. Interpreted with reference to the free carbon and the viscosity, coal tar and water gas tar may be distinguished by the specific gravity of the oils.

3. The method of manufacture. The detection of a cut back tar may be interred from an abnormal specific gravity of oil for the viscosity, and from an abnormally high melting point of the residue of distillation. For this purpose the melting point of the residue should always be required.

4. The presence of abnormal amounts of naphthalene. An examination of the liquefying point of the oil will indicate abnormal naphthalene.

An examination of some of the specifications in use would seem to show little uniformity in the requirements, and few indicate the method to be used thus invalidating to a certain extent the objects aimed at. A number of current specifications calling for approximately the same grade of refined tar are given below. It will be noted that no two use the same cutting points, that no two specify the same end point and that two only call for the specific gravity of the distillate and the melting point of the residue.

The greater variety in the specifications takes away no small part of their value, as the direct comparison of the results of different observers is prevented. The importance of the test would seem to warrant its standardization.

The important points to be observed in drawing specifications for distillation are: 1 Absolute definition of method. 2. Designation of specific gravity of oil. 3. Designation of melting point of residue. 4 Conformance of distillation specification with other parts of the specification.

EXTRACT FROM THE MASSACHUSETTS HIGHWAY COMMISSION'S SPECIFICATION FOR REFINED TAR, 1909.

It shall contain no body that distills at a lower temperature than 225° C.; not over 10 per cent by weight shall distill below 270° C., and it shall contain at least 65 per cent, by weight, of pitch of bituminous material remaining after all bodies up to 360° C. have been distilled.

EXTRACT FROM THE ILLINOIS HIGHWAY COMMISSION'S SPECIFICATION FOR TAR BINDER, 1912.

Distillation: Fractional distillation shall give results within the following limits, all measurements being by volume:

Up to 110° C. the distillate shall not exceed 2 per cent, and shall be free from ammoniacal water.

From 110° C. to 170° C. there shall be not to exceed 5 per cent distillate, of which not more than one-fourth shall be naphthalene.

From 170° C. to 270° C. there shall be not more than 30 per cent nor less than 20 per cent of distillate, of which not more than one-third shall be solids when cold.

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[1] Bulletin No. 65, July, 1905.

[2] P. 241, vol. xi. 1911, Proceeding of the American Society for Testing Materials.

EXTRACT FROM NEW YORK HIGHWAY COMMISSION'S SPECIFICATION FOR BITUMINOUS MATERIAL "T" (HIGH CARBON TAR), 1912.

It shall contain no body that distills at a lower temperature than 170° C.; not over 1 per cent shall distill below 235° C.; not over 10 per cent shall distill below 270° C.; not over 20 per cent shall distill below 300° C.

The specific gravity of the entire distillate shall not be less than 1.02.

The residue from the foregoing distillation shall have a melting point not greater than 75° C.

EXTRACT FROM THE SPECIFICATION FOR "BITUMINOUS CONCRETE PAVEMENT," ADOPTED BY THE ASSOCIATION FOR STANDARDIZING PAVING SPECIFICATIONS IN JAN., 1912.

Coal Tar Cement: No distillate shall be obtained lower than 338° F., and up to 600° not less than 5 per cent and not more than 20 per cent of distillate shall be obtained. The distillate shall be of gravity of not less than 1.03 at 60° F. The residue shall have a melting point of not more than 165° F.

In making this distillation an 8-oz. glass retort shall be used, and the thermometer suspended so that before applying the heat the bulb of the thermometer is ½ in. above the surface of the liquid.

EXTRACT FROM ROAD BOARD OF ENGLAND'S SPECIFICATION NO. 5 ADOPTED IN APRIL, 1911.

Specifications for Tar No. 2—

Fractionation: The tar shall be free from water, and on distillation shall yield no distillate below 140° C.; not more than 5 per cent of distillate up to 220° C., which distillate shall remain clear and free from solid matter (crystals of naphthalene, etc.) when maintained at a temperature of 30° C. for half an hour.

Between 140° and 300° C. it shall yield not less than 15 per cent, nor more than 21 per cent of the weight of the tar.

Supplementary Reports on the 1907, 1908, 1909 and 1910 Dust Prevention and Road Preservation Experimental Work of the U. S. Office of Public Roads.

The U. S. Office of Public Roads during the spring of 1910 constructed a number of experimental sections of oil-cement-concrete pavement, for the purpose of ascertaining the value of the material for paving purposes. A description of the experimental work was given in the July 26, 1911, issue of Engineering and Contracting. Supplementary reports describing the condition of these roads and other experimental roads constructed in previous years are given in a recently issued circular in the U. S. Office of Public Roads. From this circular the matter in this article has been taken.

OIL-CEMENT-CONCRETE.

Experimental roads made of oil-cement-concrete were constructed in 1910 at New York, N. Y., at Ridgewood, N. J., and at Washington, D. C. The pavement at New York was laid in May and June, 1910. The work at Ridgewood, N. J., consisting of surfacing two bridge floors, was done in April and May, 1910, and the work at Washington, D. C., was accomplished in June, 1910. The following additional information regarding these pavements was gathered from an inspection made Dec. 18, 1911.

Experiments at New York.—The surface is worn, at every joint separating the various days' work, into a furrow from 6 to 12 ins. wide in the center of the road, tapering to nothing at from 8 to 10 ft. from the center of the road, and from 2 to 3 ins. deep. These furrows are located at approximately the following stations: 0+58, 1+20, 1+80, 2+12, 2+40, 2+75, 3+20, and 3+90. In general the surface from station 0+00 to station 3+00 is in very fair condition, with the exceptions noted above, and 6 or 8 cup-shaped depressions from 8 to 15 ins. in diameter and from 1 in. to 1½ in. in depth. From station 3+00 to station 3+50 the entire surface is badly worn—particularly in the center of the road—and in appearance and resistance to a knife appears but little better than a macadam road. From station 3+50 onward the road surface is in fair condition, except at station 3+90, where there is a hole 3 ft. in diameter and from 2 to 3 ins. deep. A joint apparently was the initial cause of failure at this point. The cut across the road at station 2+30 is still filled with the refuse of the cut.

Experiments at Ridgewood, N. J.—The floors of the two bridges are in excellent condition and no worn depression is anywhere noticeable. In the middle of the roadway the wear is on the concrete, but a strip from 3 to 4 ft. wide on each side of the center is covered with about an inch of dirt. At the ends of the bridges the edges of the concrete are rounded by wear, but not in an amount sufficient to be detrimental to the floor.

Experiments at Washington, D. C.—The general appearance of most of these sections, when inspected in March, 1912, had been marred by a number of openings in the surface. There are in all 16 of these places, 14 of which have an area of approximately a square yard each and are distributed along the south side of the roadway, while two larger ones have evidently been made for manholes and connections in sections No. 2 and No. 5. All of these holes have been "back-filled" with loose material and now exist as slight depressions. The general character of the undisturbed surfaces was good throughout, with the exception of a worn depression about 2 sq. ft. in area on the south side of section No. 2 at the middle of the section. Section No. 7, which was the first to be constructed, appeared to be a little rougher and more uneven than the others, but further than this there were no apparent differences between any of the sections.

OIL-GRAVEL-MACADAM AT BOISE, IDAHO.

This experimental pavement was constructed at Boise, Idaho, in 1910. A description of the methods employed and cost data on the work were given in the July 19, 1911, issue of ENGINEERING AND CONTRACTING. The following is the report of an inspection made in January, 1912:

As noted in the original report, the experimental section on which data were kept was laid on a subgrade of dust, and the shoulders were nothing more than dust heaps. Most of the defects up to date are evidently attributable to this. The traffic is heavy teaming and automobiling, and the shoulders have become deeply rutted. Occasional depressions, one or two to every 50 ft., are noticeable throughout the section, but the bituminous bond is still excellent, and there is no tendency to ravel. Considerable mud has been tracked on from intersecting roads, and this had frozen and covered the surface to the depth of an inch in places, thereby impairing the general appearance. There have been no repairs or systematic maintenance, other than occasionally cleaning the gutters, since the road was completed.

OIL-ASPHALT-GRAVEL AT AMES, IA.

The work was done in September, 1910. It was described in ENGINEERING AND CONTRACTING of July 19, 1911. The following is a report of the inspection made Nov. 21, 1911:

The surface is uniform throughout, excepting for a few slight breaks on the south side, about 3 ft. from the curb, and these occurred during construction. About an inch of mud has been carried on from an adjoining road, which probably accounts for the fact that the section is somewhat dusty in summer. The traffic is heavy, considering that the section is on a college campus, and there is quite a large proportion of automobile traffic. The section has been dragged a number of times in conjunction with other roads on the campus, but nothing has been spent or required for maintenance.

TAR AND OIL PREPARATIONS AT KNOXVILLE, TENN.

In the experimental work at Knoxville, one section was constructed by the penetration method, refined coal tar being used and one section with a refined tar preparation. The third section was oil-asphalt. The pavement was laid on Rutledge Pike, the work being done from July 25 to Sept. 7, 1910. A description of the experiment was given in the July 19, 1911, issue of ENGINEERING AND CONTRACTING. The following is the report of an inspection made Nov. 22, 1911:

All of the sections showed a firm, well-bonded surface. Most of the seal coat had worn off in experiment No. 1 and the surface presented more of a mosaic appearance than that of section No. 2. The sections constructed in experiments Nos. 1 and 2 with a refined coal-tar and refined tar preparation, respectively, were hard and smooth and could not be dug into with a knife. They both gave a more metallic ring under horses' hoofs than section No. 3, on which an oil-asphalt was used. This latter section had the appearance of sheet-asphalt, and the material was still soft and malleable when dug out with a knife. Two depressions were noted in this section, one about 2 ft. in diameter at the northeast corner of the intersection with Lake St. and another on the same side of the road at the east end of the section. The surface was, however, intact throughout and the depressions were evidently due to slight settlement.

SLAG, WASTE SULPHITE LIQUOR PREPARATION AND SLAG AND TAR AT YOUNGSTOWN, O.

Seven experimental sections were constructed at Youngstown, O., in the summer of 1909 with a view to determining the best method of utilizing slag for road purposes. A description of the methods of construction was given in the Aug. 3, 1910, issue of ENGINEERING AND CONTRACTING and a supplementary report on the section appeared in the July 5, 1911, issue. The inspection from which the following information was gathered was made Dec. 10, 1911, shortly after a thin covering of snow had melted away:

Experiments Nos. 1, 2 and 3.—Blast-Furnace Slag.—An inspection of these three sections showed comparatively little difference between them. Section No. 3 appeared to be a little better bonded than the other two, but they all presented a smooth surface in the wheel tracks and a rough, rather loosened, surface in the middle of the road where horses had traveled. Section No. 2 presented the least desirable appearance in the middle of the road, owing to the fact that more of the larger-sized pieces of slag were loose and exposed. An engineer who has carefully watched the road during the entire year has reported to the office that it becomes rather loose during the spring thaw, after which it packs down to a smooth surface. There is no annoyance from dust during the summer on any of the sections.

Experiment No. 4.—Blast-Furnace Slag.—Open-Hearth Slag Screenings.—This section continues about the same as when the last report was made, and presents a hard, well-bonded surface. Its general character is superior to any of the others, excepting the one treated with tar. Some slight unevenness has been caused for a distance of about 100 ft. from the north end of the section, and is evidently due to a settlement in the fill over which the section was laid.

Experiment No. 5.—Blast-Furnace Slag Screenings and Lime.—This section had the same general appearance as the adjoining section described under experiment No. 1. The surface was smooth in the wheel tracks, but rough and inclined to ravel where horses had traveled.

Experiment No. 6.—Blast-Furnace Slag and Waste Sulphite Liquor Preparation.—This section presented a generally good appearance and was apparently a little better bonded than the sections described under experiments Nos. 1, 2 and 5.

Experiment No. 7.—Blast-Furnace Slag and Refined Coke-Oven Tar.—In general this section appeared to be in better condition than any of the other sections. While the surface was too hard to be dug with a knife at the time inspection was made, those who have watched the work during the year report that the binder still shows considerable life in summer. Several small, loose spots appear across the road at about 80 ft. and 100 ft. from the north end of the section at the point where the surface extends over a fill, and there is a general slight settlement from this point across the west side of the bridge over which the section passes.

ASPHALT AND TAR PREPARATION, MOLASSES-OIL-LIME, ETC., AT NEWTON, MASS.

The experimental sections were constructed in 1908, and a description of the methods was given in the May 26, 1909, issue of Engineering & Contracting. Reports on the condition of the sections were given in the issues of Aug. 3, 1910, and July 5, 1911. They were examined again in January, 1912, and found to be in practically the same condition as when inspected before. Sections 9 and 10 (refined water gas tar) continued to present the best appearance and were bonded and in excellent condition. No repairs had been made on any of the sections since last inspected. Section 11, on which a mixture of molasses, oil and lime was used, still presents a fairly satisfactory surface and was for the most part well bonded.

SAND-CLAY CONSTRUCTION AT GARDEN CITY, DODGE CITY, BUCKLIN AND FORD, KAN.

The sand-clay roads were constructed in 1908. A description of the experiment appeared in Engineering & Contracting of May 26, 1909; the report on inspection made in 1909 appeared in the Aug. 3, 1910, issue, while the report on the 1910 inspection will be found in the July 5, 1911, issue. The following are reports of inspections made in 1911:

Experiment at Garden City.—This road was inspected Dec. 15, 1911, and found to be in good condition, except as noted below. For a distance of from 300 to 400 ft. at the south end, the road is in excellent condition—very hard, smooth, free from ruts or dust, and with uniform surface and crown. At the junction of the surface with the floor of the bridge across the Arkansas River, the surfacing was broken, causing a drop of from 3 to 4 ins. Such broken places were in evidence at a few other locations over the roadway, but they were all small in area and existed only where the material was crumbly. Otherwise the surfacing was closely bonded, free from ruts and dust, and hard, like macadam. Near the bridge and at two other places along the edge of the surfacing, it was broken from the attack of traffic. This, however, is no fault of the material, but is due to the fact that the surfacing does not seem to be wide enough to accommodate the traffic. New material has been added during the summer months to the weakened places. The whole course has been thoroughly worked once with the road machine, and the split-log drag has been used after every rain on four different occasions. The road is in much better condition than when inspected one year ago and is giving general satisfaction.

Experiments at Dodge City.—The inspection of the sand-clay road in Dodge and Richland Townships, Kansas, was made Dec. 14, 1911. The whole course was found to be in generally good condition. New material has been added to bring the weakened places up to their original condition and even with the surface. That portion of the work in Richland Township was recently given a thorough working with the road machine. The high places in the roadway and the elevations at the shoulders were pared off, so as to give the roadway a uniform surface and crown. The split-log drag was being used to spread a little sand over the surface, in order to overcome a slight tendency to stick and pick up on the wheels after a rain. That portion in Dodge Township, about ¼ mile in length, was slightly rutted and showed neglect of maintenance. The drag was not used at all on this section of the road. Several slight depressions were in evidence near the axis of the road, varying in depth from 1 to 3 ins., but covering only small areas. The deepest one was filled with water from a recent rain and the others were muddy. Otherwise the road was hard and fairly smooth, and gave a ringing sound from the horses' hoofs. The whole course is in much better condition than when inspected a year ago and is giving general satisfaction.

Experiment at Bucklin.—This road was inspected Dec. 16, 1911, and the whole course was found to be in good condition. It has been recently repaired. New material was added where necessary, and the surfaced roadway was then worked over with the road machine, so as to produce a uniform surface and crown. After this a thin layer of sand from the sides was spread over the roadway. It was packing well under the traffic without developing ruts or cups, and gave promise of an excellent road. At the junction of the surface with the floor of the bridge across the Arkansas River a drop of from 3 to 4 ins. was in evidence, but it was still closely bonded. This had been caused by the pounding action of traffic and was the only place overlooked in the repair work.

Experiment at Ford.—The road was inspected Dec. 16, 1911, and found to be in good condition, except as noted below. It had recently been repaired by the addition of new material which was not properly spread over the surface, but left uneven and wavy. It was closely bonded and practically free from ruts, dust or mud, although it had been exposed to a heavy rain a few days previous to the inspection.

EARTH-ASPHALT AT INDEPENDENCE, KAN.

This experimental road was constructed in 1908. It was described in the May 26, 1909, issue of Engineering & Contracting, and reports of inspection trips in 1910 and 1911 were given in the issues of Aug. 3, 1910, and July 5, 1911, respectively. The following report is based on an inspection made Dec. 13, 1911:

Although a heavy rain of 2½ ins. had fallen on the road only two days previous to the inspection, it was found to be generally in fair condition. Tonopah St. was covered with mud to a depth varying from 1 to 3 ins. over that part disturbed by traffic, but the sides were practically free from mud and would bear light traffic without rutting. The entire surface on this street was sufficiently hard to sustain the traffic without developing ruts other than those in the mud which had been carried on from adjacent streets and washed down from the higher elevations. Minnehaha St., or the extension of 4th St., where the soil is decomposed shale and argillaceous sandstone, had the general appearance of an earth road in good condition. There was no mud on this portion of the work, except at the intersection of a cross street where two places holding water were noted. These were found to be only about 1 in. in depth and the material remained hard and intact. The surface was entirely free from dust or ruts caused by traffic; but two gullies, one on each side, which were first caused by the breaking of a water main, had begun to form. No new material has been added nor has anything been expended for maintenance since construction.

KENTUCKY ROCK ASPHALT AT BOWLING GREEN, KY.

This was one of the earlier experimental roads constructed by the U. S. Office of Public Roads. It was built in 1907. A report based on an inspection made in May, 1908, will be found in Engineering & Contracting of May 26, 1909; a report on the inspection in 1910 appeared in the July 5, 1911, issue. The inspection on which the following report is based was made Nov. 23, 1911, during a cold and fairly heavy rain.

The surface still presented a good appearance, and was firm, hard, and generally smooth. The rock asphalt was so thoroughly chilled that it could not be easily dug out with a knife, but local observers informed the office engineers that it possesses considerable life in summer. The white spots of limestone mentioned in a previous circular were still in evidence, but the individual stones were firmly held in place.

Several small, shallow depressions were noted in the western half of the section, but these might have passed unnoticed in dry weather. The small cup-hole mentioned in previous report, however, is now about 1 ft. in diameter and is to be repaired.

RIVERS AND HARBORS

Proposed Plans for Waterfront and Harbor Development at Toronto Canada.

The City of Toronto at the western end of Lake Ontario has a naturally protected harbor of unusually fine proportions. As with most Great Lake harbors, however, artificial development of harbor works at Toronto has been unsystematic and incomplete. Unlike most Great Lake harbors, on the other hand, the water front at Toronto has in very large measure been held public property. It was therefore possible when, late in 1911, a harbor commission was appointed, for that body to proceed with unusually thorough plans for improvement without coming to preliminary arrangements with numerous and conflicting private water front interests. These plans, as developed by Mr. E. L. Cousins as Harbor Engineer, have recently been reported and from advance sheets of this report we present the outline which follows:

Figure 1 is a map of the proposed new harbor works which we have redrawn and greatly simplified from the official plans.

In order to facilitate the handling of the work when active operations are commenced, the water front and harbor has been divided into three sections. The Eastern Section takes in the Ashbridge Bay District and the sand bar in front of it, the Central Section takes in the Central Waterfront from Parliament Street to Bathurst Street, the inner harbor and bay shore of the island, while the Western Section covers the water front from Bathurst Street to the Humber River.

EASTERN SECTION.

In the Eastern Section the development planned covers three phases: commercial and dock development; industrial development, and park treatment on the lake front. A breakwater will be constructed an average distance of 700 ft. out in the lake from the present shore and reaching from the eastern harbor entrance to the east city limits at Victoria Park. To fill the space behind this wall up to 8 ft. above mean water level, including the 1,000 acres in the industrial district, will require 25,000,000 cu. yds. of material. This material can all be secured from the bay and the bed of the lake outside the breakwater, and two large hydraulic dredges will be employed on this work.

The dredging operations will be on a larger scale than ever before attempted in Canada. Each dredge will be capable of dredging either sand or clay from a depth of 50 ft. and pumping it for a distance of 4,000 ft. through long lines of pipe, from which it will be distributed to the area to be filled. The dredge will be built of steel, like an ocean steamship, and will be propelled by twin screws, and controlled by steam steering gear. In this way it cannot only go from place to place without the aid of a tug, but can work out in the open lake, and, when a storm comes up, it can disconnect the pipe-line and steam into the bay without delay, and, if necessary, take the pipe-line with it.

The machinery will be of 2,000 hp. of the latest improved type and complete electric light and searchlights will be fitted so that work can be carried on at night as well as day. A volume of 25,000 tons of sand and clay per day can be dredged and delivered a mile distant by this great dredge. This will be the most powerful dredge in America. There is nothing equal to it in the United States, although somewhat larger dredges are in use in Britain and in India. Up to the present the largest Canadian hydraulic dredge is the "Tarte," built in Toronto in 1901, and working on the St. Lawrence ship-channel below Montreal, but this new dredge to be built will be double the power of the "Tarte."

Nothwithstanding its great size and power, the dredge, with all its machinery, will be handled with ease and under the control of one man on the bridge deck. Here will be located not only complete apparatus for navigating the ship, such as steering wheel, binnacle, engine room, telegraphs, etc., but also a battery of levers controlling all the movements of the dredging apparatus, with gages indicating the depth of working and the amount of sand which is being picked up.

The crew will be cared for in commodious quarters and nothing will be omitted that will contribute to completeness and efficiency.

The dredge will be built from the designs and under the supervision of A. W. Robinson, M. Can. Soc. C. E., the well-known dredge expert of Montreal, consultant on dredging to the British admiralty.

A ship-channel will be constructed for the purpose of extending the inner harbor into the new industrial district. This channel will be 6,800 ft. long, 400 ft. wide and 24 ft. deep and will terminate in a turning basin 1,000 ft. square, and the sides of both the channel and turning basin will be so constructed as to form three miles of dockage accommodation. The industrial area when completed will contain 644 acres of land for factory sites, 235 acres of streets and railroad reservations and 130 acres of waterways.

The roadways will have a minimum width of 75 ft. and a maximum width of 175 ft. The district will be served by railway tracks connecting with all the railways and the railway layout has been so arranged that every alternate street will be free from tracks.

The western or bay face of the district will be developed for dock purposes as the district grows, and will ultimately add 2½ miles to the dock frontage of the areas. One large dock is now being constructed and will be equipped with modern freight sheds and one storage warehouse, and the beginning of a series of factory buildings will be erected back of the dock.

The mouth of the Don will be diverted from its present outlet to a new outlet into a slip at the foot of Cherry St., and the original Don Channel, now filled up, will be utilized as the location for a highway entrance to the industrial area. This new roadway will run east and west.

The area north of the ship channel will be reserved for light manufacturing plants, the area to the east will be the home of heavier plants, which do not require direct water service, and the area south of the channel will be utilized for the heaviest class of manufacturers, requiring a frontage direct on navigable water. The width of the channel, 400 ft., will allow a vessel of the largest type to safely pass through it between two vessels of equal size tied up at each side.

Along the south portion of the reclaimed land a park area 1,000 ft. wide will be reserved, fronting directly on the breakwater. Immediately to the north of the breakwater will be the lake front boulevard drives and walks, with a park and lagoon treatment north o fthe boulevard and a fine beach to the north of the lagoon. Bridges at reasonable intervals will carry traffic across the lagoon to the lake front, and 40 ft. openings in the breakwater at intervals of 2,000 ft. will allow seawall craft to pass through from or to the lake. Inside the breakwater, fronting on the lagoon, will be ample sites for aquatic clubs, and a strip of land will also be laid out, north of the park area, as a location for summer homes. There will be an entrance to the lagoon at Woodbine Ave. and another from the bay east of the eastern channel, and the west face of the area, reserved for large industries, will be treated in boulevard style, so as to make a pleasant approach.

East of Woodbine Ave. there will be no park treatment, but the seawall will be carried to the east city limit, leaving a protected waterway for the use of the residents of this district and the public generally.

CENTRAL SECTION.

In the Central Section the work planned consists almost entirely of commercial and park development, with some industrial land provided at the foot of Bathurst St. The commissioners plan to spend the sum of $2,194,000 in the construction and equipment of proper docks in the area from Bay St. to York St. and at the foot of Bathurst St., but the details of construction for the central development cannot be worked out until the question of the separation of railway and highway grades has been definitely settled.

At the foot of Bathurst St. a dock and industrial area of 17 acres will be provided north of the new Western Channel and east of the boulevard drive. This area will be served by 800 ft. of dock with 20 ft. of water, and will be accessible to all railway lines.

The commissioners propose to construct at this point modern freight sheds and storage warehouses and a factory building similar to the one planned for the Eastern Section. The balance of the work in the Central Section consists of the reclamation of 352 acres of additional park lands on the Island, a portion of which will serve as a location for the boulevard drive and the balance will improve the present unsightly portion of the Island. The boulevard drive will be carried from the east across the Eastern Channel by means of a rolling lift bridge, giving a clear entrance for boats of 200 ft. The drive across the Island will follow a winding course close to the bay shore, thus preserving the beaches to the public, and will cross the Western Channel on another lift bridge. On the Island, south of the Western Channel, a fine area for a new park will be provided, and to the north of the channel on the east side of the boulevard drive will be the industrial and dock area referred to.

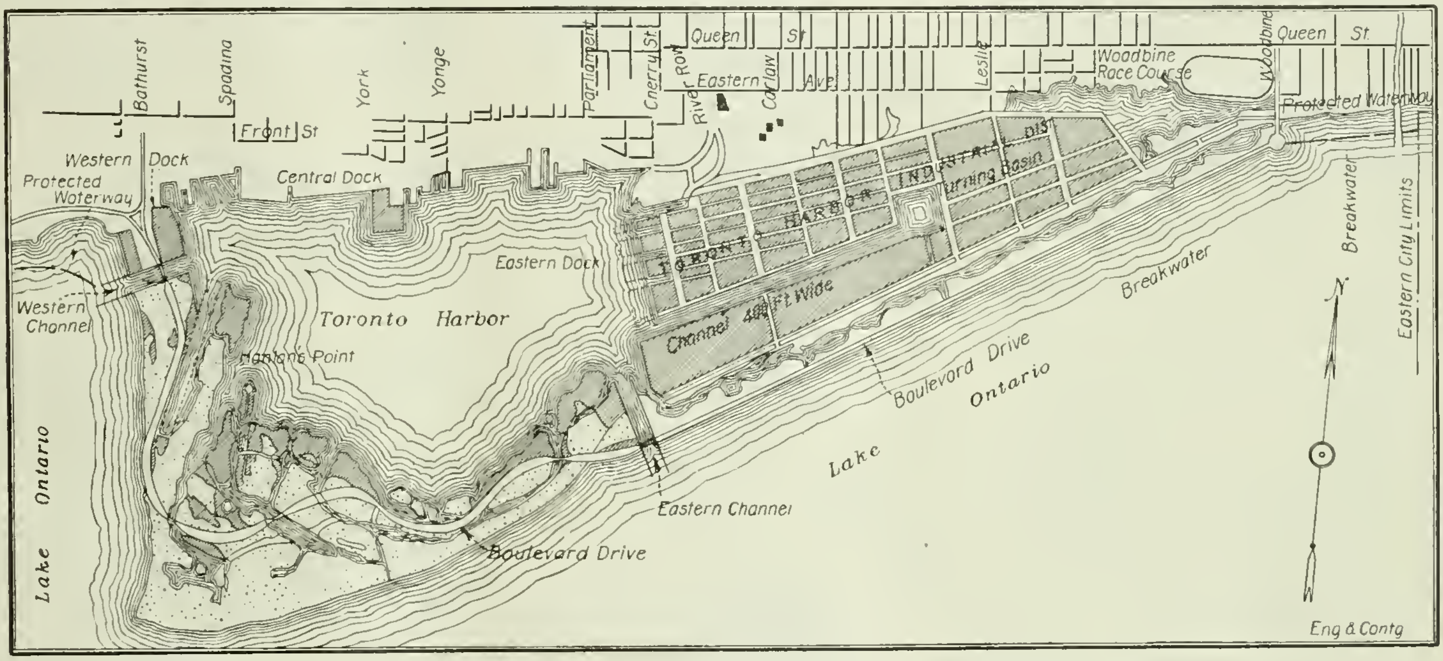


Fig. 1.— Map of Proposed Waterfront and Harbor Development at Toronto, Canada.

WESTERN SECTION.

From Bathurst St. to the Humber River the treatment is entirely along park lines, there being no provision for commercial development. A breakwater will be constructed from a point of 200 ft. west of the new channel to a point at the mouth of the Humber River, and distant an average of 900 ft. from the existing shore line. Inside this breakwater will be a protected waterway with an average width of 500 ft., reaching from the Humber to Bathurst St. and linking up with the Island lagoon system and the new lagoon system planned for the Eastern Section to form a complete protected waterway across the entire city front.

Inside this waterway boats will be in perfect safety, no matter what the weather is on the lake, and the section west of Bathurst St. will be available for a ferry service to the Exhibition Grounds and the Humber.

The western breakwater will be broken every 2,000 ft. by 40-ft. openings to permit of the egress or ingress of sailing or other craft.

The Boulevard Drive will cross the new Western Channel and run north to the present old Western Channel, which will be filled up. At this point it will divide into two roads, one running north to the foot of Bathurst St., which street it is proposed to extend straight south from Front St. with a width of 100 ft., and the other branch turning to the west from the old Western Channel, past the front of the Old Fort and Stanley Barracks, to join the present piece of seawall in front of the Exhibition Grounds. The present seawall and boulevard will be incorporated in the drive, and west of Dufferin St. an ascent will be made to the top of the high bank, in order to give the public the benefit of the fine view over the lake. The high ground is followed to the west end of Cliff Road, the drive being close to the edge of the bank, and the drive there descends to the level of 8 ft. above the lake, following this level through to the mouth of the Humber River, where provision will be made for a junction with the Humber Valley boulevard.

From Bathurst St. to the Exhibition Grounds and from Cliff Road to the Humber the sand pumps will be utilized to reclaim areas of property for park purposes, and from Sunnyside to the Humber over a mile of fine sand bathing beach will be made and a bath house erected at its east end. In the same district sufficient land will be reclaimed to provide for an 80-ft. reservation for a radial railway entrance to the city, along the location of the present Lakeshore Road, with a new 66-ft. commercial road to the south of the reservation. This roadway will replace the Lakeshore Road and will serve as the business entrance to a tier of lots reserved for building purposes. In front of this tier of building lots and 8 ft. above the boulevard proper will be a terraced boulevard and walks 55 ft. wide, faced by a parapet wall and with steps at intervals leading onto the boulevard proper. Outside the boulevard and bridle paths will be the bathing beach and protected waterway, with the breakwater as its southern boundary.

COST.

The total cost of all the work planned by the commissioners amounts to $19,142,088. This expenditure it is intended to spread over a term of years, the expectation of the commissioners being that the work will be completed within ten years.

The city is asked to undertake the expenditure of $146.500 as its share of the general work, for the purpose of constructing the highway bridge across the Don Channel into the Industrial District, and the construction of a retaining wall and balustrated along the front of the Exhibition Grounds, in order to separate the grounds from the boulevard. This expenditure will have to be followed later on by an expenditure of $1,656,383 by the city, if the lake front boulevard plan is approved and the city undertakes to complete it by constructing walks, roadways and park features after the commissioners have reclaimed the site. This makes a total expenditure allotted to the city of $1,802,883 as its share of completing within ten years the work shown on the plan.

The Dominion Government has been asked to undertake the expenditure of $6,123,284 in the construction of the eastern breakwater, the western breakwater, the ship channel in the Industrial District, the bridges over the eastern and western harbor entrances and the bridge over the ship channel and protection piling near the eastern channel.

Representatives of the Harbor Commission, accompanied by Sir Edmund Osler, the Hon. A. E. Kemp and Mr. Claude Macdonell, M. P., had an interview with the premier, the Hon. R. L. Borden, and six of his ministers, at Ottawa on the 6th inst., when the request of the commissioners was placed before the government. The deputation met with a most cordial reception and are sure that their request will be granted. One minister, in fact, suggested that the portion of work allotted to the government could be easily carried through in five years instead of ten as suggested.

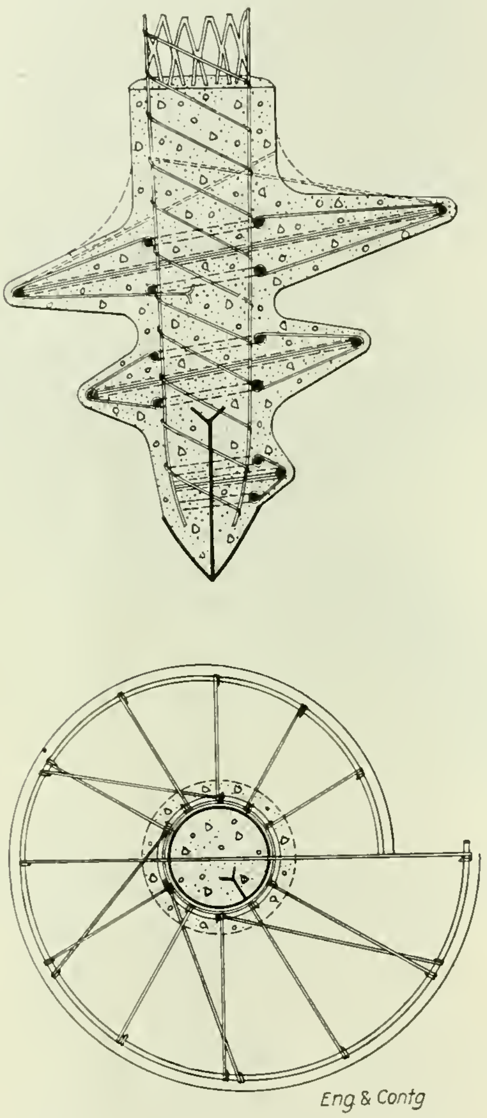
The balance of the projected work will be undertaken by the commissioners at an estimated cost of $11.215.920. The money will be raised by the issue of debentures by the Harbor Commissioners and a careful estimate of the business possibilities of the plan warrant the assurance that the ultimate annual revenue from the property entrusted to the commissioners and created by them will be such as to meet the interest and sinking fund charges on the money borrowed and to leave a handsome surplus to be handed over to the city to aid in the reduction of the tax rate.

Any guarantee by the city of bonds for this purpose, if necessary, will only be on such a plan as will not affect the city's statutory borrowing powers.

A Reinforced Concrete Screw Pile of English Invention.

Contributed by James A. Seager, Bristol, England.

The accompanying drawing shows the construction of a reinforced concrete screw pile which has been recently introduced by the Helical Reinforced Concrete Screw Syndicate of Portsmouth, England. The screw construction is the invention of Mr. A. C. Vernon-Inkpen, of Portsmouth, and, as will be seen, an essential feature is the reinforcing of the screw flange integrally with the shaft reinforcement; radiating and tangential arms connect the shaft reinforcement with the screw helix.



An English Reinforced Concrete Screw Pile.

The sinking of the pile is accomplished by means of a capstan and gear worked from central positions without shifting the plant for each pile, and for this purpose keyways or flat sides are formed along the length of the pile shaft. This shaft is helically reinforced in the opposite direction to that of the screw flange, and the metallic continuity of this reinforcement is maintained throughout the entire length of the pile so as effectively to transmit the torsional strain necessary for screwing down the pile and bringing into compression the concrete forming the body of the pile shaft. The reinforcement of the screw threads is accomplished by steel brackets with radiating and tangent arms, wrapped spirally round the reinforcement of the shaft as a helix in the direction of the pitch of the sinking screw. The members of the reinforcement are designed throughout to be in tension in order to resist the shearing of the breaking-off strain, as might occur if the pile was brought into contact with rocks, boulders, or other hard substances. Another improvement is that the screw thread can be made as a slip-on metal encasement in sections and either built-up with the shaft of the pile or attached and amalgamated with it by bonding keys formed with grouted concrete so as to form an integral part of the pile in conjunction with hexagonal sides on the shaft and metal encasements, which would prevent a twisting or turning movement resulting from the strain of screwing the pile into position. Moreover, the pile is sometimes formed with a steel protecting pointer with a hollow core within the reinforcement and having means prepared for providing water pressure to assist the screwing up or down of the pile. Where a cutting edge on the base is considered desirable, the piles may be formed hollow, the base being provided with a metal screw encasement having a chisel shaped or serrated edge for cutting through soils and obstructions in the strata. The keyways along the vertical lengths of the pile shaft may be utilized where necessary for receiving sheet piling.

Some Statistics of Performance of Stone Crushers, Cableways, Cranes and Concrete Mixers at Panama.

(Staff Article.)

Statistics showing the time worked, time lost in delays and output of the several kinds of machines employed in constructing the Panama Canal locks are given in the report of Mr. Ad. Faurè, cost accountant to the Isthmian Canal Commission. The figures cover the year ending June 30, 1912, and from them we have extracted the following summaries:

Porto Bello Crushing Plant.—The crushing plant at Porto Bello was described in our issue of Dec. 14, 1910, but for the present record of crusher performance it may be noted that it includes seven gyratory crushers as follows: One No. 21, two No. 9 and four No. 6. During the year under consideration the plant worked until April 30, 1912, eight hours per day and produced 440,413 cu. yds. of crushed stone at a cost as itemized in our issue of June 1, 1912, of $140 per cubic yard. The statistics of performance are as follows:

Delays:	Hours.	Per cent of total.
Repairing crusher	11	0.53
Repairing cross-conveyor	11	0.53
Repairing bin conveyor	12	0.59
Crusher choked	11	0.53
Waiting for stone	619	30.60
Bins full (no barges)	376	13.63
Other causes	75	3.71
Total hours delayed	1,015	50.12
Total hours crushing	1,009	49.88
Total hours in operation	2,024	100.00

From these figures it follows that the output of the plant was 436.56 cu. yds. per hour worked and 217.6 cu. yds. per hour in operation. Of the 49.88 per cent time lost it will be noted that 44 per cent was time lost waiting for stone to crush and for conveyance for removing crushed stone.

Ancon Crushing Plant.—A description and plans of the stone crushing plant at Ancon were published in our issue of Dec. 14, 1910. It contains one No. 12 and four No. 6 gyrating crushers, and was operated from 9 hours to 18 hours per day during the year as the demand for stone made necessary. The total output for the year was 837.908 cu. yds. and the cost per cubic yard was 65 cts. as itemized in our issue of Jan. 1, 1912. The statistics of performance are as follows:

Delays:	Hours.	Per cent of Total.
Repairs to crushers	213	6.43
Crusher choked	93	2.80
Waiting for stone	350	10.55

Waiting for cars	126	3.79
Other causes	150	4.52
Total hours delayed	932	28.09
Total hours crushing	2,384	71.91
Total hours in operation	3,316	100.00

From these figures it follows that the output of the plant was 351.5 cu. yds. per hour worked and 252.76 cu. yds. per hour in operation. As at the Porto Bello plant the principal causes of delay were waiting for stone to crush and for crushed stone to be taken away, although these delays were not so great in proportion as at the Porto Bello plant. Delays for repairs to crushers at Porto Bello and Ancon were as 1 to 12+.

Cableway Plant at Gatun.—The cableway plant at Gatun was described in our issue of Nov. 17, 1909; it consists of two duplex and one single cableways for unloading sand and stone from barges to stock piles and of four duplex cableways spanning the lock chambers and handling concrete for the lock walls. All cablesways were of the Lidgerwood type. The performance of the unloading cableways was as follows for an average of 4.39 cables operated and 346,767 cu. yds. handled:

Delays:	Hours.	Per cent of total.
Repairs	650	5.70
Power off	211	1.85
Moving barges	238	2.09
Waiting on barges	3,003	26.35
Other causes	721	6.32
Total hours delayed	4,823	42.31
Total hours unloading	6,575	57.69
Total hours in operation	11,398	100.00

From these figures we get an output of 52.72 cu. yds. per hour at work and of 30.42 cu. yds. per hour in operation for each cable. As in the previous performances recorded the chief causes for delays are failure to supply material to keep the machines fully occupied.

The cableways for handling concrete handled 298,776 cu. yds. of concrete and 70,758 cu. yds of large stones or "plums" or a total of 309,534 cu. yds. An average of eight cables in operation was maintained. The figures of performance were as follows:

Delays:	Hours.	Per cent of total.
Repairs	322	1.27
Waiting for concrete	1,442	5.68
Waiting for forms	7,653	30.12
Moving towers	1,633	6.42
Total hours delayed	11,050	43.49
Total hours working	14,355	56.51
Total hours in operation	25,405	100.00

The 14,355 hours of working time was divided as follows:

Handling concrete, hours	9,841
Handling forms and filling, hours	4,514

The output or amount of material handled per hour worked was 31.46 cu. yds. per cable.

Boom Derricks.—Five boom derricks were operated at Gatun including sand and crushed stone from barges. Their output for an average of 3.83 derricks operated was 192,916 cu yds. The record of performance was as follows:

Delays:	Hours.	Per cent of total.
Repairs	547	7.25
Moving barges	238	3.16
Waiting on cars	641	8.48
Waiting on barges	1,609	21.33
Other causes	642	8.51
Total hours delayed	3,677	48.73
Total hours unloading	3,869	51.27
Total hours in operation	7,546	100.00

The output per hour worked was, according to these figures, 49.87 cu. yds. and per hour in operation was 25.57 cu. yds.

Electric Cranes.—Three cranes having a right and left boom extending beyond the wharf edge over a barge on one side and reaching back over railway track on the opposite side are employed at Balboa to transfer sand from barges to cars by means of grab buckets suspended from trolleys traveling on the booms. Two of these cranes operated eight hours per day and unloaded 564,387 cu. yds. The performance figures are as follows:

Delays:	Hours.	Per cent of total.
Repairs	28	0.56
Waiting for barges	12	0.25
Waiting for cars	1,309	26.87
Other causes	25	0.49
Total hours delayed	1,373	28.17
Total hours unloading	3,500	71.83
Total hours in operation	1,873	100.00

From these figures it follows that the output per crane per hour worked was 161.41 cu. yds., and per hour in operation was 71.83 cu. yds.

Concrete Mixing Plant at Gatun.—The concrete mixing plant arrangement for the Gatun Lock work was described in our issue of Sept. 22, 1909. It consists of a main plant of eight 2-cu. yd. mixers and of an auxiliary plant of two 2-cu. yd. mixers. All mixers are of the Austin Improved Cube type.

The main mixer plant averaged 4.3 mixers operated and mixed 343,364 cu. yds., with the following performance record:

Delays:	Hours.	Per cent of total.
Repairs	....	....
Waiting for cars	7,659	56.93
Other causes	....	....
Total hours delayed	7,659	56.93
Total hours mixing	5,794	43.07
Total hours in operation	13,453	100.00

These figures give an output per mixer per hour worked of 59.26 cu. yds., and per hour in operation of 25.52 cu. yds.

The auxiliary mixing plant operated an average of 1.89 mixers and mixed 80,544 cu. yds., with the following performance record:

Delays:	Hours.	Per cent of total.
Repairs	13	0.45
Waiting for cars	2,406	66.30
Other causes	35	0.96
Total hours delayed	2,454	67.61
Total hours mixing	1,175	32.39
Total hours in operation	3,629	100.00

The output per mixer per hour mixing was thus 68.54 cu. yds., and the output per hour in operation was 22.2 cu. yds.

Mixers at Pedro Miguel and at Miraflores.—Performance of the concreting plants for the lock work at Pedro Miguel and at Miraflores requires explanation. At each lock the main plants consisted of traveling cantilever cranes, one set mounted on the berm and having a travel along the lock site and one set mounted on the bottom of the lock chamber and traveling along the lock site. On each berm crane were two mixers. In operation each berm crane handled raw materials to its mixers and also handled mixed concrete from its mixers to a chamber crane which placed it in the locks. Forms and other materials were similarly handled. A description of these cranes was published in our issue of Dec. 14, 1910, and may be consulted for details. Besides the crane plants, there was at each lock an auxiliary mixing plant. The performance records of these various plants are summarized in Tables I to V, inclusive.

TABLE I.—PERFORMANCE OF BERM CRANES, MIRAFLORES LOCKS.

Average number of cranes operated...... 3.58
Average number of mixers operated..... 6.55
Concrete mixed, cu. yds.................409,651

	Hours.	Per cent of total.
Mixing and placing	5,827.31	55.49
Handling forms, steel and other material	683.86	6.51
Total time working	6,511.17	62.00
Delays:		
Repairs to cranes	534.45	5.09
Repairs to mixers	47.37	0.45
Waiting for forms	1,474.50	14.04
Bridging	894.72	8.52
Other causes	1,039.79	9.90
Total delays	3,990.83	38.00
Total crane time	10,502.00	100.00
Working time, mixer	10,763.85	55.80
Total time, mixer	19,287.99	100.00

Average per mixer per hour, working time, cu. yds...............38.06
Av. per mixer per hr., total time, cu. yds.21.24
Per cent of crane-working time to total time under pay...............62.00

TABLE II.—PERFORMANCE OF CHAMBER CRANES, MIRAFLORES LOCKS.

Average number of cranes operated...... 2.48
Concrete handled, cu. yds...............234,520
Back fill, cu. yds...................... 7,342

	Hours.	Per cent of total.
Placing material	4,143.23	55.34
Handling steel forms	674.17	9.00
Total time working	4,817.40	64.34
Delays:		
Repairs to cranes	170.77	7.28
Waiting for concrete	866.15	11.57
Waiting for forms	1,091.52	14.58
Bridging	300.24	4.01
Other causes	240.88	3.22
Total delays	2,669.56	45.66
Total time oper. per mo.	7,486.96	100.00

Material handled per hour working time, cu. yds...............58.38
Material handled per hour, total time, cu. yds...............32.30
Per cent of hrs. at work to hrs. operated.64.34

TABLE III.—PERFORMANCE OF CHAMBER CRANES, PEDRO MIGUEL LOCKS.

Average number of cranes operated...... 1.72
Concrete placed, cu. yds.................28,450

	Hours.	Per cent of total.
Placing concrete	669.68	22.75
Handling steel, forms, filling, etc.	1,148.28	39.01
Total time working	1,817.96	61.76
Delays:		
Repairs to cranes	87.33	2.97
Waiting for concrete	261.51	8.88
Waiting for forms	367.06	12.47
Bridging	143.39	4.87
Other delays	266.49	9.05
Total delays	1,125.78	38.24
Totat unit hours operated per month	2,943.74	100.00

Concrete handled per hour, working, cu. yds...............42.48
Per cent of hrs. at work to hrs. operated.61.76

TABLE IV.—PERFORMANCE OF AUXILIARY MIXING PLANT, PEDRO MIGUEL LOCKS.

Average number of mixers operated.... 2.14
Concrete mixed, cu. yds.................122,497

	Hours.	Per cent of total.
Delays:		
Repairs	42.00	.72
Waiting for material	237.08	4.06
Waiting for forms	1,493.50	25.55
Waiting for cars	596.50	10.21
Other delays	83.75	1.43
Total delays	2,452.83	41.97
Mixing time	3,391.67	58.03
Total time in operation	5,844.50	100.00

Mixed per hr., working time, cu. yds.....36.12
Mixed per hr., total time, cu. yds........20.96

TABLE V.—PERFORMANCE OF AUXILIARY MIXING PLANT, MIRAFLORES LOCKS.

Average number of mixers operated.... 2.09
Concrete mixed, cu. yds.................253,450

Delays:	Hours.	Per cent of total.
Repairs	199.79	3.18
Waiting for material	38.70	0.62
Waiting for forms	109.55	1.74
Waiting for cars	297.62	4.73
Other causes	1,824.49	29.00
Total delays	2,470.15	39.27
Mixing	3,820.85	60.73
Total time in operating	6,291 00	100.00

Mixed per hr., working time, cu. yds....66.33
Mixed per hr., total time, cu. yds.........40.29

Test of Large Hoisting Cable.—Sections of a large hoisting cable which has been in use at the Mayari mines in Cuba, were recently tested in the 800,000-lb. testing machine of the Fritz Engineering laboratory at Lehigh University. The test was conducted by the civil engineering department of the University, in the presence of representatives of John A Roebling's Sons Co., the manufacturers of the cable, and of the Spanish-American Iron Co., which has been using it. It took a pull of 364 tons to break the new cable, and the portions which had been in use a year and a half, withstood a pull of nearly 30 tons.

The cable consists of six strands, each of 19 wires, twisted around an independent wire rope center. This center also consists of six strands of 19 wires each, twisted around a hemp core. The finished cable was 7,810 ft. long and weighed 125,360 lbs. Cars with a capacity of 100,000 lbs. of ore are lowered by means of this cable down an incline plane 7,800 ft. long.

WATER WORKS

The Design and Equipment of the New Mission Street Pumping Station, Pittsburgh, Pa.

The essential features of the design of the new municipal water works pumping station in Pittsburgh were described by Mr. C. O. Daughaday, Division Engineer of the Bureau of Water, in a recent paper before the Engineers' Society of Western Pennsylvania. The plan is a good example of present practice in district pumping station design in the larger cities. Mr. Daughaday's description, somewhat amplified by notations taken from the drawings, follows:

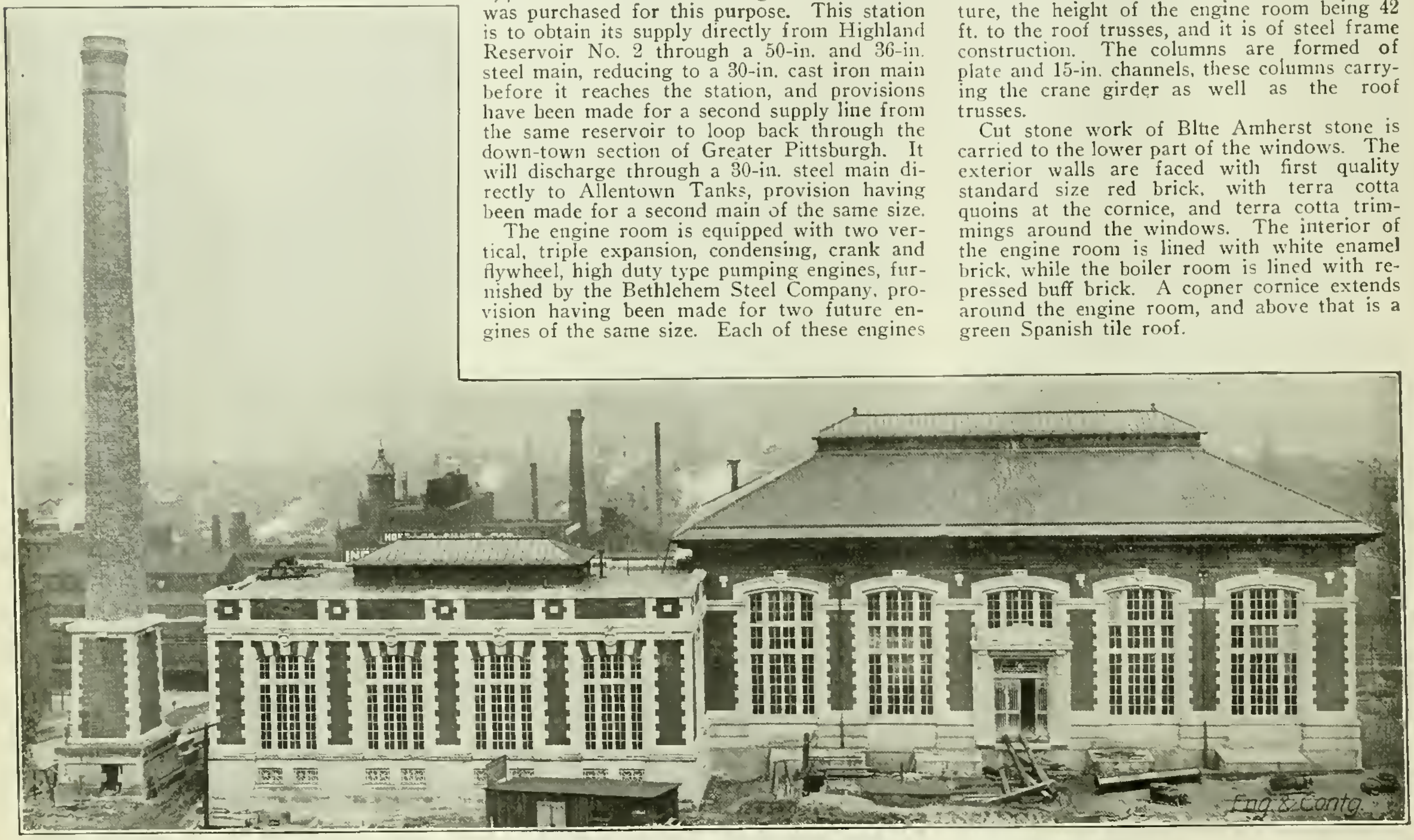


Fig. 1—View of New Mission Street Water Works Pumping Station, Pittsburgh, Pa.

The Monongahela Water Company, which formerly supplied the larger portion of that territory in Pittsburgh south of the Monongahela River, known as the South Side, was purchased and put in operation to supply filtered water in the early part of 1908. The city was able to supply the lower sections of this territory with filtered water directly from Highland Reservoir No. 2. In order to supply the Hill Tops the present pumping equipment in the South 29th Street Pumping Station had to be used. There were only two pumps capable of giving water to high elevations; one a Worthington duplex, horizontal, compound, high duty, condensing pump, erected in 1895, having a capacity of 5,000,000 gals. per 24 hours against a total head of 600 ft. and one a Laidlow-Dunn-Gorden duplex, horizontal, flywheel, cross-compound, condensing pump, erected in 1902, having a capacity of 3,500,000 gals. against the same head.

During the appraisal proceedings tests were made on these pumping engines, with the result that a duty of 28,000,000 ft. lbs. was obtained from the Worthington pump and 20,000,000 ft. lbs. from the Laidlow-Dunn-Gordon pump.

The consumption per capita of this district rapidly increased, as had been previously predicted with the furnishing of filtered water, so that shortly instead of the supply being 3,800,000 gals. per 24 hours, it had increased to over 5,000,000 gals. per 24 hours. With this new condition there was only one unit capable of delivering the required amount of water, and that only by working it over its rated capacity. It was therefore considered advisable to purchase new pumping engines of greater efficiency.

Various sites were considered for a location for this proposed pumping station, one of them being the location of the Monongahela Water Company's station at South 29th St. The present location of this station was finally decided upon and a plot of ground containing 2¼ acres, with 325 ft. frontage on Mission St. was purchased for this purpose. This station is to obtain its supply directly from Highland Reservoir No. 2 through a 50-in. and 36-in. steel main, reducing to a 30-in. cast iron main before it reaches the station, and provisions have been made for a second supply line from the same reservoir to loop back through the down-town section of Greater Pittsburgh. It will discharge through a 30-in. steel main directly to Allentown Tanks, provision having been made for a second main of the same size.

The engine room is equipped with two vertical, triple expansion, condensing, crank and flywheel, high duty type pumping engines, furnished by the Bethlehem Steel Company, provision having been made for two future engines of the same size. Each of these engines will have a unit capacity of 7,000,000 gals. for 24 hours, a duty of 175,000,000 ft. lbs. having been guaranteed.

A 25 K. W., 125 volt steam turbine driven, direct current generator set, consisting of a DeLaval steam turbine, direct connected to a Crocker-Wheeler generator, is installed in the engine room and will supply electric current both for lighting and the operation of a ten ton crane.

The boiler room is equipped with two 325 HP. boilers, furnished by the E. Keeler Company, and is designed for two future boilers of the same capacity. These boilers are arranged to use gas at present for fuel, although coal and ashes handling apparatus has been installed in order that coal may be used for fuel in any emergency, or at any future time.

In general, the design consists of a separate engine and boiler room, having a common longitudinal wall of about 18 ft., the engine room being 134 ft. 10 ins. x 68 ft. 10 ins., and the boiler room 52 ft. 4 ins. x 96 ft. 4 ins. Although the elevation of the engine room floor is 6 ft. higher than the floor of the boiler room, the basement of the two rooms has the same elevation. This design was chosen on account of the contour of the ground, and the frontage on Mission St.

All construction work was completely detailed in the office before proposals were asked for the submission of bids. The foundation walls are built of concrete, the longitudinal walls of the pumping station being reinforced. A reinforced concrete gallery 6 ft. wide is run around the entire engine room, this gallery being supported by steel I beams, with angle iron knee braces attached to the foundation walls. The flue in the boiler room is underground and is constructed of concrete, lined with Vitribestos. A loading platform is provided at the Mission St. entrance so that any heavy material can be delivered on this platform and lifted to place by means of the station crane.

The building itself, as shown in Fig. 1, is of the French Renaissance type of architecture, the height of the engine room being 42 ft. to the roof trusses, and it is of steel frame construction. The columns are formed of plate and 15-in. channels, these columns carrying the crane girder as well as the roof trusses.

Cut stone work of Blue Amherst stone is carried to the lower part of the windows. The exterior walls are faced with first quality standard size red brick, with terra cotta quoins at the cornice, and terra cotta trimmings around the windows. The interior of the engine room is lined with white enamel brick, while the boiler room is lined with repressed buff brick. A copper cornice extends around the engine room, and above that is a green Spanish tile roof.

The boiler room roof is of the flat type of construction, the roof trusses being carried by brick pilasters. On the flat boiler room roof there is a red quarry roofing tile.

The main entrance to the station is in the engine room and faces toward the Monongahela River. A marble wainscoting 7 ft. high lines the entry way. To the left of the main entrance is located the chief engineer's office, a room 12 ft. square; and to the right of the office there is a toilet room of the same size. Running entirely across this entrance on the second floor is a locker room for the use of the employes, which is reached by a spiral staircase. The 6-ft. gallery, the main entrance and the engineer's office all are floored with red quarry tile.

Ventilation in the engine room is obtained by means of eight large windows 14 ft. wide by 27 ft. high, and by the 50 small windows in the monitor. The ventilation in the boiler room is secured by 10 large windows 12 ft. wide by 20 ft. high, and by the 30 small windows in the monitor.

An abundance of light is furnished by the large windows previously mentioned, and to accentuate this light, besides the white enamel brick, the roof trusses and crane girder in the engine room have been painted a battleship gray, while all of the pump below the main floor, which is exposed to view from the gallery has been painted the same color, as well as the walls of the pump pit.

Two hanging arcs have been placed in the engine room, and two in the boiler room, while 13 fixtures containing 15 wall brackets, containing 2 16-candle power incandescent lamps and a gas burner, are placed in the engine room, and 12 in the boiler room. Bronze standards are placed at the front entrance and bronze lanterns at the rear and boiler room entrances. The engine room lights are formed of a cluster of 6 16-candle power incandescents.

An 8-in. drain line is run directly through the engine room. It enlarges to 12 ins. in the boiler room, and connects to a sewer on 21st St. To this drain line are connected all drains from the pump pits, the rain leaders, the toilets, and a 6-in. line for blowing off the boilers.

In the toilet room in the engine room is installed one water closet, two lavatories, and one urinal. A toilet room is provided in the basement of the boiler room, which contains two water closets, two lavatories, two urinals, one slop sink, and one shower bath.

Drinking fountains are installed in the pump pit, and also on the main floor of the engine and boiler rooms. A lavatory is also provided in the office.

The total volume of the station is 70,000 cu. ft., and 5,141 sq. ft. of radiating surface has been installed for heating the same, this being a ratio of 140 cu. ft. to 1 sq. ft. of radiation.

It is planned to heat the building by means of exhaust steam, but reducing valves have been installed so that it may be heated by live steam. Radiators of the floor type have been placed in the engine room gallery, office, lavatory, and the boiler room floor, while those of the wall type have been placed in the pump pit and boiler room basement. All of these radiators drain directly to the hot well.

The chimney is 152 ft. high above the foundations. It is square for 35 ft. of this distance, and of the same general type of architecture as the building. The lower 10 ft. of the square section is 17 ft. 6 ins. square and the remaining 25 ft. is 14 ft. square. The column of the chimney is constructed of radial brick, the internal diameter at the bottom is 12 ft. 1 in.; at the top it is 7 ft. A lining of fire brick with an air space is carried up 75 ft. from the point where the flue enters the chimney.

Methods and Cost of Making House to House Inspection to Detect Water Waste in Chicago During 1911 —Permanency of Plumbing Repairs.

The methods and cost of conducting the house to house inspection of water fixtures in the city of Chicago during 1911, for the purpose of detecting leaks and ordering repairs, were described by Mr. T. C. Phillips, Engineer of Water Surveys, in his latest annual report. Mr. Phillips also discussed the permanency of plumbing repairs with special reference to the long hopper closets which are very wasteful of water. In an article contributed to ENGINEERING & CONTRACTING of Jan. 1, 1913, Mr. Phillips in discussing the waste of water by these closets said that it is doubtful if the revenue derived from the water consumers with hopper closets, considering such consumers as a class, is sufficient to pay for the coal burned to pump water for them. The data here presented are abstracted from the report.

WATER SAVED BY SURVEYS IN 1911.

It is difficult to show directly in dollars and cents all the results that were accomplished during the year 1911 by the survey to stop the losses of supply such as is being carried on in the city of Chicago. This survey includes house to house inspection work, district surveys, flow tests of trunk or large feeder mains, tests of mains in the street for leakage before the paving is laid, meter and pump slip tests. The Water Survey division also recommends the installation of meters, has charge of the repairs and operation of all valves 16 ins. and above, and, in general looks after the conservation of the supply.

Provision is made each year in the budget under the classification of Water Surveys for men and equipment to do the work described above. The appropriation for 1911 was $154,544 and for 1912 was $163,147. In view of these large appropriations it is reasonable and natural to inquire what benefit the city derives therefrom. A portion of the direct benefit may be shown in dollars and cents. It is that benefit resulting directly from stopping waste and leakage.

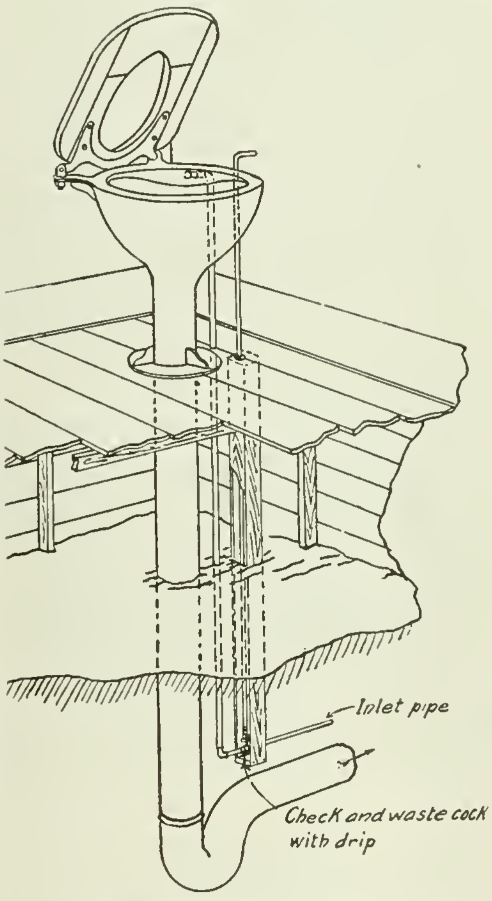


Fig. 1—Sketch of Long Hopper Closet.

(It is estimated that there are 60,000 of these closets installed in Chicago. They are permitted to run during summer for sanitary reasons, and during cold weather to prevent freezing. A meter test showed that one of these closets running continuously wasted 10,000 gals. of water in a day.)

The surveys during 1911 covered about 12 square miles of densely populated city area. The total saving made during 1911 by eliminating plumbing leakage in 35 districts amounted to approximately 15,000,000 gals. per day. The total saving made by eliminating underground loss in the street amounted to a little over 4,000,000 gals. per day.

In addition, the survey work in 15 districts, averaging 160 acres, was practically completed. The final tests were not run on account of the extreme cold weather in November. The saving from these districts is not included in the above.

Considerable leakage was found in a number of streets, but the repair work was deferred until early the coming season. The low pressure conditions prevailing during 1911 made the total savings somewhat smaller than otherwise. Extensive improvements and additions under way and partly completed are expected to improve the service and pressure.

The total saving made during 1911 amounted to approximately 19,000,000 gals. per day. The value of this saving at 3 cts. per 1,000 gals. amounts to $208,050 per annum. Against this portion of the work the city spent $83,178.44 for district work in eliminating plumbing leakage and $9,121.46 for eliminating leakage in the street.

The total expenditure by the Division of Water Surveys during 1911 was $111,255.47. About $18,955.57 of this amount was expended in miscellaneous routine work described above, which cannot be shown directly in saving.

HOUSE TO HOUSE INSPECTION.

House to house inspections are not made in premises that are metered, for the reason that it is not necessary to regulate plumbing leakage, waste and neglect of the water supply beyond a meter.

In the City of Chicago it has been found profitable to "house to house" inspect practically all the territory surveyed so far. In a few high-class residence sections such inspections were not necessary because many premises were metered or, where not metered, the plumbing in the buildings is generally kept in good repair.

The most profitable sections in which savings are made are those districts where the better plumbing conditions do not prevail and where the sections are old and have undergone frequent changes.

Two visits to each place by the inspector are generally all that are necessary in making house to house inspections. There are usually a few places that require one or more additional visits before the plumbing repair is made properly.

A complete record of all leaking fixtures is made at the first visit. Ten-day notices to make repairs are sent to the places where leaks are found, after which the second visit, or re-inspection is made. It generally requires four or five weeks for 20 inspectors to inspect and reinspect a 160-acre tract having 1,400 to 1,800 places.

On the re-inspection work one inspector will visit and report on from 10 to 20 places per day, but the first inspection work requires a little more time than this.

The men employed on house to house inspection work are men who are competent and who are experienced in this work. They are plumbers by trade and are classified in the city service as plumbing inspectors. They are paid $143 per month.

Table I gives a summary of the house to house inspections by districts made during the year 1911. Table I contains a summary of the leaky fixtures found in the 37 districts surveyed and completed during 1911. The territory surveyed covers 12 square miles. The table shows the number of places inspected, the number of leaks inside premises found and repaired above and below ground, the number of long hopper closets found, the amount of leakage measured at the fixtures, the number of inspector days required in each district, and the total cost of the house to house inspection, including the cost of testing the district by the pitometer field party.

PERMANENCY OF PLUMBING REPAIR.

Plumbing leakage is the leakage which occurs on the premises of a consumer because the pipe, fittings, fixtures or one or more of the many regulating devices used to control the water supply, in or outside the building, has given way or is out of repair.

The responsibility of keeping the plumbing free from leakage and in good order falls upon the owner, tenant or consumer. In the city of Chicago the Commissioner of Public Works may, in the event of neglect, failure or refusal to stop leakage, after due notice, shut off the water supply to any premises. Notwithstanding the existence of this ordinance it is being constantly violated.

There are two methods by which the plumbing leaks may be eliminated. One is by frequent house to house inspection, and the other is by metering. The latter is the more efficient method, because a meter is "always on the job." Good results and profitable returns are obtained by the method of house to house inspection, but it cannot be said to be complete or permanent in stopping waste and leakage. The efficiency of the house to house inspection work depends almost directly upon the inspector. When the qualification of the men employed to make the house to house inspection is high and they are diligent good results are generally obtained.

The permanency of plumbing repair is so indefinite that any estimate of the length of life of the same is conjectural. The plumbing may be as good as new when repaired, or the repair may be only temporary. The plumbing leakage occurs most frequently in the class of fixtures that is subject to the greatest "wear and tear" of service.

The permanency of plumbing repair is much greater in districts with first-class fittings and fixtures than in those sections which are older and where the plumbing is poor. In older sections where the property is being held in expectation of the future frequent inspection is necessary to maintain good conditions and prevent continuous wastage. Taking the permanency of plumbing repair as a whole, the life of the same is believed to be considerably more than one year. The results obtained in making plumbing repairs in Chicago are based upon a permanency of one year.

Where the house to house inspection shows that water is wasted by the improper adjustment of water regulating devices or by such devices when out of order, the permanent saving made by the inspection is probably very small because the consumer will often resume his wasteful tactics almost immediately after inspection. Hopper closets, and closets and urinals automatically controlled, hydraulic motors and pumps, and flushing appliances of all kinds, belong to the class of most wasteful and extravagant devices. Many of the devices are directly connected to the water supply in such a manner that when they are abused or neglected, the total waste is surprising. The annual revenue derived from these devices is, no doubt, much less than the cost of the water supply they consume.

A case of neglect in point came to notice recently when a hopper closet was found running continuously. A meter was installed on the service, which registered 10,000 gals. of water daily for some time after installation. The annual cost to the city of this amount of water at 3 cts. per 1,000 gals. amounts to $110 per year, but the consumer is charged only $3 or $3.50 per annum for a fixture of this type.

It is conservatively estimated that there are over 60,000 long hopper closets in the city of Chicago at present. It is not known how many automatic controlling and regulating devices, hydraulic pumps, motors, etc., are in use at present, but the total number of them is exceedingly large.

Permanency of results from house to house inspections cannot be claimed for the devices just described. They should be controlled by meter. This would relieve the city from the burden of regulation of these wasteful devices.

A long hopper closet is a sanitary device, used for water closet purposes. It costs less to install than closets with flush tanks and can also be used outside or in basements where a moderate amount of freezing will occur. A long hopper closet consists of a bowl with a long sweep downward, as shown in Fig. 1, connected to a vertical drain pipe with a water trap or seal at its base. The water for flushing the bowl is admitted around the roll rim at the top. The water used for flushing is regulated by hand or by seat-action, by opening a stopcock below the frost line, which admits the water supply direct from the water main.

The admission of water for flushing is controlled by various ways, but the three devices commonly used are as follows: By means of a rod, operated by hand, connected to a check and waste stopcock placed at or near the base of the vertical drain pipe; by means of a self-closing hopper cock controlled by seat-action; and by means of a compression hopper cock, which is merely another name for an ordinary faucet.

The various controlling devices used to regulate the supply for hoppers are inexpensive fixtures and are apt to get out of order easily. In addition, a part of the device is under cover and difficult to get at, so that maintaining them in good order is a burden to the consumer.

When the temperature drops in cold weather residents having hoppers attempt to prevent them from freezing by letting the water run continuously. This is somewhat effective from the standpoint of the consumer, but it often fails to prevent freezing in cold weather. A great many hoppers froze up during the winter of 1911-12.

There seems to be a common belief among owners and tenants that hoppers, if permitted to run continuously, promote greater sanitary efficiency. This fallacy is difficult to overcome and is costly to the water department.

A survey was run in cold weather to determine, if possible, the effect of letting hoppers run continuously. Two districts, Nos. 62 and 5, having a great many hoppers, were selected for this test, and the results obtained are here given.

Water Survey District No. 62.—This is a west side district and has 1,198 long hopper closets. It covers 160 acres and has a population of 17,600. It has a density of population of 110 persons per acre and a density of 7.4 hopper closets per acre. Three tests were run on this district, each test lasting about seven days.

The first test was run before the plumbing in the district was repaired; the second was run after the plumbing was repaired, and the third test was run in cold weather in January, 1912. The first test showed a total rate of flow into the district of 2,066,000 gals. per day. The second test showed 1,558,000 gals. per day, and the third test showed 2,272,000 gals. per day, or an increase of 46 per cent.

The mean average temperature during the second test was 35° above zero and the mean average temperature during the second test was 4.8° above zero. The mean average temperature for three days preceding the third test was 7° below zero. The average pressure over the district during the second test was 22 lbs., and during the third or cold weather test was 12½ lbs.

Water Survey District No. 5.—This district is a south side district and has 1,269 long hopper closets. It covers 258 acres and has a population of 20,000. It has a density of 4.8 hoppers per acre, and density of population of 77 persons per acre.

Three tests were run on this district, as in District No. 62. Twenty months elapsed between the first and second tests and 32 months elapsed between the second and third tests.

The diagram of the tests shows that when cold weather came on the demand for supply

TABLE I.—SUMMARY OF COST OF HOUSE TO HOUSE INSPECTION, WATER SURVEYS, CITY OF CHICAGO, 1911.

District No.	Date.	No. of inspections.	Total of fixtures.	Leaks Above Ground.						Underground leaks	Hopper Closets						
				Faucets.	Closets.	Baths.	Riser pipes.	Miscellaneous.	Total leaks.		Check and waste.	Compression.	Seat acting.	Total hopper closets.	Measured leakage, gals. per day.	No. inspector days.	Cost.
8	April, 1911	1,179	2,043	214	180	4	25	4	427	194	128	14	17	159	234,072	191.5	$ 1,011.12
9	March, 1911	1,724	7,429	409	732	30	24	32	1,227	233	95	50	36	181	569,224	254.0	1,341.12
10	March, 1911	1,313	8,096	341	486	21	9	21	878	159	97	53	44	194	352,363	230.0	1,214.40
19	May, 1911	1,571	7,983	359	609	8	10	31	1,017	418	191	68	17	276	565,450	261.5	1,380.72
20	April, 1911	1,312	9,049	240	420	10	8	8	686	144	105	54	19	178	346,885	188.0	992.64
38	June, 1911	935	5,504	174	315	6	13	20	528	211	63	42	31	136	260,206	136.5	720.72
39	April, 1911	1,515	5,268	293	338	5	24	18	678	516	497	168	97	762	234,975	306.0	1,615.68
47	January, 1911	3,829	7,268	572	893	6	27	78	1,576	1,532	2,451	...	...	2,451	788,060	640.5	3,381.88
48	February, 1911	1,812	7,453	379	656	7	20	31	1,093	543	484	91	47	622	572,195	376.0	1,985.28
51	March, 1911	3.495	13,681	908	782	4	54	45	1,793	1,381	1,703	276	92	2,071	793,019	619.5	3,270.96
54	July, 1911	2,922	20,426	449	1,346	51	26	35	1,907	634	198	45	26	269	665,342	620.5	3,276.24
56	April, 1911	1,727	10,983	424	762	52	35	29	1,302	395	145	42	21	208	416,078	359.0	1,895.52
57	June, 1911	1,910	12,494	291	828	28	23	36	1,206	416	161	25	26	212	370,645	371.5	1,961.52
58	July, 1911	1,722	8,900	271	592	21	23	25	932	577	232	15	5	252	349,181	312.5	1,650.00
59	November, 1911	1,505	7,097	357	638	25	14	26	1,060	490	190	24	33	247	339,985	170.0	897.60
60	August, 1911	1,925	7,823	311	641	11	16	30	1,009	892	592	64	16	672	369,863	372.0	1,964.16
61	November, 1911	1,373	5,230	276	487	9	6	14	792	398	323	49	3	380	283,105	133.5	704.88
62	September, 1911	2,584	98.474	468	839	11	17	82	1,417	1,007	760	382	50	1,198	466,427	414.5	2,188.56
63	....	1,159	8,274	346	596	38	5	12	997	229	55	42	1	98	246,857	77.5	409.20
64	October, 1911	2,460	14,278	550	963	26	23	120	1,682	979	612	325	14	951	482,723	392.5	2,072.40
66	November, 1911	1,659	69,343	412	584	7	11	42	1,056	751	554	263	10	827	374,930	151.0	797.28
67	December, 1911	1,332	3,447	289	683	24	28	42	1,066	485	208	166	8	382	604,184	109.5	578.16
68	November, 1911	626	2,057	135	213	2	8	35	393	316	265	123	14	402	219,223	50.0	264.00
69	May, 1911	1,667	7,574	329	590	10	11	36	976	843	639	240	...	879	361,708	157.5	831.60
70	November, 1911	729	1,899	142	174	2	18	30	366	290	276	91	8	375	201,655	89.5	472.56
78-79	April, 1911	2,100	99,942	241	654	30	8	16	949	193	58	9	7	74	370,216	741.0	3,912.48
80	February, 1911	1,417	6,170	222	309	12	42	11	596	646	526	67	56	649	350,326	558.0	2,946.24
81	February, 1911	1,201	6,033	332	447	17	19	15	830	499	308	35	12	355	362,855	466.5	2,463.12
85	August, 1911	3,717	17,776	541	1,280	30	25	76	1,952	1,599	708	101	15	824	1,227,078	1,014.0	5,353.92
86	October, 1911	4.013	18,091	374	930	20	22	134	1,480	1.389	1,518	127	11	1,656	665,012	468.0	2,471.04
98	December, 1911	1,718	9,332	277	586	3	12	17	895	345	100	23	5	128	561,394	129.5	683.76
300	June, 1911	1,901	11,291	342	658	14	13	96	1,123	381	221	288	127	636	651,627	370.5	1,956.24
301	July, 1911	1,149	6,694	286	515	8	21	108	938	386	182	343	214	739	494,777	250.0	1,320.00
302	August, 1911	1,588	7,585	351	688	20	14	76	1,149	452	206	371	142	719	577,603	237.5	1,254.00
303	October, 1911	1,189	4,639	259	538	15	16	65	893	334	151	235	44	430	473,106	141.5	747.12
304	October 1911	1,429	10,303	416	844	88	15	46	1,409	200	55	49	30	134	600,650	184.5	974.16
305	August 1911	2,025	14,085	685	1,037	58	15	51	1,846	313	148	132	...	280	770,899	308.5	1,628.88
*	May, 1911	184	689	22	51	1	..	2	76	95	65	28	...	93	29,862	.....	....
†	May, 1911	1,429	18,436	402	704	26	33	25	1,190	798	331	136	15	482	761,059	811.5	4,284.72
		72,345	583,112	13,689	24,588	760	733	1,620	41,390	21,663	15,607	4,656	1,318	21,581	18,364,819	12,665.5	$66,873.88

*Troy street. †Roseland.

increased from 2,531,000 gals per day to 5,108,000 gals. per day. The mean average pressure in this district is normally about 23 or 24 lbs., but during the cold weather test it varied from 15 to 20 lbs. The mean average temperature during the third test was 19° above zero.

In both Districts No. 62 and No. 5 the principal difference in the conditions of the second and third tests was the difference in temperature.

In District No. 62 the greatest demand for supply seemed to follow the area of the district having the greatest density of hoppers, but in District No. 5, where the demand for supply doubled in cold weather, the effect of the consumption by hoppers was merged into the general loss from all sources and could not be followed.

When District No. 5 was house-to-house inspected, 2,471 places were visited, and in these 1,738 leaky fixtures and 1,565 underground leaks inside premises were found and repaired.

The sudden increase in the demand for water supply in Districts No. 62 and No. 5 was undoubtedly due to hopper closets running continuously and to the bad condition of the plumbing. Hopper closets and bad plumbing conditions go hand in hand and both are sources of great waste.

Poor service and low pressure in some sections are undoubtedly due in a large measure to the extravagant practice of the consumer in letting the water run, as shown by the tests described above.

Unfortunately the demand for water by hoppers usually comes at a time when there is a general demand for more water supply all over the city. The fire risk at such times on this account is greatly enhanced, in addition to the interruption of the service and the inconvenience caused by poor service. The fact that in cold weather in District No. 62, where the mains are sufficient, the average pressure was reduced from 22 to 12½ lbs. is most significant and indicates a condition of waste and abuse that is of very grave concern. To this should be added, that during this time the city pumped more water daily per capita than ever before.

From a report of the number of long hopper closets in the districts already surveyed it is estimated there are over 60,000 long hopper closets in use in the city of Chicago at present. There is little restriction in the installation of a long hopper closet, and in consequence large numbers of them are being installed each year.

The city receives a revenue of $3 or $3.50 per year for a hopper closet. At meter rate this would pay for 50,000 gals. of water. A meter placed on a hopper closet found running continuously registered 10,000 gals. per day. After the meter was installed on this hopper closet, the waste of water stopped suddenly.

It is doubtful if the waste of water supply by long hopper closets already installed can be regulated without the use of a meter.

The Interpretation of Stream Flow Gaging Records of the Sunol and Niles Dams by an Experimental Study of the Flow Over Models.

For a number of years the city of San Francisco has had the advisability of going to the Sierra mountains for water under consideration. The Hetch Hetchy project, the salient features of which were stated in an article published in ENGINEERING & CONTRACTING of Nov. 20, 1912, is the latest plan of that kind to receive consideration. A chief contention of those who favor the Hetch Hetchy project is that the water resources of the Spring Valley Water Co. will not continue indefinitely to furnish an adequate supply of water for the city's needs. The officials of and the experts employed by the Spring Valley Water Co. have recently issued a voluminous report on the water resources of the company, in which it is concluded that sufficient water can be developed from the sources of supply readily available to the company to supply a population of 2,000,000 people, with 100 gals. per capita per day. It is estimated that San Francisco will attain this population in about the year 2000.

The estimates of the company are based in part upon the gaging records made at the Sunol and Niles Dams on Alameda Creek during the past 23 years. The proper method of interpreting these gaging records has caused considerable discussion between the various parties to the San Francisco water supply controversy. The company caused models of the dams to be made and tested, in the manner hereinafter described, in order to support their reasoning from theoretical grounds by experimental data based on actual flowage tests over the models. A full statement of the considerations which made the experimental work desirable is made by Mr. F. C. Herrmann, Chief Engineer of the Spring Valley Water Co. in the report above mentioned. The methods employed by Prof. J. N. Le Conte in calibrating the models for various depths of flow, and in applying the experimental results to the stream flow records taken at the actual dams are also described in the report. An abstract of Mr. Herrmann's comments on this point is here presented to preface Prof. Le Conte's report on his experimental work.

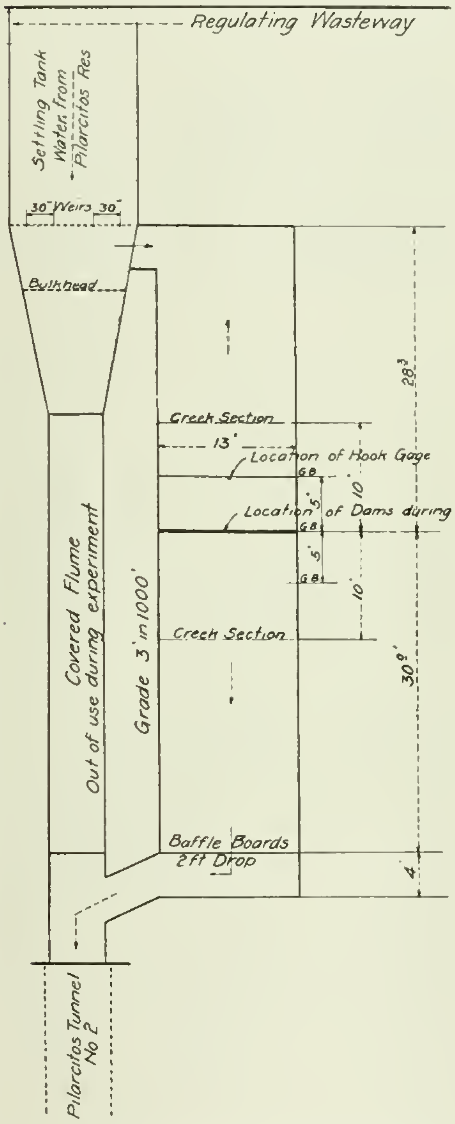


Fig. 1—Plan Showing Arrangements Made for Testing Flowage Over Models of Sunol and Niles Dams.

(Note.—G. B. signifies Gage Board.)

Records of the depth of water over the Niles Dam have been kept by the Spring Valley Water Company from November, 1889, to October, 1900, and over the Sunol Dam from October, 1900, to the present time. From these records computation of the volume of run-off water at these dams has been made by applying a weir formula of the ordinary Francis type, the units used being in inches for linear dimensions, and gallons per day for rate of flow, thus:

for Niles $Q = 4200\ bh^{3/2}$
for Sunol $Q = 4400\ bh^{3/2}$

These formulas do not take into consideration either the impulse of the water due to its velocity as it approaches the weir, the retarding effect of submergence below the weir, nor the shape of the weir crest. No measurements have been made to determine the effect of these factors, it being assumed that in the aggregate they offset one another.

Neither of the dams is ideal for measuring the flow of water, and the great number of irregularities entering into the problem make it very complex. The method by which gage rod readings have been taken adds further to its complexity. At the Niles Dam the readings, except for low water flow, have been taken at the forebay, which is well below the crest of the dam. At the Sunol Dam the readings for other than low water flow have been taken at a series of points, which progress upstream from the crest of the dam as the stage of the water increases to a certain depth, after which the measurements were taken just above the crest. All rod readings for both dams are well within the curve of water surface as it falls over the dam.

Results of experiments on various types of dams of irregular cross-section have been published, which show coefficients that vary between wide limits for the different types considered. A study of these results impresses one with the fact that large variation in the coefficient exists for comparatively insignificant changes in cross-section of the dam. None of the types of which we have published experimental results are identical with either the Niles or the Sunol Dam in cross-section. Theoretical solution of the flow over these dams must, therefore, be built up as a modification of some standard weir formula, changing it by combining the effects of the various irregularities as expressed in published experimental data, with weirs containing one or more of these irregularities, together with computations of the forces due to accelerations from irregularities not expressed by these experimental data.

As noted above, for some stages of flow the Niles and Sunol Dams must be considered as submerged weirs. Standard formulas for weirs are unreliable when the difference in elevation of the water above and below the weir, or the afflux, is less than 35 per cent to 50 per cent of the depth of water over the weir.

Accurate Results Determined by Experiments with Model Dams.—From the foregoing it is seen that theoretical solution, unsupported by the proper experimental data, will be clothed with uncertainty. By reason of this, the services of Prof. J. N. Le Conte of the University of California, were secured for the purpose of making the necessary experiments to determine the proper discharge curves for the two dams under the conditions of gage rod readings which obtained when they were made.

The text of Prof. Le Conte's report to Chief Engineer Herrmann, stating the purpose of the experiments and the methods by which they were made, follows:

The object of the tests was to determine with such data as were obtainable the rate of flow over the large dams in terms of the gage readings, or in other words, to determine an approximate rating curve for each of these dams. The dams are irregular in profile, causing the stream to assume different cross-sections at various heights. The location of the gages was not in midstream and beyond the influence of the surface curve, but in the case of the Sunol Dam was on the wingwall of the north bank, and in the case of the Niles on the upstream face of the intake tower. Both of these positions are well within the surface curve. Furthermore, at times of high and moderately high water the dams discharged against a submerged head, and no record has been kept of the amount of this submergence corresponding to different gage heads.

These various complex conditions make the computation of the discharge curve difficult, and therefore it was suggested that tests on models of these dams be made, and the results extended so as to apply to the large dams.

CONDITIONS FOR EXPERIMENTS.

The models were constructed of wood. The Sunol model was exactly 1/20 the size of the large dam in every dimension. The Niles was about 1/19 the size of the dam. The upstream channel was made of cross-section similar to the present cross-section of the stream bed above the large dams. This section may have been different at times of high water, but no better data are obtainable. The stakes and other bench marks from which gagings were made were located in their proper relative positions. In addition to this a hook gage reading to 0.001 ft. was located in midstream 5 ft. above the crest of the model, and the main upstream head was taken with this. A 2 in by 6 in. timber was placed across the channel 5 ft. downstream from the crest, and this furnished a bench mark from which the downstream head and hence the submergence could be measured. Baffle boards about 40 ft. downstream served as a means of varying the submergence through any required range. The flow over the models was measured by means of two sharp-edged fully contracted weirs, the weir box being amply large to eliminate the effects of velocity of approach. The head on the weirs was taken on a standard hook gage reading to 0.001 ft.

The testing box was located on San Mateo Creek, and was fed by water from the flume leading from the first Pilarcitos tunnel. Main adjustment of the supply was effected by operating the gates at Lake Pilarcitos. Closer adjustment was obtained by wasting water above the weir box into San Mateo Creek. The arrangement of the testing station is shown in Fig. 1.

SUNOL MODEL DAM EXPERIMENTS.

The test on the Sunol model was made on June 13, 1912. The hook gages were leveled with reference to the dam and weir crests with an engineer's level, and all bench marks were leveled in a similar way. The Pilarcitos gate was opened about 3 ft., which corresponded on the model to high water. The hook gage on the weir was set and read. All baffle boards were removed so that the discharging vein made a clear overfall. The hook gage above the dam was set and read (h). With an ordinary rule the position at the surface of the gaging point was then noted (g). Then the position of the downstream surface was taken with a rule, giving the downstream head (h_1). Owing to the disturbed condition of this surface no more accurate method of measuring was necessary.

Allowing the same quantity to flow over the model, baffle boards were inserted below so as to raise the downstream surface, and the above described measurements were repeated. Then more baffles were put in, and so on until 5 to 7 complete sets of measurements had been made on one rate of flow, or till the ratio $\frac{h-h_1}{h}$ dropped to about 2/10 or less.

The waste gate above the weir box was then opened a small amount, allowing less water to pass over the weirs and to the model. After conditions became steady, the entire set of measurements was repeated, starting with a clear overfall. This method was followed till the quantity was reduced to as small an amount as the 30-in. weirs could handle.

NILES MODEL DAM EXPERIMENTS.

The test on the Niles model was made on June 16, 1912, and was identical with that made on the Sunol model, with the exception of the measurements at the gage points (g). In the latter instance five measurements were made at different points around the gate tower.

The discharge curves for the models were first computed. The flow over the sharp edged weirs were computed by means of the standard formula

$$Q = c\ 2/3\sqrt{2g}\ b\ h^{3/2}$$

the coefficient "c" being taken from Hamilton Smith's tables for contracted weirs.

For each complete set of measurements, that is, for each single value of Q, a curve was plotted showing the relation between $\frac{h-h_1}{h}$, which may be called the "submergence ratio," and h, the upstream center head. One fact is clearly seen from this set of curves, namely, that "h" is constant, or is unaffected for all ratios of submersion down to about 6/10 or ½. It may be stated that the effect of back water down to ratios of submergence of ½ is so slight as to be practically negligible on both models. In these tests with a given upstream head h, the quantity flowing over is practically the same for a submersion ratio of ½ as it is for a free overfall. As the ratio $\frac{h-h_1}{h}$ is reduced below ½, the upstream head h begins to rise, at first slowly, and then more rapidly; the condition $\frac{h-h_1}{h} = 0$ being manifestly impossible.

Next the discharge curves for the models were plotted. They give the discharge over the models in second feet in terms of the midstream hook gage head 5 ft. upstream. The lowest curve plotted is for a submersion ratio of 5/10, and this curve also corresponds to all larger ratios including free overfall. The next curve above is for a ratio of 4/10, etc. These are rating curves, exactly as measured, and bear no relation to any discharge formula. All effects of velocity of approach and of variable cross-section of the escaping stream are included in them.

APPLICATION OF EXPERIMENTAL RESULTS.

So far the problem is merely one of measurement or calibration of the models. The extension of these results to the large dams, however, it is a matter of theoretical investigation purely. Apparently the required result can be obtained by the following method of procedure.

The point given by the great flood of 1911 can be located on a reduced scale of heads but for identical submersion and similar probable discharge curves for the models can be drawn. These would represent the discharge over the models if operating under a varying submersion in exactly the same way that the large dams operate. Then by the use of standard submerged weir formulas, the scale of these last curves can be extended to that of the large dam.

The standard formula for the free overfall is

$$Q = c\ b\ h^{3/2}.$$

If h_v is the head corresponding to the velocity head of approach

$$Q = cb\ [\ (h + h_v)\ 3/2 - h_v^{3/2}].$$

For a submerged weir.

$$Q = c\left[h_2^{\frac{1}{2}}\left(h - \frac{h_2}{3}\right)\right]$$

where h_2 is the difference in level between the upstream and downstream heads, or $h-h_1$.

Finally, if velocity of approach is taken into account,

$$Q = cb\ [\ (h + h_v)\ (h_2 + h_v)^{1/2} - 1/3\ (h_2 + h_v)^{3/2} - 2/3\ h_v^{3/2}].$$

Now, if a weir or dam is extended in linear dimensions n times in each direction

$$b' = nb,\ h' = nh,\ h_2' = nh_2,\ \text{and}\ h_v' = nh_v.$$

This latter, though slightly approximate, may be seen as follows: The flow over a dam varies as the 3/2 power of the head and directly as the breadth, or as the 5/2 power of the linear dimension n. But the cross-section of the channel varies as the square of n, hence the velocity of approach or $\frac{Q}{a}$ varies as $n^{5/2}/n^2 = n^{1/2}$, and the square of the velocity of approach varies directly as n.

Hence, substituting in the above formula for the submerged weir, we have

$$Q' = cnb\ [n\ (h + h_v)\ n^{1/2}\ (h_2 + h_v)^{1/2} - 1/3n^{3/2}\ (h_2 + h_v)^{3/2} - 2/3\ n^{3/2}h_v^{3/2}] = Q\ n^{5/2}.$$

Hence, in order to exaggerate the probable discharge curve of the small dam to such a scale as to represent the flow over the large dam, we must multiply the heads h by n and the discharge Q by $n^{5/2}$.

In a dam like the Niles, we have two separate portions, a rectangular notch or series of notches in the middle, and two sloping sides which together form a triangular notch. The flow over such a combination will be

$$Q = c_1b_1h_x^{3/2} + c_2b_2h_y^{3/2} + ——— + c_3kh_z^{5/2}$$

and since $b_1' = nb_1$; $b_2' = nb_2$; $h_x' = nh_x$; etc: $Q' = Qn^{5/2}$.

The same will be true if velocity of approach is taken into account. It will be observed that this method requires no knowledge of the coefficient "c." This is taken care of in the assumed discharge curves of the models.

Now, in the case of the Sunol model $n = 20$, $n^{5/2} = 1789$. With this the discharge curve is computed. In the case of the Niles dam $n = 19$, $n^{5/2} = 1574$. From these figures the discharge curve of the main dam was plotted.

Finally for each hook gage reading on the model, we have a surface measurement corresponding to that of the main gage on the dam. The ratio of these two measurements is taken directly from plates where the readings are plotted. The final discharge curves show the flow over the dams in terms of the gage heads. These final curves are the ones which should be used in computing the flood discharge of the creek in years past. It is interesting to note that the lower part of the curve for the Niles dam check the only actual measurements made by the Government.

Lawrence Experiment Station Studies in the Purification of Water.

In ENGINEERING & CONTRACTING of Jan. 17, 1912, the results of the experimental work on the purification of water at the Lawrence experiment station during 1910, were given. The present article gives similar data for the studies made in 1911.

During 1911 studies were continued by the Massachusetts State Board of Health upon the purification of Merrimack River water by slow sand filtration, by double filtration and by mechanical filters with the aid of coagulants; upon the preliminary clarification of water by upward filtration through a roughing filter of coarse gravel; and upon the purification of water by a sand filter to which the water is applied at frequent intervals in small doses, in much the same way, in fact, that sewage is applied to sprinkling or trickling filters. During the year a new series of experiments has been started to study the relative efficiency of continuous water filters of the same depth and size of material when operated at widely different rates. Mr. H. W. Clark, chemist to the Board, was in direct charge of the experimental work. Mr. Stephen De M. Gage, biologist, and Mr. George O. Adams, chemist, are the principal assistants at the station. The data here presented are abstracted from the latest annual report of the Board.

SLOW SAND FILTERS NOS. 8A AND 343.

Filter No. 8A, 1/200 of an acre in area and first put into operation on Sept. 26, 1893, contained about 29 ins. in depth of sand of an effective size of 0.28 mm. at the beginning of the year. The average rate of operation during 1911 was 2,854,000 gals. per acre daily. During the year this filter was scraped to relieve clogging 13 times, the total amount of sand removed by scraping being about 3 ins.

This is equivalent to the removal of about 0.23 in. of sand at each scraping, or slightly less than 30 cu. yds. per acre per scraping. The average volume of water filtered between scrapings was about 63,000,000 gals. per acre, the average time between scrapings being about 23 days. The longest run of the filter was from July 10 to Aug. 22, when the filter was operated at the prescribed rate for 38 days without scraping, about 110,000,000 gals. of water per acre being filtered in this period. The shortest run of the filter was in February, when only about 27,000,000 gals. per acre could be filtered, and the filter could be operated only about 10 days before scraping was necessary.

Filter No. 343, $^{1}/_{20000}$ of an acre in area, was first put into operation on March 27, 1908, and contained about 33 ins. in depth of sand of an effective size of 0.35 mm. at the beginning of the year. The average rate of operation during 1911 was 5,064,000 gals. per acre daily. The surface of this filter was washed 26 times during the year, or about once in two weeks, the average amount of water filtered between washings being about 69,000,000 gals. per acre.

As stated previously, owing to the extremely small rainfall the river water was much more difficult to purify than usual, and this undoubtedly affected the work of these and other water filters at the station. Filter No. 8A, constructed of the grade of sand usually recommended for municipal filters, and operated at a rate similar to that at which such filters are usually operated, has yielded an effluent of excellent quality, bacterially speaking, throughout the year. Filter No. 343, on the other hand, which has been in operation for a much shorter period, and is constructed of a much coarser grade of sand and operated at a much higher rate than is usually the practice when dealing with a water of the character of the Merrimack River, has yielded an effluent of less satisfactory quality than that from Filter No. 8A, although one which would compare favorably with filtered waters which are used for municipal supplies in many places.

The average number of bacteria in the effluent from Filter No. 8A was 53 per c. c., and in the effluent from filter No. 343, 160 per c. c. The total numbers of bacteria exceeded 100 per c. c. about 15 per cent of the time in the effluent from Filter No. 8, and about 18 per cent of the time in the effluent from Filter No. 343. Samples containing 1,000 or more bacteria per cubic centimeter were also obtained from the latter filter about 3 per cent of the time, but no such high results were obtained from Filter No. 8 at any time during the year. The average bacterial efficiencies of these two filters were 99.1 per cent for Filter No. 8A, and 97.2 per cent for Filter No. 343; and B. coli were found in 1 c. c. in about one-fourth of the samples of the effluent from Filter No. 8A, and in about 32 per cent of the samples collected from Filter No. 343.

STUDIES OF THE RELATIVE EFFICIENCY OF SAND FILTERS OPERATED AT DIFFERENT RATES.

Filters Nos. 417, 418, 419 and 420.—During the years 1908, 1909 and 1910 four filters, each containing the same depth and character of sand, were operated at widely different rates to study comparatively the effect of the rate of operation upon the hygienic efficiency and operating economy of such filters. These filters, however, had each been operated previously at a different rate and for a different period, and as pointed out in the report of last year, the comparison of the influence of different rates was hardly a fair one, since the results were undoubtedly influenced to a greater or less extent by the different age and particularly by the amount and character of the clogging material which the different filters had stored previous to the beginning of the experiment. On Dec. 28, 1910, therefore, four new filters were put into operation to begin this study anew. Each of these filters was constructed of 4½ ft. in depth of sand of an effective size of 0.25 mm. Filter No. 417 has been operated at a theoretical rate of 2,500,000 gals. per acre daily. Filter No. 418 at a rate of 5,000,000 gals., Filter No. 419 at a rate of 10,000,000 gals. and Filter No. 420 at a rate of 20,000,000 gals. per acre daily.

The average numbers of bacteria in the effluents from these filters have been 840 per c. c. for Filter No. 417, 855 for Filter No. 418, 790 for Filter No. 419 and 1,070 for Filter No. 420, these figures corresponding to bacterial removals of 85.3, 85.0, 86.2 and 81.2 per cent, respectively. B. coli were found in the effluent from Filter No. 417 in 29 per cent of the samples; in the effluent from Filter No. 418 in about 27 per cent of the samples; in the effluent from Filter No. 419 in about 24 per cent of the samples; and in the effluent from Filter No. 420 in about 57 per cent of the samples.

These results are far from satisfactory, and the influence of the different rates of operation is not apparent. The filters were started, however, at a time when the river water was more difficult to purify than in former years, and all of the filters were very slow in coming to maturity. During the latter part of April and the first part of May they had apparently matured, and the numbers of bacteria in the effluents from all the filters were low. With the beginning of warm weather, however, the bacterial counts became very erratic and fluctuated within wide limits. The plates showed that the bacteria causing the high counts were of one or two kinds, proving that the trouble was due to growths of bacteria within the filters. During these summer months, also, the amount of dissolved oxygen in the canal water was low, and this oxygen was practically all used up in the passage of the water through the filters. Conditions favorable to the growth of bacteria within water filters have not occurred to any extent at the station for many years past. During the years 1895, 1896 and 1897, however, conditions were favorable and much trouble of this nature was experienced, and the causes and effects of such growths of alien bacteria were discussed in the reports for these years. For these reasons the results obtained probably do not show the true effect of different rates of operation, although they do show what kind of results may be obtained with new filters when operated at these rates under the conditions which prevailed during the past year.

Effect of Rates Upon Operating Results.—In addition to the comparative determination of the relative hygienic efficiency, one of the objects of this investigation has been to obtain comparative data as to the amount of mechanical treatment required to maintain these various rates of filtration. It has been the practice in the operation of these filters, as with many other experimental filters at the station during recent years, whenever the loss of head has become so great that the theoretical rate could not be maintained, to remove clogging materials by washing the surface of the sand in place; that is, to clean the surface by what is now generally known as the "Brooklyn method." By surface washing in this manner the effective depth of sand in the various filters has been kept much more uniform than would have been the case had the clogged sand been removed from the filter by scraping, which is the more usual practice. As has been found in many places where this method of cleaning has been used on large filters, satisfactory reduction in the loss of head cannot always be obtained by the practice of surface washing, and at times it has been necessary to resort to other remedies in order to maintain the filters in operation at or near the prescribed rates. The various remedies tried at different times in addition to surface washing comprised scraping, digging over the surface sand to a depth of about 6 ins., and washing the upper layers of sand to a depth of about 12 ins. by means of a rake having hollow teeth through which jets of water were forced under pressure into the sand. The comparative operating records of these different filters, although extending over a period of 11 months only, have yielded some very interesting and practical data as to the relative efficiency of these various methods of surface treatment.

Filter No. 417, operating at a rate of 2,500,000 gals. per acre daily, required no surface treatment of any kind during the first six months of its history, in which period 447,000,000 gals. of water per acre were filtered. On June 30 the surface of this filter was scraped, instead of being surface washed, through a misunderstanding of orders by a filter attendant. No further surface treatment was necessary up to Nov. 30, but on Dec. 16 it was again necessary to relieve clogging and the surface was washed. During this period of 11 months and 20 days, therefore, in which about 852,000,000 gals. of water per acre were filtered, only two surface treatments were required.

Filter No. 418, operating at a rate of 5,000,000 gals. per acre daily, was washed six times up to the end of the year. The first surface treatment required by this filter was on April 19, 3 months and 22 days after starting. The total quantity of water filtered up to the first washing was 582,000,000 gals., and the average quantity filtered between each of the subsequent washings was about 192,000,000 gals. per acre.

Filter No. 419, operating at a theoretical rate of 10,000,000 gals. per acre daily, was washed 56 times, was dug over to a depth of 6 ins. once and was washed with the water rake to a depth of about 12 ins. twice. The surface of this filter required cleaning for the first time on Jan. 21, or 23 days after being started, during which period 240,000,000 gals. of water per acre were filtered. Omitting the periods subsequent to other methods of surface treatment, the average volume of water filtered between washings was about 50,000,000 gals. per acre. After digging over to a depth of 6 ins. the filter passed about 129,000,000 gals. per acre before surface treatment was again necessary. On the two occasions when the water rake treatment was used, the volume of water passed before surface treatment was again necessary, in one case was about 2½ times the amount passed during the period just before water raking, and in the other case the volume of water filtered during the succeeding period was much less than the amount passed during the period just befor treatment.

The theoretical rate of 20,000,000 gals. per acre daily at which it has been attempted to operate Filter No. 240 appears to approach the maximum limit at which a filter of this depth and material can be operated, and in spite of frequent surface treatment throughout the year the average rate of operation was only about 17,000,000 gals. per acre daily. The surface of this filter was washed 112 times, scraped twice, dug over to a depth of 6 ins. 12 times, and washed to a depth of 12 ins. with the water rake 14 times, during the period of 11 months the filter was in operation. The first surface treatment of this filter was given on Jan. 13, 15 days after the filter was started, during which period about 300,000,000 gals. of water per acre were filtered. Omitting the periods following other methods of surface treatment, the average volume of water filtered between surface washings was about 46,000,000 gals. per acre daily. In the periods immediately following scraping, between 65,000,000 and 70,000,000 gals. of water per acre were filtered before surface treatment was again necessary. During the periods immediately following digging over the surface to a depth of 6 ins., the average volume of water filtered before surface treatment was again required was about 88,000,000 gals. per acre. As in Filter No. 419, the agitation of the upper 12 ins. of sand by means of the water rake failed as a rule to produce results commensurate with the labor involved. Twice out of the 14 times that this treatment was tried there was no reduction in the loss of head, and other treatment was required before the filter could be operated at the prescribed rate. On four other occasions the volume of water filtered during the period immediately following water-raking was from 11 to 58 per cent less than the volume passed in the period preceding such treatment. In the eight other instances when this process was used the volume of water filtered in the period following the water-raking was from 12 to 140 per cent more than was filtered in the period immediately preceding water-raking. Omitting the two instances when the process afforded no relief whatever, the volumes after treatment showed an average increase of about 20 per cent over those of the periods preceding the treatments.

The increased frictional resistance due to air entrained in sand filters has been discussed frequently in the reports. Trouble of this character is always more serious in the winter when the water is practically saturated and at times supersaturated with air, and always more noticeable in the operation of sand filters in which the rates are high and the loss of head correspondingly large (much negative head) than in the case of filters operated at lower rates. This has been true in the operation of this series of filters. Considerable trouble was experienced during February and March on account of entrained air in Filter No. 420, and part of the surface treatment applied during these months was for the purpose of liberating this air. Some trouble of this nature was also experienced in the operation of Filter No. 419 during these months, but to a markedly less extent than in the case of the filter operated at the higher rate, and very little trouble of this kind was found in the filters operated at the lower rates.

DOUBLE FILTRATION.

Filters Nos. 331 and 286.—Filter No 331, $^1/_{80000}$ of an acre in area is constructed of 18 ins. in depth of sand of an effective size of 0.45 mm., and was first put into operation on July 7, 1907. This filter has been operated as a pre-filter, the canal water applied being first passed through a settling basin having a storage capacity of about 10 hours. The effluent from pre-filter No. 331 is pumped into a storage tank from which it is applied to secondary Filter No. 286. Filter No. 286, $^1/_{20000}$ of an acre in area, and containing 4 ft. in depth of sand of an effective size of 0.21 mm., was first put into operation on Jan. 20,1906. Pre-filter No. 331 has been operated at a rate of 50,000,000 gals. per acre daily and secondary Filter No. 286 has been operated at a rate of 5,000,000 gals. per acre daily, throughout the year, the net rate of the double filtration system as a whole being about 4,500,000 gals. per acre daily.

The entire body of sand in Filter No. 331 was washed by reversed flow, in the same way that mechanical filters are washed, 87 times during the year, or on an average of about once in four days. The average quantity of water filtered between washings was about 174,000,000 gals. per acre. During the winter the filter required washing much less frequently than in the summer. During January and February it was necessary to wash the filter only three times, or at average intervals of about 20 days, while in July and August it was necessary to wash the filter 33 times, or about every other day. The relative volumes of water filtered between washings in winter and summer were 480,000,000 gals. and 84,000,000 gals. per acre, respectively. During September and October the volume of water passed between washings gradually increased, and by the end of November the volumes were practically the same as during the winter months. The surface of secondary Filter No. 286 was scraped 15 times during the year, or an average once in 18 days, the average quantity of water filtered per scraping about 86,000,000 gals. per acre. The longest run of this filter without surface treatment was from April 3 to June 17, a period of 57 days, during which about 285,000,000 gals. of water per acre were filtered. During the summer months the average time between scrapings was about 33 days, while during the winter months the average time between scrapings was only about 10 days, and the records show four scraping intervals of less than seven days during the colder months.

The increased difficulty in keeping the pre-filter in operation during the summer months is very unusual and cannot be satisfactorily explained at this time. All of the experimental filters have required somewhat more frequent surface treatment than in previous years, but this increased treatment has generally been found necessary during the colder months of the year. This was the case with the secondary filter as noted above, and with the other filters described elsewhere, and is caused by a combination of three well-known factors: (1) The increased viscosity of the water at low temperatures; (2) the presence of entrained air in the sand owing to the saturation or oversaturation of the water with oxygen in the winter; and (3) the somewhat larger amounts of suspended matters in the river water during the winter and early spring. In the case of the pre-filter, however, the most serious difficulty was encountered at a time when the water was warm, when the amount of dissolved oxygen was exceptionally low, and when the water was unusually free from suspended matters. It was suspected that the trouble might be due to growths of microscopical organisms within the filter or in the preliminary settling basin. Careful examinations proved, however, that while there was a growth of bacteria in the settling basin there was nothing of this nature present which could account for the unusual clogging of the filter.

During the months of February, April, June, July and August the numbers of bacteria increased during the passage of the canal water through the settling tank before its application to the pre-filter. This increase, which was especially large in the month of June, greatly over-balanced the decrease in numbers which occurred during the remaining months of the year, with the result that the yearly averages show an increase of about 30 per cent in the numbers of bacteria in the water after passing through the settling tank. During passage through the pre-filter there was an average decrease in the bacterial content of the water of about 37 per cent. In the tank where the effluent from the pre-filter was stored before being applied to secondary Filter No. 286, there was again an increase in the numbers of bacteria amounting to about 36 per cent, the result being that the water as applied to the secondary filter contained on an average more bacteria than the canal water before treatment. The average removal of bacteria by the secondary filter was about 92 per cent, while, owing to the increases above noted, the bacterial efficiency of the entire system of double filtration was only 90 per cent. This system of double filtration shows more clearly, perhaps, than other types of filters the exceptional character of the river water during the past year. As has already been stated, owing to the extremely low stage of the river, the river water has received much longer storage in the mill ponds above Lawrence than usual, and a much greater opportunity for sedimentation has been afforded than has generally been the case in previous years. The result has been that all or practically all settleable materials had been eliminated when the water reached the settling basin. It was not to be expected, therefore, that much additional clarification would be accomplished in the settling baisn. On the contrary, in this settling basin, especially during the unusually hot months of July and August, favorable conditions were provided for a growth of saprophytic bacteria in the water. Furthermore, the water being practically devoid of suspended matters, and containing extremely large numbers of bacteria, was not purified to such an extent as would have been the case under normal conditions. The secondary increase in bacteria in the effluents from the pre-filter during storage—an increase which has been noted in previous years and which may be stated to be a normal occurrence—was exceptionally large this year during the months of July and August. The previous history of the water and the extreme temperature of the two months noted, offer a rational explanation of the apparently abnormal results obtained during the year 1911. As has been stated elsewhere, while the results obtained with this system of double filtration during the year are disappointing when viewed in connection with those obtained in other years, they are nevertheless extremely valuable in demonstrating what such a system of filtration can or cannot accomplish under especially difficult conditions.

MECHANICAL FILTRATION.

Filter No. 336.—Filter No. 336, $^1/_{40000}$ of an acre in area, and containing 24 ins. in depth of sand of an effective size of 0.35 mm., was first put into operation on Dec. 11, 1907. This filter has been operated as a mechanical filter at a rate of 100,000,000 gals. per acre daily with canal water which has been treated with sulphate of alumina and soda ash and passed through a settling tank with a storage capacity of 3¼ hours.

By the operation of this filter in 1908 it was shown that an effluent of reasonably satisfactory bacterial quality might be obtained by the use of about 2.0 grains sulphate of alumina and 1.5 grains soda ash per gallon, and during 1909 and 1910 it was shown that by the addition of small amounts of a disinfectant, such as hypochlorite of lime, an effluent of excellent bacterial quality and of satisfactory physical appearance could be produced by the use of about 1.0 grain of sulphate of alumina and 0.75 of a grain of soda ash per gallon. During 1911 this filter has again been operated as nearly as possible in the same manner as during the year 1908, no disinfectant being used to increase the bacterial efficiency. Operated in this manner it has been necessary to use over 2.0 grains sulphate of alumina and about 1.25 grains soda ash, and even with these amounts of coagulants unassisted by disinfection, the numbers of bacteria in the effluent from the filter have not been entirely satisfactory. The average numbers of bacteria in the canal water before treatment were 5,700 per c. c. After coagulation and sedimentation the numbers of bacteria in the water as applied to the filter were 3,200 per c. c., and after passing through the filter the numbers were reduced to an average of 540 per c. c. In other words, about 44 per cent of the bacteria in the canal water were removed in the coagulation basin, and about 83 per cent of the bacteria remaining after coagulation were removed by the filter. The bacterial efficiency of the entire system, however, was only about 90 per cent. Bacterially, therefore, the effluent from this filter was not nearly so satisfactory as in the years when coagulation with smaller amounts of chemicals was practiced and a disinfectant was used to assist in the elimination of bacteria. Chemically speaking, the effluent from this filter was somewhat better than during the two previous years, owing to the greater clarification and color removal accomplished by the incresed amounts of coagulants.

As is usual with filters of this type the entire body of sand was washed by reversed flow whenever the filter became so clogged that the precribed rate of filtration could not be maintained. The average time which the filter could be opertaed without washing during the year was about 6 hours and 36 minutes, the average quantity of water filtered between washings being 27,600,000 gals. per acre. The quantity of water filtered between washings was much smaller than during the two preceding years owing to the more voluminous precipitate caused by the larger amounts of coagulant used to obtain a satisfactory effluent.

CLARIFICATION BY UPWARD FILTRATION THROUGH A ROUGHING FILTER OF COARSE MATERIAL.

Filter No. 389.—Filter No. 389, $^1/_{20000}$ of an acre in area, was first put into operation on April 14, 1910. This filter is constructed of 6 ins. in depth of wood charcoal supported upon a ¼-in. mesh galvanized wire screen placed 12 ins. above the bottom of the tank. Overlying the charcoal and separated from it by a ⅛-in. mesh copper screen, is 24 ins. in depth of broken stone pebbles of an effective size of 4.4 mm. The canal water enters at the bottom, passes upward through the filter material and overflows through an orifice placed 3 ins. above the surface of the stone, the available loss of head with the filter in operation being about 10 ins. This filter was continued in operation during the first four months of the year at a rate of 10,000,000 gals. per acre daily. On April 6 the operation of the filter was temporarily suspended, and it was not again put into operation until after the end of the year. During the four months of the year in which it was operated the filter was washed by reversing the flow for a short period 21 times, the average volume of water filtered between washings being about 44,000,000 gals. per acre daily. As stated in the report for last year this filter cannot be considered as other than a roughing filter to prepare the water for ultimate treatment by some other process. From this viewpoint the work of the filter was extremely satisfactory. During February and March, before the operation of the filter was suspended, the numbers of bacteria in the effluent had decreased to 220 and 160 per c. c., respectively, corresponding to bacterial efficiencies of over 96 per cent,—efficiencies which compared well with those obtained at times with filters constructed of much finer materials when operated at similar rates.

PURIFICATION OF WATER BY A SPRINKLING FILTER OF SAND.

Filter No. 390.—Filter No. 390, $^1/_{20000}$ of an acre in area and constructed of 54 ins. in depth of sand of an effective size of 0.42 mm., was first put into operation on April 21, 1910. The canal water has been applied to the surface of this filter by means of a tipping basin discharging into a perforated pan placed 12 ins. above the surface, the outlet of the filter being kept wide open at all times, and the rate of operation controlled at the influent pipe. The practice has been to rake the surface of the filter to a depth of 1 in. whenever pooling of the water on the surface occurred, and to scrape or dig over the surface when no further relief could be obtained by raking. During the period from December 1 to February 3, canal water was thus applied to the filter at a theoretical rate of 5,000,000 gals. per acre daily. During this period the filter was operated 63 days, and in spite of the fact that the surface was raked 57 times, and 1 in. in depth of the surface sand was removed on January 18, water stood on the surface practically all the time. On February 3 the rate was reduced to 2,500,000 gals., at which rate the filter was operated throughout the remainder of the year. With the decreased rate it was somewhat easier to keep the filter in operation. Nevertheless, during this period in which the filter was in actual operation, 284 working days, it was necessary to rake the surface 102 times, or on an average at intervals of less than once in three days, and in addition to raking, the surface was scraped twice, was dug over to a depth of 6 ins. twice, the entire body of sand in the filter was washed by reversed flow once, and on two occasions the filter was allowed to drain and rest for a period of one week. The mechanical difficulties in keeping a filter of this type in operation would apparently increase the cost of filtration to an unreasonable figure. The actual volume of water passed by the filter between rakings was only about 4,500,000 gals. per acre during the period when operated at the higher rate, and only about 5,000,000 gals. per acre when operated at the lower rate.

The results obtained with this filter, with a water which was more difficult to purify than usual, were excellent; better, in fact, than those obtained with any of the other filters operated at the station during the year. At no time during the year did the numbers of bacteria in the effluent exceed 100 per c. c., while the average number was only 37 per c. c., and B. coli were found in only about 12 per cent of the samples. These are much better results than were obtained with either Filter No. 8A or the old city filter, both slow sand filters operated at low rates. The superior results obtained with this filter can only be attributed to the incresed amount of oxygen in the water owing to the method by which this water was applied to the filter, and to the increased nitrification within the filter consequent upon the presence of an unlimited supply of oxygen for the completion of the purification processes.

BRIDGES

General Method Adopted for Constructing a 312-ft. Reinforced Concrete Arch Bridge at Larimer Ave., Pittsburgh, Pa.

Contributed by Charles H. McAlister, Superintendent for the Contractor.

The Larimer Avenue Bridge crosses Negley Run and Washington Blvd. in the city of Pittsburgh, Pa. It is a reinforced concrete arch bridge, with a main and span of 312 ft., and a length over all of 670 ft. The main span is the longest of its kind in America and there is but one longer concrete arch in the world. At its highest point the roadway is 115 ft. above the roadway of the boulevard, which is spanned by the main arch.

The form of arch adopted for the Larimer Avenue Bridge and the design of the bridge were dictated by several local conditions. The narrowness of the ravine carrying Negley Run and the steepness of its banks made an arch bridge with trestle approaches of special advantage. Since the foundation rock was shale it was necessary to design a structure whose full weight should not bring a pressure exceeding 6 tons per square foot on the foundation bed. Finally the design needed to be one which would combine strength, cheapness and good appearance.

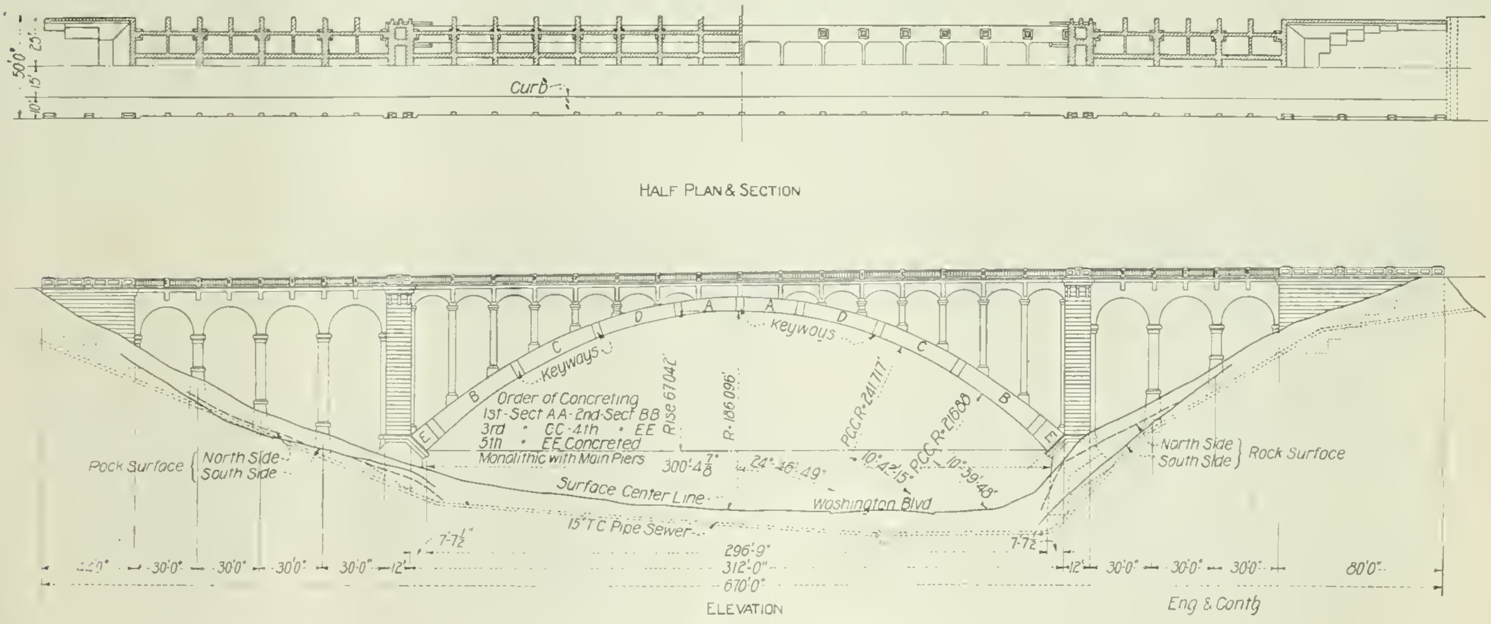


Fig. 1—General Plan and Elevation of Larimer Ave. Bridge, Pittsburgh, Pa.

The design adopted is shown in Fig. 1. The 30-ft. roadway is designed to carry two 35-ton street cars and one 15-ton truck on any place on the floor, assuming 10 tons on the rear axle and 5 tons on the front axle. However, a uniform loading of 150 lbs. per square foot was considered and the condition giving the largest stress taken. The sidewalk, which was carried on cantilever brackets, projecting from the spandrel columns on the main arch, and from the lateral beams 15 ft. on centers on the approaches, was computed for a uniform live load of 100 lbs. per square foot. The approaches were designed as reinforced concrete trestles and the arches on the outside carry only a small part of the load, and were used primarily for architectural effect.

Preliminary Work.—Preliminary work was started almost immediately after the award of the contract and particular attention was given to the rapid delivery of such construction material as was most needed for making rapid progress from the start. The old wooden bridge, which spanned the site of the new structure, was lightened of miscellaneous timbers, railing, flooring, etc., and was demolished by being pulled over and down by a hoisting engine placed near the structure. This was accomplished by one pull of the engine. As soon as the wreck was cleaned up (there was considerable salvage of bolts, rods, railing and timber), the excavation for the two main piers was started, an orange peel bucket being used in connection with a stiff-leg derrick. Shale rock was encountered at a depth not very great and forms for the main pier bases were placed and concreted. Work was also started on the falsework for the main arch span and on the western abutment.

Construction Plant.—The principal feature of the plant installation was a Lidgerwood cableway, with towers 60 ft. high, and a span of 750 ft. In order to handle all material to any part of the structure, and also to cover the grounds adjacent to the sides of the bridge, on which were stored lumber, pipe, reinforcing bars, etc., the towers were placed on tracks and equipped with moving engines, so that they could be moved for nearly 100 ft. This also permitted the handling of all car load shipments, as the railroad siding was extended, so that the cars could be placed directly under the cableway.

This siding was laid to the work from the tracks of the Pennsylvania R. R. on the Brilliant cut-off, which passes nearly at right angles to the eastern end of the bridge. Over 90 per cent of the material used in the construction work was delivered by this siding. The track was located on the hillside near the eastern abutment and was approximately 18 ft. below the level of the roadway on the bridge.

A concrete mixing plant was located on the eastern hillside about 100 ft. north of the work, and consisted of four storage bins for sand and crushed stone, each of about 40 cu. yds. capacity; these bins were filled by 3 cu. yd. side-dump cars running into tunnels under the railway siding. Four chutes led from these bins to the measuring box, or hopper, which was directly over the hopper of a 1-cu.-yd. Smith mixer. An instantaneous dumping device on the measuring hopper was operated by a laborer who also handled the cement into the hopper and added the water from a steel tank, equipped with a gage glass and graduated scale. The mixer dumped directly into Hains concrete buckets, placed on narrow-gage flat cars, running by gravity to a point directly under the cable-way, from which the concrete was hoisted and delivered by the cable-way to any point on the bridge. A hoisting engine was used to haul the flat cars with the empty Hains buckets back to the mixer and also pull the three yard side-dump cars from the tunnels to the bins.

Alongside Washington Blvd., which runs directly under the main span of the bridge, there was located a wood working mill and machine and blacksmith shop, fully equipped to build all forms required for keeping all the plant

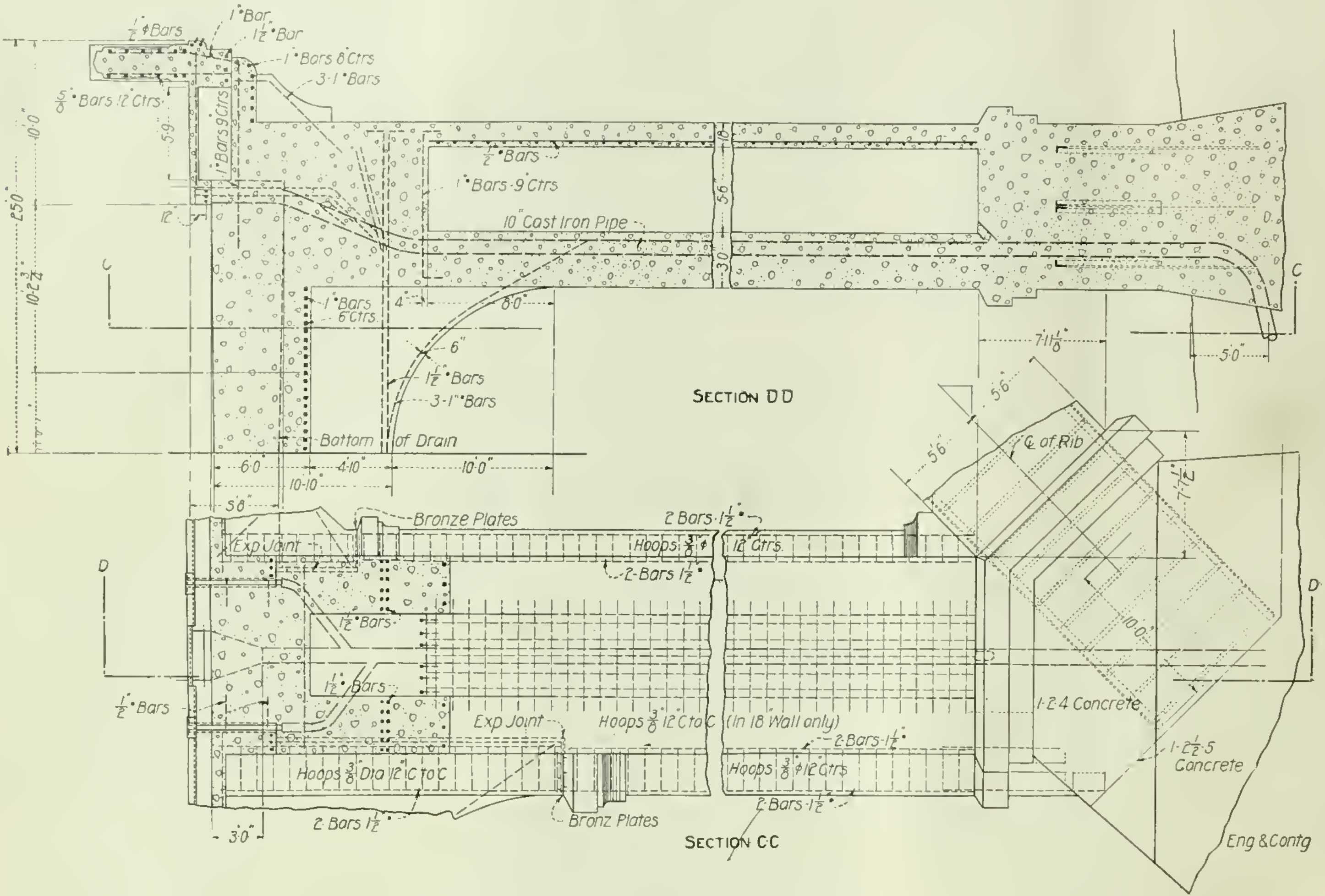


Fig. 2—Details of Main Piers and Reinforcing.

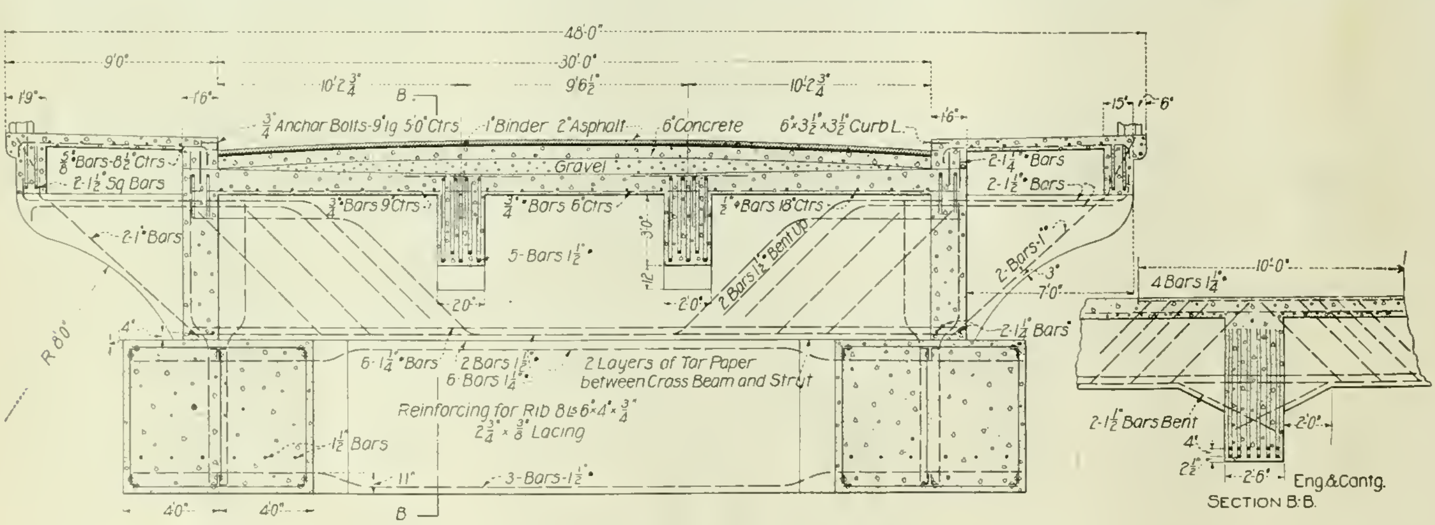


Fig. 3—Section Through Floor and Main Arch Ribs.

in first-class repair. An Ingersoll-Rand compressor furnished compressed air over the whole work for boring, chipping, hammering and drilling and was almost indispensible. A rock drill was placed in the shop and converted into an air hammer, and was successfully used in all forging and machine work. A stiff-leg derrick completed the main parts of the plant installation and was employed first equipped with an orange peel bucket for excavating the main pier foundations, then for loading excavated material from the spoil piles into buckets which were carried by cableway to various points where bucket filling was necessary, and finally was placed on the roadway at the eastern end of the bridge and then used to complete the extreme end of the eastern abutment, after the cable-way was removed.

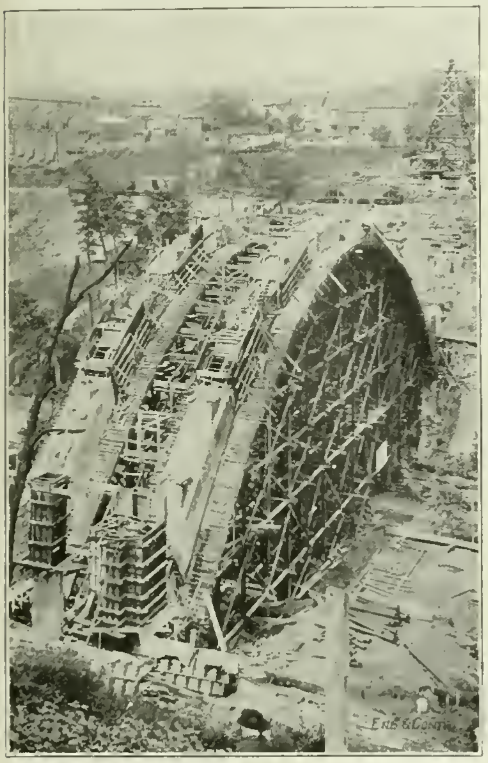


Fig. 4—General View Showing Main Arch Falsework and Forms.

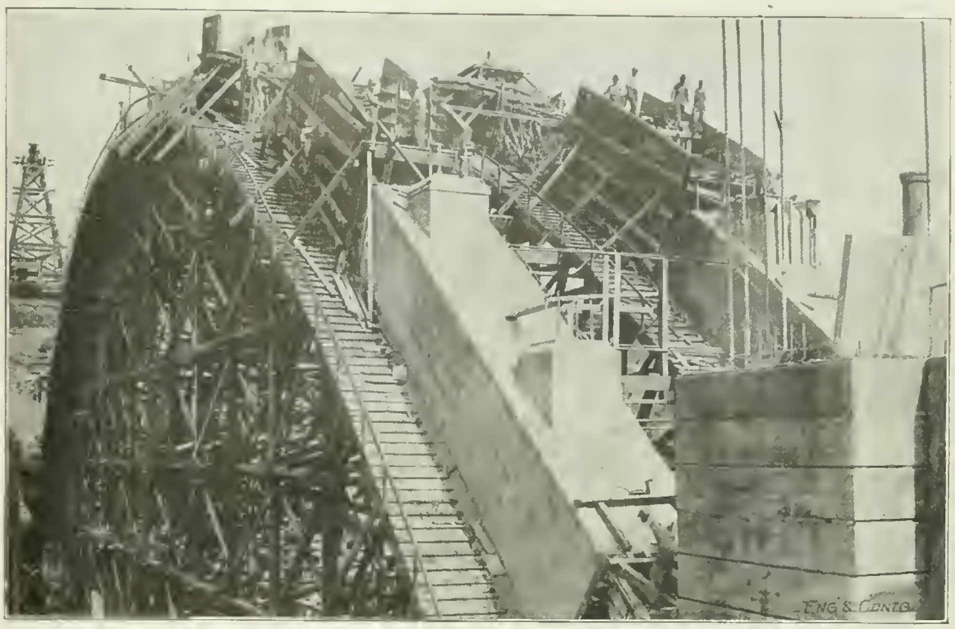


Fig. 7—View Showing Details of Arch Construction.

Centering for Main Arch.—The centering for the main arch span was designed, and its erection supervised by Mr. Ottomar Stange, general superintendent, who gave his personal attention to this work until Aug. 1, 1911, when the writer assumed charge of the construction. Each bent consisted of five plumb posts; two under each rib, of 12x12-in. yellow pine, and one in the center of 8x12-in. yellow pine, tied with horizontal and diagonal braces. Each plumb post was carried on a plank footing 7 ft. square, except the bents on either side of the Washington Blvd., which were supported on piling. Beside being well braced laterally by 4x10-in. and 4x12-in. yellow pine timbers, the bents were sway-braced longitudinally by 3x10-in. yellow pine timbers and strutted with 8x8-in. timbers. Resting on wedges placed on the cap timbers, a 10x14-in. yellow pine timber carried the ribs upon which the ⅞-in. matched decking was placed. This decking projected on each side of the neat lines of the arch ribs a sufficient distance to allow of proper working room to handle forms and give an ample passage way for the workmen. A well braced railing was placed on each edge of the decking.

Each bent was framed horizontally, and hoisted into place by the cable-way and the entire falsework for the main arch ribs was erected in the comparatively short time of three weeks. The highest bents were built up in three lifts, the highest of these lifts being 44 ft. The entire boring of timbers for bolts was done by boring machines operated by compressed air; 1-in. bolts were used and holes were bored with 1⅛-in. bits. Two machines were used on this boring and at no time was this part of the work behind the rest in progress.

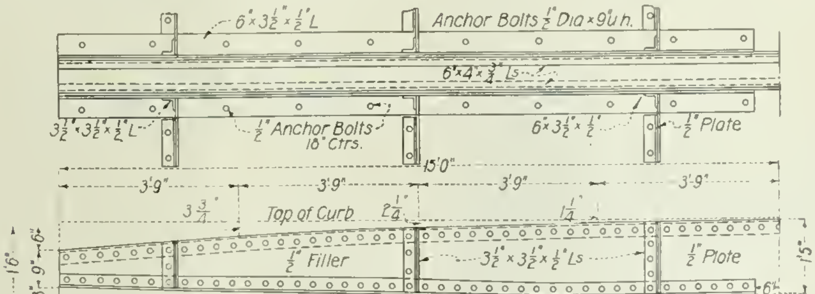


Fig. 5—Sketch Showing Details of Expansion Joints in Floor.

Form Work.—All forms were built of ⅞ in. matched pine, and as far as possible were made up into panels. The studding was 2x6-in. material and braced by horizontal walings of 4x6-in. pine spaced 4 ft. centers. These walings were tied by means of ⅝-in. iron rods, running to within 4 ins. of the inner faces of the molds and connected by a coupling to a tapered stub rod which ran through the sheeting of the mold and through the 4x6-in. waling, and was bolted outside this latter timber. After the concrete had set sufficiently, the stubs were freed from the coupling (now imbedded in the concrete) by one turn and were withdrawn; the hole let in the face of the work was eventually plugged with mortar, leaving a smooth surface and no metallic ends projecting. This method of tieing forms has been used by this company for years and is the invention of Mr. Stange. A merit of this tie is that after the removal of the forms the stubs can be again replaced in the coupling, and 4x6-in. timbers bolted on to support a scaffold, both the next higher lift of forming and a platform for the workmen engaged in form construction. The main piers were built up in this way and a large quantity of labor and material ordinarily necessary in shoring from the ground up was saved to the contractor. Bevel strips, made of ⅞-in. and 1¾-in. lumber were used over the entire work to relieve all sharp corners, which was necessary in view of the bush-hammer work to be done on the exposed faces. This method of beveling corners leaves the work with a pleasing appearance and facilitates the early removal of all form work. All forms were oiled with a mixture of black oil and kerosene, which proved very satisfactory.

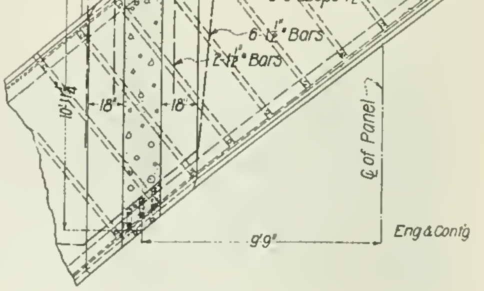


Fig. 6—Details of Reinforcement at Spandrel Post in Main Arch.

Concreting Main Arch Ribs.—The two sections at the crown of each rib were poured first, except that the two 8-ft. sections of the rib immediately adjacent to the main piers were concreted simultaneously with the pier heads to insure the action of the arch as a no-hinged structure. The concreting of the crown sections was followed by the placing of the lowest sections and then working toward the top. Four similar sections were placed at the same time, thus insuring the symmetrical leveling of the centering. A 4½-ft. key-way separated adjacent sections and at these key-ways the steel forming the reinforcement frame for the rib was left unconnected until all the sections had been completed, which made it possible to have no initial compression in the steel. All key-ways in each rib were concreted in one operation. The placing of the concrete in the main arch ribs was carried to completion without serious interruption and consumed about twenty days. After the two arch rings were completed, they were connected by concrete struts, 18 ins. wide, and of the vertical depth of the arch ring. The bases of the spandrel columns were placed at the same time as the sections of the arch.

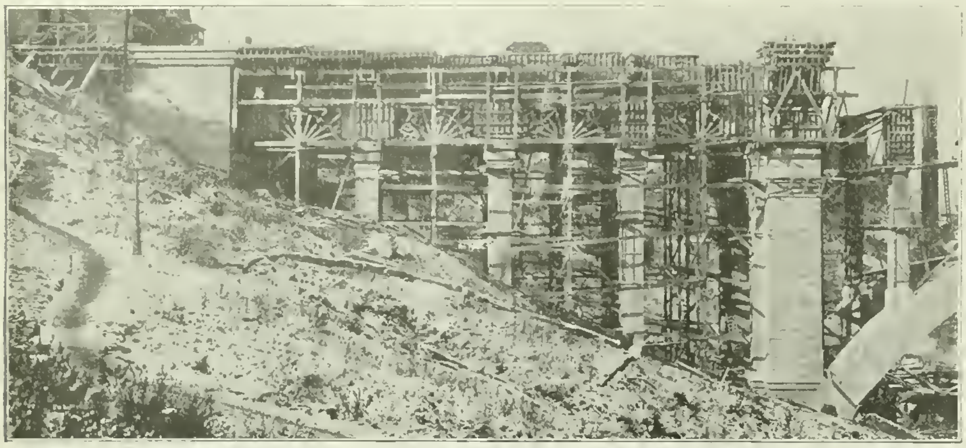


Fig. 8—View Showing Forms and Approach Piers.

The main reinforcement for the main arch rings consisted of a rectangular steel frame made up of eight 6x4x¾ in. angles tied by 2¾ x⅜ in. lacing bars spaced about 2 ft. on centers. This frame was delivered fabricated in sections and was landed from the cars onto the centering by the cableway previous to the erection of any of the main arch forms, the joints being left unfastened until after the main sections had been concreted. Six 1½ in. Diamond reinforcing bars bent to form trusses and spliced at varying distances were also used in the ribs, and the spandrel column bases were tied in with 1½ in. bars. After the concrete in all sections of the ribs had hardened, the reinforcement lifts exposed and unconnected in the key-ways was drilled and spliced with plates fastened by ⅞-in. machine bolts.

Main Pier Construction.—The pouring of the main piers was carried on with great rapidity and the building of the forms for these piers in panels facilitated this progress, which also benefited from the use of the light scaffolds, bolted against the sides of the completed work by means of the embedded coupling and the tapered stub. These piers were carried up in lifts approximating 16 ft., the last lift consisting, however, of the right and left hand piers and the connecting arches, between them.

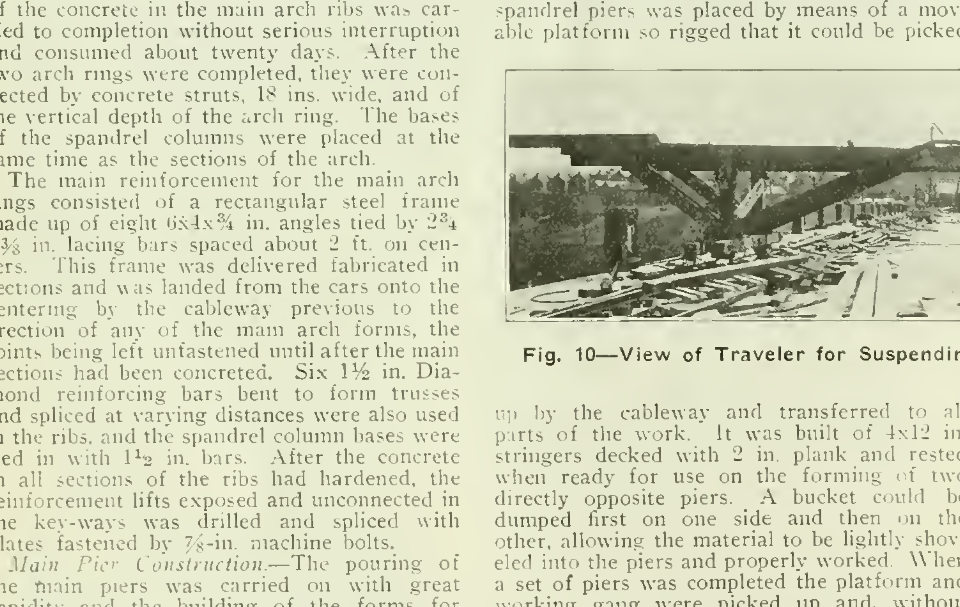


Fig. 9—View of Forms for Floor Construction.

Approach Piers.—These piers were sunk to shale rock and were battered below their bases. From the bases up they were rectangular in shape (3x5 ft.) to their caps, between which are sprung the ornamental arches previously mentioned. On the inside the pier shaft continues, reinforced as below the caps, to the bottom of the bridge floor and carries the main lateral floor beam and the two outer longitudinal beams. These piers were concreted in lifts to the top of the caps, from which point they were poured monolithic with the floor and beam sections.

The concrete in the approach piers and spandrel piers was placed by means of a movable platform so rigged that it could be picked up by the cableway and transferred to all parts of the work. It was built of 4x12 in. stringers decked with 2 in. plank and rested when ready for use on the forming of two directly opposite piers. A bucket could be dumped first on one side and then on the other, allowing the material to be lightly shoveled into the piers and properly worked. When a set of piers was completed the platform and working gang were picked up and, without loss of time, taken to the next set and operations were immediately resumed. Very often the concrete left over from the completed set of piers was also transferred and used in the next set of piers.

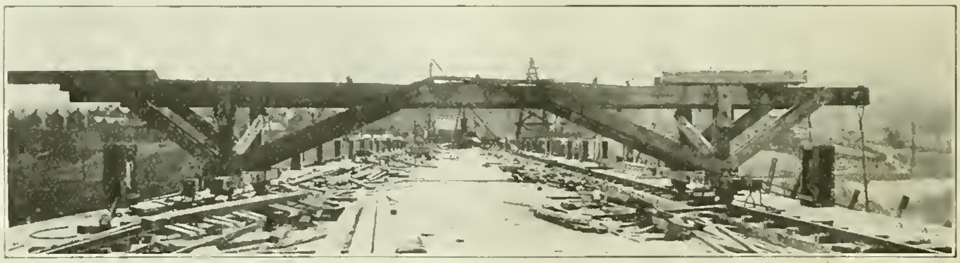


Fig. 10—View of Traveler for Suspending Working Scaffolds for Bushhammer Work.

West Abutment.—The west abutment was completed before the winter of 1911 and 1912 set in, as was also the floor and beam construction of the west approach to the main pier. The abutment was founded on shale rock and the walls were battered on the inner side, the outside being carried up perpendicularly, to the coping, and ornamental grooves were placed about 2 ft. apart on this outer face. The inner side was lined with French drain and the whole was backfilled to the subgrade of the roadway and sidewalk. The abutment was not built monolithic, but was brought up in horizontal layers, each stopping at some one of the ornamental grooves. A connection, from the French drain, was made to a sewer running under the abutment from Larimer Ave. and drained surplus water from the abutment. Top and bottom bronze bearing plates placed on the bridge seat and pilaster caps were imbedded in the concrete and an allowance of 3 ins. was made for expansion joints at the main piers and abutments, provision for this expansion joint while concrete was being placed, being made by nailing ¼-in. sheets of corrugated straw board to a ⅞-in. matched form of the size of the expansion opening.

Cold Weather Cementing.—Upon the approach of cold weather, preparations were made for mixing, placing and protecting the concrete during cold periods. Steam coils, 2½ ins. in diameter were placed in the sand and gravel bins, and live steam was piped to the railroad siding for use in heating the material brought in cars. Perforated 1 in. steam lines were placed under canvas, which covered the newly placed concrete. By these methods work was carried on until Jan. 1, 1912, but such severe weather was encountered after this date that it was decided not to take any chances on pouring the approaches, or the main arch floor, as this work was entirely exposed and even the most elaborate precautions might not be sufficient to guarantee safety. However, during the latter part of the winter and the early part of the spring of 1912 the falsework for the main arch floor span was erected.

Falsework for Main Arch Floor.—It was determined after investigation to place the whole load on the arch rings and not build the falsework for the main arch floor span upon that previously erected to carry the main arch rings.

When the spandrel column caps were concreted, extra cement was used to strengthen this work, and the caps themselves were heavily reinforced with ½ in. bars, placed at the contractors' expense. On each side of these caps 10x14 in. timbers were placed, and bolted together. These timbers were about 50 ft. long and were carried on the caps of the two spandrel piers directly opposite one another. They were held together by five bolts to prevent spreading, and the proper distance was maintained between the two timbers by 4x6 in. struts. Equidistant between spandrel piers 6x12 in. vertical posts carried 10x14 in. horizontal cross timbers, these timbers were level with the two 10x14-in. timbers carried on the spandrel column caps. Upon these cross timbers rested 12x12 in. longitudinal timbers, one under each roadway beam, and the floor slabs and roadway beams were supported directly from these timbers. The centering for the spandrel arches rested upon the 10x14 in. cross timbers, and the lateral floor beam at each set of piers was carried from these cross timbers. These members formed the principal units of the main arch floor span falsework and were well braced, laterally and longitudinally.

On account of a possible movement resulting from high winds, the spandrel piers were heavily braced laterally and guy lines were made fast to each main arch rib. This precaution was well taken, as there was perceptible vibration of the structure when loads of timber were placed on the partially completed falsework by the cableway.

Concreting Main Arch Floor.—With the advent of spring, concreting was actively resumed and the main portion of the concrete was completed by June 1, 1912. The diamond bar was used for reinforcement throughout the entire structure with Universal Portland cement. Crushed Ligonier limestone formed the aggregate for all the concrete above the surface of the ground and Alleghany River gravel was used for that portion of the work where the faces were below the ground line. Alleghany River sand was used throughout. So that the load would be placed evenly upon the arch rings, symmetrical sections of the main arch floor span were poured at one operation, the joints being formed at the crown of the spandrel arches, except over the third set of piers from the main piers, at which points expansion joints were provided. In all, six expansion joints were placed in the roadway: two at the abutments, two on the shore sides of the main piers, and two in the main arch floor span directly over the center of the third set of piers from the springing line of the main arch. It was first determined to place these last joints at the main piers, but as the main arch rings were "tied in" with the main piers, the upward or downward motion of the arch due to temperature changes would affect the spandrel piers unequally and might cause a rupture of the spandrel piers. The expansion joint was then moved over the third spandrel pier, at which point it was believed the greatest stress would be encountered and that portion of the main arch floor from the third spandrel pier to the main pier was tied by heavy reinforcing bars to the main piers. A bronze bearing plate was placed under the portion resting upon the third pier, so that the movement would take place on the pier. The third pier was tied by upright bars into the floor section extending over the crown of the arch.

Surface Finish.—All work above the elevation of the roadway is panelled. That portion of the railing directly above the abutments is of panelled concrete, the outer portions of the pedestals being given a smooth brush and wooden float finish, while the sunken surfaces of the pedestals are given a rough bush hammer finish; in this case the hammers were used until enough of the outer face had been removed to expose the stone aggregate which brought out the stone in clear relief and effected a mose pleasing finish.

The other pedestals (located at each panel point) holding in place an iron pipe railing, are finished in the same manner as those forming the abutment railing and are anchored to the girder beam, which supports the outer portion of the sidewalk by two vertical ½-in. rods. The sidewalk is given a rough finish throughout its entire length and is reinforced with ⅝-in. rods laterally and ⅜-in. rods longitudinally.

All surfaces below the roadway, including the faces of the two abutments, but excepting the column caps and bands around the approach and spandrel piers, were finished with a bush hammer. The result is exceptionally fine, being set off to further advantage by the smooth rubbed bands, caps on piers and grooves placed 24 ins. apart on the main pier and abutment faces.

Compressed air for the bush-hammer work was furnished all over the bridge and the cutting bits were operated by No. 3, Ingersoll-Rand and Keller hammers. The men operating the hammers were fitted out with goggles to protect their eyes, and they soon became very proficient in the use of the hammers, the best results being obtained on the main arch rings, where the gang was consolidated and directly under the supervision of the foreman. A traveler was rigged on the roadway, mounted on wheels, which ran upon standard railroad rails. Its top members were two 10x14-in. timbers, extending out and over the sidewalk. A swinging platform was suspended from this traveler so that it hung directly under the main arch ribs. Opon this swinging platform the bush-hammer operators worked, the scaffold or platform being first taken to the crown and from thence worked downward in both directions, the lines being "let out" as the platform and traveler moved from the center of the bridge toward the main piers.

Supervision.—The work was done under the direction of Mr. N. S. Sprague, superintendent of the Bureau of Construction, City of Pittsburgh, and was designed and supervised by T. J. Wilkinson, Division Engineer. It was constructed by the John F. Casey Co., Ottomar Stange, general superintendent, who started this work and later placed it in charge of the writer. The writer wishes to note his appreciation of the co-operation of Mr. R. V. Warren, engineer; Mr. D. F. Davison, carpenter foreman, and Mr. P. W. Chabot, master mechanic.

BOOK REVIEWS

Three New Books on the Strength of Materials.

Three books on the strength of materials, all written by men experienced in teaching the subject to students in American technical schools, have recently been published. One work is now in its sixth edition, that of Prof. Merriman, but the other two works are in their first edition. A brief summary of the scope of the books is here given.

Strength of Materials.—By Mansfield Merriman. John Wiley & Sons, New York. Cloth; 5¼x7½ ins.; 166 pp.; illustrated; $1.00.

As stated previously this work is now in its sixth edition. The author has attempted to present the subject in such a manner that it may be grasped by those who have not studied calculus. Only the high school branches of mathematics, together with such a course in theoretical mechanics as is commonly presented in elementary treatises on physics, are essential to an understanding of Prof. Merriman's presentation of the subject.

The book deals primarily with the resistant qualities of the various materials used in engineering construction. The subject of elastic deformations is accorded only secondary consideration. The formulas for the deflections of beams are stated but are not derived since these derivations are best made by an application of the calculus.

The general principles underlying the design of beams are developed from the elementary mathematics. The design of columns and shafts also is discussed in separate chapters. The chapter on elastic deformations presents that phase of the mechanics of materials in outline.

A separate chapter is devoted to the computation of the stresses in and the design of water and steam pipes and riveted joints. Temperature stresses, the shrinkage of hoops, shaft couplings, and the rupture of beams and shafts are also discussed in this chapter on miscellaneous applications of mathematics to the strength and resistance of materials.

The chapter on reinforced concrete discusses concrete and steel compound bars, short columns, beams with symmetrical and unsymmetrical reinforcement, and presents the methods employed in designing reinforced concrete beams.

The combined stresses resulting from compression and flexure, tension and flexure, shear and axial stress, compression and torsion, flexure and torsion, and tension and compression are adequately discussed in a separate chapter. The latter chaoter appears for the first time in the present edition of the work. The final chapter also is a new feature in the latest edition. This chapter deals with the elastic resilience of beams and bars, and ultimate resilience. Stresses due to impact and repeated loads are also discussed. The fact that the book is now in its sixth edition seems sufficient proof of its worth.

Strength of Materials.—By H. E. Murdock. John Wiley & Sons, New York. Cloth; 5x7½ ins.; 308 pp.; illustrated; $2.

This work was written by Mr. Murdock for classroom use by his students of the subject at the University of Illinois. The author attempts to make the principles of the subject clear without full recourse to calculus. In addition to employing the more elementary branches of mathematics wherever practicable, the author makes extensive use of graphical constructions in presenting the various phases of the subject.

The opening chapter discusses the mechanical and physical properties of the ordinary materials of construction. There are two chapters on direct stresses; the first discusses deformations of a simple character with the attendant direct stresses, and the second takes up the determination of stresses in thick and thin cylinders, hoops and spheres, and temperature stresses. There is a very good chapter on the design of various kinds of riveted joints. There are two chapters on beams. The first one takes up a study of the external forces acting on simple and cantilever beams and of bending moment and shear in beams of these types. The second chapter on beams discusses the internal stresses produced by the external forces considered in the preceding chapter. A separate chapter is devoted to a treatment of stress computation in such structures as chimneys, dams, walls, and piers. There is a chapter on graphic integration and also a chapter on the deflection of beams in which the graphical analysis of the problem is utilized. There are two chapters on the elastic curve for beams. The first of these two chapters takes up simple and cantilever beams and beams fixed at both ends, while the second chapter takes up overhanging, fixed and supported, and continuous beams. A following chapter treats of the determination of the elastic curve for beams by the algebraic method. The remaining chapters take up secondary stresses, columns and struts, tension, and the final chapter discusses repeated stresses, resilience, mechanical hysteresis, and impact. The single appendix gives the methods of determining the centroids and moments of inertia of areas.

The presentation of the matter contained in this work is clear and forceful. It is especially good in definition of terms. The matter is well grouped and arranged. Numerous problems are given at the ends of the several chapters. The work should prove very helpful to students and others who have little understanding of or liking for the calculus.

Strength of Materials.—By James E. Boyd. McGraw-Hill Book Co., New York. Cloth, 7x9 ins.; 290 pp.; illustrated; $2.50.

This book, unlike the two preceding, presupposes a knowledge on the part of the student of the Integral Calculus as well as theoretical mechanics, including statics and moments of inertia of plane areas. This work is replete with problems which, as a rule, are given at the end of articles. The problems are designed to emphasize and to test the student's ability to apply the principles stated in the article. Answers to nearly all the problems are given. These numerous problems constitute a very valuable feature of the work.

The scope of the book is fairly well indicated by the chapter headings, which are as follows: Stresses, Stress Beyond the Elastic Limit, Shear, Riveted Joints, Beams, Stresses in Beams, Deflection of Beams, Beams with More Than Two Supports, Shear in Beams, Beams of Special Form, Bending Combined with Tension or Compression, Columns, Column Formulas Used by Engineers, Torsion, Resilience in Bending and Torsion, Center of Gravity, Moment of Inertia, Computation without Integrals, and Repeated Stresses.

The book is well illustrated by the usual notation diagrams, diagrams of tests, and by halftone views of various test specimens which have been tested to destruction. The book is a good one.

A Notable Reference Book for Civil Engineers.

American Civil Engineers' Pocket Book.—John Wiley & Sons, New York. Leather; 4x7 ins.; pp. 1473; illustrated; $5.

To those who know the first edition of this work a review of the second edition need only note the additions and changes. This will be done. The book is, however, of so recent publication and at best can be familiar to so few engineers only, that a review, though it be of a second edition, may well embrace all its contents. These cover the whole field of civil engineering, so that ample opportunity exists for dispute with the authors of the various parts, or with the editorial plan as a whole should one seek an argument. Obviously the first question to which one needs an answer is: What is the intention of the book? Next one wants to know how well that intention has been fulfilled.

The book is named a pocket book. In shape and class it conforms to what custom has agreed to designate as "pocket book" shape and style, though, like many of its companions of the class, it is rather beyond the capacity of all but very large pockets and is a rather cumbersome load for any pocket. In this respect of pocketability however it is as satisfactory as many other "pocket books" for engineers and compared with some it is perfection. As a matter of fact the term pocket book does not now signify a book for the pocket. Aside from form and size, what do engineers understand by a "pocket book"? The majority probably will hold it to be a collection in book form of classified data, rules, formulas, examples, etc., a sort of sublimated engineers' note book. It is true of course that there is no reason why a pocket book must be of this character, and of course also one knows that there are many which are not. The book being considered, is one which is not. This fact has been held as a cause for criticism. Is one so certain that it is? Personally the reviewer prefers as a pocket book for his own use one which is as wholly as possible a reference book for engineering data but this is nothing more than personal preference. Another may prefer for his use a pocket book which is a concise systematic presentation and explanation of the principles and practice of civil engineering. If he does, we believe that he will find it in more nearly perfect form in this book than in any other one book. So much for the intention of the book before us. How has this intention been fulfilled?

The book consists of 15 sections each the product of a single author except in two cases where two authors have worked jointly. The titles of the sections and the names of their authors are: Mathematical Tables, Mansfield Merriman; Surveying, Geodesy, Railroad Location, Charles B. Breed; Steam and Electric Railroads, Walter Loring Webb; Materials of Construction, Rudolph P. Miller; Plain and Reinforced Concrete, Frederick A. Turneaure; Masonry, Foundations, Earthwork, Ira O. Baker; Masonry and Timber Structures, Walter J. Douglas; Steel Structures, Frank P. McKibbin; Hydraulics, Pumping, Water Power, Gardner S. Williams; Water Supply, Sewerage, Irrigation, Allen Hazen; Dams, Aqueducts, Shafts, Tunnels, Alfred Noble and Silas H. Woodard; Mathematics and Mechanics, Edward R. Maurer; Physics, Meteorology, Weights and Measures, Louis A. Fischer; Steam and Electric Engineering, George A. Goodinough and F. Malcolm Farmer; Highways and Streets, Arthur H. Blanchard.

At the conclusion of this schedule is the best place perhaps to note the changes from and the additions to the first edition. The most important additions are the section on Steam and Electric Engineering and the section on Highways and Streets. Other additions are eight pages of new matter to the chapter on Earthwork computations and seven pages of new matter to the section on Steam and Electric Railways. The omissions from the first edition aggregate 45 pages. An entirely new index has been made for the new edition.

Each of the sections scheduled is in intention a condensed treatise on its subject. Naturally the sections exhibit some unevenness of quality. Naturally too one will not always agree with the author's selection of what to include and what to exclude in presenting his subject. With these qualifications and with the statement that it is a condensed treatise on the principles and practice of civil engineering and not a civil engineer's classified note book, the American Civil Engineers' Pocket Book can be heartily commended.

A New British Work on Sewage Disposal.

Sewage Disposal in the United Kingdom.—By Henry Lemmoin-Cannon. St. Bride's Press, Ltd., London, England. Cloth; 6x9 ins.; 320 pp.; illustrated; $1.80.

This new British work on sewage disposal presents a concise review of the present status of the art in the United Kingdom. The subject matter is presented in 44 chapters and 10 appendices. Some of the chapters are very short, some being only one page in length. This style of arrangement of the matter given was adopted by the author to render the various matters discussed easy of reference. The book discusses some topics which one would not expect to find under the title given the book. American readers are likely to assume that the disposal of water carried sewage is meant by the general term sewage disposal. However, the dry system is discussed in some detail in this work. This is due to the fact that many towns in England have retained the dry or conservancy system because they do not feel sure as to what is the best method of treating water carried sewage. The author realizes, however, that is only a question of time until the water carriage system will be generally adopted. Another matter not usually discussed in works on sewage disposal is sewer ventilation, which is here considered in a short but specific chapter. There is also a short chapter on the water carriage sewerage system.

There are four chapters, aggregating ten pages, devoted to a consideration of broad irrigation or sewage farming. The principles underlying this treatment are discussed and the author's observations at eight sewage farms are described. The third chapter on sewage farming discusses the suitability of various soils for this purpose. Methods of applying the sewage to the land and working the land are considered in the fourth chapter.

A short chapter on screening water carried sewage is followed by three chapters on the chemical treatment of sewage. Methods of adding the chemicals are described and various devices for that purpose are illustrated. There are three chapters on plain settling and septic tanks, including a chapter on construction of such tanks. Contact beds are considered in three chapters in which the principles of contact treatment and the construction of beds are discussed, and typical installations are described. Percolating or sprinkling filters are treated in a similar manner. The various kinds of growths on contact beds and filters are discussed.

There are also short chapters on ponding effluents from contact beds and filters, disposal by dilution in seas and estuaries, the pollution of streams and trade wastes in sewage. There are three chapters on sewage disposal systems available for country houses, and isolated public institutions, with illustrative examples. The sterilization of infected excreta is discussed in two short chapters. The disposal and manurial value of sludge thrown down by the various processes previously discussed is considered in two chapters replete with detail. Various proprietary, automatic and other appliances for use in sewage plants are described and illustrated. There are two additional chapters, aggregating about 20 pages, in which the salient features of typical installations are described. The final chapter deals with sewage disposal from troops in the field.

One chapter which deserves special mention is that in which the author enumerates the various points to be kept in mind in designing disposal works. The special fields of applicability of the various processes are stated. The author recommends exhaustive preliminary experiments for the larger works, and discusses the nature of such experiments. Another notable chapter discusses the relative costs of plants and operation for the several systems of disposal described. The appendices all relate to laws regulating the disposal of sewage and the pollution of streams in the United Kingdom. Almost one-third of the book is devoted to this purpose.

The illustrations are well selected but in many cases they are faulty in printing and in reduction. In a few cases the reduction of the original drawing is so great that the lettering in the cuts can be read only with difficulty.

On the whole the book should prove interesting to sewerage engineers, particularly to those to whom it is addressed, in the United Kingdom.

Cyclopedia of Fire Prevention and Insurance.—American School of Correspondence, Chicago. Half leather; 7x9¾ ins.; 4 vol.; 450 pp. each; illustrated; $15.80.

This is a general reference work prepared by architects, engineers, underwriters, and practical insurance men. It covers the subjects of fire and fire losses, fireproof construction, building inspectors, inspectors' reports, private and public fire protection, common and special hazards, chemistry of combustion, underwriters' requirements, fire insurance law, the standard policy, rating, underwriting, brokerage, settlement of losses. The books are chiefly valuable to engineers for the data which they contain relating to causes and the effects of important fires which have occurred in the United States. The sections devoted to fireproof building construction also, give much good general information on types and methods of fireproof construction used in modern building.

Interesting Manila.—By George A. Miller. E C. McCullough & Co., Inc., Manila, P. I. Cloth, 6½x8 ins.; 239 pp.; illustrated; $1.50.

This is the third edition of this book, which has been revised and brought down to date. It is an interesting collection of bits of history, tradition and description, relating mostly to Spanish relics and ruins in the city of Manila. The old walls and Spanish fort, convents and churches, old organs and libraries are sketched in picturesque language. The canals and bridges of the city, something of Filipino industries and a little of the home life of the natives are also touched upon. The book is well illustrated with artistic photographs and quaint sketches.

Mission Furniture; How to Make It. Part III.—Popular Mechanics Co., Chicago. Cloth, 4½ x7 ins.; 120 pp.; illustrated; 50 cts.

This book is one of a series of hand-books on industrial subjects being published by the Popular Mechanics Co. The instructions for making various articles of mission furniture are presented in a simple, concise and comprehensive manner, with tables giving quantities and dimensions of materials needed. Each article is illustrated with a diagram of detail and with a finished view. Directions are given for the manufacture of 55 pieces of furniture, with advice as to kind of material best suited to each, and for appropriate finish

NEWS SECTION

Editorial Comment—Personals—Society Meetings—Trade Notes—Catalog Reviews—Contract News, Embracing Bids Asked, Work Projected, Contracts Let and Contract Prices on All Classes of Civil Engineering Construction Work.

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The Doings of the Week.

Railway construction, as regards the placing of contracts, has made an auspicious beginning of the new year. Several good sized jobs have been put under contract in the past two weeks, and a number of other big pieces of work will come up for letting in the near future. The Minneapolis, St. Paul & Sault Ste. Marie Ry. has awarded the contract on the first of its North Dakota extensions, and will, it is probable, follow this up by placing the work for its other extension in the above state. Even up in New England developments of the past week indicate that there is a possibility of the Grand Trunk resuming work on the extensive construction program that it has outlined for these states. Among the contracts awarded recently are the following: Twohy Bros., Portland, Ore., for betterment work on the line of the North Bank R. R. between Portland and Astoria, Ore., for which about $800,000 is said to have been appropriated; Charles F. King & Co., for grading and masonry work from Yardley to Woodburn, Pa., for 4-tracking for the Philadelphia & Reading Ry.; A. M. Clapton, Elgin, Tex., for widening embankments and cuts for rebuilding roadbed of Missouri, Kansas & Texas Ry. between Waco, Tex., and Smithville; Guthrie & McDougall, St. Paul, Minn., for second track work through the Cascades between Easton and Lester, 15 miles, for the Northern Pacific Ry.; Foley Bros., Welch & Stewart, St. Paul, Minn., for building an 80-mile extension for the Minneapolis, St. Paul & Sault Ste. Marie Ry. from Ambrose, N. Dak., into Montana; W. R. Felker Construction Co., Rogers, Ark., for constructing a 35-mile extension of the Kansas City & Memphis Ry., and a 6-mile extension for the Ozark Land & Lumber Co. s line.

Nothing of importance has developed in the past few days in the way of highway construction coming up for bids. In Illinois the Tice good roads committee, appointed at the last session of the general assembly finished its investigations and agreed upon a bill which will be offered to the new general assembly. The committee recommends a revolutionary change in the Illinois system of caring for roads and bridges; abolition of the present 4,800 separate taxing and administrative units, and a uniform system of state aid through a new highway department. The bill provides that all convicts in state prisons may be used to help construct the roads, and all state automobile license fees shall be payable to the highway commissioner.

About the only good sized drainage job that has come up for letting since our last issue is the work for Wharton County Drainage District No. 1 of El Campo, Tex. This contract calls for the excavation of about 1,750,000 cu. yds. of open ditches; bids will be opened Jan. 21.

An announcement of considerable interest to the steel industry was made last week. This was that the U. S. Steel Corporation had plans well along for the establishment of a new plant at Sandwich, Ont. It is proposed to build a wire mill, rail mill, structural mill and bar mill, and the first cost will be in the neighborhood of $20,000,000. A large contract in connection with the new Corrigan-McKinney steel plant to be erected at Cleveland, O., was awarded last week to Hunkin-Conkey Construction Co., Cleveland, O. This contract calls for the foundation work; it includes pile driving and concrete work and probably amounts to several hundred thousand dollars.

In the way of bridge work the largest contract awarded in the last few days appears to be the one secured by William P. Seaver, 322 Fifth Ave., New York City. This contract calls for the improvement of the Manhattan Plaza of the Manhattan Bridge, New York City; the contract price was $817,380.

About the largest Government contract on which bids have been opened recently appears to be the work at St. Mary's Canal. MacArthur Bros. Co., Fisher Bldg., Chicago, Ill., at $288,140, was the low bidder on this contract. It calls for excavating lock pit for the fourth lock.

Several large contracts have been awarded since our last issue by the New York State Superintendent of Public Works, at Albany. Terminal Contract 15, was let to Albert M. Banker, Gloversville, N. Y., at $557,104; Contract C, C. & S. Canal, was let to Larkin & Sangster, Lockport, N. Y., at $1,187,047; Contract E., C. & S. Canal, was let to Cleveland & Sons Co., Brockport, N. Y., at $347,216.10.

The Chicago City Council on Jan. 2 authorized the purchase of surveying instruments, engineering supplies, etc., for use during 1913, as follows: Board of Local Improvements, Ed. J. Glackin, Secretary, $900; Department of Maps and Plats, $1,000; Department of Bridges and Viaducts, $200. L. E. McGann, Commissioner of Public Works; Subway and Harbor Commission, $150. Date of purchase has not been announced.

The Chicago City Council on Jan. 2 authorized the purchase of one 200,000-lb. testing machine, automatic and autographic; one transverse testing machine; one combustion furnace and rheostat for use of testing division, Bureau of Engineering, $5,800. L. E. McGann, Commissioner of Public Works. Date of letting contract has not been announced.

Railway Construction in 1912.

According to statistics collected by the Railway Age Gazette 2,977 miles of new line were completed in 1912; these figures do not include the mileage of second, third and fourth main tracks or sidetrack completed during the last year. This mileage, as pointed out by the above mentioned paper, is not a true indication of the present activity in railway construction, for there is undoubtedly more work under way at present than at any time since 1907. The completed mileage for 1912 was less than that for any year since 1897 when 2,109 miles were built. In 1911 3,060 miles were completed and in the previous year 4,122 miles were built, while the average for the 19 years previous to last year was 3,842 miles. It will thus be seen that the record of 1912 was nearly 1,000 miles under the average. However, over 2,500 miles of new line were under construction last year. Work on most of this was started in the spring and it is not included in the total given above, which relates only to completed line. In addition 1,214 miles of second, third, fourth and sixth track were completed in 1912, and 1,150 miles were under construction. In the new line the mileage was divided between 41 states, North Dakota leading with 347 miles; Texas, which has been first for the three perious years, is second with 336 miles, and Oklahoma third with 242 miles. Of the new line in North Dakota, the Great Northern had 202 miles and the Minneapolis & Sault Ste. Marie had 131 miles. Of the other states reporting more than 100 miles of completed line, Florida had 182 miles; Georgia, 153; Montana, 130; Kentucky, 119; Washington, 105; Arizona, 105; and Idaho, 105. In Canada the mileage of new lines completed in the past year was 2,232, as compared with 1,898 miles in 1911. The Grand Trunk Pacific completed 609 miles, which the National Transcontinental completed 361. The Canadian Pacific completed 404 miles on its western lines. In Mexico a total of 212 miles of new lines was completed in 1912 as compared with 351 miles in 1911. Assuming an average cost of $50,000 per mile for new line, and second and third track and using the above figures as a basis, work costing nearly $400,000,000 was completed or under construction last year by the railways in the United States. This approximate of $400,000,000 is made up as follows:

Completed main line	$149,850,000
Main line under construction	125,000,000
1st, 2d, 3d tracks completed	60,700,000
1st, 2d, 3d tracks under construction	57,500,000
Total	$393,050,000

Logarithms.

As a labor saving device for engineers the meek and humble logarithm ranks very high. It is therefore of interest to note that the Royal Society of Edinburgh is making preparations for celebrating in 1914 the 300th anniversary of the discovery of this "simplifier" of calculations. In 1614 the "Descriptio" of Sir John Napier was published. It was not a "first seller" but the scientific world ranks it next to Newton's "Principio" as the most important work in the history of mathematical science. In it Napier elucidated the principles on which logarithms are founded. The natural logarithms came later, and the decimal logarithms were the result of the study by Henry Briggs who published the first book containing tables of them in 1617.

Engineer—Art Collector

As an example of what an engineer can do in other lines of work, it may be stated that at a sale last month of a collection of paintings the property of a follower of the transit and level, the neat sum of $1,243,200 was realized. The collection was owned by Henri Rouart, an engineer by profession, a painter by prefernce, and probably a rich man by inheritance. The collection consisted chiefly of works of 19th century artists, many of the paintings being those of his contemporaries purchased at a time when the public was indifferent. As a result his heirs now profit by his discrimination, realizing probably many hundred times the sum which he invested in these masters.

PERSONAL

Mr. C. R. Brawner has been appointed city engineer of Eagle Rock, Cal.

Colonel George W. Goethals accompanied President Taft and his party on their return from Panama, and is now in Washington.

Mr. J. Paul Jones, civil engineer of San Francisco, has joined the force of Judd & Co., auditors and efficiency engineers, New York City.

Mr. Duncan W. Peck of Syracuse, N. Y., has been reappointed to the position of state superintendent of public works of New York state.

Mr. George P. Winn has been appointed city engineer of Nashua, N. H., succeeding Erwin O. Hathaway. Mr. Patrick J. Dolan was elected superintendent of streets.

Mr. W. P. Near has been appointed city engineer for St. Catharines, Ont. Mr. Near for some time has been resident engineer of the main drainage works at Toronto.

Mr. D. E. McComb, formerly superintendent of sewers of the District of Columbia, has been appointed engineer of bridges, succeeding the late Thomas C. J. Baily, Jr.

Mr. A. L. Wilcox has been appointed superintendent in full charge of construction of the new hydro-electric power plant, being built by the Cerro de Pasco Mining Co., at Aroya, Peru.

Mr. Frank A. Creighton has resigned as city engineer of Prince Albert, Sask., which position he has held since July, 1907. It is believed that Mr. Creighton intends to locate in Winnipeg for private practice.

Mr. M. C. Kennedy has been elected president of the Cumberland Valley Railroad, succeeding Mr. James McCrea, who recently resigned. Mr. Samuel Rea was elected vice-president, succeeding Mr. Kennedy.

Mr. W. D. Faucette has been appointed chief engineer of the Seaboard Air Line, and Mr. W. L. Seddon has been made assistant to the president. Mr. Seddon will have general supervision of the engineering department.

Mr. M. H. Dance, assistant engineer of construction of the Illinois Central R. R., and engineer in charge of the new yards at Centralia, Ill., was killed Dec. 19, while riding in a motor car which was struck by a locomotive.

William J. Vaughn, professor of mathematics and astronomy at Vanderbilt University, died at his home in Nashville, Tenn., Dec. 16, aged 78. Professor Vaughn founded the school of engineering at the University of Alabama in 1881.

Mr. A. C. Janni, consulting engineer of St. Louis, Mo., will deliver an address Jan. 13, before the bridge and structural section of the Western Society of Engineers. His topic will be: "Arch Design by the Elipse of Elasticity."

Mr. E. G. Connette is the new head of the Buffalo street railroad system. Mr. Connette was at one time vice-president and general manager of the Syracuse Rapid Transit Railway Co. Later he went to Worcester, Mass., to take charge of the Consolidated street railway system at that place. He next became transportation engineer for the Public Service Commission of New York City.

Mr. A. T. Dice has been made one of the vice-presidents of the Reading system, and will also continue his duties as general manager. Mr. Charles H. Ewing, superintendent of the Atlantic City division, has been made general superintendent, a newly created position. Mr. F. M. Falch, superintendent of the Columbia division, will succeed Mr. Ewing. Mr. John F. Auch, freight traffic manager, was also made one of the vice-presidents.

Mr. Frank Stewart, surveyor, of Hammond, Ind., was killed, and his assistant, William Pryor, seriously injured in an explosion in the Tecumseh mine near Bicknell, Ind. The men had gone into the mine to make a survey when the explosion occurred.

Mr. George Gill has resigned as superintendent of the Great Lakes Construction Co.'s contract at Lyons, N. Y., on the New York state barge canal. Mr. James Cook of Buffalo, chief engineer of the company, will take personal charge of the Lyons contract.

Mr. O. E. Osthoff, vice-president and chief engineer of H. M. Byllesby & Co., consulting engineers, 175 Jackson Blvd., Chicago, announces the appointment of Mr. W. R. Thompson, formerly assistant chief engineer, as manager of engineering and construction.

Mr. Walter H. Fulweiler, engineer in the Research Department of the United Gas Improvement Co., Philadelphia, on Dec. 27 delivered an illustrated lecture on the "Manufacture of Refined Water Gas Tar" before the graduate students in highway engineering at Columbia University.

Roswell Miller, chairman of the board of directors of the Chicago, Milwaukee & St. Paul R. R., died suddenly of apoplexy at his home in New York Jan. 3. Mr. Miller was 70 years old and was born and educated at Harford, Pa. His first railroad service was with the Cairo & Vincennes R. R. He rose rapidly to the position of superintendent and in 1882 became second vice-president and treasurer of the Chicago & Western Indiana. In 1883 he became assistant to the general manager of the Chicago, Milwaukee & St. Paul. In 1885 he was appointed general manager and three years later became president and general manager. In 1899 he was made chairman of the board of directors and head of the New York office.

Civil Service Examinations.

The United States Civil Service Commission announces the following examinations:

Alloy Chemist, Bureau of Mines, $2,400 to $3,000 per annum, Jan. 27.

Junior Computer, Bureau of Mines, $900 to $1,320 per annum, Jan. 22-23.

Junior Chemist, Bureau of Mines, $1,020 to $1,380 per annum, Jan. 22-23.

INDUSTRIAL

A contract for the Raymond concrete piles, in the foundation of a new apartment building on Walton Place, Chicago, has been awarded to the Raymond Concrete Pile Co. of New York and Chicago, William Ernest Walker, Architect.

The Epping-Carpenter Co., manufacturers of pumping machinery of Pittsburg, Pa., announce that they have opened a branch office in Chicago, Ill., at 728 Monadnock building. This office will be in charge of R. E. Burke, formerly of the International Steam Pump Co.

CATALOGUES

Steam Hoisting Engines.—Paper, 9x11 ins., 76 pp. The John F. Byers Machine Co., Ravenna, O.

This is a very complete catalogue of steam hoisting engines, derrick cars, derrick irons, hand powers, and blocks and sheaves for contractors and quarrymen. Details of the equipment are illustrated and specifications with tables of dimensions, etc., are given.

Cranes & Hoists.—Paper, 8½x11 ins., 4 pp. New Jersey Foundry & Machine Co., 90 West St., New York City.

This pamphlet contains a number of illustrations of the cranes, tracks, trolleys and hoists showing general views and details of these overhead carrying devices.

Floating Dry Dock.—Paper, 6¾x5¾ ins., 24 pp. John A. Roebling's Sons Co.

A most interesting article describing and illustrating the voyage of the dry dock Dewey from Sparrows Point, Md., where it was built, to the Philippine Islands, a journey of 13,089 miles, requiring more than six months to make. The article is by W. J. Aylward and is reprinted from Scribner's Magazine.

Kno-Fur Expanded Metal Lath.—Paper, 3¼x6 ins., 3 pp. Northwestern Expanded Metal Co., Chicago, Ill.

Kno-Fur Lath is an expanded metal lath which has a furring as an integral part of the lath and takes the place of the ordinary furring strips which are used to bring the metal lath away from wood studs so that the plaster may be formed with a perfect key without coming in contact with the wood, thus preventing cracking.

Standard Mixers.—Paper, 3½x6 ins., 12 pp. The Standard Scale & Supply Co., 1345 Wabash Ave., Chicago, Ill.

This pamphlet illustrates and describes the Standard Low Charging Concrete Mixer operated with steam or gasoline engines. There are also included in the book illustrations of the Eclipse Stone or Block Machine, the "Perfect" machine, the Standard hoisting equipment and Standard wheelbarrows and carts.

Power Plant Equipment.—Paper, 8x11 ins., 20 pp. Schutte & Koerting Co., Philadelphia, Pa.

Power house equipment included in this catalog includes injectors, condensors, valves, spray nozzles, primers, automatic eductors, blowers, chimney ventilators, etc. The catalog is illustrated with halftones and line drawings, and brief descriptions are given.

Wire, Glass and Steel Sash and Doors.—Paper, 8½x11 ins., 8 pp. Mesker Bros. Iron Co., St. Louis, Mo.

This catalog contains illustrations and diagrams showing the construction of fireproof and solid section steel sash and plate steel door frames or jambs, and metal covered wood core doors. Descriptions are given.

Water Supplies for Automatic Sprinklers.—Paper, 5x7¼ ins., 64 pp. Rusling Co., 43 Cortlandt St., New York City.

This catalog deals with tanks, towers, reservoirs for automatic sprinkler systems and waterworks plants, and shows the different methods of installing gravity and pressure tanks with their supports and enclosures, on top of building walls or columns; also tanks with towers supported on piers constructed in the ground, all as water supply for automatic sprinkler systems.

Kingsford Boilers.—Paper, 5½x8½ ins., 12 pp. Kingsford Foundry & Machine Works, Oswego, N. Y.

This catalog illustrates and describes a water tube boiler of the horizontal type with steel construction throughout, horizontal drums, elliptical hand holes, and vertical baffles.

Another catalog, (5½x8½ ins., 12 pp.), illustrates and describes the Advance Water Tube Boiler. A pamphlet issued by the same company (8½x11¼ ins., 4 pp.), gives a description of the details of construction with illustrations of a double flow centrifugal pump for low and medium lifts up to 150 ft. Air pressure turbine pumps for lifts up to 500 ft. are dealt with in another pamphlet. A loose leaf circular gives line drawings of the Scotch Water Back Boiler with the different types of furnaces.

Cone Batch Mixing Machines.—Paper, 8¼x10¾ ins., 20 pp. The Lansing Co., Lansing, Mich.

This catalogue deals with Northwestern Concrete Mixing Machinery and gives a very complete illustrated description of the construction and operation of the Northwestern Cone Batch Mixing Machine. A continuous mixer with a proportioning hopper is also described and illustrated. Mixers for hand power are shown; also gasoline engines of various sizes.

Other pamphlets issued by this company give illustrations and information on concrete carts, mixer parts, wheelbarrows and concrete tools.

Piles & Poles of Concrete.—Paper. 5½x 8½ ins., 24 pp. Robert A. Cummings, Pittsburgh, Pa.

This book contains extracts from papers read before the National Association of Cement Users, and the Association of Iron and Steel Electrical Engineers by Mr. Cummings. It is well illustrated. The contents deal with concrete piles of the "pre-cast" type and the "cast-in-place" type; also with reinforced concrete poles. A test of a concrete column reinforced by the coming system is shown and described in an enclosed leaf.

Hayward Digging Equipment.—Paper, 9x 12 ins., 94 pp. The Hayward Co., 50 Church St., New York City.

A general catalog (No. 740) shows the standard types of Hayward automatic buckets with a general description of three leading types, and in addition many illustrations of Hayward buckets and digging machines in actual operation. For further details of these buckets and other machines, the company has issued a number of smaller pamphlets as follows:

Pamphlets No. 564 (7¼x9 ins.), Clam Shell Buckets; No. 566, Buckets for Caisson and Well Digging; No. 567, Counterweight Hoisting Drum; No. 569, Buckets for Canal Excavation; No. 571, Orange Peel and Clam Shell Buckets; No. 572, Dwarf Buckets for Sinking Pipes, Wells, etc.; No. 573, The Three Blade Orange Peel Bucket; No. 576, Drag Scraper Bucket; No. 578, Plantation or Drainage Work; No. 580, Buckets for Handling Concrete Materials; No. 585, Buckets for Handling Coal. A number of pamphlets (6x9 ins.), including pamphlets Nos. 587 to 596, give additional information and illustrations covering the various classes of work in which these buckets have been engaged.

Condensed Catalogs of Mechanical Equipment.—Cloth, 6x9½ ins., 376 pp. The American Society of Mechanical Engineers, 29 W. 39th St., New York City.

This is a collection of catalog data concerning the products of 285 manufacturers of mechanical equipment. Its purpose is to present facts which are likely to be required for preliminary reference by engineers and executive heads of industrial plants. The second annual volume under date of 1912 contains a great deal of new matter and is much more comprehensive than the first volume. The book has a classified index of mechanical equipment and an index to condensed catalogs.

RAILWAYS

Alabama.

The Gulf, Florida & Alabama Ry. contemplates the extension of its line from the present northern terminus at Local, Ala., to a connection with the Southern R. R. at Pine Hill, Ala., a distance of 70 miles north. The work will comprise about 20 miles of heavy steam shovel work, the remainder consisting of grading that will be handled by teams and station men. Included in this 70 miles will be a steel bridge over the Alabama River, involving about 600 ft. of river spans, included in which will be a draw span, with 1,200 to 1,500 ft. of approaching trestle. Plans are now in preparation in the office of G. A. Berry, Vice-President and General Manager, Pensacola, Fla., for the Alabama River bridge. It is also expected to invite bids shortly from grading contractors for the roadbed work.

There is a movement under way at Gadsden, Ala., to connect that city with Centre by an interurban electric line. Right of way and subscriptions for stock are now being secured, and if proper encouragement is received the road may be constructed during 1913. Loui. Hart, Gadsden, Ala., is reported to be interested.

Arkansas.

⊙The W. R. Felker Construction Co., Rogers, Ark., has the contract for constructing a 35-mile extension of the Kansas City & Memphis Ry., east Huntsville. The construction company also has been awarded the contract for a 6-mile extension from Monte Ne, Ark., to War Eagle of the Ozark Land & Timber Co.'s line. G. D. Locke, Rogers, Ark., is President of the Kansas City & Memphis Ry., and also of the Ozark Land & Lumber Co.

Capitalists of Little Rock, Ark., are reported to have under consideration the construction of a railroad from Salem, Ark., to a connection with some trunk line. As proposed the road will be built from West Plains, Mo., to Salem, on to Melbourne, Izard County, and then to Guion, a point on the White River branch. This line would open up a fine timber, fruit and agricultural belt, and it is thought that the people along the proposed route will aid liberally in the building of the road.

California.

A project is under consideration for securing the engineers to make surveys, etc., for a power development to utilize the waste waters of the North Fork water sheds, and for the construction of an electric railway from Madera to Yosemite Valley. J. S. Harker, Coarsegold, Cal., is the promoter.

The Angel's Flight Ry. Co. has filed with the State Railroad Commission of California an amended application for authority to purchase the Angel's Flight Ry. in Los Angeles. The company seeks to issue $100,000 in bonds and to use $40,000 of the proceeds in payment for the purchase of the property and the remaining $60,000 for such extensions of the railway as may be decided upon.

The Ocean Shore R. R., A. Williams, General Manager, San Francisco, has made surveys and has secured the right of way for a 10-mile extension from Tunitas to the heart of a rich timber belt. The company will apply shortly to the Railroad Commission for permission to issue $400,000 for the immediate construction of the extension. A further extension from Tunitas to Smith Cove, 28 miles, is also under consideration.

Colorado.

Plans for the reorganization of the Denver, Laramie & Northwestern R. R. are practically completed. It is understood that work will be started shortly on the completion of the extension from Greeley north to Severence, Colo. It is stated that New York interests will pay off the company's indebtedness and build the extension. Attorneys are now preparing an application to the District Court for authority to issue $575,000 in receivers' certificates with which to cancel the debt. Of this sum $125,000 will be applied on construction work. Holders of $1,200,000 of the company's first mortgage bonds have consented to this plan and consent of holders of $300,000 remainder is being sought. J. L. Terry, Continental Bldg., Denver, Colo., is Superintendent.

It is reported that practically all details for remodeling the Union depot at Denver have been agreed upon, and it is probable that construction work will be started in a few months. Plans are being considered for issuing $1,500,000 of bonds for carrying out the work, which will call for larger depot facilities, offices for all of the roads and the raising of the tracks, together with baggage subways. Among the roads interested are the Denver & Rio Grande and the Union Pacific.

Advices from Denver state that prospects are good for the expenditure this year of something like $30,000,000 in Colorado and vicinity by various railroads. Among the improvements making up this total are the following: Denver, Northwestern & Pacific Ry.-James Peak tunnel (prospective). $4,000,000; Steamboat Springs extension (contract awarded), $2,500,000; Denver & Rio Grande-Detour line around Soldier Summit (contract awarded), $3,500,000; electrifying Soldier Summit detour, $1,500,000; standardizing Marshall Pass division, $2,500,000; double-tracking in Arkansas Valley, $1,000,000. Santa Fe System: 60-mile cut-off through Baca County, $3,000,000; rebuilding Denver to Pueblo line, $1,000,000; new terminals and depot, South Denver, $450,000; new depot, Colorado Springs, $250,000. The Burlington: Construction Hudson-Greeley branch, $1,400,000; shops and roundhouses, $200,000. Union Pacific: Denver-Fort Morgan cut-off, $4,000,000; Wamsutter, Wyo., Craig extension (prospective). $2,000,000. Laramie, Hatins, Peak & Pacific: Relaying 100 miles heavy steel, $400,000; additional improvements, $200,000.

Florida.

Citizens of Pensacola, Fla., on Dec. 30 voted to issue $400,000 of bonds. Of the series, $300,000 is for municipal wharves, and $100,000 for a belt railroad to connect the wharves. Plans have not been matured, but it is probable that the wharves will be erected at foot of Cevallos St. L. E. Thornton is City Engineer of Pensacola.

Illinois.

The Gulf Lines Connecting R. R. of Illinois has started construction work at Golconda on its projected line. The company proposes the building of 150 miles of railway in Southern Illinois, connecting with the Thebes bridge across the Mississippi River and the bridge across the Ohio River at Metropolis, on which work is now being started. As its name implies, this company will form connections for several trunk lines. Robert A. Craig, Box 354, Golconda, Ill., is Chief Engineer.

The Illinois Central R. R. is reported to be planning to start work early this year on a new roundhouse and shops at East St. Louis, which will involve the expenditure of about $500,000.

It is rumored that the Illinois Central Ry. is contemplating the construction of a branch line from Freeport, Ill., to Beloit, Wis. No definite information in regard to the project is as yet available. A. S. Baldwin, Chicago, Ill., is Chief Engineer of the company.

The Alton, St. Louis & Cairo R. R. Co., which proposes a railroad from Alton to Cairo, Ill., is stated to control 108 miles of graded roadbed. The object of the company is to give St. Louis connection to several lines of railway which now terminate at the Mississippi River on the proposed line. It is planned to build the road in 50-mile sections, the first section to be constructed being that from East St. Louis to East Ste. Genevieve. The company has temporary offices in the Navarre Bldg., St. Louis, Mo.

The Caseyville Ry. Co. has been incorporated with a capital stock of $50,000 and principal offices at Belleville and proposes to con-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

struct a line from a point at or near the Caseyville-Engmona road, in St. Clair County, to East St. Louis.

The Springfield & Central Illinois Traction Co., mentioned in our last issue, proposes to build an electric railway from East St. Louis to Terre Haute, Ind., serving a territory approximately midway between the B. & O. S. W. on the south and the Vandalia on the north. It also proposes a line from Springfield, Ill., south through all of the county seats, to Duquoin, in Perry County. The aggregate length of the two lines is 316 miles. The company has been organized for two years, has completed its surveys, has secured its franchises and the majority of its rights of way. It is stated to have been financed by foreign capital and preparations are now said to be in progress for letting contracts. Isaac A. Smith, Security Bldg., St. Louis, Mo., is President.

Indiana.

Surveys have been made by engineers of the Erie R. R. for a 2½-mile spur from a point on the line near Bolivar to North Manchester.

The Grand Trunk R. R. has been investigating traffic possibilities with a view to the construction of a 15-mile branch from Edwardsburg to Adamsville and thence to Elkhart.

The Southern Interurban Construction Co. of Terre Haute, Ind., has been incorporated with a capital stock of $25,000, and proposes to construct interurban lines and do a general contracting business. J. W. Brown, Terre Haute, L. F. Rawlins and S. B. Boggs are the incorporators. It is possible that this company has been organized to complete the Terre Haute & Meriom Traction Co., projecting a 32-mile line.

Iowa.

Business men of Burlington, Ia., interested in heavy shipments of merchandise, have organized the Burlington Belt Line R. R. Co. and propose to build a line from Burlington through Carthage, Ill., to Beardstown, Ill., where it will tap the Baltimore & Ohio. The line will form junctions with the Santa Fe at Lomax, the Toledo & Peoria at Ferris, and the Wabash at Carthage. The new road will cross the Mississippi River over the Burlington R. R. bridge at Burlington. It is stated that the money to build the road is all in hand and work on the construction will begin as soon as the city of Burlington grants the use of land for terminals.

Kansas.

Citizens of Newton, Kans., have raised a bond subscription of $20,000 as an inducement for the Arkansas Valley Interurban Ry. Co., O. A. Boyle, General Manager, Wichita, Kans., to extend its line two miles north from Newton to Bethel College.

Kentucky.

The Mountain Central Ry. Co., John C. M. Day, Vice President and General Manager, Winchester, Ky., has made some investigations looking to the extension of its road. It is hardly likely, however, that anything will be done this year.

Louisiana.

City Council of Lafayette, La., has ordered an election for Feb. 4 to take the sense of taxpayers on the question of levying a 1½-mill tax for 10 years in favor of the Louisiana Power & Traction Co., of which E. E. Shackford, Lafayette, is local manager.

The New Orleans, Mobile & Chicago R. R., B. V. Wright, Chief Engineer, Laurel, Miss., is reported to have completed 25 miles of its line by which it will secure an entrance to New Orleans. This 25-mile section extends from Wiggins, Miss., in the direction of Ashley, La. Surveys have also been completed, it is said, from Beaumont, Miss., to Ashley, La.

Maine.

Stockholders of the Maine Central R. R., B. T. Wheeler, Chief Engineer, Portland, Me., will hold a meeting on Jan. 8 to act on a proposal to increase the stock from $15,000,000 to $25,000,000.

About $70,000 is reported to have been raised for the projected Skowhegan-Athens R. R. project. It is stated that when $30,000 more is assured construction work will be started. R. L. Marston, Skowhegan, Me., is interested.

Maryland.

According to information received from Hagerstown, Md., the Norfolk & Western Ry. Co. has purchased the Scott farm in the southern suburbs of the city and will use the land as the site for its new yards, including roundhouse, turntable, etc.

Massachusetts.

The directors of the New York Central Lines have authorized the construction by the Boston & Albany R. R. of a $400,000 union station at Pittsfield. It is understood that bids will be asked in the near future so that work can be started in the spring. It will be situated directly east of the present station, and eight tracks will enter it.

There are some prospects at present that the Grand Trunk Ry. will yet carry out its extensive construction program in New England. It is understood that if the Grand Trunk will give up the proposed alliance with the New York, New Haven & Hartford and allied lines, the money will be forthcoming whereby the whole Grand Trunk construction policy in the New England states, including the entrance to Boston, can be resumed and completed. It is believed that arrangements already have been practically completed with Boston capitalists for furnishing the money.

The State Commission has issued orders extending to Oct. 1, 1913, the time for the construction by the Berkshire St. Ry. Co.'s (Pittsfield, Mass.), extension of track in North Adams and Pittsfield and to Jan. 1, 1914, the time for construction of the proposed extension to the top of Greylock. There is also an extension to Jan. 1, 1914, of the proposed connection between the present street railway in Huntington and some point on existing railway in Berkshire.

Michigan.

The Detroit, Bay City & Western R. R., Wm. N. Boyd, Chief Engineer, Bay City, Mich., is considering the extension of its line from Akron, northward to Sebewaring.

The Michigan State Railroad Commission has been asked to approve plans for the improvement of the Grand Trunk terminal facilities at Detroit, Mich. The Detroit Terminal Ry., which is the property of the Grand Trunk and the New York Central Systems, would be extended according to the report. H. R. Safford, Montreal, Que., is Chief Engineer of the Grand Trunk.

Surveys are under way for the projected extension of the Benton Harbor-St. Joe Railway & Light Co.'s electric railway from Coloma to Hartford. It is probable that construction work will be started in the early spring, and the portion to Watervliet will be completed by May 1. This section will cost $30,000; and the cost of the entire construction from Coloma to Hartford will approximate $150,000. H. C. Mason, Benton Harbor, Mich., is General Manager.

Minnesota.

⊙Whitney Bros., Superior, Wis., have been awarded a $30,000 contract by the Duluth & Iron Range R. R. for building a concrete retaining wall along the shore bank of Dock No. 1 in Two Harbors, Minn.

City Council of International Falls, Minn., has decided to call a special election on the question of granting an exclusive street car franchise. R. C. Fraser is City Clerk.

The Great Northern Ry. has been making surveys in the vicinity of Avon, and is reported to be planning extensive betterment work this spring between St. Cloud and Evansville.

Engineers have been working for some time trying to locate a suitable route for the proposed spur of the Duluth & Iron Range R. R. to the Consolidate Vermilion Co. mines at Mud Creek. It is hoped to have the line constructed this winter. Wayne A. Clark, Duluth; Minn., is Chief Engineer.

Missouri.

The Moberly, Huntsville & Randolph Springs R. R. Co. has been incorporated with a capital stock of $500,000 and proposes the construction of a railroad between Moberly, Huntsville and Randolph Springs. The incorporators include W. T. Dameron, G. P. Dameron and William Evans, of Huntsville, Mo.

Plans for the reorganization of the Kansas City, Mexico & Orient Ry. Co. are understood to be progressing rapidly. Advices from Kansas City quote Frederick Hurdle of London, representing English capitalists interested in the same, as stating that a program of construction which ultimately will give the road 1,116 miles of main lines, will be started within two months.

Montana.

Northern Pacific engineers have started surveys, it is said, for the extension of the line terminating at Bridger, Mont., to the Bear Creek coalfields. W. L. Darling, St. Paul, Minn., is Chief Engineer.

Surveys have been completed for an extension of the Great Falls & Teton County R. R., now under construction from Power to Chouteau, from the latter place to Bynum. This is a Great Northern Ry. proejct.

The Great Northern Ry. has filed resolutions with the Secretary of State at Helena providing for the construction of the Bainville-Northwest line, 69 miles long. According to the resolutions the line will begin at a point on the company's present located line, in the northwest half of section 25, township 35 north, range 53 east, Montana principal meridian, and extend thence westerly to a point on the west branch of the Poplar River, about 12 miles south of the international boundary line, a distance of about 67 miles, all in Valley County.

New York.

The Public Service Commission for the first district will hold public hearings at Room 305, No. 154 Nassau St., New York City, Jan. 14, on the form of contracts containing terms and conditions to govern joint construction by the city and by the Interborough Rapid Transit Co. and by the New York Municipal Ry. Corp., of certain rapid transit railroads embraced in the Dual System, and operation by those companies respectively of the portions of said lines allotted to each in conjunction with existing rapid transit roads now operated by each.

North Dakota.

⊙Foley, Welch & Stewart, St. Paul, Minn., have been awarded the contract for constructing the Ambrose extension of the Minneapolis, St. Paul & Sault Ste. Marie Ry. This extension extends from Ambrose, N. Dak., to a point in Montana, and is about 81 miles long.

Ohio.

The Cleveland, Painesville & Eastern R. R. Co., Willoughby, O., has been granted permission to issue $62,000 of 40-year refunding and extension bonds. The money is to be spent on a $15,000 power house at Painesville, an $18,000 substation at Willoughby and other improvements at Painesville, Mentor and other points.

W. M. Duncan, Cleveland, O., Receiver for the Wheeling & Lake Erie R. R., has been granted permission to issue $2,425,000 in receivers' certificates for the purchase of new equipment. He is instructed to purchase 1,300 freight cars and 20 locomotives, the remainder to be used to maintain bridges and the company's docks at Huron, O.

The Baltimore & Ohio R. R. Co. has purchased land in the eastern part of Huntington, O., for the purpose of constructing new yards at that place.

It is rumored that the Pennsylvania railroad is contemplating the purchase of the Detroit, Toledo & Ironton Ry. and that the route of the road into Ironton will be changed so that the tracks will go around and come down through the city instead of out Railroad St.

The Ohio Public Utilities Commission, Columbus, O., has granted permission to the Ohio River & Northern Railroad Co., a new corporation mentioned in the Nov. 13 issue of Engineering & Contracting, to issue $1,000,000 in capital stock and $2,500,000 in bonds. The money is to be used for the construction of an extension of the Erie Railroad system from Youngstown, O., into Pittsburgh, thus invading new territory so far as the Erie is concerned. The Erie already competes for Pittsburgh business though a close-working arrangement with the Pittsburgh and Lake Erie, entered into almost two years ago. The distance via the Pittsburgh and Lake Erie is 69 miles, and the new line, if constructed, would parallel that. Officials of the Erie, however, stated that they had no knowledge of either the building of a new line by the company or what interests were behind the Ohio River & Northern.

Oklahoma.

Suit has been filed by Dorset Carter of Purcell, Okla., to condemn a segregated right of way from Ardmore to Waurika, a distance of 60 miles west, for a proposed line of railroad between Ardmore and Waurika.

Forfeit of $7,000 is reported to have been put up by John Ringling, of Ringling Bros. Circus, 221 Institute Pl., Chicago, Ill., that he will start construction work by Jan. 30 on a new railroad connecting Ardmore with Lawton.

An agreement has been reached with William Kenefick, Kansas City, Mo., promoter of the Missouri, Oklahoma & Gulf R. R., whereby the city of Allen, Okla., will give a bonus of $60,000 for the extension of the line and the establishment of the terminals at that place.

Oregon.

⊙Twohy Bros., Portland, Ore., have been awarded a contract for betterment work on the line of the North Bank R. R., between Portland and Astoria. The work calls for eliminating curves, widening fills, etc. An appropriation of $800,000 is said to have been set aside by the company for the improvement.

Advices from Lakeview, Ore., state that H. J. Groendyke, Chief Engineer of the Oregon Eastern Railroad, is working in the vicinity of Wagontire Mountain engaged in restaking the survey for the proposed line. It is reported that the survey will come up Malheur canyon across Low desert to Albert Lake, through Valley Falls and up Crooked Creek to Goose Lake valley and thence to Alturas, Modoc County, California. The road will connect with the line surveyed down Pit River canyon.

Good progress is being made by promoters of the Pacific Interior Railroad, mentioned in the Dec. 11 issue of Engineering & Contracting, in securing subscriptions and right of way. Arrangements for 27 miles of right of way between Grants Pass, Ore., and Love's Station have been made. W. P. Quinlan, Grants Pass, Ore., is one of the incorporators of the company.

The fact that engineers of the Spokane, Portland & Seattle Ry. (North Bank Line) are resetting ballast stakes and setting change-of-line stakes eliminating bad curves causes it to be believed that preparations are being made for the reconstruction of the beach line. While considerable improvement has already been made in the line from Astoria to Portland, fast time is impossible on the run from Seaside to Astoria and there seems no doubt but that considerable changes are in prospect. The line discussed to connect with the Tillamook branch of the Southern Pacific is now surveyed completely from Buxton, on that road, to Astoria, passing through Seaside. For many miles the surveys follow closely the line of the Necanicum River and the fact that on the slopes of the Necanicum watershed are to be found the finest virgin timber yet untouched in Oregon leads Seaside people to place more than a cursory belief in the coming of the new road. R. Budd, Portland, Ore., is Chief Engineer.

Pennsylvania.

⊙Charles F. King & Co. have been awarded a contract by the Philadelpha & Reading Ry. for grading and masonry work from Yardley to Woodburn, five miles. The work is to be done in connection with the 4-tracking of the New York branch.

A certificate has been filed with the Secretary of State, Harrisburg, Pa., by the Philadelphia & Western Ry. Co., Upper Derby, Pa., increasing their stock from $4,000,000 to $6,000,000 and taking up $4,000,000 of 4 per cent bonds.

A decree has been entered in the United States District Court at Pittsburgh authorizing Special Master William H. McClung to sell the Wabash Pittsburgh Terminal R. R. under foreclosure on a date to be named by the master. The lowest bid to be accepted is placed at $6,000,000.

The Lehigh & New England R. R. has filed notice of an increase of capital stock from $3,000,000 to $7,500,000.

The Sunbury & Susquehanna Ry. Co., Sunbury, Pa., is reported to be planning to extend its traction lines into Snyder County, and from Northumberland to Lewisburg, Milton, Watsontown and eventually to Williamsport.

The Ephrata & Lebanon Ry. Co. of Lebanon, Pa., has sold the entire issue of bonds, valued at $250,000, to J. A. Vandergrift, representing New York financial interests. The purchaser has contracts to finish the road in eight months from Jan. 1. Of the 23 miles of road to be built, 7½ miles have been completed, and $135,000 has already been expended. The purchaser's plants are said to call for the erection of a power plant at Lebanon, the enlarging of the Ephrata plant and the full equipment of the road.

The financial interests back of the Ohio Valley Scenic Route (Tri-State Ry. & Electric Co., of which J. G. White & Co., 43 Exchange Pl., New York City, are operating managers), are understood to have completed arrangements for the expenditure of $2,000,000 on the construction of a power plant on Beaver Creek at the Island Run mines, one mile north of Smith's Ferry, Pa.

South Carolina.

The citizens of Woodruff, Reidville and Cross Anchor have united in a movement to induce the Greenville, Spartanburg & Anderson Ry. Co., Greenville, S. C., to build an interurban line from the main line near Greer to Woodruff, passing through Reidville and from Woodruff to Cross Anchor and thence to Union.

South Dakota.

It is believed that the Chicago, Milwaukee & Puget Sound Ry. will extend the line from Faith, Meade County, S. Dak., to Rapid City or some other city in the Black Hills and eventually northwest connecting with the coast line at some point in Montana.

Tennessee.

The Nashville Traction Co., chartered recently with a capital stock of $500,000, has applied to the City Council of Nashville, Tenn., for a franchise to construct a 30-mile street car system. The company also proposes to build interurban lines and power plants, the total expenditure proposed being about $4,000,000. Among those interested are Walter O. Parmer, Nashville; George M. Hendrie, Russell A. Alger, Henry B. Ledyard and W. H. Muir, of Detroit, Mich.

Judge W. K. McAlister and H. B. Chamberlain, both of Nashville, Tenn., have been appointed receivers for the Tennessee Central R. R., a 250-mile line running from Hopkinsville, Ky., to Harriman, Texas. The following statement regarding the receivership has been given out: "The owners of the Tennessee Central have formulated plans for the reorganization and refinancing of its properties and in order to carry out their plans it is found desirable to have a general mortgage foreclosed and a receiver appointed as the preliminary step in the reorganization. The entire proceeding is friendly and has been instituted with the consent and approval of the owners of a large majority of the stock and bonds. Definite plans for the future of this property will be announced later."

Texas.

⊙The Missouri, Kansas & Texas Ry. is preparing to rebuild the roadbed between Waco, Tex., and Smithville, and it is reported that a contract has been let to A. M. Clopton, Elgin, Tex., for widening embankments and cuts and constructing ditches, etc. The contractor will probably start work at once.

Surveys are to be started this month for the projected interurban line from Denison to Durant, Okla., promoted by J. R. Cullinane and associates of St. Louis, Mo. The Feild Engineering Co., Denison, Tex., has the contract for the survev work.

The Bryan & College Interurban Ry. Co. has made surveys and has received the capital for the construction of 35 miles of line from Bryan to Stone City and thence down the Brazos River. Construction contracts will be received after January. W. S. Hunter, Crowley, La., is President; W. S. White, Crowley, La., is Chief Engineer, and O. E. Gammill, Bryan, Tex., is General Manager.

T. F. MacMiller, Chicago, Ill., who purchased the Gainesville, Whitesboro & Sherman Ry. Co. in the latter part of December, is said to be planning the completion of the electric line to Sherman, a distance of 30 miles. The Gainesville, Whitesboro & Sherman Ry. has its headquarters at Gainesville, Tex.; it proposes the construction of 39 miles of interurban, and grading on some of this line has been completed.

The Hidalgo Construction Co., San Benito, Tex., is now building 22 miles of line for the San Benito & Rio Grande Valley Ry., E. E. McLellan, Chief Engineer, San Benito. Of the 22 miles, 5 miles extend south of Mission, Tex., and 17 miles north. The construction company is also building 28 miles of line from Santa Maria to La Lomito for the above railway.

Construction work is reported to have been started by Col. R. A. Love, San Antonio, on his projected railroad from San Antonio to Fredericksburg.

Final arrangements are being completed for the ballasting work on the Missouri, Kansas & Texas Ry. between Denison and Whitesboro, Tex., a distance of 20 miles. Rock will probably be used. Other work contemplated on the Katy is the ballasting of the Texas lines from Hillsboro south to Houston. Burnt clay or gumbo will be used for ballasting this division. A. M. Acheson, Dallas, Tex., is Chief Engineer.

It has been announced by N. H. Ragland, General Manager of the Paris & Mount Pleasant R. R., Paris, Tex., that as soon as the present tracklaying on the extension from Bogata to Mount Pleasant is completed and trains put in operation it is the intention of the directors to extend the road northwest from Paris to Atoka and the Lehigh coal fields and to connect with lines running to Oklahoma City. It is also likely that the road would be extended south from Mount Pleasant to a connection with the Missouri, Kansas and Texas, either at Daingerfield or Pittsburgh. It is expected to have trains operating from Paris to Mount Pleasant not later than March 1.

It has zeen announced that the Asherton & Gulf Railroad, operating an independent line from Asherton Junction on the International & Great Northern R. R. to Asherton, a distance of 32 miles, will extend from the former point to Aransas Pass on the Gulf Coast, 140 miles; also from Asherton west to Eagle Pass, about 50 miles. Bonuses in land and money are being raised by the towns along the route to aid in the fulfillment of the project. It is stated that aside from these bonuses the necessary financial arrangements for construction have been made. The route from Asherton Junction to Aransas Pass will follow the valley of the Nueces River for nearly the entire distance. Asher Richardson, Asherton. Tex., is President and General Manager of the road.

Bids have been received by the Gulf, Colorado & Santa Fe Ry. for the construction of the proposed Union Depot and General Office Building at Galveston, Tex., from the following firms: James Stewart & Co., St. Louis, Mo.; the American Construction Co., Houston; Westlake Construction Co., St. Louis, Mo.; Texas Building Co., Fort Worth; Selden-Breck Construction Co., St. Louis, Mo., and the Fred A. Jones Building Co., Dallas. Bids are being considered on 6 and 8-story structures and it is expected that the contract will be let at once.

Utah.

Grading work has been started in Salt Lake City on the projected interurban line of the Salt Lake & Utah R. R., from Salt Lake to Payson, Utah. Track material for a 35-mile line is already being received. This line, as previously noted in these columns, is being built by A. J. Orem & Co., Salt Lake City.

Vermont.

The Brattleboro & Wilmington R. R. Co., projecting a 24 mile line from Wilmington to Brattleboro, Vt., has made preliminary surveys, and probably will let construction contracts next summer. Chief Engineer has not been selected as yet. J. P. Kellas, Malone, N. Y., is interested.

West Virginia.

The Welsh Colony R. R. Co. of West Virginia has been chartered with a capital stock of $5,000 and headquarters at Buckhannon, W. Va., and proposes to build a railroad from Avondale, Randolph County, to Pendro, Webster County. The incorporators include Matthew Perkins, Samuel Davies, John P. Williams, Davil S. Thomas, Shenandoah, Pa.

Washington.

City Commissioners of Tacoma are considering advisability of embodying a request for $85,000 for a municipal street car line from 11th St. to the Milwaukee docks, in a proposed bond issue to be voted on this spring. W. C. Raleigh is City Engineer of Tacoma.

According to the report of the committee appointed at Colfax, Wash., to secure right of way for the proposed new railroad from that city down Union and Alkali flats and to secure data on the approximate tonnage available, good progress is being made in the matter.

Extension work will be resumed in the spring on the line of the Toppenish, Fort Simcoe & Western R. R. and the line will be built to White Swan, a distance of 20 miles west of Toppenish, Wash. A connection will be made near the latter city with the Northern Pacific.

Wisconsin.

About 50,000 tons of rails have been stored at Superior by the Great Northern Ry. for use on extensions to be built this spring.

It is probable that the Green Bay & Western R. R., a 250-mile line, will soon be purchased by Newman Erb and associates. An option expiring March 1, 1913, on 18,000 of the 25,000 shares of stock, has been secured.

Canada.

⊙Gurthrie, McDougall & Co., Portland, Ore., who were recently awarded the contract for the construction of an extension to the Victoria, Vancouver & Eastern R. R. & Navigation Co.'s line, have transferred Supt. McDonald from the work on the Great Northern at Wrencoe, Ida., to Coalmont, B. C., to take charge of the new contract. A sub-contract for a portion of the extension, which is 50 miles long, has been let to Werdenhoff & Jacobson, St. Paul, Minn.

The Windsor, Essex & Lake Shore Rapid Ry. Co., Kingsville, Ont., is considering extending its traction line to London, Ont.

Property owners at Lakeview Heights, a suburb of Calgary, Alberta, have made a proposition to the City Council to build and equip a car line to run to their property from the Tuxedo branch of the city lines.

Citizens of Calgary, Alberta, have passed by-laws providing funds for additional equipment and extensions to the municipal street railway. J. T. Childs is City Engineer.

The Canada & Gulf Terminal R. R. projects a 223-mile line from Ste. Flavie on the Intercolonial R. R. to Gaspe Bay at the end of Gaspe Peninsula, where a port open all the year round is to be created. The road is already in operation from Ste. Flavie to a point beyond Matane, and construction, it is said, is being rushed towards the new terminal. M. J. O'Brien, a railroad contractor of Montreal, Que., is President of the Canada & Gulf Terminal R. R.

Preliminary announcements state that the Canadian Pacific Ry., Canadian Northern Ry. and the Grand Trunk Pacific Ry. will spend an aggregate of approximately $41,000,000 this year for new construction work. The companies will build about 2,700 miles of additional trackage. Of this total of new lines to be constructed throughout the prairie provinces and British Columbia, the Canadian Pacific alone will build between 1,000 and 1,100 miles of additional trackage and the balance will be the work of the Canadian Northern and Grand Trunk Pacific. One of the chief undertakings of the Canadian Pacific will be the double-tracking of the main line between Brandon and Calgary.

ROADS AND STREETS

Alabama.

✣Bids will be received until Jan. 16 by City of Birmingham, it is reported, for the construction of 25,000 sq. yds. of granite block pavement in certain alleys. W. G. Kirkpatrick is City Engineer.

⊙The Board of Revenue and Road Commissioners, Mobile, Ala., has awarded the contract for hauling material for surfacing the St. Stephens road to A. E. Perry of Montgomery, Ala., for $17,615. Other bidders were: S. L. Christy, $18,600; Seabry & Pringle, $19,645; W. J. Bradford, $24,748; Jett Bros. Contracting Co., $25,625.

Arkansas.

A mass meeting was recently held in Little Rock, Ark., at which it was decided to undertake the construction of a macadam highway for the use of the general public from Little Rock to Texarkana. A committee of which George B. Rose of Little Rock is chairman was appointed to draft the proposed bill for submission to the legislature, creating an improvement district for the building of the proposed road.

The District Commissioners, at the office of Marshall & Coffman, Southern Trust Bldg., Little Rock, Ark., recently received bids for the paving of Arch St., south from 18th to 28th St. The bidders on the work were: Memphis Asphalt & Paving Co., Southern Bitulithic Co., Nashville, Tenn.; Rackliffe, Gibson & Dillingham of St. Joe, Mo.; Levy & Levy of Muskogee, Okla.; E. J. Wetterstraum of Memphis, Tenn., and M. D. L. Cook, Shelby & Bateman and the Arkansas Paving Co. The bids ranged in the neighborhood of $60,000. Either asphalt or wooden blocks will be used. Ford & McCrea, Little Rock, are Engineers.

Arizona.

✣Bids will be received until 5 p. m., Jan. 13, by Frank Thomas, City Recorder, Phoenix, riz., for the construction of about 25,000 sq. yds. of bitulithic pavement and nearly 10,000 lin. ft. of curb and gutter. F. N. Holmquist is City Engineer.

California.

⊙The Board of Supervisors, Los Angeles, Calif., has awarded the contract for the improvement of Alhambra Ave., from the East City Limits to Mission Road, to the Fairchild-Gilmore-Whilton Co. of that city at $55,664. The company's itemized bid was: $0.19 per sq. ft. for asphalt paving, $0.30 per lin. ft. for cement curb, $1 per lin. ft. for cement curb for concrete wall, $0.30 per sq. ft. for vitrified block gutter, $0.40 per sq. ft. for granite block gutter, $75 each for two catch basins, and $2,075 for storm drains and appurtenances.

⊙The city of Fresno, Calif., has awarded the contract for the improvement of Blackstone St., from Belmont to Englewood Sts., to Thompson Bros. of that city at ⅞ ct. per sq. ft. for grading, $0.12½ for paving, $0.12 for cement gutter, $0.30 for cement curb, and $150 for corrugated iron culverts.

⊙The city of San Diego, Calif., has awarded the contract for improving Washington, Fifth and Hawk Sts. at $26,755, $5,442 and $4,755, respectively, to Ford & Stout of Los Angeles.

At a recent conference held in Marysville, Yuba County, Calif., Supervisor Morrison agreed to appropriate $10,000 from the road fund of the district to build a new road from Marysville to Hammonton. The dredging companies operating in the vicinity of Hammonton will also appropriate $10,000 toward the road.

The Board of Trustees of Chula Vista, Calif., has ordered National Ave. paved; also E St. and Third Ave., at an estimated cost of $25,000.

Colorado.

According to a reported announcement of C. P. Allen, Denver, chairman of the state highways of Colorado, over $88,000 will be spent for roads which will have their terminal in Mesa County. These roads will cross the divide, meeting the transcontinental highways on the east and west.

Florida.

✣Bids will be received until Jan. 14, it is reported, by F. Robert Wilson, Town Clerk, Brooksville, Fla., for about 10,000 sq. yds. of vitrified brick paving.

⊙The City Council of Oscala, Fla., has awarded the contract for the construction of four additional blocks of paving to the Alabama Paving Co. The Kelly-Springfield Road Roller Co., Springfield, O., secured the contract for furnishing a five-ton road roller for future use on the streets.

Engineers Jenkins & Woodham have completed the survey of the county roads from Kissimmee to Whittier and have submitted their report to the County Commissioners, Kissimmee, Fla. It is proposed to complete a system of good roads over the entire county.

Georgia.

⊙The City Council of Atlanta, Ga., has awarded the contract for tearing out the bituminous pavement on the North Boulevard and repaving the same with bitulthic. The contract price is $1.75 per sq. yd.

The Bibb County Road Board, Macon, Ga., desires to spend $75,000 a year on improving the public highways of the county, and will ask the Bibb representatives in the legislature to introduce a bill to have one-fourth of one per cent of the tax receipts set aside each year for this work.

Idaho.

✣City Clerk Nancy E. Robertson of Boise, Ida., is reported to be asking bids on 76,575 sq. yds. of pavement.

The City Council of Pocatello, Ida., will shortly award a contract for the paving of Seventh Ave., from Center to the academy, also residents along Arthur and First Aves. are asking that the next paving district be created in their sections of the city.

Illinois.

✣Bids will be received until 11 a. m., Jan. 16, by Department of Public Works, L. E. McGann, Commissioner, Chicago, Ill., for furnishing and delivering washed gravel for use of the Bureau of Engineering during the term ending December 31. Plans and specifications are on file at the office of the Department, 406 City Hall.

✣Bids will be received until 11 a. m., Jan. 13, by Department of Public Works, L. E. McGann, Commissioner, Chicago, Ill., for furnishing and delivering Portland and natural cement required during the year. The quantities and points of delivery are as follows: 3500 Fillmore St., 300 bbls. natural cement, 100 bbls. Portland cement; 69th and Peoria Sts., 300 bbls. and 100 bbls.; 2662 Lawrence Ave., 100 bbls. and 25 bbls.; Southport Ave. and Seminary Pl., 100 bbls. and 25 bbls. A certified check or cash amounting to $100 must be filed with each bid.

✣Bids will be received until 11 a. m., Jan. 15, by Department of Public Works, L. E. McGann, Commissioner, Chicago, Ill., for furnishing and delivering torpedo sand, as required by the Bureau of Engineering, during the year 1913. No quantity is guaranteed. During 1912 500 cu. yds. were received by car and 2,350 cu. yds. by team. Separate prices will be received for team delivery inside the district bounded by Lawrence Ave., 48th Ave., 75th St. and Lake Michigan, and for team delivery within the city limits outside of that district; also for delivery f. o. b. cars on any industrial track in Chicago, according to plans and specifications on file in the office of the Department of Public Works of said city, room 406 City Hall.

✣Bids will be received until 11 a. m., Jan. 13, by Department of Public Works, L. E. McGann, Commissioner, Chicago, Ill., for furnishing Portland cement as required during the year 1913 by the Bureau of Engineering. The approximate quantities used in 1912 were 7,000 barrels. A certified check for $200 must be filed with each bid.

✣Bids will be received until 11 a. m., Jan. 16, by Department of Public Works, L. E. McGann, Commissioner, Chicago, Ill., for furnishing and delivering natural stone for use in the Bureau of Engineering during the term ending Dec. 31, 1913. Specifications are on file at the office of the Department, 406 City Hall.

✣Bids will be received until 11 a. m., Jan. 16, by Department of Public Works, L. E. McGann, Commissioner, Chicago, Ill., for furnishing and delivering crushed stone for use of the Bureau of Engineering during the term ending Dec. 31, 1913. A certified check for $200 must be filed with each bid. Plans and specifications are on file at the office of the Department, 406 City Hall.

The Chicago City Council on January 2, 1913, appropriated the sum of $44,000 for the purpose of machines for digging ditches and constructing country roads on the outskirts of the city. L. E. McGann, Commissioner of Public Works. Date of letting has not been announced.

The Chicago City Council on Jan. 2nd appropriated $21,000 for providing a new asphalt plant with the necessary equipment, etc., for the manufacture of new asphalt and utilization of old asphalt. Date of purchase not given.

The Chicago City Council on Jan. 2, 1913, authorized the Bureau of Streets to construct concrete sidewalks at various street intersections, estimated cost $15,000. L. E. McGann, Commissioner of Public Works. Date of letting contract has not been announced.

The Chicago City Council on January 2, 1913, appropriated $54,000 to cover cost of furnishing and erecting 12,000 street signs, the same to be purchased not previous to July 1, 1913, and installed at various street intersections.

The Chicago City Council on Jan. 2nd authorized the purchase of street cleaning tools and machinery, consisting of shovels, brooms, street boxes, street sprinklers, flushing machines, street sweepers, boulevard scrapers, etc., by the Bureau of Streets; appropriation, $24,060. L. E. McGann, Commissioner of Public Works. Date of purchase has not been announced.

The Chicago City Council on Jan. 2, 1913, authorized the purchase of poles, globes, ornamental posts, etc., as follows: House of Correction, John W. Whitman, Supt., $250; Dept. of Electricity, Roy Palmer, City Electrician, $10,000. Date of letting contract has not been announced.

The Board of Local Improvements of Freeport, Ill., has made recommendations to the City Council for about five miles of street work and several miles of sewers. Charles Hepner is City Engineer. C. J. Dittmar is Mayor.

The Tice good roads committee, appointed by the last session of the general assembly, on Dec. 31 finished its investigations and agreed upon a bill which will be offered to the new general assembly. The committee recommends a revolutionary change in the Illinois system of caring for roads and bridges; abolition of the present 4,800 separate taxing and administrative units, and a uniform system of state aid, through a new highway department. Forty feet will be the standard width of all public highways, subject to topographical conditions. All convicts in state prisons may be used to help construct the roads, and all state automobile license fees shall be payable to the highway commissioner.

The Board of Local Improvements of Ottawa, Ill., has passed resolutions calling for the paving of the west side district by special taxation. City Engineer Geo. L. Farnsworth has estimated the cost of the improvement at $281,000.

A petition has been presented to the Board of Local Improvements of Bloomington, Ill., providing for the paving of East Washington St., from East Front St. to the Illinois Central tracks.

The Cook County Commissioners, Chicago, Ill., recently met at Jefferson Park with the organized farmers and discussed plans for the proposed expenditure of $150,000 for good roads throughout the county outside of the city limits. It is probable that the roads in Maine, Niles, Leyden, Northfield, Norwood and New Trier Townships will be improved.

An ordinance has been submitted to the City Council of Carlinsville, Ill., providing for the paving of High St., from East Main to the L. C. & W. railroad.

Public hearings on the proposed paving of 25th St., from Ninth to 18th Ave., and 20th St., from Seventh to 18th Ave., were held by the Board of Local Improvements of Rock Island, Ill., on Jan. 4 and 6, respectively. The former improvement contemplates the laying of brick for a 36-ft. street up the hill to 13th Ave., and a 30-ft. street from there to the limits, the total cost to be $33,543. The latter improvement includes a 30-ft. asphalt street from 7th to 11th Aves., and brick from there out to 18th, the total cost being estimated at $35,602.

The Board of Local Improvements of Kewanee, Ill., proposes to pave McKinley Ave. next year with either asphaltic concrete or bitulithic with a concrete base. O. D. Peterson is City Clerk.

The Board of Local Improvements of Peoria, Ill., has decided to resurface the present pavement on Fayette St., from Adams to Knoxville Ave., with asphalt.

The City Council of Paxton, Ill., has passed an ordinance providing brick pavement for East State St. north to the Lake Erie tracks and thence north to Pine St. and then east with a macadam pavement.

Iowa.

✣Bids will be received until 5 p. m., Jan. 13, by Charles J. Duff, City Clerk, Council Bluffs, Ia., for the construction fo a combination curb and gutter 920 ft. in length on portions of Bryant St. and Fourth Ave.

Resolutions are before the City Council of Grundy Center, Ia., for the paving of two business blocks of Main St., the street around the court house, and the street to the depot. Part of the paving will be 60 ft. wide, part 40 ft. wide and part 30 ft. wide. Several kinds of material are under consideration.

The Iowa Good Roads Association has asked the legislature to submit the proposition of issuing bonds in the sum of $25,000,000 for good roads throughout the state to the voters at an early date. It is proposed to levy a one-mill tax and lay a network of paved highways, 5,000 miles in all, connecting every county seat in the state. A permanent state highway commission with adequate power to provide for the system of permanent roads is recommended.

Petitions have been filed with the City Council of Burlington, Ia., asking that Denmark St. be paved with concrete from Main to River Sts., and that River St. be improved with the same material from Denmark to Acres St.

The Board of Marshall County Supervisors, Marshalltown, Ia., contemplates purchasing a tractor engine for road work while in session at their January session.

Kansas.

The officials of Junction City, Kans., W. Van Buck, City Engineer, contemplate paving the Main street for its entire length.

Maryland.

Mayor Preston of Baltimore, Md., has appointed a committee to select the material to be laid on the Reisterstown road, which is to be paved by the State Roads Commission.

Michigan.

⊙The County Board of Road Commissioners, Escanaba, Mich., has awarded the contract for the building of the five miles of road from Beaver to the new settlement of St. Nicholas to Bichler Bros., at $5,740.

The City Council of Bay City, Mich., contemplates paving Wenona Ave. south of Midland St.

Plans will be prepared by City Engineer John Irwin of Mt. Clemens, Mich., for the construction of 20,000 sq. yds. of pavement at an estimated cost of $42,000. Bids will be received about March 1 on all kinds of pave- and concrete curb, asphalt, pitch and cement filler and 6,000 cu. yds. of excavation.

Minnesota.

Property owners on Second St., Faribault, Minn., have petitioned the City Council for the paving of that street. It is probable that creosoted wod blocks will be used.

The budget ordinance making appropriations for the support of the city government of St. Paul, Minn., recently signed by Mayor Keller, includes a provision for additional paving equipment to the extent of $25,000.

New Hampshire.

Mayor William H. Barry of Nashua, N. H., has recommended to the City Council an extra appropriation of $20,000 annually for five years for permanent road improvement.

New Jersey.

⊙The Board of Freeholders, Freehold, N. J., has awarded the contract for the building of the third section of the Holmdel-Red Bank gravel road, a little more than a mile in length, to the Monmouth Contracting Co. of Red Bank, N. J., at $6,661.

State Road Commissioner Col. Edwin A. Stevens, Trenton, N. J., has submitted his report on New Jersey road work for the fiscal year, accompanied with plans for the present year and recommendation for legislation to make the state road problem more of a success.

New York.

✣Bids will be received until 11 a. m., Jan. 14, by Patrick Jones, Supt. of School Supplies, Park Ave. and 59th St., Manhattan, New York City, for furnishing and delivering gasolene motor trucks to the Board of Education of the city of New York.

✣Bids will be received until 2 p. m., Jan. 15, by Quartermaster, Fort Totten, N. Y., for constructing cement walks, macadam roads, etc.

⊙Following low bids were received at the Borough Hall, Long Island City, N. Y., for street work: For paving with (a permanent pavement) asphalt block on a concrete foundation, together with all work incidental thereto, in Radde St., from Payntar Ave. to Webster Ave., First Ward: Hastings Paving Co., $9,434. For regulating, grading the sidewalk spaces, curbing and laying sidewalks (where not already laid to grade and in good condition) and all work incidental thereto, in Jackson Ave., from Junction Ave. to 54th St., Second Ward: Frank J. Clancy, $17,447. For regulating, grading, curbing, recurbing, flagging and reflagging with bluestone and paving with (permanent pavement) asphalt blocks on a concrete foundation, together with work incidental thereto, in the Boulevard, from Webster Ave. to Washington Ave., First Ward: Hastings Paving Co., $8,926 For regulating and paving with improved granite blocks (permanent pavement) on a concrete foundation, together with all work incidental thereto, in Cypress Ave., from Myrtle Ave. to Cooper St., Second Ward: Frank J. Clancy, $44,670. For regulating, grading and paving with (a permanent pavement) asphalt blocks on a concrete foundation, together with all work incidental thereto, in Prospect St., from Payntar Ave. to Beebee Ave., First Ward: Hastings Paving Co., $6,575. For furnishing and delivering to the Bureau of Highway three ten gross ton steam road rollers: Kelly Springfield Road Roller Co.

Plans are being prepared for the construction of about 44,000 sq. yds. of pavement in Utica, N. Y., at an estimated cost of $53,000. The work will include bituminous bound macadam, gravel or crushed stone or concrete foundation, asphalt filler, 20,000 cu. yds. of excavation, and no curbing. The work is in charge of the superintendent of parks, 41 Martin Bldg., city.

The Board of Contract and Supply of Syracuse, N. Y., on Dec. 30 received the following bids for the paving of North Clinton St., from near Spencer St. to West Division St., and in West and East Divisions Sts., between North State St.; also for paving South Beech St., from East Water St. to Westcott St.: North Clinton and West and East Division Sts.—F. J. Baker, sandstone block, $28,072; vitrified block, $20,872; asphalt, $20,272. Warner-Quinlan Asphalt Co., sandstone block, $27,169.40; vitrified brick, $20,149.40; asphalt, $19,369.40. G. B. Dickinson, sandstone, $27,964.70; vitrified block, $20,626.70; asphalt, $20,146.70. C. T. Hookway, sandstone block, $26,519; vitrified brick or block, $20,819. Same pavement with the ordinary combinations—F. J. Baker, sandstone block and brick, $22,672; sandstone and asphalt, $22,222. Warner-Quinlan Co., sandstone and brick, $21,904.40; sandstone and asphalt, $21,319.40. G. B. Dickinson, sandstone and brick, $22,465.70; sandstone and asphalt, $22,096.70. C. T. Hookway, sandstone and brick, $22,244. South Beech St.—F. J. Baker, sandstone, $66,489.50; vitrified block, $49,287.50; asphalt, five years, $46,467.50; ten years, $47,172.70. G. B. Dickinson, sandstone, $66,418; vitrified block, $49,178; asphalt, five years, $46,678; ten years, $47,172.50. Warner-Quinlan Co., sandstone, $68,117.70; vitrified block, $50,069.70; asphalt, five years, $47,249.70; ten years, $47,954.70. C. T. Hookway, sandstone, $61,336; vitrified brick or block, $47,941; macadam, bitulithic binder, $35,956; macadam, water bound, $36,197.

Ohio.

⊙Kelly Bros., of Portsmouth, O., have been awarded the contract by the city of Pikesville, Ky., for the construction of 90,000 sq. yds. of brick pavement at approximately $100,000. Portsmouth brick will be used.

⊙John L. West of Uhrichsville, O., has been awarded the contract by that city, H. O. Snyder, City Clerk, for grading, curbing, draining and paving Trenton Ave., at $21,463. Paul R. Murray is City Engineer. Bids were opened Dec. 27.

The Board of Cuyahoga County Commissioners, Cleveland, O., rejected the one bid received on Dec. 28, for the improvement of Gardner Road from East Lake Road to Lake Erie in Nottingham and Euclid Townships, as being over the engineer's estimate. J. F. Goldenbogen is Clerk.

The City Council of Steubenville, O., has been petitioned by property owners on McDowell Ave., from Market St. to Ridge Ave., for the paving of that street. Plans and specifications will be prepared by City Engineer John N. Leech.

The City Council of Akron, O., has passed an ordinance providing for the issuance of bonds in the sum of $49,850 for the making of repairs to certain streets.

The City Council of Cleveland, O., has decided to grade, drain, curb and pave Perkins Ave. N. E., from E. 35th St. to the east line of E. 37th St. R. E. Collins is City Clerk.

The City Council of Cleveland, O., has decided to grade, drain, curb and pave Herschel Ct. S. W., from West 5th St. to West 7th St.

The City Council of Cleveland, O., has decided to grade, drain, curb and pave Western Ave. N. W., from W. 100th St. to W. 106th St.

The City Council of Cleveland, O., has decided to grade, drain, curb and pave Bristol Ave. S. E., from E. 79th St. to E. 81st St. Charles W. Lapp, President of Council.

The County Commissioners, New Philadelphia, O., have instructed County Engineer Stingel to prepare a preliminary survey over a proposed roadway leading through Mineral City, from Canal Dover to the Stark County line.

The City Council of Canton, O., has passed a resolution providing for the paving of Garfield Ave., from Navarre St. to the southern terminus of the street.

The City Council of Canton, O., has adopted a resolution declaring it necessary to re-pave West Tuscarawas St., from the square to Harrison Ave., and providing that bids be received on vitrified paving block, creosote block, sheet asphalt and Medina stone. City Engineer Phil Weber has estimated that it would cost $115,512 for sheet asphalt or Medina stone, and $80,000 if brick were used.

Oklahoma.

The City Council of McAlester, Okla., has rejected the two bids received recently for street paving in the Second Ward because they were above the engineer's estimate. McEachin & McEachin were low at $7,808.

The City Commission of Tulsa, Okla., has called an election for Jan. 20 for the purpose of voting on the issuance of bonds in the sum of $175,000 for a city hall, convention hall and market combined, additional park sites and the beginning of a boulevard system.

Oregon.

⊙The street committee of the City Council, Portland Ore., has awarded the following contracts for street improvements: Farragut St. district—Grading and concrete curbs and walks, Elwood Wiles, $15,655. Lombard St., from Patton to Swinton—Grading and concrete curbs and walks, Elwood Wiles, $3,966. Boise St., from East 8th to East 9th—Grading and concrete curbs and walks, Stevens & White, $543. Center St., from East 8th to East 9th—Grading and concrete curbs and walks, Stevens & White, $479. East 56th St., from Hawthorne Ave. to East Lincoln St.—Gravel bitulithic, Warren Construction Co., $10,566. East 3d St., from East Burnside to East Davis—Bitulithic redress, Warren Construction Co., $3,603.

The Board of Trade of Montavilla (P. O. Portland), Ore., advocates the laying of a hard-surface pavement on East Glisan St., between East 60th St. and East 82d St. The paving improvements contemplated in this district will necessitate an expenditure of approximately $100,000.

Pennsylvania.

Definite plans have not been prepared for the proposed construction of brick pavement during the year to cost about $25,000 in the borough of Chambersburg, Pa. R. M. Huber is Borough Engineer.

South Carolina.

The City Council of Columbia, S. C., has not decided upon the proposed construction of about 35 blocks of streets during the year. A report recommending the work has been submitted by City Engineer John McNeal.

Tennessee.

The Board of Cheatham County Commissioners, Ashland City, Tenn., plan to commence work early in the spring on the construction of good roads for which bonds to the amount of $100,000 were recently voted Hugh Dozier is a member of the Board.

Texas.

⊙The contracts recently awarded by the city of Houston, Tex., F. L. Dormant, City Engineer, for which bids were opened on Dec. 16, calls for creosoted wood block paving to be done by the Creosoted Wood Block Paving Co. of New Orleans, La., amounting to $75,000, and Hassam paving by Ockander Bros., of Waco, Tex., at $19,000.

Plans and specifications for the construction of a system of macadam roads in Grimes County are being prepared. This county recently voted a $125,000 good roads bond issue. Anderson is the county seat.

The citizens of Greenville, Tex., recently voted bonds to the amount of $75,000 for paving additional city streets. The City Council contemplates expending about $225,000 for paving work during the coming year.

The City Council of San Angelo, Tex., has instructed City Engineer J. J. Goodfellow to ask for bids for the paving of approximately 40,000 sq. yds. of residence streets.

Engineers W. H. Crossland and C. H. Craig of the Good Roads Bureau, Washington, D. C., have prepared maps and profiles of the 10-mile stretch of road between Temple, Tex., and Belton, Tex. The Commissioners' Court at Belton approved surveys, maps and profiles for this road and it is intended to commence construction work at once.

The City Council of Denison, Tex., has passed an ordinance providing for the creation of an improvement district of Austin Ave., from Chestnut to Woodard Sts. It is the intention of the Council to pave this street with brick at an early date. Bids will be asked within a few weeks.

The citizens of Greenville, Tex., have voted bonds to the amount of $75,000 for the paving of additional streets. The Council contemplates expending about $225,000 for paving work during the coming year.

The $150,000 road bond issue for Mexia precinct, Mexia, Tex., has been sold and it is expected the contracts will be let for the crushed rock roads in the near future. Groesbeck is the county seat.

✣ indicates work now open for bids. ⊙ indicates a contract let recently

At a recent good roads meeting at the court house in Kerrville, Tex., a committee was appointed to prepare and present a petition to the Commissioners' Court for a bond issue.

West Virginia.

✣Bids will be received until 7 p. m., Jan. 10, by Charles B. Miller, Town Recorder, Warwood, W. Va., for the grading and macadamizing of Main St. from 23rd St. to the northerly corporation line, a distance of approximately 3,100 lin. ft. Plans and specifications are now on file with the Town Recorder. All bids must be accompanied with a certified check for $200, made payable without recourse to the Town of Warwood, W. Va.

Washington.

Survey of that portion of the Davenport-Harrington road, on which the permanent highway money of 1913 will be expended, has been completed by County Engineer J. L. Thayer and Deputy G. G. Harvey of Lincoln County, Wash. The sum of $36,000 is available for this work and it is proposed to let contracts about March 1. Davenport is the county seat.

⊙The Union Contracting Co. has been awarded the contract by the Board of Public Works of Seattle, Wash., for the grading and curbing of east ½ of 36th Ave W. et al. at $6,342.

⊙The County Commissioners, North Yakima, Wash., have awarded the contract for the construction of 4,000 ft. of highway to Eschbeach-Bruce Co. at $4,000.

Canada.

The municipality of Victoria, B. C., proposes street paving for the year amounting to about $48,500.

A by-law providing $350,000 bonds for street work in South Saanich, B. C., is being drafted. The proposed work includes East Saanich Road from city limits to boundary between North and South Saanich, 12.60 miles; Cedar Hill Road, from city limits to fork of roads in Section 55, Victoria district, 1.90 miles; Burnside Road from Washington Ave. to Harriet Road.

BRIDGES

California.

⊙The Board of Glenn County Supervisors, Willows, Calif., has awarded the contracts for the construction of bridges over Sugar and Walker Creeks to R. A. Mann at $1,500 and $1,600, respectively.

⊙The Glenn County Board of Supervisors, Willows, Calif., has awarded the contracts for the construction of two bridges, one over Sugar Creek and the other over Walker Creek, to R. A. Mann at $1,500 and $1,600, respectively.

Florida.

⊙The Engineering Construction Co., Jacksonville, Fla., has been awarded the contract for the construction of the concrete bridge over Oyster Creek in New Augustine, Fla. The contract price was $1,195, and the structure will be of concrete.

Plans are being prepared by engineers of the Gulf, Florida & Alabama Ry. Co. for the construction of a steel bridge over the Alabama River in connection with the extension proposed from Local, Ala., to Pine Hill, Ala. The structure will include 600 ft. of river spans, one of which will be a draw span and 200 to 1,500 ft. of trestle approach. G. A. Berry, Pensacola, Fla., is Vice President and General Manager of the railroad.

Illinois.

⊙The contract for the construction of a steel highway bridge in Cooperstown township, Brown County, Ill., and Woodstock township, Schuyler County, Ill., has been let to E. E. Brick, Springfield, Ill., at $4,890. The structure will be 147 ft. long with 16-ft. roadway and will rest on old stone foundations, the abutments being capped with concrete. Bids were opened by Isaac Lewis, County Clerk, Rushville, Ill., Dec. 28.

⊙L. E. McGann, Commissioner of Public Works, Chicago, Ill., has awarded to the Great Lakes Dredge and Dock Co., 104 S. Michigan Ave., Chicago, the contract for constructing the pile protection of the 92d St. bridge over the Calumet River. The contract price was $7,000. Bids were opened Dec. 16 and the contract was let Dec. 31.

⊙L. E. McGann, Commissioner of Public Works, Chicago, Ill., has awarded to the Kettler-Elliott Erection Co., 32 N. Clark St., Chicago, Ill., the contract for furnishing labor and material necessary to construct the superstructure of the double bascule bridge over the Chicgao River at Chicago Ave., at $154,500. The contract was awarded Dec. 31. Bids were opened Dec. 5.

The Chicago City Council on Jan. 2 authorized the construction of the following bridges over the Chicago and Calumet Rivers; 12th St. bridge, estimated cost $480,000; one-half cost to be defrayed by Sanitary District of Chicago; Lake St. double deck bridge, estimated cost $430,000; Wood St. bridge, estimated cost $175,000; S. California Ave. bridge, estimated cost $200,000; Fuller St. bridge, estimated cost $175,000; N. Central Park Ave. bridge, $19,000; N. 40th Ave. bridge, $9,000; N. 48th Ave. bridge, $9,000; Irving Park Blvd. bridge, $68,000; Madison St. bridge, estimated cost $330,000; Webster Ave. bridge, estimated cost $250,000; 106th St. bridge, estimated cost $250,000; Belmont Ave. bridge, estimated cost $250,000. L. E. McGann, Commissioner of Public Works.

The Chicago City Council on Jan. 2 appropriated $6,000 for the preparation of plans for the construction of a double deck bridge across the Chicago River at Michigan Ave. L. E. McGann, Commissioner of Public Works.

The Chicago City Council on Jan. 2 authorized the construction of the following fixed concrete bridges: N. Kedzie Ave. bridge, estimated cost $20,000; E. Foster Ave. bridge, estimated cost $20,000; Forest Glen Ave. bridge, $20,000; N. 56th Ave. bridge, $20,000; Montrose Ave. bridge, $63,000; Wilson Ave. bridge, $54,000. L. E. McGann, Commissioner of Public Works. Date of lettings has not been announced.

Business men of Dixon, Ill., are agitating the construction of a new bridge over the Rock River at Peoria Ave., two blocks west of the present structure. Blake Grover is City Clerk.

Indiana.

⊙The Board of Posey County Commissioners, Mt. Vernon, Ind., has awarded the contract for the construction of 34 bridges to the Mt. Vernon Construction Co., Mt. Vernon, Ind., at $19,336. Bids were opened Dec. 27. J. R. Haines is County Auditor.

Iowa.

⊙The Board of Polk County Supervisors, Des Moines, Ia., has awarded the contract for the construction of a concrete bridge in Elkhart township to Marsh & Reed at $1,387. The Board has under consideration the issuance of $50,000 worth of bonds for the construction of new bridges during 1913.

Plans are being prepared by K. C. Gaynor, Sioux City, Ia., for the construction of a steel highway bridge over the Missouri River at Sioux City, Ia. As proposed the structure will consist of four 500-ft. spans and 1,000 ft. of approach or five 400-ft. spans and 1,000 ft. of approach. The roadway will be 20 ft. wide and the substructure will include five or six piers. The bridge will be the property of Woodbury County, Ia., and Dakota County, Nebr.

Plans are now being prepared for the construction of the proposed viaduct and river bridge at 7th St., Des Moines, Ia. The structure will be 1,600 ft. long with a 48-ft. roadway and will consist of three Pratt truss and 22 plate girder spans. The floor will be wood block on concrete slab and the substructure will be of concrete. The cost is estimated at about $230,000. The date for letting the contract has not, as yet, been determined. W. D. Maxwell, Office Engineer, care of F. N. Carss, City Engineer, is official in charge of the work.

Maine.

A petition is being circulated at Fort Fairfield, Me., and other parts of northern Maine to allow the Restigouche & Western Ry. Co. to construct a bridge over the St. John River between Van Buren, Me., and St. Leonards, N. B. The company has already received the necessary charter from the Dominion government. Thomas Malcolm, Campbellton, Neb., General Manager of the International Ry. of New Brunswick, is interested in the R. & W. Ry.

Massachusetts.

A Commission composed of G. W. Bishop, Newtonville, Mass.; Edward T. Scully and John Barker held hearings on the construction of the following bridges and underpasses: Jason Ave. underpass and new bridge at Pittsfield, Mass.; First St. bridge and Hubbard Ave. underpass at Pittsfield; Richmond Furnace bridge.

The Board of Bristol County Commissioners, Taunton, Mass., has decided to appoint W. F. Williams as a representative to interview W. H. Ellis, Boston, Mass., low bidder on the Acushnet bridge, with a view of inducing him to modify the specifications and bring his bid down to about $25,000.

Michigan.

Plans are being prepared by City Engineer H. E. Terry, Flint, Mich., for the construction of bridges which are to be constructed to Moon Island, the park site offered the city by Joseph Walsh, Sr. Two bridges will be built and bids for the work will probably be asked in the near future.

Missouri.

A resolution has been passed by the City Council, Chillicothe, Mo., instructing the Chicago, Burlington & Quincy and the Wabash Railroads to construct a steel bridge over their tracks at the foot of Locust St. The plans will provide for a structure with a 30-ft. roadway and two 5-ft. sidewalks. B. F. Thorp is City Clerk.

It has been recommended by John Gmeiner, Chairman of the Finance Committee of the City Council, Joplin, Mo., that $20,000 be appropriated to construct a viaduct on East Third St. Charles Robinson is City Clerk.

Plans for the part of the 23d St. traffic way spanning the Kaw River at Kansas City have been sent to the United States War Department for approval. The traffic way is to cross the Kaw River on a high line bridge. That is, the wagon and street car portion will be overhead. The bridge will be similar to that on which the InterCity Viaduct crosses the Kaw River, but will be one span longer.

Montana.

The Commissioners of Custer County, Miles City, Mont., have appropriated a sum not to exeed $5,000 to assist the city of Miles City in building the proposed bridge over the slough. G. C. Pruitt is City Engineer.

The Board of Custer County Commissioners, Miles City, Mont., has adopted a resolution providing for the construction of a new bridge over the Yellowstone opposite Miles City on a continuation of 7th St.

Nebraska.

✣Bids will be received until noon, Jan. 17, by Board of Buffalo County Supervisors, Kearney, Nebr., for construction of all bridges and bridge repair work and furnishing the material therefor, to be built in Buffalo County during the year 1913. Bids for said work and material to be used in the construction of said work shall be submitted as follows: The amount of cost per lineal foot for the superstructure of all bridges and approaches thereto; the amount of cost per cubic foot in place of stone, cement or concrete, used in such bridges and approaches; the amount of cost per lineal foot for all oak and cedar oiling used in the substructure of all such bridges and approaches thereto; the amount of cost per lineal foot of tubing for substructure, and the amount of cost of steel piles per foot for substructure. J. H. Dean is County Clerk.

✣Bids will be received until noon, Jan. 17, by J. H. Dean, Buffalo County Clerk, Kearney, Nebr., for furnishing the county with bridge plank of the following dimensions, full size measurements required in all instances: Oak, 3x12, 16 ft.; fir, 3x12, 16 ft.; fir, 4x12, 16 ft.; fir, 4x12, 20 to 32 ft.; fir, 10x10, 12 to 18 ft. Red cedar and oak piling not less than 8 ins. at small end, per foot. To be delivered at any station in Buffalo County, Nebraska, F. O. B. in car load lots. Each bid to be accompanied by a certified check in the amount of $100.

✣Bids will be received until Jan. 11 by O. E. Walters, Boone County Clerk, Albion, Nebr., for furnishing all labor and material necessary for the construction of steel and wooden bridges in Boone County, Nebr. A certified check for $1,000 must be filed with each bid.

New Jersey.

⊙The United States War Department has approved plans and specifications for the new Allen-Osborne draw bridge over the Manasquan River between Manasquan and Point Pleasant. The contract for the structure was awarded to William Thompson by the Boards of Freeholders of Monmouth and Ocean Counties at Freehold and Toms River, N. J., respectively.

⊙The Board of Freeholders of Middlesex County, New Brunswick, N. J., has awarded the contract for completing the Woodbridge Creek bridge to John F. McGovern, New Brunswick, N. J.

New York.

✣Bids will be received until 7 p. m., Jan. 14, by Purchasing Agent, Bureau of Insular Affairs, Room 1530, 17 Battery Place, New York City, for furnishing all the fabricated steel and field rivets for: Two spans at 90 ft., one span at 100 ft. and one span at 130 ft. for Nueva Evija bridges; seven spans at 160 ft. for the Laoag bridge, Ilocos Norte, and one span at 160 ft. for the Rugao bridge, Isabela, for the government of the Philippine Islands.

⊙The contract for the construction of the superstructure of a bridge over the Deerfield River, between the towns of Buckland and Charlemont, has been awarded by the Massachusetts Highway Commission to the United Construction Co., Albany, N. Y., at $9,000. Bids were opened Dec. 31.

Arthur N. Christy, President of the Village of Newark, N. Y., and W. T. Purchase of the Municipal Board, have filed a petition with Duncan W. Peck, Superintendent, State Board of Public Works, asking that the bridge at Allertons be removed to a site opposite Edgett St., Newark.

The Town Boards of Volney and Oswego, N. Y., have decided to locate the proposed new bridge over the Oswego River at a point 1,000 ft. south of the present structure. The structure will be of reinforced concrete and will cost $80,000.

Ohio.

✣Bids will be received until 1 p. m., Jan. 13, by Board of Columbiana County Commissioners, Lisbon, O., for the construction of Concrete girder bridge No. 1523 in accordance with plans prepared by B. M. French, County Engineer, on file with County Auditor. A certified check for $200 must be filed with each bid.

⊙The Jefferson County Commissioners, Steubenville, Ohio, have awarded a contract to the Central Concrete & Construction Co. for the construction of the Finley bridge over Island Creek at $1,125.

⊙George J. Bock & Son, Coshocton, O., have been awarded a contract by Board of Tuscarawas County Commissioners, New Philadelphia, O., for the construction of the superstructure of the bridge near "52 cut" of the P., C., C. & St. L. R. R. over the Tuscarawas River near the village of Tuscarawas, O. The contract price was $12,000. W. C. Shott is County Auditor. Bids were opened Dec. 30.

Board of Cuyahoga County Commissioners, Cleveland, O., contemplate starting work in the Spring on the proposed new bridge over Big Creek to replace the condemned Brooklyn-Brighton bridge. The improvement will necessitate, it is estimated, an expenditure of $1,000,000. J. F. Goldenbogen is Clerk of the Board. F. R. Lander is County Surveyor.

Hamilton County Engineer, at a recent meeting of the County Commisisoners, Cincinnati, O., recommended the construction of a new concrete bridge over Muddy Creek on the Muddy Creek road to replace the present structure at that place. A new bridge will cost about $16,500, and $5,000 will be required to repair the abutments. Plans and specifications will be prepared by the surveyor at once.

The Board of Hamilton County Commissioners, Cincinnati, O., at a recent meeting approved plans and specifications for the construction of a concrete culvert on Shawnee Run near Wooster Pike, and bids for the work will be advertised for at once. The cost of the work is estimated at $21,162.

The City Council of Toledo, O., has authorized Director of Public Service Cowell to enter into a contract for the construction of a new bridge across the Lake Shore tracks at Sumner St. An appropriation of $25,000 has been made by the city for the work.

Following an examination by the city engineering department, the Herman Ave. bridge at Dayton, O., was closed to traffic. The matter will be open to further investigation. George W. Tonson is City Engineer.

Oregon.

⊙The Coast Bridge Co., Portland, Ore., has been awarded contract at $6,050 for furnishing five steel bridges in Baker County before July 1, 1913. The contract states that the bridges shall be delivered at Copperfield, Robinet, North Powder and Baker.

The following bids were received for erecting trolley poles on the Broadway bridge at Portland, Ore., by the City Executive Board: Independent Foundry Co., $7,694; Smith & Watson Iron Works, $3,808; John Wood Iron Works, $7,030; Phoenix Iron Works, $6,675; Hesse-Martin Co., $7,311.

It is believed that the Washington Legislature will be asked to appropriate $1,000,000 for the construction of new bridges. The largest one contemplated is the Columbia River bridge between Portland, Ore., and Vancouver, Wash., estimated to cost $500,000. Next in importance is the structure over the Columbia River at Kennewick and Pasco, in Benton and Franklin Counties. The cost of this bridge is estimated at $200,000.

Pennsylvania.

Citizens of Lower Pottsgrove have petitioned the Commissioners of Northumberland County, Sunbury, Pa., for the construction of a new bridge over Sprogell's Run near Pottstown.

Texas.

Stockholders of the new Red River Bridge Co. at a recent meeting in the rooms of the Chamber of Commerce, Denison, Texas, determined to erect a modern steel bridge across Red River at the site of the one which washed away five years ago. The new structure is to be erected with a view of accommodating wagons, automobiles, pedestrians, and an interurban line. Barring unforeseen delays, work will begin within a few weeks, and the bridge should be completed and open not later than Sept. 1, 1913.

Officials of the Orange-Northeastern R. R. are contemplating the construction of a trestle over the marsh east of the Sabine River along the trans-Calcasieu Road levee, from the river to high land, instead of building a levee, as at first planned. Henry White, Orange, Texas, is an official of the company.

The Board of Municipal Commissioners, Dallas, Texas, on Dec. 27 passed the ordinance providing for the construction of the Merlin St. viaduct. The viaduct will cost about $100,000, of which the city's part will be $30,000 or $40,000 and the Santa Fe's part $60,000 or $70,000. The main span will be built by the railroad and the approach at either end by the city. The viaduct will be an extension of Merlin St. across the Santa Fe tracks. It will afford an easier access to all of the city south of those tracks and between Harwood St. and the Fair Grounds. The ordinance grants to the Santa Fe the right to make certain additions to its switch tracks across Chestnut, Harrison and Latimer Sts., in consideration of the building of the Merlin St. viaduct. J. B. Winslett is City Secretary.

Brenneke & Fay, Engineers, have completed preliminary plans for the construction of the proposed bridges at Samuels Ave. and Riverside, Fort Worth, Texas. The cost of the structures will amount to about $150,000. If the specifications are accepted by the Commissioners, the estimates will be prepared and bids will be advertised for. The girder type of viaduct is planned for the new bridges. It consists of massive steel girders which rest on piers. The girders are not supported by arches, but are of sufficient weight to support the floor of the bridge and the traffic without the aid of arch supports. There will be a 32-ft. roadway, with two 5-ft. sidewalks, one on each side of the bridge. The present plans provide for two car tracks. W. J. Estes is City Secretary.

A public hearing was held in the Council Chamber, Houston, Texas, Jan. 4, on the proposition to construct a concrete arch bridge across Buffalo Bayou at foot of San Jacinto St., Houston, Texas.

Utah.

⊙The Salt Lake & Ogden Ry. Co. has awarded the contract for the construction of a new railway bridge over the Weber River at Ogden, Utah, to James J. Burke, Salt Lake City, Utah. The structure will be of steel on a concrete substructure.

Virginia.

Residents of South Richmond, Richmond, Va., are advocating the construction of a new bridge to span the river on the site of the present free bridge.

A conference was recently held by C. S. Churchill, Chief Engineer of the Norfolk & Western Ry., with the Municipal Street Committee, Lynchburg, Va., in regard to the construction of new bridges at McKinley and Park Aves. over the Durham branch of the Norfolk & Western System. H. L. Shaner is City Engineer and J. M. Oley is City Clerk.

Washington.

⊙Harry Gabel, Chehalis, Wash., has been awarded the contract for the construction of a 70-ft. bridge over the Newaukum river at

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Centralia, Wash. The structure will have 100-ft. approaches.

⊙The contract for the construction of three rustic bridges on the new Tacoma-Steilacoom Blvd. has been awarded to G. A. Marsh, Seattle, Wash., at his bid of $8,442. The structures will span Flett Creek, Chambers Creek and Murray Creek.

⊙The Board of Lewis County Commissioners, Chehalis, Wash., has awarded the contract for the construction of a bridge over the Newaukum River near the Gottlieb Salzer ranch to Harry Gabel. The structure will have 70-ft. spans and 100-ft. approaches.

The Pierce County Engineer, Tacoma, Wash., is preparing plans for the construction of a bridge over the Nisqually river at La Grande. The structure will be 1,000 ft. long and will cost about $10,000.

Wisconsin.

A meeting was recently held at Merrimac, Wis., for the purpose of discussing plans for the construction of a free highway bridge over the Wisconsin River at that place.

The Northern Pacific Ry. officials have reached an agreement with the Commission whereby the company will construct steel spans over West Fourth and Fifth Sts. and wooden spans over 12th St. and other streets over which the approach to the ore dock on Robinson Ave. from West 18th St. to Superior bay, Superior, Wis., will pass.

Canada.

✣Bids will be received until 5 p. m., Jan. 27, by P. A. Malcolmson, County Clerk, Kincardine, Ont., for the construction of a center pier in the Saugeen River for the Southampton Bridge. Plans and specifications for a concrete pier can be seen at the office of the clerk. Tenderers may also tender for any other form of substructure provided tenderer furnish plans and specifications and general details therefor. Party whose tender is accepted to furnish satisfactory security for completion if required. Tender to name date by which to be completed. Marked check for 5 per cent of tender to accompany each tender, which will be returned if tender not accepted.

The District Council, according to advices from North Vancouver, B. C., has decided to permit the West Vancouver Council to erect a bridge and approaches at Capilano connecting Marine Drive and Robson Road, and will turn over to them the proceeds of the 1911 by-law, amounting to $50,000, for that purpose.

At an election held Jan. 1, at Toronto, Ont., it was decided to construct the proposed Bloor St. viaduct in order that Civic car service might be inaugurated. The cost of the structure was estimated at $2,500,000. R. C. Harris is City Engineer.

DRAINAGE AND IRRIGATION

California.

✣Bids will be received until 2 p. m., Jan. 22, by U. S. Reclamation Service, Los Angeles. Calif., for furnishing hydraulic apparatus for the St. Mary Storage Unit, Milk River project, Mont.

✣Bids will be received until Jan. 13, by the Board of Directors of the Turlock Irrigation District, Turlock, Calif., for the construction of 18 dams in the Davis reservoir.

The Arrowhead Reservoir & Power Co., San Bernardino, Cal., has applied to the State Railroad Commission for permission to put out a bond issue for $4,000,000.

Farmers in the vicinity of Dixon have negotiations under way for securing water for irrigation purposes from the Yolo County Water & Power Co. This company has engineering work under way at Clear Lake, in Lake County, for the purpose of building a dam capable of storing water for 200,000 acres of land.

Colorado.

⊙Lee F. Williams, Pueblo, Colo., has been awarded a contract, at about $12,000, for constructing a diversion dam in the Arkansas River at Weitzer for the Rocky Ford Ditch Co., of Rocky Ford, Colo.

Work is to be started at once on a large irrigation ditch to be built near Meeker by the Elk River Irrigation & Construction Co. W. P. Finley, Craig, Colo., is Chief Engineer.

Idaho.

County Commissioners at Boise, Idaho, have appointed W. T. Booth, W. H. Thompson and Arthur E. Cunningham as trustees of the recently formed Hillcrest Irrigation District.

Indiana.

⊙J. H. Crawford, Michigantown, Ind., has been awarded the contract at $8,149 for labor and material for constructing the Chas. Cooper Tile Drain, bids for which were opened Dec. 28 by Edward C. Off, Superintendent of Construction, Tipton, Ind.

Iowa.

⊙Contracts for Philips Joint Ditch No. 138 of Hamilton and Story Counties have been let as follows: Furnishing tile, Lehigh Clay Products Co., at $13,986; labor, Chris Haugestad, Nevada, Ia., at $12,500.

Louisiana.

✣Bids will be received until 1 p. m., Jan. 15, by the Hamlin Dam Association at the office of William Rath, Ludington State Bank Bldg., Ludington, Mich., for the construction of a reinforced concrete dam with all appurtenances. The work will embrace the following quantities approximately: (1) Plain concrete, 800 cu. yds.; (2) R. F. concrete and thin walls, 417 cu. yds.; (3) steel sheet piling, 3,240 sq. ft.; (4) gate; (5) reinforcing metal. 20,000 lbs.; (6) anchor bars, 800 lbs.; (7) anchor cable, 800 lbs.; (8) bearing piles; (9) flash boards; (10) excavation, 750 cu. yds.; (11) fish ladder. Each proposal must be accompanied by a certified check payable to the Hamlin Dam Association, to an amount equal to 5 per cent of the bid, as a guarantee that the contract will be entered into if awarded. A bond of 60 per cent of the contract price will be required. Payments will be made cash on monthly estimates. Plans and specifications are on file at office of A. A. Keiser, Ludington, Mich., where they may be examined. They are also on file with Phillips & Dean, Engineers, Armour Institute of Technology. Chicago, Ill. Bidders may obtain copies from the Engineers upon payment of $5 for each set of plans and specifications.

⊙The General Contract Co., Hibernia Bank Bldg., New Orleans, La., has been awarded the contract, at 84 cts. per lin. ft., for constructing 6,000 lin. ft. of revetment, Stanton to Beka, for the Orleans Levee District. Bids were opened Dec. 27 at New Orleans.

Property owners of Gilliam, La., known as subdistrict No. 1 of the North Caddo Drainage District, have voted a special bond issue of 35 cts. an acre for 15 years for drainage work, especially for clearing Dooley Bayou, thereby lessening overflow risk.

Minnesota.

⊙A. Folstad & Sons, Balaton, Minn., have been awarded the contract, at 14½ cts. per cu. yd., for constructing Open County Ditch No. 26, bids for which were opened Dec. 30 by W. A. Seeman, County Auditor, Slayton, Minn. The ditch will be 18,233 ft. long, and requires 34,442 cu. yds. of excavation.

Hearing will be held at Minneapolis, Minn., on Jan. 9 on Hennepin County Ditch No. 24, which is to begin in Rice Lake, running thence to the outlet of the lake, following Elm Creek as near as practicable, in a northerly direction across Secs. 10 and 15, T. 119 N., R. 22 W., as far as necessary to drain said Rice Lake. Al. P. Erickson, Minneapolis, is County Auditor.

Hearing, was held at Bemidji, on Jan. 4, on the petition for the establishment of Judicial Ditch No. 17 of Beltrami County.

Hearing was held at Elk River on Dec. 30 on petition for public ditch in the town of Becker, petitioned for by B. Kilgard and others. Chas. E. Swanson, Elk River, is County Auditor.

Final hearing will be held at Jackson on Jan. 13, on Judicial Ditch No. 19 of Jackson County.

Montana.

✣Bids will be received until 2 p. m., Jan. 22, by U. S. Reclamation Service, Los Angeles, Cal., for furnishing electrical apparatus for St. Mary Storage Unit, Milk River project, Mont.

Nebraska.

⊙Matzen Bros., Hooper, Neb., have been awarded the contract, at $4,709, for constructing the Byrne drainage ditch, bids for which were opened Dec. 30 by Ed. F. Vrzah, County Clerk, Schuyler, Neb.

New Mexico.

The Dexter-Greenfield Drainage District has petitioned the County Court at Roswell, N. Mex., to name Commissioners for the district. This will compose one of the largest drainage districts in the valley. Several miles of main tile drains are to be laid.

North Dakota.

Establishment of Hunters Lake Drain No. 1 of Caralin County has been ordered. K. J. Hamilton, Langdon, N. Dak., is County Auditor.

A plan is under consideration for diverting Moose River so that it will flow into Devils Lake. E. J. Thomas, City Engineer, of Minot, N. Dak., is interested.

Texas.

✣Bids will be received until 3 p. m., Jan. 21, by John A. Norris, El Campo, Texas, for the excavation of approximately 1 750,000 cu. yds. of open ditches. W. W. Duson, Secy., Wharton County Drainage District No. 1, El Campo, Texas.

Washington.

⊙C. D. Walter of Prosser, Wash., secured the contract for constructing pipe and flume distributing system for Commercial Orchards Land Co., at Colbia, Wash., and for designing power and pumping plant at Sunnyside, Wash., canal.

Wyoming.

Barnett & Sturgis, Associated Engineers, 150 Kansas City Life Bldg., Kansas City, Mo., have been retained by the Louis Lake Conservation Co. to prepare plans and specifications for an irrigation project in Fremont County, Wyo. Development work is now under way. Later announcement will be made of the approximate quantities and the probable date for calling for bids on construction work.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

WATER WORKS

Alabama.

The report of City Engineer W. G. Kirkpatrick of Birmingham, Ala., shows that the water plant operated by the city at North Birmingham can be placed on a paying basis. Commissioner James Weatherly plans to authorize the commission to authorize certain expenditures in line with the suggestions of the engineer. It is proposed to install meters.

Arizona.

✣Bids will be received until 5 p. m., Jan. 13, it is reported, by City Recorder, Phoenix, Ariz., for the construction of a syphon flume over Central Ave. at the Salt River Canal.

Plans and estimates are being prepared by W. H. Thompson of Tucson, Ariz., for the proposed changes in the waterworks system and when completed an election for the issuance of bonds will be called.

California.

The mayors of the seven cities to be included in the proposed metropolitan water district recently held a conference in the office of Mayor Frank K. Mott of Oakland, Calif., to discuss the campaign that is to be made in behalf of the election to create a water district. Signed petitions have been presented to the Board of Supervisors of Alameda County, Oakland, who will canvass the names and set a date for the election. The cities to be comprised in the district are: Oakland, Berkeley, Alameda, Piedmont, Emeryville, San Leandro and Albany; also unincorporated territory.

The town of Perris, Calif., plans the construction of a reinforced concrete reservoir at an estimated cost of $4,000. H. W. Skin is City Clerk.

District of Columbia.

The District Commissioners, Washington, D. C., W. A. McFarland, Superintendent, have awarded the contract for supplying 835 tons of 12-in. cast iron water pipe to be used in connection with the extension of the city's water mains to Good Hope and the high ground east of Anacostia River. Bids were received Dec. 30 for the construction of a pumping station to be located at 18th St. and Minnesota Ave. southeast. In addition it is proposed to erect water towers at Good Hope, Congress Heights and at 30th and R Sts. The entire project will cost about $40,000. The water towers will have about 100,000 gal. capacity each and will cost about $12,000. It is expected that the pumping station will cost a similar amount, while the necessary equipment for the station will entail an additional expense of $10,000.

Florida.

According to advices from Jacksonville, Fla., the Lake Worth Light Water & Ice Co. will be incorporated about the middle of this month. It is probable that water will be supplied to the surrounding towns and territory.

Illinois.

✣Bids will be received until 11 a. m., Jan. 15, by Department of Public Works, L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering at the Harrison St. pumping station, Harrison and Halsted Sts., approximately 15 tons of 48-in. cast iron flanged pipe and fittings. The city furnishes patterns.

✣Bids will be received until 11 a. m., Jan. 15 by Department of Public Works, L. E. McGann, Commissioner, Chicago, Ill., for furnishing and delivering mason sand for building construction as required by the Bureau of Engineering. About 1,000 cu. yds. were required during the year of 1912. A certified check for $100 must be filed with each bid.

⊙The Southern Railroad has awarded the contract for building a reservoir at its shops at Princeton, Ill., to L. W. Hancock Co., of Louisville, Ky.

⊙L. E. McGann, Commissioner of Public Works, Chicago, Ill., on Dec. 31 awarded the contract for the furnishing, delivering and erecting structural steel for crane runway at the 14th St. pumping station, 14th St. and Indiana Ave., to the American Bridge Co., New York City, at $2,100.

⊙L. E. McGann, Commissioner of Public Works, Chicago, Ill., has awarded to the Davies Supply Co., 412 W. Ontario St., Chicago, the contract for furnishing and delivering 550 lin. ft. of 12-in. wrought iron pipe at $1,787. Contract was awarded Dec. 31.

Following are the lowest bids submitted to L. E. McGann, Commissioner of Public Works, Chicago, Ill., on Dec. 28 for furnishing, delivering and erecting one air compressor at the Chicago Ave. loading station: Sullivan Machinery Co., 122 S. Michigan Ave., $1,581; Chicago Pneumatic Tool Co., 343 S. Dearborn St., $1,700. The contract has not been awarded.

Following bid was received Dec. 23 by L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing 7 steel coal hoppers to the 68th St. pumping station, 68th St. and Oglesby Ave.: Kenwood Bridge Co., First Nat. Bank Bldg., Chicago, $1,687.

The Chicago City Council on Jan. 2, 1913, authorized the purchase of fire hose by the Chicago Fire Dept., Chas. Seyferlich, Chief, to the extent of $4,000. Date of letting contract has not been announced.

The Chicago City Council has appropriated the following amounts for the purchase of supplies necessary in the construction of the following improvements: Water service pipes, $7,000; repair and replacement of tapping connections, $15,250; Roseland pumping station, 2 engines and appurtenances, estimated cost $270,000; Lake View pumping station, 3 pumping engines, boilers, etc., estimated cost, $865,000; Fullerton Ave. pumping station, remodeling pump pits, $15,000; Chicago Ave. pumping station, 2 25,000,000-gallon engines and appurtenances, estimated cost, $2,500,000; 14th St. pumping station, turbine driven centrifugal pump, including piping, etc., estimated cost, $45,000; Harrison St. pumping station, 1 turbine driven centrifugal pump and piping, estimated cost, $71,000; Springfield, Ill., pumping station, I turbine driven centrifugal pump and piping, estimated cost, $45,000; Mayfair pumping station, complete

The citizens of Hinckley, Ill., recently voted the issuance of bonds to the amount of $12,000 for the construction of a waterworks plant.

It is reported that the citizens of Carpentersville, Ill., recently voted the issuance of bonds to the amount of $18,000 for the installation of a waterworks plant.

The city of Peru, Ill., will bore a new artesian well to increase the supply of water for the waterworks.

Mayor Carter H. Harrison of Chicago, Ill., sent a communication to the City Council urging the establishment of a high pressure water system for fire protection in the manufacturing centers, the down town district and the stock yards. The estimate on the proposed improvements is $4,423,518. new installation, estimated cost, $1,100,000; new 68th St. pumping station, including complete new equipment, estimated cost, $1,250,000; 2 booster pumps at Washington Heights pumping station, $20,000; Jefferson Park pumping station, pumps, $7,500.

The Chicago City Council on Jan. 2 authorized the construction of proposed feeder mains, in the following streets, from Centre Ave. and 104th St. to 47th St. and Ashland Ave.; from 47th St. and Packers Av. to Union Ave. and 45th St., various discharge mains, etc., mains for booster stations, etc., feeder mains in State St. and 103d St., etc.: 59th St. and State St., etc., and water supply pipe east of the Calumet river, appropriation to cover cost of work during 1913, $100,000. L. E. McGann, Commissioner of Public Works. Date of letting has not been announced.

The Chicago City Council on Jan. 2 appropriated $945,000 to cover the cost necessary to erect buildings, install equipment, etc., for the care of tubercular charges.

The Chicago City Council on Jan. 2 appropriated $54,000 to cover cost of new water meters, tools, measuring devices, etc. L. E. McGann, Commissioner of Public Works. Date of letting has not been announced.

The Chicago City Council, on Jan. 2, authorized the following improvements to the city water supply: 22nd St. pumping station, wiring stations and betterments; Chicago Ave., additional changes to building coal storage plant, etc.; 14th St. pumping station, lowering suction pipes, 2 turbo generators, switchboards, etc.; Harrison St. pumping station, constructing boiler improvements and necessary piping; Springfield Ave. pumping station, new coal storage plant and equipment, ash handling machinery, changes in building, etc.; Central Park Ave. pumping station, new coal storage plant and equipment, ash handling machinery, building changes, etc.; Chicago Ave. pumping station, repairs to water tower, new boiler plant, etc.; 14th St., new crane and runway, new iron and brass foundry and equipment; Roseland pumping station, boiler equipment, etc.; 22nd St. pumping station, remodeling boiler plant and equipment, estimated cost, $30,000.00. L. E. McGann, Commissioner of Public Works. Date of purchase has not been announced.

The Chicago City Council on Jan. 2, 1913, authorized the construction of the following water tunnels: Fullerton Ave. intake crib, estimated cost, $15,000; Wilson Ave. tunnel and crib, estimated cost, $3,500,000; tunnel connection between South West Land tunnel and 68th St. systems, estimated cost, $340,000; changes and connections in Chicago Ave. pumping station tunnel, estimated cost, $95,000; 35th St. water tunnel and crib, estimated cost, $4,750,000; repairs and improvements on existing tunnels and cribs, $27,800. L. E. McGann, Commissioner of Public Works. Dates of lettings have not been announced.

Indiana.

Charles McCauley of Montpelier, Ind., submitted the only bid to the City Council of that city recently for the contract for supplying the city with light and water. The bid was opened by the council of Jan. 6.

Iowa.

⊙The City Council of Albia, Ia., has awarded a contract to S. W. Dooley to sink test wells out near the city reservoir at $0.25 per foot. It is thought that no well will be more than 100 ft. in depth.

The citizens of the village of Welton, Ia. (population 69), recently voted the issuance of bonds for the installation of a water works.

Kentucky.

The W. T. McCaskey Light & Power Co., according to advices from Leitchfield, Ky., contemplates the installation of a water works system.

Massachusetts.

Architects Park & Bateman are preparing plans for the dam to be built at Hay-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

wood basin adjoining the so-called Dennis E. Wheeler farm which will be an extension to the Wekepeke water system of the town of Clinton, Mass. The dam will probably be built of reinforced concrete.

Michigan.

The City Council of Grand Rapids, Mich., has sold bonds to the amount of $100,000 to the W. R. Bond & Mortgage Co. of St. Louis, Mo. These bonds are for waterworks extensions.

Minnesota.

✣Bids will be received until Noon, Jan. 23, by Roscoe Ozman, City Clerk, Lincoln, Nebr., for furnishing 500 H. P. water tube boiler, one chain grate stoker for one 250 H. P. boiler. The boiler shall be of 500 H. P. capacity base on 34½ lbs. of water evaporated per hour at 212 degrees Fahr., and shall stand forcing to 1½ times that amount temporarily. Boiler will be tested to 225 lbs. hydrostatic and will be inspected and insured for 180 lbs. by a reliable boiler inspection and insurance company and a certificate of inspection and policy of insurance to be furnished. Boiler when set to require a floor space not to exceed 14x22 ft.: to be erected and bricked in complete by the contractor on a foundation to be furnished by the city; to be properly set for the installation of chain grate stoker. Bids will also be received for furnishing and erecting a chain grate stoker with the necessary engine to operate it; of the proper capacity for a 500 H. P. water tube boiler. Stoker and engine to be erected, complete, ready for operation. Each bidder on boiler or stoker will furnish complete detailed plans and specifications for the work bid upon. If the contract for boiler and stoker is awarded to different bidders, the boiler contractor will set in place any parts necessary for the proper installation of the stoker. Bids will also be received for furnishing and installing a chain grate stoker in connection with the 250 H. P. boiler now installed at the City Water and Light Plant.

✣Bids will be received until 1 p. m., Jan. 16, by Board of Trustees at the office of the Village Clerk, Doniphan, Nebr., it is reported, for the construction of a system of water works and electric light plant.

⊙The City Council of Alexandria, Minn., has let the contract for the extension of the intake of the water system into Lake Winona to Wm. B. Boswell of Ada, Minn., at $2,300.

⊙The Water Department of St. Paul, Minn., plans to lay from 10 to 13 miles of street mains during the year. The U. S. Cast Iron Pipe & Foundry Co. secured the contract for furnishing about 1,000 tons of cast iron water pipe at $27.85 a ton. The pipe will be 4, 6, 8, 12 and 16 ins. in diameter. Bids were opened Dec. 30.

⊙The U. S. Cast Iron Pipe & Foundry Co., at $27.85 per ton, submitted the lowest bid to the City Purchasing Agent, Minneapolis, Minn., on Dec. 30, for furnishing the city with approximately 3,000 tons of cast iron water pipe and 200 tons of special castings. The Columbia Iron Works at $32.85, was low bidder on 5-in. hydrants.

City Recorder C. T. Weiland of Shakopee, Minn., is reported to have sold bonds on Jan. 7 amounting to $10,000 for water works extension.

Mississippi.

The City Council of Biloxi, Miss., has awarded the contract for the construction of a new reservoir and pumphouse to Giles Harkness at $4,597, and a contract for the piping work for the pumping station to the Cooper-Greer Co., at $2,887.

Missouri.

The city of Maryville, Mo., has formally taken over the present waterworks plant for which bonds to the amount of $100,000 were issued. About $30,000 will be spent in the spring and summer improving the plant and purchasing new machinery. C. L. Gann is City Clerk.

Montana.

The citizens of Billings, Mont., will vote on the issuance of bonds to the amount of $600,000 for the construction of a waterworks system.

Nebraska.

The waterworks pumping station to be erected by South Sioux City, Nebr., will be located at Dakota St. and Dakota Ave. Plans are being made for the laying of one and one-half miles of water main on Dakota St., with laterals two blocks long on both sides. Bonds in the sum of $25,000 have been issued for this work.

New Hampshire.

Mayor F. B. Preston of Rochester, N. H., has recommended to the City Council the laying of a larger water main from Round Pond to connect with the main below the reservoir, a new gatehouse at Round Pond and such changes at the reservoir as will improve the water supply at that point.

New Jersey.

The Essex Pumping Co., Bayonne, N. J., has been incorporated with a capital stock of $300,000 to operate waterworks. The incorporators are: J. O. Shipman, Jos. H. Steinhardt, P. A. Caviccha, all of Essex Bldg., Newark, N. J.

The Borough Council of Garfield, N. J., proposes to better its water plant. It is probable the plant will be enlarged and connected with the Acquackanonk Water Co. Anton L. Petersen is Engineer.

New York.

✣Bids will be received until 2 p. m., Jan. 13, by Henry S. Thompson, Commissioner of Water Supply, Gas and Electricity, 13-21 Park Row, New York City, for furnishing, delivering and laying water mains and appurtenances in Cypress Ave., from Myrtle Ave. to Troutman St., in the Boroughs of Brooklyn and Queens. The security required is $20,000.

North Carolina.

The Board of Aldermen of Raleigh, N. C., has adopted a resolution to buy or build a waterworks plant. The General Assembly will be asked to pass an act allowing the city to issue bonds to the amount of $400,000 for waterworks.

Ohio.

✣Bids will be received until noon, Jan. 8, by Walter S. Ruff, Director of Public Service, Canton, O., for furnishing one power pump, capacity of 2,000,000 gals. per 24 hrs.: driving 10 6-in. wells 100 ft. deep; furnishing 1,030 ft. wrought iron pipe; one steam pump, capacity 1,500,000 gals. per 24 hrs.

✣Bids will be received until noon, Jan. 28, by James Gavin, Director of Public Service, Steubenville, O., for design, construction and erection of a 6,000,000-gal. compound condensing, vertical, crank and flywheel pumping engine. A certified check for $1,000 must be filed with each bid. Chester & Fleming, Union Bank Bldg., Pittsburgh, Pa., are engineers.

Supt. C. F. Schulz of the waterworks department, Cleveland, O., has announced that the city would build the new West waterworks tunnel by direct labor. The tunnel will be four miles in length, extending from Edgewater Park shore to the new intake crib, and, it is estimated, will cost $900,000. Bids aggregating more than $1,000,000 were recently received on this work and rejected.

The city of Steubenville, O., has employed Hydraulic Engineers Chester & Fleming of Pittsburgh, Pa., to prepare plans and specifications for new high service pumping machinery and other extensive improvements to the waterworks system. The estimated cost of the work is $175,000. Bids will be received about April 1.

Oklahoma.

The city of Collinsville, Okla., municipal improvements to the extent of $40,000. Among the proposed improvements are sewer purification and disposal plant at an estimated cost of $5,000, and extensions to the water mains and improvements. W. F. Keller is Engineer. Wm. H. Gresham is City Clerk.

Oregon.

⊙The Reliance Construction Co., of Portland, Ore., has been awarded the contract by the city of Hood River, Ore., for the making of extensions to the waterworks system at $44,021. The work includes divisions 1, 3 and 4, furnishing material, digging of trenches and placing of pipe. Bids were opened Dec. 23 by H. L. Howe, City Recorder.

⊙C. L. Houston of Astoria, Ore., has been awarded the contract for the construction of 2,400 ft. of 4-in. pipe line at Fort Canby, Wash., at $2,225.

South Dakota.

The City Council of Beresford, S. Dak., has let a contract to J. H. Jansen of Woonsocket to sink a well to the artesian stratum which is believed to underlie the surface at a depth of 500 to 600 ft. The well will be 8 ins. in diameter to a depth of 300 ft., and 6 ins. in diameter the rest of the way.

Tennessee.

The Board of Public Works of Nashville, Tenn., has requested the City Council to set aside $150,000 in the budget for repair of the city reservoir. Rudolph Hering, New York City, is Engineer.

Texas.

The city of Big Spring, Tex., will shortly take over the waterworks system of that city. It is proposed to lay about eight miles of cast iron mains. L. T. Deats is Mayor.

Washington.

⊙Foster & Trimble of Spokane, Wash., have been awarded the contract for the construction of a waterworks system in Farmington, Wash., at $7,892.

The Board of Public Works of Seattle, Wash., has instructed City Engineer A. H. Dimock to prepare plans and specifications, etc., for the construction of the Cedar Lake dam which is estimated to cost between $1,000,000 and $1,750,000. Plans will be ready for contractors about March 1.

The Leadbetter Co., owners of the Municipal Water Co., Camas, Wash., will start the construction of a 100,000-gal. reservoir this month. It will be a reinforced concrete reservoir and water will be piped from numerous springs on the hills back of Camas and from the Little Washougal River.

The Board of Public Works of Seattle, Wash., has postponed the proposed construction of a water main an Alki Ave., for which bids were to have been opened Dec. 20.

Wisconsin.

The Electric Light & Water Commission of New London, Wis., has decided to procure the services of a state hydraulic engineer to look into the matter and ascertain what the water supply is and the approximate cost of furnishing the city with fountain water.

Canada.

✣Bids will be received until 5 p. m., Feb. 3, by J. J. Hackney, Commissioner of Utilities, Port Arthur, Ont., for the supply and delivery of the following valves, f. o. b. Port Arthur: 24-in. gate valves, equipped

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

with operating gears, 30; 12-in. gate valves, without gears, 9; 24-in. check valves, with 3-in. by-pass, 2. Specifications can be seen at the office of L. M. Jones, City Engineer, Port Arthur.

✣Bids will be received until 5 p. m., Feb. 3, by J. J. Hackney, Commissioner of Utilities, Port Arthur, Ont., for the supply and delivery of the following lapwelded steel pipe, f. o. b. Port Arthur: 24-in. pipe, 5-16-in. metal, Bell & Spigot joints, 40,200 lin. ft.; 24-in. pipe, 5-16-in. metal, flanged joints, 2,700 lin. ft.; 24-in. pipe, ¼-in. metal, flanged joints, 2,700 lin. ft. (alternative); 12-in. pipe, 3-16-in. metal, Bell & Spigot joints, 6,000 lin. ft. Also specials and flexible joints for the above, as per list furnished with the specifications. Specifications can be seen at the office of L. M. Jones, city engineer, Port Arthur.

✣Bids will be received until Jan. 27, according to reports by W. Galt, City Purchasing Agent, Victoria, B. C., for furnishing supplies, including hydrants, valves, castings, brass goods, lead pipe, sewer bricks, vitrified sewer pipe, portland cement, etc.

The ratepayers of Toronto, Ont., on Jan. 1, voted by-laws for waterworks extension at Scarboro to the amount of $6,677,000 and for addition to the filtration plant at the Island amounting to $1,375,000.

The ratepayers of Victoria, B. C., will vote some time this month on the proposition of issuing bonds to the amount of $50,000 for waterworks extensions, and $700,000 for sewers. C. H. Rust is City Engineer.

The citizens of Calgary, Alta., have passed five by-laws for the raising of $705,000 for additional fire equipment and fire station sites, sewer connections, catch basins and a municipal paving plant.

SEWERAGE AND SANITATION

Alabama.

⊙The City Council of Brighton, Ala., has let the contract for the construction of a sewer on Edwards St. to The Currigan Lynn Co. of Birmingham, Ala., at $1,983. Back filling will be done by convict labor.

Arizona.

✣Bids will be received until about Jan. 15, according to reports, by the City of Nogales, Ariz., for the construction of a $50,000 sewer system at that place. F. A. Lathrop, Higgins Bldg., Los Angeles, Calif., is Engineer.

California.

✣Bids will be received until 7 p. m., Jan. 20, by Board of Trustees, Ontario, Calif., for the construction of an outfall sewer pipe line from the corner of Maitland and Plum Ave. southeast to the corner of Dessau and Sultana Sts., and south 250 ft. on Sultana St. A check for 10 per cent must accompany all bids. R. O. Brackenridge is City Clerk.

⊙A. Anthony has been awarded the contract by the City Council of Monterey, Calif., for the construction of the Clay St. sewer, at $1,099.

The City Council of Oakland, Calif., has adopted plans and specifications for sewering D St., from 86th Ave., easterly, and recommended passage of resolution of intention for the same.

City Engineer S. J. Van Ornum of Pasadena, Calif., has completed plans for the construction of a system of sewerage in the Grand Ave. District. The main sewer of the system will be connected with the outfall by means of a pumping station. The estimated cost is $17,000.

The City Trustees of Gridley, Calif., have adopted a resolution providing for the installation of a sewerage system. Plans prepared by Engineer Carston have been accepted. The system will be built in four units, the first costing about $2,302.

Connecticut.

The Selectmen of Hazardville, Conn., contemplate letting a contract for the making of a survey and layout for a sewerage system. Frank Rosenberger is a member.

District of Columbia.

⊙The Engineering Department of Washington, D. C., has awarded the contracts for the construction of sewers in the valley of Broad branch and in Military road between Rock Creek Church road and Piney Branch road to the W. F. Brenizer Co., at $3,480 and $3,307, respectively.

⊙The Commissioners of the District of Columbia, Washington, D. C., have awarded contracts for constructing certain sewers in the District as follows, (1) bid on excavation, (2) bid on sewer brick masonry, and (3) bid on 15-in. pipe sewer: Warren F. Brenizer Co., Washington, sewers in valley of Broad Branch, (1) $0.18; (2) $14, and (3) $0.65. The same company secured the sewer on Military Road between Piney Branch and Rock Creek at the same prices. George Hyman, Washington, for constructing sewers on Military Road between Broad Branch Road and Connecticut Ave., at (1) $0.59, (2) $12, and (3) $0.70.

Florida.

✣Bids will be received until noon, Jan. 15, by Board of Bond Trustees, Arcadia, Fla., J. L. Jones, Secretary and Treasurer, for the construction of a system of sewerage in said city. The pipe will be furnished by the Bond Trustees and is now distributed where it is to be laid. Plans and specifications are now on file in the office of the city engineer at Arcadia. Each bid to be accompanied by certified check for $1,000, made payable to the Bond Trustees, City of Arcadia, Fla., as a guarantee that the successful bidder will execute a proper contract and bond in a guarantee company acceptable to the bond trustees, within fifteen days.

Illinois.

✣Bids will be received until 11 a. m., Jan. 13, by Department of Public Works, L. E. McGann, Commissioner, Chicago, Ill., for furnishing and delivering to various pipe yards salt-glazed hard-burned tile sewer pipe. A certified check for $100 must be filed with each bid.

⊙Following contracts for constructing sewers have been awarded by the Board of Local Improvements of Chicago, Ill.: N. 56th Ave., Wrightwood Ave. to Fullerton Ave., 1,330 lin. ft., 2 ft. single ring brick, 8 manholes, 14 catchbasins, total $3,790, The Ryan Co., 10 S. La Salle St.; E. 106th St., Ave. H to Ave. F, 670 lin. ft. of 3-ft. double-ring brick, Ave. F to Ave. C, 690 lin. ft. 2½-ft. double-ring brick, Ave. C to Indianapolis Ave., 850 lin. ft. 2-ft. double-ring brick, Ave. G, 40 lin. ft. 12-in. tile pipe, 105th St. to 107th St., 320 lin. ft. 18-in. tile pipe, E. 107th St. to E. 108th St., 40 lin. ft. 12-in. tile pipe wing sewers, 80 lin. ft. 15-in. tile pipe, 30-in. cast iron pipe, 6 manholes and 41 catchbasins, Cleary Bros., 5536 Winthrop Ave.; Edward T. Glackin, Secy. of Board.

Plans have been prepared by City Engineer Edw. O. Hills of Fulton, Ill., for the construction of sewers at an estimated cost of $29,839. Contracts will be let about March 1.

The Chicago City Council on Jan. 2, 1913, authorized the Bureau of Sewers to purchase sewer cleaning machinery, tools, etc., for the year 1913 to the extent of $3,100. Date of purchase has not been announced. L. E. McGann, Commissioner of Public Works.

The Chicago City Council on Jan. 2, 1913, authorized the purchase of sewer pipe of various sizes for use during 1913 as follows: Special Park Commission, A. W. Beilfuss, Chairman, $200; Dept. of Electricity, Roy Palmer, City Electrician, $300; Bureau of Sewers, $1,000; Water Pipe Extension Dept., $5,000, L. E. McGann, Commissioner of Public Works. Date of letting contract has not been announced.

The Board of Local Improvements of Bloomington, Ill., has approved the estimate for the cemetery sewer amounting to $6,573 and passed an ordinance providing for the same.

The City Council of DeKalb, Ill., has passed an ordinance providing for the construction of a system of sewerage. It is intended to install this system the coming summer.

The city of Milan, Ill., is preparing to put in a storm drain and sewer.

City Engineer E. O. Hills of Fulton, Ill., has completed the new estimate for the installation of a sewerage system and the same has been accepted by the City Council.

City Engineer John Schwaab of Upper Alton, Ill., has submitted plans to the City Council for the construction of a sewer system. According to the plans there will be little difference in the cost of the septic or pipe sewer for the west side of Upper Alton but on the east side the difference will amount to about $13,000.

The citizens of Byron, Ill. (population 932), recently voted the issuance of bonds to the amount of $11,000 for an extension of the sewerage system.

The Board of Local Improvements of Wilmington, Ill., on Dec. 31 held a meeting with the property owners to discuss the proposed sewerage system which is estimated to cost $30,777, and the proposed water system which is estimated to cost $31,710. Plans and specifications have been prepared. W. H. Carter is Secretary of the Board.

Indiana.

The Board of Public Works of Fort Wayne, Ind., has adopted a resolution for the construction of a sewer to drain North Wayne Heights. The sewer will connect with the Third St. drain and will be built so that it eventually can be made a portion of a comprehensive system that is intended to drain all of Bloomingdale and Spy Run.

The Board of Public Works of Elkhart, Ind., has adopted resolutions providing for the construction of the Clinton St. and alley sewer, and the Cassopolis St. sewer.

Iowa.

Plans have been prepared by Consulting Engineers M. Tschirgi & Sons, Cedar Rapids, Ia., for the construction of new sewers in Belmond, Ia. The work will include two miles of sewers and a septic tank. Contracts will be let some time this winter.

Kansas.

✣Bids will be received until Jan. 14 by L. R. Wallace, City Clerk, Yates Center, Kan., for the construction of a sewer system. The cost of the work is estimated at $80,000. Worley & Black, Kansas City, Mo., are Engineers.

✣Bids will be received until 7:30 p. m., Jan. 15, by G. E. Strauchon, City Clerk, Ottawa, Kan., for the construction of a main sewer in King St. and a lateral sewer in District No. 56. The work will include furnishing and laying approximately 1,870 lin.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ft. of 10-in. vitrified sewer pipe and 1,600 lin. ft. of 8-in. vit. sewer pipe. Plans and profiles are on file with the city engineer. A certified check for $100 must be filed with each bid.

The Kansas State Board of Health has notified the officials of Garden City, Kans., that the main sewer trunks must be enlarged so as to provide better facilities.

Engineer J. H. Dousman of Kansas City, Mo., will prepare plans and estimates for a plant to take care of the sewage overflow for the city of Salina, Kans. Paul Wakenhut is City Engineer.

Louisiana.

The City Council of Shreveport, La., on Jan. 2 considered an ordinance providing for a bond issue of $250,000 for city improvements. The proposed improvements include the resurfacing of many paved streets, graveling of thoroughfares connecting with model good roads built by the parish, building of several storm sewers to serve suburban sections, extension of the paving system and the purchase of the cross lake lands for a water supply for Shreveport.

Maryland.

✣Bids will be received until 11 a. m., Jan 22, by Board of Awards, at the office of City Register, Baltimore, Md., for constructing District No. 8, Sanitary Contract No. 107. Specifications may be had upon application to H. W. Rogers, secretary of the commission, 904 American Bldg., Baltimore, Md. A certified check of the bidder on a clearing house bank, made payable to the order of the Mayor and City Council of Baltimore, in the sum of $3,500.00 will be required to be deposited with each bid. Approximate quantities are 35,000 lin. ft. vitrified pipe house connections; 39,000 lin. ft. vitrified pipe sewer, 8 ins. to 24 ins. in diameter. Official advertisement will be found elsewhere in this issue.

The plans proposed by Chief Engineer Robert B. Morse of the Bureau of Sanitary Engineering, State Department of Health, Baltimore, Md., for a sewerage system for Catonsville, Md., call for about 18 miles of sewers, four disposal plants consisting of settling tanks (one plant only temporary), hypochlorite also to be used in two of the permanent plants. The estimated cost is $106,000. No engineer has been chosen for detail design.

Massachusetts.

✣Bids will be received until noon, Jan. 14, by Department of Public Works, Boston Mass., for furnishing and erecting an automatic electric sewage pumping plant in Summer St., South Boston. Blank forms for proposals may be obtained at Room 57, City Hall.

The Sewer Commissioners of Fitchburg, Mass., contemplate installing the proposed sewage disposal some time during this year. It is proposed to let the contract as one contract instead of subdividing it. Harrison P. Eddy, Boston, is Consulting Engineer. David A. Hartwell is city official in charge of sewers.

Michigan.

The City Council of Escanaba, Mich., has called an election for Jan. 20 for the purpose of voting on the issuance of bonds to the amount of $117,000 for the construction of a sewerage system. T. Chalkley Hatton, Wilmington, Del., is Engineer.

✣Bids will be received until 10 a. m., Feb. 4, by Department of Public Works, Detroit, Mich., J. J. Haarer, Commissioner, for furnishing labor and material and erecting complete and put in operation an incinerating plant in the city of Detroit. A certified check payable to the Department of Public Works for $10,000 must be filed with each bid.

Plans will be prepared by City Engineer John W. Irwin of Mt. Clemens, Mich., for the construction of new sewers and extensions to the present sewers at an estimated cost of $50,000. The work will include 4 ft. sewer on Church St., North Ave. and Clemens St. Contracts will be let about March 1.

Minnesota.

⊙The City Council of Duluth, Minn., has awarded a contract for sewer laterals in Glen Avon, Seventh division, and Brookline division, to Bert Kribsback at $1,594.

Missouri.

✣Bids will be received until about Jan. 20, it is reported, by City of Richmond, Mo., for the construction of vitrified pipe sewers. The cost of the work is estimated at $18,000. Worley & Black, Kansas City, Mo., are Engineers.

City Engineer C. E. Phillips of Springfield, Mo., is preparing plans for at least nine sewer districts which will be connected with the mains provided by the recent bond issue of $70,000. It is probable that $50,000 will be expended for this work during the year.

The City Council of Maplewood, Mo., has passed an ordinance providing for the construction of sewers on Manchester Ave., between Big Bend road and the St. Louis city limits. About six blocks of new sewers will be constructed at an estimated cost of $15,000. S. W. Shinkel is City Engineer.

Montana.

The City Council of Missoula, Mont., has accepted the plans of Engineer C. W. Swearingen of Great Falls, Mont., for the construction of sewers in the south side. The plans provide for 19.15 miles of sewer at an estimated cost of $289,178. It is not probable that these sewers will be installed for some time.

New Hampshire.

Mayor William H. Barry of Nashua, N. H., has recommended to the City Council the extension of the Lake St. sewer system west. George P. Winn is City Engineer.

New Jersey.

⊙The Boroughs of Madison and Chatham, N. J., have awarded the contract for constructing special concrete and wood sewage conveyors for the four sand beds at the sewer plant to Charles H. Van Wert, at $545.

Engineer Edward S. Rankin of the Newark, N. J., Board of Public Works prepared plans and specifications for the construction of a sewerage system in Belleville, N. J., at an estimated cost of $308,111. The town officials plan to commence contsruction work in the spring.

New York.

⊙Peace Bros., 20 Main St., New York City, submitted the lowest bid to President Maurice E. Connolly, Borough of Queens, New York City, on Dec. 30, for the construction of the main outlet trunk sewer for the Corona district, which will drain more than 5,000 acres. The bid was $255,290. The section affected includes Corona, Elmhurst, Maspeth and Woodside, in the Second Ward, and Steinway and North Beach, in Long Island City. The trunk is to be constructed in 43d St. from the pierhead line to the bulkhead line and from the bulkhead line to Ditmars Ave., and in Ditmars Ave., from 43d St. to 51st St.

The State Health Department has approved the plans of Engineers Smith & Malcomson for the proposed trunk sewer and sewage disposal plant for Freeport, L. I. The village has been divided into three drainage areas, designated as the eastern, central and western sewer districts. The proposed sewers would vary in size from 8 to 24 ins. A pumping plant would be installed and provided with three centrifugal pumps, having a total capacity of 5,500,000 gals. The proposed sewage plant would consist of a settling tank, intermittent sand filters and auxiliary sludge beds.

Ohio.

⊙Following contracts have been awarded by the Board of Control of Canton, O., for the construction of a number of small sewers: Brown Ave., Erie St. and Bay St. sewer, John Skeeles, $1,091; Prescott Ave. sewer, John Skeeles, $1,673; Bank St. sewer, John Skeeles, $900; Brant Ave. sewer, Jones & Adessi, $1,230; West Third and Ralph St. sewer, George W. Luke, $1,776; Georgetown road, Taft St. and Otto St. sewer, John Skeeles, $725; Winfield Ave. sewer, George W. Luke, $1,117.

⊙Orr Webster of Put in Bay, O., has been awarded the contract by that village, E. H. Ritter, Clerk, for furnishing the necessary labor and material for the construction of sewers in Sewer District No. 1, at $287. Bids were opened Dec. 30.

City Council of Toledo, O., has passed an ordinance authorizing issue of $22,000 of bonds for a sewer to drain a marsh in North Toledo. Geo. W. Tonson is City Engineer.

Oklahoma.

A mass meeting of the citizens of Durant, Okla., was recently held for the purpose of discussing the advisability of extending the waterworks and sewer system to practically all portions of the city in the near future. It is proposed to issue bonds to the amount of $80,000 for the work.

Oregon.

Giebisch & Joplin of Portland, Ore., submitted the lowest bid to the City Council of that city on Dec. 30 for the construction of the East Glisan St. branch of the East Stark St. sewer system. The bid was $156,107. Other bidders were: Consolidated Contract Co., $159,731; Jeffery & Bufton, $158,230; James Kennedy Construction Co., $159,859.

Pennsylvania.

The citizens of Jenkintown, Pa., at a recent election voted the issuance of bonds to the amount of $75,000 to construct a modern sewerage system. J. K. Leatherman is City Clerk.

The City Council of Reading, Pa., has under consideration the enlargement of the present sewer system in the northeastern and northwestern sections of the city, comprising about one-third of the city. E. B. Ulrich is City Engineer.

The Town Council of Towanda, Pa. (population 4,281), recently approved plans for the construction of a sewerage system and disposal plant at an estimated cost of $96,510. E. Hainsworth is official in charge of sewers. S. B. Park is Borough Clerk.

Following bids were received Dec. 23 by the Department of Public Works, Bureau of Surveys, Philadelphia, Pa., for the construction of sewers: Branch Sewers—Emilio Pascuzzi, sewer in Frazier St., $3,000; Vincent Jafolla, sewer in Ludlow St., $1,400. Main Sewers—Adolph Jafolla, for Cobbs Creek intercepting sewer extension, $32,000; Emilio Pascuzzi, for Lincoln Ave. extension, $13,000. Reconstruction—Robert Higgins, Mill Creek sewer at 43rd St. and Woodlawn Ave., $25,000. George S. Webster is Chief Engineer and Surveyor.

Texas.

Plans will be prepared for the installation of a sewerage system in the town of Freeport, Brazoria County, Tex.

H. W. Cardwell of Lufkin, Tex., recently secured a franchise from the town officials of that place, L. H. Gray, City Secretary, to install a sewer system at an estimated cost of $15,000.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Washington.

Following bids were received by the Board of Public Works of Seattle, Wash., on Dec. 27 for the furnishing of 50 garbage wagons: Modern Carriage Co., $265 and $275 each; Star Carriage Co., $265 and $275 each.

West Virginia.

The Town Council of Berkeley Springs, W. Va., has had preliminary plans made for the construction of a sewerage system. The work will include about five miles of sewerage pipe, natural drainage, and disposal plant. G. C. Hunter of Berkeley Springs is official in charge.

Wisconsin.

Civil Engineer C. F. Leins of West Bend, Wis., has recommended to the special committee of the County Board, Juneau, Wis., the installation of a septic tank for the asylum and poor house, with the proper sewerage and drainage.

Consulting Engineer W. G. Kirchoffer of Madison, Wis., has been retained by the Common Council of Lake Geneva, Wis., to examine and report upon the plans and specifications for the installation of the proposed sewerage system.

Canada.

The City Council of St. Vital, Man., has passed a by-law authorizing the borrowing of $250,000 for sewer and water mains on St. Mary's road.

The city of Victoria, B. C., proposes the following sewer work for the year 1913. Northeast Sewer System—Oakland, 13 streets, $35,500; streets requiring sewers at once, completing Shelbourne St., sub-main from Ryan St. to North Dairy road, $37,000; northeast main sewer, Cedar Hill road to King's road, $17,000; northeast main sewer, Haultain, Victor and Cecil, $7,700. Northwest Sewer System—Northwest main sanitary sewer, $231,000; streets requiring sewering at once, $38,000. Extensions to Present System—Streets requiring sewers at once, $26,450. Surface Drain Extensions—Completing St. Charles St., surface drain, $11,000; main surface drain on Prior St. and King's road, $42,000; surface drains, $9,400; drains in conjunction with northwest system, $16,500.

The Board of Control of Toronto, Ont., has sanctioned an appropriation of $43,000 to carry out the sewerage system for Balmy and Kew Beaches. R. C. Harris is Commissioner of Public Works.

The ratepayers of Victoria, B. C., C. H. Rust, City Engineer, will vote this month on municipal by-laws embracing the following work: Sewers, $700,000. waterworks extensions, $50,000.

The ratepayers of Toronto, Ont., on Jan. 1 voted approximately $13,000,000 for improvements as follows: Waterworks extension at Scarboro, $6,677,000; addition to filtration plant at the Island. $1,375,000; storm overflow sewers, $954,000; garbage disposal, $1,000,000, and good roads, $100,000.

BUILDINGS

California.

Citizens of San Francisco have voted a bond issue of $1,700,000 to complete the city and county jail, the emergency hospital and the morgue; to complete the city and county hospital, and to erect separate buildings for the treatment of tuberculosis and other infectious diseases.

Delaware.

The State Legislature is to be asked to appropriate $125,000 for the proposed college for women to be erected in connection with the Delaware College at Newark. George A. Harter, Newark, Del., is President.

Georgia.

✣Bids will be received until noon, Feb. 4, by Chairman Board of Commissioners, Roads and Revenues of Clark County, at the office of Tate Wright, Clerk, Athens, Ga., for furnishing all labor and material for the erection and completion of a basement, three-story and mezzanine court house, covering an area of approximately 95 ft. 8 ins. by 139 ft. 4 ins. For plans and specifications address A. Ten Eyck Brown, Architect, 607-610 Forsythe Bldg., Atlanta, Ga.

Plans have been made and contracts will be let about Feb. 1 for a new electric light plant for the city of Eatonton, Ga. The estimated cost is $16,000. Solomon & Norcross, Atlanta, Ga., are the Engineers.

Illinois.

It is reported that the Loyal Order of Moose, Rodney H. Brandon, Secretary, Anderson, Ind., has decided on Aurora as the location for its proposed $1,500,000 industrial and agricultural school and aged members' home.

The Chicago City Council on Jan. 2 appropriated, contingent on bond issue, the sum of $250,000 for the construction of municipal bathing beaches and bathing pools.

The Chicago City Council on Jan. 2, 1913, appropriated, contingent on bond issue, the sum of $2,247,750 for the erection and equipment of new police stations at various locations throughout the city.

The Chicago City Council on Jan. 2, 1913, appropriated, contingent on bond issue, the sum of $70,000 for the construction and equipment of two new bath houses and extension of two old bath houses.

The Chicago City Council on Jan. 2 authorized the purchase of cement, sand, stone, etc., as follows: House of Correction, John J. Whitman, Supt., $1,130; Fire Dept., Chas. Seyferlich, Chief, $2,000; Special Park Commission, A. W. Beilfuss, Chairman, $600; Department of Electricity, Roy Palmer, City Electrician, $200; Bureau of Sewers, $1,250; Water Pipe Extension Department, $21,000. L. E. McGann, Commissioner of Public Works. Date of purchase has not been announced.

The Chicago City Council has authorized the purchase of twelve tile fire brick, fire clay, for boilers, furnaces, etc., as follows: Department of City Hall, $5.00. L. E. McGann, Commissioner of Public Works. Date of letting has not been announced.

The Chicago City Council on Jan. 3 authorized the construction of buildings as follows: Special Park Commission, A. W. Beilfuss, Chairman, shelter houses in small parks, $88,000; Department of Electricity, Roy Palmer, City Electrician, $35,000; Bureau of Streets, L. E. McGann, Commissioner Public Works, $6,000. Date of letting contract has not been announced.

The Chicago City Council on Jan. 2, 1913, authorized the construction of wading pools in Hamlin Park and Holden Park; cost not given. A. W. Beilfuss, Chairman Special Park Commission; Bridge Department, waterproofing, machinery rooms of various bridges, $10,000. L. E. McGann, Commissioner of Public Works. Date of letting has not been announced.

The Chicago City Council on Jan. 2 authorized the purchase of steel lockers for use in various pumping stations, $1,535. L. E. McGann, Commissioner Public Works. Date of letting contract has not been announced.

Indiana.

Plans for the new St. Francis Hospital to be located at Beech Grove, just outside of Indianapolis, are well along. The structure will cost about $350,000. D. X. Murphy & Bro., 140 South 5th St., Louisville, Ky., are the Architects.

Iowa.

✣Bids will be received until 4 p. m., Jan. 18, by Board of Education, Dubuque, Ia., T. C. Murphy, Secy., for the erection and completion of a new Grammar School building, as follows: Letting No. 1—General work; required deposit, $1,000. Letting No. 2—Plumbing and sewering; required deposit, $300. Letting No. 3—Heating and ventilating; required deposit, $750. Letting No. 4—Temperature regulation; required deposit, $250. Letting No. 5—Electric work; required deposit, $200. All bids must be made on printed blanks, which will be furnished for the purpose.

A company has been formed at Iowa City, Ia., with a capital stock of $100,000, for the erection of a 5 or 6-story hotel building at Washington and Dubuque Sts., in that city. W. P. Hohenschuh, Iowa City, is President.

Kansas.

⊙The Gray-Wimmer Construction Co., St. Louis, Mo., has been awarded the contract for rebuilding the passenger station of the Missouri, Kansas & Texas R. R., at Parsons, Kans., at a cost of $150,000.

Massachusetts.

✣Bids will be received until noon, Jan. 14, by the School House Department, Boston, Mass., for the construction of an elementary school in the Emerson District, East Boston. Blank forms for proposals may be obtained at the office of the Commissioners, 120 Boylston St.

Minnesota.

Plans are under way for a new factory building to be erected in the Midway District at Minneapolis for Brown & Bigelow, 176 E. 3rd St., Minneapolis, manufacturers of specialties and art calendars for advertisers. The building will be 3 stories high, of reinforced concrete and will cost $300,000. Construction work is to be started in the spring.

Mississippi.

✣Bids will be received until 11 a. m., Jan. 28, by Maj. C. A. F. Flagler, U. S. Engineer, Mobile, Ala., for building a storehouse and shed for shipyard at Pascagoula, Miss.

Missouri.

✣Bids will be received until noon, Jan. 14, by Board of Public Improvements, St. Louis, Mo., for the erection of Public Bath House No. 3. Plans, specifications, form of contract and other information may be had at the office of Maxime Reber, President of the Board.

✣Bids will be received until 9 a. m., Feb. 6, by County Court, Livingston County, at the office of A. M. Shelton, County Clerk, Chillicothe, Mo., for the necessary labor and materials for the construction of the proposed court house. Sasse & Roberts, 312 Exchange Bank Bldg., Columbia, Mo., are architects.

Plans are being prepared for an 18-story hotel structure to be erected at 12th and Olive Sts., St. Louis, Mo., for James H. McTague, St. Louis.

Negotiations are pending for the purchase of a site at the southeast corner of 7th and Chestnut Sts., St. Louis, Mo., for the erection of an 18 to 20-story hotel building. William Irvine Edwards, St. Louis, Mo., Manager of the Leathe estate, is interested.

Nebraska.

✣Bids will be received until 2 p. m., Feb. 4, by Commissioner of Indian Affairs, Washington, D. C., for furnishing labor and materials

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

necessary for the construction of two brick dormitories and a lavatory building and the extension of a steam heating system at the Genoa Indian School, Nebraska.

New Hampshire.

City of Rochester, N. H., may take up matter of establishing a municipal electric plant. At last session of State Legislature the city was authorized to appropriate $50,000 for establishing a light and power plant. F. B. Preston is Mayor.

An 8-story, steel frame, fireproof hotel building is to be erected at Vine and Concord Sts., Manchester, N. H., for Frank P. Carpenter, Manchester, and others. The R. H. Howes' Construction Co., Manchester, is reported to have the contract for the foundation work.

New York.

The State Fair Commission, Albany, is to ask the Legislature for an appropriation of $450,000 to provide for a new coliseum, a new poultry building, reconstructing the race track, removing the grandstand and building subways.

The State Legislature is to be asked to appropriate $250,000 for a new forestry college to be erected at the State College of Forestry, Syracuse University, Syracuse, N. Y. Hugh Baker is Dean of the college.

The Thorntons of Heuvelton, N. Y., are expected to be planning the expenditure of $30,000 for the erection of a dam and powerhouse at that place.

Bids have been asked on a $1,000,000 bakery building to be erected on Thompson Ave., Queens Pl., and Oston St., Long Island City, for the Loose-Wiles Co. of Kansas City, Mo., and Boston, Mass. William Higginson, 13 Park Row, New York City, is the Architect.

Ohio.

⊙The Hunkin-Conkey Construction Co., Cleveland, O., has been awarded the contract for the foundation work for the new Corrigan-McKinney steel plant in the flats at Cleveland, O. The contract for the structural steel work was let some time ago to the American Bridge Co. The new plant is to cover 40 acres of ground between Clark Ave. S. E. and Dille Ave. S. E. It will be on the east side of the river directly across from the company's blast furnaces. A short time ago the company obtained permission from the city council to span the river with a bridge connecting the two plants. The old plant, which consists of ore yards and furnaces for making pig iron, will be used in the future to supply the new mills, in which will be manufactured finished steel. One large central building will be devoted to the making of steel by the open hearth method. The general scheme also includes mills for the manufacture of merchant bars, plates and rails. Switching facilities on the new grounds will call for the laying of several miles of tracks. It is planned to have the plant completed and ready for business by 1914. Building construction and track laying will call for an expenditure of several millions. The contract with the Hunkin-Conkey Co., it is said, calls for an expenditure of several hundred thousand dollars in pile driving and in concrete foundation work.

A $125,000 hospital building to accommodate 400 patients is to be erected this year at the Massillon State Hospital. H. C. Eyman, Massillon, is Superintendent.

Plans are being prepared by Frank L. Packard, Architect, Hayden Bldg., Columbus, O., for a $250,000 memorial building to be erected this spring at Springfield, O.

Oregon.

The Pacific Power & Light Co., Guy W. Talbot, President, Spaulding Bldg., Portland, Ore., will begin construction work early this year on a 7,000 H. P. hydro-electric plant at Hood River. The plant and distribution system will cost about $750,000.

Pennsylvania.

⊙Cramp & Co., Denckla Bldg., Philadelphia, have been awarded the contract by the Board of Education of that city for the construction of two school buildings of 29 divisions each. The contract price is about $406,000.

⊙John R. Wiggins & Co., 717 Heed Bldg., Philadelphia, Pa., have been awarded the contract for building a 10-story office building, to cost $250,000, and to be erected on Arch St. and the Parkway, Philadelphia, for the Pennsylvania Mutual Life Insurance Co., 1619 Arch St. The building will be constructed of steel, granite, brick, concrete and terra cotta, and will be fireproof throughout.

Texas.

✣Bids will be received until Jan. 9 at the office of Green & Finger, Architects, Houston, Texas, for the erection of a 2-story bank and office building at Crosby, Texas.

✣Bids will be received until 2 p. m., Jan. 31, by J. B. Winslett, City Secretary, Dallas, Texas, for the erection and construction of the new municipal building on Main, Commerce and Harwood Sts., in the city of Dallas, Tex., according to plans and specifications on file in the office of C. D. Hill & Co., 723 Wilson Bldg., Architects. A certified check in the sum of $20,000 must accompany each bid submitted.

Utah.

⊙Contract for the excavation work for the State Capitol building at Salt Lake City was awarded to P. J. Moran of that city, at 15 cts. per cu. yd., on an estimated quantity of 70,000 cu. yds.

Washington.

✣Bids will be received until 11 a. m., Feb. 15, by H. R. Stanford, Chief of Bureau of Yards and Docks, Navy Department, Washington, D. C., for the construction of quarters for inspector of ordnance, a frame house, at the naval magazine, Puget Sound, Wash. The cost of the structure is estimated at $8,500.

Canada.

✣Bids will be received until 4 p. m., Jan. 22, by R. C. Desrochers, Secy., Department of Public Works, Ottawa, Ont., for the construction of an armory at Port Arthur, Ont. Plans, specification and form of contract can be seen and forms of tender obtained at the office of the City Clerk at Port Arthur, Ont.; at the office of H. E. Matthews, Esq., Superintending Architect of the Dominion Public Buildings, Winnipeg, Man., and at the Department. Tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and places of residence of each member of the firm must be given. Each tender must be accompanied by an accepted check on a chartered bank, payable to the order of the Honorable Minister of Public Works, equal to 10 per cent of the amount of the tender.

Bids will be asked about Feb. 15 on a concrete stadium to be erected for the city of Vancouver, B. C., at a cost of $300,000. Wm. McQueen is City Clerk of Vancouver. Heath & Grove, National Realty Bldg., Tacoma, Wash., are the Architects.

Ratepayers of Victoria, B. C., will vote this month on by-laws authorizing $290,000 for school building and $125,000 for sea water baths. W. J. Dowler is City Clerk of Victoria.

Michael Shea of Shea's Theater, Toronto, Ont., and associates, propose the erection of a new theater in Toronto which will have a seating capacity of 3,000 and will represent an investment of $750,000. The building is to be of brick and steel construction, and fireproof throughout.

The United States Steel Corporation E. H. Gary, Chairman, New York City is understood to have plans well along for the establishment of its proposed plant at Sandwich, Ont., just opposite Detroit, Mich. It is proposed to build a wire mill, rail mill, structural mill and bar mill, and the first cost will be in the neighborhood of $20,000,000.

Preliminary sketches have been prepared for the erection of a group of buildings for a girls' academy at Vancouver, B. C. It is planned to construct the buildings this year. The cost will be about $350,000. Robert F. Teagen, Swetland Bldg., Portland, Ore., is the Architect.

RIVERS AND HARBORS

California.

⊙The Mercerau Bridge & Contracting Co., Los Angeles, Cal., has been awarded the contract, at $55,390, for constructing a municipal pier for the city of Hermosa Beach, Cal.

District of Columbia.

✣Bids will be received until 2 p. m., Feb. 1, by Bureau of Lighthouses, Department of Commerce and Labor, Washington, D. C., for furnishing material and labor necessary for the construction, equipment and delivery of two steel light-vessels, Nos. 96 and 98, in accordance with plans and specifications, copies of which, with blank proposals and other information, may be had upon application to the Commissioner of Lighthouses, Washington, D. C.

✣Bids will be received until noon, Jan. 10, by William Crozier, Chief of Ordnance, Washington, D. C., for furnishing two sets of steel forgings for 14-in. guns, Model 1910.

✣Bids will be received until 10:30 a. m., Jan. 27, by Maj. F. C. Boggs, General Purchasing Officer Isthmian Canal Commission, Washington, D. C., for furnishing lumber under Canal Circular 754.

Florida.

✣Bids will be received until noon, Jan. 23, by Capt. J. R. Slattery, U. S. Engineer, Jacksonville, Fla., as noted in our Jan. 1 issue, for furnishing material and raising jetty at entrance to St. Johns River, Fla. The work is located at the entrance of the St. Johns River, Fla., where two jetties, consisting mostly of rip-rap, have been built, one extending from east shore and converging until on the outer shoal they become parallel and 1,600 ft. apart. The north jetty is 13,000 ft. long and the south jetty is 11,000 ft. long. The crests of the jetties have been built to the height of high water and higher in place. Portions of the jetties have been lowered by wave action. It is proposed under the contract to build up the portion of the north jetty between points 4,000 and 8,000 ft. from the shore where the crest of the jetty averages about 2 ft. above mean low water. Sand has accumulated along the inner side of this portion of the jetty so that, as shown by the survey of June, 1912, between points 4,000 ft. and 5,000 ft. from the shore the bottom is bare at low water. Elsewhere along the inner side of this portion of the jetty depths varying from 1 to 5 ft. at mean low water are found. The estimated quantity of stone required is 36,000 tons.

✣Bids will be received until noon, Jan. 30, by Capt. J. R. Slattery, U. S. Engineer, Jacksonville, Fla., for the alteration of dredge, Jacksonville.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Bids were opened Dec. 30 by the U. S. Engineer at Jacksonville, Fla., for dredging and rock removal in channel from Clearwater Harbor in Tampa, Fla., the bids received being as follows: (1) Bid on 5,239 cu yd. rock, (2) bid per cu, yd. on 17,865 cu. yds. soft material; (3) total: Hillsboro Dredging Co., Tampa, Fla. (probable contractor), $1.65, (2) 15½ cts., (3) $11,413; Home Dredging Co., Mobile, Ala. (1) $4, (2) 20 cts., (3) $24,529; Southern Dredging Co., Mobile, Ala. (1) $3, (2) 80 cts., (3) $30,709.

Citizens of Pensacola, Fla., have voted a $300,000 bond issue for constructing municipal wharves and a $100,000 bond issue for a belt railroad. L. S. Thornton is City Engineer.

Illinois.

The Chicago City Council on January 2, appropriated contingent on bond issue the sum of $1,000,000 for the construction of an outer harbor.

Louisiana.

✣Bids will be received until 7:30 p. m., Jan. 22, by Board of Commissioners, Port of New Orleans, New Orleans, La., for the construction of the Pauline St. wharf, the materials for which are to be furnished by said Board. Deposit: $1,000 cash or certified check. Bond: In full amount of the contract. Plans, specifications, proposal forms, etc., are on file in the office of the Engineer, A. C. Bell, Suite 200, New Orleans, Court Bldg., New Orleans, by whom full sets will be furnished on deposit.

✣Bids will be received until 7:30 p. m., Jan. 22, by Board of Commissioners, Port of New Orleans, New Orleans, La., for the construction of the Pauline St. wharf, the materials for which are to be furnished by the Board. A certified check for $1,000 must be filed with each bid. Plans, specifications, proposal forms, etc., are on file in the office of the engineer, A. C. Bell, suite 200, New Orleans Court Building, New Orleans, by whom full sets will be furnished on deposit of $15; said deposit will be refunded upon the return of the said set in good order.

Massachusetts.

⊙The Eastern Dredging Co., 247 Atlantic Ave., Boston, Mass., has been awarded the contract at the unit price of $18.90 for removing ledges and boulders from Harbor Cove, Gloucester, Mass. Bids were opened Dec. 26 by the State Board of Harbor and Land Commissioners, Boston, Mass.

Michigan.

Bids were opened Dec. 31 by Lt.-Col. Mason M. Patrick, U. S. Engineer, Detroit, Mich., for excavating a pit for the fourth lock at the St. Marys Canal, Sault Ste. Marie, Mich. MacArthur Bros. Co., Fisher Bldg., Chicago, Ill., at $288,140, were low bidders, and will probably be awarded the contract.

Minnesota.

The Duluth, Missabe & Northern Ry., H. L. Dresser, Chief Engineer, Duluth, Minn., will let contracts shortly for a concrete and steel iron ore dock to be erected at Oneota, near Duluth, at a cost of about $2,750,000. It will be 2,300 ft. long, 56 ft. wide, 80 ft. high, and will have 384 pockets of a storage capacity of 300 tons each. The pile-driving work will be done this winter and the concrete work during the summer.

New York.

⊙Contracts have been awarded as follows by Duncan W. Peck, State Superintendent of Public Works, Albany, N. Y., the work on which bids were opened Dec. 31: Terminal Contract 15. For constructing a harbor, dock wall, connecting channel, lock and dam adjacent to barge canal at Utica, to Albert M. Banker, Gloversville, N. Y., at $557,104; Contract C., Cayuga and Seneca Canal, Sec. 1, constructing locks, dams, etc., at Seneca Falls, to Larkin & Sangster, Ashley Bldg., Lockport, N. Y., at $1,187,047; Contract E, Cayuga and Seneca Canal, Sec. 1, constructing lock, dam, etc., at Waterloo, Cleveland & Sons Co., Brockport, N. Y., at $347,216.

New Jersey.

✣Bids will be received until noon, Jan. 31, by Col. W. T. Rossell, U. S. Engineer, Army Bldg., New York City, for dredging in South and Hackensack Rivers, N. J.

Pennsylvania.

Bids as follows were received Dec. 28 by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for dredging at the navy yard, Philadelphia, Pa.: Rickards Dredging Co., Real Estate Trust Bldg., Philadelphia, Pa., $9,640; American Dredging Co., 308 Chestnut St., Philadelphia, Pa., $9,750; August Nelson, 178 Donaldson Ave., Rutherford, N. J., $11,900.

Rhode Island.

✣Bids will be received until 11 a. m., Feb. 8, by H. R. Stanford, Chief of Bureau of Yards and Docks, Navy Department, Washington, D. C., for furnishing and installing direct current switchboard and station wiring at the naval torpedo station, Newport, R. I.

Texas.

⊙Isaac Heffron, Galveston, Tex., has been awarded the contract by the U. S. Government for building a brush and pile dyke from the Federal Quarantine Station in Galveston Harbor to the junction of the Texas City and Galveston channels. The contract price was $2.09½ per lin. ft., the total being $9,427.

Virginia.

✣Bids will be received until noon, Jan. 28, by Lieut. Col. Eveleth Winslow, Room 2, Custom House, Norfolk, Va., for the removal of the iron barge Florida sunk in Hampton Roads, Va.

Washington.

✣Bids will be received until 11 a. m., Jan. 28, by Col. W. H. Miller, Depot Quartermaster, Seattle, Wash., for repair work and installing new boilers for the U. S. Cableship Burnside.

The dock of the Chicago, Milwaukee & Puget Sound Ry., at Tacoma, Wash., is to be extended at a cost of $100,000. The work will be done by day labor.

Canada.

✣Bids will be received until 4 p. m., Jan. 20, by R. C. Desrochers, Secy., Department of Public Works, Ottawa, Ont., for the reconstruction and enlargement of the Old Railway Wharf (so called) at Dorchester, Westmoreland County, N. B. Plans, specification and form contract can be seen and form of tender obtained at the Department and at the offices of Geoffrey Stead, Esq., District Engineer, Chatham, N. B.; J. K. Scammell, Esq., District Engineer, St. John, N. B., and on application to the Postmaster at Dorchester, N. B.

✣Bids will be received until 4 p. m., Jan. 31, by R. C. Desrochers, Secretary, Department of Public Works, Ottawa, Ont., for dredging required at False Creek, Vancouver, B. C. Tenders will not be considered unless made on the forms supplied, and signed with the actual signatures of tenderers. Combined specifications and form of tender can be obtained on application to the Secretary, Department of Public Works, Ottawa, and to C. C. Worsfold, Esq., District Engineer, New Westminster, B. C. Tenders must include the towing of the plant to and from the work. Dredges and tugs not owned and registered in Canada shall not be employed in the performance of the work contracted for. Contractors must be ready to begin work within 30 days after the date they have been notified of the acceptance of their tender. Each tender must be accompanied by an accepted check on a chartered bank, payable to the order of the Honorable the Minister of Public Works, for 5 per cent of the contract price.

✣Bids will be received until 4 p. m., Feb. 10, by R. C. Desrochers, Secy., Department of Public Works, Ottawa, Ont., for the construction of two locks and dam in Quebec Harbor, Que. Plans, specification and form of contract can be seen and forms of tender obtained at the Department and at the offices of J. L. Michaud, Esq., District Engineer, Merchants Bank Bldg., St. James St., Montreal; A. R. Decary, Esq., District Engineer, Post Office, Quebec; C. E. W. Dodwell, Esq., District Engineer, Halifax, N. S.; F. G. Goodspeed, Esq., District Engineer, St. John, N. B., and J. G. Sing, Esq., District Engineer, Confederation Life Bldg., Toronto, Ont.

⊙Pettrick Bros., London, England, are reported to have been awarded the contract for constructing a dry dock and shipbuilding plant at Sault Ste. Marie, Ont., to cost $1,500,000. It is stated that work will be started about April 1. The plant and dock are to be erected for English shipbuilders.

City of New Westminster, B. C., is a busy plant for carrying out by day labor the work of dredging and making a fill for its proposed harbor improvement. A. O. Powell, Central Bldg., Seattle, Wash., is Engineer in charge.

The Canadian Parliament will probably appropriate $3,000,000 for Georgian Bay Canal construction. This first appropriation will be sufficient to permit of the preparation of contract plans and the beginning of preliminary construction work.

Spain.

✣Bids will be received until Jan. 25 at the Ministerio de Fomento, Madrid, Spain, for the construction of outer breakwaters and wharves in Valencia Harbor, at an estimated cost of $3,500,000.

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The Growth of Efficiency in City Government.

The advance toward higher efficiency in conducting the business affairs of American cities which has been under way during the past few years, now seems to have effected a permanent betterment in the handling of municipal finances. The movement has been truly national in character as is evidenced by investigations of city expenditures in various cities. Such investigations have been made, for example, in Boston and New York in the East, in Chicago and Milwaukee in the Middle West, and in San Francisco in the far West. In many other cities throughout the country more or less thoroughgoing studies have been made of the uses to which city money is put, with a view to the elimination of the useless expenditure of public funds.

The movement is so young, so far as results go, that its developments are well within the memory of our youngest readers. Naturally the movement grew out of widespread dissatisfaction with former methods, and the causes of their inadequacy were fairly well recognized before the remedy was applied. Although the movement is young it is interesting to review its developments. A study of its progress illustrates the rapidity with which leaders of thought now shift from one angle of attack to another.

The first municipal bureaus to take up the work of introducing better business methods in city government were called "economy" bureaus. Without regard to the accepted meaning of the word economy in its general use, as a municipal reform slogan it never met with the same popular favor which later has been shown toward the word efficiency. For some reason economy seemed to suggest parsimony to the popular mind. Of course the popular attitude was largely influenced in this as in other things by the opinions expressed in the popular press. It was felt by many that the introduction of economy meant the reduction of necessary expenditures for needed improvements in a growing community. However, the word efficiency was promptly taken up as embodying all the good thought conveyed in the word economy and more besides. The latter word was accepted as meaning, in one sense, not simply the saving of money but the subsequent use of the money saved for other public uses. The thought of efficiency was readily associated with the thought of collecting data in a scientific and systematic manner and in basing reforms on the facts so brought out. Any observer will recall how readily the movement toward efficiency in city business management was met with hearty acceptance by the press and public.

We have spoken many times of the great amount of good which has grown out of the investigation of city expenditures which was made in Chicago by a committee of the city council. The good work started by that committee is now being carried on by the Efficiency Division of the Civil Service Commission. An example of one of the studies made by this division appears elsewhere in this issue: the study of the cost of municipal refuse collection and disposal in this city. In Milwaukee for a total expenditure of $33,000 the Bureau of Economy and Efficiency recommended reforms which, if put into effect, will result in an annual saving of $150,000.

The experience of San Francisco serves well to illustrate the saving effected by two phases of the efficiency movement, namely, the purchase of all city supplies on specifications, and the adoption of motor vehicles.

One year prior to letting a contract for coal the city council of San Francisco received two bids; one was $14.90 and the other $14.20 per ton. Service tests of the two grades of coal were made and it was found that the added expenditure of 70 cts. per ton incurred in buying the higher priced coal, resulted in the production of 2½ times the steam production effected by the cheaper coal. As stated by Charles A. Murdock, a member of the Board of Supervisors, the Board felt that they were actually awarding the contract to the lowest bidder when by adding 5 per cent to the purchase price they increased the value of the thing purchased by 150 per cent.

In the use of motor conveyances San Francisco has realized a large saving over the corresponding expenditures arising from the use of the supplanted conveyances. In the police department it was found that the use of a motorcycle enabled one man to accomplish in one day what, under the old conditions, had taken the time of 2 men for 2½ days. The Board found that the Bureau of Electricity was using a great many horses and buggies in making inspections. The purchase of a small runabout for $525 enabled the inspector to increase the number of inspections made from 12 to 30 per day. Under the former system of operation the city paid $545 per year for horse hire for each inspector. With the introduction of the motor vehicle at least half of the inspectors can be dispensed with. Mr. Murdock reports a similar saving all along the line from the use of motor vehicles.

The illustrations here used are merely typical examples of what is being done in the way of improving the efficiency of conducting the business affairs of cities throughout the country. This evidence of permanent improvement in city business management should be particularly gratifying to engineers, for not only were city engineers among the first and most persistent advocates of reform in this matter, but the scientific studies upon which specific economies have been based were made, in the majority of cases, by engineers.

GENERAL ARTICLES

Method and Cost of Constructing a 9½x8½ Ft. Rock Tunnel for Mine Haulage.

A number of the methods adopted in driving 3,267 ft. of rock tunnel for the Mammoth mine in California, as described in the "Engineering & Mining Journal" for Dec. 21, 1912, will be found useful by tunnel men generally.

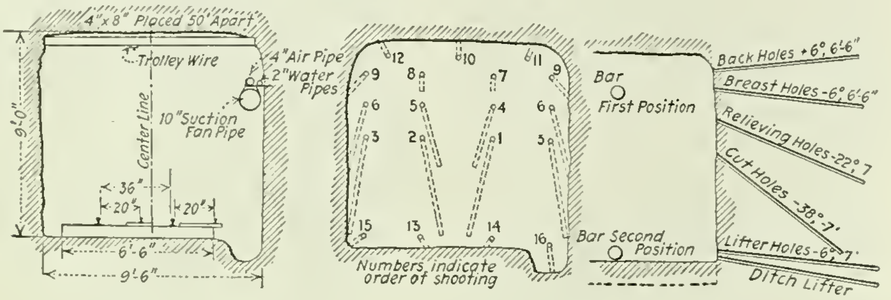


Fig. 1—Cross Section and Drilling Diagram, Mammoth Tunnel.

The cross-section of the tunnel is shown by Fig. 1, but the actual ground broken averaged 10x9 ft. or 90 cu. ft. per foot advance. The following is a condensed summary of the plant and operations and of the costs obtained:

Permanent 50 lb. rails were laid on 6x8 in. ties, spaced 2½ ft. centers, forming the 36 in. gage haulage line. Two 16 lb. rails were laid temporarily, forming with the 50 lb. rails, two 20 in. gage tracks used for the narrow-gage 14 cu. ft. dump cars while driving the tunnel. Later it was found that by using the cross-over switch and "slick-sheet" device, as shown in Fig. 2, it was only necessary to lay one temporary 16 lb. rail between the permanent 36 in. gage 50 lb. rail track to handle the material as broken in the face, with the exception of the stretch between movable slick sheet and face and near portal, where the four tracks were laid to facilitate switching the dump cars.

The tunnel was driven as an adjunct to the mine operation, and had no special equipment. The equipment used was: Five 3 in. Ingersoll-Sergeant rock drills; twenty 14 cu. ft. side or end-dump mine cars, 20 in. gage; one 6-ton electric locomotive for 36 in. gage track; one 10 in. exhaust fan driven by one 5-h.p. three-phase 220 volt motor; one 4x10 ft. air received; four 4x10 ft. slick sheets, ⅜ in. thick; one 6x10 ft. movable slick sheet for switching cars; one short movable cross-over 16 lb. track for switching, and four sets of temporary 16 lb. track, 30 ft. long, used ahead of permanent track to face.

Air at 85 lbs. pressure was furnished by the mine through a 4 in. pipe line about 700 ft. long. A 10 in. suction pipe, made of No. 18 iron, a 4 in. air line and a 1 in. water line were carried in the tunnel. The dump was of the usual type, one car at a time being dumped over the end.

During the earlier months of the work various plans of working were tried with different crews, but the one with which most of the tunnel was driven and which gave the cheapest results is given below:

7 A. M.-3 P. M.

Men.	Rate per day.
1 Foreman	$6.00
3 Machine men	3.50
2 Chuck tenders	3.25
3 Muckers	3.00
1 Trammer	3.00
1 Motorman	3.00
1 Pipeman	3.25
1 Single-hand miner	3.00

3 P. M.-11 P. M.

1 Shift boss	$4.00
3 Machine men	3.50
2 Chuck tenders	3.25
3 Muckers	3.00
1 Trammer	3.00
1 Motorman	3.00

11 P. M.-7 A. M.

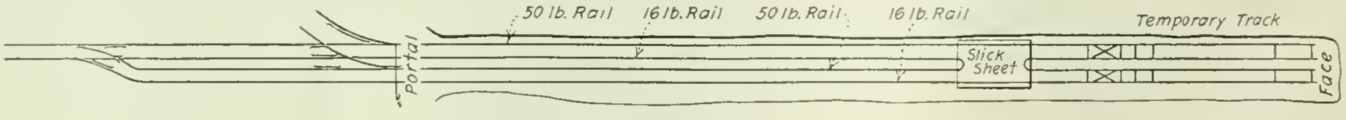
1 Shift boss	$4.00
3 Machine men	3.50
2 Chuck tenders	3.25
3 Muckers	3.00
1 Trammer	3.00
1 Motorman	3.00

Total, 35 men, costing $116.25 per day.

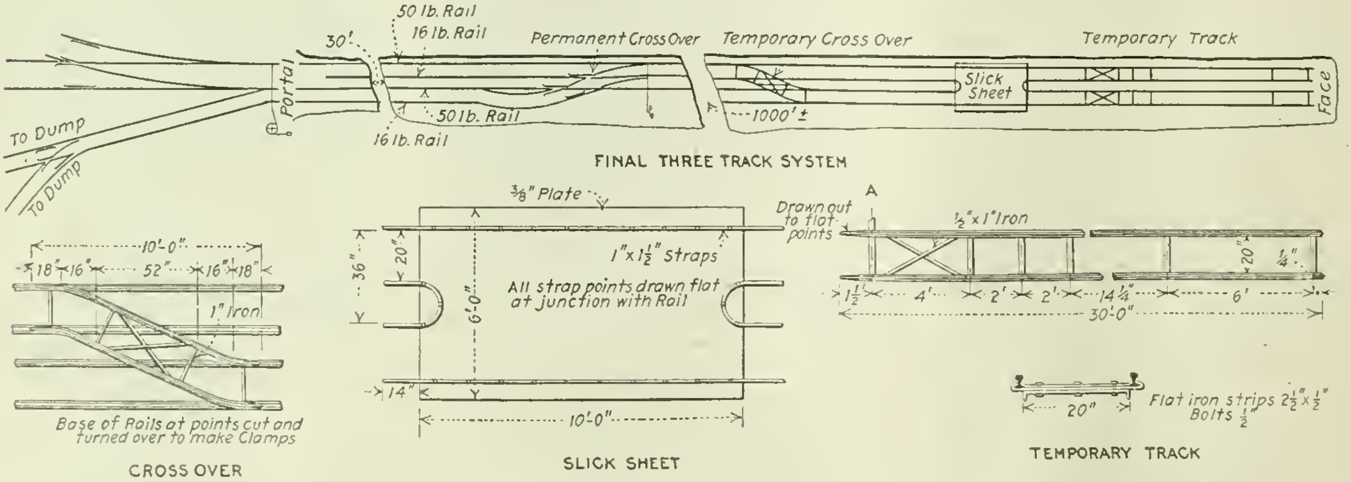
This force could drive and finish from 11 to 13 ft. daily in ordinary ground, the labor in the tunnel costing from $9 to $12 per ft. In the main heading, however, there were encountered many hard bars from 50 to 150 ft. thick, which necessitated a readjustment of the working force and retarded the progress greatly. These bars were difficult to drill. A machine which ordinarily could drill 11 ft. per hour in the usual porphyry could only drill from 2½ to 3½ ft. per hour in these stretches of silicified porphyries.

After the blast the crew waited from 12 to 45 minutes for the greater part of the gas to be drawn out, the variation in time being due to the grade of powder used; the 40 per cent powder used in good breaking ground permitting a much speedier return than the combination containing 60 per cent powder and 100 per cent strength blasting gelatin used in tough ground. As the tunnel progressed and the suction pipe of the fan grew to be over 1,000 ft. long, the fan's efficiency was noticeably decreased.

To overcome this defect somewhat the fan was moved in 1,063 ft. from the portal to a point in the main heading where a crosscut began, and was then operated as a suction machine from face to fan, and as a blower from fan to portal.



ORIGINAL FOUR TRACK SYSTEM



FINAL THREE TRACK SYSTEM

CROSS OVER

SLICK SHEET

TEMPORARY TRACK

Fig. 2—Track Layout and Details, Mammoth Tunnel.

A further change was also make, as the tunnel progressed, by taking out the 10 in. exhaust line for about 500 ft. back from portal and constructing in its place a wooden box, which was fitted over the new end of the 10 in. line and extended down into the tunnel drain, where it was covered tightly with plank and dirt packed over the plank. As the gas and smoke were forced out through the pipe

TABLE I.—COST OF NO. 5 TUNNEL, MAMMOTH MINE, CALIFORNIA. LENGTH 3,008½ FT.

Operation.	Labor.	Material.	Air.	Power.	Total.	Cost per foot.
Drilling	$14,355.99	$ 394.25	$3,629.18	....	$18,379.42	$ 6.109
Mucking	10,451.82	1,172.92	....	....	11,624.74	3.864
Timbering	206.91	300.96	....	....	507.87	0.169
Piping	812.54	2,511.63	....	....	3,324.17	1.105
Explosives	....	12,034.07	....	....	12,034.07	4.000
Making drill tools	49.57	1,075.18	....	....	1,124.75	0.374
Repair burleighs	131.31	1,002.69	....	....	1,134.00	0.377
Sharpening steel	814.92	....	....	....	814.92	0.271
Track and wiring	516.33	3,811.25	....	....	4,327.58	1.438
Electric lights	78.25	114.68	....	....	192.93	0.064
Electric tramming	2,448.54	401.19	....	$156.08	3,004.81	0.999
Repair cars and locomotive	153.40	627.36	....	....	780.76	0.260
Foreman	3,506.30	....	....	....	3,506.30	1.165
Superintendence, engineering and office	1,594.55	....	....	....	1,594.55	0.530
Widening tunnel	133.50	....	....	....	133.50	0.044
Total actual work	$35,253.93	$23,446.18	$3,629.18	$156.08	$62,485.37	$20.769
Pipeline to portal					556.80	0.118
Extension of tramroad					675.19	0.224
Grading for yards					1,573.11	0.523
Miscellaneous preliminary work					1,803.51	0.599
Total of all costs					$67,093.98	$22.23

to the wooden box, a spray shower attached to the 1 in. water line came in contact with the gas and smoke, causing instant absorption. The arrangement is shown in Fig. 3. By this means we could probably have taken up all of the 10 in. exhaust pipe by merely placing the box ahead in the tunnel as it progressed.

The fan was operated alone until five minutes before the men were to return, when compressed air was blown against the face in quantity, all that a 1 in. outlet could deliver, thus driving the gas back from the face. When the men return, one man connects the water hose and sprays the muck, roof and walls of the tunnel, to absorb the remainder of the gas, while the other three miners, with the boss, carry up the machines and blocking and commence to set up the bar.

A 5½ in. horizontal bar, 9 ft. long, was used and was set usually about 4 ft. back from the face and 2 ft. 8 in. below the back. The time used in setting up the bar, placing the three machines and connecting air hose varied from 25 to 55 minutes.

Meanwhile the muckers cleared the track of debris, put temporary tracks in place and commenced mucking. This usually took from 20 to 30 minutes. Three men mucked while one man trammed the loaded cars to a point about 100 ft. back from the face to a slick sheet laid over the rails, as shown in Fig. 2. This slick sheet was movable, and was pushed ahead as the tunnel progressed. The train was made up here, the one man tramming back and forth from the face with the empty and filled cars. A train consisted of about eight cars, and was handled and dumped by the motorman on each shift. There was at all times at least one empty car at the face into which the muckers could shovel. The first 10 to 12 ft. of the muck heap was shoveled from off the tunnel bottom and was slower work than when the slick sheets were reached. These slick sheets were four in number, and were laid about 25 ft. back from the face. When mucking from the sheets an output of from 16 to 20 cars per hour was obtained. Removing the last portion of the pile was slow work, as there were, of course, no sheets under the space occupied by the ground just broken, and the muckers worked beneath a light scaffolding carrying the machine men. The time required for removing the muck varied from 4½ to 8½ hours, averaging about 6½ hours.

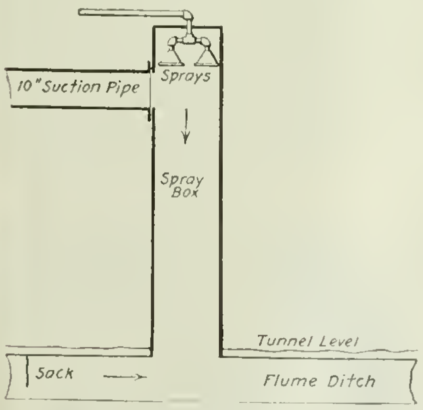


Fig. 3—Spraying Arrangement for Deadening Gases.

The air hose for the drills was held above the head of the muckers by two extension rods placed in hitches in the sides, and shown in Fig. 4. The cars used were ordinary mine cars of 14 cu. ft. capacity, much too small for effectiveness in this class of work. As the muckers removed the rock on which the machine men were standing they set two ladders against the walls, and two or three planks set in these ladders formed the scaffold for the machine men to stand on while the muckers removed the last of the rock from beneath them.

TABLE II.—DAILY AND MONTHLY PROGRESS, MAMMOTH TUNNEL.

Month.	Days worked.	Feet per month.	Feet per day.
April, 1911	18	217	12.06
May	31	309	9.97
June	30	310	10.33
July	30	274	9.13
August	31	327	10.55
September	30	347	11.57
October	31	395	12.74
November	30	347	11.57
December	29	260.5	8.98
January, 1912	26	222	8.54
Totals	286	3,008.5	
Average feet per day			10.52

In easy ground the machine men could finish the holes above the bar before the muckers had completely cleared the face; in this case the machine men shoveled the muck back on the slick sheets, where the muckers loaded it into cars. The muck cleared, except a few cars for covering the sheets, the muckers pulled the sheets ahead, covered them with loose dirt and then carried back the temporary track and steel, etc., preparatory to blasting.

The machine men drilled 15 holes above the bar; three back holes looking up about six degrees, four breast holes looking down six degrees, four relievers looking down 21 degrees and four cut holes looking down 38 degrees, as shown in Fig. 1. This took from 4½ to 12½ hours, averaging about 6½ hours. The bar was then taken down and set about 24 ins. above the bottom and four lifters drilled. It took from 12 to 25 minutes to reset the bar and place the three machines on it. Drilling the lifters took from 1½ to 4½ hours, averaging about 1¾ hours. It took about 10 minutes to remove the bar and machines.

The holes were the following lengths: Back, 6 ft. to 6½ ft.; breast, 6½ ft.; relievers, 7 to 7½ ft., and lifters, 7 ft. Two sticks of high-grade explosive (60 per cent-100 per cent) were placed in the bottom of the holes, followed by the primer also in high-grade powder. Then from three to seven sticks of 40 per cent finished the charge. In no case was it found advisable, in point of cheapness or efficiency, to load a hole for more than three-quarters of its length.

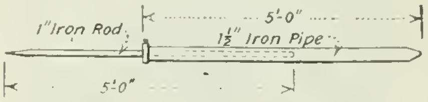


Fig. 4—Telescope Bar for Supporting Air Hose.

During several months clay tamping was used with beneficial results in tough ground. The primers were made up by the foreman using fuse cut to lengths varying from 6 ft. 3 ins. to 10 ft. 3 ins. by 3 in. graduations. The prepared primers were carried to the face in a pigeon-hole box, corresponding to the holes as drilled in the face, and were handed to the loaders by the boss as needed.

Pacific fuse and 6-X caps were found most effective. The fuse was doubled only on the lifters, and the water-hole caps were "doped" with an armature compound. The fuse ends were split, gathered into four bunches and split by four miners simultaneously. Loading, including blowing out the holes, took about 40 minutes. In tough ground it proved advisable to shoot the cuts and lifters first, then to reshoot these with the whole round. The advance per round obtained varied from 3½ to 6½ ft., averaging a little under 5 ft. The powder used per foot advanced varied from 16½ to 35 lbs., averaging about 24 lbs. The most effective combination of powder was found to be one-third 100 per cent blasting gelatin and the balance 40 per cent dynamite.

Permanent track laying was done two to three times per week on the day shift by the entire force, exclusive of the miners. It was commenced as soon as the face was cleared of muck and was nearly always completed while the miners were drilling the lifters. Two rails, weighing 50 lbs. per yd. and 33 ft. long, together with the same length of 16 lb. temporary rails, were laid at one time, the 50 lb. rail being laid permanently, to grade and line given by the mine surveyor. Ahead of these rails, as the tunnel progressed, were laid the two sets of 16 lb. movable track 30 ft. long, as shown in Fig. 2. The laying of track took from 2½ to 3 hours, and usually delayed the machine men from ¾ to 1¼ hours. Had the

TABLE III.—COMPARISONS OF COST PER FOOT, MAMMOTH TUNNEL—BI-WEEKLY PERIODS.

Operation.	One Heading.		Two Headings.		
	Lowest June 11 to June 24.	Highest June 25 to July 8.	Lowest Oct. 1 to Oct. 14.	Highest Nov. 26 to Dec. 9.	Average cost per foot.
Drilling	$ 4.780	$13.765	$ 5.519	$ 6.409	$ 6.109
Mucking	2.918	4.216	3.455	3.728	3.864
Timbering	0.121	0.257	.....	0.217	0.169
Piping	1.076	0.800	0.206	0.778	1.105
Explosives	4.047	8.276	3.614	3.841	4.000
Making drill tools	0.381	0.697	0.038	0.021	0.374
Repairing burleighs	0.392	0.862	0.281	0.403	0.377
Sharpening steel	0.164	0.513	0.162	0.165	0.271
Track and wiring	1.123	2.662	0.840	3.027	1.438
Electric lights	0.025	0.002	.....	0.020	0.064
Electric tramming	1.638	3.097	0.847	0.927	0.999
Repair cars and locomotive	.....	.....	0.115	0.153	0.260
Foreman	1.178	1.532	1.094	1.206	1.165
Superintendence, engineering and office	0.472	0.974	0.469	0.511	0.530
Widening tunnel	.....	.....	.....	.....	0.044
Total	$18.315	$37.653	$16.640	$21.406	$20.769
Feet of advance	163	79	164	151	3,008.5

track been of a lighter weight, faster progress could have been made in the tunnel.

From Aug. 18 to Dec. 21 two headings were driven, but there was no increase in the working force. Two headings enabled the delay caused by waiting for smoke, and that due to setting up the bar, to be eliminated and shortened, the time per round from 1¼ to 1¾ hours. The rate of progress and the costs varied markedly, due to the extremely variable ground encountered.

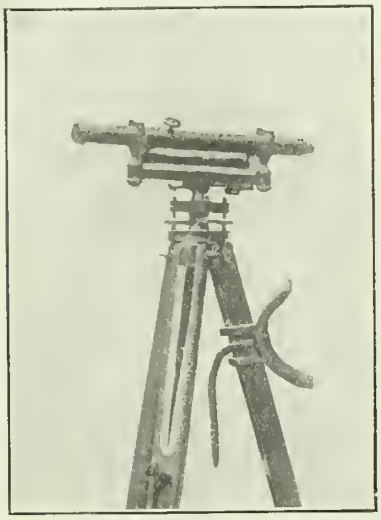


Fig. 1—View of Shoulder Pad Attached to Tripod Leg.

Table I gives costs covering the entire period, as well as high and low periods. These include all labor and supplies used in the tunnel, together with cost of powder, repairs to equipment, first cost of equipment and cost of supervision. Table II gives the average progress throughout, as well as by months.

A Shoulder Pad for Instrumentmen.

(STAFF ARTICLE.)

A pad which is designed to protect the shoulder in carrying surveying instruments has been placed on sale by Mr. F. A. Dee of Buffalo, N. Y. The pad is attached to the tripod as shown in the accompanying cut. The inventor believes that this pad will be welcomed by engineers and surveyors who have long distances to walk in going about their work. It sells for $1.50, prepaid.

The pad consists of a sheet iron plate enclosed between a leather covering on top and a heavy felt pad on the bottom. The leather and felt are stitched together, and the pad is shaped to fit the shoulder. It is unnecessary to remove the pad from the tripod when the instrument is in use.

Method of Reducing the Vibration of Jaw Crushers.

The rock crusher with a vibrating jaw has been developed to such size that the horizontal forces are of considerable magnitude when the crusher is running at reasonable speed. It is not an uncommon sight to see such crushers working loose on good foundations, or seriously jarring buildings in which they are placed. These conditions have been met by stronger anchoring and bracing but were it possible it would seem better to remove the cause by properly balancing the crushers. A method of doing this is suggested in a paper by Mr. O. P. Hood before the Lake Superior Mining Institute and we describe it as follows:

This paper describes the results obtained in counterbalancing a 36x24-in. crusher, and also gives the method devised for determining the proper counter weight.

The crusher was mounted on a truck resting on rails in such a manner that when the crusher was run by a vertical engine, carried on top of the crusher, the whole device of engine, crusher and car could vibrate freely on the rails. When the crusher was run at fifty revolutions per minute the vibration of the whole mass, weighing about 45 tons, was nearly ½ in. 45/100 in., to be exact. Since, in the manufacture of such machines, it is not the practice to balance the fly wheels, these were removed and carefully balanced so that the vibration could not be due to inaccurate fly wheels. When running at 50 revolutions per minute the vibration was then found to be increased to 48/100 in., showing that the position of the unbalanced mass in the fly wheels had partly counteracted the natural vibration due to the jaw. There was then placed within the rim of the fly wheel certain counterbalancing weights which had been computed. The crusher was then found to vibrate but 3/100 in. Reducing the free vibration from 48/100 in. to 3/100 in. can be called a practical balancing of the rock crusher, and this is done by the proper placing of a single weight in the fly wheel. It is, therefore, possible so to balance jaw rock crushers that they can be run at any reasonable speed without the vibration of buildings or the destruction of foundations. This method has been applied to old crushers already installed and the vibration eliminated.

In analyzing this balance problem a graphical method was devised which can be applied to many similar problems involving vibrating masses.

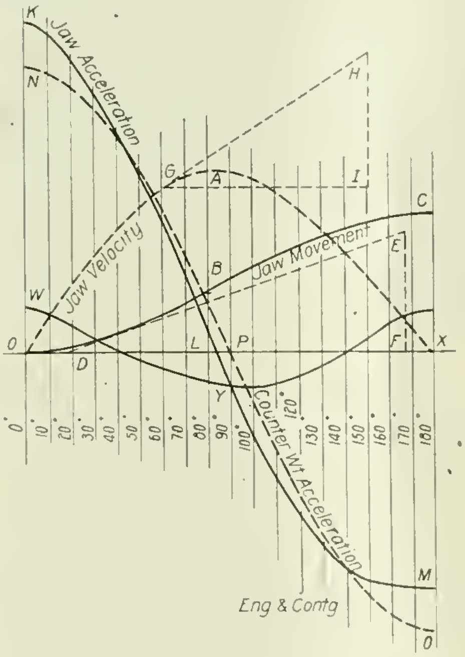


Diagram for Balancing Jaw Crushers.

The jaw of the crusher is moved forward by the raising of a pitman operated by an eccentric. The pitman spreads the ends of two inclined links, thus moving the jaw. The eccentric has a uniform rotative motion, so that equal angles are passed in equal times.

This train of mechanism is easily measured and reproduced on paper—and the successive positions of the jaw plotted for the different positions of the eccentric. This is shown by the distance of the curve *OBC* from the horizontal line *OX*. Distances along *OX* represent angular motion of the eccentric, and, since this motion is uniform, represent time. When the eccentric has moved 90° from its lowest point the jaw movement is represented by *PB*, and when it has moved 180° the jaw movement is represented by *XC*.

From this curve of jaw movement the velocity of the jaw at any instant can be found. Thus, if a tangent *DE* be drawn to the curve the jaw would have moved to distance *FE* in the time represented by *DF* if the jaw velocity has been uniform. Plotting the jaw velocities obtained in this way the curve *OAX* is obtained.

The rate at which the velocity of a mass is changing is a measure of the force acting on that mass, so that if we can obtain the rate at which the curve *OAX* is changing its direction we have a representation of the forces acting on the mass. This can be obtained also by drawing tangents to the velocity curve as at *G*, where, had the velocity continued to change uniformly at the same rate for the time *GI* the accelerations would have been *HI*. Plotting these several accelerations the curve *KLM* is obtained, which represents to some suitable scale the forces acting on the vibrating jaw necessary to produce its peculiar kind of vibration.

This curve looks very much like the curve that would result from an unbalanced rotating mass, except that it is unsymmetrical, having a greater value at 0° than at 180°. If an unbalanced rotating mass were added to the system which would have an acceleration as much too small at 0° as it was too large at 180° these forces would be represented by the curve *NPQ*. These forces could be put in opposite phase to those moving the jaw, so that they would form a counterbalance. The lack of agreement of the curves *K* and *N* would leave a small resultant, shown by the curve *WYZ*, as the remaining unbalanced forces. These remaining unbalanced forces are but a small per cent of the original forces, and their rate of alternation has been doubled. Doubling the rate of alternation would reduce the vibration to one-quarter of the original amount were there no reduction in the magnitude of the forces. It is interesting to note that the forces shown by the curve *WYZ* can be balanced by a suitable weight revolving at twice the speed of the main shaft. While this is possible it is neither desirable nor necessary on a rock crusher because the single weight produces a practical balance. This method of determining unbalanced forces is applicable to many mechanisms and its application might lead to the smoother running of many machines.

A Concrete Barrow With Special Dumping Device.

(STAFF ARTICLE.)

A wheel barrow which is dumped by pushing down on the handles and with half the work, it is claimed, that is expended in lifting the barrow in dumping by the ordinary method is illustrated here. The barrow calls for little description. When loaded, the steel body rests on the frame in virtually the same position in respect to the wheel and handles as does the body of the ordinary barrow. It can thus be dumped like an ordinary wheel barrow by tipping sidewise or by lifting the handles and dumping over the front edge, or it can be dumped as shown by the illustration. In dumping by pushing down on the handles it is easy to regulate the outflow to a thin stream in filling narrow forms or by a quick downward thrust to discharge the whole load suddenly. This barrow is known as the Long Self Dumping Wheel Barrow and is sold by Miller & Coulson, Pittsburgh, Pa.

A Wheel Barrow That Can Be Dumped by Pushing Down the Handles.

ROADS AND STREETS

Oil-Cement Concrete and Bituminous Concrete in Experimental Pavements on Hillside Avenue, Queens Borough, New York City.

During August and September, 1911, the U. S. Office of Public Roads in co-operation with the Bureau of Highways of Queens Borough, New York City, laid sections of experimental pavement on Hillside Ave., in Queens Borough. The work comprised nine experimental surfaces as follows: One oil-cement concrete pavement, four bituminous-concrete pavements and four bituminous-macadam pavements. A description of the work and the general specifications under which it was done were given in ENGINEERING & CONTRACTING of July 24, 1912. Further details are given in a circular issued recently by the U. S. Office of Public Roads, from which the matter in this article is taken:

The aggregate used in all the experiments was clean, crushed trap rock, screened according to the following grades:

Screenings: That product of the ordinary run of the crusher passing a ½-in. or ⅝-in. circular opening, including the dust of fracture.

¾-in. stone: Crushed rock passing the 1⅛-in. or 1¼-in. opening, but retained on the ½-in. or ⅝-in. opening.

1½-in. stone: Crushed rock passing the 2¼-in. opening, but retained on the 1⅛-in. or 1¼-in. opening.

⅜-in. stone: Screenings which are screened to remove practically all stone dust by passing over a ¼-in. or ⅜-in. screen.

The following tests on representative samples show the average grading of material received on the work:

Materials.	¾-in. stone. %	⅜-in stone. %	Stone screenings. %
Retained on 1-in. screen	1.2	...	...
Retained on ¾-in. screen	13.7	...	...
Retained on ½-in. screen	37.5	...	...
Retained on ¼-in. screen	40.3	46.0	14.8
Retained on ⅛-in. screen	5.4	50.2	35.9
Passing ⅛-in. screen	1.9	3.8	49.3

The equipment consisted of a concrete mixer with arrangement for heating the aggregate, a patented distributor with 350-gal. tank, and a 375-gal. heating kettle. These were loaned by the manufacturers. The 10-ton steam roller, small kettles, pouring pots, and tools were furnished by the Borough of Queens. The labor was furnished from the regular city force, which, with few exceptions, was composed of inexperienced and unsatisfactory workmen, and this fact is undoubtedly responsible for higher costs than should be the case for this class of work.

Experiment No. 1.—Oil-Cement Concrete.—Beginning with station 0 (at the N. Y. & Q. C. R. R.), this section extends to station 1 + 73 and includes the south intersection with Flushing Ave. The concrete was made up of 1 part by volume of Portland cement, 2 parts of sand, and 4 parts of stone, which was hard trap rock ranging in size from ¾-in. maximum to ¼-in. minimum diameter, and oil was added to the amount of 10 per cent, by weight, of the cement. The materials were mixed in a mechanical concrete mixer, and the most satisfactory results were obtained by the following procedure for each batch: About 3 gals. of water were put into the skip, followed by a barrow of stone, a barrow of sand, a bag of cement, and a barrow of stone in order mentioned. The stone was leveled down and the balance of the water necessary to form a wet concrete was added. The measured amount of oil was then poured over the wet stone, after which the skip was elevated and the contents were dumped into the drum and thoroughly mixed. The concrete was conveyed and dumped in place by wheelbarrows. It was placed to a depth of 4 ins. uncompacted in a single uniform layer across the entire width of and at right angles to the center line of the road. The surface was tamped with concrete tampers until water flushed to the surface. Any uneven places which developed were filled with trap-rock screenings, and the first 12.5 ft. of the section were finished by spreading a thin coat of these screenings over the wet surface. The remainder of the section was finished by spreading over the tamped concrete a mortar composed of 2 bags of cement, 2.5 cu. ft. of sand, 7.5 cu. ft. of screenings, and 8 qts. of oil. Square joints were formed between the days' work by butting the concrete against oiled 2x4 scantling.

From station 0 to station 0 + 97.2, a residual oil showing the characteristics under No. 1 in Table I was used, while the product of another manufacturer, and represented under No. 2, was used on the remainder of the section. The two parts of the section were separated by an expansion joint consisting of two courses of 3-in. wood block, laid on a sand cushion and filled with the fluxed native asphalt used in experiment No. 3. The section was closed to traffic for 28 days and was kept wet during the first 7 days of that period.

TABLE I.—ANALYSES OF RESIDUAL OILS USED IN EXPERIMENT NO. 1.

	(1)[1]	(2)[1]
Specific gravity 25°/25° C.	0.935	0.922
Viscosity, Engler, 100 c. c. at 50° C., specific	49.20	14.40
Per cent of loss at 163° C., 5 hours (20 grams)	1.19	2.91
Per cent of total bitumen insoluble in 86° B. paraffin naphtha	3.13	1.94
Per cent of fixed carbon	3.04	2.42
Per cent of bitumen soluble in CS_2 (total bitumen)	99.89	99.95
Organic matter insoluble	.11	.03
Inorganic matter insoluble	.00	.02
Total	100.00	100.00

[1] Fluid, greasy.

TABLE II.—TESTS OF PORTLAND CEMENT USED IN EXPERIMENT NO. 1.

Specific gravity 25°/25° C.	3.11
Per cent of water for normal consistency.	21.00
Initial set	2'15"
Final set	3'40"
Fineness:	
Per cent retained on 200-mesh sieve	20.6
Per cent retained on 100-mesh sieve	3.6
Pat in air 28 days	Sound.
Pat in water 28 days	Sound.
Pat steamed 5 hours	Sound.
Tensile strength:	
Neat 24 hours	443 lbs. per sq. in.
Neat 7 days	691 lbs. per sq. in.
Neat 28 days	651 lbs. per sq. in.
1:3 standard Ottawa sand 7 days	376 lbs. per sq. in.
1:3 standard Ottawa sand 28 days	483 lbs. per sq. in.
Per cent of magnesia (MgO)	3.05
Per cent of sulphur trioxide (SO_3)	1.05

Experiment No. 2.—Cut-back Oil-Asphalt—Mixing Method.—This section adjoins the oil-cement concrete section and is 299 ft. in length, extending from station 1 + 97 to station 4 + 96. This machine mixer was used and the charge for each batch consisted of 7.5 cu. ft. of the ¾-in. stone and 5.5 gals. of bitumen. Owing to considerable wet weather, the stone was frequently quite wet, and time was lost in drying it for three or four minutes by means of the hot-blast before the addition of the binder. The bitumen was melted in a 375-gal. tar kettle and heated to a temperature of about 240° F. before being poured into the skip of the mixer. The mixed aggregate was taken to the road in wheelbarrows and evenly spread on the foundation with rakes to insure a thickness of 2 ins. after rolling. The rolling was done on the day following that on which the mixture was laid, and in portions of the experiment there was considerable rainfall before the rolling took place. The characteristics of the bituminous binder used are shown in Table IV.

TABLE III.—TEST OF SAND USED IN EXPERIMENT NO. 1.

Per cent retained on 8-mesh screen	7.4
Per cent retained on 10-mesh screen	5.2
Per cent retained on 20-mesh screen	17.1
Per cent retained on 30-mesh screen	20.6
Per cent retained on 40-mesh screen	19.9
Per cent retained on 50-mesh screen	9.8
Per cent retained on 80-mesh screen	13.9
Per cent retained on 100-mesh screen	2.6
Per cent retained on 200-mesh screen	1.8
Passing 200-mesh screen	2.3
Total	100.0
Silt (by volume)	4.3

TABLE IV.—ANALYSES OF BITUMINOUS BINDERS USED IN EXPERIMENT NO. 2.

	Cut-back oil-asphalt.[1]	Oil-asphalt.[2]
Specific gravity 25°/25° C.	0.981	1.002
Melting point °C.	....	72.00
Penetration (5 seconds, 100 grams, 25° C. [mm.])	....	4.80
Viscosity °Engler 50 c. c. at 100° C. (time) seconds	324.60	....
Flash point °C.	149.00	....
Burning point °C.	194.00	....
Per cent of loss at 163° C., 5 hours (20 grams)	9.12	.18
Penetration of residue:		
(5 seconds, 100 grams, 25° C. [mm.])	18.60	4.2
(5 seconds, 100 grams, 4° C. [mm.])	....	1.2
Per cent of total bitumen insoluble in 86° B. paraffin naphtha	17.02	25.52
Per cent of bitumen insoluble in CCl_4	.00	.00
Per cent of fixed carbon	7.10	9.99
Per cent of paraffin scale	.12	.14
Per cent of bitumen soluble in CS_2 (total bitumen)	99.68	99.64
Organic matter insoluble	.15	.25
Inorganic matter insoluble	.17	.11
Total	100.00	100.00

[1] Sticky, very viscous. [2] Sticky, semisolid.

Owing to delay and a period of rainy weather, the application of a seal coat to this section was delayed for two weeks. The surface was then swept clean and an application of a heavy oil-asphalt, an analysis of which is also shown in Table IV, was applied by means of the distributor. The application was not as uniform as might be desired, and it was necessary to touch up with pouring pots a number of bare spots that were missed by the distributor when it became clogged. The seal coat was immediately followed by a layer of ⅜-in. stone, after which the surface was well rolled.

Experiment No. 3.—Fluxed Native Asphalt—Mixing Method.—This section adjoins the one just described and is 304 ft. in length, extending from station 4 + 96 to station 8 + 0. The method of construction was the same as in experiment No. 2, excepting for the fact that the seal coat was applied entirely with pouring pots. Considerable delay was occasioned by rain and consequent wet stone. The bitumen required more heating than that used in the previous experiment, and an average temperature of 340° F. was maintained in the heating kettle.

The characteristics of the material used in both the mixing and seal coat are shown in Table V.

Experiment No. 4.—Refined Coal Tar—Mixing Method.—This section adjoins the one just described and is 298 ft. in length, extending from station 8 + 0 to station 10 + 98.

TABLE V.—ANALYSIS OF FLUXED NATIVE ASPHALT[1] USED IN EXPERIMENT NO. 4.

Specific gravity 25°/25° C.	1.045
Penetration (5 seconds, 100 grams, 25° C. [mm.])	13.00
Per cent of loss at 163° C., 5 hours (20 grams)	3.31
Penetration of residue (as above)	5.50
Per cent of total bitumen insoluble in 86° B. paraffin naphtha	22.49
Per cent of fixed carbon	10.96
Per cent of bitumen soluble in CS_2 (total bitumen)	95.11
Organic matter insoluble	2.01
Inorganic matter insoluble	2.88
Total	100.00

[1] Sticky, granular, semisolid.

TABLE VI.—ANALYSIS OF REFINED COAL TAR[2] USED IN EXPERIMENT NO. 4.

Specific gravity 25°/25° C.		1.253
Float test at 50° C. (time)		1′51′
Per cent of free carbon (insoluble in CS_2)		22.42
Distillation:	Per cent by volume.	Per cent by weight.
Water	0.0	0.0
First light oils to 110° C.	.0	.0
Second light oils, 110-170° C.	[3] 1.2	.9
Heavy oils, 170-270° C.	[4] 17.6	15.1
Pitch residue	[5] 81.2	83.8
Total	100.0	99.8

[2] Very viscous fluid. [3] Solid. [4] Three-quarters solid. [5] Hard, dull, brittle.

The same method of construction as described under experiment No. 2 was pursued, and a refined coal tar having the characteristics shown in the following table was used. Each batch consisted of 10 cu. ft. of stone and 7 gals. of binder.

With a view to determining the relative value of coal tar and oil asphalt for a seal coat, the section was divided into two parts, and these subdivisions have been treated separately in the cost data. For the first 150 ft. of the section a seal coat of the tar used in the construction was employed, while the remaining 148 ft. were covered with a seal coat of the oil-asphalt used in experiment No. 2 and shown in Table IV. The application of both materials was made with pouring pots.

Experiment No. 5—Cut-Back Oil-Asphalt—Mixing Method.—This section adjoins experiment No. 4, and is 296 ft. in length, extending from station 10 + 98 to station 13 + 94. The experiment is in every way identical with experiment No. 2, excepting that a similar type of material from another manufacturer was used, and the seal coat was of the same material as was used in the aggregate. The bitumen was all applied with pouring pots. The analysis of the bituminous binder used was as shown in Table VII.

The material mixed well in batches of 10 cu. ft. of stone to 7 gallons of bitumen, and owing to improved organization of labor and more favorable weather conditions, the cost was lower than that of experiment No. 2.

TABLE VII.—ANALYSIS OF CUT-BACK OIL-ASPHALT[1] USED IN EXPERIMENT NO. 5.

Specific gravity 25°/25° C.	0.988
Penetration (5 seconds, 100 grams, 25° C. [mm.])	19.70
Flash point °C.	165.00
Burning point °C.; did not burn at	300.00
Per cent of loss at 163° C., 5 hours (20 grams)	5.20
Penetration of residue (as above)	6.90
Per cent of total bitumen insoluble in 86° B. paraffin naphtha	21.47
Per cent of total bitumen insoluble in CCl_4	.13
Per cent of fixed carbon	12.79
Per cent of bitumen soluble in CS_2 (total bitumen)	99.20
Organic matter insoluble	.68
Inorganic matter insoluble	.12
Total	100.00

[1] Sticky, semisolid.

Experiment No. 6.—Oil-Asphalt—Penetration Method.—This section adjoins experiment No. 5 and is 156 ft. in length, extending from station 13 + 94 to station 15 + 50. The general method of construction was to spread over the prepared foundation a single course of the 1½-in. stone to a depth of 3 ins., loose measurement. The course was rolled sufficiently without sprinkling to compact the fragments of stone, leaving the surface open enough to allow the hot bitumen to penetrate. The application of all the bitumen in this experiment was made by pouring pots and at the rate of 1½ gals. per square yard. The first application was immediately followed by an application of sufficient ⅜-in. stone to fill the surface voids completely, and the road was at once thoroughly rolled until solid.

TABLE IX.—ANALYSIS OF OIL-ASPHALT[1] USED IN EXPERIMENT NO. 9.

Specific gravity 25°/25° C.	0.996
Penetration (5 seconds, 100 grams, 25° C. [mm.])	11.60
Per cent of loss at 163° C., 5 hours (20 grams)	.21
Penetration of residue (as above)	7.40
Per cent of total bitumen insoluble in 86° B. paraffin naphtha	23.28
Per cent of total bitumen insoluble in CCl_4	.04
Per cent of fixed carbon	12.82
Per cent of bitumen soluble in CS_2 (total bitumen)	99.41
Organic matter insoluble	.50
Inorganic matter insoluble	.09
Total	100.00

[1] Sticky, semisolid.

TABLE VIII.—ANALYSIS OF OIL-ASPHALT[1] USED IN EXPERIMENT NO. 6.

Specific gravity 25°/25° C.	0.996
Penetration (5 seconds, 100 grams, 25° C. [mm.])	17.00
Per cent of loss at 163° C., 5 hours (20 grams)	.50
Penetration of residue (as above)	14.10
Per cent of total bitumen insoluble in 86° B. paraffin naphtha	18.62
Per cent of total bitumen insoluble in CCl_4	.00
Per cent of fixed carbon	8.29
Per cent of paraffin scale	.14
Per cent of bitumen soluble in CS_2 (total bitumen)	99.78
Organic matter insoluble	.17
Inorganic matter insoluble	.05
Total	100.00

[1] Sticky, semisolid.

The bitumen, an analysis of which is given in Table VIII, was used for the first application on the entire section and for a seal coat on the eastern half of it. As there was not sufficient of this material to finish the section, a seal coat of the oil-asphalt used in experiment No. 2 and shown in Table IV was applied to the western half. This was immediately followed by a light application of ⅜-in stone and thorough rolling.

TABLE X.—MATERIALS AND COST DATA OF OIL-CEMENT-CONCRETE EXPERIMENT AT JAMAICA, N. Y.

	Description.			Quantities of materials.					Cost data (cents per square yard).										Total cost.	
Experiment No.	Oil.	Length of section. (feet).	Area of section. (square yards).	¾-in. stone (cu. yds. per sq. yd.).	Sand (cu. yds. per sq. yd.).	Cement (bbls. per sq. yd.).	Screenings (cu. yds. per sq. yd.).	Oil (gallons per sq. yd.).	Preparing foundation.	¾-inch stone.[1]	Screenings.[1]	Sand.[1]	Cement.[1]	Oil.[1]	Mixing and laying.	Superintendence.	Watchmen.	Miscellaneous.	Cts. (per sq. yd.).	Entire section.
1A	Residual petroleum No. 1	97.2	269.9	0.091	0.049	0.140	0.009	0.650	12.30	24.13	2.38	4.33	18.84	4.73	34.00	6.73	14.09	7.06	128.59	$347.06
1B	Residual petroleum No. 2	75.8	301.4	.091	.049	.140	.009	.700	12.30	24.13	2.38	4.33	18.84	4.57	34.00	6.73	14.09	7.06	128.43	387.10

[1] Delivered on work.

TABLE XI.—MATERIALS AND COST DATA OF EXPERIMENTS AT JAMAICA, N. Y.

Mixing Method.

	Description.			Quantities of Materials.					Cost data (cents per square yard).														Total cost.			
Experiment No.	Bituminous binder.	Length of section (feet).	Area of section. (square yards).	1½-in. stone (cu. yds. per sq. yd.).	¾-in. stone (cu. yds. per sq. yd.).	⅜-in. stone (cu. yds. per sq. yd.).	Binder in mix (gals. per sq. yd.)	Binder in seal coat (gals. per sq. yd.)	1½-in. stone.[1]	Preparation.	¾-in. stone.[1]	⅜-in. stone.[1]	Binder in mix.[1]	Binder in seal coat.[1]	Preparing and laying mix.	Heating and applying seal coat.	Spreading ⅜-in. stone.	Rolling.	Superintendence.	Watchmen.	Miscellaneous.	Cts. (per sq. yd.).	Entire section.	Foundation and wearing surface (cts. per sq. yd.).	Entire section — foundation and wearing surface.
2-5	Foundation	1,197	3,325.0	0.038	....	....	...	...	10.10	12.30	....	...	....	....	....	...	...	...	...	....	...	22.40	$ 744.80	.....	.....
2	C.-B. oil-asphalt.	299	830.5	....	0.082	0.017	1.61	0.72	....	....	21.63	4.50	18.56	8.31	22.48	1.94	1.32	5.44	6.73	14.09	7.06	112.06	930.66	134.46	$1,116.69
3	Flxd. nat. asphalt	304	844.5	....	.088	.017	1.73	.82	....	....	23.18	4.50	23.04	10.93	22.46	1.20	1.27	5.43	6.73	14.09	7.06	119.89	1.012.47	142.29	1,201.64
4	Refined coal-tar[2].	150	417.0	....	.090	.017	1.69	.79	....	....	23.78	4.50	16.92	7.92	15.86	.84	.88	5.43	6.73	14.09	7.06	104.01	433.72	126.41	527.13
	Do[3]	148	411.0	....	.090	.017	1.69	.70	....	....	23.78	4.50	16.92	8.05	15.86	.86	.88	5.43	6.73	14.09	7.06	104.16	428.10	126.56	520.16
5	C.-B. oil-asphalt.	296	822.0	....	.085	.017	1.60	.75	....	....	22.45	4.50	14.08	6.60	15.57	1.23	.69	5.43	6.73	14.09	7.06	98.43	809.09	120.83	993.22

[1] Delivered on work. [2] Coal-tar, seal coat. [3] Oil-asphalt, seal coat.

Penetration Method.

	Description.			Quantities of materials.				Cost data (cents per square yard).										Total cost.			
Experiment No.		Length of section (feet).	Area of section (sq. yds.).	1½-in. stone (cu. yds. per sq. yd.).	⅜-in. stone (cu. yds. per sq. yd.).	Binder, first application (gals. per sq. yd.).)	Binder, seal coat (gals. per sq. yd.)	1½-in. stone delivered on work.	Preparation and spreading 1½-inch stone.	⅜-in. stone delivered on work.	Binder.	Heating and applying binder.	Spreading ⅜-in. stone.	Rolling.	Superintendence.	Watchmen.	Miscellaneous.	Cts. (per sq. yd.).	Entire section.	Foundation and wearing surface (cts. per sq. yd.).	Entire section — foundation and wearing surface.
6-9	Foundation	606.0	1,684.3	0.038	....	....	....	10.10	12.30	...	....	...	...	...	...	....	...	22.40	$377.28	.....	.....
6	Oil-asphalt	156.0	433.3	.083	0.025	1.52	0.77	22.00	3.67	6.63	26.33	4.27	1.26	5.16	6.73	14.09	7.55	97.69	423.29	120.09	$520.35
7	Refined coal tar	150.0	417.0	.083	.025	1.54	.94	22.00	3.67	6.63	24.89	5.25	5.62	5.16	6.73	14.09	7.55	101.59	423.63	123.99	517.03
8	Fluxed native asphalt	150.0	417.0	.083	.025	1.50	1.04	22.00	3.67	6.63	33.78	7.41	3.67	5.16	6.73	14.09	7.55	110.69	461.58	133.09	554.98
9	Oil-asphalt	150.0	417.0	.083	.025	1.53	1.15	22.00	3.67	6.63	22.91	6.81	2.79	5.16	6.73	14.09	7.55	98.38	410.08	120.74	503.48

Experiment No. 7.—Refined Coal Tar—Penetration Method.—This section adjoins experiment No. 6 and is 150 ft. in length, extending from station 15 + 50 to station 17 + 0. The method of construction was exactly the same as described under experiment No. 6, excepting for the fact that all the bitumen was applied by means of the distributor. The refined coal tar used in experiment No. 4, an analysis of which is given in Table VI, was used. An 8-bbl. open pan and two 2-bbl. kettles were used for heating the tar before it was pumped into the distributor, and the temperature of the material at the time of application ranged from 260° F. to 270° F.

Experiment No. 8.—Fluxed Native Asphalt —Penetration Method.—This section adjoins experiment No. 7 and is 150 ft. in length, extending from station 17 + 0 to station 18 + 50. The method of construction and application was the same as in the preceding experiments, and the fluxed native asphalt that was used was the same as was used in experiment No. 3. The bitumen was applied by the distributor, and the average temperature of the material at the time of application was about 330° F.

Experiment No. 9.—Oil-Asphalt—Penetration Method.—This is the last section and adjoins experiment No. 8. It is 150 ft. in length, extending from station 18 + 50 to station 20 + 0. The experiment was carried out in exactly the same manner as the preceding one, with an oil-asphalt, the analysis of which is given in Table IX. The application was made by means of the distributor, and the average temperature of the bitumen while being applied was 335° F.

Shortly after the sections were completed, a traffic census covering a period of 11 days under average conditions showed a maximum of 2,794 and a minimum of 655 vehicles, or an average of 1,493 for a period of 24 hours. This included practically every form of vehicle, from light pleasure carriage to heavy motor dray, but approximately 75 per cent was motor driven. During the aero meet at Belmont Park, the number of automobiles for one period of 24 hours was 5,808.

When last inspected in December, the surfaces all presented an excellent appearance.

In making up the tables of cost data, the following unit prices were used:

Foreman, per day of 8 hours	$ 4.00
Assistant foreman, per day of 8 hours	3.25
Roller man, per day of 8 hours	4.50
Engineer for mixer, per day of 8 hours	4.50
Laborer, per day of 8 hours	2.50
Watchman, per day of 8 hours	2.50
Horse and cart, with driver, per day of 8 hours	3.50
Team, with driver, per day of 8 hours	6.00
Roller, with engineer, per day	10.00
Scarifier, per day	4.00
Heating kettles, 400 gals. capacity per day	.30
Heating kettles, 140 gals. capacity per day	.15
Small tools, per day per man	.03

The cost data do not include any charge for the use of the mixer or distributor.

Notes on Road and Street Work.

(STAFF ARTICLE.)

Experimental Reinforced Concrete Pavement at Riverbank, Cal.—In order to determine the applicability of concrete pavement to local climatic, traffic and subgrade conditions the West Sacramento Co. has constructed a 3,000-ft. experimental road between Sacramento and Riverside. The pavement was built under the direction of Haviland, Dozier & Tibbitts, Engineers, San Francisco, Cal. We are indebted to Fred H. Tibbitts for the following information regarding this work. Eleven experimental sections were built. On four of them a light wire mesh reinforcing was used having a cross sectional area of slightly less than one-tenth of 1 per cent of that of concrete. This was considered insufficient to reinforce the slab against temperature and shrinkage stresses, but it was thought that it might prove valuable in holding the road intact. Two of the sections were reinforced with No. 12 rectangular mesh; No. 7 triangular mesh was used on the other two sections. Four types of expansion joints were experimented with as follows: (1) Lines of oiled surfaces spaced at 10, 20, 30 and 40 ft., square and diagonally across the pavement; (2) lines of tar paper spaced 10 and 20 ft., square and diagonally across pavement; (3) ¼-in. spaces filled with bitumen at 25 and 40 ft., square and diagonally across pavement; (4) ⅜-in. spaces at 30 ft., square across pavement, edges protected by soft steel plates, 4 ins. wide, held in places by anchor bolts into the concrete. In addition a section 217 ft. long was laid without any expansion joints. Various styles of surface finish were employed. The surfaces used were: (1) Roughened with wire brooms; (2) pitted by using embossed tamper; (3) checkered, grooved surface, checks 6 in. square; (4) plain concrete surface; (5) sanded surface, and (6) surface covered with a 3/16-in. coat of bitumen and Natomas rock screenings. On three sections the pavement was 4 ins. thick, on two sections it was 5 ins., and on six sections it was 6 ins. A number of different mixes were also employed.

Street Sprinkling in St. Paul, Minn.—Mr. C. L. Annan, in the Proceedings American Society of Civil Engineers, Vol. 38, No. 10, pp. 1720-5, gives the following data on dust prevention work at St. Paul, Minn. The matter was given as a closure of his paper, "Street Sprinkling in St. Paul, Minn.," which was reprinted in the June 5, 1912, issue of Engineering & Contracting. The sprinkling was done by means of 80 teams, the total travel per day of these being 5,248,000 lin. ft.; the total effective travel (76 per cent) was 3,883,520 lin. ft., and the total area sprinkled (width of spray 22 ft.) was 9,493,050 sq. yds. The daily expense was as follows:

80 teams at $100 per month	$267
10 Inspectors at $75 per month	25
Standpipe repairs, average	15
Sprinkler repairs, average	13
2,000,000 gals. water at $90	180
Total per day	$500

The cost of sprinkling 1 sq. yd. once was 0.00527 ct.; the average cost of sprinkling 1 sq. yd. 4 times per day for 210 days was 4.4 cts. During the summer of 1910, 80,000 gals. of a 45 per cent liquid asphalt heated to 150° F. was applied to 300,000 sq. yds. of macadam, the cost per square yard being as follows:

Cleaning street surface	0.35 ct.
Road oil	1.00 ct.
Application	.15 ct.
Total	1.5 cts.

Mr. Annan states that three applications would be required for the full season, which would make the cost practically the same as for water sprinkling. When the St. Paul pavements are bare in freezing weather they are sprayed with calcium chloride (1 lb. per gallon), dissolved with a steam jet. The following figures are for a period of three weeks in December, 1910:

27 tons calcium chloride at $14	$378
8 tons coal at $4.35	38
4 teams, 18 days at $4	288
3 men, 18 days at $2	108
Total	$812

At intervals during the period 100,000 sq. yds. of pavement were treated.

Street Sprinkling and Street Flushing at Grand Rapids, Mich.—Street sprinkling at Grand Rapids is done by the street railway and by the city highway sprinkling department. The street railway covers a route of 28.56 miles. Sprinkling in 1911 on this route was started March 24, and carried on until Oct. 28, 1911. The company was paid at the rate of 12 cts. per mile and the water was supplied at the rate of 4 cts. per 1,000 gals. The cost of the work by the street railway was as follows:

11,280.27 miles sprinkled at 12 cts. per mile	$1,354
24,256,400 gals. water used at 4 cts. per M gals.	970
Total	$2,324
Average cost per mile of route sprinkled	$81.37
Cost of sprinkling per mile (street railway)	0.12
Cost of water per mile	.086
Average cost per mile	$ 0.206
Water used per mile, gals	2,150

The sprinkling by the highway department was started on April 8, 1911, and carried on until Oct. 2, 1911, the route covering 182.254 miles. There were 30 carts in service, each having a 750-gal. tank. Details of the sprinkling were as follows:

Number miles sprinkled, 30,920.021	$12,501
Gals. water used, 87,168,750	4,184
Total cost of sprinkling	$16,685
Cost of sprinkling per mile (labor)	$0.3736
Cost of sprinkling per mile (supplies and repairs)	.0307
Cost of sprinkling per mile (water used)	.1353
Average cost per mile	$ 0.5396
Average cost per mile of route sprinkled	$86.06
Average cost per ft. (lineal 30-ft. roadway)	0.0163
Water used per mile, gals	2,820

The equipment used in street flushing consisted of one Studebaker gasoline automatic flusher and one Sanitary air pressure flusher. A total of 137 miles of street, equal to 3,495,340 sq. yds., was flushed, the amount of water used being 2,815,500 gals. The amount of water used per 1,000 sq. yds., according to the last annual report of the Board of Public Works from which this note is taken was 806 gals. The cost of the flushing was as follows:

	Total.	Per mile.	Per 1,000 sq. yds.
Water	$ 135.15	$0.98	$0.04
Labor	1,087.84	7.94	.31
Repairs	69.69	.51	.02
Oils	38.75	.29	.01
Total	$1,331.43	$9.72	$0.38

TABLE I.—COST OF ROAD ROLLER MAINTENANCE AND OPERATION FOR ONE YEAR.

	No. 1 Roller.	No. 2 Roller.	No. 3 Roller.	No. 4 Roller.	No. 6 Roller.
Maintenance:					
Labor, shop	$ 29.33	$ 87.46	$ 136.50	$ 62.09	$ 68.57
Repair parts	28.98	142.70	392.77	120.64	15.64
Padlocks	.50			.25	.50
Weights	6.00		6.00		
Oil cans	.77		.75	.10	.50
Insurance	37.50	37.50	37.50	37.50	37.50
Repairing wagon	1.75	2.10		17.50	.15
Paint	1.45	1.45	1.45	.75	1.50
Scraper		2.00			
Jug	.20	.10			
Belt		1.99	1.25	.71	
Bolts			.30		
Repair boiler and stack			4.75	9.06	
Umbrella				3.00	
Express				.60	
Rolling flues				7.60	
Operation:					
Labor, running	717.10	681.20	743.00	769.10	809.20
Labor, cleaning	30.00	26.00	30.00	60.00	18.40
Labor, piloting	1.92	.60	.60	1.32	.60
Tools	.48		.78	.26	1.23
Coal	267.51	227.66	246.83	152.99	277.05
Kindling	24.70	21.90	22.30	11.60	20.95
Oil	5.96	9.74	8.90	7.32	4.21
Waste	3.52	3.33	3.84	1.44	2.77
Packing	1.80	.80			.97
Cartage	3.80	3.30	4.75	1.00	2.30
Boiler compound	7.56	5.46	3.90	1.50	2.76
Lanterns and globes	2.37	.05	1.23	.92	
Matches	.20	.05	.05		.05
Grease	.21	.90	1.74	.15	.60
Delay penalty			1.00		
1-inch pipe				.25	
Hose					5.80
	$1,173.61	$1,256.29	$1,650.19	$1,267.65	$1,271.25

Cost of Road Roller Operation and Maintenance.—Table 1, which is taken from the last annual report of the Board of Public Works of Grand Rapids, shows the cost of maintenance and operation, during the fiscal year ending March 31, 1912, of five steam road rollers owned by the city.

A Suggested Improvement in Water-Bound Macadam Construction.—The separation of the screenings into two sizes in water-bound macadam construction is suggested by Mr. J. L. Meems in a paper in the December Proceedings of the American Society of Civil Engineers, Vol. 38, No. 10, pp. 1713-1715. Mr. Meems states that he has used successfully this method of proportioning the rock, and is using it at the present time on an 8-mile section of the Memphis-Bristol Highway, in Tennessee. By this method Mr. Meems separates the screenings into two sizes, one size being from ½ to ¼ in., and the other the dust of fracture, and applies these two sizes to the road in separate operations. Assuming a depth of 9 ins. of loose rock as a standard Mr. Meems suggests the following specifications for building a water-bound macadam road:

(a) The sub-grade shall be thoroughly rolled until it is firm and compact, with the proper crown of ¾ in. per ft.

(b) On this shall be placed 6 in. of No. 1 grade rock, ranging in size from 1½ to 3 in. This shall be spread uniformly and rolled dry until the rock does not creep before the roller, or creeps just enough to set it in place without crushing.

(c) Then 2 in. of stone of No. 2 grade, ranging in size from ½ to 1½ in., shall be spread uniformly, sprinkled, and rolled thoroughly into the voids of the No. 1 grade.

(d) Then ¾ in. of the coarse material from the screenings, consisting of sizes from ¼ to ½ in., shall be spread uniformly, sprinkled, and rolled thoroughly into the voids of the No. 2 grade.

(e) Finally, ¼ in. of the dust from the screenings shall be spread (preferably by hand from shovels), thoroughly soaked, and rolled to a finish.

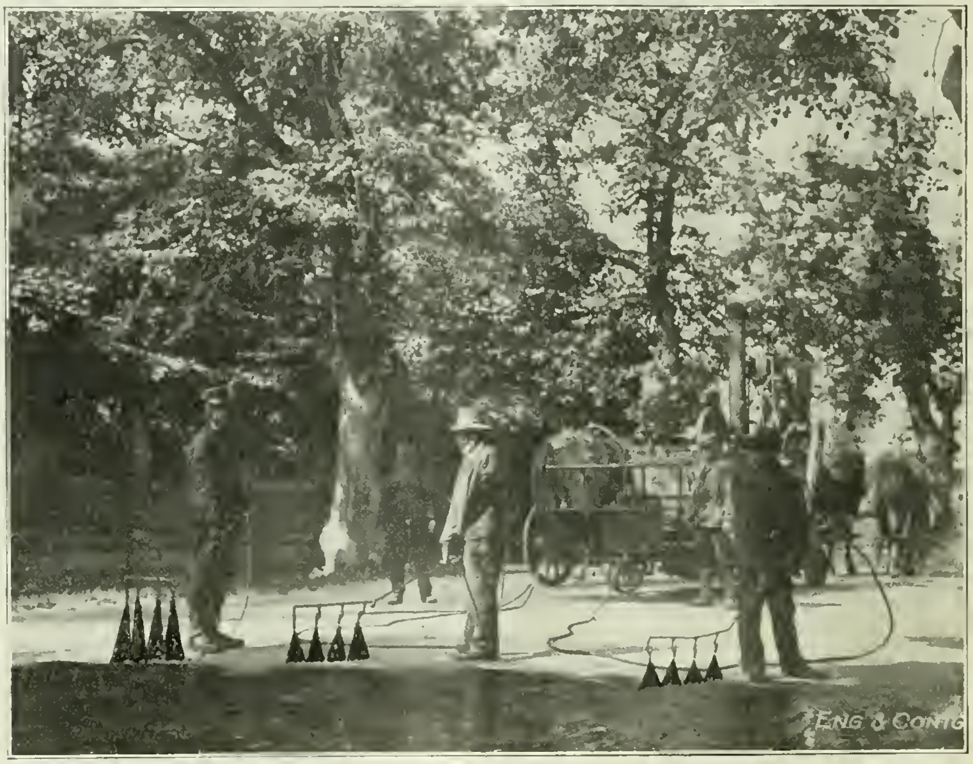
This method Mr. Meems states gives a surface which is virtually impervious to water, and is less affected by automobile traffic than any with which he has had experience; in fact, it has been a matter of great surprise to him to see how well roads built by this method withstand automobile traffic without "raveling" or showing signs of deterioration. From the contractor's point of view, as an economical method of building macadam roads, he finds that on the Memphis-Bristol Highway he is able to care for 100 cu. yds. of rock per day with one 10-ton roller, where previously, before the change was made, there was some difficulty in rolling properly one-half this quantity and getting the proper bond therein, in spite of the fact that it requires one more operation to put on the extra course of stone. This, he states, is very much more than balanced by the quicker method of obtaining the required bond, and the final results as stated are so much more satisfactory than those obtained by using only three grades of rock and not separating the dust from the screenings that it would seem to be a material improvement in the method of road building, and should appeal to both engineers and contractors. This work requires a standard screen with a "dust jacket" (¼-in. perforations) over the ⅝-in. screen.

La Salle Street Tunnel Accepted.—The La Salle Street tunnel, Chicago, which carries part of the street car traffic of the north side under the Chicago river, has been finally accepted by the board of supervising engineers. The cost of the tunnel completed was about $1,600,000. The work was done by the M. H. McGovern Co. of Chicago, and it has now been in operation about six months. Descriptions of the work on this tunnel, which is unique, appeared in "Engineering and Contracting," Jan. 11, Apr. 5, and May 3, 1911.

A German Tar-Spraying Machine.

(Contributed by James A. Seager, Bristol, England.)

A machine designed with a special view to securing high penetrative action of tar in the surface spraying of macadam road is shown in the accompanying illustration. This arrangement was first employed in Munich where a machine of the type shown in the illustration made by Adolf Stephan's Nachfolger Maschinenfabrik of Scharley, was used. With this machine the tar is first heated so as to get rid of a large part of its viscosity, and is then applied to road surface under pressure from tubes terminating in fine spray nozzles. The machine illustrated is capable of holding 800 litres of tar, and can, it is claimed, cover about 8,000 sq. metres of road surface per 10-hr. day. The tar is applied to the road surface in a very finely divided and almost atomized state at between 100° and 120° F. and under a pressure of about 10 atmospheres. It is claimed that under these conditions the tar is in a state to be immediately absorbed by the road and penetrates to some considerable distance under the surface. The system has been so successful in the town mentioned that it has been extended to other localities with every appearance of success.



German Tar-Spraying Machine for Securing High Penetrative Action.

A Method for Determining the Toughness of Bituminous Materials.

The extensive use of bituminous binder in road construction in the state of New York was begun in 1909, and approximately 200 miles of asphalt-bound macadam were constructed by the penetration method during that year. The asphalt used had a penetration of about 225 (No. 2 needle, 100 g. wt., 25° C., 5 sec.). In the spring and early summer of 1910, the roads which had been constructed in 1909 began to bleed, as the asphalt softened by warm weather, was forced to the surface of the road by the consolidation of the road surface under traffic. This bleeding made it necessary to place additional screenings on the road surface, thus increasing the expense and in a number of instances producing a mat on the surface which was not firmly bound to the stone of the top course, giving a loose surface which was uneven, wavy and easily rutted. The bleeding was evidently due to one or both of two causes: The use of too large an amount of asphalt in construction or the use of too soft an asphalt.

For the construction work in 1910 the specifications were changed reducing the quantity of binder used and requiring a harder binder having a penetration of about 120 (No. 2 needle, 100 g. wt., 25° C., 5 secs.). Approximately 435 miles of road were constructed during the season of 1910. The roads did not bleed showing that the use of a harder material and a slight reduction of the quantity used gave the desired result as far as bleeding was concerned. Late in the fall of 1910 and during the early winter, roads on which certain types of asphalt were used, raveled badly, or broke up entirely. By a comparison of the chemical and physical characteristics of the asphalt used, it was found that their chemical properties were practically the same, but in physical properties the difference in the material was very pronounced. Those asphalts which were used on the roads that retained their bond and remained in good condition, were found to be less susceptible to changes in temperature and at low temperature were more "tough," as opposed to "brittle," than the asphalt used on the roads which broke up and raveled in cold weather.

The above brief outline of the experience of the New York State Highway Department, given by Mr. J. E. Meyers, Chief Chemist of the Department, in a paper presented Jan. 3 before Section D of the American Society for the Advancement of Science, brings out the importance of toughness in binder. Details as to methods of determining this quality were given by Mr. Meyers as follows:

Various methods for testing the toughness of bituminous materials were tried. The test for toughness which was finally adopted as being the most reliable and giving results which could be checked with reasonable accuracy, is made in the following manner: The material to be tested is heated and while in a melted condition poured into a 3-oz. tin box (3.5 cm. deep by 5.5 cm. in diameter). The box is filled and the material allowed to cool to room temperature. When cold the box is held by a pair of tongs, rapidly heated over a Bunsen burner, and the asphalt emptied out of the tin box into a pan of cold water. In heating the material in the box, only enough heat is applied to free the material from the box so when emptied into the water it is still solid, being softened only on its surface. By wetting the hands this cylindrical piece of asphalt, softened on the outside, is easily rolled into a ball. By exercising a little care no seams will be formed, the quantity of material in a 3-oz. box being sufficient to make a ball 5 cm. in diameter. These balls are packed in a mixture of finely cracked ice and water giving a temperature of 0° C. for one hour before breaking. When a ball is to be broken, in order to maintain the temperature at which the test is to be made, it is placed in cracked ice and water in a small tin box. The box is placed on the anvil of the impact or toughness machine. A patch of linen about 1 in. square is placed on the top of the ball. On this patch of linen rests the plunger of the impact machine. Care is taken that no pieces of ice are between the ball and the bottom of the tin box.

The testing or impact machine used for breaking the ball is the machine adopted by the American Society for Testing Materials, for determining the toughness of rock used in macadam road building. The essential working parts of the testing machine consist of an anvil of 50 kg. weight, the hammer is of 2 kg. weight and drops on an intervening plunger of 1 kg. weight, which rests on the material to be tested. The lower or bearing surface of the plunger has a hemispherical shaped head of one centimeter radius. The material to be tested being so placed under the plunger that its upper surface is tangent to the spherical end of the plunger. The mechanical construction of the machine allows the hammer to be dropped from any given height from 1 to 70 cm.

In testing asphaltic materials the drop of the hammer is from a height of 5 cm. for the first blow, and the drop of each succeeding blow is increased 5 cm. until rupture occurs. The height from which the hammer falls when rupture occurs, is given as the toughness of the material.

Again in 1911 the specifications under which construction was carried on were so changed that a slightly softer asphalt having a penetration of about 160 (No. 2 needle, 100 g. wt., 25° C., 5 secs.) was required. In addition to this the asphalt was required to meet a toughness test made in the manner described. No material was used in 1911 which did not have a toughness of at least 15. Of the 500 miles of road constructed in 1911 there were no failures due to the asphalt becoming brittle in cold weather and breaking up under traffic. The same requirements in regard to the toughness of asphalts at low temperatures have been enforced during the season of 1912 and to date there have been no failures of the roads constructed during 1911 and 1912, due to the asphalt becoming brittle and breaking up in cold weather.

The following figures give an idea as to the accuracy of the results obtained by the above described test for toughness:

Brand.	Number of tests.	Toughness Average.	Toughness Maximum.	Toughness Minimum.
A	30	45	65	35
B	35	40	45	25
C	17	25	35	20
D	35	45	60	40
E	50	20	25	15
F	20	35	45	20
G	5	40	45	30
H	12	5	10	5

The figures given in the above table are taken from the laboratory tests made on various materials and are not from a blend of the same material, but from tests made on separate samples taken at various times from each brand of material.

The table is representative of the way results will run. The tougher the material, the greater the variation between maximum and minimum results obtained in check results from the same blend of material. When the material shows a greater toughness than 35, the results are not reliable when regarded from the standpoint of checking the result. Materials which give a toughness greater than 35 should be tested at a lower temperature than 0° C., thus giving lower figures representing the toughness, and figures which may be more accurately checked.

Department records are kept, covering all the details of construction on each road. These records show the method of construction, the material as stone, asphalt, oil, tar, etc., used together with the tests and analysis made on the material. In case of failure on any road or type of road, by a comparison of the construction records, it is comparatively easy to determine the cause of failure. This is especially true as the mileage of roads constructed and the quantities of materials tested and used increase. The following conclusions are drawn from about 2,000 tests made on material used on approximately 1,400 miles of asphalt-bound macadam roads which have been in use from one to four years:

First: Any asphalt which has a toughness test of less than 15 at 0° C. as determined by the tests described in this paper is not safe to use as a binder, especially where the penetration or grouting method of applying the asphalt is used.

Second: A material which has a toughness of 15 to 25 at 0° C. does not have a large factor of safety in regard to toughness, but will not give trouble because of brittleness unless the roads are built late in the fall and therefore not thoroughly consolidated under traffic before freezing weather sets in.

Third: Any asphalt which has a toughness of 25 or more at 0° C. will not give trouble because of brittleness under any ordinary conditions to which the road will be subjected.

Vibrolithic Concrete Pavement.

A new method of constructing concrete pavement has been developed by Mr. R. C. Stubbs, Contracting Engineer, Dallas, Tex. The pavement is known as Vibrolithic. In 1910, 3,000 sq. yds. of this pavement were constructed at Dallas and in 1912, 10,000 sq. yds. were constructed at Ft. Worth, and a like amount at Greenville, Tex. The special feature of the pavement and the one from which it takes its name, is the use of a vibrator for forcing surfacing material into the body of the concrete, thus producing a dense mass. In the work at Dallas the vibrator consisted of a motor revolving about 1,000 r. p. m. and supported upon broad wheels. The following discription of the method of constructing vibrolithic is taken from a paper by Mr. Stubbs, presented at the 9th annual convention of the National Association of Cement Users, Pittsburgh, Pa.

The sub-grade is prepared as for any other pavement; then the concrete aggregate is brought and stored on the sub-grade. A traction concrete mixer is next brought in with charging bucket to material and a chute is attached to discharge end of mixer. This chute delivers the concrete to place of beginning in the street.

Concrete is composed of 1 part Portland cement and 5 parts aggregate of sharp sand and pebbles, the portion passing a ¼-in. screen not to exceed 40 per cent nor be less than 33 per cent. As much water is used in mixing as the mass will retain without draining after depositing. The concrete comes directly along the chute to the street and is immediately raked to approximate grade. After and advance of a few feet, the surface is brought to a float finish by means of long-handled floats. Immediately upon this surface there is thrown a coating of crushed granite, graded from ⅝ ins. to 1¼ ins. This stone is applied until surplus matrix has been taken up. The surface is then ready for vibration, which operation is obtained by placing platforms along or across the street. Platforms are made up of ⅝-in. x 4-in. strips, cleated ¼ in. apart. Each platform is 20 ins. wide and as long as desired. Cleats project 1 in. along one side, and the forward platform cleat projection laps back onto the other platform. When two or three platforms have been placed, a vibrator mounted on roller is rolled onto the first platform and passed along from one to the other as they are put to grade and concrete is brought to a very high state of density. As the work progresses the platforms are brought forward and the granite street surface is immediately covered with sharp sand and wetted.

Two or three days later, the sand is swept off the surface into the gutter with stiff wire brooms, and ¼-in. Tarvia A is poured on at a temperature of 150° F., and leveled with rubber rakes. Immediately behind the levelers a coating of hard stone ¼ in. to ⅜ in. is spread in sufficient quantity to thoroughly coat the pitch. Upon this is spread the sharp sand that has been swept into the gutter. The surface is then rolled with a 500-lb. hand roller and street is closed to traffic until the concrete is 7 days old.

In the construction of the pavement provision is made for contraction only. It is assumed that if the slab contains a contraction stress throughout its mass sufficient to strain the growing bond, this stress will be relieved by small cracks at irregular intervals following lines of weakness. Mr. Stubbs' plan contemplates these cracks and forces them to come in straight lines wherever desired by placing thin, wooden planes ½ in. x 3 ins. on edge upon the prepared sub-grade in such manner that they will be buried in the concrete and will occupy the bottom half of concrete cross section. It is stated that within 48 hours after the concrete has been laid, thin straight lines of relief will appear over the breaker strips. In this way the street is laid monolithic, and there is so general a distribution of breakers that no relief line gets of greater size than 1/16 in., which is barely noticeable.

RAILWAYS

Method of Removing a Large Snow Slide From a Railroad Track by Blasting.

(Staff Article.)

An interesting use of explosives was recently made by a western railroad in clearing deep snow from its tracks. At one point the following conditions were encountered which were handled as described.

At one point in the Rocky Mountains the road had a snow slide 600 ft. long and about 40 ft. deep over the rails. On account of other snow slides along the line the snow gang was unable to reach this particular snow slide for a period of about 24 hours. When the snow slide occurred the weather was mild and the snow very soft, but when it turned cold the slide froze and became very hard. After working some time with a large crew of men and a rotary snow plow the snow gang was somewhat discouraged with the progress they were making. A "powder man," who was working for some contractors just east of that point on some heavy work, made the suggestion that they shoot the snow slide with blasting powder. Having had no previous experience with explosives, the division superintendent was rather fearful of the results in that the blasting might damage the track, but the powder man advised him it would be perfectly safe and was allowed to prepare the blast.

The powder man welded three steel bars together each 1¼ ins. in diameter and about 18 ft. long, and forced them through the snow almost down to the track, or to a depth of about 35 ft. Into this hole was loaded four or five cartridges of dynamite of about 40 per cent strength, which was detonated by means of electricity and which resulted in springing the hole. It will be noted that the hole was placed so that its bottom was about 5 ft. above the track.

The powder man then loaded this hole with 62 kegs of blasting powder. After all the men and machinery had been withdrawn to a safe distance, this charge was exploded with the result that instead of a great volume of snow the gang had a hole reaching within 1 ft. of the track. Immediately after this blast men were put down in the hole to see if the track was damaged in any way. On careful examination no damage was found.

The gang then loaded and fired two or three more similar charges with the result that the slide was cleared in about three hours' time, as it gave the rotary snow plows a chance to work, and the line was opened promptly.

Since this experience this same railroad company has used several car loads of blasting powder to blast snow slides on its line, resulting in a large saving of money for the company.

A Method for Forecasting Rail Failures Which Is Also Useful in Determining the Part Played by Broken Rails in Wrecks.

A short description of a method which has been used in Europe for forecasting rail failures and for determining the part played by a broken rail in causing a wreck was given by A. Mesnager of Paris in a paper before the International Association for Testing Materials. The information here given is taken from the translation, from the French, made by H. Borns of the original paper.

We have known from the publications of Stead and Ledebur, 1897, and Von Dormus, 1898, that rails sometimes present on their upper surface tranverse cracks which form the starting point of fractures. We do not in general attribute to this character all the importance, however, which it appears to me to have with regard to fractures of rails on the permanent way. We have indeed observed in the Laboratoire de l'Ecole des Ponts et Chaussées that more than three-quarters of the rails which are sent there by the Service de Contrôle, after having broken in the service, show these superficial cracks in a very pronounced manner. Others have broken in consequence of cracks in the core, but these in general are rails which show so pronounced traces of pipe or defects that one should not have accepted them.

Symmetrical rails which show superficial cracks break under bending, when the stretched surface is put under tension, under loads which are noticeably smaller than when this surface is put under compression. The strength decreases by ½ or ⅞. The reduction varies naturally according to the importance of the cracks. These fissures attain depths which are reckoned in millimeters; we may have some of 4 and 8 mm.

Specimens of impact bars provided with notches, 5 mm. in depth, have broken outside the notch straight across these cracks. On the other hand, rails, which behaved well, though well worn on the upper surface, did not present any fissures. These fissures show different configurations in different cases. Sometimes they are almost entirely perpendicular to the axis of the rail; in other cases they show a polygonal character. It is impossible not to be struck by the analogy of the network of cracks, which we find in brass and in bronzes that have undergone cold working and which finally cause their fractures.

We conceive that the passage of trains and the tensions which are produced in the heads of the rails above their supports on the crossties may cause rupture under loads which sound rails would bear without any inconvenience. How can we perceive these fissures?

HOW FISSURES ARE FOUND.

On some rails fissures are visible without any special preparation of the surface of the head of the rail. In most cases, however, we have to file the head or have to apply emery paper or grinding stone to remove the hard-worked layer of metal of a thickness of about 1/10 mm., which masks the fissures and which seems to have undergone flowing under the pressure of the wheels. When we afterwards spread on the surface a weak solution of hydrochloric acid or of commercial sulphuric acid, diluted with ten times its volume of water for several minutes, we recognize these fissures, even the very finest, very easily, and can photograph them.

If we have time after this treatment we can dry the surface carefully and, after this first etching, spread on it and leave there until it is dry a solution of tannin containing about 3 per cent gallic acid applied with the aid of a brush. This will take three or four minutes; the tannin forms with the iron oxide a kind of ink in each fissure. When we afterwards rub with a dry cloth we make the surface bright between the cracks which come out black and are then well visible.

It is possible to apply this process for the testing of dangerous rails, and this can even be done in the intervals between the passages of trains. We know that fractures ensue more frequently near spots where the trains slow down as a rule and where the application of the brakes modifies the surface of the rails.

Quite recently Sabouret, Chief Superintending Engineer of the rolling stock of the Paris-Orléans Rys., has acquainted me with an improvement of this process which has been applied in his department. We clean the surface of the rail and etch it as before. After the etching we smear it with an ordinary, well fluid printing ink and, if necessary, heat it gently in order to make this ink enter into the clefts. We dry carefully afterwards. We thus obtain a surface which has been prepared like an engraver's plate which has been etched slightly. We then apply a sheet of white paper under sufficient pressure and obtain a picture of the surface with all its fissures and defects.

By these means one can often recognize the primary cause of the accident in a case of derailment; for example, whether the rail was brittle on account of internal fissures, or whether the train has derailed by some other cause.

A Discussion of the Theory of and Modern Practice in Designing Structural Steel Towers and Poles.

The editors of Engineering and Contracting have, from time to time, pointed out the possibilities in power development work to the civil engineer. In power plant work certain phases of the design unquestionably should be passed upon by men of experience in mechanical and electrical engineering practice. There are also certain phases of power development work which just as surely should be handled by the civil engineer. The structural features of a transmission line form a case in point. The electrical engineer has given careful attention to the electrical features of such lines but often designs the structural features in a haphazard and irrational manner. The electrical engineer should seek the advice of the civil engineer in designing towers and poles of structural steel.

A paper dealing with the theory and practice of designing structural steel towers and poles was presented by Mr. R. Fleming of the American Bridge Co., before the latest annual convention of the Association of Iron and Steel Electrical Engineers. The following matter is taken from Mr. Fleming's paper:

We have yet no form of either pole or tower that can be called "standard." Present-day practice for poles is crystallizing about the latticed four-angle type. Towers are being built mostly of the square wind-mill type. An exception is the 140,000-volt line put in operation this year in Michigan, where the towers, of which there are ten to the mile, are of the braced-tripod type, composed entirely of galvanized-steel angles. This line, at present 125 miles long, is being extended 100 miles farther and carries the highest voltage yet undertaken, the previous maximum being 110,000 volts.

Loads.—In designing either a pole or tower the first question for determination is the loads to be carried. These loads are of three kinds: (1) Vertical or dead loads; (2) loads at right angles to the direction of line, due to lateral wind pressure; (3) unbalanced loading in the direction of the line, due to breaking wires. The forces of these three loadings are at right angles each to the other.

(1) The vertical or dead loads are: (a) the weight of the structure itself; (b) the weight of the wires supported by the structure; (c) the weight of the snow or ice coating, if any, on the wires. In sleet regions, ice is generally assumed to accumulate ½ in. thick around the wire. These vertical loads are easily determined, but are seldom a governing feature in the design of the structure, except for the cross-arms. The cross-arms should be designed for a minimum load of 1,000 lbs. at each end. They carry not only the insulators and wires but at times a man or two to adjust them.

(2) The lateral wind pressure on transmission lines has been much discussed. Well known engineers have arrived at widely different conclusions. One writer says:

> The actual possibility of wind pressure is very generally over-estimated, and has resulted in much needlessly costly construction.

Another writer says:

> Such lines should, therefore, be built strong enough to resist not only the commonly occurring, but also the exceptionally violent, local storms.

From a mass of data, the writer recommends the use of the following wind loads: (a) On the structure itself, 30 lbs. per sq. ft. of exposed surface; (b) on bare wires, 15 lbs. per sq. ft. of projected area (length multiplied by diameter); (c) on wires covered with ½-in. coat of ice, 10 lbs. per sq. ft. of projected area. In a sleet region (c) should be followed as it is the more severe.

It is noted at once that the requirements given for (1) and (2) do not in themselves determine the loads on the towers or poles unless their distance apart is known. In laying out a transmission line the first thing to find is the most economical span. This is both an electrical and a structural problem. The voltage, size and kind of wires, are to be decided. With these given, the spacing of towers can be determined. The foundations also enter in the calculations. Empirical formulas have been given for the most economical span, but so many variables enter into the question, that they can only be regarded as approximate. Each line is a problem by itself and must be solved independent of all other lines.

(3) The assumptions regarding unbalanced loading in the direction of the line will often determine the design of the tower. Practice as well as theory varies widely in this respect. The following is recommended: A tower having three line conductors or three conductors and one ground wire should be designed to withstand the unbalanced load due to any single wire breaking a tower, having six line conductors or six conductors and a ground wire should be designed to withstand the unbalanced load due to any two wires breaking. The breaking of a wire throws upon the wire in the adjacent span and thence to the tower a load equal to that which caused the wire to break. For the smaller sizes of wire, No. 4 and under, this load should be taken as the ultimate strength of the wire itself. For No. 3, 90 per cent; No. 2, 80 per cent; No. 1, 70 per cent; No. 0, 60 per cent; and for No. 00, and larger wires it is recommended that 50 per cent of the ultimate strength of the wire be used. The reason for the larger wires being given an advantage is that a break is not likely to occur in them until there has been a reduction of cross-section from burning due to a short-circuit from any cause. The smaller sizes will not permit any reduction of section without breaking.

For line conductors hard-drawn copper wire is generally used. The American Steel & Wire Co. find, from tests, the elastic limit of their copper wire to be 34,500 lbs. per sq. in., and more and the tensile limit from 50,000 to 65,000 lbs. per sq. in. For No. 00 copper wire, a size often used, the longitudinal pull due to one wire breaking will be 2,500 lbs.; for No. 0000 copper wire 4,000 lbs. will answer. Care must be taken to provide for torsional stresses caused by unbalanced loading.

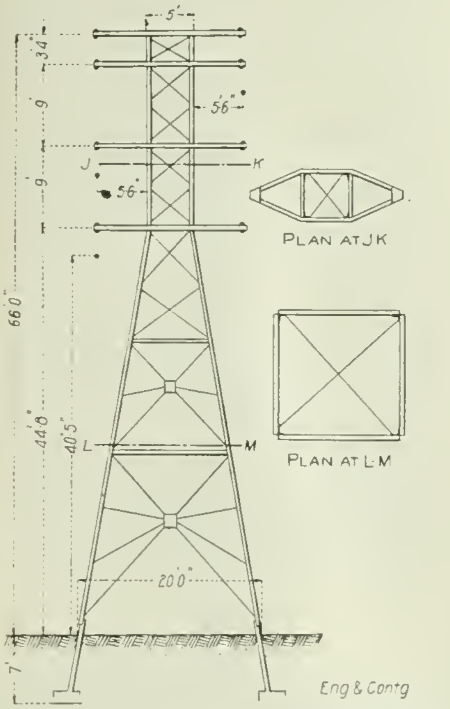


Fig. 1—Elevation and Sections of the Standard Transmission Line Tower of the Connecticut River Power Co.

In designing the standard towers of the line, the material is to be proportioned for maximum stresses due to any combination of loads (1), (2), and (3).

Unit Stresses.—Equally important with assumed loadings are assumed unit stresses. It might be well to divide proposed towers into three classes—(A), (B) and (C), and assume unit stresses in accordance with the classification of the tower. Two prominent features to be considered regarding any line are the importance of uninterrupted service and the probability of loss of life, due to accident of wires or towers giving way. If the purchaser of power insists upon service at all times under heavy penalty, the tower would come under (A) If interruption under certain limitations are allowed, (B) may answer. From the standpoint of loss of life due to accident, a line over a thinly settled mountain country would come in (B), while the thickly settled zone about a town or city would require (A). Using open-hearth steel with an ultimate tensile strength of 55,000 to 65,000 lbs. per sq. in., and an elastic limit of 55 per cent of the ultimate strength, the working unit stress of steel in tension may be taken at 22,500 lbs. per sq. in. for (A) and 27,000 lbs. per sq. in. for (B). For steel in comparison the recommended formula is:

$$\frac{22{,}500 \text{ or } 27{,}000}{1+\dfrac{l^2}{18{,}000\, r^2}}$$

To (C) is consigned poles and towers where the primary feature to be considered is the cost. The question then too often becomes, not what the structure should be, but what are the least requirements that can be exacted and the line probably do its work. A common method of reducing material is to consider loadings (2) and (3) not acting at the same time, and increasing the unit stress to 30,000 lbs. per sq. in. Some engineers think a high wind will not occur when the wires are covered with sleet.

Even admitting this to be true, arcing sometimes happens between wires when there is a high wind on the bare wires. Owing to lightening discharges, accompanied with wind, it may happen over insulators. This is certainly a combination of (2) modified, and (3) which should not be neglected. For wires covered with ½-in. coat of ice, 8 lbs. per sq. ft. of projected area for wind load is considered allowable by some good authorities. To this there is not the objection as to the use of 30,000 lbs. per sq. in. for unit stresses. The latter comes too near the elastic limit of the steel likely to be used.

It may be said here that comparatively few existing towers are of classes (A) or (B). The engineer often finds it a commercial impossibility to have the towers built as he would like to design them. The situation is similar to that of the highway bridges 30 or 40 years ago. The bridges of that day would not be tolerated now. The towers of today will not be tolerated a generation or two hence.

Tests.—Specifications often require that towers withstand certain artificial tests. This means the minimum amount of material that will meet these tests will be used regardless of other considerations. The conclusions from artificial tests are often misleading. The material is new and in good order, and there is the friction of pieces bolted or riveted close together. The workmanship for the test pieces has at least not been slighted. The structure is assembled at the shop under more favorable conditions than will exist in the field. The loads are applied gradually and in one direction, quite different from those that will come after erection. The test generally takes but an hour or two, while the structure is built to last for years, during which it is subject to a continued test.

What is wanted in steel work is durability. This cannot be assured by a structure simply meeting an artificial test. It may be noted that almost every bridge that has failed or had to be replaced was "tested" before acceptance. This does not mean that a mechanical test has no value. The contention is that an artificial test alone does not give the true value.

For poles which are composed of few pieces and are of simple construction, a greater value may be placed upon the test than for towers which are made up of a multitude of pieces and are complicated in their structure, but for both poles and towers conditions should be imposed regarding thickness of material, relation of unsupported length of column to radius of gyration, and details—the last being considered especially important.

Special Cases.—A careful study should be made of special cases of loading. Generally when a pole or tower fails it is under conditions for which it was not designed. Horizontal and vertical angles in the line should be considered. Some English specifications allow the standard tower to be used without further calculation when a horizontal angle in the line does not exceed 8°. American specifications often allow this angle to be 10°, though there is no uniformity of practice in this respect. Frequently standard towers are used and the approach spans are decreased. In one large system, where the average cable span length on tangents for level country is 550 ft., the approach spans to angles in the center line vary from 400 ft. on angles up to 8° to 100 ft. on angles of 45°, the maximum angle turned on one tower. Sometimes a standard tower is used and guyed. This is generally objectionable. The most satisfactory practice is to use a tower calculated to withstand the increased loads due to the deviation in the direction of the line. Poles or towers adjoining railroads should be designed to meet special requirements. The specifications issued by some railroad companies for lines crossing their right-of-way are quite severe. The National Electric Light Association's "Specifications for Overhead Crossing of Electric Light and Power Lines" are less stringent. Poles used about manufacturing plants will be mentioned later.

Flexible Towers.—What are known as flexible towers originated in Italy a few years ago, and are being used to some extent in this country. Semenza, an Italian engineer, conceived the idea of caring for the longitudinal forces in a line through a flexible system rather than by a single rigid tower. By this method an occasional tower, about one in ten, is "dead-ended" or made perfectly rigid to take longitudinal stresses, the intervening towers being made to withstand only the dead weight and transverse wind loads. If a wire breaks there is a drop in the catenary and the shock is absorbed into the series of poles by each yielding at the top. The "dead-end" tower being designed for all the wires breaking, prevents the longitudinal pull extending farther along the line. The intermediate or standard towers are generally made A-shape of two channels latticed together with angles. The advocates of this method are enthusiastic over the saving they claim in steel material and foundations.

A point generally overlooked in making a comparison between the flexible and the rigid towers is that if flexible towers are used either heavier wire or higher towers are required. With the rigid type, if a wire breaks, the tower at each end will take up the unbalanced loading. In the flexible type, say with three line conductors and a ground wire, if a wire breaks the tops of the towers on either side of the break will be pulled over by the four cables in the next span until the total tension in them would be just balanced by that in the remaining conductors of the damaged span. That is, the three cables remaining would do the work of the four in the adjoining spans, showing the need of heavier wire. Of course, this unbalanced loading can be taken up by a greater sag and less tension in the cables, but this necessitates higher towers to maintain the required clearance underneath the wire. It is an open question just how far flexible towers are to be commended. Does the reduced cost overbalance the lessened reliability? For low voltages with towers or poles comparatively short distances apart, they may sometimes be used to advantage. Where high voltages are used with but eight or ten towers to the mile, rigid towers should be used. The city of Winnipeg in its municipal line from Pointe du Bois on the Winnipeg river to the city, a distance of 72 miles, compromises on the choice of towers. Rigid towers are spaced 1,200 ft. apart with a flexible tower midway between. Towers are 43 ft. to the crossarm and carry a double circuit or six wires.

Foundations.—It matters little how near perfect the superstructure may be, if it rests on insufficient foundation. It will then fail in the hour of stress. The theoretical considerations governing the design of foundations are well known, but it is folly to design these foundations in an office, unless it is known the assumptions made fit the actual conditions of the soil at the site. The attempt to do this

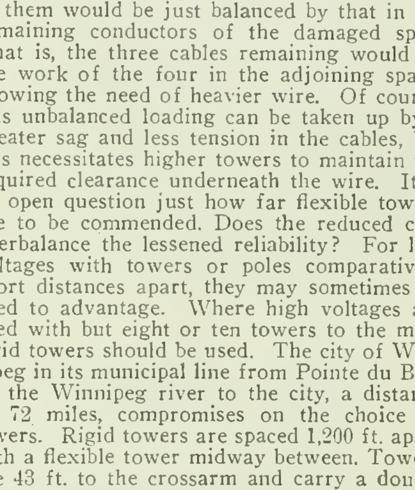


Fig. 2—Vertical Sections of the Standard Structural Steel Tower of the Georgia Power Co.

will probably result in a footing with an undue margin of stability, causing unnecessary expense, or a footing of insufficient strength, liable to cause trouble ever after. Especially to be condemned is a prevalent practice of placing the steel anchorage without any thought of surrounding conditions. Some towers recently built showed excellent results when tested at the shop in the usual way by firmly fastening the foot of each leg to a heavy steel frame. In the field they were pulled over without any difficulty. The soil yielded and the steel anchorages pulled out. Such designing, or lack of designing, is foolish.

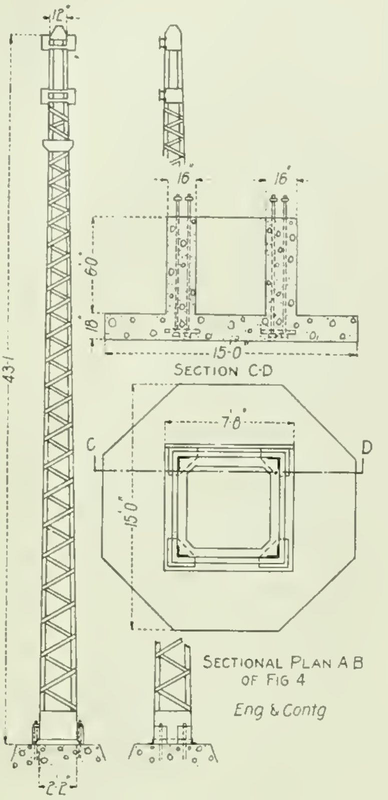


Fig. 3—Details of the Standard 40-ft. Two-Arm Steel Pole Fabricated by the Indiana Steel Co. of Gary.

The usual method of anchoring is to run an angle stub 5 to 8 ft. in the ground. This stub extends a foot or so above the ground level, and at the top are open holes for bolts to take the corner legs of the tower. At the bottom of the stub is a cross piece 3 or 4 ft. long of either channels or angles. This anchorage is placed in a hole dug in the ground and the hole refilled. For light lines with short spans and good soil, this may be sufficient for a time. For the usual long-span transmission line, the overturning moment due to the side wind pressure becomes much larger. A platform at the bottom of the angle stub can easily be designed to withstand the uplift, if the soil conditions are known.

Without any protection save a coat of galvanizing, corrosion is bound to set in at or near the ground level. The writer, a year ago, saw some towers in a cultivated field against the corner angles of which the soil had been turned in plowing. The galvanizing had nearly disappeared, though the towers had been erected but two years. There is trouble at no distant future for those towers. The anchorage should extend not less than a foot above the ground line and should be entirely encased in concrete; though a sleeve of concrete extending from the top to two or three feet below the ground line is sometimes used. Here at once a practical objection is raised. To get water and material at the site of the various towers of a transmission line, make concrete and properly set it, is difficult and expensive. Unless a strict supervision is exercised the work is sure to be slighted.

Thicker steel sections used for the anchorage will delay, but not prevent, failure from corrosion. It has been suggested that the anchor stubs be designed in two lengths, the upper length to be removable and thus replaced without tearing down the tower. A large line installed last year used a preservative paint instead of galvanizing their anchorages.

Life.—The life of a wooden pole is given, if of cedar, as from 15 to 20 years, and longer if preservatives are used. The life of a steel pole or tower cannot yet be definitely stated. It is only as far back as 1903 that the first high-tension transmission line was built in which steel towers were used exclusively. This was a line 101 miles long in Mexico, with towers about 450 ft. apart. The present practice of a multiplicity of light sections will not be conducive to long life. Sections ⅛ in. thick are very common—more of this thickness than of any other are used in the average tower. Towers made of such material, galvanized at the shop, bolted together in the field, and then left alone cannot last for a long term of years.

The use of unusually thin metal for compression values calculated in accordance with accepted formulas is to be criticized. In a number of tower tests, under the writer's observation, the failure was always in the 4x4x¼-in. corner-angle leg. They were not good for their calculated value. This confirms Talbot & Moore in "An Investigation of Built-up Columns Under Load"* in which they write:

> It would seem quite probable that, for columns of the same lentgh and containing the same amount of metal, one which is of stocky form and in which the metal is distributed so as to resist local flexural and torsional action, will be much stronger and more satisfactory than a column of more flimsy form, which has its metal spread in thinner sections, even though the slenderness ratio l/r of the former may be considerably more than that of the latter.

Important changes will take place in the direction of thicker material after some of the present lines fail, and the present policy of purchasing only what will answer for the immediate present is abandoned. There is no reason why a tower properly designed, inspected at regular intervals, painted when necessary, should not last 50 years, perhaps longer.

EXAMPLES OF TOWERS.

Connecticut River Power Co.—The 917 towers for the line of the Connecticut River Power Co. were designed and built by the American Bridge Co. Of these towers, 862 are the standard, shown in Fig. 1. The specifications, drawn up by J. G. White & Co., call for the strength of these towers to be as follows:

The towers shall be designed for, and shall be guaranteed to stand, the following test loads without stressing any member beyond its elastic limit:

Insulator pins and grounded wire cap:

(1) At top of insulators for line conductors, 1,600 lbs. in any direction perpendicular to pin axis. (2) At top of iron cap support for grounded wire, 1,400 lbs. in any direction perpendicular to axis of support.

Supports for pins and caps:

(3) 1,400 lbs. load in any direction on grounded wire cap and 1,600 lbs. load in any direction on line conductor insulators, to be applied singly or in any combination to produce maximum stress in the supports.

Main tower structure:

(4) A load of 4,800 lbs. in any direction at point A (Fig. 1), and no load at B and C.

(5) A load of 4,800 lbs. in any direction at points A and B, together with a load of 1,400 lbs. in any direction at point C.

In proportional material the unit stresses were taken at 24,000 lbs. per sq. in. net for tension and for compression.

$$\frac{24{,}000}{1+\dfrac{l^2}{13{,}500\, r^2}}$$

Georgia Power Co.—Some towers designed and built by the American Bridge Co. for the Georgia Power Co. are shown in Fig. 2. Suspension insulators are used. There are 735 towers of the dimensions shown in cut carrying six line conductors of No. 0000 copper wire, and two 7/16-in. galvanized-steel-strand ground wires. The data drawn up for the Georgia Power Co. by the Northern Contracting Co., C. O. Lenz, chief engineer, from which the towers are designed, follow:

The test load shall be: (1) A longitudinal pull of 4,300 lbs. at right angles to the end of any one cross-arm. (2) A vertical load of 1,500 lbs. at the ends of any or all cross-arms. (3) A load of 1,500 lbs. pulling in any direction at the top of tower. (4) A load of 10,000 lbs. pulling at right angles to the line or parallel to the cross-arms; that is, 2,500 lbs. at each cross-arm. At the same time a pull parallel to the line or at right angles to the cross-arms of 8,000 lbs.; that is, 4,000 lbs. in the same or opposite directions at each end of any single cross-arm or at one end of any two cross-arms.

Cross-arms are proportioned for combined loading (see section on "Loads" under "Towers" above) of Case 1, Case 2, and 1,250 lbs. horizontal thrust at end of arm. The tower is proportioned for maximum combination of Cases (2) and (3), or (2) and (4). Unit stresses used are 25,000 lbs. per sq. in. net for tension and for compression.

$$\frac{25{,}000}{1+\dfrac{l^2}{18{,}000\, r^2}}$$

There are also 816 standard towers carrying six line conductors of No. 00 copper wire and two ⅜-in. galvanized-steel-strand ground wires, the towers being 16 ft. square at the base and 70 ft. to the upper cross-arm. The loads for which they are designed are: (1) A longitudinal pull of 3,000 lbs. at right angles to the end of any one cross-arm. (2) A vertical load of 1,200 lbs. at the ends of any or all cross-arms. (3) A load of 1,200 lbs. pulling in any direction at the top of the tower. (4) A load of 8,000 lbs. pulling at right angles to the line or parallel to the cross-arms, that is, 2,000 lbs. at each cross-arm. At the same time a pull parallel to the line or at right angles to the cross-arms of 5,000 lbs., that is, 2,500 lbs. in the same or opposite directions at each end of any single cross-arm or at one end of any two cross-arms.

The combination of loadings and unit stresses is the same as for the towers with No. 0000 wires. In addition to the above standard towers there are 200 towers designed to meet special conditions.

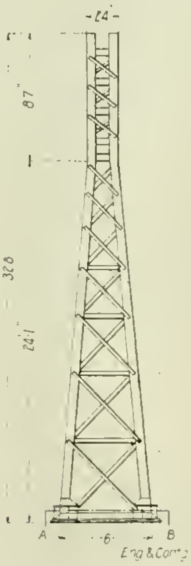


Fig. 4—Steel Pole for Railway Yards, by Westinghouse, Church, Kerr and Co.

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*Bulletin No. 44. University of Illinois Engineering Experiment Station.

STRUCTURAL STEEL POLES.

Much of what has been written in this paper is intended to be applicable to either poles or towers, though for transmission and distribution systems about the yards of manufacturing plants some of the conditions are quite different from lines through great stretches of open country. The size of base is restricted to as small an area as possible. This necessitates a pole instead of a tower.

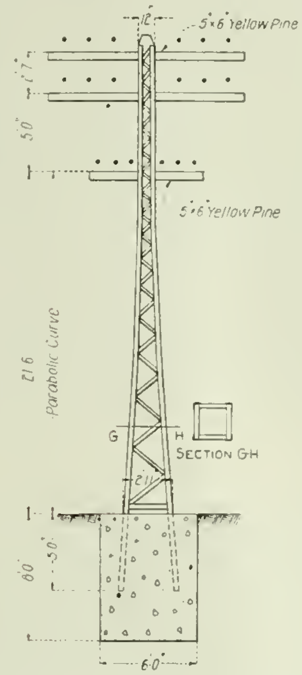


Fig. 5—Standard Transmission Line Pole of the New York Central and Hudson River Railroad.

The loads to be carried and the desired permanency demand a steel instead of a wooden pole. An interruption of service, even for a short time, means inconvenience and loss. Accidents to life and property, if any occur, are liable to be disastrous and must be guarded against. The seriousness of failure on such lines will justify heavy construction. For this reason it is recommended that each pole be designed to withstand, in addition to the dead and wind loads, the unbalanced load due to a majority of the wires coming upon it being broken. All conditions such as the probability of wires being added in the future, the deviation of the line from a tangent, or special loadings, should be considered. A unit stress of not more than 16,000 lbs. per sq. in. net for tension and the same reduced by previous formula for compression should be used.

The foundations shall be of concrete and shall be designed in accordance with local conditions. These local conditions should be thoroughly understood. A clause from the specifications of New York Central & Hudson River R. R. for lines crossing railroads is applicable here:

> The foundations shall be of concrete and shall be designed so as to be able to resist the greatest tendency to overturn, due to any combination of the loads specified. No steel shall be carried below the surface of the ground unless encased in concrete. The tops of foundations or tops of the concrete casing shall not be less than 12 ins. above the ground and always above flood water.

Indiana Steel Co.—The standard 40-ft. two-arm pole is shown in Fig. 3. The poles and towers throughout are designed to carry the dead load of the construction, including a coating of ice on the wires equal in thickness to the radius of the wire, together with an overturning load of 20 lbs. per sq. ft. on the towers, and 10 lbs. per sq. ft. on the projected area of the wires; also a torsional stress in any pole produced by an unbalanced load resulting from the cutting of 25 per cent of the wires in the adjacent span. The unit stresses used are those of the American Railway Engineering and Maintenance of Way Association. No material less than 5/16 in. thick is used.

Westinghouse, Church, Kerr & Co.—R. A. Marshall, structural engineer, has designed and built a number of poles for the yards of railroad shops. Fig. 4 shows a typical pole and its foundation. Each pole is carefully worked out by itself. The dead loads are the structural steel and the wires with a covering of ice ¼-in. thick. The wind load is figured at 13½ lbs. per sq. ft. on projected diameter of wire with ¼-in. ice coating. The tension in wire is figured on a basis of 100 ft. span with 3 per cent sag at center. A number of these poles take pulls at right angles to the main line which adds materially to the stresses. This is not an uncommon feature in the yards of railroad shops and manufacturing plants.

The steel is designed for two-thirds of the computed loadings with a unit stress of 16,000 lbs. per sq. in. net in tension and 16,000 lbs. reduced by the formula for compression. No material less than ¼ in. thick is used. Observe that the foundation is of ample proportions.

Pennsylvania R. R.—Among the interesting features of the New York tunnel extension of the Pennsylvania R. R. are the poles through the Meadows section in New Jersey. There are two lines, one for telegraph and telephone purposes, and one for power transmission; they were designed by R. D. Coombs. The poles of the telegraph lines are of concrete, 25 to 50 ft. high and spaced 70 to 135 ft. apart. The poles of the high-tension transmission line are of latticed steel, parabolic outline, square in cross-section, with one angle at each corner and single angle bracing. They are designed not only for present requirements but a liberal provision is made for future needs. The Hackensack River is crossed midway in the Meadows section. The adjoining poles, at the time they were built, were the highest in this country.

These poles (or tower-poles) are 765 ft. apart. Each one is 15 ft. square at the base and 3 ft. square at the top. The tops of foundations are 6 ft. above high water, and from the top of the foundation to the ground line is 188 ft. 4 ins. Special features are: Large number of heavy wires, of voltage requiring some separation, carried at a minimum clear height above high water of 133 ft. No strain insulators were available of sufficient electrical or mechanical strength, therefore nests of pin insulators carrying saddles were used to support the wires on the poles. The poles present a graceful appearance. The base is small in area—a greater spread would further obstruct the river and increase cost of foundation. On account of the importance of the line in operating the terminal division of a great trunk-line railroad, conservative data were used for calculations. These data are as follows:

River span: One 250,000-circ. mils, hard-drawn stranded copper ground wire; 24 250,000-circ. mils, hard-drawn stranded copper line wires; four 250,000-circ. mils, hard-drawn stranded copper signal wires; two 2,000,000-circ. mils, hard-drawn stranded copper feeder wires. Adjoining span same as river span. Second adjoining span same as river span except for signal wires—four No. 00 hard-drawn solid copper.

Loading: One-half-inch ice on all wires with 8 lbs. per sq. ft. wind pressure on diameter multiplied by length. Thirteen pounds per square foot of wind on 1½ times the pole area. Normal sag, 31.8 ft. Transverse pull, 24,900 lbs. Longitudinal pull, 22,135 lbs. Unit stresses: Steel in net tension, 15,500 lbs. per sq. in.; steel in compression, 17,600 lbs. per sq. in., reduced by formula.

New York Central.—The poles near New York city for the electric-transmission lines of the New York Central & Hudson River R. R. are often quoted as good practice. Fig. 5 shows the standard pole carrying twelve high-tension conductors. It is made of four corner 3½x3½x⅜-in. angles laced with 2½x 2x¼-in. angles. Poles on a tangent are 150 ft. apart with a wire sag of 30 ins., those on a 6° curve are 107 ft. apart with wire sag of 15 ins. The dead loads are the structure itself with the wires covered with ½-in. coating of ice. Wind pressure is taken at 30 lbs. per sq. ft. on the surface of the pole and on all wires covered with ½-in. coating of ice. The unit stresses used are 30,000 lbs. per sq. in. net for tension and for compression $\dfrac{30{,}000}{1+\dfrac{l^2}{125\,r^2}}$. While these unit stresses seem high, the loadings are large. The foundation is a solid block of concrete. The cross-arms are of wood, probably to secure greater insulation.

Long Island R. R.—A similar substantial construction is used by the Long Island R. R. for their steel poles on Long Island. The parabolic outline is abandoned. For the high-tension wires the wind is figured on the bare wire; for the low-tension wires it is figured on the wire covered with sleet ½ in thick. Wind pressure is figured according to results of German high-speed railway tests, where pressure per square foot $= 0.0027\,V^2$. With a velocity (V) of 100 miles per hour, wind pressure = 27 lbs. per sq. ft. on flat surfaces and 13½ lbs. per sq. ft. on projected areas of conductors. Side pull on pole is figured for a center deflection of 6 ft. with poles on 150-ft. centers.

New York, New Haven & Hartford R. R.—The 40-ft. yard poles of the New York, New Haven & Hartford R. R. used in the electrification of the Harlem River Branch, are rectangular in cross-section of four 5x3½x⅜-in. angles, double latticed on all four sides with 2¼x⅜ and 2¼x½-in. flat bars. The poles, back to back of angles, are 2x3 ft. at base and 2 ft. by 2 ft. 2 ins. at top. The base of each pole is made specially strong. From this base, four anchor rods of 1¾ to 2⅛ ins. diameter and upset at ends run down 8 to 10 ft. in a concrete foundation.

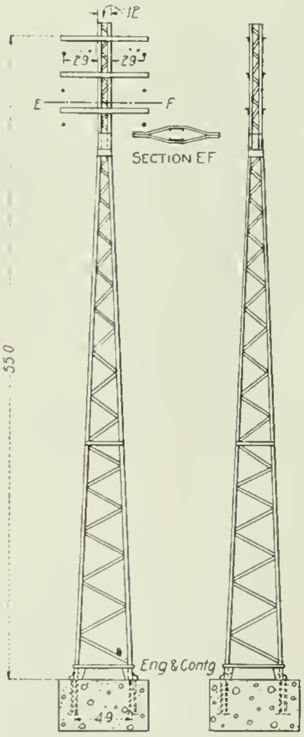


Fig. 6—Standard Steel Pole of the Tri-City Railway and Light Co. of Davenport, Ia. By J. G. White & Co.

J. G. White & Co.—Some poles designed by S. R. Jones, structural engineer of J. G. White & Co., are simple in construction. They are for a transmission system in the middle west and are shown in Fig. 6.

The data upon which design is based is:

Power wires: One circuit No. 1 stranded medium hard-drawn copper; one circuit No. 4 stranded medium hard-drawn copper.

Ground wire: No. 8 copper-clad steel.

Maximum allowable tension in wires: 50 per cent of breaking strength with ½-in. coating of ice and wind load of 8 lbs. per sq. ft. on horizontal projection of increased diameter of wire.

Assumed loads on pole: Vertical loads: Cross-arm = 600 lbs. at end of cross-arm; pole = weight of pole + weight of wires covered with ½-in. thickness of ice.

Horizontal loads: Total pull of 2,500 lbs. applied at middle cross-arm in direction of line, or at right angles to line plus wind load on pole at 20 lbs. per sq. ft. on exposed surface (both sides of pole included in surface exposed to wind pressure).

Unit stresses in steel: 24,000 lbs. per sq. in. net for tension; 24,000 lbs. per sq. in. reduced by formula for compression.

The preceding poles may be taken as illustrating the best practice of today. It will be seen that they have much in common. In each case the pole is made of four angles latticed.

VARIOUS POLES.

A pole made of two channels laced has been used, but such a pole is limited to light loads and low heights. The same can be said of a pole made of one plate and four angles. Foster ("Electrical Engineer's Pocket-Book") gives the deflection of some poles 6 ft. in ground and 24 ft. above ground, made of 6-in. to 12-in. by 3/16 in. plate and four 2½x2x¼-in. angles, for loads of 500 to 2,500 lbs. applied 3 ft. from the top, to be from 1 to 5 ins. These poles were used for electric railway service. The plate-and-angle pole has the advantage of being a good shape for inspection and painting.

Patented poles, made of rolled-steel sections fastened together at intervals, are on the market, and are meeting with considerable sale. They show good results for vertical loads, but the sections being battened and not laced together are adapted to carry only light lateral loads to the base. It is the custom to guy these poles from the top if the lateral forces are large. This restricts their use.

USE OF MATERIALS OTHER THAN STRUCTURAL STEEL.

Wood is increasing and fabricated steel is lessening in price. Fewer poles or towers are required if made of steel than of wood as they can be placed farther apart; this means fewer foundations, crossarms and insulators. In many cases, as for distribution systems in the yards of shops, wooden poles are not strong enough to carry the loads that will come upon them. Municipal authority has sometimes required the wooden pole on the city street to be replaced by the steel pole. The fire risk is eliminated with the steel support, and this is important. A substitute for wood is therefore in many cases not only desirable, but necessary.

Reinforced concrete is being used to some extent for distribution lines of electric-light and power companies, and also for overhead construction of street railways. The general tendency seems to be in the direction of a more extended application.

Tubular poles, made of successive lengths of iron pipe, take up little room, present a round resisting surface to external loads, show excellent results when tested, and can easily be repainted when necessary. Their limitations as to size restrict their use to light loads.

WATER WORKS

The Design of a Water System for the Boiler Feed and Fire Protection of a Modern Saw Mill.

Contributed by R. W. Rea, Civil and Hydraulic Engineer, Ellensburg, Wash.

During the summer of 1910, there was completed at Winchester, Idaho, by the Craig Mountain Lumber Co., a modern two-band saw mill. The protection of such plants against fire is often very inadequate, and, in many instances, lacking altogether, so that a brief description of the yard and automatic sprinkler systems installed there may prove of interest. The general plan of the system is shown in Fig. 1.

The plant was built in the midst of a virgin forest of yellow pine situated on top of a broad table-land known as Craig Mountain, in Nez Perce County, and at an elevation of 4,000 ft. above sea level. The mill site was the terminus of the Craig Mountain Railway, a standard-gage road, built by the company to a junction with the Lewiston-Grangeville branch of the Northern Pacific Railway, and over which all machinery and supplies for the mill and water system were brought in.

Inasmuch as the water for domestic use as well as that for the yard mains and boilers had to be supplied, two independent pumping plants were installed. The domestic supply was obtained by drilling a 6-in. well to a depth of about 350 ft. The well was cased for practically its entire depth. The normal water level in the well was about 40 ft. below surface of ground, and during a 48-hour test a flow of 60 gals. per minute was maintained with no appreciable lowering of the water level.

The well was equipped with an 8x36-in. deep well pumping engine, and 2-in. octagon ash wood pumping rods attached to an all-brass, double-acting, removable valve, water cylinder size 3¾x36-in. stroke, all supplied by the American Well Works. Steam was obtained from the mill boilers located near by. Against a total head of about 125 ft., this water was pumped directly into a 60,000-gal. steel tank of the hemispherical bottom type, on a 75-ft. steel tower. Tank and tower were designed and erected by the Chicago Bridge and Iron Works.

The supply for the yard mains, automatic sprinkler system and boiler feed, was obtained from the Mill Pond, which has an area of some 50 acres and contains ample storage capacity for any possible emergency.

A Worthington Underwriters Fire Pump of 1,000 gals. per minute capacity, was installed in a separate concrete building on the shore of the lake. Steam was supplied from the mill boilers through a specially protected pipe, some 250 ft. in length. An automatic pressure regulator on the pump maintained at all times a constant pressure of 80 lbs. per sq. in. in the mains at the highest point in the yards. The adjustment of this regulator is such that were the automatic sprinkler system, or several hydrants out in the yards, to be suddenly thrown open, the pump would immediately speed up to the rate necessary to furnish the requisite quantity of water under a minimum hydrant pressure of 80 lbs. per sq. in.

The 60,000-gal. steel tank, mentioned above, was intended primarily as a part of the domestic supply system of the town of Winchester, but, by means of a by-pass and check-valve arrangement, shown in Fig. 1, it was also made to serve as an auxiliary supply to the mill sprinkler system. The elevation of the bottom of tank was such that the topmost sprinkler heads in the mill would be under a minimum pressure head of 25 ft., thus furnishing an automatic short-time supply for the entire system should it become necessary at any time to shut down the Underwriter Pump for inspection or repairs.

The deep well pump was also fitted with an automatic pressure regulator, in order that the tank might always be kept filled to its capacity. A live steam coil was placed in the tank for use during the winter months, thus practically assuring two independent water supplies at all times.

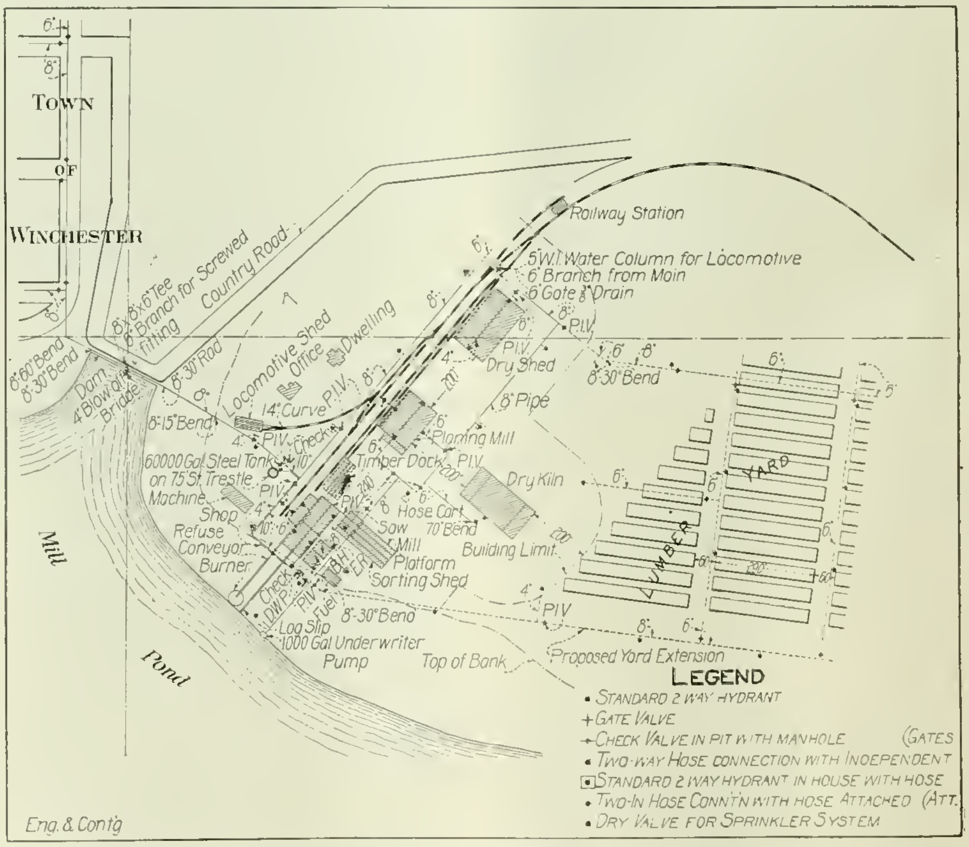


Fig. 1—Map Showing General Layout of a Modern Fire Protection System for a Saw Mill.

All distributing mains were of machine-banded, sleeve joint, wood stave pipe, designed for a working pressure of 125 lbs. per sq. in., and were supplied by the Washington Pipe and Foundry Co., of Tacoma, Wash.

Automatic brass air valves, in wooden manholes, were placed at several points to guard against collapse of the mains in case they should be suddenly drained. Gate valves were supplied by the Crane Co. and fitted with Post Indicators. Each branch main leading into a building was provided with a gate valve near the distributing main and as far from the building line as practicable, so that they could always be reached in the face of a hot fire within the building.

All distributing mains were laid with as uniform a grade as the surface conditions would permit, and with a minimum cover of 2 ft. All riser pipes leading from the distributing mains, or other exposed piping above ground surface, or suspended in the mill buildings, were of wrought iron.

Two-way Ludlow Hydrants were so placed that in no case would they be more than 300 ft. apart, thus materially lessening the pressure losses due to long lines of fire hose. The hydrants were of the rubber-faced, slide-gate, bronze mounted type, with 4-in. lead connections and 5¾-in. standpipe. Hose connections were 2½ in. diameter and fitted with 7½ threads per inch, to conform to the Underwriters standard. The 4-in. lead connections were made as short as practicable, and wherever necessary the hydrant was tied to the main with 1-in. tension rods and clamps. Owing to the impervious character of the soil, each hydrant was set over a rock filled sump of sufficient capacity to receive all the drainage from the hydrant standpipe.

At intervals of about 600 ft. wooden hose houses, containing 200 ft. of hose, were built over and around the hydrant. One hundred feet of hose was always attached to the hydrant and so coiled as to be ready for instant use. Each house also contained extra nozzle, hose spanners, lantern, and hydrant wrench.

About midway between the mill proper, planing mill and dry kiln, was stationed a two-wheeled hose reel with 500 ft. of hose, axes, nozzles, lanterns, wrenches, spanners, drag rope, etc. The reel was housed in a suitable shed that could be closed against the weather, and was provided with hose drying racks, rubber coats, hats and other necessary fire-fighting equipment.

With the exception of the dry kiln, boiler and engine rooms, all buildings were of heavy, open, timber construction. The dry kiln walls were of brick, with solid wooden roof. The other two buildings named were built of brick and steel, and were isolated from the mill buildings by a 10-ft. alley.

On account of this open construction and the fact that the plant must be protected in winter as well as summer, the automatic sprinklers were installed on the dry pipe system. The Grinnell straight way dry pipe valve and Grinnell automatic sprinkler heads were used throughout the plant. The dry valves were attached to wrought iron risers from the wooden mains, just outside each building and were enclosed in frost-proof lean-to's. Air pressure was supplied by a Westinghouse locomotive type air pump, mounted on brackets on wall of engine room.

In addition to the sprinkler system, the planing mill was equipped with two-way hose connections with independent gates, for 2½-in. hose. Fifty feet of 2½-in. standard hose was attached to each connection and coiled in a special rack for instant use. The dry shed was similarly equipped, the sprinkler system not being installed. The interior of the saw mill was, in addition to sprinklers, provided with 2-in. one-way hose connections with independent gates and 50 ft. of hose always attached.

The entire equipment was designed to comply with the standards of the National Board of Fire Underwriters, and, on completion, was carefully inspected by a representative of that association.

The yard system of distributing mains was designed so that water could circulate freely in either direction, thus always assuring a maximum of supply and pressure at any particular hydrant. All mains were also made amply large in the interest of higher efficiency during a bad conflagration. Fire hose used throughout the plant was guaranteed to conform to Underwriter standards, as were all hose pipes, couplings, hose houses, carts, etc.

The writer, as chief engineer for the Craig Mountain Lumber Co., designed the yard system and installed same for the company on force account. The sprinkler system was designed and installed by the Pacific Fire Extinguisher Co. of Portland, Oregon.

A New Water Meter Box.

(STAFF ARTICLE.)

A new water meter box, which, on account of its special adaptability to use in warm climates, is called the "Southland," recently has been put upon the market by the H. W. Clark Co. of Mattoon, Ill. The accompanying illustration, Fig. 1, shows the form of the meter box and the meter in place.

These boxes are of very light weight as ordinarily constructed. They are made of ordinary galvanized sheet iron, of galvanized sheet iron treated especially to resist rust and corrosion, or of cast iron. In the galvanized form the box is so light that the workman can easily carry it under his arm. Although of such light weight the box is strong enough to withstand all ordinary traffic and it is believed that in ordinary soils it will last for many years. For service subjected to the loads imposed by heavy traffic a cast iron box is furnished. For soils that are especially destructive to ordinary galvanized iron the "Southland" is furnished in either cast iron or of specially galvanized sheet iron.

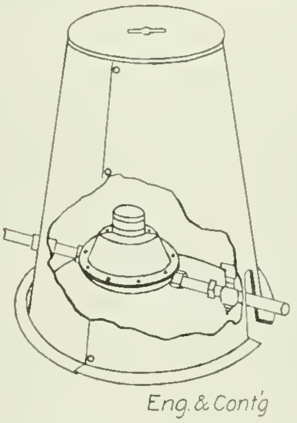


Fig. 1—A New Form of Water Meter Box Especially Suited to Use in Warm Climates.

The key which unlocks the cover also serves as a handle for lifting it from the box. The key remains in the cover until the cover is replaced upon the box. Then in order to remove the key it must be turned through the position which locks the cover in place.

The box is adjustable to variations of 6 ins. in depth of service, and is not fastened to the service pipe. Meter connections of the ordinary type can be used, and it is not necessary to dig up the box to install or remove ⅝, ¾, or 1-in. meters.

Opening of Assouan Dam.—On December 23, the Khedive of Egypt, with Lord Kitchener, British Agent and Consul General in Egypt, officially opened the Assouan dam. The work of increasing the height of the dam was begun in 1907, and according to the contract was to be completed in 1913. The storage capacity of the dam has been increased about 2½ times or about 9,375,000 cu. ft., and approximately 1,000,000 acres will be irrigated by this additional supply. The cost of the work was about $7,500,000.

Housing Exhibition at Chicago.—The City Club of Chicago is preparing to hold a "Housing Exhibition" at the club building, March 7, 1913. An interesting feature will be the display of plans for laying out and improving for residence purposes, unoccupied areas in Chicago. The club has asked the American Institute of Architects to draw up a program, addressed particularly to building and landscape architects, engineers and sociologists, for a competition for such plans. President Baker of the City Club has offered $600 in prizes.

A Report Upon the Relative Advantages and Disadvantages of Mechanical and Slow Sand Filtration Plants for Toronto, Ontario—Sand Filters Recommended.

In a recent report to the Commissioner of Works of Toronto, Ont., Mr. Allen Hazen, Consulting Engineer, considered the advantages and disadvantages of mechanical filters as an addition to the present slow sand water filtration plant, as compared with sand filters like those in the present plant. In his statement Mr. Hazen took up the peculiarities of construction, the relative costs of construction and operation, and the relative results to be obtained by the two types of plant. The following matter is taken from the report.

Head Required for Filter Operation.—About 5 ft. of head are required to operate the present slow sand plant. Of these about 4 ft. represent actual head on the filters and 1 ft. is lost in the piping and measuring devices.

Mechanical filters, as they have been ordinarily constructed, require about 10 ft. for normal operation, including the head loss in the piping and connections. If mechanical filters were built and operated as such filters have usually been built and operated, it would be necessary to have a head of about 10 ft. available. This could be brought about by lowering the water level in the pure water reservoir, or by raising the level of the filters.

Lowering the water level in the pure water reservoir by 5 ft. would destroy a large part of the storage capacity of the reservoir, and would be inconvenient from the standpoint of operating the present pumping station. It would further tend to decrease the carrying capacity of the tunnel under the bay. Mr. Hazen does not consider it wise to reduce the ordinary water level in the pure water reservoir.

The alternative is to raise the filters so that the water level on them is about 5 ft. above the level now carried on the sand filters. If mechanical filters should be adopted this is apparently the easiest way of securing the required head.

Pumping Station.—An addition to the pumping station must be built in as part of a larger plant. If more sand filters are built it will be possible to pump the additional quantity of water required for a considerable period in the future in the present pumping station. The addition would, in this case, be for the purpose of reserve. At least 100,000,000 gals. per day can be handled through the present pumping station when the new intake is connected, new pumps installed in the places already provided, and an additional discharge pipe provided. That is to say, up to the approximate limit indicated, it would be possible to supply the present filters and additional filters in the present pumping station operated by one set of men.

If mechanical filters were used the water would have to be delivered 5 ft. higher. It would be best to hold the present pumping station and intake for supplying the present filters, and to build a new pumping station drawing from the new intake to supply the mechanical filters. The present equipment is not adapted to work against the additional head, and even if it were it would not be possible to use it to supply two plants at different levels at the same time. The installation of mechanical filters would, therefore, mean the operation of a separate pumping plant to supply them, and pumping the water against an added lift. The added lift would mean an increase in the power and the cost of the equipment. In a general way the pumping station would cost 15 or 20 per cent more for mechanical filters.

The cost of operation would also be increased by the added lift of about 5 ft., costing probably 6 cts. per 1,000,000 gals. per ft. for the added lift, or 30 cts. per 1,000,000 gals. in all.

Possibility of Using Mechanical Filters Requiring Less Head.—Mechanical filters were used in paper mills many years ago that required no more head for their operation than is required by sand filters. Certain defects in operation with these filters were found, and these defects were corrected by methods which involved the use of greater head. It might be possible to take the matter up at this time and study out a type of filter which would operate with no more head than the sand filters, and in which these defects would be corrected by other methods than those which have been used. To do this, however, would involve the use of coarser filtering material and perhaps also a shallower layer of it, combined with a greater filtering area and a design of an under-drainage and washing system differing considerably from that which has been used in mechanical filters. If mechanical filters should be decided upon, Mr. Hazen thinks this general proposition worthy of careful consideration. Following it out would clearly increase the cost of the plant to a substantial extent. Whether this increase would more than offset the saving in the cost of the pumping station and in the cost of pumping, could only be determined by studying the matter out in considerable detail.

Such filters have never been built, so far as Mr. Hazen knows, and the matter would, therefore, require most careful consideration. It is suggested as a possibility, but not as a matter likely to influence the judgment of the Commissioner of Works as to the merits of the system as a whole, and therefore, not requiring more detailed consideration at this time.

Settling and Coagulating Basin.—If mechanical filters are used it is necessary to provide a basin in which the water will be held after receiving the coagulant that is applied to it for a certain period before the water goes to the filters. This period of detention is necessary to allow the chemical reaction to take place, and to allow the greater part of the precipitate caused by it to settle out of the water before it goes to the filters. After studying the records of all mechanical filter plants that are available to us that are treating lake water, we feel that a period of detention of three hours is as short as can be prudently taken in this case.

This basin should be of concrete and covered, similar in its general design to the filters, but with its flow line 5 ft. higher, and with the bottom sloped to drains to facilitate cleaning out periodically the sludge that is to be produced by the action of the chemical upon the water. The average depth of the basins would be about 15 ft. Baffles and other appliances would be required so that the cost per 1,000,000 gals. would be increased above that of a simple reservoir. For each 1,000,000 gals. daily output 125,000 gals. of basin capacity must be provided, costing for a large plant about $12,000 per 1,000,000 gals. of storage, or $1,500 for each 1,000,000 gals. daily output.

Mechanical Filter Construction.—Filters are contemplated similar to those in use at Cincinnati, Columbus, New Orleans and many other places. The filter tanks would be of concrete. The flow line would be about 5 ft. above the flow line of the present filters. The filter tanks would be about 8 ft. deep and the floors would be some feet above the present surface of the ground on a foundation which would have to be built up and made sufficiently solid so that there would be no chance of settlement.

Mr. Hazen usually allows about 430 ft. of net filter area for each 1,000,000 Imperial gals. daily capacity. In this case the lake water is usually clear, and of very constant composition, as compared with river water; it will be possible to use a somewhat higher rate than is used for river waters. He assumes that 385 ft. of net filter area per 1,000,000 gals. daily capacity will be sufficient.

The cost of mechanical filters actually built has varied considerably with design and with local conditions. About $25 per sq. ft. may be taken as a representative and not far from an average figure for recent American conditions. This includes not only the filters proper, but all the piping immediately connected therewith, and the machinery and equipment of all kinds required for their operation and the building to contain it. Taking into account the higher cost of some of the materials in Canada and the conditions of the foundation, Mr. Hazen estimates $30 per sq. ft. of net filtering area, or $11,500 per 1,000,000 gals. daily capacity.

Pure Water Reservoir and Piping.—As the requirements of sand filters and mechanical filters will be similar, they will be assumed for this purpose to be the same and will not be brought into the comparison.

Cost of Mechanical Filters and Coagulating Basins.—Adding the two items as above, we have $13,000 per 1,000,000 gals. daily capacity for filters and coagulating basin. Add to this 15 per cent for engineering and contingencies; the total probable cost is $14,950, or say $15,000 per 1,000,000 Imperial gals. daily capacity.

Cost of Sand Filters.—It appears from the analysis, excluding the cost of the pure water reservoir and pumping station, that the actual cost of constructing the present sand filters has been $57,000 per acre, including all contingencies. Engineering has cost 10 per cent in addition, making the total cost $62,700 per acre. This is a low cost for such construction, and it may be that the addition to be now built will cost more. Mr. Hazen assumes for the present that it may cost 10 per cent more, or $70,000 per acre.

Each acre of net filter surface has a nominal capacity of 5,000,000 Imperial gals. per day. On this basis the cost of the plant will be $14,000 for each 1,000,000 gals. daily capacity.

Comparison of Cost of Construction of Sand and Mechanical Filters.—Excluding the difference in cost of pumping station, and assuming items for piping and pure water reservoir to be the same, the relative costs of construction of additional plant per 1,000,000 Imperial gals. daily capacity, are as follows:

Mechanical filters	$15,000
Sand filters	14,000

It appears from the above that there will be no very great difference in the first cost of sand filters and mechanical filters, with indications that sand filters will be a little cheaper. The conditions are unusually favorable for construction of sand filters and the water lends itself readily to this treatment, while the conditions for the construction of mechanical filters, especially in connection with the present plant, are not particularly favorable.

Cost of Operation of Mechanical filters.—The experience of several plants in purifying lake waters with mechanical filters before the use of hypochlorite was introduced a few years ago indicated clearly that 1 grain of sulphate of alumina per U. S. gallon, equal to 172 lbs. per 1,000,000 Imperial gals., was too small a dose for reasonable efficiency.

The use of hypochlorite in the effluent changes the conditions, and it will be possible to operate with less coagulant than was formerly found necessary. On the other hand, it is a matter of experience that there is a fairly definite amount of coagulant that must be applied, depending upon the character of the water, and when less than this amount is applied little benefit is obtained from that which is used. In the absence of actual experience with Lake Ontario water to determine this point, Mr. Hazen assumes that as little as the amount mentioned will be sufficient in this case when used in connection with hypochlorite. At $25 per ton, the sulphate of alumina will cost $2.15 per 1,000,000 gals. The whole cost of operation, exclusive of hypochlorite and its application, is estimated as follows:

	Per million Imperial gals.
Additional cost of pumping, because of greater lift	$0.30
Sulphate of alumina, 172 lbs. per million gals.	2.15
Other costs of operation, including superintendence, labor, laboratory expenses, repairs, renewals, heat, light, drainage, oil, waste, and pumping wash water	2.35
Total	$4.80

Cost of Operation of Sand Filters.—The cost of operating sand filters, including superintendence, laboratory expenses, and the cost of pumping wash water, but excluding the cost of the main pumping, was estimated at $1.83 per 1,000,000 Imperial gals., in a communication to Mr. Rust, the former City Engineer, dated Nov. 20, 1908. The records of operation for the present year indicated a cost a third less than this, but it must be remembered that in subsequent years it may be necessary to handle more sand than in the first period, when everything is clean, and Mr. Hazen therefore deems it wise to use the same figure that he used four years ago.

Relative Cost of Operation.—The estimated costs of operation, excluding pumping, per 1,000,000 Imperial gals., are as follows:

Mechanical filters	$4.80
Sand filters	1.83

Mechanical filters cost 2½ times as much to operate. This is mainly due to the cost of the chemicals required with them.

Relative Efficiency of Sand and Mechanical Filters.—Lake Ontario water lends itself admirably to the sand filter treatment and excluding the effect of hypochlorite, better and more reliable bacterial or hygienic results will be obtained by sand filters than can be obtained by mechanical filters.

From a physical standpoint there is no appreciable difference; either kind of filters will yield water free of color and turbidity and otherwise satisfactory.

With the systematic use of hypochlorite in the effluents, Mr. Hazen considers that any difference that there might otherwise be in favor of sand filters is eliminated. The hypochlorite treatment conscientiously used can be depended upon to correct any falling off in efficiency that there may be with filters of either system, and he considers that the results will be satisfactory from a hygienic standpoint in either case.

From the standpoint of certain mechanical uses to which the water may be put, and especially with reference to boiler feed water, the sand filters have a certain advantage. The hardness in Lake Ontario water is in the form of carbonate or temporary hardness. This is the least objectionable form of hardness. The use of chemicals in the water changes a certain part of the carbonate hardness to sulphate or permanent hardness, and this is more injurious than the carbonate hardness, especially in boilers. If there were other and sufficient reasons for using chemical treatment, it would be recommended, notwithstanding this condition. In the absence of such reasons, it must be recognized that whatever change grows out of the chemical treatment tends to make the water less desirable and is to be avoided as far as may be.

Operating Mechanical Filters at Times Without Coagulant.—There are times when the lake water has a considerable degree of turbidity, which could not be removed by mechanical filters without the use of coagulant. At such times the lake water must be coagulated and the equipment for using coagulant must, therefore, be provided in the plant. There are times when the lake water is of satisfactory physical condition in its raw state, and at such times it could be passed through mechanical filters without the use of coagulant. The cost of operation would be reduced by the cost of the coagulant if this were done.

In operating filters without coagulant high bacterial efficiency would not be obtained. It is to be expected that from 10 to 90 per cent, averaging 50 per cent of the bacteria in the raw water, would pass through the filters. From a bacterial and hygienic standpoint, such purification would have but little significance, and is not worth the cost of securing it. This procedure could only be considered in connection with the use of hypochlorite, and in this case the hypochlorite would be mainly depended upon for bacterial efficiency.

This process, in reality, would be a hypochlorite treatment of raw water, with the occasional aid of coagulant when the water was turbid or otherwise of poorer quality. Mechanical filters operated in this way would be more fairly termed "scrubbers" than "filters," and the results would not be at all comparable to those that can be obtained with the present plant or with a properly operated mechanical plant. The possibility of this treatment was mentioned for completeness, and not with the idea that it would be adopted or recommended for Toronto conditions.

Proper Field for Mechanical Filters.—It may be well to point out at this time that there are many waters which can be only successfully treated by mechanical filters. Such waters include especially river waters carrying large quantities of finely divided clay and waters carrying large amounts of soluble organic coloring matter. With waters of both of these types sand filters cannot be successfully used. These waters must receive adequate chemical treatment in any event, as a preliminary to settling out the impurities and subsequent filtration. And when so prepared, mechanical filters are most appropriate for completing the process.

No such difficulties exist in the case of Lake Ontario water, which may be easily filtered without previous chemical treatment at a minimum of expense and with excellent results.

CONCLUSION.

Lake Ontario water, as obtained on the Island, is well adapted to treatment by sand filters, and the conditions are unusually favorable for carrying out the process economically. The situation is not well adapted to the use of mechanical filters, and the cost of operation of mechanical filters would be much greater than the cost of operation of sand filters. There would be no advantage in the quality of water to be obtained with mechanical filters, but on the other hand there would be some slight impairment of the quality of the water for boiler and other mechanical purposes. The use of mechanical filters is not recommended.

Method and Cost of Sand Pumping 2-in. Driven Wells at Ridgely, Maryland.

Contributed by Clark A. Bryan, Civil Engineer, Ridgely, Md.

The water system of the town of Ridgley, Maryland, which was designed by Mr. T. Chalkley Hatton of Wilmington, Del., was installed in the summer of 1906. The supply is derived from a battery of 2-in. driven wells located near the center of the town and on the north side of the Oxford branch of the Philadelphia, Baltimore & Washington Railroad. The wells are ten in number and are driven in two rows of five wells each. The rows are 60 ft. apart and the wells are spaced 12½ ft. on centers. A 6-in. suction main is laid midway between the two rows of wells and the wells are connected to it in pairs, corresponding wells in each row joining the suction main at the same point. The well points are 6 ft. long and are made of No. 60 gauze. The wells are staggered vertically and vary in depth from 37 to 55 ft. Water is pumped from them directly into the mains of the town by a Goulds triplex pump. The surplus pumpage passes into a storage tank of 60,000 gals. capacity, which stands 90 ft. above the ground, and is located directly over the wells.

The system has now been in use for eight years and has given complete satisfaction, as practically no repairs have been necessary. During the past summer the water began to show a milky appearance when drawn from the faucets, due to the presence of air. It was hoped that this would pass off as the same thing had occurred two years previously, and the water at that time soon cleared up. Instead of clearing up the conditions grew worse last summer and the writer as Engineer in charge of sewer construction at Ridgely was empowered by the Town Commissioners to investigate the matter and try to locate and remedy the defect. An examination of the pumping apparatus showed that it was holding a vacuum of 25 ins. and as it had been recently overhauled it seemed reasonable to assume that the trouble originated in the wells themselves. It was decided that it would be much cheaper to try the effect of sand pumping the wells rather than to try to pull them up, renew the well points, and then drive them again. The following method was devised:

Each well was separately disconnected from the suction main and was tested by using a number four pitcher pump. Records were made of the quantity discharged. The pump was then removed and a round stiff-bristle brush was inserted in the well, connected to a ¾-in. pipe and shoved to the bottom. The last 6-ft. length, that is, the well point, was then thoroughly scrubbed and the brush was withdrawn. Sand pumping was then tried, for which purpose the following apparatus was used. A marble about ⅝-in. in diameter was placed in a nipple of ¾-in. pipe. The nipple was about 8 ins. long. One end of the nipple was capped with a ¾-in. cap in which a ⅜-in. hole was bored, and the other end was reduced to ½ in. by means of a bushing. This marble check valve was inserted in the well and ½-in. pipe screwed to it length by length until it reached the bottom. Pipe was added until the ½-in. pipe projected 3 or 4 ft. above the ground. A short ½-in. nipple was then screwed into a ½-in. elbow, which was then screwed on top of the sand pump. A piece of green oak lumber 2 ins. by 6 ins. and 16 ft. long was used to actuate the pump. The timber was first placed in position with one end over the well to be cleaned and the other end was anchored to the ground. This timber rested on a fulcrum about 3 ft. high, which was placed about 7 ft. from the fixed end. A short cross bar was then screwed to the sand pump and allowed to rest on top of the timber. Using the timber as a spring the sand pump was then actuated up and down in the well, the water, sand and grit dislodged being discharged through the top of the sand pump. By varying the length of the stroke the entire length of the point could be thoroughly cleaned. The water first discharged was very dirty and pumping was continued until the discharge was practically clear. To clear the discharge from some of the wells required continuous sand pumping for over an hour.

When the discharge had cleared the sand pump was removed and a 2-in. fire hose connected with the well and the full town pressure of 48 lbs. turned on and allowed to run for several minutes. After disconnecting the fire hose the pitcher pump was again connected to the well and the discharge was measured. Each well was treated in the manner outlined above. By this method wells that first tested only 38 gals. per minute were increased to 165 gals. per minute. After the operation of sand pumping had been finished the vacuum gauge of the pump dropped from 25 ins. to 16 ins. where it stood when the system was first installed, and the milky appearance of the water has entirely disappeared. Moreover, the tank can now be filled in about two hours' time, an operation that had previously required about five times as long.

The work required the employment of three men, and the following is the cost:

One foreman, 12 hours at 20 cts.	$ 2.40
Two laborers, 12 hours at 17.5 cts.	4.20
Pump, lumber, etc.	6.00
Total	$12.60
Cost per well	1.26

It will be interesting to note how long this sand pumping will remain efficient as it was intended only as a temporary relief. However, local conditions were favorable for performing the work in a very thorough manner and it is hoped that its efficiency may be permanent.

BUILDINGS

Method of Building Foundations for a Typical Substation, With Special Reference to the Excavation.

Contributed by Alden W. Welch.

In building a substation for the distribution of electrical energy, it is usually necessary to make a very deep excavation beneath the proposed building. This is to provide space for the cellar and room for the electrical ducts which must be placed under the cellar floor. In a recent job with which I am familiar, much of the digging was done by means of a steam shovel. This feature of the job will be considered in detail while the other construction work will be rapidly dealt with.

A substation was to be built adjacent to an old brick structure which was being utilized as a temporary substation. The dimensions of the new foundations were 135 ft. by 40 ft. by an average of 13 ft. deep. The excavation amounted to a matter of 100x40x13 ft., which equals 1,926 cu. yds. The foundation walls were 2 ft. thick. There were also 19 footings to be built, each approximating 3.5x3.5x3.5 ft. The total concrete to be laid amounts to 500 cu. yds. The approximate maximum weights of the several parts of the foundations upon the soil are as follows:

	Tons per sq. ft.
North and south walls	2.5
Front wall	3.0
Rear wall of operating room	2.7
Rear wall of battery room	2.5
Column footings	2.7

The contractor was to excavate all of the basement portion of the new building, the area-way, and all required for the new foundations and foundation walls. All earth and other material excavated, excepting that required for the back fill, was to be removed from the premises immediately. If rock excavation were necessary, or if any pumping was to be done, the work was to be performed by the contractor without extra charge.

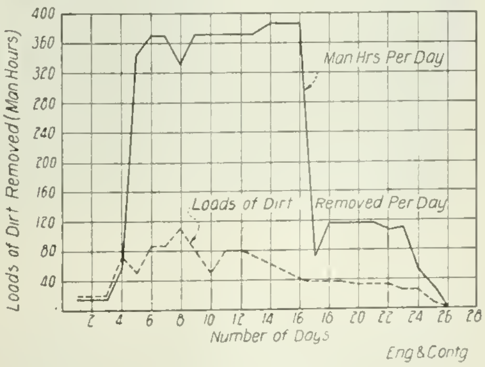
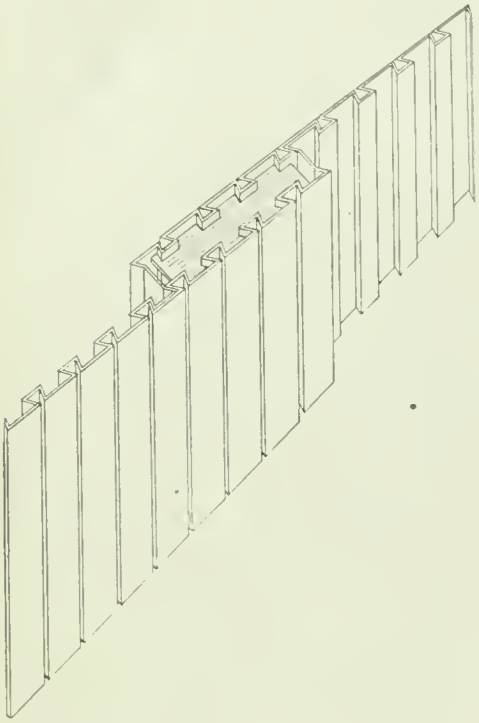


Diagram Showing Progress and Cost of Excavating a Basement with Steam Shovel.

The contractor had to do all of the necessary sheet piling and bracing, as directed by the engineer in the field. The sheet piling and bracing was to be exceptionally strong and rigid, so that no movement of the soil could possibly take place. The sheet piling was to be of yellow pine not less than 3 ins. in thickness, and was to be properly tied together by suitable longitudinal pieces spaced not more than 3 ft. apart, vertically. Sheet piling was to be driven around the four sides of each individual pier for the column foundations and along the sides of the concrete foundation walls and area-way, except at adjacent building to a depth which would properly retain the adjacent earth. The area inside this sheeting was to be then excavated down to the bottom of the footings.

The contractor was to back fill the basement floor to the level of the underside of concrete floor slab, the back fill to be the material previously excavated, well tamped in place and level. He was to back fill the battery room floor in the rear of station to underside of concrete floor slab in a similar manner.

The contract called for excavation and putting in foundation for substation building. All work was to be completed in two months. The price of $7,500 included all the work called for in the specifications with the exception of the shoring and underpinning. This latter work being an uncertain quantity was to be performed on a cost plus 10 per cent basis.



View of Corrugated Sheet Mould and Reinforcement for Concrete Walls and Slabs.

Field work commenced on the day following the placing of the contract. An old building had stood upon the site of the proposed substation and although it had been wrecked its cobble stone floor still remained. The first work, therefore, consisted of removing these stones from the job. For this purpose two men with a truck were employed. They finished this preliminary work in four days, having removed 20 loads of the cobble stones. On the fifth day after beginning the work the steam shovel arrived and on the following morning was in operation and excavated 70 loads of dirt. With the digger came 30 men and 6 trucks. In addition to these, from 7 to 14 men were employed to contribute toward the proper execution of the work. The number of trucks varied from six to nine. The maximum quantity of earth and stone was excavated on the eighth day when 114 loads were carted away.

The digger remained on the job twelve days and in that time 874 loads of dirt were excavated. It then became advisable to continue the work by hand. Rocks of such proportions were uncovered that blasting was resorted to. The average amount of dirt removed per day by hand was 30 loads. During this time five trucks and five extra horses were utilized. Three horses were used on the job for helping to pull the carts out of the excavation and two were used on the dock when the dirt was loaded on the scows. The excavating was practically completed 26 days after the job was started and at the end of that time the trenches were begun for laying the fibre ducts. This latter work was not included in the contract as it was performed by the company and is therefore not considered here.

The progress of the work as outlined in the foregoing is graphically presented in the accompanying curve. The product of the number of men employed on the job per day multiplied by the average number of hours which they worked gives a fair measure of the amount of work accomplished per day. The dashed line represents the number of loads of dirt excavated and removed from the job per day.

A Corrugated Sheet Mould and Reinforcement for Concrete Walls and Slabs.

(Staff Article.)

A new construction of concrete walls and slabs is shown by the accompanying sketch. Described briefly, specially corrugated metal plates are set parallel and filled between with concrete and also plastered on the outside, thus joining a concrete slab in which the metal sheets act as reinforcement. Referring to the sketch it will be seen that the corrugations are of dove-tail shape and separate sheets are connected by interlocking the corrugations at adjoining edges. Separator plates as indicated at S in the sketch keep the distance between the side plates uniform.

In construction the wall plates are set up as indicated by the sketch and medium wet concrete is tamped between them in layers about 8 ins. deep. At the same time the outside is plastered. In this way the wall is built up in stages of about 4 ft. height.

The metal sheets are made by the Edwards Metal Structures Co., Kansas City, Mo., in various sizes and weights and are known by the trade names of "lockform" and "lockrib" metal.

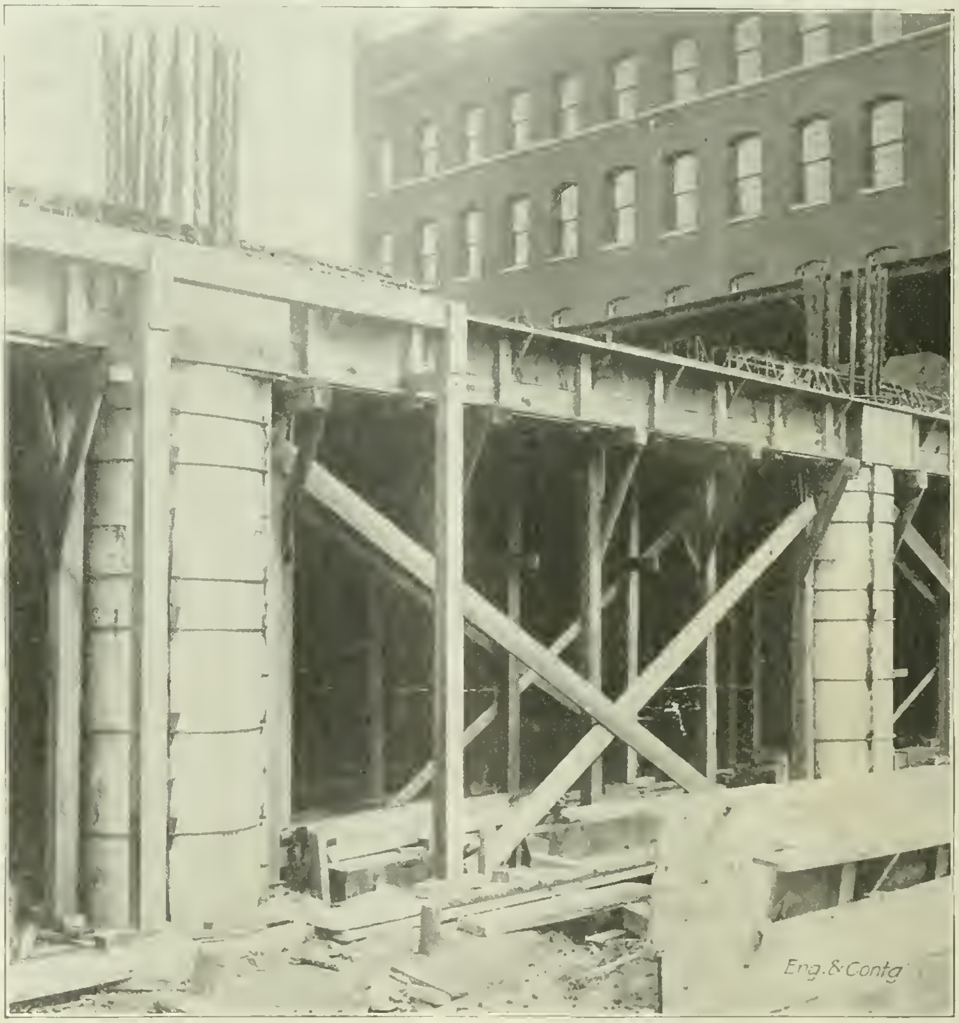
Method and Cost of Steel Form Erection for Circular Concrete Building Columns.

(STAFF ARTICLE.)

Steel forms for concrete building columns of circular section are being used in the construction of a building at the McCormick plant of the International Harvester Co. These forms have been found exceptionally light and easy to handle. It is claimed that they so reduce the cost of work that a column form will pay for itself after five columns have been built with it and it will last for about ten good-sized building jobs.

The forms used at the McCormick plant are for 42-in. columns, 9 to 10 ft. in height. On the first floor a record was kept of the labor for 41 columns which shows that the 41 columns were put up in 42 men hours, divided among three pairs of men, and the cost was 68 cts. per column. This is at the rate of 16 columns per day for each pair of men. The outside columns were built with wood forms on account of their shape, which is half square and half octagonal, and these forms were built at about four times the cost of the steel forms.

The steel forms are shown in the accompanying view. They are made of 20-gage galvanized sheet iron and held to shape by bands made of 1x1¼-in. steel bent edgewise to fit the circle. The sheet iron is made in segments covering one-third of the circumference of the column and the vertical edges are bent outward forming a web. The bands pass through slots in these webs and are keyed together with steel wedges which are passed through the slots near the ends of the bands.



View Showing Steel Column Forms at McCormick Plant of International Harvester Co.

Steel bands are not placed around the column at every slot in the web of the sheet iron forms but only at such vertical distances as considered necessary. At each slot in these webs, where no band is used, a small piece of flat steel, with a slot in it, is slipped through the web and steel keys or wedges are slipped through the flat steel piece, thus binding the sections at these points.

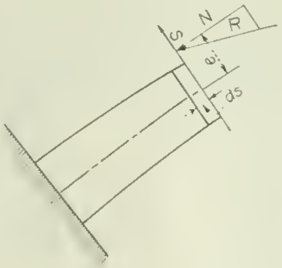


Fig. 1.

The vertical height of the sections is from 3 to 6 ft. and an 18-in. section is made for adjusting the height of the column exactly. The sections telescope into one another, the small end being the lower end so that in erecting, the top section is set up first, and is held up in place on a couple of 2x4 pieces while the lower section is assembled. On some jobs it is possible to assemble the columns on the falsework for the floor above and slip them down to place in one piece. They are light enough so that a whole column can be handled by two men, a mechanic or carpenter and his helper.

Columns of any diameter can be made with forms of this type by the proper selection of the standard sizes of segments which make up the circle. Another special advantage claimed in using these forms arises from the fact that they can be removed from the column before the beam and floor slab forms are taken down, as these forms are not attached to the column forms and do not bear upon them. The manner of supporting the floor and girder forms is shown in the accompanying view which shows the work at the McCormick plant. This makes it possible to shift the column forms as rapidly as the conditions of the work may demand, and a comparatively small outfit of forms will take care of a good-sized job. The forms are made by the Blaw Steel Centering Co., of Pittsburgh, Pa.

Formulas and Diagrams for the Design of Rigid Frames for Steel and Reinforced Concrete.

In reinforced concrete building construction the entire structure is rigid to a certain extent, but for simplicity of design this rigidity usually is not fully taken advantage of. In steel design insufficient attention is often paid to bending in columns caused by the rigidity of the connections. Frequently, in both building construction and bridge work, as well as in other designs, the bending moment for the beam is taken as an assumed fraction of wl^2, while the bending moments at the ends and in the columns are disregarded entirely. The effect of this is either to make the whole structure inadequate or to make one part stronger at the expense of another. In a paper presented to the National Association of Cement Users by Mr. Sanford E. Thompson and Mr. Edward Smulski, formulas and diagrams are given to simplify the design of rigid construction in steel and reinforced concrete. We reprint this paper as follows:

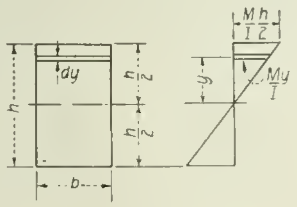


Fig. 2.

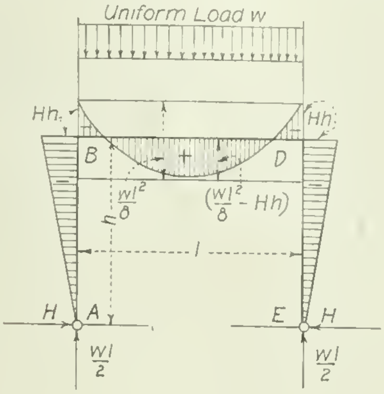


Fig. 3.

It is not proposed in this paper to advocate the accurate computations of all the joints in a building several stories high. In ordinary cases the usual arbitrary practice, provided sufficient attention is paid to negative bending moment, gives safe results, since the bending in columns is negligible.

Many cases occur, however, in the design of reinforced concrete where material can be saved and a much better result obtained from an architectural as well as a structural standpoint by the adoption of a rigid frame. In cases like this, the adoption of a rigid frame permits a considerable reduction in sectional area of members and produces a well balanced design.

Rigid frames are not, as such, being used in America to a very great extent, while in Europe they form a standard practice. A partial reason for this lies in the fact that many engineers do not believe in continuity and doubt the effect of the rigidity. They do not hesitate to figure on concrete resisting positive bending moments in the center, neither do they object to using cantilever construction where negative bending moments must be provided for, but they have a religious fear of combining the two so as to allow the concrete to take the negative bending moment at the support as well as the positive bending moment in the center.

Another reason is that the formulas usually given—and there are hardly any published in English—are not in shape for practical use and frighten an engineer who is not of a mathematical turn of mind. To partially remedy the matter, the writers have endeavored to give formulas and diagrams by the use of which the finding of moments for the rigid frames will be scarcely more difficult than using arbitrary fractions of wl^2.

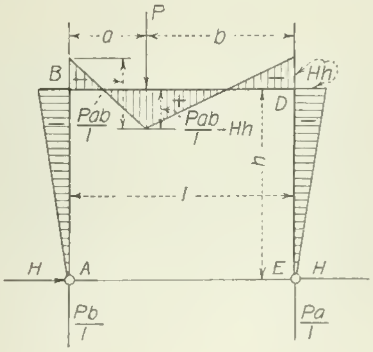


Fig. 4.

The rigid frame is a statically indeterminate system with one, three, or more indeterminate quantities, depending upon the number and fixity of the supports. The method used in finding the indeterminate quantities is the same in all cases of rigid frames, the difference being only in the method of procedure.

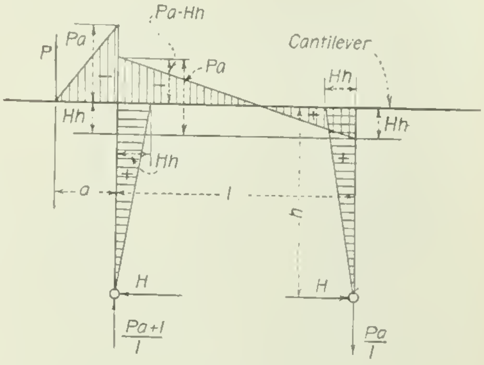


Fig. 5.

The method of figuring is based on the theory that the deflection of a body under external lateral loads must be such as to make the sum of the work performed by the internal forces a minimum. The theory, commonly termed the "theory of least work," was originated by Castigliano and further developed by Muller-Breslau in his book on Mechanics.

In the present paper two types of design are specifically considered, the one consisting of a horizontal member rigidly attached to two columns with hinged ends, and the other an A-frame, like a roof attached to two similar columns. The formulas and diagrams are adapted both to the simple designs and also the design where cantilevers extend out from the beams.

As stated above, the columns are assumed to be hinged at the bottom. Such a case occurs where the columns rest on or are but slightly imbedded in the ground, or rest upon another part of the structure without rigid reinforcement at the connections. Where the connections at the base of the column are rigid, the same computations may be used, although the results will err on the safe side.

An illustration of a problem which may be solved is the design of a girder bridge. Instead of computing the girder and the abutments more or less independently, the structure may be considered as one rigid frame, and, knowing the loads upon the bridge and the earth pressure, the stresses in all portions of the structure may be readily computed by the formulas given below and a design established which will require the minimum amount of material, and which, at the same time, will be rationally designed. Another case where a design of this type can be applied to advantage is in a structure like a machine shop, which consists simply of wall and roof. By designing the joints at the eaves so as to make them rigid instead of providing, in accordance with common practice, a large excess of material so as to be sure to be on the safe side, and instead, even then of having no knowledge whatever of the stresses that occur at the

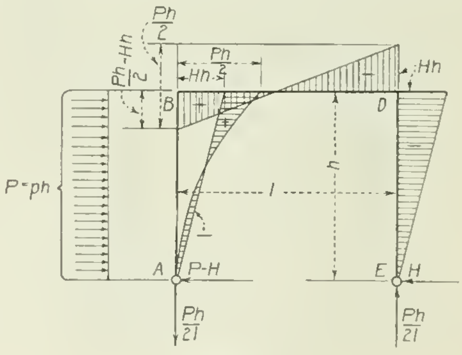


Fig. 6.

critical points, the dimensions and reinforcement may be fixed by definite computations based on figured stresses. Many other applications of the analysis will occur to a designer who hitherto has had no means of solving such problems except by guess work or by laborious mathematical computations.

The formulas and the diagrams apply to steel frames as well as reinforced concrete.

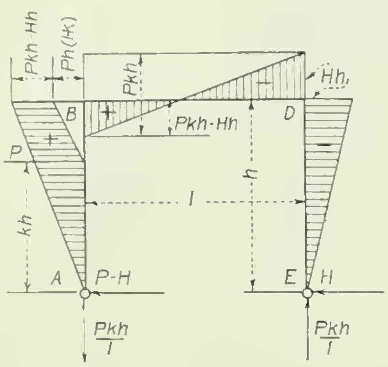


Fig. 7.

In presenting this treatment and recommending it for reinforced concrete structures, the writer appreciates that it implies a construction in which the joints are as carefully designed and constructed as the rest of the members. The use of concrete has already advanced so far in America for high buildings and other large engineering structures, that we believe it is fully time to get in line with the practice adopted throughout Europe of making thorough computations according to the laws and principles of mechanics instead of adopting more or less arbitrary and imperial methods.

It is not proposed to present in full the mathematical work entailed in the derivation of the formulas; in fact, in most cases simply the final formulas, which are obtained by the application of the theory of least work, are given. However, to indicate the procedure for the benefit of mathematical readers, the general method of analysis is first given, followed by the practical formulas for use in design.

THEORY OF LEAST WORK.

Let us suppose that a portion of a curved beam shown in Fig. 1 is subjected to a force, R, not acting in the center of its cross-section. This inclined force may be resolved into two components, one perpendicular to the section, which is the thrust, N, and the other parallel to it, which is the shear, S. The influence of shear on deflection is very slight, so that the eccentric thrust only need be considered in the subsequent discussion.

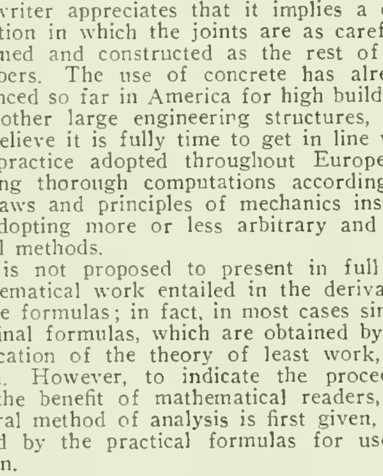


Fig. 8.

A portion of the beam shown is thus subjected to a force, N, acting at a distance, e, from the center, which may be replaced by a force, N, acting at the center and a moment, $M = Ne$.

Consider now a portion of the beam between two parallel sections which are an infinitely small distant apart, ds. The work performed by the eccentric force in deforming this portion may be devided into work done by the force, N, acting centrally and by the moment, $M = Ne$.

Now, let A = area of the section, E = modulus of elasticity, ds = thickness of the portion considered and K = work.* Then the deformation due to the central forces, N, is $\delta = \frac{N}{EA} ds$. In performing this deformation the work, being force times distance, may be found by multiplying the average force, $\frac{N}{2}$, by the deformation:

$$dK_1 = \frac{N}{2}\frac{N}{EA}ds = \tfrac{1}{2}\frac{N^2}{EA}ds$$

This represents the work performed by the thrust.

To find the work performed by the bending moment, $M = Ne$, let us assume for the sake of simplicity a rectangular section, where $b = 1$. (Fig. 2.) The stress on a strip $b \times dy$ at a distance, y, from center line of section is $\frac{My}{I} bdy$. The deformation in length, ds, due to this stress is $\frac{My}{IE} b\ dy\ ds$, and the corresponding work is $\tfrac{1}{2}\frac{M^2y^2}{I^2E} b\ dy\ ds$. The work at any point of the section is thus represented by a function of y. By adding together the work of the different points, which may be done by integration, we obtain the work done on the whole section, or

$$dK_2 = \int_{-\frac{h}{2}}^{h_2} \frac{My^2}{2I^2E} dsdy = \tfrac{1}{2}\frac{M^2}{I^2E} ds \int_{-\frac{h}{2}}^{\frac{h}{2}} y^2dy$$

$$\text{and since } \int_{-\frac{h}{2}}^{\frac{h}{2}} y^2dy = I,$$

we may write $dK_2 = \tfrac{1}{2}\frac{M^2}{IE} ds$ as the work performed by the moment.

The work of the eccentric force, that is, the combination of the thrust and moment on the portion of beam, ds, is $dK = dK_1 + dK_2$, and the sum of the work on the whole beam is

$$K = \tfrac{1}{2}\int \frac{N^2}{EA} ds + \tfrac{1}{2}\int \frac{M^2}{EI} ds \ldots\ldots (1)$$

The values of N and M are dependent upon the indeterminate quantities, H, V, and M_z.

According to Castigliano, the values of the indeterminate quantities must be such that the work is a minimum. To satisfy this requirement, the first partial derivative of equation (1) in respect to H, V, and M_z, the usual indeterminate values must equal zero. This gives the following relation:

$$\frac{\delta K}{\delta H} = o \quad \frac{\delta K}{\delta V} = o \quad \frac{\delta K}{\delta M_z} = o \qquad (2)$$

from which the values of H, V, and M_z may be determined.

NOTATION.

The following notation corresponds in general to standard practice.

E = modulus of elasticity considered as constant.

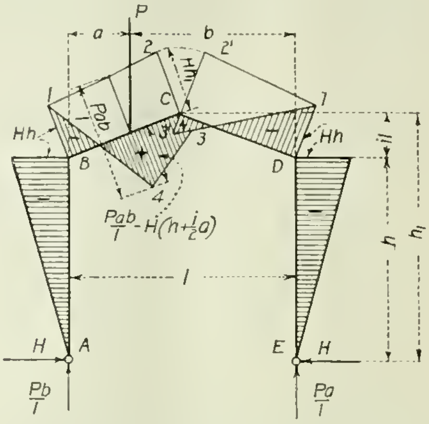


Fig. 9.

I = moment of inertia of columns.

I_1 = moment of inertia of beam.

$\frac{I_1}{I} = q$ = ratio of moment of inertia.

A = area of beam.

h = height of frame.

l = width of frame.

i = ratio of rise of roof to width of frame.

M = actual bending moment at any point.

M_0 = bending moment for a statically determinate system.

N = thrust at any point.

H = horizontal reaction.

GENERAL FORMULA FOR RECTANGULAR FRAME WITH HINGED ENDS.

Before giving the simple formulas for practical use, the derivation of the general formula will be given for the benefit of mathematical readers. For frames hinged at the bases of the columns, the horizontal reaction, H, is the only statically indeterminate quantity and the following equation is sufficient for determining it.

$$\frac{\partial K}{\partial H} = 0 = \int \frac{N}{EA}\frac{\partial N}{\partial H} ds + \int \frac{M}{EI}\frac{\partial M}{\partial H} ds \ldots . (3)$$

Since E is considered a constant, it will be omitted in the subsequent discussions and formulas. The values of the moment, M, and the thrust, N, to be substituted in the above must be determined for the different parts of the frame, as shown below.

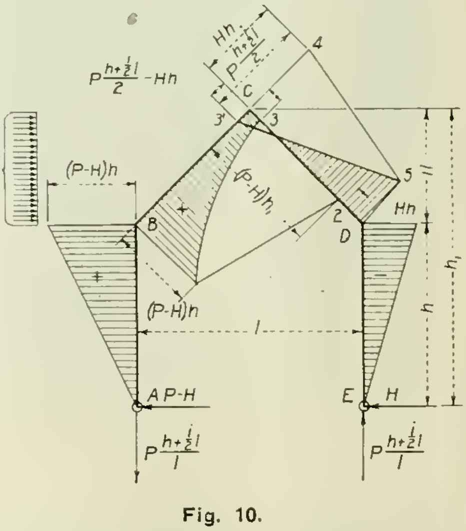


Fig. 10.

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*For "work" the letter K has been selected. This term has hitherto been used so little in English that there is no standard letter for it. The German designation, A, however, which stands for arbeit, is not adaptable to English treatment because the letter A is used so universally for area.

For columns *AB* and *ED* in Fig. 3:

$$N = R_b \text{ constant } \frac{\partial N}{\partial H} = 0, \int_o^h \frac{N}{A}\frac{\partial N}{\partial H} ds = 0$$

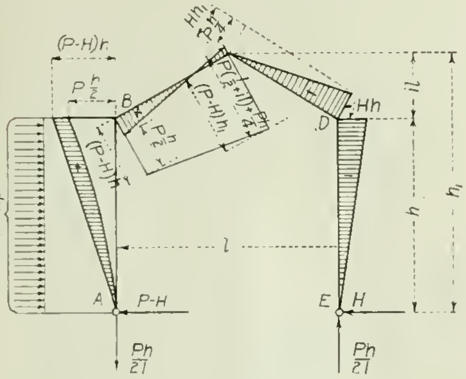

Fig. 11.

$$M = -H_x \, \partial M \frac{\partial M}{\partial H} = -x, \int_o^h \frac{M}{I}\frac{\partial M}{\partial H} ds = \frac{1}{I} H \frac{h^3}{3} \quad \text{(a)}$$

For *BC* in same figure:

$$N = -H \frac{\partial N}{\partial H} = -1, \int_o^l \frac{N}{A}\frac{\partial N}{\partial H} ds = \frac{Hl}{A} \ldots\ldots \text{(b)}$$

$$M = M_0 - Hh_1 \frac{\partial M}{\partial H} = -h, \int_o^l \frac{M}{I}\frac{\partial M}{\partial H} ds = H\frac{h^2 l}{I_1} - \frac{h}{I_1}\int_o^l M_0 dx \ldots\ldots\ldots\ldots \text{(c)}$$

The integrals above designated as (a), (b), and (c) introduced into equation (3) and solved for *H* after omitting the negligible quantity, $\frac{l}{h}\frac{I}{A}$ give

$$H = \frac{\int_o^l M_0 dx}{h^2\left(\frac{2}{3}\frac{I_1}{I} + \frac{l}{h}\right)}$$

The value of $\int_o^l M_0 dx$ must be found for every loading.

After determining the horizontal reaction, *H*, the moments and thrusts at any point of the frame may be easily determined by statics.

WORKING FORMULAS AND DIAGRAMS.

Without going further into the theoretical derivations, the practical side of the problem will next be taken up for the various types of design selected. As already stated, with the formulas and diagrams given below, it is possible to design all parts of the frames shown in the sketches.

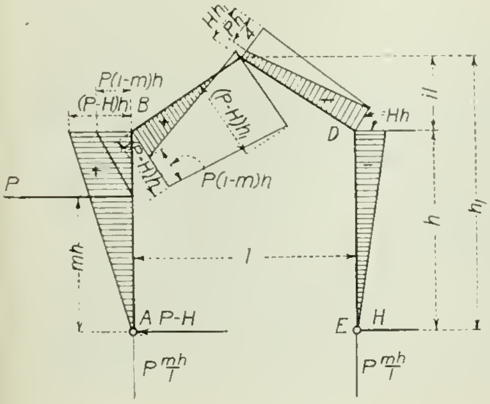

Fig. 12.

Taking any one of the types of frame, the loads produce bending in all of the members. The bending of the columns produces horizontal reactions at the base (in addition to the vertical reactions). These horizontal reactions are the most difficult forces to determine, but when once found, they, with the known external forces, provide the solution of the entire problem. This is analogous to the problem of a beam in which, when we know the reactions and the external loads, the bending moments can be figured at any point. The following cases are treated for rectangular frames with hinged bases and for roof-shaped frames with hinged bases: (1) Uniformly distributed vertical loading; (2) concentrated vertical loading; (3) loading on cantilever projections; (4) horizontal loading such as wind load, and (5) concentrated horizontal loading.

CASE I.—UNIFORMLY DISTRIBUTED VERTICAL LOAD ON RECTANGULAR FRAME (FIG. 3).

The thrust at the base of either column is obtained in the following manner:

Let w = unit load, then $\int_0^l M ds = \frac{wl^3}{12}$. Substituting this value in equation (4), and calling

$$C_1 = \frac{\left(\frac{l}{h}\right)^2}{12\left(\frac{2}{3}\frac{I_1}{I} + \frac{l}{h}\right)} \text{ we obtain } H = C_1 wl \ldots\ldots \text{(I)}$$

In which C_1 is a constant to be taken from Diagram 1, selected for the proper $\frac{l}{h}$ and $\frac{I_1}{I}$.

Having thus obtained the value of *H*, the moment at any section in the beam or the columns is determined by ordinary principles of mechanics. For example, beam *BD* is subjected to a negative bending moment at the support, $M_a = M_c = -Hh$, and a positive bending moment in the middle $M_{max} = \frac{1}{8}wl^2 - Hh$ and also to a thrust $N = H$.

The columns are subjected to a thrust equal to the vertical reaction and a negative bending moment varying from zero at *A* and *E* to a maximum of $M = -Hh$ at *B* and *D*. The individual bending moments are outlined in Fig. 3, and the combined moment is shown for each member in the cross-hatched area.

CASE II.—CONCENTRATED VERTICAL LOAD ON RECTANGULAR FRAME (FIG. 4).

The treatment for concentrated load is similar to that for distributed loads.

Let R = concentrated load, then $\int_0^l M dx = \frac{1}{2}Pab$. Substituting this in equation (4) and calling $C_2 = \frac{\left(\frac{l}{h}\right)^2}{2\left(\frac{2}{3}\frac{I_1}{I} + \frac{l}{h}\right)}$ we obtain

$$H = C_2 \frac{a}{l}\frac{b}{l} P \qquad \text{(II)}$$

In which C_2 is a constant to be taken from Diagram 2.

The moments and thrusts at different points are determined as explained in Case I.

CASE III.—RECTANGULAR FRAME WITH CANTILEVERS (FIG. 5).

When a frame has projections such as may occur in the roof of a train shed, as shown in Fig. 5, the influence of the load on the cantilever may be determined. The vertical reactions may be found by statics, and the horizontal thrust from the following equation, in which $C_3 = \frac{\left(\frac{l}{h}\right)^2}{2\left(\frac{2}{3}\frac{I_1}{I} + \frac{l}{h}\right)} = C_2$ is

$$H = C_3 \frac{Pa}{l} \qquad \text{(III)}$$

For values of C_3 see Diagram 2. When both cantilevers are loaded, the horizontal thrust due to the load on the other cantilever must be determined by the above formula and the results added. After determining the horizontal thrust, the moment may be found at any point in the frame.

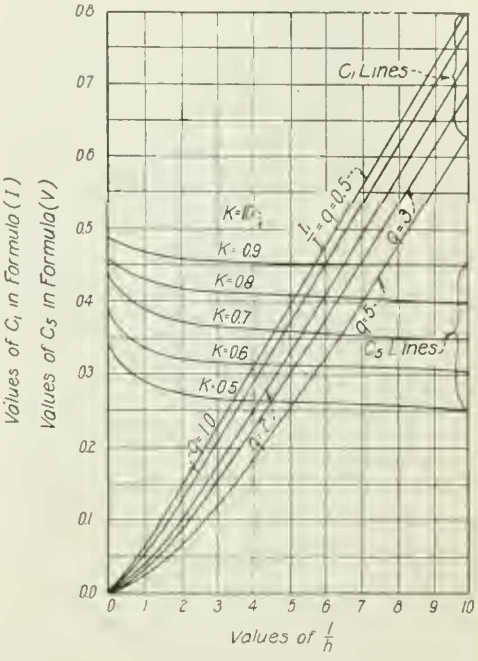

Diagram 1.

CASE IV.—WIND LOAD ON RECTANGULAR FRAME (FIG. 6).

Let p = the uniformly distributed wind pressure per unit of length, then the total wind pressure is $P = ph$, and the formula for horizontal thrust, in which $C_4 = \frac{5\frac{I_1}{I} + 6\frac{l}{h}}{16\frac{I_1}{I} + 24\frac{l}{h}}$ is $H = C_4 ph$ (IV)

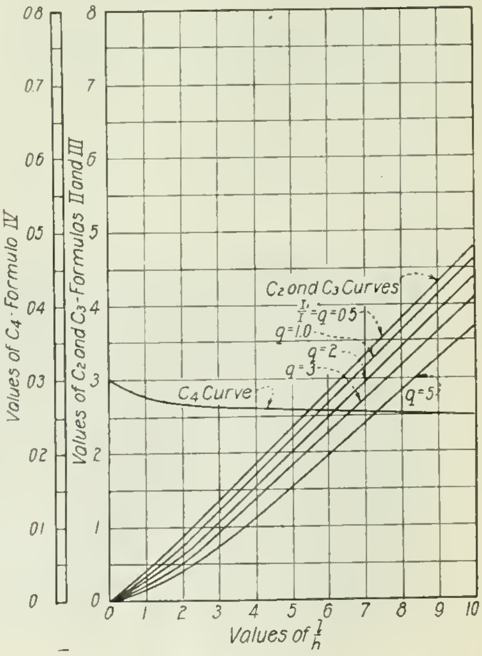

Diagram 2.

The value of C_4 may be taken from Diagram 2. The values are the same for all ratios of

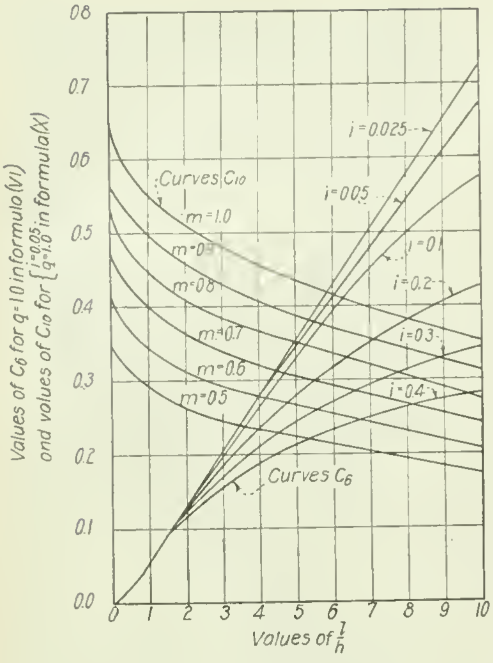

Diagram 3.

$\frac{I_1}{I}$. The moments at different points in the frame are illustrated in Fig. 6. The treatment of earth pressure or water pressure is similar except that the horizontal load is not uniformly distributed.

CASE V.—CONCENTRATED HORIZONTAL FORCE ON RECTANGULAR FRAME (FIG. 7).

If a force, P, acts horizontally at a distance kh from the base, the reactions are shown in Fig. 7. The vertical reactions may be found by statics, and the value of H, the horizontal thrust, from formula $H = C_5P$, in which

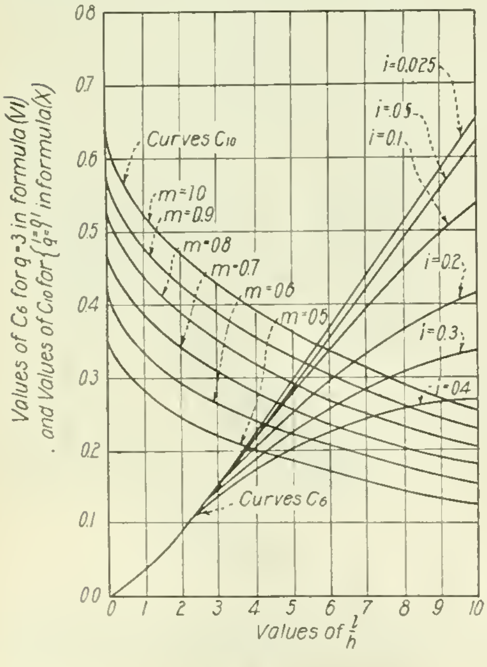

Diagram 4.

$$C_5 = \frac{3k\left[\frac{I_1}{I}\left(1-\frac{k^2}{3}\right)+\frac{l}{h}\right]}{2\left(2\frac{I_1}{I}+3\frac{l}{h}\right)}P \ldots\ldots (V)$$

The value of the constant C_5 is taken from Diagram 1 for different values of K. As the influence of $\frac{I_1}{I}$ is small, the curves may be used for any ratio of $\frac{I_1}{I}$.

The moments are computed in the usual way and are illustrated in Fig. 7.

GENERAL FORMULA FOR FRAME WITH RIDGE ROOF.

A very common type of construction where a rigid frame design may be adopted with economy is that of a sloping roof, such as is shown in Fig. 8. Frequently a building like a picture gallery, an auditorium, a church, or a market, may be of the general type shown, and by adopting rigid frame construction, the horizontal roof chords, frequently so unsightly or obstructive, may be entirely omitted. A machine shop or power house may have its central part of rigid frame design. These principles of design apply also to arch roofs.

The derivation of the general formulas is similar to that already illustrated for the rectangular frame, although considerably more complicated. After substituting the solved integrals in the equation, we have

$$H = \frac{\int_0^{\frac{l}{2}} M_0\left(h+\frac{i}{2}x\right)dx + \int_{\frac{l}{2}}^{l} M_0\left[h+\frac{i}{2}\left(l-x\right)\right]dx}{h^3\left[\frac{2}{3}\frac{I_1}{I\sqrt{1+\frac{i^2}{4}}}+\frac{l}{h}+\frac{1}{4}i\left(\frac{l}{h}\right)^2+\frac{1}{48}i^2\left(\frac{l}{h}\right)^2\right]} \ldots\ldots (4)$$

This equation is altogether too involved for practical use. For special loadings the formulas become simpler and have been used for the compiling of curves so as to make the actual problem no more complicated than for the rectangular frames already discussed. Since the type of frame now discussed is adapted chiefly for roofs, it will be termed a roof frame.

CASE VI.—UNIFORMLY DISTRIBUTED LOAD ON ROOF FRAMES (FIG. 8).

In Fig. 8 let w = the uniformly distributed vertical load per horizontal foot on BCD. The horizontal thrust then for a fully loaded roof is $H = C_6wl$. (VI)

If only half of the roof is loaded, the formula becomes $H = \frac{1}{2} C_6wl$. (VI′)

The values for C_6 may be taken directly from the diagram which is worked out for different ratios. Occasionally it may be necessary to obtain a value not given in the table, and for this purpose, the constant may be taken as

$$C_6 = \frac{\left(\frac{l}{h}\right)^2\left[1+\frac{5}{32}\frac{l}{h}\right]}{12\left[\frac{2}{3}\frac{I_1}{I\sqrt{1+\frac{i^2}{4}}}+\frac{l}{h}+\frac{1}{4}i\left(\frac{l}{h}\right)^2+\frac{1}{48}i^2\left(\frac{l}{h}\right)^3\right]}$$

CASE VII.—CONCENTRATED LOADS ON ROOF FRAMES (FIG. 9).

The horizontal thrust, H, for a concentrated load is then a distance, a, from the support is $H = C_7P$. (VII)

Values of C_7 are given in Diagrams 5 and 6 for $q = \frac{I_1}{I}$ equal 1, values of $i = 0.05$ and $i = 0.1$, different ratios of $\frac{l}{h}$, and also for ten different positions of load.

CASE VIII.—UNIFORM WIND LOAD ON ROOF FRAME (FIG. 10).

The wind is taken as acting on the inclined surface BC. For simplicity, assume that the wind acts horizontally. For any other angle of inclination of the wind, the formulas given below may be used by resolving the inclined force into horizontal and vertical components. Then for the horizontal component, use the formulas given below and for the vertical component follow the plan outlined in Case VI.

Let p = uniform horizontal load per vertical foot, then $P = ilp$, and the thrust may be expressed as $H = C_8P$. (VIII)

Values of the constant C_8 are obtained from Diagram 7. In case the values are not included in the curves, the thrust may be deter-

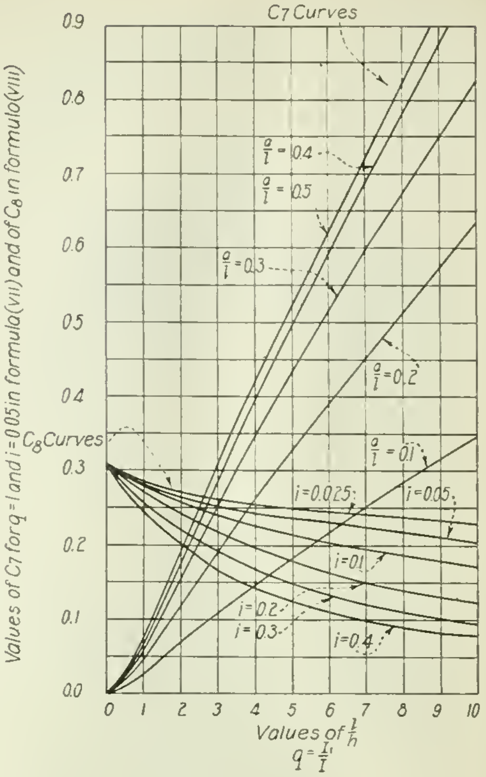

Diagram 5.

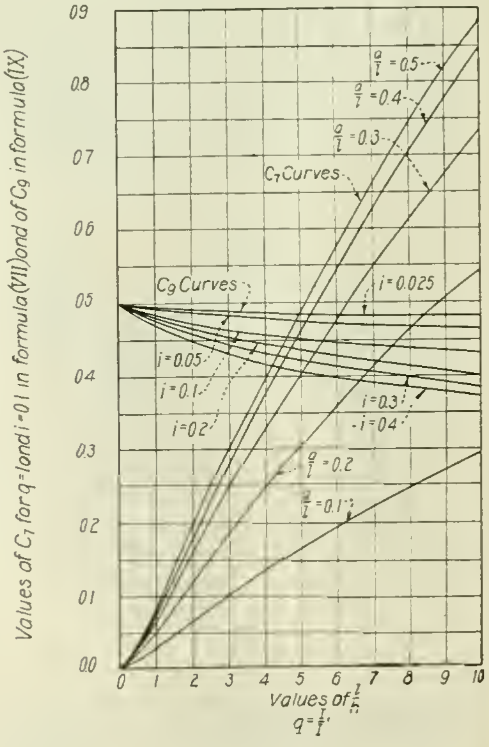

Diagram 6.

mined from the formula

$$H=\frac{\left[\frac{I_1}{3I}+\frac{1}{2}\frac{l}{h}+\frac{5}{48}i\left(\frac{l}{h}\right)^2\right]}{\left[\frac{2}{3}\frac{I_1}{I}+\frac{l}{h}+\frac{1}{4}i\left(\frac{l}{h}\right)^2\right]}P$$

CASE IX.—UNIFORM WIND LOAD ON VERTICAL MEMBER OF ROOF FRAME (FIG. 11).

Let p = uniform load per foot and $P=ph$, then the thrust becomes $H=C_9P$. (IX)

Values of C_9 may be obtained from Diagram 6. In case the values are not included in the curves, the thrust may be determined from the formula

$$H=\frac{\frac{5}{24}\frac{I_1}{I}+\frac{1}{4}\frac{l}{h}}{\frac{2}{3}\frac{I_1}{I}+\frac{l}{h}+\frac{1}{4}i\left(\frac{l}{h}\right)^2}$$

CASE X.—CONCENTRATED HORIZONTAL FORCE ON VERTICAL MEMBER OF ROOF FRAME (FIG. 12).

For concentrated wind acting at a distance mh from base or for other horizontal force, we have for the thrust $H=C_{10}P$. (X)

Values of C may be obtained from Diagrams 3 and 4.

In case the values are not included in the curves, the thrust may be determined from the formula:

$$H=P\frac{m\left[\frac{I_1}{I\sqrt{I+\frac{i^2}{4}}}\left(1-\frac{1}{6}m^2\right)+\frac{l}{h}+\frac{1}{32}i\left(\frac{l}{h}\right)^2\right]}{2\left[\frac{2}{3}\frac{I_1}{I\sqrt{I+\frac{i^2}{4}}}+\frac{l}{h}+\frac{1}{4}i\left(\frac{l}{h}\right)^2+\frac{1}{48}i\left(\frac{l}{h}\right)^3\right]}$$

SEWERAGE AND SANITATION

Outfits for Chemical and Bacteriological Field Analyses in Connection With Water Supplies, Sewage Effluents and Stream Pollution.

The value of chemical and bacteriological field analyses, made in connection with the examination of water supplies, sewage, sewage works effluents and stream pollution is well appreciated by many engineers. We here present a description of the field kits suitable for making the necessary analyses, with an outline of such analytical work as is ordinarily done with field outfits. This information is taken from an article by Mr. L. H. Van Buskirk, Assistant Engineer of the Ohio State Board of Health, published in the Bulletin of the Board for December, 1912. The illustrations used are furnished by courtesy of Mr. E. F. McCampbell, Secretary of the Board and editor of the Bulletin.

One of the important reasons for making field analyses is that the chemical and bacterial changes taking place in samples of water which are shipped to laboratories for examination are both rapid and complex. It has been found by engineers and chemists who have had wide experience in analytical work that not all chemical results are seriously affected by the delay incident to shipping. Consequently, field analytical work has, to a large extent, been confined to those determinations which are subject to rapid change. It must be borne in mind, however, that in many instances either a temporary laboratory is constructed or a laboratory in the vicinity is available for use. In such cases equipment may be supplied from the central laboratory, so that complete analytical work may be conducted.

The bacterial work which is usually carried on when field outfits are used includes what are commonly called the presumptive tests for B. coli in addition to the pouring of plates from which the total number of bacteria in the sample is obtained. The bacterial content of a water changes rapidly and is influenced greatly by the temperature. It is always advisable, therefore, to plate samples as soon as possible after collection at which time the inoculations for the presumptive tests should also be made. This procedure reduces the number of samples it is necessary to send to the laboratory and produces results which are more representative of the quality of the water at the time of sampling.

The chemical work, which it is necessary to conduct in the field, is determined entirely by the character and scope of the proposition to be investigated. It is recognized that owing to the varied conditions introduced studies of water supplies, sewage treatment works effluents, and stream pollution require special chemical determinations in each case to secure the most valuable results.

In a study of a water supply it may be found advisable to determine the alkalinity and chlorine in addition to free carbonic acid, which latter determination can be accurately made only at the time of sampling. In examinations of water purification plants it is frequently desired to include the determination of causticity, or caustic alkalinity. In sewage and stream pollution work alkalinity, chlorine and dissolved oxygen are ordinarily determined. In some particular cases free carbonic acid is determined. Successful field kits, therefore, must contain the necessary chemicals and chemical and bacterial apparatus so that the required determinations can be made in the field.

Many difficulties present themselves when field work is undertaken. As stated above, one of the advantages of such work is that a large number of determinations may be made. This requires a large number of sample bottles which increases the weight and bulkiness of the field outfit when the bottles are included. The field kits must be made of sufficient capacity so that several bottles may be carried, thus avoiding small shipments. When investigations requiring the collection of a large number of samples are made, it becomes not only impracticable but impossible to carry a sufficient number of bottles. In such cases it is necessary to have shipments forwarded to convenient points where the field kits may be replenished and the used apparatus returned to the central laboratory. In the design of field kits an attempt should be made to include in the outfit sufficient material to provide for at least one day's work. The kit must be made compact, convenient and of as small weight as possible. In designing kits which would be flexible and suitable for the field work as outlined above, these qualities must be considered. The following, together with the accompanying cuts, is descriptive of the field kits designed for use by the engineering department of the Ohio State Board of Health.

In designing cases for field work an attempt was made to obtain standard sized cases which could be equipped with special trays or compartments suitable for conducting the various field tests. The cases are of sole leather and are 19⅜ ins. by 14¼ ins. in plan and 5⅞ ins. in depth. Two cases were obtained, each one being equipped with removable trays suitable for carrying bacterial apparatus. Provision is made for carrying twelve four ounce sampling bottles and the necessary plates, bile tubes, agar, pipettes and other apparatus for the bacterial determinations. A space has been provided in front of the plate compartment in the case which may be utilized for the carrying of reports or miscellaneous papers. If it is desired the compartments containing the sample bottles may be turned so that the bottles may be carried in an upright position. Fig. 1 shows the trays removed from the case, illustrating the flexibility of the outfit.

Fig. 2 shows the same kit with two of the trays replaced by those of different design. This kit is for use in conducting the dissolved oxygen determination and contains the necessary chemicals, chemical apparatus, five eight ounce sampling and a special sampling outfit. Fig. 2 shows the trays removed from the case. The sampling bottles, chemicals and analytical apparatus are shown in Fig. 3. The reagents are added to the sample by means of special pipettes, each of which has a capacity of approximately 2 c.c. below the restriction. The graduated pipettes are carried in Nessler tubes

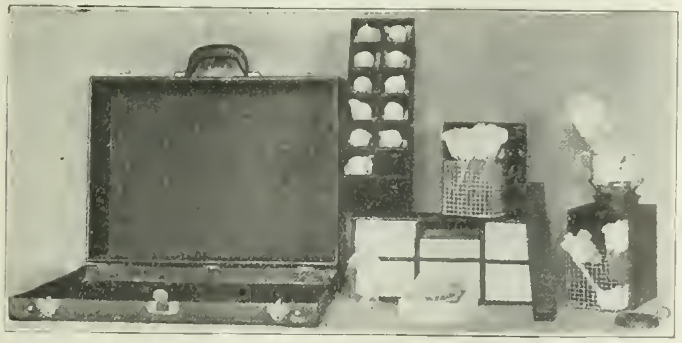

Fig. 1—Bacterial Case Unpacked, Showing Apparatus.

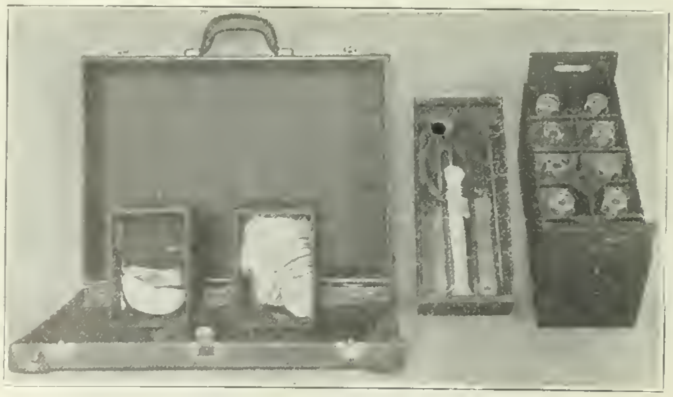

Fig. 2—Dissolved Oxygen Case Unpacked.

which have cotton placed in the bottom and which are provided with rubber stoppers. A 100 c.c. portion of the treated sample is measured in a Nessler jar and transferred to a porcelain dish in which the titration is made. The sample bottles and reagents are conveniently packed and carried in the tray shown in Fig. 3. The analytical apparatus, together with a special sampling outfit, are carried in the small tray shown in Fig. 2.

Fig. 4 shows a special sampling apparatus. A piece of rubber tubing of sufficient size to fit over the neck of the sampling bottle is provided, with a two hole rubber stopper. Brass tubes are placed through the stopper, as shown in the cut. The metal tubes are much more serviceable than glass, which have been ordinarily used. The rubber tubing is rigid, so that the bottle can be submerged by simply pushing downward on the brass tube. When it is desired to collect a sample from a point at which the water cannot be conveniently reached a standard consisting of a brass rod, wooden base and brass weight has been provided with which to lower the bottle. It will be observed that this apparatus can be used only where a sufficient depth of water for its vertical submergence is available. A piece of rubber tubing with a small funnel has been provided for the collection of samples where the water is too shallow to permit the use of the special apparatus. Fig. 5 shows the sampling apparatus taken apart ready for packing.

The two bacterial cases and trays cost $25, and the two trays for the dissolved oxygen outfit $3.00, making a total cost of $28.00. The sampling apparatus, consisting of the standard, rubber tubing, brass tubes, rope, etc., cost $2.00. The other apparatus was obtained from the Laboratory of the Ohio State Board of Health. The cases weigh 16 lbs. empty, and 32 lbs. filled.

Some Data on the Amount of Ground Water Infiltration Into Sewers, with Suggested Usage of Terms in Recording Such Infiltration.

An article published in Engineering and Contracting of Dec. 27, 1911, gave some data on the amount of ground water infiltration into sewers in various American cities. The article also outlined some of the general methods of waterproofing sewers. Articles describing methods of waterproofing sewers which were successfully employed at the cities of Summit and South Orange, New Jersey, were published in the issues of Engineering and Contracting for January 3 and February 21, 1912, respectively. Further data along the lines of the article first mentioned above, with a suggested usage of terms in recording ground water infiltration into sewers are given in a paper by John N. Brooks entitled: "The Infiltration of Ground-Water Into Sewers," which was published in Vol. xxxviii of the Transactions of the American Society of Civil Engineers. The data here given are taken from Mr. Brooks' paper which will be presented before the Society on Feb. 5, 1913.

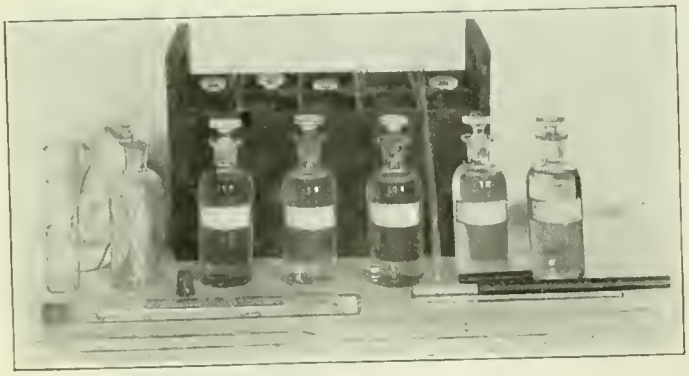

Fig. 3—Chemicals and Analytical Apparatus in Dissolved Oxygen Case.

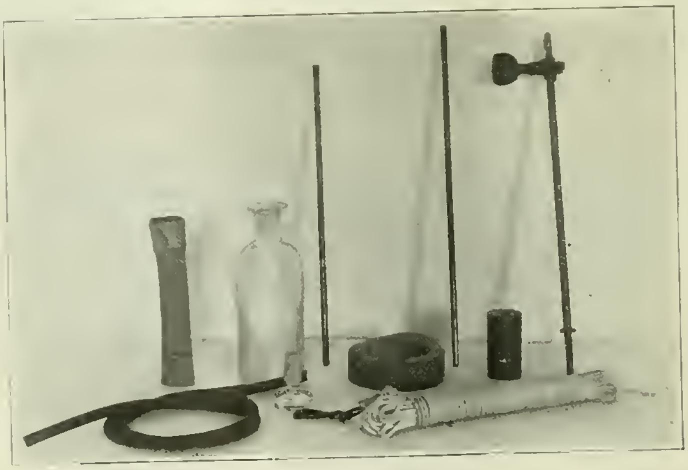

Fig. 5—Sampling Apparatus Ready for Packing.

An examination of the Index to the *Transactions* of the American Society of Civil Engineers, published recently, shows that the Society has never published a paper on the infiltration of ground-water into sewers. Some recently collected data on the subject are presented in Table I, and a glance shows that the information is incomplete in most cases, and that there is a wide variation in the form in which it is presented.

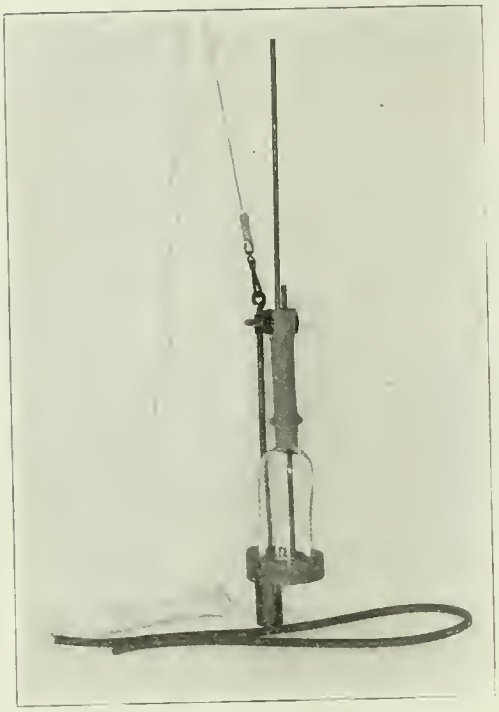

Fig. 4—Dissolved Oxygen Sampling Apparatus.

The writer, therefore, has attempted to prepare a comprehensive and compact form for the presentation of data on infiltration, and to suggest rational units for the measurement of its quantity.

The factors governing the total quantity of infiltration into a sewer are: 1. The diameter and length of the sewer. 2. The material of which the sewer is constructed. *a.*—In vitrified pipe sewers, the type of joint used. *b.*—In concrete or brick sewers, the type and quantity of water-proofing used. 3. The skill and care used in laying the sewer. 4. The character of the materials traversed by the sewer. 5. The relative positions of the sewer and the ground-water level.

Reference to Table I shows that in every case data on some of these factors are missing. As it is evidently impossible to express all these factors in precise terms, it becomes necessary to agree on such terms, and the writer suggests the following:

For the material of which the sewer is constructed, in the case of pipe sewers, use the term "Vitrified Pipe." In the case of concrete sewers, state the thickness of the wall, the mixture, and whether crushed stone, gravel, or slag was used in the aggregate. For brick sewers, state the thickness of the wall, the quality of the brick, and the bond.

The type of joint is usually easily described. If the joints are of cement, it should be noted whether they are finished with a bevel or flush with the bell of the pipe.

For the type and quantity of water-proofing, if a fabric is used, the percentage of the total length of sewer treated may be stated, together with the number of plys of fabric and the kind of paint. In cases where a water-proofing compound is mixed with the concrete, a statement of the kind and quantity of compound will be sufficient.

For skill and care used in laying, use such terms as "Little," "Ordinary," and "Unusual."

For the character of the materials traversed, use such terms as "Wet," or "Dry," "Rock," "Gravel," "Sand," or "Clay."

For the relative positions of the sewer and the ground-water level, reference may be made to the daily reports of the engineer or inspector; and the length of wet trench reported may be expressed as the percentage of the total length of the trench, assuming that where wet trench is reported the sewer will be below the ground-water level.

The foregoing descriptive terms will inevitably have different shades of meaning for different engineers, but the writer believes that they are sufficiently definite to present the salient features of a sewer described by them with a degree of accuracy sufficient for an intelligent comparison with other sewers.

Reference to Table I shows that there is a wide variation in the units chosen for the measurement of the quantity of infiltration, and that none of them is altogether satisfactory. Expressing the quantity of infiltration as a percentage of the maximum capacity of the sewer is irrational, because the maximum capacity depends in part on the gradient of the sewer, which has no relation whatever to the quantity of infiltration.

Gallons per day per mile of sewer is a useful unit only when the size of the pipe and the length of each size are stated, and in a collecting system with many laterals such a statement becomes decidedly cumbrous.

Gallons per day per capita of tributary population appears to be the favorite measure of the quantity of infiltration, but this unit is entirely irrational, for there is no conceivable relation between the number of people contributing sewage and the quantity of ground-water percolating into a sewer.

TABLE I.—DATA ON INFILTRATION OF GROUND-WATER INTO SEWERS.

Item No.	Place.	Diameter of sewer, in ins.	Length of sewer, in miles.	Leakage, in percentage of capacity of sewer.	Leakage per day per mile of sewer, in gals.	Leakage per day per capita, in gals.	Total leakage in gals., per day.	Remarks.
1	Boston, Mass.	8 to 36	137	....	40,000	50	5,480,000	Before any connection to sewer.
2	Massachusetts State	Various	700	....	80,000	100	56,000,000	Densely populated section—800 people per mile of sewer.
3	Kalamazoo, Mich.	....	...	20%	....	...	....	Before any connection to sewer.
4	Norfolk, Va.	....	...	60%	....	100	....	
5	Schenectady, N. Y.	....	...	5%	....	...	....	Wet ground and quicksand.
6	Canton, Ohio	....	11	....	26,500	*44	73,000	
7	Taunton, Mass.	24	...	20%	....	...	....	Passing through swamp.
8	North Brookfield, Mass.	12	0.3	....	17,000	71	2,500-5,000	
9	Rogers Park, Ill.	6	1.7	....	1,240	*2	2,108	Deep sockets and careful ramming to minimize leakage.
10	Brockton, Mass.	....	16	....	25,000	31	400,000	
11	Altoona, Pa.	27	1.2	....	40,814	*65	47,181	
		30	0.6	....	86,592	*145	52,352	
		33¼ by 44	0.95	....	264,000	*442	252,342	Brick and concrete sewer. Leakage reduced after careful watching of contractor.
12	East Orange, N. J.	....	29	....	22,400	*43	650,009	10 ft. or more under water. Quicksand. Great precaution to prevent leakage.
13	East Orange, N. J.	....	25	....	8,700	*14	217,500	
14	Joint Trunk Sewer	....	150	10%	25,000	25	3,750,000	Glacial drift and quicksand.
15	Av. of Bloomfield, Orange, Montclair and Glen Ridge	....	...	....	....	107	6,430,000	Average for the years 1895 to 1906.

*600 people per mile of sewer.

The total quantity of infiltration, in gallons per day, is a statement which is evidently entirely useless in making comparisons between systems unlike in diameter and length of conduit.

In view of the unsatisfactory form of the data, and of the units thus far considered, the writer suggests the presentation of such data in the manner shown in Table II, and the following units for the measurement of the quantity of infiltration. These units are used by Mr. Nicholas S. Hill, Jr., and are believed by the writer to be both simple and rational.

TABLE III.—VITRIFIED PIPE.

Nominal diameter, in ins. (1)	Laying length, in ft. (2)	Length of each joint, in ft. (3)	Length of joint per 100 lin. ft. of sewer, in ft. (4)
4	2	1.05	52.5
6	2	1.57	78.5
8	2	2.09	104.5
10	2	2.62	131.0
12	2	3.14	157.0
15	2	3.93	196.5
18	2	4.71	235.5
21	2	5.50	275.0
24	2	6.28	314.0
27	2½	7.09	283.6
36	2½	9.42	376.8

For vitrified pipe sewers, the unit is gallons per day per foot of joint. Table III shows the total length of joints per 100 ft. of sewer for the commercial sizes of pipe, for which the total length of joints for any length of sewer is obtained by a single multiplication. Evidently, in a vitrified pipe sewer free from cracks, infiltration can occur only at the joints. An examination of Table I shows that sufficient data for the computation of infiltration, in gallons daily per foot of joint, are presented in only four cases, namely, Items 8 and 9, and in two sewers under Item 11. The data for these cases are repeated in Table II, with the computed infiltration expressed in gallons per day per foot of joint; this is seen to vary from 0.3 to 5.0.

For concrete and brick sewers, the unit is gallons per day per square yard of interior surface. Table IV shows the interior surface area, in square yards per 100 ft. of sewer, for circular sewers, from 3 ft. 8 ins. to 6 ft. in diameter, and a single multiplication gives the interior surface area for any length of sewer. For sewers of egg-shaped or basket-handle cross-section it is necessary to compute the circumference for the special sections involved, but these computations will have been made in the design of the sewer long before the engineer is ready to make infiltration tests.

Item 16 of Table II gives the results of a test for quantity of infiltration, recently made by the writer, under the direction of Mr. Hill, on a new reinforced concrete trunk sewer. Triangular weirs were set at two points, 47,745 ft. apart, and each weir was provided with an automatic head-recording device, giving a continuous record of change in head, and reading to the nearest .005 ft. From these records, the average head on each weir for a period of one week was computed, by obtaining with the planimeter the area between the curve of change in head and an arbitrary base line, and dividing by the proper length. From this average head the corresponding average rate of discharge was computed, making allowance for velocity of approach. The average time of flow between the weirs was obtained by the comparison of maxima and minima points on the respective curves showing decided change of head.

The interval or lag between the time of corresponding discharges having been determined as described, the total discharge at the upstream weir for a period of one week was then subtracted from the total discharge at the down-stream weir during the corresponding period. The difference in discharge thus determined is a very close measure of the quantity of infiltration between the weirs during one week. The conditions for this test were ideal, as no sewage entered the trunk lines between the weirs during the test. The infiltration found was at the rate of 0.8 gal. per day per square yard of interior surface.

TABLE IV.—CIRCULAR SEWERS.

Diameter. (1) Ft.	Ins.	Inside area per 100 lin. ft. in sq. yds. (2)
3	8	127.99
4	0	139.63
4	3	148.35
4	6	157.08
4	9	165.81
5	0	174.53
5	3	183.26
5	6	191.99
5	9	200.71
6	0	209.44

A careful inspection of the length of sewer tested revealed no visible cracks, and the work in general appeared to be first-class, but the quantity of infiltration measured appears to be much smaller than may in general be expected in work of this class.

At Southport, England, a motor vacuum road-cleaning machine was recently tried out, and a dog catcher's motor wagon is being operated by the Detroit police department.

TABLE II.—DATA ON INFILTRATION OF GROUND-WATER INTO SEWERS.

		Sewer.									Infiltration in Gallons per day.	
Item No. (1)	Place. (2)	Type of section. (3)	Material. (4)	Diameter. (5)	Length, in feet. (6)	Skill and care in laying. (7)	Type of joints. (8)	Waterproofing; type and percentage of total length. (9)	Wet trench; percentage of total length. (10)	Character of material traversed. (11)	Per foot of joint. (12)	Per square yard of inside surface. (13)
8	No. Brookfield, Mass.	....	....	12 in.	1,581	....	....	....	..	....	2.0	...
9	Rogers P'k, Ill.	....	....	6 in.	8,976	Unusual.	Deep sockets.	....	..	....	0.3	...
11	Altoona, Pa...	....	....	27 in.	6,336	....	....	....	..	....	2.6	...
	"	....	....	30 in.	3,168	....	....	....	..	....	5.0	...
16	....	Circular.	Reinf. concr'te stone or gravel, 1:2:4.	3 ft. 8 in.	2,462	Ordinary.	....	3-ply felt and pitch, 4 per cent.	80	Wet and dry gravel.	...	0.8
		"	"	4 ft. 3 in.	7,220	"	....	"	"	"	...	
		"	"	4 ft. 4 in.	1,904	"	....	"	"	"	...	
		"	"	4 ft. 6 in.	11,066	"	....	"	"	"	...	
		"	"	4 ft. 9 in.	5,838	"	....	"	"	"	...	
		"	"	5 ft. 0 in.	3,574	"	....	"	"	"	...	
		"	"	5 ft. 3 in.	2,901	"	....	"	"	"	...	
		"	"	6 ft. 0 in.	12,779	"	....	"	"	"	...	

The Studies Made in Estimating the Cost of Refuse Disposal in Chicago.

On July 15, 1912, the City Council of Chicago passed an ordinance, directing the Civil Service Commission to make an investigation of the physical needs of the various wards of the city and of the systems and methods in use for the purpose of determining equitable ward appropriations for street and alley cleaning and refuse collection and removal. These activities are performed under the direction and supervision of the Bureau of Streets, Department of Public Works.

For the purpose of government, the city is divided into 35 separate wards. These same divisions are used for administrative purposes by the Bureau of Streets. At the beginning of each year the council appropriates the money to be used in each ward for all operations of this bureau.

The efficiency division began this investigation by making a detailed study of all bibliography available on the subject. This was followed by an investigation of all available records regarding the quantity of different kinds of refuse collected in the city for the past five years.

The general classification of the city's waste is defined in the revised municipal code, as follows:

> In the construction and application of this chapter the word "garbage" shall be taken to include any and all rejected or waste household food, offal, swill and carrion. The word "ashes" shall be taken to include all ashes of wood, coal, coke and the residue resulting from the combustion of any material or substance, and soot, cinders, slag and charcoal. The words "miscellaneous waste" shall be taken to include dust and all refuse, except excrement and dead animals and parts thereof, and also except all articles and substances herein included under "garbage," "ashes" and "manure." The word "manure" shall be taken to include the excrement of all domestic animals and fowls, and stable bedding, and all hay, straw, shavings, grass or leaves which have been used for stable bedding.

In the course of the analysis of methods and cost of the disposition of municipal wastes in different cities of the country, the investigators were impressed by the lack of uniformity in the classification of such wastes in each city. Because of this lack of uniformity, it has been impossible to definitely ascertain the relative effectiveness and costs of caring for these wastes. It would be highly desirable that some uniform classification be prepared by representative officials and adopted throughout this country. With the establishment of uniform classification and record systems, it will be possible definitely to ascertain relative costs and best methods in caring for these important municipal activities.

The municipal refuse problem may be properly separated into four divisons, viz., house separation, house collection, hauling, and final disposition. Each division of the problem is so important that they should all be studied together and each weighed carefully in determining the final solution. Up to the present the greatest study has been given to the final disposition, yet this feature of the problem, as far as affecting the finances of the city is concerned, is of the least importance. Heretofore the whole problem has usually been handled as a condition to be met, rather than a problem to be solved. Collection and haul are the most important phases of the problem.

The ordinance of the City of Chicago provides that rubbish and ashes shall be separated from garbage by the householders, and each kept in separate receptacles. Ashes and rubbish are collected together by wagons of 5-cu. yd. capacity and are dumped into large clay holes or into low marsh land as shown by the map here given as Fig. 1.

In order to determine the costs of collection and the factors affecting it, study has been made as to time of collection, number of collections made each day by various teamsters, the service rendered, the rate of haul in miles per hour, location of dumps, and the co-operation given the city's employes by the people served.

The above curves for the 25th ward, as shown in Fig. 2, are typical of any section of the city, and illustrate the wide variation of quantities to be collected during different seasons of the year. It will be noticed that the general law shows the peak quantity of garbage is to be collected in August and September, the canning season. The law of rubbish and ashes, as illustrated by the above curve, is the reverse, and indicates the peak quantity of rubbish to be collected in the winter months. The breaks in the curves indicate days of no collection, such as Sundays and holidays.

The following tendencies have been found to control the expenditure necessary to care for these activities: (a) Character of district; (b) population; (c) distribution of population; (d) location of dumps; (e) time required to collect; (f) time required to haul; (g) length of hauls.

Complete information, by wards, as to the character of population, districts and methods used in 1912 in the collection and disposal of rubbish and ashes in the city were tabulated. The tabulation showed that certain definite tendencies control the quantities of wastes.

A close study of conditions in the City of Chicago for the past several years shows that

TABLE 1.—ESTIMATES OF COST AND CHARACTERISTICS BY WARDS

Ward.	Area, square miles.	Population.	Character of Population. Per cent. American	German	Irish	Italian	Polish	Russian	Dutch	Scandinavian	Bohemian	Hungarian	Colored	Austrian	Lithuanian	Others	Yardage per month. Minimum	Maximum	Total yardage, 1913	Place of disposal.	Average haul, miles
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	3.09	50,299	29	7	4	38	..	3	..	2	..	..	10	3	..	4	5,880	4,710	62,100	A-B	2.9
2	1.89	64,724	49	8	4	2	..	6	..	3	..	..	23	..	..	5	6,280	3,520	59,080	B	4.4
3	2.00	66,079	60	8	10	..	..	5	..	4	..	1	8	1	..	3	4,535	2,260	43,063	B	3.8
4	1.58	53,853	32	20	9	3	19	5	..	2	2	..	..	1	4	2	4,644	1,906	40,631	A-B	1.9
5	6.80	57,060	37	23	14	..	10	2	..	2	..	..	..	1	8	3	3,790	1,640	29,912	B	1.5
6	3.64	73,035	70	13	4	..	..	3	..	4	..	1	..	..	..	5	3,635	2,000	32,425	B	4.5
7	5.22	73,752	68	8	8	..	..	2	..	9	..	..	..	..	..	3	4,850	3,395	48,395	D	3.1
8	21.70	62,677	25	11	4	2	32	4	..	12	..	1	..	7	..	2	4,070	2,078	35,142	E	1.7
9	22.5	64,557	30	10	3	7	4	4	14	15	..	4	..	4	1	4	4,520	3,320	43,830	D-F	1.2
10	1.17	51,354	6	4	1	..	3	32	3	..	40	1	..	4	..	6	3,840	2,150	33,770	A-B	1.0
11	2.23	56,115	14	14	3	2	23	18	..	1	17	..	..	4	1	3	3,645	1,820	33,675	A-B	1.3
12	2.92	60,231	22	8	1	..	13	5	..	2	45	..	..	1	..	3	4,980	1,620	31,860	G	2.3
13	2.39	70,875	64	13	11	1	..	5	..	1	..	..	..	..	..	3	8,260	2,660	58,600	G	3.0
14	2.63	63,902	49	13	6	9	3	2	..	4	..	1	7	3	..	3	5,050	2,750	44,600	H	3.0
15	2.13	69,631	23	26	1	..	6	23	..	10	1	3	..	5	..	2	5,250	2,520	44,120	H	3.0
16	1.13	58,716	8	12	..	..	69	6	..	..	..	1	..	2	..	2	3,600	1,590	31,545	H	3.4
17	1.00	50,380	9	7	..	19	47	3	..	2	..	2	..	9	..	2	3,340	1,845	30,775	H	5.0
18	2.02	66,180	48	7	7	3	..	28	..	1	..	..	..	..	..	6	6,160	2,590	53,910	A-B	2.5
19	1.08	53,071	13	3	5	46	1	27	..	..	..	..	..	1	..	3	5,500	2,860	48,110	A-B	2.5
20	1.24	42,840	10	6	1	5	5	54	..	..	2	..	..	13	..	1	6,200	3,540	59,905	A-B	2.5
21	2.05	61,020	53	15	10	6	..	2	..	9	..	..	..	1	..	4	8,750	3,930	77,390	H	4.8
22	1.50	52,198	22	24	3	33	1	2	..	8	..	4	..	2	..	1	5,340	2,400	49,000	H	3.6
23	1.98	70,658	50	28	3	..	..	1	..	13	..	..	..	..	..	5	6,500	2,930	56,620	H	3.1
24	2.06	62,115	36	45	4	..	3	1	..	4	..	2	..	1	..	4	6,080	2,420	47,434	H	2.0
25	5.13	83,871	58	20	2	..	..	..	..	17	..	..	..	..	..	3	5,050	2,780	46,695	H	3.5
26	9.00	78,186	43	31	2	..	..	..	..	20	..	..	..	..	..	4	7,975	3,380	65,230	H	1.5
27	20.0	83,007	23	27	1	..	27	2	..	15	2	..	..	1	..	2	3,360	2,020	28,490	H	2.0
28	2.16	68,516	25	22	1	..	26	3	..	19	..	..	..	..	..	4	4,160	2,450	41,150	H	1.8
29	12.12	65,739	24	20	6	2	11	3	..	3	10	1	..	4	12	2	3,170	1,872	29,621	B	1.5
30	2.50	60,801	34	10	24	2	6	2	1	3	1	1	13	1	..	2	4,080	1,663	36,266	B	2.1
31	2.44	69,745	45	12	18	..	..	2	..	16	..	..	2	..	..	4	3,800	2,335	36,895	B	3.5
32	19.97	87,924	54	17	14	..	..	1	4	5	..	..	..	..	..	3	6,050	3,410	58,015	D	1.3
33	12.35	85,056	41	19	2	1	3	..	..	29	..	..	..	1	..	4	4,530	2,260	41,330	G-H	4.0
34	4.06	71,528	32	11	4	..	2	13	..	1	31	..	..	3	..	3	6,330	2,080	43,525	G	1.2
35	5.62	77,825	42	16	16	1	..	1	..	16	1	1	..	2	..	2	4,020	2,390	37,840	G-H	4.0
	191.3	2,287,520	..	..	..	..	..	..	..	..	..	..	..	..	..	..	177,224	89,094	1,560,949		2.7

Notes—
Estimates of costs based upon standard eight-hour day.
Cost of garbage reduction ($47,500), lighterage, operation of platforms and dumps, not included in above.
Cost of superintendence, depreciation, interest charges not included in above.
Population figures based on 1912 school census and tendencies to increase since 1910 U. S. census.
A = 15th and Loomis streets. See Fig. 1.
B = 46th street and Oakley avenue.
D = 83rd street and Stewart avenue.
E = 95th street and Yates avenue.
F = 103rd street and Lake Calumet.
G = 33rd street and Lawndale avenue.

a general law has been followed throughout the entire city in the matter of growth, and that set cycles of growth have obtained in the majority of districts in the past. While these cycles are changing, they are changing at a known rate, and this rate may be determined by studying the conditions for the past five years. The quantity of garbage and rubbish collected for each month of each year expressed in terms of percentage based upon January of that year, indicates that the quantity collected by months for any given district follows well established cycles peculiar to that particular district.

These tendencies and cycles for a given district for the years 1908-1912 having been determined, it was comparatively easy to estimate what percentage of the January collection for 1913 may be expected in February of 1913. Carrying the same cycle through for March, the percentage for March was determined and so on. By getting the percentages between the Januaries of the various years by the same method, the quantity of garbage and rubbish that would probably be collected in January of 1913 was determined. As a further check upon this estimate, the percentage of garbage collected in one year over the percentage collected in another has been compiled for the past five years for each ward in the city.

As a further check upon these estimates, the physical characteristics of the wards have been studied very carefully by investigators, engineers, and by others familiar with the conditions of each section of the City of Chicago, and estimates made as to the increase or decrease that may be expected in the various wards in 1913.

Based upon conditions found to exist among efficient teamsters, the following units have been determined and used in formulating estimates: The average time required for dumping has been taken as 25 minutes; the average rate of haul during the summer months at 3 miles per hour; and the average haul during the winter months at 2½ miles per hour. In some of the outlying wards where it is very difficult to haul a load during certain months of the year, the number of months during which the men are allowed to make speed of 2½ miles per hour has been increased. Many writers upon the subject assume that a loaded team will make four miles per hour, but investigation of conditions existing here does not bear out these assumptions.

After studying the conditions very carefully in each ward of the city, it has been found that for the entire city the average time required for the collection of one load of rubbish averaged 1.7 hours in summer and 2.19 hours in winter.

The house collection of garbage is made by wagons equipped with steel tanks having a capacity of about 2½ tons of garbage. Each ward is divided into garbage districts and collections are made from each district by one driver according to the density and character of population. A study has been made of this system of collection and it is found that under ordinary conditions it requires an average of approximately 3 hours and 55 minutes to collect a full load. Usually the greater number of garbage collectors collect one load per day and the remaining time, over the 3 hours and 55 minutes, is spent either in going to and from the loading station or disposal plant, or in waiting at the loading station.

All garbage which is collected from the north and west parts of the city is delivered either to the Chicago Avenue loading station or to the Oakley Avenue loading station, each of which is located on the north branch of the Chicago river, as shown in Fig. 1. The garbage is transported by barge to the reduction plant at 39th and Iron streets. The garbage delivered to these two stations in 1911 constituted 56 per cent of the total garbage collected. For the first eight months of 1912 the cost of operation, maintenance and lighterage chargeable against garbage delivered at Oakley Avenue station has averaged 75 cts. per ton, and at Chicago Avenue loading stations, 64 cts. per ton.

To best comply with the ordinance regarding boxes in which to collect the garbage of the city, the city has used sheet steel tanks. These metal tanks are supplied with iron covers, attached by hinges with a common rod at the center of the top of the box. These tanks are loaded very heavily at times and receive considerable rough usage, both at the loading stations and at the reduction plant. The use that they receive on the barges in being transported from the loading stations to the reduction plant is especially deteriorating to the tank. The superimposed boxes rest directly on the boxes in the lower tiers and this has considerable to do with destroying the metal covers. Garbage contains considerable acid of various kinds, which has a tendency to remove the paint and destroy the metal. Many of the covers are completely gone and are being replaced from time to time.

With the rapid growth of the motor truck industry, many questions have arisen as to the adaptability of motor trucks to the needs of various city departments. The Commission has made inquiries of municipalities and motor truck companies regarding the adaptability of their product to the class of work which is done by the city.

The Engineering Magazine published an article on the cost of operating motor trucks in the October, 1912, issue. The following table appeared in this article, showing the increase of operation with the increase in tonnage (See top of p. 84):

FOR RUBBISH, ASH AND GARBAGE SERVICE IN CHICAGO FOR 1913.

Rubbish and Ashes.								Garbage.													
Average Time per Load, hrs.								Tonnage per Month.					Average Time per Load, Hrs.								
Collection	Hauling	Total	Collection cost per yard, dollars.	Cost of hauling per yard-mile.	Cost collection and hauling per yard.	Total cost collection and hauling.	Per cent of total.	Maximum	Minimum	Total tonnage, 1913	Place of loading.	Av. haul, miles.	Collection	Hauling	Total	Collection cost per ton.	Hauling cost ton-mile.	Cost collection and hauling, per ton...	Total cost collection and hauling.	Per cent of total.	Ward.
23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
2.0	2.1	4.1	$0.28	$0.12	$0.66	$41,000	3.98	170	96	1,598	R	7.4	4.31	2.92	7.23	$2.37	$0.157	$3.50	$6,430	1.6	1
2.0	3.1	5.1	.28	.11	.79	46,330	4.50	560	211	4,391	R	5.4	4.31	2.24	6.55	1.69	.118	2.30	9,910	2.5	2
2.0	2.7	4.7	.28	.11	.76	32,880	3.19	302	226	3,655	R	7.4	4.31	2.92	7.23	1.64	.108	2.41	9,390	2.4	3
2.0	1.3	3.3	.28	.12	.54	21,970	2.13	371	160	2,969	R	4.0	4.33	1.78	6.11	1.94	.144	2.49	7,920	2.0	4
2.0	1.0	3.0	.28	.13	.37	11,070	1.07	365	91	2,648	R	2.0	4.57	1.12	5.69	1.89	.172	2.24	6,210	1.6	5
2.0	3.2	5.2	.28	.11	.86	27,920	2.71	622	139	4,500	R	11.0	4.31	3.69	8.00	1.77	.113	2.83	12,360	3.2	6
2.0	2.2	4.2	.28	.11	.67	32,290	3.13	604	184	4,374	R	14.6	4.31	3.40	7.71	1.77	.109	2.83	12,990	3.3	7
2.4	1.2	3.6	.32	.13	.60	20,900	2.03								No Separation.						8
2.4	0.8	3.2	.32	.14	.55	24,160	2.34								No Separation.						9
2.0	0.7	2.7	.28	.15	1.15	38,670	3.75	411	127	2,985	R	6.6	4.57	2.82	7.39	1.97	.137	2.85	9,340	2.4	10
2.0	0.9	2.9	.28	.14	.49	16,370	1.58	383	135	2,969	R	6.0	4.57	2.60	7.17	2.05	.138	2.92	9,040	2.3	11
2.0	1.6	3.6	.28	.12	.61	19,480	1.89	416	136	3,013	R	8.8	4.31	3.42	7.73	1.73	.112	2.70	7,780	2.0	12
2.0	2.1	4.1	.28	.12	.68	39,600	3.85	710	296	5,324	C	9.4	4.57	3.43	8.00	1.84	.122	2.79	16,160	4.1	13
2.0	2.1	4.1	.28	.11	.64	28,340	2.85	484	145	3,291	C	6.4	4.31	2.60	6.91	2.01	.136	2.85	9,880	2.5	14
2.0	2.1	4.1	.28	.12	.68	29,770	2.89	739	279	5,395	C	6.0	4.57	2.60	7.17	2.02	.141	2.87	16,310	4.2	15
2.0	2.4	4.4	.28	.11	.72	22,550	2.19	316	135	2,492	C	4.6	4.31	1.98	6.29	2.07	.150	2.72	7,520	1.9	16
2.0	2.4	4.4	.28	.11	.87	26,600	2.59	485	146	3,663	C	1.6	4.31	.96	5.27	1.95	.195	2.22	8,480	2.2	17
2.0	1.8	3.8	.28	.12	.61	32,900	3.20	497	242	4,275	C	4.2	4.31	1.84	6.15	2.26	.168	2.92	13,490	3.4	18
2.0	1.8	3.8	.28	.12	.62	29,900	2.91	380	122	2,862	C	4.6	4.31	1.94	6.25	1.93	.140	2.53	7,610	2.0	19
2.0	1.8	3.8	.28	.12	.61	36,560	3.55	390	164	2,969	C	5.6	4.31	2.32	6.63	2.02	.140	2.76	8,950	2.3	20
2.0	3.4	5.4	.28	.11	.87	67,290	6.54	473	193	3,507	C	3.2	4.31	1.50	5.81	1.94	.151	2.39	9,050	2.3	21
2.0	2.6	4.6	.28	.11	.74	36,210	3.52	367	122	2,788	C	1.4	4.31	.88	5.19	2.09	.214	2.35	7,550	1.9	22
2.0	2.2	4.2	.28	.12	.68	38,230	3.84	583	247	4,400	O	5.2	4.31	2.18	6.49	2.07	.145	2.78	12,620	3.2	23
2.0	1.4	3.4	.28	.13	.59	28,140	2.73	486	172	3,369	O	2.0	4.57	1.12	5.69	2.08	.190	2.46	8,740	2.2	24
2.0	2.5	4.5	.28	.11	.75	34,840	3.38	887	383	6,531	O	9.2	4.57	3.43	8.00	2.13	.139	3.24	22,330	5.7	25
2.0	1.1	3.1	.28	.14	.50	32,500	3.16	868	359	6,331	O	5.6	4.57	2.46	7.03	2.05	.144	2.85	18,740	4.8	26
2.0	1.4	3.4	.28	.12	.55	15,720	1.53	531	182	3,679	O	7.0	4.57	2.98	7.55	2.17	.149	3.19	13,350	3.4	27
2.0	1.3	3.3	.28	.13	.57	23,580	2.28	435	132	2,762	O	2.6	4.31	1.28	5.59	2.20	.183	2.63	7,750	2.0	28
2.0	1.1	3.1	.28	.14	.56	16,610	1.61	317	144	2,513	R	8.0	4.57	3.34	7.91	1.97	.132	2.89	8,670	2.2	29
2.0	1.5	3.5	.28	.12	.58	20,960	2.03	595	217	4,049	R	6.0	4.57	2.60	7.17	1.88	.132	2.68	11,250	2.9	30
2.0	2.5	4.5	.28	.11	.74	27,350	2.66	642	249	4,751	R	7.0	4.57	2.96	7.53	2.06	.140	2.29	15,220	3.9	31
2.0	0.9	2.9	.28	.14	.48	28,030	2.72	826	277	5,689	R	11.0	4.57	3.43	8.00	2.09	.135	3.25	20,270	5.2	32
2.0	2.8	4.8	.28	.11	.75	30,980	3.01	850	286	5,865	O	10.0	4.57	3.43	8.00	2.18	.143	3.34	19,940	5.1	33
2.0	0.8	2.8	.28	.14	.46	19,900	1.93	595	196	4,013	R	10.4	4.57	3.43	8.00	2.07	.135	3.19	13,250	3.4	34
2.0	2.8	4.8	.28	.11	.75	28,450	2.76	933	335	6,767	C-O	10.0	4.57	3.43	8.00	2.06	.135	3.15	23,040	5.9	35
2.0	1.9	3.9	.28	.12	.66	$1,028,050	100	17,593	6,578	$130,369		6.5	4.43	2.52	6.95	$2.00	$0.144	$2.78	$391,540	100.0	

H = Campbell avenue and Addison street.
* Totals and averages, entire city.
Column 4 includes Americans, Canadians and English.
Column 11 includes Danish, Norwegians and Swedish.
Nationalities not specifically shown—
Twentieth Ward—Roumanians, 3 per cent.
Twenty-ninth Ward—Croatians, 2 per cent.
Thirty-first Ward—Scotch, 1 per cent.
Seventh, Thirteenth, Thirty-second and Thirty-fifth Wards—Scotch, 2 per cent.
Nineteenth Ward—Roumanians, 1 per cent.

Size.	Fixed charges.	Increment per mile.
1,000 lbs.	$5.07	$0.0886
3-ton	5.33	0.0860
5-ton	5.60	0.1253
6-ton	6.00	0.1540
7-ton	6.10	0.1718
12½-ton train	7.40	0.2070

The cost per day of the operation of a motor truck is equal to the fixed charges plus the miles per day times the cost per mile. This table indicates that the heavier the truck the smaller the cost of operation per ton capacity. It is very evident that the cost of hauling per ton mile by this method is considerably less than the cost per ton mile of hauling by team providing the truck can be kept in continual operation and in performing the work to which it is best adapted. There is no doubt that teams and wagons constitute the cheapest method of collecting garbage, rubbish and street dirt. Teams, however, constitute a more expensive method of removing garbage from the center of collection to the disposal plant, especially where the haul is any considerable distance, as exists in most sections of the city.

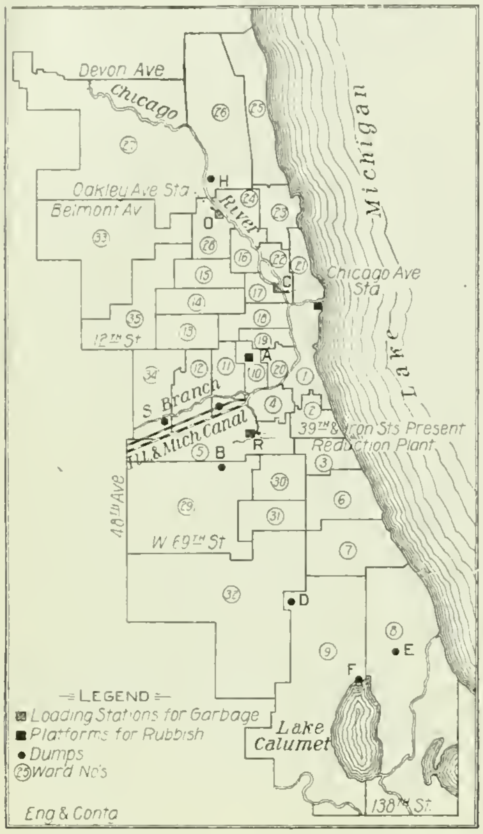

Fig. 1—Map of Chicago Showing Wards, and also the Municipal Refuse Dumps Loading Stations, and Platforms Now Available.

In Engineering & Contracting published February 22, 1911, an article on the adaptability of motor trucks to contractor's uses appeared, contemplating especially the haulage of heavy materials, such as crushed stone, cement and lumber. These materials, however, differ very little from the material which the Bureau of Streets is required to handle as regards their bulkiness and weight. The motor tractor especially described in this paper is one so designed that it may replace the front wheels of an ordinary wagon and in this way furnish the motive power, as well as the front running gear. An apparatus required to make this change consists simply of a knee jack to raise the front of the wagon while the change is being made. With the adoption of a change of this kind, definite time schedules can be arranged for garbage, rubbish and street dirt collection or refuse wagons for a given district to deliver to a central station or yard where the change can be made. This plan will use the horses and wagons where they are best adapted and the motor trucks where they are of the highest efficiency.

There is a number of methods of garbage disposal carried on in different parts of the country, depending mainly upon the conditions existing. The following are the principal ones: (1) Reduction; (2) incineration; (3) land fills.

The reduction of garbage consists of rendering or extracting grease from garbage and converting the remaining portion into a tankage, which is used in the manufacture of commercial fertilizer. Considerable demand exists for the oil extracted from the animal and vegetable matter of garbage, the price paid for this product depending entirely upon the supply and demand. The tankage is constantly in demand by fertilizer companies. There are two different methods of final extraction of grease—one with, and the other without the use of naphtha. The use of the latter gives the larger percentage of grease.

The advantages and disadvantages of reduction are as follows:

Advantages: (1) Garbage changed into a product of commercial value and the addition of an industry to the community.

Disadvantages: (1) Uneconomical for the city on account of the length of haul to a central reduction plant. For many sections of the city the haul is excessive and expensive. (2) Labor employed must have considerable experience and skill. (3) Large first cost of plant and high maintenance charges. (4) Separate collection of garbage and rubbish required. (5) Two separate systems of refuse disposal.

The advantages and disadvantages of incineration of garbage are as follows:

Advantages: (1) Complete destruction of germs, organic matter and offensive gases of all municipal wastes. (2) The reduction of length of haul, as small incinerators can be operated more economically than small reduction plants and can be established locally to meet the needs of local sections. (3) Unskilled labor can be largely employed in the operation. (4) No separation of refuse required.

Disadvantages: (1) Is expensive, as there are no by-products to help pay operating expenses. (2) Unless experienced firemen are employed, results are not satisfactory or efficient.

Owing to the remoteness of certain sections of the city from the central garbage disposal plant, the separation of refuse, as defined by the city ordinance, has been impractical and uneconomical. In these districts all house refuse has been collected together and has been disposed of in either low swampy lands or in clay holes. Up to the present time this method of disposal has met with very little objection. However, the time when this method will not meet the conditions of these localities is close at hand. The geographical locations of these districts and the character of population within them will make it practically impossible to economically obtain the proper separation of garbage from the other forms of house refuse, or to dispose of garbage at a central disposal plant. It will be necessary within a short period of time to devise some method of disposing of refuse in these districts in local plants.

A combination plant in which the salable portion of the refuse collected can be sorted and the balance destroyed by fire is, no doubt, the most practical, and will meet the needs of these districts in the most economical manner. It may be that some revenue may be obtained from the power that might be generated. However, this feature has been given no consideration and the economy of this method is based on reducing the time spent in long hauls and unproductive work and the sanitation of the whole locality.

The number of pounds of garbage to be collected has been estimated in the same manner as has the number of loads of rubbish. It has been assumed that various wards having the same character of populations and having the same general conditions should collect the same number of pounds of garbage per load. Keeping these facts in mind, the number of pounds of garbage per load to be expected for 1913 has been averaged over these various wards and over the various years. After having estimated the number of pounds per load to be hauled, the number of loads per month is directly obtainable.

Using the time of collection, the rate of haul under varying conditions, the distance to be hauled to the point of disposal, and scale of labor and teams, a standard cost of collection and hauling has been determined, and estimates made as given in Table I.

The investigation described above was made by the Chicago Civil Service Commission under the direction of Major James Miles, Examiner in Charge, and J. L. Jacobs, Engineer in Charge, F. H. Cenfield and A. B. Segur, Engineers of the Efficiency Division.

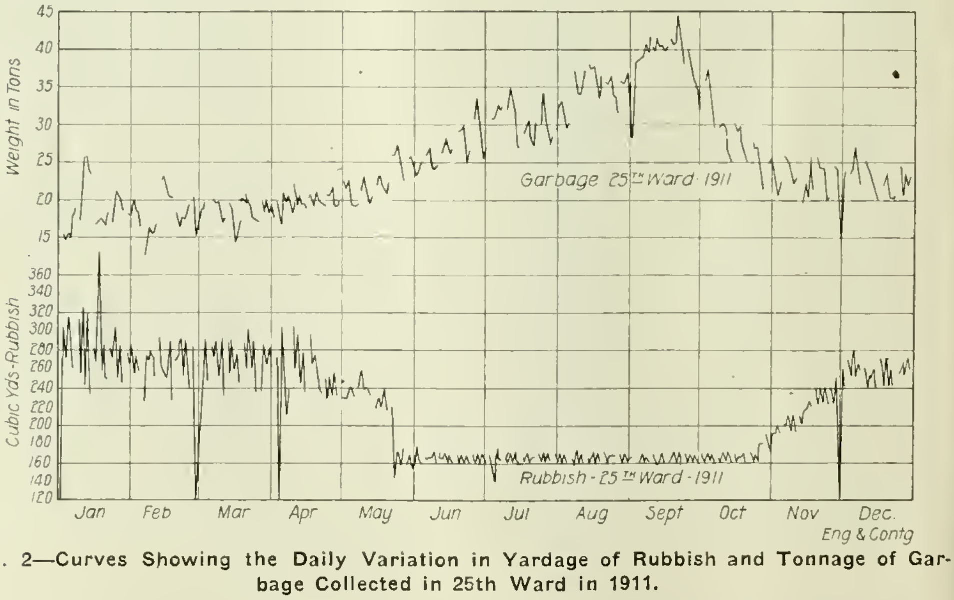

Fig. 2—Curves Showing the Daily Variation in Yardage of Rubbish and Tonnage of Garbage Collected in 25th Ward in 1911.

Kansas Engineering Society.—The annual meeting of the Kansas Engineering Society will be held at Topeka, Kas., Jan. 21 and 22. The president of this society is Mr. R. V. Leeson of Topeka. Mr. T. J. Strickler, also of Topeka, is secretary and treasurer.

Municipal Drainage System.—Plans for the construction of a drainage system have been approved by the municipality of Bahia Blanca, Argentina, and work will be begun at once. The estimated cost of the system is $3,500,000 (Argentine). The work will be paid for in bonds bearing 5 per cent interest and 1 per cent accumulating amortization.

NEWS SECTION

Editorial Comment—Personals—Society Meetings—Trade Notes—Catalog Reviews—Contract News, Embracing Bids Asked, Work Projected, Contracts Let and Contract Prices on All Classes of Civil Engineering Construction Work.

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The Doings of the Week.

Not many large railroad construction contracts have been awarded the past few days. Reports from various parts of the country, however, indicate that a considerable amount of work has been figured on or is about ready for bids. There was a report that the Great Northern Ry. had awarded the contract for the Libby cut off, but this is without foundation. It is probable, nevertheless, that this work will be let in the near future. Another Great Northern job which is likely to come up in a few days is for the continuation of the Great Falls & Teton County Ry., from Choteau to Bynum, Mont. The Minneapolis, St. Paul & Sault Ste. Marie Ry. will also probably let contracts shortly for its Plaza extension. The Public Service Commissioners of the First District, New York City, are asking bids until noon, Jan. 28, for the construction of a section of the first rapid transit line to be built in Queens Borough, New York City. This is Section No. 2 of the Astoria, Woodside and Corona rapid transit route, which runs from the Queens end of the Queensboro Bridge north through Second or Debevoise Ave. to Ditmars Ave., Astoria. The section covers that part of the line north of Beebe Ave. The road is to be an elevated railroad, and the contractor will have 18 months in which to complete the work. The engineers of the Commission are finishing plans for the rest of this line, and bids for its construction will be called for soon. Under the Dual System this road will be operated jointly by the Interborough Rapid Transit Co. and the Brooklyn Rapid Transit Co. The Interborough Co. will connect with it by trains from the Steinway Tunnel and the Second Ave. elevated railroad, and the Brooklyn Rapid Transit Co. by trains through the proposed Broadway, 7th Ave. and 59th St. subway. Among the railroad construction contracts let recently are the following: National Contracting Corp., Norfolk, Va., for the construction of a 247-mile double track electric railway from Kansas City, Mo., to St. Louis, for the St. Louis & Kansas City Electric Ry. Co.; P. F. Brendlinger, Arcade Bldg., Philadelphia, Pa., for grading and masonry for a third track in the New York branch of the Philadelphia & Reading Ry., between Skillman and Hopewell Station (Chas. F. King & Co., Pottsville, Pa., as noted in our last issue, were awarded the contract for constructing a fourth track for the above railroad, between Woodburn and Yardley Station); Hastings, Young & Dumm, Cheyenne, Wyo., at $46,600, for constructing railroad spur, sidings, etc., at Fort D. A. Russell, Wyo.; Utah Construction Co., Ogden, Utah, for constructing the Mountain Home cut off of the Oregon Short Line.

About the only development of the past week in the line of state highway construction is the completion of two plans for road improvements in Ohio. One of them provides for roads leading to various market centers. These roads would amount to about 9,000 miles and would establish highway travel for 90 per cent of the market travel in the state. The other plan is for roads built with government aid or with special state aid. The General Assembly will be asked to levy a tax of one-half of one-mill for road purposes. In order that the start may be made at once, an appropriation of $1,760,000 will be requested for the present year. After that the half-mill levy will supply about $3,000,000 a year. In Canada the Deputy Minister of Roads, Quebec, Que., is calling for bids until Jan. 27 for grading and constructing bridges and culverts for 155 miles of road between Saint Augustin and Charlemagne. Included in the work is the construction of about 30 miles of macadam, concrete or bituminous macadam.

A good-sized concrete sea wall job has been let by the State Harbor Commissioners, San Francisco, Cal. The contract called for the construction of 1,710 ft. of wall at San Francisco. The Daniel Contracting Co. secured the work at $392,000. Bids on another fair sized concrete job were taken by the U. S. Engineer at Nashville, Tenn. This called for the construction of Lock D, Cumberland River. The Mansfield Engineering Co., Indianapolis, Ind., at $269,270, was the only bidder.

Surveys have been started for two large hydro-electric developments in Montana. One of them calls for the development of the Big Falls of the Missouri River, near Great Falls, Mont., the other calls for developing Thompson Falls, on Clark's Fork, of the Columbia River. It is probable that the Big Falls development will have a capacity of 125,000 H. P. and the one at Thompson Falls 50,000 H. P. Charles T. Main, 201 Devonshire St., Boston, Mass., is engineer for both projects.

Two of the largest dredging jobs on which bids are now being taken are located in Canada. One of these calls for dredging 2,500,000 to 5,000,000 cu. yds. of sand from Quebec Harbor. The other calls for dredging in False Creek, Vancouver, B. C. The latter work requires the removal of about 3,000,000 cu. yds. of gravel and sand.

PERSONAL

Mr. Donald F. McLeod has resigned as city superintendent and engineer for Ithaca, N. Y.

Mr. W. F. Aymond has been appointed superintendent of the electric light and water plant at Natchitoches, La.

Mr. James Wilson has been appointed State Highway Commissioner of Delaware, succeeding Mr. Francis A. Price.

Mr. H. C. Young has been appointed Superintendent of Bridges and Buildings of the International Railways Co.

Mr. Charles H. Manning has resigned as mechanical and engineering superintendent for the Amoskeag Manufacturing Co., Manchester, N. H.

Mr. E. A. Kingsley, consulting engineer, announces his removal from the Auten building to 716-17-18 Southern Trust building, Little Rock, Ark.

Mr. Halford Erickson of the Wisconsin Railway Commission will deliver an address on "Regulation, and Enforcement of Public Utility Laws," before the Electrical Section of the Western Society of Engineers and the Chicago Section of the American Institute of Electrical Engineers, on Jan. 27.

Mr. W. C. Whitnall has opened an office as consulting engineer in Puyallup, Wash. Mr. Whitnall was formerly assistant city engineer of Puyallup.

Mr. James J. Hayes has been elected city engineer of Brockton, Mass., to succeed Mr. Chas. R. Felton. Mr. Felton retires after 14 years of service as city engineer.

Mr. George P. Flynn, representative in Boston of Ernst Wiener Co. of New York, designers and builders of Wiener Industrial Railways, now has his office at 201 Devonshire St., Boston, Mass.

Mr. Henry C. Ryon has been appointed commissioner of public works at Bridgeton, N. J. Mr. Ryon is a chemist and engineer, with large experience in sewer and disposal plant construction.

Mr. Christopher H. Bierbaum and Mr. William M. Dollar have organized a corporation under the name of Bierbaum-Dollar, Inc., for consulting engineering practice with offices at 1142-44 Prudential building, Buffalo, N. Y.

Mr. G. C. Wilhelmi of the firm of Wilhelmi & Smith announces the dissolution of his partnership with Mr. Wm. B. Smith. He will continue in the contracting and building business at 810 Columbia building, Cleveland, Ohio.

The Western Society of Engineers elected officers as follows: A. Reichman, president; A. Bement, 1st vice-president; B. E. Grant. 2nd vice-president; J. F. Hayford, 3d vice-president; C. R. Dart, treasurer; F. E. Davidson, trustee.

Mr. Philip P. Sharples, chief chemist, Barrett Manufacturing Co., Boston, on December 30, delivered an illustrated lecture on the "Manufacture of Refined Coal Tar," before the graduate students in Highway Engineering at Columbia University.

Mr. John H. O'Neil has been appointed sanitary engineer for the State Board of Health of Louisiana. Mr. O'Neil has been with the American Museum of National Arts, New York city, in charge of the water, drainage and other sanitary investigation.

Mr. R. J. Middleton has been made engineer of track elevation in charge of the Bloomingdale Road Elevation, for the Chicago, Milwaukee & St. Paul Ry. Mr. Henry Eggert is made acting chief carpenter, with headquarters at Milwaukee. He succeeds Mr. J. B. Merkel who has been assigned to other duties.

Mr. Harry A. Hyman, specialist in reinforced concrete construction, has become associated with Mr. Marshall W. Brown, consulting engineer, under the firm name of "The Waterproofing & Construction Co.," with offices at 35 Wall St., New York City. Mr. Brown will continue his private practice as construction engineer.

Mr. Joseph Strnad, Bohemian contractor and builder, died at his home in Chicago, Jan. 7. Mr. Strnad came to America from Bohemia, 37 years ago, and settled in Chicago. He built a number of the Chicago public schools, the addition to the Parental school, the Bohemian

Settlement House, the St. Joseph's Orphanage at Lisle, Ill., and was at work on St. Procopius College.

Eben Smith Wheeler, assistant United States engineer in the Detroit district and chairman of the Nicaraguan Canal Commission, died at his home in Detroit, Jan. 5, aged 74. Mr. Wheeler was a native of Pennsylvania, and entered the employ of the Government immediately after his graduation as civil engineer from the University of Michigan. He had charge of construction work at the Soo canal and spent much time in perfecting surveys of the Great Lakes. In 1897 he went to Nicaragua where he spent a year in making surveys for the proposed waterway, which was later abandoned in favor of the Panama route.

The Meyer Bros. Construction Co., of Montrose, Colo., has been incorporated with a capital stock of $50,000. The company takes over the holdings and uncompleted contracts of the Meyer Bros. & Kulp and the Foster-Pinkerton contracting companies, one of the principal contracts of which is the $192,500 work for the completion of the Lilylands Irrigation Project. The officers of the new company are Fred J. Meyer, president and general manager; Henry E. Meyer, vice president; J. C. Kulp, treasurer; P. W. Pinkerton, secretary; Foster and Pinkerton, engineers.

Mr. Dennis F. Murphy, master mechanic for the Great Lakes Dredge and Dock Co., died in Chicago, Jan. 9. Mr. Murphy was one of the well known construction men on the Great Lakes. He began his career under Mr. Dennis McCarthy, former general superintendent for the company, as a fireman on a tug boat 20 years ago and in five years became master mechanic in charge of the entire plant of the Great Lakes Dredge & Dock Company. His four brothers, who survive him, all started as tug boat firemen and all now occupy executive positions of importance in engineering construction. Mr. Murphy was 44 years of age.

Civil Service Examinations.

The United States Civil Service Commission announces examinations as follows:

Topographic Draftsman, $1,000 to $1,500 per annum, Feb. 5-6.

Copyist Topographic Draftsman, $900 to $1,500 per annum, Feb. 5-6.

Surveyor, $125 to $150 per month, Feb. 5-6.

Transitman, $100 to $110 per month, Feb. 5-6.

INDUSTRIAL

The Wheeler Condenser & Engineering Co., Carteret, N. J., announce that they have acquired the American license to build turbo air pumps of the A. E. G. type, as manufactured in Europe by the Allgemeine Electricitaets Gesellschaft. This air pump is of the rotary water jet type, for motor or steam turbine drive, air being removed from the condenser by ejector action of a series of small water jets and also by positive entrapment of air between successive small slugs of water. A number of these pumps are now under construction at the works of the Wheeler Condenser & Engineering Co., Carteret, N. J.

The Raymond Concrete Pile Co., of New York and Chicago, have been awarded a contract by the National Fire Proofing Co. for placing Raymond Concrete Piles for the foundation of a new building for the Goodyear Tire & Rubber Co. at Jackson Ave. and Honeywell st., Long Island City, N. Y.

The new White companies held their organizing meetings January 7, and announced the following board of directors and officers: Of The J. G. White Engineering Corporation the directors are: Harry Bronner, of Hallgarten & Co.; James Brown, of Brown Brothers & Company; F. Q. Brown, of Redmond & Company; Douglas Campbell, of Campbell, Harding & Pratt; Geo. C. Clark, Jr., of Clark, Dodge & Co.; Bayard Dominick, Jr., of Dominick & Dominick; A. G. Hodenpyl, of Hedenpyl, Hardy & Co.; T. W. Lamont, of J. P. Morgan & Co.; Capt. Marion McMillin, of Emerson McMillin & Co.; J. H. Pardee, President The J. G. White Management Corporation; E. N. Potter, of Potter, Choate & Prentice; Frederic H. Reed, Vice President J. G. White & Co., Inc.; Chas. H. Sabin, Vice President Guaranty Trust Co.; Frederic Strauss, of J. & W. Seligman & Co.; Moses Taylor, of Kean, Taylor & Co.; George H. Walbridge, of Bonbright & Company; E. N. Chilson and C. E. Bailey. And the officers are: J. G. White, Chairman Finance Committee; Gano Dunn, President; E. G. Williams, A. S. Crane, H. A. Lardner, Vice Presidents; H. S. Collette, Secretary and R. B. Marchant, Treasurer. During the year ending Oct. 1, 1912, the departments of J. G. White & Co., Inc., which have just been organized into the above engineering company, were at work on contracts aggregating in cost over $28,000,000, and on appraisals and reports upon properties aggregating over $400,000,000. Many different types of engineering service were required throughout thirty different states and Canada, among them the complete rehabilitation of several public service properties, the construction and equipment of two high-speed interurban electric railways, one of which is eighty-four miles long and includes difficult tunnel and canyon construction in California. There was also engineering for the drainage of 118,000 acres in Florida, and the design and construction of a 124-mile 12-inch natural gas pipe line, which line is noteworthy because it is the first in California, and because it is to operate at a pressure of 450 pounds per square inch, the highest ever yet employed.

The hydro-electric developments include some of the most important in the United States, such as the Big Sandy, at the foot of Mount Hood in Oregon; the Deerfield, an important tributary to the Connecticut River; the Savannah River development near Augusta, Georgia; the Broad River near Columbia, South Carolina, and the Ocoee in the mountains of eastern Tennessee. In addition to these, there are the San Joaquin development in California, and that of the Beauharnois, on the Saint Lawrence in Canada. The aggregate capacity of these water powers is approximately 366,000 horse power. The J. G. White Management Corporation announces as directors Cecil Barret, of Spencer Trask Co.; F. Q. Brown, of Redmond & Co.; P. M. Chandler, of Chandler Brothers & Co., Philadelphia; Arthur Coppell, of Maitland, Coppell & Co.; Gano Dunn, President The J. G. White Engineering Corporation; Geo. E. Hardy, of Hodenpyl, Hardy & Company; R. G. Hutchins, Jr., Vice President National Bank of Commerce; R. L. Montgomery, of Montgomery, Clothier & Tyler, Philadelphia; John T. Pratt, of Campbell, Harding & Pratt; Frederick Strauss, of J. & W. Seligman & Co.; H. R. Tobey, of N. W. Halsey & Co., and J. G. White, President J. G. White & Co., Inc. And the officers are: J. H. Pardee, President; F. H. Reed and S. L. Selden, Vice Presidents, and T. W. Moffat, Secretary and Treasurer. The business of the Management Company was established some years ago as a department to supervise the operation of properties in which J. G. White & Co., Inc., were interested. This department, which has now been formed into a separate company, was, on Dec. 31, 1912, acting as Operating or Consulting Operating Manager of public utility and railroad properties in the United States, Nicaragua and the Philippine Islands, including The Manila Electric Railroad & Lighting Corporation and subsidiaries; the Helena (Montana) Light & Railway Co.; the Eastern Pennsylvania Railways Co., of Pottsville, Pa., and subsidiaries; the United Light & Railways Co. and subsidiaries; the Associated Gas & Electric Co. and subsidiaries; the Augusta-Aiken (Georgia) Railway and Electric Corporation and subsidiaries; Pacific Railroad of Nicaragua; Kentucky Public Service Company and subsidiaries, and other properties. The parent organization, J. G. White & Co., Inc., controls the new company and will continue as an active financing and owning company.

The H. W. Johns-Manville Co. has completed recently a new factory at Manville, N. J. The new plant consists of nine buildings, classified as follows: Textile and packing; rubber plant, electrical supplies and printing department; pipe covering; paper mill; magnesia; roofing; mastic and waterproofing, and roofing coatings, power plant and power house. The buildings represent the most advanced ideas in fireproof construction, being of brick, steel and concrete, with roofs of J-M asbestos roofing. The day-light form of construction is employed throughout. The buildings have an average length of 1,000 ft., and each is a separate factory in itself, capable of being operated as an independent unit without reference to other buildings in the group. The total floor area is about 1,000,000 sq. ft.

CATALOGUES

Apperson Motor Cars.—Paper, 6x9 ins., 28 pp. Apperson Bros. Automobile Co., Kokomo, Ind.

This is a book of instructions for users of "Jack-rabbit" cars.

Portable Air Compressors.—Paper, 8½x 11 ins., 8 pp. General Electric Co., Schenectady, N. Y.

Bulletin No. A-4069 is devoted to the subject of motor-driven portable and stationary air compressor sets.

Bulletin No. A-4066 illustrates the General Electric Company's electric hardening furnace and gives a complete description.

Compressors.—Paper. 6x9 ins., 28 pp. Chicago Pneumatic Tool Company, Fisher Bldg., Chicago, Ill.

This is Bulletin No. 34-F, which gives a description of the desirable features of design in the Class G Compressors. Illustrations are shown, including views of machines, in their parts, and line drawings showing the design.

Scale Removal from Condensers.—Paper, 6x9 ins., 16 pp. The Lagonda Manufacturing Co., Springfield, Ill.

This book contains a very interesting discussion showing the harmful effects of scale in condensers. Curves are included showing the increased steam consumption resulting from the accumulation of scale in surface condensers. This is catalog No. 0-1.

Imperishable Silos.—Paper, 9x6 ins., 32 pp. National Fireproofing Co., Pittsburgh, Pa.

This catalog is devoted to discussions and descriptions of silos made of vitrified clay blocks and covers the subject very completely. It is illustrated and contains tables showing the sizes, capacities, and a being driven, braced, cut by the oxy-acety- number of illustrated articles.

Lackawanna Steel Piling.—Paper, 8x10½ ins., 28 pp. Lackawanna Steel Co., Lackawanna, N. Y.

Bulletin No. 105 describes and illustrates Lackawanna steel sheet piling in a clear and concise way, the classes of work for which each of the three types is adapted and the value of steel piling for the work. Straight-web sections such as were used in the raising of the Maine are used for ordinary work where the principal forces to be resisted are tensile or where water tightness is essential. Arched-web sections are of value where the piling must resist transverse bending forces as in foundations. Steel piling protected by concrete, a new piling just put on the market, is used for permanent levee construction, revetments, etc. Illustrations showing the piling being driven, braced, cut by the oxyacetylene process, etc., are included.

RAILWAYS

Alabama.

The Tidewater Co., Birmingham, Ala., has asked for an additional franchise in Birmingham to cover about 125 city blocks with two crosstown and east and west street car lines.

The Birmingham Railway, Light & Power Co., Birmingham, Ala., is planning four extensions at Birmingham for the immediate future if franchises and other details can be arranged satisfactorily. The Owenton line is to be extended from Owenton to Tuxedo, the East Lake line is to be extended to Roebuck Springs and beyond the Avenue F line will be extended to Elmwood cemetery, and the Gate City line will be extended to Irondale.

Arkansas.

Grading has been completed on the Rock Island R. R. line from Camden, Ark., to Malvern and track laying has been commenced.

Promoters of the Fort Smith, Subiaco & Eastern R. R. have submitted a proposition to the city of Dardanelle, Ark., offering to construct an extension to that place from Scranton, 26 miles distant, or Subiaco, 32 miles away. The city is asked to furnish right of way to the Logan County line 8 miles, and a bonus of $15,000. Judge G. L. Wirt is Chairman of the Committee appointed to consider the matter.

California.

According to amended articles of incorporation filed by the Central Pacific R. R. at Alturas, Calif., actual work will be started on the Modoc Northern from Susanville to Lookout and from Klamath Falls, Ore., to Lookout by June 1.

Surveys have been completed, E. U. Leh, Chief Engineer, San Juan Portland Cement Co., San Juan, Cal., for an extension of the Central California R. R. from San Juan to Hollister. Contractors are reported to have been figuring on the grading for the extension.

The San Pedro, Los Angeles & Salt Lake R. R., E. G. Tilton, Chief Engineer, Los Angeles, Cal., has a party in the field locating a line between Riverside, Cal., and Daggett, Cal., via Cajon pass through the San Bernardino range of mountains.

It is believed that the Western Pacific is backing F. E. Snowden, who is promoting the extension of the Watsonville line to Fresno, Calif., at a cost of about $40,000,000. Mr. Snowden has recently secured, it is reported, the Pajaro Valley Consolidated R. R., giving him control of the Salinas and Pajaro valleys and other Monterey shipping points.

Colorado.

It has been announced that the Atchison, Topeka & Santa Fe R. R. has decided to construct its own tracks into Denver and to build freight terminals. F. M. Bisbee, La Junta, Colo., is Engineer of the western lines of the Santa Fe.

The Missouri Pacific Ry. is to expend about $100,000 in the next six months in repairing its yards at Pueblo. About $60,000 will be spent for filling in the yards south of the machine shops.

The Montezuma & Western Ry. Co. contemplates the construction of the Argentine Tunnel and about 40 miles of narrow gage track this spring. The road will be from Silver Plume, Colo., via Argentine Tunnel to Montezuma and Dillon, Colo., and will open up the mining camps of Montezuma. C. W. Hopkins, 708 Equitable Bldg., Denver, Colo., is engineer Montezuma & Western Ry.

A project is under consideration for the construction of an electric railway from Colorado Springs to Greeley, by way of Denver. At the latter city it is planned to have the line run through the business district, and the success of the entire project is understood to be dependent on receiving franchises in this city. Two surveys of the route from Denver to Greeley have been made. It is estimated that the road will cost about $3,000,000. Frank P. Read, Denver, Colo., is the promoter.

Delaware.

The Wilmington, New Castle & Delaware City R. R. Co., New Castle, Del., has acquired in Wilmington Southern Traction Co., a 5-mile line, and will it is understood, establish a service of storage battery cars, doing away with all overhead wiring.

Georgia.

The Board of Trade of Jesup, Ga., has decided to take up the matter of assisting the promoters of the new railroad to be constructed from Jesup to Douglas, Ga. It is hoped to have work under way by July 1, 1913.

The Americus, Tifton & Atlantic R. R. Co. has made preliminary surveys for its projected 110-mile line from Americus to Milltown, Ga. The capital for construction has not been secured as yet. I. W. Myers, Tifton, Ga., is President, and John W. Greer, Tifton, Ga., is Secretary.

Honduras.

Preliminary surveys have been started for the Truxillo R. R., which is to extend from the Port of Truxillo to Tegueigalpa. A partial survey for that portion of the road from Truxillo to Juticalpa, 200 miles, has already been made. Victor Camora, New Orleans, La., has the concession from the Honduran Government for this railroad.

Idaho.

⊙The Oregon Short Line Ry. has awarded the contract for the construction of the Mountain Home cutoff to the Utah Construction Co., Ogden, Utah. The proposed line obviates double tracking, it is said, and with the Raft River connections, shortens the distance from Salt Lake to Boise 84 miles. Work will begin in March from Bliss to Mountain Home.

The Idaho Northern Ry., operating between Nampa, Murphy and Emmett, and building an extension to the Payette Lakes, is reported to have been purchased by the Oregon Short Line. It is reported that the latter road will complete the extension and then build north to the Solomon river, and then down to the Snake and Lewiston.

City Council of Lewiston, Idaho, has granted franchise to F. M. Sturm, Wahpeton, N. Dak., for the operation of an electric railway. According to the franchise term the cars are to be in operation by Aug. 1, 1913. The line is to extend to Clarkston, and surveys for this are to be made at once.

Illinois.

The Santa Fe System has authorized the following minor improvements along its line: Albuquerque division, changing channel of Rio Puerco at Pinta, $5,400; constructing new second track between Cactus and Flagstaff, estimated cost, $1,174,101; relaying rail on main line between mileposts 12 and 23, estimated cost, $14,346; between mileposts 73 and 74, restoring embankments and constructing protection ditch, estimated cost $7,768; Arizona division, between mileposts 492 and 496, fencing right of way, $1,490; Needles, protection work along Colorado River, $93,352; Chloride, constructing a spur track to serve the Rainbow Mountain Mining Co.; Beaumont division, Oakdale, constructing a storage track for the Bowman, Hicks Lumber Co.; Illinois division, between Chicago and Neiska, installing automatic signals, estimated cost, $30,900; furnishing fire protection at Corinth, Kansas City division, installing additional crossovers at Argentine and equipping with air and water line; Middle division, replacing bridge No. 247 B, estimated cost, $5,949; Missouri division, increasing drainage facilities and repairing slides, $22,000 estimated cost, changing tracks at round house, estimated cost, $5,800, improving boiler plant, estimated cost, $10,500; Richmond, erecting a concrete dam in Crooked River, estimated cost, $3,000; Oklahoma division, building auxiliary pumping station and providing fire protection, $6,000; repairing roadbeds between Paul's Valley and Thackery, estimated cost, $35,000; Plains division, widening embankment between Sweetwater and Snyder, $23,000; Dawn, building a new station; Canadian, providing fire protection at car shops, estimated cost, $5,000; Happy, installing improved water facilities; Rio Grande division, providing new water facilities at Leasburg, $4,000; Santa Fe, Prescott and Phoenix lines, constructing new side track; Ramsgate, constructing new side track; Southern Kansas division, Capaldo, constructing new coal chute, new side track and station, estimated cost, $7,000; Dewey, constructing new passing track, $5,500; Collinsville, making track changes in yard, $25,000; Valley division, Fellows, installing spur track for American Oil Fields Co., Dodge City, constructing a brick power house and appurtenant facilities, $11,000 additional.

Indiana.

The Louisville & Nashville R. R. is to expend $200,000 for enlarging its shops and yards at Howell, two miles below Evansville.

Kansas.

The Midland Valley Railroad, operating across Oklahoma from Fort Smith, Ark., to Wichita, Kan., will, according to reports, extend its line westward from Wichita to a Denver connection. G. E. Ingersoll, Philadelphia, Pa., is President.

The Scott City Northern R. R. has recently completed betterment work and improvements which were begun with the change of management last September. The work included ditching of cuts, widening banks and replacing tile and timber drainage openings with substantial concrete structures. This line was constructed on easy curves and light grades, so no grade or alignment revision was deemed necessary at this time. New buildings have been erected at Scott City and include a 2-stall engine house, freight house, store house and blacksmith shop with up to date equipment. Trains are operated by telephone and Scott City has been made the terminal, the general offices being located at that point. Frank S. Yantis is Vice President and General Manager and Ben. L. Allen, Chief Engineer.

Kentucky.

The Louisville & Nashville R. R. is reported to be planning to build a second track this year from Lebanon Junction to Elizabethtown, Ky. The company is also said to be planning double tracking its line this season from Lebanon Junction to Nashville.

The Caneyville Ry. Co. of Floyd county, a coal-carrying road, has filed its articles of incorporation. The road extends from the mouth of Caney creek, where it makes junction with the C. & O., up Caney creek and Middle creek, a distance of 12 miles. The incorporators are James Salisbury, B. F. Combs and F. Flannigan of Prestonsburg.

The Kentucky Southwestern Electric Railway, Light & Power Co., according to an announcement of H. C. Rhodes, President, Paducah, Ky., is to commence construction work shortly on the first section of its projected line. This section will extend from Paducah to Murray, via Mayfield.

Articles of incorporation have been filed with the Secretary of State and the State Railroad Commission, Frankfort, Ky., by the Caney Railway Co., of Prestonburg, Ky. The company is capitalized at $10,000 and proposes the construction of a standard gage railroad branching off from the Chesapeake & Ohio R. R. at the mouth of Caney Creek in Floyd County following the middle branch of the Big Sandy River to Beaver Creek, where it will tap the coal fields in Eastern Kentucky. The incorporators are James Salisbury, B. F. Combs, M. Flannigan, W. T. Hite, W. P. Mc-

✣ indicates work now open for bids. ⊙ indicates a contract let recently

Vay, W. W. Brown and A. Flannigan, of Prestonburg.

Maine.

Stockholders of the Maine Central R. R., B. T. Wheeler, Chief Engineer, Portland, Me., on Jan. 8 voted to increase the capital stock from $15,000,000 to $25,000,000.

Maryland.

The Western Maryland Ry., H. R. Pratt, Chief Engineer, Baltimore, Md., is now said to be preparing to begin work this winter on a cut off line from Williamsport, Md., to Westminster, instead of in the spring, as previously noted in these columns. It is probable that a single track line will be constructed, although the fills, cuts, culverts and bridges will be made wide enough for the addition of a second track.

It is understood that the Baltimore & Ohio R. R. will soon offer for sale a $75,000,000 bond issue of that road. At the present time this road has no convertible bond issues. It is proposed to authorize an issue of $200,000,000 to care for future financing needs, the most pressing of which is the meeting of $50,000,000 of three-year 4½ per cent notes, which fall due on the first of next January.

Massachusetts.

The Norwood, Canton & Sharon Street Ry. Co., a 6-mile line connecting the places named, has been purchased by a company headed by M. A. Cavanaugh of Boston as President and Joseph B. Murphy of Taunton as Treasurer. It is said that the new company intends to extend the line to Taunton. It now runs from Sharon Teights through Canton to Norwood Centre.

Michigan.

A meeting was recently held at Bay City, Mich., to discuss the proposition submitted by the Detroit, Bay City & Western R. R. for an extension of the line from Akron north to Sebewaing, as mentioned in our last issue. T. L. Handy, of Bay City, Mich., representing the company, asks a bonus of $5,000 and right of way between Sebewaing and Unionville.

Minnesota.

The Minnesota, Dakota & Western Railroad is preparing to start construction work in the spring on an extension of its line to Craig, the northern terminus of the Deer River logging railroad. C. S. Giles, International Falls, Minn., is Chief Engineer.

It is expected that preliminary work for the new union station at St. Paul will be finished about April 1, and that construction work can be started in the early summer. According to rough estimates the station proper is to cost $4,000,000, and the freight terminals, track elevation and changing of river channel $5,000,000 more. The Great Northern Ry. and Northern Pacific Ry. will use the station.

Duluth and Vicinity.

BY PETER E. MEAGHER.

⊙Butler Bros., the stripping contractors on the Iron Range, were awarded another stripping contract of 500,000 yds. recently by the Person Mining Co. Butler Bros. are the largest stripping contractors in this vicinity and have, at the present time, ten stripping contracts, running from 500,000 to 5,000,000 yds. each.

Mr. A. G. Kingston and Mr. A. J. Brown of the Roberts-Kingston Contracting Co., were callers at this office recently. They have closed down their operations for the winter and expect to start up about March 15th. They have had a very successful season.

Mr. Eugene Fogg of Fogg Bros., boarding contractors, was a caller this week. They have a great many camps and boarding trains on work at the present time but are handicapped somewhat by the shortage of laborers.

E. C. Coons of the Butler-Coons Contracting Co., was a caller recently and stated that they were going to start work immediately on the drainage contract that they were awarded some time ago.

Mr. Edward Hingeston, representative of the Bucyrus Steam Shovel Co., was a caller recently and stated that steam shovel business at present was the best that his company had ever experienced.

Mr. James Harden, representative of the Broderick & Bascom Co., wire rope manufacturers, came in to see us recently and reports business booming in the wire rope line, and we are glad to hear it.

Mr. J. B. Rhodes, traveling representative for the Western Wheeled Scraper Co., is here with us at the present time.

Mr. P. C. Pastoret, the sewer and water works contractor, came in to see us this week and stated that they have finished all of their work and at the present time are in a position to figure on new work for the season of 1913.

Thomas Higgins, the railroad contractor, who has been working on the Canadian Northern in Canada, when talking to the writer this week stated that he had just about completed his work there and was going to look for some new work in the States.

Peter E. Meagher, 409 West Michigan street, Duluth, Minn., has some railroad work to let, consisting of steam shovel, drag line, grader, and team work. Any contractors wanting work will get full information by writing. This work can be started now or in the spring, just as they prefer.

The outlook for construction work for 1913 is very bright, and there is a great deal of work that will be let here, which will be started early in the spring.

At the present time the Duluth, Mesaba & Northern Ry. Co. is considering bids for their new iron ore dock, which will cost about $2,500,000. There are several large dock building concerns in the city at the present time figuring on this work. The successful bidder will be known in a few days.

Mr. H. C. Stansill, representing Kilbourne & Jacobs, was a caller recently and after spending a few days in this vicinity left for the East.

We regret very much to announce the death of Mr. Horace Clarke, representative in Denver, Colo., for the Western Wheeled Scraper Co. Mr. Clarke was very well known in this territory, and had a great many personal friends here.

John Porter of Porter Bros., railroad contractors, spent a few days in Duluth recently and has left for his home in Spokane, Wash.

The labor situation in Duluth is still in a very serious condition. There are, conservatively, two jobs for every man that we can get at the present time. Wages were never higher, and the few men that are here are very independent. I do not believe the situation is going to improve—in fact, I believe it will get worse.

Mr. John Bergman was a caller and we secured for him a railroad contract, consisting of rock work, which he will start on immediately.

Missouri.

⊙The St. Louis & Kansas City Electric Ry. Co., D. C. Nevin, President, New York Life Bldg., Kansas City, Mo., is reported to have awarded a contract to the National Contracting Corp., J. E. Cole, President, Norfolk, Va., for the construction of a 247-mile double track electric railway to extend from Kansas City to St. Louis, Mo. Griffith & McMurray, Kansas City, Mo., are reported to have the contract for work near Independence.

C. F. Enright, St. Joseph, Mo., who is promoting the construction of a new railroad connecting St. Joseph, Mo., with the coal fields at Cainsville, has a corps of surveyors locating the proposed route.

St. Louis Items.

BY A. B. KOENIG.

Dave Griffith and J. W. McMurray were with us the other day. They have started work on the new St. Louis & Kansas City Electric line in Jackson county.

Engineers of the Missouri Pacific and Frisco railroads are now considering details and plans of the Board of Public Improvements for eliminating the Tower Grove grade crossing. The only question now remaining in abolishing the surface crossing at that point is the decision of the engineers as to the exact plans for depressing the tracks and raising the grade of the street. If the engineers approve the Board of Public Improvements plans, or submit new specifications, an ordinance will be introduced in the Municipal Assembly within the next month authorizing the railroads to separate the grades. The railroad representatives and city officials practically agreed at the conference, it is said, that the plan of depressing the tracks and raising the street grade is feasible and reasonable. The proposed plans provide for approaches about 350 ft. in length to the street elevation, which will make the elevated highway about 1,000 ft. long. Representatives of the American Car Co. and the American Tobacco Co. who filed suits resulting in the court decision declaring void the former ordinances for crossing elimination, attended the conference. They indicated that the new plans will not seriously interfere with the switching facilities at their plants and will not be objected to by them.

Mike Conroy has his extensive team outfit laid up at Granite City, Ill. Mike is not going to do anything until spring, when he expects to finish the levee work across the river. He says his mules have been very faithful in the past and he is giving them a well earned rest.

Upper Alton property owners who have been objecting to a sewer plan proposed by the Board of Local Improvements of Alton, have been advised by a sewer expert they employed, to favor a sanitary sewer to empty into the Mississippi River. It will cost about $11,000 more than the sewer planned by the city. A septic sewer system is opposed for sanitary reasons.

Wm. Fairbanks, at Bement, Ill., has 10 teams idle.

McAndrew Bros. secured a nice machine job on the Big Four R. R. at Valley Junction, Ohio, from Costello Bros.

Costello Bros., Claypool Bldg., Indianapolis, Ind., finished all of their Wabash contracts ahead of contract time.

At a special election held in Kansas City on Jan. 8th, city officials were authorized to issue bonds to be used for improvements protecting the city against floods.

J. J. McInerney has moved his outfit to Indianapolis, where he is grading some town site lots.

W. E. Tench of W. E. Tench & Co., Detroit, Mich., was in town the other day. Nothing new with them.

F. W. Johnston of Grommet & Johnston was accidentally killed last week near Moberly, Mo., on the Wabash R. R. An accident to a speeder on which he was riding with one of the engineers caused him to be thrown in front of it, the speeder running over him. His remains were sent to St. Elmo, Ill., for interment.

Chas. Adams has 22 cracker-jack teams at Askew, Ark., idle.

Jack Gordner, the Memphis representative of Koenig's Labor Agency, has moved from 65 to 75 Poplar Ave., there. Jack has a much larger and comfortable place now to take care of the numerous contractors who make this office their headquarters while in Memphis.

The labor market is easier here right now than it has been at any time within a year. The Wabash and Iron Mountain Railroads having laid off quite a number of their extra gangs. Very little work is going on on account of the severe cold and sleet storm which struck this vicinity Sunday, Jan. 5th.

Jas. Dowd & Son expect to finish their levee work at Point Pleasant, Mo., in a couple of weeks and will be in the market for some team work.

The Stone-Webster Engineering Corporation of Boston, Mass., who have constructed the new electric transmission line between Keokuk and St. Louis, expect to close their local office on Feb. 1st.

L. J. Smith of the L. J. Smith Construction Co., is in Arizona and California sticking close to his Santa Fe double-track work.

The Missouri, Kansas & Texas Railroad Co. has several engineering parties in Texas surveying new lines and extensions.

It is the plan of the management of the Missouri, Kansas & Texas to make improvements in the roadbed and in operation of the line in Texas during the year. Approximately more than $2,000,000 will be expended. It is proposed to reballast every mile of the main line with burnt clay and crushed rock. This calls for an outlay of something like $700,000. Something like 170 miles of the present rails now in use will be replaced by 85-lb. steel, and in many other sections lighter rails will be abandoned for the use of the heavier steel. A half million dollars will be spent in the one item of steel rails. In the building of sidetracks, team tracks and passing tracks at various points in the state, for the widening of embankments and the improvement of drainage conditions there will be an estimated outlay of $100,000. New bridges, trestles and culverts will cost $77,000. Water and fuel stations will cost $70,000 and $195,000 will be put into stations, depots, new section houses and in the reconstruction of present structures along the line. New interlocking plants, electric block signals, signal towers and other modern designs will be installed at a cost of more than $200,000. Additional telegraph and telephone lines will cost $27,000. Reduction of grades and the double tracking of several congested sections will add another $130,000 to the total expense.

The Gray-Wimmer Construction Co., Victoria Bldg., St. Louis, was awarded the contract for rebuilding the Passenger Station of the Missouri, Kansas & Texas R. R. at Parsons, Kan. The new station will cost approximately $150,000.

Montana.

The Great Falls & Seton County Ry. Co. now under construction from Power to Choteau, has authorized the building of an extension to Bynum. Surveys for the extension, as noted in our last issue, have been completed, and it is probable that construction contracts will be let at once. This is a Great Northern Ry. project.

Nebraska.

The Omaha, Lincoln & Beatrice Interurban Co., now operating 6½ miles of line, and projecting 50 miles additional, has applied to the State Railroad Commission for permission to sell $2,250,000 bonds and $850,000 common stock. The proposed route extends through Lincoln, University Place, Bethany, Waverly, Greenwood, Ashland, Papillion and South Omaha. H. S. Norton, 1400 O St., Lincoln, Neb., is Secretary.

New York.

✣Bids will be received until noon, Jan. 28, by the Public Service Commission for the First District, 154 Nassau St., New York City, for the construction of the first rapid transit line to be built in Queens Borough, New York City. This section is Section 2 of the Astoria, Woodside and Corona rapid transit route; it covers that part of the line north of Beebe Ave. This is to be an elevated road.

Both of the transportation companies which are to operate the Dual System of rapid transit and contribute to the cost of construction of the new lines under the proposed contract with the City of New York, have filed with the Public Service Commission for the First District applications for the approval of mortgages and bond issues needed to finance the project. The Interborough Rapid Transit Co. proposes to issue bonds not to exceed $170,000,000. Its petition states that the company has made a contract with J. P. Morgan & Co. for the purchase of the entire issue at 93½ and accrued interest. At this rate the company wants permission to issue bonds, under date of Jan. 1, 1913, bearing interest at 5 per cent, and payable in 1966, sufficient to raise $150,797,500. Of this amount the company will use $74,000,000 in cash for its contribution toward the construction of new subways and subway extensions and the purchase of equipment for the same; $16,154,000 to pay for the extension and $10,800,000 for third-tracking of its elevated lines; $34,668,900 to refund all outstanding bonds; $15,000,000 to pay off outstanding short term notes, and $174,600 to be reserved to pay off outstanding liens on real estate. The Commission held a hearing on this application on Jan. 13. The Brooklyn Rapid Transit Co., through the New York Municipal Railway Corporation, which was formed to enter into the proposed contract with the city, has made application to the Commission for the approval of a mortgage to secure an issue of not to exceed $100,000,000 of first mortgage 5 per cent sinking fund gold bonds, and of this amount asks for permission to issue immediately $65,000,000. Of the proceeds the company is to apply $13,500,000 toward the cost of construction of new subways and subway extensions; $1,000,000 to pay for the proposed connection between the Fourth Ave. Subway and the Broadway Subway at Canal St.; $26,000,000 for the purchase of equipment for the new system and the old lines to be operated in conjunction therewith: $6,500,000 for the construction of additional tracks on its elevated railroads, $8,000,000 for the extension of such elevated railroads, and $10,000,000 for the reconstruction of these lines. The Commission will set an early date for a hearing on this application.

The International Railway Co., as part of its reorganization plan, has filed with H. J. Price, Clerk of Erie County, Buffalo, N. Y., a mortgage for $60,000,000, given to the Bankers' Trust Co. of New York. Bonds to the amount of $8,176,000 are to be issued at once. E. G. Connette, Buffalo, N. Y., is President of the company.

North Carolina.

The Raleigh, Atlantic & Western Ry. Co. is to apply to the General Assembly this month for a charter. The company has not yet organized and nothing has been done except to prepare the charter for introduction in the legislature. The company proposes a 52-mile line, running northwest and southeast from Raleigh and connecting with the Norfolk & Western R. R., and the Atlantic Coast Line R. R. Surveys have not been made. James H. Pou, Raleigh, N. C., is interested.

Ohio.

H. A. and R. L. Culbertson, Youngstown, O., have a contract for changing the Mahoning River channel at Lowelville, O., for the Pittsburg & Lake Erie R. R. The new channel will be cut for a distance of 2,000 ft. and will be 250 ft. wide.

Oklahoma.

The Tulsa Street Ry. Co., Tulsa, Okla., is to expend $100,000 at Tulsa this year for improvements. These include an extension through the Belleview addition and some double tracking.

Application has been made for a state charter for the Oklahoma, New Mexico & Pacific Ry. The company is to have a capital stock of $2,500,000. This is the project promoted by J. L. Harmon, Lawton, Okla., and John L. Ringling. The company is now surveying its line to Lawton, and plans its immediate construction. Geo. L. Reeder, Guthrie, Okla., is engineer.

It is reported that the Oklahoma Central Ry. is planning the extension of its line from Lehigh, Okla., to McAlester, Okla., where it will connect with the Santa Fe, Rock Island and the Missouri, Kansas & Texas Railroads. Dorset Carter, Chickasha, Okla., is Chief Executive Officer and W. G. Choate, Chickasha, Okla., is General Manager.

Capitalists of Hugo, Okla., are endeavoring to construct a tap line railroad which will give the city direct connection with both Oklahoma City and Muskogee, Okla.

Oregon.

The Portland, Eugene & Eastern Ry., R. F. Strahorn, President. Portland, Ore., is reported to be about ready to let a contract for construction of its line from Portland, south 40 miles.

The M. C. Minney Realty Co., Oakland, Cal., owning 4,000 acres of land near Medford, Ore., have applied to the city council of Medford for a franchise to construct and operate a city and interurban electric railway. The company agrees to construct 10 miles of road within a year if a franchise is granted. The men interested in the company asking for the franchise are M. P. Minney, Oakland; C. S. Morris, Oakland, and F. B. Walte, Sutherlin, and A. A. Davis, Medford.

The Portland Railway. Light & Power Co., 7th and Alden Sts., Portland, is contemplating a considerable amount of construction this season, and has already placed orders for $100,000 worth of special track work. Thos. Pumfrey is Chief Engineer.

Pennsylvania.

⊙The Philadelphia & Reading Ry. has awarded a contract to Charles F. King & Co., Pottsville, Pa., as noted in our last issue, for constructing a fourth track on the New York branch between Woodburne and Yardley Stations. P. F. Brendlinger, Arcade Bldg., Philadelphia, Pa., has been awarded the contract for grading and masonry for a third track on the New York branch between Skillman and Hopewell Stations.

The Erie R. R. is to expend $25,000 for enlarging its yards at Hubbard.

The Baltimore & Ohio R. R. is to expend $32,000 for enlarging its yards at Connellsville, Pa.

The Lehigh Valley Transit Co., Allentown, Pa., is contemplating extending its line from Slatington to Lehighton, 13 miles.

The City Council of Pittsburgh, Pa., has granted a franchise to the Pittsburgh Subway Co. for a system of rapid transit for that city. The estimated cost of the system is about $50,000,000. John M. Goehring, Pittsburgh, is President of the company.

The Beech Creek Railroad Co. has applied to the State Forestry Commission, Harrisburg, Pa., for right of way through the Hopkins State Forest Reserve from Keating to Queen's Run. It is believed that the new extension is backed by the New York Central Ry.

South Carolina.

The Seashore Division of the Charleston Consolidated Railway & Lighting Co. has been recently purchased by James Sottile. The company has been reorganized under the name of the Charleston-Isle of Palms Traction Co., with Mr. Sottile as the President of the company. The Charleston-Isle of Palms Traction Co. owns and operates the ferry line between Charleston and Mt. Pleasant, and likewise owns and operates the electric railway connecting Mt. Pleasant with Sullivan's Island, Atlanticville, and the Isle of Palms. The line is approximately ten miles long and serves the above named towns which have a total population of about 15,000 people. The company also furnishes electric light for Mt. Pleasant, Sullivan's Island, the Government Reservation, Atlanticville and the Isle of Palms, and owns and operates its own power station which is located on Sullivan's Island. The company is projecting a line to McClellanville and has obtained the rights of way, etc., for more than two-thirds the distance of the line which will be approximately 35 miles long. This line will connect Mt. Pleasant and McClellanville and will open up one of the most desirable farming sections of the South. In connection with this work and likewise the electric railway now in operation the company proposes to build a reinforced concrete bridge across Cooper River, for the purpose of operating all trains into the city of Charleston

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

and thereby do away with the ferry line. The bridge will be approximately one mile in length and will have a single track over which will be operated both steam and electric cars. The bridge will also be provided with driveway and foot path. It is understood that the company will be in a position to call for bids on the bridge work by first part of June of this year. The McClellanville line will hardly be started until the fall of this year. W. W. Fuller, Charleston, S. C., is Chief Engineer and General Superintendent of the Charleston-Isle of Palms Traction Co.

Tennessee.

Further information regarding the plans for the Tennessee Central R. R. mentioned in our last issue, is to the effect that a new company is to be organized to bid in the property, after which it will be extended into new territory and improved at a cost of between $5,000,000 and $8,000,000.

The Nashville-Murfreesboro Interurban Ry. Co. is reported to be planning to begin construction work April 1 on its projected line between the cities mentioned. Three routes are under consideration, and surveys of these will probably be started next month. Joe L. Parker, Murfreesboro, Tenn., is interested.

The Tennessee, Kentucky & Northern R. R., H. Adkins, Chief Engineer, Livingston, Tenn., will be ready about April 1, it is reported, for letting contracts for a 16-mile extension south to Sparta, Tenn., and a 61-mile extension north to Rock Creek, Ky.

Texas.

The Board of Trade of Laredo, Tex., is making efforts to interest capital in the construction of a railroad from that place to Beeville.

Engineers of the Missouri, Kansas & Texas Ry., A .M. Acheson, Chief Engineer, Dallas, Tex., are working on the surveys on the permanent line for the extension of the Beaumont & Great Northern R. R. into Beaumont.

The San Antonio, Fredericksburg & Northern Ry. Co. has been chartered with a capital stock of $30,000. This company proposes to build a line beginning at a point on the San Antonio & Aransas Pass R. R.—Kerrville branch—about four miles northwest of the town of Waring, in Kendall County, and from thence in a northerly direction through the counties of Kendall and Gillespie into the town of Fredericksburg, in the county of Gillespie, a distance of approximately 25 miles. The principal place of business after the construction of the road is to be located in Fredericksburg, but the construction offices of the company are in San Antonio. Construction work is now under way. R. A. Love, Thompson Hotel, San Antonio, Tex., is President.

It has been announced that the Dallas Union Terminal Co., organized by the companies operating into Dallas, during 1912, has completed financial arrangements to a maximum of $5,000,000 for the construction of the terminals and station. It is hoped to have actual construction work commenced within 60 or 90 days. The following officers were elected for the company June 19, 1912: F. G. Pettibone, Galveston, president; Murrell Buckner, Dallas, secretary; W. A. Webb, Dallas, vice-president; Thornwell Fay, Houston, vice-president, subsequently succeeded by W. B. Scott, of Dallas; R. P. Roach, of Dallas, treasurer; C. H. Dana, of Dallas, chief engineer, and Andrews, Ball & Streetman, of Houston, general attorneys.

It has been announced that work will be resumed shortly on the Quanah, Seymour, Dublin & Rockport Ry., through Lockhart, Texas. Surveys for the line are reported to have been made and capital for the construction secured. L. E. Walker, Rockport, Texas, is interested in the company

Utah.

A united effort will be made by the citizens of Springville and Mapleton, Utah, to secure the right of way necessary for the construction of the Utah Railway Co. to those places. The Provo people have practically closed arrangements for the right-of-way through land south of that city.

Virginia.

The New York, Philadelphia & Norfolk R. R., C. E. Brinser, Division Engineer, Cape Charles City, Va., has increased its capital stock from $3,750,000 to $4,000,000, to provide for additional track construction in Norfolk County and in the cities of Norfolk and Portsmouth

The Norfolk & Western Ry. Co. has applied to the city of Norfolk, Va., for a franchise to build a spur along Armistead Ave. and over the Smith Creek Canal. C. S. Churchill, Roanoke, Va., is Chief Engineer.

The Virginia Corporation Commissioner has granted a charter to the Norfolk, Washington & New York Railroad, which proposes the construction of a line from Norfolk, Va., north to Washington, D. C. Branches will be constructed into southern Maryland.

Washington.

⊙Guthrie & McDougall, St. Paul, Minn., have been awarded a contract by the Northern Pacific Ry. for second track work between Easton and Lester, Wash., 15 miles.

The North Yakima & Valley Ry. is now completing three miles of its 12-mile line through the Cowiche Canyon. The Valley Construction Co., North Yakima, Wash., has the contract for the work, surveys for which were made in 1910. George T. Reid, Tacoma, Wash., is President, and J. D. Hemington, North Yakima, is Chief Engineer.

E. M. Mills, 1106 Alaska Bldg., Seattle, Wash., President of the Seattle, Renton & Southern Ry. Co. has applied to the City Council of Seattle for a franchise to construct and operate a system of branch street railway lines connecting with the main line.

West Virginia.

The directors of the Fairmont & Mannington R. R. Co., Fairmont, W. Va., have ordered a survey with a view to constructing an electric road from Annabelle to Mannington.

The Monongahela Valley Traction Co., Fairmont, W. Va., is understood to have plans under way for building an extension between Gypsey and Lumberport. The construction of another line to a point three miles to the west of O'Neill is also contemplated.

It is rumored that the Pennsylvania Railroad is contemplating the construction of an extension to the Cleveland & Pittsburgh branch from Powhatan to a point near New Martinsville, bridging the Ohio River and entering the undeveloped coal fields of West Virginia. Thomas Rodd, Pittsburgh, Pa., is Chief Engineer of the lines west of Pittsburgh.

Wisconsin.

Work has just been completed on 13 miles of line in Eau Claire County, Wis., by the Fairchild & Northeastern R. R., and it is believed that the road will be extended to Durand. N. C. Foster, Fairchild, Wis., is President and General Manager of the company.

Wyoming.

⊙All bids received Nov. 25 by the Constructing Quartermaster, Fort D. A. Russell, Wyo., for the construction of a railroad spur, sidings, track scale and scale house were rejected and new bids taken on Dec. 18. Under the letting of Dec. 18 the contract was awarded to Hastings, Young & Dumm, Cheyenne, Wyo., at $46,600.

Canada.

Citizens of Fort William, Ont., have voted a by-law providing $140,000 for extension of the municipally owned street railway. George Graham is Mayor.

According to a preliminary report the Canadian Northern Ry. during the past year constructed in the Province of Alberta 362 miles of track and completed 460 miles of grading. In addition to the actual construction work completed the company finished the location of 868 miles of new roads, which will be built as soon as men, money and material can be obtained. Between 7,000,000 and 8,000,000 cu. yds. of rock and earth were moved during the course of the year's grading work. In doing the location work surveyors have run over 1,600 miles of line, and there have been employed on this staff 46 constructing engineers and five locating engineers and their parties, a total force of 300 men engaged in the location and engineering department of the railway in Alberta.

Announcement has been made that the Canadian Pacific Ry. is planning extensive improvements for the Dominion Atlantic Ry., of which P. Gifkins, Kentville, N. S., is General Manager. These improvements include the construction of a 520-ft. wharf and warehouse at the Yarmouth, N. S., terminus, and the replacing of 10 wooden bridges by steel structures.

The Pacific & Peace River Ry. Co. is to apply to Parliament for an act extending the time within which it may construct its line and for power to increase the amount of its securities.

The Athabasca & Grande Prairie Ry. Co. is to apply to Parliament for an act of incorporation. This company proposes to construct a line from some point at or near the junction of the Salmon and Athabasca River in the Povince of Alberta to run in a northwesterly direction to a point at or near the junction of the Smokey and the Muskeg rivers, thence by the most feasible route in a northerly direction to Dunvegan, passing through Grande Prairie at a point on the westerly side of Bear Lake.

The North Ry. Co., which was incorporated by the legislature of Quebec, will ask Parliament to confirm the rights and privileges which it is now entitled to under provincial incorporation. The company will ask for power to extend the lines of railway, which it is now authorized to construct from its main line to Ottawa from Montreal to Quebec and from Montreal to the boundaries of Maine, New Hampshire and Vermont, with power to construct a bridge across or a tunnel under the St. Lawrence River.

It is expected that final arrangements will be made this week between the Kettle Valley Ry., A. McCulloch, Chief Engineer, Penticton, B. C., and the Victoria, Vancouver & Eastern Ry. (Hill Line), regarding the construction and joint operation of the Hope Mountain Division. This section will be about 50 miles long and will call for expensive construction, as it is almost wholly mountain rock work.

Preliminary plans are well advanced and it is expected that construction work will be started early this year on the first section of the Hudson Bay, Peace River & Pacific Ry. This company was chartered in 1911 and proposes the building of a railway from Winnipeg to Port Nelson on the Hudson Bay, and then westerly through the Peace River country to the Pacific Coast, with terminals close to Prince Rupert. The first section is to extend from Winnipeg to a point on the east side of Lake Winnipeg near the Winnipeg River. The directors of the company are Dr. R. M. Simpson, president Hon. D. C. Cameron, F. W. Heuback, D. E. Sprague, R. C. Macdonald, F. W. Drewery, W. Sanford Evans and R. D. Waugh, all of Winnipeg, Man.

Mexico.

The Nacozari R. R., J. S. Williams, Jr., Manager, Nacozari, Sonora, Mexico, is reported to be planning to at once change its line from Purica Station into Nacozari. The new line would eliminate the grade into that place, and will require a considerable amount of heavy work. This construction is reported to be preliminary to an extension 100 miles south to reach the Promontorio mine owned by the Phelps-Dodge interests.

✣ indicates work now open for bids. ⊙ indicates a contract let recently

ROADS AND STREETS

Alabama.

✣Bids will be received until 7:30 p. m., Jan. 23, by City Council, St. Petersburg, Ala., for the construction of a pier or roadway to be built from the sand fill and breakwater on Second Ave. North, eastward into Tampa Bay. The construction of the same to be under the supervision and according to the plans and specifications in the office of the City Engineer, who will furnish blanks for bids. Certified check for $500 must accompany each bid. City reserves right to reject any and all bids. W. F. Divine, City Clerk.

⊙The County Commissioners, Mobile, Ala., have awarded the contract for surfacing the St. Stephens Road to A. E. Perry at $17,615. Other bidders were: Hett Bros. Contracting Co., $25,625; W. J. Bradford, $27,748; Seabury & Pringle, $19,645; S. L. Christie, $18,600.

The Clark Court County Commissioners, Grove Hill, Ala., rejected all bids received Jan. 6, for grading, draining and surfacing with sand-clay, approximately six miles of State Aid Road because they were considered too high. W. S. Keller, Montgomery, Ala., is State Highway Engineer.

Arizona.

Arizona State Engineer Lamar Cobb recently consulted with the Board of Supervisors, Tucson, Ariz., concerning the finishing of the state highway in Pima County. It is estimated that $15,000 will be available for this work.

California.

The City Council of Pasadena, Calif., has started proceedings for street improvements for the coming season. One of the first streets under consideration is Raymond Ave. from Hotel Green to the south city limits. It is proposed to surface this street with asphalt. Other streets proposed to be improved are Hillcrest and Oak Knoll Aves.

⊙The City Street Improvement Co., San Francisco, Calif., has been awarded the contract by the City of San Jose, Calif., for improving First St., from Taylor to Rosa, as follows: Paving, $0.18 per sq. ft.; curbing, $0.35 per lin. ft.; gutters, $0.18 per sq. ft.; catch basins, $37.50 each, and 6-in. pipe drains, $0.09 per ft.

Colorado.

The Colorado State Highway Commission has apportioned among the counties of the state $1,832,500 to be expended in improving the public highways.

District of Columbia.

Federal appropriation of $25,000,000 to aid the states for good roads is proposed in a bill by Senator Swanson. The bill contemplates the apportionment of the proposed appropriation among the states according to population and mileage of post roads. It is provided that in every instance the states shall pay one-half the cost of construction, but after the completion of any given road the national authorities are to withdraw from all supervision.

Florida.

✣Bids will be received until 4 p. m., Feb. 5, by Board of Bond Trustees, C. A. Hardee, Secy., Live Oak, Fla., for furnishing all material, labor and equipment for the following work: Approximately 25,000 sq. yds. of street paving (vitrified brick, granitoid, sheet asphalt and asphaltic concrete will be considered), with all necessary drainage and granite curb as specified. Each bid must be accompanied by a certified check, made payable to the "Board of Bond Trustees," for $2,500. Plans and specifications can be seen at the office of the consulting engineers at Savannah, Ga., and at the office of the Secretary of the Board at Live Oak, Fla., or specifications may be obtained by writing H. S. Jaudon Engineering Co., the Engineers at Box 582, Savannah, Ga., enclosing ten dollars to cover cost.

✣Bids will be received until 4 p. m., Jan. 23, by O. A. Spencer, Commissioner of Public Works, Bradentown, Fla., for furnishing all material, equipment and labor for the following work: Approximately 37,000 sq. yds. of street paving of the following construction: First—Bituminous flush coat surface concrete paving. Second—Asphaltic concrete paving. Third — Asphalt macadam paving, poured process. One of which said constructions shall be adopted and used according as it appears to the Council to be to the best interest of the city, after receiving and comparing the costs of the said several constructions, the said paving to be done upon the following named streets in Bradentown, Florida, and to extend from gutter to gutter, to-wit: Manatee Ave. from Tyler St. to City Limits on the West. Tyler St. from Manatee Ave. to Stewart Ave. Stewart Ave., from Sarasota Ave. to Tyler St. Richman Ave. from Manatee Ave. south 3,300 ft. Grove St. from Manatee Ave. to Division St. Fairview St. from Manatee Ave. to Academy St. Roesch Ave. from Manatee Ave. to Border St. Beach St. from Park St. to the River. Price St. from Broad St. to Park St. Pine St. from Manatee Ave. to Stanton St. Smith Ave. from Manatee Ave. to the River. Broad St. from Fairview St. to Main St. Broad St. from Court St. to Price St. Also widening and repairs on the following: Sarasota Ave. from Manatee Ave. to the River. Manatee Ave. from Pine St. to Prospect St., from Prospect St. to Sarasota Ave.; from Smith St. to Roesch Ave. and from Roesch Ave. to City Limits on the East. Main St. from Broad St. to Border St. Also for the construction of approximately 48,000 lin. ft. of gutter and combined curb and gutter. Separate bids will be received for the paving and curbing above specified. Bids for the entire work must be accompanied by a certified check made payable to George B. Wallace, Mayor, for $3,000, and each bid for the paving separate from the curbing and guttering must be accompanied by a check for $2,000 and each bid for the guttering and curbing separate from the paving must be accompanied by a check for $1,000. Plans and specifications can be seen at Savannah, Georgia, at the office of the Engineers, or at the office of the City Clerk, Bradentown, Florida, and specifications can be obtained by writing H. S. Jaudon Engineering Co., the Engineers at Box 582, Savannah, Georgia, or City Clerk, Bradentown, Florida, and enclosing $5 to cover cost.

✣Bids will be received until 7:30 p. m., Jan. 21, by Town Council, Clearwater, Fla., for street paving with vitrified brick and various kinds of asphalt and bitumen pavements; also storm sewers and combined curb and gutters. The amount available for the work is $90,000. Plans and specifications may be seen at the office of the City Engineer.

✣Bids will be received until 3 p. m., Feb. 10, by H. Gaillard, Chairman Committee on Public Works, Board of Bond Trustees, Jacksonville, Fla., for laying approximately 98,826 sq. yds. of concrete base in various streets. A certified check for $2,500 must be filed with each bid. Specifications, etc., may be obtained of the Clerk of the Engineering department or by addressing L. D. Smoot, Chief Engineer.

The Pasco County Board of Commissioners, Dade City, Fla., on Jan. 6 held a meeting to take action on the proposition to call a special election to vote upon whether western Pasco County shall issue $150,000 in bonds to provide funds with which to build good roads in that part of the county.

Georgia.

⊙The Southern Paving & Construction Co., has been awarded the contract by the City Council of Macon, Ga., for the re-surfacing of College St.

Idaho.

✣Bids will be received until 2 p. m., Jan. 22, as mentioned in our last issue, by the City Council, Boise, Idaho, for paving with asphalt, asphalt concrete, bitulithic, dolarway, hassamite, plain concrete, and concrete with bitumenous top in all streets and parts of streets in local paving improvement district No. 19, approximately 76,500 sq. yds., with necessary excavation, gutters, and appurtenances. Said pavement to be laid and constructed according to plans and specifications which may be seen at the office of the City Engineer. Nancy E. Robertson is City Clerk.

Illinois.

✣Bids will be received until Jan. 22, by City of Rockford, Ill., for the construction of 14,000 sq. yds. of brick pavement with asphalt filler on concrete foundation; also for curb and gutter. Edwin Main is City Engineer.

The Chicago City Council, on Jan. 2, authorized the purchase of steam rollers, shovels, dump-carts, wagons, concrete carts, etc., for use during 1913, as follows: Special Park Commissioner A. W. Beilfuss, Chairman, $1,375; Bureau of Streets, L. E. McGann, Commissioner of Public Works, $30,300. Date of soliciting bids not announced.

The Aetna Engineering Co., 17 N. LaSalle St., Chicago, has been authorized by the City of Odell, Ill., to prepare estimates for 30,000 sq. yds. pavement, vitrified brick and other materials.

The Chicago City Council, on Jan. 2, authorized the purchase of the following paving materials: Cement, sand, gravel, asphalt, paving pitch, pitch filler, crude oil, repressed vitrified paving brick, creosoted wood blocks, etc., estimated cost $257,500. Bureau of Streets, L. E. McGann, Commissioner of Public Works.

The Board of Local Improvements of Elgin, Ill., has granted a petition calling for the paving of Villa St., to a width of 39½ ft., with brick without a concrete foundation.

The Board of Local Improvements of Belleville, Ill., has decided to pave the Market Square at an estimated cost of $6,066. William Ziehnert is City Engineer.

The City Council of Waukegan, Ill., has passed ordinances providing for the paving of Clayton and Madison St. hills, the former to cost $4,665 and the latter $4,102.

The Board of Local Improvements of Ottawa, Ill., has passed a resolution calling for the paving of the west side district by special taxation. City Engineer Geo. L. Farnsworth has estimated the cost at $281,000.

The Board of Local Improvements of Dixon, Ill., has passed a resolution providing for the paving of First Ave., Second St., from Galena to Monroe Ave., Peoria and Hennepin Aves., from Second to Third Sts. The estimated cost of the improvement is $23,458.

The Board of Local Improvements of Spring Valley, Ill., has authorized the paving of two more streets during the coming year. The total cost of the proposed improvement will be about $44,000. Work will be started early in the spring.

Indiana.

⊙Voyles & Baynes of Salem, Ind., have been awarded the contract by the Board of Washington County Commissioners, Salem, for the construction of a rock road in Brown township, at $1,679. Bids were opened Jan. 6 by Frank S. Munkelt, County Auditor.

⊙Jno. W. Murphy of Greenwood, R. D., Ind., has been awarded the contract by the Board of Johnson County Commissioners, Franklin, Ind., for the construction of a gravel road known as the Milford Richardson road, at $5,163. Bids were opened Jan. 6 by H. L. Knox, County Auditor.

⊙Miller & Rapp of Seymour, Ind., have been awarded the contract by the Board of Jackson County Commissioners, Brownstown.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Ind., for the construction of the Elsner Adams road in Redding Township, at $8,644. Claud Murray, Seymour, Ind., secured the Ebeneser road in the same township, at $2,180. Bids were opened Jan. 6 by H. W. Wacker, County Auditor.

⊙Reed M. Wikle has been awarded the contract by the Board of Carroll County Commissioners, Delphi, Ind., for the construction and completion of improvements of highways in that county, at $2,695. Bids were opened Jan. 6 by M. G. Haun, County Auditor.

⊙M. W. Jones has been awarded the contract by the Board of Jay County Commissioners, Portland, Ind., for the construction of a macadam road in Wabash Township, at $3,173. Bids were opened Jan. 7 by John Bonifas, County Auditor.

⊙M. W. Jones has been awarded the contract by the Board of Jay County Commissioners, Portland, Ind., for grading and paving with crushed stone a road in Jefferson Township, at $15,345. Bids were opened Jan. 7 by John Bonifas, County Auditor.

⊙The Grant and Wabash County Commissioners, at Wabash, Ind., awarded the contract for the construction of the Smith Road, on the line of Waltz Township, to Charles M. Zeigler at $4,800.

The contract for the construction of a macadam road in Keener Township, Jasper County, Ind., for which bids were opened on Jan. 6 by the County Commissioners at Rensselaer, Ind., has not been awarded. The bids will be considered at the February term of the board. J. P. Hammond is County Auditor.

No bids were received on Jan. 6 by the Board of Fayette County Commissioners, Connersville, Ind., for the construction of a gravel road known as the D. W. Moore, et al road. Jasper L. Kennedy is County Auditor.

Iowa.

✣Bids will be received until 5 p. m., Jan. 20, by Charles J. Duff, City Clerk, Council Bluffs, Ia., for the necessary labor and material for the construction of artificial stone sidewalks. The work to be divided into three sections, as follows: Section 1 being approximately 20,053 sq. ft.; section No. 2, approximately 23,423 sq. ft.; section No. 3, approximately 23,380 sq. ft. All of said walks to be constructed in accordance with the plans and specifications now on file in the office of the City Engineer and under the supervision of the City Engineer and subject to his approval.

The Boards of Supervisors of Clinton and Jackson Counties, Ia., have agreed to jointly re-construct a piece of road about a quarter of a mile long on the county line. Clinton is the county seat of Clinton County.

⊙The Turner Improvement Co., Des Moines, Ia., has been awarded the contract by that city, for the Euclid Ave. brick pavement from Sixth to 12th St., at $1.59 per sq. yd.

The City Council of Clear Lake, Ia., has adopted resolutions of necessity for the paving of 10 blocks of city streets.

The City Council of Grundy Center, Ia., has taken preliminary steps toward improving the main streets of the city next summer.

A petition has been circulated in Sac City, Ia., which will be presented in a meeting of the Council, providing for the paving of part of Main and Fifth Sts.

The Engineering department of Cedar Rapids, Ia., will shortly commence the preparation of plans and specifications for the paving of the proposed streets this season.

Louisiana.

The Police Jury of Ascension Parish, Donaldsonville, La., held a meeting Jan. 8 to discuss the feasibility of constructing gravel roads on both sides of the river from the Iberville to the St. James lines, and on both sides of Bayou Lafourche from Donaldsonville to the Assumption line.

⊙The General Paving Co. has been awarded the contract by the City of Shreveport, La., for the paving of Wall St., from Marshall to Market at $2.10 per sq. yd.

The Police Jury, Donaldsonville, La., plan to construct good roads in the First and Second Districts during the year. It is proposed to bond the parish to the amount of $75,000 for this work, which would bring the amount available up to $85,000. About 50 miles of gravel roads are proposed.

Maryland.

According to Chairman Compton of the Paving Commission, Baltimore, Md., it is proposed to improve 35 miles of streets this year out of the commission's appropriation of $1,000,000. Vitrified brick is to be the leading material.

Massachusetts.

⊙W. R. Pratt has been awarded the contract by the Massachusetts State Highway Commission for the building of 1½ miles of state road beginning at the East Windsor line and running west.

The City of New Bedford, Mass., plans to ask the legislature for permission to borrow $1,500,000 outside the debt limit for street improvements and park extensions. Charles S. Ashley is Mayor.

Minnesota.

H. C. Hanson, superintendent of roads and bridges in Lake County, Minn., has made a resurvey of the Silver Road. This road connects with State Road No. 1, goes through Kramer, joining the Cook County survey which has been made in connection with the proposed international highway, which is to be a boulevard connecting Duluth and Port Arthur along the shores of Lake Superior. Ten miles of this road is expected to be completed in Lake County next season, making a route through that county to the Cook County line. Two Harbors is the county seat.

The county of Lincoln, Minn., will apply to the state for an appropriation, to be used on State Road Nos. 8 and 9, commencing from the southwest corner of the corporation of the Village of Ivanhoe. Karl A. Hansen, Ivanhoe, Minn., is County Auditor.

The City Council of Breckenridge, Minn., has appointed a committee to investigate the matter of extending Minnesota Ave., running east. Frank V. Everdell is City Clerk.

⊙The Town Board of Dell Grove, Minn., has let a contract for the building of a quarter of road in Section 35, to Gust Walin.

At a recent meeting of the Civic Association of Northfield, Minn., a committee was appointed to investigate the various kinds of paving and to formulate a definite proposition to put before the City Council at its January meeting.

Missouri.

The Board of Public Improvements, St. Louis, Mo., awarded the following contracts for sprinkling of streets in 1913: District No. 1. Frank Rupbrecht, contractor, $3,773; No. 2, Aqua Contracting Co., $5,997; No. 3, William H. Redemeyer, $7,800; No. 4, Peter Fabick, $5,490; No. 5, Aqua Contracting Co., $7,844; No. 6, Eyermann Construction Co., $9,599; No. 7, August F. Pollman, $7,983; No. 8, William H. Redemeyer, $9,300; No. 9, Aqua Contracting Co., $9,494; No. 10, Michael F. Pfeffle, $10,224; No. 11, Ernst Weber, $5,800; No. 12, William H. Redemeyer, $9,700; No. 13, William H. Redemeyer, $4,278; No. 14, John McMahon, $6,990; No. 15, Aqua Contracting Co., $8,333; No. 16, William H. Redemeyer, $7,800; No. 17, John McMahon, $6,873; No. 18, William H. Redemeyer, $6,400; No. 19, Luke Coal Co., $5,172; No. 20, Luke Coal Co., $7,483; No. 21, Luke Coal Co., $5,540; No. 22, Luke Coal Co., $4,442; No. 23, Luke Coal Co., $3,462; No. 24. John McMahon, $4,990; No. 25, Aqua Contracting Co., $9,888; No. 26, Luke Coal Co., $6,342; No. 27, James Davis. $5,335; No. 28, Luke Coal Co., $4,632; No. 29, James Davis, $4,775; No. 30, Aqua Contracting Co., $6,491; No. 31, Aqua Contracting Co., $9,999; No. 32, Frank A. Stiers, $5,989; No. 33, Aqua Contracting Co., $5,170; No. 34, Frank A. Stiers, $5,799; No. 35, Aqua Contracting Co., $8,143; No. 36, William H. Redemeyer, $7,800; No. 37, William H. Redemeyer, $6,300; No. 38, Fred C. Pollman, $6,583; No. 39, Wade Bros. Construction Co., $7,800; No. 40, Aqua Contracting Co., $12,494. Total cost $278,308.

The Board of Public Improvements, St. Louis, Mo., set January 31 as the day of public hearing for the following alley improvements and reconstructions: Improvements—From Eleventh to Von Phul, between John and Gano; from Tower Grove to Newstead, between Hunt and Vista; from Wisconsin to Illinois, between Utah and Withnell; from Clara to Blackstone, between Wells and Easton; between Wise Ave., Berthold, King's Highway and Hereford; from Alabama to Colorado, between Dover and King's Highway; from Lafayette to McRee, between Grand and Spring; from Cote Brilliante to North Market, between Belt and Burd; from Jefferson to Elliott, between Sullivan and Hebert; from Minerva to Ridge, between Burd and Montclair; between Osage, Keokuk, Oregon and Nebraska; from Blair to Twentieth, between DeSoto and Linton; from Von Phul to Blair, between Gano and Prairie; between Arsenal, Crittenden, Ohio and Iowa; from Sarah to Whittier, between Lindell and Maryland; between McKinley, Scott, Taylor and King's Highway; between Itaska, Neosho, Nebraska and Pennsylvania; between Miami, Potomac, Arkansas, Gratiot and Grand; between Meramec, Gasconade, Oregon and Nebraska; from Market to Alley, and between Theresa and Grand; between Farrar, Bremen, Vest and Parnell; from Rosendale to Skinker; between right of way of St. Louis, Kansas City and Colorado Railroad and Berlin; from Barton to Lami, and between Ninth and Tenth; between Keokuk, Chippewa, Oregon and Nebraska; from Louisiana to Arkansas, between Humphrey and Wyoming; from Academy to Union, between Easton and Paulian; from Newstead to Taylor, between Lee and Penrose; between Cottage, Kennerly, Marcus and western boundary of block; from Palm to Millinckrodt, between Twenty-third and Twenty-fifth; from Red Bud to Turner, between Farlin and Kossuth; from Whittier to Rolla, between Labadiex and Ashland; from Academy to Union, between Paulian and Theodosia; from Pestalozzi to Magnolia, between Nebraska and Pennsylvania; from Hamilton to Hodiamont, between Clemens and Cates; between Lee, Penrose, Grand and Obear; between Chippewa, Stansbury, Illinois and Broadway; from Page to Minerva, between Blackstone and Shawmut. Reconstructions—Between Finney, Cook, Grand and Spirng; from California to Nebraska, between Henrietta and Eads; from Twentieth to Twenty-first, between Mallinckrodt and Salisbury; from Rutger to Hickory, between Seventh and Eighth.

The citizens of Kansas City, Mo., on Jan. 7, voted against the issuance of bonds to the amount of $250,000 for improvements to Swope Park, and to the amount of $450,000 for general park improvements. Louis R. Ash is City Engineer.

Montana.

The officials of Miles City, Mont., contemplate constructing bitulithic pavement on Main St., between Sixth and Seventh Sts.

Nebraska.

Property owners on Minnesota Ave., from Second St. to Seventh, Hastings, Nebr., have circulated a petition for the paving of that street.

New Jersey.

⊙The Hunterdon County Board of Freeholders, Flemington, N. J., has awarded a contract to M. Irving Demarest of Sewaren, N. J., for the construction of the first section of the High Bridge-Califon macadam road, at $43,086. This section is a little more than three miles in length. The other bidders were: Allen Engineering Co., Netcong, N. J., $50,674, and J. C. Fowler & Co., Perth Amboy, N. J., $44,341.

New York.

✣Bids will be received until 11 a. m., Jan. 17, by Department of Public Works, Francis G. Ward, Commissioner, Buffalo, N. Y., for

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

street improvements in accordance with plans and specifications on file at the office of the Bureau of Engineering. A separate bid must be filed for each of the following contracts:: For paving Cumberland Ave., 28 ft. wide from the northwest curb line of Cazenovia St. to the southeast curb line of Salem St. with each kind of pavement for laying, of which specifications have been filed by the Commissioner of Public Works. For paving Cottage St., its present width, from the west curb line of College St. For repaving Cottage (Virginia) St., 36 ft. wide, from the west curb line of College St. to the west curb line of Mariner St., except the space occupied by the street railway tracks and 2 ft. outside the same, with each kind of pavement for laying, of which specifications have been filed by the Commissioner of Public Works. For repaving Triangle St., 32 ft. wide, from the southwest curb line of Abbott Rd. to the west curb line of South Park Ave., except the space occupied by the street railway tracks and 2 ft. outside the same, with each kind of pavement for laying of which specifications have been filed by the Commissioner of Public Works. For paving Cumberland Ave., 28 ft. wide, from the southeast curb line of Salem St. to the southeast curb line of Milford St. with each kind of pavement for laying, of which specifications have been filed by the Commissioner of Public Works.

⊙The Board of Contract & Supply of Syracuse, N. Y., has awarded the following contracts for paving work: The contract for the paving of West Newell St., from Midland Ave. to Onondaga Creek with asphalt, was awarded to the Warner-Quinlan Co., for $20,471. The bid was $2.03 per sq. yd. C. T Hookway was awarded the contract for paving East Matson St. from South Salina St. east with asphalt. The bid was $4,844. The contract for resurfacing West Onondaga St. was awarded to the Warner-Quinlan Co. for $3,381. The company's bid was $1.35 per sq. yd. The resurfacing of North West St. from West Genesee St. to Park Ave. went to the same firm for $3,173, the bid per sq. yd. being the same as on the West Onondaga St. resurfacing. The contract for resurfacing Onondaga Ave. from Onondaga St. to Stolp Ave. went to Warner-Quinlan for $7,726. The price per sq. yd. was $1.30. C. T. Hookway was awarded the contract for paving Milton Ave. with vitrified brick. The price was $1,580. The paving of Monroe St. from Grape to Orange with asphalt went to F. J. Baker for $3,500. The bid was $2.04 per sq. yd. Guy B. Dickison was awarded the contract for paving Madison St. from Irving Ave. to Almond St., with asphalt. His bid was $12,383, the price per square yard being $2.15 The Board rejected all bids for the paving of Beverly Rd. from Stolp Ave. to Crossett St. as the prices were considered excessive.

The City Council of Dunkirk, N. Y., plans to pave at least five more streets during this year.

An election was held in Holley, N. Y., on Jan. 14. to vote upon a proposition to pave the village square with brick at a cost of $9,500.

The City Council of Gloversville, N. Y., has under consideration the paving of North Perry St., from the present paving to the city line with brick, East Main St. with brick from the present pavement to the old car line and then macadam to the city line, and West Madison Ave., with brick.

Ohio.

✣Bids will be received until noon, Jan. 27, by City of Niles, O., Clare Caldwell, Director of Public Service, for paving North and South Main Sts. with vitrified shale paving block. North Main St. consists of 12,406 sq. yds. with necessary storm sewer, South Main St., consists of 7,510 sq. yds. with necessary storm sewer and stone curb. Certified checks for $1,000 and $800 respectively must be filed with bids.

✣Bids will be received until noon, Jan. 21, by W. S. Ruff, Director of Public Service, Canton, O., for the necessary labor and materials for the improvement of the following streets: West Eighth St. from High St. to the B. & O. R. R. Dueber Ave. from Navarre St. to W. & L. E. R. R. North Dewalt St. from Tuscarawas St. to North St. Cassilly St. from Tuscarawas St. to Summit St. Linden Ave. from Cassilly St. to Lawn Ave. East Lake St. from St. Elmo St. to Market St. East South St. from Market St. to P. Ft. & C. R. R. Aultman Ave. from Cleveland Ave. to Market St. Harrison Ave. from Tuscarawas St. to Maiden Lane, according to plans and specification on file in director's office, engineer's division.

⊙Robt. L. Timmons, Cadiz, O., has been awarded the contract by the Board of Jefferson County Commissioners, Steubenville, O., for the necessary labor and materials to construct the Bantam Ridge Free Turnpike road in Cross Creek Township, at $17,500. The road is 17,784 ft. long and will be of macadam. Bids were opened Jan. 3.

The Board of Cuyahoga County Commissioners, Cleveland, O., John F. Goldenbogen, Clerk, has rejected all bids received Jan. 4, for the improvement of Barton road, from Coe Ridge Road to westerly county line in Olmsted Township. The work will be readvertised.

Property owners on East Erie Ave., Lorain, O., recently held a meeting in the office of the City Engineer to discuss the paving of that thoroughfare from the L. A. Fauver property east to the Root Rd. It is proposed to let this contract early in the spring.

⊙The Board of Park Commissioners, Youngstown, O., has awarded the contract for laying artificial stonewalks in Wick Park to Turner & Olson at $1,500, and a contract for asphalt drives in the park to the Cleveland Trinidad Paving Co., Cleveland, O.

The Road Commissioners of Coshocton County, O., Coshocton, have made application to State Highway Commissioner James R. Marker for state aid to improve the roads in the district comprised of Keene, Franklin, Jackson and Tuscarawas Townships. It is proposed to improve about 13 miles of roads during the year.

State Highway Commissioner James R. Marker, Columbus, O., has completed two plans for road improvements in the state. One is a complete plan of road improvements; roads are to be completed leading to various market centers. These roads would amount to about 9,000 miles and would establish highway travel for 90 per cent of the market travel in the state. The other plan is for roads built with government aid or with special state aid. The General Assembly will be asked to levy a tax of one-half of one-mill for road purposes. In order that the start may be made at once, an appropriation of $1,760,000 will be requested for the present year. After that the half-mill levy will supply about $3,000,000 a year.

The W. J. Sherman Co., Toledo, O., has completed the plans for paving Fourth, Howard and Fifth Sts., and the curbing of Fulton Ave., from Seventh to Beech Tree St., for the City of Grand Haven, Mich.

⊙The Department of Public Service of Columbus, O., has awarded the following pavement contracts; tar filler to be used in each instance: Cross St., from Kling to Miami, William Lee, $17,063; Rhodes Ave., from Wooster to Gale St., McAlonan Bros., $36,791; West Crosier St., from Main to Wilhelm, William Lee, $18,009, and Yale extension from Crosier to Long St., Josiah Wigley, $5,837.

The Village Council of Rawson, O., has sold bonds for the paving of South Main St., to the amount of $9,672, to Spitzer-Rorick Co., of Toledo, O.

The City Council of Sidney, O., has sold paving bonds to the amount of $45,000 to the Citizens' National Bank of that city.

Oregon.

Petitions have been filed with the City Auditor, Portland, Ore., for the hard surfacing of about 100 blocks in Rossmere, Rose City Park and Elmhurst and for about 50 miles of streets in other parts of the city. It is expected the total for 1913 will run up above the $7,000,000 mark set in 1911. Tom Hurlburt is City Engineer.

A number of prominent citizens of Dallas, Ore., have urged the City Council to take action at once looking to paving 10 blocks of streets. Hard-surfaced streets are proposed.

The residents of Road District No. 6, which includes Newport, Ore., have voted a special road tax of 2 mills. The money will be used to improve the road up Big Creek and to build a new road up the coast to Agate Beach, via Oceanhill.

Pennsylvania.

✣Bids will be received until 8 p. m., Feb 6, by Council, Turtle Creek, Pa., for the grading, paving and curbing of various streets in the Borough of Turtle Creek. The principal items are as follows: 108,000 cu. yds. of embankment; 30,000 cu. yds. of dredging; 32,000 sq. yds. of vitrified block paving; 17,000 sq. yds. of brick repaving; 13,000 sq. yds. of slag paving; 40,000 lin. ft. of concrete curb and gutter; 21,800 lin. ft. of curb, re-set. Plans, specifications and bidding blank can be obtained on deposit of $10 for return of same at the office of Harrop, Hopkins & Taylor, Engineers, 900 Lewis Block, Pittsburgh, Pa

Following low bids have been received Nov. 27, by the Department of Public Works of Philadelphia, Pa., for grading and paving work; William H. Connell, Chief of Bureau of Highways and Street Cleaning: Schedule "A" grading—Conestoga-Media to Lansdowne, J. J. McHugh, 60th and Angora, 59 cts. per cu yd.; Fox—Allegheny to P. G. & N. R. R., J J. McHugh, 60th and Angora, $1.43 per cu. yd.; Mercer—Buckius to Le fevre, Franz Paving Co., 2d and Fisher Ave., 69 cts. per cu. yd.; Moore—24th to 28th, Thomas Clasby & Son, 1323 Colwyn St., 39 cts. per cu. yd.; Rosehill—Allegheny to Ontario, Thomas Clasby & Son, 1323 Colwyn St., 97 cts. per cu yd.; Tibben—Lemonte to Fountain, J. J. McHugh, 60th and Angora Ave., 63 cts. per cu yd. Schedule "B" Asphalt Paving—10th—Butler to Pike, Eastern Paving Co., Baxter bldg., asphalt, $1.32 per sq. yd., granite block paving, $3.40 per sq. yd., concrete foundation, $5.40 per cu. yd.; 21st—Snyder Ave. to Passyunk Ave., Eastern Paving Co., asphalt paving, $1.32 per sq. yd., concrete foundation, $5.40 per cu. yd.; Buist Ave.—64th to 65th, Union Paving Co., 112 N. Broad, asphalt paving, $1.65 per sq yd., concrete foundation, $4.50 per cu. yd., 6-in. T. C. laterals, 65 cts. per lin. ft.; Cambridge—Tucker to Duncan, Eastern Paving Co., Baxter Bldg., asphalt paving, $1.65 per sq. yd., concrete foundation, $4.50 per sq. yd.; Chester Ave.—59th to 60th, Eastern Paving Co., Baxter Bldg., asphalt paving, $1.29 per sq. yd., concrete foundation, $5.40 per cu. yd.; Courtland St.—Broad to Old York Road, Eastern Paving Co., asphalt paving, $1.37 per sq. yd., concrete foundation, $5.40 per cu. yd.; Franklin—Lycoming to Hunting Park Ave., Eastern Paving Co., Baxter Bldg., asphalt paving, $1.32 per sq. yd., concrete foundation, $5.40 per cu. yd.; League St.—from 20th St eastward, Eastern Paving Co., asphalt paving, $1.95 per sq. yd., concrete foundation, $5.40 per cu. yd.; Media St.—62d to 63d, Eastern Paving Co., Baxter Bldg., asphalt paving, $1.32 per sq. yd., concrete foundation, $5.40 per cu. yd.; Pike St.—9th to 10th, Eastern Paving Co., asphalt paving, $1.32 per sq. yd., concrete, $5.32 per cu. yd.; Rector St.—Manayunk to Ridge Ave., Barber Asphalt Paving Co., Land Title Bldg., asphalt paving, $2.00 per sq. yd., concrete foundation, $5.00 per cu. yd.; Sansom St.—46th to 47th Sts., Eastern Paving Co., Baxter Bldg., asphalt paving, $1.63 per sq. yd., concrete foundation, $5.00 per cu. yd. Schedule "C" Vitrified Block Paving—Front St.—Wellens St. to Fishers Ave., Cunningham Paving and Construction Co., 1345 Arch St., vitrified block paving, $1.58 per sq. yd., concrete foundation, $3.90 per cu. yd.; Front St.—Wyoming Ave. to Louden St., Franz Paving Co., N. E. Cor. 2d and Fishers Ave., vitrified brick paving, $1.63 per sq. yd.; concrete foundation, $3.95 per cu. yd.; Lauriston St.—Righter St. eastward, Franz Paving Co., N. E. Cor. 2d and Fishers Ave., vitrified brick, paving, $1.71 per sq. yd., concrete foundation, $4.60 per cu. yd.; Warnock St.—Rockland to Ruscomb, Franz Paving Co., N. E. Cor. 2d and Fishers Ave., vitrified brick paving, $1.59 per sq. yd., concrete foundation, $3.80 per cu. yd.; Sprague St.—Mt. Pleasant Ave. to Mt. Airy Ave., Mt. Pleasant Ave., Sprague St. N. of Mt. Pleasant Ave. to Sprague St. S. of Mt. Pleasant Ave., Cunningham Paving & Construction Co., 1345 Arch St., vitrified brick paving, $1.51 per sq. yd., concrete foundation, $3.85 per cu. yd. Schedule "D" Granite Block Paving—Tibben St.—Fountain to Lemonte, Mack Paving & Construction Co., Fidelity Bldg., granite block paving, $3.35 per sq. yd., concrete foundation, $3.90 per cu. yd. Scehdule "E" Asphalt Repaving—Watts St.—Cambria to a point 67 ft. 10 ins. southward, Union Paving Co., 112 N. Broad, asphalt paving, $2.20 per sq yd., concrete foundation, $4.50 per cu. yd. Schedule "F" Vitrified Brick Repaving—Church Lane—Germantown Ave. to summit S. W. of Chew St., Mack Paving & Construction Co., Fidelity Bldg., vitrified brick replaced repaving, $1.63 per sq. yd., concrete foundation, $3.90 per cu. yd.; Haines St.—Morton to McMahon St., Cunningham Paving Co., 1345 Arch St., vitrified brick repaving, $1.65 per sq. yd., concrete foundation, $3.65 per cu. yd.; Montgomery Ave.—Mascher to Howard St., E. M. Mullen & Co., 5644 Walnut St., vitrified brick repaving, $1.68 per sq. yd., concrete foundation, $4.00 per cu. yd. Schedule "G" Granite Block Repaving—Penn St.—Adam to Ruan, Mack Paving & Construction Co., Fidelity Bldg., granite block repaving, $3.17 per sq. yd., concrete, $3.50 per cu. yd. Schedule "H" Macadam Surfacing—Kingsessing Ave.—43d to 45th St., Eastern Paving Co., Baxter Bldg., surfacing, $1.20 per sq. yd., concrete, $2.75 per cu. yd. Schedule "I" Macadam Resurfacing—Church Lane, from summit S. W. of Stenton Ave., Cunningham Paving & Construction Co., 1345 Arch St., Resurfacing, $1.12 per sq. yd.. concrete, $6.00 per cu. yd.; Cottman Ave.—P. N. & N. Y. R. R. to Rising Sun Ave., D. S. Bader, 308 Bulletin Bldg., resurfacing, $1.27 per sq. yd., concrete, $7.00 per cu. yd.; Northeast Boulevard, from Broad St. to Wyoming Ave., Union Paving Co., 112 N. Broad St., resurfacing, water bound macadam, 11 cts. per sq. yd. Schedule "J" Asphalt Resurfacing—An alley N. of Pegg St., from New Market to Hancock St., Eastern Paving Co., Baxter Bldg., resurfacing asphalt, 61 cts. per sq. yd. Schedule "K" Furnishing 10-ton Steam Roller—Furnishing 10-ton steam roller, Kelly-Springfield Road Roller Co., 2132 Land Title Bldg., $1,245, delivery 10 days. Schedule "L" Furnishing Automobile and Runabouts—Furnishing two, two-seated passenger runabouts. Ford Motor Co., 250-252 N. Broad St., each $598.70, delivery 30 days; furnishing one, six or seven passenger automobile, Locomobile Co. of America, 2314 to 22 Market St., $4,598, delivery 40 days.

Tennessee.

✣Bids will be received until 7 p. m., Jan. 16, by George W. Cooke, Commissioner, and W. R. Pouder, Recorder, Johnson City, Tenn., for approximately the excavation of 4,000 cu. yds. of material on Locust St. and the construction of approxmately 14,540 ft. of curb and gutter, including grading, in Districts 17, 18, 19 and 20, according to plans and specifications in the office of the City Engineer. Each bid must be accompanied by a certified check equal to 10 per cent of the amount bid as a guarantee of good faith of the bidder. Bids are asked for payable either in cash or 5½ per cent, bonds at the option of the city.

Texas.

✣Bids will be received until 11 a. m., Feb. 4, by R. H. Rolfe, Constructing Quartermaster, Fort Sam Houston, Texas, for constructing extension to concrete target butt, concrete pavement, trolley truck and movable target frame at U. S. military reservation, Leon Springs, Tex.

⊙The following contracts have been awarded in Texas for dolarway pavement: Waco-On Jan. 2, for 3,000 sq. yds.; at Marshall—On Jan. 7, for 12,000 sq. yds.

Road District No. 2 of Calhoun County. Tex., recently voted bonds to the amount of $135,000 for good roads construction. The work will include 30 miles of gravel roads at an estimated cost of $3,000 per mile. The date for letting contracts has not been decided. F. M. Dudgean, Port Lavaca, Tex., is County Judge.

The Commissioners of Brooks County. Falfurrias, Tex., have announced that the recent election held in that county for the purpose of voting on the issuance of bonds to the amount of $45,000 for road improvements has carried.

The City Council of Houston, Tev., has granted the petition of citizens to have that portion of the Harrisburg Rd. that lies between Milby St. and the east city limits paved with asphalt. The report specifies the paving should consist of a 2-in. coat of Texaco sheet asphalt, laid on 5 ins. of concrete. Bids will be asked at once.

The citizens of Calhoun County, Tex., on Dec. 31, voted the issuance of bonds to the amount of $135,000 for the construction of good roads. It is proposed to construct about 36 miles of main road in vicinity of Fort Lavaca, Tex., the county seat. E. F. Ehlinger is County Clerk.

Virginia.

✣Bids will be received until 11 a. m., Jan. 20, by Lieut. Col. C. L. McCawley, Assistant Quartermaster, Washington, D. C., for furnishing the Marine Corps one motor truck at the marine barracks, navy yard, Norfolk, Va.

⊙Louis Lawson, Norfolk, Va., has been awarded the contract by the Board of Elizabeth City County Supervisors, Hampton, Va., for the construction of a road from Hampton to Phoebus at $17,263. The road is located in Chesapeake District. Bids were opened Dec. 27. H. H. Holt is County Clerk.

Washington.

✣Bids will be received until 11 a. m., Feb. 8, by H. R. Stanford, Chief of Bureau of Yards & Docks, U. S. Navy Department, Washington, D. C., for grading about 26,000 cu. yds. at the navy yard, Puget Sound, Wash. The amount available for the work is $10,000.

✣Bids will be received until 11 a. m., Jan. 30, by Constructing Quartermaster, Vancouver Barracks, Wash., for the construction of about 1,350 ft. of macadam road along the north side of the military reservation.

✣Bids will be received until 11 a. m., Feb. 4, by Constructing Quartermaster, Vancouver Barracks, Wash., for the construction of walks, curbs, gutters, etc., at that post.

⊙The city of Seattle, Wash., has awarded the contract for grading, etc., of the east one-half of 36th Ave. W., et al., to the Union Contracting Co., 34 Downs Blk., Seattle, at $6,342.

⊙Reinseth Bros. have been awarded the contract by the County Commissioners, Everett, Wash., for the construction of the one mile, more or less, of the Birmingham and Florence Rd., at $2,592.

The City Commissioners of Walla Walla, Wash., have declared their intention to pave with some hard surface pavement, Clinton St., from Isaacs Ave., to Whitman St., and Whitman St., from Clinton St. to Division, including grading, curbing, drainage and paving. The length of the improvement is approximately 4,400 ft. long and width of 34 ft., containing about 16,500 sq. yds. of paving. It is also proposed to pave Division St., from Alder St., to Whitman St., a distance of 1,320 ft., and about 25 ft. wide, containing about 3,650 sq. yds. Plans and specifications will be ready about Feb. 1. W. R. Rehorn is City Engineer.

It is reported that the contract recently let at $112,965 by the Citv Council of Wenatchee, Wash., for paving work, has been rescinded owing to a clerical error in the ordinance. A new resolution will be passed and advertisements made for bids. It is probable the work will not be re-awarded until the latter part of February.

Mayor J. P. Leavitt of Puyallup, Wash., is urging the paving of Meridian St., to the North Puyallup county bridge. A number of business men are considering the possibility of improving Birch, Main and Ash Sts.

Wisconsin.

⊙The County Highway Commissioners, Black River Falls, Wis., have awarded a number of contracts for road improvements to A. Hicks of Manchester, Carl Potter, H. Vilwock, William Lundner, and J. R. McDonald.

The City Council of Racine, Wis., has decided upon the streets that are to be improved this year out of about a $46,000 appropriation.

Canada.

✣Bids will be received until 4 p. m., Jan. 27, by B. Michaud, Deputy Minister of Roads, Quebec, for: Grading of about 155 miles of road between Saint Augustin, Co. Portneuf and Charlemagne, Co. L'Assomption; construction of culverts and small bridges on the same road; paving of about 30 miles of road in macadam or concrete or bituminous macadam pavement between Charlemagne, Co. L'Assomption, and Berthier, Co. Berthier. Each tender must be accompanied by an accepted cheque on a chartered bank payable to the order of the Honorable the Minister of Agriculture and Roads, equal to a certain amount of the tender, which will be forfeited if the persons tendering decline to enter into a contract when called upon to do so.

The ratepayers of Fort William, Ont., on Jan. 6, voted by-laws to the amount of $10,000 for good roads. Geo. Graham is Mayor.

The citizens of Hamilton, Ont., on Jan. 6, voted a by-law to the amount of $130,000 for the purchase of Mountain Face Park. John Allan is Mayor-elect.

The ratepayers of the Village of Richmond Hill, Ont., on Jan. 6, voted a by-law to the amount of $7,000 for good roads.

A large amount of street pavement is proposed for the City of Exeter, Ont., this year. S. M. Sanders, Exeter, is interested.

BRIDGES

Arizona.

Grade stakes are being placed by engineers of the State of Arizona for the construction of the proposed bridge at Fairbank, Cochise County, over the San Pedro River.

A new bridge will probably be constructed over the Colorado River at Yuma, Ariz., by the States of California and Arizona. The cost of the structure is estimated at $75,000, each state and the United States government paying one-third of the amount. A. D. Ogle and A. F. Smith, Government Engineers, located at Albuquerque, N. Mex., and Denver, Colo., respectively, prepared the estimate.

Arkansas.

An effort will be made to have the Arkansas Legislature pass a bill creating an Improvement District of Garland and Homan Townships and to levy a tax to raise a fund of $250,000 for the construction of a bridge over the Red River between Index and Fulton. Judge J. M. Carter, Texarkana, Ark., is interested in the proposition.

California.

✣Bids will be received until 2 p. m., Jan. 20, by Board of Los Angeles County Supervisors, Los Angeles, Calif., for furnishing all labor and material for the construction of a concrete culvert on the Ventura Road and a concrete culvert on Workman Ave. in the Calabasas Road District. H. J. Lelande is County Clerk.

Colorado.

⊙Frank Ford of Littleton, Colo., has been awarded the contract by the County Commissioners, Littleton, Robert S. Brown, Clerk, for the construction of I-beam reinforced concrete bridge over Little Dry Creek, on State Primary Road No. 3, at a point one-half mile north of Petersburg. The contract price is $1,965. Bids were opened Jan. 2.

The Board of Public Works, Denver, Colo., is contemplating the construction of five new bridges over Cherry Creek in the down town district. The cost of this work is estimated at about $60,000. O. F. Thum is City Clerk.

Florida.

The Commissioners of Pinellas County, Clearwater, Fla., are contemplating the construction of a bridge over Whitcomb Bayou at Tarpon Springs. The cost of the structure is estimated at about $6,000.

District of Columbia.

The Commissioners of the Reclamation and Improvement of the Anacostia Flats have filed with the Secretary of the Treasury for transmission to Congress, a supplemental estimate of $60,000 for altering the Pennsylvania Ave. bridge over the Anacostia River at Washington, D. C. The plans call for the removal of one of the existing dock spans and the two piers on which it stands so as to provide for an opening at least 50 ft. in width. The preferred location of the draw is the fourth span from the west abutment or the second dock span. Effort will be made to secure the appropriation in time to permit the alterations to be completed on or before March 1, 1914.

The following bids were received Jan. 4, by the Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., for the construction of a combined railway and highway bridge at the navy yard, Portsmouth, N. H.: (1) standing for substructure and superstructure complete, (2) for substructure complete, (3) superstructure complete, and (4) amount per cubic yard allowed by government for use of old granite blocks: C. M. Leach, Boston, Mass., (1) $123,983, (2) $84,000 and (3) $41,000, (4) $8; Penn. Bridge Co., Washington, D. C., (3) $34,000; Snare & Triest Co., 143 Liberty St., New York City, (1) $109,700.

Illinois.

At a recent meeting of the City Council, Joliet, Ill., City Engineer C. D. O'Callaghan reported that the bridge over Spring Creek at Washington St. was in dangerous condition and recommended that steps be taken for its improvement.

It is reported at Moline, Ill., that the city contemplates the construction of a new $10,000 bridge at Seventh St., connecting the Deere and Stephens Parks on the bluff. Lyle Payton is City Engineer.

Indiana.

⊙The Board of Noble County Commissioners, Albion, Ind., has awarded the contract for the construction of the Cavin St. bridge at Ligonier City to Perry & Knouff, at $13,915. The work will include a 90-ft. concrete arch 40 ft. wide. The contractors will remove the old structure and purchase it of the county for $225. J. C. Kimmell is County Auditor. Bids were opened on Jan. 8.

⊙Bridge Committee of the Boards of Supervisors of Brown and Schuyler Counties, Ind., has awarded the contract for the construction of the Star bridge over Crooked Creek, replacing the old structure, to E. E. Buck, at $4,890. The new bridge will be of steel, 147 ft. long, with 16-ft. roadway. Other bids submitted were as follows: Miller & Borchending, $5,195; Blodgett Construction Co., $6,995; Stites Steel Bridge Co., $5,100; East St. Louis Bridge Co., $5,200; Illinois Steel Bridge Co., $5,095; Joliet Bridge Co., $5,552.

The Commissioners of Parke County, Rockville, Ind., have decided upon the location for the proposed new bridge at Strong's Ford, Buion, and also a new structure at Armiesburg.

A meeting was held a short time ago by officers of the Monon R. R., the T. H., I. & E. Traction Co., and the City of Crawfordsville, Ind., to take up the matter of repairing the bridges over the Monon Railroad at College St. and Wabash Ave. H. C. McCluer is City Engineer.

The Board of Works, Richmond, Ind., has voted to confer with the County Commissioners over the proposed plan for removing the Main St. bridge and replacing it with a new concrete arch bridge. It is proposed to erect the old bridge over the Whitewater River at some point south of the present location. Fred R. Charles is City Engineer.

The Commissioners of Knox County, Vincennes, Ind., has instructed County Auditor Scott to notify the Board of Commissioners of Gibson County of their willingness to aid in the construction of a bridge over White River near Hazleton.

A meeting was held Jan. 9, by Marion County Council, Indianapolis, Ind., to make reappropriations for 1913. The West Side Civic League presented, according to reports, the matter of appropriating the amount necessary for the construction of a bridge over White River at New York St.

Advices from Richmond, Ind., state that Wayne County is now contemplating the removal of the present steel bridge at Main St., to a point on the Whitewater River in the south part of the town, at a cost of $11,500. A concrete arch bridge 600 ft. long is proposed at Main St.

Iowa.

⊙The contract for the construction of a new flooring system for the new Eighth Ave. bridge has been let by the City Council of Cedar Rapids, Ia., to Charles Mentzer at $9,169.

Kansas.

⊙The Board of Douglas County, Lawrence, Kan., has awarded the contract for the construction of three bridges as follows: a steel bridge with plank roadway over Washington Creek east of Lone Star to the Western Bridge Co., Harrisonville, Mo., at $2,975; reinforced concrete bridge over Washington Creek southwest of Lone Star and a steel bridge over Washington Creek southwest of Lone Star and a steel bridge with concrete floor to the Missouri Valley Bridge Co., Leavenworth, Kan., at $2,625 and $1,725, respectively.

⊙The Board of County Commissioners, Wichita, Kan., has awarded the contracts for the construction of two bridges in Sedgwick County as follows: Bridge over the Little River in Valley Center Township to the Missouri Valley Bridge & Iron Works, Leavenworth, Kan., at $5,149; bridge over Little River in Park Township to the Wichita Construction Co., Wichita, Kan., at $4,625.

⊙Commissioners of Sedgwick County, Wichita, Kan., have awarded the contracts for the construction of two bridges over the Little River. The Missouri Valley Bridge & Iron Co. gets the job of building a bridge to cost $5,149 in Valley Center Township. The Wichita Construction Co. got the other contract. It calls for a new bridge over the Little River in Park Township, the cost to be $4,625.

Property owners residing on First Ave. West, Hutchinson, Kan., are preparing to petition the City Commission for the construction of a concrete bridge over Cow Creek on that avenue. G. L. McLane is City Engineer.

Kentucky.

The Committee on Bridges of the Fiscal Court, Mercer County, Harrodsburg, Ky., has been authorized to receive bids for the construction of a steel bridge over the Salt River on Providence Turnpike.

Louisiana.

⊙The contract for the construction of two steel bridges, one over Roundaway Bayou 8 miles south of Tallulah and the other over Bull Calf Bayou 7 miles north of Waverly, La., has been awarded by the Police Jury, Madison Parish, Tallulah, La., to Hass-Skinner Engineering Co., Dallas, Texas, at $5,500. Bids were opened Jan. 2.

The Commission Council, New Orleans, La., received the following bids for the construction of a bridge over the Orleans Canal at Adams Ave.: G. B. Kelly, $3,874; Midland Bridge Company, $4,577.50; General Construction Company, $4,872; Fromhurzt & Drennan, $4,409; Craven & Co., $4,600; Hyland & Co., $4,900.

Massachusetts.

The Directors of the Port of Boston, 40 Central St., Boston, Mass., have approved detailed plans submitted by F. W. Hodgson, Chief Engineer, for the construction of the viaduct from the street level to the second story of the Commonwealth Pier Building. The viaduct will leave the level of Summer St. at a point about 50 ft. south of C St., and will make an easy rise to the second story. Its cost will be $200,000.

Maine.

L. M. Sanborn, of South Portland, Me., Representative-elect, has drafted a bill to present to the Legislature asking for the authority to have a new bridge built between Portland and South Portland. Plans for the structure are now in preparation.

Minnesota.

The Commercial Club of Cuyuna, Minn., has furnished funds for the preliminary survey for the proposed bridge over Rabbit Lake in Crow Wing County.

Mississippi.

It has been announced by W. G. Seaver, promoter of the Mississippi Northwestern R. R. from Biloxi, Miss., to Omaha, Neb., that he has taken up with the War Department the matter of building a bridge across Back Bay, and that the department has no objection to the construction of such a bridge. Captain Earles, of Vicksburg, Engineer, is expected to prepare estimates on the cost.

Missouri.

⊙McKenzie & Williams, Webb City, Mo., have been awarded the contract for the construction of a concrete bridge over the Walnut River in Augusta Township, Butler County, Kan. The contract price for the work was $6,889. Bids were opened at Eldorado, Kan., Jan. 7.

At the election held Jan. 7 at Kansas City, Mo., the proposition to issue bonds amounting to $750,000 for the construction of bridges was defeated.

Nebraska.

✣Bids will be received until noon, Jan. 28, by Allen Sharp, County Clerk, Stanton, Neb., for the construction of bridges in Stanton County, during the year commencing March 29, 1913. Separate bids will be received for repairing bridges during the year, also for furnishing lumber, timber, piling, etc.

✣Bids will be received until noon, Feb. 10, by E. F. Vrzak, County Clerk, Schuyler, Nebr., for a yearly contract of building steel, concrete and wooden bridges. Bids will be received as follows: For superstructure complete as per plans and specifications now on file in the office of the County Clerk. For lumber in place for caps, sways, backing and wings. For piling in place for bridge substructure and wings. For pile straps in place for any work. For steel caps as per plan. For tubular piers as per plan. For steel pilings. For concrete bridges complete as per plans. For extra concrete per cubic foot. For putting lumber and piling in place for repairing old bridges. Said bids must be accompanied by a certified check on some bank in Schuyler, Nebraska, for the sum of $500.00 and payable to the County Clerk of Colfax

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

County, Nebraska. The successful bidder will be required to enter into a good and sufficient bond for the sum of $2,000.00 for the faithful performance of his contract. Official advertisement will be found elsehere in this issue.

⊙The Sanitary District Board, according to information received from Lincoln, Neb., has awarded the contract for the construction of a bridge over the new channel of Salt Creek north of Havelock to John Gilligan at his bid of $2,000.

New Hampshire.

A petition has been circulated among the tax payers of Manchester, N. H., asking that the city government take some action in regard to the construction of a new bridge over the Merrimack River. Samuel J. Lord is City Engineer.

New Jersey.

⊙The Hunterdon County Board of Freeholders, Flemington, N. J., has awarded the contract for the construction of a new bridge over Alexauken Creek, near Mt. Airy, to the Dover Boiler Works, at $3,095. Other bids received were: William Y. Holt, Flemington, $4,291; F. W. Schiviers Co., New York City, $3,850. The new structure will have spans 37 and 46 ft. in length, with a 20-ft. concrete roadway.

⊙The contract for the construction of a concrete and steel bridge over the south branch of the Rahway River on the Melno Park-Iselin Road, Middlesex County, has been awarded by the Board of Chosen Freeholders, New Brunswick, N. J., to Carman & Smith, Metuchen, N. J., at $1,203. Bids were opened Jan. 2.

⊙The contract for the construction of a concrete and steel bridge over Herds Brook on St. George Ave., Woodbridge Township, Middlesex County, has been awarded by the Board of Chosen Freeholders, New Brunswick, N. J., to J. C. Fowler, Sewarden, N. J., at $1,048. Bids were opened Jan. 2.

New York.

⊙The towns of Lysander and Schroeppel, N. Y., have awarded the contract for the construction of their portion of the 6-arch concrete bridge at Phoenix, N. Y., to J. F. Connors, Fulton, N. Y., at his bid of $39,000.

The Concrete Steel Engineering Co., New York City, is designing a new bridge to be constructed over the Albany Basin from the foot of State St. to the State St. pier, Albany, N. Y. The new structure will be of reinforced concrete and will have a width of 40 ft., one sidewalk on each side 10 ft. wide and a 20-ft. driveway.

At the town meeting of taxpayers, Ogdensburg, N. Y., in February, the proposition to construct bridges, one over the Black Lake near its outlet into the Oswegatchie River and the other over Oswegatchie River between Lafayette and Spring St., will be taken up for consideration. George A. Tate is City Engineer.

Ohio.

✣Bids will be received until noon, Jan. 20, by J. R. Cowell, Director of Public Service, Toledo, O., for furnishing the necessary labor and material for the construction of the bridge over the Maumee River from Ash St. to Consaul St., complete, except the river piers and draw protection pier. Plans and specifications may be seen at the office of the Chief Engineer, Room 229, the Valentine Building, Toledo, O. F. G. Stockton is Secretary.

A meeting was recently held by the Committees of the North End and North Central Citizens' Associations, Akron, O., to consider the viaduct proposition. J. H. Gehres is City Engineer.

The Butler County Board of Commissioners, Hamilton, O., has been petitioned for the construction of a bridge in Milford Township over Seven Mile Creek at Somersville.

The New Industrial Bridge Co., Akron, O., has been organized for the purpose of constructing the proposed bridge connecting North Hill with the down town district. The cost is estimated at $1,000,000.

Oregon.

The Klamath County Court, Klamath Falls, Ore., has ordered the Wilson Bridge over Lost River, torn down and replaced with a 65-ft. steel span. The approaches on each side will be filled with earth.

Pennsylvania.

⊙The Keystone Structural Co., Harrison Bldg., Philadelphia, Pa., has been awarded the contract for the construction of the superstructure of a bridge at Table Rock on the Gettysburg branch of the Philadelphia & Reading Ry. This structure is to be erected in connection with the passing tracks to be installed during 1913.

The injunction applied for by the Baltimore & Ohio Railroad, restraining the borough of Butler, Pa., from erecting a viaduct over the tracks at Center Ave., has been dissolved by Judge James M. Galbreath. A bond issue of $100,000 for the improvement was voted by the people in 1911. H. O. Carson is City Engineer.

It is probable that steps will be taken shortly toward the construction of a bridge over Chester Creek on the public road leading to Westtown between Milltown and Dutt's Mill. Wilmer B. Cox, Willistown, Pa.; George K. Oberholtzer, Phoenixville, and Harry Hause, Marsh, Pa., are the viewers.

The Commissioners of Berks County, Reading, Pa., have received of Charles S. Sanders, County Engineer, plans for the erection of a new concrete bridge over Mill Creek in Albany Township.

The Borough Council of Westview, Pa., has passed an ordinance calling for bond issue of $70,000 to provide funds for the construction of a bridge, a sewer and street improvements. Howard Donaldson is Clerk of the Council.

South Carolina.

The Charleston-Isle of Palms Traction Co., W. W. Fuller, Charleston, S. C., Chief Engineer and General Superintendent, proposes, in connection with its new electric railway, the construction of a reinforced concrete bridge over Cooper River, replacing the ferry line. The structure will be approximately 1 mile long, supporting a single-track railway, a driveway and a foot path. Bids for the work will probably be asked early in June.

Texas.

Plans have been completed by City Engineer F. L. Dormant, Houston, Texas, for the new reinforced concrete bridge to be erected connecting Capitol Ave., Rusk Ave. and Moore St. Bids for the structure will be asked shortly.

Utah.

⊙J. J. Burke & Co., according to advices from Ogden, Utah, has been awarded the contract by the Ogden-Huntsville Electric Ry., for the construction of five steel bridges.

Vermont.

Engineers of the New York, New Haven & Hartford Railroad are making surveys for the construction of a new bridge at Broadway and Washington St., and a report will be made to the town of Brattleboro at the hearing Feb. 19.

Virginia.

✣Bids will be received until noon, Jan. 28, at Gate City, Va., for the construction of a steel bridge over the Clinch River in Scott County, ½ mile from Hill Station on the C., C. & O. Ry. The superstructure will include two 150-ft. spans, one 80-ft. span and one 50-ft. span. The substructure will be of cement rubble. Stone and sand can be secured within one mile of the site. A certified check payable to P. St. J. Wilson, State Highway Commissioner, Richmond, Va., must be filed with each bid. Plans and specifications may be seen at the office of the Clerk of the Circuit Court, Gate City, Va., or at the office of the State Highway Commissioner. Blue prints of plans can be secured of Childrey-Sunday Co., Richmond, Va., at $0.80.

✣Bids will be received until noon, Jan. 27, at Floyd C. H., Va., for the construction of a steel bridge over Burks Fork in Floyd County, 20 miles from Betty Baker on the Norfolk & Western Ry. The superstructure will include one 87-ft. 6-in. span and 8 approach spans The substructure will be of concrete, stone and sand, for which can be secured about ½ mile from the site. Bids will also be received at the same time and place for a steel bridge 87 ft. 6 ins. long over South Fork Roanoke River in Floyd County 6½ miles from Shawsville on the Norfolk & Western Ry. Stone and sand for the concrete substructure can be secured within ½ mile of the site. A certified check for $250 must be filed with each bid. Plans, etc., can be secured of the Clerk of the Circuit Court, Floyd C. H., Va., or of P. St. J Wilson, State Highway Commissioner, Richmond, Va.

The Henrico County Board of Supervisors, Richmond, Va., and officials of the Atlantic Coast Line Company, are negotiating as to the advisability of constructing an overhead bridge at the Grossmans Crossing.

Washington.

⊙The Portland Bridge & Iron Co., on Jan. 2, was awarded the contract by the Walla Walla County Commissioners, Walla Walla, Wash., for the construction of a 100-ft. steel span bridge over the Yellowhawk south of that city. The contract price was $2,546. L. Lanning, Walla Walla, Wash., was awarded the contract for the concrete work at $3,180

The City Commissioners of Tacoma, Wash., have authorized the expenditure of $40,000 for the construction of a culvert over Delin St. gulch at Tacoma Ave. W. C. Raleigh is City Engineer.

Canada.

✣Bids will be received until 3 p. m., Jan. 30, by William McQueen, City Clerk, Vancouver, B. C., for the construction of the Georgia-Harris viaduct. Plans and specifications may be obtained of C. A. P. Turner, Engineer, 424 Vancouver Block or at the office of the city engineer. Official advertisement will be found elsewhere in this issue.

DRAINAGE AND IRRIGATION

Colorado.

The H. L. Doherty Co., 60 Wall St., New York City, has agreed to underwrite a $3,000,000 bond issue of the East Denver Municipal Irrigation District and has agreed to construct the irrigation system. The district comprises 60,000, acres and water for it will be taken from the Antero Dam, on the south fork of the South Platte River, 80 miles from Denver. The water will be carried by the old English High Line ditch to the east boundary of the city of Denver. The construction work will be in charge of F. L. Lucas of New York City.

Illinois.

✣Plans for the proposed pumping plant for Coal Creek Drainage and Levee District, for which bids were to have been opened Jan. 7 at Beardstown, Ill., have been changed, and the work will be readvertised for a plant using electric instead of steam power. Jesse Lowes, Beardstown, is chairman of the commissioners.

✣Bids will be received until 2 p. m., Jan. 18, by Commissioners of Union Drainage District No. 1, Wauconda, Ill., for the furnishing of 2,800 feet of 22-in. vit. sewer tile or 22-in. glazed grain tile f. o. b. Lake Zurich, Ill. Specifications may be obtained of E. W. Brooks, Wauconda, Ill.

⊙Kelso & Wallace, Lewistown, Ill., have been awarded the contract at about $27,000 for improvements to Otter Creek Drainage District, bids for which were opened Jan. 6 at office of County Clerk, Lewistown. The work includes the following: 187,512 cu. yds. levee work, 3 to 1 slope on one side and 2 to 1 on the other, top width, 6 ft.; 11,024 cu. yds. ditch work, 8,024 cu. yds. 10-ft. bottom side slopes 1 to 1, and the remaining 3,000 cu. yds. 4 ft. bottom side slopes 1 to 1; also 4,500 ft. 10-in tile and 4,000 ft. of 8-in. tile, and also the building of one 75-H. P. 20-in. pumping station and the repairing of another 20-in. pumping station. C. H. Kreiling, Chandlerville, Ill., is the Engineer.

It is expected that within the next three or four weeks Mound City, Ill., will advertise for bids for raising and strengthening her levees. The finances have been raised and the money—Mound City's part—is now on deposit in the bank, ready to be paid out for the work. The government engineers will be asked to finally pass upon the plans before the bids are called for. The plans are to raise the levees clear around the city to a 58-ft. elevation. This is on an average of 3 feet higher than the present level, except in some cases the work will be entirely earth work. At the Williamson & Kuny mill it is proposed to do some concrete work and there may be some at some of the other factories. To raise her half of the $40,000 improvement, Mound City voted an issue of 7-year bonds, drawing 6 per cent interest. These were taken largely by citizens of Mound City, so foreign investors did not have to be asked to float the issue. They are installment bonds, one maturing each year. M. F. Browner is mayor.

Indiana.

⊙Preston A. Reese has been awarded the contract at $1,258 for constructing the Crosby tile drain, bids for which were opened Jan. 8, at Shelbyville, Ind.

Iowa.

⊙Jacob F. Beck, Spencer, Ia., has been awarded the contract for constructing drains in Drainage District No. 16 of Clay County.

Supervisors of Poweshiek County, Montezuma, Ia., have voted to establish a drainage ditch along Bear Creek. Estimated cost is $22,000.

Supervisors of Hardin County, Eldora, Ia., have decided to construct a ditch for the Silver District to drain about 13,000 acres and to cost $26,000.

⊙The Hawkeye Construction Co., Webster City, Ia., has been awarded the contract by the County Supervisors at Iowa City for constructing a 1¾-mile ditch in East Lucas Township. The bids received were as follows: Hawkeye Construction Co., $5,315; Moeller Bros., Knierim, Ia., $5,725; Haugsted Co., Nevada, Ia., $5,725; Hoar & Parkinson, Iowa City, $6,823; Richards & Co., Mason City, $6,871.

Louisiana.

Proposition has been submitted to the citizens of Thibodaux by C. P. Gable of Donner Hill (P. O. Donner, La.) for dredging a canal and building a levee in the Atchafalaya district going south to Houma and east to Chacahoula and points beyond to reclaim a long stretch of swamp land. It is proposed to start the canal from a point on the west bank of the Cancienne canal to the gulf of Lake Mechant, connecting with the gulf. The canal would cost about $500,000 and would be 35 miles long. There are at present 1,500,000 acres in the territory surrounding the site for the canal, and it is stated that with the assessment or tax of 5 cts. per acre for 10 years the project could be carried out. The canal would drain practically useless lands as well as valuable lands.

Minnesota.

✣Bids will be received until Feb. 7, it is reported, by F. D. Stocking, County Auditor, Glencoe, Minn., for the construction of Tile Ditch No. 25. The work will include a main ditch and 3 laterals requiring the following hard burned clay tile: 500 ft. of 5 in., av. depth 3.24 ft.; 4,658 ft. of 6 in., av. 4.1 ft.; 3,214 ft. of 8 in., av. 5.2 ft.; 2,400 ft. of 10 in., av. 5.6 ft.; 3,700 ft. of 12 in., av. 6.4 ft.; 941 ft. of 14 in., av. 6.6 ft.; 1,400 ft. of 18 in., av. 7.2 ft., 3,000 ft. of 20 in., av. 7.2 ft., maximum depth 9.5 ft.

✣Bids will be received until 11 a. m., Jan. 16, it is reported, by A. P. Erickson, Hennepin County Auditor, Minneapolis, Minn., for the construction of Judicial Ditch No. 20. The cost of the work is estimated at $4,000.

✣Bids will be received until 1 p. m., Feb. 13, by P. C. Neufeld, County Clerk, Windom, Minn., for the construction of Judicial Ditch No. 3 of Cottonwood County.

Missouri.

Citizens of Kansas City, Mo., on Jan. 7 voted in favor of issuing $750,000 of bonds for flood protection, dikes, etc. Louis R. Ash is City Engineer.

Montana.

⊙The U. S. Reclamation Service has been authorized to award contracts as follows for the construction of the 46 miles of the Vandalia South Canal, Milk River Project: Schedules 1 and 3, 583,500 cu. yds. excavation, J. E. Hilton, Billings, Mont., at $118,150; Schedule 2, 302,550 cu. yds., Charles Wilhite, Boise, Idaho, at $51,700. Bids were opened Dec. 2, and were given in our issue of Dec. 11.

Tennessee.

The following is the present status of a number of drainage and levee projects for which the Morgan Engineering Co., 608 Goodwyn Institute Bldg., Memphis, Tenn., is the engineer: Levee District No. 3 of Miller County, Ark.—Preliminary report completed; about 23 miles of levee is required at an estimated cost of $200,000; contracts will not be let until late in the spring. Overcup Drainage District, Jackson and Woodruff Counties, Ark.—Plans have been made and assessments completed for this district, which covers 22,000 acres and will cost about $64,000. Drainage District No. 2, Madison Parish, La.—District fully organized and will probably let contracts in 50 or 60 days. Drainage District No. 2, Tunica, Quitman and Panola Counties, Miss.—Plans made and assessments completed; first hearing on assessments held Jan. 13; district covers 3,000 acres and system will cost $15,000. Yazoo-Coldwater Drainage District, Miss.—Preliminary report has been filed, and hearing for establishment of district was held on Jan. 13 at Marks; district includes about 400,000 acres, and drainage will cost over $3,000,000. Inter-River Drainage District, Butler County, Mo.—Field surveys completed and petitions filed; hearing will be held this month by Circuit Court. Middle Fork & Spring Creek Drainage and Levee District, Weakley County, Tenn.—Plans completed and final hearing held on Jan. 6; 8,000 or 9,000 acres to be reclaimed at cost of $155,000. Reeds Creek Drainage District, Dyer County, Tenn.—Surveys completed for district covering 5,500 acres of river bottom land; estimated cost of drainage, $60,000.

Canada.

Citizens of Brantford, Ont., have voted a by-law to raise $15,000 for flood protection work T. Harry Jones is City Engineer.

WATER WORKS

Alabama.

The City Commission of Tuscaloosa, Ala., has instructed City Engineer W. H. Nicol to prepare plans and specifications for the letting of contracts to extend the mains of the waterworks system to the districts in which sewerage has been provided.

Arizona.

The city engineering epartment of Tucson, Ariz., is preparing plans for an improved waterworks system, including larger mains in the downtown section and a storage reservoir. The estimated cost is $100,000. W. H. Thompson is City Engineer.

California.

✣Bids will be received until 7:30 p. m., Jan. 20, by Board of Trustees, Tehachapi, Kern County, Calif., for the construction of a municipal water works system. Plans and specifications may be secured of F. A. Lathrop, 901 Higgins Bldg., Los Angeles, Calif., at a cost of $5. The cost of the work is estimated at about $15,000. A. S. Waterman is town clerk.

✣Bids will be received until Feb. 3, by Department Finance, Ways and Means, P. E. Woods, Supt., San Diego, Cal., for the following cast iron pipe: 1,282 tons 24-in., Class C; 464 tons 6-in., Class C.; 455 tons 12-in., Class C.; 228 tons 1-in., Class C.; 85 tons 6-in., Class C.; 485 tons 16-in., Class B.; 1,437 tons 12-in., Class B.; 51 tons 10-in., Class B.; 117 tons 8-in., Class B.; 97 tons 6-in., Class B.; 12 tons 4-in., Class B. All pipe to conform to the American Water Works standard specifications and specifications for delivery, on file with the City Clerk of the City of San Diego. Official advertisement will be found elsewhere in this issue.

⊙Wm. W. Hirsch, Irvington, Calif., has been awarded the contract by the County Supervisors, Alameda County, Oakland, Calif., for the construction of a water plant in portions of County Road No. 1,002, Main St. and Lincoln St. in Irvington, Irvington Road District, Washington Township, at $1,329. Bids were opened Dec. 30 by John P. Cook, County Auditor.

City Clerk D. O. Williams of Hanford, Calif., is asking bids for the construction of the proposed $25,000 extension to the Holly fire main system. F. N. Isaac is manager of the waterworks.

Following bids were received recently by the Board of Supervisors, Los Angeles, Calif., for the erection of a steel water tank and tower at the county farm; Llewellyn Iron Works, $10,975; Western Boiler & Steel Co., $11,600 with no guarantee, $12,600 guaranteed for one year; Security Construction Co., $9,553 complete, $7,000 not including foundations, $8,610 completed under different specifications and $6,110 not including foundation; Rogers Bros., $6,800 complete, $6,350 complete under other specifications.

Colorado.

The Board of Public Works of Denver, Colo., has announced that the Cherry Creek flood reservoir would not be built in 1913. The bed of the creek throughout the downtown section of the stream will be paved with concrete. The construction of the reservoir would necessitate the expenditure of approximately $1,000,000. Seth B. Bradley is President of the Board.

District of Columbia.

The Commissioners of the District of Columbia, Washington, D. C., on Jan. 3, received the following bids for furnishing, delivering, and erecting three steel water towers for use of the water department, that city: Des Moines Bridge & Iron Co., Des Moines, Ia., $12,930; alternate, $14,030 and $12,100; Chicago Bridge & Iron Works, Chicago, Ill., $14,450; alternate, $16,200.

Illinois.

✣Bids will be received until 11 a. m., Jan. 17, for furnishing and delivering hydrant and valve castings, for use during 1913 at the Chicago waterworks shops, 2304 S. Ashland ave; all castings to be made of good quality gray iron from patterns furnished by the city; hydrant castings to be for 2½-in. and 4-in. double hydrants, the valve castings for 4-6-8-10-16-12-24-36-in. valves. Cash or certified check for $500 must accompany proposal. The city reserves right to cancel contract upon completion of municipal foundry. L. E. McGann, Commissioner of Public Works.

✣Bids will be received until 11 a. m., Jan. 20, for furnishing and delivering to the Chicago waterworks shops, 2304 S. Ashland ave., approximately 10 tons red scrap. All brass to be free from iron, nickel, silicon, manganese, etc., and delivered in crucible not over 10 ins. in length and 8 ins. in width or depth. Cash or certified check for $100 must accompany proposal. L. E. McGann, Commissioner of Public Works.

✣Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., until 11 a. m., Jan. 20, for furnishing and delivering to the meter mechanical shops, 1330 Indiana ave., 975 disc water meters as follows: 75 of ⅝-in., 300 of ¾-in., 200 of 1-in., 200 of 1½-in., 200 2-in., the bodies of all meters, other than 2-in. to be of bronze of good grade, wearing parts of bronze or hard rubber. All meters to be tested before purchase by various size streams of water and must register in cubic feet, actual amount within 3 per cent. Cash or certified check for $300 must accompany proposal.

✣Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., until 11 a. m., Jan. 17, for furnishing and delivering to the Lake View pumping station, Montrose Blvd., and Clarendon Ave., steel reinforcing rods as follows: 2,540 pieces ¾-in. diameter from 18 ft. to 5 ft. in length, approximate total weight 44,600 lbs.; 2,560 pieces ⅝-in. in diameter, 17,500 lbs.; 1,770 lin. ft. ½-in. diameter, total weight, 9,800 lbs.; 3,000 ft. No. 10 wire. Cash or certified check for $100 must accompany proposal.

✣Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., until 11 a. m., Jan. 18, for furnishing and delivering packing as required for use during 1913, at 14 pumping stations, shops, cribs, etc. Details of specifications, and amount purchased during 1912 (approximate) are as follows: Ring, spiral, coil sectional rings or strip metal steam packing, 100 lbs. steam pressure or over, 1,500 lbs; same for less than 100 lbs. steam pressure, 1,500 lbs.; hot water packing of various kinds, 900 lbs.; hydraulic packing of various kinds, 3,000 lbs; sheet rubber packing as follows: Ebonite or equal, Rainbow or equal wire inserted, cloth inserted high pressure asbestos and prepared sheet packing, 1,200 lbs.; rope packing of various kinds, 500 lbs. Cash or certified check for $100 must accompany proposal.

✣Bids will be received until 11 a. m., Jan. 11, for furnishing and delivering to the City of Chicago, at its various pumping stations, shops, etc., No. 1 white cotton waste for use during 1913. Approximate total pounds required during 1912 were 38,200. Cash or certified check for $100 must accompany proposal. L. E. McGann, Commissioner of Public Works.

⊙L. E. McGann, Commissioner of Public Works, Chicago, Ill., on Jan. 6 awarded to Niles Bement Pond Co., 332 S. Michigan Ave., the contract for furnishing, delivering and erecting at the water works shops 2304 S. Ashland Ave., one 5-ft. universal drilling machine. Bids opened Dec. 18; contract price, $1,500.

⊙L. E. McGann, Commissioner of Public Works, Chicago, Ill., on Jan. 6 awarded to the Raymond Lead Co. the contract for furnishing and delivering at the various pipe yards, approximately 150 tons of pig lead. Contract price $13,000. Bids opened Dec. 11.

⊙L. E. McGann, Commissioner of Public Works, Chicago, Ill., on Jan. 6 awarded to Kroeschell Bros., 440 W. Erie St., Chicago, the contract for furnishing, delivering and erecting 4 oil burning crucible tilting furnaces, each of a capacity of 400 pounds, at the water works shops, 2304 S. Ashland Ave.

The Chicago City Council, Chicago, Ill., on Jan. 2, authorized the purchase of automobiles, motor trucks, motor cycles, tire parts, etc., as follows: Police Dept., John McWeeney, chief, $18,000; Fire Dept., Chas. Seyferlich, chief, $33,000; Health Dept., A. Reynolds, M. D., commissioner of health, $2,350; Dept. of Electricity, Roy Palmer, city electrician, $2,000; Bureau of Streets, amount not given; Bridge Dept., one 1-ton truck, one 5-ton auto truck, $5,500; Water Pipe Extension Dept., 4 automobiles, $2,000; Water Works Shops and Repairs, one 2-ton motor truck, $2,500. L. E. McGann, Commissioner of Public Works.

The Chicago City Council, on Jan. 2, authorized the purchase of water pipe, special castings, hydrants, valves, pipe locators, etc., by the Bureau of Engineering for use of the water pipe extension division; appropriation $240,000. L. E. McGann, Commissioner of Public Works.

The Chicago City Council on Jan. 2, authorized the purchase of engine parts, boilers, etc., as follows: House of Correction, Jno. W. Whitman, Superintendent, $1,700; Fire Department, Chas. Seyferlich, Chief, $5,500; City Hall building, L. E. McGann, Commissioner, of Public Works, $10,000.

The Chicago City Council, on Jan. 2, 1913, authorized the purchase of sanitary drinking fountains, ornamental fountains with fittings, connections, etc., as follows: Special Park Commissioner A. W. Beilfuss, Chairman, $1,000; Water Works Extension Department, installing sanitary drinking fountains throughout the city, $15,000. L. E. McCann, Commissioner of Public Works. Date of letting contracts not announced.

The Chicago City Council, on Jan. 2, authorized the purchase of waterworks supplies including tools, derricks, solder, rope, tackle gages, force pumps, etc., by the waterworks extension department during 1913. Appropriation $100,000. L. E. McGann, Commissioner of Public Works.

The Chicago City Council, on Jan. 2, authorized the purchase of pumping engines, accessories, including pipe, fittings, boiler equipment, furnace tubes, etc., for use at various pumping stations. Appropriation $650,000. L. E. McGann, Commissioner of Public Works.

Indiana.

The City Council of Washington, Ind., has notified the Washington Water, Light & Power Co., of the city's intention to purchase the water plant. H. F. O'Neall is City Engineer.

Among the improvements planned by the Louisville & Nashville Railroad at Howell, Ind., will be the construction of a new water station at an estimated cost of $20,000, a watering station for live stock, and a new water filtering plant for shop employes. John W. Logsdon, Evansville, Ind., is Division Superintendent.

Iowa.

✣Bids will be received until 10 a. m., Jan. 18, by City Clerk, Sioux City, Ia., for one 3-wire 115 to 230-volt engine, type D. C., Generator 62½-kw., arranged for 25 per cent on balanced load, 275 rpm. Bidders will also state what they will allow for the 2-wire 520 amp. engine type D. C., Generator now in use at the city hall building. Specifications and all further information can be had at office of the Engineer, G. B. Healy, Superintendent Parks and Public Property.

⊙The City Council of Denison, Ia., has let the contract for the construction of a new steel tower and tank to take the place of the old stand-pipe for the city waterworks, to the Des Moines Bridge & Iron Works, Des Moines, Ia., at $4,948. The tank and tower will be 70 ft. high.

Kansas.

⊙The Tonkawa Construction Co., Tonkawa, Okla., has been awarded the contract by the city of Burlingame, Kans., for the construction of a water works system at $18,149. Other contracts let in connection with the work were: Bash & Gray, Joplin, Mo., pipe and special castings, $21,482; E. J. Merkle & Co., Kansas City, valves and hydrants, $1,478; also pumps and motors, $1,866; New York Continental Jewell Filtration Co., New York City, filter, $3,250, and Des Moines Bridge & Iron Works, Des Moines, Ia., tank and tower, $3,200. Alva J. Smith is engineer. Bids were opened Jan. 9.

Scott City, Kans., recently voted bonds to the amount of $40,000 for the installation of a waterworks and an electric light plant. The intention is to install an electric plant which will furnish pumping power to farmers who care to avail themselves of this service for irrigation.

Louisiana.

✣Bids will be received until noon, Feb. 20, by the Baton Rouge Water Works Co., John H. Wood, Secretary, Baton Rouge, La., for constructing a 59-ft. by 120 ft., by 20 ft. deep reinforced concrete reservoir of a capacity of about 1,000,000 gals. The material required for the reservoir includes the following: 725 cu. yds. crushed stone or gravel, 363 cu. yds. sand, 1,292 bbls. Portland cement, 130 bbls. hydrated lime, 208,960 lbs. steel bars, 12 ventilators, 2 manhole covers, 2 10-in. pipe collars, 4 16-in. pipe collars, 4 10-in. pipe hangers, 2 valve stem hangers and 30 ⅝-in. round rods, 3 ft. 4 ins. long. Official advertisement will be found elsewhere in this issue.

Maryland.

✣Bids will be received at once by Brady Bros., General Contractors, 12 Welsh St., Frostburg, Md., for 10,000 ft. of 10-in. cast iron pipe for the Westernport Waterworks. Specifications for the same can be had at the Camp Brady, Bond, Md.

Massachusetts.

✣Bids will be received until noon, Jan. 22, by Metropolitan Water and Sewerage Board, 1 Ashburton Place, Boston, Mass., for furnishing the following supplies: 50,000 lbs. engine oil, 45,000 lbs. dark cylinder oil, 5,000 lbs. filtered cylinder oil, 12,000 pounds No. 1 cop waste, 4,000 lbs. grease, 7,000 lbs. soap powder, 6 doz. prs. Storm King rubber boots 6 doz. prs. hip rubber boots, 35 boxes soap, etc., pneumatic tires for nine motor cars. The quantities are approximate only. Specifications may be seen at the office of the board.

Mayor Eugene R. Stone of Quincy, Mass., has recommended to the City Council the construction of a water standpipe for Houghs Neck.

Michigan.

The committee recently appointed by the City Council of Adrian, Mich., to investigate the condition of the Adrian Water Co., as far as possible, and investigate the possibility of purchasing the plant, has submitted its report to that body.

The U. S. Cast Iron Pipe & Foundry Co., Chicago, Ill., submitted the lowest bid to C. L. Miller, City Clerk, Kalamazoo, Mich., on Jan. 6, for furnishing 500 tons, more or less, of 4, 6, 8, 10 and 12-in. cast iron water pipe.

Minnesota.

The aldermanic street committee of the City Council, St. Paul, Minn., is reported to have authorized the issuance of bonds to the amount of $150,000 for waterworks improvements.

The Village Council of Mountain Iron, St. Louis County, Minn., George Eilertson, Village Recorder, will sell bonds Jan. 28 in the sum of $50,000 for waterworks.

The Commercial Club of Duluth, Minn., has passed a resolution to urge upon the Board of Water & Light Commissioners, the necessity for taking immediate steps looking

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

toward the paralleling of the present system extending from the pumping station at Lakewood to the reservoir at 34th Ave. east as a supplementary system.

The village of Morgan, Minn. (population 553), is agitating the installation of a water works system.

Missouri.

✣Bids will be received until Jan. 21, by City of Rich Hill, Mo., S. B. Cole, Mayor, for the electric light plant, including 2 generators, 2 engines and appurtenances, 450 city poles and 9,000 lbs. of No. 8 wire. Rollins & Westover, Kansas City, Mo., are Engineers.

Montana.

The citizens of Billings, Mont., will be asking to vote on the issuance of bonds to the amount of $600,000 next April for the installation of a water plant. The city recently offered the Montana Water Co. $265,000 for its plant.

Nebraska.

✣Bids will be received until noon, Jan. 23, by Roscoe C. Ozman, City Clerk, Lincoln, Nebr., for furnishing one chain grate stoker for 250 H. P. boiler and for 500 H. P. boiler and one 500 H. P. boiler and chain grate stoker for same.

New Jersey.

⊙The U. S. Cast Iron Pipe & Foundry Co., Philadelphia, Pa., secured the contract from the Water Department of Atlantic City, N. J., for furnishing 1,206 net tons of pipe ranging in size from 24 to 8 ins. in diameter, and 88,000 lbs. of special castings. The Rensselaer Valve Co., 180 Broadway, New York City, secured the contract for furnishing 112 valves of from 24 to 6 in., and 20 gear cases, 24 to 20 in. Bids were opened Dec. 19.

New York.

✣Bids will be received until 8 p. m., Jan. 21 by L. B. Shay, Village Clerk, Brockport. N. Y., for furnishing the necessary labor and materials for the construction of a water works system. There will be required approximately the following: 5,000 tons 6-in. to 14-in. standard cast iron bell and spigot pipe; 30 tons special castings; 135 fire hydrants; 142 gate valves and boxes; about 22 miles of pipe laying; Brick Pumping Station and Chimney; pump well and intake; concrete reservoir; pumping machinery, etc. Witmer & Brown, Chapin Block, Buffalo, N. Y., are engineers.

✣Bids will be received until 2 p. m., Jan. 16, by Department of Water Supply, Gas and Electricity, 13-21 Park Row, New York City, for constructing the Jerome Park Fillers. The date for opening bids was changed from Jan. 8.

⊙William M. Sheehan & Co., have been awarded the contract by the Village Trustees of Freeport, L. I., N. Y., for the construction of a water works system at $17,970. The work will be done under the plans and specifications prepared by William R. Smith, operating engineer at the power house.

The Conservation Commission, Albany, N. Y., has granted the application of the Village of West Winfield, N. Y., for approval of its maps and plans for a municipal waterworks system. The estimated cost of the project is $33,000.

The Conservation Commission, Albany, N. Y., has granted the application of the Upper Jay water district for approval of its maps and plans for a water supply system with modifications. The district desires to install a gravity water supply system, source Sumner Brook, at a cost not to exceed $9,000.

The Trustees of the recently authorized municipal water plant, Albion, N. Y., have offered the old waterworks company $88,500 for their holdings and equipment. Bonds to the amount of $130,000 were recently voted for a municipal plant. Wm. B. Lyle is President of the Village..

Following bids were recently received by the Water Commissioners of Sodus, N. Y., for the construction of a waterworks system: S. V. R. Malcolm & Son Co., $39,224; Reliance Sewer Construction Co., $37,090; Samuel Baum, $34,426; Fishette Bros., $31,238; H. G. Burrows, without pipe, $20,110; John D. Kuhn, without pipe, $17,790; C. R. Lewis, without pipe, $17,654; Newark Construction Co., without pipe, $23,640; Wayne Construction Co., without pipe, $19,169; Frank George, $28,599; M. Applegate & Son, $28,395; A. A. Dancy, $31,739; Albert Gaffey, $30,770; Allen Pope, $24,298; A. F. Nims, $37,310; J. V. Johnson Co., $32,000; Martin Stewart, $36,000.

North Carolina.

The Board of Aldermen of Raleigh, N. C., has decided not to accept the offer of the Wake Water Co., to sell the water plant to the city for $263,000. The aldermen propose to procure authority from the legislature for a $400,000 bond issue to either buy the present water plant and enlarge it, or establish a new plant.

Ohio.

✣Bids will be received until noon, Feb. 4, by G. F. Koehler, Director of Public Safety, Canton, O., for changing a chemical wagon belonging to the Fire Department of the city into an auto chemical and supply wagon. Each bid must be accompanied by a certified check for $500.

✣Bids will be received until noon, Feb. 22, by Board of Public Affairs, Willoughby, O., for furnishing necessary labor and material for the construction of one 1,000,000-gal. water purification plant of the mechanical type. The prices bid are to cover all expenses of furnishing all material, tools, labor and utensils necessary for the full completion of the work. Plans and specifications can be seen at the office of the Board of Public Affairs or at the office of Burgess & Long, Engineers, Columbus, Ohio.

⊙The Lauese Co., Columbia Bldg., Cleveland, O., has been awarded the contract by the village of East View, O., A. A. Smith, 931 Williamson Bldg., Cleveland, O., Village Clerk, for the improvement of Kinsman road from the east line of the west line of the village, by constructing a 10-in. water main therein, at $26,515. The work includes 2½ miles of mains, connections, hydrants, etc. Bids were opened Dec. 20.

⊙The Board of Control of Toledo, O., has awarded the contract for furnishing 1,500 tons of pipe and the required amount of special castings needed by the waterworks department in 1913, to the U. S. Pipe & Foundry Co., of Chicago, at $25.20 per ton for the 4, 6 and 8-in. pipe and $55 per ton for the special castings.

The City Council of Fostoria, O., is considering a resolution authorizing the City Engineer, Chas. Latchaw, to prepare plans for an additional and better water supply.

Consulting Engineers Hering & Gregory, 170 Broadway, New York City, have prepared plans for the construction of a waterworks system for Zanesville, O., at an estimated cost of $363,000. The work will include power plant, machinery, mains, etc. Contracts will be let after April 1. E. A. Evans, Zanesville, is Official in Charge.

Oklahoma.

The Waters & Pierce Oil Co. is reported to be considering building a pipe line from the Oklahoma oil fields to its refinery at Fort Worth, Tex.

The City of Eufaula, Okla., contemplates enlarging its waterworks system.

The City Commissioners and Park Board of Guthrie, Okla., propose to ask for bids immediately for the drilling of a well to a depth of 2,000 or 3,000 ft., in one of the city parks.

Oregon.

⊙Following bids were received on Jan. 2 by the Water Board, Frank T. Dodge, Superintendent, Portland, Ore., for furnishing approximately $300,000 worth of material for the construction of new water mains this year: For 6,000 tons cast iron pipe and 225 tons special castings, Oregon Iron & Steel Co., Oswega, Ore. (awarded contract), $218,326; United States Cast Iron Pipe & Foundry Co., $218,119; Glamorgan Pipe & Foundry Co., $220,485; R. D. Wood & Co., $220,556. For the 225 tons of special castings only, Phoenix Iron Works, Portland, Ore. (awarded contract), $11,925; Independent Foundry Co., $12,825. For 410 gate valves of various sizes, Ludlow Valve Manufacturing Co., $12,295; R. D. Wood & Co., $8,250; Caldwell Machinery Co., $11,311; Nelson Valve Co., $12,784; Chapman Manufacturing Valve Co., $11,175; M. L. Kline, $10,455; Gauld Co., $11,252; Crane Co., $12,684; Eddy Valve Co., $10,942. For 40,000 ft. of small pipe and fittings, Marshall Wells, $3,979; Gauld Co., $2,731; Crane Co., $2,458; M. L. Kline, $2,518; Fairbanks-Morse Co., $2,325. The Peerless-Pacific Co. bid $1,565 for furnishing the pipe, only. For 350 fire hydrants, Ludlow Valve Manufacturing Co., $9,975; Helsor-Undine Co., $9,765; Columbia Elevator Co., $10,647; R. D. Wood & Co., $10,097; Caldwell Machinery Co., $10,216; Phoenix Iron Works, $10,325; M. L. Kline, $12,162; John Wood Iron Works, $10,237; Eddy Valve Co., $10,325. For corporation and curb cocks, Crane Co., $5,581; Mueller Mfg. Co., $5,227; Gauld Co., $6,311. For 160 tons pig lead, Gauld Co., $15,296; Crane Co., $14,816; M. L. Kline, $14,816. The successful bidders are the Oregon Iron & Steel Co., Oswego, Ore., and the Phoenix Iron Works, Portland.

Following bids were received by the Water Board, Frank T. Dodge, Supt., Portland, Ore., on Jan. 2, for one five-passenger touring car, three 1,500-lb. delivery autos or trucks, and one five-ton truck: E. E. Gerlinger, Pathfinder touring car, $2,150; three delivery wagons, $1,341.75 each; 5-ton truck, $3.000. Covey Motor Car Co., Cadillac touring car, $2,116. Paquet & Peck, Haynes touring car, $2,400. Neate & McCarty, 5-ton Locomobile truck, $5,100; Locomobile touring car, $4,500; Cole touring car, $2,160; Cole 6-cylinder touring car, $2,635. International Motor Co., three Mack 2,000-lb. delivery cars, $9,300; one Sauer 5-ton truck, $5,300. Stewart Motor Co., three Stewart delivery cars, $6,046. Moores Motor Car Co., one 5-ton Stearns truck, $3,985. Pierce Auto Sales Co., one 5-ton Pierce-Arrow truck, $4,845; one Pierce-Arrow touring car, $4,565. Frank C. Riggs, one 5-ton Packard truck, $4,781. Lippard-Stewart Sales Co., three Lippard delivery cars, $6,046. United Auto Co., Maxwell touring car, $1,850. White Co., one 5-ton White truck, $4,750; three White delivery cars, $2,475 each; one White touring car, $3,745.

A petition has been circulated in Oregon City, Ore., which will be presented in a meeting of the City Council, asking that body to provide for a bond election to raise money to secure a better water supply. W. H. Howell is in charge of the waterworks.

Pennsylvania.

✣Bids will be received until 2 p. m., Jan. 20, by Capt. H. F. Dalton, Quartermaster at the office of the Chief Quartermaster, 50th Anniversary Battle of Gettysburg, for drilling three or more 8-in. tubular wells at Gettysbury, Pa.

The Greenville Water Co. has employed Chester & Fleming, Hydraulic Engineers, Pittsburgh, Pa., to prepare plans and specifications for storage dam and other improvements to the water supply. Several miles of pipe lines will be laid. Work will be ready to receive bids by May 1.

The Halifax Water Co., Halifax, Pa., has filed notice of increase of debt from $15,000 to $30,000 for improvement work.

The Borough Council of Coatesville, Pa., has decided to put a $185,000 loan bill up to the people for a new water supply from Rock Run. The new plant will include a storage dam to hold 3,000,000 gals. and filter beds. J. G. Pugh is Water Commissioner.

South Dakota.

The Brule County Commissioners, Chamberlain, S. Dak., have received notice from

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

the land department at Washington, D. C., that the government will offer no objections to the proposed digging of four artesian wells in that county to secure enough water to refill Red Lake, for which bonds to the amount of $10,000 were recently voted.

Texas.

⊙Following bids were recently received by the Board of Municipal Commissioners, Dallas, Tex., for the construction of the Oak Cliff pumping station: Alex Watson Construction Co., $11,500; J. M. Green, $14,665; Trinity Construction Co., $12,880; Lindsey & Smith, $9,751, (awarded contract for superstructure) and Milliken Construction Co., $11,700. The superstructure has been completed by day labor.

The Attorney General at Austin, Tex., has approved the bonds of the Big Springs, Tex., people for waterworks to the amount of $50,000. James Brooks is City Attorney of Big Springs.

Mayor A. W. Acheson of Denison, Tex., has asked the City Attorney to investigate the possibility of the city issuing bonds to the extent of $40,000 to be used in installing a filtering plant at Shawnee reservoir.

Virginia.

The water committee of the Town Council, Highland Park, Va., (P. O. Richmond), has passed a resolution authorizing the water committee, M. C. Doubles, Chairman, to enter into a contract for the digging of an artesian well and erecting the necessary pumps.

The citizens of Blacksburg, Va., will vote, Jan. 16, on the issuance of bonds to the amount of $3,000 to complete the laying of water and sewer pipe now in progress.

Washington.

The Leadbetter Co., owners of the Municipal Water Co., Camas, Wash., will build a 60,000-gal. reinforced concrete reservoir.

Wisconsin.

⊙The City Council of La Crosse, Wis., has let the contract for the laying of water pipe through the marsh from the wells to the high reservoir to the J. W. Turner Improvement Co. of Des Moines, Ia., at $17,899. Other bidders were: J. A. Trane, La Crosse, $18,900, and J. J. Fiebig, La Crosse, $18,567. Alvord & Burdick Chicago, Ill., are Engineers.

Wyoming.

⊙Mackay & Geddis, 401 Exchange Bldg., Denver, Colo., have been awarded the contract by the city of Rawlins, Wyo., Lillian Junngquist, City Clerk, for the improvement of the water works system at $20,908. The work includes Bid "A"—furnishing all material and completing all construction work on the laying of 5,000 ft. of 10-in. lap welded steel pipe, 4,160 ft. of 6-in. cast iron pipe, with necessary valves, fittings and connections; bid "E"—furnishing material and completing construction of 500,000 gal. steel reservoir with foundation complete. Bids were opened Dec. 28.

Canada.

✣Bids will be received until 4 p. m., Feb. 10, by City Purchasing Agent Galt, Victoria B. C., for the supply of 10,000 ft. of 6-in steel pipe and 3,000 ft. of 8-in. steel pipe, for water works purposes. Tenderers are invited to submit their own specifications and to also submit a price for 4-in. steel pipe.

✣Bids will be received until noon, Feb. 10, by City Commissioners, Moose Jaw, Sask., for the manufacture, supply and delivery and erecting one 1,500-kw. steam turbine and generator. Specifications and general conditions may be obtained upon application to J. D. Peters, Electrical Superintendent, Moose Jaw; The Commercial Intelligence Branch, Board of Trade, 73 Basinhall street or London Chamber of Commerce, London, England.

The ratepayers of Ottawa, Ont., on Jan 6, voted against a by-law of $1,100,000 for the construction of a mechanical filtration plant J. A. Ellis is Mayor-elect.

The ratepayers of Brantford, Ont., on Jan. 6, voted a by-law to the amount of $150,000 for waterworks improvements and $15,000 for flood prevention. David Webster is in charge of waterworks.

The ratepayers of Galt, Ont., on Jan. 6, voted a by-law to the amount of $15,000 for waterworks extensions. F. Stewart Scott is Mayor.

The ratepayers of Welland, Ont., on Jan. 6, voted a by-law for the purpose of making extensions to the waterworks system. John Goodwin is Mayor.

SEWERAGE AND SANITATION

Arkansas.

✣Bids will be received until noon, Jan. 20, by Board of Public Affairs, Little Rock, Ark., for the construction of sewers in the Deaf Mute Section, Lincoln & Zimmerman's addition and Fulk's addition. F. A. Isgrig is Clerk.

⊙The McPeay Construction Co. of Little Rock, Ark., has been awarded the contract for the construction of a sewer system in Eufaula, Okla., for $67,250.

California.

✣Bids will be received until noon, Feb. 4, by Treasurer, E. W. Moore, Pacific Branch, N. H. D. V. S. Soldiers' Home, Los Angeles County, Calif., for the construction of a sewage disposal plant at the home.

✣Bids will be received from 11 a. m. until noon, Jan. 20, by Frank R. Thompson, City Clerk, Oakland, Calif., for the construction of sewers in 90th Ave.

Kentucky.

✣Bids will be received until 2 p. m., Jan. 17, by Board of Public Works, Louisville, Ky., for the construction of the following sewers: Section 3, 32rd Street Sewer, contract No. 7; section 2, Madison Street Sewer, contract No. 6; section 2, Green Street Sewer, contract No. 8; 11th and West Street Sewers, contract No. 9; 8th, 10th and Madison Street Sewers, contract No. 10, according to the plans and specifications on file at the office of the Board of Public Works of the City of Louisville. Bidders' bond with a guaranty or surety company acceptable to the Board of Public Works is required. Copies of the plans and specifications and blank affidavits and bidders' bonds may be obtained at the office of the Board of Public Works by making a deposit of $1 for each contract in the form of a money order or check made payable to the City Treasurer. The estimated amount of work to be performed and materials furnished is as follows: 540 lin. ft. 36-in. sewer, average cut 15 ft.; 520 lin. ft. 33-in. sewer, average cut 12 ft.; 1,850 lin. ft. 30-in. sewer, average cut 10 ft.; 390 lin. ft. 27-in. sewer, average cut 8 ft.; 1,440 lin. ft. 24-in. sewer, average cut 9 ft.; 400 lin. ft. 20-in. sewer, average cut 6 ft.; 2,010 lin. ft. 18-in sewer, average cut 10 ft.; 3,540 lin. ft. 15-in. sewer, average cut 9 ft.; 250 vertical feet of manholes. Roy W. Burks is First Assistant Engineer.

Illinois.

✣Bids will be received until 11 a. m., Jan. 21, for furnishing and delivering lumber as required by the Bureau of Sewers, Chicago, Ill., during the year 1913; approximate quantities are as follows: 23,500 ft. B. M. No. 1 Norway Pine of various sizes; 2,000 ft. B. M. Norway Pine clear; 15,000 ft. B. M. Hemlock, No. 1 common; 36,000 ft. B. M. No. 1 Oak, common; 2,000 ft. B. B. White Oak, clear. Cash or certified check for $200 must accompany proposal. L. E. McGann, Commissioner of Public Works.

✣Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., until 11 a. m., Jan. 21, for furnishing and delivering municipal castings to the Bureau of Sewers for use during 1913, as follows: 400 manhole curbs, total weight 78 tons, manhole lids, 1,500 of standard diameter, 200 22-ins., 500 22½-ins., 25 23-ins., 25 23¼-ins., 350 special deep lids, total weight 223.27 tons; 200 grate boxes, 650 inlet grates, 100 lawn cover curbs, 400 perforated catch basin lids, 200 standard lawn cover lids, total weight 75.25 tons; 25 lawn cover lids, 20½-ins., total weight, 1.05 tons; all castings to be of tough gray iron according to plans and specifications. Cash or certified check for $300 must accompany proposal.

Massachusetts.

⊙The Board of Public Works of Boston, Mass., has awarded the contract for the construction of sewerage works in Northern Ave., to Louis Balboni at $7,822.

⊙The Department of Public Works of Boston, Mass., has awarded a contract to William L. Dolan for constructing sewerage works in Brainerd Rd., Brighton, at $7,278.

Minnesota.

✣Bids will be received until Jan. 21, according to reports, by Village Council, Hibbing, Minn., for the construction of the proposed sewer outlet to the sewer south of Brookston.

Missouri.

⊙The American Construction Co., St. Louis, Mo., is the probable contractor for the construction of sewers in Northwestern Sewer District No. 30, including sewers of materials, lengths and sizes as follows: Vitrified clay pipe sewers, 108 ft. of 18-in. inside diameter, 360 ft. of 15-in. inside diameter, 1,164 ft. of 12-in. inside diameter, with sewer inlets, manholes and all other appurtenances. The contract price is $2,168. Bids were opened Jan. 7

Nebraska.

✣Bids will be received until noon, Jan. 15, by Roscoe C. Ozman, City Clerk, Lincoln, Nebr., for the construction of sewer in Sewer District No. 95, being the sewer between 24th and 25th Sts., from Holdrege to Dudley St., according to plans and specifications on file in the office of the City Clerk. Plans and specifications may be seen, and blank proposals obtained from the City Engineer.

⊙Arthur A. Dobson, 813 First Nat. Bank Bldg., Lincoln, Nebr., has been awarded the contract by the town of Manning, Ia., Martin Brunnier, Town Clerk, for the furnishing of labor and materials for the construction of a sanitary sewer system at $18,873. The work includes 30,000 ft. of sanitary sewers of standard, first grade, salt-glazed, vitrified clay sewer pipe and the manholes, flush tanks and other accessories of brick, concrete and iron. Bids were opened Jan. 6.

New York.

The New York State Board of Health has approved the plans prepared by Consulting Engineers Smith & Malcomson for the Village of Freeport, (L. I.), N. Y., providing for the construction of a sewerage system and disposal plant. The citizens will shortly be asked to vote on the proposition. Capt. James Hanse is Village President.

Plans and specifications were recently completed by City Engineer Charles E. Snyder of Oswego, N. Y., for the construction of the Harbor Brook storm water sewer on the east side. Bids on this work will be asked as soon as the specifications have been printed. The engineering department is now preparing plans for sewers in other sections of the city which will be built under the $200,000 bond issue after the Harbor Brook improvement is finished.

North Carolina.

The city of Winston, N. C., R. I. Dalton, Mayor, has not decided on the date for the letting of contract to construct approximately three miles of vitrified clay sanitary interceptor sewer, ranging in size from 12 to 24 ins.

Ohio.

✣Bids will be received until noon, Jan. 23, by W. J. Springborn, Director of Public Service, Cleveland, O., for the construction of sewers in the following named streets, avenues, courts and thoroughfares, to-wit: Arkansas Ave. S. W., between West 56th St., and West 58th St. Behrwald Ave. S. W., between West 35th St. and Pearl Road S. W. Cotes Ave. S. E., between East 116th St. and 280 ft. west of East 114th St. Proctor Ct. S. E., between East 114th St. and 279 ft. westerly. Olney Ct. S. E., between East 114th St. and 279 ft. westerly. Kepler Ct. S. E, between East 114th St. and 277 ft. westerly. East 63rd St., between Francis Ave. S. E. and Waterman Ave. S. E. East 56th St., between Harvard Ave. S. E. and Newburgh & South Shore R. R. East 57th St., between Harvard Ave. S. E. and Newburgh & South Shore R. R. East 59th St., between Harvard Ave. S. E. and Newburgh & South Shore R. R. Orey Ave. S. E., between East 54th St. and East 57th St. St. Clair Ave. N. E., between East 40th St. and East 45th St. Each bid must be made in accordance with the plans and specifications which may be seen at the office of the Chief Engineer, Room 305, City Hall.

✣Bids will be received until noon, Feb. 4, by G. B. Hatfield, Director of Public Service, Troy, O., for the construction of a sanitary sewer 6 miles in length. W. B. Freeman is Clerk of the Director. A. W. Scott is City Engineer.

⊙Wm. Strachan of Lancaster, O., has been awarded the contract by the village of Bremen, O., for the construction of a sewer in District No. 2, at $9,963. Bids were opened Jan. 6.

⊙The Department of Public Service, Columbus, O., has awarded the following sewer contracts: Louisa St., from Kling to Bryan, Waters & Russell, $941; Switzer Ave., from Stanton to Cole St., E. McShaffrey, $921; Carlyle Ave., from Cuyahoga Falls St., to 840 ft. north, H. M. O'Toole, $842; Lamparter St., from Kling to Brown, Waters & Russell, $588.

Texas.

✣Bids will be received until 9 a. m., Jan. 17, by Thomas B. Dunn, City Secretary, Corpus Christi, Texas, for the construction of approximately 2,500 lin. ft. 18-in. vit. pipe sewer; 4,000 lin. ft. 15-in. vit. pipe sewer; 2,700 lin. ft. 12-in. vit. pipe sewer; 650 lin. ft. 8-in. vit. pipe sewer. Together with necessary catch basin inlets, manholes and other appurtenances, all as per plans and specifications on file in the office of the City Engineer. All bids shall be made upon blanks accompanying specifications, which will be furnished by the City Engineer of Corpus Christi. Each bid must be accompanied by a certified check made payable to Clark Pease, Mayor of the city of Corpus Christi, in the amount of not less than 10 per cent. of the bid, said checks to be returned to unsuccessful bidders upon the awarding of the contract. Plans, maps and specifications can be seen in the office of the City Engineer or at the office of the City Secretary. The city of Corpus Christi, Texas, reserves the right to reject any or all bids or to accept any bid deemed advantageous to the city. Hubert A. Stevens is Acting City Engineer.

⊙The City Commission of Dallas, Tex., has awarded to C. W. Olcott a contract for laying a 6-in. sanitary sewer in Elizabeth St., from an alley between Cole and McKinney and thence east in an alley to Knox, at $3,184.

Washington.

⊙The city of Seattle, Wash., has awarded the contract for the construction of sewers in Burke Ave. et al. to the International Contracting Co., Central Bldg., Seattle, at $8,249.

A member of the firm of C. H. Green & Co., of Spokane, Wash., Engineers for the proposed sewerage system in Kellogg Ida., outlined the needs for the sewer at a recent mass meeting of citizens.

West Virginia.

✣Bids will be received until 1:30 p. m., Jan. 30, by Board of Commissioners, Huntington, W. Va., for the construction of 12 and 15-in. laterals on 1st, Hagan and Smith Sts., 2nd Ave. and on alley. A certified check for $500 must be filed with each bid. L. A. Pollock is Commissioner of Streets.

Canada.

✣Bids will be received until noon, Jan. 21, by H. C. Hocken, Chairman Board of Control, Toronto, Ont., for the construction of sewers on the following streets: Earlscourt Outlet, western section (6 ft. by 8 ft. 10 ins); culvert-shaped sewer; length 2,246 ft. Specifications and tender forms may be obtained upon application at the office of the Sewer Branch, Department of Works, City Hall, Toronto.

✣Bids will be received until noon, Jan. 31, by City Commissioners, Regina, Sask., for the supply of 37,700 sq. ft. of galvanized iron sheeting, etc. Plans and specifications may be obtained on application to J. M. MacKay, Chief Engineer Trunk Sewer Works, Regina. Sask.

BUILDINGS

District of Columbia.

✣Bids will be received until 11:30 a. m., Jan. 20, by Chief Signal Officer, Washington, D. C., for furnishing under proposal No. 634 1,556 ft. cable, type 213; 1,200 ft. cable, 150-pair, paper insulated; 5,000 ft. phosphor bronze antenna cord; 10,000 ft. cable, type 214; 3,000 ft. cable, type 308; 10,000 ft. cable, type 401, and 2,000 ft. cable, type, 408; also 30,000 ft. wire outside distributing. For further information address W. L. Clark, captain, disbursing officer, U. S. army.

✣Bids will be received until 2 p. m., Jan. 25, by Secretary of Interior, Washington, D. C., for rewiring rooms, top floor, in the Pension Office building, Washington, D. C.

Illinois.

✣Bids will be received at once by the Illinois Glass Co., Alton, Ill., for the erection of a fireproof office building two stories and a basement, area 80x100 ft.. on the grounds of the company at Alton.

⊙The Aspey & Fusch Co., Monmouth, Ill., has been awarded the contract at $83,000 for constructing infirmary buildings for Henry County, bids for which were opened Jan. 7 at Cambridge, Ill. Buildings are to be of fireproof, stone and brick construction, 2-story and basement. J. Grant Beadle, Architect, Galesburg, Ill.

Kansas.

✣Bids will be received until 10 a. m., Jan. 16, by Lieut. Col. T. H. Slavens, Constructing Quartermaster, Fort Leavenworth, Kan., for furnishing and delivering f. o. b. cars, terminal railway station, Fort Leavenworth, Kan., the following material: Item 1, round and flat mild steel bars; item 2, mild steel plates: item 3, angles, channels, etc. (structural steel): item 4, steel, cold rolled; item 5, rivets; item 6, castings, patterns to be furnished by the government, cast iron and yellow brass; item 7, bolts, washers, screws, etc.

✣Bids will be received until 3 p. m., Feb. 19, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the extension, remodeling, etc., including plumbing, gas piping, heating apparatus, electric conduits and wiring interior lighting fixtures, mail lift and approaches, of the United States post office and court house at Topeka, Kan. The work contemplated is the construction of a one-story and basement extension of approximately 3,100 square feet ground area, fireproof construction, exterior facing of stone, and copper roof, and there will be certain repairs and alterations in the present building. Drawings and specifications may be obtained from the custodian of the building at Topeka, Kan., or at the discretion of the Supervising Architect.

Missouri.

✣Bids will be received until 8 p. m., Jan. 23, by the Board of Education of University City, Mo., for the erection and completion of a new grammar school building, from the plans and under the supervision of Wm. B. Ittner, Architect, as follows: Letting No. 1—General work, for the building complete, according to the drawings and specifications (excepting plumbing and sewering, heating and ventilating and electric work). Required deposit with this bid, $700. Letting No. 2—Plumbing and sewering complete, according to the drawings and specifications. Required deposit with this bid, $200. Letting No. 3—Heating and ventilating complete, according to the drawings and specifications. Required deposit with this bid, $300. Letting No. 4—Electric work complete, according to the drawings and specifications. Required deposit with this bid, $100. All bids must be made out on the bid forms, which will be furnished for this purpose: must be sealed and indorsed, and deposited by the bidder with the Secretary of the Board of Education at University City, Mo., on or before the above date. Plans and specifications for the above work may be viewed at the office of Wm. B. Ittner, Architect, No. 408 Board of Education Building, St. Louis, Mo. Bidders desiring to carry away plans and specifications will be required to deposit $10 to guarantee the safe and prompt return of same. Bidders desiring to carry away specifications only will be required to deposit $5.

Ohio.

✣Bids will be received until 3 p. m., Feb 17, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction, complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures, and approaches, of the United States post office at Bowling Green, Ohio. The building is of one story and basement and has a ground area of approximately 5,400 sq. ft.; fireproof first floor; stone facing and tin roof. Drawings and specifications may be obtained from the custodian of site at Bowling Green, Ohio, at the discretion of the Supervising Architect.

✣Bids will be received until noon, Jan. 21, at the office of S. W. Haight, Clerk of the Board of Education, Newark, O., for furnishings for three school buildings now under construction.

South Dakota.

✣Bids will be received until 3 p. m., Feb. 3, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the installation complete of an electric passenger elevator and a hydraulic lift in the United States post office and court house at Sioux Falls, S. Dak., in accordance with the drawing and specification, copies of which may be had at the discretion of the Supervising Architect.

Texas.

✣Bids will be received until 10 a. m., Feb 4., by J. G. Sutton, City Secretary, Beaumont, Texas, for furnishing and installing all machinery and equipment necessary to the complete operation of a municipal abattoir, according to plans and specifications and list of machinery and equipment now on file in my office. All machinery and equipment specified

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

is to be delivered, erected, tested and turned over to the city of Beaumont in first-class working order.

✣Bids will be received until 10 a. m., Feb. 4, by J. G. Sutton, City Secretary, Beaumont, Texas, for the construction of a brick and concrete abattoir, in accordance with plans and specifications on file at the office of the Secretary. A certified check for $250 must be filed with each bid.

✣Bids will be received until 2 p. m., Jan. 27, at the office of M. L. Waller, Architect, Fort Worth, and at the office of the Secretary of the School Board, Dublin, Texas, for the erection and completion of a three-story stone school building to be erected at Dublin. A certified check for $600 must be filed with each bid.

RIVERS AND HARBORS

Delaware.

✣Bids will be received until 11 a. m., Feb. 3, by Maj. R. R. Raymond, U. S. Engineer, Wilmington, Del., for the construction of jetty work at the mouth of Mispillion River, Del.

District of Columbia.

✣Bids will be received until 10:30 a. m., Feb. 3, by Maj. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for hose, packing, rubber belting, wrought steel pipe, valves, ball cocks and water closet seats.

✣Bids will be received until 10:30 a. m., Jan. 28, by Maj. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for steel unloader masts, babbitt metal, pig tin, pig lead, nails, hack saw blades, 15-ton scales and cotton canvas under Canal Circular 755.

Louisiana.

✣Bids will be received until noon, March 5, by the Board of Commissioners of the Caddo Levee District, Shreveport, La., for bank protection work in the following named reaches, Caddo Parish, Red River, Right Bank, viz.: Scott's Slough Reach, approximate length of revetment 2,500 ft.; deposit required $700; bond required $12,500. Rattling Slough Reach, approximate length 2,500 ft.; deposit required $700; bond required $12,500. Havana Reach, approximate length 2,500 ft.; deposit required $700; bond required $12,500. Corner Place Reach, approximate length 2,000 ft.; deposit required $600; bond required $10,000. Fire Point Reach, approximate length 2,000 ft.; deposit required $600; bond required $10,000. Silver Point Reach, approximate length 2,000 ft.; deposit required $600; bond required $10,000; Twelve Mile Bayou Reach, approximate length 3,000 ft.; deposit required $800; bond required $15,000. Dixie Reach, approximate length 2,000 ft.; deposit required $600; bond required $10,000. Lucas Reach, approximate length 3,000 ft.; deposit required $800; bond required $15,000. Leonard Reach, approximate length 2,500 ft.; deposit required $700; bond required $12,500. Long Point Reach, approximate length 2,000 ft.; deposit required $600; bond required $10,000. Campo Bello Reach, approximate length 2,000 ft.; deposit required $600; bond required $10,000. Proposals will be received on any one or more reaches separately or upon the total number of reaches as a whole. Cash or certified check to the amount named as deposit must accompany each proposal. The right to reject any or all proposals is reserved. Other information as to location, character of work, terms of payment, manner submitting proposals, execution of contract and bond and time of beginning and completing of work, as well as blank forms for submitting proposals, may be had on application to the Board State Engineers, rooms 213-215 New Orleans Court Bldg., New Orleans, La., or to J. M. Sentell, President. W. A. Kerley is Secretary.

Mississippi.

✣Bids will be received until 2:30 p. m., Jan. 17, by Levee Board, Clarksdale, Miss., for the enlargement of levee sections 69, 70 and 71, including 375,000 cu. yds. of material and also levee sections 13H to 18H inclusive, including 850,000 cu. yds. T. G. Dabney is Chief Engineer, Clarksdale, Miss.

New Jersey.

✣Bids will be received by Col. Wm. T. Rossell, U. S. Engineer, 802 Army Bldg., 39 Whitehall St., New York City, until noon, Jan. 31, as noted in our last issue, for dredging in South River, N. J. The work to be done consists in dredging for extending the improvement of the South River in order to provide a depth of 6 ft. at mean low water from Bissetts to Old Bridge connecting the 6-ft. channel at Bissetts, previously dredged. The extension will be made from 60 to 100 ft. in width, depending upon the price paid for the work. The material is believed to be mud, sand, gravel and clay; the yardage is 260,000 cu. yds., and the amount of money available for payment of contractor's estimates is about $75,000.

✣Bids will be received by Col. Wm. T. Rossell, U. S. Engineer, Army Bldg., New York City, until noon, Jan. 31, as noted in our last issue, for dredging in Hackensack River, N. J. The work to be done in Hackensack River consists in dredging for making a channel and completing same in and near the mouth of the river, and from Little Ferry towards Hackensack, as far as the available funds will admit, in order to provide a depth of 12 ft. at mean low water to Little Ferry; thence to Hackensack of same depth. The bottom width of the channel to be 200 ft. in the lower part of the river and 150 ft. above Little Ferry. The material is believed to be mud, sand, gravel and clay, the yardage is about 200,000 cu. yds. and the amount of money available for payment of contractor's estimates is about $40,000.

New York.

✣Bids will be received until noon, Jan. 21, by Culluloo Park Co., Lawrence, L. I., New York, for the construction of approximately 2,000 lin. ft. bulkhead and 29,000 cu. yds. dredging for canal. Cyril E. Marshall, Marbridge Bldg., New York City, is Engineer. Plans and specifications may be secured at the office of the engineer on payment of $10.

✣Bids will be received until noon, Feb. 4, by Duncan W. Peck, Supt. of Public Works, Albany, N. Y., for the improvement of the New York State Canals as follows: Contract No. 42A, Erie Canal, section 5—For completing the construction of the canal, together with all incidental work between the Herkimer-Oneida County line and a point just east of Oriskany road, station 5775; length 8.96 miles. Contract No. 87, Erie Canal, section 4—For constructing a bridge over the Erie Canal at station 4078+00, near Rocky Rift dam on contract No. 20A. Contract No. 92, Erie Canal, sections 1 to 4; Champlain Canal, sections 1 to 2—Power plants, electrical equipment and machinery for operating and lighting locks and guard gate as follows: Erie Canal, Locks 2 to 19 inclusive; Champlain Canal, Locks 1 to 8 inclusive, and Guard Gate, station 293+70, Erie Canal. Contract No. 94, Erie Canal, sections 8 to 11—Power plants, electrical equipment and machinery for operating and lighting locks as follows: Erie Canal, Locks 26, 27, 28A, 28B, 29, 30, 32, 33, 34, 35.; Guard Lock, station 2413+42, and Guard Lock, station 2468+48, near the Genessee River. Contract No. 102, Erie Canal, section 7—For the construction of a steel superstructure for the Howland's Island Highway Bridge over the Erie Canal on contract No. 5A at station 5151+78.5+. Plans may be seen and detailed specifications, engineer's estimate of quantities, proposal blanks, form of contract and bonds required and other information for proposers may be had at the office of the Superintendent of Public Works at Albany, N. Y., at the office of the Assistant Superintendent of Public Works for the middle division at Syracuse, N. Y., at the office of the Assistant Superintendent of Public Works for the western division at Rochester, N. Y., and at the canal office, Spaulding's Exchange, Buffalo, N. Y. Copies of detailed plans or drawings may be obtained from the State Engineer and Surveyor at Albany, N. Y., upon payment to him of the cost of producing them.

✣Bids will be received until 2 p. m., Jan. 22, by Maj. Wendall L. Simpson, Assistant Purchasing Officer, Isthmian Canal Commission, 24 State St., New York City, for furnishing under Zone Requisition 6263-A, necessary suspended lights, ceiling lights, suspended fixtures, wall brackets, etc.

✣Bids will be received until 2:30 p. m., Feb. 3, by William Williams, Commissioner of Immigration, New York City, for the construction of a section of concrete and stone sea wall along southwesterly face of Ellis Island (main island) under Seawall Contract No. 1.

North Carolina.

✣Bids will be received until noon, Feb. 1, by Maj. H. W. Stickle, U. S. Engineer, Wilmington, N. C., for furnishing manila rope.

Texas.

✣Bids will be received until noon, Feb. 6, by Maj. T. H. Jackson, U. S. Engineer, Dallas, Texas, for furnishing sand for guard lock, Sabine-Neches Canal, Texas.

Washington.

✣Bids will be received until 2 p. m., Feb. 3, by Lighthouse Inspector, Portland, Ore., for furnishing material and labor necessary for the construction, erection and delivery of a light and fog signal building at Point Wilson, Wash.

Canada.

✣Bids will be received until 2 p. m., Jan. 31, by Raoul Renault, Secy.-Treas. Quebec Harbour Commission, Dalhousie St., Quebec, for the removal of from 2,500,000 to 5,000,000 cu. yds. of materials, chiefly sand, down to a depth of from 35 to 47 ft. below low water. Particulars of the required dredging may be obtained by applying to the Harbour Engineer's office, Quebec. Each tender must be accompanied by an accepted bank cheque for $50,000, made payable to the order of the Chairman of the Harbour Commission. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 5 p. m., Jan. 27, W. A. Duncan, City Clerk, New Westminster, B. C., for the construction of 1,782 ft. of cedar pile quay wall and for 30,000 tons of quarry run rock. For further information apply to A. O. Powell, Harbor Engineer, 511-14 Westminster Trust Bldg., New Westminster, B. C.

✣Bids will be received until 5 p. m., Jan. 20, by W. A. Duncan, City Clerk, New Westminster, B. C., for furnishing a 3-yd. clamshell dredge and three 2-yd. clamshell stiff-leg derricks; for construction of four wooden scows 38 ft. by 100 ft. by 8½ ft., one new or second-hand steam tug. Further information may be obtained of A. O. Powell, Harbor Engineer, 511 Westminster Trust Block, New Westminster, B. C.

✣Bids will be received by R. C. Desrochers, Secretary Department Public Works, Ottawa, Ont., until 4 p. m., Jan. 31, as noted in our last issue, for dredging in False Creek, Vancouver, B. C. This contract calls for making a channel 350 ft. in width from a point in English Bay where shallow water commences to the Great Northern bridge, just west of Main St., Vancouver. This channel is to be 20 ft. deep. About 3,000,000 cu. yds. of gravel and sand will have to be removed.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ENGINEERING AND CONTRACTING

Devoted to the Economics of Civil Engineering Design
and to Methods and Cost of Construction

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(See News Section Index for Prices, Bids Asked, Work Proposed and Contracts Awarded.)

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A Presentation of Some New Thoughts on Bridge Design.

We publish in this issue two papers on bridge design which are quite different in intention but which may properly be considered together since they are alike in presenting new ideas for consideration.

The first of these papers explains a new method of graphical computation of reinforced concrete arches. Compared with computation by the usual assumptions and analyses of the elastic theory, the new method greatly reduces the time required to arrive at final plans. We have this statement from others than the author of the method who have employed it in recent work. The author, moreover, presents the method as a development made to meet an actual task of arch designing, and he explains it in the article which we publish by applying it to a specific problem which came before him for solution. Altogether the analysis which we publish, therefore, has a practical character which commands attention.

The second paper is more general in its intention. It is a discussion of the possible necessary modifications in road bridge design and construction to meet the changed nature of road traffic and vehicle loadings. The automobile and the motor truck are comparatively new burdens for the road bridge, and the road roller and traction engine are so much more extensively used than formerly that they have become emphasized as bridge loadings. In brief the normal vehicle speeds and weights which road bridges must endure are now quite different from those of even a few years ago.

The article which we publish analyzes the nature and intensity of these new traffic loads and speeds and inquires into their effect on bridges. A repetition here of the results of the author's study is unnecessary. They indicate that design and construction of modern road bridges demand modifications of importance in the practice of the past. We urge this fact to our readers' attention because we have encountered frequent evidence showing that in country bridge work there was scant realization of any change in conditions existing due to modern road traffic.

Electrically Operated Contractors' Plant.

Three examples of the application of electricity in place of steam for the operation of familiar contractors' plant have come to the editors' table within a week and are presented elsewhere in this issue. None of these plants is yet capable of furnishing operating data for a close analysis, but in each case reason is given upon good authority for the adoption of electric power and that reason is at bottom always—increased economy. This reason is most candidly stated in the article by Mr. Frank Richards, discussing electrically operated air compressing plants on tunnel work in New York City. The completeness of the change from steam, the philosophy of this change and the advantages in city work of electric compressor plants are outlined by Mr. Richards, and deserve notice.

Cities generally no longer permit the freedom that they once permitted to contractors doing city work. The old careless liberty in encumbering streets and open spaces and in filling the air with smoke has of late years been materially curtailed. This change has increased contractors' costs. Hard coal, a better class of furnaces, and more careful stoking to avoid smoke are expensive compared with unrestricted choice in those matters of steam generation. Restriction of space free to be encumbered by power plant has put a premium on compactness in such plants. The demands for better hygiene and less obstruction in prosecuting construction work in cities makes some of the older methods in steam generation impossible and increases the cost of such as remain possible. Meanwhile, electric power has been cheapened.

For work outside of cities, as for example the electric drag line excavator work in the Calumet-Sag channel of the Chicago Drainage Canal, but where electric power is yet obtainable, this power presents a different claim. It is quite possible that delivered to the motors on the drag line described, electricity will cost the contractor as much as would steam delivered to engines. It, however, eliminates the contractor's fuel problem; it eliminates the endless task of delivering, say ten tons of coal per day, into the drag line excavator bunkers. There will be no teams and teamsters, no wagon equipment, no car demurrages, no purchasing agents or bookkeeper's work, no fuel supply troubles of any sort. In these gains the contractor expects to find the economy to him of electric power operated drag line machines.

Portable Towers for Depositing Concrete by Chuting.

On another page of this issue is described a portable wooden tower used as the main part of a concrete chuting system in constructing a large reinforced concrete grand stand at the University of Chicago. This is a step in advance of the stationary towers which have come into very general use within the last few years. It may, in a great many cases, eliminate the multiple tower system which includes one very high main tower where the mixing plant is located, and two or more auxiliary towers built to act as supports for the chutes and as centers to serve a given portion of the work. The portable tower will not need to be any higher than an auxiliary tower in a multiple system.

The cost of a wooden tower is about $600. If we figure that it will be good for only one job, that job must be large enough to warrant the expenditure of $600 to avoid using the ordinary wheelbarrow method. The difference in cost of placing concrete by the two methods is usually about 75 cts. per cubic yard of concrete so that if we have a job containing more than 800 cu. yds., or say 1,000 cu. yds., the chuting system will be the more economical. If the tower is built carefully and so that it may again be erected on other work it will pay to build one for smaller jobs. It will cost about $200, however, to erect such a tower on any job, so that on a job containing less than 200 cu. yds. it would not be practicable to use a tower, especially a tower of such size.

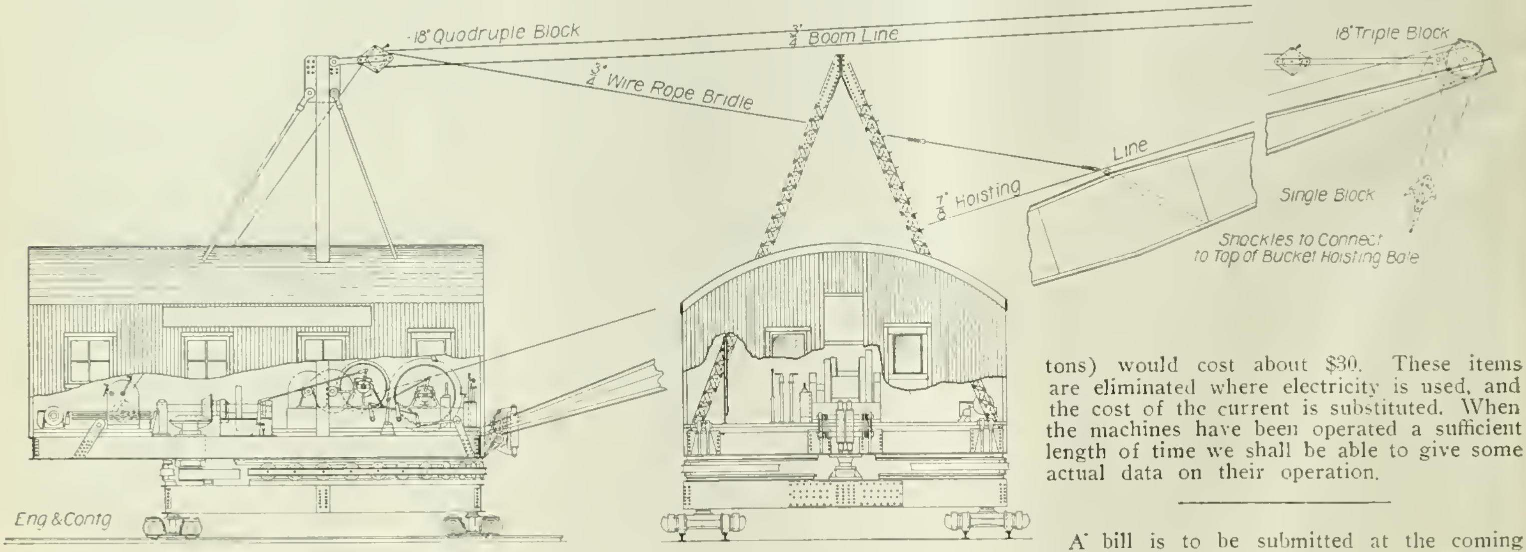
There will be no difference in the cost of concreting as between wooden and steel towers as their operation is practically the same. The difference in first cost is the main consideration and for towers 75 ft. high this is about $400. The wooden tower can not, however, be expected to maintain its rigidity for more than a half dozen jobs and there is no doubt that, if a permanent tower is desired, a steel tower will be more economical than a wooden tower after five or six jobs have been built. This is very well illustrated by comparing the cost of setting up. Assuming that the cost of the erection of the wooden tower is $200 and the cost of erecting the steel tower is $100, we have added $800 to the original cost of the wooden tower by the time it has been erected for its fifth job. The money invested in it then is $600 + $800 or $1,400 By the time the steel tower is erected for its fifth job the money invested in it is $1,000 + $400 or $1,400, an equal amount to that invested in a wooden tower. The wooden tower may still be in fair condition but it is reasonable to believe that the steel tower will remain in good condition for a much longer time and it will cost only about half as much to erect. We may assume, therefore, that a portable wooden tower is economical for jobs above 1,000 cu. yds. and until it has been erected five times, and that a portable steel tower would be more economical if its use is contemplated for more than five jobs.

GENERAL ARTICLES

Large Electrically Operated Dragline Excavators for the Calumet Sag Canal.

(STAFF ARTICLE.)

Two of the largest electrically operated drag line excavators ever built have been installed on Section 5 of the Calumet Sag Channel of the Sanitary District of Chicago. They are Ligerwood-Crawford machines with 100 ft steel booms and are equipped with 2½ cu. yd. Page buckets. The machines present the appearance in general outline of the ordinary steam-operated revolving dragline excavator except that the machinery is completely housed in and the only smoke stack is that from a small coal stove placed on board during cold weather. The machines each weigh about 120 tons.



Arrangement of Operating Machinery of Electrically Operated Dragline Excavator.

The arrangement of the operating machinery is shown in the accompanying drawing. The double drum hoist is operated directly by a gear on the shaft of a 112-h.p., 60-cycle, 3-phase motor, making 690 r.p.m. A 52-h.p., 60-cycle, 3-phase motor, 855 r.p.m., operates the bevel swing gear as shown. The air brakes are operated through power furnished by a 25-cu. ft. motor-driven air compressor. The current is furnished by a public service company and is brought from Blue Island, several miles away, over a high tension line at 33,000 volts to a transformer house on the work where the voltage is stepped down to 2,300 volts. It is again stepped down to 440 volts through a portable transformer which is attached to the dragline machine by a cable and is pulled along on its trucks as the machine moves ahead. On the machine the current is stepped down to 110 volts for the incandescent lamps and to 35 volts for the searchlight which is placed on the front of the house and just under the boom.

The machine is operated by two men on board and two men outside for handling the track. While moving to position for commencing work one of the machines was moved 410 ft. in one day. The track sections upon which the machine runs are 15 ft. long and are built up solidly. They are built of a solid 3-in. plank bottom upon which are fastened the ties set about 8 ins. apart. On top of the ties are 8x16-in. timbers on edge under the 90-lb. rails. The whole is bolted together and has eyebolts near the ends of the 8x16-in. timbers so that it can be handled by a four-way chain.

The work upon which the machines are engaged consists of about 8,000 ft. of canal section from 31 to 37 ft. deep, 36 ft. wide on the bottom and with slopes of 2 on 1. The south berm will be about 90 ft. wide or will extend 150 ft. from the center line of the canal and the north berm will be 40 ft. narrower, according to the plans. The canal itself was described in our issue of Dec. 17, 1911. About 8 to 12 ft. of the bottom work on Section 5 will be rock and it is not yet decided by the contractor how this will be handled, though it is likely to be handled in skips by a derrick with a very long boom. The dragline machines are set on opposite banks. The one on the south will excavate half the canal section in two cuts.

That the use of electricity will be economical is illustrated by machines in California which actually used 1/5 of a kilowatt per cubic yard of material handled. The cost of the current there, was on a sliding scale ranging from ¾ to 1 ct. per kilowatt hour. On the New York Barge Canal electrical machines were used where the cost of current at about 2½ cts. per kilowatt hour was about 1 ct. per cubic yard

The reliability of the power is a most important argument in favor of the use of electricity. The uncertainty of securing fuel and water, especially in bad weather is a source of trouble to the contractor.

The cost of hauling coal for a steam machine of this size would likely amount to $40 per day, and the coal itself (about 10 tons) would cost about $30. These items are eliminated where electricity is used, and the cost of the current is substituted. When the machines have been operated a sufficient length of time we shall be able to give some actual data on their operation.

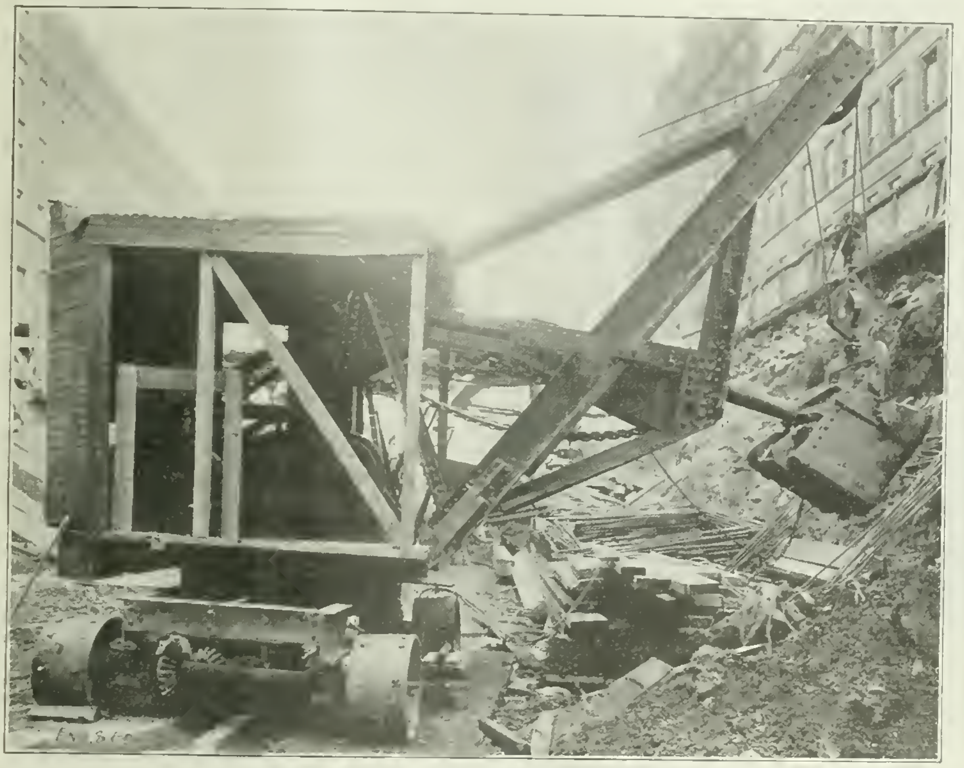
A bill is to be submitted at the coming session of the Oregon Legislature by I. N. Day, Senator from Multnomah County, having for its object the harnessing of the entire current of the Columbia River, developing a minimum of 100,000 H.P., the project to be prosecuted and operated by the states of Oregon and Washington. The bill will provide for the immediate appointment of a commission of competent hydro-electric engineers to investigate the feasibility of the project and to report to the coming Legislature; for the acquisition of the property necessary for the construction of a canal and power plant in case the commission's report is favorable; for the moving of the Oregon State Prison to the scene of the work, or the location of a branch prison there, and the employment of the prisoners on the project; and will embody a resolution addressed to the Washington Legislature, asking that body to appoint a commission to work with the Oregon commission, and urging the state to co-operate with Oregon throughout in the prosecution of the enterprise.

The Use of Electrically Operated Shovels for Building Foundation Excavation in Boston.

(Contributed.)

During the last few months there has been considerable building work in course of construction in the very heart of Boston, where buildings are huddled together and where the nuisance of smoke even from contractors' outfits would not be tolerated. This is one of the important reasons why the contractors for some of these buildings have used the electric shovel for digging. Notable work on which the electric shovel has done the entire excavating include the new City Hall on Court St. and the Merchants' Bank Building on Exchange St.

The Boston Smoke Law became effective July 1, 1910, but it was not until the very end of November of that year that a smoke inspector was finally appointed and set to work on the enforcement of the law. Since that time the enforcement has been most rigorous, but as there has been wide co-operation between the owners of power plants, engineers, and firemen, the smoke law has been quite successful. Contractors have kept to the law, and the use of the electric shovel in excavation is an example of what they have done in this connection.



Electrically Operated Shovel for City Work.

The area excavated for the new City Hall measures about 225 ft. by 60 ft. and on all sides are buildings, one of them being Young's Hotel, making any noise or smoke particularly objectionable. On the site was formerly the old Boston Court House which was torn down and it was then necessary to excavate on an average to a depth of about 20 ft. The soil was fairly loose at the top, but near the top clay and rocks were encountered. After thoroughly studying the conditions, Wells Bros. Co. of New York, the building contractors, decided to use an electric shovel for this work, and secured a Type No. 0 Thew electric shovel.

The operation of this electric shovel in the center of the city attracted much attention, for even the layman could recognize the many advantages of handling excavating work in this manner over hand labor. The shovel was operated by current supplied direct from the Edison lines which were brought in at one side of the street.

The teaming was done by two horse 40-cu. ft. end dumping wagons which had to descend rather a steep incline into the excavated part. Each team made on an average of from eleven to twelve trips per day of nine hours. About 28 or 30 of these teams were kept busy and it only took a wagon about 10 minutes on an average to go from the street level down to the electric shovel, get a load and return to the street. It only took two lifts of the shovel to completely fill one of the wagons. A hoist and cable was used to assist the wagons up to the street level. The actual time required for three men to fill by hand labor one of the wagons with loose earth, where no digging was required, was 15 minutes. It can readily be seen that the electric shovel effected a big saving in time over hand labor to say nothing of keeping more teams busy and doing more work. It was noticeable that the shovel was not only useful in excavating but was also used for lifting rocks upon the wagons, a chain being simply swung around the rock and fastened and the signal given to the operator.

Certainly the operation of an electric shovel is a one man job. The operator stood by the levers and had absolutely no assistance. No fireman was required, and the question of water supply was avoided, together with that of transportation of fuel. The electric shovel had the further advantage that in cold weather there was no danger from freezing, while in the hot weather the operator was not troubled by discomfort due to boilers. The banking of fires at night, the delay of getting up steam in the morning, and frequently the necessity for a watchman when the shovel was not in operation, were all features which were appreciated by the contractors in using this electric shovel.

The Central Construction Co. of Boston have used a type No. 0 Thew steam shovel in a good deal of the work in and around Boston, and it is interesting to note that when operating in the city of Boston, they found it was necessary in order to be free from fines on account of breaking the smoke law to use different kinds of coal for power. In order to be safe it was necessary for them to use a mixture of two-thirds of a ton of soft coal costing $4.50 a ton, and one-third ton of hard coal, costing $12 a ton. This made the cost of coal $7 per ton, and even then the contractors state they had to be very careful as to firing.

The labor cost of operating a Thew Type No. 1 electric shovel with a 1 cu. yd. dipper on railroad work in Canada figured out as .029 to .037 per cubic yard. While the conditions were different, it may be interesting to note this cost with the figures furnished by the Central Construction Co. of Boston in operating a Thew type No. O steam shovel:

Item.	Per day.
Engineer	$6.00
Fireman	3.00
Two truckmen at $2.25	4.50
Coal at $4.50 per ton	1.25
Total	$14.75

The average output for an 8-hour day was about 350 cu. yds., making the cost per cubic yard .042.

The electric shovel operated on the work in Boston was mounted upon traction wheels so that it could be moved from point to point under its own power. The traction truck was equipped with both hand and power steering devices. In excavating material it was necessary to crowd the dipper forward into the material—a horizontal motion, and second, to hoist the dipper upward through the material—a vertical motion. The dipper cleaned out the dirt to the grade upon which the shovel was operated. This machine can be successfully run on ascending, descending or side-hill grades up to 10 per cent in slope. It was noticeable that the operator had at all times an unobstructed view of the dipper and was able to handle the machine in a very effective manner.

The use of a shovel of this character saves a great deal in team time. The crews ordinarily employed in hand shoveling will load a 2-yard wagon in from 6 to 10 minutes, while the shovel will do the same work in from one to two minutes. The machine offers the further advantages of getting the teams away quickly when bunched and when the delays in loading affect not only the team being loaded, but the others that are waiting. It is believed that an average saving for the shovel in team time of three minutes per yard loaded is conservative. This represents a saving of about $9 or $10 daily, an amount almost equal to the entire cost of operating a shovel with a rated capacity of 35 to 40 cu. yds. per hour.

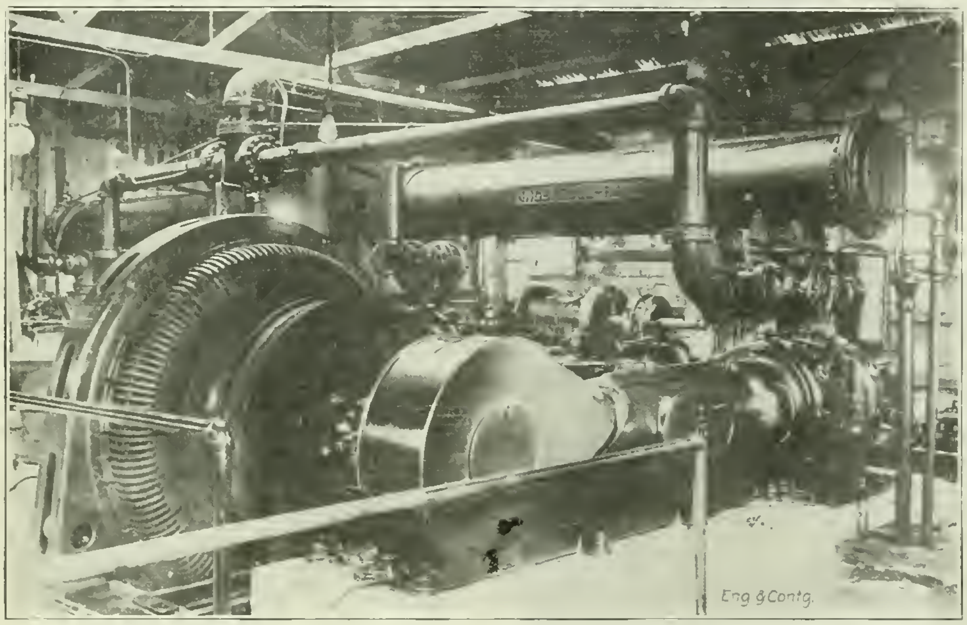
Electric Driven Air Compressors as Exemplified by Plants for Underground Work in New York City.

Contributed by Frank Richards, 229 W. 135th St., New York City.

Changes in compressed air practice, or, more precisely, in air compressing practice, have been succeeding each other with astonishing rapidity since the present century began, and nowhere more noticeably than in New York City and its immediate vicinity. Here compressed air has found one of its great opportunities. The North River and the East River Tunnels and the subway work, and the latest of all, the great water tunnel, have not provided the ways and means for what is best in compressed air practice, but the magnitude of the undertakings has made it worth while, and even imperative, to adopt the most economical and reliable apparatus procurable regardless of the cost of installation.

It followed, then, that the several air compressing plants employed by the great contracting companies for the works but recently completed were regarded as models of up-to-dateness in every detail which could promise economy and precision of working, and the contractors who owned and operated them and the designers and builders who were their sponsors were proud of them, and the technical press wrote appreciative descriptions of them as a labor of love.

These plants referred to were steam driven, with all the accepted steam and power economizing devices, which need not here be enumerated in detail, and the air ends also provided for two stage compression with efficient intercooling and automatic regulation which allowed no power to run to waste when the load was light. Although the work for which these compressors were employed was necessarily of a temporary character, there was no temporizing or makeshift about them, and day by day, comparing their performance with that of "simple" machines which might have done the work, they piled up the savings and paid for themselves over and over. They made such an excellent showing that, humanly speaking, we might have said that these machines, although their first job was done, would be sure of employment again as soon as there was more work in their line to be done. They were still practically good as new, so there could be no plea of old age suggested against them.



Electrically Driven Air Compressor Plant for Lexington Ave. Subway Work, New York City.

The first batch of New York river tunnels, the first subways, the Pennsylvania terminal, have all been completed. Now we have the great water tunnel being driven the entire length of Manhattan and through Brooklyn to Staten Island; and subways without end are under way, but so far as the present writer is informed not one of these compressors of such excellent record has come into play. While these fine steam-driven compressors were at work other things also were working. Especially was electricity having a phenomenal business development. Splendidly equipped electric light and power plants of almost unlimited capacity were being installed in New York, as well as in every large city, and these, taking advantage of every possible economy in steam generating and power development, have been enabled to offer current for driving air compressors and for other power purposes at rates which have practically compelled acceptance.

The electric drive under such circumstances is an attractive proposition. The first cost of the electric driven compressor is much less than that of the steam-driven plant with boiler, piping and other appurtenances, and fuel handling and storing arrangements. The operating force required is reduced to one-fourth or less and the ground occupied is also minimized, with no exacting requirements as to location, so that generally the compressor may be located much nearer the work with a great saving in air pipe lines. The power required is always ready without preliminary notice and the power cost stops entirely when the compressor stops.

The advantage of the electric drive thus offered has been so evident from a strictly business and money-making viewpoint that it could not be ignored, and new electric-driven plants have been installed for the extensive new lines of work because it was simply the cheapest thing to do.

The installation which we get a glimpse at in the half-tone herewith is that of the Bradley Contracting Co., New York, which has a contract for a large portion of the Lexington Ave. subway. It is located at 96th St. and First Ave., close to the East River, and it is typical of the plants employed upon this and similar work, there being a score of compressors of the type here shown now in operation in greater New York.

The plant comprises five Ingersoll-Rand, Class PE-2, electrically driven, cross-compound compressors, with cylinders 25¼ ins. and 15¼ ins. diameter and 21 ins. stroke, delivering air at 100 lbs. gage, with an individual free air capacity at 187 r. p. m. of 2,110 cu. ft. per minute, or an aggregate of 10,550 cu. ft. These machines have General Electric direct connected self-starting synchronous motors with belted exciters, 365 brake horse power, 6,600 volts, 3 phase, 25 cycle, the rotor mounted on the crank shaft with a bearing in each frame, this arrangement giving a greater efficiency than that of a high-speed belted motor. Current is supplied by the New York Edison Co. The rotor of the motor is heavy enough to give a sufficient flywheel effect, in this assisted also by the pulley which drives the exciter. A speed of 187 r. p. m.—654 ft. piston speed—is high for a compressor of this size, but it is easily practicable with this type of machine by reason of the massive design, the perfectly maintained alignment, the equitable distribution of the load and the flood system of lubrication.

It is not necessary to mention in detail the special features of design and construction in these machines. The frame on each side is of the heavy duty engine type, supported for its entire length upon a massive and carefully prepared foundation, while the cylinders resting on sole-plates are made underneath with full box construction, the box forming a settling chamber for the water jacket.

The cranks, crossheads and connecting rods can all be got at while the machine is running, through the doors on the oil guards and through a larger doorway on the side. A constant flow of oil is delivered to the main bearings, the crank pins and crosshead pins, and also to crosshead slides and piston rods. The flow of oil begins as the machine starts and its delivery is proportioned to the speed, all the oil returning continuously to the oil reservoir. For lubricating the air cylinders, where the desired quantity is a minimum, sight feed lubricators are provided.

A special conduit running lengthwise under the building is provided for the free air supply. The air inlet valves are of the "Hurricane" piston inlet type and the discharge valve "Cushioned Direct Lift," both having the highest practicable endorsement of long and extensive successful service.

A large intercooler is set transversely above the cylinders, forming the air connection between them. In this case special cooling tubes of "admiralty bronze" are provided, so that the more or less saline water of the East River may be used for the circulation. The tubes are in pairs, an inner and an outer; the cooling water enters the lower row of tubes and passes back and forth between the inner and the outer tubes, discharging from the top row. Leaving the intercooler the water passes around and under the high pressure cylinder and thence to the jacket of the head, from below, discharging through the side of the cylinder. The air pressure at the intercooler is 27 lbs. gage. After leaving the intercooler and before entering the high pressure cylinder the air passes through a separator which takes care of all the water liberated by the intercooling.

The compressor runs at constant speed, and the means provided for controlling the air output according to the demand is an interesting and important feature. Each end of each cylinder is provided with an auxiliary clearance chamber, and when communication is automatically opened between any clearance chamber and its cylinder the air compressed for that stroke is not discharged into the receiver and pipe system, but merely enters the clearance chamber, and upon the return stroke of the piston the force which has been expended in its compression is, upon its re-expansion, given back to the piston, and little of the power is lost. According to the number of these clearance chambers which may be thrown into action, at once, the compressor may be working at full load, three-quarter load, half load, quarter load or no load, and the power consumed will be according to the actual air delivered. In two stage machines, such as those of the Bradley Contracting Co., clearance space in corresponding proportion is used simultaneously on both the low and the high pressure cylinders, thus maintaining the ratio of compression constant and effecting an equal apportionment of the load.

From the preceding it will easily appear that a modern air compressor of the highest type is by no means so simple a machine as some might easily imagine, but all the refinements have full business warrant for their being.

From the compressor house the air is carried by a 10-in. pipe westward to Lexington Ave., about half a mile, and then it is led away both north and south through long and increasing distances through 8-in. pipes and smaller. From the nature of the work it is impossible to make any intelligible comparison between the power used at the compressor and the power actually realized where the work is going on, as that is so widely distributed, so intermittent and of such varied character. The only thing until the work is finished is to have enough air always ready.

The 10-in. pipe from the compressor house is laid in the gutter in 96th St., close to the curb, being carried overhead to cross three avenues. In the middle of each block a sliding expansion joint is placed and the long vertical pipes and curves at the crossings also yield more or less. As the air starts on its journey its temperature is not less than 200°, but before Lexington Ave. is reached not the slightest trace of heat remains, which shows how quickly the air cools off and the futility of ever attempting air reheating except close to the work.

Canadian Cement Production.—The increase in annual production of cement in Canada since 1905 has been nearly fourfold. The total quantity made in 1911 was 5,677,539 bbls. of 350 lbs. net each, as compared with 4,396,282 bbls. in 1910, an increase of over 29 per cent. The consumption of cement in Canada in 1911 is estimated at 6,354,831 bbls., of which 661,916 bbls. were imported. An average of 3,010 men were employed in the industry and wages paid for the year aggregated $2,103,838.

Method and Cost of Constructing a Concrete Lined Shaft by Sinking Through Overburden and Enlarging a Drift Raised Through Ledge Rock.

The shaft described was built to connect the ninth level of the Negaunee Mine, Michigan, with the surface, 806 ft. above. The depth of earth over the rock was 68 ft., so that the depth of shaft in ledge was 738 ft. The procedure was as follows: (1) A test pit was sunk through the earth to rock; (2) a rectangular shaft was raised from the ninth level to meet the test pit; (3) a circular shaft was sunk around the test pit to rock; (4) the rectangular shaft in rock was enlarged to the same circular section as the shaft through the earth covering; (5) the whole shaft was lined with concrete. The following description in detail of the work is extracted from a paper by Mr. S. R. Elliott, before the Lake Superior Mining Institute.

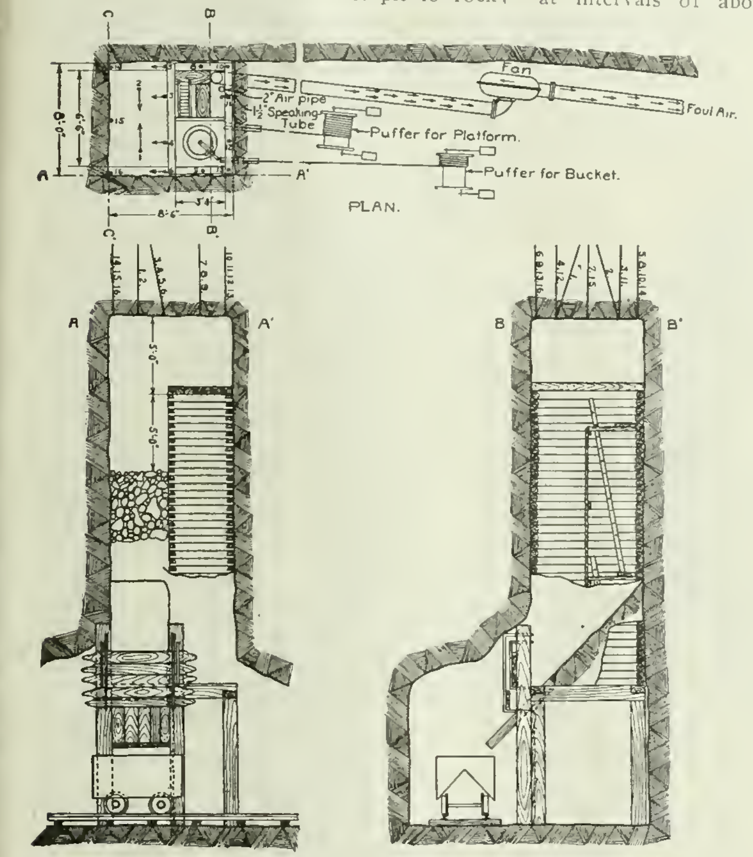


Fig. 1—Sketch Showing Plant and Arrangement of Works for Raising.

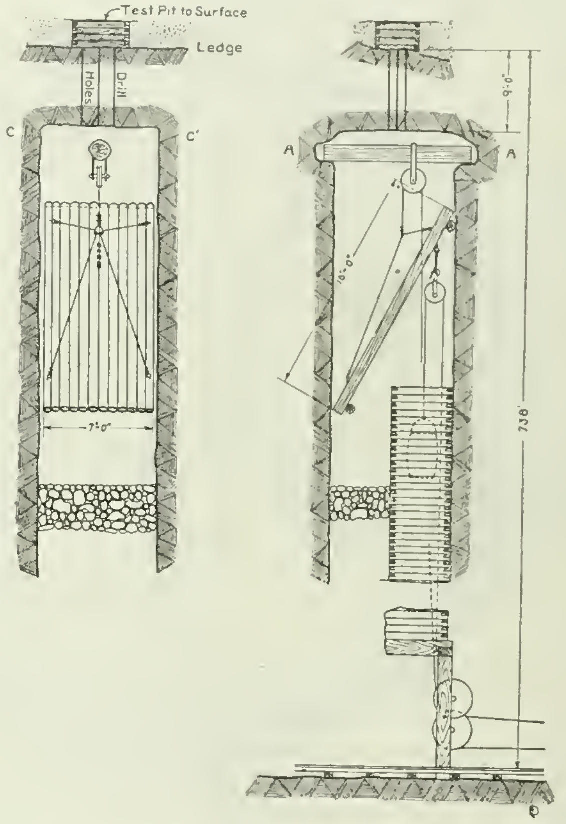


Fig. 2—Sketch Showing Arrangement for Running Cribbing in Raise.

CONSTRUCTING RAISE.

Figure 1 shows the arrangement of workings and plant at drift level. The cribbed compartment shown was subdivided by 2-in. plank into two compartments, one of sufficient size for the pipes and the ladder road, and the other for a small bucket to be used in hoisting tools and cribbing. Figure 1 shows the method of supporting the cribbing, and the arrangement of the chutes from which the rock was loaded into motor cars. Directly below the dirt compartment a bench of solid rock was left, running back on the same angle as the lip of the chute. This served as a permanent indestructible bottom. The cribbing was accurately framed from 6 to 8-in. round tamarack timber. Each piece was faced on one side in order to maintain the same dimensions on the inside of the compartments. This greatly aided the miners in building up the cribbing plumb and made rapid hoisting practical, as there were no irregularities to strike the bucket. After the cribbing had been put in line it was necessary to wedge it very firmly in order to keep it from shifting.

Drilling and Blasting.—The crew was composed of nine miners, three on each eight-hour shift. While drilling the cuts each miner used a Waugh No. 8 C stoper. It was found by experience that it was not advantageous to blast a deeper cut than 5 ft. on account of the breaking or shifting of the cribbing. The best results were obtained by drilling the round as shown in Fig. 1. Before blasting, the cribbed compartments were covered with a 6-in. sollar, one small hole being left in the ladder-road side to allow a man to pass through after blasting. The cut, consisting of 16 holes, was blasted with fuse in three rounds as follows: First holes 1 and 2; second, 3 to 9; third, 10 to 16. In order to make it practical to blast with fuse, at intervals of about 200 ft., small drifts about 8 ft. long were driven from the ladder compartment. Each drift was protected by a door. A connection was made with the air pipe to prevent the possible danger of the men being knocked out if, for any reason, the fan failed to work. It would have consumed too much time for the men to have gone to the bottom after the raise reached a great height. Before blasting the crew would enter these small drifts and suffer no discomfiture even when the breast was not over 30 feet above them.

Hoisting.—A small puffer was located on the level and run by compressed air. After each cut was blasted and the loose rock in the back well trimmed, a stout pole was wedged across the raise as close to the back as possible. A 10-in. sheave was then hung from this pole so that the rope leading to the bucket was in the center of the hoisting compartment, the other end passing down one corner of the compartment to an angle sheave and then to the puffer. The signals were all given through a speaking tube which was simply a 1½-in. pipe extending from the puffer to the top set of cribbing. An oil barrel, reinforced in the bottom with wood and on the side with strips of steel, was used in preference to an iron bucket. On account of its depth tools and cribbing could be hoisted with little danger of them falling out. The bulge in the center lessened the possibility of the bucket catching in the cribbing. All tools, supplies and cribbing were hoisted to the breast, thus saving much time and labor.

Ventilation.—On the level at a short distance from the raise a fan capable of exhausting 2,040 cu. ft. per minute was set up. Ten-inch spiral-riveted pipe with flanged joints every 10 ft. extended from the fan up into the ladder compartment. The upper end of the pipe was kept as close to the last set of cribbing as possible. The discharge pipe, 10 ins. in diameter, was made of galvanized iron but was not perfectly tight. This fact caused a small amount of trouble. This pipe extended to an abandoned part of the mine. The foul air was discharged behind a tight door which prevented any of it re-entering the main drift and contaminating the pure air which was needed in the breast of the raise. After blasting the fan was started, the gases being sucked into the pipe and the pure air from the main drift flowing naturally to the breast. It was found to be a great advantage to run a piece of old hose above the sollar and discharge compressed air directly after blasting, as this hastened the removal of the gases. Before this was done there was a tendency for the air current to pass below the sollar. It was found that the gases were all removed within fifteen minutes, but as an extra precaution the men did not return to work for thirty minutes. It was never found necessary to run the fan except while blasting the rounds.

Progress.—On Jan. 1, 1909, the top of the raise was 20 ft. above the rail in the drift. On July 19, 1909, a hole was located in the back of the raise to strike the center of the testpit, the size of which was 2x3 ft. The first attempt was successful, showing that the raise had been brought up with great accuracy. The total distance from the rail to the bottom of the test-pit is 738 ft. The last 5 ft. was not blasted out until a later date. From the first of January up to the last of April the ground was quite favorable for drilling, but the upper 250 ft. was extremely hard, being sideritic chert. The greatest amount raised in any one month was in March, the footage being 142. No difficulty was experienced in completing the raise and if it had been necessary it could have been taken to a much greater height. As the raise increased in height the broken rock was allowed to accumulate, only enough being drawn out each day to keep it level with the top of set of cribbing.

Removing Cribbing.—Ordinarily in a raise which is to be stripped to a larger size, for a shaft, the cribbing is taken out during the process of sinking. Before blasting the men go down and remove and hoist to the surface the proper number of sets in order to make sufficient room for the rock which will be broken by the stripping cut. This operation is slow, as the cribbing is difficult to remove. The miners have to stand on broken rock which is liable to settle without warning. The cribbing is so damaged that it is useless for other work. The most serious disadvantage, however, is on account of the great danger of the raise hanging up. This almost invariably occurs. It is extremely difficult to break these jams and it is often necessary to hoist a large amount of rock to the surface. In a raise, over 700 ft. in height, a jam occurring near the bottom would cause a great loss of time and expense. In order to avoid this jam and save the cribbing for other uses, it was decided to strip the entire raise of all cribbing. If this could be done the chances of the rock hanging up would be extremely small as the outside dimensions would then be about 9x9 ft. The method of removing the cribbing was as follows: A platform 7x16 ft. was made out of 8-in. round tamarack poles bolted to cross-pieces as shown in Fig. 2. A wire rope was attached to each corner, their lengths being so adjusted that when the platform was suspended it would hang at an angle of 65° from the horizontal. Near the back of the raise hitches were cut and a strong timber put in place. From this timber a 10-in. sheave was hung. The platform was hoisted one piece at a time and bolted together in the raise. A ⅝-in. wire rope passed over the sheave and was attached to the ropes from the four corners of the platform. The other end passed through a slot in the center of the platform, down one side of the hoisting compartment, to a small puffer on the level below. The angle of the platform was so steep it would be practically impossible for any piece of rock, which might fall from the sides, to break through it. As the cribbing was removed and lowered to the level in the bucket, the platform was lowered and kept at the proper height above the heads of the men, protecting them absolutely from the fall of any ordinary mass of rock. The sheave for the bucket, which was used to lower the cribbing, was supported from the platform. In 22 working days the entire raise was stripped of all cribbing, pipe and plank. No serious accident occurred during any part of the work in the raise.

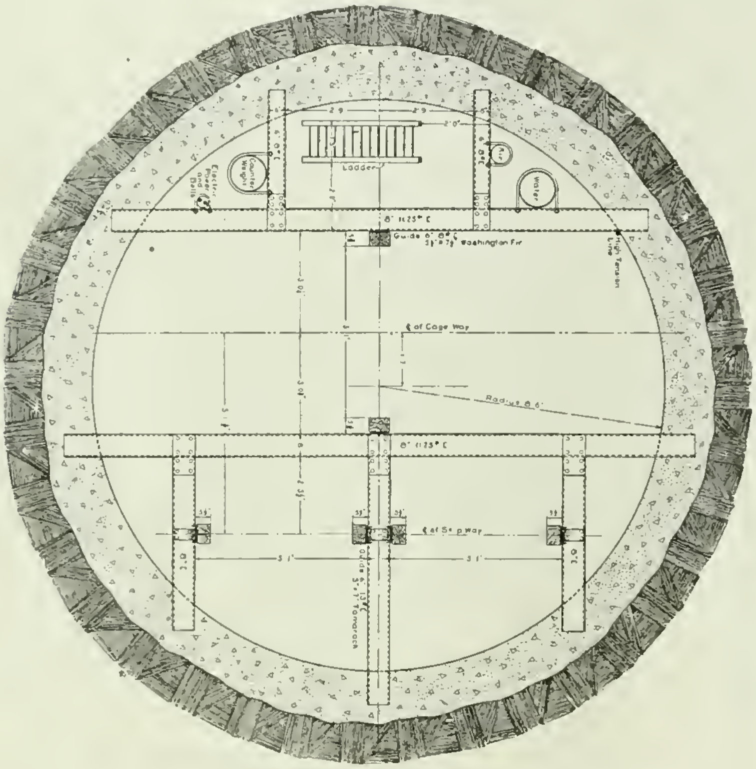


Fig. 3—Section of Completed Concrete Lined Shaft.

The following figures show the cost of the raise:

	Labor.	Supplies.	Total.	Cost per ft.
Miners	$5,291.29		$5,291.29	$7.17
Fuse, powder, caps, etc....		$1,238.25	1,238.25	1.68
Drilling supplies and tools....	726.79	331.23	1,058.02	1.41
Trammers	424.62		424.62	.58
Candles		110.27	110.27	.15
Cribbing	666.71	634.12	1,300.83	1.76
Timbering	690.23	190.00	880.23	1.20
Nails, iron and bolts		41.39	41.39	.06
Proportion electric haulage.	199.80	50.14	249.94	.34
Proportion of air charge...		260.00	260.00	.35
Shop labor and teaming		73.67	73.67	.10
Puffer	93.05	102.70	195.75	.27
Pipe and fittings	270.84	113.85	384.69	.52
Buckets and sheaves	74.60		74.60	.10
Total	$8,437.93	$3,145.62	$11,583.55	
Total cost per foot	11.43	4.26	15.69	$15.69
Cost of removing cribbing.......			1,067.59	1.45

SHAFT CONSTRUCTION.

It was decided to make the shaft circular and to line the walls with ½ ft. of concrete, inside diameter to be 17 ft., which is sufficiently large to enclose a rectangular shaft of standard dimensions of 10 ft. 10 ins. x 14 ft. 10 ins. inside measurements. Fig. 3 shows the plan of the shaft and the general dimensions.

Sinking in Sand.—After the raise had been blasted through to the test-pit, work was commenced on the surface to mill the sand into it in order to make a sufficiently large conical shaped hole to provide head room for installing the concrete equipment. The milling of this sand would also decrease the distance which it would be necessary to sink to the ledge. In a very short time this work was stopped. The sand, in falling for a distance of about 800 ft., packed so tightly in the bottom of the raise that it prevented the water, which came through the rock, from reaching the level. When the sand became saturated it would rush out with great force. It was therefore not practical to handle it in this way. A derrick, with a 90-ft. boom, was set up on the surface and the remainder of the sand hoisted. At a point 40 ft. below the original surface a hexagon-shaped wooden shaft, 24 ft. inside diameter, was built. The sets were placed 5 ft. apart and 3-in. plank spiked to the outside. The alternate planks were cut 5 ft. 6 ins. and 11 ft. in length. These served to tie the adjacent sets together, making the structure quite rigid and preventing it from getting out of line. The shaft was allowed to drop slowly to the ledge as the material below was excavated.

Concrete Equipment.—A bed of gravel was found, at a point a short distance from the shaft, which was suitable for the making of concrete. From the conical shaped hole around the test-pit a cut 12 ft. deep was made to the gravel-pit and a track put in. Four feet below this track two pockets were built, the capacity of which was 35 cu. yds. These pockets were provided with chutes from which the gravel could be drawn into a small car holding the exact amount for a charge. This car dumped into the hopper of a batch-mixer which was at a still lower elevation. Below the mixer the concrete was dumped into a kibble which rested on a small truck. This truck could be pushed to the center of the shaft, the kibble attached to the hoisting-rope and lowered, and the concrete dumped into the forms. The crew of five men on the surface could easily handle 35 cu. yds. of concrete on an eight-hour shift, or enough to complete 10 ft. of shaft. The gravel contained a small amount of loam and for this reason the proportion of cement used, about 1 to 5, was quite high. The water was heated to boiling by exhaust steam, the tank being arranged with a gage so that the proper amount was used with each charge. In the winter months the gravel was also heated by steam pipes in the bottom of the pockets. The cement house was located close to the edge of the conical shaped hole. A slide was built from one end of the house to the elevation of the hopper of the mixer. The bags of cement were thrown into this slide until it was full. As one bag was removed another would slide into its place. The general plan is shown in Fig. 4.

Drilling and Blasting.—The crew in the shaft consisted of three miners on three eight-hour shifts. One man on each shift acted as boss and was paid $3.25; the others received $2.90 per shift. On Jan. 3, 1910, sinking in rock was started. This consisted of drilling a sufficient number of vertical holes, which depended upon the hardness of the material, and blasting them into the raise. After a careful investigation it was decided that the best progress could be obtained by using Murphy hand-sinkers. These machines drill rapidly, no time is lost in setting up, and they do not get out of order easily. While the round is being drilled each man in the shaft uses a machine. The round usually consisted of 18 holes 6 ft. deep. In iron ore formation these holes could be completed in one eight-hour shift by three men. They were blasted in one operation by electricity, delay-action fuses being used. The general plan was to strip to as great a depth as practical. The sections were made multiples of 10 ft. and varied from 20 to as great as 90 ft., according to the hardness of the rock. After each blast the entire section was examined and carefully trimmed. If it could not be trimmed solid, stripping would be discontinued and preparations made to commence concreting. It is a great advantage to make the sections as long as possible as considerable time is lost in changing from one operation to another.

Forms for Concreting.—The concrete forms consist simply of rings which are 5 ft. high and 17 ft. in diameter, made in four sections in order that they might be collapsible. They

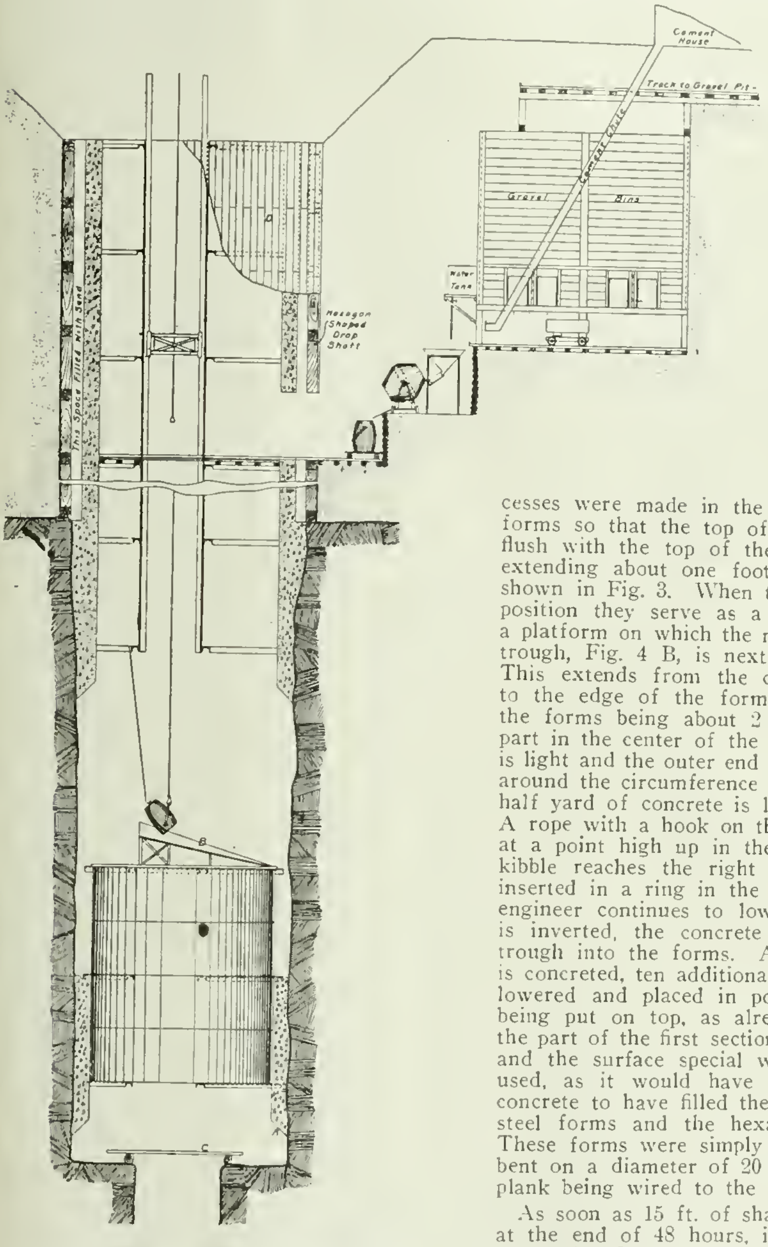


Fig. 4—Sketch Showing Plant for Constructing Concrete Lining.

were properly braced on the inside to withstand the pressure of the concrete. When a certain section had been stripped the engineer would locate the elevation for the bottom of the first form. The procedure is to put in a number of short pieces of timber, Fig. 5 A, around the collar of the raise, and level them properly, to form a base for the floor upon which the forms will rest. The floor, Fig. 5 B, was made out of 2-in. hardwood plank, 7 ft. long, sawed on a radius of 10 ft., which is the radius of the outside diameter of the shaft. When the floor is laid on the blocking, the ends of the plank being shoved up against the irregular wall, it will completely cover the circumference. The small openings next to the rock are filled in with short pieces of wood to keep the concrete from running through. The plank being only 7 ft. long a hole about 6 ft. in diameter is left in the center. In order to make it possible to remove the floor without cutting any of the pieces, one of the plans, Fig. 5 C, is laid down with the wide end towards the center. This can be easily pulled out and the others will then come freely. The first form lowered is a special one intended to cut off the lower face of the concrete at an angle of 45°. A regular 5-ft. section is placed in position by dropping plumb lines from above. The special form fits snug up against this 5-ft. section, the upper circumference being 1½ ft. above the floor. The steel sets, which divide the shaft into compartments, are lowered and placed accurately in position by lines dropped from above. They are then attached to the forms by simple clamps which keep them from shifting. Recesses were made in the top of two of the forms so that the top of the sets would be flush with the top of the forms, their ends extending about one foot into the walls as shown in Fig. 3. When the sets are once in position they serve as a means of building a platform on which the men can stand. The trough, Fig. 4 B, is next placed in position. This extends from the center of the shaft to the edge of the forms, the end next to the forms being about 2 ft. lower than the part in the center of the shaft. This trough is light and the outer end can easily be moved around the circumference of the shaft. One-half yard of concrete is lowered in a kibble. A rope with a hook on the end is supported at a point high up in the shaft. When the kibble reaches the right point this hook is inserted in a ring in the bottom of it. The engineer continues to lower, and the kibble is inverted, the concrete running from the trough into the forms. After the first 5 ft. is concreted, ten additional feet of forms are lowered and placed in position, a set again being put on top, as already explained. In the part of the first section between the ledge and the surface special wooden forms were used, as it would have required too much concrete to have filled the space between the steel forms and the hexagon shaped shaft These forms were simply rings of strap-iron bent on a diameter of 20 ft., 3-in. hardwood plank being wired to the inside of them.

As soon as 15 ft. of shaft is completed, or at the end of 48 hours, it is possible to remove the floor upon which the first form rested. The lower set of forms is also taken out and used in the work higher up. It is then practical to continue the stripping. The morning shift would concrete 10 ft. one day and on the following place in position 10 ft. of forms. By concreting on alternate days the crew on surface had sufficient time to fill the pockets with gravel. With only 20 ft. of forms it was not possible to average faster speed than 5 ft. of completed shaft in 24 hours, as it was necessary to give the concrete sufficient time to set. While concreting was being done on the morning shift the afternoon and night shifts would continue to strip and prepare the next section. The size of the crew was figured so that the two operations, concreting and stripping, would proceed at about the same speed.

Making Joints.—The object in cutting off the lower face of the concrete of the first section on an angle of 45° was to provide a means of obtaining a tight joint between two sections. When the lower section was completed the top of the form would then be in line with the thin edge of the concrete of the upper section. A special collar was then bolted to the form, its height being 1½ ft., the upper edge being turned in towards the center of the shaft, forming a lip. Rich concrete was rammed in between the ring and the old face. In the first operation the space was not completely filled. After the concrete had set the ring was removed and all leaks between the new and the old face corked tightly with oakum. The small triangular remaining space was next filled in with rich mortar. All joints between sections were made by this method and practically all of the water shut off.

Costs.—The cost of the completed shaft is given in the following tabulation:

Surface to Ledge—48 ft.	Amount.	Cost per ft.
Sinking in sand	$ 3,638.76	$ 75.81
Steel shaft frames	493.56	10.28
†Steel forms	56.00	1.17
†Temporary surface structure and equipment	350.74	7.30
Cost of concrete	919.45	19.16
Estimated charge for compressed air	48.00	1.00
Temporary steam line in shaft	392.25	8.17
Total cost per ft.	$ 5,898.76	$122.89
Less salvage		.12
Net total cost		$122.77

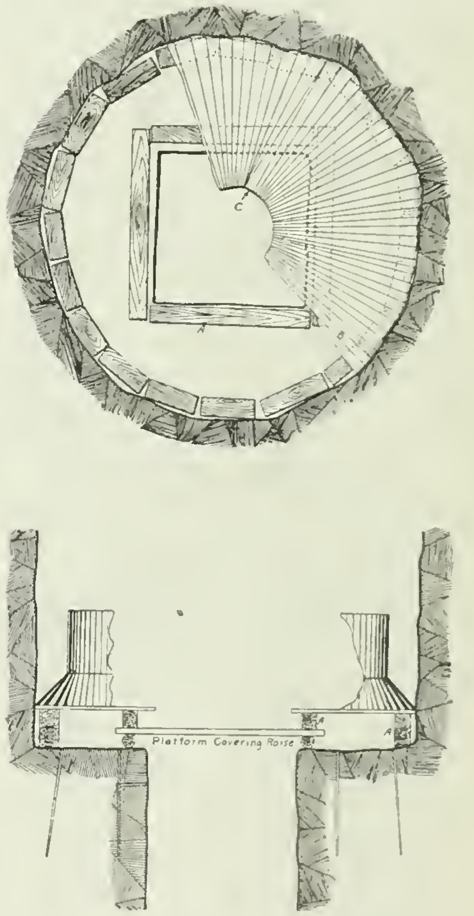


Fig. 5—Sketches Illustrating Method of Starting a Section of Concrete Lining.

Ledge to 9th Level—738 ft.		
*Cost of raising	$13,789.19	$ 18.68
Cost of stripping	12,787.20	17.33
Steel shaft frames	7,420.27	10.06
†Steel forms	927.87	1.26
†Temporary surface structure and equipment	4,975.78	6.74
Cost of concrete	12,710.06	17.22
Estimated charge for compressed air	738.00	1.00
Total cost per ft.	$53,348.37	$ 72.29
Less salvage		.12
Net total cost		$ 72.17

*Includes ventilating plant.
†Cost pro rated.

Growing Demand for Water Meters.—The city of Pittsburgh is considering a plan to install water meters in all saloons, livery and boarding stables, public garages and laundries. The chief of the Philadelphia water bureau has asked for the installation of water meters, and the city engineer of Baltimore has entered a like plea

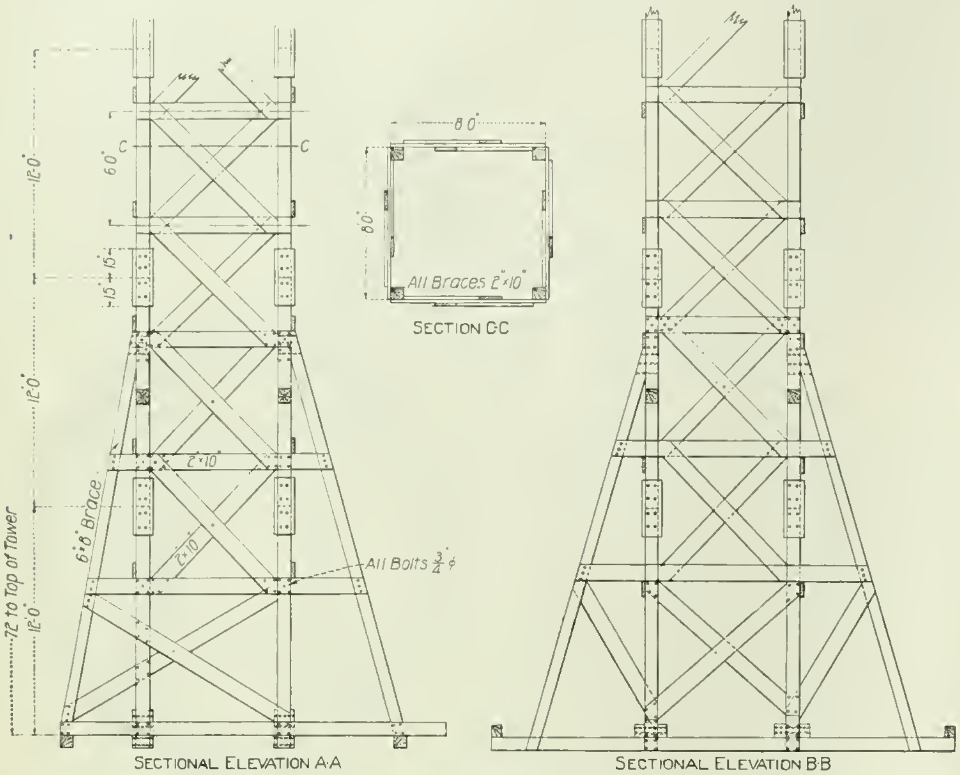
A Movable Wooden Tower for a Concrete Chuting System.

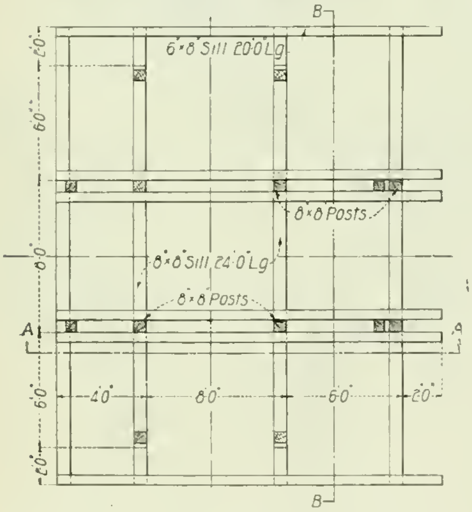
(STAFF ARTICLE.)

The use for chuting concrete of a portable steel tower was described in our issue of Aug. 21, 1912. A tower of similar movable character but constructed of wood is shown by the accompanying drawings. This tower, with four "moves" starting from near one end provided for placing all the concrete for the new reinforced concrete grand stand built at the University of Chicago.

The grand stand is 484 ft. long and has a width of 114 ft. It is entirely enclosed and the interior is finished off to provide rooms, baths, etc., for indoor athletics. The structure is mainly of reinforced concrete and the structural trimmings consist of cast cement stone. At each of the rear corners is a circular tower about 20 ft. in diameter and rising several feet above the main part of the structure. There are 33 rows of seats which are reached by reinforced concrete stairways from the interior. The seats are built up on a slab 2 ft. in thickness which is carried on a beam and girder frame supported by concrete columns. The rear and end walls are 10 ins. thick with a surface finish 2 ins. thick composed of ¼ to ½-in. screened limestone and placed behind steel plates which are carried up simultaneously with the concreting. The walls are reinforced with ½ and ¾-in. Havemeyer bars running vertically and horizontally.

The wooden tower was set at the rear and about 75 ft. from the south end of the structure. It was 72 ft. high and 8x8 ft. in section. It was built of 8x8 in. timbers and 2x10 in. cross braces, all held together with ¾-in. bolts. At the bottom the sills were extended out as shown in the accompanying drawing and braces of 6x8 in. material were run from the sills to the legs of the tower. A Marsh-Capron ¾ cu. yd. mixer was set on the bottom framework of the tower so that it would discharge into a standard Lakewood hoist bucket which elevated the concrete to another similar hopper hung on the side of the tower about 60 ft. above. The chutes from this hopper were of the 10x12 in. open trough Lakewood type made of galvanized iron and suspended on cables run from the tower over the grand stand. This chute could be swung to cover an angle of about 90° so that from one position of the tower a length of about 225 ft. of the lower seats could be poured. Toward the top of the stand the reach of the chute was limited by the angle which the chute could cover from one position of the tower.





Eng & Contg

Movable Wooden Tower for Concrete Chuting System.

The materials for concrete were dumped on the street near the tower and wheeled in wheelbarrows to the mixer.

The tower was moved on 6 in. wooden rollers placed on a plank runway and under the sills, power being supplied by a cable from the hoisting engine. Usually six men were required to place the rollers, lay the runway and change the guy cables while moving the tower. A move of 50 ft. required about 4 hours. The cost of the tower, including labor and material for its erection and the labor for dismantling was approximately $600. The contractor for the work was Mr. Edward L. Scheidenhelm of Chicago, Ill.

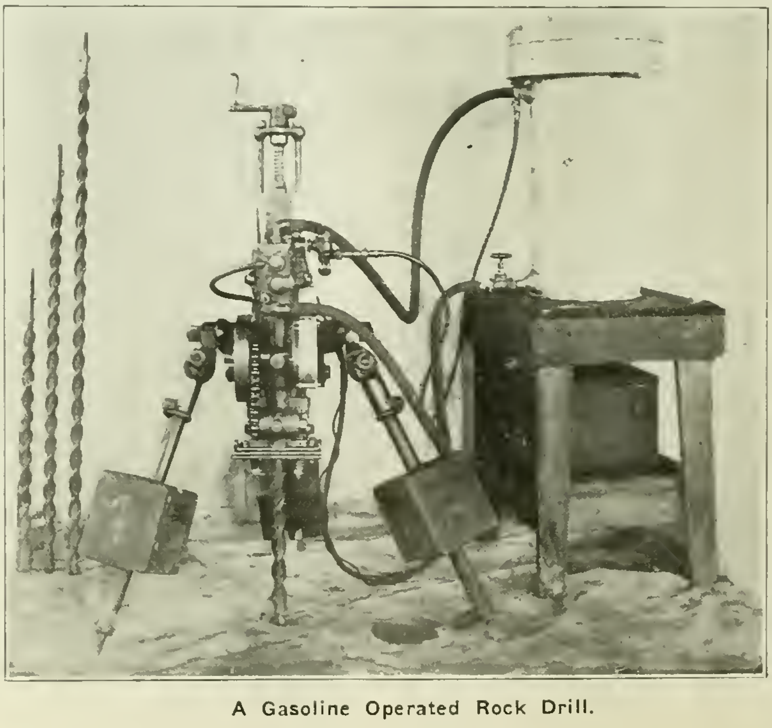
A Gasoline Operated Percussion Drill.

(STAFF ARTICLE.)

A new gasoline rock drill is illustrated by the accompanying engraving. This drill was first tested out in 1908 and has since been used in the Joplin, Mo., mining district and in quarries near St. Louis, Mo. In its perfected form the machine is considered to have several advantages which commend its use by drill men. A description of the drill arranged from information furnished by the inventor, Mr. L. L. Scott, St. Louis, Mo., follows:

The engines work on the "two-cycle," single-acting principle, and are free from all gears, cams, push rods, etc. Speed up to 3,000 r. p. m. may be had if desired; roller bearings are used throughout, and are not exposed to crank case pressure, so that leaks from the crank case are impossible. No deflecting plate is used on the piston, and the inlet and exhaust ports are not opposite, so that there are no leaks between ports. The hammer piston is made of Vanadium steel and is acted on by 300-lb. explosive pressure, and when it strikes the blow on the shank of the drill steel it is free from all connected parts of the machine.

The piston is moved toward the rear by energy stored in the fly wheel, and is picked up for the return stroke on a cushion of air. The drill steels are automatically rotated by means of a chain and sprockets which connect the crank shaft to the rotator shaft. The



A Gasoline Operated Rock Drill.

rotator shaft is formed with a worm which drives a worm wheel formed on the drill chuck. The chuck holds the shank of the drill steel loosely, the shank being formed with lugs which fit in corresponding slots in the chuck. Two types of drill steel are used; one, the common hollow steel, through which water and a pinch of explosive pressure are sent, for the purpose of removing the rock cuttings from the drill hole; the other, solid steel, with a spiral conveyor which works the rock cuttings from the drill hole as the steel is rotated. The spiral steel does away with the water connections which cause trouble. On down holes water is poured into the drill holes, as is done with other solid steel.

The engine is water cooled, but no pumps are required. The cylinder is oiled automatically by oil that is mixed with the gasoline, so that the machine gets oil, and in the proper proportions, as long as it runs. The roller bearings are packed with grease and require attention once a month. In "close" ground the exhaust is piped out to the mouth of the shaft or tunnel, or it is run into water. If the pipe is several hundred feet long it is sometimes advisable to put a small suction blower at the end to reduce the back pressure. With any ventilation at all it is not necessary to pipe out the exhaust.

As the hammer piston does not rotate, there is no reaming effect on the cylinder. Dirt can not be carried into the cylinder from pipe lines, so that there is no cutting of cylinder walls. The rotation of the drill steel is accomplished by purely rotary motion, therefore the rotating device will not wear out, and any kind of drill bit can be used, according to the particular rock being drilled.

Progress of Work on the Terminal Quay at Balboa.

(STAFF ARTICLE.)

Construction work on the foundations for the terminal quay at the Pacific entrance of the Panama Canal is now well under way. The section upon which work is now being done is 400 ft. long and 68 ft. wide. This will rest upon 450 concrete piers in four parallel rows spaced 35 ft. apart, except under the railroad, where they will be closer together. The piers are founded on bed rock, which is from 40 to 100 ft. below the surface, and the present work is being done in the deepest part. For 40 to 60 ft., thick black mud only is excavated. Then comes gravel, boulders, tree trunks and other vegetation, then the hardpan which overlies the rock bottom.

The piers are built in reinforced concrete caissons, 8 ft. in outside diameter and 12 ins. thick. These are built in sections 6 ft. high. The bottom section is only 6 ins. thick, and is shod with a steel shoe in order that it may sink readily into the ground. The caissons are placed on the surface, and the earth dug from under them, when they will sink by their own weight. When the first section has sunk below the surface of the ground, another section is added. As the caisson sinks deeper into the earth, its own weight is not sufficient to sink it, and blocks of concrete, eight tons in weight, are loaded upon it. To overcome the binding effect of the surrounding earth, the engineer in charge of construction is now making the sections above the bottom one 6 ins. less in diameter. In this way a hole 8 ft. in diameter is dug for the bottom section, and the sections above it have a play of 3 ins. all around. For this purpose also a ¾-in. pipe is embedded in the top of the first section near the outside edge. Water under 140 lbs. pressure will be carried to this pipe, and holes in it will allow jets of water to play upwards and fill the 3-in. space between the caisson and the surrounding earth, thus probably preventing binding. When the caisson reaches bedrock the resultant reinforced concrete cylinder is filled with concrete.

It is necessary to install pumps in the caissons to keep them dry enough to work in, as subterranean veins of water are often struck. The work in these caissons is conducted in semi-darkness, the bottom is wet and muddy and the air is foul. For these reasons the caisson workers receive 16 cts. per hour.

At present the average penetration is about 45 ft. a day with short equipment. As soon as cranes can be spared from other parts of the canal, and the deeper part of the work is passed, this will be greatly increased.

After some of the piers are in place, the superstructure will be begun and arches of concrete and steel will span the spaces between the piers, which must be heavily and securely built to bear the weight of the superstructure, the merchandise which will be piled upon it, and the railway trains which will run over it.

Time Lost in Diamond Drilling Operations.

As the prospecting of a mining property by diamond drilling requires a large expenditure, the owners expect to get the desired information as quickly as possible. One of the most important items in the cost of this work is the time required for operations other than actual drilling, which may properly be called lost time; of this, pulling and lowering the rods account for the greater part. The proportion of time lost can be reduced by good judgment on the part of the drill runner. As indicating possibilities the following records of time lost are given by Mr. A. E. Hall in the Columbia School of Mines Quarterly for November, 1912:

SHIFT I.—DEPTH, 735 FT.

Operation.	Time drilling. h. m.	Time lost. h. m.
Drilling (8 ft.)	1 30	..
Pulling rods		35
Dropping rods		15
Drilling	2 53	
Lunch, 55 min.		
Pulling rods		34
Changing bit		02
Dropping rods		22
Drilling	3 27	
No water		40
Total, excluding lunch time	7 52	2 28
Time efficiency	76%	

SHIFT II.—DEPTH, 770 FT.

Operation.	Time drilling. h. m.	Time lost. h. m.
Dropping rods		22
Drilling (8.8 ft.)	3 57	
Pulling rods		37
Removing core, etc		01
Dropping rods		23
Lunch, 1 h. 26 m		
Blowing cqlinders		02
Running over core		07
Repairing gear		02
Running over core		09
Drilling (2.25 ft.)	1 39	
Pulling rods		34
Fixing core and bit		02
Dropping rods		22
Drilling	1 32	
Total, excluding lunch time	6 59	2 39
Time efficiency	72.6%	

SHIFT III.—DEPTH 803 FT.

Operation.	Time drilling. h. m	Time lost. h. m
Pulling rods		30
Fixing core and bit		02
Dropping rods		19
Drilling (4 ft.)	1 52	
Pulling rods		27
Fixing core and bit		02
Dropping rods		19
Drilling	1 09	
Pulling rods		25
Dropping rods		20
Drilling (8 ins.)		3.
Pulling rods		28
Dropping rods		19
Drilling (3.1 ft.)	1 31	
Pulling rods		28
Fixing core and bit		02
Dropping rods		21
Drilling	0 52	
Total	5 58	4 02
Time efficiency	59.7%	

SHIFT IV—DEPTH 820 FT.

Operation.	Time drilling. h. m.	Time lost. h. m.
Drilling	38	
Pulling rods		22
Fixing core and bit		02
Dropping rods		11
Fishing for core		06
Pulling rods		28
Fixing core and bit		03
Dropping rods		19
Running over core		12
Drilling	1 49	
Pulling rods		32
Fixing core and bit		02
Dropping rods		18
Drilling (3.67 ft.)	2 01	
Pulling rods		31
Fixing core and bit		02
Dropping rods		22
Drilling	1 46	
Total	6 14	3 30
Time efficiency	64%	

SHIFT V—DEPTH 550 FT.

Operation.	Time drilling. h. m.	Time lost. h. m.
Dropping rods		30
Drilling (4.67 ft.)	2 40	
Pulling rods		32
Dropping rods		23
Drilling (2.75 ft.)	1 20	
Pulling rods		35
Dropping rods		30
Fishing for core		05
Trial pull and re-running		05
Trial pull and re-running		07
Pulling rods		25
Dropping and hammering		25
Fishing		03
Pulling rods		25
Changing bits		09
Dropping rods		29
Pump repairs		42
Running to bottom		35
Drilling	0 35	
Total	4 35	
Time efficiency	43.3%	

SHIFT VI—DEPTH 572 FT.

Operation.	Time drilling. h. m.	Time lost. h. m.
Dropping rods		30
Drilling	2 15	
Trial pull		05
Re-running to bottom		16
Drilling	0 16	
Pulling rods		29
Removing core and examining bit		06
Dropping rods		22
Drilling	0 55	
Drilling	0 35	
Pulling rods		30
Examining core and bit		05
Dropping rods		26
Drilling (1.8 ft.)	1 12	
Pulling rods		47
Fixing core and bit		02
Dropping rods		16
Drilling (1.75 ft.)	0 55	
Pulling rods (part)		47
Total	6 08	4 41
Time efficiency	56.7%	

SHIFT VII—DEPTH 600 FT.

Operation.	Time drilling. h. m.	Time lost. h. m.
Drilling (1.75 ft.)	1 00	
Pulling rods		30
Fixing core and changing barrels.		05
Dropping rods		33
Reaming (6 ft.)		1 19
Drilling	1 43	
Lunch, 1 hr.		
Drilling	3 00	
Pulling rods		34
Fixing core and bit		11
Dropping rods		19
Drilling	0 46	
Total, excluding lunch time	6 29	3 31
Time efficiency	62.9%	

SHIFT VIII—DEPTH 626 FT.

Operation.	Time drilling. h. m.	Time lost. h. m.
Drilling (8 ft.)	3 13	
Pulling rods		35
Removing core and fixing bit		10
Dropping rods		22
Running over core		04
Drilling	0 36	
Lunch, 1 hr. 5 m.		
Drilling	2 04	
Pulling rods		33
Fixing core and bit		08
Dropping rods		18
Drilling	1 37	
Total, excluding lunch time	7 30	2 10
Time efficiency	69.7%	

The above records show that in some cases less than 60 per cent of the shift was used in actual drilling; the highest efficiency was 76 per cent. This is one of the reasons for the high cost of diamond drilling. Another item on which the judgment of the runner has a great influence is the speed of rotation adopted. The hardness and character of the rock are the controlling factors, which must be estimated in the light of observation and experience in order to determine the proper speed. Again, with a lightly built friction gear, if too great a pressure is applied to the bit in the effort to accomplish faster work, the probability of deflection in the hole is much increased. In one hole in which the bit was forced down pretty hard, the inclination decreased from 40 to to 10° at 1,500 ft. depth. The following table shows the speeds of several of the holes under consideration:

TABLE I.—SPEED OF DRILLING SEVERAL HOLES WITH DIAMOND DRILLS.

Speeds.	Hole 00000. per shift. ft.in.	Hole 00000. per day. ft.in.	Hole 00. per shift. ft.in.	Hole 00. per day. ft.in.	Hole 000. per shift. ft.in.	Hole 000. per day. ft.in.	Hole 0000. per shift, ft.in.	Hole 0000. per day. ft.in.	Hole Vo. per shift. ft.in.	Hole Vo. per day. ft.in.
Maximum	33 6	50 10	36 9	60 5	30 10	48 11	30 4	45 2	32 4	59 1
Minimum	7 1	15 4	6 5	20 6	5 11	22 0	6 7	20 2	4 0	9 0
Average	17 1	34 2	17 6	35 0	16 9	33 5	15 11	32 0	16 2	32 4
Speeds.	Hole V00. per shift. ft.in.	Hole V00. per day. ft.in.	Hole V100. per shift. ft.in.	Hole V100. per day. ft.in.	Hole V1100. per shift. ft.in.	Hole V1100. per day. ft.in.	Hole IX00. per shift, ft.in.	Hole IX00. per day. ft.in.	Hole XOX. per shift. ft.in.	Hole XOX. per day. ft.in.
Maximum	37 11	70 8	30 1	40 0	23 0	34 4	35 2	35 2	28 6	39 10
Minimum	2 0	12 11	6 0	11 0	3 11	9 1	8 0	10 4	5 10	11 9
Average	17 2	34 4	15 1	30 2	not finished		14 1	28 2	13 0	26 0

During a period of 5½ months in which two drills ran for the whole time, and two drills for 1½ months only (equivalent to one drill for 14 months), a total of 10,278 ft. of hole was drilled, or 730 ft. per month per drill. The drills worked 26 days per month, on two 10-hour shifts. This gives a general average of 14 ft. per shift.

A third factor on which the skill of the runner has a great influence is the cost of carbons per foot. The actual wear depends directly on the character of the rock, but the runner has to decide at any given time whether to use the bit for another run or to put down a new one. Several of the holes above mentioned cost, for carbons, less than 15 cts. per ft. Another hole, in which all new stones were used, showed a cost of over $2 per foot for carbons; this was due to the breaking of several of the stones. Being unworn, they had sharp edges and corners, which accounts for the breakage and chipping.

Drilling at the Dome mine is done on contract, but is paid for by the month and not by the foot. The mining company supplies fuel and water, or allows 10 cts. per ft. for water and 14.6 cts. per ft. for coal.

Rhine River Improvement.—An international commission has been appointed to examine into works in connection with the navigation of the Upper Rhine between Strassburg, Basel, Schaffhausen and Lake Constance. The president of the commission is M. C. A. Jolles, engineer in chief and director of the Rijkswaterstaat at Arnheim, Holland. The proposed improvements will cost about $3,500,000.

Waterworks at Port au Prince.—The Department of Public Works at Port au Prince, Haiti, will receive bids for reconstructing and extending the waterworks. The estimated cost of the work is $300,000 to $400,000.

ROADS AND STREETS

The Traffic Census as a Preliminary to Road Improvement.

The constantly increasing number of vehicles using the public highways and the constant variation in the character of the traffic, changing from horse-drawn vehicles to motor vehicles, has made necessary fundamental changes in methods of construction and maintenance. Road builders must consider not only the traffic that is now using any given road to be built or resurfaced, or even maintained, but also what the traffic will be in the near future, and how much it will increase and what changes will come in its character and volume. In order to provide an economical and efficient design a knowledge of the kind and amount of traffic that will use the road is essential. These subjects are discussed in a valuable paper presented by Col. Wm. D. Sohier, Chairman of the Massachusetts Highway Commission, at the Third American Good Roads Congress at Cincinnati, last December. In his paper Col. Sohier discusses the traffic census as a preliminary to road improvement, and gives the experience of the Massachusetts Commission with certain materials and certain kinds of construction and maintenance compared with the traffic on the road. An abstract of Col. Sohier's paper follows:

Traffic Census in Massachusetts.—The Massachusetts Highway Commission in 1909 had a census taken upon the state highways at 238 stations, scattered throughout the state; and in 1912 a similar traffic count made at 156 stations. While the count in 1912 was taken at fewer points than in 1909, it was felt that the percentages of increase and decrease could safely be used to indicate the traffic on other similar roads. A traffic census was also taken at the same time at quite a number of points around the city of Boston on roadways in Metropolitan and Boston park systems. The time and method of counting was identical at all points.

The vehicles actually passing on the road were counted by observers who were engaged for the purpose. All vehicles were counted for 14 hours a day (7 a. m. to 9 p. m.) for seven consecutive days in August, 1909, and again for seven days in October, 1909, at 238 stations, the daily census at each station being tabulated on a card. This same census was made again for like periods of time in August and October of 1912. At a few important points a count was also made at night, the census at these places covering the whole 24 hours.

TABLE I.

Kind of Vehicle.	1909 CENSUS 238.5 Stations. Av. total No. per day.	1909 CENSUS Av. No. per day per station.	1909 CENSUS Per cent of No. per station.	1912 CENSUS 156.5 Stations. Av. total No. per day.	1912 CENSUS Av. No. per day per station.	1912 CENSUS Per cent of No. per station.	Inc. or dec., per cent.
Motors.							
Runabouts	4,958.5	20.8	8.5	5,819.0	37.2	11	+79
Touring cars	17,950.5	75.3	30.5	27,178.5	173.5	49	+130
Trucks	....	.....	....	1,800.0	11.5	3	...
Total motors	22,909.0	96.1	39.0	34,797.5	222.2	63	+131
Horse-drawn vehicles:							
1-horse, light	17,033.0	71.5	29.0	8,380.0	53.5	15	—25
1-horse, heavy	11,762.5	49.3	20.0	7,458.0	47.6	14	—3
2 or more horses, light	1,006.0	4.2	2.0	556.0	3.6	1	—14
2 or more horses, heavy	6,205.5	26.0	10.0	3,870.5	24.7	7	—5
Total horse-drawn	36,007.0	151.0	61.0	20,264.5	129.4	37	—14
Totals of all kinds	....	247.1	....	....	351.6	..	+42

Changes of Traffic.—In Massachusetts the traffic using our roads is constantly increasing, but it is changing much more rapidly than it is increasing. This is conclusively shown by Table I.

The foregoing figures represent a traffic count taken in 1909 and 1912 for 14 days in each year, and from 7 a. m. to 9 p. m. on each day. It will be noted that the total number of vehicles using the road has increased 42 per cent in three years. This is not the most significant feature for the roadman, however. The change in the traffic is what must be considered and prepared for. Motor vehicles have increased in numbers on the average of 131 per cent, from 96 to 222 a day; on the other hand the teams have decreased on the average 14 per cent, from 151 to 129 a day, making the net increase only 42 per cent. Here again you do not realize all the factors until you analyze still further; light single-horse vehicles have decreased 25 per cent, two-horse light vehicles 14 per cent, while heavy single-horse teams have decreased only 3 per cent, and heavy teams with two or more horses have decreased only 5 per cent.

Equally interesting for the future may be the fact that while we had almost no motor trucks in 1909, in 1912 we have an average of over 11 per station per day, or about 3 per cent of the total traffic in numbers and much more in weight. The increase in motor trucks between the August and October census was notable. The average number of vehicles at each station decreased 72 a day or 18 per cent, while the number of motor trucks actually increased 4 per cent. In one town there was an average of only one truck a day in August, while in October there were 27. In another town there were 27 a day in August and 49 in October. The count is taken all over the state, in the country towns as well as near cities, and the figure, 11 trucks, is merely an average.

On the state highways near the cities we

TABLE II.—METROPOLITAN PARKS.

(Mostly Pleasure Vehicles.)

Location.	Total of all vehicles.	Motor vehicles.	Per cent motor to total traffic.
Lynn, Prescott Pl. and Shore Res.	1,530	1,411	92
Revere, Saugus River Bridge	1,872	1,808	97
Somerville, Alewife Bridge	491	474	97
Medford, Parkway and Main street	515	492	95
•Somerville, Wellington Bridge	2,528	2,174	86
•Milton, Mattapan Bridge	2,383	1,717	72
Medford, Malden River Bridge	1,884	1,848	98
BOSTON PARKS. (All Classes of Vehicles.)			
Prince St., Jamaica Plain	1,934	1,715	89
Commonwealth Ave., a city residential street	3,009	2,634	88
Washington St., a suburban city avenue	1,109	671	60

•All classes of vehicles.

TABLE III.—DAY AND NIGHT, 12 HOURS EACH—OCTOBER, 1912.

	Automobiles.		Vehicles (all kinds).		Total vehicles.	Percentages at night.
	Day.	Night.	Day.	Night.		
Lexington	302	59	438	104	542	19
Watertown	373	72	671	141	812	17
Chelsea	103	10	358	53	411	13
Somerville	266	70	689	231	920	25
Boston	358	69	513	94	607	15

often found from 50 to 75 trucks a day, and usually from 15 to 30. On some roads motor trucks constituted over 16 per cent of the total number of vehicles and actually outnumbered touring cars. Merely to illustrate, I might state that on some of our roads we had 2,100 to 2,400 vehicles daily, and on many we had 800 to 1,000, and yet the average for the whole 156 stations was about 350.

The census near Boston in the parks may be interesting, but it must be remembered that it is, in many instances, light pleasure traffic. The figures in Table II relate to the census taken in August, 1912.

At the last two points there were daily 247 and 296 heavy teams.

A count of night traffic was made for 24 hours a day at a few points, and the result is given in Table III.

Several night and day counts were compiled for the two years to get an average, and it was found that on the average the night traffic constituted about 18 per cent of the total traffic; consequently, one should add about 22 per cent to the 14-hour day count to ascertain the total number of vehicles.

Weight of Traffic.—After a careful study they have adopted in England an assumed weight, or coefficient, for each kind of vehicle using the roads, in order to make a fair comparison of the traffic upon different roads where the traffic varies, and to more nearly show what the road must support. It is quite similar to the formula in use in France and on the Continent. I have therefore used it, both for want of a better one and also because it gives a fair basis of comparison. Table IV shows the weight of the road traffic on our roads computed in this way, with the coefficient reduced to our tons of 2,000 lbs. each in every case, both on the English and our Massachusetts roads.

Here again not only are the changes in traffic notable, but the weights are even more important. The average weight per station per day of the motor vehicles in 1909 was 197 tons, in 1912 it was 512 tons. For horse-drawn vehicles is was 147 tons in 1909 and only 135 tons a day in 1912.

The weight of the automobile traffic has increased 160 per cent in three years, while the weight of horse-drawn vehicles has actually decreased 8 per cent in the same time. While this is true, note what happened—the motor truck has come in with an average number of trucks of 11½ per station, and their weight is nearly 72 tons a day. Weight of teams decreased 12 tons a day; trucks came in with a weight of 72 tons a day—making good the loss in team weight six times over.

Width of Roadway.—The width of the roadway must be taken into consideration, as it is manifest that what wears out a road is the actual weight and volume of traffic that has to be sustained by each inch in width of the road surface. Consequently, I have had some tables prepared (see Table VI) showing the assumed actual weight, in tons per day, passing over each yard in width of the macadam roadway on certain roads in Massachusetts.

I selected a teaming road near Boston (Medford); a teaming road in Shrewsbury near Worcester (population, 150,000); one road at a popular seashore resort (Beverly East); a main through line with local travel, also 20 miles from Boston (Beverly North); a station 10 miles from Boston (Weston) on the through line to Worcester, with some local travel; and a second station on a fairly heavily traveled road leading into Boston.

For purposes of comparison I also show a like table of the traffic upon the London-Folkestone Road, one of the main roads in England, leading into London. It was made to show what the traffic was over the piece of road the Road Board selected, on which they placed the many experimental pieces of road which are being built and are to be carefully measured to show actual wear upon the roads. It was selected as a typical, heavily traveled, English main road; heavy suburban travel, not city traffic.

TABLE V.—CONCLUSIONS AS TO EFFECT OF TRAFFIC IN ROADS.

	Light teams. Per day.	Heavy teams, 1 horse. Per day.	Heavy teams, 2 or more horses. Per day.	Automobiles a day.
A good gravel road will wear reasonably well and be economical with	50 to 75	25 to 30	10 to 12	100 to 150
Needs to be oiled with	....	....	....	over 150
Oiled gravel fairly good either hot or heavy cold oil ½-gal. coating (cold oil must be used yearly)	75 to 100	30 to 50	20	500 to 700
Water bound macadam will stand with	100 to 150	175 to 200	60 to 80	*
Dust layer will prove serviceable on such macadam with	....	....	....	50 to 100
Macadam will then stand (but the stone wears, of course), with	....	....	....	300 to 500
Water bound macadam with hot oil blanket coat will be economical with	250 to 300	75 to 100	25 to 30	†
Will stand at least	50 motor trucks; probably more.			
But will crumble and perhaps fail with over	100	50	....	....
	on narrow tires. (loaded farm wagons, ice and wood teams, etc.)			
Water bound macadam with a good surface coating of tar will stand with	30 to 50	25 to 30	10 to 15	1,800

*Not over 75 at high speed.
†Up to 1,400 and more with fewer teams.

Effect of Traffic on Road Surfaces.—The experience in Massachusetts and elsewhere has shown that large numbers of swiftly moving automobiles cannot successfully be carried over a water bound macadam road or over a gravel road. Such a road becomes raveled very rapidly, rutted and disintegrated. Our traffic studies indicate that from 50 to 100 automobiles a day make the use of some dust layer or binder necessary. Possibly its use would prove economical on a road where there is even less motor traffic. Massachusetts state highways seldom have city traffic, as they are located mostly on main roads in the country, although often near the cities and leading into them.

With the motor traffic which we already have, we are forced, we think, both for economy and for efficiency, where a road has heavy team traffic as well, to adopt in construction or resurfacing some form of bituminous mixture for the upper 2 or 3 ins. of the road surface, at least, or some stronger road-like concrete.

TABLE IV.—WEIGHT OF TRAFFIC ON MASSACHUSETTS ROADS.

	1909			1912		
	Av. No. per day per Sta.	Assumed weight, tons.	Wt. tons per day per Sta.	Av. No. per day per Sta.	Assumed weight, tons.	Wt. tons per day per Sta.
Motors—						
Runabouts	20.8	1.35	29.7	37.2	1.43	53.2
Touring cars	75.3	2.23	167.9	173.5	2.23	386.9
Trucks	....	6.25	....	11.5	6.25	71.9
Totals	96.1	....	197.6	222.2	....	512.0
Horse-Drawn Vehicles—						
1 horse—Light	71.5	0.36	25.7	53.5	0.36	19.3
1 horse—Heavy	49.3	1.12	55.2	47.6	1.12	53.3
2 or more horses—Light	4.2	0.54	2.3	3.6	0.54	1.9
2 or more horses—Heavy	26.0	2.46	64.0	24.7	2.46	60.8
Totals	151.0	....	147.2	129.4	....	135.3
Totals of all kinds	247.0	....	344.8	351.8	....	647.3

On the other hand, we have also some oiled gravel roads which are satisfactory and very economical, if they are constantly and properly maintained, where there are large numbers of swiftly moving automobiles a day, in the summer months at least, but not many heavy, loaded teams. Some of these roads have 500 automobiles or more a day, and yet they are cheaply built and cheaply maintained. We can show you some roads built of sand and asphaltic oil of which the same is true, but, mark this well, these roads have very little heavy teaming on them. Heavy teams and many heavy motor trucks would rut such roads quickly and soon wear them out.

Bituminous Binders are Dust Layers.—We have saved many miles of our old roads by spreading a coat of asphaltic oil—light or heavy—or tar, over them. Today some asphaltic binder or dust layer has been used on over 80 per cent of our state highways, and the only roads on which it has not been used are those located in the country districts where there is very light traffic. In 1912 we have used nearly 2,000,000 gals. of bituminous material in construction or maintenance. Over 800 of the 930 miles of our state highways have received some form of bituminous treatment. We have resurfaced as many miles of road every year as we could compatibly with saving all our roads; using, where the traffic was heavy, a bituminous macadam on the top 3 ins.

Heavy Oils.—We have a good many miles of old macadam road which have been saved and maintained by ½ gal. of hot asphaltic oil spread upon each square yard of surface and properly covered with sand and pea stone or gravel. These roads have, many of them, worn three years, and in their fourth year are still in good condition. A few miles have worn four years and are now on their fifth year. The patching has cost but little (their treatment and maintenance might average from 2 to 3 cts. a yard a year). These roads often have very heavy automobile travel, possibly over 1,000 cars a day. They often have large numbers of teams daily. One has over 500 teams and 1,000 automobiles, and a heavy blanket oil surface has worn reasonably well for three years, and will a fourth, with a few exceptional places. This same road also has an average of 55 motor trucks a day.

Near two stations where the teaming was heavy and excessive, for ¼ mile in each place (out of four miles), the blanket oil failed. It crumbled, went into mud, developed holes and was disappearing. We have replaced the top three inches with an asphaltic bituminous macadam.

The traffic study shows that it is not the number of teams, but heavy teams—two or more horses, heavy loads on narrow tires—that cause the failure.

The failure of roads treated with heavy oil

TABLE VI.—COMPARISON OF WEIGHTS OF TRAFFIC PER YARD OF WIDTH OF CARRIAGE WAY.

Classification of Vehicles.		Average number of vehicles per day.	Assumed average weight of vehicles.	Total weight in tons per yd. width of carriage way per day. Census 1912.	Total weight in tons per yd. width of carriage way per day. Census 1909.	Increase or decrease. Per cent.
SHREWSBURY (OBSERVATION STATION 310) WORCESTER-BOSTON ROAD.						
Motor Vehicles	Runabouts	76	1.43	21.7	90	+141
	Touring cars	407.5	2.23	181.7	87.4	+108
	Trucks	17	6.25	21.2	....	.....
Horse Drawn Vehicles	Light vehicles*	64	0.36	4.6	7.1	— 35
	Heavy vehicles*	60.5	1.12	13.6	20.9	— 35
	Light vehicles†	4.5	0.54	0.5	0.4	+ 25
	Heavy vehicles†	36	2.46	17.7	29.5	— 40
	Totals	665.5	....	261.0	154.3	+ 69.0
	Carriage way 15 ft.					
MEDFORD-SOMERVILLE (OBSERVATION STATION 342) BOSTON-LAWRENCE ROAD.						
Motor Vehicles	Runabouts	44.5	1.43	6.8	1.8	+278
	Touring cars	121.5	2.23	29.0	12.9	+125
	Trucks	49	6.25	32.8	....	.....
Horse Drawn Vehicles	Light vehicles*	47.5	0.36	1.8	1.9	— 5
	Heavy vehicles*	198.5	1.12	23.8	18.6	+ 28
	Light vehicles†	2	0.54	0.1	0.5	— 80
	Heavy vehicles†	183.5	2.46	48.4	28.9	+ 67
	Totals	636.5	....	142.7	64.6	+121
	Carriage way, 28 ft.					
BEVERLY (EAST) (OBSERVATION STATION 331) BEVERLY-MANCHESTER ROAD.						
Motor Vehicles	Runabouts	163	1.43	38.8	30.7	+ 26
	Touring cars	849	2.23	315.5	246.8	+ 28
	Trucks	56.5	6.25	58.8	....	.....
Horse Drawn Vehicles	Light vehicles*	274.5	0.36	16.5	26.2	— 37
	Heavy vehicles*	118.5	1.12	22.1	29.3	— 25
	Light vehicles†	29.5	0.54	2.7	5.2	— 48
	Heavy vehicles†	70.5	2.46	28.9	40.2	— 28
	Totals	1561.5	....	483.3	378.4	+ 27
	Carriage way 18 ft.					
WESTON (OBSERVATION STATION 344) WALTHAM-MARLBOROUGH ROAD.						
Motor Vehicles	Runabouts	115	1.43	27.4	18.4	+ 49
	Touring cars	533	2.23	198.1	95.5	+108
	Trucks	30	6.25	21.2	....	.....
Horse Drawn Vehicles	Light vehicles*	167	0.36	10.0	13.0	— 23
	Heavy vehicles*	98	1.12	18.3	20.5	— 11
	Light vehicles†	5	0.54	0.4	0.7	— 43
	Heavy vehicles†	59	2.46	24.2	28.7	— 16
	Totals	1007	....	319.6	176.8	+ 81
	Carriage way 18 ft. October census only.					
NATICK (WEST) (OBSERVATION STATION 345) FRAMINGHAM-BOSTON ROAD.						
Motor Vehicles	Runabouts	42	1.43	10	4.3	+132
	Touring cars	240	2.23	89.2	34.9	+155
	Trucks	20	6.25	20.8	....	.....
Horse Drawn Vehicles	Light vehicles*	41	0.36	2.5	2.1	+ 19
	Heavy vehicles*	61	1.12	11.4	8.0	+ 42
	Light vehicles†	1	0.54	0.1	0.3	— 67
	Heavy vehicles†	22	2.46	9.0	5.3	+ 70
	Totals	427	....	143.0	54.9	+160
	Carriage way 18 ft. October census only.					
BEVERLY (NORTH) (OBSERVATION STATION 332B) WENHAM-BEVERLY ROAD.						
Motor Vehicles	Runabouts	83	1.43	19.8	18.6	+ 6
	Touring cars	342	2.23	127.1	73.2	+ 74
	Trucks	46	6.25	47.9	....	.....
Horse Drawn Vehicles	Light vehicles*	73	0.36	4.4	7.7	— 43
	Heavy vehicles*	108	1.12	20.2	17.9	+ 13
	Light vehicles†	5	.54	0.4	1.1	— 64
	Heavy vehicles†	116.5	2.46	47.8	27.7	+ 72
	Totals	773.5	....	269.6	146.2	+ 84
	Carriage way 18 ft.					
QUINCY (EAST) (OBSERVATION STATION 403) BOSTON-SOUTH SHORE ROAD.						
Motor Vehicles	Runabouts	114	1.43	15.3	14.8	+ 3
	Touring cars	467	2.23	97.6	47.9	+ 84
	Trucks	38.5	6.25	22.6	....	.....
Horse Drawn Vehicles	Light vehicles*	45	0.36	1.5	3.0	— 50
	Heavy vehicles*	216.5	1.12	22.7	20.5	+ 11
	Light vehicles†	0.5	0.54	....	0.1	.....
	Heavy vehicles†	104.5	2.46	24.1	20.4	+ 18
	Totals	986.0	....	183.8	106.7	+ 72
	Carriage way 32 ft.					
LONDON-FOLKESTONE ROAD (Between London County Boundary and Sidecup).						
Motor Vehicles	Not including cycles, omnibuses, lorries or traction engines	130.6	1.83	34.1	....	.....
	Lorries, omnibuses, traction engines	151.9	6.25	135.6	....	.....
Horse Drawn Vehicles	Light vehicles*	104.9	0.36	5.4	....	.....
	Heavy vehicles*	19.3	1.12	3.1	....	.....
	Light vehicles†	82.9	.54	6.4	....	.....
	Heavy vehicles†	247.1	2.46	86.8	....	.....
	Totals	736.7	....	271.4	....	.....
	Carriage way 21 ft.; census. 6 a. m. to 6 a. m.					

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*One horse.
†Two or more horses.

has occurred on a few miles of road at certain places where it was clear that heavy horse-drawn teams were responsible. In two instances it was 50 to 75 ice teams a day, together with the other teams, carrying three tons or more each on ½-in. to 3-in. tires. In a month the oil surface began to crumble and break up on the side of the road on which the loaded teams traveled. It lasted three months on the other side of the road where these teams came back empty. This same road, treated with the same oil, is still in good condition beyond these ice houses; in one case for three miles, in the other for 15 or 16 miles, and the oil is three years old and still only needs patching.

Light cold oiled has been substituted as a dust layer and has proved reasonably satisfactory, though the stone, of course, is wearing out, and a bituminous macadam would probably prove economical.

The Gloucester road, covered with a hot oil blanket, was rutting and wearing out quickly in 1909. A coal team was passing to some hotels three or four times a day during the summer (carrying six or seven tons of coal on narrow tires). A motor truck was substituted for the coal team, and the surface of the road, which had been oiled, was again in good condition. It has worn three years, and now only needs patching.

Oil Surface.—A hot oil blanket surface, made of a good asphaltic oil, will be economical and will carry large numbers of automobiles at high speeds (over 1,000 a day in summer) for several years, will carry large numbers of light teams (500 a day), and quite a number of motor trucks (50 or so a day), but will be destroyed by a large number of heavy teams, especially with narrow tires. Fifty or more such teams, farm teams, wood teams, or teams on narrow tires, will rapidly destroy the road surface. A surface coat of a good quality of tar will last satisfactorily under a large amount of automobile travel, but usually, in our experience, it has to be renewed more often than a good quality of oil.

In all cases, I assume that all holes and depressions will be filled before tar or oil is used, that the bituminous material is evenly distributed and is sufficiently covered and kept so that it will not pick up, and that all holes that develop are patched at once as soon as they form. Constant repairs, at a cost of 1 ct. to 2 cts. a square yard a year will save an expenditure of from 40 cts. to $1 a square yard for the resurfacing of these bituminous surfaces if they are allowed to go to pieces. They will do it in a year, or two at the most, if not cared for properly.

When these surface treatments fail, as they will where the traffic is extremely heavy—meaning heavy in weight of vehicles, not numbers of vehicles—then you must select your road as soon as possible. It will prove to be true economy in the end, and the end is not far off.

Light cold oils, water gas tar, Tarvia B and the hundred and one different products on the market, dust layers, etc., prevent motors from raveling roads. These materials may be economical and work satisfactorily for small team traffic (30 to 50 a day) and medium automobile traffic (50 to 100 a day) provided the road is not one where high speeds are usual. They may also help to preserve the road from the effect of automobile traffic where the team traffic is too heavy, or the loads are carried on such narrow tires that a hot oil blanket surface will not wear satisfactorily, until money becomes available to resurface the top 3 ins. with some form of bituminous macadam.

Summary of Conclusions.—In concluding his paper Col. Sohier states that with much hesitation he has prepared a table (Table V) showing as nearly as he can the results observed after four years' experience with bituminous materials, comparing these results with the traffic going over the road in 1909 and again in 1912. He states further that more experience will undoubtedly cause him to change or modify some of his present opinions, but that the present one is submitted as indicating the results of experience in Massachusetts. The figures in Table VI are based on a standard road 15 ft. wide, having 3-ft. gravel shoulders on each side.

The Value of the Traffic Census in the Economical Design of Highways.

Elsewhere in this section we give the main portions of an interesting paper on the traffic census as a preliminary to road improvement. This paper was presented by Col. Wm. D. Sohier at the Third American Good Roads Congress. The following discussion of Col. Sohier's paper was presented to the above Congress by Arthu H. Blanchard, M. Am. Soc. C. E., Professor of Highway Engineering at Columbia University:

The value of the traffic census taken preliminary to construction is intimately connected with the traffic census taken after the highway is built. The traffic census taken after the road or pavement is open to traffic gives the information upon which to base the design, having in mind the traffic to which the highway will be subjected. The necessity for such practice is based upon the multiplicity of types of roads and pavements which are in common use today, and the great variety of effects produced by the different classes of traffic which must pass over a highway under various conditions.

The traffic census preliminary to construction gives information relative to local traffic, and, if the highway in question is a link between improved sections, data relative to through traffic may be obtained. In the investigation of the probable traffic, it is found that a careful consideration of all the surrounding highways and the relationship of each to the highway system is necessary. If the traffic census has been taken on these highways, deductions may be made relative to the increase in traffic due to the construction of the highway under consideration. The improving of highways invariably results in an increased amount of traffic, and in most cases increased loads to be carried. In some cases such improvement means the attraction of all classes of commercial motors. In other cases the change will be in the line of the use of high speed motor traffic. It is surprising how accurate and valuable deductions relative to future traffic may be made, if the engineers have at hand such data as have been obtained by the Massachusetts Highway Commission.

Traffic data, actual and estimated, in many cases, are of vital import in designing certain component parts of a highway, such as width, foundation and wearing surface. Traffic data will also provide considerable information relative to the method of maintenance which should be adopted.

It is believed that with a more intimate knowledge of traffic and the data secured by the traffic census, the width of the metaled surface or pavement of highways in the northeastern states at least will be increased over the present practice. In place of the common assumption of 6 to 8 ft. for a single line of traffic, 9 and 10 ft. will be substituted, so that many trunk highways of our eastern states will be 20 ft. in width, instead of 14 or 16 ft. It is of interest to note in this connection that the width of many of the main county roads of England is 20 ft., while that of the main trunk highways of France is about 23 ft.

That the design of the foundation of the road or pavement should include a careful consideration of the traffic is self-evident. Tonnage in this case is of the utmost importance. Increase in tonnage, due to increased commercial traffic, will in many cases necessitate much stronger foundations than are now being built. Either cement-concrete foundations, or thoroughly compacted broken stone foundations of from 7 to 10 ins., will have to be built in place of the 4-in. foundations used in many parts of the country. This phase of the problem is causing grave concern in England at present where many requests are being made to the Road Board for grants to build up the foundations of the main county roads.

Due to the many different types of construction and the large variety of materials employed in the construction of wearing surfaces, the nature and amount of the traffic are of vital import. In the design of the wearing surface the following factors have been found of value:

(1) Differentiation between horse drawn vehicle traffic and motor car traffic.

(2) Division of each of these classes of traffic into pleasure and commercial traffic.

(3) Subdivision of commercial traffic into loaded and unloaded vehicles.

(4) Determination of the weight per linear inch of width of tire of all types of commercial traffic.

(5) Subdivision of the two classes of horse drawn vehicle traffic, dependent upon the number of horses.

(6) Subdivision of pleasure motor car traffic upon the basis of weight and speed, since in many instances the greatest damage to certain types of roads is caused by seven seat touring cars, limousines, or laundulets, traveling at speeds of 40 to 60 miles an hour.

(7) Extraordinary character of local traffic; for example traction engines hauling trailers, motor bus traffic, ice wagons, mill drays, etc.

It is believed that grave danger is incurred if it is attempted to base the design of a highway outside of a built-up district upon a mere record of tonnage per unit of width per annum, or to use exclusively the sum of the products resulting from weighting different classes of traffic. It should not be inferred from the above, however, that the use of some common unit or units in which to express all classes of traffic, for the summation of totals and a general comparison of the traffic on different highways in different localities is not favored. In cities it is evident that the tonnage life of various roads and pavements is of great value. For example, Mr. John A. Brodie, the City Engineer of Liverpool, in 1910 used, as a basis for the comparison of different kinds of roads and pavements subject to the same kinds of traffic, the tonnage per yard of width. He expressed the life of a granite block pavement as 7,500,000 tons per yard of width; of a bituminous macadam pavement, that is one constructed by the penetration method, as 750,000 tons; and of water bound macadam, 100,000. However, to base the economical use of a macadam road, for instance, upon a knowledge of tonnage alone would not be sufficient in most cases.

As illustrative of some of the effects produced by different classes of traffic on roads and pavements of various types, the following examples are cited:

The first case is that of a water bound macadam road, located in an isolated district, and subjected to a traffic of 150 motor cars and 50 horse draw vehicles per day. The motor cars consisted of heavy touring cars which traveled at speeds of 30 to 50 miles an hour. Within six months after construction, the wearing surface had disintegrated to such an extent that the cost of reconstruction amounted to practically $1,000 per mile. It is self-evident that if a macadam surface on a residential street in a city had been subjected to this amount of traffic, moving at a speed of not greater than 20 miles an hour, very little disintegration would have taken place.

The second example is that of a macadam road constructed of shale rock and finished with a bituminous surface in connection with which a heavy asphaltic oil was used. The road was subjected to a large amount of motor car traffic during the summer months and during this period gave entire satisfaction. In winter, however, the traffic included heavy horse drawn vehicles used for hauling logs. As the horses were equipped with sharp calks, the effect of drawing heavy loads upon the above surface was disastrous. The road in the spring was full of holes, some of which were twelve inches in depth. The above emphasizes the value of taking a traffic census at different seasons of the year and also the value of a thorough investigation of the character of the traffic by consultation with the various interests using the highway.

As the third illustration will be cited the case of a bituminous concrete pavement subjected to a total traffic varying from 500 to 1,000 vehicles per day, the horse drawn vehicles and motor cars being about equal in number. The bituminous cement used in the mix was a coal tar. The pavement was not furnished with a seal coat. The result of winter traffic for five months was the disintegration of the surface, consisting in the formation of many pot holes. An adjacent section on which a seal coat was used was in excellent condition at that time. The disintegration in the above instance was due entirely to the horse drawn vehicle traffic as the blows from the horses' hoofs loosened the individual stones in the open mosaic surface of the pavement.

The fourth example is that of a water bound macadam road built of trap rock, which highway was subject to a daily traffic of 50 motor cars and 100 horse draw vehicles. This road raveled continuously during dry spells due to the insufficiency of the dust, formed by abrasion, which was required to bond the road. On the other hand, a macadam road, similarly constructed, subjected to 25 motor cars and 225 horse draw vehicles per day, remained in an excellent condition. Of the 225 horse drawn vehicles, 150 were commercial vehicles, which naturally tended to produce a certain amount of dust by abrasion and to continually compact the surface.

The last illustration to be cited is that of a water bound macadam road upon which was constructed a mat surface by using a heavy asphaltic oil and stone chips. Under a traffic of 300 horse drawn vehicles and 400 motor cars per day, the mat surface crept, forming a wavy surface. Many holes developed caused by the blows of horses' hoofs on the mat surface.

It is evident from the above illustrations that it is essential to keep accurate traffic records after the construction of roads and pavements in order to have at hand complete data upon which to base the design of wearing surfaces of highways to be constructed under similar conditions.

Method of Making a Survey for a Highway Improvement.

An interesting method of doing the field work for a highway improvement was described by Mr. John J. Cox, of Coldwater, Mich., in a paper presented at the last annual meeting of the Michigan Engineering Society. The following description of the way the surveys were conducted is abstracted from Mr. Cox's paper:

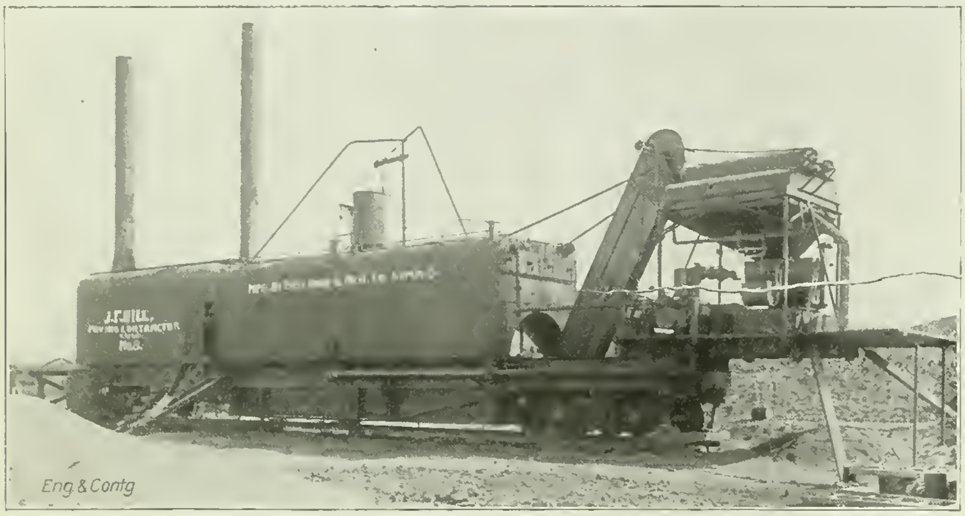
In our survey work on highways during the past season of 1912 we used the following party in doing the field work. We had an engineer in charge, a transit man, a level man, two chain men and one rod man. The equipment consisted of the following: 1 transit, 1 level, 1 level rod, 3 flagpoles, 1 100-ft. tape, 1 sledge, 1 hand-axe, 2 picks and 2 shovels, 1 claw-hammer, about 50 60D spikes and a piece of kiel for marking stakes. The work in the field was handled by this party about as follows: When we arrived at the location of the proposed piece of road to be improved the engineer in charge proceeded to size up the situation, and the rest of the party was divided into two gangs and these two gangs proceeded separately to look for corners marked by the government survey, and to distribute the stakes and gas pipe or iron, to be used for monuments, in convenient piles along the route of the proposed improvement.

After enough corners of the government survey had been located to make a start with the transit work, the gang composed of the transit man and the two chainmen ceased to look further for corners and would begin locating the starting point and proceed to run the center line; while the other party, composed of the level man and rod man, would still continue to locate the rest of the corners necessary; after which they would return to the point of beginning and take levels. The operation of running the transit line was about as follows: After the location of the point of beginning had been properly tied in, the transit man set up his transit over the point of beginning and took a sight on the flag ahead set by the engineer in charge. The chain man now began to measure the line; the head chain man taking a range pole, the claw hammer and the head end of the tape with about 30 60D nails in his pocket proceeded down the road about 100 ft. With his range pole he was lined in by the transit man; then with the assistance of the rear chain man he measured off 100 ft. and drove in the ground with his claw hammer a spike. This spike was in the center line of the highway just 100 ft. from the point of beginning. After this was done, he picked up his range pole and proceeded 100 ft. farther down the road, where the same operation was again repeated with the assistance of the rear chain man, who followed up with the rear end of the tape and a bundle of stakes which he distributed along the road, leaving two stakes, one marker and one grade stake, at each spike. After proceeding in this way for about ½ mile, or until the first angle was reached, the head chain man signaled the transit man and leaving his flagpole he and the rear chain man with the tape returned to the point of beginning. On arriving at the point of beginning the head chainman, catching the chain at the 25-ft. mark and with the assistance of the rear chainman, measured out as near as possible at right angles with the center line a distance of 25 ft. where the rear chainman drove the grade hub so that the inside face or the face toward the center of the highway was just 25 ft. from the center line. The head chainman numbered the marker while the rear chainman was driving the grade stake, after which the rear chainman drove the marker with the number facing the highway. After this operation was completed the two chainmen proceeded to the next station marked by a spike and the operation was repeated. They proceeded in this manner until they arrived at the last spike which had been driven in the ground. In the meanwhile the transit man picked up his transit from its position over the point of beginning, replacing the same by a flagpole, and proceeded down the road to the last spike driven or to the angle, where he again set up his transit. After taking a back sight on the point of beginning and plunging his telescope, reading the angle of deflection if there was one, also the magnetic bearing, he noted the same in his note book, together with such other information as to condition affecting design that he may have noted while walking from the point of beginning to his present transit station. After which, upon the arrival of the two chainmen, the gang was again ready to measure and stake out the next course. This process was repeated until the entire line was run and staked and the end tied in with the same degree of care and accuracy as the point of beginning. In the meantime the level man and the rodman were following the transit party taking the levels while the engineer in charge directed the entire operations of both gangs, assisting first one and then the other, and endeavoring to have the level gang complete the levels only a few minutes after the completion of the work of the transit party.

This method of doing field work worked out very well and economically for us. After each man in the party had learned his duties it became quite rapid. At the end of the season we were doing about twice as much work in one day as at the beginning. By the use of the spikes we consider that we were able to save the time of one if not two men and at the same time give our transit man some time to observe conditions around him which he could not if his entire time was taken up by the men measuring and driving stakes.

A Portable Plant for Asphaltic Pavement Construction.

(STAFF ARTICLE.)



Portable Plant for Asphaltic Pavement Construction.

In general three types of plants are used for mixing the ingredients for asphaltic pavements. These three types are: Permanent plant, semi-portable and portable. The accompanying illustration shows a plant of the latter type. In the plant illustrated the asphalt is melted by means of steam, furnished from a 125 h.p. Marine type return boiler. The pipe coils for the steam heating are electrically welded, and all connections are made outside of the tanks. Each tank has four of these coils, containing 1,130 lin. ft. of 1¼ in. double strength pipe, and the heating power is claimed to be sufficient to melt down a tank of asphalt in four or five hours. The plant has two tanks, each of a melting capacity of 712 cu. ft.; either tank will hold sufficient asphaltic cement for a day's run. The pipes for conducting the asphalt to the weigh-box and mixer are steam jacketed, making it possible to run in cold weather without the possibility of the asphaltic cement becoming cold in the supply pipes. As each tank has a capacity sufficient for a day's run, it is possible to fill one tank during the day, while running from the other tank, melt down the asphalt during the night, and run from that tank the next day.

The steam for running the machinery is obtained from the 125 h.p. boiler mentioned above. The plant has four engines, including the hoisting engine. These are all connected with steel gears and are independent of each other. The cold sand and stone elevators have clutch pulleys, making it possible to throw them in or out without stopping the machinery. The condensed steam for the asphaltic cement tanks is returned to the boiler by means of a hot water pump working automatically. The sand drum, 28 ft. long and 5 ft. in diameter, is of the return heat type.

The hot sand tank, screens, mixers and mixer engine, hoist and elevator engine are all on a sliding carriage on one end of the plant, and when in use are slid out in position by means of two large screws. This is a one car plant and all parts are carried on the one car.

The organization for operating the plant is about as follows: 1 foreman, 1 engineer, 1 mixer man, 1 man to oversee filling of kettle, 1 night man, 1 sand or stone feeder, 1 boiler fireman, 1 drum fireman, 1 man to shove the asphalt barrels, 1 yard clerk, 1 water boy, 9 laborers. The number of laborers depends on circumstances such as the location of the work, ease of getting at materials, etc.

The plant is stated to have a capacity of 1,800 sq. yds. of 2-in. top, or 4,000 sq. yds. of 1-in. binder in 10 hours. One plant last fall under ordinary working conditions is stated to have laid 28,000 sq. yds. of 3-in. finished work in 24 working days. Another plant in one season laid 114,000 sq. yds. of finished work, traveled 1,185 miles, was set up and taken down 7 times and lost four weeks waiting on materials. With another plant 162,000 sq. yds. were laid in one season; this plant traveled 1,260 miles.

The portable plant just described is manufactured by the East Iron & Machine Co., Lima, O., to whom we are indebted for the information given.

Notes on Road and Street Work.

Cost of Road Roller Operation and Maintenance.—In our last issue we printed a table showing the cost of maintaining and operating for a period of one year five steam road rollers owned by the city of Grand Rapids, Mich. The weight and number of hours operated in the year by the rollers mentioned in the table are as follows:

	Weight, tons.	No. hours operated in year.
No. 1 roller	15	1,793
No. 2 roller	13	1,703
No. 3 roller	14	1,857
No. 4 roller	8	1,922
No. 6 roller	10	2,023

The cost of maintenance and operation of these rollers for the year and the cost per hour in operation were as follows:

	Total.	Per hour.
No. 1 roller	$1,173.61	$0.605
No. 2 roller	1,256.29	.737
No. 3 roller	1,650.19	.888
No. 4 roller	1,267.65	.659
No. 6 roller	1,271.25	.628

A full day's work at Grand Rapids the past season has been 10½ hours, figuring 10 hours actual operation, and the balance firing up in the morning.

Cost of Maintaining Horses at Boston, Mass.—The following table, taken from an annual report of the Public Works Department of Boston, Mass., for 1911, shows the cost of maintaining the horses of the street cleaning and street watering service of the highway division. These figures are on a basis of 365 days per year, and are for an average of 154.3 horses:

	Per year.	Per horse per day.
Labor	$29,805	$0.529
Hay and grain	29,391	.523
Fuel, light and rent	4,969	.089
Shoeing	6,567	.117
Stable repairs	6,052	.107
Veterinary services and medicine	908	.016
Furnishings and repairs	1,018	.018
Totals	$78,710	$1.399

The amount of hay, straw, oats and shorts used and the price paid were as follows:

		Price paid.	
	Amount used.	High.	Low.
Hay	1,033,160 lbs.	$24.50*	$16.50*
Straw	66,369 lbs.	19.00*	11.00*
Shorts	23,900 lbs.	29.00*	26.00*
Oats	24,451 bus.	.58†	.39†

*Per ton. †Per bushel.

Road Construction by Convict Labor in Louisiana.—The following figures, compiled by C. C. Sandez, secretary Louisiana State Highway Department, show the approximate mileage and location of improved roads constructed in Louisiana with convict labor from Jan. 1, 1908, to Jan. 1, 1913:

Parish.	Mileage.
Natchitoches	49.23
De Soto	57.02
Ouachita	17.25
Rapides	3.57
East Baton Rouge	22.22
Orleans	15.50
City of Baton Rouge	.82
St. John the Baptist	8.50
Total mileage constructed	174.11

During 1912 a total of 26.63 miles of earth road was constructed with convict labor, the distribution and amount expended on account of the convict camp being as follows:

Parish.	Miles.	Cost.
De Soto	6.63	$ 8,769
Natchitoches	12	12,503
St. John	8	8,672

Road Equipment of Maryland State Roads Commission.—The road equipment of the State Roads Commission of Maryland on Dec. 31, 1911, according to the last annual report of the commission, included the following:

Description. Date Purchased.	Cost.
10-ton road roller—June, 1910	$2,366.00
Sprinkler wagon—May, 1911	373.00
White oiling attachment—June, 1911	150.00
Sweeper—Aug., 1910	220.00
Sprinkler wagon—Aug., 1910	278.00
Western grader—April, 1911	145.00
Portable house—Sept., 1911	145.62
Steam drill—Sept., 1911	287.50
Climax stone crusher—Sept., 1911	3,240.00
Buffalo Pitts roller and spikes—Oct., 1911	2,552.80
New parts for Buffalo Pitts roller—Nov., 1911	291.51
Road roller and crusher plant—Dec., 1911	3,500.00
Road sprinkler—Dec., 1911	250.00
Miscellaneous—Dec., 1911	235.25
4 wheel scrapers—May, 1910	100.00
8 grading wagons—June, 1910	960.00
8 dump wagons—June, 1910	944.00
4-horse power engine and parts—Oct., 1910	169.10
Stone crusher and equipment—Oct., 1911	262.50
2 steam road rollers—Oct., 1910	4,500.00
Steam drill and tools—Oct., 1910	295.00
2 sprinkling wagons—Oct., 1910	546.00
Wagon scales, platform, etc.—Nov., 1910	120.00
Sprinkling wagons, etc.—Nov., 1910	596.00
Climax road machine—Nov., 1910	210.00
Engine and fittings—Nov., 1910	170.00
2 Monarch rollers—Nov., 1910	4,450.00
Climax crusher—Nov., 1910	3,225.00
Round cedar tank—Nov., 1910	27.00
Studebaker sprinkler—Nov., 1910	180.00
Climax crusher, elevator and screen—Nov., 1910	2,515.75
Austin road grader—Dec., 1910	225.00
Sprinkler wagon—May, 1911	373.00
Pumping outfit—April, 1911	240.76
Portable water tank and equipment—July, 1911	225.00
Steam roller—Oct., 1910	2,300.00
Tar boiler and sprinkler apparatus—Oct., 1910	300.00
Gasoline pumping engine—Oct., 1910	227.96
Steam road roller—Oct., 1910	2,302.00
Sprinkler wagon—June, 1911	200.00
Road oiler and attachment—June, 1911	118.50
Tar heater—Sept., 1911	400.00
Western grader—Sept., 1911	142.63
6 wheelers—Sept., 1911	205.50
10-ton roller—Oct., 1909	2,525.00
10-ton roller—June, 1910	2,366.00
Gas engine—Oct., 1910	142.00
Sprinkler—June, 1911	330.00
Gas engine—Aug., 1911	142.00
10-ton roller—Sept., 1911	1,220.00
White oiler attachment—Oct., 1910	140.00
Total equipment	$47,430.38

Method of Handling Street Cuts at Cincinnati.—In a paper presented on Dec. 4 last at the third American Good Roads Congress, Mr. J. E. Barlow, principal assistant city engineer of Cincinnati, O., outlined as follows the manner in which the problem of street cuts and their restoration is handled in that city: When a street is to be improved notices of the two final steps in the legislation are sent to all the public service corporations and again when bids are received and again when the contractor is ordered to begin work. The object of these notices, of course, is to keep the companies informed of the status of the proposed improvement and allow them ample time to plan repairs, renewals or extensions. At the outset, however, it may as well be admitted that the franchises of the local public service corporations are such that the city has little or no control over what they shall do along these lines. As an additional lever, early in 1912 a city ordinance was passed which virtually prevents any opening in a newly laid pavement for a period of three years, except in unforseen emergencies. Notices calling attention to this ordinance are sent to all public service corporations and to property owners along the proposed improvement about three months before the actual work of construction begins. The topography of Cincinnati is such that often the heavy cuts and fills practically prohibit the laying of water mains until the street is graded. On all contracts now let, if the street does not already contain water and sewer mains, they are included in the street improvement contract. To prevent, in so far as possible, openings for house connections, the city is now serving notices on all property owners along a proposed improvement to make water and sewer connections to their lots whether occupied or vacant. If these are not made in 20 days, the city makes such connections to the curb line and assesses the cost thereof against the individual property. This calls forth considerable objection, but it must be borne in mind that half of the owners gladly make all connections, and it is only just that the city take steps to prevent the other half from damaging the pavement. The preceding may all be classed as preventive measures. There is also to be considered the proper control and restoration of the necessary openings. An important step in an intelligent control of street openings is to know what you have under the pavements and where these structures are. This primary information is not always in the hands of cities. In connection with an investigation for a comprehensive sewer layout at Cincinnati a complete underground survey is being made to locate all of the subsurface structures. These plats will be made on a scale of 40 ft. and 50 ft. to the inch. There will be possibly 1,000 sheets 24 ins. by 34 ins. in the complete set. When compiled these will be kept up-to-date as a basis for our underground records and we can then more intelligently direct future underground construction. As a final step there is to be considered the actual making of the openings and their repairs. Several years ago a city ordinance was passed making it unlawful for any person other than the Street Repair Department to open any pavement without a permit therefor. This ordinance further provided that the application for this permit should state the location of the opening and the kind of pavement. Before the permit is issued a deposit is required based on the published sliding scale of prices for the restoration of different sized openings in the various kinds of pavements. No person other than the employes of the Street Repair Department are allowed to permanently restore these openings. The party making the opening does the backfilling and makes a temporary restoration of the pavement; if the backfilling is not properly done, the Street Repair Department will do the work over and deduct the cost from the deposit of the party responsible. The Street Repair Department handles the issuing of all permits and of course makes all rules in accordance with which such openings can be made. The control of these openings and the responsibility of their speedy and adequate restoration is thus centralized. This outlines the principal steps taken here to control street openings. Some of these measures cause friction and delay especially those involving serving of legal notices which require definite periods of time before action can be taken.

BRIDGES

Arch Design By the Method of the Ellipse of Elasticity.

The rapid increase in the use of arch spans, especially in plain and reinforced concrete, during the last ten years, has more and more emphasized the fact that the application of the usual theories of the elastic arch is very laborious and the results obtained are limited by the preliminary hypotheses of loading assumed; the adoption of a second hypothesis entails a repetition of this work from the beginning, etc., and for everyday purposes this application is very unsatisfactory. Combinations of analytical and graphical methods have been devised depending upon certain arbitrary assumptions, which to some extent facilitate the application of the elastic theory to arch design. It is, of course, unnecessary to state that a purely graphical method has great advantage over analytical or combined analytical and graphical methods.

By the method of the ellipse of elasticity developed below, it is possible to draw the influence lines for moments with regard to any section. These influence lines show at once with respect to that section the most prejudicial hypothesis of loading, and this independent of any assumptions. In other words, the influence lines for moments and for horizontal thrusts and vertical reactions (polygons, p_1, p_2, and p_3, Fig. 2), have been constructed absolutely independently of any hypothesis of loading, and are dependent solely upon the geometrical shape of the arch considered. They are characteristics peculiar to the arch alone, and they serve for the complete calculation of the stresses in any section caused by loading according to any hypothesis. The nature of this method is explained by specific example in a paper by Mr. A. C. Janni before the Western Society of Engineers. The example selected is the Kingshighway Viaduct recently completed at St. Louis, Mo. An abstract of the paper follows:

This viaduct was designed under the assumption that the three main arches, with their corresponding piers, act as a single elastic system. However, for the sake of brevity, we shall develop the method as applied to the central 170-ft. arch only, afterwards explaining in a few words the extension of this method to the main arch system as a whole.

The important dimensions of the span, which is being discussed, are as follows:

	Ft.
Span	170.00
Rise	17.00
Thickness at the key	2.80
Thickness at the spring	3.50
Intrados radius	221.00
One-half Geom. axis	87.85

The first step is to divide the arch into an arbitrary number of voussoirs, so taken that each voussoir can be considered as approximately of constant cross-section. In this particular case the half span has been divided into ten voussoirs, each being 8.78 ft. long along the geometrical axis.

Then calculate for each voussoir the following quantity:

$$w = \frac{\Delta s}{E\,I},$$

where

Δs is the length along the geometrical axis and is the same for all voussoirs;

E is the modulus of elasticity of the material of the arch, which also is constant for all voussoirs; and

I, the moment of inertia of the cross-section at the center of gravity of the voussoir, is, of course, variable.

The quantity w is known as the "elastic weight" of the voussoir.

Tabulations of the values of I and w follow:

$I_1 = 2.98$
$I_2 = 3.04$
$I_3 = 3.10$
$I_4 = 3.29$
$I_5 = 3.48$

$$w_1 = \frac{8.78}{2.98} = 2.91$$

$I_6 = 3.68$
$I_7 = 3.96$
$I_8 = 4.33$
$I_9 = 4.71$
$I_{10} = 5.12$

$$w_6 = \frac{8.78}{3.68} = 2.38$$

$$w_2 = \frac{8.78}{3.04} = 2.88 \qquad w_7 = \frac{8.78}{3.96} = 2.21$$

$$w_3 = \frac{8.78}{3.10} = 2.83 \qquad w_8 = \frac{8.78}{4.33} = 2.02$$

$$w_4 = \frac{8.78}{3.29} = 2.66 \qquad w_9 = \frac{8.78}{4.71} = 1.86$$

$$w_5 = \frac{8.78}{3.48} = 2.52 \qquad w_{10} = \frac{8.78}{5.12} = 1.71$$

(In the above values of *w*, *E*, for the sake of simplicity, have been assumed equal to unity. The value of *E* has no importance except when considering temperature stresses, in which case the assumed value of *E* must be given due weight as we shall show.)

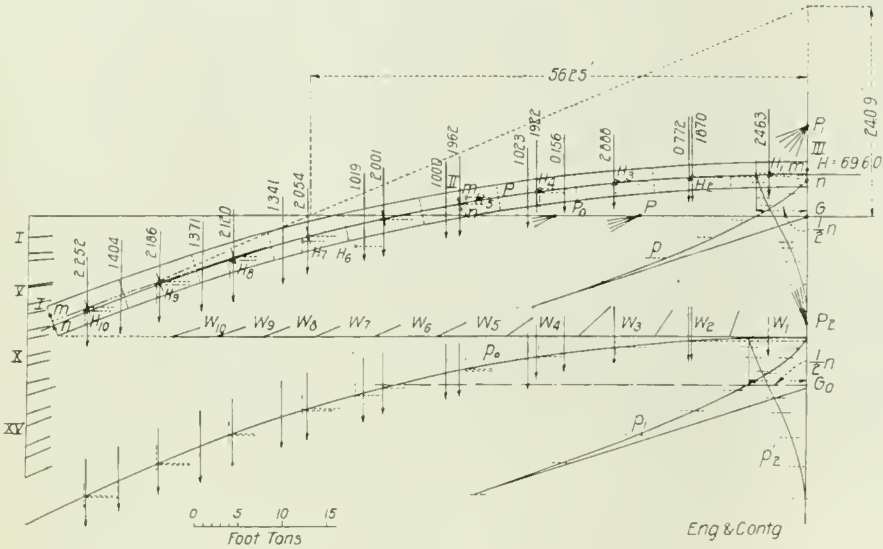


Fig. 1.

Now, for each voussoir, there exists a particular ellipse, the "ellipse of elasticity," its center coinciding with the center of gravity of the voussoir. In this case the major axis of the ellipse coincides with the geometrical axis of the arch.

The value, ρ_a, of the major axis is $\Delta s \sqrt{\frac{1}{12}}$.

The value, ρ_b, of the minor axis is $\sqrt{\frac{I}{A}}$, where

A equals the area of the cross section of the voussoir, and

Δs and *I* have the same significance as above.

The following tables give the values of *A* and ρ_b; ρ_a being the same for all voussoirs, and having the value of $8.78 \sqrt{\frac{1}{12}} = 2.54$.

$A_1 = 3.72$ sq. ft. $\qquad A_6 = 3.94$ sq. ft.
$A_2 = 3.74 \qquad A_7 = 4.02$
$A_3 = 3.76 \qquad A_8 = 4.12$
$A_4 = 3.82 \qquad A_9 = 4.22$
$A_5 = 3.88 \qquad A_{10} = 4.32$

$$\rho_{b1} = \sqrt{\frac{2.90}{3.72}} = \sqrt{0.89}\text{ ft.} \qquad \rho_{b6} = \sqrt{\frac{3.68}{3.94}} = \sqrt{0.96}\text{ ft.}$$

$$\rho_{b2} = \sqrt{\frac{3.04}{3.74}} = \sqrt{0.90} \qquad \rho_{b7} = \sqrt{\frac{3.96}{4.02}} = \sqrt{0.99}$$

$$\rho_{b3} = \sqrt{\frac{3.10}{3.76}} = \sqrt{0.91} \qquad \rho_{b8} = \sqrt{\frac{4.33}{4.12}} = \sqrt{1.02}$$

$$\rho_{b4} = \sqrt{\frac{3.29}{3.82}} = \sqrt{0.92} \qquad \rho_{b9} = \sqrt{\frac{4.71}{4.22}} = \sqrt{1.05}$$

$$\rho_{b5} = \sqrt{\frac{3.48}{3.88}} = \sqrt{0.94} \qquad \rho_{b10} = \sqrt{\frac{5.12}{4.32}} = \sqrt{1.09}$$

PRELIMINARY INVESTIGATION

Pressure Polygon for Dead Loads.—After tentatively deciding upon the main details of the arch, such as its span, thickness at spring and key, and the percentage of steel, it is possible, before entering into an exhaustive study of the arch, to make certain preliminary investigations which will serve later as a method of checking subsequent work and give immediately a criterion by which the designer may judge as to the probable adequacy of the dimensions assumed.

Draw for each voussoir (Fig. 1) the axis of the corresponding ellipse of elasticity. Then consider that the elastic weights found as above are horizontal forces, each applied at the center of its corresponding voussoir. Let us find the center of gravity of this system of forces as well as the static moments of the forces with respect to the horizontal passing through the center of gravity.

In order to accomplish this, we lay off on an arbitrary horizontal line the elastic weights calculated as above and take an arbitrary pole P_1, projecting from it the elastic weights. Then connecting the horizontals passing through the centers of gravity of the voussoirs draw the funicular polygon p_1, corresponding to the pole P_1. We have, then, in *G*, the point of intersection of the first, or vertical, and last, or closing, side of this polygon, the center of gravity of the system of elastic weights considered as forces. The successive sides of the funicular polygon cut, on the horizontal through *G*, segments proportional to the static moments of the corresponding elastic weights, with respect to this horizontal.

Next, considering the horizontal through *G* as polar, find for each ellipse whose semi-axes have been laid out as above the corresponding anti-pole, H_1, H_2, . . . H_{10} respectively. Assuming another pole P_2, and treating as horizonital forces applied at the anti-poles, H_1, H_2, . . . H_{10}, the static moments found as above, construct the corresponding funicular polygon, p_2. The distance ½*n*, between the first and last sides of the polygon p_2, is proportional to the inertial moment of the system of elastic weights, referred to the horizontal passing through *G*.

In the table below are given the dead loads calculated from the data of the design:

	Tons.		Tons.
I	2.463	XI	1.019
II	1.870	XII	2.054
III	0.772	XIII	1.341
IV	2.888	XIV	2.120
V	0.156	XV	1.371
VI	1.922	XVI	2.186
VII	1.023	XVII	1.404
VIII	1.962	XVIII	2.252
IX	1.000		
X	2 001	Total	29,804

On an arbitrary vertical (O-XVIII at the left) let us lay off these loads, starting from the point *O*, and on the horizontal *OG* let us assume the point P_0 as pole. Draw the funicular polygon p_0 intersecting with the verticals through the points of application of the loads and with respect to the pole P_0. Let us load the polygon p_0 horizontally with the same elastic weights as determined for the arch at the points where the verticals through the centers of gravity of the voussoirs meet with the polygon p_0. Then intersecting these horizontals, draw the funicular polygon p_1', using the same pole, P_1, thus obtaining G_1, the center of gravity of this new elastic system. If we again load horizontally the polygon p_0 with the same static moments found as above, and at the meeting points of the verticals through the anti-poles with the sides of the polygon p_0, construct the funicular polygon p_2', intersecting these horizontals, we shall have the distance ½n_1, between the first and last sides of p_2'. This distance is proportional to the inertial moment of the elastic weights acting on this new elastic system, in the same manner as ½*n* is proportional to the inertial moment of the system of elastic weights with respect to the horizontal passing through *G*.

Since the distance *OP*, except by accident, could not be equal to the true thrust, the polygon p_0 is not the true pressure polygon. Between the polygon p_0 and the true pressure polygon *p* there is, however, a geometrical relation; they are homological by affinity and the ratio of their affinity is given by $\frac{n}{n_1}$. Therefore the distance of any point on the true pressure polygon *p* from the horizontal through *G* can be obtained by multiplying by the ratio of affinity $\frac{n}{n_1}$, the distance from the horizontal through G_1, to the point of the polygon p_0 on the same vertical with the point in question. In this instance ½n_1 = 1.01 in., ½*n* = 2.21 in. Therefore $\frac{n}{n_1} = 0.86$. Taking, for example, the intersection of the polygon p_0 with the vertical through *G*, we find this to be equal to 1.85 in. The corresponding point of the true pressure polygon, *p*, will be on the same vertical and at a distance from *G* equal to 0.86x1.85 in. = 1.59 in., which locates definitely the point of intersection of the true pressure polygon with the key. The true horizontal thrust, likewise, will be found by multiplying the assumed thrust (60 tons) by the inverse of the ratio of affinity, or

$$H = \frac{n_1}{n} \times 60 = 1.16 \times 60 = 69.60 \text{ tons.}$$

The true pressure polygon is perfectly determined by the data above obtained and can be drawn as shown in Fig. 1.

The formulæ from which are calculated the stresses existing in sections I, II and III are:

$$\sigma_e = \frac{M_n}{A\,\delta_e} \qquad \text{(extrados)}$$

$$\sigma_i = \frac{M_m}{A\,\delta_i} \qquad \text{(intrados)}$$

where

M_n and M_m are the moments,

A is the area of the section,

σ_e is the distance from the center of gravity of the section to the kernel point *n*; and

σ_i is the distance from the center of gravity to the kernel point *m*. We may calculate, therefore, the values given in the following table:

Stresses Due to Dead Load.

Section.	Lb. per sq. in.	Lb. per sq. in.
I	—109	—236
II	—316	—208
III	—260	—260

TEMPERATURE STRESSES.

The horizontal thrust due to change of temperature will pass through the center of gravity, G_1, of the elastic system, and will be given by

$$H = \frac{a\,t^0\,E\,l}{\Sigma \frac{\Delta s}{I}\,y_1\,y_2}$$

a = coefficient of expansion 0.0000066;

E = modulus of elasticity 144,000 tons;

l = chord of the geometrical axis 171.3 ft.;

$\Sigma \frac{\Delta s}{I}\,y_1\,y_2$ = moment of inertia of the whole elastic system, with respect to the horizontal passing through *G*: y_1, y_2, being the polar distances, respectively, from P_1 and P_2, so that:

$$\Sigma \frac{\Delta s}{I} y_1 y_2 = 2 \times 1.91 \times 24 \times 12 = 1100.16$$

we have therefore

$$H = \frac{0.0000066 \times 144000 \times 171.3}{1100.16} = 0.147 \times t^\circ$$

and for 20 degrees change of temperature, we will have

$$H_{20^\circ} = 2.94 \text{ tons.}$$

Therefore, for the sections I and III, using the same formulæ as above, the following maximum tensile and compressive stresses are found:

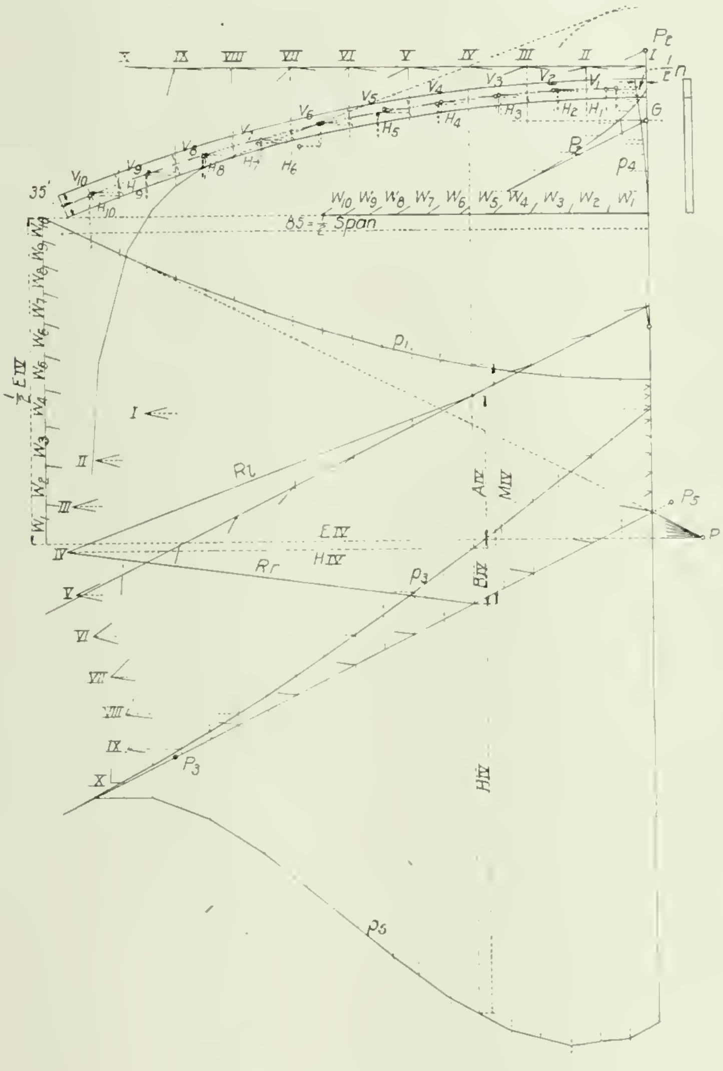


Fig. 2.

Stresses Due to Range of Temperature of 40° F.

Section	Lb. σ_e per sq. in.	Lb. σ_i per sq. in.
I	±134	∓ 94
III	± 81	∓103

From these data one can judge as to whether or not this arch as tentatively designed will be capable of withstanding the stresses generated by the addition of the live load.

The effect of shrinkage of concrete in setting, and of the shortening of the geometrical axis due to striking of the false-work, has been considered in this design as a sinking of the key resulting from a lowering of the temperature. This virtual drop in the temperature has been added to the change in temperature assumed in the data of the design. In this case the virtual drop amounted to 36 degrees, producing, with the dead load, the following stresses in Sections I and III, the stresses in Section II being negligible:

Stresses Due to Shrinkage Caused by Setting and Dead Load.

Section	Lb. σ_e per sq. in.	Lb. σ_i per sq. in.
I	+242	—165
III	—145	+184

COMPLETE METHOD FOR THE DESIGN OF THE ELASTIC ARCH.

The preceding preliminary work has served to indicate to us the probable condition of stability of the arch, and warrants us, if the indications are satisfactory, in investigating fully the effect of the live load; and the preliminary study alone might be sufficient in the case of a masonry highway arch, where the stresses generated by the live loads are in general small, in comparison with those generated by the dead load of the arch.

Figure 2 represents one-half of the span of the same arch previously treated. It has been divided in the same manner and the values A, I, w, Δs, σ_a and σ_b will therefore have the same values as above calculated.

For a complete analysis of the arch, five funicular polygons, p_1 to p_5, must be constructed, as follows:

Polygon p_1: Consider the elastic weights as vertical forces applied to the centers of gravity of their respective voussoirs. Now let us find the static moments of these elastic weights, considered as forces, when referred to the vertical passing through the center of the arch.

Lay off in their proper order on any arbitrary vertical at the left of the drawing the ten elastic weights, and, assuming as pole the point P_1, at a distance equal to the sum of the elastic weights of the whole arch (that is Σw), construct a funicular polygon p_1, intersecting the vertical lines of action of these elastic weights.

The intersection of the sides of this funicular polygon with the vertical through the center of the arch will determine the static moments of each elastic weight with respect to this vertical.

Polygon p_2: The polygon p_2 is in every particular the same as the polygon p_1 constructed in Fig. 1 for the dead load.

Polygon p_3: Let us locate the anti-poles V_1 to V_{10} of the vertical through G with respect to the ellipse of elasticity of each voussoir. Considering the static moments found by the polygon p_1 as vertical forces applied to the points V_1 to V_{10}, construct a funicular polygon connecting them, using an arbitrary pole P_3 for this purpose.

Polygon p_4: This polygon is similar in most respects to the polygon p_2 of Fig. I. There is this difference, however: The polar distance in polygon p_2 of Fig. I was arbitrary, but in this case the polar distance was equal to the vertical distance between the first and last sides of the polygon p_3 as is indicated in the drawing.

Polygon p_5: Let us regard the static moments, considered as forces which were used in constructing polygon p_4, as applied vertically instead of horizontally to the same points (H_1, H_2, . . . H_{10}, of Fig. 2).

Then lay off these moments on the vertical through G (for convenience of drawing), and assume a pole p_5, at a distance from that vertical equal to the horizontal distance between the first and last sides of the complete polygon p_4, or

$$2 \times \tfrac{1}{2}n = n.$$

With these vertical forces construct a funicular polygon p_5 with respect to the pole P_5.

From the polygons p_1, p_3 and p_5, we may obtain for unit loading at any point the moment, the vertical reaction at the springs, and the horizontal thrust at the key. For instance, the vertical drawn through the point IV gives M_{IV}, B_{IV}, A_{IV} and H_{IV}; M_{IV} being the moment; A_{IV}, the vertical reaction at the left; B_{IV}, the vertical reaction at the right; and H_{IV}, the horizontal thrust at key.

It is therefore easy to construct the intersection of the envelope lines. For instance, considering again the vertical through IV: A_{IV} and B_{IV} are the two vertical reactions, and H_{IV} the horizontal thrust at the key, when the unit load is located at this point. Laying off H_{IV} horizontally as in the drawing and joining the point IV to the ends of A_{IV} and B_{IV}, we will have R_l and R_r, which are the left and right reactions, respectively, in their true directions and magnitudes.

It now remains to locate the true intersection and envelope lines. Knowing the moment M_{IV}, we have

$$M_{IV} = R_l \times d.$$

where d will be the distance from R_l to G. In this particular instance,

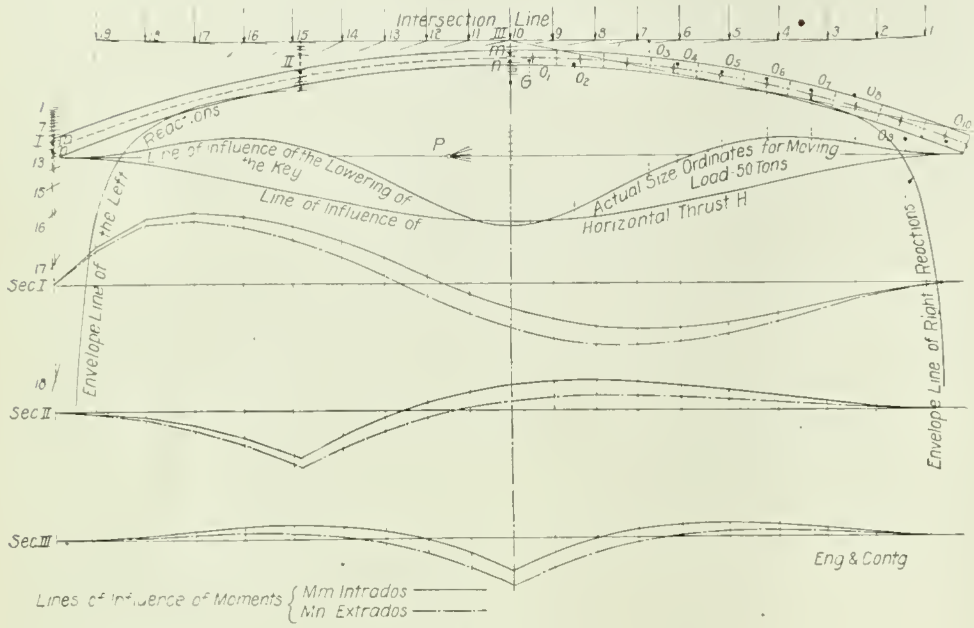
$$d = \frac{M_{IV}}{R_l} = \frac{35.0}{2.09} = 16.74 \text{ ft.}$$

With a radius equal to d, draw a circle with G as a center, and a tangent to this circle, parallel to R_l. The intersection between this tangent and the vertical through the point of application of the load will locate the point IV, which is a point of the intersection line, the tangent itself forming a side of the polygon tangential to the envelope line. A similar construction has been followed for R_r, and an analogous method is to be followed for the points other than IV.

In Fig. 2 the entire construction for a unit load in position IV is carried out. In a similar manner the points I, II, . . . X, have been determined, and the line of intersection and the left envelope line drawn.

It should be noted, that in locating the positions of the points I, II, . . . X, the unit load was considered as acting through the points of intersection of the geometrical axis with the planes dividing the voussoirs. This was done because the polygons p_1 and p_3 are very nearly, and because polygon p_5 is actually, a true envelope tangent at these points to the true envelope curves which they approach as limits when the lengths of the voussoirs become infinitesimal.

The polygon of pressure due to the dead loads and found as shown previously by means of Fig. 1, can be checked by the data given in Fig. 2, using the polygons p_1 and p_ℓ, in the following manner: Locate on the arch in Fig. 2 the lines of action of the dead loads as shown in Fig. 1. Then the segments cut on these verticals by the sides of the polygon p_1 will give us the moments caused by unit loads at the corresponding points, and multiplying each moment so found by the actual corresponding dead load on that vertical, we find the real moment due to that load. The same method, using the horizontal thrust polygon p_5, will give us the horizontal thrust caused by the actual loading at each point.



Intersection Line
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
I
II
III
m
n
G
P
O_1
O_2
O_3
O_4
O_5
O_6
O_7
O_8
O_9
O_{10}
Reactions
Line of Influence of the Lowering of the Key
Line of Influence of Horizontal Thrust H
Actual Size Ordinates for Moving Load 50 Tons
Envelope Line of the Left Reactions
Envelope Line of Right Reactions
Sec I
Sec II
Sec III
Eng & Contg
Lines of Influence of Moments { Mm Intrados, Mn Extrados

Fig. 3.

Moment Polygon p_1.

2.463 ×	19.55 =	48.15
1.870	20.05	37.49
0.772	20.10	15.52
2.888	21.10	60.94
0.156	22.10	3.45
1.922	22.65	43.53
1.023	22.90	23.43
1.962	24.80	48.66
1.000	25.10	25.10
2.001	27.20	54.42
1.019	27.90	28.43
2.054	30.10	61.83
1.341	31.15	41.77
2.120	33.30	70.60
1.371	34.90	47.84
2.186	36.85	80.55
1.404	39.00	54.76
2.252	40.75	91.77
Σ P = 29.804		838.24
		2
		1676.48 = Σ M

Horizontal Thrust Polygon p_5.

2.463 ×	2.41 =	5.936
1.870	2.30	4.301
0.772	2.29	1.767
2.888	2.08	6.007
0.156	1.90	0.296
1.922	1.78	3.421
1.023	1.75	1.790
1.962	1.44	2.825
1.000	1.38	1.380
2.001	1.07	2.141
1.019	0.98	0.998
2.054	0.71	1.458
1.341	0.60	0.805
2.120	0.40	0.848
1.371	0.28	0.384
2.186	0.15	0.327
1.404	0.06	0.084
2.252	0.01	0.022
		34.790
		2
		69.580 = Σ H

The total horizontal thrust, ΣH, and the sum of all the moments, ΣM, due to the dead loads, are shown above. It may be seen that the horizontal thrust found by this method is within 0.02 of a ton of that found from the construction shown in Fig. 1. Having both ΣM and ΣH and with $\Sigma P = 29.804$ tons, it is simple to find the coördinates of the total reaction of the arch with respect to the center of gravity G.

$$x = \frac{\Sigma M}{\Sigma P} = \frac{1676.48}{29.804} = 56.25 \text{ ft.}$$

$$y = \frac{\Sigma M}{\Sigma H} = \frac{1676.48}{69.60} = 24.09 \text{ ft.}$$

where

x is the distance from G to the point where the line of action of the resultant cuts the horizontal through G, and

y is the distance from G to the point where the line of action of the resultant cuts the vertical through G.

While the data in this case were determined from Fig. 2, the construction of the resultant was made on Fig. 1, in order to afford a check between this method and the one previously outlined in explaining Fig. 1. It may be seen, from inspection of Fig. 1, that the check is remarkably close, no distance being shown between the position last determined and that given before in the explanation of Fig. 1.

THE INVESTIGATION OF PARTICULAR POINTS.

In investigating the effect of a live load with respect to particular sections, the entire arch is drawn as shown in Fig. 3, and on it are placed the envelope lines, the intersection line, and the line of influence of the horizontal thrust, which is really the envelope of the polygon p_5—all these taken from Fig. 2. The first side of polygon p_5 corresponds to the horizontal through the point P in Fig. 3. In this particular design we considered nineteen positions of the live loads, and have computed the stresses due to the action of these loads, for the sections I, II, and III. The sections I, II and III are the same sections that have been considered in the determination of the effect of dead load and temperature.

Let us consider the influence on Section II of a unit load at point 12. The segment cut on the vertical through 12 by the horizontal line through P, referred to above, and the line of influence of the horizontal thrust, gives us the horizontal thrust due to a unit loading at 12. This amounts to 2.25 tons. Having the location 12, which is the intersection of the vertical through the load and the intersection line, we draw from that point a tangent to the envelope line of the left reaction. This cuts the vertical through the kernel point *m*, at Section II, as is shown on the drawing. The vertical distance from *m* to the point of intersection gives us to scale the lever arm of the moment about *m*, at II, generated by the unit load 12. This amounts to —0.72 ft. The moment, therefore, will be —1.620 ft. tons. On the vertical through 12 lay off —1.620 from an arbitrary horizontal. This is one point of the line of influence for the intrados for Section II, due to unit load in position 12. Similarly for the extrados we take our measurement from the point *n*; the figures are $+2.25\ T \times +0.52$ ft. = 1.17 ft. tons.

Table I was derived in this manner for the nineteen positions of loading considered for each of the sections I, II and III.

Assuming that the live load is 150 lbs. per square foot, we are enabled to find the actual moments and from them the actual stresses as follows:

STRESSES DUE TO LIVE LOAD.

Section.	Lb. δ_e per sq. in.		Lb. δ_i per sq. in.	
I	—190	+135	—135	+103
II	—174	+ 67	—150	+126
III	—110	+ 35	— 99	+ 49

Incidentally it might be well to mention that the data given in Fig. 3 afford still another check on the stresses due to the dead load as determined in the explanation of Fig. 1.

In order to locate cuspidal points of the influence lines more precisely in Section II, the live load was considered as passing through *m* and *n*, in turn.

These influence lines are polygonal from positions 1 to 6, and from 14 to 19; and curves from 6 to 14. This is due to the fact that the construction of the arch calls for concentrated loadings at the first mentioned points, and for a concrete fill between positions 6 to 14. It may therefore be assumed

TABLE 1.

		Spring (Section I)				Section II				Key (Section III)			
Position.	H	h_m	M_m	h_n	M_n	h_m	M_m	h_n	M_n	h_m	M_m	h_n	M_n
1	0.06	6.70	+0.402	8.17	+0.490	—2.88	—0.172	—0.172	—0.097	—3.20	—0.192	—2.00	—0.120
2	0.27	6.53	+1.763	8.00	+2.160	—2.86	—0.772	—0.772	—0.437	—3.05	—0.823	—1.85	—0.499
3	0.60	6.25	+3.750	7.70	+4.620	—2.83	—1.698	—1.698	—0.960	—2.70	—1.620	—1.55	—0.930
4	0.98	5.85	+5.733	7.35	+7.203	—2.80	—2.744	—2.744	—1.528	—2.40	—2.352	—1.18	—1.156
5	1.38	5.40	+7.452	6.88	+9.494	—2.75	—3.795	—3.795	—2.097	—1.90	—2.622	—0.70	—0.966
6	1.76	4.77	+8.395	6.25	+11.000	—2.72	—4.787	—4.787	—2.569	—1.30	—2.288	—0.12	—0.211
7	2.03	4.25	+8.627	5.75	+11.672	—2.64	—5.359	—5.359	—2.801	—0.65	—1.319	0.50	+1.015
8	2.25	3.62	+8.145	5.13	+11.542	—2.50	—5.625	—5.625	—2.745	+0.10	+0.225	1.30	+2.925
9	2.39	2.80	+6.692	4.32	+10.324	—2.30	—5.497	—5.497	—2.390	1.22	+2.915	2.40	+5.736
10	2.44	1.90	+4.636	3.40	+8.296	—2.00	—4.880	—4.880	—1.709	2.65	+6.466	3.80	+9.272
11	2.39	0.77	+1.840	2.34	+5.592	—1.50	—3.585	—3.585	—0.478	....	....	....	....
12	2.25	—0.62	+1.395	0.98	+2.205	—0.72	—1.620	—1.620	+1.170	....	....	....	....
13	2.03	—2.42	—4.872	—0.70	—1.421	+0.50	+1.015	+1.015	+3.654	....	....	....	....
14	1.76	—4.50	—7.920	—2.82	—4.963	+2.60	+4.576	+4.576	+6.952	....	....	....	....
	1.43	....	....	....	....	+6.08	+8.694	+8.694	....	....	....	....	....
	1.45	....	....	....	....	....	....	....	+10.585	....	....	....	....
15	1.38	—7.90	—10.902	—6.15	—8.487	+5.88	+8.114	+8.114	+9.729	....	....	....	....
16	0.98	—13.08	—12.818	—11.12	—10.897	+4.95	+4.851	+4.851	+6.027	....	....	....	....
17	0.60	—22.40	—13.440	—20.00	—12.000	+4.25	+2.550	+2.550	+3.288	....	....	....	....
18	0.27	—45.00	—12.150	—41.45	—11.191	+3.72	+1.004	+1.004	+1.336	....	....	....	....
19	0.06	+20.55	+6.967*	+21.95	—6.283†	+3.50	+0.210	+0.210	+0.283	....	....	....	....

*20.55 × 0.06 — 1 × 8.2 = 6.967.
†21.95 × 0.06 — 1 × 7.6 = 6.283.

that the loads between 6 and 14 act as a continuous loading.

Take such simultaneous values of dead load, live load, and temperature stresses for the sections I and III as will produce a maximum stress in each of the respective sections. The maximum values are shown in the following table:

MAXIMA FOR SECTIONS I AND III.

Section.	Lb. δ_0 per sq. ft.		Lb. δ_1 per sq. ft.	
I	+402			— 630
		— 324		— 204
III		— 596	+ 76	
		— 289		— 278

It is evident that in sections in which tension is shown in the above table we are compelled to make further calculations (purely graphical also), to find the compression in concrete and the tension in steel, disregarding the tension in concrete, in accordance with the usual procedure. We obtain the following results:

Section.	Tension in steel.	Compression in concrete.
I	14,000 lbs. per sq. in.	810 lbs. per sq. in.

INVESTIGATION OF DEFLECTION.

In this investigation we employ, besides the elipse of elasticity, the principle of Maxwell.

Again referring to Fig. 3, let us draw the right reaction line for a unit force applied to the arch at position 10. For each voussoir then locate the anti-poles, O_1, O_2, ... O_{10}, of the ellipse of elasticity of each voussoir with respect to this reaction line. Let us suppose that to the anti-pole O_1 is applied as elastic weight $\frac{I_{10}}{I_1} n_1$, regarded as a vertical force to the anti-pole O_2, the elastic weight $\frac{I_{10}}{I_2} n_2$; . . . to the anti-pole O_{10}, the elastic weight $\frac{I_{10}}{I_{10}} n_{10}$; in these expressions I_1, I_2, . . . I_{10} have already been computed; and n_1 is the vertical distance, taken with the proper sign, from the center of gravity of the first voussoir to the reaction line above drawn; n_2 is the corresponding value for the second voussoir; . . . ; n_{10}, for the last.

The values for $\frac{I_{10}}{I_k} n_k$ are as follows: wherein $\frac{I_{10}}{I_k} n_k$, $k = 1, 2, \ldots 10$:

$$+\frac{5.12}{2.98} \times 2.90 = +4.12$$

$$+\frac{5.12}{3.04} \times 0.92 = +1.55$$

$$-\frac{5.12}{3.10} \times 0.18 = -0.30$$

$$-\frac{5.12}{3.29} \times 0.93 = -1.45$$

$$-\frac{5.12}{3.48} \times 1.35 = -1.98$$

$$-\frac{5.12}{3.68} \times 1.45 = -2.02$$

$$-\frac{5.12}{3.96} \times 1.15 = -1.49$$

$$-\frac{5.12}{4.33} \times 0.50 = -0.59$$

$$+\frac{5.12}{4.71} \times 0.40 = +0.44$$

$$+\frac{5.12}{5.12} \times 1.72 = +1.72$$

On the middle vertical line through G lay off these values, with proper regard to sign, from the horizontal through P, and construct a force polygon with the pole P, taking the pole on this horizontal at a distance $\frac{\lambda}{60}$, from the vertical. (1:60 is the scale of the drawing.)

$$\lambda = \frac{E I_{10}}{H \triangle s} = \frac{144000 \times 5.12}{2.44 \times 8.78 \times 50} = 688.3$$

Then the polar distance $\frac{1}{60} \lambda$ will be

$$\frac{688.3}{60} = 11.47 \text{ ft.}$$

Drawing the funicular polygon corresponding to this force polygon, with pole P, intersecting the verticals through O_1, O_2, . . . O_{10}, will give us, to actual size (on the original drawing), the deflection of the key for each position on the arch of a moving load of 50 tons. That this line gives the true lengths of ordinates for a moving load of 50 tons follows from the fact that λ was divided by 50. By the principle of Maxwell, of course, this also represents the form of the geometrical axis of the arch when a load of 50 tons is applied at the crown. The deflection being proportional to the load, it is easy by the use of the proper ratio to find the deflection of the key where the assumed loading of 150 lbs. per square foot is applied to the arch; it was found to be 0.128 in. We are similarly able to determine that on striking the centers if the temperature is 65° F. and there is no initial stress before this operation upon removing the centers, the dead load will produce a deflection at the key of 0.33 in.

RECAPITULATION.

It would be possible to reduce all stresses on the arch caused by dead load and live load from the lines of influence in Fig. 3, without resort to the pressure polygon drawn by the two different methods previously described and illustrated in Figs. 1 and 2. This polygon, however, besides being very useful for a quick preliminary trial of the stability of the arch under dead load, should not be omitted, because it gives to an experienced designer a graphical representation from which he may judge at a glance of the behavior to be expected under different conditions of live load and temperature, and it is easy for one familiar with the slide rule to make the few simple calculations necessary for its construction.

In the foregoing article we have applied the new method of the ellipse of elasticity to the investigation of the central arch of the Kingshighway viaduct. We have determined by easy graphical methods the influence lines for moments, vertical reactions and horizontal thrusts due to a unit load in any position on the arch, from which it is but a step to derive the corresponding values for any hypotheses of loading. Similar graphical methods have given the deflection of the geometrical axis of the arch under any loading.

In the final design of this viaduct, however, the theory of the ellipse of elasticity was applied in a more exhaustive form. The three large arches, together with the four corresponding piers (which all together form a monolithic structure), were regarded as a single elastic system, since a load on one of the arches has an effect on the adjoining ones, owing to the fact that the middle piers are of light construction.

Cofferdam Construction for the River Pier of the Sewickley Bridge.

Piers Nos. 2 and 3 carrying the main 750-ft. span of the Ohio River Bridge at Sewickley, Pa., and located respectively in 14 ft. and 6 ft. of water, were built inside cofferdams. The depths of the bottoms of the two piers were respectively 33 ft. and 30¾ ft. below pool level. The cofferdams had therefore depths exceeding the figures stated and lateral dimensions capable of providing room for a pier base 71x26 ft. The method of constructing the cofferdam for Pier 3 is described by V. R. Covell, Deputy County Engineer, in a paper before the Engineers' Society of Western Pennsylvania as follows:

The sand and gravel was excavated to rock by a dipper dredge of standard type, to a line 6 ft. outside the outer line of the cofferdam, with the necessary slopes, and the material removed in dump scows. The cofferdam used in constructing the foundations was 76 ft. long, 28 ft. wide, and 40 ft. deep, or 2 ft. wider and 5 ft. longer than the extreme dimensions of the foundation masonry, to provide room for constructing the forms for the concrete masonry and a well hole for the pumps.

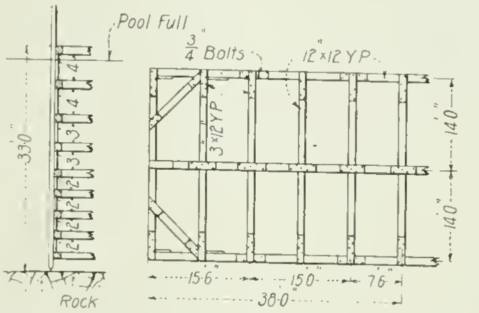


Fig. 1—Cofferdam for River Pier of Ohio River at Sewickley, Pa.

The inner frame of the cofferdam was built of a series of rings, the spacing varying from 2 ft. at the bottom to 5 ft. at the top, see Fig. 1. These rings were built of 12x12-in. yellow pine, having nine intermediate cross struts and one longitudinal strut, all 12x12-in. yellow pine, dividing the cofferdam into 20 areas or pockets. A waling piece was used on the outside, all being firmly bolted together. The first three rings were framed on shore and then floated to place and held by six posts or spuds driven to rock. These posts were placed in the inside and held in place by an iron bridle bolted to each frame. Posts of the proper length to space the rings were then set on top of the upper frame. As the additional rings were built the cofferdam settled by its own weight and when within 2 ft. of the bottom was set to the proper position and firmly anchored by bolting the spuds to the top frame and loading with about ten tons of stone. Sheathing was next laid on the outside of the rings. This consisted of 8x12-in. yellow pine, 40 ft. in length, each piece having strips 3x2 ins. and 2x2 ins. spiked to it to form a tongue and groove. This sheathing was set in place by a diver at the bottom and held in place at the top by a ribbon piece bolted to the top frame and was driven to rock by a 2,500-lb. hammer operated from a derrick boat.

After the sheathing was in place the cofferdam was filled on the outside with puddle clay, obtained from the vicinity of Pier No. 1, to a height of 6 ft. and then back filled to the original surface of the river bed with sand and gravel taken from the other foundations. In the meantime the surface of the rock on the inside was thoroughly cleaned off with a clam shell dipper operated from the derrick boat, and three 8-in. centrifugal pumps installed. These pumps were capable of lowering the surface of the water 25 ft. A 10-in. pump was set on the braces 10 ft. below pool level and had lowered the water to within 2.50 ft. of the bottom when the main shaft on the 10-in. pump broke. As it was getting late in the season and the repair parts could not be obtained under two weeks, it was thought advisable to place the first 10 ft. of concrete under water. The cofferdam was allowed to fill up and the concrete was placed with a submarine drop-bottom bucket, the full area inside the cofferdam being filled. After the concrete had been placed and set for 24 hours, the cofferdam was again pumped out and the remainder of the foundation placed inside of forms to the level of the stone work. One 8-inch pump, working three hours per day, was sufficient to keep the cofferdam dry. As the concrete and stone masonry was brought up, the inside bracing was removed and, after the pier was carried above pool level, the remainder of the cofferdam was pulled.

The Design of Various Types of Highway Bridges From the Standpoint of Modern Traffic.

Highway traffic now comprehends travel and haulage by a number of vehicles whose speed and weight alter materially the assumptions on which roadways and road structures must be designed. Much has been written of the effect of the motor vehicles on roadway, but almost nothing of its possible effect on road structures, the most important of which are bridges. It is interesting to note, therefore, the paper by Prof. F. H. Neff, Case School of Applied Science, read before Section D of the American Association for the Advancement of Science, on highway bridge design for modern traffic conditions. We give the essential parts of this paper as follows:

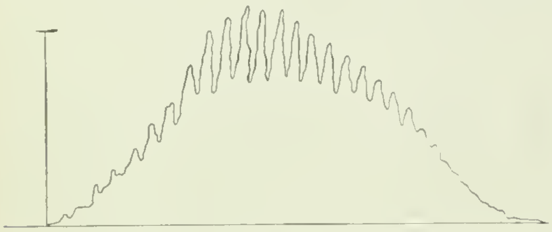


Fig. 1—Deflection Diagram for 300-ft. Truss Span at Locomotive Speed of 25 Miles Per Hour.

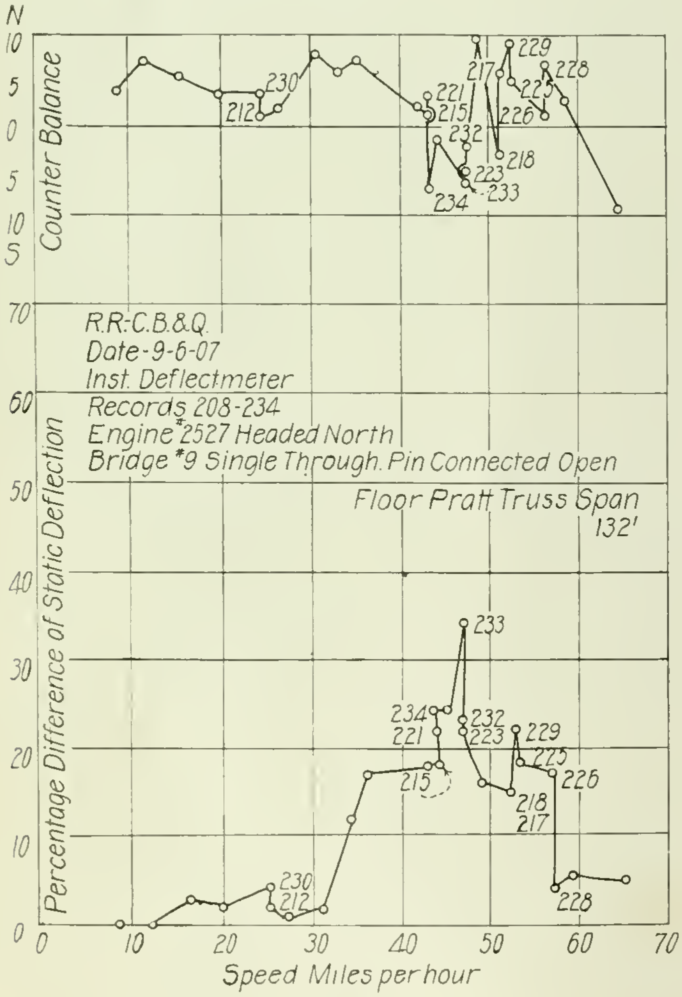


Fig 3.

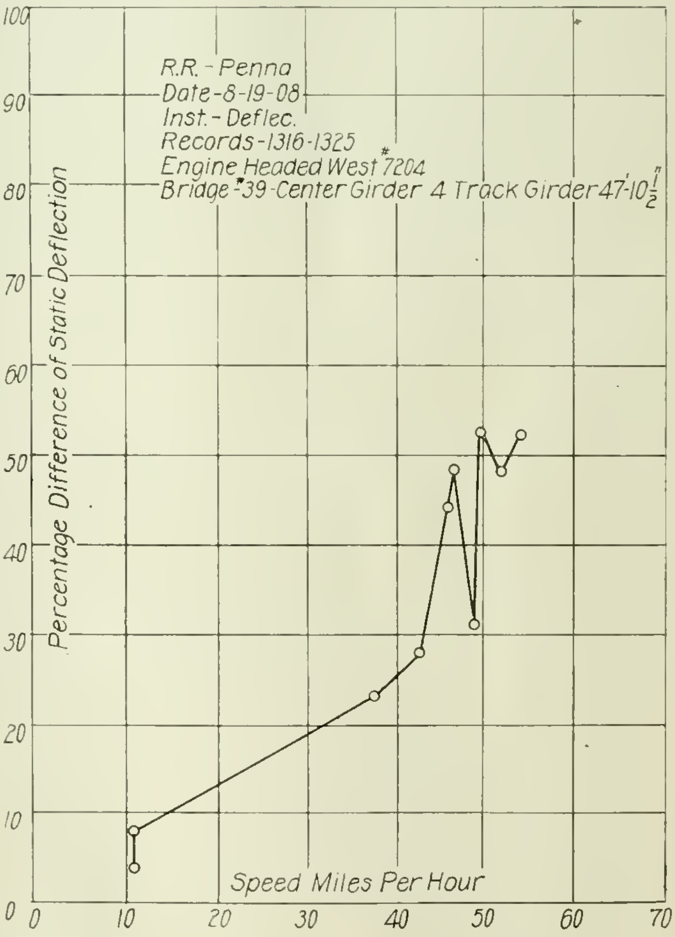


Fig. 4.

MODERN TRAFFIC.

Modern traffic differs from that which preceded it in the following ways: (1) Increased concentration of loads; (2) increased speed, and (3) increased dimensions requiring increased clearances.

Loads.—In the proceedings of the American Society of Civil Engineers for December, 1911, is given a list of the truck loads that have occurred in New York City. They are as in Table I.

TABLE I.—WEIGHTS OF TRUCKS.

Kind of truck.	Total load. Tons.	Load, lbs., per lin. ft.	Load, lbs. per sq. ft. width 12 ft.
Cable truck	102	1,800	150
Automobile truck	16	1,600	135
Girders on truck	76	1,500	125
Lidgerwood truck	21	1,150	95
Coal truck	12	1,000	85
Standard truck	9	750	65

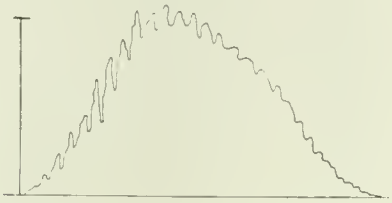


Fig. 2—Deflection Diagram for 300-ft. Truss Span at Locomotive Speed of 31 Miles Per Hour.

The Board of Engineers for the Manhattan Bridge recommended for local concentrations 24 tons on two axles spaced 12 ft. with a 5-ft. gage, and assumed to occupy 12x30 ft

In the same article a concentration of 15 tons on an axle 8-ft. gage was recommended in place of the above.

In making use of weights of motor trucks it is important to know the percentage of the live load that comes upon the rear axle. The usual amount is 80 per cent to 90 per cent. In the 10-ton truck of the International Motor Co. it is 90 per cent. This, with the weight of the chassis of 6,300 lbs. on the rear axle makes a total of 24,300 lbs. The body is 7 ft. 4 ins. x 22 ft. 1 in., which makes 195 lbs. per square foot of the actual car body.

The following weights of road rollers and traction engines are given in the "Engineering Record" of Jan. 21, 1911:

TABLE II.—WEIGHTS OF ROAD ROLLERS AND TRACTION ENGINES.

Manufacturers.	Tons.	Front wheel. Lbs.	Rear axel. Lbs.
Road rollers—			
	21	14,000	28,000
Buffalo Steam	20	16,000	24,000
Austin Western Co.	15	8,000	22,000
Iroquois	13	8,000	18,000
Traction engines—			
J. I. Case, 110 h. p.			31,500
Rumely Co., 120 h. p.			31,000
Avery Co., 90 h. p.			24,000
Case, 75 h. p.			20,400

In the bridge department of the State of New York, bridges are classified as City, Town, Country and Farm. In addition to the usual uniform loads the floor system is designed for trucks weighing 18, 15, 12 and 9 tons, respectively, on four wheels of 5-ft. tread and 10-ft. wheel base with two-thirds of the load on the rear axle to which is added 50 per cent for impact.

Speeds.—Motor-driven trucks have on the average a speed of 12 miles per hour, while a speed of not less than 30 miles per hour must be taken into consideration for automobiles, even if such speeds are much in excess of legal limits.

Dimensions.—Car bodies have platforms

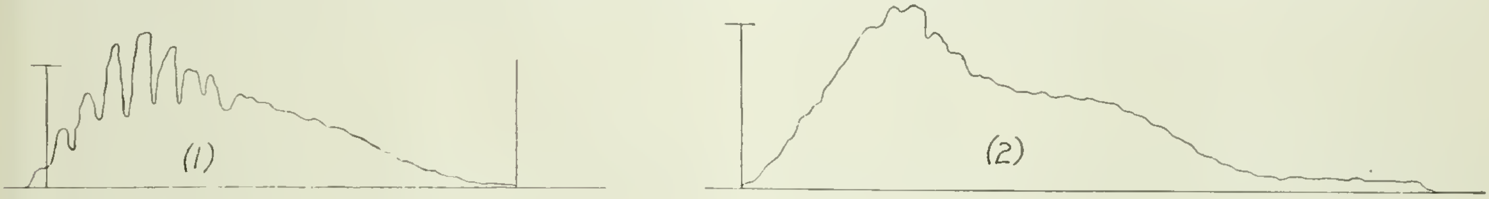
from 7 to 8 ft. in width and lengths from 14 to 22 ft.

THE EFFECTS AND REQUIREMENTS OF MODERN TRAFFIC.

The effects of modern traffic may be considered under two heads: (1) Their static effects, and (2) their dynamic effects.

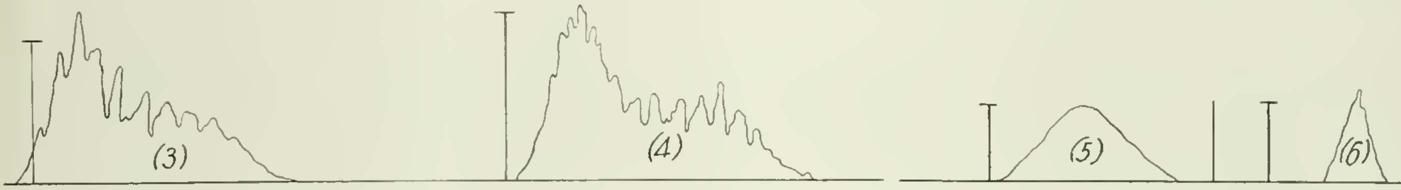
These have been amply provided for as far as the floor system is concerned, but the question of the dynamic effects of these heavier and more rapidly moving loads calls for an investigation with reference to other parts of the structure, than the floor system. There are three phases of this effect to consider: (1) With reference to the sudden application of the load; (2) with reference to the cumulative vibration of the bridge as a whole, and (3) with reference to the stopping of the forward movement of such loads.

Cumulative Vibrations.—In the absence of observations made upon bridges under the traffic considered, we may turn to the experiments carried on during the past five years by a committee of the American Railway Engineering Association. From the results of their work we can draw conclusions which seem to make experiments on highway bridges unnecessary. A description of the work done, the results obtained and a discussion of them, is to be found in Part III, Vol. 12, of their Proceedings. The accompanying few diagrams are taken from their report and give information upon the above points.



(1) Compound; 149-ft. truss; 42 miles per hour.

(2) Balanced Compound; 149-ft. truss; 36 miles per hour.



(3) Compound; 70 ft. Plate Girder; 53 miles per hour.

(4) Balanced Compound; 70-ft. plate girder; 52 miles per hour.

(5-6) Electric Locomotive; 50 ft. plate girder; 20 and 63 miles per hour.

Fig. 5—Comparison of Deflections Due to Compound, Balanced Compound and Electric Locomotives.

Figure 1 shows the cumulative effect of synchronous impacts at critical speed, and shows the number of impulses necessary to build up an appreciable effect.

Figure 2 shows how the vibrations are broken up if the impulses are not properly timed.

Figure 3 shows the increase in impact effects as speed increased to the critical speed and the decrease as the speed goes beyond the critical speed.

Figure 4 shows a continually increasing impact, the span was so short and time of vibration so small that the critical speed was not reached.

Figure 5 brings out the lack of vibration in the balanced compound and electric locomotives as compared with the ordinary compound engine.

Figure 6 shows the effects of design, short ties and rail joints producing jarring effects in the part immediately receiving the loads.

Figure 7 shows effect of long ties and ballast flows in eliminating jar.

Conclusions 11, 12 and 13 of the Committee are as follows:

(11) The impact due to rapid application of a load, assuming smooth track and balanced loads, is found to be from theoretical and experimental grounds, of no practical importance.

(12) The impact caused by balanced compound and electric locomotives was very small and the vibration caused under the loads was not cumulative.

(13) The effect of rough and flat wheels was distinctly noticeable on floor beams, but not on truss members. Large impact was, however, caused in several cases by heavily loaded freight cars moving at high speeds.

The statement is also made in their report that no effect of any consequence was ever observed under passenger cars. Looked at in the light of these experiments it is evident that there can be no such cumulative vibrations produced by motor trucks or automobiles. The only way in which it could occur would be by the vibration of the car body in its springs, and as seen, such impulses must be repeated many times to build up an appreciable vibration. But in the case of these loads as in the case of the passenger cars, there is no continued vertical vibration of the car body.

The electric street car might build up such a vibration if its speed was such that its trucks would cross the panel points at intervals coinciding with the time of vibration of the structure, but the total effect of a single car could not be very great; if, however, these electric railroads in time develop a regular freight business, then we may look to see developed under the above conditions, cumulative vibrations, as has been shown to be the case on the steam road. One would, however, think that in the case where the floor is of concrete, the conditions would be much less favorable to the development of such vibrations than where the track is supported on separate steel stringers.

Higher impact effects, which are, however, as shown, limited to the floor and hip verticals, will be caused by the irregularities of the pavement, due to the fact that the heavy motor truck moves at a speed three or four times that of the heavy horse-drawn truck. Pneumatic tires largely neutralize this effect but in the case of the solid rubber tire the effect is quite appreciable.

What have observations shown with reference to the cumulative vibration due to horse-drawn vehicles or a body of men? In the Annales des Ponts et Chaussees 1892, Vol. II, p. 765, there is given a description of experiments upon a steel highway bridge of 99.4-ft. span. These showed that by timing the step of a single horse weighing 1,540 lbs., which was attached to a cart weighing 1,760 lbs., that cumulative vibrations were developed to such an extent as to produce a deflection equal to one-half that arising from a total live load capacity of 86,000 lbs., and that three such horses and carts having a total weight of less than 10,000 lbs. gave a deflection equal to that produced by the total live load.

The effect of a body of men upon a reinforced concrete arch is described in the Annales des Ponts et Chaussees, Jan., 1912. The structure, a single reinforced concrete arch, having a span of 328 ft. and a rise of 32.8 ft., was built across the river Tiber at Rome, by the Hennebique Co., according to plans prepared by their engineers. The total weight of the structure was only about 2,000 kgs. per square meter. When loaded over the entire span with 620 kgs. per square meter the maximum deflection was 0.0322 m. Maximum deflection due to the vibration produced by 900 men was 0.0026 m.

From the above it is to be seen that the new and increased loads of modern traffic cannot produce vibration effects at all comparable with those caused by the old one-horse shay, jogging along or by a body of men, but that the direct impact or flow of such loads is greater, so that while the members immediately receiving the load would require far larger impact allowances under these new loads, the main truss members would require less than before.

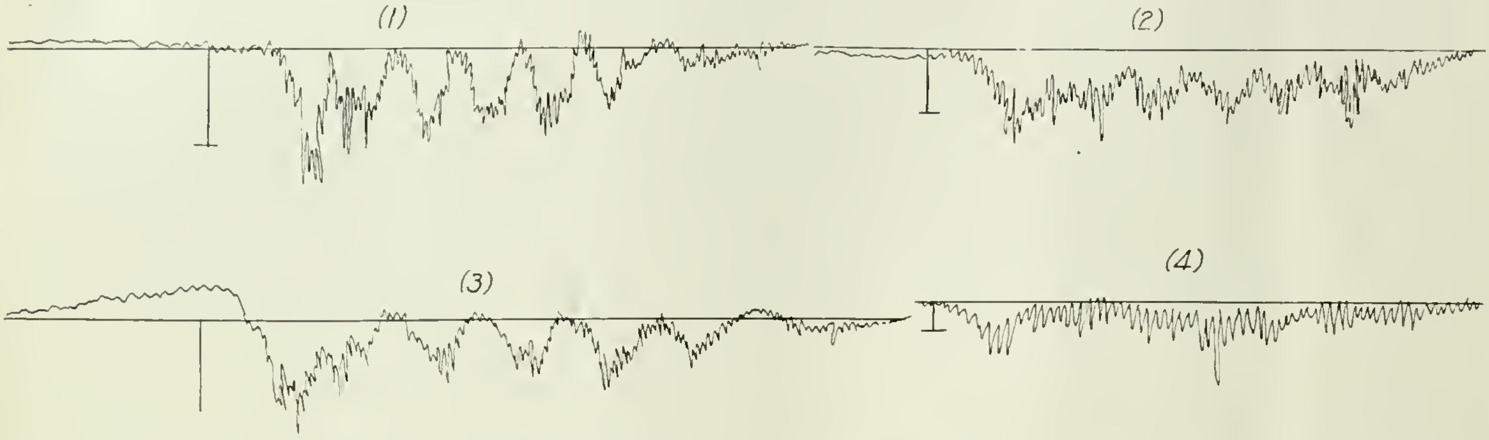
The Starting and Stopping of Cars.—Experiments made on automobiles with reference to the distance within which they can be stopped give a coefficient of friction averaging 0.5 or two and one-half times that used for railroad trains. As long as street cars or motor cars are under control of the driver there would seem to be no necessity for considering the effects of their sudden starting or stopping, for the reason that a single truck or car would not have an appreciable effect, and it is impossible to conceive that a large number of cars would start or stop in unison so as to require that provision be made for their longitudinal effect. This fact permits of the construction of a concrete trestle without bracing other than is given by the floor slab.

Clearance of Bridges and Bridge Approaches.—The increase in the power of the motor truck over the horse-drawn truck has been utilized in two ways, to increase their speed and to increase their carrying capacity. With this latter has naturally come a greater width of car body demanding greater clearance.

An increase in the general speed of circulation of vehicles would of itself demand greater clearances to avoid accidents and when with the increased speed we have an increased width of body it is apparent that unless city bridges are to congest traffic, they must have roadways of greater width than have been necessary under traffic in the past. Especially as we have seen there is no reason from the standpoint of the stresses developed in the structure, why motor trucks should not maintain their usual speed over bridges. The above considerations indicate that there should be a material increase in the width of roadway, and in the case of Cuyahoga County the new bridges on through roads replacing old bridges have their roadways increased from 14 ft. and 16 ft. to 30 ft. Also that where this width on the bridge is less than that of the roadway leading up to it there should be, if conditions permit, a gradual and not an abrupt change from one width to the other, which will help to reduce the liability for congestion and accident.

An automobile ride upon the paved roads of this county will convince one that the width of pavements that was sufficient for horse-drawn vehicles gives insufficient clearance for rapidly-moving automobiles of present dimensions and there is every reason to think that the size of car bodies will increase, at least for handling lighter kinds of freight.

While considering the question of approaches there is one other point in which some of the old bridges should be modified in consideration of high speed traffic, that is the question of the grades of the approaches. There are bridges in which the steep grade of the approaches change abruptly to the level grade of the bridge. A simple calculation will show that a car moving at 40 miles per hour up a 6 per cent grade would leave the road surface where it changed to a level grade and make a clear leap of 12 ft. Such a condition was naturally not considered in the Railway Engineers' report above, when the statement was made that there was no impact due to the sudden application of the load. But it might easily be the factor that would cause an automobile to break through the floor of some existing bridge.



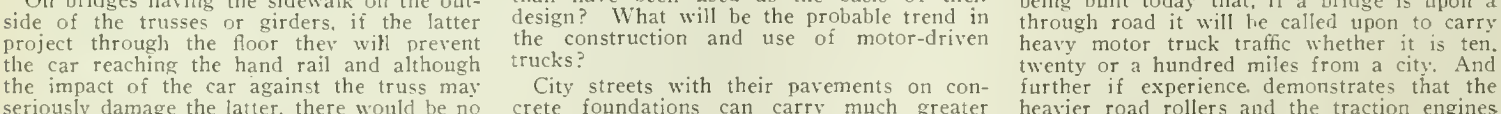
(1) Rail joint at center of stringer; bottom stringer; truss span 228 ft.; 44 miles per hour. (2) Short tie; bottom stringer; truss span 330 ft.; 39 miles per hour. (3) Rail joint at floor beam; bottom flange; truss span, 228 ft.; 39 miles per hour. (4) Short tie; bottom flange stringer; truss span 300 ft.; 39 miles per hour.

Fig. 6—Deflection Diagrams Showing Effects of Location of Rail Joints and of Short Ties.

Hand Rails.—Increase in the speed with which the traffic on bridges both cars and automobiles are run has indicated a weakness in the design of the hand rail of existing structures, as it now has an additional function to perform. In one case at least a serious accident that would have resulted in a large loss of life was prevented, not by the strength of the handrail, but by the fact that the car broke through the floor of the structure and was thus stopped, but not before the forward end of the car had broken through the hand rail. In another instance the combined resistance of the curb and hand rail stopped the car. Since this paper was written a car in Cincinnati has broken through a hand rail and caused a serious if not fatal injury of a number of people.

On bridges having the sidewalk on the outside of the trusses or girders, if the latter project through the floor they will prevent the car reaching the hand rail and although the impact of the car against the truss may seriously damage the latter, there would be no reason to fear its failure if of a modern type of construction. Where however the bridge is of the deck type no such barrier is interposed. Two methods have been considered for meeting this problem:

The first method is to make the curb so high that a car or automobile would not mount it, or if it did it would be greatly retarded. The 9 and 10-in. curbs in the designs of the bridges of Cleveland, O., were for this purpose. While this height would be adequate for a street car it would not be high enough for an automobile, and it would seem that a greater height would be advantageous rather than otherwise by tending to keep pedestrians off the roadway.



(Plate girder span 37 ft. 2 ins.; speed 42 miles per hour.)

Fig. 7—Deflection Diagrams Showing Effect of Long Ties and Ballast Floors.

The second method suggested is to design the hand rail to take the impact of a moving car. A rough calculation would indicate that it would require a 10 or 12-in. channel with the web horizontal instead of the customary lattice work or gas pipe, to stop an automobile moving 20 miles per hour.

Another method suggests itself, that of constructing a low barrier or railing at the curb line which would be capable of withstanding this impact, it could be more easily constructed and attached at this point than at the ends of the usual sidewalk brackets. The strength required will make such a barrier massive. Along the curb it would be unobtrusive whereas if the hand rail is to be made to take the impact its dimensions would be so great as to make it difficult to design so as to look well and difficult to attach to the structure with sufficient strength.

STRUCTURES AFFECTED.

To what class of bridges and to what extent in such classes shall the design be affected by the consideration of this traffic? All standard specifications for highway bridges have these structures classified. The basis of such classifications is the location of the structures with refernce to cities. That is, they are usually city, suburban or country bridges. In addition there is the factor of the electric railway, which, if it be provided for, may modify some details only or the entire structure depending upon the span and type of the bridge. Will a consideration of these modern loads, with their probable changes, change these classifications or call upon the bridges now building to carry greater loads than have been used as the basis of their design? What will be the probable trend in the construction and use of motor-driven trucks?

City streets with their pavements on concrete foundations can carry much greater loads than the present trucks impose upon them, as shown by the special loads hauled in New York City. And on account of the greater facility of handling a single truck by comparison with a motor truck and a trailer, it would seem that the increase in the efficiency of haulage within the city will come by increasing the capacity of the motor truck, and in view of the fact that the ten-ton truck mentioned earlier averages nearly 200 lbs. per square foot of actual area covered, it seems probable that in the near future these bridges will be subjected to loads per square foot of floor considerably in excess of those now specified. In the case of haulage to considerable distances in the country, the use of the smaller motor truck and wagon train will probably be employed as it is now being used abroad. This combination gives a larger carrying capacity and corresponding labor efficiency without the heavy concentration of loads, which as noted we may look to see prohibited as far as country roads are concerned. Also in the case of long hauls the use of the wagon train does not have the disadvantages that it would have when used for short hauls or in congested streets. That such long haulage is a question to be considered is evident from an instance cited at the American Roads Congress in Cincinnati last month. The statement was made that freight originating in New Jersey had been hauled from there through New York and Connecticut and into Rhode Island, a distance of over 200 miles.

In this instance it is at once apparent, what delays due to terminals and transfers from one railroad to another were avoided by such through motor truck haulage, and it is in the case of just such freight, that we may expect to see the motor haulage first developed in a large way, in localities well provided with railroads, as we may also look to see it developed where railroad service is lacking.

Another factor which at this moment is affecting shipping and which may give the motor truck a start in this field, which it would not under ordinary conditions obtain, is the present car shortage upon the steam roads.

From the above considerations it seems reasonable to assume that in the near future, and certainly within the life of the bridges being built today that, if a bridge is upon a through road it will be called upon to carry heavy motor truck traffic whether it is ten, twenty or a hundred miles from a city. And further if experience demonstrates that the heavier road rollers and the traction engines of weights previously given or still heavier ones are more desirable for road construction than those now in general use, these bridges will be called upon for much heavier duty than present specifications provide for.

The consideration of the probable growth in traffic with reference to its weight and concentration in loading, as well as from the standpoint of the amount of traffic for which provision should be made in the case of city bridges, both tend to the selection of the concrete arch bridge as the economical type of construction. Bridges of this type on account of the small effect of the live load, even of the heavier loads that we have to anticipate, will either take care of these loads without increase in section or with an increase in section involving an inappreciable increase in cost as compared with that required in the case of a steel structure. Also in the case of a masonry arch, especially one carrying an earth fill, the width in the original structure can be made larger at a smaller increased percentage of cost than any other type of structure, and it lends itself to future widening better than any other type.

CONCLUSIONS.

(1) Modern traffic has modified the design of all new bridges in so far as their floors are concerned, the greater concentration of load requiring greatly increased strength.

(2) While a part of the increased weight of the bridge floors is due to the increased strength required of them, the larger part is due to the use of concrete for floor construction, the use of which and the increase in the weight of the truss members themselves being for the larger part due to the general advancement in the science of bridge engineering.

(3) This traffic due to its increased speed and the increased clearance required has made necessary greater widths of roadway, which fact has been recognized to some extent in recent bridges.

(4) This traffic calls for better designed approaches than horse-drawn traffic will permit.

(5) The danger of rapidly moving cars or automobiles falling from bridges, due to the breaking through hand rails of present design, make it necessary that a sufficiently high curb or other barrier of suitable strength be interposed between the roadway and the sidewalks, or that the hand rail and its connections be so designed as to be capable of stopping a runaway car.

(6) The vibration effects of the loads considered are negligible by comparison with those produced by a horse and wagon.

(7) The direct impact effect of such loads upon the floor due to the irregularities of surface, is greater on account of their greater speed than in the case of the horse-drawn truck.

(8) That city bridges should be designed for heavier loads than are now in general use.

(9) That all bridges outside the city regardless of their distance, should, if they are on through roads, be designed for heavy motor truck traffic.

(10) That the concrete arch bridge is best adapted to make economical provision for increased loads and increased widths of roadway.

WATER WORKS

Reasonable Requirements Imposed Upon Water Works Systems By the Fire Protection Problem. Review of Modern Practice.

A very full discussion of modern water department methods, with special refrence to the reasonable requirements imposed upon water works systems by the fire protection problem, was given in a paper by Mr. Clarence Goldsmith, Assistant Engineer, Public Works Department, Boston, Mass., before the latest annual convention of the New England Water Works Association. The following matter is taken from Mr. Goldsmith's paper:

In any water works system the requirements imposed by the fire protection problem have very much in common with those involved in furnishing an adequate and reliable domestic supply.

The success of any enterprise is dependent upon its financial resources and the organization of its working force. Under ordinary conditoins a per capita expense of from $30 to $40 is necessary to develop an adequate water works system. Climatic and topographic conditions, however, are the controlling factors, and in localities where expensive water rights have to be acquired, or where a wide range in elevation exists, the expense may increase to about double the above-named figures.

One of the fundamental difficulties encountered in properly developing a water works system is the securing of necessary funds to develop the works in advance of the increase in consumption. In some cases this difficulty is due to lack of confidence in the engineering ability of the department, and in others to political reasons. No money is ever saved by postponing a proper development, for in nearly every case the delay causes a large loss by necessitating a temporary construction which is comparatively useless in the regular development of the works, besides subjecting the inhabitants to extreme inconvenience, and perhaps exposing the city to epidemic and conflagration.

Instances of dilatory tactics in financing necessary developments are, unfortunately, too numerous; in fact, a large proportion of our cities outgrow their supplies or equipment before the necessary additions are made. For example, the city of Lawrence, Mass., was warned early in 1900 that the consumption had reached the winter capacity of the filter beds, which at that time were not covered. Yet no money was placed at the disposal of the water board until 1906, when a new covered filter was contracted for, but not in time for construction work to be completed before the cold weather set in. The supply available from the old filter was so seriously depleted during the exceptionally cold weather of December of that year and the following month that early in February not more than 1,000,000 gals. of water was available in the reservoir. At this time relief was afforded by water supplied from the mains of adjoining towns. If a large fire had occurred during the period of low water in the reservoir, it would have been necessary to take suction from the river, which is highly polluted with sewage, in which case an epidemic of typhoid fever would have been inevitable.

In order to enable the employes of a water department, when well organized, to render prompt and adequate service, complete records, properly filed, and suitable quarters are necessary. A detailed discussion of the subject of records is impossible in a paper of this character, but because of its great importance, those most essential are here briefly referred to:

A skeleton map of the distribution system on a scale of about 1 in. to 500 ft., showing mains, gates and hydrants, is of great use for reference purposes, and of particular value in making studies for the extension or reinforcement of the distribution system.

Detailed locations in plat form on a scale of about 1 in. to 40 ft., showing mains, gates and hydrants, are indispensable, and it is convenient in many cases to show service connections on these sheets as well.

Records of service connections, gates, hydrants, and meter locations should be arranged in card index form.

The location of gates on the distribution system and those on services larger than 2 ins. in diameter should be arranged in convenient form for ready refernce, and copies of these records should be supplied to all employes authorized to operate gates.

Records of pumpage or delivery of flow lines, as made by one of the several accurate continuous-recording devices now on the market, should be kept, and the pumping station records should show the complete performance of the equipment.

Records of pressure maintained at several points of the system should be secured by the installation of recording pressure gages.

The above-mentioned records, together with such necessary and desirable amplifications as may be called for, should be kept up to date. The more important plans and records should be in duplicate, and one set should be stored in a substantial fireproof vault. The question of guarding records against destruction by fire cannot be too strongly emphasized, and it is to be regretted that it is a subject which is often completely or partially neglected. The ordinary fireproof vault is of questionable efficiency in a conflagration, and in many cities it is the custom to provide safe storage at the supply works, but removed from the danger of sweeping fires.

The engineering office, which generally occupies a building in common with the executive and clerical forces, should have ample area for carrying on the maximum amount of work which is liable to devolve upon this branch of the service during periods of active construction. Partitions should be so constructed that the occupants shall not be subject to the intrusion of the public, or other distraction. Well-arranged filing cases and vaults should be readily available for the storing of all plans and records. A library should be provided which should contain the latest editions of the most desirable handbooks and scientific works bearing on the various subjects which have to be dealt with in the design, construction, and operation of a water works system, and in addition a file of the best engineering magazines should be available, so that the working force may keep in touch with work of a nature similar to their own carried on in other cities.

The storage yard, usually containing a repair shop and stable, should be of ample area, and so located that shipments of material may be conveniently and economically handled both from the cars and in the area covered by the distribution system. The yard should be so laid out with paved drives that all the stock shall be readily accessible, and chain falls, with either derricks or cranes, should be provided for handling the heavier pieces. Fittings, valves and hydrants may well be kept in covered sheds. If the yard is located in a closely built-up district, it is particularly desirable that the buildings be of fireproof construction; otherwise, they should be equipped with sprinklers, standpipes and hose. The shop should contain tools of the kinds and sizes required to do all but the heavier repair work, and particular attention should be paid to the layout of the meter repairing and testing rooms. The offices of the several branches of the work should be connected by telephone, and constant watch should be maintained at the repair shop in all cities having a population of over 50,000. The requirements mentioned thus far are necessary for the construction and maintenance of a water works plant furnishing a reliable domestic supply.

Fire alarms should be received over the gong or tapper circuit of the fire-alarm system in one or more offices of the department, and at least one employe familiar with the distribution system and prepared to operate gates should respond to all first alarms in mercantile and manufacturing districts, and second alarms elsewhere. Provision in duplicate should be made for notifying the pumping station of alarms. The experience of many departments, as well as of public service corporations engaged in similar work, is that the motor-driven vehicle has become a necessary adjunct to the equipment of every water works system. It enables a prompt response in case of accident, and increases the efficiency not only of the executive force, but also of the laborers in many branches of the work. There is hardly a plant of any magnitude on which one or more automobiles cannot be profitably operated.

The source of supply must be carefully studied before its adequacy from the fire protection standpoint can be determined with certainty. The total quantity of water used for the extinguishment of fires is proportionately very small, being approximately 1/10 gal. per capita per day, or in round numbers about 1/1000 of the total consumption, but for short periods of time the rate is very high. From a perusal of the consumption records of any well-operated works, the maximum hourly, daily and monthly rates can be readily determined, and from a study of the structural conditions in the city—areas, heights, protected openings, exposures, occupancies, construction of buildings, etc.—the probable maximum quantity which would be required to combat a fire of large proportions can be estimated within reasonable limits. The number of fire streams required simultaneously in cities of average character has been discussed by our leading hydraulic engineers, with practical unanimity of opinion. Their estimates are based on actual practice, and the values given by Mr. Kuichling are expressed by the formula $Y = 2.8 \sqrt{x}$, where Y equals the number of 250-gal. streams and x equals the population in thousands. This formula does not make any allowance for broken services, and should be applied only after a study of the local conditions has been made, for in many cities the size of the mercantile or manufacturing districts is not in proportion to the population. A very full discussion of this subject was presented to the American Water Works Association last year by Messrs. Metcalf, Kuichling and Hawley (see Engineering and Contracting of June 7, 1911, p. 652). Although the chance of a large fire occurring during the hours of maximum consumption is somewhat improbable, nevertheless it is wise to err on the safe side, and to use the maximum hourly consumption figure in the calculations, although in most cases the maximum daily rate may be used with comparative safety. This step is not so unreasonable as at first appears, for any city should have its supply developed somewhat in advance of present requirements, in order to care for future growth. In cities not exceeding 100,000 in population, where the lawn-sprinkling is restricted to certain periods of the day, it is feasible to enforce an ordinance prohibiting irrigation during the progress of a fire, thus materially reducing the maximum rate for which the city would otherwise have to provide. In some cities, dependent upon fire engines, the pressure is so reduced by large fire drafts that the domestic consumption rate will drop appreciably. Such distribution systems cannot, however, be considered adequate for the service required of them.

There are many cities located on large lakes and rivers where a practically unlimited supply is available, and one does not have to give the question a thought, but in others it is a most important question with the engineer. In these latter the problem is varied, but resolves itself into some method of storage so that the maximum rates can be delivered to the distribution system. If the supply is derived from driven wells, they should be so developed as to furnish the maximum daily rate, and the maximum hourly and fire-flow rates may economically be cared for by storage in a covered reservoir available for delivering into the distribution system. If the supply is derived from storage from a large catchment area, the capacity of this storage should be ample to meet the demands made upon it through a series of dry years. In dealing with such a supply, the average daily consumption, and not the varying hourly rates, must be considered in determining the minimum capacity of the storage reservoirs.

In a few cases the topography of the country is such that the sources of supply are in close proximity to the distribution system, but in by far the greater number they are at some distance. In the latter cases, distributing reservoirs within or near the area served by the distribution system become an economical necessity, for their existence permits the use of much smaller conduit lines. These lines should have a capacity at least equal to the maximum daily consumption, and one such line cannot be depended upon unless the storage in the distributing reservoir is ample to furnish the supply during the longest period that will be required to make repairs. The conduits delivering the Catskill supply to the city of New York, the Owens River supply to Los Angeles, and the Wachusett supply to the Metropolitan District of Boston, are not in duplicate, but the permanency of their construction and the storage provided along their routes and at their termini assures the continuity of the supply. On systems where there is more than one supply line, these lines should not follow the same route, as the failure of one may cause the the failure of another, or both may be put out of service at the same time from the same cause, as was recently the case in Seattle, Wash. Where pumps are required to deliver the supply to the distribution system, the pumping station should be of fireproof construction. No valid excuse can be offered for not constructing stations absolutely fireproof. The installation of sprinkler equipment, standpipes equipped with hose, and chemical extinguishers, in the many existing stations which are not fireproof, should be strongly advocated. In all cases oil should be stored outside the building, and all internal hazards should be reduced to a minimum. When stations are exposed to external hazards, outside sprinklers, water curtains and wire-glass windows should be provided. On buildings having incombustible roof coverings and cornices these give reasonable protection.

The selection of the equipment of the station requires careful study in order that units of proper capacity and number to insure economic and continuous service may be provided. Plans which are supplied by pumpage may be broadly divided into three classes, namely, those which distribute from a storage reservoir, from an equalizing reservoir, and direct from a station. Under the latter class those which are supplied with an equalizing standpipe should be included, for in only small towns can a standpipe furnish any reasonable proportion of the draft, and in the larger cities it is a useless adjunct, as the pressure can be as uniformly maintained by means of pressure governors.

The stations which deliver direct to the system will first be considered. Their pumping capacity should be sufficient to deliver the maximum domestic and fire draft combined, with any two units in reserve; and the boiler capacity should be sufficient to enable the pumping of this maximum draft by the most uneconomical units in the station, with one boiler out of service for repairs or cleaning. This requirement of two reserve pumps over and above the maximum capacity has frequently been questioned, one of the foremost objections offered being the large amount invested for machinery which may never be called into use. The answer to this objection will be given along the line of cost. If the city were located in close proximity to a hill of sufficient elevation to furnish the desired pressure, the advisability of building a reservoir of sufficient capacity to assure the supply would not be questioned. Such a reservoir would cost, in round numbers, about $5,000 per 1,000,000 gals., which corresponds closely with the cost of high-duty pumping machinery of equal capacity; and low-duty or centrifugal pumps can be purchased at a much lower figure. Viewed from the cost standpoint, therefore, no argument can be adduced against installing pumps to perform the same function as the reservoir.

Where an equalizing reservoir is in service, the pumping capacity need not be as great as in the preceding case, but there should be one unit in reserve over and above the maximum possible draft for ten hours, minus the reservoir capacity. When a station delivers to a storage reservoir, the pumping capacity should be equal to the average daily draft during the maximum month. Such capacities may perhaps appear high to many who have successfully maintained an ample supply from stations which are not equipped with the above-mentioned reserve units, but no station can be considered reliable unless it can maintain the supply at all times, and it is not infrequent in a station containing four or five units for two to be out of service at the same time, and, although one of the units may be undergoing only trivial repairs, such as replacing valves or packing glands, it would nevertheless be impossible to get it back in service on short notice.

The capacity for coal storage should be sufficient to hold fuel enough to run the plant through any period in which the delivery may be interrupted by strikes or unfavorable weather conditions, and coal to meet such emergencies should, of course, be kept always on hand.

If the water is delivered direct from the pumping station to the distribution system or to an equalizing reservoir, there should be two or more discharge mains, and their capacity should be such that with any one main out of service, the other or others could deliver somewhat in excess of the maximum domestic consumption; and, of course, it would be much more desirable if, under such circumstances, the maximum domestic and fire draft combined could be provided for. When delivering into a storage reservoir, one main having a capacity equal to the maximum daily rate is ample, for repairs can be made before the water in the storage reservoir will be exhausted.

Today filtration plants are in operation in many cities, and the capacity of these plants need not be as great as the maximum hourly rate of consumption if enough filtered water is held in storage at some point on the works to provide for the drafts. On many plants this supply is provided by large covered clear-water basins which supply the high-lift pumps. In some plants a bypass is installed so that unfiltered water can be delivered direct into the distribution system in case the fire draft exceeds the capacity of the filters and exhausts the supply in the clear-water basins. Where the original source is contaminated, however, this expedient should not be resorted to, but provision should rather be made for additional clear-water storage, as an epidemic is even more undesirable than a conflagration.

The supply mains connecting the storage or equalizing reservoir with the distribution system should be bypassed around the reservoir, and of such capacity that the maximum rate can be delivered with any one main out of service. In some cases, the installation of cross-connections and suitably located gates in the supply mains enables their size to be somewhat reduced. Blowoffs should be established at all low points, for it often requires more time to empty a main and dispose of the water than it does to accomplish the actual repair work.

In the construction of force and supply mains, the question of material is often difficult to settle. Cast iron, wrought iron, steel and wood are each used with good results. Up to 30 ins. in diameter, cast iron generally proves the more economical, but in larger sizes steel lines prove cheaper even if they have to be replaced within 25 or 30 years. Besides, it is impracticable to use cast iron in mains of more than 60 ins. in diameter. The carrying capacity of lines constructed of either material gradually decreases, but the cast-iron lines can be cleaned and their capacity restored at a nominal cost. On the other hand, cast iron is subject to rupture, which will put the line completely out of service, while in the case of steel any general weakening of the structure is portended by small leaks. Continuous wood stave pipe has proved very reliable; it is almost always cheaper, can be readily repaired, and maintains its carrying capacity throughout its life.

All force and supply mains should be equipped with air valves at their high points, and they should be frequently inspected, for a defective air valve will cause a steel or wood line to collapse in case of a break at one of the low points.

There is no better item to observe than the per capita consumptoin records if one cares to make a snap judgment in regard to the efficiency of the operation of a water works system, for almost invariably the high consumption rate is a sign of inefficiency, and, conversely, the low consumption rate is indicative of efficiency. The per capita rate which is necessary to meet modern conditions in our cities ranges from about 50 to 150 gals. per day, but these rates are exceeded in most cities. This unnecessary consumption has a very important bearing upon the question of cost, for it has to be met by the development of larger supplies, the construction of additional filtration works (if there be any), and the installation of additional pumping equipment and of force, supply and distributing mains of increased carrying capacity, if the domestic and fire-flow requirements are to be fully met. Unfortunately, in such instances the fire-flow is generally only partially provided for during periods of maximum domestic consumption.

The installation of meters is the surest and practically the only way to effect a permanent reduction of the per capita rate. Many and fallacious as are the arguments advanced by the opponents of the general installation of meters, the results where they have been installed are incontrovertible. Water works engineers are not as yet agreed that the metering of all services is an economic necessity, but the results attained in cities that have metered practically every service shows that as much benefit may be derived from metering the last ten per cent of services as was obtained from any prior installation of an equal number of the same size. The water used in public buildings and for other municipal purposes is generally far in excess of that actually needed. In cities which have paid particular attention to this class of consumption, the conclusion reached is that all water used by the several city departments, except for the extinguishment of fires, should be metered and paid for by the users. Such a course not only effects an important reduction in consumtpion, but gives the water department credit for the service rendered.

One of the points upon which insurance and water engineers differ is in regard to the metering of fire services. The water works engineer, who generally takes the affirmative side of the question, is in much closer touch with the situation, and when such results as the following are obtained, there seems to be no doubt in regard to the justification of his stand.

Worcester, Mass., metered all fire services in 1905, and the following year the revenue increased $15,000, and the consumption decreased over 300,000,000 gals.

Lockwood, N. Y., metered all fire services, and the following year the revenue increased 25 per cent and the pumpage decreased 20 per cent.

The pressures which are maintained on works which are supplied by gravity from distributing or equalizing reservoirs are governed by the elevation of the reservoirs. In many cases suitable sites are not available at desired elevations, but when they are, it is highly desirable to so locate the reservoir that a pressure of 100 lbs. will be maintained over the greater portion of the distribution system, and particularly in the closely built-up sections. In a recent paper before the New England Water Works Association, Mr. E. V. French dwelt upon the advisability of such a pressure, and showed that it was sufficient to furnish direct hydrant hose streams to all fires except those in the larger and higher buildings, for which more powerful streams would have to be furnished by fire engines. As the number of fire engines can be greatly reduced if many streams can be taken direct from the hydrants, a very considerable saving can be thus effected, for it costs between $3,000 and $4,000 a year more to maintain an engine company (horse-drawn) than to maintain a hose company. In planning for extensive improvements in any city, therefore, it is desirable to provide, if possible, for the raising of the pressure to about 100 lbs., for in addition to cutting down the expense of the fire department, other economies can in this way be also effected. Take, for example, the large cities of New York, Chicago, Philadelphia and Buffalo. In these it is necessary to pump all the water used in buildings of moderate height and in small plants, and this could be done more economically in one central station. Of course it would still be necessary to pump the supply to buildings over 200 ft. in height, but these are comparatively few.

Next in importance to the saving which could be accomplished is the increased reliability of sprinkler equipments when supplied from a central station. The number of such equipments in service is increasing rapidly, and they constitute practically the only safeguard to buildings of non-fireproof construction and fireproof buildings containing combustible material. In many systems supplied by direct pumpage provision is made to raise the pressure upon receipt of fire alarms and maintain this pressure until the all-out is sounded. This practice is good, and may well be adopted in all such systems. The permanent raising of pressure on a system does not necessarily increase the consumption, for thorough inspection and the prompt following up of defects will enable an unincreased consumption rate to be maintained. This has been proven in several cities during the past few years, and though heavier materials, requiring more careful workmanship, are used in the original installation, the subsequent cost of maintenance of a distribution system under 100 lbs. pressure is no greater than under 50 lbs. pressure.

Few engineers have the opportunity to design a new distribution system for a city of any considerable size. New Orleans is the only large city which has installed a new piping system in the last score of years. The problem of today is the reinforcement and rehabilitation of outgrown distribution systems, or of systems which have deteriorated in carrying capacity or were faulty in their original design. To accomplish this task, a careful study of the existing system should be made, present requirements determined, and proper allowance made for future growth. This done, a plan for all future work should be adopted and followed. This plan should include main arteries of ample carrying capacity girdling the city as its growth demands, secondary feeders of suitable size about 3,000 ft. apart in either direction, and deadened lines extended to outlying sections without reduction in size—the system to be so designed as to furnish fire protection as follows:

(a) In outlying residential districts not likely to become closely built up, a minimum of 1,500 gals. per minute.

(b) In closely built-up residential and minor mercantile sections, 2,000 to 5,000 gals. per minute.

(c) In manufacturing, warehouse and congested value districts, from 5,000 to 20,000 gals. per minute, depending on the structural conditions.

The above supply should be in excess of the maximum daily domestic consumption, and should be available in manufacturing districts to any large group of buildings of special hazard, and in mercantile and residential districts about any block. In order that these quantities shall be available, the following minimum sizes of mains should be used for hydrant supply:

For residential districts, 6-in. and 8-in. mains, the former to be used only where they complete a good gridiron, and the latter in locations where dead-ends and a poor gridiron are likely to exist for some time, and in all blocks 600 ft. or more in length.

For mercantile and manufacturing districts, 8-in. and 12-in. mains, the former to be used only in sections where they complete a good gridiron, and the latter for long lines not cross-connected.

Four-inch mains cannot furnish sufficient hydrant supply, and should be replaced as fast as circumstances will permit, the replacement to commence in the more thickly built-up sections. In order that not more than one hydrant will be on a 6-in. nor more than two hydrants on an 8-in. main between intersecting lines, dead-ends should be eliminated wherever practicable, large mains cross-connected to distributors at all intersections, and long unsupported lines of pipe cross-connected.

The city of Reading, Pa., affords a good example of the results which may be accomplished by the adoption of a well-designed plan to be followed out in future construction. Some 17 years ago such a plan, prepared by the superintendent, Mr. E. L. Nuebling, was approved by the city, and has been followed since that time. At present there are ample quantities of water available for both domestic and fire protection purposes throughout the entire system, and future additions to meet increased growth in population can be readily and economically made.

Unfortunately, the topography of some cities precludes the making of plans for future growth, for it is impossible to foresee in what direction the growth will extend. For a number of years the probable growth of Los Angeles appeared to be in an easterly direction, and it is only in the past two or three years that a definite trend showed it to be in a westerly and southerly direction.

Tar-coated cast-iron pipe is unquestionably the best material to install in a distribution system. In some parts of the country kalameined pipe is extensively used, because of the saving in freight rates which can be effected on account of its lighter weight, and this pipe gives very good results. Machine-banded wooden pipe does not give satisfaction in a distribution system on account of the excessive leakage which generally occurs. Cast-iron pipe should be inspected at the foundry and again before it is lowered into the ditch. Special care should be taken to prevent any foreign matter from getting into the line during laying, and the line should be thoroughly blown out before it is put into service. If practicable, a test pressure of 1½ times the working pressure should be applied to the line before backfilling.

Pipe less than 6 ins. in diameter should never be installed to furnish hydrant supply. In cities where the distribution system is weak, it is desirable not to install any pipe less than 8 ins. in diameter, for the new lines of these larger sizes will reinforce the old lines. The weight of pipe purchased should be sufficient to enable at least 300 ft. head to be maintained at the point of lowest elevation in the city. If the heavier classes of pipe are installed, it enables the pressure on the system to be raised to the desired point without the additional expense which would otherwise be required for relaying. The coefficient of carrying capacity of the older lines should be determined by experiment, and in many cases, where the supply is deficient, the results obtained will show that it is more desirable to clean the line than to lay a new line. Sufficient cover should be provided to insure the pipe from freezing, even in the coldest winter. Exposed pipes at bridge crossings should be well supported and protected from injury, and extreme care should be paid to the design of the line near the approaches.

Electrolysis is a subject which must not be neglected, for it is most insidious in its action. Frequent surveys should be made, and remedial measures approved by the best water works practice, rather than those generally advocated by street railroad engineers, should be adopted. Grounds from electric circuits should be made on the street side of the meters, main cocks, etc., in accordance with the National Electric Code, and no power circuit which depends upon a grounded return should be connected to the system in any manner.

In order to operate a distribution system with the desired facility, the mains should be equipped with gate valves so located that no single case of accident, breakage, or repairs to the pipe system in important mercantile and manufacturing districts will necessitate the shutting from service a length of main greater than the side of a single block, or a maximum of 500 ft., or in other districts a length greater than two sides of a single block, or a maximum of 800 ft. If possible, the location of gates should be uniform; that is, they should be set on the property or curb lines at street intersections, so as to be more readily located. On paved streets it is advisable to provide a box or vault of sufficient size to permit of packing the gland without excavation. When the approximate location of a box is known, and it is covered by dirt on an unpaved street, or by ice, a pocket compass will prove an invaluable aid in determining its exact location, for by passing the compass over the supposed location, about 1 in. above the ground, the needle will deflect toward the iron cover, and by a little careful work can be made to indicate the exact center of the cover. The compass will determine the location of a box that is covered as deep as 1 ft. This method is also of use in finding cast-iron service boxes which have been covered by granolithic sidewalks.

The gate valves on a system should be inspected at least once a year, at which time they should be operated, and packed if necessary. The boxes should be kept clean, and if water is liable to collect and freeze in them, they should be provided with a drain to the sewer or be pumped out. All operating nuts should be of the same size, and all gates should operate in a uniform direction. On a system of any considerable size, gates should only be operated by employes specially assigned to the work, and a record should be kept by them of each operation. Careless inspection and operation is sure to cut down the carrying capacity of the system by allowing some gates to remain closed, and frequently causes serious delays in cases of accidents. Occasionally divison gates between different services are left open, and the apparent increase in consumption in the higher service is puzzling to the superintendent until the cause is discovered. In one city where a record of gate operation was not kept and inspections were infrequent, an examination of 7,000 valves showed:

49 closed and 300 partially closed valves on lines from 4 to 20 ins. in diameter.
12 inoperative valves.
100 valves either not on the plans or not in the ground.
2 gate vaults completely filled with crushed stone.
1 division gate open.
1,952 boxes requiring cleaning.

In a smaller city an inspection of 40 valves showed:

1 valve closed.
1 valve with a broken spindle.
1 valve so deep that it could not be reached with the wrench.
2 valves operated in a direction opposite from the others, and no note made of the fact on the plans.
2 valves inaccurately located on the map.
3 valve boxes filled with bricks and earth.
1 operating nut too large for the wrench.

The hydrant is the last link in the chain from the source of supply to the point of delivery to the fire hose lines. Hydrants should have 6-in. barrels with 6-in. gated connections to the main and a foot valve having a free waterway of at least 20 sq. ins. so that the loss when 1,000 gals. are being withdrawn shall not be excessive. In cases where provision is made for more than one engine to take suction from a single hydrant, the above dimensions should be increased, and no loss greater than 4 lbs. should be permitted when hydrant hose streams are utilized. The operating nuts of all hydrants in a system should be of uniform size and turn in the same direction. Where hydrants are supplied from different services it is advisable to paint those on separate services a distinctive color. Care should be taken to have the threads on the outlet nipples of the same size as that adopted by the fire department for hose couplings, and it is especially desirable to adopt the National Standard hose thread, so that apparatus summoned from neighboring cities can make connections.

Hydrants should be frequently inspected to assure their operation. They should be packed and lubricated, and the outlet caps greased, at least once a year, and they should then also be operated and blown out. Before cold weather sets in they should be carefully inspected for drainage, and if any are set below the ground-water level the drips on such should be plugged and the water in the barrel pumped out. During periods of cold weather those in high-value districts should be inspected once a day, and those in other sections twice a week. Special connections should be provided for filling flush wagons and sprinkling carts, and the use of fire hydrants should be confined solely to the fire department.

The question of the distribution of hydrants in a city is a very important one from the fire department standpoint, on account of the great friction loss in long lines of hose. The distribution should be such that ample quantities of water can be delivered to a large fire from hydrants at an average distance therefrom of not more than 350 ft. The customary method of figuring hydrant spacing on a linear basis does not convey any definite information, for without a knowledge of the size of the blocks linear spacing would be apt to convey an erroneous impression. For example, the locating of hydrants at linear distances of 200 ft. in one city where the blocks are 200 ft. square would, in the matter of distribution, be equivalent to the locating of hydrants at linear distances of 100 ft. in another city where the blocks are 800 ft. square—in either case the area served by a single hydrant being 40,000 sq. ft. Under the differing block conditions referred to, Portland, Ore., illustrative of the former, would require one hydrant at each street intersection, or one hydrant to a block, while Salt Lake City, illustrative of the latter, would require 16 hydrants to each block between the center lines of the four bounding streets. It is clear, therefore, that the area in square feet served by each hydrant is the proper unit to adopt in order to be able to determine the adequacy of hydrant distribution and to make comparisons. Where it is necessary to concentrate 10,000 or more gallons of water per minute upon any building or block, there should be one hydrant for each 40,000 sq. ft. In minor mercantile and small manufacturing districts and in densely built-up frame areas, there should be one hydrant for every 60,000 sq. ft., and as the buildings become less congested the distribution may become wider, up to 120,000 sq. ft. in outlying residential sections.

From the operating standpoint the inside independently gated hose outlet cannot be considered as giving the best results. The leverage furnished by the wrench ordinarily used by the fireman is far in excess of that required to operate a valve of equal size in any other service, and so great that the stem can be broken or other parts crushed without any undue exertion on the part of the operator. The end to be attained may best be accomplished by attaching outside hose gates before the hydrant is open, and such a procedure will not introduce an objectionable delay. Such gates carried on hose wagons are more reliable, as they can be easily inspected and kept in order.

The matter of original expense is also a very important item. Assume a city with 2,000 hydrants and 16 hose or engine companies. To equip the 2½-in. outlets on all the hydrants would cost over $20,000, while to supply the 16 companies, each with four hose outlet valves, would cost about $650, and the cost of maintenance would be in about the same proportion. It is not so practicable to deal with the 4½-in. steamer outlets in the same way, because the portable valve is much heavier, so where it is desirable to connect a steamer to a hydrant which may already be delivering to a hose line, or where there are two steamer connections on a hydrant, it proves more convenient to equip these outlets with inside gates.

The purchaser of a hydrant should insist upon having the waterways carefully designed, the castings smooth, and the workmanship good. The neglect of these points often admits of the installation of a type of hydrant which is well-nigh valueless. There are hydrants in service in some cities today which show a loss of 35 lbs. between the street main and the hose outlet when 600 gals. of water are being drawn, whereas there are many hydrants of reliable make and at reasonable cost which can deliver the same quantity of water with a loss of less than 4 lbs.

The requirements necessitated by the fire protection problem are, of course, a large factor in the cost of a water works system, increasing that cost from 50 to 100 per cent over what it would be were the question one solely of furnishing water for domestic and business purposes. But these requirements have to be met, and while in no one city are they all fully provided for, a large number of our municipalities are earnestly endeavoring to attain the best possible results in this connection, and it is to be hoped that their example will be speedily followed by those that now lag behind in the matter of water works administration.

It is evident from the foregoing that the fire protection problem is one of the first importance for the water works engineer, for it is primarily with him and the fire department that its solution lies. It is perhaps not to be expected that any water works system will fully meet its requirements in all their complexity of detail, but while the ideal is never attainable, it is always more and more nearly approachable. That it may be the more nearly approximated to in the design, construction and maintenance of a water works system, our municipalities should make it an indispensable part of their policy to secure for this work the best engineering talent available, and then leave it unhampered by political or other considerations.

The Design of a 300,000 Gal. Reinforced Concrete Standpipe for Penetanguishene, Ontario.

(Staff Article.)

The details of the design of the 300,000 gal. reinforced concrete standpipe which was recently constructed in the city of Penetanguishene, Ontario, are shown herewith in Fig. 1. As will be noted from the drawings the tank is 50 ft. in diameter and 21 ft. deep. The side walls are of 1-1-2 concrete, 12 ins. thick at the base and 8 ins. thick at the top. The walls are made thicker than necessary for strength in order to prevent the formation of a thick ice crust. The tank is covered by a reinforced concrete dome of a height of 1/10 of the diameter. It is 4 ins. thick and is reinforced by ⅜-in. bars 12-in. on centers.

The tank was built in about six weeks during October and the early portion of November of 1912. It was filled the latter part of December, and did not show a leak or sweating at the first filling nor thereafter.

The reinforcement of the shell was figured by a method not ordinarily used in the United States. If we consider a shell alone and assume that it is not connected with the bottom, it will increase in size as shown by curve A of Fig. 2. Inasmuch as the shell is connected with the bottom, and besides rests on the ground, it cannot elongate at the bottom, and if a proper connection is made between the side walls and bottom, the lowest portion of the shell cannot even change its directions at the bottom; or, in other words, it is fixed at the bottom. Hence, the real deformation of the shell will be a line somewhere as shown by curve B in Fig. 2. It clearly depends on the thickness and height of the shell where the deviation from the ideal line of deformation stops. This problem was first investigated by Professor Grashof, and published in his book on "Theory of Elasticity" in 1878. The differential equations governing the conditions are, however, of a high order, and even in the simplest case where the walls are of uniform thickness, the equations for the elastic curve are expressed in periodical functions and it takes several days' labor to solve a single problem. The equation cannot be solved for walls of various thicknesses, as the integrals of the differential equations are unknown up to this day. However, the elastic equations clearly show that the shape of the elastic curve is a function of $\frac{h^2}{rt}$, wherein h is the height of the tank, r the radius of the tank, and t the thickness of the shell at the base, all being expressed, of course, in the same unit.

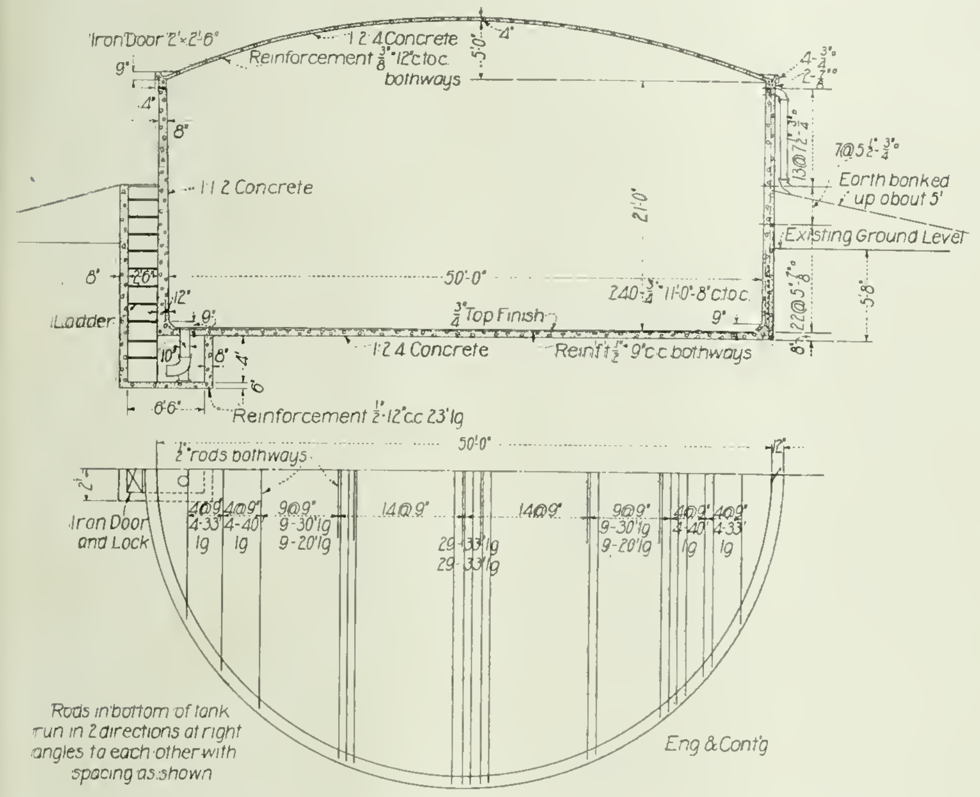


Fig. 1—Details of Design of New 300,000-Gal. Reinforced Concrete Standpipe for Penetanguishene, Ontario, Water Works.

In the present case $\frac{h^2}{rt}$ equals 16 and the elastic curve for this case only starts to deviate abruptly from the ideal deformation at the point of 4/10 h above the base, as shown in Fig. 2, curve B. This means that the water pressure corresponding to the shaded portions is not taken up by the ring action but by the cantilever action of the connection of base and shell. After a little consideration, it will be clear that there must be acting on the ideal beam, for this case a force above the 4/10 h point, which tends to bend it back into the line formed by the ideal deformation of the ring sections, as the cantilever would tend to bend the top portion further out and the deformation on top must be zero from the nature of the case. This force is nearly a uniform load also for a height of 4/10 h in this case and equals approximately $\frac{ph}{24}$ in this case. Now, if a beam is assumed which is acted upon by the forces as shown in Fig. 3, we can find the elastic curve from the equation $\frac{d^2y}{dx^2} = -\frac{M}{EI}$, wherein M is the moment at any section x feet from the top, E the modulus of elasticity and I the moment of inertia at the section x. If the assumption of the form and position of curve B of Fig. 2 is correct, the elastic curve obtained by the foregoing general equation must be identical with curve B. This agreement can be reached after a few trials.

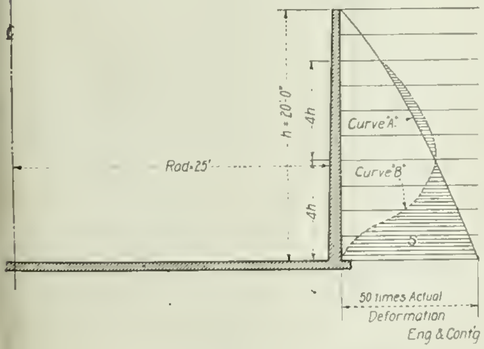


Fig. 2—Deformation Diagram.

It is also clear that there exists beside the negative moment at the bottom of the shell on the inside, a positive moment higher up on the outside of the shell. The maximum value of this positive moment occurs where the shear passes through the zero value. The shear at the bottom of the shell can also be obtained from Fig. 3. This shearing stress governs the reinforcing of the bottom of the tank. The moment at the bottom of the shell, in this case is about $\frac{ph^3}{66} = \frac{62.5 \times 20^3}{66} =$ 7,600 ft.-lbs. per lin. ft.

The reinforcing here adopted is more than ample. The positive moment on the outside of the shell is $\frac{ph^3}{217}$, which can be taken up by the concrete without reinforcing. If the reinforcement at the bottom of the shell be omitted, the tank will first crack on the inside of the shell at the junction with the bottom, and then a larger bending moment will appear on the outside of the tank $= \frac{ph^3}{163}$ in this case. This bending moment is already large enough to cause cracking of the concrete at the surface of separation between the portions placed on different days.

For other values of $\frac{h^2}{rt}$ the shape of the elastic curve is, of course, different from that here shown as curve B of Fig. 2. The greater the value of $\frac{h^2}{rt}$ the lower the point where the curve deviates from the ideal deformation of the ring sections.

The standpipe here described was designed and built by L. J. Mensch, M. Am. Soc. C. E., of Chicago. We are indebted to Mr. Mensch for the information here presented.

The Supervision of Private Fire Service Lines by the Detroit Water Department.

The methods in vogue in Detroit for regulating the design and operation of private fire service lines was described by Mr. Geo. H. Fenkell, Superintendent of the Detroit Water Department, in a paper before the Central States Water Works Association, as follows:

Private fire protection plants in Detroit were first installed about 15 years ago, and they were usually a line led in with hydrants and placed inside on private property. Little by little they were extended until now we have nearly 300 private fire lines of all sizes and descriptions. If any one has an idea that the private fire line proposition is an easy one to handle, he is very much mistaken. We at the present time are doing what we can toward the regulation of private fire lines. We first require private fire lines to file blue prints, together with a statement of what they propose to install, with the valves and tanks indicated, stating their capacity and height, and various other information of interest in order that we might form a clear and definite idea as to just what they wanted to install. We allow them to have a valve at the property line, and require that this shall be closed and sealed up and to be used only in case of fire. Unfortunately there is no one that wants to put in such an arrangement, and there is where the trouble begins. We have been placing a considerable number of detector meters, and we forbid the use of direct fire lines unless they are metered, that is fire lines which depend upon the city pressure for putting out the fire.

We require them to maintain an excess pressure either by an elevated tank or by a pressure tank. Where pressure tanks are used, in all cases we have self-recording pressure gages; these charts are sent in each week. Even at that we have some trouble.

If a town adopts a policy of metering all of its private fire protection plants I am sure that it will save the officials in the future a great deal of anxiety and trouble, and the city will likely increase its revenue. I might say that there are some private fire lines that extend into factory grounds on which they have one hydrant for fire purposes, and the underwriters say that no line less than 6 ins. will answer the purpose. What to do in such cases it is rather difficult to tell. I am sure that metering would be a very desirable ar-

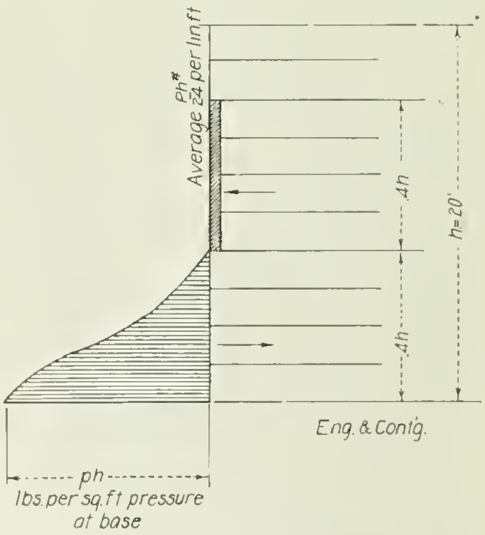


Fig. 3—Loading on Ideal Beam.

rangement even in those cases, if it could be done.

The difficult situation that sometimes arises is where there is a double source of supply, one of these sources being polluted water. In such cases it is quite common to depend upon a check valve to separate the polluted water from the city water; but I would warn you all against such an arrangement. The only sure way is to separate them entirely. But if you find it is impossible to do that, perhaps the next best thing is, in addition to a check valve, to put in a sealed glass valve, and impose a fine of $25 upon any one who opens that valve without reporting it within an hour, or some other short specified period of time.

It has also been said that water might be polluted from these elevated tanks. The elevated tanks are not very well covered and the water sometimes stands in them for a number of years. Now if a check valve leaks, water of course might escape into the system. These check valves must be inspected at regular intervals to insure their being kept tight.

Water Works Notes.

(Staff Article.)

Contractor Must Buy Replaced Water Pipe in Boston.—Nearly all the work of laying new lines of water mains and of replacing worn out mains with new pipe is done by contract in the city of Boston. An innovation was made in 1911 in the manner of disposing of the old cast iron pipes which are taken up in relaying the mains with new pipe. In former years such pipe was hauled to the city pipe yard and there broken up and sold for junk. The new system, introduced in 1911, makes the disposal of the old pipe a part of the contract by requiring the bidder to pay a stipulated price per foot for it.

Water Main Cleaning in Cincinnati.—Before the Cincinnati water filtration plant was put in service, in 1907, water directly from the Ohio River was pumped through the city mains. Since this water had a turbidity ranging from 7 to 300 parts per 1,000,000 very heavy deposits of mud were found in the water distribution system. The water department has been almost continuously engaged in cleaning the mains since the filtration plant was put in service, and a large part of the system is still to be cleaned. The cost of cleaning the pipe varies from 10 cts. to 26 cts. per ft. cleaned.

Method of Making House to House Water Waste Survey in Boston.—The work of water waste prevention was carried on in Boston, in the year 1911, by a force of 13 men. In Charlestown the effect of the work was particularly noticeable, the consumption being reduced 1,500,000 gals. per day as a result of the inspection work which was done in two months. The following method of carrying on the inspection work was employed: In the event of a leak being found, a notice was left on the premises stating this fact and requesting that immediate repairs be made; after a week's time a re-examination was made and if the leak still existed a second notice was left similar to the first; a third examination followed after another week, and if nothing had been done a notice was delivered stating that a fine of $2 would be imposed and the water would be shut off if repairs were not made at once; this last notice in almost all cases produced the desired result; in only 50 cases was it necessary to shut off the water; in no case was a fine imposed.

Bulletin on Municipal Water Supplies of Colorado.—The University of Colorado recently issued a bulletin on water supply with special reference to the municipal water supplies of that State. The bulletin, which was prepared by C. C. Williams, Assistant Professor of Civil Engineering, was written with a view to assisting the people of the State in obtaining a better understanding of the value of potable water supplies as well as the methods by which they may be obtained. In addition to general discussions on the requirements for a municipal supply, the sources of water supplies, the purification of water, the distribution of water, and water rates, the bulletin also gives many data on existing systems in the State. Table I, presented herewith, gives the comparative water rates for various classes of service in 40 cities and towns of Colorado:

Saving Effected by Water Waste Survey in Memphis.—During the year 1911 the work of the water waste survey division of the Memphis water department resulted in the saving of 948,500 gals. per day within the area of 1,300 acres which was so surveyed. The various classes of leaks reported and repaired, with the number of leaks of each class, is as follows: 63 mains, 27 valves, 95 service pipes, 150 fire hydrants, 3 stop cocks, 380 property leaks, 47 leaks due to carelessness, and 8 flush tanks. The cost of work for 1911 was $4,572.65. Valuing the water saved at $40 per 1,000,000 gals., the value of the water saved, based on one year, is $13,848.10, or a saving over the expense to the water department of $9,275.45. The actual saving is much greater, as the repairs to mains are probably permanent, and the repairs to connections should last at least five or six years.

Irrigation Project in Chile.—The Government of Chile has under consideration a scheme for the construction of four irrigation works in the central valley, south of Santiago. The system would cost about $2,600,000, and would supply water to 308,875 acres.

Water Works at Seville, Spain.—An agreement has been signed by the city of Seville, Spain, and the municipal water-supply concessionaire for enlarging and improving the water system. The proposed improvements will amount to about $750,000, including the cost of erecting the necessary plant.

London's Water Supply.—The eighth annual report of the Metropolitan Water Board of London, England, shows that 82,170,000,000 gals. of water were supplied during the year ending March 31, 1911. This is a daily average of 225,000,000 gals. The total volume of water abstracted from the Thames was 49,962,000,000 gals., the remainder being obtained from the Lea, and from gravel beds, natural springs and wells. The average daily supply per head for the year was 31.57 gals., the estimated population of the area supplied by the Board being 7,099,871.

At the annual meeting of the Engineers' Society of Western New York, held Jan. 4, the following officers were elected: President, Harry B. Alverson; first vice-president, Frank N. Speyer; second vice-president, John G. Ullman; secretary, Elwin G. Speyer; treasurer, Thomas J. Rogers.

TABLE I.—WATER RATES PER YEAR IN 40 CITIES AND TOWNS OF COLORADO.

City.	Bakery, each oven.	Barber shop, one chair.	Bath, private, first tub.	Drug store.	Grocery store.	Lawn, per front foot, per lot.	Livery stable, per stall.	Meat or butcher shop, minimum.	Residence, minimum.	Residence, each additional room.	Water closet, residence.	Water closet, public.	Meter rate, per 1,000 gallons.
Alamosa	......	......	......	......	......	......	......	......	$ 8.00	......	......	......	$ .25
Aspen	......	......	......	......	......	......	......	......	17.50	......	......	......	......
Berthoud	......	$ 8.00	$ 2.40	$12.00	$ 6.00	$ .08	$30.00	$ 6.00	12.00	......	$ 2.40	......	......
Boulder	$10.00	5.00	1.00	10.00	......	.10	1.50	10.00	8.00	$ 1.00	3.00	$ 6.00	......
Canon City	24.00	12.00	4.00	10.00	......	.20	40.00	10.00	40.00	1.00	4.00	......	.25- .15
Central City	......	......	......	......	......	......	......	......	18.00	......	......	......	.25-1.00
Colorado Springs	....	3.00	1.00	10.00	......	Free	......	......	8.00	1.00	2.00	6.00	.15- .08
Del Norte	......	......	......	......	......	......	......	......	6.00	......	......	......	......
Delta	12.00	12.00	3.00	12.00	12.00	......	5.00-8.00	12.00	15.00	......	3.00	12.00	......
Denver	8-40	6.40	4.00	12-24	12-24	.22	1.60	12-24	4.00	.40	4.00	8.00	......
Durango	......	10.00	Free	......	......	......	60.00	25.00	10.00	2.00	Free	10.00	......
Ft. Collins	20-40	6.00	1.60	15.00	......	Special	25-40	20.00	10.00	......	......	......	.40- .18
Ft. Morgan	10.00	6.00	3.00	......	8.00	8.00	1.50	8.00	6.00	1.00	3.00	5.00	.30- .20
Fowler	......	......	......	......	......	......	......	......	......	......	......	......	.50
Goldfield	25.00	7.00	5.00	34.00	12.00	.16	3.00	......	12.00	1.00	8.00	......	.50- .25
Grand Junction	......	......	Free	......	......	Free	......	......	12.40	2.00	Free	......	......
Greeley	5.00	6.00	1.00	15.00	......	.10	1.50	10.00	7.00	1.00	3.00	6.00	......
Holly	......	......	......	......	......	......	......	......	18.00	......	......	......	.30- .15
Holyoke	......	......	......	......	......	......	......	......	......	......	......	......	.25
Hotchkiss	......	......	......	......	......	2.00	......	......	18.00	.84	......	......	......
Idaho Springs	5.00	5.00	3.00	8.00	......	1.00	1.00	8-15	5.00	......	......	......	.13- .05
Julesburg	5.00	6.00	1.00	12.00	6.00	.10	......	12.00	7.00	1.00	3.00	6.00	......
La Junta	......	......	......	......	......	......	48.	......	6.00	......	......	......	......
Lamar	......	......	......	......	......	......	......	......	12.00	......	......	......	.13
Limon	......	......	......	......	......	......	......	......	6.00	.50	......	......	......
Littleton	......	......	......	......	......	......	......	......	......	......	......	......	.53- .40
Longmont	......	......	2.00	......	......	7.00	......	......	9.00	2-1	2.00	......	.25- .08
Loveland	10-25	6.00	2.00	10.00	......	......	meter	10-25	12.00	......	......	......	.25- .08
Mancos	......	......	......	......	......	......	......	......	10.00	......	......	......	......
Manzanola	......	......	......	......	......	......	......	......	......	......	......	......	.50- .10
Palisade	48.00	36.00	3.00	36.00	......	.10	12.00	24.00	18.00	3.00	......	......	.25
Paonia	......	......	......	......	......	......	......	......	15.00	......	......	......	.50- .10
North Pueblo	36.00	24.00	6.00	60.00	24.00	9.00	3.00	......	12.00	3.00	6.00	12.00	......
South Pueblo	21.00	18.00	6.00	12.00	12.00	......	3.00	12.00	12.00	3.00	6.00	......	.30- .06
Rocky Ford	......	......	......	......	......	......	......	......	15.00	......	......	......	.50- .10
Salida	10.00	8.00	......	10.00	10.00	.05	......	18.00	10.00	1.00	6.00	8.00	......
Silverton	28.00	10.00	3.00	18.00	Front	......	2.00-1.20	18.00	8.00	1.00	3.00	12.00	.45- .10
Trinidad	10-25	8.00	5.00	12-15	12-15	.10	2.00	......	8.00	1.00	5.00	10-15	.40- .07
Victor	......	......	......	......	......	......	......	......	10.00	......	......	......	......
Walsenburg	24.00	12.00	......	12.00	12.00	.10	......	30.00	12.00	1.20	......	......	......

NEWS SECTION

Editorial Comment—Personals—Society Meetings—Trade Notes—Catalog Reviews—Contract News, Embracing Bids Asked, Work Projected, Contracts Let and Contract Prices on All Classes of Civil Engineering Construction Work.

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The Doings of the Week.

Nothing of particular interest in the railroad construction field has developed during the past week. No contracts of any size appear to have been let, nor has much new work come up. Among the railroad construction contracts let recently are the following: Maydwell Railroad Supply Co., San Francisco, Cal., for constructing the Fresno, Hanford & Summit Lake interurban railway; The Northern Construction Co., Vancouver, B. C., for constructing the 10-mile Steveson branch of the Canadian Northern Ry.; The West Virginia & Ohio Construction Co., Ashland, O., for constructing an extension of the Ashland & Western Ry. from Ashland to Lorain, O.; Boyd & Bradshaw, Columbia, Miss., for a 3-mile extension of the New Orleans Great Northern R. R.; Bates & Rogers Construction Co., Spokane, Wash., and Chicago, Ill., for bridges and concrete tunnel lining on the Grand Trunk Pacific line between Prince Rupert and Edmonton, Alberta.

In the line of road work the principal job on which bids are now being taken appears to be the one for the construction of 65 miles of highway in Aurora County, S. Dak. Bids on this work are to be opened Feb. 25 at Plankinton, S. Dak. In Mississippi bids are being asked on 22 miles of road construction in Monroe County, and on 26 miles of road in Clay county. Two or three fair sized highway contracts in the East have been let. The Connecticut Highway Department has awarded a contract to Leonard Suzio for 10,375 ft. of macadam road; Commissioners of Essex County, Mass., have awarded a contract to Joseph Wagenbach & Son, Lawrence, Mass., at $47,492, for constructing the Lawrence-Methuen boulevard. In New Jersey the freeholders of Sussex County have rejected all bids for building the improved road between Newton and Branchville. The lowest bid submitted amounted to $66,988. The Board of Estimates of New York City has appropriated $3,000,000 for repaving work the present season.

About the largest municipal contracts let the past week have been for sewer work. The Borough of the Bronx, New York City, has awarded the contract for constructing the Lacombe Ave. sewer to Rodgers & Hagerty, 52nd St. and Harlem River, New York City, at $568,947; the Board of Public Works of Los Angeles, Cal., has awarded the contract for the Arroyo de la Bua storm sewer to Holt & Jeffrey, Los Angeles, at $538,844; city of Wilmington, N. C., has let a contract to Miller & Martin, Passaic, N. J., at $134,494 for labor and material for about 36 miles of vitrified pipe, concrete and cast iron pipe sewer, 8 in. to 24 in. in diameter.

A considerable amount of drainage work is now open for bids. One of the largest of these contracts calls for the construction of the J. A. Borntragen ditch in Indiana. This work calls for a main ditch, requiring 1,540,123 cu. yds. of excavation, and three laterals, requiring about 61,000 cu. yds. excavation. Another good sized job is the work for the Wood River Drainage and Levee District of East Alton, Ill. This contract includes 443,000 cu. yds. excavation, earthwork and embankment.

The largest contract so far this year for irrigation work has been awarded to Joseph Osner, Denver, Colo. The contract amounts to about $750,000 and calls for the completion of the Antero irrigation system near Denver, Colo. The U. S. Reclamation Service opened bids on Jan. 10 for the construction of Schedule 2, Dodson North Canal, North River Project. Maney Bros. & Co., Boise, Idaho, at $51,075, was the low bidder.

The state development of electric power is proposed by a bill to be submitted at the coming session of the Oregon Legislature by I. N. Day, Senator from Multnomah County. The bill has for its object the harnessing of the entire current of the Columbia River, developing a minimum of 100,000 H. P., the project to be prosecuted and operated by the states of Oregon and Washington.

Road Bonds in Texas in 1912.

A record kept by the Texas Commercial Secretaries and Business Men's Association on good roads bond elections held in Texas during the year 1912 shows that 33 bond elections carried in various counties of the state resulting in a total of $3,496,200 being voted for highway improvements. Altogether there were 50 good roads bond elections held in 41 counties, 17 of which resulted in the issue being defeated. A sum total of $5,603,700 was voted upon during the year. The amount of funds on hand Jan. 1, 1912, raised by appropriations and issues of bonds prior to that date was approximately $4,504,456, making a total of $8,000,656 available for road construction for the year, subsequent to the sale of bonds. Besides the above amount many counties of the state issued scrip for road work during the year which will be redeemed at some date in the future. In addition to this many counties worked their roads out of a fund raised by voting a special tax which with their regular road tax was sufficient to keep up their highways. It is estimated that about one-fourth of the highways improvements carried on in the state during 1912, was accomplished in this manner. Information received from county judges, commissioners and commercial clubs through the state indicate that over $5,000,000 was expended in Texas on highways during the year, resulting in the improvement of approximately 1,500 miles of roads. Many counties and precincts have spent as high as $5,000 per mile for road construction during the year. While the above amount was expended per mile for good road construction in many counties of the state, it was the exception rather than the rule, the general average running about $3,000 per mile. Robertson county voted the largest sum for highway improvement during 1912, with a total of $500,000 good road bonds voted in four separate elections. El Paso county came second with $390,000 while Fort Bend County was third voting $355,000 in three elections. Wharton county voted $300,000 in one election while Montgomery voted $250,000. In El Paso county it was necessary to hold two elections before the bonds carried. The first election held in August resulting in a defeat of the issue, while in the December contest the issue carried by an overwhelming two-third majority. In practically every election in which the bonds were defeated the returns showed a majority in favor of the issue but as a two-thirds count is necessary to carry, the issues were lost for the time being. However, plans are on foot in nearly every county where the elections failed, for another contest in the near future and in many cases the date has already been set for the second ballot upon the issue. Commercial clubs all over the state are endeavoring to create a sentiment among the rural people for good roads and have in most cases been instrumental in bringing about the successful result in the bond elections. While large amounts of bonds were issued by the various counties and districts of the state during the past year for road improvement and much activity in good roads building has been in vogue for the last several years, the State of Texas itself has done nothing to aid or encourage the building of good roads and has so far taken no steps to see that the sums being raised for this purpose are being wisely spent.

Ez Has Went.

The touching little ditty that follows is printed not so much for the beautiful sentiments it contains as for the moral it conveys. It appeared originally many years ago in a country newspaper. The editor of this country newspaper was a model prisoner and his sentence was commuted on his promise never to write another "pome."

He has went, went and left us,
Went and left us all alone,
Left us all alone in sorrow,
Sorrow heavy as a stone.

Heavy as a stone gigantic,
Stone which crushed the Greek of yore,
As the stone beside the highway,
Highway down by Skinner's store.

Skinner's store wherein his lifetime,
Lifetime full of pleasant hours,
Hours he used to set a talking,
Used to set a talking hours.

Hours while other men were toiling,
Toiling in the race for wealth,
Wealth he never wanted while he
Could get credit and had health.

Wealth however is not lasting,
Lasts no longer than the rain,
Rain that soaks the morning glory,
Glories blooming in the lane.

Lanes they say must have a turning,
Turning, twisting and again
And again we see turn upward,
Upward turned our Ezra Lane.

Ezra Lane used blasting powder,
Blasting powder tried to dry,
Tried to dry it did our Ezra,
Ezra then was called on high.

High to glory he ascended,
Ascended and we know alack
From a lack of things returning,
That we'll never see him back.

PERSONAL

Mr. James Logan of Mount Holly, N. J., has been appointed supervisor of roads and county engineer for Burlington County, New Jersey.

Samuel Barclay Charters, Jr., assistant professor of electrical engineering at Leland Stanford, Jr., University, died in Pittsburgh, Dec. 29.

Mr. Gilbert S. Walker, assistant inspecting engineer for the Isthmian Canal Commission, has been placed in charge of the New York office of the Commission, at 24 State street.

Mr. Roy S. Lanphear has been appointed head chemist for the sewer department of Worcester, Mass. Mr. Lanphear was formerly at the sewage disposal plant of Plainfield, Mass.

Mr. C. B. Bailey of Wayne, Ark., has been appointed engineer of the St. Francis drainage district, in Missouri and Arkansas, succeeding Mr. J. D. Mitchell, who recently resigned.

John H. Spengler, engineer, in the employ of the Chicago Subway Commission, and formerly assistant city engineer of Chicago, died suddenly at his home, 7022 Constance Ave., Chicago, Saturday, Jan. 11.

Mr. D. E. Douty has resigned his position with the Bureau of Standards at Washington, D. C., to become general manager for the United States Conditioning & Testing Co., 340 Hudson St., New York City.

Mr. C. S. Sheldon, formerly first assistant engineer for the Cincinnati, Hamilton & Dayton Ry., has been appointed engineer of bridges and structures of the Pere Marquette R. R., with headquarters at Detroit, Mich.

Mr. John T. Simpson, engineer and architect, has opened an office in the Essex Bldg., Newark, N. J. Mr. Simpson was one of the organizers, and for the past five years president, of the American Concrete Steel Co. of Newark.

Mr. John E. Fearing has been appointed city engineer of South St. Paul, Minn., to succeed Mr. W. A. Hunt, who recently resigned. Mr. Fearing has been a member of the city engineering staff of St. Paul for the past eight years.

Robert Forsyth, Consulting Marine Engineer and Naval Architect, died at his home in San Francisco recently, at the age of 66. Mr. Forsyth was for many years president and chief engineer of the Union Iron Works of San Francisco.

Mr. Stephen B. Vernon, for five years connected with the Intercepting Sewer Board of Syracuse, N. Y., has been appointed engineer in charge of design and construction of the $1,000,000 sewer system to be built by the city of Albany, N. Y.

Mr. Harold Parker, first vice-president of the Hassam Paving Co., Worcester, Mass., on Jan. 10 delivered an illustrated lecture on "Specifications Covering Patented Pavements," before the graduate students in highway engineering at Columbia University.

Mr. Earl C. Elliott has been made superintendent for the Kokomo Water Works Co., Kokomo, Ind., succeeding Mr. O. O. Jones, who recently resigned. Mr. Jones has been with the company 26 years and will continue his service in an advisory capacity.

Mr. C. M. Garland, recently engineer in charge of the gas-producer department of the Camden Iron Works, Camden, N. J., has become associated with the firm of Woodmansee, Davidson & Sessions, consulting engineers, First National Bank building, Chicago.

James Whiting Johnson, for several years manager of the western department of the General Electric Co. in Chicago, died of pneumonia at his home, 5047 Washington avenue, Jan. 14. Mr. Johnson was born at Waverly, N. Y., in 1862. He was a member of the American Institute of Electrical Engineers.

Mr. S. G. Pollard, who was the engineer in charge of construction of the Cincinnati water works and water purification plant, has formed a partnership with Mr. J. W. Ellms, under the name of Pollard & Ellms, Consulting Engineers, with offices at 603 Miles Greenwood Bldg., Cincinnati. Mr. Ellms is superintendent of the water purification plant, and will continue in that position.

Mr. C. M. Lawrence, County Engineer of Hughes County, Oklahoma, was elected President of the Oklahoma Engineering Society at the annual meeting in Oklahoma City, Jan. 7. Other officers elected were: First vice-president, W. L. Benham, consulting engineer, of Oklahoma City; second vice-president, S. A. Joyner, county engineer of Comanche county, Oklahoma; third vice-president, W. C. Burke, consulting engineer of Oklahoma City; secretary-treasurer, H. V. Hinckley, consulting and supervising engineer of Oklahoma City.

Mr. J. H. Gray of New York, for 11 years president of the J. H. Gray Co., engineers and contractors of New York, has become associated with the Roanoke Bridge Co., of Roanoke, Va., as general manager. Mr. Gray is the inventor of the "Gray column," the "prismoidal derrick" and a "pneumatic caisson" for deep foundation work. He was designer and superintendent of construction of the steel work of many large buildings, such as the Witherspoon and Hotel Walton, in Philadelphia; the New Amsterdam and Liberty theaters in New York; Troop C. Armory, Brooklyn, etc. He was contractor for the New York extension of the Brooklyn bridge, and for some work on the Williamsburg bridge and New York subway.

Civil Service Examinations.

The Civil Service Commission of Chicago, Ill., announces the following examinations:

Chief Engineer (Board of Education), Jan. 22.

Engineer of Water Works Design, $3,600, Feb. 3, 4, 5.

Heating and Ventilating Designing Engineer (promotion), Jan. 17.

Architectural Designer (promotion), Jan. 24th.

School Sanitary Engineer, $1,920-$2,400, Jan. 28.

INDUSTRIAL

Epping-Carpenter Co., manufacturer of pumping machinery, has opened a District Sales Office at 131 State St., Boston, Mass., in charge of Mr. James J. Hart, formerly with the International Steam Pump Co. and the Warren Steam Pump Co.

The Raymond Concrete Pile Co. of New York and Chicago has been awarded the contract for placing 1,317 standard Raymond concrete piles for the foundation of a new building for Sears, Roebuck & Co. at North Kansas City, Mo. This building is the first unit of the large improvement contemplated by Sears, Roebuck & Co. at this location. George C. Nimmons is the architect. Swenson Construction Co. are the general contractors for the building.

The Blaw Steel Construction Co., Westinghouse Building, Pittsburgh, Penn., with plants at Reynoldsville, Penn., and Hoboken, Penn., has recently taken the following contracts: 3,000 tons of galvanized transmission towers for shipment to Spain; 200 tons of galvanized transmission towers for shipment to Keokuk, Ia.; two steel viaducts for the West Penn. R. R. Co. near Scottdale, Pa.; steel form contract for the New York Subway construction; steel form contract for the Pennsylvania R. R. Bridge near Baltimore, Md.

The Hess Flume Co., 2166-76 Fifteenth St., Denver, Colo., announces the purchase of the Maginnis flume patents, covering both the Maginnis Standard Flume and the Maginnis Smooth Interior Flume, together with the business, stock and good-will of Mr. P. Maginnis of Kimball, Neb. The Hess Co. will continue the manufacture of both the Maginnis flume and the Hess flume at both their Denver and Canton, O., factories.

The American Cast Iron Pipe Co., Birmingham, Ala., announces that the growth of its business has necessitated the following changes in its selling organization, effective Jan. 1, 1913: Paul A. Ivy, transferred from Kansas City to Birmingham, and made general sales manager; Joseph W. Ivy, transferred from Dallas to Kansas City, and made manager of Kansas City office; William J. Lyman, transferred from Birmingham to Dallas, and made manager of Dallas office; Henry D. Hughes, transferred from Kansas City to Birmingham, and made manager of southern sales; D. W. Wallace, transferred from Birmingham to Kansas City and made assistant to Joseph W. Ivy.

CATALOGUES

Concrete Guard Rails.—Paper, 6x9 ins., 12 pp. Concrete Guard Rail Co., Ellwanger & Barry Bldg., Rochester, N. Y.

A highway guard rail for embankments, culverts and bridges. Complete weights, dimensions and prices are given.

Cast Iron Flanged Pipe.—Paper, 4x6¾ ins., 32 pp. The Massillon Iron & Steel Co., Massillon, O.

This catalog is Special Catalog A, and contains a condensed set of tables and other data on flanged pipe and flanged fittings. The tables are convenient for use in connection with work on detailed drawings.

Ugite.—Paper, 3½x6 ins., 24 pp. United Gas Improvement Co., Philadelphia, Pa.

This booklet contains specifications for a dust laying and road preservative for earth or cinder roads.

Wheelbarrows & Concrete Carts.—Paper, 3½x6 ins., 21 pp. The Lansing Company, Lansing, Mich.

The barrows shown in this booklet have been designed to meet the requirements of the contractor who works in brick, stone, mortar and cement.

Elastite.—Paper, 3½x6 ins., 6 pp. Philip Carey Company, Lockland, Cincinnati, O.

This is a material for paving joints made from wool felt which is thoroughly saturated, coated and bonded with a special waterproof asphalt compound, making a compact board that is easily handled.

Three Way Road Drag.—Paper, 6x9 ins., 4 pp. J. D. Adams & Co., 392 North High St., Columbus, O.

The Adams Three Way Drag is illustrated and described in this pamphlet. It is made up of two forward right and left hand sections and one rear section. The right and left hand sections scrape the material from the sides of the road to the center and the center section crowns the material.

Ohio Kerosene-Gasoline Tractors and Tractor Rollers.—Paper, 6x9 ins., 8 pp. J. D. Adams & Co., 392 No. High St., Columbus, O.

This folder gives illustrations, descriptions, dimensions, etc., of the Ohio Kerosene-Gasoline Tractors and Tractor Rollers, which are made in 2 sizes, 30 hp. and 50 hp. with friction drive and friction steering gear.

Another catalog issued by this company describes the Road King Line Leaning Wheel Graders. Illustrations are given showing the machine in operation using the wheels in leaning position and using the steerable tongue by means of which the grader may be worked either right or left hand in the ditch as well as on the center of the road, with the engine always in the center of the road.

RAILWAYS

Alabama.

It is stated that construction work will be started on the Gadsden, Bellevue & Lookout Mountain R. R. as soon as arrangements can be completed for an entrance to Gadsden, and that the line will be built from that city to Noccalula Falls. U. J. Virgin, New Orleans, La., is President.

Arizona.

Surveys are reported under way for a railroad from Clarkdale to Phoenix, opening a rich mining and agricultural section. The line would be about 100 miles long. Ex-Senator W. A. Clark, 20 Exchange Pl., New York City, is understood to be interested.

Arkansas.

The State Penitentiary Board has adopted a resolution providing for the building of a line of railroad four miles long from the State Farm to Varner. The work will be done by convict labor. John H. Page, Little Rock, Ark., is Commissioner of Agriculture.

California.

⊙The Maydwell Railroad Supply Co., San Francisco, of which C. A. Maydwell is President, has been awarded the contract for constructing the Fresno, Hanford & Summit Lake R. R. (electric). The railroad company is stated to have disposed of $1,250,000 of bonds to French bankers for the construction of its lines. F. S. Granger, Fresno, Cal., is President.

The United Railroads of San Francisco, 85 Second St., San Francisco, is to build a 2-mile single track street car line through Presidio at a cost of about $100,000.

The Board of Public Works, F. J. Churchill, Secretary, San Francisco, has notified public service corporations that they must remove or alter conduits or other underground work owned by them in Market St., between Kearny and Sansome Sts., before Feb. 11, so as not to interfere with the laying of rails for the Geary Street Municipal Railway, when it is being extended to the ferry landing. Work on the extension will begin on that date and connection made with the outer rails in lower Market St., at Sansome St.

Work is progressing nicely on the line of the Oakland, Antioch & Eastern R. R., from Oakland, Calif., to Sacramento. Work on the 14,000-ft. trestle through Glide Tule ranch will be completed by the middle of March. Mervy Elwell Co., contractors for building culverts and the slips at Black Diamond and Pittsburgh, have about completed one of the slips. Grading work in the Montezuma hills is being pushed by Millard & Co., who have several large forces on the job.

Engineers of the Santa Fe system are now at work between Fallbrook and Oceanside, Calif., determining whether or not a suitable route can be found for a new railroad line between the two places. G. W. Harris, Los Angeles, Calif., is Chief Engineer of the Coast Lines of the Santa Fe.

The Santa Fe System, according to reports from San Diego, Calif., has had preliminary work under way for several weeks on the proposed second track line from San Diego, Calif., to Los Angeles by way of La Jolla. Instead of tunneling Soledad hill the company, it is said, contemplates leaving the track as it is. From Los Angeles to Del Mar the two tracks will be side by side. After leaving Del Mar, according to plans, the second track will diverge along the ocean shore by way of the Torrey pines to La Jolla. From there it is proposed to go to San Diego over the old Keller-Kerckhoff right-of-way.

Colorado.

The receivers of the Denver, Laramie & Northwestern R. R., J. L. Terry, Superintendent, Continental Bldg., Denver, have been authorized to issue $550,000 of receivers' certificates. Of this sum $419,000 would be used to pay the company's debts, and the remainder will go for completing the line from Greeley to Severence, 12 miles. It is expected that construction work will be started in the early spring.

Georgia.

The Waycross & Suburban Ry. Co., Waycross, Ga., will probably take up shortly matter of extending its line to Hebardville.

Idaho.

Work has been started on the reconstruction of the Oregon Short Line car shops at Pocatello, Ida., by Patrick Moran, contractor, Salt Lake City. F. J. Householder, Chief Engineer for the contractor, is in charge of the work.

It is reported that the Central Idaho Ry. (Oregon Short Line) is contemplating the construction of a new line from a connection with the Wood River branch at Tikura, along the Little Wood River to Latham's and possibly to a connection with the Mackay branch at Arco, Blaine County, Idaho. Carl Stradley, Salt Lake City, Utah, is Assistant General Manager of the Oregon Short Line.

Illinois.

It is believed that the Chicago, Burlington & Quincy R. R. will start active construction some time this year on the elevation of its tracks through Aurora, Ill. W. L. Breckinridge, Chicago, Ill., is Engineer Maintenance of Way.

The Chicago & Alton Ry., according to reports, has appropriated $726,000 for the completion of the work of building the new Glenn yards, the proposed new terminal of the road. About 60 miles of track will be laid in the new yard this year and probably 40 additional miles during the following year. The work will also include a new roundhouse, a 100-ft. turntable and auxiliary shops. H. T. Douglas, Jr., is Chief Engineer, Chicago, Ill.

It is rumored that the Chicago Great Western R. R. has surveys under way for the construction of a line from Bolton to Freeport, Ill. L. C. Fritch, Chicago, Ill., is Chief Engineer.

Mike Conroy, Granite City, Ill., has just completed about 750,000 cu. yds. of levee work near Granite City, and his outfit is now idle, but will be ready to tackle any good big job in the early spring. The outfit consists of 50 teams, four excavating graders and two traction engines, all in good repair.

The Alton & Eastern Electric Ry. Co., Alton, Ill., has been incorporated with a capital stock of $2,500, for the purpose of operating a street railway in Madison County. The incorporators include L. C. Haynes, East St. Louis, Ill., President of the Alton, Granite & St. Louis Traction Co., and O. C. Macy, Alton, Ill., Superintendent of the same company.

The Central Terminal Ry. Co., of Chicago, Ill., which is to construct the Canadian Pacific terminal in that city, has acquired for its freight terminal, to be erected at Canal and 15th streets, 13 additional parcels of property in the vicinity of West 15th and South Union Sts. The company is also purchasing land for auxiliary track yards at Harvard St. and 48th Ave. Up to date it has acquired for both sites 252 parcels of land for a total stated price of $2,480,681

Indiana.

The Chicago, Indianapolis & Louisville Ry., A. S. Kent, Chief Engineer, Transportation Bldg., Chicago, Ill., has been making surveys for a branch from Switz City to Linton, Ind. No construction, however, is contemplated in this territory at present.

The Indianapolis Union Railway Co. has authorized the expenditure of $120,000 for the remodeling of the Union Station preliminary to track elevation at Indianapolis, Ind. Bids for the work, it is said, will be taken at once.

Iowa.

E. N. Mathews & Co. have completed their contract on the big cut north of Chariton, Ia., for the Chicago & Northwestern Ry. and track-laying has progressed to a point near that city. It is rumored that the company will extend its line from Chariton to Buxton.

The Iowa City Electric Ry. Co. has been reorganized under the name of the Mississippi Valley Electric Co., and its capital stock increased from $100,000 to $1,450,000. The company will develop its service at Iowa City, and will purchase other street railways. J. O. Schulze, Iowa City, Ia., is President.

The City Council of Burlington has passed ordinances granting the Burlington Belt Line Ry. Co. the right to lay track over certain streets. The company has filed its articles of incorporation. The capital stock is $100,000 and the officers are: President, George H. Boynton; vice president, Ed. E. Egan; secretary, Amos F. Cutter; treasurer, Ed. E. Egan, of Burlington. As noted in our Jan. 8 issue the company plans a line through Henderson and Hancock counties, Illinois, to tap the Santa Fe, the T., P. & W., the Wabash and the Baltimore & Ohio roads, and plans to build as far as Beardstown, Ill.

Kentucky.

The Maysville Public Service Corporation, Maysville, Ky., is considering extending its lines to Eastland and Oklahoma, two suburbs of the city.

The Ohio Valley Electric Ry. Co., Huntington, W. Va., is reported to be planning to construct an electric line this spring from Ashland to Russell, Ky., a distance of five miles.

Louisiana.

The Opelousas, Gulf & Northeastern Ry., T. J. Freeman, Vice President, New Orleans, La., is reported to be considering extending its line from Crowley to Lake Charles during the coming spring.

The Baton Rouge Electric Co., 317 Main St., Baton Rouge, has accepted the franchise offered by the city for extension of the street car lines, building out Florida St., down East Boulevard to Railroad Ave.

Maryland.

Plans are rapidly nearing completion by the Baltimore & Ohio Ry. for the construction of a cut-off shortening the line between Philadelphia and Washington. The railroad company's plan seems to be to build new tracks for the use of express trains from a point north of Lansdowne, in Baltimore County, to a point at or near Hanover, in Howard County. The new link will be about six miles long. F. L. Stuart, Baltimore, Md., is Chief Engineer.

Michigan.

The State Railroad Commission, Lansing, Mich., has instructed the Lake Shore & Michigan Southern and the Detroit & Toledo Shore Line Railroads to establish connections at Monroe. G. C. Cleveland, Chief Engineer of the Lake Shore & Michigan Southern R. R., Cleveland, O., and J. P. Main, Detroit, Mich., is General Manager of the D. & T. S. L. Ry.

Mississippi.

⊙Boyd & Bradshaw, Columbia, Miss., have been awarded a contract by the New Orleans Great Northern Railroad Co. for the construction of an extension of this line to the timber holdings of the Great Southern Lumber Co., a distance of 3 miles.

The Laurel Light & Ry. Co., Laurel, Miss., has completed the clearing of the right of way as far as Tallahala Creek for its projected interurban from Laurel to Ellisville, and construction work will be rushed from now on. The road is to be completed by Oct. 1.

Missouri.

The Missouri Public Utilities Co., incorporated two weeks ago with a capital stock of $1,000,000, was organized to develop plants for lighting, power, etc., and also for operating interurban electric railways. The company is reported to be planning extensive development work in Southeast Missouri. Hugo Wurdack, Wright Bldg., St. Louis, Mo., is interested.

A meeting was held Jan. 6 at Bolivar, Mo., by the Board of Directors of the Nevada, Lebanon & Eastern Ry. Officers were elected and plans discussed for building the proposed line. The headquarters of the company will be located at Nevada, Mo. J. A. Daly and J. A. Thompson, Nevada, Mo., are directors of the company. W. W. Thompson of Kansas City, one of the original promoters, was elected President, S. A. Wright of Nevada, Vice-President, and W. I. Diffenderffer of Lebanon, Secretary and Treasurer. The route of the proposed road has already been surveyed from Nevada to Lebanon, through Bolivar and Buffalo, over the line of survey of the old Fort Scott & Laclede line, projected years ago.

Nebraska.

A project is under consideration for the construction of an 18-mile railroad from Tekamah to Decatur. Franklin Everett, Lyons, Neb., is the promoter.

The State Railway Commission held a hearing on Jan. 15 on the application of the Omaha, Lincoln & Beatrice Interurban Ry., H. S. Norton, Secretary, 1400 O St., Lincoln, Neb., for the right to issue and sell bonds to the amount of $2,250,000 and common stock to the amount of $850,000 to be used in the extension of that road from Lincoln to Omaha. The Northern Construction Co. is stated to have offered to build and equip the line in consideration of the delivery of the bonds to it.

Nevada.

The Nevada Copper Belt R. R., W. C. Orem, President, Salt Lake City, Utah, has made a survey for an extension from its terminal at Ludwig to the Kennedy Consolidated Mine at Buckskin. The survey leaves the main line of road some distance south of Ludwig, near Delphi Springs, and runs lower down than the main line, passing between the town of Morningstar and the old pump station on the flat. The Kennedy Consolidated Mine is about six miles west of Ludwig.

New Mexico.

The Phelps, Dodge & Co., owners of extensive copper mines in the Burro Mountain District of New Mexico, have made preliminary surveys for a railroad to extend from Tyron to Whitewater, where a connection will be made with the Atchison, Topeka & Santa Fe Ry. The line will be about 15 miles long and will cost about $200,000. Walter Douglas, Bisbee, Ariz., is interested.

New York.

The State Public Service Commission has authorized the Liberty & Callicoon R. R. Co., Liberty, N. Y., to build a 14-mile railroad to connect Liberty and Jeffersonville in Sullivan county. The line will pass through the villages of Loomis, White Sulphur Springs and Youngsville and the towns of Liberty and Callicoon. The commission has also authorized the company to issue $200,000 in common capital stock and its first mortgage 25 year five per cent gold bonds to the amount of $250,000. The road's charter provides that it may be operated either by steam or electric power.

The Public Service Commission of the Second District has held a hearing on the application of the Little Falls Johnstown Ry. Co. for permission to execute a mortgage for $3,000,000 and to issue thereunder $3,200,000 of 50-year 6 per cent bonds and also to issue $550,000 preferred and $1,000,000 common capital stock. At the hearing the engineer of the railway testified that the estimated cost of the main line of 28 miles with a branch of eight miles from St. Johnsville through Nelliston and Fort Plain to Canajoharie would be approximately $1,845,000. He stated the proposed main line right of way is to be double-tracked with single track on the branch. Power is to be purchased from either the East Creek Light & Power Co. or the Mohawk Hydro Electric Co., both of which companies have transmission lines adjacent to the proposed route of the new road. J. Ledlie Hees, Gloversville, N. Y., President of the Fonda, Johnstown & Gloversville R. R., is also President of the new company.

During the last week the Public Service Commission for the First District, 154 Nassau St., New York city, held public hearings, as required by law, on the terms and conditions of the proposed contracts with the Interborough Rapid Transit Co. and the New York Municipal Railway Corporation (Brooklyn Rapid Transit) covering the construction and operation of the new subway lines and elevated railroad extensions in the Dual System. These contracts were as follows: 1. With the Interborough Rapid Transit Co. for the operation of extensions of the existing subway in Manhattan, The Bronx and Brooklyn, the cost of construction to be borne jointly by the City of New York and the company, each contributing $58,000,000. The cost of equipment, estimated at $22,000,000, has to be borne by the company. 2. With the Interborough Rapid Transit Co. for the construction, at its own expense, of extensions of the existing elevated railroads in Manhattan and The Bronx, to cost about $16,000,000; also the operation thereof by the company. 3. With the Manhattan Railway Co. for the third-tracking of the elevated railroads in Manhattan and The Bronx leased to and operated by the Interborough Rapid Transit Co. to cost about $11,000,000; also for the operation of the same by the Interborough Company. 4. With the New York Municipal Railway Corooration (Brooklyn Rapid Transit) for the construction by the City and the company jointly of the new Broadway Subway in Manhattan, two new tunnels to Brooklyn and extensions of the Center Street Loop Subway and the Fourth Avenue Subway, the company to contribute $14,500,000 and the City about $100,000,000 toward the cost of construction; all to be equipped and operated by the company in conjunction with its existing elevated railroad system in Brooklyn. It is estimated that the new equipment will cost $26,000,000. 5. With the New York Municipal Railway Corporation (Brooklyn Rapid Transit) for the construction, at its own expense, of certain extensions to its elevated railroads to Jamaica and other points, and the operation thereof in connection with the rest of the new system. The cost of such extensions is estimated at $8,000,000. 6. With the New York Municipal Railway Corporation (Brooklyn Rapid Transit) for the construction, at its own expense, of additional tracks on existing elevated railroads and for the operation thereof in connection with existing lines. The cost of such additional tracks is estimated at $6,500,000; also for the reconstruction of existing elevated lines at its own expense at an estimated cost of $10,000,000. The hearings on these contracts were to be concluded this week and thereafter the contracts will be put in final form and submitted to the Corporation Counsel for his approval. It is hoped that the contracts will be approved by the Board of Estimate and Apportionment and signed by the Commission and the companies concerned within the next few weeks.

The Public Service Commission for the First District, 154 Nassau St., has completed the first draft of the forms of contract for the construction of the remaining portions of the Broadway, 7th Ave. and 59th St. Subway in Manhattan, planned for operation by the New York Municipal Railway Corporation (Brooklyn Rapid Transit). Public hearings on the terms and conditions of these contracts, which cover that portion of the route in Broadway from Houston St. north to 42nd St., thence through 7th Ave. to 59th St., and thence through 59th and 60th Sts. to the Queensboro Bridge, have been called for Jan. 30. The Commission has also forwarded to the Art Commission, for its approval, plans for the construction of the proposed rapid transit railroad from the Queens end of the Queensboro Bridge to Astoria.

North Dakota.

The Brazil, Devil's Lake & Minneapolis Electric Ry. Co. of Brazil, N. Dak., has been incorporated with a capital stock of $100,000, the incorporators being A. B. Fox, Brazil, C. B. Glasgow and J. B. Richey.

Work will be resumed in the spring on the Northern Pacific extension from Mandan, N. Dak., to Stanton, and it is to be extended into the Knife River country, possibly to the Kildeer Mountain section, by next fall. W. L. Darling is Chief Engineer, St. Paul, Minn.

Ohio.

⦿Winston & Co., who have the contract for the construction work for the Cincinnati Union Depot & Terminal Co., at Cincinnati, as noted in our Dec. 25 issue, are making good progress. The contract comprises the construction with the exception of the structural steel work, which has not been determined upon as yet. The construction being done at present is what is known as the urban railway work. This comprises the building of a double-track rapid transit line from the heart of the city to connect with the various interurban lines that come into the suburbs of the city at present. This line is about 16 miles in length and will enter the Union Depot at Cincinnati. Winston & Co.'s work includes all of the grade work, concrete work, track laying and other work necessary to complete the line, with the exception of the electrical and structural steel work. Practically all of this line is on private right-of-way. There will be a number of subways, but it is not expected that there will be any tunnel work. It is expected to complete this work in 1914. The other construction work of the Cincinnati Union Depot & Terminal Co. will probably not be started for some months yet. The contractors are doing the work with their own forces, but later on it is possible that some of it may be sublet. Roswell D. Trimble is in charge for Winston & Co., and offices have been opened in the Carew Bldg., Cincinnati.

⦿The West Virginia & Ohio Construction Co., Ashland, O., has been awarded the contract for constructing the extension of the Ashland & Western Ry. from Ashland to Lorain, O.

The Cincinnati Traction Co., E. H. Berry, Engineer Roadway, Traction Bldg., Cincinnati, O., is to expend about $1,000,000 this year for improvements. A large part of this sum will be spent for track improvements.

Oklahoma.

In connection with the proposed purchase of the Clinton & Oklahoma Western from Clinton to Strong City, by the Missouri, Kansas & Texas (Katy) Railroad, making it a portion of the recently acquired Wichita Falls & Northwestern System, it is reported also that the Katy's intention is to extend the line southeast from Clinton to Chickasha for a connection there with the Oklahoma Central. This would permit the Katy people, through the Wichita Falls and Northwestern and Clinton and Western state charters, to purchase the Oklahoma Central. This would give the Katy direct connection between its Eastern and Western Oklahoma north and south lines.

Oregon.

It is expected that the Grants Pass & Crescent City Ry. Co. will be in a position shortly to call for bids for the construction of its line. This company was organized for the purpose of constructing a railway between Grants Pass, Oregon and Crescent City, California (about 103 miles). Citizens of Grants Pass are to build, or spend $200,000 in the

✣ indicates work now open for bids. ⦿ indicates a contract let recently building, of the first ten miles on the Grants Pass end of the project. Crescent City timber owners and citizens are putting up $250,000, making a total of $450,000 subscribed. The balance is expected to be raised from the sale of bonds. J. F. Reddy, Grants Pass, Ore., is interested.

Pennsylvania.

The Pittsburgh Rys. Co., F. Uhlenhart, Jr., 435 Sixth Ave., Pittsburgh, Pa., will probably have work started soon on an extension of its Charleroi line from Roscoe to California, Pa.

The Wilkes-Barre Ry. Co., 8 W. Market St., Wilkes-Barre, Pa., has filed notice of increase of stock from $300,000 to $900,000.

Residents of Nesquehoning, Pa., have started a movement to extend the present electric railway to Summit Hill. This would shorten the distance between the latter place and Mauch Chunk by seven miles.

It is believed here in Philadelphia that the first step in the progressive policy of Samuel Rea, the new President of the Pennsylvania R. R., will be that of adding two more tracks to the main-line road between New York and Philadelphia, making it a 6-track road between these two cities. It is supposed that two of the tracks will be used exclusively for through transit, while the other four will be used for local traffic and freight trains. Some basis for the report is indicated by the fact that the railroad is preparing to put in eight tracks at the North Broad street station and that it is preparing to widen its trackage through the city. Quietly property has been acquired along the right of way and residents have been given 30 days' notice to vacate.

The Warren Street Ry. Co., 101 Liberty St., Warren, Pa., is to construct an extension this spring to Youngsville, nine miles west of Warren. The route crosses a number of railroads, and the construction of the line will cost something like $300,000.

Activity of real estate agents in West Newton, Dawson and other towns, acting for the Baltimore & Ohio R. R., has led to the report that this road would soon take up the matter of constructing two additional tracks between Pittsburgh and Connellsville. The company now has four tracks between Connellsville and Broad Ford. From the latter place to McKeesport, a distance of 42 miles, there are only two tracks. Between Glenwood and Pittsburgh, five miles, there are but two. This would be a total of 47 miles to be given additional tracks.

The Eastern Midland R. R. Co. has been chartered with a capital stock of $400,000 and proposes to build a line from Matomoras, Pike County, to the Delaware Water Gap, 40 miles. H. C. Miller of McKeesport is president and the incorporators include R. M. Wilson, A. B. Thornburg, B. C. Davis and C. R. Turton of Aspinwall, C. W. Helman of Homestead, Ray Lowe, A. A. Adams, C. G. Hanna, W. W. Bald and Byron Trimble of Pittsburgh and H. B. Rhine and Herbert Hunt of Bellevue.

The General Elevated Ry. Co. of Philadelphia, Pa., has been chartered under the laws of Delaware. The capital stock is $1,000,000, and the company's objects are to apply for any and all rights, inventions, improvements, etc., for improved railway system. The incorporators are: Frank A. Butler, Henry N. Montgomery, W. H. Doeble, J. George Schemff, Frank K. Stahl, U. G. Yoder, George B. Young and C. U. Martin.

Tennessee.

A project is under consideration for the construction of an electric railway from Tullahoma to Lynchburg. W. G. Cummings, Manchester, Tenn., General Manager of the Stone Fort Power Co., is interested.

Texas.

⊙A. M. Clopton, Elgin, Tex., as noted previously, has a contract for widening banks, opening cuts, etc., from Waco south to Lagrange for the Missouri, Kansas & Texas R. R. C. L. Owens, Elgin, Tex., and L. F. McMillen, Belton, Tex., have subcontracts on this work.

The Board of Trade of Laredo, Tex., has reported good progress on the proposition to secure the construction of a railroad from that city to Beeville or some other point where a connection can be made with Houston.

Among the reports circulating concerning improvements contemplated by the Missouri, Kansas & Texas R. R., is one to the effect that additional freight yard facilities costing $50,000 are planned at Houston, Tex.

It is reported that the Asherton & Gulf R. R. has let the contract for the construction of an extension to its line from Artesia Wells, a point on the International & Great Northern, to Corrizo Springs, a distance of 10 miles. W. McComb, Asherton, Tex., is Secretary of the company.

The Marshall & East Texas R. R. contemplates the construction of its line from Winnsboro to Mount Pleasant, thereby securing a connection with the Frisco out of Paris. R. J. Lockwood, Marshall, Tex., is Chief Engineer.

Good progress is reported as being made in the promotion work for the proposed interurban line from Martin to Temple. E. P. Turner, Dallas, Tex., is the promoter.

The San Antonio & Austin Interurban R. R. Co., chartered last week with a nominal capital stock of $25,000, proposes the construction of an 85-mile interurban line between Austin and San Antonio by way of Davenport, New Braunfels, Hunter, San Marcos, Kyle, Buda, Manchaco and several smaller places. It is estimated that the construction and equipment will cost approximately $3,000,000. Among the incorporators are: W. B. Tuttle, vice-president San Antonio Traction Co.; Frederick Terrell of San Antonio, president City National Bank; R. R Russell of San Antonio, president State Bank & Trust Company; Franz C. Groos of San Antonio, president Groos National Bank; Will C. Barber of San Marcos, president State Bank & Trust Company; J. H. Barbee of San Marcos, cashier First National Bank; George W. Littlefield of Austin, president American National Bank; Chester Thrasher of Austin, cashier Citizens' Bank & Trust Co.; Otto Wahrmund of San Antonio, vice-president San Antonio Brewing Association; Otto Koehler of San Antonio, president San Antonio Brewing Association, and Edwin Chamberlain of San Antonio, capitalist.

The directors of the San Antonio, Uvalde & Gulf R. R., A. R. Ponder, General Manager, San Antonio, Tex., have authorized an increase in the capital stock of the corporation from $230,000 to $280,000. This increase is for the stock value on the 50 miles between Campbellton and Mathis, to which point the Gulf Coast extension of the line has been definitely fixed.

The Paris & Mt. Pleasant Ry., H. P. Mobberly, Chief Engineer, Paris, Tex., will complete its tracklaying to Mount Pleasant in the near future, and will then take up the matter of building on to Atoka.

The Estacado & Gulf R. R., which was recently purchased by L. C. Eastland, Oklahoma City, under a foreclosure judgment sale, has been reorganized, and it is stated that steps will be taken at an early date to complete the line to Roby. This road is to extend from McCaulley to Roby, 12 miles. Practically all of the grading has been completed and six miles of steel laid.

It is expected that the Missouri, Kansas & Texas Ry., A. M. Acheson, Chief Engineer, Dallas, Tex., will reach a decision shortly as to the route for the proposed extension from Austin to a point on the Smithville-San Antonio Division, and that construction work will be started early in the spring. Three routes have been under consideration. One runs from Austin to Lockhart, another from Austin to Beeville and the third from Austin to Maxwell. The distance to each of these points is about 30 miles. The Missouri, Kansas & Texas at present uses the track of the International & Great Northern between Austin and San Marcos, running from the latter place to San Antonio over its own track. Involved in the proposed extension is the building of a bridge across the Colorado River here. It is stated that the cost of the proposed structure will be about $400,000.

Utah.

According to advices from Salt Lake City, Utah, the Buckhorn Land Co., recently organized to divert waters of the Hunting River in the northern part of Emery County for irrigation purposes, proposes also the construction of a railroad from Price, Utah, to that section of the county.

Washington.

It is rumored at Toledo, Wash., that work is to be started within a short time on the proposed extension of the Tacoma Eastern R. R. through that place to Portland, Ore. E. O. Reeder, Seattle, Wash., is Chief Engineer.

The Northern Pacific Ry., according to maps filed at Olympia, is planning a considerable amount of construction work in Washington for this year. This work will probably include the Ritzville-Ellensburg cutoff, 100 miles; the extension from Kelso on the Columbia River through Brookfield, Oneida and Nema to Willapa harbor and north to Grays Harbor, the extension of the Sunnyside branch from Grandview to a connection with the main line at Gibbon.

West Virginia.

The Morgantown & Wheeling Ry. Co., organized to construct an electric railway from Morgantown to Wheeling, 73 miles, is understood to have purchased the Morgantown & Dunkard Valley R. R., operating a line from Morgantown to Cassville. The new owners will extend the line from the latter place to Wheeling. J. M. Martin, Morgantown, W. Va., is General Manager.

The Red Creek R. R. Co., of Hendricks, W. Va., has been chartered with a capital stock of $40,000. The incorporators are R. B. Norsburgh, D. G. Wilson, E. M. Bechtel, L. R. Harvey and A. J. Armstrong, all of Hendricks.

The Monongahela Valley Traction Co., Jas. O. Watson, General Manager, Fairmont, W. Va., has authorized extensions which will involve the expenditure of about $400,000. The work includes the building of an additional ten miles from Wolf Summit, Salem and an extension of two miles from Haywood to Lumberport. It is also proposed to build a 2-mile extension from East Run, two miles south of Mannington, to Annabelle.

Wisconsin.

The Chicago & Northwestern Ry. is reported to have secured options on 260 acres of land between Berryville Station and Pikes Creek, with a view to establishing yards at that point. It is reported that about $400,000 will be expended for the land and for building 10 miles of yard tracks.

Canada.

⊙The Northern Construction Co., Vancouver, B. C., has been awarded the contract for the Steveston branch of the Canadian Northern Ry. The contract covers about 10 miles of line and includes 1½ miles of trestle.

⊙Bates & Rogers Construction Co., Spokane, Wash., and Chicago, Ill., has been awarded a contract by the Grand Trunk Pacific R. R. for the construction of all bridges and tunnel lining on the line between Prince Rupert and Edmonton, Alta. The cost of the work is estimated at $2,000,000. The first work on the job has just been started by the company, bridge gangs and tunnel lining crews having begun operations both at Edmonton and a short distance east of Prince Rupert. It is the present intention of the company to have these two large forces of men work toward each other and one or two more big crews probably will be put to work about midway between Prince Rupert and Edmonton in the near future.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Announcement has been made at Moose Jaw, Sask., by John E. Chisholm, an attorney, that a company was being formed to build a railroad from that place to the international boundary to a connection with the Great Northern Ry.

City Council of Brandon, Man., has decided to apply to the Manitoba legislature for a charter to build and operate an electric railway connecting all the small towns surrounding the city. R. E. Speakman is City Engineer.

Mexico.

Hoogwhinkel, Anthony, Brown & Co., London, England, have acquired the street railway systems of the cities of San Luis Potosi, Leon, Guanajuato, Torreon and Tampico. The street railway lines in all of these cities are to be reconstructed and converted into electric traction. Work on rehabilitating and extending the system in San Luis Potosi has already been started, and preparations are being made to begin similar work in the other cities. G. H. Hoogwinkel is now at San Luis Potosi, Mexico, directing the work. It is probable that the London company is a subsidiary of S. Pearsons & Son, Ltd. The latter concern has large interests in Mexico, and maintains offices in the City of Mexico.

Construction work will be started shortly by S. Pearson & Son, Ltd., City of Mexico, on an electric railway from Tampico to La Barra, six miles, and a street railway system at Tampico, for which they have a concession.

ROADS AND STREETS

Alabama.

County Surveyor Fitzhugh Lee, Gadsden, Ala., has started a survey of a new county road across Lookout Mountain, through what is known as Huff Gap. The road will be about one mile in length.

The Birmingham Motor & Country Club, Birmingham, Ala., plans the construction of a three-mile motor speedway at that city. The club recently increased its capital stock from $15,000 to $100,000 for that purpose.

Arizona.

⊙The Barber Asphalt Paving Co., Church St., New York City, has been awarded the contract by the city of Phoenix, Ariz., Frank Thomas, City Recorder, for the construction of 24,000 sq. yds., of bitulithic pavement, 9,000 lin. ft. of curb and gutter, and a syphon flume across Central Ave., at the Salt River Canal. The pavement will cost $2.15 per sq. yd. Bids were opened Jan. 13.

The City Council of Bisbee, Ariz., contemplates asking bids during this month for the paving of Subway St., from the end of the paving of the plaza to a point at the rear of the Bisbee Bank building, with brick on a concrete base. The estimated cost is $5,000. Ralph A. Ziesemer is City Engineer.

The Cochise County Board of Supervisors, Tombstone, Ariz., contemplate the purchase of a road building outfit and will advertise for bids for the machinery at once. It is thought that an outfit can be obtained for $6,000. J. S. McNeish is County Engineer.

California.

⊙The Board of Public Works of Los Angeles, Calif., has awarded the contract for the paving of E. Seventh St., from Boyle Ave. to Utah St., to W. F. Hewitt & Co., at $14,500.

The City Council of Santa Monica, Calif., has passed ordinance providing for the paving of Fremont Ave., Bontty and 19th Sts. Petitions are being circulated for the paving of Bay, 23d, 26th and part of 19th St. The estimated cost is $200,000.

The city of Redding, Calif., proposes to build a road to connect that city with the Trinity-Humboldt state road to Eureka. H. W. Glover is Mayor.

Superintendent of Streets D. K. Adams of San Diego, Calif., has forwarded to the state legislature at Sacramento a memorial asking it to dedicate to the city of San Diego a right of way through the land adjoining the marine biological station north of La Jolla. It is proposed to lay a paved boulevard 150 ft. wide from the end of India St. to connect with the state highway at Del Mar by way of La Jolla.

Connecticut.

⊙The Connecticut State Highway Commission has awarded the contracts for the improvement of four miles of roadway between Middletown and Waterbury, a part of the trunk line system. The contract for building 10,375 ft. of macadam road from Pratt's corners to the Milldale trolley station was secured by Leonard Suzio, of Meriden, Conn., and the contract for the building of 9,630 ft. of gravel road from Milldale to the base of the Waterbury mountains went to Sternberg & Son, of West Hartford, Conn.

District of Columbia.

✣Bids will be received until 2 p. m., Jan. 27, by Board of Commissioners, Washington, D. C., for grading certain streets aggregating about 47,000 cu. yds. Further information may be obtained of Chief Clerk, Engineer, Department Room 427, District Bldg., Washington, D. C.

✣Bids will be received until 2 p. m., Jan. 24, by District Commissioners, Washington, D. C., for furnishing and delivering 100,000 gals. or more of emulsifiable road oil for use in the surface division of the city.

Georgia.

The City Council of Waycross, Ga., has passed a resolution providing for the paving of Gilmore St. with asphalt block. T. H. Finn is City Engineer.

The street committee of the City Council, Atlanta, Ga., has decided to recommend approximately $425,000 worth of work for the street department during the year. The appropriation is to be divided as follows: Chert and stone, $50,000, which means $150,000 of work on the assessment plan; asphalt and bituminous repairs, $30,000; chert repairs, $20,000; streets ordinary, $50,000; to complete Marietta St., $10,000; paving in front of city property and churches, $10,000; drainage on streets paved by county, $10,000; repairs on unpaved streets, $10,000; sidewalk repairs, $5,000; wood block repairs, $3,000; belgian block repairs, $2,000; drainage on De Kalb Ave. and McLendon St., $3,000; W. Hunter St., $1,000; city stockade expense, $246,000.

Illinois.

✣Bids will be received until 10:30 a. m., Jan. 24, by Col. A. L. Smith, Quartermaster Corps, 556 Federal Bldg., Chicago, Ill., for furnishing one 3-wheel 10-ton steam or gasoline motor road roller.

✣Bids will be received by the Board of Local Improvements, Chicago, Ill., Edward J. Glackin, Secretary, until 11 a. m., Jan. 27, for furnishing labor, materials, etc., necessary to construct pavements in the following streets: W. 38th Pl., S. Washtenaw Ave. to S. Kedzie, 6,470 lin. ft. granite concrete combined curb and gutter, 9,650 sq. yds. asphalt pavement; Quarry St., Archer Ave. to 27th St.; 27th St., Halsted St. to Quarry St., 2,500 lin. ft., sandstone curbing to be furnished and set, 5,450 sq. yds. brick pavement; N. Hamlin Ave., Byron St. to Grace St.; N. Springfield Ave., Avondale Ave. to Irving Park Boul.; Byron St., N. Hamlin Ave., to N. 40th Ave., 9,800 lin. ft. granite, concrete combined curb and gutter, 4,000 cu. yds. earth cutting, 14,640 sq. yds. asphaltic macadam; Haddon Ave., N. Leavitt St. to N. Western Ave., 2,620 lin. ft. granite concrete combined curb and gutter, 1,700 cu. yds. earth cutting, 4,150 sq. yds. asphalt; Ballou St., Armitage Ave. to Fullerton Ave., 5,250 lin. ft. granite concrete combined curb and gutter, 600 cu. yds. rock excavation, 1,600 cu. yds. earth cutting, 8,000 sq. yds. asphalt; E. 83rd St., Exchange Ave. to Ontario Ave., 2,420 lin. ft. granite concrete combined curb and gutter, 5,090 sq. yds. asphaltic pavement, 40 sq. yds. brick pavement; Commercial Ave., South Chicago Ave. to E. 104th St., 16,640 lin. ft. sandstone curbing to be furnished and set; 3,000 sq. ft. concrete sidewalk, 12,000 cu. yds. earth cutting, 32,320 sq. yds. brick pavement; Hirsch St., Grand Ave. to N. 44th Ave., 4,750 lin. ft. granite concrete combined curb and gutter, 400 sq. ft. concrete sidewalk, 850 cu. yds. earth cutting, 7,320 sq. yds. asphalt; N. Harding Ave., W. Division St. to North Ave., 5,200 lin. ft. granite concrete combined curb and gutter; W. 36th St., Western Ave. to California Ave., 4,980 lin. ft. granite concrete combined curb and gutter, 700 sq. ft. concrete sidewalk, 8,470 sq. yds. asphalt pavement; W. 38th St., Morgan St. to 475 east of east line Butler St., 7,140 lin. ft. gravel concrete combined curb and gutter, 1,000 sq. ft. concrete sidewalk, 118,000 sq. yds. asphalt pavement: Cornelia St., Ashland Ave. to East Ravenswood Park, 2,650 lin. ft. granite concrete combined curb and gutter, 1,000 sq. ft. concrete sidewalk, 4,600 sq. yds. asphalt pavement; Irving Park Boulevard, Ashland Ave. to East Ravenswood Park, 2,610 lin. ft. sandstone curbing to be furnished and set, 1,000 cu. ft. concrete curb wall, 400 cu. yds. earth cutting, 650 sq. yds. brick pavement, 3,850 sq. yds. creosoted wood block pavement; W. 36th St., California Ave., to Kedzie Ave., 5,400 lin. ft. sandstone curbing to be furnished and set, 550 sq. ft. concrete sidewalk, 7,210 sq. yds. brick pavement. All work (unless otherwise specified) includes a 6-in. Portland cement concrete foundation, sand cushion and asphaltic filler for brick pavements, sewer, manhole and catchbasin construction and adjustment. Cash or certified check for 10 per cent of bid must accompany proposal.

The Aetna Engineering Bureau, 17 N. La Salle St., Chicago, Ill., has been authorized by the city of Longview (Texas) to prepare plans and specifications for constructing pavements, estimated costs as follows, creosoted wood blocks, $50,000; macadam or asphaltic macadam, $37,000.

Following is the lowest bid submitted Jan. 15 for furnishing and delivering mason sand as required by the Bureau of Engineering, Chicago, during the ensuing year; inside specified territory, $124 per cu. yd., outside territory, $134, delivery by cars, 75 cts. American Sand & Gravel Co., 133 W. Washington St. The contract has not been awarded. L. E. McGann, Commissioner of Public Works.

Following is the lowest bid submitted Jan. 15, for furnishing and delivering torpedo sand to the Bureau of Engineering, Chicago, as required during the ensuing year, within specified territory, $1.70 per cu. yd., outside specified territory, $1.80, by carload lots, $1.25 per cu. yd. American Sand & Gravel Co., 133 W. Washington St. The contract has not been awarded. L. E. McGann, Commissioner of Public Works.

The City Council of Aurora, Ill., has passed ordinances providing for the construction of asphalt pavement on Union and Flagg Sts. and Maple and Stolp Aves. Property owners on Pennsylvania, Columbia, Holbrook, Woodlawn, Hardin, Iowa, Concord, View, May, Garfield, Palace and Gale Sts. have asked that asphalt pavement be laid on their streets. Myron J. Tarbel is City Engineer.

The Board of Local Improvements of Rock Island, Ill., has adopted resolution for the improvement of 25th St., from Ninth to 18th Ave., by paving with brick. This improvement will cost about $30,000. The Board is considering the proposed extension of Second

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Ave., paving from 14th St. west to Seventh St., and the paving of Seventh St., from Second to Fourth Aves. The estimated cost of this improvement is $40,219. Wallace Treichler is City Engineer.

The Board of Local Improvements of Waukegan, Ill., has decided to pave Washington St. this year with brick upon a 6-in. concrete foundation. The improvement will extend from West St. to the city limits. M. J. Douthitt is City Engineer.

The Board of Local Improvements of Dixon, Ill., has passed a resolution calling for the construction of brick pavement on Second St., from the west line of Galena Ave. to the Illinois Central viaduct; on Hennepin Ave., from Second to Third St.; on Peoria Ave., from Second to Third St., and on Monroe Ave., from First to Third St. Chas. F. Nesbit is City Engineer.

The city officials of Ottawa, Ill., propose the construction of a considerable amount of pavement in West Ottawa at an estimated cost of $281,208. The territory as outlined includes that district lying south of Lafayette St. Geo. L. Farnsworth is City Engineer.

The Board of Local Improvements of Elgin, Ill., proposes the construction of the following pavements during the year: St. Charles St., $38,500; Division St., $27,500; Walnut Ave. hill, $7,500; Villa St., $58,000; Milwaukee St., from Spring to Center Sts., $3,300, and Riverside Ave., $7,000. The St. Charles St. work has been let. M. H. Brightman is City Engineer.

The Board of Local Improvements of Peoria Ill., has decided on creosote block as the material for paving S. Adams St., from Oak to Cedar. Thrush Ave., from Knoxville to Wisconsin, will be paved with brick on a concrete base at an estimated cost of $22,947. L. D. Jeffries is City Engineer.

The Village Council of East Peoria, Ill., proposes to construct a brick pavement on North Main St. The paving would be 14 ft. between curbs and about 1¼ miles in length.

Indiana.

✣Bids will be received until noon. Feb. 13, by commissioners of Morgan and Johnson counties, at Martinsville, Ind., for the construction of a gravel road known as the Elburn Brown et al. gravel road. J. S. Whitaker is County Auditor.

✣Bids will be received until 2 p. m., Feb. 4, by Board of Grant County Commissioners, Marion, Ind., for the construction of three stone roads and one gravel road. E. H. Kimball is County Auditor.

✣Bids will be received until 2 p. m., Feb. 4, by commissioners of Orange county, at Paoli, Ind., for the construction of a gravel road in French Lick township, Northwest township, Paoli township, Orangeville township. Ed. A. Palmer is Auditor of Orange county.

✣Bids will be received until noon, Feb. 4, by commissioners of Pulaski county, at Winamac, Ind., for the construction of a gravel road on Van Buren and Indian Creek township line. W. E. Munchenburg is County Auditor.

✣Bids will be received until 10 a. m., Feb. 4, by commissioners of Montgomery county, at Crawfordsville, Ind., for the construction of gravel roads in Brown, Franklin, Union and Scott townships. B. B. Engle is County Auditor.

✣Bids will be received until 2 p. m., Feb. 4, by commissioners of Monroe county at Bloomington, Ind., for the construction of a gravel road known as Fred I. Owens et al. road in Richland township, Monroe county; W. F. Kinser is County Auditor.

✣Bids will be received until 2 p. m., Feb. 4, by commissioners of Grant county, for the improvement of certain highways in Grant County. E. H. Kimball is County Auditor.

✣Bids will be received until 5 p. m., Feb. 4, by H. M. Johnson, Town Board of Beech Grove, Ind., for the improvement of 3rd Ave., from the south line of Albany St. to the south line of Bethel Ave. Also for the improvement of 4th Ave., from the south line of Albany St. to the south line of Bethel Ave., in said town.

✣Bids will be received until 2 p. m., Feb. 4, by commissioners of Jefferson county, at Madison, Ind., for paving a certain highway in Shelby township. A. M. Taff is County Auditor.

✣Bids will be received until 2 p. m., Feb. 3, by commissioners of Rush county, at Rushville, Ind., for the construction of a macadam road in Rushville township. A. R. Holden is County Auditor.

✣Bids will be received until 10 a. m., Feb. 3, by commissioners of Clark county, at Jeffersonville, Ind., for the construction of a macadam road in Jeffersonville township. George W. Stoner is County Auditor.

✣Bids will be received until 10 a. m., Feb. 3, by commissioners of Clark county, at Jeffersonville, Ind., for the construction of a crushed rock or macadam road on the old Plank road. G. W. Stoner is County Auditor.

✣Bids will be received until 2 p. m., Feb. 3, by commissioners of Rush county, at Rushville, Ind., for the construction of a macadam highway in Rushville township. Allen R. Holden is County Auditor.

⊙The Montgomery County Commissioners, Crawfordsville, Ind., Bennett B. Engle, Auditor, at their January meeting awarded contracts for road work as follows: Snyder & Barnett, Frankfort, Ind., Wm. T. Sinnet road, $7,826; Snyder & Barnett, Edgar Sentman road, $8,142; Stout & Layne, Crawfordsville, Frank Thomas road, $5,300; Frank B. Warren, Crawfordsville, Chas. E. Warren road, $19,000, and Lee & Harriman, New Richmond, Ind., Jos. Livingston road, $4,532.

⊙The Board of Cass County Commissioners, Logansport, Ind., J. E. Wallace, Auditor, awarded the following contracts for road work at their January term of court: Sim Kistler road No. 1, Walter Girton, Logansport, $1,998; Sim Kistler road No. 2, Martin McHale, Logansport, $1,960, and John H. McMillen road, Eel Township, Beal & Bell, Logansport, $26,862.

⊙The County Commissioners, Anderson, Ind., have let contracts for the construction of four gravel roads to the Madison Construction Co. of that city. Three of the improvements will be in Pipe Creek township and the fourth one in Monroe township.

Iowa.

✣Bids will be received until Feb. 1 by J. T. Sampson, R. F. D. 2, Audubon, Ia., Viola Township Clerk, for the township roadwork during 1913.

✣Bids will be received until 8 p. m., Feb. 11, by C. J. Reusche, City Clerk, Clinton, Ia., for the construction of 19,600 sq. yds. of concrete, brick asphalt or Dolorway pavement and 8,300 lin. ft. of curbing. A certified check for $1,000 must be filed with each bid. J. G. Thorne, 317 Howes Block, is City Engineer. Official advertisement will be found elsewhere in this issue.

✣Bids will be taken at once by a Special Committee of the Common Council, Muncie, Ind., for street flushers. Official advertisement will be found elsewhere in this issue.

⊙Peter Nelson, Council Bluffs, Ia., has been awarded the contract by the City Council of that city, Chas. J. Duff, City Clerk, for the construction of a combination curb and gutter 920 ft. in length on portions of Bryant St., and Fourth Ave., at $0.59. Bids were opened Jan. 13.

⊙The M. Ford Paving Co., Cedar Rapids, Ia., has been awarded the contract by the City Council of Clinton, Ia., for the construction of 36,800 sq. yds. of brick paving on Second St., from Eighth Ave., to Reynor St., at $81,579. The work also includes 11,000 lin. ft., of combined curb and gutter. Bids were opened Jan. 14 by C. J. Reusche, City Clerk.

In his biennial message to the legislature Governor Carroll of Iowa will recommend a proposition to submit to the people of the state at the next general election the question of a bond issue for road improvements.

A preliminary survey of the main street of Mt. Vernon, Ia., is being made in order that an estimate may be made by the City Council of the cost of paving the street. It is proposed to pave First St. as far west as the viaduct bridge.

The City Council of Cedar Rapids, Ia., has been petitioned for the paving of a number of streets and avenues. C. H. Streeter is City Engineer.

The City Council of Clear Lake, Ia., has decided to begin work early in the spring on the construction of about 10 blocks of street paving. H. J. Cameron is City Engineer.

The Board of Local Improvements of Davenport, Ia., has recommended an ordinance for the City Council to pass on for the paving of 25th St., from Ninth to 18th Ave. The paving is to be of brick and the thoroughfare will be 26 ft. wide. J. A. Ryan is City Engineer.

Kentucky.

✣Bids will be received until 2 p. m., Feb. 11, by Board of Public Works, Louisville, Ky., for the construction of street improvements as follows: Letting No. 479, including 18,350 sq. yds. of sheet asphalt, creosoted wood block or vit. block pavement; No. 480, including 19,125 sq. yds. sheet asphalt pavement; No. 481, 19,075 sq. yds. vit. block pavement; No. 482, 11,800 sq. yds. of sheet asphalt pavement; No. 483, 27,615 sq. yds. of vit. block pavement; No. 484, 3,570 sq. yds. of vit. block alley pavement; No. 485, 6,740 sq. yds. of concrete sidewalk pavement. Plans and specifications are on file at the office of Engineering & Contracting. D. R. Lyman is Chief Engineer of the Board. Official advertisement will be found elsewhere in this issue.

The Board of Public Works of Paducah, Ky., in its recommendation to the Mayor and General Council asks for about $50,000 with which to maintain the various departments under its control; for the construction of creosote streets along Broadway, replacing the brick streets; the construction of a concrete bridge across Island creek at Sixth St.; the building of a street from Goebel Ave. to Kentucky Ave., and the purchase of additional machinery to be used at the municipal lighting plant.

Louisiana.

✣Bids will be received until 7:30 p. m., Jan. 22, by Board of Commissioners, 200 New Orleans Court Bldg., New Orleans, La., for paving with small granite blocks on a concrete foundation of a roadway on the river front from Nuns St. to Thalia St. A certified check for $1,000 must be filed with each bid. A. C. Bell is Engineer of the Board.

Commissioner of Public Property Lafaye of New Orleans, La., is agitating the complete paving of the city streets.

Maryland.

The State Highway Commission of Maryland plans the improvement of roads in Montgomery County, as follows: Road from Woodmont to Glen Echo, through the subdivision of Edgewood, a distance of about three miles; the River Road from Cohasset to the District of Columbia line, also about three miles in length. These roads intersect at Cohasset. The estimated cost is $50,000. E. E. Goslin is Secretary of the Commission.

Plans have been prepared by City Engineer H. K. McCay of Baltimore, Md., for the construction of 30 miles of all kinds of paving at an estimated cost of $1,000,000. The pavement is to be laid on a 6-in. foundation. Contracts will be let in February for about $300,000 worth of the work.

Massachusetts.

⊙The Commissioners of Essex County, Mass., at a recent meeting in Lawrence, awarded a contract for the construction of the Lawrence-Methuen boulevard to Joseph Wagenbach & Son of Lawrence. The contract price is $47,492.

Michigan.

State Highway Commissioner Townsend A Ely of Michigan proposes to ask the legislature to appropriate $1,000,000 to be used in the construction of state reward roads through-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

out the state. At the present time there are 935 miles of road applied for on which there is reward asked to the amount of $591,591.

The Chamber of Commerce of St. Louis, Mich., is agitating the paving of the main street of the city.

Mississippi.

✣Bids will be received until 2 p. m., Feb. 3, Good Roads Commission, Supervisor's District No. 1, at the office of the Chancery Clerk, Aberdeen, Miss., for the construction of about 22 miles of good roads in the First Supervisor's District. estimated work and material as follows: 102,568 cu. yds. of earth; 1,320 ft. 18-in. pipe; 575 ft. 24-in. pipe; 55 ft. 30-in. pipe; 85 ft. 36-in. pipe; 60 ft. 48-in. pipe; 125 cu. yds. concrete. Clearing and grubbing. Plans, specifications and profiles are now on file and subject to inspection in the Clerk's office at Aberdeen, Mississippi, or at the office of the First District Good Roads Commission at Amory, Mississippi. All bids must be accompanied by a certified check for the sum of $1,500 on some solvent bank or trust company in the State of Mississippi, payable to A. B. Cowden, Secretary of the First District Good Roads Commission.

✣Bids will be received until 2 p. m., Feb. 5, by E. H. Kennedy, Secy., Highway Commissioners, District No. 3, Clay County, West Point, Miss., for the work of permanently improving approximately 9 miles of public road in said district. Tishomingo gravel or novaculite will be used for the finishing surface, and it is to be compact with a power roller. Alternate bids on sand-clay surfacing will be taken. Concrete will be used in the construction of culverts and small bridges. "I" beams and concrete bridges for the larger openings. For small drains vitrified pipe will be used. Bids are invited for doing the entire work or any division thereof, consisting of bridge and culvert work, grading, surfacing and graveling, everything to complete the roadway, and with furnishing all material and tools necessary to complete said roads. Plans, profiles and specifications are on file in the office of the Chancery Clerk of Clay County and in the office of C. L. Wood, Highway Engineer, Columbus, Miss., and with E. H. Kennedy, Secretary of the Highway Commissioners, West Point, Miss., and blank forms for proposals will be furnished upon application by the Engineer or Secretary on deposit of $5. Each bidder must accompany his proposal by a certified check for $1,000, made payable to the Highway Commissioners of Supervisors' District No. 3, Clay County, Mississippi.

✣Bids will be received until 2 p. m., Feb. 5, by W. F. LaGrone, Secy., Highway Commissioners of Supervisors' District No. 2, Clay County, West Point, Miss., for the work of permanently improving approximately 17 miles of public road in said district. Tishomingo gravel or novaculite will be used for the finishing surface, and is to be compact with a power roller. Alternate bids on sandy-clay surfacing will be taken. Concrete will be used in the construction of culverts and small bridges. "I" beam and concrete bridges for larger openings. For small drains vitrified pipe will be used. Bids are invited for doing the entire work or any division thereof, consisting of bridge and culvert work, grading, surfacing and graveling, everything to complete the roadway, and with furnishing all material and tools necessary to complete said roads. Plans, profiles and specifications are on file in the office of the Chancery Clerk of Clay County and in the office of C. L. Wood. Highway Engineer, Columbus, Miss., and with W. F. Lagrone, Secretary of the Highway Commissioners, West Point, Miss., and blank forms for proposals will be furnished upon application by the Engineer or Secretary on deposit of $5. Each bidder must accompany his proposal by a certified check for $1,000, made payable to the Highway Commissioners of Supervisors' District No. 2, Clay County, Mississippi.

The Road Commissioners of District No. 2. Covington County. Miss., expect to ask bids in February for the construction of a number of the district roads, for which $35,000 will be appropriated. Collins is the county seat.

Missouri.

✣Bids will be received until Jan. 28 by City of Maplewood, Mo., for the construction of sidewalks.

Missouri State Highway Engineer Curtis Hill suggests road legislation for a state road department entirely separate from any other department and without creating any additional salaried offices.

Farmers living between Avondale and Compton's Farm, Clay County, Mo., have voted bonds for the building of nine miles of rock road in that county between Kansas City and Excelsior Springs. The road will cost $65,000 and the work of grading will be started early in the spring. Liberty is the county seat.

The County Court, Carthage. Mo., has instructed the county highway engineer to advertise for bids for grading roadway and filling bridge approaches on and along a road running north from Purcell on section lines.

The McCredie-Hereford-Stephens Store Benefit Assessment Road District. Fulton, Mo., has been organized for the improvement of roads in that district. Property in the district has been assessed $0.15 on the $100 valuation for roads.

A bill was introduced in Congress on Jan. 17 by Representative Bourland of Missouri, providing for a coast-to-coast national highway, to cost $20,000,000 or more. The measure provides a national highway commission of six members and calls the contemplated road "the national old trails road." Beginning at Washington, the highway would pass through Frederick, Hagerstown and Cumberland, Md.; Petersburg, Uniontown and Alexander, Pa.: Wheeling, W. Va.; Columbus, Zanesville, Springfield and Dayton, Ohio; Indianapolis and Terre Haute, Ind.; Vandalia and Troy, Ill.; St. Louis and Kansas City, Mo.; McPherson and Dodge City, Kan.; Trinidad, Col.; Santa Fe, N. M.; Douglas and Phoenix, Ariz., and San Diego, Los Angeles and El Centro, Cal.

Nebraska.

The Douglas County Commissioners, Omaha, Neb., rejected all bids received Dec. 14 for the paving of Dodge St. The improvement is to be of brick and extend 1½ miles. The commissioners intend to re-advertise the work. Frank Dewey is County Clerk.

New Jersey.

⊙Wm. Van Keuren, Prior St., Jersey City, N. J., has been awarded the contract by the Board of Street & Water Commissioners of that city, for improving Van Wagenen Ave., from Stuyvesant Ave., to Sip Ave., at 88½ per cent of the engineer's estimate. Bids were opened Jan. 6.

⊙The Barber Asphalt Paving Co., Church St., New York City, has been awarded the contract by the Board of Street & Water Commissioners of Jersey City, N. J., for the making of repairs to the asphalt pavements, at 94½ per cent of the engineer's estimate. Bids were opened Jan. 6.

⊙Wm. Van Keuren, Prior St., Jersey City, N. J., has been awarded the contract by the Board of Street & Water Commissioners, Jersey City, for the making of repairs to macadam roadways, at 80 per cent of the engineer's estimate. Bids were opened Jan. 6.

The Fourth Ward Taxpayers' Association of Westfield, N. J., has circulated a petition providing for the curbing, macadamizing and regrading of Osborne Ave., from Cumberland St. to First St. L. H. Phelps is President of the Association.

The Board of Freeholders of Sussex County, Newton, N. J., rejected all bids received recently for the building of the proposed improved road between Newton and Branchville because they were above the estimate of County Engineer Konkle. Bids submitted were: Cotter & Bergen, Echo Lake, type B., $74,281.67; type C., $67,969. Allen Engineering & Construction Co., Netcong, type B., $84,515; type C., $81,359. Salmon Bros., Hackettstown, type B., $84,498; type C., $75,030. M. Irving Demarest, Sewaren, $74,403; type C., $67,039. E. C. Humphreys & Co., Hackensack, type B., $72,248; type C., $66,988.

New York.

✣Bids will be received until 8 p. m., Jan. 23, by Village Board of Ilion, N. Y., for paving W. Clark and W. North Sts.

⊙The Village Board of Ilion, N. Y., has awarded the contract for the paving of West and East River Sts. to Warren Bros. of Boston, Mass, at $2.18 per sq. yd. The work includes about 10,000 sq. yds. of paving, drains and sewerage.

⊙The Collins Contracting Co., Whitestone, N. Y., has been awarded the contract by the Quartermaster at Fort Totten, N. Y., for the construction of macadam roads, cement walks, etc., at $2,186. Bids were opened Jan. 15.

The city engineering department of Troy, N. Y., is preparing plans for the improvement of Fifth Ave., North Troy, from First to 26th Sts. Contracts for this work will be let in the spring. Paul Schultze is City Engineer.

The citizens of the village of Lancaster, N. Y., on Jan. 6 voted the issuance of bonds for the paving of Church St.

The Board of Estimate of New York City, N. Y., has authorized the extension of Seventh Ave., from Greenwich Ave. to Carmine St., and the widening of Varick St., from Carmine to Franklin St., and the extension of Vardick St., from Franklin to West Broadway. The extension will cost $7,000,000.

The Board of Estimate of New York City has appropriated $8,000,000 for improvements, as follows: Manhattan—for repaving, $1,000,000; Brooklyn—repaving. $1,000,000; Queens—for repaving, $350,000; Bronx—for repaving, $350,000; Richmond—for repaving, $300,000. Nelson P. Lewis is Chief Engineer of the Board.

North Carolina.

⊙The Norfolk Southern Railway Co. has awarded the contract for the paving of Hancock and South Front Sts., in New Bern, N. C., to L. Lawson of Norfolk, Va.

Ohio.

✣Bids will be received until noon, Jan. 29, by W. J. Springborn, Director of Public Service, Cleveland, O., for grading, draining, curbing, paving with paving brick and improving the following named thoroughfares: Bailey Ave. S. W. from W. 44th St. to W. 45th St.; Beulah Ave. N. E. from E. 115th St. to Lakeview rd. N. E.; Broadway S. E. from Miles Ave. S. E. to about 450 ft. southerly; Burke Ave. S. E. from E. 78th St. to E. 83d St.; Carlvle Ave. S. W. from W. 34th St. to Fulton rd. S. W.; Carlyle Ave. S. W. from Fulton rd. S. W. to W. 41st St.; Chambers Ave. S. E. from E. 69th St. to E. 71st St.; Colburn Ave. S. W. from W. 35th St. to about 118 ft. east of W. 30th St.; Covert Ave. S. E. from E. 71st St. to E. 74th St.; Forestdale Ave. S. W. from W. 18th St. to W. 25th St.; Grand Ave. S. E. from E. 79th St. to 92 ft. east of E. 82d Pl.; Irma Ave. S. E. from E. 71st St. to E. 74th St.; Lakeview rd. N. E. from St. Clair Ave. N. E. to E. 123d St.; Osage Ave. S. E. from E. 77th St. to E. 78th St.; Osceola Ave. N. E. from Lakeview rd. N. E. to E. 125th St.; Rogers Ave. S. E. from E. 65th St. to E. 68th St.; Temple Ave. S. E. and E. 68th St. from Morgan Ave. S. E. to E. 79th St.; Trowbridge Ave. S. W. from Fulton rd. S. W. to W. 44th St.; E. 38th St. from Kelley Ave. N. E. to Perkins Ave. N. E.; E. 45th St. from Czar Ave. S. E. to Clark Ave. S. E.; E. 46th St. from Independence rd. S. E. to about 1,579 ft. northerly; E. 47th St. from Independence rd. S. E. to Chard Ave. S. E.; E. 48th St. from Independence rd. S. E. to Chard Ave. S. E.; E. 56th Pl. from Lufkin Ave. S. E. to Drake Ave. S. E.; E. 59th St. from Francis Ave. S. E. to Bower Ave. S. E.; E. 74th St. from Clement Ave. S. E. to Irma Ave. S. E.; E. 106th St. from Cedar Ave. S. E. to Arthur Ave. S. E.; E.

124th St. from Superior Ave. N. E. to Phillips Ave. N. E.; E. 124th St. from Superior Ave. N. E. to Auburndale rd. N. E.; Wade Park Ave. N. E. from E. 118th St. to Lakeview rd. N. E.; Worley Ave. S. E. from E. 66th St. to E. 71st St.; W. 34th St. from Meyer Ave. S. W. to Sackett Ave. S. W.; W. 35th St. from Meyer Ave. S. W. to Carlyle Ave. S. W.; W. 89th St. from Madison Ave. N. W. to Sauer Ave. N. W.; W. 91st St. from Lorain Ave. to Sauer Ave. N. W. Each bid must be made in accordance with plans and specifications which may be seen at the office of the City Engineer, Room 305 City Hall.

✣Bids will be received until noon, Feb. 3 by W. H. Linton, Director of Public Service, Ravenna, O., for furnishing the necessary labor and material for the improvement of Cleveland Ave. and North Chestnut St. The approximate quantities included are as follows, (I) standing for Cleveland Ave. and (2) for North Chestnut St.:

	(1)	(2)
Sq. yds. of paving	6,930	3,280
Lin. ft. of straight curbing	4,805	2,069
Lin. ft. of circle curbing	131	40
Lin. ft. of abutment curbing	176	48
Number of manholes	14	13
Number of catch basins	13	12
Number of small openings	6	6
Lin. ft. of pipe sewers, 8-in	516	...
Lin. ft. of pipe sewers, 10-in	1,088	548
Lin. ft. of pipe sewers, 12-in	604	800
Lin. ft. of pipe sewers, 15-in	150	490
Lin. ft. of pipe sewers, 18-in	503	245
Lin. ft. of pipe sewers, 24-in	...	250
Lin. ft. of pipe sewers, 36-in	328	...
Inlet specials, 5% of approximate lengths, above 2-in. drain tile appr.	1,000	1,000
3-in. drain tile appr.	1,200	1,000
Cast iron monument covers	6	4
Sq. yds. of sidewalks relaid, approx.	2,000	2,500
Cu. yds. of extra excavation, approx.	2,000	2,000
Number of private driveway approaches, approximately	15	20
Cu. yds. reinforced concrete, Wahoo culvert	160	...

✣Bids will be received until noon, Feb. 10, by Carl A. Palmer, Village Clerk, Shaker Heights, at his office, First National Bank, Cleveland, O., for the grading, draining, curbing and paving with brick on concrete foundation of a number of roads. Plans and specifications are on file with the clerk or at the office of B. W. Willard, Village Engineer, 931 Williamson Bldg., Cleveland, O.

✣Bids will be received until noon, Feb. 1, by Board of Trustees of Sullivan township, Ashland County, at the office of Maurice Frink, Clerk of the Board, Sullivan, O., for furnishing all the necessary tools, labor and materials for the improving of about 2½ miles of road from Sullivan east and about 2½ miles from Sullivan west, in said township, by grading and macadamizing the roadway with gravel and stone and constructing the necessary drainage. Bids will be received separately for the two sections above named and will also be received for the entire work of about five miles. All proposals must be made in accordance with the plans and specifications on file in the office of the township clerk. Said plans and specifications will also be found on file in the office of T. Brindle, County Surveyor, Ashland County, Ashland, O.

✣Bids will be received until noon, Jan. 31, by A. W. Carpenter, Director of Public Service, Norwalk, O., for grading, macadamizing and paving Woodlawn Ave. from Pitt St. to the Old State Road. Bituminated concrete, brick or block asphalt, block or sheet asphalt will be used. A certified check for $200 must be filed with each bid.

✣Bids will be received until noon, Jan. 31, by A. W. Carpenter, Director of Public Service, Norwalk, O., for paving, macadamizing, grading and improving East Main St. from Townsend Ave. to the Old State Road. Bids will be taken on bituminated concrete or (alternative) brick or block asphalt, block or sheet asphalt. A certified check in the amount of $200, payable to the city of Norwalk, Ohio, must be filed with each bid.

✣Bids will be received until noon, Feb. 11, by the Director of Public Service, Bellevue, O., for furnishing the necessary labor and materials for grading, draining, and paving with fire clay or shale brick or bituminated concrete, and improving Monroe street between the W. & L. E. R. R.-Pennsylvania R. R. transfer track and N. Y., C. St. L. R. R.-L. S. & M. S. R. R. transfer track according to plans and specifications on file in said office. Each bid must contain the full name of every person or company interested in the same, and be accompanied by a bond in the sum of $500.

✣Bids will be received until noon, Jan. 31, by Robert C. Parks, Village Clerk, Chardon, O., for furnishing the necessary labor and material for grading, draining, curbing and paving with brick or asphalt, North Main St. All bids must be accompanied by a certified check for $2,000. E. A. Fiedler is Engineer.

✣Bids will be received until noon, Jan. 27, by Board of Control, Niles, O., for furnishing the necessary labor and materials for constructing a vitrified brick pavement on South Main St. from Mahoning River to Meander Creek in accordance with the plans, profile and specifications on file in the office of the Director of Public Service. Each bid must be accompanied by a certified check of $800. J. E. Tregaskis is Clerk.

✣Bids will be received until noon, Jan. 29, by Village Council, New Concord, O., for furnishing the necessary labor and material for the improvement of Main St., of the Village of New Concord, O., by grading, curbing and paving the same according to plans and specifications now on file in the office of the Village Clerk. Each bid must be accompanied by a bond in the sum of $500. W. G. McKinney is Clerk.

✣Bids will be received until noon, Feb. 1, by C. E. Mark, Director of Public Service, Washington, O., for furnishing the necessary labor and materials for the improvement of Rawling St., from North St. to Delaware St., by grading and paving the roadway 26 ft. wide with hard burned paving brick and constructing the necessary sub-drains and catch basins and curbing in the City of Washington, O., according to the plans and specifications on file in said office. Each bid must contain the full name of every person or company interested in the same, and be accompanied by a bond in the sum of $200.

✣Bids will be received until noon, Feb. 3, by A. C. Brown, Village Clerk, Burton, O., for furnishing the necessary labor and material for grading, draining, curbing and paving with concrete North Cheshire St., in accordance with specifications on file with the village clerk.

✣Bids will be received until 10 a. m., Jan. 25, by Board of Auglaize County Commissioners, Wapakoneta, O., for furnishing the necessary labor and material for the construction according to plans and specifications of the following work, to-wit: The Kirwan Pike, located in Goshen Township, Auglaize County, O. Plans and specifications are on file in the office of the County Surveyor of said county. A certified check for $100 must be filed with each bid. A. E. Schaffer is County Auditor.

✣Bids will be received until noon, Jan. 22, by W. J. Springborn, Director of Public Service, Cleveland, O., for grading, draining, curbing and paving with brick and otherwise improving portions of 35 thoroughfares. W. H. Kirby is Secretary.

✣Bids will be received until noon, Jan. 22, by J. A. Holzberger, Director of Public Service, Hamilton, O., for furnishing the necessary labor and material for paving, curbing and guttering Sycamore St., from Front St. to East Ave. A. J. Pater is Clerk.

✣Bids will be received until noon, Jan. 27, by Board of Control, J. E. Tregaskis, Clerk, Niles, O., for furnishing the necessary labor and materials for paving with vitrified brick, North Main St., from Erie R. R. to the North Corporation line, in accordance with plans and specifications on file with the Director of Public Service.

⊙The city of Bryan, O., has awarded the contract for the paving of West High, Mulberry and Centre Sts., to E. A. Freshwater & Sons of Cleveland, O. Smith & Boulay, The Nasby, Toledo, O., are Engineers. Bids received Jan. 9 on this work were submitted by Warren Bros. Co., Boston, Mass.; Lambert Bros. & Wert, Delaware, O.; Andrews Asphalt Paving Co., Hamilton, O.; T. J. Mulligan Co., Lima, O.; J. O. Shoup & Co., Dayton, O.; H. S. Enck, Lima, O.; Asphalt Block Paving Co., Toledo, O., and Kelly Construction Co., Bryan, O., the last named bidding only on the Mulberry St. work. The itemized bid of the successful contractor is shown in the following table. The itemized bids on Mulberry St. and Centre St. are the same as on West High St.

		West High St.
Grading, per cu. yd	4,696	$ 0.18
3-in. drain tile, per lin. ft	100	16
4-in. drain tile, per lin. ft	100	.18
Catch basins, complete, each	6	35.00
Inlets, set, each	8	20.00
Manholes, each	4	35.00
24-in. V. S. pipe, per lin. ft	....	....
20-in. V. S. pipe, per lin. ft	....	....
18-in. V. S. pipe, per lin. ft	625	1.05
15-in. V. S. pipe, per lin. ft	370	.90
12-in. V. S. pipe, per lin. ft	486	.65
10-in. V. S. pipe, per lin. ft	184	.60
8-in. V. S. pipe, per lin. ft	154	.50
5x20 stone curb, hand dressed, lin. ft.	6,464	.63
" " machine " "	6,464	.63
5x18 " " hand " "	6,464	.61
" " machine " "	6,464	.61
4x20 " " hand " "	6,464	.59
" " machine " "	6,464	.59
4x18 " " hand " "	6,464	.56
" " machine " "	6,464	.56
Concrete curb and gutter, per lin. ft.	....	.42
Cement curb, per lin. ft	6,464	.40
4x20 stone headers, per lin. ft	306	.30
Old stone headers reset, per lin. ft.	....	.25
Cast iron track drips, per lb	....	.07
Asphalt filler, per sq. yd	10,345	.30
Tar filler, per sq. yd	10,345	.18
Sand filler, per sq. yd	10,345	.06
Cement filler, per sq. yd	10,345	.10
Laying new cement walks, per sq. ft.	....	.16
Cement walks relaid, per sq. ft	....	.10
Taking up and relaying old pavement, per sq. yd	....	3.20
Extra concrete, per cu. yd	....	6.00
Concrete masonry, per cu. yd	....	8.00
Extra gravel or broken stone, cu. yd.	....	1.75
Team labor, per hr	....	.50
Skilled labor, per hr	....	.50
Common labor, per hr	....	.25
No. working days to complete job	....	....
Total accessories	....	....
Brick pavt. on 6-in. concrete, using:		
Athens block, per sq. yd	10,345	1.73
Peebles block, per sq. yd	10,345	1.73
Nelsonville block, per sq. yd	10,345	1.73
Harris block, per sq. yd	10,345	1.75
Big 4 block, per sq. yd	10,345	1.75
Townsend block, per sq. yd	10,345	1.75
Medal block, per sq. yd	10,345	1.75
Hocking block, per sq. yd	10,345	1.77
Metropolitan block, per sq. yd	10,345	1.76
Bessemer block, per sq. yd	10,345	1.77
Dun Wire Cut block, per sq. yd	10,345	....
If slag is used in found. deduct	10,345	.01
If gravel is used in found. deduct	10,345	.01
For brick pavement within 8 ft. R. R. strip	....	....
12-in. concrete, complete, per sq. yd.	2,711	2.96

Preparations have been completed by the city of Cleveland, O., to pave 40 miles of streets during the year. Bids on the entire work will be received during February and March. The estimated cost is $2,000,000. Robert Hoffman is City Engineer.

The Village Council of East Youngstown, O., has passed ordinances providing for the following work: To grade Fifth St. and construct sidewalks the entire length of the thoroughfare; to grade and sidewalk Sixth St. from Wilson Ave. to the northerly village line; to grade and sidewalk Seventh St. from Wilson Ave. to the northerly limits; to grade and sidewalk Eighth St. its entire length within the village boundaries; to grade and sidewalk Ninth St. from Wilson Ave. to its northerly boundary; to grade and sidewalk Tenth St. its entire length within the village limits; to sewer and sidewalk Fairview and Murray Ave. in the Fairview district; to pave Wilson Ave. from McVey's Run to the westerly village limits, connecting with the pavement already down Youngstown city line.

The County Commissioners, Cincinnati, O., have instructed the surveyor to prepare plans and specifications for the improvement of Mill Road, from Hamilton pike to the Butler County line. The improvement will extend for a distance of four miles. The estimated cost is $21,683. The surveyor will also prepare plans and specifications for the improvement of Blue Rock and Colerain pikes for a distance of 2½ miles. This improvement will cost about $16,367.

The County Commissioners, Portsmouth, O., have granted a petition of Chillicothe pike property owners asking for two additional miles of paving of the pike.

The city of Madison, Lake County, O., has decided to construct 10 miles of tar-concrete highway next season. The pavement will be 16 ft. wide.

An ordinance has been introduced in the City Council of Cincinnati, O., providing that Vine St., from Fourth to 12th Sts., be paved with wood block. H. M. Waite is City Engineer.

Plans have been prepared by City Engineer John C. Grim of Wauseon, O., for the construction of 16,229 sq. yds. of brick pavement or macadam with binder stone or slag, 10,800 ft. of stone or concrete, with asphalt, tar or glutrin filler. The work also includes 13,000 cu. yds. of excavation. Contracts will be let about the middle of April.

Oklahoma.

⊙The city of McAlester, Okla., has awarded the contract for the construction of street pavement in the Second Ward to McEachin & McEachin at $7,806, the engineer's estimate.

An election was held in Tulsa, Okla., on Jan. 21 for the purpose of voting on the issuance of bonds to the amount of $125,000 for a convention hall, $40,000 for parks, and $10,000 for a boulevard.

Pennsylvania.

The Borough Council of West View, Pa., has passed an ordinance providing for a $70,000 bond issue for street improvements, a tunnel for sewer purposes and a bridge. The greater part of the money will be used for street paving.

The County Commissioners, Scranton, Pa., on Jan. 13 advertised for bids for the construction of the uncompleted sections of the county road. The work is located in Old Forge, Archbald, Jermyn, Mayfield, Fell township and Vandling.

North Dakota.

Mayor H. A. Wagner and the City Commissioners of Watertown, S. Dak., have decided to allow the property owners to select the kind of pavements desired. It is proposed to pave the main streets this season.

Tennessee.

The Commissioners of Jefferson County, Tenn., plan to ask the general assembly to pass an act to enable the county to issue additional bonds for bridges and pikes. Dandridge is the county seat.

South Dakota.

✣Bids will be received until Feb. 25, at Plankinton, S. Dak., for grading 65 miles of highway in Aurora County, S. Dak. The Dakota Engineering Co., Mitchell, S. Dak., Engineers. Official advertisement appeared in our last issue.

Texas.

⊙The city of Victoria, Tex., has entered into a contract with the contractors who are building the roads in that county for the placing of 2,500 yds. or more of gravel on the streets at $0.67 a yd., with an additional cost of $0.17½ for the gravel, which is to be paid to the county.

The citizens of Honey Grove, Tex., are agitating the paving of the square. It is proposed to commence the work early in the summer.

An election was held in Hearne, Tex., on Jan. 21 for the purpose of voting on the issuance of bonds for the construction of roads in that precinct of the county. Franklin is the county seat.

Civil Engineer G. R. Abney of Eagle Lake, Tex., has commenced surveying the roads of Smithville precinct of Bastrop County, Tex. Mr. Abney will also supervise the building of good roads in that precinct.

The City Council of Houston, Tex., on Jan. 13 considered the petitions asking for the paving of La Branch St., between Texas Ave. and Walker Ave., with vitrified brick, and Prairie Ave., between Milam St. and Smith St. H. B. Rice is Mayor. Dan C. Smith, Jr., is City Secretary.

The City Council of Houston, Tex., has adopted resolutions providing for the paving of portions of Washington and La Branch Sts.

Washington.

✣Bids will be received until 11 a. m., Feb. 4, by Constructing Quartermaster, Vancouver Barracks, Wash., for the construction of walks, curbs, gutters, etc., at that post.

✣Bids will be received until 11 a. m., Jan. 30, by Constructing Quartermaster, Vancouver Barracks, Washington, D. C., for the construction of about 1,350 ft. of macadam road along the north side of the Military Reservation.

Commissioner of Public Works Owen Woods of Tacoma, Wash., is planning three paving jobs to put up to the City Council and the property owners. The work will involve the expenditure of several hundred thousand dollars in new pavements. The proposed improvements include Yakima Ave., from 38th to 56th Sts., Fife St., from South 12 St. to North 21st St., and South Tacoma Blvd.

The City Council of Seattle, Wash., has instructed City Engineer A. H. Dimock to prepare plans for the improvement of East Howell St., from 34th to 37th Ave., and connecting streets by paving, and for grading, planking and wooden walks for Evanston Ave., from Ewing St., to Leary Ave., and Leary from Fremont to Evanston, and Blewett St., from Aurora to Phinney Ave.

Wisconsin.

A petition has been circulated in Fond du Lac, Wis., asking that South Park Ave. be paved with cement from Fourth to 13th St.

Canada.

⊙The St Vincent de Paul Municipal Council, Que., has awarded the contract for the paving of the roads of the municipality to M. J. Stack & Co., at $95,000.

BRIDGES

California.

⊙The Mercereau Bridge & Construction Co., Los Angeles, Calif., has been awarded the contract for the construction of a bridge over Cerritos Slough at 7th St., Long Beach, Calif. The contract price was $1,595.

The City of Redding, Calif., according to reports, contemplates the construction of a $40,000 bridge over the Sacramento River in order that the State Highway might pass through the business district. H. C. Woodrum is City Clerk.

The Board of Glenn County Supervisors, Willows, Calif., has, it is reported, adopted plans for the construction of a bridge near Orland for which bonds were voted a year ago.

The following bids were received at Oakland, Calif., Jan. 6, for the construction of a reinforced concrete bridge at 8th St., over the lagoon connecting Lake Merritt and the Estuary: Ross Construction Co., Sacramento, Calif., $25,714; W. N. Concannon, $30,000; F. Rolandi, $29,631.40; Healy-Tibbitts Co., $30,750; State Construction Co., $33,615; A. W. Gerrell, $33,748; Portland Concrete Pile Co., $28,485.50; Foster-Vogt Co., $29.897; Contra Costa Construction Co., $27,490; Coast Improvement Co., $27,500; Earnest A. Sonberg, $28,434; Ross Construction Co., $25,714; Monson Brothers, $27,550.

Florida.

Tentative plans for the construction of the proposed bridge over the Hillsborough River at Tampa, Fla., have been agreed upon by the Bridge and Docks Committee of the City Council and officials of the Atlantic Coast Line Ry. W. A. Johnson is City Clerk.

Georgia.

✣Bids will be received until Feb. 4, by J. M. Tomlinson, Chairman, Crisp County Commisisoners, Cordele, Ga., for the erection of a 150-ft. bridge over Gum Creek, one mile from Cordele.

Illinois.

✣Bids will be received until noon, Jan. 25, by J. L. Hall, Town Clerk, Springfield Township, at his office (Probate Court's office, county courthouse), Springfield, Ill., for the construction of the new Chinkapin bridge over the Sangamon River on the Athens Road. All bids must be accompanied by certified check for $1,000. Specifications for the bridge may be seen at the office of Frank Hamilton at the City Hall, Springfield, Ill.

⊙Bates & Rogers Construction Co., of Spokane, Wash., and Chicago, Ill., has been awarded the contract for the construction of bridges and tunnel lining on the Grand Trunk Pacific R. R. from Prince Rupert B. C., to Edmonton, Alta., a distance of 700 miles. The cost of the work is estimated at about $2,000,000.

The City Council of Edwardsville, Ill., has passed an ordinance instructing the Wabash R. R. to build an overhead bridge over the tracks at Philippine St. A. O. Cunningham, St. Louis, Mo., is Chief Engineer of the Wabash R. R.

Indiana.

⊙The Cleary Keust Construction Co., of Indianapolis, Ind., has been awarded the contract by the Board of Marion County Commissioners, Indianapolis, W. T. Patton, County Auditor, for the construction of a reinforced concrete bridge with Bedford or native limestone facing over Crooked Creek, Riverside Park, Indianapolis. The contract price is $29,492. Bids were opened Jan. 14.

The Board of Howard County Commissioners, Kokomo, Ind., has under consideration the construction of a new bridge at Washington St. and has proposed that the city remove the old bridge to La Fountain St. Henry Steward, Kokomo, Ind., is Commissioner of Public Works.

Commissioners of Knox and Gibson Counties are contemplating the construction of a bridge over White River, near Hazelton, at a cost of about $100,000. Vincennes, Ind., is the county seat of Knox County.

Iowa.

A hearing was held Jan. 17 at Washington, D. C., by the Interstate and Foreign Commerce Committee on the proposition of the Inter-City Bridge Co. to operate a bridge over the river at Keokuk, Ia. C. R. Joy, Keokuk, Ia., is President of the Bridge Company.

Kansas.

⊙The Commissioners of Butler County, Eldorado, Kan., have awarded the contract for the construction of a flat top concrete bridge 120 ft. long and 16 ft. wide over the Walnut River, near Augusta, Kans., to McKenzie-Williams Co., Webb City, Kan., at $6,895.

It has been suggested by City Engineer Bert C. Wells, Wichita, Kans., that bonds be issued for the construction of a double-decked concrete bridge to replace the present structure at the Murdock Ave. entrance to Central Riverside Park.

An agreement is reported to have been reached with the officials of the Union Pacific Ry. and the Chicago, Rock Island & Pacific R. R. by the City Commissioners, Kansas City, Kan., whereby the railroads will construct a 2,000-ft. viaduct over their tracks at the 18th St. crossing. The cost is estimated at approximately $125,000. J. B. Berry, Chicago, Ill., is Chief Engineer of the Rock Island.

The Board of Reno County Commissioners, Hutchinson, Kan., is contemplating the construction of a new bridge over the Arkansas River. Plans for a concrete structure will probably be prepared by Van Unwerth & Cooke, Consulting Engineers, Kansas City, Mo. W. B. Harris, Hutchinson, Kan., is County Engineer.

The Board of Commissioners, Montgomery County, Independence, Kan., has been petitioned for the construction of a bridge over Little Cheyenne Creek, in Caney Township, Section 34-35-14.

Maine.

A bill has been introduced into the Legislature by Senator Albert A. Burleigh, Houlton, Me., for the incorporation of the Van Buren Bridge Co., which proposes the construction of a bridge for the use of steam and electric roads from Van Buren, on the American side, to St. Leonards, across the St. John River on the Canadian side. St. Leonards is the terminus of the Westgouche & Western Ry., which has a line of 112 miles to tidewater on the Bay of Chalmers. The capital is given as $250,000 and the incorporators are: E. Hammond, Harry A. Gagnon, C. L. Cyr, Willis F. Paradis, J. F. Theriault of Van Buren, H. D. Collins of Caribou and A. P. Libby of Fort Fairfield. The company wishes the right to charge toll for the use of the bridge.

Massachusetts.

A citizens' committee of Winthrop (P. O. Boston), Mass., recently conferred with the city officials of Boston, Mass., in regard to the construction of a new bridge to replace the present structure at Saratoga St. The committee was informed that the city would offer nothing better than to pay one-half the expense.

Michigan.

A contract has been signed by city officials of Lansing, Mich., and officials of the Michigan United Railways authorizing the reconstruction of the East Michigan Ave. bridge. Peter F. Gray is City Clerk.

Kent County Commissioners of Good Roads recently held a meeting at Grand Rapids, Mich., at which they discussed with Charles A. Floyd, Grand Rapids, Mich., General Manager of the Grand Rapids, Holland & Chicago Ry., the proposition to build bridges over the Silver Creek.

The Calhoun County Road Commissioners and officials of the Michigan Central Railroad and Michigan United Traction Companies have decided upon the erection of an overhead bridge over the Michigan Central tracks and subway under the M. U. T. at Gulch Crossing, west of Marshall, Mich., the county seat. The cost of the improvement is estimated at $50,000.

Minnesota.

✣Bids will be received until 2 p. m., Feb. 19, by Commissioner of Indian Affairs, Washington, D. C., for furnishing the necessary labor and materials for the erection of a riveted steel highway bridge across Clearwater River, Red Lake Indian Reservation, Minn.

Mississippi.

⊙The Forest County Board of Supervisors, Hattiesburg, Miss., has awarded the contract for the construction of four steel bridges to the Converse Bridge Co., Chattanooga, Tenn., at $7,421. Three of the structures are to have wooden flooring and the fourth is to have a concrete floor.

Missouri.

It has been announced by A. DeBernardi, Kansas City, Mo., General Superintendent of the Missouri Pacific Ry., that work will be commenced at once on the proposed viaduct over the belt line tracks in Omaha.

Nebraska.

✣Bids will be received until noon, Jan. 25, by C. L. Hedlund, Phelps County Clerk, Holdrege, Nebr., for the construction and erection of the super-structure, the sub-structure and approaches of all bridges, and for the furnishing of labor and materials in connection with the same, to be built within Phelps County, for the period of one year. All bids to be accompanied by $100 cash or certified check payable to the County Clerk.

✣Bids will be received until 10 a. m., Feb. 4, by C. H. Hudson, County Clerk, Hastings, Nebr., for furnishing the necessary labor and material for the erection and completion of bridges required by Adams County for one year, 1913. A certified check for $500 must be filed with each bid.

⊙The Omaha Structural Steel Works, Omaha, Nebr., has been awarded the contract by the Board of Buffalo County Supervisors, Kearney, Nebr., for the construction of all bridges and bridge repair work and furnishing the material therefor, to be built in Buffalo County during 1913. The contract amounts to about $25,000. Bids were opened Jan. 17 by J. H. Dean, County Clerk.

At a joint session of the Boards of Supervisors of Dodge and Saunders Counties at Fremont, Neb., it was decided to make the three spans at the south end of the new bridge over the Platte River at Fremont, 180 ft. in length, instead of 100 ft., as at first suggested.

Real estate men of Omaha and South Omaha, Nebr., have conferred with the city officials in regard to the erection of a bridge over the Burlington tracks from 42d St. to 43d and P. Sts. Herman Beal is City Engineer of South Omaha, Nebr.

New Hampshire.

Residents of the south and east section of Manchester, N. H., are agitating the construction of a new bridge over the Merrimack River.

New Jersey.

⊙The New York & Long Branch Railroad Co. has awarded the contract for the construction of a new bridge spanning the North Shrewsbury River, to Jesse L. Holland, Seabright, N. J., at $250,000. The bridge will be 1,600 ft. long. The sub-structure will consist of four concrete piers for each span. Each pier will rest on twenty piling, driven to a good foundation. The top of the concrete will be about 1 ft. above the surface of the river. It is expected that the bridge will be completed the coming spring.

The Board of Chosen Freeholders, New Brunswick, N. J., has adopted an item of $20,000 for the repair of county bridges.

New York.

✣Bids will be received, it is reported, until Feb. 8 by Town Board, Ilion, N. Y., for the construction of two steel and concrete bridges over Fulmer Creek, in Mohawk and Steele's Creek, Ilion.

⊙The New York, New Haven & Hartford Ry. Co. has awarded a contract for catenary bridges requiring 2,500 tons of structural steel, to W. Boles & Co.

The Board of Public Works, Niagara Falls, N. Y., has decided to determine what steps it will be necessary to take in order to rebuild the old bridge over the tracks of the Erie R. R. at Pierce Ave. Thomas H. Hogan is City Clerk.

County Superintendent of Highways, E. A. Howard, Oswego, N. Y., has been authorized to have preliminary plans prepared for the construction of the proposed new bridge over the Oswego River at Minetto and to secure estimates of the cost. It is believed that the state will bear one-half the expense.

The following bids were received Jan. 13 by the New York State Commission on Highways, Albany, N. Y., for the construction of the Southbay bridge, near Whitehall, Washington Township, in connection with State Road 22: Owego Bridge Co., Owego, $44,431; Robert Kennedy, Middletown, Conn., $46,890, and Richard Hopkins, Troy, $49,316. The specifications call for the completion of the bridge by Aug. 1 next.

Alderman O. K. Sharp and John Moon have been named on a committee by the Chamber of Commerce, Lockport, N. Y., to confer with J. A. Bensel, State Engineer, Albany, N. Y., and secure, if possible, a change of the barge canal plans to provide for a girder beam instead of an overhead truss at the west end of the bridge at Lockport.

The Board of Estimate, New York City, has approved the plans of the Long Island R. R. for a bridge carrying the Main and North Side Divisions of the road over 4th St., in Queens. The bridge will consist of a deck-plate girder, with a solid concrete floor spanning the street without intermediate supports. The girder will be a trifle less than 60 ft. long and a little more than 6 ft. deep. Nelson P. Lewis is Chief Engineer of the Board of Estimate. F. Auryansen, Jamaica, N. Y., is Bridge Engineer of the Long Island R. R.

Stowell & Cunningham, Bridge Engineers, Albany, N. Y., are preparing a report on the physical condition of the bridge of the Schenectady Ry. over Cotton Factory Hollow, Schenectady, N. Y. The data will be filed with W. Thomas Wooley, City Engineer, and plans for remodeling the structure will probably be prepared at once.

Ohio.

✣Bids will be received until noon, Feb. 5, by commissioners of Miami County, Troy, O., for the improvement and erection of bridges and arches in Miami County. Frank K. McElheny is County Auditor.

The City Council of Toledo, O., has authorized the Director of Public Service, J. R. Cowell, to contract for the construction of a new bridge over the Lake Shore tracks at Sumner St. Funds amounting to $25,000 have been appropriated for the improvement.

The Railroad and Viaducts Committee of the City Council of Columbus, O., recently took up for consideration the ordinance allowing the T. & O. C. Ry. to build a viaduct over Parsons Ave. at the T. & O. C. crossing, instead of a subway.

Pennsylvania.

✣Bids will be received until 10 a. m., Feb. 3, by City Controller, Pittsburgh, Pa., for the construction of the substructure consisting of concrete abutments, piers and pedestals for the Bloomfield bridge. A bond for $5,000 must accompany each bid.

The Art Commission of the city of Pittsburgh, Pa., has approved the plans for the Bloomfield bridge over Junction Hollow and connecting Liberty Ave. with Grant Blvd. The steel structure, which will cost $500,000, is to be 2,000 ft. long. The plans for the Haights Run bridge call for concrete over a fabricated steel frame. It will cost $10,000, the main span to be 195 ft. Both of these projects will be started as soon as contracts can be let. J. G. Armstrong is Director of the Department of Public Works.

The Surveyor of Delaware County, Media, Pa., has completed soundings for the proposed new 5th St. bridge over the Chester River at Chester, Pa.

The Board of Viewers appointed by the courts of Lehigh and Northampton Counties, Pennsylvania, to take testimony and report on the project for a new inter-county bridge over the Lehigh River, between Bethlehem and South Bethlehem, will submit the findings to the courts on Jan. 27. A. C. Lebarre, Easton, Pa., and G. M. Lutz, Allentown, Pa., are members of the Board.

Tennessee.

The Hamilton County Court, Chattanooga, Tenn., has under consideration the proposition of constructing jointly with the Birmingham & Chattanooga R. R., a bridge across the Tennessee River at the neck of the Moccasin Bend.

The Hickman County Court, Centerville, Tenn., has under consideration the proposi-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

tion of building a bridge over Duck River, just west of Centerville.

The Sullivan County Court, Blountville, Tenn., at a recent meeting, appropriated funds for the construction of three steel bridges, one over the Holston River at Kingsport, to $20,000; another over the same river on the Weaver pike, and a third at Shady Ford, on the road to Mountain City. The cost of the three will be about $50,000. Citizens of Kingsport have subscribed $3,000 of the money for the bridge to be built there.

Texas.

⊙The Commissioners' Court of Bell County, Belton, Tex., has awarded the contract for the construction of two bridges on the Temple-Belton Air Line road, to Hess & Skinner Engineering Co., Dallas, Tex.

✣Bids will be received until noon, Feb 20, by Lieut. Co. C. S. Riche, U. S. Engineer, Galveston, Tex., for the construction of four highway swing bridges over Inland Waterway, between Brazos River and Matagorda Bay, Texas. Official advertisement will be found elsewhere in this issue.

The Aetna Engineering Bureau, 17 N. La Salle St., has been authorized by the city of Longview, Tex., to prepare plans and specifications for constructing bridges, estimated cost, $3,000.

The Commissioners' Court of Tarrant County, Fort Worth, Tex., has decided that the new E. 4th St. bridge and the new Samuels Ave. bridge shall be built at the same locations as the present bridges.

It is reported that F. L. Dormant, City Engineer of Houston, Tex., has completed plans for improvements that contemplate the elimination of both the Franklin Ave. and Louisiana St. bridges. The structures, according to the plans, will be replaced by a concrete roadway covering the bayou at the points named.

At a meeting of the Good Roads Promoters at Henrietta, Tex., the Interstate Bridge Co. was organized, with a capital stock of $30,000, $21,000 of which was paid in, for the purpose of building a model steel bridge across Red River, near the town of Charlie. This bridge will form the connecting link between the Texas and Oklahoma division of the Interstate Good Roads Association. The officers and directors are W. B. Worsham, President; J. P. English, Vice-President; W. H. Featherston, Treasurer; H. H. Haggard, Secretary; J. T. Bailey, C. H. Boedeker, T. L. St. Clair, A. H. Bevering and W. H. Chilson. Work will begin as soon as a charter is obtained.

Utah.

The City Commissioners of Ogden, Utah, have authorized the Mayor and the Recorder to enter into a contract whereby Ogden City will join the Salt Lake & Ogden Railway Co. in the construction of a joint bridge over Weber River at 33d St. The cost of the structure is not to exceed $5,313. George Seaman is City Clerk.

Virginia.

It is understood that the officials of the Atlantic Coast Line Ry., following a conference with the Board of Supervisors, Chesterfield County, Chesterfield, Va., decided upon the construction of an overhead bridge at Crosmans Crossing. M. E. Nelson, Wilmington, N. C., is Engineer of Bridges for the railroad.

Washington.

⊙The following bids were received Jan. 10 at Tacoma, Wash., for the construction of the concrete viaduct at South Tacoma Ave.: C. L. Creelman, Tacoma, $43,413 (contract awarded); Hurley Mason Co., $45,500; J. W. Johnson, $46,423; Pearson Const. Co., $52,630; Int. Cont. Co., $57,114; M. J. Hursen & Co., $57,500; Butler Const. Co., $59,900; Geo. T. Wright, $69,800.

The Oregon-Washington Railroad & Navigation Co., M. B. Bayer, Supt., will construct a $350,000 steel bridge and a $150,000 concrete freight shed on the tide flats, Tacoma, Wash., at once. G. W. Boschke, Portland, Ore., is Assistant General Manager of the line.

West Virginia.

A bill has been introduced into the House of Representatives, Washington, D. C., by John W. Davis, a bill to authorize the Buckhannon & Northern R. R. Co. to construct and operate a bridge across the Monongahela River at Catawba, Marion County, West Virginia.

Wisconsin.

A resolution has been introduced into the City Council of Milwaukee, Wis., by Alderman J. Casey, authorizing the Department of Public Works to submit plans and estimates of the cost of building the proposed viaduct connecting the north and south sides of the city at 35th St. and 30th Ave. It is reported that the Chicago, Milwaukee & St. Paul Ry. has donated the city the necessary land for the construction of the viaduct. The improvement will necessitate an expenditure of about $300,000. P. F. Leuch is City Clerk.

At a meeting of the Bridge Committee, Nekoosa, Wis., Jan. 6, it was decided to ask that the Village Board submit to the electors the proposition to authorize the issuance of $15,000 for the construction of a bridge over the Wisconsin River, between Nekoosa and the town of Saratoga. It is hoped to have Adams County and Saratoga, Wis., raise a like amount.

Plans calling for the construction of a two-leaf bascule bridge over the river at Buffalo St., Milwaukee, Wis., have been approved by the U. S. War Department. A public hearing on the improvement will be held. Fred G. Simmons is Commissioner of Public Works.

Canada.

⊙The Municipal Council, St. Vincent de Paul, Que., has awarded the contract for the construction of 10 reinforced concrete bridges to M. J. Stack & Co. The costs of the structures range from $10,000 to $15,000.

DRAINAGE AND IRRIGATION

California.

Bids as follow were received Jan. 2 by the U. S. Reclamation Service, Los Angeles, Cal., for steel tower tops and structural material for the Roosevelt-Mesa transmission line, (1) being total price bid, and (2) price including freight: Pierson Roeding & Co., San Francisco, Cal. (f. o. b. Ambridge, Pa.), (1) $20,424, (2) $24,582; Riter-Conley Mfg. Co., Pittsburg, Pa. (f. o. b. Pittsburg, Pa.), (1) $21,172, (2) $25,482; Chicago Steel Producers Co., Chicago, Ill., (f. o. b. Chicago, Ill.), (1) $22,569, (2) $26,091; Challenge Company, Batavia, Ill. (f. o. b. Batavia, Ill.), (1) $23,343, (2) $26,751; Fulton Engine Works, Los Angeles, Cal., (f. o. b. Los Angeles, Cal.), (1) $34,689, (2) $37,606.

Bids as follow were received Dec. 31 by the U. S. Reclamation Service, Los Angeles, Cal., for line material for Roosevelt-Mesa Transmission line: Pierson Roeding & Co., San Francisco, Cal., (f. o. b. Victor or Lima, New York)—Item 1, 1,675 suspension type insulator chains, straight bid, $4,300; alternate bid No. 1, $5,300; alternate bid No. 2, $6,000. Item 1-a, suspension type insulator chains in lots of 1000 (option), straight bid, $2.82; alternate bid No. 1, $3.48; alternate bid No. 2, $4.00. Item 2, 1,080 strain insulator chains, straight bid, $6,900; alternate bid No. 1, $3,400; alternate bid No. 2, $3,875. Item 2-a, strain insulator chains in lots of 100 (option), straight bid, $7.80; alternate bid No. 1, $3.18; alternate bid No. 2, $1.00. Item 3, 1,675 suspension clamps, straight bid, $1,260. Item 3-a, suspension clamps in lots of 100 (option), straight bid, 78c each. Item 4, 1,080 strain clamps, straight bid, $1,200. Item 4-a, strain clamps in lots of 25 (option), straight bid, $1.25 each. John A. Roebling's Sons Co., (f. o. b. Trenton, N. J.), Item 5, 200 guy clamps, $20.00. Newhall Chain Forge & Iron Co., Item 5, 200 guy clamps $40.00. John A. Roebling's Sons Co., (f. o. b Trenton, N. J.), Item 6, 800 wire rope clips, $64.00. Item 7, 200 ⅜-in. thimbles, $3.50. Item 8, 800 ¼-in. thimbles, $12.00. Item 10, 200 McIntire connectors, $90.00. Item 13, 100 miles No. 8 tel. wire, $1,049.10. Item 14, 530,000 ft. steel strand ground wire, $5,951.90. Item 15, 1,000 ft. ¼-in. galv. steel strand, $5.65. Item 16, 10,000 ft. steel guy strand, $91.60. B. F. Kierulff, Jr., & Co. (f. o. b. Muncie, Ind.), Item 13, $1,106.00; item 14, $5,980.00; item 15, $6.00; item 16, $91.50. U. S. Steel Products Co. (f. o. b. Worcester, Mass.), Item 13, $1,107.60; item 14, $6,962.50; item 15, $6.65; item 16, $99.00. No bids received on Items 9, 11, 12 and 17.

Colorado.

⊙Joseph Osner, Denver, Colo., has been awarded a $750,000 contract for completing the Antero irrigation system for the H. L. Doherty Co., 60 Wall St., New York City. This system covers about 60,000 acres of land near the eastern boundary of Denver. The contract is understood to include the following work: Raising the spillway of the Antero dam 6 ft. in order to increase the capacity of the dam from 71,000 to 85,000 ft.; complete the rip-rapping on the face of the dam; put the High Line canal in first class condition for 75 miles, at cost of $100,000, including siphons under Cherry creek and other streams; build the Extension ditch from a point two miles east of Monclair to the main line of the canal, approximately 23 miles, with a carrying capacity of 400 second-feet; construct a lateral system 55 miles long; build two distributing reservoirs and enlarge the distributing reservoir already completed.

The bondholders' committee of the Pueblo-Rocky Ford Irrigation Co., Pueblo, has authorized Receiver Devine to expend $50,000 for completing the system.

Florida.

✣Bids will be received until noon, Feb. 10, by Board of Bradford County Commissioners, Starke, Fla., for the excavation of 200,000 cu. yds., more or less, of canals and ditches, draining a territory embracing about 17,280 acres of land east of and adjoining Starke, known as the East Starke Drainage District. This work will be divided into three separate parts as shown on the plans, and bids will be received on each part according to the plans and specifications in the office of the Clerk of the Circuit Court at Starke, Fla. All bids must be made per cubic yard of excavation. W. T. Weeks is Clerk of the Board.

Illinois.

✣Bids will be received until Jan. 28 by Commissioners of the Wood River Drainage and Levee District, East Alton, Ill. (readvertisement of work for which bids were rejected Jan. 11), for clearing, grubbing and excavating for new channels, building levees and embankments, ditching, building culverts, laying drain tile, bank and channel protection work, and doing other work connected with the Wood River Improvement in West Madison County, Ill. The following approximate quantities will be included: 55 acres of clearing, grading, etc.; 443,000 cu. yds. excavation, earthwork and embankments; 300 lin. ft. 12-in. tile for culverts; 450 lin. ft. 18-in. tile for culverts; 440 cu. yds. concrete headwalls, culverts, etc.; 7,000 lbs. iron for valves, and valve seats; 3,500 sq. yds. willow mattress, complete; 16,000 sq. yds. rip-rap for channel

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

protection; 1,000 lin. ft 12-in. drain tile, average cut 4 ft. James H. Chessen is Secretary of the Commission.

✣Bids will be received until 2 p. m., Jan. 31, by Drainage Commissioners, Drainage District No. 2, Town of Vernon, Lake County, Ill., at Priest's Hotel, Prairie View, Ill., for the construction of approximately 60,000 cu. yds. of earth excavation for open drainage ditch. Specifications, profiles and maps of the said district may be procured at Quentin's Garage, Libertyville, Ill., or at the office of Attorney M. C. Decker, North Chicago, Ill.

✣Bids will be received until 2 p. m., Jan. 25, by Commissioners of the Crow Creek Drainage District, G. W. Smith, Secy., Lacon, Ill., for excavating ditches and laying tile in accordance with specifications on file with the said clerk. The ditches to be excavated by a dredge and approximately 220,000 cu. yds., 2,500 ft. of 14-in. tile, 4,100 ft. of 10-in. tile and 1,200 ft. of 8-in. tile. Dredges can be floated into district from the Illinois River. Terms of payment shall be 75 per cent to be paid contractor on work actually done when contractor has finished 50,000 yds. or more of excavating in manner acceptable to commissioners, 25 per cent to be held by commissioners until entire contract is completed and accepted by commissioners. Commissioners reserve the right to reject any or all bids. All bids to be accompanied by certified check in 10 per cent of the amount bid.

Indiana.

✣Bids will be received until Jan. 25 by Paul Ward, Drainage Commissioner, at the office of the White County Surveyor, Monticello, Ind., for the construction of the Harvey Schuyler ditch in West Point township. A certified check for $100 must be filed with each bid.

✣Bids will be received until noon, Jan. 25, by A. B. Ireland, Commissioner of Drainage, at the office of the County Surveyor, Logansport, Ind., for the construction of a tile drain in Boone Township, Cass County, Indiana, known as the John H. Plotner Ditch, said drain to be constructed according to plans and specifications now on file in the clerk's office in the City of Logansport, Cass County, Indiana. A certified check for $200 must accompany each bid.

✣Bids will be received until 2 p. m., Feb. 1, by Myrt B. Price, Supt. of Construction at the Court House, Rensselaer, Ind., for the construction of the J. A. Borntrager ditch. Successful bidder must give approved surety bond of $50,000. The improvement consists of the main ditch and three laterals, as follows: Main ditch, 720 stations, 100 ft. each and estimated excavation of 1,540,123 cu. yds. earth: Howe lateral 90 stations of 100 ft. each and estimated excavation 43,337 cu. yds. earth: Curtis Creek lateral, 35 stations, 100 ft. each and estimated excavation 19,960 cu. yds. earth; Mosquito Creek lateral, 31 stations of 100 ft. each and estimated excavation of 8,221 cu. yds. earth. Superintendent reserves right to sell laterals separately and main ditch in parts or offer all for sale as entirety. Plans and specifications at office of Superintendent in Rensselaer, Ind. Official advertisement will he found elsewhere in this issue.

Iowa.

✣Bids will be received until 2 p. m., Feb. 3, by H. B. Frase, County Auditor, Des Moines, Ia., for work on Drainage Ditch No. 12, including 1,465 ft. of 16-in. tile; 1,650 ft. of 18-in. tile; 5,720 ft. of 24-in. tile. A check for 10 per cent the amount bid must be filed with each proposal.

✣Bids will be received until noon, Jan. 29, by J. G. DeVine, County Auditor, Dakotah, Ia., for the construction of Humboldt County Drain No 52, estimated to cost $6,165. A certified check for 10 per cent the amount bid must be filed with each bid. Vit. clay tile, strength tests specified. J. L. Parsons, Humboldt, Ia., is Engineer. The maximum depth is 8 ft. 5 ins. The lengths, sizes and depths of the drain are as follows: 13,001 ft. of 24-in. tile at 7 ft. 2 ins.; 2,900 ft. of 18-in. at 6 ft. 2 ins.; 1,500 ft. of 16-in. at 6 ft. 9 ins.; 1,100 ft. of 15-in. at 6 ft. 3 ins.; 1,400 ft. of 14-in. at 6 ft. 3 ins.; 800 ft. of 12-in. at 5 ft. 9 ins.; 2,800 ft. of 10-in. at 5 ft. 8 ins.; 1,035 ft of 8-in. at 4 ft. 5 ins.; 450 ft. of 6-in. at 5 ft.; cleaning out 3,200 ft. of capstan ditch for outlet including 1,970 cu. yds.

✣Bids will be received until noon, Jan. 29, by J. G. DeVine, County Auditor, Dakotah, Ia., for the construction of Humboldt County Drain No. 47. Work must be commenced within 60 days and completed Dec. 1, 1913. A certified check for 10 per cent the amount bid must be filed with each bid. The average haul is 4¼ miles. The cost of the work is estimated at $7,977. Vitrified clay tile is specified. Length, sizes and depths are as follows: 3,950 ft. 22-in. at 8 ft. 2 ins.; 1,400 ft. of 18-in. at 9 ft. 3 ins.; 2,450 ft. of 16-in. at 7 ft. 1 in.; 1,600 ft. 14-in. at 6 ft. 2 ins.; 4,000 ft. of 12-in. at 6 ft. 4 ins.; 1,250 ft. of 10-in. at 5 ft. 2 ins.; 4,950 ft. of 8-in. at 5 ft.; 100 ft. of 6-in. at 1 ft. 3 ins. J. L. Parsons, Humboldt, Ia., is Engineer.

✣Bids will be received until 1 p. m., Jan. 29, by J. G. DeVine, County Auditor, Dakotah Ia., for the construction of Joint Drain Humboldt Jt. 4-Webster No. 59 as follows: Sec. 1, Max. cut 12.70 ft., av. cut 9.80 ft., 104,229 cu. yds., base width 10 ft. Sec. 2, Max. cut 12.50 ft., av. cut 12 ft., 1,170 cu. yds., base width 10 ft. Sec. 3, Max. cut 13.40 ft., av. cut 11.70 ft., 94,519 cu. yds., base width 8 ft. Sec. 3, Max. cut 15.20 ft., av. cut 11 ft., 140,072 cu. yds., base width 6 ft. Side slopes 1 to 1. Berms 8 ft. Total estimated cost of open work $27,200. Work to be commenced in 30 days from letting, completed Dec. 1. 1913. Bids to be accompanied by 10 per cent certified check. Successful bidder to execute bond for 25 per cent. Payments 80 per cent each month. J. L. Parsons, Humboldt, Ia., Constr. Engr. Ditch to be to grade when completed and ditch edges trimmed of sods and dumps of earth.

✣Bids will be received until noon, Feb. 1, by W. L. Fitkin, Hancock County Auditor, Garner, Ia., for necessary labor and material for the construction of Drainage Ditch No. 26, including 211,939 cu. yds. of open ditch work and a large quantity of tile.

⊙Bids were opened Jan. 14 by W. W. Bennett, County Auditor, Storm Lake, La., for constructing drains in Drainage District No. 45, contract for the tile being let to Newell Cement Tile Co., Newell, Ia., at $9,999 and contract for labor to Claus Peterson, Storm, Lake, Ia., at $6,068.

⊙The Hawkeye Construction Co., Mason City, Ia., has been awarded the contract for constructing a tile drain in Drainage District No. 2, bids for which were opened Jan. 3 by W. J. Freeman, County Auditor, Iowa City, Ia. The work calls for 8,650 ft. of 12-in. to 24-in. tile. The contract price was $5,116.

Louisiana.

Petition will be presented on March 3 to the Parish Jury of Pointe Coupee Parish, New Roads, La., for the organization of the Slidell Drainage District.

Michigan.

✣Bids will be received until 1 p. m., Jan. 21, by Leonard Alger, County Drain Commissioner, Saginaw, Mich., at Town Hall, Nelson, Mich., Fremont Township, Mich., for the construction of the Engle Drain and four highway bridges over the same.

Andrew Lenderink, City Engineer, Kalamazoo, Mich., has submitted a plan to the council of that city for roofing over Portage Creek at a cost of about $100,000.

Minnesota.

✣Bids will be received until 11 a. m., Jan. 30, by Jesse L. Herring, Faribault County Auditor, Blue Earth, Minn., for constructing Judicial Ditch No. 4 of Faribault and Martin Counties. The approximate amount of work and material to be furnished in the construction of said ditch is as follows: 17,515 ft. of 6-in. tile, av. cut 5.15 ft., min. cut 3.45 ft., max. cut 9.10 ft.; 27,700 ft. of 8-in. tile, av. cut 5.17 ft., min. cut 3.40 ft., max. cut 9.40 ft.; 7,200 ft. 10-in. tile, av. cut 5.25 ft., min. cut 4.10 ft., max. cut 7.30 ft.; 7,700 ft. of 12-in. tile, av. cut 5.47 ft., min. cut 3.95 ft., max. cut 7.95 ft.; 1,800 ft. 14-in. tile, av. cut 4.90 ft., min. cut 4.10 ft., max. cut 7.35 ft.; 11,900 ft. of 15-in. tile, av. cut 6.79 ft., min. cut 3.85 ft., max. cut 9.50 ft.; 4,100 ft. of 16-in. tile, av. cut 7.35 ft., min. cut 4.65 ft., max. cut 10.20 ft.; 2,400 ft. of 20-in. tile, av. cut 7.37 ft., min. cut 5.35 ft., max. cut 9.39 ft.; 1,900 ft. of 22-in. tile, av. cut 6.16 ft., min. cut 4.93 ft., max. cut 7.85 ft. All tile or closed work requiring junctions for the connecting of laterals, concrete abutments at outlets as per engineer's specifications. The soil is black loam with clay subsoil; no timber. Nearest railroad station, Guckeen, on the C. & N. W. Average haul about 1 mile. Time one year from date of contract. First quality hard burned clay tile specified.

✣Bids will be received until 2 p. m., Feb. 1, by J. L. George, Beltram County Auditor, Bemidji, Minn., for the construction of Judicial Ditch No. 15 in Towns T. 154-155 and 156 N. R30W. 25 miles from the nearest railroad. The ditch will be 20 miles long including approximately 220,788 cu. yds. of excavation. The work is estimated to cost $33,266. W. M. Everts is Engineer.

✣No bids were received Jan. 16 by A. P. Erickson, Hennepin County Auditor, Minneapolis, Minn., for constructing Judicial Ditch No. 20 and two branches requiring about 30,000 cu. yds. of excavation. The work is to be readvertised and new bids opened March 17.

⊙Chas. Chesnut, Delavan, Minn., has been awarded the contract at $12,335 for constructing Judicial Ditch No. 5 of Faribault County, bids for which were opened Jan. 14 by Jesse L. Herring, County Auditor, Blue Earth, Minn. The work includes 10,250 ft. 6-in. tile, 1,200 ft. 7-in. tile, 5,100 ft. 8-in. tile, 11,900 ft. 10-in. tile, 16,500 ft. 12-in. tile, 4,500 ft. 14-in. tile, 4,500 ft. 18-in. tile. H. W. Holley, Winnebago, Minn., is the engineer.

The Duluth & Iron Range R. R. has petitioned the Commissioners of Saint Louis County, Duluth, to establish a public ditch near Wallace and enlarge the drainage ditch of the Duluth, Missabe & Northern R. R. near White Face River. The latter work will require the building of 30 miles of ditches for the improvement of its road. The number of acres it is expected to reclaim is 30,000.

Hearing will be held at Duluth on petition for county ditch in Township 55 North, Range 17, and Township 54 North, Range 18. C. Halden is County Auditor.

Hearing will be held at Minneapolis on Feb. 10 on petition of Simon Gelle and others for public Ditch No. 24. Al. P. Erickson, Minneapolis, Minn., is County Auditor.

Missouri.

⊙A. A. Mutti, Rolfe, Ia., has been awarded the contract for constructing 5.5 miles main ditch (157,500 cu. yds. of excavation), 5.5 miles of laterals (41,000 cu. yds.) and 1.5 miles of levee (6,500 cu. yds), for the Crooked River Drainage District of Ray County. All of the main ditch and part of the laterals is suitable for floating dredge work. Bids were opened Jan. 11 at Richmond, Mo., by John W. Harvey, Secretary. Brooks & Jacoby, Shukert Bldg., Kansas City, Mo., are the engineers.

Montana.

The following bids were received Jan. 10 by the U. S. Reclamation Service, Geo. O. Sanford, Project Engineer, Malta, Mont., for construction of Schedule 2, Dodson North Canal, Milk River Project, (1) bid of Maney Bros. & Co., Boise, Idaho, (2) bid of Carlson, Chindahl & Co., Spokane, Wash.:

Schedule 2.

Excavation.	Cu. yds.	(1)	(2)
Class 1	200,000	$0.24	$0.29
Class 2	5,000	0.50	0.40
Class 3	500	0.75	1.00
Overhaul	10,000	0.02	0.02
Totals		$51,075	$60,700

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Nebraska.

✣Bids will be received until noon, Feb. 20, by John O'Connor, Dodge County Clerk, Fremont, Nebr., for cleaning out the Winslow Ditch. A certified check for $50 must be filed with each bid.

Texas.

⊙J. B. Arpin Dredging Co., Houston, Tex., has been awarded the contract at 10½ cts. per cu. yd. for ditch work for Brazoria County Drainage District No. 9, bids for which were opened Jan. 16 at Alvin, Tex. The work calls for 500,000 cu. yds. of excavation.

Utah.

The Buckhorn Land Co., according to advices from Salt Lake City, proposes the construction of an irigation system for a tract of land on Buckhorn flat, 25 miles south of Price. The plans call for building a dam in the Huntington River, and excavating canals.

Wisconsin.

⊙The LaCrosse Dredging Co., LaCrosse, Wis., has been awarded the contract at 8½ cts. per cu. yd. for constructing drainage ditches and laterals for the Trempealeau Drainage District of Trempealeau, Wis., bids for which were opened Jan. 14 The contractor receives the bonds of the district at par in payment.

WATER WORKS

Arizona.

The city of Tucson, Ariz., plans the making of extensions to the waterworks system at an estimated cost of $150,000. The work will include enlarging distributing mains in business section of city, additional fire plugs, and a 4,000,000-gal. reservoir. Contracts will be let in about six months. W. H. Thomson is City Engineer.

Arkansas.

Engineer Guy A. Watkins of Little Rock, Ark., is making a survey of the town of Heber Springs, Ark., for the proposed water works system. It is proposed to let construction contracts soon.

California.

⊙The City Trustees of Fullerton, Calif., have let the contract for the construction of the distributing system of the municipal water works to C. D. Vinson of San Francisco, Calif., for $44,405. Converse lockjoint pipe of ⅛-in. thickness, dipped and coated, will be used. In making estimates, $45,000 was reserved by the city for distributing system. The remainder will be spent in drilling water wells, for the pumping system and for the reservoir.

The Antelope Creek & Red Bluff Water Co., Red Bluff, Calif., has been granted permission by the State Railroad Commission to issue its promissory notes to the amount of $15,000 for the improvement of the plant. This company furnishes water to Red Bluff for domestic use and irrigation.

Plans are now being prepared by Shipman, Denny & Rhame, 604 Mission St., San Francisco, Calif., for the construction of a new waterworks system in Burlingame, Calif., at an estimated cost of $175,000. The work will include distribution system, reservoir, pumping plants and wells. Contracts will not be let before March 1.

Supt. of Water H. R. Fay of San Diego, Calif., has submitted to the City Council a plan, accompanied by maps, for a comprehensive system of water mains and fire protection for the district east of Balboa Park, from University Ave. to Juniper St.

The Board of Supervisors of San Francisco, Calif., has passed a resolution instructing City Engineer M. M. O'Shaughnessy to complete the work of putting a bottom in the Twin Peaks reservoir by day labor. This work will cost about $7,000.

The citizens of Riverside, Calif., on Jan. 14 voted bonds to the amount of $1,160,000, of which $342,000 will be used for consolidating the three privately-owned water plants that were purchased from the proceeds of the bond issue. This work will require new reservoirs, pumping machinery and a complete reconstruction of the three plants which will be taken over by the municipality. Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., are Engineers.

Mayor Alexander of Los Angeles, Calif., has included in his annual message to the City Council a suggestion to call a bond election for the purpose of voting on the issuance of bonds to the amount of $2,500,000 for the construction of parts of a conduit line to carry water to the vicinity of San Dimas, in the San Gabriel valley.

The new owners of the Fullerton Domestic Water Co., Fullerton, Calif., plan extensive improvements to its plant. H. M. Haven, Fullerton, is Engineer.

Connecticut.

The Public Utilities Commission has instructed the Cromwell Water Co., Cromwell, Conn., to clean its standpipes; flush the mains and distributing pipes; repair all broken mains and leaks; repair and renew present filter system or install a more modern filtration system, and put pumping station and equipment in perfect working order.

Delaware.

The Delaware Legislature has been asked to permit the commissioners of Rehoboth, Del., to borrow money to lay new board walks and provide for a water system.

Illinois.

The city of Portland, Ill., has instructed the water works committee to commence the sinking of new test wells along the river bottoms to supply the city with water.

Following is the lowest bid submitted for furnishing and delivering to the Harrison St. pumping station, flanged cast iron pipe and fittings, 48 ins. in diameter. Masillion Iron and Steel Co., Masillion, O., 4.2 cts. per lb. The contract has not been awarded. L. E. McGann, Commissioner of Public Works. Bids opened January 15.

Iowa.

The Town Council of Farragut, Ia. (population 431), is considering the question of installing a water works system. It is probable the matter will be submitted to the voters.

The citizens of Davis City, Ia., at a recent election voted against the issuance of bonds for the installation of a water works system.

The City Council of Bedford, Ia., has authorized Mayor H. C. Webb to purchase a suitable pump for the deep well.

The citizens of Thor, Ia. (population 271), recently held a meeting to consider the proposition of installing a water works and an electric light plant.

Kansas.

✣Bids will be received until 7:30 p. m., Feb. 2 by City Council, Frontenac, Kan., at the office of the City Clerk, for the construction of a water main on West McKay St. from the present terminus of the main to the city limits.

The citizens of Scott City, Kans., at a recent election voted the issuance of bonds to the amount of $40,000 for the installation of a municipal light and water works plant.

A petition has been circulated among the property owners on North Quincy St., from Saywell St. to Garfield Park, Topeka, Kans., for the extension of the water mains.

Plans have been completed by Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., and submitted to the city for water works improvements at Oswego, Kans. The proposed improvements include filtration, steel tower and tank, settling basins, etc. The estimated cost is $25,000. An election will be called to vote on the improvements.

Owing to the fact that the city of Turon, Kans. (population 572), has been unable to sell bonds which were recently voted for a municipal water works, it is probable another election will be held to vote bonds calling for a higher rate of interest.

The city of Minneola, Kans. (population 348), contemplates the installation of a water works system or an electric light plant. A bond election will be held shortly.

Louisiana.

✣Bids will be received, as noted in our last issue, until noon, Feb. 20, by the Baton Rouge Water Works Co., J. H. Wood, Secy., Baton Rouge, La., for the construction water reservoir. Alvord & Burdick, Hartford Bldg., Chicago, Ill., are Engineers.

Massachusetts.

At a recent meeting of the Blandford, Mass., fire district a plan was discussed whereby it is proposed to establish a reservoir on Prospect hill, to be supplied with water from the Mountain View reservoir, in order that residences in that section may be furnished with an adequate water supply. H. K. Herrick. Blandford, is interested.

Michigan.

The City Council of Adrian, Mich., has retained W. C. Hoad of Ann Arbor. Mich., to appraise the plant of the Adrian Water Co. with a view to purchasing the same.

Engineer Gardner S. Williams, Ann Arbor, Mich., has submitted his report to the Water Commissioners of Detroit, Mich., recommending the establishment of a sterilization instead of a filtration plant and the erection of pumping stations in the north and west sections of the city. The city's water supply is secured from Lake St. Clair.

The Saginaw Bay Water Association directors at a recent meeting adopted a resolution urging the City Council of Saginaw, Mich., to take action upon the project of securing better water for the city.

Minnesota.

At a recent mass meeting of the citizens of Morgan, Minn., it was voted to have the water works committee take the matter up with the Village Council to call a special election to vote on the question of issuing bonds to build and install a system of water works. The estimated cost of a system is $12,435.

The citizens of the village of Deerwood, Minn. (population 586), will probably be asked to vote in the spring on the proposition of installing a water works system and sewers.

The Water & Light Commission of Hibbing, Minn., has retained Engineer L. Hill of Minneapolis, Minn., to make a thorough inspection of the village water and light plant and report to the commission as soon as a careful inspection can be made. It is probable the plants will be remodeled and new machinery installed.

Missouri.

Guy Study of the firm of Roth & Study, Liggett Bldg., St. Louis, Mo., has been retained by the city of St. Louis to draw plans for a new intake tower for the city water works at the Chain of Rocks. This is the first step taken toward enlarging the water works.

A special election was held in Plattsburg, Mo., on Jan. 20 for the purpose of voting on the question of issuing bonds to the amount of $23,000 for the installation of a system of water works and sewers.

Permission has been given the Kansas City, Mo., water department by the Kansas City, Kans., commissioners to lay a water

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

main from James St. and Ohio Ave. to N. Second St., thence to Bunker Ave., then east to Ewing St., and south toward the Turkey creek pumping station.

Civil Engineer Albert C. Moore of Joplin, Mo., has submitted a proposition to the City Council of Springdale, Ark., for the establishment of a municipal water and light plant in Springdale.

Montana.

Consulting Engineers Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., have completed plans and submitted the same to the city officials of Billings, Mont., for a new water works plant. The work will include settling basins and filtration plant. An election will be held March 25 for the purpose of voting on the issuance of bonds to the amount of $575,000 for the improvement.

Consulting Engineers Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., are preparing plans for a new water works plant for Livingston, Mont. The work will include filtration and settling basins. An election will be called as soon as plans are completed, which will be in about 30 days.

Nebraska.

⊙The J. B. Katz Construction Co., Omaha, Nebr., has been awarded the contract by the Board of Trustees, Doniphan, Nebr., for the complete construction of a waterworks system, at about $15,000. Bids were opened Jan. 16.

The citizens of Creighton, Nebr., on Jan. 7 voted to authorize the City Council to issue bonds to the amount of $6,500 for the erection or construction and for the extension of the system of water works. W. L. Turner is City Clerk.

New Jersey.

✣Bids will be received until 8 p. m., Jan. 27, by the Water Committee of the Village Board of Trustees, South Orange, N. J., for one 8-in. water meter. J. J. Boyd, 11 Broadway, New York City, is Consulting Engineer. M. A. Fitzsimmons is Village Clerk.

The Borough Council of Pitman, N. J., (population 1,950) is considering a scheme promoted by a number of citizens for the installation of a municipal waterworks system.

Preliminary plans have been made for the installation of a waterworks system at Hawthorn, N. J. Harry J. Harder is City Engineer.

New York.

✣Bids will be received until 11 a. m., Feb. 6, by Lieut. E. S. Miller, Fort Niagara, N. Y., for the construction of a 60,000-gal. steel water tank and trestle.

✣Bids will be received until 11 a. m., Feb. 11, by Board of Water Supply, J. P. Morrissey, Secy., 165 Broadway, New York City, for furnishing and delivering valves, hydraulic cylinders, piping and appurtenances for the city tunnel of the Catskill aqueduct in the city of New York.

The citizens of Chatham, N. Y., on Jan. 15, it is reported, voted to purchase the plant of the Chatham Water Works Co. for a consideration of $90,000.

Ohio.

✣Bids will be received until noon, Feb. 4, by Village Council at the office of E. L. Garmon, Mayor, New Berlin, O., for furnishing the necessary labor and materials for the construction of a system of water works in said village, according to the plans and specifications on file in the office of Mayor. The approximate quantities are as follows, to-wit: No. 1—6,100 lin. ft. 8-in. pipe; 4,600 lin. ft. 6-in. pipe; 250 lin. ft. 4-in. pipe; 22 fire hydrants; 7 8-in. valves and valve boxes; 6 6-in. valves and valve boxes; 3 tons special castings. No. 2—1 elevated steel water tank, with a capacity of 50,000 gals., on a tower to give a height of tank of 104 ft. No. 3—1 Triplex pump and motor, with a capacity of 360,000 gals. in 24 hours and concrete foundation for same. No. 4—One brick pumping station. Each bid must contain the full name of every person or company interested in the same, and be accompanied by a bond in the sum of $200 for each item, as numbered, or $400 for a bid on two or more of said items. W. A. Hess is Clerk.

✣Bids will be received until noon, Feb. 10, by Carl A. Palmer, Village Clerk, Shaker Heights, at his office, First National Bank, Cleveland, O., for the construction of 6-in. water mains in a number of roads. Plans and specification are on file with the clerk or at the office of the Village Engineer, B. W. Willard, 931 Williamson Bldg., Cleveland, O.

✣Bids will be received until noon, Jan. 22, by C. W. Nessler, Director of Public Safety, Sidney, O., for the purchase of a Triple Combination Pumping Chemical Engine and Hose Motor Car, to have carrying capacity of not less than 1,200 ft. of 2½-in. fire hose and one 40-gal. chemical tank.

The village of Bridgeport, O., contemplates voting on the issuance of bonds for the purpose of extending and enlarging the water works system.

The City Council of Hamilton, O., has authorized Director of Public Service Holzberger to have plans drawn up for the rebuilding of the city water works plant, increasing its capacity from 3,000,000 to 10,000,000 gals. a day and submitting a proposition to purchase the necessary land for the new wells.

Oregon.

⊙C. L. Houston of Astoria, Ore., has been awarded the contract by Lieut. Augustus Norton, Quartermaster, Fort Stevens, Ore., for the construction of 2,400 ft. of 4-in. pipe line at Fort Canby, Wash., at $2,225. Bids were opened Dec. 10.

Pennsylvania.

The McClintic-Marshall Construction Co., of Pittsburgh, Pa., have employed Chester & Fleming, Hydraulic Engineers of Pittsburgh, to make an investigation and report on the water supply for the Rankin plant, Rankin, Pa., with a view to rebuilding same in the near future.

The Lehigh Coal & Navigation Co., of Mauch Chunk, Pa., is planning the building of a reservoir at Hauto, Carbon County, to have a capacity of over 1,000,000 gals., from which to procure the water necessary for the company's power plant.

The Kyle Water Co., Ridgway, Pa., has increased the bonded indebtedness $170,000 for improvement work.

The Cloe Water Co., Ridgway, Pa., has increased its bonded indebtedness $65,000 for improvement work.

The Ketner Water Co., Ridgway, Pa., has increased its bonded indebtedness $50,000 for improvement work.

The Cummings Water Co., Ridgway, Pa., has increased its bonded indebtedness $10,000 for improvement work.

Rhode Island.

⊙The Board of Contract & Supply of Providence, R. I., has awarded the contract for the furnishing of fire hydrants and water gates to the Coughlin Valve Co., of Boston, Mass., for $12,563.

⊙The Board of Contract & Supply of Providence, R. I., has awarded the contract for furnishing 20 conductor cable to The Safety Insulated Wire & Cable Co., of Boston, Mass., at $12,730.

The engineering division of the Department of Public Works, Providence, R. I., will, in the near future, ask for bids on the installation of centrifugal electric and reciprocating steam pumps, with a 30,000,000-gal. daily capacity, for the Pettaconsett pumping station.

South Carolina.

⊙The Board of Commissioners of Camden, S. C., has awarded the contract for the installation of a water works and an electric light system to Tucker & Laxton of Charlotte, N. C., at about $125,000. Gilbert C. White of Charlotte is Engineer.

Tennessee.

The Davidson County, Tenn., delegation has introduced two bills in the legislature asking that the city of Nashville, Tenn., be allowed to exceed the 1913 budget to the extent of $200,000 for two years in succession, for the purpose of repairing the city reservoir and improving the streets and alleys.

Texas.

⊙The city of Port Arthur, Tex., has awarded the contract for the construction of two sand traps and two settling basins at the Port Neches water works to Knapp & Secrest, at $3,627. Other bidders were: O. R. McDaniel, $4,130, and Lindsy & Smith, $3,508.

The city of Granbury, Tex., plans the construction of a waterworks system at an estimated cost of $25,000; also an electric light plant. J. B. Ross is Mayor.

The Tarrant County Commissioners' Court, Fort Worth, Tex., has awarded a franchise to B. K. Wilson and associates to pipe water from Elderville mineral wells to the city limits of Fort Worth. The petitioners intend to establish a mineral water distributing depot inside the city and to advertise extensively the medicinal properties of the water.

The City Council of Paris, Tex., has adopted a resolution ordering an election Feb. 4 on the issuance of $85,000 bonds. Of this amount $40,000 is for water works, including the installation of electrical pumping from the lake six miles west of town and various extensions of mains and fire hydrants.

The City Council of Beaumont, Tex., is negotiating for the purchase of the Beaumont water works. W. C. Teter of New York City, the owner of the property, has offered the same to the city for a consideration of $500,000.

Vermont.

The Westminster Aqueduct Society, W. S. Fenn, President, Westminster, Vt., has decided to relay its water main on School St., this spring, with larger pipe.

Virginia.

The Common Council of Portsmouth, Va., has adopted a resolution to refer to the Water Commission the matter of official conference concerning the question of a joint water supply for Norfolk and Portsmouth.

West Virginia.

⊙J. L. Stewart & Sons of Milton, W. Va., have been awarded the contract by that city, H. E. Jackson, City Recorder, for the construction of a waterworks system at $7,417. The work includes the furnishing of hydrants, pipe, lead, valves, etc., building reservoir, laying pipe, constructing pump house. The contract for machinery has not yet been awarded. Plans were prepared by The Leete-Maupin Engineering Co., Huntington, W. Va. Bids were opened Jan. 3.

Canada.

⊙Following contracts have been awarded by the Board of Control of Winnipeg, Man., M. Peterson, Secy., for all labor, material and plant required or the execution of the following works in connection with the extension of the Artesian Well Water Supply System: bids opened Nov. 15: Section "B"—Erection of 17 pump houses, K. C. Sutherland, Winnipeg, $21,250; Section "C"—Supply and erection of deep well turbine pumps and meters, Canada Foundry Co., Winnipeg, $6,801 each; Section "D"—Supply and installation of necessary voltage transformers at the individual pumping stations, Chapman & Walker, Ltd., Winnipeg, $2,100 each; Section "E"—Supply of material for power line construction and erection of same, to City Light & Water Dept., at $17,200; Section "F"—Supply, delivery and laying of approximately 61,000 ft. of steel pipe line with valves and specials, Canadian Steel Pipe Co., New York, N. Y., at $5.50 per ft. plus $.40 per lin. ft. for double coating and wrapping.

The City Council of Ottawa, Ont., has decided to engage Sir Alexander Binnie, water engineer, London, Eng., and Dr. Houston, scientific adviser to the Metropolitan Water Board of London, Eng., to come to Ottawa at once and report upon the best supply of pure water for the city.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

SEWERAGE AND SANITATION

Arizona.

The City Council of Bisbee, Ariz., is considering plans for the extension of the city sewer system in Tombstone Canyon. D. R. Perry is official in charge of sewers.

Arkansas.

Consulting Engineer Wm. J. Parkes, 203 Citizens Bank Bldg., Pine Bluff, Ark., has completed preliminary plans for a sewer system for Fordyce, Ark., to cost approximately $22,500. These plans have been approved by tracts will probably be let in March.

tracts wil lprobably be let in March.

Preliminary plans have been made by Consulting Engineers Dickinson & Watkins, State Bank Bldg., Little Rock, Ark., for the installation of new sewers in Heber Springs, Ark., at an estimated cost of $25,000. The work will include 3,200 ft. of 15-in. pipe, 2,100 ft. of 10-in. pipe, 6,300 ft. of 8-in. pipe, 18,700 ft. of 6-in. pipe, 20 flush tanks, 85 manholes, and disposal plant. Contracts will be let in about 60 days.

California.

⊙The city of Los Angeles, Calif., has awarded the contract for the construction of a sewer on Santa Cruz St., from Pacific St. to Grand Ave., to John Balch, at $33,983.

⊙Holt & Jeffery of Los Angeles, Calif., have been awarded the contract by the Board of Public Works of that city, Horace Lewis, Secretary, for the construction of the Arroyo de La Brea storm sewer at $538,844. City Engineer Homer Hamlin estimated the cost at $540,000. Bids were opened Jan. 6.

Plans have been outlined in Oak Park, Calif., for a campaign advocating the issuance of bonds for the construction of a comprehensive system of sewerage and drainage in the annexed district. According to the estimate of City Engineer Geo. H. Randle, of Sacramento, the system will cost about $1,500,000. This work will be done by the city of Sacramento.

The City Trustees of Oceanside, Calif., plan to have work started early in the spring on the installation of a sewerage system for which preliminary estimates have been made. The estimated cost is $20,000. N. G. Carpenter is Engineer.

The City Trustees of Dinuba, Calif., have sold bonds to the amount of $42,000 for the construction of the outfall sewer system to the Capital National Bank of Sacramento, Calif.

The City Board of Trustees of Gridley, Calif., has accepted the plans, specifications, maps and plats submitted by Engineer Castner for a sewer system for the city. It is proposed to provide a sewer system that will accommodate the four business blocks of the city fronting on Virginia St., and extending west to Ohio St., with Spruce St., for the north boundary.

The Board of Public Works of Los Angeles, Calif., has urged the City Council to provide in the bond issue to be voted on next February, an item of $610,000 for outlets for the Jefferson St. and Vernon Ave. storm drains into Ballona Creek. City Engineer Homer Hamlin estimates that the Jefferson St. outlet would cost $430,000, while that on Vernon Ave. would cost about $180,000.

The construction of a sewer system of a permanent nature for the district recently annexed to Richmond, Calif., will begin early in the year. City Engineer W. S. Farley and Chief Assistant Ross Calfee, have been going over that section of the city gathering the necessary data and figures on a route for the main outfall pipe.

City Clerk D. O. Williams of Hanford, Calif., is asking bids for the construction of the proposed new $80,000 sewer system and disposal plant. J. D. Bozeman is official in charge of sewers.

Colorado.

The City Council of Loveland, Colo., has approved the plans and specifications of City Engineer A. E. Sprague for the new sewer district in the McKee addition.

Connecticut.

The Board of Apportionment & Taxation of Derby, Conn., has appropriated $3,000 as the city's share of building a 5-ft. sewer in the bed of the Old River, from a point north of the Sterling Co. to a point 50 ft. south of Main St.

Florida.

The City Council of Tampa, Fla., has authorized City Engineer Fred Warren, Mayor McKay and a member of the Board of Public Works, to visit the Imhoff tanks being used in Worcester, Mass., and Atlanta, Ga., with a view to adopting a similar system in Tampa. Alexander Twombley, 111 Broadway, New York City, is Engineer.

The Board of Public Works of Sarasota, Manatee County, Fla., sold bonds Jan. 9, as follows: $15,000 for sewerage, $15,000 for waterworks, $15,000 for street improvements, $9,000 for drainage and $1,000 for building.

Idaho.

The City Council of Kellogg, Ida., has retained Consulting Engineers C. H. Green & Co., of Spokane, Wash., to prepare plans and specifications for the construction of a sewer system.

Illinois.

✣Bids will be received until 7:30 p. m., Jan. 30, by Board of Local Improvements, Bradley (Kankakee), Ill., for the construction of a 10,550-ft. outlet sewer. The work will include vitrified pipe, excavation through limestone and is estimated to cost $48,000. Plans and specifications will be mailed by Charles A. Voorhees, President, Bradley, Ill., upon receipt of $10. Bell Telephone No. 900 or 557, Kankakee Exchange.

✣Bids will be received by the Board of Local Improvements, Berwyn, Ill., until 8 p. m., Feb. 11, 1913, at the City Hall for furnishing and delivering labor and materials necessary to construct a brick sewer with necessary manholes, catch basins, house drain connections, etc., in the following streets: 39th St., S. 56th Ave. to 62nd Ave ; in 62nd Ave. from 39th St. to 37th St.; 37th St., from 62nd Ave. to Oak Park Ave.; Oak Park Ave., from 37th St. to first ally north of Stanley Ave. Engineer's estimate is as follows: 9,336 lin. ft. 5-ft. brick sewer at $7, $65,352; 830 lin. ft. 4½-ft. brick sewer at $6.20, $5,146; 1,190 lin. ft. 4-ft. brick sewer at $5.60, $6,664; 860 lin. ft. 3½-ft. brick sewer at $4.85, $4,171; 485 lin. ft. 3-ft. brick sewer at $4.25, $2,061.25, including all necessary house and catch basin slants and street connections; 24 manholes at $35, $8,400; 49 catch basins and connections complete at $40, $1,960; removing existing sewers and reconnecting existing sewers, catch basins, etc., $575; replacing existing curb and pavement, $1,200; total, $87,969.25. Plans and specifications on file with A. Wolfe, 602 New York Life Bldg., Chicago, or J. Jaros, City Clerk, Berwyn, Ill. Plans and specifications will not be mailed. Cash or certified check for 10 per cent of bid must accompany proposal. Official advertisement will be found elsewhere in this issue.

The City Council of Marshall, Ill., has adopted an ordinance providing for the construction of the Lynn St. sewer. The estimated cost is $2,500. C. A. Pendum is City Engineer.

The Board of Local Improvements of Belleville, Ill., has decided to construct sewers in Silver and B Sts. City Engineer William Ziehnert has estimated the cost at $2,854.

The city of Moline, Ill., plans the laying of about 10 miles of sewer and water mains in the territory east of 34th St. to the city limits, and from the river to 11th Ave., during the year. The work will involve the construction of a separate sewer system to drain the added district. Lyle Payton is City Engineer.

The Board of Local Improvements of Galesburg, Ill., has ordered the construction of the Lincoln St. sewer. F. M. Connolly is City Engineer.

The Board of Local Improvements of Rockford, Ill., plans the construction of a sewer in the west end, extending from Royal Ave. to the city limits. The cost is estimated at $30,000.

The Chicago City Council, on Jan. 2, authorized the construction of loading platforms for the removal of street dirt, ashes and refuse; estimated cost, $43,000. L. E. McGann, Commissioner of Public Works. Date of letting contracts not announced.

The Chicago City Council, on Jan. 2, authorized the purchase of 5 garbage incinerators by the Bureau of Engineering for use on the various lake cribs; estimated cost, $500. L. E. McGann, Commissioner of Public Works. Date of letting contracts not announced.

The Board of Local Improvements of Galesburg, Ill., has ordered the construction of the Lincoln St. sewer, extending from North St. to Ella St.

The City of Moline, Ill., plans the installation of 10 miles of sewer and water mains in the territory east of 34th St. to the city limits and from the river to 11th Ave. The work will involve the construction of a separate sewer system to drain the added district. Lyle Payton is City Engineer.

Following are the lowest bids submitted on Jan. 13 for furnishing and delivering such cement as is required by the Bureau of Sewers of Chicago during 1913: Knickerbocker Ice Co., 39 S. La Salle St., Chicago, Portland cement, $1.61 per bbl.; natural cement, 84 cts.; Wisconsin Lime and Cement Co., $1.60 per bbl., 87 cts. per bbl.; Wm. E. Dee, 133 W. Washington St., $1.60 per bbl., 97 cts. per bbl. The contract has not been awarded. L. E. McGann, Commissioner of Public Works.

Following are the lowest bids submitted for furnishing and delivering vitrified tile pipe to the Bureau of Sewers, Chicago, during 1913: A. S. Rosing, Harris Trust Bldg., Chicago, 78 per cent less; Wm. E. Dee & Co., 133 W. Washington St., 69½ per cent less; Chicago Fire Brick Co., 6383 W. Washington St., 68½ per cent less. All prices are quoted with reference to standard western price list. The contract has not been awarded. L. E. McGann, Commissioner of Public Works. Bids opened Jan. 15.

Indiana.

⊙Patrick Shahan has been awarded the contract by the Common Council of Lebanon, Ind., for the construction of a sewer 1,300 ft. in length, to be of 8 in. in diameter, at $1,265. The work also includes one flush tank, two lamp holes, and five manholes. Bids were opened Jan. 13.

The Board of Public Works of Evansville, Ind., has passed a preliminary resolution for the opening of 6th St., from Broad St. to Oakley, and for the building of a sewer in Oregon St., from Rowley St. to an alley in Kumler's addition. The estimated cost of the sewer is $8,000.

Louisiana.

The Chamber of Commerce of Shreveport, La., has co-operated with the Real Estate Exchange in securing better sewer facilities for the suburban residence sections of the city. W. E. Glassell is President of the Chamber of Commerce.

Michigan.

The City Council of Cadillac, Mich., has ordered plans and specifications for the construction of the proposed Cobbtown sewer,

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

to be a combined sanitary and storm water sewer.

Indiana.

The Board of Public Works of Bloomingdale, Ind., has adopted resolutions for two sewers which will furnish sanitary drainage for northwest Bloomingdale. City Engineer Frank M. Randall has prepared plans and specifications, one to be 10,257 ft. in length and the other $12,514 ft. A public hearing will be held Jan. 15.

The City Officials of Crawfordsville, Ind., have communicated with H. E. Barnard of the State Laboratory of Hygiene relative to a sewage disposal plant which may be installed in that city.

Kansas.

⊙D. F. Seevers of Ottawa, Kan., has been awarded the contract by that city, G. E. Strauchon, City Clerk, for the construction of the King St. main sewer, at $2,355. C. W. Barnett of Ottawa secured the contract for constructing lateral sewer in District No. 56, at $840. Bids were opened Jan. 15.

⊙The Inter-Mountain Bridge & Construction Co., Tecumseh, Neb., has been awarded the contract by the city of Yates Center, Kan., L. R. Wallace, City Clerk, for the construction of a sewer system and disposal plant, at $74,295. Worley & Black, Kansas City, Mo., are Engineers. Bids were opened Jan. 14.

Louisiana.

⊙The American Blower Co., Detroit, Mich., has been awarded the contract by the Sewerage & Water Board, New Orleans, La., F. S. Shield, Secy., for furnishing and erecting mechanical draft apparatus, at $8,260. Bids were opened Dec. 20.

Maine.

The City Council of Portland, Me., has appropriated $126,000 for sewerage extensions during the year. Bion Bradbury, Jr., is City Engineer.

Michigan.

The Park Board of Detroit, Mich., contemplates asking the City Council to have an appropriation granted for the construction of a central and lateral sewage system on Belle Isle.

Minnesota.

The Board of Public Works of St. Paul, Minn., will ask for bids immediately for the construction of sewers, as follows: Curtice St., from South Robert to a point 150 ft. east of Riverview St.; Superior St., between Duke and Oneida St.; Augusta St., between Goff Ave. and South Robert Sts.; Minnehaha St., between Grotto and Avon Sts.; Cretin Ave., between Dayton and Portland Aves., and on Selby Ave. from Certin to 143 ft. west of Cleveland Ave.; Atlantic St., between East Seventh St. and the Chicago, St. Paul, Minneapolis & Omaha railroad tracks; Bates Ave., between McLean Ave. and Elliott Pl., and Brown Ave., 90 ft. north and west from Winifred St.

Consulting Engineer Frederick Bass of the State Board of Health has submitted a report to the city officials of Hibbing, Minn., relative to proposed sewer work in that city. The report indicates the plan of A. P. Silliman, involving the construction of several miles of ditch to the south of Brooklyn along the line of Penobscot Creek, would probably be the most desirable and in the end the most economical. The total cost of the project is $110,000.

Missouri.

✣Bids will be received until Feb. 25, it is reported, by Kansas City, Mo., for the construction of an incinerator at 20th and Vine Sts., estimated to cost $92,000. L. R. Ashe is City Engineer.

✣Bids will be received until noon, Jan. 24, by Board of Public Improvements, Maxime Reber, President, St. Louis, Mo., for the construction under Letting No. 10786, of sewers in Clifton Heights Sewer District No. 2, embracing sewers of the materials, lengths and sizes, as follows, to-wit: Brick and Portland cement mortar sewers, 732 ft. of 28-in. x 42-in. inside dimensions, 340 ft. of 26-in. x 39-in. inside dimensions. Vitrified clay pipe sewers: 210 ft. of 27-in. inside diameter, 410 ft. of 24-in. inside diameter, 340 ft. of 21-in. inside diameter, 440 ft. of 18-in. inside diameter, 240 ft. of 15-in. inside diameter, 3,790 ft. of 12-in. inside diameter, with sewer inlets, manholes and all other appurtenances. Deposit required, $578. A separate proposal must be made for each letting on a blank form furnished by the Board of Public Improvements. Plans and specifications and forms of contract may be seen at the offices of the Board of Public Improvements and the Sewer Commissioner. Copy of plans and specifications will be furnished to parties giving two days notice in advance and upon deposit of $10 in each case, which sums will be returned to depositor upon the return of such plans and specifications.

✣Bids will be received until noon, Jan. 24, Board of Public Improvements, Maxime Reber, President, St. Louis, Mo., for the construction, under Letting No. 10785, of Clifton Heights Joint District Sewer — Second Section in Clifton Heights Joint Sewer District, embracing sewers of the materials, lengths and sizes as follows, to-wit: Brick and Portland cement mortar sewers, 388 ft. of 54-in. inside diameter, 355 ft. of 52-in. inside diameter, '627 ft. of 32-in. x 48-in. inside dimensions, with manholes, junctions and all other appurtenances. Deposit required, $494.

✣Bids will be received until noon, Jan. 31, by Board of Public Improvements, Maxime Reber, President, St. Louis, Mo., for the construction, under Letting No. 10787, of sewers in Gratiot Sewer District No. 2, embracing sewers of the materials, lengths and sizes as follows, to-wit: Vitrified clay pipe sewers, 618 ft. of 27-in. inside diameter, 224 ft. of 18-in. inside diameter, 610 ft. of 15-in. inside diameter, 4,174 ft. of 12-in. inside diameter, with sewer inlets, manholes, and all other appurtenances. Deposit required, $495. Proposals must be made for said letting on a blank form furnished by the Board of Public Improvements. Plans and specifications and form of contract may be seen at the offices of the Board of Public Improvements and the Sewer Commissioner. Copy of plans and specifications will be furnished to parties giving two days' notice in advance and upon deposit of $10, which sum will be returned to depositor upon the return of such plans and specifications.

✣Bids will be received until Feb. 11 by City of Maplewood, Mo., for the construction of a sewer in Manchester Ave.

The City Council of Kansas City, Co., has passed ordinances providing for the construction of sewers in joint districts 356 to 365, inclusive, division 5; in district 334, division 5, and joint districts, 363, 364 and 365, division 5. At the same time ordinances were considered for the establishment of the following sewer districts: district 374, division 5; district 106, division 2; district 403, di-

Montana.

⊙Lindstrom & Green of Billings, Mont., have been awarded the contract by the city of Livingston, Mont., for the building of the sewer between Main and 2d Sts., at approximately $59,600. The work is to be finished by March 1.

New York.

✣Bids will be received until 3 p. m., Feb. 5, by Board of Trustees, Princeton University, Princeton, N. J., for the construction of an outfall sewer and sewage purification plant, consisting of settling tanks, sprinkling and sand filter beds, together with manholes and other appurtenances. Plans and specifications can be obtained at the office of G. C. Wintringer, Secretary of Business Administration, Board of Trustees, Princeton University, Princeton, N. J. A charge of $20 will be made for each specification and blueprints. This charge will be refunded upon the return of the unused specifications and plans in good condition on or before Feb. 10.

⊙Rodgers & Hagerty, 152nd St. and Harlem River, New York City, have been awarded the contract by President Cyrus C. Miller of the Borough of The Bronx, New York City, for constructing sewers and appurtenances in Lacombe Ave., between Bronx River Ave. and Bronx River, and in Bronx River Ave., between Lacombe Ave. and Metcalf Ave., and in Metcalf Ave., between Bronx River Ave. and E. 177th St., at $568,947. Bids were opened Jan. 15.

⊙Michael Decieco of Larchmont, N. Y., is the probable contractor for the construction of sewers in that city for which bids were opened on Jan. 15 by the Board of Trustees, Eugene D. Wakeman, Clerk. The bid was $21,959. L. E. Van Etten, Nos. 12 and 14 Lawton St., New Rochelle, N. Y., is Engineer.

The city departments of Dunkirk, N. Y., have submitted estimates to the Common Council for extensive improvements, including an intercepting sewer, paving of five streets, and minor extensions of the sewer system, involving an outlay of over $200,000. J. M. Hacket is City Engineer.

The citizens of Huntington, L. I. (N. Y.), have voted in favor of the establishment of a new sewer district.

A public meeting of the citizens of Lawrence, N. Y., was recently held in Firemen's Hall to discuss the question of the installation of a complete sewer system for the village as suggested and outlined in a circular recently issued by the Village Trustees.

Ohio.

✣Bids will be received until noon, Jan. 30, by H. P. Fribley, Director of Public Service, New Philadelphia, O., for furnishing the necessary labor and material for the construction of a storm sewer. T. L. Aughinbaugh is Clerk.

✣Bids will be received until noon, Feb. 4, by Village Council at the office of E. L. Garmon, Mayor, New Berlin, O., for furnishing the necessary labor and materials for the construction of a sewage disposal plant for the said village of New Berlin, according to the plans and specifications on file in the office of said Mayor. The approximate quantities are as follows, to-wit: 450 cu. yds. excavation, 500 cu. yds. gravel, 3,500 cu. yds. sand, 105 cu. yds. concrete, 1,150 lin. ft. 4-in. under-drains vit. pipe, 500 lin. ft. 6-in. under-drains vit. pipe, 300 lin. ft. 8-in. under-drains vit. pipe, 104 lin. ft. 10-in. sewer vit. pipe, 608 lin. ft. 12-in. sewer vit. pipe, 12 lin. ft. 15-in. sewer vit. pipe, 420 lin. ft. 10-in. split pipe carriers, 84 lin. ft. 15-in. split pipe carriers, 4 10-in. gates, 1 screen No. 1, 1 screen No. 2, 2 weirs, 1 manhole, 550 sq. yds. sodding, baffle boards for septic tank. Each bid must contain the full name of every person or company interested in the same, and be accompanied by a bond in the sum of $200, or a certified check on some solvent bank, as a guarantee that if the bid is accepted a contract will be entered into and its performance properly secured.

✣Bids will be received until noon, Feb. 4, by Council, village of New Berlin, O., for furnishing the necessary labor and materials for the construction of sanitary sewers in said village of New Berlin, according to the plans and specifications on file in the office of Mayor. The approximate quantities are as follows, to-wit: Vit. pipe—3,150 lin. ft. 15-in. sewer, 1,200 lin. ft. 12-in. sewer, 1,800 lin. ft. 10-in. sewer, 6,730 lin. ft. 8-in. sewer, 34 manholes, 6 flush tanks. Each bid must contain the full name of every person or company interested in the same, and be accompanied by a bond in the sum of $200.

✣Bids will be received until noon, Feb. 10, by Carl A. Palmer, Village Clerk, Shaker Heights, at his office, First National Bank, Cleveland, O., for the construction of sewers in a number of roads. Plans and specifications are on file with the Clerk or at the office of B. W. Willard, Village Engineer, 931 Williamson Bldg., Cleveland, O.

✣Bids will be received until noon, Jan. 30, by W. J. Springborn, Director of Public Service, Cleveland, O., for the construction

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

of sewers in the follow-named streets, avenues, courts and thoroughfares to-wit: Dawning Ave. S. W., between Pearl Rd. S. W. and 620 ft.easterly; Mobile Ct. S. W., between W. 35th St. and 240 ft. westerly; Leopold Ave. S. W., between Pearl Rd. S. W. and W. 35th St.; Independence Rd. S. E., between Winnenden Ave. S. E. and Stillson Ave. S. E.; E. 68th St., between Rogers Ave. S. E. and 315 ft. south; E. 73d St., between Ivy Ave. S. E. and Morgan Ave. S. E.; E. 73d Pl., between Aetna Rd. S. E. and 268 ft. southerly; E. 78th St., between Holton Ave. S. E. and Crowell Ave. S. E.; Putnam Ave. S. E., between E. 116th St. and E. 120th St.; Regent Rd. S. E., between E. 66th St. and Consul Ave. S. E.; Garfield Ave. N. E., between E. 100th St. and E. 105th St.; E. 143d St., between Lake Shore Blvd. and Westropp Ave. N. E. Each bid must be made in accordance with the plans and specifications, which may be seen at the office of the Chief Engineer, Room 305, City Hall.

✣Bids will be received until noon, Jan. 22, by Director of Public Service, Lorain, O., for furnishing the necessary labor and material for the construction of a lateral sanitary sewer. L. B. Johnston is Clerk.

The City Council of Hamilton, O., has made arrangements for over $100,000 worth of sewer construction and $300,000 worth of street paving for this year on the following streets: Fifth, Seventh, Greenwood Ave., South Seventh, Washington, Hanover, Gray, Webster and Harmon Aves., Vine, Walnut and Sycamore Sts.

The City Council of Salem, O., has been petitioned for the construction of a sanitary sewer on Railroad St., between Depot St. and Newgarden St.

The City Council of Delaware, O., has been petitioned to extend the sanitary sewer on North Franklin St.

The City Council of Fostoria, O., has adopted a resolution instructing City Engineer Chas. Latchaw to prepare plans for the improvement of the sewage disposal plant to comply with the recent order of the State Board of Health.

North Carolina.

⊙Miller & Martin of Passaic, N. J., have been awarded the contract by the Councilmen of Water & Sewerage, Wilmington, N. C., for the furnishing of labor and material for the construction of about 36 miles of vitrified concrete and cast iron sewers from 8 to 24 ins. in diameter, complete, with appurtenances, at $134,494. Bids were opened Jan. 14.

Pennsylvania.

✣Bids will be received until Jan. 29, by Commissioners of Somerset County, Somerset, Pa., for building a sewage disposal plant on the county home farm, two miles east of Somerset. Clyde Potts, 30 Church St., New York City, is Engineer.

⊙R. F. Rhodes & Son of McKeesport, Pa., have been awarded the contract by the borough of West Newton, Pa., A. M. Duk, Borough Clerk, for the construction of a sanitary sewer in certain streets. Bids were opened Dec. 16.

⊙Reinhart Bros. of East Liverpool, O., have been awarded the contract by the Street Committee, New Kensington, Pa., W. J. Pflough, Chairman, for the construction of sanitary sewers on Catalpa St., Victoria Ave., Taylor Ave., Woodmont Ave. and Proctor alley. Bids were opened Jan. 7.

⊙Phillips & George, Kirkpatrick Ave., North Braddock, Pa., have been awarded the contract by that borough. George F. Siefers, Engineer, for the construction of a 15-in. terra cotta pipe sewer in Verona St., with laterals, manholes and receiving basins complete. The contract price is $1,059. Bids were opened Jan. 3.

The Common Council of Reading, Pa., has passed a bill for a loan of $300,000 to construct 10 miles of storm sewers in the northeastern, northwestern and southeastern sections of the city.

Representatives of boroughs and townships in Delaware County, Pa., recently held a meeting in Darby, Pa., for the purpose of considering a bill, looking toward county aid in building outfall sewers and sewage disposal plants. A bill has been prepared by Engineer A. F. Damon, of Darby, Pa., which is to be presented at the coming session of the Legislature.

Plans for sewage disposal for Philadelphia, Pa., to stop pollution of the Delaware and Schuylkill Rivers and streams within the county limits are being completed. George S. Webster is Chief Engineer and Surveyor.

The Borough Council of West View, Pa., has passed an ordinance providing for a $70,000 bond issue for street improvements, a sewer and a bridge. Howard Donaldson is Clerk.

Rhode Island.

⊙The Board of Contract and Supply of Providence, R. I., has awarded the contract for the installation of sewers in Agnes, Troy and McDonough Sts. and Rogers Court to Frederick E. Shaw, at $15,680. Other contracts awarded to Mr. Shaw were as follows: Sewer in Branch Ave. and Woodward road, $6,214; in Irving Ave., $1,164; in Downing and Whitmarsh Sts., $1,225; in Eaton St. and Academy Ave., $6,364.

Texas.

Consulting Engineers Nagel & Petersen, Muskogee, Okla., are preparing plans for the construction of sanitary sewers and water extension at Jacksonville, Tex., to cost about $25,000 and $10,000 respectively. The citizens will probably vote in March or April on the proposition. J. E. McFarland is Mayor.

The Aetna Engineering Bureau, 17 N. La Salle St., Chicago, Ill., has been authorized by the city of Longview, Tex., for constructing a system of sewers, estimated cost $10,000.

An election is to be held in Waco, Tex., on Feb. 6, for the purpose of voting on the proposition of issuing bonds to the amount of $245,000 for public improvements, as follows: $25,000 for sanitary sewers, $100,000 for streets, and $120,000 for improving the public school buildings.

Washington.

Commissioner of Public Works D. C. Coates, of Spokane, Wash., has recommended to the City Council the award of contract for the Fifth Ward Sewer District No. 15, in Corbin Park, to J. L. Wood, at $11,078.

Commissioner of Public Works D. C. Coates, of Spokane, Wash., proposes to commence preliminary work necessary for the installation of the proposed $212,000 downtown intercepting sewer.

Canada.

Mayor Scott of Galt, Ont., advocates the putting into effect of a garbage system, the establishment of a fire-alarm system and additional apparatus, the building of good roads under the by-law which provides $75,000 for the purpose, the draining of the east end of the town, and the construction of a semi-trunk sewer to serve the northern portion of the town on the east side of the river. Reeve Robinson is chairman of the Board of Works.

The Board of Control of Montreal, Que., has decided to complete the Notre Dame de Grace trunk sewer at an outlay of $350,000 next summer. S. Howard is Superintendent of the Sewer Division.

The ratepayers of Fort William, Ont., on Jan. 6, voted by-laws to the amount of $35,000 for the construction of an incinerator plant. Geo. Graham is Mayor.

The ratepayers of Peterboro, Ont., on Jan. 6, voted a by-law to the amount of $10,000 for the construction of an incinerator. T. A. S. Hay is City Engineer.

The ratepayers of Newmarket, Ont., on Jan. 6, voted a by-law to the amount of $100,000 for the construction of a sewerage system. Wm. O. Hallarn is City Engineer.

BUILDINGS

California.

Plans and an efficiency report have been completed on municipal lighting plant at Riverside, Calif., by Burns & McDonnell, Scarritt Bldg., Kansas City, Mo. The plans call for an expenditure of $429,112 on a hydroelectric plant, $100,351 steam reserve plant, or an alternate oil engine plant of 2,000 K. W. capacity, $200,000.

District of Columbus.

✣Bids will be received until 2 p. m., Jan. 28, by District Commissioners, Washington, D. C., for constructing an extension to the ward building and dining room, including the installation of conduits, wires and fixtures, for an electric light system at the Home for the Aged and Infirm at Blue Plains, D. C. Specifications and all necessary information may be obtained from the chief clerk, engineer department, room 427, District Building, Washington, D. C.

Georgia.

✣Bids will be received until 3 p. m., Feb. 20, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction of the United States Post Office at Augusta, Ga. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until noon, Feb. 4, by Board of Roads and Revenues Commissioners, Clerks County, Athens, Ga., for the necessary labor and material for the erection of a 3-story and mezzanine court house. A. Ten Eyck, Forsyth Bldg., Atlanta, Ga., is Architect.

Idaho.

✣Bids will be received until 3 p. m., Feb. 28 by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction, complete, including plumbing, gas piping, heating apparatus, electric conduit and wiring, and lighting fixtures, of the United States post office and courthouse at Pocatello, Idaho. The building is three stories and basement, with a ground area of approximately 4,500 sq. ft.; fireproof construction, stone and brick facing, tin roof. Drawings and specifications may be obtained from the custodian of site at Pocatello, Idaho, or at the discretion of the Supervising Architect.

Illinois.

✣Bids will be received by Chas. Seyferlich, Fire Marshal, Chicago, Ill., until 11 a. m., January 24, for furnishing and delivering rubber tires, for use during 1913, to the Fire Department, as follows (approximate quantities shown), engine tires, 2 48½ in. by 3½ in. overall, 2 80 in. by 40 in. solid rubber tires, hook and ladder truck tires, 4 42 in. by 3½ in. over all of solid rubber, hose wagon tires, 3 39 in. by 2½ in. over all, 2 51 in. by 2½ in. over all, buggy tires, 600 lin. ft. of 1½ in. solid rubber side wire type, motor tires, 96 tires of various sizes and types, 36 pneumatic tires of various sizes and types, including inner tubes.

The City Council of Chicago on Jan. 2 authorized the purchase of arc lamps, wire cables, fire alarm and police pedestals, protectives, lamp posts, masts, bases, insulators, etc. Dept. of Electricity, Roy Palmer, City Electrician, $20,000. Date of letting contracts not announced.

The Chicago City Council on Jan. 2 authorized the purchase of paints and painting supplies for use during 1913 as follows: Fire de-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

partment, Chas. Seyferlich, chief, $3,000; health department, A. Reynolds, M. D., Commissioner of Health, $400; department of electricity, Roy Palmer, City Electrician, $1,900; department of City Hall, $500; Bureau of Engineering, painting various water towers, $2,250. L. E. McGann, Commissioner of Public Works. Date of letting contracts not announced.

The Chicago City Council on Jan. 2 appropriated, contingent on bond issue, the sum of $295,000 for the construction and equipment of a new contagious disease hospital.

The Chicago City Council on Jan. 2 appropriated, contingent on bond issue, the sum of $1,734,000 for the construction and complete equipment of new fire stations.

Indiana.

✣Bids will be received until 3 p. m., March 1, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures, and approaches of the United States post office at Frankfort, Ind. The building is of one story, basement, and mezzanine, and has a ground area of approximately 5,000 sq. ft. fireproof construction throughout; stone facing and copper and tile roof. Drawings and specifications may be obtained form the custodian of site at Frankfort, Ind., or at the discretion of the Supervising Architect.

Maryland.

Dietrich Bros., North St., Baltimore, Md., are planning the erection of a steel shop, to cost about $500,000, at 27th St., Baltimore, Md. Plans for three large shops, 70x300 ft., have already been completed.

Massachusetts.

⊙J. W. Bishop Co., 109 Foster St., Worcester, Mass., has been awarded the contract for the erection of a mill for the Ludlow Manufacturing Association at Ludlow, to cost about $450,000. The new mill is to be 560 ft. long and 122 ft. wide and of 5 stories in the main part. Besides the main building the Bishop company is to build a 6-story building of brick which will connect mills 10 and 11, after the completion of the No. 11 mill. On each end of the new mill there will be a large tower. The main building is to be of brick and gypsum blocks. The partitions and interior will be of mill construction, the columns of cast iron. The footings and foundations will be of reinforced concrete. Plans for the building were prepared by Charles T. Main, Boston, engineer in charge of the work. The contract calls for the building to be completed Aug. 1.

Plans are being prepared by H. P. Graves, Architect, Glidden Bldg., Lowell, Mass., for a 6-story fireproof building to be erected on Mechanic St., Worcester, Mass., for the estate of Horace E. Bigelow. Plans will be ready for estimates about Feb. 1.

Minnesota.

H. M. Byllesby & Co., O. E. Osthoff, Chief Engineer, 175 Jackson Blvd., Chicago, Ill., have preliminary work under way for the erection of a power dam at the junction of Coon Creek and the Mississippi River, a few miles below Anoka. The work is being done under the name of the Great Northern Development Co.

Missouri.

✣Bids will be received until 8 p. m., Jan. 28, by Board of Directors of the School District of Webster Groves, Mo., E. S. Healey, Pres., Webster Groves, Mo., for the additions and alterations to the Webster High School Bldg. Plans and full particulars can be obtained of M. P. McArdie, Architect, 1104 Chemical Bldg., St. Louis, Mo.

⊙S. L. Jones Building Co., Mercantile Bldg., St. Louis, Mo., has been awarded the contract at $31,575 for constructing a bath house for the city of St. Louis, Mo. Bids were opened Jan. 14.

Montana.

Charles T. Main, Engineer, 201 Devonshire St., Boston, Mass., has been awarded the contract for the engineering work in connection with the development of the Big Falls of the Missouri River, near Great Falls, Mont., and Thompson Falls, on Clark's Fork, of the Columbia River. The surveys of these developments have started. It is probable that the Big Falls development will have a capacity of 125,000 H. P. and the one at Thompson Falls 50,000. H. P.

New Mexico.

✣Bids will be received until 2 p. m., Feb. 12, by Commissioner of Indian Affairs, Washington, D. C., for furnishing materials and labor for the erection of a brick schoolhouse at the Pueblo Bonito Indian School, N. Mex.

New York.

⊙Metz Bros., 1295 Fillmore Ave., Buffalo, N. Y., have been awarded the contract at $596,635 for constructing the new Masten Park High School of the City of Buffalo.

Ohio.

✣Bids will be received until noon, Jan. 23, Board of Education, Steel High School, Dayton, O., for all labor and material required by the plans and specifications for the addition to and completion of Stivers Manual Training High School Building, located on E. 5th St., between Eagle and High Sts., in Dayton, O. Said plans and specifications are on file in the office of E. J. Mounstephen, Architect, McIntire Bldg., corner Main and 2d Sts., Dayton, O., and also in the office of the Clerk of the Board of Education, Steele High School Bldg., corner Main St. and Monument Ave., Dayton, O. C. J. Schmidt is Clerk.

✣Bids will be received until noon, Feb. 3, by Board of County Commissioners, Painesville, O., for labor and material necessary for the erection of a tenant house at the County Infirmary in accordance with specifications on file with W. Albert Davis, County Auditor.

✣Bids will be received until noon, Jan. 31, at the office of the Secretary of the Director of Public Service, Cleveland, O., for the furnishing and erecting of and painting of structural steel work for the Municipal Electric Light Plant of Cleveland, O. Specifications may be obtained of the Engineer of Construction, 319 City Hall. W. J. Springborn is Director of Public Service. W. H. Kirby is Secretary.

✣Bids will be received until noon, Jan. 30, at the office of the Secretary of the Director of Public Service, Cleveland, O., for electric wiring for the Fire Service Pumping Station of the Water Department of the city. Specifications may be obtained of the Superintendent of the Water Department. W. J. Springborn is Director of Public Service. W. H. Kirby is Secretary.

Oklahoma.

✣Bids will be received until 2 p. m., Feb. 21, by Commissioner of Indian Affairs, Washington, D. C., for the erection of a stone school house at the Pawnee Indian School, Okla. The bids are to be for furnishing necessary labor and material.

Pennsylvania.

⊙The Larkin Co. has placed a contract with the Aberthaw Construction Co. of Boston, Mass., contracting engineers specializing in concrete, for the building of a $500,000 storage and manufacturing building on the Larkin Co.'s property at the corner of Arch and 23d Sts., Philadelphia. The building will be 12 stories high, ranking among the high reinforced concrete structures of the country. The construction will be reinforced concrete throughout, the floors carried for part of the way on structural steel columns. Work on this building is to begin in the early spring.

The W. G. Wilkins Co., Westinghouse Bldg., Pittsburgh, has been working on plans for the erection of 200 rectangular ovens of the pusher type for the Sykesville Coke Co., Sykesville, Pa. Power for operation will be supplied from the present power plant, which is equipped with 1,200 H. P. boiler capacity. Additional equipment also will be installed soon.

Texas.

⊙The American Construction Co., Houston, Tex., has been awarded the contract for constructing the $500,000 union depot at Galveston, Tex., for the Gulf, Colorado & Santa Fe Ry. The building is to be 6-story with reinforced concrete columns, girders and slabs.

⊙J. A. Holmboe Co., Oklahoma City, Okla., has the contract for erecting two dormitories, to cost $169,000 and $132,000, for the new Southern Methodist University at Dallas, Tex.

Utah.

⊙Jas. Stewart & Co., New York and Chicago, have been awarded the contract at $1,040,000 for the construction of the State Capitol building at Sale Lake City.

Washington.

✣Bids will be received until 11 a. m., Feb. 21, by H. R. Stanford, Chief Bureau of Yards and Docks Navy Department, Washington, D. C., for hospital buildings at the naval hospital reservation, Puget Sound, Wash. The cost is estimated at $13,000.

West Virginia.

Election is to be held at Moorefield, W. Va., on Feb. 1 to vote on issuing bonds for the construction of the municipal electric lighting plant. John T. Chipley is Mayor.

Canada.

✣Bids will be received until Feb. 1, by J. W. Walker, Clerk of the town of Fort Frances, Ont., for the installation, construction and complete equipment of a telephone system for the town of Fort Frances. Tenderers may tender on: (1) The equipment in whole or in part; (2) on the construction and installation; (3) on the complete construction and installation, including all material. Plans and specifications may be seen at the office of the Town Clerk. A marked check equal to 5 per cent of the amount of the tender must accompany each tender, payable to the order of the Town Treasurer.

⊙John S. Metcalf Co., Montreal, Que., has been awarded a contract at $600,000 for doubling the capacity of Elevator No. 1 by the Harbor Commissioners of Montreal, Que. The elevator is to have a capacity of 2,000,000 bus.

RIVERS AND HARBORS

California.

⊙The Daniel Contracting Co. has been awarded the contract at $392,000 by the Board of State Harbor Commissioners for the construction of 1,710 ft. of concrete sea wall, extending from the foot of Harrison St. to the foot of King St., at San Francisco.

Plans for a new municipal wharf have been submitted to the Board of Trustees of Martinez. As proposed the structure will be 1,300 ft. long and 80 ft. wide. E. C. Brown is City Engineer.

The Harbor Board of San Francisco has approved plans and specifications submitted by Assistant Engineer Carl Uhlig for pier 41, to be constructed at the foot of Stockton St., San Francisco. The new pier is to be 1,080 ft. in length on one side and 880 ft. on the other; 200 ft. wide, with a spur truck on each side; concrete pillars, supported by wooden piling will be 10 ft. apart.

Delaware.

✣Bids will be received until 11 a. m., Feb. 12, by Maj. R. R. Raymond, U. S. Engineer, Wilmington, Del., for dredging Leipsic River, Del., above Leipsic.

Illinois.

⊙The contract for constructing a dock on the east side of the Chicago River, south of Madison St., has been awarded to Fitzsimons & Connell Dredge and Dock Co. Contract price, $2,390. L. E. McGann, Commissioner of Public Works, Chicago, Ill.

Louisiana.

⊙Caddo Levee Board has awarded the contract for building the Brown Levee containing 85,000 cu. yds., to Mike Hunt, Shreveport, La., at 14.2 cts. per cu. yd.

⊙R. L. Steward, Donaldsonville, La., has been awarded the contract by the Lafourche Basin Levee Board for constructing a concrete revetment on the river front from the Bayou Lafourche dam to Houmas St., Donaldsonville. About 18,000 sq. yds. of concrete will be placed.

About $140,000 is to be expended by the Caddo Levee Board for furnishing protection along the Red River, where the caving banks are situated. In all there will be about 27,500 lin. ft. of construction work, which will bring about improvements at the following points: Scott's Slough Reach, Rattling Slough Reach, Havana Reach, Corner Place Reach, Fire Point Reach, Silver Point Reach, Twelve-Mile Bayou Reach, Dixie Reach, Lucas Reach, Leonard Reach, Campo Belle Reach.

Michigan.

⊙MacArthur Bros. Co., Fisher Bldg., Chicago, Ill., have been awarded the contract, at $295,000, for excavating lock pit at the 4th lock, St. Marys Canal, Sault Ste. Marie, for the U. S. Government.

Minnesota.

City Council of Rochester, Minn., is reported to have taken final action regarding a contract with the Zumbro Power Co. for furnishing electric power to the city. The Power Co. proposes to erect a 50-ft. dam at Zumbro Falls. H. A. Christensen, Charles Armstrong and J. M. Norton of Rochester are the promoters.

Mississippi.

✣Bids will be received until Feb. 10 by W. J. Shackelford, Greenville, Miss., Chief Engineer of the Mississippi Levee District, for the following work, above Greenville: Bolivar Enlargement—Sta. 2550 to 2670, 170,000 cu. yds.; riverside borrow; about 10,000 cu. yds. for false berms on landside with landside borrow is included in this estimate. Catfish Point Enlargement—Sta. 2913 to 2992, 110,000 cu. yds.; landside enlargement, landside borrow; enlargement of three dikes is included in this estimate, stations 2913, 2975 and 2992; dike enlargement is estimated at 20,000 cu. yds., and pits for same will be on lower side of dikes. Eutaw Enlargement—Sta. 2992 to 3100, 90,000 cu. yds.; riverside enlargement; riverside borrow. Bolivar work is three miles from Benoit and at Bolivar Landing on the river. Catfish Point work is eight miles from Scott Station. All work to be completed by Dec. 15, 1913. All work will have 8 ft. crown with light topping in addition 1 ft. above gross grade. Landside work will be combined with banquette enlargement. Specifications, profiles and maps and other information that bidders may desire can be obtained at the office of the Chief Engineer at Greenville, Miss.

New Hampshire.

✣Bids will be received until 11 a. m., Feb. 21, by H. R. Stanford, Chief of Bureau of Yards & Docks, U. S. Navy Department, Washington, D. C., for one 15-ton locomotive crane, delivered and erected at the navy yard, Portsmouth, N. H.

New Jersey.

✣Bids will be received until 11 a. m., Feb. 10, by Maj. R. R. Raymond, U. S. Engineer, Wilmington, Del., for dredging Absecon Creek, N. J.

✣Bids will be received until 11 a. m., Feb. 11, by Maj. R. R. Raymond, U. S. Engineer, Wilmington, Del., for dredging the Maurice River, N. J.

✣Bids will be received until 11 a. m., Feb. 13 by Maj. R. R. Raymond, U. S. Engineer, Wilmington, Del., for dredging Alloway Creek, N. J.

✣Bids will be received until 11 a. m., Feb. 8 by R. R. Raymond, U. S. Engineer. Wilmington, Del., for dredging Raccoon Creek, N. J.

The Rahway Docks Co., of Jersey City, N. J., has been incorporated with a capital stock of $30,000, for the purpose of constructing docks. The incorporators are Albert L. Drayton, Munge J. Currie and George J. Fernier.

North Carolina.

Bids as follows were received Jan. 11, by Maj. H. W. Stickle, U. S. Engineer, Wilmington, N. C., for dredging for improving Pamlico and Tar Rivers, N. C., (1) being bid per cubic yard on 392,000 cu. yds. below Washington, (2) bid on 194,000 cu. yds. above Washington, (3) bid for board for U. S. Inspectors, inspecting during operations, and (4) total: Pickard Dredging Co., Philadelphia, Pa. (all work or none), (1) 12½ cts. (2) 20 cts., (3) $444, (4) $88,244; Hillsboro Dredging Co., Tampa, Fla., (1) 13 2/10 cts. (2) 22 cts., (3) $600, (4) $95,024; W. H. French, Norfolk, Va., (2) 13 7/10 cts., (3) $172, (4) $26,750; Norfolk Dredging Co., Norfolk, Va., (1) 11 9/10 cts., (3) $246, (4) $46,894; R. & H. Improvement Co., Philadelphia, Pa., (1) 17 4/10 cts., (3) $328, (4) $68,536; Standard Engineering Co., New York, N. Y., (1) 16⅜ cts., (4) $64,190; Atlantic Gulf & Pacific Co., New York, N. Y., (1) 15 4/10 cts., (3) $328, (4) $60,696; Maryland Dredging & Contracting Co., Baltimore, Md. (all work or none), (1) 12¾ cts., (2) 12¾ cts., (3) $450, (4) $75,195.

The following bid was received Dec. 26 by the U. S. Engineer, Wilmington, N. C., for about 1,000 tons steel sheet piling for lock and dam No. 1, Cape Fear River, King's Bluff, N. C.: Lackawanna Steel Co., Buffalo, N. Y., $49,584.

Pennsylvania.

⊙American Dredging Co., 308 Chestnut St., Philadelphia, Pa., has been awarded the contract at $9,750 for dredging at Navy Yard, Philadelphia, Pa. Bids were opened Dec. 28 by the Bureau Yards and Docks, Navy Department, Washington, D. C.

Rhode Island.

✣Bids will be received until 11 a. m., Feb. 8, by H. R. Stanford, Chief of Bureau of Yards & Docks, Navy Department, Washington, D. C. for steel float for the U. S. Government landing, Newport, R. I. The cost is estimated at $2,000.

Tennessee.

✣Bids will be received until noon, Jan. 31, by Maj. E. M. Markham, U. S. Engineer, Memphis, Tenn., for furnishing and loading 10,000 cu. yds. of riprap stone on the government barges.

Bids were opened Dec. 23 by Maj. H. Burgess, U. S. Engineer, Nashville, Tenn., for building Lock D, Cumberland River; the Mansfield Engineering Co., Indianapolis, Ind., was the only bidder, its bid being as follows:

Cofferdam	650 lin. ft.	$48.00
Earth excavation	4,000 cu. yds.	.90
Rock excavation inside cofferdam	8,900 cu. yds.	4.60
Rock excavation outside cofferdam	6,900 cu. yds.	3.20
Back fill	9,000 cu. yds.	.50
Puddling	500 cu. yds.	2.00
Concrete in lock	13,100 cu. yds.	8.80
Concrete in guide walls and guard walls	4,500 cu. yds.	9.70
Bolt holes	300 lin. ft.	1.00
Handling and placing iron and steel work	62 tons	60.00
House	1	3,000.00
Total		$269,270

Texas.

The Commissioners' Court at Galveston has taken action to provide for the legal requirements of an extension of the Galveston seawall at some future time. The court passed a resolution calling upon the Legislature to submit a constitutional amendment which would permit the organization of the seawall improvement district. The estimated cost of the project is $5,000,000. The amendmend sought would provide that any county bordering on the Gulf, having an island on which there is a city of 25,000 population, may at the desire of its citizens construct whatever seawall and reclamation projects to protect lives and property from a possible storm that it sees fit.

Virginia.

Ordinance is before City Council of Norfolk, Va., calling for an appropriation of $15,000 for constructing a sea wall from Ghent Bridge to Duke St. Of the $15,000, about $11,000 is for the wall and the remainder for drains. W. T. Brooke is City Engineer.

Washington.

✣Bids will be received until 2 p. m., Jan. 29, by Port Commission, of the Port of Seattle, Wash., at the office, 843 Central Bldg., Seattle, Wash., for the construction of earth fill, Project No. 4, Proposition No. 5, Central Waterfront Improvement. C. E. Remsberg is Secretary of the Commission.

⊙The Port of Seattle Commissioners, Seattle, have awarded a contract to the Weymouth Construction Co., Seattle, at $139,350, for the sub-structure work on the East Waterway project. The contract includes 225,000 lin. ft. of creosoted piling, 35,000 lin. ft. of untreated fender piles, 14,000 ft. of treated fender piles; 539 M ft. lumber; 95 M ft. of creosoted lumber; 2,145 ft. sheet piling and 143 cu. yds. of concrete. The Commissioners have also awarded the following contracts: J. A. McEachern Co., Bailey Bldg., Seattle, at $12,652, for bulkheads, etc., at Salmon Bay; The Puget Sound Bridge & Dredging Co., Seattle, at $22,000, for dredging at the Salmon Bay project.

Plans for a new municipal dock have been submitted to the City Council of Tacoma. W. C. Raleigh is City Engineer.

Bids will be asked shortly by the city of Tacoma, Wash., for the construction of a municipal dock, warehouse and storage plant. Estimated cost is about $200,000. Plans have been completed by Owen Woods, Commissioner of Works.

The Pacific Terminal Co. will start work soon for its improvements at Harbor Island, Seattle. The plans call for the immediate expenditure of about $2,000,000 for a 200x1,000 ft. reinforced concrete dock and three warehouses. Charles Fenn, Levy Bldg., Seattle, Wash., is interested.

Plans and specifications have been completed by the Waterway Commission No. 1, Burke Bldg., Seattle, Wash., for constructing hull, pontoons, installing machinery, etc., for a dredge to cost $150,000.

Canada.

The Canadian Government is to at once secure a site at Vancouver, B. C., for a public dock to cost $500,000. Robert Rogers, Ottawa, Ont., is Minister of Public Works.

⊙The Department of Public Works of Canada has awarded the contract for the construction of a landing pier at St. Antoine, County of Vercheres, P. Q., to Olivier Paul of St. Anne de Sorel, P. Q.

⊙The Department of Public Works of Canada has awarded the contract for the construction of a breakwater at Victoria, B. C., to Sir John Jackson (Canada), Ltd., A. Brooks, Director, of Montreal, Que.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ENGINEERING AND CONTRACTING

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and to Methods and Cost of Construction

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Some Dangers of the Practice of Competitive Commercial Designing of Reinforced Concrete Buildings.

A distinguishing feature of reinforced concrete building design in America is its monopolization very largely by commercial firms. The inventors of special reinforcing bars or frames or metal mesh or of particular arrangements of reinforcing or structural forms have established building designing and constructing firms as means of marketing their inventions. Naturally these firms are of all varieties of worth and rank as building designers. Some are wholly excellent and others are mediocre and some are very poor. On the whole, as we have frequently said, reinforced concrete owes these building firms for much of its present popularity as a building material. Had it not been for their labors, the material would not have had the proved efficiency which it now possesses in popular thought. Altogether, also, the reinforced concrete buildings which these firms have built are good buildings, not the best by any means in many instances that the material might easily have been made to produce, but good as building quality averages.

Some pains have been taken as will be observed to credit reinforced concrete building commercial designing firms with their work for the good of reinforced concrete. We have done this the more carefully because in what follows we propose to exemplify and comment on some of the evils for which the same firms are equally responsible. Our data will, because of its greater convenience then, be taken from a recent paper by Mr. Ernest McCullough, Consulting Engineer, before the Illinois Society of Engineers and Surveyors. We quote the following excerpts:

In taking a span length in order to obtain the load the clear span, face to face of supports, should be taken and this multiplied by the load per lineal foot gives the total load. Using this total load to obtain the moment we should use a span from center to center of supports, or the clear span plus enough to give a bearing at either end. These items are mentioned in every building ordinance and in every text book on structural mechanics. Today nearly every beam designed in reinforced concrete is a T-beam. That is, the stem we call the beam is comparatively narrow and contains merely enough concrete to protect the steel and take care of shear, assisted sometimes by stirrups. The upper part of the beam that takes all the bending compression extends part way into the floor slab on either side of the stem, and thus we obtain a T-section for the beam.

Assume a T-beam having a top 24 ins. wide. Assume a span, center to center of beams, of 19 ft., the stem of the beam being 12 ins. To obtain the load on the slab we deduct the stem thickness from the span, $19 - 1 = 18$ ft. and multiplying this by the load per lineal foot, say 100 lbs., obtain $18 \times 100 = 1{,}800$ lbs. total load. The bending moment will then be $1{,}800 \times 19 = 34{,}200$ in. lbs. The writer knows from actual experience in checking designs that many design as follows: The flange of the $T = 2$ ft., so the load is $19 - 2 - 17 \times 100 = 1{,}700$ lbs., taking the clear span from face to face of the flange edges. Using the same span the moment is $1{,}700 \times 17 = 28{,}900$ in. lbs. In this method of designing to save steel, and thus obtain a contract, the load on the overhanging portions of the flanges is neglected in designing the floor slab, and a condition of perfect restraint is assumed, with no attention paid to any possible bending of the flanges. When designing a beam to carry the floor the span is figured face to face of the flanges on the girders and when designing the girders the span is figured face to face of columns.

It is customary with independent structural engineers, and also expressed in the majority of building ordinances, to reduce the loads going to columns as follows: The columns carrying the roof are designed for the full live load and dead load. The live load on the top floor is reduced to 15 per cent and the live load is successively reduced 5 per cent on each floor below until the total reduction of live load amounts to 50 per cent. From this floor all the floors below are designed to carry only 50 per cent of the live load on the particular floor considered, the full dead load being provided for on each floor.

Competitive designers frequently reduce the live load 10 per cent on each floor, the reduction not being limited, so that the writer has sometimes found structures designed with as little as 30 per cent of the live load considered on the first floor. In one building the difference in load to be carried to the footings amounted to 20 per cent of the total, when compared with the standard method accepted by good designers.

Common practice among good designers permits a reduction of 15 per cent of the live load going to girders, except in warehouses or buildings presumed to be fairly constantly loaded with the design load. The writer has found designs in which the 15 per cent reduced live load was applied also to beams and he has found designs in which the 15 per cent reduction was figured on the total load and not limited to the assumed live load.

When reinforced concrete columns are used it is good practice to specify that the steel be set so that a cover of not less than 2 ins. of concrete will be provided. This cover is for fire protection, and many engineers will not consider any of the concrete outside the steel as carrying load. Thus, if the design shows a 12-in. column required, the fire protection will cause the use of a column 16 ins. by 16 ins. square. The writer has never yet examined a competitive design in which the concrete outside the steel was excluded.

Columns of the hooped variety, variously known as wrapped, wound, spirally reinforced, etc., always show signs of failure by the concrete peeling away from the steel, so it is necessary to consider for such columns only the concrete area enclosed within the hooping, not to the center of the hooping, but completely inside. Unless competitive designers are closely watched, the full area of the concrete may be used in computing the strength. Assuming a coil 20 ins. in diameter inside a column 26 ins. by 26 ins. square, the strength of the column is fixed by the concrete inside the coil, but many designers will count the full area of the 26-in. square rectangle.

One might easily cite further examples, but it is not necessary. Nor is it necessary to fasten faults of the sorts quoted specifically on individuals or firms. They are the result of a condition, and will be corrected when a better condition is established. So long as building owners put no check on competitive commercial designs for buildings, they may expect that "skinned" designs will at times and indeed frequently be put through. The remedy is a simple one and one that can easily be applied.

ROADS AND STREETS

Method of Laying Wood Block Pavement.

A contract for wood block pavement usually includes regulating the entire portion of the street to be paved, removing the old pavement, regrading the street, readjusting other types of pavement at intersections, setting new curb, dressing and resetting old curb, resetting catchbasins, manhole frames and sewer heads, putting in new concrete foundation and laying the wood block. At the 9th annual meeting of the American Wood Preservers' Association, held last week at Chicago, Mr. H. S. Loud presented a paper in which he describes in some detail the more important operations entering into the construction of a modern wood block pavement. Mr. Loud's paper, practically in full, follows:

The first operation is to set the curb. Then the old pavement is removed and the street graded from curb so that the subgrade shall be exactly parallel to the finished grade and as much below same as the added depth of the wood block, the cushion and the concrete foundation. Soft or spongy places should be dug out and refilled with proper material. Unless the subgrade is quite solid it should be compacted by tamping or rolling with a heavy roller.

Upon this subgrade must be placed a concrete base, finished with a commercially smooth surface, and from 4 to 6 ins. in depth, depending on the traffic and the condition of the subgrade. The concrete should be constructed in accordance with the materials and methods described in the specifications reported by the committee on cement adopted January, 1912, by the Association for Standardizing Paving Specifications.

In general the question of concrete has been worked out in each locality according to the materials available, and all that is needed is a good substantial base that is deep enough to carry the traffic. Great care should be taken to secure a smooth surface on the concrete and to keep it exactly parallel with the finished grade.

Three longitudinal rows of grade stakes should be put in. One row down the center of the street and one row midway between the center and each curb. The stakes in each row should be about 15 ft. apart. With a good concrete gang this should be sufficient, but with an inexperienced gang the stakes in each row should be closer. On a wide street intermediate rows should be added. For very particular work masons' lines may be stretched along the longitudinal stakes.

After the foundation has set thoroughly, a layer of sand, or of sand and cement (1 cement to 4 sand) is spread over it and struck to a true surface exactly parallel to the top of the finished pavement and as many inches below same as the depth of the blocks to be used. This cushion or bed is simply a means of securing a perfectly uniform surface for the blocks to rest upon, and if the concrete has been properly laid should not average over ½ in. in thickness for mortar cushion and 1 in. for sand cushion. Whichever material is used should be laid dry and free from pebbles. If it is not perfectly dry it should be combed out with a rake, smoothed to an approximate surface, rammed or rolled and then struck with a drawing board.

There are two ways of striking the even surface required. One of the most common, but not the best, is to use flexible strips of wood or iron about ⅜ in. thick and 4 ins. wide. These strips are set parallel to each other and about 8 or 10 ft. apart, running from curb to curb. They should be imbedded in sand throughout their length, so that their top surface shall be parallel to the grade of the finished pavement and as many inches below same as the depth of the blocks to be used. The space between the two strips having been filled with a bed material, a true and even top surface is struck by using an iron-shod straight edge on the strips as a guide, and as soon as the bed has been struck the strip which would interfere with laying the block shall be removed and its place carefully filled in with cushion.

The other and better method is to draw the bed in a direction parallel to the curb. Instead of flexible strips pieces of wood are used about 12 ft. long and as wide and thick as the blocks are deep. These guide pieces are set parallel to the curb and to each other and are bedded on cushion material throughout their length so that their top surface shall coincide with the top surface of the finished pavement. One such guide is placed next to each curb and one is set 1 ft. off the center of the street. The space between the guides having been filled with cushion material, a true and even top surface is struck by using an iron-shod templet which is 1 ft. longer than one-half the street width. This surfaces one-half the bed. The middle guide is shifted 1 ft. off center in the opposite direction and the other half of the bed struck. The guides are then removed and the bed is ready for use without the necessity of any hand fluting. The templet has notched ends as it is drawn over guides which are level with the top of the finished pavement, while its drawing edge is below that level by the depth of the block. Shoes should be fastened to each end of the templet to prevent its tipping while being drawn. The second method is much superior to the first. It is more accurate, quicker and cheaper.

The question as to whether a sand or mortar cushion should be used is a matter of opinion, as both have given excellent results. In general sand gives a true cushioning effect, and the blocks do not have to be rolled as soon after paving as when a mortar cushion is used. The mortar cushion is better on appreciable grades especially in car track work. If mortar cushion be used the pavement should be sprinkled sufficiently during the rolling of the block to supply water to set the concrete.

English and French practice does away with a soft cushion. The concrete base is floated over to a depth of 1 in. with a 1 to 3 mixture of cement and sand laid to the proper crown. This is allowed to set thoroughly.

After the bed is prepared provision for expansion joints is made by placing boards along each curb. These boards should be about 6 ins. wide and thicker on one edge than the other, so that they may be easily withdrawn after the blocks are paved. They should leave a 1½-in. space to be filled with bituminous material. Alongside the above board three rows of block should be paved parallel to the curb. On the rest of the street the block should be laid at right angles to the curb. Blocks should be laid neither too tight nor too loose—about so that before the joints are filled any block can be easily pulled out of the pavement by jabbing a knife blade into it. The blocks should be paved with the grain vertical and all joints broken by a lap of at least three inches.

With streets of light traffic it is desirable and necessary to have transverse expansion joints. These should be about ¾ in. wide and placed from 25 to 50 ft. apart.

After the blocks are paved the surface should be rolled with a roller weighing from 2½ to 5 tons and then inspected, and any lack of uniformity or unevenness corrected by taking up and relaying the defective portion.

The joints should then be filled with clean sharp sand, perfectly dry and free from pebbles. The sand should be thoroughly broomed until the joints are completely filled. The surface should then be covered with ½ in. of sand and traffic admitted to the street. It will take about 10 days under traffic for the joints to take up all the sand they require.

In England where they use a smooth hard concrete surface they lay two courses of hand-dipped (in pitch) block parallel to the curb. A space of from 1 to 2 ins. is left between the curb and the wood block to allow for expansion; this space is filled with clean puddled clay or approved bituminous filler. After laying the blocks a mixture of boiling pitch and creosote oil is poured over the whole surface and well forced into the joints and the surplus scraped off with wooden or rubber squeegees. A top dressing of crushed stone, passing a ⅜-in. screen, is then spread over the pavement. In some places the top of the concrete is flushed with a bituminous material just before paving.

It is desirable that wood block be paved into the street as soon after treatment as possible. For this reason it is well to have the concrete laid before the blocks are received and thus be able to deliver them directly to the pavers. In case this is impossible, the blocks should be tight-piled along the line of the work and they should be protected from the sun by wet straw, tarred paper or similar means and sprinkled with water from time to time to keep them from drying out too much. In piling block alongside of the street it is desirable to make the piles as high as convenient, for they will occupy less sidewalk area and interfere less with pedestrian and delivery traffic.

In paving, care should be taken to keep the courses straight and at right angles to the curb. Special attention should be given to paving around manhole heads, street car tracks and other iron work. Blocks should be paved against a vertical surface; to get this it is necessary with rails and may be necessary with other iron work to plaster the abutting face with a rich mixture of sand and cement. It is absolutely necessary adjacent to all such iron work that the cushion be specially tamped and thickened so that the block when paved shall be from 3/16 to ¼ in. above the wearing surface of the iron. Traffic will bed these blocks down to the level of the iron in a short time.

Block paved as already outlined is all right for streets having a grade not over 3 per cent. Streets with greater grades should be paved with a ⅜-in. groove between each row of block. The best way of doing this is to separate each row with a creosoted strip ⅜ in. thick. The width of these strips should be one inch less in depth than the block, so as to leave a groove 1 in. deep. These grooves are sometimes filled with pebbles and pitch. Wood block should not be used on grades exceeding 6 per cent except in special cases.

With wood block pavement the crown should be as light as possible; just sufficient to shed water freely.

It has already been pointed out that in paving against street car rails the blocks should be set against a perpendicular surface and also paved about ¼ in. high. Between the car tracks it is possible to use this construction with a Trilby rail. With the old form of girder rail this may be done, too, but the surface of the block within the car tracks will be on a level with the wagon wheel tread of the rail.

A great many street railways use T-head rail. Blocks may be paved against such rails by plastering the surface and paving low enough to allow the flange of the wheel to pass freely. This means that the pavement within the tracks will be about one inch below the abutting pavement. Or the rail may be plastered and the blocks paved from rail to rail at the same level as the surrounding pavement: the blocks that set up against the rail in this case must have one corner chanpfered off to permit the passage of the wheel flange. Instead of plastering the side of the rail, creosoted strips are often used. Specially formed blocks are also used.

Many bridges are paved with wood blocks. Some of them have concrete roadways on which the blocks are paved substantially as outlined previously. Many have plank floors and some iron floors. Planks should be creosoted, surfaced to an even thickness and laid smooth. Blocks may be laid directly on the creosoted plank, but it is often desirable to cover the plank first with one or two layers of tarred paper. The joints between the blocks should be filled with bituminous filler. This filler is recommended for all bridge, shop and stable floors. Whenever there is a plank foundation laid on a grade or with traffic all one way, it is desirable to fasten angle irons across the roadway every 20 ft. or so to prevent the block from creeping.

In regard to the blocks themselves: they are made either 3, 3½ or 4 ins. deep; their width varies from 3 to 4 ins., but all blocks in one improvement should be of the same width. Three-inch block should be limited in width between 3 and 3½ ins. Deeper block should be 4 ins. wide. The average weight per yard of wood block is 140 lbs. for 3 ins. deep; 165 lbs. for 3½ ins. deep and 187 lbs. for 4 ins. deep.

As to treatment: 20 lbs. per cubic foot of wood has been standard in this country, but for heavily travelled streets 16 lbs. is sufficient.

Long-leaf yellow pine and Southern black gum have been the standard woods for streets of heavy traffic. In the West they have also used Norway pine and tamarack, and in the East and South North Carolina pine is coming into great favor for residential streets, for those of moderate traffic and for streets with heavy grades. North Carolina pine more nearly resembles the creosoted wood used in Paris and London than does the long leaf; it wears uniformly and permits crushed trap rock to be rolled into its surface, making it less slippery than long leaf. It is ideal for state highways, where if used it should be laid with bituminous filled joints. It is also extensively used for factory floors.

In regard to the labor necessary to lay wood block pavement, leaving out the preliminary work of excavation, foundation, etc., I would say that an ordinary paving gang consists of a foreman, about four pavers, a bed-maker and his helper and some 12 laborers. The yardage that such a gang will lay in a day depends largely on local conditions, but they should pave in the neighborhood of 500 yards per day on continuous work. The above men do not include those engaged in carting and piling the block on the sidewalk or the rolling.

Maintenance and Repair of Asphalt, Bitulithic and Creosoted Wood Block Pavements.

By comparison with all the new procedures in the construction of country highways and city pavements, toward making them the best for the funds expended, very little thought and energy have been expended in devising means to keep these pavements in repair. Irrespective of the construction, any pavement will need repairs in time, whether from wear and tear, expansion and contraction trouble, or improperly repairing excavations made by service corporations and plumbers. An interesting discussion of this subject of repairs to smooth surface pavements was given by Mr. W. L. Hempelmann of the Street Department of St. Louis, Mo., in a paper presented on Jan. 24 at the 28th Annual Meeting of the Illinois Society of Engineers and Surveyors. In his paper Mr. Hempelmann described as follows the methods used at St. Louis in maintaining and repairing asphalt, bitulithic and creosoted wood block pavement:

Everyone interested in the maintenance of bituminous pavements is familiar with the asphalt patching gang, the necessary equipment and the manner in which repairs are made. "Cutting out and plugging in," as the most common means of repairing an asphalt or bitulithic pavement is termed, is most generally used. To do this properly and satisfactorily requires more attention to details than the casual observer would believe. Trimming the joint, properly painting same, tamping or rolling the hot asphaltic top mixture of the desired consistency into the prepared depression, is the general procedure. A careful examination of such a pavement where patching, as described, has been done, will frequently reveal the fact that the joint between the patch and the old pavement has not been sealed, due either to what is known as a "dirty joint" or more generally to carelessness on the part of the laborer in not painting every part of the exposed edge of the depression. This condition is easily observed when, after a rain, the sun has dried up the surface of the pavement, while the patches are definitely outlined by a wet line. Another source of trouble comes from the pushing or displacement of patches because of the material used. The patching material should be as nearly as possible of the same consistency as the old pavement, so that when the summer's sun warms up the pavement, the old and the new material may soften to the same degree. The folly of using a new street mix as patching material in an old pavement has frequently been exemplified.

A temperature variation of from 5° to 10° below zero to 120° or 130° F. in the summer's sun, on the surface of the pavement, presents a complex problem concerning the proper mixture to be used. Under slow moving, heavy loads in the summer, the material is apt to push or creep, bringing about a wavy or undulating condition of the surface. Such a pavement is very "bumpy" to the automobilist. This condition can frequently be remedied by the use of surface heaters. By this means, the bumps or high places are softened and all the burned and soft material is scraped off, leaving a clean surface of the old material. Such burning should be continued until the burned area will require at least 1 in. of added material to restore the pavement to its proper surface and cross-section. In almost every case, it is well to cut a joint at the edge of the burned area, 1 in. or 1½ in. deep, so that the edge of the old pavement may serve as a shoulder for the new material. The surface of such burned area should be made as rough as possible, using a pick or the point of a hoe, that the old material may serve as a key to mechanically hold the new material in place. The whole area should be literally sprayed or sprinkled with an adhesive asphaltic cement, to bring about a better union between the old surface and the new material. This method is economical and when properly done, gives entire satisfaction. Our records show that this method of making repairs, including labor, material, roller and fuel, costs from 50 cts. to 55 cts. per square yard, depending upon the conditions, while straight patching in the ordinary way costs from 75 cts. to 95 cts. per square yard.

Here, again, it is absolutely necessary that the joint between the old and the new pavement be waterproof for the best results. The effect of an imperfect joint or not properly sealed joint is best seen in the late fall or early spring of each year, when by alternately freezing and thawing, the moisture in the joint tends to entirely separate the patch from the rest of the pavement. Such a joint, once opened up during the winter, will not heal in the summer under traffic, the dust from the surface finding its way into these small crevices and preventing for all time the amalgamation of the two mixtures.

In the case of larger stone mixtures, it is this open surface condition which permits moisture to freeze and thaw in the surface, that materially aids in pitting the surface. Steel tire traffic on such a wet, open surface is much more detrimental, in that the steel grinds or crushes the surface rock much more readily because of the better "grip" it gets on same. In the case of mixed traffic, motor and steel tired, the suction, created by the rapid motion of the former, tends to redistribute these fine particles. This can be plainly seen, when after a heavy shower, the fine material from the surface can be found at the low point in the grade.

Recognizing water as one of the worst enemies to smooth pavements, we have endeavored to waterproof our asphalt and bitulithic pavements by treating the surface. Flush-coating or squeegee-coating the last-named pavements has generally been done as a matter of course, to "seal the surface." Hand squeegee carts or pressure wagons to evenly distribute the bituminous material with a coating of sand are generally used. In recent years, the economy of flush-coating the bitulithic streets under contract maintenance is evidenced by the fact that a flush-coat gang is one of the regularly equipped maintenance gangs when repairs are begun after the winter. This thin coat on the surface performs a double duty. It tends to waterproof the surface, by filling all the surface voids, and with the sand forms a thin cushion coat on the surface, taking the wear off the pavement proper. In other words, we tend to build up the pavement by the judicious application of flush coats, rather than permit the pavement to wear down under traffic. Under our traffic conditions, such a flush coat wears at least a year. Using tar at 7¼ cts. per gallon and applying same by means of pressure-wagons, our total flush-coat cost on bitulithic pavements last summer, including tar, sand, teams and labor was about 2½ cts. per square yard.

In the case of asphalt pavements, we applied the same reasoning. We have oiled some of our asphalt pavements and covered them with sand at a cost of about 1 ct. per square yard for material, covering and applying. In an old pavement in this case, it was thought that the oil treatment would help keep the water out of the pavement and at the same time tend to give new life to the bitumen in the pavement. This thin cushion coat on the surface plays an important part in the wearing of such pavement during the winter months, when chains are attached to the driving wheels of the automobile, the pounding having the same effect as so many trip-hammers passing over the pavement. This thin layer on the surface largely takes care of this added wear.

It has been the practice in St. Louis for the last three years to oil and sand the wood-block thoroughfares. This largely is a treatment for slipperiness, and was evolved gradually. Sand or sharp grit was first spread over the surface of such pavements.

Most of the sand was soon found in the gutters, blown to the side by the rapidly moving motor cars and by the wind. The benefit from such a treatment was very short-lived. Next, oiled-sand was tried, the oil and sand being mixed in asphalt mixing pans and spread over the surface from wagons. This was slow, expensive and unsatisfactory, since the sand had to be heated and dried to mix the oil with same and when this warm material was hauled to the street, the bottom of the load was extremely soggy because of the oil which percolated from particle to particle of sand and collected near the bottom. Spreading this soggy material uniformly was impossible. Then, at the suggestion of J. C. Travilla, Street Commissioner, the oil was sprayed on the wood-block surface and covered with sand. This method proved very satisfactory and was economical, costing about 1 ct. per square yard for oil, sand and labor. For this work we apply about ⅛ gal. per square yard, using a pressure wagon for distribution. Such a treatment lasts through the winter and largely helps to waterproof the surface.

Experimental Road Construction at Chevy Chase, Md., by the U. S. Office of Public Roads.

During the year 1911 the U. S. Office of Public Roads constructed a number of sections of experimental pavements at Chevy Chase, Md. The work consisted of a series of comparative tests of bituminous binders now on the market, applied according to the specifications of the manufacturer. The road selected is an extension of Connecticut Ave., Washington, D. C., and the work was started at the District of Columbia line at Chevy Chase Circle, and continued through Chevy Chase to Bradley Lane, a distance of 3,300 ft. This road is subjected to a wide range of traffic, consisting of country and heavy automobile traffic during the entire year, and much hauling of materials of construction from the railroad station during the season favorable to building and development work. In addition to the series of tests on Connecticut Ave. two experiments in surface treatment were conducted on Bradley Lane, a roadway crossing Connecticut Ave. at the north end of the experimental sections. This is a macadam road which was resurfaced in the spring of 1911 and presented a smooth, well bonded surface. The treatments on Bradley Lane were made with refined semi-asphaltic oil and with molasses-lime. The following details of the experimental work at Chevy Chase are taken from a report of the U. S. Office of Public Roads.

EXPERIMENTS ON CONNECTICUT AVE. WITH TARS AND NATIVE AND OIL-ASPHALT PREPARATIONS.

The middle 17 ft. of the road are occupied by a double-track electric-car line. The road was built 19 ft. wide from the outside rail on each side with a crown of ⅜ in. per foot for the first 10 ft. and ½ in. per foot for the remaining 9 ft. A cobblestone gutter was laid adjoining the paving. The bitumen was applied by the penetration method and the characteristics of the materials used will be found in the tables elsewhere in this article.

The original roadway was built by dumping crushed stone and gravel into holes on the right of way as they developed under traffic, until the depth of the stone finally varied from 2 ins. to 14 ins. on a micaceous clay subgrade. This stone was distributed so irregularly that only 140 cu. yds. were saved for replacing. The old roadway was spiked up with a steam roller, the surface broken with a plow drawn by a team, and excavation of the subgrade completed by hand. French drains 2½ ft. deep, immediately under the gutters and along the car tracks, supplied underdrainage where required. As the work was done late in the season surface ditches were dug along the outside edge of the subgrade where there were no French drains to facilitate subgrade drainage during the construction.

TABLE I.—ANALYSES OF REFINED COAL TARS USED AT CHEVY CHASE, MD.

Materials.	Light.		Heavy.	
Where used	Sec. No. 2.		Secs. 1 and 2.	
Specific gravity 25°/25° C.	1.219		1.258	
Float test (time)	47 seconds.[1]		2 minutes 30 seconds.[2]	
Per cent of free carbon	23.35		29.60	
Distillation:	Per cent by volume.	Per cent by weight.	Per cent by volume.	Per cent by weight.
Water	1.2	1.0	0.0	0.0
First light oils to 110° C.	[3]1.0	0.7	[4]0.2	0.2
Second light oils 110° C.-170° C.	[5]0.7	0.5	[4]0.8	0.6
Heavy oils 170° C.-270° C.	[6]20.4	16.8	[7]12.5	10.2
Heavy oils 270° C.-315° C.	[8]7.4	6.5	[4]8.9	7.5
Pitch residue	[9]69.3	74.3	[9]77.6	81.4
	100.0	99.8	100.0	99.9

[1] At 32° C.
[2] At 50° C.
[3] Clear.
[4] Solid.
[5] Turbid.
[6] Two-thirds solid.
[7] One-third solid.
[8] One-sixth solid.
[9] Hard, dull, brittle.

The stone was laid and rolled in courses. The final depth of the foundation course was 5½ ins. compacted, and that of the wearing course was 2½ ins. compacted, except in certain places, where other figures have been given in the description of the individual sections. The size of the stone varied according to specifications for the material, but the completed thickness of all the sections was approximately 8 ins. of compacted material. It was supplied in all commercial sizes at a cost of $1 per ton f. o. b. cars at the Chevy Chase siding and was hauled to the work at an additional cost of 47 cts. per ton.

The bitumen was donated by the manufacturers and the freight charges were included in the project. Application of the bitumen was begun 2 ft. from the outside rail to permit repairs to the car track without disturbing the finished surface. The strip between the car tracks and the bituminous work is water-bound macadam. The bitumen was applied under the direction of a representative of the manufacturer donating the binder and such minor variations from the specifications as occurred were acceptable to the manufacturer. The sections are discussed in the order of their location and the following tables show the general character of the bituminous binders used.

Section No. 1.—Refined Cool Tar—Penetration Method.—This section begins at the District line on the west side of Chevy Chase Circle. It is 513 ft. long, of varying width, and contains 1,581 sq. yds.

The wearing course consisted of 3 ins. of loose stone from 3 ins. to 1 in. in the largest dimension. After rolling lightly, an application of 1.8 gals. of heavy refined coal tar per square yard was made at temperatures varying from 200° F. to 300° F. Screenings from ¾ in. to dust were thickly spread over the surface and the course was thoroughly rolled with a 10-ton standard type steam road roller. When the rolling was completed, all loose screenings were carefully swept into heaps with rattan hand brooms and removed. A second application of the tar of 0.8 gal. per square yard was then applied, and this in turn was covered with screenings similar to those used before. The road was then rolled until compacted.

The tar was supplied from a local plant in tank wagons heated and ready for application. The tank wagon was connected to the roller by a steam hose and the bitumen was applied to the road surface through a nozzle under pressure. Besides the roller man, two men were required to apply the bitumen.

Section No. 2.—Refined Coal Tar—Modified Gladwell Method.—This section is 373 ft. long and contains 705 sq. yds. of treated surface. The essential difference in type between this and Section 1 lies in the fact that a cushion of Potomac River sand 1 in. thick was spread evenly over the foundation course and given an application of 1.18 gals. of the light refined coal tar per square yard. After absorption of the tar by the sand, the wearing course of from 3-in. to 1-in. stone, 3 ins. thick before compacting, was spread and the surface completed as in Section 1. An average of 1.95 gals. of the heavy tar per square yard was applied as the second coat, and 1.02 gals. per square yard as the seal coat. The construction was varied in that the wearing course of stone was very thoroughly compacted, so that all low spots were developed and brought to grade before applying the tar. As a consequence of this, the surface on Section 2 presents a more even appearance than that of Section 1.

These sections were surfaced between Oct. 15 and Oct. 31, 1911, and of this time there were five days on which rain fell and six on which the mornings were very foggy. The maximum temperature at 3 p. m. was 63° F., the minimum 44° F., and the mean at 3 p. m. for the period was 50° F., with the wind generally from a northerly direction.

Section No. 3.—Fluxed Native Asphalt—Penetration Method.—This section adjoins Section 2 on the north. It extends from station 4 + 98 to station 13 + 21 on the west side of Connecticut Ave. and comprises 1,555 sq. yds.

The wearing course consisted of crushed hard limestone from 2 ins. to 1 in. in size, spread 3 ins. thick before being compacted. The bitumen was applied by means of hand-pouring pots, after having been heated to a temperature of from 340° to 360° F. in 100-gal. kettles.

The first application of asphalt was made after the wearing course had been thoroughly compacted with a 10-ton road roller. It consisted of an average of 1.46 gals. per square yard. Chips ranging in size from ¾ in. to ¼ in. were applied and the surface was rolled, after which all excess of chips was removed by sweeping with rattan hand brooms. A seal coat of 0.5 gal. per square yard was then applied, covered with screenings as above, and rolled. The total amount of screenings applied was approximately 1 cu. yd. to each 36 sq. yds. of surface. Owing to a slight

TABLE II.—NATIVE AND OIL-ASPHALT PRODUCTS USED AT CHEVY CHASE, MD.

Materials.	Fluxed native asphalt.	Gilsonite oil-asphalt.	Oil-asphalt.	Oil-asphalt.	Oil-asphalt.
Where used	Sec. 3.	Sec. 4.	Sec. 5.	Sec. 6.	Sec. 7.
Specific gravity 25°/25° C.	1.058	0.974	0.999	0.989	0.973
Melting point °C.	46	52	74	47	90
Penetration (5 seconds, 10 grams, 25° C. [mm.])	12.80	14.60	7.30	9.40	5.50
Per cent of loss at 163° C., 5 hours (20 grams)	2.14	.87	.05	.68	.44
Penetration of residue (mm.)	[1]5.60	[2]9.90	[3]6.50	[1]7.90	[4]5.00
Per cent of total bitumen insoluble in 86° B. paraffin naphtha	20.78	21.13	24.68	20.10	26.20
Per cent of fixed carbon	10.64	7.79	13.53	8.36	10.15
Per cent of bitumen soluble in CS_2	94.51	99.81	99.46	99.59	99.82
Organic matter insoluble	1.00	.12	.50	.28	.15
Inorganic matter	4.49	.07	.04	.13	.03
	100.00	100.00	100.00	100.00	100.00

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[1] Sticky, glossy surface.
[2] Mottled surface.
[3] Sticky, slightly mottled surface.
[4] Hard, fairly lustrous.

TABLE III.—MATERIALS AND COMPLETE COST DATA OF CONNECTICUT AVE. SECTION AT CHEVY CHASE, MD.

Subgrade.

Items.	Spiking.	Excavation.	Shaping.	Rolling.	Subgrade complete.
Quantity (sq. yds.)	......	12,903	12,903	......	12,903
Labor	$57.09	$1,426.15	$429.34	$ 78.54	$1,991.12
Material	24.65	......	......	27.48	52.13
Total	81.74	1,426.15	429.34	106.02	2,043.25
Cost per sq. yd. (cts.)	.63	11.05	3.33	.82	15.83
Per cent of total cost	.5	8.1	2.5	.6	11.7

Drainage.

Items.	French drain. Ft.	8-inch bell pipe. Ft.	Subgrade ditches. Ft.	Gutters. Ft.	Catch basins.	Drainage system.
Quantity	3,084	465	2,980	5,741	4	......
Labor	$492.66	$ 73.02	$115.36	$ 904.75	$24.35	$1,610.14
Material	704.00	87.57	236.49	218.39	30.53	1,276.98
Total	1,196.66	160.59	351.85	1,123.14	54.88	2,887.12
Cost per sq. yd. (cts.)	9.28	1.24	2.73	8.52	.43	22.20
Per cent of total cost	6.8	.9	2.0	6.4	.3	16.4

Surfacing.

Items.	Stone on work.	Spreading stone.	Bitumen on work.	Application of bitumen.	Rolling.	Surface complete.
Quantity	[1]4,660.6	......	......	[2]9,377	[2]12,903	......
Labor	......	$665.98	$ 85.91	$249.03	$314.01	$ 1,314.93
Material	$8,398.20	......	302.40	49.28	109.95	8,859.83
Total	8,398.20	665.98	388.31	298.31	423.96	10,174.76
Cost per sq. yd. (cts.)	65.05	5.16	3.01	2.32	3.28	78.82
Per cent of total cost	47.8	3.8	2.2	1.7	2.4	57.9

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[1] Cubic yards.

[2] Square yards.

Incidental.

Items.	Superintendence.	Watchman and lights.	Miscellaneous.	Drying stone.	Handling screenings.	Total cost.
Labor	$419.75	$202.50	$275.94	$134.20	$391.68	$ 6,340.26
Material	......	150.00	699.90	181.57	......	11,220.41
Total	419.75	352.50	975.84	315.77	391.68	17,560.67
Cost per sq. yd. (cts.)	3.25	2.73	7.53	2.45	3.03	135.84
Per cent of total cost	2.4	2.0	5.53	1.83	2.23	99.9

shortage in bitumen some of the refined semiasphaltic oil used on Bradley Lane was applied as a seal coat over the entire width of the roadway from station 4 + 98 to station 5 + 13 and over a width of 3 ft. along the gutter or outer edge of the pavement from station 5 + 13 to station 6 + 63.

This section was surfaced from Nov. 15 to Nov. 18, 1911, inclusive, when the weather was particularly cold and raw, though fair. The maximum temperature at 3 p. m. was 55° F., the minimum 44° F., and the mean 47° F. The wind was generally from the north. Owing to heavy rains just preceding the application of bitumen to this section, it was necessary to dry all the screenings in drying pans to insure satisfactory results.

Section No. 4.—Gilsonite Oil-Asphalt—Penetration Method.—Section 4 adjoins Section 3 on the north. It extends from station 13 + 21 to station 21 + 44 and comprises 1,555 sq. yds. of surfaced roadway.

The wearing course of stone consisted of particles ranging in size from 2 ins. to 1 in. in diameter, spread to a depth of 3 ins. before compacting. This was rolled lightly before the application of bitumen, which was poured by hand in two courses, as in the case of Section 3. The first application consisted of 1:65 gals. and the second of 0.55 gal. per square yard. Screenings were spread sparingly after the first application, and brooming before applying the seal coat was considered unnecessary. The total application of screenings amounted to approximately 1 cubic yard to each 48 sq. yds. of paving. From station 13 + 21 to station 17 + 35 chips varying in size from ¾ in. to ¼ in. were used, while over the remainder of the section screenings ranging in size from ¾ in. to dust were used. Upon completion the section was rolled with a 3-ton tandem roller.

This section was surfaced from Nov. 3 to Nov. 8, 1911, inclusive, and during this time the weather was cloudy and damp. Northerly winds predominated. The maximum temperature at 3 p. m. was 68° F., minimum 45° F., and mean 54° F. The screenings for this work, however, were not heated and dried.

Section No. 5.—Oil-Asphalt—Penetration Method.—This section lies on both sides of the car tracks. On the west it extends from station 21 + 44 to station 25 + 82 and on the east from station 22 + 01 to station 25 + 82. It comprises 1,447 sq. yds. of finished pavement.

The stone of the wearing course consisted of limestone crushed to sizes ranging from 2 ins. to 1 in. in diameter, spread 3 ins. thick before compression. It was thoroughly compacted before the application of the binder. The binder was heated to temperatures varying from 330° F. to 360° F., and applied by hand-pouring pots as in the case of Section 3. The first application was at the rate of 1.69 gals. per square yard. Chips from ¾ in. to ½ in. in diameter were then spread sparingly over this course of bitumen and the surface was thoroughly rolled. Brooming was considered unnecessary, and the second application of 0.56 gal. per square yard was poured, and was followed by chips from ¾ in. to ¼ in. in size. The surface was then rolled until firm and smooth with a standard type 10-ton road roller.

This bitumen was applied between Nov. 27 and Dec. 2, 1911, and during this time heavy rainfalls prevented continuous work. The weather at the time of application was cloudy and cold, with a maximum temperature at 3 p. m. of 56° F., a minimum of 37° F., and a mean of 47° F. The prevailing wind was from the north.

All chips used on this section were heated and dried. They were applied at the rate of approximately 1 cu. yd. to each 48 sq. yds. of surface.

Section No. 6.—Oil-Asphalt—Penetration Method—This section extends from station 25 + 82 to station 30 + 20. It lies on both sides of the car tracks and comprises 1,555 sq. yds. The wearing course consisted of limestone crushed to sizes ranging from 3 ins. to 1 in., spread to a depth of 3½ ins. before compacting, and thoroughly rolled before the application of the bitumen.

The bitumen was applied by means of hand-pouring pots as in the preceding cases and the first application amounted on the average to 1.56 gals. per square yard. Immediately following this application, the roadway was covered with a coating of chips

TABLE IV.—COST DATA OF EXPERIMENTAL ROAD CONSTRUCTION AT CHEVY CHASE, MD.

Description.			Quantity of material.				Cost data (cents per square yard.																
Section No.	Building materials.	Area of section (sq. yds.).	No. 2 stone (cu. yds. per sq. in.).	Screenings (cu. yds. per sq. in.).	Binder, 1st application (gals. per sq. yd.).	Binder, 2d application (gals. per sq. yd.).	Stone on work.	Spreading stone.	Screenings on work.	Screening chips.	Drying chips.	Spreading chips.	Brooming chips.	Binder.	Freight on binder.	Hauling binder.	Hauling, placing and cleaning kettles.	Chopping, charging and heating bitumen.	Carrying bitumen.	Pouring bitumen.	Rolling.	Cost per square yard.	Total cost.
1	Refined coal tar	1,581	0.083	0.02	1.78	0.81	15.31	1.11	4.58	...	...	0.81	1.61	20.72	...	...	...	...	...	0.50	1.54	46.18	$ 730.11
3	Fluxed native asphalt	1,555	.083	.03	1.46	.50	15.31	1.11	6.10	2.19	5.95	1.08	.30	22.99	3.47	1.14	0.59	1.90	0.76	.26	1.54	64.69	1,005.93
4	Gilsonite oil-asphalt	1,555	.083	.02	1.64	.55	15.31	1.11	4.58	.82	...	.81	...	24.27	4.18	1.24	.41	1.91	.65	.33	1.54	57.18	889.15
5	Oil-asphalt	1,447	.083	.02	1.69	.56	15.31	1.11	4.58	1.64	4.46	.81	...	19.58	4.34	1.27	.36	2.66	.44	.17	1.54	58.27	843.17
6	Do	1,555	.083	.03	1.56	.53	15.31	1.11	7.63	2.74	7.44	1.35	.79	21.95	4.39	1.04	.49	1.49	.73	.22	1.54	68.22	1,064.24
7	Oil - asphalt 2 coat	131	.083	.02	1.66	.60	15.31	1.11	4.58	1.64	4.46	.81	...	23.14	3.98	1.06	.25	1.52	.39	.17	1.54	59.96	78.55
	1 coat	848	.083	.02	1.86	...	15.31	1.11	4.58	1.64	4.46	.81	...	19.05	3.27	1.06	.25	1.25	.33	,14	1.54	54.80	464.70

Description.			Quantity of Material.					Cost data (cents per square yard													
Section No.	Binding materials.	Area of section (sq. yds.).	Sand cushion (cu. yds. per sq. yd.).	No. 2 stone (cu. yds. per sq. yd.).	Screenings (cu. yds. per sq. yd.).	Binder, 1st application (gals. per sq. yd.).	Binder, 2d application (gals. per sq. yd.).	Binder, 3d application (gals. per sq. yd.).	Sand on work.	Spreading sand.	Drying sand.	Stone on work.	Spreading stone.	Screenings on work.	Spreading screenings.	Brooming screenings.	Binder.	Applying binder.	Rolling.	Cost per sq. yd.	Total cost.
2	Refined coal tar	705	0.03	0.083	0.02	1.18	1.95	1.02	4.95	0.39	0.17	15.31	1.11	4.58	0.81	1.61	33.20	0.75	1.54	64.42	$454.16

TABLE V.—ANALYSIS OF REFINED SEMI-ASPHALTIC OIL[1] USED IN EXPERIMENT NO. 1 ON BRADLEY LANE.

Specific gravity 25°/25° C.	0.972
Viscosity, Engler, 100 c. c. at 100° C. specific	9.5
Per cent of loss at 105° C., 11 hours (20 grams)	2.1
Per cent of loss at 163° C., 5 hours (additional)	.68
Float test on residue[2] at 32° C. (time)	4′ 48″
Per cent of bitumen insoluble in 86° B. paraffin naphtha	8.72
Per cent of fixed carbon	7.36
Per cent of bitumen soluble in CS_2 (total bitumen)	99.79
Organic matter insoluble	.19
Inorganic matter	.02
	100.00

[1] Viscous fluid, fairly sticky; contained some water.

[2] Granular surface, very viscous, fairly sticky.

from ¾ in. to ½ in. in size and rolled, after which it was thoroughly swept with rattan hand brooms. An application of 0.53 gal. of a harder grade of the same material was then made and this in turn was covered with chips and rolled. The screenings were spread to such thickness that 1 cu. yd. covered approximately 30 sq. yds. of surface. All the screenings for this work were heated and dried.

This section was surfaced from Nov. 21 to Nov. 23, 1911, while the weather was fair but cold. The maximum temperature at 3 p. m. was 50° F., minimum 41° F., and mean 45° F., with a prevailing northerly wind.

Section No. 7.—Oil-Asphalt—Penetration Method.—This section lies on the east side of the car tracks. It extends from station 16 + 83 to station 22 + 01. It is made up of two distinct tests, the first of which consisted of a one-coat application extending from station 16 + 83 to station 21 + 32, and the second of a two-coat application from station 21 + 32 to station 22 + 01.

The wearing course of stone was identical in both tests. It consisted of a layer of stone ranging from 1 in. to 2½ ins. in size and spread to a depth of 3½ ins. before compacting.

The application of the bitumen in two courses was similar to that of the preceding sections. The first application was made at the rate of 1.66 gals. per square yard and the second at 0.6 gal. per square yard. Chips from ¾ in. to ¼ in. in size were used sparingly between the two courses and brooming was considered unnecessary.

In the case of the one-coat test a small amount of stone chips, ranging from 1 in. to ½ in., were spread over the surface of the wearing course of stone after it had been thoroughly compacted, for the purpose of partially filling the coarse surface interstices and leaving the surface free from the larger irregularities due to the coarse stone. The hot oil-asphalt was then poured evenly over this surface at the rate of 1.86 gals. per square yard and followed by a layer of chips ranging from ¾ in. to ¼ in. The section was rolled until there was no further evidence of compressibility. The total amount of chips used was approximately 1 cubic yard to 48 square yards of surface. The chips were dried before applying.

This section was surfaced on Dec. 2 and Dec. 5, 1911, with the temperature at 3 p. m. 46° F. and 44° F., respectively, the weather fair and the wind moderate. The application of bitumen to this section was not supervised by the representative of the manufacturer.

The cost of the work was borne by the Office of Public Roads and the taxpayers' committee of Section No. 2, Chevy Chase, Md.

The following unit prices prevailed:

Foreman, per day of 9 hours	$4.00
Assistant foreman, per day of 9 hours	3.50
Roller man, per day of 9 hours	3.50
Labor, per day of 9 hours	1.75
Labor, per day of 9 hours	1.60
Watchman, per week	9.00

Hand tools and small equipment, together with contractor's profit, amounted to 12½ per cent of the total of the above-named items.

Team and driver, per day of 9 hours	$5.00
Horse, cart, and driver, per day of 9 hours	3.00

The cost data do not include rent on roller, heating kettles, and sprinkler.

EXPERIMENTS WITH OIL AND MOLASSES-LIME ON BRADLEY LANE.

Experiment No. 1, Sections Nos. 1, 2 and 3.—Refined Semi-Asphaltic Oil.—Section No. 1 begins 50 ft. west of the west rail of the Connecticut Ave. car tracks. It is 811 ft. long and comprises 1,216 sq. yds. The oil was applied at a temperature of 170° F., approximately, and was spread in two courses, the first of which consisted of 0.61 gal. per square yard and the second of 0.31 gal. per square yard. The characteristics of the material used are shown in Table V.

The road surface was swept with a horse-drawn rattan street sweeper, followed by hand push brooms, and was thus freed from dust and loose particles of stone. The oil was allowed to run upon the road by gravity from a tank wagon until an area of about 6 ft. by 8 ft. was covered. The wagon was then drawn forward a few feet, and the oil was spread and broomed into the road surface with hand push brooms. As soon as the brooming was completed, the oil was covered with chips and the surface was rolled. Six men were required to spread the oil and two to spread the chips. The chips were secured by passing crusher-run screenings ranging from ¾ in. to dust over a ¼ in. screen. In this manner both applications were made under the direction of the representative of the manufacturer.

Section No. 1 extends from Connecticut Ave. to the first side street leading into Bradley Lane, and a vacant lot on this side street served the purpose of a contractor's material yard. Traffic over this section may be classed as heavy, since, in addition to the mixed through traffic over Bradley Lane, there are frequently as many as 120 loads of 3 tons gross per day going to the yards and as many empty wagons returning.

Section No. 2 adjoins Section 1 on the west. It is 256 ft. long and comprises 384 sq. yds. It consists of a single application of approximately 0.61 gal. per square yard, spread and treated as described in Section 1.

Section No. 3 is 1,188 ft. long and comprises 1,784 sq. yds. Two applications of oil were made as in Section 1, and the average application per square yard in the first course was 0.61 gal. and 0.31 gal. in the second.

After the surface applications were completed, all excess of oil or "bleeding" was taken up with sand and screenings ranging from ½ in. to dust. Some of this material was applied by brooming into the roadway the excess screenings which had been brushed aside by traffic, but no more screenings or chips were applied at any time than were needed to absorb the excess of oil then apparent.

TABLE VI.—MATERIALS AND COST DATA OF OIL SURFACE TREATMENT ON BRADLEY LANE.

Section numbers	2	1 and 3
Applications	1	2
Total area covered (sq. yds.)	384	2,999
Oil per sq. yd. (gal.)	.61	.92
Screenings per sq. yd. (cu. yd.)	.025	.040
Cost of superintendence per sq. yd. (cts.)	.25	.40
Cost of cleaning surface per sq. yd. (cts.)	1.97	1.97
Cost of oil per sq. yd. (cts.)	2.18	3.28
Cost of freight on oil per sq. yd. (cts.)	1.02	1.55
Cost of heating oil per sq. yd. (cts.)	1.08	1.63
Cost of pumping oil per sq. yd. (cts.)	.11	.16
Cost of hauling and applying oil per sq. yd. (cts.)	.87	1.28
Cost of sand and screenings per sq. yd. (cts.)	4.50	7.20
Cost of screening chips per sq. yd. (cts.)	.67	.98
Cost of spreading sand and chips per sq. yd. (cts.)	1.11	1.64
Cost of brooming chips per sq. yd. (cts.)	.23	.45
Cost of rolling per sq. yd. (cts.)	.52	1.04
Total cost per sq. yd. (cts.)	14.51	21.58
Total cost of entire section	$55.72	$647.18

TABLE VII.—COST DATA OF MOLASSES-LIME EXPERIMENT AT CHEVY CHASE. MARYLAND.

Labor, for sweeping, 2½ hrs., at 20 cts.	$ 0.50
Labor, for mixing, etc., 16 hrs. at 20 cts.	3.20
Team, for sprinkling, ½ day, at $5	2.50
Lime, 360 lbs., at 90 cts. per 100 lbs., delivered on work	3.24
Molasses, 150 gals., at 15 cts. per gal., delivered on work	22.50
Total cost of treatment	$31.94
Total cost per sq. yd.	.02

The traffic over Sections 2 and 3 is identical, as there are no intersecting or side streets. It may be classed as suburban traffic.

Table VI which gives cost data for the work on Bradley Lane is based on the same unit prices as prevailed on Connecticut Ave., and the oil was donated by the manufacturer.

Experiment No. 2, Section No. 4.—Molasses-Lime.—The theory upon which this method of treatment was based depends upon the fact that a mixture of molasses and lime results in the formation of calcium sucrates, which are tough, sticky salts, rather sparingly soluble in water.

Laboratory results from properly proportioned mixtures of lime, molasses and rock dust or clay have shown that the salts formed are capable of developing a remarkably high binding value, and since waste molasses or black strap is obtained at a comparatively low figure in the neighborhood of sugar refineries it was thought that an economic and efficient method of surface treatment for such localities might be developed and that the experiment which had previously failed might be well worth another trial under somewhat different conditions.

The section selected was 1,060 ft. in length and adjoins the west end of Section 3, on which oil was used. The road surface was well bonded and in good condition. Before treating the excess of dust and detritus was swept off and the surface was given a light sprinkling with water to lay and saturate the remaining dust.

Basing a formula on some experimental results in the laboratory, the materials for treatment were mixed in the proportion of 360 lbs. of lime, 150 gals. of molasses, and sufficient water to dilute the above mixture to 450 gals, which was the capacity of the sprinkler used. This made a sticky mixture, but one that could be run from an ordinary sprinkler quite readily. The method of operation was crude, and as the work was done in December difficulty in mixing was largely increased by the cold weather and consequent viscosity of the molasses. The lime was slaked in barrels to form a thick cream, and to each ½ bbl. of this cream a ½ bbl. of molasses was added with constant stirring. It was hoped that a small rotary hand pump could be used to force the material up into the sprinkler, but it failed from the start, and as no other facilities were at hand the mixture had to be bailed with long-handled dippers. When it had all been transferred from the barrels, water was added up to the capacity of the sprinkler, and the solution was immediately sprayed on the road in sufficient quantity to saturate the surface thoroughly. The application was made heaviest on the crown of the road and any excess drained off toward the shoulders. The surface dried quite rapidly, and there was no interruption to traffic. When inspected, about one month after treatment, the surface still showed evidences of having been treated, although there had been several heavy rains previous to the inspection. It is hoped to continue the experiment with one or more applications during the coming summer.

The total area treated was 1,531 sq. yds., and the cost data are given in Table VII.

Sewers and Water Mains in Calgary.—Calgary, Alberta, laid 40 miles of water mains in 1912, making a total of 147 miles laid in the city, and supplying water to every section. The city also built 50 miles of sewers, making a total of 151 miles.

Country Road Construction With Small Quantities of Gravel.

The simplest way of constructing a gravel road is to dump the material on the roadbed and allow it to be consolidated by the traffic. In most cases a large amount of gravel is applied, a considerable part of which is wasted. The application of small quantities of gravel in work of this sort has been employed successfully by Mr. G. W. Allyn, a practical road builder of Mission Lake, Minn. He claims that about 200 cu. yds. of gravel per mile is all that is necessary, and is even better than a larger quantity. Mr. Allyn has had no small measure of success in his county by the use of the method, which he describes as follows:

The word gravel often conveys the wrong idea as to what is best to use on a road. Good coarse plastering sand with a small mixture of small gravel is the best material for our black or clay soil roads, though anything that contains sand or small gravel is better than nothing.

There are two essential things to be accomplished: First, stop the mud or clay sticking to the wagon wheels and horses' feet; this is immediately accomplished when sand is mixed with the mud. This stops the rutting up of the road, and therefore stops the holding of the water in the holes. Second, the forming of a "hard pan" or solid crust, which is done by the mixing of clay and sand, or black dirt and sand. Sand or gravel alone makes the poorest road in the world, and dirt or clay alone are only good when partially wet. When too wet they are soft and cut up by travel, and when too dry they will not pack, but work up into a deep dust. Dirt roads would be good roads if we could regulate the rainfall on them all the time, but as we cannot, they are not good except occasionally, when the weather has been just right for a spell, but with the mixture of sand and dirt, the road will remain hard as a floor through rain or drouth. If the mixture has been about right (and it is easy to get this mixture just right on all dirt or clay soils if a little care is used in putting on the sand), it will naturally mix itself exactly right by travel, if it has any kind of a chance to really mix. This has been proven in all kinds of dirt soil, and is no longer a theory but a proven fact.

If too much sand is applied to any one spot at one time, there is no chance to mix with the dirt below it by travel, because the wear of the travel is all spent on the loose sand, and does not mix it with the dirt. Some of the best road advocates today are using manure spreaders to apply the sand and go over the roads every few days with a sprinkling of sand, during the mixing process. If this is attended to properly it makes a splendid road, but it is expensive, and usually does not get the sand applied as often as it should be at just the right time. It has been demonstrated time and again that just as good, or better results are obtained, where the right quantity of sand is dumped exactly in the center of the road, and a common field drag run over the road once or twice, lengthwise. In doing this care should be taken to drag but little out into the wheel tracks at first; then later repeat the drag process, when the first sand has been mixed by the wheels. The horses' feet and other travel inside the wheel tracks will usually scatter out the sand about fast enough, and the rains will also wash it out, and the track where the wheels run, and inside where the horses' feet travel soon mixes with dirt until it's as hard as adamant.

The tendency is always to put on too much sand at first, rather than too little. This not only wastes the labor of hauling the sand but spoils the road, as it cannot properly mix, and the road will never be as good as it would have been had the sand been put on lighter at first so it could properly mix. About ½ yd. is all that should be put in the center of the road at one time, the length of a set of 12-ft. boards, and in soil that is hard and has some sand and gravel in it already, a less amount is better.

The writer has several times demonstrated the fact, on the same road where there was a rather soft dump, that ½ yd., properly applied, made a harder and better road than a yard or more dumped on the same ground. In the latter case the gravel would not properly mix with the top dirt, to form the crust, but was punched deep into the mud later when the whole dump softened up by continued wet. On a soft dump (and also many other places on the road) it will be necessary, sooner or later to again haul on a small amount of sand, but a road cannot be made, so that all of it will remain good, without the second application, and occasionally we find on certain soil that the third coat is necessary. But the most of the roads will require but one, if the proper mixture is secured the first time. But in all cases remember that the mixture with the dirt is absolutely necessary, and if the sand and gravel is in any spot too thick to properly mix, there will always be a soft spot there, and will "rut up" and make "pitch holes." Two inches of a crust, that was allowed to mix properly, will never break through unless drainage was not secured, and water softened the dump beneath.

I am aware that these facts cannot be explained so that the average road builder will agree with me fully, for it seems logical that a soft place requires more sand than a hard bed. This is true, but the fact remains that it must be put on as needed, and only a thin coat at any one time must be allowed under the horses' feet and the wheels; otherwise it will not mix with dirt, and no crust will be formed. It will eventually be punched deep in the ruts, and make no mixture with the dirt but will remain chunks of sand and chunks of mud.

Dirt readily absorbs water. Sand is a ready conductor of water, and retains moisture, and when a dump is mixed in chunks of each, it is the worst possible water absorbent, and retains the moisture, but when sand and dirt are properly mixed together, it is impossible to get a drop of water through them, and the dirt under the crust always remains dry.

For 28 years I have been making a study of this matter, closely watching the graveling under all conditions, and in various ways, from the brick clay and gumbo mud of Missouri to the black mud and gumbo of the Red River Valley, and while different soils require different treatment, yet there is no soil that it pays to put a large amount of sand or gravel on at once. It is worse than wasted time and money. A thin crust about 2 ins. in thickness is all that can be made to mix properly by the ordinary travel, and it's expensive to mix it in any other way. Soft soil must receive a second coat, about the time the first coat gets well mixed, but it is extremely expensive to try to build a road by putting on too much at once. In case the sand could not be hauled at some subsequent time (usually about a year later, depending on the soil and rainfall as well as the travel), the extra amount should be piled by these softer spots in the road, and applied when needed.

GENERAL ARTICLES

A Method of Proximate Analysis for the Commercial Evaluation of Coal.

The purchase of coal on analysis is becoming constantly more common. As the practice increases provision will be necessary by consumers, of individual laboratories for testing coal, just as now cement-testing laboratories are universally provided by large works and cities and public service corporations when much cement is used. Also as is the case with these cement-testing laboratories, the coal-testing laboratory for individual service will be one for proximate evaluation only, not a research laboratory, and will thus be a part of the working equipment of city and corporation engineers. To provide information concerning the equipment of laboratories for proximate coal tests, and concerning laboratory methods the Bureau of Mines has published the statement which we print as follows:

The commercial evaluation of coal is based on the results of a proximate analysis, a sulphur determination, and a heating-value determination. The proximate analysis consists of the determination of moisture, ash, volatile combustible matter, and fixed carbon, the latter being determined by difference.

DETERMINATION OF MOISTURE.

The determination of moisture in coal, though seemingly very simple, presents many difficulties. It is impossible, for instance, to reduce the sample to a convenient weight and size without losing some of the moisture in the process of reduction. How much is lost depends on the proportion of moisture originally carried by the coal. For this reason a "total-moisture" sample is taken immediately after the coal has been reduced to pass a 20-mesh sieve. The moisture in this sample is determined separately and is called total moisture. Further, one must exercise care in regulating the temperature if heat is used in the drying. The temperature must not be too low lest all the moisture be not driven out, and it must not be too high lest some volatile matter that is not moisture escape. For this discussion moisture is defined as that water which was contained in the coal before it was mined (including only that moisture which is driven off under the conditions above specified) and in addition some water taken up through exposure to the weather.

Apparatus.—For the determination of moisture there should be provided a good analytical balance, several Royal Meissen procelain capsules, about No. 2 size, with thin aluminum lids, several ordinary glass desiccators, and a specially constructed drying oven.

The drying oven used in the fuel-inspection laboratory of the Bureau of Mines is rectangular (10 ins. wide by 13 ins. high) and is built entirely of heavy sheet copper. The drying space consists of four separate compartments into each of which fits a drawer or tray holding 12 sample crucibles. Each compartment is surrounded by a bath of boiling glycerin (2 parts glycerin to 1 part water) and has an opening at the back for admitting chemically dried air. The bath is heated by means of two Bunsen burners, and the entering air is heated to the temperature of the bath by passing through a coiled tube in the base of the oven. A return condenser is inserted into an opening at the top of the bath to prevent concentration by distillation. The chief advantages of this type of drying oven are that it has large capacity, can be uniformly heated, requires little attention and that any of the compartments may be opened without disturbing the temperature of the others. The trays are small (6x7½ ins.) and as completely surrounded by the bath as may be, thus preventing temperature variations within the drying spaces. The glycerin solution boils at 248° F. and keeps the temperature within the drying spaces constant at about 221° F. By means of this oven complete drying of a coal sample may be accomplished in one and one-half hours.

Method.—One gram (about 1/30 o

coal is taken from a bottle sample which has been thoroughly mixed on the mixing wheel. This is weighed into a porcelain capsule, the weight of which has been ascertained, and the capsule is placed in the oven and allowed to remain there for an hour and a half. It is then removed, covered with an aluminum lid, and placed in a desiccator to cool. When cool it is again weighed; the loss in weight represents moisture. The function of the desiccator is to keep the sample in a dry atmosphere and to prevent it from taking up moisture while cooling.

On account of the tendency of coal to lose moisture while being pulverized and exposed to the dry air of the laboratory, a moisture determination must be made on a comparatively coarse sample. This sample, called a "total-moisture" sample is taken as quickly as possible after the coal has been reduced to 20-mesh fineness. The figures resulting represent total moisture; that it, all the moisture held by the coal.

DETERMINATION OF ASH.

Ash, as determined by the proximate analysis, is much the same chemically as the refuse found in the ash pit of a furnace. However, there is this important difference: In making an ash determination in the laboratory all the combustible contained in the coal is burned, and the manner of the combustion does not permit clinkering, whereas ash from combustion in an ordinary furnace is usually found to contain from 10 to 50 per cent of unburned combustible and sometimes considerable clinker. This clinker incloses some carbonaceous matter which thus escapes combustion. However, most of the combustible in the ash-pit refuse is from the unconsumed coal that drops through the grate bars, especially when the fire is cleaned.

Apparatus.—In the Bureau of Mines laboratory an ordinary assayer's furnace is used for burning out the combustible. The assayer's furnace consists of a fire-clay box or receptacle called a muffle inclosed in an iron-bound fire-box built of firebrick and so supported in an interior-combustion chamber that the furnace gases do not enter it and that access may be had to it through an open end at the front. The muffle is heated to cherry redness by means of a gas blast from a special burner projecting into the combustion chamber.

Method.—The capsule containing the residue from the moisture determination is placed in the muffle and heated for one and one-half hours at about 1,652° F., with a slow draft of air circulating over it. This treatment burns out all the combustible and drives off some volatile matter that is not combustible. Here it may be explained that all the constituents given off by the coal in "ashing" are not heat producing. Aside from a certain amount of water of composition, there are always present volatile constituents of inorganic matter which do not burn and are volatile at the ashing temperature; consequently the value of ash found by this method is slightly lower than it should be. This difference from the true ash value varies with the coal tested. The capsule containing the ash is allowed to cool and is weighed. Then it is placed back in the furnace, and the process is repeated to make sure that the combustible has been burned.

DETERMINATION OF VOLATILE COMBUSTIBLE MATTER.

There is considerable uncertainty among technical men as to just what the so-called combustible matter of coal is and as to what are the best methods of determining it. Volatile combustible is that part of coal (consisting of a number of compounds not well known chemically) which is distilled or driven off in the manufacture of coke. The difficulty in determining these distillation products is that they vary in quantity and character according to the heating method employed, and the problem is to adopt a method that will give uniform results. A knowledge of the volatile combustible content of a coal enables one, within the limits of accuracy of the determination, to classify the coal.

Apparatus.—At the fuel-inspection laboratory the apparatus for the determination of volatile matter includes platinum crucibles (30 c. c. capacity), platinum supports for them, ring stands, and flame shields. The crucibles are the most expensive part of the equipment. To insure the best results they are always kept clean and in good condition and are provided with tightly fitting lids. A flame shield is made by bending a rectangular piece of sheet iron (about 6x10 ins.) longitudinally in the form of a tube, punching holes in it to admit the platinum triangles or crucible supports, fitting the whole to a ring support, and clamping it to a stand.

Method.—One gram of the coal is weighed into a weighed 30-c. c. platinum crucible, and the crucible is covered and placed on the crucible supports. A burner is placed underneath the crucible and so adjusted that it gives a carbon-free flame about 20 cm. in length; the bottom of the crucible is 7 cm. from the top of the burner. The Fletcher burner is used because it is best adapted for burning the gas supplied to the laboratory. The crucible is heated in the flame for exactly 7 minutes, taken off, allowed to cool and then weighed. The loss in weight represents volatile combustible matter.

DETERMINATION OF SULPHUR.

Sulphur, like ash, is one of the constituents of coal that depreciate its value. For instance, a coal containing much sulphur is unfit for making coke and, in general, for use in all metal-working processes. Sulphur combines with the metal, forming compounds that make the metal brittle. It exists in coal as iron pyrite, combined with the organic matter, and as sulphates of the metals of the ash. When the sulphur content of a coal is high (say 3 per cent), iron pyrite is usually present.

Apparatus.—A detailed description of the methods used in the bureau's laboratory for the determination of sulphur in coal is thought advisable in view of the fact that methods found in chemical literature have been slightly modified to suit special needs. A list of the necessary apparatus, chemicals, and materials follows: 11-cm., No. 595, S. & S. filter papers for rapid filtration; 7-cm., No. 589, blue-ribbon S. & S. papers for retaining the sulphate precipitate; No. 00 Royal Meissen porcelain crucibles; an ordinary hot plate; special filter table, shown in Plate I, *B*, designed to facilitate the handling of a large number of determinations at one time; a 10 per cent solution of barium chloride; a 5 per cent solution of silver nitrate; a dilute solution of sulphuric acid; asbestos trays for holding crucibles in sets; 250-c. c. Jena glass beakers.

Bomb Calorimeter Method.—After the combustion the calorimeter is washed out thoroughly and the washings collected in a 250-c. c. beaker. The washings are titrated with standard ammonia to obtain the "acid correction" for the heating value; 4 c. c. of strong ammonia is added, to insure complete precipitation of any metals in solution, and the solution is heated to boiling on the hot plate. The residue, mostly ash from the combustion, is filtered off and washed five times with hot water, and 5 c. c. of concentrated hydrochloric acid and a few drops of bromine water are added to the solution, which is placed back on the hot plate and heated to boiling; 10 c. c. of the hot barium chloride (10 per cent) solution is added, and the precipitate is allowed to settle for at least two hours. The beaker containing the solution is then taken to the filter table, where the supernatant liquid is siphoned off and tested with dilute sulphuric acid for excess barium chloride, and the precipitated barium sulphate is collected on a 7-cm. filter paper. The precipitate is washed with hot water till the washings show no reaction for chlorides: it is then placed in the crucible, dried, ignited and weighed. The ignition is effected by means of the muffle furnace (by using a small filter paper appreciable loss in weight by reduction is avoided) and is completed in about 10 minutes. The crucible is then covered and allowed to cool. After cooling, the precipitate is brushed out on a balanced watch glass and weighed.

Eschka's Method.—Eschka's method for determining sulphur is used to check or verify results, and is as follows:

One gram of finely pulverized coal is weighed into a 30-c. c. platinum crucible into which about 1.5 grams of "Eschka's mixture" has been weighed. The coal and the mixture are then intimately mixed with a glass rod, covered completely with about 0.5 gram of the mixture, and heated over a small alcohol flame till the coal is all burned. The heating is done slowly at first (not rapidly enough to blacken the mixture covering the charge) to avoid loss of volatile matter. The flame is then turned up and the combustion finished. The coal should be completely burned in two hours. The crucible is then allowed to cool. After cooling, its contents are brushed out into a beaker containing about 75 c. c. of boiling water, and the solution is stirred thoroughly. The residue is digested on the hot plate for about an hour and a half, washed two or three times by decantation (the washings being poured through a filter), and transferred to a filter. It is then washed thoroughly on the filter, 3 c. c. of concentrated hydrochloric acid and 5 c. c. of bromine water are added to the solution, and the process is continued as described in the first-mentioned method.

DETERMINATION OF HEATING VALUE.

The figures for heating value or calorific power give perhaps the most valuable information as to the quality of a given coal. By heating value is meant the heat that the coal yields on being burned completely. There is no simple unit by which heat quantity may be measured, so that the use of a derived unit is necessary. Such a unit is derived by measuring the effect of the absorption of a given amount of heat by some substance of uniform heat capacity. The substance selected is water, because water has a large and constant heat capacity and uniform heat distribution in water is easily effected. The heat unit commonly used in engineering is the so-called British thermal unit (B. t. u) and may be defined as the amount of heat required to raise 1° F. the temperature of 1 lb. of water at or near 39.1° F. There is also the French or metric unit (calore), which is commonly used in scientific investigations. The gram calorie, or small calorie (cal.), is the amount of heat required to raise the temperature of 1 gram of water 1° C., and the kilogram calorie, or large calorie (Cal.), is the amount of heat required to raise the temperature of 1 kilogram of water 1° C. Another thermal unit sometimes used is the pound calorie, the amount of heat required to raise the temperature of 1 lb. of water 1° C.

For example, assume that under a vessel containing 2,000 lbs. of water 20 lbs. of coal is burned in such a manner that all of the combustible in the coal is consumed and all of the heat given off is used in heating the water. Assume that the temperature of the water before firing the coal was 40° F. and after the coal was all burned it was 186° F., or that there was a temperature rise of 146° F. caused by the combustion. The heating value (per pound) of the coal is derived as follows:

$$2{,}000 \times 146 = 292{,}000 \text{ B. t. u. for every 20 lbs. of the coal, or,}$$

$$\frac{292{,}000}{20} = 14{,}600 \text{ B. t. u. per pound of coal.}$$

If conversion of the above figure into calories per gram of combustible is desired, the calculation is as follows, using the following relations: 1° C. equals 9/5° F., and 1 lb. equals 453.6 grams:

$$14{,}600 \times \frac{5}{9} \times 453.6 = 3{,}679{,}200 \text{ calories per pound.}$$

$$\frac{3{,}679{,}200}{453.6} = 8{,}111.1 \text{ calories per gram}$$

LABORATORY RECORD.

Serial No. 37210. Index No. 145. Can No. 1864.

Air-dry.	Moist. 105°.	Total moist.	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	B. t. u.	B. t. u. M.&A.F.
	1.30	1.60	21.20	....	7.30	.65	14,325	....
	....	....	21.00	....	....	....	14,310	....
Average	....	....	21.10	....	....	....	14,317	....
True volatile......	....	....	19.80	....	....	....	......	....

Date received, Jan. 2, 1912. Date reported, Jan. 9, 1912.

Remarks: ....

Fig. 1—Laboratory Record Card of Chemical Test of Fuel.

Apparatus.—Of course, an ordinary boiler would not give the results outlined above, for several reasons. Some of the heat given off would be used in heating the walls of the furnace, the steel of the boiler, the air used, etc. Moreover, the combustion would not be complete. For exact heating-value determinations of the Bureau of Mines uses a bomb calorimeter. This is an instrument in which a small quantity of combustible is completely burned and the resultant heat is transmitted to a weighed quantity of water in such a manner that the effect of the heat can be accurately measured by means of a thermometer. The chief requirements of a combustion-calorimeter outfit are: (*a*) That it shall effect complete combustion; (*b*) that it shall allow no heat to escape absorption by the water; (*c*) that its radiation and absorption factor shall be as small as passible, thus making correction easy; (*d*) that the thermometer used for measuring temperature differences shall be of the best quality and carefully calibrated.

The standard calorimetric outfit consists of a steel cup or bomb (lined with some acid-resisting material, such as procelain or platinum) closed with a screw cap, and fitted with an oxygen valve, electrodes for electrical firing of the charge, a metal bucket for holding water and the bomb, a mechanical stirrer, and a thermometer. There is also an inclosing jacket to protect the instrument against room-temperature variations. The jacket consists of a double-walled brass can containing a relatively large quantity of water; it is covered with felt.

Method.—One gram of coal is weighed into a platinum tray and placed on a support inside of the bomb, a piece of platinum fuse wire is then connected to the electrodes and allowed to dip into the coal. The bomb cap is screwed into place (the cap is seated on a lead gasket so as to form a perfectly tight joint) and oxygen is forced in at a pressure of about 350 lbs. per square inch. The bomb so charged is then placed in the can containing the weighed amount of water, the whole is put in place in the jacket, the thermometer and the stirrer are inserted, and the jacket is covered. The temperature of the calorimeter is observed at minute intervals for five consecutive minutes, and at the end of the fifth minute the electric circuit is closed, thus firing the coal. The thermometer is now observed carefully, as it registers the temperature increase of the water, and the temperature noted at given intervals is entered on the record sheet. The first two readings after firing are taken at half-minute intervals. Three more readings are taken at minute intervals. The maximum temperature will now have been reached and the thermometer is observed for five consecutive minutes to determine the rate of gain or loss of heat. All the data for calculating the heating value of the coal have now been determined. The following corrections must, however, be made:

LABORATORY REPORT.

Serial No. 37210. Index No. 145. Can No. 1864.

Date received.. Date reported..

Air-dry loss.	As received.	Dry coal.	M. & A. F.
Moisture	1.6	....	....
Volatile matter..................................	19.7	20.1	....
Fixed carbon....................................	71.4	72.5	....
Ash	7.3	7.4	....
Total	100.0	100.0	....
Sulphur	.65	.65	....
B. t. u...	14,270	14,510	15,660

Analysis desired:

Fig. 2—Laboratory Report Card for Fuel Test.

(*a*) The nitrogen content having been burned to nitric acid, the nitric-acid correction is obtained by titration of washings of the bomb with standard alkali of such a strength that 1 c. c. equals 5 calories or 9 B. t. u.

(*b*) The sulphur content, instead of having been burned to sulphurous acid, as in furnace combustion, has been burned in the bomb to sulphuric acid, and a correction must be made for this difference. The correction is made by using the figures for the percentage of sulphur found by analysis.

The net heating value is obtained by multiplying the rise of temperature caused by the combustion of the coal by the water value of the calorimeter (this includes the water equivalent of the apparatus plus the weight of the water used).

Calculations and corrections involved in this determination are given in detail in Technical Paper 8 of the Bureau of Mines.

CALIBRATION OF THE CALORIMETER.

In order that calorimetric results shall be reliable the water equivalent of the calorimeter must be accurately known. The water equivalent of the calorimeter is the heat capacity of the apparatus referred to water as unity; that is, the sum of the products of the parts multiplied by their several specific heats. The following are some of the methods used for arriving at these figures:

(1) By weighing the parts and adding the products of the weights multiplied by the specific heats.

(2) By burning in the calorimeter the same weight of a given substance, but using different amounts of water. Two equations may then be written involving two unknowns, namely, the water equivalent and the heating value of the substance.

(3) By introducing electrically into the calorimetric system a known amount of heat.

(4) By the well-known method of mixtures.

(5) By burning in the calorimeter a known weight of a substance, the heating value of which is accurately known, and calculating the water equivalent by heat difference.

The last-mentioned method, by reason of its ready application, is the one most used by the bureau's fuel-inspection laboratory. A calorimeter may be frequently and easily checked by this method. The several calorimeters used by the bureau's fuel-inspection laboratory are frequently checked with standard sucrose obtained from the Bureau of Standards and are further cross-checked with each other daily. Thus the probability of error is made very small.

PROCEDURE IN MAKING CALCULATIONS.

The results of the fuel-inspection work of each chemist are in the form of assays, which must be assembled and calculated to the proper basis before reporting. All these figures, as well as those on the assay sheets, are checked by the chemist who does the calculating and are rechecked by his assistant. As an example of a routine calculation, the following figures from an assay sheet, together with the record cards Figs. 1 and 2, properly filled out, are here shown:

Determination.	Amt.	Determined by—	Checked by—
Volatile matter......	21.00	K.J.O.	H.M.C.
Duplicate volatile....	21.20	C.	H.M.C.
Moisture at 105° C...	1.30	N.	H.M.C.
Ash	7.30	N.	H.M.C.
Total moisture.......	1.60	B.	H,M.C.
B. t. u..............	14,325	B.	K.J.O.
Duplicate B. t. u.....	14,310	W.F.	H.M.C.
Sulphur	.65	K.J.O.	H.M.C.

As will be seen, the results are reported on the basis of moisture-free coal and of coal "as received." The calculation consists simply in dividing the assay results by 100, minus the moisture at 105° C., to obtain "dry coal," and in multiplying these figures by 100 minus the total moisture, to get the "as-received" value. The "fixed-carbon" figures are determined by difference, or by subtracting the sum of the ash, moisture, and volatile matter from 100 in each case. All figured results are checked with a mechanical calculating machine before being reported.

A Suggested Method for Closing a Crevasse in a Levee.

The possibility of closing crevasses in levees is discussed briefly by Capt. C. O. Sherrill in "Professional Memoirs" for January-February, 1913, as follows:

Each time disastrous floods occur on the Mississippi River, the question comes up as to the advisability of attempting to close crevasses. The reasons generally given for not attempting their closure are: (1) The great difficulty and expense of the undertaking, even if successful; (2) the probability of failure, and (3) the great damage that will have been done before the closure is completed.

The chief reason for failure in closing crevasses in the past has been that no previous plans have been made for the work, no materials and plant have been collected, and no organization provided ready for the emergency. The result has been that several days' delay in getting started occurs, the width of opening becomes greatly enlarged, and the erosion of the gorge immensely increases the difficulty of the work.

Up to the present, too, no successful effort has been made to improve the system of closure heretofore used—an open-crib structure floored throughout by the simultaneous deposit of sacks of earth. To close a crevasse by the present methods the entire crib must be finished before the sacking begins; otherwise, erosion of the soil is so rapid due to a partial obstruction of the current by the sacks placed at one spot, as to cause the piles to be quickly undermined and the structure to be destroyed. When the entire crib has been floored with sacks of earth, it is possible to elevate the sack filling by successive layers without causing extensive erosion. It is evident that in water 10 to 20 ft. deep an enormous number of sacks must be used to fill the four or five rows of cribs necessary to the stability of the structure under a head of 8 or 10 ft., and against a 12 to 15-mile current.

The only other method of closing crevasses, seriously suggested up to this time, is the use of timber sheet-piling driven from each end, as in case of the timber crib. This has never been used successfully against heads of more than 5 or 6 ft., on account of the swift current and enormous erosion caused as the flow is reduced, due to the obstruction of the sheet-piling. This difficulty will be appreciated by any one who has ever seen the rapids below Niagara, as a large crevasse is quite as turbulent.

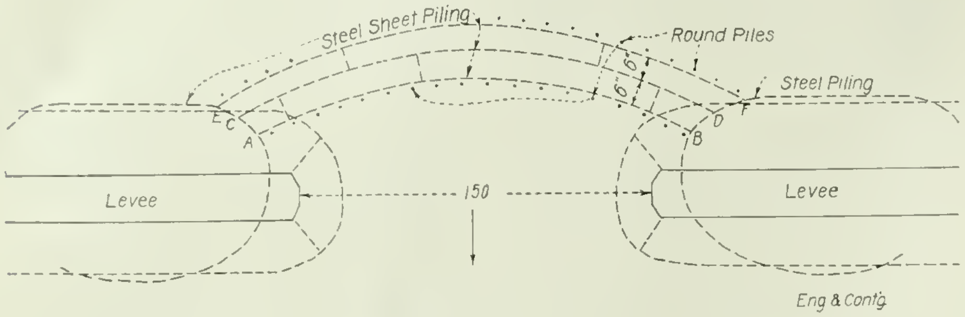


Fig. 1—Sketch Showing Suggested Method for Closing Crevasse in Levee.

Figure 1 shows type of closure that appears to me to be possible at small cost and with reasonable certainty of success. The first essential in the work is to have two complete independent units fully equipped on barges, with supplies of steel sheet piling, steam pile drivers, and all supplies necessary for the work. These barges would be moved to the two ends of the crevasse and the construction of the sheet-piling caissons would be begun (as indicated on Fig. 1) for holding the ends of the levee. It would be necessary to extend the land side of these caissons until there would be no danger of the erosion cutting the levees in rear of the caissons. If the sheet piles were driven to a penetration of about 20 ft. at first, it would be sufficient. Later, as the earth at the ends of the levee eroded enough to threaten the caisson, the resistance to driving would be so decreased that these piles could be driven as deeply as required.

As soon as caissons were finished, pile drivers would start driving the line of sheet piling marked *A*, *B*, the pile driver being supported on round piles driven as it advanced across the crevasse. This first row of sheet piles would be driven practically flush with the original ground surface in order not to obstruct the current and thus increase the scour. As soon as this row was completed, working from both ends, a second row would be driven to a height of about 3 or 4 ft. above the first; because, having the first row placed, the fall of water between the two rows would not cause undue scour and also the small head would be easily supported by the sheet piles. Similarly, a third and, if need be, a fourth row would be driven, until the last row extended above the water. The location of the lines of sheet piles would be varied according to current and soil; in good clay they could run straight across. A hydraulic dredge would then be put to work filling behind and over the sheet-piling to rebuild the levee. The sheet piles could be removed for future use as soon as the levee in rear was finished.

The greatest difficulty in this work would be to drive the round piles for the pile driver platform in the swift current, but as there would be no obstruction to flow other than the levee ends, this should be feasible. The work of driving the sheet piling would involve only two sheet piles being opposed to the current at a time, for as soon as the one in advance was driven to a sufficient penetration, the next one in rear would be then driven flush with the original ground surface—using a follower. The above system can, in my opinion, be used successfully in all cases where the soil is of clay and probably in all kinds of soil, but with greater risk where silt and sand are found.

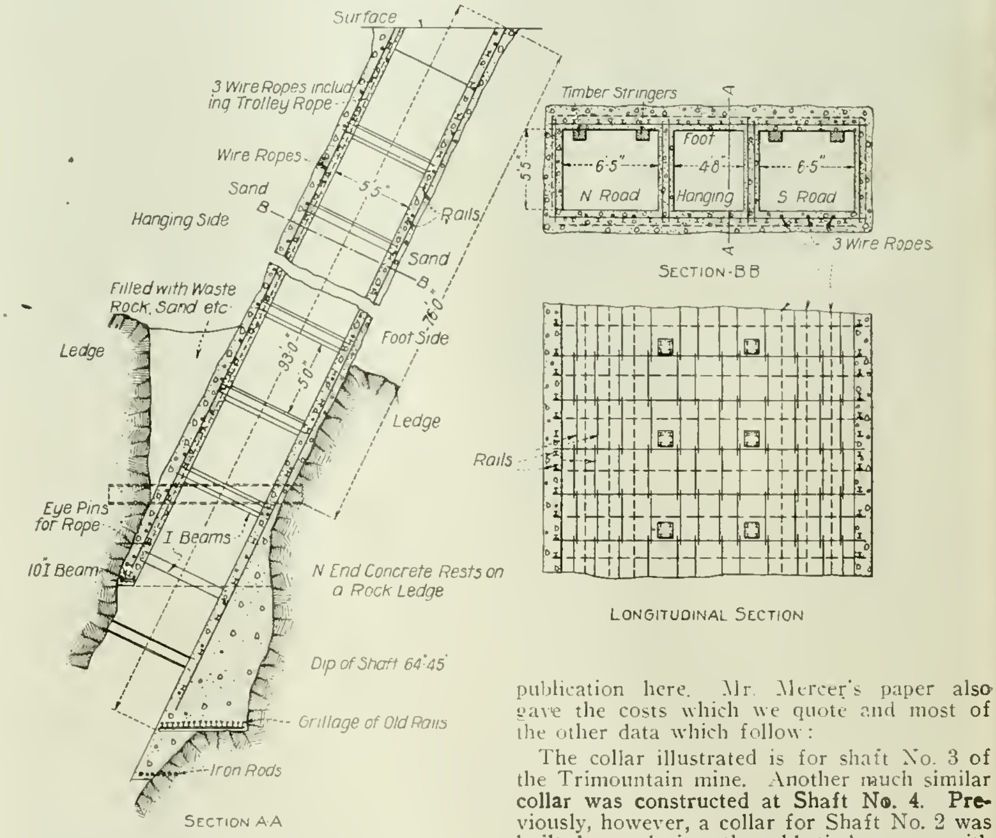
The majority of engineers seem to be of opinion that even if a crevasse could be closed it would not pay, because most of the damage would be done before the work could be completed. With this view I do not agree, because, assuming that the closure would require three weeks at the outside, this would mean that the water would be on none of the land much longer than that time and the extent of territory covered would be small as compared with that covered if the crevasse were allowed to flow for three or four months as usually happens in such cases. I believe the closure could generally be effected in less than two weeks.

The losses from crevasses in the Mississippi Valley are largely due to the destruction of crops and live stock, but most of all to the fact that planters are prevented from replanting by the length of time the water remains on their fields. To see the frightful rush of waters over the country, one naturally thinks everything is lost, but the actual damage to buildings and improvements, except above noted, is relatively small. Residents could even remain in their houses and care for their stock for two or three weeks, if assured that the flow would be stopped. A large percentage of the lands could be protected from overflow by the present systems of back levees, if the elevation of the crevasse water were limitd by a two weeks' flow. A crevasse closed within two weeks would usually reduce the losses to one-fifth or one-tenth of the total that would occur if it were left unclosed. The resultant saving would amount to millions of dollars for each crevasse closed, so why not spend some money on previous preparation for an attempt which promises so much if successful? The Hymelia Crevasse was flowing until about Aug. 1, or 2½ months after it occurred, and replanting in the affected territory was impossible. The losses from crevasses in Louisiana this year are estimated at $25,000,000, of which about half was due to breaks in Arkansas.

In conclusion, this is an engineering problem which promises probably larger returns on the investment for successful solution than any other ever presented, and I, for one, am convinced that it can be solved by careful preparation beforehand, combined with organizations practiced for a few weeks in their duties.

Reinforced Concrete Collars for Mine Shafts With Some General Costs.

When mine shafts penetrate an overburden of earth before coming into rock which will stand the portion through earth is lined and this lining is called a collar. In some of the copper mines of Michigan, where the original timber collars have deteriorated, reinforced concrete collars have been substituted. One of these concrete collars which is interesting because of the manner of its reinforcement is illustrated in a paper by H. T. Mercer before the Lake Superior Mining Institute and we have redrawn the illustration for publication here. Mr. Mercer's paper also gave the costs which we quote and most of the other data which follow:



Reinforced Concrete Collar for Shaft No. 3 Tri-Mountain Mine, Michigan.

The collar illustrated is for shaft No. 3 of the Trimountain mine. Another much similar collar was constructed at Shaft No. 4. Previously, however, a collar for Shaft No. 2 was built by replacing the old timber sets with steel I-beam sets and converting the walls between steel sets, these concrete walls being reinforced. The collar illustrated is a development from that built at shaft No. 2 and is wholly reinforced concrete including the dividers between the hanging and foot walls and separating the shaft compartments. The collar at Shaft No. 4 was like that illustrated except that the dividers were made 12x48 ins. in section. The length of the collars at the three shafts in numerical order were 80 ft., 93 ft. and 158 ft.

The concrete used was a 1:3:5 mixture of Portland cement, amygdaloid stamp sand and crushed trap rock. It was mixed by hand and lowered into the shaft by bucket. Concreting proceeded from the bottom upward, using ordinary methods and form work. The feature of unusual character is the use for reinforcement of old rails and old wire hoisting rope. This obviously reduced costs and the cost of sand and stone, both mine wastes, was very small. The yardages of concrete are not given but estimated from the proportions of the mixture and the quantities of cement used they were probably about 275 cu. yds. each for Shafts Nos. 2 and 3 and about 480 cu. yds. for Shaft No. 4. The itemized total costs of the collars for each of the three shafts are given in Table I. A summary from this table gives the following costs per foot of collar:

Item.	No. 2.	No. 3.	No. 4.
Labor	**$47.47**	**$16.77**	**$15.04**
Supplies	43.70	16.66	7.25
Total	$91.17	$33.43	$22.29

Shafts Nos. 3 and 4 only can properly be compared. Assuming the yardages named above the costs per cubic yard of reinforced concrete in place were about $8 and $7.50.

TABLE I.—COMPARATIVE COSTS OF CONCRETE SHAFT COLLARS.

Labor—	No. 2 shaft.	No. 3 shaft.	No. 4 shaft.
Length, to foundation	80 ft.	93 ft.	158 ft.
Shaftmen	$2,019.10	$1,028.85	$1,994.70
Masons	528.51	......	......
Surface labor	301.80	295.50	192.45
Blacksmith labor	360.41	67.55	40.50
Machinist labor	311.76	41.82	27.85
Carpenter labor	144.97	42.73	54.69
Electrician labor	10.84	8.82	8.96
Teaming labor	120.56	74.46	56.64
Supplies—	$3,797.95	$1,559.73	$2,375.79
Structuural steel	$2,180.56	......	$ 136.00
Cement—1,252 sacks No. 2	588.83	......	......
Cement—1,238 sacks No. 3	......	$ 470.80	......
Cement—2,169 sacks No. 4	......	......	810.09
Stamp sand—11 cars No. 2	159.50	......	......
Stamp sand—3¼ cars No. 3	......	45.70	......
Fine rock, 6 cars	90.00	......	......
Stamp sand—8½ cars No. 4	......	......	123.25
Sundry supplies	261.75	102.55	75.91
Freight	215.33	......	......
	$3,495.97	$ 619.05	$1,145.25
Total cost of shaft collars	$7,293.92	$2,178.78	$3,521.04

Stream Pollution from Mine Tailings.—The farmers of Amador county, California, have made complaint that mine tailings escape into Jackson and other creeks, thereby polluting the water and damaging lands. The various mining companies have agreed to take steps for removing the trouble. The Kennedy Co. is to install overshot wheels which will carry the tailings to settling ponds. The Argonaut Co. will store its waste on a neighboring ranch. The South Eureka and Central Eureka will sluice the tailings to settling ponds, through a ditch.

Water Meters for Kenosha, Wis.—The board of water commissioners at Kenosha, Wis., has ordered the installation of meters on all factory sprinkling plants. The manufacturers are strongly opposed to the step on the ground that their sprinkling systems will be weakened. They also protest against paying for fire protection which they claim is the business of the city fire department.

WATER WORKS

The Design of the New Water Works Intake and Screen Tower at Louisville, Ky.

Contributed by G. D. Grain Jr., Louisville, Ky.

The new intake and screen tower of the Louisville Water Company is nearing completion. This town is located at the pumping station on the Ohio River, about four miles upstream from the business center of the city. Although the contract for the construction of this tower was awarded on Sept. 15, 1910, with a provision that the work was to be completed by August, 1911, under a daily penalty of $25 for all time in excess of that period, the tower is still some 30 days from completion. A view of the structure is given in Fig. 1.

Excessive high water during the latter part of 1911 and the early months of 1912 hampered the contractors in the work, and during a part of this period it was found necessary to discontinue work altogether; especially in the work of laying the connecting mains between the tower and the pumping station, which could be done only at a comparatively low stage of the river.

The tower is of heavy concrete construction, generally not reinforced because of the great weight of the structure and the thickness of the walls. This weight was thought to render steel reinforcing of the usual sort entirely superfluous. The correctness of this view may be gathered from the fact that the walls of the tower proper, above the foundation, are 6 ft. in thickness at the bottom, gradually tapering to 3 ft. 9 ins. at the top. A vertical section through the tower is shown in Fig. 2. The tower was designed by Theodore A. Leisen, Chief Engineer and Superintendent of the company, who has exercised a general supervision over the work since its beginning, with a resident engineer continually on the ground.

The tower has a height totaling 100 ft. above low-water mark, of which 60 ft. is the measurement from the intake pipes to the working floor above, and 17 ft. is the height of the superstructure. A sectional view of the structure shows a rectangle with pointed ends, the design closely approximating that of the usual bridge pier, with a pointed end heading upstream to divide the force of the current which is usually very swift in the Ohio River, and to meet driftwood and floating ice as easily as possible, and the downstream end being constructed in a similar fashion for the sake of symmetry. Horizontal sections of the tower are shown in Figs. 3 and 4.

The structure was designed along extremely masisve lines, in order to give it sufficient weight to overcome its buoyancy in the water in case it should become necessary, at a high stage of the river, to pump out the tower for the purpose of examining the screens or other equipment, for the removal of an obstruction, or to make emergency repairs. Weight was also necessary in order to insure perfect stability at all times, and to anchor the tower securely to its bed.

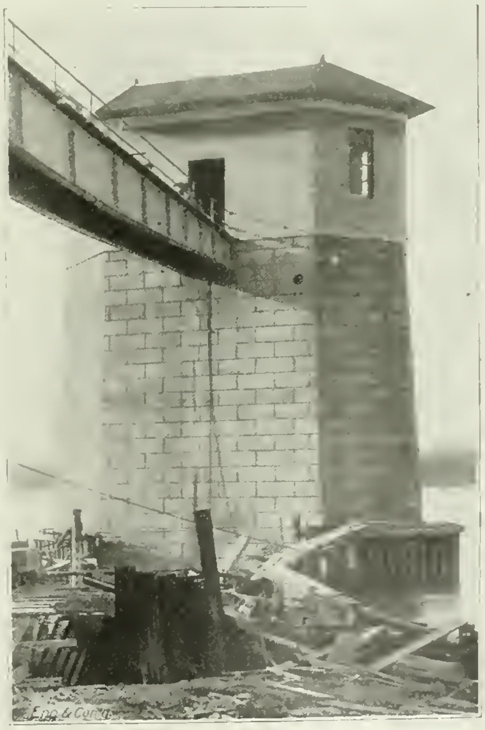


Fig. 1—View of Intake and Screen Tower of the Louisville Water Co.

With these ends in view, the site of the foundation proper was prepared by driving 99 wood piles as deep as conditions would allow. Upon the comparatively solid foundation thus presented, a mass of concrete measuring 58 ft. long from point to point, by 26 ft. wide, was laid. Its lowest point, at the tops of the piles, is 28 ft. below low-water mark, and 20 ft. below the lower level of the intake pipes. The amount of concrete used in the foundation and tower totals 2,050 cu. yds., and the weight of the entire structure, with its equipment, is in the neighborhood of 3,000 tons, giving sufficient mass to hold it firmly in place under any conditions.

The placing of the foundation concrete was accomplished with considerable difficulty. The specifications called for the construction of a watertight cofferdam, behind which it was intended that the 20-ft. thickness of the foundation, tieing in around the heads of the piles, should be put in dry. But when the cofferdam had been constructed and pumped out, and part of the excavation had been made, it was found that it was impossible to keep the work dry owing to an immense quantity of water which made its way in through a substratum of sand. In view of this unexpected condition the city, as a special concession, agreed to allow the contractor to place the first 10 ft. of concrete in still water, instead of trying to pump out the constantly flowing stream of water coming from below.

The first 10 ft. of the concrete foundation was therefore placed in this manner, under water, the walls of the cofferdam serving as a form to shape the work. A diver was necessary during all of this part of the work, directing the chute through which the concrete mixture, prepared above, was shot into place. Inasmuch as the work was done within the protection of the cofferdam in absolutely still water, the mixture was put in place in a mass in the manner indicated, no sacks or other devices being necessary to keep it in place while setting up. The remainder of the foundation was laid dry in the cofferdam. The portion laid first presented an effectual obstacle to the water which rendered its placing under water necessary.

The tower is composed of two complete units. It is divided through the center by a reinforced concrete wall 2 ft. in thickness extending from foundation to top. The reinforcing in this wall consists of ½-in. twisted steel bars of the ordinary type. These rods were not considered essential to the strength of the wall, since its thickness and weight are sufficient to withstand the pressure of the water on one side. This is the maximum strain to which the wall will be subjected, but reinforcing was used merely as a matter of extreme caution. The idea of having two units capable of independent operation was that on which installations of various sorts of machinery and power equipment are made in duplicate, namely, to enable the cutting off of one unit for purposes of repair, leaving the other in operation without any impairment of the efficiency of the plant.

For ordinary purposes, however, the entire tower will be used. The gate at the bottom, set in the dividing wall between the two chambers, will be left open to permit the water taken in to find the easiest course through the outlet pipes to and through the pumps.

Besides the gate mentioned in the dividing wall there are two intake gates set in the outside wall of the tower, one for each side. These gates are of the same size, 48x72 ins. There are also four outlet gates 48 ins. in diameter. All of these gates are operated by individual motors of 8 HP. The gates and motors were furnished by the Roe Stevens Manufacturing Company of Detroit. The intake gates are set at a depth of 7 ft. below extreme low water, and about the same distance from the bottom of the stream. Figure 5 is a sectional view of the benches for supporting the effluent pipe.

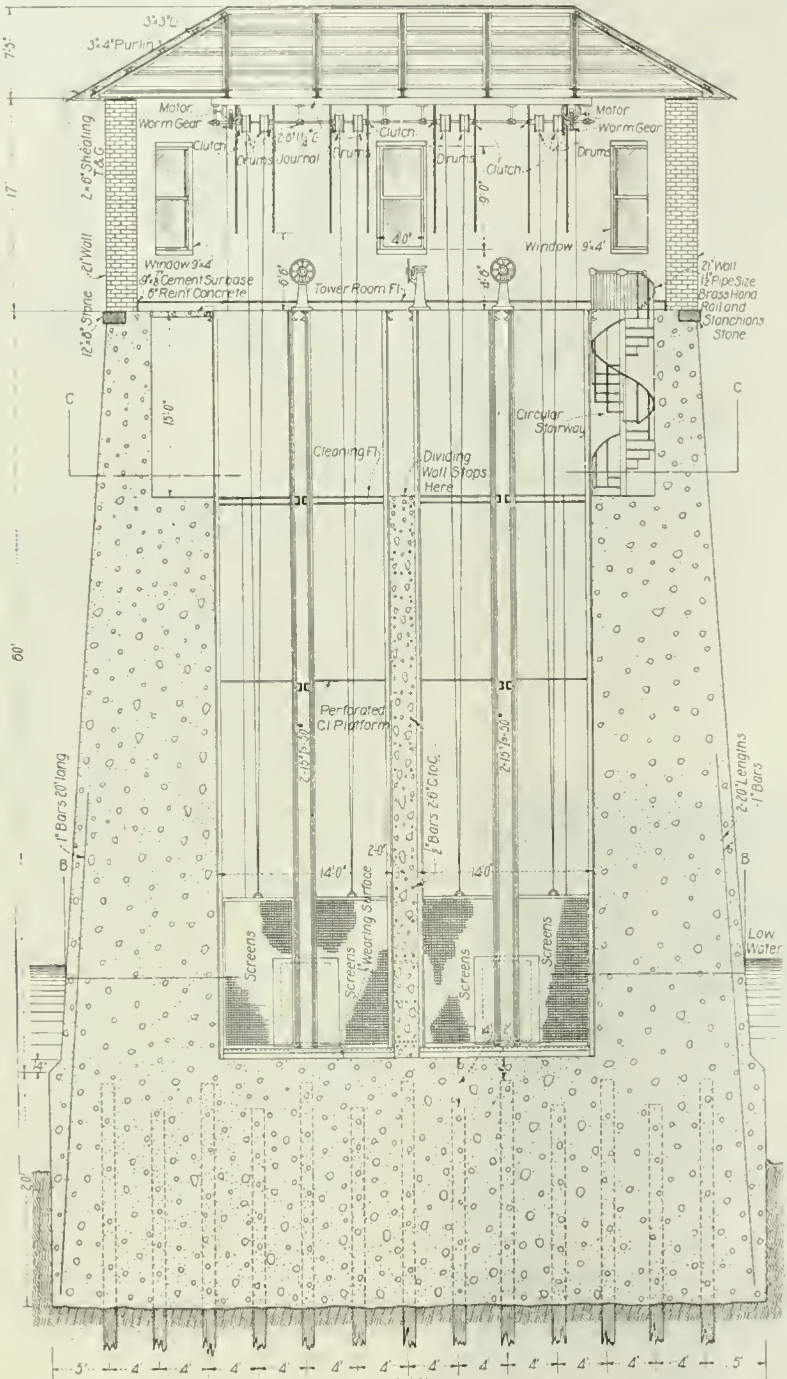


Fig. 2—Vertical Section Through Intake and Screen Tower.

Two of the outlet gates mentioned are designed to supply each pumping station, these being Nos. 1 and 2, and any future pumping stations that may be constructed. The screening system which is designed to eliminate the larger impurities from the water taken in is placed midway in the tower in two sets, one for each side, between the intake and the outlet pipes. It will consist of two screens for each division, each five ft. wide and 11 ft. high. These screens are made of bronze wire with ½-in. mesh openings. The screens are put in place, hoisted and lowered by a motor-driven winch. The motor, winch and screens were furnished complete by the W. T. Pyne Mill & Supply Company, of Louisville, the motor coming from the James Clark, Jr., Electric Company, and the screens from the Dow Wire & Iron Works, both of Louisville.

The working floor of the tower is connected with the pumping station building by a steel bridge 130 ft. in length, resting at the shore end on a concrete pier containing 140 cu. yds.

The intake capacity of the new tower will be between 100,000,000 and 125,000,000 gals. a day. The addition recently of a new turbine to the equipment of the pumping station has raised the pumping capacity of the plant to about 70,000,000 gals. a day; and inasmuch as at this time the average daily consumption of the city is about 25,000,000 gals., it will be seen that further betterment along the line of supply of water will not be necessary for some years. Considerable additional work in the way of distribution mains and laterals is planned, however, as the present facilities are taxed to their utmost in this direction. When the projected mains are laid, and the splendid filtration plant at Crescent Hill is extended, according to the present program of the company, to practically double its present capacity, Louisville will have a water system hardly surpassed, in the matter of supplying the needs of its population, by any in the country.

The present intake facilities consist of a steel-lined conduit supplying Station No. 1, and two submerged iron pipes each 36 ins. in diameter, supplying Station No. 2, the outer ends of which are protected by a timber crib built about 100 ft. from the southern shore line of the river upon which the pumping stations are built. The completion of the new intake tower will render these pipe lines obsolete. The contract price of the work now about to be completed is $69,800. The American Engineering and Construction Co., of Chicago, is the contractor on this work.

A Discussion of the Present State of the Art of Constructing and Operating Water Works Systems.

The Committee on Water Works of the Illinois Society of Engineers and Surveyors presented, as its report, a discussion of the present trend in constructing and operating water works systems. The subject was discussed under the heads of purification, reservoirs, electric power for pumping, centrifugal pumps, crank and fly-wheel machinery, impeller pumps and wells. The full report of the committee, Messrs. Dabney H. Maury and Charles B. Burdick, follows:

Purification.—Many facts are combining to cause an increase in the number of water works taking their supply from surface sources. Among these may be mentioned the high mineral content of many well waters, especially in iron and in scale forming salts; the rapidly receding level of the water table, which has been especially marked in the deep wells in the previous or stratified rocks; and the fact that very few well supplies, no matter what their source, are adequate for the needs of a large community.

With the growth of knowledge of the menace inherent in bad water, there has been a steady increase in the demand for pure supplies; and, as almost all surface supplies are now more or less polluted, the purification of such supplies has become a necessity rather than a luxury, and the rule rather than the exception.

Few slow sand filters are now constructed, the almost universal practice being to install, where filtration is required, filters of the so-called mechanical or rapid type, the sand beds, strainers and under drains being now usually placed in concrete tanks of large size, instead of in the wooden tubs or steel tanks formerly used.

Perhaps the most notable of all the modern developments in water purification is the use of hypochlorite of lime. The cost of treatment with this chemical is so small, the methods of its application so simple, and its destructive effect on bacteria, especially on those of the colon type, so great, that many cities rely upon hypo alone for the purification of their water supply. Even where filters are in use, hypo is frequently added as an additional safeguard.

Reservoirs.—The advance in the use of reinforced concrete has made itself strongly felt in reservoir construction. Sedimentation basins and clear water reservoirs of the covered box type are growing in favor; and a number of storage reservoirs of circular form have been built or planned. The circular reservoir at Bloomington, with a capacity of 10,000,000 gals., is built of reinforced concrete throughout, and with no expansion joints. The walls of this reservoir are of gravity section. This, and a number of other reservoirs, ranging in capacity from several million gallons down to a few hundred thousand gallons, and constructed with thin walls heavily reinforced with steel rods or hoops in tension, could be cited as evidences of the adaptability of reinforced concrete for structures designed to store water.

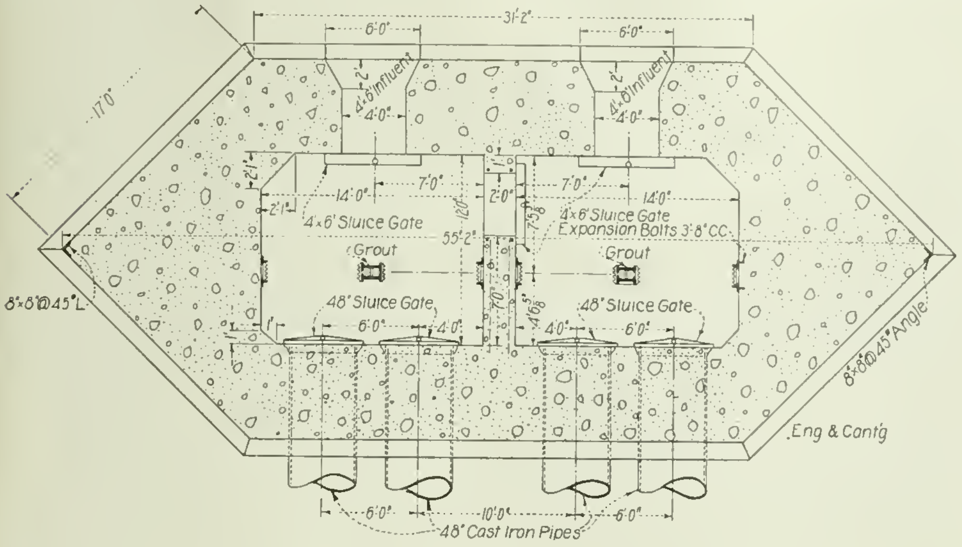


Fig. 3—Section B-B of Fig. 2.

The cost of reinforced concrete reservoirs will range from the exceptionally low price of $3,500 per 1,000,000 gals. capacity for the large open circular reservoir at Bloomington, up to $12,000 or more per 1,000,000 gals. capacity for small covered reservoirs of the box type. The new 4,000,000-gal. open circular reservoir for Sioux City, 142 ft. in diameter, and with the walls under tensile stress, will cost a little less than $6,000 for 1,000,000 gals.

Electric Power for Pumping.—The past few years have seen an enormous increase in the output of electric power. Nowhere has this been more marked than in and near the State of Illinois. Not long ago the 25,000 HP. capacity of the water power plant of the Sanitary District of Chicago would have been considered large; but the Commonwealth Edison Company is already equipped to produce more than ten times that power from coal, and is constantly increasing its capacity. In the southern part of the state, the Southern Illinois Public Service Company, said to be affiliated with the Commonwealth Edison, as well as with large coal mining and street railway interests, is building a new and absolutely modern town, where the coal will be hoisted from its mines straight into the bunkers over the boiler of an enormous new power plant.

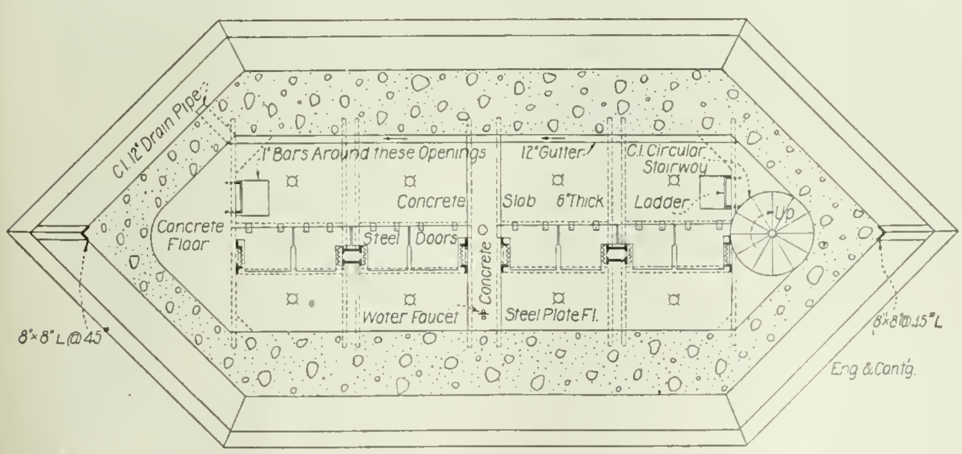


Fig. 4—Section C-C of Fig. 2.

On the west, at the great Keokuk dam, a power plant is being built for an ultimate capacity of nearly 300,000 HP., and it is stated that the first units will be ready to run before next June.

All of these power companies are seeking users of their output. Many small electric lighting, power and street railway plants have been purchased with this in view, and in some instances small water works plants have been acquired for the same reason. The large power companies are also trying to add to their list of customers as many more water works as they can reach, being especially anxious to secure contracts for power where the load is uniform during the 24 hours, or better yet, where the maximum demand occurs at such times as would tend still further to smooth out the peaks in their own load curve. These enormous plants can produce electric power very cheaply, and where a water works plant can be so easily operated as to make its load curve a desirable one for the power company, it is now possible to secure very much lower rates for electric power than could have been obtained in former years.

One method of properly adjusting the load curve of a water works plant, and diminishing the so-called "right demand charge" for power, is to install sufficient reservoir capacity to tide over the usual peaks in the load curves of the power company. When this is done, rates for electric power for water works pumping should be secured that would compare very favorably, especially in small plants, with the cost of pumping by steam.

Centrifugal Pumps.—This type of pump is well adapted to use in connection with electric motors. No marked advance has been made recently in the design or construction of centrifugal pumps. The manufacturers have, however, gained a wider experience, and are able to meet the requirements of service more accurately than was possible a few years ago. It is practicable to purchase from the leading manufacturers with good assurance that guarantees of capacity and efficiency will be reasonably well met.

The more recent tendency is toward the omission of guide vanes, thought necessary to best efficiency a few years ago. A number of manufacturers are making volute pumps of excellent efficiency. The split case for ease of maintenance is much used upon horizontal machines and one manufacturer is making a vertical pump with the split case.

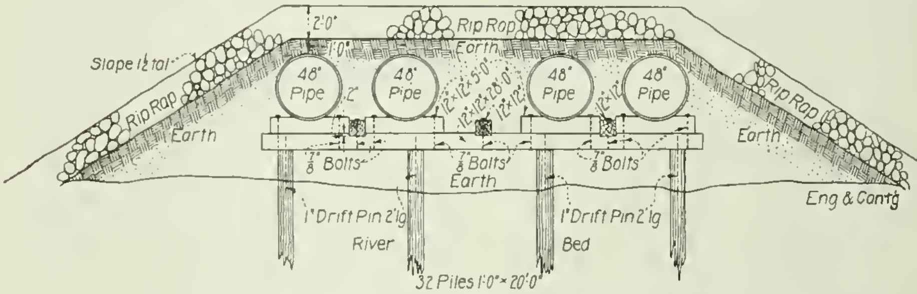


Fig. 5—Section Showing Benches for the Effluent Pipes.

Within the past five years the centrifugal steam turbine driven pump has been finding a place in water works installations. In duty they are not equal to crank and flywheel machinery of equal capacity, but their considerable lower first cost makes them financially practicable in many cases where their use is intermittent, as for reserve purpose, or where the small space occupied is particularly valuable; and where their use obviates the enlargement of buildings or pits.

In some cases where the cost of fuel is low, machinery of this type compares favorably with any type of pumping device on the market.

At Evansville, Ind., two 15,000,000-gal. turbine centrifugals have been recently installed upon the high lift service in that city, and two machines of the same general description on the low-lift service supplying river water to the filtration plant. The high-lift pumps, operating against a total lift of 165 ft., with 140 lbs. boiler pressure, showed a duty of 111,000,000 ft. lbs. per 1,000 lbs. of dry steam. The duties include the steam used by the condenser apparatus, the machinery being equipped with surface condensers. Two units of each type were installed.

Crank and Flywheel Machinery.—Within the past five years the cross-compound pumping engine has been largely introduced in the situations where four-cylinder horizontal machines were formerly used. For engines of moderate capacity, say from 3,000,000 to 10,000,000 gals. per day, practicable duties have been increased nearly 25 per cent, and the part load duties, as compared with full load, have also been very much improved.

A recent test of a 2,000,000-gal. cross-compound condensing engine at Oskaloosa, Ia., operating at 290 ft. total lift, showed a duty of 126,700,000 ft. lbs. per 1,000 lbs. of dry steam at full capacity, and 120,800,000 ft. lbs. at half capacity. The tendency has been toward much higher engine speeds than formerly.

Impeller Pump.—The use of vertical shaft pumps of small diameter for the pumping of deep wells has been extended and the machinery improved.

The impeller pump for the same purpose, although in use ten years or more, has been considerably improved in its details. Several installations of modern type, have proven quite reliable in continuity of operation. The mechanical efficiency of this device is less than that of the vertical shaft centrifugal. It is, however, applicable to well bores as small as 7 ins. or 8 ins., and therefore has a certain field to which the pumps of larger diameter can only be adapted at considerable expense.

Wells.—There has been much improvement in the design of wells for gravel strata, the more modern practice being to follow the rational plan of using strainers coarse enough to allow the fine particles to come through into the well, and be pumped out, thus building up a larger strainer of gravel outside the metal strainer. In some wells of special design the strainers have been made so large that no sand will run into it, even though the openings in the strainer are much larger than the coarsest particles in the gravel, for the reason that the velocity of flow of the water through the strainer is too small to move the finest sand.

In short, it would appear that water works methods show a progress in keeping with the many other advances which characterize this progressive age.

The Cause of the Failure of the Nashville Water Works Reservoir Wall—Nature of Recommended Repairs and Improvements.

In a report recently made to the Board of Public Works of Nashville, Tenn., Mr. Rudolph Hering discussed the cause of the failure of the water works reservoir in that city and indicated the method of repairing it so as to make it safe in future service. The following information is taken from Mr. Hering's report. We are enabled to publish this matter through the courtesy of the Board of Public Works of Nashville:

The reservoir is located on Kirkpatrick's Hill, a dome-shaped elevation situated in a residential suburb, and is divided into two basins. About midnight, Nov. 4, 1912, the East basin when it was full of water collapsed by about 150 ft. of wall slipping out, and discharging its water into a partially built-up part of the city. The reservoir was built from 1887 to 1889 and was immediately put in use.

The reservoir is elliptical in plan, the major axis being about 605 ft., the minor axis about 463 ft. It is divided by a cross wall into two equal parts called the East and West Basins, respectively. The combined capacity of the two basins is 50,000,000 gals., each holding half this quantity. The average water consumption of the city is about 12,000,000 gals. daily. The water is pumped into the reservoir from the Cumberland River, which is 277 ft. below the bottom of the reservoir.

"The hill upon which the reservoir stands," says Mr. A. H. Purdue, State Geologist, "is composed of much jointed limestone beds between many of which are thin layers of shale. In exposed places the shale layers are altered to clay, which is soft and slick." The limestone rock lies in almost horizontal layers of various thicknesses. Weathering and some slight disintegration shows itself at exposed places.

The walls of the reservoir are 33 ft. 9 ins. high, about 23 ft. thick at the base and 8 ft. thick at the top. The water line is about 31 ft. above the bottom.

The limestone from the top of the hill was excavated and used for constructing the walls, the face work consisting of rough range rubble work both outside and inside. The middle of the wall was made of cement concrete. The cement used in the structure was natural Louisville cement.

The walls were built upon the limestone rock beds, and in many cases the foundation course starts but about 1 ft. below the original surface of the ground. It was not started up on one particular layer of rock, but was generally, though not everywhere, stepped outwardly, and here and there also laterally, by irregular steps.

THE BREAK OF THE RESERVOIR.

About midnight, Nov. 4, 1912, a portion of the wall of the East Basin slipped outward, the wall breaking substantially at three places and allowing the water of the basin to escape. In about 30 minutes the basin was empty.

An examination showed that at the conter-break the wall has been pushed out furthest, namely, about 23 ft. at the bottom. The water had undermined portions of the broken wall and had sufficient force to overturn one block thereof. It was evident that the weight of the water had not been resisted by the weight of the wall at this point.

An examination of the rock beneath showed that the original shale had been altered to clay at a number of points. It was further found that the failure was apparently due to a slip on a layer of the altered shale, which was about 4 ft. below the top of the rock upon which the wall had been placed. This was evident because about 4 ft. of bed rock adhered to the base and was moved out with it. That there had been a slip was shown also by the fact that the surface of parts of this clay layer was quite smooth, showing that the superimposed material had slipped upon it.

When the water was first admitted into the reservoir many leaks were found, both at the bottom and at the sides, but gradually they stopped either by themselves or were made fairly tight by cementing. It is said that there were always minor leaks through the walls of the reservoir and that new leaks developed from time to time.

A short time before the break some of these leaks became much worse, and water in the neighborhood of and at the location of the subsequent break was flowing freely down the walls on the east side of the reservoir to an almost alarming extent. As leaks had often occurred and again stopped there was no thought of immediate danger. Nevertheless, the water was at once lowered several days before the catastrophe and many joints were patched and repaired on the inside. The reservoir was then again filled with water and was full at the time of the break.

The material of the wall exposed at the breaks was fairly good. No disintegration appeared. The cement mortar was generally hard, though here and there quite porous. In some cases it was stronger than the limestone, the latter breaking rather than the cement pulling off. In other cases it was rather soft and could be crumbled with the fingers. Some of the limestone in the wall is of excellent quality; some is poor, laminated and weathered. At some points it was evident that percolation through the wall had been going on for some time. It can be said that generally the masonry and core wall were good and built as average work was usually done at the time of its building and were in a good condition.

The foundation courses were not found to be so well built. Mortar here and there was more scarce and the masonry was not as compact as in the upper parts. In other places, there were indications that mortar had been used plentifully, indicated by the fact that some of the foundation stones adhered to the rock layers better than the rock layers adhered to each other, indicated by the fact that portions of the original rock moved out with the wall. The shale and clay layers in the original rock under the wall were quite frequent and varied from ⅛ in. to 5 or 6 ins. in thickness.

Before the break occurred water at the location of the subsequent break ran down freely on the front of the wall, into the natural ground beneath, and into and below the foundation, where it evidently soaked into the soft layers of clay or shale, which had been transformed into clay. This percolation was probably the final cause for removing the frictional resistance of these transformed layers. The percolating water had thoroughly saturated and softened them. They had become slippery like a lubricated surface.

The first rupture no doubt occurred at the central break, where the wall had been pushed out furthest, and the other breaks, one on each side were consequential.

When the rupture occurred and the wall was pushed out, together with several feet of bed rock holding to it, the mass pushed out the rock layers in front sufficiently to cause a fold in the layers, which was quite apparent at the inspection. A thick clay layer located about 4 ft. below the bottom of the wall is probably the one which allowed of the initial slip.

There seems to be some doubt as to whether the entire floor of the reservoir was covered with Louisville cement concrete, and if so, what the depth of concrete was. At the break it is evident that such a floor existed, but the depth may vary. At the places observed it was about 12 ins. thick.

RETENTION OF THE PRESENT RESERVOIR SITE.

The question has been raised as to whether the present reservoir should be retained, after proper repairs and improvements had been made, or whether it should be abandoned. The conditions relating to this question are as follows:

The rock under the walls in its present condition is not the best foundation for them. A deeper foundation would have been preferred at this time. There are many seams of shale and clay with the probability of the shale more and more altering into clay. The clay layers, if saturated with water, become slippery, and under present conditions there is no assurance that there will not be a repetition of the recent slip.

The walls themselves are fairly well built. Their cross section is sufficiently large and strong to hold the stored water at 31 ft. depth. They are not perfectly water tight and leak at numerous places. These leaks are sufficiently large to be stopped only by radical means.

The leaking water flows down the outside of the wall and percolates into the wall at its foot, with a tendency to soften the clay layers below the foundation, because these absorb the water by capillarity. This softening would neutralize the horizontal frictional resistance and thus impair the stability of the wall. Dry clay will furnish some horizontal frictional resistance which wet clay does not.

There is no evidence of percolation through the bottom of the reservoir. As such a percolation is not improbable, it should be assumed that it occurs.

The theoretical section of the wall has been carefully examined and computed. The stability of the wall is dependent on its ability to hold its place when resisting the horizontal pressure from the water. It is sufficient to safely resist overturning when the water is 31 ft. deep. The pressure line remains within the middle third of the section. This conclusion is based upon the assumption that the foundation, particularly in the outside third of the wall, is quite firm, solid and permanent, and that no upward water pressure within the wall tends to lighten its weight.

With water penetrating clay layers beneath the foundation under a pressure of 31 ft. and softening the material so as to remove the frictional resistance, it is but a question of the size of the area of the softened clay to remove the resistance against the horizontal water pressure. This pressure per running foot of the reservoir wall with the water standing 31 ft. deep would be about 30,000 lbs. per running foot of wall. The frictional resistance of a wet clay seam, were it horizontal and did it extend across the entire footing of the wall would, therefore, have to be greater than 30,000 lbs. per running foot of wall.

It is Mr. Hering's opinion that the clay layers, softened by the water forced into them under the pressure in the reservoir, through seams in the masonry, pores in the concrete and seams in the limestone rock, lost some of their power of frictional resistance to an extent which caused the water pressure to rupture and push out the wall at that place, thereby causing the compound fracture or breaks which may now be seen.

If the mentioned objectionable conditions can be removed, or sufficiently balanced, there is no reason why the reservoir cannot be satisfactorily repaired and remodeled to safely hold water therein for an indefinitely long time.

After careful examination of the ground, of the conditions, of the plans, of the means of repair, of the encountered difficulties and of the expense, it is Mr. Hering's opinion that the reservoir can be safely and economically repaired, altered and improved so that a future failure can be avoided with entire confidence.

It is, therefore, not necessary to abandon the present site and instead to build another reservoir at another place.

RECOMMENDED REPAIRS AND IMPROVEMENTS.

From what has been said above, the probable cause of a repeated failure of the reservoir will be confined to a leakage of water from the same into the rock underlying the foundation, and particularly into the layers of clay which it contains.

The stability of the reservoir walls for the past 23 years demonstrates that they are sufficiently strong and that their settlement, if any, has been insignificant.

If, therefore, the reservoir can be made entirely water tight, so that no water can leak from it into the underlying clay strata, either through the walls and their foundations or through the flooring, the only cause for future rupture is eliminated. It is Mr. Hering's opinion that this water tightness, after the present break has been repaired and the reservoir has been re-established, can be obtained by the following means:

First: In order to secure water tightness of the present walls they should receive a lining of cement mortar over the entire inside surface of the reservoir, applied by the Cement Gun. By this method wet cement mortar of a proper moisture is shot against the surface of the wall, after this has been thoroughly cleaned, first by thorough washing and scraping, then by sand blasting, which will make the adhesion of the cement complete. The density of this gun-cement is very great and it penetrates into all open crevices and covers every fine crack. An average thickness of about an inch is more than enough to make a wall entirely water tight.

Second: In order to make the floor of the reservoir water tight it should receive, after thorough cleaning, a layer of 5-ply asphalt felt. Upon this layer, which secures the water tightness of the floor, there should be placed, to protect it, preserve it and keep it in place, a 4-in. layer of Portland cement concrete. This layer should be put down in 16-ft. squares.

Dividing the concrete floor into 16-ft. squares has the purpose not only of obtaining better joints between the separate applications, but also of providing facilities for an expansion and contraction of the concrete, due chiefly to temperature changes.

Third: Having water tight walls and flooring, it becomes necessary to provide also for a thorough water tightness of the joint between the wall and the floor. This joint is liable to change in width, because there is a possibility of the walls settling slightly in the future, due to the altering of the shale layers. A settling, even the most insignificant, will produce a crack, and this would allow water under 31 ft. of head to penetrate and enter the clay layers. The width of the joint is also affected by contraction of the concrete of the floor.

Provision must, therefore, be made to allow for these probable vertical and horizontal movements in a manner to obviate the formation of any crack with consequent leakage.

This condition can be secured by placing at the inside foot of the wall a large wedge of concrete, the two sides being at an angle of 60° from the horizontal, and both sides resting upon layers of waterproof materials, one upon the wall and the other upon the floor, so that any vertical movement of the wall or horizontal movement of the floor, will correspondingly move the wedge upon the asphalt surfaces, and therefore avoid any tendency to cause a crack, either in the floor or at the wall. The water pressure in the reservoir would continually tend to press the wedge against the adjoining surfaces, and not prevent its rising in case there is an expansion of the floor.

Fourth: Below the wedge it is proposed to lay a 4-in. drain pipe on a slight grade around the entire inside of the reservoir, discharging with two outlets outside of the wall, so as to give assurance, either that the leakage within the reservoirs, if there is any, is insignificant, or and mainly, that any leakage water will neither soak down into the clay strata beneath the walls and lubricate them, nor exercise any upward pressure within the wall, to reduce its weight, and therefore its stability. This pipe is to be placed in a bed of small stone or gravel.

This drain pipe will be safe indicator of the water tightness of the reservoir. If either or both of the pipes do not discharge any water outside of the reservoir, its water tightness and the entire safety of the walls is demonstrated. If either or both show a flow of a constant but small amount of water, it indicates a small leakage, which should be observed and gaged to ascertain whether it is constant or increases. A constant small leakage does not indicate any danger. If it increases continuously and becomes large, the reservoir in which it occurs should be emptied, and the location and cause should be ascertained and remedied. Had such means existed in the present reservoir, an examination and repairs could have been made in ample time and the break obviated. After the present break has been repaired, the interior surface of the wall made water tight with Gun Cement, the floor made water tight with asphalt felting covered with concrete slabs, a concrete wedge placed along the entire length of the inside foot of the reservoir wall, for the purpose of avoiding cracks from settlement or contraction, and a drain pipe laid below it, to control any slight leakage, the East Basin of the reservoir will be ready for service.

The West Basin should then be treated in the same manner as just described for the East Basin, so as to prevent any slippage and break occurring in it, as this wall is also built upon the shale and clay strata, which underlie the entire reservoir, and which might in the future also cause a slippage as in the East Basin. Horizontal leakage now occurs to some extent through the wall of the West Basin below the present water level.

Motor Water Wagon for the Army.—A motor vehicle and water purifying plant combined has been devised for army service. The body of the wagon consists of tanks and pipes. The engine which drives it is also used to pump water from a stream, well or other source, and force it through clay filters. The wagon can supply 500 gals. of clarified water per hour.

The annual meeting of the National Paving Brick Manufacturers' Association will be held March 3, 4 and 5 in the Green Room, Congress Hotel, Chicago. The secretary of this association is Mr. Wm. P. Blair.

An Experience With Water Ram Resulting From the Operation of a Hydraulic Elevator at Northeast Harbor, Maine.

About three years ago the Northeast Harbor Water Company experienced difficulty with fluctuations of water pressure arising from the operation of a hydraulic elevator. The company served notice upon the proprietor of the building in which the elevator was installed, to install a tank to supply water through a 4-in. service pipe for the operation of the elevator instead of drawing water for that purpose directly from the 8-in. street main. The proprietor objected to installing tanks. The company notified him that his water supply would be shut off unless he complied with their requirements. At that point the proprietor brought suit in equity to enjoin the company from shutting off his water. The result of the case, which was tried in April, 1910, may be summarized briefly as follows: The court decided that the use of water for a hydraulic elevator was a domestic use within the ordinary meaning of that term. On this ground it ruled that the company was obliged to furnish water for a hydraulic elevator, if the proprietor so desired. The court ruled, however, that the company was justified in asking the proprietor to install a tank of suitable capacity to relieve the street mains from the water ram caused by operating the elevator by direct pressure from the mains. The court decided, further, that the requirement of the company was justified since its order was given to protect its own property and to safeguard the interests of other water consumers on the same main pipe line. The injunction was not granted and the company was left free to enforce its ruling unless the proprietor substantially conformed to the requirements it laid down.

Mr. Charles W. Sherman, Principal Assistant Engineer with Metcalf and Eddy of Boston, was called as an expert witness by the proprietor. The results of tests made by Mr. Sherman in preparation for his testimony, as well as the principal figures submitted by the water company, were given in Mr. Sherman's paper before the New England Water Works Association at the annual meeting of the Association which was held in Boston on Jan. 8, 1913. The information here given is taken from Mr. Sherman's paper.

PHYSICAL CONDITIONS.

The hotel was supplied by a 4-in. pipe, 300 or 400 ft. long, leading from an 8-in. main supply pipe at a distance of some 2 or 3 miles from the pond from which the supply is taken. The hydraulic elevator—the only one in town—is of an old type and has a total lift of about 32 ft. The travel of the plunger is about 4 ft., and its diameter is 22 ins. It was found that the elevator valve was made to open or close a series of holes, with the intention of making the opening or closing rather slow; and that it was necessary to overhaul 4½ ft. of valve rope to open or close the valve, or 9 ft. to reverse the elevator. The static pressure at the hotel was about 40 lbs. per sq. in., and a relief valve set at 45 lbs. had been installed near the elevator.

Nobody seemed to know just how long it took the elevator to make a trip, but it was conceded that it could hardly have been less than 30 seconds. Assuming this to be correct, the 22-in. plunger traveled about 4 ft., and consequently the displacement was 79 gals., in 30 seconds, or the flow was 158 gals. per minute. This flow corresponded to a velocity of less than 3 ft. per second in the 4-in. pipe, which is certainly not an excessive velocity. If this could have been checked instantaneously the resulting water ram would have been considerable, but it would obviously have required an appreciable time to overhaul 4½ ft. of valve rope to shut off the water.

The data available before the water company had presented its case were not sufficient to enable Mr. Sherman to make an estimation of the increased pressure which might have resulted from the operation of the elevator, to which he would care to testify. In order to get some information an experiment was made, through the courtesy of the Superintendent of the Water Works at Ellsworth, Maine, where the court was in session. Here a place was found where there was a 4-in. pipe, some 400 ft. long, supplying a locomotive standpipe, where the normal pressure was about 68 lbs. per sq. in. This branch, like that at Northeast Harbor, was from an 8-in. main leading from the reservoir at a considerable distance. No method was discovered of drawing water, or of opening and closing the valve, at the same speed as with the elevator, so it was determined to make the test as severe as possible. The pressure gage was attached to a house service pipe about 150 ft. from the locomotive standpipe, and the standpipe valve was opened wide, as rapidly as possible, left open until a condition of steady flow was obtained, and then closed as rapidly as possible. Mr. Sherman estimated the maximum velocity in the 4-in. pipe at not less than 10 ft. per second. The time of opening the 4-in. valve was 30 seconds, and the time of closing was 20 seconds. The pressure dropped almost immediately upon starting the valve from 68 to 28 lbs. per sq. in., or to 41 per cent of the normal. At the instant of closing the pressure gage registered 134 lbs. per sq. in., or 202 per cent of the normal.

TABLE I.—PRESSURES OBSERVED AT VARIOUS PLACES DURING OPERATION OF HYDRAULIC ELEVATOR.

Pounds per square inch			Per cent of normal.	
Normal.	Highest.	Lowest.	Highest.	Lowest.
56	75	40	135	71
58	60	35	104	60
55	62	32	112	58
32	40	10	126	31
32	50	10	156	31
60	80	40	133	67
58	85	35	147	60
55	75	35	136	63
54	70	25	128	46
51	70	28	137	55
30	50	10	167	33
30	50	8	167	27
28	60	10	213	35

Mr. Sherman considers that this maximum pressure is not great enough to be dangerous to any well-constructed pipe system, although he believes that the sudden fluctuations would doubtless be annoying at times.

The officers of the water company presented gage readings showing what the actual fluctuations had been in various parts of town. The significant figures, as taken down during the testimony, are as given in Table I.

The figures given in Table I show that in general the operation of the elevator caused a drop in pressure ranging from 40 per cent to between 60 per cent and 70 per cent when the valve was opened, and an increase in pressure, or water ram, amounting to from 30 to 50 per cent of the normal pressure under ordinary circumstances, and sometimes running up to about 100 per cent increase in pressure.

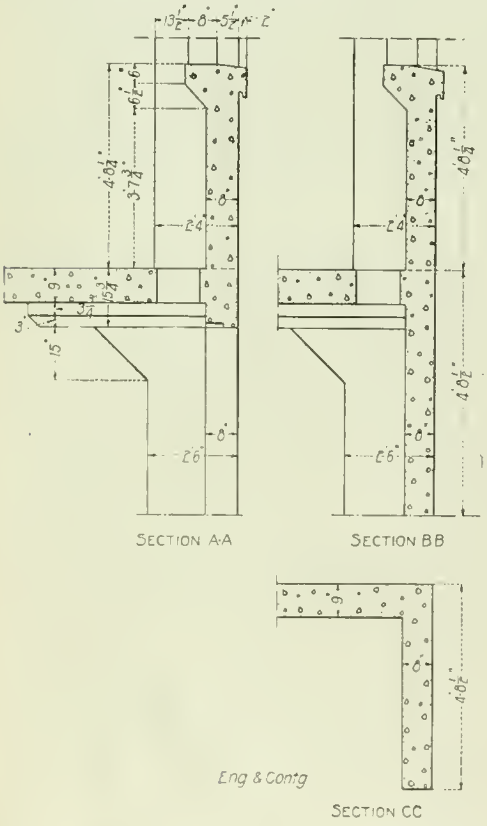
These results confirm in a general way the conclusions reached by Mr. Sherman from the experiment described above—that the pressure might drop about 60 per cent below normal when the valve was opened, and rise to a maximum of about 100 per cent above normal at the moment of closing the valve. These fluctuations are sufficient to cause annoyance, but where the normal pressures are as low as in the cases cited, should not be dangerous to the pipes.

Mr. Sherman points out that none of these results can be applied to conditions differing materially from those here described, but they may serve to give some indication of the extent of the water ram that may be experienced in a small water works system from the rapid closing of valves or fire hydrants.

BUILDINGS

Tests of a Building Floor to Determine Distribution of Stresses and Relative Magnitude of Stresses in Wall and Interior Panels.

The tests outlined were made on the second floor of an eight-story reinforced concrete warehouse building in Chicago for the Larkin Co., and are more fully described in a paper by Mr. Lord before the National Association of Cement Users. The building is 200x125 ft. in plan, divided into panels 20x24 ft. 2 ins. in dimensions. The type of reinforced concrete construction used is that known under the trade name of "Cantilever Flat Slab," and the designers were the Concrete Steel Products Co. of Chicago. The Leonard Construction Co. of Chicago were the general contractors. The building was designed in accordance with the building ordinances of the city of Chicago which govern cantilever flat slab construction. The slab thickness, panel dimensions, size and thickness of depressed head, size of column capital and shaft, the section of the adjacent concrete wall, and other physical data of the floor tested are given in Fig. 1.



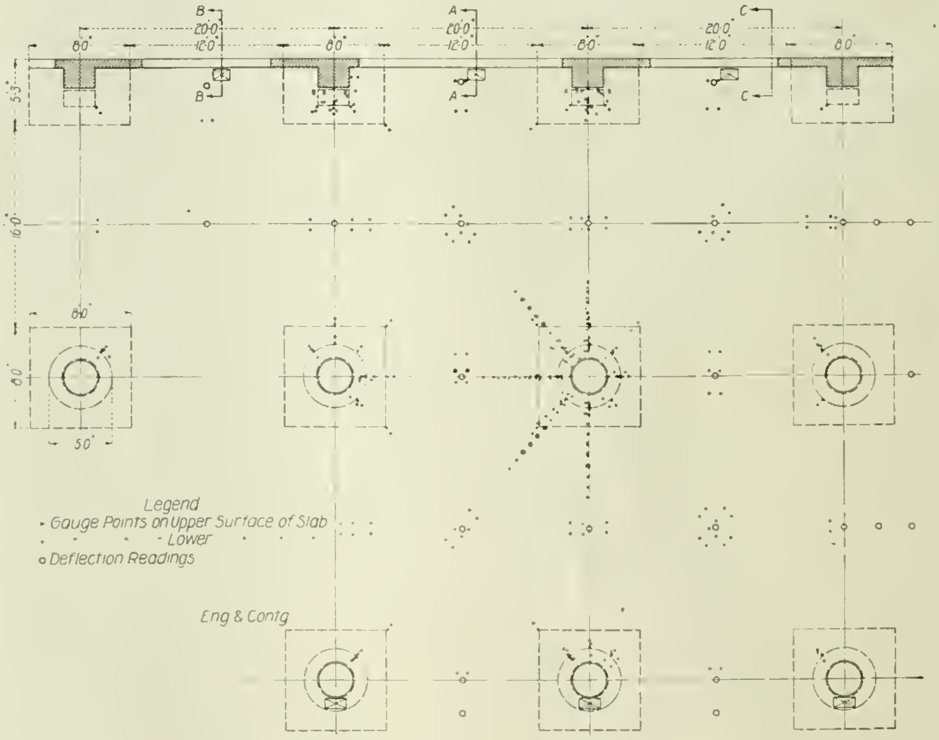


Fig. 1—Details of Slab Construction and Supports. Fig. 2—Diagram of Location of Points for Determining Stresses and Deflections.

The test was planned with two chief objects in view: *First,* to secure data on the distribution of stress in the various directions in a flat slab floor having decidedly rectangular panels; and, *second,* to ascertain the relative magnitude of the stresses in wall and interior panels. Various other points of more purely scientific interest, such as the determination of the point of inflection, the effect of the depressed head construction, the stress in the column capital and column shaft, the action of adjoining unloaded panels, etc., were inquired into, but the emphasis was placed on the two points mentioned above.

Observations and Loading.—Figure 2 shows diagrammatically the position and nature of the observations taken on both the upper and the under surface of the test slab. In order to make more extensive observations on the upper surface than had hitherto been attempted large areas of the floor were covered over, and the observers worked under the test load which was transmitted to the floor by means of numerous posts, giving practically uniform loading. The attempt to determine the point of inflection from deflection readings, always unsatisfactory in the past, was abandoned in planning this test and measurements of stress over consecutive gage lengths along the direct and diagonal center lines of the panel and on both the upper and lower surfaces were substituted instead with very gratifying results. For the upper readings of these series special bars were laid near the top of the slab, thus avoiding the disturbance of readings due to the breaking of the concrete in tension under heavy test loads. Inserts were placed on the reinforcing rods and in the concrete at points where readings were desired at the time when the concrete was poured, and by this means the time and labor of the final preparations were very materially reduced.

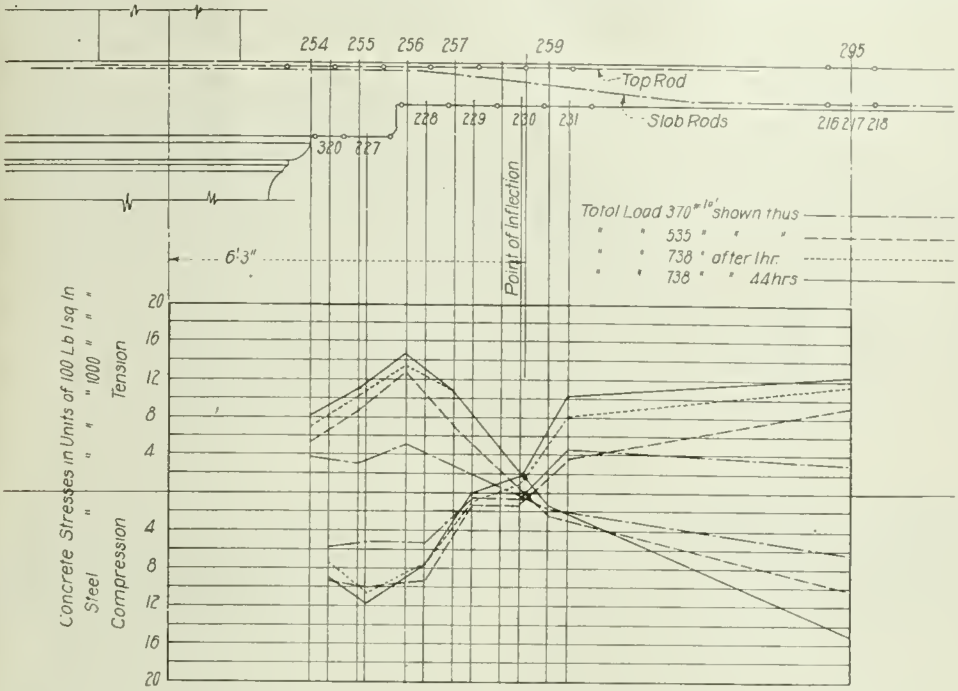


Fig. 3—Point of Inflection Readings in Diagonal Direction Across Wall Panel.

The sand used for loading the test panels was very well graded and extremely dense. It was slightly damp and would stand for a considerable time at an angle of 75° to 80° with the horizontal. The containing bins were tied with rods and not braced back on the adjoining panels. When the bin tie rods were loosened under maximum load no appreciable movement took place, which would indicate that the arch action in the load itself was very slight. Small quantities of the sand measured previous to the test gave a weight of 97 lbs. per cubic foot, and the measurement of 130 cu. ft. of the actual load in place gave a weight of 101 lbs. per cubic foot. The floor was designed for a live load of 225 lbs. per square foot and a maple floor on fill the weight of which was considered to be 25 lbs. per square foot. This maple floor was not in place at the time of testing.

Preparations for the test occupied somewhat over a week. Two entire days were spent in getting the zero readings accurately, as these are the most difficult and important on the test. Two hundred and fifty-five gage lengths were read throughout the test, involving more than 18,000 individual observations. At each stage in the test the notes were calculated and check readings taken whenever they seemed valuable, before the loading was resumed. For many of the important gage lines the load-deformation curves were plotted as the test progressed. All signs of stress were carefully searched out and recorded.

Quality of the Concrete.—The materials used in the making of the concrete were of very good quality. The coarse aggregate was ¾-in. crushed hard limestone, the cement was Universal Portland, and the sand was clean and graded from large to small particles, giving an exceptional density. The mixture was 1:2:4. At the time the test panels were being poured specimens of the concrete in the form of cubes, prisms and beams were taken from the concrete placed in the floor. These were tested immediately after the conclusion of the building test, at an age of 62 days, and gave a crushing strength in excess of 3,300 lbs. per square inch, and an initial modulus of elasticity of 4,000,000 lbs. per square inch. This modulus has been used in computing the concrete stresses in this report of the tests. The results of all measurements are summarized in Table I. For convenience in the use of these data for design purposes the stresses have all been given for the total *dead and live* load on the floor. The dead load stress has been taken as equal to that observed under a live load equal to the weight of the slab (120 lbs. per sq. ft.).

Since all of the stress diagrams cannot be given, all are omitted except types per point of inflection, and for deflections which are shown by Figs. 3 to 6.

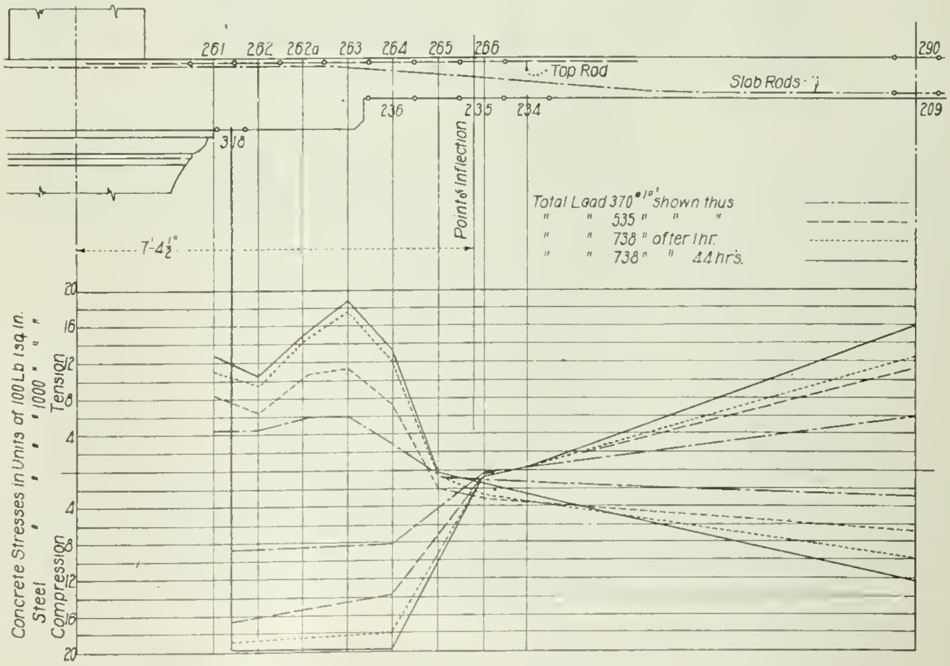


Fig. 4—Point of Inflection Readings in Long Cross Direction of Wall Panel.

TABLE I.—SUMMARY OF STRESS OBSERVATIONS.

(Total dead and Live Load Stresses in Pounds per sq. in.)

		(Design load).	Twice design load).
Total load on floor in lbs. per sq. ft.	370 lbs.	535 lbs.	738 lbs.
CONCRETE STRESSES.			
On Drop at Edge of Capital:			
Diagonal direction	570	1,030	1,550
Long cross direction	460	710	700
Short cross direction	240	440	570
Average	420	730	940
On Slab at Edge of Depressed Head:			
Diagonal direction	530	900	1,140
Long cross direction	760	1,380	1,600
Short cross direction	270	590	700
Average	520	960	1,150
At Top of Capital:			
Diagonal direction	510	860	910
Long cross direction	610	870	1,230
Short cross direction	360	560	1,050
Average	490	760	1,060
On Top of Slab at Center:			
Diagonal direction	460	870	1,310
Long cross direction	550	770	1,260
Short cross direction	430	850	1,510
Average	480	830	1,360
STEEL STRESSES.			
Over Edge of Capital:			
Diagonal direction	3,500	5,200	10,800
Long cross direction	2,500	3,000	7,000
Short cross direction	2,100	3,000	7,300
Average	2,700	3,700	8,400
Over Edge of Depressed Head:			
Diagonal direction	5,400	8,700	14,200
Long cross direction	4,100	7,800	10,400
Short cross direction	2,100	2,900	5,800
Average	3,900	6,500	10,100
At Center of Span:			
Diagonal direction	3,000	6,600	12,900
Long cross direction	3,300	5,700	10,200
Short cross direction	3,100	12,300	24,200
Average	3,100	8,200	15,800

Point of Inflection Readings: (See Figs. 3 and 4)—Point of inflection stress readings were taken on both the upper and lower faces of the slab in five directions along the direct and diagonal center lines of the panels. The results were very satisfactory, and indicate that the point of inflection may be determined from stress measurements with far greater accuracy than from deflection measurements. Figs. 3 and 4 each show load-stress curves in one direction for four stages of the loading. As all the curves on one diagram are plotted from a common zero axis, the intersection of like lines gives an indication of the position of the point of inflection in that direction, so that each diagram gives four indications of the point of inflection. The agreement is excellent.

Deflections: (See Figs. 5 and 6)—The total number of points at which deflections were measured throughout the test was 24. In Fig. 6 a large number of these measurements are plotted against load up to full load on two panels. In Fig. 5 three important readings are plotted for the entire period of the test and for one week subsequent to the removal of the load. The upper part of the diagram is plotted to a scale of time. Four sets of readings were taken under full load (twice the dead and live design load), and three sets after the load was removed. In Fig. 5, note that the deflection decreased during the last five hours that the full load remained on the floor. A few days after the test load was removed it became necessary to place the cinder fill and floor strips for the maple flooring and these were held in place by posts and wedges driven hard against the slab above.

CONCLUSIONS.

The writer feels that statements of opinion and personal conclusions should be excluded from a report of a scientific test. Accordingly, only brief mention will be made here of a few of the observed facts not mentioned thus far. The test has afforded some very valuable design data, and very interesting mathematical relations can be deduced from the data obtained, but the present paper must leave this matter untouched.

Arch Action.—In previous tests the writer has measured compressive stresses on lines directly between columns, which would indicate the presence of considerable arch action, but which did not determine the amount closely. The point of inflection readings, Figs. 3 and 4, and the others not given in this paper, however, give the best arch action measurements that have so far been obtained. Figure 4 does not give a positive indication, but Fig. 3 and two of the other series of readings show both the upper and lower surfaces of the slab to be in compression for a considerable distance on either side of the point of inflection. The average compression on the section at the point of inflection is indicated as from 150 to 250 lbs. per square inch. The other two series of readings indicate more nearly normal beam action.

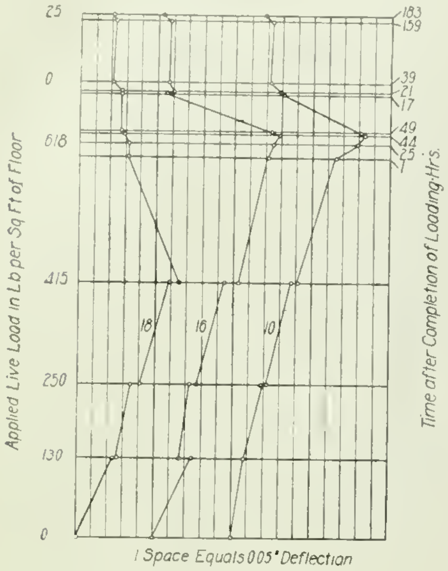


Fig. 5—Deflection Diagram.

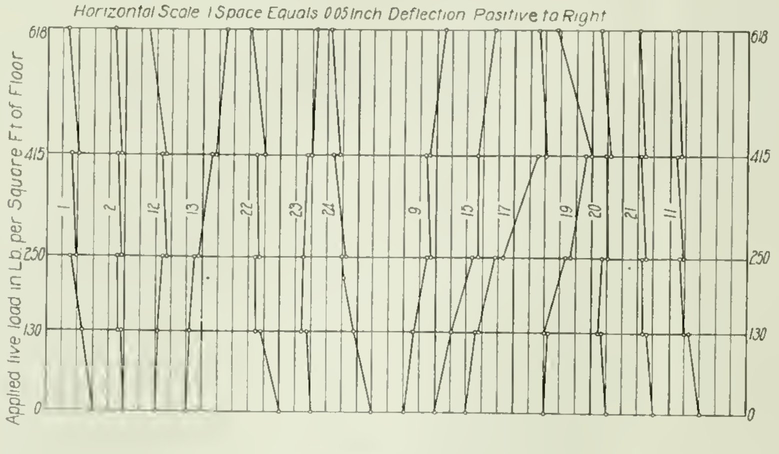


Fig. 6—Deflection Diagram.

TABLE II.—SUMMARY OF DEFLECTION OBSERVATIONS.

Load per sq. ft., lbs.	130	130	250	250	415	415	618	618	618	618	0	0	0	0	25
No. of panels.	5	5	5	5	3	3	2	2	2	2					5
Load applied.	1 hr.	4½ hrs.	1 hr.	16 hrs.	1 hr.	18 hrs.	1 hr.	25 hrs.	44 hrs.	49 hrs.	17 hrs.	21 hrs.	39 hrs.	*	†
Gauge line.															
1	—.0375	—.0395	—.0775	—.0575	—.0725	—.0550	—.0848	.....	—.0635	—.0815	—.0544	.....	.....	.....	.....
2	—.0145	—.0205	—.0237	—.0165	—.0230	—.0180	—.0310	.....	—.0320	—.0040	—.0214	.....	.....	.....	.....
3	—.0162	—.0212	—.0142	—.0008	.0081	.1223	.0322	.....	.0573	.0498	.0103	.....	.....	.....	.....
4	.0362	.0452	.0622	.0742	.0485	.0472	.0312	.....	.0346	.0247	.0534	.....	.....	.....	.....
5	—.0550	—.0740	—.0880	—.0777	—.0960	—.0800	—.1010	.....	—.1126	—.1250	—.1375	.....	.....	.....	.....
6	—.0190	—.0140	—.0085	—.0000	—.0125	—.0040	—.0055	.....	.0075	.0035	.0175	.....	.....	.....	.....
7	—.0067	—.0122	.0008	.0258	—.0264	—.0159	—.0242	.....	—.0124	—.0220	—.0137	.....	.....	.....	.....
8	.0625	.0668	.1308	.1468	.0548	.0508	.0471	.....	.0588	.0508	.0647	.....	.....	.....	.....
9	.0312	.0302	.0742	.0825	.0717	.0782	.1305	.....	.1567	.1522	.0473	.....	.....	.....	.....
10	.0395	.0385	.0920	.1085	.1875	.2045	.3285	.3932	.4139	.4095	.1543	.1446	.1104	.1187	.0933
11	—.0380	—.0500	—.0670	—.0620	—.0720	—.0640	—.0730	.....	—.0830	—.0920	—.0935	.....	.....	.....	.....
12	.0048	.0021	.0208	.0338	.0186	.0288	—.0240	.....	—.0252	—.0352	—.0127	.....	.....	.....	.....
13	.0063	.0038	.0213	.0328	.0808	.0918	.1278	.....	.1550	.1478	.0408	.0403	.0336	.0368	.0313
14	.0413	.0438	.1140	.1311	.0253	.0258	.0163	.....	.0198	.0103	.0096	.....	.....	.....	.....
15	.0513	.0536	.1198	.1383	.1318	.1363	.1863	.....	.2156	.2088	.1033	.0861	.0640	.0703	.0444
16	.1219	.0812	.1137	.1347	.2202	.2674	.3592	.3760	.3972	.3687	.0285	.0514	.0368	.0386	.0115
17	.0304	.0344	.0884	.1144	.2254	.2519	.2304	.....	.2588	.2503	.1228	.1201	.0793	.1124	.1063
18	.1292	.1207	.1747	.2010	.2967	.3267	.1582	.....	.1605	.1467	.1370	.1352	.1090	.1174	.1060
19	.0074	.0002	.0682	.0805	.1307	.1472	.0387	.....	.0262	.0127	.0300	.....	.....	.....	.....
20	—.0161	—.0241	—.0171	.0002	—.0061	.0094	—.0211	.....	—.0096	—.0226	—.0044	.....	.....	.....	.....
21	—.0237	—.0292	—.0332	—.0259	—.0407	—.0332	—.0452	.....	—.0492	—.0592	—.0582	.....	.....	.....	.....
22	—.0610	—.0755	—.0760	—.0640	—.0706	—.0495	—.0905	.....	—.0825	—.0950	—.0886	.....	.....	.....	.....
23	—.0160	—.0290	—.0235	—.0240	—.0137	.0020	.0160	.....	.0365	.0330	—.0112	.....	.....	.....	.....
24	—.0613	—.0936	—.1013	—.0888	—.1298	—.1098	—.1393	.....	—.1666	—.1868	—.2005	.....	.....	.....	.....

*6 days 15 hours. †7 days 15 hours.

Tension in Concrete.—As in other tests for actual stresses, it is evident from the measured stresses that a great deal of the load is carried by the moment of the plain concrete slab and by arch action. The compressive stresses are altogether greater than the tensile stresses in the steel would lead us to expect.

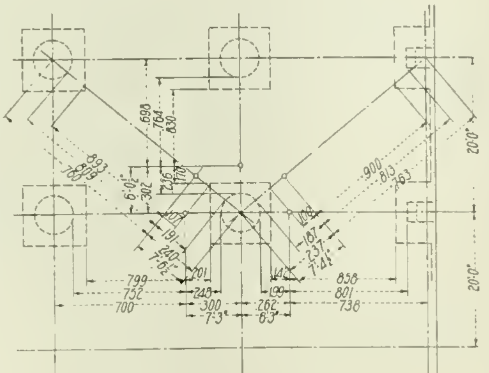


Fig. 7—Proportionate Distances to Line of Inflection in Five Directions.

Point of Inflection.—In Fig. 7 the position of the point of inflection along five direct and diagonal center lines has been plotted and the proportionate span computed. Ratios are given for the span between column centers, for the span between edges of column capitals, and for the span between edges of depressed heads.

The writer has been interested for a long time in the statement made in a book written by Mr. C. A. P. Turner, entitled "Concrete Steel Construction," and repeated often in the subsequent writings of Mr. Turner, to the effect that the section of maximum stress on the diagonal bands of flat slab construction lies at a point very close to the probable position of the line of inflection, if we consider

TABLE III.—COMPARATIVE STRESSES AT CENTER OF SPAN.

	Total dead and live load on floor.		
Band.	370 (Design load.)	535	738
Short cross band	1,850	8,340	14,200
Diagonal band, interior panel	2,080	3,240	8,950
Diagonal band, wall panel	3,760	7,540	14,800
Long cross band, interior panel	3,000	2,740	8,520
Long cross band, wall panel	4,770	9,380	14,300

TABLE IV.—COMPARATIVE STRESSES OVER EDGE OF CAPITAL.

	Total dead and live load on floor.		
Band.	370 (Design load.)	535	738
Short cross band	1,710	2,760	6,540
Diagonal band	3,620	5,600	7,880
Long cross band	3,000	3,540	7,000

TABLE V.—COMPARATIVE STRESSES OVER EDGE OF DEPRESSED HEAD.

	Total dead and live load on floor.		
Band.	370 (Design load.)	535	738
Short cross band	2,000	2,760	5,500
Diagonal band	5,120	8,270	13,470
Long cross band	4,270	9,300	13,900

the bands as beam strips. The writer of this paper has never found any visible indications of stress at this point in any of his tests, and in the Larkin warehouse the point of inflection readings were planned so as to measure stresses directly over two such regions. The readings indicate that this is a section of very low stresses.

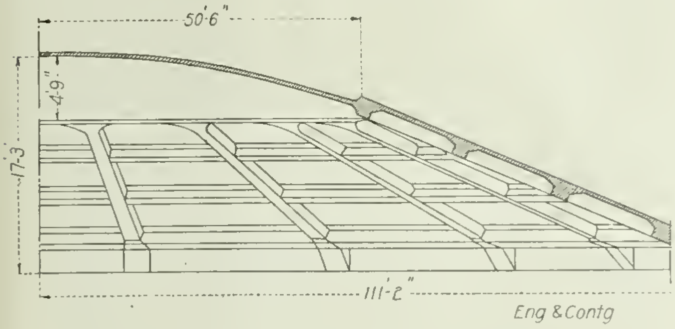


Fig. 1—One-Half Sectional Elevation of Reinforced Concrete Dome.

Distribution of Stress in Various Directions.—The designers of the Larkin warehouse do not care to give out the steel reinforcement for the floor slab tested, knowing from past experience that such data are subject to abuse on the part of irresponsible designers. We may arrive at a clear conception of the relative moments in the various directions, however, by considering what the stress per square inch in the steel would be if the observed stress in the various bands were distributed in each case over the same steel area as was actually present in the diagonal bands at the center of the spans. Tables III, IV and V give the values of the tension in the steel, at certain sections, considering the total tension as observed to be distributed over a fixed steel area. These figures are not actual stresses, and may be used for comparative purposes only.

Tables III, IV and V give comparative steel stresses only. To arrive at a conception of the comparative moments at the various sections, we must allow for the fact that while the same steel area was considered in each band, the depth from the compressive face of the slab to the steel varied, being about 8 ins. at the center, about 14 ins. at the column capital, and about 7 ins. at the edge of the depressed head. The tension existing in the concrete of the test floor also exerted its influence on the steel stresses, and this is a variable quantity, depending on the amount of load on the floor. The distribution of the load at the various stages must also have had a very appreciable effect, especially on the stresses in the long cross bands.

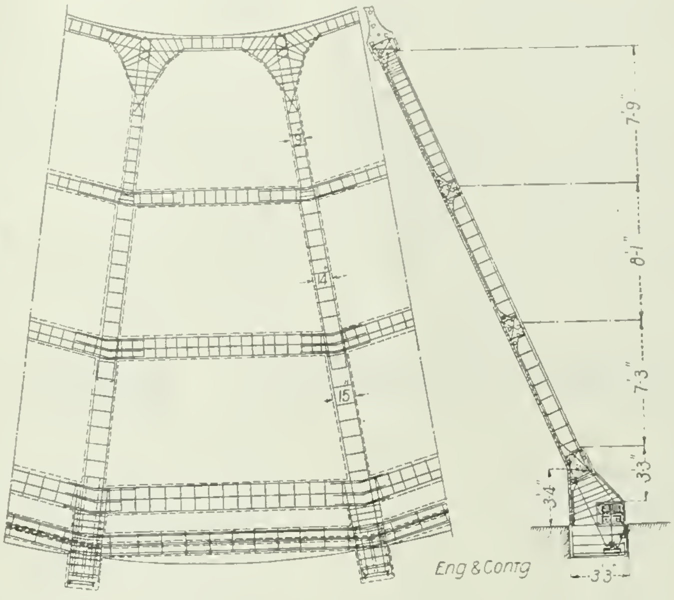


Fig. 2—Girder Arrangement and Reinforcement for Tent Dome.

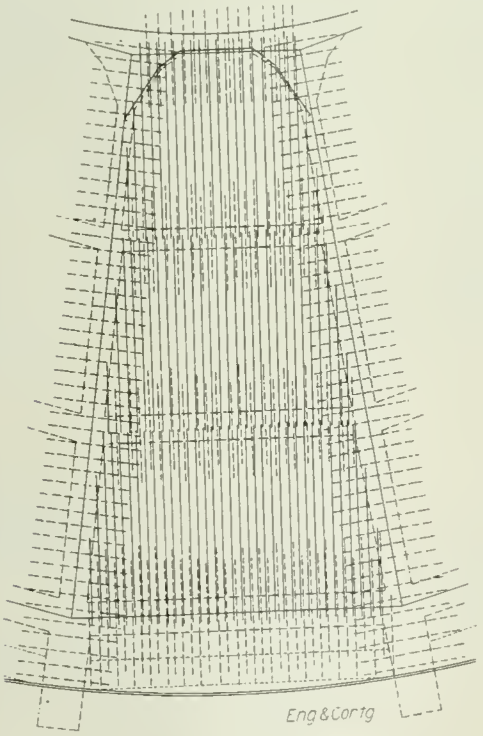


Fig. 3—Tent Dome Slab Reinforcement.

Effect of Drops.—In the typical flat slab construction, where the slab is supported simply by the column capital, the critical stress section is located at the edge of the capital, as is shown by several previous tests for actual stresses. In the Larkin warehouse, the Concrete Steel Products Co. carried out the depressed head design, which leaves a full thickness of slab for a considerable distance around the column capital, and employs a much thinner slab at the center of the span. The stress readings show that with the proportions used in the Larkin warehouse, the critical stress section is located at the edge of the depressed head, instead of at the capital, although the difference between the stresses at the two points was very slight. The deflection readings, compared with those of other tests, show that the resulting structure is stiffer and stronger than the straight flat slab, as ordinarily designed, with anywhere near the same amount of materials.

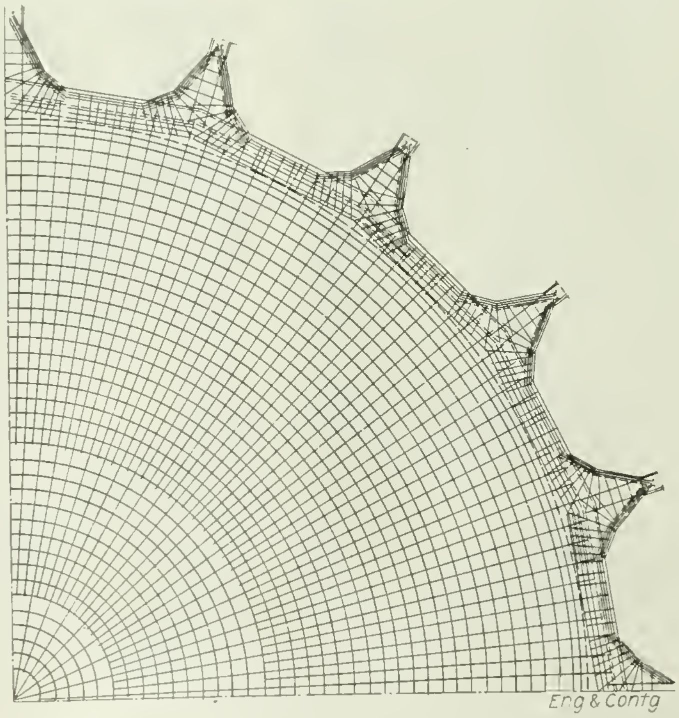


Fig. 4—Saucer Dome Slab Reinforcement.

Other Test Indications.—Signs of stress were carefully watched and recorded, and were such as to check very satisfactorily the stress measurements. At design load there was practically no visible evidence of stress, and throughout the test the indications were much fainter than has been the case in any building test which the writer is familiar with, including two beam and girder constructions and many flat slab constructions of various designs.

The test has afforded most valuable design data. While the structure showed itself under test to be of excess strength in every respect, the test discloses ways in which the materials may be used more economically in rectangular panels, and indicates the relation between interior and wall panels. The point of inflection readings are most interesting scientific data, both as locating the approximate position of the line of inflection and as giving indications of the presence and magnitude of the arch action.

An Interesting Flat Dome Construction of Reinforced Concrete.

(Staff Article.)

The designs shown by the foregoing drawings are those adopted for the inner dome of the church at St. Blasien, Germany. This building had been recently destroyed by fire, and the outer dome had been rebuilt of steel with wood and copper covering. Since the new outer dome had been rebuilt of very light construction, the inner dome could not be suspended from it. Also, as the old circular wall carrying the dome had been weakened by fire, it was advisable not to cut into it more than could not be avoided. These conditions influenced the design of the dome illustrated, as will be explained further on.

The general construction of the new dome is shown by Fig. 1. Carried on the dome walls is a 20-sided tent dome having a circular opening at its top filled with a spherical slab or saucer dome. Referring to Figs. 2 and 3, which show the tent dome details, it will be seen that the end of each vertical rib is set into a socket into the drum wall. Each of these sockets is 60 c.m. (2 ft.) deep and 1 m. (3.28 ft.) high, and the width 40 c.m (15¾ ins.) of the girders. These 20 sockets are the only cuttings into the old drum wall, since the circular tension ring of the dome is located in from the ends of the radials sufficiently to clear the drum walls. This detail is indicated clearly by Fig. 2, which also shows the rib and ring reinforcement. This reinforcement of this tent dome stub carried by the ribs is indicated by Fig. 3.

The reinforcement of the saucer dome is shown by Fig. 4, which, with Fig. 2, also shows the manner of attaching the saucer dome to the tent dome. This saucer dome, as shown by Fig. 1, is a thin spherical slab 15.4 m. (50½ ft.) in diameter and 1.5 m. (4.92 ft.) rise. The thickness of this slab is from 5 ins. to 3 ins., and it is reinforced by an inner and outer wire mesh. The total diameter of this saucer and tent dome is 33.7 m. (110½ ft.) The entire work called for 160 cu. m. of concrete and 38 tons of steel. We are indebted to "Concrete and Constructional Engineering," of London, England, for the information given above.

SEWERAGE AND SANITATION

Some Notes on Modern Sewage Pumping Machinery and Appliances with Illustrative Examples.

There are several widely varying types of sewage pumping appliances and installations now in service in this country. Each type has its special field of economic application, and the choice of apparatus for a given installation, therefore, must be a result of a study by the sewerage engineer of the particular requirements of the situation and of the various advantages and disadvantages of the several types of sewage pumps. The present article discusses some of the chief types of sewage pumping machinery and appliances now available to engineers, and gives examples of their installation, with special reference to pneumatic ejectors. The pumping of sewage differs from the pumping of water principally on account of the suspended matter carried in sewage. This suspended matter comprises the organic wastes of the sewage, mineral matter which is washed into the sewer through the manhole openings, and foreign matter such as rags, sticks, etc. Reliable operation is a prime consideration in sewage pumping, since the failure of such a plant to meet the requirements imposed upon it will cause the sewage, in the event of a sufficiently long continued shut down, to back up in the sewer and enter houses through the various plumbing fixtures.

Pneumatic Ejectors.—Since all rubbing surfaces or moving parts are eliminated and the sewage is lifted entirely by a piston of air, the pneumatic ejector is well adapted to pumping crude and unscreened sewage. Figure 1 illustrates a typical isolated sewage pumping plant with three Priestman ejectors and air tanks installed complete in a pit below the street level. An installation of this kind would be made for instance to pump sewage from a low lying district of a sewerage system up to a main outfall sewer, saving the excavation and construction work necessary to lay the large main sewer at a depeer level so as to permit drainage by gravity.

Air is supplied from a central compressor plant furnishing air to other similar ejector stations, or else for other work. Besides the air tank and ejectors there is also installed in the pit the ejector operating valve. With this type ejector the air valves may be located at some convenient and accessible place near the top of the pit and are independent of the ejector bodies themselves, being connected with them by small piping only. The operation is as follows: Sewage gravitates to the ejector bodies; as it rises to the top it entraps and compresses the small amount of air in the small bell. This bell is connected by small piping to the operating valve. The slight compression acting on a diaphragm in the valve is sufficient to operate it so that the main air valve is opened and air is admitted to the ejector to displace and discharge the sewage. The valve is also designed and set so that the air supply is cut off after a predetermined interval before all the sewage has been displaced so that the remainder of the discharge takes place while the air is expanding and the greatest economy is secured.

Figure 2 shows another isolated compressor station of somewhat different arrangement and with only one ejector. Where there is only one pumping plant to be installed a complete ejector plant with motors, compressors and auxiliaries is installed in a suitable station as shown in Figs. 3, 4 and 5. In Fig. 3 the ejector proper is in the pit below the street surface, while the air compressors, mo-

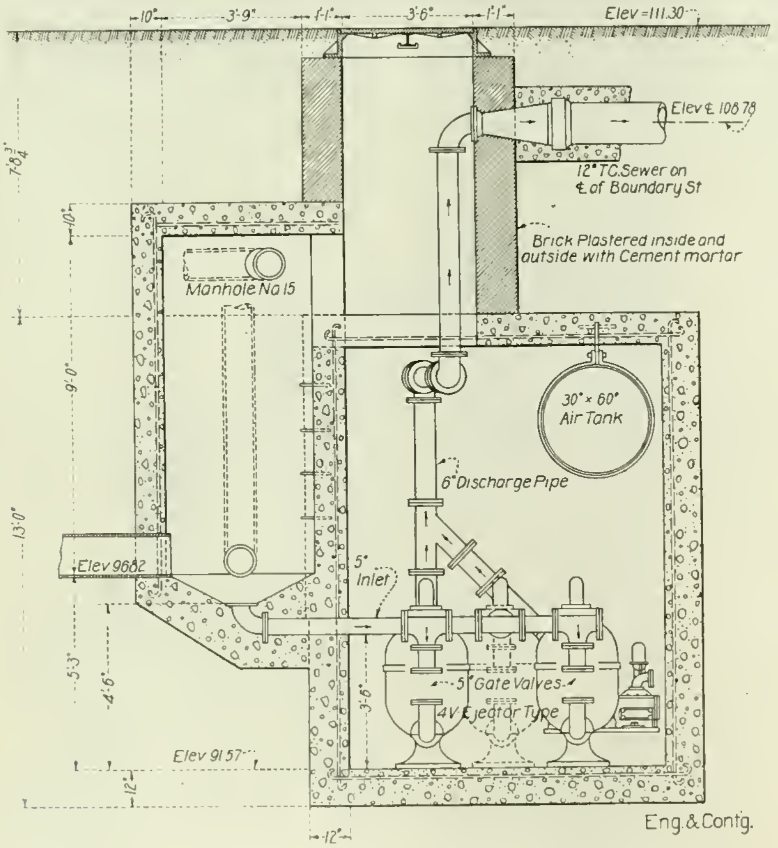


Fig. 1—Typical Isolated Sewage Pumping Plant Equipped With Three Priestman Pneumatic Ejectors.

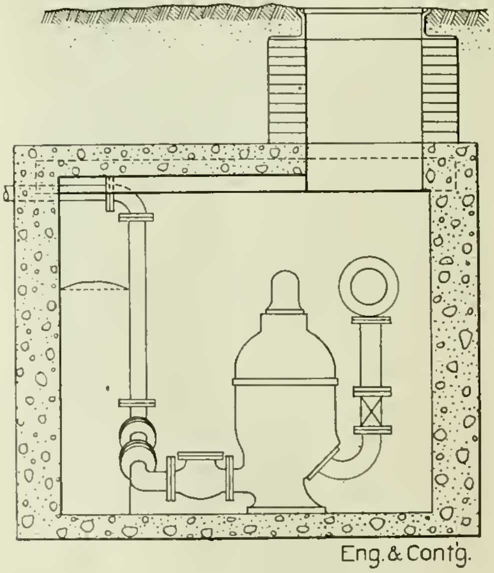


Fig. 2—Typical Isolated Lifting Station With One Pneumatic Ejector.

tors, auto starters and operating valves are in the house immediately above the pit. The advantage of operating valves which may be located at a distance from the ejectors is apparent; the valves are located above the street level along with the compressors and auto-starters where they can all be readily inspected and oiled by the engineer. Figure 4 shows the operating valves located on the wall to the right of the small compressor both above the street level, while the ejector and air tank are below in the pit. Figure 5 shows a complete system below the street level in a very compact station.

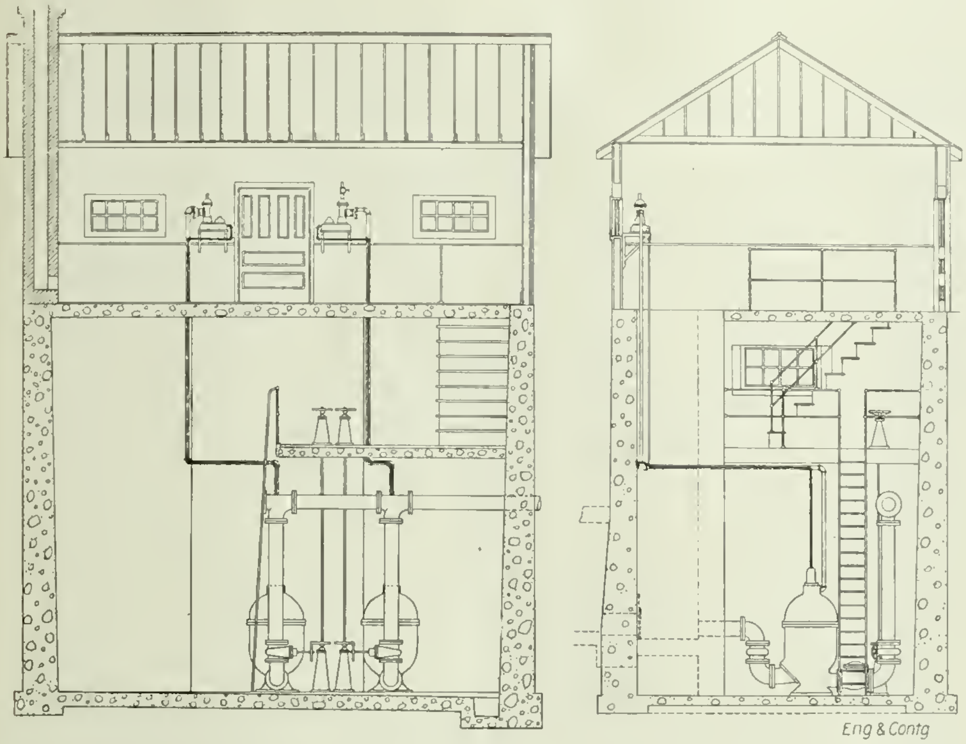


Fig. 3—Complete Pumping Plant With Motors, Compressors, Ejectors and Auxiliaries.

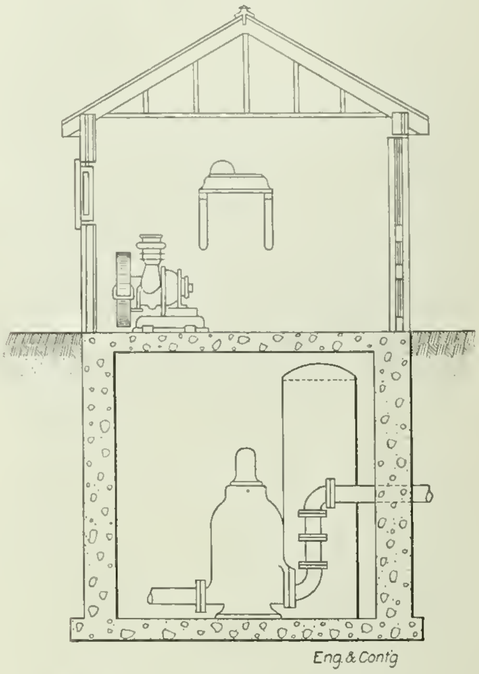


Fig. 4—Complete Pumping Plant.

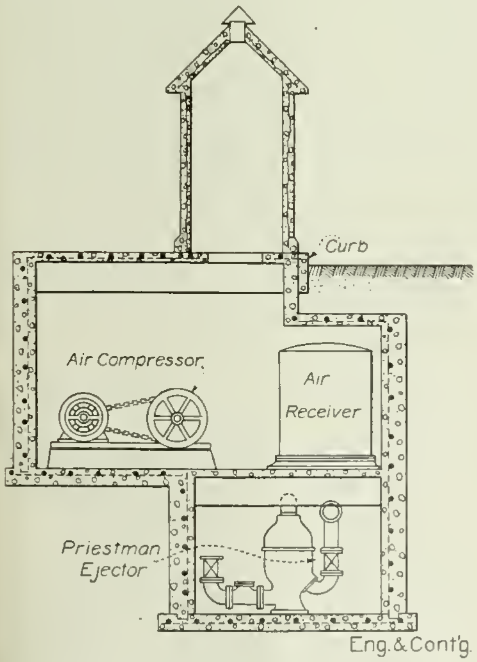


Fig. 5—Complete Pumping Plant.

The advantages of the pneumatic ejector have already been pointed out, namely, the absolute reliability of operation depending on the fact that the power is transmitted not by plungers, pistons, impellers, screws or similar devices, but by a piston of compressed air. The mechanism for opening the valve to admit the compressed air, as, for instance, a float rising with the sewage, may also be replaced by a piston or spring of compressed air which acts upon a suitable diaphragm in the valve mechanism. By this arrangement all moving parts are entirely eliminated in every stage of the operation of the ejector, nothing coming in contact with the sewage but air.

But while the pneumatic ejector is very reliable, it is open to some objection on the grounds of inefficiency in large plants operating continuously. In small plants the reliability of the pneumatic ejector and the fact that it handles crude and unscreened sewage and thus requires no attendance, or cleaning of screens, and is entirely fool proof, makes the question of efficiency of comparatively minor importance. This is even more the case where the sewage flow is intermittent. The compressor automatically maintains the air supply in the tank, and when there is no demand the air compressor is shut down. The ejector does not operate until it is filled and it may discharge once an hour or twice a minute, depending upon the rate at which sewage gravitates to it. On the other hand, a small pump of the centrifugal or plunger type may be operating for long periods at far under its full capacity thus underloading the driving motor as well with resulting fall in efficiency.

The main reason for the higher efficiency of the pump as compared to the pneumatic ejector is that with the pump the drive is direct, whereas with the pneumatic ejector, the driving motor must first compress the air which in turn discharges the sewage. An improvement in the efficiency of ejectors is now obtained, however, by using the air expansively. By cutting off the air supply at a predetermined point expansion occurs during the discharge of the remaining volume, so that the air is released from the ejector body at a pressure approximating that of the atmosphere instead of the full pressure of the air in the storage tank.

Centrifugal and Plunger Pumps.—If the sewage is thoroughly screened, a centrifugal pump will handle it at somewhat lower efficiency than that when handling pure water, as the solids and grit and grease which cannot be screened out cause corrosion and incrusatation of metal parts. Screens must always be supplied, but even these will not always prevent rags and other foreign matter from entering the pump impellers, where they are passed with difficulty and very often become entangled, thereby causing vibration and reduction of the pump capacity, and eventually requiring a shut down.

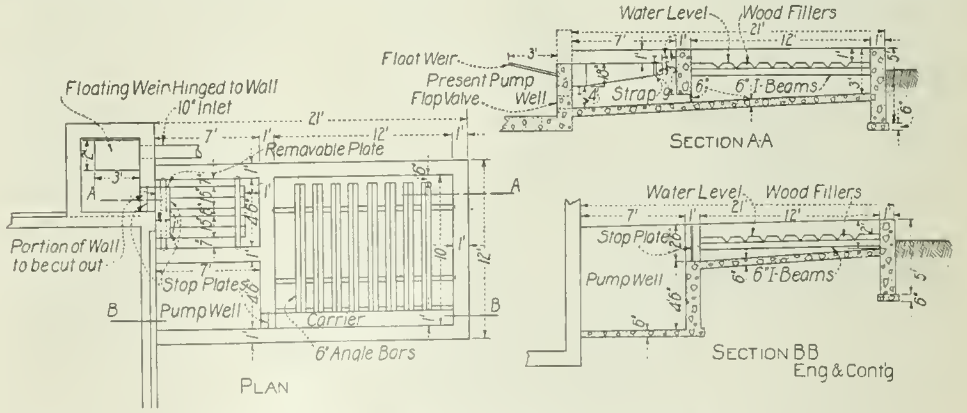


Fig. 6—Pre-Tank for Separating Solids and Liquids of Sewage Before Pumping, Used in Conjunction With Pumping Station Shown in Fig. 7.

By making the screens finer, a larger proportion of the solids may be prevented from entering the pump, thus increasing its reliability, but on the other hand, necessitating more frequent cleaning of the screens and more careful attention to the working of the plant. The accumulation of screenage becomes foul and dangerous to health, and the removal of the screenings themselves is costly and troublesome.

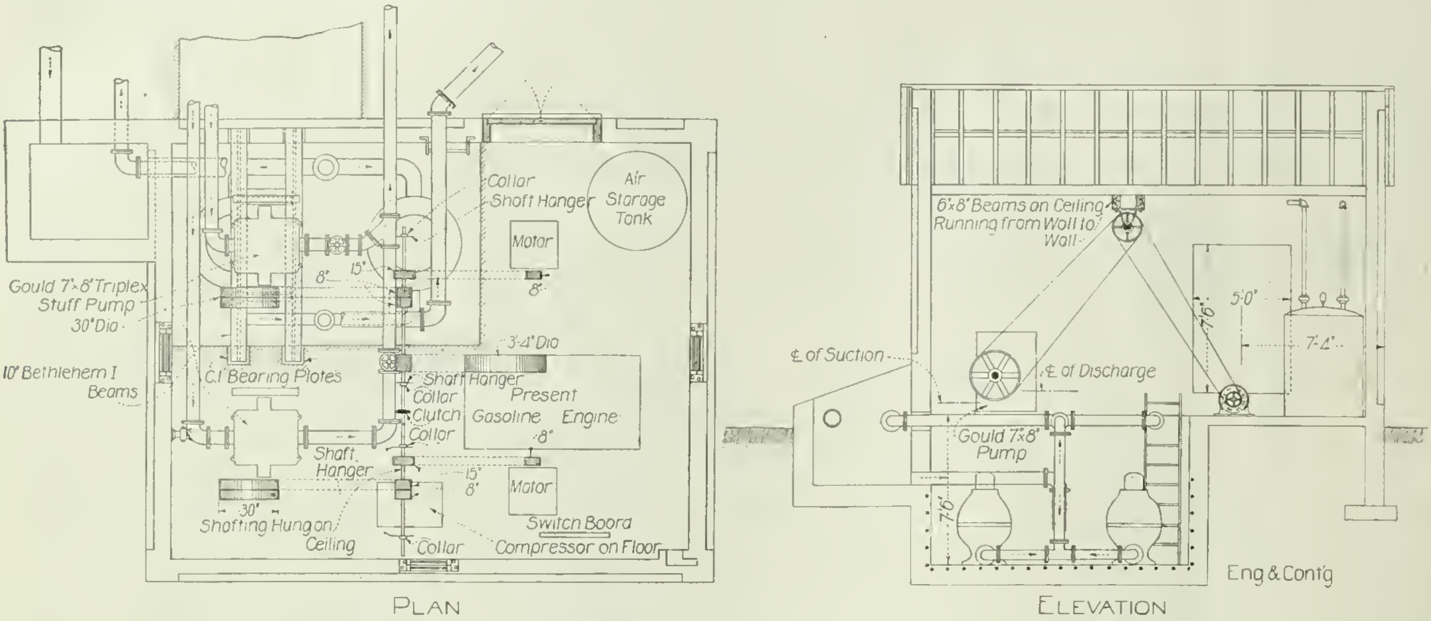


Fig. 7—A Sewage Pumping Station Designed on the Natural Compound Pumping System Plan.
(Pneumatic ejectors lift the sludge, and triplex pumps lift the clarified liquid portion of the sewage.)

The Natural Compound Pumping System.—The ordinary stationary screens have not proved satisfactory, as pointed out, because they require constant attention and become rapidly choked and the removal of the screening is very objectionable and costly work. But screens cannot be done away with, or else the pumps will clog. The Priestman natural compound pumping system has been perfected in order to overcome these difficulties by separating the solids in the sewage from the liquids by pre-tanks. The solids and liquids are then lifted separately by pumping apparatus best adapted to each service from the standpoint of both reliability and efficiency.

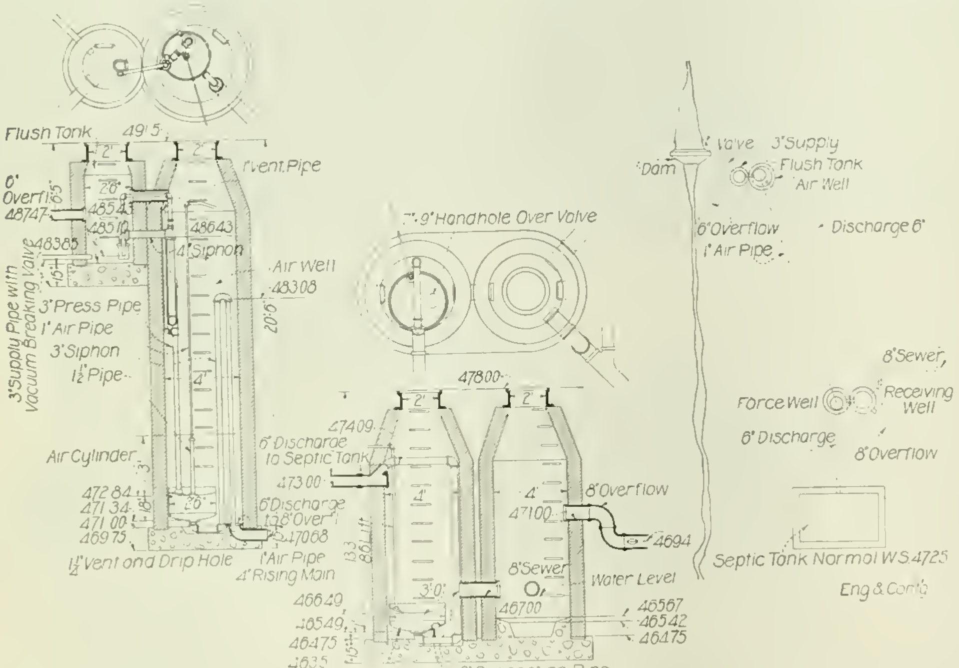


Fig. 8—Power for Sewage Lift Derived from Dam in Small Stream.

Instead of the ordinary screens the solids are separated out by pre-tanks in which baffles, collecting weirs, self-cleaning screens, etc., are so arranged that the solids are retained in one portion of the tank and the clarified liquid passes on to another. The solids which make up only a few per cent of the total volume gravitate into Priestman pneumatic ejectors and are discharged by compressed air into the delivery main by passing the pump, or else to a separate discharge pipe. The clarified liquid is pumped by either high efficiency centrifugal or plunger pumps. The pumps can be driven by motors, gas or oil engines, or steam turbines. The air compressor is small and may be readily driven by belting or from the shaft of the main driving motor or engine.

Figure 7 shows a sewage pumping station designed on the Priestman natural compound pumping system plan, comprising Priestman ejectors for the sludge and high efficiency triplex plunger pumps for the clarified sewage. Instead of the plunger pumps, centrifugal pumps could also be used. Figure 6 shows the pre-tank as used in the installation shown in Figure 7. The drawing shows the inlet chamber, the sludge chamber, weir chamber and the pump well from which the clarified sewage is lifted while the sludge gravitates to the ejectors.

Automatic Sewage Lifts and Water Power.—By use of the automatic sewage lift, sewage may be pumped by sewage, without cost or else the water power lift, by water, sometimes with and sometimes without cost for the motive power. As conditions do not always permit of the use of the lifts, they are not found so generally in service but the entire absence of operating cost with these devices warrants their consideration under all circumstances.

The cost of a sewerage system may be decreased by draining a low lying district separately and by lifting the sewage, thus avoiding deepening the excavation throughout the entire system. A pumping station may not be advisable owing to the cost of attendance of operation. In such cases a study should be made of the possibility of using the automatic sewage lift. Very often topographical conditions permit of using the power stored in high level sewage to compress air so that the low level sewer may in turn be lifted by using this compressed air furnished at no cost. The lift is entirely automatic and clogging is avoided by the flushing effect of successive discharges of sewage.

Instead of pumping the low level sewage by power derived from the fall of high level sewage, water from a nearby stream or city main may be used instead. Figure 8 shows a sewage lift wherein the power is derived from damming a small stream.

We are indebted to the Merritt Hydraulics Company of Philadelphia for the illustrations shown herewith.

Lawrence Experiment Station Studies of the Disinfection of Sewage and Effluents from Sewage Filters.

A large number of experiments have been made at the Lawrence experiment station of the Massachusetts State Board of Health, during the past ten years, to determine the effectiveness of various disinfectants in destroying the bacteria in water, sewage, and the effluents from sewage filters. In these investigations the studies of both water and sewage disinfection have been carried on simultaneously, the difference between water and sewage, as far as disinfection is concerned, being one of degree of pollution only. The more important data obtained in the investigations upon the disinfection of sewage and the effluents from sewage filters are here given, as abstracted from the latest annual report of the Board. The experiments herein described were made under the direct supervision of Messrs. H. W. Clark and Stephen De M. Gage.

By far the most satisfactory results have been obtained by the use of the hypochlorites, of which the compound variously known as hypochlorite of lime, chloride of lime or bleaching powder is the most common and most readily and cheaply obtained. The efficiency of this group of disinfectants is due to the fact that they are easily dissociated in solution with the liberation of nascent oxygen, and while by long established custom it has been the practice to express the strength of solutions of these disinfectants in terms of the amount of available chlorine, it is the oxygen which is the active agent in the disinfection. Similar in action to the hypochlorites are other oxidizing agents, such as permanganates, peroxides, ozone, etc. All the disinfectants of the oxidizing type act not only upon the bacteria, but also upon any readily oxidizable organic matter which may be present, and for this reason the condition of the sewage or effluent as regards avidity for oxygen is an important factor in determining the amount of disinfectant required for disinfection. Unlike the metallic salts and certain organic substances which act as sterilizing agents through their poisonous properties, the hypochlorites and other disinfectants of the oxidizing type entirely lose their identity during the disinfection process, and the further disposal of the disinfected sewage is affected only by the fact that the bacteria necessary for self-purification have been to a greater or less extent removed.

The data here given are from two sources. A large number of experiments have been made in the laboratory in which gallon samples of the sewage or effluent under investigation were treated with varying amounts of the disinfectant, and were examined bacteriologically after standing for periods of 1, 2, 4, 6 and 24 hours or longer. In the investigation of the action of hypochlorites, not only was the experimental treatment of each sewage or effluent repeated at least once after an interval of some days or weeks, but similar experiments were made with effluents from other filters of the same type. These data, therefore, show not only the approximate amount of disinfectant required to obtain a given result, and the effect of the time during which the disinfectant was allowed to act upon that result, but also show what effect the usual fluctuations in composition of sewages and sewage effluents may have upon the disinfection process. Similar but much less extensive studies have also been made of a number of other disinfectants, the results of which are summarized. Supplementary to the above experiments with the hypochlorites were those in which the entire volume of sewage applied to, or the entire effluent from, certain of the experimental filters at the station was treated daily with hypochlorites.

STANDARDS OF DISINFECTION—METHOD OF EXPRESSING RESULTS.

There are two ways of looking at the results of the disinfection of sewage and the effluents from sewage filters. In Germany, where disinfection of hospital sewage is compulsory, and where municipal sewage is required to be sterilized during cholera epidemics, absolute sterilization is aimed at, and it is considered necessary to add the disinfectant in such proportions that the test organisms, usually B. coli, shall be absent from all 1 c. c. samples, and shall be only occasionally present in samples of 100 and 1,000 c. c. Practically all of the numerous German experiments on sewage disinfection have been made with this in view, and the results have been presented with reference to the bacterial content of the liquid after disinfection, irrespective of the numbers originally present. On the other hand, some American investigators have laid considerable emphasis upon the percentage of the original numbers of bacteria which have been destroyed by disinfection, but have entirely omitted to discuss, or have given scant attention to, the significance of the numbers of bacteria which remain after disinfection. Of these two viewpoints, the former, in which the final bacterial content is made the criterion, appears to be the most logical, although the standards recommended by the German investigators are much more severe than are necessary for average American conditions. If the object in sterilization is to prevent the carriage of some specific disease at times of epidemics, or if the sterilized sewage or effluent from a sewage filter is to be turned into a lake or river which is to be used without further purification as a source of water supply, then absolute sterilization is undoubtedly desirable. If, however, the body of water which is to receive the final effluent is already polluted, and the object in sterilization is only to prevent further contamination, then the standard may be lowered to meet the local need. In either case, however, the numbers of bacteria in the liquid after sterilization should be made the basis of comparison. In presenting the results of these experiments, both methods of expression have been employed, and since standards may vary with local conditions, a number of arbitrary standards have been assumed for the purpose of discussion.

Three separate counts of bacteria—*i. e.*, total colonies on agar plates incubated four days at room temperature and total and red colonies on litmus lactose agar plates incubated 24 hours at body temperature—have been made on all samples. It has been found that waters in Massachusetts suitable for drinking usually contain less than 100 bacteria per c. c. determined at room temperature, and that the total number of bacteria developing on litmus lactose agar at body temperature is usually less than 10 per c. c., and the number of red colonies on such plates is usually less than 5 per c. c. This we have called the "drinking water" or "100—10—5" standard. For purposes of comparison two other standards containing, respectively, 10 and 100 times as many bacteria as the drinking water standard, and designated the "1,000—100—50" and the "10,000—1,000—500" standards, have been assumed. These latter correspond approximately to the upper and lower limits of bacterial counts on river waters receiving more or less pollution.

EXPERIMENTS WITH VARIOUS AMOUNTS OF CALCIUM HYPOCHLORITE.

In this series of experiments the sewages or effluents from sewage filters were divided into aliquot parts, which were treated with hypochlorites in gradually increasing amounts, and determination of bacteria were made after 1, 2, 4, 6 and 24 hours. The effect of allowing the disinfectant to act for varying periods of time will be discussed later. In practice, four hours' disinfection would probably be the limit, as the improvement obtained by a longer period would probably not warrant the extra cost of the larger tanks necessary to retain the sewage. For this reason, the two and four-hour results have been selected for comparison and discussion.

Sewages.—In all, eleven experiments were made with different kinds of sewages, including the untreated and the settled Andover sewage and the Lawrence sewage before and after treatment by settling, by straining and by septic tanks. The initial numbers of bacteria in these sewages ranged from 735,000 to 2,340,000 per c. c. In the majority of cases treatment with 0.38 part available chlorine caused a bacterial reduction of 75 to 90 per cent. Treatment with 0.75 part was required to produce a production of 75 per cent in the total bacteria in two experiments, and a similar reduction in the body temperature types in three experiments, and the same amount was required to cause a 90 per cent reduction in the body temperature counts in four experiments. In only one experiment was a completely sterile effluent produced by the maximum amount of chlorine used, 3.75 parts per 100,000. In general, a reduction of total bacteria to less than 100 per c. c. was produced by available chlorine equal to 1.88 parts per 100,000 or less, in five experiments 0.38 part being sufficient. In eight of the experiments, however, the maximum amount of disinfectant used was not sufficient to reduce the body temperature counts sufficiently to fall within the entire 100—10—5 standard. In two experiments 2.63 parts available chlorine were required to reduce the bacteria within the limits of the 1,000—100—50 standard, or to the limits of a moderately polluted water, and in one experiment 1.13 parts available chlorine were required to produce an effluent of the 10,000—1,000—500 quality.

Contact Filter Effluents.—The effluents from five different contract filters were studied, two experiments being made with each. The initial numbers of bacteria in these samples ranged from 257,000 to 1,200,000 per c. c. In eight experiments 0.38 part available chlorine produced a reduction in bacteria of 75 to 90 per cent, and in the other two experiments about 0.75 part chlorine was required to reduce the bacteria to the same extent. In seven of the experiments a reduction of 99 per cent was accomplished by the use of 0.38 part, in two experiments by the use of 0.75 part, while in one experiment 1.13 parts were required to produce a similar reduction. Considering these results from the viewpoint of standards, in only one experiment was a sterile effluent produced by the use of the maximum amount of chlorine, 3.75 parts per 100,000, and in only this single experiment were the bacteria reduced within the 100—10—5 or water standard. In five experiments the bacteria were reduced to the 1,000—100—50 standard by the use of 0.38 part available chlorine, while in one experiment 2.25 parts were required to reduce the bacteria to this standard, and in another experiment 1.13 parts available chlorine were required to reduce the bacteria within the very polluted, or 10,000—1,000—500 standard.

Trickling Filter Effluents.—Ten experiments were made with untreated trickling filter effluents, and two experiments with trickling filter effluents from which most of the suspended matters had been removed by settling. The initial numbers of bacteria in these samples ranged from 14,000 to 475,000 per c. c. These effluents differed from the sewages and contact filter effluents in being generally more completely oxidized, and thus absorbing less of the hypochlorite before the disinfection should begin. In all of these experiments a reduction of 90 per cent of the bacteria was produced by 0.38 part available chlorine or less, while in nine of the twelve experiments the same amount of disinfectant caused a reduction of over 99 per cent in the bacterial content, and in the other three experiments a like reduction was produced by the use of 0.75 part per 100,000. In only one of these experiments, however, was a sterile effluent produced, and in five out of the twelve experiments the numbers of bacteria were not reduced within the 100—10—5 standard by the use of the maximum amount of disinfectant, 3.75 parts available chlorine per 100,000. In seven of the experiments 0.38 part chlorine was effective in reducing the bacteria to a standard 1,000—100—50, in one case, however, 1.88 parts chlorine being necessary to bring the samples down to this standard. In only one sample was 0.38 part chlorine insufficient to produce a bacterial reduction to the 10,000—1,000—500 standard, and in this case the next largest amount of disinfectant tried, 0.75 part chlorine per 100,000, proved effective.

Sand Filter Effluents.—Seven experiments were made with effluents from sand filters. These effluents were all clear and free from suspended matters, and the organic matters had been practically all oxidized, conditions being particularly favorable for disinfection treatment. The initial numbers of bacteria in these samples ranged from 36 per c. c. to 35,000 per c. c. In two of the experiments, 0.75 part available chlorine was necessary to produce a bacterial reduction of 75 per cent; in one experiment 1.13 parts chlorine were required to produce a reduction of 90 per cent, and in another experiment 3.75 parts available chlorine were required to produce a bacterial reduction of 99 per cent. In two of the seven experiments a completely sterile effluent was produced by the use of 0.38 part chlorine, and in one other experiment a sterile result was obtained by the use of 0.75 part chlorine, while in one experiment 3.38 parts were required to produce a like result, and in one other experiment a sterile effluent was not produced by the maximum amount of disinfectant used, 3.75 parts available chlorine per 100,000. Two of the samples were already within the standard of 100—10—5 before adding disinfectant, and three others were brought within this standard by the use of 0.38 part chlorine, the smallest amount used. Of the other two samples, one required 0.75 part and one required 1.88 parts available chlorine per 100,000 to reduce the bacteria within the limits of this standard. All of these samples, which were not already within the limits of the 1,000—100—50 standard, were brought within that standard by the use of 0.38 part available chlorine per 100,000.

In all of these experiments it was to be noted that while a very great reduction in the room temperature counts was obtained by relatively small amounts of disinfectant, a very much larger amount of disinfectant was necessary to produce a corresponding reduction in the types of bacteria growing at body temperature. The significance of this will be discussed later.

EFFECT OF TIME OF STORAGE UPON EFFICIENCY OF HYPOCHLORITE DISINFECTION.

In the laboratory experiments, analyses of all samples were made at intervals of 1, 2, 4, 6 and 24 hours after the disinfectant was added, and in the experiments in which the entire volume of settled sewage applied to Filter No. 248 was treated daily with hypochlorites. Many series of hourly samples were collected of the disinfected sewage as it flowed upon the filter. While there is some disagreement in the results of the various experiments, it is possible to determine approximately the relative amounts of disinfectant which would be required to yield similar results with different storage periods. In all cases the greater portion of the work of disinfection occurred during the first hour, after which the elimination of bacteria continued more slowly for some hours. This is especially noticeable in those cases where relatively small amounts of disinfectants were used. A general average of all the results shows the effect of storage to be about as follows: with 2 hours' storage about 84 per cent as much hypochlorite was required to produce the same result as with a storage of 1 hour; with 4 hours' storage about 82 per cent as much hypochlorite was required; with 6 hours' storage about 77 per cent as much hypochlorite was required, and with 24 hours' storage about 61 per cent as much hypochlorite was required to produce the same result as with a storage of one hour.

THE APPARENT SELECTIVE ACTION OF HYPOCHLORITES AND OTHER OXIDIZING DISINFECTANTS.

The results of all the experiments on disinfection of water and sewage show that the disinfectants of the oxidizing type apparently exert a selective action on different types of bacteria. It has already been noted that although an effluent of about the same bacterial quality as many good municipal water supplies might be obtained by the use of a certain amount of hypochlorites when the results of disinfection were judged solely by room temperature counts, a much larger amount of disinfectant is required to produce an effluent of the same standard if body temperature counts are taken into consideration. A similar selective action has also been noticed with other oxidizing disinfectants, such as permanganates and peroxides. It has not been evident, however, when the metallic salts or organic antiseptics have been employed. Considerable study has been given to this phenomenon of abnormally high body temperature counts in waters and sewages which have been treated with disinfectants.

The difference in the significance of the counts of bacteria made at the two temperatures is becoming much better understood as the making of routine counts at both temperatures has become more general. The room temperature count includes many types of bacteria whose numbers are subject to fluctuations which have no sanitary significance. This count has until within a very few years been used practically alone for stating the bacterial content of natural waters and sewages. The body temperature counts, on the other hand, while much smaller than the room temperature counts, show more closely the numbers of bacteria present which are of the types of fecal origin and therefore of sanitary significance. Moreover, in natural waters and sewages under ordinary conditions there is an approximately definite ratio between the counts obtained at the two temperatures, and while higher counts at body temperature than at room temperatures are not unknown, they are of relatively rare occurrence. In both waters and sewages which have been treated with disinfectants of the oxidizing type, however, relatively high counts at body temperature and much smaller counts' at room temperature in the same sample are of frequent occurrence, and much larger quantities of these disinfectants are required to eliminate the types of bacteria shown by the body temperature counts than are required to cause a corresponding reduction in the great mass of ordinary bacteria which appear on the room temperature plates. Such results cannot but indicate that the oxidizing disinfectants and particularly the hypochlorites are selective in their action, and are least efficient in destroying certain types of bacteria which show up on the body temperature plates but fail to develop on room temperature plates. These types are not of the usual colon type, as is evident by the small proportion of red colonies on the body temperature plates. Furthermore, these resistant types are not, in the majority of instances, spore-forming bacteria, although a small proportion of spore formers is found among them. During recent years considerable emphasis has been laid upon the results of tests for B. coli in interpreting the analysis of water. This emphasis is well grounded, and tests for B. coli are undoubtedly a valuable part of sanitary water analysis, but it must be borne in mind that the B. coli test as at present applied in the majority of laboratories is a test only for the presence of a certain group of fecal bacteria, and that there are other types of fecal bacteria which are fully as numerous and which may and probably do have as much or more sanitary significance than the types included under the usual B. coli tests. In the analysis of natural waters perhaps the omission to look for these types may not be of great practical importance, since the bacterial tests are usually supplemented by chemical analyses and by rigid inspection of the sources. In the disinfection of waters and sewages, however, reliance must be placed entirely upon the bacteriological tests, and if any of the types of bacteria included within the great fecal group are less amenable to disinfection than are the vast majority, that fact is of the utmost significance and should be given all due prominence.

INCREASE IN BACTERIA AFTER DISINFECTION WITH HYPOCHLORITES.

In the discussion of the results of experiments on disinfection of water in a former report, attention was called to the fact that large secondary growths of bacteria may occur rapidly in waters which have been treated with hypochlorites. Similar phenomena have been noted in the experiments on disinfection of sewages and sewage effluents. In a considerable number of the bottle experiments it was found that while the bacteria had been reduced to very small numbers when the samples were examined at the end of 2 to 4 hours, examinations made at the end of 24 hours showed that a very large secondary increase had taken place in the bacterial content of the samples.

It will be noted that bacterial multiplication after disinfection was only observed in part of the experiments, and that it was not observed at all in the experiments with effluents from sand filters. The reason for this will be apparent when the reason for secondary bacterial growths is made clear. The power of the hypochlorites as disinfectants lies in their property of liberating oxygen which may act upon the bacteria, or which may be absorbed wholly or in part by any other oxygen-absorbing substance with which it comes in contact. When once the oxygen is all absorbed the disinfecting value of the hypochlorites is exhausted. The sewages and effluents from contact and trickling filters contain substances which have greater or less affinity for this oxygen, so that only a part of the hypochlorite oxygen is available for destroying the bacteria. If, then, such an amount of hypochlorites be added that all the oxygen is completely absorbed before complete disinfection has occurred, the remaining bacteria may multiply without restraint. In fact, through the elimination of a large proportion of the bacteria, including probably the entire numbers of certain species, the conditions have been made peculiarly favorable for rapid multiplication of those bacteria which remain, since bacterial equilibrium has been destroyed, natural bacteria antagonism has been to a greater or less extent eliminated, and, certain portions of the organic matters having been oxidized, the dissolved matters may perhaps have become better suited for bacterial food than previously. These are the conditions which probably were obtained in the experiments made. In every case practically all of the bacteria were destroyed, but a few were left which, the disinfectant being all exhausted, found themselves in a peculiarly favorable environment. That they multiplied under these conditions from 100 to 1,000 times their original numbers is in accord with the usual multiplication of bacteria under other favorable conditions. That no such after-growths were observed in the case of sand filter effluents is explained, when we consider that these sand filter effluents were all highly oxidized and probably did not absorb the oxygen from the disinfectant, so that the smallest amount of hypochlorites used in the experiments made with them, 0.38 part per 100,000, was sufficient not only to destroy practically all the bacteria, but to leave some traces of disinfectant still in solution by which the germinating bacteria were destroyed and after-growths prevented. Had tests been made on these effluents with smaller quantities of hypochlorites it is very probable that after-growths of bacteria would have been observed, as, in fact, such growths have been frequently observed in water under similar conditions.

The occurrence of these after-growths introduces the very interesting and important question as to their possible sanitary significance. From the results of the experiments made it is evident that not only were after-growths found in the types of bacteria usually determined on room temperature plates, but they were also observed in the types determined on the body temperature plates, and were particularly prevalent in the acid-producing types developing on plates at the higher temperature. Since the body temperature counts undoubtedly indicate the possible presence of disease-producing germs of intestinal origin more clearly than do the room temperature counts, and since a considerable proportion of the bacteria appearing as red colonies on the plates at the higher temperature when dealing with natural waters and sewage are of, or akin to, the colon type, which type has been used for some years as an index of possible danger, the occurrence of after-growths of these types is highly significant, and raises the question whether multiplication of disease-producing organisms might not possibly occur under similar conditions in disinfection practice. This question cannot be satisfactorily answered until a more extended study has been made of the species of bacteria which appear in these after-growths and a careful study of the behavior of various pathogenic bacteria under similar conditions. The conditions implied are such as might readily be obtained with greater or less frequency in the practical disinfection of sewage and sewage effluents on a large scale, although they would be less likely to occur in disinfection of stools and other infected material in which an excess of disinfectants are usually employed and from which our present knowledge of the resistance of pathogenic bacteria to various disinfectants has been largely drawn.

Another question which arises is, if a rapid multiplication of the bacteria remaining after treatment with a disinfectant is possible under certain conditions, would a similar multiplication occur if the disinfected sewage were diluted with natural water, as, for example, when such a sewage were turned into a river? In this case bacterial multiplication would undoubtedly be influenced both by the amount of dilution which the disinfected sewage received and by the numbers of bacteria in the water used for dilution. Studies of this phase of the problem are now in progress at the experiment station. In these studies samples of sewage have been treated with amounts of hypochlorite of lime sufficient to reduce the bacteria to very low numbers, but not sufficient to produce complete sterilization. After the disinfectant has been allowed to act for a period of two hours the samples have been diluted with various proportions of natural water, and analyses of a sample of the water used for dilution, of the undiluted sewage, and of the various mixtures of the two have been made at intervals for a number of days. At the present time these studies are far from complete, but the results so far obtained indicate that there may be a rapid increase in the numbers of bacteria after partial disinfection and subsequent dilution, this increase being much greater in the mixtures of sewage and water than in either the sewage or the water used for dilution alone. This is particularly noticeable in the total and red colony counts on the body temperature plates. Ordinarily there is little or no increase in these counts on samples of water or sewage on standing, and this has been true of the samples of the water used for dilution. In the disinfected sewage and in the mixtures of disinfected sewage and water, however, there has always been a large increase in these counts on standing, in some cases the numbers of these types of bacteria increasing many thousandfold in the course of a few days. It would appear from these results that the exterior of certain particles of organic matter was seared by the disinfectant and the bacteria killed, but the bacteria within the particles left unharmed. So far experiments have only been made with disinfected settled sewage diluted with tap water, and it is impossible to predict what results may be obtained when other sewages, or effluents from sewage filters, are diluted with waters containing larger initial numbers of bacteria. The problem is an important one, and fully merits thorough investigation before disinfection of sewage, etc., by hypochlorites comes into more general practice.

ESTIMATION OF AMOUNT OF HYPOCHLORITES REQUIRED FOR DISINFECTION FROM OXYGEN CONSUMED.

In his excellent book upon the purification of sewage, Rideal states that the amount of chlorine necessary for disinfection may be closely estimated from the oxygen consumed from permanganate (five minutes). In the Lawrence experiments it was found that in about one-half of the samples of sewage and sewage effluents the amount of chlorine computed from the oxygen consumed, and the amount of chlorine required as shown by experiment, agreed with some degree of accuracy. In about one-fourth of the samples the computed amount of disinfectant was very much less than the amount which the experiments showed to be necessary to produce any practical effect, while in the remainder of the experiments the amount computed from the oxygen consumed was from two to ten times as much as was actually required to produce complete disinfection. Judging from these resutls, while the oxygen consumed values might furnish some idea as to the amount of disinfectant to be used, the possibility of error would be so large that little reliance could be placed upon this method of estimating the proportion of disinfectant required.

COST OF HYPOCHLORITE DISINFECTION.

Commercial bleaching powder or calcium hypochlorite packed in sealed drums holding 700 to 800 lbs. each, with a guaranteed strength of 36 to 38 per cent available cholrine, may be purchased in carload lots for about 1¼ cts. per pound. In smaller drums of 25 to 100 lbs. each, bleach of the same strength costs about 2 to 3 cts. a pound, depending upon the size of the shipment. Broken bulk bleaching powder costs 3 to 5 cts. per pound in New England when obtained in small lots from a chemical stockhouse. Commercial bleach loses strength rapidly up to a certain point when exposed to the air, and broken bulk purchases, or drum packages whose contents are not used at once after opening, will be found to contain less available clorine. Analyses of a number of samples of broken bulk bleaching powder at the experiment station show that in many cases the strength may be less than 25 per cent available chlorine. The cost of this disinfectant, therefore, depends largely upon the daily amount of hypochlorites required, the extremely large disinfecting plant having the advantage of low price on bleach of guaranteed strength, the full strength of which would be available through immediate use of the contents of the large drums shortly after they were opened. The plant treating a small volume of sewage daily would pay a higher price for smaller packages, or if buying in larger lots to obtain low first cost, would find the ultimate cost increased by loss of strength which the contents of these larger packages would suffer during the period before they were consumed. For the large plant, where large volumes of sewage were to be treated daily, the disinfection costs might be reduced somewhat by the use of sodium hypochlorite manufactured at the plant. Sodium hypochlorite is readily prepared by electrolysis of solutions of common salt. As it exists only in solutions its use has been limited owing to difficulty of transportation. As a disinfectant it is fully as efficient as bleaching powder, and where common salt can be cheaply obtained and the cost of electric power is low there is no reason why the installation of an electrolytic plant should not help to reduce disinfection costs when a large amount of disinfectant is required. For the small disinfection plant, however, the use of commercial bleaching powder would probably be the cheapest in the end. Another factor which enters into the cost of disinfection is the standard of quality required in the effluent from the disinfecting plant.

Assuming a disinfectant containing 33⅓ per cent available chlorine at a cost of 2 cts. per pound, the treatment of a sewage with 0.1 part per 100,000 available chlorine would require 25 lbs. of disinfectant at a cost for chemicals of 50 cts. per 1,000,000 gals. On this basis the cost of disinfecting the various kinds of sewage and sewage effluents to definite prescribed bacterial contents would be about as follows:

To produce complete sterilization the cost would be well over $19 per 1,000,000 gals. for sewages and the effluents from contact and trickling filters, and would vary from $1.50 to over $19 for effluents from sand filters.

To produce a bacterial quality which would conform to the drinking water, or 100-10-5 standard, the cost would vary from $3.75 to over $19 per 1,000,000 gals. for raw sewage and effluents from trickling filters, from $7.50 to over $19 per 1,000,000 gals. for settled sewage, from $15 to $19 per 1,000,000 gals. for strained sewage and contact filter effluents, would be over $19 for septic sewage, and would vary between $1.75 and $9.50 per 1,000,000 gals. for the effluents from sand filters which were not originally of that quality.

To produce a bacterial quality to correspond to the 1,000-100-50 standard, or one which would be about equal to that of the better class of streams or rivers which are not seriously polluted, the cost would be from $1.75 to $5.60 per 1,000,000 gals. for raw sewage, from $1.75 to $13 for settled sewage, about $3.75 and for strained sewage, between $3.75 and $5.60 for septic sewage, from $1.75 to $5.60 for effluents from contact filters, and from $1.75 to $3.75 for effluents from trickling filters. The cost of disinfecting sand filter effluents to produce this quality would not be over $1.75 per 1,000,000 gals., judging from the experimental results.

If it was desired to reduce the bacterial content only to a point where they would approximately correspond with the more polluted rivers, or say within the 10,000-1,000-500 standard, the costs would be from $1.75 to $5.60 per 1,000,000 gals. for raw sewages and effluents from contact filters, between $1.75 and $7.50 for settled sewages, from $1.75 to $3.75 for septic sewage and effluents from trickling filters, and about $1.75 per 1,000,000 gals. for strained sewage.

These cost estimates are for chemicals only and do not include operating and sinking fund charges.

EXPERIMENTS WITH COPPER SULPHATE.

A number of experiments have been made at Lawrence to determine the disinfecting value of copper sulphate, which, before the hypochlorites came into use, was employed to a certain extent in water purification, and was advocated as a practical disinfectant for sewages and sewage effluents. These experiments showed that a reduction of 75 per cent of the bacteria could be obtained in settled and strained sewages and in the effluents from contact filters by the use of 1 part copper sulphate per 100,000, and in raw sewages and effluents from trickling filters by the use of about 10 parts per 100,000. To obtain a reduction of 90 per cent in the bacteria about 1.0 part per 100,000 was required for strained sewage and contact filter effluents, about 10 parts were required for raw and settled sewage, and about 100 parts for trickling filter effluents. To obtain a reduction of 99 per cent or over in the bacterial content it was necessary to use copper sulphate in the proportion of about 10 parts per 100,000 for settled and strained sewages and for contact filter effluents, of about 100 parts for raw sewages, and about 1,000 parts per 100,000 for trickling filter effluents. In no case was a complete sterilization obtained on any of the samples of sewages or effluents tested by the use of 1,000 parts of copper sulphate per 100,000, and at least this amount was required to reduce the bacterial content of these samples to within the 1,000-100-50 standard. A reduction of the bacteria to the 10,000-1,000-500 standard was obtained by the use of about 10 parts of copper sulphate per 100,000 in the case of settled sewages and contact filter effluents, and by the use of about 100 parts per 100,000 in the case of raw sewages and trickling filter effluents. The results quoted are for a disinfection period of four to six hours. With the higher amounts used, the bacterial counts were still further reduced after more extended disinfection periods. With the smaller amounts, 10 parts per 100,000 in the case of raw sewage and 1 part per 100,000 in the case of other samples, while a substantial decrease in the bacteria occurred during the first six hours, analyses at the end of twenty-four hours usually showed that there had been a large seconadry growth of the types of bacteria recorded on the room temperature plates.

At the present time copper sulphate can be bought in large lots at about 4¾ cts. per pound. At this price the cost of treatment with 1.0 part per 100,000 copper sulphate would be about $3.95 per 1,000,000 gals.

Leaks in Water System.—The assistant city engineer of Augusta, Ga., claims that there are 4,500 leaks in the city water distribution system. He estimates the resultant waste of water at 2,000,000 gals. per day.

Method of Locking Sewer Manhole Covers Employed at Webb City, Mo.

Contributed by E. W. Robinson, City Engineer, Webb City, Mo.

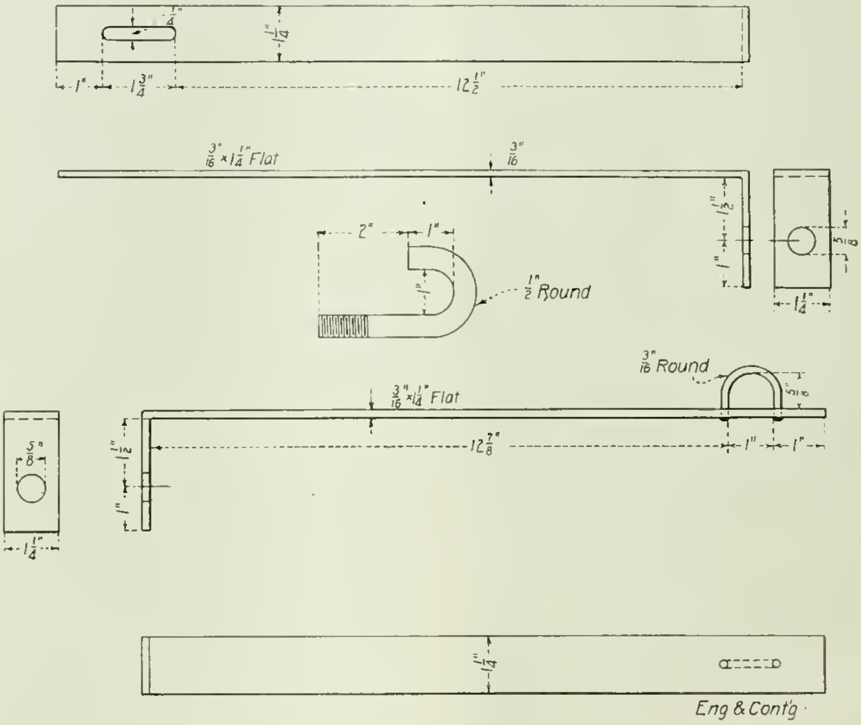
Approximately $200 was expended in Webb City, Mo., during the year 1912 in cleaning out and relieving stoppages in sanitary sewers that were caused through no fault of the design or method of constructing the system. All of the sanitary sewers are of clay pipe from 8 to 15 ins. in diameter, and, with one or two exceptions, the interior presents a straight smooth bore, both as to line and grade. The grade is rarely less than one-half of one per cent. While there has been some trouble from improper materials entering the sewer through faulty house connections, most of the stoppages have been caused by people removing the lids of the manholes and throwing in rocks, sticks, rags and various other articles they wished to get rid of with little trouble.

This has been easily remedied in the populated part of town, for the manholes can be lowered below the surrounding grade of the street or alley, either by removing one or two rings of brick or by filling the surrounding surface with earth or rock and thus obliterating all trace of the location of the manhole. This method has the disadvantage of making more trouble and work for the city employes in getting access to the manholes for flushing and inspection purposes, but is about the only practical way to eliminate such practices entirely.

But in the case of the outfall sewers, which follow the natural drainage courses, there are many places where it is not expedient to place the tops of the manholes below the ground surface. In some places the sewer is so near the surface of the ground that the manholes have to be built above the ground to give room inside for a man to work in case the sewer becomes stopped from any cause. Then again in many places the tops of the manholes have to extend above the surface several feet to keep flood waters from entering through the ventilation holes in the lid. It is in these places that boys seem to take a delight in taking off the lids and filling the manholes full of whatever is handy, usually boulders about the size of a man's head being used. In case some one has dumped a load of trash within a quarter of a mile of the place of operation, the next time the sewer is cleaned one is apt to find various sized pails, pans, etc., stuffed into the pipe. Such obstacles can be removed only by means of sewer rods or by digging up the pipe at the point of stoppage. On one occasion nearly two wagon loads of boulders and rubbish of every sort were taken out of one manhole and the 300 ft. of pipe immediately below it.

On some of the earlier sewers constructed in this city the manhole lids were fitted with iron locks on the underneath side, but they rusted so quickly and so badly that it soon became necessary to break them to get the lid off, and the only alternative was to devise some other scheme to fasten them on. The writer finally hit upon the method shown by the accompanying figure, and it does very well where the lids have to be lifted 2 ins. or more vertically before they can be slid off of the main casting. As shown in the sketch it consists simply of two hasps meeting at the center of the cover, one having a slot which fits over a staple in the other, and fastened with an all brass padlock. On manhole covers where it is only necessary to raise one side of the lid an inch or less to be able to slide it off it would not do the work, and three or four hasps would be demanded for the reason that it is practically impossible to make them fit the top of the cover snugly. The hasps are fastened at the sides by drilling a hole in the iron casting that supports the lid and then inserting U-bolts in the holes so drilled.

The work of making the hasps, bolts and drilling the castings was done by a local machine shop. The fastening devices were put on the manholes complete, including an all brass padlock for each, at a total cost of $2 each.



Device for Fastening Sewer Manhole Covers in Position.

The Disposal of Garbage by Burial in Small Cities and Villages.

The disposal of garbage by burial is considered the most sanitary method of disposal within the reach of small cities and villages where economy must be considered. In writing on the disposal of municipal wastes in small cities and villages, Mr. R. F. MacDowell, Assistant Engineer of the Ohio State Board of Health, commented as follows, in the Bulletin of the Board for November, on the disposal of garbage by burial:

For this method level land should be secured which is considerably removed from habitations, preferably outside the corporation limits, but easily accessible for hauling. For burial purposes a loose, loamy soil is desirable. The garbage is not as readily decomposed in a heavy clay or coarse sandy soil. For burying, trenches may be dug from 1 ft. to 2 ft. deep and of a convenient width, say 6 or 7 ft. These trenches may be then filled and the garbage should be covered at once with the loose earth from an adjacent trench newly excavated to the same depth. In this manner the whole field may be covered. After a certain time, dependent somewhat upon the character of the soil, this area can again be used. Mr. John W. Alvord, in a report to the city of Davenport, Iowa, stated that if the garbage is spread in a layer about 12 ins. deep, and covered to about the same depth, it has been found that, in from six to nine months the greater part of the garbage has disappeared without any objectionable odors having been created, while within three or four years every vestige even of the more solid parts of the waste will have completely disappeared. The experience at Columbus, where the soil was not especially favorable, was that it required about 30 months after burial to render the garbage stable and innocuous and that it then resembled humus matter and had a slightly musty odor. There should be provided a sufficient area, at least to permit of re-excavation only after the garbage has become entirely decomposed and stable in character. The part of the field not in use may be employed for the growing of crops, as the fertilization effected by the decomposed garbage makes the soil especially good for this purpose. At Columbus, where a part of the garbage farm was rented each year, large crops of corn were produced.

Earth Slides at Culebra Cut.—A new slide was developed on the east bank of the Panama Canal, opposite Culebra, early in December. The bank has broken for 1,000 ft. along the face and if all the material within the break slides into the canal, there will probably be about 1,000,000 cu. yds. to excavate and remove. Two steam shovels have been put at work on the face of the slide, with the view of checking further development, and of cutting a bench in the bank, into which broken material from the slide will fall, thus being prevented from entering the prism of the Canal proper.

A portion of the Cucaracha slide, which has given little trouble during the past two or three years, has commenced fairly active movement, and about 125,000 cu. yds. will have to be removed as a result. Two shovels are working on this slide.

The slide in the east bank of the cut at Empire, near the office of the Division Engineer, has given no trouble for a year or more. On Jan. 2 this slide began to move very rapidly towards the Cut, the rate of vertical subsidence on that afternoon being 4 ft. in 17 minutes. The total amount of material in motion is about 125,000 cu. yds., but as the broken edge on the land slide is practically vertical for a depth of at least 50 ft., it is probable that this slide will extend farther. One shovel is at work on this slide.

The total amount of material to be moved as a result of these three slides is about 1,250,000 cu. yds., which is equal to a little more than one month's excavation in the Central Division.

The Agricultural Experiment Station of the University of Wisconsin has issued a circular, No. 34, on Sewage Disposal for Rural Homes. The circular discussed single and double chamber septic tanks, and the absorption system for the tank effluent. Cost and quantity data are given.

NEWS SECTION

Editorial Comment—Personals—Society Meetings—Trade Notes—Catalog Reviews—Contract News, Embracing Bids Asked, Work Projected, Contracts Let and Contract Prices on All Classes of Civil Engineering Construction Work.

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The Doings of the Week.

Developments of the past few days indicate that a number of the larger railroads will soon begin the awarding of construction contracts. Announcement was made last week by Edmund Pennington of the Soo that that road would begin the expenditure of something like $25,000,000 for the building of 725 miles of new line to cross Montana to strike the Canadian Pacific nea the extreme edge of the state. In New York City final hearings on the forms of contracts for the proposed subways under the Dual System of rapid transit were held by the Public Service Commission for the First District last week. The Commission is now considering various amendments to the contracts proposed at these hearings, and after adopting or rejecting such amendments will put the contracts in final form and transmit them to the Board of Estimate and Apportionment for approval. These contracts are to be made with the Interborough Rapid Transit Co. and the New York Municipal Railway Corporation (Brooklyn Rapid Transit) for the operation by those companies of the new system, and for a contribution by each company toward the cost of construction. The new system will represent an outlay by the City of New York and the companies in excess of $300,000,000, and will provide the city with a rapid transit system containing 630 miles of single track road as against 296 miles of the existing lines. The largest letting of the past few days is for work in the western part of Canada for the Canadian Pacific Ry. The contracts covered some 807 miles of new line. Some idea of the size of this work can be obtained from the statement that one of the contractors, Janse Bros. of Calgary, secured 106,000,000 cu. yds. of excavating. The other contractors who got in on the Canadian Pacific work were Boomer & Hughes, Spokane; Ed Peterson, Omaha, Neb.; Foley, Welch & Stewart, St. Paul, Minn; J. D. McArthur, Winnipeg, and George Webster.

In the way of levee construction the largest contract let recently appears to be the one secured by Edgar A. Stacy, of Greenville, Miss. This contract amounts to about $342,915, and calls for the enlargement of 9 miles of levee at Clarksdale, Miss., involving 1,228,000 cu. yds. of earthwork and embankment. The state of Ohio is to ask Congress to construct levees. A joint resolution has been introduced in the Ohio Legislature memorializing Congress to build levees along the Ohio River where flood waters do the most damage.

Bids on another section of the Woodside, Astoria & Corona Rapid Transit R. R., in New York City, will be opened at noon, Feb. 7, by the Public Service Commission for the First District, New York City. This work calls for the construction of Section No. 3, which embraces what is known as the Corona branch, running from the Queens end of the Queensboro Bridge out Queens Boulevard, Greenpoint Ave. and Roosevelt Ave. to Sycamore Ave., Corona. This road will be a 2 and 3-track elevated railroad, owned by the City of New York, and operated jointly by the Interborough and Brooklyn companies. In that portion running through Queens Boulevard, which the city intends to make a wide and handsome thoroughfare, the structure will be of reinforced concrete of ornamental design. It is estimated that the road can be built within 18 months. Bids for the construction of Section No. 2, the branch from the Queensboro Bridge to Ditmars Ave., Astoria, also an elevated railroad, were opened Jan. 28. This branch also will be owned by the city and operated jointly by the Interborough and the Brooklyn companies.

A number of big bridge projects are taking shape in the Northwest. In Seattle, Wash., a bill has been introduced in the City Council asking that an election be held in March to submit to the voters the proposition to issue bonds amounting to $1,750,000 for the construction of concrete bridges across the Lake Washington Canal. At Vancouver, plans for the proposed second Narrows bridge at that place have been completed and forwarded to Ottawa by the consulting engineers. The structure is to be erected by the Burrard Bridge & Tunnel Co., at a cost of approximately $2,100,000. It is expected that bids for the work will be taken as soon as the government approves the plans.

Bids on the largest municipal contract of the year were opened a few days ago by the Department of Water Supply, Gas and Electricity of New York City. This contract called for the construction of the Jerome Park filter. The Keystone Construction Co., Pittsburgh, Pa., at $5,139,015, was the lowest bidder. In the way of private work the biggest job let in the last few days appears to be the one secured by the H. E. Talbot Co., Dayton, O. This contract calls for constructing a dam across the St. Maurice River, near Grandmere, Que., and is reported to involve an expenditure of about $2,500,000.

City Engineer J. J. Jessup of Berkeley, Calif., has submitted plans and specifications of the proposed sewer system to the City Council. The plans and estimates are arranged in three general divisions, the first being for covering the entire city, which will cost $475,000. Another division, for which plans have been drawn, covering only a portion of the first territory, is estimated at $170,000, and the lowest for the smaller territory, $60,000.

20 Years of Road Building.

The present year marks the 20th anniversary of the Massachusetts Highway Commission. Much of the progress that has been made in the application of scientific principles to the construction of improved roads has been due to the work of this commission. From the very beginning Massachusetts has handled its road building in a systematic manner. In 1892 a commission was appointed by the governor to consider what legislation was necessary for the better construction and maintenance of the highways in the state. In June of the following year the legislative act for the formation of the Massachusetts Highway Commission was approved From the outset the Commission recognized the important principle that it is impossible to find a single material and method of construction that are applicable to all conditions. As a consequence the state work was started by building some 70 pieces of roadway, each about one mile long. These sections were so placed in different parts of the commonwealth that, while in time they would form links in a system of state roads, they served as tests of the suitability of material and methods to meet the peculiar needs of each locality. Beginning its work at a time when many engineers still followed the principles laid down by Macadam, and when the changes wrought by the introduction of the steam road roller and the rock crusher were just commencing to be recognized, the Commission had its own trail to blaze. That it has done this successfully every road engineer will admit.

Stevens Institute Graduates.

Stevens' Institute ranks high as a technical school for the training of mechanical engineers. That the high rank accredited this institution is well deserved the careers of its alumni bears ample witness. Interesting figures bearing on the success attained by the graduates in mechanical engineering have been given out lately by Professor Furman of the Department of Mechanism and Machine at the Institute. Of the 1,039 graduates in this course in the last 30 years, at the end of 15 years more than 90 per cent had reached positions that fairly entitled them to be ranked as successful. Forty per cent of the graduates had executive or managerial positions; 37 per cent occupied broad technical positions, such as consulting engineers, professors, etc., 11 per cent held positions calling for technical detail; and only 2 per cent had to be numbered among the missing.

Contract Prices 1894 and 1911.

Labor, supplies, machinery, in fact everything entering into construction work has increased greatly in cost in the past 15 years. Has there been a corresponding increase in the cost of contract work? The following figures showing the contract prices in 1894-95 and in 1911 for road work done under the supervision of the Massachusetts Highway Commission give some interesting information on this point:

	1894-5.	1911.
Excavation (all kinds) per cu. yd..	$0.301	$0.533
Ledge excavation, per cu. yd.......	1.725	1.800
Vitrified clay pipe, 12-in., per lin. ft.	.598	.719
Broken stone (local) in place, per ton	1.518	1.597
Broken stone (trap) in place, per ton	2.059	2.217
Fencing, per lin. ft..........	.137	.315
Bounds, each	1.256	1.783

It will be noted that with the exception of the unclassified excavation the only large increases come in the minor items. For the chief item in the cost of macadam—the stone in place—the contract prices for 1911 on local stone show an increase of 8 cts. per ton, or about 5 per cent over the prices 16 or 17 years previous. For trap the increase is a trifle less than 16 cts. per ton.

PERSONAL

Mr. Charles D. Ryder has been appointed city engineer of Stamford, Conn.

Mr. W. R. Cameron has resigned as city engineer of Cairo, Ill. His successor has not yet been appointed.

Mr. Frank Burton has been appointed concrete engineer for the Department of Buildings, Detroit, Mich.

Mr. W. C. Hartman has been made superintendent of light, water and sewerage for the city of Thomaston, Ga.

Mr. Calvin M. Duke, for ten years assistant engineer for the Louisville Water Co., Louisville, Ky., has resigned.

Professor H. O. Gannon of LaFayette, Ind., has been elected president of the Indiana Engineering Society.

Mr. D. F. McLeod, superintendent of public works at Ithaca, N. Y., has been appointed city engineer of New Glasgow, N. S.

Mr. M. M. Worthington, for several years civil engineer with the Atlantic Coast Line R. R., has been appointed the first city manager of Sumter, S. C.

Mr. Philip Lacey has resigned as city engineer of Bessemer, Ala., and will go to Tampa, Fla., where he will be engaged on sewer and paving construction.

Mr. Frank C. Askwith is acting city engineer of Ottawa, Ont. He has been connected with the city engineer's department of Ottawa for the past five years.

Mr. Charles C. Ferguson has been appointed superintendent of highways in Butler county, Pennsylvania, succeeding Mr. Charles Robinson, who recently resigned.

Mr. L. K. Sherman, of Chicago, has been elected president and Mr. J. J. Harmon of Peoria, vice-president of the Illinois Society of Engineers and Surveyors.

Mr. C. E. Cate is appointed an assistant superintendent of the Sonora division, Southern Pacific Ry., of Mexico, with headquarters at Empalme, Son., succeeding Mr. C. J. Anderson, who has been promoted.

Mr. Albert C. Moore, consulting engineer of Joplin, Mo., has been retained by the city of Sulphur Springs, Ark., to prepare plans and supervise construction of new waterworks and electric lighting plant.

Mr. George W. Fuller of New York and Mr. Langdon Pierce of Chicago have been retained as consulting engineers by the city of Evanston for the designing and supervision of construction of the filter plant.

Mr. Clifford Richardson, consulting engineer, of New York City, delivered a lecture Jan. 17, on "The Economies of Highway Construction," before the graduate students in highway engineering at Columbia University.

Mr. Charles S. Cunningham has resigned as superintendent of the Grand Trunk lines, west of Detroit, and is succeeded by Mr. Joseph Caldwell, formerly agent in Chicago. Mr. D. Crombie is general superintendent of transportation.

Mr. John Towne, for many years contracting engineer of the Berlin Iron Bridge Co., of East Berlin, Conn., and later contracting manager of the American Bridge Co. of Maine, died at his home in Springfield, Mass., Jan. 12, aged 74.

Mr. M. L. Culley has been appointed city engineer of Jackson, Miss., succeeding Mr. John I. Pierce. Mr. J. W. Cullen succeeds Mr. J. N. McLeod as street commissioner. Mr. A. E. Fisher succeeds Mr. J. P. Williams as building, electrical and plumbing inspector.

Mr. J. E. Pennybacker, secretary of the American Highway Association, and editor of the Official Good Roads Year Book of the United States, has been selected by the Joint Congressional Committee on Federal Aid in the construction of Post Roads, as statistician to the Committee.

Mr. Raymond H. Williams announces that the firm of Williams & Straus, Engineers and Contractors, 819 Equitable Bldg., Baltimore, will continue the business of Williams & Hines, Mr. Hines having retired because of illness. Mr. Joseph H. Straus, Jr., is now the junior member of the firm.

Mr. Robert W. Bailey of Des Moines, Ia., has been made general manager for the Interstate Manufacturing Co. of Oskaloosa, Ia., manufacturers of wrought iron and steel furnaces. Mr. Bailey has been with the Des Moines Bridge & Iron Works for the past six years, as contracting engineer.

Mr. David Grant, graduate of the civil engineering department, University of Illinois, and now with the J. M. Hassett & Co., will be married Feb. 3 to Miss Catherine Brown of Cincinnati. Mr. Grant is engaged on the L. & N. Ry. extension from Winchester to Irvine, Ky., and the couple will be at home after March 1 at Irvine.

Civil Service Examinations.

The Civil Service Commission of Chicago announces examinations as follows:

Examiner of Efficiency, $1,920-$2,400 per year, Jan. 13.

Junior Examiner of Efficiency, Feb. 6.

Fire Prevention Engineer, Feb. 13.

Engineer of Water Works Design, $3,600, Feb. 3, 4, 5.

Sanborn Map Expert, $1,800, Feb. 4.

The State Civil Service Commission of New York will hold examinations as follows:

Junior Bridge Draftsman, $900-$1,200, Feb. 15.

Special Deputy, Superintendent of Weights and Measures, $1,100, Feb. 15.

INDUSTRIAL

The MacArthur Concrete Pile & Foundation Co., 11 Pine St., New York, has been awarded the contract for placing the foundations of the new county jail in Mt. Clemens, Mich., Architect Theopolus Van Dammn, Mt. Clemens. The MacArthur Concrete Pile & Foundation Co. has also been awarded the contract for placing the foundations of the new Terminal Storage Warehouse, Mystic Wharf, Charlestown, Mass. Warren & Gerrish, Architects, 53 State St., Boston, and F. C. Alexander, Boston, the general contractor for this work. The foundation will be composed of about 600 pedestal concrete piles.

The Chicago Pneumatic Tool Co. held the annual convention of its sales and factory organization on Jan. 9, 10 and 11. The convention was held at the show rooms of the company, 1337 South Michigan Ave., Chicago, Ill., and was concluded with a banquet on Saturday evening, Jan. 11, at the Chicago Automobile Club. Nearly 100 of the company's representatives were present. The meeting was opened on Thursday morning with an address by President W. O. Duntley, and the succeeding meetings were divided into sessions devoted respectively to the air compressor department, railroad department, Cleveland plant, general sales department, Detroit plant, electrical department and commercial automobile department.

CATALOGUES

The Phoenix.—Paper, 9x12 ins., 20 pp. New York Leather Belting Co., 51 Beekman St., New York City.

This is the January number of this journal which is devoted to belt engineering.

Better Buildings.—Paper, 6x9 ins., 62 pp. The American Tin Plate Co., Pittsburgh, Pa.

This is a very useful book of information relative to the uses of formed metal roofing and siding materials. Complete data and illustrations are given showing the materials and details of design for various classes of buildings.

Bain Dump Wagons.—Paper, 6x9 ins., 1 p. Bain Wagon Co., Kenosha, Wis.

Several circulars issued by the Bain Company show and describe wagons up to 4 yds. capacity. The dumping device is given special prominence in the descriptions and its simplicity is set forth in detail.

Eureka Mixers.—Paper, 6x9 ins., 24 pp. C. Taylor Handman, Cincinnati, O.

This circular illustrates mixers weighing from 2,000 to 4,700 lbs. operated by steam, gasoline or electric power in capacities from 5 to 35 cu. yds. per hour. Letters from users are given.

Pulverizer.—Paper, 8x10½ ins., 4 pp. Universal Road Machinery Co., Kingston, N. Y.

This circular illustrates and describes the Reliance Steel Pulverizer which is mounted on foundation timbers. A line drawing is given with a table of sizes and dimensions.

Tanks.—Paper, 5½x7¾ ins. The Consolidated Expanded Metal Companies, Pittsburgh, Pa.

This booklet contains data to be used in the design of tanks to contain water or a lighter liquid and to be built of concrete reinforced with "Steelcrete" expanded metal.

Concrete Facts.—Card, 4½x7½ ins., 6 pp. Lehigh Portland Cement Co., Chicago, Ill.

This folder tells how Portland cement is made.

Carlyle Paving Block.—Paper, 4x5 ins., 4 pp. The Carlyle Paving Brick Co., Portsmouth, O.

This booklet gives the guarantees made by the company for rattler tests.

Troy Dump Wagons.—Paper, 3½x6 ins., 12 pp. Troy Wagon Works, Troy, O.

This pamphlet contains illustrations and descriptions with dimensions, etc., of dump wagons of various weights and sizes.

Road Engines.—Paper, 3½x6 ins., 6 pp. A. B. Farquhar, Ltd., York, Pa.

This folder illustrates and describes briefly the Farquhar Ajax Engine, which is made in sizes from 40 to 50 hp. A table of principal dimensions is given.

Asphalt Paving Plants.—Paper, 6x9 ins., 16 pp. Warren Bros. Co., 59 Temple Place, Boston, Mass.

This catalog contains illustrations and descriptions of a number of stationary asphalt plants built for municipalities.

Collapsible Steel Forms.—Paper, 9x6 ins., 24 pp. Miracle Pressed Stone Co., Minneapolis, Minn.

This book illustrates and describes in detail the Miracle collapsible steel forms for culvert work, sewers and conduits. Complete information is given.

Watson Wagons.—Paper, 6x9 ins., 4 pp. The Queen City Supply Co., Cincinnati, O.

This booklet illustrates the construction of the Watson wagons and shows views of this wagon being used for transporting wet concrete.

Steel Bond and Concrete Curb.—Paper, 6x9 ins., 8 pp. Steel Protected Co., Real Estate Trust Bldg., Philadelphia, Pa.

This catalog illustrates and describes the Wainwright steel concrete curb and corner bar.

Burch Sewer Inlets.—Paper, 6x9 ins., 32 pp. Burch Plow Works Co., Crestline, O.

In this catalog are illustrated and described sewer inlets, manhole covers and tops. Each type shown is accompanied by a table of dimensions, sizes, etc.

RAILWAYS

Alabama.

The Mobile & Baldwin County R. R. Co. of Mobile, which filed its articles of incorporation at Montgomery two weeks ago, purposes the ultimate construction of an interurban electric railway from Mobile to Pensacola. The first section to be built will be from Mobile to Bay Minette. The capital stock is $50,000, of which $25,000 is paid in. W. P. Miller, Chicago, Ill.; M. H. Miller, John P. Lowell and J. R. Cross of Fairhope, Ala., are the incorporators.

Arkansas.

Ordinance has been submitted to the City Council of Little Rock granting a franchise to the Little Rock Railway & Electric Co., Little Rock, for an extension to Biddle, a suburb.

City Council of Argenta, Ark., has granted a franchise to J. W. Carpenter, Corsicana, Tex., President of Corsicana Gas & Electric Co. and Corsicana Transit Co., for constructing and operating an electric street railway at Argenta. Franchise terms provide that the road must be in operation in 36 months. The franchise will probably be used as a part of a proposed interurban system.

The Memphis, Dallas & Gulf R. R., C. C. Henderson, General Manager, Nashville, Ark., is reported to have completed financial arrangements for its Hot Springs extension, and it is believed that construction work will be started by March 1. About 30 miles of line between Murfreesboro and Hot Springs will be graded.

A charter has been granted to the Rock Island, Stuttgart & Southern Ry. Co. by the Secretary of State, Little Rock, Ark., for the purpose of building a line of railway from Mesa, in Prairie County, to Suttgart, in Arkansas, a distance of 22 miles. The capital stock is $300,000, all of which has been subscribed. The new company is probably a subsidiary of the Rock Island. The officers are Thomas S. Buzbee, Little Rock, Ark., President; A. B. Copley, Little Rock, Ark., Vice-President; George B. Pugh, Secretary-Treasurer: George H. Crosby, Assistant Secretary-Treasurer.

California.

⊙The Board of Public Works of Los Angeles has awarded the contract for constructing the San Pedro link of the municipal railway to the Pacific Electric Ry. Co., 6th and Main Sts., Los Angeles, at $246,570.

According to plans submitted to the management of the Southern Pacific Ry., the new station at Los Angeles will cost about $1,000,000.

The Visalia Electric R. R. (a Southern Pacific line) Paul Shoup, vice president, Los Angeles, according to advices from Fresno, is to be extended to that city from Visalia It is believed that work on the extension will be started shortly.

It is rumored that the San Pedro, Los Angeles & Salt Lake R. R. is contemplating the construction of a line from Los Angeles to San Diego, Calif., a distance of 130 miles, and that the company has been offered the right of way and franchises of the San Diego & Riverside Ry. Co. and the Southern California Utilities Co., concerns organized by Californians to build a road between San Diego, Riverside and Los Angeles. These companies own a right of way into San Diego, terminal land there, and have built 10 miles of standard gage track from the city northward. They also own rights of way up the coast. Engineers in their employ have surveyed a line along the coast which is said to have easy grades and offer an excellent route for a railroad. Engineers estimate the cost of the line at from $7,000,000 to $10,000,000. H. C. Nutt, Los Angeles, Calif., is General Manager of the S. P., L. A. & S. L. R. R.

Colorado.

The Plateau Valley R. R. Co., is reported to have disposed of a $750,000 bond issue, and will, it is stated, have work started shortly on its projected lines. This road is to extend from Collbran through the Plateau Valley to a connection with the Rio Grande Junction R. R., eight miles above Palisade. It will be about 25 miles long. A. J. Halter, Denver, Colo., is interested. J. J. Yeckel is President.

It is reported that the Chicago, Burlington & Quincy R. R. will let contracts in the near future for its Hudson-Greeley line.

Connecticut.

The Central New England Railroad Co. has applied to the Public Service Commission of New York for authority to issue bonds in the sum of $2,429,000 to be used for permanent improvements. According to a statement filed by the railroad, the money will be used for the following purposes: $355,601 for double tracking, $16,411 for new bridges and improvements to old ones, $402,441 for increased yardage in Maybrook, $2,707 for new sidings and extensions, $3,688 for passenger, freight and water stations, $40,442 for other buildings, $2,062 for signal protection and improvements, $1,588,193 for new equipment, including 1,000 freight cars, 15 freight locomotives, and other rolling stock. W. J. Backes, Hartford, Conn., is Chief Engineer.

Florida.

The St. Augustine Public Service Corporation, St. Augustine, Fla., has applied to the City Council for an electric railway franchise.

The Florida Interurban Railway & Tunnel Co., projecting a line from St. Augustine to Pablo Beach and South Jacksonville, is reported to have completed practically all preliminary work and is said to be planning to begin construction this year. The company will use gasoline operated motor cars. R. B. Harrison, Jacksonville, Fla., is attorney for the company.

The Tampa & Gulf Coast R. R. Co. has been incorporated with a capital stock of $250,000, and proposes a railway to run from Tampa direct to St. Petersburg, entering the Pinellas peninsula just at the head of Old Tampa bay and running westward to Clearwater, thence south to St. Petersburg; also north to Tarpon Springs and Port Richey. The new company will probably take on the Tampa & Gulf Coast Ry., a 25-mile line, extending from Lutz Junction to Port Richey. J. Edgar Wall, Tampa, Fla., is President, and J. A. Griffin, Tampa, is Secretary.

Georgia.

A report from Moultrie states that work is to be started soon on the projected line of the Moultrie, Meigs & Panama R. R. J. Hope Tignor, Atlanta, Ga., and W. E. Aycock, Moultrie, Ga., are said to be interested.

Advices from Tifton, Ga., state that preliminary surveys have been completed for the Americus, Tifton & Atlantic R. R. from Americus to Milltown, 114 miles. From Americus to Oakfield is 28 miles, Oakfield to Ashburn 23 miles, Ashburn to Tifton 25 miles, Tifton to Nashville 23 miles, Nashville to Milltown 15 miles. The grading south of Tifton will cost but little, as the country beyond New River, seven miles out, is almost level. North of Tifton the line follows that of the Tifton Terminal Co. to Waterloo, 10 miles, and is several miles distant from that of the Georgia Southern & Florida, until it turns west to cross at Ashburn.

Honduras.

No immediate work is contemplated on the Truxillo R. R. mentioned in our Jan. 15 issue. An engineer and aids have been sent to accomplish the preliminary survey for a railroad from Truxillo to Tegucigalpa via Juticalpa, and a wharf plan in Truxillo Bay. From survey made in 1885 by W. W. Hungerford, C. E., the distance of road construction Truxillo to Juticalpa amounts to 202 miles. Branch lines contemplated will readily increase the ultimate development of several hundred miles more, including the main line to Tegucigalpa. The financing of this project will be accomplished in New York and London. Victor Camors, New Orleans, La., has the concession.

Idaho.

The Twin Falls, Oakland & San Francisco Ry. Co. has been organized at Twin Falls, Idaho, for the purpose of raising funds for the construction of a line south from Twin Falls, Idaho, to Wells, Nev., connecting with the Western Pacific.

Surveys have been started from Lewistown for the projected railroad from that place to Vollmer, via Tammany, Waha and Forest. Another party is also working toward Lewistown. Z. A. Johnston, Lewistown, is the promoter.

Illinois.

The Wabash Railroad is contemplating the ballasting of the roadbed between Chicago and St. Louis this year with crushed stone and is installing two crushers at Richie, Ill.

The Pennsylvania R. R. has accepted an ordinance for the elevation of the Englewood Connecting Ry., west of Halsted street, Chicago. No contract, as yet, has been made for the work. Detailed plans for the masonry are in course of preparation and the additional property required is being bought.

The following improvements have been authorized by the Santa Fe system, Albuquerque Division, Clear Creek, improving and adding to the pumping plant and constructing a new pipe line between Clear Creek and Winslow, estimated cost, $138,720; Arizona division, installation of new air compressor at Seligman, estimated cost, $4,600; Colorado division, replacing bridge No. 630A, estimated cost, $14,700; Eastern division, purchase and installation of new turn table at Atchinson, $3,400; Illinois division, extensive improvements to yards and shops, estimated cost, $41,000; Los Angeles division, constructing a new second track between Summit and Keenbrook, $1,029,000; Missouri division, constructing track to serve Southwestern Blau Gas Co., at Big Blue Junction, Northern division, repairing bridges 69C and 80C, estimated cost, $18,500; Plains division, inserting crushed stone ballast between mileposts 246 and 323, estimated cost, $185,900; Southern division, constructing new turn table at Brownwood, estimated cost, $13,600; Southern Kansas division, changing tracks at Vera, estimated cost, $7,354; Ramona, constructing joint interlocking plant, estimated cost, $4,100; Texas & Gulf Ry., constructing new house track at Tatum, estimated cost, $9,900; Valley division, between Fresno and Colua, installing automatic block signals, estimated cost, $6,400.

The Alton, St. Louis & Cairo Ry. Co., mentioned in our Jan. 8 issue, expects to let contracts in the near future for the first section, at least, of its projected line. This company proposes to build a line from Alton, Ill., to Cairo, Ill., a distance of 175 miles. The road will extend along the East side of the Mississippi River, from ½ to 1 mile from the river's banks, and will be above the high water mark of 1844, which is the highest high water on record for the Mississippi River. It will connect with the Alton, Merchants' McKinley, Eads, Free and Thebes bridges. The object of this road is to give a St. Louis connection to several lines of railway which now terminate at the Mississippi River. It is intended to extend the road to New Orleans. The company is stated to have 108 miles of graded road, bought at a cost of over $500,000. The first section will be from East St. Louis to East St. Genevieve, 50 miles. Of this 40

✣ indicates work now open for bids. ⊙ indicates a contract let recently

miles is already graded. There will be very little bridging and trestle work required. Steam engines are to be used to haul freight and motor cars for passengers, mail and express. The officers of the company are Col. Thos. N. Chase, President; Wm. R. Borders, Vice-President, and Adam Hoffmann, Secretary. The temporary offices are in the Navarre Bldg., St. Louis, Mo.

Indiana.

The Pennsylvania R. R., from present indications, will begin work in the spring at Charlottesville, Greenfield and Irvington on double tracking its line. The company plans to complete the work from Charlottesville to Indianapolis the coming summer.

Iowa.

The Kohlmann, Luck & Walker Construction Co. has two steam shovels at work on the double tracking of the Chicago, Milwaukee & St. Paul Ry. between Green Island and Browns. The work is located near Preston, Ia. They have a new outfit including a 70C Bucyrus working in a 40-ft. rock cut and a 40R Bucyrus.

The Iowa Southern Ry. Co. of Des Moines, Ia., has been incorporated with a capital stock of $900,000, and proposes a 25-mile line from Albia to the coal mines at Centerville. The incorporators are William Gardner, Richard Aishton, John Caldwell and Jonah Cleveland.

The Conn Construction Co., Boone, Ia., has finished its contract on the C. P. & N. W. Peora-St. Louis extension in Illinois, and has a 50-team outfit idle, for which it wants work. Location of work does not matter, as long as the prices are right.

Kansas.

Bond proposition for the Anthony & Northern Ry. has been submitted to a number of towns and townships in Pratt County. The city of Pratt is asked to vote $20,000 terminal bonds, Center township, $15,000 bonds and Iuka township, $15,000 bonds. The company proposes to build from Pratt north to Iuka, thence northwesterly to Larned, crossing the Santa Fe's Kinsley cutoff either at St. John or Macksville. The line from Pratt to Larned is the first section to be built. The second division built will be from Pratt southeast to Anthony. The next will be an extension north from Larned with Hastings, Neb., as the objective point. O. P. Byers, Hoke Bldg., Hutchinson, Kan., is General Manager.

Kentucky.

The Ohio Valley Electric Ry. Co., Huntington, W. Va., is to extend its line from Ashland to Russel, a distance of 4 miles.

Louisiana.

A proposition is under consideration for building an electric interurban line connecting Homer, Minden and Shreveport. The plan proposes taking over the 20 miles of graded roadbed between Homer and Minden. A. K. Clingman, Keithville, is interested.

Maine.

The Rockland, South Thomaston & St. George Ry. Co., Rockland, Me., proposes to extend its electric railway this season to the Keag.

The Rangeley Lakes & Megantic R. R. is now completed to Kennebago. It is probable that there will be no further extension during the present year.

Maryland.

Plans are being formulated for the consolidation of the Frederick R. R. Co., the Hagerstown R. R. Co., the Frederick & Hagerstown Power Co., and the Frederick Gas & Electric Co. It is understood that the consolidated company will make a number of improvements including betterments of the roadbed and a possible extension from Jefferson to Brunswick. O. B. Coblenitz, Frederick, Md., is Chief Engineer of the Frederick R. R.

Minnesota.

It is probable that the Canadian Northern Ry. will have plans completed by early spring for a considerable amount of improvement work in West Duluth. It is understood that about $1,000,000 will be expended for building an extension of the company's tracks to the water front at the foot of 48th Ave., the construction of docks, warehouses and possibly the erection of a large grain elevator.

Mississippi.

Indiana capitalists represented by Y. D. Lott, Realty Dealer, Jackson, Miss., will apply to the city of Jackson for a franchise covering the city part of a proposed interurban electric railway from Jackson to Canton. Supervisors of Madison county have granted franchise and right of way to the promoters, but no action has yet been taken by the city council of Canton.

Missouri.

The Moberly, Huntsville & Randolph Springs Ry. Co. has made surveys for a 12-mile line from Moberly via Huntsville to Randolph Springs. Enough capital has been secured to begin construction work and contracts will be let about April. C. H. Dameron, Huntsville, Mo., is president; John J. Mundinger, Huntsville, Mo., is Chief Engineer, and W. M. Evans, Huntsville, is Secretary.

Montana.

✣Plans and specifications have been completed and bids will be received until Feb. 1 at the St. Paul, Minn., offices of the Great Northern Ry. for the construction of the new passenger station at Butte, Mont. The new building, which will be in the shape of an L, will have a frontage on Arizona St. of 120 ft. and east and west will cover a length of 180 ft. The cost of the improvement is estimated at $125,000. S. L. Bartlett, St. Paul, Minn., is Architect.

The Butte Electric Ry. Co., J. R. Wharton, Manager, Butte, Mont., has placed orders for material for the extension of the railway in the southwestern section of the city. Construction work will be started about April 15.

New Jersey.

The State Public Utility Commission has granted permission to the Elizabeth & Trenton R. R. Co. (a subsidiary of the Public Service Corp., Broad and Bank Sts., Newark, N. J.), to cross several roads at grade in Woodbridge township; also to make connections with the existing lines of the Public Service, the Elizabeth & Trenton R. R. will bring Elizabeth into closer touch with Rahway, Perth Amboy, New Brunswick and provide through service over a short route to Trenton.

New York.

✣Bids will be opened Feb. 7, by the Public Service Commission for the First District, 154 Nassau St., New York City, for the construction of Section No. 3 of the Woodside, Astoria and Corona Rapid Transit Railroad of New York City. This is a 2 and 3-track elevated railroad in Queens Boulevard, Greenpoint Ave., Skillman Ave. and Roosevelt Ave., between the Queensboro Bridge Approach and Sycamore Ave., Corona, including two express and eight local stations.

Incorporation papers of the James Stewart Contracting Co., succeeding James C. Stewart & Co., a co-partnership, have been filed with the Secretary of State in Albany. The new corporation takes over all the business of the co-partnership of James C. Stewart and Alexander M. Stewart, including the $20,000,000 worth of barge canal contracts in Central New York. Before the incorporation it was one of the largest unincorporated firms of contractors in the world. The capital stock of the new corporation is $3,750,000 and it is understood that the entire stock issue has been taken by those interested in the old firm.

Application has been made to the Public Service Commission by the Second District for permission to merge the Rochester, Syracuse & Eastern, the Syracuse, Lake Shore & Northern and the Auburn & Northern Rys. (electric) into a company to be known as the Empire United Rys.

The Cortland County Traction Co., Cortland, N. Y., has applied to the City Council of Cortland, for a franchise to extend its line along Railway Ave. west to Oswego St.

Town Board of Granville has granted a franchise to Thomas F. Haley, a civil engineer of that place, for an electric railway to run from Granville through North Granville and to the Fort Ann line.

North Carolina.

The New Bern-Ghent Street Ry. Co., New Bern, N. C., is considering extending its line to Pollocksville via Trenton in Jones County.

It is reported that the traction line at Hendersonville, owned by Charles A. Carlson of Philadelphia, Pa., will be extended through to Asheville.

Ohio.

Plans are under consideration for the construction of an electric street railway from Youngstown to Poland, a suburb. The Realty Security Co., Judge Rose, President, Youngstown, O., is interested.

The Cleveland Short Line Ry. Co. (a Lake Shore & Michigan Southern line), has been granted permission to increase its capital stock from $7,725,000 to $8,725,000. The addition $1,000,000 will provide for additional sidetracks and other construction.

Van Camp Bros., Newtonsville, O., have a 20-team outfit idle and would like to connect up with some team grading job.

Construction work is reported to have been started at West Rayen Ave. and Covington St., Youngstown, on the Lake Erie & Youngstown R. R. This company plans a double-track line from Youngstown to Conneaut, to be operated by gasoline motors. The company has been granted permission to issue $4,800,000 in stock and $4,500,000 in bonds for building and equipping its lines. Its officers are John H. Ruhlman, President, Youngstown, O.; George C. Chapman, Conneaut, vice-president; W. H. Ruhlman, North Lima, secretary and treasurer; A. W. Jones, general counsel. The Caldwell Construction Co. has the construction contract.

Oklahoma.

Right of way has been secured as far as Caney for the proposed extension of The Union Traction Co., D. H. Siggins, President, Coffeyville, Kan., from Independence through Caney and Dewey to Bartlesville, Okla.

Plans have been approved for the construction of the New Missouri, Oklahoma & Gulf R. R. shops at Muskogee, Okla. J. J. Harrison, Muskogee, Okla., is Chief Engineer of the company.

Work will be started on the proposed railroad from Sapulpa, Okla., to Cushing, by Feb. 15, providing a contract between C. N. Haskell, Muskogee, Promoter, and the city of Sapulpa, Okla., is signed as expected. Surveys are said to have been completed for the line entering Sapulpa from the southwest, along Rock Creek.

The Oklahoma, New Mexico & Pacific Ry. projects a 100-mile line. The capital for construction has been secured. Surveys have not been made as yet. John Ringling, New York City, is President, and Geo. W. Reeder, Ardmore, Okla., is Chief Engineer.

Oregon.

Surveys for the projected line of the Bandon & Oregon Eastern R. R. Co., of Bandon, Ore., have been completed, and it is reported that construction work will be started in the near future. This company was incorporated a short time ago with a capital stock of $14,000,000.

Pennsylvania.

The Erie Traction Co., C. M. Hatch, General Manager, Erie, Pa., is considering extending its electric railway to Corry.

It is reported that the Pennsylvania R. R. has under consideration the four-tracking in the near future of the Cumberland Valley R. R. from Harrisburg to Chambersburg. The

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

plans are said to include a junction point at Newville, a few miles west of Carlisle, from which a four-track road will be run straight to Pittsburgh along the lines of the old South Penn survey.

Officials of the Pennsylvania R. R. are reported to have authorized the construction of three double-track tunnels on the Allegheny Valley R. R. for the purpose of straightening the line. The tunnels will be from 2,500 to 3,500 ft. long and will cost about $1,500,000. A considerable amount of realignment work will be necessary. The tracks of the Allegheny Valley follow the course of the Allegheny River, and between Kiskiminetas Junction and Oil City, a distance of 105 miles.

The Gettysburg & Hanover Traction Co. of Gettysburg, has been chartered with a capital stock of $5,000.

Work is to be started this month for the completion of the Ehrata & Lebanon Electric Ry. It is hoped to have the line in operation by Sept. 1. Chester Shoff, Lancaster, Pa., is Superintendent of Construction.

Work is under way on a 7-mile extension of the Leedonia R. R. to tap the Tiadaghton timber region. Thomas Casale is the contractor. This road is in operation from Tiadaghton on the N. Y. C. & H. R. R. R., to Leetonia. P. M. Newman, Williamsport, Pa., is President.

The first annual meeting of the stockholders of the South Fork-Portage Ry. Co. was held at the offices in the Supps Bldg., South Fork, Pa., Jan. 13, and Charles H. Morgan of Altoona, was elected President. He, with the following, compose the body of directors, all being re-elections: A. J. Strayer, Vice-President; O. P. Thomas, Secretary; A. C. Simier, Treasurer; Charles N. Crouse. The President's report showed that good progress has been made in the construction of the line between South Fork and Portage, and by April 1 it is hoped the road will be in operation. A tentative plan for financing the extension from Portage up the mountain was presented, whereby the present second mortgage bonds would be retired at par by next summer, which met with the approval of the shareholders.

South Dakota.

Towns of western South Dakota are greatly interested in the report that the Chicago, Milwaukee & Puget Sound R. R. plans the construction of the proposed extension northward from Rapid City, S. Dak., to Marmarth, N. Dak. Such a line would extend through the lignite coal fields of Northwestern South Dakota and would also give the Sioux City packing houses an outlet for their product. C. F. Loweth, Chicago, Ill., is Chief Engineer of the Milwaukee Railroad.

Tennessee.

The Memphis Street Ry. Co., Memphis, Tenn., will begin work within a few weeks on the extensions of the Central Ave. car line and the new line which is to be built into Riverside Park. The rails have been ordered and will be delivered as soon as the grading has been done.

The County Court, according to advices from Sevierville, Tenn., has granted the request of the Knoxville, Sevierville & Eastern R. R., the South Atlantic & Western Railroad and W. J. Oliver, Knoxville, Tenn., for an extension of time in which to begin work on the extension of the K. S. & E. In accordance with the new grant work must be under way on the road toward the Carolina line by April 1, 1913.

Texas.

⊙The Orange & Northeastern R. R., Ed Kennedy, President, has awarded the contract for the grading of the line from Vinton, La., north, to M. Tansey, Mount Pleasant, Texas.

A bill has been introduced in the state senate to authorize the Atchison, Topeka & Santa Fe System to consolidate and operate under one agreement the Concho, San Saba & Llano Valley, the Gulf & Interstate, the Pecos & Northern Texas, and the Gulf, Colorado & Santa Fe railroads. This is the second railroad consolidation measure to be introduced at this session, the other one being to authorize the Missouri, Kansas & Texas Ry. to take over and operate several of its Texas lines.

The Galveston, Houston & Henderson R. R., J. H. Hill, Manager, Galveston, Tex., is to expend about $60,000 for additional trackage at its west yards at Galveston.

The Southwestern Traction Co., A. F. Bentley, President, Temple, Tex., operating a 14.3-mile line in Temple and between that place and Belton, is reported to have completed arrangements with New York capitalists for the capital for constructing an interurban line from Dallas to Houston. The first section will extend from Temple to Marlin. It is also proposed to extend the street car system to Temple.

Surveys have been completed for a railroad from Ferris to Teague, Tex., via Kerens and Fairfield. Finley, Ayres & Parsons, Masonic Temple Bldg., Tuscaloosa, Ala., are the Consulting Engineers, and W. R. Parsons of the above firm is Chief Engineer for the railroad. W. T. Stockton, Kerens, Tex., is interested.

The Attorney General's Department, Austin, Texas, has approved an amendment to the articles of incorporation of the San Antonio, Uvalde & Gulf Ry. Co., headquarters at Crystal City. The amendment, which was filed in the State Department, provides for an increase in the capital stock of the company from $230,000 to $280,000, and also for an extension of 50 miles. The decision to amend the charter was reached at a meeting of the directors held Jan. 13. The road now runs from Uvalde to San Antonio and from Pleasanton Junction southeast through Atascosa County to a point near the Live Oak County line in Atascosa County. The amendment proposes the construction of an extension, commencing near the Live Oak County line, in a southeasterly direction, through the counties of Live Oak and San Patricio to Mathis, in San Patricio County, a distance of 50 miles. A. R. Ponder, San Antonio, Texas, is Vice-President and General Manager.

The Kansas City, Mexico & Orient Ry. tracks are now laid for a distance of 28 miles out of Fort Stockton, leaving but 34 miles to be laid before they reach Alpine. The roadbed is finished ready for the tracklayers up to within 20 miles of Alpine, and work is being rushed on the last lap of the way. It looks now as though the road will be finished by March 15.

Virginia.

The Southern Ry., B. Herman, Chief Engineer Maintenance of Way, Washington, D. C., is to undertake a considerable amount of improvement work on its line from Richmond to West Point, Va., 40 miles. Heavier rails will be laid, the track ballasted and structure strengthened.

Charter of the New River, Holston & Western R. R. Co., a lumber road, has been amended to provide for building an extension not more than 20 miles long. F. E. Bastian, Narrows, Va., is Manager.

Wisconsin.

The Hillsboro & Northeastern R. R. Co. has secured sufficient signatures to the petitions in the towns of Henrietta, Rockbridge and Bloom to bond those towns for aid in extending the road. E. Hammar, Hillsboro, Wis., is President of the company.

Mark Wymond, Civil Engineer, according to advices from Platteville, Wis., has completed location surveys, estimate of the cost and report on the proposed construction of the steam railroad between Platteville and Scales Mound, Wis.

Trustees of the county institutions at Wauwatosa, Wis., have been in conference with R. B. Stearns, Vice-President Milwaukee Electric Ry. Co., Terminal Bldg., Milwaukee, Wis., on a proposition to extend the street car lines to the county buildings. The extension would cost about $20,000.

Wyoming.

The Chicago, Burlington & Quincy R. R. is reported to be making some changes in the survey of its projected line from Powder River to Orin Junction. It is reported that the construction work on the line will be let soon.

Canada.

✣Bids will be received until noon, Feb. 24, by the City Commissioners of Regina, Sask., for track and trolley material for the municipal railway. The materials called for are as follows: Contract D.—1,100 long tons street railway steel 7-in. Tee rails, Lorain section 80/335; 1,550 pairs 6-hole 26-in. splice bars for Lorain rail section 80/335, 1,040 long tons street railway Tee rails, 60 lb. A. S. C. E. section, 2,000 pairs 4-hole 24-in. angle bars for 60 lb. A. S. C. E. steel rails, 10,000 track bolts and nuts, 3½ in. by 1-in., oval heads, hexagon nuts, 9,000 track bolts and nuts, 3¾-in. by ¾-in., oval heads, hexagon nuts, 10,000 split lock nut washers for 1-in. track bolts, 10,000 split lock nut washers for ¾-in. track bolts, 660 kegs (each keg 200 lbs.) standard railroad spikes, 5½-in., by 9/16-in.

Contract E.—5,400 4/0 standard copper rail bonds, 10⅛-in. C. C., 3,600 4/0 standard copper rail bonds, 13-in. C. C., 630 4/0 solid copper rail bonds, 62-in. C. C., 60 4/0 solid copper rail bonds, 72-in. C. C.

Contract F.—10,000 standard sawn square B. C. fir railroad ties, 6-in. by 8-in. by 7 ft., 35,000 standard sawn square B. C. fir railroad ties, 6-in. by 8-in. by 8 ft., 1,250 Western cedar poles, 30 ft. long, 7-in. top.

Contract G.—20,000 bbls. Portland cement.

Contract H.—21 miles 2/0 hard drawn trolley wire, 12 miles 4/0 D. B. W. P. 19 stranded copper wire, 4 miles 2/0 D. B. W. P. 7 stranded copper wire, 10 miles ⅜-in. stranded soft drawn iron wire.

Contract J.—Insulators, hangers, brackets, pullovers, turnbuckles, trolley frogs, crossovers, clinch bars, pole line hardware, etc. All material to be delivered f. o. b. Regina. Freight and duty paid. Copies of specifications, schedules, delivery dates, and form of contract, and other particulars can be had upon application to H. Doughty, Superintendent, the Regina Municipal Railway, Regina, Sask., Canada.

⊙The Canadian Pacific Ry. has awarded contracts for 807 miles of new line to be constructed in the west during the present year. Janse Bros., Boomer & Hughes, Calgary, Alberta, and Spokane, Wash., secured 375 miles of work, including the line from Milden to Empress and from Empress to Bassano, a distance of 244 miles. The contractors for the remainder of the 807 miles were Ed. Peterson, Omaha, Neb.; Foley, Welch & Stewart, St. Paul, Minn.; J. D. McArthur, Winnipeg, and George Webster.

⊙Edward Peterson Co., Omaha, Neb., as noted elsewhere in this section, has been awarded a contract for construction work on the Weyburn West Branch of the Canadian Pacific Ry. The contract includes 4,000,000 cu. yds. earth excavation and 1,000,000 cu. yds. rock excavation. The work will be sub-let.

Surveys are to be started shortly for an electric railway to connect Fort Erie with Port Colborne and other nearby towns in Ontario. The road will be known as the Niagara Falls, Welland & Lake Erie Ry. and the general offices will be in Welland, Ont. The future plans are said to call for the erection of a bridge at Fort Erie for a connection with the lines of the International Ry. in Buffalo. Construction work on the 36 miles of line will probably be started in the spring. Charles J. Loughlin, Welland, Ont., is Manager, and Thomas R. Cummings is Chief Engineer.

The Midland Ry Co. of Manitoba (Great Northern Ry.) has applied to the Legislature for extension of time to complete a network of railway in that province and to an increase of its capital stock from $500,000 to $10,000,000. The routes of these branches have not been defined yet, but they will compete closely with Canadian Pacific territory in retaliation for Soo competition in the states against the Great Northern. The Midland wants five years' time. It now has lines to Winnipeg, Brandon and Portage la Prairie.

Advices from Little Current, Ont., state that the Algoma Eastern R. R. Co. has completed the steel as far as the yards on Goat Island, immediately in front of Little Current, and is waiting for the completion of the bridge to enter the town. The Foundation Co. of Montreal has the concrete contract for the bridge and expects to be through by April 1, when the steel work will begin.

ROADS AND STREETS

Alabama.

⊙Contracts for the treatment of not less than 10 nor more than 15 miles of Jefferson County, Ala., roads with an asphalt road binder were awarded by the Board of Revenue, Birmingham, to Sam E. Findley of Atlanta, Ga., at about $20,000. Work will be started at once.

The City Council of Gadsden, Ala., has decided to pave Forest Ave., from Sixth to 12th Sts., at an estimated cost of from $10,000 to $15,000. The material to be used has not been decided upon.

Arizona.

⊙The Barber Asphalt Paving Co. has been awarded the contract bv the city of Phoenix, Ariz., Frank Thomas, City Recorder, for the construction of 24,350 sq. yds. of bitulithic pavement at $2.15 per sq. yd. The work includes 8,980 lin. ft. of curb at $0.50; 6,393 lin. ft. of gutter at $0.50; 232 lin. ft. of gutter at $1, and one reinforced concrete culvert at $790. Bids were opened Jan. 13.

Arkansas.

The Howard County Court, Nashville, Ark., has appointed viewers for the proposed ridge road from the north end of the county to Nashville, avoiding all water courses. Viewers also have been appointed to locate a road to leave the Center Point and Corinth Road at M. C. Pope's and intersect the proposed new road at the farm of J. C. Chandler.

Property owners residing on East Capitol Ave. and Sixth St., Little Rock, Ark., propose to form a district running from Sixth and Rock Sts. east on Sixth to Fletcher St., north on Fletcher to Fifth St., thence east to the plant of the Weil Packing Co., for street paving purposes.

California.

✤Bids will be received until 7:30 p. m., Feb. 3, by Board of Trustees, Huntington Beach., Calif., for the construction of street improvements. C. E. Lavering is City Clerk.

✤Bids will be received until 5 p. m., Feb. 6, by Alfred Davis, City Clerk, Santa Barbara, Calif., for the construction of combination curbs and gutters on Victoria St., between State and Garden Sts.

✤Bids will be received until 11 a. m., Feb. 3, by Board of Public Works, Los Angeles, Calif., for considerable street improvement work, including paving, sidewalks, culverts, etc.

⊙The California State Highway Commission has awarded the contract for the construction of a cement conduit, 4 ft. in diameter and 365 ft. in length, on the state highway at Cardiff-by-the-Sea, to W. L. Thompson of San Diego, Calif. The contract includes the construction of the balance of the cement sidewalks in the business section of the townsite.

City Engineer M. M. O'Shaughnessy of San Francisco, Calif., has completed all work in connection with the proposed construction of the Stockton St. tunnel. It is expected to commence work on the tunnel at an early date.

Colorado.

The County Commissioners of Routt, Moffatt and Grand Counties, Colorado, have decided to construct an air line highway from Denver to Salt Lake City. It is planned to rebuild the old wagon road over the Gore Range, shortening it in places so that it will be only 503 miles long. The road is to be finished by next summer.

City Engineer F. F. Mallon of Colorado Springs, Colo., has estimated the cost of the proposed paving in Boulder Street Improvement District No. 1 at $75,292. The work would include grading, surfacing and oiling a 40-ft. roadway from Cascade Ave. east on Boulder St. to the city limits, side parking and the laying of sidewalks. Public hearing was held by the City Council on Jan. 21.

Connecticut.

⊙The Robert D. Daley Co., of New Haven, Conn., has been awarded the contract for 6,000 lin. ft. of macadam road construction on the Seymour road in the town of Woodbridge by Highway Commissioner James H. MacDonald. The contract price is $1.83 per lin. ft.

⊙Highway Commissioner James H. MacDonald, Hartford, Conn., has awarded contracts as follows for state highway work: Southington—to Leonardo Suzio, Meriden, 9,153 ft. of macadam road at $2.20 per lin. ft. Cheshire—1,945 ft. to the same concern. Beacon Falls—To E. N. Clark, Milford, two sections, first, 1,640 ft. at $0.79 per lin. ft.; second, 2,350 ft., to Franconi & Benedetto, Torrington, at $1.30 per lin. ft. Orange—To the B. D. Pearce Jr. Construction Co., of Bridgeport, 12,650 lin. ft. of macadam at $2.31 per ft. Bolton—To the Pearson & Engineering Co., of Bristol, 791 ft. of grading, at $750. Bloomfield—To Robert G. Miller, 2,845 ft. of macadam at $2.45 per lin. ft. Waterbury—To Franconi & Benedetto, Torrington, 6,900 ft. of grading, at $11,600. The contracts for 12,037 ft. of macadam in Bolton, 12,953 in Pomfret, and 4,290 ft. in North Branford have not been awarded.

Florida.

⊙The Alabama Paving Co., 810-11 American Trust Bldg:, Birmingham, Ala., has been awarded the contract by the town of Brooksville, Fla., F. Robert Wilson, Town Clerk, for the construction of approximately 10,000 sq. yds. of brick paving, including curbing, at $1.85 per sq. yd., for paving and $0.45 per ft. for curbing. Bids were opened Jan. 14

The City Council of St. Augustine, Fla., will call for bids at once for the paving of Saragossa St. with asphalt macadam.

Idaho.

✤Bids will be received until 10 a. m., Jan. 29, by Board of Ada County Commissioners, Boise, Idaho, for the care and maintenance of what is known as the Clawson toll road for the year of 1913. Stephen Utter is Clerk of the Board

Bids were opened Jan. 22 by the city of Boise, Idaho, C. C. Stevenson, City Engineer, for paving in Local Paving Improvement District No. 19. The low bidders on the different classes of pavement were as follows: Reliance Construction Co., Portland, Ore., asphalt without guaranty, $120,470; asphalt with 5-year guaranty, $123,528. Northwest Paving & Contracting Co., Spokane, Wash., asphaltic concrete, without guaranty, $121,727; asphaltic concrete, with 5-year guaranty, $125,852. Northwest Paving & Contracting Co., Spokane, bitulithic, $151,017 to $169,893. Reliance Construction Co., Portland, Ore., Dolarway, without guaranty, $110,735; Dolarway, with 5-year guaranty, $113,803. Northwest Paving & Contracting Co., Spokane, Hassanite, without guaranty, $116,497, with 5-year guaranty, $120,622; Concrete, without guaranty, $94,797; with 5-year guaranty, $98,167. Reliance Construction Co., Portland, Ore., concrete with bituminous top, without guaranty, $104,082; with 5-year guaranty, $106,104.

Illinois.

✤Bids will be received until 11 a. m., Feb. 4, 1913, by the city for furnishing and delivering to the Bureau of Streets approximately 2,000 cu. yds. paving gravel, same to be delivered to 1st, 17th, 18th, 19th, 21st and 22d ward yards as required during year 1913. City reserves right to vary from these specifications by 50 per cent. Cash or certified check for $200 must accompany proposal. L. E. McGann, Commissioner of Public Works, Chicago, Ill.

✤Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., until 11 a. m., Feb. 3, for furnishing and delivering approximately 600,000 repressed vitrified paving brick to the Bureau of Streets. All brick to be of the kind known as No. 2 of the following size, 8 in.x4 ins.x2½ ins. City reserves right to vary from specified quantity by 50 per cent. All bids to be F. O. B. cars. Cash or certified check for $500 must accompany proposal.

✤Bids will be received until 11 a. m., Feb. 1, by L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering approximately 1,600 doz. street brooms to the Bureau of Streets during year 1913. City reserves right to vary from specified quantity by 50 per cent. Cash or certified check for $700 must accompany proposal.

✤Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., until 11 a. m., Feb. 1, for furnishing and delivering approximately 100,000 gals. of paving pitch. Same to be delivered as required in tar wagons of 500 gals. capacity, teams to be furnished by city. Pitch to be "straight run" coal tar, and contain not less than 15 per cent nor more than 35 per cent free carbon, with a melting point of not less than 130° F. nor more than 140° F. City reserves privilege of varying 50 per cent from specified quantity. Cash or certified check for $300 must accompany proposal.

✤Bids will be received until 11 a. m., Feb. 3, by L. E. McGann, Commissioner of Public Works, Chicago, for furnishing and delivering to the Bureau of Streets at the 12th, 24th and 30th ward yards, approximately 3,000 sq. yds. of cedar blocks, the same to be cut from live cedar, 5 ins. in length and from 4 ins. to 10 ins. in diameter. City reserves right to vary from specified quantities by 50 per cent. Cash or certified check for $100 must accompany proposal.

✤Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., until 11 a. m., Feb. 4, for furnishing and delivering approximately 5,000 sq. yds. No. 2 granite blocks to the Bureau of Streets, the same to be delivered F. O. B. public team track in 1st and 18th wards. City reserves privilege of varying from specified quantities by 50 per cent. Cash or certified check for $500 must accompany proposal.

✤Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., until 11 a. m., Feb. 5, for furnishing and delivering to the Bureau of Streets, approximately 505,000 ft. B. M. of pine lumber of various lengths and sizes, same to be distributed to the various ward yards. City reserves privileges of varying quantities by 50 per cent. Cash or certified check for $800 must accompany proposal.

✤Bids will be received until 11 a. m., Feb. 11, by the Board of Local Improvements, Chicago, Ill., for furnishing labor, materials, etc., necessary to construct pavements in the following streets, 52d St., Morgan St. to Loomis st., 3,780 lin. ft. granite concrete, combined curb and gutter, 340 lin. ft. concrete gutter, 7,320 sq. yds. asphaltic macadam, assessment available $191.50; E. 57th st., State St. to South Park Ave., 5,000 lin. ft. granite

✤ indicates work now open for bids. ⊙ indicates a contract let recently.

concrete combined curb and gutter, 9,760 sq. yds. asphalt pavement, assessment available $25,729; N. Hoyne Ave., Clybourn Ave. to Belmont Ave., 3,700 lin. ft. (9-in.x10-in.) granite concrete combined curb and gutter, assessment available $17,763; Hoyne Ave., Washington Blvd. to Harrison St., 5,500 lin. ft. granite concrete combined curb and gutter, 200 lin. ft. concrete gutter, 11,400 sq. yds. asphalt pavement, assessment available $30,450; Leland Ave., Clarendon Ave. to Sheridan Road, 2,450 lin. ft. granite, concrete combined curb and gutter (5-in.x18-in.), 3,720 sq. yds. asphalt pavement, assessment available $10.-500; Lime St., Archer Ave. to 27th St., 1,200 lin. ft. gravel, concrete combined curb and gutter, 2,920 sq. yds. asphalt pavement, assessment available $8,000; N. Prairie Ave., Augusta St. to Division St., 2,600 lin. ft. granite, concrete combined curb and gutter, 3,900 sq. yds. asphalt pavement, assessment available $12,000; Peoria St., 49th Pl. to 52d St., 3,030 lin. ft. granite, concrete combined curb and gutter, 4,970 sq. yds. asphalt pavement, assessment available, $14,350; Sawyer Ave., Foster Ave. to Balmoral Ave., 2,700 lin. ft. granite, concrete combined curb and gutter (12-in.x 8-in.), 3,700 sq. yds. asphaltic macadam pavement, assessment available, $9,000; Springfield Ave., 15th St. to 16th St., 1,220 lin. ft. granite, concrete combined curb and gutter, 1,950 sq. yds. asphalt pavement, assessment available, $6,000; St. Louis Ave., Fillmore St. to 12th St., 1,100 lin. ft. granite, concrete combined curb and gutter, 1,700 sq. yds. asphalt pavement, assessment available, $5,500; Tripp Ave., Hirsch St. to North Ave., 2,650 lin. ft. granite, concrete combined curb and gutter, 4,100 sq. yds. asphalt pavement, assessment available, $11,925; Pensacola Ave., N. Western Ave. to 541 ft. west of N. Campbell Ave., Pensacola Ave. to Montrose Ave., 3,500 lin. ft. sandstone curbing (7-in.x18-in.), on concrete, 5,500 sq. yds. asphaltic macadam, assessment available, $11,964; Christiana Ave., Elston Ave. to Irving Park Blvd., Kimball Ave., Grace St. to Irving Park Blvd., Bernard St., Elston Ave. to Irving Park Blvd., Eberly Ave., Elston Ave. to Irving Park Blvd., Grace St., Christiana Ave. to Elston Ave., Bryon St., Christiana Ave. to Eberly Ave., 14,100 lin. ft. sandstone curbing on concrete (7-in.x18-in.), 20,900 sq. yds. asphaltic concrete pavement, assessment available $47,819. The work includes a 6-in. Portland cement concrete foundation unless otherwise specified, sewer, manhole and catch basin construction, and adjustment, etc. Cash or certified check for 10 per cent of bid must accompany proposal. Edward J. Glackin is Secretary of the Board. Board.

✣Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., until 11 a. m., Feb. 3, for furnishing and delivering to the Bureau of Streets approximately 125 doz. No. 2 shovels and 275 doz. No. 7 scoops, according to specifications on file at office. City reserves privilege of varying from specified quantity to the extent of 50 per cent. Cash or certified check for $150 must accompany proposal.

✣Bids will be received until 11 a. m., Feb. 4, for furnishing and delivering to the Bureau of Streets, Chicago, Ill., approximately 2,000 cu. yds. of clean, round, paving gravel, the same to be delivered to the 1st, 17th, 18th, 19th, 21st and 22d ward yards. City reserves right to vary by 50 per cent from specified quantities. Cash or certified check for $200 must accompany proposal. L. E. McGann, Commissioner of Public Works.

✣Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., until 11 a. m., Feb. 4, for furnishing approximately 1,000 cu. yds. of bank sand during the ensuing year. Sand to be free from clay loam and other impurities. City reserves privilege of varying from specified quantities by 50 per cent. Cash or certified check for $200 must accompany proposal.

⊙A. E. Rutledge of Rockford, Ill., has been awarded the contract by that city for the construction of 14,000 sq. yds. of brick pavement with asphalt filler, including cement curb and gutter, at $33,000. Bids were opened Jan. 22.

Following are the lowest bids submitted to L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering natural cement to the Bureau of Engineering as required during 1913; approximate quantity used in 1912, 5,000 lbs. Thos. Connelly, 133 W. Washington St., within limits prescribed in specifications, 95 cts. per bbl., outside limits, 95 cts. per bbl., plus 2 cts. per bbl. per mile teamed F. O. B. cars, 77 cts. Bids opened Jan. 16. L. E. McGann, Commissioner of Public Works. The contract has not been awarded.

Following are the lowest bids submitted for furnishing and delivering to the Bureau of Engineering, at the waterworks shops, 2304 S. Ashland Ave., approximately 600 tons of hydrant casting for 2½-in. and 4-in. double hydrants and valve castings for 4-6-8-10-12-16-24 and 36-in. valves. American Brake Shoe & Foundry Co., McCormick Bldg., Chicago, $39.90 per ton; Bates Machinery Co., Joliet, Ill., $49.25 per ton; T. A. Cummings Foundry Co., 1338 Clybourn Pl., Chicago, $54.30 per ton. The contract has not been awarded. Bids were opened Jan. 17. L. E. McGann, Commissioner of Public Works, Chicago, Ill.

The Village Trustees of Glencoe, Ill., have voted to expend $200,000 for street paving this year. Alfred Washington is a member of the Board.

The city of Evanston, Ill., on Jan. 21 appropriated $14,000 for equipment, tools, material and labor necessary in street repair. J. F. Hahn is City Clerk.

Following are the lowest bids submitted to city of Chicago for furnishing and delivering to the Bureau of Engineering such washed gravel as is required for use during year 1913; approximate quantity used in 1912, 500 cu. yds.: American Sand & Gravel Co., 133 W. Washington St., Chicago, within limit, $1.24 per cu. yd; outside prescribed limit, $1.24 per cu. yd., plus 10 cts. per mile of teaming, F. O. B. cars, 75 cts. per cu. yd. The contract has not been awarded. Bids opened Jan. 16. L. E. McGann, Commissioner of Public Works.

Following are the lowest bids submitted for furnishing and delivering to the Bureau of Engineering during 1913 such crushed stone as is required; approximate quantity used in 1912, 5,000 cu. yds.: Producers' Stone Co., Campbell Ave. and Barry Ave., within prescribed limit, $1.65 per cu. yd.; outside prescribed limit, $1.65 per cu. yd., plus 10 cts. per mile of teaming; $1.15 per cu. yd. F. O. B. cars. L. E McGann, Commissioner of Public Works. Bids opened Jan. 16. The contract has not been awarded.

The Board of Local Improvements of Peoria, Ill., has passed ordinances providing for the paving of Seventh Ave., from Union St. to Western Ave., with brick early in the spring.

The Board of Local Improvements of Macomb, Ill., has passed an ordinance recommending to the City Council the continuing of the present pavement from the terminus about the middle of the south cemetery hill, on down and over the valley and to the north side of the middle entrance at the big arch, a distance of 1,006 ft. The pavement will be of two-course concrete and will cost about $6,000.

The Village Board of Bartonville, Ill., has adopted resolutions urging the Board of Local Improvements to secure estimates for the paving of Adams St., from the Kickapoo bridge to Roosevelt Ave. The proposed improvement is to be of brick and will complete the brick highway from Peoria to Bartonville.

The Board of Local Improvements of Quincy, Ill., has ordered 20th St., from Maine to Spruce Sts., paved with brick on a concrete foundation. City Engineer W. P. Bushnell has estimated the cost at $38,000.

Indiana.

✣Bids will be received until 2 p. m., Feb. 6, by Board of Fayette County Commissioners, Connersville, Ind., for the improvement of certain highway, D. W. Moore et al. road in Fayette County. J. L. Kennedy is County Auditor.

✣Bids will be received until 10 a. m., Feb. 28, by Board of Marion and Hendricks County Commissioners at Indianapolis, Ind., for the construction of a free stone road on county line. W. T. Patten is Auditor of Marion County. L. W. Borders, Danville, Ind., is Auditor of Hendricks County.

✣Bids will be received until 11 a. m., Feb. 8, by Board of Vigo County Commissioners, Terre Haute, Ind., for the construction of gravel roads in Vigo County. N. G. Wallace is County Auditor.

✣Bids will be received until 2 p. m., Feb. 3, by Board of Blackford County Commissioners, Hartford City, Ind., for the construction of the Fear Macadam road on the Harrison-Jackson township line, and the Park Ave. macadam road in Licking township. James Cronin, Jr., is County Auditor.

✣Bids will be received until noon, Feb. 5, by Board of Lake County Commissioners, Crown Point, Ind., for the construction of four gravel roads. Charles A. Johnson is County Auditor.

✣Bids will be received until 2 p. m., Feb. 4, by Board of Public Works, C. L. V. Tucker, Clerk, Vincennes, Ind., for the installation of a new gutter on the n. e. side of the city hall building.

Iowa.

✣Bids will be received until 7:30 p. m., Feb. 11, by W. C. Chubb, City Clerk, Corning, Ia., for grading, paving, curbing and guttering parts of Adams St., Davis Ave., Loomis Ave., Seventh St., Eighth St., Tenth St. and Grove Ave. T. S. Delay is Engineer, Creston, Ia.

The Board of Supervisors of Boone County, Ia., and the City Council of Boone, at a recent meeting voted to spend $8,000 on the highway known as the transcontinental route across Boone County. Story County recently raised $12,000 for this road. An appropriation of $10,000 will be secured from the government, making $30,000 in all.

Kentucky.

The Todd County Good Roads Association recently held a meeting in Elkton, Ky., and instructed its legal committee to prepare a petition for circulation throughout the county calling an election at the earliest practicable date on the question of a bond issue.

Louisiana.

✣Bids are being asked by State Highway Engineer W. E. Atkinson of Louisiana for the construction of what is known as Section No. 1 of the road improvement work which recently was decided upon by the Police Jury of Sabine Parish, Many, La. This section extends from Many northeast to the Natchitoches Parish line on a line to Robeline. It comprises 11 miles, and will cost approximately $20,000. It is also proposed to advertise shortly for the construction of Section No. 2, extending from Many north to the De Soto Parish line through Sodus, a distance of 20 miles.

⊙James Geary of New Orleans, La., has been awarded the contract by the Board of Commissioners, Port New Orleans, New Orleans, for the construction of the Pauline St. wharf, the materials for which are to be furnished by said board, at $16,207. The Grasser Contracting Co. secured the contract to construct roadway to wharf, at $45,866. Bids were opened Jan. 22.

According to State Highway Engineer W. E. Atkinson of Louisiana it is proposed to issue bonds to the amount of $200,000 for a special constituted road district, comprising that part of Ouachita Parish east of the Ouachita River, for the construction of 85 miles of gravel roadways. All roads are to radiate from the city of Monroe.

Massachusetts.

The Massachusetts State Legislature will probably pass a petition authorizing the city

✣ indicates work now open for bids. ⊙ indicates a contract let recently

of Pittsfield to make an appropriation of $100,000 for paving and resurfacing of streets. A. B. Farnham is City Engineer.

Moderator W. G. Lord of Athol, Mass., has announced the names of the special committee which is to have general oversight of building the new road in the spring for which $60,000 is to be expended. This committee will consist of A. J. Raymond, W. W. Woodward and Fred W. Lord.

Minnesota.

✣Bids will be received until Feb. 3 by A. P. Erickson, County Auditor, Minneapolis, Minn., for furnishing the labor and material for graveling 4,007 ft. of Road No. 93, commencing at the intersection of Road No. 23, in the town of Independence. A certified check for 5 per cent the amount bid must be filed with each bid.

The City Council of Ely, Minn., is considering the laying of more cement sidewalks. This work, together with the proposed paving, will cost about $50,000. O. E. Brownell is City Engineer.

The City Council of Minneapolis, Minn., has passed a resolution providing for the paving of East 26th St., from Nicollett Ave. to Park Ave., with 3½-in. creosoted wood blocks. Henry N. Knott is City Clerk.

Mississippi.

No contract was let by the Board of Road Commissioners of District No. 3, Covington County, Collins, Miss., for the maintenance of all unlet roads for two years, for which bids were opened Jan. 6. Sam Williamson is interested.

The Board of Supervisors, Yazoo City, Miss., recently passed an order to issue $300,000 of bonds for the construction of permanent roads for the county.

A special election is to be held in the first district of Copiah County, Miss., on Feb. 1 to vote on the issuance of bonds to the amount of $75,000 for good roads. Hazlehurst is the county seat.

The County of Sunflower, Miss., intends to float bonds shortly to the amount $55,000 for the construction of good roads in districts Nos. 2 and 5. Indianola is the county seat.

The Hancock County Board of Supervisors, Bay Saint Louis, Miss., will sell bonds Feb. 3 to the amount of $52,000 for the construction of roads and bridges.

The Board of Montgomery County Supervisors, Winona, Miss., will sell bonds Feb. 3 to the amount of $40,000 for the construction of good roads.

The Board of Neshoba County Supervisors, Philadelphia, Miss., has made arrangements for the issuance of bonds to the amount of $100,000 for good roads. It is probable this may be increased to $150,000.

The citizens of District No. 5 of Lamar County, Miss., on Jan. 14 voted against the issuance of bonds to the amount of $50,000 for the construction of good roads. The city of Sumrall is located in District 5. Purvis is the county seat.

Missouri.

✣Bids will be received until 5 p. m., Feb. 3, by Audrey D. Risdon, City Clerk, Kirksville, Mo., for the improvement of the alley running east and west through Block 8, original town of Kirksville, Missouri, from the west line of Franklin St. to the east line of Elston St., in said city, by paving and otherwise improving the same.

✣Bids will be received until 5 p. m., Feb. 3, by City Council, Kirksville, Mo., for the grading and paving and otherwise improving of Harrison St. from Mulanix St. to Bradford St. Audrey D. Risdon is City Clerk.

✣Bids will be received until 5 p. m., Feb. 3, by City Council of Kirksville, Mo., A. D. Risdon, Clerk, for the improvement of a number of streets.

✣Bids will be received until Feb. 11, by the Board of Public Improvements, Maxime Reber, President, St. Louis, Mo., it is reported, for the following street paving contracts: With asphalt—Abner from Ashland to Natural Bridge, estimated cost, $12,387; Williams from Ashland to Natural Bridge, estimated cost, $11,868; Arkansas from Osage to Chippewa, estimated cost, $12,019; Carrie from Bulwer to Broadway, estimated cost, $12,315; Delor from Virginia to Alaska, estimated cost, $8,209; Labadie from Union to Abner, estimated cost, $5,331; total, $62,129. With bitulithic—Maffitt from Clara to Goodfellow, $13,631; Cora from Natural Bridge to Margaretta, $9,604; total, $23,233. With Telford (oil treatment)—Improving Bowman from Simpson to Elizabeth, $1,560. With brick—Bessie from Newstead westwardly for distance of 820 ft., $10,144; Idaho from Kansas to Fillmore, $11,349; Natural Bridge from Taylor to Kingshighway, $32,241; Natural Bridge from Kingshighway to Union, $31,785; Gravois from Grand to Spring, $15,397; Carter from Newstead to Marcus, $33,002; Newby from Halls Ferry road to the intersection of Canaan and Estella, $17,038; Duncan from Sarah running north of Duncan to Boyle, $14,437; Billon from Manchester to Oakland, $33,050; Meramec from Grand to 38th, $12,541; Lexington from Taylor to Cora, $9,861; Prairie from Cozens to Easton, $2,631; Virginia from Cherokee to Utah, $6,645; Glasgow from a line about 133 ft. south of Bailey to intersection of Kossuth and 25th, $4,692; 22d from Angelica to Glasgow, $6,282. Reconstructing Penrose from 20th to Florissant, $6,407; Mullanphy from 20th to Jefferson, $22,641; Hebert from 11th to 21st, running north of Hebert, $22,577; total, $292,721. Total estimated cost, $379,645.

⊙D. G. Hendrix of Brookline Station, Mo., has been awarded the contract by the Greene County Court, Springfield, Mo., for the construction of the Springfield-Brookline road at $17,060. The highway is to be 14 ft. wide, with a 6-in. base of broken rock and a top dressing of crushed stone ranging from 6 ins. in thickness at the center to 3 ins. at the outer edge. The road will be eight miles long.

An election is to be held in Monroe Township of Nodaway County, Mo., on Feb. 8 for the purpose of voting on the issuance of bonds to the amount of $15,000 for the construction of good roads. Maryville is the county seat.

The Commissioners of Ridge Road Boulevard District, Clay County, Mo., held a meeting Jan. 25 to discuss the rock road question. It is proposed to construct a road from Liberty to the Compton farm, a distance of about 6½ miles. The estimated cost is $40,000. Liberty is the county seat.

The Board of Public Works of Kansas City, Mo., has been urged by the Mayor to have repairs made on the rock roads constructed by the County Court years ago, but which are in the city limits south and east.

Montana.

The Board of County Commissioners, Forsyth, Mont., has decided to issue bonds to the amount of $130,000, of which $45,000 will be used for the construction of roads and $85,000 for bridges.

Nebraska.

⊙Maret & Anthony of Joplin, Mo., have been awarded the contract by the city of Pittsburgh, Kans., for the construction of curbing and guttering, at $0.46 per lin. ft. H. R. Nesch of Pittsburg secured the contract to construct two-course brick pavement, and Thogmartin & Gardiner of Fort Scott, Kans., were awarded the contract to construct a single course concrete base. Bids were opened Jan. 15.

The City Council of Madison, Nebr., has decided to use brick in the replacing of granite blocks on a number of the residence streets this year.

New York.

⊙A. L. Guidone & Co., 162 E. 23d St., New York City, have been awarded the contract by the Board of Water Supply of that city for Contract No. 134, for surfacing with vitrified brick block highways around the Ashokan reservoir in the towns of Olive, Marbletown, Hurley, Woodstock and Kingston, Ulster County, N. Y. Bids were opened Jan. 21.

⊙The German Rock Asphalt & Cement Co. is the probable contractor for the paving of Cumberland Ave., and for repaving Cottage and Triangle Sts., in Buffalo, N. Y., for which bids were opened Jan. 17. The Cumberland Ave. paving will cost $19,720; Cottage St., $9,505, and Tiangle St., $15,480. The work includes, paving, curb stone, base, surface drain tile and grading of roadway and sidewalks; in repaving new base, surface, resetting the old curb and furnishing as much new as necessary, and drain tile.

The citizens of Holley, N. Y., have voted to have the public square paved at a cost of not to exceed $9,500.

The Local Board of Newton, Borough of Queens, New York City, has passed a resolution to grade, curb, pave with asphalt and lay cement sidewalks on Cornelia St., Ridgewood, westerly from Wyckoff Ave. to Brooklyn line, at an estimated cost of $8,000. Also to pave with asphalt block and a concrete foundation Sherman St., Long Island City, from Broadway to Grand Ave., at an estimated cost of $18,100; also Woolsey Ave., Long Island City, from Steinway Ave. to Second Ave., at an estimated cost of $25,900.

The Board of Public Works of Fulton, N. Y., on Jan. 21 recommended that the city either purchase a new street sprinkling wagon or a sprinkling truck. G. C. Hill is City Engineer.

Ohio.

✣Bids will be received until noon, Feb. 14, by W. G. McKinney, Clerk, Village of New Concord, O., for furnishing the necessary labor and material as hereinafter specified for the improvement of Main St. of the Village of New Concord, Ohio., by grading, constructing of brick vitrified block, street paving, including slag base, sand cushion, extension joints, concrete curb, storm sewer, catch basins, discharges and accessories, all according to plans and specifications on file in the office of the Clerk of said Village. Paving blocks will be furnished by the Village and delivered along the line of the work.

✣Bids will be received until noon, Feb. 5, by W. J. Springborn, Director of Public Service, Cleveland, O., for grading, draining, curbing, paving with paving brick and improving the following thoroughfares: Althen Ave. S. W. from W. 25th St. to W. 30th St.; Ambler Ave. S. E. from Holton Ave. S. E. to Buckeye Rd. S. E.; Cornell Rd. S. E. from Euclid Ave. to 58 ft. southerly from Cornell Pl. S. E.; Chicory Ct. S. E. from E. 35th St. to E. 33d St.; Collier Ave. S. E. from E. 66th St. to E. 67th St.; E. 33d St. and Pauline Ave. S. E. from Broadway S. E. to 131 ft. north of Pauline Ave. S. E. and from E. 33d St. to E. 34th St., respectively; E. 66th St. from Clement Ave. S. E. to Harvard Ave. S. E.; E. 71st St. and Hand Ave. S. E. from Ivy Ave. S. E. to Hand Ave. S. E. and from E. 71st St. to E. 72d St., respectively; E. 72d St. from Ivy Ave. S. E. to Morgan Ave. S. E.; E. 75th St. from Union Ave. S. E. to Aetna Rd. S. E.; E. 76th St. from Union Ave. S. E. to Bates Ave. S. E.; E. 81st St. from Holton Ave. S. E. to Kinsman Rd. S. E.; E. 82d St. from St. Clair Ave. N. E. to the L. S. & M. S. Ry.; E. 96th St. from Woodland Ave. S. E. to Steinway Ave. S. E.; E. 98th St. from Union Ave. S. E. to Heath Ave. S. E.; Force Ave. S. E. from Warner Rd. S. E. to E. 77th St.; Ivy Ave. S. E. from E. 70th St. to E. 75th St.; Launer Ave. S. E. from Warner Rd. S. E. to W. L. of E. 77th St.; Leading Ave. S. W. from Fulton Rd. S. W. to W. 39th Pl.; Lederer Ave. S. E. from E. 65th St. to E. 67th St.; Macon Ave. N. W. from W. 95th St. to W. 98th St.; Penobscot Ave. N. E. from St. Clair Ave. N. E. to easterly city limits; Random Rd. S. E. from Cornell Rd. S. E. to Paul Ave. S. E.; Sadie Ave. S. W. from Scranton Rd. S. W. to W. 16th St.; Seager Ave. S. E. from Broadway S. E. to about 210 ft. easterly; St. Clair Ave. N. E. from Penobscot Ave. N. E. to Cleveland Short Line Ry.; Tompkins Ave. N. W. from W. 85th St. to

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

W. 89th St.; Warren Ct. S. E. from Warren Ave. S. E. to 173 ft. easterly; W. 15th St. from Denison Ave. S. W. to northerly end; W. 22d Pl. from Denison Ave. S. W. to about 448 ft. northerly; W. 78th St. from Detroit Ave. N. W. to the L. S. & M. S. Ry.; W. 79th St. from Lorain Ave. to Hope Ave. S. W.; W. 93d St. from Detroit Ave. N. W. to Desmond Ave. N. W.; W. 115th St. and Fruitland Ct. N. W. from Lake Ave. N. W. to W. 116th St. Also for grading, draining, curbing, paving with Common Medina stone and improving Wamelink Ave. S. E. from Woodhill Rd. S. E. to Steinway Ave. S. E. Each bid must be made in accordance with the plans and specifications which may be seen at the office of the City Engineer, Room 305 City Hall.

The City Council of Toledo, O., has decided to improve Summit St., from Perry to Cherry Sts., with a smooth pavement in the spring. Geo. W. Tonson is City Engineer.

⊙Jas. H. Scroggie of Olmsted Falls, O., has been awarded the contract by the Board of Cuyahoga County Commissioners, Cleveland, O., for the improvement of Usher Road, from Irish road to the village line in Olmsted Township. Bids were opened Jan. 15.

Oklahoma.

⊙Levy & Levy of Muskogee, Okla., have been awarded the contract by the city of Okmulgee, Okla., for the construction of approximately 13,100 sq. yds. of bituminous concrete paving in Street Improvement District No. 3. Bermudez asphalt will be used. The contract price is about $25,000. Contract was awarded Jan. 6. James G. Lyons is Commissioner of Public Works.

Petitions for the paving of Broadway with vitrified brick have been presented to the City Council of Cleveland, Okla., and paving work will be pushed as rapidly as possible. The city has employed the Benham Engineering Co., 812-14 American Nat. Bank Bldg., Oklahoma City, Okla., to draw plans and specifications, and supervise the work of construction.

Oregon.

⊙The City Council of Portland, Ore., has awarded contracts for the improvement of the following streets, as follows: E. Water St., from E. Morrison to E. Washington, stone block pavement, Pacific Bridge Co., $10,045; Ainsworth Ave., from Delaware to Gay Sts., grading and concrete curbs and walks, Bechill Bros., $2,076; Kerby St., from Ainsworth Ave. to Portland Blvd., grading and concrete curbs and walks, Kibbe-Welton Co., $3,535.

Appropriations of money to meet the expenses of the various departments of the city for the present year have been recommended to the City Council of Portland, Ore. Among the items are $141,565 for street repair; $325,000 for street cleaning; $149,440 for parks and $26,000 for a crematory.

Pennsylvania.

✣Bids will be received until noon, March 3, by M. L. Cooke, Director of Public Service, Philadelphia, Pa., for the completion of the Northeast Blvd., from 2d St. to Rhawn St. Approximate quantities of principal items of work as follows: 402,729 cu. yds. grading; 445,700 sq. yds. bituminous macadam surfacing; 69,000 sq. yds. water bound macadam surfacing; 59,000 sq. yds. vitrified brick gutters on 4-in. concrete foundation; 68,700 lin. ft. 8 in. steel protected concrete curb; 49,200 sq. yds. cement sidewalks; 431,800 sq. yds. top soil and grass seeding. Together with all other work incidental thereto, including sewers, masonry, vitrified pipe, manholes, inlets and trees and shrubs. The amount of money available for the work is $1,000,000. A charge of $10 will be made for each set of specifications and blue prints, which charge will be refunded upon the return on or before March 3, 1913, of the unused specifications and plans in good condition, or upon the return of the plans in case a bid is submitted. Specifications and blank forms upon which bids must be made can be obtained upon application at the office of the Bureau of Highways, Room 232, City Hall. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 3 p. m., Jan. 31, by Borough of North Braddock, Pa., for the grading, curbing and paving of Rebecca St. from Ann St. to Verona, 250 cu. yds. of grading, 725 yds. brick paving, 450 lin. ft. of combination curb and gutter. Plans, specifications and bidding blanks at Borough Engineer's office, Spring and Jones Ave., North Braddock, Pa. The Borough of North Braddock reserves the right to reject any or all bids. Geo. F. Siefers, Borough Engineer.

The highway committee of Williamsport, Pa., has asked the City Council for an appropriation of $40,000, of which $25,000 is wanted for the building of sewers and $15,000 for street paving.

The City Council of Lebanon, Pa., has been urged by the Paving Committee to levy a one mill additional tax for street paving. Two squares are to be paved.

State Senator Sproul of Delaware County, Pa., has introduced a bill in the legislature providing that all moneys on hand or that shall hereafter be realized from the sale of automobile licenses shall be immediately available for road purposes. The state has, at present, on hand about $2,000,000 of this money.

South Carolina.

⊙The City Council of Spartanburg, S. C., has awarded the contract for the construction of concrete sidewalks to Rose & Kerline of Atlanta, Ga., at $0.83 per sq. yd., for all 4 and 6-in. walks, and $1 per sq. yd. for all 8-in. walks. The contract will amount to about $40,000.

South Dakota.

Plans are being made to lay several miles of new sidewalks in Sisseton, S. Dak., early in the spring.

Texas.

✣Bids will be received until Feb. 11, by W. H. Ely, Hearne Precinct of Robertson County, Hearne, Tex., for the construction of 60 miles of gravel and sand clay road.

⊙Moxeley & Co., of Sweetwater, Tex., have been awarded the contract by the city of San Angelo, Tex., for the placing of more than 40,000 sq. yds. of pavement at $1.23½ per sq. yd. The pavement will be asphalt on a concrete base.

An election is to be held in Harris County, Tex., on Feb. 20 for the purpose of voting on the issuance of bonds to the amount of $1,000,000 for the extension and improvement of roads. Houston is the county seat.

An election was held in the commissioners' precinct in which is located the town of Charlotte, Tex., on Jan. 22 for the purpose of voting on the issuance of bonds to the amount of $22,000 for good roads in that part of Atascosa County. The proposition carried.

Following bids were received Jan. 13 by the City Council of Houston, Tex., for the paving of Louisiana St., between various intersecting streets, and for Harrisburg Road, between Milby St. and east city limits: Louisiana, between Pease and Berry Sts.—Texas Bitulithic Co., with bitulithic, $2.38 a sq. yd.; with five year guarantee, $2.43. Louisiana, between Congress and Capitol Sts.—Creosoted Wood Block Paving Co., with creosoted wood blocks, as follows: With 3-in. blocks, $2.63 the sq. yd.; with 5-year guarantee, $2.66. With 3½-in. blocks, $2.88 the sq. yd.; with 5-year guarantee, $2.91. With 3-in. blocks and a technical difference in the foundation for the blocks, $2.58¾ the sq. yd.; same with 5-year guarantee, $2.60. With 3½-in. blocks, difference in foundation same as last quotation, $2.84 the sq. yd.; same with 5-year guarantee, $2.87. The Eureka Construction Co. offered to pave Harrisburg Rd., between Milby St. and east city limits, with Texaco asphalt for $1.74 the sq. yd.; same with 5-year guarantee, $1.79.

Engineers Hughins and Hayles, assistants to Engineer J. C. Travilla of St. Louis, Mo., have completed preliminary work of surveying the lateral road to be constructed from Mansfield to Arlington via Webb. This is the first work done in connection with the good roads system for Tarrant County, Tex., of which Fort Worth is the county seat.

The City Council of Houston, Tex., has adopted a resolution providing for the paving of Burlington St., between West Alabama and Hawthorne St., with bitulithic.

A good roads association has been organized in Hillsboro, Tex. The association will draft a bill to be placed before the coming legislature to enable the County of Hill to issue about $300,000 in bonds for road work.

The citizens of El Paso County, Tex., recently voted the issuance of bonds to the amount of $390,000 for the construction of good roads. Work is to begin at an early date. El Paso is the county seat.

The City Council of Houston, Tex., has adopted resolutions providing for the paving of Austin St., between Texas and McGowen Aves.; Leeland, between Crawford and the San Antonio & Aransas Pass Railroad tracks, and Fannin, between McKinney and McGowen.

Mayor P. P. Putney and City Council of Eagle Lake, Tex., are agitating the question of paving the square. It is also proposed to extend the pavement on Main St. to the intersection of Lake Ave.

Virginia.

⊙The Board of Control of Norfolk, Va., has contracted with the Continental Public Works Co. for paving 11th St., on the same terms as were set out in the contracts for 10th, 13th, 14th and 15th Sts.

The Board of Supervisors of Wise County, Va., will sell bonds Feb. 11 to the amount of $260,000 for road improvements in the Gladeville and Richmond magisterial districts. Each of these districts has voted $130,000 for roads. In the former district about one-half will be used for macadamizing and one-half for grading new roads. In the latter district all grading work has been completed and the proceeds will be used for macadamizing. E. J. Prescott, Big Stone Gap, Va., is chairman of the board.

The Lipps magisterial district of Wise County, located on the eastern border of the county, will shortly vote on an additional bond issue of $100,000 for road work. Big Stone Gap, Va., is the county seat. E. J. Prescott is chairman of the Board of Supervisors.

Washington.

⊙The Spokane Asphalt Co., Spokane, Wash., has been awarded the contract for paving Roads Nos. 4 and 5 at Pullman and Rosalia, respectively, at $13,779 and $23,628.

The city of Everett, Wash., has readvertised for bids for the paving of Oak St. Bids recently received were considered too high. The estimated cost of the improvement is $28,000.

The City Council of Seattle, Wash., has passed resolutions ordering the regrading of 20th Ave. N. E. et al., Jackson St. and 22d Ave. S.; also Sixth Ave. et al.

The City Council of Seattle, Wash., has passed ordinances providing for extending, widening, etc., of Western Ave., from Eagle St. to Mercer St., and Denny Way, from Western Ave. to Fifth Ave. N. et al.

The city of Walla Walla, Wash., plans the construction of about 17,000 sq. yds. of paving on the principal streets. W. Rehorn is City Engineer.

State Highway Commissioner W. J. Roberts of Washington, in his annual report to Governor M. E. Hay, recommends the building of the Pacific highway, and the building of a road over the Cascade mountains. The report also indorses the state road between Easton, in Kittitas County, and Seattle, known as state road No. 7.

Following bids were tabulated Jan. 18 by the Board of Public Works of Seattle, Wash., for the grading and paving of Ione Pl. and Leary Ave.: Sloane Bros., $26,035; McGuire & Moon, Northern Bank Bldg., Seattle, $25,466; G. De Long, $27,243; Union Construction Co., $26,155; T. Ryan & Co., $27,520; McQuaid & Moore, $28,186.

Following bids were tabulated Jan. 18 by the Board of Public Works of Seattle, Wash., for the grading of 24th Ave. S. et al.: Henry Brice, $13,648; Sloane Bros., $13,519; R. M. Overstreet, Mutual Life Bldg., Seattle, $13,414; A. Peterson, $16,962; Rufus Buck, $14,515, and Russell & Gallagher, $14,654.

Following bids were tabulated Jan. 18 by the Board of Public Works of Seattle, Wash., for the paving of Ravenna Ave.: P. J. McHugh, $47,239; Barber Asphalt Paving Co., $46,870; Krogh & Jessen, 1418 24th Ave., Seattle, $45,671, and Independent Asphalt Paving Co., $48,890.

West Virginia.

⊙The Town Council of Warwood, W. Va., has awarded the contract for macadamizing Main St., from 23d northward to the corporate limits of the town, to Ward Patrick of Wellsburg, Va., at $2,780.

Wisconsin.

State Senator Brown of Wisconsin has submitted a bill in a meeting of the Legislature providing for an appropriation of $500,000 for the work of the new Highway Commission.

The City Council of Oshkosh, Wis., has adopted resolutions directing the Board of Public Works to prepare and report to that body plans and profiles and general specifications for the paving of the following streets: New York Ave., from Jackson St. to Main St.; choice of material to include sarcolithic, tar macadam and cement No. 1 and No. 2. Franklin Ave., from Scott St. to Irving St.; choice of paving the same as New York Ave.; Hazel St., from Merritt St. to Irving St.; material same as above streets. Central Ave., from Scott St. to Irving St.; material same. South Main St., from the south line of South Park Ave. to the south line of 16th St.; choice of material to include cedar blocks, sarcolithic and cement No. 1 and No. 2. Dotv St., from 25th St. to the north line of 16th St.; choice of material to include cedar blocks, sarcolithic and cement No. 1 and No. 2. 16th St., from South Main St. to Doty St.; choice of material to include cedar blocks, sarcolithic and cement No. 1 and No. 2. J. H. Randall is City Engineer.

The Common Council of Madison, Wis., has adopted an ordinance providing for the paving of certain streets, including Monroe, Hamilton, Jefferson and Water Sts.

The Fond du Lac Board of Supervisors, Fond du Lac, Wis., has authorized an expenditure of $9,000 for road building machinery. The equipment is to consist of two complete road building outfits and a stone crusher. It is probable contracts will be let next month.

Canada.

The Municipal Commissioners of Edmonton, Alta., have under consideration the purchase of a paving plant and machinery for the same. Between $50,000 and $60,000 will be expended.

According to advices from North Bay, Ont., T. F. Whitson has made preparations for the building of a trunk road of 20 miles from North Bay to Callendar and into the township of Chisholm. The money for this road has been provided by the legislature.

Parks Commissioner Chambers of Toronto, Ont., has outlined plans for the extending of 42 miles of boulevard along the outer edge of Greater Toronto, to cost about $7,000,000. Construction work is to commence this spring.

BRIDGES

Alabama.

⊙The contract for the construction of the Norwood viaduct, Birmingham, Ala., has been awarded to John W. Ashe, Chattanooga, Tenn., by the engineering department of the Southern Railway. Bids for the structure were received Jan. 6. It will be of reinforced concrete and will be located at 27th St. and 12th Ave. crossing the tracks of the Southern, the Frisco and the Illinois Central Railroads.

Arizona.

It has been announced that a bill providing for an appropriation of $70,000 for the construction of bridges over the Gila and San Carlos Rivers, has passed the house. Both the structures will be located on the San Carlos Indian Reservation, one in Gila County and the other in Graham County, Ariz.

Arkansas.

⊙The County Court at Sheridan, Ark., has awarded the contract for the construction of a steel bridge over the Saline River, one mile west of Prattsville on the Pine Bluff-Malvern road, to the Vinson Steel & Bridge Co. at $4,400.

California.

The Board of Glenn County Supervisors, Willows, Calif., has submitted to the Engineer of the State Highway Commission, Sacramento, Calif., plans for the construction of the proposed $140,000 bridge at Orland.

County Engineer L. C. Stiles, Willows, Calif., has submitted plans and specifications to the Board of Glenn County Supervisors for the construction of six new county bridges, three south of Willows and three in the Newville vicinity. The money was raised for these structures under the $450,000 bond issue of 1912.

The Board of Supervisors of Tehama County, Red Bluff, Calif., has ordered plans and specifications prepared for the construction of a steel bridge at Jelly's Ford. The cost of the structure is estimated at $45,000.

District of Columbia.

✣Bids will be received until 11 a. m., Feb. 21, by H. R. Stanford, Chief of Bureau of Yards & Docks, Navy Department, Washington, D. C., for brick and concrete subway at the naval hospital, Washington, D. C. The work is estimated to cost $1,800.

The Citizens' Association, Anacostia, D. C., has appointed a committee to take steps toward securing an appropriation for the complete reconstruction of the bridge over the Anacostia River at Pennsylvania Ave., instead of merely the installation of a draw span costing $60,000.

Georgia.

An election is to be held in Sumter County, Ga., on Feb. 26 for the purpose of voting on the issuance of bonds to the amount of $90,000 for the improvement of graded roads. This amount will be spent entirely upon concrete culvers and steel bridges, and is supplementary to the $50,000 expended annually by the county in road improvement. Americus is the county seat.

Iowa.

Plans have been completed by the City Engineering Department, Des Moines, Ia., for the construction of the proposed new bridge over Four Mile Creek on Scott Ave. The plans for the structure over Walnut Creek on the Valley Junction road are nearing completion. John Budd is Assistant City Engineer.

Stockholders of the Inter-City Bridge Co., at the annual meeting elected the following officers and directors for the ensuing year: C. R. Joy, President; Wm. Logan, Vice-president; C. P. Dadant, Vice-president; A. E. Johnstone, Secretary and Treasurer; Directors: William Logan, C. R. Joy, A. E. Johnstone, Wells M. Irwin, C. P. Dadant, R. R. Wallace and J. P. Allen.

Illinois.

⊙William Drinnen & Son, Galesburg, Ill., have been awarded contracts for the construction of the Goodspeed and Bowman bridges in Victoria township at $1,955 and $1,990, respectively.

Kansas.

⊙The Board of Montgomery County Commissioners, Independence, Kan., recently awarded the contracts for the construction of three bridges as follows: 35-ft. bridge over Cheyenne Creek west of Tyro to the Topeka Bridge Co., at $1,800; 30-ft. bridge over Cherry creek in Cherry township near Cherryvile to Fred Applebv, Kansas City, Mo., at $874; 80-ft. bridge over Cotton Creek near Liberty to Fred Appleby, at $2,960.

⊙The Commissioners of Barton County, Great Bend, Kan., have awarded the contract for the construction of a concrete bridge over the Arkansas River at Great Bend to the Kansas Construction Co., Wichita, Kan., at $24,800.

⊙The Mitchell County Board of Commissioners, Beloit, Kan., let contracts for the construction of the bridges mentioned in our issue of Jan. 1, as follows: Nos. 67,261, 76,191, 96,241 and 810,261 to the Midland Bridge Co., at $2,395; No. 67,141 to Green & Bliss at $114; No. 76,101 to F. C. Brown at $855; No. 67,191 to Madtson & Weldin at $840; No. 9,671 to J. G. Thompson at $525; Nos. 89,352, 89,281 and 810,341 were above the estimates. Bids were opened Jan. 10.

Louisiana.

Following a conference with the Mayor and City Commissioners of Shreveport, La., representatives of the Texas & Pacific and the Houston & Shreveport (Southern Pacific) Railroads announce that a subway will probably be constructed under the tracks of the two lines at Linwood Ave. The cost of such an improvement will amount to about $16,000. I. A. Cottingham, Houston, Texas, is Assistant General Manager of the H. & S. R. R.; C. H. Chamberlain, Dallas, Texas, is Chief Engineer of the T. & P. Ry. and George R. Wilson is City Engineer.

Maine.

A resolution has been presented in the House of Representatives, Bangor, Me., providing an appropriation of $62,400 for the construction of the easterly span of the bridge between Old Town and Milford.

Massachusetts.

The City of Boston, Mass., has decided to lay out Medway St. as a public thoroughfare and construct a new bridge over the tracks of the New York, New Haven & Hartford Ry.

The City Council of Lawrence, Mass., by a unanimous vote favored any feasible plan to secure the construction of the proposed new bridge over the Merrimac River.

A bill has been filed with the Legislature by R. M. Washburn, Representative, providing for a bridge over the causeway at Lake Quinsigamond costing not more than $150,000. The expense will be divided between the City of Worcester, the State and the Worcester Consolidated Street Railway Co.

Two petitions are being circulated among the citizens of Gardner, Mass., calling for the appropriation of $7,000, of which $5,000 will be spent for the construction of a bridge from North Main St. on the east side to the foot of Willow St.

Plans have been prepared by F. C. Wales, 1150 Tremont Bldg., Boston, Mass., for the construction of a $30,000 steel draw bridge at the town of Falmouth, Mass., and bids for the work were opened Jan. 27. The structure will have one clear channel span 31 ft. 6 ins. long with a 40-ft. roadway paved with wood and 2 granite abutments 45 ft. long.

Michigan.

The Ottawa County Board of Supervisors, Grand Haven, Mich., is contemplating the construction of a new bridge over Grand River at Grand Haven, Mich.

Mississippi.

✣Bids will be received until Feb. 3 by Board of Panola County Commissioners, Batesville, Miss., for the construction of the following bridges: Farley (new) bridge over McIver Creek, six miles west of Batesville; steel (new) bridge across Yarbrough's ditch, four miles west of Como; steel (new) bridge across Bynum Creek; new steel bridge over Hays Creek, north of Hays Bros.' store, and approaches and additions to steel bridge at Reeder's Ferry. R. W. Draper, clerk.

⊙The Lawrence County Board of Supervisors, Monticello, Miss., has awarded the contract for the construction of three steel bridges to A. T. Newell & Bros., Birmingham, Ala., at $6,813.

Missouri.

⊙The Midland Bridge Co., Kansas City, Mo., has been awarded a contract at $2,094 for the construction of a 130-ft. steel bridge in Gentry County. John Ray, Albany, Mo., is Engineer.

It has been announced that work will be commenced in the spring by the Missouri Pacific on the proposed new viaduct over the tracks at Nicholas St. extending from 16th to 13th St. Work on the Locust St. viaduct will be started later. The cost of the Nicholas St. structure will amount to $80,000. C. E. Smith, St. Louis, Mo., is Bridge Engineer.

Montana.

✣Bids will be received until Jan. 29 by E. H. Schumacher, County Clerk, Bozeman, Mont., for the construction of a wooden Howe Truss bridge over Gallatin River. Separate bids will be received on the superstructure.

The Commissioners of Rosebud County, Forsyth, Mont., have under consideration the issuance of $45,000 of bonds for the construction of bridges.

Nebraska.

✣Bids will be received until noon, Feb. 11, by Board of Seward County Supervisors, Seward, Nebr., for the construction and erection of the superstructure, the substructure and approaches of all new bridges and for furnishing the materials in connection with the same required for Seward county, Nebraska, for the period of one year after the date of letting the contract therefor, and for repairing all bridges and approaches to bridges which are required to be built, repaired or maintained by said county during the said period.

⊙The Standard Bridge Co., Omaha, Nebr., has been awarded the contract for the construction of all bridges throughout Fillmore County, Nebr., during the year of 1913. Bert A. Lynn is County Clerk, Geneva, Nebr. Bids were opened Jan. 14.

A bill has been introduced in the State Senate, Lincoln, Nebr., providing that the State Engineer draw uniform plans and specifications for all bridges in the State.

New Jersey.

⊙The contract for the construction of the wooden bridge over the Great Egg Harbor Bay between Ocean City, N. J., and Somer's Point has been awarded to Sutton & Corson Co. and the Hill Dredging Co.

It is probable that the Erie Railroad will shortly reconstruct the Kearny Ave. bridge over the Greenwood Lake branch cut in Arlington, N. J.

Plans have been prepared by Arthur C. King, Toms River, N. J., for the construction of the $85,000 bridge for the Island Heights & Sea Side Park Bridge Co. at Island Heights, N. J. The structure will consist of timber trestle and earth including 500 bents 18 ft. apart and totaling 10,362 ft. in length. The roadway will be 20 ft. wide, paved with wood, and the substructure will be of piles. The contract will be let some time in March.

The Board of Trade, Belmar, N. J., has been notified, it is reported, that the New York & Long Branch R. R. contemplates the construction of a new steel bridge over Shark River. It will be necessary to install a draw span to permit the passing of craft.

According to the estimate prepared by Garfield Ferguson, Passaic County Engineer, Paterson, N. J., the cost of erecting a new bridge at Eighth St., Passaic, would amount to about $55,000. Providing the material of the old Rutherford Bridge was used the structure would cost but $35,000.

New York.

✣Bids will be received until 1 p. m., Feb. 8, by Town Board of German Flatts, at the office of Fred H. Sayles, Town Clerk, Mohawk, N. Y., for the construction of two bridges, one over Steele's Creek on Main St. in the village of Ilion, N. Y., and another over Fulmer Creek on Main St., Mohawk, N. Y. Plans and specifications are on file with F. H. Sayles, Mohawk, N. Y., town clerk of German Flatts.

✣Bids will be received until noon, Feb. 18, by D. W. Peck, Supt. of Public Works, Albany, N. Y., for the construction of a lift bridge and a fixed bridge over the Erie Canal at Little Falls, under Contract No. 107, Erie Canal Section 4. Plans may be seen and detailed specifications, engineer's estimate of quantities, proposal blanks, form of contract and bonds required and other information for proposers may be had at the office of the Superintendent of Public Works at Albany, N. Y., at the office of the Assistant Superintendent of Public Works for the Middle Division at Syracuse, N. Y.; at the office of the Assistant Superintendent of Public Works for the Western Division at Rochester, N. Y., and at the canal office, Spaulding's Exchange, Buffalo, N. Y.

The Supreme Court, Justice McCall, has denied an application made by the Manhattan State Hospital for Insane to prevent the New York Connecting Railroad from building a bridge across Ward's Island according to proposed specifications.

Virginia.

The Board of Southampton County Supervisors, Courtland, Va., has rejected all bids received for the erection of new steel bridges. The lowest bid was that of Austin Bros., Greensboro, N. C., at $32,798, for plain concrete substructure and $30,798 for alternate reinforced concrete. The county having but $25,000 available for the work will probably construct the bridges with its own forces.

Ohio.

⊙The Board of Columbiana County Commissioners, Lisbon, O., has awarded the contract for the construction of a bridge in Washington township, near Salineville, to Frank Cox, Kensington, O., at $1,087.

⊙The Board of Hamilton County Commissioners, Cincinnati, O., has awarded the contract for repairing the floor of iron bridge to Emanual Fagaly, Cleves, O., at $1,264.

Representatives of the Lake Shore, the Erie and the Mahoning Valley Railroads have agreed upon the plans adopted by the general improvements committee of the City Council of Youngstown, O., for the proposed new bridge at East Federal St. eliminating the Himrod Ave. crossing and also for the bridge at Oak St.

The Board of Cuyahoga County Commissioners, J. F. Goldenbogen, Clerk, Cleveland, O., has announced its intention to erect a bridge within the city of Cleveland, O., 60 ft. in width, 2,540 ft. in length, and to occupy land approximately 80 ft. in width and 2,540 ft. in length, and with the center line of such bridge located as follows: Commencing at a point in the center line of W. 25th St., at the intersection of the south line of Selzer Ave. S. W., produced to the center line of said W. 25th St.; thence southerly in a straight line to the intersection of the north line of Henninger Rd. with the center line of W. 25th St. A hearing will be held Feb. 20 at the office of the Board, Cleveland.

Negotiations are under way between the city officials of Youngstown, O., and the railroad company in regard to the construction of a new viaduct to replace the old structure at East End. The cost of such an improvement would probably amount to about $225,000. The cost of repairing the present viaduct would be, it is estimated, about $6,000.

Oklahoma.

⊙The Norman Bridge Co., Norman, Okla., has awarded the contract for the construction of the bridge over the South Canadian River at Adkins' crossing, South Norman, to the Kansas City Bridge Co., Kansas City, Mo., at $38,000. The structure is to be completed by Sept. 15.

Engineers, according to information received from Oklahoma City, Okla., are preparing estimates of the cost of building a new steel bridge over Lightning Creek at A Ave., to replace the present wooden structure. The cost will probably amount to $3,000. C. R. Goucher is City Clerk.

Oregon.

The Southern Pacific Ry. Co. has completed plans for the construction of a viaduct over the tracks on Holgate St., Portland, Ore., and bids for the structure will probably be taken soon. A temporary roadway of plank has been laid in the street from East 18th to East 23d Sts. to permit traffic until such time as the viaduct has been completed. F. L. Burckhalter, Portland, Ore., is District Engineer.

Pennsylvania.

✣Bids will be received until 7:30 p. m., Feb. 10, by Town Council, Ridgway, Pa., for the construction of a reinforced concrete arch bridge over Elk Creek at Depot St. Plans and specifications may be secured of F. W. Ward, Borough Engineer, Masonic Temple, Ridgway, Pa.

✣Bids will be received until Jan. 31, by M. L. Cooke, Director of Public Works, Philadelphia, Pa., for repairing the 40th St. bridge over the Pennsylvania Railroad; also for repairing the Penrose Ave. bridge over the Schuylkill River. The amount available for these contracts is $16,500.

The United States War Department and the Commissioners of Delaware County, Media, Pa., have approved the plans for the construction of the proposed new bridge over Chester River at Fifth St., Chester, Pa. As soon as the State Water Commission sanctions the plans preliminary work will be started. The new structure as proposed will be of concrete, 172 ft. long, including wing walls, and with an 80 ft. clearance underneath.

Ordinances providing for the erection of bridges over Paxton Creek at Cumberland and Walnut Sts., Harrisburg, Pa., were introduced at a recent meeting of the City Council of Harrisburg.

⊙Fehr & O'Rourke, according to advices from Reading Pa., have been awarded the contract for the construction of a new concrete and iron bridge to be erected over the tracks of the Belt Line Railway at Schuylkill Ave., Glenside. The new structure will be 85 ft. in length and will replace the old wooden bridge at that point. Work will be started May 1. The contract price was $7,000.

The Grand Jury, according to advices from Towanda, Pa., has under consideration the construction of new steel bridges across the Susquehanna River at Towanda and Athens. David A. Keefe, Athens, Pa., is Engineer.

It is reported that the viewers appointed to investigate the necessity of constructing a new bridge over the Allegheny River at Hazel St., Warren, Pa., have decided to recommend

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

the improvement at the March term of court. It is proposed to build an arch bridge of concrete and steel about 40 feet wide with a 24 ft. roadway and 6 ft. sidewalks, and strong enough to carry trolley cars, is desired. The cost of such a bridge is estimated at $35,000 and will likely be divided between the city, county and the Warren Street Railway Company.

The Board of Bucks County Commissioners, Doylestown, Pa., has approved plans for the construction of a new bridge over the canal at Yardley and also for a new bridge over the creek at Durham Furnace.

Rhode Island.

Plans are being pushed by the Department of Public Works, Providence, R. I., for the reconstruction of the Crawford bridge on South Water St. The section of the bridge to be repaired is 100 ft. long and about 25 ft. wide. It is hoped to have the work completed by July 1. Walter F. Slade is Commissioner of Public Works.

Tennessee.

The City Commissioners of Memphis, Tenn., have passed an ordinance granting the Arkansas & Memphis Bridge & Terminal Co. concessions for trackage improvements and for the construction of subway on Pennsylvania Ave.

Virginia.

The City Council, Roanoke, Va., adopted an ordinance recommending that the contract for the construction of the proposed concrete bridge at Patterson Ave. and 21st St. be awarded to J. T. Muddiman & Co., at $1,487.

Washington.

⊙Sam Lamping, Bailey Bldg., Seattle, Wash., has been awarded a contract by the Canadian Pacific Ry. for the construction of concrete substructures for several bridges near the Washington State Line in the vicinity of Mission City, B. C. The work will cost about $30,000.

A bill has been introduced in the City Council of Seattle, Wash., asking that an election be held in March to submit to the voters the proposition to issue bonds amounting to $1,750,000 for the construction of concrete bridges across the Lake Washington Canal. According to the city's agreement with the U. S. Government the structures will be located as follows: Latona, Stone Ave., Fremont, 3d Ave. W., 15th Ave. N. W. and one at 34th Ave. W. The bridge at Stone Ave. will probably be the largest and is estimated to cost about $100,000. The 3d Ave. W. bridge will cost about $250,000, the bridge at 34th Ave. W., $200,000; 15th Ave. N. W., $200,000; Latona, $250,000, and Fremont about $250,000. A. H. Dimock is City Engineer.

B. B. Horrigan, Franklin County Representative, will bring before the Washington State Legislature, Olympia, Wash., a bill authorizing the appropriation of $250,000 for the construction of the proposed bridge between Pasco and Kennewick.

It has been announced by the engineering department of the Northern Pacific, according to advices from Tacoma, Wash., that work will be started soon on the proposed new $250,000 viaduct from 15th St. and Court A. to the city water way. H. E. Stevens, St. Paul, Minn., is Chief Engineer of Bridges.

Wisconsin.

The Bridge Committee of the Menominee, Mich., City Council and the Board of Public Works of Marinette, Wis., have decided to repair the Interstate bridge. The cost of the work will amount to about $2,000. Albert Hass is City Engineer of Menominee, Mich.

The City of Prairie du Sac, Wis., will ask the State Legislature for a new bridge to be erected over the Wisconsin River.

Canada.

✣Bids will be received until 3 p. m., Jan. 30, by William McQueen, City Clerk, Vancouver, B. C., instead of Jan. 13, as noted in our issue of Jan. 1, for the construction of the Georgia-Harris viaduct. Plans and specifications and form of tender may be obtained at the office of C. A. P. Turner, Engineer, Room 424, Vancouver Blk., city, or plans may be seen at the office of the City Engineer, City Hall. A deposit of $50 will be required on all plans given out.

The Ratepayers of Vancouver, B. C., have voted by-laws providing $5,112,800 for civic improvements. The above amount includes $148,500 for the construction of the proposed East End viaducts. F. L. Fellowes is City Engineer.

The plans for the proposed Second Narrows Bridge, according to advices from Vancouver, B. C., have been completed and forwarded to Ottawa by John Wolfe-Barry, Lister and Partners, Consulting Engineers. The structure is to be erected by the Burrard Bridge & Tunnel Co., at a cost of approximately $2,100,000. It is expected that bids for the work will be taken as soon as the government approves the plans.

DRAINAGE AND IRRIGATION

Arkansas.

✣Bids will be received until noon, Feb. 10, by Board of Commissioners, C. H. Triplett, Chairman, Waterloo Drainage District, Pine Bluff, Ark., for the digging and excavation of about 44 miles of drainage ditches at the district known as the Waterloo Drainage District, in Jefferson County, Arkansas, according to the plans and specifications filed therefor by White & Watson, engineers, in the office of the County Clerk of Jefferson County, Arkansas. Each bids must be accompanied by a certified check for $2,500, payable to the Board of Commissioners. Official advertisement will be found elsewhere in this issue.

California.

✣Bids will be received until noon, Jan. 31, by F. G. Dessery, 1116 Hibernian Bldg., Los Angeles, Calif., for the construction of an irrigation system on Tapo ranch, near Santa Susana, Ventura County, for the Patterson Ranch Co. There will be 7,070 feet of 12-inch concrete pipe, 4,440 feet of 18-inch, 13,700 feet trench for above, Kellar-Thomason gate valves, etc.

⊙A. G. Chatom and H. A. Dunn, Turlock, Cal., have been awarded the contract for constructing an irrigation system at Brentwood, Contra Costa County, to cost about $200,000.

⊙The Turlock Irrigation District, Burton Smith, Chief Engineer, Turlock, Cal., has awarded the contract for constructing 13 small dams to T. K. Beard, Modesto, Cal. Bids were opened Jan. 13.

Colorado.

The San Luis Valley Drainage District, Wm. J. Etherton, Secretary, Mosca, Colo., will receive bids on Feb. 7 for the purchase of a $350,000 bond issue, voted on Aug. 31, 1912.

Indiana.

✣The work on the Borntrager Ditch, contract for which will be let Feb. 1, as noted in our last issue, includes the following: Main ditch is about 13 miles long, requiring an estimated excavation of 1,540,123 cu. yds. of earth, bottom width is 40 ft. to 60 ft. There are three laterals with total length of about 2½ miles, bottom width 15 to 30 ft. There are four wagon bridges over main ditch and one over one of the laterals, all to be removed and replaced by contractor as part of his contract; also two railroad bridges, both to be removed and replaced by the railroad companies. The improvement follows Iroquois River from point 1½ miles southwest of Rensselaer, Ind., and ends at point near Brook, Ind. About ½ of work will be new channel. The improvement is the deepening, widening and straightening of Iroquois River. Digging will be by floating dredge. Contract to be let Feb. 1, at 2 p. m., by public outcry. Bidders to have certified check or bidding bond of $5,000 and furnish bond of $50,000 if successful. Digging is through black dirt and clay. Contractor is to have 24 months to complete work and 120 days from date of contract to erect dredge and begin work. Payments are to be made as work progresses, not to exceed 80 per cent of estimate. Myrt B. Price, Superintendent of Construction, Court House, Rensselaer, Ind.

Illinois.

✣Bids will be received until 11 a. m., Feb. 8, by Commissioners of Willow Branch Drainage District No. 4 of Piatt County, Ill., for the cleaning out of the main drain of the district which work amounts to 43,394 cu. yds. of excavation. The ditch is 13,300 ft. long. A certified check for $600 must be filed with each bid. W. J. Day, Bement, Ill., is Engineer.

✣Bids will be received until 11 a. m., Feb. 8, by Commissioners of the Drainage District No. 10, Willow Branch township for the construction of the Main drain of the district necessitating the excavation of about 43,348 cu. yds. of material. The ditch will be 13,341 ft. long. A certified check for $600 must be filed with each bid. Plans for the work may be inspected at the office of W. J. Day, Bement, Ill., Engineer.

✣Bids will be received until 10 a. m., Feb. 12, at the Town Hall, Deshler, O., for constructing the J. W. Butler Joint ditch located in Hancock, Henry and Wood Counties, O., the John Learn Branch in Hancock County is 50,171 ft. long, including 70,200 cu. yds.; "the Yellow Creek Branch" in Putnam County is 50,700 ft. long and contains 51,054 cu. yds.; "the Brush Creek Branch" in Henry County is 32,300 ft. long and contains 42,393 cu. yds.; the outlet known as "Ditch 12 and the Jackson Cutoff," in Wood County, is 55,223 ft. long and contains 168,565 cu. yds. The three branches will be team work and the outlet will be dredge work, with 12 to 20 ft. bottom. The county surveyor in each case will have charge of the work in his own county. The right is reserved to reject any or all bids. Elmer Hilty is Surveyor, Hancock County, Findlay, Ohio; J. S. Cartwright is Surveyor Putnam County, Ottawa, Ohio; F. A. Daum is Surveyor Henry County, Napoleon, Ohio, and E. F. Metzger is Surveyor Wood County, Bowling Green, Ohio.

Good progress is being made in constructing the Calumet Sag Canal of the Sanitary District of Chicago. Four contracts, covering Sections 2 to 5, inclusive, were let for this work last season. Winston Bros. of Minneapolis have Section 2. They have completed the work of stripping the surface and are now engaged in getting out the rock. Mr. L. S. Oakes, who has had charge of their work on the C. M. & St. P. Ry., is in charge here and has about 100 men at work this winter. They have a plant consisting of three 18-ton Porter locomotives and about 40 4-yd. Peteler dump cars, a Marion shovel with a 35-ft. boom, and two Ingersoll-Rand drills of the Locher type but set on revolving tables. Section 3 is let to S. R. Robinson of St. Louis and is just being opened up. Drag line machines are to be used. The contractor is figuring on a scheme for taking out the rock by loading it into skips by steam shovel and handling it to the spoil banks by means of the drag line machine. Foershner Bros. have Section 4 and had started to excavate with

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

a drag line machine but the work has been stopped because the weight of the spoil banks has caused heaving in the center of the canal, and the engineers are considering a plan for disposing of the material elsewhere. Jas. A. Green & Son have Section 5 and have put on two 100-ft. boom electrically operated drag lines of the Lidgerwood-Crawford type. Considerable trouble with water for boilers has been experienced along the work and this is one of the reasons that electrically operated machines were put on Section 5. Mr. Geo. T. Donaghue, who was in charge of a part of the work on the North Shore canal for the District, is resident engineer at the Sag Canal in charge of the work now under contract.

Iowa.

✣Bids will be received until noon, March 4, by Charles A. Root, Emmet County, Auditor, Estherville, Ia., for the construction of Joint Drainage District No. 17 in Emmet and Palo Alto Counties. Sections 1 will include Dam and Spillway and Sections 2, 3, 4, 5, 6, 7, 8 and 9 will include open ditches necessitating the excavation of 959,033 cu. yds. All bids must be accompanied by a certified check for 10 per cent the amount bid.

Supervisors of Webster County, Ia., have appointed C. A. Snook as engineer for Drainage District No. 164 in Johnson Township, petitioned for by Mrs. Ellen Toony and others. J. L. Hanrahan, Fort Dodge, Ia., is County Auditor.

Petition has been filed with the Webster County Supervisors, Fort Dodge, Ia., for drain and drainage district in Elkhorn Township. C. P. Smith was appointed engineer.

Supervisors of Polk County, Des Moines, Ia., have voted to establish a drainage ditch in Franklin Township, to cost about $7,000.

Louisiana.

Bids will be asked shortly for the construction of levees and canals for the drainage of 26,000 acres in Jefferson and Plaquemine Parishes. Bids on the pumps and engines have already been opened and bids on boilers and accessories will be asked shortly. J. F. Coleman, 920 Hibernian Bldg., New Orleans, La., is Consulting Engineer.

Minnesota.

✣Bids will be received until 11 a. m., Feb. 20, by L. H. Slocum, Koochiching County Auditor, International Falls, Minn., for the construction of Judicial Ditch No. 4, Koochiching County, according to the plans and specifications of the engineer, now on file in the office of the clerk of court. Said ditch as surveyed by the engineer is about twelve miles long and the estimated number of yards of dirt to be excavated is about 107,920 yds.; total estimated cost of the construction of said ditch being about $21,418.70. Bids will be received for the work as one job or for one or more sections of said work. Each bid must be accompanied by a certified check on a national bank or trust company for not less than 10 per cent of the bid.

✣Bids will be received until 10:30 a. m., Feb. 20, by L. H. Slocum, County Auditor, Koochiching County, International Falls, Minn., for the construction of Judicial Ditch No. 5, Koochiching County, according to the plans and specifications of the engineer now on file in the office of the clerk of court. Said ditch as surveyed by the engineer is about 14 miles long, and the estimated number of yards of dirt to be excavated is about 132,813 yds.; total estimate cost of the construction of said ditch being about $29,640.16. Bids will be received for the work as one job or for one or more sections of said work. Each bid must be accompanied by a certified check on a national bank or trust company for not less than 10 per cent of the bid.

✣Bids will be received until 10 a. m., Feb. 20, by L. H. Slocum, Koochiching County, International Falls, Minn., for the construction of Judicial Ditch No. 8, Koochiching County, according to the plans and specifications of the engineer now on file in the office of the clerk of court. Said ditch as surveyed by the engineer is about 18 miles long, and the estimated number of yards of dirt to be excavated is about 191,083 yds.; total estimated cost of the construction of said ditch being about $35,040.97. Bids will be received for the work as one job or in sections. A certified check for 10 per cent of the amount of bids must be filed with each proposal.

Commissioners of Sherburne County have appointed F. W. Nickerson engineer for ditch in town of Becker, petitioned for by R. Kilgard and others. Chas. E. Swanson, Elk River, Minn., is County Auditor.

Hearing will be held on Feb. 18 on petition of Mathias Mathiason et al. for a public ditch, commencing at the S. W. corner of Section 35, Twp. 44, Range 24. J. B. LeMire, Aitkin, Minn., is County Auditor.

Missouri.

Report has been submitted to the Commissioners of the St. John Levee and Drainage District and the Commissioners are now in the field viewing the benefits. The report shows that the improvements in this district will cost about $1,000,000. A. J. Wheeler, Charleston, Mo., is Chief Engineer.

Montana.

Drawings and specifications for the lateral distribution system for the Vandalia South Canal in the Glasgow Division of the Milk River Project are being prepared by the U. S. Reclamation service and bids on the work will be asked soon. G. O. Sanford, Malta, Mont., is Project Engineer.

The land owners in the Chinook Division of the Milk River Project have voted unanimously to petition the reclamation service to construct a complete irrigation system, including diversion dams, main canals and laterals to cover the irrigable lands in this division. There is a total of about 75,000 acres in the division, a portion of which lies in the Belknap Indian reservation, which, it is understood, will be open to entry in the not too distant future.

A large amount of construction work will be undertaken in the Milk River Project this season. J. E. Hilton, Malta, Mont., has about 800,000 cu. yds. of excavation; Chas. Wilhite, Boise, Idaho, has 1,500,000 cu. yds., mostly team work; and Winston Bros., Minneapolis, Minn., have one cut of about 500,000 cu. yds. In addition contracts for about 1,000,000 cu. yds. of laterals are yet to be let. There will also be a concrete dam constructed at Vandalia at a cost of about $1,000,000.

Washington.

Commissioners of Pacific County, South Bend, Wash., have appropriated $20,000 for the building of the Palix dike across the Palix River. About 1,700 acres of land will be reclaimed. The dike will cost about $60,000, $40,000 of which is to be paid by the land owners.

Wisconsin.

⊙The Rood Construction Co., Grand Rapids, Wis., has been awarded the contract for constructing a drainage ditch in Linwood and Carson.

WATER WORKS

Arkansas.

Consulting Engineer Albert C. Moore of Joplin, Mo., has been retained to design and supervise the municipal waterworks and electric lighting plant for Sulphur Springs, Ark., to cost about $40,000. The money for this job is available and the plans are well under way. Contracts will probably be awarded in about 40 days.

California.

The Trustees of Tulare, Calif., have called an election for the purpose of voting on the proposition to purchase the existing water works system at $44,000. The election will be held Feb. 6.

Idaho.

⊙O'Toole Bros., of Weiser, Ida., have been awarded the contract for installing a water works system in Burley, Ida., and James Kennedy, of Fargo, N. Dak., secured the contract to construct a sewerage system.

Illinois.

✣Bids will be received until Feb. 11 by City of Decatur, Ill., for the construction of a new filtration plant 9,000,000 gals. daily capacity estimated to cost $125,000. The work will include filter plant, sedimentation basins, chamber or baffling section, sedimentation basins, head house, filter house, etc. W. G. Clark, 1050 Spitzer Bldg., Toledo, O., is Engineer. Harry Ruthranft, Decatur, Ill., is Commissioner of Public Property. Official advertisement will be found elsewhere in this issue.

✣Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., until 11 a. m., Feb. 1, for furnishing and delivering to pipe yard "B," 2352 S. Ashland Ave., 1 diamond drilling machine, with gasoline engine and appurtenances (exclusive of carbon) F. O. B. cars. The machine to be a mounted gasoline diamond case drill, having a capacity of 350 ft. of 1⅛ in. core, of a direct connected type with friction feed allowing variation of speed from 100 to 500 R. P. M. The engine to be of two cylinder opposite type, cylinders 5½ in.x5 in., rated at 15 H. P., and complete in every respect. Bidders are requested to furnish prices for 8 carbons of 1¼ carats each, of the best quality and suited for diamond drill. Cash or certified check for $100 must accompany proposal.

✣Bids will be received by the city until 11 a. m., Feb. 5, 1913, for furnishing labor, materials and tools necessary to construct and erect at the Lake View Pumping Station, Montrose Ave. and Clarendon Ave., 1 steel shell for shaft excavation, estimated weight 19,000 lbs., 11 ft. 6 ins. internal diameter; to be composed of 5 circular sections, riveted end to end, each section to be 72 ins. in length, one end to be reinforced to form a cutting edge, all outside rivet heads to be countersunk. Cash or certified check for $100 must accompany proposal. L. E. McGann, Commissioner of Public Works, Chicago, Ill.

✣Bids will be received until 11 a. m., Feb. 5, by L. E. McGann, Commissioner Public Works, Chicago, Ill., for furnishing and delivering to the Lake View Pumping Station, Montrose Ave. and Clarendon Ave., the materials, labor and tools necessary to erect 1 steel shell for shaft excavation. The shell to be made of 5 circular sections united end to end, one end of section to be reinforced to form a cutting edge or shoe. Each section to be 72 ins. in length, to be formed of 38-in. rolled plate with butt joints and inside splice plates. All rivets to be counter-sunk. Cash or certified check for $100 must accompany proposal.

⊙The Krehbiel Co., 140 S. Dearborn St., Chicago, Ill., has been awarded the contract by the city of Earlville, Ill., for the installation of one deep well pump and one centrifugal fire pump, at $4,039.

The City Council of Evanston, Ill., on Jan. 21 appropriated $10,000 for maintenance and repair to pumping stations; $4,500 for maintenance and repair to water mains and lowering same; $186,000 for construction and improvements connected with a new filtration plant; also $15,000 for improvements in water system and purification supply. J. F. Hahn is City Clerk.

A petition has been circulated in Paris, Ill., providing for the calling of an election to vote on the issuance of bonds to the amount of $30,000 for the construction of a filtration plant.

Following is the lowest bid submitted to the city of Chicago for furnishing and delivering to the various pumping stations, cribs, shops, etc. No. 1 white cotton waste as required during year 1913, approximate quantity 19 tons, 8.75 cts. per lb., Crerar Adams Co., 259 E. Erie St., Chicago. L. E. McGann, Commissioner of Public Works. Bids opened Jan. 17. The contract has not been awarded.

Indiana.

✣Bids will be received until 7:30 p. m., Feb. 17, by Common Council in the City Hall, Lawrenceburg, Ind., for furnishing power plant apparatus for Municipal Light plant in accordance with specifications on file with Frank Goble, City Clerk. The apparatus will include an engine, single-phase alternator, switchboard and boiler. Paul H. White, Union Trust Bldg., Indianapolis, Ind., is Consulting Engineer.

Iowa.

The town of Readlyn, Ia. (population 227), plans to install a waterworks system.

A petition is being circulated in the town of Boyden, Ia. (population 364), asking for an election to determine the question of issuing bonds for a waterworks system.

An election is to be held in Estherville, Ia., on Feb. 17 for the purpose of voting on the issuance of bonds to the amount of $25,000 for the construction of a waterworks system.

The Almo Engine & Supply of Omaha, Nebr., has prepared plans for the installation of a new waterworks system in Pisgah, Ia., at an estimated cost of $7,000. The work will include laying pipe, constructing reservoir, installing hydrants, fire hose, hose house, engine and engine house. Water supply will be secured from wells. Contracts will be let about March 1.

State Waterworks Engineer, Prof. Evinger, Ames, Ia., has submitted his report to the City Council of Knoxville, Ia., recommending that the present waterworks be torn down and a new plant constructed.

The citizens of Osceola, Ia., recently voted against the issuance of bonds for the sinking of a deep well for city water.

Kansas.

✣Bids will be received until 2 p. m., Feb. 3, by G. A. Howe, City Clerk, Kingman, Kan., for furnishing labor and material necessary for constructing and equipping an electric lighting plant. Worley & Black, Kansas City, Mo., are Engineers.

Consulting Engineer E. E. Harper of Kansas City, Mo., is preparing plans for the installation of a waterworks system in Jewell City, Kans., to cost about $40,000. The water supply wlil be secured from a creek. E. D. Fisher is Mayor.

The citizens of Jewell City, Kans., have voted to issue bonds to the amount of $40,000 for the construction of a waterworks system. The plans include a dam across West Buffalo creek, making a 16,000,000-gal. reservoir, a complete purification plant, and a standpipe high enough to give good fire pressure.

Kentucky.

⊙The Hancock Construction Co. of Louisville, Ky., will shortly commence work on the construction of a reservoir at Princeton, Ind., for the Southern Railway Co. The reservoir will be of concrete and is to have a capacity of 300,000 gals. The work will be in charge of Engineer Charles Campbell of the construction company.

Louisiana.

J. H. O'Neil, sanitary engineer of the State Board of Health, has been inspecting the waterworks plant of Natchitoches, La., and other places with a view of recommending improvements.

Maryland.

⊙The City Council of Crisfield, Md., has awarded a contract to J. H. K. Shannahan Artesian Well Co., of St. Michaels, Md., to sink a new well at the Crisfield waterworks.

Massachusetts.

✣Bids will be received until noon, Feb. 4, by Supply Department, J. E. Mullen, Supt., Boston, Mass., for furnishing to the Public Works Department, Water Service, for High Pressure Fire Service, as follows: 100,000 pounds, more or less, Type No. 1 iron castings—blow-offs, 9,000 pounds, more or less; flanged pipes, 45,000 pounds, more or less; flanged offsets, 46,000 pounds, more or less. 1,270,000 pounds, more or less, Type No. 2 iron castings—curves, 511,000 pounds, more or less; offsets, 160,000 pounds, more or less; branches, 356,000 pounds, more or less; reducers, 119,000 pounds, more or less; increasers, 17,000 pounds, more or less; sleeves, 82,000 pounds, more or less; caps, 14,000 pounds, more or less; plugs, 11,000 pounds, more or less. Blank proposals can be obtained at the office of the Supply Department, Room 826 Tremont Building. The bidder must leave his proposal and a certified check for $1,000, payable to and to become the property of the City of Boston if the proposal is not carried out.

✣Bids will be received until noon, Feb. 19, by Supply Department, J. E. Mullen, Supt., Boston, Mass., for furnishing 6 6-in. valves, 410 8-in. valves, 106 12-in. valves, 120 16-in. valves, according to specifications. The bidder must use the form to be obtained at Room 826 Tremont Building, furnish a bond of $15,000 with a surety company authorized to do business in Massachusetts, as surety for the faithful performance of the work. Bids must be accompanied by a certified check for $1,000, payable to and to become the property of the City of Boston if the proposal is not carried out.

Michigan.

The City Council of Battle Creetk, Mich., has instructed the Board of Public Works to prepare plans and estimates for a pumping station at Verona wells.

Minnesota.

✣Bids will be received until 8 p. m., Feb. 7, by C. Theodore Weiland, Jr., City Clerk, Shakopee, Minn., for the construction of water main extensions as mentioned in this issue under "Sewerage and Sanitation."

✣Bids will be received until 7 p. m., March 3, by C. W. Carlson, Village Clerk, Gibbon, Minn., for furnishing the necessary labor and material for the extension of the waterworks mains. Specifications are on file with the clerk.

✣Bids will be received until noon, Feb. 7, by City Council, St. Peter, Minn., for a new 72-in. by 18-ft. tubular boiler for the municipal power plant at St. Peter, Minn. Each bid must be accompanied by a certified check for $500. F. W. Rose, 904 Palace Bldg., Minneapolis, Minn., is Consulting Engineer.

The town of Ironton, Minn., contemplates installing a waterworks system early in the spring.

The village of Morristown, Minn. (population 592) is agitating the installation of a waterworks system.

The citizens of the village of Maple Lake, Minn. (population 522), are agitating the installation of a waterworks system.

The waterworks committee of the City Council, Minneapolis, Minn., has asked that the plans for a new 50-in. force main from the northeast pumping station to the reservoir be completed as soon as possible.

The City Council of Virginia, Minn., has passed an ordinance directing the issue of waterworks bonds for a water supply. Geo. Eilertson is City Recorder.

The City Commissioners of St. Cloud, Minn., plan to have outside firms bid against the city in the laying of the water mains in a district planned for completion this coming spring.

Missouri.

✣Bids will be received until 6 p. m., Feb. 3, by S. L. Asbury, City Clerk, Farmington, Mo., for sinking, constructing and completing a deep well not exceeding 1,500 ft. deep. A certified check for $100, payable to the city, must be filed with each bid.

⊙E. J. Merkle Co. has been awarded the contract by the city of Rich Hill, Mo., S. B. Cole, Mayor, for the installation of an electric light plant, at $13,600. The work includes 1 skinner engine, 2-ft. Wayne generators, one 150 boiler, feed pump, switchboard, etc., complete pole line and equipment to be furnished Merkle by Wesco Co., of St. Louis. Bids were opened Jan. 21.

The matter of installing a waterworks and an electric light plant in Drexel, Mo., has been dropped for the present. The estimated cost of the proposed improvements was $40,000. E. T. Archer & Co., New England Bldg., Kansas City, Mo., are Engineers.

At a recent meeting of the Commercial Club of Charleston, Mo., it was decided to ask the City Council to employ a consulting engineer to appraise the water company's plant and to prepare plans for submission to the voters of the city for the issuance of $85,000 bonds for waterworks and sewerage. Lynn E. Haw is chairman of the club's committee and City Attorney.

The city of St. Louis, Mo., is considering two propositions, one to issue bonds to the amount of about $1,250,000 to reconstruct the present waterworks plant, and the other to build an entirely new plant at an estimated cost of $12,000,000. E. E. Wall is Water Commissioner.

The City Council of Memphis, Mo., has employed Civil Engineer C. J. Wiegner to make topographical surveys of pieces of land on the outskirts of town. The city is considering these sites as available location for a city reservoir, providing the voters of the city decide favorably on a waterworks bond issue if said proposition is submitted to a vote in the spring.

New Jersey.

⊙The J. S. Rogers Co., of Moorestown, N. J., has been awarded the contract for the construction of a 30,000,000-gal. filtration plant for the city of Trenton, N. J. The work will cost approximately $330,000.

The City Council of Orange, N. J., has appointed a special committee to consult with experts in the search for the best course to pursue to conserve the water supply.

New York.

⊙The Water Commissioners of Sodus, N. Y., have let the contract for the construction of the water system in that village to Fischette Bros., of Clyde, N. Y., at $31,238. A list of the bids received was given in our Jan. 15 issue.

⊙The Keystone Construction Co., of Pittsburgh, Pa., has been awarded the contract by the Department of Water Supply, Gas and Electricity, 13-21 Park Row, New York City, for the construction of the Jerome Park filters in the boroughs of Manhattan and the Bronx, at $5,139,015. Other bidders were: Luke A. Burke Co., New York City, $5,672,145; McArthur Bros. Co., and Mason & Hanger Co., New York City, $5,783,170; T. A. Gillespie Co., $6,752,500; Carter Construction Co., $5,885,875; E. E. Smith Co., $6,619,960; Oscar Daniels Co., $6,140,410; and Booth & Flinn, Pittsburgh, Pa., $6,094,855.

The City Council of Albany, N. Y., has been asked to pass an ordinance providing for an appropriation of $100,000 to enable Commissioner of Public Works Wallace Greenalch to extend the city's water system during the coming year.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

State Commissioner of Health, Dr. Eugene H. Porter, has urged the city of Watervliet, N. Y., to purify its water. Theodore Horton, Chief Engineer of the department, has recommended extensive reconstruction of the plant.

The Common Council of Albany, N. Y., has passed an ordinance providing for the extension of the water supply system to the numerous new streets that recently have been opened in outlying districts in the Arbor Hill, Pine Hills and Delaware Ave. sections.

Ohio.

✣Bids will be received until noon, Feb. 7, by the Secretary of the Director of Public Service, Cleveland, O., for electric generator and equipment for the Municipal Electric Light Plant of the city of Cleveland. Each bid must be made in accordance with the specifications which may be obtained at the office of the Engineer of Construction, Room No. 319, City Hall. W. J. Springborn is Director and W. H. Kirby is Secretary.

✣Bids will be received until noon, Feb. 3, by Fred Feuchter, Clerk Board of Trustees of Public Affairs, Rockport Village, for constructing water mains in Harrington Road. Plans and specifications are on file at the office of the Clerk and William H. Evers Engineering Co., 332 The Arcade, Cleveland, O.

The Board of Control of Akron, O., has recommended to the City Council the laying of a new pipe line out to Summit Lake, at an estimated cost of $8,538.

⊙Jos. L. Sheldon Engineering Co., Spitzen Bldg., Toledo, O., has been awarded the contract by the Board of Public Affairs of Clyde, O., for extending, repairing and improving the waterworks system and electric light plant, at $25,497. The work includes one boiler, two generators, two engines, one pump, two motors, switchboard, building, one deep well pump. Bids were opened Oct. 26.

⊙The Pitt Construction Co., Pittsburgh, Pa., has been awarded the contract by the city of Alliance, O., D. M. Armstrong, Director of Public Service, for the construction of a 6,000,000-gal. filter plant and earth storage dam, at about $67,000. The work also includes low service pumping machinery. Bids on this work were opened Oct. 24, 1912.

Oklahoma.

Surveyors for the Atchison, Topeka & Santa Fe Railroad Co. are at work east of Guthrie, Okla., on the land where the deep wells and water reservoir will be built by that company. Work will begin in the spring.

Oregon.

⊙The City Council of Portland, Ore., on Jan. 20 awarded the contract for furnishing the Water Department with 320,000 lbs. of pig lead to M. L. Kline, at $14,816.

⊙Commissioner Winn and Fire Chief Dowell of Portland, Ore., have re-awarded the contract for furnishing 350 fire hydrants. Hesler & Undine of Portland, will furnish the hydrants, at $9,765.

The City Council of Oregon City, Ore., has voted in favor of installing a hydrochloride plant.

Mayor Rushlight of Portland, Ore., has asked the Water Board to authorize the installation of reinforcing mains along the waterfront, for which a bond issue was provided several years ago.

Pennsylvania.

✣Bids will be received until 2 p. m., Feb. 17, by Capt. H. F. Dalton, Quartermaster, 50th Anniversary Battle of Gettysburg, Gettysburg, Pa., for the construction of a water system at Gettysburg, including tanks, trestles, gasoline engines and pumps, water distributing system, hydrants, drinking fountains, frame enclosures for latrines, also digging of pits.

⊙Thos. B. Harper Estate has been awarded the contract by Capt. H. F. Dalton, Quartermaster, Gettysburg, Pa., for the drilling of three or more 8-in. tubular wells at Gettysburg, at $5,500. Bids were opened Jan. 20.

The city of Troy, Pa., plans the making of improvements to its waterworks system at an estimated cost of $20,000. The work will include building and reservoirs. Henry W. Taylor, 100 State St., Albany, N. Y., is Engineer.

The Pennsylvania State Water Supply Commission, Harrisburg, has approved the mergers of three water and power companies, as follows: Wallenpaupack & Paupack Power Companies, in northeastern Pennsylvania, into the Pennsylvania, New York & New Jersey Power Co.; Barnsboro & Spangler Water Companies, Cambria County, into the Northern Cambria Water Co., and Upper, Middle & Lower Broadheads Power Companies, Northampton County, into the Central Broadheads Power Co.

Chester & Fleming of Pittsburgh, Pa., are supervising the installation of a new waterworks for the American Glue Co., at Springdale, Pa. The plant will have a capacity of $3,000,000 gals. and will consist of a well system and a new pump station equipped with direct steam pumps.

Advices from Pittsburgh, Pa., state that the Council of Farrell passed an ordinance providing for the issuance of bonds to the amount of $125,000 for the installation of a waterworks system.

South Dakota.

Brule County, S. Dak., has voted $10,000 for the purpose of digging four artesian wells to secure enough water to refill the Red Lake. Chamberlain is the county seat.

Texas.

✣Bids will be received until Feb. 1 by H. C. Rogers, Malone, Tex., for the construction of waterworks extension. McCall-Moore Engineering Co., are Engineers.

⊙Lindsay & Smith of Dallas, Tex., has been awarded the contract by that city for the construction of a pumping station at Oak Cliff, at $9,751. Bids were opened Jan. 20 by J. B. Winslett, City Secretary.

The City Council of Waxahachie, Tex., has taken steps toward enlarging the waterworks system. Mayor Prince has recommended the construction of another reservoir and the sinking of an additional deep well. The city is also planning to purchase a combination auto fire engine.

The Attorney General, Austin, Tex., has approved a bond issue of Madisonville, Tex., to the amount of $16,000, for the installation of a waterworks system. W. W. Sharpe, Madisonville, is interested.

The citizens of Bay City, Tex., on Jan. 18 voted the issuance of bonds to the amount of $6,000 for the making of extensions to the waterworks system.

The City Council of Longview, Tex., has decided to bore another well 2,500 ft. deep in order to reach a good stream of artesian water. This city proposes the installation of a new waterworks system for which bonds to the amount of $100,000 have been issued. Construction work will be begun at once. N. L. Cunningham is City Attorney.

The Bishop Water & Electric Co., of Bishop, Tex., has been incorporated, with a capital stock of $50,000. The incorporators are F. Z. Bishop, R. R. Hall and H. T. Ellsworth.

The City Council of Rockdale, Tex., has called an election for Feb. 25 for the purpose of determining whether or not the city will issue bonds in the sum of $30,000 for the purchase or construction of a waterworks system.

The Tarrant County Commissioners, Fort Worth, Tex., has awarded a franchise to B. K. Wilson and associates to pipe water from Eiderville mineral wells to the city limits of Fort Worth.

Utah.

The City Council of Moroni, Utah, recently received the following bids for the furnishing of pipe, brass fittings and other supplies for a municipal waterworks system: D. C. Dunbar and the Joseph Nelson Supply Co., of Salt Lake City, and the Portland Wood Pipe Co., of Portland, Ore. The bids ranged from about $8,000 to $8,500.

Washington.

State Engineer H. L. Gray of Washington has recommended the construction of a waterworks system in North Yakima, Wash., at an estimated cost of $472,000.

The Pacific Power & Light Co., owners of the waterworks system in North Yakima, Wash., proposes to spend another $500,000 in rendering the city supply of water as efficient and as protected from contamination as possible. The cementing of the Wapato ditch, which carries the city supply from the intake, 13 miles up the Naches River, is one of the improvements contemplated, according to D. F. McGee of Portland, Ore., Chief Engineer for the company. Work will be begun Feb. 1 and it is expected to have the new canal carrying water by April 1. It will cost about $350,000. An additional power plant will be constructed to manufacture 7,000 horsepower.

Following bids were received Jan. 17 by the Board of Public Works of Seattle, Wash., for the construction of a water main in E. 60th St., et al.: Erickson Bros., $19,650; E. J. Rounds Construction Co., $19,595; Dickens & Rightmire, $20,487; McQuaid & Moore, $20,856; Washington Construction Co., $18,809; Ferguson Coit Co., $20,221; Jno. W. Johnson, $19,463; Krogh & Jessen, $20,479; International Dredging Co., $20,087, and Jahn Construction Co., $20,072.

Wisconsin.

✣Bids will be received until 2 p. m., Feb. 1, by A. J. Scheele, Village Clerk, Waterford, Racine County, Wis., for drilling an 8-in. well in the village. P. J. Hurtgen, Burlington, Wis., is Engineer.

The Wisconsin State Rate Commission has set Feb. 13 as the date for considering the price the city of Oshkosh should pay to acquire the present waterworks system in that city.

The village of Mukwonago, Wis. (population, 615), has sold bonds to the amount of $14,000 for the installation of a waterworks system.

The Department of Public Works of Milwaukee, Wis., Louis M. Kotecki, Comptroller, will sell on Jan. 30 the old garbage plant, located on Jones Island. The bid is to be in the aggregate for the entire building, including all its machinery, boilers, etc. Certified check of $400 is required with each bid.

Canada.

✣Bids will be received until Jan. 31, by City Clerk, Kamloops, B. C., J. Carment, for erecting power station buildings at that city. Plans and specifications may be seen at the office of the City Clerk, Kamloops, or at the office of the Consulting Engineers, DuCane, Dutcher & Co., Rogers Bldg., Vancouver.

✣Bids will be received until Feb. 6 for hydrants, valves, deep well pump and engine, excavation and pipe laying, at Park Hill, Ont. Bowman & Connor, Berlin, Ont., are Engineers.

⊙City Engineer F. L. Fellowes of Vancouver, B. C., has recommended the award of the remainder of the city's waterworks pipe purchase to Wilkinson Co., Ltd., 846 Beach Ave., Vancouver. The first order awarded to the company comprised 28,000 ft. of 6-in. steel pipe and 16,000 ft. each of 8 in. and 12-in steel pipe. The balance of the order will include 5,280 ft. of 2-in. galvanized iron pipe, 5,280 ft. of 4-in. steel pipe, 107,000 ft. of 6-in. and 50,000 ft. of 8-in. steel pipe; 100,000 ft. of 6-in. and 50,000 ft. each of 8-in. and 12-in. steel pipe. The total order will amount to about $300,000.

Mayor Greenwood of Stratford, Ont., in his inaugural address to the City Council, called attention to the necessity of enlarging, in the near future, the main sewers of the city, in addition to connecting up with the sewage system in the southern portion of the city.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

SEWERAGE AND SANITATION

Arizona.

The City Council of Bisbee, Ariz., has decided to extend the sewer system, running the pipe up Tombstone canyon. It is estimated that two carloads of pipe will be necessary for the work. The cost will be in the neighborhood of $15,000.

California.

✣Bids will be received until 11 a. m., Feb. 3, by Board of Public Works, Los Angeles, Calif., for the following sewer work: Constructing a public sewer in Reservoir St., between Mohawk St. and the first alley east, and in other streets. For constructing a public sewer in Kingsley Drive from Wilshire boulevard 105.59 ft. south of Fifth St. For constructing a public sewer in the Atlantic St. District in Atlantic, Decatur and Lawrence Sts.

⊙Hardy & Dyer of Ontario, Calif., have been awarded the contract by that city for the enlarging of the outfall sewer for a distance of 1,605 ft., at $730. The work also includes four manholes and sand box. Bids were opened Jan. 20.

⊙The City Trustees of Bakersfield, Calif., have awarded the contract for the construction of the new supplemental sewer system to T. J. Shea of Los Angeles, Calif., at $177,397. The system provides for a 42-in. outfall sewer, which will parallel the 22-in. outfall of the present system. Inside the city the mains will range up to 36-ins. in diameter.

City Engineer J. W. McAfee of Lodi, Calif., is preparing plans and estimates for the installation of an antiseptic tank sewerage system for the county buildings and for a sewer system for San Andreas. The estimated costs are $3,500 and $8,000, respectively.

The Trustees of Tulare, Calif., have voted to extend the sewer one mile on Clay Ave. Thos. R. McSwain is City Engineer.

The City Council of San Bernardino, Calif., has adopted plans and specifications for the L St. and Pine St. sewer.

The City Commissioners of Stockton, Calif., have instructed City Engineer W. G. Hunter to prepare plans and specifications for a complete sewer system for the city. An election will be held to vote on the issuance of bonds for this improvement.

Following bids were received recently by the building and grounds committee of the Fair Board, San Francisco, Calif., for the construction of the storm sewers in the state and foreign site districts of the Exposition: Michael Murphy, $28,350; Pringle, Dun & Co., $31,000; Contra Costa Construction Co., $49,200; Healy-Tibbitts Co., $35,000; Hilmer & O'Connell, $43,500; Edward Malley, $43,700, and Sunset Construction Co., $32,000. The contract will be awarded to the lowest bidder.

Colorado.

A bond issue of $2,500 voted last October by the citizens of Johnstown, Colo., has been declared illegal. The citizens will be asked to vote on the proposition in May. The money was voted for the construction of a sewer system.

Florida.

⊙The Bond Trustees of Arcadia, Fla., have let the contract for the completion of the sewerage system to the Searcy Construction Co., of Greenville, Ala. The contract calls for the laying of 1,500 ft. of 15-in. pipe; 1,000 ft. of 12-in. pipe; 4,200 ft. of 10-in. pipe, and 19,000 ft. of 8-in. pipe. There are to be 64 manholes and 10 flush tanks.

Plans and specifications are to at once be prepared for the storm sewer system which is to drain West Hyde Park, or all that section lying south of the Atlantic Coast Line Railroad and east of Grand Central Ave., in the city of Tampa, Fla. The estimated cost is $40,000. Bids will be asked as soon as plans have been prepared. Fred T. Warren is City Engineer.

Georgia.

⊙The Mayor and aldermen of Ocilla, Ga., have sold bonds to the amount of $10,000 for a sewer system. The contract for installing the system was secured by the J. B. McCrary Co., of Atlanta, Ga. Work is to be started at once.

Illinois.

⊙The poor farm committee of the Board of Supervisors, Hillsboro, Ill., has let the contract for putting in 1,200 ft. of glazed 8-in. sewer pipe to John Carter. Material will be furnished by the county.

The City Council of Cuba, Ill. (population 2,019), is agitating the installation of a new sewerage system.

The Village Board of East Dundee, Kane County, Ill. (population 1,405) has decided to install a sewerage system in that village at an estimated cost of $18,000. A report and drawings for the system have been made.

Following are the lowest bids submitted to L. E. McCann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering municipal castings to the Bureau of Sewers during the year 1913: T. A. Cummings Foundry Co., 338 Clybourn Pl., 301.27 tons of catch basin and manhole covers, at $23.60, 2,205 tons of lawn covers, at $26.46, 45.25 tons of inlet grates and boxes at $24.26, total, $87.91. The contract has not been awarded.

Following are the lowest bids submitted to L. E. McCann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering lumber as specified for use during 1913, by the Bureau of Sewers: Thornton, Clancy Lumber Co., 2315 Elston Ave., $14.58; price based on quantities and sizes shown in specifications.

Indiana.

✣Bids will be received until March 11, it is reported, by City of South Bend, Ind., for the construction of the Bowman Creek sewer, estimated to cost about $100,000. William Moore is City Engineer.

⊙The Board of Public Works of Elkhart, Ind., has awarded the contract for the construction of the 13th district sewer to the Northern Construction Co., at $6,524. The sewer will extend on Oakland Ave., from Leonard Ave. to Lusher Ave., four blocks. Pipe ranging in size from 24 to 15 ins. will be used.

Iowa.

✣Bids will be received until 7 p. m., Feb. 11, by G. J. Byers, Town Clerk, Belmond, Ia., for the construction of 8,313 lin. ft. of 8 to 12-in. sewers and settling tank. M. Tschirgi & Sons, Engineers, Cedar Rapids, Iowa.

The city of Tipton, Ia., P. D. Ketelsen, City Clerk, rejected all bids received Jan. 15 for the construction of sewers along and in certain streets, avenues and highways in the city.

The engineering department of Davenport, Ia., has about completed plans and specifications, including plats and estimates, for the 13th District main and lateral sewer system for the west end of the city. The contract will probably be awarded before March 1.

Kentucky.

City Engineer L. A. Washington of Paducah, Ky., in his annual report, recommends the building of the trunk line sewer to District No. 3, which would call for a total expenditure of about $200,000. A number of smaller sewers are also recommended.

The Board of Public Works of Louisville, Ky., has received bids for the construction of five sewers, to cost about $25,000. The following firms bid on the work: L. R. Figg & Co., F. H. Cahill, Henry Bickel Co., L. W. Hancock, Edwin S. Larson and George M. Eady, all of Louisville; John Shefold, of New Albany, Ind., and James Ferry & Son, of Pittsburgh, Pa.

Louisiana.

Mayor Eastham of Shreveport, La., has asked Sanitary Engineer Neil, of the State Board of Health, to prepare plans for a system of sewage disposal adequate for the present and future needs of the Fair Grounds.

Michigan.

The City Council of Cadillac, Mich., has ordered plans and estimates for the construction of a combination storm and sanitary sewer, known as the Cobbtown sewer.

The city of Oakwood, Mich., is preparing to present to the Legislature a petition for permission to bond the town for a greater per cent than is allowed under the home-rule charter, to install a sewerage system. The sewer will extend through eight alleys of five blocks each.

Minnesota.

✣Bids will be received until 8 p. m., Feb. 7, by C. Theodore Weiland, Jr., Shakopee, Minn., for the construction of sanitary outlet sewer and water main extensions. The work to consist approximately of the following: (1) For the furnishing and installing of a 10-in. outlet sewer approximately 1,500 ft. in length with 7 manholes 4 ft. in diameter of variable depth, and 1 catchbasin. In the above there will be about 120 ft. of 10-in. Class A, C. I. B. & S. pipe used to cross under the tracks for the low water outlet, together with a small amount of rip-rap work and a concrete outfall. (2) The furnishing and installing of approximately 760 ft. of 8-in. vitrified sewer pipe, together with 2 manholes and all appurtenances, including Ys for house connection and plugs as shown upon plans and specifications. (3) The furnishing and laying of approximately 760 ft. of 8-in. C. I. B. S. water main, together with hydrants, valves, etc. The above to include all trenching and back-filling and the furnishing of everything complete ready for continued use and successful operation, all in accordance with the plans and specifications on file in the offices of the Consulting Engineering Co., 514-16 Nat. Ger. Am. Bank Bldg., St. Paul, Minn., or at the office of the City Clerk, C. Theodore Weiland, Jr., Shakopee, Minn.

City Sewer Engineer Carl Ilstrup of Minneapolis, Minn., has recommended to the council committee the immediate construction of $535,100 of new sewers for relief purposes. The engineer has been directed to begin at once the extension of the Hopewell hospital sewer through the Camden pumping station grounds to the river, estimated to cost $15,500.

It is probable that the question of installing sewers and waterworks in Deerwood, Minn., will be placed before the people at the spring election.

The City Council of Minneapolis, Minn., proposes to ask the legislature for authority to issue bonds for sewer work, as follows: Permanent improvement fund, $300,000; permanent improvement revolving fund, $300,000; main sewers, $250,000; relief sewers, $250,000.

Missouri.

✣Bids will be received until Feb. 18, by Board of Public Improvements, St. Louis, Mo. (readvertisement), for the construction of the Rocky Branch Joint district sewer. Maxime Reber is President of the Board.

✣Bids will be received until noon, Feb. 4, by Board of Public Improvements, St. Louis, Mo., for the construction under Letting 10788, of sewers in Harlem Creek Sewer District Number Nine, embracing sewers of the ma-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

terials, lengths and sizes as follows: Vitrified clay pipe sewers, 135 ft. of 15-in. inside diameter, 1,114 ft. of 12-in. inside diameter. With sewer inlets, manholes and all other appurtenances. Deposit required, $175.

✣Bids will be received until noon, Feb. 4, by the Board of Public Improvements, St. Louis, Mo., for the construction under Letting No. 10789 of sewers in Dale Ave. Sewer District Number Two, embracing sewers of the materials, lengths and sizes as follows: Vitrified clay pipe sewers, 436 ft. of 27-in. inside diameter, 1,067 ft. of 24-in. inside diameter, 634 ft. of 21-in. inside diameter, 364 ft. of 18-in. inside diameter, 1,307 ft. of 15-in. inside diameter, 7,342 ft. of 12-in. inside diameter. With sewer inlets, manholes and all other appurtenances. Deposit required. $800.

The city of Richmond, Mo., R. E. Brown, City Clerk, will not ask for bids for the construction of the proposed vitrified pipe sewers until about the middle of February or some time in March. The estimated cost is $18,000. Worley & Black, Kansas City, Mo., are Engineers.

New Jersey.

✣Bids will be received until Feb. 10, according to reports, by Mayor and Council of Spring Lake, N. J., for the construction of a sewer outlet at the foot of Brighton Ave.

✣Bids will be received until 8 p. m., Feb. 4, by the Town Council of West New York, N. J., at the office of J. L. Wolfe, Town Clerk, for the construction of a sewer in 22d St., between Polk St. and the Hudson Blvd. west.

The Jersey City Water Commission is planning to commence actual work on a trunk line sewer between Dover and Boonton in the spring. Engineers are now checking surveys.

Engineer Mosher of Cranford Township, Cranford, N. J., has submitted plans to the State Board of Health, Trenton, for the new North Ave., east, sewer. The plans have been approved, but the township is not allowed to make use of the system until something has been done to take the sewage out of the Rahway River.

New York.

✣Bids will be received until 5 p. m., Feb. 4 by D. J. Coutant, City Clerk, Newburgh, N. Y., for furnishing all materials and labor necessary for constructing a trunk sewer in Fullerton Ave., from Third St. northerly to Gidney Ave. There is about 2,011 lin. ft. of 30-in. vitrified pipe sewer, about 852 lin. ft. of 20-in. vitrified pipe sewer, about 6 manholes, about 25 cu. yds. rock excavation, about 1,000 ft. of timber sheathing left in trench if required. Cash or certified check for $250 must accompany each bid. Specifications and forms of proposals will be furnished upon personal application and plans may be seen at the office of City Engineer.

⊙The Board of Contract & Supply of Rochester, N. Y., has awarded the contract for building the Fairview Ave. sewer to Passero & Petrossi Co., at $2,274. Work will be started at once.

A committee of taxpayers of Huntington, L. I., has recommended to the taxpayers the Imhoff sewage disposal system and states that the estimated cost of installing the plant and its pipe lines is $96,000. Bonds will probably be issued for this improvement.

Commissioner of Public Works Wallace Greenalch and City Engineer Frank R. Lanagan of Albany, N. Y., are preparing to rush the proposed intercepting sewer and sewage disposal plant on Westerlo Island. The general plans have been approved by the State Health Board.

Village Attorney H. C. Perkins of Lestershire, N. Y., has obtained the grant to the right-of-way over the Erie Railroad's property for a distance of 1,700 ft., of the Binghamton-Lestershire trunk line sewer, also the rights to build the sewer through under the company's tracks. ' J. J. Irving is Mayor.

President Maurice E. Connolly, Borough of Queens, New York City, has rejected the two bids received Dec. 30 for the construction of the main outlet trunk sewer for the Corona district, which will drain more than 5,000 acres. The lowest bid submitted was $255,290. The engineer's estimate was $205,000. The work will probably be re-advertised.

The Board of Trade of Port Washington, N. Y., at a recent meeting discussed the advisability of building a trunk sewer through part of the village. The proposed sewer would cover two square miles, and would take in the Beacon Hills development, Port Washington Park, Port Washington Estates and the Hicksville section. It is proposed to establish a sewer district as soon as possible and have the work started on the sewer within the next year. It is estimated that the proposed plant would cost $100,000.

North Carolina.

⊙The City Council of Wilmington, N. C., has awarded to Miller & Martin of Passaic, N. J., the contract for constructing the extensions to the municipal sewerage system in the northern, eastern and southern sections of the city, at $134,494.

⊙Frank Hackney, of New Bern, N. C., has been awarded the contract by the Board of Aldermen of that city, for the construction of approximately 4,000 ft. of sewers at $5,033. Bids were opened Jan. 20 by F. T. Patterson, City Clerk.

Ohio.

✣Bids will be received until noon, Feb. 6, by W. J. Springborn, Director of Public Service, Cleveland, Ohio, for the construction of sewers in the following named streets, avenues, courts and thoroughfares: East 40th St., between Prospect Ave. S. E. and Central Ave. S. E. East 99th St., between Adams Ave. N. E. and Ostend Ave. N. E. East 85th St., between Tioga Ave. S. E. and Connecticut Ave. S. E. East 103rd St., between Harvard Ave. S. E. and southerly end. Harvard Ave. S. E., between old city limits and East 110th St. East 124th St. between 160 ft. south of Ingomar Ave. N. E. and 390 ft. south of Ingomar Ave. N. E. East 128th St., between St. Clair Ave. N. E. and Penobscot Ave. N. E. Ferris Ave. S. E., between East 131st St. and East 136th St. East 137th St., between Aspinwall Ave. N. E. and Toneka Ave. N. E. Horner Ave. S. E., between East 131st St. and East line O. L. 462. Macomb Ave. S. E. and East 86th St., between East 86th St. and Turney Rd. S. E. and between Macomb Ave. S. E. and Connecticut Ave. S. E. Maryland Ave. S. E., between Warner Rd. S. E. and East 85th St. Each bid must be made in accordance with the plans and specifications which may be seen at the office of the chief engineer, room 305 City Hall.

✣Bids will be received until noon, Feb. 17, according to advices from Cincinnati, O., by A. J. Orth, Clerk of the Village of Arlington Heights, for furnishing the necessary labor and material for the construction of sanitary sewers.

⊙Wm. Strachan of Lancaster, O., has been awarded a sewer contract at Bremen, O., embracing 16,500 ft., at $9,963.

A. J. Orth, Clerk of the village of Arlington Heights, O., will sell bonds Feb. 4 to the amount of $12,000 for the construction of sewers.

Oklahoma.

The City Commissioners of Tulsa, Okla., have accepted the report of City Engineer T. C. Hughes recommending the construction of a storm sewer to take care of the flow of water that courses through a ravine in the Hackathorn addition.

The city of Shawnee, Okla., did not let the contract for the construction of lateral sewers, for which bids were opened on Jan. 14. B. N. Craig is Secretary of the Board of Public Works.

The city of Sulphur, Okla., plans the making of extensions to the sewer system at an estimated cost of $35,000. D. J. Kendall is Mayor.

Oregon.

⊙Parrott Bros., of Baker, Ore., have been awarded the contract by the city of Idaho Falls, Ida., for the construction of one of the sewers in connection with the new sewer system.

The City Council of Portland, Ore., has rejected all bids received recently for the construction of the East Glisan St. sewer, and will readvertise for new bids shortly. The lowest bid received was $154,000

Pennsylvania.

⊙The City Councils of Erie, Pa., have awarded contracts for a 9-in. sewer in 20th St., from Wayne to Perry St., and a 9-in. sewer in 22d St., from Poplar St., west to Edward Driscoll.

⊙The Borough Council of New Kensington, Pa., has awarded the contract for the construction of sewers to Rinehart Bros., at $0.88 per cubic yard, or a total of $3,371.

City Engineer DeForest A. Wheelock of Warren, Pa., is preparing a plan for a sewage disposal works and system for that borough. Plans are to be on file by May. 1.

An ordinance has been introduced in the Common Council of Harrisburg, Pa., providing for the construction of a sewer in 15th St., from Berryhill to Catherine St., to connect with a main sewer.

The Select Council of Reading, Pa., has concurred in the action of the Common Council in passing the $300,000 storm sewer loan bill.

Consulting Engineer L. E. Chapin of Pittsburgh, Pa., has made surveys of the city of Salem, O., for the proposed construction of a storm water sewer system. It is also proposed to make a number of changes in the sanitary sewer system. These improvements will cost about $200,000. B. W. French is City Engineer.

At a recent meeting of representatives from about 22 of the 29 boroughs and townships of Delaware County, Pa., held at Darby, Pa., Consulting Engineer Albert F. Damon of Darby presented a plan which suggests the construction of three large disposal plants and a number of trunk line sewers be constructed to take care of the sewage for a number of years at a cost of construction and maintenance that would be less than that of separate sewer systems and disposal plants for each borough. The representatives have decided to ask for state aid.

Rhode Island.

A bill has been presented in the upper branch of the General Assembly of Rhode Island, providing for the appointment of a commission to prepare plans for a metropolitan sewer system to include Providence and the surrounding cities and towns.

South Dakota.

⊙The village of Hibbing, Minn., has let the contract for the construction of the sewer outlet to the sewer south of Brookston to P. M. McDonnell of Duluth, Minn., at $61,268. A. G. Osman of Duluth is the probable contractor for the construction of a ditch, at $29,966. Bids were opened Jan. 21.

Plans have been prepared by Consulting Engineer W. P. Wolff of St. Paul, Minn., for the construction of lateral sewers in Districts Nos. 1, 2 and 3, at an estimated cost of between $15,000 and $20,000. Contracts will be let in February or March. S. B. Howe is City Engineer.

Texas.

⊙The City Council of Houston, Tex., has awarded the contract for the construction of the storm sewer in the Fourth Ward, to Horton & Horton of Houston, at $269,721.

At a special election in Austin, Tex., the citizens voted to issue bonds to the amount of $100,000 for the purchase of the sewerage system of the Austin Sewerage Co. Jno. O. Johnson is City Clerk.

Henry County Representative, W. E. Weldon, has introduced a bill in the present session of the Texas Legislature, making it pos-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

sible for the city of Paris, Tex., to issue bonds for improvements. The improvements are the installation of a sewerage system, costing about $35,000, for the extension of the water and light system and the erection of a new public school building.

An election is to be held in Pecos, Tex., on Jan. 31 for the purpose of voting to the amount of $30,000 for a complete sewerage system.

Consulting Engineers Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., are appraising the privately-owned sewer system in Temple, Tex., and making plans for its extension and improvement when acquired by the city, for which bonds to the amount of $50,000 have been voted.

Consulting Engineer James H. Puertes of New York City has submitted his report to the Municipal Commissioners of Dallas, Tex., relative to the installation of a sewage disposal plant. The report recommends the construction of a plant having a capacity of 34,700,000 gals.

Four bids were received Jan. 20 by the City Council of Houston, Tex., for constructing the proposed storm sewer in the First and Sixth Wards. The bidders were: H. C. Gass, Waco, Tex.; Horton, Gage & Horton, and Freund & Quay, Houston, and John Striffler, Wichita, Kans. The storm sewer will be 4, 5 and 6 ft. in diameter, as follows: 1,653 ft. of 6-ft. sewer, 1,173 ft. of 5-ft. sewer, 1,600 ft. of 4-ft. sewer; also 50 catch basins attached.

Four bids were received by the Municipal Commissioners of Dallas, Tex., recently for the contract of city scavenger service. Bidders were F. L. Coe, holder of the present contract, E. L. Haralson, Dallas; J. P. McNair, and Emile Wunderlich, Dallas.

Virginia.

The citizens of Ashland, Va., will vote Jan. 28 on the proposition of installing new sewers and a waterworks at an estimated cost of $40,000.

City Engineer W. T. Brooke of Norfolk, Va., will make an estimate of the cost of extending the storm sewer, emptying at the head of Roanoke dock, to the Elizabeth River.

Washington.

The Board of Public Works of Seattle, Wash., on Jan. 17 received the following bids for the construction of the Rainer Ave. sewers, et al.: International Dredging Co., Central Bldg., Seattle, $80,031; Ward & Sherer, $91,115; W. F. Meismer, $95,335.

West Virginia.

✣Bids will be received until 1:30 p. m. (eastern time), Jan. 30, by Board of Commissioners, Huntington, W. Va., for the construction of a number of 12 and 15-in. lateral sewers. A. B. Maupin is City Engineer.

Wisconsin.

A petition has been filed with the City Clerk of Wausau, Wis., asking for the construction of a sewer on Thomas St., from Harrison Blvd. to Cleveland Ave., thence north to Williams St. and east on that thoroughfare to the Wisconsin River.

The citizens of Racine, Wis., will vote in the spring on the proposition of issuing bonds to the amount of $185,000 for the construction of three sewers in the western part of the city, one in the northern part of the city, and one in the southern part. P. H. Connolly is City Engineer.

BUILDINGS

Arkansas.

The Pulaski Construction Co. of Little Rock, Ark., has been organized with a capital stock of $10,000, for the purpose of taking charge of the construction work on the new 16-story Auten Bldg., to be erected on the site of the present Auten Bldg., Markham and Center Sts., Little Rock. The officers of the company are: Harry Auten, President; H. F. Auten, Vice President; E. L. Endicott, Secretary; H. F. Auten, Treasurer.

Colorado.

✣Bids will be received until 3 p. m., March 5, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures, and approaches, of the United States Post Office at Grand Junction, Colo. The building is to be two stories and basement, and has a ground area of approximately 5,700 sq. ft.; fireproof construction, except ceiling and roof; brick and stone facing and tin roof. Drawings and specifications may be obtained from the custodian of site at Grand Junction, Colo., or at the discretion of the Supervising Architect.

District of Columbia.

✣Bids will be received until 10:30 a. m., Feb. 11, by Maj. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under Circular 757, claw bars, bits, chain blocks, tackle blocks, steel cable, cable clips, emery cloth, grease cups, chain dies, padlocks, chisels, hacksaw frames, hasps, shovels, monkey wrenches, files, nails, tacks, steel tapes, brass tubing, bronze, galvanized buckets, sheet steel or iron, track bolts, boat spikes, wire, sheet zinc, poultry netting, oilers, signal flags, memorandum books, waste baskets, brushes, mop heads, sponges, chipped soap, candle wicking, Babbitt metal, yellow metal, marline, carbide, turpentine, linseed, neat's-foot, creosote and fish oils, burnt umber, raw sienna, Black Jacket enamel, cab, etc.

Kansas.

✣Bids will be received until 10 a. m., Feb. 6, by Constructing Quartermaster, U. S. Military Prison, Fort Leavenworth, Kans., for furnishing and delivering f. o. b. cars at terminal station, Fort Leavenworth, Kans., the material listed below: 2,372 bars steel, round and flat, assorted sizes, mild; 442 steel plates, assorted sizes, mild; 468 bars steel, angles, assorted sizes, structural; 142 bars steel, channels, assorted sizes, structural, and 183 bars steel, cold-rolled, assorted sizes. Further information may be obtained of Lieut. Col. T. H. Slavens, Constructing Quartermaster.

Massachusetts.

✣Bids will be received until 2:30 p. m., Feb. 3, by Walter R. Forbush, Public Building Commissioner, West Newton, Mass., for furnishing all material and performing all labor required to erect two new vaults and the installation of metal furniture in said vaults, and in other vaults, furnishing and installing new safes in the City Hall; Fire Department Headquarters; School Department, Technical High School, Nv.; Inspector of Milk, Nonantum Sq., Newton.

Minnesota.

✣Bids will be received until 8 p. m., Feb. 20, by Board of Education, Lester Prairie, Minn., for the erection of an addition to the school building and remodeling the present building in School District No. 70. Kirby T. Snyder, Architect, 92 S. 7th St., Minneapolis, Minn.

✣Bids will be received until 8 p. m., Feb. 12, by Board of Education, Independent School District No. 27, St. Louis County, at the office Jefferson School Building, Hibbing, Minn., for the forge shop equipment and decorations of the Lincoln High School. S. L. Holtzlander is Clerk of the Board. W. B. Ittner, St. Louis, Mo., is Architect.

✣Bids will be received until 8 p. m., Feb. 18, by Board of Education, Browerville, Minn., for the erection of a brick school building in accordance with plans by K. T. Snyder, 92 S. 7th St., Minneapolis, Minn.

The Merchants' Building Co. has been formed by the Merchants' National Bank, St. Paul, Minn., for the purpose of erecting a large building at 4th and Robert Sts., St. Paul. It is stated that the character of the building will not be determined until the widening of Robert St. is decided. As soon as the Robert St. project is settled, an architect will be employed and work started at once. Kenneth Clark is President.

Missouri.

Plans have been drawn for a 12-story brick finish addition to the Hotel Jefferson at St. Louis, Mo. The addition will cost about $1,250,000, and will be erected for the Hotel Jefferson Co. of St. Louis.

New Hampshire.

✣Bids will be received until 11 a. m., Feb. 21, by H. R. Stanford, Chief of the Bureau of Yards & Docks, Navy Department, Washington, D. C., for extension to foundry at the navy yard, Portsmouth, N. H. The work proposed is estimated to cost $12,000. Plans and specifications may be obtained on application to the Bureau or to the Commandant of said navy yard.

New Jersey.

According to an announcement of Dean McClenahan, Princeton, N. J., Chairman of the Board of Athletic Control of Princeton University, a $300,000 stadium will be erected at Princeton.

North Dakota.

✣Bids will be received until 2 p. m., Feb. 14, by State Board of Normal Trustees, at the office of E. J. Taylor, President, Bismarck, N. Dak., for the erection of a fireproof dormitory to be erected on the Normal School grounds at Minot, N. Dak. Haxby & Gillespie, Fargo, N. Dak., are Architects.

Ohio.

✣Bids will be received until noon, Feb. 5, by C. A. Palmer, Clerk of the Board of Education, Shaker Heights, at his residence on Broxton Road or addressed to him at his office, care of the First National Bank, Cleveland, O., for furnishing the labor and material necessary for the construction and furnishing of a school house near the intersection of Coventry and Southington Roads in said district, according to the plans and specifications on file at the residence of said Clerk, and at the office of George F. Hammond, at 4220 Prospect Ave., S. E., Cleveland, Ohio.

✣Bids will be received until noon, Feb. 10, by Clerk of the Board of Education, E. 6th St., Cleveland, O., for furnishing desks and seats for Miles, Warner, Memphis, Mt. Pleasant, Washington Park, Dawning and Eagle Schools and various other rooms, in accordance with plans and specifications on file in the office of the Director of Schools. Each bid must contain the name of every person interested in it and must be accompanied by a certified check on a solvent bank for 10 per cent of the amount of bid.

✣Bids will be received until noon, Feb. 3, by Charles W. Stage, Director of Public Safety, Cleveland, O., for furnishing and delivering emergency patrols for the Police Department of Cleveland, O. Specifications may be had at the office of the Director.

✣Bids will be received until noon, Feb. 4, by S. A. Kinnear, Director of Public Service, Columbus, O., for furnishing approximately 50,000 ½x12 cored carbons and approximately 50,000 ½x12 solid carbons for the municipal light plant. P. B. Kemper is Clerk.

✣Bids will be received until noon, Feb. 1, by Board of Education of Bowling Green, O., at the office of the Clerk, N. R. Harrington, for necessary labor and material for the complete installation of plumbing, gas fitting and sewerage, for a fireproof high and grade school building in Bowling Green, O. Plans and specifications are on file at the office of the Clerk of the Board of Education, Bowling Green, O., copies of which can be procured upon application to either the Clerk of Board of Education or at the offices of the Architects, Howard & Merriam, State Savings & Trust Bldg., Columbus, O. Plans are also on file at the Builders' Exchange, Columbus, O., at the Builders' Exchange, Toledo, O., at the Builders' Exchange, Cincinnati, O., and at the Builders' Exchange, Cleveland, O.

⊙H. Harig & Co., 31 E. 4th St., Cincinnati, O., have been awarded the contract for constructing the new Reinbold Bldg., at Main and 4th Sts., Dayton, O. The structure will be of steel, tile and terra cotta and will cost about $400,000.

Oregon.

✣Bids will be received until 10 a. m., Feb. 10, by J. B. Coffey, County Clerk, Portland, Ore., for the lighting fixtures, book shelving, tables, furniture, etc., and stone fence for the New Central Library Bldg., Portland, Ore. Plans and specifications may be obtained at the office of the Architects, Doyle, Patterson & Beach, Worcester Bldg. Contractors will be required to deposit $25 for each set of plans.

✣Bids will be received until 8 p. m., Feb. 25, by City Council, St. Johns, Ore., for lighting the city in accordance with specifications on file with F. A. Rice, Recorder of the city.

Pennsylvania.

✣Bids will be received until noon, Feb. 11, by Board of Allegheny County Commissioners, Pittsburgh, Pa., for alterations and additions to the court house and jail made necessary by the removal of the "Fifth Ave. Hump." Alden & Barlow, Farmers' Bank Bldg., Pittsburgh, Pa., are Architects. The work is estimated to cost $200,000. R. J. Cunningham is County Controller.

South Dakota.

Agitation has been started at Artesian, S. Dak., for installing an electric light system.

Tennessee.

An ordinance is before the City Commissioners of Memphis, Tenn., requiring the Cumberland Telephone & Telegraph Co. to construct underground conduits for its lines in certain defined limits in the city. George J. Yundt, Atlanta, Ga., is Chief Engineer for the company.

Texas.

✣Bids will be received until noon, Feb. 17, by Maj. T. H. Jackson, U. S. Engineer, Dallas, Tex., for furnishing 9,000 barrels American Portland cement.

✣Bids will be received until 10 a. m., Feb. 5, by Capt. A. P. Watts, Constructing Quartermaster, Fort Bliss, Texas, for furnishing the necessary labor and material for the construction of an addition to post hospital.

Brickley & Brickley, Architects, Praetorian Bldg., Dallas, Tex., have plans under way for a 10-story building to be erected on Lamar, Monroe and Austin Sts., Dallas, for the Dallas Dry Goods Co., John R. Cavanaugh, President. Structure is to be 10-story, reinforced concrete construction, with concrete foundation and roof.

The W. C. Munn Co., W. C. Munn, President, Houston, Tex., has decided to erect a $500,000 building in the business section of Houston.

Virginia.

✣Bids will be received until 11 a. m., Feb. 4, by Maj. H. L. Pettus, Constructing Quartermaster, Fort Monroe, Va., for furnishing all materials and labor required for installing hot water heating system in U. S. Engineer's office building No. 147, at Fort Monroe, Va., in accordance with plans and specifications. The government reserves the right to reject or accept any or all bids or any part thereof. Plans, specifications and blank proposals on application.

Washington.

✣Bids will be received until Feb. 5, by P. F. Clark, City Clerk, Aberdeen, Wash., for furnishing one auto patrol.

A 10-story fireproof office building, to cost about $400,000, is to be erected on 3d Ave., Washington St. and Prefontaine Pl., Seattle, for W. G. Norris, President of the Norris Safe & Lock Co., Seattle. Architect is not to be selected until spring.

West Virginia.

✣Bids will be received until 3 p. m., March 6, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures, hydraulic mail lift, and approaches, of the United States Post Office at Grafton, W. Va. The building is of three stories and basement, and has a ground area of approximately 6,000 sq. ft. Fireproof construction, except the roof, stone facing, terra cotta and copper cornice, tile and copper roof. Drawings and specifications may be obtained from the custodian of site at Grafton, W. Va., or at the discretion of the Supervising Architect.

Wisconsin.

✣Bids will be received until noon, Feb. 4, by Capitol Commission, Madison, Wis., L. F. Porter, Secy., for furnishing the necessary labor and material for plumbing work on the central portion of the Wisconsin State Capitol, now under construction at Madison.

✣Bids will be received until 10 a. m., Feb. 15, by Carl Herman, County Clerk, Medford, Wis., for the complete erection of a court house for Taylor County in accordance with plans and specifications prepared by Raeuber & Mehner, Architects, Manitowoc, Wis.

Canada.

✣Bids will be received until 5 p. m., Feb. 6, by Winnipeg Public Schools Board, Winnipeg, Man., for the supply of lumber required for use in the Kelvin and St. John's Technical High Schools, and also in the Manual Training rooms of the Elementary Schools. For specifications, forms of tender, and further information required, apply direct to J. B. Mitchell, Commissioner of Supplies, School Board office. R. H. Smith, Secretary-Treasurer of the Board.

✣Bids will be received until 4 p. m., Feb. 10, by R. C. Desrochers, Secy., Department of Public Works, Ottawa, Ont., for the construction of public building, Morden, Man. Plans, specification and form of contract can be seen and forms of tender obtained at the office of Mr. H. E. Matthews, Superintending Architect of the Dominion Public Buildings, in the Province of Manitoba, Winnipeg, Man., at the Postoffice, Morden, Man., and at the Department of Public Works.

RIVERS AND HARBORS

District of Columbia.

✣Bids will be received until 10:30 a. m., Feb. 11, by Maj. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under Circular 757 claw bars, bits, chain blocks, tackle blocks, steel cable, cable clips, emery cloth, grease cups, chain, dies, padlocks, chisels, hack-saw frames, hasps, shovels, money wrenches, files, nails, tacks, steel tapes, brass tubing bronze, galvanized buckets, sheet steel or iron, track bolts, coat spikes, wire, sheet zinc, poultry netting, oilers, signal flags, memorandum books, waste baskets, brushes, mop heads, sponges, chipped soap, candle wicking, babbitt metal, yellow metal, marline, carbide, turpentine; linseed, neat's-foot, creosote and fish oils; burnt umber, raw sienna, black jacket enamel, cab enamel, lampblack, flour, lime and white pine or sugar pine lumber.

Delaware.

✣Bids will be received until 11 a. m., Feb. 20, by Maj. R. R. Raymond, U. S. Engineer, Wilmington, Del., for dredging the Murderkill River.

✣Bids will be received until 11 a. m., Feb. 12, by Maj. R. R. Raymond, U. S. Engineer, Wilmington, Del., as noted in our Jan. 22 issue, for dredging Leipsic River, above Leipsic, Delaware. Leipsic River enters the Delaware Bay about 38 miles below Wilmington. Leipsic, the present head of steamboat navigation, is about 10 miles, and Garrisons Mill, the upper limit of improvement and head of tide, is about 15½ miles above the mouth. It is proposed to dredge, as far as the available funds will permit, a channel 5 ft. deep and 40 ft. wide on the bottom from Leipsic upstream towards Garrisons Mill, including one cut-off, about 800 ft. in length, just above the Factory bridge at Leipsic, and a turning basin at Garrisons Mill, the channel widening to from 100 to 150 ft. for a length of about 150 ft., to form a turning basin, near Garrisons Mill. The depth of cutting will be from 0 to 5 ft. Estimated quantity is 148,000 cu. yds. of mud, sand and gravel.

✣Bids will be received until 11 a. m., Feb. 14, by Maj. R. R. Raymond, U. S. Engineer, Wilmington, Del., for dredging in Appoquinimink River. Appoquinimink River enters the Delaware Bay about 20 miles below Wilmington. Odessa, the head of navigation, is about 7 miles above the mouth. Under previous contracts, the channel has been dredged from the mouth of the river to the head of navigation at Odessa, to a depth of 7 ft. and a width of 50 to 60 ft. It is proposed to dredge as far as available funds will permit, a channel 8 ft. deep, at mean low water and 100 ft. wide, through Rock Reach. The depth of cutting will be from 0 to 5 ft. The material to be removed is believed to be sand, gravel and some bog iron ore in thin strata in Rock Reach. Estimated quantity is 15,500 cu. yds.

Florida.

The Tampa Dock Co., of Tampa, Fla., has been formed and will take out articles of incorporation. The company will have a capital stock of $1,000,000 and proposes building docks and developing the A. J. Knight property at the head of the estuary. The principal stockholders are A. L. Knight and L. E. Knight. The improvements include dredging a strip 900 ft. long, building docks on each side and a dock along the head of the estuary, securing 2,200 ft. of wharfage thereby, with more later on.

Georgia.

Bids were opened Jan. 21 by the U. E. Engineers at Savannah, Ga., for dike construction in Savannah River, near Augusta, the bid of A. J. Twiggs & Son, Augusta, Ga., at $48,187 being recommended for acceptance. Bids on this work were originally opened Dec. 28, but all proposals received at that time were rejected as excessive.

Mississippi.

⊙Edgar A. Stacy, Greenville, Miss., has been awarded the contract at $342,915 for the enlargement of 9 miles of levee at Clarksdale. The work calls for 1,228,000 cu. yds.

✣ indicates work now open for bids. ⊙ indicates a contract let recently

of earthwork and embankment. Bids were opened Jan. 17. T. G. Dabney, Clarksdale, Miss., is Chief Engineer.

Missouri.

✣Bids will be received until noon, Feb. 7, by Maj. Clark S. Smith, U. S. Engineer, Secy. Mississippi River Commission, 1311 Liggett Bldg., St. Louis, Mo., for the construction and delivery of twin-screw engines and propelling machinery.

✣Bids will be received until noon, Feb. 17, by Maj. Herbert Deakyne, U. S. Engineer, Kansas City, Mo., for constructing about 12,000 ft. of standard revetment on the Missouri River about 302 miles below Kansas City, 2 miles below Bernheimer and 2 miles above New Haven, Mo.

✣Bids will be received until noon, Feb. 17, by Maj. Herbert Deakyne, U. S. Engineer, Kansas City, Mo., for constructing about 12,000 ft. of revetment (standard) on the Missouri River about 262 miles below Kansas City and 1 mile out from Mokane, Mo.

New Jersey.

✣Bids will be received until 11 a. m., Feb. 13, by Maj. R. R. Raymond, U. S. Engineer, Wilmington, Del., as noted in our last issue, for dredging in Alloway Creek, which is a tidal stream flowing southwesterly through Salem County, New Jersey, and emptying into Delaware River about 17 miles below Wilmington, Delaware. Quinton, the head of the improved channel, is about 10 miles above the mouth. It is proposed to dredge a channel 5 ft. in depth below mean low water and 75 ft. in width at bottom from Fosters Bottle to 1,000 ft. above Upper Hancock Bridge, and thence, as far as the available funds will permit, 60 ft. in width at bottom, and 6 ft. deep, toward Quinton, a total distance of about 7 miles. The depth of cutting will average about 3 ft. The work requires the dredging of 13,650 cu. yds. of mud, sand and gravel.

✣Bids will be received until Feb. 10 by Maj. R. R. Raymond, U. S. Engineer, Wilmington, Del., as noted in our Jan. 22 issue, for dredging in Absecon Creek, a tidal stream on the eastern shore of New Jersey, emptying into Absecon Bay about 5 miles northwest of Atlantic City. About 2 miles above its mouth is the town of Absecon, where it is crossed by two fixed bridges with a headroom clearance of about 6 ft. at mean low water. The work is the dredging of a channel to a depth of 5 ft. at mean low water and a width of 80 ft. across Absecon Bay to the mouth of Absecon Creek, and thence dredging to a depth of 5 ft. at mean low water where necessary to provide a channel 50 ft. in width through Absecon Creek from its mouth to the highway bridge at Absecon, including a cut through the island just below, as far as necessary to complete the required channel. The length of the channel to be dredged across Absecon Bay is 1.1 miles, bottom width 80 ft., depth 5 ft. below mean low water, and depth of cutting will vary from 2½ to 5 ft., and the length to be dredged in Absecon Creek is about 2 miles, with depths of water from 3½ to 13 ft., and the dredging will consist in the removal of shoals with depth of cutting from 0 to about 2 ft. to provide a channel with bottom width of 50 ft. and depth of 5 ft. at mean low water. The quantity of material to be removed is about 90,000 cu. yds. of mud and sand.

✣As noted in our last issue bids will be received until 11 a. m., Feb. 8, by Maj. R. R. Raymond, U. S. Engineer, Wilmington, Del., for dredging in Raccoon Creek, a tidal stream emptying into Delaware River about opposite the lower limits of Chester, Pa. The present project of improvement extends to the head of navigation at Swedesboro, N. J., 9¾ miles from the mouth. The creek has been improved by dredging the channel 7 ft. deep and 75 ft. wide between the Delaware River and Bridgeport, 1¾ miles; 7 ft. deep and 60 ft. wide from Bridgeport to Springers, 3¼ miles; 5 ft. deep and 40 ft. wide from Springers to Swedesboro, 4¾ miles; and by making the cut-off at Molonox Shoal. It is proposed with the available funds to remove shoaling that has occurred in the channel from the mouth to Bridgeport to a depth of 7 ft. at mean low water and a width of 75 ft. at bottom, and near Swedesboro to a depth of 5 ft. at mean low water and a width of 40 ft. at bottom. The depth of cutting will be from 0 to 5 ft. About 21,000 cu. yds. of mud, sand and gravel are to be removed.

Surveys have been made by Brown & Tobish, Engineers, Trenton, N. J., for waterfront improvements at Trenton for the American Bridge Co. The company is said to be considering building large docks and making other improvements.

New York.

✣Bids will be received until noon, Feb. 17, by Maj. G. B. Pillsbury, U. S. Engineer, London, Conn., for the construction of a pile and timber wharf in Plum Gut Harbor, Fort Terry, N. Y.

✣Bids will be received as noted in our last issue until 11 a. m., Feb. 11, by Maj. R. R. Raymond, U. S. Engineer, Wilmington, Del., for dredging in Maurice River. This river enters Delaware Bay through Maurice Cove, about 19 miles northwest of Cape May, N. J., and about 58 miles from Wilmington, Del. The head of navigation is at Millville, about 24 miles from the mouth. The dredging to be done is in the upper 5 miles of the river from French's Bar to Millville. Under a previous contract, the channel was dredged from the 7-ft. curve at French's Bar upstream to the Millville drawbridge, about 4½ miles, to a depth of 7 ft. and to a width of 100 ft. It is proposed to continue the dredging from the Millville drawbridge along the wharves of Millville to the head of navigation, about ¾ mile, and to dredge around the bend at Silver Run to a depth of 7 ft. and to a width of 60 ft. on the bottom. Also to redredge to a depth of 7 ft. and to a bottom width of 100 ft. wide where shoaling has occurred, between Millville drawbridge and French's Bar. The dredging will also include widening at sharp bends and turning basins, necessary to allow the free movement of vessels. The lower turning basin will begin about 1,500 ft. below the Millville drawbridge, widening upstream in a length of 300 ft., from the channel width of 100 ft. to 200 ft., holding that width for 100 ft., and then narrowing, in a length of 300 ft., to the channel width of 100 ft. The upper turning basin will be an expansion of the channel at the head of navigation at the upper limit of improvement, widening, funnel shape in a length of 250 ft., from the channel width of 60 ft. to a width of 160 ft. The depth of cutting will be from 1 ft. to 7 ft. The estimated quantity is 90,000 cu. yds. of sand and gravel.

Ohio.

A joint resolution has been introduced in the Ohio Legislature memorializing congress to build levees along the Ohio River where flood waters do the most damage.

Bids were opened Dec. 31 by Maj. L. H. Rand, U. S. Engineer, Cincinnati, O., for use of U. S. land and unused water at Dams Nos. 3, 4, 5 and 6, Muskingum River, at Lowell, Beverly, Luke Chute and Stockport, O. The bidders were William W. Mills, Marietta, O., S. D. Camden, Henry Archer, Parkersburg, W. Va. The bids received were as follows, the bidders also offering to increase the rental stated by 20 per cent if period be 40 years instead of 22, as specified:

Dam.	Location.	Water—Quantity at low water flow not now used. Cu. ft. per min.	Land, acreage.	Unit price per year per 1,000 ft. of water per min.	Land, price per year.	Total.
3	Lowell, O.	44,800	2 1/6	$61.25	$50.00	$2,794.00
4	Beverly, O.	31,750	¼	40.00	60.00	1,330.00
5	Luke Chute, O.	50,750	1⅝	46.50	40.00	2,399.88
6	Stockport, O.	43,450	3	51.00	75.00	2,290.95
	Grand total					$8,814.83

Pennsylvania.

✣Bids will be received until Feb. 15 by T. J. Rout, Inspector, Fourth Light House District, 427 Post Office Bldg., Philadelphia, Pa., for rebuilding the Brandywine Shoal Light Station, Delaware Bay. The light station is located in Delaware Bay, about 12½ nautical miles from Lewes, Del. The site has a depth of 8 ft. The light house consists of a cylindrical iron foundation pier about 46 ft. high and 35 ft. in diameter. It is to be sunk in the sand shoal about 14 ft. by the pneumatic process. The station supports a three-story iron dwelling. The lantern will be about 60 ft. above the water. Bids were invited on this structure on September 20, but no satisfactory bids were received.

Texas.

✣Bids will be received until noon, Feb. 18, by Maj. T. H. Jackson, U. S. Engineer, Dallas, Texas, for furnishing 1-man stone and crushed rock or gravel for guard lock Sabine-Neches Canal, Texas.

Virginia.

Bids as follows were received Jan. 20 by the U. S. Engineer, Norfolk, Va., for 208,000 cu yds. of dredging in James River, Va.: Coastwise Dredging Co., Norfolk, Va., 10¼ cts.; Norfolk Dredging Co., Norfolk, Va., 11.1 cts.; Maryland Dredging & Contracting Co., Fidelity Building, Baltimore, Md., 9.95 cts.; P. Sanford Ross, Inc., 277 Washington St., Jersey City, N. J., 11 cts.

Washington.

✣Bids will be received until noon, Feb. 5, by Maj. J. B. Cavanaugh, U. S. Engineer, 602 Burke Bldg., Seattle, Wash., for furnishing two flat bottom wooden hull barges.

✣Bids will be received until Feb. 1 by Owen Woods, Commissioner of Public Works, Tacoma, Wash., for the construction of an 8-story 100 ft. by 300 ft. municipal dock, office and storage building at the foot of Pacific Ave. The cost of the work is estimated at $175,000.

⊙Erickson Construction Co., New York Block, Seattle, Wash., has been awarded the contract at about $156,000 for dredging the East Waterway at Seattle for the Port Commission of that city.

Wisconsin.

City Council of Ashland, Wis., has voted to expend $50,000 for the construction of a municipal dock. Contracts will probably be let this spring. J. W. Day is City Engineer.

Canada.

⊙Contract for installation of plant for the new power house at the Barrier River site for the city of Kamloops, B. C., has been let to C. C. Moore, Mutual Life Bldg., Seattle, Wash. DuCane, Dutcher & Co., Rogers Bldg., Vancouver, B. C., are consulting engineers.

⊙A. E. Poenford, St. Thomas, Ont., has been awarded the contract by the Department of Public Works of Canada for constructing a dock at Windsor, Ont.

⊙The H. E. Talbot Co., Dayton, O., has been awarded the contract for constructing a dam across the St. Maurice River near Grandmere, Que. The work calls for an expenditure of about $2,500,000.

Bids will be asked in a few days by DuCane, Dutcher & Co., Consulting Engineers, Rogers Bldg., Vancouver, B. C., for the construction of a hydro-electric plant at the Skutz Falls for the city of Duncans, B. C. The estimated cost is $45,000, and the first installation will provide for 250 h. p., with a final installation of 1,000 h. p.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ENGINEERING AND CONTRACTING

Devoted to the Economics of Civil Engineering Design
and to Methods and Cost of Construction

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Retrogression in Public Utility Regulation.

There is a movement on foot in the state of Washington to curtail the field of action of the Public Service Commission. It is proposed to exempt utilities in cities of the first class from regulation by the state commission, on the ground that the larger cities can regulate the utilities within their confines better than a state commission can regulate them. This movement is a backward step, and is to be regretted.

The tendency nowadays is to combine and operate under one management many public utilities in neighboring cities, and the tendency is in the right direction. Better management and a higher grade of engineering follows the consolidation of smaller utilities. But this is by no means the only reason why it is economic. In the case of electric companies, a better diversity factor is thus secured, so that a power plant of given size is able to serve many more people and industries than would otherwise be possible without increasing the size of its installations.

Few kinds of public utility companies now confine their operations to one city. Electric railways are urban, suburban, and interurban. Telephone service is not merely state-wide but nation-wide, the city having long ago ceased to be the operating unit. No rate-making engineer who has had the experience of trying to prorate fixed charges and operating expenses among different parts of an operating system is likely to look with favor on any scheme whereby such an operating system is to be partitioned by city limits. As sensibly go a step farther and make the ward in the city the operating unit.

Finally, now that cities are emerging from the bondage of rotten politics and graft, it is unfortunate that any cities invite a repetition of history by returning to "home rule" of public utilities. The "home rule" that the average city council gives is one from which the average voter and the average public utility company prays to be delivered.

Unit Costs as a Test of Merit.

Men in public office are usually unfit occupants of their position. Popular election is a poor test of economic fitness, and political appointment is often not much better. How, then, can more capable public servants be secured? The civil service examination was regarded a few years ago as the great panacea for public service ills. Those who have looked into the results of its application agree that it is surely better than popular election, and, on the whole, is an improvement over selection by appointment. Still examinations are, at best, a negative test of efficiency. They serve to weed out the least fit, but rarely do they serve to secure the most fit. Ability to answer questions does not necessarily link arms with ability to manage men, or to improve methods, or to solve for minimum costs.

In the ideal state there would be a perfect record kept of the unit costs of performance of every government employe. These unit cost records would be the "batting averages" of the men entered in the game of public service. By this unit cost record would each man be publicly judged, and according to his record would he receive promotion and advance in salary. Is the scheme Utopian? Give it thought. Can not the efficiency of a street cleaning department be measured by the unit costs of street cleaning? Is not the efficiency of a municipal water works system similarly measurable?

Indeed, is there any kind of public service that will not lend itself to some sort of unit cost recording?

Some day we may read—and this vision need not be a century in focusing upon the screen—an item to this effect:

> John Smith, formerly chief of the Department of Sewers in San Francisco, has accepted a similar position in New York City. Mr. Smith has maintained for five years a weighted average unit cost 5 per cent less than that of any other American sanitary engineer engaged in this line of municipal work. Mr. Smith's new salary of $50,000 seems large, but if he can save even a fraction of 5 per cent of the annual cost of operating and maintaining the sewer systems of New York, the city will be greatly the gainer. Mr. Smith has established a standard of efficiency in San Francisco that his successor will find it difficult to improve.

The Engineering Age.

While engineers are more or less accustomed to regard their profession as being perhaps the most important in the world, there is a distinct surprise in finding that the thinking public is also of the same opinion. And now we are beginning to find the non-thinking, the imitative, part of the public coming to hold to this view also. Ask the average man what sort of a profession he would prefer to see his sons follow, and note his answer. In the majority of cases engineering of some sort will be the reply.

Note also the tendency to affix or prefix the word engineering to pursuits that involve the application of science. At the present rate of progress it will be only a generation before our present great engineering societies will seem small indeed by the measure of some that are now in their infancy. The stature of the composite civil engineer will stand in Lilliputian inches by the Brobdignagian leagues of the composite agricultural engineer.

There was a time when some of us regretted that so many fathers had simultaneously decided to give their boys an engineering training. It made jobs scarce and salaries small for the newly graduated C. E. Many find the condition even worse now, but are they not of the class who fail to see that an engineering training is one that should readily enable its possessor to step from one occupation to another?

Economics and efficiency, based on scientific study, are the things that differentiate an engineer from other professional men. Fortunately the principles of engineering economics learned by the young civil engineer are quite as applicable in a quarry as in road building, in logging as in railroading, in agriculture as in bridge designing. A somewhat extended trip through the various states has served to bring the writer in contact with a large number of civil engineers who have left the old paths. They are no longer civil engineers in the narrow sense that we commonly use the term in America. Still they are engineers. One is the head of a great logging and milling industry. Another is dredging sand and gravel for industrial uses. A third is making paper pulp. A fourth is a broker who handles the securities of public service companies. A fifth is "freighting" with automobile trucks.

Each of these men, and others in different industries, is applying his engineering knowledge, and is helping to make this the engineering age.

An Old Problem in Engineering Education Still Unsolved.

An old time problem in engineering education, which is of more importance to practical engineers than may at first seem to be the case, relates to the advisability, or otherwise, of giving the answers to problems stated in engineering text-books. Just how old this educational problem is we cannot say, but that it is still unsolved was brought to our attention recently in a very forceful manner.

In one issue of this journal, published within the last month, we reviewed, under one general heading, three new books, all of which are entitled, "Strength of Materials." As stated in the review, the books are good. All were written by experienced teachers of that important part of the course of study as offered in three American engineering colleges of high standing. In many ways the books are much alike. This, no doubt, is necessarily the case. But the authors of the books differ widely in the matter of giving the answers to the problems stated in their respective works.

In one book the author states in his preface that many problems are given for the purpose of making clear the application of the theory. The author also states that answers to some of the problems are given, in order that the student may occasionally check his numerical work. The plan so outlined is followed throughout the book. When answers are given, they are printed immediately following the statement of the problem.

The preface to the second book states that since the mechanical ideas involved are by far the most difficult part of the subject, a special effort was made to present them clearly and to illustrate them by numerous practical numerical problems. The preface to this book does not mention the subject of answers to problems. Throughout the book the problems are stated, but not a single answer is given until the last page is reached. In the closing article of the book the answers to 45 problems, stated in various parts of the book, are listed. In referring to these answers the author conveys his opinion on the advisability of giving answers to problems by the following brief statement:

> Below are given answers to a few of the problems stated in the preceding pages. However satisfactory it may be to a student to know the true result of a solution let him remember that after commencement day answers to problems will never be given.

The third book serves well to illustrate the other extreme in the matter of publishing answers to problems. In the author's preface he states that the problems, which are given with nearly every article, form an essential part of the development of the subject. He states further that they were prepared with the two-fold object of fixing the theory and of enabling the student to discover for himself important facts and applications. Throughout this book answers are given to nearly all the problems immediately following their statement.

Many practicing engineers may feel that the subject here discussed is merely a "school boy" problem, and therefore unworthy of their consideration. It is, of course, primarily an academic question, but, like many another question of a similar nature, it may ultimately exert a far-reaching influence in the professional careers of individuals. Engineers who employ young graduates experience much trouble from the fact that the results of computations made by these assistants often are quite unreliable. Any tendency in education, then, which increases or decreases the accuracy of the computations made by young graduates becomes of immediate personal interest and importance to the employing engineer.

The editors believe that the publication of answers to problems given in engineering textbooks exerts a strong influence upon the student's dependability in making accurate computations. The present writer observed, while a teacher of engineering subjects, that even the average conscientious student is very well satisfied with the results of his own computations, which are more often incorrect than correct, when the true result is not printed in the book. Surely this makes for a lack of reliability in the later work of the engineer assistant.

It seems that there should be less difference of opinion between educators, with regard to this question, than that disclosed by a comparison of the three books here mentioned. Engineering training has now been offered for a long time by our colleges, and there should be closer agreement, among the educators, on all such fundamentals as that here discussed.

GENERAL ARTICLES

Method and Cost of Unloading Coal with a Weeks Shovel.

Contributed by W. C. Weeks, Vancouver, B. C.

Coal from the mines on Vancouver Island is transported to the city of Vancouver on scows holding from 300 to 700 tons each. These scows are the ordinary flat bottom, flat-decked affairs with numerous side and end stanchions, between which is held planking to retain the coal. There is no arrangement of deck or sides to facilitate unloading. Generally speaking, the coal is unloaded by means of wheelbarrows into storage sheds, where it is sacked for distribution about the city.

The MacDowell Mouat Coal Co. unloads from coal scows by means of a Weeks patented shovel. The scows to be unloaded are brought to the berth alongside the coal bunkers and made fast. Transversely across one end of the berth is placed a heavy timber, the ends of which are supported on piles, and along this timber the back haul block fastening is moved as required. At the other end of the berth is hung a counter-balanced incline operated by a hand gear, which is lowered onto and rests upon the end of the scow to be unloaded. At the upper end of the incline is a hopper covered by a coarse grizzley, through which the coal must pass before it is fed to the inclined elevator, up which it is elevated to the top of the bunkers for screening. Beyond and in line with the hopper is placed the electric hoist by which the shovel is operated. The positive digging and releasing motion peculiar to this shovel enables the load to be obtained in a short distance, and it is not necessary to drag the shovel far back over the coal.

A considerable portion of the coal handled is lump and the breakage by this type of unloader is said by the owners to be much less than that caused by a clamshell. The shovel is 3 ft. 3 ins. square on the bottom and 18 ins. deep, having a nominal capacity of 16 cu. ft. and weighs about 900 lbs. It is of the standard shape, save that it has no side arms, and the cutting edge is replaced by long teeth beveled to prevent digging into the deck of the scow. The main haul line is ⅝-in. cable and the back haul ½-in. cable. When dumping, the coal slides out the inclined back of the shovel, which operation is accomplished without stopping or slackening the hoisting line, and the coal slides out and does not drop, thereby reducing breakage.

Scrapers of various designs were tried and discarded before the present shovel was installed. The hoist is run by a constant speed 20 h. p. motor, and has two 12x24-in. drums, giving a rope speed of about 230 ft. per minute. The operator stated recently that he had on several occasions unloaded 450 tons of coal in eight hours, and that this included some stoppage in no way connected with the unloading mechanism.

The engineers for the coal company, Messrs. Wilson & Lake, state that the average amount unloaded ranging over a considerable period of time, is 40 tons per hour at the cost per ton for power of six mills, with electric power at 2 cts. per kilowatt hour. The cost of introducing is as follows:

1 operator at $3.50 per 8-hour day	$3.50
1 laborer at $3.00 per 8-hour day, ¼ time	.75
4 laborers 15 minutes cleaning up	.40
Wear and tear	.75
	$5.40
320 tons at	$0.0168
Add for power	0.006
Total cost per ton unloaded	$0.023

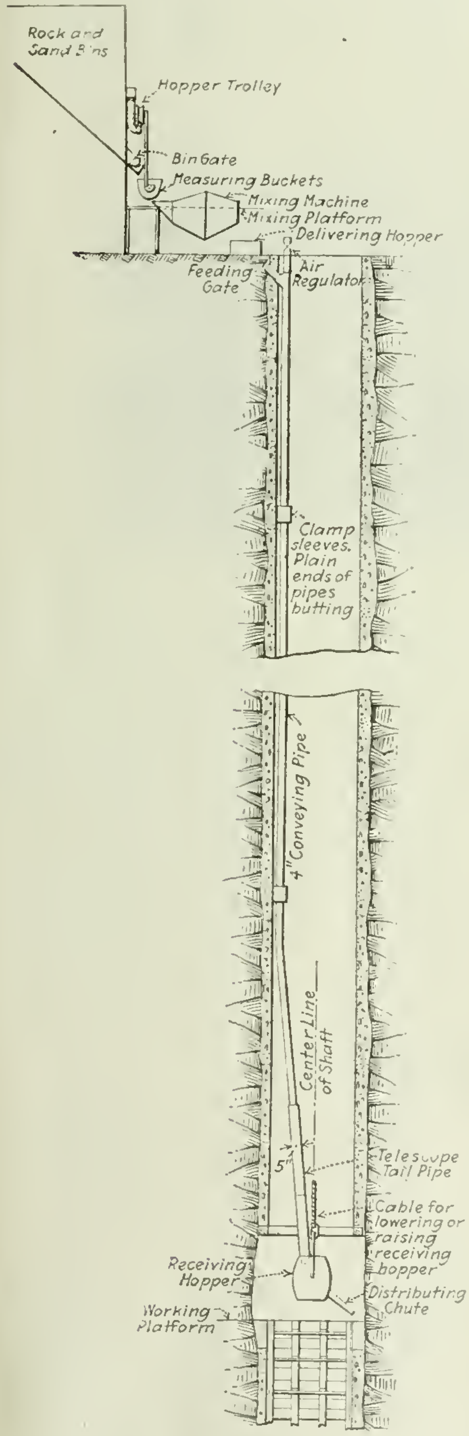
Method of Handling Concrete in Lining a Shaft.

(STAFF ARTICLE.)

An effective method of handling concrete in lining a shaft 1,017 ft. deep is illustrated by the accompanying sketch. The shaft had been previously lined with timber, which had burned out. The remaining partly burned timbers of the old lining were removed, a lining of light timbering merely to prevent rock from falling onto the workmen was built and the concreting done as indicated by the illustration. The cleaning, temporary lining, and permanent lining were performed, beginning with the top section, in six sections of 150 ft. to 220 ft. The lining was rectangular, with a center partition dividing it into two compartments 5 ft. x 7 ft. 2 ins. each, and it was built for each section from the bottom up as indicated by the illustration. The procedure in detail was as follows:

Beginning at the bottom of a section, a timber set was fitted to support a form for a reinforced concrete set which was hitched onto the walls solidly as a foundation footing for the lining. A 12-ft. section of forms was next erected on the concrete set. The forms consisted of 12-in. dressed lumber nailed to a cage of 12-ft. form posts made up of a 4x4-in. post in the corner of each compartment, a 4x6 in. intermediate post on each 5-ft. side, and two 4x6-in. intermediate posts on each 7-ft. side, with 2x6-in. across compartment beams between posts every 3 ft. vertically. To allow space for the forms, two bays of temporary lining were removed. After concreting, two more bays of temporary lining were removed and another 12-ft. height of forms was placed. All forms for a full section of shaft were left standing until the entire section was concreted, then they were taken down and cleaned and used again for the succeeding sections of shaft.

The arrangement for concreting was novel and is indicated by the illustration. The concrete was run from the mixer into a hopper and thence conducted down the shaft through a 4-in. steel pipe to an ordinary steel sinking-bucket, suspended from the finished portion of the lining above, and allowed to run through a hole cut in the side of the bucket a few inches above the bottom, and through a short steel chute into the forms. This was an efficient and flexible arrangement, as the bucket could be easily swung or turned, and a continuous stream of concrete directed to any part of the forms desired. The concrete was successfully dropped in this manner for a distance of over 1,000 ft. in building the last section. The velocity of the concrete was but little greater through the pipe to the deepest part of the shaft than to the sections near the surface, provided the mixture was fed regularly and the upper end of the pipe closed at the end of each batch. This was easily done by placing a piece of canvas over the opening, stopping the air current in the pipe thus checking the velocity of the concrete, and tending to break it up into smaller pieces, which fell with less force.



Plant for Lining a Shaft With Concrete.

The long walls of the lining were given a minimum thickness of 10 ins. and the short walls and center wall 8 ins. Where the rock walls were very irregular, forming large concavities, large rocks brought down on the cages were thrown into the concrete. The center wall was reinforced every 18 ins. vertically with mine rails laid across the shaft in the center of the wall. The end and side walls were thus reinforced only at points where the ground was bad and at stations.

The concrete was a 1:3:6 mixture of Portland cement, quartz sand, and crushed limestone from ¼-in. to 1-in. mesh. About 2,300 cu. yds. of concrete and 750 cu. yds. of large rock were used.

About 25 men were employed on the job, working two shifts. The total time consumed was eight months, of which the first month was spent in rigging up the surface plant, etc., and most of the rest of the time in cleaning down the walls and putting in temporary timbering preparatory to concreting. Also the lower 110 ft. of the shaft consisted of a raise driven to one-compartment size and this had to be enlarged to full size. The actual work of concreting was done in 100 days, or about 40 per cent of the total time consumed. Ordinarily, one 12-ft. section of concrete per day was put in, but in bad ground a 6-ft. form would be used. The maximum day's work was 22 ft. The contract price was $30,000 or $28 per lineal foot of shaft. We are indebted for the facts given in this article to an article in the "Engineering and Mining Journal" for Jan. 18, 1913.

Methods and Cost of Dredging Gravel, Using a Weeks' Two-Line Shovel.

Contributed by W. C. Weeks, Vancouver, British Columbia.

Gravel for building purposes for the city of Vancouver, B. C., is obtained in part from submerged deposits, one of which lies at the mouth of Indian River at the head of the North Arm of Burrard Inlet. To obtain the gravel from this place over which the tidal range is about 12 ft., a Weeks patented shovel has been used in various ways since the spring of 1910.

First Plant.—The first method of operating the shovel was from a skid A-frame mounting a swinging boom, on a scow. The shovel with its load is lifted and swung over the scow to be loaded and returned to its loading place by means of a ⅝-in. back-haul line passing from the hoisting engine over a sheave supported by a float suitably anchored.

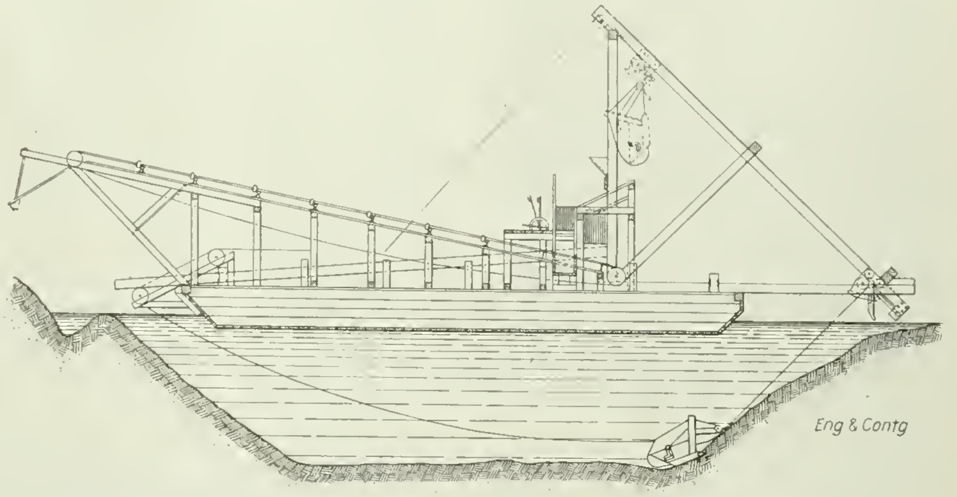


Fig. 1—Gravel Dredging and Washing Scow Equipped With Weeks Two Line Shovel.

The shovel has a capacity of 24 cu. ft., and 35 cu. yds. of gravel per hour is loaded when the distance the shovel transports its load is not over 200 ft.

It may be noted here that the tendency with this shovel wherever installed has been to make it a transporter of material as well as an excavator, with the inevitable result of reduced capacity and increased wear.

The operating crew consists of a foreman, engine runner, fireman and laborer, the principal duty of the latter being to spring the latch on the shovel which causes it to dump its load.

An 8¼x10-in. double drum hoisting engine burning 1½ tons of coal per ten-hour day, when working steadily, supplies the power. Through the top of the A-frame, a heavy link passes, at the rear end of which the backstays are fastened, and from the front end the boom hangs by means of a special shackle, the pin of which is enclosed by a couple of wearing sleeves. These sleeves are made of pipe and take the wear due to the swing of the

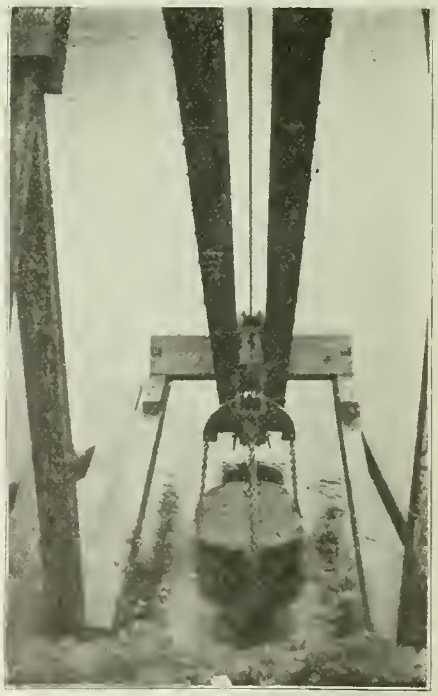


Fig. 2—Shovel Emerging From Water and Adjusting Itself on Trolley.

boom. If kept well greased this wear is very small. At the point of the boom is a three-armed forging, the arms of which are set at equal angles. To the top arm is fastened the boom line of fixed length, and to one of the lower arms is hung a sheave for the ⅞-in. main line to the shovel. At the base of the boom is bolted a heavy bent plate, the long end of which fastens to the boom and the short end pivots between two angles riveted to a heavy plate, which is bolted to the bottom of the A-frame. When the load comes upon the end of the boom, its tendency, by reason of the eccentrically suspended load, is to swing toward the side on which the main line sheave is hung, and this tendency is increased as the scow tips. A fair leader for the main line hung in the A-frame, prevents this tendency to swing, from being excessive. With this arrangement of boom and tackle, no swinging gear is necessary. The sweep of the loaded shovel over the scow is regulated to a nicety by the engine runner paying out the back haul. The original rig is still in use. The cost of operating is as follows:

1 foreman at $4.75	$ 4.75
1 engine runner at $4.50	4.50
1 fireman at $3.00	3.00
1 laborer at $2.75	2.75
1½ tons coal at $8.00	12.00
Wear and tear, depreciation, etc.	3.00
300 cu. yds. at 10 cts.	$30.00

Second Plant.—Later a larger, but in every way similar, dredge was installed, and the original rig mounted for a time on pile bents instead of a scow. The object of this change was to facilitate washing and storing the gravel, which was done with a special type of washer, and the washed gravel elevated into bunkers. Owing to a desire to reclaim all the gravel possible from the fixed location of the dredge, the distance which the shovel hauled its load was made nearly 300 ft., which was too great to attain a large output. The depth of the pit to which dredging was carried was about 60 ft. below low tide. From 225 to 240 trips of the 1¾-cu.-yd. shovel was all that could be averaged in ten hours. Considerable time was lost due to clogging of the washer by over-feeding. About 40 cu. yds. could be dredged per hour, washer permitting. The same crew was used as on the floating dredge, but the consumption of coal was greater by half a ton. The cost per cubic yard was 9 cts., including all expenses.

Improved Plant.—Wishing to reduce the length of haul, with its attendant wear and diminished output, a new method of operating has been devised so that now the shovel digs under the scow, Fig. 1, upon which the washer also is mounted. An inclined trolley track projects beyond the front of the scow upon which runs a trolley car carrying a large sheave over which passes the main-haul line. The trolley is locked at the lower limit of its run while the shovel is digging, and is unlocked by the shovel striking the releasing levers. Upon being unlocked, the trolley runs up the inclined track, the shovel being hung (Fig. 2) meanwhile from the trolley car by two hooks upon which it adjusts itself automatically and which prevent it lowering or twisting. Arrived at the upper limit of its travel, the shovel dumps into a hopper, whence the gravel is conveyed by a belt to the washer. The shovel and trolley are then lowered to the bottom of the incline and the shovel returned to its loading position by the back haul which passes over sheaves at the back of the dredge. Springs in tension absorb the shock of the descending trolley car. The scow is held by adjustable anchor lines passing over the front corners and the middle of the stern.

The shovel now in use holds 1½ cu. yds and averages 50 seconds per trip. Owing to a lack of sufficient scows for loading, no positive statement of its daily capacity can be made at this time, but it is known to be much faster than either of the other methods of operating. At present, the same crew as before operates the dredge, including the washer, but later, when the output becomes larger, an additional man may be required to assist in spotting scows.

A New Oil Burning Contractors' Locomotive.

(Staff Article.)

One of the more recent developments in narrow gauge locomotives is that illustrated by the accompanying photograph, which shows the locomotive in service on the work of W. C. Baxter, contractor on the Catskill Aqueduct, at Pleasantville, N. Y. On this work it is used to haul three concrete cars from the hopper into a tunnel, a round trip of 2¾ miles, and including a grade of about 10 per cent, which is in favor of the load. When running on the longest haul the mileage amounts to 60 miles in an eight-hour day, and the fuel cost amounts to about 4 cents per mile, using gasoline for fuel.

The locomotive is 9 ft. long over all and has a 5-ft. wheel-base. It weighs 5,000 lbs. empty and 6,500 lbs. with weight boxes loaded. The wheels are 20 ins. in diameter, and have a 3½-in. face. An oil tank is located on the front of the locomotive, and the operator's seat is placed just behind this tank, with the back of the seat at the side, so that the operator can easily watch the rear of the train as well as the track in front. The boiler and engine are housed on the center of the truck frame, and the water tank is located at the rear.

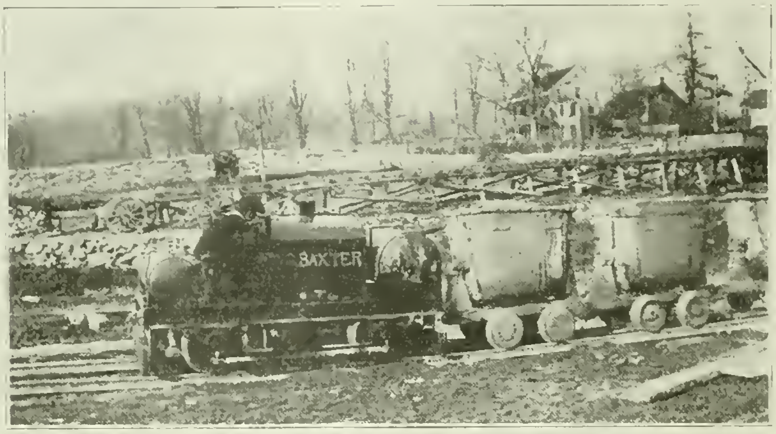


Fig. 1—View of Oil Burning Locomotive Used on Catskill Aqueduct Construction.

The engine is two-cylinder, high pressure, double acting, of the regular locomotive type, with cylinders 4½x6½ ins. The cranks run in an oil bath. The boiler is of the vertical type, 25 ins. in diameter, and with 156 sq. ft. of heating surface. The actual drawbar pull, allowing for slippage, is 1,200 lbs. The burner for the locomotive is supplied for gasoline or for kerosene, as desired.

The maximum speed with a load is from 15 to 20 miles per hour, depending upon the condition of the track. A table of haulage capacities on different grades is as follows:

Grade	Tons.
Level	60
1 per cent	60
2 per cent	28.5
3 per cent	12.75
4 per cent	9.6
5 per cent	7.33

Where conditions are such that the haulage of coal is troublesome or expensive, this type of locomotive offers obvious advantages. It is very compact for its capacity. The locomotive is built by H. W. Bell & Co., Yonkers, N. Y.

Water Meters in Mexico.—The annual municipal budget for the city of Puebla included an appropriation of $20,000 for the purchase of water meters for installation in the houses of the consumers.

Water Works at Tangier.—The Committee of Public Works, at Tangier, Morocco, has recently submitted a proposal for constructing a water works system at Tangier, at an estimated cost of $347,000. The water will be conveyed through conduits by power stations from sources at Sharf-el-Akab, about 10 or 12 miles from Tangier.

Report of the Annual Meeting of the Kansas Engineering Society.

Contributed by C. S. Loper, Topeka, Kans.

The third annual meeting of the Kansas Engineering Society was held at Topeka, Kan., Jan. 21 and 22. Without doubt it was the most interesting and instructive of the three conventions held since the organization of the society. Each paper read related directly to the work in which the author is engaged; and each one showed the active efforts which he is making in placing the profession on a higher plane. Many of the engineers have had considerable difficulty in educating the taxpayers to the point where they will build permanent structures, instead of spending such large percentages of their labor and funds in maintenance of poor work. This particular point was especially emphasized in the papers of the men who are engaged in county road and bridge work either as surveyors or county engineers. It was also pointed out that a large amount of very poor construction had been the result of incompetent supervision by men who had held their offices by virtue of political pull. J. Will Kelly, secretary of the Commercial Club of Topeka, and legislator, in welcoming the engineers on behalf of the business men of the city, stated that he favored a bill which will be considered during the present legislative session, making it possible to have competent engineers in each county having a valuation of $25,000,000 or more.

The first number of the program was a symposium entitled, "Problems in the Construction and Maintenance of County Roads, Bridges and Culverts and How We Have Solved Them." J. Max Yingling, County Engineer at Emporia, Kan., lead the symposium and summed up in an able manner the methods which he has applied and the results obtained in his county. He stated that at the present time he was engaged on a system of dirt roads as a preliminary to roads of a more permanent character. He placed special emphasis on the matter of proper dragging. The various roads have been divided into four-mile sections, over which one man and team can make two rounds with an 8-ft. drag in eight hours. The price paid is $1.50 per mile. In comparing the cost between engine and team work Mr. Yingling stated that if the engineer could have at his command at all times four well matched mule teams he would do work cheaper than with the engine; but if he had to depend on picking up farm teams here and there when he happened to need them, the engine was probably the cheaper and handier. R. F. Gallup, from Marysville, Kan., has realized that the most difficult problem of the engineer aside from mere matters of design has been to educate the farmers to build permanent structures. He has found structures far too light, and culverts much out of proportion to drainage area. He believes, however, that there is steady progress in the matter of road and culvert building. Mr. Gearhart, State Highway Engineer, in discussing this paper, advocated a yearly inspection and detailed reports on all bridges over 25 or 30-ft. space. He also believes that the County Commissioners should be empowered to condemn land and change the direction of the road where by so doing expensive structures and costly maintenance could be avoided. Lloyd Duffee's paper raised considerable discussion owing to his severe criticism of vitrified clay pipe for culverts. It is his experience that the clay pipe goes to pieces in a short time, probably due to formation of hair-like cracks. The water getting into these cracks, freezes with disastrous effect on the pipe. Mr. Meade expressed the opinion that the clay pipe had been subject to a great deal of unjust criticism. In using them for railroad culverts a few years ago, he had found them unsatisfactory, but had decided that the poor service was due to improper foundations as well as to the inferior quality of the pipe manufactured at that time. He and others expressed the opinion that with proper foundations and depth of fill the clay pipe manufactured today would compare well with any other material on the market. Mr. Duffee, as well as Mr. Buskirk, who followed him, found that the people of their counties were in sympathy with them in their efforts to better road conditions, but that they were slow to adopt concrete structures. Mr. Gearhart gave some startling figures relative to the cost of maintenance. He has found that in 18 representative counties of Central and Eastern Kansas, 43 per cent of road funds were so used; and in one county 75 per cent of the funds went into maintaining poor work.

Following the symposium of J. W. Mavity, Civil Engineer of Lyndon, Kan., presented a paper entitled, "The Surveyor Engineer." In his search for facts Mr. Mavity discovered that out of 54 counties from which he received answers to his inquiries, 50 had suffered from incompetent service by surveyors and county engineers. He read a sample of field notes wherein a surveyor, after making a re-survey and finding that the government corners did not agree with his work, stated that he had moved them over and reset them. Mr. Mavity believes that the average county will furnish sufficient engineering work to keep a good engineer busy all the time.

On Wednesday morning Mr. E. Lee Heidenreich opened the program with a discussion of "Bending Moments," in beams and slabs. He pointed out that most of the formulas for the computation of floor slabs were erroneous because in their development the lateral continuity of the material was entirely disregarded. As a consequence most slabs are made too heavy. In designing slabs he uses $\frac{Wl^2}{8}$, $\frac{Wl^2}{10}$ and $\frac{Wl^2}{16}$ for the maximum bending moment, and cites a case where $Wl^2/56$ was actually used. On being asked what grade of steel should be used for reinforcement, Mr. Heidenreich warned the engineers against the use of cheap steel in beams. For slabs most anything can be used, but he is a strong advocate of fabric reinforcement. L. E. Conrad, Professor of Civil Engineering, Kansas State Agricultural College, presented a paper on "Some Observations on the Tractive Power of Horses and the Tractive Resistance of Road Surfaces." His paper summed up the results of some experiments made on good earth roads near Manhattan with a new dynomometer designed by Dean E. B. McCormick. Mr. Conrad had long suspected that the common practice of assuming the tractive power of a horse as 25 per cent of its weight was too conservative. His experiments bore out his belief when they gave average results of from 28.8 per cent to 36 per cent.

A lengthy session was held Wednesday afternoon in an effort to finish the regular papers. The afternoon was mostly given over to the Water Supply and Irrigation section. Jesse W. Shaw read a paper on "The Ground Water Supply from Large Wells at Topeka, Kansas." J. H. Dousman told of "Recent Improvements in Centrifugal and Turbine Pumps Applied to Power and Irrigation Purposes." "Some Observations on Municipal Water Plants" was presented by Alva J. Smith, City Engineer of Emporia. Professor Granville R. Jones, of the University of Kansas, read a paper on "The Value of Pure Water." "Construction Cost Data," was the title of a paper submitted by F. D. Hughs, Engineer, Kansas City, Mo. It was the general opinion of those present that this was one of the most interesting and valuable sessions of the entire convention.

Besides the regular professional papers, the executive committee arranged for several illustrated talks on some important existing engineering structures. These were given on Tuesday and Wednesday evenings and were open to the general public. C. C. Witt, Engineer of the State Utilities Commission, described the construction of the Missouri River Bridge at Pierre, S. D. He showed some very clear views of the entire work and especially of the interesting process of sinking the pneumatic caissons.

Following Mr. Witt, Lloyd B. Smith gave an original illustrated analysis of the elastic arch. He pointed out some new and interesting facts regarding the loads and reactions on earth-filled reinforced concrete arches.

The retiring president of the society and engineer with the Topeka Bridge & Iron Works, R. V. Leeson, showed some fine views and gave an excellent description of the "Market House Bridge" at Monterey, Mexico. This bridge was built by Mr. Leeson's company and under his supervision. His talk and pictures particularly emphasized the remarkable adaptability of concrete as a material of construction. Mr. Leeson is an enthusiastic champion of concrete for permanent structures.

At an adjourned session held Wednesday evening two illustrated talks were given by engineers who have achieved more than ordinary success in their profession. Mr. J. M. Meade, Engineer of the eastern lines of the Santa Fe Railroad Co. and the President of the society for the next year, gave an illustrated description of the longest span concrete arch in the United States. This arch was built at Pittsburgh, Pa., and is a remarkable structure from many points of view. Aside from its long span of over 300 ft. and rise of 67 ft., it possesses a large measure of architectural beauty.

Following Mr. Meade, Hugh L. Cooper of New York, Vice-President and Chief Engineer of the Mississippi River Power Co., told about the ups and downs of the "dam" business. He had a large number of views of the $40,000,000 water power project now in progress of construction across the Mississippi River at Keokuk, Ia. Among the views were pictures of special features designed by Mr. Cooper to overcome difficult parts of the great work. Mr. Cooper is a ready speaker and possesses a generous fund of wit and humor. He impresses one as being a man of unusual ability as an organizer and manager of men. Kansas engineers are especially fortunate in having been able to meet him and hear him talk.

Through the courtesy of the Santa Fe R. R. Co. the engineers were able to spend part of Wednesday morning in visiting the mammoth Santa Fe shops.

At the business meetings of the convention, the proposition of affiliating the society with the Kansas Academy of Science was discussed at considerable length. On first thought many of the engineers expressed themselves as being opposed to the plan; but later the consensus of opinion seemed to be that it would be an advantageous move from many points of view. The proposition was finally voted upon favorably, and a committee was appointed to confer with a similar committee from the Academy of Science and perfect the details of the reorganization.

The officers of the Engineering Society for the next year are: J. M. Meade, Topeka, President; H. A. Rice, Kansas University, Lawrence, Vice-President; T. J. Strickler, Topeka, Secretary-Treasurer, and Directors, R. V. Leeson, Topeka; J. W. Mavity, Lyndon, and Fred Hesser, Beloit.

ROADS AND STREETS

Method and Cost of Constructing a Granitoid Pavement in Pierce County, Washington.

Contributed by C. H. Sweetser, M. Am. Soc. C. E.

Under the provisions of the Permanent Highway Act of the State of Washington, Pierce County last fall built about four miles of granitoid pavement. The contract calls for approximately eight miles or 76,000 sq. yds. of pavement, but owing to delays and injunction suits construction was started too late to finish all of the work in the fall of 1912.

The Permanent Highway Act, passed by the legislature of 1911, repealed the old State Aid law, under which the cost of improved highways was borne equally by the county and state, the supervision of the work being in the hands of the State Highway Department. The new law provides that the expense be borne entirely by the state, while the supervision of construction as well as the making of surveys and preparation of plans and specifications is performed by the County Engineer or by an engineer appointed by the Board of County Commissioners, with the provision that the location of road to be improved and plans and specifications must be approved and the work finally accepted by the State Highway Commissioner. The writer had charge of the work described in this article.

The road improved is a portion of the Pacific Highway which, if the plans of the Pacific Highway Association are followed, will extend from Hazelton in British Columbia, through Washington, Oregon and California to the Mexican boundary. Considerable work has been done in other counties in Washington along the route of the Pacific Highway. During the summer of 1912 a contract was let for three miles of brick road in King County, and other sections have been paved with warrenite and macadam with applications of tarvia.

When bids were called for the Pierce County work there was keen competition as evidenced by the fact that 11 contracting firms made 34 different proposals on 9 different types of pavements as follows: Brick, asphalt, concrete, Gladwell, granitoid, warrenite, bitu-crete, Dolarway and Elo Oso. The five pavements last named are patented pavements. A tabulated list of these bids, showing prices, was published in ENGINEERING & CONTRACTING May 1, 1912.

A technical error in allowing contractors to submit their own specifications was the cause of an injunction suit, and the Board of County Commissioners readvertised the work, calling for bids on three types of pavements, asphalt, brick and granitoid. Fourteen bids were received and the contract awarded to the Washington Paving Co. of Tacoma, for a granitoid pavement at $1.40 per square yard, which price included preparation of sub-grade and shoulders. Grading, clearing and grubbing, culverts, etc., were let on unit prices submitted with bids for pavement.

Granitoid Pavement.—Granitoid pavement is a high-class, patented concrete pavement laid under the following specifications:

Sub-grade—The usual specifications for a thoroughly compacted sub-grade

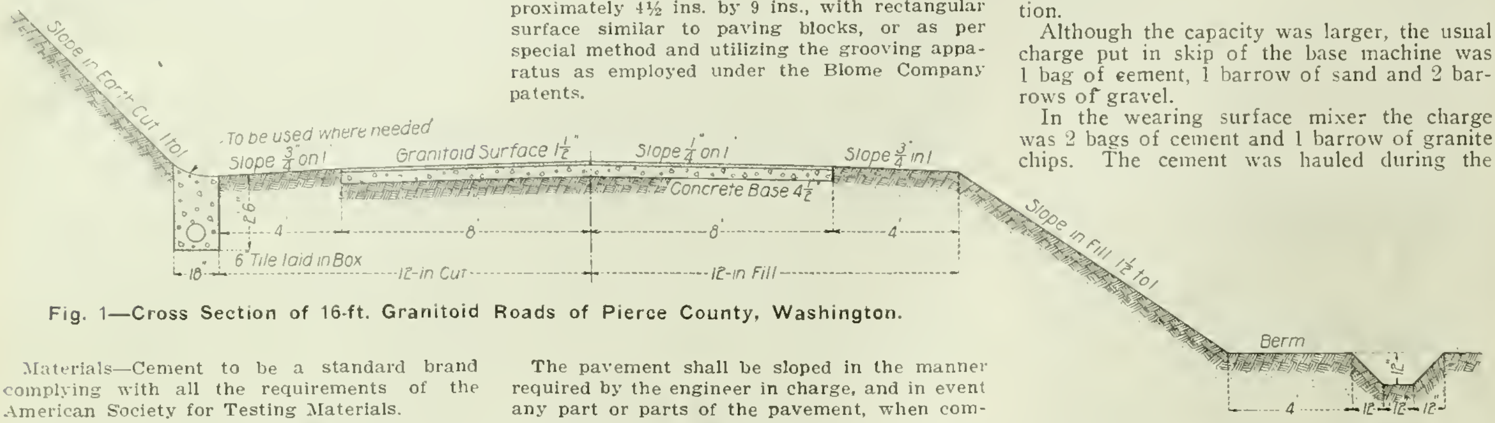


Fig. 1—Cross Section of 16-ft. Granitoid Roads of Pierce County, Washington.

Materials—Cement to be a standard brand complying with all the requirements of the American Society for Testing Materials.

The sand used shall be clean, coarse and sharp, free from loam, clay or earthy particles.

The stone used in making the concrete shall be of the best quality of limestone, trap rock or other hard stone or gravel of size so as to measure not more than 2½ ins., and in the event of stone being used same shall not measure under ¼ in. in dimension.

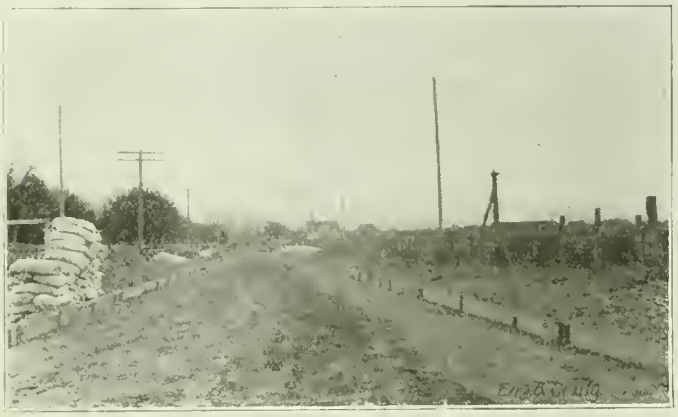


Fig. 2—Subgrade With "Ribbons" in Place.

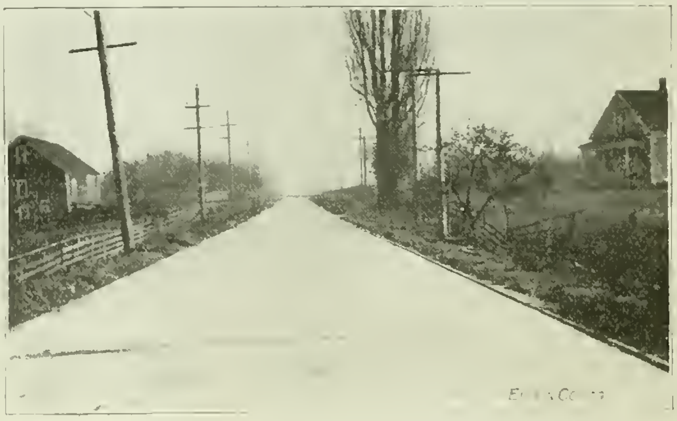


Fig. 4—View of Finished Pavement Without Shoulders.

Upon the sub-grade and foundation prepared as herein specified, the granitoid concrete pavement shall be laid, consisting of 4½ ins. of concrete, and on same shall be placed the granitoid surface blocking of uniform thickness of 1½ ins.

The concrete shall be composed of 1 part of Portland cement, 3 parts of sand and 6 parts of limestone, trap rock, or other hard stone or clean gravel. These materials are to comply with the requirements herein set forth and shall be mixed by an approved mixing machine, suitable for the purpose, approved by the engineer in charge, each batch being turned at least five times before being removed from the mixer.

The concrete shall be thoroughly tamped into place and shall be of the thickness specified, after having been compacted, and shall be carefully rammed into sections separated by expansion joints, all as per the Blome Company patents, and the said concrete shall follow the slopes of the finished pavement so that the surface blocking is, and shall be, of uniform thickness at all points.

Granitoid Blocking.—After the concrete has been placed and before it has begun to set, there shall be immediately deposited thereon the granitoid blocking, which shall be 1½ ins. in thickness, to be composed of two parts of approved Portland cement and three parts of crushed granite, trap rock, or other hard stone of approved quality, free from dust or sand. To this mixture shall be added lamp black for coloring at the rate of about 1 lb. of lamp black to 1 bbl. of cement. (This quantity must be varied to produce the required shade.)

The composition of stone in the surfacing shall be substantially as follows: Approximately 50 per cent to be what is known as ⅜-in. size, 25 per cent of ¼-in. size and 25 per cent of ⅛-in. size, with all finer particles removed. This material shall be thoroughly mixed with approved cement, and after being wetted to the proper consistency and deposited on the concrete shall be worked into brick shapes of approximately 4½ ins. by 9 ins., with rectangular surface similar to paving blocks, or as per special method and utilizing the grooving apparatus as employed under the Blome Company patents.

The pavement shall be sloped in the manner required by the engineer in charge, and in event any part or parts of the pavement, when completed, where slopes, contours, etc., have not been carried out in a true manner, then, under these specifications, the contractor will be required to take up such part or parts, and replace same to the proper level without expense.

The marking off into blocks was omitted. Transverse expansion joints were placed every 40 ft. and at the end of each day's work.

The cross section of finished roadway is shown in Fig. 1.

Method of Laying Pavement.—After the road was rough graded the sub-grade was prepared. Two-inch strips of plank were staked 8 ft. each side of center line of road, the top surface of these "ribbons" being left 1 in. above the finished grade. After sub-grade was rolled the concrete was deposited. Figure 2 shows section of sub-grade with "ribbon" in place.

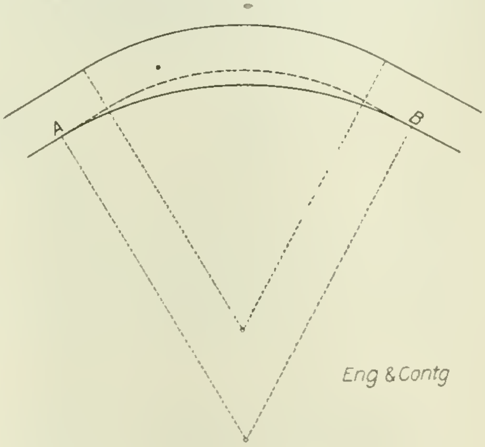


Fig. 3—Sketch Showing Method of Widening Roadway on Sharp Curves.

On a 2-mile section of the work a steam cube mixer was used for concrete for the base, while on another section a gasoline Foote machine was employed. For the wearing surface a smaller gasoline Foote mixer kept pace with larger machine. Templates were used for bringing the sub-grade and each course of concrete to the required cross section.

Although the capacity was larger, the usual charge put in skip of the base machine was 1 bag of cement, 1 barrow of sand and 2 barrows of gravel.

In the wearing surface mixer the charge was 2 bags of cement and 1 barrow of granite chips. The cement was hauled during the progress of the work and placed in such a manner that one man at skip could carry and dump the bags of cement into the pan without assistance.

On two miles of the work a 14-in. wood stave pipe water main was accessible. Two ¾-in. pipes were carried along the section which had no water main, but the pressure was not enough to supply all the water needed for mixing and considerable had to be hauled by carts over this portion of the work.

The granite, sand and granite chips were distributed at intervals of about 400 ft. Concrete from the larger mixer was hauled in carts. After a section of the base was laid the smaller mixer used for the wearing surface was operated directly on this base, planks being laid on which the mixer was moved forward as the work progressed. The product of the smaller mixer was transported by means of wheelbarrows.

Superelevation of Curves.—The outside of curves was elevated by 4 ins. above the inside, the crown slope being carried across the roadway so that on the curve, instead of the outside being 2 ins. below the center as on tangents, it was made 2 ins. higher. Beginning 40 or 50 ft. each side of the P. C. and P. T. of curves, on the side to be elevated the "ribbon" was gradually raised so that at P. C. and P. T. the total elevation was obtained. On the sharper curves the pavement was widened about 4 ft. at center of curve by introducing a curve of longer radius, the P. C. and P. T. intersecting the tangent to the regular inside curve at points *A* and *B*, as shown in Fig. 3. As the graded roadway was only 24 ft. wide more difficulties were met with in handling the work than would be found in wider city pavements.

When the roller was not being used on subgrade it was used in scarrifying the old gravel road and in plowing for grading work. The surface of the pavement was finished rough to afford a more secure foothold for horses.

At first it was hard to keep the finishers from smoothing it off like cement sidewalks are finished.

In Figs. 4 and 5 are shown views of the finished pavement before shoulders and ditches were constructed. Figure 6 is a view of the mixer used on the wearing surface.

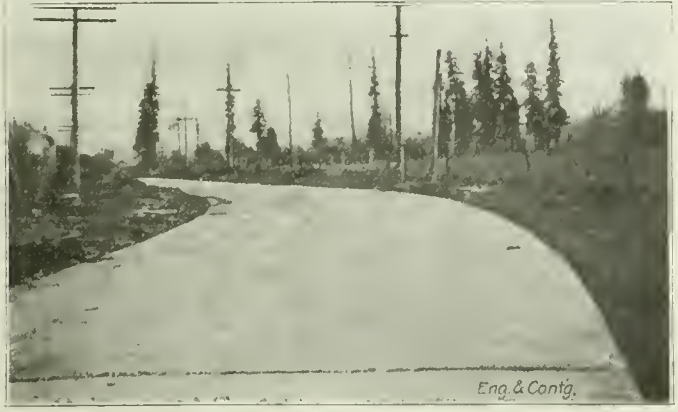


Fig. 5—View of Finished Pavement on Curve.

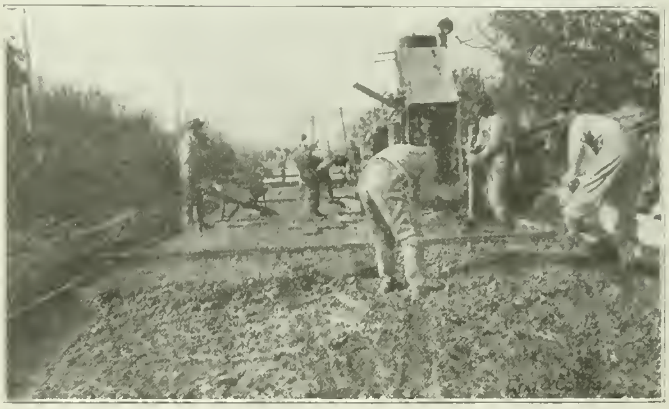


Fig. 6—Mixing and Placing Wearing Surface.

Labor Cost.—The following figures show the labor costs on the two concrete mixers for 30,075 sq. yds. Usually one move of the base mixer was made each day. At times a different apportionment of labor was made, but this was done when sub-grade was not far enough ahead or when other delays made changes economical:

Base:	
1 foreman at $5.00	$ 5.00
1 engineer at $3.50	3.50
1 man at skip at $2.75	2.75
9 men hauling gravel and sand at $2.50	22.50
2 men spreading at $2.50	5.00
1 man tamping at $2.50	2.50
2 carts hauling at $4.00	8.00
	$49.25
Wearing Surface:	
1 foreman at $3.00	$ 3.00
1 engineer at $3.50	3.50
1 man at skip at $2.75	2.75
4 men hauling granite chips at $2.50	10.00
4 men on wheelbarrows and spreading at $2.50	10.00
2 finishers at $3.00	6.00
	$35.25
1 form setter at $2.75	2.75
1 helper at $2.50	2.50
	$ 5.25

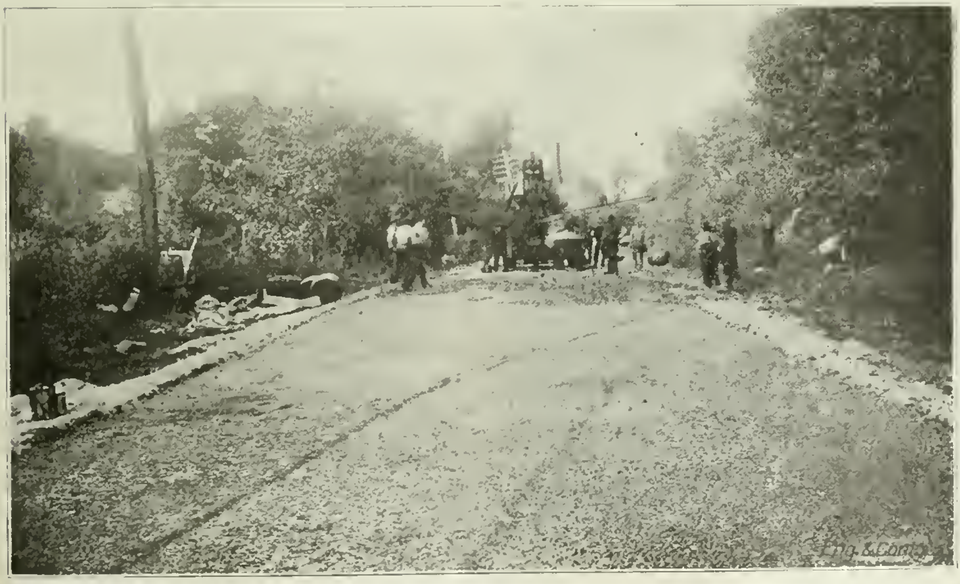


Fig. 1—View Showing Mixture of Gravel and Asphalt After Being Rolled With 10-Ton Roller.

The foreman on the base mixer looked after the work of sub-grade men, ribbon setters and finishers. The largest amount of work done in one day was 881 sq. yds. When conditions were favorable no trouble was experienced in making 711 sq. yds. between setups, and in moving mixer to be ready for the next day's work. Toward the close of the work weather conditions became so unsettled that, through no fault of the management of the work, the cost was increased. The average daily run was 528 sq. yds. Outside of unavoidable accidents and delays the average should have been higher if more care had been taken in having sub-grade prepared enough in advance of work to insure an uninterrupted day's run of the mixers. Probably with a mixer provided with a bucket and boom a lower cost could have been obtained.

On an average of 528 sq. yds., cost of labor figures as follows:

	Per sq. yd.
Base	$0.0933
Wearing surface	0.0667
Setting forms	0.0099
Total	$0.1699

On basis of 711 sq. yds., which under favorable conditions should have been an average not difficult to make, the cost would have been:

	Per sq. yd.
Base	$0.0693
Wearing surface	0.0496
Setting forms	0.0074
Total	$0.1263

In considering these figures the high cost of labor in the Pacific Northwest should be kept in mind.

Bituminous Gravel Concrete Pavements.

A pavement consisting of a mixture of asphalt and gravel has been constructed on some of the highways near New York City. The highways as originally built eight or ten years ago were designed to take care of horse-drawn traffic and were of the waterbound macadam type of construction. About four years ago the general design of alignment, grade and wearing surfaces was changed to conform to the daily increasing automobile traffic, the penetration method of construction being substituted for the old waterbound macadam surface. At present these roads have not only to take care of the vehicles and motor car traffic but also of the motor truck, which is fast increasing in use as a local freight carrier. This condition made necessary the construction of a comparatively more permanent type of pavement, and as a result a bituminous gravel concrete surface was designed by Mr. Stewart, the division engineer of the State Highway Department in charge of this territory.

The following description of this pavement is taken from a paper presented at the Cleveland meeting of Section D of the American Association for the Advancement of Science by Spencer J. Stewart, Assoc. M. Am. Soc. C. E., Division Engineer, New York State Department of Highways, White Plains, N. Y.

Method of Construction.—The pavement consists of a mixture of asphalt and gravel in the proportion of 1 cu. yd. of loose gravel to an average of 20 gals. of asphalt, the gravel containing not less than 10 per cent of clay. The gravel is bank run, the largest particle of which was 2 ins. in its longest dimension, and containing sufficient fines to partially fill the voids. The bitumen was a fluxed natural lake asphalt with a penetration between 10 and 13 mm. when tested for 5 secs. at 77° F. on a No. 2 needle weighing 100 grams.

The gravel was heated in a mechanical revolving drier to a temperature of over 225° F., after which the asphalt, heated to not less than 275° F., was added and the mixture placed in a revolving mixer and thoroughly agitated until all particles were thoroughly and completely coated with the bituminous material. The mixture, at not less than 250° F., was then spread upon the prepared bottom course by use of shovels from dumping boards and raked to a uniform surface with hot rakes, after which it was rolled with a self-propelled roller weighing at least 10 tons until thoroughly consolidated.

Upon this surface was placed ½ in. of gravel screenings, containing not less than 10 per cent of clay, which was saturated with water and rolled thoroughly and continuously until a clay mortar had been obtained. This process filled all the surface interstices with a gritty and adhesive substance, which made the road practically "non-skid." The traffic in a short time drives away all surplus screenings, leaving a mosaic surface.

In constructing this pavement it is not considered expedient to have a small percentage of voids, thereby allowing the heat of the sun and the traffic to gradually consolidate the pavement, resulting in a comparatively smooth and even surface and avoiding the short wavy condition of pavements in which the mineral aggregate is fine and the bitumen in larger proportion to the mineral aggregate than in the above described specifications. This theory has been substantiated in actual construction.

Fig. 2—View of Surface After Rolling; Surface Voids Filled by Puddling in Gravel Screenings.

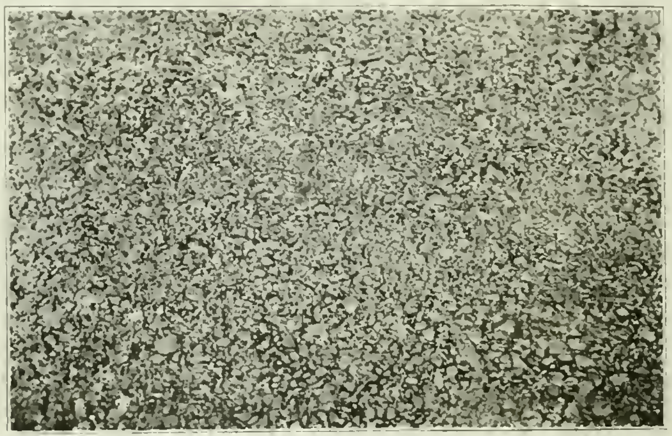


Fig. 3—Mixture of Gravel and Asphalt After Rolling; Camera About 6 Ft. From Surface.

The Gravel.—The gravel is composed of calcareous sandstone, granite and quartzite, associated with a considerable amount of finer particles of the above named rocks, together with a percentage of clay. This latter substance gives the gravel a good cementitious value, which is an essential to the comparative permanency of the pavement. The clay acts as a catalyzer on the asphalt, making it more viscous, less volatile and also less brittle.

The success of this pavement, in Mr. Stewart's opinion, is due to the physical qualities possessed by the gravel that was used as the mineral aggregate, the gravel being Hudson River cementitious gravel, of which there are many pits along the banks of the Hudson River and at least three that are developed commercially. The nature of this material was brought to his attention, first by its general use on the parkway systems of New York City and many of the country roads on Long Island where it had been used very successfully as a water-puddled roadway until the advent of the motor vehicle. It occurred to him that if it was possible to use this material and obtain similar results with an additional element in its composition that would insure its resistance to motor traffic, that it would be an economical and desirable result.

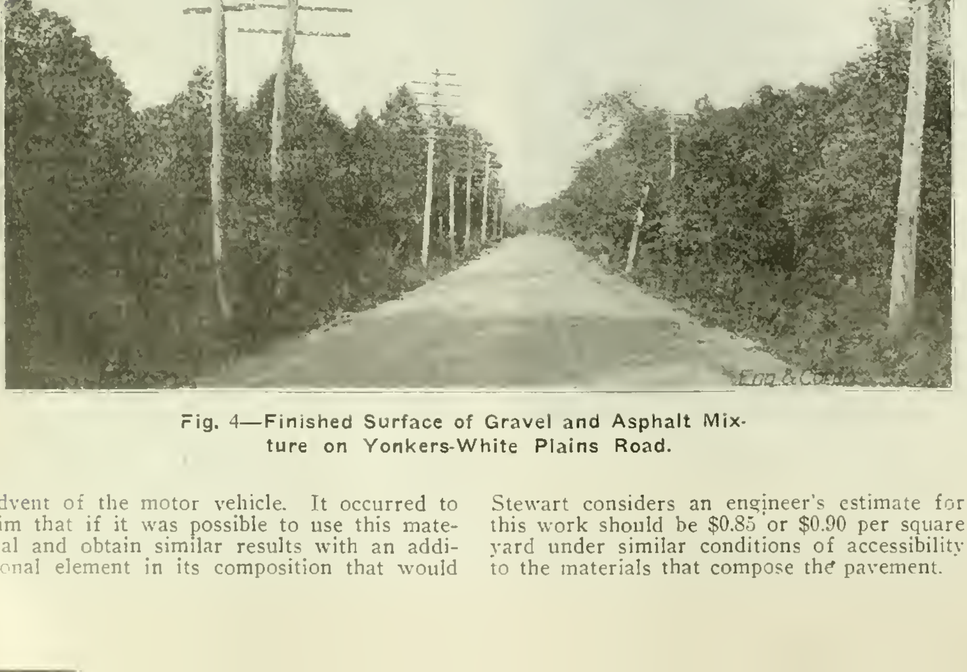


Fig. 4—Finished Surface of Gravel and Asphalt Mixture on Yonkers-White Plains Road.

This composition of gravel and asphalt retains all the agreeableness of travel and also retains the appearance of the original gravel road. At the same time it has the added feature of comparative stability and resistance to wear of other pavements that could be justly classified as those belonging to a city or a populous village.

Pavements of a semi-permanent nature, now commonly used in cities and villages, seem somewhat out of keeping with the surroundings when placed upon park driveways or country highways, being noisy, hard and unattractive. This mixture of gravel and asphalt overcomes all these criticisms by being comparatively noiseless, resilient, easy riding, and conforming to our ideals of what should be the appearance of a country or park driveway, and in addition to this it possesses a feature which not only the driver of a horse, but also the users of automobiles can readily appreciate, namely, that it has a "non-skid" surface.

Costs.—Another feature of this pavement is the lower cost as compared with other so-called permanent pavements.

The average price bid by contractors for a pavement 2½-in. deep of this nature has been $0.85 per square yard. From reports of engineers in immediate charge of the different contracts, the percentage of profit has varied from 0 to 15 per cent. On this basis Mr. Stewart considers an engineer's estimate for this work should be $0.85 or $0.90 per square yard under similar conditions of accessibility to the materials that compose the pavement.

The cost of the mineral aggregate averaged $3.25 per cubic yard on the site of the work. The cost of the asphalt averaged $0.15 per gallon on the site of the work. On one road the contractor erected a central plant at the railroad station, involving a cost of about $8,000.

On another road the contractor made use of a portable plant costing about $2,200. This plant was designed to carry the mixture by means of an extending arm from the mixer to the place where the pavement was being laid. This necessitated a constant shifting of the plant. Another contractor used a portable plant, moving it on an average of 1,000 ft., and transporting his mixture by means of horse-drawn steel carts. This last method Mr. Stewart considers the most satisfactory and economical.

Where the above described ingredients can be obtained, Mr. Stewart believes this form of pavement to be worthy of investigation and consideration for the following reasons:

First on account of its comparatively low cost.

Second because of its adaptability to country and parkway purposes, due to the easy riding surface, and its conformity to our ideals of the surroundings of a parkway or country highway.

Third on account of its non-slippery nature, it being practically a "non-skid" road.

Examples of this pavement can be seen on Central avenue from the northerly line of the City of Yonkers extending northerly towards White Plains for 2¾ miles. In this case the pavement was placed upon an old macadam foundation.

On the south shore of Long Island in the Village of Amityville, built upon a gravel foundation.

On the south shore of Long Island in the Village of Babylon, built upon a gravel foundation.

On the road extending from East Hampton to Sag Harbor on Long Island, built upon a trap rock sand filled foundation.

The Petrographic Study of Road Building Rocks in The U. S. Office of Public Roads.

The importance of selecting proper materials for the construction of macadam roads has become generally recognized and has led to a careful study of road material, both for the purpose of classification as well as to determine in what manner certain physical properties are dependent upon mineral composition and rock structure. Since the reorganization of the U. S. Office of Public Roads by the Secretary of Agriculture in December, 1900, about 2,000 samples of rock and slag from nearly every state in the Union have been examined microscopically and tested to determine their adaptability for road construction purposes. The method of making this examination was described in a paper presented at the Cleveland meeting of Section D of the American Association for the Advancement of Science by E. C. E. Lord, Petrographer, U. S. Office of Public Roads, Washington, D. C. In his paper, which is reprinted below practically in full, Mr. Lord refers in a general way to more important rock types, discusses their method of analysis, classification and physical properties, and briefly mentions such artificial products as give promise of being valuable for road building.

Analysis of Inorganic Road Materials.—The analysis of this material consists chiefly in a quantitative microscopic determination of the rock-forming minerals. To accomplish this it is in the first instance necessary to prepare a thin slice or section of the rock sample so that its mineral constituents may be readily recognized and measured. This is done by grinding down with emery powder on a revolving iron disc a chip from the sample until a smooth, flat surface is obtained. This surface is then firmly attached to a thick glass by means of Canada balsam and the grinding continued until the chip becomes transparent, when it is transferred to an object glass and protected with a very thin cover glass. The minerals present in the slide are then identified under the microscope and their relative volumetric proportions determined by means of a measuring apparatus fixed in the eye-piece of the instrument. This apparatus was designed by Mr. L. W. Page and consists of a cross-line micrometer about 1 cm. square divided into 100 small squares (see Fig. 1). One of these squares being 1/100 or 1 per cent of the larger field, the percentage proportions of the minerals present in the field are determined by simply noting the square areas occupied by each mineral in turn. Averages obtained from numerous examinations of this kind in various parts of the section indicate the percentage of the different minerals constituting the rock itself. In reporting the results of the microscopic analyses, the geologic character, name and location of the sample are indicated, and the minerals classed according to the microscopic determination, as essential, accessory and secondary, and their general chemical composition and volumetric percentages given. Finally the color, texture and other properties likely to be of value to road engineers are noted.

Classification of Material.—The present systematic arrangement of rocks for road building adopted by the Office of Public Roads has been made so far as possible to meet the requirements of road engineers without departing from established geologic principles. Thus it will be seen in Table I that all rocks used for road metal may be separated into three general groups or classes according to their geologic character and that these groups may be again divided into types and families according to their structure and mineral composition. Rocks of the igneous class have either cooled very slowly at great depths below the earth's surface to form the coarse-grained plutonic types such as granite, diorite, gabbro, etc., or have chilled suddenly upon reaching the surface as finer grained rhyolite, andesite, basalt, etc. Rocks of the second class owe their origin chiefly to the induration of water-deposited material either of a siliceous or calcareous character (sandstones, limestones, chert, etc.), and are usually stratified. White rocks of the third class have been formed by the prolonged action of heat and moisture on both igneous and sedimentary rocks, and show generally of a more or less foliated or schistose structure. The mineral components of these rocks vary greatly in shape and size and in their manner of aggregation (structure) according to the character of the rock in which they occur.

TABLE I.—GENERAL CLASSIFICATION OF ROCKS FOR ROAD MAKING.

Class.	Type.	Family.
I. Igneous	1. Intrusive (plutonic)	a. Granite
		b. Syenite
		c. Diorite
		d. Gabbro
		e. Peridotite
	2. Extrusive (volcanic)	a. Rhyolite
		b. Trachyte
		c. Andesite
		d. Basalt and diabase
II. Sedimentary	1. Calcareous	a. Limestone
		b. Dolomite
	2. Siliceous	a. Shale
		b. Sandstone
		c. Chert (flint)
III. Metamorphic	1. Foliated	a. Gneiss
		b. Schist
		c. Amphibolite
	2. Nonfoliated	a. Slate
		b. Quartzite
		c. Eclogite
		d. Marble

Turning now to a very brief consideration of these minerals, we find that the bulk of road-making rocks is made up of ten primary or original components, ranging in composition from pure silica (quartz) to magnetic iron oxide (magnetite) and five secondary minerals, or the resulting products of rock decay, of which kaolin, a constituent of clay chlorite and calcite (carbonate of lime) are the most abundant.

TABLE II.—MINERAL CONSTITUENTS OF ROCKS USED FOR ROAD MAKING.

Name.	Chemical composition.	Volumetric percentages.
Quartz	Silica	23
Orthoclase	Silicate of alumina and potash	15
Plagioclase	Silicate of alumina, lime and soda	15
Augite	Silicate of lime, magnesia, iron and alumina	8
Hornblende	Silicate of lime, magnesia. iron and alumina	7
Calcite	Carbonate of lime	7
Dolomite	Carbonate of lime and magnesia	5
Chlorite	Hydrous silicate of iron, magnesia and alumina	4
Biotite	Hydrous silicate of alumina, iron, magnesia and potash	3
Muscovite	Hydrous silicate of alumina and potash	3
Kaolin	Hydrous silicate of alumina	2
Epidote	Hydrous silicate of lime, iron and alumina	2
Magnetite	Magnetic oxide of iron	2
Garnet	Silicate of iron, alumina and lime	1
Limonite	Hydrated oxide of iron	1

In Table II are given the essential minerals occurring in rocks for road making, together with their general chemical composition and approximate volumetric percentages. These minerals when freely developed have characteristic crystal form with well-defined plane surfaces, whereas when present in rocks this crystal form is to a large extent lacking. With the aid of the microscope, however, we are enabled to readily identify each mineral by means of definite optical and physical properties that are not discernible with the naked eye.

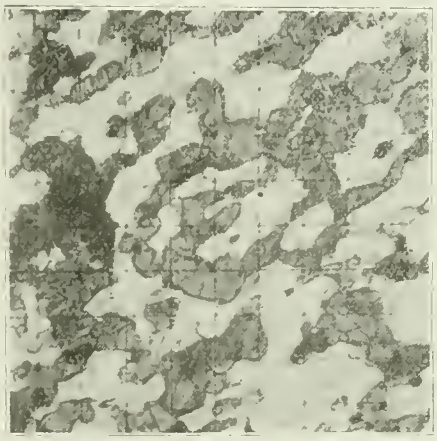


Fig. 1—Crossline Field Illustrating Method of Estimating Minerals in Thin Section.

From a road-making standpoint, the chief interest attached to these minerals is the manner in which they occur to form the rocks in use on the road. Of these rocks the more important varieties belong to the ingneous class which have formed from a state of liquid fusion. In this general group may be included the rock-like materials known as furnace slag or cinder that are produced in the manufacture of iron, steel and other metals. The minerals constituting these igneous rocks and slags are largely determined by the chemical composition of the fused material (rock magma). Thus we find that certain magmas rich in silica and potash produce on cooling light colored granite or rhyolite composed chiefly of quartz, orthoclase and mica; while other magmas, among which slag may be classed, having less silica and more iron, lime and magnesia, give rise on cooling to so-called trap rocks such as diabase, basalt, gabbro, etc. These trap rocks are made up chiefly of plagioclase feldspar, augite and hornblende very compactly intergrown. Owing to the great amount of lime used in fluxing many iron ores, the resulting slag is frequently so rich in lime and poor in silica that certain minerals, resembling those of Portland cement, are developed.

The mineral components of sedimentary rocks consist chiefly of fragments of quartz, orthoclase and calcareous shells that have withstood the abrasive effects of transportation and have become cemented together by carbonate of lime (calcite), hydrated iron oxide (limonite) or silica (quartz). Chert, or flint, differs somewhat from normal sedimentary rocks in that it is composed chiefly of very finely divided quartz deposited in sea water from chemical solutions, the silica being derived mainly from siliceous shells of minute marine animals.

The minerals constituting metamorphic rocks are essentially similar to those found in igneous and sedimentary rocks with the exception that certain constituents, such as biotite, muscovite, hornblende, etc., have been reformed through metamorphic agencies and arranged in more or less parallel layers, thereby causing the characteristic foliated or schistose structure already referred to.

Physical Properties of Road Materials.—The suitability of rocks for road making is determined largely by the physical properties of the material which may be expressed by resistance to impact (toughness), loss on abrasion (hardness), per cent of wear and cementing value, the latter being a measure of the property of rock dust to adhere or cement together when moistened and compressed. These properties and their method of determination have been recently described in bulletin No. 44 of the U. S. Office of Public Roads, and it will therefore suffice to call attention here to certain differences in structure and composition of the principal rock types which may be said in a general way to effect their road-making value. Thus it has been found that igneous rocks composed of hard silicate minerals that have crystallized in such a manner as to form dense compact masses have as a rule better wearing properties than the stratified sedimentary or foliated metamorphic rocks which, owing to their mode of origin, are usually more loosely textured and contain frequently large quantities of softer constituents (calcite, chlorite, muscovite, etc.).

The physical differences in road-making rocks is especially noticeable in the peculiar shapes of their smaller fragments or screenings. It will be observed in the first place that the screenings from coarse-grained granites, gabbros, gneisses, etc., after the removal of the very fine dust are much more cubical in form than similar fragments from the finer grained igneous rocks, such as rhyolite, diabase, andesite, etc., which appear splintery or wedge-shaped as a result of greater toughness caused by the dense interlocking structure of their mineral components. In case of sandstone and schist screenings the rounded form of the former resembling loose sand and the flat, lath-like shape of the latter may be directly ascribed to the peculiar structure and mineral composition of these rocks.

If we turn now to the behavior of these various rock screenings on the road, we find that the splintery, wedge-shaped fragments from the fine grained igneous rocks (traps) produce ordinarily a firmer and more permanent bond with the coarser road stones than can be obtained with the more cubical and rounded fragments of granite and sandstone or with the fragile, lath-shaped schist screenings. This interlocking of the coarse fragments under the roller may be termed the mechanical bond in distinction from the cementing bond or binding effect produced by the fine rock dust. This cementing property is caused by adhesive coloidal silica and hydrated silicates present in the dust or by the later formation of such substances on the road through the chemical action of water on the soluble constituents of the rock powder.

In the case of many rocks, however, this cementing value is insufficient to prevent disintegration of the road surface under modern traffic conditions and recourse has consequently been taken to bituminous and other organic road binders. It should be mentioned, however, on the other hand that certain artificial inorganic binders, such as basic slags, have proved successful when properly applied, and in conclusion it may be of interest to say a word regarding them.

It has been found that much of the slag resulting from the manufacture of iron and steel throughout the country has solidified in a crystalline or semi-crystalline condition and while having about the average toughness and hardness of natural rock, shows in many cases very high cementing values. This is specially true of the very basic dark brown slag produced in the manufacture of steel by the basic open-hearth process. This material when ground will harden under water in much the same manner as Portland cement. When used on the road as a binder in conjunction with ordinary blast-furnace slag, it has given very satisfactory results and it would therefore seem to offer possibilities for a wider field of usefulness as a binder on water-bound macadam roads.

Rock Crushing by Convict Labor in Washington.

The State of Washington owns five rock quarries, selected for their superior quality of road material. At each of these quarries, under the control of the Highway Commissioner, the state operates a modern rock crushing plant with convict labor. In connection with each plant there is a modern camp built for permanency, and the comfortable housing of officers and convicts.

The quarries were originally designed to provide first-class material at a low cost, for use on state and state aid roads. The general scheme of road building at the time they were first planned, contemplated a bituminous road on a crushed rock base or macadam, which provided a market for all sizes in the proportions crushed. Since that time the state aid law has been repealed. Furthermore, no appropriations for state roads were made by the 1911 Legislature, and the counties, which under the new permanent highway law, furnish the material and build the roads, that were formerly built by the Highway Commissioner under the state aid law, have in some instances opened their own quarries. All this reduced the market for the crushed rock from the state quarries. However, the quarries are now self-sustaining, and there is no fund available for their operation other than the rotary fund which is credited with all sales of rock from the five quarries. The management of the quarries from Oct. 1, 1910, to March 31, 1911, rested with the State Board of Control. The statement for this period is as follows:

Net resources in excess of liabilities Oct. 1, 1910		$ 1,210
Credit for sale of 26,273 cu. yds. of rock		21,351
Total credit		$22,561
Cost of operation	$24,345	
Less amounts subsequently paid from other funds	2,553	
Operation paid from Good Roads Fund		$21,791
Net resources in excess of liabilities		$ 770

On April 1, 1911, the quarries come under the control of the State Highway Commissioner. The statement covering the period from this date to Sept. 30, 1912, shows the following:

Net resources	$ 770
Credit from sale of 96,225 cu. yds. rock	66,878
Total credit	$67,648
Cost of operation for 18 months	63,482
Net resources in excess of obligations on Sept. 30, 1912	$ 4,166

On Dec. 1 last the surplus had been increased to $7,597, with good business in sight for the two quarries operating.

The following details of the working of the Meskill quarry are given in the 4th Biennial Report of W. J. Roberts, State Highway Commissioner, from which the matter in this article is taken. These figures are given to show that the cost of producing the rock depends upon the volume of business. As an example of the wide fluctuation between different months, the record of operation at Meskill quarry is given for two months, one showing a very high cost and the other a very low cost.

The rock at the Meskill quarry is a basalt of average hardness and toughness and rather high resistance to wear; it has a fair cementing value. The quarry is situated in Lewis County, at Meskill, 14 miles west of Chehalis, on the South Bend branch of the Northern Pacific Ry. The 160 acres of ground was donated to the state by Lewis County. The product of the quarry is transported by the railway.

The buildings at the quarry consist of a superintendent's cottage, officers' quarters, including suitable accommodations for a clerk, and his wife, main convict bunkhouse for 48 men, combination building, including cook's bunkhouse for six men, laundry and three dungeons, dining-room and kitchen. In addition there is a 15-ft. stockade wall.

The crushing plant at the quarry includes the following: Austin No. 6 gyratory, main crusher; Austin No. 6 standard elevator, 68 ft. long; Austin No. 6 revolving screen, 20 ft. x 40 ins., three sections; Fairbanks-Morse motor, 75 H. P. operating main crusher, elevator and screen; Austin No. 3 gyratory-auxiliary crusher for regrinding oversize from No. 6 crusher; Fairbanks-Morse motor, 30 H. P. The quarry equipment consists of the following: Ingersoll-Rand air compressor, 12¼ ins. x 12 ins., capable of furnishing compressed air for two 3¼-in. drills; Fairbanks-Morse motor, 50 H. P.; two "Wood" air drills; Deane triplex 4-in. x 5-in. pump operated at present by air compressor motor and used for washing rock and removing overburden; nine 15-cu.-ft. end-dump quarry cars; blacksmith outfit complete. Power for small motors and lights is furnished by a power line 14 miles long from Chehalis. Three-phase 2,400-volt current is supplied and the state transforms this to 110 volts. The bunkers are of the center loading type, with standard railroad clearance. They have a capacity of 750 cu. yds. The sidetrack is 1,450 ft. long from head block to head block, and has a length available for car storage of 1,150 ft., affording room for 12 empty cars and 13 loaded ones. The water supply is obtained from a well, by means of a Buffalo pump 2¾ ins. x 4 ins. direct connected to a 3-H. P. Fairbanks-Morse motor; 2-H. P. Fairbanks-Morse gasoline engine and pump supplies water for the air compressor.

The cost of operating the quarry for the month of February, 1912, was as follows:

MESKILL QUARRY, FEBRUARY, 1912.

Salaries and wages	$396.55
Subsistence	178.12
Clothing and shoes	19.00
General supplies and expense quarry	33.69
Power, light and heat	65.27
Repairs	.40
Medical	.....
Tools	5.38
Powder	.....
Escapes	.....
Transportation of convicts	.....
General expense, Olympia	160.53
Total cost of operation	$858.94
Received from sale of rock	360.00
Operated at a loss	$498.94

Cubic yards rock sold, 500.
Cost per cubic yard, $1.72.

Notwithstanding the low total cost, the cost per cubic yard was high because the orders were light. The spare time of the men was profitably occupied, however, by the removal of overburden, preparatory to the next summer's run. The cost of operating the quarry during September, 1912, was as follows:

MESKILL QUARRY, SEPTEMBER, 1912.

Salaries and wages	$ 400.00
Subsistence	277.77
Clothing and shoes	24.86
General supplies and expense quarry	91.60
Power, light and heat	122.68
Repairs	177.26
Medical	.50
Tools	6.78
Powder	111.91
Escapes	......
Transportation of convicts	......
General expense, Olympia	95.80
Total cost of operation	$1,399.69
Received from sale of rock	3,011.00
Operated at a profit of	$1,611.31

Cubic yards rock sold, 4,305.
Cost per cubic yard, $0.33.

The organization at the quarry, when running at capacity, consists of seven free men and 35 convicts. The force is made up as follows: Superintendent, clerk, foreman, mechanic, and three guards. One guard is on night duty and two are on day duty. All of these seven men, except the guards, would be necessary for the operation of a free labor quarry.

The division of convict labor is as follows:

Camp crew	4
Blacksmith	1
Mechanic's assistant	1
Crusher feeder	1
Burley men	2
Quarry	26
Full crew	35

The camp crew consists of a cook, cook's helper, laundryman, and a fourth man who keeps the bunk houses and officers' quarters clean, distributes the coal and wood, and acts in other capacities as a trusty.

The blacksmith sharpens the drill steel and does such iron work as is needed for repairs. The mechanic's assistant is generally a handy man about the machinery. The paid mechanic, blacksmith and mechanic's assistant are supposed to keep the plant in constant operation, and there has been very few shut downs for repairs since this plan was adopted.

The crusher feeder distributes the rock into the crusher as it is dumped from the quarry cars, equalizing the crushing strain. The burley men operate the air drill, bar down loose rock from the ledge and load railroad cars.

The quarry crew is divided, as a rule, into six groups of four each, with two extra rock breakers. Each group is assigned a station and car and must move its share of the day's output from the quarry to the crusher.

The plan of the Board of Control in furnishing these prisoners is to construe the quarries as parole camps and send men who after nine months' faithful service at the quarry are eligible for final discharge.

The men are fed well, clothed comfortably and given springs and mattresses to sleep on. In the summer they have the freedom of the stockade yard, and in winter are free to pass the long evenings in social amusements in the bunk house. It is the freedom of intercourse with each other as compared to the cell life of the penitentiary which they seem to appreciate most, and it undoubtedly has a good effect upon their work.

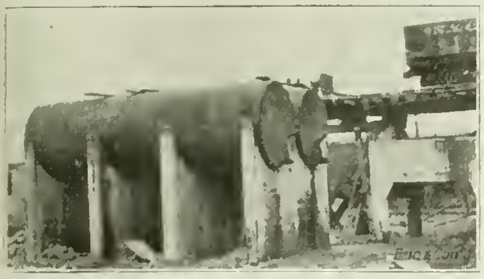


Fig. 1—Storage Plant of First Class at Springfield, Mass.

Municipal Plant for the Storage of Road Oil.

One source of loss that the purchaser of oil for use in street or road purposes often fails to consider is the amount of time the tank car is kept out of service owing to the lack of proper facilities for receiving the oil and through lack of co-operation between the departments purchasing the oil and the department that has charge of receiving and applying it. By the erection of oil receiving tanks or by the installation of trestles which will expedite the unloading of the cars and facilitate the handling of the oil, the purchaser can make a saving in demurrage and other charges that will repay very quickly the cost of such construction. An interesting discussion of this question was given in a paper presented at the Cleveland meeting of Section D of the American Association for the Advancement of Science by William H. Kershaw, Assoc. M. Am. Soc. C. E., Chief Engineer, Paving and Roads Division, The Texas Co., New York City. The following matter is abstracted from Mr. Kershaw's paper:

There are at present very few municipal storage plants for the handling of road oil, but they can be divided into three general classes:

First Class.—The first class is an arrangement whereby the oil may be emptied by gravity from tank cars into stationary receiving tanks, and from the latter drawn by gravity into distributing wagons.

Second Class.—The second class is an arrangement where the receiving tanks are placed beside the track and either in unloading the oil from the car to the receiving tank or from the receiving tank to the distributing wagon, one operation is performed by pumping and the other by gravity.

Third Class.—The third class is an arrangement whereby it is necessary to pump the oil from the car to the receiving tank and again from the receiving tank to the distributing wagon.

Figure 1 shows a storage plant of the first class located at Springfield, Mass. This equipment consists of two 10,000-gal. tanks carried on concrete footings. These tanks are arranged so that there is a fall of 2 ft. from the bottom of the tank car as it stands on the track, to the top of the receiving tanks and a fall of 2 ft. from the bottom of the receiving tanks to the top of the distributing wagons. These are single compartment tanks.

St. Louis, Mo., is equipped to handle road oil, binders, and asphalts by means of a storage plant of the second class. In their case the tanks are equipped with coils and the piping is steam jacketed. Greenwich, Conn., has a 10-000-gal. plant of the second class. This plant is located on the side of the railroad fill, allowing filling of tank from tank car by gravity. There are a few other isolated cases of towns possessing equipment of some sort. One of the largest cities, handling many hundred thousand gallons of road oil per year, appropriated money for the erection of five receiving tanks a year ago, but the importance of the proposition and the saving that would result was not appreciated and the money was allowed to return to the treasury unused.

One road contracting concern has within the past year installed eight receiving tanks of the type described below.

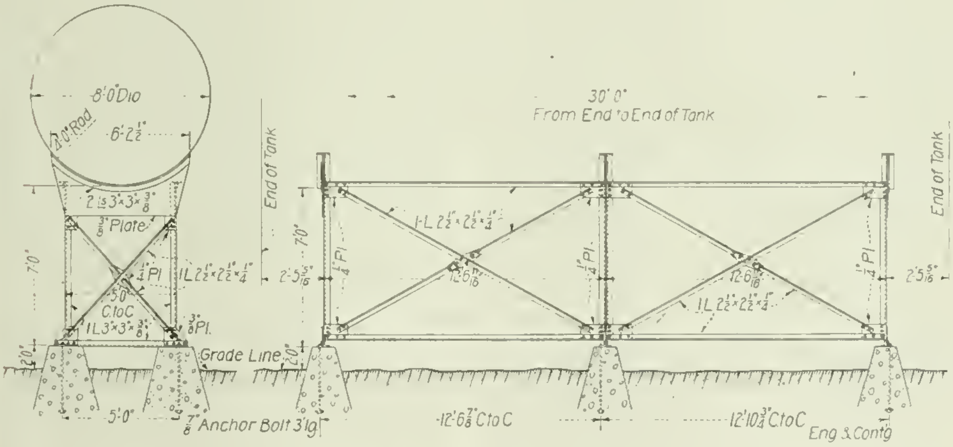


Fig. 2—End Elevation and Side Elevation of Recommended Type of Storage Plant.

Inasmuch as road oil is being shipped in tank cars varying in capacity from 4,000 to 12,000 gals., a tank 8 ft. in diameter by 30 ft. long, with an approximate capacity of 12,000 gals., is recommended. Steel supports are less expensive than concrete and are as efficient. Figures 2 and 3 show the arrangement will give the details of the construction.

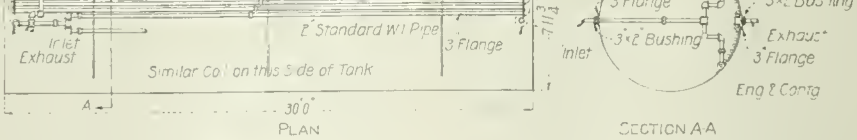


Fig. 3—Plan and Section of Tank of Recommended Type of Storage Plant.

These tanks are equipped with steam coils to make it possible to handle any of the heavier grade binding oils and solid asphalts as well as the light oils. The cost of installing of the tanks, and careful study of these plans these coils is nominal and as the plants would usually be constructed in the city yard where there is a steam plant in operation or where a steam roller can be quickly connected, it is a profitable investment to install coils when the tank is erected, even though the possibility of using it for anything but light oil cannot be foreseen.

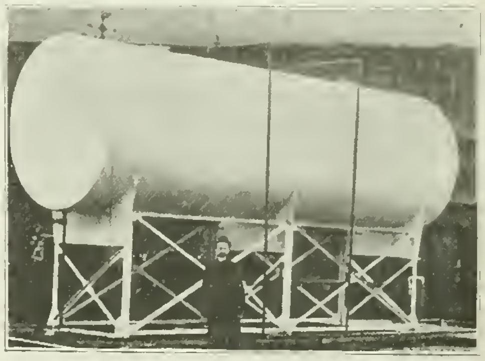


Fig. 4—Oil Storage Plant of Recommended Type.

It is recommended that the tank be so placed as to give a minimum fall of 2 ins. in 30 ft. toward the outlet end of the tank.

It is important that the arrangement of the steam coils in the tank should be such that a coil is placed immediately above and around the opening in the outlet pipe, thus preventing any possibility of heavier material blocking up the outlet.

To satisfactorily handle all the heavier grades of material the steam coils should be placed not over ¾ in. from the bottom of the tank. The amount of piping in connection with a plant of this kind is relatively small and the difference in cost between steam-jacketed pipes and ordinary piping is so small that a steam-jacketed pipe should, without exception, be used, thus making it impossible for the discharge pipe to be stopped even in the coldest weather.

Pumps operated by power can many times be made a profitable part of the equipment, and, of course, even though double gravity arrangement is possible, the solid bitumens cannot be drawn from the car or the tank without the aid of a pump, and inasmuch as a steam pump with its necessary connections can be installed for from $50 to $75, it should be added to the plant. A set of connections varying in size from 3 to 6 ins. to fit the various makes of tank cars now in road oil service should be kept at the plant.

The type of plant recommended and shown in Figs. 2, 3 and 4 cost, during the summer of 1912, $640 for the tank with the coils and exclusive of the supports. The steel supports erected cost approximately $150. If the tank is placed near a railroad siding the cost of piping with steam jacketed pipes would be under $150.

The Springfield plant above described cost in 1912 $688 for the two tanks and in the installation with concrete abuttments, and including the piping, cost $812, making a total cost for the complete equipment of $1,500.

A road oil storage plant would pay for itself in the saving of the fixed demurrage charge of $1 per day that is charged by the railroads, and the saving in the cost of oil to towns and cities equipped to receive it would show a decided earning on the investment.

The advantage of waiting after a rain until the road is in the proper condition to receive the oil is recognized. The combined urging of the owner of the tank car for the prompt return of the car, together with the accumulating fixed demurrage charge of the railroad company, has often influenced road officials to apply the oil at a time and under conditions which made it impossible to obtain the full efficiency of the treatment.

Modern Road Making Machinery and Its Uses.

In 1879 when the law establishing the labor system for maintaining the public highways in Illinois was enacted, it enumerated as follows the various implements that overseers might require to be furnished: Spade, shovel, ax, hoe, plow, yoke of oxen or team of horses or mules, and a wagon or truck. This indicates about the equipment that was deemed necessary in those days of highway work. In the last 30 years there has been a great evolution both in the processes and in the machinery used in road construction. The variety and uses of present day machinery are well set forth by Mr. T. R. Agg, Road Engineer of the Illinois Highway Commission, in a paper presented at the recent convention of the Illinois Society of Engineers and Surveyors. In his paper, which is reprinted below practically in full, Mr. Agg enumerates the more important modern road machinery, and outlines briefly its field of usefulness.

There are certain kinds of machinery that have come into use in the construction and maintenance of earth roads, and are used more or less in all other forms of road construction. One of the simplest, yet one of the most necessary of these implements, is a strongly constructed plow of suitable design. It should be sufficiently heavy to permit its being drawn with a tractor and at the same time should be narrow enough that it can be drawn with teams when occasion demands. A plow having a long beam with shoes for regulating the depth and with a share not to exceed 10 ins. wide, will answer most requirements.

Soils of a gravelly nature or hard baked earth can be most readily broken up with the type of plow known as the "rooter." The rooter plow should be very strongly built and weigh not less than 300 lbs. It should have a short beam fitted with a shoe for regulating the depth of plowing.

There are many ways of moving material after it has been loosened, but the slip and wheel scrapers meet all ordinary conditions. For moving earth a distance of not to exceed 100 ft., the slip scraper having a capacity of 5 cu. ft. is best. For distances of 100 ft. to 1,000 ft., the wheel scraper should be used. Inasmuch as a snap team is necessary for economy in any case, it is advisable to use a scraper having 14 to 16 cu. ft. capacity; that is, size No. 2½ or 3; one wheeler should be used for each 100 ft. of haul for each gang.

If material is to be moved for general reshaping of a public highway, a road grader of some kind will be used. The tendency in modern road work is to draw the grader with some sort of a tractor, therefore the grader which will give the best results, is one built sufficiently strong to withstand the hard service of tractor grading. It should also be arranged with some device for independent steering because it is impossible to steer a heavy tractor with sufficient accuracy to do the proper work with the grader. The grader should of course be capable of all the ordinary adjustments of the blade.

For crowning up earth roads where much material must be moved, excellent results are being obtained with the elevating grader, particularly on county road work being done by T. H. McDonald, State Engineer of Iowa. He has demonstrated that this machine furnishes a most economical and satisfactory method for handling this class of work. Such a grader may be of a size to be drawn with a tractor, or it may be smaller and drawn with team, but the tractor outfit is preferable on good soil.

An objection that is often made to the use of the elevating grader is that it leaves the road rough, due to clods of earth and sod being deposited on the roadway, making it unpleasant to travel. It should not be expected that the elevating grader will construct a finished job, but a small amount of work done by a disc harrow and drag after the elevating grader has finished will leave the road in excellent condition.

The use of steam and gasoline tractors for drawing road machinery is rapidly becoming standard practice and there are a great many types of tractors on the market. The tractor for this use should be multiple cylinder, oil burning and of strong design mechanically. It should be designed for hand steering and so arranged as to give the operator a good view of the roadway. The driving wheels should be of sufficient width to permit the use of the tractors on soft soil.

The general effect of traffic on an earth road is to flatten it and work the soil away from the traveled portion of the road towards the ditches. At least once a year a little material must be drawn back towards the center of the roadway in order to maintain a proper cross section. Several devices have been perfected for doing this work, and the machine of the general type of the Monroe leveler seems to give about as good results as any that are available. This machine is drawn by a tractor which travels in the middle of the road, and the leveler has wings which draw in the material from the side of the road spreading it in the middle portion. Such a device is an excellent one for heavy maintenance work. One bad feature of the work done with these machines is that a ridge of loose earth is usually left in the middle of the road. If such a machine is used with a drag following and then rolled, this fault is overcome and the road will be so shaped that the traffic will use the middle of the road instead of getting off to one side.

For light maintenance work on earth roads, the most satisfactory device in use is the split log or some similar form of drag. A number of types of these road drags have been developed. The split log is a form which was first used and seems to give about as good results as any other. The plank drag is very similar in form to the split log drag except that heavy planks are used instead of halves of a split log. The front plank is usually shod with metal while the rear plank is not. Another form of drag which is in the nature of a slicker and is very satisfactory for very sticky soil, is made by nailing three or four planks together, overlapping slightly. There have been in addition a number of special forms of drag designed, but all operate on the same general principles, although many of them have special features which are of interest and perhaps of some benefit in operation.

A large item of expense in ordinary road maintenance, particularly in Mississippi Valley states, is in the construction of culverts ranging in size from 12 ins. in diameter to 3 ft. in diameter, those, however, from 12 ins. to 24 ins. predominating.

Concrete is coming into general use for the construction of these culverts, and collapsible metal forms are of decided economy in the construction of these small culverts. There are a great many types of these collapsible forms to be had, but that which will give a circular opening is perhaps to be preferred. The essential principle of all of these forms is, of course, that when the concrete has set the forms can be removed and used for another culvert. A very satisfactory home-made form for circular culverts can be made by building up 2x4 scantlings of the desired length around a disc which has been cut to give a desired diameter to the culvert. The 2x4's are first strung on a wire run through holes at each end bored through the 4-in. dimension of the scantling. The scantlings are then rolled up around the disc and tied with a wire hoop and the wire through the holes removed. The closure is held slightly open by means of wedges which are removed to permit the collapse of the form. These forms are very cheap and can be used a number of times, and while they do not give as smooth a finish to the inside of the culvert as the metal forms, yet on account of the cheapness, they may often be used when it would hardly pay to purchase more expensive forms.

A concrete mixer having a capacity of 3 or 4 cu. ft. per batch is of advantage in small culvert work, and the choice from any one of a number of makes on the market will insure a machine which will give satisfactory results. In general, while the continuous mixers in many cases are excellent machines, yet with the unskilled operation usual in road work, it is believed that much better results in the long run will be obtained by the use of the batch mixer, and probably this principle holds true on even larger work.

Besides the tools and machines which are necessary in the construction and maintenance of earth roads, there are a number of additional kinds of machinery that are necessary for use in the construction of the various kinds of hard roads. In the preparation of the roadbed, the ordinary grading tools which are used in earth road work should be available, and in addition there will be a number of special pieces of machinery necessary.

In the construction of hard roads, the material is usually shipped in coal cars and hauled by wagon to the work. There is on the market a chute which is suspended from the side of the car large enough to hold a wagon load of material. The wagon is placed under the chute and the contents dumped into the wagon by tripping the door, thus securing a wagon load in a very short time. These chutes are of considerable economy where large quantities of material are being handled. The cost of shoveling material into the chutes is less than for shoveling into the wagon, because the opening into which the material is thrown is visible from any position in the car. The great economy in their use, however, is due to the fact that the team is not idle for any considerable length of time while the wagon is being loaded at the car. It oftentimes happens that the material is shipped in and stored during the winter, and with the difficulty of securing coal cars during the construction season, this practice is becoming more and more general. When loading such material on to the wagons for the placement on the road, a loading incline is essential. It consists of an inclined trough so arranged that the wagon can be drawn up under an apron at the upper end and the crushed stone or other material dragged up by means of a team and slip scraper and dumped into the wagons. While the cost of operation of such a loading device is per cubic yard about as great as the cost of shoveling the material into the wagon, yet the time of loading is much reduced, and there is a saving on the time of the teams.

In some instances the material for the construction of hard roads is quarried and crushed near the site of the construction. The machinery required is a stonecrusher of the desired capacity, a gasoline or steam engine for operating the crusher and a screening plant and bins. The details of the arrangement of the machinery depends upon the class of work being done, but it is common to use a plant having a capacity of 75 to 100 tons of material in 10 hours, together with the necessary screens and bins.

In two or three plants of about this capacity which have been in operation in Illinois from which data are available, the cost of the crushed stone on wagons was 60 cts. per ton. This included all the cost of quarrying and crushing. The stone being rather a soft limestone and badly fissured in the ledge, the expense for blasting was small.

A macadam road should always be built with a roller. The accepted form for macadam highway construction or street work is a three-wheel, self-propelled roller weighing from 10 to 12 tons. Such a roller is also suitable for rolling embankments in heavy grading work, although the weight might need to be varied with different classes of material to be compacted. If the roller is to be used on bituminous macadam work, it should be equipped with an apparatus for spraying water on the wheels.

The weight of the machine should be so distributed between the front and rear rolls that the weight per lineal inch on the front roll is not less than 75 per cent nor more than 90 per cent of the weight per inch of width on the rear roll. The machine should be hand steered unless the weight is greater than 12 tons, and if mechanically steered, the steering apparatus should be independent of the engine operating the roller. Both steam propelled and gasoline and oil motor rollers are being used and are giving satisfactory results, and there are classes of work and conditions under which each is most economical.

In the construction of waterbound macadam roads or bituminous macadam roads with a bonded lower course, a sprinkling wagon is a necessity. Any type of street sprinkling cart is adapted for this service, but it should be constructed with 6-in. tires and the type of gear known as "race track"; that is, the tread of the front wheels narrower than the tread of the rear wheels, so that in effect the wagon when drawn along the road has a bearing on the surface of 12 ins. on each track. This is necessary, because the sprinkling wagon is used on the macadam at the time when it is in condition to be easily injured, and if the tires are narrow, serious damage will result. The spray apparatus should be designed to throw the water directly down on to the road surface, because the object of the sprinkler is to wash in the screenings and bonding material. The sprinkling cart should have a pump attached for taking water from wells or ponds and should be equipped to force water into the roller boiler for washing out.

In preparing macadam for rolling, excellent results are obtained by harrowing the stone after it is spread and just before rolling begins. The harrow should be heavily built with teeth 1 in. or 1¼ in. in diameter, and the entire harrow should have a weight equal to about 10 lbs. for each tooth. It should also be so designed that when drawn by the hitch which is provided, the teeth will not follow each other, but will be well distributed across the width of the harrow.

A complete macadam outfit then should contain the following tools: Roller, sprinkling wagon, plow, harrow, tool box, rooter plow, and the necessary small tools. Such an outfit will cost approximately $3,100. Records kept in the work of the Illinois Highway Commission for six years and embracing 52 outfit seasons of operation, show that the average cost per outfit per season for maintenance is $61. This includes all repairs and replacement on all parts of the equipment mentioned above.

If the materials for road construction are hauled long distances, a traction engine outfit is necessary for economical work. The choice between the gasoline or oil tractor and the steam engine will depend very largely on the condition under which the machinery is to be operated. In general, it seems possible that there are decided advantages in the use of the gasoline tractor for this purpose. The cars which are used for hauling the material should be reversible so that it is unnecessary to turn the train around at the end of the trip. They should be dump-bottom and arranged so that the load can be spread as dumped. The size of the unit should be such that the load including the wagon will not exceed 5 or 6 tons if the hauling is over roads similar to those in the state of Illinois. For the car of this weight the wheels should be at least 8 ins. broad and should be cambered so as to fit the crown of a finished road.

Experience in Illinois shows that hauling with such an outfit is cheaper than team hauling for the same distances, and that the economy increases with the length of the haul up to the maximum for which data have been obtained in the work of the commission. The cost per cubic yard for hauling crushed stone with the tractor outfit is about 60 per cent that of team hauling for one mile and about 40 per cent of the cost of team hauling for distances of three miles. This cost includes the pay of the operator for the engine, who is paid straight time regardless of the conditions of the weather and whether the job is running or not, the cost of the fireman who is paid only for the days when the outfit works, the cost of fuel, oil and supplies for the steam engine, and the cost of maintenance.

During the average season in Illinois from May 1st to Dec. 1st, a tractor outfit can be used for hauling over earth roads only about 50 per cent of the time. A hauling outfit costs approximately $4,000, and in the work of the commission, the cost of maintenance has been $100 per season.

If a macadam outfit is doing any maintenance work, a scarifier is a necessary addition to the equipment. The desirable characteristics in a scarifier are that it shall have sufficient weight to insure that the picks will be held down into the surface which is being loosened, that the picks themselves will be susceptible of adjustment so that the surface may be loosened to any desired depth, that it be arranged so that there can be some variation in the width which is scarified in one trip and should, if possible, be arranged so that it can be steered independent of the movement of the tractor which is drawing it.

If an outfit of road making machinery is to be used in the construction of bituminous macadam roads by the penetration method, in addition to the machinery already enumeratd, there will also be required the machinery for spreading the bituminous compound on the road. The spreading may be done by hand spreading cans, in which case there are two general types available. One type is constructed so that the slot through which the bituminous compound is poured is vertical, and in the other it is horizontal. There is a decided difference in the method of handling these two types of cans in pouring the bituminous compound and experience indicates that the can with a vertical slot permits more even distribution than the one provided with the horizontal slot. Both types of can are made with arrangements for varying the width of the slot. This, however, is not believed to be a very important feature of the can, because the operator will govern the quantity of the material spread very largely by judgment regardless of the thickness of the slot.

If the bituminous compound is to be spread by means of a wagon, there are two general types of distributing wagons available. One is known as the gravity distributing wagon, and its name indicates the method of operation, and the other is the pressure distributing wagon. The gravity distributing wagon is suitable for a limited range of operation. The spreading of light oils for dust laying and similar work where a slight variation or bunching of the material as it leaves the machine is immaterial, can be satisfactorily done with a gravity wagon. For high-class bituminous macadam constructed by the penetration method, the gravity distributing wagon does not give satisfactory results.

Of the pressure distributing wagon, there are two types, one type which may or may not be equipped with a heating apparatus, is designed so that the pressure on the material in the wagon forces out the binder through a hose and nozzle and thus distributes it on the road surface. This type of distributing wagon seems to give very satisfactory results for certain class of binders, but not with the binders requiring high temperature for application, and not for viscous binders.

If solid asphaltic or tar binders are being distributed the spray type of distributing wagon is essential to satisfactory results, and of the spray type wagon, there are two general classes, the one class is illustrated by the Pillsbury distributing wagon, which is arranged with a series of nozzles close to the road surface through which the bituminous material is forced by means of pressure produced by an auxiliary pump. A strip of roadway, the width of the spray apparatus, is covered at each trip with this machine. The other type of machine is used by the Illinois Highway Commission. The binder is applied by means of a nozzle which is carried by an operator walking behind the machine. The air pressure on the tank forced the material through the nozzle and a jet of steam forced into the binder at the orifice in the nozzle breaks the binder into fine spray. The operator carries the nozzle over the road surface spreading the material on as required.

In addition to the distributing wagon or cans for distributing the binder, there will also be needed tanks for heating the asphaltic binder. Some of the distributing wagons are also heating wagons and materials can be heated in them, but in general, for successful operation, open top heating kettles into which large pieces of solid binders can be placed are also needed. Along with these tanks there will be required a certain amount of small apparatus such as asphalt cutters and various small tools.

The cost of a bituminous outfit is $1,000. Data collected upon 12 outfit seasons of operation show that the cost of maintenance per outfit per season is $106.

The construction of concrete roads requires a complete outfit of machinery. A steam or gasoline roller weighing about 10 tons will be required, and in addition there will be certain special machinery for handling the concrete.

The mixer should be a batch mixer and should load from in front and discharge from the rear. The mixer should be self-propelled and for this class of work experience shows that the steam driven machine is more satisfactory than the gasoline driven.

In country road work it will also be found that the water supply system will require special attention. The water will be obtained from ponds, reservoirs or from wells, and must be pumped to the mixer. This will necessitate a pumping outfit and a system of piping arranged alongside the road so that the hose from the mixer can be attached at any place. The pumping outfit should be of ample capacity, certainly capable of delivering three or four times the amount ordinarily required by the mixer itself, because in hot weather a large amount of water is necessary for wetting down the subgrade before the concrete is placed and for sprinkling the concrete behind the mixer. In addition to the concrete apparatus there will be required templets for striking the road surface. These usually consist of two boards 1 in. or 1¼ ins. thick, cut to the desired crown for the road and fastened to blocks parallel to each other and about 6 ins. apart. They are drawn along the top of the forms at the edge of the concrete.

For floating the surface after it has been struck off to the desired crown, a float made of a thin board of sufficient length to reach the entire width of the pavement being constructed and 1 ft. on each side is bent to the crown of the finished pavement and held by means of ribs to which it is attached. This float is drawn with a combined forward and crosswise movement in such a way as to float the finished concrete and at the same time strike it down to the desired shape.

There will also be required with the concrete outfit the ordinary tools used in concrete work, that is, wheelbarrows, shovels, picks, tampers and similar tools. The cost of a complete concrete road outfit can be made anything desired, but the essentials for placing the concrete and furnishing the water supply, including a mixer having a capacity of about 1,000 sq. yds. of 6-in. pavement per day with all auxiliary apparatus and tools, will cost about $2,700.

Reduction of Water Rates at Montevideo.—The Montevideo Waterworks Co. has reduced the water rate from 24 cents to 20 cents per thousand litres, in accordance with an agreement made with the Government of Uruguay in 1907, that as soon as an average of 25,000 services was obtained, rates would be reduced.

The Consistency of Bituminous Material—Its Determination and Value in Specifications.

A notable practical discussion of the significance of consistency or viscosity of bituminous materials for road work is contained in a paper presented at the Cleveland meeting of Section D of the American Association for the Advancement of Science by W. W. Crosby, M. Am. Soc. C. E., Chief Engineer to the Maryland Geological Survey and Consulting Engineer, Baltimore, Md. This paper follows:

The consistency of a bituminous material or pitch may be defined as its degree of firmness and is determined by measuring its internal friction. Consistency in fluids is generally referred to as viscosity. Lewkowitsch says "Viscosity is internal friction and has no relation to density."

Differing consistencies are colloquially expressed by such terms as liquid, fluid, semi-fluid, semi-solid, hard or soft, cheesy or sticky. Consideration of consistency will not be extended here beyond those pitches known to be capable of flowing perceptibly from their own mass at temperatures of 100° C. and below if given reasonably sufficient time to do so.

The consistency is, of course, affected by physical conditions of temperature, atmospheric pressure, etc., and may be materially affected by the chemical composition of a pitch compound. For instance, two equal portions of a hard asphaltic pitch, when fluxed separately with equal portions of two oils, the one having a paraffin base, the other an asphaltic base, will produce compounds quite different in consistency. Hubbard has shown some effects of naphthalene in pitch compounds and some effects of the presence of free carbon are already known.

The consistency does not concord with the specific gravity of pitches or pitch compounds generally, though it may frequently seem to be a fairly definite relation to the specific gravities in a group of materials of the same general origin. This concordance in a group may not always exist. For instance, pitch compounds of the same specific gravity may be made from coal tar in three ways, supposing the tar to be divided into three fractions of light oils (to 170°), middle oils (170°-270°), and hard pitch (270°). If now a certain specific gravity is reached by a combination of the first and third fractions, the same may be had by combining proper proportions of the first and second, or of the second and third. Yet it will be found that the consistencies of the three compounds so secured are visibly, or when measured by any of the methods usually followed, quite different from each other.

The measurement of the internal friction of a pitch can perhaps be made by finding its rapidity of flow, or its resistance to penetration or to displacement inside its own body. In making this determination, it is important that the results be not vitiated by the effects of surface tension, of adhesion or of specific gravity. For instance, with the penetrometer (referred to more fully later) it frequently happens that the readings are materially affected by the "cratering" of the pitch under the needle and by the adhesion of the pitch to the sides of the needle penetrating it from without. With a viscosimeter, such as the Engler, the specific gravity of the material must affect the determination and this is also the case with the ordinary plunger instruments even if the adhesiveness of the pitch be avoided in the use of the latter.

The characteristics of a pitch as to its specific gravity, its adhesiveness, its cohesiveness and on many other points expressed intelligibly and simply are generally desirable, but for the greatest value they should be as far as possible determined and stated separately, as otherwise confusion or worse may result.

The measurement of the internal friction in a pitch, or of its resistance to displacement inside its own body, when separately made and not vitiated by other factors, is the true determination of its consistency.

The determination of the consistency or viscosity of pitches and the intelligible expression of such determination are necessary in highway engineering, as will be more fully indicated later in the portion of the paper referring to their values in specifications. Perhaps it might be said here that naturally before the specifications for the methods of use of the material are drawn an idea must be held of the physical structure of the pitch to be used—i. e., whether it is to be fluid or semi-solid, for instance—as many of the details of the method depend entirely on the approximate consistency of the pitch. Certain methods, such as cold-sprinkling, would be impossible with a too viscous pitch compound and hot mixing would be impracticable with a pitch too fluid at normal temperatures. Further, a pitch with a moderate amount of internal friction is less likely to yield to displacement under stress than one with lower cohesiveness, while a pitch showing too high a resistance to internal displacement will probably prove to be brittle under shocks. Excess in adhesive qualities will not wholly make up for lack of cohesiveness or of resistance to internal displacement, hence the importance again of determining these qualities separately.

The determination of consistency is now usually made by various instruments based on different principles and among the more generally used of these instruments are the following:

The Engler viscosimeter is one of the oldest and is perhaps the most generally used for oils. It is the standard in Germany. Its principle is that of measuring the relation between the flow of the oil through an orifice or small tube and that of water under the same conditions. Its use is limited to those pitch compounds fluid at normal temperature or sufficiently so at temperatures up to about 110° C. as to permit their passing in proper quantity through the orifice in a reasonable time.

Another objection to the use of this instrument in determination on pitch compounds is its apparent lack of concordance in repeated determinations. An average variation of the results seems to be about 5 per cent. While it may give valuable information as to the probable behavior of a pitch compound in a sprinkling machine, the Engler instrument does not seem to be a satisfactory one for laboratory determinations on such materials.

The Sayboldt and the Redwood viscosimeters are modifications of the Engler and are open to the same objections.

The penetrometer as exemplified by the Dow and the Richardson machines was originally designed for measuring the relative softness or hardness of solid or semi-solid asphaltic pitches. As its name implies, the instrument measures the amount of penertation by a loaded needle within a fixed time into the pitch. Its use is limited to the harder varieties of pitch. Recently an attempt has been made to increase its range by fixing different loads and times so as to accommodate softer, as well as harder, pitches than could satisfactorily be tested under the original standards of 100 grams on the needle for five seconds. Its use also seems unfortunately attended by a certain non-concordance of results, the average variation being about 20 per cent. Although very widely used on solid or semi-solid pitches, its limited range makes it unsatisfactory as a laboratory instrument, especially since the advent of the more fluid pitch compounds into road work.

It seems to the writer that the concordance of the penetrometer could be improved and the determinations be made more accurate were a slight change made in the methods of use. That is, instead of placing the clean needle or wire (preferably the latter) with its end in contact with the surface of the material before releasing the plunger, thrust the wire once well into the pitch, withdraw it and reset it on another spot with the lower end through the surface of the pitch and then release the plunger. In this way the effects of adhesion and surface tension would be lessened.

Before passing to the third main class of instruments for determining the consistency of pitches, one may perhaps be considered for a moment which is unique in that it seems to belong to none of the classes referred to. It is true it does not actually determine the consistency itself of a material used in it, but rather the rate of change of its consistency. The float test (Richardson) determines the time required for a cool plug of pitch to melt out of an orifice sufficiently to permit the entrance of a considerable quantity of water. The test is a handy one, but its range is limited to those materials which will solidify sufficiently at 4° C. and flow under 100° C. The assumption is made that the rate of softening measured is akin to the actual consistency of a material. This may be correct, but the limited range of the float offers a sufficient ground for objection to it as a reliable laboratory instrument for general use. The non-concordance of repeated results with it seems to average about 12 per cent.

The third class of instruments used in determining consistency may be said to comprise those measuring in one way or another the resistance of the material to internal displacement. In it are included the Lunge and the Hutchinson floats, the Doolittle Torsion machine, the Stormer paddles, the Serra Carpi and the Schutte plungers. All but the two latter are usable only on liquids. The Serra Carpi and the Schutte plungers cover also the semi-fluid materials to some extend, but do not permit of use on the harder varieties of pitch—hence an objection to them under present conditions.

With the above listed instruments for determining the consistency of pitch compounds, and which comprises practically all in general use, there remain some gaps; i. e., a considerable number of materials cannot be tested satisfactorily by any of them.

It is probably readily apparent that one instrument with a range over the entire field of pitches and pitch compounds is desirable, especially for laboratory work and in view of the investigations necessary and now being made in the matter of bituminous materials. The inconvenience, expense, delay and other disadvantages of a variety of instruments for determining this one attribute—consistency—of such materials need not be dwelt upon here.

Two independent attempts to provide such an instrument have been carried on almost simultaneously by Mr. H. W. Abraham and by the writer with more or less success. Both of these instruments readily cover, in similar ways, the entire field of bituminous materials performing the work of the needle in the penetrometers, of the paddles in the Stormer and such instruments, and of the plungers in the Serra Carpi and Schutte machines, with apparently greater accuracy and co-ordination of repeated results in most cases. They do not measure directly orificial flow, as does the Engler, but this loss of a doubtful determination of consistency in pitch compounds for road work is of minor importance and it seems quite probable that this characteristic may be safely deduced from the direct determinations of these instruments. Both these instruments use needles and various disks, pistons, or plungers, and for a full description of each *reference should be had to the Proceedings of the American Society for Testing Materials, vols. IX, X and XI. As these instruments do cover in the range of their applicability the entire field of pitch compounds, as the concordance in their repeated results is on the average well within 5 per cent, and as their determination of consistency seems to be direct, it appears to the writer that they may be considered as satisfactory laboratory instruments. If generally used they should prove of great value in determining and recording the consistency of bituminous materials now so widely used in road work, and such records should be of great assistance to all in the investigations now being carried on concerning the use of such materials.

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*For Crosby Consistometer, see "The Surveyor" (London), Oct. 20, 1911, and May 3, 1912; also Good Roads (New York), Sept., 1911, and May, 1912.

With most of the instruments above referred to, the time factor is usually made a constant. As the writer has elsewhere stated previously, it frequently seems that the "time" or "time load" should be the variable to be actually determined. A blown oil and a reduced coal tar may show almost identical "penetration," yet if the former be struck smartly with the edge of a hatchet the latter will rebound, leaving a clean gash. On the other hand, the rebound from the tar will be imperceptible, while the material near the line of contact will be shattered irregularly, generally flying off in chips. Were the "penetration" made the constant, the difference in the resulting "time" or "time load" would better indicate the differing character of the material.

The writer realizes that in view of the already accumulated mass of records from the use of the older instruments and their customary methods of use that a change to a new instrument or to new methods presents its difficulties. But if such changes are now desirable because, for instance, of the greater variety and the wider applicability of the pitch compounds, the delay in changing will seriously increase such difficulties.

With penetrometers, as generally used, apparently insufficient consideration of the effect of surface tension on the determination has been had, at least until recently, in prescribing standards for their methods of use.

With such instruments as the Engler and to some extent with the penetrometers, a certain factor affecting the character of the material and apparently comprehended under the term consistency is ignored. For example: Three samples respectively of asphaltic oil, water-gas tar and coal-tar were shown by two Engler instruments to have practically the same viscosity (though the two instruments gave results on the same materials differing by 6 per cent). The consistency of the three materials was visibly different. That this was actually a fact was shown on the Crosby consistometer by the record of a plunger, as follows:

Net load of 0.5 gr. on for 5 seconds.

Record—
Asphaltic oil, 106.
Water-gas tar, 25.
Coal tar, 12.
Plunger, No. 12 Special.
Temperature in all tests, 25° C.

For complete satisfaction in the determination of the consistency of a pitch, one instrument able to cover the entire range of materials, at any temperatures—cold, normal or hot—should give concordant results by various operators at different times with the use of small quantities of material in each test. The main criticisms of the Abraham's instrument seems to the writer its complexity and cost, if consideration of the plungers up to the present used by it, and which could of course be readily altered, is omitted. The objection to the Crosby instrument seems to be its delicacy. Otherwise either of these two instruments seems capable of filling the requirements.

In 1909, a rough test for "Viscosity" of tars was suggested by J. Walker Smith, City Engineer of Edinburgh, in his book, "Dustless Roads Tar Macadam" (p. 52), which test was made by placing copper disks of uniform weight on the surface of the tar and noting the time required for the disappearance of the disk in the tar. The writer at that time was engaged in developing his instrument and in 1910 had the pleasure of discussing the matter with Mr. Smith. Later, in the "Minutes of Proceedings of the Inst. of Civil Engineers, Vol. CLXXXVI (1911)," paper No. 3939, "The Improvement of Highways to Meet Modern Conditions of Traffic," "Appendix V—Description of Laboratory Tests for Tar" under "Penetration or Viscosity" after describing such a test as above made with "new copper half penny coins," said:

"It would probably be better to have a penetration machine so arranged that a plunger (say) ½-in. in diameter could be used upon the same principle as the needle penetration machines; by this method, taking a standard weight and a standard depth of penetration, the quantity to be determined would be the time taken to effect that penetration."

As before stated, the writer believes the practice of fixing the time load and then measuring the penetration is wrong and agrees with Mr. Smith that the load and penetration should be the fixtures with the time to be measured. The prevailing practice of measuring the penetration, however, is fairly firmly established from its general use, developed with the asphalt paving industry. Possibly in this case of more limited variation in the pitches tested the objections are not as strong as they would be when the variations between the pitches, such as are available for road work, are great.

So far the writer has operated the Crosby instrument along the lines of other penetrometers in general use, mainly because the bulk of the records available have been so secured and for the purpose of comparison with such. He hopes, however, that an early modification, such as is suggested, of the penetration test may be generally adopted, as he believes the light thus thrown on the matter under investigation would be appreciable.

With Smith's crude test or his suggested refinement of it, consideration of the effects of surface tension and of specific gravity should not be neglected. They have been fully considered and the writer thinks provided for by the Crosby instrument.

Reference has just been made to the determination of consistency at different temperatures. Those used are usually 0° or 4° C. and 100° C. The writer prefers 4° C. for the low temperature, because of the greater ease of obtaining it and because he feels nothing is gained by going to the additional trouble of securing 0° C. Those determinations made on normal material are frequently supplemented by others on the residues left after heating the normal material for fixed periods at certain temperatures. These latter determinations of consistency are usually made at only two temperatures (4° and 25° C.) and as the quantity of the residue is usually small—less than 50 grams—hence the desirability in a comprehensive instrument for an ability to perform its work on small quantities of material.

As yet no relation between the different consistencies of the same material at various temperatures seems to exist, and none can, of course, be expected between different bituminous materials at any temperatures. Determinations of consistency are wanted on the normal pitch at 4°, 25° and 100° C. in order, as before suggested, to know the best methods of using the material offered or in order to prescribe limits for materials to be offered when the methods of use are predetermined. They may also be wanted in order that the probable results of the use of any materials may be deduced.

Determinations of the consistency of the residues after heating the normal material are wanted for the sake of comparison with the determinations on the normal material in order that deductions may better be made concerning the results of the use of the material in question.

For instance, the writer has learned from experience that an oily pitch compound showing by test the following consistencies:

Normal material
25° C. = 22 sec. Lunge (to 1.40).
100° C. = 112 sec. Engler.
After evaporation for 21 hours at 105° C. where loss was 1.75 per cent.
Residue at—
4° C. = too soft to measure with needle.
25° C. = too soft.
After evaporation for 5 hours at 205° where loss was 7.8 per cent.
Residue at—
4° C. =146 with needle.
25° C. = too soft to measure with needle.

Must be heated in order to be applied to the road would require more than three years to "set up" sufficiently, would flow in the road during warm weather and would act more as a lubricant between pieces of stone as large as pigeon's eggs rather than as a binder of them.

With a sticky pitch compound showing the following consistencies:

Normal material
25° C. = 358 with needle.
100° C. = 302 sec. Engler.
Evaporation for 21 hours at 105° C., loss—9.5 per cent.
4° C. = too hard for needle.
25° C. = 13 with needle.

would require heating before use, gave a resulting surface very hard and slippery in cold weather, but the binding of the stone was excellent, the pitch hardened sufficiently in quick time and was inclined to be at first susceptible to temperature change, though this feature gradually disappeared with age, and later to be friable in cold weather.

In the third case where the consistencies of the normal material were

25° C. 656 Sec. Lunge (read to 1.40)
100° C. 9 Sec. Lunge (read to 1.40)
Evaporation 21 hours at 105° C., loss = 6.5 per cent.
4° C. = 14 with needle.
25° C. = 59 with needle.

the pitch required heating before use, "set up" sufficiently quickly, bound the stone properly, never has become slippery or hard, never has been objectionably soft in hot weather, and after three years' exposure to traffic shows as yet no signs of loss of life nor of material physical deterioration.

A determination of the consistency of the residue is absolutely necessary in order that a purchaser may know how much "asphalt," "asphaltic base," "pitch," or whatever term for the base you will, he is getting when the delivery is made with this base in a fluxed condition. It is generally the case that this base is the more valuable portion of an asphaltic pitch compound and that, other things being equal, the value of the compound varies in proportion to the amount of base contained. Such a base is of too complex a chemical character to be exactly defined, under the present state of the chemical knowledge of the subject, but its satisfactory description may now be made by the reliance upon a few chemical qualities and a few physical ones including an expression of the Consistency. The writer is of the opinion that such a description may be made clearer and simpler as improved methods of determining and expressing the measure of Consistence become recognized.

In this connection it may be of interest to note that where specifications formerly provided that the pitch-compound should contain a specific percentage of "asphaltic base of a penetration of 50," they now require that the compound having been subjected to evaporation for a definite period at a fixed temperature, the residue shall be at least a certain percentage of the original sample and shall "show a penetration of not less than ——— nor more than ———." The impracticability of evaporating to any definite penetration became quickly apparent when the softer pitch compounds began to be used in large quantities—hence the change in expression. It is now well known that a difference of a small percentage of the loss on evaporation or distillation materially affects the consistency of the residue or vice versa.

The Value of the Determination of Consistency in specifications has been referred to and will be admitted as large from the foregoing and from the following:

As a physical test it is more generally intelligible and appreciable than any corresponding chemical one. As a physical test it perhaps will appear to be more pertinent to physical work than a chemical one. Properly made and expressed it will probably relieve the necessity of several chemical tests and possibly tend to reduce the number of physical tests specified without any lack of clearness if not with a real addition to the definition of the material desired.

For instance, in the case of specifications for a pitch compound sufficiently fluid to be applied without artificial heating from a distributing wagon supplied with small orifices, it will be necessary to provide such a consistency for the material at normal temperatures as will insure its flow through such orifices under the method of application. The usual way of so doing is to specify that 50 c.c. of the material will pass an Engler instrument in not more than, say, 1,500 seconds. But, as had been referred to, the Engler seems to have proved unsatisfactory in some cases where the material offered approached the prescribed limit because in practice the distribution of the material did not accord with the expectations. A reason for this unexpected behavior was indicated by tests with the plungers of the Consistometer and by the apparent stickiness of the material revealed on inspection.

With this class of material it becomes desirable to know in advance its probable ability to "set up" or harden in a short time. Hence an evaporation test follows and the residue of such a test is measured as to the change of consistency occurring—i. e., the penetration of the residue is determined. This penetration is measured at 40° C. and at 25° C. in order to deduce the probable hardness (and brittleness or slipperiness under travel) of the material after such "setting up" has occurred. Tests of Consistency at these two temperatures also indicate the probable susceptibility of the material under climatic changes of temperature and thus its suitability for use under known local conditions on these lines.

With a similar material to be applied hot, a test for its consistency at 100° C. is usually introduced on the normal material and the tests on the residue are also made for the same reasons as above.

Another reason for testing the residue is that the proportion of the base to the flux and some criterion of the value of the material itself is thus had, as before stated.

With the heavier pitches used for work under the penetration and mixing methods, similar desiderata exist and the same determinations are made. To them is frequently added another evaporation (or distillation) test at a higher temperature with tests for the consistency of its residue because of the higher temperature of use and of the greater weathering action expected. With asphaltic cement used for "sheet asphalt" pavements the determination of Consistency is most important as cements outside of the proper limits as to Consistency can but produce unsatisfactory results under the customary methods of use.

While it is quite possible that ultimately the consistency of a pitch can be predicted from a thorough knowledge of its chemical composition, this is not possible at present and it seems doubtful whether such a method of prescribing or determining this characteristic will ever be generally used. Such a method must necessarily be long and complicated, not readily intelligible to many of those engaged in the actual work with such materials, and not easily expressed briefly. Moreover, the interpretation of specifications is much easier and more satisfactory to all concerned when reliance for limiting conditions is to be had on clauses describing physical tests than when seemingly theoretical chemical processes are involved. Just as the older custom of specifying the characteristics of both the "asphalt" and the "flux" has given way to the newer and simpler one of specifying the characteristics of the combination of the two into the "asphaltic cement" ready for use, so the tendency now appears to lead to further simplification regarding the characteristics of all pitch compounds wherever safely possible.

The writer hopes that the proper development of Consistency tests will do much along this line. Such a test is a determination of "effect" not necessarily of "cause" but knowledge of the "effect" is generally more desirable in actual practice. The exact proportion of naphthalene in a pitch would have far less weight under the conditions of the ordinary problem than a determination, properly made, of the varying consistency of the pitch under changing physical conditions. Again, many specifications contain a "Ductility" test. This, though a purely physical test, is one that has caused any amount of discussion and is still open to question as to its exact value. Its most persistent advocates admit its present indefiniteness. If now a Consistency test can be made that will show the characteristics of a material more simply but along the same lines as the "ductility" test, as perhaps indicated by the earlier remarks of the writer and as believed by him to be possible, then a further simplification of the ordinary specifications will be secured.

The desirability of specifications as simple and brief as consistent with safety needs no argument here.

In the foregoing, it perhaps may seem that the writer is inclined to decry the value of chemical investigations and scientific knowledge of the subject of bituminous materials. Such is not the case and he would really desire to be the last one to do so. In the matter of Specifications, however, art must be given, if not more, at least equal consideration with science, though the art must be clearly recognized as being based on the science. Therefore, the highest art can only be reached from the most perfect science.

The writer believes that the scientific knowledge concerning bituminous materials would be much enriched by researches in the matter of their Consistency, and that the art of road making would be thereby greatly advanced.

DRAINAGE AND IRRIGATION

A Study of Variations in Run-off Observations and Their Relation to Drainage.

The subject of run-off has been written about and discussed many times; yet one approaching a problem in land drainage, requiring a fairly correct estimate of the run-off to be provided for is impressed with two obstacles: First, the paucity of data giving definite results of observation under conditions closely resembling those with which he has to deal; second, the wide variation in the results of such observation, when the known conditions do not appear to warrant such a difference. In a report to the Illinois Society of Engineers and Surveyors the Committee on Drainage discusses this variation in run-off observations, with the view of bringing out the necessity for the greatest caution in the application of results observed in one locality to the solution of problems arising in another, where the difference of conditions appears to be unimportant. We give the following parts of this report:

LARGE AREAS.

Recently the writer had occasion to study the run-off for Savannah River at Augusta, Ga. This watershed has an area of about 7,000 square miles, of very rugged to mountainous land, in the zone of 50 to 60 ins. annual precipitation. It is on the eastern slope of the Appalachian System, and is subject to heavy precipitation from single storms. A careful computation of flow over the dam at Augusta showed a run-off in the flood of 1908 of 41 second feet per square mile of watershed, or practically 1.50 ins. depth per 24 hours. Compare this with the discharge of the Yazoo River at Greenwood, Miss., with a watershed of almost exactly the same area, also within the 50 to 60-in. annual precipitation zone, and also subject to heavy precipitation during single storms. From a study of the records for some seven years, during which practically as high waters have occurred as any before recorded (except from overflows from the Mississippi) it is seen that the maximum run-off of record (in 1912) was 6.4 second feet per square mile, or 0.24 ins. per 24 hours; about one-sixth the rate from the same sized watershed on the Savannah, with rainfall conditions fairly similar. The Yazoo watershed, however, lies about one-fourth in the "Yazoo Delta," which is a flat, "slow-spilling" area. The other three-fourths cover a hill area of considerable ruggedness as compared with what would be termed a "rolling country," but far less steep and rugged than the Savannah River area. An analysis of the conditions on the Yazoo brings out the fact that, were the "peaks" of the "flood waves" from its several tributaries to arrive simultaneously at their despective junction points, and delay by natural storage be prevented, the maximum discharge at Greenwood would be about 50 per cent greater. Under present conditions the flood waters from the hills spread over a wide area when they reach the low land, this low ground serving as a natural storage reservoir. If this storage shall ever be prevented, the limit of maximum run-off at Greenwood will still be only about one-fourth that at Augusta.

Another case which came under observation is even more striking. During about four years, from 1998 to 1911 inclusive, careful discharge observations were made on the Coldwater and Tallahatchie rivers in Mississippi, where these rivers emerge from the hills and enter the "Delta." Daily gage readings were kept, discharge observations made at different stages, and rating curves constructed. The watersheds for these two streams are contiguous for a distance of some 40 or 50 miles. In traveling through these two areas one was unable to note any general difference in either topography or soil, though it is believed that the soil in the Tallahatchie watershed is, generally, a little more pervious. It would require a close investigation at many points in the two areas to determine.

At Pratt's Bridge on the Coldwater, for the 1906 flood, the maximum run-off from 1,000 square miles was approximately 1.50 ins. for 24 hours; at Batesville on the Tallahatchie, the maximum run-off from the same storm was, from 1,620 square miles, approximately 0.55 ins. per 24 hours, or little more than one-third as great.

The precipitation which produced this flood was about the same at the two stations on each watershed from which there are records, the average being about 8½ ins. in five days.

The difference in the size of the watersheds is sufficient to account for only a very small part of this discrepancy. Differences in topography are not marked, and it is believed that differences of soil would not be noted by a casual observer, yet one is almost obliged to concede that such differences exist, to account in part for the discrepancy. It is believed that it is accounted for largely by the geographical differences between the watersheds.

In the Coldwater, tributaries of large size spread out fan shape a short distance above the gaging station. The flood crests from these several tributaries reach the gaging station in a short time and almost simultaneously. In the Tallahatchie, on the other hand, the area is narrow for some miles above the gaging station. The crests from the lower tributaries pass out well in advance of the combined crest from the upper tributaries. Also, the distance that the latter must travel affords it time to "flatten out" considerably, giving a smaller discharge at the "peak."

In a study of the run-off in Red River at Garland City, Ark., it was deduced that the maximum rate was approximately 5½ seconds feet per square mile from an area of 48,000 square miles, or 0.2 in. per 24 hours. Red River and its tributaries drain territory in the 10 to 20-in., 20 to 30, 30 to 40 and 40 to 50-in.

annual precipitation zones before reaching Garland City.

An attempt was made to select from U. S. G. S. Water Supply Paper, No. 162, for comparison, watersheds as similar to Red River as can be found, with the following result: (1) Arkansas River at Lawrence, Kas.; area 59,841 sq. miles; maximum run-off 0.14 ins. (2) Colorado River at Austin, Tex.; area 37,000 sq. miles; maximum run-off 0.12 in.

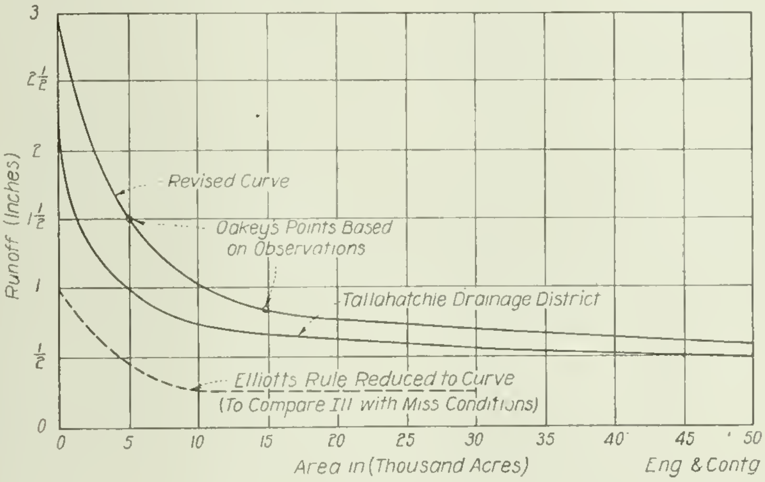
A study of the maximum discharges from a number of watersheds in various parts of the country will further impress one with the great difficulty of deducing from the maximum run-off from one watershed what it will be from another.

SMALL AREAS.

The drainage engineer has usually to deal with much smaller areas than those discussed above, and these will now be considered, with reference to open ditches. Mr. C. G. Elliott (Engineering for Land Drainage) says:

> While ½ in. per 24 hours is about correct for open ditches, it does not apply to tile except under special conditions. Results of experiments and observations sustain the practice of many careful engineers, who state that the removal of ¼ in. per 24 hours meets the requirements of the average soil.

Again, Mr. Elliott recommends designing open ditches for ¾ in. for areas of 1,000 to 3,000 acres, when the land slopes toward the ditch 2 or 3 ft. per mile; ½ in. for areas 3,000 to 8,000 acres and ¼ in. for areas 8,000 to 30,000 acres.



Run-Off Curves for Design of Open Ditches.

(Curves Applicable to the Northern Part of the Yazoo-Mississippi Delta, Mississippi.

It is assumed that the above rules are based on conditions similar to those in Illinois, where the average annual rainfall varies from 30 to 40 ins. in the northern portion of the state, to 40 to 50 ins. in the southern portion. From papers and reports presented at former meetings of this society, it appears that pumping plants designed for ¼ in. per 24 hours run-off from the watershed have proven of sufficient capacity. From time to time members have given to the society their opinions and the benefit of the results observed in Illinois, from the published reports of which the writer has made many notes on this subject. The consensus of these opinions and results appears to bear out the correctness of the above figures for open ditches, and for pumping plants also, where the latter are discussed.

Mississippi is in the zone of 50 to 60 ins. annual precipitation. It has been figured from U. S. Weather Bureau Reports covering the years 1872 to 1896 inclusive, that this average annual precipitation at Memphis was 52.5 ins., and the average annual precipitation at Vicksburg was 55.4 ins.

The Hopson Bayou Drainage District, area 15,000 acres, one of the first to be completed in the "Yazoo Delta," is near Clarksdale, or about 80 miles south of Memphis. By interpolation, the average annual rainfall appears to be 53.5 ins., although the lands are almost level, with slight fall for both main and branch drains, the plans were made for ¾-in. run-off per 24 hours. While this drainage system has proven fairly adequate for all but extraordinary storms, it is worthy to note that the run-off has at times, by actual observation, exceeded the above rate. After an unusual precipitation, Mr. C. W. Oakey, Drainage Engineer, U. S. Department of Agriculture, observed the discharge near the outlet of the main canal, and found that it was as great as 1.13 ins., continuing at this rate for about 12 hours. This followed a precipitation of 7 ins. in 24 hours. It continued to discharge ¾ in. and above for three days.

In the main canal of a smaller district, area 3,500 acres, adjoining the Hopson Bayou District, the run-off was observed to be at the rate of 2½ ins. per 24 hours, continuing so for eight hours. Following another storm (precipitation 2.88 ins.), the larger district had a maximum run-off of 0.72 ins., the smaller 2.20 ins.

Mr. Oakey deduced from his observations that to provide for a rainfall of 4 ins. in two days, the 15,000 acre district should have capacity in the main canal for 0.85 ins. run-off per 24 hours; the 5,300 acre district, 1.50 ins. per 24 hours.

Thus far it has been difficult to persuade taxpayers in this locality that such adequate drainage would be a good investment. The plans generally made have been based upon a rule represented by the curve marked "Tallahatchie Drainage District Curve" in the accompanying diagram. Above this curve, another has been drawn through the two points suggested by Mr. Oakey from his observations. It is believed that when the Yazoo Delta reaches a higher state of development, the taxpayers will demand ditches of greater capacity than at present, and that the "revised curve" represents about the run-off rates that will then be provided for.

Conservation of Snow for Irrigation; Its Dependence on Mountains and Forests.

Snow water constitutes a vast proportion of the water available for irrigation in the far west. Snow conservation is therefore of economic importance and methods are receiving increased study by irrigationists. In the Bulletin of the International Irrigation Congress Prof. J. E. Church, Jr., University of Nevada, discusses the problem of snow conservation and gives useful data of water content of snow on areas of different character. The following is a reprint of the discussion and data:

The conservation of snow is dependent upon mountains and forests, and is most complete where these two factors are combined. The mountain range is not only the recipient of more snow than the plain or the valley at its base, but in consequence of the lower temperature prevailing on its slopes the snow there melts more slowly. However, mountains, because of their elevation, are exposed to the sweep of violent winds which not only blow the snow in considerable quantities to lower levels, where the temperature is higher, but also dissipate and evaporate the snow to a wasteful degree. The southern slopes, also, are so tilted as to be more completely exposed to the direct rays of the sun, and in the Sierra Nevada and probably elsewhere are subjected to the persistent action of the prevailing southwest wind. On the other hand, the mountain mass, by breaking the force of the wind, causes much of the drifting snow to pile up on its lee slope and at the base of its cliffs, where it finds comparative shelter from wind and sun.

Forests, also, conserve the snow. In windswept regions, they break the force of the wind, catching the snow and holding it in position even on the windward slopes of the mountains. On the lower slopes, where the wind is less violent, the forests catch the falling snow directly in proportion to their openness, but conserve it after it has fallen directly in proportion to their density. This phenomenon is due to the crowns of the trees, which catch the falling snow and expose it to rapid evaporation in the open air, but likewise shut out the sun and wind from the snow that has succeeded in passing through the forest crowns to the ground. Both mountains and forests, therefore, are to a certain extent wasters of snow—the mountains because they are partially exposed to sun and wind; the trees, because they catch a portion of the falling snow on their branches and expose it to rapid disintegration. However, the mountains by their mass and elevation conserve immeasurably more snow than they waste, and forested areas conserve far more snow than unforested. If the unforested mountain slopes can be covered with timber, much of the waste now occurring on them can be prevented, and by thinning the denser forests the source of waste in them also can be checked.

The relative value of mountains and forests apart from each other cannot easily be estimated. Mountain crags are better windbreaks than are trees and are found at higher elevations than the latter. Consequently, the last drifts of snow to disappear from the mountain side in summer are those lying at the base of the cliffs and particularly those far above timber line, in case the timber does not cover the summit of the mountain. This is the phenomenon that leads the casual observer to disparage the value of forests. However, since the area covered by crags is small in comparison with the normal slopes of a mountain, the forest cover of whatever kind possible must be utilized for the extensive conservation of snow, and for increasing the efficiency of the natural windbreaks of the mountain.

Quantitative values of the efficiency of mountains and forests can be obtained only by measuring the water content of the snow under all conditions of depth and exposure, for the relative density of snow is affected by a series of elements, such as wind, gravity, and sun. Therefore, careful distinction must be made between the water content of snow laid by the wind, as on mountain tops, and of snow laid in regions of comparative calm, where it settles mainly under its own weight. Precaution must also be taken in estimating the run-off from fields of snow that settle visibly in the spring under the warmth of the sun but actually have lost only a small proportion of their water content.

SNOW SAMPLING AND WEIGHING.

The water content of snow can best be determined by weighing, a method first used by the author in the open field as early as the spring of 1909. A sampler consisting of one or more sections of cold-drawn seamless steel tubing and a bevelled tubular chisel was devised which is capable of penetrating fields of snow of whatever depth and of bringing the core to the surface. The external diameter of the sampler is about two inches, which permits the sampler to be readily grasped by the hand, and likewise brings its weight within the limits of human strength, even where depths of twenty feet are found and the snow is compacted to a density more than one-half that of water. The gage of the metal is from 18 to 24, according to the length of the sampler. The diameter of the cutter is carefully maintained at one and one-half inches; and the computing of the water content is based on this standard.

The spring balance, whose dial is graduated to show the equivalent inches of water and is movable to permit the immediate adjustment of the O-point to any sampler irrespective of its weight or the number of sections employed at the time, shows the net water equivalent of the sample of snow at a glance. The spring balance also contains a special pointer to facilitate accurate reading of the dial, and is made of aluminium to reduce weight. To eliminate vibration, the spring balance is hung from a supporting staff, whose iron-shod point readily penetrates all crusts. In fluffy snow, however, four metal wings or fins give the staff stability.

The sampler complete with attachments and containing sections enough to penetrate to the depth of 20 ft. can be carried by two persons over mountain slopes, and has been carried on occasions by one.

A thin coating of oil or preferably shellac will protect the metal from moisture and reduce clogging or freezing to a minimum.

With a light sampler and delicate spring balance, similar to the one mentioned above, it is easy to determine the fluctuations in the water content of the snow. With such a sampler as this, the author and his associates have surveyed large areas of snow both on mountain tops and in the lowlands, and determined their water content quantitatively. The increase in depth and density with elevation has also been studied, and seasonal forecasts of the moisture stored in the high mountains have been inaugurated for the assurance of the irrigationist and the user of power, such as, for example, the forecast of the double store of moisture in the Sierra Nevada in 1911.

But the task to which attention has specially been given is the determination of the principles that underlie the relation of mountains and forests to the conservation of snow, a work that should ultimately lead to the improvement of forests and the prediction of floods so far as these shall still occur. The regions studied include both the semi-arid and wind-swept eastern side of the Sierra Nevada with the adjacent lowlands and also the moister and more sheltered basin of Lake Tahoe, where forests of varying types and densities occur.

The general principles of the conservation of snow are illustrated by the following series of measurements:

COMPARISON OF TYPICAL AREAS AT THE EASTERN FOOT OF THE SIERRA NEVADA.

Base of Mount Rose (elevation 5,500 ft.), March, 1909: (a) Reforested area thickly covered with young pines averaging 30 feet in height: water content of snow 5.5 ins. (b) Deforested area dotted with clumps of manzanita and snowbush; water content of snow 2.4 ins. (c) Typical sagebrush area: water content of snow 0.6 in.

Of the snow found on this sagebrush area, one-third should be credited to the southern side of a gulch which offered considerable shelter from sun and wind. Furthermore, at least one-fourth of the snow in the deforested area should be attributed to the influence of thickets of pine scrub. But even as the original figures stand, the reforested area has conserved two and one-third times as much snow as the deforested area dotted with manzanita, and nine times as much as the typical sagebrush area.

COMPARISON OF BARE AND FORESTED MOUNTAIN TOPS.

Summit of Mount Rose (elevation 10,800 feet), March, 1909: Course I. Comparison of Rocky Summit and Timber-line Forest. (a) Unforested talus slope. (1) Cornice, where snow lingers until late in the summer: water content of snow 25.1 ins. (2) Wind-swept slope, where the slope is almost bare the winter through; water content of snow 2.6 ins. (3) Lee slope protected from the wind; water content of snow 35.1 ins. The average water content of the entire talus slope was 18.4 ins. (b) Forested slope, the timber consisting mainly of mountain tamarack with occasional mountain hemlock; water content of snow 41.1 ins.

The forested slope, therefore, contains an average water content one-fifth greater than the unforested but protected slope above it, nearly twice as much water as the cornice at the apex of the mountain, over fourteen times the moisture conserved by the wind-swept slope, and more than twice the average water content of all three areas combined.

The superiority of the forested slope as a gatherer of snow is made yet more convincing by comparing the increase of snow in it and its nearest unforested competitor, "the lee slope protected from the wind." During the period of five weeks from March 1 to April 5 the increase in water content of the snow on the forested slope was 4.3 inches, while on the protected slope the increase was only 2.8 inches, the gain on the former being, therefore, nearly one-half greater than on the latter.

Course 2. Comparison of Scrub of Varying Heights. (a) Talus slope covered with low scrub; water content of snow 13.4 ins. (b) Talus slope dotted with screens of timber ten to 20 ft. high; water content of snow 26.5 ins.

It is noteworthy that in seasons of normal or heavy precipitation the snow on the first slope rises as high as the tips of the scrub but no higher, for with the burial of the scrub beneath the snow, which the former's own branches have accumulated, the slope is exposed to the unobstructed sweep of the wind. If this scrub should be removed, the wind would practically denude the slope of snow.

VALUE OF TIMBER SCREENS ON THE LIPS OF CANYONS.

The value of timber screens on the lips of canyons, where both slope and timber unite in conserving the snow, is shown by the fact that the cornice is always deepest where the screen is highest and most impervious to the wind, while the snow is very thin or entirely wanting on the unforested portion of the lip of the canyon. The following comparison of the cross section of such a cornice with a similar cross section of the cornice on the unforested summit of Mount Rose reveals the relative merit of a slope capped by a timber screen as compared with a slope lacking such screen. (a) Cornice accentuated by timber screen: water content of snow 48.9 ins. (b) Cornice formed without timber screen; water content 25.1 ins.

However, owing to the difference in elevation of almost 1,800 ft. and less exposure to the sun the shallower cornice at the summit of the mountain outlasts for a short time the deeper cornice below.

NECESSITY OF TIMBER SCREENS TO DIMINISH EVAPORATION.

The necessity of timber screens, especially on the high mountains, to break the force of the wind and thus reduce the rate of evaporation is strikingly shown by the following experiment made at the elevation of 9,000 ft. on Mount Rose. This experiment was made at night. Furthermore, the temperature of the air was below freezing and the snow itself was frozen hard when placed in the evaporation pans. Yet under the wind movement, that averaged slightly over 33 miles an hour, a loss of approximately 1/10 in. water content occurred in thirteen hours, or 1/120 of the snow on the ground. This extraordinary, yet not infrequent, evaporation finds its counterpart in a relatively small evaporation in the forested areas of the Tahoe basin.

SEASONAL BEHAVIOR OF SNOW UNDER VARYING DEGREES OF FORESTATION AND TYPES OF FOREST TREES

Series 1. Comparison of Open Area with Forests of Pine and Fir.

(a) Treeless meadow:

Maximum storage of snow 11.7 ins (water content).

Remaining April 20, 0.0 in.

(b) Forest of pine and fir:

Maximum storage of snow 12.1 ins. (water content).

Remaining April 20, 0.6 in

(c) Fir forest:

Maximum storage of snow 11.0 ins. (water content).

Remaining April 20, 2.7 ins.

Although the treeless meadow had the maximum store of snow at the beginning of the season, at the end the fir forest still retained one-fourth of its total store after the meadow had been bare for a week. The more open forest of pine and fir, which at the height of the season possessed the maximum store of snow, now retained but one-twentieth of it.

Series 2. Comparison of Fir Forests of Varying Densities.

(a) Very dense fir forest:

Maximum storage of snow 10.9 ins. (water content).

Remaining April 25, 0.9 in. (water content).

(b) Fir forest, dense but filled with glades:

Maximum storage of snow 16.5 ins. (water content).

Remaining April 25, 3.2 ins. (water content).

It is evident that density of foliage is not the only factor in the conservation of snow, for the very dense forest has conserved only one-twelfth of its snow till the end of the season despite the fact that the rate of melting in it is much lower than in forests of lesser density. On the other hand, the fir forest filled with glades has conserved approximately one-fifth of its store of snow despite the fact that the rate of melting in it is as rapid as in an adjoining forest of pine and cedar, which has conserved only one sixty-eighth of its store of snow. The reason is found in the presence of the glades which have greatly increased the snow-gathering capacity of the forest. In fact, it is the snow drifts lying in the sheltered portions of these glades that constitute the bulk of the snow still unmelted.

Series 3. Comparison of Red Fir Forest with Forest of Mountain Hemlock:

(a) Red fir forest (elevation 7,600 ft.):

Maximum store of snow 20.8 ins. (water content).

Remaining May 1, 14.0 ins. (water content).

(b) Mountain hemlock forest (elevation 8,100 ft.):

Storage of snow at time of maximum storage in red fir forest 36.0 ins. (water content).

Storage May 1, 37.3 ins. (water content).

The essential difference between the red fir and the mountain hemlock is in their crowns. The crown of the red fir is spreading and its needles upturned, while the crown of the mountain hemlock is slender and spire-like and its foliage drooping.

The difference in elevation of the two forests is probably slightly to the disadvantage of the red fir forest in respect to snowfall and melting. But the first factor, that of snow fall, can represent only a small portion of the excess, amounting to 76 per cent, conserved by the mountain hemlock forest in March, while the factor of melting at this time can be wholly disregarded, for melting had not yet begun at this elevation. Regarding the snow in May, the increased storage in the hemlock forest is due in part, at least, to difference in elevation. However, the relative superiority of the hemlock forest over the red fir forest can safely be placed at 50 per cent.

THE IDEAL FOREST.

The most efficient forest, therefore, from the point of view of conservation is the one that conserves the largest amount of snow to the latest possible time in the spring. For elevations below 8,000 ft. this has been found to be the fir forest with a maximum number of glades, for the foliage of the fir is much more impervious to the rays of the sun than that of the cedar or pine. At 8,000 ft. elevation or higher the mountain hemlock is most efficient, for not only is its foliage dense but its tapering spire-like crown offers little resistance to falling snow. The ideal forest seems to be one filled with glades whose area bears such proportion to the height of the trees that the wind and the sun can not reach the bottom. These glades can be produced by the forester by judicious pruning and cutting as well as by proper planting. However, the mountain hemlock requires but little or no pruning to attain its maximum efficiency.

THE EFFECT OF ELEVATION.

Elevation is one of the largest factors in the conservation of snow. A difference in elevation of even 1,000 ft. effects a marked change in the store of available snow. A significant example is the Ruby mountains in eastern Nevada, which attain an altitude of 11,000 to 12,000 ft., but are covered with scant verdure except brush. These mountains are the main source of the Humboldt River, the longest river in Nevada and one whose maximum flow is normally retarded by the elevation of its snow fields until early June—a fact of the utmost consequence to the ranchers along its course. On the other hand, the Truckee River, which rises in the Sierra Nevada and is fed by a region partially forested but 2,000 ft. lower than the Ruby mountains, attains its maximum flow in May, a date too early for the most efficient use of the water. A striking feature of the value of elevation is the continued accumulation of snow at the higher levels long after the snow at the lower levels has begun rapidly to disappear.

The elevation of the zone of maximum snowfall, according to the observations of Professor A. G. McAdie on glacier-building on Mount Rainier, is approximately 11,000 ft. In the Sierra Nevada, the increase in maximum snowfall from 13.5 ins. at 6,225 ft. elevation, found in the open forest at Lake Tahoe, to 35.9 ins. at 9,000 ft. elevation near the summit of Mount Tallac, indicates the rate of increase in snowfall that may be expected with increase in elevation. The zone of maximum snowfall on Mount Rose lies above the elevation of 9,000 ft. However, the snow is swept away so persistently on this exposed peak that the exact elevation of maximum snowfall has not been satisfactorily determined.

The evidence on the retardation of melting with elevation is clearly shown in the Tahoe basin by the presence at the end of April of only 0.2 in. water at 6,225 ft. at the level of the lake and of 35.9 ins. at 9,000 ft. near the summit of Mount Tallac.

THE CONTROL OF STREAM FLOW.

There can no longer be any question of the direct influence of forests in delaying the melting of the snow and thus in retarding stream flow at the very time when floods normally occur. It is also equally true that forests, if too dense, fail to attain their maximum efficiency as conservers of snow. On the other hand, the planting of timber screens at strategic points on exposed slopes will greatly increase their capacity to store more snow.

There are two types of reservoirs—the snow reservoir, formed by mountain cliff or forest to hold the snow in its original form, and the water reservoir below to impound the flood waters of the streams. The development of the former is the immediate and feasible task of the forester, the construction of the latter is the work of the engineer.

INCREASE IN WATER RESOURCES FEASIBLE.

The development of the national forests to their full capacity means not only the control of the present run-off, but also a large increase in the storage of snow, without in any wise jeopardizing legitimate lumbering interests. For pine, the timber of commerce, seems to prefer the warmer southern exposures, while fir, the most available cover for snow, thrives best on the shady northern slopes. The southern slopes, therefore, where snow can be protected only with difficulty from the direct rays of the sun, can be set aside for lumbering, while shaded northern slopes can be reserved for the fir, only sufficient fir being cut to insure the maximum storage of snow. At 8,000 ft. and over, where protection from wind is imperative, the mountain hemlock or tamarack should be planted wherever conditions will permit their growth. In this way, water can be conserved for direct application where the soil is arable, without permitting a large portion of it to be evaporated or to run off uselessly. Furthermore, the greater portion of the seasonal evaporation will occur in summer through transpiration by the trees rather than in the winter through the effect of wind. The transfer of moisture to the air will thus occur in the summer when its presence is most needed.

Some Drainage Projects in Southeastern Illinois.

Flowing into the Mississippi River from the east there are no large streams between the Illinois River on the north and the Kaskaskia River on the south. The largest stream is Cahokia Creek, having a length of about 40 miles, and a drainage area of 259 square miles. The next largest is Wood River, having a drainage area of 122 square miles. The drainage problem of these streams is discussed in a paper by Mr. Charles A. Sheppard before the Illinois Society of Engineers and Surveyers.

The general topography of the two streams, excepting the shape of their drainage areas, is similar from their sources to where they emerge from the eastern bluffs and enter the valley of the Mississippi River. From here on they are quite different. Wood River, though it has many long bends and is very crooked in most of its course, reaches the Mississippi River within a distance of three miles from where it comes out of the bluffs, while Cahokia Creek, which emerges from between the bluffs, only 4½ miles from the Mississippi River, formerly meandered through the alluvial valley of the Mississippi and discharged its waters into the Mississippi River 20 miles farther down stream.

Cahokia Creek has been cut through to the Mississippi River by the new Diversion Channel, recently completed by the East Side Levee and Sanitary District, and the Wood River Drainage and Levee District has been formed for the purpose of doing the same thing with Wood River so that the parts of the Mississippi valley which these streams flow through will be amply provided with drainage and protected against overflow. The drainage of the lower end of Cahokia Creek Valley, within 4,000 feet of the east end of the new Diversion Channel, has already been favorably affected by this new channel, so that there is a disposition on the part of the landholders to go on with the work farther up the valley.

Surveys have been made for ten miles up stream from the upper end of the diversion channel, and a study of the conditions is of considerable interest, as it is typical of many other Illinois streams whose tributaries are short and have a rapid fall, while the main stream is very crooked and has only a light fall to it.

When the county was first settled the channel of the creek was deep and reasonably wide and, though crooked, it carried off the rainfall so well that the whole valley was not flooded by anything but an extraordinary storm. Land in the valley was cleared up by the farmers and most of the fields were in a good state of cultivation up to the creek banks. As the prairies became cultivated there was more erosion of the soil along the small tributaries, whose slopes are steep and have in many instances been straightened out by the land holders cutting small ditches and letting the water do the rest of the work. Where the slope is over 12 or 15 ft. per mile these cuts have been easily made and rapidly carry off the water, burdened with silt, to the main channel, which gradually began to fill up and contract in width. This process was encouraged by drifts forming across the channel, also some bridges being of insufficient capacity and in some bridges being built of piles. When the current become more sluggish, trees began to grow along the sloping banks of the channel, hindering the flow more and more until the carrying capacity became less than half of what it was formerly. As a consequence, floods became more and more frequent, and damage to crops and land began to increase.

In many instances the farmers constructed levees alongside of the channel, but where the embankments were built too close to the stream they have broken. Where they were safely located they remain standing, but the land enclosed and protected by them is lower than the land on the outside on account of the deposits from the overflows not having built them up. It must be remembered that while the channel has been filling up, the banks and all the area near the banks have also been building up by reason of the heavy deposits of silt. This process has been going on more rapidly than ever during the past ten years, so that hundreds of acres that were formerly good pasture lands have gone back to primitive conditions and many of the former good fields are now second class pasture lands, so that it is not so much a question of increasing the area of cultivated land by drainage as it is to get back the land that used to be cultivated and hold on to what is now being cultivated. The surveys show that the highest land in the valley is generally close to the stream, so that a straight new channel is most economical, using the old channel only in stretches where it lines up with the general course of the new channel. Highway bridges and railroad bridges, however, must be taken into consideration on account of the fact that the law will compel railroad companies and highway commissioners to build bridges of sufficient capacity to meet the improved conditions of a stream if their present bridges are inadequate, while on the other hand, if a new ditch is laid out so as to cross a highway or railroad where no stream previously existed, the drainage district will have to bear the expense of such bridging.

With the exception of about a mile of its distance, the Cahokia Creek valley is fairly straight, so that a new channel will only have a few bends, and in the first ten miles the new channel will be ten miles shorter than the old one. The size of the new channel to be dug is of the greatest important of all, and here we have the greatest diversity, both in the actual practice of engineers having a national reputation and in the minds of the laymen and taxpayers having the work done.

The proposed new channels of the Wood River District, which are based and planned on observations and recommendations of Robert Moore and John W. Alvord, both eminent engineers, provide for 245 second feet per square mile run-off for the entire drainage area of Wood River, while Cahokia Creek channel, recently opened, of which Col. J. A. Ockerson was consulting engineer, provides for less than half as much run-off per square mile of drainage area and observations taken in 1912 by the writer along the new channel during a flood which was only 3½ ft. below the highest water known three miles up stream from the upper end of the diversion channel showed only 28 second feet per square mile run-off. Most of this apparent discrepancy is caused by the difference in the shape of the drainage basins of the two streams, Wood River drainage basin being nearly as broad as it is long, while Cahokia Creek basin is over twice as long as it is broad, but even with all of these factors taken into account a great deal of latitude is still left.

The next question of importance is the proportion of the total area to be provided for below the general surface of the ground, so that a flood would not overflow the bottoms if levees were not provided. The cost of improving a stream would be almost prohibitive if a large enough channel had to be made to carry all flood water off without overflowing the banks, and besides this the waste earth from the channel will build levees without any additional cost, which are more than sufficient to prevent overflow. If too much water is to be carried above the banks, its effect on surrounding land will be bad for the many streams that enter the same channel, even if provided with automatic water gates, will not empty themselves in time for the rise of water in the main channel and damage will result from standing water while the crest of the flood is passing down the valley.

In plans which we recently outlined for Cahokia Creek, for ten miles above the east end of the Diversion Channel, the overbank height is kept to 3 ft., and about one-third of the total area below flood plane is taken care of above-bank between levees and two-thirds of the area is to be excavated below the general surface. The above factors are susceptible of treatment by careful examination, mathematics and good judgment, but the hard problem appears when it comes to raising the money for making the channel. These valleys are comparatively narrow, not averaging a mile wide of land subject to overflow from the main stream, which means that there are only about 500 acres per mile in the lower part of the valley that are directly benefited by the new channel.

The required channel, including right of way and other expenses, will cost from $15,000 and $20,000 per mile, so that it is necessary to spread a tax of from $30 to $40 per acre to cover the cost of the improvement. Owing to the great cost per acre to be raised on a purely agricultural basis, there are many landholders who hesitate to make the investment, and there is a great tendency to scale down the size of the channel and trust to nature to wash out a larger and larger channel as time goes on. This method has been put into actual practice in Silver Creek bottom, between Edwardsville and Alhambra, where a district 3 miles long has been formed, and assessments of about $7 per acre have been made and a straight channel averaging 5 ft. deep with about a 6-ft. bottom has been opened through the valley, shortening the present meanderings of the channel about half.

The old channel is also left open, and it is hoped by the landholders that the straight ditch will rapidly enlarge itself and in a few years will carry more water than the old one and that it will eventually carry off the floods. We do not believe that there have been any recommendations made to this effect by any engineer, and from a theoretical standpoint the velocity of water in the new channel will not be great enough to cause rapid erosion unless the sub-strata proves to be easily washed soil or sand.

However, this is the first purely agricultural community to actually construct an improvement in a locality at a considerable distance from a large city in this part of the state, and it is to be hoped that it will work out successfully so that it will encourage more efforts in reclaiming land along the bottoms of small streams. If it does not work out well it will demonstrate the fact that they should have been well advised before beginning and not relied too much on what nature will do. It will undoubtedly do some good, for many backwater sloughs are encountered by the new ditch which will drain out rapidly after a flood is over, and if it proves a good investment, they will have the right of way and organization to go ahead and do more, if nature does not meet their expectations.

The only thing to be feared is that if it fails to do the work expected of it by optimistic landholders, they will call all drainage a failure. While only a few localities have been mentioned in this short article, the general conditions apply to many streams in all parts of the state, and especially to the shorter tributaries of the Mississippi River. In most drainage projects the surface to be drained is relatively flat, and storm water travels slowly to the main channel, and this channel has somewhere near the same slope as the laterals, so that the velocity in it will compare favorably with the velocity of the flood waters entering it.

The areas are also usually large, so that one mile of channel will represent the outlet for thousands of acres of land so that, while the aggregate cost may be high, the cost per acre benefited will not be great. Here, however, the slope of the tributaries is steep and in many cases they have been straightened, so that the water from a storm now reaches the main channel very soon after it has fallen and must be conducted down the valley by a channel having a fall of from only 3 to 5 ft. per mile. These are the problems which are coming up more insistently as the surrounding lands become more valuable and small valleys, which were formerly considered the best in the country, depreciate in value.

It may be some time before much progress is made along these small streams, for the cost is high per acre, and there are more incidental expenses following the opening of a new channel, such as the reclearing the land and the larger number of laterals to take care of on account of the many hillside streams. The problems involved are interesting and intricate and the engineers who successfully solve them will have some work to do after many of the larger, flatter lying acres have been drained.

WATER WORKS

The Results Acomplished in Kalamazoo, Michigan, by the Installation of Water Meters, with Special Reference to "Steals" from Fire Sprinkler Lines.

Commenting on the opposition by some water works officials to the installation of water meters on the ground that meterage imposes an unnecessary and unjust burden upon citizens generally, Mr. George Houston, Water Commissioner of Kalamazoo, in a paper before the Michigan Engineering Society, advised such officials to adopt meterage as a means of reducing water charges without the curtailment of an ample supply of water.. Mr. Houston gave some interesting data drawn from his experience in Kalamazoo to illustrate the good results to all concerned following the installation of meters. The following abstract of his paper has been prepared:

During the year ending March 31, 1893, without meters, and with a population, according to the census of 1890, of less than 18,000, and with only about 30 miles of mains, and less than 300 hydrants, the Kalamazoo works pumped a total of 787,621,902 gals. of water, receiving therefore a trifle over $15,000.

It might be well to add here, that during a great portion of the months of July and August and January and February of this period it was necessary to drop the pressure at the pumps in order to keep the supply in the wells above the intake of the suction line, and Mr. Houston was informed by the superintendent that it was carried as low as 15 lbs. many times, while the regular pressure at that time was supposed to be about 45 lbs., so if the works had been able to supply the demand fully, the total consumption for the year would have been increased by a good many million gallons.

Now to compare the above record with that of the department for the year ending March 31, 1912, during which period everything was metered, as is the case at the present time.

During this period, with a population of more than 45,000 and with over 78 miles of mains, and with 680 hydrants, and with everybody getting all the water they wanted at all times, and with pressure constant at from 55 lbs. to 60 lbs., and with a great deal of water used for washing pavements which had never been done before, the works pumped a total of 696,898,979 gals., receiving therefor the sum of $42,773.12, with a net minimum charge of $3 per year, the lowest rate charged by any city in the State with the exception of Battle Creek.

By comparing the above totals, one discovers that the works pumped 90,722,923 gals. less in 1912 than in 1893, and increased the revenue $27,773, and still had plenty of water in reserve.

All this has been brought about by the use of meters and without any increase of the original supply to speak of, and if followed up will insure an abundance of water for many years to come.

Any city that starts in to change from a flat to a meter rate system will, no doubt, meet with the same troubles encountered in Kalamazoo, as there are to be found in every community a large number of people who insist on having as near all they can get for as near nothing as possible, and especially so when the furnishing agency is the municipality.

The foregoing was written without reference to any particular kind of meter or service, but as all services are metered, Mr. Houston got ready some data with reference to the consumption of water through sprinkler lines before and after the installation of meters on them, which can be used if one sees fit, in support of the proposition that all such services should be metered.

The cases referred to below are those in which the department has been able to make a fair comparison from the fact that the uses of the institutions concerned have not been changed (with the exception of No. 4) since the installation of the meters. The cases are referred to by number.

1. In this case all lines through which water for general purposes was used were metered, and the average consumption per month for 21 months prior to the installation of the fire line meter was 6,066 cu. ft., while with the same use of water after the installation of the fire line meter and the cutting off of the lines through which they were formerly supplied and removing the old meter, the consumption has averaged 42,305 cu. ft. per month.

2. For 27 months prior to the installation of the fire line meter the average consumption per month was 5,200 cu. ft. Since the installation of the fire line meter, and with a 2½-in. line, through which they admittedly used a considerable quantity of water, cut out, and a large number of taps removed from the sprinkler system, the consumption has averaged 10,000 cu. ft. per month.

3. Prior to the installation of the fire line meter, the consumption averaged 4,443 cu. ft. per month, and they were not at all careful about the use of water in any part of the factory. Since the installation of the fire line meter, and, after making every reasonable effort to conserve their water supply, which they admit that they did not attempt to do before their fire line was metered, the average monthly consumption has been 30,379 cu. ft.

4. In this case they were supposedly not using water for their plant except for sprinkling purposes, but, after the installation of the fire line meter, and after cutting off three of their 6-in. lines supplying three of their plants, and opening valves from the main plant, so as to give a supply of water to the plants so cut off, through the one metered line, by simply opening up the valves, they consumed about 20,000 cu. ft. of water in about one month, when it was, as before stated, supposed that they were not using any city water at all about the plant. After this was

discovered, they closed the gate entirely so that the line supplying the sprinkler system with city water was shut off, they having in the meantime provided a secondary supply by means of an elevated tank. This condition prevailed for a few months, at the end of which time they concluded that they would have to have city water for drinking purposes in and about their mill, giving as a reason that their employes thought that they ought to have city water to drink. A 2-in. connection was then made with the sprinkler line between the check valve and the meter, and the line was carried into the building and the water turned on from the city main. Since that time they have used an average of 58,440 cu. ft. per month, and during last month they used 95,100 cu. ft. and the water department officials naturally asked the question, "What were they doing for drinking water during all the years prior to the installation of the fire line meter?"

5. In this case, prior to the installation of the meter for 18 months, the consumption had averaged 15,511 cu. ft. per month, and since the installation of the fire line meter with no changes in their requirements unless it has been for a smaller consumption on account of dull times and not employing as many hands, their consumption has averaged 34,444 cu. ft.

Mr. Houston, in connection with the foregoing facts, contends that since the meters were installed on fire lines every one of the firms above referred to have been doing all they could within reason to check any unnecessary use of water, and still the consumption has increased as shown, which proves that this same waste, or uses other than were known, were going on before the meters were put in, and, no doubt, to a far greater extent than the above figures show, and he believes this to be the case with every institution supplied with sprinkler lines, but he does not feel like saying that he believes it to be a case of stealing in every instance, but that a great deal of the water wasted in this way is without the knowledge of the proprietors of the institutions. This seems to argue very strongly in favor of an ordinance requiring all such services to be metered, if permitted at all. As nearly every one of the institutions in Kalamazoo supplied with sprinkler systems has shown quite a large consumption since the meters were put in, Mr. Houston is of the opinion that a minimum charge, based upon the idea of the "ready to serve" proposition, together with the loss of water from numerous small leaks that a large meter will not register, is entirely reasonable.

Now with reference to another feature of the question, namely the risk that the municipality or water company has to carry by reason of the danger of the risers to sprinkler systems breaking off, in the event of a fire, and thereby endangering the balance of the property in the city through having no pressure on the system.

In this connection three cases of this kind occurred in Kalamazoo, which, fortunately for the balance of the city, did not so happen as to cause any serious loss other than to the plants affected. The first instance was that of one of the large paper mills where it seems that one of the arms to the sprinkler system became clogged and allowed the fire to gain such headway that the sprinkler had no effect on it, and after the walls fell in, the water department was practically helpless, so far as rendering any valuable service was concerned, until the sprinkler line could be shut off and the pressure raised. The loss in this case was about $90,000, and had the fire occurred in a district where there were other large buildings close by, there is no telling what the loss might have been.

The second case was that of one of the chemical companies where practically the same thing occurred, but in this case they were able to get the line supplying the sprinkler system in the building where the fire was raging, shut off in time to enable the water department to regain the pressure, and in a very short time the fire was under control.

The third case occurred only a short time ago where the building itself was completely destroyed, and the trouble was due to a lack of pressure caused by so many sprinkler heads going out, and the breaking off of the risers to the sprinkler when the walls fell in. This building stood out entirely by itself, and had it been in a congested district there is no telling to what extent the fire might have gone. The loss is this case was about $125,000.

From these three cases it can be easily understood why Mr. Houston believes that the benefits claimed for sprinkler systems, through their being auxiliaries to the regular city fire departments, are a great deal more than offset by the dangers they entail upon all of the rest of the property in the city through just such instances as the ones above referred to. He feels that instead of their being an assistance they are really a detriment, and a great one at that, for it seems that every water works man will concede that in the end the only real and permanent fire protection that cities can have in the way of a water supply must come from fire hydrants, and any system that can, in any way, interfere with the effectiveness of a fire hydrant is a danger that should be avoided as much as possible. If permitted at all it should be only upon the basis that the owner should pay for the privilege in accordance with the risk that the city or water company has to carry on that account. If possible the charge should be made in the way of a premium, the same as upon an insurance policy.

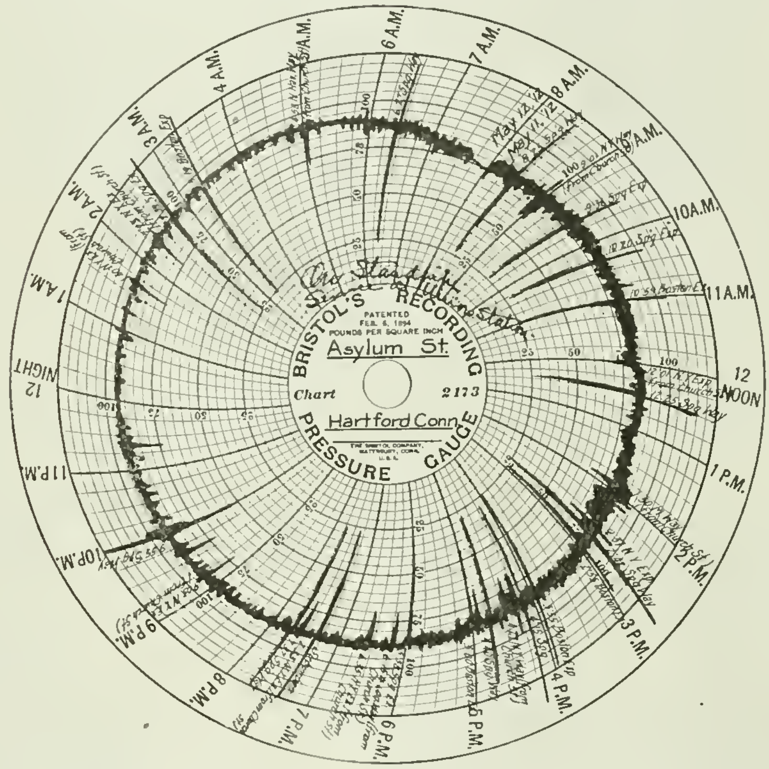


Fig. 1—Chart From Recording Pressure Gage on 8-in. Lateral Directly Supplying a Railroad Standpipe at Hartford, Conn.

Experience with Water Ram at Hartford, Connecticut, Due to Operation of Quick Opening Valve on Locomotive Standpipe and to Fire Engines in Service.

The experience of the Hartford water department officials with water ram caused by the operation of a standpipe for railroad water supply and by fire engines in service, was described by Mr. Caleb M. Saville, Chief Engineer of the Hartford Water Works, in a recent paper before the New England Water Works Association. This paper was given as a companion paper to that on water ram, resulting from the operation of a hydraulic elevator at Northeast Harbor, Maine, presented by Mr. C. W. Sherman and published in abstract in Engineering and Contracting of Jan. 29, 1913. The following data are taken from Mr. Saville's paper:

In January, 1912, the 30-in. supply main leading from the Hartford reservoirs to the city broke late in the evening of one of the coldest days of the year. One month later a similar misfortune happened to the 20-in. supply main in Asylum St., and this year only about a month ago an 8-in. pipe in Church St. also broke. In casting about to explain these occurrences, a very probable cause seemed to be likely in the method of operating the standpipes for filling locomotives at the Union Station of the New York, New Haven and Hartford Railroad. While the break in the 30-in. main was located at a point about 1½ miles distant from the Union Station, the Asylum and Church Street breaks were within a few hundred feet from the stand pipes. As all of these mains let go immediately after the locomotive tanks had been filled, the occurrence of each break greatly strengthened the suspicion of the probable cause. As a result of the investigations and after conference with the railroad people, it is probable that the trouble can be obviated in a manner satisfactory to all parties.

The following ways of handling this matter have suggested themselves: 1. By a slower motion valve on the standpipe. This is objected to by the railroad people on account of delay to train service. 2. The use of a water cushion valve on the standpipe which would act similar to the air checks on doors. This device is now in operation in various places, and when new works very satisfactory. After constant use, however, the parts wear, and if repairs are not made the conditions of ram became as bad as before installation. 3. An air pressure tank or chamber may be installed so devised that, theoretically at least, the shock of the quick closing valve will be mostly taken up by an air cushion. Such a device is in operation in several places, but it is understood to be not entirely satisfactory. This condition may be due, however, to a defect in the installation, rather than inherent to the system. 4. An elevated and independent tank may be used, and this, from a water works standpoint, is probably the most satisfactory solution of the problem. In this case the water may be drawn out as quickly as desired and the tank refilled by a steady stream that will be automatically and gradually cut off as the tank is filled. Unfortunately, this method of solving the problem is not always feasible, either on account of aesthetic conditions which forbid an unsightly tank, or on account of the cost of an architecturally satisfactory structure. The diagrams shown herewith as Figs. 1-3 are perhaps the best evidence needed to show the stress that is put on the pipes when quick motion valves are allowed on locomotive standpipes in cases where no effort is made to prevent ram.

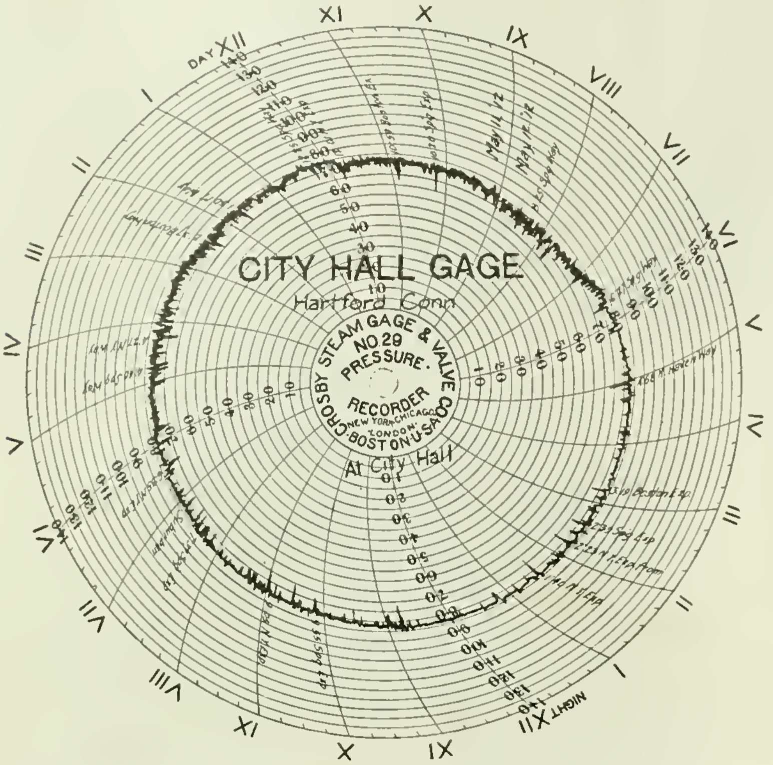


Fig. 2—Chart From Recording Pressure Gage in Water Department, City Hall, Hartford, Conn., One-half Mile From the Railroad Standpipe.

The chart shown as Fig. 1 is from a recording pressure gage located on the 8-in. lateral directly supplying the standpipe. It is to be noted that the extreme vibrations of the pen show a total length representing about 120 lbs. per sq. in.

The chart shown as Fig. 2 is from a recording pressure gauge located in the Water Department office at the City Hall, about ½ mile from the Union Station. This diagram is particularly interesting as showing that the water ram impulse is transmitted to considerable distance through a distribution system, and with a decidedly appreciable force. A few of the principal deflections have been marked here and there to indentfy the same period on these two charts. A number of observations during the period of filling the locomotive tanks have given the following information, which is believed to be fairly representable of the average conditions which obtain:

Capacity of locomotive tanks (through service) ....6,000 to 7,000 gals.
Quantity usually drawn (meter readings) ....4,230 gals.
Length of time flow is maintained........ ....2 minutes, 50 seconds
Velocity in lateral....................9.50 ft. per sec.
Size of lateral....................8-in
Size of street main....................12-in. and 16-in.

Beside that from locomotive standpipes another source of water ram may be found in the operation of steam fire engines. On Dec. 13, 1912, at 2:15 a. m. an alarm was rung in for a fire in the building occupied by Smith and Northam on State St., Hartford. The building was supposed to contain a considerable quantity of hay and was located in a district where serious results were apprehended if the fire was not quickly controlled. Besides other apparatus four steamers responded to the alarm. Two of them were of the large self-propeller type, capable of delivering 1,200 gals. per minute each. The other two were of the ordinary type, one of 900 gals., the other of 600 gals. each per minute. Besides the above the fire pumps at the nearby car barns of the Connecticut Company were put in service. The hose line system consisted of the following lines: 2 3-in., 4 2½-in. and 3 1½-in. lines. The venturi meter on the supply main at the effluent gate house indicated a draft for this fire of about 350,000 gals., the rates of draft in excess of the ordinary consumption being as follows:

10 min. intervals.	Gals. per hr.
1st period	125,000
2d period	190,000
3d period	200,000
4th period	240,000
5th period	195,000
6th period	160,000
7th period	170,000
8th period	170,000
9th period	110,000
10th period	130,000
11th period	140,000
12th period	100,000
13th period	70,000
14th period	30,000
15th period	20,000
16th period	30,000

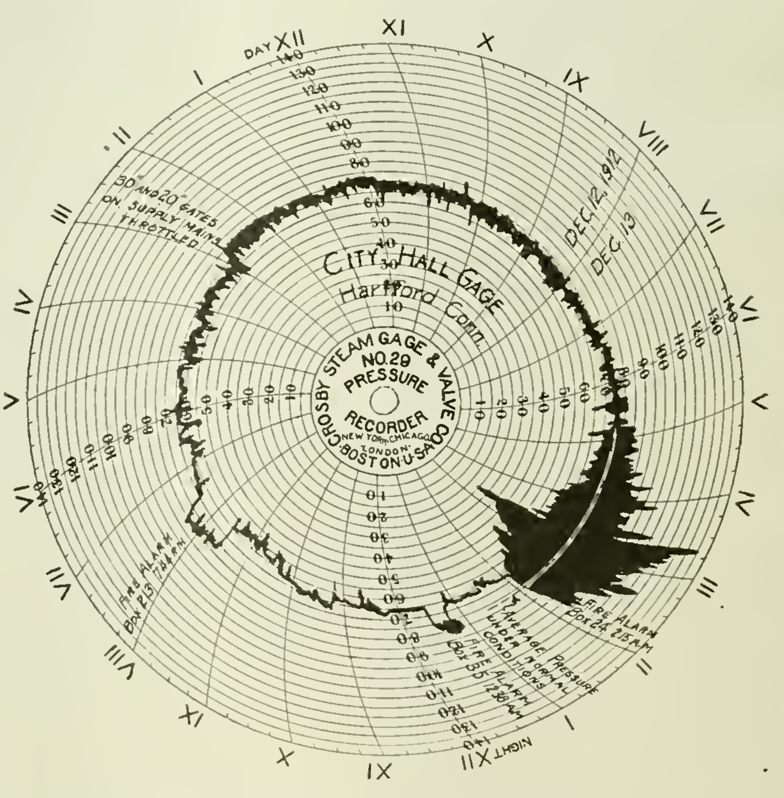


Fig. 3—Chart Showing Pressure Fluctuations in Water Main Drawn Upon by Fire Engine —Gage and Steamer on Same Main.

The diagram here shown as Fig. 3 is from the recording pressure gage located in the Water Department office about 500 ft. from the location of the fire. The gage and the steamer were on the same main. Particular attention is called to the frequency of the vibration, which was such as to cause the pen to paint a continuous blotch rather than to show the individual movements. It is also to be noted that the extreme length of vibration corresponds to about 110 lbs. pressure per square inch. The withdrawal of some of the fire engines is well marked, especially at about 3:30 a. m., by the sudden cessation of the extreme amplitude of the vibration.

In connection with this diagram it may be of interest to state that the city of Hartford has recently passed through a rather disturbing period due to low rainfall and the excessive calls that have been made on the storage in the reservoirs. In order to take every precaution possible to conserve the supply and to put off as long as possible the evil day of turning to the Connecticut River for an emergency supply, the gates on the supply mains were throttled during the later afternoon and night. The intention was to keep the pressure during this period at about the same point as it stood during the day hours of maximum consumption. A drop in pressure of about 15 lbs. per sq. in. was made in this manner, and the Venturi meter records indicate a saving of at least 250,000 gals. per day. By good fortune there are two fire engine houses not far from the city line and also near the main gates on the supply main. Two men were stationed at each of these houses and on an alarm of fire they open the gates as soon as possible. A number of alarms have come in during this period but at no time has there been any lack of pressure when the engines arrived. The ordinary night consumption at this season of the year is at a rate of about 4,000,000 gals. per day. The time of closing the gates appears on the diagram about 3 p. m. and the effect of opening up on account of other fire alarms the same night is shown at 8 p. m., 12:45 p. m. and 2:15 a. m. Ordinarily the gates are opened each morning at 5:30 a. m.

A Discussion of Some Common Faults in the Engineering Preliminaries for Water Power and Water Supply Developments.

Some of the questions which must be decided before a water power or water supply project reaches the construction stage, and upon the decision of which the ultimate success or failure of the undertaking is largely dependent, were discussed by Mr. Robert E. Horton, Consulting Hydraulic Engineer, Albany, N. Y., in a recent paper before the Michigan Engineering Society. The paper is a frank statement of some common faults in the engineering preliminaries for projects of the class above named. The major portion of the paper is here given:

Usually three men are identified with the preliminaries of a water power or water supply project—an engineer, a lawyer and a promoter. The promoter, if he is a good one, knows three things, namely, how to get money, how to spend it and how to make a thing equal to more than the sum of its parts. On the first point the engineer obviously cannot help the promoter, since the engineer is, as a rule, notorious for his inability to get money. On the second point, how to spend money, the engineer is supposed to come in on the construction end only. The lawyer more often is the man consulted as to the acquisition of options, real estate, etc. On the third point, how to make a thing equal to more than the sum of its parts, the lawyer comes in strong. This procedure involves corporation organization and the marketing of securities in such manner that property costing $100,000 to acquire and develop can be sold for $150,000.

The case as outlined is a favorable one—one that succeeded. Probably 90 per cent of the projects that come up fail of promotion on the first trial, and a lamentably large portion of those that pass the promotion stage ultimately fail financially. When such failures occur the engineer comes in for his share of blame, and usually for more than his share.

Mr. Horton discussed some of the more common reasons why hydraulic works do not always turn out as well financially as expected when they were in the preliminary or promotion stage. The first cause of financial failures is excessive outlay for the necessary lands and water rights. This is a more common occurrence than is ordinarily believed. In one instance cited a water power company paid a large sum of money for water rights it needed, and in addition it contracted to furnish the mill in question with a certain constant amount of power. After the power was developed it turned out that the power pledged in part payment for bare water rights was more than the ordinary low water flow of the stream could supply. The development company then had two alternatives to choose between, namely, to break its contract and lose the water rights, or to supply the deficiency in power by steam. It chose the latter alternative and bankruptcy followed. No reputable engineer was ever asked to pass on the power contract, so far as Mr. Horton knows, and the failure was probably deserved as a penalty for lack of foresight.

In other cases of failure the property gets involved in costly litigation during the promotion or early construction stage. This is a not uncommon cause of financial embarrassment and cannot ordinarily be charged against the engineer, excepting in backwater cases.

A water power project was promoted in Connecticut which illustrates a case of this kind. A dam of certain height was built. After the dam was built it was found that it backed water four or five miles upstream into the state of Massachusetts. The Connecticut corporation could not condemn property in Massachusetts and the necessary acquisition of the flowage rights by purchase at the price asked, whatever its amount, was nearly ruinous. The engineer was rightfully blamed in this case.

SOME COMMON CAUSES OF FAILURE.

The four most common causes of failure of water power or water supply projects are, according to Mr. Horton, the following: Failure to develop expected market, structural failure, construction cost underestimated, water supply and available output overestimated.

A failure to develop the expected market is generally due to a too optimistic view of the market by the promoter. A structural failure, while probably the fault of the engineer, need not be discussed here, because in the preliminary stage of a project it is always assumed that the works if carried out will not intentionally be designed or constructed improperly.

However, failures due to the preliminary estimate of construction cost being largely exceeded, or to the water supply proving less than anticipated are usually due to faulty preliminary work by the engineer. If the preliminary work was properly done there would be fewer failures. It is easy to get at the weak points in hydraulic engineering preliminary work by a study of the common causes of failures.

Two causes of failure attributed to the engineer, namely, underestimating the cost and overestimating the output, are lamentably common. The engineer of one of the foremost Eastern banking concerns dealing in hydraulic investment securities said the other day that in project reports coming to him the cost was almost invariably underestimated and the power available in water power projects was similarly overestimated. Recently the representative of another Eastern firm of security underwriters remarked, perhaps jokingly, that his firm would not consider a water power proposition unless it still looked good after the engineer's preliminary estimate of cost had been doubled and the engineer's estimate of the available power cut in two.

Are such aspersions on the hydraulic engineering profession just? If so, it is time we located the fault and found the remedy. Perhaps some engineers do not realize how easy and natural it is to underestimate costs in a preliminary estimate made up before plans are prepared or surveys completed. Both the cause and remedy for such underestimates are so commonly known that their discussion here is needless, except to remark that the engineer who deliberately underestimates—and such have been known; for the sake of getting the job—deserves the millstones of tribulation which later on are certain to be hanged about his neck.

The causes which underlie the very common and generally unintentional overestimating of the yield and power of streams, are somewhat complex and were referred to in some detail by Mr. Horton. Of course, engineers are not always directly to blame for overestimates being used.

Not long ago Mr. Horton made an estimate of power created by the New York Barge Canal. The next day the substance of his report was published in newspapers with the amount of power doubled. His name was not mentioned, but it was credited to the department with which he was connected. The state official who published it increased the figures for, it may be, political effect.

However, Mr. Horton frankly admits that in the majority of cases where a water supply is overestimated the engineer is at fault.

ESTIMATING THE FLOW OF STREAMS.

From a careful study of very many engineers' estimates of the flow of streams and after having made some, Mr. Horton has reached some interesting conclusions. First, in the absence of actual gagings of a stream, it is nearly impossible to estimate accurately the low water flow, especially that of a small stream, such as is commonly used for gravity water supply systems in the Eastern states. Hence, in working up any project involving the low water yield of a stream a few gagings, at least, taken during the low water season are almost indispensable. In the absence of records of continuous gagings a fairly reliable estimate of the flow of a stream during other than low water months can usually be made if it is gone about in the right way. Such an estimate may be based on rainfall data alone in conjunction with a knowledge of the physiographic and cultural conditions, but is preferably based also on long gaging records of adjacent or similar streams, or of the same streams at another location. In making such estimates the principle of "making the best possible use of all the available information" is the safest guide.

It must be admitted that many engineers, and some otherwise good hydraulic engineers are included in the statement, do not know how to make as good an estimate as might be made of the yield and power of a stream. This is apparently due to three causes, namely: they consider the problem simpler and easier than it really is, they haven't the necessary data, lacking these they have failed to acquire properly experienced judgment in such matters. There is no book in print that adequately treats of this subject. Mead's "Stream Flow and the Factors that Modify It," an abstract of which was published in Engineering & Contracting, Vermeule's "Water Supply" and Vol. III of the N. J. State Geological Survey will be found helpful.

When one considers that for a given rainfall there are some 40 or 50 factors which affect or co-operate to determine the amount and character of the run-off which that rainfall will produce, the complexity of the problem and the difficulty of making reliable estimates from rainfall alone become at once apparent.

The U. S. Geological Survey, and in some cases state governments and corporations, have done much to provide records of the flow of streams. These records should be fully utilized wherever possible, and even if remote in point of time or incomplete, they should be given weight in making up an estimate. In general "an ounce of gagings is worth a pound of estimates." But, unfortunately, the chance that a gaging record will have been kept right at the point involved in a hydraulic project is rather small. In Mr. Horton's experience this favorable condition occurs perhaps one time in five. In the other four cases some estimating must be done.

For example, to illustrate the nature of the problem of estimating the run off from drainage basins, assume two adjacent basins, the yield of one of which has been gaged and an estimate of the yield of the other of which is desired. Assume that the rainfall and other physical features are alike, but that one is cleared and cultivated and the other is forest-covered. What will be the difference in the character and the amount of the run-off?

There is much good experimental data bearing on this and similar questions arising in water power and water supply project preliminaries which do not appear to be as generally known or used as they should be. Much of the data are in foreign literature. As an example, there are the results of Ebermayer's classical experiments on the relative evaporation, percolation and other conditions in forest and the open. A brief study of these data reveals at once that there is no universal answer to such questions, but that each case must be studied by itself.

STORAGE.

Engineers should realize that a water power plant without storage can utilize only the water that comes to it day by day, never the average flow of a variable stream, not even for a single month. Yet estimates dealing only with monthly average flow are surprisingly common. Mr. Horton has compared the estimated power available, as shown by an estimate made up from monthly averages, with the power actually available day by day, as shown by daily records of a stream, and found in the case of a fairly typical Eastern stream that the maximum actual power produced would be only about 75 per cent of that estimated from the monthly run-off. The error from this source is obviously greatest at times when the average monthly flow is about equal to the plant capacity, and the actual daily flow alternately exceeds and is less than plant capacity. Generally a power plant cannot utilize all the flow at times when the flow is less than the plant capacity. An allowance for waste of some available flow should be made, depending on the conditions.

Speaking of the desirability of estimating power output from daily and not from monthly flows, it is to be regretted that the U. S. Geological Survey has hitherto followed the policy of publishing monthly but not daily run-off. Mr. Horton opposed this method some years ago, with no immediate result. However, in his own work he has been publishing daily as well as monthly flows for ten years. It is understood that the U. S. Geological Survey has changed or is about to change over to this system. In the meantime the results for years back do not include daily flows and the engineer is put to considerable trouble to get them or work them out.

The intention of Mr. Horton's paper was to suggest the proper lines of investigation and the points where caution should be exercised in making preliminary reports on water power or water supply projects. Not only is a moral wrong committed by the making of an incorrect estimate, but the engineer as an individual suffers, and by implication the profession at large is cast under suspicion.

The engineer who has discovered and worked up a project believes in it and wants it to go through. He is often tempted to be over-optimistic. On the other hand, considerations of self-preservation would naturally make him pessimistic. Under such circumstances it is often hard enough to be fair, but that is the only safe road. In general the exercise of great care and the maintenance of absolute impartiality in preparing preliminary reports is the best possible insurance against trouble later on.

RAILWAYS

Methods and Cost of Constructing the Bear Creek Branch of the Cincinnati, New Orleans and Texas Pacific Railway.

Contributed by David W. Stradling, Assistant Professor of Railway Engineering, University of Kansas.

Two miles south of Winfield, Tenn., the Bear Creek Coal Co. has extensive coal lands located in the western part of the Jellico coal field, along the line of the Cincinnati, New Orleans & Texas Pacific Ry. (Queen & Crescent Route). In the fall of 1907 the coal company commenced developing their mines by driving several entries at the better outcrops in the property; and arrangements were made with the management of the C., N. O. & T. P. Ry. for the construction of a branch railroad to the mines.

In February, 1908, the writer, who was Resident Engineer in charge of the double-track construction then in progress on the C., N. O. & T. P., received instructions to also take charge of the construction of the Bear Creek R. R.—the corporate name of the branch line to be built to the new mines.

As the new line was being built for a comparatively small amount of freight traffic only, and at a period when financial conditions were such as to necessitate minimum expenditures for new work of all kinds, every economy was practiced in its construction. Some of the methods used for reducing the cost of construction are explained herewith in the descriptions of various features of the work. Attention is called to the advantage obtained from rates of grade used on account of traffic being practically all in one direction.

ALIGNMENT AND GRADES.

The Bear Creek R. R. branches off from the main line of the C., N. O. & T. P. Ry. two miles south of Winfield, which point is about a mile north of the main line arch over Bear Creek. Skirting around the spurs of the Jellico Mountains, along the northern edge of Bear Creek Valley, the line drops down on a maximum grade of 1.60 per cent, compensated for a curvature, as shown on the profile, Fig. 1, to a reasonably low and short trestle crossing over Bear Creek about 1½ miles from the junction with the double-track main line. Just east of the trestle the ½-mile spur up West Hollow curves off sharply to the right. West of Bear Creek trestle the line ascends grades of 1.90 per cent and 1.50 per cent for ½ mile, where it crosses a ridge between Bear Creek and Raynor Creek, one of its tributaries to the south. Here, as well as at other places, shallow cuts were made to avoid solid rock excavation as much as possible to keep down the cost of the grading. It should be noted that the resulting steep grades are favorable to loaded trains from the mines. The Wilson Hollow spur turns off to the right, at the west end of the cut through the ridge between Bear Creek and Raynor Creek, and extends for ½ mile up to the headwaters of Wilson Creek, in Wilson Hollow. West of the ridge the main track of the Bear Creek R. R. ascends on 1 per cent and 2 per cent grades up through the valley of Raynor Creek, nearly a mile further to the west end of the line. Grades of 1.90 per cent and 2.20 per cent favorable to loaded trains are used on the West Hollow Branch, which follows up Fox Run, a small stream flowing into Bear Creek from the east, see Fig. 2. Grades of 2 per cent, 1 per cent and 2.50 per cent occur on the Wilson Hollow Branch, which are also favorable to loaded trains, see Fig. 3.

Grades favorable to traffic were not compensated for curvature. If the line should ever be extended any considerable distance, which might result in a flow of traffic in both directions, such an extension would be commenced at some point near the Bear Creek trestle, and continue on down Bear Creek, which offers the only outlet to the west. The grades on such an extension would, of course, be compensated for curvature.

Referring to Figs. 1-3, it will be noted that the sharpest degree of curve used is 12°—30′, one curve of that degree occurring near the beginning of the line at Station 14+46.3; and extending to Station 22+42.6; and the other is about midway along the West Hollow Branch, being part of a compound curve extending from Station 69+05.6 to Station 73+75. Several 12° curves and curves of still less degree occur along the line, sharp curvature being necessary to carry the line on supporting ground without causing excessive rock excavation.

The rate of compensation for curvature used where sharp curvature occurred on grades adverse to the traffic was 0.04 ft. per degree per station. Curves were not spiraled as only short trains at slow speed were to be run over the line. Short vertical curves, as shown on the profiles, were used at points wherever required by change in rate of grade. The total length of line constructed is 19,400 ft. or 3.68 miles. The total length of line on curve is 7,360 ft., or 1.39 miles, which is 38 per cent of the line. The total amount of curvature on the line is 745°—45′. Four hundred eighty-three degrees and fifty-one minutes or 65 per cent, occur on the main line of the Bear Creek R. R.; 143° 24′ or 19 per cent, occur on the West Hollow Branch and 113° 30′ 16 per cent, occur on the Wilson Hollow Branch. The entire line is located above high water, and where the fills are low, as at the end of the main line and at the ends of the two branches, ample ditches were made, it being necessary to borrow material at those places for making the embankments. If the hills and ridges had been free from rock a much better alignment, with easier curves, could have been secured, and the large proportion of borrowed material to total excavation, referred to under the heading of Earthwork, could have been greatly reduced.

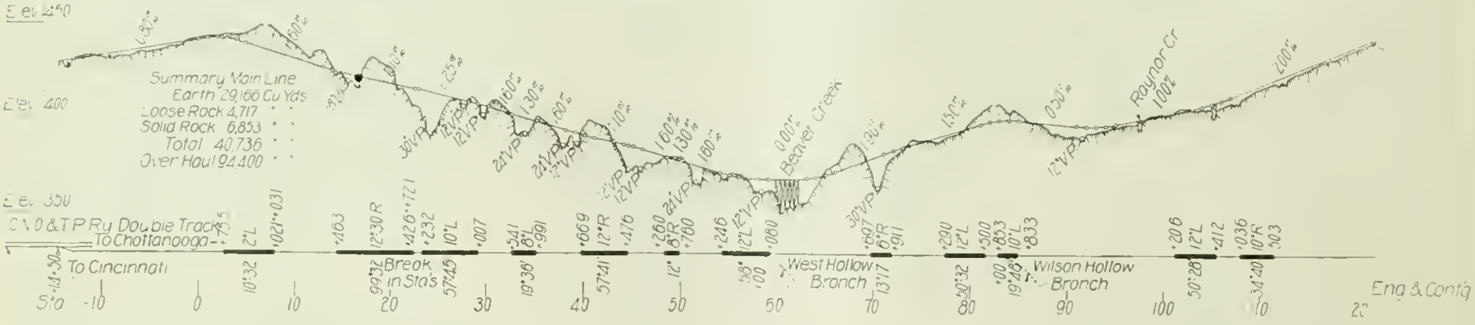


Fig. 1—Condensed Profile and Alignment of the Main Line of the Bear Creek Railroad.

EARTHWORK.

When the writer was placed in charge of the work the line had been located, contracts let, and a portion of the work was in progress, the locating party being temporarily in charge of construction. The general contractors were Carlin & Flanders of Cincinnati, O. All of the earthwork had been sublet to George Stissor & Sons of Toledo, O., who had again sub-let part of the work to the local grading firm of Todd & Williams.

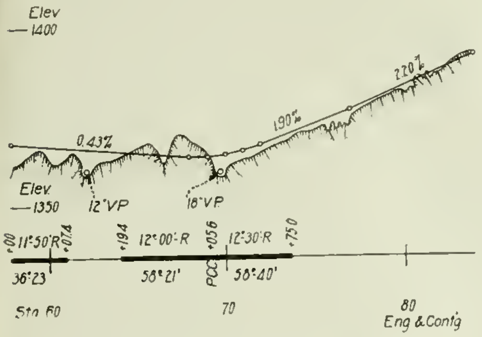


Fig. 2—Condensed Profile and Alignment of the West Hollow Branch of the Bear Creek Railroad.

The contract prices for the work were as follows:

C., N. O. & T. P. Ry. Co. to Carlin & Flanders:

Earth excavation, per cu. yd.	$0.25
Loose rock excavation, per cu. yd.	.40
Solid rock excavation, per cu. yd.	.75
Overhaul, per cu. yd. per 100 ft.	.01
Free haul, 500 ft.	

Carlin & Flanders to Geo. Stissor & Sons:

Earth excavation, per cu. yd.	$0.20
Loose rock excavation, per cu. yd.	.35
Solid rock excavation, per cu. yd.	.60
Overhaul, per cu. yd. per 100 ft.	.01
Free haul, 500 ft.	

Geo. Stissor & Sons to Todd & Williams:

Earth excavation, per cu. yd.	$0.16
Loose rock excavation, per cu. yd.	.30
Solid rock excavation, per cu. yd.	.50
Overhaul, per cu. yd. per 100 ft.	.01

The profiles indicate the amount of earthwork in the various cuts and fills, ditches, road changes and borrowpits, also the amount of overhaul and distribution of material. It is interesting to note the large amount of borrowed material compared to the total amount of material placed in the embankments, there being 25,879 cu. yds. borrowed out of a total of 47,716 cu. yds. of fill; or stated in percentage, 54 per cent. No material was wasted. The explanation of this unusual proportion of the earthwork on a mountain line consisting of borrow is that rock was known to exist close to the surface all along the line, and cuts were made shallow to avoid rock excavation as much as possible.

One thousand four hundred feet of the roadbed at the west end of the main line, and 1,000 ft. of the roadbed on both the West Hollow spur and the Wilson Hollow spur, had to be made wide enough for two or more tracks at the tipples. At these three situations rock outcropped from the steep slopes of the hills, preventing side hill location, and making it necessary to throw the center line onto embankment averaging 2½ ft. high, while the edges of the roadbed came on ground about at grade. Ditches cut along both sides carry the surface water coming down the slopes of the hills as well as the water of the streams that formerly flowed in the natural channels that were filled in to provide the necessary roadbed. Practically all of this 3,400 ft. of wide roadbed had to be built on embankment which is a second cause for the large amount of borrow. Fig. 4 is a typical cross-section near the west end of the main line, showing embankment for tipple tracks, and the surface conditions mentioned above.

The right of way has a uniform width of 100 ft., except where additional tracks require a width of 125 ft. Only a width of 50 ft. of the right of way was cleared, except where clearing was required for borrowpits. No separate payment was made for clearing and grubbing, the cost of doing that work being included in the unit prices for earthwork. Most of the line was covered by a dense undergrowth of laurel, ivy, briars and vines; also considerable second-growth timber had to be removed. The larger stumps were blasted out, the smaller ones cut out by grubbing and much of the work of handling small stumps was done by a team of strong oxen owned by Todd & Williams. The ox team was especially useful in plowing and in loosening large roots, etc.

Wages were $1.50 for labor, $3 for foremen and $5 for team with driver, for a 10-hour day.

The earth excavation was handled by team outfits, both slip scrapers and wheeled scrapers being used. Horses, mules and oxen were used for teams. The usual method of building banks by end dumping was employed. The loam at the surface was comparatively shallow and was underlaid by a heavy clay which was supported by shale, loose rock and solid rock. At the beginning of the work, during cold weather, care had to be taken to leave no loose plowed material in the cuts over night, as it was hard to manage when frozen. Where small quantities of rock had to be moved, the rock was blasted, broken into fragments small enough to be loaded into wheelers and hauled out onto the fills. A few short sections of the fills had to be protected from side wash by the larger streams by riprapping with rock, hauled in the same manner. The material in the two large cuts, Station 2 to Station 20, was handled with narrow-gage, side-dump, 3-cu.-yd. cars, which were pulled by mules over a track built by the contractor. As only one or two cars were used in a train, end and side dumping methods were used and the track was extended as the fill was made. All drilling was done by hand.

The final estimate of the cost of grading was as follows:

38,076 cu. yds. earth excavation at 25 cts.	$ 9,519.00
4,757 cu. yds. loose rock excavation at 40 cts.	1,902.80
7,083 cu. yds. solid rock excavation at 75 cts.	5,312.25
95,800 cu. yds. overhaul, 100 ft. at 1 ct.	958.00
Total	$17,692.05

The approximate estimate of cost of grading made by the engineering department before contracts were let or cross-sections taken was as follows:

11,000 cu. yds. earth excavation at 25 cts.	$ 2,750.00
24,860 cu. yds. borrow excavation at 25 cts.	6,215.00
5,280 cu. yds. loose rock excavation at 45 cts.	2,376.00
1,540 cu. yds. solid rock excavation at 80 cts.	1,232.00
100,000 cu. yds. overhaul at 1 ct. per 100 ft.	1,000.00
	$13,573.00
+ 10 per cent	1,357.30
Total	$14,930.30

CULVERTS.

Culverts were made of double-strength vitrified pipe, furnished by the railway company. They were constructed by force account, the general contractors furnishing men, teams and tools, and performing the labor at a cost to the contractor as follows:

326 lin. ft. 12-in. vit. pipe, excavating and placing, at 10.2 cts.	$ 33.20
56 lin. ft. 18-in. vit. pipe, excavating and placing, at 17.5 cts.	9.80
146 lin. ft. 24-in. vit. pipe, excavating and placing, at 15.1 cts.	22.00
178 lin. ft. 30-in. vit. pipe, excavating and placing, at 14.8 cts.	26.40
Total cost of excavating and placing	$ 91.40
Labor, unloading two cars of pipe	9.30
Hauling above pipe, from siding at sta. —12 to various culvert situations, 52 tons of vitrified pipe, an average haul of one mile	78.00
Total cost of labor to contractor	$178.70
10 per cent for force account	17.90
Total cost of labor to railway company	$196.60

Cost of double-strength vitrified pipe to railway company:

326 lin. ft. 12-in. D. S. vit. pipe at 20 cts.	$ 65.20
56 lin. ft. 18-in. D. S. vit. pipe at 40 cts.	22.40
146 lin. ft. 24-in. D. S. vit. pipe at 75 cts.	109.50
178 lin. ft. 30-in. D. S. vit. pipe at $1.30	231.40
Total for pipe	$428.50
Freight on 52 tons, 200 miles at ½ ct. per ton-mile	52.00
Total cost of pipe at Bear Creek Jct.	$480.50
Total cost of labor to railway company	196.60
Total cost of D. S. vit. pipe culverts to railway company	$677.10

The figures stated above for the cost of laying pipe for culverts include cost of all excavation necessary to provide good foundation for the pipe and good grades through the culverts, each culvert being placed on the best grade that the topography of its situation would allow. Trenches were made semi-circular in cross-section and proper holes were provided for the bells of the joints in the line of pipe. After the culverts were laid the earth fills were made in layers over them to provide solid embankments and to insure an arch action of the fill over the culverts. The material first placed along the sides of the pipe was dumped from slip scrapers as the teams were driven parallel to the line of the culvert, thus avoiding danger of breaking the pipe by teams or scrapers. As the filling material placed next to the pipe was clay, and quite well compacted by the teams and a small amount of extra hand labor, no cement was placed in the pipe joints. This omission of cement at the joints would not be desirable on any line except such a cheaply constructed line as is being described.

The writer believes the unit prices for labor of excavating for and placing vitrified pipe in railroad culverts stated above to be the first he has seen offered for the benefit of engineers and contractors in making estimates for such work. The cost of labor for making Portland cement joints should generally be added to the above unit prices, unless the pipe are to be laid without such joints. If pipe is used that has deep sockets, it is not so necessary to use cement in some cases, and cases often occur where it can be entirely omitted. Gillette's "Handbook of Cost Data," pages 820 and 821, furnishes some useful tables showing the amount of mortar and cement required for both flush joints and overfilled joints for standard sewer pipe, and deep socket sewer pipe. Some accurate data on the labor cost of making cement joints would be desirable. The data on costs of sewer work appear always to include the item of joint-making with pipe-laying. As the work is done by one man in the trench it is probably difficult to separate the two items of labor. The cost of hauling 52 tons of pipe from the siding at Station 12 to the various culvert sites was $78 or $1.50 per ton per mile. The average haul was about one mile. As the hauling was done over rough, ungraded trails, having no bridging over creeks and ditches, and had to be done in bad weather, when the roads were almost impassable, the cost of $1.50 per ton-mile, which included unloading the pipe at the culvert sites, is probably not excessive. Wages were $1.50 per day for labor, $3 for foremen and $5 for team and driver, for a 10-hour day.

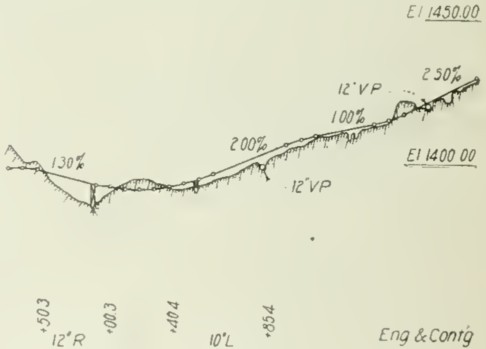


Fig. 3—Condensed Profile and Alignment of the Wilson Hollow Branch of the Bear Creek Railroad.

All work of placing and cementing pipe in culverts should be done under the instructions of a competent inspector. Each pipe should be tested just before it is placed in the culvert. If the pipe is cracked it will fail to give out a clear metallic ring when struck with a light hammer. When good pipe are carefully placed in a properly prepared trench or bed, and are carefully covered with well-rammed clay, or other heavy soil, good culverts will be obtained. The ramming should be especially well done along the sides of the pipe and near the ends of the culvert. It is better to have the culvert built on a grade so arranged that if the culvert settles there will still be enough fall through the culvert to drain it properly. Two methods of making such a grade are: (1) To place the flow line of the pipe on an inclined vertical curve; (2) to place the flow line of the pipe on a light grade for the up-stream half of the culvert and on a steep grade on the downstream half of the culvert.

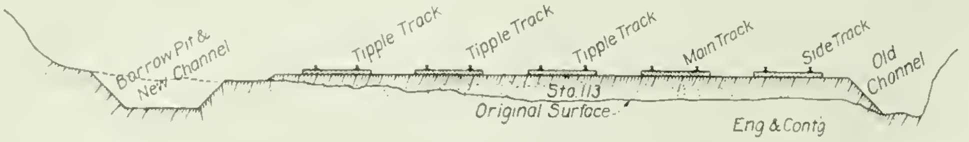


Fig. 4—Typical Cross Section Near the West End of Main Line of Bear Creek Railroad.

TRESTLES.

Fig. 5 shows elevation and section of C., N. O. & T. P. Ry. standard framed trestle supported on mud sills. Pile supports when used are constructed as indicated by dotted lines. Good rock foundation was available for the trestle over Bear Creek, the mud sills being placed on rock and the bents braced as shown. Most of the large-sized timbers used in the Bear Creek trestle was first-class white oak hewn from trees felled near the site of the trestle. The oak timber was cut and hewn by laborers, living in the neighborhood, employed by the contractor. The writer has no data showing the cost to the contractor of this labor. The trees were donated to the railway company by the coal company. The following item shows the cost of the oak timber to the railway company:

2,337 lin. ft. of trestle timber at 15 cts., $350.55.

As there were about 30,000 ft. B. M. the cost was approximately $11.68 per M. B. M.

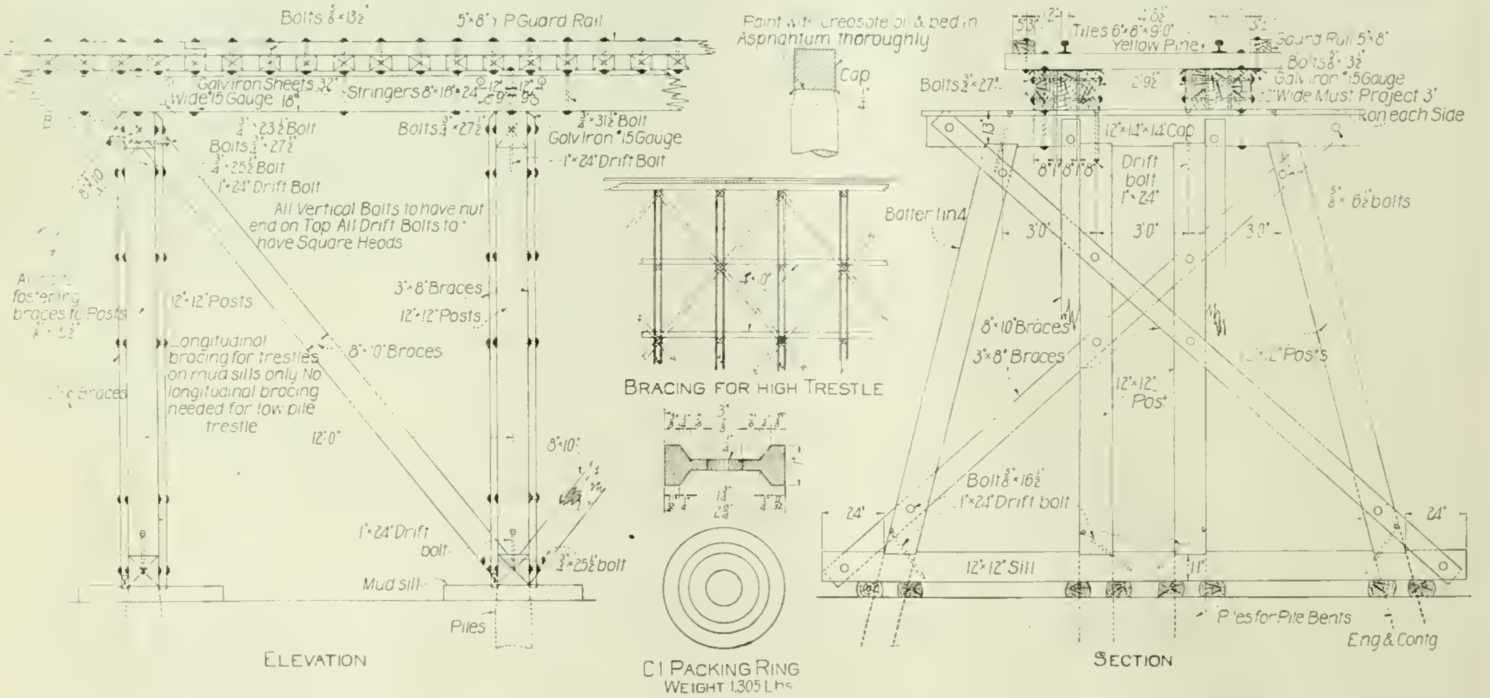


Fig. 5—Elevation and Section of the Standard Framed Trestle of the Cincinnati, New Orleans & Texas Pacific Railway.

The railway company furnished the other timber, bolts, washers, spikes, etc., and the labor for framing and erecting the trestle. The small single span trestles shown on the profiles at other stream crossings consisted of a deck supported by two frame bents on mud sills. The bents were planked to retain the low embankments, and wings made of logs were constructed to protect the foot of the slopes from side wash by the streams. All of the labor for making timber and erecting the small spans was furnished by the railway company. The timber used was obtained near each trestle, except for the deck. All deck timber was furnished by the railway company. All material furnished by the railway company was shipped by freight to the site of each trestle as soon as track laying had reached that point. Following is an estimate of the cost to the railway company of the Bear Creek trestle:

30,000 ft. B. M. oak timber furnished by contractors	$ 350.55
23,000 ft. B. M. timber furnished by railway company at $25.00 M.	575.00
2,500 lbs. wrought iron bolts and nuts at 3 cts.	75.00
1,200 lbs. wrought iron drift bolts at 2½ cts.	36.00
450 lbs. wrought iron washers at 3 cts.	13.50
250 lbs. cast iron separators at 2 cts.	5.00
4,700 lbs. galvanized iron, No. 15 gauge, at 3 cts.	141.00
25 lbs. small galvanized nails at 4 cts.	1.00
Freight on timber furnished by railway company (at ½ ct. ton-mile, 52 tons. 100 miles)	26.00
Freight on iron furnished by railway company	2.95
Train service spotting bridge material	14.00
Total cost of material at site	$1,240.00
Labor, framing and erecting 53,000 ft. B. M. at $10 per M.	530.00
Total cost of Bear Creek trestle to railway company	$1,770.00

Following is an estimate of cost of each of the four small trestles on the line:

1,700 ft. B. M. deck timber and bulkhead planking at $25.00 M.	$ 42.50
800 ft. B. M. bent timber, hewing at bridge site, at $5.00 M.	4.00
250 lbs. wrought iron bolts and nuts at 3 cts.	7.50
120 lbs. wrought iron drift bolts at 2½ cts.	3.00
30 lbs. wrought iron washers at 3 cts.	.90
15 lbs. cast iron separators at 2 cts.	.30
320 lbs. gal. iron, No. 15 gauge, at 3 cts.	9.60
2 lbs. small gal. nails	.10
Freight on timber and iron (at ½ ct. ton-mile, 4 tons, 100 miles)	2.00
Train service spotting material	5.00
Total cost of material at bridge site	$ 74.90
Labor, framing and erecting 2,500 ft. B. M. at $15.00 M.	37.50
Labor, building 4 log wings	20.00
Total cost to railway company of 1 small trestle	$ 132.40

Summary of cost of trestles:

Bear Creek trestle	$1,770.00
Four small trestles at, say, $132.50	530.00
Total cost of all trestles to railway company	$2,300.00

Attention is called to the labor cost of framing and erecting small, single-span trestles. Such trestles cannot be built for the same labor cost, per 1,000 ft. B. M. of timber contained, as larger and longer trestles. The proportion of time used in laying out the work, moving tools and equipment from one bridge to another, etc., compared to the time actually spent in framing and erecting is greater with such small trestles than with the larger structures.

TRACK AND TRACK LAYING.

The track was laid by the railway company forces. Seventy-five-pound rail, released from the double-track work, 4-bolt angle bars, and white oak ties were used. The track was surfaced with the roadbed material. The amount of traffic and unsettled conditions of the roadbed warranted the delaying of ballasting to a later time. The turnouts at junctions and tipples were constructed with second-hand split switches and second-hand frogs, the switches being of the ground-throw type. A No. 5 frog was used at West Hollow Junction, and a No. 8 frog was used at Wilson Hollow Junction. The other frogs used were No. 6. The turnouts and crossover on the double-track main line of the C., N. O. & T. P. Ry. were constructed with No. 10 spring frogs, 18-ft. split switches, and in all other respects conformed to the high standard of track construction of that railway.

The total length of track constructed, including sidings, tipple tracks, etc., was 26,200 ft. or 4.96 miles.

Following is an estimate of the cost of track, exclusive of the turnouts connecting to the double-track main line, and the crossover between the double tracks:

Item.	Amount.
12,500 cross ties at $0.30	$ 3,750.00
25 sets switch ties at $30.00	750.00
1 set switch ties at $40.00	40.00
580 long tons 75-lb. relay steel rail at $23.00	13,340.00
2,000 pairs second-hand angle-bars at	

50 cts.	1,000.00
225 kegs spikes at $5.00	1,125.00
40 kegs track bolts at $5.00	200.00
26 split switches, second-hand, at $19.00	494.00
24 No. 6 frogs, second-hand, at $11.50	276.00
1 No. 8 frog, second-hand, at $13.00	13.00
1 No. 5 frog, second-hand, at $10.00	10.00
26 ground-throw switches at $5.00	130.00
26,200 lin. ft. track-laying and surfacing at 10 cts.	2,620.00
26 switches, laying, at $20.00	520.00
Total track material and labor	$24,268.00

A summation of the cost of construction follows:

Earthwork	$17,692.05
Culverts	677.10
Trestles	2,300.00
Track (no ballast)	24,268.00
Engineering (construction only)	1,280.00
	$46,217.15
Superintendence and general expenses, 2 per cent	924.35
Total cost	$47,141.50

$\frac{\$47,141.50}{26,200} = \$1.80$, cost of railroad per ft. of track.

$\$1.80 \times 5.280 = \$9,504$, cost of railroad per mile of track.

$\frac{\$47,141.50}{\$3.68} = \$12,810.20$, cost of railroad per mile of line.

Gillette's "Handbook of Cost Data," pages 1289, 1290 and 1291, furnishes some interesting cost data for short railroads, and the writer of this article hopes that the information he has furnished will be of interest and assistance to any one who has to estimate the cost of such a railroad.

Some Features of Grade Separation by Joint Track Elevation in Joliet, Illinois.

The extensive track elevation construction which has been underway for several years in the city of Joliet, was completed a short time ago. Owing to the large number of railroads, to their proximity to the business center of the city, to the importance of the roads, and to the fact that they passed through the city in all directions, the delay to vehicular traffic on the intersected streets was unusually great for a city the size of Joliet. The benefit to the city resulting from the elimination of the grade crossings was correspondingly great. The principal features of the engineering work in connection with this improvement were described by Mr. R. A. Cook, of the engineering staff of the Chicago & Alton R. R., in a paper before the Illinois Society of Engineers and Surveyors. The information here presented is taken from Mr. Cook's paper.

The railroads affected by the track elevation are the Chicago & Alton, the Atchison, Topeka & Santa Fe, the Chicago, Rock Island & Pacific, the Michigan Central and the Elgin, Joliet & Eastern. These railroads may be divided into three groups. The first comprises the Alton and Santa Fe Companies, whose tracks and right of way extend through the city in a north and south direction and adjacent to each other, being located two blocks east of the business district. The second group comprises the Rock Island and Michigan Central Companies, whose tracks and right of way extend through the city in an east and west direction, being located about two blocks south of the center of the business district. Prior to the track elevation period, the tracks of the Michigan Central did not extend west of the Alton tracks, but that company has now extended its line west to the city limits and beyond, on the same roadbed with the Rock Island tracks, which have been located on a new right of way two blocks south of the old right of way in the vicinity of the Alton-Santa Fe tracks. The Elgin, Joliet & Eastern Co. comprises the third group. As nearly all of its tracks are outside the track elevation territory, it elected to abandon those inside that territory rather than elevate them.

Prior to the track elevation period, the Alton and Santa Fe tracks crossed 14 streets at grade, the distance between the two outside streets being 1 7/16 miles. The track elevation ordinance, however, provided for the elimination of the 11 south crossings, seven streets to be provided with subways and four to be closed, but it did not provide for the elimination of the three north crossings. The streets provided with subways in their order from north to south are Cass, Clinton, Jefferson, Washington, Osgood, and Fourth and Fifth Aves. The distance between the Cass St. and Fifth Ave. subways is ⅞ mile, and the length of the Alton's roadbed which has been elevated, including approaches, is 1½ miles.

Under the old arrangement of tracks at grade, the Alton and Santa Fe Companies each had independent tracks, those of the Santa Fe being on the west side of the Alton tracks north of the Rock Island tracks and on the east side south of the Rock Island tracks. The two companies, however, now have a joint, four-track line from Cass to Osgood St., a distance of 3,200 ft., but each has its own double track line north of Cass St. and south of Osgood St. The position of these latter tracks has not been changed essentially from the old alignments, but the joint tracks do not coincide with either of the old alignments, being situated for the most part between them. The length of the Alton main tracks which have been elevated, including those on approaches, is 1.84 miles, and of the Alton-Santa Fe joint tracks 2.42 miles. The profile of the elevated tracks between the outside subways is very nearly level, and the amount which the tracks have been raised within the same limits varies between 9 and 16½ ft.

In addition to raising the tracks, the streets were also depressed, the amount of depression varying from nothing at Osgood St. to 6.6 ft. at Fifth Ave. The most important streets, Cass and Jefferson, were depressed 3.4 and 2.8 ft., respectively. The rate of grade of the approaches is in all cases 3.5 per cent. The width of roadway in the subways is 36, 42 or 50 ft., all streets being 66 ft. in width and no contraction in width having been made except at Washington St., where a small subway 24 ft. in width was provided. The overhead clearance in all subways is 12 ft., except at Cass and Jefferson Sts. and Fifth Ave., where it is 13.5 ft. on account of there being electric car lines on these streets. The drainage of all subways is taken care of by sewers previously constructed, except of the Cass and Clinton Sts. subways, for which a new sewer had to be constructed. The roadways of all subways are paved with brick on a concrete base, and all sidewalks in the subways are of concrete. The pavements, sidewalks, catch basins, etc., are constructed according to the Joliet specifications.

The bridges over the streets are of three types, reinforced concrete deck bridges, deck steel bridges, and through steel bridges. Wherever possible deck bridges were provided in order to eliminate girders between the tracks. The bridge at Washington St. is of reinforced concrete construction, the clear span being slightly under 25 ft. The depth of the slab is 37 ins. The concrete is a 1:2:4 mixture, reinforced with 1-in. corrugated bars. Deck steel bridges were provided at four of the subways. In three of these subways rows of columns were permitted along the curb lines and along the center line of the street. These columns support cross girders which in turn support 15-in. I-beams placed longitudinally with the tracks. The length of the roadway span of these bridges is either 21 or 25 ft. One subway bridge is similar to the above except that there are no columns on the center line of the street and consequently 30-in. built beams were used instead of I-beams for the roadway span of 36 ft. The two remaining bridges are through girder construction with 12-in. I-beam cross girders. The roadway span of one is 36 ft. and of the other 42 ft. All the steel bridges have a 4-in. reinforced concrete floor, over which a layer of waterproofing 1½ ins. in thickness is placed. The water proofing consists of a coat of asphalt paint, three layers of burlap, and one layer of saturated felt, each having been thoroughly mopped with hot asphalt before the next one above was applied. These are covered with an asphalt mastic for protection purposes. The track is laid over this floor with 6 to 8 ins. of rock ballast under the ties.

In regard to foundations, limestone bedrock is found at depths below the ground surface varying from 4 ft. in the vicinity of Cass St. at the north end of the work to about 11 ft. at Osgood St. and 22 or 23 ft. at Fifth Ave. at the south end of the work. All foundations north of Osgood St., where the material above the rock is gravel, clay and filled-in material, were carried to bed rock. Masonry south of Osgood St. was built upon coarse gravel and boulders which lie over the rock there.

Regarding masonry, all abutments and retaining walls are of 1:3:6 concrete. Either crushed limestone or crushed and washed gravel was used in the concrete, the latter being preferred. The aggregate length of retaining walls is 2,200 ft. and the heights vary from about 6 to 22 ft. All are built upon bed rock. Both retaining walls and abutments are of gravity section.

In regard to the method of carrying on the work, both the Alton and Santa Fe Companies had their independent forces, the Alton undertaking the south half of the work and the Santa Fe the north half. Owing to there having been two sets of tracks, it was possible to do nearly all the work without having to run trains over it at the same time. This was a great advantage, both from an operating and construction standpoint. All trains were first operated on the east tracks, comprising the Alton tracks north of and the Santa Fe tracks south of the Rock Island crossing, while the west elevated tracks were being constructed. Traffic was then changed to these latter tracks, after which the surface tracks were taken up and the east elevated tracks constructed. Traffic was first run over the Alton-Santa Fe elevated tracks in July, 1910, whereas the Rock Island Co. continued to operate its surface tracks until November, 1912. This condition made it necessary for the Alton and Santa Fe Companies to construct a temporary hump in the elevated tracks at the Rock Island crossing, of sufficient height to carry their trains over those of the Rock Island. This hump was about 8 ft. in height above the permanent elevation of the elevated tracks. This portion of the work was built on trestle.

The filling material used by the Alton Company was mainly fine sand which was obtained from a deposit on the line of the road about 20 miles south of Joliet at Braidwood. This sand was loaded with a steam shovel and unloaded mainly with Lidgerwood equipment. Very nearly all the filling was put in without the use of trestles except across the streets. The sand was covered with a layer of dirt or cinders to prevent the wind from blowing it onto adjacent property. For mixing concrete a Smith ½-cu.-yd. mixer was used. To supply the mixer and deposit concrete, Kopple cars were used wherever practicable and with very satisfactory results. The materials were handled directly from cars into the mixer. All work of every description carried on by the Alton Company, except moving large buildings was done by the company's forces.

In addition to the track elevation work proper, there has been a very considerable amount of other work occasioned by it. The Alton Company owns a large piece of land between the old Rock Island tracks and Osgood St. On this were situated the main tracks, the passenger depot, freight depot, and other buildings; the main freight yard at Joliet, team tracks, a seven-stall brick roundhouse with turntable, cinder pits, etc., stock pens, and various industries, including the local branches of Swift & Co., Armour & Co. and Morris & Co., and the agency of the Anheuser Busch Brewing Co. The transformation of this piece of property has been most complete. The industries have been moved to new locations by the Rock Island in connection with obtaining the right of way for its new line. The passenger station was torn down. The freight depot was moved to a new location. The roundhouse, turntable, cinder pits, and the main yard were torn down or taken up and were rebuilt at South Joliet, two miles south of the city. New industries were brought in and an entirely different arrangement of tracks has been made, including ample provision for team tracks and driveways. In fact, it is true that with the exception of two or three tracks, every structure on the Alton Company's right of way within the city limits of Joliet has been taken up and rebuilt or has been moved. The new arrangement which has resulted is of course much better suited to present day requirements than was the old.

The most noteworthy feature of this improvement, however, is the Union Station which has been constructed by the Alton, Santa Fe and Rock Island Companies at the intersection of the north and south with the east and west lines and fronting on Jefferson and Scott Sts. This building, which was opened on Nov. 1, 1912, represents an expenditure, including foundations, of about $300,000. It is a two-story building, the ticket office, ticket lobby, and baggage and express rooms being on the ground floor and the main waiting room, the women's room, smoking room, and toilets being on the second floor, which is on the track level. Ample platforms of concrete and brick have been provided and of sufficient length to accommodate a 10-car train. There is also a subway giving an entrance under the tracks from Michigan St. on the east side and providing a means of access without crossing tracks to the platforms between tracks. The building is faced with Bedford stone laid in ashlar masonry and backed with brick. The foundations are of concrete and some of the columns and the roof trusses are of steel. The roof is a concrete slab covered with slate. Reinforced concrete has been used very largely throughout the building, in fact the type of construction throughout is of the most approved design and all materials used are of the best quality. The appearance of the building is especially pleasing, for the architectural and ornamental features have been given much more attention than has hitherto been customary in station construction, except in recent years and in cities much larger than Joliet. The station is a credit to the city of Joliet and to the railroads and it will rank easily among the best examples of station construction in this country. Mr. Jarvis Hunt of Chicago is the architect.

One feature of the Joliet work which has not yet been completed is an interlocking plant which will govern all train movements at and near the crossing of the north and south with the east and west lines. There will be four Alton-Santa Fe main tracks and four Rock Island-Michigan Central main tracks, with numerous switches and crossovers, and a transfer connection between the two lines. The total train movements will be about 200 per day.

Regarding the results accomplished, the greatest benefit has of course accrued to the city of Joliet, due to the elimination of delay to street traffic and the elimination of accidents at street crossings, and to the greatly improved station facilities. The amount of such delay was probably greater than is ordinarily experienced in a city of the size of Joliet. This was due to the proximity of the railroads to the business center, to the fact that they crossed the city both north and south and east and west, and especially to the crossing of the Alton, Santa Fe and Rock Island Companies, which required all trains to come to a full stop when in the busiest portion of the city, and very often a train on one road would delay one or more trains on the other roads until it had cleared the crossing. Jefferson St., which is probably the busiest street involved, was crossed by all three roads and the chances for obstructing it were consequently three-fold. The acquisition of a magnificent Union Station, which is one extreme in station facilities, whereas the former stations were the other, is an asset to the city which appears to be fully appreciated and a source of general satisfaction. The number of crossing accidents was not especially noteworthy. The railroads have also been benefited by the track elevation, but not in proportion to what it has cost them. Their benefits consist in the saving of the expense of protecting grade crossings, the elimination of street crossing accidents, the elimination of some delay to trains, and the better arrangement of their tracks, etc., which has resulted. All the cost of the work has been borne by the railroads except property damages, which are borne by the city. The total cost to all the railroads is understood to have been about $2,000,000. The population of Joliet is given in the census of 1910 at 34,670, but the residents usually give a higher figure, owing to the considerable population residing within a short distance outside the city limits.

The work of the Alton Company has been successively under the jurisdiction of the former Chief Engineer, the late W. D. Taylor, the Assistant Chief Engineer, Mr. E. L. Crugar, and the present Chief Engineer, Mr. H. T. Douglas, Jr. Mr. Cook has been in direct charge of the work.

The Advantages of Adzing and Boring Crossties by Machinery—Cost of Installing Plants.

The economic advantages arising from the adzing and boring of railroad ties by machinery, particularly in the case of ties which are to be treated later by preservatives, were discussed by Mr. James A. Lounsbury in a paper before the recent annual convention of the American Wood Preservers' Association. The paper, in full, follows:

Railway track construction in this country has never, for any long period, been adequate to the demands made upon it. Traffic, wheel loads and speeds have continually outrun all efforts to keep the sub-structure equal to the requirements. Track improvement programs providing for a liberal margin in carrying capacity have been overtaken and passed by the growth of traffic almost before the work was completed, and therefore little relative gain has been made. This has been due to some extent to the fact that such improvements have been made under pressure, and time has not permitted the close investigation and study of the means and methods necessary to produce the highest ultimate economy, but the necessity of doing the best possible with the amount of money available for the work has probably been the chief limiting factor.

The era of extensive railroad building is practically past, and future progress will be along the line of intensive development, in which the quality will be higher as the quantity grows less. The continually narrowing margin between income and operating expense is forcing railroad officials to consider details of economy which heretofore have not appealed so strongly to them.

Probably the most important step that has been taken in this direction is the rapidly growing practice of chemically treating ties in order to secure the longest serviceable life for the smallest tie investment. But the chemical treatment cannot show its maximum efficiency with the prevailing methods of handling the ties when putting them in track. The folly of paying 20 to 35 cts. per tie for chemical treatment and then to so mutilate them by hand adzing and spike driving as to greatly reduce the beneficial effect of the treatment is too obvious to require argument.

MACHINE ADZING.

Of the 150,000,000 ties used annually in this country, approximately 74 per cent are hewn and 26 per cent sawed. Hewed ties are never straight and the face side is never a plane surface. Sawed ties are straight when first made, but go "into wind" during seasoning. This is particularly true of many varieties of hard wood. The consequence is that the rails when laid have an insignificant bearing on the tie, throwing the weight of the supported load on a very restricted area of the rail base and introducing very serious stress factors into the rail problem. Hand adzing is resorted to commonly to correct the defects in the tie surface, but this is at best only a partial remedy, and its effect on the impregnated part of the tie is destructive. The advantage of having a full and perfect bearing for the rails over the whole width of the face of every tie is evident. It reduces rail cutting, decreases the danger of half moon breaks in rail bases, reduces disturbance of the ballast and gives added firmness and stability to the track. Where plates are used it is a practical necessity to give them a full bearing on the ties, as the increased surface makes it more difficult for them to properly seat themselves under traffic. If their bearing on the tie is not parallel with the bottom of the rail they increase the danger of rail breakage, as they form an anvil upon which the impact of rapidly moving loads is received. If the point of support is along one edge of the rail base only, the danger to the rail is apparent.

BORING FOR SPIKES.

Many tests made by the U. S. Bureau of Forestry, by several universities and independently by a number of the railroads have demonstrated conclusively that common square spikes have increased holding power when driven into previously bored holes. The records of the tests agree as to the main facts, but the difference in the conditions surrounding the several tests makes exact comparison difficult. It is sufficient to note that the differences are in degree only. They indicate that in the oaks, beech, gum, long leaf and short leaf pine and Douglas fir the increase in resistance to vertical pull varies from 5 per cent to 15 per cent in favor of the spikes in bored holes, where the holes are ⅛ in. to 3/16 in. smaller than the spikes.

It is unfortunate that there are almost no reliable data showing the comparative resistance to lateral pressure of spikes driven directly and those driven into previously bored holes. This is of even more importance than the resistance to vertical pull, as upon it depends the maintenance of gage and the prevention of rail spreading under high speed trains. It is probable that the resistance to flange pressure is increased in much greater proportion than the resistance to vertical pull, because the spike in a bored hole has a backing of solid wood instead of being surrounded by torn and broken down fibres, as is the case when driven directly.

The use of screw spikes, of course, makes pre-boring absolutely necessary. A number of roads are already committed to this form of rail fastening, and its extended use is only a matter of time. At present probably 75 per cent of the ties that are bored are for square spikes. The possession of a convenient means for cheaply and rapidly doing the boring will cause the early adoption of the screw spike on many roads which would be slow to take it up under other conditions.

Of chief interest, however, to the members of this association is the great advantage from a treating standpoint of having the adzing and boring of ties done before the treatment takes place. The vital points of a tie are the parts under the rails and contiguous to the rail fastenings, and this is where the impregnation should be most thorough. In air seasoning the ties become case hardened on the outside, and this hard skin is more difficult of penetration than the portion immediately beneath. In adzing previous to treatment this more resistant portion is removed for a distance of 12 ins. to 14 ins. in length for each rail bearing. This permits the chemical to penetrate more freely transversely to the grain. The holes bored for the spikes give the chemical free entrance into the interior, allowing it to radiate from each hole by end grain penetration, thoroughly saturating these portions even when the tie as a whole is not given a heavy treatment. How much this saturation of the parts of the ties subject to earliest failure will increase their life cannot be measured until sufficient time has elapsed to allow accurate comparative data to be obtained, but there is no doubt that it will greatly increase the efficacy of the treatment and produce results far out of proportion to the cost of the adzing and boring operation. It is stated by the railroad engineers who have had several years' experience with adzed and bored ties that the saving in time and labor in putting the ties in track is sufficient to pay the cost of the adzing and boring, leaving all the other advantages a net gain.

ADZING AND BORING MACHINES.

The adzing and boring of ties has been standard practice in Europe for upwards of 20 years, and the results have proved its economy. Owing to the abundance of cheap labor in those countries, the development of machines of the highest labor-saving capacity has not been rapid. Their ties are more carefully made, and therefore machines are not required to meet such wide variations as in this country. In England the majority of ties are sawed from dimension stock and vary little in size. A range of 1½ in. difference in thickness is all that is provided for in their machines, while ours must be designed so that ties from 5 ins. to 10 ins. thick, and from 7 ins. to 14 ins. wide, may be run promiscuously. Again, their ties being practically of the same width, no provision need be made for centering so that the holes will always be properly placed in the face of the ties. With our extreme variations in width, and the fact that no two ties are alike in shape, that crooked and straight ties must follow each other through the machine, makes it necessary that they be centered over the boring bits so that the holes shall be accurately placed in relation to the center line of the face of each tie. In other words, the machine must take ties as they come, of all sizes and shapes, and automatically adjust itself to variations and irregularities, without human aid and without decrease in its rate of production.

INSTALLATION.

Two distinct patterns of adzing and boring machines are built for different methods of mounting. One is designed for installation on a stationary foundation, and the other, a more compact form, for mounting in a car. As more machines are specified for stationary mounting, this type is known as the Standard pattern. It is more open in design and accessible in its working parts than the more compact car type.

The question of which method of mounting is preferable must always depend upon yard and plant conditions, and each case must be decided upon its merits. It is probably true, however, that there are more treating plants in which the stationary mounting will give the higher economy in operation than those in which the movable type will give the better results.

The location of the stationary machine in relation to the retort house, power house, etc., in the case of plants already built, must, of course, be governed by the space that may be available, because it must be made to fit into conditions as they exist. In laying out a new plant the location is subject to control, and can be made where the least switching and handling of ties will be involved.

Wherever possible the machine should be placed between the stacking yard and the cylinders, so that all ties must pass it in their movement between those points. The trackage (narrow gage) should be arranged so that trams from any part of the yard may be brought to the machine with the minimum amount of switching, and by-pass tracks must also be provided by which timbers not to be machined, such as switch ties, bridge timbers, piling, etc., can pass the tie machine without interfering with its supply. The tram track on the in-feed side of the machine should be about 1 ft. higher than that on the delivery side, and should run out to a spring switch, so that an unloaded tram, given a start, will run by gravity past the spring switch, reverse its direction and return on the discharge side of the machine ready to be loaded for the cylinder. The space required between these supply and delivery tracks should never be less than 32 ft. centers when the ties are to be taken from the tram and placed on the machine conveyor by hand. If the dumping hoist and the skid are employed the minimum distance between track centers is 46 ft. These dimensions apply only to the machine without the cut-off saw attachment. If the latter is required, 6 ft. should be added to the track center distances.

Where drainage will permit, the best form of foundation is to enclose a space 11 ft. x 20 ft. with a concrete wall, the interior being excavated and a cement floor laid. The side walls should be 7 ft. to 8 ft. high to give good head room below, as in the basement so formed a 50 HP. motor for driving the machine is placed, together with the shavings exhaust fan. The top of the foundation should be about 3 ft. above the grade line, making the actual excavation only about 5 ft. deep. Steel I-beams and 4-in. plank floor form the support for the machine. The weight of the latter is 20,000 lbs. This form of foundation is not always necessary, but is the most advisable when conditions permit.

The smallest building which will accommodate the machine and appliances is about 25 ft. square. This, however, leaves the men unloading trams on the in-feed side, and the tram loaders on the discharge side exposed to the weather. It is better to provide a building 25 to 30 ft. wide and long enough to span both the supply and delivery tracks so that the tie handlers may work under cover. Of course, in the South the matter of protection is not so important, and can be arranged to suit local conditions.

One of the most important facts to be borne in mind in considering the installation of a machine of this kind is that, in order to bring the cost of the adzing and boring operation down to the lowest point it is necessary that it be operated continuously at its full capacity, and that there shall be no irregularity in the tie supply nor any interference with the quick handling of trams at either side of the machine.

Machines designed for mounting in cars perform the same operations in practically the same way, but, as stated before, the dimensions are held down in order to bring them within the limit of width of a wide box car, having extra wide doors through which the conveyors extend. The original installations (two machines on the Santa Fe and one on the Northern Pacific) were all of this type.

The car used for this purpose should be of steel under-frame construction, 40 ft. long, 9½ to 10 ft. wide, and of 40,000 lbs. load capacity, and not less than 9 ft. high in the clear. The cars are usually made self-propelling from the same source of power which drives the machine, a clutch being provided by which the machine is disconnected and the car axle drive thrown into gear when the car is to be moved. As the car is commonly designed to move about the tie yard only, the speed is kept down to about three miles an hour. The principal movement being only from stack to stack, no higher speed could be used to advantage.

The kind of power to be used in these movable plants is often a somewhat troublesome problem. Electric drive is by far the most reliable and satisfactory if it is available. In yards using electric switching locomotives and strung with trolley wires the application of electric power is easy, but where this is not to be had resort must be made to some other source of power, usually a self-contained gasoline engine of about 60 HP. installed in the car with the machine. This gives satisfactory results, but requires more careful management than would be necessary with an electric motor.

The track arrangement in a yard already laid out is, perhaps, the most important factor in determining the comparative merits of the stationary and car mounting. The usual system, a three-rail track between the tie piles, would make it necessary for the trams to follow directly behind the machine car, a position which is not convenient for loading by the machine conveyor, as a right-angled change of direction must be made by the ties in their progress from the machine to the tram. At the Somerville plant the Santa Fe has a temporary track 60 to 90 ft. long which is placed between the tie pile and the three-rail track, and upon this the machine car is placed. One rail length after the other is moved forward and laid ahead of the car. This leaves the tram track clear, and trams can be brought up to the side of the machine car, allowing the conveyor to discharge the machined ties directly into them. On the feeding side the ties are thrown down from the top of the piles and placed directly on the in-feed conveyor, so that one handling is saved by the movable machine arrangement. This, however, is offset by the time lost in changing the position of the car. As an average it is probable that about one-third more ties can be put through the stationary machine in a day than through the movable plant.

COST.

The cost of installation of machines for adzing and boring ties, is a difficult thing to cover without definite specifications. It is more an engineering problem than a manufacturing one, as the conditions are not the same in any two cases. The cost of the machine itself may vary as much as $1,500, depending upon what is wanted in the number of boring spindles, the lengths of conveyors, and whether or not the machine is to be provided with cut-off saws, branding device, dumping hoist and other special features. The cost of the power plant may also vary between wide limits; steam engine and boiler, or a gasoline engine, costing much more than an electric motor. The building may be sufficient to protect the machine only, or may be large enough to cover both tracks and give protection to the tie feeders and loaders. One machine in the South is placed upon a foundation of heavy creosoted timbers laid on shed. Another on the Pacific Coast is placed on the end of a dock of piling, 18 ft. above the ground, into which the piles are driven. It is all a question of the governing local conditions, and how much money the purchaser is willing to spend. Some plants have been installed complete for $10,000, and the cost of others has run as high as $15,000, but in the long run the most thorough work is the cheapest, the saving in operation and maintenance paying large interest on the additional cost.

Does adzing and boring pay? It is believed that the increase in life that may be expected from ties adzed and bored before treatment will not be less than one-third, but to be conservative we will consider that it is only 15 per cent, or say 21 months of added service. In the case of a railroad using 1,000,000 ties a year, costing when treated, delivered and put in track 85 cts. each, the total saving in tie renewals will amount to something over $100,000 a year. In comparison with the cost of equipment, is this not worth while?

The New Gas-Electric Locomotive of the Minneapolis, St. Paul, Rochester & Dubuque Electric Traction Company.

(Staff Article.)

The first gasoline-electric locomotive ever built is expected to be in operation on the Dan Patch Electric Line, an electric suburban railroad which operates between Minneapolis, Minn., and Northfield, Minn., after May 1st, 1913. A general view of the proposed locomotive is shown herewith.

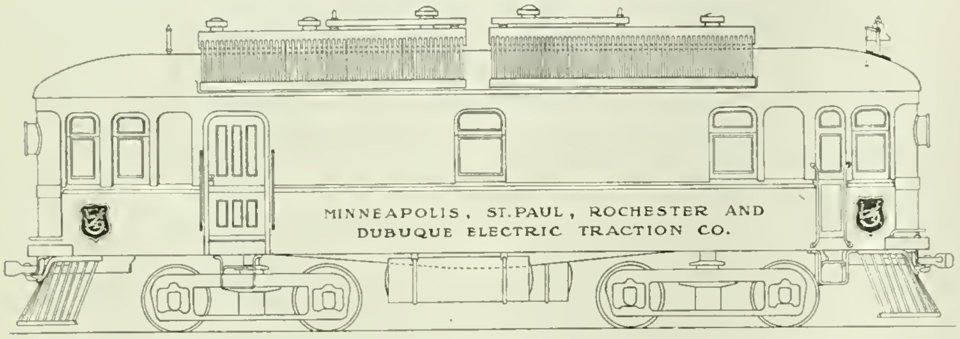
This new gas electric locomotive will be 39½ ft. long, 20 ft. between truck centers, 6 ft. 10 ins. wheel base, 12 ft. 8 ins. high from rail to roof, 14 ft. 8 ins. high from rail to top of radiators, 3 ft. 7 ins. high from rail to floor line. The diameter of each of the eight drive-wheels is 33 ins. The car is to be of all steel construction. It will develop a maximum of 640 H. P. from its two gas electric engines, with a normal capacity of 250 H. P. each. This new type of gas electric locomotive will also contain an air compressing set and lighting generator, capable of lighting 10 passenger coaches with 20 16-candle power lamps each.

The information here given was furnished by Mr. Charles A. Parker of the staff of the general manager of the Dan Patch line. Mr. Parker makes the following statements with reference to the economic advantages anticipated from the use of the gas-electric locomotive as compared with the steam locomotive and trolley and third rail motor equipment.

GENERAL COMPARISON OF GAS-ELECTRIC AND STEAM LOCOMOTIVE.

The weight of the gas-electric locomotive will be 54 tons, as against the weight of the average steam locomotive of 115 tons. This means a smaller ratio of fuel required to maintain an equal ratio of tractive effort and speed. The gas-electric locomotive will carry two 200-gal. tanks for gasoline. The weight of these tanks when filled will be 12,000 lbs., as against the weight of an engine tender of 33,000 lbs.

The radiators at the top of the gas-electric locomotive will hold about 500 gals. of water, weighing about 4,000 lbs. This would be all the water required to run a gas motor a month. The tender of a steam locomotive has a capacity of from 10 to 15 tons of coal, which is held to be sufficient to run the locomotive for a distance of 150 miles. In other words, in a trip to Chicago from Minneapolis, a steam locomotive would be required to make at least three stops in order to take on water and recoal, while the gas-electric locomotive could run this distance of 500 miles without a single stop.


MINNEAPOLIS, ST. PAUL, ROCHESTER AND DUBUQUE ELECTRIC TRACTION CO.

General View of the New Gasoline-Electric Locomotive for the Dan Patch Electric Line.

Each of these stops for the steam locomotive would require additional men, crews and equipment to rewater and recoal the steam locomotive. To make such a trip it would also require, for the steam locomotive, both an engineman and fireman. For the gas-electric locomotive only a motorman would be required. During each time that a steam locomotive would be standing still, taking on water and recoaling, the steam and power would have to be kept up just the same, which means an additional ratio of waste power. When the gas-electric locomotive is not running, all power is shut off and there is no waste of power.

In the gas-electric locomotive, two separate units have been provided for in the engine. Each of these units contains 8 cylinders, or 16 in both. When the locomotive is pulling three or four cars, the use of but one of these engines will be required; but when double that number of cars are to be hauled, 16 cylinders are placed in service by simply turning a valve. In other words, it is necessary to place in service only such power as the weight of the train load requires.

The locomotive body is so constructed as to have a compartment in the center of the car, capable of carrying 10 or 15 tons of freight, and making an additional freight capacity to the regular train.

A large portion of the weight of a steam locomotive is on the pony truck, while practically all of the weight of the gas-electric locomotive is directly on the drive wheels. This permits of a very much greater ratio of efficiency in tractive effort. The usual wheel base of a steam locomotive is from 12 to 25 ft., while the wheel base of the gas-electric locomotive is but 6 ft. 10 ins., making it capable of taking a much sharper curve than can be done by the steam locomotive. The new gas-electric locomotive can be operated by either engine from either end, there being a controller on each end and brake valves.

The lower the wheel on a railroad locomotive, the greater the tractive effort, and as the wheel diameter on the gas-electric locomotive is but 33 ins., as against the wheel diameter of the average steam locomotive of about 6 ft., the marked advantage in favor of the gas electric machine in this respect is obvious.

The time saved in stopping and starting a railroad train propelled by a gas-electric locomotive over that of a steam locomotive is very marked. It costs about 5 cts. to make a station stop for a gasoline-electric train, and from $1.50 to $2.50 to do the same thing with a steam railroad train.

As an illustration of the time saved, in a trip from Minneapolis to Northfield, with say possibly 20 stops, an average of more than one minute per each stop can easily be saved, thereby cutting the running time 20 minutes when compared to steam operation.

REPAIR AND TROUBLE COMPARISONS OF STEAM AND GAS-ELECTRIC LOCOMOTIVES.

An additional generator is attached to the gas-electric locomotive handled with an air compressing set and lighting generator combined, for lighting trains. Many steam locomotives have a steam turbine attached to the boiler for lighting passenger coaches, which makes an additional equipment to carry and additional trouble and expense to the maintenance.

The gas-electric locomotive has no main rod brasses, no main or side rods, no eccentrics, no boilers to leak, no tenders to freeze in cold weather, no flues to blow out, no boiler to wash out every three weeks, no crown sheet to burn out, which sometimes kills firemen and engineers, and no danger of scalding employes by the bursting of steam pipes. Additional advantages of the gas-electric locomotive is that it has five less pair of wheels to be kept in repair, it can be filled, gassed and oiled in 15 minutes, it has no fires to be cleaned, tanks to be filled with water and coal or lubricators to be filled with oil, it does not require a hostler to clean the fire, or two men at the coal chute to load coal, or two men in the ash pit to take ashes out of the ash pan, or two men or gas engine at the turn table as in handling steam locomotives. The operator of the gas-electric locomotive takes care of his own machine.

The engine base of the gas motor holds 20 gals. of oil, which will run the gas electric locomotive ten days without refilling. A valve is turned on from the standpipe in the shop of the gas-electric locomotive, and in five minutes the gas tank is filled.

LOCOMOTIVE SHOP COMPARISONS.

Generally to care for steam locomotives at the round house or shop, a traveling crane is required, costing about $25,000, in connection with the coal chute. This traveling crane is to unload coal cars, and extra crews are generally kept busy night and day hauling coal to the coal chute. As stated above, extra crews are also required at the turn table for the steam locomotive. The cost of the average turn table is from $2,000 to $3,000, with additional expense in repairs and maintenance.

In the shops of the steam locomotive, additional expense is also involved in big traveling cranes necessary to remove and repair the locomotive's wheels. In the shops of the gas electric locomotive, the wheels are removed when necessary but by a hydraulic jack, at a comparatively small cost. To remove a truck from under a gasoline-electric locomotive, the machine has to be jacked up about 4 ins., while with the steam locomotive, in order to take the drive wheel off, it is necessary to raise about 50 tons 3 ft. into the air.

TROLLEY AND THIRD RAIL COMPARISONS.

It costs at least 18 cts. per car mile to operate the ordinary trolley car, while the gas-electric car can be operated for fully a third less. In addition, for trolley lines, there is the expense in overhead construction, the installing and maintaining of power houses and transforming stations, and the danger from contact with feed wires.

The cost of the third rail equipment alone is from $15,000 to $18,000 per mile. This does not include rolling stock, cost of power houses, rights of way, laying of tracks, maintenance, or any other features of operation and construction. It simply includes the rails, bonds, third rail brackets, insulators, third rail protection and other precautionary but necessary construction.

After these have all been constructed and installed, there is yet to be purchased the electric locomotive suitable for the third rail system of operation. These third rail electric locomotives cost from $35,000 to $40,000 each.

Cost of Western Red Cedar Poles and Butt-Treatment of Same.

(Staff Article.)

The figures given herewith in Table 1 show the cost of Western Red Cedar Poles, the cost of putting the poles in the line, and the cost of butt-treating such poles with the highest grade wood preserver and also with creosote. The tabulation brings out clearly the number of years of added life necessary to pay the cost of such treatments. The figures are from a quotation recently made by the Page & Hill Co. of Minneapolis, to whom we are indebted for the data here given. The quotation is for the upright open tank method of treatment.

The report of the Telegraph Department of the German Government for the years from 1853 to 1903 shows that poles butt-treated with creosote had an average increase of life of 12.9 years over untreated poles. Similarly, the United States Forest Service observation of experimental poles, in the Warren-Buffalo line, made after five years of service, showed that all of the 551 untreated poles in the line were affected by decay, and of the 613 treated poles some which were brush treated showed decay, while none of the open tank butt-treated poles showed a trace of rot.

TABLE I.—COST OF WESTERN RED CEDAR POLES AND BUTT-TREATMENT FOR SAME.

Diameter of pole Length of pole	8 in. 35 ft.	8 in. 40 ft.	8 in. 45 ft.	8 in. 50 ft.	8 in. 55 ft.	8 in. 60 ft.
Price of pole	$ 7.75	$ 9.15	$12.20	$13.95	$16.20	$18.40
Cost of putting in line	3.89	4.77	6.05	6.85	7.61	9.08
Total	$11.64	$13.92	$18.25	$20.80	$23.81	$27.48
Using U. S. average, 12 years life, cost per annum	0.97	1.16	1.53	1.74	1.99	2.29
Cost of butt-treatment according to Specification A, highest grade wood preserver	1.50	1.75	2.00	2.50	3.00	3.50
Cost of butt-treatment according to Specification AA, creosote	1.20	1.35	1.60	1.85	2.00	2.50
Number of years added life necessary to pay entire cost of treatment—						
Specification A	1.6	1.5	1.3	1.4	1.5	1.5
Specification AA	1.2	1.3	1.-	1.1	1.-	1.1
Probable increase of life	10 to 15 years					

NEWS SECTION

Editorial Comment—Personals—Society Meetings—Trade Notes—Catalog Reviews—Contract News, Embracing Bids Asked, Work Projected, Contracts Let and Contract Prices on All Classes of Civil Engineering Construction Work.

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The Doings of the Week.

Nothing particularly startling in the way of new railroad construction work has developed in the past few days. As predicted in our last issue several good-sized contracts are now up for letting. Chief of these is the construction of the 140-mile Powder River-Orin Junction line in Wyoming for the Chicago, Burlington & Quincy R. R. Bids have been asked from contractors on this work, and it is probable the contract will be awarded in a few days. The Pennsylvania R. R. is to expend something like $50,000,000 for equipment and expansion. It is likely that the first big improvement to be undertaken will be the remodeling of Broad St. Station, Philadelphia. Other improvements will include abolition of grade crossings, establishment of additional freight facilities and the electrification of suburban lines. The Pennsylvania has just awarded contracts for three tunnels on its Allegheny Division, as follows: Tunnel at East Brady, 2,660 ft. long; at Woods Hill, 2,870 ft. long; at Kennerdell, 3,350 ft. long. Among the railroad construction contracts let recently are the following: Bay County Construction Co., Bay City, Mich., for an extension to the Detroit, Bay City & Western R. R., from Akron, Mich.; Burke Bros. & McNerney, Fort Smith, Ark., for grading, bridging and tracklaying for 16 miles of railroad for the J. H. Phipps Lumber Co., Fayetteville, Ark.; Dudley & Orr, El Paso, Tex., for grading for a 30-mile interurban line from El Paso to Fabens.

Just at this writing it appears likely that the Senate Committee on Interstate Commerce will make a favorable report some time this week on the bill to authorize a physical valuation of railroads. Senator La Follette has the matter in charge, and it is said the committee approves his recommendations. The bill has passed the House.

A number of good-sized bridge jobs are now open for bids. One of the largest of them calls for the construction of the substructure for a 7-span half through truss bridge for the municipality of St. Boniface, Man. The estimated cost of the concrete substructure is $200,000; bids on it will be opened Feb. 17. The city of Oshkosh, Wis., has just awarded a fair-sized bridge contract. This called for the West Algoma St. structure, bids on which were opened Jan. 29. The Joliet Bridge & Iron Co., Joliet, Ill., secured the contract for the superstructure at $86,440; the FitzSimons & Connell Dredge & Dock Co., Chicago, Ill., was awarded the substructure at $93,523.

A considerable amount of drainage work has come up for bids in the last few days. One of the larger of these contracts calls for the construction of the Little Sioux drainage ditch in Iowa, the work providing for about 483,000 cu. yds. of excavation. A good-sized job in Mexico, on which bids are now being asked, calls for the construction of 2½ miles of canal with sluicing channel from the Yaqui River near Esperanza. This work involves about 670,000 cu. meters earth excavation, 215,000 cu. meters rock, and the placing of about 6,500 cu. meters of concrete channel lining. Of the drainage contracts let recently that for the Clay County Drainage District in Arkansas appears to be the largest. This work called for 119 miles of open ditch and 12 miles of levee. The Clay County Dredge Co., Corning, Ark., secured work amounting to $48,750; J. S. & Otto Kochtizky, Cape Girardeau, Mo., secured $298,312 of the work; Sternberg & Son, Kansas City, Mo., $53,124, and the Northern Construction Co., Elkhart, Ind., $73,920.

A large amount of improvement work is projected for the year by Canadian municipalities. The ratepayers of Vancouver, B. C., have authorized over $5,000,000 for civic betterments. Of this sum $1,000,000 is for the construction of sewers, $385,000 for street improvements, and $800,000 for water works' improvements. The ratepayers of Point Grey, B. C., have voted $740,000 for sewers and $200,000 for roads. In Toronto, Ont., the Works Committee of the City Council has approved the proposed Ward 7 sewer system, which is estimated to cost $1,317,000.

The State Board of Harbor Commissioners have awarded a good-sized contract for the construction of Pier 37 at the foot of Kearney St., San Francisco. The Thomson Bridge Co., San Francisco, Cal., received the contract at $475,200. The pier will be 1,080 ft. long by 200 ft. wide, with reinforced concrete pillars on heavy timber piling.

Bids were opened Jan. 28 by the Public Service Commission of the First District, New York City, on Section 2 on the Woodside, Astoria and Corona Rapid Transit R. R., a two and three track elevated line. The four low bids on this work were as follows: Cooper & Evans, 220 Broadway, New York, $850,000; Snare & Triest Co., 143 Liberty St., $893,000; Oscar Daniels Co., 38 Park Row, $933,000; E. E. Smith Contracting Co., 71 Broadway, $937,000. The other bidders were: Thomas J. Buckley Engineering Co., Inc., 103 Park Ave.; Peace Brothers, 20 Main St., Flushing; Fraser, Brace & Co., 1328 Broadway; Percy Litchfield, 23 Flatbush Ave., Brooklyn; Post & McCord and the Tidewater Building Co., 16 E. 33rd St.; Rodgers & Hagerty, 152nd St. and North River; Terry & Tench Co. of Lexington Ave. and 131st St., and the Marble Arch Co., and Connors Brothers, 17 W. 42nd St.

Short Course in Road Work.

An excellent opportunity to secure a better knowledge of how to do good road work is offered by the winter course in highway engineering which is to be held at Columbus, O., under the auspices of the Department of Civil Engineering of the Ohio State University and the Ohio State Highway Commission. This is to be a lecture course, and men of the highest reputation in their special lines have been secured to aid in making it worth while. The plan of the lectures is to follow as closely as possible the logical order of road construction, explaining each method and discussing each material. Each lecture will be one hour long, and the following 45 minutes will be given up to questions and discussions. Two classes of men, it is expected, will attend those lectures. One class will be men having a fair engineering training and more or less experience in road construction methods. To these men, much valuable experience, information and advice will be brought, which will fit in perfectly with their training and personal experience and should make them still better fitted for their daily tasks. The other class will be men who have not had an engineering training. To these also will be brought much useful information about road material, construction and maintenance methods. The best material for the various conditions, the best methods of construction, how to conserve economy and efficiency will be presented and discussed. It is not expected to turn out experienced, efficient road engineers in two weeks; the course is offered simply with a view to giving a convenient opportunity at small expense to all who desire to secure a better knowledge of how to do good road work. The course will open Feb. 24 and close March 8. The only fee required is $1 for registration. Anyone interested can obtain further information by writing Prof. Edward Orton, Jr., Dean of the College of Engineering, Columbus, O.

The Growth of a Bridge.

The fickleness of rivers and things in general is exemplified by what the Des Moines River did to an Iowa county. Back in 1880 the river started a new channel in the lower part of the county. In 1889 the county erected a 16-ft. bridge over this channel; six years later the length was increased by a span of 32 ft. In 1898 two spans each 80 ft. in length were added. In 1903 after a flood, the bridge was repaired and a span of 40 ft. tacked on its west end. By the end of 1907 it was necessary to add an extra 100 ft., and within the last three weeks another 100-ft. section has been put in place. Thus from a tiny baby bridge of 16 ft. the structure has grown in 23 years to the respectable length of 448 ft. Just to get even the county commissioners are now considering dredging the river so as to make it navigable for catfish.

0 in Poetical Possibilities.

The driver of a hen coop snow plow zigzagging along a cement sidewalk, shoving the snow to each side, can see no poetical possibilities in his job. Another zero in the poetry line for most men would be the dragging of a road. Out in Missouri, however, some genius, has risen to the occasion and immortalizes the plain and humble road drag in the lines that follow:

When smiles of spring appear,
Drag the roads;
When the summertime is here,
Drag the roads;
When the corn is in the ear,
In the winter cold and drear,
Every season of the year,
Drag the roads.

When you've nothing else to do,
Drag the roads;
If but for an hour or two,
Drag the roads;
It will keep them good and new,
With a purpose firm and true;
Fall in line! It's up to you!
Drag the roads.

PERSONAL

Mr. W. L. Anderson has been re-elected light and water superintendent for Vidalia, Ga.

Mr. J. A. Burgeson has resigned as superintendent of the electric light and water department of St. Peter, Minn.

Mr. S. P. Waldron of New York has been appointed contracting manager of the Boston office of the American Bridge Co., succeeding the late Mr. H. J. Kattell.

Mr. J. T. Haralson has been appointed assistant superintendent of the Sonora division, Southern Pacific Railways of Mexico, with headquarters at Empalme, Son.

Mr. George Craig, formerly city engineer for Omaha, Neb., has been appointed city engineer of Calgary, Alta., and Mr. A. Fox of Minneapolis has been appointed waterworks engineer.

Mr. Joseph D. Evans has resigned as chief engineer for the Montreal Tramways Co., Montreal, Que., to become construction manager of the Electric Bond & Share Co. of New York city.

Mr. F. W. Cappelen, chief engineer and general manager of the Decarie Incinerator Co., Minneapolis, Minn., has been made city engineer of Minneapolis, succeeding Mr. Andrew Rinker.

Mr. Walter Chess, president of the Expanded Metal Engineering Co. of New York and vice-president of the Consolidated Expanded Metal Companies of Pittsburgh, died Jan. 19, aged 73.

Mr. A. N. Johnson, state highway engineer of Illinois, delivered an address before the students and faculty of the College of Engineering, University of Illinois, on Jan. 15, entitled, "The Present Status of Road Work in Illinois."

Captain James M. Garth of Fort Worth, Texas, a railroad builder of many years' experience in Texas, died at Fort Worth, Jan. 27, aged 81. In the early '70s Captain Garth was one of the builders of the Texas & Pacific R. R.

Mr. Jarvis Hunt will present a paper on "A Proposed Central Passenger and Freight Terminal for Chicago's Railroads," before the Western Society of Engineers, Monday evening, Feb. 3. The paper will be illustrated by stereopticon views.

Mr. B. C. Lillis, civil engineer, announces that he has removed his office to suite 203, Acme building, Billings, Mont., and in addition to general engineering he will pay particular attention to examinations, appraisements and irrigation work.

Mr. Alfred Knight Chittenden, forester in the U. S. Indian Service, has been appointed assistant to the director of the engineering experiment station and lecturer on timber and timber resources in the College of Engineering, University of Illinois.

Mr. E. W. Sylvester, formerly an assistant engineer in the New York State Highway Department, and later assistant engineer on the New York State Barge Canal, and in the city engineering department of Albany, has been appointed superintendent of public works for Poughkeepsie, N. Y.

Mr. Charles H. Moore has resigned as principal assistant engineer of the Erie Railroad to become director of engineering and construction of the Curaray railroad in Ecuador, a road being built by the government of Ecuador. Mr. Moore has been consulting engineer for Ecuador for some time.

The following officers were elected for the ensuing year at the concluding session of the Canadian Society of Civil Engineers today: President, Phelps Johnson, Montreal; Vice-President, F. C. Gamble of Victoria, B. C.; Members of Council, Messrs. J. M. F. Fairbairn, W. J. Francis and R. J. Durley, Montreal; F. A. Bowman, Halifax; W. D. Baillairge, Quebec; S. J. Chapleau, Ottawa; H. G. T. Haultain, Toronto; W. A. Duff, Winnipeg, and T. H. White, Vancouver.

Civil Service Examinations.

The United States Civil Service Commission announces examinations as follows:

Petroleum Engineer, $2,000 to $3,600 per annum, Feb. 24.

Assistant Irrigation Engineer, $1,200 to $1,600 per annum, Feb. 26-27.

Examiner of Surveys, $1,200 to $1,500 per annum, Feb. 26.

Apprentice Map Engraver, Mar. 1.

Aid, Coast and Geodetic Survey, Mar. 12.

Assistant and Junior Engineers, Reclamation Service, Mar. 12.

Computers, Coast and Geodetic Survey, and Supervising Architect's Office, Mar. 12.

Draftsmen, Architectural, Topographic, Engineering, Heating and Ventilating, Mar. 12.

Superintendent of Construction, Mar. 12.

Cadet Engineer, Lighthouse Service, April 9.

Civil Engineers, Engineer Department at Large, April 9.

Draftsmen, Mechanical and Topographic, Isthmian Canal Service, April 9.

Engineer, Indian Service, April 9.

Junior Engineer, Mining. Department of Mines, April 9.

Surveyor, Philippine Service, April 9.

CATALOGUES

Steam Machinery.—Paper, 9x12 ins., 32 pp. Steam Machinery Publishing Co., Duluth, Minn.

This is a new monthly magazine for the logger, contractor, excavator and railway builder. It is edited by Mr. Chas. McIntosh of the Clyde Iron Works, and contains a number of interesting and useful articles.

Shovel and Dredge Repair Parts.—Paper, 6x9 ins., 20 pp. Edgar Allen Manganese Steel Co., McCormick Bldg., Chicago, Ill.

Bulletin 55 is now ready for distribution. It contains illustrations and descriptions of manganese teeth, racks, pinions, sheaves, drums and other repair parts.

Northfield Mixer.—Paper, 8½x11½ ins., 12 pp. Northfield Iron Co., Northfield, Minn.

This catalog illustrates and describes a hand-operated mixer. The cost of mixing is given and a complete description of the operation is shown in detail.

Pneumatic Hammers.—Paper, 6x9 ins., 24 pp. Chicago Pneumatic Tool Co., Fisher Bldg., Chicago, Ill.

This catalog contains illustrations and descriptions of the pneumatic riveting, chipping, calking and stone hammers. Line drawings, sizes, etc., are included.

Rumely Power.—Paper, 6x9 ins., 16 pp. M. Rumely Co., LaPorte, Ind.

This is a monthly news bulletin published by the Rumely Co. It contains articles describing the work of Rumely Oil Pull Tractor.

Bucket Conveyors.—Paper, 6½x9¼ ins., 64 pp. C. W. Hunt Co., New York City.

This catalog contains very complete illustrations and descriptions of the Hunt Noiseless Bucket Conveyor. Detailed drawings and photographs show the construction of the conveyor and various installations.

Dragline Cableway Excavator.—Paper, 6x9 ins., 24 pp. Sauerman Brothers, 1140 Monadnock Block, Chicago, Ill.

This illustrates and describes a catalog designed primarily for digging sand and gravel, and which is well adapted to the stripping and other kinds of excavation work. Illustrations of installations for stripping and for trench, canal and levee work are shown.

Expanded Metal Construction.—Paper, 6x9 ins., 8 pp. Expanded Metal Company, 37 W. Van Buren St., Chicago, Ill.

This catalog contains illustrations and a number of large buildings in which Kno-burn Expanded Metal Lath has been used.

Wheeling Forced Feed Crusher.—Paper, 10½x8 ins., 8 pp. Wheeling Mold & Foundry Co., Wheeling, W. Va.

This pamphlet contains illustrations with descriptions and tables of dimensions of a crusher for road builders, quarries, etc.

Sandusky Portland Cement.—Paper, 8x10½ ins., 32 pp. Sandusky Portland Cement Co.

This catalog illustrates a large number of buildings which have been finished with white portland cement and gives considerable information regarding the use of cement for stucco and building ornamentation.

Steel Fabric.—Paper, 7x10 ins., 22 pp. The Clinton Wire Cloth Co., Boston, Mass.

This is a monthly journal of fire-proof construction and concrete reinforcement. It contains a number of articles showing the use of electrically welded wire of large mesh for reinforcing, embankment protection, and other concrete work.

Non-tilting Batch Mixer.—Paper, 8¾x11¼ ins., 4 pp. The Waterloo Cement Machy. Corporation, Waterloo, Ia.

This catalog illustrates a number of concrete mixers including the "Little Wonder," "The Triumph Low Charging," "The Triumph Non-Tilting" and "The Polygon" line of concrete mixers.

INDUSTRIAL

The Taylor-Wharton Iron & Steel Co. has moved its Western sales office from 203 Mills Bldg., San Francisco, Cal., to 504 Newhouse Bldg., Salt Lake City, Utah.

The name of the Simplex Electrical Co. has been changed to the Simplex Line & Cable Co. No change of management or interest is effected by the change of name.

The San Francisco Bridge Co., engineers and contractors, has removed to offices in the Nevada Bank Bldg., Market and Montgomery Sts., San Francisco, Cal.

Mr. Willis Shaw, formerly connected with the Willis Shaw Machinery Co. has recently withdrawn from that company and has opened offices at 1216 Peoples' Gas Bldg., Chicago, where he will continue to handle railway equipment and contractors' machinery, both new and second hand, under name of Willis Shaw.

Mr. Henry C. Morrison, local manager of McCormick Waterproof Portland Cement Co., Chicago office, has been appointed General Manager of the company, and will take his new position in the main office of the company, St. Louis, Mo., March 1, 1913. The company has branch offices over the United States and Canada.

The Washington Iron Works, Seattle, Wash., manufacturers of mill, mining and marine machinery and who make a specialty of logging and hoisting engines, is installing a three-ton Girod electric furnace in its new foundry, together with complete steel foundry equipment for the manufacture of high grade steel castings. This will be the first electric steel casting plant on the Pacific coast.

The American Can Co., New York, Mr. N. M. Loney, Engineer, has awarded a contract for placing standard Raymond concrete piles for the foundation of its new factory at Luzerne and Hudson Sts., Baltimore, Md., to the Raymond Concrete Pile Co. of New York and Chicago. The Raymond Co. has recently completed contracts for concrete piling foundations for the American Can Co. in Philadelphia and Brooklyn, and is now working on a similar contract for them in San Francisco.

RAILWAYS

Alabama.

The Southern Ry. is to let contracts in the near future for the construction of a double track from 27th St., Birmingham, Ala., to the east end of the North Birmingham yard.

Arkansas.

⊙The firm of Burke Bros. & McNerney of Fort Smith, Ark., has been awarded the contract, grading, bridging, and track laying of 16 miles of railroad work by J. H. Phipps Lumber Co. of Fayetteville, Ark., commencing at a point at the station of Combs, Ark., on the St. L. & S. F. Ry., and extending the first 8 miles up a creek valley opening a good developed agricultural district. The last 8 miles will be largely heavy sidehill classified work, the greater portion of it being steam shovel work, extending into a large body of hardwood timber. The line crosses the Boston Mountains, where there is an almost natural gap extending over to the head of Mulberry Creek. The probabilities are it will be extended 6 or 8 miles further than the end of this present contract. The contractors are now moving forces on to the work.

California.

Board of Public Works of San Francisco has approved plans of M. M. O'Shaughnessy, City Engineer, for the extension of the Municipal Railway from its present Geary St. terminus along Market St. Estimated cost of work is $27,000. The material has already been ordered.

The Shasta & Eastern R. R., which has 16 miles of line between Anderson and Bella Vista, has applied to the State Railroad Commission for permission to sell bonds to the amount of $797,000 on a capitalization of $1,975,000 par value for the purpose of building and improving a railroad, proposed to connect Anderson, Shasta county, with Ingot in the same county. It is proposed to improve the present line and extend it from Bella Vista to Ingot, a distance of about 13 miles.

Application has been made to the Supervisors of Contra Costa County, at Martinez, by Fred E. Brooks, of Walnut Creek, formerly construction engineer of the Oakland & Antioch Ry., for permission to build n electric line along the county roads from Martinez to Bay Point and through Alhambra valley, Pleasant Hill, Walnut Creek, Alamo, Danville and San Ramon to the Alameda county line, thence to Hayward and Livermore. Preliminary surveys for this line two years ago and the promoter is reported to have secured the assurance of financial backing to build the line if the rights of way are secured. Free rights of way have been offered along portions of the route.

The Pacific Electric Ry. Co., Paul Shoup, Vice President, Pacific Electric Bldg., Los Angeles, will start work soon on the construction of a 9-mile extension of the Riverside-Arlington line. About $450,000 will be expended for the construction and equipment of the line.

The Pacific Electric Ry. Co. has awarded the contract for a line from San Bernardino to Riverside by way of Colton.

A bill is before the State Legislature giving the State Board of Harbor Commission, San Francisco, the right to extend the Belt Line R. R. to the exposition ground and thereby afford better transportation facilities in 1915. The bill confers upon the Harbor Board the additional authority to construct, maintain, operate and extend the State Railroad and railroad tracks over any state lands within its jurisdiction, or the water front, or over any streets or property of San Francisco or of the United States, or private property in San Francisco, in which it may then have permission.

Tentative plans for an interurban electric railway for Humboldt County have been completed by J. N. Lentell, C. E., Eureka, Cal., and submitted to the promoter, Rufus R. Wilson. According to the plans the road will be 53½ miles long and will take in Eel River valley and have its northern terminal at Korbel. On the southern end the line will go to Fortuna, Rohnerville, Alton and Grizzly Bluff, making a loop which will run through Ferndale and back to the main line at Weott. The estimated cost is $1,259,000.

Colorado.

The Securities Co., a $25,000,000 corporation, is being organized in New York City for the purpose, it is reported, of acting as a holding concern for a merger of the El Paso Mining Co., the Golden Cycle mine and the following railroads in the Cripple Creek district: The Colorado Springs & Cripple Creek District Ry., 50 miles; the Midland Terminal, 30 miles; the Florence & Cripple Creek, 41 miles; the Gold Belt, 11½ miles, and the High & Low electric lines, 18 miles. The Florence & Cripple Creek R. R. has not been operated since the flood of last spring. It is stated that the line is to be put back in shape and reopened. Richard A. Parker, Mining Engineer, Denver, Colo., is Engineer for the Securities Co.

Stockholders of the Denver, Laramie & Northwestern Railroad Co. have voted to resume the construction of the road northward from Greeley to Severance, Colo., by March 1. Plans are also under way to continue the construction of the road through the town of Wellington to the townsite of Scott, a distance of 11 miles. The terminus of the Denver, Laramie & Northwestern line will be at Kent, Wyo., about 216 miles northwest of Denver. The stockholders hope to complete the entire line without interruption when the work commences in March. W. E. Green, Denver, Colo., has been re-elected President.

Florida.

Stockholders of the Birmingham, Columbus & St. Andrews Ry., A. D. Campbell, Receiver, Chipley, Fla., are reported to have decided favorably on a proposed extension to Lynn Haven, Panama City and Deep Water at Bunker's Cove.

Idaho.

City of Pocatello, Idaho, has granted a street railway and electric lighting franchise to L. R. Martineau of Salt Lake City, Utah. Mr. Martineau recently secured control of water power sites near Pocatello. It is stated that electric storage battery steel cars will be used.

A proposition to construct a railroad from Twin Falls to Wells, Nevada, connecting with the Western Pacific, with a branch to Boise, is under consideration. George D. Aiken, Twin Falls, Idaho, is interested.

A campaign has been started by the Commercial Club of Boise, Idaho, for the promotion of the proposed Twin Falls, Oakland & San Francisco R. R. According to the plans, the line will have a junction at Berger, from where one branch will run to Buhl, thence across the Snake river to Boise, while the other branch will continue on to Twin Falls, thence to Idaho Falls, connecting with the new Northwestern line now being constructed south from Laramie, Wyo. W. T. Booth of the Boise Commercial Club, Boise, Idaho, is interested.

Illinois.

The Gary & Interurban R. R. of Chicago has been incorporated. F. N. Gavit, Whiting, Ind., President of the Gary & Interurban Ry., operating 22 miles of line, is President of the new company.

It is rumored that the Illinois Central is contemplating the construction of a new line out of Cedar Rapids to Iowa City, Ia. No definite information has as yet been obtained in regard to the matter.

It is rumored at Aurora, Ill., that the officials of the Michigan Central Railroad are contemplating the extension of its line from Joliet to Aurora, where a connection with the Chicago & Northwestern can be effected. E. D. Bronner, Detroit, Mich., is General Manager of the company.

At a meeting of the stockholders of the Oil Belt R. R. at Bridgeport, Ill., Jan. 22, it was voted to increase the capital stock from $500,000 to $2,500,000. This was done to cover the expense of the extensive construction now being done by the road, which is being built from Oblong to Mount Carmel. The construction work on the north end of the line has been interfered with a great deal of late, on account of the high waters in the Embarrass river, which the road will cross. It is predicted that the line will have been completed to Mt. Carmel, Ill., by the middle of the summer. When this is done it will be built to Charleston on the north.

Iowa.

The Chicago, Milwaukee & St. Paul Ry. is to start work this spring on improvements on its Sioux City division. It is stated that about 25 new sidings, each 3,000 ft. long, will be built between Manilla, Ia., and Mitchell, S. Dak.

The directors of the Interurban Ry. Co., C. F. Hewitt, General Manager, 607 Mulberry St., Des Moines, Ia., have authorized the expenditure of $350,000 for buying new cars, remodeling sub-stations and general construction work.

Kansas.

The Missouri Pacific Ry. I. R. Leighty, Engineer Maintenance of Way, Kansas City, Mo., will have work started in the spring on improvements to its roadbed between Wichita and Yates Center, 98 miles. About $100,000 will be expended in widening the roadbed between these points.

Surveys are reported underway for the projected electric railway from Kansas City to Bonner Springs by way of the Kaw Valley. J. D. Waters, Bonner Springs, Kan., is reported to be interested.

It has been announced at Vinita, Okla., that promoters of the Coffeyville, Caney & Southeastern R. R. (Porter Road) have succeeded in financing the project and that work will be started about July 1. The proposed road is to be constructed from Coffeyville, Kan., through Nowata, Centralia and Vinita to Siloam Springs, Ark. This road will give Vinita an outlet to the northwest and southwest.

Kentucky.

Surveys are well under way and rights of way are being secured for the extension of the Lexington & Eastern R. R. up Line Fork Creek in the southern section of Letcher County, Ky. It is believed that contracts for the construction will be let within 60 days. J. H. Peyton, Lexington, Ky., is Engineer of Construction.

The Kentucky Southwestern Electric Railway, Light & Power Co. has completed surveys for the first division, covering 55¼ miles, and arrangements are now being made to secure the construction capital. It is intended to let construction contracts soon for spring work. The route is from Paducah via Mayfield to Murray, Ky.; it takes in six other towns directly on the line and gives service to about 30 other towns and hamlets. The estimated cost of the first division is $1,304,000. Col. H. C. Rhodes, Paducah, Ky., is President; F. M. Smith, Paducah, is General Manager, and Maj. W. A. Calhoun, Paducah, is Chief Engineer.

Louisiana.

The Orleans-Kenner Electric Ry. Co. is making good progress with its plans for the construction of its projected electric railway in Orleans Parish to Kenner. A. Smith Bowman, Hibernia Bank Bldg., New Orleans, La., is President.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Maine.

A bill has been introduced in the State Legislature to give the Quebec Extension Ry. Co. the power to take over the rights and privileges of the Aroostook Valley R. R., a 24.7 mile electric railway. The act also provides for the incorporation of the Quebec Extension Ry. Co. with a capital stock of $4,000,000. A. R. Gould, Presque Isle, Me., is President of the Aroostook Valley R. R.

Maryland.

A corps of engineers is busy relocating the route of the proposed cutoff of the Baltimore & Ohio Railroad from Hancock through Warfordsburg, Fulton County, Pa., to a point 4 miles north. The right of way for the proposed stretch of line was purchased, it is said, some years ago.

Petition has been filed with Public Service Commission for permission to incorporate the Hagerstown & Frederick Ry. Co., with an authorized capital of $1,000,000 preferred stock, bearing interest at 7 per cent, and $2,000,000 common stock. The new company is the consolidation noted in our last issue of the Hagerstown Ry. Co. and its subsidiary companies, the Frederick & Hagerstown Power Co., the Frederick R. R. Co. and the Frederick Gas & Electric Co. The consolidated company also asks authority to execute a mortgage on the combined properties, securing an issue of $10,000,000 of 30-year 5 per cent sinking fund bonds. Of this amount, $3,300,000 will be authorized at once to make exchanges with certain underlying security holders, and to furnish the company with new capital for extensions, betterments and improvements. Emery L. Coblentz, Frederick, Md., is interested.

The directors of the Western Maryland Ry., H. R. Pratt, Chief Engineer, Baltimore, Md., have authorized the extension of the present passing tracks on the line between Hagerstown and Cumberland, a distance of 80 miles, to 4,000 ft. clear length. They have also authorized the construction of five additional passing tracks of the same clear length. This will provide passing track facilities for 100-car trains moving over that district. The construction of these facilities involves about 7½ miles of track and the expenditures will aggregate from $250,000 to $300,000. The new passing tracks will be constructed at Park Head, Hancock, Big Six, Baird and Town Creek. The extension will be made to the present sidings located at Williamsport, Charlton, Clear Spring, Big Pool, Park Head, Mill Stone, Hancock, Round Top, Pearre, Doe Gulley, Fair Play, Old Town and Sloan.

Michigan.

⊙Bay County Construction Co., Bay City, Mich., has been awarded the contract for an extension of the Detroit, Bay City & Western R. R., from Akron north to Sebewaing.

The State Railroad Commission has authorized the Detroit-Port Huron branch of the Detroit United Ry. Co., 12 Woodward Ave., Detroit, to issue capital stock to the amount of $75,000, the proceeds to be used in making additions and betterments to the road.

The Grand Rapids, Grand Haven & Muskegon Ry., Grand Rapids, Mich., is contemplating a number of improvements for this year. These include a double track from Grand Rapids to Walker substation and the installing of a number of additional passing tracks.

Minnesota.

The Canadian Northern has engineers at work staking out a proposed lumber dock at Duluth, Minn., for the purpose of securing an estimate of the cost. M. H. MacLeod, Winnipeg, Man., is Chief Engineer.

Financial and preliminary construction plans for the new St. Paul, Minn., Union Depot were presented for the approval of the nine railroads concerned at a meeting of the Station Committee recently, it is reported. Howard Elliott, President of the Northern Pacific, St. Paul, Minn., is Chairman of the Committee.

Missouri.

Plans have been prepared by Charles W. Campbell, City Engineer of St. Joseph, Mo., at the order of Mayor Pfeiffer, for the construction of a new union passenger station between Felix and Francis Sts., west of Second. The matter will now be taken up with the officials of the railroads concerned.

St. Louis Items.

BY A. B. KOENIG.

Mike Casey was with us several days. Mike reports Kennefick-Hoffman & Co.'s work at Charleston, N. C., well covered and getting along nicely.

E. O. Sullivan reports his levee work near Portageville, Mo., finished. He wants another job for his 6-team outfit.

Jas. Dowd & Son have moved their outfit on the Griffith & McMurray's work on the Chicago & Eastern Illinois R. R. near Morrisonville, Ill.

The Acqua Contracting Co., a new street-sprinkling company that was awarded the contracts to sprinkle the streets in ten districts, applied last week for articles of incorporation. The company will use 20 auto sprinklers that are being manufactured in the east and are expected to be here ready for use March 1. Part of the company's territory is from Market St. to Washington Ave. and from the wharf to Jefferson Ave. The incorporators are: J. Arthur Christopher, Henry Ziegenhein, Louis J. Nicolaus, Henry Ruckert and Benjamin G. Brinkman. Mr. Christopher is president, Mr. Nicolaus vice-president and Mr. Ziegenhein secretary. Messrs. Christopher and Ziegenhein are in the east getting equipment. The capital stock is $100,000, one-half paid up.

Plans are being formulated in Edwardsville, Ill., for the organization of the county ditch drainage and levee district, which will include about 5,000 acres of valuable farm lands in the American Bottoms, west of Edwardsville, Ill. It is estimated the improvement will cost about $20,000.

Andy Ward reports his 35 team outfit idle. Oak Glen, Ill., will catch him.

We are very sorry to hear of our old friend, Geo. B. Vaughn, being laid up at his home in Kirkwood, Mo., with rheumatism.

C. F. Nagel has just finished his work on the C., B. & Q. R. R. at Gallant, Ia. He expects to resume getting out rip-rap for the government early this spring.

Dan "Mush Head" Kennedy was accidently killed at Illmo, Mo., by having a train run over him.

Dan Hannefin has finished his work on the Wabash R. R. at Poag, Ill. He is in the market for more of this kind of work.

J. E. Lyman has been at home for several weeks suffering with the grip. He is up and around again.

The labor market continues to be easy here and any amount of white labor can be had on an hour's notice.

Harrington Bros. have finished their grading near Delmar Garden in the western part of the city. They want work for their 30-team outfit. Post office address is Clayton, Mo.

Alex. M. Stewart and Jas. C. Stewart, who have been doing business as Jas. Stewart & Co., contractors, have incorporated under the name of Jas. Stewart & Co. of New Jersey with a capital of $3,750,000. Their general offices will be at 30 Church St., New York, and Bank of Commerce Bldg., St. Louis, Mo. They will also have district offices in Chicago, Pittsburgh, Salt Lake City, Montreal, New Orleans, Houston and San Francisco. At the present time they are working on over 50 large contracts in various parts of the country.

Montana.

The Northern Pacific Ry. is reported to be perfecting plans for starting construction work this spring on an extension of its Clark Fork line to Chance, Mont. It is stated that the line will run practically parallel with that of the Montana, Wyoming & Southern from Bridger to Belfry, and that from that town it will continue up the Clark Fork valley to Chance. The primary purpose of the extension is to tap the coal field at that place and Belfry.

Announcement has been made by Edmund Pennington, President of the Minneapolis, St. Paul & Sault Ste Marie Ry., as noted briefy in our last issue, that the company was to expend about $25,000,000 in the construction of 725 miles of new line, crossing Montana. This is to be a continuation of the extension of the Plaza, N. Dak., line. Previous announcement had been made that this line was to be extended to the Missouri River. The new plans are for a continuation of this extension crossing the Missouri River at Sansit. The route outlined will follow the Yellowstone River through Dawson county, will cross the Musselshell River into Fergus county, continue through Choteau and Teton counties and cross the Canadian boundary either in Teton or Flathead county.

New Hampshire.

A bill has been introduced in the state legislature to extend the charter of the Newport & Sunapee Electric Ry. Co. This company was chartered some years ago and proposed the construction of an 8 or 10-mile line from Newport, N. H., to Lake Sunapee.

Bill is before the state legislature authorizing the Suncook Valley R. R. to extend its line to Manchester, N. H.

A bill has been introduced in the state legislature to extend the charter of the Nashua & Hollis Electric R. R. Co. This company proposes a line between the places mentioned in its title.

New Jersey.

The Northampton, Easton & Washington Traction Co., 341½ Northampton St., Easton, Pa., will probably begin work this spring on the extension of its line from Port Murray to Hackettstown. The extension will be about 10 miles long.

A comprehensive plan for the improvement of traffic conditions at Newark, N. J., has been made public by Thomas N. McCarter, President of the Public Service Corporation of New Jersey, Newark, which controls the electric railway systems in that city. The plans call for the expenditure of about $4,000,000 in the construction of subways and elevated tracks for the trolley lines in the city. The scheme contemplates direct communication between the terminal and the surface trolley lines from both east and west. On the east an elevated structure is to be erected, extending from Mulberry St. On the west the communication will be by means of a subway that will have an outlet on property of the company, fronting in Washington St., between Warren St. and the Morris Canal.

New York.

It is stated that the project to build the Buffalo, Rochester & Eastern R. R., from Buffalo to Troy, is to be revived at once, and another application made to the public service commission for permission to finance the enterprise and construct the line.

It is expected that the Lehigh Valley R. R., E. B. Ashby, Chief Engineer, New York City, will begin active work in the spring on its new line over right on the south side of the Seneca River at Seneca Falls.

The sale of the Auburn & Geneva R. R., with all its equipment and franchises, which was to have taken place Jan. 28 at Waterloo, has been postponed until March 14.

North Dakota.

Advices from Esmond state that it is likely the Oberon-Esmond branch of the Northern Pacific will be extended in the spring to some point on the Great Northern, probably Granville, Towner or Rugby.

The Northern Pacific Ry. will probably complete the remaining links in the extension of its Fergus Falls branch the coming summer. Agents are now stated to be in the field contracting for hay along the right of way for use for the grading outfits. The two gaps to be filled are Edgerly, N. Dak., to Cannonball, and Mott, N. Dak., to Terry, Mont.

Ohio.

⊙The Caldwell Construction Co., Youngstown, O., has been awarded the contract for constructing the Lake Erie & Youngstown R. R., mentioned in our last issue, from Youngstown to Conneaut, O. The contract includes 1,400,000 cu. yds. earth excavation, 360,000 cu. yds. rock excavation, five bridges requiring about 4,600 tons of steel and 18,700 cu. yds. of concrete masonry, one machine shop and equipment, one dock equipped, two round houses and turntable, telegraph service, water tanks, coal chutes, station buildings, etc. The grading, concrete and steel will probably be sub-let; no date for this, however, has been fixed. The Lake Erie & Youngstown is to be a double track road laid with 90 lb. steel. The freight service will be handled by steam, and passenger service by McKeen motor cars. The officers are as follows: President, John H. Ruhlman, Youngstown, O; vice-president, G. M. Brown, Conneaut, O.; general superintendent, Geo. J. Chapman, Conneaut, O.; chief engineer, H. Robert Clayton, Youngstown, O.

The Cleveland Ry. Co., C. H. Clark, Engineer Maintenance of Way, 620 Electric Bldg., Cleveland, O., proposes to expend about $516,000 for relaying 15 miles of track and $126,000 for miscellaneous improvements.

Mayor Hunt of Cincinnati, O., is advocating a plan for calling a special election this spring to vote on issuing $7,000,000 of bonds for the construction of interurban terminals in the city.

The Cleveland Ry. Co., Cleveland, O., has applied to the State Public Service Commission for permission to issue $3,600,000 additional capital stock. Of this it is proposed to use $3,000,000 in retiring matured bonds, the balance for extensions, track renewals, enlargement of car barns, etc.

Oklahoma.

The Tulsa Street Ry. Co., Tulsa, Okla., is to expend $60,000 this year for improvements and extensions. Work is to be started next month.

Oregon.

Citizens of Hood River Heights, a suburb of Hoods River, Ore., are to organize a company to construct an electric street railway from the lower section of the city. It is stated that about $10,000 worth of stock has been subscribed.

Officials of the Oregon-Washington Railroad & Navigation Co., who are in charge of the construction of the Oregon Eastern R. R. from Vale, Ore., to Dog Mountain, have announced that good progress is being made and it is hoped to have the entire project completed during the present year. Approximately 28 miles of track have been completed west of Vale, and grading has been finished 20 miles beyond that point. At the west end of this grade is a tunnel 2,500 ft. in length, upon which the contractors now are working. About 1,500 ft. of the tunnel have been driven. The remaining portion will be bored before April 1, it is estimated. West of the west portal of the tunnel is a comparatively level stretch of territory, across which the tracks can be laid with comparative ease and speed. This will finish the authorized undertaking to Dog Mountain, on the prairie about 20 miles south of Bend and nearly 200 miles east of Eugene. It is believed that the work of building west from Dog Mountain to Eugene, or to a point on the new Southern Pacific line south of Eugene, will be provided for before the end of the present year. J. D. Farrell, Portland, Ore., is President of the O.-W. R. R. & N. Co.

Pennsylvania.

The Pennsylvania R. R. has just awarded contracts for the following tunnels on its Allegheny Valley Division: Tunnel at East Brady, 2,660 ft. long; this will effect a saving in distance of 5.7 miles over the present line. Tunnel at Wood Hill, 2,870 ft. long; this will effect a saving in distance of 5.5 miles over the present line. Tunnel at Kennerdell, 3,350 ft. long; this will effect a saving in distance of 4 miles over the present line.

⊙Philadelphia & Reading Ry. Co. has awarded a contract to William S. Danzer & Co. for the construction of two signal towers at the yards which are being built at Hellertown. The Keystone Structural Co. was awarded the contract for signal bridges at the same place.

The Lehigh Valley Coal Co. is making preparations for opening a large stripping east of Hazelton to get at veins that have not yet been reached. Contract for stripping had not been awarded late last week.

Advices from Sunbury state that it is rumored there that the New York Central has secured possession of the right of way from McElhattan to Keating Summit and that preparations are under way to build a line so that through trains may run from Chicago over the New York Central lines to Williamsport and over the Reading lines to Tamaqua and reach New York City from Tamaqua over the Central Railroad of New Jersey lines.

The interests controlling the Hummelstown & Campbellstown Street Ry. Co., Hershey, Pa., are reported to be considering extending their lines in Lebanon County to Jonestown and Fredericksburg, either via a northern route run eastward from Hershey via Bindnaugle's Church, along the old Union Canal, or by way of the Lebanon to Fredericksburg route, connecting at Lebanon with the Hershey, Campbelltown & Lebanon line now being completed.

Stockholders and directors of the Pottsville Union Traction Co., of Pottsville, Pa., have voted to borrow $1,000,000 for improvements. These will probably include extensions and possibly the construction of the projected line from Pottsville to Shenandoah over Broad Mountain. W. B. Rockwell, 43 Exchange Pl., New York City, is Manager.

Announcement has been made that the Pennsylvania R. R. is to expend $50,000,000 for equipment and expansion. It is probable that the first big improvement to be undertaken will be the remodeling of Broad St. Station, Philadelphia. Other improvements will include abolition of grade crossings, establishment of additional freight facilities and the electrification of suburban lines.

Engineers are now at work on the contemplated railroad from Bond, Garrett County, Md., to Confluence, Somerset County, Pa., which, it is said, will be built by the Baltimore & Ohio R. R. and used as a low grade road to avoid both the heavy grades of the 17-mile grade on the main line of the B. & O. and the heavy Pittsburgh division grade to Sand Patch tunnel. The line will also make a short cut to Pittsburgh. The engineers are following the Savage River part of the way, starting from Bond, and they then go down the Youghiogheny River in Garrett County, Md., and Somerset County, Pa., to Confluence, Pa. F. L. Stuart, Baltimore, Md., is Chief Engineer.

Tennessee.

A bondholder's committee, consisting of the following, has been named to look after the refinancing of the Tennessee Central R. R., now in the hands of the receivers: A. J. Hemphill, president of the Guaranty Trust Co.; Albert H. Wiggins, president of the Chase National bank; Walter T. Rosen, of Ladenburg, Thalmann & Co., of New York; Breckenridge Jones, president of the Mississippi Valley Trust Co., of St. Louis, and Graham H. Harris, representing the estate of Jesse Spaulding.

Texas.

⊙Dudley & Orr, according to advice from El Paso, have been awarded the grading contract for the 30-mile interurban line from El Paso to Fabens. This line is to be constructed for the Stone & Webster Engineering Corporation, Boston, Mass.

Preliminary surveys have been started for the projected line of the San Antonio & Austin Interurban Ry., chartered recently, as noted in our Jan. 22 issue. W. B. Tuttle, 305 E. Houston St., San Antonio, Tex., is in charge of the engineering and construction work.

An appropriation has been authorized by F. G. Pettibone, Vice-President and General Manager of the Gulf, Colorado & Santa Fe Ry., Galveston, Texas, for the reconstruction of the roundhouse at San Angelo, Tex.

Advices from Orange, Texas, state that the Gulf, Sabine & Red River Ry., a 35-mile line extending from Niblett's Bluff and Fields, La., and operated by the Lutcher & Moore Lumber Co. of Orange, Texas, will shortly relay a portion of its line with heavier steel.

The Gulf, Texas & Western Ry., B. B. Cain, General Manager, Dallas, Tex., has filed an amendment to its charter for the construction of 16 miles of branch line. The proposed extension will be started at a point on the main line about 15 miles southeastward from Jacksboro in Jack County, and thence in a southerly direction to Salesville in Palo Pinto County, a distance of about 8 miles. From this point the extension will be made to Mineral Wells in Palo Pinto County, a distance of 8 miles.

Work has been started by Contractor Harris of El Paso cutting down the grade and double tracking the Katy Railroad from Waco to Hewitt, 9 miles south.

The Gulf, Colorado & Santa Fe Ry. is to expend about $1,500,000 for improvements during the present year in Texas. These include the following: Shops, engine houses and turntables, $260,000; sidings and spur tracks, $230,000; water and fuel stations, $160,000; terminal yards, $140,000; station buildings and fixtures, $125,000; track fastenings and appurtenances, $115,000; increased weight of rail, $80,000; right of way and station grounds, $50,000; bridges, trestles and culverts, $50,000; additional main tracks, $40,000; block and other signal apparatus, $38,000; telegraph and telephone lines, $28,000; shop machinery and tools, $26,000; protection of banks and drainage, $25,000; dock and wharf properties, $21,000; fencing right of way, $20,000; ballasting, $20,000; improved frogs and switches, $5,000; interlocking plants, $1,500; miscellaneous additions and betterments, $39,000. F. Merritt, Galveston, Tex., is Chief Engineer.

Virginia.

The Southern Ry. will let contracts shortly for the construction of double track north of Monroe, Va., to Amherst, Va.

At a meeting of the Blue Ridge Development Co., Culpeper, Va., promoters of the Culpeper, Madison & Rappahannock R. R. Co., it was agreed that the balance of the capital necessary be secured at once in order that construction work can be commenced at the earliest possible date. D. G. Wright, H. C. Robinson and F. C. Baggerly are interested in the project.

Washington.

⊙Brainard & Englebrecht, Boston Block, Seattle, Wash., have been awarded the contract at about $8,100 for supplying and setting poles for the Seattle Municipal Street Railway. Bids were opened Jan. 10.

The Northern Pacific Ry. will probably have work started in the spring on improvements on the Sumas branch between Tacoma and Sumas. It is likely that about $1,500,000 will be expended in revising grades and curves and in bettering the road bed.

Plans for the construction of new extensions on the Pacific Coast for the Northern Pacific Ry., shortening the line between Tacoma and Spokane, have been approved, according to reports, at the offices of the company at St. Paul, Minn. New lines will be built between Ellensburg and Ritzville via Bassett Junction and Sprague, and a projection is proposed from Kelso, following the valley of the Columbia River, to South Bend, where connections may be made with the central branch of the main line. The construction of second main track practically is proposed from the transcontinental route through the Yakima Valley to Grand View, through the extension of the Sunnyside branch, which now terminates at that point. W. L. Darling, St. Paul, Minn., is Chief Engineer.

West Virginia.

It is understood Eastern capitalists are financing a project for the construction of the Huntington & Northern Ry., a 35-mile line connecting the B. & O. and the C., H. & D. Railroads, and opening up a rich coal field in West Virginia. Rights of way, franchises and government approval have been secured and, according to reports, the United States Engineering & Construction Co. has the contract for the construction. Edward B. Garretson, Cincinnati, O., is said to be interested.

Wyoming.

The Chicago, Burlington & Quincy R. R. has asked bids on the construction of its projected line between Powder River and Orin Junction, Wyoming. The contract will probably be let the early part of the month.

The Union Pacific Ry., according to advices from Cheyenne, Wyo., contemplates the improvement and enlargement of the shops at that city. The cost of the work is roughly estimated at about $250,000. W. M. Jeffers, Cheyenne, Wyo., is Superintendent.

Canada.

⊙Foley Bros., Welch & Stewart, 202 Chamber of Commerce, Winnipeg, Man., have secured the following new grading work from the Canadian Pacific Ry. Co. for the coming season: Gimli, north (Manitoba), 22 miles; westerly extension, Weyburn branch (Saskatchewan), 145 miles; Gleichen-Shepherd (Alberta), 40 miles. Together with the following double track work: 31 miles, Whitewood-Grenfell, Saskachewan; 400 miles, Indian Head-Regina, Saskachewan. The above work amounts to about 7,000,000 cu. yds., mostly earth, prairie grading.

Application will probably be made at the next session of Parliament for the incorporation of the Ottawa, Rideau Lakes & Kingston Ry. Co. This company proposes an electric railway between the points named, and is reported to have secured about $250,000 toward the construction of its line. J. S. R. McCann, Kingston, Ont., is a director.

The Western Canada Ry. Co. is to apply at the present session of Parliament for an act of incorporation. The company propose to construct a line to be operated by steam and electricity from Fort Churchill, on Hudson Bay, through Manitoba, south of the Churchill River and north of the Nelson River, to a point at or near Sea Falls, on Nelson River, thence north of Lake Winnipeg, through Saskatchewan to Prince Albert; thence continuing through Saskatchewan and Alberta, in a direct line to Calgary, with power to construct a branch line from a point near Manitoba Lake in Saskatchewan to Edmonton. The company proposes to ply between Fort Churchill and other countries to construct, operate and maintain docks, wharves and elevators and operate telegraph and telephone lines along the whole length of the proposed railway.

Work has been started by Foley, Welch & Stewart of Spokane and St. Paul on their contract for the construction of the Pacific & Great Eastern Railroad from Vancouver, B. C., northeast. The new line will follow the course of the Fraser River and will open up a new territory. A. H. Sperry, Spokane, Wash., is General Manager of the road.

The Athabasca & Grand Prairie Ry. Co. is to have a bill introduced at the present session of Parliament to permit the construction of a line of railway from some point at or near the junction of the Solomon River, with the Athabasca River in Alberta in a northwesterly direction to a point at or near the junction of the Smoky River with the Muskeg River in Alberta, thence by the most feasible route in a northerly direction to Dunvegan in Alberta, passing through Grand Prairie at a point on the westerly side of Bear Lake. Pringle & Guthrie, of Ottawa, Ont., are the solicitors for the applicants.

The Canadian Western Ry. Co. will apply to Parliament at its present session for an act extending the time for the commencement and completion of its lines and by partially changing the route so as to provide that the line shall be built "from a point on the international boundary, near Coutts, Alberta, in a northerly and westerly direction to Cardston; thence in a northwesterly direction through the town of Pincher Creek."

The Canadian Central & Labrador Ry. is to apply to Parliament for powers to build a railway from Cochrane in a northeasterly direction to a point at or near Cape St. Lewis on the Atlantic coast, with a branch line to a point near the mouth of the Hamilton River, Quebec, and also a branch line to the city of Quebec.

The Manitoba Radial Ry. Co. will apply to Parliament for an extension of the time for the commencement and completion of its lines.

The Toronto Suburban Street Ry. Co., 1688 Dundas St., W. Toronto, has laid out a trial line for its entrance into Guelph, Ont.

The construction program of the Canadian Pacific Ry. for its lines in the west for the present year includes the following: Fort William, Ont.—Six stall addition to round house, increased storage capacity of elevator B to 4,000,000 bushels, increased size of freight car repair and workshops. Kenora, Ont.—Six stall addition to engine house. Minnedosa, Man.—Five stall addition to engine house. Arcola, Sask.—Four stall addition to engine house; additional trackage at Regina, Moose Jaw, Saskatoon, Sutherland. Dunmore, Alberta—Additional trackage. Wetaskiwin, Alberta—Increased trackage facilities; extension to express room. Calgary, Alberta—Automatic block signals between Ogden and Sunalta; passenger coach house with ice house; coal shed, etc. Alyth, Alberta—Six-stall addition to round house. Strathcona, Alberta—Increased trackage facilities; overhead bridge at Anthony St. Edmonton Alberta—Increased trackage facilities. Lacombe, Alberta—Two stall addition to round house; 50 ft. additional to freight shed. Vancouver, B. C.—Complete new terminal station and wharf; additional trackage at False Creek yards. Sicamous, B. C.—Additional trackage facilities. In addition, contracts have been let for about 807 miles of line, as noted in our last issue. This work includes the following new double track: Kemnay to Virden, 40 miles; Whitewood to Broadview, 15 miles; Broadview to Grenfell, 16 miles; Indian Head to Regina, 44 miles; Chaplin to Swift Current, 57 miles; Swift Current to Junction Point, with Swift Current northwest, 6 miles; Gleichen to Shepard, 40 miles. In addition to the above double tracking there will be 81 miles of double track built in British Columbia from Vancouver to Ruby Creek. A portion of this, between Vancouver and New Westminster Junction, is already built and in operation, and the balance to Ruby Creek will be completed this year. The following new branch lines will be as follows: Kootenay Central, Shookumchuck to Mile 60; Coronation to Sedgewick, 25 miles; Kootenay Central, Mile 42 to Mile 60, south of Golden; standardization of Kaslo and Slocan Ry. from Whitewater to Kaslo, 17 miles; Snowflake west, 9 miles; Lacombe east to Kerrobert, 66 miles; Stirling east, 25 miles; Suffield, southwest, 25 miles; Weyburn, west, 145 miles; Assiniboia, first division point west of Weyburn, new yard; Bassano to Empress, 118 miles; Gimli to Riverton, 26 miles.

Mexico.

Bondholders of the Mexican Northwestern Ry. Co. will meet Feb. 12, according to an announcement, for the purpose of passing on the issuance of $2,500,000 of 6 per cent 15-year prior lien bonds. Chas. S. Henning, Ciudad, Juarez, Chih., Mex., is Chief Engineer.

ROADS AND STREETS

Alabama.

✣Bids will be received until March 3 by City of Opelika, Ala., for paving 40,000 sq. yds. of artificial stone cement sidewalk. J. G. Palmer is Mayor and S. S. Black is City Clerk.

✣Bids will be received until noon, Feb. 10, by the Board of Revenue, Mobile County, Mobile, Ala., for furnishing and delivering at Saraland and Dorf Landing on the Southern Ry., approximately 2,500 cu. yds. of clay gravel. A certified check for $400 must be filed with each bid. W. S. Keller, Montgomery, Ala., is State Highway Engineer.

California.

⊙The Board of Trustees of Fresno, Calif., has awarded the contract for resurfacing 10 of the downtown streets to the Ransom-Crummey Construction Co., at $0.13 per sq. ft.

⊙The Associated Oil Co. and C. C. Harris Oil Co., Los Angeles, Cal., have been awarded the contract by the Board of County Supervisors, San Bernardino, Cal., for furnishing 20,000 bbls. of crude road oil, at an average price of $0.91 f. o. b. different points in the county. Bids were opened Dec. 30.

The Board of City Trustees of Colusa, Calif., has accepted the plans and specifications for the grading and paving of Market St. and will receive bids on the work at once. Civil Engineer Kaerth prepared plans for the grading and paving of four blocks, calling for 23,470 sq. ft. of asphalt pavement, the same amount of grading, 267 sq. ft. of gutters, 342 lin. ft. of concrete, 344 ft. of iron culverts, and 200 lin. ft. of gutter bridges.

The Board of Supervisors of San Mateo County, Redwood City, Calif., has called an election for the purpose of voting on the issuance of bonds to the amount of $1,285,000 for the construction of good roads throughout the county.

The Sierra County Board of Supervisors, Downieville, Calif., will receive bids at its April meeting for the construction of the Gold Lake road in that county. The national forest has provided $4,000 to assist in building the road.

The Board of Supervisors of Orange County, Calif., Santa Ana, have sold bonds to the amount of $1,270,000 for the construction of good roads. It is proposed to commence construction work on the system of good roads within four months. About 107 miles will be built.

Delaware.

The directors of the street and sewer departments of Wilmington, Del., have sent a communication to the City Council requesting that body to ask the legislature for the power to issue additional street improvement bonds to the amount of $150,000 for the purpose of continuing the paving of the streets contained on last year's list.

District of Columbia.

Following bids were received Jan. 24 by the Commissioners of the District of Columbia, Washington, D. C., for furnishing and delivering 100,000 gals., more or less, of emulsifiable road oil for use in the surface division: The Texas Co., 17 Battery Pl., New York City, $0.0566 per gal.; Joseph H. Cranford, Washington, D. C., $0.059 per gal., and The Sun Co., Philadelphia, Pa., $0.0473 per gal.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Florida.

✣Bids will be received until noon, April 7, by J. A. Johnson, Clerk, Board of Polk County Commissioners, Bartow, Fla., for the construction of a macadamized road and highway from a point beginning at Eagle Lake in Polk County, Florida, and running thence in a northeasterly direction to the Osceola County line by way of Winter Haven, Florence Villa, Lucerne Park, Davenport and Loughman. Plans and specifications are on file with the clerk. A certified check for $1,000 must be filed with each bid.

⊙The Georgia Engineering Co., Augusta, Ga., has been awarded the contract by the city of Clearwater, Fla., for street paving with vitrified brick and various kinds of asphalt and bitumen pavements, at $1.69 per sq. yd.; also storm sewers and combined curb and gutter, at $0.55 per lin. ft. The total cost of the work will approximate $90,000. Bids were opened Jan. 21.

⊙E. W. Porken of Tampa, Fla., has been awarded the contract by the City Council of St. Petersburg, Fla., for the construction of a pier or roadway to be built from the sand fill and breakwater on Second Ave. North, eastward into Tampa bay, at $1,595; also for the construction of a wharf and freight office, at $4,375. Bids were opened Jan. 23 by W. F. Divine, City Clerk.

⊙The West Construction Co. has been awarded the contract by the Board of Public Works of Bradentown, Fla., O. A. Spencer, Commissioner, for the construction of approximately 37,000 sq. yds. of new paving and 13,000 yds. of widening and repairing, at $1.69 per sq. yd. T. L. Shirley and M. O. Mattison secured the contract to construct approximately 48,000 lin. ft. of gutter and combined curb and gutter, at $0.52 per lin. ft. Bids were opened Jan. 23. The H. S. Jaudon Engineering Co., Savannah, Ga., are engineers.

The Board of Trade of Tampa, Fla., has appointed a committee to go before the County Commissioners and recommend that the board should build no more macadam or shell roads, and not expend much funds on the repair of those already in existence, but proceed to build brick paved roads henceforth.

Idaho.

Bids were received on Jan. 22 by the city of Boise, Ida., C. C. Stevenson, City Engineer, for the construction of pavement in Paving Improvement District No. 19. The bidders on the work being (1) Keasel Construction Co., Tacoma, Wash.; (2) Warren Construction Co., Portland, Ore.; (3) J. J. Carroll, Boise; (4) A. C. Bird Construction Co., Salt Lake City, Utah; (5) Inland Empire Hassan Paving Co., Spokane, Wash.; (6) G. A. Heman, St. Louis, Mo.; (7) Maney Bros. & Co., Boise; (8) Reliance Construction Co., Portland, Ore.; (9) Wilson, Bailey Construction Co., Walla Walla, Wash.; (10) J. A. Spaulding, Coeur D'Alene, Ida.; (11) Morrison, Knudson, Boise, Ida.; (12) J. W. Wood, Spokane, Wash.; (13) Northwest Paving & Construction Co., Boise, Ida.; (14) Barber Asphalt Paving Co., Spokane, Wash.; (15) J. F. Hill, Chicago, Ill. All of the above bid on the curb, gutter plates, sidewalk, etc., their bids being shown in the following table. The bids on the various classes of pavements are also shown in the tables that follow:

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Gutter plates, 150,500 lbs	$0.06	$0.03¾	$0.04½	$0.04½	$0.04	$0.10	$0.04½	$0.03¾	$0.05	$0.04½	$0.05	$0.05	$0.03½	$0.04	$0.04½
Sidewalk, 100 lin. ft	.70	.60	.75	.74	.65	.80	.90	.63	.70	.75	.65	.68	.60	.69	.65
Curb, 6,500 lin. ft	.35	.35	.45	.30	.37	.50	.36	.30	.40	.38	.40	.39	.32	.35	.35
Concrete curb gutter, without guarantee, 15,100 sq. yds	1.00	1.00	1.20	.90	1.02	1.00	1.15	1.12	1.00	1.05	1.05	1.05	1.00	1.02	.87
Concrete curb gutter, 5-year guarantee, 15,100 sq. yds	1.10	1.06	1.28	.92	1.04	1.25	1.25	1.15	1.02	1.07	1.08	1.08	1.10	1.07	.90
Street car pavement, with concrete base, 9,000 sq. yds	3.50	3.75	3.80	2.20	2.80	2.65	1.60	1.40	1.80	1.80	1.90	2.00	2.00	2.60	2.37

Hassamite (5½-in. concrete base; top, ⅓ to ½ gal. Hassamite bitumen per sq. yd.).

	(5)	(13)
Excavation, 18,900 cu. yds	$0.75	$0.70
5½-in. concrete base, no guarantee, 52,300 sq. yds	1.25	1.20
5½-in. concrete base, 5-year guarantee, 52,300 sq. yds	1.32	1:25

Asphalt (4-in. concrete base; 1-in. binder; 1½-in. surface).

	(1)	(3)	(4)	(5)	(6)	(8)	(13)	(14)	(15)
Excavation, 19,800 cu. yds	$0.55	$0.65	$0.70	$0.75	$0.60	$0.60	$0.70	$0.80	$0.55
Without guarantee, 52,300 sq. yds	1.60	1.70	1.70	1.64	2.05	1.38	1.60	1.69	1.63
With 5-yr. guarantee, 52,300 sq. yds.	1.65	1.80	1.70	1.70	2.25	1.43	1.65	1.75	1.65

Asphaltic concrete (4-in. concrete base; 2-in. top).

	(3)	(6)	(7)	(13)	(15)
Excavation, 18,900 cu. yds	$0.65	$0.60	$0.60	$0.70	$0.55
Concrete base, without guarantee, 52,300 sq. yds	1.65	1.50	1.50	1.30	1.60
Concrete base, 5-year guarantee, 52,300 sq. yds	1.75	1.60	1.90	1.35	1.62

Bitulithic.

	(2)	(3)	(6)	(13)	(14)
Excavation, 6-in. paving, 18,900 cu. yds	$0.60	$0.65	$0.70	$0.70	$0.80
Excavation, 5½-in. paving, 18,000 cu. yds	.60	.65	.70	.70	.80
4-in. stone base, 2-in. top, no guarantee, 52,300 sq. yds	1.75	1.93	2.20	1.80	1.85
4-in. stone base, 2-in. top, with guarantee, 52,300 sq. yds	1.81	2.03	2.40	1.85	1.90
4-in. concrete base, 2-in. top, no guarantee, 52,300 sq. yds	1.95	2.14	2.40	1.95	1.95
4-in. concrete base, 2-in. top, with guarantee, 52,300 sq. yds	2.01	2.18	2.60	2.02	2.00
4-in. stone base, 1½-in. top, no guarantee, 52,300 sq. yds	1.67½	1.80	2.20	1.70	1.78
4-in. stone base, 1½-in. top, with guarantee, 52,300 sq. yds	1.72½	1.90	2.30	1.75	1.85
4-in. concrete base, 1½-in. top, no guarantee, 52,300 sq. yds	1.84	1.96	2.35	1.82	1.90
4-in. concrete base, 1½-in. top, 5-year guarantee, 52,300 sq. yds.	1.89	2.06	2.50	1.87	1.95

Dolarway (5½-in. concrete base; top, ⅓ to ½ gal. Dolarway bitumen per sq. yd.

	(4)	(5)	(6)	(8)	(9)	(10)	(11)	(12)	(13)
Excavation, 18,900 cu. yds	$0.70	$0.75	$0.70	$0.60	$0.65	$0.70	$0.75	$0.74	$0.70
Without guarantee, 52,300 sq. yds	1.29	1.24	1.70	1.23	1.24	1.25	1.30	1.26	1.20
5-year guarantee, 52,300 sq. yds	1.31	1.32	1.98	1.28	1.29	1.30	1.36	1.29	1.25

Concrete (6-in.; 1-3-5).

	(1)	(6)	(7)	(8)	(11)	(13)
Excavation, 18,900 cu. yds	$0.55	$0.60	$0.60	$0.60	$0.75	$0.70
Without guarantee, 67,400 sq. yds	1.00	1.05	1.12	1.00	1.10	.90
With 5-year guarantee, 67,400 sq. yds	1.05	1.15	1.22	1.05	1.30	.95

Concrete, bitumen top (5½-in. concrete base; top, ⅓ to ½ gal. bitumen per sq. yd.

	(6)	(7)	(8)	(13)
Excavation, 18,900 cu. yds	$0.60	$0.60	$0.60	$0.70
Without guarantee, 52,300 sq. yds	1.30	1.35	1.12	1.05
With guarantee, 52,300 sq. yds	1.60	1.60	1.15	1.20

Illinois.

✣Bids will be received by the Board of Local Improvements, Chicago, Ill., Edw. J. Glackin, Secy., until 11 a. m., Feb. 10, for furnishing and delivering labor, materials, etc., necessary to construct pavements in the following streets: Elston Ave., Fullerton Ave. to Belmont Ave., 15,000 lin. ft. sandstone curbing 7x18 in., 19,800 sq. yds. creosoted wood block pavement, 2,000 sq. ft. concrete sidewalk, assessment available $84,083; 40th Ave., Fullerton Ave. to Milwaukee Ave., 12,200 lin. ft. vertical concrete curb, 7x9 in. x 24 in., 18,500 sq. yds. brick pavement, 2,000 sq. ft. concrete sidewalks, assessment available $59,530; 41st Ave., Irving Park Blvd. to C. & N. W. Ry., 920 lin. ft. sandstone curbing, 5 in. x 30 in., 1,340 sq. yds. brick pavement, 50 sq. ft. concrete sidewalks, assessment available $4,400; 42nd St., Vincennes Ave. to Cottage Grove Ave., 3,650 lin. ft. gravel concrete combined curb and gutter, 125 lin. ft. concrete gutter, 6,920 sq. yds. asphaltic concrete pavement, 50 sq. ft. concrete sidewalk, assessment available $16,250; Hoyne Ave. 105th St. to 107th St., 2,700 lin. ft. sandstone curbing on limestone blocks, 3,970 sq. yds. asphaltic macadam pavement, 209 sq. ft. concrete sidewalks, assessment available $8,470; Loretto Court, Van Buren St. to Congress St., 600 lin. ft. sandstone curbing, 1,280 sq. yds. brick pavement, 50 sq. ft. concrete sidewalk, assessment available $3,884; S. Oakley Ave., 35th St. to Archer Ave., 1,700 lin. ft. granite concrete combined curb and gutter, 2,800 sq. yds. brick pavement, 250 sq. ft. concrete sidewalks, assessment available $8,592; 105th St., Throop St. to Prospect Ave., 3,610 lin. ft. concrete curbing, 5,060 sq. yds. asphaltic macadam, 8-in. slag, 2½-in. gravel top, 400 sq. ft. concrete sidewalks, assessment available $10,640; 63rd St., Western Ave. to 108 ft. E. of Irving Ave., 2,530 lin. ft. sandstone curbing, 4,240 sq. yds. brick pavement, 100 sq. ft. concrete sidewalks, assessment available $13,011; 20th St., Blair St. to Jefferson St., 650 lin. ft. granite concrete combined curb and gutter, 1,010 sq. yds. asphaltic pavement, 100 sq. ft. concrete sidewalks, assessment available $3,500; Waller Ave., Augusta St. to W. Division St., 2,650 lin. ft. granite concrete combined curb and gutter, 2,970 sq. yds. asphaltic pavement, 400 sq. ft. concrete sidewalk, assessment available $12,500; Buffalo Ave., 133rd St. to 136th St.; Superior Ave, 132nd to 136th; E. 132nd St., Ontario Ave. to Superior Ave.; E. 133rd St., Ontario Ave. to P. F. W. & C. Ry.; E. 134th St., Ontario Ave. to Buffalo Ave.; E. 136th St., Howard Ave. to Buffalo Ave., produced south, 15,970 lin. ft. sandstone curbing on concrete blocks, 23,770 sq. yds. asphaltic macadam, 8-in. slag, 2½-in. limestone top, 600 sq. ft. concrete sidewalk, assessment available $48,932; Irving Park Blvd., Ashland Ave. to E. Ravenswood Park Bk., 2,610 lin. ft. sandstone curbing, 1,000 cu. ft. curb wall, 3,850 sq. yds. creosoted wood block, 650 sq. yds. brick pavement, 1,000 sq. ft. concrete sidewalk, assessment available, $18,894; alley Madison St., California Ave., etc., 1,220 lin. ft. concrete curbing, 950 sq. yds. brick pavement; alley Carroll Ave., Union Park Pl., etc., 750 lin. ft. concrete curbing, 500 sq. yds. brick pavement; alley Potomac Ave., Hirsch St., etc., 1,220 lin. ft. concrete curbing, 950 sq. yds. brick pavement; alleys Van Buren St., Pearce St., etc., 970 lin. ft. concrete curbing, 770 sq. yds. granite block pavement, assessment available $3,344; alley Ashland Ave., Madison St., etc., 1,220 lin. ft. concrete curbing, 950 sq. yds. brick pavement, assessment available $2,862; alleys Polk St., Laflin St., etc., 2,140 lin. ft. concrete curbing, 1,570 sq. yds. brick pavement, assessment available $5,152; alley Taylor St., Lowell Ave., 2,140 lin. ft. concrete curbing, 1,570 sq. yds. brick pavement, assessment available, $5,152; alley Taylor St., Hermitage Ave., etc., 1,600 lin. ft. concrete curbing, 1,250 sq. yds. brick pavement, assessment available $4,037; alley Elburn Ave., Edgemont Ave., etc., 1,200 lin. ft. concrete curbing, 680 sq. yds. brick pavement, assessment available $2,322; the work includes a 6-in. Portland cement concrete foundation. asphaltic filler and 2-in. sand cushion is here specified, sewer, manhole and catch basin construction and adjustment. Cash or certified check for 10 per cent of bid must accompany proposal.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

The Board of Local Improvements of Rossville, Ill., has passed a resolution providing for the paving of Chicago and Attica Sts. with vitrified brick. The estimated cost is $65,000.

The City Council of Joliet, Ill., has passed an ordinance providing for the resurfacing of Eastern Ave., from Cass St. to Third Ave., with bituminous paving. City Engineer C. D. O'Callaghan has estimated the cost at $13,350.

The City Council of Quincy, Ill., has decided to pave 16th St., from Main St. to Broadway, with brick, at an estimated cost of $8,322, and 20th St., from Maine to Cedar St., with brick, at an estimated cost of $38,400. Web P. Bushnell is City Engineer.

The Board of Local Improvements of Peoria, Ill., has decided to use creosoted wood block in paving Adams St., between Oak and Cedar Sts. The improvements will be made in the spring. L. D. Jeffries is City Engineer.

The citizens of Middleport Township, Iroquois County, Ill., will be asked to vote at the April election to levy a tax of $0.50 on the $100 for five years for the building of stone roads. This is to be in addition to the tax already voted and will make a total of $1 on the $100 stone road tax. Watseka is the county seat.

Indiana.

✣Bids will be received until 11 a. m., Feb. 6, by Board of Wabash County Commissioners, Wabash, Ind., for the construction of a gravel road known as Engleman Road, on the line between Wabash and Miami Counties. Dan Showalter is County Auditor.

✣Bids will be received until 10 a. m., March 3, by Board of Newton County Commissioners, Kentland, Ind., for the construction of a macadam road in Jefferson Township. S. R. Sizelove is County Auditor.

✣Bids will be received until Feb. 7 by Board of Public Works, Indianapolis, Ind., for the improvement of River Ave., from Division to Morris St., by grading and paving the roadway.

⊙The city of Shelburn, Ind., has awarded the contract for the paving of Mill St. to the Foulkes Construction Co. of Terre Haute, Ind.

City Engineer Robert M. Burns of Terre Haute, Ind., has completed new plans and specifications for the paving of East Wabash Ave., North 14th, Poplar and South Sixth Sts.

The Common Council of Muncie, Ind., has instructed City Engineer Benj. F. Deardorff to prepare plans and specifications for a number of public improvements, including paving, concrete sidewalks, curbs and gutters.

The Town Board of Walkerton, Ind., has decided to pave Main St., from limit to limit. Plans and specifications will be prepared by Civil Engineer W. H. English of Plymouth, Ind.

Iowa.

✣Bids will be received until Feb. 12 by M. H. Jones, Township Clerk, Lime Spring, Ia., for the road work of the township.

⊙The bids received Jan. 14 by City Clerk C. J. Reusche of Clinton, Ia., for the paving of Second St., from Eighth Ave. to Reznor St., were as follows, (1) standing for bid of M. Ford Paving Co., Cedar Rapids, Ia. (awarded contract); (2) Thos. Carey & Sons, Clinton, Ia.; (3) J. S. McLaughlin & Sons, Red Oak, Ia.; (4) O'Rourke & Ridge, Sterling, Ill.; (5) John Fey, Davenport, Ia.; (6) James J. Ryan, Muscatine, Ia., and (7) M. Tschirgi & Sons, Cedar Rapids, Ia.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Excess grading, 100 cu. yds.	$ 0.40	$ 0.60	$ 0.45	$ 0.55	$ 0.62	$ 0.55	$ 0.50
Vitrified block paving, 36,802 sq. yds.	1.98	2.49½	2.51	2.50	2.49	2.51	2.50
Combined curb and gutter, 10,878 lin. ft.	.70	1.09	1.12	1.10	1.13	1.10	1.20
Catch basins, complete, 5	25.00	35.00	35.00	35.00	45.00	40.00	50.00
Track inlets, 72	7.50	9.00	10.00	10.00	40.00	10.00	15.00
10-in. catch basin pipe, 165 lin. ft.	.40	.50	.50	.55	.50	.50	.80
8-in. track inlet pipe, 725 lin. ft.	.35	.40	.45	.45	.40	.45	.50
Adjusting adjacent paving connection	8.00	10.00	10.00	10.00	12.00	12.00	15.00
Totals	$81,579	$105,024	$105,995	$105,428	$105,417	$105,831	$107,068

The City Council of Burlington, Ia., has adopted resolutions providing for paving work, as follows: North 10th St., from from Franklin to Iowa St.; South Seventh, from Angular to Locust St.; Cedar St., from Fourth to Seventh, and South St., from Ninth to Summer St. H. G. Vollmer is City Engineer.

The Board of Supervisors of Dubuque County, Dubuque, Ia., propose to raise $20,000 in order to secure $10,000 for the government for the construction of good roads in that county.

Iowa.

⊙E. A. Wickham has been awarded the contract by the City Council of Council Bluffs, Ia., C. J. Duff, City Clerk, for the construction of artificial stone sidewalks at $0.09 per sq. ft. The work includes approximately 66,856 sq. ft. Bids were opened Jan. 20.

A petition has been circulated among the property owners of Sac City, Ia., which will be presented to the City Council, asking for the paving of Main and Fourth Sts. during the coming summer. The petition provides for the paving of 14 blocks on Main St. extending from the Northwestern tracks on the west to the east bridge across the Coon River on the east, and 10 blocks on Fourth St. extending from the Nory River bridge to four blocks south of Main St.

Kansas.

The city of Manhattan, Kans., proposes to ask for bids about March 1 for the paving of Osage St., from Third to the city park. Other streets proposed to be improved this year are: Colorado, Sixth St., South Fourth and a short piece on Manhattan Ave. Chester Gist is City Clerk.

Louisiana.

The City Council of Shreveport, La., has passed an ordinance calling an election for March 4 to vote on a bond issue of about $200,000 for street paving.

Maryland.

✣Bids will be received until noon, Feb. 20, by Highway Commission, Towson, Md., for the construction of a section of the Black Rock road from the end of the improved section to Mount Zion Church, a distance of 1.98 miles. All bids must be on blank forms to be obtained at the office of the State Roads Commission, 534 North Howard St., Baltimore, Md.

The Paving Commission of Baltimore, Md., on Jan. 29 sent to the Board of Awards for its approval contracts calling for an estimated aggregate expenditure of $230,000. The contracts to be approved are grouped as follows: Contract No. 43—Vitrified block: Fayette St., from Broadway to Luzerne. Contract No. 45—Sheet asphalt and bituminous concrete: Mount St., from Laurens to Riggs Ave.; Laurens, from Eutaw Pl. to Linden Ave.; Laurens, from Pennsylvania Ave. to Druid Hill Ave.; Division St., from Lafayette Ave. to Mosher. Contract No. 46—Vitrified block: Charles St., from Barre to Hill; Commerce St., from Lombard to Baltimore. Contract No. 47—Vitrified block: Park Ave., from Laurens to North Ave.; Greene St., from Baltimore to Lexington; Fayette St., from Pine to Paca. Contract No. 48—Granite block: Commerce St., from Lombard to Pratt; Lombard, from South to Gay. Contract No. 49—Granite block: Frederick St., from Lexington to Gay; Exeter St., from Fayette to Baltimore; Saratoga, from Gay to Calvert. Contract No. 50—Sheet asphalt: Fort Ave., from Lawrence St. to Fort McHenry. Contract No. 51—Sheet asphalt and bituminous concrete: Calvert St., from Saratoga to Pleasant; Preston St., from Cathedral to Guilford Ave.; Biddle St., from Cathedral to St. Paul; Maryland Ave., from Chase to Preston, and Maryland Ave., from Pennsylvania R. R. bridge to North Ave.

Senator Jackson of Maryland on Jan. 30 introduced a bill in the U. S. Senate, proposing a plan of federal co-operation with the states for highway improvement. The bill would authorize the government to pay one-half the cost of improving highways used by mail carriers, and would appropriate $10,000,000 annually for the work.

According to reports from Baltimore, Md., City Engineer H. K. McCay is ready to proceed with the widening of Guilford Ave. between Mount Royal Ave. and Chase St.

Massachusetts.

The directors of the port of Boston, Boston, Mass., have voted to order 63,000 sq. yds. of bitulithic macadam for the first floor of the Commonwealth pier; 20,900 sq. yds. of granolithic for the second floor to be used by passengers, and 4,094 sq. yds. of wood block for the concourse for carriages on the second floor.

Michigan.

✣Bids will be received until 2 p. m., Feb 11, by John W. Ederer, County Road Commissioner, Court House, Saginaw, Mich., for furnishing materials to be used in the construction of highways in Saginaw County during 1913. A certified check for each bid must accompany each bid. Specifications are on file with the commissioner.

The Board of Public Works of Bay City, Mich., has recommended the paving of six streets not hitherto reported upon. The streets are: Water St., from 28th St. to Cass Ave.; Johnson St., from Sixth to Eighth Sts.; Ninth St., from Water St. to Washington Ave.; Water St., from McKinley to Ninth St.; Ohio St., from Euclid Ave. to Wenona Ave., and Wenona Ave., from Ohio St. to Midland St.

The City Council of Traverse City, Mich., has made preparations for a considerable amount of paving and sewer work. A hearing will be held Feb. 17.

Minnesota.

The Board of Public Works of St. Paul, Minn., J. J. O'Leary, President, proposes paving work on sections of the following streets during 1913: Jackson, Linwood Pl., Holly, Portland, Arcade, Plum, Hastings, Broadway, Sixth, Jackson, Snelling, Pleasant, Summit, Osceola, Dale, Victoria, Selby, Case, Arundel, Pine, Cathedral Pl., Western, 14th, Hague, University, and Prior Sts. Between $1,000,000 and $1,500,000 will be spent.

The City Council of Duluth, Minn., has ordered the acquirement of the route for the proposed extension of the Farrell road, for which surveys have been made. The road is now graded across the boulevard to the Villa Scholastica.

The committee on streets, alleys and sidewalks of the City Council, Duluth, Minn., has circulated a petition for the improvement of Grand Ave., from Vernon St. to 54th Ave. W., the cost not to exceed $175 per 50 ft. lot. The estimated costs are $135,727 for creosote block, $166,298 for sandstone, $126,643 for brick and $86,589 for concrete. John Wilson is City Engineer.

Missouri.

⊙The Board of Public Works of St. Joseph, Mo., has awarded contracts for improving with Hassam paving 17th St., from Walnut to Bell, and Olive, from 28th to 29th Sts., to the Rackliffe-Gibson Construction Co.

The Commercial Club of Linn Creek, Mo., has launched a movement to build a rock road from Linn Creek to Lebanon. The proposed highway will be 33 miles long. Col. R. J. Scott is president of the club.

Nebraska.

The City Council of Norfolk, Nebr., was recently petitioned to pave Fourth St. with

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

bituminous concrete material. H. H. Tracy is Acting City Clerk.

New Jersey.

✣Bids will be received until 2:30 p. m., Feb. 13, by Board of City Commissioners, Atlantic City, N. J., for furnishing setting and laying 12,800 sq. yds. of vit. fire clay block, creosoted wood block or asphalt block pavement, including grading, cushion and concrete foundation; 15 cu. yds. of concrete not covered with block pavement; 350 ft. B. M. lumber left in the work; 19,510 lin. ft. straight 4 in. x 16 in. bluestone curbing furnished and set; 110 lin. ft. curved 4 in. x 16 in. bluestone curbing 10 ft. radius, furnished and set; 37.7 lin. ft. curved 4 in. x 16 in. bluestone curbing 6 ft. radius, furnished and set; 37.7 lin. ft. curved 4 in. x 16 in. bluestone curbing 4 ft. radius, furnished and set; 219.8 lin. ft. curved 4 in. x 16 in. bluestone curbing 2 ft. radius, furnished and set; 725 lin. ft. curbing reset; 173 lin. ft. 4 in. by 12 in. bluestone heading stones, furnished and set (not including concrete support). Each proposal for each class of paving material will be considered an indepedent bid and bidders may bid upon any one or more of said surfacing materials. Each proposal must be accompanied by a certified check upon a national or state bank or trust company, drawn to the order of Albert Beyer, City Treasurer, for the sum of $2,500. Specifications and blank forms of proposal and envelopes which must be used may be procured at the office of J. W. Hackney, City Engineer, Room 25, City Hall, Atlantic City, N. J.

New York.

✣Bids will be received until 11 a. m., Feb. 7, by Department of Public Works, Francis Ward, Commissioner, Buffalo, N. Y., for paving portions of Hamburg turnpike, St. Louis Ave., Marion Ave. and Baitz Ave., and repaving a portion of Michigan St.

⊙The Board of Trustees of Ilion, N. Y., has awarded the contract for paving West North and West Clark Sts., with bitulithic pavements to Warren Bros. Co.

⊙The Collins Contracting Co., White Stone, N. Y., has been awarded the contract for the construction of macadam road and cement sidewalks at Fort Totten, N. Y., at $2,186.

North Carolina.

The citizens of Greenville Township, Pitt County, N. C., are agitating the construction of good roads. It is probable that a considerable amount of roads will be constructed throughout the county during the year. Greenville is the county seat.

Ohio.

✣Bids will be received until noon, Feb. 17, by J. W. Chrisford, Director of Public Service, Lakewood, O., for furnishing the necessary labor and material for the construction of sewers in the following named streets: Harlan Ave., from Richmond Ave. to Jackson Ave.; Merl Ave., from Nicholson Ave. to Jackson Ave.; Emerson Ave., from Nicholson Ave. to Jackson Ave.; Jackson Ave., from Clifton Blvd. to N. P. R. R. Plans and specifications on file in said office and at the office of C. W. Root, 1033 Society for Savings Bldg., Cleveland, O. Each bid must separately state the labor and material which shall be furnished with the price thereof and contain the name of every person or company interested in the same, and be accompanied by a certified check in the sum of $200.

✣Bids will be received until noon, Feb. 7, by V. T. Price, Director of Public Service, Cincinnati, O., for the construction of cement sidewalks and appurtenances in Sidewalk Districts Nos. 1, 2, 3 and 4 for the season ending Dec. 31, 1913. A certified check for $1,000 must be filed with each bid. M. J. Keefe is Clerk.

✣Bids will be received until noon, Feb. 17, by J. W. Chrisford, Director of Public Service, Lakewood, O., for furnishing the necessary labor and materials for grading, draining, curbing, paving with paving brick and improving the following named thoroughfares: Wayne Ave., Roycroft Ave., Ethel St., Bonnie View Ave., Edward St., Winton Ave. The foregoing to be done according to plans and specifications on file in said office and at the office of C. W. Root, 1033 Society for Savings Bldg., Cleveland, O. Each bid must separately state the labor and material which shall be furnished, with the price thereof, and contain the name of every person or company interested in the same, and be accompanied by a certified check in the sum of $200.

✣Bids will be received until noon, Feb. 14, at office of W. J. Springborn, Director of Public Service, Cleveland, O., for two asphalt motor trucks for use in Street Repair and Paving Permit Department. W. H. Kirby is Secretary.

✣Bids will be received until noon, Feb. 14, at the office of the Director of Public Service, Cleveland, O., for the furnishing of a road roller for the street department. Specifications may be obtained of W. J. Springborn, Director of Public Service. W. H. Kirby is Secretary.

✣Bids will be received until noon, Feb. 13, by Charles W. Stage, Director of Public Safety, Cleveland, O., for furnishing a one-ton automobile truck for Cooley Farms Infirmary Division, Warrensville, O. Each bid must be in accordance with the specifications, which may be obtained at the office of the Director of Public Safety, Room 109 City Hall. H. F. Stillman is Secretary.

✣Bids will be received until noon, Feb. 12, by W. J. Springborn, Director of Public Service, Cleveland, O., for grading, draining, curbing, paving with paving brick and improving the following thoroughfares: Cannon Ave. S. E., from E. 86th St. to E. 93d St.; Gertrude Ave. S. E., from E. 57th St. to E. 65th St.; Heisley Ave. S. E., from E. 61st St. to E. 65th St.; Kenyon Ave. S. E., from E. 59th St. to about 600 ft. easterly; Lansing Ave. S. E., from E. 57th St. to E. 65th St.; Mack Ave. S. W., from W. 39th St. to W. 37th St.; Marble Ave. S. E., from the E. L. of E. 77th St. to E. 83d St.; Mound Ave. S. E., from E. 53d St. to E. 59th St.; Sackett Ave. S. W., from Fulton Rd. S. W. to W. 44th St.; Westropp Ave N. E., from E. 140th St. to the E. L. of E. 142d St.; Westropp Ave. N. E., from E. 142d St. to E. 152d St.; E. 52d St., from Kirkham Ave. S. E. to Fleet Ave. S. E.; E. 53d St., from Eliza Ave. S. E. to Fleet Ave. S. E.; E. 55th St., from Fleet Ave. S. E. to 211 ft. north of Mound Ave. S. E.; E. 57th St., from Fleet Ave. S. E. to Mound Ave. S. E.; E. 61st St., from Fleet Ave. S. E. to Kenyon Ave. S. E.; E. 66th St., from Lansing Ave. S. E. to Warsaw Ave. S. E.; E. 67th St., from Fleet Ave. S. E. to Baxter Ave. S. E.; E. 91st St., from Harvard Ave. S. E. to Cannon Ave. S. E.; E. 152d St., from Waterloo Rd. N. E. to MacCauley Ave. N. E.; W. 40th Pl., from Denison Ave. S. W. to 474 ft. southerly; W. 41st St., from Denison Ave. S. W. to 321 ft. southerly; W. 42d St., from Denison Ave. S. W. to 563 ft. southerly; W. 43d St., from Denison Ave. S. W. to 760 ft. southerly; W. 50th St., from Storer Ave. S. W. to Denison Ave. S. W.; W. 71st St., from Clark Ave. S. W. to Big Four R. R.· W. 82d St., from Clark Ave. S. W. to Brinsmade Ave. S. W.; W. 84th St., from Clark Ave. S. W. to Brinsmade Ave. S. W.; W. 86th St., from Clark Ave. S. W. to Brinsmade Ave. S. W.; W. 97th St., from Lorain Ave. to Almira Ave. S. W.; W. 103d St., from Madison Ave. N. W. to Lorain Ave.; W. 105th St., from Madison Ave. N. W. to Lorain Ave.; W. 106th St., from Madison Ave. N. W. to Lorain Ave. And for grading, draining, curbing, repaving with brick, creosoted wood block or sheet asphalt, Carnegie Ave. S. E., from E. 55th St. to E. 89th St. Also for grading, draining, curbing, repaving with creosoted wood block, dressed block Medina stone, or granite block, Eagle Ave. S. E., from E. 4th St. to E. 9th St. Each bid must be made in accordance with the plans and specifications which may be seen at the office of the City Engineer, Room 305, City Hall.

✣Bids will be received until noon, Feb. 24, by Village Council, at the office of Frank Reed, Village Clerk, Lockland (Cincinnati), O., for furnishing the necessary labor and material for the improvement of Wyoming Ave., from the east line of Wayne Ave. to the west corporation line of the village of Reading, O., by grading, paving the roadway with vitrified brick on concrete foundation, constructing artificial stone sidewalks and concrete curbs and gutters and the necessary drains, culverts and retaining walls, all in accordance with the plans, profiles and specifications now on file in the office of the Village Clerk of Lockland, Ohio.

✣Bids will be received until noon, Feb. 11, by Samuel A. Kinnear, Director of Public Service, Columbus, O., for the following improvements, in accordance with the plans, profiles, specifications and estimates of cost therefor, on file in said department, and shall be made on blanks to be procured from the chief engineer, to-wit: Deming Ave., from Blake Ave. to Arcadia Ave., by grading, draining, curbing, paving the roadway with brick or asphalt and laying water service pipe; Engler Ave., from Pearl St. to Fourth St., by grading, draining, curbing, paving the roadway with asphalt or brick, and laying water service pipe; Kossuth St., from High St. to Bank St., by grading, draining, curbing and paving the roadway with asphalt or brick; Maynard Ave., from Indianola Ave. to Summit St., by grading, draining, curbing, paving the roadway with asphalt or brick, and laying water service pipe; Medary Ave., from Deming Ave. to Arcadia Ave., by grading, draining, curbing, paving the roadway with asphalt or brick and laying water service pipe; 19th St., from Bryden Ro. to Main St., by grading, draining, curbing, paving the roadway with asphalt or brick and laying water service pipe; Ninth St., from Broad St. to Gay St., by grading, draining, curbing, paving the roadway with asphalt (top and binder to be placed by municipal asphalt plant) and laying water service pipe; Poplar Ave., from Neil Ave. to Michigan Ave., by grading, draining, curbing, paving the roadway with asphalt or brick and laying water service pipe; Summit St., from Hudson St. to Indianola Blvd., by grading, draining, curbing, paving the roadway with asphalt or brick, and laying water service pipes; Walters St., from Fifth Ave. to Leona Ave., by grading, draining, curbing, paving the roadway with brick and laying water service pipes. Each bid shall contain the full name of every person interested in the same, and shall be accompanied by a certified check on a solvent bank of Columbus, O., made payable to the order of Samuel A. Kinnear, Director of Public Service, or bond in the sum of $500.

✣Bids will be received until noon, Feb. 14, by W. G. McKinney, Clerk, New Concord, O., for the furnishing of vitrified paving block to said village, block to be delivered along the line of proposed improvements, and piled neatly in place. Block will be purchased for the surfacing of 16,500 sq. yds. of pavement, more or less. Ten per cent of the number of block must be delivered in place within 30 days after the letting of the contract, balance to be delivered in place as may be required by the Engineer. A certified check for $500 must be filed with each bid.

⊙Service Director W. J. Springborn of Cleveland, O., has awarded contracts for street paving, for which bids were opened Jan. 23, as follows: Roehl Bros., 12 contracts; Baldwin Bros., seven contracts; Reilly Bros., eight contracts; Enterprise Paving and Construction Co., three contracts, and one to the Cleveland Trinidad Paving Co.

⊙The Board of Control of Springfield, O., has awarded the contract for the paving of North St., between Limestone St. and Western Ave., with Elso asphaltic concrete, with Harris blocks in the tracks, to Edward Ryan of that city, at $32,335. McHugh Bros. se-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

cured the contract to pave Jefferson St., from Fountain to Wittenberg, with Athens block, at $3,406. W. F. Payne will pave Fountain Ave., between Columbia and North Sts., at $1,472.

⊙The Andrews Asphalt Paving Co., Hamilton, O., has been awarded the contract by the Department of Public Works of that city, A. J. Bates, Clerk, for the paving and curbing of Sycamore St., at $30,823. Bids were opened Jan. 22.

⊙J. E. House & W. J. Copeland have been awarded the contract for the construction of 1¾ miles of stone road in Goshen Township, Auglaize County, O., at $4,352. Bids were opened Jan. 25 by A. E. Schaffer, County Auditor, Wapakoneta, O.

The City Council of Wooster, O., proposes to pave the following streets this summer: Pittsburg Ave.; Gasche St., in two places; Nold Ave., two places, at each end of the street; West Bowman St.; North Grant St. to Larwill; East Bowman St.; North St., at the extreme west end; West Liberty St. road; South Walnut St.; Spink St. above Bowman; North Buckeye St., above Bowman; Derr Ave., and South Bever St. John Johnson is Director of Public Service.

Residents of the district lying along the old State road, near Akron, O., have petitioned the County Commissioners, Akron, for the building of a brick road, connecting with the proposed bridge north of Howard St. extension.

The City Council of Middletown, O., has decided to expend about $200,000 during the year for street paving. Broadway, Jefferson and East Third Sts. will be improved. H. J. Duane is City Engineer.

Mayor Baker of Cleveland, O., is considering the advisability of advocating a special election on the issuance of $1,000,000 bonds for establishment of playgrounds.

The City Council of East Youngstown, O., has approved ordinances providing for improvements in Fifth, Sixth, Seventh and Eighth Sts., including sidewalks and grading.

Service Director W. J. Springborn of Cleveland, O., has rejected all bids received Jan. 23 for the paving of Madonna Ave., E. 34th St. and Armitage Ave., because they were in excess of the engineer's estimates.

The citizens of Milton Township, Mahoning County, O., voted the issuance of bonds to the amount of $10,000 for the construction of good roads. Youngstown is the county seat.

Oklahoma.

The City Council of Tulsa, Okla., has instructed City Engineer T. C. Hughes to advertise for bids at once for the construction of 12,000 lin. ft. of granitoid sidewalks.

Oregon.

The City Council of Condon, Ore., is considering the installation of hard surface pavement early in the spring. The first contract for pavement will consist of the improvement of six blocks of the main business thoroughfare.

The City Council of Cornelius, Ore., plans hard-surface pavement for the main thoroughfare of the town the coming summer. A test of the various kinds of pavements is now being made.

The City Council of Pendleton, Ore., has been petitioned by a majority of the property owners on West Webb St. for the construction of hard-surface pavement on that thoroughfare, a distance of 20 blocks.

The special sanitary commission of the city of Portland, Ore., has decided to have a survey of the city made to determine where is the proper place to locate a new incinerator plant. Tom M. Hurlburt is City Engineer.

Pennsylvania.

Following bids were received by Assistant Director Reed of the Department of Public Works, Philadelphia, Pa., for repairing and patching asphalt paved streets occupied and unoccupied by railroad tracks, for which purpose the sum of $40,000 is available: Barber Asphalt Paving Co., $1.35 per sq. yd., where foundation is not to be renewed, and $1.97 where new foundation is required; Eastern Paving Co., $1.72 and $2.75, and Union Paving Co., $1.60 and $2.60.

⊙Mayor W. A. Magee and Director Joseph G. Armstrong of Pittsburgh, Pa., have awarded the following contracts for paving work for which bids were opened Jan. 13: Grading, paving and curbing, Decision alley, J. B. Sheets Co., $1,597; Jordan alley, to J. B. Sheets Co., $3,476; Cowley St., Neelan & Daly, $4,931; O'Neil alley, W. J. Payne, Jr., Co., $1,744; Wood block, Mary St., J. B. Sheets Co., $4,216; asphalt and brick, Lilac St., to Booth & Flinn, Ltd., $12,305; asphalt, Lloyd St., Barber Asphalt Paving Co., $954; Antietam St., Barber Asphalt Paving Co., $12,321; Blockstone, B St., Booth & Flinn, Ltd., $2,360; Reynolds St., Booth & Flinn, Ltd., $3,389; Kirkpatrick St., J. B. Sheets Co., $43,864; Brick and stone, Rockland Ave., J. B. Sheets Co., $14,060; repaving block stone, South Eleventh St., South Twelfth St., Sarah and Brandish Sts., Booth & Flinn, Ltd., $8,847; retaining wall, Brownsville Ave., Martin O'Hagan, $5,998.

Form of proposal and specifications for the completion of the Northeast Blvd., for the city of Philadelphia, Pa., are on file at the office of ENGINEERING & CONTRACTING, 608 South Dearborn St., Chicago, Ill. Bids will be opened March 3, as noted in official advertisement elsewhere in this issue. This work includes the following: 402,729 cu. yds. grading; 445,700 sq. yds. bituminous macadam surfacing; 69,000 sq. yds. water-bound macadam surfacing; 59,000 sq. yds. vitrified brick gutters on 4-in. concrete foundation; 68,700 lin. ft. 8-in. steel protected concrete curb; 49,200 sq. yds. cement sidewalks; 431,800 sq. yds. top soil and grass seeding.

South Carolina.

The City Council of Darlington, S. C., contemplates paving the principal streets of town. W. L. Word is official in charge of streets.

Tennessee.

The City Commissioners of Memphis, Tenn., have passed ordinances providing for the paving of East Carolina Ave., from South Second St. to South Main, at an estimated cost of $8,415, and Monroe Ave., from South Second St. to Marshall Ave., resurfacing, at an estimated cost of $20,135.

The Commissioners of Sullivan County, Tenn., have sold bonds in the sum of $200,000 for road work. Blountville is the county seat.

Texas.

✣Bids will be received until noon, Feb. 13, by Board of Commissioners, Galveston, Tex., for furnishing all material and doing all work necessary for paving and other improvements to be constructed along Ave. J, from the east side of 24th St. to the east side of 14th St., as shown on plans and in accordance with specifications therefor prepared by the City Engineer, which will be furnished upon application to his office in the City Hall, Galveston, Tex. The following are the approximate quantities required for proposed work: 27,615 sq. yds. concrete pavement, 8,532 sq. yds. vitrified brick pavement on 4-in. concrete base, 2,228 lin. ft. concrete culverts, 5,100 lin. ft. concrete coping, 1,229 cu. yds. of extra concrete, 1,682 lin. ft. of concrete bulkheads. All proposals must be submitted in duplicate and accompanied by a certified check payable to the order of the City Secretary in the sum of 5 per cent of amount of bid or the same will not be considered. Bond in the sum of 50 per cent of the total contract price will be required for the faithful performance of the work. V. E. Austin, Commissioner of Streets and Public Property; A. T. Dickey, City Engineer; John D. Kelley, City Clerk.

✣Bids will be received until noon, Feb. 10, by Dan C. Smith, Jr., City Secretary, Houston, Texas, for the grading and paving of Washington St., between its intersection with the east line of Fifth St. and its intersection with a line drawn across Washington St. measured a distance of 210 ft. from the west line of Third St., with No. 1 repressed vitrified brick, as prayed for in the petition, and in accordance with the specifications adopted by the City Council. Each bid must be accompanied by a certified check for 10 per cent of the cost, made payable to H. B. Rice, Mayor. Specifications and all necessary information can be obtained upon application at the office of F. L. Dormant, City Engineer.

✣Bids will be received until noon, Feb. 10, by Dan C. Smith, Secretary of the city, Houston, Tex., for the grading and paving of La Branch St., from its intersection with the north line of Bell Ave. to its intersection with the north line of Leeland Ave., with creosoted wood blocks. Each bid must be accompanied by a certified check on any bank in the city of Houston for 10 per cent of the cost of constructing said pavement, said check being made payable to H. B. Rice, Mayor. Specifications and all necessary information can be obtained upon application at the office of F. L. Dormant, City Engineer.

✣Bids will be received until noon, Feb. 10, by Dan C. Smith, Jr., City Secretary, Houston, Tex., for the grading and paving of Burlington St., from its intersection with the south line of Hawthorne Ave. to its intersection with the north line of West Alabama Ave., with bitulithic pavement, in accordance with the specifications adopted by the City Council. Each bid must be accompanied by a certified check on any bank in the city of Houston for 10 per cent of the cost of constructing said pavement, said check being made payable to H. B. Rice, Mayor. Specifications and all necessary information can be obtained upon application at the office of F. L. Dormant, City Engineer.

✣Bids will be received until noon, Feb. 10, by Dan C. Smith, City Secretary, Houston, Tex., for the grading and paving of Hogan and Lorraine Sts., from Montgomery Ave. to Carr St., as prayed for in petition and in accordance with the specifications adopted by the City Council as follows: A 5-in. concrete base covered with a naptha paint coat upon which shall be laid a 2-in. Texaco sheet asphalt wearing surface, with a 5-year maintenance guaranty. Each bid must be accompanied by a certified check on any bank in the city of Houston for 10 per cent of the cost of constructing said pavement, said check being made payable to H. B. Rice, Mayor. Specifications and all necessary information can be obtained upon application at the office of F. L. Dormant, City Engineer.

⊙The Texas Bitulithic Co. has been awarded the contract by the City Council of Houston, Tex., to pave Louisiana St. from Pease to Berry Sts., with bitulithic, at $2.43 per sq. yd. The Eureka Construction Co. secured the contract to pave Harrisburg road with Texaco asphalt from Milby St. to east city limits, and Louisiana St. with the same material from Capitol to Pease Sts., at $1.79 a sq. yd.

The City Council of Houston, Tex., H. B. Rice, Mayor, on Feb. 3 considered a petition requesting the improvement, by paving with Texaco asphalt, of Garrott St., between its intersection with the north line of West Alabama St. and its intersection with the south line of Hawthorne St. Dan C. Smith is City Secretary.

The citizens of Mumford, Tex., at a recent election voted bonds for the improvement of public roads.

Utah.

The City Commission of Provo, Utah, has passed an ordinance creating a curbing and guttering district for Center St., between Fifth West and Fifth East Sts. The cost is estimated at $8,701. A hearing will be held Feb. 17.

Virginia.

✣Bids will be received until noon, Feb. 17, by C. E. Bolling, City Engineer, Richmond, Va., for paving with asphalt blocks Broad St., from 3d to Jefferson Sts., necessitating about 16,000 sq. yds. A certified check for $1,000 payable to the City Treasurer must accompany each bid.

✣Bids will be received until noon, Feb. 18, at the clerk's office, Culpeper, Va., for the construction of 24 miles of macadam roads in Culpeper County, Va. Specifications are on file with the clerk, the resident engineer, Culpeper, Va., and P. St. J. Wilson, State Highway Commissioner, Richmond, Va.

The Administrative Board of Richmond, Va., has instructed City Engineer Chas. E. Bolling to advertise for bids for the paving of Broad St., from Third St. to Jefferson, with asphalt blocks. It is anticipated that the Council will provide $50,000 in the annual budget for continuing the paving of Broad St. westward from Third St.

Washington.

⊙R. M. Overstreet of Seattle, Wash., has been awarded the contract by the Board of Public Works of that city for grading, curbing, etc., 24th Ave. S. et al., at $13,414.

⊙McGuire & Moon of Seattle, Wash., have been awarded the contract by the Board of Public Works of that city for paving, etc., Ione Pl. and Leary Ave., at $25,466.

The City Council of South Bend, Wash., C. H. Mills, City Clerk, is asking bids for the filling of another section of low land, the district being directly back of the business section and covering approximately 10 blocks The total cost will be about $55,000.

The County Commissioners, Wenatchee, Wash., have created a local improvement district for a Chelan County road. The road is 1½ miles long. Warrenite pavement will be laid at a cost of $18,000.

The Park Department of Seattle, Wash., proposes to commence improvement work in the Queen Anne Hill district not later than March 1. The work planned is as follows: Paving between Second Ave. N. and Prospect St., and between Third Ave. N. and McGraw St.; paving between 10th Ave. W. and Halliday St.; grading and construction of retaining walls and viaducts between Seventh Ave. W. and Crockett St. and Seventh Ave. W. and Highland Drive. The estimated cost of this work is $214,000. George F. Cotterill is Mayor.

Commissioner of Public Works Owen Woods of Tacoma, Wash., proposes to install 40 miles of new sidewalks during 1913. City Engineer W. C. Raleigh has been working on some of the plans for new walks and estimates the cost at about $100,000.

The City Council of Pullman, Wash., has instructed City Attorney M. S. Jamar to prepare a resolution providing for the paving of the macadam district. This would include Main, Grand, Alder and a part of Olson Sts. A. E. Shaw is Mayor.

West Virginia.

⊙The Town Council of Edgwood, W. Va., has let the contract for the new street improvement to the Atlantic Bitulithic Co., of Richmond, Va. The streets to be improved with Warrenite are as follows: Edgwood St., from Cherry St. to Edgington Lane; Heiskell Ave., Cherry St., Porter Ave. and Edgington Lane, from the Home of the Good Shepherd to the National Pike. Bonds to the amount of $54,000 were voted for this work.

The Cabell County Commissioners, Huntington, W. Va., are making plans for the proposed road building this year. Approximately $100,000 is available for road work in this county for the year.

Wisconsin.

The City Council of Appleton, Wis., has decided to improve the following streets this year: Drew St., from College Ave. to Pacific St.; Franklin St., from Appleton to Durkee St.; North, from Oneida to Rankin St.; Union, from the railway track to Second Ave. About 7,500 barrels of cement will be used. C. H. Vinal is City Engineer.

The City Council of West Allis, Wis., plans to improve with asphalt the west end of Greenfield Ave., from 66th to 73d Aves., and 73d Ave., from Greenfield to National Aves. C. J. Moritz is City Engineer.

Residents and property owners on West Ave. have petitioned the City Council of Oconomowoc, Wis., for the paving, curbing and guttering of that street.

Canada.

The citizens of Point Grey, B. C., have voted by-laws to the amount of $740,000 for sewerage, $200,000 for roads, $10,000 for sidewalks and $5,000 for parks. D. W. Johnston is City Engineer.

The Wellington County Council, Guelph, Ont., has appointed a committee to investigate and report on the condition of the roads of that county. It is proposed to expend about $500,000 in improving the roads.

The City Council of Fort Williams, Ont., plans to construct about $10,000 worth of gravel road. Jno. Wilson is City Engineer. A. McNaughton is City Clerk.

The citizens of Vancouver, B. C., have voted a by-law to the amount of $165,000 for rocking, planking, etc., of roads and streets; $220,000 for grading roads, streets, etc.; $82,500 for park improvements; $165,000 for the Vancouver exhibition, and $275,000 for opening and clearing Edward VII St. F. L. Fellowes is City Engineer.

BRIDGES

Alabama.

✣Bids will be received until noon, Feb. 25, by Board of Washington County Commissioners, Chatom, Ala., for furnishing and erecting two steel bridges with concrete floors. A certified check is required with each bid. Additional information may be obtained by writing W. S. Keller, State Highway Engineer, Montgomery, Ala.

Articles of incorporation were filed at the Probate Office, Bay Minette, Ala., by the Perdido Bay Bridge & Ferry Co. recently.

Arkansas.

✣Bids will be received until Feb. 12, it is reported, by W. M. Vanhook, Union County Judge, El Dorado, Ark., for the construction of seven steel bridges.

⊙The Vincennes Bridge Co., Vincennes, Ind., instead of the Vinson Steel & Bridge Co., as mentioned in our last issue, has been awarded the contract by the County Court at Sheridan, Ark., for the new steel bridge over the Saline River one mile west of Prattville, on the Pine Bluff-Malvern Road. The contract price was $4,441.

⊙The Commissioners of Newton County, Jasper, Ark., has awarded a contract for the construction of two bridges to the Joliet Bridge & Iron Co., Joliet, Ill., at $29,970. Both structures will be of steel, one located on the Harrison-Jasper Road and the other at the mouth of Big Creek on the Harrison-Mount Judea Road. By the terms of the contract the work is to be finished by Sept. 1.

California.

⊙The Board of Los Angeles County Supervisors, Los Angeles, Cal., has awarded the contract for the construction of two concrete bridges in North Glendale to the Mercereau Bridge & Construction Co., Los Angeles, Cal., at $1,944.

⊙The Board of Stanislaus County Supervisors, Modesto, Cal., has awarded the contracts for the construction of two bridges as follows: T. K. Beard, at $3,331 for the construction of the bridge over Modesto Main Canal on McHenry Road; Ulrich & Howell, at $1,800 for the erection of the beam bridge over lateral No. 5 on the Maze Road.

It has been announced by J. D. Drennan, Supt. of the Western Division of the Southern Pacific, Stockton, Cal., that the company is contemplating the construction of a drawbridge over Alhambra Creek at Martinez, Cal.

Advices from Sacramento, Cal., state that Southern California legislators of both houses have almost unanimously agreed to support the bill offered in the upper house by Senator Wright, San Diego, Cal., and in the Assembly by Moorhouse of Imperial, asking an appropriation of $25,000 as California's share in the construction of a $75,000 interstate bridge over the Colorado River at Yuma, Ariz.

A site is reported to have been selected by the City Trustees, Redding, Cal., for the construction of the proposed Market St. bridge over the Sacramento River. Plans and specifications will be prepared at once and bids for the work will be advertised for. H. C. Woodrum is City Clerk.

The Board of Stanislaus County Supervisors, Modesto, Cal., has instructed the clerk to advertise for bids for the construction of a new bridge over the Tuolumne River below the dam at LaGrande, to replace the one which recently collapsed.

Illinois.

✣Bids will be received up to 9:30 a. m., Feb. 15, at the office of Jesse Gates, Lena, Ill., for the construction of one reinforced concrete bridge to be built between the towns of West Point and Winslow, Stephenson County. A. F. Gassman, Town Clerk, Lena, Ill. Sullivan Bridge—Span, 30 ft.; roadway, 16 ft.; height, 15 ft. Estimated concrete, 88.2 cu. yds.; reinforcing steel, 10,510 pounds. Nearest railroad station, Nora, about 1¾ miles. Low water flow, dry; high water flow, about 9 ft. deep. It is reported that gravel may be had f. o. b. Nora at about $1.30 per cu. yd. Quality not known. Present bridge, 30 ft., steel span on tubes. New bridge to be located at site of present bridge. Excavation to be carried about 4 ft. below stream bed. Piles will probably be necessary. Engineer's estimate, $1,300. Work to be completed on or before July 1, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office, or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

⊙The Cass County Board of Commissioners, Virginia, Ill., has awarded the contract for the construction of a concrete bridge near Bluff Springs, to be known as the Oetgen bridge, to H. H. Wessler, Arenzville, Ill., at $1,750.

⊙Frank R. Miller, Springfield Ill., has been awarded the contract for the construction of a 200-ft. iron bridge over the Sangamon River on the Athens Road in Springfield Township. The contract price was $14,500. Bids for the work were opened by J. L. Hall, Town Clerk, at the Probate Court's office, Springfield, Jan. 25.

The City Council of Rockford, Ill., has appropriated $2,000 for the construction of a concrete bridge over Keith Creek at Seventh St. Edwin Main is City Engineer and E. A. Wettergren is City Clerk.

Indiana.

The City Council of Richmond, Ind., has passed a resolution postponing the selection of the site for the proposed bridge to be known as the South Side bridge in that city. B. A. Bescher is City Clerk.

The Miami County Council, Peru, Ind., has made appropriations for the construction of the following proposed bridges: Bridge No. 1, in Erie Township, $300; Bridge No. 2, in

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Perry Township, $400; Bridge No. 3, in Perry Township, $400; Bridge No. 4, in Clay Township, $400; Bridge No. 5, in Allen Township, $300; Bridge No. 6, in Jefferson Township, $400; Bridge No. 7, in Jefferson Township, $300; Bridge No. 8, in Jefferson Township, $450; Bridge No. 9, in Washington Township, $300; Bridge No. 10, in Butler Township, $400; Bridge No. 11, in Richland Township, $800; Bridge No. 12, in Richland Township, $700; Bridge No. 13, in Richland Township, $350; Bridge No. 14, in Richland Township, $500; Bridge No. 15, in Washington Township, $1,200.

Iowa.

✣Bids will be received until Feb. 11 by Board of Pocahontas County Supervisors, Pocahontas, Ia., for the construction of all bridges in the county during the year of 1913. A certified check for $1,000 must be filed with each bid. Specifications are on file with the County Auditor.

✣Bids will be received until 1:30 p. m., Feb. 11, by George E. Frost, Cerro Gordo County Auditor, Mason City, Ia., for the construction of the following highway bridges: One 40-ft. reinforced concrete deck girder; one 26-ft. reinforced concrete deck girder; two 24-ft. reinforced concrete slab bridges; one 60-ft. riveted steel truss on concrete abutments; one 40-ft. steel truss on concrete abutments; one 47-ft. through plate girder on old abutments. Certified check for 5 per cent to accompany bid. Plans and specifications may be had by application to the Iowa Highway Commission, Ames, Ia. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until noon, Feb. 12, by W. C. McKee, Poweshiek County Auditor, Montezuma, Ia., for the necessary labor and material for the construction of all concrete bridges and concrete culverts required by the county during the year of 1913.

⊙The Marsh Engineering Co., Des Moines, Ia., has been awarded the contract for the construction of a $12,000 concrete bridge over Maple River at Ida Grove, Ia. The plans call for a bridge 212 ft. long with two 80-ft. arches for waterway.

Kansas.

⊙The Board of Osage County Commissioners, Lyndon, Kan., has awarded the contract for the construction of a 110-ft. steel bridge over the creek at Curry Crossing, northwest of Pomona, to the Topeka Bridge & Iron Co., Topeka, Kan., at $5,000.

⊙The Commissioners of Morris County, Council Grove, Kan., have awarded the contract for the construction of a new concrete arch bridge on Main St. over the Neosho River to the Topeka Bridge & Iron Co., Topeka, Kan., at $13,000. The new bridge will be 190 ft. long and will consist of three spans, the middle span will be 70 ft. long and the others 60 ft. each. The bridge will be 40 ft. wide, 30 ft. for roadway, with 5-ft. walks on each side. There will be a 4-ft. concrete wall on either side, with ornamental light post on each wall.

⊙The Board of Riley County Commissioners, Manhattan, Kan., has awarded the contracts for the construction of two bridges as follows: Lundberg & Gustafson, at $800 for the Meisenmeyer bridge; Gustafson & Foresburg, at $1,100 for the Rictor bridge.

The Missouri Valley Bridge & Iron Co., Leavenworth, Kan., is to start work at once on its contract for the construction of the steel bridge over Chevalon Creek between Holbrook and Winslow, Ariz. The structure will cost $4,800.

The State Utilities Commission of Kansas has extended until March 6 the time granted the St. Joseph & Grand Island R. R. in which to commence work on the proposed new viaduct on Main St. in Seneca, Kan. The new structure will be of steel and will be much wider and higher than the old bridge. O. H. Andrews, St. Joseph, Mo., is Superintendent of Bridges and Buildings.

Maine.

The citizens of Bowdoinham, Me., have appointed a committee to interview the people of the county and to present before the State Legislature the matter of rebuilding the Bay bridge. The cost of the work, it is estimated, would be about $80,000. L. M. Fulton, Bowdoinham, Me., is interested in the movement.

Maryland.

Bids for the construction of a highway bridge over Dorsey Creek at the Naval Academy, Annapolis, Md., were received Jan. 25 by the Chief of Bureau of Yards and Docks, Washington, D. C., as follows: (1) Standing for bridge complete excepting concrete balustrade; (2) price for concrete balustrade; (3) amount to be added or deducted from item 1 if the sand blast treatment be omitted and the surfaces called for sand blast treated be tooled with six cuts to the inch, the tooling to be done either by hand or by pneumatic apparatus; (4) amount to be added to or deducted from item 2 if the treatment specified in paragraph 77 of the specifications be omitted and the surfaces called for to be treated be tooled with six cuts to the inch, tooling to be done either by hand or pneumatic apparatus; (5) price per ft. of tile for additional lengths; (6) deduct from item 1 if that portion of the granite above the line BB, drawing No. 2, concrete having the same section be substituted; (7) price for the complete removal of the old bridge on completion of the new. Sanford & Brooks Co., 24 Commerce St., Baltimore, Md., (1) $64,145, (2) $1,540, (3) add $1,360, (4) add $924, (5) $0.45, (7) $500; Baltimore Stone Co., Washington, D. C., (2) $3,250, (4) add $250, (5) $0.60; McLean Construction Co., Fidelity Bldg., Baltimore, Md., (1) $80,603, (2) $3,780, (3) add $1,122, (4) add $699, (6) $1,425, (7) $1,200; W. W. Lindsay & Co., 920 Harrison Bldg., Philadelphia, Pa., (1) $61,000, (2) $1,190, (3) nothing, (4) add $200, (5) $0.25, (6) $2,000, (7) $850.

The Board of Caroline County Commissioners, Denton, Md., has applied to the State Roads Commission for the construction of a new bridge over Choptank River in connection with a road from Willow Pond to Denton.

An ordinance has been introduced into the City Council of Baltimore, Md., authorizing the Pennsylvania Railroad to construct a 4-track concrete bridge over Gwynn's Falls near the Western Cemetery to replace the present double-tracked trestle. H. R. Leonard, Philadelphia, Pa., is Engineer of Bridges and Buildings for the railroad.

Massachusetts.

The Board of Hamden County Commissioners, Springfield, Mass., has granted the Springfield St. Railway Co. authority to construct on the present substructure a new bridge over the Boston & Albany tracks at St. James Ave. E. J. Dickson, Springfield, Mass., is Manager of the street railway company.

Michigan.

⊙The Beach Manufacturing Co., Charlotte, Mich., has been awarded the contract by the Good Roads Commissioners for the construction of bridge over Raisin River at Norvell. The structure will be 52 ft. long, with 16-ft. roadway, and will be completed, according to the terms of the contract, by April 10.

The city of Marshall, Mich., has under consideration the proposition to issue bonds for the construction of a new steel and concrete bridge over the Kalamazoo River at Kalamazoo St. to replace the present iron structure. P. L. Joy is City Engineer.

Minnesota.

The Board of Mower County Commissioners, Austin, Minn., has decided upon the construction of 14 additional steel and concrete single span bridges during the coming season.

The Boards of Hennepin and Wright Counties and the Town Board of Rockford, Minn., have under consideration the construction of a new bridge over the Crow River to replace the present wooden structure. A. P. Erickson, Minneapolis, Minn., is Auditor of Hennepin County.

It has been announced by K. Ousted, Bridge Engineer of Minneapolis, Minn., that crew of the Steel Concrete Engineering Co., Consulting Engineers, New York City, has started work on borings to determine the formations of the river bed relative to the safety of constructing the piers for the proposed Third Ave. S. bridge.

Missouri.

At an election held at Joplin, Mo., recently it was voted to issue $50,000 of bonds to provide funds for paying the city's share of the cost of building the proposed reinforced concrete viaduct on Broadway over the Kansas City bottoms.

Montana.

⊙The Board of Fergus County Commissioners, Lewiston, Mont., has awarded the contract for the erection of 14 bridges to the Security Bridge Co., Minneapolis, Minn., at about $23,000. The location of the bridges, with the cost of each, is as follows: Steel bridge over McDonald Creek, near Grass Range, $3,250; combination bridge over Upper Box Elder Creek, at Point of Rocks, $1,588; combination bridge over Box Elder Creek, at mouth of Fort Creek, $1,868; steel bridge over Box Elder Creek, one-half mile from Section 16, $3,864; combination bridge over McDonald Creek, two miles east of Winnett, $975; combination bridge over McDonald creek, one mile south of Winnett, $1,055; wooden bridge over Elk Creek near its mouth, $902; wooden bridge over Elk Creek, on the township line south of Winnett, $951.15; combination bridge over Flatwillow, near Fisher's ranch, $1,358.50; wooden bridge, 22 miles below Flatwillow, $785.20; combination bridge over Box Elder at Roy, $1,425; combination bridge over Dog Creek at Palmer's ranch, $1,560; combination bridge over Dog Creek at Hunter's ranch, $1,368; combination bridge at Gus Scheibelhut's ranch, $713.

The Board of Cascade County Commissioners, Great Falls, Mont., has instructed the County Surveyor to select a definite location for the proposed Ulm bridge and to make soundings of the river bed.

Nebraska.

✣Bids will be received until noon, Feb. 11, by Board of Cherry County Commissioners at the office of F. A. Cumbow, County Clerk, Valentine, Nebr., for furnishing the necessary labor and material for the construction of all bridges and repairing of all old bridges required by the county during the 12 months following the letting of the contract. A certified check for $1,000 must accompany each bid.

⊙The contract for furnishing all labor and material necessary for the construction of bridges in Sanders County, Nebr., during the year 1913 has been awarded to the Canton Bridge Co., Canton, O. Bids were opened Jan. 15 by J. O. Frahm, County Clerk, Wahoo, Nebr.

New York.

✣Bids will be received until March 1 by Harry K. Eckert, Supt. of the State Reservation, Niagara Falls, N. Y., for constructing relieving walls for present spandrel walls, new parapet railings, new sidewalks, etc., on bridges between the mainland and Goat Island, Niagara Falls, Niagara County, N. Y. Plans, etc., may be obtained of the Superintendent.

The City of Lackawanna, N. Y., has under consideration the matter of building two bridges on South Park Ave. The cost of the work is estimated at about $50,000. R. H. Reed is Mayor. J. J. Monoghan is City Clerk.

The Board of Estimate, New York City, has adopted a resolution requesting Congress to extend the charter of the New York & New Jersey Bridge Co. until 1922. Gustav Lindenthal, New York City, is President of the Bridge Company.

North Carolina.

A bill has been prepared for submission to the State Legislature authorizing the coun-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ties of Forsyth and Davie to construct a joint bridge over the Yadkin River at some point within two miles of Halls Ferry. J. Hamilton Rich, Winston-Salem, the county seat of Forsyth County, N. C., is interested in the movement.

Plans prepared by engineers of the Southern Railroad providing for the construction of a flat slab reinforced concrete bridge over the tracks at East Morehead St. have been submitted to headquarters at Washington, D. C. The cost of the structure is estimated at $12,000. J. S. Lemond, Charlotte, N. C., is Engineer Maintenance of Way of the Southern and Joseph Firth is City Engineer of Charlotte, N. C.

Ohio.

✣Bids will be received until noon, Feb. 17, by J. R. Cowell, Director of Public Service, Toledo, O., for furnishing the necessary labor and material for the construction of the Summer St. bridge over the Lake Shore & Michigan Southern Ry. Plans and specifications can be seen at the office of the Chief Engineer of the Department of Public Service, and the same may be obtained upon terms to be ascertained by applying at the office of said Director of Chief Engineer, room No. 223 or No. 229, the Valentine Bldg., Toledo, O. F. G. Stockton is Secretary Public Works.

⊙The contract for repairing the floor of the iron bridge over the Great Miami River at Elizabethtown, Whitewater Township, Hamilton County, O., has been awarded to William Harrell & Co., Cleves, O., at $9,606. Bids were opened by the County Commissioners at Cincinnati, O., Jan. 17.

⊙The Board of Clark County Commissioners, Springfield, O., has awarded the contract for the superstructure of the bridge over Beaver Creek on the line of the new county road to the Home Engineering & Contracting Co., Canton, O., at $2,287. The substructure was let to Patrick Farley, Springfield, O., at $7.20 per cu. yd. of concrete in place. Bids were opened Jan. 23. J. M. Pierce is County Auditor, Springfield, O.

⊙The Board of Clark County Commissioners, Springfield, O., has awarded the contract for the construction of a bridge over Donnels Creek on Carlisle Pike, Bethel Township, to the Home Engineering & Contracting Co., Canton, O., at $2,190. The substructure was let to George D. Nagel, Christiansburg, O., at $6.74 per cu. yd. for concrete in place. Bids were opened Jan. 23. J. M. Pierce, Springfield, O., is County Auditor.

The City Council of Toledo, O., voted to grant the Lake Shore & Michigan Southern Railroad 60 days extension of the time in which to prepare plans for the separation of grades at Oak St.

The West Cincinnati Improvement Association, Cincinnati, O., has passed resolutions approving Bion Arnold's plans for the construction of a viaduct over Queen City Ave. for rapid transit only.

Oregon.

The United States War Department, through Capt. H. H. Robert, U. S. Engineer, has granted permission for the construction of a bridge over the Siuslaw River near Acme, Ore., and as the Willamette Pacific has also secured permission to extend drawbridges across the Coos and the Umpqua, it is believed that construction work will be started on the structure at once.

Plans are being prepared by W. W. Lucius, Consulting Engineer, Portland, Ore., for the construction of a steel bridge to be erected over the Skookumchuck River. The structure will include two 100-ft. spans with necessary approaches, pier and abutments. Bids for the superstructure will be asked for shortly.

Sherman and Gilliam Counties are planning to construct a joint bridge over John Day River at Cottonwood Canyon. The cost of the structure, according to advices from Moro, Ore., the county seat of Sherman County, will amount to about $5,600.

Pennsylvania.

✣Bids will be received until 5 p. m., Feb. 10, by J. C. Armstrong, Borough Clerk, Etna, Pa., for furnishing the necessary labor and material for the erection of a steel truss bridge with concrete abutments over Pine Creek on Butler St. Further information may be obtained at the office of the Borough.

The State Water Supply Commission, Harrisburg, Pa., has granted permission to the Commissioners of Delaware County Commissioners, Media, Pa., to construct a bridge over Chester River at Chester, Pa.

The Street Committee of the City Council, Newcastle, Pa., has recommended that the city take steps to have Gardner Ave. vacated and that an ordinance be drawn up describing the proposed viaduct over the Pennsylvania tracks and stating just what share of the cost of erection and maintenance is to be borne by the city, the county and the railroad company. Another viaduct at Moravia St. over the Pittsburgh & Lake Erie, the Baltimore & Ohio, the Buffalo Rochester & Pittsburgh and Erie Railroad tracks and the Shenango River is also under consideration. Perry Williams is City Clerk.

The Board of Viewers has recommended to the Lehigh County Court, Allentown, Pa., that a new overhead bridge of the Nelmeyer plan be constructed over the Lehigh River at Bethlehem to replace the old covered structure at that place. The new bridge when completed will abolish the grade crossings of the Lehigh Valley, Philadelphia & Reading, the Central Railroad of New Jersey and the canal of the Lehigh Coal & Navigation Company, and in return the four corporations will contribute $275,000 toward its cost. C. M. Schwab and Warren Wilbur have guaranteed $50,000 more and each county will be asked to give $100,000 each. When the bridge is built the Lehigh and Philadelphia & Reading railroads will build, it is said, a $500,000 station to architecturally conform with it.

A resolution is to be introduced into the city council of Harrisburg, Pa., providing that the County of Dauphin be asked to construct two new bridges over Paxton Creek, one at Cumberland and the other at Walnut St.

South Carolina.

The Board of Supervisors of Orangeburg County at Orangeburg, S. C., will probably take steps shortly toward raising the bridge spanning Edisto River in that county.

South Dakota.

✣Bids will be received until 2 p. m., Feb. 11, by H. R. Wood, Spink County Auditor, Redfield, S. Dak., for furnishing all labor and material necessary for the construction of steel, concrete and pile bridges and for doing bridge repair work in the county during the ensuing year. Each bid must be accompanied by a certified check for $1,000.

Texas.

✣Bids will be received until 10 a. m., March 11, by Clerk of Tom Green County, San Angelo, Texas, for the construction of a concrete bridge across the North Concho River on Chadbourne street in said city of San Angelo, in accordance with the drawings and specifications prepared by B. F. & C. M. Davis, engineers of Fort Worth, Tex., now on file in said office of said clerk. Each bid must be accompanied by a certified check on a San Angelo bank, made payable to Oscar Frink, County Judge Tom Green County, Tex., in the amount of $2,500.

Advices from Henrietta, Texas, state that an engineer has taken soundings of the river bed at the site of the proposed bridge over the Red River at Charlie. As proposed, the structure will be 2,300 ft. long and will be erected in connection with the Meridian road.

Virginia.

✣Bids will be received until noon, April 15, by the Administrative Board, Thomas Whittet, Jr., Chairman, Richmond, Va., for the erection of reinforced concrete bridge and viaduct approaches on the site of the present Free Bridge over James River from 9th to Byrd Sts. to 7th and Semmes Sts. Competitive plans, specifications and estimates of the cost will be received and a premium of $1,500 is offered for the best or accepted design. Further information may be obtained of C. E. Bolling, City Engineer.

✣Bids will be received until noon, Feb. 11, by Board of Brunswick County Supervisors, Lawrenceville, Va., for the construction of an 80-ft. steel bridge with a 12-ft. roadway over Waqua Creek, 2 miles from Rawlings, on the Sea Board Air Line Ry., in Brunswick County. The substructure will be old masonry encased in concrete and the work will include tearing down the present bridge. Stone can be secured at the site. Plans and specifications can be seen at the office of the Clerk of Circuit Court, Lawrenceville, Va., or at the office of P. St. J. Wilson, State Highway Commissioner, Richmond, Va. Blue prints can be secured of Childrey-Sunday Co., Richmond, Va., at a cost of 20 cts.

Washington.

The Board of Clallam County Commissioners, Port Angeles, Wash., received the following bids for the construction of the proposed bridge at Elwha: The bids on the bridge were as follows: H. B. Ackert, wood, $20,000; steel, $21,800; Midland Bridge Co., steel, three types, $19,686, $23,480, $23,420; Fisher Engineering Co., steel, $26,986: Portland Bridge Co., steel, $26,861; Puget Sound Bridge Co., steel, three types, $27,700, $26,700 and $24,000; International Construction Co., wood, $13,179, steel $19,678. All bids were rejected on account of a defect in the call for bids.

The City Council of Seattle, Wash., has decided to submit to the voters at the election held March 4, the proposition of issuing bonds in the sum of $1,600,000 for the construction of bridges over the Lake Washington Canal. A. H. Dimock is City Engineer.

West Virginia.

At a conference of the Harrison county court, Clarksburg, W. Va., with the officials of the Monongahela Valley Traction Co. and the Baltimore & Ohio R. R. Co., it was determined that the cost of the proposed bridge at Lumberport would amount to about $32,000. The B. & O. offers to pay $8,500 of the amount, and the traction company agrees to pay one-third of the cost and one-third cost of maintenance. The court will render decision in a few days.

It is rumored that the Baltimore & Ohio R. R. has plans well under way and is planning to close a contract shortly for the construction of a steel railway bridge over the Ohio River at Huntington, W. Va., in connection with the new Huntington & Northern Ry. J. E. Greiner, Baltimore, Md., is Consulting Bridge Engineer of the B. & O. Ry.

Wisconsin.

⊙The Board of Public Works, Tomah, Wis., has awarded the contract for the construction of a reinforced concrete bridge over the Lemoneir River at the north end of Superior Ave. to Michael Lynch, New Richmond, Wis., at $1,835.

⊙Bids were opened Jan. 29 by the City of Oshkosh, Wis., for the construction of the West Algoma St. bridge, for which the Scherzer Rolling Lift Bridge Co. are the engineers. The contract for the superstructure was awarded to the Joliet Bridge & Iron Co. at $86,440, and the contract for the substructure was let to the Fitzsimmons & Connell Dredge & Dock Co., at $93,523. The bids received on the substructure were as follows, (1) bid on new substructure, (2) bid on temporary bridge, (3) total: Fitzsimmons & Connell Dredge & Dock Co., Chicago, Ill., (1) $78,285, (2) $15,237, (3) $93,523; Creiling Brothers, Green Bay, Wis., (1) $76,360, (2) $18,000, (3) $94,360; Adolph Green, Green Bay, Wis., (1) $84,200, (2) $11,000, (3) $95,200; Milwaukee Bridge Company, Milwaukee, Wis., (1) $90,000, (2) $20,000, (3) $110,000; John T. Walbridge, Chicago, Ill., (1) $100,000, (2) $15,000, (3) $115,000; Walsh & Masterson, Chicago, Ill., (1) $105,000, (2) $12,000, (3) $117,000. The bids received on the superstructure were as follows: Joliet Bridge & Iron Co., Joliet, Ill., $86,440; Modern Steel Structural Co., Waukesha, Wis., $90,000; Wisconsin Bridge & Iron Co., Milwaukee, Wis., $90,700; Detroit Bridge & Steel Works, River Rouge, Mich., $90,700; Milwaukee Bridge Co., Milwaukee, Wis., $92,000; Toledo Bridge & Crane Co., Toledo, O., $92,500; Penn Bridge Company, Beaver Falls, Pa., $93,000; Central States Bridge Company, Indianapolis, Ind., $93,378; Strobel Steel Construction Co., Chicago, Ill., $99,700; King Bridge Company, Cleveland, O., $99,998.

A resolution is before the joint committee on laws, legislation and rules and highways, bridges and railroads of the Milwaukee County Board, asking that a bridge be built to replace the one now spanning the Root River on the Loomis Road in the town of Franklin. H. J. Kuelling, County Highway Commissioner, Milwaukee, Wis., estimates the cost of the work at about $3,000.

Canada.

✣Bids will be received until Feb. 17 by the City of St. Boniface, Man., for the construction of the concrete substructure consisting of 8 piers, for the proposed 7-span 930-ft. half through truss bridge. As proposed the structure will have a roadway 46 ft. and 86 ft. wide and will be paved with creosoted block. The cost of the substructure is estimated at $200,000. M. P. Blair is City Engineer and Col. H. N. Ruttar is Consulting Engineer.

The Associated Boards of Trade of Temiskaming, according to advices from Cobalt, Ont., have petitioned Frank Cochrane, Federal Minister of Railways and Canals, asking aid of the government in the construction of a bridge over the Quinze River at North Temiskaming, in the northern part of Quebec. The cost of the structure will amount to about $60,000.

DRAINAGE AND IRRIGATION

Arkansas.

⊙R. V. Jones, Finance Bldg., Kansas City, Mo., has been awarded the contract at $38,075 for pumping station for the Fourche Drainage District. Bids were opened Jan. 16 by W. M. Kavanaugh, Little Rock, Ark., President of the District. Contract covering sluice gates was let to the Coffin Valve Co., Neponset, Mass. Lund & Hill, Little Rock, Ark., are the Engineers.

⊙Bids were opened Jan. 22 by the directors of the Central Clay Drainage District, J. T. Campbell, Secretary, Piggott, Ark., for 6,160,000 cu. yds. of ditch excavation and 480,000 cu. yds. of levee embankment. Contracts were let as follows: Contract 1, Clay County Dredge Co., Corning, Ark.; Contract 2, 4, 5 and 6, J. S. & Otto Kochtitzky, Cape Girardeau, Mo.; Contract 3, Sternberg & Son, Kansas City, Mo.; Contract 7, Northern Construction Co., Elkhart, Ind. J. R. Rhyne, Corning, Ark., is the Engineer.

Colorado.

The Dolores Reservoir Co. has filed plans with the State Engineer at Denver for the irrigation of 75,000 to 100,000 acres of land in the southern part of the state. The reservoir will consist of the Natural Valley of the Dolores River. The dam will be 230 ft. high. H. F. Morgan, Cortez, Colo., is President; E. H. Burdick, Durango, Colo., is Secretary, and W. M. Strong is Engineer.

Advices from Cripple Creek, Colo., state that $100,000 has been subscribed for a new deep drainage tunnel to be constructed 500 ft. below the Roosevelt tunnel in the Cripple Creek District. A. F. Carlton, Cripple Creek, Colo., is promoting the project.

The H. L. Doherty Co., 60 Wall St., New York City, has acquired the stock of the Redlands Irrigation Co. and 2,500 acres of land near Redlands. About $50,000 worth of new work will be done.

Florida.

✣Bids will be received until Feb. 10 (postponement of date) by the Board of County Commissioners, Starke, Fla., for the construction of canal and ditch work, including approximately 200,000 cu. yds. of excavation. C. A. Roberts is Chairman and W. T. Weeks is Clerk.

Illinois.

⊙Tripp & Devault, Greenview, Ill., have been awarded the contract at $26,378 for excavating one main ditch and two laterals, involving the handling of about 220,000 cu. yds., for the Crow Creek Drainage District, G. W. Smith, Secretary, Lacon, Ill. The ditches can be excavated with a dredge. Bids were opened Jan. 25. No bids were received on the tile work. The latter called for 2,500 ft. 14-in. tile, 4,100 ft. 10-in. tile and 1,200 ft. 8-in. tile.

Indiana.

✣Bids will be received until 2 p. m., Feb. 7, by Samuel Carr, Superintendent of Construction, Medora, Ind., for the construction of Richards and Ball ditches in Jackson County.

⊙Leonard F. Frye, Royal Center, Ind., has been awarded the contract at $3,620 for constructing a tile drain in Brown Township, Cass County. Bids were opened Jan. 25 by A. B. Ireland, Drain Commissioner, Logansport, Ind.

⊙Alex Spencer, Wolcott, Ind., has been awarded the contract at $1,931 for constructing the Harvey Schuyler ditch in West Point Township. The work is located five miles south of Wolcott, and calls for 9,600 ft. of 8-in. to 16-in. tile. Bids were opened Jan. 25 by Paul Ward, Drainage Commissioner, Monticello, Ind.

Iowa.

✣Bids will be received until Feb. 25 by E. E. Hosmer, County Auditor, Sioux City, Ia., for the construction of the Little Sioux Drainage ditch, including approximately 482,700 cu. yds. of excavation. C. M. Tinley, American Bldg., Sioux City, Ia., is Engineer.

✣Bids will be received until 2 p. m., Feb. 11, by Board of Kossuth County Supervisors, Algona, Ia., for the construction of four drainage districts, known as Drains Nos. 71, 72, 75 and 76, and the cleaning of Lateral 11 of Drain No. 4. Drain No. 71 to consist of 1,500 ft. of open ditch, 3 ft. base, average depth 3.50 ft., estimated yardage 1,272 cu. yds., and 16,725 ft. of tile ranging in size from 6 to 20 ins. Drain No. 72 to consist of 100 ft. of open ditch, 8 ft. on bottom and 6 ft. on top, average depth 2.35 ft., estimated yardage 61 cu. yds., and 70,140 ft. of tile ranging in size from 6 to 30 ins. Drain No. 75 to consist of 50 ft. of open ditch, estimated yardage 25 cu. yds., and 48,028 ft. of tile, ranging in size from 6 to 24 ins. Drain No. 76 to consist of 17,065 ft. of tile, ranging in size from 6 to 16 ins. Cleaning of Lateral 11 of Drain No. 4 to consist of excavating approximately 14,000 cu. yds. Ten per cent check to accompany bids. B. E. Norton is County Auditor.

✣Bids will be received until 1 p. m., Feb. 5, by A. J. Peterson, Hamilton County Auditor, Webster City, Ia., for the construction of the Frayne tile drain No. 3 including 2,000 ft. 28-in. tile; 2,000 ft. 24-in. tile; 4,900 ft. tile. The average cut is 3 ft. Bids will be taken on first class salt glazed vitrified clay tile only.

⊙Jens N. Kjar, Humboldt, Ia., has been awarded the contract at $5,687 for constructing Drain No. 52 of Humboldt County, bids for which were opened Jan. 29 by J. G. Devine, County Auditor, Dakota City, Ia. The lengths, sizes and depths of the drain are as follows: 13,001 ft. of 24-in. tile at 7 ft. 2 ins.; 2,900 ft. of 18-in. at 6 ft. 2 ins.; 1,500 ft. of 16-in. at 6 ft. 9 ins.; 1,100 ft. of 15-in. at 6 ft. 3 ins.; 1,400 ft. of 14-in. at 6 ft. 3 ins.; 800 ft. of 12-in. at 5 ft. 9 ins.; 2,800 ft. of 10-in. at 5 ft. 8 ins.; 1,035 ft. of 8-in. at 4 ft. 5 ins.; 450 ft. of 6-in. at 5 ft.; cleaning out 3,200 ft. of caostan ditch for outlet including 1,970 cu. yds. J. L. Parsons, Humboldt, Ia., is Engineer.

⊙Wm. S. Johnston, Fort Dodge, Ia., has been awarded the contract at 6 cts. per cu. yd. for the construction of joint drain for Humboldt and Webster Counties. The work includes the following: Sec. 1, Max. cut 12.70 ft., av. cut 9.80 ft., 104,229 cu. yds., base width 10 ft. Sec. 2, Max. cut 12.50 ft., av. cut 12 ft., 1,170 cu. yds., base width 10 ft Sec. 3, Max. cut 13.40 ft., av. cut 11.70 ft., 94,519 cu. yds., base width 8 ft. Sec. 3, Max cut 15.20 ft., av. cut 11 ft., 140,072 cu. yds., base width 6 ft. Side slopes 1 to 1. Berm 8 ft. Bids were opened Jan. 29 by J. G Devine, County Auditor. J. L. Parsons, Humboldt, Ia., is the Engineer.

⊙Ben S. Edge, Dakota City, Ia., has been awarded the contract at $9,284 for constructing Drain No. 47 of Humboldt County, bids for which were opened Jan. 29 by J. G. Devine, County Auditor, Dakota City, Ia. The work includes the following: 3,950 ft. 22-in. at 8 ft. 2 ins.; 1,400 ft. of 18-in. at 9 ft. 3 ins.; 2,450 ft. of 16-in. at 7 ft. 1 in.; 1,600 ft. 14-in. at 6 ft. 2 ins.; 4,000 ft. 12-in at 6 ft. 4 ins.; 1,250 ft. of 10-in. at 5 ft. 2 ins.; 4,950 ft. of 8-in. at 5 ft.; 100 ft. of 6-in at 4 ft. 3 ins. J. L. Parsons, Humboldt, Ia., is Engineer.

Louisiana.

The Police Jury at New Roads, La., has reorganized the Slidell Drainage District and an acreage tax of 15 cts. will be levied. The district comprises 14,000 acres. Y. W. Green, Oscar Long and John M. Wilson are commissioners. The first meeting of the commissioners will be held at Lottie on Feb. 10.

A convention is to be held at Monroe, La., on Feb. 19 under the auspices of the Monroe Chamber of Commerce to discuss draining the Lafourche Basin. This undertaking would reclaim a large area, approximately 300,000 acres, of rich, fertile agricultural lands now practically worthless by reason of the overflow of water.

Mexico.

✣Bids will be received until 1 p. m., April 1, by Compania Constructora Richardson, S. A., Esperanza, Sonora, Mexico, for the construction of about 2½ miles of canal with sluicing channel from the Yaqui River near Esperanza involving the excavation of 670,000 cu. meters of earth and 215,000 cu. meters of rock, and the placing of about 6,500 cu. meters of concrete channel lining. Further information may be obtained of L. H. Taylor, Chief Engineer, at the above address.

Minnesota.

✣Bids will be received until 10 a. m., Feb. 15, by S. G. Iverson, State Auditor, St. Paul, Minn., for the work of completing State Ditch No. 84 in Kittson County. The work will include 80,273.3 cu. yds. of floating dredge work, 9,381 cu. yds. scraper work, 17.3 miles of road leveling and the installation and furnishing of all corrugated culverts. Further information may be obtained of George A. Ralph, State Drainage Engineer, Old Capital Bldg., St. Paul, Minn.

Mississippi.

✣Bids will be received until 2 p. m., Feb. 18, by Commissioners of Drainage District No. 2, Tunica, Quitman and Panola Counties, Miss., Crenshaw, Miss., for the construction of ditches including 61,014 cu. yds. in accordance with specifications prepared by the Morgan Engineering Co., Goodwyn Institute Bldg., Memphis, Tenn. The District is located near Crenshaw, Miss., on the Yazoo & Mississippi Valley Railroad, about 48 miles south of Memphis. The specifications, form of contract and other data can be seen either at the office of the Board of Commissioners, or of the Morgan Engineering Company. Blueprints of the plat and profiles will be mailed, upon receipt of 50 cents, in 2-cent stamps or cash, by the Morgan Engineering Company.

The Chancery Court at Marks, Miss., has issued a decree creating the Yazoo-Coldwater Drainage District. The plan calls for a diversion of the Coldwater River into Horn Lake and the main canal will be about 15 miles in length. This district will involve more than 350,000 acres of lands which lie in parts of Tunica, De Soto, Panola, Tate, Quitman and Coahoma Counties. The commissioners appointed to carry out this work are as follows: Leo Lesser of Tunica, H. W. Crenshaw of Crenshaw and W. A. Cox of Marks. The drainage project will cost about $2,500,000. The Morgan Engineering Co., Memphis, Tenn., is the Engineer.

New York.

✣Bids will be received until noon, Feb. 18, by Duncan W. Peck, Superintendent of Public Works, Albany, N. Y., for Terminal Contract No. 23, for dredging a channel and constructing a dockwall on Lake Champlain at Plattsburg. Plans may be seen and detailed specifications, engineer's estimate of quantities, proposal blanks, form of contract and bonds required and other information for proposers may be had at the office of the Superintendent of Public Works at Albany, N. Y., at the office of the Assistant Superintendent of Public Works for the Middle Division at Syracuse, N. Y., at the office of the Assistant Superintendent of Public Works for the Western Division at Rochester, N. Y., and at the canal office, Spaulding's Exchange, Buffalo, N. Y.

Ohio.

✣Bids will be received until March 8 by Board of Darke County Commissioners, Greenville, O., for the construction of the Whitewater ditch, which, it is estimated, will necessitate an expenditure of $10,000. J. L. Morgan is County Auditor.

South Dakota.

✣Bids will be received until 2 p. m., Feb. 5, by Theodore Anker, Clay County Auditor, Vermilion, S. Dak., for the construction of Clay Creek ditch lateral 4.

Washington.

✣Bids will be received until 2 p. m., Feb. 21, by U. S. Reclamation Service, North Yakima, Wash., for furnishing electrical apparatus for power plant for storage unit, Yakima Project, Washington.

✣Bids will be received until 2 p. m., Feb. 15, by U. S. Reclamation Service, North Yakima, Wash., for furnishing hydraulic apparatus for power plant for storage unit, Yakima Project, Washington.

Wisconsin.

Preliminary steps have been taken for the organization of the Rat River Drainage District, covering land in Clayton, Winchester and Wolfe River Townships in Winnebago County, and Dale and Greenville Townships in Outagamie County. Preliminary plans and estimates have been made by Prof. E. R Jones, Madison, Wis.; Hume & Oelerich, Neenah, Wis., are the attorneys for the petitioners. The estimated cost of the drainage system is $90,000, and it will require about 1,350,000 cu. yds. of excavation.

WATER WORKS

California.

⊙Philip Schuyler of Oakland, Cal., has been awarded the contract for the installation of additional 10-in. water main and by-pass at Fort Winfield Scott, Cal., for $3,049.

⊙The Municipal Industrial Equipment Co., Los Angeles, Calif., has been awarded the contract by Board of Trustees, Tehachapi, Kern County, Calif., for the construction of a municipal water works system, at $13,797. F. A. Lathrop, 901 Higgins Bldg., Los Angeles, is Engineer. A. S. Waterman is Town Clerk. Bids were opened Jan. 20. Contract let Jan. 27.

The residents of Riverside, Cal., have voted to issue $1,160,000 for the acquisition and extension of a municipal water supply system. The proceeds of the bond issue will be used to purchase and extend the plant of the Riverside Water Co. Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., are Engineers.

Colorado.

✣Bids will be received until 5 p. m., Feb. 21, by City Clerk, Greeley, Colo., for the furnishing of materials for and the construction of Distribution Reservoir No. 2 of the water works of the city of Greeley, Colo. The proposed work consists of about 1,560 cu. yds. of concrete for lining, walls, etc., of a reservoir 232 by 256 by 14 ft. deep. Plans, specifications, form of contract and proposal blanks may be obtained at the office of the City Clerk or of the City Engineer, O. F. Shattuck, Greeley, Colo. Official advertisement will be found elsewhere in this issue.

The City of Fountain, Colo., did not let the contract for the construction of a water works system in accordance with plans and specifications on file with A. W. Payne, Jr., Engineer, Century, Bldg., Denver, Colo., for which bids were to have been opened on Jan. 27. Specifications will be held until bids are asked by the Town Board.

Georgia.

The City Council of Valdosta, Ga., has taken steps toward the expenditure of $103,000 for public improvement, including improvements to the water works system, sanitary sewers and street paving.

Hawaii.

Following bids were received Jan. 25 by the Chief of the Bureau of Yards and Dock, Navy Department, Washington, D. C., for furnishing steel fuel oil storage tanks at the naval station, Pearl Harbor, H. T.: W. N. Concanon Co., Monadnock Bldg., San Francisco, Cal., $61,785; Riter-Conley Mfg. Co., 55 Water St., Pittsburgh, Pa., $60,900; Chicago Bridge & Iron Works, Chicago, Ill., $73,000; Petroleum Iron Works Co., Sharon, Pa., $63,717; Treadwell Construction Co., Midland, Pa., $60,000, and the Reeves Bros. Co., Alliance, O., $67,920.

Idaho.

It is reported that T. D. McDonough of Hazelton, Ida., will purchase 20,000 ft. of 6, 8 and 12-in. pipe for the construction of the local water system.

✣Bids will be received until 11 a. m., Feb. 10, by the Board of Local Improvements, Chicago, Ill., Edward J. Glackin, Secretary, for furnishnig and delivering labor, materials, etc., necessary to construct cast iron water supply pipes in the following streets: La Salle St., W. 108th St. to 300 ft. south of W. 107th St., 300 lin. ft. 8 in., estimated cost, $420; N. 42d Av., Fullerton Av. 1st alley south of Wrightwood Av., 1,140 lin. ft. 8 in., 3 2½ double nozzle fire hydrants, 1 8 in. gate valve, 1 buck valve basin, estimated cost, $1,833; N. 44th Av., Roscoe St. to Belmont Av., 1,320 lin. ft. 8 in., 4 2½ fire hydrants, 1 8 in. gate valve, brick valve basin, estimated cost $2,144; Leland Av., N. 44th St. to Elston Av., 645 lin. ft. 8 in., 1 fire hydrant, 1 8 in. gate valve and valve basin, estimated cost $1,020; W. 63d St., S. Western Ave. to S. Leavitt St., 1,000 lin. ft. 8 in., 1 8 in. valve and valve basin, estimated cost $1,437; Fulton Ave., Alton Ave. to Bellevue Ave, Bellevue Ave., Fulton Ave. to Hamilton Ave., 866 lin. ft. 6 in., 3 fire hydrants, 1 valve and valve basin, estimated cost $1,311; S. Sangamon St., W. 96th St. to W. 99th St., W. 99th St., S. Sangamon St. to S. Morgan St., 2,176 lin. ft. 8 in., 7 fire hydrants, estimated cost $3,578; W. 63d St., S. Hamlin Ave. to S. 45th Ave., S. 44th Ave., W. 59th St. to W. 63d St., S. 44th Ave., W. 59th St. to W. 63d St. to S. Hamlin Ave. to S. 45th Ave., S. Hamlin Ave., alley north of W. 62d Pl. to 63d St., S. 44th Ave., W. 59th St. to W. 63d St., S. 45th Ave., S. 44th Pl. and S. 45th Pl., W. 59th St. to W. 63d St., 5,010 lin. ft. 12 in., 11,028 lin. ft. 8 in., 46 fire hydrants, 8 gate valves and 8 valve basins, estimated cost $29,011; weights of pipes specified: 8 in., 4.75 lbs.; 12 in., 82.1 lbs.; 6 in., 33.3 lbs. Cash or certified check for 10 per cent of bid must accompany proposal.

Illinois.

The citizens of Ashton, Ill., on Jan. 30, it is reported, voted in favor of the installation of a complete water works system.

Indiana.

The Cambridge Water Co., Cambridge City, Ind., has been incorporated with a capital stock of $5,000. The directors are John W. Judkins, Milton H. Gaar and Walter Waddell.

Iowa.

✣Bids will be received until 9 a. m., March 10, by Board of Trustees of the Muscatine City Water Works, Muscatine, Ia., for furnishing all of the materials, labor, tools and equipment, and for doing all of the work required in the construction of the distributing reservoir on the water works property between Cook St. and Kindler Ave. and north of Lucas St. Each bid shall be enclosed in a sealed envelope, addressed to T. R. Fitzgerald, Secretary Board of Trustees, Muscatine, Ia., and shall be accompanied by a certified check, made payable to W. L. Roach, President, in the amount of $1,000. Official advertisement will be found elsewhere in this issue.

The town of Essex, Ia., plans to make improvements of the water works system by extending the mains.

Kansas.

Commissioner of Utilities J. F. Smith of Hutchinson, Kan., has recommended to the City Commission the installation of about 70 more fire hydrants.

Maryland.

✣Bids will be received until 11 a. m., Feb. 12, by Board of Awards, at the office of the City Register, Baltimore, Md., for furnishing 10 sluice gates and appurtenances at Loch Raven, in accordance with plans on file with the Water Engineer. A certified check of the bidder on a Clearing House Bank, made payable to the order of the Mayor and City Council of Baltimore in the sum of $500 will be required with each bid. Aoproximate quantities: Four 42-in. x 72-in. sluice gates with appurtenances; two 48-in. dia. sluice gates with appurtenances; four 24-in. dia. sluice gates with appurtenances. Additional items that may be required: 260 lin. ft. additional 3½-in. gate stems with couplings; 172 lin. ft. additional 2¼-in. gate stems; 24 additional guides for 3½-in. stems; 8 additional guides for 2¼-in. stems. Ezra B. Whitman, Water Engineer.

The Town Council of Williamsport, Md., William Stake, Burgess, has retained Consulting Engineer Alfred M. Quick of Baltimore, Md., to prepare plans for the installation of a water works system.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Massachusetts.

⊙The Eastern Bridge & Construction Co. of Worcester, Mass., has been awarded the contract for the furnishing of material and labor for work at Breed's Pond Dam and the structural work for hoist beams at the new gate house, near Lynn, Mass.

The City Council of Pittsfield, Mass., has sold bonds to the amount of $100,000 to Merrill, Oldham & Co. of Boston. The bonds were issued for improvements to the water works system.

Minnesota.

The City Water and Light Commission of Fergus Falls, Minn., has nistructed the Engineer to make a survey of three routes for the proposed extension of the city water main to the new power station that is to be erected at Hoot Lake.

Mississippi.

The City Council of Jackson, Miss., is considering the question of securing a new source of water supply. Consulting Engineer W. G. Kirkpatrick of Birmingham, Ala., recently advised against the removal of the plant, owing to the increased danger of contamination. The Commissioners believe that a pure supply of artesian water can be secured by using the segregated pump system employed in Memphis.

According to advices from Vicksburg, Miss., Federal Judge H. C. Niles has enjoined that city from building its independent water plant until the franchise of the private company now operating expires in 1916.

Missouri.

Chester & Fleming, Consulting Engineers, Pittsburgh, Pa., are preparing plans and specifications for new pumping machinery for the water works system of Jefferson City, Mo. Bids will be received on same at the Pittsburgh office of the engineers, 1111 Union Bank Bldg., at an early date.

Montana.

The citizens of Billings, Mont., have been asked to vote March 25 on the proposition to issue bonds in the sum of $575,000 for a city water works system.

Nebraska.

The village of Silver Creek, Nebr. (population 379) proposes the installation of a water works system. A committee composed of F. E. Layton and A. A. Sanders recently visited Winner, S. Dak., to inspect the plant in operation in that city.

Nevada.

The City Council of Reno, Nev., contemplates asking the Reno Power, Light & Water Co. to make a number of improvements to the water works system of that city. City Engineer J. R. Meskimons recommends the construction of a power plant at an estimated cost of $15,000 and the replacing of the Highland ditch with a conduit, a distance of 14 miles.

New Jersey.

✣Bids will be received until 2:30 p. m., Feb. 13, by Board of Commissioners, Atlantic City, N. J., for constructing a 24-in. and 20-in. cast iron main on Arctic Ave. from Missouri Ave. to Maine Ave., with lateral mains on intersecting streets, in accordance with specifications on file in the office of the Water Department. Harry Bacharach, Commissioner.

✣Bids will be received until 8 p. m., Feb. 15, by Borough Council, Belmar, N. J., for furnishing all material and doing all work necessary for (a) about 4 miles of vitrified pipe sewers from 8 to 18 inches in diameter, together with manholes and necessary appurtenances; (b) about 4½ miles of cast iron water pipe, from 4 to 10 inches in size, together with all the necessary valves, hydrants, specials, etc., for same. Plans may be seen and specifications and forms of proposal obtained at the office of the Borough Clerk, Belmar, N. J., or at the office of Clyde Potts, Engineer, 30 Church St., New York City. Each bid must be accompanied by a certified check on a solvent bank for $1,000. Chas. O. Hudnut is Borough Clerk, Belmar, N. J.

New York.

✣Bids will be received until 11 a. m., Feb. 18, by the Board of Water Supply, J. P. Morrissey, Secy., 165 Broadway, New York City, for Contract 84, for furnishing and delivering bronze shaft caps and appurtenances for City Tunnel of Catskill aqueduct in New York City.

✣Bids will be received until noon, Feb. 17, by the Board of Water Commissioners, Jamestown, N. Y., for the construction of a 6,000,000-gal. pumping engine, reciprocating or turbine, in accordance with specifications on file at the office of the Board.

✣Bids will be received until 11 a. m., Feb. 13, Board of Water Supply, 165 Broadway, New York City, for the removal of chestnut growth around the site of the Kensico reservoir in the towns of Mt. Pleasant, North Castle and Harrison, Westchester County, N. Y. J. P. Morrissey is Secretary.

✣Bids will be received until 11 a. m., Feb. 18, by Board of Water Supply, 165 Broadway, New York City, for Contract 84, for furnishing and delivering bronze shaft caps and appurtenances for city tunnel of Catskill aqueduct. J. P. Morrissey is Secretary.

The Town Board of Marion, N. Y., will appoint a Board of Water Commissioners in February to have charge of the proposed new water works system. The plans as prepared by Engineer Kittredge of Rochester, N. Y., provide for piping the water from a spring on the Luce farm, one mile southeast of Marion. A concrete reservoir is planned for Prospect Hill.

The city of Glens Falls, N. Y., proposes to make improvements to the water works system, to cost between $150,000 and $175,000. The proposed improvements provide for a duplicate main from the Upper Junction to the center of the city; a new dam at the Wilkie reservoir; repairs to the Keenan dam; cleaning the Wilkie and Keenan reservoirs.

The members of the Onondaga Golf and Country Club propose to obtain a supply of water from the municipal water works system of Fayetteville, N. Y., at an estimated cost of $4,000.

The Town Board of Sodus, N. Y., will consider a petition on Feb. 1 for the construction of the water works system. The estimated cost of the system under the new plans will be $38,000. The plans call for 7,280 ft. of 6-in. cast iron pipe in the place of the 4-in. pipe of the original plans. It also provides for the installation of a duplex pumping unit, employing a gasoline engine and motor equipment.

North Carolina.

✣Bids will be received until 3 p. m., Feb. 25, by Board of Commissioners, Clayton, N. C., for building a water works and electric light plant and a system of sewerage. The water works will embrace fireproof building, power pumps, clear water basin, and about 4 miles of 6, 8 and 10-in. water pipe laying with hydrants and valves. The electric light plant will consist of about five miles of pole lines and a 100 K.W. transformer station. The sewerage will consist of about 3 miles of pipe sewers, 8 inches to 15 inches diameter and appurtenances. Plans and specifications will be on file at the office of the Mayor at Clayton, N. C., and at the office of Gilbert C. White, Engineer, at Charlotte, N. C. No bid will be considered unless accompanied by a certified check for not less than 5 per cent of the bid, but not less than $250, as an evidence of good faith. D. L. Barbour is Clerk.

⊙The Board of Aldermen of New Bern, N. C., has awarded the contract for the building of a fireproof building for the water and light system to H. S. Hancock for $9,800.

The city of Durham, N. C., proposes to call an election shortly for the purpose of voting on the issuance of bonds for the installation of a water works system. It is proposed to elect a commission of three men to have charge of the water works.

Ohio.

✣Bids will be received until noon, Feb. 14, at the office of the Secretary of the Director of Public Service, Cleveland, O., for lead pipe for the Water Department of the City of Cleveland. Specifications may be obtained of the Superintendent of the Water Department. W. J. Springborn is Director of Public Service and W. H. Kirby is Secretary.

✣Bids will be received until noon, Feb. 11, by S. A. Kinnear, Director of Public Service, Columbus, O., for the laying of water service pipe in a number of streets, as mentioned in this issue under "Roads and Streets."

⊙The Board of Control of Urbana, O., has awarded the contract for a new boiler at the water works to the Babcock & Wilcox Co. of Cincinnati, O., at $2,530.

The City Council of Elyria, O., has authorized bonds to the amount of $7,500 for the making of extensions to the water mains during the year.

Service Director Joseph S. Wilson of East Liverpool, O., proposes to expend about $10,000 for enlarging and extending the water mains in certain districts this spring.

The Water Department of Cleveland, O., has asked for authority to expend $176,000 for improvement work. Of this amount $100,000 is to be used in the purchase of mains for extending the system in outlying districts; $5,000 for the purchase of chlorine, used in the treatment of the city water supply, and the remainder for fire hydrants, valves, etc.

Oregon.

The citizens of the town of Nyssa, Ore. (population 449) at a recent election voted the issuance of bonds for the construction of a water works system.

The citizens of the city of Newport, Ore., have voted bonds to the amount of $10,000 for the making of extensions to the water works system.

Pennsylvania.

The Borough Council of Ashland, Pa., has decided to replace all the small water lines leading to fire hydrants with larger ones. A bill will be presented to the Legislature authorizing the borough to increase its indebtedness for the purpose of improving the water department.

South Carolina.

⊙The Public Works Commission of Rock Hill, S. C., has let the contracts for the bringing of a pure water supply from the Catawba river, as follows: Case & Cothran of Atlanta, Ga., for building pumping station, furnishing and placing pump connections, coagulating basin, storage reservoir, pumping station machinery foundations, auxiliary pumping station, intake and pipe connections, $23,365; Tucker & Laxton, Charlotte, N. C., filter plant, $6,545; R. D. Wood & Co., Philadelphia, Pa., hydrants and valves, $534; Howard Neely of Chattanooga, Tenn., and the Rock Hill Plumbing & Heating Co., for laying the pipe line to the river, at $8,700 for iron pipe, $5,700 if wood pipe is used; J. R. Purser of Charlotte, N. C., for the high service pump, sand pump, raw water pumps, motors and installation, at $5,450. The contract for the pipe, making the electrical connections and building the pole lines was not awarded.

Tennessee.

An election is to be held in Dresden, Tenn., in the near future for the purpose of voting on the issuance of bonds to the amount of $25,000 for a water works and an electric light plant.

The Memphis Artesian Water Co., Memphis, Tenn., proposes to ask the State Legislature for authority to issue bonds to the amount of

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

$500,000 for the extension of water mains during the next four years.

Texas.

The city officials of Fort Worth, Tex., have declared in favor of the issuance of bonds to the amount of $300,000 for the completion of the West Fork reservoir.

The Concho Water Works Co., Palm Rock, Concho County, Tex., has been incorporated with a capital stock of $6,000. The incorporators are: J. W. Norman, B. B. Stone, and J. B. Wade.

Mayor Ed. H. McCuistion of Paris, Tex., has received plans for the pumps and other improvements to be installed at the municipal water works station at the city lake, preparatory to changing from steam to electric power for furnishing the water supply.

The West Side Water Co., Arlington Heights, Tarrant County, Tex., has been incorporated with a capital stock of $25,000. The incorporators are A. J. Duncan, Jr., W. M. Short and R. Montgomery.

Virginia.

The Town Council of Vinton, Va. (population 1,928) is considering the matter of floating a bond issue of $40,000 for the installation of water and sewerage systems.

West Virginia.

The W. J. Sherman Co., The Nasby, Toledo, O., is preparing plans and specifications for the installation of a new water works system in Tunnelton, W. Va. Water will be secured from springs.

Wisconsin.

✣Bids will be received until 2 p. m., Feb. 8, by Village Board, Waterford, Wis., for furnishing water pipe and specials for the system of water works for the village. Each bid must be accompanied by a certified check for 5 per cent of the amount bid. A. G. Scheele is Village Clerk and P. J. Hurtgen, Burlington, Wis., is Engineer.

✣Bids will be received until 2 p. m., Feb. 8, by Village Board, Waterford, Wis., for furnishing valves and hydrants for the proposed system of water works. A certified check for 5 per cent of the amount bid must accompany each bid. A. G. Scheele is Village Clerk and P. J. Hurtgen, Burlington, Wis., is Engineer.

✣Bids will be received until 2 p. m., Feb. 15, by Village Board, Waterford, Wis., for furnishing and erecting a steel water tower for the water works system at that place. The tank is to have a capacity of 30,000 gals., and is to rest on a tower making a total height of 112 ft. Each bid must be accompanied by a certified check for 5 per cent of the amount bid. A. G. Scheele is Village Clerk and P. J. Hutrgen, Burlington, Wis., is Engineer.

The citizens of the city of Boscobel, Wis. (population 1,525), on Jan. 28, it is reported, voted in favor of the issuance of bonds to the amount of $24,000 for the installation of a water works system.

The citizens of Prairie du Sac, Wis., have voted bonds to the amount of $30,000 for the laying of additional water mains in the spring.

The City Council of Janesville, Wis., has informed the Wisconsin Railway Commission and the waterworks company of that city that the city is ready to have a valuation made on the water works. The Council proposes to purchase the plant and make improvements on the same.

Consulting Engineer Arthur M. Morgan, 111 W. Monroe St., Chicago, Ill., has submitted his report to the Board of Public Works of Antigo, Wis., on the valuation of the water works system in that city. The appraised value of the system is $86,000, with an additional $40,000 if the plant is to be purchased and improvements made.

Canada.

✣Bids will be received until noon, Feb. 8, by H. Thompson, Secy.-Treas., 215 Chamber of Commerce, Winnipeg, Man., for drilling wells in the municipality. Bids should state price per foot through earth and rock. A deposit of $200 must be made by the successful bidder.

✣Bids will be received until 10 a. m., Feb. 18, by John Allen, Mayor, at the office of S. H. Kent, City Clerk, Hamilton, Ont., for supply and delivery of 12-in. flanged pipe, high pressure; 12-in. bell and spigot pipe, high pressure; 12-in., 16-in. and 24-in. special castings for high and low pressure service. Specifications, etc., may be secured of A. F. Macallum, City Engineer, Hamilton, Ont.

The citizens of Vancouver, B. C., have voted a by-law to the amount of $800,000 for water works improvements. S. Maddison is Superintendent of Water Works.

The Board of Trade of Trenton, Ont., has passed a resolution providing for the installation of a permanent hydrant system to supplement the present fire protection facilities.

Engineers Walter J. Francis, R. A. Ross and R. S. Lee of Montreal, Que., retained by the municipality of Edmonton, Alta., to look into the water situation of the city, have submitted their report. The report recommends that the future supply be obtained from the Saskatchewan River, the pumping plant to be located on the site of the present plant, the South Side plant to be dismantled or merely retained as a standby, a 10,000,000-gal. clear water basin covered in, to be built for filtered water, a permanent intake to be constructed from the middle of the river to connect with the present low-lift pump pit, and additions and extensions to the present plant be made along a definite line.

SEWERAGE AND SANITATION

Arkansas.

City Engineer F. R. Allen of Pine Bluff, Ark., was recently authorized by the City Council to construct storm sewers to relieve the flooded conditions existing at certain points on Main and Pine Sts., and Second, Fifth and Sixth Aves. The work will be done by day labor.

City Engineer L. G. Ferrie of DeQueen, Ark., is preparing plans for the installation of sewers in a proposed new district.

California.

⦿Philip Schuyler, First Nat. Bank Bldg., Oakland, Calif., has been awarded the contract by the city of Oakland for sewering in 90th Ave., etc., at $0.74 per lin. ft. Bids were opened Jan. 20.

⦿The Los Angeles Bridge & Construction Co., has been awarded the contract by the Board of Public Works of Los Angeles, Calif., for the construction of the Fries St. storm and sanitary sewer at Wilmington, for $7,300. The drain will be 10,105 ft. long and of 12-in. pipe construction.

⦿The City Trustees of Gridley, Calif., have let the contract for the first unit of the new sewerage system to William Farr of that city, at $4,175.

The Los Angeles County Supervisors, Los Angeles, Calif., R. W. Pridham, Chairman, are planning the construction of a storm drain in the northwest section of Pasadena and Altadena.

The Board of Public Works of Los Angeles, Calif., has asked the City Council to take immediate action on the proposed installation of sanitary sewers in the territory from Mateo St., to the river. Homer Hamlin is City Engineer.

Colorado.

The City Council of Canon City, Colo., has taken steps to organize sewer district No. 2, comprising the territory east of 11th St. Work will be done in the spring. Harmon Minor is City Engineer.

Georgia.

The Town Council of Adairsville, Ga., (population 751) contemplates installing a sewerage system. Hon. J. A. Price is a member of the Council.

Idaho.

The City Council of Kellogg, Ida., has retained Engineer Robert Sterling of that city to superintend the construction of a sewerage system. The contract has not yet been awarded.

Illinois.

The finance committee of the City Council, Chicago, Ill., on Febr. 3 recommended to that body the advertisement for bids on the disposal of Chicago's garbage for the next five years. Specifications will be prepared by City Engineer Henry Allen.

Consulting Engineer Charles Cottingham of Danville, Ill., has submitted his final report to the City Council of Mattoon, Ill., on the plans and specifications for a complete sewerage system for that city. The proposed system, including about 32 miles of pipe, septic tanks, etc., would cost about $166,827. C. L. James is City Engineer.

Indiana.

✣Bids will be received until 10 a. m., Feb. 13, by Board of Public Works, Richmond Ind., for the construction of 12-in. to 30-in. sewers estimated to cost about $20,000. Fred R. Charles is City Engineer.

⦿The Board of Public Works of Fort Wayne, Ind., has awarded the contracts for the construction of five sewers totaling 7,463 ft., to Anton Rieg at an average cost of $1.21 3-5 per ft.

City Engineer Joe Hershey of Vincennes, Ind., is preparing final plans for the construction of the downtown storm sewer. The district includes all the city between Hart and Vigo Sts., and Eighth St. and Wabash Ave.

Iowa.

✣Bids will be received until about March 1, by the city of Toledo, Ia., for the construction of a sewage disposal plant and about 1,000 ft. of outlet sewer. The work must be completed by Aug. 1, 1913. Sam Steigerwalt, Nevada, Ia., is Engineer.

The engineering department of Davenport, Ia., has completed plans and specifications together with the plats and estimates for the construction of the 13th district main and lateral sewer system. The City Council on Feb. 5 will probably order the advertisement for bids on this work. J. A. Ryan is City Engineer.

City Engineer Jent G. Thorne of Clinton, Ia., is preparing plans for the construction of a sewerage system in District No. 7 and No. 8, in Lyons.

The City Council of Carroll, Ia., has decided to take preliminary steps toward building about three miles of lateral sewers and make extensions to the present system. H. M. Haussen is City Engineer.

The City Council of Cedar Rapids, Ia., has ordered the construction of a sewer in the southwest part of the city, to be 2,800 ft. in length and from 60 to 72-ins. in size, of either concrete or two-ring brick.

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

Kentucky.

⊙The Board of Public Works of Louisville, Ky., has awarded contracts for the construction of sewers, as follows: L. R. Figg Co. of Louisville, Madison, Green and 11th St. sewers, $8,461, $7,208 and $4,217 respectively. L. W. Hancock of Louisville, 32nd St. sewer to cost $12,176, and Edwin R. Larson of Louisville, West St. sewer to cost $5,097.

Louisiana.

City Engineer G. R. Wilson of Shreveport, La., has about completed the plans for the proposed extension to the city sewerage system, to cost about $250,000. The City Council proposes to call an election to vote on a bond issue for the movement.

Maryland.

Following bids were received by the Board of Awards of Baltimore, Md., on Sanitary Contract No. 106, Storm-Water Contracts Nos. 24 and 25: Contract No. 106—Wm. McCarthy & Co., Baltimore, Md., $37,831; Jas. H. McQuade, Pittsburgh, Pa., $40,093; Gallagher, Boyle & Bryan, Baltimore, Md., $40,777; Jas. Ferry & Son, Baltimore, Md., $45,371. Storm-Water Contract No. 24—B. F. Sweeten & Son, Baltimore, Md., $166,194; Ryan & Reilly, Baltimore, Md., $187,244; Wm. McCarthy & Co., Baltimore, Md., $198,755; Jas. Ferry & Sons, Inc., Baltimore, Md., $209,814. Storm-Water Contract No. 25—Jas. Ferry & Sons, Baltimore, Md., $279,990, $285,090; Ryan & Reilly, Baltimore, Md., $283,562, $288,812; Whiting Turner Con. Co., Baltimore, Md., $286,146, $292,898.

Massachusetts.

⊙Commissioner of Public Works L. K. Rourke, Boston, Mass., has awarded the contract for furnishing and erecting automatic electric sewage pumping plant in proposed underground station in Summer St., opposite E St., South Boston, to the Power Equipment Co., at $2,977. Bids were opened Jan. 14.

Michigan.

The citizens of Escanaba, Mich., have voted against the issuance of bonds to the amount of $117,000 for the construction of a complete sanitary sewerage system and disposal plant.

The Village Council of Highland Park, Mich., proposes to construct a sewer on Hamilton Blvd., from the city limits to divert the waters of Whetmore ditch, where it crosses 12th St., south to Glendale Ave., to the Benne ditch, thence into Detroit sewers.

Minnesota.

✣Bids will be received until 2:30 p. m., Feb. 5, by Kossuth E. Alexander, Purchasing Agent, Minneapolis, Minn., for furnishing the city with vitrified clay sewer pipe during the season 1913. A certified check for $1,000 payable to C. A. Bloomquist, City Treasurer, must be filed with each bid.

✣Bids will be received until 2:30 p. m., Feb 5, by K. E. Alexander, Purchasing Agent, Minneapolis, Minn., for furnishing the city with approximately 400 tons of special castings for sewers. A certified check for $500 must be filed with each bid.

Following bids were received Jan. 21 by the City Council of Hibbing, Minn., for the construction of the new sewer outlet and ditch: Ditch—A. C. Osman, $29,966; Coons & Butler, Hibbing, $37,117; Carl Hall & Co., Duluth, $42,572; Patrick McDonnell, Duluth, $44,743. Sewer—Patrick McDonnell, Duluth, $61,268; A. G. Osman, $65,252; P. G. Pastoret, Duluth, $68,843, and Lawrence & Co., Duluth, $75,749. The estimate of the engineer on the sewer outlet is approximately $60,000 and that on the ditch approximately $30,000. The specifications call for the completion of the ditch by Nov. 1 and of the sewer by July 1.

The city of Ely, Minn., plans the construction of a cement walk, curbing and storm sewer in all the district between Camp St., on the north and Harvey St., on the south, and from Third Ave, east to Sixth Ave. On Harvey St. the improvements will be extended from the high school to the Lincoln school. It is thought that this will require an expenditure of $35,000 or $40,000. O. E. Brownell is City Engineer.

The City Council of St. Cloud, Minn., proposes to install a sewer system in the lower section of the city this summer. C. H. West is City Engineer.

Missouri.

⊙N. B. Watters, 6948 Tyler Ave., St. Louis, Mo., has been awarded the contract by the Board of Public Improvements of that city, for the construction of sewers in Gratiot Sewer District No. 2, at $8,964. Bids were opened Jan. 31.

⊙The Board of Public Improvements of St. Louis, Mo., has awarded the contract for the construction of sewers in the Clifton Heights Joint Sewer District to John B. Turner, Pierce Bldg., St. Louis, at $9,568. P. McIntyre, 1383 N. Union Ave., St. Louis, secured the contract to construct sewers in Clifton Heights Sewer District No. 2, at $12,965. Bids were opened Jan. 24.

⊙E. F. Mignery has been awarded the contract by the Board of Public Works of St. Joseph, Mo., for the construction of a sewer in District No. 125, at $550. John Marnell secured the contracts for a sewer in District No. 38 and District No. 68, at $816.

Nebraska.

The city of Madison, Nebr., will let contracts in about 15 or 30 days for the installation of a new sewer system at an estimated cost of $16,000. The W. K. Palmer Co., Kansas City, Mo., prepared the plans.

City Clerk Thomas J. Flynn of Omaha, Neb., will sell bonds Feb. 18 to the amount of $100,000 for the building of sewer mains in 1913, $100,000 for paving intersections in 1913, and $100,000 for building fire engine houses.

New Jersey.

✣Bids will be received until 2:30 p. m., Feb. 14, by Board of Commissioners, Trenton, N. J., for the construction of a sewer in Euclid Ave., from a point near Chambers St., thence easterly to Hampton St., thence northwesterly in Hampton St. to Walnut Ave., there to connect with sewer No. 273; also with a branch in Tioga St. from a point near Chambers St., easterly to Hampton St., there to connect with the herein described sewer, said sewer to be constructed with house connections from said sewer to the curb lines on each side of said avenue and said streets. Plans and specifications, with a draft of the contract and of the bonds required to be given, may be seen at the office of the Engineer of Sewers and Water, at the City Hall. Each proposal must be made on a blank form which will be furnished by the Engineer, and must be accompanied by a certified check to the amount of $500.00.

The City Council of Avon by the Sea, N. J., has ordered that the sewer and water systems be extended into the southern end of the borough as they are laid out on the borough maps. Engineer Emlen will prepare plans and specifications.

New York.

✣Bids will be received until 7:30 p. m., Feb. 18, by Board of Public Works, Niagara Falls, N. Y., for the necessary labor and material for the construction of a sewer and appurtenances in and along the alley between Sixth St. and Seventh St. west of Ferry Ave. Plans and specifications may be obtained of the City Engineer, F. S. Parkhurst, Jr., Convention Hall. T. H. Hogan is City Clerk.

The City Council of Poughkeepsie, N. Y., has adopted a resolution of the Board of Public Works for the construction of a storm and public sewer on Washington St., from Taylor Ave., to connect with the sewer on Bain Ave.

The village officials of Patchogue, L. I. (N. Y.), contemplate the installation of a system of sewers with a sewage disposal plant. Dr. Frank Overton is village health officer.

The Board of Village Trustees of Cooperstown, N. Y., has authorized Engineer Chester S. Lee to make a survey and map out a complete sewer system for that village. The work will also include a disposal plant.

Matthew D. Young, president of the Board of Trustees of Kenmore, N. Y., has sent a communication to the Board of Aldermen of Buffalo, N. Y., asking for further sewer connections for the village, either at Elmwood Ave. or Military road.

North Carolina.

✣Bids will be received until 3 p. m., Feb. 25, by Board of City Commissioners, Clayton, N. C., for the construction of a system of sewerage including about 3 miles of 8 to 15-in. pipe sewers with appurtenances, as mentioned under "Waterworks" in this issue. Gilbert C. White, Charlotte, N. C., is Engineer. D. L. Barbour is Clerk of the city.

Ohio.

✣Bids will be received until Noon, Feb. 5, by G. H. Lewis, Director of Public Service, Elyria, O., for the construction of a sewer connecting with the present outlet and the so-called Faxon Sewer.

✣Bids will be received until Noon, Feb. 13, by W. J. Springborn, Director of Public Service, Cleveland, O., for the construction of sewers in the following named streets, avenues, courts and thoroughfares, to-wit: Crenell Ave. S. E., between East 131st St. and E. L. of O. L. 462; Preston Ct. S. E., between East 131st St. and E. L. of O. L. 462; Cypress Ave. S. W., between West 39th St. and West 35th St.; St. Catherine Ave. S. E., between East 88th St. and East 93rd St.; St. Catherine Ave. S. E., between East 98th St. and East 99th St.; Sophia Ave. S. E., between Woodhill road S. E. and East 92nd St. Wamelink Ave. S. E., between Steinway Ave. S. E., and Woodhill road S. E.; Theuer Ct. S. W., between Fulton road S. W. and 350 ft. easterly; West 59th Pl., between Storer Ave. S. W. and Gilbert Ct. S. W.; West 94th St., between Denison Ave. S. W. and Almira Ave. S. W.; West 54th St., between The Boulevard and Tillman Ave. N. W.; Stone Ave. N. W., between West 54th St. and West 58th St. Each bid must be made in accordance with the plans and specifications which may be seen at the office of the Chief Engineer, Room 305 City Hall. W. H. Kirby is Secretary.

✣Bids will be received until Noon, Feb. 5, by G. H. Lewis, Director of Public Service, Elyria, O., for the construction of a sewer in Second St. from West Ave. to Court St.

✣Bids will be received until about March 1, by Geneva, O., for the construction of about 6,590 lin. ft. of 5 to 12-in. vit. pipe sewer including 19 manholes, 4 flush tanks, connections, etc. Cummings & Downer, Painesville, Ill., are Engineers. W. E. Morgan is City Clerk.

⊙The Board of Control of Springfield, O., has awarded the contract for the installation of two sewers, the storm water sewer in Limestone St., from Catherine St. to Lansdowne Ave., at $4,345, and the Walter St. extension system in the West End, for $39,428. M. J. Cooney was the successful bidder.

⊙The Department of Public Service of Lorain, O., is reported to have awarded the contract for the construction of a sanitary sewer in the alley east of East 30th St., between Tacoma Ave. and Grove Ave., to H. L. Shaw, at $3,271.

The Village Council of Celina, O., has accepted the plans of the W. J. Sherman Co., The Nasby, Toledo, O., for a complete sanitary and storm sewer system. The cost of the improvement is estimated at $200,000.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

⊙The Board of Control of Middletown, O., has awarded the contracts for the construction of sewers on Moore St., and First St., to the Arpp-Simpson Co., of that city.

R. Winthrop Pratt, Consulting Engineer of Cleveland, O., has been retained to assist Geo. E. Arnold, City Engineer, of Canal Dover, O., and Robert Wagar, City Engineer, of Sandusky, O., in the design of intercepting sewers and sewage treatment works for these cities.

Pennsylvania.

✣Bids will be received until 8 p. m. (eastern time), Feb. 19, by Borough Council, Beaver Falls, Pa., for the construction of a sanitary sewer system in accordance with the plans and specifications on file in the office of the Secretary of Council in Beaver Falls and at the office of the Engineer at McKeesport, Pa., and from whom copies may be obtained. The work to be done consists of laying approximately 16 miles of sanitary sewers with appurtenances, sewers ranging in size from 8 ins. to 24 ins. in diameter. Each proposal shall be properly signed and accompanied by certified check on a solvent bank for an amount equal to $5,000, to be drawn payable to the order of the Treasurer of the Borough of Beaver Falls. Leo Hudson, McKeesport, Pa., is Consulting Engineer.

Texas.

⊙The City Council of Houston, Tex., has awarded the contract for the construction of the proposed First and Sixth Wards sewer aggregating $43,251, to H. C. Gass of Belleville, Ill., and Waco, Tex. The contract calls for a reinforced concrete sewer with manholes and catch basins complete, the sewers to be 6 ft., 5 ft. and 4 ft. in diameter. Horton, Cage & Horton bid $57,983 on the work.

⊙The City Council of Corpus Christi, Tex., has awarded the contract for storm sewer work in the downtown section of the city to J. O. Severns of Oklahoma City, Okla., at $13,787. Other bidders were: Trueheart & Jackson, $13,884; Richland Concrete Co., $15,315, and Sherman Concrete Co., $16,504.

Washington.

⊙The International Dredging Co., of Seattle, Wash., has been awarded the contract by the Board of Public Works of that city, for the construction of sewers in Rainier Ave. et al., at $80,031.

⊙Krogh & Jessen of Seattle, Wash., have been awarded the contract by the Board of Public Works of that city, for paving, constructing sewers and water mains in Ravenna Blvd. et al., at $45,671.

Wisconsin.

✣Bids will be received until 8 p. m., Feb. 18, by the Board of Public Works, at the office of the city clerk, New London, Wis., for the necessary labor and material for the construction of a sewer on Cook St., between Wyman and Dorr and on Dorr St., between Cook St. and Wolf River. A certified check for 10 per cent of the amount bid must be filed with each bid. Plans and specifications are on file with the city clerk.

✣Bids will be received until 7 p. m., March 1, by City Clerk, Prairie du Chien, Wis., for the construction of 27,520 ft. of vitrified pipe sewers from 6 to 12-in. in diameter. A certified check for 5 per cent of the amount bid must accompany each bid. Plans may be seen at the office of the city clerk or at the office of W. G. Kirchoffer, Engineer, Madison, Wis.

BUILDINGS

Arkansas.

✣Bids will be received until 10 a. m., Feb. 27, by Constructing Quartermaster, Hot Springs, Ark., for the construction of Army Nurse Corps Home, including heating, plumbing, electric wiring, fixtures, etc., at Army and Navy General hospital.

California.

⊙Grant Fee, 2449 16th St., San Francisco, Cal., has been awarded the contract at $384,300 for the construction of the U. S. subtreasury at San Francisco.

Georgia.

Park A. Dallis, Architect, Atlanta, Ga., has prepared plans for a $100,000 2-story 99x196 ft. addition to the Dixie Cotton Mills at La Grange, Ga.

Idaho.

An appropriation of $700,000 is to be asked of the State Legislature for completing the capitol building at Boise.

Illinois.

✣Bids will be received until 4 p. m., Feb. 24, by the Township Board of Education, Robert Hopper, Secy., Herrin, Ill., for furnishing the necessary labor and material for the construction of a new schoolhouse in accordance with plans and specifications prepared by Spencer & Temple, Champaign, Ill., Architects. Each bid must be accompanied by a certified check for 5 per cent the amount bid. Plans may be had by addressing the architects.

✣Bids will be received until 1 p. m., March 3, by Calvin C. Loy, County Clerk, Effingham, Ill., for furnishing the necessary labor and material for the erection and completion of the proposed new jail and sheriff's residence for Effingham County. J. W. Gaddis, Vincennes, Ind., is Architect.

Iowa.

✣Bids will be received until noon, Feb. 11, by Board of Calhoun County Supervisors Rockwell City, Ia., for the construction of a new $125,000 court house, at Rockwell City. Specifications will be mailed upon receipt at the Auditor's office of a certified check for $100.

✣Bids will be received until 5 p. m., Feb. 28, by Board of Education, Independent School District, Sioux City, Ia., for the erection of an addition to the high school building in Block 69, Sioux City, Ia. All bids must be in strict accordance with the plans and specifications prepared by F. E. Colby, Architect, 615-617 F. L. & T. Building, Sioux City, Ia., which will be on file at his office. Plans will be on file also at the Builders' Exchange, Minneapolis, Minn., and Omaha, Neb. also at the office of I. F. Stern, Consulting Engineer, Old Colony Building, Chicago, Ill. Contractors wishing to procure plans for their own special use until bids are opened can do so by depositing the sum of $35 with said architect, $25 of this amount to be returned to the bidder when plans are returned.

✣Bids will be received until 5 p. m., Feb. 28, by Board of Education of the Independent School District of Sioux City, Ia., T. C., Secy., Sioux City, Ia., for the erection of an addition to the High School Building in block 69, Sioux City, Iowa. All bids must be in strict accordance with the plans and specifications prepared by F. E. Colby, Architect, 615-617 F. L. & T. Building, Sioux City, Iowa, which are on file at his office. Plans will be on file at the Builders' Exchange, Minneapolis, Minn., and Omaha, Neb., also at the office of I. F. Stern, Consulting Engineer, Old Colony Building, Chicago, Ill. Contractors wishing to procure plans for their own special use until bids are opened can do so by depositing the sum of $35 with said architect; $25 of this amount to be returned to the bidder when plans are returned.

Kansas.

✣Bids will be received until 10 a. m., Feb. 6 (readvertisement), by Lieut. Col. T. H. Slavens, Constructing Quartermaster, Fort Leavenworth, Kan., for furnishing and delivering f. o. b. cars, terminal railway station, Fort Leavenworth, Kan., the following material: Item 1, round and flat mild steel bars; item 2, mild steel plates; item 3, angles, channels, etc. (structural steel); item 4, steel, cold rolled; item 5, rivets; item 6, castings, patterns to be furnished by the government, cast iron and yellow brass; item 7, bolts, washers, screws, etc.

Maryland.

✣Bids will be received until noon, Feb. 15, by Capt. D. J. Markey, Chairman Frederick Armory Commission, Frederick, Md., for the erection and completion of an armory building in that city. John B. Hamme, York, Pa., is Architect.

✣Bids will be received until 2 p. m., Feb. 12, by F. W. Keating, M. D., Supt. Rosewood State Training School, for the erection of a dormitory building on the grounds of the said institution in accordance with plans and specifications prepared by Ellicott & Emmart, Architects, 1101 Union Trust Bldg., Baltimore, Md.

Minnesota.

✣Bids will be received until 8 p. m., Feb. 13, by O. W. Lundsten, Secy., Board of Education of Independent School District No. 2, McLeod County, at Hutchinson, Minn., for furnishing all material and labor to install a heating and ventilating plant in a new high school building at Hutchinson, Minn., in accordance with plans and specifications as prepared by F. W. Kinney, architect, 1003-4 Plymouth Building, Minneapolis, Minn. Said plans and specifications will be on file in the office of the secretary of the Board of Education at Hutchinson, Minn., at the Builders' Exchange, Minneapolis, Minn., also at the office of the architect.

Montana.

✣Bids will be received until 2 p. m., Feb. 28, by Commissioner of Indian Affairs, Washington, D. C., for the furnishing of necessary labor and material for the erection of a brick school building at the Cut Bank Boarding School, Blackfeet Indian Reservation, Montana.

North Dakota.

✣Bids will be received until 2 p. m., Feb. 14, by the State Board of Normal Trustees, E. J. Taylor, President, Bismarck, N. Dak., for the erection of a fireproof dormitory to be erected on the Normal School Grounds, Minot, N. Dak. Haxby & Gillespie, Fargo, N. Dak., are Architects.

Ohio.

✣Bids will be received until noon, Feb. 14 at the office of the secretary of the Director of Public Service, 104 City Hall, Cleveland, O., for furnishing electric meters for the Municipal Electric Light Department of Cleveland. W. J. Springborn is Director of Public Service and W. H. Kirby is Secretary.

✣Bids will be received until noon, March 4, by H. H. Canfield, Clerk, Cleveland Heights, at his office, 309 Beckman Bldg., Cleveland, O., for the furnishing of one complete motor fire truck for said village, according to plans and specifications on file at the office of said Clerk at the Town Hall, and at the office of F. A. Pease, 931 Williamson Bldg., Cleveland, O.

✣Bids will be received until noon, Feb 10, by Board of Education, East 6th St., Cleveland, O., for furnishing desks and seats for Miles, Warner, Memphis, Mt. Pleasant, Washington Park, Dawning and Eagle Schools and various other rooms, in accordance with plans and specifications on file in the office of the Director of Schools.

Bids will be asked in the spring for county jail to be erected at Mt. Vernon, O. Building will be of brick, fireproof construction. Marriott, Allen & Hall, Columbus, O., are the Architects.

Oregon.

✣Bids will be received until 10 a. m., Feb. 10, by John B. Coffey, County Clerk, Port-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

land, Ore., for the lighting fixtures, book shelving, tables, furniture, etc., and stone fence for the New Central Library building, Portland, Ore. Plans and specifications may be obtained at the office of the architects, Doyle, Patterson & Beach, Worcester Building. Contractors will be required to deposit $25 for each set of plans as a guarantee that the plans and specifications will be returned to the office in good condition on or before the date set for opening the bids. On return of the drawings and specifications the money will be refunded. A certified check for 10 per cent of the amount of the bid, drawn to the order of the County Treasurer, must accompany each bid.

Pennsylvania.

⊙Jacob Myers & Son, 608 Witherspoon Bldg., Philadelphia, Pa., have been awarded the contract for erecting the addition to the University of Pennsylvania Museum at Philadelphia. The cost, including equipment, will be about $300,000. The extension consists of a gallery extending from the present building southward and terminating in a round tower, which will be 96 ft. in diameter and more than 100 ft. high.

Texas.

✣Bids will be received until noon, Feb. 17, by North Texas Hospital for Insane, Terrell, Texas, for furnishing the necessary labor and material for re-covering with metal shingles new female and new male annex buildings at the hospital, Terrell, Texas.

✣Bids will be received until 1 p. m., Feb. 10, by M. L. Waller, Fort Worth, Texas, for the construction and completion of a reinforced concrete gymnasium building for the Sam Houston State Normal, Huntsville, Texas. A certified check for $500 must be filed with each bid.

Virginia.

✣Bids will be received until noon, Feb. 25, by Board of Bath County Supervisors, Warm Springs, Va., for the erection of a court house at Warm Springs, according to plans and specifications prepared by T. J. Collins & Son, Architects, Staunton, Virginia. A certified check equal to 2 per cent of bid to accompany each bid. Plans and specifications can be seen on and after February 11, 1913, at the Clerk's office, Warm Springs, Va., and at office of said Architects. Persons desiring to bid will apply to Architects for plans and specification. F. L. La Rue is Clerk of the Board.

✣Bids will be received until 11 a. m., March 1, by H. R. Standford, Chief Bureau of Yards and Docks, Navy Department, Washington, D. C., for a tar and felt roof for buildings at the navy yard, Norfolk, Va.

Canada.

✣Bids will be received until 11 a. m., Feb. 14, by Chairman Board of Control, at the office of M. Peterson, Secretary-Treasurer, Winnipeg, Man., for manufacture and delivery and erection in the power house at Point Du Bois, Man., of one 9,000-k.w. 3-phase step-up reformer, with oil and accessories complete. Instructions to bidders, specification and form of tender may be obtained at the office of the City Light & Power Department, 54 King St.

✣Bids will be received until noon, Feb. 8, by Department of Railways and Telephones, Regina, Sask., for insulators, toppins, guy wire, copper sleeves, cross arms, galvanized iron wire, pole line hardware, porcelain insulators, bare copper wire. Specifications, form of tender and all information may be obtained on application to the department.

⊙The Dominion Construction Co., Northwest Trust Bldg., Vancouver, B. C., has been awarded the contract for the $500,000 10-story office building to be erected on Seymour St., Vancouver, for the Yorkshire Guarantee Corporation. Somervell & Putnam, Vancouver, are the Architects.

RIVERS AND HARBORS

Arkansas.

The Arkansas Hydro-Electric Co., organized recently with a capital stock of $500,000, proposes to begin work in the spring on the construction of a dam and hydro-electric plant on the Red River, four miles east of Heber Springs. U. S. Bratton, Little Rock, Ark., is Secretary of the company.

California.

⊙The Thomson Bridge Co., 103 Main St., San Francisco, Cal., has been awarded the contract at $475,200 by the State Board of Harbor Commissioners for the construction of Pier 37 at the foot of Kearny St., San Francisco. The pier will be 1,080 ft. long by 200 ft. wide, with reinforced concrete pillars on heavy timber piling.

The Advisory Board of the State Engineer's Office has approved the plans submitted by the State Board of Harbor Commissioners, San Francisco, for the construction of a pier at the foot of Stockton St., San Francisco, to cost $500,000, and two freight ferry slips to cost $200,000. Bids will probably be asked at once.

District of Columbia.

✣Bids will be received until 10:30 a. m., Feb. 15, by Maj. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for the furnishing under Canal Circular 752 of materials and equipment for the Cristobal-Balboa transmission line, including steel track-span bridges, copper wire, insulators, ground plates and equipment for substations.

Florida.

Bids as follows were received Jan. 23 by Capt. J. R. Slattery, U. S. Engineer, Jacksonville, Fla., for furnishing material and raising jetty at entrance to St. Johns River: R. G. Ross, Jacksonville, Fla., $2.87 per cu. yd.; R. S. Sales, Savannah, Ga., $3.41 per cu. yd.; Johnston & Virden, Lewes, Del., $3.65 per cu. yd. The estimated quantity of stone is 36,000 cu. yds.

Hawaii.

✣Bids will be received until 11 a. m., March 1, by H. R. Stanford, Chief of Bureau of Yards and Docks, Navy Department, Washington, D. C., for one narrow-gage and two standard-gage saddle tank switching locomotives delivered at the naval station, Pearl Harbor, Hawaii. Specifications may be had by addressing the Bureau.

Iowa.

✣Bids will be received until 1 p. m., Feb. 5, by Board of Pottawattamie County Supervisors, Council Bluffs, Ia., for the construction of levees in Rockford and Crescent townships including approximately 33,340 cu. yds. J. D. Hannan is County Auditor.

Mississippi.

✣Bids will be received until 7:30 p. m., Feb. 25, by Joseph F. Cazeneuve, Chairman, Bond Commission, Bay St. Louis, Miss., for the construction of a concrete sea wall along the front of the city, from the south end of the present concrete wall to the north end of the St. Stanislaus College breakwater, approximately 1,500 ft. Plans and specifications may be had on application to R. F. O'Brien, clerk of the Bond Commission, not later than Feb. 11, 1913, on depositing $2.50 per set.

✣Bids will be received until 2 p. m., Feb. 8, by Commissioners of Drainage District No. 2, of Tunica, Quitman and Panola Counties, at their office, Crenshaw, Miss., for the construction of levees necessitaing 14,458 cu. yds. of embankment. The specifications, form of contract, etc., can be seen at the office of the board or at the office of the Morgan Engineering Co., Goodwyn Institute Bldg., Memphis, Tenn. Blueprints of the plat and profiles will be mailed by the Engineering Co. upon receipt of 50 cts. in 2-cent stamps or cash.

✣Bids will be received until Feb. 10, by Board of Mississippi Levee Commissioners, Greenville, Miss., for 370,000 cu. yds. of levee enlargement at a cost of about $80,000. The machinery is to be furnished by the contractor. W. J. Shackelford, Greenville, Wis., is Chief Engineer of the Board.

Missouri.

✣Bids will be received until noon, Feb. 27, by Maj. Herbert Deakyne, U. S. Engineer, Kansas City, Mo., for constructing and delivering 16 steel barges.

New Jersey.

✣Bids will be received until 11 a. m., Feb. 24, by Maj. R. R. Raymond, U. S. Engineer, Wilmington, Del., for the dredging of Cohansey River, N. J.

✣Bids will be received until 11 a. m., Feb. 21, by Maj. R. R. Raymond, U. S. Engineer, Wilmington, Del., for the dredging of the entrance to Salem River, N. J.

✣Bids will be received until 11 a. m., Feb. 21, by Maj. R. R. Raymond, U. S. Engineer, Wilmington, Del., for the dredging of Cooper Creek (River), N. J.

The Delaware River Development Co., of Belvidere, N. J., has been incorporated with a capital stock of $50,000 for the purpose of constructing dams in the Delaware River and erecting a power station. C. C. Wilson, M. L. Albertson and A. M. Wilson, Belvidere, are the incorporators.

Ohio.

The U. S. War Department has approved the dock lines on the Cuyahoga River as laid out by the city of Cleveland, and the work of straightening and widening the upper river to a point as far south as the Denison-Howard bridge can now be undertaken. The improvement for the most part will be paid for by the benefited property owners. W. J. Springborn is Service Director of Cleveland.

Pennsylvania.

✣Bids will be received until noon, Feb. 28, by Lieut.-Col. Francis Shunk, U. S. Engineer, Pittsburgh, Pa., for furnishing and delivering four gate recess covers and four gate engine pit covers for Dams Nos. 7 and 9, Ohio River.

An appropriation of $2,000,000 will probably be asked from the present legislature by the city of Philadelphia for the purpose of carrying on the contemplated improvement of the port. The work will be done under the supervision of Director Norris of the Department of Wharves, Docks and Ferries, Philadelphia.

Virginia.

Bids as follows were received Jan. 28 by the U. S. Engineer, Norfolk, Va., for removing wreck of the Barge Florida from Hampton Roads, Virginia, (1) being bid for removing according to specifications, bodily, and (2) for blowing up with dynamite and removing pieces. Informal, not in accordance with specifications: F. Staud Ximinez, City Dock, care I. W. Trautwein, Annapolis, Md., (1) $18,860; Baxter Wrecking Co., 308 West St., New York, N. Y., (1) $37,500; Merritt & Chapman Derrick & Wrecking Co., 17 Battery Pl., New York, N. Y., (1) $31,750; Eugene Boehm, Island House, Atlantic City, N. J., (2) $11,822; Johnson & Virden, Lewes, Del., (2) $13,765.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ENGINEERING AND CONTRACTING

Devoted to the Economics of Civil Engineering Design
and to Methods and Cost of Construction

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Flood Control of the Mississippi River.

In another column of this issue we publish an unusually good account of the flood history of the Lower Mississippi River and an explanation of the theory of flood control by levees. The data given are not new, nor is the reasoning in support of levee control. The value of the paper lies in its assemblying of the pertinent data and in its vigorous defense of the adoption of and adherence to the method of levee control by the government engineering bodies, in whose charge is the regulation of the river. For these reasons we urge the study by our readers of the article which we publish.

The time will never come, possibly, when all persons will be agreed upon the proper method of regulating the Mississippi floods. Certainly at this time there is no such general agreement. By this is not meant the contrary notions of local geniuses who each spring flood take up the Mississippi problem as a side issue to piloting an Ohio coal barge or rafting logs, but the legitimate differences of opinion of trained men. Those engineers, and there are some very good engineers among them, who see merit in flood control by headwater storage reservoirs do not come within the designation of cranks or charlatans, however much one may disagree with them as to the possibility of their remedy. There is an unwarranted disposition toward partisan argument and exhortation in much engineering discussion of Mississippi flood control. Following the great flood of last year some influential engineering journals vigorously urged engineers to use their influence with the public to uphold the policies and works of the Mississippi River engineers. This may have been sound advice, but it was not scientific in thought. Engineers may well be urged to work together in combating undoubtful popular fallacies about flood regulation, but this is as far as they may legitimately be urged.

Returning to the article which we publish elsewhere in this issue, attention should be given to one particular fact, which it brings out clearly. This fact is that the levees of the Mississippi River, as they now exist, are, contrary to a very general notion, not completed structures. They are in large measure only a fraction in dimensions of the complete structures long known to be necessary and already carefully planned. The fact that these incomplete structures failed in places during the extraordinary flood of 1912 is not nearly so remarkable as the fact that they did not fail in many more places. If the points of breaks indicated on the map which the article presents are counted, it will be seen that there were only 22 breaks in the whole 2,000 miles of levee. One break per 100 miles of earth dam subjected to unusual flood conditions is not such a bad record for endurance.

Another fact of importance demonstrated by the article which we publish is that the Mississippi River engineers are completing the levees as fast as they are given money with which to work. They are cognizant also of how the work should be done. This statement deserves emphasis because of the evident popular appreciation given to such announcements as that Col. Goethals of Panama Canal fame was to be called to the direction of a comprehensive task of making the Mississippi levees safe. There is no doubt of Col. Goethals' ability to perform the task if the necessary money be given him. There is also no reason to think that under the same conditions of adequate financial means, a like result will not follow under the direction of the engineers who are now at work. It is money that is wanted to complete the levee system of the Lower Mississippi and not other engineers or different methods of construction. The fact last stated needs recognition in particular.

With the Chicago-Gulf deep waterway, the Mississippi levee work has shared in the prominence of being, in popular thought, an unexcelled means of continuing the usefulness of the great construction plant assembled at Panama. Anyone who canvasses a list of the canal machines will soon realize that only a very small number could be adapted to levee construction even if these particular machines after the completion of their work at Panama were worth shipping to the United States. There will be some work value left in the Panama plant when it has finished the canal, but it will be only a very small part of the investment of $25,000,000 which that plant has cost.

We urge again that our readers shall study the article on Mississippi flood control which we publish in this issue. Whether or not the reader agrees with the author that control by levees is the best solution of the problem, he can at least assent to the statement that the river engineers have done about the best with levees that could be done under the conditions.

Good Roads Exhibition in Canada.—A Good Roads Exhibition will be held in Toronto, Ont., in February, demonstrating the advance of this movement in Canada and especially in Ontario. The exhibit will include road rollers, road materials and road making plants of all kinds. The secretary of the exhibition is Mr. E. A. James, 57 Adelaide Street East, Toronto, Ont.

ROADS AND STREETS

Some Cost Data on Street Paving.

The following cost data on street paving work are taken from a paper by W. W. Kerch, Granite City, Ill., presented at the recent annual meeting of the Illinois Society of Engineers and Surveyors. The costs relate to contracts for two street improvements. Job No. 1 was a wooden block pavement on a 5-in. concrete base with a 1-in. sand cushion and a coal tar pitch filler. In connection with this job, there was a straight curb on either side of a 22-ft. strip in the center of the roadway, making a boulevard occupied by street car tracks. On the property side of the paving, there was a 2-ft. gutter and an 8-in. curb. The gutter was 6 ins. and the curb 8 ins. thick, all resting on a 6-in. cinder foundation. The mixtures on the straight curb, the dimensions of which were 6 ins. by 2 ft. with a 3-in. batter and also the curb and gutter, were 1 cement to 3½ parts binder gravel. The mixture for the street base was 1:3:6. The roadway on either side of the boulevard was 18 ft. wide, 16 ft. of paving and 2 ft. of gutter.

Job No. 2 was a brick pavement on a 6-in. concrete base, with a 2-in. sand cushion and a cement grout filler. The curbing was a 5-in. sandstone on a 2-in. concrete base and backed up within 6 ins. of the top with 6 ins. of concrete. The mixture on this job was 1:3:5.

The scale of wages paid on these two improvements was as follows:

	Per hour.
Common labor	$0.20
Concrete mixers	.40
Concrete blockmen	.45
Concrete finishers and form setters	.60
Brick and block setters	.40
Teams and drivers, without wagons	.50

On the wooden block pavement of 27,300 sq. yds. the cost of the pitch filler material was $1,675 or 6.1 cts. per sq. yd. For the brick pavement the grout filler required 456 sacks of cement at 90 cts. per barrel and 60 cu. yds. of sand at $1 per cubic yard. The cost of the grout material was 4.7 cts. per square yard. The labor cost in each case was 1.4 cts. and 1.6 cts. per square yard. In connection with the method employed in filling the wooden blocks, squeegee machines were used for the coal tar which cut the cost of filling materially. For the brick pavement the grout box method for cement filler was discarded for a hand mix of dry materials, and wheelbarrows for the wet mix, which also made a considerable saving.

In setting the wooden blocks Mr. Kerch states that it was found that in no case where the blocks are placed at any angle other than 90° could the cost of laying be reduced to less than 6½ cts. per square yard, or 1½ cts. more than the usual cost of setting bricks. If, however, the specifications permit the laying of blocks at 90° to the curb lines, the cost of laying can be cut to 4 cts. per square yard.

The drayage charges on the blocks and brick were 3.2 cts. and 6 cts. per square yard, respectively. The brick laid 25 sq. yds. to the 1,000. In connection with the drayage charge on materials there are more factors entered into this item than the distance from the railroad facilities. Jobs No. 1 and 2 occupied practically the same positions relative to the team tracks, yet on No. 1 the cost of hauling sand was 28-2/10 cts. per cubic yard, while on Job No. 2 the cost was 18-6/10 cts. This was due entirely to the way the neighboring streets were laid out, one with parallel streets, the other with long round-about ways.

On Job No. 1 the cost of street base labor was 8.8 cts. per square yard; on Job No. 2 the cost was 7.7 cts. per square yard. In the first case there was a 5-in. base; in the second there was a 6-in. base. The difference in cost may be explained by the conditions of the improvements. In the first case the roadway was but 16 ft. wide which prevented the backing of the concrete mixer down the line of improvement and, moreover, the street car tracks to be crossed at all intersections made it an expensive operation. On Job No. 2 there was a 36-ft. roadway free from car tracks and the specifications permitted driving over the finished subgrade without planking.

The overhead charges for the contractor on Job No. 1 was 14.1 cts. per square yard; on Job No. 2 it was 13 cts. per square yard. That the cost of floating the bonds taken by a contractor in payment for the work is an important item is shown by the fact that on Job No. 1 a charge of 16 cts. per square yard is made for this; on Job No. 2 the charge was 11½ cts. per square yard of paving.

Bituminous Materials: Their Use and Misuse.

Neglect of some of the minor details in the more commonly used methods of applying bituminous material is responsible for many failures in this kind of work. An excellent resume of this matter is contained in a paper presented at the last annual meeting of the Michigan Engineering Society by Mr. C. S. Reeves, Chemist, U. S. Office of Public Roads. In this paper Mr. Reeves considers the methods of application from the standpoint of both surface treatment and construction and points out some of the minor omissions of small details that experience has demonstrated to be responsible for the early failure of bituminous work. Mr. Reeves' paper, in greater part, follows:

Depending upon the character of material used and the methods of application, the surface treatment of existing or newly constructed macadam roads as it is carried on today may be considered as either a mere laying of the dust or as virtually a part of the construction. For a dust palliative, crude or partially reduced petroleum or tars are applied cold by means of a sprinkling cart or preferably some form of distributor that will give a small and uniform spray of material. The results of this treatment are only temporary and several applications are frequently necessary to successfully lay the dust for a season.

Simple as this treatment may sound, it is often badly managed and gives rise to dissatisfaction and adverse criticism. A great deal of trouble arises from a general misunderstanding of the purpose of a dust layer, and the use of a material that is more adapted for regular surface treatment which will be discussed later. The real purpose of a simple dust layer is to lay or hold the dust that is formed by traffic after the material has been applied, but it is too frequently assumed that it will lay any quantity of dust that may be upon the road surface at the time of application. The consequence of this assumption is the formation of a thick surface layer of dust and bitumen which picks up and balls and forms a particularly disagreeable muddy condition in wet weather. A road surface should be reasonably clean for the successful application of a dust layer, and a material should be used that is capable of being readily absorbed in order that it may not give offense to pedestrian and vehicular traffic.

Working on the theory that the dust bond of a well-constructed macadam road is all that can be desired, providing that it is protected from the ravages of traffic, has led to some excellent developments along the lines of surface treatment; the idea being to form a mat or carpet of bituminous binder and mineral matter over the surface of the road. To accomplish the most satisfactory results in this way, the road surface should be first thoroughly swept to remove all dust and detritus. An old road should be brought to uniform grade and crown by filling all ruts and depressions with new material and thoroughly compacting it. The bitumen, which should be a refined petroleum or tar product possessing some binding qualities may then be applied either cold or hot depending on the consistency of the material, in just such amount as the surface is capable of retaining, and it is desirable when convenient to let this application soak in undisturbed for twelve or more hours. A thin coating of clean pea gravel or stone chips should then be lightly rolled into the surface and the road opened to traffic.

There are at least two precautions, neglect of which has caused failure and criticism of this form of treatment: One is the tendency of many who are engaged in such work to operate on the theory that if a little bit is good a whole lot must be better, and many a highway has been literally flooded with oil with gallons going to waste on the roadside and in the ditches. Naturally, this excess is picked up by vehicles and pedestrians and carried in all directions, with consequent damage to property. The effort should be made to have an application that will completely and uniformly cover the surface, and the surface should be sufficiently clean to permit of the oil penetrating and adhering to it, instead of floating on a layer of dust, to be picked up as soon as traffic is admitted. Too much stress can not be laid upon the necessity for having a thoroughly swept, clean surface for the production of the most satisfactory results with this form of treatment.

By such a treatment with a properly selected cold residual petroleum properly applied, the author has seen an excellent surface maintained for an entire season, and a few small repairs with a very light application of oil and screenings each spring is all that is necessary to keep up such a surface from year to year. Such treatment is, however, most efficient only when the automobile traffic is in excess of the horse-drawn. The thin carpet formed is easily broken by hoofs and tires, particularly in wet weather, and unless there is a preponderance of motor vehicles to iron it out again, the whole surface is soon disintegrated.

Having considered the method of surface treatment and its purpose in protecting the dust bond of a macadam road, we may now consider some of the essential features in construction work where some form of bituminous binder is used as an integral part of the wearing surface. In general, these binders are either the fluxed native asphalts, oil-asphalts, refined coal and water-gas tars, or some mixture of asphalts and tars. This construction is carried out by either the mixing method or the penetration method, after the first or bottom course of macadam has been laid in the usual manner.

In the mixing method the stone for the wearing surface and bitumen are heated separately to the desired temperature after which a specified amount of bitumen sufficient to thoroughly coat every particle is well mixed with the stone. The mixture is laid to the specified depth by shoveling into place and when a sufficient amount has been spread it is rolled until firm. A coat of clean screenings is usually necessary to prevent the roller from sticking.

In the penetration method, the second course of stone is spread to a depth of preferably about 3 ins. and rolled. The rolling, however, should be only sufficient to give the road its final shape, without crushing the individual fragments of rock or filling the voids with dust when a soft rock is used. The hot bitumen is then applied uniformly at the rate of about 1½ gals. to the square yard, after which clean screenings are spread over the surface and it is rolled until firm. In either method it is best practice to apply a seal coat consisting of about ½ gal. of hot bitumen to the square yard followed by only a sufficient amount of screenings to absorb any excess of bitumen and fill the surface voids.

From purely theoretical considerations there is much to be said in favor of the mixing method and likewise much to be said against the penetration method. In the former, where the materials are mixed in small batches, it is easy to maintain accurate and uniform proportions of stone and bitumen, and each particle can be completely coated before the batch is deposited. In the latter method there is the danger of an unequal distribution and lack of penetration throughout the wearing surface. However, we find many failures in both forms of construction, and while the blame is commonly placed on the binding material, a full knowledge of all the apparently minor details that enter into construction would often reveal other and truer causes of failure. The engineer or inspector in charge of the work can not watch too closely for the small avoidable errors that may be the seal of failure on the entire work he has on hand.

As has been said, the mixing method has much to commend it, and when proper facilities are at hand for carrying out the work, there is perhaps less opportunity for failure than when the penetration method is used. With a complete portable paving plant or a good form of stone heater and mechanical mixer that will mix and deliver the material rapidly and economically, good results should be obtained at a cost somewhat greater than that of water-bonded macadam under the same conditions, plus the cost of the binder. The facilities above mentioned are, however, not always at hand in many of our rural sections and recourse must be had to improvised apparatus with every opportunity for failure. The stone heater will probably consist of a section of boiler plate supported over a wood fire, and the stone is to be raked back and forth over this plate until uniformly heated. There will very likely be several of these heaters and even with the most careful watching of the labor engaged at them, there is a practical certainty of neglect at times to turn the stone over, and some portions are overheated and delivered on the mixing board at a temperature that burns the life out of the added bitumen. The result soon shows up in ravelling spots where these burnt batches have been deposited. Moreover, the mixing method by these improvised methods proceeds slowly with consequent high cost, and under such circumstances, cheaper and often better results for given conditions can be obtained by the penetration method. A repetition of many past failures in the latter method can also undoubtedly be avoided by the exercise of special care regarding some of the details of construction.

A wearing course 3 ins. in thickness before rolling is sufficient. It is best composed of that portion of run of crusher stone which passes a 2-in. ring and is retained upon a 1-in. ring, and this course should be lightly rolled to shape it before the bitumen is applied. The practice of doing all the rolling after the binder has been poured on is not a good one. The surface should be carefully inspected before the bitumen is applied, and any dense or dusty spots should be dug out and filled with clean stone. The binder will not penetrate into these dense places, and they are left only to appear later as ravelled places throughout the road surface. The stone should, of course, be dry, and the work should be done in warm weather. There is every evidence that many failures ascribed to a poor binder are really due to a late beginning and the consequent extension of the construction period into the late fall when the stone is too cold to prevent a proper penetration or adhesion of the bitumen.

In heating the material care should be taken that it is stirred and not allowed to be burned by lying in contact with the sides of the kettle. It should be heated until sufficiently fluid to pour almost like water, and with a little observation and experience one can soon tell whether it is "going in" well. When the engineer has decided upon the range of temperature that appears to give best results, the kettle man should be provided with a thermometer in order to assure himself that each lot of binder is properly heated. It is rarely necessary or advisable to heat a properly selected asphalt or petroleum product over 325° F. to 350° F., and the tar products can usually be poured successfully at from 250° F. to 275° F.

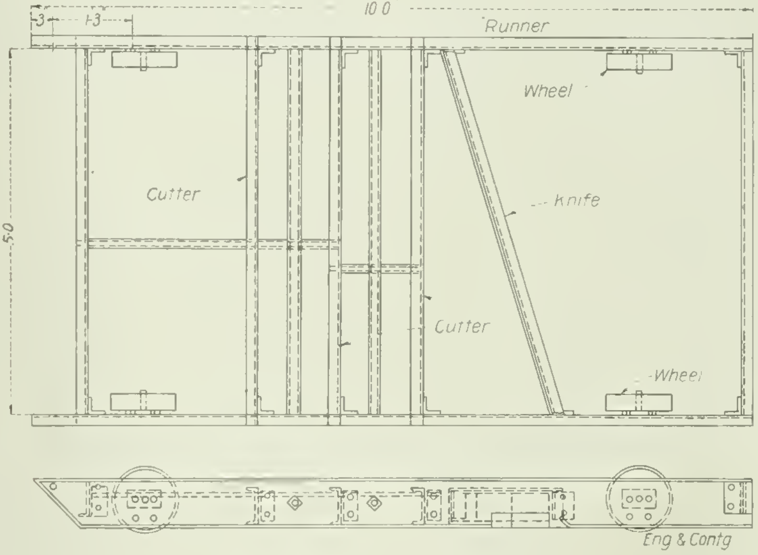
The application of the binder may be made by one of the many forms of distributors, or by a pouring pot with fan-shaped or slotted mouth. The former may prove satisfactory and economical when there is a sufficient yardage and rapid prosecution of work to warrant the use of one, but in general, sufficiently rapid, economical, and excellent work can be done by hand pouring with a properly organized force. By this method one has also the advantage at any moment of being able to check up the rate of application.

The method frequently proves unsuccessful from a general tendency to swing the pot, sending the material out in a broad thin fan, and producing an extra dash of material in the pause at the end of each swing. This operation usually produces a black film on the sides of the stones facing the worker, but an examination of the other or far sides of the same stones will show them to be largely without any coating. To avoid this, one or two men should be trained to do careful pouring by holding the spout of the can a few inches from the stone and pouring a narrow strip while walking across the road. Every stone should appear perfectly black, and there should be evidence of complete penetration without any formation of pools of binder. A trained man will soon notice and touch up any places he may have missed and it will be found most economical and successful to keep a couple of trained men to do all the pouring. They may be kept supplied with full cans by a sufficient number of laborers carrying material from the heating kettle.

Stone screenings free from dust should now be applied to this course in only sufficient quantity to prevent the roller from sticking, and the surface should be rolled until it no longer creeps.

If a soft rock is used it may be necessary to sweep the surface before applying a seal coat which can not be made to adhere properly where dust is present. This seal coat should be spread thin and in just sufficient quantity to coat the surface. It should be immediately followed by a thin scattering of screenings and final rolling. An excess of screenings should be avoided. Should the surface show a tendency to bleed, additional screenings can be added from time to time but only in sufficient amount to take up the excess of bitumen. By following the usual method of procedure in construction by the penetration method and carefully looking after some of the smaller details above mentioned, entirely satisfactory results should be obtained. Our experience has demonstrated this and it will no doubt be found to be the best method for communities which have not the equipment for properly carrying out construction by the mixing method.

The selection of a proper grade of bituminous material for the several forms of maintenance or construction work would of itself form subject matter for a lengthy discussion. A highway engineer who is held responsible for the behavior of such materials should make an effort to familiarize himself with their characteristics, and learn what is best adapted to his various needs. His purchases had best be made upon a specification and he should assure himself by laboratory tests that he is obtaining the specified grade and character of material desired. It is fully appreciated that this may not always be convenient and that it may at times result in a slight delay of the work. When, however, a project involves the expenditure of thousands of dollars, it is far better to have the future success of the work protected by slight delays, if necessary, than to take for granted a material which may very frequently be wholly unsuited for his purposes.



A Planer for Smoothing Bituminous Roads.

A Road Planer for Bituminous Surfaces.

(STAFF ARTICLE.)

In bituminous road construction by the penetration method the surface sometimes becomes wavy and bumpy. In order to improve this condition without removing the top dressing the bituminous road planer shown in Fig. 1 was designed by Mr. W. T. Headley, president of the Headley Goods Roads Co., Philadelphia, Pa.

The object of this machine is to cut off the high places and deposit the material in the low ones or to waste it along the side. The planer has three sets of cutters, placed at different elevations. The front row is set about 1 in. above the bottom of the runners, the second cutter about ½ in. above and the third even with the bottom of the runners. The smoothing knife is also placed even with the bottom of the runners. In operation, the front row of cutters taeks off the bump, the second and third rows cut deeper and the steel knife spreads the material either into the depressions or allows it to pass out through an opening in one of the runners. The planer is drawn either by horses or a road roller and is weighted with extra weight, according to the kind of surface to be planed. The device was first used on some of the penetration work done in 1910 on the New Jersey state roads, which during the summer of 1911 had become wavy and bumpy. It gave quite satisfactory results in reducing the waves. It has also been used by the Massachusetts Highway Commission. It is stated that when the machine is properly operated a surface treatment can be planed off without pulling it loose from its base.

Letter patent for this machine has been granted to Mr. Headley. The Headley Co. does not manufacture the planers for sale, but can arrange to have them built should anyone desire them.

Fixed Carbon in Bituminous Materials: Its Determination and Value in Specifications.

Fixed carbon requirements have been introduced largely in specifications for paving asphalts and road binders. The value of the fixed carbon test, however, has been subjected to considerable question and in many instances much confusion has arisen through improper and empirical interpretation of results. Fixed carbon determination must be properly considered in connection with other analytical data and, further, in connection with the character of the bitumens under examination. When so considered many chemists and engineers are of the opinion that the fixed carbon test has a decided value in specifications and is capable of yielding much information to the experienced asphalt analyst. A valuable discussion showing in what particulars this test is of value is given in a paper presented at the Cleveland meeting of Section D of the American Association for the Advancement of Science by Lester Kirschbraun, Asphalt Chemist, City of Chicago. This paper, practically in full, follows:

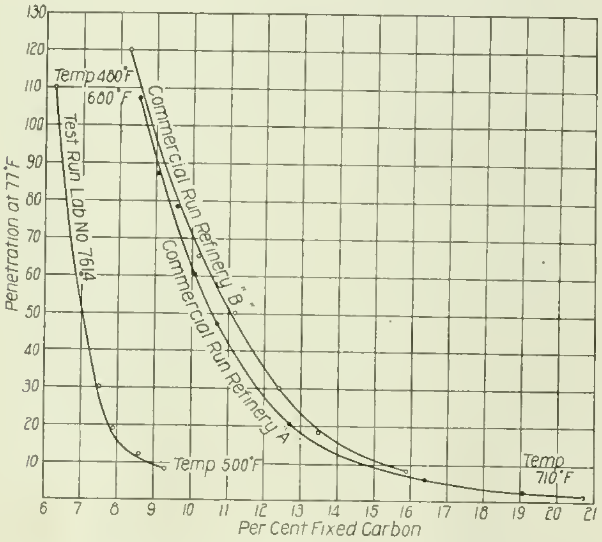


Fig. 1—Curves Showing Relationship Between Consistency and Fixed Carbon.

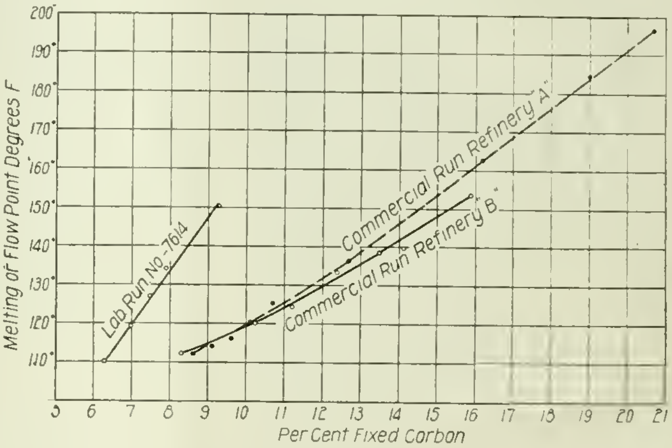


Fig. 2—Curves Showing Relationship Between Melting Point and Fixed Carbon.

A sample of one gram of the bitumen to be examined is weighed into a previously tared platinum crucible of about 30 cc. capacity, provided with a close-fitting cover. This is ignited for exactly 7 mins. on a platinum triangle over a bunsen burner carefully regulated so as to give a flame 6-8 cm. high to the top of inner cone and fully 20 cm. high to the tip. The platinum crucible is placed ½ cm. above the tip of the inner cone. The ignition should be carried out on a place free from drafts and permitting a steady flame. At the end of 7 mins. the crucible is removed from the flame, cooled in a desiccator and weighed. It is then returned to the flame, uncovered, turned on its side to give access to air, and ignited until all carbonaceous matter is removed. The cover is ignited to remove carbon deposited upon the under side. The crucible and cover are again cooled and weighed, the weight subtracted from that previously obtained, representing the fixed carbon. When the bitumen carries mineral matter containing carbonates, the ash in the crucible is treated with a few ccs. of a saturated solution of ammonium carbonate, dried, and ignited at a low heat to remove excess of carbonate and the corrected weight of ash obtained.

The percentage of fixed carbon is calculated to the weight of the original sample less the mineral matter obtained in the ashing. When notable amounts of "free carbon" are present in the bitumen, the result may be reported as fixed carbon less free carbon. The author, however, prefers to report the fixed carbon as obtained for the reason that the organic non-bituminous residues reported by the usual methods of extraction are probably seldom actual elemental carbon, but more often highly dehydrogenized hydrocarbon or hydrocarbon derivatives. In cases where it is desired to obtain a fixed carbon figure apart from such non-bituminous matter, a portion of the soluble bitumen may be recovered from extraction for this purpose.

In the hands of a single operator, uniform and consistent results may be obtained by this standard method, but skilled analysts are known to vary considerably upon check determinations. The heating value of the gas available in different localities is probably a large factor in this variation. Where certain natural gas is available for making this test, variation of ⅔ per cent are known to result on this account. The quality of gas used is, of course, beyond the control of the analyst, although in the larger cities the heating value of artificial gas is fairly well regulated. Aside from this, however, other considerations enter into the accuracy of the determinations—the exact size of the crucible, the tightness of the cover, freedom from draft, the position of the crucible in the flame and the exact size of the flame, are all important factors. Considerable stress should be laid upon this latter. The standard method permits of variation of 2 cm. in the height of the inner cone and the exact length of the flame is limited only to a minimum.

In the author's laboratory a bunsen burner of the Chaddock type is used for these determinations. This affords a protected and steady flame. The same burner is used for all determinations. The flame is adjusted to a scale laid off on a wood rod, graduated at a point level with, 8 cm. and 20 cm. above the top of the burner. Before making the ignition, the rod is placed on the hip of the burner and the flame adjusted exactly in accordance with the graduations. A further advantage results from the use of a Chaddock burner in that the distance of the triangle (on the crown) above the top of the burner is necessarily always constant. The importance of a more exact regulation of the flame may be illustrated by the following experiment wherein determinations were made upon the same sample under varying conditions of the flame, all other factors being the same and the crucible adjusted in each case ½ cm. above the tip of the inner cone.

8 cm cone, 20 cm flame	13.59
6 cm cone, full flame 25 cm	12.64
8 cm cone, 20 cm flame	13.55
6 cm cone, full flame 25 cm	12.52

The determinations were made in the order given so that the effect of the manipulation in changing the flame, might be observed on the duplication of results.

It is evident that very exact conditions of manipulation are necessary to obtain consistent results in these determinations. The discrepancies resulting from careless manipulation or even from variation of the flame with the limits given as standard may be sufficiently great to invalidate the correctness of deductions or proper interpretation of the results. It is believed that these factors are accountable for much of the lack of confidence in fixed carbon tests, and that with closer attention, a high degree of accuracy may be attained. Where conditions of gaseous fuel give comparatively high results, there should at least be no difficulty in making relatively correct and consistent determinations, and specifications in such case can be modified and interpreted accordingly.

In considering the significance of fixed carbon and its consequent value in specifications, some discussion of the derivation of the fixed carbon yielded by bitumens upon ignition, is pertinent. The character of the hydrocarbons present in the bitumen is a determining factor in their yield of fixed carbon. According to Richardson, these data show the "relative proportions of carbon and hydrogen in the bitumen under examination. In the case of paraffine hydrocarbons of the formula $C^nH_2^n + 2$ no fixed carbon is left on ignition, while the amount increases with each diminution of the proportion of hydrogen to carbon, until in Grahamite as much as 50 per cent is found, where the relation of carbon to hydrogen is as 8 to 1." In other words, the yield of fixed carbon in bitumen is commensurate with the degree of condensation of the particular classes of hydrocarbons present in such bitumens.

This condensation is brought about by natural agencies in the native bitumens. The manufacture of solid bitumen from native liquid bitumens involves the production of more condensed aggregations of hydrocarbons as the resultant product. This is a function of the process used, and may be effected by means of dehydrogenization by air or sulphur, by oxygenation, by the splitting off of hydrocarbon, or merely by the concentration of more condensed hydrocarbon through the removal of lighter ones by distillation. Several means of condensation may be employed in the same process.

Bearing in mind the fact that fixed carbon is a measure of condensation of any given aggregation of asphalt hydrocarbons; and that such hydrocarbons may vary in degree of condensation to the extent that they become

TABLE I.—FIXED CARBON IN BITUMINOUS CEMENTS WITH THE FOLLOWING FLUXES.

	Paraffine. Per cent.	Illinois. Per cent.	Texas. Per cent.	Calif. Per cent.	Character of Cement.
Grahamite	14.5				Punky, non-homogeneous.
		13.3			Dull, greasy, short.
			12.3		Bright.
				12.4	Bright, ductile.
Calif. "B"	16.3				Dull, short, granular.
		15.2			Dull, granular.
			13.6		Slightly granular.
				12.6	Homogeneous, ductile.
Cuban	13.9				Dull, short.
		13.6			Bright.
			11.9		Bright, ductile.
				11.9	Bright, ductile.+

insoluble in certain fluxes, in carbon tetrachloride, and even in the usual solvents for bitumen, the value of this test will be further and more specifically discussed.

It is the belief of the writer that the fixed carbon characteristics of various paving bitumens are significant in three particulars: First, as a means of identifying and classifying native bitumens; secondly, as a check upon the suitability of flux combinations with hard bitumens, and again, in the production of oil asphalts, as an important means of controlling the quality and uniformity of the product.

With reference to the value of fixed carbon as a means of identification of native bitumens, little need be said. In connection with other data, this feature affords an important item of identification. As is well known, the Grahamites yield very high fixed carbon, ranging from 30 per cent to 55 per cent. The solid native asphalts used in the paving industry yield approximately 9 per cent to 26 per cent of fixed carbon. Gilsonites show 12 per cent to 17 per cent, the harder varieties giving the higher yield. Distinction between Gilsonite firsts and seconds and their quality is indicated by fixed carbon. The fixed carbon characteristics of the individual paving asphalts are fairly well defined for each kind and this feature affords a means of check of uniformity of such natural products and sometimes of the uniformity of their refinement. This function of the fixed carbon test is not directly pertinent to specifications so far as identification is concerned, but is of much value to the analyst in affording knowledge as to the material dealt with, and correlating with such knowledge a proper treatment in fluxing and handling.

Fixed carbon as applied to native asphalts or partially fluxed refined products, has no place in specifications. The preparation of asphaltic cement or binders from hard, highly condensed bitumens is a matter of great importance. As previously indicated, such highly condensed products vary in solubility in the different kinds of fluxes available for softening purposes, some fluxes being totally unable to dissolve these products. The life and cementing powers of asphaltic binders are directly dependent upon the permanency and extent of solution of the harder in the liquid hydrocarbons present. The reference to solution is made here, not in the strict sense of the word, but by considering combinations of this character as colloidal systems of widely varying degrees of dispersion. Certain of these highly condensed bitumens such as pitch produced by cracking paraffine oils are entirely insoluble in paraffine flux so that only a mechanical mixture of oil and solid results from attempts to flux them. They are likewise insoluble in semi-asphaltic fluxes but are dissolved by strictly asphaltic fluxes. With other highly condensed bitumens a granular or non-homogeneous compound results with paraffine fluxes, representing a minor degree of solubility, increasing generally as the flux or refined asphalts contains more of the heavy asphaltic malthenes which are of high solvent character. The effect of the presence of the heavy asphaltic malthenes, is to "dilute" the highly condensed hydrocarbons, which yield high fixed carbon, thus producing bituminous cement of proportionately lower fixed carbon yield. Some illustration of the variation of fixed carbon in cements in accordance with the character of the flux is given in Table I; all cements between 50 and 60 penetration.

There is no mechanical method of measuring the condition of solution of these combinations, but the physical appearance together with the ductility gives a general index of this feature. The reference to "punky" indicates a putty-like condition, similar to shoe polish and will be recognized by those familiar with bituminous products thus described. In the preceding illustration the same lot of flux was used throughout, so that this factor remained the same. In the use of California flux, the higher fixed carbon yield of this offsets in some instances the dilution of the hard bitumen.

In fluxing combinations, there is a generally improved condition of solution as the more asphaltic fluxes are used in combinations with the hard bitumens. The higher fixed carbon figures are associated with an imperfect state of solution, and the lower ones with more satisfactory combinations or greater degree of dispersion—or if the term might be used, with a better "grading" of hydrocarbons from heavy to light.

The foregoing tabulation is not directed to any particular type of bituminous cement, but is given rather as illustrating the principles involved in this feature of the discussion. It must not be assumed that a comparatively low fixed carbon yield without reference to other tests necessarily signifies in all cases a proper flux combination, but in dealing with hard bitumens fluxed back to paving consistency, the writer believes the reverse may be correctly stated—that a high yield of fixed carbon invariably signifies an improper fluxing, producing a cement of lower or impermanent binding value. This may be often recognized by the physical appearance, homogeneity or ductility of the cement. If these latter characteristics remained permanent through aging, it might be safe to place complete reliance upon them for determining these features, but as a matter of fact, combinations of the kind referred to are particularly liable to change and their appearance when fresh and especially their ductility is subject to great loss upon standing, so that the significance of a high fixed carbon content is of evident importance in such connection.

Fixed carbon, of course, varies with the consistency, naturally decreasing in a given combination as the amount of flux used and the consistency increases. It is evident that an apparently low fixed carbon yield obtained at a high consistency may be in reality excessive. For example, a fixed carbon yield of 12 per cent in a fluxed cement may not appear excessive when considered alone, but if associated with consistency of 200 penetration would be of undoubted significance. Therefore this must be interpreted in accordance with consistency, and the correct significance may be conveniently arrived at by preparing a curve for the given combination covering a sufficiently wide range of consistency to give the relationship desired. Such a curve is given hereinafter for an oil asphalt cement.

Where specifications are so drawn as to cover the character of fluxes used in the cement and carefully prescribe the kinds and amount which may be employed under various conditions, a fixed carbon requirement is hardly necessary. However, very large quantities of prepared cements and binders for bituminous roads and pavements are now purchased and used under such conditions as to make it impracticable to govern the fluxing operations directly. Under such conditions, particularly when a number of bitumens, rather than a single combination may be compounded into the marketed product, the value of fixed carbon requirement in the specification as applied to the cement, becomes apparent.

The foregoing discussion has referred only to conditions in which hard, highly condensed bitumens are fluxed to paving consistency. In dealing with asphaltic products brought to grade by distillation from liquid native bitumens, a somewhat different and more important significance may be attached to fixed carbon. As has been previously stated, the formation of this class of materials involves the production of more condensed products than the liquid bitumen from which they are made. In the distillation of liquid bitumen for residual asphalt, it is recognized that it is desirable to avoid cracking or the splitting off of hydrocarbon so far as possible, in order that the residual may retain its binding strength and permanency to the greatest possible useful extent. The splitting off of hydrocarbon may take place in a comparatively slight degree, or it may go so far as to evidence itself in the production of "carbenes" or even of insoluble hydrocarbon and free carbon. For a bitumen of a given character, the splitting off of hydrocarbon with consequent condensation evidences itself by greater fixed carbon yield. It follows therefore, that the yield of fixed carbon upon solid bitumens produced by distillation, becomes an index of the extent to which the splitting off operation takes place as compared with a simple concentrating of condensed hydrocarbons already present in the crude bitumen. Fixed carbon thereby affords an index of the severity of heat treatment, ranging from evidences of lesser degree to the accompaniment by carbenes or insoluble hydrocarbon or free carbon.

Where solid bitumens are produced by condensation of residuum with air without distillation taking place, a normal fixed carbon content will result from such condensation, greater of course than that of the residuum. If, however, the residuum be cracked or partially decomposed in preparation, an abnormally higher fixed carbon will result; likewise if the air treatment be so conducted as to result in distillation by splitting up of hydrocarbon, the product will show higher yield of fixed carbon.

In order to illustrate the effect of heat treatment in the distillation of native liquid bitumen, the writer has prepared data giving the range of fixed carbon figures upon samples taken at various intervals from a still during a commercial run of residual asphalt under known temperature conditions. A lot of the same crude as used in this run was subjected to careful distillation in a laboratory still under conditions, including lower temperature, which minimized if not entirely avoided, all splitting up or cracking action. The results are given in graphical form in Fig. I, wherein the commercial run referred to is designated refinery "A." The results obtained upon a series of commercial samples from refinery "B" are likewise given, although no data were obtainable in connection with these samples as to temperature conditions during their preparation. Fig. I gives the relationship between consistency and fixed carbon. A sharp turn in the curves is noted at the harder consistencies, which might be construed as representing conditions of greater severity. This, however, is not strictly the case but is due rather to the imperfection of the penetration test which does not accurately measure relative hardness, particularly at the low

TABLE II.—ANALYSIS OF RESIDUAL PRODUCTS.

Pen.	42	46	80	41	26	22	46	32
Fxd. C.	14.7%	14.3%	16.8%	16.9%	16.6%	20.0%	17.0%	18.6%
Sol. CS_2	99.8%	99.3%	99.7%	99.7%	99.7%	97.2%	99.0%	98.0%
Sol. CCl_4	98.8%	96.5%	96.0%	96.0%	96.9%	86.6%	94.4%	90.9%
Ductility	115+cm	110+cm	110+cm	60.0cm	55.0cm	18.0cm	7.0cm	4.5cm

penetrations. In Fig. 2 the flow or melting point relationship with fixed carbon is given, the former representing relative hardness to a more accurate extent. It is noted that these latter curves approach a straight line, indicating nearly direct variation between these elements.

It is apparent that a difference of some 200° F. in heat treatment of the bitumen results in a showing of materially different fixed carbon characteristics in the resulting products. At the low temperatures the distillation approaches closely to a true concentration of condensed hydro-carbons originally present in the crude. The difference between this and the commercial run is evidently represented by additional condensation due to the higher heat treatment in splitting off hydrocarbon. The writer considers the fixed carbon characteristics of the commercial runs given as representing the better grades of this kind of product now available commercially upon the market.

As an illustration of the effect of this action to an undesirable degree, a few analyses of residual products of like asphaltic crude is given, the first two of which were produced from the same crude as used in the preparation of samples of series "A."

Of the cements in Table II, the third has a history of service test. It was laid in a sheet pavement in 1910 on a residence street. The pavement marked well in 1910 and passed through the winter with one crack. The following summer it was harder but still marked. It cracked unusually severely in the winter of 1911. In the summer of 1912 it was very hard in the hottest weather but showed freely the calk marks of previous traffic, the pavement being too stiff to iron out. The general appearance indicated very rapid hardening of the cement.

TABLE III.—EFFECT OF CHARACTER OF CRUDE ON FIXED CARBON.

	Gravity. Crude.	Fixed carbon. Crude.	Fixed carbon. Distillate.	Fixed carbon. Product.	Yield of product.
Crude A...........	12.5° B	3.7%	.02%	6.3%	60%
Crude M...........	18.0° B	7.5%	.....	15.8%	50%

Inspection of these results shows the effect of condensation in various degrees to the final stages where the material has retained but little binding value and is characterized by little ductility, by the presence of considerable amounts of carbenes and by insoluble carbonaceous matter. It will be of interest to locate the fixed carbon points of these samples in comparison with the curves given for the acceptable grades of the commercial article.

Attention may be called at this point to the fact that some crude oils normally give rise to asphaltic residues of much higher fixed carbon yield than the materials used in the foregoing illustration. This is possibly due to an originally large content of highly condensed hydrocarbons, and to the nature of the particular hydrocarbons present, as, with certain crudes it is undoubtedly an effect of the presence of unstable sulphur compounds which may promote condensation in the usual manner. In such cases a relatively high fixed carbon content in the residual product is not necessarily related to the severity of heat treatment and in dealing with such residuals, specifications and proper interpretation of fixed carbon characteristics must be based upon data obtained by careful run of the crude under known conditions.

The effect of the character of crude upon the fixed carbon yield of product prepared therefrom, is illustrated in Table III upon two samples treated by test runs as previously illustrated.

It will be noted that by careful distillation the formation of condensation products is but little greater than that derived from the normal content of the crude and that the value of 15.8 per cent of fixed carbon obtained in the residual of crude "M" is quite normal for this, although it would not be so for crude "A."

It will be seen that the determination of fixed carbon in oil asphalts produced by distillation, affords an important means of control of the quality, uniformity and care used in preparation of the product. The excess of fixed carbon yield above that normally resulting by concentration from the condensed hydrocarbons present in the crude, is a measure of condensation produced by the effects of the heat treatment in splitting off of hydrocarbon. It is apparent that the best practice should limit this action to a minimum and that specifications should control this by a fixed carbon limit within which the product will retain to a useful and permanent extent the qualities necessary for pavement and road construction.

The writer has attempted to explain somewhat in detail his understanding of the significance of fixed carbon determinations, and to present, so far as possible, laboratory data upon which the conclusions are based. It must be understood that this test like others employed in the examination of bitumens, must be interpreted and applied in specifications upon the basis of a broad understanding of the relationship between the various chemical and physical characteristics of paving bitumens and their origin and methods of preparation for the market.

GENERAL ARTICLES

A Study of Motor Truck Operation and Economy in City Sale and Delivery of Sand and Crushed Stone.

Contributed by R. W. Hutchinson, Jr.

A recent report prepared by the National Association of Automobile Manufacturers on the lines of industry which were most interested in the use of motor transportation disclosed the fact that in the engineering and contracting businesses there were 482 inquirers on motor trucks as against about 300 for the next closest industry. These figures indicate the activity in the contracting field in investigating the opportunity for the utilization of motor transportation. Another very healthy indication of the appreciation of motor transportation by contractors is evidenced by the frequent requests which motor truck manufacturers receive for the rental of trucks for some particular contracting work.

One of the most interesting examples of the value of the motor truck in the contracting business is shown in a traffic investigation recently made by the transportation cost department of the International Motor Co. The company in question, the Crescent Delivery Co., New York city, is engaged in the sale and distribution of sand, gravel and broken stone. The transportation equipment consists, in addition to horse-drawn trucks, of three Mack dump trucks of 7½ tons capacity.

Conditions.—All the hauling is done from the company's dock, at the foot of E. 35th St. (with very few exceptions). The materials are delivered for the most part in the downtown section, so that the hauls are short, the average distance being 2.95 miles. Time required for loading and unloading is reduced to a minimum. The various materials handled are carried in large overhead hoppers, which are kept filled by one stem and one electrically operated boom derrick, with clam shell buckets. The trucks run underneath either one of three hoppers, there being one each for sand, gravel and broken stone, from which they are loaded, in a few seconds by opening a swinging gate, or valve, in the bottom of the hoppers. These gates are operated by attendants, so that the truck drivers remain on their seats, and move their trucks as soon as filled to make room for other vehicles, of which there are usually a number waiting in line. The motor trucks, as a rule, are given precedence over the horse wagons, not being required to wait in line.

The unloading is accomplished with equal facility, on account of thep ower dumping bodies, although there are occasional slight delays when the drivers must see the contractor's foreman to ascertain where load is to be dumped, etc. These cases seem to be the exception.

The trucks, being confined to city work, are operated over uniformly good roads, excepting at the dock, where the accumulation of broken stone, and the fact that more or less maneuvering is required, doubtless affect the tires to some extent, by abrasive action.

The only causes of delay are those noted above, which are almost negligible, and those due to congestion in traffic in the downtown section.

Equipment.—The three trucks are of standard construction, having bodies of nominal five yards capacity. By loading with a "crown" it is possible to load them with 6 cu. yds. They were delivered with dual 42x6 in. tires, of block type, which have recently been changed to 42x5 in. triple tires. The trucks are geared for a maximum speed of 10.2 miles per hour, the original 13 tooth sprockets having been changed to the present 11-tooth size.

Operation.—The trucks are operated nine hours daily, in which time 6.7 trips are averaged. The trucks make an average speed of 9 miles per hour, not including traffic or other stops, while the actual speed, as governed by traffic conditions, is 7.3 miles per hour. The maximum speed, with engine limited to 1,000 r. p. m., is 10.2 miles per hour.

The average time required to load, from the time the truck arrives at the dock till it leaves the office where drivers receive delivery slips, is 5 minutes. The average time for unloading is estimated to be 8 minutes. The loads vary from 15,000 lbs. in the case of broken stone to 16,200 lbs. for a full load of sand.

The condition of the three machines at this time is excellent and it is evident that they are well looked after, even to the extent of frequent washing and polishing of brass. The drivers are better than the average and take good care of their machines.

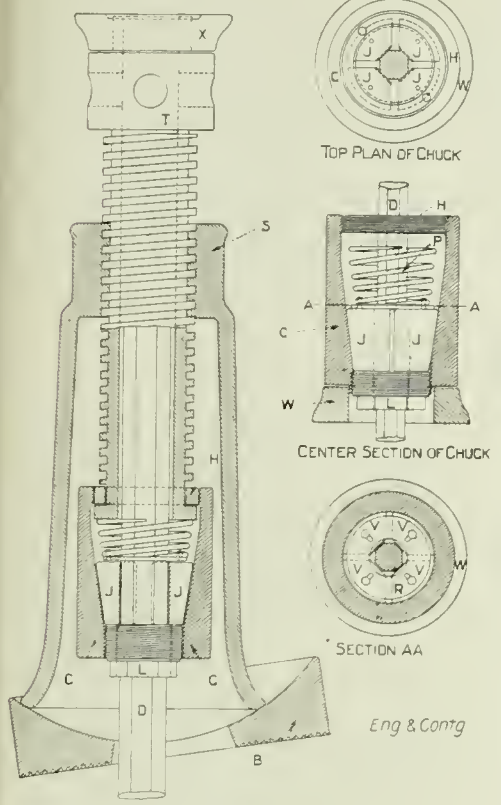
Maintenance.—The garage facilities are of the best, and the location of the garage in E. 31st St. reduces dead mileage to a minimum. No facilities are at hand for repair work except light repairs, as there are no machine tools, benches, etc. Ample provision for daily attention, such as oiling, greasing and minor repairs and adjustments, is made by the employment of one mechanic, all of whose time is given to that work. Practically no spare parts nor equipment are kept on hand, and in view of the close proximity to the service station this seems unnecessary.

The figures for mileage, trips, etc., are based on the actual performance of the trucks for two weeks—from Nov. 11 to 23, inclusive, and were obtained from authoritative sources. The figures for average speed are based on the observations under various conditions.

Operation.—The following tabulation summarizes the data and presents an estimate of the cost of operation;

Conditions:	
Average daily mileage....................	39.5
Average trips, miles....................	6.7
Average length of haul....	2.95
Average load	8
Assumption:	
Working days per year..................	300
Miles per year (each truck)............	11,850
Miles life of truck......................	100,000
Investment:	
Three 7-ton "Mack" dump trucks......	$17,400.00

Fixed charges:	
Interest on $8,700, at 6 per cent........	522.00
Insurance: Fire, 2% on 80% of value..	278.40
Fixed depreciation (exclusive of tires) on $15,450, at 10 per cent............	1,545.00
Wages, at $22.50 per week..............	3,510.00
Garage, at $20 per month..............	720.00
Total fixed charges.................	$ 6,575.40



Section of Paul-Mitchell Drill Pulling Jack.

(B, cast iron base; S, standard bell; T, hollow screw; X, disk jack cap; W, chuck washer; L, screw sleeve; C, hollow chuck; J, ¼ conical gripping jaws; H, thrust bushing; R, spring base, slotted disk; P, spring.)

Operating charges:	
Depreciation: 1 per cent per 1,000 miles for all mileage in excess of 1,000 miles	285.83
Maintenance at $0.079 per mile (approximately)	2,821.00
Tires at $0.0809 per mile.................	2,877.42
Gasoline at $0.067 per mile.............	2,380.07
Oil and grease at $0.013 per mile.......	468.00
Total operating charges............	$ 8,832.32
Total cost per annum..................	15,407.72
Average cost per day....................	17.12
Average cost per ton mile..............	0.108

On two consecutive days in the above period the trucks averaged 60 miles per day, and, while this is considerably in excess of the general average, it was accomplished without unduly speeding, the machines now working overtime, so that it is apparent that the fact that the average daily mileage is only 39.4 miles is not due to any limitation of the machines, nor of loading and unloading facilities.

It seems to be the policy of the company to hold its equipment more or less in reserve to the horse wagons, and while the wisdom of this policy cannot be questioned in view of the fact that the horse equipment costs practically the same whether working or idle, it must be borne in mind that the condition is unfavorable to the most efficient performance of the trucks. On the days when the machines are kept busy the efficiency, or the ratio between ten mile performance and cost of operation, including fixed charges, must certainly be considered better than that of the horse equipment.

Conclusions.—The conditions as outlined above disclose very little which is abnormal or which would justify any dissatisfaction on the part of the owners. The short hauls, traffic delays, etc., are inherent to the business, but these are largely overcome by the exceptional facility with which the trucks are loaded and unloaded. The drivers are under efficient supervision, and there seems nothing in connection with the handling of the trucks while in service that is subject to any improvement.

The average consumption of gasoline for the period covered by this report, and since it was known that an investigation was in progress, has been considerably less than what it was before, according to Mr. Warren, secretary to the company, and while no deduction should be drawn from this fact, it suggests a better check on this item of expense. The particular value of this test to contractors is that it proves that a motor truck is equally as valuable for short haul as for long haul work when facilities for rapid loading and unloading can be obtained.

A Jack Screw for Pulling Stuck Drills and Sounding Rods.

Contributed by Charles C. Mitchell, Millbrook, New York.

The time lost and the annoyance caused by sticking drills are known to all who have charge of drilling operations. The causes of drills sticking are many, but the most important perhaps are: (1) Wabbling of the drill driving apparatus; (2) one side of the bit breaking off, causing the drill to cut unevenly and work to one side; (3) improper sharpening or selection of the size of bit to follow that preceding; (4) seams or faults in the rock, causing the drill to work to one side; (5) stones or pieces of iron dropping into the drill hole and binding against the drill; (6) "miring" of the drill by an over accumulation of drill cuttings in the hole, particularly in soft rock. Although care and vigilance will prevent drills from getting stuck frequently, yet in spite of all precautions sticking will occasionally happen, and when it does the drill must be pulled or abandoned.

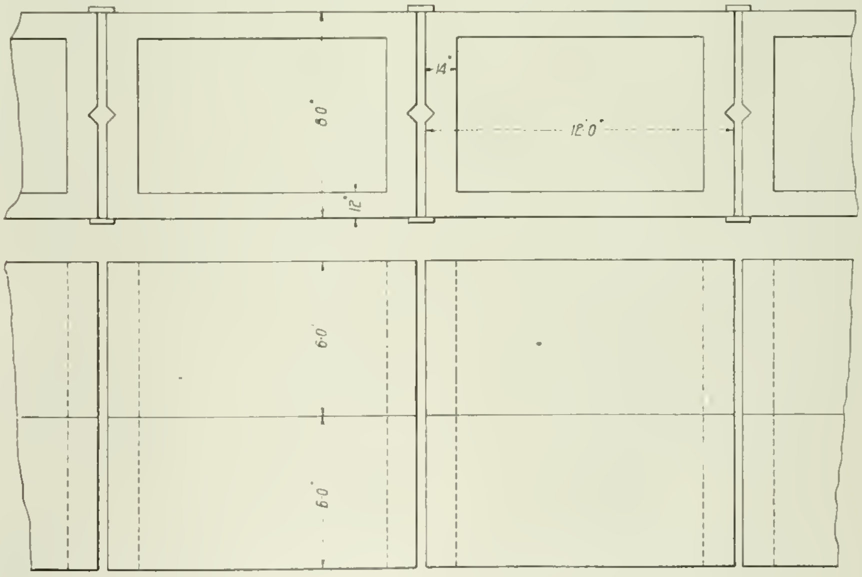
When the drill is lightly stuck a jack head slipped over it with a wedge alongside, or a cramping dog on the order of a sheathing puller, or a pipe wrench or a U-bolt clamp and chain with a lever will generally "start" the drill. When these simple means fail a clamp and chain may be used attached to a short iron beam resting on two jack screws or a pine derrick, with block and pully, or some similar pulling device, may be installed. All of these devices have the disadvantages of lack of regularity or not giving a stiff pull and of pulling on one side or eccentrically. More important than these objections are the facts that they are slow and laborious to install and difficult to handle where the working space is restricted or the ground is uneven or on a steep slope. Frequently so serious is the task of removing the stuck drill that the hole is abandoned and the drill left to be recovered when the rock shall be blasted out in the progress of construction.

Similar sticking of sounding rods is common. Usually the earth last penetrated by the rod when it is "driven home" with a sledge will grip the bar so firmly that it requires considerable pull to withdraw it.

The foregoing explanation leads up to the description of a drill and sounding rod pulling device which has been successfully used on the subway work in New York city, at the Kensico Dam on the Catskill Aqueduct and for pulling long tower driven drills going down 40 to 50 ft. in granite at Valhalla, N. Y. The device is illustrated by the accompanying drawing on which the various parts are marked and explained in the caption.

Briefly, the device is a hollow jack screw with a collar on its lower end, to which is attached a cylindrical gripping chuck containing a set of toothed gripping jaws in its conical interior. This jack screw stands on a saucer-shaped base which, as the sketch indicates, permits the jack to set vertically on sloping ground. In operation, jack and base are threaded over the drill. When the screw is turned upward its operation, pulling on the sleeve, compresses the spring, forcing the wedges tighter and tighter against the drill bar to which the force of the pull is transmitted. The standard jack, 3 ins. in diameter with ¼-in. pitch, has a lift of 8 ins. and if this does not loosen the drill bar sufficiently to permit of its removal by hand, a new grip is secured by simply turning the jackscrew backward, lifting again and so on, repeating until the drill bar is free. The apparatus, weighing only about 100 lbs., is then raised and the screw bushing turned upward until the jaws are loosened and the jack released and removed. Several sets of grip jaws are provided, so as to handle different sizes of drill rods.

As compared with the ordinary methods of pulling stuck drills this device is compact and portable and it gives a rigid non-binding pull. It is made in sizes to suit the work required to be done. For drills and testing rods less than 1¼ ins. in diameter we are using a 3-in. jackscrew 80 lbs. weight and 30 tons lifting capacity; for drills up to 2 ins. diameter of shank and 50 ft. long on heavy quarry drilling a 3-in. jackscrew 100 lbs. weight and 50 tons lifting capacity. The jack is controlled and marketed by Paul & Mitchell Co., Millbrook, N. Y.



Sketch of Reinforced Concrete Open Caissons for a Dam Foundation.

Waterworks Construction in Mexico—A contract for the installation of a waterworks system in the city of Matamoros, Tam., Mex., has been approved by the state legislature of Tamapaulis. The city council of Tuxtla Gutierrez, Chiapas, is also considering the question of a water system for the town.

Method of Constructing Foundations for a Small Dam Using Open Caissons of Reinforced Concrete.

The dam was 200 ft. long and 8 ft. high and was located on the Kickapoo River at Viola, Wis. It was necessary on account of the size of the job and the remoteness of the place to construct the dam by force account and as cheaply as possible. For these reasons and because of the small amount of equipment available, the engineer, Mr. W. G. Kirchoffer, Madison, Wis., decided to employ a method of foundation construction which he had previously employed with success in constructing reservoirs and wells at a number of places. As described in a paper before the Illinois Society of Engineers and Surveyors, the plan was to sink a row of rectangular boxes or caissons of reinforced concrete as indicated by the sketch on page 175. We quote from the paper as follows:

The forms were made of 2-in. plank in a substantial manner, so that they could be used several times. The concrete was reinforced with ½-in. round rods, spaced 1 ft. vertically and 3 ft. horizontally. The water in the river was from 1 to 3 ft. deep. The work was begun on the flats along the river and as excavation progressed, only the dirt was used for coffer dam about the forms. These rectangular sections were constructed end to end as they were sunk, and as soon as the top of one came close to the top of the water, another section was poured on top of it until a total depth of 12 ft. below the river level was reached. The material to be excavated was sand, gravel and clay, with some old logs and slabs scattered through it. The openings between the cribs or sections were closed by pouring concrete in the V-shaped openings left at the ends, as illustrated by the sketch. The space within the wall was filled with gravel, stone and clay. The whole foundation, including an apron in front of dam, was then covered with a slab of concrete 18 ins. to 2 ft. thick, upon which the dam was constructed.

This method appeals to me as being very practical where a full contractor's equipment is not available and work must be done at a minimum of cost and with inexperienced labor. It has the advantage of being cheap, saves time, eliminates many dangers of open excavation held by curbing and bracing, is effective and easily put in by men of little experience in construction work. It would seem to be a very practical method to use for the construction of not only circular reservoirs and small dams, as mentioned herein, but for small bridges, chimneys, monuments and other foundations where the ground is soft or where it is desirable to eliminate the use of a large amount of lumber for forms.

I am unable to give cost figures, as the work was carried on in conjunction with other work and the cost was not separated.

WATER WORKS

The Pitting of Steel Water Pipes Due to Mill Scale.

The point was made that the pitting of steel water mains is due chiefly to the nature of the surface scale formed on the pipe during the manufacturing process by George Whipple and Melville C. Whipple in a paper presented before the latest International Congress of Applied Chemistry.

It is usually considered by water works engineers that cast iron is preferable to steel for the smaller sizes of water mains, say up to 36 ins. diameter. Above that size steel is given the preference on the score of economy and facility in handling. This view was concurred in by the authors.

Although the use of steel for water mains is on the increase its more general adoption for that service is retarded by the fear of corrosion and the resulting short life of the pipe. This corrosion usually takes the form of pitting. Pitting of this character does not attack wrought iron pipe; it rusts more uniformly than does steel pipe.

In making experiments to ascertain the causes of this corrosion, samples of steel and iron were placed in jars of water by the authors, and in jars containing various corrosive solutions. It was found, however, that the immersion tests in tap water and dilute solutions progressed too slowly, while the use of strong solutions failed to duplicate in the laboratory the conditions of actual practice.

Finding these tests unsatisfactory, a test in which corrosion was accelerated by a current of electricity was used. By this electrolytic test corrosion was made to take place in ordinary water and, although the ordinary conditions of service were not reproduced, it was unnecessary to use an acid solution. This test presented the manner of corrosion as distinguished from the rate of corrosion better than the acid tests inasmuch as the question under consideration was one of pitting and not one of general corrosion. The results clearly showed that mill scale has a marked influence on the uniformity of corrosion in the formation of pits.

With regard to this electrolytic test, it should be observed that when two plates of iron are immersed in water and connected with a battery in circuit, a current of electricity will pass through the water from one plate (the anode) to the other (the cathode), and iron will be dissolved from the anode. In other words corrosion will take place. If the plate forming the anode is uniform in composition, the corrosion will be uniform over its surface. If the anode is not uniform in composition, the corrosion will be greater at some points than at others, since the density of the current will not be uniform over the plate.

The mill scale on the surface of steel differs in chemical composition from the metal beneath it, also its thickness varies, and it exists commonly as a series of flakes; hence it was expected that the current density would vary and that the corrosion of the metal would occur in spots. Plates of steel ingot iron and wrought iron were thus tested, with the result that the wrought iron rusted in streaks, which covered nearly the entire surface, while the steel and ingot iron rusted in spots, the pitting in the steel being the more pronounced.

A second series of tests were made, but the mill scale was removed in each case by grinding on an emery wheel; these plates corroded uniformly without any sign of pitting. Further experiments were made with reference to the fact that mill scale may exhibit marked differences of potential toward iron due to its varying composition and thickness. According to the electrolytic theory of corrosion a solution of iron is brought about by the action of current set as between different particles of the metal which have different electrical potentials. Uniformity of composition of the metal tends therefore to diminish corrosion; it is believed that pits in steel occur at points where the particles have greater differences of potential than that of the metallic iron and the mill scale. It is thought that these may result from segregation of the impurities during the cooling of the ingot, or may be due to the effect of rolling, cooling or other treatment.

In order to study the potential differences between the mill scale and the raw metal beneath, the method was adopted of connecting the raw metal of a sample with its mill scale by means of wires and placing a very sensitive galvanometer on the circuit. It will be understood that one wire was connected to the metal and one wire to the mill scale. It is interesting to note that when both poles were connected with the raw metal no current could be detected, but when one pole touched the raw metal and the other pole touched the scale a noticeable current was set up. On the steel plates the current sometimes differed greatly at points only 1 mm. apart, and it was found that the current varied with the thickness of the scale generally, but not always. In order to compare the different samples, areas of 1 sq. cm. were marked out in squares, and nine spots were tested in each square. The results were tabulated and show a surprising difference in the intensity of the current at various points. Microscopical examination of the scales showed in many instances the presence of minute cracks, through which water might enter and come in contact with the metal.

Experiments made with copper steels showed that, while the presence of small amounts of copper in steel may retard corrosion by strong acids, they do not serve to protect the steel against corrosion in weak acid solutions or in ordinary water. The presence of copper does not materially alter the electrical conditions of the scale, and does not therefore protect the metal against pitting. American ingot iron plates, so far as failure by pitting is concerned, proved to be somewhat better than steel, but the difference was insufficient to justify any great difference in cost. Wrought iron is much less likely to pit, and only under conditions of severe chemical corrosion sufficient to remove the mill scale and silicates, or under conditions of atmospheric corrosion where the electrolytic form of corrosion does not predominate, would the two metals be equal.

The effect of removing the mill scale is marked. A partial removal tends to increase corrosion, and thus where scale becomes chipped off in handling and in fabrication there is greater opportunity for electrolytic action between the scale and the raw metal. The complete removal of the mill scale appears to prevent pitting absolutely, and in the tests made after the removal of the scale there was not a single instance of pitting. The authors suggested that some method might be found to modify the mill scale during manufacture so as to make it more uniform, to improve its electrical condition, or to make it more easily removable.

Design for Increasing Depth of Brick Reservoir by Means of Reinforced Concrete, and Design of New Circular, Open, Reinforced Concrete Reservoir for Sioux City, Ia.

(STAFF ARTICLE.)

Sioux City, Ia., while compactly built in the business district, has a number of more or less isolated groups of houses which are spread out over an unusually large area in proportion to the population of the city. In topography the city lies nearly level in the business center, but rises, in the residence districts, to hills, some of which are not far below the level of the existing distributing reservoir.

These conditions make the furnishing of an adequate supply of water at a satisfactory pressure more than usually expensive for certain parts of the city. Long lines of mains are required to reach the outlying groups of buildings, and the altitude of the ground upon which some of these are located is such that the friction losses in the long mains use up a large part of the pressure which would otherwise be available from the reservoir.

The existing reservoir has a capacity of only a little over 1,700,000 gals. The flow line of the reservoir is not very much above the elevation of some of the territory in the northern part of the city and is only about 75 ft. higher than the district known as Morningside Hill. In a report to the Department of Water Works, Mr. Dabney H. Maury stated that it is exceedingly important that there should be more storage capacity, and that the elevation of the flow line of the present reservoir should be made higher.

The enlargement of the existing reservoir and the construction of a new reservoir are two of the chief structural features of the extensive improvements to the Sioux City water works system, which will follow the adoption of Mr. Maury's report. Contracts for this work have been awarded and construction work will begin in the spring.

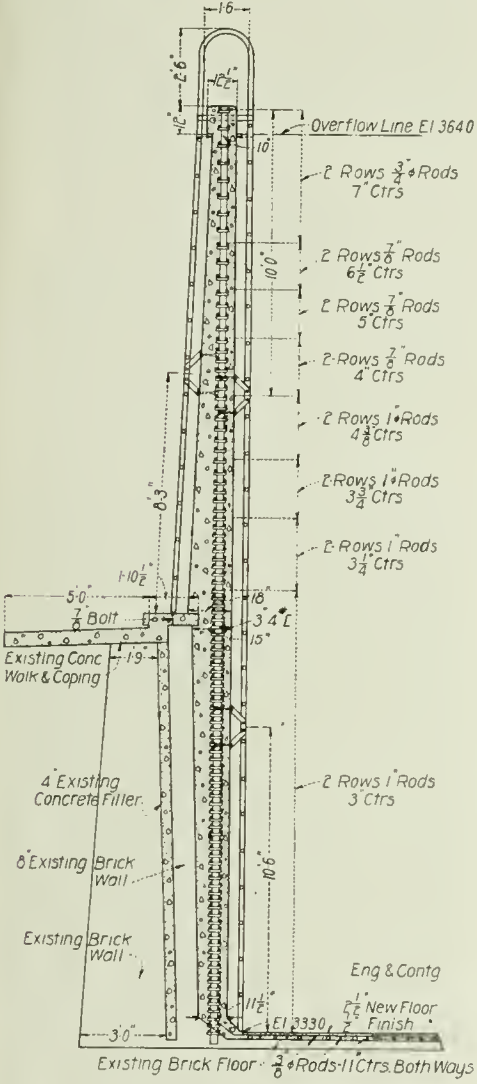


Fig. 1—Vertical Section Through the Existing Reservoir Wall and the Proposed Reinforced Concrete Enlargement to Same.

ENLARGEMENT OF EXISTING RESERVOIR.

The existing reservoir is a circular basin enclosed by a brick masonry wall, backed on the outside by an earth embankment. The basin has an inside diameter of about 144 ft.; a total depth of about 14.7 ft., and a depth below the top of the overflow pipe of about 13.5 ft. Its bottom is paved with grouted brick, with a fall of about 4 ins. towards the southeasterly part of the wall. The present and proposed reservoir wall is shown in Fig. 1.

The enlargement of the existing reservoir is to be made by building on the inside of the wall a new wall of reinforced concrete, which will extend up above the existing wall so as to form a tank having an inside diameter of 142 ft., a total depth of 32 ft., and a depth of 31 ft. from the top of the overflow pipe to the top of the new floor.

DESIGN OF NEW RESERVOIR.

The new reservoir will be 142 ft. inside diameter, 32 ft. at the wall, and 36 ft. deep in the center, the bottom being a segment of a sphere. The center of the new reservoir will be located about 160 ft. northwesterly from the center of the existing reservoir. The dimensions and details of the wall of the new reservoir are shown in Fig. 2.

Additional information relating to the design and construction of the reservoirs is here given as abstracted from the specifications.

The concrete will be mixed in the proportion of at least one part of cement to two parts of sand and four parts of clean, broken stone. It is the intention that there shall always be more than enough cement to fill the voids in the sand, and more than enough of the mortar thus made to fill the voids in the broken stone. The stone used will not be larger than 1 in. in the greatest dimension.

The mixing will be done by a batch mixer, the mixing being continued at least one minute to each batch. Enough water is to be added to produce a so-called "wet mixture."

The concrete is to be placed as rapidly as possible after leaving the mixer and will at once be thoroughly puddled, spaded and worked, so as to eliminate all contained air, and so as to produce a mixture free from voids. Any concrete not placed before it is one-half hour old will be thrown away.

Concreting when started must be vigorously carried on to completion. If the concreting is stopped before the completion of the work, the plane where concrete work is stopped is to be approximately horizontal. Before work is resumed the abutting surface of the old work must be thoroughly cleaned and brushed, and then sprinkled with water, and cream of neat cement will be spread over and thoroughly brushed into the surface of the joint to be abutted. All forms will be wetted just before concreting.

The steel channels and the cross-pieces riveted thereto and used to support the reinforcing rods will conform to the Manufacturers' Standard Specifications for Structural Steel for Railway Bridges, as given on page 187 of List of Shapes, published in 1910, by Jones and Laughlin Steel Co.

The steel rods used to reinforce the concrete wall and bottom will all be round rods of the respective diameters shown in Figs. 1 and 2. They must be the product of the mill of a reputable manufacturer, and must have an ultimate tensile strength of between 60,000 and 70,000 lbs., and an elastic limit of not less than half the ultimate tensile strength. The steel is not to be painted, but will be thoroughly cleansed of dirt, grease or scale before being imbedded in the concrete.

To reduce the number of laps, the length of the rods will be as great as may be economically practicable. No welded steel will be permitted.

Over all of the new floors of both of the reservoirs and over the top of the coping of the new walls, the contractor will lay cement mortar, ½ in. thick, mixed one part cement to two parts sand. This will be applied before the concrete beneath it has thoroughly set, and will be troweled to a smooth sidewalk finish.

All other inner or outer surfaces of walls will be given as smooth a finish as possible by spading the concrete next to the forms so as to keep the larger stones away from the forms and to bring the cement mortar up against them. All forms must have smooth surfaces and close and even joints on the side next to the concrete, and are to be built and firmly held true to line and level until the concrete has set. Any roughness or irregularity in the surface of the concrete that may have resulted from failure to comply with the foregoing provisions will be removed and made good by chipping or bush-hammering, or in such other manner as the engineer may direct.

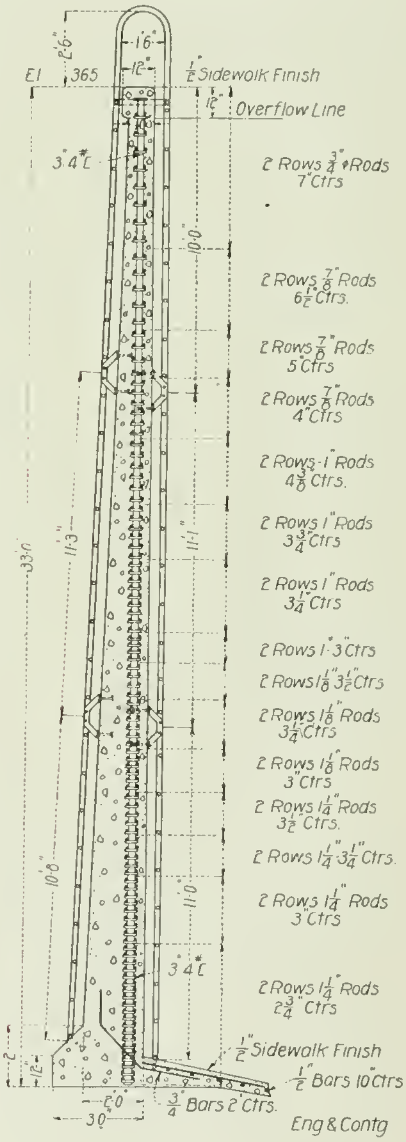
The interior of the new walls of the reservoirs will be treated or covered with a waterproof coating. The nature of this coating will be left to the discretion of the contractor, provided he satisfies the engineer that the coating used will be permanent.

The steel channels are to be spaced equally, 60 to the circumference. Great care will be taken to set them truly vertical and in correct alignment. The cross bars must be accurately spaced on the channels, and securely riveted thereto with two ¼-in. rivets to each cross-bar.

The reinforcing rods in the wall will be bent to a true circle, and will be thoroughly wired to the channels and cross-bars. The rods must be accurately spaced, and once placed, they must be so firmly held that they cannot be misplaced.

The ends of the rods in the walls will overlap each other by not less than 30 diameters of the rod, and the overlapping ends will be firmly held together by not less than two clips. The laps of the rods will be staggered, each ring of rods lapping as far as possible away from the laps of the adjacent rings.

The reservoirs must be so constructed that when they are finished there shall be no appreciable loss of water from either of them, and no wet spots shall show on the outside. When finished each reservoir will be filled with water by the city, and if leakage develops or if wet spots show, the reservoir will be emptied by the city and the contractor must stop the leakage in a manner acceptable to the city. The work will not be accepted until both reservoirs are water-tight, and the contractor will give bond to maintain both resrvoirs water-tight for one year from date of the completion of the work.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1'6"
1'2"
El 365
1/2" Sidewalk Finish
Overflow Line
3'4" ⊏
2 Rows 3/4" Rods 7" Ctrs
2 Rows 7/8" Rods 6 1/2" Ctrs
2 Rows 7/8" Rods 5" Ctrs
2 Rows 7/8" Rods 4" Ctrs
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11'0"
3'4" ⊏
1/2" Sidewalk Finish
1/2" Bars 10" Ctrs
3/4" Bars 2" Ctrs
2'0"
3'0"
Eng & Contg

Fig. 2—Vertical Section Through the Wall of the Proposed Open, Reinforced Concrete Reservoir at Sioux City, Ia.

The contractor will provide, set and firmly fasten, a steel ladder which will extend up the outside of the wall, over the wall, and down the inside to the floor. The details of the ladders are shown in Figs. 1 and 2.

The reinforcing rods which would otherwise cross the space occupied by all openings for pipes, whether in the new reservoir or in the existing reservoir, will be neatly bent out of the way of such openings in such manner as may be required to permit the passage of the respective pipes, and at least two additional round rods of like diameter with those so bent, will in each case be set in on each side of the pipe, the rods being not less than 8 ft. long, and being securely fastened to the adjacent rods by two clips near each end of each 8 ft. rod. The purpose of inserting the additional rods is to leave the wall or floor in which the pipe is set at least as strong as the other portions of the walls or floor at like elevations, and in which no pipe is set; and the rods above referred to must be so arranged as to thoroughly accomplish this purpose. No rod near any pipe, nor in any other part of the structure, is to be imbedded less than 1½ ins. in the clear from the nearest surface of the concrete.

The contractor is to entirely finish all of his work on the new reservoir first, and before interfering in any way with the usual safe and proper use of the existing reservoir. The concrete in the new reservoir will then be allowed to set for seven days, and the city will then fill the reservoir with water and test it for leakage. Should any leakage develop, or should wet spots show on the outside, the city will empty the reservoir, and the contractor will at once remedy all such defects; and the reservoir will be again filled and tested by the city.˜ This process will be repeated until the reservoir has been proven to be without leakage or outside wet spots.

The city will then empty the existing reservoir and allow the contractor to begin the work of constructing the enlargement to it.

The amount of steel, rivets, and concrete in the new reservoir and in the enlargement to the old reservoir is as follows:

NEW RESERVOIR.

Steel rods in wall, lbs.	318,800
Steel rods in floor, lbs.	28,836
Steel channels, lbs.	7,689
Steel cross bars on channels, lbs.	1,100
Rivets, lbs.	590
Concrete in wall, cu. yds.	810
Concrete in floor, including sidewalk finish, cu. yds.	300
Total weight of all above materials, tons	2,426

QUANTITIES IN ENLARGEMENT TO OLD RESERVOIR.

Steel rods in wall, lbs.	255,700
Steel rods in floor, lbs.	14,700
Steel channels, lbs.	7,680
Steel cross bars on channels, lbs.	1,200
Rivets, lbs.	600
Concrete in new wall, cu. yds.	633
Concrete in new floor, including sidewalk finish, cu. yds.	122
Total weight of all above materials, tons	1,668

The city will furnish all the excavation or embankment required for the new reservoir. The city will also furnish and install in place all necessary inlet and outlet, overflow and drain pipes for the new reservoir, except the 12-in. riser pipe which will be furnished by the city, but will be installed by the contractor. Such pipe and fittings as may be required for extensions to the inlet, outlet, overflow or drain pipes of the existing reservoir will be furnished by the city but will be installed by the contractor.

The contract for building the new reservoir and for building the enlargement to the existing reservoir was awarded to Jensen and Krage, of Sioux City, Ia., for the sum of $39,812. Mr. Dabney H. Maury, of Chicago, drew up the plans and specifications to govern the reservoir constructions.

—According to the report of the secretary of the Louisiana State Highway Department, 127.38 miles of road have been built during 1912. Of this, 100.75 miles were constructed by convict labor. The total expenditure was $199,931.22. The majority of the roads are of dirt; 8 miles are of shell, and 4 miles of petrolithic.

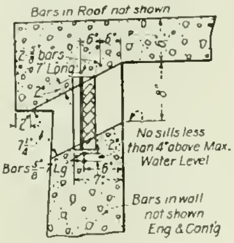
The Design of the Ventilators for the New Water Works Reservoir at Baton Rouge, La.

(STAFF ARTICLE.)

The new reinforced concrete reservoir which was designed by Alvord and Burdick, of Chicago, for the Baton Rouge Water Co., is to be of the covered box type. The reservoir will be divided into two equal compartments, each 60 ft. long by 56 ft. wide, inside measurement. The depth of water stored is 20 ft. The accompanying sketch shows an interesting detail of the design, the ventilator opening and grating for the same.

There are to be six of these ventilators in each compartment; three in the outside end wall and one at the center of both of the side walls of the compartment. As shown the ventilator opening is 8 ins. deep and lies immediately below the reservoir roof. The openings are 24 ins. wide. The bottom of this rectangular opening is at least 4 ins. above the high water level.

The ventilator grating is made up of riveted structural steel shapes. The frame of the grating which is made 8 ins. by 24 ins. to fit the opening, is made of a ⅛ in. by 3 in. plate which bears against the concrete surfaces of the ventilator opening. This plate is riveted to an ⅛x¾x¾ angle iron by means of ¼ in. rivets spaced 3 ins. on centers. Each angle iron is cut at the corners of the rectangle to fit against the adjacent angle iron.



Section Through Reservoir Wall Showing Ventilator.

Along the long dimensions of the built up frame so formed ⅛ in. by 2 in. plates extend, with each end of a plate turned down to a length of ⅞ in., and the turned down part of the plate is riveted by means of ¼ in. rivets to the end angles of the frame. The plates are set at an angle with the vertical as shown in the accompanying figure. They are spaced ⅞ in. back to back.

There are four ventilator ports through the division wall between the two compartments. These ports are not grated. Each port is 8 ins. deep and 24 ins. wide. As in the case of the outside ventilator openings, the ports in the division wall are set just under the reservoir roof. The bottom of the port is 4 ins. above the high water level of the stored water.

Method of Selecting a Sample of Coal for Analysis.

The economic advantages arising from the payment for coal according to its heat value have been pointed out repeatedly in this journal. The purchase of coal under specifications is a matter of great importance to all water works superintendents and managers who have steam power pumping stations in their water works systems. The selection of a truly representative sample for test purposes is essential to the satisfactory application of the specifications. A method of selecting the sample is here given, as taken from an article in the Bulletin of the Institute of Operating Engineers for February, 1913.

It would at first seem a simple matter to select a sample of coal from a cargo, analyze it and from a pre-agreed schedule compute the price per ton. But as the results of the analysis may mean a severe loss to the coal dealer or the owner of the plant and as each party must protect itself against loss, the importance and value of a system for gathering the sample so that it truly represents the whole cargo and so the chemist's report will be final and conclusive, is apparent.

The sample must show the same proportion of moisture, ash, sulphur, volatile matter, and carbon as is contained in the cargo, together with the general physical condition of the coal. It is obvious that before purchasing coal on this basis both parties must signify their willingness to be governed by the results of the analysis of the sample and in case of dispute must refer the matter to an uninterested third party for final adjustment. It is not as difficult to sample anthracite coals as it is to sample those of the bituminous variety. Owing to screening and picking the former is more uniform in size.

While specifications for buying hard coal differ somewhat from those for soft coal the manner of gathering soft coal samples for the chemical laboratory is essentially the same as for hard coal, differing somewhat when the physical characteristics are considered. This article deals with the sampling of soft coal.

It matters not whether the sample is to be taken from cargoes for large or small consumption, the proportionate value of the plant is the same, and the sample in each case must be taken with the same care.

The portions which are to constitute the sample should bear a fixed relation to the number of wheelbarrow and bucket loads, shovelfuls or other measures used to deliver coal to the furnace. In large stations it is usually taken from the weighing hoppers as it is being unloaded from the cars or boats, and after the lumps have been crushed to a uniform size. The mechanical sampler is constructed on the principle of the old shot-pouch nozzle which consisted of a tube fitted with two gates opening and closing alternately and operated by a lever, the required amount of shot being determined by the space between the gates. Experiments made to determine the size opening in a sampler necessary to gather the proportional number of lumps, resulted in openings 6 ins. square and 6 ins. apart as the standard size. This sampler is attached to the side of the weighing hopper and is filled through an opening as the hopper is being filled, yielding about 200 cu. ins. of coal for each 5 tons weighed, the gates being operated each time the hopper is dumped. It is necessary to gather the proper number of lumps for a sample because different lumps carry different percentages of ash, moisture, sulphur, etc., and these percentages must bear the same relation to the sample as they do to the whole cargo of coal.

Moisture.—The losses from moisture are too often neglected. In a cargo of 800 tons 1 per cent of increase in the moisture content may mean a loss of $40 to $50, to which must be added losses due to evaporating and superheating this moisture in the furnace. The "mine moisture" of bituminous coal shipped to the New York markets averages approximately 2 per cent. Moisture in excess of this amount is usually caused by rain and leakage in boats, during transportation, so that the allowable moisture in a sample should be limited to about 3 per cent.

Preparing Samples for the Laboratory.—The coal as it is discharged from the sampler is broken so that the pieces would just drop through a screen of ¼ in. mesh after which it is placed in a covered can. After the cargo has been discharged, this can is dumped on the *clean* floor or on a canvas sheet and is thoroughly mixed by shoveling over and over and formed into a circular pile which is divided into four equal parts, one of which is rejected, the remaining three are again mixed and the operation repeated until a sample weighing 5 or 6 lbs. remains, from which a quart glass jar is filled, sealed and labeled with the date and number or name of cargo. The balance of the sample is then crushed very fine and from it two 4-oz. bottles are filled, one being for the chemist of each party. The amount used by the chemist is usually one gram and the remaining part of the sample is kept in case of disagreement, and from which the final analysis is made. When the bottles are filled they are placed in galvanized iron boxes, sealed and locked to prevent being tampered with.

While local conditions may vary the manner of gathering coal samples, the essential features of any method are the same as above described. It is hoped that in the future the engineer will purchase coal with a definite knowledge of its value to the plant, whether delivered in trucks or large cargoes, and thereby abolish the present acceptance of coal without knowing whether it contains the heat value for which he is paying. He must remember that losses due to the old manner of purchasing coal are charged against him and included in the power costs.

Water Works Notes.

(STAFF ARTICLE.)

Use of Flange Joints on Submerged Pipe Lines—In discussing the paper by Mr. M. L. Worrell on the "Construction Methods Employed in Laying Submerged Water Mains Across Three Rivers in Georgia and Mississippi," which was delivered before the latest annual convention of the American Water Works Association and was published in ENGINEERING & CONTRACTING of June 19, 1912, Mr. John A. Kienle called the attention of the association to the fact that considerable danger may arise from failure to use flange joints in submerged pipe lines. The gist of Mr. Kienle's remarks, as abstracted from the recently published proceedings of the convention, follows:

The experience of the Water Department of Wilmington, Del., shows the necessity of having some available means of repairing a submerged line in case of damage to it, either by a barge anchoring at or near the pipe and settling on the line and breaking it, or through its being struck by a steam dredge in deepening the channel.

At Wilmington in the fall of 1911 an increased depth of channel was required by the United States government and a dredge was sent to take out several feet of the bottom. There is a 12-in. submerged line approximately 350 ft. long in the river. The dredge used was of the suction type, having a cutter head, and in dredging this cutter head struck the top of the pipe and broke out a section possibly 3 ft. long and of the diameter of the pipe. A crack extended along the pipe approximately 18 ins. Being exclusively Ward joint pipe (bell and spigot) it was a difficult matter to repair it. There being no flange joints it was impossible to take out a section, and the officials were at quite a loss to know what to do. It was decided to have a diver go down to investigate, which he did, and brought up the top section that was broken out.

The pipe was not broken clear through, but there was just a slash taken out of the top of it by the cutter head of the dredge. It was finally decided to make the repairs with a split sleeve. One could not have been purchased in the open market which would have answered the purpose, but there are several large boiler shops in the city and one of them made a split sleeve 9 ft. 6 ins. long which covered and extended beyond the cracks. It was constructed after the manner of the ordinary split sleeve, and required two days to make, working night and day in the boiler shop, as they had to do the work by hand.

The ends of that split sleeve were grooved out in order to hold the lead after caulking. It was quite a problem to handle that split sleeve under some 17 ft. of water. The sections were lowered from a derrick mounted on the driver's outfit, and the first half of it was held in place by long eye bolts until the two sections were slipped together with a rubber gasket between the flanges. A meter was put on the line to test it, and it was found that the pipe was leaking about 3 gals. a minute. The pressure was left on for a period of about a week while the Government engineers were making certain determinations with reference to the work done by their contractor. At the end of that time they reported a very serious leak at approximately the same point.

The diver had left, but he was called back again, and it was found that even with the precautions taken to hold the lead in the sleeve, namely, the groove that had been cut around the end of it, the pressure on the line, which was 45 lbs., had forced the lead out.

It is a rather difficult matter to work under 17 ft. of water with an ordinary hand hammer. There were no data in the office as to the original construction of the line, but it was thought that it might have been possible that a flanged knuckle joint had been installed. A section of this pipe cannot be cut under water, if there are no flange knuckles, without destroying the ball joints. A bucket dredge was secured to work in the channel some 20 or 30 ft. further beyond the break to uncover the pipe in the center of the stream. The diver was then sent down, and with his hose nozzle under about 100 lbs. water pressure he washed the pipe clean. A flange knuckle was discovered in this line, and it afforded us considerable relief to find that a certain section of that pipe could be thus taken out, removed to the shore, repaired in the proper manner, and then again lowered down.

Mr. Kienle brought up this subject to show that in the design of a submerged pipe line a flange knuckle joint should be installed at every third or fourth section to facilitate making repairs on the line. He cited another example where instead of a Ward joint the pipe is a 20-in. flanged line with Hyde ball joints submerged in the same creek. This was broken by the settling of a barge that had anchored over it notwithstanding that warning signs were placed marking the location of the water pipe. When the tide went down the barge settled on the pipe and broke it. This Hyde ball joint is made up in a manner somewhat similar to the Ward joint, except that there is a flange at the joint which has a groove to it which holds the lead in place on the ball of the joint. There are knuckles at every third section, which makes it an easy matter to make repairs. A broken section of flange pipe was removed and sent to the shop and both ends were turned. The two pieces were then put together with an ordinary sleeve. This section was then lowered into the creek before it was caulked, and by long bolts extending through it was pulled together at the flanges and the joints in the sleeve were caulked, making a tight job. There are three such lines at Wilmington, one 16-in., one 12-in. and one 20-in. Of these, two are of the flange and ball joint type; the third one is a 12-in. Ward joint pipe.

Mr. Kienle does not want what he said to be considered as a condemnation of the Ward joint. He believes that it is good, economical joint pipe; but he advocates that it is preferable to have flange knuckles at least every third or fourth section on submerged pipe lines.

City Guarantees Accuracy of Water Meters—The ordinance recently passed by the City Council of Bucklin, Kans., to govern the operation of the new water works system in that city, provides that when a consumer thinks his bill is too high he shall deposit $2 with the City Treasurer. Following this action on the consumer's part the meter will be tested by city employes. If the test shows that the meter registers accurately the city will keep the deposit. If the meter is shown to be inaccurate the consumer's deposit is returned to him, and a new meter is installed on his service connection free of charge.

Use of Dynamite for Removing Broken Sections of Heavy Cast Iron Pipe—In a general experience discussion, at the annual convention of the American Water Works Association, Mr. W. F. Wilcox described the use he has made of dynamite for removing broken sections of large size cast iron pipe. There are pipes 30-in., 36-in., 42-in. and 48-in. in diameter in the Birmingham, Ala., system. When any of them are broken it is, of course, necessary to hurry up and make repairs. In striking a piece of pipe 2 ins. thick it is very hard to break it, although a flaw may have developed in it. A plan of dynamiting out a broken section has been adopted in Birmingham.

As can be readily understood, shutting down a large industrial plant on account of lack of water is an expensive procedure, thus anything that will expedite repairs in case of a break in a main is of material value.

The method utilized in Birmingham is as follows: Starting in the center of the pipe to be removed, place ¼ to ⅓ of a stick of 40 to 60 per cent dynamite on top of the main and cover it with a handful of clay. The blast blows out a small hole or starts a crack. Further shots are shot off working toward each end of the pipe. By this means four pieces of 42-in. and one each of 36 and 30-in. pipe have been removed from the line. As some of the pipes were 2 ins. thick a heavy sledge made little impression on them. Twenty minutes after starting to blast the pipe was ready to take out.

Mr. Wilcox suggests experimenting on broken or scrapped lengths. He also suggested that electric exploders be used, as they are safer and are also more readily used. Fused exploders are uncertain and often dangerous. An ordinary battery such as is used in coal mining will cost about $15 and will last a lifetime.

Electric Thawing of Frozen Mains and Services—Useful data relating to the use of electricity for thawing out frozen water mains and services in the cities of North Attleboro, Mass., and Evanston, Ill., are published in the recently issued Proceedings of the American Water Works Association. The North Attleboro data on thawing mains follow:

The electric light and water departments of the town of North Attleboro are under municipal control and under the same management; therefore access to the electric current was very convenient. The electrical equipment consist of two 20-k.w. transformers, 2,200-volt primary and 220-volt secondary current, the 220 current being used for the thawing. An ammeter was connected in the circuit so as to determine the amount of current to be used on the various kinds and sizes of pipes. The amount of current determined for thawing was found by experimenting in about one-half day's time. The current was regulated by means of water in ordinary oil barrels; by bringing the terminals nearer to each other in the barrel the current would increase and the converse would decrease the current.

The following data are given: Current required to thaw water mains of cast iron pipe—4-in. pipe, 1,400 to 1,900 amperes at 220 volts; 6-in. pipe, 1,900 to 2,300 amperes at 220 volts. The time required was from 15 to 25 minutes. The transformers were overloaded from 100 per cent to 300 per cent during this operation. Transformers used were the ordinary lighting transformers of the General Electric make.

The North Attleboro data on thawing out frozen service pipes by the use of electricity follow:

The current used to thaw a ¾-in. lead service would require 600 to 900 amperes, while an ordinary galvanized iron pipe of the same size, ¾ in., would require 400 to 500 amperes. The time required in thawing would be from four to eight minutes in each case.

The lighting wires were not always available where the pipes were frozen, consequently the cable had to be run in some instances 1,200 ft. to the service pipe in the cellar, while the other end was connected to the nearest hydrant, which was always available within 300 ft., as the hydrants are located on an average of every 500 ft. The water supply system covered more territory than the lighting wires.

A great deal of judgment had to be used as to the quantity of current on account of the age of the galvanized pipe. When the pipe was very old the current applied was not as strong as that for new pipe owing to the liability of burning the service pipe off. In carrying the wires to the house or service to be thawed they were run on top of the ground.

The men required were two linemen from the electrical department. These men attended to connecting the transformers to the 2,200-volt lines and made the necessary taps from the wire reels to the water barrels. In addition to these two men, four water department men ran cable to the service, removed the meter and placed in the service a nipple to take the place of the meter, so that the consumer could secure water. The two linemen would then connect to the hydrant by means of a ring made to fit the hose nozzle.

On an average 15 services were thawed out in a day and in some cases as high as 22 services. Most of the time was spent in getting the equipment in readiness and connected. In one connection or location have been thawed out as high as 12 services; the average is about three services without relocating the equipment. In 17 days 150 service pipes were thawed out, also two 6-in. cast iron water mains, seven hydrants, and one 4-in. cast iron water main.

At Lake Forest, Ill., frozen services are thawed by electricity at the expense of the consumer. Table I gives data on the amount of current and the length of time required to thaw frozen water pipes by electricity.

TABLE I.—CURRENT AND TIME REQUIRED TO THAW WATER PIPES BY ELECTRICITY.

Size pipe (iron).* Inches.	Length. Feet.	Volts.	Amperes.	Time required to thaw. Min.
¾	40	50	300	8
¾	100	55	135	10
¾	250	50	400	20
1	250	50	500	20
				Hours.
1	700	55	175	5
4	1,300	55	260	3
10	800	62	400	2

*To thaw out lead pipe, increase the amperage 50 per cent.

RIVERS AND HARBORS

A Review of the Floods of the Lower Mississippi With a Discussion of the Methods of Control by Levees.

Following the great Mississippi flood of 1912, there was a multitude of plans and suggestions for flood control of some sort different from the present method of levees. To all of these plans the engineers having in charge the Mississippi regulation works offered the invariable comments: (1) The plans suggested are all old and are unnecessary; (2) the present levee plan fully carried out is a complete solution of the problem. A review of the evidence and reasoning on which these conclusions are based is given by A. L. Dubuey, Chief Engineer, Upper Yazoo Levee District, in a paper before the Illinois Society of Engineers and Surveyors, and we publish this review nearly in full as follows:

The logical mind seeks to connect cause and effect. The floods of the Mississippi River result from different causes. As there is a finite limit to those causes (even those that produced the great flood of 1912 and which will produce other occasional great floods), so there is a finite limit to the magnitude of these floods.

With a given slope and a definite volume of water to be discharged, one can estimate the size of channel necessary for such discharge. The channel of the lower Mississippi River is not large enough to discharge its flood volume, and additional capacity must be provided. Obviously (to the engineer if not to the "practical man") the cheapest way to provide this additional capacity at the least sacrifice of land is by elevating the top of the channel section, which is accomplished by building levees on or near the banks of the river. It is clear to an engineer that by this method not only is a larger section provided, but the hydraulic radius is increased, resulting in a greater velocity than would obtain if the surplus water were sent through an auxiliary channel or allowed to spread over a wide belt of land.

The Leveed "Basins."—From Cairo to the Gulf, territory contiguous to the Mississippi River on either side is subdivided into a series of so-called "basins," named after the smaller rivers that traverse them, empting into the Mississippi in each case at or near the lower end of the "basin." In the basins in southern Louisiana only such streams as exist flow directly to the gulf. Each of the larger of these basins now has a line of levees extending from high ground at its upper end to near its lower end, which is left open. This will probably be made more clear by reference to the map, Fig. 1, showing present levee lines. In 1882 there existed more or less continuous lines of levees along the fronts of the basins on the east side of the river from Memphis to New Orleans, while on the west side the basins were open except below the Arkansas River. The levees were of inadequate size and indifferently built, largely by individual or neighborhood effort.

The flood of 1882 came, swept away great stretches of the levees and left devastation behind it. For years the flood of 1882 was regarded as probably "the worst" that the Mississippi River would ever have in store.

Cairo Gage an Index for Lower River.—The Mississippi and Missouri Rivers having joined at St. Louis and their combined waters meeting those from the Ohio at Cairo, the latter point is watched as an index by river engineers below. All of the principal factors have combined there. The Cairo gage measures the flood for the lower Mississippi. The modifications below due to the St. Francis, White, Arkansas, Yazoo and Red Rivers do not greatly affect this relation.

At Cairo the 1882 stage was slightly exceeded in 1883 by a flood of shorter duration and was almost equalled in 1884, but from that year until 1912 there had been no repetition of this high stage.

From the stage at Cairo engineers on the lower river have been able to predict fairly closely the stages to expect at their several localities, except when the "balance" has been upset from time to time by the closing against overflow of a considerable basin that had formerly been open, thus locally raising the flood plane. The rebuilding of the levees along the "Yazoo Basin" front in Mississippi, in 1884, excluded the flood waters from about 4,000,000 acres that were submerged in 1882. When the next considerable flood came (in 1886), while a comparatively small volume of water entered this area through breaks, the flood plane was, as a logical result of confining the water to narrower space, raised higher along that front than the Cairo gage would have indicated. From time to time other basins have been closed. The Louisiana and Arkansas levee was extended up the west side of Arkansas River, materially reducing the volume of flood water that formerly flowed southward from that stream through a system of large bayous and swamps. The 1897 flood found the White River front (from Helena southward) closed also, for the first time; and until breaks occurred, the levees on both sides of the river in that locality were called upon to confine the water which before had flowed over 580,000 acres of low lands in that basin.

Records Definitely Show Effect of Closing Basins.—A super-elevation of the flood plane at Sunflower landing of 3.1 ft. occurred as a direct result of the closure of the White River basin alone. In a report by Mr. T. G. Dabney, dated June 2, 1897, appears the following:

> The greatest actual relative flood elevation on the front of this levee district, and indeed the highest water throughout the entire length of the Mississippi River, was on Sections 80 and 81 on the McCloud front (opposite White River basin), where it reached the extraordinary height of 5.6 ft. above that of 1890 and 7.1 ft. above the 1882 flood. (Cairo was 0.2 below the 1882 flood.)

The levee engineers have full records for a number of years from gages placed at frequent intervals, so that the effect (in raising the flood plans), due to the closure of one of these basins, can be stated with fair exactness after the first high water succeeding such closure; but it cannot be closely predicted with confidence; hence the difficulty of correctly establishing grades until after all of these basins had been closed and the results observed; also the necessity for hastily placing temporary "topping" on the levees along such a basin during the first flood to occur after its closure, the failure by overtopping of one or both levees and then the outcry from the "practical man": "The floods are constantly getting higher; the levees are *raising the bed of the river;* you will never build them high enough to hold; the higher you build them the higher the water will rise!"

Col. C. McD. Townsend, president Mississippi River Commission, in an address before the Levee Convention in Memphis, on Sept. 26, 1912, said: "I take the liberty of recalling that about twenty years ago I submitted a paper to prove that if the St. Francis basin were leveed a flood like that of 1882 would attain a height at Helena of at least 54 ft." In a report dated June 2, 1897, Mr. T. G. Dabney showed, by the stages of that year, that the super-elevation of the Helena gage due to closing the Yazoo front on the east side of the river and the White River and part of the St. Francis fronts on the west side was 4.8 ft.

In 1906, for the first time, the entire flood volume passed from Cairo to the Gulf between levees, the St. Francis front having been finally closed. As a result, the gage at Memphis went 1.92 ft. above 1882, while at Cairo it was 4.97 ft. below 1882. At Helena the 1906 stage was 0.15 below 1882. The fact that all basins were leveed and that no levee broke in 1906 makes the high water of that year, while of moderate proportions, one of special interest to levee engineers, as it enabled them for the first time to observe accurately the effect of such complete confinement of the water. It was deduced from this year's record that a repetition of the 1882 water would mean about 42 at Memphis and 52 at Helena.

After 1906, grades along the entire lower river could be predicated with confidence to withstand any assumed future stage at Cairo, and until 1912 that assumed stage was generally taken as a repetition there of 1882, which was expected to occur at some time. As stated above, the 1882-3-4 stages had not been reached at Cairo during the 27 years to 1911 inclusive. In 1912 such expectation was greatly exceeded. The water of 1907, about 3½ ft. higher than 1906, also passed to the gulf between levees without a break. The crest of this flood at Cairo was within 1.57 ft. of 1882.

Taking the relation at Cairo, Memphis and Helena between 1907, when all levees were up and the water entirely confined between them, and 1882, when the opposite condition existed, the effect of confinement was to raise the flood plane (as compared with Cairo) at Memphis 6.7 ft; at Helena, 4.8 ft. In 1882 Memphis went to 35.15, so that with a repetition of 1882 at Cairo, if all levees held, Memphis should have gone, according to the 1907 relation, to 41.85, while Helena should have gone to 52.

One not familiar with the situation will inquire why this difference of about 10 ft. between the Memphis gage and the Cairo and Helena gages, one above and the other below Memphis, and the two being in close accord. This difference has been perplexing to many persons, some confidently believing that when the St. Francis basin should be closed, Memphis would jump up the additional 10 ft. to meet Cairo and Helena. To those who gave the matter careful investigation it was clear that non-conformity was accounted for by local differences in slope and section.

The years 1906 and 1907 were of most active interest to those who had studied this local question, and it was gratifying to note how closely had been estimated by them the ultimate relation which should be continuous. About ten or twelve years ago, when a large part of the St. Francis front was still open, several engineers independently estimated this relation, among whom were: Members of the Mississippi River Commission, Mr. William Starling, chief engineer Lower Yazoo Levee District, and Mr. T. G. Dabney, chief engineer Upper Yazoo Levee District. At that time the writer, working independently of the others, estimated that when continuous levees should be maintained a repetition of the 1882 stage at Cairo would produce a stage of 42½ or 43 ft. at Memphis. The other estimates predicted very nearly the same relation. Note that the deduction from the 1906 to 1907 waters when all levees held was 42. Note also that at the time that these estimates were made the highest recorded stage at Memphis was 37.66 (in 1897).

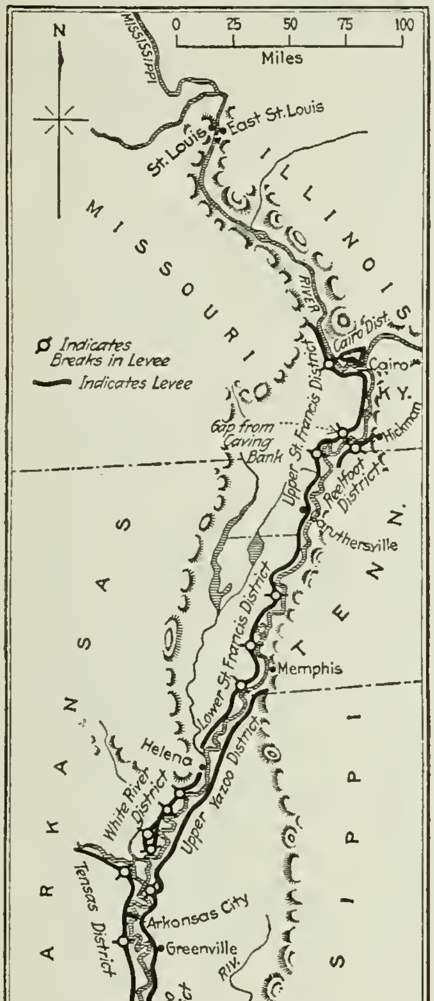


Fig. 1—Map of Levee System of the Lower Mississippi Showing Location of Breaks Due to Flood of 1912.

The following is from a prominent levee engineer's report immediately after the 1906 high water:

> The record of extreme high water at Cairo may be taken as 52 ft., though it was two-tenths below that in 1882 and 0.15 above in 1883, the latter stage, however, having less influence upon the gages in this part of the river than in the former, in which the flood volume was much greater.
>
> This should give, according to the premises assumed above, about 42 ft. at Memphis and about 52.6 ft. at Helena, as the normal flood plane, the whole volume being confined to the channel from Cairo down. But the River Commission has assigned an ultimate value of 54 ft. to the Cairo gage, presumably in anticipation of an extension of the levee line above Cairo to Cape Girardeau, and thus increasing the flood volume to be carried by Cairo.
>
> This should logically project itself down the river, with a flood plane parallel to that above noted and 2 ft. higher, giving Memphis a gage reading of about 44 ft., and Helena about 54.6 ft.

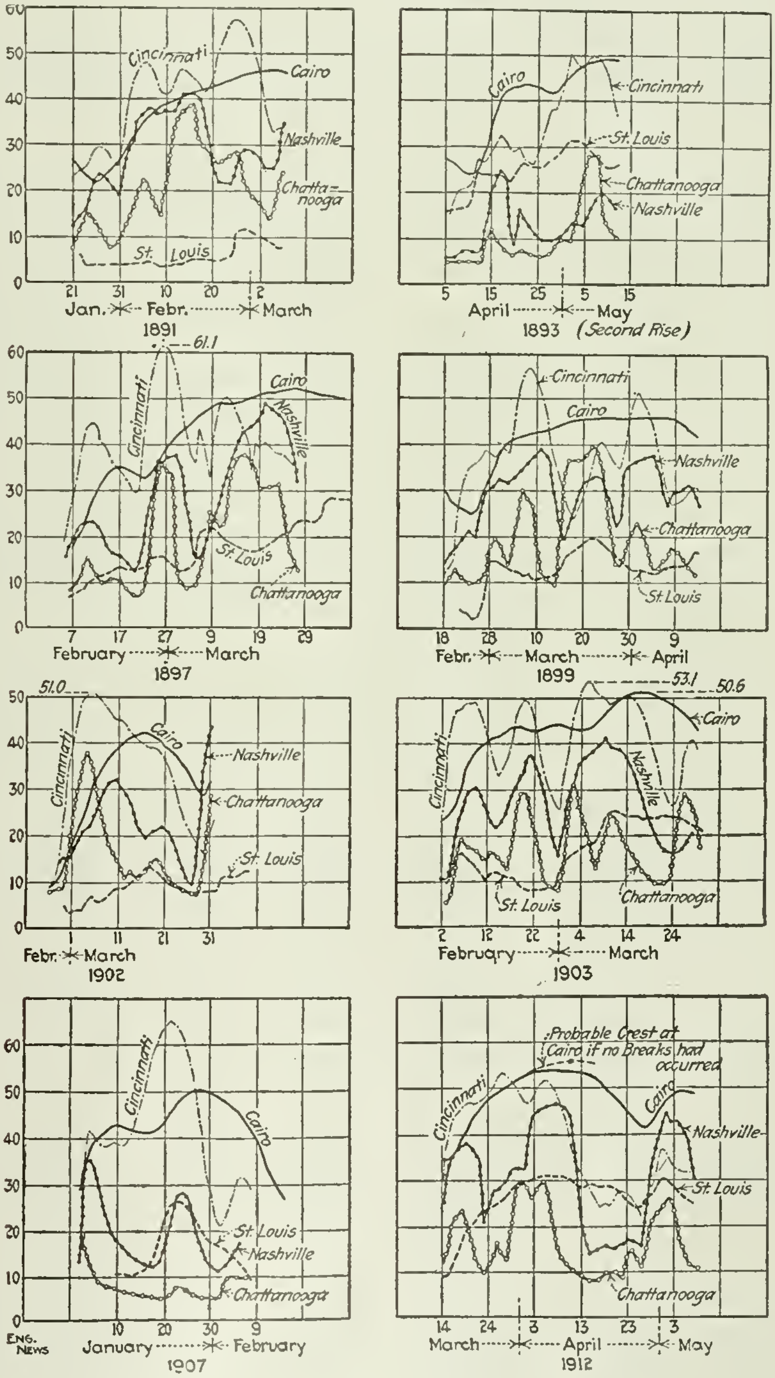


Fig. 2—Hydrographs of Lower Mississippi During Flood Years From 1891 to 1912.

Weigh the above prediction, made six years ago, with the conditions met at Cairo, Memphis and Helena by the 1912 water, which went to 54.0, 45.3 and 54.3, respectively, at those places. Cairo was in extremity lest her levees be overtopped. Memphis (with only 1¼ per cent of the city not well above chance of overflow, it is true) had built a levee, the top of which was only 42.0 by the gage. At that state this area went under, car service was interrupted, the gas plant "put out of business," the water supply contaminated and the pumping station almost stopped. Helena had to top her levees. Honor to whom honor is due. Had the officials of these cities consulted, five or six years ago, the levee engineers in their midst and acted upon their recommendations as to proper grades to adopt, they sure-

TABLE 1.—RECORD OF HIGHEST WATER FOR FLOOD YEARS AT STATION INDICATED.

Compiled from publications of the Mississippi River Commission (Stages of the Mississippi River) and of the U. S. Weather Bureau. Bold face figures indicate highest water of record.

Stream.	Name of Gage Station.	1882		1883		1884		1892		1897		1898		1903		1907		1908		1912		Highest since 1871.	
Missouri	Omaha	14.50	June 28	14.20	°	15.90	April 6	15.30	July 3	17.10	April 6	14.70	July 3	14.40	June 1	17.30	July 18	19.10	July 3	....		23.60	1881
	Kansas City	19.20	July 3	23.80	June 26	17.20	July 5	24.90	May 21	27.80	April 17	21.50	June 12	**35.00**	June 1, 2	23.50	July 20	30.20	June 15	23.10	April 2	35.00	1903
Upper Miss.	St. Louis	32.15	July 4	34.80	°°	28.10	April 9	36.00	May 19	30.95	May 2	27.20	May 23	**38.00**	June 10	28.00	July 25, 26	34.94	June 20	30.70	April 6	38.00	1903
Ohio	Pittsburg	21.00	Feb. 27	....		31.80	Feb. 6, 7	22.80	Jan. 15	28.90	Feb. 24	28.50	Mar. 24	28.80	Mar. 1	**35.00**	Mar. 15	26.70	Mar. 20	28.10	Mar. 22	35.00	1907
	Cincinnati	58.58	Feb. 21	66.35	Feb. 15	**71.06**	Feb. 14	43.90	April 25	61.10	Feb. 26	61.40	Mar. 24	53.30	Mar. 5	65.10	Jan. 21	55.70	Mar. 11, 12	53.20	Mar. 27	71.06	1884
	Louisville	37.40	Feb. 22	43.80	Feb. 16	**46.60**	Feb. 16	21.80	April 23	35.30	Feb. 28	36.20	Mar. 30	28.50	Mar. 9	44.20	Jan. 22	31.10	April 6	28.70	Mar. 28	46.60	1884
Cumberland	Nashville	**55.30**	Jan. 22	41.60	Feb. 11	48.30	Mar. 15	38.80	April 26	49.25	Mar. 20	38.80	Jan. 23	40.10	Mar. 9	28.20	Jan. 24	29.50	Feb. 16	46.50	April 8	55.30	1882
Tennessee	Chattanooga	40.17	Jan. 19	38.17	Jan. 23	42.83	Mar. 10	37.90	Jan. 17	37.90	Mar. 15	24.60	Sept. 5	31.80	April 11	19.60	Jan. 2	24.70	Feb. 17	30.20	April 5	54.00	1875
Mississippi	Cairo	51.87	Feb. 26	52.20	Feb. 27	51.79	Feb. 22, 24	48.29	April 28	51.67	Mar. 25, 26	49.78	April 6	50.60	Mar. 15, 17	50.30	Jan. 27	45.55	Mar. 19	**54.00**	April 6, 7	54.00	1912
	Memphis	35.15	Mar. 9	34.75	Mar. 6, 8	34.15	Mar. 13	34.50	May 2, 3	37.66	Mar. 20	37.59	April 10	40.10	Mar. 20	40.30	Feb. 3	35.55	Mar. 24-25	**44.90**	April 6	44.90	1912
	Helena	47.20	Mar. 9	46.90	Mar. 8, 9	47.00	May 6	45.73	May 11	51.75	April 4	49.11	April 17	51.00	Mar. 26, 27	50.10	Feb. 5, 6	45.20	Mar. 26	**54.20**	April 20	54.20	1912
	Mth. White Riv	48.40	Feb. 28	48.00	Mar. 9, 12	47.90	Mar. 7, 8	49.27	June 1	52.42	Mar. 29	51.05	April 19	53.70	Mar. 28, 29	51.90	Feb. 7, 8	49.50	June 1, 2	....		.....	....
Arkansas	Fort Smith	21.80	Feb. 23	22.80	June 11	27.90	Feb. 14	30.90	May 19	17.00	Mar. 20	**35.00**	May 7	24.10	May 26	18.80	Jan. 24	32.70	May 27	21.50	April 2	35.00	1898
	Little Rock	25.70	Feb. 25	25.80	Feb. 19	30.60	Feb. 15	**31.20**	May 21	23.20	Mar. 21	29.30	May 11	26.20	June 2	20.40	Jan. 25	27.80	May 30	24.00	May 1	31.20	1892
Mississippi	Arkansas City	47.10	Feb. 28	46.35	Mar. 11	46.50	Mar. 7, 9	50.00	June 1	51.90	Mar. 20	51.13	Apr. 19, 21	52.90	Mar. 27, 28	52.10	Feb. 8	49.90	June 2, 3	**55.40**	April 12	55.40	1912
	Greenville	41.68	Feb. 27	40.40	Mar. 9, 13	41.10	Mar. 7, 8	44.28	June 1	46.75	Mar. 29	46.16	April 21	49.10	Mar. 27	47.30	Feb. 9	44.75	June 3, 5	**50.50**	April 12	50.50	1912
	Lk. Pr'vid'nce	38.32	Mar. 20	36.47	Mar. 11, 14	38.40	Mar. 23, 24	41.90	June 2	44.54	Mar. 30	44.35	April 23	46.48	Mar. 27	46.30	Feb. 10	44.10	June 5	**48.25**	April 12	48.25	1912
	Vicksburg	48.75	Mar. 20	43.80	April 7	49.00	Mar. 25	48.45	June 2, 3	**52.48**	April 16	49.40	April 24	51.80	Mar. 28	49.60	Feb. 10, 11	47.80	June 5-8	**51.90**	April 13	52.43	1897
	Natchez	47.75	Mar. 28, 29	44.00	April 7, 9	47.40	Mar. 24, 26	48.10	June 26	49.82	May 2	47.40	Apr. 26, 27	50.35	§	48.90	Feb. 13, 14	48.70	June 14	**51.40**	Apr. 16-17	51.40	1912
Red	Fulton	....		....		....		34.85	May 23	28.60	Mar. 23	27.90	May 11	31.15	Mar. 14	31.10	June 4	33.95	June 2	30.90	April 6	35.75	1876
	Shreveport	31.40	Feb. 21	25.30	Mar. 11, 12	32.70	May 14	**35.70**	May 28	24.10	Apr. 11, 13	15.00	May 21	33.10	Mar. 22	26.90	June 13	35.10	June 15	19.30	April 15	35.70	1892
	Alexandria	34.85	Mar. 17, 19	25.45	Mar. 27	35.25	*	38.25	June 12, 13	26.25	Apr. 14, 15	17.40	Jan. 25	35.05	Mar. 28	32.60	June 18, 19	**41.82**	June 6	33.50	Apr. 19-20	41.82	1908
Atchafalaya	Barbres Ldg.	49.90	Mar. 27	46.30	Apr. 8, 10	48.60	Mar. 30, 31	49.70	June 27, 28	**50 95**	May 13, 14	42.35	May 2	50.50	April 7, 11	45.70	Feb. 19, 20	48.00	June 14, 23	53.55	May 10, 15	53.35	1912
	Melville	37.00		....		....		35.00	July 2, 5	35.10	May 15	33.90	‡	38.70	April 4, 5	37.70	Feb. 20	39.70	June 22	**41.90**	May 6-15	41.90	1912
Mississippi	Red Riv. Ldg.	48.50	Mar. 27	45.20	April 9	47.30	Mar. 29, 31	48.87	June 27	**50.20**	May 14, 15	44.30	Apr. 28, 29	50.08	April 8, 9	46.90	Feb. 15, 19	48.74	June 14, 16	**53.20**	May 11, 12	53.20	1912
	Baton Rouge	35.95	Mar. 26	35.08	April 9	36.20	Mar. 24	38.45	June 28	40.65	May 13, 15	34.60	Apr. 29, 30	40.05	Apr. 7, 8, 10	37.40	Feb. 17, 19	39.60	June 16-17	**43.80**	May 11-13	43.80	1912
	Plaquemine	31.30	Mar. 21, 27	30.80	April 9	31.70	Mar. 24	33.50	June 13	36 25	May 13, 17	30.57	Apr. 29, 30	36.12	Apr. 5, 7, 8	33.40	Feb. 17, 19	35.20	June 15-16	**39.74**	May 11	39.74	1912
	Donaldsonville	....		....		25.70		30.15	June 13	32.75	May 13	27.95	Apr. 28, 29	32.23	April 7	30.00	Feb. 15, 21	31.60	June 18	**34.80**	May 11	34.80	1912
	College Point	23.20	Mar. 26	23.45	April 9	24.10	Mar. 24	25.62	June 13	27.95	May 15	23.50	Apr. 27, 30	27.81	Apr. 5, 6	25.90	Feb. 15, 19	27.19	June 17	**30.18**	May 11	30.18	1912
	Carrollton	14.95	Mar. 27	15.40	April 7	15.60	Mar. 18	17.35	June 10	19.17	May 13	15.90	April 25	19.42	Apr. 5, 6	18.70	Feb. 16	18.75	June 18	**20.70**	May 11	20.70	1912
	New Orleans	15.80	Mar. 27	....		16.20	Mar. 26	17.60	June 11	19.50	May 13	16.90	Apr. 27, 28	20.30	**	19.80	Feb. 18, 21	20.00	June 19, 22	**21.40**	May 9	21.40	1912
	Fort Jackson	....		....		....		6.90	Mar. 31	7.20	†	6.70	Apr. 23, 26	8.05	Mar. 27	8.30	Feb 14, 16, 18	8.10	Feb 14, 16, 18	**8.50**	May 3, 4, 11	8.50	1912

*May 30-June 1, 5. †April 22, 23-May, 14, 16. ‡April 29-May 4. §Mar. 28, 31-April 2. **Mar. 30-April 1. °June 28-May 25. °°Jan. 12-Dec. 29.

ly would have had the resources to build properly and they would have been saved the annoyance and expense of 1912.

As early as 1897 Mr. William Starling, chief engineer Lower Yazoo Levee District, wrote:

> In 1894 the writer, in a published report to the Board of Mississippi Levee Commissioners, declared his belief that the levees of the Lower Yazoo District would have to be 3 ft. higher to hold a flood like 1882, and in 1895 he showed, to hs own satisfaction at least, that the flood of 1882, if confined, would have gone to 55.8 at Arkansas City. This means 2.5 ft. above the top of the levee at that point.

At the time that the last named prediction was made, the record stage at Arkansas City was 50.0 (in 1892). In 1882 it was 47.10, so that Mr. Starling's estimate was a super-elevation of 8.7 ft. at that place, due to the closure of basins which were flooded in 1882. It is to be remarked here that in 1912 the stage at Arkansas City was 55.4, or only 0.4 below the prediction made 17 years before; but it should be borne in mind that this cannot be regarded as a strict verification of the estimate then made, because in 1912 there was a stage nearly 2 ft. higher than 1882 at Cairo, while the ultimate stage both there and at all points below was considerably modified by breaks. The comparison serves, however, to show that Mr. Starling realized 18 years ago, as did all other engineers in charge of levee construction, that the closing of these vast basins against the flood water and confining the latter between levees would raise the flood plane to elevations considerably above the levees then building. But the territory supporting these levees was then, to a large extent, wild and unproductive, and it was a struggle to raise the funds to do even as much as was being done.

Levee Building of a Progressive Nature.—On June 2, 1897 (after the high water of that year), Mr. T. G. Dabney, in a report to the Yazoo Mississippi Delta Levee Board, said:*

> The problem of levee protection has in the nature of the case been progressive in its development, requiring that we should proceed step by step in an uncertain and tentative manner, restricted on the one hand by the lack of means to go as far as we would, and on the other hand by the want of information to know how far we should go.
>
> This want of information has been due to the ever present uncertainty as to the future high water elevations, under progressively changing conditions of flood restriction, caused by continuous extension of new levee lines along hitherto unenclosed basins, which had afforded avenues of escape for part of the flood volume. The task of predicating estimates of the future high water elevations upon any data that have been heretofore available, with even approximate certainty, has baffled the ingenuity of all engineers who have assayed to do so.
>
> It seems also quite evident, that with the combined resources of the United States and the local levee boards, in so far as those resources now appear to be available, the time has not yet arrived for a realization of that condition (of continuous levee lines on both sides of the river adequate to resist the ultimate flood), and its final attainment must still be approached in a gradual manner, as the necessary means can be controlled, and further necessary information of future high water elevations shall develop.†

The levee engineer knew that the closure of the then open basins, still more wild and unproductive than the leveed ones, would be a slow process. He knew that a levee of inadequate size to stand the greatest flood would protect all of his district against the more frequent floods of lesser magnitude and that even when unusual floods should come and crevasses occur, only a limited per cent of the area of the district would be inundated. The levee

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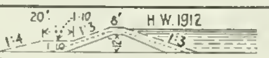
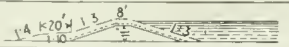
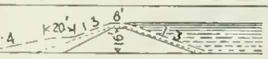
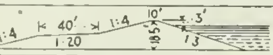
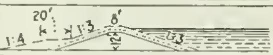
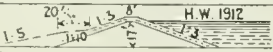
*Note.—In view of a reasonable criticism that might be advanced, that this paper is largely composed of quotations, it seems proper to explain that an important point to be made is that levee engineers have worked with a full realization of certain increase of flood elevations, and that this point can best be sustained by direct quotations from reports of past years.

†"The Floods of the Mississippi River," by William Starling.

TABLE II.—MISSISSIPPI RIVER LEVEE DISTRICTS—APPROXIMATE DATA AS TO DIMENSIONS AND BREAKS IN 1912.

NAME OF DISTRICT	Side of River	State	Date of Organization	Date of first work by Miss. River Commission	Miles of Levee Front	Average height as built	Average deficiency below standard Grade	Greatest deficiency below standard Grade	Standard grade for top of Levee equivalent to stage an: Cairo Gage	Memphis Gage	Helena Gage	Arkansas City Gage	Greenville Gage	Vicksburg Gage	Natchez Gage	New Orleans Gage	THE SECTIONS BELOW SHOW: Standard proposed before 1912 H.W. – – – Average for district as built .... Minimum in district as built ———	Number of Breaks in 1912	Total Length of Breaks	Area of District in sq. Miles	Percentage of District Flooded
Upper St Francis	W.	Mo.		1898	55	12 ft	2 ft	4.5 ft	55.2								 20' 1·10 8' H W. 1912 1·4 1·10 1·3 12' 1·3	2	25 Miles	700	Practically all
Cairo Drainage District	E.	Ill.	1888		15	15 ft.		1-2 ft	56 0								Varies	7	800 ft.	11	All
Reelfoot	E.	Ky & Tenn.			21	11 ft	2 ft	3 ft	55.2	45.0								1	5,500 ft.	310	All
Lower St Francis	W.	Mo. & Ark.	1893		215	16 ft	40% of Yardage	Approx 3 ft	55.2	45.6	56.2							3	(4000 in open Gap) 10500 ft.	3125	80%
Upper Yazoo	E.	Miss	1884		98.5	18.5 ft.	0	▨ 1.5 ft	57 0	47 0	57.6							0	0	3680	0
White River	W.	Ark		1887	75	12 ft	2 ft	4.0 ft			56.2							5	5400 ft.	910	80%
Lower Yazoo	E.	Miss.	1865		187		1.5 ft.	3.5 ft			55.0	56.9	53.1	55.8				1	2400 ft	2600	50%
Louisiana Districts	Both	La. & Ark	1886 to 1898		1140													10		Estim. 14000	⬚ 20%

▨ A few hundred yards were 1 or 1½ ft below standard, but still had ample margin ⬚ Including area not protected by Levees; about 30% of all alluvial lands in State were Overflowed

engineer's problem was not then to establish final grades and build to them; but to utilize such insufficient resources as were available in such manner as to give the most immediate protection. That he builded wisely is proven by the fact that the Yazoo Delta, an area of about 4,000,000 acres, which in 1884 was very largely a wilderness where the bear and panther abounded, and which had, in this entire area, only about 75 miles of *narrow gage* railroad, is today about one-third cultivated, with land selling at from $40 to $100 per acre. The population in the Yazoo Delta was multiplied by nearly three between 1880 and 1910, according to the U. S. Census. It has within its boundaries today at least 900 miles of standard gage railroad, over which some 50 passenger trains per day are operated. The development along all commercial lines is about in proportion to the railroad development; and the development in all other basins along the lower Mississippi is commensurate with the length of time since their reclamation was effected.

Table I, compiled in the office of Board of State Engineers, New Orleans, from records of the Mississippi River Commission and U. S. Weather Bureau, shows the stages at the principal stations on the Mississippi River and its tributaries for the important floods from 1882 and 1912, inclusive. Enough has been said to show the method of comparing one with another and predicting future stages therefrom, and to point out those floods prior to 1912 which have had most significance to levee engineers along the whole (lower) river, except that the 1897 flood should be mentioned as the only one to closely approximate the 1882-3-4 stages at Cairo, giving record stages at all points below and resulting in many levee crevasses. Until 1912 it was the most destructive flood of record; more than that of 1882, because of the more highly developed state of the country inundated, and the much more expensive levees that were destroyed. Enough has also been said to show that the levee engineers knew what they were doing. All of the quotations given are from printed reports. Had people read and heeded them, they would have seen that higher stages would come; they would have seen why, and some would still have closed their eyes and followed the omnipresent faddist.

The 1912 Flood.—The flood of 1912 was startling to the engineer as well as to the layman. For 19 years the water had not attained the 1882-83 stages at Cairo, upon a probable repetition of which most predictions of the ultimate stages below had been based. In 1912 not only was this stage exceeded by about 2 ft., but it would have been exceeded twice as much if the levees had not given away. It has been estimated by several authorities that, had there been no breaks, the stage at Cairo in 1912 would have been about 56.0 or 4.13 ft. above 1882. The gage there actually registered 54.0. This flood was the more remarkable because of the fact that at no gage above Cairo was a record stage reached. Why, then, a flood of such magnitude at and below Cairo? The answer has been given clearly enough by Mr. S. C. Emery, U. S. Weather Bureau Observer, Memphis, Tenn., by Prof. H. C. Frankenfield, U. S. Weather Bureau, Washington, D. C., in his able paper in "Engineering News" of April 18, 1912, and by river engineers who have studied the precipitation records.

In brief, the explanation is that a series of storms accompanied by unusual precipitation were so correlated in both locality and time that the lower portions of the Mississippi and Missouri River watersheds and all of the Ohio watershed sent out flood waves which, though not as high as had been recorded in former years, were unusually prolonged and of considerable magnitude. The path of these storms and their timing was such as to bring together these several flood waves at Cairo in a synchronism which greatly increased the stage there over any formerly experienced. Quoting Professor Frankenfield:

> The first southwestern storm passed over the gulf states and the Ohio valley on March 11-12, attended by seasonable temperatures and rain in fair quantity. At this time the lower Ohio and lower Mississippi rivers were at moderately high stages on account of an Ohio River rise in the early part of the month.
>
> On March 14-15, and again on March 20-21, southwestern storms moved over the gulf states and the Ohio valley, attended by moderately heavy rains, but not by very high temperatures. On March 23-24 there was another, but this one was attended by abnormally high temperatures and excessive rains, with a fall of snow over Missouri and Kansas that was almost unprecedented for the season. On March 28-29 there was another southwest storm, accompanied by high temperatures and heavy rains, and still another on April 1-2. The precipitation was from 2 to 4 ins. in excess of the normal amount over the lower Missouri, the Ohio and the middle and lower Mississippi watersheds, and owing to the frozen soil, a much larger percentage than usual of the total amount must have run into the rivers, carrying with it the water from the melted snows, which on the Ohio watershed must have amounted to at least an additional half inch.

The accompanying hydrographs, Fig. 2, are from the records of the Upper Yazoo Levee District. The hydrographs will illustrate the point under discussion. Note on that for 1912 the prolonged high stages at Cincinnati and St. Louis and their synchronism as compared with those of other years.

The usual spring flood in the lower Mississippi comes principally from the Ohio watershed. As stated by Professor Frankenfield, these 1912 storms gave heavy precipitation on the lower Missouri and Mississippi watersheds, to augment much more than usual the volume from the Ohio. Thus is explained the apparent anomaly of record stages considerably exceeded in the main trunk, while not being reached in any of the tributaries.

What will happen when we get record stages in the tributaries all at the same time? The writer has heard this question asked. In reply, it can be said that if the elements should so far exceed the very unusual phenomena of the 1912 series of storms as to give a larger precipitation over the same area, so timed in its general sections that synchronous flood waves will pass from the several watersheds of prolonged duration as in 1912 and of higher stages, the 1912 high water will be exceeded in the lower Mississippi. This is not probable. Within the time of which we have records, there has been no such precipitation as to produce a greater flood than 1912. Prior to 1882, 1785 and 1844 were spoken of as the great flood years. Since 1882, to quote Professor Frankenfield, the fame of these floods has diminished. The writer is not informed whether there are records of these floods at Cairo, but if it can be assumed that neither was as high as 1912 than for 127 years back, the elements have not so conspired as to give such a flood as occurred in 1912. Then, by probabilities, 1912 will not be repeated and less probably will it be exceeded for at least 127 years. The resources of the lower Mississippi Valley to build flood protection works will be increased tenfold by then. It would seem that if we build for the 1912 flood, with a reasonable margin of safety above that flood plane (as it would have been if confined to the channel), we need concern ourselves no more for the adequacy of our works than for the danger from storm and earthquake.

Damage by the 1912 Flood.—The levees of the lower Mississippi were not completely demolished. The country dependent upon them was not reduced to desolation and ruin. In Memphis, dependent very largely for support upon the levee protected lands of the Yazoo and St. Francis Basins, one is struck, at this writing, nine months after the crest of the flood wave was passing, with the great activity in building and all commercial lines. Most of the levee breaks have been repaired and the others will soon be closed. Most of the lands that were submerged were cultivated this year.

Tabulations II and III which were presented with this paper* were compiled from information gathered during the latter stages of the flood somewhat hastily; yet it is believed that a more careful compilation would make only slight changes. The information for the several districts was furnished by district engineers and U. S. assistant engineers in charge of work therein, and is essentially correct. Among the more prominent facts brought out by these tables are:

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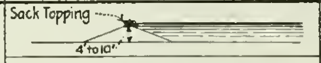
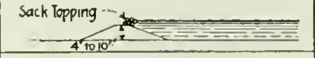
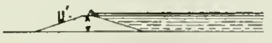
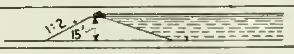
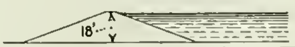
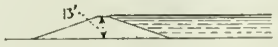
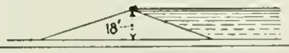
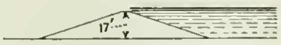
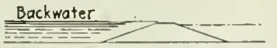
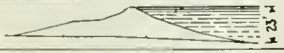
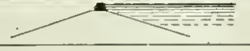
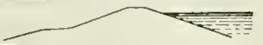
*These tables were first published by the writer in "Engineering News" of June 13, 1912.

TABLE III.—APPROXIMATE DATA ON BREAKS IN LEVEES IN 1912 FLOOD.

NAME OF DISTRICT	Side of River	State	Name of Break	Location	Date of Occurrence	Width at Date of this Information	Sections of Levee at Breaks showing water level at time Break occurred (Drawn to Scale) All Levees have 8 ft. crown and 1:3 Slopes	Deficiency below Standard Grade, ft.	Water Level when Break occurred (Feet above or below Top)	CAUSE OR MANNER OF OCCURRING
Upper St Francis	W.	Mo.		From opposite Cairo northward for 20 Miles	March 30th to April 6th	Aggregate 22,000 ft		4.5′	About 1.5 ft. above when Breaks began	Mainly occurred in small and inadequate Levees that had been built by the County Districts and had never been worked on by the Miss. River Com. over a length of 25 mi. (in two places) There were abt. 80 Gaps washed
Upper St Francis	W.	Mo.		About opposite Hickman Ky.	March 30th to April 6th			4.5′	do.	
Cairo Drainage District	E.	Ill.	Seven Small Breaks	Just above Cairo	April 3rd and 4th	Aggregate 850 ft.		2′	0	Seven Breaks occurred. Most of them by sloughing of landside slope which was steep. One by deep landside borrow pit
Reelfoot	E.	Ky.	Hickman	5 Miles below Hickman	April 5th	5500 ft		3′	1 ft. Above	Windstorm Waves undermined Sack Topping
Lower St. Francis	W.	Mo.	Pt. Pleasant	Just below Pt Pleasant		4000 ft.				Levee had caved into River two Years ago and River Commission prepared to close Gap. Local Authorities had not succeeded in acquiring necessary right of way. Gap left open
Lower St. Francis	W.	Ark.	Wilson	40 Miles above Memphis	April 10th	4000 ft.		3′	1 ft. Above	Blow-out from Sandboil at toe of Slope
Lower St Francis	W	Ark.	St. Clair	10 Miles above Memphis	April 6th	2500 ft		1′	1 ft. Below	Blowout
Lower St Francis	W.	Ark.	Wynoak	10 Miles below Memphis	April 6th	4000 ft		2′	Just Above	Overtopping
Upper Yazoo	E.	Miss.	None							
White River	W.	Ark.	Modac	23 Miles below Helena	April 6th	3200 ft.		4′	0.5 ft. Above	Leak appeared in back Slope and suddenly blew out
White River	W	Ark.	Ferguson	57 Miles below Helena	April 15th	1200 ft		1′	1 ft. Above	Overtopping
White River	W.	Ark	Laconia Circle Back Levee	One Mile below Laconia	April 7th	700 ft.		2′	2 ft. Below	Blowout
White River	W.	Ark.	Laconia Circle Front Levee	One Mile below Henrico		300 ft.				After circle filled from Break in back Levee, this Break was caused by Water running over top to get back into River
Lower Yazoo	E.	Miss.	Beulah	42 Miles above Greenville	9 P.M. April 17th	2400 ft		2′	0	Sand foundation. Sandboil near base. "Hoop" of sacks being built when banquette caved in and blowout occurred
Upper Tensas (La.)	W.	Ark	Lake Jefferson	Near Mouth of Arkansas River	April 16th	960 ft		4′	2.5 ft. Above	Overtopping
Upper Tensas (La)	W.	Ark	Panther Forest	16 Miles below Arkansas City	April 12th	2350 ft.		3′	0	Sloughing of landside embankment
Fifth Louisiana	W.	La	Alsatia	17 Miles below Lake Providence	April 12th	5000 ft		2′	3 ft Below	Sandboils
Louisiana	W.	La	Torras	Mouth of Red River	May 1st	3000 ft	10′	0.5′	3 ft. Below	Sloughing landside enlargement
		La.	Hymelia		May 14th	2500 ft	12′		3 ft. Below	Unstable Substrata
	E.	La.	Nestor	60 Miles below New Orleans	May 14th	Closed soon after	8′		2.5 ft. Below	Crawfish Holes
(Not shown on Map)	S Bank Red River	La	Normands	45 Miles below Alexandria		200 ft	9′ Heights		Top (?)	Cut for Roadway improperly filled
	S Bank Red River	La.	Lakelong	53 Miles below Alexandria		250 ft.	35′		3 ft. Below	Cut (?)
	W Bank Atchafalaya R.	La.		12 Miles below Head of River	May 19th	1500 ft.	10′		2.5 ft. Below	Sandboils
	W Side Atchafalaya R.	La	Alkms Bayou	25 Miles below Head	April 10th	5300 ft.	12′		4 ft. Below	Cut (?)
	E. Side Atchafalaya R.	La.	McCracken Bayou	30 Miles below Head	April 6th	5300 ft.	12′		0	Overtopping

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First, that of about 1,700 miles of levees south of the Missouri-Arkansas line on the west side and the Tennessee-Mississippi line on the east side, only about one-half of one per cent of the levees, in lineal extent, was lost (it will be understood that this is not a true measure of damage, but is mentioned to clear away misconception of conditions).

Second, that most of the breaks occurred in levees that were overtopped and which would doubtless have held, had they been a few feet higher.

Third, of all levee protected lands below Cairo (some 25,000 square miles) only about 32 per cent was inundated.

Fourth, only three breaks occurred on the east side of the river between Cairo and New Orleans, and two of these were in small local basins.

Especial attention is called to the Upper Yazoo Levee District which in its entire front of about 100 miles had no break; and to its levee section in comparison with the stage reached. This district had a sufficient height and section to have withstood the additional water had there been no breaks elsewhere to modify the height of the flood crest.

Lessons of the 1912 Flood.—Col. C. McD. Townsend, president Mississippi River Commission, in his address to the Levee Convention in Memphis on Sept. 26 last, said:

> The flood of 1912 affords no argument for the abandonment of levee construction. It has simply attained the height which Gen. Comstock and Maj. Starling predicted the flood of 1882 would have attained if the river had been confined. It has cleared the atmosphere of certain false theories, and we can now resume operations with a definite knowledge of the problem before us. We are passing through the same experience European nations have had. Levees have been tested for centuries, and have proven uniformly successful when built of adequate dimensions. No other method of relief from floods has been successfully applied to large streams.

At the same convention, Mr. T. G. Tabney said:

> It is not expedient here to discuss or argue about the various adjunctive devices to promote flood protection, the adoption of which has been insisted upon, by various persons at different times, from the era of Capt. John Cowden down to the present. It is sufficient to say that this problem has been in the hands of many able engineers for many years, who have brought to bear upon its solution, in the aggregate, about as much engineering skill and professional acumen as the world's resources can supply.
>
> There has been and is substantial unanimity of conviction among these authorities as to the proper and only practicable solution of the problem, which may be expressed in simple terms, and consists of just two factors, to-wit:
>
> First—A general system of levees which shall be high enough and strong enough to resist any flood that may come against them; and second, stability of the banks of the Mississippi River, which is necessary to give permanence to the levee lines, and so justify the large expenditures of money needed to bring such system to a perfected state.
>
> There is a feeling of skepticism in the minds of many people as to whether levees can be built to withstand the occasional great floods in the lower Mississippi River.
>
> But no man ever witnessed the breaking of a levee without facing the self-evident proposition that if this particular piece of levee had been made a few feet higher, with a corresponding increase of base width, it would not have so yielded. It is a proposition that a child can understand, that if levees break because there is not enough earth in them, then by placing a sufficiency of earth disposed in a proper levee section, such levees cannot break under any flood pressure that they may be designed to resist.

The writer has estimated that to raise all levees an average of about 6 ft. and to increase their base approximately to the largest standard section shown in the table will make them adequate in size for a repetition of the 1912 water confined between them. This assumes levee grades 4 ft. above the following stages: 56.0 on the Cairo gage, 47.5 on the Memphis gage and 56.5 on the Helena gage, with corresponding stages at points lower down the river, being about the stages which would have resulted if the 1912 flood had been confined between levees. The 4 ft. additional elevation will give a margin of safety sufficient to stand nearly 4 ft. higher stages than those above noted, if the proper section be built. Attention will then have to be given to special cases of foundation weakness.

Conclusion.—There is nothing inscrutable about Mississippi River floods. All changes in the flood plane, shifting of river bed and other phenomena of the river have been either predicted or readily accounted for by those who have made river engineering a study.

It is beyond the province of this paper to discuss the various substitutes for the levee system which have been proposed. They have all been discussed by engineers time and again, and their fallacies shown; but the class of "inventors" that produce these plans for flood control do not, as a rule, read engineers' reports, consequently they do not know that all of the "new ideas" brought forth by the 1912 flood, for instance, were fully aired 20 years ago—some 40 years ago. Suffice it to say that reasons can be given which will be conclusive to any man of ordinary education and fair intelligence (provided he will weight them with an open mind), that none of the substitutes proposed can take the place of the levee system or be applied as an auxiliary to it as cheaply as the same degree of security can be provided with levees only, protected by bank revetment.

One does not consult a lawyer when he has appendicitis, nor a dentist for a remedy for chills. As reasonable would be the above as the following after the theories of Isom Brown, who keeps a "government light," and has been "watching the river for 30 years," or a riparian owner who probably never sees a precipitation chart or a hydrograph.

Many engineers have studied this problem. Among them have been a number of the most who have been in charge of a great variety of works over the entire country, and are broad enough in experience to view the Mississippi problem in all of its aspects. All engineers who have ever dealt with the problem long enough to become familiar with it are agreed that levees are the only practicable means of reclaiming the lands along the Lower Mississippi. The existing levees from Cairo to the Gulf have cost, to date, more that $80,000,000. They will not be abandoned. The levee districts and U. S. government are now engaged in closing the breaks and enlarging the levees. Suppose another $80,000,000 must be spent to make the entire system adequate; the present resources of the country are better equal to this task than were those upon which the cost heretofore has fallen.

Authorities are agreed that the only plan open for the dwellers along the Lower Mississippi is to build their levees to a reasonable margin above the revised ultimate flood plane indicated by the 1912 flood, with commensurate base width and attention to foundation weaknesses, all of which are curable; and that the consummation of this plan will mean assured protection.

SEWERAGE AND SANITATION

Methods of Garbage Disposal Applicable to Conditions in the Smaller Cities, with Some Costs and Other Data.

The major portion of the literature on municipal refuse disposal deals primarily with the problem as encountered in our larger cities. It is, therefore, gratifying to note the presentation of a paper on Garbage Disposal in the Smaller Cities before the recent annual meeting of the Illinois Society of Engineers and Surveyors. The author of the paper, Mr. Samuel A. Greeley, of Winnetka, Ill., has made numerous important contributions, as our readers are aware, to the literature on refuse disposal in the cities of the first class. We are pleased to present in full herewith Mr. Greeley's latest paper, which discusses the various methods economically available for disposing of garbage in cities of from 10,000 to, say, 75,000 population.

The United States census of 1910 records 31 cities in Illinois having populations greater than 10,000; of these only Chicago had a population in excess of 67,000, so that there were 30 cities in the state which may reasonably be designated as "smaller cities." These 30 cities had an aggregate population of 751,402, or about 13 per cent of the total population of the State. Various kinds of cities are represented among them. Two of them—Oak Park and Evanston—are within the Chicago metropolitan area and are more or less residential in character. Others—such as Bloomington, Elgin and Alton—have more than an average proportion of manufacturing establishments. Most of the others are river towns or county seats. These may be described in a general way as being located in open or farming country, without large adjacent populations, and with ample areas of vacant land easily accessible, either outside the city or along the river banks.

In such cities the principal refuse materials to be removed include (1) ashes, (2) rubbish, (3) manure and (4) garbage. These terms, fortunately, are better understood than they used to be and I shall not dwell on defining them at length. Rubbish should not be confused either with refuse, which is a general term for all wasted materials, or with garbage, which is the animal and vegetable portion of house refuse. Rubbish consists of wood, paper, rags, bedding, etc.

As a general rule, in the smaller cities, there are low areas requiring filling, where ashes and rubbish can be dumped without creating a nuisance. However, proper precautions are necessary, and these are frequently neglected. It is unfortunate that such a simple, cheap method of disposal should so frequently be abused. Among the precautions recommended, depending upon local circumstances, may be mentioned (1) fencing the dump; (2) abolishing uncontrolled scavenging; (3) burning the rubbish unsuited for filling. When properly applied a certain proportion of garbage can be handled in this way. Where planting is to follow, some manure can also be disposed of to advantage on the dump.

The stable treatment and removal of manure is important because it is such a favorable place for breeding flies. This is particularly true since the discovery last year that infantile paralysis is transmitted by the stable fly. Time limits me, however, and I cannot go into these other subjects further but must discuss more specifically the garbage question. It is necessary, nevertheless, to emphasize the points that ashes and rubbish are more bulky than garbage; that rubbish is more dangerous from the public health point of view; that both affect the economy of methods employed for the collection and disposal of garbage, and that the treatment of manure is intimately related to the health of the city.

The three general divisions of the garbage disposal problem are (1) the house treatment; (2) the collection; and (3) the final disposal. Of these the house treatment has the more direct effect upon the comfort of a household and its neighbors; the collection is the most costly; while the final disposal makes more trouble for the city officials and has therefore received more attention in the past.

I cannot urge you too strongly not to overlook the house treatment and collection of garbage in your search for better methods of disposal. Good metallic cans with tight fitting covers should be required. The location of the can is important, because the cumulative effect of small delays at each house in the collection work has a marked influence upon the cost of collection. The collection is equally important. How often have I heard the remark, "What is wrong with your disposal system? My garbage has not been collected for two weeks." Regular collections at intervals of not more than three days should be made. The wagons should be as large as is consistent with local grades and pavements, and should be of metal, easily and frequently washed. The covering over the wagon is important. I prefer a wagon with fixed, arched top, fitted with trap doors. Other common types of cover are iron plates attached by hinges with a common rod at the center of the top of the box; or a canvas sheet may be used. These are subject to the objection that the covers are frequently broken or bent and not closed tight, and the canvas cover is frequently omitted or becomes dirty.

GARBAGE DISPOSAL.

For the disposal of garbage several methods are commonly employed. Most of these are applicable to smaller cities. The reduction method, however, is not generally in use in cities having a population below 100,000. Briefly, this method consists in extracting the grease from garbage and converting the remaining portion into a dry material called yambage, which is used in the manufacture of commercial fertilizers. The smallest plant of this sort is at Vincennes, Indiana. It reduces the garbage and dead animals, from a population of about 15,000. On account of the high first cost, and of the cost of operation, this method is not applicable except where these costs can be distributed over a large tonnage of garbage.

The methods of garbage disposal available for the smaller cities are, therefore: (1) burial; (2) feeding to pigs; (3) burning.

The applicability of these methods of disposal in each case depends upon local conditions. I desire to consider each method briefly and from the point of view of the practical application.

Burial.—Dumping garbage in vacant low lying lands is, perhaps, the most common method of disposal in small cities. When done in an unrestricted way this method cannot be condemned too strongly. But when properly done, so that true burial of the garbage results, the method is effective, cheap and successful in practice.

The principle upon which garbage burial rests, lies in the activity of the bacteria of the soil. This activity results in a mineralization of the organic matter and when conducted in the presence of sufficient air or oxygen, no putrefaction or other odors are produced. Therefore, the following conditions must be observed if the method is to be applied with success:

1. The garbage must not be buried so deep that bacterial activity is reduced; nor must the garbage be spread in a thick layer on the surface of the ground. 2. The ground used should be sufficiently open and drained so that the air can penetrate. 3. The garbage must not overload the soil or bacteria, but must be sufficiently diluted so that mineralization proceeds on an aerobic basis.

Frequently on poorly kept dumps, the garbage is deposited without spreading, sometimes in a heap so deep that there is little bacterial activity, or else left on the surface to rot and putrefy. Three correct methods have been practiced successfully. The garbage can be spread on the ground and plowed in at sufficiently frequent intervals to prevent nuisance. This method I have seen applied successfully to mixed refuse at Cologne, Germany, and to garbage at York, Pennsylvania, where, however, more than an occasional nuisance resulted. A better method is actually to bury each day's garbage in a shallow trench, covering it with the excavation from the trench for the next day's garbage. This method has been practiced successfully at Milwaukee, Wisconsin, and Columbus, Ohio. Finally, the so-called "dilution method" can be used as practiced at Essa, Germany, Davenport, Iowa, and New Orleans, Louisiana. This method consists in dumping the garbage on low ground and dumping with it for "dilution" a sufficient quantity of ashes, street sweepings, building excavations and similar materials.

Experience indicates that for open soil about 1.5 acres will be required to handle each daily ton of garbage, the same soil being in shape for re-use after two years. For heavy soils, the time required for the complete assimilation of the garbage will be four years and the area required per daily ton of garbage will be about 3 acres. At Davenport, where the dumping method is used, 1.3 cu. yds. of diluting material is required per ton of garbage. The total cost per ton, including rent of land, labor, upkeep, etc., at Milwaukee and Davenpart, is reported as follows:

Milwaukee, Wis.	40 cts.
Davenport, Iowa	50 cts.

At New Orleans the dumping grounds are seeded as soon as sufficient filled area is available and later trimmed and planted for use as small parks and playgrounds. Many city dumps or garbage burial fields could be kept free from nuisance and transformed into suitable methods of disposal if regarded as such and properly maintained. A proper plan of procedure is needed and a diligent superintendence to follow it.

Pig Farms.—There are a great many cities in this country, both large and small, in which part or all of the garbage is fed to pigs. This method and its control, therefore, demands our attention. A considerable difference of opinion exists as to the safety with which garbage from crowded centers of population can be used as food for pigs. In Los Angeles, California, the garbage piggery was investigated by the Grand Judy. They reported as follows:

> The investigation of this grand jury shows that at the present time (March, 1912) there are located on this hog ranch about 21,000 head of hogs; that the percentage of death of these hogs ranges from 40 to 65.
>
> We find further that the percentage of tubercular hogs on this ranch ranges from 10 to 20. Of this number 2 per cent are condemned by the health officials, the other portion being placed on the market. . . . We further find that cholera, strike, swine plague or swine fever is prevalent on the ranch at all times. In fact, we find that at the present time this hog ranch is quarantined for all purposes except for the purposes of slaughtering for meat and food.

The sanitary conditions at this pig farm are the worst that I know of. The method has been practiced with success in New England for many years. Dr. L. V. Chapin, the well known health officer of Providence, Rhode Island, states in his annual report for 1902 that

> Feeding garbage to swine will not cause disease, either in Providence or in the towns to which it is removed. In an experience of 19 years I have never found a case of sickness that could be thus explained.

Undoubtedly, the difference between these two points of view can be explained by the efficiency with which the sanitary conditions at the farms are maintained. At a tuberculosis sanitarium outside of New York the garbage is fed to pigs after first being sterilized by cooking in a large iron cauldron. The garbage of Grand Rapids, Michigan, is taken to a large pig farm near the city and fed to pigs. At the pig farm provision is made for sterilizing the garbage and the pigs are carefully vaccinated against cholera. The farm is kept clean and in a sanitary condition. These facts emphasize the point that this method of garbage disposal will not run itself and is dangerous if abused. Sanitary methods of operation are essential. The method is advantageous from a financial point of view and therefore should be used only under proper control. Each city should have its own pig farm or should enter into a contract under carefully prepared specifications.

It is found that about 75 pigs are required per ton of garbage per day. For a city of 50,000 inhabitants, therefore, from 1,200 to 1,500 pigs should be required. The equipment at the farm should include tracks and cars for distributing the garbage along concrete feeding platforms, substantial and well kept sleeping and roaming pens, tanks for sterlizing the garbage, apparatus for vaccinating the pigs, a means of disposal of the unconsumed garbage by burial or otherwise and plenty of washing facilities.

TABLE I.—TESTS OF GARBAGE CREMATORIES IN OHIO, 1909.

	Material burned.					
City.	Garbage. %	Mixed garbage. %	Night soil. %	Equivalent coal used per ton material burned.	Average temperature combustion chamber. Deg. F.	Average CO_2. %
Canton	100.	...	...	730.	755.	3.1
Mansfield	100.	...	...	362.	1,002.	8.3
Marion	31.7	11.7	56.6	370.	803.	1.2
Steubenville	86.	14.	...	642.	716.	1.6
Zanesville	81.	19.	...	631.	682.	3.7
Coal equivalent to gas used, average				547	792	

Where one central farm is not available and under proper control, other precautions are recommended. Frequently in small cities a part or all of the garbage is removed by farmers. The city should have available some other method of disposal, so that garbage not suitable for pig food could be condemned. The farms should also be inspected and insanitary farms blacklisted. With such regulations carefully enforced the method should be useful to many cities in Illinois for quite a number of years.

Incineration.—When cities reach populations of 20,000 to 30,000, I think a more satisfactory method of garbage disposal is incineration. Present day experience justifies the statement that this is more expensive than other methods either by burial or feeding to pigs, but from a sanitary point of view it is preferable. The construction and operation of a furnace or incinerator is necessary. In general, two types of incinerators are used: the coal-fired or so-called low temperature type and the higher temperature type which is desired to burn mixed refuse (garbage, ashes and rubbish) without the use of additional fuel. In a general way, the former is more applicable to small communities, the latter to larger ones.

The coal-fired garbage furnaces are an American development from over 25 years of practice. Nearly all the furnaces in operation have been designed and built by contractors or manufacturers whose general attitude has been governed by a desire for profit rather than for permanent construction and good operation. City advertisements for bids and specifications for the work have been badly drawn up and much poor work has resulted. Extravagant claims have been put forward which have not been fulfilled. As a result this type of furnace has acquired a reputation not wholly deserved.

Practically all the furnaces of this type are arranged with charging doors in the top of the furnace. Below these are large drying hearths capable of holding about one day's delivery of garbage. Below these hearths are coal grates on which a hot coal fire is maintained. A long flaming coal of good quality is required. The flames from the coal fire are led over and under the garbage to dry it. When this is dry it is stoked down and finally consumed on the coal fire. The temperature of the furnace depends largely upon the coal fire. Manufacturers frequently claim that 200 lbs. of coal per ton of garbage is sufficient. A heat balance computation shows that this is not sufficient to maintain a safe temperature in excess of 1,200° F. unless the garbage is very dry and contains a large proportion of relatively combustible rubbish. Table I shows the coal used and resulting temperature in coal-fired plants which have been carefully tested.

The cost of the coal required for this service is about $4 per ton, so that on the basis of these tests the fuel cost may amount to as much as $1 per ton of garbage burned. In practice this amount of coal is not used, with a result that unburnt gases and odors escape from the chimney top. Fortunately, plants of this type, used chiefly in smaller cities, have not been critically located and some odors can be discharged into the air without arousing severe public criticism. A furnace of this type at Oak Park, Illinois, created sufficient nuisance in this way to require an increase in the height of the chimney. The labor costs are not excessive, but as a general rule the life of the furnaces is short, often not exceeding ten years. What is needed to bring this type of plant up to satisfactory efficiency is more care on the part of city officials in drawing up specifications and in using sufficient coal to produce reasonably complete combustion. The facts upon which to base future improvement can only be known through the publication of carefully made test runs.

The advantage of this type of plant is that ashes need not be burned but can be dumped in low places, on new roads or elsewhere. This reduces the size of the furnace and its first cost. This feature is particularly important in small residential cities where very few ashes are produced in the summer months.

In Table II are given the costs of construction of several incinerators of this type.

The high temperature incinerator is a developed recent American adaptation of the incinerator from over 25 years' practice in England. In this country it has received more careful engineering attention than has the coal-fired incinerator and has consequently been designed on the correct principle of combustion. The half dozen or more plants built in this country have been of substantial construction and are giving good service. All of them have been built under specifications and plans prenared by competent engineers and have been thoroughly tested before operation.

As distinct from the coal fired garbage incinerators, the high temperature furnace is designed to burn mixed refuse containing sufficient carbon from the ashes and rubbish to maintain combustion. This material is charged in relatively small quantities directly onto the grates of which there are two or more. A forced draft of heated air passes through this grate, thus directly oxidizing the organic matter. Temperatures in excess of 1,200° F. are maintained, thus insuring complete combustion.

In Table III measured temperatures and

TABLE II.—COST OF COAL-FIRED GARBAGE INCINERATION.

Place.	Date of erection.	Rated capacity, tons per 24 hrs.	Character of construction.	Material burned.	Cost—Total.	Cost—Per ton rated capacity.
Milwaukee, Wis.	1901	150	Brick chimney and bldg.	Garbage.	$92,000	$ 612
Oak Park, Ill.	1905	45	Brick chimney, good bldg.	Garbage.	11,000	245
Ft. Douglas, Utah	1906	20	Steel stack, cor. iron bldg.	6 parts manure, 1 garbage.	4,500	225
Terre Haute, Ind.	1907	40	....	Garbage and night soil.	25,000	625
Muskogee, Okla.	1911	70	....	Garbage.	23,000	330
Oak Forest, Ill.	1912	24	....	Garbage.	12,000	500
Lake Forest, Ill.	Bid.	23	Brick chimney and bldg.	Garbage.	12,400	1,000
Average						$ 505

TABLE III.—TESTS OF REFUSE DESTRUCTORS.

City.	Test period.	Material burned, per cent: Ashes.	Garbage.	Rubbish.	Manure.	Av. temp. combustion chamber. Deg. F.	Av. CO_2. Per cent.	Evap. per lb. refuse from and at 212° F.	Rated h. p. of boilers.	Clinker. Per cent.
Westmount, Canada	May 3, '06.	70.0	15.0	15.0	...	1,994	10.9	1.36	220	42.1
Seattle, Wash	July 31,'08, Aug. 1,'10; 2 yrs.	43.5	32.1	20.4	4.0	2,376	10.2	1.00	220	43 2
West New Brighton, N. Y.	July 1, '08, July 1, '11; 3 yrs.	68.0	24.9	7.1	...	*1,750	†8.8	‡1.23	183	40.0
Milwaukee, Wis	May 19, '10, June 3, '10.	43.8	42.4	5.8	80.0	1,646	10.3	1.25	800	...
Montgomery, Ala	July 26, '11.	§25.0	42.0	13.0	20.0	1,920	11.0	1.37	180	...

*Fery recording pyrometer—continuous record; average, 1,937.
†Simmance-Abady CO_2 recorder.
‡Meter record.
§Mainly street sweepings and green grass.

other data secured in test runs and in practice are recorded.

The first cost of construction of this type of plant ranges from $700 to $1,000 per ton capacity, as against $500 for the coal-fired plant. A greater capacity per ton of garbage is also required to provide for the necessary quantity of ashes and rubbish. Therefore, the first cost of the high temperature plant is greater. I think the difference in the per ton costs would be less if better construction were put into the coal-fired plants. The cost of operation varies, depending upon the local value of the steam which can be generated with the high temperature furnace.

No high temperature incinerator has yet been built for a small city. The smallest single furnace unit in operation in this country is at Clifton, Borough of Richmond, New York City, which has a capacity of 45 tons per 24 hours, sufficient to serve a population of 30,000 to 40,000 people. Smaller units have been built in England. This type of furnace is being constantly improved. The latest plants are charged and clinkered mechanically, thus reducing the labor costs and the handling of refuse at the plant. There is need to commend this type of furnace to the large cities of the class under discussion.

Summarizing these different points relative to garbage disposal in smaller cities, I should say that in the smallest cities disposal by burial or feeding to pigs would be satisfactory and that in the larger cities feeding to pigs or burning would be better.

However, the thing to be secured is better service to the householders. This can be accomplished by better organization and operation in the collection work and by a sanitary and efficient management of whatever system of disposal is locally in use. Permanent improvements providing for future growth can and should be made after careful study of the special local condition.

A Diagram for Estimating the Cost of Laying Sanitary Sewers.

Contributed by F. O. Eichelberger, Assistant City Civil Engineer, Dayton, Ohio.

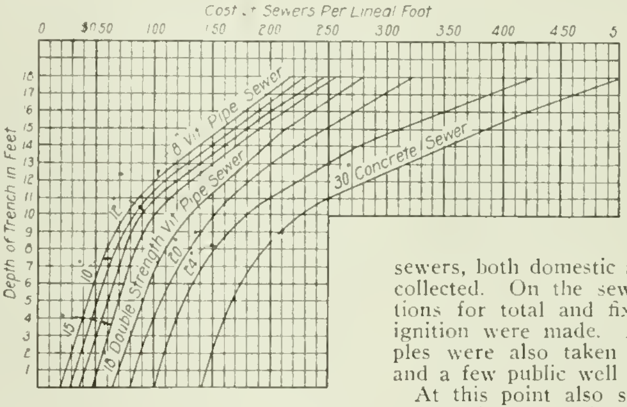
The accompanying diagram will be found useful in making preliminary estimates of the cost of sanitary sewers, exclusive of manholes, flush tanks and other appurtenances. The diagram was compiled from the average of 50 proposals made by contractors to the city of Dayton, Ohio, during the year 1912. It gives, at a glance, the cost of furnishing and laying the various sizes of sewers from 8 to 30 ins. in diameter, per lineal foot, including the cost of excavating and backfilling trenches up to 18 ft. in depth.

The diagram can be adjusted to the fluctuations of prices of vitrified pipe by comparing the cost of furnishing and laying the various sizes of pipe, as found on the bottom line of the diagram, with present quotations of pipe in carload lots plus the local cost of handling and laying same, and by adding to or subtracting the difference so found from the result as given in the diagram. For example, by consulting the diagram we find the cost of laying 8-in. pipe including trench at a depth of 8 ft. to be 58 cts. per lineal foot. The cost of furnishing and laying the pipe (bottom line) is 20 cts. per lineal foot. If it is found that the present quotation of 8-in. pipe plus the cost of handling and laying same is 22 cts. per lineal foot, a correction in the above result (58 cts.) should be made by the addition of 2 cts., bringing the total cost to 60 cts. per lineal foot. Should the price of both pipe and trench need adjustment, the same should be done on a percentage basis.

Owing to the recent increases in the price of sewer pipe and State legislation fixing 8 hours as a day on public work the Dayton engineering department is increasing its estimates 20 per cent over the results as shown by the diagram.

Methods Employed in Making a Sanitary Survey of the Wabash River.

The Indiana State Board of Health is investigating the sanitary condition of the lakes and streams in that state. A sanitary survey of the Wabash River, from Bluffton to its mouth, was made during the summer of 1912. The methods employed in making the survey were described by Mr. Jay Craven, Assoc. Mem. Am. Soc. C. E., in a paper before the Indiana Engineering Society. The information here presented is abstracted from Mr. Craven's paper.



Unit Prices of Trenching, Furnishing, Laying and Backfilling per Lineal Foot of Sanitary Sewer, Dayton, Ohio, 1912.

From Bluffton to Lafayette, a distance of about 130 miles, the trip was made in a rowboat, and even then some difficulty was met with in getting the boat past some of the shallower places. On this portion of the work, 10 to 12 samples were collected at each city. One would be taken above all points of pollution, several along the city proper and some below the city. Two samples of the city water at each place were also collected. These samples were shipped to Lafayette and the analyses made on the houseboat laboratory.

A description of the houseboat is of interest. The previous summer on the Ohio River survey, a one-room houseboat, the cabin of which was 8 ft. wide and 20 ft. in length, was found to be too small. As this method of handling the work was found to be most advantageous, it was determined to build a boat along lines suitable for the work. A two-room houseboat, each room being 10x12 ft., was built at Lafayette. One room was devoted entirely to the laboratory work, and the second was the living room. The over-all dimensions were 10x34 ft. and the boat when fully equipped drew about 8 ins. of water. The previous summer a part of each day was spent in bailing the water out of the boat, but the new boat was so well constructed that the only bailing necessary was after hard rains which got in at both ends of the boat.

The laboratory work consisted of the determination of chlorine, nitrites, nitrates, dissolved oxygen, oxygen consumed, alkalinity, bacteria counts on gelatin, presumptive tests for B. Coli on all samples, and positive tests for B. Coli on every tenth sample.

On the Ohio River Survey samples were collected every mile only, and but one set was taken. On the Wabash River stops of from several days to two weeks were made, sampling points were established and several sets of samples were collected. Cross-river samples were also collected; that is, sets of five samples each were collected at one point on the river, one near each bank, one in the center of the river and one between the center and each shore sample. Three sets were usually taken in one day, one above all points of pollution at a city, one at the city proper, and one below the city. Samples from all sewers, both domestic and manufactural, were collected. On the sewer samples determinations for total and fixed solids and loss on ignition were made. As stated before, samples were also taken from all city supplies and a few public well samples were analyzed.

At this point also several sets of 15 samples each were taken at one point on the river at points approximately equally spaced. Determination for chlorine and alkalinity were made on these samples. This was done to see what variation existed at a point where the composition of the water should be about the same; that is, where no tributaries or sewers had emptied into it for some time, and the water should have had time to be thoroughly mixed.

Three sets were collected at Terre Haute, and variations in alkalinity of 2.2 parts per 100,000 to 20 parts per 100,000 were found. The chlorine varied from 2.4 to 3 parts per 100,000.

At Terre Haute, where the longest stop was made, 14 days, 158 samples were collected and analyzed, as follows: Seven sets of 15 each along the river, 6 sets of 5 each of cross-river samples, 11 samples from the city supply, 4 samples, from public wells and 6 samples of the sewage and manufacturing wastes. The seven sets of samples along the river were taken at intervals covering a period of 10 days. They are of value for purposes of comparison, as they show the variation existing at different times and at different stages of the river. The river stage varied during that time from 4.8 ft. to 1.2 ft.

A total of 828 samples were analyzed during the survey, this number covering samples from all sources.

In addition to the chemical and bacterial work, data regarding water supplies, sewerage systems, manufacturing wastes, the disposal of garbage and night soil, and typhoid fever was also collected at each city and town. Most of this has not been worked up in shape to be used at this time.

Fourteen cities on the survey have water works. Of this number eleven use ground water supplies, two filtration plants, and one, Logansport, pumps raw water from Eel River, a tributary of the Wabash. The ground water supply in some of the places seems abundant, but in others great difficulty has been encountered to get an adequate supply, because the water level is lowering each year and the population is increasing. It is only a question of time until a new source will have to be found and this would naturally be a surface supply, the Wabash River. The volume of water in the Wabash River is large for the greater part of the year, and sufficient for the disposal of the sewage by dilution, and very little attention has been given by the different cities located on it to the waste they contribute. When the time comes for a city to begin using the river water, even though filtered, the thoughts of having all the sewage and manufactural wastes from the city above go into the source of their water supply, are, to say the least, not pleasant ones. Moreover, it also adds an extra burden to the filtration of the water. It is believed that most of the cities will gradually overcome their selfishness and endeavor to co-operate with one another in the protection of the river from pollution. On the upper portion of the river the dry seasonal flow is small at times, and it is the cities on this part that are finding their ground water supplies inadequate. The volume of sewage, domestic and manufactural, that they contribute to the river is large, and when it is necessary to use the Wabash River water, this pollution will have to stop. Therefore, it is advisable to prepare for the future and begin at the present time the task of keeping the river water pure.

Above Wabash, Ind., the water is of good quality, physically at least, and while making the rowboat trip, many bass could be seen jumping out of the water, especially at the ripples. After passing the large strawboard works at Wabash, very few fish were seen. The contrast was decidedly noticeable, and surely water that is not suitable for fish life, water that will force the fish to go above the point of pollution, is not the best for human consumption.

There were but few manufacturing concerns dumping detrimental waste into the river. The most important of these were strawboard works and distilleries. Of the former, large plants were located at Wabash, Lafayette, Terre Haute and Vincennes, in Indiana, and Mt. Carmel in Illinois. The distilleries were at Terre Haute.

In nearly all cities and towns the night soil collected was hauled to the country and buried or used as a fertilizer.

The garbage in most of the cities and towns was collected and used for feeding, some of it was buried, and in but three of the cities were garbage disposal plants in use. These cities were Huntington, Lafayette and Terre Haute, and the plants were all in good condition and were working satisfactorily. In 12 cities where the data were available, typhoid fever deaths were obtained for the last five years. But one, Attica, has had no deaths in the last five years. The rate for all the cities ranging from nothing up to 173.8 per 100,000. This last figure was for Peru in 1911. The rate there has gradually increased from 17.2 in 1908, 38.5 in 1909, 57.2 in 1910, to 173.8 in 1911. In 1912 the figure was greatly reduced, dropping to 26.9. The two cities having filtration plants, Terre Haute and Vincennes, have the most uniform death rate, Terre Haute averaging about 40.5 and Vincennes 20.8. In Terre Haute there are a good many wells in use and this may account for the high rate.

One noticeable thing was that following the high death rate in Peru in 1911, which was 173.8 per 100,000, a serious epidemic occurred at Logansport. The supply at Logansport is taken from Eel River, but preceding the epidemic, when 83 cases and 12 deaths occurred in 6 months, an ice gorge caused the water to flood a portion of the city. Following this the epidemic occurred and a greater portion of all well samples analyzed was found to be bad. This epidemic was due to the water supply, either the city supply or wells, or both.

While the dilution method of sewage disposal is satisfactory at the present time, and no nuisance was found to exist at any point, steps should be taken for the gradual improvement of the sanitary conditions at each city, so that when the use of the river water is necessary, very little if any of the present large volume of sewage will be entering the stream. To this end all new sewers should be designed to convey the sewage to one central point if possible, where it could be handled by a disposal plant by gravity, eliminating the expense of a sewage pumping station.

The boat used on this work was so well suited to the purpose that a paddle wheel was built and an engine installed, in preparation for its use on White River in the summer of 1913.

Salient Features of Modern Refuse Destructor Practice in Great Britain.

Contributed by James A. Seager, Bristol, England.

The problem of refuse destruction has received very considerable attention in Europe within recent times, both on the part of municipalities and private corporations, and some reference to recent work in this direction may be useful to American engineers. It is not proposed in the present article to describe in detail the constructive forms adopted, as these are very varied and numerous, but rather to indicate the general lines upon which advance has been made, by reference to some typical examples.

Disposal by fire is coming more and more to be recognized as the most sanitary method of disposal, and refuse dumping is going out of practice. In a good many districts adjacent to the seashore it has been customary to carry the refuse out to sea and dump it there, but modern requirements insist on the absence of any danger of any refuse returning to the shore on the tides. Of course, unless the barges are taken a very considerable distance away, no such guarantee can be given, so that the refuse destructor is now recognized as the best final arrangement.

The earliest destructors installed were operated with chimney or natural draught alone,and were of the low temperature type and were not altogether satisfactory. Cremators were then introduced to destroy the low temperature gases by providing a separate furnace built in the main flue between the destructor and the chimney. This furnace was fed with coke and was therefore somewhat expensive to operate, but the low temperature gas passing from the cells of the chimney had to travel over the top of the cremator fire and were thus rendered more or less free from danger and disagreeable odor. The cremator, however, had no effect on the solids remaining in the cells and the result was that a soft and offensive clinker was often produced. By using forced draught, however, and closed ash pits such as is adopted in the system operated by Meldrum Brothers, Ltd., of Timperley, near Manchester, England, the temperature of the cells was materially raised; the refuse was cremated much more thoroughly and the output was increased some 50 per cent.

The next step was introduced by Mr. W. Horsfall of Leeds, in the type of forced draught cell which was a distinct advance in the design of destructor plant, and other modifications were brought out by other manufacturers. In every case, however, the cellular system was maintained and although steam production was generally used, this was not made a special feature in any case, as it was looked upon as quite of secondary importance.

The Beaman and Deas destructor was then produced, its special feature being the combination of two cells with one combustion chamber, this being the first twin cell destructor placed on the market. This was first installed at Warrington and very good results were obtained. In 1893 Messrs. Meldrum Brothers brought out a special destructor furnace on the cellular system with regenerator and in the following year introduced a continuous grate with divided ash pits. In 1896 the design was completed by the addition of the regenerator. This was probably the most sweeping advance of destructor design since the introduction of the original "Fyer" cell by Messrs. Manlove & Alliott, and the first installation of the new type of cell was completed for the corporation of Darwin in 1897. Since then the development of destructor installations has been continuous and marked.

In order clearly to outline the position at the present time it is proposed to refer particularly to two modern types, these being the Meldrum and the Horsfall, and the former will be considered first. An outstanding feature of the Meldrum destructor is the continuous grate adopted. The destructor is a large chamber divided below the grate only into separate ash pits. In this way instead of a cold and inactive cell next to a cell in full work, there is one large furnace chamber always active. When any portion of the continuous grate is being clinkered and recharged the remainder of the cell is in full work and at its greatest heat. The conditions within the cell are therefore constant and in this respect differ from the system of single, separated and isolated cells. This continuity of high temperature ensures perfect cremation within the cell and supplies high temperature gas to the boilers. A minimum of fluctuation in the temperature of the gas of combustion means a maximum of efficiency in power production. Where it is possible to set the boiler behind and parallel with the destructor, furnace radiation is reduced to a minimum. Moreover it lends itself admirably to either front, back or top feed.

The application of regeneration dispensed with the drying hearth, which was a frequent source of nuisance and inefficiency in early destructors and tended to very rapidly evaporate moisture in the refuse and to raise the temperature of combustion by at least 300° F. The temperature of the heated air supplied to the forced draught blowers when taken from the regenerators is at least 350° F., although this temperature is frequently exceeded. In an installation at Lancaster an average temperature of 478° F. was recorded.

The value of heated air is very great, especially in rainy seasons when the refuse charged into the destructor is usually soaking, and with the summer refuse of low calorific value, especially when wet, preheating the air is practically a necessity in order to rapidly evaporate the moisture and quickly ignite the refuse. In the Meldrum system the regenerator is often made to act as a ventilator by arranging a cold air inlet so as to draw the air supply of the regenerator from within the building. In this way the atmosphere of the building is kept clean and pure. Examples of this arangement are to be found in the destructor installations at Sheerness and Watford, where it is found that the containing buildings are extremely clean and comparatively pleasant to work in.

For the forced draught either centrifugal fans or steam jet blowers are used, the latter being a simple, efficient and inexpensive system of forced draught under the immediate control of the fireman, the combustion chamber is designed to trap the majority of the dust passing over the grate, about 75 per cent of the dust being retained within the destructor portion of the plant at a point from which it may be conveniently removed every day if so desired in a few minutes. Any dust reaching the regenerator is trapped in a pit immediately underneath it and this portion also can be removed at any time. Both the combustion chamber and regenerator pit are before the main flue and thus all dust is trapped before reaching the flue. The advantage urged in respect of this arrangement as against providing a dust catcher at the base of the chimney or at any other portion of the main flue is that whereas in the former case the dust pits can be cleaned at any time when the fires are banked, in the latter it is only possible to clean the flues when the destructor is shut down because a good deal of the dust deposits on the main flue itself before it reaches the dust catchers arranged at the chimney end.

It is of course obvious that refuse destructors for a town of any magnitude must in order to be thoroughly efficient, be able to deal not only with the ordinary house refuse, but with trade wastes of various descriptions, and here very considerable difficulty has been from time to time encountered. When quantities of butchers' and fishmongers' wastes have to be disposed of it is necessary to introduce such objectionable material into the destructor cell expeditiously and without handling, and in the Meldrum destructor a hopper is arranged at the end of the cell furthest from the combustion chamber. Immediately underneath the offal charging hopper and level with the grate is a hearth. The receptacles containing the waste are brought to the works by means of an overhead gantry crane emptied through the hopper, the waste at once falling upon the hearth underneath. The noxious gases as distilled must then pass over the entire grate area from end to end, and finally through the combustion chamber, securing perfect cremation within the cell at a rapid rate and in a thoroughly effective manner. With the continuous grate system it is possible to automatically secure that the whole volume of high temperature gases are brought into immediate contact with the noxious gases distilling either from a charge of offal in the cell or a carcass in the combustion chamber.

In some of the most modern destructor installations means have been provided, due largely to the action of the British Board of Agriculture, to readily and effectively destroy the carcasses of cattle and horses, etc., suffering from contagious diseases, and at Glasgow for example, means have been provided for lowering these carcasses whole into the combustion chamber of the destructors. In these works the number of such carcasses disposed of averages about 70 per annum. Owing to the fact that the entire volume of high temperature gases have to pass through the combustion chamber ensuring high and constant temperature, the chamber is well adapted for the cremation of such carcasses without causing a nuisance.

Turning to the Horsfall type made by the Horsfall Destructor Co., Ltd. of Pershore, the particular points in the system are the use of high pressure blowers, steam or electrically driven, with steam jets as an auxiliary for use according to the nature of the refuse, the capacity of the plant, etc. These blowers are so designed as to supply at all times the proper quantity of air to the furnace, the regulation in this respect being claimed to be superior to the use of fans which supply less air when the fires are thick and heavy and more air is needed. Regenerators are also provided to heat the air for combustion by means of the waste heat escaping to the chimney.

The Horsfall destructor is on the cellular system, the gases from each cell being thoroughly mixed and cremated in a large combustion chamber before passing to the boilers, ample fire brick surfaces being provided to retain and reflect the heat. The flues, which are of ample size are carefully lined with fire brick to insure durability and the arrest of dust in the flues is accomplished by a centrifugal dust catcher. The furnaces are provided with grates having very small holes to insure a maximum blow pipe efficiency on the fire and are carefully proportioned. The clinker is withdrawn at the front to the clinkering door having a rake door attached to it to avoid frequent opening of the main door. During normal working the furnace is entirely gas-tight, and it is claimed that the cost of working on their back fed cells is lower than on other hand fed systems, while the tub feed system introduces a further saving of 30 to 50 per cent, which means an enormous annual economy on a large plant.

This tub feed system may be referred to in a little more detail. The refuse arriving at the destructor in carts of any pattern is discharged through a shoot into a storage tub standing ready in the pit. This storage tub has a hopper bottom which is held shut by the rods and hooks by which the tub is suspended. The tub is constructed to hold a full cart or van load of refuse. When full the tub is lifted by an overhead traveling crane and deposited on the upper storage platform until it is required. The storage of refuse thus takes place in enclosed boxes far removed from the heat of the destructor. At regular intervals the cell is charged the full tub being lifted by the crane and placed on a cradle on the top of the cell. The weight of the tub causes the cradle to descend and by a simple system of levers, the charging door is lifted from its water-sealed seat and pushed on one side, permitting the lower edge of the cradle to descend into the mouth of the charging hole. The crane continues to lower and the hopper bottom of the storage tub thereupon opens and the whole load falls directly into the furnace, spreading itself naturally over the grate the thickest being at the rear. It is claimed that the labor involved in the charging of cells by hand is entirely dispensed with by this tub feed system and the cost of working is reduced by 30 to 50 per cent. The charging takes place without the liberation of dust and fumes from the furnace, the door being opened only a few seconds. The charging door when shut is perfectly airtight and the provision of an inclined road or an elevator for the carts is unnecessary while the carts can be ordinary dump carts of any description. These tub feed cells are built for 15, 20 and 24 tons per cell per day and a useful comparison can be instituted in the following way as regards cost of labor obtained from actual practice. In the Horsfall hand fired cells each man burns 7 to 7½ tons of refuse in an 8-hour shift. With the tub feed system each man (stokers and crane men included) burns about 12 tons of refuse in an 8-hour shift.

In the Meldrum types of furnaces the systems of charging adopted are either top charging, back feed or front feed. In their destructors erected for the Metropolitan Borough of Wandsworth at Tooting and also at Kingston on Thames, they dump a whole load of refuse direct from the cart into the cell by means of special charging apparatus. Other things being equal, the best results in destructors as with other types of furnaces, are obtained with continuous feed, or failing that, small and frequent charges, but there are, of course, advantages in dumping cartloads at once as described above.

Back feed is adopted in a good many installations, but it is hardly correct to suppose that this system is any more cleanly or cheaper in labor cost than the front feed and in the back-feed system two distinct operations are necessary: Firstly the feeding in of the refuse by shovel or hand labor at the back of the cell by one man and, secondly, the dragging, spreading and leveling of the refuse at the front of the cell by another man. With the front feed there is one operation only: The refuse is thrown directly onto the grate where it is wanted immediately and a level fire is secured in the initial and only operation. There is thus a concentration of the whole of the labor at one point saving time and labor.

With regard to storage the system advocated by Meldrum Bros. is the cleanest, coolest and most sanitary method of storage, is in bins or hoppers conveniently placed either for front feed with a shoveling sill in tunnels and parallel with the destructor furnace, or for top feed near the feeding hole. For a bunker of given capacity the top feed system necessitates a higher dumping platform but in neither case is the refuse in contact with or near to the heated surface, and therefore there is no heating of the refuse prior to its being placed in the destructor. A strong point in favor of this system of storage is the accessibility of the material at the cell and the absence of mechanical devices.

In the present article it is not intended to deal with the use of the destructor for generating steam for pumping or for electric power production as this forms an entirely distinct branch of the subject. It has, however, been attempted to show by reference to the practice of two of the foremost makers of destructors the lines upon which this apparatus has been evolved from an imperfect and sometimes offensive installation to its modern state of cleanliness, convenience and thorough adaptability to the sanitary disposal of towns' waste. The progress during the past few years has been so great that it is impossible in the space of a short article to deal comprehensively and in detail with the whole range of activity, but an attempt has been made to map out the main features which have made most strongly for satisfaction and economy.

DRAINAGE AND IRRIGATION

The Lahontan Dam, Truckee-Carson Irrigation Project U. S. Reclamation Service.

Contributed by F. H. Tillinghast, Engineer, U. S. Reclamation Service.

The Lahontan Dam, now under construction by the U. S. Reclamation Service, is located about 18 miles west of Fallon, Nev., across the Carson River and at a point where the Truckee Canal discharges into this river through a concrete chute.

The Government construction camp has been built close to the Lahontan railroad station, 7 miles southwest from Hazen, along the Goldfield branch of the Southern Pacific R. R. The site of the work is within ¼ mile of the station.

The dam will impound all waters from the Carson River in a storage reservoir having a surface area of 12,000 acres and a capacity of 280,000-acre feet. The Truckee Canal, with a capacity of 1,200 sec. ft., takes water from the Truckee River by means of a diversion dam across the Truckee River at Derby, runs through the irrigable districts of the project in the vicinity of Fernley and Hazen, a distance of 31 miles, and all unused water will discharge and be stored in the new reservoir.

This canal is 125 ft. higher in elevation than the Carson River and approaches the reservoir in a direction upstream along and parallel to the left bank. Advantage has been taken of this fact to install a Hydro-electric plant in the vicinity of the dam to furnish power for construction purposes and also for permanent use for distributing power for future pumping for irrigation and domestic supply.

Investigation and Design.

The site of the Lahontan Dam is at a point where the Carson River flows through a comparatively narrow gorge. The mesa lands on each side rise fairly abruptly to about 130 ft. above the river whence they gradually ascend towards the foothills, which are approximately 1 mile away on the north side, and about 2 miles away on the south side. The right bank rises very abruptly 130 ft. high in a badly broken and seamy rocky promontory, while the left bank has an abrupt rise for only 50 ft., then a gradual rise for 350 ft., then a fairly abrupt one for 80 ft. to the mesa land.

Thorough investigations of the foundation were made by a series of diamond drill borings, wash drill borings, test pits and tunnels and the bearing power of the soil was determined, before attempting to design the dam. The investigations brought out the following results:

(1) That the river at the dam site has ap-

parently cut through an isolated rock butte, the cut in all probability, having been started by the water following a fault line in the rock.

(2) That the rock strata are inclined in all directions and badly faulted.

(3) Borings and test pits in the mesa lands on both sides indicate that the rock limits do not extend very far from the river.

(4) That the material upon which the dam is to be built consists of seamy, badly broken sandstones, mudstones and shales of varying degrees of hardness, sandy clay, lake deposit or silt, and sand and gravel. The seams in the rock are filled with clay or gravel. Nearly all the material is subject to easy disintegration and water erosion.

(5) That the diamond drill borings showed presence of artesian water and underground flow.

(6) That the mesa land to the north and adjacent to the proposed site shows from 1 to 4 ft. of surface soil or "silt"; 8 to 15 ft. of sand and gravel; and then a clay or sandy clay indefinitely.

The surface soil or silt is an extremely fine floury substance containing about 70 per cent of a very fine sand and 30 per cent of a clayey material composed mostly of silica and alumina compounds. There is very little vegetable material or alkali salts in the silts.

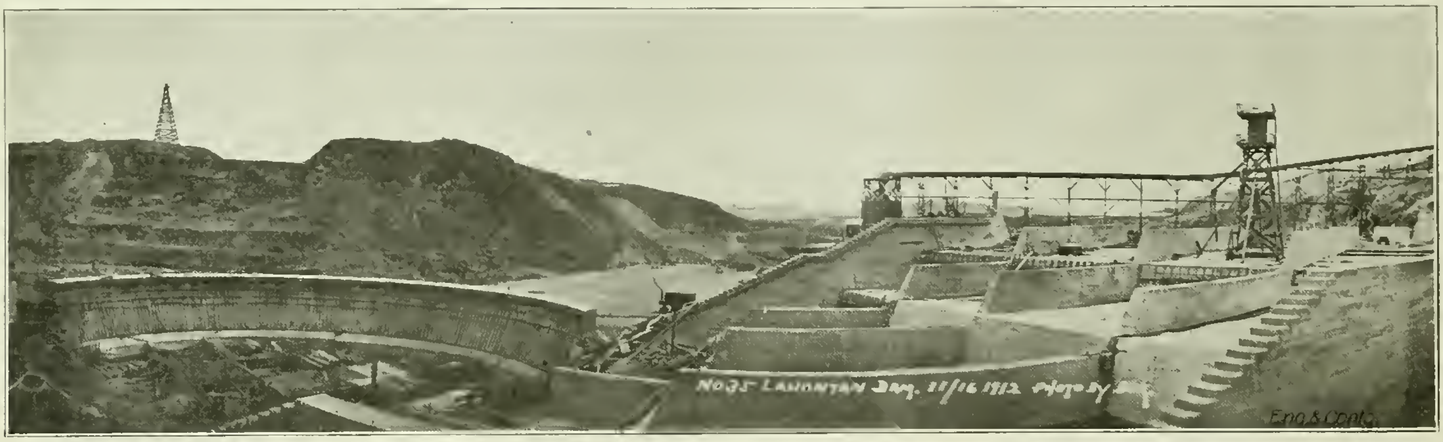


Fig. 1—Lahontan Dam Looking Up-stream, Truckee-Carson Irrigation Project.

(On right, partly completed left spillway and pool; on left, excavation for right spillway; right background, belt conveyor carrying earth nto dam.)

On account of the seamy, unstable and soft nature of the shales and clays and the probability of serious erosion and uneven settlement, the combined rock and earth-fill type of dam was designed.

Studies were made of the discharge measurements of the Carson River to determine the necessary spillway capacity and to determine the rate of progress and construction methods to be employed.

Hydrographic records of the Carson River cover a period of 12 years, measurements having been taken at Empire, Nev., 48 miles upstream from the dam site. The Carson River has its source in the Sierra Nevada Mountains, with a watershed above Empire of 988 square miles. A period of flood flow obtains from January to June, due to the melting of mountain snows and spring rains, while for the remainder of the year the volume of discharge is comparatively small. The total annual runoff for 10 years averaged 415,000-acre feet, ranging from 150,000 to 825,000 acre feet. The highest recorded flood was 20,000 sec. ft. The spillway is designed to carry a 30,000 sec. ft. flood continued for three days, starting with a full reservoir and 5,000 sec. ft. passing over the spillway.

The type of dam adopted (rock fill with a tight earth facing) presents an elastic structure, and by bringing the rock fill and earth portion up together with their respective heavy surface paving, insures safety during construction. If overtopped by a flood the water would flow down over this heavy paving without serious damage to the structure or to the valley below.

The type of dam adopted was chosen after careful experiments had been made with the two available materials at hand, namely, silt and gravel.

The main portion of the dam will be built of back run gravel spread and rolled. The water-tight material will be composed of a mixture of silt and gravel as determined by experiments.

Percolation experiments showed that using a mixture of gravel and silt containing from 0 per cent to 60 per cent of gravel the rate of percolation, Table I, was uniformly low, while above 60 per cent of gravel the percolation increased rapidly. Using 50 per cent of each material gave a minimum of voids (18 per cent), a maximum specific gravity of mass of 2.05 and a satisfactory working material with low rate of percolation.

TABLE I.—PERCOLATION RATES.

	Specific gravity.	Per cent voids.	Rate of percolation. Gals. per acre per day through 3 ft. of material with 3 ft loss of head.
85% gravel.. 15% silt.	2.02	17.2	162,000
10% gravel.. 50% silt.	2.05	18.0	20,000
Pure silt....	1.72	23.8	14,000

The silts and gravel are in abundance on the mesa to the north and adjacent to the dam and at elevation above the top of the dam.

Structural Features.

The main dam is to be 20 ft. wide on top, with an upstream slope of 3:1, protected by a 12-in. layer of gravel, covered with 2 ft. of riprap, and a downstream slope of 2:1, with a surface cover of 12 ins. of coarse screened gravel. The dam will have a maximum height of 129 ft., a maximum base width of 660 ft. and a crest length of approximately 1,700 ft. The volume of slope paving amounts to 15,000 cu. yds. of gravel and 25,000 cu. yds. of riprap.

There will be an earth dike extending from the south end of the dam towards the foothills, averaging 5 ft. in height and 4,000 ft. in length. The main embankment of the dam will be composed of a gravel fill in the downstream portion and of mixed silt and gravel in the upstream portion. Preparatory stripping for the dam amounts to 16,000 cu. yds.

Gravel Embankment.—The gravel portion is to be composed of bank-run gravel deposited and spread in 4-in. layers, rolled dry by means of a traction engine. The volume amounts to 281,000 cu. yds.

Mixed Embankment.—The material for the water-tight portion of the dam or mixed embankment is to be composed of silt and gravel mechanically mixed in such proportions (probably 50 per cent of each) as will give the desired degree of impermeability as determined from time to time by experiments. The composite material will be deposited, by means that will avoid separation, in horizontal layers not exceeding 4 ins. in thickness after compacting. This water-tight material covers the reservoir side of the dam upstream from a 1:1.1 slope line extending from downstream edge of crest as shown on the drawing, Fig. 3. The volume of this material amounts to 125,000 cu. yds.

Drains.—Just above the river bed and extending from a point 30 ft. downstream from the axis of the dam and perpendicular to the same, are to be laid 8-in. vitrified pipe. These pipes are to be laid with open joints in coarse gravel and in lines 25 ft. apart extending into the drains within the inspection gallery in the spillway pool walls, which will be described later. The object of these drains is to carry away all seepage water that may find its way through the dam to a safe collecting gallery or well, where it may be inspected and measured.

SPILLWAYS.

Provision has been made for two spillways, each having a weir crest length of 250 ft., one at either end of the dam, so arranged as to discharge into the same pool, located in the river bed at the toe of the dam. The spillway on the left bank and north of the river is designated the "Left Spillway," and the other the "Right Spillway." The crests of both spillways are 12 ft. below the top of the dam. Both spillways, which are of concrete throughout, consist of a series of steps located according to the contour of the ground, both terminating at the pool.

Right Spillway.—The right spillway is located in a natural saddle to the south of the rock promontory. This spillway runs in the form of a lined chute with easy gradient from the weir crest to a point where it drops 75 ft. over the rocky ledge by a series of seven steps built on a general slope of 2 to 1 to the pool below.

The main weir has a crest length of 250 ft. and a height of 14 ft. above the lined chute. It is 10 ft. wide. Beneath the upstream portion of the crest is a cutoff wall of concrete 30 ins. thick extending into the clay foundation to a depth of 16 ft. Extending upstream from the crest of the weir, a distance of 90 ft., is a concrete paving 24 ins. thick laid on the rolled water-tight embankment. The abutment guide walls at either side of the paving are built as reinforced retaining walls of the buttress type.

The sloped portion, or main chute and lower steps, are divided into four flumes by means of guide walls extending the entire length of the spillway. This was deemed necessary to prevent the piling up of the water against the outer wall as the direction of flow is changed 90° in a wide, sweeping curve. These guide walls are 8 ft. in height and 2 ft. wide on top, with a side batter of 1:8. They are reinforced vertically with ⅝-in. square twisted bars 12-in. centers, placed within 4 ins. of either face. There is a parapet wall on each side of the spillway for its entire length, the top of which is provided with steps to be used as a foot walk. The steps have 16-in. treads and 8-in. risers. The bottom width of the parapet walls is approximately 6 ft. The outer face is vertical. The inner face rises on a 1:3 batter to a point 30 ins. below the top, where the wall is 2 ft. thick, thence curving away from the wall on a 12-in. radius curve so as to form an overhang, making the top of the wall 3 ft. wide. There is no reinforcement in these walls. All parapet and guide walls are designed to be built in sections about 30 ft. in length, allowing for contraction joints. The ends of the sections are provided with suitable keys and the surfaces are oiled with a crude mineral oil as successive sections are built. The floor is 18 ins. thick, laid in sections with contraction joints. Each section is reinforced with ⅝-in. square twisted bars, spaced 24-in. centers both ways. Each section is provided with a cross cutoff wall normal to the direction of flow, and which at the upstream end is 2 ft. thick and extends 2 ft. below the sub-grade of the floor. The reinforcement is bent down into these cutoff walls and the whole built as a monolith.

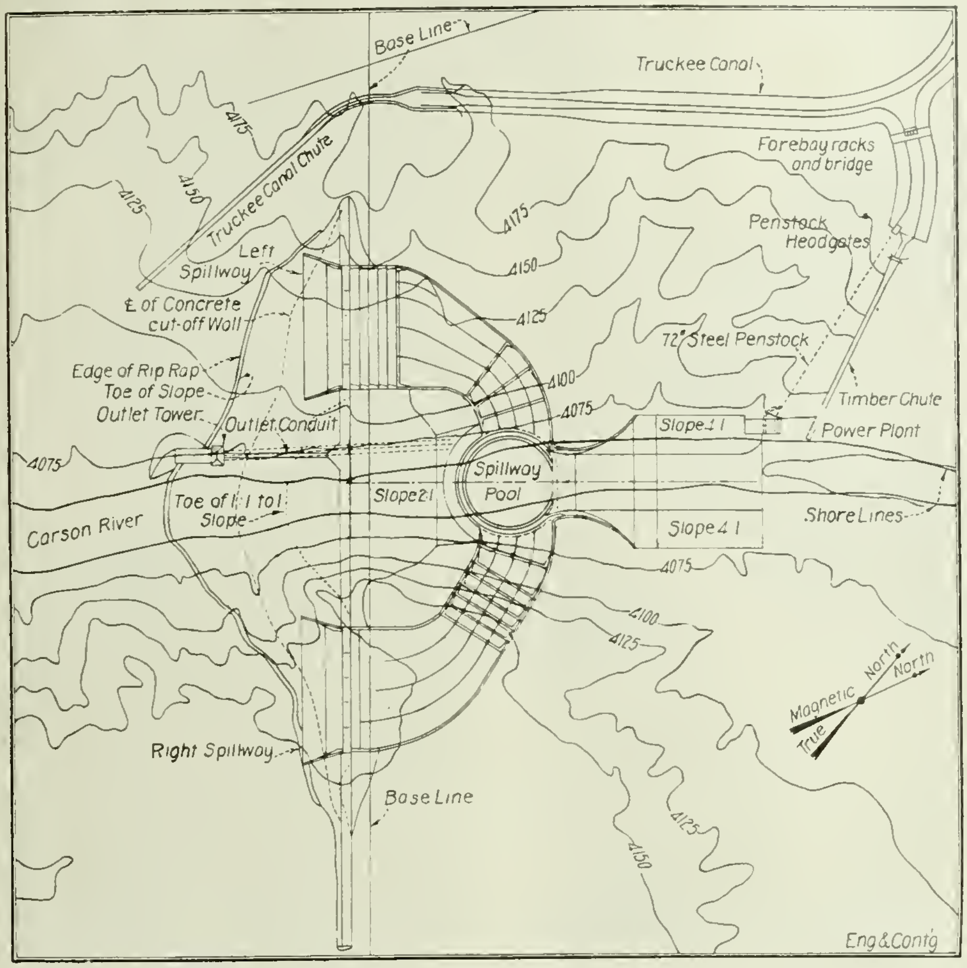


Fig. 2—General Plan of Lahontan Dam Structures.

The reinforcing rods are placed 6 ins. below the top surface of the concrete. Immediately upstream from these cutoff walls and located at every joint are drainage trenches 18 ins. square filled with clean gravel. These drains are made standard, having 15 ins. of coarse gravel in the bottom, topped with a 2-in. layer of pea gravel and a 1-in. layer of sand. These cross drains of gravel are intercepted by two lines of 6-in. vitrified pipe drains laid with open joints in gravel-filled trenches running lengthwise of the spillway and extending to the spillway pool.

As already stated, the upper one-half of this spillway is in the form of a lined chute with light gradient. The half adjacent to the pool has a general slope of 2 to 1 built in steps having 26-ft. treads and 11-ft. risers. The two lower steps are of different dimensions, due to the change in direction of the spillway at its entrance to the pool. The riser walls are 3 ft. thick at the top, with the bank face vertical and water face having a 1:3 batter. The riser walls extend in height to the subgrade of the floor, the floor system over-capping the riser and being separated from it by an oiled joint. The pipe drains pass through the riser walls, discharging in each case to the step below. There is no reinforcement in the riser walls except at their connection to the floor at base. The portion of the floor system adjacent to and at the base of the riser walls is thickened from 18 to 30 ins. for a distance of 12 ft. and is built as a monolith with the riser wall, the reinforcing bars extending into the latter.

The entire floor system, comprised as it is of individual sections, is wholly separate from the guide and parapet walls. All floors located on a curve are super elevated toward the outer edge. The footings of the walls are extended on either side, the ends of the floor slabs resting on these extensions. Just above these extensions and running the full length of the floor system, key ways are built into the walls. All key ways and joints are oiled. Thus by means of these keys and extensions, the whole structure is connected, but chances for rupture or unsightly cracking due to contraction or expansion are minimized.

All side walls are to be backfilled with selected material, reasonably water tight, compacted either by hydraulicing or tamping. The surface of the backfilling is topped by a 12-in. course of riprap paving extending from the top of the wall on a 5:1 slope for 5 ft. and thence on a 2 to 1 slope till it intersects the original ground surface. Right spillway quantities are approximately as follows:

Excavation, cu. yds.	68,000
Concrete, cu. yds.	18,500
Vitrified pipe, lin. ft.	1,000
Steel reinforcement, lbs.	187,000

Left Spillway.—The left spillway is located on a sloping bench about 50 ft. above the river bed on the left bank of the river. This spillway is so designed that during the construction of the dam, flood water can flow over a concrete-lined channel—called the main chute and forming a permanent portion of the spillway—at an elevation of 50 ft. above river bed until the dam is at a safe height when the remainder of the spillway will be brought up to final height in a series of steps and buttress walls of concrete, the hollow steps being back filled with gravel. The elevation of the river bed is approximately 4,050, and the top of the wall of pool 4,070. From the top of pool the spillway rises by a series of three steps located on a curve to elevation 4,100, which is the elevation of the main chute. The lower two steps are an exact counterpart of the right spillway lower steps. The detail construction of these lower steps and the main chute is identical with that of the right spillway, which has already been described. That portion of this spillway between elevation 4,100 and 4,162 rising from the main chute to the weir crest consists of a series of six steps with 10-ft. riser walls and 20-ft. treads. These steps are laid on eleven buttress walls spaced 25.63 ft. on centers. The top riser wall forms the weir crest, having the same form as the right spillway weir. The space under the steps and between buttress walls is to be filled with compacted gravel. At the upstream face of the weir and extending down from weir crest to elevation 4,100 is a concrete curtain wall 2 ft. thick forming the dividing line between the gravel fill and tight embankment. The lower portion of this curtain wall is built in a series of arches to allow any possible seepage through the tight embankment to flow through the gravel fill under the steps, thence to be caught in a cross drain located upstream from a cutoff wall at the foot of the buttressed steps and at upstream edge of main chute, and thence carried in said drain (12-in. pipe) along through the right side wall and discharged onto the next lower step of the spillway at elevation 4,087. There is a manhole built in the side wall to inspect this drain. The remainder of the drainage system is identical to that in the right spillway. The protecting apron upstream

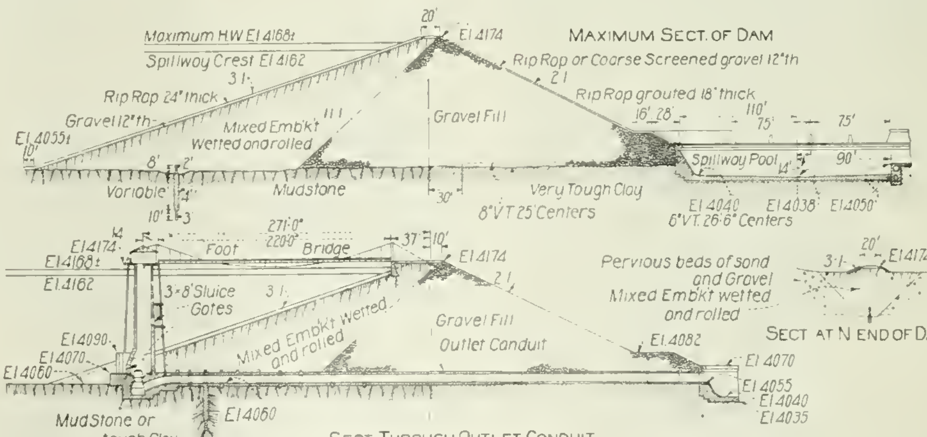


Fig. 3—Typical Sections of Lahontan Dam.

from the weir crest is similar to that of the right spillway.

The buttress walls, which vary in height from 6 to 46 ft., are 3 ft. thick at the top, with a side batter of 1:50, capped by a corbel 5 ft. thick and 3½ ft. deep. The corbels are built with a key into which the floor slabs are dovetailed. This key is reinforced. The buttress walls are not reinforced. The floor slabs being approximately 25 ft. x 23 ft. x 4 ft. thick are reinforced crosswise by 1-in. square twisted bars, 12-in. centers and longitudinally by ½-in. square twisted bar, 24-in. centers, the same being placed 6 ins. from the bottom face of the slab. Alternate cross bars are bent upwards at the ends. The floor slabs extend under the upstream and lap over the downstream riser walls. The riser walls are 3 ft. thick, 6 ft. high and are reinforced vertically with ½-in. square bars, 12-in. centers extending into the floor slabs and horizontally with ⅜-in. bars, 12-in. centers. The two side parapet walls are built monolithic with the side floor slabs, the same resting on the buttress walls. These parapet walls are reinforced on the spillway side and 6 ins. from the face, horizontally with ½-in. square twisted bars, 12-in. centers, and vertically with ⅝-in. square twisted bars, 12-in. centers, bent into floor slab. The embankment sides of these walls are reinforced vertically with ⅝-in. square twisted bars, 8-in. centers, extending 8 ft. below floor slab bottom. The curtain wall is reinforced vertically with ⅜-in. square twisted bars, 12-in. centers, and horizontally with ¾-in. bars, 12-in. centers. The parapet walls are surmounted by a foot walk consisting of steps having 16-in. tread and 8-in. rise. There are no interior guide walls on the buttress steps, the guide walls starting at the upstream end of main chute.

The weir for both spillways is 5 ft. thick at the crest, with a 1 to 1 slope upstream thickening to 10 ft. The downstream face of the weir is 10 ft. downstream from the center line of the dam. The approximate quantities in Left Spillway are:

Excavation, cu. yds	114,000
Concrete, cu. yds	23,500
Drain pipe, ft	1,500
Reinforcing steel, lbs	380,000

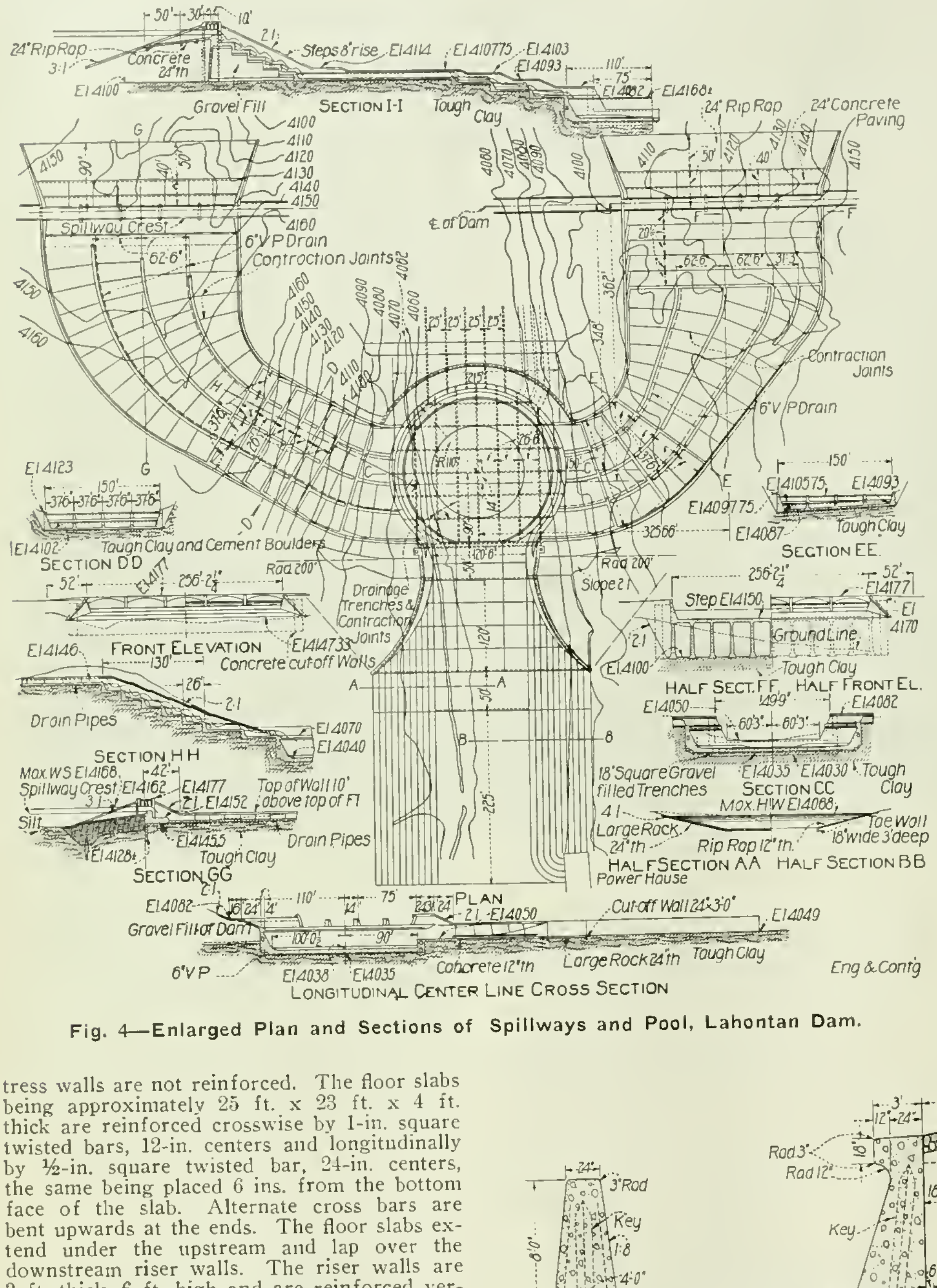


Fig. 4—Enlarged Plan and Sections of Spillways and Pool, Lahontan Dam.

SPILLWAY POOL AND RIVER CHANNEL.

The spillway pool is a concrete basin located in the center of the river bed, both spillways discharging into same normal to the flow of the river. The outlet conduit also flows into this pool. The pool, which is circular in plan, has an inside diameter of 220 ft. and depth of 30 ft. The object of this pool is so to retard the velocity of the water as to allow its discharge into the old river bed without danger of eroding the soil. The walls of the pool except at the outlet are of heavy concrete construction, having an interior slope of 1 to 2, and are capped by a parapet similar in design to that of the spillway walls. The outlet from the pool consists of a vertical weir wall having a crest length of 120 ft. 6 ins., located at the downstream side of the pool. The crest of this weir is at elevation 4,050, being 10 ft. above top of floor and 20 ft. below crest of pool wall. A feature in the design of this pool is the incorporation in the work of a complete drainage system. Completely encircling and contained within the walls of the pool is an inspection gallery. This is 6 ft. high, 3 ft. 6 ins. wide and has 12-in. open side drains built in the floor of the gallery for conducting the water from tile drain pipes in the embankment of the dam. This is known as the upper inspection gallery. All water entering same, coming from the drains located under the main embankment, pass through 12-in. vitrified pipe extending through pool walls into gallery. By this means all seepage through the dam, if any, may be collected and amount determined. The water from these drains is collected in two pump wells located at either end of the weir wall. It is removed from these wells by means of automatic water elevators or ejectors and discharged into the spillway pool. Overflow outlets are provided in these wells in case the pumps refuse to work.

Another feature in the design of this pool is the installation in the present work of a reinforced concrete tube which constitutes a portion of a siphon to be built later which will convey water direct from the Truckee Canal on the left bank to irrigate table lands on the right bank of the Carson River. This siphon, which has a maximum head of 140 ft., is reinforced within the spillway pool structure by 1-in. square twisted bars, 5½-in. centers, placed circularly, and longitudinally by ½-in. square twisted bars, 12-in. centers.

The spillway floors, which consists of approximately 26 ft. square concrete slabs, is 2 ft. 6 ins. thick in center and 5 ft. thick where it joins the walls. A complete system of standard gravel filled cross drains and

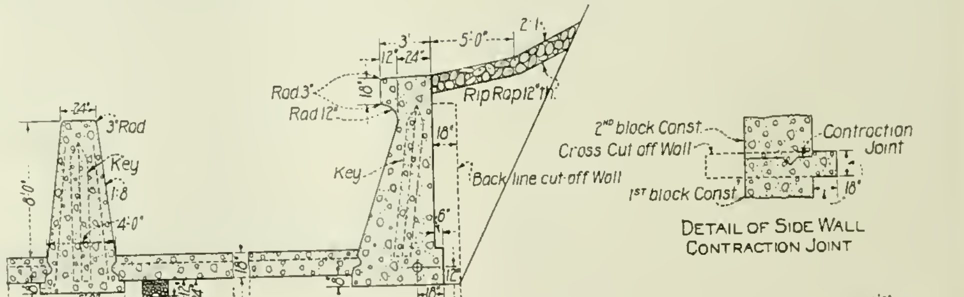


Fig. 5—Details of Spillways, Lahontan Dam.

longitudinal pipe drains located directly under floor joints, will control all seepage water, leading same to a lower inspection gallery built in the weir wall directly under the siphon with its outlet in the pump wells at either end of said weir wall.

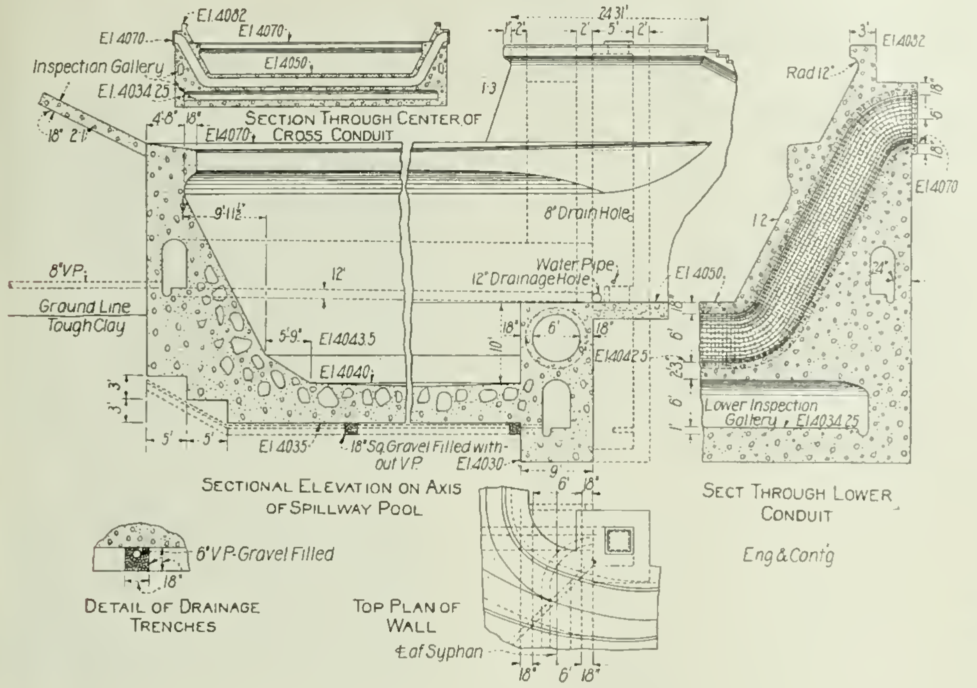


Fig. 6—Details of Spillway Pool, Lahontan Dam.

Water from the spillways after entering the pool will flow at a much reduced velocity over the crest of the weir, thence over a concrete lining 12 ins. thick and 170 ft. long to the paved channel below. This concrete lining is at the same elevation as the crest of the weir. The water is confined to the channel by means of concrete wing walls connected to side walls of both spillways extending from ends of weir crest and tapering into paved channel below.

The river channel below the structure for approximately 300 ft. in length has a bottom width of 120 ft. 6 ins., side slopes of 2½ to 1, is 20 ft. in depth and is paved with 24 ins. of riprap.

The main dam, where it joins the pool, is protected by a concrete lining on a 2 to 1 slope from the top of the pool wall, elevation 4,070, to elevation 4,082, and connecting with both spillway side walls.

Contraction Joints.—All walls in the pool are built approximately in 30-ft. sections and not as a monolith. These joints are all plain surfaces and have no special key except at contraction joints along the siphon barrel. The siphon joints consist of a 6-in. key placed 6 ins. from the inside and entirely surrounding the barrel. Three inches from the inside of the barrel and entirely surrounding the same will be placed a strip of 12-gage lead 10 ins. wide, being 5 ins. on either side of the joint and incorporated in the concrete to make joints water tight to withstand pressure due to 140-ft. head. The approximate quantities in the pool and channel are:

Excavation, cu. yds.	47,000
Concrete, cu. yds.	15,000
Riprap, cu. yds.	3,500
Reinforcing steel, lbs.	43,000

MISCELLANEOUS STRUCTURES.

Cutoff Wall.—The only core wall in the dam is a low cut-off of concrete located midway in the mixed portion of the embankment and extending only 6 or 8 ft. above the original ground surface and down into the ground at varying depths. Above ground the wall is 2 ft. thick, while below ground the thickness varies from 4 to 3 ft. This wall was designed to be approximately 50 ft. below ground level in river section and on side hills to be carried well into the tough clay formation.

Outlet Works.—The outlet works consist of twin conduits of horseshoe shape 9 ft. in diameter and heavily reinforced. The invert is reinforced longitudinally with 1-in. square twisted bars, 12-in. centers, and crosswise with ⅜-in. square bars, 12-in. centers. Both tubes are reinforced with ⅜-in. square twisted bars, 12-in. centers, both ways. Cutoff collars, 3 ft. high and 18 ins. thick, completely encircle the structure at varying intervals to prevent seepage along same. The conduit is located along the left bank of the river, has a grade of 1 per cent and is designed to carry 2,000 sec. ft. The intake is at elevation 4,060 and the outlet terminates in the pool at elevation 4,055.

The flow is regulated by a system of gates and valves of special design, which are controlled from a gate house or tower. The tower consists of two separate reinforced concrete tubes in juxtaposition, each 14 ft. in diameter. Extending the full height of the tower and located on the up and downstream sides the structure is strengthened by a series of reinforced stiffening walls, seven on a side. These walls are 2 ft. thick and are to be built monolithic with the main structure. The whole structure is heavily reinforced. The control works are in two distinct units.

The design of the valve control is somewhat unique. At the base of the tower is a water cushion cylindrical in shape, being 12 ft. deep and having a diameter of 12 ft., the invert of the conduit leading from this pool being 10 ft. above the base of said cushion. At the top of this cushion is the main control valve. This valve works in a similar manner to a piston rod. The upper end of the vertical piston rod slides into a metal cap about 9 ft. in diameter and 3½ ft. deep, rigidly attached to the tower by means of brackets and approximately 3 ft. above the opening to the water cushion, which at this point is 8 ft. in diameter. The piston rod is hollow, being 8 ft. in diameter and 3 ft. long and works up and down within the cap. When the valve is closed the water pressures around the cylindrical piston rod are balanced, thus minimizing the friction. As the piston rod is raised within the cap the water rushes in uniformly around the circle down onto the water cushion. Water is to be admitted to the tower chambers by means of standard vertical lift gates located at different elevations in the tower. By this method water may be turned into the tower by raising the gate having the minimum water pressure against it.

There are three sets of standard vertical lift gates for admitting water within the tower. At elevation 4,060 are two 3x3-in. sluice gates, one to each valve chamber; at elevation 4,070 are standard gates 3 ft. wide and 8 ft. high, three to each chamber; at elevation 4,116 are 3x8-ft. standard gates, three to each chamber. The spillway crest is at elevation 4,162. The control mechanism for the gates consists of hydraulic operating cylinders, one for each gate, located in the tower house. Oil will be used in the cylinders. Electric motors will be installed to generate power.

A 220-ft. span suspension bridge between the tower and the top of the dam gives access to the gate-house.

Access to Structures.—All structures are made accessible throughout by means of iron ladders placed at convenient locations and built as permanent parts of said structure.

Roadway on Dam.—The top of the dam is to be capped with a macadam roadway 17 ft. wide, either side of which is edged with a concrete curbing surmounted by an iron railing.

Across each spillway and continuous with the roadway on the dam are reinforced concrete bridges, made up of a series of arches, each having a span of 48 ft., 5 ins. and a rise of 7 ft.

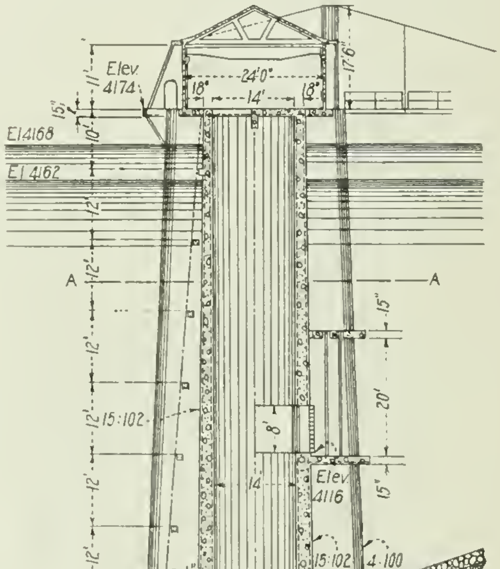


Fig. 7—Sections of Outlet Tower, Lahontan Dam.

Progress.

Work on the construction of the camp and power plant commenced in February, 1911, both of these features being completed during that year. Work on installing the rest of the plant progressed as rapidly as equipment arrived. The first work done on actual features was on excavation of outlet conduit, left spillway and cutoff trench.

A rate of progress is to be maintained as follows: The cutoff wall across the river bed to be completed March 1, 1912; spillway pool by Jan. 1, 1913; outlet conduit by May 1, 1912; the main dam to elevation 4,070 by Jan. 1, 1913, and the entire work by July 1, 1914. The construction to date is practically up to schedule. The flood waters of the spring of 1913 will be allowed to flow over the dam into the pool and as soon as the high water subsides the work on the embankment will progress. The flood waters of 1914 will be taken care of by the left spillway at elevation 4,100.

CONSTRUCTION PLANT.

Power.—The main feature of the construction plant has been the erection of a hydro-electric power plant. This plant is a permanent feature designed to furnish ample power for operating the construction plant, and later to furnish power for irrigation and domestic use.

The water for power is derived from the Truckee Canal being tapped at elevation 4,170 and conveyed through a steel penstock to the power house on the left bank of the Carson River, 850 ft. downstream from the dam. The maximum available head is 125 ft. The salient features of the power plant are concrete forebay and attendant headworks, control gates, etc.; a riveted steel penstock 72 ins. in diameter and 500 ft. long; a concrete power house 32x72 ft., duplicate 500 k.w. power units each, consisting of a Pelton-Francis turbine developing 830 h.p., with 24-in. double runner, 514 r.p.m., with a draft tube 15 ft. in length, General Electric generators, direct connected exciter belted to main shaft, generating voltage 2,300, 3-phase, 60-cycle, complete General Electric switchboard, transformers, etc.

Camp.—A camp fully equipped for caring for 300 men has been built. Features of the camp are the installation of an electric light system, a water works and sewerage system, fire protection, and an electrically operated ice plant. The water supply is derived from a natural spring and is pumped by an electrically driven pump to elevated storage tanks. The location of the camp, including the supply, equipment, cement and other warehouses being close to the railroad, make the handling of all freight exceptionally convenient and economical. A spur track has been built direct from the main line of the Southern Pacific R. R., being a combination standard and narrow gage, in order that switching can be done by construction dinkies. All warehouses, shops, and material yards have been located along this spur.

One of the most important items of the plant is a Lidgerwood cableway of the movable type, having a span of 1,600 ft. The traveling towers are slightly over 100 ft. in height and run on 80-lb. rails on either side of the river and parallel to same, covering a distance of approximately 800 ft. The head tower is located on the left bank. Features of this cableway are as follows: Diameter of cable, 2¼ ins.; motor 300 h.p., 3-phase, 60 cycles, 410 volts, 575 r.p.m., alternating current; capacity, 10 tons; speed hoisting, 250 ft. per minute; speed of carriage, 1,200 ft. per minute. The main duty of the cableway is to transport concrete from the mixer to place and for handling the riprap and paving. It will also be used for transporting machinery, lumber, supplies, etc.

In connection with the plant there have been constructed well equipped blacksmith, carpenter and machine shops in close proximity to the work and also close to the spur track. The machinery in the three shops is run by a 35-h.p. motor. Features of these shops are a 20-in. Smith shaper, one Aurora 24-in. back geared drill press, one 18-in. iron turning lathe, one power hacksaw, two grindstones, one 12-in. Crescent buzz saw, one 24-in. Crescent surface planer, one 36-in. Crescent band saw, etc.; also air compressor and riveting outfit.

EXCAVATION.

The bulk of the excavation is confined to the structures, namely, the outlet conduit, the two spillways, spillway pool, and cutoff wall. Besides the river channel, other excavation is principally limited to the borrow pit for furnishing material for concrete and embankment, and the quarry.

The equipment for excavating all structures in the main, with the exception of the cutoff, wall, consists of two 35-ton Marion revolving traction steam shovels, 1¼-cu.-yd. dipper. On account of the irregularity in the form of the structural excavation and inacessibility to same it was deemed advisable to use the above form of shovel. These shovels have proved entirely satisfactory. These shovels have loaded direct into 4-cu.-yd. Peteler side dump cars drawn by 12-ton Porter locomotives. The excavated material from the conduit and left spillway, consisting of sandstone, mudstone, clay and sandy clay, has been hauled 2,200 ft. upstream to the spoil dump. All sandstone and mudstone was blasted ahead of the shovel. These shovels averaged 400 cu. yds. per day excavated. The locomotives hauled eight cars on a 2½ per cent grade. The maximum grade at any time was 10 per cent when the train consisted of two cars. In the right spillway the shovel excavated on top step first and worked itself down over successive steps to the bottom, the train track being laid along the side hill downstream at different elevations. The material consisted mostly of sandstone requiring blasting. The material which will accumulate from final trimming of the steps will be handled by derrick and skips loading into dump wagons.

The upper lift of the pool was excavated direct by the shovel into cars, but the lower lift was handled by means of an electrically operated derrick, the shovel excavating into skips and the derrick hoisting same and dumping into cars above. The shovel was dismantled and hoisted out by the cableway after the excavation was completed.

The cutoff wall was excavated by mucking into buckets, the latter being hoisted out of trench by electrically operated derricks.

Stripping and miscellaneous earth excavation will be done by wheelers, fresnos, wagons, etc.

BORROW PIT.

As already stated the borrow pit is to the north and at an elevation above the top of the dam. The top soil or silt must be stripped in order to uncover the gravel bed. This stripping is to be done by a Bucyrus Electric 56-ton Drag Line Excavator, 1½-cu.-yd. bucket, 60 ft. boom, 95-h.p. Wagner main motor and 50-h.p. Wagner swinging motor; all motions air controlled; capacity, 100 cu. yds. per hour.

The gravel for the main dam will be excavated by a Bucyrus Electric 60-ton shovel.

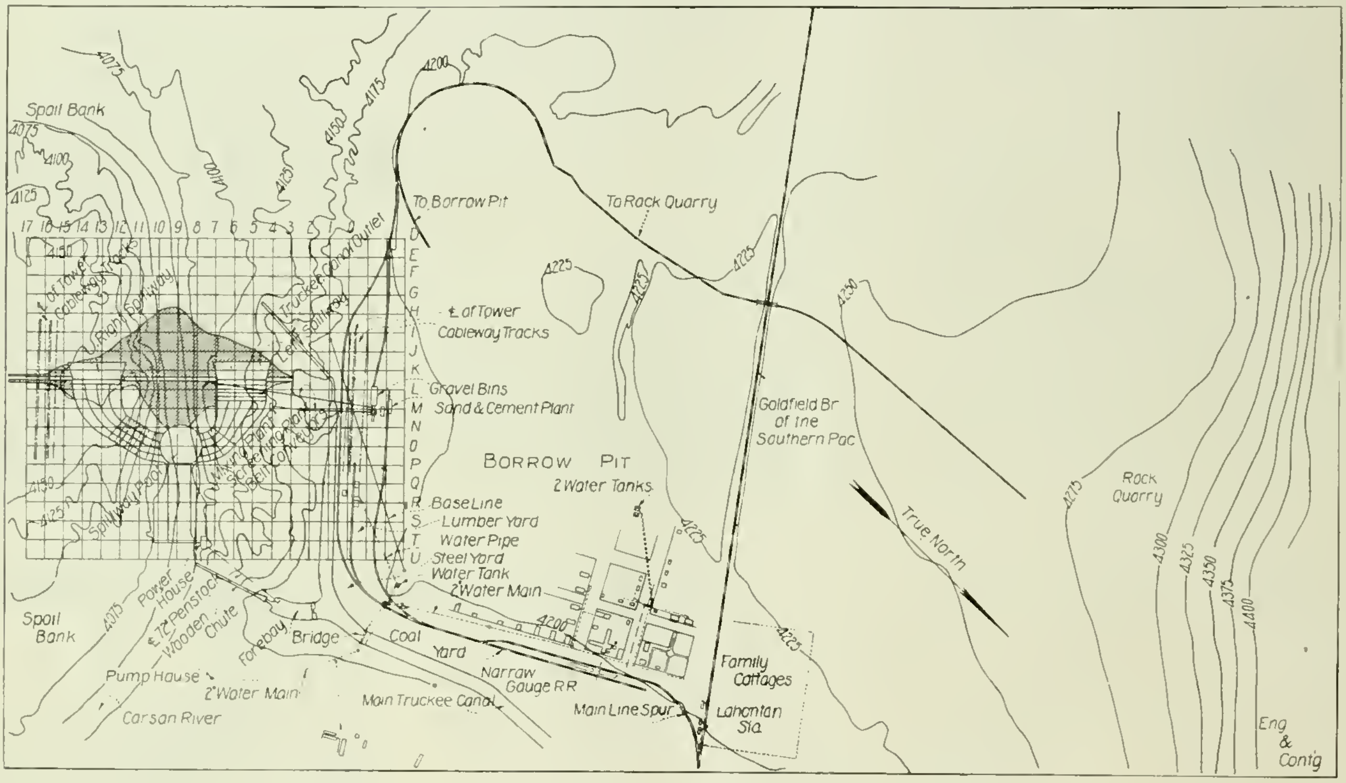


Fig. 8—Lay-out Plan of Camp and Construction Plant, Lahontan Dam.

The swing and thrust are operated by 50 h.p. motors each, and the hoist by a 115-h.p. motor, intermitting duty 30 minutes rating. Twenty-three hundred volts are led direct to the shovel, where it is transformed to 440 volts.

The gravel for the concrete will be excavated at times by the electric shovel and at other times by one of the Marion steam shovels after the earth excavation for structures is completed.

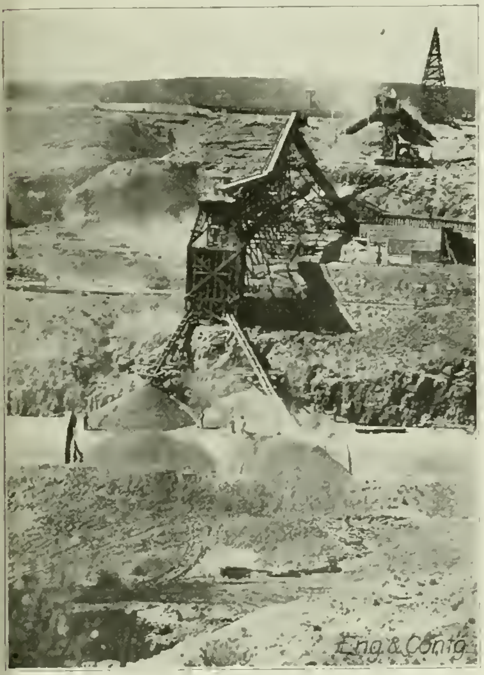


Fig. 9—Conveyor and Distributing Bin for Dam Embankment, Lahontan Dam.

(In background at right are receiving bins and concrete mixing plant.)

All material from the borrow pit will be loaded into 4-cu.-yd. Peteler dump cars, hauled by 12-ton Porter locomotives to the receiving bins. The track will be laid out as an endless circular one, the main face of the borrow cut being parallel with the river. The gravel bin for concrete and the combined silt and gravel receiving bins for the dam embankment are located side by side. These bins are located to the north of the Truckee Chute and near the center line of the dam. The receiving bins for the dam material have a capacity of 1,000 cu. yds. and the one for the concrete gravel 200 cu. yds.

CONCRETE EQUIPMENT.

From the concrete gravel bin the material is carried to the screening plant, a distance of 400 ft., by a Stephens-Adamson belt conveyor with 18-in. belt, operated by a General Electric 35-h.p. motor. The gravel is run through a series of three revolving screens, each being 3½ ft. long and 3 ft. in diameter, having a slight pitch. The screen is operated by a 35-h.p. motor. The screens are 3/16 in. and ⅞ in. and 3-in. mesh, separating the gravel into three sizes. The three sizes of gravel are collected in distinct piles beneath the screens. Under these piles a timber tunnel was constructed containing six adjustable metal measuring hoppers, two for each size of gravel. From these hoppers the aggregates are carried on another belt conveyor to the mixer. The cement bin is located over this same belt. All cement was loaded direct from the cars before the sand-cement mill was put in operation and later direct from said mill onto the gravel belt conveyor that feeds the screens, thence by an auxiliary belt to the cement bin. The water supply for the mixer is obtained by means of a gravity pipe line direct from the Truckee Canal. A boiler close by heats water during cold weather. The concrete is mixed in a 1½-cu.-yd. Smith mixer operated by a 30-h.p. motor. From the mixer the concrete is deposited into a 2½-cu.-yd. slide bottom dump bucket on a flat car (two batches to a bucket). This flat car is hauled by one horse on a track situated along the side hill at right angle to the cableway and covering the entire scope of the latter. The bucket is then taken by the cableway to the placing point.

On account of the extensive wall work and the area to be covered by the concrete there are few places where the concrete can be dumped from the bucket direct. This method would also entail frequent shifting of the cableway. Consequently a hopper tower was constructed high enough to reach the top of the walls, etc. The hopper is built at the top of the tower and contains approximately 3 cu. yds. The concrete is deposited from this hopper by means of a tubular spout built in take-down sections and arranged so as to be flexible at the tower through an arc of 90°. In operation two buckets are used. The hopper tower is readily moved from place to place by means of the cableway.

The labor necessary for this portion of the work consists of 1 man to operate the gravel measuring hoppers, 1 on cement hopper, 1 on the mixer, 2 on the bucket and car, and 4 on the hopper tower. The concrete is tamped in place in the usual way, the top surface brought to a true line by means of a screed, and a finish put on by sprinkling a small amount of dry neat cement over the surface, rubbing in with a wooden trowel and final top smoothed to a finish by a metal trowel. All edges are finished with an edging tool. All concrete is covered up for protection by burlap sheets 10x20 ft. and kept wet 10 days. The greater portion of the concrete will be proportioned as follows: 1 cement, 3 sand and 6 parts of gravel.

Forms.—The main form work consists of 2x8-in. lumber for lagging, surfaced both sides to a uniform thickness, 2x6-in. studs spaced 2 ft. on centers; waling pieces 4x6 ins. up to 8x8 ins., according to height of walls. For the high walls ½-in. iron bolts are passed through the waling pieces, and elsewhere bracing and wire hold the forms in place. Special forms for conduit, siphon, copings, etc., are made in the shops. For curved work 2x10-in. boards are cut in the shop into four pieces having the proper bevel. All curved form work is set to a true line by means of templets.

SAND CEMENT PLANT.

An electrically operated tube mill has been installed, equal amounts of surface silt and Portland cement being ground together. Capacity of plant, 15 barrels an hour. This cement is now being used in the work instead of straight Portland. The first was used in November, 1912.

MAIN DAM.

The receiving bins for the gravel and silt lie side by side and have a 36-in. belt conveyor running lengthwise through and under the center line. The material is fed to the belt by twelve reciprocating feeder slide doors operated from a shaft, the doors being attached to cams on same. By regulating the stroke the amount fed to the belt is controlled. Thus the mixed embankment material may be readily proportioned to a 50 per cent-50 per cent mixture or a 40 per cent-60 per cent mixture, as desired. The conveyor through the bins feeds onto a 30-in. belt 900 ft. long, driven by a 100-h.p. motor, which in turn carries across a high trestle to the distributing bin located in a central portion of the dam. From this latter bin the material is deposited through metal lined chutes into 1½-cu.-yd. dump wagons and hauled to place. The material is spread by fresnos in 3 to 4-in. layers and rolled by a 10-ton traction engine. The gravel fill will be dry rolled while the tight portion, consisting of 50 per cent gravel and 50 per cent silt, will be well sprinkled and rolled. Adjacent to all hillsides and structures the tight material consisting of silt will be puddled.

The 12-in. gravel facing will be deposited by wagons and spread to line by fresnos. The riprap will be hauled from a rock quarry, a distance of about one mile, in skips on flat cars, thence by cableway to place on the slope.

Before any material is deposited in the dam the original surface will be cleaned of all vegetable matter, and well furrowed. The river bed was cleaned to either rock or clay, all sand, gravel and loam being excavated and wasted. The rock portion of the bed is irregular and contains numerous pot holes.

Upstream from the cutoff wall in the river bed numerous ground water springs were encountered. These spots were left uncovered when depositing the tight material until the fill had been brought up 6 or 8 ft., when the holes were puddled with pure silt and springs smothered. No evidence of leakage at these points has been discovered.

CUTOFF WALL.

The cutoff wall was not built exactly according to plan. It was found that the trench had to be excavated wider to do away with timbering. In the river section the concrete corewall was brought up vertically in the center of the trench and on the side hills was laid against the downstream face of the trench. The trench will be afterwards puddled with silt.

In the river section the trench was excavated to a depth of about 30 ft. by hand mucking into buckets and hoisted out by an electrically driven derrick. Drilling and blasting was necessary. The water, of which there was a considerable quantity, was controlled by electrically driven pumps. The river was diverted first to the south half and later to the north half by means of low sack dams.

On account of the stratified condition of the rock it was decided not to excavate any deeper, but to resort to drilling and grouting to close the seams to an additional depth of 30 to 50 ft. This was done. Two rows of 5-in. well casing 2 ft. apart (the pipes in each row being 3 ft. apart on centers, each row being staggered) were concreted in the wall clear to the bottom. After the concrete work was completed the holes were drilled, tested for leakage by water, then grouted with neat

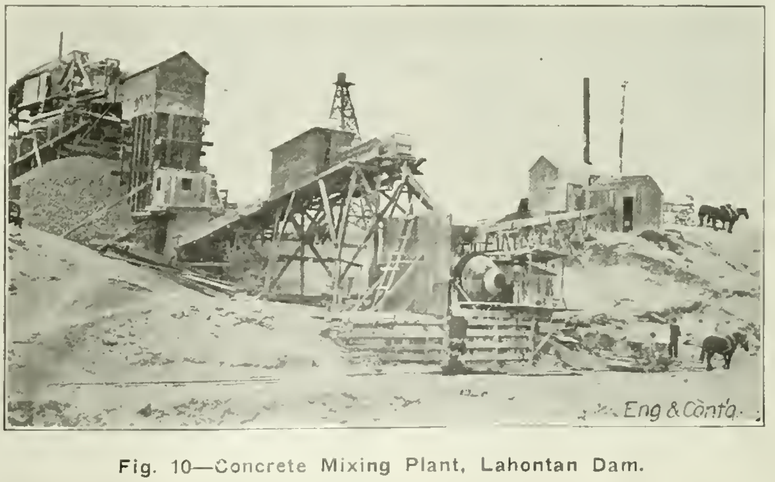


Fig. 10—Concrete Mixing Plant, Lahontan Dam.

cement and water to which, in a few instances, fine sand was added, and after same had become set tested again with water under pressure. The results of the grouting were entirely satisfactory. Most of the holes became practically tight, while those showing a large amount of leakage were reduced to a minimum.

The drills employed were Calyx shot drills, made by the Ingersoll Rand Co. These drills gave a core 1½ ins. in diameter. The outside diameter was 2⅜ ins. Two drills were operated, each being driven by a 5-h.p. motor. The grouting apparatus consisted of a Canniff air stirring grouting machine, made by the Tide Water Iron Works of Hoboken, N. J. Air was furnished by a Gardner compressor run by a 16-h.p. motor. Air pressure was used up to 100 lbs.

RIVER CONTROL.

The method employed to control the flow of the river during construction was to build the outlet conduit, which is designed to carry 2,000 sec. ft. first, then cofferdam the stream at the intake, forcing the river through the completed conduit. The cofferdam consists of 12x12-in. cribs spaced 12 ft. apart and rock filled. These cribs were made of 12x12-in. x 16-ft. timbers drift bolted together; 12x12-in. timber stringers connected the cribs one to another. The facing consists of 2x12-in. plank placed vertically and an earth fill was built upstream from this facing. The space between cribs was afterwards filled with rock. The cofferdam is located about 10 ft. in the clear upstream from the toe of the dam and is connected to the conduit by a curved timber retaining wall backed by timber braces on a concrete footing. This portion was built of 8x10-in. studs, spaced 4 ft. on centers, 8x10-in. back braces and faced with two thicknesses of 1-in. plank, with tar paper between. The cofferdam is absolutely water tight. A timber flume having a capacity of 2,000 sec. ft. was constructed from the lower end of the conduit along the left bank to a point downstream from the work, where it discharged into the old river channel.

The flood waters of the spring of 1913 will flow over the cofferdam and as soon as the flow subsides to a discharge of 2,000 sec. ft. work will be resumed on the dam embankment.

CONSTRUCTION ENGINEERING.

The whole dam site was laid out in 100 ft. squares, the lines parallel to the center line of the dam being designated by letters and those parallel to the axis of the dam by numerals. The area thus covered was carefully cross sectioned and plotted to a scale of 30 ft. to the inch, with contours of 2-ft. interval. The salient control points of the dam and all structures were figured to conform to and were located by this co-ordinate system.

ORGANIZATION.

All work is being accomplished by government forces. The government hires all labor, purchases all material, equipment and supplies, operates its own dining hall and general store.

It is the intention to carry on the work in the same manner as would apply on construction under contract, all portions of the work being done under rigid inspection, the Superintendent representing the contractor and the Resident Engineer the government, both acting under the Project Engineer.

This work is in the Pacific Division of the U. S. Reclamation Service, Mr. E. G. Hopson, Supervising Engineer, Mr. D. W. Cole, Project Engineer. Mr. L. G. Maney is Superintendent and the writer is Resident Engineer.

BOOK REVIEWS

Railroad Construction.—By Charles L. Crandall and Fred A. Barnes. McGraw-Hill Book Co., New York City. Cloth, 6x9 ins.; 320 pp.; illustrated; $3.

This new work on Railroad Construction is a thoroughly modern book. It gives a great deal of data bearing upon the methods and cost of doing various classes of railroad construction work.

The subject matter of the book is presented in ten chapters. The following are the chapter headings, which will serve to indicate the scope of the work: Introductory, Earthwork, Rock Excavation, Tunneling, Masonry, Foundations, Culvert and Bridge Masonry, Trestles and Bridges, Track Material and Roadbed, Estimates and Records. At the end of each chapter there are numerous references to other books, to proceedings of the engineering societies and to articles in the technical journals bearing upon the matters discussed in the chapter.

The book is well illustrated with views of tools, appliances and machinery used in building railroads. It is a pleasure to recommend this work to railroad engineers and contractors who appreciate the value and utility of working data on methods and costs.

"Water Supply" and "Drainage" Systematised and Simplified.—By C. E. Housden, Longmans, Green and Co. Cloth, 5x7 ins.; 28 pp.; illustrated; 60 cts.

This is a new work by the author of the small book entitled "The Precise Calculation of Pipe Drain and Sewer Dimensions, which was reviewed in a previous issue of Engineering and Contracting. The present work is in reality a supplement to the one formerly reviewed, but it is complete in itself and can be used independently of the former volume if so desired.

In this book the author states specimen problems of the types which recur frequently in water supply and drainage work. These problems are solved by means of a scale and a diagram. The scale is detached and is applied to the lines of the diagram. Numerical results are given by the length intercepted upon the movable scale between two lines upon the diagram. The diagram is based upon the slope of the hydraulic grade line. The problems relate to pressure conduits and to open ditches.

The book is designed to be of special service to those who have small rural water supply or drainage problems to solve and who cannot afford to employ an engineer. The engineer will also find the diagrams of service in solving simple hydraulic problems.

Smoley's Parallel Tables of Logarithms and Squares.—By Constantine Smoley. McGraw-Hill Book Co., New York. Leather, 4¾x7 ins.; illustrated; $3.50.

This is the seventh edition of these familiar "tables." In this edition a special diagram has been added for solving right triangles of comparatively small dimensions. The diagram is supplemented by a table giving in parallel columns the logarithms and squares of numbers varying by intervals of 1/64 in. to 16 ins., which may be used to supplement the diagram when great accuracy in results is required.

The work contains the original "parallel" tables of logarithms and squares which have proved to be useful in solving problems in mensuration, and most effective in the solution of triangles in computing the data required for structural detail drawings. The parallel combination makes it possible to find the hypotenuse, slope, and logarithmic functions of the triangle in one process of calculation and to check the calculation at the same time. The parallel tables of logarithms and squares of feet and inches vary by 1/32 in. from zero to 50 ft. and by 1/16 in. from 50 to 100 ft.

The book contains also a table of common logarithms of numbers, a multiplication table or rivet spacing, and a five place table of logarithms of trigonometric functions.

Cement Pipe and Tile.—By E. S. Hanson. The Cement Era Publishing Co., Chicago, Ill. Cloth, 5⅛x7¾ ins.; 152 pp.; illustrated; $1.

The earlier edition of this book was written less than three years ago, but the rapid progress in methods of manufacturing and practice in the use of cement pipe and tile has made the present book very different from the previous one. The book deals with the advantages of cement for pipe and tile; methods of manufacture; tests; costs, and machines. Details of pipe laying in cities in this and foreign countries are presented. Pipe for pressure service on reclamation work is described and illustrated. There are interesting chapters on plants for manufacturing pipe and tile, and methods used by two railroads in the manufacture of the pipe for culverts. The book is exceptionally useful in its field.

Popular Mechanics Year Book.—Edited by H. H. Windsor. Popular Mechanics, Chicago, Ill. Paper, 6½x9½ ins.; 224 pp.; illustated; 50 cts.

The first of each year a reprint of all the articles which have been published in the "Shop Notes" department of "Popular Mechanics" during the year is issued in one volume. This is the ninth volume. It contains 595 articles and nearly as many illustrations. The articles are short descriptions of methods and devices for performing various mechanical tasks which come up in daily work in the shop and about the house.

Boundaries and Landmarks.—By A. C. Mulford. D. Van Nostrand Co., New York. Cloth, 5½x8¼ ins.; 90 pp.; illustrated; $1.

This manual will familiarize the land surveyor with different types of old boundaries that exist throughout the country. The intent is to furnish suggestions as to the methods of locating lines to be measured, rather than to describe how the lines should be measured. The contents of the book are divided into fifteen chapters as follows: The work and training of the surveyor; descriptions of property; relative legal value of evidences of boundary; landmarks—stakes and stones; fences and walls; deeds with complete descriptions; sources of error in descriptions; relations of the surveyor and lawyer; house lots; highway records and rerunning; laying out new roads; and responsibilities of the surveyor.

Modern Illumination, Theory and Practice.—By Henry C. Horstman and Victor H. Tousley. Frederick J. Drake & Co., Chicago, Ill. Flexible leather; 4¾x7 ins.; 270 pp.; illustrated. $2.

This is a handbook of practical information and suggestions for architects, contractors and electricians. It is intended for the practical workman rather than the student, but the intent of the authors has been to give as much of theory as is needed to make clear the principles.

The book is in twenty chapters, under the following titles: Light; Principles of Vision; Reflection, Refraction and Diffusion; Photometry; Calculation of Flux from Photometric Curves; Illumination Calculations; Characteristics of Electric Illuminants; Shades and Reflectors; Location and Height of Lamps; Color of Light; Choice of Lamps; Choice of Fixtures; Indirect Lighting; Practical Considerations; Table of Intensities in Foot Candle for Various Classes of Service; Plans and Specifications; Illumination Tables; Incandescent Light Wiring and Other Tables; Glossary of Terms and Phrases; Tables of Square Roots and Standard Symbols.

The chapter, entitled Practical Suggestions, suggests peculiar and general requirements which obtain in many different locations. The chapter on plans and specifications contains useful information, which will be valuable to those who plan and make specifications.

The Kingdom of Dust.—By J. Gordon Ogden, Ph. D. Popular Mechanics Co., Chicago, Ill. Cloth; 5x7 ins.; 116 pp.; illustrated. 50 cts.

This is a story of the physical phenomena of dust in its metallic, mineral and organic forms, its relation to bacteria and disease and its importance to the lives of human beings.

NEWS SECTION

Editorial Comment—Personals—Society Meetings—Trade Notes—Catalog Reviews—Contract News, Embracing Bids Asked, Work Projected, Contracts Let and Contract Prices on All Classes of Civil Engineering Construction Work.

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The Doings of the Week.

A number of rumors of large railroad construction contracts let or to be let have developed during the past week. For example, it is reported that the Harriman system has awarded contracts for the construction of 250 miles of railway between Nampa, Idaho, and Winnemucca, Nevada, to connect the northern and southern lines of this system. Another report that has come to light in the last few days is that ex-Senator W. A. Clark was contemplating building a new line from Los Angeles to San Diego, which would involve 130 miles of new construction at a cost of $10,000,000. The Norfolk & Western Ry. has announced that it proposes to complete the double tracking of its line all the way from Norfolk, Va., to the Ohio River, building, 147 miles of second track. Another report from the south is to the effect that the contract for constructing the Richmond, Washington & Chesapeake Ry. has been awarded to Lane Bros. Co., Altavista, Va. This contract is said to cover 82 miles of line extending from Doswell to Sandy Point, Va. Among the other construction contracts let recently are the following: Twohy Bros., Portland, Ore., for the enlargement of terminal facilities at Oakland for the San Francisco, Oakland & San Jose Terminal Ry., the work calling for filling in the Key Route pier and providing for increased trackage facilities; contract for three tunnels on the Allegheny Division of the Pennsylvania R. R.: East Brady tunnel, 2,660 ft. long, Arthur McMullen, Singer Bldg., New York City; Wood Hill tunnel, 2,870 ft. long, Arthur McMullen; Kennerdell tunnel, 3,350 ft. long, John A. Kelly Co., Pennsylvania Bldg., Philadelphia, Pa.

Most of the state highway work at present seems to be that which is being done by the State Legislatures. In nearly every state of the Union bills are before the legislatures to provide funds to aid in state highway construction. The California State Highway Commission is now calling for bids on two additional sections of its system One of these calls for 10-miles of concrete with bituminous top in Los Angeles County; the other calls for 7½ miles of water-bound macadam on gravel foundation in Mendocino County. Two fair-sized highway contracts have been let since our last issue in Mississippi. One of these called for 17 miles of road in Supervisors' District No. 2 of Clay County. J. R. Sutherlin, Kansas City, Mo., secured the work. The other contract calls for 22 miles of road in Supervisors' District No. 1, Monroe County, Miss. Boyd & Bradshaw, Columbia, Miss., and F. D. Harvey & Co., Memphis, Tenn., secured the contract.

A number of small drainage contracts, mostly for tile systems, have been awarded in the last few days. Of the other contracts in this line perhaps the largest is the one secured by C. H. Sternberg, Rensselaer, Ind. This contract calls for the construction of the J. A. Borntragen Ditch near Rensselaer, and includes 1,540,000 cu. yds. of excavation in the main ditch. In the way of levee contracts about the largest new job coming up for bids recently is the work for the Obion River Drainage District, Union City, Tenn. This contract calls for 314,800 cu. yds. of levee work and 178,000 cu. yds. of ditch work.

Bids on a large sewer job were opened last week by the Passaic Valley Sewerage Commissioners of Newark, N. J. This contract called for the construction of Section 7 of the main intercepting sewer—the compressed air tunnel portion. Bids were received on the construction with metallic shields and without metallic shields. Booth & Flinn, Ltd., Pittsburgh, Pa., were the low bidders on both methods, at $1,853,450 and $1,413,030, respectively. The Dock Construction Co., Hoboken, N. J., at $3,131,777 was the only other bidder on the construction with metallic shield. Chas. A. Haskin, Boston, Mass., bid $2,117,400 on the construction without metallic shield.

A resolution will be introduced in the State Legislature of Wisconsin for a constitutional amendment empowering the state to develop and control reservoirs at the head of the principal Wisconsin rivers. The resolution passed the legislature two years ago and if it passes at this session it will be submitted to a vote of the people in 1914.

PERSONAL

Mr. John H. Hall, consulting metallurgical engineer has opened an office at 165 Broadway, New York.

Mr. Herman F. Doeleman, consulting engineer, has opened an office in the American building, Baltimore.

Mr. L. J. Houston, Jr., has resigned as assistant chief engineer of the Paving Commission of Baltimore.

Mr. A. J. Hanson, pioneer railroad builder of Colorado, died at his home in Longmont, Colo., Feb. 2, aged 70. Mr. Hanson went to Colorado in 1869.

Mr. H. T. Clarke of Omaha, bridge contractor, and president of the Missouri River Improvement Association, died recently at Excelsior Springs, Mo., aged 78.

Mr. Fred Shutts has been appointed engineer in charge of sewers, incinerators and pumping stations for the city of San Francisco, succeeding Mr. Adolph Judell.

Mr. Howard D. Bennett, consulting engineer, Baltimore, Md., is now in charge of the dredging department of the Skinner Ship Building and Dry Dock Co., Baltimore.

Mr. C. M. McBride and Mr. Andrew Paul have been appointed engineers in the water department of the city of Savannah, Ga., succeeding Mr. J. W. Hefferman and Mr. J. C. Ennis.

Mr. Edward Godfrey addressed the Bridge and Structural Section, Western Society of Engineers, Chicago, Feb. 10, on "Railroad Bridge Design in Europe and America, Compared."

Mr. James P. Barnes has resigned as chief engineer of the Syracuse and Central New York lines of the New York State Railways to become general manager of the Syracuse & Suburban Railroad Co., succeeding Mr. Milford Badgero, who will devote his time entirely to the interests of the Allen & Peck Co., Inc., of which he is secretary and assistant treasurer.

Mr. Robert Livingston consulting and constructing engineer of New York City, has opened a branch office in the People's Gas building, Chicago, with Mr. A. P. Peck in charge.

Mr. Shirley Baker has resigned as manager of the engineering department of the Redwood Manufacturing Co. of San Francisco, and will become constructing engineer for the Panama Pacific Exposition Co.

Mr. Frank F. Fowle announces that he has severed his connection with the McGraw Publishing Co., as one of the editors of "Electrical World," and will resume his electrical engineering practice with offices at 68 Maiden Lane, New York City.

Mr. Francis P. Smith, chemical and consulting paving engineer, New York City, on Jan. 21 delivered an illustrated lecture on "Maintenance of Sheet Asphalt Pavements," before the graduate students in highway engineering at Columbia University.

Mr. W. W. Berry has resigned as superintendent of the city water system at Denison, Tex., to become superintendent of the East Chicago, Ind., water department. Mr. Berry has been superintendent of the Denison plant for the past ten years.

Major W. W. Crosby, chief engineer to the Maryland Geological Survey, and consulting engineer, Baltimore, Md., on Jan. 31 delivered a lecture on "Engineering Duties and Responsibilities" before the graduate students in highway engineering at Columbia University.

Mr. Richard S. Buck has retired from the firm of Sanderson & Porter, engineers and contractors of New York and San Francisco, to become chief engineer for the Dominion Bridge Co., Canada. Mr. Seton Porter has been admitted as a member of the firm in his place.

Mr. Leonard Goodwin of the Boston office of Lockwood, Greene & Co., Architects, has been appointed Manager of the Chicago office in the First National Bank building. Mr. Harold V. Coes, formerly manager at Chicago, has been transferred to the Boston office to assume charge of special work.

Mr. E. C. Hall has resigned his position with the Worden Allen Co., consulting and contracting engineers, and has opened offices in Chicago for practice as consulting engineer. Mr. Hall has for the past ten years been in charge of the railroad bridge construction department of the Worden Allen Co.

Mr. R. Peattie will address the Western Society of Engineers, Chicago, Feb. 17, on "Topography of the Bed Rock Under Chicago." On Feb. 24, Mr. L. B. Andrus will address the Electrical Section of the society and the Chicago section of the American Institute of Electrical Engineers on "Synchronous Condensers."

Mr. H. B. McMasters, representative of the Expanded Metal Lath Manufacturers' Association addressed a meeting of engineers and architects, Feb. 6, at the La Salle Hotel, Chicago. His subject was the fire and water tests made by the Cleveland Building Department on various classes of plastered partitions and stucco walls, and was illustrated.

Mr. William G. Fargo, civil and hydraulic engineer, 303 Commonwealth building, Jackson, Mich., announces that Mr. R. G. England, civil engineer, has been admitted as a member of the firm which will hereafter be known as the Fargo Engineering Co., and will continue to specialize in the design of hydroelectric plants and reports upon hydraulic properties.

Mr. W. H. Penfield, formerly assistant chief engineer for the Chicago, Milwaukee & St. Paul Ry., is made assistant to Vice President D. L. Bush, who has charge of operation and construction on the lines east of the Missouri River. Mr. P. C. Hart, formerly general superintendent of the Puget Sound at Seattle, becomes general manager of the Chicago, Milwaukee & St. Paul, succeeding Mr. Bush. Mr. G. T. Gillick, who has been superintendent of the Hastings & Dakota division at Aberdeen, S. D., becomes assistant to the general manager at Chicago.

David McNeely Stauffer, formerly editor of "Engineering News," and a civil engineer of prominence, died at his home in Yonkers, N. Y., Feb. 7, 1913. Mr. Stauffer was born March 24, 1845, at Mount Joy, Lancaster county, Pennsylvania, and was educated at Franklin and Marshall College, which, however, he left before graduation to enlist in the navy in the civil war. During 1865 Mr. Stauffer commanded the dispatch "Alexandria" of the Mississippi River fleet. At the close of the war Mr. Stauffer took up civil engineering, and from 1865 to 1882 was in turn division engineer Philadelphia & Reading R. R., assistant chief engineer Delaware & Bound Brook R. R., and engineer of construction Philadelphia Water Department. Two of the most notable engineering works accomplished by Mr. Stauffer were the South St. bridge, Philadelphia, and the Dorchester Bay Tunnel in Boston. These two works were made the subjects of elaborate papers presented by Mr. Stauffer before the American Society of Civil Engineers. In 1882 Mr. Stauffer secured part ownership in Engineering News and was editor of that paper until 1906, when he retired from business. Mr. Stauffer was a member of the American Society of Civil Engineers, of the Institution of Civil Engineers of Great Britain, and of many other technical societies and clubs. He was also a member of the Loyal Legion, of the Union League and Pennsylvania Clubs of Philadelphia, the Century and the Grolier Clubs of New York and of several historical and patriotic societies. Besides his editorial writing Mr. Stauffer was author of "Modern Tunnel Construction" and of "American Engravers on Copper and Steel." His collection of prints of the work of both American and European engravers was one of the largest in the United States. Mr. Stauffer is survived by his wife Florence, daughter of the late G. Hilton Scribner.

CIVIL SERVICE EXAMINATIONS.

The United States Civil Service Commission announces examinations as follows:

Junior Topographer, $720 to $1,200 per annum, March 6-7.

Topographic Aid, Temporary, $40 to $75 per month, March 5.

Senior Highway Engineer, $2,000 to $2,400 per annum, March 10.

INDUSTRIAL

The Ransome Concrete Machinery Co. announces the establishment of a Buffalo agency at No. 4 Builders' Exchange Bldg., Buffalo, N. Y.

The Solomon Electric Light, Power & Water Co., Solomon, Kans., has ordered a 27-hp. and a 70-hp. stationary Blanchard oil engine, the same to be belted to generators.

Robinson, Cary & Sands, St. Paul, Minn., have been appointed Northwestern Agents for The Terry Steam Turbine Co., Hartford, Conn. They will give particular attention to Minnesota, North and South Dakota territory.

Refrigerating & Engineering, Ltd., Somerset Block, Winnipeg, have been appointed agents for The Terry Steam Turbine Co., Hartford, Conn., for the territory represented by Manitoba, Alberta and Saskatchewan. The Terry Co. already has agents at Toronto and Montreal, Canada.

The Terry Steam Turbine Co. announces that on and after Feb. 15th the general sales office will be removed to the works at Hartford, Conn., and will be under the direction of Mr. Norman L. Snow. The New York office will remain under the charge of Mr. Frederick D. Herbert, as in the past.

The Consolidated Expanded Metal Cos. of 1180 Broadway, New York City, has opened a western sales office at 904 Westminster Bldg., Chicago, Ill., and installed Mr. John P. Wagner as western sales manager. A warehouse for this office has been opened, where a large stock of steelcrete will be kept on hand to supply the surrounding territory.

The Williams Contractors' Supply Co., Brunson Bldg., Columbus, O., has taken the agency for the Chain Belt concrete mixer, hoists, spouts and other concrete machinery made by the Chain Belt Co., Milwaukee, Wis. The Williams Co. handles a complete line of rock crushing, earth moving and street cleaning machinery. It will handle the Chain Belt mixer in the western part of Ohio, Kentucky and West Virginia.

CATALOGUES

Lever Punches and Shears.—Paper, 6x9 ins., 40 pp. The Watson Stillman Co., 50 Church St., New York City.

This catalog contains illustrations and descriptions of many types of punches and shears with full tabulations. A few screw punches and power driven machines are also shown. Nine pages are devoted to fittings and repair parts.

Flexible Metallic Combination Hose.—Paper, 3½x6 ins., 4 pp. The H. W. Johns-Manville Co., Chicago, Ill.

A description of the construction of this hose is given and also a table of sizes and prices.

3½ Yd. Steam Shovel.—Paper, 10x12 ins., 6 pp. The Marion Osgood Co., Marion, O.

This 3½ yd. steam shovel weighs 82 tons and is built for heavy work. It is Type M-O 73. A complete description of the machine is given. Illustrations showing it at work are included. The company has also issued circulars illustrating traction shovels and dredges.

Sternberg Motor Trucks.—Paper, 7x5 ins., 48 pp. The Sternberg Manufacturing Co., Milwaukee, Wis.

This catalog gives specifications for 2, 3, 4 and 5-ton trucks, with complete illustrations and descriptions of the chassis, motor transmission clutch, etc., and illustrations of various types of bodies.

Oshkosh Mixer.—Paper, 9x11 ins., 4 pp. The Oshkosh Manufacturing Co., Oshkosh, Wis.

This mixer is completely illustrated and described. It is stated to be the mixer with the quadruple mixing principle, having a simplicity of the plate arrangement with a minimum number of mixing projections in such a position that the drum can be readily cleaned. Complete details are given with tables of sizes, weights, etc.

Standard Concrete Machinery.—Paper, 6¾x9¼ ins., 12 pp. Ashland Steel Range Mfg. Co., Ashland, O.

Bulletin No. 21 illustrates and describes continuous mixers and building block machines. Bulletin No. 22 deals with U. S. Building Block Machine.

Wire Ties.—Paper, 9½x12½ ins., 4 pp. The United Watertight Co., Toledo, O.

This pamphlet illustrates and describes wire ties for sacks of every description and for binding reinforcing rods. A bag tying machine is illustrated.

Concrete Silos.—Paper, 6x9 ins., 16 pp. The New Enterprise Concrete Machy. Co., 517 1st Natl. Bank Bldg., Chicago, Ill.

This illustrates and describes the methods of constructing monolithic concrete silos with Peerless molds.

Automatic Concrete Mixer.—Folder, 7x36 ins. Automatic Concrete Mixer Co., 286 Fifth Ave., New York City.

This folder illustrates and describes the methods of installing Haines mixers for various classes of concrete work.

Sterling Concrete Machines.—Paper, 6x9 ins., 24 pp. Sterling Machinery Co., La Crosse, Wis.

This catalog contains illustrations and descriptions of the Sterling Mixer, a cube mixer, and the Sterling brick and block machines.

Simplex Concrete Mixer.—Paper, 4½x9½ ins., 48 pp. The Miles Manufacturing Co., Jackson, Mich.

This catalog illustrates and describes a continuous mixer with an automatic proportioning device. Building block machines are also described.

Elite Concrete Mixer.—Paper, 6x9 ins., 16 pp. Elite Manufacturing Co., Ashland, O.

This catalog describes and illustrates a so-called low down concrete mixer and its measuring and proportioning device.

Blystone Batch Mixer.—Paper, 6x9 ins., 24 pp. Blystone Machinery Co., Cambridge Springs, Pa.

This catalog illustrates and describes the Blystone Batch Mixer and its parts. The mixer is made for hand or gasoline power operation.

Bulldog Batch Mixers.—Paper, 3½x6 ins., 8 pp. Raber & Lang Manufacturing Co., 800 Mill St., Kendallville, Ind.

This folder gives illustrations of a Crescent line of concrete machinery, including sewer pipe and tile molds, concrete mixers and brick machines.

Steel Forms.—Paper, 4¼x9¼ ins., 6 pp. The W. B. Jones Boiler Co., Streator, Ill.

This circular illustrates and describes sidewalk, sewer and culvert, arch, post, shaft and chimney forms. These forms are patented and known as the Heltzel System.

Park's Adjustable Step Form Holders.—Paper, 9x12 ins., 4 pp. H. L. Park, Reading, Mass.

This illustrates and describes a form for building concrete steps which may be adjusted for any steps and requiring no lumber, sawing or fitting.

V. & R. Concrete Mixer.—Card, 6½x3½ ins. Van Duzen, Roys & Co., Columbus, O.

This gives illustrations and prices of a 1/6 yard machine.

Milburn Oxy-Acetylene Welding & Cutting Apparatus.—Paper, 6x9 ins., 32 pp. The Alexander Milburn Co., 1420-26 W. Baltimore St., Baltimore, Md.

This catalog gives a thorough description of the apparatus, the methods of its use and tables of cost of operation per lin. ft. for various thicknesses of metal. In addition to the oxy-acetylene cutting and welding apparatus, the company has catalogs on portable acetylene lights, house lighting machines, miners' lights and steam and acetylene generators for locomotive head lighting.

RAILWAYS

Alabama.

Bids were opened last Saturday by the Southern Ry. for building an additional track from 27th St., Birmingham, to the east end of the North Birmingham yards, a distance of 3.4 miles. The contract calls for laying an additional track on present grades and alignment; it is not very heavy work.

Arkansas.

Capitalists of Fayetteville, Ark., have completed preliminary plans for the building of a short line of railroad, 15 to 20 miles in length, to haul timber from the forest districts near Fayetteville to a junction point on the St. Louis & San Francisco R. R.

The T. H. Bunch Coal Co., Little Rock, Ark., has applied to the city council of that city for a street railway franchise over certain streets.

The Board of Directors and members of the Advisory Board of the Fort Smith, Ark., Business Men's Club recently met to consider the proposition of the promoters to construct an extension of the Fort Smith, Subacio & Eastern Ry. to Dardanelle. Two routes are under consideration between the two towns. The first would connect with the Scranton line at that town and would require 26 miles of construction. The alternate route would start at Subacio and run several miles to the south of Scranton, which town would thus be connected with the main line by a spur. The latter route would be 29 miles long, but the topography of the country along the latter presents easier grades so that the comparative expense of the two routes would be approximately the same.

California.

⊙Twohy Bros., Spokane, Wash., and Portland, Ore., have been awarded the contract by the San Francisco, Oakland & San Jose Terminal Ry. for the enlargement of terminal facilities at Oakland, the work calling for filling in the Key Route pier and providing for increased trackage facilities.

Lieut. Col. Williamson of Fort Mason, San Francisco, Calif., recently appeared before the Commerce and Navigation Committee of the Assembly, Sacramento, Calif., advocating the passage of the Canepa bill empowering the Harbor Commission to extend the belt line railroad to the exposition grounds under Fort Mason and to the transport docks.

The Red River Co., the holding company of the Walker lumber interests, according to a report from Greenville, will build a lumber railroad around Big Meadows from Dotas Springs to Robbers Creek, where the company plans to build one of the largest sawmills in the United States.

Colorado.

A party of engineers in the employ of the Wichita Falls Northwestern (Katy line) is now at work a few miles south of Holly, Colo., locating a proposed line to shorten the route of the Katy's main line in Oklahoma. S. B. Fisher, St. Louis, Mo., is Chief Engineer of the Missouri, Kansas & Texas.

The San Luis Valley Sugar Co., Monte Vista, Colo., has decided to construct a railroad from that city to Center. Work will probably be started in the spring, so that the line will be ready for operation about Sept. 1.

Florida.

It has been announced that the Tampa & Gulf Coast Railroad Co. will start work as soon as a charter is secured, on the proposed line to St. Petersburg. The new road will be independent, but will connect with the Seaboard Air Line R. R. and will give competitive rates to St. Petersburg. It will extend along the Pinellas peninsula, and will join the Seaboard north of Tarpon Springs. W. R. Rowland, St. Petersburg, Fla., is Counsel for the company.

Georgia.

Officials of the Central of Georgia Ry., C. K. Lawrence, Chief Engineer, Savannah, Ga., have laid before the City Administration of Macon the plans decided upon by the road for the construction of the new $1,500,000 terminal at that place.

There are some prospects that the Georgia & Florida Ry. will take up shortly the construction of its projected extension from Augusta, Ga., to Columbus, S. C. The company has just been reorganized. R. Lancaster Williams of Baltimore has been elected President of the line; B. W. Durr, formerly Superintendent of the Baltimore & Ohio, Vice-President, and C. T. Earnist, Secretary and Treasurer. E. B. Eppes, Augusta, Ga., is Chief Engineer.

Idaho.

Further information received from Twin Falls, Idaho, in regard to the Twin Falls, Oakland & San Francisco Ry., mentioned in our last issue, states that at a recent meeting of the Board of Directors the company was reorganized. Each director has subscribed to an equal share, amounting to $15,000 of the $150,000 promotion stock issued at the time of the incorporation and organization. Previous to the reorganization the entire stock had been subscribed by T. O. Boyd, E. J. Roberts and G. D. Aiken.

Illinois.

The Alton & Eastern Electric Ry. Co., incorporated recently with a capital stock of $250,000, has elected the following directors: L. C. Haynes, East St. Louis, Ill.; A. J. Puritan, T. W. Gregory, East St. Louis; O. C. Macey, Alton, and R. C. Hardy. Messrs. Haynes, Gregory and Macy are officials of the Alton, Granite & St. Louis Traction Co., operating 61 miles of line. The new company plans to build lines east of Alton, and is understood to be planning to begin work this summer.

The Chicago & Alton R. R., H. T. Douglass, Chief Engineer, Chicago, Ill., is understood to be planning to begin work this spring on extensive improvements at the Glenn Yards, located a short distance from the interchange at Clearing, Ill. The improvements will include about 40 miles of switch tracks, 30-stall round house, shop buildings and water tanks.

The Minneapolis, St. Paul & Sault Ste Marie Ry. is understood to have signed a contract with the Baltimore & Ohio R. R. for the use of its tracks into the Grand Central Station in Chicago. The Soo at present enters Chicago over the tracks of the Illinois Central into the Park Row Station. It is probable that the change to the Grand Central will not be made for 1½ years, at which time it is expected that the Soo freight terminals, now under construction, will be completed.

The Tri-City Ry. Co., J. G. Huntoon, General Superintendent, Davenport, Ia., is to double track its line on 3rd Ave., Rock Island, between 15th and 25th Sts.

The Chicago, Ottawa & Peoria Ry., H. E. Chubbuck, General Manager, Peoria, Ill., a subsidiary of the Illinois Traction System, has acquired the right of way, and will probably undertake shortly the construction of its extension to Peoria. The line will run south from Streator to Ancona, Long Point, Dana, Minonk, Roanoke, Eureka, Washington to Mackinaw, where it will connect with the McKinley lines and run into Peoria.

The Tri-State Traction Co., of Warsaw, Ill., has been incorporated with a capital stock of $200,000 and proposes a line from Quincy, in Adams county, to Hamilton, in Hancock county. The incorporators and first board of directors are: J. Henry Bastert, Quincy, Ill.; Henry F. Dayton, Quincy, Ill.; John M. Hungate, Warsaw, Ill.; Richard O Marsh, Warsaw, Ill.; Cornelius T. Daugherty, Hamilton, Ill.; Earl W. Wood, Hamilton, Ill.

Indiana.

Business men of Laporte, Ind., have taken steps for the organization and incorporation of a company to promote the building of an interurban railway to extend from Laporte by way of Bass Lake and Knox to Logansport, where it is planned to make traffic arrangements which will insure a direct line from Laporte to Indianapolis.

The Gary & Interurban R. R., incorporated recently, as noted in our Feb. 5 issue, has been formed as a merger of the subsidiary interurban lines in the Calumet District of the Chicago-New York Electric Air Line R. R. Co., 22 W. Monroe St., Chicago, Ill. It is stated that the new company will extend the Hammond-Gary-Laporte line to Ft. Wayne. Construction in this extension will begin at Ft. Wayne and will proceed westward to Warsaw. From Warsaw a division will be built to Plymouth and from there to Laporte. Surveys on the Ft. Wayne extension will begin as soon as the Gary-Indiana Harbor extension is placed in operation next month. Traffic agreements for entrance into Chicago will be made.

The Indianapolis & Cincinnati Electric R. R. Co., incorporated two weeks ago with a capital stock of $10,000, has been organized for the purpose of building an extension for the Indianapolis & Cincinnati Traction Co., from Rushville to Cincinnati, by way of Brookville and Harrison, O. Charles L. Henry, 123 E. Market St., Indianapolis, Ind., is President.

Iowa.

The Chicago, Milwaukee & St. Paul Ry. has completed surveys for its change of line from Council Bluffs to Manilla, Ia.

It is reported that the Santa Fe System has completed a survey for a line across Iowa to Quincy, Ill. Such a road would necessitate the construction of a bridge over the Mississippi River at Keokuk, Ia.

Kansas.

Plans for remodeling the Santa Fe yards south of Douglas Ave., Wichita, Kan., have been submitted to C. J. Skinner, Resident Engineer, Wichita, in charge of the station construction. Work on the yards, it is expected, will be started at once.

It is rumored that the Santa Fe and the Missouri Pacific systems have made arrangements for extending the Larned-Jetmore branch of the first named company and the Larned-Conway Springs branch of the latter. The plan, it is said, is for the Missouri Pacific to connect with the Santa Fe branch at Larned, Kan. The Santa Fe branch will then be operated jointly as far west as Burdett. The M. P. will build from Burdett to Utica, on its main line, and the Santa Fe will extend its branch west from Jetmore to Garden City to connect with its main line. John R. Stephens, St. Louis, Mo., is Chief Engineer of the Missouri Pacific and C. F. W. Felt, Topeka, Kan., is Chief Engineer of the Santa Fe System.

Kentucky.

Surveys have been completed for the proposed line of the Cincinnati, Licking Valley & Virginia R. R., up the Licking River Valley from the Ohio River. Construction work, it is said, will be started on the road in the spring.

Maine.

Application has been made for a charter for the York & Oxford R. R. Co. This company proposes a line for Sanford, through several towns to connections with the Boston & Maine R. R. and the Maine Central R. R.

The Atlantic Shore Electric Ry. Co., L. H. McCray, General Manager, Kennebunk, Me., operating 95 miles of line from Biddeford,

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Me., to Portsmouth, N. H., has applied for permission to increase its capital stock to not over $2,500,000.

Massachusetts.

The Boston & Eastern R. R. has secured its charter, and it is stated that actual construction work will now be started in the spring. This company proposes a high speed electric railway to run from Postoffice Sq., Boston, to Odell Sq., Beverly, with branch lines to Revere Beach and to Danvers. The new road will leave Boston by a subway and a tunnel under Boston Harbor, about 250 ft. east of the present East Boston Tunnel. It is hoped that the road will be open for traffic late in the spring of 1916. The route, as finally approved by the Railroad Commissions, is almost a direct line from Boston to Salem, by way of East Boston, Revere, Lynn, Glenmere and Peabody Highland, with a branch line to Peabody and Danvers, ending in Danvers Sq. From Salem the main line will pass through Salem, over the Beverly River and terminate at Odell Sq., Beverly. John H. Bickford, 110 State St., Boston, Mass., is Chief Engineer.

The directors of the Boston & Maine R. R. have voted to appropriate $1,423,000 for additions and betterments.

Michigan.

It has been announced that the Michigan United Railways has decided to reconstruct the road bed of the Lansing-St. Johns line, which is 21 miles in length. M. S. Ralls, Jackson, Mich., is Chief Engineer.

At a meeting of the citizens and farmers at Fremont, Mich., about $17,000 was subscribed for the proposed Grand Rapids & Northwestern R. R. Fremont has agreed to donate $25,000, providing the new railroad from Grand Rapids to Ludington runs through Fremont.

A meeting was recently held by the Eastern Route Committee, Herman O'Connor, Holton, Mich., Chairman, to put through the deal for financing the Muskegon & Manistee Ry. Steps will probably be taken immediately for raising the $200,000 bonus fund.

Mississippi.

An election will be held at Biloxi, Miss., Feb. 23, for the purpose of submitting to the voters the proposition to issue bonds amounting to $150,000 for concessions for the Mississippi Northwestern R. R. W. G. Seaver, Pascagoula, Miss., is the promoter.

Missouri.

The Missouri Pacific Ry. will let contracts in the spring for widening 320 miles of present roadbed.

It is stated that work is to be started about April 1 on the construction of the Moberly, Huntsville & Randolph Springs R. R. projecting an interurban line from Moberly to Randolph Springs via Huntsville. C. H. Dameron, Baton Rouge, La., is President.

Nebraska.

The Railway Committee of the Commercial Club of Beatrice, Neb., recently held a meeting to consider the matter of the Missouri Pacific extending its line from Virginia to that city, a distance of 15 miles. It was decided that active steps will be taken at once to secure the construction of the line.

New York.

The directors of the Lehigh Valley R. R., E. B. Ashby, Chief Engineer, New York City, have adopted the route for the extension through Senaca Falls, mentioned in our last issue, and a map and profile of the location has been filed with the Village Clerk. The extension will extend from Sucker brook on the west, through Webb and Harmon's farm to T. J. Yewger's property, past and through the Veeley farm and cutting Ovid St. at the works of the road. An overhead crossing will be made at this point. The extention continues past and through Boardman's farm, through the Thorpe property, then swinging south over to the farm of James Souhan, cuts across the trolley line of the Geneva & Auburn Ry. to Cayuga Lake, where it will run parallel across that body with the New York Central.

The Erie R. R. has been making surveys for a cutoff on the main line between Sparrowbush and Tusten, a distance of 30 miles.

North Carolina.

The South Carolina Western R. R., which recently purchased the Charlotte, Monroe & Columbia Ry., is completing its line into Lamar and Timmonsville, and it is understood that the road will be continued into Monroe, N. C., at once. The officers of the South Carolina Western at Hamlet, N. C., are: President, W. R. Bousal; general manager, J. E. Hancock; traffic manager, C. C. Graves. W. A. Creech of Florence has recently been appointed general trainmaster for the system.

North Dakota.

⊙W. H. Noel, Jamestown, N. Dak., has received a 4-mile sub-contract from Barnard & Frederickon, St. Paul, Minn., general contractors for the 28-mile extension of the Midland Continental R. R. from Jamestown to Winbleton.

According to a resolution filed with the Secretary of State, the Great Northern Ry. will start work shortly on a line from Crosby, which will extend southwest 24 miles in Divide County. This line will probably end at Ferile, after passing through Stady, Plummer and Tansem.

The expenditure of $25,000,000 by the Minneapolis, St. Paul & Sault Ste. Ry. for new construction is simply a newspaper report. It may be stated, however, that during the present season this company expects to construct an extension of what is known as the Flaxton Line in North Dakota, for a distance of about 81 miles, and will probably construct an extension of the Plaza Line in North Dakota, a distance of 34 miles.

Ohio.

The Big Four R. R. has acquired the Cincinnati & Springfield Ry. Co.'s right of way between Ivorydale and Dayton, O., as well as a large number of other concessions.

The Toledo Traction, Light & Power Co. has been incorporated under the laws of Maine, with a capital stock of $6,000,000 in preferred and $9,200,000 in common. This is a reorganization of the Toledo Railways & Light Co., of Toledo, which has been taken over by Henry L. Doherty & Co., New York City.

Pennsylvania.

⊙The contractors for the three tunnels on the Allegheny Division of the Pennsylvania R. R., mentioned in our last issue, are as follows: East Brady tunnel, 2,660 ft. long, Arthur McMullen, Singer Bldg., New York City; Wood Hill tunnel, 2,870 ft. long, Arthur McMullen; Kennerdell tunnel, 3,350 ft. long, John A. Kelly Co., Pennsylavina Bldg., Philadelphia, Pa.

The City Council of Pittsburgh, Pa., has passed the franchise ordinance granting rights under certain part of the city to the Pittsburgh Subway Co., which, as previously noted in these columns, proposes the expenditure of about $50,000,000 for building transit lines for the downtown districts to the outskirts. John H. McGibbons, Chicago, Ill., and John B. Carter, New York City, are understood to be interested.

The Chambersburg & Shippensburg Ry. Co. has been organized at Chambersburg and proposes the construction of an electric railway from that place to Shippensburg. Thad M. Mahon is President.

The Greenwood Cemetery Association, Altoona, has asked the Altoona & Logan Valley Electric Ry. Co., Altoona, to extend its tracks to the cemetery gates by building a loop from the present terminus at East End to the Red Bridge by way of the cemetery.

South Carolina.

Engineers of the Great Northern R. R. have completed preliminary surveys of the proposed line from Tea to Platte. One route proposed will run through the center of Douglas County, touching Corsica, a station on the Milwaukee, while the other loops through Armour, the county seat of Douglas County, S. Dak., thence on to Platte.

Plans are reported to be rapidly maturing for the construction of the Greenville & Knoxville R. R. to Knoxville, Tenn. The line at present extends from Greenville, S. C., to Riverview, a distance of about 27 miles. Asa G. Candler, Atlanta, Ga., is reported to have become interested in the project. W. H. Patterson, Greenville, S. C., is President.

Tennessee.

The Nashville Railway & Light Co., Watkins Bldg., Nashville, Tenn., has applied for a charter amendment to permit extensions on its present street car system at Nashville.

The Illinois Central R. R. is reported to have purchased the Chicago, Memphis & Gulf R. R., a 52-mile line extending from Dyersburg, Tenn., to Hickman, Ky. Some surveys were made by the former owners for an extension to Clinton, Ky.

A new railroad to be known as the Kentucky, Tennessee & Alabama R. R. is being promoted, according to advices from Chattanooga, Tenn., to succeed the Appalachian R. R. Co., which was chartered last May and for which surveys were made in Scott and Morgan counties, Tenn. The new line will connect Williamsburg, Ky., and Chattanooga, Tenn., and will practically parallel the Cincinnati Southern the entire distance, with branch lines to Harriman and Wartburg, Tenn. The president of the company is H. F. Lee of Chicago; J. W. Prevost of Knoxville is secretary and treasurer and E. E. Thorpe of New York is manager and directing the engineering work.

Texas.

The Quanah, Acme & Pacific Ry., Robert Cray, General Manager, Quanah, Tex., now building an extension from Paducah, Tex., to Roaring Springs, is reported to be considering continuing the line across the panhandle and through eastern New Mexico to Roswell, a distance of 300 miles. It is stated that three routes are under consideration, one via Plainview, another via Lubbock and the third via Tahoka. The Quanah, Acme & Pacific is closely allied with the Frisco interests and is being constructed largely by St. Louis capital.

The Rio Grande & Eagle Pass R. R., E. F. Wager, Vice-President, Laredo, Tex., is reported to be considering building an extension from Laredo down the valley of the Rio Grande to a connection at Sam Fordyce with the branch line of the St. Louis, Brownsville, & Mexico R. R. As proposed, the extension would be about 125 miles long.

Young Men's Business Club of Marshall, Tex., has appointed a committee of which W. L. Martin is a member, to take steps toward raising $200,000 for the extension of the Black Bayou R. R. from Smithville, 20 miles distant.

Work has been started at Waco, Tex., cutting down the grade and double tracking the Missouri, Kansas & Texas R. R. from that city to Hewitt, 9 miles south. It is believed that this stretch will be a link of the double track between Hillsboro and Granger.

Work, according to advices from Fredericksburg, Tex., has been started at the San Antonio & Aransas Pass bridge over the Guadalupe River by Charles Vann, who has a subcontract for grading a portion of the San Antonio, Fredericksburg & Northern R. R. R. A. Love, San Antonio, Tex., is President of the company.

Virginia.

⊙Lane Bros. Co., Altavista, Va., are reported to have been awarded the contract for constructing the Richmond, Washington & Chesapeake R. R. from Doswell to Sandy Point, Va., a distance of about 80 miles. Channing M. Ward, 1106 E. Main St., Richmond, Va., is President and Chief Engineer of the railway.

Bids were opened this week for the construction of an additional track from Monroe to Ambert, Va., 7 miles, for the Southern Ry. The contract consists of building a track on present grades and alignment, and is not very heavy work.

Washington.

The Oregon-Washington Railway & Navigation Co. has purchased 200 acres of land at Sprague Ave., east of the city limits of Spokane, for shop and townsite purposes.

Engineers of the Port Angeles, Lake Crescent & Seattle R. R. are said to be at work in the Chimacum Valley making changes in the proposed route of the new line, which is to terminate either at Oak Bay or at the head of Port Townsend Bay, Wash.

The Washington Electric Co., A. Welch, General Manager, 1311 Yeon Bldg., Portland, Ore., has filed a mortgage for $10,000,000. This company is to build an electric railway between Portland at Tacoma, and $2,000,000 of the above will be used for the three links south of Chehalis. Work on the Olympia-Tacoma section probably will not be started until next year.

The Puget Sound Traction, Light & Power Co., George P. James, Chief Engineer, Seattle, has applied to the officials of Seattle for permission to double track its Meridian Ave. line from N. 46th St. and Meridian to N. 58th St. and Latona Ave., a distance of approximately one mile.

Canada.

✣Bids will be received until noon, Feb. 20, by J. C. Holden, Division Engineer, Canadian Pacific Ry., Winnipeg, Man., for the erection of engine houses, from stations and section houses on the Manitoba Division.

✣Bids will be received until noon, March 10, by the City Commissioners of Regina, Sask., for the supply of: Contract K.—40,000 sq. yds. track paving with top finish and subbase. Contract L.—Eleven single track, three part Wyes, 60 lb. A. S. C. E. section. Eight single track, plain curves, 60 lb. A. S. C. E. section. Four Turnouts, guarded rail, 60 lb. A. S. C. E. section. Various cross-overs, Diamond Turnouts and special intersections. All track intersections and specials to be delivered F. O. B. Regina, freight and duty paid. Copies of specifications, schedules delivery dates, and blue prints with full particulars, and form of contract can be had upon application to H. Doughty, Superintendent, The Regina Municipal Railway, Regina, Sask., Canada.

City of Saskatoon, Sask., is considering raising $100,000 for a municipal street railway system.

The Hyland Navigation & Trading Co., Winnipeg, Man., has the contract for constructing the Grand Trunk Pacific Ry. from Hartney into Brandon, Man., 50 miles. Material for the branch will be brought to the right of way during the next few weeks, so that active work may be started as soon as the weather permits.

The Canadian Pacific Ry. is understood to be planning to start active work in the early spring on double tracking its line from Toronto to Guelph Junction.

A bill to incorporate the Lake Winnipeg & Nelson River Ry. Co. has been reported to the Manitoba Legislature. The line is to be built from the north end of Lake Winnipeg to Hudson Bay.

It has been announced that work will be started early in the spring by the Canadian Pacific on the double-tracking of the line between London and Woodstock, Ont. A. L. Hertzberg, Toronto, Ont., is Division Engineer.

The Toronto & York Radial Ry. Co., W. H. Moore, General Manager, Toronto, Ont., has asked the Board of Control for a conference over the bill which the company is introducing at the Legislature. The bill asks the following: Right to enter an agreement with the city for the double-tracking of Yonge St. north as far as York Mills; right to run cars on the Metropolitan division on Sundays; rights to construct, maintain and operate lines from the Metropolitan division to connect with the Scarboro' division and the Mimico division; right to increase the bond issue from $20,000 per mile to $30,000 on the track to be constructed; extension of time to construct extensions and branches already authorized.

ROADS AND STREETS

Alabama.

✣Bids will be received until noon, Feb. 17, by Commissioners of Elmore County, Wetumpka, Ala., for grading, draining and graveling 1 mile and grading and draining 4 miles of the Tuscaloosa Road. A certified check for $500 must be filed with each bid. W. S. Keller, Montgomery, Ala., is State Highway Engineer.

The City Council of Carrollton, Ala., has passed an ordinance for the paving of the principal streets of the town. Jack M. Pratt is Mayor.

Arkansas.

Street Commissioner Carl Shibley of Van Buren, Ark., proposes to have all the principal streets in the city paved with either macadam or brick.

California.

✣Bids will be received at the office of the California Highway Commission, 515 Forum Bldg., Sacramento, Cal., until 2 p. m., on Feb. 28, for constructing a portion of a State highway in Mendocino County, between Ukiah and Forsythe Creek, Division I, Route I, Section C, about 7½ miles in length, to be built with gravel foundation and water bound macadam surface. No bid will be received unless it is made on a blank form furnished by the Commission. The special attention of prospective bidders is called to the "Notice to Contractors" annexed to the blank form of proposal, for full directions as to bidding, quantities of work to be done, etc. Plans may be seen and forms of proposal, bonds, contract and specifications may be obtained at the said office; and they may be seen at the office of the Division Engineer at Willits. Austin B. Fletcher is State Highway Engineer; Wilson R. Ellis, Secretary.

✣Bids will be received at the office of the California Highway Commission, 515 Forum Bldg., Sacramento, Cal., until 2 p. m., on Feb. 28, at which time they will be publicly opened and read, for constructing a portion of a state highway in Los Angeles County, between Rancho El Encino and Calabasas, Division VII, Route 2, Section B, about 10 miles in length, to be built of Portland cement, concrete and bituminized surface, in accordance with the specifications therefor, to which special reference is made. No bid will be received unless it is made on a blank form furnished by the Commission. The special attention of prospective bidders is called to the "Notice to Contractors" annexed to the blank form of proposal, for full directions as to bidding, quantities of work to be done, etc. Plans may be seen and forms of proposal, bonds, contract and specifications may be obtained at the said office; and they may be seen at the office of the Division Engineer at Los Angeles. Austin B. Fletcher is State Highway Engineer; Wilson R. Ellis, Secretary.

✣Bids will be received until 2 p. m., Feb. 24, by Board of Los Angeles County Supervisors, Los Angeles, Calif., for the construction of asphalt pavement at the Juvenile Detention Home in the city of Los Angeles, Calif. Each bid must be accompanied by a certified check for 10 per cent the amount bid. H. J. Lelande is County Clerk.

✣Bids will be received until 11 a. m., Feb. 14, by Col. G. McK. Williamson, Quartermaster, Fort Mason, Calif., for constructing improvements to the roads, etc., at Letterman General Hospital, Presidio, San Francisco, Calif.

⊙The Board of Public Works of Los Angeles, Cal., has awarded the contract for the construction of asphalt paving on South Main St., from 36th Pl. to Manchester Ave., a distance of a little less than three miles, to George H. Oswald, at $146,082.

The Town Trustees of Roseville, Calif., have decided to build two miles of streets to be linked with the state highway. The estimated cost is $10,000.

Connecticut.

⊙The Ahern Construction Co. of Willimantic, Conn., has been awarded the contract for the construction of the 12,935 ft. of native stone macadam road in the town of Pomfret, Conn., at $2.35 a lin. ft. The road is laid out between Abington and Pomfret Station and will be 14 ft. wide, with 5-ft. shoulders on each side, making a total width of 25 ft. The contract will amount to approximately $30,397.

Delaware.

Representative Owens has introduced a bill in the House of Delegates, Dover, Del., proposing a $750,000 bond issue for the improvement of the public highways of the state. The creation of a State Highway Commission is proposed in the bill.

District of Columbia.

✣Bids will be received until 2 p. m., Feb. 14, by Commissioners of the District of Columbia, Washington, D. C., for grading certain streets, aggregating about 17,000 cu. yds. Further information may be obtained of Chief Clerk, Engineering Department, Room 427 District Bldg.

Florida.

✣Bids will be received until 2 p. m., Feb. 18, by Board of Commissioners, D. B. McKay, Chairman, Tampa, Fla., for furnishing any number of paving brick between 500,000 and 5,000,000, f. o. b. cars or wharf Tampa, at the rate of 500,000 per month. Allen Thomas is Clerk.

Georgia.

✣Bids will be received at once by Board of Aldermen, Waycross, Ga., for furnishing f. o. b. cars Waycross, approximately 21,000 lin. ft. of granite curbing. Specifications are on file with B. H. Klyce, City Engineer.

✣Bids will be received until 7:30 p. m., Feb. 18, by Board of Aldermen, Waycross, Ga., for the following improvements on Albany Ave.: Laying 6,000 sq. yds. of asphalt blocks on sand foundation, and the construction of 4,500 lin. ft. curbing, either granite or concrete. Plans and specifications are on file with B. H. Klyce, City Engineer.

J. O. Cochran, President of the Park Board, Atlanta, Ga., has announced that approximately $15,000 will be spent during the year for improving roadways in Grant Park.

Idaho.

⊙Libby Clawson, of Boise, Ida., has been awarded the contract for the care and maintenance of the Clawson toll road, for $1,000. Bids were opened Jan. 29.

Illinois.

✣Bids will be received by L. E. McGann, Commissioner of Public Works, until 11 a. m., Feb. 21, 1913, for furnishing and delivering to the Bureau of Streets, such crushed limestone, as is required during 1913. Cash or certified check for $3,500 must accompany proposal.

✣Bids will be received until 11 a. m., Feb. 14, by Ray Palmer, City Electrician, Chicago, Ill., for furnishing and delivering to the Department of Electricity, one 2-passenger gasoline runabout. Details of specifications are as follows. Motor shall be capable of driving the machine at a speed of 35 miles per hour up a 7 per cent grade; ignition shall be of the magneto type; guarantee 1 year. Cash or certified check for 5 per cent must accompany proposal.

⊙The State Board of Administration has awarded the contract for the paving of the street car tracks in front of the Elgin, Ill., Hospital to Logan & Giertz of Elgin for $1,039.

The Board of Local Improvements of Bloomington, 'Ill., has passed an ordinance providing for the pavement of Morris Ave., from the south line of Washington St. to the north line of Wood St. The estimated cost is $18,402. Elmer Folsom is City Engineer.

The Village Council of Rossville, Ill., has decided to pave portions of Chicago and Attica Sts. with brick on a concrete foundation. T. A. Graham is Village Attorney.

The Board of Local Improvements of Wood River, Ill., has decided to pave Ferguson Ave. with brick or macadam.

The Board of Local Improvements of Rock Island, Ill., on Feb. 5 held a public hearing to consider the proposed improvement of Ninth Ave., from 11th to 25th Sts., with brick. The estimated cost of the improvement is $35,172. Wallace Treichler is City Engineer.

A petition has been circulated in Urbana, Ill., asking that Goodwin Ave. be paved from Springfield Ave. to Dublin St., a distance of over one mile. A 24-ft. brick pavement with a concrete curb and gutter is asked. A. M. Danley is City Engineer.

The Board of Local Improvements of Anna, Ill., has passed a resolution to pave the streets of Anna. The plans provide for the paving of Main St. and Franklin St., from the Jonesboro line to Lincoln St.; Washington St., west from Main to the alley between Main and Morgan St.; Jackson St., from Main to the alley between Main and South Sts.; West Railroad St., from Morgan St. to Freeman St., and East Railroad St., from Franklin St. 370 ft. east and 428 ft. west. Vitrified brick with concrete foundation will be used, with concrete curbs.

The Board of Local Improvements of Lincoln, Ill., has voted to pave one block each on Broadway, McLean, Pulaski and Kickapoo Sts., surrounding the courthouse, with creosote blocks on a concrete base. W. C. Bates is City Engineer.

City Engineer Fred Renz of Streator, Ill., has completed his estimate for the paving of North Bloomington St., from Boys St. north to the C. I. & S. track.

The Cook County Commissioners, Chicago, Ill., and the Lake County Commissioners, Crown Point, Ind., have decided to pave State Line St., between Hammond, Ind., and West Hammond, Ill.

L. E. McGann, Commissioner of Public Works, Chicago, Ill., has awarded the following contracts for furnishing and delivering materials to the Bureau of Engineering during the ensuing year: Washed gravel, American Sand & Gravel Co., 133 W. Washington St., Chicago; cotton waste, Crerar, Adams Co., 259 E. Erie St., Chicago; Portland Cement, Wisconsin Lime & Cement Co., 133 W. Washington St., Chicago; torpedo sand for mason work, American Sand & Gravel Co., 133 W. Washington St.

L. E. McGann, Commissioner of Public Works, Chicago, Ill., has awarded the following contracts for furnishing and delivering materials to the Bureau of Streets for use during 1913: Cedar blocks, 60 cts. per sq. yd., W. B. Crane Co., 4338 Michigan Ave., Chicago, Ill.; paving pitch, 5 cts. per gallon, Barrett Mfg. Co., 10 S. La Salle St.; paving brick, $16 per M. Puritan Paving Brick Co., Galesburg, Ill

Following are the lowest bids submitted to L. E. McGann, Commissioner of Public Works, Chicago, Ill., on Feb. 4, for furnishing and delivering granite blocks to the Bureau of Streets: Wisconsin Granite Co., 133 W. Washington St., $1.65 per yd.

Following are the lowest bids submitted to L. E. McGann, Commissioner of Public Works, for furnishing and delivering bank sand and paving gravel to the Bureau of Streets for use during 1913: Bank sand, $1.25 per cu. yd.; paving gravel, $1.95 per cu. yd.; McLaughlin Building Material Co., 133 W. Washington St., Chicago, Ill. The contracts have not been awarded.

Following is the lowest bid submitted to L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering pine lumber as specified to the Bureau of Streets during the year 1913: $13,177.50; Edw. Hines Lumber Co., 2431 S. Lincoln St., Chicago, Ill. The contract has not been awarded.

Following are the lowest bids submitted to the Board of Local Improvements, Chicago, Ill., Edw. J. Glackin, Secretary, for furnishing and delivering labor, materials, etc., necessary for the construction of pavements in the following streets: Ballou St., Armitage Ave. to Fullerton Ave., 5,250 lin. ft. granite concrete combined curb and gutter, 62 cts.; 8,000 sq. yds. asphalt pavement, $1.76; total, $19,683.40; F. P. McCormick Co., 133 W. Washington St. Cornelia Ave., Ashland Ave. to East Ravenswood Park, 2,650 lin. ft. granite concrete combined curb and gutter (9 in. x 10 in.), 69 cts.; 4,600 sq. yds. asphalt pavement, $1.78; total, $11,419.50; F. P. McCormick Co., 133 W. Washington St. 83d St., Exchange Ave. to Ontario Ave., 2,420 lin. ft. granite concrete combined curb and gutter, 69 cts.; 40 sq. yds. brick pavement, $2.50; 5,090 sq. yds. asphalt, $1.80; total, $12,765.80; F. P. McCormick, 133 W. Washington St. Haddon Ave., Leavitt St. to Western Ave., 2,020 lin. ft. granite concrete combined curb and gutter (5 in. x 18 in.), 62 cts.; 4,150 sq. yds. asphalt pavement, $1.72; total, $10,364.80; F. P. McCormick, 133 W. Washington St. Harding Ave., Division St. to North Ave., 5,200 lin. ft. granite concrete combined curb and gutter (5 in. x 18 in.), 60 cts.; 8,100 sq. yds. asphalt pavement, $1.76; total, $19,352; F. P. McCormick, 133 W. Washington St.; Hirsch St., Grand Ave. to 44th Ave, 4,750 lin. ft. granite concrete combined curb and gutter, 60 cts.; 7,320 sq. yds. asphalt pavement, $1.76; toal, $17,460.50; F. P. McCormick, 133 W. Washington St. 36th St., California Ave. to Kedzie Ave., 5,400 lin. ft. sandstone curbing (7 in. x 18 in.), 75 cts.; 7,210 sq. yds. brick pavement, $2.12; total, $22,368.70; Ready & Callahan Coal Co., 133 W. Washington St.; 36th St., Western Ave. to California Ave., 4,980 lin. ft. granite concrete combined curb and gutter, 70 cts.; 8,470 sq. yds. asphalt, $1.83; total, $21,787.10; American Asphalt Paving Co., 133 W. Washington St. 36th St., Oakley Ave. to Western Blvd., 770 lin. ft. granite concrete combined curb and gutter, 70 cts.; 1,150 sq. yds. asphalt, $1.85; total $2,918.50; American Asphalt Paving Co., 133 W. Washington St.' 38th Pl., Washtenaw Ave. to Kedzie Ave., 6,470 lin. ft. granite concrete combined curb and gutter, 70 cts.; 9,650 sq. yds. asphalt pavement, $1.84; total, $25,165; American Asphalt Paving Co., 133 W. Washington St.; 38th St., Morgan St. to 475 ft. east of Butler St., 7,140 lin. ft. gravel concrete combined curb and gutter, 61 cts.; 11,800 sq. yds. asphalt pavement, $1.84; total, $28,198.40; R. F. Conway Co., 133 W. Washington St. Quarry St., Archer Ave. to 27th St.; 27th St., Halsted St. to Quarry St., 2,500 lin. ft. sandstone curbing (7 in. x 18 in.), 75 cts.; 5,450 sq. yds. brick pavement, $2.17; total, $14,411.50; Ready & Callahan Coal Co., 133 W. Washington St. Commercial Ave. system, 16,640 lin. ft. sandstone curbing (7 in. x 18 in.), 75 cts.; 32,320 sq. yds. brick pavement, $2.05; total $86,920.70; Calumet Coal & Teaming Co., 9022 Commercial Ave.; Hamlin Ave. system, 9,800 lin. ft. sandstone curbing, 79 cts.; 14,640 sq. yds. asphaltic concrete, $1.46; Standard Paving Co., 9 S. La Salle St. All work includes a 6-in. Portland cement foundation, earth cutting, sidewalk construction, sewer, manhole and catch basin construction and adjustment. The contracts have not been awarded.

Following are the lowest bids submitted to the Board of Local Improvements, Chicago, Ill. Edw. J. Glackin, Secretary, on Feb. 3, for furnishing and delivering labor, materials, etc., necessary to construct pavements in the following streets: W. 52d St., Morgan St. to Loomis St., 3,780 lin. ft. granite concrete combined curb and gutter (9 in. x 10 in.), 62 cts.; 340 lin. ft. concrete gutter, 33 cts.; 7,320 sq. yds. asphaltic concrete, $1.56; R. F. Conway Co., 133 W. Washington St.; total, $18,206.80. 57th St., State St. to South Park Ave., 500 lin. ft. concrete combined curb and gutter; 9,760 sq. yds. asphalt pavement, $1.90; total, $24,112; F. P. McCormick Co., 133 W. Washington St. Hoyne Ave., Washington Blvd. to Harrison St., 5,500 lin. ft. granite concrete combined curb and gutter (5 in. x 18 in.), 58 cts.; 200 lin. ft. concrete gutter, 34 cts.; 11,400 sq. yds. asphaltic pavement, $1.59 cts.; total, $23,380; F. P. McCormick Co., 133 W. Washington St. Leland Ave., Claremont Ave. to Sheridan Rd., 2,450 lin. ft. granite concrete combined concrete curb and gutter (5 in. x 18 in.), 50 cts.; 3,720 sq. yds. asphalt pavement, $1.87; total, $9,277.90; F. P. McCormick Co., 133 W. Washington St.; Lime St., Archer Ave. to 27th St., 1,200 lin. ft. granite concrete combined curb and gutter, 49 cts.; 270 lin. ft. gravel concrete gutter; 2,920 sq. yds. asphalt pavement, $1.78; total, $6,177.90; F. P. McCormick Co., 133 W. Washington St. Prairie Ave., Augusta St. to Division St., 2,600 lin. ft. granite concrete combined curb and gutter, 58 cts.; 3,900 sq. yds. asphalt pavement, $1.84; total, $10,126.50; H. G. Goelitz, Oak Park, Ill. Peoria St., 49th Pl. to 57th St., 3,030 lin. ft. granite concrete combined curb and gutter (9 in. x 10 in.), 62 cts.; 4,970 sq. yds. asphalt pavement, $1.83; total, $12,223.70; R. F. Conway Co., 133 W. Washington St. Sawyer Ave., Balmoral Ave. to Foster Ave., 2,700 lin. ft. granite concrete combined curb and gutter (12 in. x 8 in.), 68 cts.; 3,700 sq. yds. asphaltic macadam, 2¼ in. top on 6 in. Portland cement concrete base, $1.35; total, $7,660; Central Paving Co., 179 W. Washington St. Springfield Ave., 15th St. to 16th St., 1,220 lin. ft. granite concrete combined curb and gutter, 69 cts.; 1,950 sq. yds. asphalt pavement, $1.91; total, $5,105.30; Standard Paving Co., 9 S. La Salle St., St. Louis Ave., Fillmore St. to 12th St., 1,100 lin. ft. granite concrete combined curb and gutter (5 in. x 18 in.), 59 cts.; 1,700 sq. yds. asphalt pavement, $1.95; total, $4,247; Standard Paving Co., 9 S. La Salle St. Tripp Ave., Hirsch St. to North Ave., 2,650 lin. ft. granite concrete combined curb and gutter, 59 cts.; 4,100 sq. yds. asphalt, $1.69; total, $9,560.30; F. P. McCormick, 133 W. Washington St. Pensacola Ave., Western Ave. to 540 ft. w. of Campbell Ave.; Campbell Ave., Pensacola Ave. to Montrose Ave., 3,500 lin. ft. sandstone curbing, 86 cts.; 5,900 sq. yds. asphaltic macadam, 2½ in. granite top on 8 in. slag or stone; total, $10,948; John McGarry & Co., 189 W. Madison St. Christiana Ave., Elston Ave. to Irving Park Blvd.; Kimball Ave., Grace St. to Irving Park Blvd.; Bernard St., Elston Ave. to Irving Park Blvd.; Eberly Ave., Elston Ave. to Irving Park Blvd.; Grace St., Christiana Ave. to Elston Ave.; Byron St., Christiana Ave. to Elston Ave., 14,500 lin. ft. sandstone curbing (7 in. x 18 in.), 80 cts.; 20,900 sq. yds. asphaltic concrete, 2 in. granite top, 8 in. slag or stone base; total, $44,582; F. P. McCormick Co., 133 W. Washington St. The contract has not been awarded.

Indiana.

✣Bids will be received until 10 a. m., Feb. 14, by Board of Public Works, Indianapolis, Ind., for the improvement of the following streets, alleys and avenues: First alley n. of 16th St., from e. property line Capitol Ave. to w. property line of first alley e. of Capitol Ave., by grading and paving the roadway; Park Ave., from n. property line of 34th St. to s. e. property line of Fairgrounds Ave., by grading, graveling and rolling the roadway; Samoa St., from s. e. sidewalk Brookside Ave. to n. w. property line Coyner Ave., by grading and paving sidewalks; Samoa St., from s. e. property line of Brookside Ave. to n. w. property line of Coyner Ave., by grading, graveling and rolling the roadway; Olney St., w.

side, from s. property line 28th St. to s. property line 30th St., by curbing outer edges of roadway; Burgess Ave., s. side, from e. property line Ritter Ave. to n. e. curb line of Beechwood Ave., by grading and paving the sidewalks; Yandes St., from n. curb line of 23d St. to s. property line 24th St., by grading and paving the sidewalks; Olney St., w. side, from s. property line 28th St. to s. property line 30th St., by grading and paving sidewalks; Beechwood Ave., from e. sidewalk Burgess Ave. to w. sidewalk Audubon Road, by grading and paving sidewalks.

✣Bids will be received until 2 p. m., March 3, by Board of Newton County Commissioners, Kentland, Ind., for the construction of two gravel roads in McClelland Township. Samuel R. Sizelove is County Auditor.

✣Bids will be received until 2 p. m., March 3, by Board of Posey County Commissioners, Mt. Vernon, Ind., for the construction of a gravel road on line between Black and Lynn townships. J. R. Haines is County Auditor.

✣Bids will be received until noon, March 3, by Board of Franklin County Commissioners, Brookville, Ind., for the construction of a gravel road on the line between Posey and Salt Creek townships. C. G. Reifel is County Auditor.

⊙The Board of Orange County Commissioners, Paoli, Ind., has awarded the following contracts for the construction of gravel roads for which bids were opened on Feb. 4: Hudelson Cross Road in Paoli Township to Oliver P. Turley, Orleans, Ind., $2,169; Flat Lick Road in Jackson Township to James Case, French Lick, Ind., $5,346; West Baden and Orangeville Road in Orangeville Township, Wm. H. Burton, Orleans, Ind., $3,154; West Baden and Orangeville road in North West Township, Wm. H. Burton, Orleans, Ind., $1,655, and West Baden and Georgia Road in French Lick Township, C. H. Trowbridge, West Baden, Ind., $2,190. E. A. Palmer is County Auditor.

⊙William Avery of Waldron, Ind., has been awarded the contract by the Rush County Commissioners, Rushville, Ind., for the construction of a macadam highway in Rushville Township, for $14,737. Bids were opened Feb. 3.

⊙Albert Clamm and Joe Dailey of Hartford City, Ind., have been awarded the contract by the Board of Blackford County Commissioners, Hartford City, for the construction of the Fear Macadam Road on the Harrison-Jackson Township line, and the Park Ave. macadam road in Licking Township, at $6,965 and $3,912 respectively. Bids were opened Feb. 3 by James Cronin, Jr., County Auditor.

⊙Hawkins Bros. of Brazil, Ind., have been awarded the contract by the Town Board of Shelburn, Ind., A. M. Carter, Clerk, for the construction of approximately 7,000 sq. yds. of street pavement on Mill St., at $16,328. Bids were opened Jan. 6.

The Marion County Construction Co., Indianapolis, Ind., submitted the only bid to the Board of Public Works of that city for the paving of Georgia St., from Illinois St. to Capitol Ave., the bid being $3.40 a lin. ft. on each side of the street and $1,350 for paving street and alley intersections. The contract calls for asphalt roadway and brick gutters.

The Board of Public Works of Evansville, Ind., has passed preliminary resolutions for the improvement of the following streets: Walnut, from Morris to Kentucky; Second Ave., from Ingle to Bond; Grand Ave., from Powell to Green River Road; Chestnut St., from Fourth to Eighth St.; Carpenter St., from Second to Third St.; Baker Ave., from Franklin to Illinois St. The list of improvements includes 24 blocks. August Pfafflin is City Engineer.

Iowa.

✣Bids will be received until 2 p. m., Feb. 24, by S. P. Ferres, City Clerk, Belle Plaine, Ia., for furnishing the necessary labor and material for the paving with vitrified block on a 4-in. base and 1½-in. sand cushion with a sand filler. The work will include grading, curbing and guttering. A certified check for $500 must be filed with each bid and must be payable to W. O. Brand.

✣Bids will be received until 3 p. m., Feb. 24, by S. P. Ferree, City Clerk, Belle Plaine, struction of 20 blocks of pavement. Bids will be taken on brick, asphaltic concrete, cement concrete and Dolarway concrete. S. R. Ferree is City Clerk. Charles P. Chase, Clinton, Ia., is Engineer.

✣Bids will be received until 10 a. m.; Feb. 15, by Paul J. Wells, City Clerk, Sioux City, Ia., for furnishing one street flushing machine.

No contract was awarded on Feb. 1 by J. T. Sampson, R F. D. 2, Audubon, Ia., Viola Township Clerk, for the township road work during 1913.

The City Council of Burlington, Ia., has ordered the following streets to be paved with cement concrete, the width to be determined later: Eighth St., from Oak to Ash; also Ash St., from Eighth to Mark Lane; also Mark Lane, from Oak to Corse, and Corse, from Mark Lane to Osborn. It was also ordered that South St. be paved with cement concrete, 40 ft. in width, from the west side of Ninth to the east side of 12th, and 30 ft. in width from the east side of 12th to the east side of Summer St. Also Marietta St. be paved with the same material from the north side of Smith St. to a point 7 ft. north of the south side of Market St. H. G. Vollmer is City Engineer.

The City Council of Sioux City, Ia., has passed a resolution providing for the paving of W. Third St. The Council has also been petitioned to pave 26th St., from Pierce to Jones, and sidewalks on S. Royce St.

The City Council of Davenport, Ia., has instructed City Engineer J. A. Ryan to prepare plans and estimates for the improvement of a number of streets in the city. Following are the streets named in the paving resolution: Myrtle, from Seventh to Eights Sts., brick; Eighth St., from Marquette to Vine Sts., brick; Judson St., from Fulton to Summit Aves., brick; Winthrop Ave., from High to Rusholme Sts., brick; High St., from Iowa St. to Winthrop Ave., brick; Brown St., from Front to Second Sts., brick; Warren St., from Front to Second Sts., brick; Eighth St., from Fillmore to Marquette Sts.; asphalt. Sixth St., from Fillmore to Marquette Sts., asphalt; LeClaire St., from 11th to 13th Sts., brick; alley between Fifth and Sixth, from Brady to Main Sts., brick.

Resolutions have been presented in a meeting of the City Council, Sioux City, Ia., to pave West 16th St., from Summit St. to Main St., and 26th St., from Pierce St. to Jackson St. Fred C. Smith is City Engineer.

Kansas.

✣Bids will be received until 11 a. m., Feb. 27, by Maj. J. T. Davidson, Quartermaster, Fort Riley, Kan., for the construction of 6,850 lin. ft. of concrete curbing and gutter and 12 concrete catch basins.

Kentucky.

✣Bids will be received until noon, March 10, by I. H. Goodnight, Chairman Committee, Franklin, Ky., for building and macadamizing the Lincoln-Jackson Way through Simpson County. Official advertisement will be found elsewhere in this issue.

The Greensburg & Camp Knox Turnpike Co., Greensburg, Ky., has been incorporated with a capital stock of $12,000. The incorporators are: D. T. Wilson, J. L. Wilson, J. D. Spillman, W. L. Howell and J. H. Gilpin.

The citizens of Trigg County, Ky., at a recent election voted against the issuance of bonds to the amount of $150,000 for the construction of good roads. Cadiz is the county seat.

Louisiana.

✣Bids will be received until noon, Feb. 25, by Highway Department of the Board of State Engineers of Louisiana, 104 New Orleans Court Bldg., New Orleans, La., for the construction of a main public highway extending from Many to Natchitoches Parish line in a northeasterly direction, Sabine Parish, La., a distance of 11 miles. Further information may be obtained at the office of the Highway Department. W. E. Atkinson is State Highway Engineer. Frank M. Kerr is Chief State Engineer.

Maryland.

Bids will be received until 11 a. m., Feb. 19, by Board of Awards at the office of the City Register, Baltimore, Md., for grading, curbing and paving with granite block, vitrified block, sheet asphalt and bituminous concrete, all on a concrete base, the streets listed in the following contracts: Vitrified Block Contract No. 43—Fayette St., from Broadway to Luzerne St.; vitrified block, 17,000 sq. yds.; certified check, $1,000. Sheet Asphalt and Bituminous Concrete Contract No. 45.—Mount St., from Laurens St. to Riggs Ave.; Laurens St., from Eutaw Place to Linden Ave.; Laurens St., from Penna. Ave. to Druid Hill Ave.; Division St., from Lafayette Ave. to Mosher St.; sheet asphalt, 4,750 sq. yds.; bituminous concrete, 4,750 sq. yds.; certified check, $500. Vitrified Block Contract No. 46.—Charles St., from Barre St. to Hill St.; Commerce St., from Lombard St. to Baltimore St.; vitrified block, 5,380 sq. yds.; certified check, $300. Vitrified Block Contract No. 47.—Park Ave., from Laurens St. to North Ave.; Greene St., from Baltimore St. to Lexington St.; Fayette St. from Pine St. to Paca St.; vitrified block, 8,110 sq. yds.; granite block, 1,900 sq. yds.; certified check, $500. Granite Block Contract No. 48.—Commerce St. from Lombard St. to Pratt St.; Lombard St. from South St. to Gay St.; granite block, 5,060 sq. yds.; certified check, $400. Granite Block or Hassam Granite Block Contract No. 49.—Frederick St. from Lexington St. to Gay St.; Exeter St. from Fayette St. to Baltimore St.; Saratoga St. from Calvert St. to Gay St.; granite block, 1,750 sq. yds.; certified check, $400. Sheet Asphalt Contract No. 50.—Fort Ave. from Lawrence St. to Fort McHenry; sheet asphalt, 16,200 sq. yds.; vitrified block, 9,200 sq. yds.; granite block, 390 sq. yds.; certified check, $1,400. Sheet Asphalt and Bituminous Concrete Contract No. 51.—Biddle St. from Maryland Ave. to St. Paul St.; Calvert St. from Saratoga St. to Pleasant St.; Preston St. from Cathedral St. to Guilford Ave.; Biddle St. from Cathedral St. to Maryland Ave.; Maryland Ave. from Chase St. to Preston St.; Maryland Ave. from P. R. R. Bridge to North Ave.; bituminous concrete, 3,000 sq. yds.; sheet asphalt, 9,100 sq. yds; vitrified block, 6,170 sq. yds.; certified check, $1,100. Specifications and proposal sheets can be obtained upon application to the office of the Paving Commission, City Hall. A deposit of $5 will be required for a specification covering each contract. Plans and profiles are on file for the information of bidders in the office of H. Kent McCay, Chief Engineer. R. Keith Compton is Chairman, J. Myers Hedian is Secretary.

Massachusetts.

The Selectmen of Lenox, Mass., are considering the resurfacing of all the main highways, as well as Depot St. It is estimated that these improvements will necessitate an expenditure of more than $10,000. W. J. Welsh is official in charge of the streets.

Michigan.

The Clinton County Board of Supervisors, St. Johns, Mich., will submit to the voters at the regular election on April 7 the matter of adoption of the county road system.

The Board of Trade of South Haven, Mich., has endorsed the proposition to pave with concrete the streets in Monroe Park. City Engineer John S. Lozier has estimated the cost of the improvement at $12,000. The work includes about 11,000 sq. yds.

Commissioner of Public Works J. J. Haarer of Detroit, Mich., has included in his budget for 1913 an estimate of $559,210 for repaving; $559,200 for clearing and sprinkling streets; $69,385 for repairing sidewalks and intersections, and $39,175 for an asphalt plant.

Minnesota.

The Minnesota State Highway Commission, Geo. W. Cooley, Engineer, St. Paul, has approved the proposed construction of two roads under the Elwell law and ordered surveys of five proposed rural highways. The roads approved are one of 32 miles in St. Louis County, being part of the Duluth and St Vincent Road, and one of 6 miles in Steele County, north from Owatonna to the county line. The roads where surveys were ordered are one of 25 miles in Beltrami County, being part of the Bemidji-International Falls road; one of 31 miles in Yellow Medicine County, east and west through Canby; one of 54 miles in Clearwater County, north and south through Bagley; one of 24 miles in Cass County, from Boy River to Federal Dam, and one of 12 miles in Waseca County, from Waseca to the county line.

A bill has been introduced in the Minnesota Legislature authorizing Ramsey County to spend $15,000 a year on roads in adjoining counties. St. Paul is the county seat.

The City Council of Ely, Minn., on Jan. 21, it is reported, arranged for the laying of more cement sidewalks and street paving at an estimated cost of $50,000. O. E. Brownell is City Engineer.

The Board of Jackson County Commissioners, Jackson, Minn., has made provisions for building nine miles of road during 1913, according to the specifications of the State Highway Commission, at an estimated cost of approximately $15,000.

Mississippi.

⊙The Board of Supervisors of Adams County, Natchez, Miss., on Feb. 3 awarded the contract for the improvement of 45 miles of public highway in that county to P. W. Mulvihill of Natchez for $130,970. Four bids were received on the work. The contract is to be completed within 18 months.

⊙The Good Roads Commission, Supervisors' District No. 1, at the office of the Chancery Clerk, Aberdeen, Miss., has awarded the following contracts for the construction of about 22 miles of road, for which bids were opened Feb. 3: Boyd & Bradshaw, Columbia, Miss., and F. D. Harvey & Co., of Memphis, Tenn. The work includes approximately 102,568 cu. yds. of earth; 1,320 ft. of 18-in. pipe; 575 ft. of 24-in. pipe; 55 ft. of 30-in. pipe; 85 ft. of 36-in. pipe; 60 ft. of 48-in. pipe, and 125 cu. yds. of concrete. A. B. Cowden is Secretary of the First District Good Roads Commission.

⊙J. R. Sutherlin, of Kansas City, Mo., has been awarded the contract by the Highway Commissioners of Supervisors' District No. 2, Clay County, West Point, Miss., W. F. LaGrone, Secy., for the work of permanently improving approximately 17 miles of public road in said district. Bids were opened Feb. 5.

The Board of Supervisors of Hancock County, Bay St. Louis, Miss., has sold bonds to the amount of $50,000 for road improvements to W. R. Compton Bond & Mortgage Co. of St. Louis, Mo.

The Board of Supervisors of Forrest County, Hattiesburg, Miss., on Feb. 4 sold bonds to the amount of $100,000 for the construction of good roads in Beats Nos. 1 and 3 to the First Nat. Bank of Commerce and the Hattiesburg Trust & Banking Co.

The citizens of Beat No. 2, Copiah County, Miss., on Feb. 1 voted the issuance of bonds for the construction of good roads. The roads are to be graveled. Hazlehurst is the county seat.

According to advices from Collins, Miss., the Wood Lumber Co. has offered to furnish the Road Commissioners of District Three with gravel for the graded roads. It is thought the Commissioners will expend several thousand dollars on the work.

Missouri.

⊙The Board of Public Works of St. Joseph, Mo., has awarded the contract for grading 23d St., Olive to Lafayette, to W. B. Kelley.

The County of Greene, Mo., has more than $51,000 available for road work during 1913. In addition to this, the bonds voted in Springfield and Brookline, West Division and other special road districts are expected to more than double this amount. The work will be done under the supervision of the County Commissioners, Springfield.

According to advices from Carthage, Mo., plans are well under way for the construction of the Springfield-Carthage-Joplin Road. It is the intention to have the highway pass through Carthage, Diamond, Wentworth, Pierce City, Monett, Aurora, Verona, Marionville, Republic, Billings, Nichols, and then into Springfield. The estimated cost of the road is $50,000. Charles Bowman of Carthage is interested.

The Board of Public Works of St. Joseph, Mo., has been petitioned for the paving of Market St., Third St. to Washington Ave.

The Board of Public Works of St. Louis, Mo., has asked the Municipal Assembly to order the straightening, widening and connecting of the two sections into which 12th St. now is divided.

The Board of Public Works of St. Joseph, Mo., has instructed City Engineer Charles Campbell to prepare an ordinance for paving 29th St., Jule to Sylvanie, with concrete. The Board was also petitioned to pave Renick St., 26th to 27th Sts., with Hassam, and 23d St., Olive to Lafayette Sts., with Hassam.

Montana.

The citizens of Lewistown, Mont., have decided in favor of brick as the material to be used in the proposed paving of the business district. W. M. McCleon is City Engineer.

Nebraska.

City Engineer C. A. Heartwell of Hastings, Nebr., is preparing two sets of specifications for repaving Second St., between St. Joe and Burlington Ave., one calling for brick paving and the other for asphalt with brick gutters. Bids are to be asked for shortly.

New Jersey.

⊙James MacLinden of North Wildwood (P. O. Wildwood), N. J., has been awarded the cointract for the paving of Pacific Ave., from the limits of Wildwood Crest to the Extension, at $88,000. The material to be used is wood block.

Sussex County Engineer Harvey Snook, Newton, N. J., has completed the survey of the Whitehall Road, to be approximately 7/10 of a mile long. Plans and specifications are now being prepared.

The Borough Engineer of Totowa, N. J., has prepared all the necessary maps and data for the proposed widening of Totowa Road. The road is to be 50 ft. wide at the Hillary St. end and will continue for that width to William St., from which point to Union Ave. it will be slightly narrower. The Borough Council proposes to ask the Board of Freeholders to co-operate in making the improvement.

New Mexico.

Dona Ana County, N. Mex., has just floated a bond issue of $100,000 for the construction of good roads. Francis E. Lester of Mesilla Park, N. Mex., Secy.-Treas. Dona Ana County Road Board, is interested.

New York.

✣Bids will be received until 11 a. m., Feb. 20, by Lieut. Col. C. L. McCawley, Quartermaster, Washington, D. C., for furnishing the marine corps with one or more motor trucks, 3,000 lbs. capacity, to be delivered at the marine barracks, navy yard, New York, N. Y.

⊙The Board of Contract and Supply of Syracuse, N. Y., has awarded the contract for paving S. Beach St., Water to Westcott, with macadam with sandstone block gutters, between Genesee and Madison, to the Hookway Construction Co. at $40,001. Fred J. Baker secured the contract to pave Woodland and Garfield Aves., with asphalt and brick and stone curb, at $11,476.

The Board of Public Works of Watertown, N. Y., has taken preliminary steps toward the paving of four additional streets, as follows: Polk, Union, Goodale and Jackman. The Board has also designated bituminous paving for Massey, Holcomb, Jay and Gotham Sts. E. W. Sayles is City Engineer.

The Board of Public Works of Tonawanda, N. Y., has adopted a resolution requesting the Common Council to raise by taxation this year $12,500 for the use of the street department during 1913.

Following bids were received Jan. 27 for the construction of walks, roads, gutters, etc., at Fort Slocum, N. Y.: Rochelle Construction Corporation, New Rochelle, N. Y., $4,629; Frank Sibenaler, New Rochelle, N. Y., $4,883; Ensinger Contracting Co., New Rochelle, N. Y., $4,991; Long & Miller, New York City, $4,773, and Frederick Eldridge, Mystic, Conn., $4,912.

Ohio.

✣Bids will be received until noon, Feb. 25, by Director of Public Service W. J. Springborn, Cleveland, O., for one motor lawn mower for the cemetery department. W. H. Kirby is Secretary to the Director.

✣Bids will be received until 11 a. m., March 12, by Board of Cuyahoga County Commissioners, Cleveland, O., for the improvement of Solon Road extension from Solon Road to Franklin St., Chagrin Falls Township. Frank R. Lander, County Surveyor, prepared specifications. A certified check for $1,000 must be filed with each bid. J. F. Goldenbogen is Clerk.

✣Bids will be received until noon, Feb. 18, by Board of Control, Niles, O., for furnishing the necessary labor and material for the paving with vitrified brick, asphalt block, creosoted wood block or asphalt macadam of Church St., from Main to Chestnut Sts. Specifications are on file with the Director of Public Service. A certified check for $500 must accompany each bid. J. E. Tregaskis is Clerk of the Board.

✣Bids will be received until noon, Feb. 13, by Director of Public Service, Toledo, O., for the construction of pavement on a number of streets. F. G. Stockton is Secretary.

✣Bids will be received until noon, Feb. 20 (readvertisement), by A. C. Brown, Village Clerk, Burton, O., for furnishing the necessary labor and material for the grading, draining, curbing and paving with concrete of North Cheshire St.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, O., until 2 p. m., Feb. 19, for grading and paving with brick for heavy traffic the Ravenna-Youngstown Road, State Highway "F" Pet No. 552 in Palmyra Township, Portage County. Length, 11,960 ft., or 2.27 miles; width of pavement, 12 ft. Estimated cost of construction, $30,521. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. James R. Marker, the State Highway Commissioner, reserves the right to reject any and all bids.

✣Bids will be received until noon, Feb. 27, by George S. Caton, Director of Public Service, Coshocton, O., for furnishing the necessary labor and material for paving with brick each of the following streets: North Eighth St., from Chestnut St. northward to the north end of said North Eighth St.; Walnut St., from Water St. to Second St., according to the plans and specifications on file in said office. Each bid for the paving of North Eighth St. must be accompanied by a bond or certified check for $500 and each bid for the paving of Walnut St. must be accompanied by a bond or certified check for $200.

✣Bids will be received until noon, Feb. 19, by W. J. Springborn, Director of Public Service, Cleveland, O., for grading, draining, curbing, paving with paving brick and improving the following named thoroughfares: Allerton Ave. N. W., from W. 95th St. to W.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

98th St.; Armitage Ave. S. E. and E. 92d St., from E. 93d St. to E. 92d St., and from Cannon Ave. S. E. to Armitage Ave. S. E.; Bellford Ave. S. E., from E. 55th St. to E. 61st St.; Colgate Ct. N. W., from W. 73d St. to W. 80th St.; Constance Ct. N. E., from E. 71st St. to E. 72d St.; Carlyle Ave. S. W., from W. 34th St. to Fulton Rd. S. W.; W. 34th St., from Chickory Ct. S. E. to 460 ft. southerly; E. 65th St., from Carnegie Ave. S. E., to Cedar Ave. S. E.; E. 71st St., from 101 ft. n. of Kazimier Ave. S. E. to center of Oak Ave. S. E.; E. 102d St., from Miles Ave. S. E. to n. l. of Frizelle Subdivision; E. 104th St., from Harvard Ave. S. E. to Miles Ave. S. E.; E. 113th St., from Harvard Ave. S. E. to Miles Ave. S. E.; E. 114th St., from Miles Ave. S. E. to Cotes Ave. S. E.; E. 131st St., from Miles Ave. S. E. to northerly city limits; Fanwell Ave. S. W., from W. 65th St. to 68 ft. e. of W. 61st Pl.; Kouba Ave. S. W., from W. 48th St. to W. 56th St.; Library Ct. S. W. from W. 39th Pl. to W. 32d St.; Madonna Ct. S. E., from E. 34th St. to E. 35th St.; Niessen Ct. S. W., from W. 44th St. to W. 46th St.; O'Shea Ct. S. W., from W. 44th St. to W. 46th St.; Oakley Ave. S. W., from W. 48th St. to W. 46th St.; Port Ave. S. E., from E. 72d St. to E. 75th St.; Reserve Ct. N. E., from E. 105th St. to E. 107th St.; W. 43d St., from Howlett Ave. S. W. to Cloud Ave. S. W.; W. 61st Pl., from Lorain Ave. to Schott Ave. S. W.; W. 61st St., from Lorain Ave. to Clark Ave. S. W.; W. 63d St., from Stock Ave. S. W. to Storer Ave. S. W.; W. 79th Pl., from Lake Ave. N. W. to 273 ft. northerly; W. 91st St., from Lorain Ave. to Willard Ave. N. W.; W. 99th St., from Lorain Ave. to Theodore Ave. N. W.; and for grading, draining, curbing, widening the roadway and paving with common Medina stone, E. 55th St., on east side only, from Woodland Ave. S. E. to Haltnorth Ct. S. E.; and for grading, draining, curbing, paving with paving brick and dressed block Medina stone E. 67th St., from St. Clair Ave. N. E. to the L. S. & M. S. Ry.; also for grading, draining and improving Independence Rd. S. E., from Fleet Ave. S. E. to the southerly city limits. Each bid must be made in accordance with the plans and specifications, which may be seen at the office of the City Engineer, Room 305, City Hall. W. H. Kirby is Secretary.

✣Bids will be received until March 3, it is reported, by the Commissioners of Stark County, Canton, O., for the construction of 4 miles of brick pavement on the Massillon-Wooster Pike from West Brookfield to the Wayne County line.

✣Bids will be received until 11 a. m., March 8, by the Board of Cuyahoga County Commissioners, Cleveland, O., for the construction of bridge work per Report No. 3068, diversion of stream, Harvard Road, Brooklyn Township, in accordance with specifications furnished by Frank R. Lander, County Surveyor. A certified check for 10 per cent the Engineer's estimate must accompany each proposal. J. F. Goldenbogen is Clerk.

✣Bids will be received until noon, Feb. 20, by W. J. Springborn, Director of Public Service, Cleveland, O., for grading, draining, loaming and otherwise improving Forest Hill Parkway, between the Cleveland Short Line Railway at Eddy Road and the westerly line of Original East Cleveland Township Lot No. 372. Each bid must be in accordance with the plans and specifications, which may be obtained at the office of the Park Superintendent, Room 214, City Hall. W. H. Kirby is Secretary to the Director.

✣Bids will be received until noon. Feb. 13, by Charles W. Stage, Director of Public Safety, Cleveland, O., for furnishing a 1-ton automobile truck for Cooley Farms, Infirmary Division, Warrensville, O. The specifications are on file at the office of the Director. H. F. Stillman is Secretary.

✣Bids will be received until noon, Feb. 18, by Clare Caldwell, Director of Public Service, Niles, O., for paving the following streets with vitrified shale paving block, asphalt block, creosoted wood block or asphalt macadam: Cedar St., including 8,692 sq. yds.; Beaver St., 3,507 sq. yds.; Church St., 3,106 sq. yds; Chestnut St., 7,934 sq. yds., and Mechanic St., with 7,950 sq. yds. The bid on each street must be accompanied by a certified check for $500.

⊙The Hamilton County Commissioners, Cincinnati, O., have awarded the contract for the improvement of the Gum Run Road, in Miami Township, to William Harrell & Co., at $9,607.

⊙The Department of Public Service of Akron, O., has awarded contracts for street and sewer improvements, as follows: Manchester Rd., from Thornton to East Ave., stone; also Thornton from Bowery to Manchester Rd., $32,647; E. McSchaffrey & Son. Huron St., Poplar to Campbell, $8,787, stone; McSchaffrey & Son. Kenyon St., Princeton to South, $12,787; S. W. Parshall. Poplar St., Commins to Holloway, $10,361; E. M. McSchaffrey & Son. Prince William Alley, Thornton to Coburn, $7,041, stone; Waters & Russell. Washington St., Crosier to South, storm sewer, $1,124, stone; Waters & Russell. Sewer on Cole, Curtis and Moore Sts., from High to Beardsley, Cole to Stanton, $7,962; M. H. O'Tool.

⊙The Board of Control of Niles, O., has awarded the contract for the paving of North and South Main Sts., as follows: North Main, James DiGuida of Niles, for $19,830; South Main, Martin P. Connelly & Sons of Youngstown, O., for $16,116.

⊙The Buckeye Engineering Co. has been awarded the contract by the Department of Public Service of Norwalk, O., for the improvement of Woodlawn Ave. with brick pavement, at $17,000. Bids were opened Jan. 31.

⊙The Modern Construction Co. has been awarded the contract by the Department of Public Service of Norwalk, O., for the improvement of E. Main St. with brick pavement, at $13,000. Bids were opened Jan. 31.

The City Council of Akron, O., has passed an ordinance providing for the paving of East Market St., from High St. to Case Ave.

No bids were received by W. H. Linton, Director of Public Service, Ravenna, O., for the improvement of Cleveland Ave. and N. Chestnut St. The work will be re-advertised.

Following bids were received recently by the Director of Public Service, Norwalk, O., for the paving of East Main St., from Townsend Ave. to the city limits, and Woodlawn Ave., from the end of the present pavement to the city limits: East Main St.—George E. Scott & Co., Norwalk, brick, $15,772; concrete, $12,662. Modern Construction Co., Fremont, O., brick, $13,272; concrete, $11,824. Buckeye Engineering Co., brick, $13,338; concrete, $10,452. Woodlawn Ave.—George E. Scott & Co., brick, $22,574; concrete, $14,387. Modern Construction Co., brick, $19,167; concrete, $13,153. Buckeye Engineering Co., brick, $17,355; concrete, $12,778.

The Board of Lorain County Commissioners, Lorain, O., has called an election, to be held April 6, for the purpose of voting on the question of organizing Sheffield and Black River townships into a road district. W. N. Little, President of the Lorain Board of Commerce, is interested.

The Board of Hamilton County Commissioners, Cincinnati, O., has approved an estimate of $13,415 as the cost of improving the Ohio pike from the Bogart Road to the Clermont County line and ordered plans and specifications for the work.

Property owners on East Liberty St., Youngstown, O., have reported to the City Council the use of either bitulithic, brick or wood block in the paving of that street. The proposed improvement calls for approximately 3,213 lin. ft.

The City Council of Canton, O., has adopted resolutions providing for the paving of Pennsylvania Ave., from Cherry St. to the East Creek, and the paving of East Ninth St., from Mulberry St. to Belden Ave. Phil Weber is City Engineer.

Oklahoma.

⊙The Kelly Springfield Road Roller Co. of Springfield, O., has been awarded the contract for furnishing one coal-burning road roller for Fort Sill, Okla.

Pennsylvania.

✣Bids will be received until 10 a. m., March 1, by F. E. Phelps, Capt., Acting Quartermaster, Pittsburgh Storage and Supply Depot, Pittsburgh, Pa., for the construction of concrete sidewalk, curbing and driveway on the northerly side of Butler St., between 39th and 40th Sts.

✣Bids will be received until noon, Feb. 24, by J. H. Gibson, Chairman of Improvement Committee of Borough of Greenville, Pa., for furnishing necessary labor and material for grading and paving about 30,000 sq. yds. and curbing and guttering 22,150 ft. J. M. Hittle is Secretary.

⊙McCrady Bros., of Braddock, Pa., have been awarded the contract by the borough of North Braddock, Pa., Geo. F. Siefers, Engineer, for grading, curbing and paving of Rebecca St. from Anna St. to Verona, 250 cu. yds. of grading, 725 yds. of brick paving, 450 lin. ft. of combination curb and gutter, at $2,246. Bids were opened Jan. 31.

Senator Sheatz of Philadelphia, Pa., has introduced in the Senate a bill making an appropriation of $800,000 to the County of Philadelphia for highway improvements for the next two fiscal years of the state, starting June 1. The measure provides for payment of $400,000 each fiscal year.

Tennessee.

The Tennesseee Legislature has passed an enabling act providing for the issuance of bonds in the sum of $25,000 for the construction of the road between East Chattanooga and Chattanooga. It is the purpose of those interested to construct a chert road, 50 ft. wide, over the right of way which has been promised as donations to the county. This road will necessitate the construction of a bridge over Citico Creek, at an estimated cost of $4,500.

Texas.

✣The Commissioners' Court of Matagorda County, Tex., has instructed J. H. Eldridge of the U. S. Highways Engineer Corps to prepare specifications for 20,000 yds. of mudshell to be used on the roads in the Palacios Precinct. Bids are to be opened on March 10. Bay City is the county seat.

⊙Sing & Hughes of San Antonio, Tex., have been awarded the contract by R. H. Rolfe, Constructing Quartermaster, Fort Sam Houston, Tex., for constructing extension to concrete target butt, concrete pavement, trolley truck and movable target frame at U. S. military reservation, Leon Springs, Tex., at $2,476. Bids were opened Feb. 5.

The City Council of Houston, Tex., has adopted resolutions ordering the paving of portions of no less than six streets with vitrified block and wood block. The streets are Capitol Ave., between Caroline and Chartres; Austin St., between Texas and Prairie; LaBranch St., between Texas and Prairie; Lamar Ave., between Main and Milam; Holman Ave., between Main and Crawford, and Prairie Ave., between Milam and Smith.

The City Council of Corpus Christi, Tex., will petition the Nueces County Commissioners to call an election early in April for the purpose of voting $400,000 in bonds for the construction of 150 miles of modern roads in that county.

The Commissioners' Court of Matagorda County, Tex., has ordered an election held March 1 for the purpose of voting on the issuance of bonds to the amount of $300,000 for good roads. Bay City is the county seat.

The City Council of San Benito, Tex., has authorized the preparation of an ordinance and resolution providing for the paving of six blocks of Sam Houston Ave. with wood blocks on a concrete foundation.

The City Council of Houston, Tex., on Feb. 3, it is reported, approved petitions calling for the paving of Garrott St., between West Alabama and Hawthorne, and Chenevert St., between Texas and Leeland. F. L. Dormant is City Engineer.

The citizens of Franklin, Tex., have asked that another election be held for the purpose of voting on the issuance of bonds in Justice Precinct.

City Engineer J. M. Preston of Dallas, Tex., has submitted the estimates for the assessment for the paving of Parry Ave., between Fourth Ave. and Parry. The estimated cost is $23,430.

The City Council of Corsicana, Tex., has co-operated with the Commercial Club and the Booster Club in the proposed paving of the public streets, at an estimated cost of $20,000. Geo. A. Duren is City Engineer.

Utah.

The Utah State Road Commission will ask the Legislature for $396,000 for State road work. $100,000 to be set aside for experimental purposes. Caleb Tanner is State Engineer.

Virginia.

✣Bids will be received until Feb. 27 by J. T. Penn, Chairman, Board of Managers, Martinsville, Va., for furnishing material and laying 2,000 yds. granolithic walks.

The citizens of Spotsylvania County, Va., on Feb. 4 voted the issuance of bonds to the amount of $30,000 for improving public roads in Berkeley district, and $40,000 for improving roads in Livingston district. Spotsylvania is the county seat.

Washington.

⊙The Board of Public Works of Seattle, Wash., has awarded the contract for the removal of the slide at 10th Ave. S. and Jackson St. to J. A. Zinkan, at $2,560.

Following bids were received Feb. 1 by the Board of Public Works of Seattle, Wash., for the paving of North 50th St.: P. J. McHugh, Third Ave. W., Seattle, $156,128; Jahn Contracting Co., $161,935; F. McLellan, $158,169; Barber Asphalt Paving Co., $170,636; Ward & Scherer, $167,029; Independent Asphalt Paving Co., $159,499, and Krogh & Jessen, $159,160.

The Board of Public Works at Seattle, Wash., has approved plans and specifications for grading, planking, etc., Harris Pl. et al., at an estimated cost of $50,800. The work includes clearing and grading 20 acres, 98,000 cu. yds. of earthwork and 762 M. ft. of curbs and gutters and other lumber.

The Chelan County Commissioners, Wenatchee, Wash., have approved a petition asking for the creation of an improvement district. The road is a mile and a half long and will be improved with Warren paving at an estimated cost of $18,000.

The Spokane County Commissioners, Spokane, Wash., have decided to build two highways, the Moran Road, a distance of eight miles, and six miles of the Waikki Road.

West Virginia.

The Board of Control of Wheeling, W. Va., has petitioned the City Council for the paving of the following streets: Chapline St., between 26th and 32d Sts.; 26th, north to Alley 19; Chapline St., from 11th to 16th.

Wisconsin.

✣Bids will be received until 2 p. m., Feb. 13, by Board of Public Works, Oshkosh, Wis., for the construction of pavements on nine streets. Work is to be started in the spring. Dan Witzel is City Clerk.

The City Council of Superior, Wis., contemplates opening, grading and turnpiking all the streets in the section bounded by 18th St., Lamborn, 21st and Grand Ave. E. B. Banks is City Engineer.

Canada.

✣Bids will be received until noon, March 4, by H. C. Hocken, Chairman Board of Control, Toronto, Ont., for furnishing concrete mixers, grading machines, tar kettles, three-wheel road rollers, tandem road roller, scarifiers, stationary stone crushing outfit, centrifugal pumps, portable with boilers mounted; boilers mounted, hoisting engines and boilers, derricks, clams, buckets, excavating machine complete, diaphram pumps and hose, inspection rods. Specifications, etc., may be obtained upon application at the office of the purchasing section, Department of Public Works.

✣Bids will be received until 4 p. m., Feb. 13, by Board of Control, Chairman, Ottawa, Ont., at the office of the Secretary, for broken stone, setts, cement, plank, and cedar, sand, vitrified clay pipe, refined asphalt, castings, sweepers, brooms and draughting supplies. F. C. Askwith is Acting City Engineer.

✣Bids will be received until 11 a. m., Feb. 14, by Chairman, Board of Control, at the office of M. Peterson, Secy., Winnipeg, Man., for supply of 50 dump wagon boxes, standard wagon gear, either side or bottom dump, and having a capacity of 2 cu. yds. each. Each tender must be accompanied by an accepted check or cash deposit for a sum equal to 5 per cent of the total amount of the tender.

✣Bids will be received until 6 p. m., Feb. 24, by Sidney Appleby, Secretary-Treasurer, Sutherland, Sask., for the labor and materials for street work, as noted more completely under "Waterworks" in this issue.

✣Bids are asked until March 10 by the City Commissioners of Regina, Sask., for 40,000 sq. yds. of track paving. For further details see under Railways.

The Council of York County, E. A. James, Toronto, Ont., Engineer, has decided to expend $100,000 on the good roads system.

The Wellington County Council, Guelph, Ont., has voted to expend $400,000 during the year on the construction of permanent roads. About $50,000 of this amount will be set aside to complete county bridges. The remainder will be divided approximately as follows: Townships—Arthur, 16 miles, $30,247; Eramosa, 10 miles, $24,734; Erin, 18 miles, $30,632; Guelph, 13 miles, $21,801; Garafraxa, 12 miles, $24,834; Luther, 11 miles, $19,699; Maryboro, 13 miles, $30,527; Minto, 12½ miles, $30,104; Nichol, 11 miles, $15,893; Peel, 22 miles, $40,442; Pilkington, 13 miles, $16,405; Puslinch, 13 miles, $22,032. Villages—Arthur, $4,105; Clifford, $2,212; Drayton, $2,874; Elora, $4,644; Erin, $1,820; Fergus, $5,981. Towns—Harriston, $6,768; Mount Forest, $9,040; Palmerston, $6,720. Total, $351,305.

According to advices from Ottawa, Ont., Dr. Alfred Thompson, member for the Yukon, has asked the government to include in the estimates for this year a vote of $150,000 as initial expenditure on a trunk road for automobile and general traffic from White Horse into the interior and Dawson City.

BRIDGES

Arkansas.

A bill is to be introduced into the Legislature, Little Rock, Ark., by Senator Calvert authorizing the construction of a free bridge over the Arkansas River at the foot of Garrison Ave., Fort Smith, Ark., connecting with Sequoyah county, Okla. The estimated cost of the structure is estimated at approximately $1,000,000.

Colorado.

⊙Advices from Glenwood Springs, Colo., state that the commissioners of Garfield County have awarded the contract for the construction of a new steel bridge to replace the structure near Lacy, to the Colorado Bridge & Construction Co., Denver, Colo.

Connecticut.

The New York, New Haven & Hartford R. R., it is said, is planning the expenditure of several hundred thousand dollars for the strengthening and rebuilding of bridges on the Central New England lines in Connecticut and in Dutchess County, N. Y. Some of the old iron structures are to be replaced with concrete arches and in a few cases new steel bridges will be required. D. W. Sharpe, New Haven, Conn., is Bridge Supervisor.

Delaware.

The Sussex Levy Court, according to advices from Georgetown, Del., has asked permission to borrow $30,000 to build a drawbridge across the proposed inland canal, which will connect Norfolk, Va., with Philadelphia and open up a large portion of Delaware to the markets of the latter city.

The Levy Court, Wilmington, Del., is considering the advisability of proceeding with the construction of a new bridge at 3d St. and the repair of the Washington St. bridge, and it is reported that the State Legislature will be asked to authorize the issuance of bonds amounting to $275,000 for that purpose.

District of Columbia.

H. R. Stanford, Chief of the Bureau of Yards & Docks, Navy Department, Washington, D. C., has rejected all bids received Jan. 25 for the construction of a bridge across Dorsey Creek, U. S. Naval Academy, Annapolis, Md. The plans will be revised in order to bring the cost for constructing the bridge under $50,000 and the work readvertised.

The United States War Department, Washington, D. C., has approved the plans submitted by the Illinois Central R. R. Co. for the reconstruction of its bridge crossing the Galena River. The bridge will be of the jack-knife type with a clear opening in the draw of 80 ft. The construction is to begin within the year and will be completed on or before Jan. 13, 1916, the authority otherwise becoming void. F. L. Thompson, Chicago, Ill., is Engineer of Bridges and Buildings.

Idaho.

The city of Salmon, Idaho, is planning to apply to the legislature at Boise, Idaho, for state aid towards building a new bridge across the Salmon River in this city. Surveyor Crandall has reported to the board of county commissioners that the present bridge is in poor condition. About a year ago this bridge was condemned by the old board of commissioners. The proposed new bridge will be of steel girder construction, 420 ft. long, 30-ft. roadway, with 8-ft. sidewalk on each side. There will be three spans, with concrete piers and abutments. The estimated cost will be about $40,000.

Illinois.

✣Bids will be received up to 10 a. m., March 1, 1913, at the office of the Town Clerk, Crete, Ill., for the construction of one reinforced concrete bridge to be built in Crete Township, Will County. S. Rose, Town Clerk, Crete, Ill. Lockhart Bridge: Span, 14 ft.; roadway, 20 ft.; height, about 12 ft. Estimated total concrete, 55.6 cu. yds.; reinforcing steel, 4,870 lbs. Nearest railroad station, Faithorn, about 1 mile. No local concrete materials available. Present bridge wood, 22 ft. span. Low water flow about 6 ins. deep and 10 ft. wide; high water about 6 ft. deep. Excavation averages about 6 ft. in loam and silt. Footings about 4 ft. below stream bed. Engineer's estimate, $750. Work to be completed on or before July 1, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received up to 1 p. m., Feb. 21, at the Town Clerk's office, Coatsburg, Ill., for the construction of one steel bridge on reinforced concrete foundations to be built in

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Honey Creek Township, Adams County. Albert Brosi, Town Clerk, Coatsburg, Ill. Tenvorde Bridge: Span, 80 ft.; roadway, 16 ft.; height, 22.5 ft. Floor, reinforced concrete. Total concrete in abutments, 215.1 cu. yds.; reinforcing steel, 9,920 lbs. Nearest railroad station, Mendon, 5 miles; Loraine, 5 miles. It is reported that gravel may be obtained at Lost Creek, about 2 miles from bridge site, at 10 cts. per cu. yd. at pit. Quality and quantity not known. It is also reported that gravel from Hannibal may be had f. o. b. cars at Mendon at $1.25 per ton. No present bridge. Green timber for falsework may be cut near the site. Average excavation about 12 ft. to be carried about 3 ft. below stream bed. Stream bed gravel. Acceptance of any bid to be conditional upon granting of county aid at March meeting of Adams County Board of Supervisors. Work to be completed on or before July 1, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Ill.

At the hearing held Jan. 27 by Maj. Charles Keller, U. S. Engineer, Rock Island, Ill., on the proposition to construct a bridge over the Mississippi River at Keokuk, Ia., it developed that the Santa Fe System was back of the project to construct a third bridge over the Mississippi River at that place. It is said that the railroad has already completed a survey for a line across Iowa to Quincy.

Iowa.

The City Council of Des Moines, Ia., has again postponed the consideration of plans for the proposed new bridge over the Raccoon River at Seventh St. The legal department of the city, owing to the rush of business, has been unable to secure the land on the south side of the river necessary for the approach. A hearing of objections will be fixed for the last week in February.

The City Council of Waterloo, Ia., has under consideration the proposition to build a new Melan arch bridge over Cedar River at Mullan Ave. The Mullan Ave. location is said to be the most desirable of any along the river as at this point the stream is narrower than at any other and the city also owns the land abutting the river. Condemnation proceedings would not have to be instituted to gain possession of land approaching the bridge. C. A. Roley is City Engineer.

The City Council of Waterloo, Ia., has been petitioned for the construction of a new concrete bridge over the Blackhawk Creek. C. A. Roley is City Engineer.

Kansas.

The city of Hutchinson, Kan., has granted permission to the Hutchinson Mill Co. to construct a new bridge across Cow Creek east of the warehouse.

Louisiana.

⊙Advices from Hackley, La., state that the contract for the construction of the bridge over the Paushapattapa River has been awarded to Louis Crain.

Maryland.

The County Commissioners, Denton, Md., and the State Roads Commission have reached an agreement in regard to the plans for the construction of a new bridge over the Choptank River at Denton. It is now proposed to construct the bridge of concrete, with a bascule draw, Engineer Mackall, in charge of the survey, having recommended this form of structure.

Michigan.

✣Bids will be received until Feb. 15 by Bay County Bridge Commission, Bay City, Mich., for automatic bridges gates with the view of equipping the Third St. bridge with same. John H. Blomshield is Engineer of the Commission.

✣Bids will be received until noon, Feb. 15, by Bay County Bridge Commission, Bay City, Mich., for changing the floor system and paving with creosote blocks the Lafayette Bridge over the Saginaw River at Bay City, Mich. J. H. Blomshield is Engineer of the Commission.

Commissioner of Public Works J. J. Haarer of Detroit, Mich., has included in the budget for 1913 an estimate of $46,221 for repairing and building bridges, docks and fountains.

Minnesota.

At a recent meeting of the City Council, Redwood Falls, Minn., M. A. Adams, Bridge Engineer, recommended that a new bridge be constructed over Redwood River to replace the present structure, which has been pronounced unsafe.

Tentative plans have been prepared by Oscar Claussen, City Engineer, St. Paul, Minn., for the construction of a bridge on College Ave., over 9th St.

Mississippi.

The Illinois Central R. R. has had surveys made preparatory to the construction of two new concrete bridges over two streams south of Coldwater, Miss. G. M. Hubbard, Water Valley, Miss., is Supervisor of Bridges and Buildings.

Missouri.

Soundings of the Kansas City Bottoms, Joplin, Mo., are to be made at once by engineers of the Santa Fe System to determine the depth at which the foundation piers for the new $100,000 Broadway viaduct must be sunk. Detailed specifications for the structure are now under way at the main offices of the company at Topeka, Kan. C. A. Morse, Topeka, Kan., is Chief Engineer of the Santa Fe. The specifications will be completed and forwarded to the city officials as soon after the preliminary tests are made as possible. Bids for the contract to construct the viaduct and the sale of bonds will then be made. The viaduct bonds are being printed in denominations of $500.

It has been announced that the Terminal Railroad Association, St. Louis, Mo., has agreed to construct the Union Ave. viaduct and to pay $48,000, the cost of the retaining walls. The total cost of the viaduct will be $117,000, exclusive of the retaining walls, the consequential damages, or the paving of the approaches. The city had offered to pave the approaches and bear the consequential damages if the railroad would assume the retaining wall cost.

Nebraska.

The Cedar County Commissioners, Hartington, Nebr., have ordered the construction of a number of bridges, located as follows: between section 33 of precinct 15 and section 4 of precinct 21; section 34 of precinct 16 and section 3 of precinct 20; section 5 of precinct 17 and section 6 of precinct 17; section 26 of precinct 15 and section 35 of precinct 15; section 54 of precinct 4 and section 3 of precinct 9; section 19 and section 20 of precinct 12; section 19 and 30, precinct 12; section 7 and 18 of precinct 12 and section 1 and 2 of precinct 19.

The Commercial Club of Valley City, Nebr., has petitioned the County Commissioners, Omaha, Nebr., for the construction of a bridge over Platte River near Valley to replace the structure washed out a year ago.

New Hampshire.

The Boston & Maine R. R., according to reports from Concord, N. H., is planning the construction this year of four new steel bridges, costing about $90,000, to replace structures on the line between Concord and White River Junction. J. P. Canty, Boston, Mass., is Superintendent of Bridges and Buildings.

Plans are now being prepared at the office of Frank A. Merrill, Division Engineer of the Boston & Maine R. R., Concord, N. H., for modern structures of steel to replace the wooden bridges on the Suncook branch of the Boston & Maine road, between this city and Hooksett. The plans include a double track bridge at Bow to carry the tracks of the steam road as well as the tracks of the electric branch, thereby doing away with the cross overs at that point as well as the services of a signal man to protect trains and electrics in transit in the joint use of the old wooden bridge, which has recently had to be strengthened by placing horses beneath it. The plans will also include the replacement of the three bridges across the river near the junction of the branch with the main line at Hooksett. Bids for the construction will be asked as soon as plans are completed and it is expected that the work will be undertaken during the coming spring.

New Jersey.

Plans are on file at the city hall for the construction of the proposed bridge over the Delaware River at a point below Trenton, N. J., and a hearing on the improvement was held by Lieut. Col. J. E. Kuhn, U. S. Engineer. The plans provide for a bridge of deck truss construction, with a through truss draw span. The closed draw will have a clearance of 56 ft. above mean low water and a width of 130 ft. between fenders on each side of the center pier. Abram Swan, Jr., is City Engineer.

New Mexico.

It has been announced by W. T. Shelton, Supt. of the San Juan Indian Agency at Shiprock, N. Mex., that Congress has appropriated $16,000 for the reconstruction of the bridge over the San Juan River at Shiprock.

New York.

According to reports from Albany, N. Y., a bill has been submitted to the house providing that a new bridge be built spanning Mohawk River at Crescent. The location of the structure is to be designated by the Canal Board.

Buchman & Fox, 11 E. 59th St., New York City, have filed plans for the construction of a viaduct leading from Riverside Drive, just north of Northern Ave., to the level of the house of C. K. G. Billings, Manhattan. The viaduct will be 40 ft. high., 34 ft. wide and 154 ft. long, and will be constructed of granite and local rubble.

North Carolina.

✣Bids will be received until Feb. 17 by Board of Johnston County Commissioners, Smithfield, N. C., for the construction of two iron bridges, one 240 ft. long and the other 190 ft. long.

Ohio.

⊙Board of Summit County Commissioners, Akron, O., according to advices from that city, has let the contract for the construction of the new gorge bridge to W. J. Watson, Cleveland, O., at $78,000.

G. C. Cummin, City Engineer, Dayton, O., estimates the cost of building a new bridge over the Miami & Erie Canal at Valley St. at $20,000. The structure is to be a steel lift bridge with a wooden block floor, two 4-ft. sidewalks and a clearance of 35 ft. The estimate also covered a change of grade. It was referred to the finance committee.

Plans are being prepared by engineers of the Pennsylvania Lines for the entire reconstruction of the Ohio Connecting Railroad Bridge across the Ohio River at Brunots Island. The bridge will be widened 13 ft. and double-tracked. The present steel construction will be removed and replaced with new steel work. The river piers will not be changed in any particular, as the masonry was constructed so that the structure could be widened without changing the location of the piers in the river. The eastern wing of the bridge has already been so constructed that it can be double-tracked, but the western wing will have to be widened 13 ft., and it may be the piers of this portion of the bridge will be relocated.

The city of Dayton, O., will advertise for bids on the construction of a reinforced concrete bridge at Keowee St., it is reported, as soon as an agreement with the People's Railway Co. can be reached. G. C. Cummin is City Engineer.

The Board of Hamilton County Commissioners, Cincinnati, O., has approved an estimate of $4,885 as the cost of constructing a culvert on the Delhi pike and ordered plans and specifications for the work.

The city officials of Conneaut, O., the commissioners of Ashtabula County and promoters of the Lake Erie & Youngstown R. R. have practically reached an agreement in regard to the construction of the proposed joint public and railroad bridge. The structure will be of steel with concrete abutments. The bridge proper will be about 110 ft. in length. The needed approaches will make the completed structure fully 900 ft. in length. T. F. Lininger is City Engineer, Conneaut, O. John Ruhlman, Youngstown, O., is President of the railroad company.

Oregon.

✣Bids will be received until noon, Feb. 25, by Helmus W. Thompson, Lane County Judge, Eugene, Ore., for the labor and material necessary for the removal of the old wooden bridge; for the building of new concrete piers and abutments, and the erection of a steel superstructure (steel furnished by Lane County) complete ready for travel, located at the foot of Ferry St. in Eugene, Ore. All material to be furnished and work done shall be in accordance with the plans and specifications on file at the office of the County Clerk or County Judge in the Court House at Eugene, Ore. Each bidder shall deposit with the County Clerk a cashier's check for 5 per cent of his proposal.

⊙The Board of Yamhill County Commissioners, McMinnville, Ore., has awarded the contract for the construction of repairs and improvements to the bridge over the Yamhill River at Dayton to C. T. Long, McMinnville, Ore.

A joint meeting was recently held at Portland, Ore., by the Vancouver Bridge Committees of Washington and Oregon Legislatures and plans for the proposed structure were gone over in detail. The site of the proposed structure was viewed.

Advices from Gold Beach, Ore., state that considerable agitation is going on in Curry County, especially in the southern end, for the construction of a bridge over the Chetco River at a cost of between $15,000 and $35,000.

Pennsylvania.

⊙M. & J. B. McHugh, 714 Arcade Bldg., Philadelphia, Pa., have been awarded the contract by M. L. Cooke, Director of Public Works, Philadelphia, for repairing the 40th St. bridge over the Pennsylvania Railroad, for $12,290. Bids were opened Jan. 31, and contract was let Feb. 4.

Viewers have approved the petition of the Supervisors and taxpayers of Londongrove Township, Chester County, Pa., for the erection of a new county bridge over White Clay Creek on the lands of Henry Palmer.

It has been announced by Commissioners of Luzerne County, Wilkes-Barre, Pa., that a new bridge will be constructed at Nanticoke, shortly.

The York Bridge Co., York, Pa., at $6,530 submitted the only bid received by C. V. Terwilliger, Director of Public Works, Scranton, Pa., for the lowering of the west span of the Spruce St. bridge over the Roaring Brook and the approach thereto. The estimate of the engineer was $3,200. New bids will be taken for the work.

Advices from Greensburg, Pa., state that local courts will shortly start condemnation proceedings to secure the necessary land for the proposed overhead bridge over the Hempfield branch on the West Newton road. Plans for the bridge call for a steel reinforced concrete structure 140 ft. long and 24 ft. wide. J. F. Beatty is City Clerk.

The following bids were received by the Department of Public Works, M. L. Cooke, Director, Philadelphia, Pa., for the repairing of the 40th St. bridge over the Pennsylvania R. R.: M. & J. B. McHugh, $12,290, to complete the work within 105 days; American Paving & Construction Co., $12,900, 130 days; William A. Mundy, $13,000, 180 days; Steyer-March & Co., $14,755, 150 days.

E. R. Troxell, Jr., Pittston, Pa., is preparing plans for the construction of the proposed new bridge at Water St. Bids for the work will be advertised for shortly.

The officials of the West Penn Ry. Co. have announced their intention to construct a 450-ft. bridge over the Pennsylvania R. R. branch at Whitney on the new trolley line from Hecla to Latrobe. J. L. Fritsch, Connellsville, Pa., is Chief Engineer of the company.

It is reported that the directors of the Lehigh Valley R. R. have decided upon the construction of a new bridge over the Lehigh River at Packerton, Pa. F. E. Schall, South Bethlehem, Pa., is Bridge Engineer of the railroad.

Rhode Island.

✣Bids will be received until noon, Feb. 24, by Commissioners, 213 State House, Providence, R. I., for rebuilding approaches of the Rhode Island Stone bridge. Plans and specifications may be seen at the office of the Secretary of the Commission, 434 Dexter Street, Central Falls, R. I., or at the office of J. R. Worcester & Co., civil engineers, 79 Milk St., Boston, Mass. A certified check for $1,000 must be filed with each bid.

The State Board of Public Roads of Rhode Island in its eleventh annual report submitted to the General Assembly, Providence, R. I., asked an appropriation of $100,000 for the construction, repair and reconstruction of bridges on State Highways.

South Dakota.

✣Bids will be received until 1 p. m., March 5, by R. A. Zangle, County Auditor, Mitchell, S. Dak., for the construction of bridges in Davidson County for the year beginning March 1, 1913. A certified check for $100 must be filed with each bid.

Texas.

⊙The Red River Bridge Co., of Denison, Tex., has awarded the contract for the construction of the proposed bridge over the Red River 4 miles north of Denison to the Midland Bridge Co., Kansas City, Mo., at $50,000. According to the terms of the contract the work must be completed before Oct. 1, 1913. The bridge is to be built on the site of the one washed away in the spring of 1908, during the flood. The approaches on both sides and one pier of the old bridge will be utilized.

It is rumored in Paris, Tex., that the Frisco Ry. is planning to replace the bridge over the Red River with a heavier structure. The Board of Trade of the city, in case the railroad's plans materialize, contemplate making an effort to secure the old structure and converting it into a road crossing.

The City Council of Corpus Christi, Tex., has retained Consulting Engineers Bartlett & Ranney, 807 Gibbs Bldg., San Antonio, Tex., to prepare plans and specifications for the causeway across Nueces Bay. Under the terms of the contract the engineers agree to have all plans prepared and a report submitted back to the committee within 30 working days. The committee will then determine the amount of money needed for building the big bridge and will petition the County Commissioners to call a special bond election to vote approximately $150,000 bonds. It is thought that the election can be held early in April and in that case actual construction work could begin by June 1. The causeway will link together Nueces and San Patrico Counties with a modern concrete bridge designed for the convenience of all vehicles and would be of special service to tourists driving to Corpus Christi in their automobiles from San Antonio and other southwest Texas points. H. A. Stevens is City Engineer.

Washington.

⊙The Commissioners of Thurston County, Olympia, Wash., have awarded the contract for the construction of the O'Connor bridge over the Skookumchuck River between Bucoda and Centralia, Wash., to the Post Bridge Co., Portland, Ore., at $5,000. It will be a 101 ft. steel span, with an 18 ft. roadway, and will be set on steel tubes filled with concrete. The approaches are to be made of piling to cost $5 per ft. The bridge is to be finished in 35 days.

West Virginia.

C. B. Kimberly Co., of Wheeling, W. Va., has been incorporated with a capital stock of $10,000 and proposes to engage in the construction of bridges, buildings and the manufacture of materials for the construction work. The incorporators are C. B. Kimberly Jr., E. D. Kimberly, A. A. Douglass, E. C. Bailey and J. E. Moss, Wheeling, W. Va.

Canada.

✣Bids will be received until noon, Feb. 26, by Department of Public Works, Fredericton, N. B., for the construction of the substructure and approaches of a new bridge on a new site at Newcastle, N. B., over the Miramichi River, between the Parishes of Newcastle and Glenelg, Northumberland County, N. B., according to plans and specifications to be seen at the Public Works Department, Fredericton, N. B., at the office of John Morrissy, Chief Commissioner of Public Works, Newcastle, Northumberland County, N. B., at the Provincial Government Rooms, St. John, N. B., and at the Chief Draughtsman's Office of the Public Works Department, City Hall, Montreal, P. Q.

✣Bids will be received until noon, Feb. 18, by H. C. Hocken, Chairman Board of Control, Toronto, Ont., for reinforced concrete retaining wall at Coxwell Ave. subway. Specification and tender form may be obtained upon application at the office of the Railways, Bridges & Docks Section, Department of Works, City Hall, Toronto.

✣Bids will be received until noon, Feb. 15, by George Kerr, Chairman Roads and Bridges Committee, Fallbrook, Ont., for the construction of five concrete piers and two abutments for the projected steel highway bridge over the River Mississippi, at Innisville, in the Township of Drummond, Lanark County, Ont. Drawings, general conditions and specifications may be seen at the office of the County Clerk, Perth, Ont., or at the office of the Engineer, Carleton Place, Ont. B. G. Michel, C. E., is Acting Engineer.

✣Bids will be received until noon, Feb. 15, by George Kerr, Chairman Roads and Bridges Committee, Fall Brook, Ont., for the construction and erection of a steel highway bridge over the River Mississippi, at Innisville, in the Township of Drummond, Lanark County, Ont. Drawings, etc., may be seen at the office of the County Clerk, Perth, or at the office of B. G. Michel, Engineer, Carleton Place, Ont.

⊙It is reported that the Hyland Navigation & Trading Co., Winnipeg, Man., has been awarded the contract by the Grand Trunk Pacific Ry. for the construction of two bridges on the line over the Assiniboine River and the Canadian Pacific between Harte and Brandon.

⊙The contract for the construction of the center pier in the Saugeen River for the Southampton bridge has been let to the Hunter Bridge & Boiler Co., Kincardine, Ont., at $10,000. Bids were opened by P. A. Malcolmson, County Clerk, Kincardine, Ont., Jan. 27.

Preliminary surveys and examinations have been made by the Minister of Public Works for the Government bridge across the Pitt River at Victoria, B. C. The city looks for early erection of a permanent structure that will provide not only for wagon traffic, but contain lines for tramways and steam trains. The matter has been the subject of conferences between the minister and officials of the proposed Mission City-to-Vancouver tram line. C. H. Rust is City Engineer.

According to an announcement by E. A. Lancaster, M. P., Chairman of the Dominion Ry. Committee at Ottawa, Ont., the Canadian Northern Ry. is willing to join hands with St. Catharines, Ont., and construct a bridge and build a road into the central part of the city, giving railway connection between the city and Hamilton.

DRAINAGE AND IRRIGATION

California.

✣Bids will be received until 2 p. m., Feb. 14, by U. S. Reclamation Service, Los Angeles, Calif., for furnishing 300 pin type porcelain insulators for use on a 10,000-volt, 25-cycle, steel pole transmission line on the Salt River project. O. H. Ensign is Consulting Engineer.

Bids as follows were received Jan. 22 by the U. S. Reclamation Service, Los Angeles, for electrical apparatus for St. Mary's Power Plant: Allis-Chalmers Co., Los Angeles, Cal.: Item 1, $5,800, West Allis, Wis., 90 days; Item 2, $3,180, Norwood O., 110 days; Item 3, $1,975, West Allis, Wis., 90 days; Item 4, $475, West Allis, Wis., 90 days. General electric Co., Schenectady, N. Y., Item 1, $5,819, Schenectady, 90 days; Item 2, $3,966, Pittsfield, Mass, 90 days; Item 3, $2,515, Schenectady, 50 days; Item 4, $440, Pittsfield, Mass., 50 days. Westinghouse Electric & Mfg. Co., Los Angeles, Cal., Item 1, $6,175, East Pittsburgh, 95 days; Item 2, $4,400, East Pittsburgh, 75 days; Item 3, $2,066, East Pittsburgh, 85 days; Item 4, East Pittsburgh, 70 days. Ridgway Dynamo & Engine Co., Ridgway, Pa., Item 1, $6,119, Ridgway, 75 days; Item 2, $4,840, East Pittsburgh, 80 days; Item 3, $2,272, East Pittsburgh, 90 days; Item 4, East Pittsburgh, 90 days. Pittsburgh Transformer Co., Pittsburgh, Pa., Item 2, $3,648, Pittsburgh, Pa., 90 days. Moloney Electric Co., St. Louis, Mo., Item 2, $3,660; St. Louis. Mo., 90 to 100 days. Wagner Electric Mfg. Co., St. Louis, Mo., Item 2, $5,202, St. Louis, Mo., 56 days.

Bids as follows were received Jan. 22 by the U. S. Reclamation Service for hydraulic apparatus, St. Mary Storage Unit, Milk River Project, Montana: C. C. Moore & Co., Los Angeles, Cal., Item 1, $6,016, Dayton, O.; Item 2, 60 days, $541, Indian Orchard, Mass., 60 days; Item 3, $1,710, Dayton, O., 60 days; Item 4, $12. S. Morgan Smith, York, Pa., Item 1, $7,800, York, Pa., 100 days; Item 2, $485, York, Pa., 100 days; Item 3, $2,050, York, Pa. (Lombard), $1,500, York Pa. (Woodward), 100 days; Item 4, $12. Joshua Hendy Iron Works, San Francisco, Cal., Item 1, $8,550, Sunnyvale, Cal., 90 days; Item 2, $800, Sunnyvale, Cal., 60 days; Item 3, $1,430, Sunnyvale, Cal., 90 days; Item 4, $12. Trump Mfg. Co., Springfield, O., Item 1, $10,715, Springfield, O., 150 days; Item 2, $525, Springfield, O., 60 days; Item 3, $1,710, Springfield, O., 75 days; Item 4, $13. Pelton Water Wheel Co., $8,010, f. o. b. Harrisburg, Pa., 75 days.

A measure has been introduced in the House of Representatives providing for a constitutional amendment in order that the state of California may bond itself in any sum not to exceed $50,000,000 to extend state aid in carrying out irrigation and reclamation projects. If adopted by the legislature the amendment will be submitted to the people at the November, 1914, election.

Colorado.

⊙A. H. Smith, Pueblo, Colo., has been awarded a $3,000 contract for constructing ditches and riprapping for the Butte Mesa Reservoir & Land Co., south of Pueblo on the Huerfano.

Idaho.

The Crane Creek Irrigation Co., E. D. Ford, General Manager, according to advices from Weiser, Idaho, has disposed of $500,000 of bonds in the east, and early in the spring will begin the construction of the main and lateral ditches for the 26,000 acres covered by the project.

Indiana.

✣Bids will be received until 1 p. m., Feb. 14, by Don Heaton, Drainage Commissioner of Benton County, at Fowler, Ind., for the construction of a tile drain in Richland and Union townships.

⊙Bids were opened Feb. 1 by Myrt B. Price, Superintendent of Construction, Rensselaer, Ind., for the construction of the J. A. Borntrager Ditch, the contract being let to C. H. Sternberg, Rensselaer, at 5.9 cts. per cu. yd. The main ditch is about 13 miles long, requiring an estimated excavation of 1,540,123 cu. yds. of earth, bottom width is 40 ft. to 60 ft. There are three laterals with total length of about 2½ miles, bottom width 15 to 30 ft. There are four wagon bridges over main ditch and one over one of the laterals, all to be removed and replaced by contractor as part of his contract; also two railroad bridges, both to be removed and replaced by the railroad companies. The improvement follows Iroquois River from point 1½ miles southwest of Rensselaer, Ind., and ends at point near Brook, Ind. About one-half of work will be new channel. The improvement is the deepening, widening and straightening of Iroquois River. Digging will be by floating dredge. Digging is through black dirt and clay. Contractor is to have 24 months to complete work and 120 days from date of contract to erect dredge and begin work. Payments are to be made as work progresses, not to exceed 80 per cent of estimate. The other bidders on the work included the following: Hummer Construction Co., Marion, O.; Clyde A. Walb, LaGrande, Ind.; Thomas & Sweet, Royal Seute, Ind.; Foohey Dredging Co., Ft. Wayne, Ind.; Wolcott Dredging Co., LaFayette, Ind.; Rensselaer Dredging Co., Rensselaer, Ind.; Dilley & Berdine, Hebron, Ind.; Will Brown, Hebron, Ind.; Sullivan Bros., Napinee, Ind.; D. H. Yeoman, Rensselaer, Ind.

The Drainage Commission for the proposed straightening of the Eel River from Neal's Mill, in Clay County, to Worthington, in Greene County, is completing its report. It is estimated that the work will cost about $10 per acre of benefited land. George Sheehan, Brazil, Ind., is County Surveyor.

Iowa.

✣Bids will be reserved until March 10 by Harry B. Frase, County Auditor, Des Moines. Ia., for constructing ditch in Franklin Drainage District No. 13 of Polk County. Ditch is to be 2¾ miles long, 4½ ft. average cut, with a maximum of 6 ft., and a minimum of 3½ ft. Slope 1 to 1 and 8 ft. beam. The total excavation is 36,240 cu. yds., and the width of bottom is to be 12 ft. for 6,420 ft., 9 ft. for 6,500 ft. and 6 ft. for 2,500 ft. The soil is a black sandy loam, and there is very little timber, and no railroad crossings or bridges. The average length of coal haul is four miles, and the nearest station 5 miles distant on the Chicago Great Western R. R. Plans and specifications are on file with the County Auditor. H. G. Curtis, 1330 W. 11th St., Des Moines, Ia., is the Engineer.

Minnesota.

✣Bids will be received until Feb. 25, it is reported, by County Auditor, Redwood Falls, Minn., for the construction of Judicial Ditch No. 12, in Westline Township. The ditch will be about 9 miles long, tiled with 5 to 26-in. cement drain tile, laid at an average depth of 6 ft. O. H. Sterk, Marshall, Minn., is Engineer.

✣Bids will be received until Feb. 20 by C. B. Howard, Freeborn, Minn., for the construction of Freeborn Township Ditch No. 1, requiring the following vitrified salt glazed or concrete drain tile: 717 ft. of 6-in., av. depth 6.4 ft.; 247 ft. of 7-in., av. depth 5.5 ft.; 2,869 ft. of 8-in., av. depth 5.5 ft.; 2,862 ft. of 10-in., av. depth 6.5 ft.; 1,800 ft. of 12-in., av. depth 5.5 ft.; 1,047 ft. of 15-in., av. depth 4.6 ft.; 2,900 ft. of 16-in., av. depth 6 ft.; 7,000 ft. of 22-in., av. depth 8 ft.; 2,070 ft. of 24-in., av. depth 7.1 ft.; 1,520 ft. of 26-in., av. depth 5.7 ft. Maximum depth, 9.3 ft. Estimated cost, $14,133. Work to be completed by June 1, 1913. E. V. H. Brown, Albert Lea, Minn., is the Engineer. Morgan & Meighen, Albert Lea, are the attorneys.

✣Bids will be received until 11 a. m., Feb. 26, by Jesse L. Herring, County Auditor, Blue Earth, Minn., for the construction of Judicial Ditch No. 6 of Faribault County. The approximate amount of work and material to be furnished in the construction of said ditch is as follows: 24,189 ft. of 6-in. tile, av. cut 4.58 ft., max. cut 8.54 ft.; 9,900 ft. of 7-in. tile, av. cut 5.33 ft., max. cut 8.25 ft.; 17,403 ft. of 8-in. tile, av. cut 5.04 ft., max. cut 9 ft.; 11,862 ft. of 10-in. tile, av. cut 5.76 ft., max. cut 9.44 ft.; 13,133 ft. of 12-in. tile, av. cut 6.08 ft., max. cut 9.01 ft.; 3,700 ft. of 14-in. tile, av. cut 6.23 ft., max. cut 8.38 ft.; 4,638 ft. of 16-in. tile, av. cut 7.48 ft., max. cut 10.82 ft.; 4,900 ft. of 18-in. tile, av. cut 6.40 ft., max. cut 7.74 ft.; 3,500 ft. of 20-in. tile, av. cut 7.16 ft., max. cut 9.91 ft.; 4,600 ft. of 22-in. tile, av. cut 6.50 ft., max. cut 10.42 ft.; 4,350 ft. of 24-in. tile, av. cut 7.53 ft., max. cut 9.39 ft. All tile or closed work requiring 31 open catch basins, each composed of 10-ft. 6-in. tile and one 18-in. vitrified sewer pipe 30 ins. long, and one bulkhead at outlet, as per engineer's specifications. The soil is black loam with clay subsoil; no timber. Average haul about 8 miles, either from Frost or Marna on the C. & N. W.; Easton, on the C., M. & St. P., or Blue Earth, on the C. & N. W. and Omaha R. R. No. 1 hard burned clay tile specified. All bids must be accompanied by a certified check for not less than 10 per cent of each bid, payable to the order of Jesse L. Herring, County Auditor. Robert B. Miller, Engineer, Blue Earth, Minn.

⊙D. C. Armstrong & Co., Sioux City, Ia., have been awarded the contract at $19,875 for constructing Judicial Ditch No. 4 of Faribault County, bids for which were opened Jan. 30 by J. L. Herring, County Auditor, Blue Earth, Minn. The work includes the following: 17,515 ft. of 6-in. tile, av. cut 5.15 ft., min. cut 3.45 ft., max. cut 9.10 ft.; 27,700 ft. of 8-in tile, av. cut 5.17 ft., min. cut 3.40 ft., max. cut 9.40 ft.; 7,200 ft. 10-in. tile, av. cut 5.25 ft., min. cut 4.10 ft., max. cut 7.30 ft; 7,700 ft. of 12-in. tile, av. cut 5.47 ft., min. cut 3.95 ft., max. cut 7.95 ft.; 1,800 ft. 14-in. tile, av. cut 4.90 ft., min. cut 4.10 ft., max. cut 7.35 ft.; 11,900 ft. of 15-in. tile, av. cut 6.79 ft., min. cut 3.85 ft., max. cut 9.50 ft.; 4,100 ft. of 16-in. tile, av. cut 7.35 ft., min. cut 4.65 ft., max. cut 10.20 ft.; 2,400 ft. of 20-in. tile, av. cut 7.37 ft., min. cut 5.35 ft., max. cut 9.39 ft.; 1,900 ft. of 22-in. tile, av. cut 6.16 ft., min. cut 4.93 ft., max. cut 7.85 ft. The soil is black loam with clay sub-soil; no timber. Nearest railroad station Guckeen, on the C. & N. W. Average haul about I mile. C. W. Gove, Windom, Minn., is the Engineer.

⊙Jensen & Juul, Hutchinson, Minn., have been awarded the contract at $5,612 for constructing county tile ditch No. 25 of McLeod county, bids for which were opened Feb. 7 by F. D. Stocking, county auditor, Glencoe. Minn. The work will include a main ditch and 3 laterals requiring the following hard-burned clay tile: 500 ft. of 5-in., av. depth 3.24 ft.; 4,658 ft. of 6-in., av. 4.1 ft.; 3,214 ft. of 8-in., av. 5.2 ft.; 2,400 ft. of 10-in., av. 5.6 ft.; 3,700 ft. of 12-in., av. 6.4 ft.; 941 ft. of 14-in., av. 6.6 ft.; 1,400 ft. of 18-in., av. 7.2 ft.; 3,000 ft. of 20-in., av. 7.2 ft., maximum depth 9.5 ft.

⊙Charles Chesnut, Delavan, Minn., has been awarded the contract for Judicial Ditch No. 5.

⊙Chas. G. Eklund Dredging Co., Grand Rapids, Wis., has been awarded the contract at $32,032 for constructing Judicial Ditch No. 15 of Beltrami County, bids for which were opened Feb. 1 by J. L. George, County Auditor, Bemidji, Minn.

Bids will be received until I p. m., Feb. 17, for digging Ditch No. 32, Martin county; cleaning out 400 ft. of ditch, 108 yds. of earth; 4,600 ft. 12-in. tile; 600 ft. 10-in. tile; 3,000 ft. 8-in. tile; 3,600 ft. 7-in. tile; 1,700 ft. 6-in.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

tile; one catch-basin, retaining wall. Check for ten per cent. H. C. Nolte, Fairmont, Minn., is county auditor.

Bids will be taken until 10 a. m., Feb. 21, for Ditch No. 8, Big Stone county; check for 10 per cent; A. V. Randall, Ortonville, Minn., county auditor. Estimated work, 49,048.48 cu. yds. of earth; length of ditch about 6 miles.

Hearing will be held Feb. 25 at Slayton, Minn., on petition for County Ditch No. 29 of Murray County.

Hearing will be held on March 17 on petition of Charles Nisnaber and others for a ditch in the town of Indian Lake, Nobles County. E. C. Pannell, Worthington, Minn., is County Auditor.

Hearing will be held Feb. 27 on petition of Val Imholte and others for a public ditch in Sherburne County. Charles E. Swanson, Elk River, Minn., is County Auditor.

A bill has been introduced in the State Legislature to authorize the State Drainage Commission, St. Paul, Minn., to straighten the Wing River and improve the Wing River State Ditch in Todd County.

Mississippi.

L. W. Washburn, C. E., Tunica, Miss., has about completed plans for the Sevier Lake drainage system in Coahoma County, Miss., and will be in the market to let about 600,000 cu. yds. of excavation in 45 or 60 days.

L. W. Washburn, C. E., Tunica, Miss., has been appointed engineer to make preliminary plans for a drainage district northwest and west of Tunica, Miss. The district will include about 60,000 acres of land.

Montana.

The bids received Jan. 10 by the U. S. Reclamation Service, Geo. O. Sanford, Project Engineer, Malta, Mont., on Schedule 2, Dodson North Canal, Milk River Project, have been rejected. This work called for about 255,000 cu. yds. of excavation. The unit bids were printed in our Jan. 22 issue.

New York.

⊙Contracts for the drainage of Tonawanda Swamp have been awarded as follows: Main drainage channel and four sub mains, R. H. & G. A. McWilliams, 28 E. Jackson Blvd., Chicago, Ill., at about $60,000; lateral ditches, Western New York Farms Co., New York City, at about $50,000.

Ohio.

Petition is to be presented to the Commissioners of Ashland and Richland Counties for the dredging of the Black Fork starting at a point in the vicinity of Olivesburg and extending down the creek 11 miles to a point near Mt. Zion church. A similar petition is now before the Ashland and Wayne county boards to have a steam dredge running in these two counties.

Tennessee.

✣Bids will be received until noon, Feb. 21, by Directors of the Obion River Drainage District No. 2, J. A. Coble, Secy., Union City, Tenn., for approximately 314,800 cu. yds of levee work and 178,000 cu. yds of ditch work, clearing and grubbing 6 miles of levee base, and constructing two concrete sluiceways with automatic back water gates.

Washington.

Farmers in Skagit County are considering a plan for the diking and drainage of the Skagit River. Mount Vernon is the County Seat.

Canada.

⊙L. M. Rice & Co., Coleman Bldg., Seattle, Wash., are reported to have been awarded the contract for the Sumas diking and reclamation project in British Columbia, which will reclaim about 40,000 acres of land.

WATER WORKS

Alabama.

✣Bids will be received until Feb. 18 by City of Tuscaloosa, Ala., for the extension of the water works system, including the laying of 1,000 ft. of 12-in., 500 ft. of 8-in., 14,125 ft. of 6-in., 3,475 ft. of 4-in. water pipe. The city will furnish the material. W. H. Nicol is City Engineer.

The J. B. McCrary Co., of Atlanta, Ga., has submitted a report to the City Council of Bessemer, Ala., relative to the building of a municipal water works system in that city.

Arkansas.

✣Bids will be received until 1:30 p. m., Feb. 24, by Board of Commissioners of Water and Light District No. 2 and Sanitary Sewer District No. 1, Wynne, Ark., for the construction of improvements consisting of the following work: One artesian well, electric motor and pump erected in pump pit, power-house extension, 12,000 ft. 8-in. C. I. W. P. line, 11,400 ft. 6-in. C. I. W. P. line, 8,930 ft. 4-in. C. I. W. P. line, 41 standard fire hydrants, 25 valves, 2 high-speed engines, 1 H. R. T. boiler, 2 generators, switchboards, street-lighting system, five miles pole-line construction, transformers and supplies, 5,620 ft. of 15-in. sewer pipe, 3,050 ft. of 12-in. sewer pipe, 2,650 ft. 10-in. sewer pipe, 16,000 ft. 8-in. sewer pipe, 13,200 ft. 6-in. sewer pipe, 73 manholes, 2 special manholes, 40 lamp holes, 24 flush tanks. Plans and specifications are on file at the office of the Secretary of the Board of Commissioners, Wynne, Arkansas, and at the office of R. C. Huston & Co., Consulting Engineers, 630-34 Exchange Bldg., Memphis, Tenn. Complete plans and specifications will be mailed on receipt of $5 to cover cost. C. B. Bailey is secretary.

Florida.

The city of Tallahassee, Fla., A. M. Lowry, Mayor, plans paving and water mains extensions to cost approximately $40,000. An election will be held in April. Contracts will not be let before May.

The finance committee of the City Council, Tampa, Fla., has authorized Mayor McKay to offer the Tampa Water Works Co. $500,000 for its plant. Stuart Wood, president of the water company, recently offered to sell the plant to the city for $1,000,000.

Georgia.

✣Bids will be received until 7:30 p. m., Feb. 18, by Board of Aldermen, Waycross, Ga., for one boiler of the horizontal return tubular type without dome. Specifications are on file with B. H. Klyce, City Engineer.

The business men and citizens of Rochelle, Ga., are contemplating establishing a combined electric light and water works plant for their town in the immediate future.

Illinois.

✣Bids will be received until 11 a. m., Feb. 18, by Board of Local Improvements, Lyle Payton, Secy., Moline, Ill., for the construction of water mains in the 25th St. Water Main District. The work will include the following approximate quantities: 6,850 ft. of 6-in. and 3,385 ft. of 8-in. cast iron water pipe; 18 6-in. Ts; 14 8-in. Ts; 3 8x6 crosses; 1 6x6 cross; 3 8x6 reducers; 3 6-in. 1/16 bends; 4 8-in. 1/16 bends; 2 8-in. Double Ys; 4 8-in. valves and brick boxes; 14 6-in. valves and brick boxes; 9 dead end plugs. The cost of the work is estimated at $11,585. Clark G. Anderson is a member of the board.

Fire Chief Harrison of Evanston, Ill., has asked the City Council for three chemical motorcycles, two automobile trucks and a pulmotor.

According to advices from Moline, Ill., the county court has confirmed the petition for a new sewer and water system in the Sugar Hollow district. The system will take in a section running south on 19th St., between 12th and 18th Aves., and also portions of 22d and 23d Sts. Bids for the construction work, amounting to about $20,000, will be received soon.

Engineer J. S. Fittsimmons of Chicago, Ill., has made a survey of the lands in and about the water works station in Logansport, Ind., preparatory to drafting plans for the proposed filtration plant.

The village of Riverside, Ill., has accepted the report of Dabney H. Maury, Consulting Engineer, 1137 Monadnock Bldg., Chicago, and have ordered that plans and specifications be prepared at once for the construction of a new water works plant. When completed the plant will consist of 2 electrical reciprocating deep well pumps, 2 centrifugal fire pumps, 2 centrifugal or triplex service pumps, 1 elevated steel tank, of 150,000 gallons capacity, and 1 pumping station building. All machinery to be automatically controlled. Estimated cost $42,000.

L. E. McGann, Commissioner of Public Works, Chicago, Ill., has awarded to the Kenwood Bridge Company, 38 S. Dearborn St., Chicago, Ill., the contract for constructing, delivering and erecting seven steel coal hoppers on the roof of the 68th St. pumping station, 68th St. and Oglesby Ave., total $1,687.

Following are the lowest bids received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., on Jan. 28 for furnishing and delivering reinforcing rods to the Lake View pumping station, Montrose Ave. and Clarendon Ave. as follows: 44,699 lbs. ¾-in. rods, $0.02075; 17,500 lbs. ⅝-in. rods, $0.022 per lb.; 9,800 ½-in. rod, $0.0223 per lb.; 3,000 lin. ft. No. 10 steel wire, $0.0198. Jos. T. Ryerson & Son, 16th & Rockwell Sts., Chicago, Ill. The contract has not been awarded.

Following are the lowest bids submitted to L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering to the water works shops, 2304 S. Ashland Ave., such red scrap brass as is required during 1913. Loewenthal Co., 947 W. 20th St., Chicago, Ill., 135—8 cts. per lb.

Following are the lowest bids submitted to L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering to the Bureau of Engineering at its water mechanical shops, 1330 Indiana Ave., disc water meters, as follows: 75-⅝-in., $5.95 each; 300-¾-in., $7.90 each; 200-1in., $10.50 each; 200-1½-in., $22.45 each; 200-2-in., $25 each; total, $14,406.75. Badger Meter Mfg. Co., Milwaukee, Wis. The contract has not been awarded.

Mr. Ray Palmer, City Electrician, Chicago, Ill., has awarded contracts for furnishing electrical supplies for use during 1913, as follows: 240,000 14x⅝-in. copper coated carbons, $13.75 per M; 50,000 12x½-in. copper coated carbons, $8.50 per M; 70,000 12x.510-in. to .520-in. solid, high-grade carbons, $18.25 per M; 70,000 12x.510-in. to .520-in. cored, high-grade carbons, $19.15 per M; 20,000 12x.510-in. solid, high-grade carbons, special gage, $18.25 per M, National Carbon Co., New York, N. Y. 3,000 pairs white flame carbons for Stave arc lamps, dimensions for upper carbons, 10¼-in. x 20 m.m., lower carbons, 8¾-in. x 18 m.m., Stave Electric Co., 131 Hudson St., New York. 93,759 white flame carbons for G. E. Lynn lamps, $148 per M. Proposals submitted Dec. 27, 1912. General Electric Co., Monadnock Bldg., Chicago. 1,800 50-watt, 115-volt, metallized carbon, filament lamps, $0.1405; 150 40-watt, 115-volt, drawn wire, tungsten filament lamps, $0.3155; 4,000 100 watt, 4.2 amperes, drawn wire filament, series tungsten lamps, .838; Western Elec-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

tric Co., 500 S. Clinton St., Chicago, Ill. 50 dozen, plain globes, for open arc lamps, dimensions 8x12x4¾-in., bottom to be flanged, $4.55; 37.5 dozen, plain outer globes, for Fort Wayne A. C. and D. C. enclosed arc lamps, $5.75; 100 dozen plain outer globes, for Western Electric, A. C. enclosed arc lamps, $5.16; 50 dozen plain outer globes, for General Electric, A. C. enclosed arc lamps, $5.44; 100 dozen Alba outer globes, for G. E. Lynn flame lamps, $8.60; 100 dozen Alba outer globes, for 100-watt tungsten lamps, $11.75; 50 dozen clear inner globes, Thermo heat resisting, for Fort Wayne D. C. enclosed arc lamps, $1.97; 175 dozen clear inner globes, Thermo heat resisting for Western Electric A. C. enclosed arc lamps, $2.27; 25 dozen clear inner globes, Thermo resisting for Fort Wayne A. C. enclosed arc lamps, $1.96; 75 dozen clear inner globes, Thermo heat resisting for Central Incandescent A. C. enclosed arc lamps, $1.90; 75 dozen clear inner globes, Thermo heat resisting, for General A. C. enclosed arm lamps, $1.99; 225 dozen clear inner globes, for G. E. Lynn flame lamps, $3.75; 20 dozen clear inner globes, for Stave flame lamps, $8.20. Western Electric Co., 500 S. Clinton St., Chicago, Ill.

Following are the lowest bids submitted to L. E. McGann, Commissioner of Public Works, Chicago, Ill., on Feb. 1, for furnishing and delivering F. O. B. cars at pipe yard "B," 2352 S. Ashland Ave., 1 Diamond drilling machine, exclusive of carbons, having a capacity of 350 ft. of 1⅛-in. core; equipped with a gasoline engine of 2 cylinder opposite type; rated at 15-horse power; E. J. Longyear Co., Minneapolis, Minn.; Sullivan Mch. Co., 122 S. Michigan Ave., $2,675; diamonds per carat, $70. The contract has not been awarded.

Following is the lowest bid submitted to L. E. McGann, Commissioner of Public Works, Chicago, Ill., on Feb. 5, for furnishing and delivering to the Lake View Pumping Station, Montrose Ave. and Clarendon Ave., 1 steel shell for shaft excavation; estimated weight 19,000 lbs.; internal diameter, 11 ft. 6 in., composed of 5 circular sections 72 inches in length. John Mohr & Sons, 349 W. Illinois St., Chicago, Ill., $1,289. Contract has not been awarded.

Indiana.

The water works system of Hobart, Ind., is to be thoroughly overhauled. New mains and a filter plant are to be constructed. The City Council has authorized City Engineer Walter G. Black to retain Ernest McCullough, Consulting Engineer, Monadnock Blk., Chicago, Ill., to act as consulting engineer. It is expected that plans will be ready in March.

Iowa.

⊙The Murray Iron Works, Burlington, Ia., has been awarded the contract by the city of Sioux City, Ia., for furnishing and installing one 500 H.P. water tube boiler for the water and light plant, at $4,935. Bids were opened Jan. 23. Contract awarded Feb. 3.

⊙The Allis-Chalmers Co., Milwaukee, Wis., has been awarded the contract by the city of Sioux City, Ia., for one 3-wire 115 to 230-volt engine, type D.C., generator 62½-kw., arranged for 25 per cent on balanced load, 275 rpm., at $1,080. Bids were opened Jan. 18.

The Town Council of South Sioux City (P. O. Sioux City), Ia., has sold bonds to the amount of $25,000 for the installation of a water works system.

The City Council of Davenport, Ia., has decided to hold an election March 10 to decide whether or not the city is to own its own water works system.

Kansas.

⊙The city of Burlingame, Kans., has awarded the following contracts for the installation of a water works system: Bash & Gray, Joplin, Mo., furnishing cast iron pipe and special castings, $21,482; E. J. Merkle & Co., Kansas City, Mo., furnishing valves, hydrants, pumping machinery, etc., $3,344; Tonkawa Construction Co., Tonkawa, Okla., furnishing filter house, pump house, settling basin, pole line, clear water well, dam and machinery, foundations, and all material and labor except cast iron pipe, valves and hydrants, $18,149; New York Continental Jewell Filtration Co., Kansas City, furnishing and installing filtering equipment, etc., $3,250; Des Moines Bridge & Iron Co., Des Moines, Ia., constructing tank and tower, $3,200.

⊙The city of Kingman, Kans., G. A. Howe, Clerk, has awarded the following contracts for constructing and equipping an electric light plant, for which bids were opened on Feb. 3: Chas. Rayl, Kingman, Section No. 1—building and foundation, $5,524; E. J. Merkle & Co., Kansas City, Mo., Section No. 2—boilers and stokers, $5,800; S. A. Hadley, 206 Reliance Bldg., Kansas City, Mo., Section No. 3—engines; Staley & Fees, Wichita, Kans., Sections Nos. 4 and 6—electrical work; B. R. Electric & Telephone Co., Kansas City, Mo., Section No. 5—31 posts for white way. Worley & Black, Kansas City, Mo., are engineers.

⊙E. E. Scanezzi has been awarded the contract by the City Council of Frontenac, Kans., for the construction of a water main on West McKay St., from the present terminus of the main to the city limits, at $0.08. The work includes 300 ft. of 2-in. wrought iron pipe. Bids were opened Jan. 2.

Kentucky.

The Louisville Water Co., Louisville, Ky., is considering the question of placing additional filter beds in the water works station in Crescent Hill. Plans have been prepared.

Louisiana.

⊙Lyman H. Alpha, of Franklin, La., has been awarded the contract to lay water mains throughout the section lately included in the corporation of Franklin. The work covers approximately 2,000 ft.

Maryland.

✣Bids will be received until 11 a. m., Feb 12, by Board of Awards, at the office of the City Register, Baltimore, Md., for the improvement of the Gunpowder Supply Contract No. 8, for sluice gates in accordance with plans and specifications on file with E. B. Whitman, Water Engineer, City Hall, Baltimore, Md. The work will include the following approximate quantities: Four 42-in. x 72-in. sluice gates with appurtenances; two 48-in. dia. sluice gates with appurtenances; four 24-in. dia. sluice gates with appurtenances. Additional items that may be required: 260 lin. ft. additional 3½-in. gate stems with couplings; 172 lin. ft. additional 2¼-in. gate stems; 24 additional guides for 3½-in. stems; 8 additional guides for 2¼-in. stems.

Massachusetts.

✣Bids will be received until 5 p. m., Feb. 18, by J. D. Coughlan, Chairman Committee of Fire Alarm Telegraph System, High School Building, Revere, Mass., for the furnishing and installation of the following apparatus for a fire alarm and telegraph system, the design to be selected by the committee from the different specifications submitted to the committee by the different bidders and approved by competent judges: Fire alarm equipment for New Central Fire Station, Fire Alarm Central Office. 1 16-circuit protector board, 1 12-circuit combination storage battery and repeater controlling switchboard, 1 10-circuit automatic positive noninterfering repeater, 1 punching register, time stamp and take-up reel, 1 metallic battery rack of sufficient size to hold 800 cells of B. T. storage batteries, 250 cells of B. T. batteries, steel cabinets for all above apparatus and 1 4x4 ft. slate police board. Apparatus Floor—1 6x5 ft. slate board set in iron frame and wood finish, 1 punching register and take-up reel, 1 12-ft. electro mechanical gong, 1 8-ft. electro mechanical gong, 1 automatic electric light time switch, 1 combined electro time and stop clock, 1 P. N. I. successive auxiliarized fire alarm box and keyless door. Tower—1 Diaphone compressed air plant with Diaphone horn and automatic whistle blowing machine, guaranteed to be heard at a distance of two miles from its location in any direction. Each bidder must accompany his bid with certified checks in the amount of $1,000 on some National bank or solvent trust company located in Boston, Mass.

The officials of Blandford, Mass., propose to ask the legislature for permission to increase the bonded indebtedness of the district $15,000, to extend the bound of the fire district about a mile beyond Prospect Hill, the northern boundary of the new extension to be a mile wide, extending half a mile east and an equal distance west from North St.

A bill has been introduced in the legislature of Massachusetts by the city of Monterey, Mass., asking for authority to take Lake Garfield for a water supply. It is proposed to expend about $500 in raising the dam.

Michigan.

✣Bids will be received until 8:30 a. m., Feb. 21, by A. J. Warren, Village Clerk, Saline, Mich., for the construction of a system of water works for the village.

The ways and means committee of the City Council, Grand Rapids, Mich., has made a favorable report upon the immediate additions to the fire department and the water service department. The equipment is to consist of two ladder trucks, one of the aerial type, an automobile for the assistant fire marshal, time stamp equipment in all the station alarms, to cost approximately $43,525. For the water department it is proposed to install a 12,000,000-gal. high pressure low duty pump for emergency purposes and $50,000 into water main construction. The pump will cost $24,000.

Minnesota.

✣Bids will be received until 8 p. m., Feb. 25, by City Council, Hutchinson, Minn., for the construction of water mains and appurtenances as mentioned under "Sewerage and Sanitation" in this issue.

Nebraska.

⊙The City Council of Lincoln, Nebr., Roscoe C. Ozman, City Clerk, has awarded the contract for furnishing and installing one chain grate stoker for 500 H.P. boiler for the water and light plant, to LaClede-Christy Clay Products Co., of St. Louis, Mo., at $1,594. Bids were opened Jan. 23. Contract awarded Feb. 3.

New Jersey.

✣Bids will be received until 8 p. m., Feb. 15, by Borough Council, Belmar, N. J., for the necessary labor and material for the construction of about 4½ miles of 4 to 10-in. water pipe, including hydrants, valves, etc. Clyde Potts, 30 Church St., New York City, is engineer. C. O. Hudnut is borough clerk.

✣Bids will be received until Feb. 20 by Board of City Commissioners, Atlantic City, N. J., for the construction of a mile of water main on the meadows. Harry Bacharach is Commissioner.

Following bids were received by the Water Board of New Brunswick, N. J., for the furnishing of water pipe and 10 tons of lead: Pipe—James F. Fox & Co., New York, for 12 and 10-in. pipe, $25 ton; 6-in., $27 ton; 8-in., $26; for specials, 2½ cts. lb. Warren Foundry & Machine Co., New York, for the four sizes, $24.50 per ton; specials, $50 per ton. Standard Cast Iron Foundry Co., Bristol, Pa., for all sizes, $23.55 per ton; specials, $50 per ton. Behre Co., New York, for 10 and 12-in. pipe, $25.10; 6-in., $28.33; 8-in., $26.29; specials, 2½ cts. lb. R. Drummond & Co., Philadelphia, 12-in., $23.50 ton; for the other three sizes, $24 ton; specials, 2¾ cts. lb. Lynchburg Foundry Co., New York, 10 and 12-in., $24.50; 6 and 8-in., $24.75; specials, $50 per ton. Donaldson Iron Co., Enaus, Pa., 6-in., $25; 8-in., $25; 10 and 12-in., $24.13; specials, 2½ cts. lb. United States Cast Iron Pipe & Foundry Co., Philadelphia, all sizes, $24.20; specials, 2½ cts. lb. Lead—No contract was awarded for the 10 tons of lead because the advertisement did not specify the kind of lead. The bids were rejected and the committee is to readvertise. The bids received were as follows: Philip Weigel Jr., this city, for 100 lbs., $4.65; Kahn Bros., Brooklyn, for 100 lbs., $4.85; Bruce & Cooke, New York, for 100 lbs., $4.64; Nathan Trotter, Philadelphia, for 100 lbs., $4.57½; United Lead Co., New York, for 100 lbs., $4.63; Behrer & Co., New York, for 100 lbs., $4.62½. The bids on the pipe were for 100 lengths of 12, 171 of 10, 227 of 8 and 827 of 6-in. pipe.

The taxpayers of Clarksboro, Mickleton and Mount Royal, N. J., have objected to the granting of a franchise to furnish a water supply for those towns.

New York.

⊙The Village Board of Brockport, N. Y., has awarded the contract for furnishing hydrants and valves, laying pipe, setting pump machinery, constructing concrete reservoir and furnishing and erecting steel pressure filters as per specifications for the new water system, to Frank George of Batavia, N. Y., for $94,693. The contract for pipe and special castings was let to R. D. Wood & Co., of Philadelphia, Pa., at $24.38 per ton for the pipe and $0.02½ per lb. for special castings. The J. Victor Johnson Co., of Jamestown, N. Y., secured the contract to construct the brick pumping station chimney, pump, well and intake, at $25,400. The entire cost will be $248,093.

The Board of Aldermen of Schenectady, N. Y., has been asked to authorize to provide funds for the betterment of the water works system, including the construction of the new main from the wells to the city, the establishing of the two-levels and the construction of the Bevis Hill reservoir, having a capacity of 15,000,000 gals.

A bill has been introduced in the Assembly at Albany, N. Y., authorizing the city of Troy, N. Y., to borrow money on bonds for the water works department in an amount not to exceed $205,000, or as much thereof as may be necessary, for the purpose of supplying the differences and deficiencies and for improvement and extension work.

The Trustees of the Chamber of Commerce, Oneida, N. Y., contemplate looking into the matter of getting city water from Florence Creek, about 20 miles distant. It is thought this would entail an expenditure of $150,000.

Ohio.

⊙Safety Director Bargar of Columbus, O., has let the contract for motor fire apparatus for the new Hilltop engine house, No. 17, to the Seagrave Co. The equipment consists of a fire engine, with a turbine pump which will throw 1,000 gals. of water a minute, to cost $11,500; a chemical and hose wagon, to cost $6,260.

⊙Phillips & Bixel of Cleveland, O., have been awarded the contract by the Board of Trustees of Public Affairs, Rockport Village, O., for constructing water mains in Harrington Road, at $8,800. Bids were opened Feb. 3. William H. Evers Engineering Co., Arcade Bldg., Cleveland, O., are engineers.

⊙National Carbon Co. has been awarded the contract by the Department of Public Service, Columbus, O., for furnishing approximately 50,000 ½x12 cored carbons and approximately 50,000 ½x12 solid carbons for the municipal light plant. Bids were opened Feb. 4.

Oklahoma.

Engineers Hunter & Hunter of Oklahoma City, Okla., have prepared plans for water works improvements at Cushing, Okla., at an estimated cost of $2,000. Contract will be let after Feb. 17.

Pennsylvania.

The Borough Council of Lewistown, Pa., has passed an ordinance to submit the question of ownership of the municipal water plant to the vote of the people. J. Harry Saxton is Borough Clerk.

Legislation was introduced in the Common Council of Altoona, Pa., looking toward the construction of a second reservoir at the Prospect Hill plot at Second Ave., between 12th and 13th Sts. The estimated cost is $100,000. S. F. Crilly is chairman of the Water Commissioners.

The Borough Council of Hamburg, Pa., has decided to vote whether to hold a public election and allow a vote on the proposition of acquiring the plant of the Windsor Water Co. for a municipal water works.

Rhode Island.

✣Bids will be received until 11 a. m., Feb. 15, by H. R. Stanford, Chief of Bureau of Yards & Docks, Navy Department, Washington, D. C., for furnishing and installing two 450 cu. ft. free air per minute air compressors, steam driven, supplied complete with accessories including two intercoolers, one aftercooler, an air receiver and the air piping in the central power plant, United States Naval Torpedo Station, Newport, R. I. The cost is estimated at $6,000.

South Dakota.

The Commercial Club of Newell, S. Dak., has started a movement to provide the town with a city water works system.

A number of residents of Kidder, S. Dak., have raised a fund and will have an artesian well drilled to furnish water for domestic and other purposes.

Texas.

✣Bids will be received until Feb. 20 by City of Madisonville, Tex., for the construction of a new $16,000 water works system. Oneil Engineering Co., Dallas, Tex., are Engineers.

The citizens of the town of Spur, Tex., will vote Feb. 17 on the issuance of bonds to the amount of $25,000 for a water works system.

The Water Commissioners of Waco, Tex., recently placed orders for pipe and standpipe material, totaling more than $35,000. It will be used in making extensions and improvements to the plant now in operation. W. M. Sleeper is a member of the commission.

Utah.

The City Commission of Salt Lake City, Utah, has instructed City Engineer D. H. Blossom to prepare plans and specifications for the first unit of the proposed pumping plant for the utilization of the old flowing wells near Liberty Park. The Commission will probably order the enlargement of the flowing wells and new ones driven in the same vicinity. Supt. C. F. Barrett has estimated the cost at $40,000.

Virginia.

The Portsmouth Suburban Water Co., Portsmouth, Va., proposes to issue bonds to the amount of $2,000,000 for the purpose of refunding previous bond issues and making extensions and improvements to the plant and equipment of the company.

The stockholders of the Vinton-Roanoke Water Co., C. Markley, National Exchange Bldg., Roanoke, Va., President, have authorized an expenditure of $15,000 for the purpose of building a dam across Beaver Dam Creek to create a storage reservoir. W. L. Andrews is Secretary-Treasurer.

Engineer J. L. Ludlow of Winston-Salem, N. C., has prepared plans for the installation of a water works, electric light plant and sewerage in Rocky Mount, Va., at an estimated cost of $50,000. Water will be secured from deep wells. Contracts will probably be let early in the spring. C. S. Greer is Mayor.

Washington.

✣Bids will be received until 11 a. m., Feb. 24, by Constructing Quartermaster, Vancouver Barracks, Wash., for the extension of the storm water system at that place.

✣Bids will be received until 11 a. m., Feb. 25, by Constructing Quartermaster, Vancouver Barracks, Wash., for removing center boiler of battery of 3, furnishing and installing boiler at pumping plant at that post.

Wisconsin.

✣Bids will be received until 1 p. m., Feb. 24, by Board of Trustees, Mukwonago, Wis., for furnishing, f. o. b. cars at Mukwonago, Wis., about 130 tons of cast iron water pipe, in 4, 6 and 8-in. sizes, and about 2½ tons of special castings, together with 22 fire hydrants and 10 gate valves with extension boxes. Specifications covering the above can be seen at the office of the Village Clerk, E. Wanner, Mukwonago, or at office of the Engineer, J. Rollins Gray, 803 Great Northern Bldg., Chicago. Emil Wanner, Village Clerk. Official advertisement will be found elsewhere in this issue.

⊙E. F. Drought of Waterford, Wis., has been awarded the contract by that city for drilling an 8-in. well to a depth of 600 ft. if necessary, and for furnishing wrought iron pipe weighing 28 lbs. per ft. The well will cost $2.25 per ft., $10 per day being allowed for testing. Bids were opened Feb. 1.

The Wisconsin State Railway Commission has decided that the city of Manitowoc, Wis., must furnish free meters to patrons of the municipal water works.

Canada.

✣Bids will be received until 8 p. m., March 15, by Town Clerk, Sarnia, Ont., for the supply of material and construction of water works. The work will include: Contract A—All labor necessary for laying the force main, and furnishing certain materials therefor. Contract B—Furnishing all materials for and constructing pumping station. Contract C—Furnishing all materials for and constructing infiltration basins sluiceway. Contract D—Furnishing cast iron or steel water pipes and special castings. Contract E—Furnishing gate valves, flexible joints, expansion joints, etc. Contract F—Furnishing material for and constructing timber wharf or dock. Contract G—Furnishing and erecting pumping machinery and accessories. Contract H—Furnishing and erecting boilers and accessories. Copies of plans, profiles, specifications, instructions to bidders, etc., may be seen at the office of H. A. McLean, Town Engineer, Sarnia, or at the office of Chipman & Power, Toronto.

✣Bids will be received until 8 p. m., March 5, by Alex. J. Le Blanc, Town Clerk, Dalhousie, N. B., for electric lighting system including the following works: Contract B—Power House. Contract G—Booster pump; (1) steam pump; (2) turbine pump. Contract H—Two boilers. Contract J—Electric light engine; (1) high speed steam engine; (2) gas engine and gas producers; (3) Diesel oil engine; (4) crude oil engine. Contract K—Electrical equipment and distribution system. Plans and specifications may be seen at the office of Chipman & Power, the Chief Engineers, Mail Building, Toronto, or at Dalhousie, N. B.

✣Bids will be received until 4 p. m., Feb. 13, by Chairman of Water Works Committee, City Hall, Ottawa, Ont., for the supply and delivery of brasswork, special pipe castings, hydrants, cast iron pipe, lead pipe, and pig lead, valves or oils and grease, as the case may be. Specifications, form of tender and full particulars may be obtained on application at the City Engineer's Office, City Hall, Ottawa. W. H. Storrie is Acting Water Works Engineer.

✣Bids will be received until 5 p. m., Feb. 17, by J. B. Cote, City Clerk, St. Boniface, Man., for the delivery of one fire engine.

✣Bids will be received until 6 p. m., Feb. 24, by Sidney Appleby, Secretary-Treasurer, Sutherland, Sask., for the supply and delivery of the following materials, and the performance of certain works: Tender A—For the supply and delivery of approximately 8,650 ft. of 12-in. steel pipe and specials. Tender B—For the supply and delivery of approximately 9,775 ft. of 10-in. steel pipe or cast iron pipe; approximately 4,000 ft. of 8-in. steel pipe or cast iron pipe; approximately 18,800 ft. of 6-in. steel pipe or cast iron pipe and specials. Tender C—For the supply, de-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

livery and erection of stand pipe. Tender D—For the erection of sewage disposal works. Tender E—Trenching and laying 8,650 ft. of steel water pipe for supply main, setting valves, etc., and back filling. Tender F—Trenching and laying of approximately 9,775 ft. of 10-in. steel pipe or cast iron pipe; 4,000 ft. of 8-in. steel pipe or cast iron pipe; 18,800 ft. of 6-in. steel pipe or cast iron pipe; setting valves, hydrants, etc., and back filling. Tender G—Supply and delivery of 3,420 ft. of 20-in. vitrified sewer pipe; 8,030 ft. of 18-in. vitrified sewer pipe; 2,200 ft. of 15-in. vitrified sewer pipe; excavating and laying and construction of manholes, etc. Tender H—The supply and delivery of 3,766 ft. of 12-in. vitrified sewer pipe; 5,650 ft. of 10-in. vitrified sewer pipe; 5,080 ft. of 8-in. vitrified sewer pipe; excavating and laying and construction of manholes, etc. Tender I—For the construction of approximately 62,000 sq. ft. of concrete sidewalks; 1,670 lin. ft. of curb. Tender J—Approximately 2½ miles of street grading. Tender K—For the supply and delivery of 30 fire hydrants, 52 gate valves, 1 automatic air relief valve. A marked cheque for 5 per cent of the amount of the tender must accompany each bid. The lowest or any tender not necessarily accepted. For the supplying of materials and all trenching the tender forms must be filled in; these are obtainable at the consulting engineers' office. Plans and specifications may be seen at the offices of Murphy & Underwood, Consulting Engineers, Saskatoon, Sask., or a complete set of plans and specifications for any contract will be sent on a deposit of $25 and a set covering all the contracts on a deposit of $100. This deposit will be returned if plans and specifications are returned within 5 days of closing of tenders.

✣Bids will be received until March 1 by J. W. Walker, Clerk of the town of Fort Frances, Ont. (readvertisement), for the installation, construction and complete equipment for the town of Fort Frances. Tenderers may tender on: (1) The equipment in whole or in part; (2) on the construction and installation; (3) on the complete construction and installation, including all material. Plans and specifications may be seen at the office of the Town Clerk. A marked check equal to 5 per cent of the amount of the tender must accompany each tender, payable to the order of the Town Treasurer.

The Board of Water Commissioners, St. Thomas, Ont., is planning the construction of a second main through the city, and a standpipe to increase the pressure, at an outlay of from $65,000 to $77,000. George K. Crocker is chairman.

The Board of Water Commissioners of London, Ont., propose to ask for $70,000 debentures for the extension of the water services to the newly-annexed district in the east end.

The City Council of Wallaceburg, Ont., is considering the matter of installing a water works plant, water to be pumped from the Snye River. The matter will be submitted to a vote of the people. T. B. Dundas is Mayor.

SEWERAGE AND SANITATION

Arizona.

The Citizens' Sewer Committee of the town of Tempe, Ariz. (population 1,473), has retained Engineer P. E. Fuller of Mesa. Ariz., to prepare plans and specifications for the installation of a sewerage system.

Arkansas.

Engineer Sledge Tatum, in his final report to the Interior Department at Washington, D. C., favored a sewer drainage system for Hot Springs, Ark., reservation that will cost $324,435. Of this sum $26,000 is for the construction of a sanitary sewer and $90,000 for two purification plants.

California.

✣Bids will be received until 11 a. m., March 5, by Maj. F. A. Grant, Quartermaster, Presidio of Monterey, Calif., for construction of garbage crematory complete at this post.

⊙The City Council of Oakland, Calit., has awarded the contract for the construction of an 8-in. sewer in portions of 90th Ave. to Philip Schuyler.

⊙Chambers & Heafey of Oakland, Calif., have been awarded the contract for the construction of a sewerage system and a disposal plant in Hanford, Calif., at $75,000. Monolithic pipe will be used. S. M. Kerns bid $77,000 on the work. Sloan & Robson, Nevada Bank Bldg., San Francisco, Calif., are Engineers.

⊙The J. D. Kneen Contracting Co., Santa Monica, Calif., has been awarded the contract for the construction of a sewage disposal plant at the Pacific Branch, N. H. D. V. S. Soldiers' Home, Los Angeles County, Calif., for $19,-800. Bids were opened Feb. 4 by E. W. Moore, Treasurer.

Civil Engineer Jack Shelton, 326 Union Bldg., San Diego, Calif., has completed surveys for a system of sanitary sewers for Point Loma, Calif. Plans, profiles and specifications are now being prepared.

The City Council of Oakland, Calif., has instructed City Engineer Perry F. Brown to prepare proceedings for the construction of a sewer in Linden St., from Eighth to Tenth Sts.

The City Commissioners of Stockton, Calif., have retained Consulting Engineer Carl E Grunsky, Mechanics' Inst. Bldg., San Francisco, Calif., in connection with the proposed new sewerage system for Stockton.

Delaware.

A committee of the Town Council, Newark, Del., has prepared a bill authorizing the town to issue bonds to the amount of $60,000 for the installation of a system of sewerage. T. Chalkley Hatton, Wilmington, Del., is Consulting Engineer.

Florida.

✣Bids will be received until 2 p. m., Feb. 18, by Board of Public Works, Tampa, Fla., for the construction of a system of reinforced concrete storm drains in Hyde Park. Allen Thomas is Clerk of the Board.

The City Council of Plant City, Fla. (population 2,481), has passed an ordinance providing for an election on bonding the city for sewerage, drainage and paving. The election will be held March 18.

Idaho.

The Trustees of Kellogg, Ida., have asked the citizens to vote on April 8 on the question of issuing bonds for the installation of a sewerage system.

Illinois.

✣Bids will be received until 11 a. m., Feb. 18, by Board of Local Improvements, Moline, Ill., for the construction of sewers in the 25th St. Sewer District. The following approximate quantities are included: 825 ft. 12-in. vit. pipe sewer; 1,890 ft. 10-in.; 5,740 ft. of 8-in.; 33 12x6 Ys; 60 10x6 Ys; 230 8x6 Ys; 15 vents; 10 manholes. The cost is estimated at $6,735. Lyle Payton is Secretary of the Board.

✣Two bids of $75,000 each were recently received by the Village Board of Bradley, Ill., for the installation of a new sewer system. These bids were rejected because they were above the estimate, $45,000. The Village Clerk is re-advertising the work, bids to be opened Feb. 25. All trenches will be in solid rock. Ernest McCullough, Monadnock Blk., Chicago, Ill., is Engineer.

The Board of Local Improvements, Chicago, Ill., Edw. J. Glackin, Secretary, announces that during the first week in March they will receive bids for the Albany Ave. system of sewers, the largest sewer contract to be let in years. Details of which are as follows: S. Albany Ave., Chicago River to W. 30th St., 610 lin. ft., 3 ring brick 9 ft. internal diameter; 18 ft. cut; W. 30th St., S. Albany Ave. to S. Troy St., 310 lin. ft., 3 ring brick, 9 ft. in diameter, 17 ft. cut; S. Troy St., W. 30th St. to W. 26th St., 1,990 lin. ft., 3 ring brick, 9 ft. in. diameter, 18 ft. cut; W. 26th St., S. Troy St. to S. Turner Ave., 1,360 lin. ft., 3 ring brick, 9 ft. in. diameter, 16 ft. cut; S. Turner Ave., W. 26th St. to W. 22nd St., 2,600 lin. ft. 3 ring brick, 9 ft. in. diameter, 16 ft. cut; S. Turner Ave., W. 22nd St. to W. 16th St., 2,710 lin. ft., 3 ring brick, 8 ft. in. diameter, 16 ft. cut; W. 16th st., S. Turner Ave. to S. Spaulding Ave., 310 lin. ft., 3 ring brick, 8 ft. in. diameter, 16 ft. cut; S. Spalding Ave., W. 16th St. to W. 13th St., 1,960 lin. ft., 3 ring brick, 7½ ft. in. diameter, 16 ft. cut: S. Spalding Ave., W. 13th St. to W. Polk St., 2,330 lin. ft. 3 ring brick, 7 ft. in. diameter, 15 ft. cut; W. Polk St., S. Spalding Ave. to S. Homan Ave., 670 lin. ft. 3 ring brick, 7 ft. in. diameter, 15 ft. cut; S. Homan Ave., W. Polk St. to first alley North, 160 lin. ft. 3 ring brick, 7 ft. in diameter, 15 ft. cut; S. Homan Ave., first alley north of Polk St. to W. Van Buren St., 1490 lin. ft. 3 ring brick, 6½ ft. in. diameter, 16½ ft. cut; S. Homan Ave., W. Van Buren St. to Colorado Ave., 580 lin. ft. 2 ring brick, 6 ft. in diameter, 16 ft. cut; S. Homan Ave., Colorado Ave. to W. Monroe St., 950 lin. ft. 2 ring brick, 4 ft. in. diameter, 15½ ft. cut; W. Monroe St., S. Homan Ave. to S. Central Park Ave,, 1,320 lin. ft. 2 ring brick, 4 ft. in. diameter, 15 ft. cut; first alley north of W. Polk St., S. Homan Ave. to S. Central Park Ave., 1,360 lin. ft. 2 ring brick, 4 ft. in. diameter, 15 ft. cut; W. Van Buren St., S. Homan Ave. to S. Central Park Ave., 1,370 lin. ft. 2 ring brick, 4 ft. in. diameter, 15 ft. cut; W. 16th St., S. Turner Ave. to S. Central Park Ave., 1,710 lin. ft. 2 ring brick, 4½ ft. in. diameter, 15 ft. cut; W. 16th St., S. Spalding Ave. to S. Kedzie Ave., 710 lin. ft. 2 ring brick, 4 ft. in. diameter, 11 ft. cut; Colorado Ave., S. Homan Ave. to S. Kedzie Ave., 1,460 lin. ft. 2 ring brick, 5½ ft. in. diameter, 16 ft. cut; W. 13th St., Spalding Ave. to S. Homan Ave., 670 lin. ft. 2 ring brick, 4½ ft. in. diameter, 15 ft. cut; first alley north of W. 13th Place, S. Homan Ave. to S. Central Park Ave., 1,370 lin. ft. 2 ring brick, 4½ ft. in. diameter, 15 ft. cut; S. Homan Ave., W. 13th St. to alley north of W. 13th Place. 55 lin. ft. 2 ring brick, 4½ ft. in. diameter, 15 ft. cut; 1 concrete bulkhead, 215 manholes, 20 catchbasins and wing sewers in intersecting streets as follows: 70 lin. ft. 2 ring brick, 6 ft. in diameter, 40 lin. ft. 2 ring brick, 5 ft. in. diameter, 26 lin. ft. 2 ring brick, 3 ft. in. diameter, 90 lin. ft. 18 in. double strength tile pipe, 420 lin. ft. 20 in. double strength tile pipe, 100 lin. ft. 18 in. double strength tile pipe, 640 lin. ft. 15 in. tile pipe, 940 lin. ft. 12 in. tile pipe.

The work requires the removal of all existing sewers now in the line of the new work and connections of all existing catchbasins, hydrant basins, house drains, etc. Estimated cost $470,000.

City Engineer John Schwaab of Alton, Ill., has presented an ordinance in the City Council calling for a sewer to be built east of Central Ave., in the alley between Fifth and Sixth Sts.

Indiana.

✣Bids will be received until 7:30 p. m., Feb. 27, by Board of Public Works, Fort Wayne, Ind., for the construction of sewers and branches. H. W. Becker is Clerk of the Board.

City Engineer Fred R. Charles of Richmond, Ind., has been instructed by the Board

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

of Public Works to prepare plans and specifications for a sewer to be built at South L St.

Iowa.

✣Bids will be received until Feb. 26 by City of Tipton, Ia., for the construction of 10 miles of 8 to 15-in. sewers and accessories. A certified check for $500 must be filed with each bid. Philip D. Ketelsen is City Clerk. Iowa Engineering Co., Clinton, Ia., Engineers.

The City Council of Fort Dodge, Ia., has passed a resolution of necessity for sewer on the following streets and avenues: Beginning at Eighth Ave. S. and Park Blvd. E., to 18th St., north on 18th St. to 50 ft. south of Seventh Ave. S.; also beginning at 18th St. and Eighth Ave., south to a point 100 ft. north of 10th Ave. S.

The Department of Streets and Public Improvements of Cedar Rapids, Ia., proposes the construction of a number of sewers during the year. Probably the largest is to be constructed in the north end of the West Side from I Ave. West to Ellis Lane.

Asst. City Engineer E. E. Cook of Council Bluffs, Ia., has estimated the cost of the proposed west end storm and sanitary sewer system, under the gravity plan, at $160,000.

Kansas.

⊙R. H. Robson of Arkansas City, Kans., has been awarded the contract by that city, S. K. Titus, City Engineer, for the construction of a sanitary sewer between D and E Sts. for $3,811. Alex. Livingston of Arkansas City secured the contract for constructing a lateral sewer on North Summit St. for $249.

The officials of Salina, Kans., have been securing cost estimates from Kansas City on the maintenance of a sewerage pumping station. It is proposed to install a similar one in Salina. Charles Banker is City Clerk. P. G. Wakenhut is City Engineer.

Kentucky.

✣Bids will be received, it is reported, until March 3 by Board of Public Works, Louisville, Ky., for the construction of sewers estimated to cost $60,000. The sewers are to be placed as follows: Gray St., from Jackson to Shelby and Brook to First; Finzer, from Preston to Clay; Jacob, from Brook to Clay; Roselane, from Preston to Shelby; Lampton, from Preston to Shelby; College, from Brook to Floyd; Floyd, from College to alley north; Breckinridge, from Brook to Jackson and Second to First; Shelby, from Caldwell to Oak; Caldwell, from Clay to alley west of Shelby; Speckert, from Clay to alley west of Shelby; Kentucky, from Clay to Shelby; alley between Kentucky and Baroness, from Clay to alley west of Shelby; alley between St. Catherine and Baroness, from Clay to alley west of Shelby; Camp, from Floyd to Shelby;. Burnett, from Preston to Bland and from Shelby to Texas; First, from Broadway to College.

The town of Fort Thomas, Ky., proposes to extend the sewer system into the Highland District. H. M. Stigman is chairman of the Trustees.

The Board of Public Works of Louisville, Ky., will receive bids about Feb. 25 for the construction of about 4¼ miles of sewers in the eastern section of the city. Roy W. Burke is City Sewer Engineer.

Maryland.

⊙The Board of Awards of Baltimore, Md., has let the contract for the construction of sanitary sewerage contract No. 107 to Frank Bruno & Co. of Newark, N. J., at $117,874. Irwin & Conklin of Greenville, O., bid $124.887 on the work.

Massachusetts.

The citizens of Lenoxdale have asked the Selectmen of Lenox, Mass., to install sewers in their section. It is probable that these sewers will require the installation of a sewage disposal plant. W. J. Welsh is official in charge of sewers.

The City Council of Lawrence, Mass., is considering the installation of a sewerage system for the section west of the crest of Tower Hill. The estimated cost is $30,000. Arthur D. Marble is City Engineer.

Michigan.

✣Bids will be received until 3 p. m., Feb. 17, by D. E. Newcombe, City Clerk, Flint, Mich., for furnishing the city such cement sewer pipe, specials and manhole tops and catch basin inlets which may be needed for the year commencing March 1. E. E. Newcombe is City Clerk.

Commissioners of Public Works J. J. Haarer of Detroit, Mich., has included in his budget for 1913 an estimate of $707,760 for sewer work.

The Village of Union City, Mich. (population 1,340), has accepted plans for a complete sewerage system. It is probable only a section of the system will be installed in the spring.

State Sanitary Engineer Edward D. Rich has recommended a thorough revision of the sewerage system of Port Huron, Mich. A. J. Smith is official in charge of sewers.

The city of Mt. Clemens, Mich., proposes to expend $50,000 this year in the construction of three trunk sewers on Market, Clemens and Church Sts. The total number of feet will be 5,000, or nearly a mile. City Engineer John W. Irwin is preparing plans and specifications for the systems.

Minnesota.

✣Bids will be received until 8 p. m., Feb. 25, by City Council, Hutchinson, Minn., for the construction of certain sewers and water mains and appurtenances. The work will include 2,000 ft. of 10-in. sewer; 3,025 ft. of 8-in. sewer; 3 flush tanks and manholes combined; 4 junction manholes; 3 straight manholes; 80 Ys for house connections; also water main weighing not less than 21 7/10 lbs. per ft.; 4,000 ft. standard cast iron pipe; 6 standard hydrants. C. K. Goodnow is City Clerk.

⊙J. J. Connolly of St. Paul, Minn., has been awarded the contract by the city of Shakopee, Minn., C. T. Weiland, Jr., City Clerk, for the construction of sanitary outlet sewer and water main extensions, for $4,669. Bids were opened Feb. 7.

The city of Ely, Minn., plans to expend about $40,000 in the extension of the storm sewer system to cover practically the whole of the city.

Missouri.

✣Bids will be received until noon, March 3, by Council of Hannibal, Mo., for the construction of District Sewers No. 9 and No. 100, estimated to cost $85,000. All bids must be accompanied by a certified check for $250. Specifications may be secured for $5 of B. F. Smiley, City Engineer.

⊙The American Construction Co., 725 Clarendon Ave., St. Louis, Mo., has been awarded the contract by the Board of Public Improvements of that city, for the construction of sewers in Dale Ave. Sewer District No. 2, for $17,821. Bids were opened Feb. 4.

⊙Fax & Bristol, 510 Third Nat. Bank Bldg., St. Louis, Mo., have been awarded the contract by that city, for the construction of sewers in Harlem Creek Sewer District No. 9, at $1,497. Bids were opened Feb. 4.

⊙James A. Pringle of Carthage, Mo., has been awarded the contract for the installation of a sewer system and a waterworks system at Lake of the Wood, 18 miles west of Kansas City on the Union Pacific Railway, for about $35,000. Work will be started at once.

The Board of Public Works of St. Joseph, Mo., has authorized City Engineer Charles Campbell to expend a sum not exceeding $5,000 in repairs on the lower end of the Blacksnake sewer.

The South Side Improvement Association of Hannibal, Mo., is agitating the installation of sewers in that section of the city. B. F. Smiley is City Engineer.

Nebraska.

✣Bids will be received until 1 p. m., Feb. 28, by Leslie Neubauer, Village Clerk, Sidney, Nebr., for the construction of a sewer system, main and laterals, and a disposal plant. The approximate quantities of the work to be done, as follows: Main and Lateral Sewer System—16,470 lin. ft. 8-in. vit. pipe sewer, 4,586 lin. ft. 10-in. vit. pipe sewer, 3,100 lin. ft. 12-in. vit. pipe sewer, 120 lin. ft. 10-in. cast iron pipe sewer, 156 lin. ft. pipe line, 58 manholes, 10 flush tanks. Disposal Plant—110 cu. yds. excavation, 110 cu. yds. reinforced concrete, 2 manholes, 6 valves, 782 lin. ft. pipe line, 2,400 lin. ft. 6-in. ½ round tile. Feed and Discharge Apparatus—320 lin. ft. fence. The Engineer's estimate of cost is $20,720. Each bid must be accompanied by a certified check for $1,000, made payable to the Village of Sidney, Nebr., as a guarantee of good faith. Plans and specifications may be seen and proposal blanks obtained at the office of the Village Clerk, or at the office of the Engineers, Grant & Fulton, 402 F. & M. Bldg., Lincoln, Nebr. Bidders desiring plans and specifications for their own use may obtain the same from the Engineer upon payment of $5.

⊙J. M. Deffenbaugh has been awarded the contract by the city of Lincoln, Neb., Roscoe C. Ozman, City Clerk, for the construction of a sewer in Sewer District No. 95, at $363. Bids were opened Jan. 15.

The Village Council of Bancroft, Nebr., is considering plans for the installation of a complete sewerage system (population 742).

New Hampshire.

A public meeting has been held at Charlestown, N. H., to discuss the matter of installing a sewer system for the village. Fred Perry is Town Clerk.

New York.

⊙The Board of Contract and Supply of Syracuse, N. Y., has awarded the contract for building a 15-in. sewer in Fairview Ave., Hawley to Burnet, and 12-in. lines in Hawley Ave., between Fountain and Oak, Beach and Vine and Sherwood and Teall, to Charles Bonn at $3,440.

⊙Frank George of Batavia, N. Y., has been awarded the contract for the construction of 14 miles of sewers at Newark, N. Y., in connection with the new sewer system.

The Board of Sewer Commissioners of Ilion, N. Y., has decided to proceed with the matter of construction of a sewage disposal plant. According to the new plans the cost will be about $33,000, with a cost of $2,500 per year for operating. The proposition will be submitted to the voters at an early date. A. M. Sterling is official in charge of sewers.

City Engineer Clyde M. Jones of Jamestown, N. Y., has found the sewerage system of that city in bad condition and overtaxed beyond its capacity. Consulting Engineers Waring, Chapman & Farquhar, 874 Broadway, New York City, have been retained to investigate and report on the best course to pursue.

The Common Council of Schenectady, N. Y., has passed an ordinance providing for the employment of an engineer to draw plans and specifications for a sewage purification plant.

City Engineer John M. Hackett of Dunkirk, N. Y., has started preliminary work of surveying and soundings for the proposed intercepting sewer along lake front, which project is under consideration by the Board of Health with a view of purifying the water supply by connecting all city sewers with the intercepting sewer.

The City Council of Newburgh, N. Y., D. J. Coutant, City Clerk, did not open bids on Feb. 4 for furnishing all materials and labor necessary for constructing a trunk sewer in Fullerton Ave., from Third St., northerly to Gidney Ave. Action has been postponed until March 4.

City Engineer C. E. Harris of Norwich, N. Y., has petitioned the Village Trustees to authorize the raising of $6,000 to put in a new sewer on South Broad St., between Hayes and Division Sts.

New Jersey.

✣Bids will be received until Feb. 20, by Board of Commissioners of Atlantic City, N. J., for the construction of extensions to storm water drainage system. The work to be done

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

embraces the building of approximately 1,210 ft. of reinforced concrete drains from 3 ft. 6 ins. to 4 ft. wide; 6,633 ft. of brick and concrete drains from 27 ins. to 36 ins. in diameter; 7,172 ft. of terra cotta and concrete drains from 12 ins. to 24 ins. in diameter; 5,200 ft. of terra cotta and cast iron inlet pipes from 10 ins. to 12 ins. in diameter, together with manholes, catch basins, stormwater inlets and the necessary timber and pile foundations. Each proposal submitted must be accompanied by a certified check upon a National or State bank or Trust company, and to the order of Albert Beyer, City Treasurer, for the sum of $5,000. Specifications and blank forms of proposal can be obtained of John W. Hackney, the City Engineer, and a full set of plans can be obtained from him for the sum of $10, such sum to accompany the order. Specifications and plans can also be seen at the office of T. Chalkley Hatton, Consulting Engineer, Wilmington, Delaware. J. B. Thompson is Director of Streets and Public Improvements.

✣Bids will be received until 8 p. m., Feb. 15, by Borough Council, Belmar, N. J., for furnishing all labor and material necessary for the construction of about 4 miles of 8 to 18-in. vitrified pipe sewer with manholes and appurtenances, also, for about 4½ miles of 4 to 10-in. cast iron water pipe with valves, hydrants, specials, etc. Clyde Potts, 30 Church St., New York City, is Engineer. A certified check for $1,000 must be filed with each bid. C. O. Hudnut is Borough Clerk.

The city of Elizabeth, N. J., will engage an expert engineer to investigate the intercepting drain which was recently built at a cost of $275,000. An effort is to be made to prevent the pollution of Staten Island Sound.

Following bids were received Feb. 4 by the Passaic Valley Sewerage Commission, Newark, N. J., for the construction of Section 7 of the intercepting sewer, compressed air tunnel; the bidders being (1) Dock Contractor Co., Hoboken, N. J.; (2) Chas. A. Haskin, Boston, Mass., and (3) Booth & Flynn, Pittsburgh, Pa.:

WITH METALLC SHIELDS.

	(1)	(3)
Excavation, in tunnel, for 135-in. concrete sewer, including furnishing and use of shields and cast-iron plates, etc., 4,930 lin. ft.	$ 211.39	$ 115.00
Excavation, in tunnel, for 141-in. concrete sewer, including furnishing and use of shields and cast-iron plates, etc., 8,800 lin. ft.	212.98	115.00
Concrete masonry, in tunnels and shafts, and appurtenant work, 30 000 cu. yds.	7.00	9.00
Brick masonry, in shaft-manholes, and appurtenant work, 300 cu. yds.	18.00	15.00
Total	$3,131,777.00	$1,853,450.00

WITHOUT METALLIC SHIELDS.

	(1)	(2)	(3)
Excavation, in tunnel, for 135-in. concrete sewer, including furnishing and use of ¾-full reinforcement plates, etc., 4,930 lin. ft.	$ 218.52	$ 130.00	$ 81.00
Excavation, in tunnel, for 141-in. concrete sewer, including furnishing and use of ¾-full reinforcement plates, etc., 8,800 lin. ft.	222.16	140.00	84.00
Concrete masonry, in tunnels and shafts, and appurtenant work, 30,000 cu. yds.	10.00	8.00	9.00
Brick masonry, in shaft-manholes, and appurtenant work, 300 cu. yds.	18.00	15.00	15.00
Total	$3,337,712.00	$2,117,400.00	$1,413,030.00

Ohio.

✣Bids will be received until noon, Feb. 17, by J. W. Chrisford, Director of Public service, Lakewood, O., for furnishing the necessary labor and materials for sewers in the following named thoroughfares: Harlan Ave., from Nicholson Ave. to Jackson Ave.; Merl Ave. from Nicholson Ave. to Jackson Ave; Emerson Ave. from Nicholson Ave. to Jackson Ave.; Jackson Ave., from Clinton Blvd. to N. P. R. R. The foregoing to be done according to plans and specifications on file in said office and at the office of C. W. Root, 1033 Society for Savings Bldg., Cleveland, O.

⊙Wills & Dick of New Philadelphia, O., have been awarded the contract by that city, for constructing additional storm sewers, at $9,702. Bids were opened Jan. 30.

⊙Fidler & Brock of Springfield, O., have been awarded the contract by G. B. Hatfield, Director of Public Service, Troy, O., for the construction of a sanitary sewer 6 miles in length, at $32,848. Bids were opened Feb. 4.

Service Director A. B. Hollenbaugh and City Engineer Chas. Latshaw of Fostoria, O., recently inspected the sewage disposal plant in operation at Columbus, O., with a view to recommending the same kind for Fostoria.

The City Council of Akron, O., contemplates having plans prepared for an entire new sewerage system for the city in connection with the plan to rebuild the sewer now broken near Lakeside Park. Jas. H. Gehres is City Engineer.

Oklahoma.

The city of Durant, Okla., will vote March 18 on the issuance of bonds in the sum of $85,000 for the following: For sewer extension, sewage disposal and incinerator, $72,000; $13,000 for water extension and motor-driven pumps at waterworks station. W. P. Danford is City Engineer. A. Neely is Mayor.

Pennsylvania.

The citizens of the East Ward, Elizabethville, Pa., recently held a meeting to take steps relative to sewering that ward.

The Borough Council of Collingdale, Pa., has sold bonds to the amount of $40,000, the money for which is to be used for the installation of a modern sewerage system. Construction work is to be started at once.

The State Board of Health of Pennsylvania has instructed the city officials of Sharon, Pa. to erect a sewage disposal plant. The estimated cost of the plant is $130,000. G. W. Nicholls is City Engineer.

Texas.

✣Bids will be received until March 15, by the City of Pecos, Texas, for the construction of a new sewer system in accordance with plans prepared by Jennings & Wood, El Paso, Texas. The cost of the system is estimated at $35,000.

⊙Truehart & Jackson of San Antonio, Tex., have been awarded the contract by the town of Bishop, Tex., for the laying of five miles of sewer mains at an approximate cost of $25,000. The work also includes the building of a disposal plant. Thos. J. Cahill of Corpus Christi, Tex., is Supervising Engineer.

Plans are now being prepared for the installation of a septic tank sewer system in the town of Hamilton, Tex. (population 1,548).

The citizens of Pecos, Tex., some time ago voted bonds to the amount of $35,000 for the installation of a sewerage system. It is proposed to commence work at an early date.

Utah.

The City Commissioners of Ogden, Utah., intend to create sewer district No. 115. Final consideration will be given Feb. 19. H. J. Craven is City Engineer.

City Engineer D. H. Blossom of Salt Lake City, Utah, in his annual report to the City Commission recommends the installation of a sanitary sewer system for the southern portion of the city.

Vermont.

The Village Trustees of Bellows Falls, Vt., are to investigate and report on a plan for extending the sewer system. About $15,000 probably will be expended for the extension. Dennis M. Damon is a Village Trustee.

Virginia.

The town officials of Woodstock, Va., (population 1,314) are considering a plan for the installation of a complete sewerage system.

Washington.

⊙H. Young of Seattle, Wash., has been awarded the contract by the Board of Public Works of that city for the construction of sewers in Lucile St. et al., at $10,074.

Following bids were received Jan. 24 by the Board of Public Works of Seattle, Wash., for the construction of sewers in Lucile St. et al.; Meismes and Nordstrom, $11,619; Frasca & Coluccio, $10,320; Dicken & Rightmire, $10,326; T. I. Peterson, $13,503; Union Construction Co., $11,374; C. Cristorofo, $11,345; H. Young, Northern Bank Bldg., Seattle, $10,074; Dahlstrom & Rodal, $10,169; Nelson & Carlson, $10,290, and N. Fiorito, $11,223.

Plans recently completed by City Engineer N. A. Gilman of North Yakima, Wash., for the proposed sewerage system for that city will call for the expenditure of approximately $274,000. The citizens will shortly be asked to vote on the proposition to issue bonds to the amount of $260,000 for the improvement.

The city of Everett, Wash., plans the construction of the Harrison St. trunk sewer line, and the probable construction of a larger sewer in the southern part of town.

Wisconsin.

The finance committee of the City Council, Milwaukee, Wis., has approved an appropriation of $800,000 in this year's budget for sewerage. These bonds will permit the building of the Imhoff settling tanks, as recommended by the sewage commission. Provision also is made for enlarging the west side sewers.

The finance committee of the City Council, Milwaukee, Wis., has approved an appropriation of $300,000 in this year's budget for a water works intake.

Plans and specifications for the new west side sewer system and also the new sewage disposal plant for Fond du Lac, Wis., have been completed and are on file at the office of City Clerk J. T. Hohensee.

The City Council of Rhinelander, Wis., has decided to immedately take steps toward securing data regarding the installation of a sewerage system. Mayor Jas. Esterl and City Clerk J. F. Blanchard have been instructed to secure the service of an engineer to make a plat of the district.

City Engineer E. B. Banks of Superior, Wis., has made a report to the City Commission as to the cost of constructing a sewer which it is proposed to construct in the Ninth ward to serve some portions of that section of the city which are now without sewage facilities. The estimated cost is $30,910.

Canada.

✣Bids will be received until 6 p. m., Feb. 24, by Sidney Appleby, Secretary-Treasurer, Sutherland, Sask., for the labor and material for the construction of sewers as noted more completely under "Roads and Streets" in this issue.

The citizens of Vancouver, B. C., have voted a by-law to the amount of $1,000,000 for the construction of sewers. F. L. Fellowes is City Engineer.

The citizens of Point Grey, B. C., have voted by-laws to the amounts of $740,000 for sewerage, $200,000 for roads, $10,000 for sidewalks and $5,000 for parks. D. W. Johnston is City Engineer.

The works committee of the City Council, Toronto, Ont., has approved the proposed Ward Seven sewer system as recommened by Works Commissioner R. C. Harris at a cost of $1,317,477.

Darling & Pearson, Architects, Toronto, Ont., have prepared plans for a 10-story office building to be erected at King and Young Sts., Toronto, for the Dominion Bank. Stone with granite facings, terra cotta and structural steel will be used. The structure is to be erected this spring.

BUILDINGS

District of Columbia.

✣Bids will be received until 10 a. m., Feb. 25, by Maj. F. C. Boggs, General Purchasing Officer Isthmian Canal Commission, Washington, D. C., for furnishing under Circular 759 structural steel.

✣Bids will be received until 10:30 a. m., March 6, by Maj. F. C. Boggs, General Purchasing Officer Isthmian Canal Commission, Washington, D. C., for furnishing under Circular 760 structural stel for administration building.

Illinois.

✣Bids will be received by Chas. F. Seyferlich, Fire Marshal, Chicago, Ill., until 11 a. m., Feb. 15, for furnishing building materials to the City of Chicago, for the use of the Fire Department, for the year 1913, as per specifications on file at office.

✣Bids will be received by Chas. F. Seyferlich, Fire Marshal, Chicago, Ill., until Feb. 15th, 1913, for furnishing plumbing supplies to the City of Chicago for the use of the Fire Department for year ending December 31, 1913, as per specifications on file at office.

✣Bids will be received by Chas. F. Seyferlich, Fire Marshal, Chicago, Ill., until Feb. 17, 1913, 11 a. m., for furnishing building cement to the City of Chicago, for the use of the Fire Department, for the year ending December 31, 1913, as per specifications on file at office.

Iowa.

✣Bids will be received until 3 p. m., March 17, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures and approaches, of the United States postoffice at Denison, Iowa. The building is one story and basement and has a ground area of approximately 4,200 sq. ft.; fireproof first floor; stone and brick facing and tin and tile roof. Drawings and specifications may be obtained from the custodian of site at Denison, Iowa, or at the discretion of the Supervising Architect.

Kansas.

✣Bids will be received until 11 a. m., Feb. 27, by Maj. J. T. Davidson, Quartermaster, Fort Riley, Kan., for the construction, plumbing, heating and electric lighting of an addition to the bakery at that post.

Louisiana.

✣Bids will be received until 3 p. m., March 13, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the interior finish of the United States postoffice and courthouse at New Orleans, La. Drawings and specifications may be obtained at this office, or at the office of the architects, Hale & Rogers, 11 E. 24th St., New York, at the discretion of the Supervising Architect, or from the Government superintendent of construction, United States postoffice, New Orleans, La.

Nebraska.

✣Bids will be received until 3 p. m., Feb. 27, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the installation complete of an electric passenger elevator in the United States postoffice and courthouse at North Platte, Neb., in accordance with the drawing and specification, copies of which may be had at the discretion of the Supervising Architect.

New York.

✣Bids will be received until 11 a. m., Feb. 20, by Department of Public Works, Buffalo, N. Y., for furnishing the labor and material required in the erection of a two-story frame administration building, a two-story frame superintendent's residence and for making sundry alterations in the two-story brick main hospital building and nurses' home, in connection with the present Municipal Hospital, located on the north side of East Ferry street, near Fillmore Ave. Francis G. Ward is Commissioner of Public Works.

Ohio.

✣Bids will be received until noon, Feb. 24, by Charles W. Stage, Director of Public Safety, Cleveland, O., for furnishing and installing lighting fixtures in the Administration building, hospital building No. 1, and connecting passage and cottage ward No. 1 of the tuberculosis sanatorium group at Cooley Farms, Warrensville, O. J. Milton Dyer, 825 Cuyahoga Bldg., Cleveland, O., is Architect.

Pennsylvania.

✣Bids will be received until 3 p. m., Feb. 26, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including mechanical equipment and approaches, of the United States postoffice at Bristol, Pa. Drawings and specifications may be obtained from the Custodian of site at Bristol, Pa., or at the discretion of the Supervising Architect.

RIVERS AND HARBORS

Chile.

✣Bids will be received until Sept. 10 by Comision de Puertos, Santiago, Chile, for supplying and erecting a plant for the electric illumination of the new port works at Valparaiso, Chile. Full information may be obtained of the Consulate General of Chile, Room 431, 2 Rector St., New York City, between the hours of noon and 3 p. m., excepting Sundays.

District of Columbia.

✣Bids will be received until 2:30 p. m., Feb. 14, by Maj. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under Canal Circular 757-B cast iron car wheels.

✣Bids will be received until 10:30 a. m., Feb. 26, by Maj. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing dynamite, steel pipe, valves, hacksaw blades, solder, stable brooms, lumber, etc.

✣Bids will be received until noon, Feb. 18, by N. C. Twining, Chief of Bureau of Ordnance, Navy Department, Washington, D. C., for furnishing armor for naval vessels.

Florida.

⊙E. W. Parker, Tampa, Fla., has been awarded the contract at $15.95 per lin. ft. for constructing a new pier at the foot of 2nd Ave. N. for the city of St. Petersburg, and at $4,375 for the landing place and freight sheds at end of pier.

Illinois.

✣Bids will be received until noon, Feb. 13, by the Sanitary District of Chicago, Board of Trustees, 1500 American Trust Bldg., Chicago, Ill., for dredging or excavating approximately 130,000 cu. yds. scow measurement of material. Plans and specifications may be obtained at the office of the Sanitary District. John McGillen is Clerk.

Kentucky.

✣Bids will be received until noon, standard central time, March 7, by Maj. J. C. Oakes, U. S. Engineer, Louisville, Ky., for two steel barges.

Louisiana.

⊙James Geary, New Orleans, La., has been awarded the contract at $66,207 by the Port Commission of New Orleans for the construction of a wharf at Pauline St., that city.

Massachusetts.

✣Bids will be received until noon, Feb. 15, by Col. Frederic V. Abbot, U. S. Engineer, Boston, Mass., for rock excavation in Beverly Harbor, Mass.

New Jersey.

✣Bids will be received until 2 p. m., Feb. 27, by Board of Managers of the Geological Survey at the office of Henry B. Kummel, State Geologist, Trenton, N. J., for the construction of reinforced concrete jetties at Shark River Inlet. C. C. Vermeule, 203 Broadday, New York City, is Engineer in charge. A charge of $1 will be made for a copy of the plans.

✣Bids are now being asked by Maj. R. R. Raymond, U. S. Engineer, Wilmington, Del., as noted in our last issue, for dredging in Cooper Creek, N. J., Cohansey River, N. J., and the entrance to Salem River, N. J. The Cooper Creek work calls for the dredging of 18,200 cu. yds. of mud, sand and gravel; the dredging in the Cohansey River requires the removal of about 50,000 cu. yds. of mud and sand; the work at the entrance to Salem River involves the dredging of about 18,000 cu. yds. of mud, sand and gravel.

New York.

A bill has been introduced in the State Legislature providing for a $40,000,000 bond issue. The specific improvements set forth in the bill are the extension of the Black River Canal, the reconstruction of the Chemung Canal, the conversion of the Glens Falls feeder into a canal and the construction of a canal between Flushing River and Jamaica Bay. The bill calls for a referendum vote in 1913.

Vermont.

The Consildated Lighting Co., Montpelier, Vt., has purchased the Molly Falls Light & Power Co. of Marshfield. The new owners propose to rebuild the dam and construct a power house and a 1½ mile penstolk. The Charles H. Tenney Co., Boston, Mass., controls the Consolidated Lighting Co.

Washington.

Sloane Bros., Seattle, Wash., at 24½ cts. per cu. yd., were the low bidders for making a 520,000 cu. yd. earth fill at the foot of Bell St. for the Port of Seattle Commission.

Wisconsin.

A resolution will be introduced in the State Legislature for a constitutional amendment empowering the state to develop and control reservoirs at the head of the principal Wisconsin rivers. The resolution passed the legislature two years ago and if it passes at this session it will be submitted to a vote of the people in 1914.

Canada.

⊙W. A. Armstrong, Whitworth & Co., Newcastle-on-Tyne, England, have been awarded the contract at $690,000 for a new car ferry steamer to operate between Prince Edward Island and the mainland.

⊙The Department of Public Works of Canada has awarded the contract for the construction of an extension to the wharf at Providence Bay, Mantoulin Island, Algoma District, Ont., to E. V. H. White, of Burlington, Ont.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ENGINEERING AND CONTRACTING

Devoted to the Economics of Civil Engineering Design
and to Methods and Cost of Construction

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A Study of the Tractive Power of Horses.

What is the tractive power of a team of horses on level haul? One knows, of course, that it depends upon a variety of conditions: The tractive resistance of different road surfaces; the foothold which the surface gives; the training and fibre of the horses all count a part in determining the exact figures. But the engineer wants for handy use a value. What is this value? The one given in text books is: The tractive power of a team, on level haul, is 25 per cent of the weight of the team. This value has done good service and at least has proven itself to be within the limits of safety for general use. The question has often arisen whether it is the correct value. Recent experiments indicate that it is considerably below the correct value.

In our issue of Nov. 6, 1912, we published an article on the effect of grade and surface of roads on tractive force based on tests conducted under the direction of Dean E. B. McCormick, Kansas State Agricultural College. This article gave data on tests of tractive power of horses. Those data were, however, somewhat subordinated in this article to data on tractive resistances of different road surfaces and to other matters, and at the risk of some repetition we give in another column a discussion by Prof. L. E. Conrad of the same school of the tractive power tests specifically. The second tabulation of this discussion is the part to which we direct particular attention. It indicates that instead of a quarter of its weight being the index of the tractive power on level haul of a team, a more nearly correct index is 35 to 40 per cent of the team's weight.

The last statement will, we believe, be surprising enough to make those interested wish to read the article in detail, and we would suggest that, if they have not already done it, they read at the same time the article in our issue of Nov. 6, 1912. We believe that these two articles give engineers the very best data that are available at present on tractive power of horses and tractive resistance of road surfaces and grades.

The Economy of Wagon Train Haulage with Motor Trucks.

The motor truck carrying load fails most often to meet contractors' haulage requirements because: (1) It cannot go where a team can, and, (2) it cannot wait, like a team, without excessive cost, for loading and unloading. To be most economical, indeed in order successfully to compete in economy with teams, the motor truck must have haulage conditions which make the ratio of running to standing time large and high average speeds possible. Specifically, the time of loading and unloading must be short, the haul must be long, and the road must be sufficiently good to permit speed.

All of these requirements noted have been repeatedly stated and there is no good reason for a failure of contractors to understand them. In fact, we think that lack of such understanding is not nearly so common a contractor's fault as is the notion that contract work does not permit such requirements to be met. There is disposition, for example, for contractors to feel that quick loading methods are impossible in handling spoil from excavation except where steam shovels and trains can be worked. Usually this feeling has no better reason than the fact that such methods are not commonly employed. Yet the contractor who forgets precedent and puts his invention to the task of meeting the new condition seldom fails, as many examples testify, to discover a method.

One may inquire what all this preamble has to do with wagon train haulage with motor trucks. It has this to do with it: The article on wagon train haulage, which we publish elsewhere in this issue, indicates so insistently that greatest economy of motor truck haulage lies in the use of the motor truck solely as a locomotive, that the utility of the motor truck as a load carrier may be belittled unless the warning is called that seldom has the load carrying truck had a fair trial in contractors' haulage. The contractor has demanded that the motor truck shall conform to his practices and refused too generally to modify his practices to fit the requirements of economical motor truck operation. The contrary disposition would have put the motor truck carrying load into much greater favor with contractors than it now is.

To the data on wagon train haulage which we publish one must, perforce, accord high praise. The enterprise which led to their collection and the care with which this collection was made, reflect credit upon all persons having a part in the work. The figures of capacity and economy of wagon trains hauled by motor truck may well be left to speak for themselves. The ton-mile costs show and reason tells us also that wagon train haulage can be made very inexpensive. Like railway haulage, however, wagon train motor truck haulage on common roads calls for a very perfect co-ordination of traffic and transportation requirements to ensure the highest possible economy.

On Furnishing Water Supply to Remote Sections of Cities.

A problem in water supply engineering which nearly always makes trouble for the engineer is that of furnishing water to isolated sections of a city which are remote from the business center. In such cases, where the improvement is paid for out of a general fund, the taxpayers in the city proper object to the additional and often excessive cost of extending mains to the isolated district, while the residents of the district demand that they be granted the same character of water service as that furnished to the residential areas of the city proper. Somebody must determine the relative merits of the two claims, according to the local conditions, and often the proper course of action is not clear.

It may prove helpful to describe a situation of this character which recently arose in a city in the Middle West, and to state the opinion of the Consulting Engineer who passed upon the advisability of furnishing high class service to the remote district.

The district is so situated, both as to distance from and elevation above the business center, that it would be especially difficult to supply it with an abundance of water at a high pressure. In addition to a number of good residences there are several college buildings and a large church in the district. Part of the buildings are located on a hill. In discussing the class of service which could reasonably be granted to the residents of the district the Engineer said:

> In the selection of the hills in the isolated district as the site for an educational institution, or for residences, the builders doubtless had in view the superior advantages offered by a picturesque location, high elevation, fresh air, and freedom from the noise, bustle and dirt of a business center. The doctrine, "Let the purchaser look out for himself," must, however, in all reasonableness, apply to some extent to those who, for the sake of the advantages just enumerated, chose a location so remote from and so far above the center of the city from which their water supply and fire protection were to be derived. For example, to furnish, on the top of the hill, a water supply as abundant and a pressure as great as those provided in the center of the city, might very readily involve an expense upon the water department far greater than the total value of the buildings to be supplied and protected. So large an expenditure for this purpose would manifestly not be fair to the rest of the ratepayers, and therefore it cannot be expected, with conditions as they exist, that the water supply in the district should ever be as abundant, or the fire pressure as good as they are in the business district.

The case cited is no doubt rather extreme. However, it serves well to illustrate a principle which often applies in problems of the general character here discussed. The application of this principle in the solution of such problems will be helpful in many cases.

ROADS AND STREETS

Method and Cost of Brick Paved Country Road Construction in New York State.

In 1909 the New York State Highway Commission decided to use a more permanent form of construction than macadam for the main highways leading into the larger cities. After extensive investigation the Commission concluded to use brick on these roads, and as a result, in 1910, about 20 miles of this kind of pavement were constructed in the vicinity of Buffalo, N. Y. These roads proved so satisfactory to the traveling public, as well as from a maintenance standpoint, that the mileage of brick pavements in the vicinity of Buffalo at the present time is about 100 miles. This mileage will be greatly increased during 1913 if the present plans of the Commission are carried out.

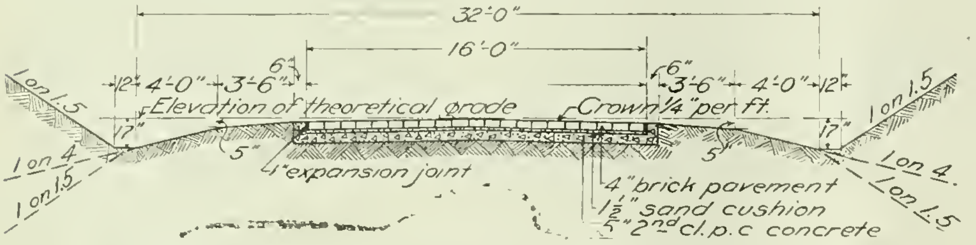


Fig. 1—Standard Section (Brick) of New York State Highway Department.

When in 1910 a wire cut lug block, made under the Dunn patents, was placed on the market, an experimental section using this material was laid on the main highway between Buffalo and Rochester, about one mile from Buffalo. This section proved so satisfactory that since that date a large percentage of the paving blocks used on the roads in Western New York have been wire cut lug blocks. During 1912 the records show that nearly 25,000,000 of these blocks were used on the highways of Western New York, although the specifications of the State Highway Department do not specify any style of block, merely requiring them to have lugs.

The following description of the methods employed in the construction of brick pavement on the New York State highways is taken from a paper presented at the Cleveland meeting of Section D of the American Association for the Advancement of Science, by William C. Perkins, Resident Engineer, Department of Highways, State of New York, Niagara Falls, N. Y.:

Figure 1 shows the New York State Highway Department's standard section for a brick country road. This calls for 16 ft. of brick surfacing, 1½ in. sand bed (this will be increased to 2 in. in 1913), and a foundation of 5 in. thick of concrete mixed 1:2½:5. The brick surfacing is confined by a concrete edging 6 in. wide, flush with the pavement and separated from the pavement by a well defined expansion joint ⅞ in. to 1 in. wide. For surfacing wider than 16 ft. these longitudinal expansion joints are increased proportionally to the width of pavement. No transverse expansion joints are used. In 1910, transverse expansion joints placed 50 ft. apart were used with disastrous results, the blocks having become loose and crushing on each side of the joint.

The shoulders or wings on each side of the edging are of earth 7½ ft. wide, making the width of the roadway 32 ft. between ditches. Normal ditches are 1 ft. wide and 17 ins. below the center of the road or theoretical grade; back slopes of ditches 1 on 1½. If necessary for proper drainage to deepen the ditches, or on embankment the slopes are made 1 on 4, or 1 on 1½; but if the steeper slope is used, guard rail is necessary. The crown of the brick section is ¼ in. per foot.

Figure 2 shows a special section combining a brick and earthen road used on the highway between Niagara Falls and Buffalo. This is very similar to the section used on the roads around Cleveland. This section has 16 ft. of brick surfacing with necessary edging and wing on one side of highway, and a 12 ft. to 16 ft. earthen road on the other side. This highway was opened for traffic on Christmas day; it is 17 miles in length between the city lines. Fifteen miles of this highway is laid with wire cut lug blocks, the other two miles having been built in 1911 of repressed block. The traffic, especially automobile, will be very heavy. No traffic census has been taken, but on a Sunday afternoon (two weeks before the road was opened), at a time when it was necessary to make several bad detours, 256 automobiles passed a specific point in one hour.

In the preparation of plans for a brick highway on New York State work, the designing engineer carefully examines the surveyed plan, making a new location of the center, if, in his judgment, it will improve the alignment; avoids all sharp turns, taking new rights of way, if necessary. Easy grades are designed for the main highways, which often necessitates the cutting down of hills and the filling in of hollows. The surface drainage is carefully examined, and concrete culverts used for the larger waterways and cast iron pipe for the smaller.

The construction of a brick highway is in charge of a constructing engineer with a force of inspectors, and he is held responsible for the proper construction of the road and for all lines and grades. The method of construction is as follows:

The road is first rough-graded; and when sufficient material has been excavated, the subgrade is rolled with a self-propelled road roller until it is thoroughly consolidated. Any weak spots that may develop are dug out and properly taken care of by either a sub-base course or a tile drain. In some instances a combination of the two are used. The surface is then trued up by means of picks and shovels, to conform to the cross-section.

The concrete used for the base is made of 1 part of Portland cement, 2½ parts of clean approved sand, and 5 parts of crushed stone or screen-washed gravel. The mixing is done by machines of the batch type. Great care is used in having the concrete base smooth and of the same cross-section as the finished templet which rests on the edging forms and is drawn along as the work progresses.

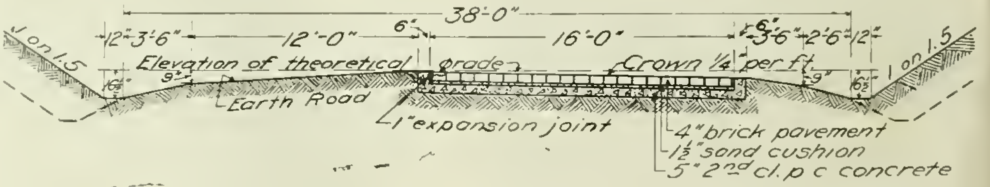


Fig. 2—Special Section (Brick) With Earth Road at Side.

Upon this concrete foundation a bed of clean, dry sand is laid which is 1½ ins. thick when pavement is complete. This sand bed is rolled with a hand-roller weighing about 200 lbs. and then brought to the exact form and crown by means of a templet of the proper shape resting on the edgings, or on scantlings embedded in the sand. The templet is drawn forward and backward immediately in front of the brick-laying so that the sand cushion is maintained constantly at the proper cross sections. On this sand bed the bricks are laid on edge at right angles to the edging, except at road intersections where they are laid at such angles as directed by the Engineer. All longitudinal joints are broken by a lap of one-half the length of the brick.

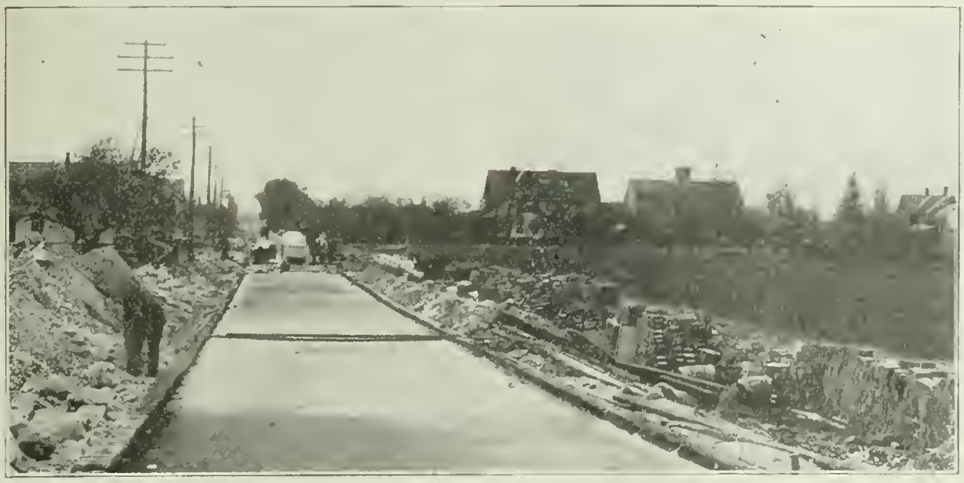


Fig. 3—Concrete Base for Brick Pavement.

The bricks are laid in close contact with each other by experienced bricklayers, with the lugs in the same direction. After a stretch of pavement is laid, it is inspected and all soft, broken or misshapen bricks are removed. Any brick slightly spalled or kiln marked is turned over, and if the opposite face is acceptable, it is allowed to remain in the pavement; otherwise, it is removed. Any unevenness or irregularities of the surface, after rolling, are removed by means of ramming. The pavement is then thoroughly wet by sprinkling and the filler applied. This filler and its proper application is one of the essentials of a good brick pavement. The filler used is composed of one part of Portland cement and one part sharp, clean sand, mixed in small quantities and carefully applied to the brick surface by means of scoop shovels and swept at once into the joints by means of push brooms or squeegees. Before the cement has attained its initial set the same portion of the work is gone over a second time, using the same mixture of grout, care being taken in each instance to thoroughly fill all joints flush with the top of the brick. With blocks with imperfect lugs, in order to secure flush joints a third, fourth or fifth coat of grout is often necessary.

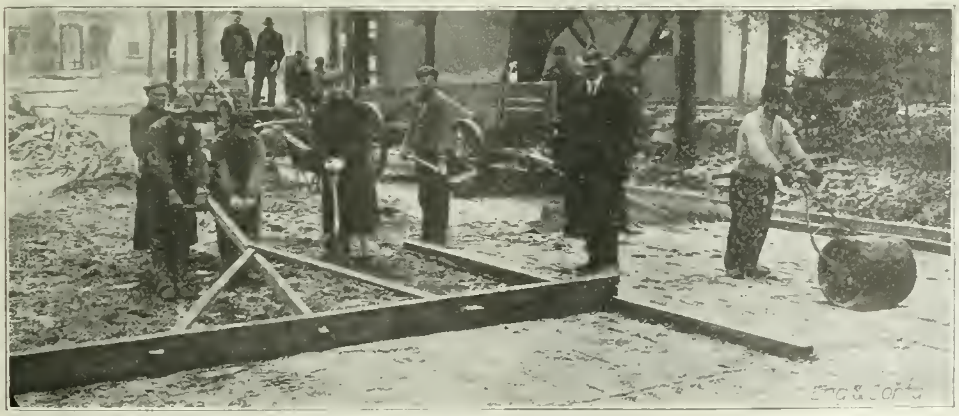


Fig. 4—Preparing Sand Bed.

When sufficient time for hardening has elapsed, a coating of sand is spread over the whole surface and kept moist during the heated period of the day, in order to obtain as uniform a temperature as possible while the grout is setting. The roadway is then allowed to remain absolutely free from disturbance or traffic of any kind for a period of ten days.

Some engineers advocate a weaker grout than a 1 to 1 mixture; others, a pitch filler; but Mr. Perkins' experience has been that better results can be obtained with a 1 to 1 cement filler properly mixed and properly applied. The object of a filler is to make the surface waterproof, prevent undue wear of the individual block, and to join all the blocks together in a monolithic structure. The joint should become part of the pavement and, as near as possible, of equal strength with the brick. All expansion and contraction should be counteracted by the use of well constructed longitudinal expansion joints.

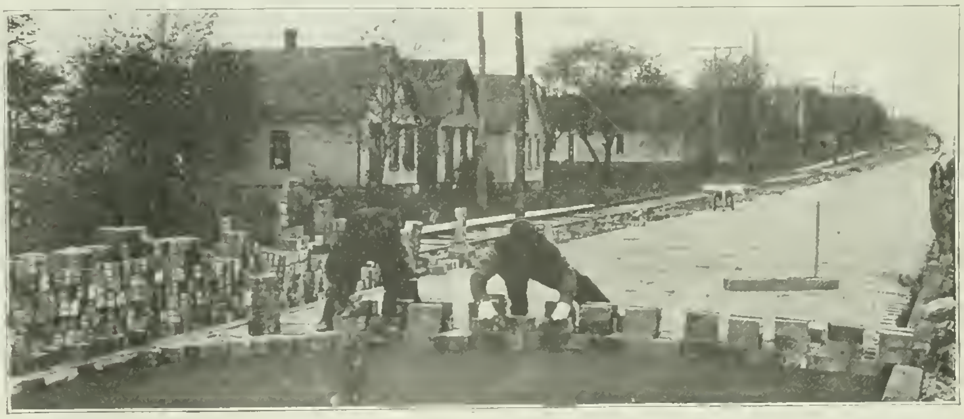


Fig. 5—Laying Wire Cut Lug Blocks.

In constructing longitudinal expansion joints, two clapboards, or wedge-shaped boards, are used in each joint, while the brick surface is being rolled and the cement filler applied. After the filler has been applied, the boards are removed, the cut-side board being removed first in order to avoid loosening the blocks adjacent to the joint. The joint is then thoroughly cleaned to the full depth of the block, and the pitch, or asphaltum, applied.

On all sharp curves it has been found to be an advantage to use a wider expansion joint on the outside of the curve, as the tendency of the pavement is to move in that direction and away from the inside edging.

All bricks are subject to tests for abrasion and impact, according to the standard methods prescribed by the National Paving Brick Manufacturers' Association. In 1910 and 1911, when the old form of rattler was used, a block which lost over 19 per cent was rejected. In 1912, all tests were made on the new standard rattler and all blocks which lost over 24 per cent were rejected. Samples are taken at the roadside from every 200,000 blocks, or from any shipment which may be questionable.

As to the cost of brick paving on country roads, this varies according to local conditions. Highway contractors make use of various labor-saving devices to decrease the cost of construction. All unloading of stone and sand is done by machines. Many contractors are using traction engines for the hauling of material; some use small gage tracks with locomotives and cars. A modern concrete mixer is very necessary.

From data obtained from various roads, a fair estimate of cost, based on labor at 17½ cts. per hour, teams at 50 cts. per hour, and foreman at 35 cts. per hour, would be as follows:

Labor cost per square yard, brick paving in place, exclusive of concrete base:

	Per sq. yd.
Unloading and piling brick	$0.035
Hauling brick one mile	0.040
Laying and rolling	0.070
Making sand cushion	0.020
Grouting	0.028
Expansion joints	0.007
Culling, replacing, etc	0.005
Total labor	$0.205

No office or incidental charges are included in the above.

The manipulation of the concrete for the base varies from 40 cts. to 60 cts. per cu. yd., using batch machines and depending on gravel or stone concrete. The average bid price for brick pavement in Western New York, including concrete base 5 in. thick, but excluding excavation, is $2.05 per sq. yd.

American Road Machinery for Honduras.—The Government of Honduras recently placed an order in the United States for a complete outfit of road-making machinery, including engines, rock crusher and cars. Extensixe road repair work and construction of new roads will be begun by the government at once. One new road will be built from Tegucigalpa to Olancha, and the old road to Comayagua, which has been abandoned, will be repaired.

Limitations in the Use of Bituminous Carpet Surfaces.

Bituminous carpet surfaces have been used in this country for about four years, with variable results. The Massachusetts Highway Commission probably has had the most success with work of this sort, and for this reason a paper discussing the limitations of this type of surface, presented at the Cleveland meeting of the American Association for the Advancement of Science, by Arthur W. Deane, M. Am. Soc. C. E., Chief Engineer of the Massachusetts Highway Commission, Boston, Mass., is of particular interest. Mr. Deane's paper follows:

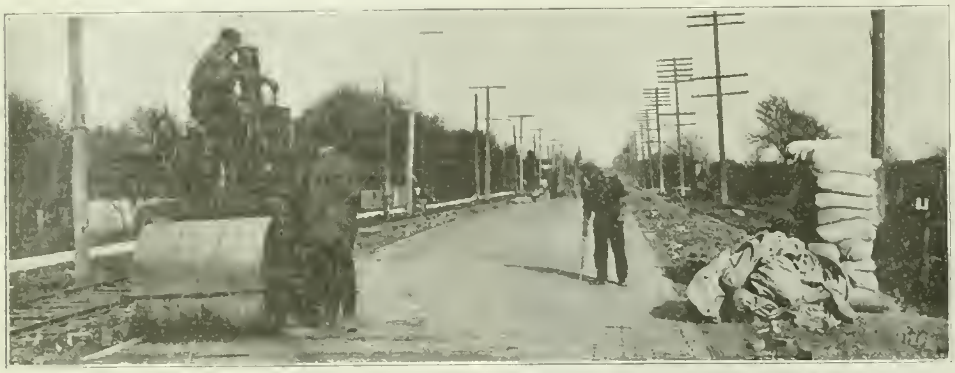


Fig. 6—Inspecting and Rolling.

A bituminous carpet surface is well defined as "a bituminous surface of appreciable thickness formed on top of a road crust by the application of one or more coats of bituminous material, with gravel, sand or stone chips added." Such a carpet is not formed by the use of oil emulsions, consequently emulsions will not be considered in this discussion, nor will a crust approximating 2 ins. in thickness be considered, inasmuch as when a coat or blanket is made of such thickness, it ceases to become a carpet, but rather becomes an integral part of the road crust or pavement.

Limitations in the use of bituminous carpet surfaces are governed by three principle features: First, character of the road crust under the carpet; second, character of the carpet itself, including both the bitumen and the grit of such material as is applied with the bitumen; third, character of traffic to be sustained. Taking these in their order named, let us first consider the character of the crust.

This should be of such a nature and on such foundation that the weight of the traffic will be thoroughly sustained without any aid whatever from the carpet. For average traffic on suburban roads, a waterbound macadam road on a suitable and sufficient foundation is an ideal crust upon which to apply a bituminous carpet, regardless of the nature of the bitumen used to form the carpet. Under some conditions, a cement concrete crust is excellent and preferable to waterbound macadam, in that it has more stability and will withstand a greater load. A concrete crust, however, does not appear to hold a carpet of an asphaltic nature as well as it holds one formed by the use of tar, the adhesion being apparently less with the former than with the latter material. A crust of good gravel, thoroughly compacted, is good under restricted traffic conditions, but it does not appear to hold a carpet formed by the use of heavy asphaltic or tar binders, unless the carpet is made of such thickness that it becomes a part of the road crust. Heavy binders as referred to herein, are intended to mean binders that require heating to a temperature of at least 180° F. in order to permit satisfactory application. A bituminous carpet on a gravel road appears to be successful under comparatively light traffic if a bitumen is used that does not require heating to a temperature above 100° F. before application.

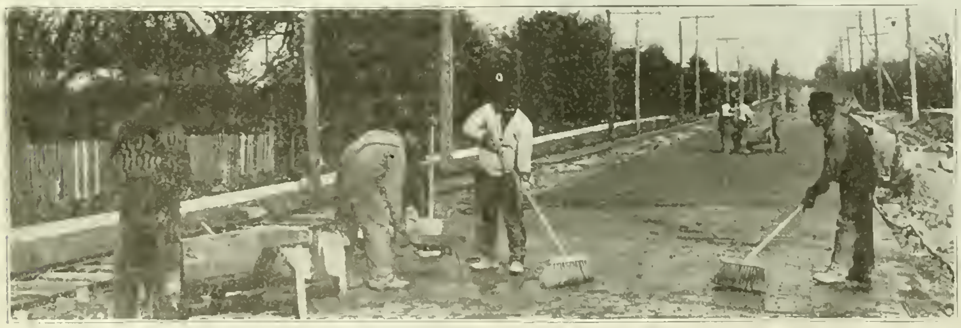


Fig. 7—First Application of Cement Grout.

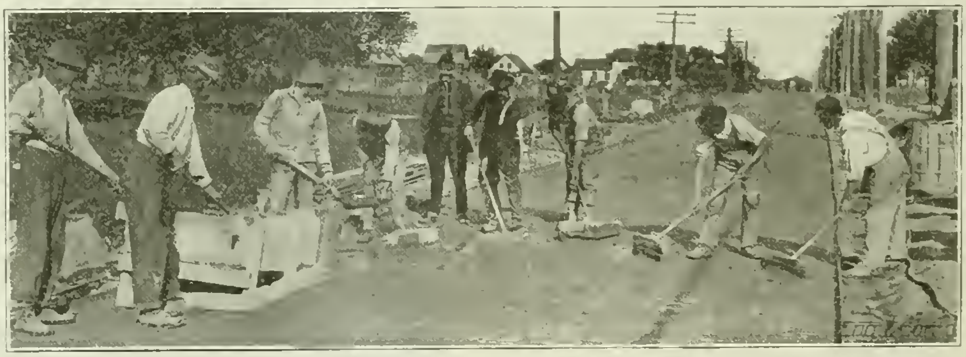


Fig. 8—Second and Final Application of Cement Grout.

A carpet formed by the use of any material on a dirt road is of no value whatever, as it breaks up under any kind of traffic and very soon ceases to be a carpet.

Continuing to the second principle feature, namely, the character of the bituminous carpet, we have again a very important factor. The kind of bitumen used and the method under which it is applied, the kind and amount of grit used, and the character of the grit, each and all have a very decided influence on the limitations of economical use. Experience has shown that a carpet must be uniform in thickness, and in order to be so, the bitumen and grit must each be spread uniformly, and in order to spread the bitumen uniformly, experience has shown that it must be distributed by means of pressure applied in some manner, either by introducing air or steam pressure directly into the tank in which the bitumen is contained, or in securing pressure by means of a pump of some form. Experience has demonstrated also that where it is desired to make a carpet requiring the bitumen to be applied at the rate of ½ gal. per square yard, uniformity is more successfully obtained by applying the bitumen in successive layers of approximately ¼ gal. per square yard, each layer of bitumen being covered with grit before the succeeding layer is applied.

The grit used for covering the bitumen should contain no clay or loam, and if the traffic to be borne is a mixed traffic, with steel tires predominating, it appears that the best and most lasting results are obtained by using a mixture of coarse and fine material, the coarse material consisting of tough pebbles, or stone broken to pebble size (approximately ½ in. in diameter), mixed with material of a finer nature, such as sand or a coarse grade of stone dust. Such mixing is better accomplished if the two grades of grit are applied separately in forming the blanket; that is, the coarser material being applied first and immediately followed by the finer material. Such method of application appears to give a firmer carpet that will withstand a greater amount of steel tire traffic than will a carpet formed by the use of either coarse or fine material alone. If a carpet is to carry a traffic consisting largely of automobiles, the coarser material does not become as necessary, although it appears to be preferable.

The kind of bituminous material that is preferable to use in a carpet is still a debatable subject, particularly as to whether tar or asphalt products are preferable and in the use of asphalts, whether a heavy asphalt requiring high temperature (200° F. or more) before application is preferable to one that does not require such high temperature. It has been the experience and observation of the writer, however, that the asphalts requiring high temperature before application give better and more permanent results under a mixed traffic than do the lighter asphalts. By mixed traffic, the writer means a combination of trucks, automobiles and heavy and light horse-drawn vehicles. A carpet formed with a heavy asphaltic material, however, does not withstand traffic consisting largely of heavy tired vehicles, the effect of such being to cut the blanket and cause it to crumble and to soon disappear from the surface.

The third principal feature, namely, the character of traffic, must necessarily be considered in connection with the second principal feature, already discussed. In fact, neither one of these three features hereinbefore mentioned can be discussed entirely by itself, as each is dependent somewhat upon the others. With a suitable road crust to sustain a bituminous carpet, traffic is an extremely important factor in determining what type of materials to use for such a carpet. The amount, type and weight of vehicles must necessarily be considered. It has been demonstrated that a tar carpet will carry economically 100 automobiles per day per foot in width of roadway, together with a horse-drawn traffic of 15 vehicles per day per foot in width of roadway. On the other hand, a similar tar carpet failed under a traffic consisting of 20 heavy horse-drawn steel tired vehicles per foot in width of roadway per day, with only 8 automobiles per foot. This clearly demonstrates that a tar blanket is not suitable and should never be used to sustain heavy horse-drawn traffic, but is suitable and economical in carrying automobile traffic. Inasmuch as no particular wear appeared to be caused by the above mentioned automobile traffic, it is safe to assume that a much larger traffic could be economically carried. Records kept by the writer show that what has been stated above regarding the tar carpet is true also of the heavy asphaltic oil carpet. Failures that have occurred under the writer's observation with a heavy asphaltic oil carpet have occurred where the ratio of the number of automobiles to the number of horse-drawn vehicles was not any greater than two to one, and if the horse-drawn vehicles are of the heavy two-horse type, with narrow tires, no amount of automobile traffic appears to be sufficient to counterbalance the destructive effect of 15 heavy horse-drawn vehicles per foot in width per day.

The writer is of the opinion that it is not wise at the present time to state general positive conclusions regarding limitations in the use of bituminous carpet surfaces. Such surfaces have been in use in this country only about four years, and the character and quality of the bitumen used at various times and in various places are so unequal, and the character of traffic over the highways is and has been changing so rapidly, that the results of experiments and observations have been variable. Positive and definite conclusions as to limitations can only be drawn after careful observation through a period of years, keeping a record of the kind and quality and amounts of material used in the carpet, and of the kinds, number and approximate weights of vehicles passing over the sections under observation.

Fig. 9—Completed Pavement, Buffalo, Glenwood Road.

Cost of Street Cleaning, Sprinkling and Oiling at Boston, Mass., in 1911.

(Staff Article.)

During the year ending Jan. 31, 1912, the street cleaning, street sprinkling and oiling branch of the Highway Division of the Department of Public Works of Boston, Mass., cared for 135.57 miles of paved street and 114.43 miles of macadam. The total area of paved street was 2,831,000; including gutters 9 ft. wide the area was 3,435,195 sq. yds. The following is a summary of the cost of the street cleaning service and street water service:

	1910-11.	1911-12.
Street Cleaning Service:		
Labor	$314,430	$323,536
Teaming	14,182	9,337
Supplies and repairs	87,621	115,800
Totals	$416,233	$448,673
Street Watering Service:		
Labor	$ 24,946	$ 25,173
Teaming	60,158	58,527
Supplies and repairs	76,080	82,285
Totals	$161,184	$165,985

The street cleaning was done by flushing, by machine sweeping and by the patrol system. Six districts were covered by the push cart patrol, the total cost of inspection, labor and teaming for this being $66,777. A total of 153,385 bbls. or 21,586 cu. yds. of dirt and other waste was removed, the average cost per cubic yard being $2.89. The average cost per barrel was 40.6 cts. The capacity of the wooden barrels was 4.6 cu. ft., and the capacity of the metal barrels was 3 cu. ft.

The cost of flushing was as follows:

Supervision	$ 635
Labor and teams	5,817
Repairs and tools	5,906
Total	$12,358

A total of 34,955,327 sq. yds. was flushed once, 8,205,605 gals. of water being used for this purpose. Approximately 0.234 gal. of water was used per square yard. The cost per 1,000 sq. yds. flushed once was 38.1 cts.

A total of 15,894.23 miles of paved streets was cleaned once by machine sweeping, the total area cleaned once being 328,562,000 sq. yds. To this should be added the 4,566.48 miles of gutter, or 24,112,000 sq. yds., cleaned once, making a grand total of 352,674,000 sq. yds. The total cost of the machine sweeping was $132,498. The average cost per mile cleaned once was $7.05, and the average cost per 1,000 sq. yds. cleaned once was 42.4 cts. The total number of loads of dirt removed was 68,386. As each load averaged 2 cu. yds. the total yardage removed was 136,772. The average number of cubic yards of dirt removed per 1,000 sq. yds. was .46 and the average cost of removal was 96 cts. per cu. yd.

The first application of water for street sprinkling was made on March 22 and the last on Dec. 26. The first application of oil on the streets was on March 22 and the last on Dec. 8. From April to September, inclusive, the weather was exceptionally dry and the carts were out 85 per cent of the time. This caused an increase in 1911 over 1910 in the total cost of $1,906. There was a decrease in the area cared for by water in 1911 of 302,414 sq. yds. The oiling area, however, was increased in 1911 by 241,011 sq. yds.

Water was used chiefly on granite blocks. The number of treatments varies from four in the city proper to two in the outlying sections. Good results were obtained by having sufficient carts that were handled by competent inspectors. The total area watered amounted to 2,349,494 sq. yds., which is equivalent to 133.489 miles of 30-ft. roadway. The total cost was $55,451, or 2.899 cts. per sq. yd. The total number of cart days worked was 8,685, 130,285 loads were spread during the season and 547,197,000 sq. yds. were covered once. A total of 78,171,000 gals. of water was used during the season. A watering cart distributes on an average 15 loads per day on an area of 4,200 sq. yds. to the load. Table I gives some further details on the street watering.

During the season all macadam streets were treated with an oil preparation. About 95 per cent of the streets were treated with the Standard Oil products. Dustolene, Tascoil, Headley XXII, Texaco and calcium chloride were used on the other 5 per cent of the streets. Dustolene and Tascoil were demonstrated on streets with a good asphaltic base, the result of oiling with asphaltic oils for the two previous years. These are non-asphaltic oils and they proved satisfactory having a greater penetration than the asphaltic oils. Headley XXII and Texaco were used on a boulevard traveled principally by automobiles and gave good results. This boulevard, however, had been previously treated with another asphaltic oil. The calcium chloride was used in the Bach Bay District during March and December when the temperature was below 32° and above 0° F. The cost of the oiling with the preparations other than the Standard Oil Co.'s products was as follows:

	Area treated once. Sq. yds.	Gals. used.	Total cost.
Dustoline	143,399	18,349	$1,321
Tascoil	58,309	9,280	583
Headley XXII	16.808	4.515	324
Texaco	48,471	7,966	333
Calcium chloride	136,733	*20,075	229

*Lbs.

The above materials were used chiefly on quiet residential streets and the main arteries—where the automobile is extensively used—in the outlying districts.

The total cost of the street oiling with the Standard Oil Co.'s products was $103,255. The total area oiled was 6,319,340 sq. yds., which is equivalent to 359.02 miles of 30-ft. roadway. The area covered once was 42,178,-006 sq. yds., and the average number of oilings for the season was 7.08. The average cost per square yard covered once was $0.0025, and the average cost for the entire season was $0.01718 per square yard. A total of 1,762,763 gals. of emulsion was used or 2.2262 per square yard. According to the report of the Public Works Department for 1911, from which these notes have been taken, about 10,860,880 gals. of water was used in this work.

TABLE I.—DAYS OUT, CART-DAYS WORKED, NUMBER OF CARTS OUT AND COST OF TEAMING AND LABOR, BY MONTHS.

Month, 1911.	Days out.	Cart-days worked.	Av. cart-days worked.	Number of carts out.	Av. number of carts out.	Cost of teaming.	Av. cost per cart, teaming.	Cost of labor.	Total cost, teaming and labor.	Av. cost per cart, teaming and labor.
March	4	86.0	22.0	91.0	23.0	$ 422.35	$ 18.36	$ 19.40	$ 441.75	$ 19.20
April	22	1,186.0	54.0	1,236.0	56.0	5,968.77	106.58	899.68	6,868.45	122.65
May	28	1,578.0	56.0	1.662.0	59.0	7,880.94	133.57	742.31	8,623.25	146.15
June	23	1,180.0	51.0	1,286.0	56.0	5,913.22	105.59	794.82	6,708.04	119.78
July	30	1,730.0	57.0	1,786.0	59.0	8,549.43	144.90	1,047.34	9,596.77	162.65
August	23	1,242.0	54.0	1,330.0	58.0	6,391.92	110.20	759.46	7,151.38	123.29
September	21	817.0	40.0	993.0	47.0	4,103.90	87.30	896.41	5,000.31	106.39
October	18	578.0	32.0	640.0	36.0	2,902.84	80.63	711.61	3,614.45	100.40
November	13	227.0	17.0	236.0	18.0	1,124.37	62.46	685.32	1,809.69	100.54
December	10	83.0	....	86.0	....	....	......	605.13	605.13	......
Totals	192	8,707.0	383.0	9,346.0	412.0	$43,257.74	$849.59	$7,161.48	$50,419.22	$1,001.05
Less Nov. and Dec.	178	8,538.0	361.0	9,169.0	389.0	42,835.39	831.23	6,536.95	49,372.34	981.85
Avgs., April to Nov.	22¼	1,067.25	45.125	1,146.125	48.625	....	103.90	....	....	122.73

Method and Cost of Clearing Site, Grading Streets and Constructing Concrete Sidewalks for Real Estate Development on Long Island.

Contributed by Myron H. Lewis, New York City.

This article describes the methods pursued and the cost of clearing, for the purpose of development, about four acres of land, grading about 5,000 lin. ft. of streets and laying 33,500 sq. ft. of concrete sidewalks.

The location of the property on which this work was done was in the village of Queens, Long Island. The owners of the property were the Lorma Realty Co. a corporation organized solely for the purpose of taking over and developing 16 acres of land. As the method of procedure was somewhat unique in enterprises of this nature, it might be well to describe briefly the general method and policy of the company.

The members of the company are composed largely of civil engineers, who became interested in the property, believing, that from its splendid location, and park-like surroundings, it would make an ideal colony for a select company of professional men. The company was organized, the land taken over, and after the details of the transaction were concluded, the method of distributing the land amongst the various stockholders was as follows:

The land was sub-divided into 250 lots, the prices of each was marked on the map, a copy of which was furnished to each stockholder; numbers for securing opportunity to choose were then thrown into a hat, the stockholders drawing therefrom; each stockholder, in his proper order, selected the lots that best suited his taste, paying therefor the prices previously set down on the map. In this way the equities of all concerned were preserved.

The writer would call attention to this method of securing well-located home sites for very low prices. No expenses were paid from the funds of the company for promotion or other fees, such as advertising literature, selling, commissions, or any other of the numerous expenditures for which the purchasers of land usually pay. The only overhead charge was a small fee to the secretary for services. None of the other officers received any compensation whatever. In this manner all of the available funds were employed to make improvements on the property.

The land purchased by the company consisted of a heavily wooded tract, in which lumber had been cut a number of times in past years, leaving some very large stumps and second and third growth timber. There were in all about 2,400 trees and stumps of which about 650 were removed by blasting, the remaining being removed by grubbing and the stump-pulling machine. The blasting required about 100 lbs. of dynamite, thus averaging about 2 lbs. of dynamite to each stump. There were moved in all about 3,000 cu. yds. of earth and there were laid on the property 33,500 sq. ft. of sidewalk. The method pursued in the clearing was as follows:

CLEARING LAND.

All the standing timber was first cut down and removed to adjoining property to be later cut up into cord wood. The smaller timber was then removed by means of the grub and stump-pulling machine and while this work was in progress holes were being bored with crow-bars and augurs into the roots of the stump making them ready to receive the dynamite. The charges were placed in the holes and after about 10 to 15 stumps were prepared they were fired by means of an electric battery 300 ft. distant from the nearest charge. After the explosions, men were set to work immediately with the grub to take out the roots which still remained clinging to the ground, although the stumps themselves were shattered into fragments. The removal of these remains proved costly on account of the springy and clinging nature of the roots.

LAYING WALKS.

When the clearing had been concluded and the necessary grading was approaching completion, the laying of the sidewalks was begun and continued successively for 22 working days until completion. Several interruptions were necessary on the account of additional grading. The average rate of laying concrete was almost 1,500 sq. ft. a day. When the sidewalk work was first begun, steel forms were employed and a continuous concrete mixer, but owing to the rough nature of the soil the use of steel forms and mixer were abandoned and wooden forms and hand mixing were found very much more economical.

The specifications called for a one-course walk laid on the natural soil which had first been thoroughly compacted and drenched with water and rammed so as to secure a thoroughly hard bottom.

The concrete was mixed in proportion of 1 part Portland cement and 5 parts Band-Run-Gravel. The walks were 4 ins. thick and varied in width from 4 ft. on the side streets to 5 ft on the main streets. The full 4 ins. of concrete were laid thoroughly wet so that little ramming was required. After being struck off with a straight edge, there was sprinkled over the walk a dry mixture of cement and sand in the proportion of 1 to ½ per cent of lamp black, having been first mixed with the sand. This mixture was sprinkled on the walks and worked into the rough concrete with a trowel, followed with a wooden float, sufficient water being sprinkled to enable the perfect blending of the two. The joints in all cases were cut all the way through to the bottom. These were about 3/16 in. thick and special expansion joints were left at frequent intervals. The amount of cement used was almost exactly 1 bag to 16 sq. ft. of sidewalk; or, in other words, a bag to the flag, on 4-ft. flags. The surfaces of all the walks were left much rougher than is usually the custom, at the special desire of the company in order to avoid the slipperiness incidental to sidewalks during the winter months. It is expected that the rough surface will reduce this trouble. Although the mixture for the walks appears rather lean for a one-course walk, teams passed over the walks within a few weeks after they were in places and although only 4 ins. thick, not even a scratch mark was left to show the caulk marks or marks of the steel tires. At present writing the work is in perfect condition.

COST OF THE WORK.

The work complete, including cutting of the timber, taking out 2,400 stumps, moving about 3,000 yds. of earth and laying 33,500 sq. ft. of walks, was $6,500. The contract price of the walks, including the cost of inspection, and the erection of a suitable house for storage purposes and office use, was 11 cts. per square foot, making this item $3,685. The cost therefore of the clearing and grading was $2,800, of which $260 was the contractor's profit. This part of the work was done on a cost plus 10 per cent basis, leaving about somewhat over $2,500 as the cost of clearing and grading. This amount included $150 for permits and insurance on this part of the work. The net cost of clearing and grading, excluding profit and insurance. is therefore $2,350, of which approximately $1,000 was clearing and $1,350 was grading. The material moved was a very stiff clay, all of which had to be loosened with a pick before it could be shoveled. The material was carried in 1 cu. yd. loads, the average haul being about 300 ft. The cost therefore per cubic yard was 50 cts., which included excavation, hauling, and making the fills. The cost of removing stumps was somewhat less than 50 cts. per stump. Some of the largest stumps cost over $2 apiece. Figured on the square yard basis there were 30,000 sq. yds. at about a cost of 9½ cts. per square yard for clearing and grading. The force employed on the sidewalk work consisted of a superintendent, at $5 per day, a form-setter at $4.50 per day, four masons from $3 to $4 a day and 15 to 20 laborers at $2 per day. Two teams were also employed in excavating and hauling. Four of the laborers were constantly employed in the sandbanks. The maximum rate of speed was 2,400 sq. ft. per day. This rate was reached towards the completion of the work and then with the payroll cost of $75 per day or 3½ cts. per sq. ft., which included excavating and hauling of the sand.

The most economical procedure was to excavate the trenches and have sufficient amount of forms set ahead for the completion of a day's work so that no stoppage at all was necessary in the concrete gang. The contractor's profit on this work was approximately 10 per cent, out of which the equipment for all of the work had to be paid for.

Some 6,000 sq. ft. of sidewalk laid in an adjoining development under a very much similar specification cost 1 ct. per square foot more to lay than the above work. In this stretch of walk 3½ ins. of concrete were first run in, mixed in the preparation of 1 to 6, and ½ in. of top finish mixed 1 to 2½ was placed over same immediately after the bottom was put in.

By the above procedure, the Lorma Realty Co. secured improvements on 250 lots, converting what was practically a virgin forest into a beautiful park-like development at a cost of approximately $25 per lot.

The writer would commend the methods pursued by this company as a good example of what can be accomplished by co-operation of enterprising associates. The contractors for this work were Lean Bros., of Asbury Park, N. J.

Bituminous Surfaces on Brick Pavements at Minneapolis, Minn.

One of the principal traffic streets in Minneapolis, Minn., Nicollet Ave., from 10th St. to 13th St., was paved with brick in 1898, a sand filler being used. The pavement has shown very little wear, except the edges of the brick, which have chipped considerably since power flushing was used in cleaning the street. It was thought that an asphalt coating would make the street less noisy and prevent chipping, so one-half of a block was thus treated in the spring of 1912. The following details of the treatment are taken from a paper presented at the Cleveland meeting of Section D of the American Association for the Advancement of Science, by Ellis R. Dutton, Assistant City Engineer, Minneapolis, Mnin.:

The asphalt was applied hot, using about ½ gal. per square yard. The surface and the joints were thoroughly broomed and dried before the asphalt was applied, and after the application the surface was covered with a thin coating of coarse sand. This experiment has proved so successful that application has been made to treat quite a large yardage in a similar manner, and will probably be done this season. The asphalt used in this experiment was of the following quality:

Specific gravity at 25° C	0.980
Melting point (Am. Soc. of C. E. test)	117° F.
Penetration, No. 2 needle, 100 grams, 5 sec.	77° F.-175
Penetration, No. 2 needle, 200 grams, 1 min.	32° F.-60
	Per cent.
Loss, 5 hrs., 325° F	2.4
Bitumen soluble in carbon disulphide	99.7
Organic matter insoluble	.2
Ash	.1
Bitumen soluble in 88° B. naphtha	75.5
Fixed carbon	7.8

It adheres to the brick very well, does not become excessively soft under severe sun, and has shown no chipping effect from the cold, has reduced the noise, increased the foothold for horses and greatly improved the appearance of the surface.

In the construction of new brick pavement this year it was thought that if this coating of an old brick street so improved it, why should it not be wise to so cover the new work. Consequently, instead of only filling the joints as had previously been done, the surface was also covered with asphalt, making a smooth asphalt appearing surface of the brick paving. A larger amount of asphalt was used; about twice as much per square yard (approximately 10 lbs.), but the cost was not increased over the old joint filling method, as the labor cost was so much less than in the old method. This has been used on about 38,000 sq. yds. of brick paving this year, and seems to be very satisfactory. The analysis of the asphalt used on the brick is as follows:

Soluble in carbon Tetrachloride	99.60%
Loss at 325° F., 5 hrs	.04%
Fixed carbon	11.62%
Specific gravity at 77°	.9885
Penetration, 32°	46
Penetration, 77°	67
Penetration, 115°	122
Penetration, 77° after heating	58
Flash	536° F.
Burn	580° F.
Melting point—Ball & Ring	180° F.
Melting point—General Electric	183° F.

Service Test of Street Pavements Under City Traffic.

(STAFF ARTICLE.)

The first experimental pavements to be constructed on any extended scale in this country to determine the relative qualities of wearing surfaces under city traffic have been completed recently on Second Ave., between Houston and 25th St., Manhattan Borough, New York City. The older pavements of the city, consisting of rough granite blocks with wide joints, on a surface of asphalt laid on the old block pavement, have long been recognized as unsuitable and the present city administration has devoted all available repaving funds to the superseding of this type or class of pavement with wearing surfaces of a modern type laid on a substantial foundation. The classes at present used consist in general of granite blocks laid with close joints and having comparatively flat heads, wood blocks, sheet asphalt and asphalt block. In order to furnish more accurate data as to the relative behavior of these different kinds of pavement under comparatively similar traffic there was laid during the season of 1912 a series of test pavements. The portion of Second Ave. on which these pavements were laid is subjected to a reasonably uniform traffic, including considerably heavy trucking. Except in a few blocks the experimental pavements have not been laid between the car tracks; it is planned to repave this area during 1913 with improved granite blocks. The test pavements were laid under the supervision of the Bureau of Highways of Manhattan Borough. We are indebted to Mr. H. W. Durham, Chief Engineer of the Bureau, for the information on which the contents are based.

The following types were used in the experimental pavement:

Going north from Houston St., which is paved with wood block, to the south side of 3rd St., asphalt blocks have been used laid on a ½-in. mortar bed with a 5½-in. concrete foundation. These are the standard asphalt blocks as laid on various streets in the city and are made of asphaltic cement, crushed trap rock and inorganic dust. The blocks were 5 ins. wide, 2 ins. deep and 12 ins. long. They had a specific gravity of not less than 2.45 after drying for 24 hours at a temperature of 150° F., and no greater absorption than 1 per cent of moisture when immersed in water for 7 days. The concrete base was made of 1 part cement, 3 parts sand and 6 parts gravel. The westerly roadway was opened to traffic on Nov. 15, 1912, the easterly on Nov. 22, 1912.

From 3rd St. to 4th St. 3¼-in. sawed Medina sandstone cubes have been used with a 6-in. 1-3-6 concrete foundation and a 1½-in. sand cushion. The blocks are cut with parallel sides, laid with right-angle close joints, which are tight for ⅓ of their depth, and filled with a 1 to 9 cement and sand grout. The westerly roadway was opened to traffic on Dec. 12, 1912; the easterly on Jan. 10, 1913.

From the south side of 4th St. to the north side of 5th St. Medina sandstone was also used, but standard size blocks were employed, having a width of 3½ to 5 ins., a depth of 6 to 6½ ins. and a length between 7 and 12 ins.—laid on a 1½-in. sand cushion and a 6-in. concrete foundation. The blocks are laid with close joints which were tight for at least 2 ins. down, and grouted with cement. The pavement was opened to traffic at the same time as the previous section.

From 5th St. to the north side of 7th St. the surface is wood block divided into three classes—all of Southern short-leaf pine, laid on a 1-in. sand cushion and 6-in. concrete foundation. The blocks in the first section have been treated with 20 lbs. of a heavy coal-tar product of a specific gravity not less than 1.10 at 38° C.; the second, with 20 lbs. of light creosote oil having a specific gravity of 1.03 to 1.08 at 38° C.; and the third with 20 lbs. of water-gas tar with a specific gravity not less than 1.10 at 38° C. The blocks were 4 ins. deep, 3 ins. wide and 8 ins. long. The concrete base was a 1-3-6 gravel road. This westerly roadway was opened to traffic on Dec. 20, 1912; the easterly roadway on Jan. 6, 1913.

North of 7th St. sheet asphalt was laid on common binder, in accordance with the old city specifications, the wearing surface being 2 ins. thick and the binder course 1 in. thick, on 6 ins. of 1-3-6 concrete. This material extends to the north side of 9th St. The westerly roadway was opened to traffic on Oct. 25, 1912; the easterly roadway on Nov. 12, 1912.

At 9th St. a section of rock asphalt blocks begins, made of natural bituminous limestone rock. The blocks are 2½ ins. deep on a ½-in. mortar bed with a 5½-in. 1-3-6 concrete foundation. The blocks were 2½ ins. deep, 6¼ ins. long and 4 ins. wide; they had a minimum weight of 6 lbs. per block. The westerly roadway was opened to traffic Oct. 5, 1912; the easterly roadway on Oct. 10, 1912.

From the south side of 11th St. the pavement is again sheet asphalt, but on close binder in accordance with the present standard specifications. The wearing surface is 1½ ins. thick and the binder course 1½ ins. with a 6-in. 1-3-6 concrete foundation. The westerly roadway was opened to traffic on Nov. 2, 1912, and the easterly on Nov. 16, 1912.

From the south side of 13th St. to the south side of 15th St. the pavement is wood block. Southern long-leaf yellow pine blocks being employed, but treated in six different ways, all laid on a 1-in. sand cushion and 6-in. 1-3-6 gravel concrete foundation. The blocks were 4 ins. deep, 3 ins. wide and 8 ins. long. The blocks in the first section were treated with 16 lbs. heavy oil per cubic foot; specific gravity not less than 1.10 at 38° C.; cost $3.73 per square yard including concrete base. The blocks on the next section were treated with 20 lbs. heavy oil per cubic foot; specific gravity not less than 1.10 at 38° C. The blocks in the third section were treated with 20 lbs. of light oil per cubic foot; specific gravity not less than 1.03 nor more than 1.08 at 38° C. The next series of blocks were treated with 16 lbs. light oil per cubic foot; specific gravity not less than 1.03 nor more than 1.08 at 38° C. The next, final sections, were treated with 20 lbs. water-gas tar per cubic foot and 16 lbs. water-gas tar per cubic foot; specific gravity not less than 1.10 at 38° C. The westerly roadway was opened to traffic on Oct. 21, 1912, and the easterly on Oct. 11, 1912.

From 15th St. to 17th St., past Stuyvesant Sq., asphalt blocks have been laid, including the area between the rails. It was intended to lay in this area a block more suitable for heavy traffic than that in the first section, and consequently specifications were varied slightly. As a matter of fact, however, the standard blocks of the contractors passed both tests and both sections are laid with the same block. The blocks are 5 ins. wide, 3 ins. deep and 12 ins. long. They were laid on a ½-in. mortar bed on 5½ ins. of 1-3-6 gravel concrete, and the joints filled with fine sand. The specific gravity was not less than 2.46 after drying for 24 hours at a temperature of 150° F. There was no greater absorption than .6 per cent of moisture when immersed in water for 7 days. The westerly roadway was opened to traffic Nov. 16, 1912; the track area on Nov. 29, 1912, and the easterly roadway on Oct. 30, 1912.

The intersection of 17th St. was paved with Australian hard wood blocks, which were painted with tar before laying. These blocks were purchased by the City and furnished to the contractor. They are 4½ ins. in depth, laid on a ¼-in. tar cushion with a 6-in. concrete foundation. The blocks are 4½ ins. deep, 3 ins. wide and 8¾ ins. long. They were laid with joints as close as possible and filled with paving pitch.

Between these blocks and the north side of 19th St. the pavement is again Southern short-leaf pine laid on a 1-in. sand cushion and 6-in. concrete foundation. The first section was treated with 16 lbs. of heavy oil per cubic foot; the next with 16 lbs. of light oil; and the northern section with 16 lbs. of water-gas tar. This area also includes the space between the rails. The westerly roadway was opened to traffic Sept. 7, 1912; the track area Oct. 30, 1912, and the easterly roadway Oct. 30, 1912.

Rock asphalt from the Sicilian mines at Ragusa, 2½ ins. thick, on a 6-in. concrete foundation, has been laid from the end of the wood block to the north side of 21st St. The westerly roadway was opened to traffic Sept. 19, 1912, and the easterly roadway Sept. 21, 1912.

The final section to 23rd St. is laid with the special granite block from the Rockport, Mass., quarries, cut in accordance with the latest specifications of the department; having a depth of 5 ins. and joints not to exceed ⅜ in. laid on a ¾-in. sand cushion and 6-in. concrete foundation, but with joints filled with cement grout instead of the usual paving pitch. The blocks are 7 ins. to 11 ins. long, 3½ ins. to 4½ ins. wide, and 5 ins. deep, and are so cut that the joints do not exceed ⅜ in. Dry sand was broomed into the joints to within 3 ins. from the top and a grout composed of 1 part Portland cement and 1 part sand poured into the joints until flush with top of paving blocks. The westerly roadway was opened to traffic June 15, 1912, and the easterly June 29, 1912.

Had there been sufficient room to allow it, other types of granite would have been laid for comparison, and it is the plan of the department to do this in some other place as soon as occasion arises. It is particularly desired to pave adjacent sections with blocks from different quarries, in order to observe their relative wearing qualities, as considerable difference of opinion exists about the comparative importance of hardness as against smoothness of surface. Frequently stone showing under test the greatest hardness has a coarse grain rendering it difficult to produce a smooth block without too great expense.

In a distance slightly over a mile there is for comparison three sections of asphalt block, two of Medina sandstone, one of granite, three varieties of sheet asphalt, and 13 of wood block. The latter in particular will furnish an opportunity for comparing the relative merits of different amounts and varieties of oil treatment, not only as to the durability of the block itself, but as to the amount of bleeding which may take place in warm weather; and whether any differences are observed in the slipperiness of the surface both in wet and dry weather. This latter condition of course will be studied in regard to all the different types.

On account of necessary overhauling of street mains in advance of repaving and because of the fact that the contracts included widening the street between curbs from 40 ft. to 57 ft., considerable reconstruction work was necessitated in house service pipes, vaults, etc., in advance of the repaving.

It was impossible to carry on the construction of all contracts simultaneously and consequently some sections were completed several months before the others. Measurements, however, have been taken on each section, immediately after completion, for comparison with future observations for the determination of wear. It is the purpose of the department to take systematic records of wear and depression, as well as other observations for the determination of the relative values, not only of the different types of surfaces, but the different treatments of the wood block and asphalt which have been used.

It was hoped for purposes of comparison to lay also short sections of vitrified brick, small granite cubes and Durax; but although specifications were prepared and contracts advertised and negotiations taken up with various contractors for the purpose of having this work done, no bids were received, and the attempt had to be abandoned for the present.

GENERAL ARTICLES

Tests of Efficiency of Motor Trucks With Trailers.

An investigation of the relative costs of operation of reversible dump wagons handled in trains and team dump wagons has been recently made by Mr. Richard T. Dana, M. Am. Soc. C. E., directing the Construction Service Co. of New York City. The results of these tests, as reported to the Troy Wagon Works Co. of Troy, O., have been furnished to us and from them we publish the following description and summary.

The Troy reversible dump wagons tested were of 3 cu. yds. capacity and the team dump wagon was 1½ cu. yds. capacity. Four road construction contracts of various operations and conditions were studied and curves plotted (Fig. 1), showing the haulage costs per ton in cents up to 3¾ miles haul. They were deduced from the following formulas in which C = total expense per day; t = the rated capacity; S = the average speed loaded; K = ratio of the speed light to the speed loaded; KS = the average speed returning; L = the time lost in loading, unloading, turning, resting and wasted for an average round trip; R = the total cost per ton for transportation, and W = the number of minutes or hours in the working day.

(1) D/S = time for loaded trip.

(2) D/KS = time returning.

(3) Combining with L (above) and factoring:

$T = D/S\ (1 + 1/K) + L$ = average time for round trip.

(4) $N = W/T$ = average number of round trips per day. This value must be a whole number for average work for any one day.

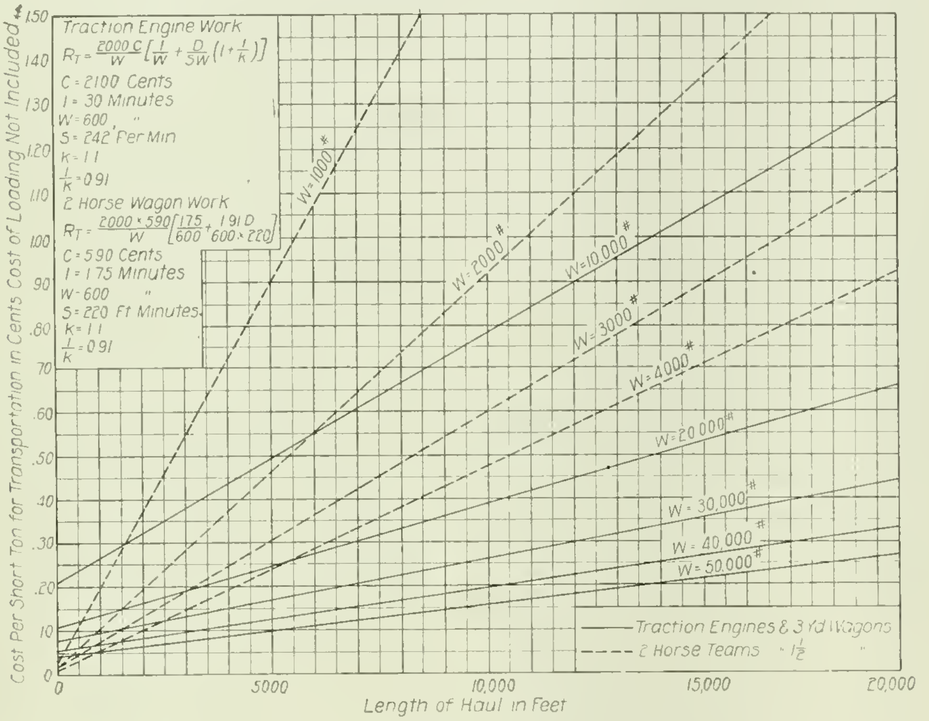


Fig. 1—Cost Per Ton Comparison Curves Between Train and Team Drawn Dump Wagons.

TABLE I.—FIRST CONDITION; ONE TEAM HAULING ONE SLAT WAGON.

Depreciation on wagon	$0.0500
Interest	0.0135
Horse hire, including driver	5.0000
Repairs	0.1500
Liability insurance	0.0300
Harness care	0.0720
Incidental, including superintendence	0.5000
Total cost per day	$5.8155

(5) Nt = average total amount transported per day.

(6) $R = C/Nt$ = cost of transportation per pound or per ton.

Tables I and II depend so largely on the prevailing price of teams that they will vary according to locality.

Tables II to V give the values for C in the classes of hauling under consideration.

Owing to the extra wear on the tires, observed in the Troy tests in hauling the trailers, the mileage of the tires in Tables IV and V is reduced.

Studying these curves (Fig. 1) it will be noted that wide savings are effected by the train (indicated by the solid line) over the teams (indicated by the dotted line) in the longer hauls, as, for instance, assuming a haulage of crushed stone in a six-wagon train (or 40,000 lbs. per load), and in a two-horse bottom dump wagon train (or 4,000 lbs.) for two miles, indicates a cost of 20 cts. per ton and 46½ cts. per ton respectively. But it will be seen that the curves cross at about 1,500 ft., showing that the teams are cheaper than the train for short hauls. The reason for the curves crossing lies in the proportion of lost time, L, to the actual time of hauling. All measures of efficiency are based on delivery, delivery being directly proportional to a combination of the average speed

TABLE II—SECOND CONDITION; ONE TEAM HAULING TWO REAR DUMP WAGONS, IN WHICH ONE IS LOADING AND ONE CONSTANTLY IN TRANSIT.

Depreciation on wagons	$0.2917
Interest	0.0788
Horse hire, including drivers	5.0000
Repairs	0.1200
Liability insurance	0.0400
Harness care	0.0720
Incidental, including superintendence	0.5000
Total cost per day	$6.1025

TABLE III—THIRD CONDITION; THREE-TON MOTOR TRUCK DELIVERING ITS RATED CAPACITY.

Depreciation	$2.3333
Interest	0.4200
Chauffeur	4.0000
Garage	0.8333
Insurance	0.5000
Total (F) per day	$8.0866
Tires, 8,000 miles	$0.0438
Gasoline	0.0485
Lubricant	0.0050
Grease, etc.	0.0025
Incidental	0.0147
Repairs	0.0400
Total (m) per mile loaded	$0.1537

TABLE IV. — FOURTH CONDITION; MOTOR TRUCK ACTING SOLELY AS A TRACTOR AND A PLANT OF THREE TRAILERS IN WHICH ONE IS LOADING AND ONE UNLOADING, AND ONE CONSTANTLY IN TRANSIT.

Motor per day (F, Table III)	$8.0866
Depreciation on trailers	1,2000
Interest	0.4500
Storage of trailers	0.5000
Insurance	0.5000
Total (F—cost per day)	$10.7366
Tires, 5,000 miles	$0.0700
Gasoline	0.0485
Lubricant	0.0050
Grease and waste	0.0050
Repairs to motor	0.0500
Repairs to trailers	0.0300
Incidental (5 per cent)	0.0104
Total (m—per mile loaded)	$0.2189

TABLE V. — FIFTH CONDITION; MOTOR TRUCK ACTING SOLELY AS A TRACTOR AND A PLANT OF SIX TRAILERS IN WHICH TWO ARE LOADING, TWO UNLOADING AND TWO CONSTANTLY IN TRANSIT.

Motor per day (F, Table IV)	$8.0866
Depreciation on trailers	2.4000
Interest	0.9000
Helper	1.5000
Storage of trailers	0.5000
Insurance	1.0000
Superintendence	1.5000
Extra labor loading and unloading	12.0000
Total (F—cost per day)	$27.8866
Tires, 4,000 miles	$0.0875
Gasoline	0.1215
Lubricant	0.0100
Grease and waste	0.0050
Repairs on motor	0.0600
Repairs on trailers	0.0600
Incidental	0.0162
Total (m—per mile loaded)	$0.3602

TABLE VI.

	First condition: One team and one wagon.	Second condition: One team and two wagons.		Third condition: Motor truck alone.	Fourth condition: 3 trailers, one only in transit	Fifth condition: 6 trailers, 2 only in transit
O	$5.80	$6.30	F	$8.087	$10.737	$27.877
t	3 tons	3¼ tons	m	$0.154	$ 0.219	$ 0.360
s	2 mi. per hour	2 mi. per hour	p	0.8	0.8	0.7
KS	2½ mi. per hour	2½ mi. per hour	pm	$0.123	$ 0.175	$ 0.252
D	Variable	Variable	S	8 mi. per hour	8 mi. per hour	8 mi. per hour
W	9 hours	9 hours	K	1.25	$ 1.25	$ 1.25
L	15 mins. loading	5 mins. dump and wind	KS	10 mi. per hour	10 mi. per hour	10 mi. per hour
	15 mins. unloading	3 mins. hitching	D	Variable	Variable	Variable
	5 mins. incidental	2 mins. incidental	L	15 min. load., unload. and 2 min. shunting	5 min. (see below)	7 min. (see below)
			W	9 hours	9 hours	9 hours
	35 mins. Total L.	10 mins. Total L	t	3 tons	5 tons	10 tons

and capacity of the outfit, and the average speed depending upon the proportion of lost time to the actual time of hauling.

It is recognized by truck users, and even by truck manufacturers, that the motor truck for short hauls is not practical and exhaustive tests show that it is not due to lack of economy in the operation of the truck. The lost time which affects the rate of delivery so largely must, therefore, be responsible.

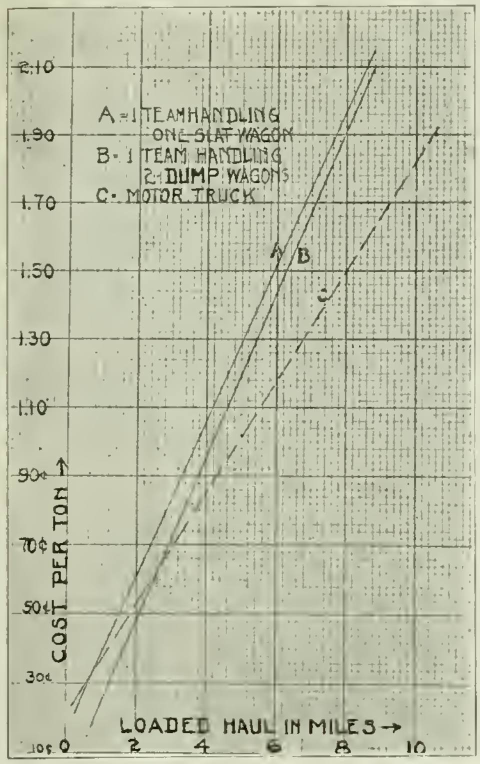


Fig. 2—Cost Per Ton Comparison Curves Between a Motor Truck and Two Horse Drawn Outfits.

The writer recently timed the loading of a five-ton English truck in Montreal. Sand was being handled, two men loading the truck from railway cars in about 35 minutes. No time was lost in placing at the railroad and about two minutes lost in placing and dumping at the unloading point, or 37 minutes in all. This truck made an average speed of about six miles per hour loaded and eight miles light. It has steel tires and was costing its owner about $18 per day.

The comparison curves *A*, Fig. 2, give *R* (cost per ton) for this truck based on the following values, using the formulas for *R* just given: $C = \$18$; $t = 5$ tons; $S = 6$ miles per hour; $KS = 8$ miles per hour; $D =$ variable; $L = 37$ minutes, and $W = 9$ hours.

In a recent article in "The Engineering Record," Oct. 2, 1912, sand and gravel haulage by a contractor in Youngstown, O., is described, in which the contractor, by means of bins and unloading platforms, reduced his lost time to less than a minute. If the Montreal contractor has had bins from which his truck could have been loaded, his lost time loading would have been reduced to about 1 minute, which with 2 minutes unloading and an incidental of 1 minute would have made a total lost time of 5 minutes as against the actual 37 minutes.

Giving this value for *L* in the formula for *R* (cost per ton) instead of 37 minutes, solving and plotting, curve *B* (Fig. 3) will result. Comparing these two converging curves (Fig. 3), the wider differences being on the short hauls, the effect of the reduction of the lost time will be seen.

Investigating further along these lines, figures on the handling of brick under the average city conditions, based on the recent observations made at Detroit and other points, will be used. Five conditions of hauling will be considered and will be grouped so as to compare two team outfits to a motor truck (Fig. 2) and a motor truck to two trailer plants (Fig. 4).

The factors and formulas given above will hold for the wagon drawn outfits, but for the motor outfit, the factor *C* (cost per ton) must contain a fixed charge *F* (per day) and operative expense *m* (per mile) *loaded haul* and a ratio *p* for cost per mile loaded to cost per mile light (a difficult factor, obtainable only from an extended series of observations). The factors, then, are as follows: $F =$ fixed charged per day; $m =$ charge per mile loaded, and $pm =$ charge per mile light. *S*, *K*, *D*, *L*, *t* and *W* are the same as given above; combining and factoring, we get:

$R =$ (cost per ton) $=$

$$R = \text{(cost per ton)} = \frac{Dm}{t}\left(Dm(1+p)\right) + \frac{F}{N}$$

In which *D* (length of the loaded haul) and *N* (number of trips per day) only are variable.

Table VI gives the values to the factors in the formulae above for the conditions noted.

These estimates are based on observation made at Troy and elsewhere and are made as nearly under same conditions as possible to obtain the comparison. The operative cost *m* are for the loaded hauls only, the factor *p* being used in the formulas to get the unloaded charge.

Substituting the above value in the formulas previously given and for *R′* above, solving and plotting—the curves in Fig. 2 and 4 result; as an example, take a four-mile haul in the 4th condition (8 miles round trip):

$T = D/S\ (1 \times 1/K) \times L = 4/8\ (1 \times 1/1.25)$
$\times\ 0.082 = 0.983$ hours.

$N = W/T = 9/0.983 = 0$ trips per day.

$R' = 1/5\ (4 \times 0.219 \times 1.8 \times 10.737/9) = \$0.555$ cost per ton.

Since in actual practice *N* must be a whole number, the resulting curves will not be regular, but varying conditions will vary the values and the curves and the comparison is made with the same conditions governing each.

Comparing the curves in Fig. 2, it will be seen, as in Fig. 1, that in the short hauls, the horse outfits are cheaper than the motor, lost time cutting down the delivery by reducing the average speed.

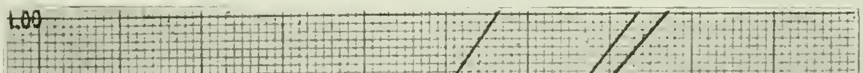


Fig. 4—Cost Per Ton Comparison Curves, Between a Motor and Two Different Trailer Plants.

A high combination of speed and capacity must compensate for the increased cost of the motor truck; therefore, increase of capacity without a corresponding decrease in speed, tend towards the solution of the problem. In the majority of cases, bins or mechanical handling devices, especially in city railway yards, are impossible. To solve the problem under these conditions, trailers have been tried.

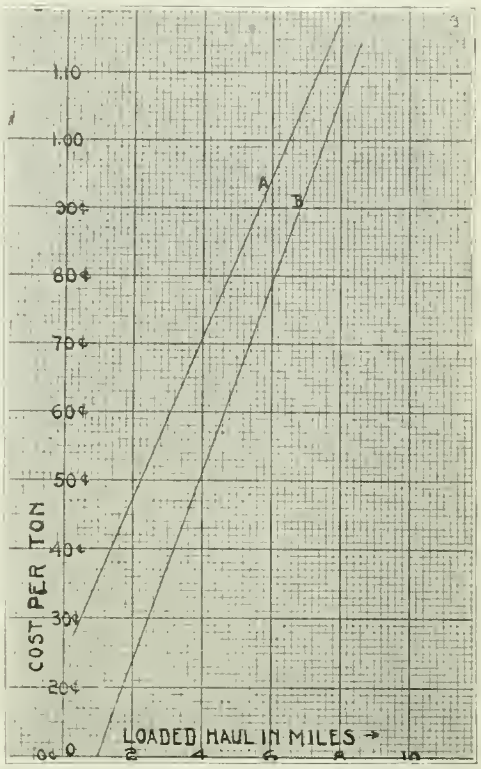


Fig. 3—Cost Per Ton Comparison Curves Between Two Methods of Handling the Same Motor Truck.

In the absence of especially designed trailers, makeshifts were employed, such as team wagons with stub tongues and the larger traction drawn wagons, but all were found to be impractical at the usual speed of the motor truck. A trailer must be one that will stand up to the stress of higher speeds with plain, stout, well lubricated bearings, one that will track perfectly with the motor on curves, that is reversible, that may be pushed or drawn at will, and small enough to be easily used in trains, so that by its use in handling, the lost time will be reduced to a minimum. Trials of such trailers were made at Troy, Ohio, a description of which will be given later in this article.

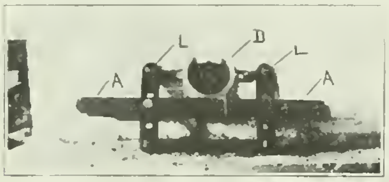


Fig. 5—Kohlbusch Dynamometer and Coupling Frame.

Continuing the investigation, the effect of trailers on the cost of delivery will now be considered.

The time observed at Detroit in handling brick was from 15 to 20 minutes per thousand (5 tons) for loading and unloading, which seems to be about the time required for loading and unloading 5 tons regardless of the weight of the brick.

At the Troy tests, 1 min. and 14 secs. were consumed uncoupling the motor, reversing truck and trailer and moving the heavy coupling frame, with the dynamometer. The lost time in this problem is based on this observation.

Assuming a condition in which the empties must be placed and fulls pulled out, time lost at loading and unloading points will be as follows:

	3 trailers: 1 in transit.	6 trailers: 2 in transit.
Placing and dropping empties..	1.5 min.	2 min.
Coupling to loaded..............	1 min.	1 min.
Placing and dropping fulls.....	1.5 min.	3 min.
Coupling to empties...........	1 min.	1 min.
Total	5 min.	7 min.

The lost time on the short hauls has been measured in the caluculations, above those shown above, because the time of the motor in transit is less than the unloading of the trailer. A small expense of superintendence and labor saving devices would still further reduce the cost shown in these tables and figures.

To make a logical comparison between the three conditions, the time of loading and unloading the two trailers must be the same as for the one trailer or the motor truck alone, hence the extra labor cost is included in the 5th condition.

Unless the conditions are favorable in the long hauls, two trailers loaded with five tons each do not seem to be practical for a motor of the capacity of a three-ton truck, as shown by the Troy tests.

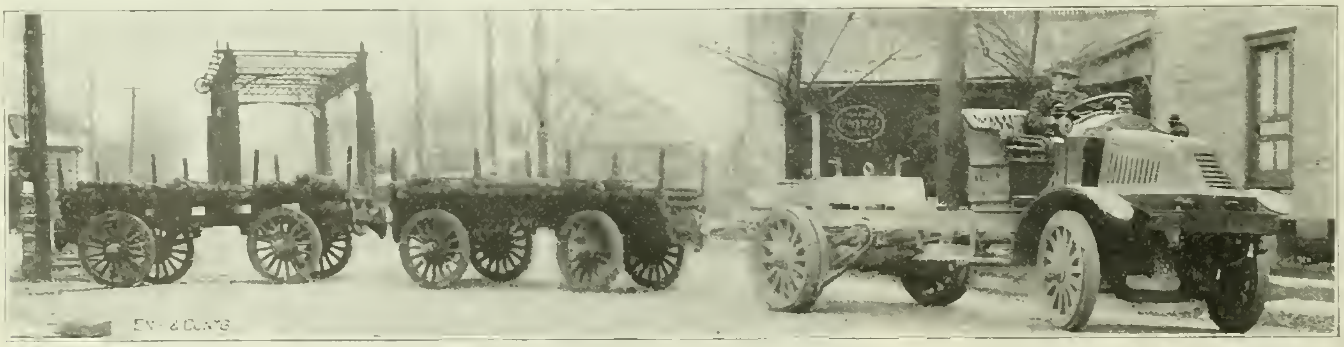


Fig. 7—Motor Truck and Trailer Showing Coupling Between Motor and Trailer.

Figure 4 compares the hauling cost between the motor truck and the two trailer plants and Table VII compares the delivery. The capacity is increased and by reducing the lost time to a minimum, the speed is increased with the result, as shown in Figs. 2 and 4, that the cost of delivery is below that of all previous methods of hauling.

Complicated problems of reversing, turning, backing of the trailers, together with the unusual wear they will sustain, make the designing of a trailer a difficult problem. But if springs, automatic steering devices, shock absorbers, etc., are incorporated, the economy that is shown will be effective. And by use of such trailers designers of motors will find their problem greatly simplified, because a large percentage of the damage to the motor truck is due to the shock of the unloaded work—springs designed for heavy loads are so stiff that they make the truck practically springless when running light.

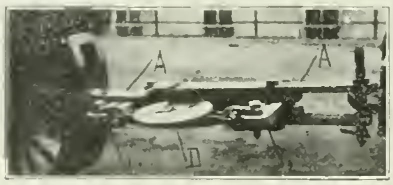


Fig. 6—Kohlbusch Dynamometer and Coupling Frame in Place Between Motor and Trailer.

TABLE VII.—TONS DELIVERED.

Length of haul.	First condition—1 team, 1 wagon.	Second condition—1 team, 2 wagons.	Third condition—Motor alone.	Fourth condition—Motor and 3 trailers.	Fifth condition—Motor and 6 trailers.
½.........	24	42	33	110	210
1.........	15	23	30	100	180
2.........	9	13	24	80	150
3.........	6	10	21	70	110
4.........	6	6.5	18	45	90
5.........	3	3.3	13	35	70

In a publication of "Cement Era" for February, 1912, there is an interesting article on this subject by Robert L. Niles, Jr., of New York city. His argument bears on suburban and country hauling largely and leads to the conclusion that the steam tractor will eventually be the motive power for all mechanical hauling. He says:

"The dealer in cement, sand or broken stone cannot afford to pay several thousand dollars for the sake of replacing three or four teams. If, however, at this expense he could replace ten or a dozen teams, he might be more ready to consider this investment."

The delivery in time in the five conditions of hauling noted above and on which curves of the preceding figures are based are as follows, from which it will be seen that his condition is met:

In the 4th and 5th conditions, it will be remembered that one-third the trailer plant only is in transit.

On the introduction of the trailers, the question of draft naturally arose. Various sources of information were consulted for figures on the draft that could be exerted by the motor trucks and that required by trailers. In Baker's "Roads and Pavements" there are tables on the draft of horse-drawn vehicles, the heavier hauling being with springless wagons, and some data on the draft of lighter spring wagons, but he says: "Apparently no experiments have been made upon the effect of springs."

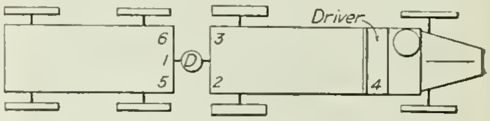


Fig. 8—Diagram Showing Assignment of Observers.

To this end and to obtain data as to the ability of motor trucks to handle trailers, the Troy Wagon Works Co., of Troy, O., in conjunction with the Kelly Motor Truck Co., of Springfield, O., conducted a series of 16 experiments with a Kelly three-ton motor truck and Troy Trailers. Ten tests were made in the city streets to determine the feasibility of making others on a more extensive scale. Only a short description and summary of these will be given.

The Kelly truck was of three-ton capacity and rated at 35 h.p., geared with four speeds, 12 miles being the highest. It carried a load during the entire test of two blocks of iron, each weighing 2,200 lbs. The truck weighed 5,200 lbs. One, two or three trailers were used, each weighing approximately 4,000 lbs., and having a carrying capacity of five tons. During most of the test, the trailers carried four tons each, but in the latter part were fully loaded to five tons.

Draw-bar drafts were recorded at every tenth revolution of the trailer wheels (about every 100 ft., the wheels being approximately 10 ft. in circumference). The drafts were read from a Kohlbusch dynamometer, D, (Figs. 5 and 6), which was mounted in a frame, consisting of a draw bar, *A*, working between the centers of the two leaves, *LL*. One end of the levers was fastened and one end attached to the dynamometer. Figures 6 and 7 show the method of coupling the dynamometer between the motor truck and the trailer, the dynamometer, therefore, recording one-half the actual pull. Time was kept by a stopwatch and was recorded at every station from which the velocity was determined. Grades of the route were obtained from the City Engineer's office.

During the test, while on the brick pavement, a demonstration of rigidity of the trailer for backing and its flexibility in making curves and turns was made. The three trailers were loaded with four tons and with the forward draw bars locked, the rear draw bars free and one man steering the trailer; the train was backed 400 ft. and around a 90° corner and could have been backed into any desired position, showing that while rigid enough to prevent buckling, the train was flexible enough to be steered around curves and turns. This same test was successfully made on macadam streets with the trailers loaded with five tons each. The tests demonstrated that the trailers acted favorably under all conditions and their adaptability was satisfactory.

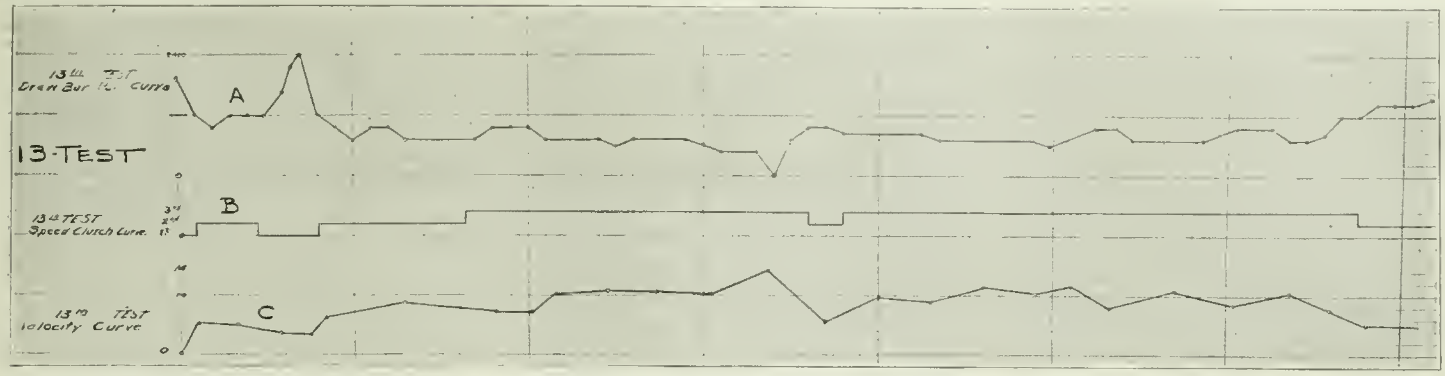


Fig. 9—Example of Road Test Record Diagram.

For the final experiments, a 7-mile route was surveyed, covering about 1 mile of brick pavement, and five miles of macadam country road, establishing well defined marks for timing, etc., accurately locating the grades and the various classes of road encountered.

In these final experiments, a Kelly three-ton, 40-h.p. truck of latest design was used (Fig. 7), having three sets of speed gears, the highest rated at 12 miles per hour. The same dynamometer and frame of the preceding experiments were used. Printed record sheets were used. Six runs were made, as follows:

(1) Motor truck and one trailer loaded with five tons of steel (12th test).

(3 and 5) Motor truck and two trailers, each loaded with five tons of steel (13th and 15th tests).

(4) Motor truck and two trailers, each loaded with two and one-half tons each.

(6) Motor truck and two empty trailers at the same approximate speed as in the fifth run.

The exact weight of the motor and tarilers and the total live load was noted, as well as the dimension of the gasoline tank, horsepower of the truck and number of speeds.

Also preliminary and final records of each tests were made of the amount of gasoline in the tank, weather, temperature and time of day.

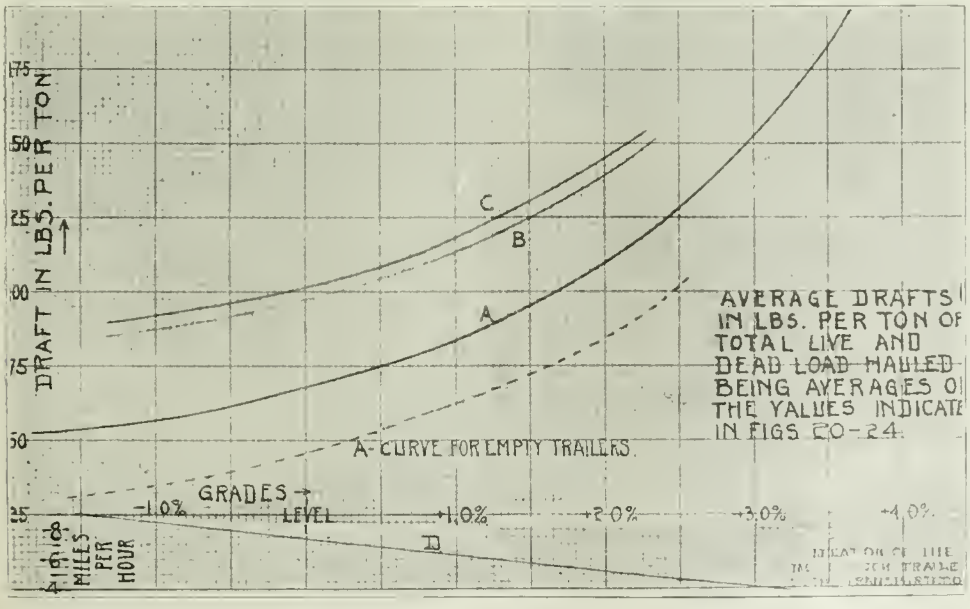


Fig. 10—Draft Per Ton Hauled.

Figure 8 represents the assignment of observers and recorders:

Observer 1—Read the dynamometer at every tenth revolution of the trailer wheels and intermediates when extraordinary pulls were indicated and kept tally of the revolution on a mechanical talley, thereby keeping observers 5 and 6 in time with him and each other.

Observer 2—Announced the time of passing the numbered landmarks established in the survey.

Observer 3—Counted the revolutions of the trailer wheels, announcing every tenth revolution.

Observer 4—Announced the speed clutch by displaying a numbered card which was read by recorder 6.

Observer 5—Noted the time announced by 2.

Recorder 6—Noted the readings announced by 1—and the clutch signalled by 4.

After all the reductions were made, the profile of the course noting the various pavements encountered, the actual draw-bar drafts, the speed gears used and the various velocities were plotted for the entire route. An example covering one test only is shown by Fig. 9, the draft, speed clutch and actual velocity curves being grouped together and marked *A*, *B* and *C*, respectively, for the various tests. The stations of the route or distance between readings and landmarks are indicated by the vertical lines, the interval being 1,000 ft. for the heavier lines. The values of the intervals between the horizontal lines differ for the different data plotted. Note the similarity between the various draft curves and relations between draft curves and corresponding velocity curves. In fact, so consistent are the curves in each test that by means of them, an error of 10 ft. in the reduction of the level notes was found.

The loads used on the motor truck were 2,250 lbs. cast iron blocks and on the trailers steel axles, 122 lbs. each. See Fig. 7. The live loads include these blocks, the axles and the men riding, except that the chauffeur was considered part of the weight of the truck. The truck dead load was 7,980 lbs., the trailer truck 4,080 each.

The first run of the 11th test was with the motor truck alone with its rated capacity. The velocities and consumption of gasoline were noted.

The 12th and 14th tests (2d and 4th runs) were made to compare the action of a five-ton load concentrated on one trailer (12th test) and uniformly distributed on two trailers (14th test).

The 15th and 16th tests (5th and 6th runs) were compared to determine the efficiency of the trailers, hence the velocity of 16th test (empty trailers) was purposely kept to approximately that in the 15th test (loaded trailers).

The 13th and 15th tests (3d and 5th runs) were made to test the maximum draft and tractive ability of the motor truck. In the 13th test the motor was stalled in four places. In the 15th test the live load on the truck was reduced from 2.6 to 1.4 tons, to observe to what extent the live load of the previous run was responsible for the stalling and the effect of the reduction of the load on the tractive ability of the motor.

There was no loss of traction due to the reduced load and one of the hills on which it stalled on the 13th test was successfully negotiated. The other hills on which the motor stalled in the 13th test were found to be prohibitive in the 15th and the weight of the motor might have been still further reduced. In other words, the 15th test was made to learn to what extent the stalling was due to the load carried by the truck and if the reduction would cause loss of traction, the result showing that the truck could be materially lightened and that the ability of the motor was sufficient to maintain a sustained pull of more than 3,000 lbs., and to handle a dead and live trailer load of 14 tons on good roads and grades up to 3 per cent.

The 13th and 15th tests also demonstrated the advisability of smaller units in trailer trains. Where the train was stalled the lost time was reduced to a minimum by breaking the train up and rapidly moving the trailers singly over the obstructing grades.

The observed consumption of gasoline over each of these seven-mile runs was as shown by Table VIII.

After all reductions were made in the notes, draw-bar drafts and velocities were compiled for each one-half degree difference in grades encountered. They were then averaged and separated for the different kinds of pavements encountered, tabulated and plotted for each test. Finally the drafts per ton were averaged from all the tests and plotted (Fig. 10).

These six runs covered approximately 42 miles. When proper allowances are made

TABLE VIII.

Test number.	Total load handled.	Gallons gasoline consumed.
11th	— 7.6	—1.9
12th	—13.7	—1.9
13th	—20.5	—6.1
14th	—16.1	—2.2
15th	—19.5	—5.0
16th	— 9.7	—4.5 (?)

TABLE IX.

Length of haul.	A 1 team and 1 wagon.		B 1 team and 2 wagons.		C Motor alone.		D 3 trailer plant.		E 6 trailer plant.	
½	8	0.475	13	0.300	14	0.478	22	0.274	21	0.326
1	10	0.386	14	0.274	24	0.317	40	0.186	36	0.216
2	12	0.322	16	0.243	36	0.242	64	0.152	60	0.153
4	18	0.263	18	0.219	48	0.205	76	0.132	72	0.138
6	18	0.245	18	0.219	60	0.182	72	0.139	72	0.139
8	16	0.242	16	0.219	64	0.177	80	0.133	80	0.131
10	....		....		60	0.182	80	0.133	80	0.131

for speed, diameter of wheel, etc., it will be seen that the curves show lower drafts than those given in Trautwine and Baker, although they are consistent with them. But other tests of like nature must be made in the future covering wider ranges of conditions.

The result of these tests demonstrated the ability of a three-ton motor truck to maintain a sustained draft of over 3,000 lbs. and that on ordinary pavements, at average speeds and usual grades the draft required by one trailer with a five-ton load ranges from 400 to 2,000 lbs. and from 750 to 3,000 lbs. for two trailers loaded with five tons each, averaging from 50 to 200 lbs. per ton. This, together with the increased delivery as shown in Table VII and the remarkable economy as shown by comparison of the cost per ton mile briefly summarized in Table IX and Fig 11, prove that the trailers more nearly solve the problem of street and highway transportation than anything heretofore.

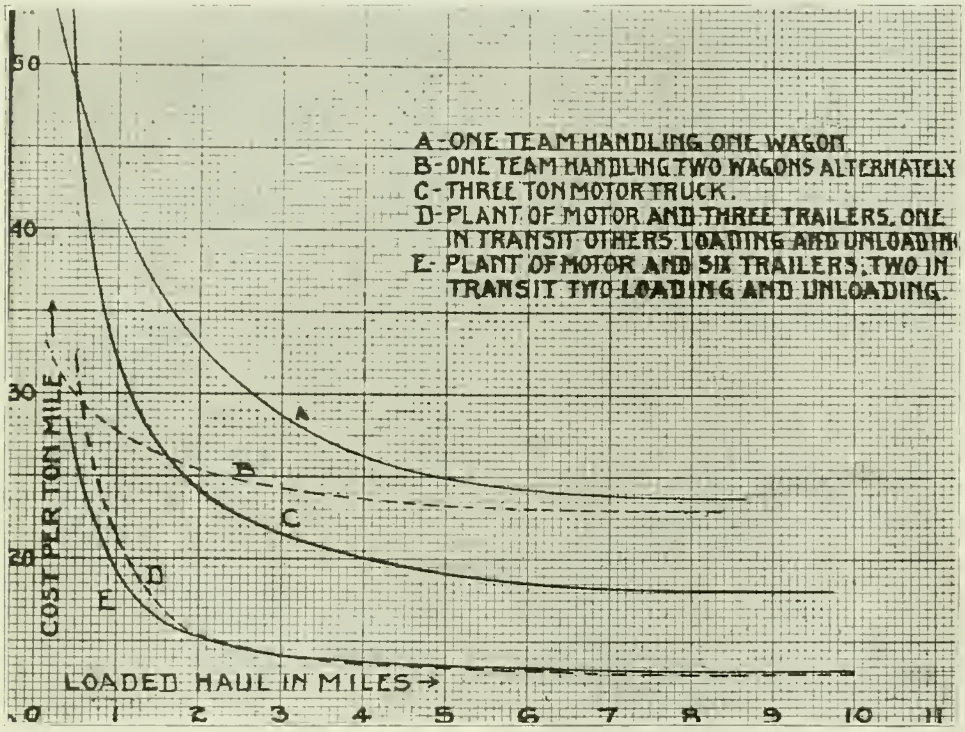


Fig. 11—Cost Per Ton Mile for Five Methods of Hauling.

Some Observations and Experiments on the Tractive Power of Horses.

Although engineers have frequently to assume, in making calculations for road grades and surfaces, values for the tractive power of horses, data on these values are rather scarce and inexact. For this reason interest will be taken in the record of horse traction experiments made by Prof. L. E. Conrad, Kansas State Agricultural College, and described by him in the following paper before the Engineers' Society of Kansas. Another and somewhat different use of the data obtained in these tests was outlined in our issue of Nov. 6, 1912. The two articles should be read in conjunction:

In the consideration of economic maximum gradients, either on railways or highways, one of the chief factors to be considered is that of the maximum tractive force of one unit of motive power. In the case of railroads this unit is, of course, a locomotive, and in the case of highways it is generally taken as a team of horses. Of course, the weight of either may vary with local operating conditions.

It will be freely admitted, on a moment's thought, that it will never be possible to determine the tractive power of the team with anything like the degree of accuracy with which it can be obtained for the locomotive. Nevertheless, so far as the writer is informed, all of the highway engineers who have attempted to treat the matter of maximum grades, economically, have based their theories to a great extent on the tractive power of a team. In reading these discussions the writer has frequently been impressed by the fact that very little is known regarding this matter. Only a few efforts have been made to determine the tractive power exerted by teams. This lack of knowledge has, naturally, led writers on highway economics to adopt what they considered to be conservative values for the tractive power of horses. In the writer's opinion all of them have adopted values that are too low.

The question as to whether or not this was true was first raised in the writer's mind when, as a student, he used a text-book in highways which accepted 25 per cent of the weight of the team as being equivalent to its tractive power on the level, assuming, of course, favorable conditions as to footing for the animal. The same author gave 100 lbs. per ton as the average resistance to wagon traffic of a good, hard earth road. The 100 lbs. per ton included axle friction as well as those resistances due to the road surface. Now, the writer remembered very well that when doing heavy teaming, in former years, it was no uncommon thing for his father to haul gross loads of 4,000 lbs. by actual weight, over hilly country roads of earth. The writer feels positive that on many of these hills the gradients were as high as 20 per cent and in some cases considerably higher, and the hills were often from 400 ft. to 1,200 ft. in length. The team generally used for this work weighed about 2,800 lbs., certainly not more. Accepting 100 lbs. per ton as the resistance of these roads to wagon traffic, and assuming that the tractive power of a horse is decreased on grades by an amount equal to its weight in tons multiplied by 20 times the per cent of the grade, we find that the team mentioned above would have been able to exert a pull of $2 \times (20 \times 20 + 100) + (20 \times 20) \times 1.4 = 1{,}560$ lbs. or 55.6 per cent of their weight.

Of course, the writer is free to admit that the above data are not as accurate as might be desired, but the case awakened his interest in the question, and the following more satisfactory data were collected in consequence.

In September, 1909, it was learned from a drayman in Mt. Vernon, Ia., that, while hauling coal, he regularly hauled loads of 6,600 lbs., gross, up a steep hill, on a poor macadam roadway. The maximum grade on this hill is 16.7 per cent and the total length of grade exceeding 5 per cent must be several hundred feet. If we take the resistance to traction of the road, at 60 lbs. per ton, we shall obtain the following as the equivalent pull exerted by the team on a level:

3.3 tons × 16.7 × 20 = 1,102 lbs., grade resistance of load.
3.3 tons × 60 = 198 lbs., rolling resistance of load.
1.4 tons × 16.7 × 20 = 468 lbs., grade resistance of team.
Total, 1,768 lbs.

That is, in hauling this load up the hill, the team exerted a pull equal to 1,768 lbs. on a level, or 63.1 per cent of its weight.

I am indebted to Prof. S. N. Williams of Cornell College, Iowa, for the rate of grade on the above hill.

A couple of years later the writer succeeded in interesting some senior civil engineering students in the question of the tractive power of horses and they consented to make a study of the question for thesis work. Excellent advantages for such an investigation were offered by the recording traction dynamometer in the Department of Experimental Engineering at the State Agricultural College.

This dynamometer was designed by Dean E. B. McCormick, of the Division of Engineering, at the college, and was constructed, and is owned, by the U. S. Office of Public Roads. It is mounted on a Studebaker truck of standard design, except for such modifications as were required for the installation of the dynamometer mechanism. The fact that considerable teaming is done into Manhattan over rather hilly roads also facilitated the tests to be made.

In making the investigations, six of the main roads leading into Manhattan were selected and the worst hills near town on each road were staked off and profiles run for determining the grade.

The dynamometer was then run over these roads and the tractive resistance of the road was obtained. In gathering these data the dynamometer truck was loaded to a gross weight of 7,110 lbs. The width of tire used was 3 ins. Following is an abstract of the data from the tests made on these six roads:

TABLE I.—RESULTS OF TRACTION TESTS OF HORSES.

Test No.	Axle friction and rolling resist. over road. Lbs. per ton.	Length of hill. Feet.	Maximum grade. Per cent.	Gross load. Tons.	Wt. of team. Tons.	Equivalent pull on level exerted by team.
1	114	1,110	2.66	2.10	1.10	415.64 lbs. = 18.9% of wt. of team.
2	124	1,865	9.0	2.28	1.25	918.0 lbs. = 36.8% of wt. of team.
3	153	524	4.93	2.16	1.20	651.8 lbs. = 27.2% of wt. of team.
4	108	1,640	4.2	2.15	1.05	501.0 lbs. = 23.8% of wt. of team.
5	129	1,300	7.4	2.20	1.30	802.0 lbs. = 30.8% of wt. of team.
6	117	1,375	7.0	1.65	1.10	578.0 lbs. = 26.3% of wt. of team.
Average	124.2			2.09	1.12	644.4 lbs. = 28.8% of wt. of team.

TEST NO. 1, MAY 2, 1911.

This road was in good condition except for being slightly soft in sags due to rain five days before the test was made. The road surface was of earth. A length of 1,110 ft. of this road was selected, after operating the dynamometer over it, which contained the ruling grade on the route. The total area of the dynamometer record for the 1,110 ft. selected was 62.79 sq. ins., giving 627,800 ft. lbs. of work done in hauling the gross load over the selected stretch of road. The difference in elevation between the ends of this stretch of road is 24.98 ft. The work done, then, in overcoming elevation was 24.98 × 7,110 = 177,600 ft. lbs. Subtracting this from the total work done, there remains 450,300 ft. lbs. required to overcome the sum of axle friction and road resistances, giving an average for these of 405.6 lbs. total, or 114 lbs. per ton of gross load.

The average of 17 loads hauled into Manhattan over this road by a certain team was 2.1 tons, gross. The weight of the team was 2,200 lbs. The maximum grade on the stretch of road selected was a 2.66 per cent grade 400 ft. long. The pull, then, exerted by the team in hauling the average load up this grade was equivalent to a pull of 416 lbs. on the level, or 18.9 per cent of the weight of the team, computed as follows:

To overcome grade, 2.1 (20x2.66) = 117.72.

Retarding effect of grade on team, 1.1 (20 × 2.66) = 58.52.

Tractive resistance of load on the level, 2.1 × 114 = 239.40.

Total, 415.64.

TEST NO. 2, MAY 6, 1912.

The road surface was a hard clay, rock and gravel combination. The dynamometer was run over 1,865 ft. of this road. The area of the record was 164.78 sq. ins. The continuous rise in this distance was 115.63 ft. This gives 822,150 ft. lbs. as the energy required to overcome the ascent, leaving 825,670 ft. lbs. as the energy that would have been required to haul the same load over an equal length of this road on the level. This gives a total resistance of 443 lbs. or 124 lbs. per ton.

Twenty-five loads hauled over this road by a team weighing 2,500 lbs. averaged 4,560 lbs. gross, or 2.28 tons. Now, if we use a 9 per cent grade as the maximum (the profile shows short stretches of that gradient, with an average, in one place, of 8.6 per cent for 800 ft), by the method of the preceding test, we shall find that the team exerted a tractive force equivalent to a pull of 918 lbs. on the level. This is equal to 36 per cent of the weight of the team. The maximum load hauled by this team over the hill in question was 2.42 tons. If we insert this load in the above computations, the maximum force exerted by the team becomes equivalent to a pull of 961 lbs or 38.4 per cent of the weight of the team, on the level.

The remainder of the six tests gave results lying between the two above given, and it will hardly be worth while to review them in detail. The information obtained from these six tests is, however, given in Table I:

A glance at this table shows that, while there was a great difference in the roads over which the different teams operated, the loads were nearly all of the same weight. This would indicate, to the writer's mind, that some other factor than the tractive strength of the team limited the loads. It will also be noted that the average sum of the axle friction and rolling resistance is higher than that ordinarily taken for earth roads. This may be accounted for by the fact that several of the roads operated over were somewhat stony.

Further light is thrown on this question of team draft by data collected by Dean E. B. McCormick last September. These data consist of weights of loads of brick, hauled by different teams, from the freight yard of the Union Pacific R. R., in Manhattan, to the Kansas State Agricultural College, a total distance of slightly more than two miles.

TABLE II.

No.	Weights—Load.	Weights—Team.	Grade. %	Probable resistance per ton overcome by team.	Total equivalent pull of team on level.	Per cent of its own wt. which the team could pull on the level.
1	8,770	2,580	7.8	206	1,104	42.79
2	8,440	2,600	7.8	206	1,069	41.11
3	8,160	2,620	7.8	206	1,044	39.85
4	7,090	2,670	7.8	206	938	35.14
Ave.	8,115	2,617½	7.8	206	1.039	39.72

The road surfaces over which these loads were hauled were about as follows:

500 ft.,	dusty cinder road.
880 ft.,	asphaltic concrete pavement.
1,175 ft.,	brick pavement with asphalt filler.
1,860 ft.,	asphaltic concrete pavement.
2,260 ft.,	brick pavement with asphalt filler.
1,850 ft.,	brick pavement with cement filler.
1,325 ft.,	earth road.
1,350 ft.,	macadam road.
725 ft.,	earth and cinders.

The hardest stretch of road for the teams on the route was the 1,350 ft. of macadam on the college campus. In the total distance of 1,390 ft., there is a rise of about 45 ft., the grade varying from less than 1 per cent to a maximum of about 8 per cent. The steepest 100-ft. stretch has a grade of 7.8 per cent.

In Table II are given the data obtained and the deductions of most interest in connection with this subject of team draft:

In working out the above table, I have assumed the rolling resistance on the level macadam road at 50 lbs. per ton.

In obtaining the equivalent pull on the level there has been added to total resistance of the load the force required to overcome the weight of the team against the given grade.

WATER WORKS

Design of Overhead Framework of Meter-Handling Motor Truck, St. Louis Water Department—Saving Effected by Vehicle.

Contributed by Fred L. Bock, Superintendent of Meter Division, St. Louis Water Department.

A 1½-ton Federal truck, as shown by the accompanying illustration, has recently been placed in the service of the Meter Division of the St. Louis Water Department. The overhead design is of especial interest, in that the quick loading and unloading of half ton meters can be handled by the driver alone.

The weight of the chassis is 4,000 lbs. and costs it $1,875. The body weighs 1,500 lbs., is 5x11 ft. inside and costs complete with trolley and chain block, $290.

The 4-in. I-beam running the entire length of the body and extending 30 ins. over the rear, is supported by a light steel framework of 2¼-in. T-bar. A half ton trolley and chain block is mounted on this I-beam. In replacing and installing large meters, the truck backs against the curb and lifts the meter from the box in the sidewalk directly into the truck or vice versa by means of the trolley-chain block arrangement. Before taking out a large meter the flanged joints are loosened by means of a meter puller especially designed for quick service in connection with the truck.

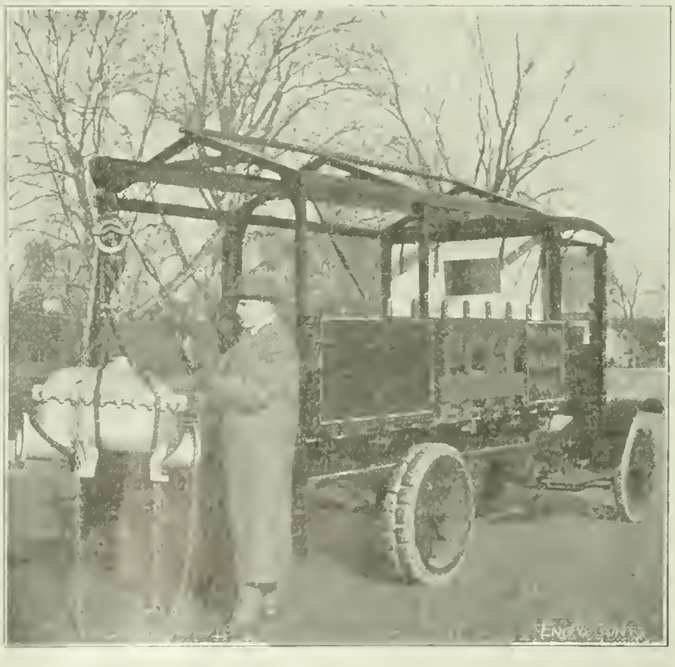
The truck covers a route of 15 to 30 miles a day in transferring the men from one job to another. To date the data show that a crew of six men divided into pairs does the work of five single horse wagons with ten men.

In figures the saving would be as follows:

Maintenance, 5 horses and wagons, per month	$100	
Wages, 10 men	600	
		$700
Maintenance, truck, per month	85	
Wages, 6 men and driver	435	
		$520
Saving per month		$180

The indications are that these figures will improve as the men become better accustomed to the new system and as the weather grows milder.

Contracts were recently let for the construction of ferroconcrete settling tanks and filtered-water reservoirs at Bangkok, Siam.



Motor Truck Equipped for Handling 1,000-lb. Water Meters, St. Louis Water Department.

Method of Applying Hypochlorite to the Water Supply of Cleveland, Ohio.

The conditions which made necessary the disinfection of the Cleveland water supply, and the results of chlorination in that city, have been fully described in previous issues of this journal. However, we have not heretofore described the arrangement and design of the plant devised for the purpose of introducing the hypochlorite into the water mains. The following description of the emergency plant and its installation is abstracted from a report made by L. H. Van Buskirk, Assistant Engineer of the Ohio State Board of Health, as published in the Bulletin of the Board for January, 1913.

The water supply of the city, for all purposes, is drawn from Lake Erie. The intake crib is located almost four miles directly north from the mouth of the Cuyahoga River. The water, on leaving the crib, passes through a 9-ft. tunnel five miles in length to the Kirtland Street pumping station. This station is located on the shore of the lake in the eastern part of the city.

The temporary hypochlorite plant was installed by the waterworks department in an unoccupied building at the Kirtland Street pumping station as protection for the apparatus necessary for the treatment. The plant consists of a mixing tank, two solution tanks, and two constant head orifice tanks.

Mixing Tank.—The mixing tank, which is of wood, is 4 ft. 2 ins. in diameter at the bottom, 4 ft. 0 ins. in diameter at the top, and 3 ft. 4 ins. deep. This tank is equipped with a mechanical stirring device operated by a 3 h. p. gasoline engine. Water is supplied through a 2-in. pipe which enters the mixing tank from below. The pipe is equipped with a meter for measuring the quantity of water used. From the bottom of the mixing tank, two 4-in. overflow pipes, equipped with valves, extend into the solution tanks. The contents of the mixing tank may, therefore, be discharged at will into either of the solution tanks.

Solution Tanks.—The solution tanks, of which there are two, are placed below the mixing tank. The tanks, which are of wood, are 11 ft. 8 ins. in diameter at the bottom, 11 ft. 5 ins. in diameter at the top, and 7 ft. 4¾ ins. deep. They are placed on timber posts so that the bottoms of the tanks are at an elevation of 6 ft. above the main floor. Two-inch discharge pipes are connected with the orifice tanks. These discharge pipes extend 6 ins. above the bottom of each solution tank. The tanks are also provided with 4-in. drain pipes for draining and the removal of sludge.

Orifice Tanks.—Below the solution tanks are two cast iron orifice tanks, rectangular in shape, coated both inside and out with tar in order to protect them against the action of the bleach solution. The solution from each solution tank is discharged into the orifice tanks through a 2-in. pipe which extends 6 ins. above the bottom of the tank. The openings of these pipes are controlled by float valves so as to maintain a uniform head of water above the discharge orifices in the orifice tanks. The head of water above the orifices is maintained at 12 ins.

Orifices.—The orifice consists of a brass plate into which a rectangular opening, ½ in. in width, has been cut. The length of the opening can be varied by means of a brass slide provided with a pointer traveling over a brass scale. This scale is graduated in pounds of solution discharged per minute. Each orifice tank is provided with the same equipment.

Tunnel.—Extending from the orifice tanks are two 2-in. pipes which convey the solution to shaft No. 5 of the main intake tunnel. One pipe extends down the east side of the shaft and the other down the west side to the bottom of the tunnel, or 115.5 ft. below the surface of the ground. Where the pipes extend across the tunnel they are perforated on both sides perpendicularly to the flow of water with 36 ¼-in. holes. The holes are fitted with hard rubber bushings to prevent corrosion.

Operation.—The bleaching powder, which is purchased in metal drums, is weighed, placed on a small car and pushed to the edge of the mixing tank. The water enters the tank from the bottom at the rate of about 100 gals. per minute, discharging at this rate through the 4-in. overflow pipe into the solution tank. The chloride of lime is added to the mixing tank at the rate of about 8 lbs. per minute. The bottom end of the drum being elevated on the car, it is easy for the attendants to introduce the bleaching powder at any rate desired. As the bleaching powder and water are introduced into the mixing tank, a mechanical agitator is kept in operation, thereby thoroughly mixing the bleaching powder and water. The agitator is kept in operation during the entire mixing process. The amount of water passing through the mixing tank and overflowing into the solution tank is dependent upon the amount of bleach used. It is aimed to make the solution so that it will contain 1 per cent of the powder. This makes it necessary to add 100 lbs. of water for each pound of the hypochlorite. The average drum contains about 350 lbs. of powder. The mixing of this with the 35,000 lbs. of water for a 1 per cent solution, requires about one hour. The amount of water added to the tank which overflows to the solution tanks, is shown by an indicator fastened to a float. The indicator passing over a wooden scale fastened to each tank is graduated in pounds. The mixture is allowed to stand in the solution tank for a period of about five hours, or during the time required for the emptying of the other solution tank. The partially clarified solution is then discharged into the orifice tanks through the float valves. The solution passes through the orifices through funnels to the two 2-in. pipes leading to the water tunnel. The greatest portion of the water rises in shaft No. 5, passing the gate and screen wells, through the aqueduct and pump wells to the pumps in the main pump house. The tunnel extends beyond shaft No. 5 to shaft No. 1, from which Worthington pump No. 4 in the temporary pump house takes its supply.

Pumping Station.—The Kirtland Street pumping station is comprised of four buildings; the main pump house, the boiler house, the temporary pump house, and to the north of this group of buildings is located the building now used as a shelter for the hypochlorite plant which has already been described.

The boiler house contains eight Babcock & Wilcox water tube boilers, each of a nominal 272.5 h.p. The boilers are automatically stoked by means of Babcock & Wilcox grates. All other boiler accessories are located in this building.

In the main pump house are located two Holly vertical triple expansion pumping engines, each with a nominal capacity of 25,000,000 gals. per day. Besides the Holly engines, there are two Knowles horizontal compound duplex direct-acting pumping engines, each with a nominal capacity of 15,000,000 gals. per day. The capacity of the pumps in the main pump house, therefore, is 80,000,000 gals. per 24 hours. As early as 1905 it was found that during certain seasons of the year the consumption was in excess of this amount, and it was found necessary to operate the pumps beyond their rated capacity. In that year a temporary pump house was constructed and a Worthington horizontal compound duplex pumping engine, with high duty attachment, was installed. This engine has a nominal capacity of 15,000,000 gals. per day. This gives a total capacity of the existing pumps of 95,000,000 gals. per day. At the present time (January, 1912) a Holly vertical triple expansion pumping engine, with a nominal capacity of 25,000,000 gals. per day is being installed in the main pump house. When this is completed, the Kirtland Street pumping station will have a capacity of 120,000,000 gals. per 24 hours. The department also intends to install another Holly pump of the same type as those already in use.

As already described, the pumps in the main pump house obtain water from shaft No. 5, while the Worthington pump in the temporary station obtains its supply from shaft No. 1. The discharge pipes, however, from all the pumps connect with a header just to the west of the station. The agitation in the header aids in the mixing of the treated waters. After leaving the header the water is forced through two 48-in. discharge mains extending from the Kirtland Street station to a point about 815 ft. to the south, where each line is provided with a check valve which again subjects the water to a final agitation which aids in obtaining a mixture of the bleach solution with the water before it reaches the consumer.

A Comparison of the Economic Advantages of Methods Available for the Hygienic Protection of Water Supplies Taken From the Great Lakes.

Since more than 5,000,000 people are now living, in various communities, within what may be termed water supply distance of the Great Lakes, the general problem of protecting such water supplies is a matter of wide interest. Most of these communities take their water supplies from the lakes and discharge their sewage into them. Except where the water supply has been purified before being used, this practice has very seriously affected the health of the lake cities and has been the cause of much loss of life. It is strange that raw lake water should continue to be used in cities which are doing so much in other ways to improve public hygienic conditions. In a recent paper before The Engineers' Club of Philadelphia, Mr. George C. Whipple discussed at length the various aspects of the problem. He discussed, also, the effect of the use of raw contaminated lake water on the public health, and pointed out the ways in which the problem has been solved or may be solved under different local conditions. The following abstract of Mr. Whipple's paper, which is published in full in the Proceedings of the Club for January, relates to the comparative economic advantages of the methods now available for the hygienic protection of water supplies drawn from the Great Lakes.

Generally speaking, the water of the Great Lakes is of excellent quality for the purposes of a public water supply. It is rather hard, but it is softer than most of the water supplies taken from streams or from the ground in the same general catchment area.

The water near the shores of the lake may be quite different in quality from that farther out. This depends much upon the character of the shore, the proximity and character of inflowing streams, the season of the year, the wind and many minor factors. Generally speaking, the shore water is more turbid and contains larger numbers of microscopic organisms and bacteria than the broad waters of the lake, and what is more important, it is more likely to be contaminated with sewage discharge either directly into the lakes or into streams that flow into them. In the vicinity of large cities, and especially when these are situated upon large rivers, the pollution of the shore waters is a very serious matter.

The principal sources of pollution of the lake water supplies are, first, sewage discharged directly into the lake along the water front. Second, sewage discharged into streams that flow into the lake. Third, sewage polluted mud dredged from rivers and harbors and dumped into the lake. Fourth, sewage sludge transported by ice from the shore outward. Fifth, fecal matter discharged into the lake from boats.

The danger of pollution of the water supply in any case depends upon the opportunities afforded for the commingling of the sewage with the water before it reaches the intake and upon the natural purification that takes place in the lake.

NATURAL AGENCIES OF PURIFICATION IN LAKE WATERS.

In addition to the very great and rapid dispersion of sewage in the water of the Great Lakes, various other agencies tend to bring about its natural purification.

Sedimentation is a potent factor. Compared with streams the velocities of the water in the lakes are low, so that, except near the shore, the suspended matter settles to the bottom, leaving the upper broad waters of the lake very clear. Sedimentation must always be considered, however, with reference to subsequent disturbances of the settled solids by currents. During long periods of quiescence, pathogenic bacteria are liable to natural death in an unfavorable environment.

According to the best available information, the germs of typhoid fever do not multiply in the waters of the lake, but rather disappear at rates that vary according to different conditions. Using approximate figures for the sake of illustration, it may be said that after a week 90 per cent of any typhoid fever germs that may enter one of the lakes will have died, and after a month 99 per cent. How long the most resistant germs can survive is quite unknown. A small number, sometimes termed the "resistant minority," doubtless remain alive for several months. They are able to live longer in cold water than in warm water, a fact that Houston has recently demonstrated by some interesting experiments.

Sunlight exerts a powerful germicidal action on the bacteria in the layers of water near the surface, but even in the waters of a clear lake the sun's rays rapidly lose their energy below the surface so that disinfection by sunlight is not a factor at depths greater than a few feet.

Very important, however, is the action of the microscopic organisms found in the waters of all the lakes and that comprise the "plankton." The biological cycle is wondrously complete. Particles of sewage solids are decomposed by bacteria; bacteria are consumed by the protozoa; protozoa are consumed by rotifers and crustacea and the latter are eaten by fish. Also the products of bacterial action on the dispersed sewage, such as nitrates and carbonic acid, furnish food for the algae, such as floating diatoms and various chlorophyceae, and these in turn furnish food for the crustacea and larger organisms.

The oxygen resources in the Great Lakes are so enormous that except very near to the sources of pollution the lake water is saturated with dissolved oxygen. The complete destruction of the organic matter of the sewage by oxidation is, therefore, the ultimate fate of all sewage matters that enter the lakes.

WATER SUPPLY INTAKES.

The lakes are the natural sources of water supply of the cities and towns near them, and in some instances they are the only possible sources. The land around the lakes is generally flat and no upland gravity supplies are obtainable. A few places, like Toledo, are supplied with water pumped from streams entering the lakes, but in most instances water of better quality and of unlimited volume is found in the lakes themselves. The fact that the supply is unlimited, or rather is limited only by the capacity of the pumps installed, seems to have encouraged a lavish use and waste of water, for we find that the per capita consumption of water in the lake cities has been high. The fact that the water is relatively cool in summer has, in some cases, developed a unique use of the water supply for cooling purposes. In recent years a number of unsuccessful attempts have been made to cut down the consumption.

The broad waters of the lake cannot be used for water supplies, as it is not practicable to extend intake pipes or tunnels to points where the depth of water much exceeds 75 ft. The longest intake in use is that at Cleveland, which is 26,000 ft. long and the end of which is about four miles from the shore. The Chicago intakes are from two to four miles long. The intakes at Milwaukee, Gary and Oswego are about a mile and a half long. There are several intakes about a mile long, namely, those at Bay City, Ashland, Kanawha, Sheboygan, Evanston, Racine and Erie. Many of the intakes are shorter than this, extending from 1,000 to 3,000 ft. from the shore, and in some cases they are less than 1,000 ft.

Comparatively few intakes are located in water more than 50 ft. deep. One of the deepest is that at Duluth, where the water is 75 ft. deep and the openings in the crib are 60 ft. below the surface of the water. The Toronto intake extends into water 68 ft. deep, and it is proposed to extend it to water 100 ft. deep. Oswego is constructing an intake in 83 ft. of water. The Milwaukee intake is in 60 ft. of water and the Chicago intakes are in from 27 to 40 ft. of water.

The attempt seems to have been made in every case to extend the intake far enough to obtain relatively clear water and avoid pollution of the intake from local sewers. How inadequately the latter has been accomplished is shown by typhoid fever statistics. Other considerations have been to have the intake in water deep enough to avoid a packing of the ice around the crib in the winter and to avoid the silting and clogging of the intake and pipe through movements of the sand. It has ordinarily been found desirable to have a depth of 20 or 30 ft.

The intakes at Cleveland and Chicago terminate in masonry cribs that extend above the water and are surmounted by lighthouses. These cribs have entry ports at different depths. More often the intake pipes terminate in a submerged crib, or the pipe is merely turned up and supported by loose rock. Cast iron pipe has been largely used in the past, but steel is gradually taking its place. Tunnels are used at Chicago, Cleveland and elsewhere.

Many breaks have occurred in the lake intakes and a recital of the accidents would be interesting. In several notable instances, as at Toronto, these accidents have permitted polluted shore water to enter the pipes and outbreaks of disease have followed.

METHODS OF PROTECTING LAKE WATER SUPPLIES.

The evidence is conclusive that natural methods of purification cannot be depended upon to protect the sanitary quality of the water supplies taken from the Great Lakes. Practically every city, whether great or small, that has depended solely upon the protection afforded by dilution and a supposedly remote location of the intake from the sewers, has suffered from water borne diseases. As a rule, the smaller cities have suffered more than the large cities, as their water supply intakes and sewer outfalls are nearer together. The visitations of typhoid fever have often been intermittent, and their failure to occur at regular seasons engenders a false sense of security; but sooner or later, when the necessary combination of currents and infection occurs, every lake city that fails to protect its water supply is bound to suffer from water-borne diseases.

Various expedients have been used at different times and at different places. At Chicago, after it became certain that its water supplies were subject to sewage pollution in different degrees, according to the weather conditions, the health department of the city inaugurated the policy of making daily analyses and issuing notices of the condition of the water in the daily papers, warning the people to boil the water or to cease using it for drinking in case the analysis was bad. This was many years ago. The practice may have had some beneficial effect, but it was placing dependence upon a frail reed. It had the inherent disadvantage that the quality of the water changed more rapidly than the analyses could be made and published.

A second method of protection would be to abandon the lake water altogether and substitute some other source of supply. This has been considered in some cities, as, for example, at Toronto, where a gravity supply has been considered and rejected. Most of the lake cities are so situated that another source of supply is impracticable, or, in any event, costly, so this course has not been adopted and is not likely to be.

A third method is to extend the intake further into the lake. This has been done repeatedly. As the cities have grown the local pollution has become heavier and larger intakes have been required on account of greater water consumption. The effect of using longer intakes farther removed from sources of pollution has invariably improved the condition of the water, sometimes very noticeably. After a time the water at the new intakes becomes contaminated so that the remedy is merely of temporary benefit. Then, too, there is a limit to which this can be carried, as the water off shore becomes too deep for economical pipe laying.

A fourth method would be to keep the sewage out of the lake. This is practically impossible, as the natural drainage of the lake cities is towards the shore. Ordinarily, no attempt has been made to keep the sewage out.

Chicago presents the only important instance where it has been accomplished and here it has not been accomplished in full. Situated at the south end of Lake Michigan and with only a low divide between it and the streams that flow westerly into the Mississippi River basin, and with this divide near at hand, it was possible to cut a canal through the divide, and turn the flow of the principal sewers into it, so that the sewage would flow westerly. This project, known as the Chicago Drainage Canal, cost upwards of $40,000,000 and entails a considerable annual charge for maintenance. A city of small size could not have financed so great an undertaking. The canal is so arranged that the Chicago River and its branches now discharge into it instead of into Lake Michigan; the lake water flows in at the old river mouth and dilutes the sewage, also turned from the lake into the river. The canal extends to Lockport, where the diluted sewage is discharged into the Des Plaines River, which flows into the Illinois River, this in turn flowing into the Mississippi River. The use of this canal led to a notable suit in the United States supreme court, brought by the state of Missouri, acting in the interest of St. Louis, against the state of Illinois and the Chicago Drainage Canal District, which was settled in favor of Chicago.

This canal receives most, but not all, of the sewage of the city. In the southern part of the city there are large sewers that still discharge into the lake and pollute its waters. Projects are now in contemplation that will divert much of this sewage westward into the canal. It is recognized, however, that this method of diversion and dilution has a limit and that this limit will be exceeded before many years, so that projects are also being considered for the treatment of the sewage before it is discharged into the canal.

The Chicago Drainage Canal has very materially reduced the amount of typhoid fever in the city. It has not entirely prevented all pollution of the water supply. The large storm flows of the sewers still go into the lake and at certain times this may affect the water supplies from the various cribs. Furthermore, the accidental contamination of the lake water from so large a city with its shipping, its dredging operations, its industries located among the shore is by no means a negligible factor. To protect the lake water against all these is a difficult task, except by filtration.

PROTECTION BY SEWAGE TREATMENT.

The next method of protection to be considered is the purification of the sewage before it is discharged into the lake. This has long received the attention of engineers and so much has been said about it in popular writings that the public has come to have faith in it. It is a plausible idea, and theoretically sound, but it has one fatal defect. To accomplish the purification of all of the sewage at all times demands works of excessive cost, while to partially purify the sewage, or to fail to purify it at times of storm does not give the desired protection to the water supply. Nearly all large cities are sewered on the combined system; that is, the same pipes and conduits carry both house sewage and storm water. Purification works large enough for the treatment of all the storm water, as well as the house sewage, are almost never constructed, but overflows are provided to take the excess sewage at times of heavy rain. This storm overflow is merely the house sewage diluted and from a sanitary standpoint is dangerous. The storms that produce the overflow are likely to be accompanied by strong winds that create rapid and direct currents of the water in the lake, so that the method of protection by sewage treatment fails at those times when it is most needed.

Treatment of the sewage of lake cities is often desirable in order to prevent objectionable conditions in the lake water near the point of discharge, and some form of treatment is likely to be adopted by nearly all of them. The nature of the treatment required will be usually governed by conditions other than the protection of the water supply. These treatments will, at the same time, somewhat reduce the danger of the pollution of the water supplies and will serve as an additional factor of safety. The point here emphasized is that in themselves they are not sufficient to protect the water supplies.

The disinfection of the sewage by the use of chloride of lime has been suggested and if this could be carried out thoroughly the safety of the sewage effluent would be materially enhanced. The cost of disinfecting sewage, however, would be much greater than the cost of disinfecting the water supply, so that, if disinfection were to be depended upon, the latter would naturally be preferred. The difficulty of disinfecting the overflow sewage at times of storm is another very great objection to this method. Used in connection with other forms of sewage treatment, disinfection would further increase the factor of safety, but it ought not to be depended upon alone to protect the lake water supplies.

DISINFECTION OF LAKE WATER.

If nature's methods of purification cannot be depended upon, if in the present state of the art an adequate purification of all the sewage is impossible of attainment, and if a partial treatment of the sewage does not suffice, the only course left is to purify the water supply itself. Fortunately this can be done satisfactorily and at reasonable cost. There are two methods of purification available for lake waters at the present time—disinfection and filtration.

The disinfection of the lake water supplies has been extensively practiced during the last few years. Among the larger cities where it has been used may be mentioned Toronto, Milwaukee, Cleveland, Erie and Niagara Falls. Chloride of lime, or bleach, has been chiefly used, but at Cleveland liquid chlorine was tried with success.

The fact that the lake waters contain relatively small amounts of organic matter as compared with other surface waters enables disinfection to be accomplished by the use of small quantities of chemicals. For the same reason, the use of an excess of chemicals is readily noticed by the consumers on account of the disagreeable odor of chloride of lime that persists until the water reaches the service taps. Great caution is, therefore, required in the use of this method. If too little bleaching powder solution is added the disinfection will not be effective, while if too much is added the water will have a bad odor. The quantities of bleaching powder used have varied from 6 to 18 lbs. per 1,000,000 gals. (10 lbs. of calcium hypochlorite, containing 35 per cent of available chlorine, per 1,000,000 gals. of water is equivalent to 0.42 parts per 1,000,000 of available chlorine). Generally, the smallest quantity found necessary to give effective sterilization of the water has been 6 to 8 lbs. per 1,000,000 gals. Quantities larger than about 10 lbs. commonly leave undecomposed hypochlorites in the water that may be detected by the consumers.

It is of the greatest importance to secure a prompt and intimate mixture of the bleaching powder solution with the water. This is not as easily accomplished as many think and requires a degree of skill in operation not easily obtained in practice. Failure to properly apply the chemical may easily escape knowledge of the authorities and such failure may be calamitous in its results. That effective sterilization of the water can be obtained by this method is admitted by sanitarians; that it actually is obtained with practice is more doubtful.

That the use of bleaching powder as a water disinfectant has reduced the typhoid fever death-rates in many places is probable, but its use has not been continued long enough to enable this to be measured with great certainty. That it does not completely protect against water-borne diseases is also probable. Thus, at Toronto, the water supply was disinfected before the recently constructed filter was put into use. During this period, it is said that the typhoid fever death-rate fell considerably below what it had been when untreated water was supplied, but after the filter was put into operation there was a further reduction of the death-rate, showing that disinfection alone had not furnished complete protection.

The method of disinfection of lake supplies ought to be looked upon not as a means of permanent protection of the quality of the water, but rather as a temporary or emergency measure. The uncertainties of operation are too great, the chances that not all bacteria are killed are too large to make this method one to be depended upon solely and permanently. And it is doubtful if the consumers will be long satisfied with water that may at any moment run from the service taps with an odor of chloride of lime. In the case of supplies that are only slightly contaminated it may be used to reduce still further the chance of infection, and thus, perhaps, postpone the time when filters are required, but such instances are few.

FILTRATION OF LAKE WATER.

The best method of protecting the lake water supplies is to filter the water. This is more efficient than disinfection of the water and is very much cheaper than purification of the sewage.

Disinfection of the water does not remove any turbidity that may be present; filtration does. Disinfection does not remove any odor that may be present, due to algae; filtration, with aeration, does this, and while it is not often a matter of great moment, at times it may be of decided benefit. Therefore, although filtration costs more than disinfection, it gives more effective service and is more dependable.

Two methods of filtration are in use in the lake cities, sand filtration and mechanical filtration. These are now so well known that they do not need to be described. Suffice it to say that sand filters are operated at relatively low rates, say from 2,000,000 to 6,000,000 gals. per acre per day, and that mechanical filters employ a rate of about 125,000,000 gals. per day. Sulphate of alumina, or some other coagulant, is employed with mechanical filters.

The choice of the two systems should be determined for each case according to the character of the water to be filtered, the availability of filter sites at proper elevation and other local conditions. Generally speaking, sand filters are especially applicable to relatively clear waters and mechanical filters to waters that are turbid for a considerable portion of the time. In general practice has followed this classification. Mechanical filters have been used by a number of the cities on the south shore of Lake Erie, as for example, Lorain, Elyria, Vermillion, Sandusky, Conneaut and Ashtabula. Here the intakes are rather near the shore and the water is somewhat turbid. A mechanical filter is now being designed for Evanston for the same reason, namely, that the shore water is turbid. At Toronto, on the other hand, where the turbidity is seldom high, a sand filter has been recently constructed and is now in operation. In a few instances, mechanical filters have been installed to purify relatively clear lake waters, namely, at Niagara Falls, on the Niagara River, and at Burlington, Vt., on Lake Champlain. Such filters are at a disadvantage from the standpoint of operation in that the attendant cannot as readily tell how the filter is working, for the reason that there is little difference in the appearance of the water before and after filtration. In the case of turbid or colored water, this difference is conspicuous, and failure to obtain perfect clarification is an indication of poor efficiency. Mechanical filters with clear waters have not been operated long enough to enable one to fairly judge of their success. It has been found that the quantity of alum necessary to be used with a mechanical filter operating on a clear water cannot be reduced much below ¾ grain per gallon without impairing the bacterial efficiency.

With clear lake waters the rate of sand filtration may be higher than in the case of other surface waters. The Toronto filter, for example, was designed for a rate of 6,000,000 gals. per acre per day, and when operated at this rate satisfactory bacterial efficiencies have been obtained.

Although sand filters cost somewhat more to construct than mechanical filters, this difference is not great and their cost of operation is less, so that when interest charges, operation and depreciation are all taken into account, the cost of the sand filtration may be less than that of mechanical filtration, while on the whole, the results are more dependable as less skill is required in operation. Good results, however, can be obtained by either method. Both mechanical filters and sand filters need to be faithfully operated and enlarged when necessary, in order that their capacity may not be overtaxed. Failure to do so may involve serious trouble. For example, the sand filter at Ashland, Wis., is said to have been overtaxed to such an extent that filtration became imperfect and typhoid fever increased in the city. At Lorain, O., faulty operation of the mechanical filter likewise caused an increase of typhoid fever in 1903.

In order to furnish an additional safeguard against infection of the water, it is becoming customary to provide for the disinfection of the water after filtration so that if for any reason the process of filtration has to be suspended, or if the bacterial efficiency falls below what it should be, hypochlorite may be used.

With the water supply filtered, expensive treatment of the sewage discharged into the lake is usually unnecessary. In fact, in some cases no purification may be required so far as the protection of the water supply is concerned. Treatment of the sewage, of course, gives an additional factor of safety.

THE PROBLEM A LOCAL ONE.

The problem of protecting the water supplies of the lake cities is primarily and distinctly a local one. Each city is guilty of polluting its own water supply and each city is innocent of polluting the water supplies of its neighbors. There are perhaps a few minor exceptions and these are chiefly on the streams connecting the lakes. For example, the water supply of Detroit is somewhat polluted by the sewage of other places on the Detroit River, and the water supply of Niagara Falls is badly polluted by the sewage of Buffalo. As an example of a lake city that slightly pollutes the water of its neighbors may be mentioned Milwaukee, where the drift of the polluted water extends as far as Cudahy, but even the Cudahy supply is polluted more by its own sewage than by that of Milwaukee.

Each city also has the remedy in its own hands, namely, the purification of its own water supply.

At the present time there is no general pollution of the lake waters worthy of serious consideration and no general pollution problem is likely to arise for many years. The nearest approach to a general problem is at the southerly end of Lake Michigan, where Chicago and a number of large cities are relatively near together.

Fearing lest a general pollution problem might arise in this region, and hoping to secure concerted action on the part of the lake cities to protect the quality of the lake water, the Lake Michigan Water Commission was organized in 1908. It is comprised of public health officials, engineers, water analysts and others from the states of Wisconsin, Illinois, Indiana and Ohio, from the lake cities themselves, with representatives also from the United States Public Health and Marine Hospital Service. The Commission has held several annual meetings and its papers contributed have been helpful in stimulating the interest in the general problem.

In 1911 a more extended organization, known as the Great Lakes International Pure Water Association, was projected and a temporary organization formed.

As sources of inspiration and as centers of scientific discussion, such organizations are of real service. But, inasmuch as each problem is a local one, it is difficult to see how concerted action can be or need be brought about. Nor does it appear that interstate or international arrangements are necessary in order to bring about local reforms. Scientific cooperation is needed much more than legal cooperation or the promulgation of general laws bearing on the subject.

The instances where the sewage of one city affects the water supply of another, as Detroit and Buffalo, or Milwaukee and Cudahy, are in almost every case contained within the limits of a single state. No international problems of water pollution of any great importance are likely to arise in the near future.

Nevertheless the United States Government can, through its Public Health Service, perform a useful service by bringing its influence to bear on individual cities, pointing out the dangers and recommending action where needed. Through its impartial position such recommendations carry weight. The power to compel action by the negligent lake cities naturally lies with the state in which the city is located rather than with the federal government.

It is evident that some very important scientific studies need to be made to determine the laws that control the currents of the lakes and influence the dispersion of the sewage discharged into them. But it is not necessary to wait for such studies or to await further developments in the art of sewage treatment, as the obvious remedy for the protection of the lake water supplies is filtration of the water, with provision for its disinfection, if necessary. With the art of water purification so fully developed as it is, so thoroughly tested by experience, and proven to be reliable, no lake city can afford not to adopt this safe and sane method of protecting its citizens against the disease and death that lurk in sewage contaminated water supply.

POWER PLANTS

Costs of Producing Power Based on Iowa Coals, With a Comparison of Estimated Costs and Costs from Actual Tests.

The following data for estimating the cost of power production, although based on the heating value of coal from a single state are from their nature of considerably more than just state-wide applicability. We therefore give them in much detail from a bulletin of the Iowa State College, where they were originally presented by Mr. H. W. Wagner, Assistant Engineer in Mechanical and Electrical Engineering:

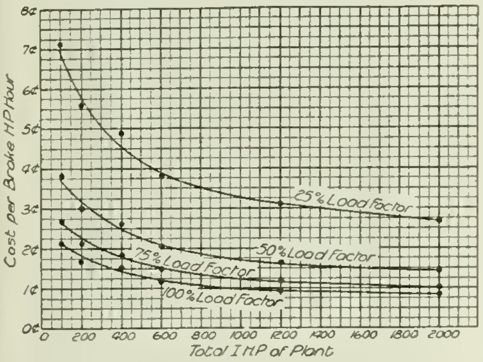


Fig. 1—Ten Hours Per Day, 310 Days Per Year, 11,000 B. T. U. Coal at $3.

In working up figures on the generation of steam power with Iowa coals no special attempt has been made to point out the most economical methods of operation. The object has been mainly to analyze the details and to show what the power costs per brake horsepower hour, delivered at the belt; and per kilowatt hour, delivered at the switchboard, under the various common conditions of operation. All assumptions are made to represent as nearly as possible the average practice in Iowa.

The conditions assumed as variable are the load factor, the number of hours the plant operates during the year, and the cost of coal. Depending upon these, variations then occur in nearly all items of expense which go to make up the cost of the brake horse power and the kilowatt hour.

The types of equipments for the different sized plants on Table I are chosen to represent not so much the most economical types for each size of plant as the most practicable of those now in common use in the state. The type for each case considered is listed in the schedule of equipment of plants on Table I, which is given further along. Table III and attached notes give the sizes and types actually found operating in the state.

No attempt has been made to estimate or calculate the cost of electric power delivered to customers. That would involve the cost and upkeep of transmission lines, meters, etc. The initial cost as given includes nothing outside the power plant, proper.

The text and data in this bulletin have been worked out under the direction of W. H. Meeker, Mechanical Engineer, and F. A. Fish, Electrical Engineer, both of the Engineering Experiment Station.

DEFINITION OF TERMS.

Indicated horsepower is the mechanical power devoloped in the engine cylinder by the steam working against the piston. It is measured from indicator cards taken from the engine cylinders.

Brake horsepower is the actual mechanical power delivered by the flywheel or pulley to the belt. It is measured by a prony brake or by an absorption dynamometer and is always less than the indicated horsepower.

Kilowatt is a unit of electrical power equal to 1,000 watts.

One horse power equals 746 watts, or .746 kilowatts.

Conversely, one kilowatt equals 1.34 horse power.

Horse power hour and *kilowatt hour* are units of energy or work done by the respective power units in one hour's time.

Load factors are defined on pages 9 and 31.

ESTIMATED POWER COSTS WITH IOWA COALS.

Table I gives the estimated costs of producing mechanical and electrical power in Iowa with Iowa coals. A thesis by W. M. Wilson was used as a basis of these figures. This thesis was prepared from a large amount of data on costs and test runs collected by Mr. Wilson and presented by him for the professional degree of Mechanical Engineer at Sibley College of Cornell University, in 1904. The figures worked out in this thesis were compared with cost data from other authorities and wherever a fair comparison could be made, were found to check fairly well. The general difference seemed to be that the other authorities gave somewhat lower costs.

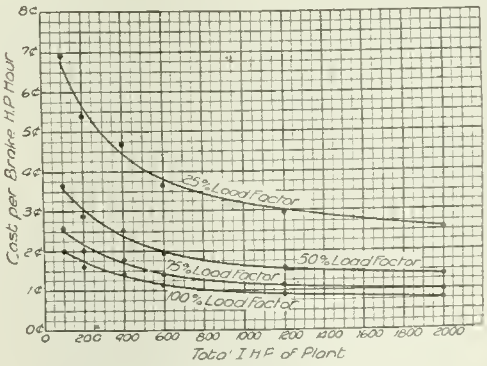


Fig. 2—Ten Hours Per Day, 310 Days Per Year, 9,000 B. T. U. Coal at $2.

The estimates in the original thesis were based upon the following conditions:

Fuel: Heating value of 14,000 B. T. U. per pound, moist coal; 60 per cent of heat in fuel absorbed by water in boiler.

Condensing Water: 30 lbs. water required to condense 1 lb. steam.

Cost: 1 ct. per 10,000 lbs. condensing water.

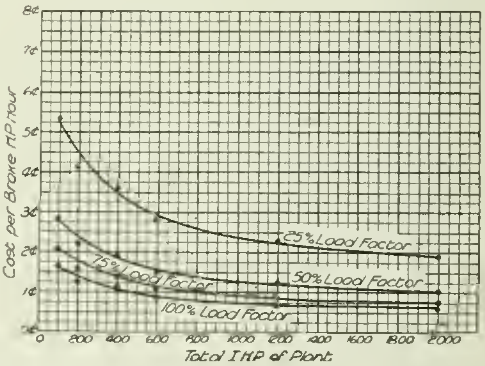


Fig. 3—Twenty-four Hours Per Day, 365 Days Per Year, 11,000 B. T. U. Coal at $3.

Fixed charges as a per cent of the initial cost of plant:

	Per cent.
Interest	5.0
Depreciation	5.0
Repairs	2.5
Insurance	0.5
Taxes	1.0
Total	14.0

Methods of operation:

First: 10 hours × 310 days = 3,100 hours per year.

Second: 24 hours × 365 days = 8,760 hours per year.

Initial costs include duplicate feed pumps, one reserve engine and one reserve boiler, in addition to those required for rated load.

The cost of building for the horizontal engines and turbines was taken at $1.50 per sq. ft. This is approximately the cost of a steel frame building having brick walls and a fireproof roof. The price of land was taken at $0.50 per sq. ft.

Where condensers are not used it is assumed that feed water is taken from the heater at a temperature of 190°; in the case of condensing engines it is taken at 160°, and where economizers are used, it is fed into the boiler at 280°.

When the plant is used only ten hours per day, 310 days per year, coal is required for banking fires and getting up steam before the ten-hour period that the plant is in operation. An allowance of 5 lbs. of coal per boiler horsepower per day is allowed for this purpose.

The load factor was taken at 100 per cent,

TABLE I.—ESTIMATED COSTS OF PRODUCING POWER WITH IOWA COALS.

Item No.		Per cent Load factor.	10 hours per day—310 days per year						24 hours per day—365 days per year						
1	Rated I. H. P. of plant	100	100	200	400	600	1,200	2,000	100	200	400	600	1,200	2,000	
2	Number of units	100	2	3	3	4	3	3	2	3	3	4	3	3	
3	Size of each unit, I. H. P	100	100	100	200	200	600	1,000	100	100	200	200	600	1,000	
4	Number of boilers	100	2	3	4	4	3	4	2	3	4	4	3	4	
5	Size of each boiler, H. P	100	92	74	88	113	230	256	92	74	88	113	230	256	
6	Brake H. P. of plant	100	85	170	340	540	1,050	1,800	85	170	340	540	1,050	1,800	
7	Cost of engines, room and equipment	100	51.72	52.20	50.05	45.06	43.60	31.55	51.72	52.20	50.05	45.06	43.60	31.55	*
8	Cost of boilers	100	22.85	14.76	11.00	9.04	12.70	11.04	22.85	14.76	11.00	9.04	12.70	11.04	
9	Cost of boilers, room and equipment	100	58.65	38.92	28.70	22.22	20.61	18.29	58.65	38.92	28.70	22.22	20.61	18.29	
10	Total initial cost	100	110.37	91.12	78.75	67.28	64.21	49.84	110.37	91.12	78.75	67.28	64.21	49.84	
11	Fixed charges, 14 per cent on initial cost	100	15.40	12.75	11.03	9.42	9.00	6.98	15.40	12.75	11.03	9.42	9.00	6.98	†
12	Oil and waste	100	1.02	1.02	1.02	1.02	1.02	1.02	2.89	2.89	2.89	2.89	2.89	2.89	
13	Attendance	100	15.50	10.85	7.56	6.35	4.65	3.72	43.80	30.66	21.37	17.96	13.14	10.51	
14	Condensing water	100	.....	.....	1.93	1.64	1.26	1.25	......	......	5.48	4.65	3.55	3.55	
15	Boiler pressure, lbs. per sq. in	100	100	120	120	120	150	156	100	126	120	120	150	150	
16	Lbs. of steam per I. H. P. hour	100	30	24	20	17	13	13	30	24	20	17	13	13	
17	Lbs. water evaporated per lb. coal	100	5.7	5.7	5.3	5.3	6.0	6.0	6.4	6.4	6.0	6.0	6.8	6.8	at $3
18	Lbs. coal per I. H. P. hr	100	5.26	4.22	3.78	3.20	2.17	2.17	4.65	3.74	3.34	2.83	1.92	1.92	at $3
19	Lbs. water evaporated per lb. coal	100	4.3	4.3	4.0	4.0	4.5	4.5	4.8	4.8	4.5	4.5	5.1	5.1	at $2
20	Lbs. coal per I. H. P. hr	100	7.00	5.60	5.00	4.25	2.90	2.90	6.20	4.98	4.45	3.76	2.55	2.55	at $2
21	Cost of coal per I. H. P. yr	100	24.40	19.60	17.60	14.80	10.20	10.20	61.30	49.30	44.10	37.20	25.40	25.40	at $3
22	Cost of coal per I. H. P. yr	100	21.60	17.30	15.60	13.10	9.10	9.10	54.30	43.70	39.00	32.90	22.50	22.50	at $2
23	Total cost per I. H. P. yr	100	56.32	44.22	39.14	33.23	25.13	23.17	123.39	95.60	84.87	72.12	53.98	49.33	
24	do	75	53.25	41.77	36.94	31.01	23.85	21.64	115.71	89.44	79.35	66.44	50.80	45.52	
25	do	50	50.22	39.32	34.55	28.63	22.45	19.98	108.07	83.27	73.28	60.51	47.28	41.36	
26	do	25	47.17	36.86	32.16	26.61	21.05	18.59	100.37	77.16	67.31	55.37	43.73	37.82	
27	Total cost per B. H. P. yr	100	66.20	52.00	46.00	36.90	28.70	25.70	145.00	112.50	99.70	80.10	61.60	54.70	‡
28	do	75	62.60	49.10	43.40	34.40	27.20	24.00	136.00	105.10	93.30	73.70	58.00	50.60	
29	do	50	59.00	46.20	40.60	31.80	25.60	22.20	127.00	97.80	86.10	67.20	54.00	46.00	
30	do	25	55.40	43.40	37.80	29.50	24.00	20.70	117.50	90.70	79.10	61.50	50.00	42.00	
31	Cost per B. H. P. hr	100	2.13	1.68	1.48	1.19	0.93	0.83	1.65	1.28	1.14	0.91	0.70	0.63	
32	do	75	2.69	2.11	1.87	1.48	1.17	1.03	2.07	1.60	1.42	1.12	0.89	0.77	
33	do	50	3.80	2.98	2.62	2.05	1.65	1.42	2.89	2.23	1.96	1.53	1.23	1.05	
34	do	25	7.15	5.60	4.88	3.81	3.10	2.67	5.37	4.15	3.62	2.81	2.29	1.92	
35	Total cost per I. H. P. yr	100	53.52	41.92	37.14	31.53	24.03	22.17	116.39	90.00	79.77	67.80	51.08	46.43	°
36	do	75	50.75	39.77	35.14	29.61	22.95	20.74	109.61	84.54	74.85	62.74	48.30	43.02	
37	do	50	48.12	37.62	33.05	27.43	21.65	19.18	102.87	79.07	69.48	57.51	45.08	39.36	
38	do	25	45.47	35.46	30.96	25.61	20.35	18.00	96.00	73.66	64.11	52.87	42.00	36.12	
39	Total cost per B. H. P. yr	100	63.38	49.73	43.98	35.17	27.52	24.50	137.90	106.89	94.75	75.80	58.64	51.75	
40	do	75	60.14	47.13	41.63	32.92	26.15	23.00	129.80	100.13	88.90	70.05	55.45	48.15	
41	do	50	56.88	44.52	39.07	30.62	24.70	21.45	121.75	93.61	82.36	64.20	51.80	43.95	
42	do	25	53.62	42.02	36.52	28.51	23.30	20.00	113.06	87.20	75.55	59.04	48.20	40.30	
43	Cost per B. H. P. hr	100	2.04	1.61	1.41	1.13	0.89	0.79	1.57	1.21	1.08	0.87	0.67	0.59	
44	do	75	2.58	2.03	1.79	1.42	1.13	0.99	1.96	1.52	1.36	1.07	0.85	0.74	
45	do	50	3.66	2.87	2.53	1.97	1.59	1.37	2.77	2.13	1.88	1.46	1.18	1.00	
46	do	25	6.91	5.42	4.71	3.69	3.01	2.58	5.16	3.98	3.47	2.70	2.16	1.85	
47	Cost per K. W. hr	100	3.62	2.86	2.43	1.95	1.49	1.33	2.80	2.18	1.87	1.49	1.12	1.01	§
48	do	75	4.85	3.80	3.24	2.56	1.93	1.70	3.73	2.88	2.46	1.94	1.47	1.27	
49	do	50	7.30	5.72	4.77	3.73	2.82	2.43	5.55	4.28	3.57	2.78	2.11	1.80	
50	do	25	14.60	11.45	9.35	7.31	5.58	4.80	11.00	8.51	6.95	5.40	4.13	3.45	
51	Cost per K. W. hr	100	3.47	2.74	2.31	1.85	1.42	1.26	2.67	2.06	1.77	1.43	1.07	0.95	**
52	do	75	4.65	3.65	3.10	2.46	1.87	1.63	3.53	2.74	2.36	1.85	1.40	1.22	
53	do	50	7.07	5 55	4.60	3.58	2.72	2.35	5.32	4.08	3.42	2.66	2.02	1.71	
54	do	25	14.13	11.11	9.05	7.08	5.42	4.65	10.55	8.15	6.66	5.18	3.89	3.33	

*Per I. H. P. †Per I. H. P. year. ‡Coal at $3. °Coal at $2. §Coal at $3. **Coal at $2.

EXPLANATIONS OF ITEMS ON TABLE I.

The left-hand margin of Table I shows which general items are figured at 100 per cent load factor. The right-hand margin shows on what basis the general costs are figured and with what price of coal each particular cost is figured.

All costs are given in dollars except those for brake horsepower hours and kilowatt hours, which are given in cents.

Item 1 gives the rated indicated horsepower of the plant upon which the yearly expenses are calculated.

Items 2, 3, 4 and 5 show the actual number and rated capacity of engines and boilers, including one reserve engine and boiler in each plant It may be noted that for the larger plants the rated horsepower of boilers is low when compared with the engine horsepower. This is explained by the fact that the larger engines require less steam per horsepower hour.

Item 6 gives the estimated brake horsepower of the plant, which represents the actual mechanical horsepower delivered by the flywheel to engine belt at full rated capacity.

Item 7 includes the cost of engine room and everything in it except the electrical machinery.

Items 7-10 give the costs per rated indicated horsepower.

Item 9 includes the cost of stack, boiler room and everything in the boiler room.

Items 11-14 give the yearly expenses per rated indicated horsepower.

Item 10 includes the entire cost of plant per rated indicated horsepower, exclusive of the electrical machinery.

The electrical machinery is not considered before item 47 because the object is first to arrive at a cost of purely mechanical power.

Item 17 gives the pounds of water evaporated per pound of moist fuel. These amounts vary with constant boiler efficiency because of the different temperatures at which the water is fed to the boiler.

The costs per indicated horsepower year and per brake horsepower year are based upon the rated indicated horsepower and brake horsepower respectively, and not upon the power actually developed at the various load factors below 100 per cent.

The costs per brake horsepower hour and per kilowatt bour are based upon the power actually delivered to the belt and to the switchboard respectively.

100 I. H. P. plant:	Simple, non-condensing, high-speed engines. Fire-tube boilers.
200 I. H. P. plant:	Compound, non-condensing, high-speed engines. Fire-tube boilers.
400 I. H. P. plant:	Compound, condensing, high-speed engines. Fire-tube boilers.
600 I. H. P. plant:	De Laval turbines. Fire-tube boilers.
1,200 I. H. P. plant:	Horizontal, condensing, low-speed Corliss engines. Water-tube boilers
2,000 I. H. P. plant:	Parson's turbines. Water-tube boilers.

TABLE II—TOTAL COST IN CENTS PER BRAKE HORSE POWER HOUR.

10 Hours × 310 Days. Fig. No.		Rated I. H. P. of Plant. 100	200	400	600	1,200	2,000	24 Hours × 365 Days. Fig. No.	Rated I. H. P. of Plant. 100	200	400	600	1,200	2,000	
5	100% L. F.	$0.31	$0.25	$0.22	$0.18	$0.13	$0.12	13	$0.27	$0.22	$0.20	$0.16	$0.11	$0.10	11,000 B. T. U. coal.
		1.21	.94	.82	.66	.55	.47		.83	.62	.54	.44	.37	.31	
6	75% L. F.	.36	.28	.26	.20	.14	.13	14	.32	.26	.24	.18	.13	.12	
		1.62	1.26	1.09	.88	.74	.62		1.11	.83	.71	.58	.49	.40	
7	50% L. F.	.46	.37	.33	.25	.19	.17	15	.41	.33	.30	.22	.17	.15	
		2.43	1.88	1.62	1.31	1.09	.92		1.65	1.24	1.06	.86	.73	.59	
8	25% L. F.	.77	.62	.56	.40	.31	.28	16	.68	.55	.49	.36	.28	.25	
		4.85	3.75	3.21	2.61	2.17	1.83		3.31	2.48	2.13	1.72	1.46	1.18	
9	100% L. F.	.41	.33	.30	.23	.17	.16	17	.37	.30	.27	.21	.15	.14	9,000 B. T. U. coal.
		1.21	.94	.82	.66	.55	.47		.83	.62	.54	.44	.37	.31	
10	75% L. F.	.48	.39	.35	.27	.20	.18	18	.42	.35	.33	.24	.18	.17	
		1.62	1.26	1.09	.88	.74	.62		1.11	.83	.71	.58	.49	.40	
11	50% L. F.	.62	.49	.45	.33	.25	.23	19	.55	.45	.41	.30	.22	.21	
		2.43	1.88	1.62	1.31	1.09	.92		1.65	1.24	1.06	.86	.73	.59	
12	25% L. F.	1.03	.85	.74	.55	.43	.38	20	.93	.75	.67	.49	.35	.33	
		4.85	3.75	3.21	2.61	2.17	1.83		3.31	2.48	2.13	1.72	1.46	1.18	

The lower figures in each line are the costs exclusive of coal. The upper figures in each line represent the amounts to be added for each dollar that the coal costs per 2,000 lbs.

i. e., the plants are assumed to run at full load during the time of operation.

In the original thesis from three to six types of engines were given for each size of plant. In the following but one type was chosen for each plant of a given rated capacity; a different type was chosen for each different size of station, while at the same time an effort was made to choose that one which was the most typical of those producing power most cheaply.

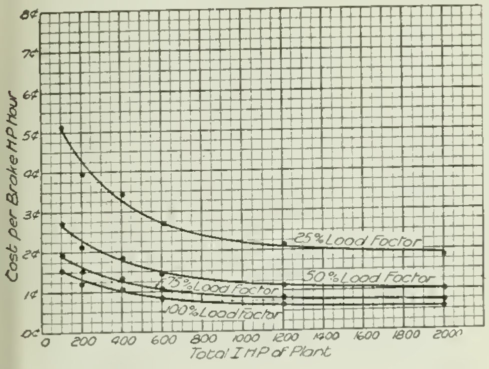


Fig. 4—Twenty-four Hours Per Day, 365 Days Per Year, 9,000 B. T. U. Coal at $2.

In order to fit Iowa conditions the following additions and modifications were made before arriving at the final figures:

Cost and Heating Value of Fuels:

First case: $3 per 2,000 lbs., delivered, for coal with a heat value of 11,000 B. T. U., per pound, moist.

Second case: $2 per 2,000 lbs., delivered, for coal with a heat value of 9,000 B. T. U., per pound, moist.

Boiler Efficiency at 100 Per Cent Load Factor:

60 per cent of heat in 11,000 B. T. U. coal absorbed by water in boiler.

55 per cent of heat in 9,000 B. T. U. coal absorbed by water in boiler.

With the above values the fuel cost of evaporating 1,000 lbs. of water from and at 212° with the $3 coal is 22 cts.; with the $2 coal it is 19.6 cts.

Initial cost of boilers and settings is increased 20 per cent because of the greater boiler and furnace areas required to get sufficient heat out of the lower grades of Iowa coals. This increase in cost of 20 per cent is arrived at as follows:

The efficiency of boilers is assumed as 60 per cent in the original calculations. Under Iowa conditions an average of 57½ per cent is assumed for the two grades of coal.

60 per cent ÷ 57½ per cent = 104 per cent, the ratio of efficiencies.

The heat value of coal in the original data is taken at 14,000 B. T. U. per pound. Under Iowa conditions the average of 9,000 and 11,000 is 10,000 B. T. U. per pound.

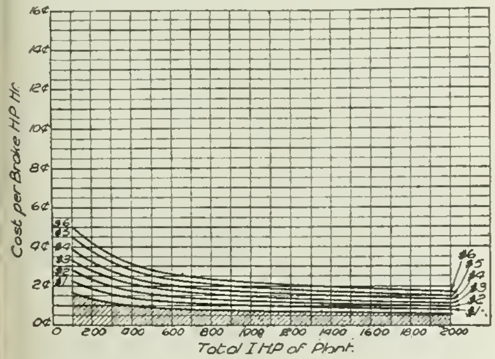


Fig. 7—Ten Hours Per Day, 310 Days Per Year, 11,000 B. T. U. Coal, 50 Per Cent. Load Factor.

14,000 ÷ 10,000 = 140 per cent, the ratio of heat value in the coal.

104 per cent × 140 per cent = 146 per cent, the ratio of weights of coal required to supply sufficient steam. In other words, 46% more Iowa coal under Iowa conditions must be burned than is estimated in the original data.

Assuming, roughly, that half of this increase in coal consumed is taken care of by a fast fire, the capacity of boilers and grates must be increased by 23 per cent. This would then make an increased cost of the boilers and settings of about 20 per cent.

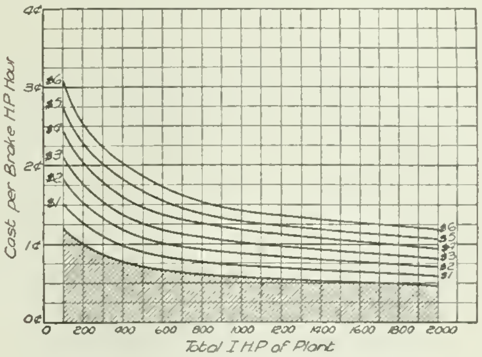


Fig. 5—Ten Hours Per Day, 310 Days Per Year, 11,000 B. T. U. Coal, 100 Per Cent Load Factor.

Mechanical Efficiencies of Engines at 100 Per Cent Load Factor:

	Per cent.
100 and 200 h.p. reciprocating units......	85.0
600 h.p. reciprocating units..............	87.5
Turbines	90.0

Percentages of Expenses at Various Load Factors:

Per cent—				
Load factor..............	100	75	50	25
Coal req., recip. engines..	100	87.5	75	62.5
Coal req., turbines........	100	85	70	57.5
Condensing water	100	100	90	80
Attendance	100	100	100	100
Oil and waste............	100	100	100	100

The above percentages represent the relative costs per rated indicated horsepower of plant and not per horsepower actually developed. For instance, the cost of coal for reciprocating engines per rated indicated horsepower is taken as 100 per cent when the plant is running at 100 per cent load factor or at full rated capacity. At 75 per cent load factor when the average load is only 75 per cent of the rated capacity, the coal required per rated indicated horsepower is 87.5 per cent of that required at 100 per cent load factor. In other words, the whole plant takes seven-eighths as much coal to develop 75 per cent of the rated load as it takes to develop full load.

The term "load factor" as used above, is the ratio between the average load and the capacity of the plant when both terms of the ratio refer only to the time operated. The same kind of load factor is used throughout on all data and curve sheets showing estimated power costs.

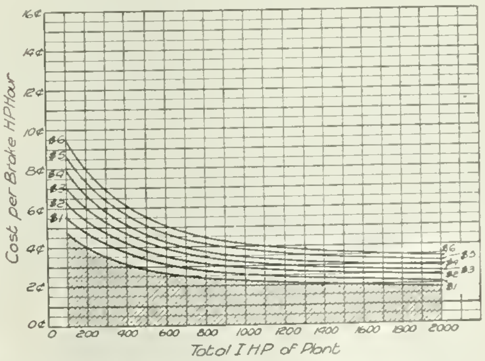


Fig. 8—Ten Hours Per Day, 310 Days Per Year, 11,000 B. T. U. Coal, 25 Per Cent. Load Factor.

The above paragraph leads to the fact that more coal is required per horsepower hour at the lower load factors. This is true because of lower boiler and engine efficiencies when working at lower load factors or when the plant is under loaded. Oil and waste and attendance costs are assumed to be the same for the whole plant at all load factors.

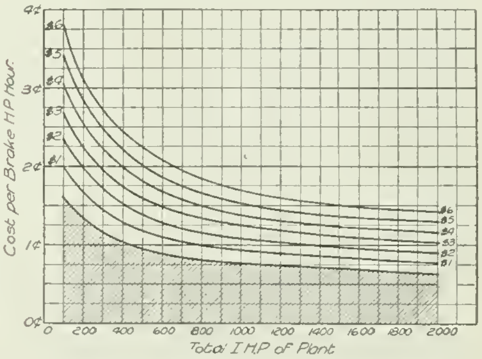


Fig. 6—Ten Hours Per Day, 310 Days Per Year, 11,000 B. T. U. Coal, 75 Per Cent. Load Factor.

Reciprocating engines are assumed to take a greater percentage of coal at the low load factors than the turbines because their efficiency drops more rapidly. The above figures referring to the various expenses at different load factors were derived from a study of the tests and data from different authorities.

The figures given above as well as those on Table I describing the conditions considered are to represent first-class operation. Local conditions vary a great deal.

By comparing actual local conditions with those used above a closer estimate can usually be made for any specific case. For instance, in some plants the exhaust from non-condensing engines may be used for steam heating, the revenue from which will effect a lower cost of power. In other cases where the load factor is low, the cost of attendance may be cut down if the firemen can be used for other work during the period of low power demand. The price of coal delivered in the furnace room depends largely upon railroad facilities and varies much at different points. Poor firing or defective equipment adds greatly to the cost of producing power. This matter is discussed further on page 13.

The costs per kilowatt hour were figured from the costs per brake horsepower by adding to the total yearly expense on account of the added electrical machinery and by taking into account the different efficiencies of the electrical generation at the different load factors. From Mr. Wilson's table initial costs of electrical generators were obtained and in the average case the fixed charges on these figure out to add about 8 per cent to the total yearly expense. The following table of electric generator efficiencies was made up from a study of tests and from data of different authorities.

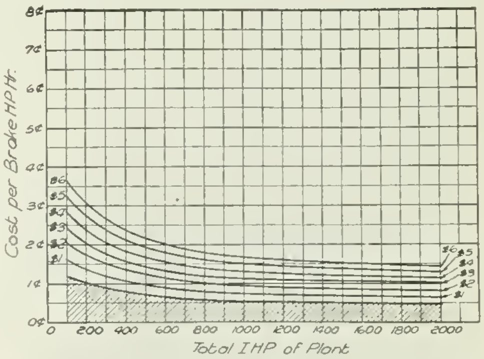


Fig. 9—Ten Hours Per Day, 310 Days Per Year, 9,000 B. T. U. Coal, 100 Per Cent. Load Factor.

	Per cent			
Load factor	100	75	50	25
Op. by 100 and 200 h.p. engines.	85	80	75	70
Op. by 400 and 600 h.p. engines.	87.5	83	79	75
Op. by 1,200 and 2,000 h.p. engines	90	87	84	80

NOTES ON GENERAL CONDITIONS.

The figures at various load factors assume that the plant be operated so as to produce rated load at any time. The load factor is taken as the ratio of the average load to the full rated capacity of the plant, when both terms of the ratio refer only to the time during which the plant operates.

All figures dealing with fuel refer to moist coal. Moist coal with a heating value of 11,000 B. T. U. per pound corresponds to coal having 8.3 per cent moisture and giving 12,000 B. T. U. per dry pound. Moist coal with a heating value of 9,000 B. T. U. per pound corresponds to coal having 10 per cent moisture and giving 10,000 B. T. U. per dry pound.

CALCULATIONS OF POWER COSTS FOR ANY PARTICULAR PLANT.

The expense items have been separated somewhat to show how the final results have been reached. The separation of expenses is of value when the reader wishes to calculate costs where certain conditions are far from the ordinary. It is not supposed that any one plant will closely approach the "average" conditions as assumed in working out the figures on Table I. Large variations may occur in the initial cost of the plant, price of coal, or efficiency of machinery.

By comparing the items of expense in an actual case with those given for the corresponding "estimated" case, a net difference of costs will be obtained. Then by adding or subtracting (as the case may call for) this net difference from the "estimated" cost per rated indicated horsepower year a new cost per rated indicated horsepower year for the "actual case" will be obtained. This "actual" total cost, divided by the "estimated" total cost, will then form a ratio of total costs. This ratio multiplied by the "estimated" costs per brake horsepower hour or per kilowatt hour given for the corresponding case, will give the calculated costs for producing these units of energy under the "actual" conditions. The following example is worked out to illustrate the above explanation:

Given: An electric power plant rated at 400 indicated horsepower; 4 second-hand boilers costing, with settings, $3,000, and operating at 45 per cent efficiency because of poor setting and careless firing; 11,000 B. T. U. coal costing $3.50 per ton because of distance from mine; load factor, 50 per cent; all other costs and conditions practically the same as in "estimated" case of 400-h.p. plant operating 10 hours per day, 310 days per year. Calculate by referring to Table I, the costs per brake horsepower hour and per kilowatt hour.

Calculation:

$3,000 ÷ 400 = $7.50, initial cost of boilers and settings per rated indicated horsepower.

$7.50 is $3.50 less than $11, the estimated cost.

14% × $3.50 = $0.49, fixed charge, saved per I. H. P. year on initial cost of boilers.

60% (estimated efficiency) ÷ 45% = 1.333. That is, the low efficiency boilers would require one-third more coal. This, multiplied by the ratio of coal costs per ton, will give the ratio of coal cost per rated indicated horsepower year. The ratio of coal cost per ton is:

$3.50 ÷ $3 = 1.1666.

1.333 × 1.1666 = 1.555, the ratio of coal cost. That is, under the conditions of this example the total cost per year will be 55.5% more than the estimated cost, or:

55.5% × $17.60 × 75% = $7.32, the added coal cost per rated indicated horsepower year.

In the above equation, $17.60 is the estimated coal cost per rated indicated horsepower year at 100% load factor and 75% is the percentage of coal required at 50% load factor.

Total cost added per rated I. H. P. year...$7.32
Total cost saved per rated I. H. P. year.... .49

Net cost added per rated I. H. P. year....$6.83

Estimated total cost per rated I. H. P. year, at 50 per cent load factor, with $3 coal, is $34.55.

$34.55 + $6.83 = $41.38, total cost per rated I. H. P. year for this example.

$41.38 ÷ $34.55 = 1.19, ratio of total costs.

1.19 × 2.62 cts. (estimated) = 3.13 cts., calculated cost per actual B. H. P. hour for this particular plant.

1.19 × 4.77 cts. (estimated) = 5.70 cts., calculated cost per K. W. hour for this particular plant.

CURVE SHEETS.

Figs. 1, 2, 3 and 4 are curve sheets showing graphically the estimated costs per brake horsepower hour for 10 and 24-hour operation, with 9,000 B. T. U. coal at $2 and with 11,000 B. T. U. coal at $3, all with 100 per cent, 75 per cent, 50 per cent and 25 per cent load factors. Curves on Figs. 1 and 2 are plotted from items 31 to 34 of Table I. Curves on Figs. 3 and 4 are plotted from items 43 to 46 of Table I.

Figs. 5 to 20 constitute a second set of curve sheets showing estimated costs per brake horsepower with coals costing from $1 to $6 per 2,000 lbs. These curves show also the cost of coal per brake horsepower hour as separated from all other costs. The curve bordering the upper side of the shaded portion represents the total of all expenses except that of coal. Each of the upper curves represents the total cost with coal at the particular price with which the curve is marked.

For example, suppose one wishes to find the total cost and the fuel cost per brake horse power in a 1,200 horse power plant operating ten hours per day, 310 days per year, at 250 load factor, with 9,000 B. T. U. coal costing $3 per 2,000 pounds.

Turning to Fig. 12 which corresponds to the conditions given, it is seen that the "$3.00" curve indicates 3.5 cts. as the total cost per brake horse power hour. Dropping down to the curve bordering the shaded portion, it is seen that 2.15 cts. is the total cost per brake horse power exclusive of coal. Subtracting 2.15 cts. from 3.5 cts. leaves 1.35 cts. per brake horsepower hour due to coal.

Table II. gives the figures from which these curves were plotted. The costs to be added for each dollar that the coal cost per 2,000 pounds are given to be used in calculations where the cost per 2,000 pounds is not in even dollars.

It will be noticed that Table II has the same arrangement of conditions as has Table I. Table II also has an index of figure numbers referring to curve sheets corresponding to each particular condition.

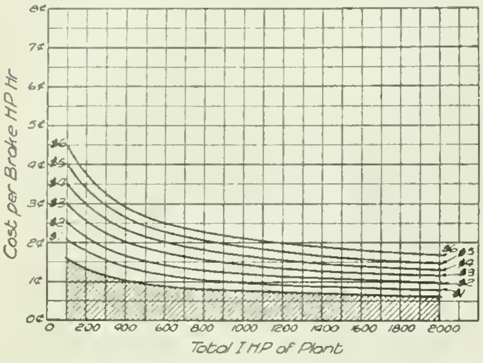


Fig. 10—Ten Hours Per Day, 310 Days Per Year, 9,000 B. T. U. Coal, 75 Per Cent Load Factor.

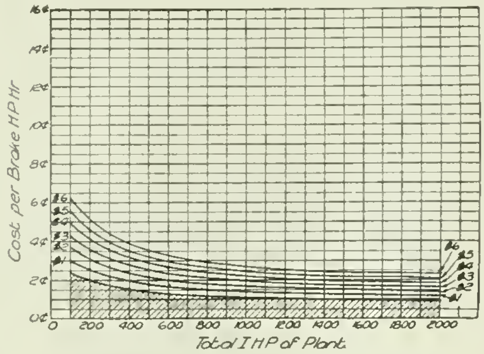


Fig 11—Ten Hours Per Day, 310 Days Per Year, 9,000 B. T. U. Coal, 50 Per Cent Load Factor.

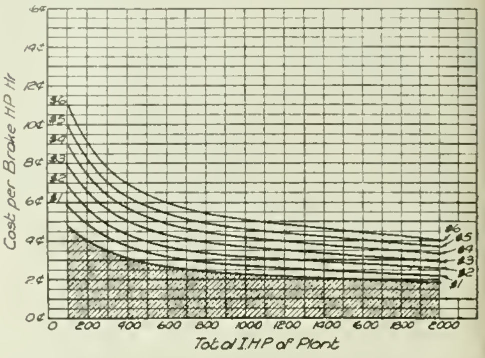


Fig. 12—Ten Hours Per Day, 310 Days Per Year, 9,000 B. T. U. Coal, 25 Per Cent Load Factor.

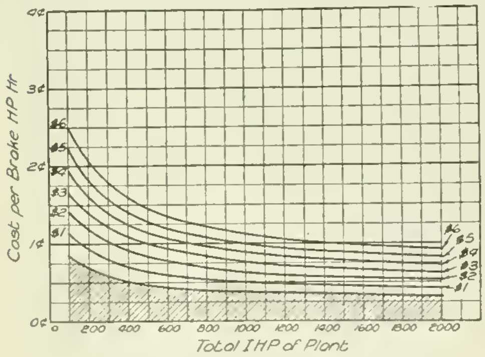


Fig. 13—Twenty-Four Hours Per Day, 365 Days Per Year, 11,000 B. T. U. Coal, 100 Per Cent Load Factor.

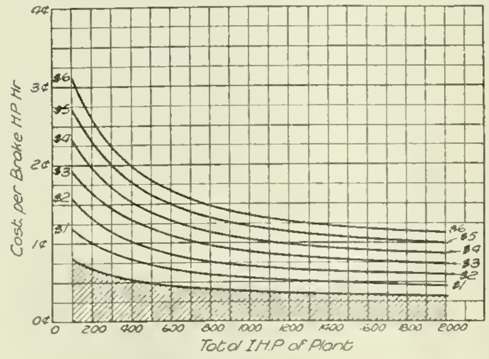


Fig. 14—Twenty-Four Hours Per Day, 365 Days Per Year, 11,000 B. T. U. Coal, 75 Per Cent Load Factor.

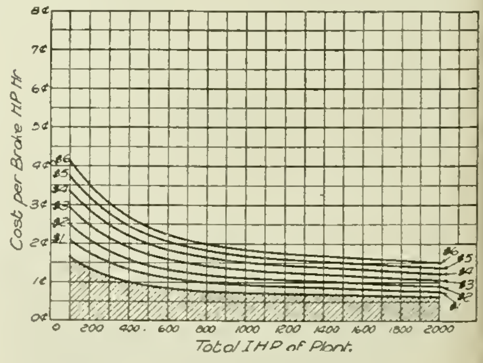


Fig. 15—Twenty-Four Hours Per Day, 365 Days Per Year, 11,000 B. T. U. Coal, 50 Per Cent Load Factor.

TABLE III.—COSTS OF PRODUCING POWER BASED ON ACTUAL TESTS WITH IOWA COALS.

1	Plant No.	1	2	3	4	5	6	7	8	9	10	Ave.
2	Year of test	1907	1908	1907	1909	1908	1906	1907	1912	1912	1910	
3	Hours operated per day	16	11	24	18	24	12	15	24	24	12	18
4	No. of engines operated	1	1	2	2	1	1	2	1	2	1	.....
5	Total I. H. P. of engines operated	80	100	115	120	150	165	200	250	375	750	230.5
6	No. of boilers operated	2	1	2	2	1	2	2	1	2	2	.....
7	Total H. P. of boilers operated	200	100	140	110	200	200	200	150	400	1,000	270
8	Total cost of plant	......	8,000	8,027	6,000	20,000	20,000	11,800	16,550	25,400	25,000	15,600
9	Total cost of plant, per I. H. P.	......	80	70	50	133	121	59	66	67	33	75.50
10	Total cost of plant, per B. H. P.	......	102	88	65	173	155	72	86	75	35	94.60
11	Fixed charges per I. H. P. year	......	10.40	10.40	9.00	17.70	14.20	10.70	7.45	9.05	4.60	10.35
12	Operating expenses per I. H. P. year	......	23.70	48.60	30.00	29.10	25.00	26.30	29.90	33.05	11.40	28.50
13	Total expenses per I. H. P. year	......	34.10	59.00	39.00	46.80	39.20	37.00	37.35	42.10	16.00	38.85
14	Cost of coal per 2,000 lbs., delivered	2.17	2.22	2.00	3.70	3.50	1.80	2.36	1.65	2.74	1.51	2.36
15	B. T. U. per lb., moist coal	8,750	10,250	8,850	12,900	11,440	9,800	10,280	8,950	11,000	9,320	10,150
16	B. T. U. per lb., dry coal	9,700	11,525	9,670	13,550	13,800	10,300	11,460	9,870	11,980	10,160	11,200
17	Boiler pressure—gauge	90	70	77	100	100	57	90	80	125	105	90
18	Lbs. of steam per actual I. H. P. hour	46.4	42	34	39	29	34	39	35.5	33	23	35.5
19	Lbs. of water evap. per lb. moist fuel	4.7	6.0	4.1	6.4	4.7	5.7	5.7	4.8	7.87	4.5	5.47
20	Equiv. evap. from and at 212° per lb. moist fuel	5.1	6.2	4.6	6.9	5.1	6.0	6.3	5.1	8.0	5.1	5.85
21	Efficiency of boiler and grate (per cent)	57	47	46	52	44	53	53	47	65	50	51.4
22	Efficiency (%) of conversion	62	55	60	53	50	56	73	53	81	70	61.3
23	Efficiency (%) of plant—Coal pile to Sw'B'd	1.7	1.33	1.9	2.0	1.83	2.6	2.62	3.24	2.59	3.9	2.37
24	Load factor, based on peak—Time operated	.50	.57	.45	.54	.26	.53	.47	.47	.38	.62	.489
25	L. F. based on I.H.P.—365 days—Time operated	.37	.32	.37	.25	.23	.36	.40	.21	.27	.30	.31
26	L. F. based on I.H.P.—365 days—24 hrs. per day	.25	.15	.37	.19	.23	.18	.25	.21	.27	.15	.22
27	Average I.H.P. during run	30	32	43	30	35	59	80	53	101	285	74.8
28	Cost per actual I.H.P. hour	2.4	2.5	1.9	2.4	2.3	2.5	1.65	2.0	1.8	0.96	2.04
29	Average B. H. P. during run	24	25	34	23	27	46	67	41	91	240	61.8
30	Cost per B. H. P. hour	3.0	3.2	2.4	3.1	3.0	3.2	2.0	2.6	2.0	1.15	2.58
31	Average K. W. during run	13.9	13.1	19.2	11.9	13.1	24.7	43.5	21.0	61.2	148.5	37.0
32	Cost per K. W. hour	5.15	5.85	4.25	6.0	6.15	5.86	3.13	5.0	3.0	1.85	4.62

EXPLANATION OF ITEMS ON TABLE III.

All costs are given in dollars except those for indicated horse power hours, brake horse power hours, and kilowatt hours, which are given in cents.

Items 4, 5, 6 and 7 give the number and ratings of only those engines and boilers actually operated in the test runs. Any reserve units are mentioned in the notes of equipment. Items 8, 9 and 10 include the cost of any reserve machinery and the costs per horse power are obtained by dividing the total costs by the rated horse power of the engines actually operated.

Item 11 gives the fixed charges per indicated horse power year and includes interest, depreciation, repairs, insurance and taxes. Expressed as a percentage of the total initial cost, this item varies from 11.3 per cent in the case of plant No. 8 to 18 per cent in the case of plant No. 4.

Item 21, Boiler and Grate Efficiency, gives the per cent of heat in the coal actually absorbed by the water in the boiler.

Item 22, Efficiency of Conversion, is the ratio of the energy delivered at the switchboard to that given the engine piston by the steam.

Item 23, Efficiency of Plant, is the ratio of the energy delivered at the switchboard to that in the coal as fired.

Item 24 is the load factor or ratio between the average load and the peak load when both terms of the ratio refer only to the time during which the plant was operated.

Item 25 is the load factor or ratio between the average load and the rated capacity of the plant when both terms refer only to the time during which the plant was operated.

Item 26 is the load factor or ratio between the average load and the rated capacity of plant when the first term of the ratio refers to the time operated and the second term refers to 24 hours operation per day.

All three kinds of load factors are figured from the indicated horse power of engines and are based upon 365 days operation per year.

Item 27 is the average indicated horse power developed as figured from the indicator cards taken during the test.

Item 29, Average Brake H. P., is figured from the average indicated horse power by assuming approximately equal losses of conversion in engine and generator.

Item 31, Average Kilowatts, was figured from the switchboard instrument readings.

In the case of the turbo-generator in plant No. 10, the efficiency of conversion was figured at about 70 per cent for the test load. The rating of 750 indicated horse power was figured from the 500 K. W. rating by assuming an efficiency of conversion of about 90 per cent at full load. The load factors for this same plant were figured from the kilowatts.

EQUIPMENT OF PLANTS TESTED.

Plant No. 1.

1 simple engine, 80 h. p.
2 boilers, 100 h. p. each.
Feed water heater.
No reserve units.

Plant No. 2.

1 high speed engine, simple, 100 h. p.
1 boiler, 100 h. p.
Feed water heater.
1 reserve boiler, 100 h p.

Plant No. 3.

1 simple engine, 70 h. p.
1 simple engine, 45 h. p.
2 boilers, 70 h. p. each.
No reserve units.

Plant No. 4.

1 Corliss engine, 100 h. p., run 5 hrs. per day.
1 Corliss engine, 20 h. p., run 13 hrs. per day.
1 boiler, 60 h. p.
1 boiler, 20 h. p.
Feed water heater.
No reserve units.

Plant No. 5.

1 compound engine, 150 h. p., run from 3 a. m. to 12 midnight, and from 5 a. m. to 10 a. m., making 14 hours of service per day for engine.
1 boiler, 200 h. p., fire kept banked while engine was not running.
1 reserve engine, 75 h. p.
Storage battery used as auxiliary to provide 24-hour service.

With the same boiler efficiency a lower priced steam coal would have reduced the K. W. hour cost from 6.15 cts. to 5.2 cts.

Plant No. 6.

1 simple Corliss engine, 165 h. p.
2 boilers, 100 h. p. each.
Feed water heater.
No reserve units.

Plant No. 7.

1 Corliss engine, 120 h. p.
1 Corliss engine, 80 h. p.
1 boiler, 120 h. p.
1 boiler, 80 h. p.
No reserve units.

Plant No. 8.

1 Corliss engine, 350 h. p.
1 boiler, 150 h. p.
Feed water heater.
1 reserve engine, 75 h. p.
1 reserve boiler, 125 h. p.

Plant No. 9.

1 tandem compound engine, 225 h. p.
1 simple engine, 150 h. p.
2 boilers, 200 h. p. each.
Feed water heater.
1 reserve engine, simple, 120 h. p.

Plant No. 10.

1 Curtis vertical condensing steam turbine, 500 K. W.
2 boilers, 500 h. p. each.
No reserve units.

The indicated horse power of the steam turbine is used as 750 on the data sheet. This figure is obtained by assuming a conversion efficiency of about 90 per cent at full load.

POWER PLANT TESTS IN IOWA.

Table III gives results of tests on Iowa power plants and supplies approximate figures on the cost of generating power in Iowa with Iowa coals in electric power plants of the capacities noted on data sheet.

All figures are based upon a one day's test of each respective plant and upon the assumption that the plant is operated the same each day of the year. These tests were practically all run during the winter months and under the ordinary load conditions. The readings were taken and the results calculated by students of the Iowa State College under the direction of instructors in the Mechanical and Electrical Engineering departments of the college. These figures were arranged and reduced to a comparative basis by the Engineering Experiment Station.

The costs arrived at are not claimed to be entirely accurate. The greatest discrepancy would perhaps be in the valuation of the power plant or in fixing the operating expenses. It will be noted that the estimated value per rated indicated horsepower ranges from $50.00 to $133.00 for plants of 200 indicated horse power or under.

Only the engines and boilers actually used in the tests are given in the table. Any reserve units are mentioned in the notes on

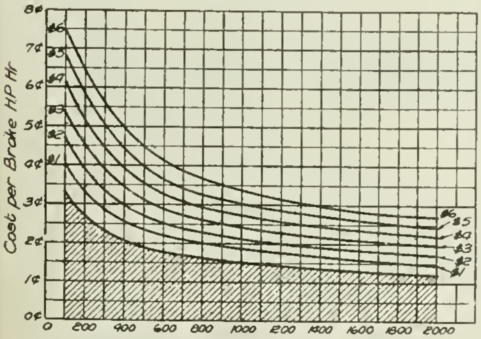


Fig. 16—Twenty-Four Hours Per Day, 365 Days Per Year, 11,000 B. T. U. Coal, 25 Per Cent Load Factor.

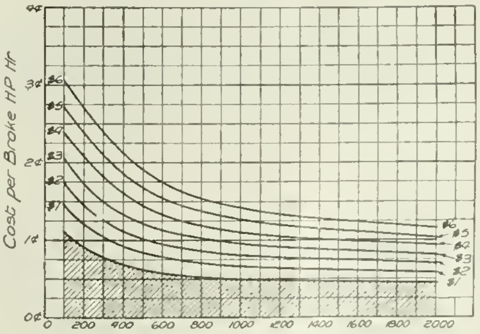


Fig. 17—Twenty-Four Hours Per Day, 365 Days Per Year, 9,000 B. T. U. Coal, 100 Per Cent Load Factor.

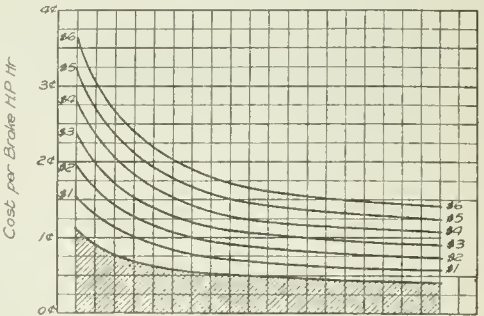


Fig. 18—Twenty-Four Hours Per Day, 365 Days Per Year, 9,000 B. T. U. Coal, 75 Per Cent Load Factor.

equipment. The total cost of plants, however, includes the reserve units.

The pounds of steam per indicated horse power hour represent dry steam and include that used for auxiliaries in practically all cases.

Efficiency of conversion is the combined mechanical efficiency of the engine and the efficiency of the electric generator.

All costs are based upon 365 days of operation per year.

The cost per brake horse power hour is calculated from the cost per indicated horse power hour by assuming approximately equal losses of conversion in the engine and generator.

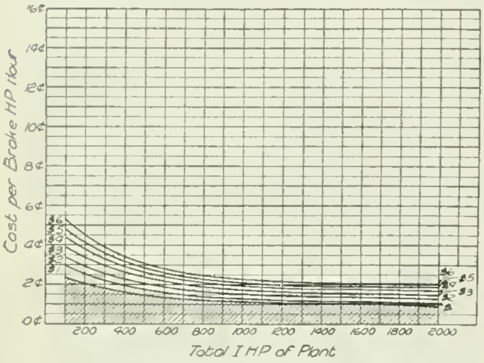


Fig. 19—Twenty-Four Hours Per Day, 365 Days Per Year, 9,000 B. T. U. Coal, 50 Per Cent Load Factor.

The cost per brake horse power hour includes fixed charges on the electrical equipment of the station, while on Table I it does not. The difference amounts to about 8 or 10 per cent.

COMPARISON OF DATA ON TABLES I AND III.

The results of actual tests are given to show how the estimated efficiencies and costs check with those found in actual practice. A very direct comparison is difficult to make because of the irregularities in cost of plants, hours of operation, load factors and types of equipment. Also most of the tests were made on plants of small capacities.

The point of load factors should receive special attention. There is some disagreement among engineers as to the correct definition of load factor. To avoid misunderstanding on this point, load factors based upon different standards are given together with a definition of each.

On Table I (estimated costs) the different percentages of load factor are based upon a peak load which is assumed to equal the full rated capacity of plant. On Table III (actual costs) the peak load was found to be below the rated capacity in all cases.

If the load factor based upon the rated capacity in the actual tests is used as a basis for comparison, the cost per unit of energy is found to be considerably below the estimated costs. But if the factor based upon the actual peak load is used, the actual check quite closely with the estimated costs. On Table I the operating expenses are put at a price which assumes the ability to produce a peak load of rated capacity at any time. On Table III the operating costs are at a price which insures the ability of the plant to produce not rated load but the actual peak load at any time. From this then, it appears that the most logical load factor to use is the one based on the actual peak load of the day. The following comparisons are made upon this principle.

The estimated costs assume two methods of operation as regards hours operated per year. The first assumes 10 hours per day, 310 days per year. The second assumes 24 hours per day, 365 days per year. The first is of value in getting at the cost of power for factories operating only 10 hours per day and 6 days per week. The second is of value in getting at the cost of all classes of power supplied every hour of the year. Most electric central stations operate every day of the year, although many run less than 24 hours per day. Referring to Table III it will be noticed that for the plants as tested the average number of hours operated per day is 18.

The following is a comparison between the averages of the actual tests and the figures of the nearest corresponding estimated case.

	Actual.	Estimated.
Hours per year	6,570	8,760
I. H. P. of plant	230.5	200
Total cost per I. H. P.	$75.50	$91.12
Fixed charges per I. H. P. year	$10.35	$12.75
Operating cost per I. H. P. yr.	$28.50	$66.32
Total cost per I. H. P. year	$38.85	$79.07
Cost of coal per 2,000 lbs	$2.36	$2.00
B. T. U. per lb. moist coal	10,150	9,000
Load factor	.489	.50
Average brake H. P. developed	61.8	85.0
Cost per brake H. P. hr., cts.	2.58	2.13
Average K. W. developed	37.	47.5
Cost per kilowatt hour, cts.	4.62	4.08

The greatest difference in the above comparison is with the operating expenses per rated horse power year. It is much lower in the "actual" column than in the "estimated" column because in the first case the plant is so operated as to produce a maximum load of only about two-thirds the rated load, while in the second case the plant is so operated as to produce the full rated load at any time. Also in the first column, the time operated is but 75% of that in the second.

The costs per unit of energy are slightly higher in the "actual" column than in the "estimated" column, but the average hours operated is only 75 per cent of the time operated in the "estimated" column, which would naturally tend to make an even greater difference than that shown.

By a general comparison of all figures, the estimated costs seem to be higher than those figured from the actual tests in Iowa power plants; this is especially true as the load factor decreases. It is possible, however, that in the case of the tests certain operating expenses were omitted, such as management and bookkeeping.

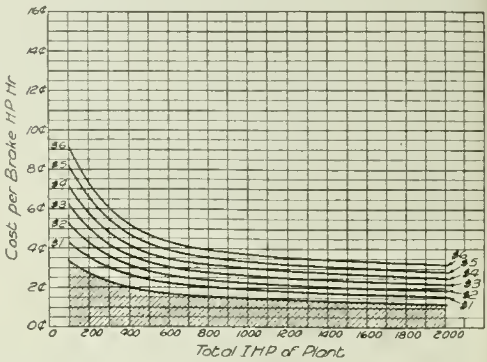


Fig. 20—Twenty-Four Hours Per Day, 365 Days Per Year, 9,000 B. T. U. Coal, 25 Per Cent Load Factor.

Following is the relationship between some additional corresponding items on Table I and III.

Table I—Steam consumption ranges from 13 to 30 lbs. per I. H. P. hour.

Table III—Same ranges from 23 to 46.4.

Table I—Boiler pressure ranges from 100 to 150 lbs. per sq. in. by gage.

Table III—Same ranges from 57 to 125.

Table I—Efficiency of boiler and grate ranges from 55 to 60 per cent.

Table III—Same ranges from 44 to 65 per cent.

Table I—Water evaporated per pound moist coal ranges from 5.3 to 6.8 lbs.

Table III—Same ranges from 4.1 to 7.87.

Table I—Pounds of coal per indicated H. P. hour ranges from 1.92 to 7.0.

Table III—Same ranges from 4.2 to 9.9.

Table I—Efficiency of conversion ranges from 49 to 81 per cent.

Table III—Same ranges from 50 to 81 per cent.

Table I—Cost of coal per million B. T. U. ranges from 11.1 to 13.6 cts.

Table III—Same ranges from 8.1 to 15.3 cts.

Note.—In all the above comparisons, except efficiency of conversion, the figures are taken from Table I at 100 per cent load factor, and from Table III at whatever load factor occurred in each case. Efficiency of conversion was taken from the extreme limits in both cases.

BRIDGES

Method of Constructing a Three-Span Skew Arch Bridge Using Steel Centers.

(STAFF ARTICLE.)

One of the notable concrete bridges recently undertaken by the city of Pittsburgh is a three-span arch structure which will carry Atherton Ave. on a skew of 62° 45′ across the four tracks of the Pennsylvania R. R. An elevation of the bridge is shown by Fig. 1 and the view Fig. 2 aids in explaining its location.

Structural Features.—The Atherton Avenue Bridge is 377 ft. long and consists of three 98-ft. arches carried on two piers and two abutments. The spandrels are solid walls capped with cornices and parapet walls and their only notable feature is the interior counter posts which brace them against the outward thrust of the granulated slag fill. The section, Fig. 3, taken at about quarter span

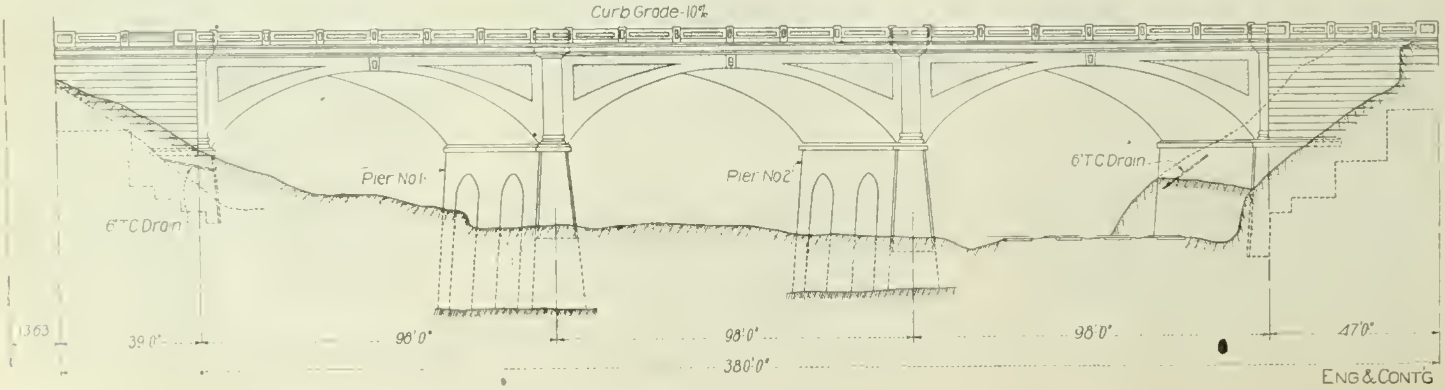


Fig. 1—General Elevation of Three-Span, Skew-Arch Bridge at Atherton Avenue, Pittsburgh, Pa.

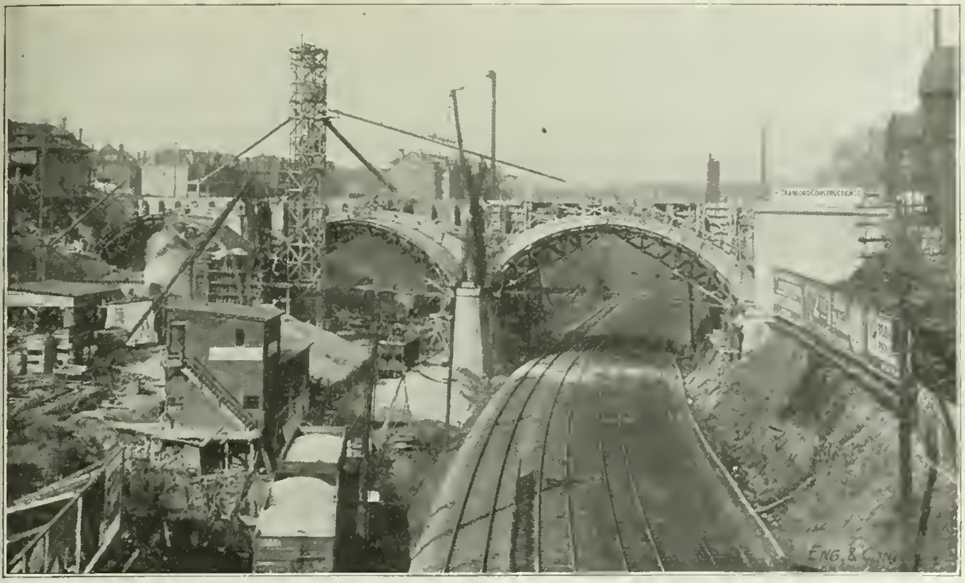


Fig. 2—View Showing Site and Plant Lay out, Atherton Ave. Bridge.

shows this counterpost construction. Figure 4 is a half longitudinal section of one arch ring. The outside width of the bridge nearest to the walls is 53 ft., except at abutments and piers where coves increase the width to 60 ft. The roadway is 36 ft. wide between curbs and is the Pittsburgh city standard street asphalt pavement laid on the slag fill. The sidewalks are normally 6 ft. wide, with enlargements at the coves previously mentioned. Their construction and that of the curb are shown in Fig. 3. Other dimensions and general structural features are shown by the drawings of Figs. 1, 3 and 4.

The foundations were simple. The curving, as shown by Fig. 2, is at a gorge some 60 ft. deep. The ground consists of some 22 ft. at the piers of filling over shale rock and all foundations were carried to rock. For the piers pits were dug and sheeted by hand, using a derrick to hoist out the spoil. Water gave considerable trouble and in the case of pier No. 2, adjacent to the railway tracks, care to avoid settlement had to be exercised. The piers it will be noted are pierced by two arches, but instead of the batter shown below ground they were built up straight to the ground surface and slipped to the batter line above ground for reasons that will be described later.

Construction Plant.—The lay-out plan of the construction plant is given by Fig. 5, and Fig. 2 shows its appearance. Scheduled briefly the plant consisted of three guy derricks covering the bridge; a stiff leg derrick for unloading material; a mixing plant and tower and chutes; and wood-working shop; cement house, and other buildings as indicated by Fig. 5.

As will be seen from the lay-out plan the three guy derricks were located at the ends and midway of the bridge site. The one at the east end had an 80-ft. mast and a 60-ft. boom, the boom as a precaution being kept short enough not to swing over the railway tracks. The middle derricks had a 103-ft. mast and a 98-ft. boom and was the largest of the three. Its boom length enabled it to handle the centers for two arches. The west abutment derrick had a 40-ft. mast and 60-ft. boom and covered the westernmost arch span. The fourth derrick was located to one side of the side track which brought in all construction materials, and was used for unloading cars, handling stone and sand from storage to mixer bins, etc. It was equipped with a Hayward clam shell bucket.

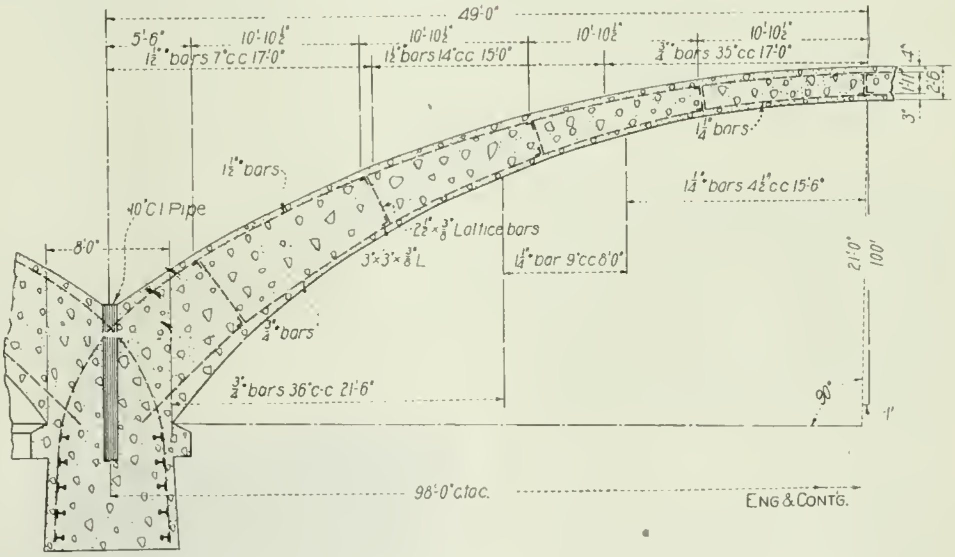


Fig. 4—Half Longitudinal Section of Arch Ring, Atherton Ave. Bridge.

The concrete plant consisted of a Smith mixer, a Ransome hoist tower and bucket and a C. H. & E. chuting system. The chutes as will be seen in Fig. 2, were supported by cables stretched from the tower to suitably located anchorages. Block and tackle suspenders at about 8-ft. intervals hung the chutes to the cables, and permitted adjustment of the inclination of the chute. The height of the tower was great enough to chute directly to all parts of arches and piers, but for the upper portions of the abutments the concrete was placed by hand from a platform to which the chutes delivered.

Pier Construction.—As stated above, the piers below ground were not battered as indicated by the plans, but were built with vertical sides and at the surface were stepped in to the indicated batter planes which were followed according to plans from the ground surface up. This step in the pier face formed a support for the arch centers, as will be described further along.

The forms for the pier sides were 2-in. plank nailed to studs and held by wales with tie bolts across pier between opposite wales. The wales were made of two 2x12-in. planks braced together by spacing blocks. The wales were set edgewise against the form studs and the tie bolts were run between the planks. These bolts were made in three pieces; two end pieces, one on each side of the pier, were just long enough to extend about 2 ins. into the concrete where they connected with the middle piece by means of an ordinary union. A twist removed the end pieces when ready to remove the forms.

The ends of the piers being conical frustrums, a special form was necessary. It was built of 1x2-in. strips laid out fanwise with galvanized iron sheets nailed to the strips. This made a flexible panel. Segmental wales were fastened to the wales of the side forms and inside these was set the flexible panel. This panel was bent against the wales, which acted like hoops, and was nailed to them. This made a curved form which after use on one pier could be lifted in one piece and set up for another pier.

As will be seen from Fig. 4, the piers have a heavy reinforcement of railway rails. To support this reinforcement falseworks were necessary. Two vents of 12x12-in. timbers, one on each side of the pier, were erected. Resting on these vents and spanning the pier, 3x12-in. planks were set on edge at intervals. Across these at each edge of the pier were set edgewise two planks. The row of vertical rails on each side extended upward between the two planks on its side and when the rails were accurately adjusted the planks were

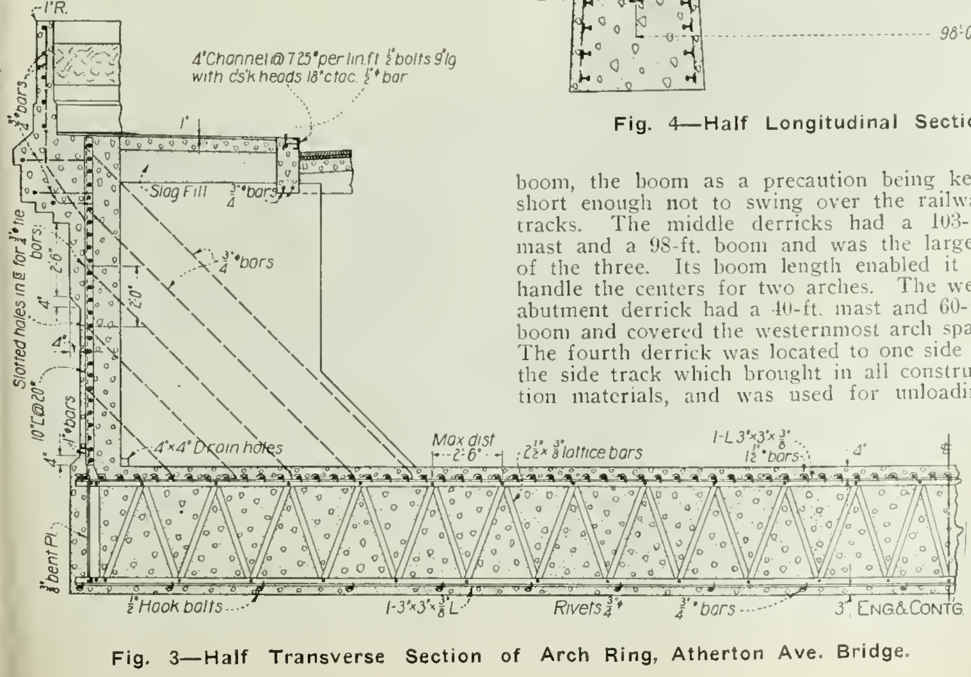
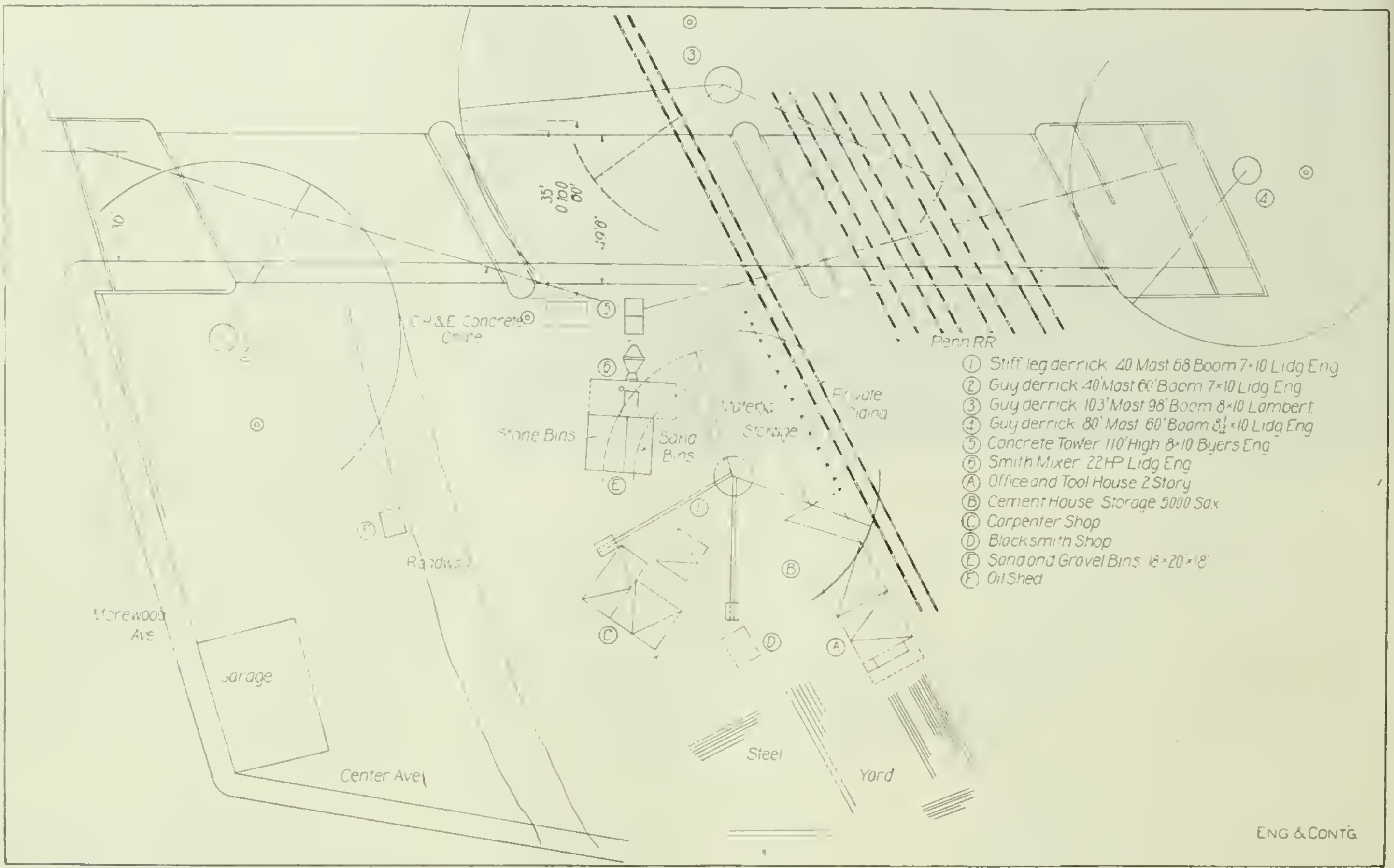


Fig. 3—Half Transverse Section of Arch Ring, Atherton Ave. Bridge.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C H & E Concrete Chute
Stone Bins
Sand Bins
Material Storage
Private Siding
Penn RR
Morewood Ave
Garage
Roadway
Center Ave
Steel
Yard
① Stiff leg derrick 40 Mast 68 Boom 7×10 Lidg Eng
② Guy derrick 40' Mast 60' Boom 7×10 Lidg Eng
③ Guy derrick 103' Mast 98' Boom 8×10 Lambert
④ Guy derrick 80' Mast 60' Boom 8¼×10 Lidg Eng
⑤ Concrete Tower 110' High 8×10 Byers Eng
⑥ Smith Mixer 22 HP Lidg Eng
Ⓐ Office and Tool House 2 Story
Ⓑ Cement House Storage 5000 Sax
Ⓒ Carpenter Shop
Ⓓ Blacksmith Shop
Ⓔ Sand and Gravel Bins 18×20×8'
Ⓕ Oil Shed
ENG & CONTG

Fig. 5—Construction Plant Lay-out Plan, Atherton Ave. Bridge.

clamped together to hold them in position. The horizontal rails were tied to the vertical rails for support. When the pier concreting had been finished ready for the arch work and the arch centers had been set the projecting tops of the vertical rails were bent over as shown by Fig. 4 and were held in position by a light framework erected on the centers.

Arch Centers.—The arch center construction is shown by Figs. 6, 7 and 8. Six steel arch ribs made by the Blaw Steel Construction Co., Pittsburgh, Pa., carried timbers and lagging as shown by Figs. 6 and 7, and the ribs were carried on bents as shown by Figs. 7 and 8. The plan was to concrete half the width of the arch ring and then shift the centers over and concrete the second half of the arch ring. The arrangement for shifting the centers is interesting.

A six-post vent was erected on the footing shelf of the pier as shown by Fig. 7, the idea being to have a vent-post under each arch rib. On the vent cups over each post was placed a block and double wedge and on these supports a 12x12-in. plate on which rested the ribs. Between each pair of ribs a dolly was fastened to the vent-caps. Other details of the rib supports are shown clearly by Figs 7 and 8, which show positions of parts while concreting.

The shifting of the center to construct the second half of the arch was accomplished as follows: Jacks were set up on the vent-cups alongside the dollies, and a strain taken on them until the wedges were loosened sufficiently to be loosened by sludging and removed. The jacks were then lowered until the weight of the centers rested on the dollies. To permit the lagging and cross timbers from being lifted off the ribs by sticking to the soffit of the arch ring one end of the center was lowered ahead of the other so as to give a stripping action in freeing the lagging. When lowered into the dollies the whole center was shifted sidewise, rubbing on the dollies, until it rested on the six-post vents under the second half of the arch. The jacks were then placed on the caps of the second vents and the center raised and the blocks and wedges inserted. A steamboat ratchet was used to pull the center on the dollies. Four men working eight hours shifted a center. Incidentally the tie rods connecting the opposite ends of the ribs were found, when planked across, to provide a most convenient bridge for the workmen engaged in shifting and adjusting the centers.

The lateral thrust on the centers due to their skewed position was taken care of by suitable lateral bracing of the ribs. In anticipation of the center rising at the crown in concreting from the haunches upward, the ribs were anchored back to the pier masonry as shown by Fig. 7.

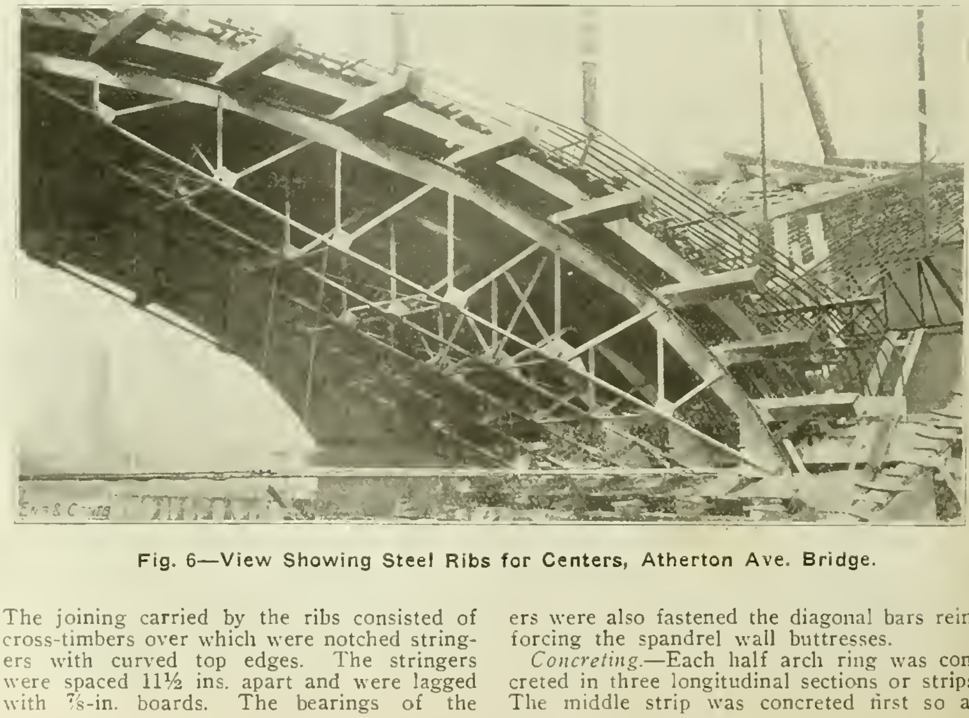

Fig. 6—View Showing Steel Ribs for Centers, Atherton Ave. Bridge.

The joining carried by the ribs consisted of cross-timbers over which were notched stringers with curved top edges. The stringers were spaced 11½ ins. apart and were lagged with ⅞-in. boards. The bearings of the stringer ends against the piers were formed by wedges.

Arch Reinforcement.—The reinforcement of the arch ring is clearly indicated by Figs. 3 and 4, and is notable chiefly for the provisions made for positively spacing and locking together the various parts. As will be seen lattice girders were set across the arch ring and the intradosal and extradosal bars were spaced on and tied to the girder flanges. At its ends each girder also carried upright channels drilled for the spacing of the spandrel wall bars which were threaded through the holes. Between these channels and the girders were also fastened the diagonal bars reinforcing the spandrel wall buttresses.

Concreting.—Each half arch ring was concreted in three longitudinal sections or strips. The middle strip was concreted first so as to load the center symmetrically; next the outside strip was connected so that the spandrel wall form work could be begun as soon as possible; finally the inside strip was concreted. The same order of procedure was followed in concreting the second half of the arch. The concreting of each strip was made continuous. A wet concrete was used and thus rather heavy form work was necessary. Figure 7 indicates the construction of the top from the lower portions of the ring. This top form was anchored to the center by 1-in. bolts and the pressure of the wet concrete was great enough to partly strip in one or two cases the threads from the anchor bolts. The spandrel wall forms were built like the previously described side forms for the piers. The semi-circular refuge bay walls capping the piers were moulded in flexible forms similar to those for the pier ends and previously described. The exposed parts of the bridge are finished by bush hammering and by rubbing with a concrete brick.

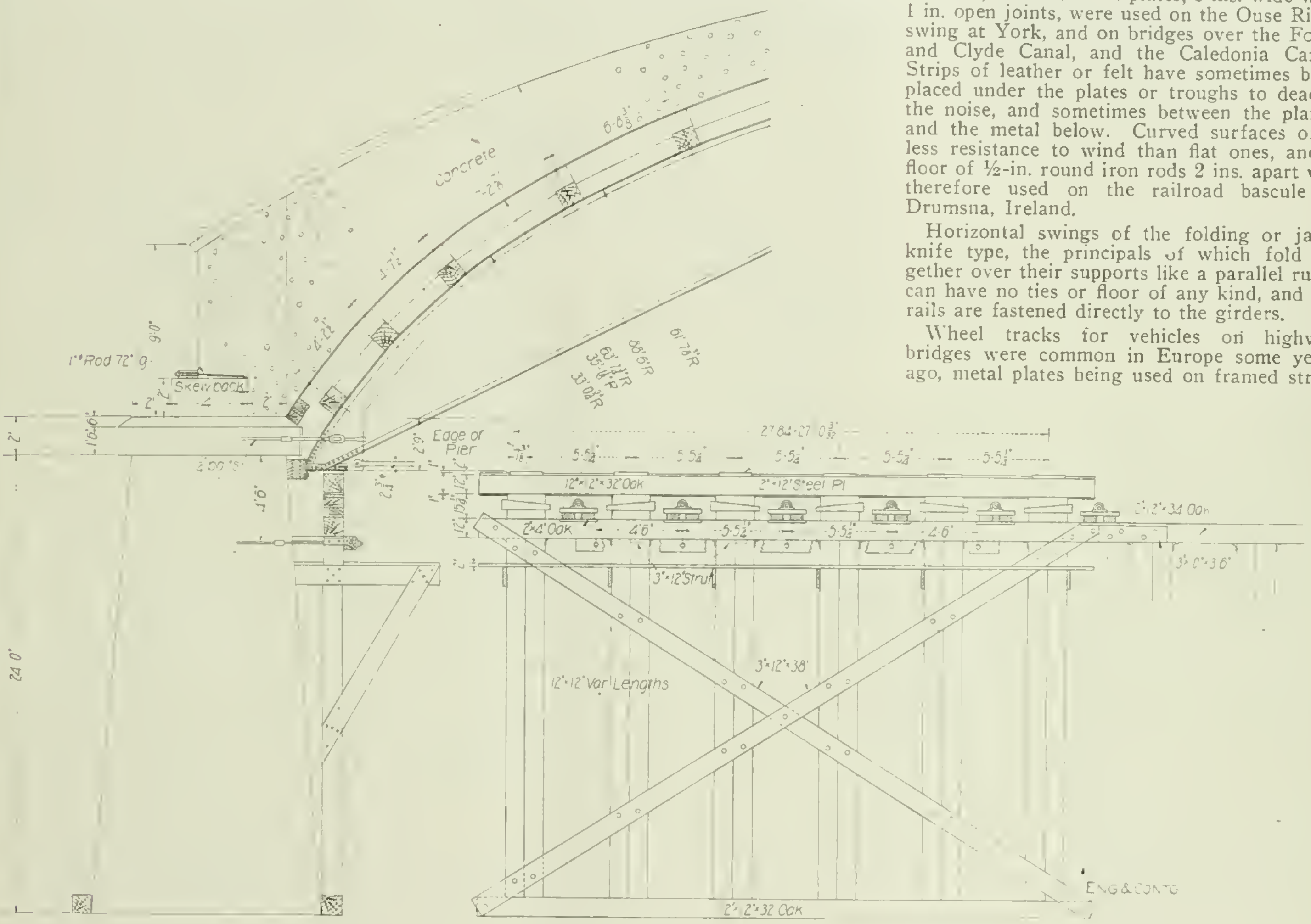

Fig. 7—Elevations of Supports for Centers, Atherton Ave. Bridge.

Conclusion.—The contractors for the bridge were the Crawford Construction Co. of Cincinnati, O. The bridge was designed and its construction was supervised by the engineers of the city of Pittsburgh. It will cost complete $95,000, which is some $5,000 within the engineers' estimate.

American Institute of Consulting Engineers.—The annual meeting of the American Institute of Consulting Engineers was held Jan. 14, at the Engineers' Club, New York City. Prof. George F. Swain of Harvard delivered an address on the question of "Education," which was then discussed by Mr. Rudolph Hering, General T. A. Bingham, Prof. Gardner S. Williams of Ann Arbor, and Mr. Frank J. Sprague. Members of council were elected as follows: Henry Holgate of Montreal, Daniel E. Moran of New York and Charles Sooysmith of New York, to serve three years; F. A. Moliter of New York, to serve one year.

Floors for Movable Bridges: A Summary of Practice and Experience.

Contributed by H. G. Tyrrell, Consulting Engineer, Evanston, Ill.

The kind of floor greatly influences the first cost of a bridge, and also the cost of its operation and maintenance. Heavy ones are not only expensive in themselves, but they require a greater weight of framing to sustain them, and it is, therefore, desirable to use the lightest kind consistent with requirements and efficiency.

The choice of floor will be influenced to some extent by the framing and arrangement of supports. In some cases, longitudinal stringers may be omitted and cross beams placed 3 to 4 ft. apart bearing on the trusses, supporting directly the track rails and flooring. Manhole covers with special framing must be placed on highway floors over the shafting heads for capstan bars, and sometimes over motors or machinery for oiling or inspection. Individual drainage scuppers may be set into the floor without special supports, but continuous scupper openings at the sidewalk curb need elevated stringers to support them.

Thin floors with a greater number of trusses or principals may in some cases be more desirable or economical than deeper floors and higher grades, the cost of raising the approaches being the governing factor. When the adjoining street is lined to the water edge with expensive buildings, the lower floors of which are suited to the existing sidewalk level, any change of street grade may be impracticable. In fact, in districts with land and water at nearly the same level, thin bridge floors are often desirable to avoid raising the approaches. Three lines of trusses are, therefore, used on many of the latest bridges in Chicago, and four lines on that at Third Ave. over the Harlem River in New York, which has a floor thickness of only 20 ins.

Railroad bridges in America previous to 1900 generally had open floors, but the recent tendency is towards solid ones, like that on the Harlem River four-track swing, which has ballast over 18-in. steel troughs. It is the practice of some railroads to place, on bridges with open floors, a water and dust proof covering on the ties above the turntable and end machinery to prevent grit and cinders from injuring the bearings. Many other railroad bridges are floored over either for regular highway travel or for the convenience of trackmen. In England and Europe, the floors of railroad bridges were frequently covered with flat plates, cast iron being used by Stephenson in 1839 on the retractile draw at Weedon, while 5/16-in. plates, 8 ins. wide with 1 in. open joints, were used on the Ouse River swing at York, and on bridges over the Forth and Clyde Canal, and the Caledonia Canal. Strips of leather or felt have sometimes been placed under the plates or troughs to deaden the noise, and sometimes between the planks and the metal below. Curved surfaces offer less resistance to wind than flat ones, and a floor of ½-in. round iron rods 2 ins. apart was therefore used on the railroad bascule at Drumsna, Ireland.

Horizontal swings of the folding or jack-knife type, the principals of which fold together over their supports like a parallel ruler, can have no ties or floor of any kind, and the rails are fastened directly to the girders.

Wheel tracks for vehicles on highway bridges were common in Europe some years ago, metal plates being used on framed structures, while cut stone was better suited to permanent masonry ones.

The choice of materials for highway floors is important, as they vary greatly in weight and durability. Asphalt cork block for paving is well adapted to bascules, and sawdust asphalt made with common coal tar has been used as a substitute for concrete. Coke concrete has also been used and is suitable for light travel, but it breaks up too easily under heavy loads. Almost any kind of good floor is suitable for horizontal swings, but special ones are needed for bascule leaves which rise nearly to a vertical position.

Plank floors in double courses with an upper 2-in. wearing surface which can be renewed as often as it wears through, are perhaps the most common. The lower layer may be 3 to 6 ins. thick and this as well as the wood joists are usually kyanized or creosoted. Stringers and lower plank course on bascule leaves are hook-bolted to the framing. The choice of lumber depends largely on the location and the market supply, that which is easily obtained in one place being scarce in another. The quality and lengths which were once common can no longer be obtained, and it is best to specify a definite grade which can be supplied. While the quality of timber is becoming inferior and the price increasing, these floors should last for several years when drained and ventilated. Yellow pine is well suited for joists and stringers, and is frequently used both for road and sidewalk, while fir or spruce may be more easily obtained in some regions. The city of Milwaukee uses for the roadway an upper wearing surface of white oak crosswise of the bridge over an under-surface course of oak or yellow pine, with ¼-in. open joints on the sidewalks, while Boston uses double layers of spruce 2 and 6 ins. thick, the lower course being kyanized. Bridges for light travel in Chicago have been floored with upper courses of 2¾-in. oak, laid crosswise and spiked to 4x6-in. surfaced yellow pine laid flat, and 12 ins. apart on centers, diagonally to the center line. To avoid diagonal courses, the city of Vancouver uses an upper 2-in. wearing course of hardwood crosswise of the bridge, over 4-in. longitudinal layers of Douglas fir on 6x9-in. cross ties, the fir on bascule leaves being hook-bolted to the stringers 30 ins. on centers. In Brooklyn, it was found that pine plank flooring costing $1.20 per square yard, must be renewed every year. A creosoted block with five-year guarantee was therefore used instead, the cost being only $2.00 per square yard, or about one-third the ultimate cost of the plank.

The city of Chicago experimented for several years with different kinds of pavement for bascule bridges and now uses the A. F. Shuman patent, consisting of 1-in. elm strips on edge, dipped in asphalt and bolted together in sections 5 to 10 ft. square. It is said to wear well and show little tendency to decay. The walks have 2x4-in. hardwood with ¼-in. open joints, preference being given to wooden stringers, for in case of damage by boats, they are more easily and quickly renewed.

A pavement of old flat manila colliery ropes 7 ins. wide and 1½ ins. thick, laid crosswise over wood plank, was used on a lift bridge over the Burgundy Canal at Dijon, as well as at many other places in France. It absorbs a lot of water, causing the bridge weight to vary, but in other respects is serviceable.

Oak for bridge floors is not now easily obtainable, as the limited supply is needed for the manufacture of furniture and other goods, and a cheaper or softer quality of preserved timber is the best substitute. Wood blocks have a very wide use and many advantages. They are durable, smooth, noiseless, sanitary and comfortable to travel on, free from dust, and water proof enough to protect the steel framing beneath them. They do not expand in hot weather like brick and are easily cleaned. They usually give a good foothold for horses, and after being in service for several years, they show little or no wear, but merely compress; those on Tremont St., Boston, diminished not over 1/16-in. per year, and that through compression rather than wear. Since the blocks are laid close together, there is no chance for the edges to break off and wear smooth, as with granite blocks or brick, which become extremely difficult to travel over in a few years. If the joints between stone blocks are filled with cement grout, the condition is but little improved, for the concrete is softer than the stone and is soon worn away.

An objection to wood block pavements is, that when wet or covered with frost, ice or sleet, they become slippery, though not more so than asphalt.

Wood block pavements are made in several ways, but the blocks are usually of yellow pine, 3 ins. deep for medium travel, and 4 ins. for very heavy service, the grain standing vertical. The wood is first dried, after which a mixture of creosote and resin is forced under heavy pressure into it, 20 to 22 lbs. per cubic foot of wood being the usual practice in America, though only about half that amount is the European custom. This filling of creosote and resin makes the block hard, tough, elastic, more durable and water proof, and under any ordinary conditions they will not burn. A hot fire burning on the floor only chars the blocks slightly but does not destroy them.

Blocks should be made only of heart wood, and should be laid close together over a sub-base, and firmly driven into place, so that no openings at the joints will remain. On grades or wherever a better foothold is needed, the blocks should have their upper edges chamfered ½ to 1 in., as on part of Boylston St., Boston, in 1902, where it proved eminently satisfactory. Sub-floors and blocks are usually coated, and after laying them the surface is given a flush coat of pitch swept well into the joints with a broom, or a preparation of asphaltic cement may be used, composed of

	Parts by weight.
Coal tar pitch	100
Refined asphalt	20
Residuum oil	3

It should be poured hot and worked into any or all openings.

When wood blocks are laid over plank, the sub-floor should either be dressed smooth and fitted tightly together, or covered with two layers of heavy tar paper held in place with hot pitch. Wood block pavement of this kind lasts six to eight years on the Strand at London, over which more than 20,000 teams pass per day, and after several years of service the wood blocks are usually in better condition than granite blocks. For very heavy traffic there is hardly any better pavement or one that is cheaper in the end, though some have a less first cost. When considering durability, the inconvenience and annoyance to the public of having repairs made on the streets should be duly considered. It will then be apparent that the lasting quality of a pavement is of great value, even though it may cost more than a more temporary one.

The weight of wood block pavement in comparison with others is as follows:

	Lbs. per sq. yd.
3-in. wood block weighs	110
4-in. wood block weighs	114
Asphalt weighs	210
Brick weighs	400
Stone block weighs	600-800

As used on a bridge over the Wallabout Canal

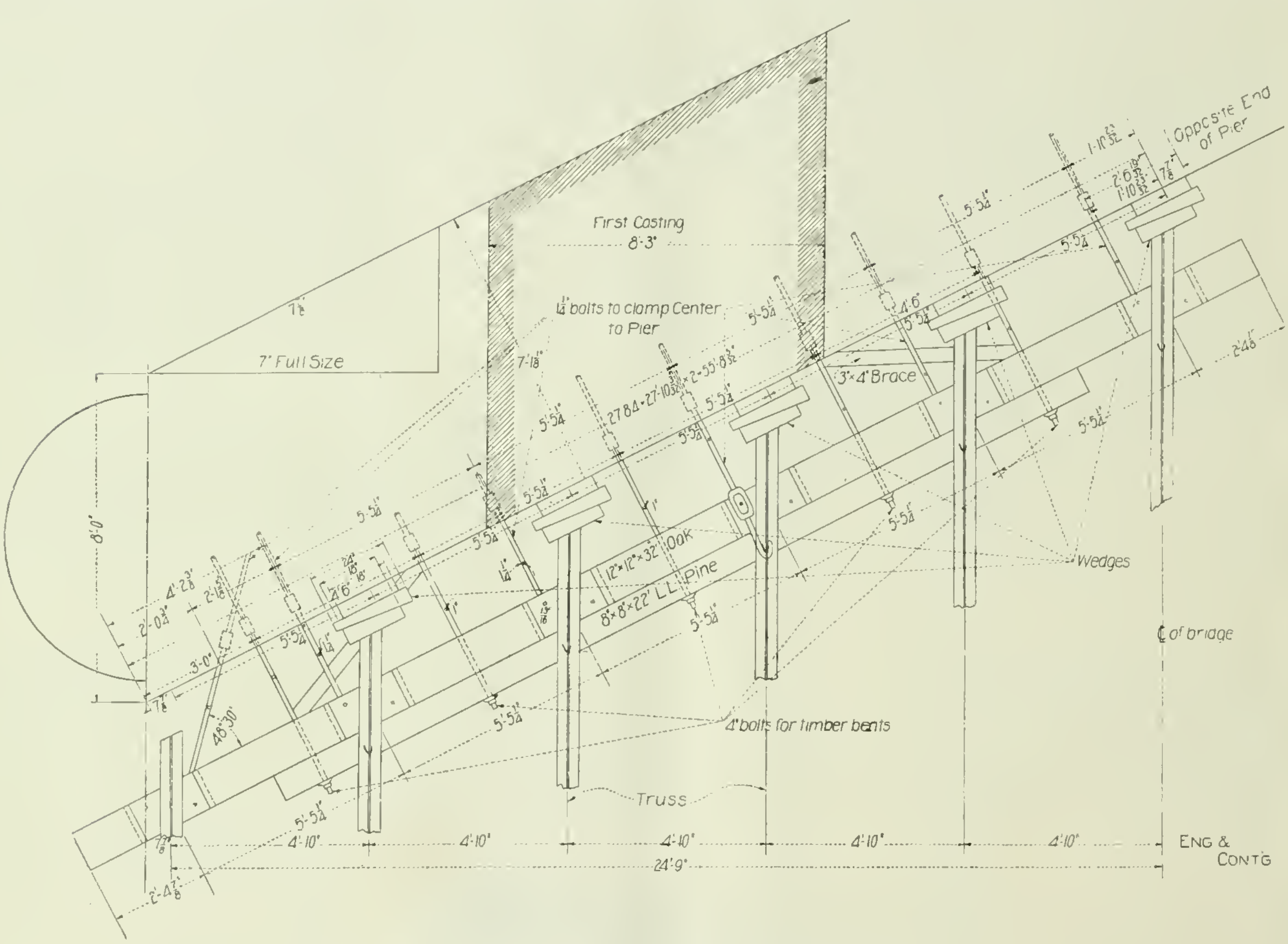

Fig. 8—Plan of Supports for Centers, Atherton Ave. Bridge.

in Brooklyn, the creoresinate yellow pine blocks, 3 ins. high, 6½ ins. long and 2½ ins. wide, are laid on 3-in. creosoted plank, the whole being covered with a five-year guarantee. As previously stated, it cost $2 per square yard. A somewhat similar pavement is used on a direct lift bridge at Portland, Ore., the plank course being supported on cross ties and all wood creosoted. Preserved wood blocks for heavy travel make an ideal pavement for bascule leaves when they can be held in place, which is usually difficult. To prevent any movement of the pavement, timbers were placed crosswise 6 ft. apart on the new bascule at Portsmouth, England.

Wood blocks over buckle plates or steel trough are durable but much heavier than those previously described. They are popular in England, where they may be found on many of the larger structures, including the Tower bridge at London, the Moorlane swing over the Manchester Ship Canal, the Boston swing over the Avon, the Taff River swing at Cardiff, the bascule at Portsmouth, the Arun bridge at Littlehampton, and the Weaver River floating swing. The Bristol double deck swing, one of the heaviest and latest in England, has roadway pavement of creosoted oak block 4 ins. deep, on concrete and buckle plates, with 3/16-in. corrugated steel plates on the walks. A layer of bitumen was placed between the blocks and concrete, but it was unsatisfactory and was replaced by a composition of pitch. Instead of using a cushion of sand or pitch, the sub-floor is sometimes leveled up with cement and sand, leaving an even surface, like that of a cement sidewalk, on which to lay the blocks. The Clarence swing bridge over the River Taff at Cardiff has a similar road pavement with asphalt on the walks. Wood blocks over coke concrete and buckle plates are on the swing at Sydney, the concrete being covered with tallow instead of bitumen.

A very heavy pavement for a bascule, much heavier than any similar one in America, is that on the Tower Bridge at London, so heavy, indeed, that it required a counterweight of lead. The wearing surface consists of creosoted pine blocks 4½ ins. deep with oak dowels, resting on a course of longitudinal greenheart plank, over a lower course of creosoted pine which is formed to fit the ⅜-in. buckle plates, both layers of plank being fastened to the metal plate with countersunk bolts. The upper blocks are attached to the plank with 5-in. spikes and joints are filled with asphalt.

Heavy floors may sometimes serve as counterweight on the short end of spans with unequal arms, plank being used on the longer arms. For this purpose, wood blocks 5 ins. deep over 6 ins. of concrete and steel trough, would weight 90 to 100 lbs. per superficial foot. A steel trough floor overlaid with plank is used on the Weaver River floating swing at Northwich, felt being placed under the plank to deaden the noise. It should be remembered that any pavement which will absorb water is subject to variation in weight, and the counterbalance of double leaves is liable to be affected.

Asphalt floors are clean but very heavy, and can be used on nearly all kinds of moving bridges except bascules. Road pavements should have asphalt 2 ins. deep over concrete and buckle plates or steel troughs, while 1 in. of asphalt is enough on sidewalks. This kind of pavement is used on swings over the Harlem at Third Ave., New York, and over the Passaic River at Fourth St., Newark, and also on the Queensferry telescoping bridge and the new swing at Cairo, Egypt.

The approaches to moving spans frequently have heavy pavement especially when weight is required to resist the upward thrust of tail arms. Solid floors with buckle plates are so used at some of the double bascules in Chicago, though reinforced concrete would be heavier and more economical than the buckle plates, brick and granolithic being much used for this purpose in Milwaukee.

For asphalt floors, grooved girder rails are preferable to those with a tram top, and they should preferably be enclosed in concrete, leaving straight vertical sides against which the blocks can stand, thus avoiding any fitting of the blocks with the resulting uneven bearing. On railway bridges planned for future or only very occasional openings, rails are frequently laid continuous over the span.

For guarding the road and walk, wood railings are frequently preferred to metal ones for moving spans, as they can be more quickly repaired in case of injury from passing boats, wooden ones being the standard in Chicago. Dutch portal bridges have railings which fold down as the bascule leaves rise, and the railings on telescoping bridges of the Queensferry type must likewise fold down to permit the moving span to pass under the approach.

Very careful investigations of bridge floors to secure a combination of lightness and durability were made for the great bridges at New York city, preference being given to lightness rather than to first cost. The first of these, the Brooklyn Bridge, has a floor 3,455 ft. long, with two roads of 16 ft. 9 ins., and a 15½ ft. promenade. The road has a wearing surface of 2½-in. untreated spruce placed transversely over 4-in. creosoted yellow pine laid close together longitudinally on floor beams 3 ft. 9 ins. on centers, the whole weighing 30 lbs. per square foot. The promenade has an upper course of 3x1 1/16-in. untreated yellow pine laid cross wise over 4x6-in. longitudinal creosoted yellow pine stringers 2 ft. apart, on floor beams spaced as on the roadway, the whole weighing only 10 lbs. per square foot. The upper course on the roadway needs renewing every year, but the lower one lasts 12 to 15 years, and that on the promenade about five years, the whole cost of renewal averaging about $11,000 per year.

The Williamsburg Bridge floor, 2,800 ft. long, has two 20-ft. roads and two 17 ft. 8 in. walks. The road is paved with 3½-in. creosoted yellow pine blocks over a thin layer of sand spread on the horizontal webs of longitudinal 12-in. channels, supported by 7-in. beams, 30 ins. apart. It has been found that the channels spring slightly under heavy loads. The walks are concrete slabs, 1½ to 2½ ins. thick, with granolithic top on longitudinal corrugated iron sheets over 12-in. beams 3 ft. apart.

The Manhattan Bridge has a 35-ft. road and two 12-ft. walks, the road being paved with creosoted wood blocks on creosoted 4¾-in. longitudinal yellow pine plank, laid on 6-in. beams 13 ins. on centers, while the walks are 2-in. reinforced concrete with a ¾-in. rock asphalt surface. The whole floor is 960 tons heavier than that of the old Brooklyn Bridge.

Blackwells Island Bridge floor is 3,724 ft. long with a 53-ft. road and two 16-ft. walks. The road is paved with creosoted wood blocks on ½-in. of sand over a concrete base from 1 to 4 ins. deep, which rounds up the surface over the ⅜-in. buckle plates. The walks are 2-in. reinforced concrete slabs on 7-in. beams 3½ ft. apart.

In order to compare the amount of travel on the streets and bridges of some important cities, Table I is given, which shows the enormously heavy traffic carried on wood block pavement, especially in some European cities. The width of streets and bridges are not given, for it was found that these did not affect the comparison. All pavements are on concrete foundations.

The following is a specification for wood block pavement:

Sub-pavement.—On the roadway there shall be laid crosswise of the bridge a lower course of 6-in. hard pine plank in widths not exceeding 10 ins., with the heart side up, the upper surface of which has previously been faced to an even thickness. Planks shall preferably be in not more than three lengths across the roadway, with joints staggered not less than 3 ft. The ends shall protrude about 6 ins., or enough to permit them to be sawed to a straight line after completion. The planks shall be driven tight together and shall be fastened to each stringer with two ⅝-in. wrought iron spikes, 11 ins. long, the holes in the plank being bored to prevent splitting.

TABLE I.—VEHICLE TRAFFIC IN IMPORTANT CITIES (1902).

City.	Street.	Pavement.	Vehicles per day.
Paris......	Rivoli	Wood block......	33,332
	Opera	Wood block......	29,460
	P. Neuf.....	Granite block....	20,682
	St. Honore..	Asphalt rock.....	16,600
	Cambon	Asphalt rock.....	13,000
London....	Oxford	Wood block.......	16,900
	Strand	Wood block.......	16,300
	Parliament .	Telford macadam	14,400
	Grace Chrch.	Asphalt rock.....	12,200
Berlin.....	Potsdam Pl.	Asphalt rock.....	17,400
	Friedrichs ..	Asphalt rock.....	13,500
	Chaussee ...	Wood block.......	13,400
	Leipzig	Asphalt rock.....	11,300
	Koenig	Asphalt rock.....	10,000
	Potsdam ...	Granite block....	8,800
New York.	Broadway ..	Granite block....	8,200
	Fifth Ave...	Asphalt mixture.	6,300
	Madison Av.	Asphalt mixture..	5,100
	Wall	Asphalt mixture..	2,400
	Chambers ...	Asphalt mixture..	2,400
Phila......	Broad	Asphalt mixture..	6,200
	Filbert	Asphalt mixture..	5,200
Boston....	Devonshire .	Granite block.....	5,400
	Kilby	Asphalt mixture..	3,500
Chicago...	Clark	Granite block....	4,700
	Wabash	Granite block....	3,800
Wshngton.	Fifteenth ...	Asphalt mixture..	4,700
	Ninth	Asphalt mixture..	2,000
Buffalo....	Main	Asphalt mixture..	2,900

The curb timber shall be not less than 10x12 ins. hard pine, standing vertical with its lower edge sawed to match the slope of roadway. It shall be bolted at intervals not exceeding 4 ft. to the lower course of plank by means of ⅞-in. screw bolts with washers, and the upper and outer edge shall be guarded by a 3½x3½x5/16-in. angle fastened thereto with 4-in. spikes, 3 ft. on centers. In the lower corner adjoining plank and curb shall be set and nailed a 1½-in. continuous hard pine miter strip.

Waterproofing.—The sub-floor and framing, as described above, shall then be covered with two heavy layers of tar felt or paper laid crosswise of the road, each layer lapping half its width over the preceding one, the lower course in each case being mopped with hot roofing pitch before the upper one is placed, and a second mopping of hot pitch shall be applied over the upper layer. At the edges the layers of paper shall be turned up 6 ins. and nailed to the curb through strips of zinc 3 ins. wide.

Scuppers of approved design, 20 to 30 ft. apart, on each side of the roadway, shall then be fitted into holes in the plank about 6 ins. out from the curb, the joints being made tight with pitch or roofing cement. The whole shall then be covered with 1 in. of dry sand laid and rolled to an even surface.

Wood Blocks.—Over the sub-pavement as described there shall be laid a course of preserved wood blocks, not more than 4 ins. deep, with the grain vertical. These blocks shall be of uniform size, 4 ins. wide and 6 to 10 ins. long, free from bark, sap, loose or rotten knots, and second growth timber will not be allowed. They shall be laid close together with joints staggered not less than 2 ins., and every five rows shall be driven tight with a sledge on a wooden striking piece. Rows shall be straight across the bridge, or diagonal, as shall be determined by the engineer. Car rails shall be squared up against the web with concrete, that the wood blocks may bear against smooth vertical surfaces, and require no fitting. Provision for expansion shall be made by laying two or three courses adjoining the curb, with 1-in. open joints, the lower half of the joints being filled with sand and the upper half with pitch.

After laying the blocks the pavement shall be rolled with a 5-ton steam roller until the surface is true and even, and over all the vertical joints shall be poured cement grout or a mixture of creosote and resin heated to 300 degrees. This mixture shall be delivered at the bridge in barrels or tanks and shall contain

100 parts by weight of tar paving cement,
20 parts by weight of refined asphalt,
3 parts by weight of residuum oil.

The whole shall then be covered with ¼ in. of clean screened sand or crushed stone screenings.

Preparation of Blocks.—Blocks shall be prepared by first drying them for one hour in an air tight cylinder heated to 210° F. The heat shall then be gradually increased for two hours up to 280° F., and a pressure of 90 lbs. per sq. in. applied and maintained for another hour, after which the heat shall be shut off and the tank cooled.

A vacuum of 26 ins. shall then be applied to the tank, into which is injected a mixture of creosote and resin at a temperature of 175° to 200°. Hydraulic pressure of 200 lbs. per sq. in. shall then be applied to the tank and maintained until the wood has absorbed 20 to 22 lbs. of the mixture for each cu. ft. of timber. The liquid shall then be run off and the wood placed in another cylinder, into which a thin lime mixture is run at a temperature of 150°, and allowed to remain for one hour under hydraulic pressure of 200 lbs. per sq. in.

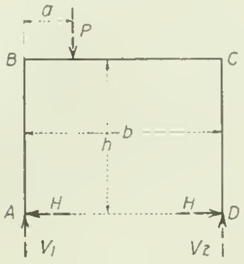

Fig. 1.

Stresses and Moments in a Rigid Frame.

The discussion of the stresses and moments in a rigid frame which appeared in an article of recent date (Eng. & Contg., Jan. 15, 1913) may be amplified by considering the base of the columns as fixed. Since in most cases the bases of columns are anchored to footings, this is a justifiable assumption and leads to a more economical design.

In treating of various loadings on the sides. I have considered besides a uniform, a triangular and trapezoidal loading such as would occur in the design of subsurface structures subject to earth or hydro-static pressures.

As in the above-quoted article the theorem of least work has been used in the derivation of the formulas given. The intermediate steps in the mathematical work have been omitted. By way of check on the formulas, the reduction to known formulas has been presented.

In the accompanying Fig. 1 dimensioned as shown, I_1 is the moment of inertia of the girder, I_2 of the columns (or sidewall), M_1 the moment at A, M_0 the moment at B. Denote as positive, moments causing compression in the outside fibre. The vertical reactions are determinate and may be obtained by taking moments around either of the lower joints A or D.

With a loading as shown in the sketch we have,

$$H = P\frac{3I_2a(b-a)}{2h(hI_1+2bI_2)}$$

$$M_1 = \frac{I_2}{2}\left(\frac{1}{hI_1+2bI_2} - \frac{b-2a}{b(6hI_1+bI_2)}\right)a(b-a)P$$

$$M_0 = -\frac{I_2}{2}\left(\frac{2}{hI_1+2bI_2} + \frac{b-2a}{h(6hI_1+bI_2)}\right)a(b-a)P$$

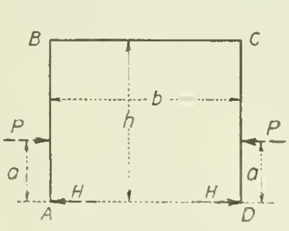

Fig. 2.

Applying these formulas to the case of uniformly distributed loading of w on the roof we have

$$H = \frac{3I_2w}{2h(hI_1+2bI_2)}\int_0^b a(b-a)da = \frac{wb^3I_2}{4h(hI_1+2bI_2)}$$

As a check with $h=o$ we have the case of a beam fixed at both ends. Substituting in the equation for M_0

$$M_0 = -\frac{1}{12}wb^2$$

Consider (Fig. 2) the case of a symmetrically placed load P on the columns. With the same notation as above,

$$H = \frac{W(h-a)^2[hI_1(h-a)+bI_2(2h-a)I_2]}{h^2(hI_1+2bI_2)}$$

$$M_1 = \frac{Pa(h-a)\,[hI_1(h-a)+bI_2(2h-a)]}{h^2(hI_1+2bI_2)}$$

$$M_0 = P(h-a)\left[\frac{(h^2-a^2)I_1+2hbI_2}{h(hI_1+2bI_2)} - i\right]$$

As a check with $b=o$, $a=\frac{1}{2}h$, $M_0=\frac{Ph}{8}$

$H=\frac{1}{2}P$

For the condition of a uniformly distributed loading of w

$$H = \frac{wh}{4}\left[\frac{2hI_1+5bI^2}{hI_1+2bI_2}\right]$$

$$M_1 = \frac{wh^2(hI_1+3bI_2)}{12(hI_1+2bI_2)}$$

$$M_0 = -\frac{wh^2}{12}\left(\frac{hI_1}{hI_1+2bI_2}\right)$$

For triangular loading (Fig. 3) taking the base load as c—any load P a distance a from $c=$

$$P = c\frac{h-a}{h}$$

Substituting this in the given expression for a single symmetrically placed load and integrating there results:

$$H = \frac{ch^2}{20}\left(\frac{7hI_1+16bI_2}{hI_1+2bI_2}\right)$$

$$M_1 = -\frac{ch^2}{60}\left(\frac{3hI_1+8bI_2}{hI_1+2bI_2}\right)$$

$$M_0 = -\frac{ch^2}{30}\left(\frac{hI_1}{hI_1+2bI_2}\right)$$

For Trapezoidal Loading (Fig. 4) taking the loading as a composition of uniform loading of d and a triangular loading with base $c-d$

$$H = \frac{h}{20}\left[\frac{c(7hI_1+16bI^2)+d(3hI_1+9bI_2)}{hI_1+2bI_2}\right]$$

$$M_1 = -\frac{h^2}{60}\left[\frac{d(3hI_1+8bI_2)+12c(hI_1+bI_2)}{hI_1+2bI_2}\right]$$

$$M_0 = -\frac{h^3I_1}{60}\left[\frac{3c+2d}{hI_1+2bI_2}\right]$$

To obtain the resulting stresses from a combination of roof and side loading it is merely necessary to add the expressions for the respective side and roof loads.

Where live loads are assumed various criteria must be determined to obtain maximum stresses at given points.

American Society of Engineering Contractors.—The fourth annual meeting of the American Society of Engineering Contractors was held Jan. 14, in the United Engineering Bldg., New York City. The morning session was devoted to business, the reading of annual reports, and discussion of plans. It was decided to establish an information bureau for the benefit of members, and to co-operate with contractors for protection against unjust contracts and specifications. Mr. William L. Bowman read a paper entitled, "The New York State Law with Regard to Public Contracts, and Legal Questions Involved in the Proposed Amendment to the General Municipal Law of New York." At the evening session, Mr. Edward F. Croker, ex-Chief of the New York Fire Department, delivered a lecture on "Fire, Its Effects and Its Prevention," illustrated with views of prominent fires in New York in recent years. Officers for the coming year are as follows: President, Howard J. Cole, Montclair, N. J.; First Vice-President, Edward Wegmann; Second Vice-President, George T. Clark; Directors, A. S. Bent, De Witt V. Moore and Leon F. Beck.

A Novel Method of Lifting and Underpinning a Bridge Span of 230 ft.

A 230-ft. span weighing 226 gross tons was recently raised 16 ft. simultaneously with its supporting piers by an unusual and interesting method. The span replaced a trestle. Four concrete filled cylinder piers were sunk under the trestle and, using the trestle as falsework, the span was erected on these piers but with bearings or stools on the piers and not directly on the pier masonry. The stools each had four legs of cast iron pipe which set into four wells formed by slightly larger cast iron pipes embedded in the pier concrete. These stools provided for raising the span and for building the piers up from trestle level to the new level 16 ft. above as pillows as described in the "South African Railway Magazine."

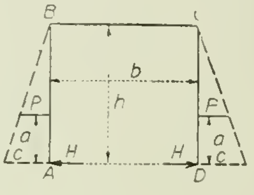

Fig. 3.

The legs of the stools did not fit tight into the pipes, but an annular space was left into which dry sand was afterwards filled—this arrangement forming what might be termed a "sand ram," its function being to take the weight off the bridge. For lifting the bridge, four 100 ton hydraulic jacks were used. These jacks were placed one on the center of each cylinder, their bases resting on the top of the concrete, while the bridge rested on the heads of these jacks. When the hydraulic jacks were pumped up, dry sand was trickled down the pipes forming the "sand ram"; thus the sand by getting underneath the cast iron legs of the stool supported the load temporarily until another lift could be taken with the hydraulic jacks. By raising each end of the bridge in this way, 12 ins. at a time, a height was ultimately attained sufficient to allow of another 4 ft. height of cylinder and pipes being added. The cylinders were composed of three segments, and these were bolted together, forming a complete length of cylinder 4 ft. high. The pipes round the legs of the stool, which were also cast in segments, were also bolted up, and immediately thereafter the added length of cylinder was filled with concrete. All four cylinders were built up in this way simultaneously. After the concrete in the cylinders had been given sufficient time to set, the hydraulic jacks were again placed upon the top of the concrete—now 4 ft. higher—and the same operation was repeated. The bridge was lifted 16 ft. in this way, until it was finally seated on the box girders placed on the tops of the cylinders.

Land Reclamation Plan Competition—Mr. Alfred T. White, a member of the City Planning Committee of New York City, has offered through the Brooklyn Engineers' Club prizes amounting to $200 for the best plans submitted for the reclamation of certain submerged property at Coney Island, Brooklyn, N. Y. The Brooklyn Engineers' Club will conduct the contest, which will close May 15, 1913, and the committee of award will furnish a map of the property and rules of the contest to engineers wishing to compete, upon application to the club at 117 Remsen St., Brooklyn, N. Y.

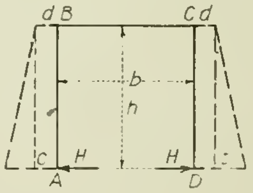

Fig. 4.

NEWS SECTION

Editorial Comment—Personals—Society Meetings—Trade Notes—Catalog Reviews—Contract News, Embracing Bids Asked, Work Projected, Contracts Let and Contract Prices on All Classes of Civil Engineering Construction Work.

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The Doings of the Week.

Construction work in all lines, except the railroad field, is beginning to pick up. More municipal work, paving, sewers, waterworks, etc., is now open for bids than at any previous time this year. In the railroad construction field, however, there is not as much activity as could be wished. The railroads are having some difficulty in disposing of their securities for financing new construction. Then, too, the threatened strike of the firemen on 54 eastern railroads may have something to do with delaying the beginning of construction work in that section of the country at least.

One of the largest railroad construction contracts so far this year has just been awarded by the Chicago, Burlington & Quincy R. R. This contract calls for the construction of the Powder River-Orrin Junction line in Wyoming. Twohy Bros., Portland, Ore., received the contract. Among the other contracts let recently are the following: Cooper & Evans Co., 220 Broadway, New York City, at $860,743, for constructing section 2 of the Woodside, Astoria & Corona Rapid Transit R. R., at New York City; E. E. Smith Contracting Co., 71 Broadway, New York City, at $2,063,588, for constructing section 3 of the Woodside, Astoria & Corona Rapid Transit R. R.; J. W. Thompson & Co., St. Louis, Mo., for freight and passenger terminals, yard tracks, etc., at Beaumont, Tex., for the St. Louis & San Francisco R. R.; Jones & Giroma, Montreal, Que., for a 30-mile line from Temiskaming to Ville Marie, Que., for the Canadian Pacific Ry.; A. Guthrie & Co., St. Paul, Minn., are reported to have the contract for a line from Stanton, N. Dak., to the south end of the Kildeer Mountains for the Northern Pacific Ry.

In the way of state highway construction about the largest piece of new work that has come up for bids since our last issue is for the State Roads Commission of Maryland. This commission is asking bids until Feb. 27 on 13 sections of highway aggregating about 35.6 miles in length. A number of good sized street paving contracts are now open for bids. Abilene, Tex., is calling for bids on 75,000 sq. yds. of asphalt macadam; Sidney, O., is asking proposals on 66,329 sq. yds. of paving; Mount Vernon, Ia., will open bids on March 25 on one mile of pavement.

The largest contract for drainage work let since our last issue appears to be the one secured by Sternberg Bros., 516 Reserve Bank Bldg., Kansas City, Mo. The contract amounts to about $146,000 and calls for the construction of 44 miles of drainage ditches, requiring about 1,600,000 cu. yds. of excavation, for the Waterloo Drainage District of Jefferson County, Arkansas. One of the larger new contracts that has come up for bids lately is the work of construction of the Plum Creek ditch and laterals in Fremont County, Ia. This calls for about 325,000 cu. yds. of excavation. The Mississippi Levee District, at Greenville, Miss., has postponed for 60 days the letting of contracts on a large amount of levee work, bids for which were to have been opened Feb. 10. This work calls for about 370,000 cu. yds. of levee enlargement.

Three good sized contracts in connection with the State Canal system of New York have been awarded recently. Grant, Smith & Co. & Locher, New York City, secured Contract No. 42A, calling for the completion of the construction of the Erie Canal near Utica, N. Y. The contract price was $1,014,671. Contracts Nos. 92 and 94, calling for erecting and installing power plants, equipment and machinery for operating locks on the Barge Canal were let. McArthur Bros. Co. and the Lord Electric Co., of New York City, the former at $1,178,976, and the latter at $433,380.

A bill was introduced last week in the State Legislature of Pennsylvania requiring the State to pay one-half of the cost of installing sewage disposal plants in cities, boroughs and other municipalities. Booth & Flinn of Pittsburgh, Pa., have been awarded the contract by the Passaic Valley Sewerage Commission, Newark, N. J., for the construction of Section 7 of the intercepting sewer, compressed air tunnel, for $1,413,030.

The construction of 733 miles of railroad in Alaska, at a cost of $35,000,000, to be built if necessary with government funds but to be operated under private lease, was recommended by President William H. Taft in a message sent to Congress transmitting the report of the Alaska Railway Commission. The roads are needed primarily to open up the vast coal fields which, during the Taft administration, have been an almost constant source of litigation and political dispute. The members of the commission were Major Jay J. Morrow, Alfred H. Brooks, Leonard M. Cox and Colin M. Ingersoll. The commission found that the coal and other resources can be developed only by the construction of lines which will connect the Pacific Ocean with the two great inland waterways, the Yukon and the Kusokwim rivers.

Mirrors on Highways.

It was to be expected that French road authorities would take the initiative in placing mirrors at dangerous highway crossings so that the drivers could see the reflection of vehicles approaching from the opposite direction. It is somewhat of a surprize, however, to learn from La Temps, that this plan has been carried out much more extensively in England. In Folkstone, the Borough Engineer, has had a mirror at a crossing of two roads since June, 1910. The mirror is 24 ins. square and cost $750. At the point where the mirror is placed the movement of motors are swift, and it was impossible for chauffeurs to see the approaching vehicles. Accidents were frequent, but none have occurred since the advent of the mirror. It was found that humidity, rain, fog or frost had no bad effect on the glass, which is cleaned at the time when the neighboring street lamps are wiped. Mirrors have been installed also at Malmesbury, at Beckenham, Norwich, Colchester and Knaresborough. The one at the first mentioned place is 8 ft. by 5 ft., and is erected with the long side horizontal. It is placed about 6 ft. from the ground. The borough surveyor states that the mirror needs cleaning about once in three months, and is not as effective on foggy or on frosty days until after the sun has shone on it for a few minutes. He adds that drivers and chauffeurs approach the turn more slowly since the mirror was put up, and that there have been no accidents since that date. The mirror at Deckenham is at the junction of four roads, and is placed on stakes at a heighth of about 5 ft.

Muskrats and Roads.

There's many a problem connected with country road maintenance other than that furnished by traffic. For example, in some localities road officials are often troubled by muskrats undermining the highway. An interesting method for preventing this was described as follows in a discussion at the recent American Road Congress:

> I recall to mind one road about 1,000 ft. across a marsh, a very nice gravel road, and the muskrats would bore into it from the side, and of course the surface crust would break up. I would fill that hole, and then they would dig another hole, and so the work of destruction kept going on continually. And they asked me to make a suggestion about it, and I suggested that they get a small boy with a shot gun. I thought that was about as effective a measure as I could suggest at that time, but it didn't seem to be successful. The muskrats got away from the boys. But in driving over a similar road in the western part of our state, I noticed in an old corduroy road built across a marsh that wherever there was a hollow log there was a muskrat, and he would make that hollow log his home. Now, on the suggestion that the muskrats made themselves, I took this piece of road that we had been troubled with so much, and every 50 or 100 ft. I would run in a blind drain about 6 or 7 ft. at about the surface of the water—a 6-in. pipe, with a T on the end of it. Then I would close up the ends with flat stones, and the muskrats would invariably go in there and they never troubled the road any more after that. I found it extremely successful and very satisfactory, and very cheap.

Something for Nothing.

Of the multitude of road improvement bills now before State legislatures the one presented by the Connecticut Good Roads Association to the general assembly of that State is of particular interest. This bill provides for an appropriation of $5,000,000 for the construction of six trunk line roads through the State, the money to be expended by a commission of five men who are to serve without pay. The measure contains a provision that the state highway commissioner shall recommend the materials to be used for the construction of the roads, but it also provides that the awarding of contracts and all expenditure shall be under the direction of the commission. A commission having the expenditure of $5,000,000, serving without hope of pecuniary reward, would be something of a novelty in these days of practical politics.

PERSONAL

Mr. Charles R. Lewis has resigned as president of the board of sewer commissioners of Ilion, N. Y.

Mr. Richard K. Meade, consulting cement engineer, has opened offices and laboratories at 202 North Calvert street, Baltimore.

Mr. T. N. Jacob has been reappointed as chief engineer of the board of trustees of the East Side Levee and Sanitary District of East St. Louis, Ill.

Mr. Clifford B. Moore, assistant engineer of the Topographical Bureau of the Borough of Queens, New York City, has been promoted to chief engineer.

Mr. J. R. Wemlinger, president of the Wemlinger Steel Piling Co., has been reelected secretary of the American Society of Engineering Contractors.

Mr. August Baltzer has resigned as city engineer for Kenosha, Wis. No successor has been appointed, and Assistant Engineer B. C. Brennan is handling the work.

Mr. Frank F. Rogers, deputy state highway commissioner, has been nominated for the office of state highway commissioner of Michigan, by the Republicans at Lansing.

Mr. Willis Ranney, formerly of Bartlett & Ranney, San Antonio, Texas, has sailed for Barcelona, Spain, to become a member of the engineering staff of the Erbo Irrigation & Power Co.

Mr. Edward C. Heald, formerly chief structural engineer in the Office of Supervising Architect at Washington, has opened an office at 1516 H street, N. W., Washington, as consulting engineer.

Mr. Edward E. Minor has been elected superintendent for the New Haven Water Co., New Haven, Conn. Mr. David Daggett has been elected superintendent for the Branford Water Co., Branford, Conn.

Mr. A. G. Holt is appointed assistant chief engineer of lines east of Mobridge, for the C. M. & St. P. Ry., with headquarters at Chicago, Ill., vice Mr. W. H. Penfield, who has been appointed assistant to Vice-President Bush.

Mr. Lloyd B. Fuller, formerly assistant city engineer of Chicago, Ill., died at his home in Chicago, Jan. 29, aged 72. Mr. Fuller was engineer in charge of the building of the Sixty-eighth street crib, and of the foundations for the four-mile crib.

M. J. M. F. de Pulligny, chief engineer of roads and bridges of France, and director of the French Commission of Engineers to the United States, delivered a lecture on Feb. 11 before the graduate students in highway engineering at Columbia University, on "The Public Service of Roads in France."

Mr. H. F. Hamilton is appointed resident engineer of the St. Paul district for the Great Northern Railway Co., with headquarters at St. Paul, vice Mr. F. B. Walker, resigned. Mr. P. S. Hervin is appointed resident engineer of the Minot district, with headquarters at Minot, N. D., succeeding Mr. Hamilton.

INDUSTRIAL

The Republic Iron & Steel Co., G. C. Shackleford, Chief Engineer, has awarded a contract to the Raymond Concrete Pile Co. of New York and Chicago, for placing approximately 1,200 standard Raymond concrete piles for the foundations of open hearth buildings and furnaces at the Open Hearth Steel Works, Youngstown, O. The Raymond Co. has recently completed a contract for placing Raymond piles for the foundation of a blast furnace for the same company.

Business men of Chicago have donated the material for the construction of a concrete paved road at La Salle, Ill. F. W. Renwick, president, Joliet Sand & Gravel Co., Chicago, is to furnish free, the gravel consisting of approximately 2,800 tons or 95 carloads of this material. The Marquette Cement Mfg. Co. and the Chicago Portland Cement Co., Chicago, will jointly furnish without cost, the cement required amounting to 26 carloads. The American Sand & Gravel Co. also of Chicago, stands sponsor for 54 carloads of sand which will be shipped as required, from sand pits at Buda and Lincoln. The La Salle Board of Highway Commissioners has appropriated $5,000 for the labor and fuel incidental to the work. The road will be built under the specifications of the State Highway Engineer. It will be .9 mile long, 20 ft. wide, with an average thickness of 7 ins. Construction will be started about May 1.

CATALOGUES

Mailing Machinery.—Paper, 7¼x9⅓ ins., 6 pp. Montague Mailing Machinery Co., Montague Bldg., Chattanooga, Tenn.

This illustrates and describes the Montague office addressor.

Cyclone Drill Record.—Paper, 16x11 ins., 4 pp. Cyclone Drill Co., Orrville, O.

This circular describes the moving of 37,100 cu. yds. of rock in 30 days and gives other information about the Cyclone drill.

How to Splice Wire Rope.—Paper, 8x10¼ ins., 12 pp. A. Leschen & Sons Rope Co., St. Louis, Mo.

A very complete article is given in this issue of Leschen's Hercules on Methods of Splicing Wire Rope.

Gurney Elevators.—Paper, 7x10 ins., 28 pp. Gurney Elevator Company, 62 W. 45th St., New York City.

Bulletins Nos. 4 and 5 give descriptions of the Gurney Type Traction Elevator, designed for high speed service.

Pipe Culverts.—Paper, 4x9 ins., 10 pp. California Corrugated Culvert Co., Los Angeles, Cal.

A paper by Arthur E. Leoder, Division Engineer of the California State Highway Commission, is reprinted in this booklet describing the pipe culverts used on the Los Angeles "Good Roads." Seveal other bulletins are issued showing the details of construction of corrugated pipe for culverts, flumes and siphons.

Hazard Elevator Rope.—Paper, 3½x6 ins., 8 pp. Hazard Manufacturing Co., Wilkesbarre, Pa.

This booklet illustrates and describes and gives tables of sizes and prices of Hazard Swedes Iron Wire Ropes for Elevators.

Iron & Steel Stock List.—Paper, 4x8¾ ins., 32 pp. Faitoute Iron & Steel Co., Newark, N. J.

A list giving sizes, weights, etc., of the 1913 stocks of bars, sheets, plates, shafts, tool steel, tin plate, chain blocks and structural steel.

American Vanadium Facts.—Paper, 10x7¾ ins., 12 pp. American Vanadium Company, 34 Vanadium Bldg., Pittsburgh, Pa.

This is a monthly paper containing articles showing the industrial applications of Vanadium. Some interesting tests are shown in this issue.

Chicago Portland Cement.—Paper, 6¼x5 ins., 6 pp. Chicago Portland Cement Co., 30 N. LaSalle St., Chicago, Ill.

This is a copy of an address by Mr. Norman D. Fraser, President of the Chicago Portland Cement Co., on the Rehabilitation of the Illinois and Michigan Canal.

Blaw Forms.—Paper, 9x6 ins., 36 pp. Blaw Steel Construction Co., Westinghouse Bldg., Pittsburgh, Pa.

This is bulletin No. 58, which deals with steel forms for tunnel and shaft construction. Full page illustrations are given, showing the work in various tunnels and shafts.

Pioneer Asphalts.—Paper, 14x10½ ins., 4 pp. The American Asphaltum & Rubber Co., 600-619 Harvester Bldg., Chicago, Ill.

This circular illustrates the Monroe St. bridge over the Spokane River at Spokane, Wash., which was waterproofed with Pioneer Waterproofing Asphalt. Other data is given.

Reinforced Concrete Block Machinery.—Paper, 8½x11 ins., 2 pp. Bragstad Concrete Machy. Co., Canton, S. D.

Bulletins Nos. 101 to 104, inclusive, illustrate and describe the Bragstad Mixer and Block Machine with the automatic proportioning device and show the Bagstad concrete block in building construction.

Electrical Equipment.—Paper, 8x10½ ins., 12 pp. General Electric Co., Schenectady, N. Y.

Bulletin No. A4073 illustrates and describes electrical equipment for bakeries.

Bulletin No. 4080, 28 pp., is devoted to the use of "Electricity in Excavation and Construction Work." The bulletin deals with both the generating of the current and its use through motors. It touches on the advantages to be derived from the use of electric power, and refers briefly to its application to the work in connection with the Panama Canal, Catskill Aqueduct, New York Barge Canal, and in general building construction.

Bulletin No. 4850C deals with Edison Mazda Lamps for standard lighting service.

RAILWAYS

Alabama.

It is rumored at Gadsden, Ala., that the Seaboard Air Line will probably extend a line to that place within the next year. No authentic information on this report has, as yet, been obtained. William J. Harahan, Norfolk, Va., is President of the company.

The work of building an additional track from 27th St., Birmingham, to North Birmingham for the Southern Ry., mentioned in our last issue requires practically no grading. For this reason the work will not be let to contract but will be done by the company.

Arizona.

The Phoenix & Copper Creek R. R. Co., according to advices from Phoenix, Ariz., has been incorporated as a subsidiary of the Copper Creek Mining Co. for the purpose of building a 13-mile, 30-in. gage, 40-lb. rail line to convey ores and concentrates to Mammoth. The Copper Creek mine is about 30 miles southeast of Winkelman. It is reported that the Arizona Eastern Ry. will build up the San Pedro to connect with the narrow gage at Mammoth as soon as a reasonable tonnage of freight is assured.

Colorado.

The Plateau Valley Ry. Co. projecting a 25-mile line from a point 8 miles east of Palisades to Collbran, has completed surveys and has construction work under way. J. J. Yeckel, Century Bldg., Denver, Colo., is President.

The Santa Fe system is planning a number of large improvements at Pueblo, Colo. Surveys have been made for a belt line around the city and this with other terminal improvements will call for a reported expenditure of several million dollars.

Florida.

A report from Melbourne, Fla., states that the Union Cypress Co. is planning to extend its line of railroad that now runs nearly 20 miles west of town to St. Cloud in Osceola County and connect with the Atlantic Coast Line at that place.

Georgia.

W. A. Winburn, Vice-President of the Central of Georgia R. R., Savannah, Ga., has submitted to the city of Macon a proposition to build a new terminal station at the foot of Cherry St. and to use the site of the present station for delivery tracks for freight. The cost of the entire improvement contemplated is estimated at about $1,250,000.

The Valdosta Traction Co., chartered recently with a capital stock of $125,000 proposes the operation of 10 miles of line in Valdosta. The charter grants authority to operate street cars through Forest, Cypress, Troup, Gordon, Lee, Ann, Pear, West, Ross, Oak, Ashley, Briggs, Toombs, South Paterson and Hill streets and Center avenue and on the public roads of Lowndes county. W. S. West, President and general manager of the Valdosta Street Ry. Co. at present operating 4 miles of line, is head of the new company.

Illinois.

The Alton, Granite & St. Louis Traction Co., L. C. Haynes, President, East St. Louis, Ill., has surveys underway for an extension from the College Ave. Alton terminus to the site of the proposed new asylum for the insane at Alton. The line will probably be extended much farther than the hospital site, and may go to Bethalto and Fosterburg.

Alex McGavock, Beloit, Wis., has a Thew automatic plant idle in Illinois, for which he is looking for work.

It has been announced by H. E. Chubbuck, Peoria, Vice-President of the Illinois Traction System, that work will be started shortly on the new $350,000 passenger terminal station to be erected in the heart of the city of Peoria, Ill. Adjoining the station is to be a train concourse large enough to accommodate twenty cars at a single time. The new structure is to be seven stories in height, the first four to be devoted to the waiting rooms and offices of the interurban, and the others to office suites. The plans call for 10,000 incandescent lights, to be arranged about the exterior walls of the building.

The Hooppole, Yorktown & Tampico R. R. Co. has been incorporated in the state of Illinois for the purpose of operating a line from Hooppole in Henry County through Bureau County to Tampico in Whiteside County. The capital stock of the company is $100,000 and the headquarters are at Hooppole, Ill. The incorporators and first board of directors are Charles W. Groves, Henry J. Ringel, George Mathis and James Tonkinson, all of Hooppole, Ill., and R. H. Mathis of Prophetstown and John H. Cooley and J. W. Mathis of Tampico, Ill.

The Chicago, Peoria & Quincy Traction Co. is reported to be planning to begin construction work this year on its projected line. At the annual meeting of the stockholders on Feb. 12, the following officers were elected: J. L. Soebbing of Quincy, president; Judge Albert Akers and W. J. Heintz, Quincy, vice presidents; C. A. Vanness, Quincy, treasurer; B. G. Vacen, Quincy, secretary, and Judge Albert Akers, Quincy, general manager.

Indiana.

The Evansville Rys. Co., Evansville, Ind., is reported to be planning to begin work in the spring on an 8-mile branch line west to Owensville.

The Indianapolis & Delphi Traction Co. has begun securing franchises for its projected electric railway. This company proposes to build an interurban line that will touch the towns of Carmel, Westfield, Hortonville, Sheridan, Kempton, Russiaville, New London, Burlington, Flora and Delphi. Edward Thistlethwaite, Sheridan, Ind., is President; M. C. Beals of Noblesville, Vice-President; H. L. Smith of Indianapolis, Secretary, and M. E. Cox of Westfield, Treasurer.

The Tipton-Frankfort Traction Co., Tipton, Ind., has been incorporated with a capital stock of $10,000, for the purpose of promoting and operating an interurban line. E. Purtelle, A. G. Busick and F. D. Russell are the incorporators.

Kansas.

At a mass meeting of the citizens of Grant and Stanton Counties at Johnson, Kans., it was voted to offer a bonus of $2,000 per mile to any railroad building through Stanton and Grant Counties.

Kentucky.

The Louisville Ry. Co., T. H. Minary, superintendent of construction, 316 W. Jefferson street, Louisville, Ky., is to make a survey to determine the cost of extending its line from Kosmosdale to West Point, Ky., 3 miles. The company has already determined to extend its Oro line to Kosmosdale, 3 miles, and will probably also decide to continue the extension as noted above. The cost of the 6-mile extension would be about $150,000.

An eastern syndicate has bought the Sam J. Wright and John Osborne tracts of coal and mineral lands near Whitesburg, Ky., consisting of about 1,200 acres, and early development is planed. The Lexington & Eastern Ry., John H. Peyton, Louisville, Ky., chief engineer of construction, will at once build a 4-mile spur from its main line to the tracts.

Louisiana.

Petitions are to be presented to the Police Jury of Vernon Parish in March, calling for a special election in Wards 1, 3 and 6 of the Parish for voting on a 5-mill tax for the St. Louis Southwestern Ry. It is stated that if a tax is voted the railway will extend its line from White City, Tex., through Leesville to the east boundary line of Vernon Parish.

The Police Jury of Vermillion has ordered a special election March 25 for the 4th Ward to vote on a 5-mill tax for 10 years in support of the Louisiana Power & Traction Co., which proposes to build an electric road from Lafayette to Abbeville on the west side of the Vermillion River.

Maine.

The Maine Central R. R. is contemplating a number of improvements at Rumford Falls, including the building of a new passenger station and the enlargement of the local freight yard to a 10-track capacity.

A bill is before the state legislature for the incorporation of the Farmington & Oakland Interurban Ry. Co., with a capitalization of $300,000. The company proposes to transport passengers and freight between Farmington and Oakland, through the towns of New Sharon, Mercer and Smithfield.

Maryland.

It is expected that contract for building and equipping the Hagerstown, Greencastle & Mercersburg Electric Ry. will be let in the near future. Frederick Skene, 149 Broadway, New York City, is consulting engineer.

Massachusetts.

It is expected that the Grand Trunk Ry. will announce shortly that satisfactory arrangements for financing the Southern New England Ry. have been completed and that construction work will be resumed, on the line from Palmer, Mass., to Providence, R. I. An indication of this is seen in the report that John Marsch, Chicago, Ill., who has the contract for one of the sections of this line, has stopped the shipment of his machinery from the Massachusetts line.

Michigan.

The Michigan United Traction Co., Jackson, Mich., has secured a large part of the right-of-way for its branch from Coloma to Benton Harbor.

The Rapid Ry. Co. (a subsidiary of the Detroit United Ry. Co., F. W. Brooks, general manager, 12 Woodward Ave., Detroit) has been granted permission to issue $75,000 of stock for continuing the work of double tracking its line between Detroit and Port Huron.

The Copper Range R. R., F. L. Batchelder, Chief Engineer, Houghton, Mich., is reported to be completing an extension north from Toivola to Painesville, 5 miles, in order to divert main line traffic through Painesdale, Trimountain, Baltic and South Range, the principal towns on the line south of Houghton.

Minnesota.

⊙Butler Bros., Hibbing, Minn., have been awarded a stripping contract for removing about 500,000 cu. yds. of surface at the mine of the Section A Mining Co., near Eveleth.

Mississippi.

The U. S. government is reported to have arranged with the Yazoo & Mississippi Valley R. R. for the latter to take charge of the closing of the Beulah crevasse. It is stated that the railroad company will build a trestle and sink as many carloads of heavy stone as may be necessary to make a firm foundation to close the crevasse and a large levee will be constructed on the stone foundation. K. L. Dubbs, division superintendent at Greenville, Miss., and J. L. Downs, roadmaster of the Memphis division, will have charge of the work.

The Mississippi Northwestern R. R., which proposes the construction of a line from Biloxi, Miss., to Omaha, Neb., has elected the following officers: M. G. Stokes of Philadelphia, Pa., Chairman of the Board and the Executive Committee; Walter G. Seaver of Biloxi, Miss., President; W. A. Pollock of Pascagoula, Vice-President; Walter B. Burns of St. Louis, Secretary; J. J. McIntosh of Moss Point, Assistant Secretary; M. S. Stokes of Philadelphia, Treasurer; O. G. Swetman of Biloxi, Assistant Treasurer; W. G. Preston of Philadelphia, General Auditor: Samuel S. Wathon of New York, General Counsel; Hudson & McKay of Vicksburg, General Attorneys; J. M. Searles of Vicksburg, General Engineer; W. S. Carter of St. Louis, Superintendent of Construction; R. C. Fazer of New York, Purchasing Agent.

Missouri.

Engineers of the Nevada, Lebanon & Eastern R. R. are making good progress with the surveys of the proposed route. The line surveyed east from Montevallo follows Stinking Creek most of the way from Montevallo to Horse Creek and crosses Horse Creek about a mile south of Filley. J. A. Thompson, Nevada, Mo., is interested.

St. Louis Items.

By A. B. Koenig.

L. J. Smith of the L. J. Smith Construction Co. spent a couple of days in town. He informs us that he has finished his Santa Fe work from the Needless east to the Colorado River and from Seligman, Ariz., west 24¾ miles, and expects to finish from Seligman ten miles east this month. This is all very heavy work. They are starting work between Flagstaff and Cactus, Ariz., and have recently finished the work between Cedar Glade and Jerome, Ariz., 42 miles of heavy work. The L. J. Smith Construction Co.'s headquarters will continue to be 1111 Commerce Bldg., Kansas City, with a branch office at Williams, Ariz.

M. L. Windham expects to resume work in the Illinois Central yards at Centralia, Ill. He is doing this on force account.

A. J. Russell is now with Smith, Scott & White on their big steam-shovel work near Pittsburg, Kan.

W. R. Forman of Cairo, Ill., has two traction engines and a good grading outfit idle. Wants work for them.

The labor market continues to be easy around this neighborhood. Plenty of white and colored laborers to be had on short notice. Foreigners are about the only class of labor that are scarce around here.

Koenig's Labor Agency has opened a branch office in Omaha at 1320 Dodge St. Jack Gardner, who formerly was in charge of the Memphis office, will represent the Koenig's Labor Agency in Omaha in the future. Contractors when in Omaha call around and get acquainted with Jack.

The Hillsboro Electric R. R. Co., which is financed by the Hillsboro Electric Light & Power Co. of Hillsboro, Ill., will build an interurban line east from Hillsboro as far as Nokomis, during the coming summer. The line will pass through Schram City, Irving and Witt.

There is no foundation in the report being published in the various railroad papers about Hannon & Hickey Bros. of St. Louis being awarded 40 miles of double track work on the Wabash R. R. in Indiana. The only job Hannon & Hickey Bros. have had in Indiana from the Wabash R. R. Co. within the past year was the one at Fort Wayne, Ind., which has long since been completed. They have a small concrete job on this same road near Kingsbury, Ill. Their steam-shovel is idle at the present time and they are in the market for some work. Navarre Bldg., St. Louis, will catch them.

A. M. Schazer, general manager of the Vandalia with headquarters in St. Louis, took his seat as a member of the Terminal Board at the February meeting of the board, held at Union Station. He succeeds Benjamin McKeen, who was recently promoted to general manager of the Pennsylvania lines west of Pittsburgh, with headquarters at Pittsburgh. The Terminal Board approved plans submitted by President McChesney for the new passenger terminal of the electric lines at Eads Bridge entrance facing on Bridge Square and Washington Ave., a three-story structure containing a waiting and rest rooms, ticket office, cafe, lavatories, barber shop and offices on the upper floor. The president was authorized to advertise for bids and it is expected that work will commence in the early spring. The station will be located on the south side of the upper roadway, replacing the present waiting rooms, and the cars will pass in and out of a covered way. Proprietory interests as follows were represented at the meeting: Missouri Pacific, B. F. Bush; Missouri, Kansas & Texas, C. E. Schaff; Wabash, Henry Miller; Cotton Belt, F. H. Britton; Rock Island, A. C. Sweet; Southern, T. C. Powell; Big Four, J. I. Van Winkler; Baltimore & Ohio Southwestern, W. C. Loree; Illinois Central, W. L. Park; Louisville & Nashville, G. E. Evans; Vandalia, A. M. Schoyer.

Street Commissioner James C. Travilla has announced he would send his resignation to Mayor Frederick H. Kreismann, March 1. Travilla will direct the expenditure of $1,600,000 in improving the roads of Tarrant County, Tex. More than 100 miles of road are to be improved. When Travilla completes his Texas work he will make his headquarters in St. Louis and will engage in engineering work. Maxime Reber, president of the Board of Public Improvements, Travilla and Mayor Kreismann agreed Chas. M. Talbert, associate to Reber, probably would be Travilla's successor, although several other persons are seeking the place. Talbert was appointed two years ago when the office of associate to the president of the board was created. His salary is $3,600. The street commissioner draws $5,000 a year.

Montana.

The Chicago, Milwaukee & Puget Sound Ry. is reported to have five parties in the field engaged on survey work on the proposed 150 miles of new line between Great Falls, Mont., and Missoula.

Among the reports in circulation concerning new work proposed by the Chicago, Milwaukee & Puget Sound is one to the effect that construction will be commenced shortly on the line from Billings, Mont., north to Roundup, a distance of 50 miles. Surveys for this line were completed some time ago. E. O. Reeder, Seattle, Wash., is Assistant Chief Engineer.

New York.

⊙The Public Service Commission for the First District, New York City, has awarded the contract for constructing Section 2 of Routes 36 and 37, Woodside, Astoria & Corona Rapid Transit R. R., to Cooper & Evans Co., 220 Broadway, New York City. This is to be a two and three track elevated line. Bids were opened Jan. 28, as noted in our Feb. 5 issue. The itemized bids on this work were as follows: (1) standing for bid of Cooper & Evans Co., total $860,743; (2) Snare & Triest Co., $893,265; (3) Oscar Daniels Co., $933,252; (4) E. E. Smith Contracting Co., $936,782; (5) Fraser, Brace & Co., $945,743; (6) Peace Bros., $946,470; (7) Percy Litchfield, $948,270; (8) The Terry & Tench Co., Inc., $981,004; (9) Post & McCord & Tidewater Bldg. Co., $991,062; (10) Rodgers & Hagerty, Inc., $1,012,260; (11) Marble Arch Co. & the Conners Bros. Co., $1,045,712; (12) T. J. Buckley Engineering Co., $1,287,165.

Classification—	Unit.	Quantity.	(1)	(2)	(3)	(4)	(6)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Column excavation	Cu. yd.	11,800	$ 1.39	$ 2.70	$ 2.50	$ 1.00	$ 3.36	$ 1.60	$ 2.40	$ 2.74	$ 2.55	$ 2.31	$ 4.50	$ 8.00
Railroad duct excavation	Cu. yd.	7,200	1.19	1.80	2.00	.60	1.54	1.40	2.40	2.79	1.62	2.01	3.00	6.00
Concrete masonry	Cu. yd.	5,100	7.25	6.50	7.50	6.00	7.25	7.50	8.00	7.35	8.67	8.50	9.00	10.00
Brick masonry	Cu. yd.	10	15.00	15.00	15.00	11.00	20.00	15.00	15.00	12.60	17.71	18.00	20.00	25.00
Timber piles	Lin. ft.	2,000	.50	.80	.40	.40	.30	.50	.50	.53	.44	.50	.60	3.00
Timber foundations	M. ft.	2 M.	60.00	75.00	50.00	50.00	60.00	75.00	50.00	45.00	75.90	50.00	80.00	200.00
(e) 4-inch vitrified pipe	Lin. ft.	525	1.00	1.00	.70	.20	1.00	.75	.30	.21	.39	.50	.50	.60
Railroad ducts	Duct. ft.	212,000	.14	.15	.13	.12	.17	.14½	.15	.12	.19	.15	.20	.90
Riveted steel	Ton	11,460	60.70	62.00	64.45	69.00	62.25	67.20	65.60	68.00	67.29	70.00	66.50	70.00
Steel beams and shapes	Ton	370	60.70	58.00	53.50	56.00	62.25	57.20	54.60	68.00	56.29	59.00	55.50	70.00
Steel rods and bars	Ton	2	60.00	70.00	60.00	42.50	65.00	50.00	60.00	80.00	69.58	70.00	120.00	75.00
Miscellaneous iron castings	Ton	495	50.00	60.00	55.00	60.00	55.00	50.00	62.00	69.00	70.22	66.50	100.00	70.00
Cast iron hub and spigot pipe	Ton	20	50.00	75.00	60.00	70.00	70.00	100.00	62.00	80.00	65.80	100.00	120.00	70.00
(h) Street surface restored	Sq. yds.	5,500	2.65	2.30	3.50	2.75	7.75	2.90	3.32	3.12	4.20	4.00	3.75	2.00
Street surface R. R. (c) electric overhead trolley, railroad single track	Lin. ft.	12,750	.69	.40	1.25	.45	1.00	1.00	.50	.53	.95	1.00	2.00	2.00

⊙Bids were opened Feb. 7 by the Public Service Commission of the First District, New York City, for the construction of Section 3 of Routes 36 and 37, Woodside, Astoria & Corona Rapid Transit R. R. This is to be a two and three-track elevated railroad. The contract was awarded to E. E. Smith Contracting Co., 71 Broadway, New York City, at $2,063,588. The itemized bids on this section were as follows: (1) standing for bid of E. E. Smith Contracting Co., total $2,063,588; (2) the Snare & Triest Co., $2,204,740; (3) Fraser, Brace & Co., $2,213,453; (4) Frawley-Kaufman Contracting Co., Inc., $2,222,408; (5) Thomas J. Buckley Engineering Co., $2,295,896; (6) Mulcahey & Gibson, $2,310,438; (7) Oscar Daniels Co., $2,333,855; (8) Marble Arch Co. and the Conners Bros. Co., $2,359,342; (9) Coleman Bros., $2,377.969; (10) P. McGovern & Co., $2,453,030; (11) Carter Construction Co., $2,887,741.

Classification—	Unit.	Quantity.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Column excavation	Cu. yd.	40,000	$ 1.75	$ 1.40	$ 1.70	$ 1.50	$ 1.50	$ 2.50	$ 2.00	$ 1.25	$ 1.50	$ 1.60	$ 1.75
Railroad duct excavation	Cu. yd.	14,000	1.25	1.40	1.65	1.00	1.50	2.40	1.50	1.25	1.50	1.50	.90
Concrete masonry	Cu. yd.	12,630	6.00	7.00	6.95	8.00	7.25	7.00	7.75	8.50	8.00	7.50	7.00
Reinforced concrete	Cu. yd.	39,200	7.20	9.60	8.25	9.00	10.25	13.14	10.50	13.00	13.00	11.00	11.50
Natural cement finish	Sq. yd.	19,000	.17½	.60	.15	.75	1.00	.25	1.20	1.10	.75	.25	.60
Mortar face finish	Sq. yd.	31,000	.90	1.00	.25	1.40	1.80	.45	1.60	2.00	.50	.50	1.60
Inlaid colored tile	Sq. ft.	21,000	1.60	.90	1.35	1.20	1.00	1.75	1.40	1.50	1.25	1.25	1.37
Granolithic surface finish (platform)	Sq. ft.	29,000	.14	.05	.07	.16	.16	.09½	.07	.10	.15	.15	.30
Concrete copings around stair wells	Lin. ft.	250	.40	2.00	.75	1.00	.75	2.75	1.75	2.00	3.00	5.00	7.50
Brick masonry	Cu. yd.	10	12.00	15.00	15.00	15.00	15.00	14.00	15.00	13.00	20.00	20.00	20.00
Timber piles	Lin. ft.	2,000	.35	.70	.30	.60	.60	1.50	.40	.30	.75	.30	1.00
Timber foundations	M. ft.	2M.	50.00	60.00	60.00	100.00	75.00	60.00	.60	90.00	100.00	50.00	100.00
(b) Waterproofing 2-ply	Sq. yds.	18,400	.50	.50	.50	.80	.40	.45	.70	.60	.60	.75	1.00
(d) Waterproofing 4-ply	Sq. yds.	1,500	.90	1.00	1.00	1.00	.80	.92	1.20	.85	1.20	1.50	1.50
(e) Vitrified pipe 4-inch	Lin. ft.	1,300	.30	.80	.50	.75	.70	.25	.60	.50	.75	.35	.80
(a) Cast iron pipe and fittings 3-inch	Lin. ft.	1,840	.55	.70	.61	.60	.80	.68	1.00	.50	1.00	1.00	.90
(b) Cast iron pipe and fittings 4-inch	Lin. ft.	4,000	.70	.80	.73	.60	.90	.75	1.25	.75	1.00	1.25	1.00
(c) Cast iron pipe and fittings 6-inch	Lin. ft.	470	1.00	1.20	1.06	1.00	1.10	.90	1.50	.95	1.25	1.70	1.75
(d) Cast iron pipe and fittings 8-inch	Lin. ft.	1,300	2.00	1.50	1.43	1.25	1.50	1.05	1.75	1.60	2.00	2.00	2.00
Railroad ducts	Duct ft.	407,000	.12½	.14	.15	.13	.15	.08½	.15	.14	.15	.14	1.25
Riveted steel	Tons	21,930	60.00	62.50	66.00	63.00	62.00	59.75	60.50	60.00	63.00	69.00	66.00
Steel beams and shapes	Tons	800	60.00	60.00	66.00	63.00	63.00	60.00	59.50	60.00	67.00	69.00	63.00
Steel rods and bars	Tons	1,050	48.00	60.00	62.50	70.00	60.00	40.00	75.00	60.00	50.00	70.00	60.00
Miscellaneous iron castings	Tons	50	60.00	60.00	55.00	70.00	60.00	65.00	55.00	120.00	60.00	70.00	60.00
New cast iron hub and spigot pipe	Tons	20	70.00	70.00	70.00	80.00	70.00	75.00	75.00	65.00	60.00	70.00	50.00
Special wire forms	Lbs.	2,200	.10	.15	.11	.10	.10	.08	.20	.15	.10	.10	.12
(h) Street surface restored	Sq. yds.	18,500	1.75	.60	.25	.10	2.00	.50	2.00	1.00	1.00	1.25	2.25
(a) Wrought iron electric conduits ¾-inch	Lin. ft.	6,850	.30	.16	.11	.15	.10	.15	.15	.20	.10	.20	.20
(b) Wrought iron electric conduits 1½-inch	Lin. ft.	6,500	.45	.32	.22	.25	.22	.30	.30	.38	.20	.30	.35
(d) Wrought iron electric conduits 1-inch	Lin. ft.	120	.35	.25	.16	.25	.15	.25	.20	.28	.20	.35	.30
Cast iron outlet boxes	Each	224	.75	1.00	.50	2.00	1.50	1.00	1.25	1.75	1.00	1.50	1.50
Cast iron pull boxes	Each	102	8.00	1.50	.50	2.00	3.00	2.00	1.25	5.00	2.00	1.50	3.50
Street surface railroads (c) electric (overhead trolley) R. R.	L. ft. s. track	1,800	2.00	1.00	.50	1.00	1.00	10.00	1.75	1.00	1.00	5.00	1.00
Steel and iron stairways	Lin. ft.	5,700	2.25	2.50	1.50	1.25	2.50	2.90	4.00	2.40	2.90	3.00	1.00
Steel and iron stairway platforms	Sq. ft.	1,900	2.00	2.00	1.00	1.25	2.50	1.90	2.50	1.50	2.90	2.00	1.00
16-oz. copper flashing	Sq. ft.	2,700	.40	.40	.40	.40	.60	1.00	.50	.50	.50	.25	.75
Wrought iron pipe 3-inch	Lin. ft.	2,400	.40	.75	.30	.50	.60	.75	.65	1.00	.50	.35	.50

Nebraska.

Plans are under consideration for building a 30-mile railroad from Hemmingford to Canton or Curley, in Sioux County. K. L. Pierce, Hemmingford, Neb., is interested.

It is rumored that the Union Pacific Ry. is planning the construction of a line from some point in the Blue Valley to connect with its line at Hastings, Nebr. The Commercial Club of Beatrice, Nebr., has appointed a committee to investigate the probability of such a line and to take steps to have it run through that city.

Merchants of Hemingford, Nebr., and farmers and ranchmen are discussing the feasibility of constructing a railroad from that city to Canton or Curly in Sioux County, a distance of 30 miles. Farmers are willing to donate most of the right of way. K. L. Pierce of the State Bank of Hemingford, one of the promoters of the project, is negotiating with the owner of an abandoned railroad in Wisconsin for the purchase of 22 miles of second-hand track and equipment.

New Hampshire.

It is probable that the Boston & Maine R. R. will this spring build an additional track from Spinney's Switch, east of Kittery, to Portsmouth, N. H. This section is about 4 miles long, and will give the eastern route of the Portland division a double track from Boston to Jewett.

The Boston & Maine R. R. has made surveys for a short line connecting the new Hinsdale-Brattleboro line, now under construction, with the Ashuelot branch at Hinsdale. The new link would make possible a more direct connection between Brattleboro and Boston.

New Mexico.

The Santa Fe system is to build a spur this spring from Maxwell station to the heart of the wheat fields west of the town.

Practically all right-of-way for an electric railway from Olean to Hinsdale, 7 miles, has been given to the Western New York & Pennsylvania Traction Co. W. R. Page, President, Olean, N. Y. The cost of the extension is estimated at about $100,000.

No surveys have been made as yet for the projected 40-mile electric railway of the Oneonta, Charlotte Valley & Cobbleskill Ry. Co. The company will probably engage an engineer for this work soon. C. G. Payne, Charlotteville, N. Y., is President.

North Dakota.

⊙It is reported that the Northern Pacific has awarded the contract for the construction of the proposed new line from Stanton, Mercer County, N. Dak., to the south end of the Kildeer Mountains to A. Guthrie & Co., St. Paul, Minn. The line will be built along the Knife River and it is expected to have it completed this year.

Ohio.

The Pittsburgh, Cincinnati, Chicago & St. Louis Ry. (Pennsylvania Line) has applied to the State Public Service Commission, asking authority to issue $7,000,000 of its consolidated mortgage bonds. The company proposes to expend the proceeds from the sale of the bonds in improvements on the lines in Ohio.

Articles of incorporation have been filed changing the name of the Columbus Traction Co., Columbus, to the Columbus Railway, Power & Light Co.

The Cleveland & Youngstown Ry. Co. is reported to have financed its projected line, and it is stated that construction work will be started by April 1. This company plans to enter Cleveland by two subways about 5,500 feet long. The construction of a terminal station is also projected. An expenditure of about $6,000,000 is proposed. O. P. and M. J. Van Sweringen, Cleveland, O., Warren S. Hayden and W. H. Gratwich are interested. W. E. Pease, Cleveland, is the engineer.

Oregon.

Special election is to be held at Ashland, Ore., to vote on granting a franchise for an interurban and street railway project promoted by F. P. Minney, Los Angeles, Cal.

McArthur Bros. & Perks Co., which has the contract for the construction of the Southern Pacific line from Eugene, Ore., to Coos Bay, will resume work on the North Bend end of the road at once. Hearquarters of the company have been established at North Bend, Ore.

Plans have been completed and construction material ordered for the electrification of the Mount Hood line of the Portland Railway Light & Power Co., Portland, Ore., between Montavallo and Gresham, 9 miles.

Pennsylvania.

It is rumored at Bethlehem, Pa., that the Philadelphia & Reading R. R. and the Lehigh Valley R. R. contemplate the construction of a $500,000 union station at that city.

Construction work will probably be started this year on the Wyomissing Valley Electric Ry., which was chartered recently. This company projects a double track line from Wyomissing to Hendleton. The route runs through a rocky section, requiring several cuts. The Reading Transit Co., Reading, Pa., is understood to be back of the new line.

Rhode Island.

The Rhode Island Co., D. F. Sherman, President, Providence, R. I., has offered to build a suburban electric railway from Centredale through Greenville and Harmony to Chepachet and possibly to Pascoag, making a through trolley route from Providence, if the people of the towns of Smithfield and Glocester will guarantee to the company interest charges on the cost of construction, which is estimated at about $300,000.

South Carolina.

The Southern Power Co., W. S. Lee, Vice-President, Charlotte, N. C., is planning to extend its interurban line from Anderson to Atlanta in the near future.

A bill is before the state legislature to incorporate the Palmetto Ry. Co. which proposes the construction of an interurban railway between Columbia and Greenville via Prosperity, Newberry, Clinton and Laurens. R. A. Cooper, Laurens, S. C., is interested.

South Dakota.

The Chicago, Milwaukee & Puget Sound, it is reported, will commence work in the spring on the proposed extension from Lantry, S. Dak., in a southwesterly direction to Rapid City, S. Dak. W. H. Penfield, Chicago, Ill., is Assistant Chief Engineer.

The Great Northern R. R., according to advices from Sioux Falls, S. Dak., is assembling material for the construction of an extension from Tea, a station south of Sioux Falls, in the direction of Wheeler on the Missouri River in Charles Mix County. A. H. Hogeland, St. Paul, Minn., is Chief Engineer.

The Minneapolis & St. Louis Ry., is understood to have arranged for acquisition of the South Dakota Central Ry., pending approval of the Minneapolis & St. Louis board and that of the Minnesota state railway commission and other state commissions having jurisdiction over the two roads. The Minneapolis & St. Louis directors will probably ratify the purchase immediately.

Texas.

⊙The St. Louis & San Francisco Ry. has awarded a contract to J. W. Thompson & Co., St. Louis, Mo., to construct freight and passenger terminals, including passenger stations, inbound and outbound freight sheds, yards, team tracks, etc., at Beaumont, Tex., at a total cost of $500,000.

Governor Colquitt has vetoed the consolidated bill to permit the merger of the Missouri, Kansas & Texas and the Texas Central Railways. He declared the consolidation was unconstitutional.

The permanent line for a part of the extension of the Beaumont & Great Northern Ry. (Missouri, Kansas & Texas System, A. M. Acheson, Chief Engineer, Dallas, Tex.) has been completed, and the engineers are now at work on the extension from Weldon to Waco.

Promotion plans are well along for the proposed railroad from Teague to a point on the Texas Midland Ry., near Ennis. Mayor T. J. Alexander, Teague, Tex., is interested.

The Artesian Belt R. R. Co., J. D. Jackson, chief engineer, Macdona, Tex., is reported to have completed arrangements for securing $170,000 for the extension of the road. This extension will probably be built from Christine, the southern terminus to Crowther, a distance of 17 miles.

Business interests of Kenedy, Tex., have pledged themselves to raise a bonus of $120,000 for the construction of the first 20 miles of a railroad out of that city, for which surveys have already been made. The proposed line is to run from Kenedy to a point on the Rio Grande, near Laredo and thence down the valley and ultimately to a connection with the San Antonia, Fredericksburg & Northern Ry.

It has been announced by Sam Lazarus, St. Louis, Mo., President of the Quanah, Acme & Pacific, that the extension of the line to Roaring Springs is nearing completion and that it will probably be in operation by June 1. The company has submitted to the city of Quanah, Tex., a proposition whereby the main shops and terminals will be located at that place.

Advices from Corpus Christi, Tex., state that a bonus of $60,000 is being raised to induce the San Antonio, Uvalde & Gulf Ry. to build into that city. J. E. Franklin, San Antonio, Tex., is President of the railroad.

Utah.

A mass meeting of the citizens interested in securing for Provo the terminal of the Utah Railroad was held at the rooms of the Commercial Club, Provo, Utah, recently. The committee appointed to secure the right of way for the road from Provo to Spanish Fork canyon, and the committee on finance, appointed to solicit subscriptions to pay for the right of way, which the company requires as a precedent to coming to Provo instead of Spanish Fork, submitted reports and officials of the road were present. The committee on right of way has deeds in escrow for practically all land required for the right of way, and know the price that is asked for the remainder of the land required.

Vermont.

The Southern Vermont Ry., a subsidiary of the Central Vermont Ry., G. C. Jones, General Manager, St. Albans, Vt., has filed details with the various town clerks in the towns from Windsor to Brattleboro, of the route of its proposed line between these places. The route follows the Connecticut River on the Vermont side, and practically parallels the Boston & Maine, which runs on the opposite side of the river. By the construction of this line the Central Vermont Ry. will avoid using the tracks of the Boston & Maine Ry. from Windsor to Brattleboro, a distance of 50 miles. Surveys for the new line were made two or three years ago, and the right to build it was granted in 1910 by the Vermont Legislature. Bids on a portion of the line were taken about two or three years ago, but nothing further was done.

Wisconsin.

A meeting was recently held in Pigeon Falls, Wis., to discuss the construction of a railway proposed to run from Fairchild to Galesville A committee of men from Northfield, Garden Valley, Pigeon Falls and Galesville was appointed to urge the matter of preliminary survey and to secure money for the expense.

Washington.

The Northern Pacific Ry. is to expend about $1,000,000 in relaying with 95 lb. rails its line between Seattle and Sumas, 120 miles. A number of reinforced concrete bridges will also be erected.

Wyoming.

⊙Twohy Bros., Portland, Ore., have been awarded the contract for constructing the Powder River-Orrin Junction line of the Burlington.

Canada.

⊙Jones & Girouard, Montreal, Que., have been awarded a contract by the Canadian Pacific Ry. for a 30-mile line from Temiskaming to Ville Marie, Que.

The Temiskaming & Northern Ontario Ry., S. B. Clement, Chief Engineer, North Bay, Ont., is reported to have decided to construct an additional branch connecting Abitibi River with the main line next spring. By leaving the main line at a point about half a mile north of the Iroquois Falls station and running on a line almost due east to Abitibi River, the railway will be able to connect with that body of water by a line about seven miles in length.

The Canadian Northern Ry. will apply to the next session of the legislative assembly of the Province of Alberta for an act so as to enable the company to construct a line from a point at or near Taber to a point in the north near Consort; a line from Calgary in a northwesterly direction to a point between its Bazeau branch and Cochrane; also another line from Calgary in a southwesterly direction to a point on its line between Cochrane and Pincher Creek. These lines are all feeders to Calgary and will likely be completed in 1913. The company is also applying for authorization to build a line from Cardston to the westerly boundary of the province.

The Canadian Government has announced that the northern terminal of the Hudson Bay Ry., now under construction, will be located at Port Nelson.

Anderson & Luneny and the Dominion Townlots, Ltd., Regina, Sask., have been granted permission by that city to construct a street car line in 16th avenue from McDonald street eastward to Park street. The city will operate cars over the line.

The Ottawa-Morrisburg Electric Ry. Co. is planning to start work in the spring on the construction of its projected line from Ottawa to Morrisburg. J. G. Kilt, Citizen Bldg., Ottawa, Ont., is President.

M. P. & J. D. Davis, Quebec, Que., have a contract from the Grand Trunk Pacific Ry. for the completion of 130 miles of line between New Brunswick and the St. Lawrence River.

The Pointe Aux Trembles Terminal Ry. Co. is to apply to Parliament for an act of incorporation. This company proposes to build a line of railway beginning at the Montreal Harbor Board's dock near the Cement Company's property, at Pointe Aux Trembles, extending along the fact of the dock to the south-western boundary of the Cement Co.'s premises, and thence to the well of the latter concern, crossing Notre Dame street, the Canadian Northern Ry. and the Montreal Terminal Ry. at Montreal. Authority is asked to build terminal stations, elevators, etc.

The construction program for the Canadian Northern Ry. in the west for the present year includes the following: In Manitoba a stretch of 500 miles beginning five miles east of Portage la Prairie and extending to near Stuartburn, and other points will be the main development. The Inwood-Fisher river route will be graded 40 miles. In Saskatchewan the work will include a line from Sturgis for a distance of 44 miles towards Hudson Bay. A like distance of line will be constructed on the Graven branch. The line through Bravelbourg toward Swift Current will have more than 50 miles added to the present grade. The McRorie-Outlook line will be extended nearly 30 miles east of that point and about twenty miles west of it. The Regina-Moose Jaw line, and the Yorkton branch, are also included in the program. In Alberta the Camrose southwest branch is the principal one, and 60 miles of new line on this will be constructed. About 50 miles will be undertaken on the Edmonton-Calgary line. The line south of McLeod, at Pincher Creek, will be graded for about 40 miles and work on the Calgary-Lethbridge branch will also be undertaken. The linking up of the Brudhein and Vermillion connection and the tapping of the Brazeau coal fields, are to be rushed. The Peace River branch is also to be started.

ROADS AND STREETS

Alabama.

⊙Thomas Worthington of Birmingham, Ala., has been awarded the contract for the improvement of the first unit of the Milner Land Co. (Birmingham) property, amounting to $100,000. This includes the street paving, the sidewalks, curb and gutter, and the storm and sanitary sewerage for about one-sixth of the Milner property, principally that part which extends down to Highland Ave. between Maiden Lane and Milner St.. The total amount of the contracts will amount to about $600,000, but the property will be improved in units. Included in the contract is 15,000 sq. yds. of street paving. The kind has not been selected by the company as yet. The cement sidewalk contract calls for 10,000 sq. yds. and the combination cement and curb and gutter contract is for 15,000 lin. ft. Over 100,000 cu. yds. of dirt will be removed. There will be 15,000 lin. ft. of storm and sanitary sewerage.

The Cullman County Commissioners, Cullman, Ala., have decided to call an election on a bond issue for good roads on March 10. It is proposed to expend $230,000 on the roads of the county.

The Commissioners of Marshall County, Guntersville, Ala., on Feb. 13 held a meeting to consider the advisability of issuing bonds to the amount of $150,000 for the construction of good roads.

California.

⊙The Board of Public Works of Los Angeles, Calif., has awarded the contract for the paving of South Main St., from 36th Pl. to Manchester Ave., to George H. Oswald, at $146,082.

⊙The San Joaquin County Supervisors, Stockton, Calif., are reported to have awarded contracts for the improvement of roads, as follows: French Camp road, a distance of 34,787 ft., Cy Moreing, Jr., $31,829; Hogan road, a distance of 27,235 ft., G. C. Stevenson, $20,713.

According to advices from San Rafael, Calif., Attorney George Harlan and others are circulating a petition for the establishing of a new road from Mill Valley to Bolinas via Willow Camp, a distance of 11 miles.

The San Mateo County Board of Supervisors, Redwood City, Calif., has agreed on the routes for the proposed highway system, for which a $1,285,000 bond election has been called for April 1.

The city of Chico, Calif., proposes to construct about 100 blocks of street paving this year. The largest contract will be that of improving First St., from Main St. to the Southern Pacific track. M. C. Polk is City Engineer.

Colorado.

The Board of Public Works of Denver, Colo., has decided upon public improvements that will aggregate in cost about $275,000, to be started early in the spring. On April 3 the board will order the paving of the alleys between Larimer and Lawrence and Market and Blake Sts., from 20th to 24th, and between Larimer and Market, from 21st to 24th Sts. The estimated cost is $13,607. On the same day the board will order the grading, curbing and guttering of the following streets: Santa Fe (Jason), from W. Sixth to W. Alameda; Kalamath and S. Kalamath, from W. Sixth to Alameda; W. First, W. Second, W. Third, W. Fourth and W. Fifth, from Santa Fe to Kalamath; W. Ellsworth, W. Alameda and W. Bayaud, from Santa Fe to S. Kalamath; W. Alameda, from the subway to S. Tejon. The estimated cost is $38,595. The board will also order on April 3 the extension of the Cherry Creek retaining walls from Blake St. to the Platte, at a cost of $144,478. On March 27 the board will order the surfacing of the following streets: Lafayette and Humboldt, from Seventh to Fourth; Franklin, Gilpin and High, from Eighth to Fourth; Race, from Eighth to Sixth; Fifth and Sixth, from Downing to High; Seventh, from Humboldt to Franklin; Eighth, from Humboldt to Vine. The cost is estimated at $36,377. On March 29 the board will order the paving of the alleys between Broadway and Logan, from Seventh to Eighth, between Sherman and Pearl, from Sixth to Seventh, and between Logan and Pearl, from Fifth to Sixth. The cost will aggregate $18,672. On March 21 the board will call for bids for paving the alleys between Broadway and Acoma, from W. Eighth to the civic center, and between Acoma and Bannock, from W. Ninth to the civic center. The cost will be about $20,000. A. L. Fellows is City Engineer.

Delaware.

A bill was introduced in the Delaware legislature, Dover, on Feb. 10 authorizing the city of New Castle to issue bonds up to $30,000 for street improvements.

District of Columbia.

The Commissioners of the District of Columbia, Washington, D. C., have rejected all bids received Jan. 24 for furnishing and delivering 100,000 gals. or more of emulsifiable road oil for use in the surface division, Washington.

Georgia.

The Bartow County Grand Jury, Cartersville, Ga., has recommended that the county have an election for the purpose of voting upon an issue of bonds to the amount of $400,000, with which to make the public roadways not only good, but permanent.

Illinois.

✣Bids will be received by the Board of Local Improvements, Chicago, Ill., until 11 a. m., Feb. 24, for furnishing and delivering labor, materials, etc., necessary to construct pavements in the following streets: Dickens Ave., 40th to 45th Ave., 6,100 lin. ft. granite concrete combined curb and gutter, 9,700 sq. yds. asphalt pavement; assessment available, $27,163.40. Indiana Ave., 51st St. to Garfield Blvd., 5,330 lin. ft. granite concrete combined curb and gutter, 11,000 sq. yds. asphalt pavement; assessment available, $29,289.43. S. Leavitt St., Ogden Ave. to 14th St., 3,000 lin. ft. granite concrete combined curb and gutter, 500 lin. ft. concrete gutter, 7,350 sq. yds asphalt; assessment available, $19,127.96. 73d St., Bond Ave. to South Shore Ave., 5,300 lin. ft. granite concrete combined curb and gutter, 2,420 sq. yds asphalt pavement; assessment available, $7,300; 3d Ave., Augusta St. to Division St., 2,500 lin. ft. granite concrete combined curb and gutter, 3,900 sq. yds. asphalt pavement; assessment available, $12,000; Troy St., Colorado Ave. to Jackson Blvd., 20,910 lin. ft. granite concrete combined curb and gutter, 1,460 sq. yds asphalt pavement; assessment available, $4,318.

✣Bids will be received by the Board of Local Improvements, Chicago, Ill., E. J. Glackin, Secretary, until 11 a. m., Feb. 28, for furnishing and delivering labor, materials, etc., necessary to construct cinder sidewalks in the following streets: Both sides Archer Ave., Clifton Park Ave. to Central Park Ave., 6 ft. wide; Ave. O, E. 112th, E. 113th St., 6 ft. wide; Cornelia Ave., 62d Ave. to N. 64th Ave.; north side W. 57th St. S. Oakley Ave. to S. Western Ave.; W. 58th St., S. St. Louis Ave.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

to G. T. R. R.; Giddings St.; both sides N. 56th Ave., N. 58th Ave, E. 112th St., south side Ave. O to Green Bay Ave., E. 113th St., north side Ave. O to Green Bay Ave., S. Oakley Ave., east side W. 61st St. to W. 63d St., W. 63d St., Hamlin Ave., S. 44th Ave., W. 52d St., S. 42d Ave to S. 44th Ave., S. 43d Ave., W. 52d St., W. 54th St., S. 43d Ct., W. 52d St. to W. 54th St., S. 43d Ct., W. 52d St. south, W. 47th St., Rockwell St. to California Ave., 48th St., Rockwell St. to California Ave., Rockwell St., 47th St. to 48th St., Talman Ave., 47th St. south, S. Washtenaw Ave., W. 47th St. south, S. Fairfield Ave., W. 48th St. south, S. California Ave., W. 47th St., W. 48th St., W. 45th St., 40th Ct., 41st Ct., 40th Ct., 44th St. to 45th St., S. 41st Ave., W. 43d St., W. 45th Ct., S. 41st Ct., W. 43d St., W. 45th St. Cash or certified check for 10 per cent of bid must accompany proposal.

✣Bids will be received until 7:30 p. m., Feb. 26, by Board of Local Improvements, William Wicke, Secy., Des Plaines, Ill., for grading, curbing, paving, etc. The work will include approximately 2,000 sq. yds. asphaltic concrete, 20,400 lin. ft. curbing and guttering and 15,000 cu. yds. earth excavation. Plans, etc., are on file with the Secretary and at the office of H. R. Emerson, Room 1118, Chamber of Commerce Bldg., Chicago, Ill., Engineer.

⊙I. D. Lain of Bloomington, Ill., has been awarded the contract for the construction of pavement on the west roadway on Clinton St., between Phoenix Ave. and Emerson St., for $2,942. Danville brick will be used.

⊙The Board of Local Improvements of Rock Island, Ill., has awarded a contract for laying brick paving on Fourth Ave., from 24th to 27th St., and thence south to Fifth Ave. to the Tri-City Construction Co., Davenport, Ia., as follows: Brick paving, $1.93 per sq yds.; sandstone curbing, $0.52 per ft., and catch basins, $50 each.

⊙The Board of Local Improvements, Chicago, Ill., has awarded the following contracts for constructing pavements in the following streets: Ballou St., Armitage Ave. to Fullerton Ave., 5,250 lin. ft. granite concrete combined curb and gutter, 8,000 sq. yds. asphalt pavement; total, $19,683.40; F. P. McCormick Co., 133 W. Washington St. Cornelia Ave., Ashland Ave. to E. Ravenswood Park, 2,650 lin. ft. granite concrete combined curb and gutter, 4,600 sq. yds. asphalt pavement; total, $11,915.50; F. P. McCormick Co., 133 W. Washington St. 83d St., Exchange Ave. to Ontario Ave., 2,420 lin. ft. granite concrete combined curb and gutter, 40 sq. yds. brick pavement, 5,090 sq. yds. asphalt; total, $12,765.80; F. P. McCormick Co., 133 W. Washington St., Chicago, Ill. Haddon Ave., Leavitt St. to Western Ave., 2,620 lin. ft. granite concrete combined curb and gutter, 4,150 sq. yds. asphalt pavement; total, $10,363.80; F. P. McCormick Co., 133 W. Washington St. Harding Ave., Division St. to North Ave., 5,200 lin. ft. granite concrete combined curb and gutter, 8,100 sq. yds. asphalt pavement; total, $19,352; F. P. McCormick Co., 133 W. Washington St. Hirsch St., Grand Ave. to 44th Ave., 4,750 lin. ft. granite concrete combined curb and gutter, 7,320 sq. yds. asphalt pavement, $17,460.50; F. P. McCormick Co., 133 W. Washington St. 36th St., California Ave. to Kedzie Ave., 5,400 lin. ft. sandstone curbing, 7,210 sq. yds. brick pavement, $22,368.70; Ready & Callahan Coal Co., 133 W. Washington St. 36th St., Western Ave. to California Ave., 4,920 lin. ft. granite concrete combined curb and gutter, 3,470 sq. yds. asphalt; total, $21,787.10; American Asphalt Paving Co., 133 W. Washington St. 36th St., Oakley Ave. to Western Ave. Blvd., 770 lin. ft. granite concrete combined curb and gutter, 1,150 sq. yds. asphalt; total, $2,918.50; American Asphalt Paving Co., 133 W. Washington St. 38th Pl., Washtenaw Ave. to Kedzie Ave., 6,470 lin. ft. granite concrete combined curb and gutter, 9,650 sq. yds. asphalt pavement; total, $25,165; American Asphalt Paving Co., 133 W. Washington St. 38th St., Morgan St. to 475 ft. E. of Butler St., 7,140 lin. ft. granite concrete combined curb and gutter, 11,800 sq. yds. asphalt pavement; total, $28,198.40; R. F. Conway Co., 133 W. Washington St. Quarry St., Archer Ave. to 27th St., 27th St., Halsted St. to Quarry St., 2,500 lin. ft., sandstone curbing, 5,450 sq. yds. brick pavement; total, $14,411.50; Ready & Callahan Coal Co., 133 W. Washington St. Commercial Ave. system, 16,640 lin. ft. sandstone curbing, 32,320 sq. yds. brick pavement; total, $86,929.70; Calumet Coal & Teaming Co., 9022 Commercial Ave. Hamlin Ave. system, 9,800 lin. ft. sandstone curbing, 14,640 sq. yds. asphaltic concrete; total, $32,704.40; Standard Paving Co., 9 S. La Salle St. All work includes a 6-in. Portland cement concrete foundation sewer, manhole, and catch basin construction and adjustment. Edw. J. Glackin, Secretary of the Board.

Property owners on Avenue D, between Tenth and 11th Sts., Sterling, Ill., have petitioned the Board of Local Improvements for paving in that block. The City Engineer, John D. Arey, will prepare plans and specifications.

The Board of Local Improvements of Macomb, Ill., has adopted a resolution providing for the extension of the pavement from the north end of Lafayette St. to the middle entrance to Oakwood cemetery. William Rardaker is City Engineer.

The Commercial Club and the Highway Commissioners of Edwardsville Township, Edwardsville, Ill., recently held a meeting to consider plans for the construction of hard roads in the township next summer. About $18,000 will be raised annually. It is proposed to rebuild 25 miles of road.

Following are the lowest bids submitted to the Board of Local Improvements, Chicago, Ill., on Feb. 10, for furnishing and delivering materials, labor, etc., necessary to construct pavements in the following streets: 63d St., Western Ave. to Irving Ave., 2,530 lin. ft. sandstone curbing, 82½c; 42,240 sq. yds. brick pavement, $2.11; total, $11,967.65; Ready & Callahan Coal Co., 133 W. Washington St. 20th St., Blue Island Ave. to Jefferson St., 650 lin. ft. granite concrete combined curb and gutter, 1,010 sq. yds. asphalt pavement, $2.04; total, 2,797.40; R. F. Conway Co., 133 W. Washington St. Oakley Ave, 35th St. to Archer Ave., 1,700 lin. ft. granite concrete combined curb and gutter, 62c; 2,800 sq. yds. asphalt pavement, $1.81; R. F. Conway Co., 133 W. Washington St. 105th St., Throop St., Prospect Ave., 3,610 lin. ft. vertical granite concrete combined curb and gutter, 72c; 5,060 sq. yds. asphaltic macadam pavement, $1.26; total, $9,998.80; Farr Bros. Co., 363 W. 111th St. Loretto Ct., Van Buren St. to Congress St., 600 lin. ft. sandstone curbing, 85c; 1,280 sq. yds. brick pavement, $2.75; total, $4,452; Central Paving Co., 179 W. Washington St. Hoyne Ave., 105th St. to 107th, 2,700 lin. ft. sandstone curbing, 70c; 3,970 sq. yds. asphaltic macadam pavement, $1.28; total, $7,961.60; Farr Bros. Co., Irving Park Blvd. Ashland Ave., E. Ravenswood Park, 2,610 lin. ft. sandstone curbing, 84c; 3,850 sq. yds. creosote of wood block pavement, $3.58; total, $19,560.90; Citizens' Construction Co., 133 W. Washington St. 41st Ave., Irving Park Blvd. to C. & N. W. R. R., 920 lin. ft. sandstone curbing, 75c; 1,340 sq. yds. brick pavement, $2.17; total, $4,066.80; Smith & Brown Co., 128 N. La Salle St. 42d St., Vincennes Ave. to Cottage Grove Ave., 3,650 lin. ft. gravel concrete combined curb and gutter, 45c; 6,920 sq. yds. asphaltic concrete pavement, $1.25; total, $11,929.50; R. F. Conway Co. Elston Ave., Fullerton Ave. to Belmont Ave., 15,000 lin. ft. sandstone curbing, 7 in. x 18 in., 86c; 19,800 sq. yds. creosote wood block pavement, $3.37; total, $87,781; Citizens' Construction Co. 40th Ave., Fullerton Ave. to Milwaukee Ave., 12,200 lin. ft. vertical granite concrete curbing 7 in. x 9 in. x 24 in., 75c; 18,500 sq. yds. brick pavement, $2.22; total, $56,520; Smith & Brown Co. Alley, Hermitage Ave., Polk St., etc., 1,600 lin. ft. concrete curbing, 15c; 1,250 sq. yds. brick pavement, $2.27; total, $3,377.50; alley, Potomac Ave., Oakley Ave., etc., 1,220 lin. ft. concrete curbing, 15c; 950 sq. yds. brick pavement; total, $2,696.50; Central Paving Co. Alley, Elburn St., Laflin St., etc., 1,200 lin. ft. concrete curbing, 15c; 680 sq. yds. brick pavement, $2.37; total, $2,016.60; Central Paving Co. Alley, Ashland Ave., Madison St., etc., 1,220 lin. ft. concrete curbing, 20c; 950 sq. yds. brick pavement, $2.66; Jas. A. Sackley Co., 133 W. Washington St. Alley, Polk St., Laflin St., etc., 2,140 lin. ft. concrete curbing, 15c; 1,570 sq. yds. brick pavement, $2.27; Central Paving Co. Alley, Carroll Ave., Armour Pl., 750 lin. ft. concrete curbing, 15c; 500 sq. yds. brick pavement, $2.39; total, $1,457.50; Central Paving Co. Alley, Van Buren St., Halsted St., etc., 970 lin. ft. concrete curbing, 15c; 770 sq. yds. No. 2 granite block pavement, $3.71; total, $3,002.20; John Dillon, 179 W. Washington St. Alley, California Ave., Francisco Ave., Madison St., etc., 1,220 lin. ft. concrete curbing, 15c; 950 sq. yds. brick pavement, $2.29; total, $2,771; Central Paving Co. Waller Ave., Augusta St. to Division St., 2,650 lin. ft. granite concrete combined curb and gutter, 65c; 3,970 sq. yds. asphalt pavement, $1.81; American Asphalt Paving Co., 133 W. Washington St. Buffalo Ave., 133d St. to 136th St.; Superior Ave., 132d St. to 136th St.; 132d St., Ontario Ave. to Superior Ave.; 133d St., Ontario Ave. to Pennsylvania R. R.; 134th St., Ontario Ave. to Buffalo Ave.; 135th, Ontario Ave. to Buffalo Ave.; 136th St., Howard Ave. to Buffalo Ave.; 15,970 lin. ft. sandstone curbing 7 in. x 18 in., 75c; 23,770 sq. yds. asphaltic macadam, $1.21; total, $45,481.20; A. J. McAlister, 1542 W. Garfield Blvd. The work includes 6-in. Portland cement concrete foundation, earth cutting or filling, sewer, manhole and catch basin construction and adjustment. E. J. Glackin, Secretary of Board.

Indiana.

✣Bids will be received until noon, March 3, by Board of Ripley County Commissioners, Versailles, Ind., for the construction of a macadam road in Adams Township. J. Francis Lochard is County Auditor.

✣Bids will be received until 10 a. m., March 3, by Board of Hendricks County Commissioners, Danville, Ind., for the construction of a gravel road in Franklin Township. Lewis W. Borders is County Auditor.

✣Bids will be received until 10 a. m., March 3, by Board of Clark County Commissioners, Jeffersonville, Ind., for the construction of a macadam or crushed rock road from Sellersburg and New Albany road to Jeffersonville Township line. George E. Stoner is County Auditor.

✣Bids will be received until 10 a. m., March 3, by Board of Tipton County Commissioners, Tipton, Ind., for the construction of a gravel road in Prairie Township and free macadam road in Cicero Township. J. H. Tranbarger is County Auditor.

✣Bids will be received until March 3, by Board of Blackford County Commissioners, Hartford City, Ind., for the construction of two roads. James Cronin, Jr., is County Auditor.

✣Bids will be received until 10 a. m., March 4, by Board of Howard County Commissioners, Kokomo, Ind., for the construction of two gravel roads in Center Township. R. B. Swift is County Auditor.

✣Bids will be received until 2 p. m., March 6, by Board of Harrison County Commissioners, Corydon, Ind., for the construction of gravel roads in Harrison and Heth Townships. J. L. O'Bannon is County Auditor.

✣Bids will be received until 2 p. m., March 3, by Commissioners of Johnson County, Franklin, Ind., for the construction of a stone road 15,010 ft. in length. H. L. Knox is County Auditor.

✣Bids will be received until 3 p. m., March 3, by Board of Spencer County Commissioners, Rockport, Ind., for the construction of a highway in Ohio Township. J. T. Stevenson is County Auditor.

✣Bids will be received until 2 p. m., March 4, by Board of Rush County Commissioners, Rushville, Ind., for the construction of one brick and macadam road and one water-bound and bituminous macadam roadway in Rush-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ville Township. Allen R. Holden is County Auditor.

✣Bids will be received until noon, March 4, by Board of Morgan County Commissioners, Martinsville, Ind., for the construction of a gravel road in Jackson Township. J. S. Whitaker is County Auditor.

✣Bids will be received until 10 a. m., March 4, by Board of Montgomery County Commissioners, Crawfordsville, Ind., for the construction of a gravel road in Union Township. B. B. Engle is County Auditor.

✣Bids will be received until 2 p. m., March 4, by Board of Knox County Commissioners, Vincennes, Ind., for the construction of gravel roads in Steen and Vincennes Townships. J. T. Scott is County Auditor.

✣Bids will be received until 10 a. m., March 4, by Board of Cass County Commissioners, Logansport, Ind., for the construction of a macadam road in Eel Township. J. E. Wallace is County Auditor.

✣Bids will be received until 2 p. m., March 4, by Board of Greene County Commissioners, Bloomfield, Ind., for the construction of a macadamized road in Wright Township. C. H. Jennings is County Auditor.

✣Bids will be received until 2 p. m., March 4, by Board of Grant County Commissioners, Marion, Ind., for the construction of a stone road in Center Township. E. H. Kimball is County Auditor.

✣Bids will be received until noon, March 4, by Board of Pulaski County Commissioners, Winamac, Ind., for the construction of a gravel road on line between Van Buren and Indian Creek Townships. W. E. Munchensburg is County Auditor.

✣Bids will be received until noon, March 4, by Board of Pulaski County Commissioners, Winamac, Ind., for the construction of a gravel road in Beaver Township. W. E. Munchenburg is County Auditor.

✣Bids will be received until 1 p. m., March 4, by Board of Lawrence County Commissioners, Bedford, Ind., for the construction of two gravel roads in Spice Valley Township. Ezra W. Edwards is County Auditor.

✣Bids will be received until 2 p. m., March 4, by Board of Orange County Commissioners, Paoli, Ind., for the construction of a gravel road in Stampers Creek Township. E. A. Palmer is County Auditor.

✣Bids will be received until 10 a. m., March 4, by Board of Adams County Commissioners, Decatur, Ind., for the construction of macadamized roads in Blue Creek, Preble, Hartford, Monroe, Washington, St. Mary and Root Townships. T. H. Baltzell is County Auditor.

⊙Shafer & Browning have been awarded the contract by the Board of Wabash County Commissioners, Wabash, Ind., for the construction of a gravel road known as Engleman road, on the line between Wabash and Miami Counties, for $16,800. Bids were opened Feb. 6.

⊙W. A. Hendricks of Terre Haute, Ind., has been awarded the contract by the Board of Vigo County Commissioners, Terre Haute, for the construction of the Bucker road in Lost Creek and Harrison Townships, for $3,495. S. L. Rhyan of Vermilion, Ill., secured the contract to construct the C. C. Rhyan gravel road in Fayette Township for $1,550. Bids were opened Feb. 8.

⊙The Perry County Commissioners, Cannelton, Ind., have awarded the contract for constructing 18 miles of rock road in that county to Frank S. Paulin & Co. of Cannelton, for $64,600. This road is to radiate in three directions form the county seat.

⊙The Clark County Commissioners, Jeffersonville, Ind., have awarded contracts to Clyde J. Sigman, Memphis, Ind., and Martin F. O'Neil, Jeffersonville, Ind., for the construction of two macadam roads in that county.

⊙The Montgomery County Commissioners, Crawfordsville, Ind., have awarded contracts for the construction of three roads as follows: John H. Smith gravel road, Franklin Township, to O'Connor Bros., Crawfordsville, $5,202; John D. Smith stone road, Scott Township, to V. B. Nowling, Rockville, Ind., $3,893; Frank Graves, gravel road, Union Township, to O'Connor Bros., $6,792; H. Clay Reeves stone road, Brown Township, to N. F. Scribner, $5,500; James S. Miles stone road, Brown Township, to Snyder & Barnett, Frankfort, Ind., $10,874; William C. Gray stone-binder road, Union Township, to J. A. Hardin, Pendleton, Ind., $19,337.

⊙George H. Palmer of Logansport, Ind., has been awarded the contract by the County Commissioners, Logansport, for the construction of the Porter road, for $8,826. Martin McHale of Logansport secured the contract to construct the Leffel road, for $21,524.

⊙J. J. Kelleher & Co. of Frankfort, Ind., have been awarded the contract for the construction of two miles of brick pavement in Warsaw, Ind., this summer. The estimated cost is $45,000.

The Board of Public Works of Evansville, Ind., has passed preliminary resolutions for the paving of Walnut St., from Morris Ave. to Kentucky Ave.; Grand Ave., from Powell to Green River road, Chestnut St., from Fourth to Eighth; Carpenter St., and the Second Ave. haymarket. Harry C. Weber is City Clerk.

Iowa.

✣Bids will be received until 7 p. m., Feb. 25, by S. W. Crowell, City Clerk, Algona, Ia., for the construction on streets included in Districts Nos. 1, 2, 3 and 4 24,000 sq. yds. of permanent pavement, 5,000 sq. yds. of which will be on 4-in. concrete base and the remainder on 5-in. base; also for the construction of 14,300 lin. ft. of curbing. A certified check for $500 must be filed with each bid for paving and a check for $200 must accompany each bid for the curbing. Theodore S. DeLay, Creston, Ia., is Engineer.

✣Bids will be received until 3 p. m., Feb. 24, by City of Belle Plaine, Ia., for brick, asphaltic concrete, cement concrete, or dolarway. C. P. Chase, Iowa Engineering Co., Clinton, Ia., is Engineer.

✣Bids will be received until March 19, by Washington, Ia., for the construction of approximately 12,000 sq. yds. of paving. Bids will be received on Dolarway coated concrete. Charles P. Chase, Iowa Engineering Co., Clinton, Ia., is Engineer.

✣Bids will be received until March 25, by Mount Vernon, Ia., for the construction of approximately 1 mile of paving. Bids will be received on brick, wood block, asphalt, plain concrete or bituminous coated concrete. C. P. Chase, Iowa Engineering Co., Clinton, Ia., is Engineer.

⊙Bids were received Feb. 11 by the City Council of Clinton, Ia., J. G. Thorne, City Engineer, for paving as follows: (a) Thos. Carey & Sons, Clinton, Ia.; (b) Ford Paving Co., Cedar Rapids, Ia.; (c) McCarthy Improvement Co., Davenport, Ia.; (d) John Fey, Davenport, Ia.; (e) Miller & Ladehoff, Clinton, Ia.; (f) C. H. Hubble, Davenport, Ia. (awarded to Thos. Carey & Sons, Clinton, Ia., vitrified block paving):

	Vitrified block paving.	A	B	C	D	E
17,600	Sq. yds vitrified block paving	$ 1.80	$ 1.83	$ 1.96	$ 2.00	$ 2.15
2,000	Lin. ft. com. curb and gutter, 10-in. face	.70	.70	.69	.70	1.00
6,300	Lin. ft. com. curb and gutter, 7-in. face	.70	.70	.67	.68	.95
16	Catch basins	25.00	25.00	30.00	40.00	30.00
150	Lin. ft. vitrified catch basin pipe	.40	.50	.40	.85	.50
100	Cu. yds excess grading	.50	.50	.50	.60	.50
3	Adjusting adjacent pavements	10.00	8.00	7.50	10.00	8.00
	Asphalt paving.	A	C			
17,500	Sq. yds. asphalt paving	$ 1.745	$ 1.90			
120	Sq. yds. vitrified block paving	2.00	2.05			
2,000	Lin. ft. com. curb and gutter, 8-in. face	.70	.68			
6,300	Lin. ft. com. curb and gutter, 6-in. face	.70	.66			
16	Catch basins	25.00	30.00			
150	Lin. ft. vitrified catch basin pipe, 10-in	.40	.40			
100	Cu. yds. excess grading	.50	.50			
3	Adjusting adjacent pavements	10.00	7.50			
	Concrete paving.	A	B	D	E	F
19,600	Sq. yds. concrete paving	$ 1.10	$ 1.13	$ 1.10	$ 1.35	$ 1.29
120	Sq. yds. vitrified block paving	2.00	2.10	2.10	2.15	1.96
8,300	Lin. ft. 24-in. curb	.43	.55	.42	.65	.37
16	Catch basins	25.00	25.00	40.00	30.00	35.00
150	Lin. ft. 10-in. catch basin pipe	.40	.50	.85	.50	.65
3	Adjusting adjacent pavements	10.00	8.00	10.00	8.00	7.00
100	Cu. yds. excess grading	.50	.50	.60	.50	.60
	Dolarway paving.	A	B	C	D	E
19,600	Sq. yds. Dolarway paving	$ 1.175	$ 1.13	$ 1.50	$ 1.40	$ 1.65
120	Sq. yds. vitrified block paving	2.00	2.10	2.05	2.10	2.15
8,300	Lin. ft. 6x18-in. curb	.40	.48	.40	.35	.55
16	Catch basins	25.00	25.00	30.00	40.00	30.00
150	Lin. ft. 10-in. catch basin pipe	.40	.50	.40	.85	.50
3	Adjusting adjacent pavements	10.00	8.00	7.50	10.00	8.00
100	Cu. yds. excess grading	.50	.50	.50	.60	.50

⊙Dunnegan & Hamilton, of Shenandoah, Ia., have been awarded the contract by the city of Corning, Ia., W. C. Chubb, City Clerk, for grading, paving, curbing and guttering parts of Adams St., Davis Ave., Loomis Ave., Seventh St., Eighth St., 10th St. and Grove Ave., for $1,83½ per sq. yd., on brick, and $0.70 per ft., on combined curb and gutter. Bids were opened Feb. 11. T. S. DeLay, Creston, Ia., is Engineer.

⊙Thos. Carey & Sons, Clinton, Ia., have been awarded the contract by the City Council of Clinton, C. J. Reusche, City Clerk, for the paving of Fifth Ave., from Fifth St., to Bluff Blvd., for $38,030. The work includes 17,600 sq. yds. of vitrified block, 8,300 lin. ft. of combined curb and gutter, 16 catch basins, 150 lin. ft. of 10-in. vitrified pipe. Bids were opened Feb. 11.

City Engineer of Grundy Center, Ia., is preparing plans and specifications for the paving of certain streets of the town.

The City Council of Sac City, Ia., is considering a resolution for the paving of Main St., a distance of 14 blocks, and Fifth St., south from the Milwaukee track, a distance of over five blocks. W. A. Blakeslee is official in charge of streets.

The town of Rock Rapids, Ia. (population 2,005), contemplates laying a considerable amount of concrete pavement this year.

The Iowa Engineering Co., Chase Block, Clinton, Ia., has prepared plans and specifications for plain concrete paving at Clarence, Ia. Contract to be let some time in March.

Kansas.

⊙The City Council of Atchison, Kans., has awarded the following contracts for paving work: 14th St., Utah Ave. to Atchison St., with brick, to E. W. Geiger Construction Co., of Leavenworth, for $12,547 for a single course on 4-in. of crushed stone, sand filler for the brick; 11th St., from Parallel to Kearney, with concrete, to J. W. Kelso, of Parsons, Kans., for $2,894; North Terrace, Kansas Ave. to Santa Fe St., with one course of brick on crushed rock, sand filler, to Geiger Construction Co. of Leavenworth, Kans., for $2,915; alley in block 74, with concrete, to J. W. Kelso of Parsons, Kans., for $714; alley in block 15, with concrete, to J. W. Kelso, $671; Kansas Ave., with one course of brick, to J. W. Kelso, for $1,096; filling Seventh St., Commercial to Main, all bids rejected because they were above the estimate, low bid being Land Construction Co., $5,372.

Louisiana.

The St. Mary Police Jury, Franklin, La., has decided to bond the parish to the amount of $300,000 for the construction of good roads.

Maryland.

✣Bids will be received until noon, Feb. 27, by the State Roads Commission, William L. Marcy, Secretary, 534 North Howard St., Baltimore, Md., for building 13 sections of state highway aggregating about 35.60 miles in length and 2 concrete bridges as follows: Baltimore County—One section along the York road, from city limits to Lyman Ave., about 1.33 miles in length (granite block in track space, bitumen macadam on concrete base for remainder of roadway); One section along the York road, from Lyman Ave. to Towson, about 2.62 miles in length (macadam); Carroll County—One section along the road from Cranberry to Mexico, about 1.08 miles in length (macadam); One section along the road from Manchester, southerly toward Mexico, about 1.46 miles in length (macadam); Cecil County—One section along the road from Elkton to Chesapeake City, about 4.60 miles in length (macadam); Charles County—One section along the road from T. B. to Charles county line, about 3 59 miles in length (concrete); One section along the road from District of Columbia line to Meadows, about 4.71 miles in length (concrete); Kent County—One section along the road from Locust Grove to Galena, about 2 miles in length (macadam); Montgomery County—One section along the road from Cedar Grove toward Damascus, about 2.12 miles in length (macadam); One section along the road from Friendship to Howard county line, about 2 miles in length (macadam); Somerset County—One section along the road from Marion to Crisfield, about 3.09 miles in length (macadam); St. Mary's County—One section along the road from Mechanicsville to Charles county line, about 5 miles in length (gravel surfacing); Talbot County—One section along the road from Easton to Wye Mills, about 2 miles in length (macadam); Frederick County—Two 25-ft. span reinforced concrete bridge, on the Emmitsburg turnpike; Harford County—Two 30-ft. span reinforced concrete bridge, over Winter's run on Belair pike.

Massachusetts.

The Selectmen of Yarmouth, Mass., on Feb. 10 appropriated $3,700 for a public park on the south shore and $500 to experiment in electric lighting; also $5,000 for a new macadam road in Englewood. Luther R. Brown is chairman of Board of Selectmen.

Michigan.

✣Bids will be received until 4 p. m., March 3, by A. A. Devantier, City Clerk, Mt. Clemens, Mich., for paving a number of streets.

Minnesota.

⊙The Republic Creosoting Co., Minneapolis, Minn., has secured the contract for furnishing 3½-in. creosoted wood paving blocks, for $1.40 and 4-in. blocks for $1.60. The total of the contract is estimated at $270,000 on the basis of 175,000 sq. yds. of paving. K. E. Alexander is Purchasing Agent.

According to advices from Hibbing, Minn., Township Engineer Pryor has presented to the Town Board of Stuntz Township his estimate for new town roads and road repairs and improvements for the year 1913. The report calls for a total expenditure estimated at $94,000.

The City Council of Winona, Minn., will hold a hearing Feb. 17 on the proposed paving of W. Fifth St., from Main to Olmstead and the connecting streets of Johnson, Washington, Winona and Huff between Fourth and Fifth Sts.

Mississippi.

✣Bids will be received until 2 p. m., March 5 by J. A. Tyson, Chancery Clerk, Noxubee County, Macon, Miss., for the construction of about 13 miles of gravel road in District No. 5 including 40,000 yds. of earth.

⊙The Worthington Construction Co., of Brookhaven, Miss., has been awarded the contract for the construction of about nine miles of gravel roads in Supervisors' District No. 3, Clay County, Miss., for which $41,000 is available. Work is to begin within 30 days. Charles Lyon Wood, Columbus, Miss., is Engineer. West Point, Miss., is the county seat of Clay County.

W. R. Pistole, Clerk of the Chancery Court of Lauderdale County, Meridian, Miss., will sell bonds amounting to $100,000 for good roads construction in District No. 1 on March 5.

New petitions are being circulated asking the Board of County Supervisors, Laurel, Miss., to authorize a bond issue for good roads in Beat No. 2, in which Laurel is located. It is said that citizens of Beat No. 3 will also present a petition for road bonds at the March meeting of the Board.

Missouri.

✣Bids will be received until Feb. 28, it is reported, by the Board of Public Improvements. St. Louis, Mo., Maxime Reber, President, for the improvement and reconstruction of the following alleys: Improvement—From Sidney to Victor and between Jefferson and Texas, $1,595; from Illinois to Missouri and between Utah and Withnell, $1,325; between Spring, Vandeventer, Magnolia and Botanical, $2,626; between Etzel, Julian, Blackstone and Goodfellow, $2,076; from Vandeventer to Warne and between Palm and Natural Bridge. $2,526; between Hartford, Arsenal, Morgan Ford road and Alfred, $2,451; from Rosedale eastward, 600 ft. and between Berlin and St. Louis, Kansas City and Colorado R. R., $1,348; from Gustine to Russell and between Wyoming and Connecticut, $2,821; between Wyoming, Connecticut, Bent and Morgan Ford road, $3,697; from Clara to Goodfellow and between Theodosia and Cote Brilliante, $5,269; between Meramec, Gasconade, Compton and Virginia, $3,544; between Castleman, Shaw Klemm and Tower Grove, $2,147; from Russell to Oak Hill and between Hartford and Arsenal, $2,532; between Wells, Easton, Laurel and Rowan, $2,493; between De Giverville, Westminster, Laurel and Hamilton, $3,789; between Cottage, Kennerly, Cora and Marcus, $3,007; from Clara to Goodfellow and between North Market and Spalding, $4,876; between Cottage, Lincoln, Spring and Prairie, $2,298; between Itaska, Neosho, Idaho and Alaska, $4,770; from Alabama to Colorado and between Wilmington and Fillmore, $2,130; between Russell, Lesperance, Third and Broadway, $526; from Boyle to Newstead and between Duncan and Forest Park, $4,339. Reconstruction—From 20th to 22nd and between Cass and Mullanphy, $3,246; from Russell to Lesperance and between Third and Broadway, $1,285; from Beaumont to Leffingwell and between Morgan and Franklin, $1,721; from Mullanphy southward 254 ft. and between 12th and 13th, $1,201; between Convent, Chouteau, Third and Fourth, $2,735; from 19th east to a line 100 ft. west of and parallel to 15th and between N. Market and Benton, $3,197; from 14th to 19th and betwen Sullivan and Hebert, $1,999.

⊙Following contracts for paving work have been awarded by the Board of Public Improvements of St. Louis, Mo., Maxine Reber, President: F. P. McCormick, 4500 Duncan Ave., St. Louis: Abner Pl., $9,517; William Pl., $9,264; Arkansas, $10,886; Carrie, $11,481; Labadie, $4,345. Ruecking Const. Co., Marine and Gasconade St., St. Louis: Idaho, $9,799; Gravois, $13,598; Carter, $27,417. Sprainka Const. Co., Security Bldg., St. Louis; Natural Bridge, $29,512; Hebert, $21,086; Glasgow, $4,369. John McMahon, 20th and Farragut St., St. Louis: Penrose, $5,814. Perkinson Bros. Const. Co., Carter and Peck St., St. Louis: 22d, $5,496; Newby, $14,609. Granite Bituminous Paving Co., Pierce Bldg., St. Louis: Maffitt, $12,901. Trinidad Asphalt Paving Co., DeMenil Bldg., St. Louis: Delor, $7,732. E. R. Schinier, St. Louis County, Mo., St. Louis: Bowman, $1,574. Hanick Quarry & Const. Co., Euclid and Ashland Ave., St. Louis: Prairie, $2,592; Bessie, $7,701. Bambrick Bros. Const. Co., St. Louis Ave. E. of Union, St. Louis: Mullanphy, $21,593. Eyermann Const. Co., Grand and Hickory St., St. Louis: Meramec, $10,841; Duncan, $13,427; Virginia, $5,970. Timothy E. Cavanagh, 180 Union Blk., St. Louis: Lexington, $8,075; Natl. Bridge, $24,479. John B. Turner, Pierce Bldg., St. Louis: Billon, $28,744.

The citizens of Center Township, Vernon County, Mo., at a recent election voted the issuance of bonds to the amount of $20,000 for the construction of rock roads. Nevada is the county seat.

The Commissioners of Campbell Special Road District, Greene County, Mo., have decided to call an election for the purpose of voting on the issuance of bonds to the amount of $10,000 for the construction of over five miles of roads. R. Steury, O. H. House and F. T. Bishop are Commissioners.

New Jersey.

Property owners on Main Ave., in the block between Grammercy Pl. and Madison Ave., Atlantic City, N. J., have appeared before the City Commission and agreed to the widening of Main Ave., from 50 to 100 ft.

New York.

✣Bids will be received until 1 p. m., Feb. 24, by Frank E. Bogardus, Onondaga County Superintendent of Highways, Syracuse, N. Y., for the construction of the Baldwinsville-Little Utica-Phoenix County road 9.36 miles in length. Plans are on file with the County Superintendent.

⊙The Board of Contract & Supply of Yonkers, N. Y., has awarded contracts for street improvements as follows: Regulating and grading Devoe Ave., from McLean Ave. to Wendover road, John O. Weston, $24,242; regulating and grading Merriam Ave., from Bronxville road to Dana Ave., Cianfaglione, $11,983.

⊙A. L. Guidone of New York City has been awarded the contract for building the 38 miles of pavement about the Ashokan dam and its approaches, New York City, for $1,301,000.

Following bids were received Feb. 10 by the Board of Contract & Supply of Syracuse, N. Y., for the paving of Beverly road: Vitrified brick, Warner-Quinlan Co., $8,254; asphalt, $7,899.

Ohio.

✣Bids will be received until 11 a. m., March 12, by Board of Cuyahoga County Commissioners, Cleveland, O., for the improvement of Station road, from Brecksville Cemetery to B. & O. R. R. station, Brecksville Township, in accordance with the form of contract and specifications to be furnished by Frank R. Lander, county surveyor. A certified check for $1,000 must be filed with each bid. J. F. Goldenbogen is Clerk of the Board.

✣Bids will be received until noon, Feb. 21, by V. T. Price, Director of Public Service, Cincinnati, O., for the improvement of Eastern Ave. from the first angle east of Delta Ave. to the old corporation line of Linwood, by grading, resetting curbs, repaving granite and constructing the necessary drains, inlets and retaining walls. Plans, specifications and blank proposals can be obtained at the office of the Chief Engineer, Department of Public Service. Each proposal must be accompanied by a bond in the sum of $8,000 or a certified check on a solvent bank. M. J. Keefe is Clerk.

✣Bids will be received until noon, Feb. 21, by V. T. Price, Director of Public Service, Cincinnati, O., for the improvement of Eastern Ave., from Philadelphia St. to Ferry St., excepting the portion to be construeted at Rookwood Crossing, in connection with the grade crossing elimination work, by grading, resetting curbs, paving the portion of the roadway occupied by tracks with the best of the old granite blocks, paving the sides with new granite blocks, and constructing the necessary drains, inlets and retaining walls. Plans, specifications and blank proposals can be obtained at the office of the Chief Engineer, Department of Public Service. Each proposal must be accompanied by a bond in the sum of $11,000, or a certified check on a solvent bank.

✣Bids will be received until 11 a. m., March 19, by Board of Cuyahoga County Commissioners, Cleveland, O., for the improvement of Barton Road from Coe Ridge Road to the county line in Olmsted Township, in accordance with plans and specifications to be fur-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

nished by F. R. Lander, County Surveyor. A certified check for $1,000 must be filed with each bid. J. E. Goldenbogen is Clerk of the Board.

✣Bids will be received until noon, March 19, by Pultney Township Trustees, at the office of W. J. Campbell, Township Clerk, Union St., Bellaire, O., for the construction or resurfacing of the pikes: The Rock Hill Pike, between the City of Bellaire and the Pultney Township line; The Bellaire and Neff Pike, between the City of Bellaire and the Pultney Township line; The Brooks Run Pike, between the City of Bellaire and the Township line, a total distance of 15,508 miles, all in Pultney Township. Bids will be received on bituminous macadam and Glutrin macadam and asphalt macadam, as specified in the specifications, and must be made out on blanks furnished gratuitously on application. Bids must be accompanied by a certified check on some solvent bank in the sum of $500. Plans and specifications may be seen at the office of the Township Clerk or at the office of D. A. Elkin, Engineer, Zweig Bldg., Bellaire, Ohio. Official advertisement will be found in this issue.

✣Bids will be received until noon, March 11, by D. H. Warner, Director of Public Service, Sidney, O., for paving with sheet asphalt, asphalt block, vitrified brick, bitulithic, asphaltic concrete, or plain concrete, certain streets and alleys in said city, together with drainage for same, containing approximately 35,190 cu. yds. grading, 66,327 sq. yds. paving, 27,476 lin. ft. curbing, 8,749 lin. ft. sewers, 8-in. to 24-in. Each bid must be accompanied by certified check. Plans and specifications can be seen and forms of proposals obtained at the office of the Director of Public Service or the Engineers, The Smith & Boulay Co., 322 The Nasby, Toledo, O. Official advertisement will be found elsewhere in this issue.

⊙P. Freshwater of Cleveland, O., has been awarded the contract to grade, curb and flag S. Harrison Ave., from W. Tuscarawas St. to Maiden Lane, in Canton, O., for $19,583.

⊙The White Co. of Cleveland, O., has been awarded the contract by Charles W. Stage, Director of Public Safety, Cleveland, O., for furnishing and delivering an automobile truck for Cooley farms, Warrensville, O., at $1,935. Bids were opened Feb. 13.

⊙Chas. Kuhl Artificial Stone Co., Cincinnati, O., has been awarded the contract by V. T. Price, Director of Public Service, Cincinnati, for the construction of cement sidewalks and appurtenances in Sidewalk Districts Nos. 1, 2, 3 and 4 for the season ending Dec. 31, 1913. Bids were opened Feb. 7.

⊙Houston & Henderson of New Concord, O., have been awarded the contract by the Village Council of New Concord, for the paving of Main St., with brick, for $31,000. Bids were opened Feb. 14.

⊙Graham & Kinneas, 1000 Hartman Bldg., Columbus, O., have been awarded the contract by C. E. Mark, Director of Public Service, Washington, O., for furnishing the necessary labor and materials for the improvement of Rawling St., from North St. to Delaware St., by grading and paving the roadway 26 ft. wide with hard burned paving brick and constructing the necessary sub-drains and catch basins and curbing in the city. Bids were opened Feb. 1.

⊙Robinson Co., 4250-4268 N. 20th St., St. Louis, Mo., has been awarded the contract by G. F. Koehler, Director of Public Safety, Canton, O., for changing a chemical wagon belonging to the fire department of the city into an auto chemical and supply wagon, for $4,450. Bids were opened Feb. 4.

⊙D. A. Phillips, N. Main St., Ashland, O., has been awarded the contract by the Board of Trustees of Sullivan Township, Ashland County, Ohio, Maurice Fink, Clerk, Sullivan, O., for the construction of five miles of macadam road in that township, for $25,500. Bids were opened Feb. 12.

⊙The Board of Control of Youngstown, O., has awarded the contracts for the North and South Main St. paving as follows: North Main St., James Diguida, of Niles, O., $19,830; South Main St., Martin P. Connelly & Son, of Youngstown, $16,116.

⊙According to advices from Newton Falls, O., The Kennedy Co. has been awarded the contract for the construction of six miles of macadam road east to Craver's corners, south to the River St. school corners and east of of the East River and southeast to the German Lutheran church, for $10,840.

An ordinance has been introduced in the City Council, Cleveland, O., authorizing Service Director W. J. Springborn to expend $25,000 for paving at Shaker Lakes.

The estimated cost of paving the various streets now under consideration by the City Council, St. Marys, O., is as follows: Spruce St., between L. E. & W. and T. & O. C. railroads, $24,000; Walnut St., one block between Spring and High, $2,500; Chestnut St., between Spring and High, $2,500; Main St., one block between Spring and High, $4,500; South St., two blocks, $6,000. Ferd. Keuthan is City Engineer.

City Engineer George Arnold of Canal Dover, O., is preparing plans and estimates for the paying of Tuscarawas Ave., a distance of approximately 11 miles. The engineer will also prepare plans and specifications for paving on Front St., from the Wooster Ave. bridge to the corporation line.

The City Council of Hamilton, O., has adopted plans for the paving of Greenwood Ave., from Heaton St., to the gates of St. Stephen's cemetery and for the paving of Walnut St., from Front St., to Central Ave. Plans are now on file with City Clerk E. C. Shafor for paving work amounting to approximately $180,000. F. E. Weaver is City Engineer.

City Engineer F. E. Weaver of Hamilton, O., has been instructed to prepare plans for the paving of five more streets.

The City Council of Cambridge, O., has instructed City Engineer Karl M. Cosgrove to draw plans for the paving of Fifth St., from Steubenville Ave., to the city limits.

A special election is to be held in Croton, O., on March 10 for the purpose of voting on the issuance of bonds to the amount of $16,423 for street paving.

The citizens of Milton Township, Mahoning County, O., at a recent election voted the issuance of bonds to the amount of $10,000 for the construction of good roads. Youngstown is the county seat.

Oregon.

✣The City Council of Portland, Ore., will receive bids until Feb. 26 for the improvement of the Thompson St. District in Rossmere by constructing pavement. Montague-O'Reilley Co. recently submitted the low bid of $107,280 for this work but it was rejected owing to a technical error.

✣Bids will be received until March 11, by Dalles City, Ore., for 30,000 sq. yds. of pavement of bitulithic, asphaltic concrete, dolarway or Hassam. Further information can be obtained with proposal blanks from C. L. White, City Engineer.

⊙The City Council of Portland, Ore., on Feb. 9 awarded contracts for street improvements as follows: Saratoga Ave. district: Grading and concrete curbs and walks—Carter Bros., $36,559; Yukon Ave., from Miuwaukie to East 14th: Macadam pavement—Keenan Bros., $4,316; East 19th St., from Clinton to Powell: Gravel bithulithic—Pacific Bridge Co., $10,601; East 30th St., from Shearer's Addition to Division St.: Gravel bitulithic—Pacific Bridge Co., $10,267.

The City Council of Portland, Ore., proposes to construct hard-surface pavements for all streets in Central East Portland between Division St., on the south to East Davis St., on the north and between and including Union Ave., and East 12th St. The district will include between 10 and 15 miles of hard-surface pavements and the cost will be about $1,000,000. Tom. Hurlburt is City Engineer.

The City Council of Hood River, Ore., will probably employ an engineer to aid the street committee in selecting material for the improvement planned for the business district the coming summer. The Council contemplates laying pavements on all the chief thoroughfares of the city. P. M. Morse is City Engineer.

Pennsylvania.

✣Bids will be received until noon, Feb. 25, by George W. Norris, Director, Department of Wharves, Docks and Ferries, 555 Bourse Bldg., Philadelphia, Pa., for wood block paving and general repairs to the pier at the foot of Chestnut St., on the Delaware River. Plans and specifications may be obtained at the office of the Director.

The Common Council of Reading, Pa., has passed an ordinance providing for a loan of $100,000 to be used in street paving and improvement.

South Dakota.

The town of Wolsey, S. Dak. (population 436), plans the construction of cement sidewalks and the grading of the streets this summer.

Tennessee.

✣Bids will be received until 1 p. m., March 10, by Pike Road Commission of Sullivan, W. D. Lyon, Chairman, Bluff City, Tenn., for grading and macadamizing about 50 miles of road. Plans and specifications are on file with C. M. Dulaney, County Engineer, Blountsville, Tenn.

Texas.

✣Bids will be received until March 10, by Commissioners' Court of Matagorda County, at the office of W. C. Lloyd, Clerk, Matagorda County, Bay City, Texas, for the purpose of purchasing 20,000 cu. yds. of mudshell, to be delivered at Palacios, Matagorda County, Tex., beginning not later than the 1st day of April, A. D. 1913, and of the following specifications: Mudshell specifications.—The mudshell must be of the best quality to be obtained from the shell reefs in the region of Dog Island and Tiger Island, near the mouth of the Colorado River, in Matagorda County, Tex., and shall contain not less than 5 per cent and not over 15 per cent of blue muck, or bottom ooze, and at least 60 per cent shall be of hard, sound shell not less than 2½ ins. in their longest dimensions, prices quoted upon the delivery of the shell to be as follows: (1) In wagons at the wharves at Palacios, Matagorda County, Tex. (2) Or on the wharves at Palacios, Matagorda County, Tex., without delivery in wagons.

✣Bids will be received until noon, March 3, by Dan C. Smith, Jr., City Secretary, Houston, Texas, for the grading and the paving of Holman Ave., between its intersection with the east line of Main St. and its intersection with the east line of Crawford Sts., with creosoted wood block as prayed for in petition and in accordance with the specifications adopted by the City Council. Each must be accompanied by a certified check on any bank in the city of Houston for 10 per cent of the cost of constructing said pavement, said check being made payable to H. B. Rice, Mayor. Specifications and all necessary information can be obtained upon application at the office of F. L. Dormant, City Engineer.

✣Bids will be received until noon, March 3, by Dan C. Smith, Jr., City Secretary, Houston, Texas, for the grading and paving of Capitol Ave., from its intersection with the east line of Caroline St. to its intersection with the west line of Chartres St., with Texaco asphalt pavement, as prayed for in petition and in accordance with the specifications adopted by the City Council. Each bid must be accompanied by a certified check on any bank in the city of Houston for 10 per cent of the cost of constructing said pavement, said check being made payable to H. B. Rice, Mayor. Specifications and all necessary information can be obtained upon application at the office of F. L. Dormant, City Engineer.

✣Bids will be received until noon, March 3, by Dan C. Smith, Jr., City Secretary, Houston, Texas, for the grading and the paving of Lamar Ave., between its intersection with the west line of Main St. and its intersection with

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

the east line of Milam St., with creosoted wood block as prayed for in petition and in accordance with the specifications adopted by the City Council. Each bid must be accompanied by a certified check on any bank in the city of Houston for 10 per cent of the cost of constructing said pavement, said check being made payable to H. B. Rice, Mayor. Specifications and all necessary information can be obtained upon application at the office of F. L. Dormant, City Engineer.

The citizens of Harlington, Tex., have voted to construct sidewalks throughout the town.

Bids will be received until 4 p. m., Feb. 27, by City of Abilene, Texas, for the necessary labor and material for the construction of approximately 75,000 sq. yds. of asphalt macadam pavement. Specifications, plans, etc., will be furnished on application to H. J. Bradshaw, City Engineer. P. L. Kirk is City Secretary.

The Texas Legislature on Feb. 6 passed a bill creating a more efficient road system for Harris County. Under the terms of the bill the Commissioners' Court is empowered to make rules and regulations for the construction and maintenance of public roads, bridges and drainage, and provides for the appointment of road foremen or superintendents in the various precincts.

The City Council of Houston, Tex., has ordered the paving of Austin St., between Texas and McGowen; Fannin, between McKinney and McGowen, and Leeland, between Crawford and the San Antonio and Arkansas Pass railroad tracks. Capt. J. Kennedy is official in charge of streets.

The City Commissioners of Abilene, Tex., have passed a resolution authorizing the improvements of the following streets: South First, Kirkland, Chestnut, Palm, Cherry, North Eighth, Hickory, Ambler, Oak, South Ninth, Cedar Gap Road, McLemore, North Second, Pine, Butternut and South Third. Bids for the work are now being asked by City Secretary P. L. Kirk.

The Young Men's Business League, of Thornton, Tex., has decided to ask the Commissioners' Court to order an election to determine whether or not the Thornton voting precinct shall issue $100,000 bonds for the purpose of building good roads in said precinct. Groesbeck is the county seat.

It is proposed to commence work at once on the roads of Justice precinct No. 1, Bastrop Hill's Prairie and Goodman, of Bastrop County, Tex., for which bonds to the amount of $80,000 have been sold. Bastrop is the county seat.

Washington.

⊙Agassiz & Hadley, Second Ave., Seattle, Wash., have been awarded the contract by the Bureau of Yards & Docks, Navy Dept., Washington, D. C., for grading at the Puget Sound Navy Yard, Bremerton, Wash., for $6,000. The work includes about 26,000 cu. yds.

Following bids were received Feb. 8 by the Bureau of Yards & Docks, Navy Department, Washington, D. C., for grading at the navy yard, Puget Sound, Wash.; (1) net price for work, complete; (2) net price per cu. yd. for material excavated from the high bank on the east or the northeast corner of the grounds and deposited on the westerly line of the fill: Andrew Peterson, 324 Pioneer Bldg., Seattle, Wash. (1) $7,000; (2) $0.27 cu. yd.: S. E. Baisden, 6528 Woodlawn Ave., Seattle, (1) $7,280; (2) $0.275; Eckerson Construction Co., 25 Downs Bldg., Seattle (1) $8,500: F. A. McDonald, Charleston, Wash. (1) $0.27; Agassiz & Hadley, 1,712 First Ave., South Seattle, Wash. (1) $5,980; (2) $0.23; Rufus Buck, 821 17th St., Seattle (1) $8,490; (2) $0.40; Sloane Bros., 1717 Belmont Ave., Seattle (1) $7,280; (2) $0.28.

The Board of Public Works of Seattle, Wash., on Feb. 7, received the following bids for the paving of Fremont Ave.: (1) being bid on brick block, (2) bitulithic, and (3) asphaltic concrete: Barber Asphalt Paving Co. (1). $69,719; (2) $60,928; (3) $58,343. Independent Asphalt Paving Co. (1) $71,154; (3) $63,424. B. J. McHugh Paving & Construction Co. (3) $59,082. G. DeFlong (1) $69,176; (2) $65,039; (3) $60,902. Ward & Scherer (1) $73,038; (2) $69,379. T. Ryan (1) $69,812.

The Board of Public Works of Seattle, Wash., has approved plans and specifications for the construction of 16,300 sq. yds. of concrete sidewalks on Eighth Ave. N. W. et al., to cost about $20,000. The work will also include 3,070 cu. yds. of earthwork and 67,000 ft. of lumber. A. H. Dimock is City Engineer.

Wisconsin.

It is proposed to expend $350,000 in special improvements of roads in Marinette County, on the Wisconsin side of the Menominee river, and in Menominee County, on the Michigan side, within the next two years. The Marinette county board has recommended an issue of $200,000 and will take action this month. Menominee county is soon to vote on an issue of $150,000.

Canada.

✣Bids will be received until 5 p. m., March 1, by City Commissioners at the office of J. M. Miller, City Clerk, Calgary, Alta., for the necessary materials (exclusive of crushers) required for equipping an asphalt paving plant for the city. The whole cost is not to exceed $60,000.

✣Bids will be received until noon, Feb. 27, by City Commissioners, Saskatoon, Sask., for one 1,000 lb. electric service truck. Firms tendering should supply the following information: Price delivered f. o. b. Saskatoon; guarantee; type of drive; make of motor and controller; speed in miles per hour; mileage travel on one charge; wheel base; gauge; over all length; over all width; clear loading space; height of platform loaded. Wagon to be painted red and lettered in yellow or gold as follows: "City of Saskatoon Service Wagon, Electrical Department." F. E. Harrison, Mayor, is Chairman of Commissioners.

✣Bids will be received until 11 a. m., Feb. 21, by Chairman, Board of Control, at the office of M. Peterson, Secy., Winnipeg, Man., for supply of steel casing for sand dryer, delivered f. o. b. City Asphalt Plant. Water St. Specifications and form of tender together with conditions governing tenders as prescribed by by-law may be obtained at the office of the City Engineer, 223 James Ave.

City Engineer F. L. Fellows, of Vancouver, B. C., has compiled estimates of new paving in various parts of the city, costing about $500,000, which will be submitted to the Board of Public Works for recommendation in the near future. The list includes Bridge So., from Dufferin to 16th, at a cost of $122,000; Fourth Ave., from Vine to Alma, at a cost of $183,000; and Burrard St., from Pacific to Seaton, at a cost of $104,000. The east side of Main St., from Broadway to 16th and from 18th to Main St., from Broadway to 16th and from 18th to 25th is also placed in the list, the estimate being $33,000. Other proposed pavements are Union, Campbell to Vernon, $47,000, and Commercial, Broadway to 12th, $31,000.

BRIDGES

Alabama.

Directors of the Business Men's League, Montgomery, Ala., have taken so much interest in the proposition of P. H. Ketchum and associates to pay one-half the expense of building a bridge over the Tallapoosa River at Ware's Ferry that an engineer has been employed to investigate the plausibility and the cost of the undertaking.

According to advices from Montgomery, Ala., the citizens of Elmore County and the Board of Revenue are contemplating the construction of a joint bridge connecting Montgomery and Elmore Counties.

Arkansas.

At a recent meeting at Russelville, Ark., citizens representing that city and Dardanelle a committee was appointed to draft a bill and present it to the Legislature legalizing the proposition to construct a $500,000 steel free bridge at a point half way between the towns. A. S. Hayes, Russellville, Ark., and Judge R C. Bullock, Dardanelle, Ark., are members of the committee.

California.

⊙The Board of Placer County Supervisors, Auburn, Calif., has awarded the contract for the construction of two steel and concrete bridges on the State Highway between Roseville and Lincoln to J. C. Will-Jorgenson, San Francisco, Calif., at $7,580.

The City of Anderson petitioned the Commissioners of Riverside County, Riverside, Calif., for the construction of a new bridge over White River at Ninth St.

At a recent mass meeting at Princeton, Calif., a committee was appointed to circulate petitions asking the Boards of Supervisors of Glenn and Colusa Counties to construct a bridge over the Sacramento River at Princeton.

Colorado.

The City of Denver, Colo., has commenced condemnation proceedings to acquire property rights for the new $800,000 West Colfax viaduct. O. F. Thum is City Clerk.

Connecticut.

The New York, New Haven & Hartford Railroad is planning the construction of a new bridge over the Thames River at New London a short distance north of the present structure, which will be offered to the state. The cost of the bridge contemplated will amount to about $2,000,000, it is estimated. W. H. Moore, New Haven, Conn., is Engineer of bridges for the railroad.

District of Columbia.

Advices from Washington, D. C., state that Representative Cooper of Wisconsin has introduced a bill to appropriate $2,000,000 for the construction of a Grant-Lee Memorial bridge across the Potomac River from Washington, beginning near the Lincoln Memorial, to the Arlington National Cemetery.

Georgia.

⊙The Board of Crisp County, Cordele, Ga., has awarded the contract for the construction of a steel bridge spanning Gum Creek on the national highway just north of Cordele, to Austin Bros., Atlanta, Ga.

The Grand Jury of Floyd County, Rome, Ga., has recommended an election for the purpose of voting on bonds for the construction of new bridges over the rivers at Rome. It is further recommended that the old steel structures now existing in Rome be taken by the county for creeks and rivers where they be needed.

Illinois.

✣Bids will be received up to 10 a. m., Feb. 28, 1913, at the Court House, Belleville, Ill., for the construction of one reinforced concrete bridge to be built between the towns of Prairie du Long and New Athens, St. Clair County. D. M. Fullmer, Town Clerk, New Athens, Ill. Hamill bridge—Span, 18 ft.; roadway, 18 ft.; height, 13 ft. Estimated total concrete, 65.6 cu. yds.; reinforcing steel, 6,220 pounds. Nearest railroad station, Lemington, about 2½ miles. No local concrete materials available. Present bridge wood, 12 ft. span. High water about 8 ft. deep. Excavation to be carried about 4 ft. below stream bed through clay. Average excavation, north side about 10 ft.; south side, about 13 ft. Engineer's estimate, $975. Work to be completed on or before July 1, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

✤Bids will be received up to 1:30 p. m., Feb. 28, 1913, at the Court House, Belleville, Ill., for the construction of one reinforced concrete bridge to be built in Shiloh Township, St. Clair County. Richard Schaffer, Town Clerk, O'Fallon, Ill. Merrill Bridge—Span, 20 ft.; roadway, 18 ft.; height, 16 ft. Estimated total concrete, 86.8 cu. yds.; reinforcing steel, 7,690 pounds. Nearest railroad station, Millers Siding, about 1½ miles. No local concrete materials available. Present bridge, wood, 18 ft. span. Low water flow trace; high water about 8 ft. deep. Excavation to be carried about 4 ft. below stream bed, through clay and loam. Total depth of excavation about full height of bridge. Engineer's estimate, $1,200. Work to be completed on or before July 1, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

✤Bids will be received up to 2 p. m., Feb. 25, 1913, at the Town Hall, Atkinson, Ill., for the construction of one reinforced concrete bridge to be built in Atkinson Township, Henry County. Emmett Brooks, Town Clerk, Atkinson, Ill. Swanson Bridge—Span, 60 ft.; roadway, 18 ft.; height, 17 ft. Estimated total concrete, 218.1 cu. yds.; reinforcing steel, 35,241 pounds. Nearest railroad station, Atkinson, about 3 miles; Hennepin canal, about ½ mile. It is reported that gravel from Moline or Buda may be had f. o. b. cars at Atkinson, for about $1.50 per cu. yd., or f. o. b. barge at nearest point on canal at about $1.60 per cu. yd. Present bridge, pile trestle, about 80 ft. long. Green timber for false work may be cut near the site. Excavation to be carried from 3 to 4 ft. below stream bed to rock. Average excavation, east abutment about 6 ft.; west abutment about 10 ft.; excavation loam. Engineer's estimate, $3,500. Work to be completed on or before July 1, 1913. More detailed informtaion may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

✤Bids will be received up to 1 p. m., Feb. 21, at the Town Clerk's office, Coatsburg, Ill., for the construction of one reinforced concrete bridge on reinforced concrete foundations to be built in Honey Creek Township, Adams County. Albert Brosi, Town Clerk, Coatsburg, Ill. Renken Bridge—Span, 16 ft.; roadway, 18 ft.; height finished roadway to bottom of foundations, 11 ft. Total concrete, 50.5 cu. yds.; reinforcing steel, 4,370 pounds. Nearest railroad station, Coatsburg, 1¼ miles. It is reported that gravel from Hannibal may be had f. o. b. cars at Coatsburg at $1.25 per yd. Present bridge wood, 16 ft. span. Green timber for falsework may be cut near the site. Average excavation about 7 ft., to be carried about 3 ft. below stream bed. Excavation in clay. Acceptance of any bid to be conditional upon granting of full county aid at March meeting of Adams County Board of Supervisors. Engineer's estimate, $650. Work to be completed on or before July 1, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Ill.

⊙The Commissioners of Hensley township, according to advices from Champaign, Ill., have awarded the contract for the construction of three bridges near Five Points to the Decatur Bridge Co., Decatur, Ill.

⊙L. F. McGann, commissioner public works, Chicago, Ill., has awarded to the Nash, Dowdle Co., 9 S. LaSalle St., the contract for constructing the substructure and superstructure of a re-enforced concrete bridge over the north branch of the Chicago river. The work includes construction of cofferdam, furnishing and driving piles, concrete cylinder, rubble masonry, asphalticmacadam pavement, granite concrete combined curb and gutter and sewer construction. Contract price, $49,600.

⊙Walter Parter, Mackinaw, Ill., has been awarded the contract for the construction of a bridge over Rock Creek in Mackinaw township between the villages of Mackinaw and Deer Creek, Ill. The contract price was $1,175.

At a recent election held at Springfield, Ill., the voters of Springfield township decided to issue bonds amounting to $10,000 for township's share of the cost of building three bridges.

It has been decided by the City Council of Aurora, Ill., to employ an expert engineer to inspect the New York St. bridge in order to determine whether or not it is necessary to build a new structure to replace the old one. A. M. Anderson is Chairman of the Committee on Railroads and Bridges of the Council. M. J. Tarble is City Engineer.

Stockholders of the Hamilton, Warsaw & Keokuk Bridge Co. recently held a meeting at the office of R. O. Marsh, Warsaw, Ill., and the total amount of stock subscribed was paid up. An organization was perfected by the election of the following officers: R. O. Marsh, Warsaw, president; Cornelius T. Daugherty, Hamilton, vice president; Earl Wood, Hamilton, secretary; J. M. Hungate, Warsaw, treasurer. The board of directors consists of the above officers together with W. A. Dodge and J. H. Giller. The executive committee consists of R. O. Marsh, J. M. Hungate and Earl Wood. As soon as the franchise is obtained the construction of the bridge will be commenced.

Indiana.

✤Bids will be received until 2 p. m., March 4, by Board of Jasper County Commissioners, Rensselaer, Ind., for the construction of a steel bridge in Wheatfield township, across the Akers Ditch, between Sections 12 and 13, township 32, range 6, said bridge to be built according to plans and specifications on file in the Auditor's office, same to be about 30 ft. long and 16 ft. roadway. J. P. Hammond is County Auditor.

✤Bids will be received until 2 p. m., March 4, by Board of Jasper County Commissioners, Rensselaer, Ind., for the construction of a steel bridge in Barkley township, across the Jungles Ditch, on the east and west road between sections 20 and 29, township 30, range 6, said bridge to be built according to plans and specifications on file in the Auditor's office. Same to be about 45 ft. long and 16 ft. roadway. J. P. Hammond is County Auditor.

✤Bids will be received until 2 p. m., March 4, by Board of Jasper County Commissioners, Rensselaer, Ind., for the construction of a steel bridge over Jungles Ditch, in Walker township, between sections 33 and 34, township 30 and 31, range 6, said bridge to be built according to plans and specifications on file in the Auditor's office. Same to be about 30 ft. long and 16 ft. roadway. J. P. Hammond is County Auditor.

✤Bids will be received until 2 p. m., March 4, by Board of Jasper County Commissioners, Rensselaer, Ind., for the construction of a steel bridge over Jungles Ditch in Section 17, Township 30 North, Range 6, Jasper County. J. P. Hammond is County Auditor.

✤Bids will be received until 2 p. m., March 4, by Board of Jasper County, Rensselaer, Ind., for the construction of a steel bridge over Jungles Ditch in Section 17, Township 30 North, Range 6, Jasper County. J. P. Hammond is County Auditor.

✤Bids will be received until 1:30 p. m., March 3, by Board of Washington County Commissioners at the office of Frank S. Munkelt, county auditor, Salem, Ind., for the construction of four concrete bridges.

✤Bids will be received until 2 p. m., March 3, by Board of Spencer County Commissioners, Rockport, Ind., for the construction of 60 bridges. J. T. Stevenson is county auditor.

A petition has been filed with the Auditor of Knox County, Vincennes, Ind., asking for the construction of a bridge over the White River at Manning's landing. The cost of the structure would probably amount to about $25,000.

Mayor E. M. Chester and City Engineer A. M. Smith, Elkhart, Ind., have asked the County Commissioners for an appropriation of $8,000 for the repair of several bridges. The city officials desire to floor with creatone block and otherwise repair the four bridges on N. Main St., Middleburg St., and two structures on East Franklin St.

Iowa.

⊙H. F. Volberding, Hudson, Ia., has been awarded the contract by the Board of County Supervisors, Grundy Center, Ia., for the construction of small bridges in Grundy County during the year of 1913.

⊙The Muscatine County Board of Supervisors, Muscatine, Ia., has let the contract for the bridge work to be done during the following year to the Decatur Bridge Co., Decatur, Ill.

⊙The Board of Keokuk County Supervisors, Sigourney, Ia., has awarded contracts for bridge work for the following year as follows: For labor on county bridges to Wellington Dudley; for steel, to Waterloo Construction Co.; for lumber, Greeman Lumber Co., Des Moines, Ia.

The Iowa State Highway Commission, Ames, Ia., Thomas H. MacDonald, Chief Engineer, is making detailed bridge maps of the counties in accordance with the law requiring each Board of Supervisors to maintain a report showing the exact location and dimensions of every bridge and culvert. A bridge map of Story County has just been completed and turned over to the Story board, and the Board of Polk County has been supplied with one. Field engineers of the commission are in Butler County getting data for a bridge map of that county. Plans are being made for seven bridges in Cerro Gordo County, $30,000 worth of bridges and culverts in Polk County and a $20,000 to $30,000 concrete span bridge over the Iowa River. Field engineers are in Polk making measurements.

Kansas.

It has been announced by W. S. Gearhart, State Engineer, Manhattan, Kan., that surveys will be made to determine the cost of lowering the Hunter's Island bridge. Work on the improvement of the north approach of the structure has already been started by Dan Walters of the Canton Construction Co., Canton, O., which has the contract. The new piers, on the span to be erected will be of stone, with a concrete base. The span will be a steel girder 32 ft. long.

Kentucky.

The City Commissioners of Lexington, Ky., have voted to apportion $70,000 for the construction of two viaducts, one on Main St. from Cox St. to Lexington Cemetery gate, and the other over the valley through which the Louisville & Nashville R. R. tracks run. The structure will extend from Main St. to High St., serving as an extension of Jefferson St. J. J. O'Brien is City Clerk and J. W. Guyn is City Engineer.

Massachusetts.

⊙The Board of County Commissioners, Taunton, Mass., has awarded the contract for the construction of the New Bedford-Acushnet

✤ indicates work now open for bids. ⊙ indicates a contract let recently.

bridge to W. H. Ellis, Boston, Mass., at $24,075. Bids for the structure were opened last December.

The Street and Engineering Department, Frederick H. Clark, Superintendent, has filed with the Finance Committee of the City of Springfield, Mass., an estimate of the money needed for repair and improvement of the public streets. About $595,500 will be asked for streets and bridges, of which $180,000 will be spent for permanent paving.

New plans for the construction of the proposed new central bridge at Lawrence, Mass., will be prepared at once.

Michigan.

✣Bids will be received until 1 p. m., Feb. 28, by Jacob Pearson, Town Clerk, Ironton, Mich., for the erection of the abutments of stone or concrete for the bridge ½ mile north of the town.

The City Council of Grand Haven, Mich., has accepted specifications for the improvement of the approaches to the Spring Lake Bridge and the matter will be submitted to a vote of the people at the April election. William Wilds is City Clerk.

Mississippi.

✣Bids will be received until March 3, by Board of Supervisors, Sardis, Miss., for constructing steel bridges across Long Creek, Hotopha Creek, Yarbrough & Sanders ditch and McKinney Creek. R. W. Draper is clerk.

⊙The Board of Panola County Commissioners, Batesville, Miss., has awarded the contract for the construction of three steel bridges to the Memphis Bridge Co., Memphis, Tenn., at $3,420; also a contract to the Vincennes Bridge Co., Vincennes, Ind., for one bridge at $2,200. Bids for the work were considered Feb. 3. R. W. Draper is Clerk.

Missouri.

James D. Houseman, President of the St. Louis County Belt Railroad Co., St. Louis, Mo., has applied to Congress for franchises for the construction of two bridges. Plans for the structures, one crossing the Mississippi River below the mouth of the Missouri, and the other over the Missouri River at Weldon, now await the approval of the U. S. War Department. The bridges are to form connecting links in an interurban trolley system in Missouri and Illinois that is to extend from Hannibal, Mo., to St. Louis, absorbing the Hannibal & St. Louis Railroad, and eastward to Pana, Ill., where it will connect with the Indianapolis Interurban system. The bridge over the Mississippi is to cost $1,500,000 and the Missouri River structure $900,000. The Missouri trolley system is to begin at West End Heights and extend westward to Weldon Springs and thence to Hannibal. It is to be known as the St. Louis & Western Traction Company. The eastern division will be known as the St. Louis Belt, Illinois & Eastern Traction Company, and when completed will connect St. Louis by trolley with Indianapolis.

The House of Delegates, St. Louis, Mo., passed the bill recommended by the Board of Public Improvements providing for tearing down the present 12th St. viaduct and the erection of a new structure. The new viaduct will be of steel and concrete and will come to grade at Chouteau Ave. on the south. The Board of Public Improvements plans to introduce bills for the cutting through of 12th St. south of Chouteau Ave., so as to provide direct thoroughfare from the bridge to points south. Maxime Reber is President of the Board.

Representatives of the Missouri Pacific R. R. at a meeting of the State Board of Railroad and Ware Commissioners at Maplewood, St. Louis, Mo., agreed to abolish a culvert under the railroad tracks at Marshall Ave., and to construct a viaduct over the tracks at that point by July 1, 1913. S. W. Shankle is City Engineer of Maplewood. C. E. Smith, St. Louis, Mo., is Bridge Engineer of the Missouri Pacific.

The Kansas City Bridge Co., Kansas City, Mo., having accepted the contract for the construction of the bridge over the South Canadian River at the Adkins crossing, has started soundings of the river bed. It is planned to have the structure completed by Sept. 15, 1913. The contract price was $36,810.

Montana.

✣Bids will be received until March 3, it is reported, by the Commissioners of Ravalli County, Hamilton, Mont., for the construction of a new bridge over the east fork of the Bitter Root River in Ross' Hole to replace the old structure now in service. The bridge will be a combination of iron and wood and will have an 80 ft. span.

⊙The Commissioners of Gallatin County, Bozeman, Mont., have awarded the contract for the construction of the steel part of a bridge over the West Gallatin River below Salesville, to the Minneapolis Steel and Machinery Co., Minneapolis, Minn., at $2,335. The County will build the sub-structure, approaches, etc.

Nebraska.

⊙The Board of Seward County Supervisors, Seward, Nebr., has awarded the contract for the construction of several steel bridges to S. G. Hunter Iron Works, Atlantic, Ia. Bids were opened Feb. 11.

⊙The Elkhorn Construction Co., Fremont, Nebr., has been awarded the contract for all steel, wood and concrete bridges in Colfax County during 1913. Bids for the work were opened Feb. 10, at Schuyler, Nebr.

The Phelps County Board on Feb. 11 rejected all bids opened Jan. 25 for the construction of bridges. C. L. Hedlund, Holdrege, Nebr., is County Clerk.

All bids received by the Board of Adams County Supervisors at Hastings, Nebr., Feb. 4, for the construction steel I-beam and truss bridges in the county during 1913 were rejected. C. H. Heedson is County Clerk.

New Hampshire.

The Board of Aldermen, Manchester, N. H., has passed a resolution asking for a survey by the City Engineer for the construction of a bridge over the Piscataquog River near Kelley's Falls. An estimate of the cost is also to be prepared. S. J. Lord is City Engineer.

New Jersey.

At a hearing held by U. S. Engineer, Col. Kuhn, at the City Hall, Trenton, N. J., on the proposition of the Pennsylvania R. R. to erect a bridge over the Delaware River at that city, two objections were entered, one by Mitchell Perkins, President of the Delaware River Transportation Co., because the structure is to be erected on a curve of the stream and the other by Elisha Webb, President of the Vessel Owners & Pilots' Association, because plans do not provide for a structure high enough.

The Cumberland County Board of Freeholders, Bridgeton, N. J., has adopted a resolution as a preliminary step to the erection of a new and modern drawbridge to span Maurice River at Millville. A survey will be made at once, plans and specifications will be drawn and a request of the War Department will be made for a liberal appropriation for the work.

New York.

⊙The State Department of Public Works, D. W. Peck, Albany, N. Y., Superintendent, has awarded contracts for the construction of two bridges for which bids were opened Feb. 4, as follows: bridge over the Erie Canal near Rocky-Rift Dam in Montgomery County, Contract No. 87, to P. B. McCaghey Co., Little Falls, N. Y., at $11,202; steel superstructure for the Howland's Ave. highway bridge in Cayuga County, Contract No. 102, to Lupfer & Remick, Buffalo, N. Y., at $25,993.

⊙The Town Board of Arcade, N. Y., has awarded the contract for the construction of a new concrete bridge over Cattaraugus Creek at Church St. to Z. T. Darrow, Canandaigua, N. Y., at $5,400.

A special town meeting will be held at York, N. Y., Feb. 24, for the purpose of raising money to build a new highway bridge across the Genesee River, between the towns of Geneseo and York, also to see what action will be taken toward abandoning the contract to rebuild the old bridge, and to arrange a settlement with the contractor, Lawrence Leonard.

Assemblyman T. C. Sweet of Phoenix, N. Y., has introduced a bill in the Legislature providing for an appropriation of $90,000 as the state's share of the cost of building the proposed bridge over the Oswego River at Minetto.

A special town meeting was held Feb. 8, according to information received from Mayville, N. Y., at which a proposition was voted on to raise $6,000 by taxation to build a bridge over the big inlet of Chautauqua Lake at Hartfield, and $2,000 for a bridge over the creek at Dewittville.

The Grade Crossing Commission, Buffalo, N. Y., has approved the plans of George H. Kimball, Engineer, Detroit, Mich., for the elimination of the grade crossings at Amherst, Austin and Tonawanda Sts. by means of a viaduct with a clearance of 21 ft. over the tracks. Mr. Kimball also submitted a plan for the elimination of the crossings by building subways, which would cost about $896,000. The majority of the property owners favored the viaduct, which will cost about $1,000,000. Under the plan for a viaduct the tracks of the roads will be depressed 10 ft.

Advices from Schenectady, N. Y., state that work has commenced on a survey for the construction of a new state hihgway bridge over the Mohawk River at the foot of Washington Ave., connecting Scotia with the city proper. D. W. Peck, Albany, N. Y., is State Superintendent of Public Works.

North Carolina.

The Durham County Commissioners, Durham, N. C., received the following bids for the erection of a steel bridge over Little River at Orange factory: Austin Brothers, $1,640; Carolina Concrete Company, $2,066; Virginia Bridge and Iron Company, $1,864; Consolidated Bridge and Machine Company, $1,779; Roanoke Bridge Company, $1,841. The contract will probably be awarded Austin Bros., Atlanta, Ga., the lowest bidders.

Ohio.

✣Bids will be received until 10 a. m., Feb. 25, by Board of Lucas County Commissioners, Toledo, O., at the office of Charles J. Sazenbacher, County Auditor, for furnishing the necessary labor and material for the construction of bridge and abutments on Dutch Road over the canal on the north line of river tract No. 31, Waterville township. Each proposal must be accompanied by a certified check for $100.

✣Bids will be received until 11 a. m., March 8, by Board of Cuyahoga County Commissioners, Cleveland, O., for the construction of bridge work per Report No. 3068, division of stream Harvard Road, Brooklyn township. Plans and specifications furnished by F. R. Lander, County Surveyor. J. F. Goldenbogen is Clerk.

The Commissioners of Cuyahoga County, Cleveland, O., have instructed County Engineer F. R. Lander to report on the cost of changing high level bridge plans eliminating a pier on the East Side to enable the city to carry out its river straightening plans.

The City Council of Columbus, O., has passed an ordinance authorizing the Toledo & Ohio Central Ry. to construct a viaduct instead of a subway at Parsons Ave. J. A. Stocker, Columbus, O., is Chief Engineer of the railway.

Oregon.

A petition signed by citizens of various towns in Malheur County, of which Vale, Ore., is county seat, will be presented to the Oregon Legislature asking an appropriation of $20,000 for the construction of a wagon bridge over the Snake River near Parma, Idaho.

Pennsylvania.

⊙The contract for the construction of a steel and concrete highway bridge at North

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Braddock, Pa., for which bids were opened Nov. 29, was awarded on Feb. 4 to C. M. Neeld Construction Co., Oliver Bldg., Pittsburgh, Pa., at $16,663. The work will include the substructure and superstructure, the latter consisting of a 75-ft. span 40 ft. wide over the P. R. R. tracks. George F. Siefers, Braddock, Pa., is Engineer.

Plans have been completed for work on the proposed Chester Ave. bridge at 49th St., Philadelphia, Pa., and bids for the work will be advertised for by the Department of Public Works. M. L. Cooke is Director.

Plans are being prepared by the engineering department of the Pennsylvania Railroad for the construction of the proposed Main St. viaduct at Urbana, O. C. S. Pratt is City Engineer. J. C. Bland, Pittsburgh, Pa., is Engineer of Bridges for the Pennsylvania R. R.

Commissioners of Fayette and Washington Counties, Pa., are contemplating the construction of a bridge over the Monongahela River at Brownsville, Pa. Permission from the War Department will be asked at once. Washington, Pa., is the county seat of Washington County.

Rhode Island.

✣Bids will be received until noon, Feb. 24, by Commissioners to reconstruct and repair the Rhode Island Stone Bridge, at their office 213 State House, Providence, R. I., for rebuilding the approaches of the Rhode Island stone bridge. Plans and specifications may be seen at the office of the Secretary of the Commission, 434 Dexter street, Central Falls, R. I., or at the office of J. R. Worcester & Co., Civil Engineers, 79 Milk St., Boston, Mass. A certified check for $1,000 must be filed with each bid.

South Dakota.

✣Bids will be received until 2 p. m., March 4, by W. R. Hall, Faulk County Auditor, Faulkton, S. Dak., for the construction and repair of all bridges in the county during the year commencing March 4, 1913.

✣Bids will be received until 2 p. m., Feb. 25, by Theodore Anker, Clay County Auditor, Vermilion, S. Dak., for cleaning and painting old bridges now standing throughout the county. Specifications are now on file with the County Auditor.

✣Bids will be received until 2 p. m., March 4, by E. S. Brown, Hamlin County Auditor, Castlewood, S. Dak., for furnishing all material and labor and building all bridges (steel, concrete or pile construction), and building all repair work that may be required and ordered by the Board of County Commissioners of said county during the ensuing year at the locations to be designated by the said board. Plans and specifications are on file in the office of the County Auditor. Each bid must be accompanied by a certified check filed in a separate envelope from the bid, in the sum of $1,000, drawn on either the First National Bank or the Citizens State Bank of Castlewood, S. Dak., and made payable to the Board of County Commissioners.

✣Bids will be received until 1 p. m., March 4, by R. A. Zangle, county auditor, Mitchell, S. Dak., for the construction of bridges in Davidson county for the year beginning March 1, 1913. A certified check for $100 must be filed with each bid.

Tennessee.

The Board of City Commissioners, Memphis, Tenn., has passed the Memphis-Arkansas Railway Bridge & Terminal Company ordinance and it is understood that arrangements are being completed for an immediate start on the construction work on the Memphis approaches to the proposed structure. Under the ordinance certain streets in the vicinity of Pennsylvania Ave. are closed to allow terminal improvements. In return the city receives $50,000 and is absolved from all condemnation suits. The sum of $10,000 is to be paid by Memphis for the east approach to the bridge. E. M. Douglass is City Clerk.

Texas.

✣Bids will be received until noon, March 3, by Dan C. Smith, Jr., City Secretary, Houston, Texas, for the construction of a reinforced concrete viaduct connecting Capitol Ave. and Rusk St. with Moore and Young Sts., in the Sixth Ward, Houston, Texas. Plans, specifications and bidder's blanks can be obtained on application at the office of the City Engineer, F. L. Dormant, City Hall, Houston, Texas. A certified check of the bidder on any bank in Houston, Texas, payable to H. B. Rice, Mayor, for $4,500 will be required to be deposited with each bid.

✣Bids will be received until March 11, by Commissioners Cout, Tom Green County, San Angelo, Texas, for the construction of a reinforced concrete bridge over North Concho river on Chadbourne street in San Angelo. Oscar Frink is county judge.

Utah.

The City Commissioners of Ogden, Utah, have authorized City Engineer H. J. Craven to secure plans and bids for the steel work for the new bridge over the Weber River at 33d St.

Virginia.

✣Bids will be received until noon, Feb. 25, by Board of Russel County Supervisors, Lebanon, Va., for the construction of a cement rubble bridge over Swords Creek, one-half mile from Swords Creek, on the Norfolk & Western Ry., in Russel County. The structure will consist of one standard 38-ft. span with a 12-ft. roadway. Stone can be secured ½ mile and sand 1 mile from the bridge site. Plans and specifications can be seen at the office of P. St. J. Wilson, State Highway Commissioner, Richmond, Va., or at the office of the Clerk of Circuit Court, Lebanon, Va. A certified check for $250 must be filed with each bid. Blue prints of plans can be secured of Childrey-Sunday, Richmond, Va., at a cost of 20 cts. and postage.

⊙The contract for the construction of 11 bridges in Southampton County, according to reports, has been let by the Board of Supervisors, Courtland, Va., to Austin Bros., Atlanta, Ga., at $31,000.

Washington.

The Commissioners of Pierce County, Tacoma, Wash., are planning the construction of a $10,000 bridge over the Nisqually River at LaGrande. Plans for the structure, which will be about 1,000 ft. long, are now being completed by the County Engineer.

Plans are under way for the construction of the highway viaduct on 15th St., Tacoma, Wash. It will be some time, however, before contracts for the work will be let. H. E. Stevens, St. Paul, Minn., is Bridge Engineer of the Northern Pacific Ry.

Wisconsin.

At a meeting of the committee on the proposed new bridge at Merrimack, at Baraboo, Wis., it was decided to have the law firm of Aylward, Olbrich & Davies, Madison, Wis., commence at once the matter of getting the question before the Legislature. The cost of the structure proposed is estimated at about $93,000.

Plans are being prepared by the Engineering Department of Milwaukee, Wis., for the construction of the proposed new Buffalo St. bridge and it is hoped to have the matter in shape for bids by the latter part of this month. J. A. Mesirof is City Engineer.

Canada.

✣Bids will be received until noon, March 11, by H. C. Hocken, Chairman, Board of Control, Toronto, Ont., for steel superstructure of St. Clair Ave. bridge east of Bathurst St. Specifications may be obtained upon application at the office of the Railways and Bridges Section, Department of Works, City Hall, Toronto.

DRAINAGE AND IRRIGATION

Arkansas.

⊙Sternberg Bros., 516 Reserve Bank Bldg., Kansas City, Mo., have been awarded the contract at about $146,000 for constructing 44 miles of drainage ditches, requiring approximately 1,600,000 cu. yds. of excavation, in Waterloo Drainage District of Jefferson County, Arkansas. Bids were opened Feb. 10, at Pine Bluff, Ark.

California.

⊙Wardall & Wagoner of Los Angeles, Calif., have been awarded the contract for the construction of an irrigation system on Tapo ranch, near Santa Susana, Ventura County, for the Patterson Ranch Co., at $5,613. The work includes 4,440 ft. of 18-in. pipe, 7,070 ft. of 12-in. pipe, 13,700 ft. of trench, six reinforced concrete boxes, 10 air vent traps, four 18-in. pressure gates, five 12-in. pressure gates and other special features to come under extra work clause. Bids were opened Feb. 1 by F. G. Dessery, 1116 Hiberian Bldg., Los Angeles, Calif., Hydraulic Engineer.

Colorado.

The San Luis Valley Drainage District, A. L. Stroup, President, Mosca, Colo., has postponed until 10 a. m., Feb. 28, the opening of bids for the purchase of its $350,000 issue of drainage bonds. Owing to delay in receiving the Prospectus from the printer, the district was unable to furnish full information to bond purchasers in time for their bids to reach this office on Feb. 7th.

The Denver Power & Irrigation Co., J. E. Rhodes, President, Denver, Colo., is reported to have received Government approval for its proposed reservoir at Eagle Rock on the South Platte River, near South Platte Station. This company proposes to irrigate about 100,000 acres of land, 12 to 14 miles east of Denver. The plans are understood to call for a reservoir to hold about 90,000 acre ft. of water.

Florida.

⊙G C. Livingston & Co., Starke, Fla., has been awarded the contract at 14 cts., 15 cts. and 16 cts. per cu. yd. for the excavation of about 200,000 cu. yds. of canals for the drainage of 17,500 acres of land in Bradford County, Fla. Bids were opened Feb. 10, by the county commissioners. W. T. Weeks, clerk, Starke, Fla.

Illinois.

✣Bids will be received until March 4, by J. M. Riggs, Winchester, Ill., for erecting and equipping of a pumping station for the Scott County Drainage & Levee District. Jacksonville Engineering Co., engineers, Jacksonville, Ill.

⊙James A. Ware Construction Co., St. Louis, Mo., has been awarded the contract for clearing and one section of earth work (¾ mile) for the Wood River Drainage & Levee District, James H. Chissen, Secretary, East Alton, Ill. The contract price for the 55 acres of clearing was $90 per acre and the contract price on the one section of earth work was 19.87 cts. per cu. yd. The contract for 440 cu. yds. of concrete for headwalls, culverts, etc., was let to R. Curdie, Alton, Ill., at $11 per cu. yd. Bids were opened Jan. 28. The bids on the balance of the work were rejected and this will be let later on.

⊙N. C. McGinnis & Co., Bement, Ill., has been awarded the contract at $11,190, for the construction of about 5 miles of dredge ditch for Drainage District No. 10 of Willow Branch Township. Bids were opened Feb. 8

W. J. Day, Bement, Ill., is the engineer.

Petition has been filed with the Monroe County Commissioners at Waterloo, Ill., by James O. Miller, for the organization of Richland Creek Drainage District No. 4.

Bids as follows were received last week by the Trustees of the Sanitary District of Chicago, for cleaning Bubbly Creek: Byrne Bros. Dredging & Engineering Co., 72 W. Adams St., Chicago, Ill., $37,050; Great Lakes Dredge & Dock Co., Chicago, $37,570; Fitzsimmons & Connell Dredge & Dock Co., $45,000.

Trustees Sanitary District of Chicago, 76 W. Monroe St., Chicago, have appropriated $25,000 for the construction of a temporary ditch to drain swamp lands along the Calumet Sag channel.

A commission consisting of Herbert R. Phelps, chairman; Carl H. Muehlenford, secretary, and Guy P. Mather, has filed its report, specifications and plat for the Eastern Lille Cache Swamp Drainage District in Dupage Township, with Ed. G. Young, County Clerk, Joliet, Ill.

Indiana.

✣Bids will be received until 2 p. m., March 1 by Board of Jasper County Commissioners, Rensselaer, Ind., for the construction of a ditch and two laterals. W. F. Osborne is construction commissioner.

✣Bids will be received until 2 p. m., March 8, by Board of Jasper County Commissioners, Rensselaer, Ind., for the construction of Lowman et al, ditch. W. F. Osborne is construction commissioner.

⊙Fred L. Morgan, Vincennes, Ind., has been awarded the contract for the Ball and Richards Ditches at 6.6 cts. and 6.66 cts. per cu. yd. respectively. Bids were opened Feb. 7 by Samuel Carr, superintendent of construction, Medora, Ind.

⊙Chas. C. Huffine, Frankfort, Ind., has been awarded the contract at $7,100 for constructing the Yeager tile drain, bids for which were opened Feb. 10 at Fowler, Ind.

Iowa.

✣Bids will be received until Feb. 26 by Louisa-Des Moines Drainage District No. 4, at the office of the county auditor, Des Moines, Ia., for open ditch of 14,000 cu. yds. excavation and tile drains aggregating 12,000 ft., ranging from 8 in. to 20 in. in size. For further information apply to the engineers, Harman Engineering Co., Peoria, Ill. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until noon, March 3, by H. B. Frase, County Auditor, Des Moines, Ia. (readvertisement), for the work on drainage ditch No. 12, including 1,465 ft. of 16-in. tile; 1,650 ft. of 18-in. tile; 5,720 ft. of 24-in. tile. A certified check for 10 per cent of the amount bid must be filed with each proposal.

✣Bids will be received until Feb. 25, it is reported, by L. O'Donnell, Pocahontas County Auditor, Pocohontas, Ia., for the construction of sections in Drainage District No. 63 of Pocahontas and Palo Alto Counties. A certified check for 10 per cent the amount bid must accompany each bid.

✣Bids will be received until 1:30 p. m., March 5, by Board of Fremont County Supervisors, Sidney, Ia., for the construction work on the Plum Creek ditch and laterals. The work consists of about 8 miles of main ditch of 30-ft. bottom, estimated 325,000 cu. yds. pay dirt. The time limit for completion of this section is May 1, 1914, and it can be cut with either a floating or a dragline dredge. There are two lateral ditches. One 4,600 ft. long with 16-ft. bottom, having about 25,000 cu. yds. of excavation. The time limit on this section is Oct. 1, 1913, and it can be cut with either teams or a dragline machine. One lateral is 15,800 ft. long with 10-ft. bottom, having about 21,900 cu. yds. of excavation. The time limit for completion on this section is Oct. 1, 1913, and it can be cut with teams or with a small dragline machine. Bids will be received for each section separately, or for the entire work. The work is located near Thurman, Ia. The nearest railroad station is McPaul (three miles west of Thurman) on the Kansas City, Council Bluffs branch of the C., B. & Q. R. R. Seth Dean, Construction Engineer, Glenwood, Ia. F. B. Jenkins is County Auditor, Sidney, Ia.

⊙Contracts for Drainage District No. 7, of Guthrie County, bids for which were opened Feb. 4, have been let as follows: Trenching and laying tile, Henry Hansen, Callender, Ia., furnishing tile, Jefferson Tile Factory, Jefferson, Ia.; Redfield Brick & Tile Co., Redfield, Ia. The district requires about 29,000 ft. of 6-in. to 24-in. tile.

⊙Bids were opened Feb. 11 by B. E. Norton, County Auditor, Algona, Ia., for work in four drainage districts in Kossuth County, contracts being let as follows: Drain 71, 1,272 cu. yds. open ditch and 16,725 ft. 6-in. to 20-in. tile, Longley & Hellberg, Algona, Ia., $6,600; Drain 72, 70,140 ft. 6-in. to 30-in. tile, W. H. O'Brien, Algona, Ia., $33,000; Drain 75, 48,028 ft. 6-in. to 24-in. tile, Welp Cement Products Co., Bancroft, Ia., $16,000; Drain 76, 17,065 ft. 6-in. to 16-in. tile, Marion Dull, Luverne, Ia., $4,600. The contracts include excavating, furnishing tile, laying and back filling.

⊙Bids were opened Feb. 12 by the County Auditor, Pocahontas, Ia., for constructing Drainage Ditches Nos. 68, 69 and 70, contracts being let as follows: Ditch No. 70, Plymouth Clay Products Co., material, $5,758; J. O. Burrington, labor, $3,200. Ditch No. 68, Redfield Brick & Tile Co., material, $3,697; P. L. Rivard, labor, $1,700. Ditch No. 69, Wm. Stewart, labor and material, $814.

Final hearing will be held on March 1 on petitions for Drainage District No. 74 of Emmet County. Chas. A. Root, Estherville, Ia., is County Auditor.

Bids were opened Feb. 5 by A. J. Peterson, County Auditor, Webster City, Ia., for constructing the Frayne drain No. 3, requiring 2,000 ft. 28-in. tile, and 2,000 ft. 24-in. tile. All bids were rejected and construction of drain postponed indefinitely.

Michigan.

✣Bids will be received by A. H. Reid, Genesee County Drain Commissioner, Flint, Mich., and contract let at 9 a. m., Feb. 25, at the residence of Henry Nimphie, 2 miles south of Duffield, Section 6, Gaines Township, for constructing the Davison Drain, 16,764 ft. in length. A certified check for $400 must be fixed with each bid. George Huggins is Surveyor.

Minnesota.

⊙A. Folstad & Sons have been awarded the contract for County Ditch No. 26 of Murray County.

⊙Smagge & Redding, Windom, Minn., have been awarded the contract at $6,954 for constructing Judicial Ditch No. 3, bids for which were opened Feb. 13 at Windom, Minn. The work includes the tile and laying.

Hearing will be held at Slayton on Feb. 25 on petition of Paul Haugen and others for a public ditch in the town of Shetek, Murray County.

Hearing will be held at Aitkin, Minn., on Feb. 25, on petition of C. G. Anderson and others, for a drain in the town of Farm Island, also on petition of D. A. Foley and others for a public ditch designated as County Ditch No. 24. J. E. Lemire, Aitkin, Minn., is County Auditor.

Mississippi.

No bids were opened Feb. 10 for levee work for the Mississippi Levee District, and the letting has been postponed for 60 days. This work calls for the following levee construction above Greenville, Miss.: Bolivar Enlargement—Sta. 2550 to 2670, 170,000 cu. yds.; riverside borrow; about 10,000 cu. yds. for false berms on landslide with landslide borrow is included in this estimate. Catfish Point Enlargement—Sta. 2913 to 2992, 110,000 cu. yds.; landside enlargement, landside borrow; enlargement of three dikes is included in this estimate, stations 2913, 2975 and 2992; dike enlargement is estimated at 20,000 cu. yds., and pits for same will be on lower side of dikes. Eutaw Enlargement—Sta. 2992 to 3100, 90,000 cu. yds.; riverside enlargement; riverside borrow. Bolivar work is three miles from Benoit and at Bolivar Landing on the river. Catfish Point work is eight miles from Scott Station. All work to be completed by Dec. 15, 1913. All work will have 8 ft. crown with light topping in addition 1 ft. above gross grade. Landside work will be combined with banquette enlargement. Specifications, profiles and maps and other information that bidders may desire can be obtained at the office of W. J. Shackelford, Chief engineer, at Greenville, Miss.

New Jersey.

✣Bids will be received until 4:30 p. m., Feb. 21, by Mosquito Extermination Commission of Hudson County, Court House, Jersey City, N. J., for the making of about 100,000 ft. of drainage ditches, to be made on the salt marsh meadows of Hudson County at various points, beginning at the Bergen County line on the north and extending along either side of the Hackensack River to the Kill Von Kull; also repairing and cleaning to a depth of 30 ins. about 315,000 ft. of old ditches covering the territory above described. Lewis E. Jackson is Secretary of the Commission.

Oregon.

Work will be started early in the spring for widening and deepening the Adams Canal of the Klamath Project of the U. S. Reclamation Service. It is probable that this work will be let in small contracts. W. W. Patch, Klamath Falls, Ore., is Project Engineer.

South Dakota.

⊙Bids were opened Feb. 5 by Theodore Anker, County Auditor, Vermilion, S. Dak., for the construction of Clay Creek Ditch, lateral No. 4, the contract being awarded to G. W. Woodworth at 10 cts. per cu. yd. for 5,000 cu. yds. of excavation.

Texas.

✣Bids will be received until March 1 by M. C. Whalen, Chairman, Board of Commissioners, Jackson County Drainage Ditch No. 1, Edna, Tex., for making and constructing all canals, drains, ditches and levees and straightening and cleaning all water courses and all other improvements, including necessary grubbing and clearing, and the construction of the necessary culverts and bridges covered by the proposed drainage improvements in Jackson County drainage district No. 1, all fully set out and included in the engineer's final report for said Jackson County drainage district No. 1, made and duly filed in the office of the County Clerk of Jackson County, Texas, at Edna, Texas. Maps and profiles on file in the office of the County Clerk of Jackson County, Texas, at Edna, Tex., and in office of W. C. Youngs, engineer, Edna, Tex. For further information address F. G. Moffett, attorney, or W. C. Youngs, engineer, Edna, Tex. All bids must be accompanied by a certified check for 5 per cent the amount bid.

Property owners at Texarkana, Tex., have voted a $50,000 bond issue for building a levee from Index on the Kansas City Southern Ry. to Living Springs. The levee will reclaim about 15,000 acres.

Utah.

⊙The State Land Board, Salt Lake City, has awarded a contract to the J. W. Ross Co., at $4,453, for the excavation for a 2-mile extension of the Piute Canal. Christiansen & Christopherson were awarded the contract at $826 for the bridges and culverts, the state to furnish the material.

Wisconsin.

Business men of Rice Lake, Wis., are considering a plan for improving a body of water lying east of the city. The plans are reported to call for the expenditure of about $200,000, including the purchase of a dredge and centrifugal sand pump. E. Knudson and C. F. Stout are members of the committee.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

WATER WORKS

California.

⊙The Trustees of Tehachapi, Calif. (population 338), have awarded the contract for the construction of a municipal waterworks system to the Municipal & Industrial Equipment Co., Merchants Trust Bldg., Los Angeles, Calif., for $13,797. Other bidders were: Westlake Construction Co., Los Angeles, $14,264; Standard Electric Construction Co., San Francisco, $14,971, and R. C. Lowell, Los Angeles, $15,976.

The City Trustees of Tehama, Calif., have decided not to submit a proposition to the citizens to vote bonds for a waterworks system.

The Hayes Valley Improvement Association has asked the Board of Supervisors, San Francisco, Calif., to install the auxiliary water system throughout the valley. The association wants a pipe line placed in Laguna St.

Delaware.

A bill was introduced in the Delaware Legislature on Feb. 10, authorizing a bond issue of $30,000 by the city of Georgetown for the establishment of waterworks.

Florida.

✣Bids will be received until 4 p. m., March 17, by Board of Public Works, Gainesville, Fla., at the office of H. E. Taylor, Chairman, for furnishing all material, machinery, equipment and labor for the construction of an electric lighting system and improvements to the waterworks system. The work will embrace a complete combined waterworks and lighting station in town, on railroad, approximately 20 miles pole line, 4,300 ft. 14-in. cast-iron pipe, one 150,000-gal. tank on 75-ft. tower. Station equipment will consist of three 150-H. P. return tubular boilers, one 600-H. P. steel or reinforced concrete stack, one 600-H. P. feed water heater and purifier, one 1,500,000-gal. high duty Meyer gear, or triple expansion pump, one cross compound condensing compressor, 750 cubic ft. capacity, or one motor-driven deep-well centrifugal one 300-gal. motor-driven centrifugal pump, one 250 and one 150-K. W. generators, direct connected to 4-valve non-condensing Corliss, or compound non-condensing engines, with switchboard and exciters. Bids must be made on blanks furnished for the purpose, and no bid will be considered unless so made. Certified check for 5 per cent of the amount of bill will be required. Specifications may be obtained from the J. B. McCrary Co., Engineers, 1408-1417 Third National Bank Bldg., Atlanta, Ga., or the Chairman of the Board of Public Works, H. E. Taylor. Plans may be seen at the office of either the Engineers or the Chairman of the Board of Public Works. Copies of plans may be had by payment of $10 to defray the actual expense of same.

Idaho.

The City Council of Lewiston, Ida., has decided to extend the intake of the local water system. Plans are being prepared by City Engineer D. C. Wrighter.

Illinois.

✣Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, until 11 a. m., Feb. 24, for furnishing and delivering to the different pipe yards approximately 5,000 tons of cast iron water pipe made up of the following sizes and amounts: 4,000 pieces 6-in. pipe, 10,000 pieces 8-in. pipe, 27,000 pieces 12-in. pipe; points of delivery are as follows: Pipe yard A, Avers Ave. and Wabansia Ave, C. M. & S. P. switch track; pipe yard B, 2352 S. Ashland Ave., C. B. & Q. switch track; pipe yard C, Pennsylvania team track, 47th St. and Stewart Ave; pipe yard D, 68th St. and Yates Ave., I. C. team track; pipe yard E, 104th St. and Stewart Ave., C. & W. I. switch track. Cash or certified check for $1,000 must accompany proposal.

⊙L. E. McGann, Commissioner of Public Works, Chicago, Ill., has awarded to the American Brake Shoe & Foundry Co., 322 S. Michigan Ave., Chicago, the contract for furnishing and delivering to the City Water Works Shops, 2304 S. Ashland Ave., approximately 600 tons of 2½ and 4-in. hydrant castings, and 4-in., 6-in., 8-in., 10-in., 12-in., 16-in,. 24-in. and 36-in. valve castings; contract price, $24,000.

⊙McGregor & Lederer have been awarded the contract by the city of Bloomington, Ill., for the construction of water mains in Morris Ave., Locust St., and White Oak Road, for $4,415.

The citizens of Ashton, Ill., at a recent election voted against the issuance of bonds for the installation of a waterworks system. Aetna Engineering Bureau, Chicago, Ill., were Engineers.

Indiana.

The City Council of New Albany, Ind., has adopted a resolution commending the bill introduced by Representative M. C. Thornton in the General Assembly requiring all water companies obtaining their supply of water from running streams to install filtration plants.

Following bids were recently received by the Board of Public Works of Logansport, Ind., for furnishing and installing the coal and ash conveyors for the electric light plant, for which the City Council appropriated $8,000: Cahall Sales Co., Chicago, Ill., $9,975; Webster Mfg. Co., Chicago, $9,850; Jeffrey Mfg. Co., Columbus, O., $9,600; Alda Ferguson Co., Cincinnati, O., $12,650, and the Link Belt Co., Chicago, $12,000.

Iowa.

The Town Council of Farragut, Ia., (population 431), has called an election for March 3 to vote on the issuance of bonds for the installation of a municipal waterworks plant. The estimated cost of the plant is $8,000.

An election is to be held in Woodbine, Ia., (population 1,538), on March 10 for the purpose of voting on the installation of a waterworks and a sewerage system, to cost $8,000 and $20,000, respectively.

The town of McIntosh, Ia., (population 409) recently issued bonds to the amount of $12,000 for the purpose of putting in a city system of waterworks. Bids are now being asked for the construction of the plant. The plans call for two 6-in. wells and a 50-ft. tower with a 100,000-gal. tank.

A special election was held in Estherville, Ia., (population 3,404) on Feb. 17 for the purpose of voting on the issuance of bonds to the amount of $25,000 for a waterworks system. The Council is in favor of sinking shallow wells of about 20 ft. in diameter to procure water supply and then construct a filtration plant.

A committee consisting of Mayor G. G. Bowers, F. H. Tinsley and Councilman G. W. Storey, of Hedrick, Ia., (population 978) has been appointed to investigate waterworks plants in towns of similar size and report on the advisability of installing a system in Hedrick.

Kansas.

The Almo Engine & Supply Co., of Omaha. Nebr., is preparing plans and specifications for the construction of a light and water plant in Scott City, Kans. It is likely that construction work will be started within 30 or 60 days.

Kentucky.

According to advices from Carlisle, Ky., (population 1,293) H. B. Bryson is heading a movement for the installation of a waterworks system.

Louisiana.

⊙The City Council of Franklin, La., has awarded a contract to E. M. Kursheedt, electrical engineer, of New Orleans, La., for the construction on Barou Teche of two motor water pumps, to be used in connection with the municipal waterworks plant. The contract price is $3,440.

Maine.

At a public meeting at the Business Men's Club, Rumford, Me., the trustees of the Rumford Water District, Dr. C. M. Bisbee, Leon S. Osgood and Arthur Gauthier, with Engineer E. Worthington, of Dedham, Mass., discussed the possibility of securing water from Mt. Vircon for the village supply. No estimate of the probable cost was presented. The matter was viewed favorably by the citizens.

The Hampden Water Co., Hampden, Me., has been incorporated with a capital stock of not more than $100,000 nor less than $25,000. The incorporators are: George W. Smith, James A. Dunning, Charles C. Garland, George H. Hamlin and Benjamin W. Blanchard.

Massachusetts.

The municipal finance committee of the Massachusetts Senate has reported a bill to allow Agawam, Mass., to borrow $100,000 for additional water supply.

The committee on water supply of the Massachusetts Senate has reported a bill to provide an additional water supply for Brookline, Mass., not exceeding 3,000,000 gals., in addition to the 5,000,000 the town is already authorized to take from land of the town on or near Charles River by driven wells and galleries, and that the town may borrow $250,000 to make such addition.

Michigan.

The Board of Fire & Water Commissioners, Marquette, Mich., has been petitioned for an extension of the water main from the end of the Center St. trunk line to Holy Cross cemetery. The estimated cost is $5,000.

The Board of Public Works of Mt. Clemens, Mich., is considering paralleling every water main in the city. It is proposed to conserve the present supply entirely for domestic use and pump river water for other purposes.

The Common Council of Hastings, Mich., has passed a resolution authorizing an election in April to vote on the proposition to bond the city for $90,000 for a municipal electric light and waterworks plant.

Minnesota.

✣Bids will be received until 3 p. m., Feb. 24, by Kossuth E. Alexander, Purchasing Agent, Minneapolis, Minn., for furnishing the City of Minneapolis with approximately 15,000 lin. ft. of 54-in. steel water main for the season of 1913, according to plans and specifications on file in the office of the City Purchasing Agent and City Engineer. Shipments to commence on or before April 15, 1913, and continue at the rate of 200 lin. ft. of pipe per day until contract is completed. A certified check payable to the order of C. A. Bloomquist, City Treasurer, in the amount of $5,000 must accompany each proposal.

✣Bids will be received until 8 p. m., Feb. 28, H. J. Bierge, Village Recorder, Pine City, Minn., for the construction of a complete water works system in accordance with specifications and plans on file at the office of the recorder or at the office of Oscar Claussen Engineering Co., Consulting Engineers, 514 German-American National Bank Bldg., St. Paul, Minn. The work will be let in five sections. Sec. 1 includes furnishing and laying 3,584 ft. of 4-in., 7,404 ft. of 6-in., 1,372 ft. of 8-in., and 468 ft. of 10-in. cast iron B. & S. pipe. Bids will also be taken on Universal cast iron pipe same as above. There will be a river crossing of approximately 400 ft. Besides the cast iron pipe, there will be a number of specials, valves, fittings and approximately 23 4-in. and 5 5-in. hydrants. Division 2 includes the installing of a 75,000-gal. steel tower and tank 100 ft. to the balcony. Division 3 includes pumping plant and accessories consisting of motor; either a double or triple

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

plunger, deep well head, pump, etc., complete installed. Division 4 includes the furnishing of labor and material and building a 14 ft. x 16 ft. pump house. Division 5 includes an 8-in. or 10-in. deep well approximately 150 ft. deep, together with casing for same. The above is to include all trenching and back-filling, furnishing and laying and installing of everything complete in all divisions ready for continued use and successful operation. A certified check for $200 made payable unconditionally to the Village Recorder must accompany proposals for each section of the work, or a certified check for $800, made payable unconditionally to the Village Recorder must accompany bid for the five divisions complete.

A report is being prepared by the Oscar Claussen Engineering Co., of St. Paul, Minn., relative to the installation of a waterworks system in Deerwood, Minn. It is thought the system can be installed for $14,000.

Mississippi.

✣Bids will be received until March 4 by City of Tutwiler, Miss., for the construction of water works. R. C. Huston, Exchange Bldg., Memphis, Tenn., is Engineer.

Nebraska.

The Village Board of Peru, Nebr., has retained Consulting Engineer Charles T. Sturtevant, of Holdrege, Nebr., to prepare plans for a waterworks system. An election is to be held Feb. 24 to vote on the issuance of bonds to the amount of $20,000 for the improvement. The plans are to call for a tower reservoir rather than a standpipe.

New Jersey.

✣Bids will be received until 8 p. m., Feb. 24, by Harry Trippett, Town Clerk, Montclair, N. J., for the following items in connection with the new municipal building, for the use of the Police and Fire Departments and other municipal purposes, according to plans and specifications therefor on file in his office, Room 3, Crane Bldg., 460 Bloomfield Ave., Montclair, N. J. Plans are by O. F. Semsch, 183 Montclair Ave., Montclair, N. J., and 109 Broad St., New York City, N. Y., and copies of the same with specifications can be obtained from the architect on deposit of $5; $3 of which will be returned to the depositor on return of said plans and specifications. First—The furnishing and installation of the necessary equipment of the New Council Chamber, including desks, seats, brass rail, carpet, linoleum, etc. Second—The furnishing and installation of all the lighting fixtures necessary for the building as planned.

New York.

✣Bids will be received at once for the construction of the uncompleted portion of the Martin-Dunham Reservoir for the city of Troy, N. Y. The work will include 60,000 cu. yds. of excavation, 5,000 cu. yds. of concrete, paving, grubbing, etc. Plans and specifications may be obtained at the office of A. P. McKean, 56 Fourth St., Troy, N. Y.

⊙The Board of Water Supply, J. P. Morrissey, Secy., 165 Broadway, New York City, has awarded the contract for furnishing and delivering valves, hydraulic cylinders, piping and appurtenances for the city tunnel of the Catskill aqueduct in the city of New York, to Caldwell-Wilcox Co., of Newburgh, N. Y., for $139,643. Bids were opened Feb. 11.

The Board of Supervisors of Oswego County, Oswego, N. Y., will equip the county almshouse at Mexico, N. Y., with a fire protection system, in accordance with a recommendation of the State Fire Marshal. It is thought that the system will cost about $3,000.

Ohio.

✣Bids will be received until noon, March 4, by W. H. Kirby, Secretary to the Director of Public Service, Cleveland, O., for steam-heating system for the Fire Service Pumping Station.

✣Bids will be received until noon, Feb. 26, by W. J. Springborn, Director of Public Service, Cleveland, O., for the extension of the waterworks tunnel under the Cuyahoga River at Clark Ave. Each bid must be made in accordance with specifications which may be seen at the office of the Chief Engineer, 305 City Hall. W. H. Kirby is Secretary to the Director.

✣Bids will be received until noon, March 3, by Board of Trustees of Public Affairs, West Park Village, Town Hall, West Park, O., for the construction of water mains in Warren Ave., Triskett Road, Raymond Ave., Settlement Road and Brown Road, in accordance with plans and specifications on file at the office of Fred Feuchter, Clerk of the board, and at the office of William H. Evers Engineering Co., 332, The Arcade, Cleveland, O.

⊙The Ludlow Valve & Pipe Works, of Ludlow, Mass., submitted the lowest bid to Service Director V. T. Price, of Cincinnati, O., on Feb. 11, for furnishing 75 fire plugs for the waterworks department, at $24.20.

The City Council of Geneva, O., has passed an ordinance providing for the issuance of bonds to the amount of $10,000 to make improvements to the waterworks by constructing a new concrete dam.

Fire Chief Stickle, of Alliance, O., has asked for the construction of a 12-in. water main for the protection of the shops in the southwestern part of the city. The cost is estimated at $5,000.

Oklahoma.

✣Bids will be received until Feb. 25 by City of Texhoma, Okla., for the construction of water works. W. M. Magruder is Engineer, Liberal, Kan. P. M. Williams is Mayor.

Engineers J. W. Billingsley, Hiram Phillips and John W. Alvord have submitted their report to the City Commissioners of Oklahoma City, Okla., together with plans, specifications and estimate of cost for a permanent water system for Oklahoma City.

Oregon.

⊙Award of the contracts for furnishing the water department of Portland, Ore., with materials was confirmed by the Water Board, D. D. Clarke, Engineer, on Feb. 1, as follows: Oregon Iron & Steel Co., Portland, Ore., 6,000 tons C. I. pipe, $204.826. Phoenix Iron Works, Portland, Ore., 225 tons specials, $11,925. Helser & Unden, Portland, Ore., 350 hydrants, $9,975. Crane Co., Portland, Ore., 40,500 ft. wrought pipe and malleable fittings, $2,458. Crane Co., Portland, Ore., 10,125 corporation and curb cocks, $5,581. M. L. Kline, Portland, Ore., 320,000 lbs. pig lead, $14,816. M. L. Kline, Portland, Ore., 10 30-in. "Roe-Stephens" gate valves, $2,800. R. D. Wood & Co., 10 24-in. "Eddy Type" gate valves, $1,600; Philadelphia, Penna., 15 16-in. "Eddy Type" gate valves, $975. Caldwell Machinery Co., 50 12-in. "Rensselaer" gate valves, $1,406. The Gauld Co., Portland, Ore., 325 6-in. "Natl. Tube Co." gate valves, $2,779. Covey Motor Car Co., 1 "Cadillac" touring car, $2,117. Neat & McCarthy, Portland, Ore., 1 "Locomobile" 5-ton truck, $5,100.

Pennsylvania.

The Borough Council of Lewistown, Pa., has passed an ordinance to submit the question of ownership of the municipal water plant to the vote of the people.

At a recent mass meeting of business men and other voters of Palmyra, Pa., it was decided to take steps to incorporate the town into a borough and place 65 fire hydrants to protect the town against fire in the future.

The Borough Council of Hamburg, Pa. (population 2,301) has decided to vote whether to hold a public election and allow a vote on the proposition of acquiring the plant of the Windsor Water Co., for a municipal water works.

South Dakota.

⊙Ellerman & McLain Construction Co., Yankton, S. Dak., has been awarded the contract by that city, J. W. Summers, City Auditor, for the construction of a new water works system, for $51,212. The work will include trenching, laying and furnishing complete the distribution system, consisting of 34,767 ft. of 6-in. cast iron pipe, 5,408 ft. of 8-in. cast iron pipe, 7,031 ft. of 10-in. cast iron pipe, 1,276 ft. of 12-in. cast iron pipe, valves, fire hydrants, and 34,424 lbs. of special castings. The Chicago Bridge & Iron Works, Chicago, Ill., secured the contract to construct a 400,000-gal. tank for $12,800. Bids were opened Feb. 3. Edmunds & Norgren, Yankton, are Engineers.

An election will soon be called in Irene, S. Dak., for the purpose of voting on the issuance of bonds for the installation of a municipal waterworks system.

Steps are being taken by the officials of the village of Chancellor, S. Dak. (population 160), to provide the village with a reserve reservoir in which to store water for use during fires.

Tennessee.

✣Bids will be received until March 7 by City of Arlington, Tenn., for the construction of water works and electric light plant. R. C. Huston, Exchange Bldg., Memphis, Tenn., are engineers.

✣Bids will be received until March 11 by City of Kenton, Tenn., for the construction of a water works and electric light plant. R. C. Huston & Co., Exchange Bldg., Memphis, Tenn., are Engineers.

Texas.

⊙The City Council of Paris, Tex., has awarded the contract for supplying three pumps and three motors for the electric pumping station, to Smith & Whitney, of Dallas, Tex., for $2,348.

The Real Estate Exchange, of Fort Worth, Tex., has endorsed the proposed bond issue of $300,000 for the completion of the West Fork reservoir.

The San Fernando Water Co., San Antonio, Tex., has been incorporated with a capital stock of $25,350. The incorporators are: J. H. Kirkpatrick, C. B. Kirkpatrick and Andra C. Dauchy.

The Dawson Water Co., Dawson, Navarro County, Tex., has been incorporated with a capital stock of $10,000. The incorporators are: B. C. Rhome, Sr., R. J. Rhome, F. Frank Williams.

Utah.

The City Commission, of Salt Lake City, Utah, has decided to construct water mains and sewers on University St., between First and Second South Sts.

West Virginia.

The legislature has voted to allow the city of Huntington, W. Va., to issue additional bonds to the amount of $880,000 to build a new water works plant.

Wisconsin.

⊙The Village Board, of Waterford, Wis., has awarded the contract for sinking an artesion well to E. F. Drought. The well will be sunk 600 ft. or more. This village recently voted bonds to the amount of $15,000 for a waterworks system.

The Great Northern Railway Co. proposes to construct a dam and reservoir in the southwest quarter of section 23-47-15, adjoining its right of way at Dedham, Wis.

The Common Council of Kerosha, Wis., has been urged to rebuild the old artesian water plant and to provide for the building of an auxiliary plant which will furnish water for table and cooking purposes. It is planned to make the system supplemental to the lake supply.

Wyoming.

The town of Glenrock, Wyo., has employed C. C. Carlisle. Consulting Engineer, First Nat. Bank Bldg., Cheyenne, Wyo., to prepare plans and specifications for a waterworks system.

Canada.

✣Bids will be received until 8 p. m., March 5, by Alex J. LeBlanc, Town Clerk, Dalhousie, N. B., for the following works: Contract B—Power house; contract G—Booster pump; (1) steam pump; (2) turbine pump; contract H—Two boilers; contract J—Electric light engine; (1) high speed steam engine; (2) gas engine and gas producers; (3) Diesel oil engine; (4) crude oil engine; contract K—Electrical equipment and distribution system. Plans and specifications may be seen at the office of Chipman & Power, Engineers, Mail Building, Toronto, or at Dalhousie, N. B.

✣Bids will be received until noon, March 4, by Chairman H. C. Hocken, Board of Control, Toronto, Ont., for 24-in. and 30-in., 36-in. A, and 36-in. B, and 42-in. cast iron pipes. Specifications may be had upon application to the water works section, Department of Works, Toronto, Ont.

✣Bids will be received until noon, Feb. 28, by J. C. Holden, Division Engineer, Canadian Pacific Ry., Winnipeg, Man., for excavating, back-filling and laying pipe lines on Manitoba Division. Plans and specifications may be seen at the office of the Division Engineer.

✣Bids will be received until 11 a. m., Feb. 21, by Chairman, Board of Control at the office of M. Peterson, Secy., Winnipeg, Man., for delivery f. o. b. cars, City Yards, Ross Ave., of air compressors and induction motors. Specification and form of tender together with conditions governing tenders as prescribed by law may be obtained at the office of the City Engineer, 223 James Ave.

⊙T. M. Cullon, of Huntsville, Ont., has been awarded the contract for excavating and pipe laying for the proposed water works system at Park Hill, Ont. The Kerr Engine Co., Walkerville, Ont., secured the contract for furnishing valves. The contract for pumping machinery has not been awarded. Bids were opened on Feb. 7. Bowman & Connor, Berlin, Ont., are Engineers.

⊙Drummond & McCall, of Montreal, Que., have been awarded the contract by J. J. Hackney, Commissioner of Utilities, Port Arthur, Ont., for the supply and delivery of the following lap-welded steel pipe, f. o. b. Port Arthur: 24-in. pipe, 5/16-in. metal, Bell & Spigot joints, 40,200 lin. ft.; 24-in. pipe, 5/16 in. metal, flanged joints, 2,700 lin. ft.; 24-in. pipe, ¼-in. metal, flanged joints, 2,700 lin. ft. (alternative); 12-in pipe, 3/16-in. metal, Bell & Spigot joints, 6,000 lin. ft. Also specials and flexible joints for the above. The contract price is $191,306. Bids were opened Feb. 3.

Bids will be received until 11 a. m., March 6, by Board of Control addressed to Chairman at the office of M. Peterson, Secy., Winnipeg, Man., for supply of quantity of cast iron water pipe and gate valves for the domestic water works system. Specification and form of tender, together with conditions governing tenders as prescribed by law may be obtained at the office of the City Engineer.

SEWERAGE AND SANITATION

California.

⊙According to advices from San Pedro, Calif., John Balch, of Los Angeles, Calif., has been awarded the contract for building the Barton Hill sewer, for $34,000.

⊙S. M. Kerns of Los Angeles, Calif., has been awarded the contract by the City Trustees of Santa Ana, Calif., for constructing sewer laterals throughout the southern portion of the city, for $13,900.

The Board of Trustees of Fowler, Calif., has adopted plans and specifications prepared by Engineer Thomas Robeson for a new sewer system. It is proposed to ask bids for the construction work at once.

The City Trustees of Oceanside, Calif., are working out a plan for a sewer district, to be installed on the district plan, and calling for an expenditure of about $20,000. Plans are being prepared by City Engineer N. K. Carpenter of Escondido, Calif.

City Engineer Homer Hamlin of Los Angeles, Calif., is preparing plans for a second outfall sewer, in anticipation of the city's growth.

Delaware.

A bill was introduced in the Delaware Legislature on Feb. 10, authorizing the town of Clayton to borrow $15,000 for the installation of a water and sewerage system.

The Town Council of Delmar, Del. (population 530) has appointed Irving Culver, Frank E. Lynch and Frazier G. Elliott as a committee to look into the matter of a sewerage system and building streets for the town.

A bill has been introduced in the Delaware legislature, Dover, authorizing the town of Newark to issue bonds to the extent of $60,000 for the installation of a sewerage system. T. Chalkley Hatton, Wilmington, Del., is Consulting Engineer for Newark.

Florida.

The Board of Public Works of Tampa, Fla., has retained Consulting Engineers Twombley & Henney, 111 Broadway, New York City, to prepare final plans and supervise the construction of the installation of the new sewerage system. The estimated cost of the system is $500,000. Fred. T. Warren is City Engineer.

Georgia.

✣Bids will be received until 3 p. m., March 3, by Mayor and General Council, Atlanta, Ga., for furnishing the following material and doing the following work for the year 1913: Cement for sewer department, castings for sewer department, vitrified pipe for sewer department, chert for street department, brick for repairs, cement for repairs, broken stone for street department, asphalt for street department, sand for repairs, tile for repairs, laying tile and cement sidewalks for repairs; also for furnishing the material and doing the following work: Furnishing and laying granite curbing, furnishing and laying concrete curbing, furnishing and laying tile sidewalks, furnishing and laying sheet cement sidewalks, furnishing and laying brick sidewalks, furnishing material and laying rubble guttering. Specifications will be furnished upon application. R. M. Clayton, Chief of Construction.

Consulting Engineers Solomon-Norcross Co., Atlanta, Ga., have submitted plans for the building of a sewage disposal plant for the Home of the Aged and Infirm, at Louisville, Ky., to the Board of Public Safety. The cost of the plant would be $8,750, while the annual cost of pumping would be $250.

Illinois.

✣Bids will be received until 7:30 p. m., Feb. 25, by the Village of Bradley, Ill., for the construction of a main sewer. Full plans and specifications are on file in the office of Blackmere & Post Pipe Co., 1201 Hartford .Bldg., Chicago, Ill., and with Evans & Howard Fire Co., 1254 First National Bank Bldg, Chicago, Brick Co., 1254 Firt National Bank Bldg., Chicago, Ill. C. A. oVorhees is President of the Board of Local Improvements, Bradley, Ill. Official advertisement will be found elsewhere in this issue.

⊙The Carson-Payson Co. has been awarded the contract for constructing the sanitary sewer extending from Collett St. east to Bowman Ave., thence north to Seminary St., and thence east to Griffith St., with several laterals, aggregating over three miles of sewer, in the city of Danville, Ill.

⊙The Streator Clay Mfg. Co., Streator, Ill., has been awarded the contract by the city of Minneapolis, Minn., Kossuth E. Alexander, Purchasing Agent, for furnishing the city with vitrified clay sewer pipe during the season of 1913, for $66,437. Bids were opened Feb. 5.

The Board of Public Improvements of Galesburg, Ill., has decided to construct a sewer in West Main St., from Ivan Ave. west about half a mile to Cedar Fork. F. M. Connolly is City Engineer.

The Board of Local Improvements of East St. Louis, Ill., has approved plans for the installation of a $341,000 outlet sewer to drain a district known as Winstanley. Plans have been submitted to the City Council. Ed. F. Harper is City Engineer.

The Board of Local Improvements of Rockford. Ill., proposes the construction of a sewer system to cover a territory five miles in length. The estimated cost is $33,600. The cost of other extensions to the system will bring the total over $43,000. Edwin Main is City Engineer.

The City Council of Cuba, Ill., has retained Consulting Engineer W. A. Fuller of the Fuller-Coult Co., Chemical Bldg., St. Louis, Mo., to make preliminary surveys for a sewerage system. Storm and sanitary sewers are to be installed.

The estimated cost of the east end sewer project for the city of Moline, Ill., as itemized by the engineering department and adopted by the Board of Local Improvements is as follows: Construction of approximately 11 miles of sewer mains and extensions, $105,249; two Imhoff sewage tanks, $3,247; pump house and pit in connection with the sewage treatment plant at 39th St., $3,732; sludge beds, part of the equipment, $762; engineering costs, assessment, etc., $6,779.

In our last issue we had an item stating that the Village Board of Bradley, Ill., was calling for bids to be opened Feb. 25 for constructing a sewer system. In this item it was stated that Ernest McCullough, Chicago, Ill., was the engineer. This was an error as Mr. McCullough is not the engineer for the work on which the bids are now being taken.

Indiana.

✣Bids will be received until 4 p. m., Feb. 24, by Board of Public Works, Terre Haute, Ind., for the construction of the following improvements: Sewer in N. Third St., from Cherry St. to Chestnut St.; sewer in S. 13th and One-half St., Walnut to Poplar St.; sewer in S. Fourth St., Idaho St. to McKeen St.; sewer in S. Fifth St., Idaho St. to McKeen St.; sewer in N. 21st St., Plum to Beech St. Detail plans and specifications are now on file in the office of the Board of Public Works of said city and may be seen by all persons interested. Each sewer must be bid upon separately. Bids must be accompanied by a bond or certified check for the sum of $200. W. A Thornton is Secretary.

⊙J. J. Quinn & Co., Bedford, Ind., have been awarded the contract at Bedford, Ind., for the construction of the East Bedford sewer, at $22,500.

⊙The Board of Public Works of Elkhart, Ind., has adopted primary assessment rolls for the 12th district sewer, the territory covering all between Vine St., and the city limits and the St. Joseph River, costing about $28,000; also the Arcade Ave. sewer, costing about $2,500.

City Engineer Harry M. Miles of Michigan City, Ind., has completed preliminary work for the construction of a trunk sewer. The proposed sewer is to be in three parts, the main portion beginning at the harbor near the foot of Seventh St., and extending to the southwestern part of the city, ending at Hoyt and Russell Sts. This section will be 6,500 ft. in length. The easterly branch will begin at Porter and Michigan Sts. and will connect with the main trunk at Thurman and Lafayette Sts. This branch will be 4,400 ft. long. The southerly branch will begin at Franklin St. and Coolspring Ave., and will connect with the main line at Franklin and Allen Sts., a distance of 3,500 ft.

The Board of Public Works of Vincennes, Ind., has decided that the city should construct a system of storm sewers. The work will include 2½ miles of vitrified pipe sewers varying from 12 to 27 ins. in diameter, and 6/10 of a mile of concrete sewer, carying in diameter from 36 to 54 ins. Joseph V. Hershey is City Engineer.

Iowa.

✣Bids will be received until 7 p. m., March 10, by City Council, Toledo, Ia., for the construction of a sewage disposal plant and outlet sewer. Plans and specifications, etc., may be seen at the office of J. N. Lichty, City Clerk, and may be obtained of Sam Steigerwalt, Engineer, Nevada, Ia., for the sum of $2. Official advertisement will be found elsewhere in this issue.

⊙M. McElligott, of Evanston, Ill., has been awarded the contract by the town of Belmond, Ia., G. J. Byers, Town Clerk, for the construction of 8,313 ft. of 8 and 12-in. sewer, for $4,771. H. J. Klemme Lbr. Co., Belmond, secured the contract to construct the settling tank for $1,180. Bids were opened Feb. 11. M. Tschirgi & Sons, Cedar Rapids, Ia., are Engineers.

Kansas.

City Engineer G. L. McLane of Hutchinson, Kans., has prepared the plans for the extension of the city sewer to the Arkansas River.

The City Commission of Dodge City, Kans., has decided to install two miles of sewer mains in Dodge. The estimated cost is $7,000. J. F. Miller is official in charge of sewers.

Kentucky.

⊙J. H. Cahill has been awarded the contract by the Board of Public Works of Louisville, Ky., for the construction of the South Louisville sewer, embracing the following streets: Fourth, between K and Central; Fifth, from L to Central; Sixth, from L to Central; N, from Third to Seventh; O, from Third to Sixth, and L, from Third to Seventh. The estimated cost of the work was $36,000.

Maryland.

Following bids were received by the Board of Awards of Baltimore, Md., on Sanitary Contract No. 107, and Sanitary District No. 8, after being re-advertised: Frank Bruno & Co., Newark, N. J., $117,674; Irwin & Conklin, Greenville, Ohio, $118,860; Carson & Lavesen, 2016 Penna Ave., Baltimore, Md., $133,629; Henry Spinach Cont. Co., Waterbury, Conn., $137,166; Wm. McCarthy & Co., Baltimore, Md., $144,716; Gallagher, Boyle & Bryan, 147 W. Montgomery St., Baltimore, Md., $151,498; Ryan & Reilly, 612 Union Trust Bldg., Baltimore, Md., $152,121.

Michigan.

The City Council of Bad Axe, Mich. (population 1,559), has decided to establish a system of sewerage.

The Village of Chesaning, Mich. (population 1,363), has employed an engineer to make plans for a sewer system. A special election will probably be held to vote bonds for the improvement.

Minnesota.

⊙The Universal Portland Cement Co., Chicago, Ill., has been awarded the contract by the city of Minneapolis, Minn., K. E. Alexander, Purchasing Agent, for furnishing 25,000 bbls. of cement for sewers, and 65,000 bbls. for paving work, at $1.20 net.

⊙Landers, Morrison & Christenson have been awarded the contract by the city of Minneapolis, Minn., K. E. Alexander, Purchasing Agent, for furnishing 300,000 paving bricks for sewers, at $15.40 per M.

⊙The city of Minneapolis, Minn., K. E. Alexander, Purchasing Agent, has awarded the contract for furnishing 600,000 sewer bricks to the Wisconsin Pressed Brick Co., at $9.70 per M., and 400,000 bricks to the Hydraulic Pressed Brick Co., at $8.95 per M, the premium being for early deliveries, and also the remaining 1,000,000 bricks at $8.70 per M.

⊙The American Brake Shoe Co., Minneapolis, Minn., has been awarded the contract by that city, K. E. Alexander, Purchasing Agent, for furnishing special castings for sewers at $32.90 per ton. Bids were opened Feb. 5.

City Engineer H. F. Gebeler of Rochester, Minn., is preparing plans and estimate of cost for a sewer on College St., between Main and Franklin Sts.

The Oscar Claussen Engineering Co., St. Paul, Minn., is preparing a report to be submitted to the Commercial Club of Deerwood, Minn., relative to the installation of a sewerage and a waterworks system in that city. It is thought the waterworks system will cost $14,000 and the sewerage system $8,000.

It is thought a sewage disposal plant will be constructed in Chisholm, Minn. City Engineer F. C. Lang of Chisholm was in Gilbert looking over the settling tank and percolating filter built in 1911 in Gilbert. This was built from plans prepared by Consulting Engineer Frederic Bass of the State Board of Health from data submitted by Village Engineer Frank A. Gowman of Gilbert. The plant has been working successfully since its installation. The Chisholm problem is more complicated than at Gilbert and a much larger population must be provided for. There is not sufficient fall for the use of gravity and pumps must be used somewhere in the process.

Missouri.

✣Bids will be received until 2 p. m., March 11, by Board of Public Works, E. J. McDonnell, Secy., Kansas City, Mo., for the construction of a refuse disposal plant of 75 tons daily capacity. Specifications can be had by application to the Secretary of the Board of Public Works, Kansas City, Mo. A certified check, in amount equal to five per cent of the first $10,000 and 2½ per cent of the balance of the price bid, made payable to the City Comptroller of Kansas City, Mo., must be filed with each bid.

✣Bids will be received until March 3 by City of Hannibal, Mo., for furnishing and laying 44,000 lin. ft. of sewers, including manholes. The cost is estimated at $125,000. B. F. Smiley, Hannibal, Mo., is Engineer.

⊙R. E. Cooney, 3511 Wyoming St., St. Louis, Mo., has been awarded the contract by the city of Maplewood, Mo., for the construction of a sewer in Manchester Ave., for $13,600. Bids were opneed Feb. 11.

⊙The City Council of Marshall, Mo., has awarded the contract for the construction of sewers in sub-district No. 6, of District No. 2, to A. Jaick Co., for $8,356. The work includes the following: 4,735 lin. ft. of 6-in. sewer; 2,180 lin. ft. of 8-in. sewer; 2,251 lin. ft. of 10-in. sewer; 20 manholes; 4 drop manholes; 10 flush tanks, and 460 lin. ft. of 6-in. connections.

New Jersey.

⊙Booth & Flinn of Pittsburgh, Pa., have been awarded the contract by the Passaic Valley Sewerage Commission, Newark, N. J., for the construction of Section 7 of the intercepting sewer, compressed air tunnel, for $1,413,030. Bids were received Feb. 4. A list of the itemized bids was given in our last issue.

The towns of Westmont and Oaklyn, N. J., are agitating the installation of municipal sewerage systems, the macadamizing and curbing of streets and increasing the electric street lighting.

The law committe of the Common Council, Rahway, N. J., has reported favorably on the plans of Consulting Engineer Clyde Potts of New York City and the Sanitary Commission for a sewage disposal plant in Rahway.

New York.

An ordinance has been introduced in the Common Council of Binghamton, N. Y., directing City Engineer John A. Giles to prepare and file plans and estimates of the cost of construction of three intercepting sewers, to be a part of the sewage disposal system.

The Chamber of Commerce at Wappingers Falls, N. Y. (population 3,195), recently appointed a committe to ascertain the cost of sewers for the village. It is probable that the citizens will be asked to vote on the proposition at the March election, and the appointment of an engineer to report on the advisability of a system.

Dr. Gilbert J. Fowler of the Institute of Chemistry of Great Britain and Ireland, and John D. Watson, a chemical engineer, in charge of the biological works at Birmingham, Eng., have submitted their report to George A. Soper, president of the Metropolitan Sewer Commission, New York City, relative to health and commerce. The report recommends the expenditure of approximately $20,000,000 by the city of New York to conserve its waters for the purposes. It suggests the installation of a system that will carry 200,000,000 gals. of waste to an artificial island in the sea and there treating it chemically before it is distributed in the waters.

The Litchfield Construction Co., 23 Flatbush Ave., New York City, submitted the lowest bid to President Maurice E. Connolly of the Borough of Queens, New York City, for building the Corona sewer main from the pierhead line of Flushing Bay through 41st St. to 51st St., a little over a mile. The company bid $223,789 on the work. The new main will be 10 ft. by 7 ft. 7 ins., and the contract includes a screening chamber in Flushing Bay and settling basins in 43d St.

Ohio.

✣Bids will be received until noon, Feb. 20, by V. T. Price, Director of Public Service, Cincinnati, O., for the construction of main and lateral sewers and drains with appurtenances in Streng St., from Top St. to Colerain Ave. A certified check for $500 must be filed with each bid. Plans and specifications can be obtained at the office of the Chief Engineer, Department of Public Service.

✣Bids will be received until noon, Feb. 21, by V. T. Price, Director of Public Service, Cincinnati, O., for the construction of main and lateral sewers, and drains with their appurtenances, in right of way and McPherson Ave., from Garfield (now Fairbanks) Ave. and Basset road to W. Eighth St.; Wells Ave., from Sedler St. to W. Eighth St.; right of way from McPherson Ave. to Terry St.; Terry St., from right of way south of W. Eighth St. to Price Ave.; W. Eighth St., between McPherson Ave. and Enright Ave., and Sedler St., from right of way to Wells St. Plans, specifications and blank proposals can be obtained at the office of the Chief Engineer, Department of Public Service. Each proposal must be accompanied by a bond in the sum of $2,000 or a certified check on a solvent bank. M. J. Keefe is Clerk.

✣Bids will be received until noon, Feb. 20, by V. T. Price, Director of Public Service, Cincinnati, O., for the construction of main and lateral sewer and drains, with their appurtenances, in Howard Ave., from Springlawn Ave. 500 south; right of way east Hamilton Ave. and north of Springlawn Ave. 70 ft. more or less. Plans, specifications and blank proposals can be obtained at the office of the Chief Engineer, Department of Public Service. Each proposal must be accompanied by a bond in the sum of $500 or a certified check on a solvent bank. M. J. Keefe is Clerk.

✣Bids will be received until noon, Feb. 21. by G. H. Lewis, Director of Public Service, Elyria, O., for the construction of a sewer in Second St., from West Ave. to Court St.. in accordance with plans and specifications on filed with the City Auditor and the Director. A certified check for $500 must be filed with each bid.

✣Bids will be received until noon, Feb. 20, by V. T. Price, Director of Public Service, Cincinnati, O., for the construction of main and lateral sewers and drains, with their appurtenances, in Lilac Ave., from Ivy Ave. to Maple Ave.; Maple Ave., from Lilac Ave. to Bradley Ave., and Bradley Ave., from Maple Ave. to Potomac Ave. Plans, specifications and blank proposals can be obtained at the office of the Chief Engineer, Department of Public Service. Each proposal must be accompanied by a bond in the sum of $1,000 or a certified check on a solvent bank. M. J. Keefe is Clerk.

✣Bids will be received until noon, Feb. 20, by V. T. Price, Director of Public Service, Cincinnati, O., for the construction of main and lateral sewers and drains with their appurtenances in Howard Ave., from Springlawn 500 ft. south; right of way east Hamilton Ave., and north of Springlawn Ave., 70 ft. more or less. M. J. Keefe is Clerk.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

✣Bids will be received until noon, Feb. 21, by G. H. Lewis, Director of Public Service, Elyria, O., for the construction of a sewer in West St., from the end of the present sewer to Huron road. A certified check for $500 must be filed with each bid. Plans and specifications are on file with the City Auditor.

⊙Following bids were recently submitted to Service Director G. B. Hatfield of Troy, O., for the construction of a sewer in that part of the city south of the canal: Fidler & Brock, Springfield, O., $32,848; Kohbarger & Hoyles, Marion, O., $43,100; W. J. Irwin & Co., Greenville, O., $41,105; Shafor & Dill, Dayton, $35,746; Sieverling & Fairburn, Springfield, O., $41,423. The sewer with all its branches is six miles in length. The contract is reported to have been awarded to the lowest bidder.

The Village Council of Celina, O. (population 3,493), has instructed the village solicitor to draw up necessary forms to initiate legislation for the issuing of $80,000 worth of sewer bonds to install a complete sanitary sewer system. W. J. Sherman Co., The Nasby, Toledo, O., are Engineers.

City Engineer Frank E. Weaver of Hamilton, O., has been instructed to prepare plans and specifications, etc., for a storm sewer system east of the canal.

The City Council of Bucyrus, O., plans to take steps immediately toward the installation of a sewage disposal plant to prevent the pollution of the Sandusky River. E. J. Songer is Mayor.

G. H. Lewis, Director of Public Service, Elyria, O., has rejected all bids received Feb. 5 for the construction of a sewer connecting with the present outlet and the so-called Faxon sewer. The work will be done by day labor.

Oklahoma.

It is probable that a bond election will be held in the town of Caddo, Okla., shortly for the purpose of voting on the issuance of bonds to the amount of from $10,000 to $25,000 for the installation of a sanitary sewer system.

Oregon.

✣Bids will be received until March 11 by Dalles City, Ore., for the construction of 15,000 ft. of 6, 8 and 12-in. lateral sewers. Further information can be obtained with proposal blanks of C. L. White, City Engineer.

Pennsylvania.

The Town Council of Norristown, Pa., has submitted plans for a sewage disposal plant for that city to the State Department of Health for approval. The plant will cost $55,000 to construct, and it will require from $2,000 to $3,000 a year for maintenance. It will consist of a two-story sedimentation tank, of the Imhoff type, capable of treating 2,000,000 gals. of sewage daily, and will be erected on a lot on the Schuyl River front. S. Cameron Corson is City Engineer.

Legislation to require the state to pay one-half of the cost of installing sewage disposal plants in cities, boroughs and other municipalities has been introduced in the Senate by Senator Beidleman of Dauphin County, Pa.

City Civil Engineer B. F. Miller of Meadville, Pa., has recommended to the City Council the construction of a number of sewers, as follows: Storm sewers in Terrace St.. estimated to cost $1,360; storm sewers in Spring St., $965; storm sewers in Prospect St., $2,780; storm sewers in Walnut St., $320; storm sewers in Water St., $3,500; storm sewers in Liberty St., $1,400; storm sewers in S. Main, $8,050; storm sewers in Washington St., $1,840; storm sewers in State St., $3,500, and storm sewers in Grove St., $1,060.

The Board of Public Works of Reading, Pa., has petitioned the Council to advertise for bids for the construction of the sewer on Sixth St., from Robeson to Arch and on Third St., from Bern to the intercepting sewer. These sewers are parts of the proposed sewer system for which bonds to the amount of $300,000 were recently issued. E. B. Ulrich is City Engineer.

According to advices from Lansdowne, Pa., the Borough Council of East Lansdowne is asking bids for the construction of a sewerage system to Darby Creek.

South Dakota.

A sewerage system is to be installed in the city of Howard, S. Dak. (population 1,026).

Texas.

An election is to be held in Temple, Tex., in April for the purpose of voting on the issuance of bonds to the amount of $280,000 for improvements, as follows: $170,000 for street paving, $90,000 for sanitary and storm sewers, $15,000 for the fire department, and $5,000 for public parks. W. E. Dozier is City Engineer.

The City Council of Pecos, Tex., has retained Consulting Engineers Jennings & Woods of El Paso, Tex., for the engineering work preliminary to the installation of a sewer system. Bonds to the amount of $35,000 were recently voted for the improvement.

City Secretary J. B. Winslett of Dallas, Tex., is asking bids for the construction of a 6-in. sanitary sewer in Exposition Ave., and in First Ave., and Second Ave., from Grand Ave. to Brady St. City Engineer J. M. Preston has estimated that 6,253 ft. of pipe will be required.

Mayor Acheson of Denison, Tex., has asked the City Council and City Attorney J. S. Kone to investigate the matter of disposing of the city's sewage.

Washington.

✣Bids will be received until Feb. 24 by M. M. Bowman, City Clerk, Charleston, Wash., for the construction of a sewer system.

✣Bids will be received until Feb. 24 by J. L. Mitchell, City Clerk, Sumas, Wash., for the construction of sewers.

The Board of Public Works of Seattle, Wash., has approved plans and specifications for the construction of sewers in 42nd Ave., N. W., et al., to cost about $23,600. The work will include 10,024 ft. of 8, 10, 12 and 15-in. pipe. A. H. Dimock is City Engineer.

Wisconsin.

⊙The Board of Public Works of La Crosse, Wis., has awarded the contract for the construction of a sewer extension on N. Third St., from La Crosse St., to the La Crosse River bridge, to the Thill-Manning-Whalen Co. of that city for $2415.

The Business Men's Association of Brodhead, Wis. (population 1,517), recently sent a committee to Evansville, Wis., to investigate plans and the cost of the sewer system of that city, with a view to installing a similar system in Brodhead. Dr. F. R. Derrick is a member of the committee.

The Board of Public Works of Evansville Wis. has ordered the construction of sewers in Sanitary District "A." E. Gabriel is a member of the board.

BUILDINGS

California.

⊙Lindgren & Co., San Francisco, Cal., has been awarded the contract at about $275,000 for erecting the 10-story, steel, brick and cement construction, Fiske Bldg., at Fresno, Cal.

Colorado.

⊙J. J. Cooke, Central Savings Bank Bldg., Denver, Colo., has been awarded the general contract for the first unit of the Myron Stratton home at Colorado Springs, Colo., at $147,895.

The Bishop-Cass Investment Co., Oscar D. Cass, President, Denver, Colo., has authorized bonds for the erection of a 10-story office building on the north corner of 16th and Curtis Sts., Denver.

Connecticut.

⊙New England Granite Works, Westerly, R. I., has been awarded the contract at $197,000 for furnishing and setting all exterior Bethel granite work on the extension to the municipal building at Hartford, Conn. Bids were opened Jan. 13.

⊙P. J. Carlin Construction Co., New York City, was awarded the contract on Feb. 13 for all work on municipal building extension of Hartford, Conn., except the exterior granite finish. The contract price is $623,677. Bids were opened Jan. 13.

Cuba.

✣Bids will be received until 11 a. m., March 1, by H. R. Stanford, Chief of Bureau of Yards and Docks, Navy Department, Washington, D. C., for buildings to be erected at the naval station, Guantanamo, Cuba. The cost of the work is estimated at $11,000.

Georgia.

✣Bids will be received until noon, March 10, by Marion M. Jackson, Chairman Building Committee, Y. M. C. A., Atlanta, Ga., for the erection and completion of the Y. M. C. A. building on Luckie St., Atlanta. This building is to be of fire-proof construction and will consist of eight stories and basement otherwise as more minutely described in plans and specifications, which can be secured under certain conditions at the office of Shattuck & Hussey and A. Ten Eyck Brown, Associate Architects, Forsyth Bldg., Atlanta, Ga.

✣Bids will be received until 3 p. m., March 25, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction, complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures and approaches of the United States Post Office at Tifton, Ga. The building is to be of one story, basement and mezzanine, and have a ground area of approximately 4,400 sq. ft.; fireproof first floor, stone and brick facing and tin and tile roof. Drawings and specifications may be obtained from the custodian of site at Tifton, Ga., or at the discretion of the Supervising Architect. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 10 a. m., March 11, by R. V. Ladow, Superintendent of Prisons, Department of Justice, Washington, D. C., for furnishing and delivering at the U. S. penitentiary at Atlanta, Ga., structural steel and iron to and including first floor framing for bath, laundry and tailor shop building, U. S. penitentiary at Atlanta, Ga., in accordance with specifications.

✣Bids will be received until 2 p. m., Feb. 21, by Commissioners of the District of Columbia, Washington, D. C., for heating and ventilating system for Normal School No. 169, located on Georgia Ave., between Howard Pl. and Fairmont St., N. W., Washington, D. C. Blank forms of proposal, specifications and all necessary information may be obtained from the Chief Clerk, Engineer Department, room 427, District Bldg., Washington, D. C.

⊙Little & Cleckley, Annister, Ala., have been awarded the contract at about $155,000 for constructing a court house at Athens, Ga., for Clarke County.

Illinois.

Bids will be received until 1 p. m., March 3, by Calvin C. Loy, County Clerk, Effingham, Ill., for the furnishing of all materials and labor necessary for the erection and completion of the proposed new jail and sheriff's residence for Effingham County, according to the plans and specifications as prepared by J. W. Gaddis, Architect, Vincennes, Ind.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Iowa.

⊙The Falls City Construction Co., Louisville, Ky., has been awarded the contract at $102,600 for constructing a court house at Rockwell City for Calhoun County.

County supervisors at Rock Rapids, Ia., have called a special election for March 15 to vote on bonding for $140,000 for constructing a court house.

Kentucky.

Plans are being made for a parochial school for St. Patrick's parish, Covington, Ky. It will contain eight class rooms, auditorium, gymnasium and assembly rooms, and will cost about $50,000. Contracts will be let about April 1st. Peter J. Gill, 263 West 4th street, Covington, Ky., is the chairman of building committee.

Massachusetts.

✣Bids will be received until 2 p. m., Feb. 27, Treasury Department, U. S. Life Saving Service, Washington, D. C., for the construction of a floating Life-Saving Station for Dorchester Bay (City Point), Boston, Mass. Specifications and drawings, forms of proposal, etc., and full information can be obtained upon application. S. I. Kimball is general superintendent.

⊙The Office, Bank & Library Co., 69 Portland St., Boston, Mass., has been awarded the contract for the erection of two new vaults and installation of metal furniture and safes in the City Hall, West Newton, Mass.: bids were opened Feb. 3.

Missouri.

✣Bids will be received until 9 a. m., Feb. 27, by County Court, Livingston County, at the office of A. M. Shelton, County Clerk, Chillicothe, Mo., for the necessary labor and material for the construction of the proposed courthouse. Sasse & Roberts, 312 Exchange Bank Bldg., Columbia, Mo., are Architects.

⊙Edward Ward, Chemical Bldg., St. Louis, Mo., has been awarded the contract for the new Children's Hospital to be erected on Kingshighway, St. Louis. Mauran, Russell & Crowell, St. Louis, Mo., are the Architects.

The Laclede Gas Light Co., Chas. L. Holman, President, St. Louis, Mo., has acquired 200 acres of land on the Des Peres River near St. Louis, Mo., and has plans prepared for a large coke oven plant to be erected at that point. The ultimate cost of the plant will be about $5,000,000. The first construction will be of 56 ovens in one battery, and storage facilities for about 200,000 tons of coal.

New Jersey.

✣Bids will be received until 8 p. m., March 6, by Committee on School No. 34, Board of Education, Jersey City, N. J., for all labor and material required for the enlargement of School No. 34, Hudson Blvd. and Warner Ave., in accordance with the plans and specifications on file in the office of the Secretary of the Boards. Copies of plans and specifications and blank form of proposal must be obtained at the office of the Supervising Architect, John T. Rowland, Jr., 98 Sip Ave., Jersey City. G. Fred. Ege is Secretary of the Board

New York.

✣Bids will be received until 3 p. m., March 17, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for a non-interfering fire alarm system at the United States Appraisers' Warehouse, New York, N. Y. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 11 a. m., March 6, by Dr. Henry H. Stebbins, President, Board of Trustees, New York State Custodial Asylum, Newark, N. Y., for the construction of cold storage building and contagious disease pavilion, construction, heating, plumbing, electric work and refrigerating and icemaking apparatus; for employes' building; construction, heating, plumbing and electric work at the New York State Custodial Asylum. Drawings and specifications may be consulted and blank forms of proposal obtained at the New York State Custodial Asylum, Newark, N. Y., and at the office of the State Architect. Complete sets of plans and specifications will be furnished prospective bidders upon reasonable notice and in the discretion of the State Architect, Herman W. Hoefer, Capitol, Albany, N. Y.

The Board of Contract and Supply, Syracuse, N. Y., has decided to call for bids for the completion of the Central fire alarm system and equipment for the city.

Ohio.

✣Bids will be received until noon, March 15, by Board of Education, East Cleveland, at the Shaw High School, Cleveland, O., for work, labor and material to complete the addition to the Rozelle School building according to the plans and specifications now on file in the office of Willard Hirsh, architect, 1302 Swetland Bldg., Cleveland, Ohio.

✣Bids will be received until noon, March 15, by Board of Education of East Cleveland, at Shaw High School, Cleveland, O., for labor and material to complete the addition to the Chambers School Building according to the plans and specifications now on file in the office of Willard Hirsh, architect, 1302 Swetland Bldg., Cleveland, Ohio. Charles Ammerman is Clerk of the Board.

✣Bids will be received until 3 p. m., March 19, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the mechanical equipment, except elevators and lifts, of the United States Post Office and Court House at Dayton, Ohio, in accordance with drawings and specifications, copies of which may be obtained at the office of the Superintendent of Construction, Dayton, O., or at the discretion of the Supervising Architect. Official advertisement will be found elsewhere in this issue.

11, by Board of Education, P. T. Harrold, Clerk, City School District, Lakewood, O., for furnishing the labor and material for the construction of the Lincoln School, located on the property owned by the Board of Education on Clifton Blvd. between Lakeland and Summit Ave., in accordance with the plans and specifications prepared by Chas. W. Hopkinson, architect, No. 900 Rose Bldg., Cleveland, O., which are on file at the office of the clerk of said board and at the architect's office. Duplicate copies of the plans and specifications may be had of said architect upon application to him and the deposit of $20.

✣Bids will be received until noon, March 10, by Cleark of the Board of Education, E. Sixth St., Cleveland, O., for furnishing all the materials and for doing all the work necessary to remodel the school building on the property owned by the board of education on the present site of the old building on Warren St. near Dille Ave., S. E., and known as Warren School, in accordance with the plans and specifications on file in the office of the architect of said board, E. Sixth St. F. G. Hogen is Director of Schools.

⊙Steinie Construction Co., Fremont, O., has been awarded the contract at $134,427 for the construction of the administration buildings of the State Normal School at Bowling Green, O.

Pennsylvania.

⊙W. F. Trimble & Sons Co., Pittsburgh, Pa., has been awarded the contract at $184,561 for alterations to court house and jail of Allegheny County, Pa., bids for which were opened Feb. 11, at Pittsburgh, Pa.

South Carolina.

✣Bids will be received until 11 a. m., March 15, by H. R. Stanford, Chief of Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., for an ice-making and refrigerating plant at the U. S. Naval disciplinary barracks, Port Royal, S. C. The cost of the work is estimated at $6,000.

South Dakota.

✣Bids will be received until 3 p. m., March 14, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures, and approaches, of the United States postoffice at Brookings, S. Dak. The building is to be of one-story and basement and has a ground area or approximately 5,000 sq. ft.; fireproof construction throughout, except roof; stone facing and copper tile roof. Drawings and specifications may be obtained from the custodian of site at Brookings, S. Dak., at the discretion of the Supervising Architect.

Tennessee.

The officers of the Commercial Trust & Savings Bank, Abe Goodman, President, Memphis, Tenn., are to have plans prepared for a steel frame and brick, 22-story office and bank building to be erected at Main St. and Union Ave., Memphis.

Texas.

✣Bids will be received until 3 p. m., March 24, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction, complete, including plumbing, gas piping, heating apparatus, electric conduit and wiring, and lighting fixtures, of the United States post office at Weatherford, Tex. The building is one story and basement, with a ground area of approximately 4,800 sq. ft. Fireproof construction; stone and brick facing; tin roof. Drawings and specifications may be obtained from the custodian of site at Weatherford, Tex., or at the discretion of the supervising architect.

✣Bids will be received until noon, Feb. 24, by Dan C. Smith, Jr., City Secretary, Houston, Tex., for the erection of a 3-story fireproof high school building. The work to be let in four separate contracts as follows: General, heating, plumbing, sewering and gas fitting. Wiring. Bids to be submitted on blanks prepared by the architects, Layton A. Smith, Houston, Tex. Plans and specifications are on file at the office of the architects and may be obtained by contractors. Each bidder on general work to enclose with his bid, his certified check for 3 per cent of bid. Bidders on other contracts to enclose check for 10 per cent of each bid. Checks to be on any bank in Houston, made payable to H. B. Rice, Mayor, and certified, to be held for damages in case successful bidder fails to make bond.

✣Bids will be received until 8 p. m., March 5, by J. D. Yocum, city secretary, Denison, Texas, for the erection of a 3-story high school building, according to the plans prepared by A. O. Watson, architect, Austin, Texas. Plans can be seen on file at the office of city secretary and architect. Contractors desiring plans and specifications for use in preparing bids can secure the same by filing with the architect at his office, Austin, Tex., a certified check for $25, subject to refund under conditions made by architect for safe return of plans.

⊙Thannes & Weber, Beaumont, Tex., have been awarded the contract at $11,550 for constructing a municipal abattoir for the city of Beaumont. The contract calls for the construction of the building but does not include any equipment. Bids were opened Feb. 4. J. G. Sutton is City Secretary.

⊙Fred A. Jones Co., Dallas, Tex., has been awarded the contract at $414,000 for constructing a city hall for Dallas. Bids were opened Jan. 31.

Virginia.

✣Bids will be received until 11 a. m., March 3, by Quartermaster, Washington, D. C., for construction and plumbing for an addition to the lodge for the superintendent U. S. National Cemetery, Hampton, Va.

Washington.

✣Bids will be received until 11 a. m., March 5, by Constructing Quartermaster, Vancouver Barracks, Wash., for the installation of ventilating ducts in 8 barracks of the old type at that post

Wisconsin.

✣Bids will be received until 3 p. m., March 15, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C.,

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

for the construction, complete, including plumbing, gas piping, heating apparatus, electric conduit and wiring, interior lighting fixtures, and approaches, of the United States postoffice at Waukesha, Wis. The building is one story, mezzanine and basement, with a ground area of approximately 6,050 square feet. Fireproof construction except ceiling and roof; stone facing; copper and composition roof. Drawings and specifications may be obtained from the custodian of site at Waukesha, Wis., or at the discretion of the Supervising Architect.

Canada.

✣Bids will be received until 5 p. m., March 6, by R. H. Smith, Secretary-Treasurer, Winnipeg Public School Board, Winnipeg, Man., for electrical machinery, equipment and tools required in connection with the Kelvin and St. John's High Schools. For specifications, form of tender or further information desired, apply direct Kelvin and St. John's Technical High Schools.

⊙Contract for the erection of the Hudson Bay Co.'s building at Granville, Georgia and Seymour Sts., Vancouver, B. C., has been let to Bourke, McDonald & Moncrieff, 142 Hastings St., W. Vancouver, at about $2,500,000. Structure is to be of steel and reinforced concrete. Burke, Harwood & White, Toronto, Ont., are the architects.

⊙M. H. Braden, Fort William, Ont., has been awarded the contract for the erection of a 5-story, 100x125 ft. Chamber of Commerce building, at Syndicate and Victoria Aves., Fort William. The building will cost about $275,000.

RIVERS AND HARBORS

Connecticut.

✣Bids will be received until 2 p. m., March 8, by Maj. G. B. Pillsbury, U. S. Engineer, New London, Conn., for dredging in New Haven Harbor, Conn.

Delaware.

✣Bids will be received until 10:30 a. m., April 1, by Maj. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for purchasing under Canal Circular 758, the purchase of supplies offered for sale by the Isthmian Canal Commision, which are no longer needed, such as rock crusher plant and spare parts for same, steam shovels and parts for same, locomotives, dump and flat cars and parts for same, cranes, spreaders and parts for same, unloaders and parts for same, ballast, plows, rock channelers and parts for same, rock drills and well drill parts, concrete mixer, mixer parts and concrete buckets, boilers, engines and pumps, injectors, inspirators and parts, oil cups, lubricators and lubricator parts, pop safety valves and parts, shop tools, machinery and miscellaneous equipment, hand tools, rubber valves, electrical material, light and heavy hardware and miscellaneous supplies, office equipment and stationery supplies, carral supplies, hotel and household supplies, steel culvert and tunnel forms and steel form tower parts, bridge parts and bar iron (French stock), iron and steel (American stock).

✣Bids will be received until 11 a. m., March 8, by Maj. R. R. Raymond, U. S. Engineer, Wilmington, Del., for dredging Wilmington Harbor, Del.

Richard Paroot, Newburg, N. Y., at $12 per lin. ft., was low bidder Feb. 3 for constructing jetty work at mouth of Nuspillion River, Del., for the U. S. Government.

Bids as follows were received Feb. 12 by Maj. R. R. Raymond, U. S. Engineer, Wilmington, Del., for dredging about 148,000 cu. yds. of mud, sand and gravel in the Leipsic River: The Rickards Dredging Co., Philadelphia, Pa., 88 cts. per cu. yd.; Atlantic Dredging Co., Philadelphia, Pa., 9.72 cts. per. cu. yd.; River & Harbor Improvement Co., Philadelphia, Pa., 11.3 cts. per cu. yd.

District of Columbia.

✣Bids will be received until 10:30 a. m., April 14, by Maj. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing and erecting under Canal Circular 763, coal handling machinery and accessories for two coal handling plants.

✣Bids will be received until Feb. 26 by Chief Signal Officer, Washington, D. C., for furnishing under Proposal 638, 24 machinists' tool chests, 18 Star drills, 10 mill files, 3,500 anchors, 1,776 expansion anchors, 288 toggle bolts, 60 Star drills, 36 do, 6 do, 500 hacksaw blades, 10-in. and 272 do 12-in. For further information address W. L. Clarke, captain, signal corps, U. S. army, disbursing officer.

✣Bids will be received until 10:30 a. m., March 5, by Maj. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under canal Circular 762 galvanized sheet steel, planished iron, babbitt metal, boiler tubing, steel pipe, stovepipe, bolts, chisels, pliers, hasps, tacks, buckets, coal baskets, water coolers, bedroom mats, metallic tapes, whitewash brushes, paint brushes, emery cloth, belt lacing, hose, packing, sash cord, rope, mop heads, twine, cotton sheeting, cheesecloth, magnesia pipe covering, chipped soap, borax, muriatic acid, aluminum paint, burnt sienna, asphaltum varnish, turpentine, cardboard, paper, tie plugs, switch ties and piles.

✣Bids will be received until 2 p. m., Feb. 21, by M. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing 150 ft. 4-in. pipe, 50 ft. do double hub, 40 ft. do 2-in. 36 Y branches, 35 bends, 2 running traps, 3 tee branches, 2 S traps, 30 ft. brass pipe, 2-in.; 30 ft. do 1½-in., 20 ft. do 1-in., 40 ft. do ¾-in., 18 tees, 42 elbows, 2 caps, 4 bushings, 3 valves, 1 elbow, 8 trap screws, 4 combination extra heavy cast iron drain traps, 5 sanitary tees, 2 shower heads, 2 ball joints, 2 cocks, 2 faucets, 80 ft. standard galvanized 2-in. pipe, 10 tees, 18 ells, 2 water closets, 2 urinal stalls and 3 lavatories.

Florida.

All bids received Jan. 30 by Capt. J. R. Slattery, U. S. Engineer, Jacksonville, Fla., for alterations to the dredge "Jacksonville" were rejected. The following bids were received: James Sherwan & Sons, New York, $93,000; Merrill-Stevens Co., Jacksonville, $90,000. The Elliott Machine Corp., Baltimore, Md., bid $43,000, f. o. b. Baltimore, for furnishing necessary machinery and equipment, but did not bid on the work itself.

Georgia.

✣Bids will be received until noon (eastern standard time), March 4, by Col. Dan C. Kingman, U. S. Engineer, Savannah, Ga., for dredging in waterway between Savannah and Fernandina, Fla., Club and Plantation Creeks, Ga., and harbor at Brunswick, Ga.

New Hampshire.

✣Bids will be received until 11 a. m., March 8, by H. R. Stanford, Chief of Bureau of Yards and Docks, Navy Department, U. S. Navy Department, Washington, D. C., for one 20-ton 4-motor electric traveling crane, delivered and installed at the navy yard, Portsmouth, N. H.

New Jersey.

⊙Saul & Glenn, Wildwood, N. J., have been awarded the contract at $2,585, plus certain unit prices, for constructing jetties at the Hereford Inlet Light Station, N. J., for the U. S. Government.

New York.

⊙Grant, Smith & Co. & Locher, New York City, have been awarded Contract No. 42A, calling for the completion of the construction of the Erie Canal near Utica, N. Y. The contract price was $1,014,671; bids were opened Feb. 4, by Duncan W. Peck, State Superintendent of Public Works, Albany, N. Y.

⊙Bids were opened Feb. 4 by Duncan W. Peck, State Superintendent Public Works, Albany, N. Y., for Contracts Nos. 92 and 94, calling for erecting and installing power plants, equipment and machinery for operating locks on the Barge Canal. McArthur Bros. Co. and the Lord Electric Co., of New York City, secured the contracts, the former for the sum of $1,178,976, and the latter for the sum of $433,380.

Ohio.

✣Bids will be received until noon, Feb. 28, at the office of W. H. Kirby, Secy. to the Director of Public Service, Cleveland, O., for the construction of eight bear dens. Specifications may be obtained at the office of the Park Superintendent, 214 City Hall.

✣Bids will be received until noon, Feb. 28, at the office of W. H. Kirby, Secretary, Director of Public Service, Cleveland, O., for jetty work at Edgewater Park. Specifications may be obtained at the office of the Park Superintendent.

✣Bids will be received until noon, Feb. 28, by W. H. Kirby, Secretary of Director of Public Service, Cleveland, O., for furnishing weatherproof copper wire for the municipal electric light plant.

Porto Rico.

✣Bids will be received until 11 a. m., March 18, by San Juan Harbor Board, J. A. Wilson, Chairman, San Juan, P. R., for the construction of 2,750 lin. ft. of concrete bulkhead with backfilling and paving or as much thereof as may be done for the sum of $371,000, U. S. currency, at San Juan, P. R.

South Carolina.

✣Bids will be received until noon, Feb. 26, by Maj. G. P. Howell, U. S. Engineer, Charleston, S. C., for dredging Sampit Bar and River, Winyah Bay, S. C.

Washington.

⊙John McAleer, Seattle, Wash., has been awarded the contract at $8,728, for furnishing U. S. Engineer, at Seattle, with two flat bottom, wooden hull barges. Bids were opened Feb. 5.

⊙Puget Sound Bridge & Dredging Co., Tacoma, Wash., has been awarded the contract at 15½ cts. per cu. yd. filling in a portion of the lowland district for the city of South Bend, Wash. The contract calls for 150,000 cu. yds. of filling to be dredged from the Willapa River.

Wisconsin.

⊙Alex McGavock, Black River Falls, Wis., has been awarded a contract for 300,000 cu. yds. of filling for the washed out section of Black River Falls, and will place his 70C Bucyrus and 4-yd. plant on the work. Mr. McGavock has just finished a contract at La Crescent, Minn., on the Chicago, Milwaukee & St. Paul Ry.

Canada.

✣Bids will be received until 4 p. m., March 3, by R. C. Desrochers, Secy., Department of Public Works, Ottawa, Ont., for dredging required at Port Burwell, Ont. Combined specifications and forms of tender can be obtained on application to the Secretary, Department of Public Works, Ottawa. Tenders must include the towing of the plant to and from the work. Dredges and tugs not owned and registered in Canada shall not be employed in the performance of the work contracted for. Contractors must be ready to begin work immediately on the opening of navigation.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ENGINEERING AND CONTRACTING

Devoted to the Economics of Civil Engineering Design
and to Methods and Cost of Construction

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The Duty and the Opportunity of the Designer in Connection With the Operation of His Plants.

While the public is now fairly appreciative of the value of engineering service in connection with the design and construction of works of a certain character, it does not yet realize that the efficient operation of works designed by the engineer often calls for a grade of technical knowledge quite as high as that required in designing and building the works. The failure of the public to appreciate the importance of this phase of engineering not only narrows the field of the engineer's activity but also tends to nullify much that he has accomplished as a designer and builder. In following the engineering work done throughout the country the editors are convinced that many engineers are on a par with laymen in their conception of the full functions of the engineer. In a recent discussion before an engineering society meeting a member cited a case which will serve well to illustrate the desirability of a wider appreciation among engineers of the true scope of engineering. An engineer designed a hydro-electric power plant, supervised its construction and then considered his work finished. He went about his business and the following year he designed and built another plant similar to the first. The next year a third plant was built by the same man. In all three plants the conditions were practically the same and the designs adopted were the same except as to size.

Shortly after the first plant was put in operation it became necessary to make certain rather expensive changes in it in order to get the cost of operating it down to a satisfactory figure. This change was made before the second plant was built, but the designer was not in touch with the situation and did not know that his first plant contained faults which unduly increased its cost of operation. Accordingly in building the second plant, and later on the third plant, he repeated the mistake made on the first plant.

There is a two-fold lesson to be drawn from this incident. First, engineers should not build plants or structures and then fail to follow their subsequent history to see whether or not they rendered satisfactory service. Both for his own future guidance and for the benefit of his future clients, the engineer should keep a line on the performance records of his past designs.

The second lesson to be drawn from the case mentioned is that works which are built by engineers should, in general, be operated by engineers. The consistent amount of expert attention to the routine affairs of the plant's operation will, of course, vary greatly between various cases. The designing engineer should preferably be retained to supervise the operation of his plants. Not only does he know the details of his plants perfectly, but he has a strong incentive to put forth his best efforts to make them operate at their highest possible efficiency.

We have said that the amount of attention which the expert can consistently give to the details of plant operation will vary greatly between different cases. Further, in saying that the designer should have charge of the operation of his plants we do not mean that he should look after small matters of a routine nature, but that he should act in an advisory capacity with reference to plant management. He should study the records of the plant to see wherein economies can be introduced in its operation. Having access to the complete records of several plants, the knowledge gained from the study of the performance of any one plant thereby becomes readily available for the use of all other plants under the same general management.

There is a growing tendency among engineers to regard plant operation as one of their legitimate fields of service. All engineers should now realize that complete engineering service embraces the general supervision of plant operation. This applies especially to small plants where the man put in direct charge of operation knows but little about the "fine points" of the design of the plant or about the sciences upon which its existence is based. This is especially true of small sewage plants. As we stated in a previous editorial, the designers of such plants should keep in close touch with their operation in all cases. The same holds true for small water works systems, hydro-electric developments, electric light plants, etc.

If engineers will cultivate this phase of their profession they will not only become better qualified to serve as designers and builders, but they will also have numerous and important additions made to their sources of income.

Difficult Pipe Line and Crib and Tunnel Lake Intake Construction and Maintenance.

Designers and builders of intakes will find much matter of interest in the article published elsewhere in this issue relating to the methods and cost of constructing and repairing tunnel and pipe line intakes in Lake Superior.

The article will be of special interest to engineers who may be called upon to design or repair intakes of any character laid in the Great Lakes.

The article to which we refer gives a detailed history of all of the intakes used by two mining companies at their stamp mills on the shore of Lake Superior. Many difficulties were encountered in constructing and repairing these intakes owing to violent storms on the lake, to the nature of the lake bottom, to the formation of surface nad frazil ice, to the shifting of the shore line, to the tendency of the tailings from the mill to find their way into the pump well, to the murky nature of the water at times which rendered very difficult inspection by a diver, and to many minor causes. The methods employed in overcoming these manifold difficulties in constructing and maintaining the intakes for the past twelve years are very fully described in the article which we commend to the careful attention of all our readers who are interested in water works construction.

ROADS AND STREETS

Relative Advantages of Laying Brick Pavements on Sand Foundations and Cement Concrete Foundations.

Many of the streets of Cleveland, O., are located in a sandy territory on which it has been possible to lay pavement without bringing to the work from elsewhere any sand or gravel ballast. It has been the practice in such localities to prepare the bed of the pavement by means of the customary puddling, rolling and shaping and laying the brick immediately upon the foundation thus prepared. In other sections of the city the streets are in a clay soil, and still others show an outcropping of shale or rock, to all of which any sand or gravel ballast, or cushion, must be brought.

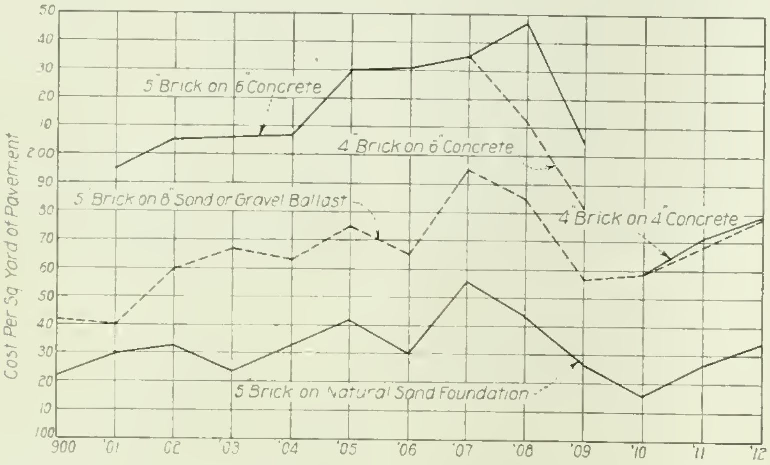

Fig. 1—Diagram Showing Cost of Pavement by Years at Cleveland, O.

Paving brick 5 in. in depth have been used to a large extent. This depth was adopted so as to ensure a block of adequate strength in itself, and also on account of the greater surface thus exposed for the adhesion of the cement grout filler. This has been thought especially advisable on sand foundations. But few brick pavements, and these in alleys and very light traffic streets, have been laid with 4 in. paving brick, unless in connection with a concrete foundation. Where the sand or gravel ballast must be brought upon the street, as in the case of clay soil, it is usual to specify such foundation to be 8 in. in thickness. This depth of ballast in conjunction with the 5 in. depth of brick, requires extra excavation, which must be taken into account when considering comparative costs.

A discussion of the relative advantages as regards first cost, maintenance and life of these brick pavements as compared with similar pavements on a concrete base is given in a paper presented at the Cleveland meeting of Section D of the American Association for the Advancement of Science, by Robert Hoffman, M. Am. Soc. C. E., Chief Engineer, Department of Public Service, Cleveland, O. The matter in this article has been abstracted from Mr. Hoffman's paper.

Cleveland first began to lay brick pavements in 1889 and has continued doing so ever since, until at present there are about 328 miles of streets paved with brick, subdivided as follows: 257.61 miles of 5 in. brick on sand foundation; 19.39 miles of 5 in. brick on concrete foundation; 39.17 miles of 4 in. brick on concrete foundation; 11.84 miles of 4 in. brick on sand foundation.

The accompanying diagram (Fig. 1) shows that prices paid for brick pavements have varied from $1.18 per sq. yd. to $2.48, depending upon the various forms of foundation and size of brick used.

The following table indicating the various paving combinations employed in Cleveland for brick pavements shows the yearly average maximum and minimum prices paid per square yard since the year 1900; cost of excavation assumed at $0.50 per cu. yd. is included as measured below the top of the paving brick:

	Min.	Max.
5-in. brick laid on natural sand foundation	$1.18	$1.56
5-in. brick laid on 8-in. sand or gravel ballast	1.40	1.97
5-in. brick on 6-in. concrete foundation	1.94	2.48
4-in. brick on 6-in. concrete foundation	1.71	2.34
4-in. brick on 4-in. concrete foundation	1.47	1.73

From an inspection of the diagram (Fig. 1) it will be seen that the prices paid for the various combinations seem to rise and fall in the same years, which would indicate that the variations depended upon the material and labor market and not on the difference in combination.

The earlier of the brick pavements consisted of small blocks of fire clay, 4 ins. in depth, laid upon a natural sand foundation. Some of these are still in use though they have served to take the traffic of residence streets for 20 years. In other localities, partly on account of traffic conditions, brick pavements on sand foundations required relaying in less than 15 years.

No pavements of brick, laid according to recent specifications and practice, nor any laid on concrete foundations have been in existence long enough to cause any thought of relaying.

In reference to the brick pavements that now require relaying, having reached a condition where any adequate repair would prove far too expensive, it could probably be shown that other defects, such as improper filler, poor brick, or defective construction, had as great an influence in causing deterioration as did the sand foundation.

Cleveland has stone pavements laid upon a natural sand foundation, which have been subjected to heavy traffic for over 20 years, and are still in good condition. Such streets, it must be remembered, are in a sandy, gravelly soil, in well built up and well drained sections, so that the effect of frost in the sub-soil is reduced to a minimum. An entirely different condition would probably be found in an open and poorly drained clay district.

In considering then the relative economy of sand and concrete foundations for brick pavements, experience will show that a properly laid pavement of 5 in. brick on a sand foundation will have a life of at least 15 years, if laid in residence or light business traffic streets. A 4 in. brick under similar conditions would probably have a life of three or four years less. The problem is to compare the cost of such a pavement with one laid on a concrete foundation, the actual life of which has not yet been determined by experience.

Referring to the cost data shown in the diagram and table, the following prices are obtained as the average for the last three years, and are therefore expressive of existing conditions:

	Per sq. yd.
5-in. brick laid on natural sand foundation	$1.27
5-in. brick laid on 8-in. sand or gravel foundation	1.58
4-in. brick laid on 4-in. concrete foundation	1.60

Assuming a 15 year life for the 5 in. brick pavement on a natural sand foundation, and the interest to be paid as 4 per cent, it will require a payment of 9 per cent per year to pay interest on the cost of paving and to provide a fund for its renewal at the end of 15 years. This means an annual payment of 9 per cent of $1.27, or $0.1143.

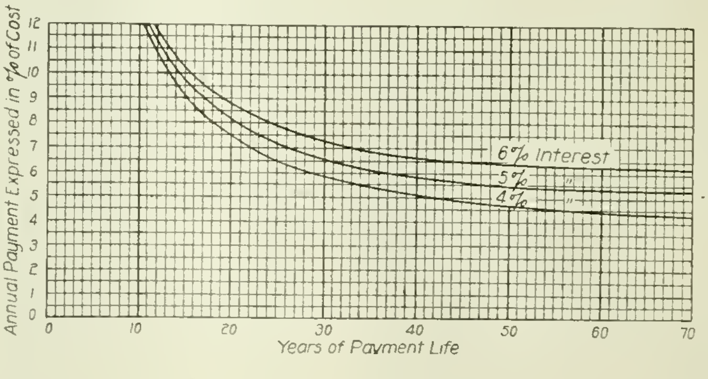

Fig. 2—Diagram Showing Relation of Annual Payment Cost to Life, at Cleveland, O.

In order to compare this with the case of a 4 in. brick pavement laid upon 4 ins. of concrete, the same annual payment of $0.1143 must be assumed. Deducting 4 per cent of $1.60, the cost of such a pavement, for the interest charge, or $0.064, leaves $0.0503 to be applied per year for amortization. This amounts to a little over 3 per cent, and according to amortization tables would require a period of 22 years to provide the renewal fund. In other words, the pavement upon the concrete must have a life of 22 years in order to be as cheap as the one upon the natural sand, having a life of 15 years.

Comparing the cost of the 5 in. brick upon a ballast of 8 ins. of sand or gravel with the brick upon 4 ins. of concrete, it is readily seen that the difference is so small that both could have the same life at the same cost per year. Evidently then the concrete foundation is as cheap as the other, and much more economical, as the probability of longer life is much greater.

A 4 in. brick laid upon a natural sand foundation would cost about $1.07 per sq. yd., using the same cost data as used for the 5 in. brick. If such a pavement had a life of 12 years, with money at 4 per cent, it would require an annual payment of about 11 per cent, or $0.1177.

Comparing this with 1 in. brick on 4 ins. of concrete, one sees that the latter would be equally cheap per year if the life of the pavement were about 21 years. It can similarly be shown that the 5 in. brick would be as cheap as the 4 in., if the life were three years longer. Similar calculations will show that a 4 in. brick laid on 6 ins. of concrete will be as cheap as 4 or 5 in. brick on the 8 in. sand ballast, if its life is 18 years.

From this method of reasoning, it may be concluded that where a natural sandy foundation under good condition is found, it will probably be as economical to lay a brick pavement without a concrete foundation as with one, and the first cost will be considerably less. In other locations, however, where it is necessary to bring upon the work from elsewhere the sand or gravel ballast, the first cost will be nearly as great, and the pavement with the concrete foundation will ultimately prove the more economical.

Several other matters must, however, be given consideration when passing judgment on this question. In Ohio, for instance, the municipality, though paying only a relatively small proportion of the cost of the initial pavement, namely, the part laid in street intersections and 2 per cent of the remaining part, must pay 50 per cent of the expense of relaying any pavement. It is therefore decidedly to the advantage of the municipality that a pavement by so laid that its life be as long as possible, so that the relaying expense shall come only at long intervals.

That an unyielding sub-base, such as concrete affords, is highly desirable, goes without question, and should be supplied wherever possible, and in most cases will prove more satisfactory, even at slightly greater cost. Concrete will carry the pavement load over the many soft places caused by street openings prior to paving and will prove a greater factor of safety against settlements and irregularities liable to occur where no concrete is employed. Any settlement in a pavement foundation breaks the bond of the brick and will be rapidly followed by serious deterioration.

Another possible economy in supplying a concrete fundation may be found in the possibility that some time it may be desired to replace brick with other kinds of paving material for which a concrete foundation must be supplied, such as wood block, asphalt or asphaltic concrete, in which event the cost will be materially lessened by reason of the existing concrete.

In open country with poor drainage facilities, there is no doubt that the damaging effect of frost and the yielding sub-soil would soon depreciate any brick pavement with only a natural soil foundation, and concrete is the only safe and economical foundation to use.

The pavements in Cleveland that have lasted so well on sandy foundation, it must be remembered, are on streets supplied with adequate sewerage and drainage, the abutting lots being well built up and graded, so that water easily finds its way to catchbasins and sewers, and all conditions are such that the heaving effect of frost is at a minimum.

Cleveland's greater mileage of brick on sand foundation is explained by the custom of former years. Improved concrete mixers and low cost of cement have made the use of concrete economically possible, where in earlier years the cost would have produced a prohibitive tax upon the abutting property, and therefore is now employed to as great an extent as possible.

There is every justification, except in case of an abnormally high price, in so laying a pavement that it may be durable and serviceable. The interruption to business and traffic by reason of relaying pavements is difficult to value, but nearly always represents a large monetary loss. It is therefore entirely justifiable to make allowances in favor of a construction promising a longer life even though it may not seem theoretically the more economical.

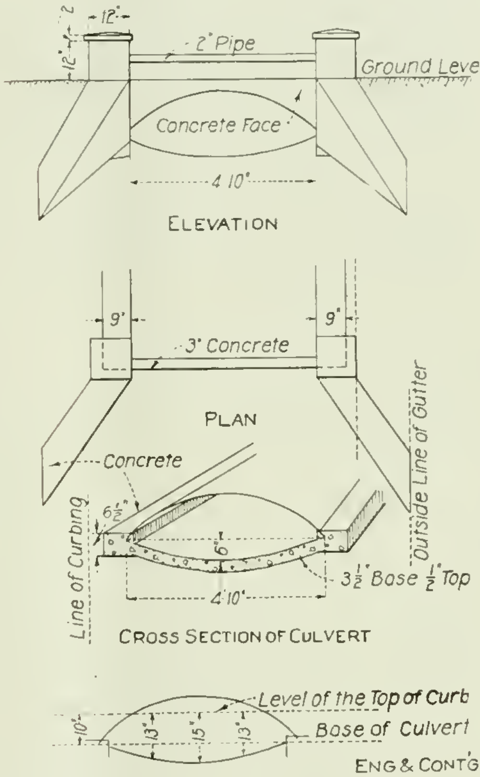

Fig. 1—Plan Elevation and Section of Culvert.

An Interesting Culvert Installation.

(STAFF ARTICLE.)

The matter of providing for drainage at street intersections where the crowning is so slight as to afford but little head room is one of the serious problems that has to be met by engineers. The part circle corrugated culvert offers a very satisfactory solution of this problem. An interesting installation of this sort is shown in the accompanying sketches. This culvert was constructed on Euclid Ave. at Ontario, Cal., under the direction of Mr. B. B. Mann, City Engineer. It consists of an American ingot iron culvert supplied by the California Corrugated Culvert Co., of Los Angeles, set in a concrete curb, and the fill made to grade.

In the culvert at Euclid Ave. as much as necessary of the old cobble stone gutter was removed and a concrete gutter laid for 30 ft. under the culvert. This gutter was composed of a 3½-in. base made of 1:2:4 concrete and a finishing coat ½ in. thick made of 1 part cement to 2 parts sand. The two sides of the gutter were enlarged to receive the edges of the culvert. The slot for them was formed by a strip of wood inserted in the concrete and removed as soon as the concrete had set. After the iron had been placed in the slots, they were filled with a 1:1 grout.

Four piers were built; each of them was 1 ft. square and made of 1 part cement to 5 parts gravel. Each pier had a cap 2 ins. thick and projecting 1 in., made of 1 part cement to 2 parts sand with a little lamp black. The piers, without caps, were 1 ft. above the finished roadway, the latter being 5 ins. above the top of the arch of the culvert. They were carried down about 3 ft. to a solid foundation.

Concrete wing walls were constructed on both ends of the culvert and a concrete face 3 ins. thick built flush with the two ends and carried up to the road level. All the exposed concrete work, except the pier caps, was plastered with cement plaster leaving a sand finish.

Notes on Road and Street Work.

(STAFF ARTICLE.)

Cost of Road Dragging.—On heavy clay or gumbo roads the proper system for maintenance is in the use of road drags. According to the last report of the State Highway Commission of Minnesota, in localities where contracts were let for dragging during the entire season, giving land owners sections of a mile or more to maintain, it has been demonstrated that roads can be kept in excellent condition at a cost of from $5 to $10 per mile per year.

Cost of Oiling Macadam Roads.—Tables I and II, taken from the last annual report of the Board of Highway Commissioners of York County, Ontario, show the cost, per application, of oiling one mile of road, of different widths, with varying quantities of material. In these tables the cost of applying the oil is taken as $25 per mile.

TABLE I.—COST, PER APPLICATION, OF OILING ONE MILE OF MACADAM ROAD WITH OIL AT 7½ CTS. PER GALLON.

Width of road, ft.	Sq. yds. per mile.	¼ gal. per sq. yd.	½ gal per sq. yd.	¾ gal. per sq. yd.	1 gal. per sq. yd.	1¼ gal. per sq. yd.
10	5,867	$135	$245	$355	$465	$ 575
12	7,040	157	289	421	553	685
14	8,213	179	333	487	641	795
16	9,387	201	377	554	729	905
18	10,560	223	421	619	817	1,015
20	11,733	235	465	683	905	1,125

TABLE II.—COST, PER APPLICATION, OF OILING ONE MILE OF MACADAM ROAD WITH OIL AT 8½. CTS. PER GALLON.

Width of road, ft.	Sq. yds. per mile.	¼ gal. per sq. yd.	½ gal. per sq. yd.	¾ gal. per sq. yd.	1 gal. per sq. yd.	1¼ gals. per sq. yd.
10	5,867	$150	$275	$400	$ 525	$ 650
12	7,040	175	325	475	625	775
14	8,213	200	375	550	725	900
16	9,387	225	425	625	825	1,025
18	10,560	250	475	700	925	1,150
20	11,733	275	525	775	1,025	1,275

Practical Unit of Cement for Each Unit of Work.—In order to arrive at a practical unit of cement for each unit of work actually constructed, Mr. Theodore S. DeLay, Consulting Engineer, Creston, Ia., averaged up the daily reports of inspectors for several jobs of which he had charge. The results were as follows:

A job of straight 6x20-in. concrete curb built of 1-mix concrete 1 part cement, 2 parts sand and as much gravel or crushed stone as could be readily bedded, used 0.2 sack of cement to each lineal foot of curb.

A job of 1-coat 6-in. concrete paving, 1 part cement, 2 parts sand and 4 parts crushed stone, used 0.985 sack cement to each square yard.

A job of combined curb and gutter consisting of a 6x12-in. curb joined to a gutter 36 ins. wide, 6 ins. thick at its junction with the curb and 8 ins. thick at its junction with the pavement made of 1-mix concrete, 1 part cement, 2 parts sand and 4 parts crushed stone or gravel, used 0.472 sack cement for each lineal foot.

A job of paving foundation 4 ins. thick of concrete, 1 part cement, 3 parts sand and 4 parts crushed stone or gravel, used 0.518 sack cement to the square yard.

A job of combined curb and gutter consisting of a 6x12-in. curb joined to a gutter 36 ins. wide and 6 ins. thick made of 1-mix concrete, 1 part cement, 2 parts sand and 4 parts gravel or crushed stone, used 0.46 sack cement per foot.

Another job of paving foundation 4 ins. thick under same specifications as above used 0.46 sack cement to a yard.

Comparative Cost of Operating Steam and Gasoline Rollers.—The road building outfit of the Highway Commissioners of York County, Ontario, includes two 12½-ton and two 11½-ton steam road rollers and a 12-ton 2-cylinder gasoline road roller. In the report of the Commission covering the year 1912 Mr. E. A. James, Chief Engineer of the Commission, gives the following figures to show the cost as nearly as can be judged of operation of the steam and gasoline machinery, both rollers working under similar conditions:

COST OF OPERATING STEAM ROLLER.

For 10 Hours' Rolling.

Fuel—	
Kindling wood	$0.05
Coal, 380 lbs. at $6.85 per ton	1.30
Water—	
600 gals.; hauling 3 hrs. at 50 cts. per hr.	1.50
Oil, etc.	0.05
Engineer—11½ hours at 30 cts. per hour	3.45
Total	$6.35

For 10 Hours' Spiking and Scarifying.

Fuel—	
Kindling wood	$0.05
Coal, 480 lbs. at $6.85 per ton	1.64
Water—	
800 gals., hauling	2.00
Oil	0.05
Engineer—11½ hours at 30 cts	3.45
Total	$7.19

COST OF OPERATING A GASOLINE ROLLER

For 10 Hours' Rolling.

Fuel—12 gals. gasoline at 15 cts. per gal.	$1.80
Water—	
Cooling, quarter hour	0.12½
Oil	0.07
Engineer—10¼ hours at 30 cts	3.07½
Total	$5.07

For 10 Hours' Spiking and Scarifying.

Fuel—20 gals. gasoline at 15 cts. per gal.	$3.00
Water—	
For cooling	0.15
Oil	0.07
Engineer—10¼ hours at 30 cts	3.07
Total	$6.29

Road Patrol Work in Minnesota.—The first attempt to maintain improved roads in Minnesota by the patrol system was made in 1909 on the Dodd Road in Dakota County. The following particulars regarding this work are abstracted from the last report of the State Highway Commission: A section of about five miles in length immediately south of St. Paul was measured off, and an agreement made with the town authorities to properly grade and crown the road, and do such work as would be necessary to put it in good condition before the state commenced its work of maintenance. Owing to the difficulty of procuring teams at the time they were needed, it was found advisable to proceed at once without waiting for such preliminary work, and a man was hired at $50 per month, who with a small kit of road tools and a wheelbarrow commenced the work of repair, a large portion of which might have been done more economically with teams. The first work consisted in opening up the ditches and culverts, which work had long been neglected, in order to provide suitable drainage; at the same time and after, stones were removed from the surface of the roadbed, soft places dug out and refilled with suitable material, ruts dragged out with the Minnesota planer, and brush and weeds removed from the side. The work was found to be more than enough for one man for the entire season, but if the preliminary work had been done when required, and gravel delivered at suitable times and places, the one road repairer could have kept in good condition about ten miles of such road. The results, however, were extremely satisfactory, and teamsters and automobile drivers passing over the road frequently stopped to say a good word to the road repairer, or to call his attention to some point where repairs were needed. Such interest manifested by the users of the road was an encouragement and an incentive to his best efforts. In 1910 the same man, who had demonstrated his worth the year before, was given a 6-mile section of Washington county State Road No. 2 running south from Stillwater. The conditions and results were about the same each year, and proved without question the value of such a system on heavily traveled roads. The road repairer is provided with a hat band and plate marked "State Road Patrol" and is instructed to be on the work during the entire day, and to examine with great care those portions of the road liable to wash from heavy rains or become worn through excessive travel. The cost of such work of repair and maintenance on ordinary earth and partly graveled roads was about $50 per mile, but with the road placed in good condition before the repairer commenced his duties, it would be approximately $25 per mile for the first year and probably less for subsequent years, provided material for repairs was distributed in advance, as is the custom in other countries. During the season of 1911 road patrols were employed in Blue Earth, Hubbard, Steele, St. Louis, Carlton, Washington, Koochiching and Mower Counties, and in all localities where patrols were employed the Commission has had applications for a continuation of the system and when it was necessary in some instances to discontinue the work it received very urgent protests.

Some Conditions Affecting the Interaction of Motor Vehicle Wheels and Road Surfaces.

An interesting discussion of certain sources of road resistance to the motor vehicle equipped with tires of approximately circular cross-section is contained in a paper presented at the Cleveland meeting of Section D of the American Association for the Advancement of Science, by Dr. L. I. Hewes, Chief, Division of Economics and Maintenance, U. S. Office of Public Roads, Washington, D. C. This paper follows:

With the rapidly increasing use of all our highways by various kinds of self-propelled vehicles, it is very desirable to develop fully the nature of the action of such vehicles on the roads and the reaction of the roads upon the vehicles. Consider first a motor vehicle running on a homogeneous level road with a constant velocity. If we let h represent the effective horsepower developed at the rear tires, v represent the velocity, and f represent the total force of resistance offered to the motion of the vehicle, there results the fundamental relation $(1)\ \frac{h}{v} = f$, which we may call the work equation.

The resistance f will be represented in pounds and the dimensional check of the equation is at once apparent. For example, if h is equal to 15 H.P. and v is 15 miles per hour which is equivalent to 22 ft. per second, the total resistance f offered to the motion of the vehicle will be 375 lbs.

An important question for us to determine is the nature of this resistance f. It is quite apparent that f must include the resistance offered by the air at the velocity v. But we may, if we like, suppose the air resistance neutralized by a current of wind parallel and equal to the velocity of the machine. With no grade and constant velocity, the resistance f is in a sense a road coefficient. For certainly f will vary for the same auto on different roads. If we accept equation 1 as fundamental, it is impossible to explain the road resistance or the necessary tangential effort to propel the vehicle entirely by the weight of the vehicle alone, for the reason that we would therefore be obliged to assume a constant resistance for all speeds on the same road. It does not appear, moreover, that the usual assumptions for calculating the resistance f from the weight, account for the total tractive resistance.

There was published in Le Genie Civil, Vol. LXL, No. 14, p. 276, a table which is here reproduced, as Table I, and which shows the relation between speed, effective horsepower and tractive resistance.

This table is the record of tests made in February, 1912, at the laboratory of the "Conservatoire des Arts et Metiers" on a Berliet truck which competed in the French government trials in July of that year. The table clearly exhibits the relation of Equation 1 between h, v and f. The weight of the truck was 4,765 kilos, of which 3,411 kilos were on the rear axle. It is not uncommon to see the statement that the tractive resistance is about 33 lbs. per 1,000 lbs weight; that is, that the resistance is about .033 w. In the above tests by this theory, the resistance to traction should then have been constant and equal to 112.56 kilos. The tests by Arnoux in Paris in 1904 with an electric car weighing 1,800 kilograms show variations in tractive forces developed from 22.9 kilos to 55.5 kilos.

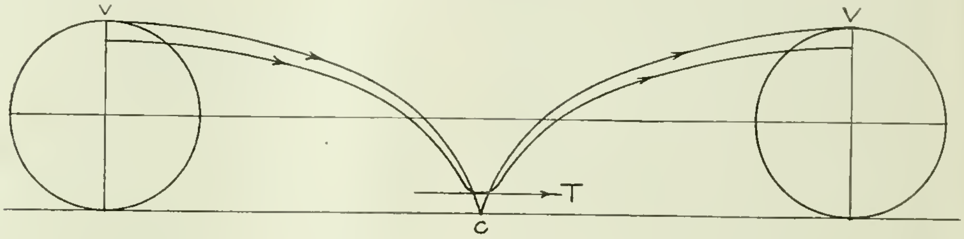

Fig. 1.

In a report to the Paris Congress of 1908, E. Girardault presents a paper entitled "La Resistance au Roulement," in which he remarks that a symbol f which denotes the relation between resistance and weight is a symbol of our ignorance! He holds that velocity has an influence and summarizes the sources of tractive resistance as (a) Weight, (b) Shocks, (c) Deformations.

Certainly tractive resistance is not entirely a phenomenon of gravity. To understand its nature we are required to visualize a complex instantaneous interaction of the tire and the road. This paper is to call attention to two simple facts which in a descriptive way may indicate certain sources of road resistance to the motor vehicle equipped with tires of approximately circular cross section. One source of road resistance may be classed with Girardault as shocks, if we extend the definition to include continuous small impulses received by the tire.

Each point of the periphery of an automobile tire moves in a cycloid with varying velocity. The velocity is a maximum at the point V and is zero at C, Fig. 1. Neglecting deformation it is seen that the horizontal component of velocity is practically zero at points near the cusp C. Consider now any point K, Fig. 2,

TABLE I.—RELATION BETWEEN SPEED, EFFECTIVE HORSEPOWER AND TRACTIVE RESISTANCE.

Effective horsepower* at tire.	Velocity in kilometers per hour.	Effect of traction. Kilograms.
9.2	14.2	175
12.9	18.8	185
15.1	21.4	189
18.5	25.5	194
19.4	28.3	184
15.5	10.7	389
17.7	12.1	394
20.7	14.3	391
21.6	15.4	378

*75 kg. m. p. s.

not on the periphery of the wheel. The path of such a point is a rolling curve with a horizontal tangent T, Fig. 1, at the lowest point. There is a forward velocity of every particle of the tire not in contact with the ground, and in the vertical plane of section. This forward velocity is small near the contact of the tire; and varies from zero to the velocity of the machine as the point considered is selected nearer the axis of the moving wheel. With a machine moving 30 miles per hour, Table II indicated the velocities of points on the tire at varying vertical distances from the road surface.

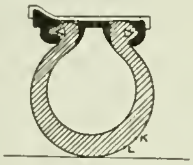

Fig. 2.

TABLE II.—HORIZONTAL VELOCITIES SPEED OF MACHINE 30 M. P. H.

Vertical distance from road in inches.	Velocity in feet per second.
1/32	.08
1/16	.17
⅛	.34
¼	.69
½	1.37
1	2.75
2	5.50

The instantaneous horizontal velocity V_1 is independent of the radius and varies as the vertical distance from the road surface, the formula is

$$V_1 = v\ (l\text{-}k)$$

where $(l\text{-}k)$ denotes the vertical distance from the road surface as a fraction of the radius.

We cannot say precisely what part of the mass of the moving vehicle or wheel operates to produce shock when the various particles of the tire not in contact with the ground strike small obstacles. If the road surface were continuously covered with loose particles varying in size from nothing to an inch in height it is not difficult to visualize the rolling and grinding action which would result when the moving tire strikes the upper surfaces of the particle. There is a rotary tendency imparted to small, loose particles and, furthermore, there may be a slight horizontal twisting action or "English" tending to throw small particles to one side. This twisting action, Fig. 2, would be caused by the varying magnitude of the velocities of different points K L in the plane of section of the moving tire. Ot course, we are considering actions which are individually very small, but they may be continuous and very great in number. The resultant effect of the continuous striking ot iregularities in the road in directions opposite to the motion of the vehicle (or with large horizontal components) constitute a source of resistance which varies with the roughness and looseness of the road and with the velocity of the machine. We dare not formulate such resistance into a mathematical expression at present.

We must add to (and distinguish from) the resistance described above the resistance due to those larger shocks caused by the striking of the periphery of the wheel (or the tread proper) directly against irregularities or loose stones.

Another source of resistance to the motion of automobiles, equipped with tires of circular cross-section, has been mentioned occasionally but does not appear to have been sufficiently recognized.* The exterior surface of a pneumatic automobile tire is approximately in the form of a torus. This surface is not applicable to the plane or to the ordinary crowned road surfaces, which are approximately planes. Owing, however, to the normal pressure of the automobile, it is necessary that the tire be deformed more or less in the region of contact with the road. Thanks to the elasticity of the rubber, such deformation is instantly followed by reformation of the surface and of the solid portions of the rubber. Now it is well known that when two non-applicable surfaces are forced into continuous contact, superficial tensions and compressions are produced Roughly speaking, the area of contact is in the form of an ellipse. We cannot say exactly in what direction forces of tension lie, but it is certain that they are directed inward in the superficial material of the tire itself. Since the surface of the tire must adhere to the surface of the road, there arise certain secondary tensions in the material of the road surface because the road and the tire are more or less perfectly engaged at the instant of contact. The important point is not that the tire itself is under tension in all directions on its surface, but that when it is engaged with the road surface the tensions in all directions become changed. It is the increment of tension due to the change of the two principal curvatures of the surface of contact with which we are concerned. The well known formula connecting pressure and superficial tension in a cylinder is

$$(2) \ldots\ldots T = r \times P$$

where T is equal to the superficial tension, r the radius of the cylinder and P the pressure normal to the surface of the pressure of the cylinder. From this formula, it is at once seen that the tension increases when the radius is increased if the pressure remains constant, as, of course, it does within the automobile tube. It is true that we are not concerned with a cylinder but the formula serves to indicate how the tension changes in the two principal directions of curvature in the ellipse of contact. It is quite possible that these tensions may be calculated from the known pressure of the air in the tire, the radius of the wheel, and the radius of the cross-section of the tire.

It is clear, therefore, that in enumerating the sources of resistance there must be included in the symbol f of Equation 1, the action on small irregularities and loose particles of those portions of the tire which are not directly in contact with the ground, and the rubbing action due to deformation with consequent change of tension. We cannot subdivide the resistance quantitatively into component resistance due to weight, shocks and deformations. At the present time, we are warranted, however, in stating that the resistance must partly depend upon these three sources and that these actions are of themselves not independent but mutually dependent action. Furthermore, that at least one of these sources of resistance, namely, shocks (in the broadest sense) must depend partly upon velocity V itself.

The imperative need of keeping the road surface or the enamel of the road intact is at once apparent. When this superficial skin is once broken the interaction of tire and road which produce wear are at once enormously accelerated. The form of the tire section must either be made cylindrical (or trapezoidal) to apply to the road or there must continue abnormal wear due to unnecessary deformation.

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*See in particular series of articles by E. Girardault, Le Genie Civil, Volume 53 (1908).

Tar Macadam Construction by the Board of Public Roads of Rhode Island in 1912.

Contributed by Herbert C. Poore.

The Board of Public Roads of the State of Rhode Island, having learned by experience the uselessness of attempting to maintain satisfactorily water-bound macadam roads on its trunk lines, has adopted for maintenance the same method as followed in new construction, namely, laying a 2-in. mixed tar macadam surface over the old road. Tar macadam under traffic for the past four and five years has proved successful, and well adapted to the Rhode Island trunk line travel. An example of one of the earlier bituminous roads in Rhode Island is shown in Fig. I. This road was constructed by the mixing method, using crude tar. It was built in 1906 and is one of the original bituminous roads in the country. The photograph from which the illustration is made was taken in 1912.

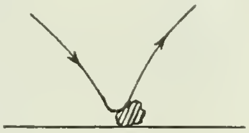


Fig. 3.

The State Board, on account of the great variations found in crude tar obtained in the past, for the work of last year decided to use a refined coal tar product, namely, Tarvia A. Sixty-eight miles of new work are now under contract and in the process of construction, and the considerable mileage of resurfacing finished brings the total to 55 miles of tar macadam for last season's work. Surface treatments of light oil were given the old macadam roads which, on account of the shortness of the season, could not last year be resurtaced with tar macadam.

Many experimental sections have been constructed by the Board during the past four years. The usual varieties of binders, sizes of stone, variations in method and seal coats have been employed. By elimination the Board has reached the following bituminous surface specification, both for new construction and maintenance:

BITUMINOUS SURFACE.

The stone for this course shall be ¼ in. to 1½ ins. in size and shall be dry and free from dust and dirt. The bituminous material will consist of refined coal tar furnished by the State Board of Public Roads at the railroad freight station nearest the site of the work, in tank cars of approximately 8,000 to 10,000 gals. capacity, fitted with steam coils.

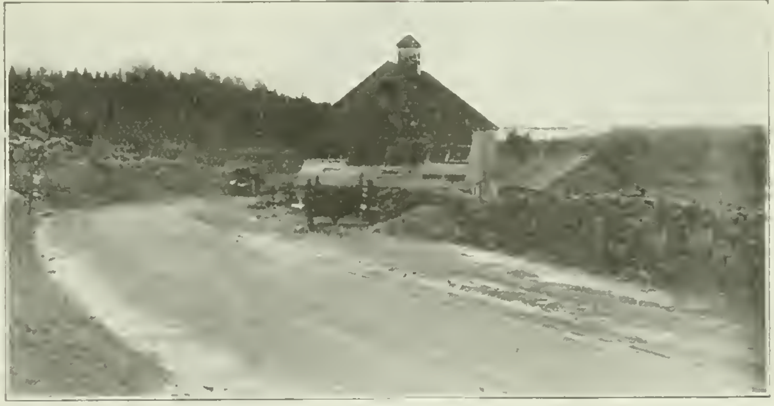


Fig. 1—Post Road, Washington, R. I., Built in 1906 by Mixing Method Using Crude Tar.

Upon the arrival of a tank car at the station, the contractor or his foreman in charge will be notified of its arrival by the inspector, whereupon the contractor shall immediately proceed to unload and deliver the same on the site of the work. The contractor shall furnish a steam boiler to heat the tank cars to a temperature such that the tar will flow freely from the tank. The contractor shall also furnish suitable means for transporting said tar from the tanks to the site of the work and for storing the same until used. Care must be taken by the contractor not to waste the tar in unloading, transporting and storing the same.

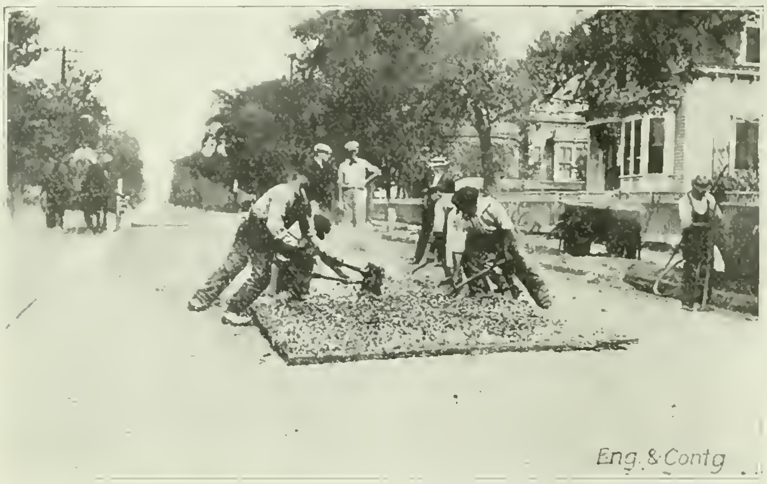


Fig. 2—Hand Mixing on Wooden Platforms With Hot Shovels.

The contractor will be held responsible for the bituminous material until the same is used on the work. He shall have a tank car unloaded within 48 hours of the time that notification is given of its arrival. Any demurrage charges on the tank cars arising through the neglect or the failure of the contractor to unload the same as above required, will be collected from said contractor through money due him by the state.

The tar shall be heated in kettles to a temperature of 200° F., and mixed with the stone either by hand on dumping boards or by machine satisfactory to the engineer. Approximately 15 gals. of tar shall be used with each cubic yard of stone, and the whole mass shall be turned until the stones are thoroughly coated. The mixing shall be done at such place or places as may be agreed upon between the engineer and the contractor.

After being thoroughly coated with the tar, the stone shall be placed upon the foundation or lower course prepared as hereinbefore described and thoroughly rolled satisfactorily to the engineer or inspector, with a roller whose weight shall not exceed 10 tons.

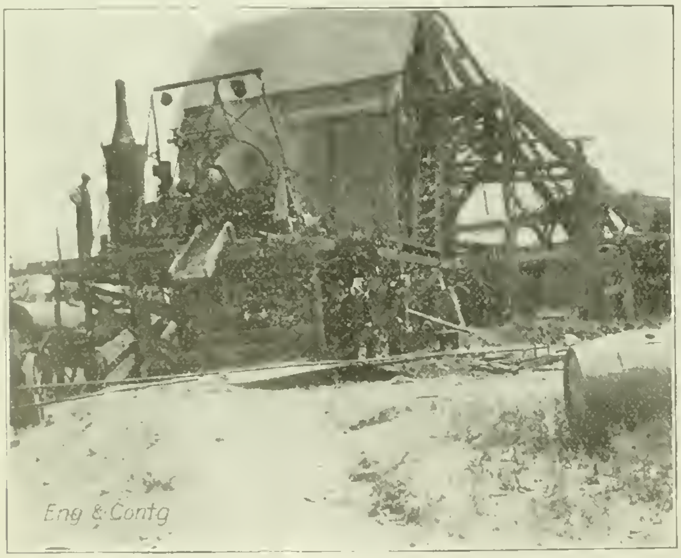


Fig. 3—Stationary Mixing Plant, Loading and Discharging by Gravity.

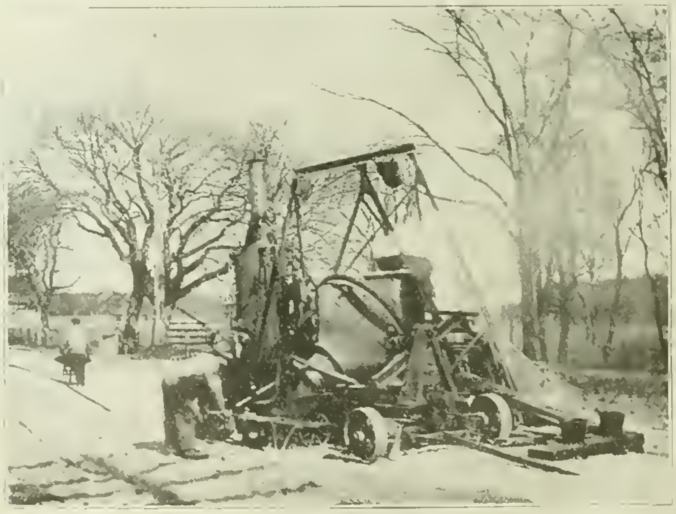


Fig. 4—Portable Mixing Plant Used on Resurfacing Work.

SEAL COAT.

After the course has been prepared as above described, a flush coat of about ½ gal. of tar or asphalt (to be furnished by the Board) to the square yard shall be applied to the surface, and clean, sharp and dry sand free from loam, clay and foreign matter of all kinds spread upon it to a depth of ½ in. The whole surface shall then be rolled as directed by the engineer or inspector.

At places where the bituminous material appears excessively on the surface more sand shall be added.

WITHOUT SEAL COAT.

Upon the bituminous course, thoroughly rolled, shall be spread a layer of clean, sharp and dry sand free from loam, clay and foreign matter of all kinds, to a depth of ½ in. The road shall then again be rolled as directed by the engineer or inspector.

At places where the bituminous material appears excessively on the surface, more sand shall be added.

No bituminous material shall be laid later than the date designated by the engineer.

The price per square yard for bituminous work as specified above will be over and above the cost of an ordinary water-bound macadam road.

A finished road 6 ins. in depth, 4 ins. of this in the foundation and 2 ins. of tar macadam, has been the usual construction. On excessively heavy traveled town streets the thickness of the tar mixed course is increased.

The base course is well rolled and then coated by hand pouring, with ¼ gal. of Tarvia per square yard. The tar-coated stone of the top course is pressed into the interstices of the foundation by rolling, thus interlocking the two courses. Tarring the base course aids the bonding. By this means the rolling up of the surface, in evidence to considerable extent on many New England trunk lines constructed with bituminous materials, is absolutely prevented.

During the first part of last season broken stone ¼ in. to 2 ins. was used in the top course. Owing to the separation of the stone into sizes by handling, the resulting surface after spreading was not uniform, and hence the old sizes of ¼ in. to 1½ ins. were readopted.

Rolling, always essential for a well-bonded plain macadam, has been found doubly so for a tar macadam. The top course is rolled until the surface is thoroughly closed, and the local stone generally employed has keyed and matted together perfectly.

Two methods are followed for finishing the road: (1) A seal coat of bitumen covered with ½ in. screenings or sand. This is the usual method where day labor under State superintendence is employed.

(2) Screenings without the bitumen. This method is used in work done by contract.

In method No. 1 the stones are not completely blanketed by the bitumen, so it, as well as method No. 2, results in a mosaic surface which makes not only a good foothold for horses, but also a perfect automobile road.

Mixing work previous to last season has generally been done by hand. Fig. 2 shows the method of hand mixing on wooden platforms with hot shovels. During 1912, however, 18 mechanical batch mixers were used. These mixers are portable and are either set up in connection with the crushing plant or else moved along the road as the work advances. To handle the stone economically the crusher bins at a stationary plant discharge directly to both wagons and to the mixer hopper by gravity and the mixer discharges the coated stone to the wagon by dropping from a spout. Figs. 3 to 6, inclusive, show some of the mixing plants on the Rhode Island work.

The apparatus most generally used is one manufactured by the Municipal Engineering & Contracting Co. of Chicago, known as the Chicago Improved Cube Mixer. When provided with the Austin oil torch heating attachment the stone may be dried for use in bituminous road construction. The machine consists of an iron cube, revolving on its diagonal axis and gear driven from a steam engine mounted on the same portable frame. A small belt-driven air compressor furnishes the necessary pressure for operating the crude oil torch. The two ingredients are mixed in the cube chamber by kneading and folding rather than by stirring and the action is rapid and complete.

The broken stone is first dumped or shoveled into the measuring hopper which is then raised on an inclined slide by a small cable hoist. After depositing the charge in the mixing chamber the stone is turned for several minutes under the oil torch blast before the hot Tarvia is poured in. To discharge the mixture, the engineer operates a single lever which tips the revolving cube and allows the material to drop by gravity to the wagon or wheelbarrow.

The mixers, generally of ½ yd. capacity, in unit with the stone crusher, run three batches in 10 to 15 mins. with four men; namely, an engineer, a tar man, a loading man and a helper. A wagon of 1½ cu. yd. capacity waits for the three batches to be mixed and then hauls them to the road, usually not more than a mile distant from the plant.

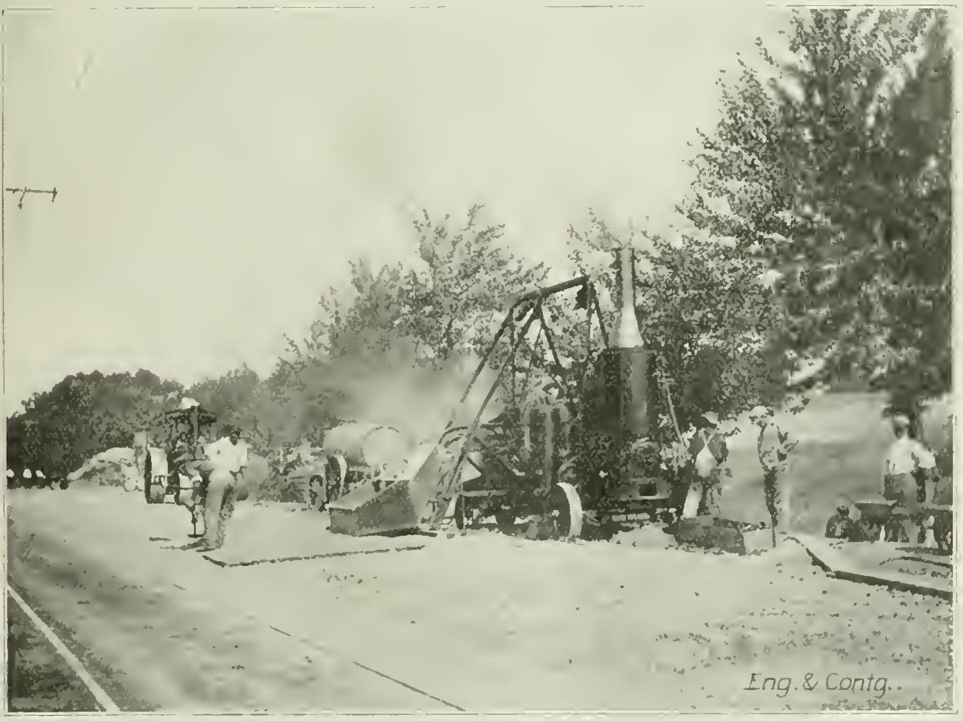


Fig. 5—Loading Mixer Skip by Hand from Dumping Board.

When the mixing machine is used on the road, the stone is dumped on a board platform at the mixer, placed some 200 ft. ahead of the point where the tar macadam is being laid, and moved as the work progresses. The loading skip of the mixer is filled by hand and the mixed macadam wheeled in barrows to the road. Portable kettles holding 100 or 200 gals. are in use at both the stationary and portable plants. The Tarvia is shipped in steam coiled tank cars, run off into barrels, and conveyed to the road in the barrels to be used as required. Contractors are asked for bids on both water-bound macadam and tar macadam. The latter price is always stated in a square yard price over and above the cost of water-bound macadam. For example, on a 6,300 sq. yd. job a price was give of $3.25 per cubic yard of stone in place with 18 cts. per square yard for bituminous work. On this 6-in. road, 1.18 gals. of Tarvia were used in the top 2 ins. of hand-mixed macadam, making a total cost of $0.935 per square yard of finished road. The contract prices average about $7,600 per mile for a 14-ft. road, or approximately $0.92 per square yard exclusive of binder. The following are the contract prices on several roads:

Coventry, R. I., length road 3.16 miles; contract price, including binder, $1.01 per square yard; Warwick, R. I., length road 4.00 miles; contract price, including binder, $0.98 per square yard. Foster, R. I., length road 4.88 miles; contract price, including binder, $0.87 per square yard. These sections were mixed by machine and the work progressed from 150 to 400 ft. per day.

The following figures, based on careful observation of the various jobs, are a close approximation of the relative costs by the two methods:

No. 1—Portable plant on resurfacing—2 ins. thick, 440 sq. yds.

	Per day.
Foreman, ½ time	$ 2.50
Engineer	2.50
6 laborers at $1.85	11.10
Kettle man	2.25
2 men spreading at $1.85	3.70
	$22.05

This gives a cost of $0.05 per square yard for labor of mixing and spreading stone and Tarvia. The mixer turned seven to eight batches per hour, which covered 50 sq. yds. of surface. Observation of two other portable plants gave approximately the same labor cost.

No. 2—Hand mixing on board platform: Resurfacing 2 ins. thick, 280 sq. yds.

	Per day.
Foreman, ½ time	$ 2.50
10 laborers at $1.85	18.50
1 kettle man	2.25
	$23.25

This gives $0.085 per square yard as the cost for labor of mixing and spreading.

In work of similar nature done by the writer the labor cost for mixing and spreading a finished 2-in. course has varied from $0.12 to $0.18 per square yard. The difference of $0.05 and $0.085, or $.035, per square yard, is further increased by the saving in bitumen in the machine mix over the hand mix, amounting to .75 gal. per square yard of approximately $0.06 per square yard. On the other hand the machine mix costs are increased by interest and depreciation and the cost of installing and moving the plant.

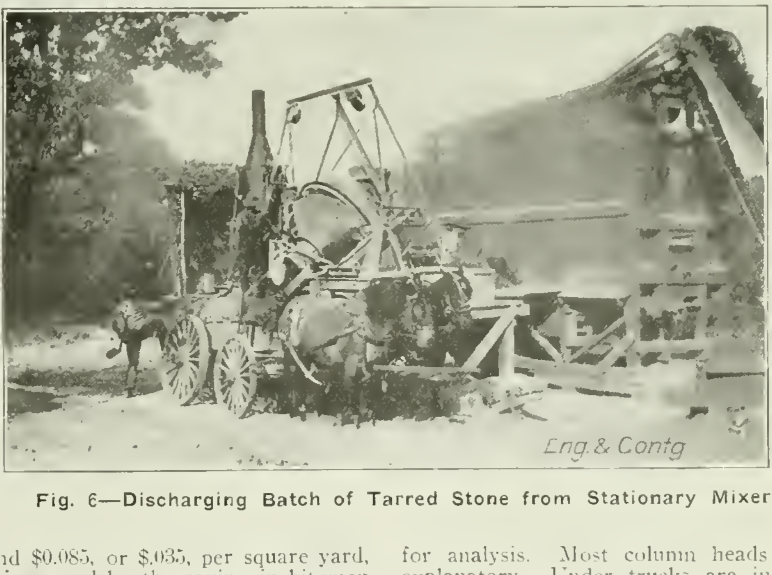


Fig. 6—Discharging Batch of Tarred Stone from Stationary Mixer.

The City Traffic Census as Conducted by the Bureau of Highways, Borough of Brooklyn, New York City.

Road censi have been taken more or less periodically for some years in parts of Europe and in some states in this country. Few cities, however, have taken any traffic records on their streets. In February, 1911, the Bureau of Highways of the Borough of Brooklyn began a traffic census, which was continued for about two months. In June, 1912, the census was permanently established as a part of the regular work of the Bureau and has been continued down to date. This is perhaps the first attempt by a municipality in this country to establish a formal, permanent, vehicle city traffic census. The traffic census in Brooklyn was originated by Mr. H. H. Schmidt, Chief Engineer of the Bureau of Highways, and was placed in charge of Mr. W. H. Messenger, Assistant Engineer of the Bureau. The following description of the manner in which the census as conducted is taken from a paper presented at the Cleveland meeting of Section D of the American Association for the Advancement of Science by W. H. Messenger, Assistant Engineer, Bureau of Highways, Borough of Brooklyn, New York City:

The census is taken by the enumeration of all vehicles passing a given point in both directions. The forms used have been adapted from those proposed by the American Society of Civil Engineers and that used by the Rhode Island State Board of Roads. Both of these forms were intended mainly for country road censi, but they contain the general classifications most needed in all vehicular traffic records. The primary objects of the Brooklyn census are to obtain an authoritative knowledge of the density and tonnage of all vehicular traffic. From this knowledge it is expected to determine, at least as far as traffic may, the solution of problems of widening, or extension of, and the character of pavements of the streets of the city. The printed forms are shown herewith.

Form 1, for field use, one sheet for each direction of flow of traffic, is printed and bound in pads of 50 with card-board back, which make very good score-boards for observers. These records are returned to the office each day, where the totals for hours, day, class and tonnage are made up. These totals are summarized on Form 2, for daily or weekly reports. Form 1 provides for all ordinary street traffic, and makes reasonable provision for separating it into its elements for analysis. Most column heads are self-explanatory. Under trucks are included all iron-tired vehicles, hauled by two or more horses, and under wagons, those hauled by one horse. Practically every point thus far observed shows at least a few of each class of vehicle in the returns.

The density of traffic being directly affected by the width of roadway, the first analysis of traffic returns is expressed in number of vehicles per foot of roadway width per hour or per minute. In congested streets the results are also computed for number per line of traffic per minute, taking 8 ft. as the mean width per line. For a 36-ft. roadway there can be ordinarily but four lines of traffic, and when two of those lines are of street car cars on tracks symmetrically laid as to the center line of the street, and there are vehicles drawn up to the curb on each side, it is very easy to find a congested street. By the adoption of the system of traffic units as used by the London Traffic Branch, as a measure of traffic density, the unit being a coefficient having relation to the size, speed and flexibility of vehicles, much the closest approximation on paper can be made to the actual conditions on the street.

Traffic Observed on.......................... .... Between...and...
Date.............................. .... Observed by..Traffic Bound...Direction...

Time	Rubber Tired Vehicles						Iron Tired Vehicles					Hourly Totals	Street Cars
	Auto Trucks				Automobiles	Wagons and Carriages	Trucks		Wagons		Carriages		
	Large		Small										
	Loaded	Empty	Loaded	Empty			Loaded	Empty	Loaded	Empty			
8 to 9 A. M.													
9 to 10													
10 to 11													
11 to 12													
1 to 2 P. M.													
2 to 3													
3 to 4													
4 to 5													
Total No.													
Total Weight													

Weather.. Pavement..

Form 1—Blank for Field Use; Actual Size, 8 in. by 13 in.

Applying such traffic units to different traffic divisions of Form 1, we get for coefficients:

Large auto trucks	5
Small auto trucks	2
Automobiles	1
Carriages	2
Trucks, loaded	10
Trucks, empty	7
Wagons, loaded	7
Wagons, empty	4
Street cars	10

These coefficients used in the study and summaries of traffic records give a totally different conception of the traffic volume than the mere numbers of vehicles. Traffic units thus applied can be used anywhere, on all classes of pavements, thus tending toward a uniformity of standards which alone can be of value in the comparisons of results on different streets, on different styles of pavements and those obtained in different cities.

The tonnages used for each class of vehicle are shown in Table I.

These weights were only arrived at after an extensive inquiry among many business and industrial houses which seemed to be among the largest users of the streets. Auto-truck manufacturers and horse-dealers were of course included in this inquiry. One manufacturer reported it not unusual to ship a 22-ton anvil on a 3-horse truck, while dry-goods concerns are said to send out about one ton net per 2-horse truck. This diversity in weight shows the constant conflict between the desire to enlarge the number of traffic divisions and the necessity of keeping that number within reasonable limits for the efficient execution of the work.

TABLE I.—TONNAGE FOR EACH CLASS OF VEHICLES.

	Tons.
Rubber Tired Vehicles—	
Large auto trucks, loaded	9
Large auto trucks, empty	4
Small auto trucks, loaded	3
Small auto trucks, empty	1½
Automobiles	1¾
Wagons and carriages	2
Iron Tired Vehicles—	
Trucks, loaded	7½
Trucks, empty	3½
Wagons, loaded	2½
Wagons, empty	1½
Carriages	1

In many streets of the city, from 70 to 90 per cent of the traffic moves at a rate of speed of four to six miles per hour. In others and on parkways the rate averages from 10 to 15 miles per hour. On the streets of the former character vehicles are very largely iron-tired and horse-drawn, and in these cases at least, speed can have little to do with the durability of pavements.

Observations have been taken at some 400 different points, mostly in duplicate since work began. These points are spread out in different sections of the city, being close together in the business and industrial sections, and the reverse in the outskirts. A large number of new records were required for the uses of the city planning committee, together with duplicate records at the points of the 1911 observations. Others have been taken on all streets now paved with belgian or cobble on sand foundation, of which there are a very few miles left in Brooklyn. Still other records have been completed or are in progress upon streets which are to be repaved during 1913, including a number of railroad streets now paved with granite on a sand foundation.

TRAFFIC OBSERVATION on ....
...............................Pavement Between...and...
...............................Roadway From...191.... to ....191....
...............................R. R. Total Observation....................Hours

	Kind of Vehicle	Total Number	Total Weight	Av. No. Per Hour	Remarks
Rubber Tired Vehicles	Large Auto Trucks—Loaded				
	Large Auto Trucks—Empty				
	Small Auto Trucks—Loaded				
	Small Auto Trucks—Empty				
	Automobiles				
	Wagons and Carriages				
Iron Tired Vehicles	Trucks—Loaded				
	Trucks—Empty				
	Wagons—Loaded				
	Wagons—Empty				
	Carriages				
Totals					
Street Cars					

Form 2—Blank for Daily or Weekly Reports; Actual Size, 8 in. by 8 in.

Two observations separated by a period of 15 days have in general been taken at each point. Records as a usual thing have been eight hours long, from 8 a. m. to 12 m. and 1 p. m. to 5 p. m., the traffic squad working six days a week, rain or shine. A few 24-hour and Sunday records have been taken, and it is hoped in the future to take such records regularly, say two or three per year, on streets typical of the different classes of traffic to be found, so as to arrive at the total tonnage per day, week, month and year. The last summarized for the life of a pavement which has become worn out, gives the traffic durability. This figure is best expressed as a total life of tons (of 2,000 lbs.) per foot of width of roadway.

The traffic squad is made up of six men, five observers and a relief. These men are selected laborers, and with a little training have become quite efficient. Just previous to make-up of assignments, an inspection of the streets at the points of observation is made for construction or other temporary obstacles to the normal flow of traffic. These assignments are made in groups of five for about one week in advance and given to the relief, who distributes them from day to day. The accuracy of the observations is frequently checked for one hour periods by an independent observer sent out from the office. The squad and its work is inspected at least once each day, when reports are collected. Where traffic is dense two observers are placed at each point, but frequently one man takes count in both directions.

Reports are made weekly, consisting of summaries, maximum and average traffic per hour and per minute, per line of traffic per minute, and per foot of roadway per minute. Special reports are made from time to time when required, showing the average and maximum density of traffic on a given street from end to end or a portion of the same. These reports also contain analyses of average per cent in number and tonnage of iron-tired and rubber-tired traffic. These data are plotted. When records have been taken on a considerable length of a street at points rather regularly placed, these plots are connected, thus assuming, for the purpose of the design of a new pavement, that traffic is uniform between observation points. This assumption holds good in many cases, but would be entirely wrong in others. Careful inspection only can make it a safe one.

Each year's results are to be plotted on a map of the city with colors to show three grades of density, light, medium and heavy. These maps are to be used for many comparisons, so that the densities used will be that of number of vehicles or of traffic units per foot of roadway width per minute. As fast as streets, upon which records have been taken, have been repaved, new records are to be begun, thus furnishing an interesting comparison between results on the old and the new improved pavement.

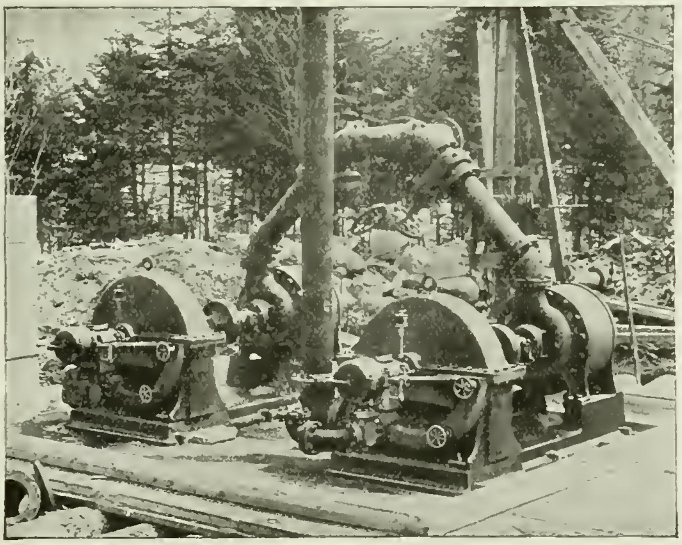
GENERAL ARTICLES

Hydraulic Fill Dike Construction Using Turbine Driven Centrifugal Pumps.

(CONTRIBUTED.)

An engineering feature of decided interest in the building of the Abbott Brook Dike, an earth dam located on the westerly side of Sawyer lake—the new reservoir formed by the Aziscohos Dam (Eng. & Contg., Jan. 4, 1911) across the Magalloway river at the headwaters of the Androscoggin river, was the placing of practically 75 per cent of the dam by sluicing methods using turbine-driven centrifugal pumps.

This dike is 900 ft. long, 165 ft. wide at the base, and about 16 ft. wide at the top, and has a 6-in. plank core, or diaphram, composed of two layers of 3-in. plank. The total volume of the dike is 46,000 cu. yds., of which amount 1,600 cu. yds. were placed by manual labor to form the toes of the dike and for the puddle fill at each side of the timber core in the cut-off trench. Of the remaining 44,400 cu. yds., 31,165 cu. yds., or the entire embankment to an elevation above normal water level, were placed by hydraulic sluicing methods, similar to those used in the big earth dams of the West.



Turbine Driven Centrifugal Pumping Plant for Hydraulic Fill.

For this work a plant consisting of two 150 h. p. Terry turbine driven pumps was used. The turbine units were direct-connected on the same base by flexible couplings to 3-stage, 8-in. Alberger centrifugal pumps and were designed to run at speeds ranging from 1,800 to 2,000 r. p. m. The main pressure line from the pumps to the burrow pit was 600 ft. long and 10 ins. in diameter. The branches connecting this main with a 2-in. monitor hydraulic giant were 350 ft. long and 7 ins. in diameter. The pipe, a No. 16 gauge spiral riveted, was fitted with flexible joints and anchored at all angles and joints, where subject to unusual strain, with wire lines fastened to dead men or stakes driven in the ground. The force of the water leaving the nozzles under high pressure was so great that although the nozzles were securely mounted on swivel bases, a long lever had to be attached to each nozzle to enable one man to control it. Even then under certain conditions two men were required at a nozzle. Steam to run the turbines was furnished by a battery of eight boilers. The battery consisted of two 50-h. p., three 40-h. p., and three 30-h. p. boilers and a multicoil feedwater heater. The boilers were all of the horizontal type and were asbestos covered to conserve as much heat as possible on account of the high cost of fuel.

In sluicing, two powerful water jets under nozzle pressure of from 20 to 80 lbs. per square inch from the 2-in. hydraulic giants were directed against the bank in a burrow pit at the northerly end of the dike. At the highest pressure, these quickly loosened the earth, and the resulting mixture of earth, stone and water was guided to the head of the main flume, then through the main flume and the laterals, or distributing sluices, to the place of deposit in the fill. The flumes were rectangular wooden structures supported on wooden trestles and had to be built with definite even slopes from the burrow pit to the fill. The main flume was about 1,000 ft. long and the main trestle about 40 ft. high at the tallest point.

The laterals were arranged to discharge at the edges of the fill and levees or dikes were built to direct the flow of incoming material from the edges to the center of the fill. In this way the loose stones and coarse material remained at the edge and the finer particles and silt were carried by the water toward the center. The result is a bank having the coarser and more porous material at the outside, grading gradually to the finer impervious material at the center. The whole mass is packed as solidly and securely as in its original bank formation, and the resulting dike is better than could have been produced by the common method of excavating, transporting, filling, and compacting.

Although turbine-driven pumps were considered somewhat of an experiment for this line of work, these units added considerably to the successful completion of the dam in the short time of about 82 full days. The Terry turbine driven pumping outfit is especially suited for this class of work, as it maintains a steady water pressure at the nozzle. The governor and all parts are completely enclosed so that the operation of the machine will not be interfered with by dirt or dust. The casings of these turbines are horizontally divided providing for complete inspection of internal parts by simply lifting the covers, and without disturbing bearings or steam or exhaust lines. The revolving element consists of a shaft and a wheel, and the only wearing surfaces are the two-ring oil bearings, so that there is but little that can possibly get out of order. No skilled engineer was required to operate the equipment.

As the location of this dam is some 40 miles from the nearest railroad station and the intervening roads are mountainous and often impassable for teams, the light weight and the small space occupied by these turbines was of particular advantage. The site of the dam so far from the railroad also made it extremely difficult to get a sufficient supply of coal and what little could be obtained was at a minimum cost of some $20 per ton. Such a price was prohibitive and it became necessary to rely on wood for fuel. A total of 1,860 cords of wood were burned and counting the 55 long tons of soft coal used as equivalent to two cords each of wood, made about 1,970 cords of wood burned in all.

The material moved by sluicing was a glacial drift composed of gravel, sand, clay and small stones, and was so firmly compacted that it was found advisable to resort at times to dynamiting to loosen the materials. Holes were drilled about 8 ft. deep and 8 ft. apart and about 6 lbs. of 60 per cent dynamite used per hole. These charges were set off in batteries of from three to seven holes to a firing. Steam pressure at the boiler ran from 80 lbs. to 105 lbs. gage and the pump pressure was about 45 lbs. per square inch down to 20 lbs. depending upon the elevation, averaging about 45 lbs. per square inch with a 2-in. monitor discharge stream.

Sluicing was carried on for thirty-two 10-hour days and for sixty-eight 24-hour days which is equivalent to 82 full days. The men worked on two shifts of twelve hours each, working week days and Sundays continuously, the only stops being for unavoidable delays, cleaning, and repairs. The average yardage placed per day was 380 cu. yds. and the best weekly record was 3,891 cu. yds., or an average of 556 cu. yds. per day. The record was determined by weekly cross sectioning the embankment. The volume of solids moved in the water averaged better than six per cent under normal conditions.

Sawyer & Moulton of Portland, Maine, were the contractors for the entire project which included not only the Abbott Brook Dike but the Aziscohos Dam.

Some Records of Steam Shovel Ditch Excavation Operations and Costs on the Los Angeles Aqueduct.

Steam shovel cost data and operating records of an interesting nature are given in an article in "Western Engineering" for February, 1913, by Mr. D. W. Peterson, Engineer, Olancha Division, Los Angeles Aqueduct.

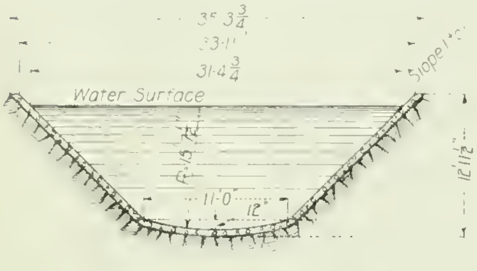


Fig. 1—Typical Section of Open Canal on Olancha Division, Los Angeles Aqueduct.

The aqueduct on this division is open concrete lined canal of the general cross-section shown by Fig. 1; the construction quantities per lineal foot nominal section are 10.57 cu. yds. of excavation and 0.813 cu. yd. of concrete. The materials excavated may be divided into four classes as follows: (1) Loose desert soil, a sandy loam; (2) boulders of medium size (up to 5 ft. diameter) more or less cemented; (3) extremely large boulders, loose or cemented; (4) cemented gravel or solid rock. All these classifications are encountered separately and in combination and either in level cutting or on the steep slopes. The yardage per foot ranges from 8½ cu. yds. minimum to as high as 30 cu. yds. on the sidehill. Long-boom power shovels are used to excavate the ditch. Two of these are model 60 Marion steamers of standard gage with 35-ft. booms and 1½-cu.-yd. dipper. A third is of the same type with 38-ft. boom and the fourth is a special model 60 Marion electric with 40-ft. boom and 1½-cu. yd. dipper. The steamers have special bank jacks designed for the small space allowed in a ditch with a 12-ft. bottom and with 1 to 1 side slopes. These jacks are operated by hand. The electric shovel has an 8-ft. gage, high A-frame, and telescoping bank jacks operated by separate 10-h.p. motors mounted over the jacks. This shovel is operated by a 2,200-volt 100-h.p. motor. The dipper handle is operated by a friction clutch.

In desert soil, the costs are quite easy to account for. Each of the two shifts on the steam shovels requires the following crew:

1 operator at, per month	$155.00
1 craneman at, per month	115.00
1 fireman at, per month	80.00
4 pitmen at, per day	2.50
4 pitmen at, per day	2.25

These men work six days per week of eight hours each and repair the shovel on Sunday. The costs shown do not include board. All meals are furnished by a mess contractor to the men at 30 cts. each. The total cost for labor is $955 per month a shift, or $1,910 for two shifts. A night watchman on the shovel at $75 per month brings the total labor cost to $1,985 per month for two shifts.

During the first year, freight on fuel oil was $11.76 per ton or $1.96 per barrel. This was later reduced to $8.52 per ton or $1.42 per barrel. The average price of fuel oil in the vicinity of Bakersfield has been 45 cts. per barrel, and so the average cost delivered to the shovels has been about $2.25 per barrel. Each shift uses 10 bbls., a total of 20 bbls. per day. With an average of 48 shifts worked in one month the total oil consumption is 480 bbls., which at $2.25 per barrel amounts to $1,080. Repairs of various kinds amount to $175 per month. Other small charges for lights, various small items, etc., bring the total costs to $3,500 per month. Thus far, the steam shovels in easy desert soil, excavating 35,000 cu. yds. per month, labor costs 6 cts. per cubic yard, fuel oil 3 cts., repairs about ½ ct., and miscellaneous small charges ½ ct., making a total of 10 cts. per cubic yard for direct construction costs.

On the same class of work, with first-class electric shovel crews, the progress is 2,000 to 3,000 ft. per month with an average of 2,500 ft. and about 23,000 cu. yds. output. The labor costs amount to about $1,700 per month, as a night watchman is not needed, also one or two less pitmen on each shift as compared with the steamers. A typical month shows 50 shifts, 11,370 kw. hours consumed at the rate of 28.4 kw. per hour during operation at a cost of $0.017 per kilowatt hour. The total cost for the month was $191.78. Repairs amount to about $200 per month. Miscellaneous small expenses are about $150 more, making a total of $2,241.78 or practically 10 cts. per cubic yard for material excavated. Labor costs $0.074 per cubic yard, power $0.0073, repairs $0.0087 and miscellaneous items $0.006.

In the second class of work in boulders up to about 5 ft. diameter, more or less cemented with a hard indurated clay or gravel, the steamers with little or no shooting ahead of the shovels, except to bulldoze some of the larger boulders, obtain 2,600 ft. progress per month with about 22,000 cu. yds. output. Due to the powder used, and the increased repairs, the cost for the month for two shifts is:

Labor	$2,000
Fuel oil	1,000
Repairs	350
Powder	400
Miscellaneous	200
Total	$3,950

This is an average of 18 cts. per cubic yard. The electric shovel cannot dig such material without having it shot up in advance at a cost of 11.4 cts. per cubic yard. Holes are put down 12 to 15 ft. apart and about 2 ft. below grade, and are shot with about 110 lbs. of black powder; 1,600 ft. of progress with 14,000 cu. yds. output is an average month's work. Delays and breakdowns become more serious and frequent. It has been found better to plug a shallow hole in boulders ahead of this shovel rather than bulldoze them, as the shovel suffers too much from heavy shooting. Here the costs are:

Labor	$1,700
Power	130
Repairs	250
Powder	100
Miscellaneous	200
Total	$2,380

Add to this $1,600 for drilling ahead of the shovel and the total excavation cost is $3,980, with an average of 28 cts. per yard. This is 10 cts. per yard more than it costs with the steamers. Here especially the smaller progress of the electric shovel seriously affects the cost of trimming and concreting the ditch.

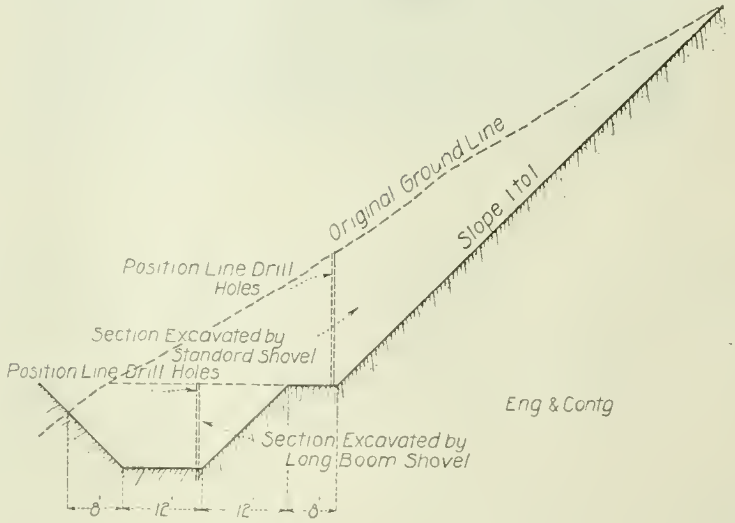

Original Ground Line
Slope 1 to 1
Position Line Drill Holes
Section Excavated by Standard Shovel
Position Line Drill Holes
Section Excavated by Long Boom Shovel
Eng & Contg
8
12
12
8

Fig. 2—Sketch Showing Two-Shovel Method of Excavating Side Hill Canal.

No attempt is made to use the electric shovel in the more difficult classes of work. In the heaviest boulders, in level cutting, it is very difficult to make more than an average of 1,800 ft. per month with the steamers on a two-shift basis. At places, granite boulders 10 to 20 and even 30 ft. in diameter are encountered in large numbers. A 3-in. Sullivan drill, operated by steam from the shovel, is used in the pit to put holes in these boulders. Of course, all boulders possible are bulldozed with large quantities of dynamite. Labor costs are higher, as two drill men and a tool sharpener are added to the usual crew. There is not much fuel oil used, for the reason that sometimes the shovel can dig only an hour or two per shift. The total expenses are:

Labor	$2,300
Fuel oil	850
Repairs	450
Powder	1,000
Miscellaneous	200
Total	$4,800

The unit cost per 15,000 cu. yds. is 32 cts.

The next condition, and this by far the most difficult class of material to excavate, is where enormous boulders are massed into fairly solid formation on a steep sidehill with cuts of 50 to 70 ft. on the upper side. There are layers of cemented gravel in with the boulders, with enough loose material at places to cause the drill holes to ravel badly. Machine drills could not be used, for the reason that the holes ravel too much and the drill would constantly stick. Two rows of deep holes have to be put down, one along the inside edge of the bottom of the ditch, about 4 ft. below grade and the second about half way up the slope. The former holes are 24 ft. in depth, the latter about 16 to 18 ft. Two or three days are required by three men to drill, or churn down each hole. The deep holes are then sprung to hold about 450 lbs. of 5 per cent Judson powder and the shallow ones to hold from 250 to 300 lbs. As each of these sets of holes loosens about 350 cu. yds. of material, the cost amounts to about 25 cts. per cubic yard.

It was realized that a shovel with a 35-ft. boom which could reach up only 22 ft. and out from 25 to 30 ft. could not handle a 70-ft. cut on the upper slope. Some work up to 50 ft. was done with one shovel, but it was extremely slow, as the top 20 ft. had to be barred down to the shovel. A model 40 Marion steamer, which was available, was put in ahead of the ditch shovel to handle the top cut. This shovel had a boom 25 ft. long, standard jacks, and a ¾-cu.-yd. dipper. It was planned to take down about 40 ft. of cut with this, leaving 20 to 30 ft. for the shovel in the ditch. It was soon found that this shovel was a benefit, but not nearly as much as a standard model 60 shovel would be. However, it was used to finish up the

TABLE I.—COST OF OPEN DITCH EXCAVATION WITH STEAM AND ELECTRIC SHOVELS.

	(1) 60 Marion; steamer; 35 or 38 ft. boom; 1½ cu. yd. dipper.	(2) 60 Marion; steamer; special elect.; 40 ft. boom; 1½ cu yd. dipper.	(3) 60 Marion; steamer; 35 or 38 ft. boom; 1½ cu. yd. dipper.	(4) 60 Marion; special elect.; 40 ft. boom; 1½ cu. yd. dipper.	(5) 60 Marion; steamer; 35 or 38 ft. boom; 1½ cu. yd. dipper.	(6) 60 Marion; steamer; 35-ft. boom; 1½ cu. yd. dipper; assisted by 60 Marion steamer, 25-ft. boom; ¾ cu. yd. dipper on top cut.	(7) 60 Marion; steamer; 35 ft. boom; 1½ cu. ft. dipper.	(8) 60 Marion; steamer; 35 ft. boom; 1½ cu. yd. dipper; ass't by 61 standard Marion steamer, 25-ft. boom; 2½ cu. yd. dipper.
Monthly progress, ft..	4,000	2,500	2,600	1,600	1,800	1,000	800	2,000
Monthly yardage......	35,000	23,000	22,000	14,000	15,000	27,000	17,600	44,000
Cost:								
Labor	$0.060	$0.0740	$0.091	$0.1210	$0.1520	$0.133	$0.140	$0.082
Fuel oil or power.....	0.030	0.0073	0.0455	0.0093	0.0570	0.048	0.060	0.035
Repairs	0.005	0.0087	0.0160	0.0178	0.0300	0.020	0.020	0.010
Power used in pit.....	.....	......	0.0180	0.0071	0.0670	0.037	0.020	0.005
Miscellaneous	0.005	0.0060	0.0090	0.0140	0.0130	0.011	0.010	0.008
Total shovel........	$0.100	$0.0960	$0.1795	$0.1692	$0.3190	$0.249	$0.250	$0.140
Prospecting, drilling and shooting, per cu. yd...............	.....	......	......	0.1140	......	0.250	55*	40*
Total drilling and excavating	$0.100	$0.096	$0.1795	$0.2832	$0.3190	$0.499	$0.355†	$0.21†
Equipment	0.005	0.010	0.0080	0.0180	0.0120	0.012	0.012	0.012
Roads	.....	......	0.0100	......	0.0100	0.015	0.015	0.015
Water supply	0.003	0.001	0.0040	0.0010	0.0040	0.005	0.005	0.005
Administration	0.005	0.008	0.0080	0.0140	0.0140	0.020	0.025	0.010
Miscellaneous	0.001	0.001	0.0010	0.0020	0.0020	0.003	0.003	0.003
General total	$0.014	$0.020	$0.0310	$0.0350	$0.0420	$0.055	$0.060	$0.045
Grand total	0.114	0.116	0.2110	0.3150	0.3620	0.555	0.415	0.255

(1) and (2), desert soil—sandy loam; (3) and (4), boulders, 5 ft. diameter, cemented; (5), very large boulders; (6) very large boulders in solid formation on side hill, top cut 70 ft; (7) and (8), loose to 20 per cent solid rock, side hill.

*Applies to solid rock portion of section equals 4.4 cu. yds. †Cost of drilling, shooting and excavating section containing 20 per cent solid rock. Solid rock portion would cost approximately $0.80 and $0.54 per cu. yd. by the respective methods.

heavy cutting through the boulders. About 100 ft. progress with 27,000 cu. yds. output was obtained by the two shovels through the heaviest boulders. The advance drilling had to be done extremely well, but an enormous amount of bulldozing was required to break up the individual boulders. Repairs naturally were very heavy. Advance drilling and shooting costs 25 cts. per cubic yard or $6.75 per foot. The cost for operating the two shovels was:

Labor	$3,600
Fuel oil	1,300
Powder	1,000
Repairs	600
Miscellaneous	300
Total	$6,800

The unit cost for excavation was 25 cts. per cubic yard or $6.80 per lineal foot, making a total for all drilling, shooting and excavation of $13.55 per foot, or 50 cts. per yard. This extreme condition did not prevail over more than a few thousand feet. In fact, the highest cost on a single mile was $9.25 per foot or 45 cts. per cubic yard for excavation.

For the first six miles in the Alabama hills, the ditch to a considerable extent is built in a formation which ranges from a solid rock cut to one which has soil, boulders, cemented gravel and broken angular rock, separately or with the last two mentioned in combination, overlying but a foot or two of solid rock. The rock of the Alamaba hills is an extremely hard andesite. Pits are dug from 12 to 100 ft. apart to prospect thoroughly ahead of the shovel, and except where there is only a foot or two of solid rock above sub-grade, drilling and shooting is done to break it up. In normal cutting, this can be done very easily with ordinary methods. In some of the work on the sidehill, with a rock cut 50 ft. deep on the upper slope, one shovel excavated the section. The line had been drilled in advance with a double row of holes and shot heavily.

Prospecting, drilling and shooting costs 25 cts. to 40 cts. per yard of solid rock. The excavation costs 18 cts to 30 cts per yard, depending on how well the shooting had been done and how much delay there was in sloping down the portion of the hillside the shovel could not reach. In rock work, every effort has been made thoroughly to shoot up the section in advance of the shovel, and this should extend to such a depth that the bottom and toe of the slopes are entirely broken. Too light shooting also makes the rock seamy and is far worse than a waste of money.

As explained previously the two-shovel plan, Fig. 2, on heavy sidehill cutting should be used. But to get the best results the top shovel must be of ample capacity and so, although but a few months' work remained, a model 60 Marion steamer with 25-ft. boom and 2½-cu.-yd. dipper was purchased. It was pointed out that this shovel would do fully four times as much work as the long boom model 40 with the ¾-cu.-yd. dipper and at the same daily cost. While the small shovel used only 7 bbls. of oil per shift the repairs for it in heavy work were so much greater than on a large shovel that it cost just as much as the larger model to operate. A dipper handle 2 ft. longer than the standard was placed on the new shovel to give it a greater working range. This shovel takes down a bench about 40 ft. high on the upper side, with some aid of the pit crew sloping at the top, leaving only a level cut of 12 ft. for the ditch shovel; besides, it leaves a 6-ft. berm between the ditch and the hill slope. There is, of course, a great deal of difference between excavating a sidehill bench cut with a standard-boom shovel and digging a ditch with a long-boom shovel. In the first case, only enough lift of the dipper is required to fill it and then it is swung quickly to dump. In the second case, the dipper usually has to be raised from 18 to 20 ft. each time, then swung slowly out and back with time to lower again into the pit. Not only is the long-boom shovel much slower in action, but the dipper used is only about one-half the capacity of that on the standard shovel. An actual test shows the 35-ft. boom shovel with 1½-cu.-yd. dipper when digging broken rock takes out 2¾ buckets per minute—4,125 cu. yds. per minute. The 25-ft. boom (standard) shovel with 2½-cu-yd. dipper takes out 4 dippers per minute—10 cu. yds. Thus during time actually spent in digging, the output of the standard shovel is 2.4 times as great as the long-boom shovel in the ditch.

Behind the first shovel, there follows the prospecting and drilling gang to find and shoot all solid rock that could not be handled economically before the standard shovel had passed. Test pits are put down about 25 ft. apart to discover any ledge of solid rock, and, when any is found it is more thoroughly prospected and shot. When but 1 or 2 ft. of rock stands above sub-grade no effort is made to work through 10 ft. of loose covering to drill it, but it is left to be drilled and shot in the pit after the ditch shovel has stripped the covering. A long-boom shovel can strip about 14 ft. ahead. This section is then drilled by machine and shot. In cemented gravel, the drilling is much easier. This formation does not require as heavy shooting, and when found in the base of the pit or up in the face, it can often be bulldozed. But as far as possible nothing solid is left for the ditch shovel. Owing to the extreme variation in the proportion of loose to solid rock it is difficult, in the absence of measured yardage of each separately, to give more than an estimate of the segregated costs. Prospecting for solid rock can be more conveniently and thoroughly done when the section is handled in two cuts and the drilling itself can likewise be done to better advantage and at less cost. Drilling and shooting is done for 25 cts. to 35 cts. per cubic yard, including prospecting for the rock. Excavation costs 6 cts. per cubic yard for the standard shovel on the bench and about 22 cts. for the long-boom shovel in the ditch. This shovel, at best, occasionally is delayed on account of outcrops of ledges just above sub-grade.

To summarize, one shovel in a cut of 22 cu. yds. per foot with 20 per cent solid rock can make only 800 ft. of progress per month at a cost of about $5.50 per foot, or 25 cts. per cubic yard, for the shovel in addition to the cost of $2.50 per foot, 55 cts. per cubic yard, for drilling and shooting all solid rock. With two shovels, fully 2,000 ft. per month progress can be made at a cost of $2.85 per foot, 13 cts. per cubic yard for excavation, and $1.80 per foot, 40 cts. per cubic yard, for prospecting, drilling, and shooting the solid rock, making a total of $4.65 per foot of ditch.

There has not been a great deal of excavation in cemented gravel exclusively, but a considerable amount of drilling and shooting in this formation has already been done. The costs are about 20c per yard for drilling and shooting such material. It drills faster and does not require as much or as strong powder as solid rock. Excavation of cemented gravel that has been shot up is about the same as broken stone or about 25 per cent more than earth, depending, of course, on how well the shooting has been done.

When sufficient water under pressure can be obtained conveniently, such materials as earth, broken rock with earth, or cemented gravel thoroughly shot up, can be washed off a hillside sufficiently to make it unnecessary to use a standard shovel to take off the top bench. A hillside is being handled in this manner at the north end of the Alabama hills.

Direct construction costs in the camps only have been considered. In adition such auxiliary charges against excavation as a contractor would have are as follows:

Excavation equipment, per lin. ft. of ditch..	$0.15
Roads, per lin. ft. of ditch..................	0.01
Water supply, per lin. ft. of ditch..........	0.04
Administration, including superintendence and housing	0.10
Other small charges........................	0.02
Total	$0.32

This overhead expense of 32 cts. per lineal foot of ditch for excavation amounts to an average of 2½ cts. per cubic yard for all work done. In easy digging it would be about 1½ cts. per cubic yard while in the heavier work it would be 3½ cts. per cubic yard. It increases the direct construction costs an average of 10 per cent.

Experience on this work has suggested some improvements in the shovel equipment. As it is a difficult matter to have cuts always normal, the ditch shovels at times have more dirt than they can conveniently dispose of. If water is available, and the ground slope sufficient, the spoil banks can be most cheaply washed away so as to provide sufficient room for the shovel to dump. But where there is no water, a great deal can be done by shovels in pushing out the dirt with the dipper. This is hard on the crane engines and also cuts down the progress of the shovel. To avoid such a practice as much as possible, the shovel booms should be sufficiently long for the work expected of the shovel. The increase of only 3 ft. in the length of the last boom purchased (38 ft.) makes that shovel fully 5 per cent more efficient than the shovels with the 35-ft. booms. There is no appreciable difference in the swinging of this 38-ft. boom compared with those 35 ft. in length. Of course there is a limit to the length of boom any one shovel can stand. Another improvement which would add all of 10 per cent to the efficiency of the steam shovels in easy digging, but less than that amount in harder and slower digging, would be to have them equipped with a high A frame and telescoping bank jacks operated preferably by steam. It takes at least 5 minutes to loosen and set the jacks by hand on the types used on the steamers and this time may be easily increased to ten minutes. With the telescoping type, but a minute or two is required. Then, too, an 8-ft. track-gage should be used, and this with the telescoping jacks would insure thorough stability of the shovel against turning over.

As regards the shovel used to take off the top bench cut, this, too, could have a special 30-ft. boom and 2-cu. yd. dipper and probably be greatly improved for higher cutting. This shovel of course would use standard jacks. The use of special booms, dippers, or jacks in no way changes the shovel itself as they can be put on the standard models, and the increased cost of special equipment is a small consideration where there is sufficient work. But it is most important to adopt as few sizes of shovels as possible, preferably one size, and especially one make of shovel. By adopting such a plan, the number of extra repair parts carried for a job can be kept at a minimum and a much smaller shop-gang can handle the repair work. Such a policy is not only economical, but most convenient.

The work on this division, as on the aqueduct generally, has been done directly by the aqueduct organization by the use of day labor. William Mulholland is chief engineer and J. B. Lippincott is assistant chief engineer on the Los Angeles aqueduct. John Anderson is an expert steam shovel man who has acted in an advisory capacity on all power shovel work on the aqueduct.

Suggestions for Recording Inventory of Gas and Electric Properties in Making Appraisements.

A suggested method of recording the information collected in making inventories of gas and electric properties, as a basis for making appraisals, was outlined by Mr. J. F. Druar of St. Paul, Minn., in a recent paper before the Minnesota Surveyors' and Engineers' Society. Mr. Druar's paper discussed the general problem of rates and rate-making very fully, but only the portion relating to recording the inventory of properties is here given.

In making up the inventory it is evident that a carefully outlined scheme of procedure should be adopted from the start so that each item may be checked separately and be at once segregated from the other. Mr. Druar outlined the following as classifications which will allow of some variations. Where valuation sheets are made in any of the following work they should be carefully worked out so as to contain every point of information which may be needed in the work. Ample space should be left for the company's valuation, if a valuation has been made by the company, space for at least two prices such as estimated, and contract price, location of equipment, year of installation, name and description of units of machinery, weights, freights, remarks and space for the signature of the appraiser who has compiled the information. These blanks should be of convenient size for handling, and should be so designed as to be readily placed in a binding without covering any of the data contained therein. Each sheet should be accompanied with letters, sketches, etc., pertaining to the special apparatus, and with copies of contracts of installation, the size and nature of foundations, etc.; the purpose of use, spaces for depreciation of various kinds, such as obsolescence, wear and tear, inadequacy, etc. We now come to the special heads.

Real Estate.—This should be accompanied with neat sketches of location of the various properties with the location of streets, railroad sidings, street cars, dockage, sewers, water, etc.

Description should be had of the influence on the valuation for other purposes than those for which it is used. The purchase price should be determined, if possible, the assessed value and appraised value by disinterested parties. The assessed value of surrounding property and other important information should be shown. Space for the depreciated or appreciated value percentages, etc., should be arranged for, together with remarks as to the necessity or adequacy of the property for the purpose used, etc.; if used for both electric and gas the relative values should be assigned to each.

Buildings.—Buildings should be carefully listed as to uses and proportional uses, whether for electric or gas. Proportional charges against the different amounts of space used for various operations or classes of service should be made. Plans of buildings should be obtained and carefully checked to see that depths of foundations and all other data check. Any difficulties of construction should be carefully listed as well as any peculiar circumstances pertaining to construction costs such as delivery of material, etc. Careful lists of material and quantities entering into the construction of the buildings should be made in detail and checked. Columns should be left for estimates and prices, and all should be arranged for separate sheets for totals. Settlement of foundations and other data should be noted, and in fact any notes should be made which might influence the depreciated cost for other than the wear and tear of age. Date of start and completion of erection should be entered.

Station Equipment.—Here extreme care must be employed. Data sheets must be carefully worked out to contain make of equipment, size, capacity, class, types, forms, date of building, date of purchase, date of erection, etc., the size and depth of foundations, weights of equipment, use to which equipment is put, special notes as to accidents, fires, or other trouble engine or other apparatus might have encountered. Space must be left for various percentages of depreciation due to wear and tear, inadequacy or obsolescence and for other remarks. The card should be so arranged that all the work and equipment may be listed which is connected in the particular chain of apparatus. Of course, the nature of each piece of apparatus must be carefully defined and all information as to its respective use tabulated whether for the gas or electric department or if used partly for one and partly for the other.

Overhead Construction.—Working maps should be made of convenient scale, one tracing for electric and one for gas.

First, the map is made and blue prints obtained devoid of any information. The city is then divided into sections and crews of two assigned to a section. They take the blue prints or convenient sections of same and make a thorough survey of all poles, their location, condition, etc., even as far as to securing information of the placing of foreign wires thereon. They carefully check the wires, cross arms, lamps, transformers, switches, junction, number of leads to consumers, etc. The same detailed information is secured for the gas except that at points it will be necessary to dig up the mains and test same for condition, size, etc. Recourse in some instances may be had to the maps and data of the public service corporations and these data can then be compiled in the office and later checked for location and condition.

Underground Construction.—Maps are made of the underground construction as above and special construction requires special sketches. All cables, all wires with connections to consumers, are carefully listed and measured. The manholes are measured for nature of bottom, size, etc. Connections to sewer, etc., are all plotted and arranged to give all the required information.

With the above information carefully tabulated and arranged together with contract prices where possible, together with costs taken through a period of four or five years before the appraisal carefully averaged to arrive at the cost of material, and by applying the same method of labor and other data required, and by securing actual estimates and cost figures from the installing contractors, the physical value of the plant is determined.

Record of Performance of Light Touring Car in Engineering Field Service, Season of 1912, Western South Dakota.

Contributed by Carl C. Adams, County Engineer, Butte County, South Dakota.

A 1911 Model T five-passenger Ford touring car was purchased in the spring of 1912 for use in survey and inspection trips of a civil engineer and surveyor located in western South Dakota. The machine was in good operating condition at the time of purchase, having been run about 2,300 miles the previous season. The equipment was reasonably complete, except for small hand tools and the car wore two new casings and the partially worn ones were included.

The purpose for which this machine was purchased was to replace a team and heavy buggy in field service and it was called upon to transport from one to four men, with surveying equipment, over unimproved earth roads, new trails and across trackless prairie during the entire season, regardless of weather and road conditions, so long as navigation was possible.

During the season commencing April 25 and ending Dec. 31, 1912, this car made a total of 4,685 miles with the following item costs:

Operation:

(1) Gasoline—Purchased at different points in quantity as demanded and at prices ranging from 19 cts. to 35 cts. per gallon, with an average price of 25.2 cts. per gallon. The quality also varied greatly.

(2) Engine and lubricating oil—Purchased under same conditions, at an average price of 72.4 cts. per gallon.

(3) Renewals—Including only casings, tubes, boots and interliners.

Upkeep:

(4) Supplies—Including charging Prestolight tank, cup grease, valves, hand tools, patches, tackle, extra parts and miscellaneous safeguards against blistered soles.

(5) Repairs—Replacements of worn and broken parts.

(6) Overhauling, cleaning, general mechanical attention and garage charges when not in home garage.

Table I gives item costs.

It will be seen that the season average was 17.9 miles per gallon of gasoline and 203.7 miles per gallon of engine and lubricating oil.

A typical case of work 15 miles out of town was taken as an average day's run, since work upon which the car was used was everywhere from a few blocks in town to 115 miles out in the country. The average daily expense when the car is in service is seen to be $1.734, which is only $0.234 above the daily expense of a

TABLE I.—COST OF OPERATING LIGHT TOURING CAR.

	Operation						Upkeep				
	Gasoline.		Engine oil.		Re-						
4,685 miles.	Gals.	Cost.	Gals.	Cost.	newals.	Total.	Supplies.	Rep'rs.	Overh'l.	Total.	Total.
Per season....	262	$65.96	23	$16.65	$93.60	$176.15	$27.95	$40.00	$26.75	$94.70	$270.85
Per mile	.0559	.014	.0049	.0036	.02	.038	.006	.0085	.0057	.02	.0578
Per day, average 30 miles.	1.667	.42	.147	.106	.60	1.128	.18	.225	.171	.60	1.734

team at this place, whether said team is on a pay job in the field or idle on expense. The team which this car displaced was charged out at $2.50 per day, including buggy, harness, picket ropes and light camp equipment for two men, but not including feed for team and men, which item is, by this office, charged to the client in addition to per diem of outfit. The basis of charge for the car was arrived at by making total cost of a given piece of field work equal to the cost if a team had been used and charged for as above. The quicker transportation was considered as saving not only in the per diem of the outfit, but in the matter of their road expenses. On a mileage charge basis this equals 20 cts. per mile in round numbers and seemed to average very closely to the team cost for both long and short distances.

Tests at Lahonton Dam of Electric Shovel.

(STAFF ARTICLE.)

The use for excavating gravel of a 60-ton electric shovel in the construction of the Lahonton Dam was mentioned in our issue of Feb. 12, 1913. This shovel is one of the standard sizes of electric shovels developed and being marketed by the Bucyrus Co., and shovel users will be interested in the record of tests made by the Government engineers at Lahonton. These records are given in Tables I and II.

Except in respect to the power equipment the construction of the electric shovel is substantially the same as that of the steam shovel of the same make and size. The electrical equipment is in general as follows: Motor equipment may be either alternating or direct current. The hoist motor is double-geared to the hoisting drum, the friction being identical with those used upon steam-operated machines. The clutch is controlled through the medium of an air thrust cylinder operated by hand lever.

The hoist controlling apparatus is of the multiple solenoid type, the operation being effected through a master controller. The solenoid switches are mounted upon a slate panel having a structural steel frame. Circuit breakers and overload coils protect the motors from injury. The resistance elements are cast iron grids mounted similarly to those used in electric railroad service. The master controller provides for six speeds of the motor and the operator can dig on any of these speeds. He can, however, throw the master controller immediately to the full speed position without danger of injuring the motors because the solenoid switches will automatically keep the current down to a pre-determined value and cut out resistance only as the motor speeds up. If the shovel becomes stalled due to heavy digging the main circuit breakers will not fly out but instead jamming relays will automatically cut resistance into the motor circuit and will allow only such amount of current to flow to the motors as will permit them to exert their maximum torque without injury. This method of control gives the electric shovel the same digging characteristics as has the steam shovel and makes the operation of the two machines practically identical.

The swing motor is geared to the swing drum through an intermediate shaft, its controller being of the series relay reversible type. These relays and all necessary switches and circuit breakers are mounted upon a slate panel similar to that for the hoist motor. The controlling apparatus provildes for a uniform acceleration of the motor, when the operator throws the master controller direct to the full speed position, and is so designed as to prevent shocks and jars to the machinery. In stopping the swing motor the operator may throw the controller from the full speed forward to the full speed reverse position, but the motor will be retarded at a uniform rate through the action of the relays. On the other hand this control enables the operator to swing as slowly as desired and to stop the swinging motion abruptly, thus avoiding loss of time in spotting the dipper over the cars in loading.

The thrust motor is also of the variable speed type, similar to the hoist and swing motors, but enclosed and ventilated. The windings are absolutely moisture proof. It is connected to the shipper shaft through intermediate gears of cast steel with teeth cut from the solid. On the intermediate shaft is an air-operated friction clutch so designed that it will slip when the torque reaches a value less than the stalling torque of the motor by a certain predetermined amount. The slipping friction clutch protects the motor from severe overloads and a brake also on this shaft may be used for holding the dipper and handle in certain positions when digging at a fixed radius. This, of course, means considerable saving of electric power. The brake clutch may also be used for quick manipulation of the dipper, whereby a condition, approximating the shaking of the dipper by a steam engine, is established.

TEST RECORDS.

A series of tests were conducted on the 60-C shovel at Lahonton Dam, Nevada, from the 1st to the 11th of September, 1912. During the test the shovel was loading cars at the rate of 2¾ cycles per minute. We give below an analysis of several of the runs made:

Test 1.—The results of this test are given in Table 1. The shovel was loading into two trains composed of six 4-yard cars. It started at 7:00 a. m. and stopped at 10:49 p. m. The bank was 10 ft. and the clear lift to dump was 16 ft. The total elapsed time was 3 hrs. and 49 mins. The error in time observations was 11 seconds.

Delays in shovel operation proper are included in "Actual time loading." During 3 hours 49 minutes, 126 cars were loaded and 254 cycles were made. The actual time of loading was 39.6 per cent of the total time while the delays amounted to 60.4 per cent. The shovel was loading at the rate of 2.8 cycles per minute. On the basis of above proportions of actual digging time and delays the shovel would show a total capacity in eight hours of:

$$(480 \div 229) \times 126 \times 4 = 1053 \text{ cu. yds.}$$

TABLE I.—RESULTS OF 3 HR. 49 MIN. TEST OF ELECTRIC SHOVEL AT LAHONTON DAM.

Train number.	Number dippers.	Actual time loading.		Time moving up.		Time waiting for cars.	
		Min.	Sec.	Min.	Sec.	Min.	Sec.
1	11	3	30	9	40	..	..
2	12	4	25	7	30	4	12
3	13	4	..	4	30	3	50
4	13	4	50	7	35	1	55
5	19	3	10	6	10	3	10
6	10	3	30	4	25	3	..
7	12	4	20	..	..	2	20
8	13	5	06	3	40	2	15
9	13	5	05	4	55	2	55
10	13	4	25	..	..	4	14
11	11	4	40	4	05	4	..
12	12	4	15	..	..	3	20
13	12	4	02	..	..	2	30
14	13	4	50	4	35	3	50
15	12	3	50	..	..	3	45
16	14	4	25	..	..	4	30
17	12	4	45	4	35	3	48
18	12	4	10	..	..	4	15
19	12	4	25	..	..	5	40
20	12	4	33	3	30	7	40
21	12	4	48	..	..	2	49
Total,	254	90	4	65	8	73	59

TABLE II.—RESULTS OF 50-MIN. TEST OF ELECTRIC SHOVEL AT LAHONTON DAM.

Train number.	Number dippers.	Actual time loading.		Time moving up.		Time waiting for cars.	
		Min.	Sec.	Min.	Sec.	Min.	Sec.
22	12	4	20	..	..	..	..
23	12	4	17	3	25	2	50
24	12	4	15	..	..	2	59
25	12	4	05	..	..	13	50
26	13	4	42	2	25	2	54
Total,	61	21	39	5	50	22	33

Test 2.—The results of this test are given in Table II. The shovel started at 12:41 p. m. and stopped at 1:31 p. m., the total elapsed time being 50 minutes. The shovel loaded at the rate of 2.82 cycles per minute, the actual loading time being 42.5 per cent of the total elapsed time, while the delays were 57.5 per cent. The capacity of the shovel on this test would be 1:150 cu. yds. per eight-hour day.

On the basis of 2 cu. yds. per cycle, 8 hours per day, 57 per cent digging time and 43 per cent for delays, which were shown by the numerous tests made to be a fair average with present conditions, the shovel capacity would be 1,500 cu. yds. However, with improved loading facilities the delays could be materially reduced and the output increased.

We are indebted for the information from which this article has been prepared to the Bucyrus Co., South Milwaukee, Wis.

Earth Slides in Culebra Cut—The Cucuracha slide on the east bank of the Panama Canal renewed its activity on Jan. 16, and the moving material in one day completely covered and destroyed five tracks in the canal, and derailed and buried two cars. A track has been built around the toe of the slide and two stem shovels commenced digging at it before noon of the 17th.

On the night of Jan. 19-20 the rock bluff, some 300 ft. in height, on the east bank of the canal, south of Gold Hill, broke away at a distance of several hundred feet east of the Canal, and a large part of the broken material fell into the Cut, entirely covering all the tracks on the east side. It is estimated that 1,000,000 cu. yds. of material will have to be removed as a result of this slide.

A new slide has developed in the east bank of the Canal about 325 yds. north of the suspension bridge. The amount of material in motion here, is estimated at 125,000 cu. yds., the greater part of which consists of rock.

There are indications that a small hill known as "Purple Hill," which divides the moving clay of the Cucuracha slide, and served to hold back a large amount, has been weakened on its north face. Should this hill break, it would probably release material aggregating something between 500,000 and 1,000,000 cu. yds.

Profit-Sharing Plan of Engineering Firm.—The architectural and engineering firm of Ballinger & Perrot of New York and Philadelphia has instituted a profit-sharing plan by which all employes will benefit. The firm has for some time divided a certain portion of its profits with the heads of their several departments, and this has proved so satisfactory that it is now extended to all employes. This division of profits is to be upon a twofold basis. The first will consist of the division of a certain sum in which all employes will share alike. The other will be a division of an additional amount based upon the proportion which each employe's salary bears to the total amount of salaries paid.

Eiffel Tower for Buenos Aires.—A firm in Buenos Aires has applied for a 60-year concession to erect in that city the "Torre Rivadavia," a tower 1,067 ft. high topped by a 106-ft. statue bearing a light of 1,000,000 candlepower. The tower is to be of steel construction and to have facilities for social gatherings, cafes, restaurants, a library, billiard rooms and gymnasium. There will also be a wireless station and a meteorological observatory.

WATER WORKS

Methods and Costs of Constructing and Repairing Tunnel and Pipe Line Intakes in Lake Superior, for Copper Mine Stamp Mill Water Supply at Beacon Hill, Mich.

As long ago as 1900 the Baltic, Trimountain and Champion Mining companies, now subsidiaries of the Copper Range Consolidated Company, found it necessary to supply 20,000,000 gals. of water per day for each of the three mills they had planned to erect on the shore of Lake Superior. The Baltic, with the Atlantic Mining Company, impounded the water of the Salmon Trout River, with a steel gravity dam, and thereby secured an ideal water supply. The Trimountain and Champion companies were forced to draw upon Lake Superior for their supply. The history of the intakes built, including the details of design and methods and cost of construction and repairs, was given by Mr. Edward Koepel, of Beacon Hill, Mich., in a paper before the Lake Superior Mining Institute. Mr. Koepel's paper is here given practically in full.

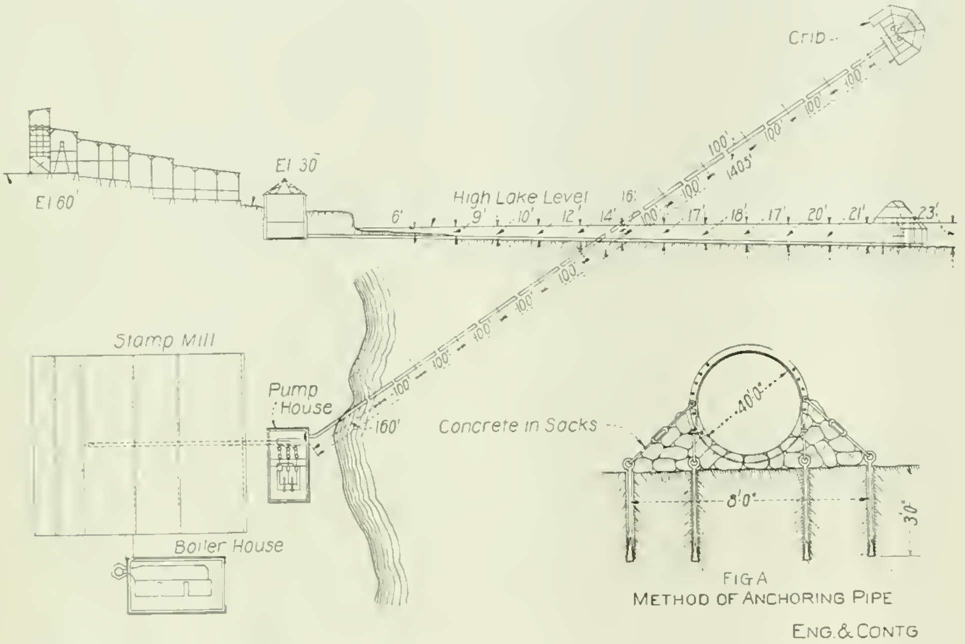


Fig. 1—Plan and Section of Buildings and Intake Pipe Line and Crib, Trimountain Mining Co. Stamp Mill, Beacon Hill, Mich.

At one point the Trimountain and Champion companies found two mill sites where one intake might serve both. Soundings showed a sandstone bottom, ideal for anchoring an intake crib and pipe line. The bottom was free from sand or boulders and inclined about 20 ins. per 100 ft.

A timber crib was designed, 56 ft. by 42 ft., with two wells and two intake pipes, one for each mill. Shortly afterwards the Champion company selected a site ¾ mile further west and planned to secure water through a tunnel. For several reasons Trimountain decided to adopt the pipe and crib intake. The sandstone bottom of the lake was crisscrossed with fissures 1½ to 8 ins. wide, with a soft white filling into some of which a steel bar was driven to a depth of 6 ft., so it was possible that a tunnel might open enough fissures to make it necessary to put in an air lock and to work under air pressure, or to abandon the tunnel entirely and put in a pipe line.

Another reason for adopting the pipe line was the need of time. It was expected that one-half the mill might be finished in a year. A tunnel 1,400 ft. long, short shaft and lake intake might take two years to complete, with a possibility of the intake being further delayed by winter. We believed a crib and 1,400 ft. intake pipe, including a trench on the shore end 400 ft. long, could be finished in four months, the cost of which should not exceed that of a tunnel. We also believed the pipe could be extended when the mine tailings encroached upon the inlet.

Trimountain started this work in June, 1901, blasting the trench on company account and contracting for the pipe and crib. The contractors did well, but the trenching suffered not only from storms, which were expected, the shore being exposed from all sides but the south, but from inability to clean out the trench after blasting. The drill platform for this trench was suspended from two wire cables fastened to timber supports in the lake. At each setting of the platform three holes were drilled on each side, pointing toward each other, and two vertical on the center line. This covered 12 ft. of the trench. Single-bit jump drills were used inside a 2½-in. pipe, three men to a drill. When the drill was withdrawn the hole was charged through the same pipe and the battery firing connection was made. The spuds or legs of the platform were then raised, the position on the cable was marked and the platform was hauled shoreward before the round was blasted.

Two settings a day were drilled, covering 24 ft. of the trench, and the entire length was blasted before we began clearing out. For cleaning away the blasted rock a five-pronged scraper made of rails was rigged to the wire cable that carried the drilling platform, and was manipulated with an engine. The blasting had looked well done but we could remove only 3 ft. of broken rock from the trench. It was re-drilled many times, but only a little rock could be removed after each blasting.

The crib was placed and, by the aid of a diver, 700 ft. of pipe was laid and partly secured by the middle of September. Another diver was engaged to anchor the pipe already laid. It was then thought possible to finish before winter. On September 17 a violent storm wrecked the 10 by 10-in. legs of our wire cable support and the cables disappeared in the water. After the weather moderated, of the 700 ft. of pipe laid from the crib toward the shore, the divers found only 300 ft. in place. This was then securely fastened and the job was stopped for the winter.

The following May work was resumed with two divers and two crews. It was evident that the job was bigger than was at first anticipated. The delivery of mill machinery was much delayed, but it still looked as if the mill would be ready before the intake. The damage by the storm taught us to secure the pipe better, and we bedded it in for half its circumference with concrete put in place in burlap bags.

In September the pipe was connected with the shore end behind a cofferdam. We then learned why the trench was so difficult to clean out. The crevices caused by the blasting were filled with a clayey cement; the force of the blast turned some of the sandstone into clay and this clay cemented the broken rock in place. The sandstone underwent the same change when exposed to the weather, turning into a clay that made a good cement.

Early in November, 1902, the mill commenced operations. The intake included 1,400 ft. of riveted pipe made of ¼-in. steel plate, in sections each 25 ft. long connected with steel flanges formed from ⅜-in. steel plate. On the shore end 400 ft. laying in a trench was covered with sand and broken stone. The rest lay on the natural rock bottom. For anchorage 240 holes were drilled, two at each flange and two more or pairs along each section. These were close to the pipe. Each hole was fitted with a 1¼-in. eye bolt and fastenings were made as shown at A, Fig. 1. Concrete in sacks was placed the whole length of the pipe, also shown at A, Fig. 1. The top of the pipe was left bare. The crib in place had cost $11,972.81. The pipe in place had cost $41,005.55.

In the winter of 1902-1903 the ice dented the pipe, and in the spring the exposed part was covered with concrete put in place in sacks. This required 34,452 bags and cost $11,064.74. The intake was then considered finished and had cost as follows:

Labor	$15,546.51
Divers	9,892.50
Consulting engineer	500.00
Supplies	16,750.68
Pipe, 1,900 ft. of 40-in.	8,380.60
Crib in place	11,972.81
Total	$64,043.10

In 1905 it was necessary to repair and reballast the crib. The ballast was gone from the inside, the rip-rapping from the outside, and the bottom timbers had their corners scoured off. The crib was reballasted with mine rock at a cost of $821.43.

Trouble then began because of tailings from the mill, wood chips and bark finding their way into the well and the pump after storms, cutting out the pump valves and stopping up pipes in the mill. We believed this resulted from leaks in the pipe, but an examination disclosed no holes, although the ice had worn the concrete from the pipe for over 200 ft. Because of the murky water all the inspections made by the diver were in almost total darkness, and he worked by the sense of touch alone, crawling along both sides of the pipe, feeling with both hands for something wrong.

In 1907 these troubles became so acute that another examination was made. Fortunately the water was clearer and the pipe could be seen from the surface. The diver reported one-third of the covering gone, the pipe flattened down to the ridges of concrete which remained on each side, the rivets in some of the girt seams and in some longitudinal seams sheared, and the pipe split open in three places, one 10 ft. long and opened to a width of 3 ins.

We covered 356 ft. of the damaged pipe with concrete, reinforced with old hoisting cable, using a movable caisson to put it in. The caisson was 18 ft. long, 10 ft. wide and 8 ft. high. The air lock for men was built of a piece of intake pipe. The locks for concrete were 10-in. pipe. The lifting tanks were two sections of intake pipe. Ten working days were required to cover 356 ft., but the caisson was in the water from September 15 to October 8, stormy weather delaying the work. Work was done during the day, using mill labor. We were able to take care of the regular stamp mill work at night. At the long split in the pipe short pieces of railroad steel were laid across the pipe, burlap was put over the split and the whole concreted over. The mill was shut down for six hours after the concrete was placed there. The caisson work, costing $5,988.97, went smoothly, but results were indifferent for reasons noted later. Two Rand three-drill compressors furnished air, and fire hose conducted it to the caisson.

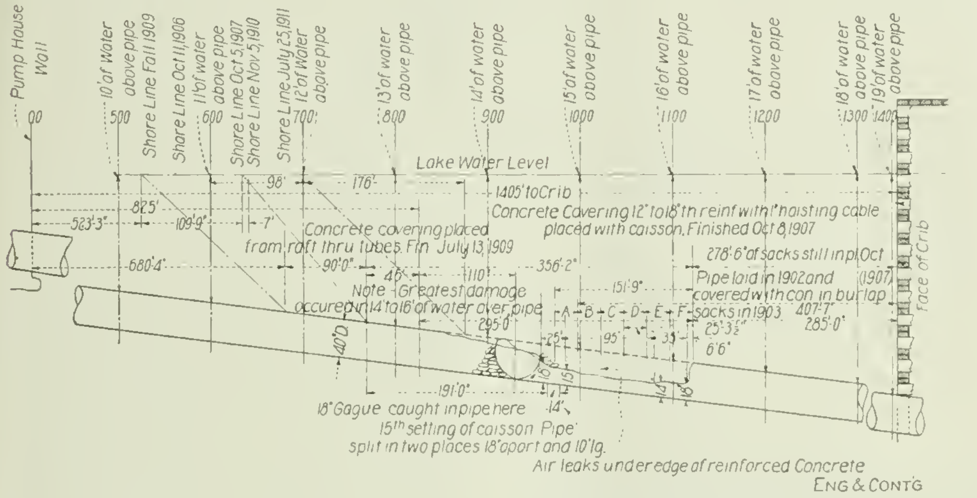


Fig. 2—Diagram Showing the Condition of the Trimountain Intake Pipe Line in 1910. Work Done on Intake Pipe in 1911.

Section A pipe removed and replaced by good length and covered with concrete in July. Shoreward from A diver found pipe in good condition. Toward crib diver found section B flattened at its center to about 30 ins., but could not crawl beyond center of section C as pipe was flattened to about 20 ins. Pipe held up well at flanges. Aug. 6 removed section E. Aug. 14 removed Section D. Aug. 14 to 20 with hydraulic jack shoved up one-half of section F, remainder toward crib in good condition, and all of sections B and C. Gauged these pipes and in no place found them smaller than 34 ins. Aug. 29 put in section of new pipe at D and on Sept. 1 one at E. Between B and E placed 3-in. tapered filling piece, bolted up flanges and covered all six sections with concrete. Concrete lowered from scow in bucket. Finished Sept. 9, 1911.

Most of the water pumped must have been sucked in through this big split and the pipe beyond it nearly filled with sand, because on starting the pump, six hours after finishing the repair to the split, the water in the pump well was lowered very much for a little while and then came back to its normal level. Two years later we pulled a hose out in the pipe from the shore end and pumped in some air, thus locating the leak by the bubbles. It was then learned that our cementing job on the split had been partly spoiled that night, the cement having been sucked out of the concrete for 6 ins. above and clear out to the side, leaving the top in good shape. Consequently the sand leaked in the same as before.

In 1908 it was found the ballast was again out of the crib and some of the timbers on three walls were gone, on one wall the gap being 14 ft. high. These gaps were closed by a diver with 2-in. plank. The crib was ballasted with 200 cu. yds. of concrete poured into the compartments through tubes in the roof. The tubes were kept full and were withdrawn as the pile came up. This concrete work cost $1,411.01, or about $7 per cu. yd. The rising and falling of the water in the crib washed most of the cement out of the mixture. Although the concrete on top got fairly hard the water could be seen sluicing back and forth through it. The next year the crib was again empty.

In 1909 it was hard to get enough water through the pipe. The diver crawled in from the crib end for 285 ft. and found the pipe flattened. He then crawled in from the shore end 825 ft., the limit of his air hose, and found the pipe in good shape. A parachute, attached to a suspended cord, was sucked through the pipe while the pump was in operation. With the suspended cord a ¾-in. rope was pulled through. With the rope a skeleton torpedo-shaped frame 18 ins. in diameter, was pulled through from the crib with another rope attached to pull it back. At 291 ft. the frame stuck a little but was pulled 35 ft. further, where it stuck. It was withdrawn and a 15-in. frame was substituted, but could go only a little further. Then a 14-in. frame was tried. It was tight about the same place the 15-in. frame stuck, but it was pulled through into the pump well. The 18-in. frame was now pulled out from the shore end until it stuck, showing only 155 ft. of the total 1,400 ft. was damaged, and that all the damage, from the ice, occurred in 14 to 16 ft. of water. With this information Fig. 2 was made.

In 1911 we replaced the 155 ft. of damaged pipe with good pipe. To remove the concrete placed with the caisson and reinforced with hoisting cable the diver blasted the concrete until some of the cable was exposed. A hook was inserted, with a strong wire rope attached to a powerful winch, which removed the large pieces. The smaller ones were hoisted in a bucket. The pipe was cut in two by blasting with 88 per cent dynamite, and a section removed. The accumulated sand was loosened with a hose and the pump sucked it into the well. A new length of pipe was put in and covered with concrete lowered into place with a self-dumping bucket holding 8 cu. ft. Two other sections were then removed and the rest of the dented pipe was sprung back, nearly to its original diameter, with a 90-ton hydraulic jack actuated from the scow above. Two new sections were then put in place of the ones removed and the whole was covered with concrete. This work cost $2,388.45.

On Nov. 28, 1911, a violent storm broke the crib away and drifted it a mile west, landing it at the Freda Park. The bottom of the crib and some ballast was left, and fortunately the pipe was not disturbed. The loss of the crib caused no worry, as it had been a constant disturbance. Before the crib was lost it had been decided to abandon the pipe and drive a tunnel with the equipment then in use extending the Champion mill tunnel.

Trimountain's total expenditures on its pipe and crib were as follows:

Original, including 1903	$64,043.10
Filling crib with rock, 1905	821.43
Placing concrete with caisson, 1907	5,988.97
Filling crib with concrete, 1908	1,411.01
Replacing damaged pipe, 1911	2,388.45
Total	$74,652.96

TUNNEL INTAKE.

Ground was broken for Trimountain's tunnel intake about Dec. 1, 1911. A shaft was sunk 100 ft. below the collar or 74 ft. below lake level. A pump station was cut and pumps were placed at the bottom. Drifting commenced February 13. Work was in 8 hour shifts. Two drilling machines of butterfly valve type worked simultaneously, two men to a machine; also two trammers to a shift. After blasting the miners and trammers of the next shift cleared away enough to rig up. The bar was set horizontally. The miners drilled upper holes while the trammers mucked the rock. Each shift squared and left the rock for the next shift to muck.

The first 1,000 ft. was dry. Then the tunnel began taking water, the flow increasing to 600 gals. per minute at 1,500 ft. where the face became dry. Water was struck at 1,600 ft. and reached a maximum flow of 800 gals. per minute. At 1,770 ft. the face became dry again and remained so until the end of the tunnel was reached, 1,970 ft. from the shaft. Aside from the wet spots the work presented no extraordinary difficulties. The work progressed as follows:—December 1 to February 12—Equipment installed and shaft sunk 100 ft.;

	Feet.
February 13 to 29, drifted	203
March, drifted	394
April, drifted	378
May, drifted	262
June, drifted	312
July, drifted	280
August 1 to 15, drifted	141
Total	1,970

The latter part of June we drilled a hole 21 ft. deep into the rock of the lake bottom, 1,970 ft. from the shaft, and into it cemented a 1-in. iron bar. With this bar as a center the tunnel inlet of concrete, in steel forms 8 ft. high, 19 ft. diameter, with a 7-ft. opening, was placed as shown in Fig. 4. A timber covering, strong enough to keep out the water if necessary when the raise from below holed through, was placed in the position to be later occupied by the grating.

On August 15 the 1-in. bar in the center of the inlet was disclosed in the breast of the tunnel. Preparations were now made to raise through to the lake bottom. A sump 6 ft. deep and 20 ft. long was taken out at the end of the tunnel and floored over. With this bar for a center, a 7-ft. raise was started and as the raise progressed the quantity of water increased. With 11 ft. to go, the raise was making 100 gals. per minute and the pumps were handling 900 gals. If the flow was increased much more it would be difficult to get the pumps out. The raise was therefore stopped, the rails taken up, the floor over the sump removed and a concrete bulkhead placed in the tunnel about 20 ft. from the shore-shaft. Openings were left in the bulkhead for the water to flow and a door for the men to come and go.

A hole was now drilled up into the inlet. It ran a full stream. Another hole was drilled and the two holes let in about as much water as the one had. The timber cover on the inlet apparently held out the water. A round of holes was now drilled and charged. To charge some of the holes a wooden plug was necessary with a hole in the center for the battery wires. The powder was pushed up into the hole and the plug was driven in with the wires projecting through it. The holes were wired up to the electric light wires, a retreat made to the bulkhead at the shaft, the door closed and the round fired. The pumps were taking care of the water all right and an inspection of the raise showed that the round had taken out about 3 ft., squaring up a seam between two layers of rock. The two through holes were again plugged and drilling was resumed. For 14 ins. the drill was in very hard rock and the hole was dry but at that depth the drill struck water and the hole ran a full stream. By moving the drill in about 4 ins. and drilling another hole it was found that the first hole let down nearly all the water and the second hole carried up 5½ ft., through rock that was very much softer than the 14-in. layer at the top of the raise. It had been planned to raise with light blasts but the large amount of water encountered above the hard layer made working in the raise so disagreeable that it was decided to drill 20 holes up 5½ ft., also 20 holes through the hard layer for drains, load and get ready to blast, remove the two plugs from the through holes to let the inlet drain and then blast. This plan was carried out but one of the two plugs broke off and could not be removed. Some time was spent in an attempt to bore it out but it was not successful with the tools at hand and further delay might jeopardize the success of the blast by chilling the powder, the water having a temperature of 43° F. Staging and tools were removed, the air pipe secured, and the door in the bulkhead closed. The blast was set off September 5.

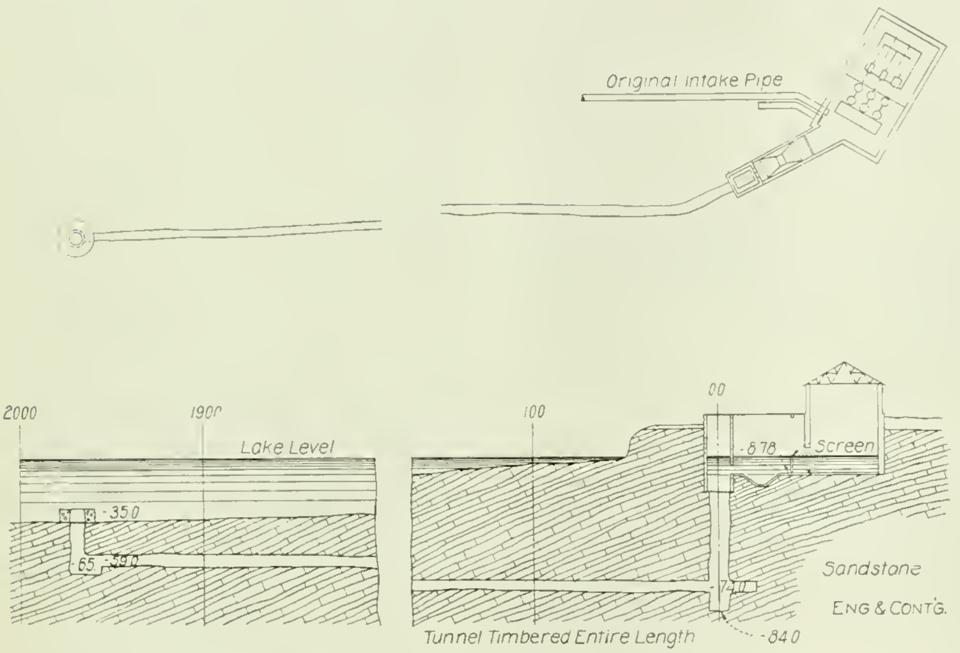


Fig. 3—Plan and Profile of Trimountain Mill Intake Tunnel.

The force of the blast instead of throwing the material down into the sump was turned upward by the hard layer of rock, knocking the timber cover off the inlet and cracking the concrete, also shearing off some of the bolts in the steel forms. The diver found the hole in the inlet half filled with broken rock through the crevices of which the tunnel had filled with water. A little of this rock was removed by him while the shaft was being cleared of pumps and timbering. On September 14 the concrete bulkhead was blasted out. The water raised in the shaft 8 ft. above lake level after the blast. Force enough had been transmitted through the water in the tunnel for about 2,000 ft. to dislodge the broken rock at the inlet of the tunnel, the inlet being found clear of rock by the diver at his next descent. While the damage to the concrete inlet is to be regretted it was not ruined. After bolting the screen in place the lake end was considered finished.

The 2-in. air line was left in the tunnel to remove any anchor or frazil ice that might form on the intake screens during the winter. The wall into the pump well was cut and arched over on Sundays and the tunnel was put into commission October 7, about ten months after the ground was broken for the shaft, at a cost for labor and supplies as follows:

	Labor.	Supplies.	Total.
Surface equipment..	$ 713.24	$ 325.43	$ 1,083.67
Shaft sinking.......	3,816.07	1,807.78	5,623.85
Shaft timbering....	456.82	184.96	641.78
Shaft concrete.....	489.85	235.10	724.95
Tunnel drifting....	17,312.07	5,481.75	22,793.82
Tunnel timbering...	1,593.09	383.10	1,976.19
Pumping	1,384.17	2,282.17	3,666.34
Intake	1,013.79	331.02	1,344.81
Channel to pump house	1,586.40	1,069.04	2,655.44
Grand totals......	$28,365.50	$12,100.35	$40,465.85

Note.—Machinery and rails were taken from the mine equipment and returned. Maintenance and freight only appearing in the supplies. Fig. 1 shows a plan and elevation of the 40-in. intake pipe as it was installed in 1901-2. Fig. 2 shows condition of pipe in 1909. Fig. 3 shows a plan and profile of intake tunnel completed October 7, 1912. Fig. 4 shows the construction and method of anchoring the concrete inlet at the lake end of the tunnel.

CHAMPION MILL INTAKE TUNNEL.

The water supply at the Champion Mill is through a tunnel intake. No trouble of note occurred until the winter of 1905, when the supply was shut off almost entirely for 30 hours. We thought fine sand and chips had collected in the bottom of the shore shaft and closed up the tunnel portal. Soundings showed a deposit there, but we had inadequate means to clean it out. An iron 2½ ins. square by 10 ft. long with prongs, was attached to a rope and was plunged repeatedly into the accumulation, the pump keeping the water in the well as low as the suction pipes would permit. Finally the tunnel contributed its usual flow of water. Later an orange peel bucket removed the accumulation, but the amount did not seem enough to have stopped the flow. We suspected that during the agitation some of it had been sucked by the pump into the mill circulation. Several stops occurred that winter of two hours and longer. During the summer there was no trouble but each succeeding fall and winter brought a little more sand and wood chips to the shaft, increasing as the waste sands encroached on the outer inlet. It was finally observed that the water in the well was lower while the pump was in operation than formerly.

In 1908 we operated a clam-shell bucket every Monday morning, the cost being charged to operating and not to the tunnel. In 1909 a diver inspected the outer inlet. The tailings from the mill had filled in as high as the concrete collar around it, which had been built up 4 ft. above the lake bottom. The screen was removed from the recess in the cast iron ring over the inlet, a steel shell of ¼-in. plate, 9 ft. in diameter and 4 ft. high was placed in this recess and a second ring placed on top of it, both shell and ring securely held by extending the original anchor bolts. Another ring of 3/16-in. steel plate 3 ft. high, 25 ft. in diameter, was placed on the bottom as nearly concentric with the first ring as possible. The sand between the two rings was removed with an ejector operated by a water jet with a pressure of 160 lbs., using fire hose to conduct the water to the ejector. The space was then filled with concrete which was mixed on shore, and conveyed to the intake on a scow, then lowered with a self-dumping bucket that held about 8 cu. ft. Care was taken to lower the bucket to the bottom before dumping. This work was carried on from a raft anchored above the intake. The completion of this work cost $1,039.32.

In January of 1910 the mill was shut down for 36 hours. The lake at the time was very quiet and free from ice over the inlet, the ice field having drifted out. A boat was carried out over the ice hummocks formed on shore, which sometimes built up from 12 to 20 ft., and with difficulty was launched. The inlet screen was found covered with anchor or frazil ice from 16 to 20 ins. thick; when barred loose it floated to the surface, the water draining from it like a sponge. Some of the pieces had a beautiful fern-like structure. The pump could not be kept going by barring the ice from the screen, since it formed very rapidly. A ½-in. rope dipped into the water and removed after two minutes, attained a diameter of 3 ins. by ice needles attaching themselves to the rope and building out in radial lines. Ice forming on the screen in this manner was undoubtedly the cause of many stoppages. In August, 1910, an inspection of the inlet showed 2 ft. of the concrete collar above the sand bottom. This was considered safe and further raising unnecessary this year.

On January 2nd, 1911, the water flow of the intake was stopped entirely, and an inspection on the lake was impossible owing to the prevailing storms, but it was surmised the inlet shaft was partially filled with sand. The pump not operating the two preceding days, it was considered that very little sand was drawn into the tunnel and, therefore, that lowering the water in the shore shaft might cause the sand to flow toward and be taken out at the shore sump. A No. 11 Cameron pump was suspended in the shaft and the water was lowered 38 ft. but no water came in the tunnel. The weather in the meantime had moderated, making it possible to inspect the lake inlet from the ice field by placing planks to walk on. Soundings indicated 2 ft. of sand over the inlet. A pointed pipe could be forced down its full length, from which it was concluded that a lot of the filling was slush ice heavy with sand. This proved to be true. A platform was placed on the ice, and a 2-in. steam line was run from the boiler house to the inlet. A 4-in. pipe had already been forced down the intake shaft about 18 ft., into which the 2-in. steam line was turned. Steam was admitted and this thawed some of the slush ice, making a depression in the sand over the inlet. It was then decided to use the 4-in. pipe for the suction, of a 4-in. steam syphon, and to discharge the sand from the shaft. This proved so effective that another syphon was rigged up and operated. Arrangements were being made to run the syphons continuously, when someone reported a crack in the ice field near shore. Bars were driven into the ice and an attempt was made to hold the field by extending the ropes from them to the shore. We managed to save the syphons and the steam pipe, but the rest of the material went out with the ice. In the morning the ice field was again in shore and we made another start, but at noon the ice moved out. This time we made no effort to hold it, but saved our entire rigging. The ice stayed out a whole day and on its return we again rigged up, and had scarcely started work when the field once more drifted out. So far we had 12 ft. of sand removed from the shaft, 22 ft. remaining. The ice was too uncertain to depend upon and this plan was abandoned.

A pile driving derrick car was secured from the Copper Range Railroad, a track laid to the lake, a cut made through the ice hummocks and piling and bridge stringers were secured. On Jan. 13, 1911, we drove six piles of the trestle and completed it from shore to inlet on the sixteenth. The ice field now seemed more regular in its habits and stayed in shore. On January 17 the pile driver leads were removed and the derrick boom was rigged with orange peel bucket. By this method the work of removing the sand from the shaft progressed very well. A small stream of surface water was turned into the pump well, raising the water there about 4 ft. above lake level, and at 7:30 p. m. this water in the pump well ran out, thereby demonstrating that the tunnel was open.

On March 27, 1911, the inlet again filled with sand. A head frame of 3-in. plank was erected over the inlet shaft as shown in Fig. 4, and was used to place a ring of 3/16-in. steel plate, 8 ft. high by 22 ft. in diameter, around the inlet. The sand was removed with ejectors operated by a water jet at 160 lbs. pressure, and the shaft was cleared of sand by April 10. On April 14, a storm carried away this head frame, the legs breaking first, also crushing the steel ring. After the storm abated the wrecked 3/16-in. plate was removed and straightened. Another head frame of green birch poles was erected. The 22-ft. ring was again put in place, also the inner ring, 9 ft. in diameter, the space between being cleaned out and the concrete raised 6 ft. below lake level. The inlet shaft was again cleaned out and on April 26 milling operations were resumed.

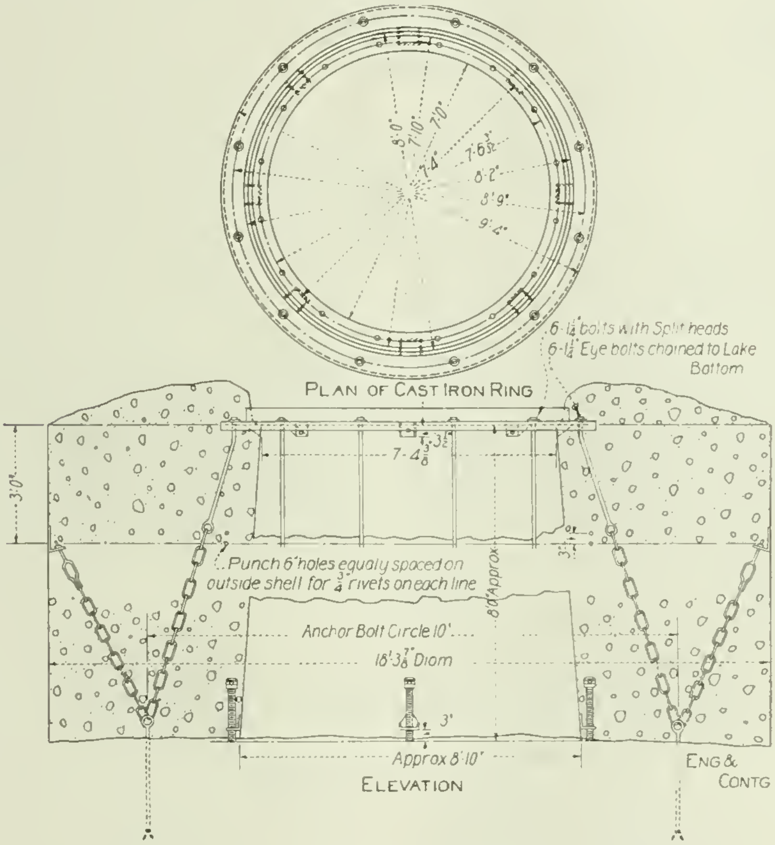


Fig. 4—Sectional Elevation of Tunnel Inlet, Showing Tank Steel Concrete Forms, Leveling Jacks and Anchor Bolts, Trimountain Intake.

The intake plans for the future called for a 600-ft. extension to the present tunnel; a temporary water supply through an open cut in the waste sands to the pump well; and the locating of a favorable place in the bottom of the lake for the end of the tunnel by means of test pipes. The open cut was excavated by shoveling, with sloping sides to lake level. Sheet piling was then driven down 3 ft. below grade, from shore to pump house, a distance of 625 ft. The work was so conducted that the heavy cut near the pump was taken out and the rock between the well and the shore line blasted out to grade, before the sheet piling was all driven. This made it possible to remove the sand inside the sheet piling below the lake level from the pump well towards the shore, permitting all the water made by the excavation to flow towards the pump well where it was removed with a syphon. This cut was started on April 11th, 1911, and on June 10th the water from it was being used to operate the mill. The cost of this temporary water supply was $8,929.58. A stout timber bulkhead was placed in the pump well to isolate the shaft from the new open cut water channel.

The concrete collar around the inlet shaft was now raised above lake level by means of steel rings and concrete filling, and an attempt made to pump out the tunnel with a No. 11 Cameron pump. This could not be done due to excessive leaks through the concrete collar at the inlet. It was decided therefore, to put a concrete plug in the shaft over the steel frame that was designed to carry the sheaves, to be used for hoisting the cage in shaft No. 2. Four 2-in. rods carried this steel frame, as shown in Fig. 6. The water was kept down below the steel while two courses of hemlock plank were fitted in the rock, and concrete was put in place. This was allowed to set one week. The engineers in the meantime had located a point for No. 2 shaft on our concrete collar by triangulation, plumbed down and established points on the under side of the hemlock plank for the new workings. This also gave an opportunity to close up their survey of the old tunnel after it would be cleaned out. The shaft was again pumped out with a flow of only 200 gals. per minute. This permitted an examination of the tunnel which was found one-half filled with sand, and the small amount of timbering mostly down. In some places it was down on the up stream side only, forming an excellent dam and thereby nearly closing off the water. The hanging was down 3½ ft. in some places and quantities of loose rock had to be barred down. The tunnel was timbered following the clearing and completed in August at a cost of $6,361.85, which includes cost of timbering and a charge of $1,079.10 for power.

Ten test holes had been driven in the overburden on the lake bottom at intervals extending 600 ft. out from the old intake. The sandstone was found 33 ft. below the lake level 100 ft. from the old shaft, and 66 ft. below at the 600-ft. point. The test holes between the old shaft and the 600-ft. point, indicated an even grade. Soundings at the 600-ft. point showed a depth of water 26 ft., and sand and gravel overburden of 40 ft. A hole here was carried down in the rock 23 ft. and an iron bar cemented in. This hole showed that it would be necessary to sink shaft No. 2 to a depth of 103 ft. This was done at the end of the old tunnel, and was made large enough for a cage with a 9-ft. tram car and a ladder way. The work was done in eight-hour shifts, with two drilling machines, two miners to each drill and four muckers, the muckers working ten-hour shift. Sinking of this shaft was commenced September 1, and completed October 9, at a cost of $3,937.90 including timbering and a charge of $597.30 for power, as well as all labor for installing hoisting engine, etc.

Drifting the No. 2 tunnel was started October 9, and was driven at the following rates: During October, 168 ft.; November, 301 ft.; December, 131 ft., reaching the iron bar on the fifteenth. This part of the work was completed at a cost of $8,691.14, including timbering and power cost of $1,079.10. A sump at the end of the tunnel was taken out 4 ft. deep and 50 ft. long. Fifty feet of the new tunnel was concreted owing to the rock being very badly shattered. The timbering was completed, rails taken up and hoisting engine and pumps removed by January 14, 1912, at a cost of $3,081.41. Before the tunnel was allowed to fill the air line was well secured, and the end was raised nearly to the timbering and fastened there. This was for the purpose of removing any anchor ice or other obstruction that might adhere to the screens on top of inlet pipes. The rails in the upper or No. 1 tunnel were now removed. In order to use the old inlet and tunnel until such a time as the new inlet pipes could be placed, it became necessary to remove the concrete plug heretofore mentioned in the old shaft. Eleven holes were drilled into it, and preparatory to blasting the tunnel and shaft were cleaned of everything except a No. 11 Cameron pump. Then the eleven holes were blasted from above with a battery. From the known leak in the concrete collar it was estimated that the tunnel would fill with water in about four hours, but after blasting, it actually filled—both tunnel and shaft—in five minutes. Where the water came in so quickly will be shown later. Our mining captain and his force were then transferred to the Trimountain stamp mill, where a shaft for a new tunnel was well under way.

Keeping the open cut clear at its inlet until the ice formed on the shore was the most disagreeable task we were saddled with. The shore line on the waste sands from the mills would shift with every storm, having been known to recede as much as 150 ft. after a very heavy storm from one direction; a storm from another direction would partly build it up again, in any case throwing up heavy sand bars. To make provision against the fall storms so prevalent here, 200 ft. of 48-in. riveted pipe was built of ¼-in. steel plate with heavy reinforcing angles every 12 ft. on the outside to help it withstand the crushing action of the ice.

The inlet to the open cut had been maintained 8 ft. wide and 2 ft. deep, but it was now cleaned out to a depth of 4 ft. The 200 ft. of pipe had been previously bolted together on skids parallel with the shore, both ends being closed with wooden blind flanges. When the weather was favorable the pipe was rolled into the lake and floated into the open cut. The spreaders that kept the sheet piling apart were removed one at a time until 70 ft. of the pipe was in the cut, when the sheet piling showed signs of giving away. The pipe was then allowed to fill and sink in place, and this 70 ft. of the cut was filled in. During this fall the storms were unusual and the shore line receded fully 150 ft., and it was found necessary to add 30 ft. of pipe in the cut. When this addition was made, there was not velocity enough in the pipe to carry the sand through and it accumulated, thereby cutting off the water supply. This made it necessary to blast off 70 ft. of the outer end where the trouble was caused. The pipe then scoured itself clean with the head we had available. A shelter was built over the inner end of the pipe in which a fire could be built, to make the place warm enough for the crew that was kept busy days and some nights removing the sand carried in through the pipe. A 3-in. water main was laid to the shore, on which was maintained a pressure of 160 lbs. This water was used to operate two ejectors made of 4-in. tees and 3-in. pipe, each ejector had a gate valve in the discharge pipe. This valve was closed turning the water back through the suction pipe when a stick or other obstruction choked the tee, which occurred very often. To keep this cut open and install the 48-in. pipe cost approximately $4,802.92 covering a period of nine months while the canal was in use.

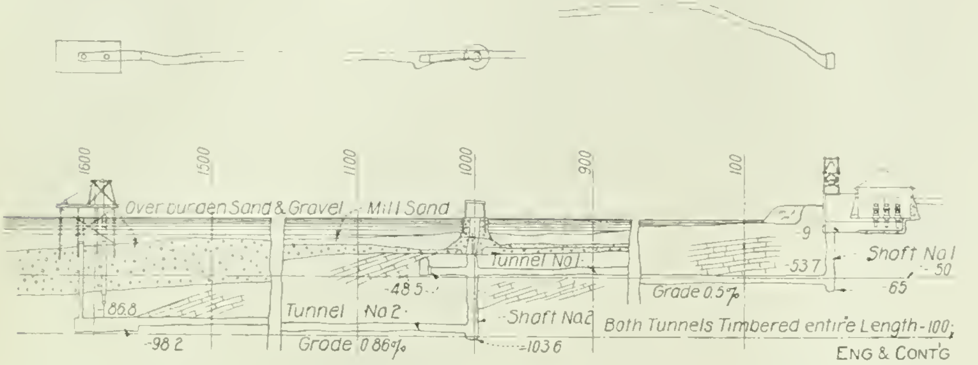


Fig. 5—Plan and Profile of Champion Mill Intake Tunnel.

During the month of February, 1912, the cause of the tunnel filling so rapidly after blasting out the concrete plug was discovered. As shown in Fig. 6 the concrete collar around the inlet was raised four different times, the first time in 1902 when the opening was made into the tunnel, the second in September, 1909, the third in April, 1911, the fourth and last time June, 1911. After placing the outer shield in April, 1911, for the concrete form, on the sand around the inlet, it was necessary for the diver to remove the sand down to the old concrete. This sand had been handled so much during the preceding winter and spring, that a concentration of slime and pieces of water-logged wood had taken place around the inlet, thereby making it very difficult to clean the place out. As soon as the diver thought he had enough of the old concrete exposed to form a base for the new concrete to rest upon, it was covered by small sections at a time. By this process it was expected that the sand would only be in small pockets and so be retained by the concrete. This was true as when we pumped out the shaft no excessive leaks showed. After the plug was put in the shaft, the wave action scoured out the sand spots in between the 1909 concrete and the concrete placed on it. To place the inner steel shield in position the bottom of it was made 1½ ins. less in diameter than the ring already in place. This allowed free access of water and possibly sand. In the spring of 1912 to secure the shaft from this temporarily, the diver drove pine wedges all around, making the inner lining practically sand tight. About one-third of the fourth section of the concrete collar was now taken off to allow the water to flow into No. 2 shaft, and the open cut was discontinued.

In May, 1912, a ½x74x118-in. steel plate was purchased and two pipes 36 ins. in diameter, each 43 ft. 4 ins. long, were made. These were fitted with steel flanges on one end and steel drive shoes on the other. Longitudinal and butt straps were placed on the inside, and all rivets were countersunk on the outside. Four sections were also made, each 6 ft. 2 ins. long, one of which had a steel flange on one end. Each section had the straight seam riveted and the butt strap riveted on one end, so the four sections could be slipped together and then bolted. With these provisions one section could be made from the four, 24 ft. 8 ins. long, and bolted to either long section. While the pipe was being made, eight piles were jetted down in the overburden on the lake bottom over the end of the 600-ft. new tunnel, and a platform was erected on them, 53 ft. by 27 ft., and 10 ft. above the lake level. A head frame 20 ft. high was placed on this platform, also the 5x8-in. Lidgerwood friction drum hoisting engine used in the tunnel to hoist the cage in the No. 2 shaft. A 5-in. water main was laid on lake bottom from the shore to the platform, also a 1½-in. air line to operate the engine. Air was furnished by the compressor used for tunnel purposes. The 5-in. test pipe left in the lake bottom was extended to the water level and a set of blocks and tackle suspended from the head frame just over the point located for the 36-in. intake pipe. After clearing the top of the overburden of all large boulders which were lying at this point, one of the 43-ft. 4 in. sections of pipe, with ends blanked, was rolled into the water, towed out and fastened to the suspended tackle blocks, pulled up and the bottom head removed. When the pipe was lowered to the lake bottom it stood plumb and in proper place. In this position a frame or guide was made for it at the top through which it could move down. The top flange was removed and three 2½-in. water jets were put in. The jets lowered the pipe 15 ft. in 15 minutes, the water being turned off when the flange neared the water level. Two of the short sections were then bolted on, and the pipe was loaded with six tons of old stamp shoes, and the water again turned on. The pipe went down fairly straight, but if showing any tendency to list, the tackle was held, and the pipe suspended in the boil until it became plumb again. The water washed out all the fine sand, while the gravel and large boulders accumulated at the bottom. To remove the coarse sand and gravel a 6-in. air lift was used, while the large boulders, some of which weighed 300 lbs., were taken out by the diver.

The pipe was then driven with a 2,000-lb. weight, the cleaning and driving continuing until sandstone was reached. A 12-in. pipe with guides to center it was then lowered down the large pipe. Into this a single bit, 12-in. drill, with stem rising to the platform was introduced to drill a pilot hole to the tunnel. This was followed by a special reamer 34 ins. in diameter, made of cast steel with twelve taper holes drilled into the bottom, the holes being fitted with twelve steel cutters. The hole was churned with this reamer, by using the friction drum of the hoist to actuate it, a 14-in. drop being maintained. By this method one hole was drilled and reamed in five days. After the drilling was completed the air lock from the Trimountain Mill caisson was fitted to the top of the pipe. A pneumatic chipping hammer was used to trim off the rock on the sides for about 2 ft. to clear the steel shoes, and the 36-in. pipes were then driven into the rock. Screens 12 ins. high were placed on each pipe. This work on the intake pipes cost for labor and supplies $5,565.07.

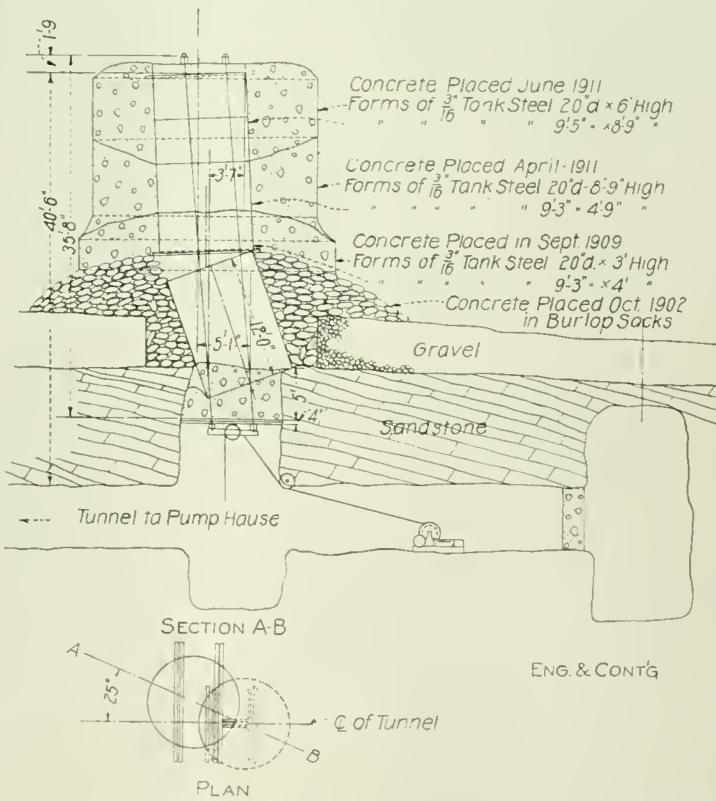

1'-9
40'-6"
35'-8"
3'-7
5'-1
12'-0"
5'
4'
Concrete Placed June 1911
Forms of 3/16" Tank Steel 20'd × 6' High
" " " " 9'5" × 8'9" "
Concrete Placed April 1911
Forms of 3/16" Tank Steel 20'd - 8'9" High
" " " " " 9'3" × 4'9" "
Concrete Placed in Sept. 1909
Forms of 3/16" Tank Steel 20'd × 3' High
" " " " " 9'3" × 4' "
Concrete Placed Oct. 1902 in Burlap Sacks
Gravel
Sandstone
Tunnel to Pump House
Section A-B
A
B
25°
℄ of Tunnel
Plan
Eng. & Cont'g

Fig. 6—Detail of Work Done on Old Inlet of Champion Mill Intake.

The Champion Copper Company has been in operation on the shores of Lake Superior for ten years and during that time they have spent for water supply as shown in Table I.

Fig. 5 shows the old Champion tunnel with the inlet sealed up and a 12-in. pipe in the seal, put in to clean out No. 2 shaft when necessary. It also shows the 600-ft. extension with the drilling rig in place. Fig. 6 shows the work done on the old inlet in detail, also the hoisting engine and head sheave in place.

The work described in this paper has all been done by the companies' employes working under the direction of their foremen. The diving and work under compressed air was done at the Trimountain Mill by Oscar Johnson, master mechanic, and at the Champion Mill by Herman Stealow, surface foreman. The mining work has been under Captain John O. Peterson.

TABLE I.—COST OF WATER SUPPLY FOR CHAMPION MILL.

	Labor.	Supplies.	Total.
Cost of the first intake tunnel	....	....	$26,389.62
Extending Tunnel Itemized Below—			
Raising outer shaft 4 ft., during September, 1909	$ 610.17	$ 429.15	$ 1,039.32
Cleaning out intake shaft during January, 1911	1,561.71	588.65	2,150.36
Raising outer shaft 4 ft. 9 ins. during April, 1911	2,281.39	573.37	2,854.76
Cleaning out intake shaft during March, 1911	395.45	....	395.45
Construction of temporary intake canal	6,025.70	2,903.88	8,929.58
Raising outer shaft to lake level, 9 ft. 3 ins. during June, 1911, and putting in concrete plug in shaft	1,566.00	785.41	2,351.41
Constructing head-frame, engine house, placing engines, compressor, piping, etc., preliminary to tunnel work	2,655.00	833.86	3,488.86
Cleaning out and timbering old tunnel, June, July, August	4,304.27	2,057.59	6,361.86
Sinking and timbering outer shaft, and drifting 20 ft.	2,908.80	1,029.10	3,937.90
Drifting tunnel, October 9 to December 15, 1911	6,428.36	2,262.78	8,691.14
Finishing sump, tearing out track, etc.	2,980.75	100.66	3,081.41
Reopening old tunnel at outer shaft, February, 1912	456.95	14.84	471.79
Sinking two 36-in. pipes through 43 ft. overburden, and drilling two 34-in. holes through 20 ft. sandstone into tunnel, May, June, July and August, 1912	3,661.13	1,903.94	5,565.07
Sundries—			
Maintenance of intake canal while in use and laying large intake pipe	1,821.87	2,981.05	4,802.92
Taking soundings, locating sandstone, end of tunnel, etc.	1,007.65	637.38	1,645.03
	$38,665.20	$17,101.66	$82,156.48

Water Works Notes.

(STAFF ARTICLE.)

Portable Steam Boiler for Thawing Out Frozen Hydrants.—Considerable trouble has been experienced in St. Mary's, Pa., with frozen fire hydrants. The old method of thawing out frozen hydrants by building fires around them, was unsatisfactory, since the time required to get the hydrant in working order was much too long.

The superintendent of the water department, Mr. Philip Dixon, mounted a 5-h.p. steam boiler on a sled which is pulled from hydrant to hydrant when there is thawing to be done. A pipe connection is made between the boiler and the hydrant, and steam under pressure of about 50 lbs. per square inch is admitted to the hydrant. Frequently the ice is melted out in less than ten minutes by this method. The water in the barrel of the hydrant, which should have drained out, is then pumped out with a small handpump. This leaves the hydrant ready for service and in such a condition that it cannot freeze up again until after it is used.

Failure of Standpipe of Cairo, Ill., Water Works.—The full length of the standpipe of the Cairo, Ill., water works fell to the ground on February 12. The standpipe was 16 ft. in diameter and 175 ft. in height. It rested upon a solid concrete foundation 10 ft. thick. The concrete rested upon and about the tops of piles 35 ft. in length.

An examination of the steel in the wrecked structure showed it to be in remarkably good condition. In falling the standpipe side-swiped the water works pumping station building and damaged both the building and the pumping machinery. The wreckage fell across the Illinois Central Railroad tracks and traffic was tied up for six hours. The fallen pipe extended about 50 ft. out into the Ohio River. Mr. Thos. W. Gannon, manager of the Cairo Water Co., gives it as his opinion that the failure of the structure was due to the settlement of the foundation. This settlement resulted from the saturation of the earth surrounding the piling by water which seeped into the soil from the Ohio River. The present high water in that stream has been long continued.

Economy of Caulking New Water Mains on Top of Trench.—In discussing water department methods at the latest annual convention of the American Water Works Association, Mr. C. E. Abbott described the method he used in laying about ten miles of cast iron pipe, ranging in size from 4 to 12 ins. Timbers 2x4 ins. in section were placed across the trench and ten 12-ft. lengths of pipe were laid along the trench upon these timbers. The joints were caulked while the pipe was in this position. Mr. Abbott found that his men caulked up a joint in the pipe so supported in exactly half the time required to make a joint with the pipe laid one length at a time in the trench bottom. One derrick was used for each two lengths of pipe. The length of ten sections was lifted from the timbers and lowered into the trench by means of differential blocks.

By this method the labor cost of laying 10,137 ft. of 12-in. pipe was $1,918.24 or 19 cts. per foot. This included pipe handling, caulking, trenching and backfilling. Five men lined the pipe up over the trench and moved the derricks. A pipe line a block long can be laid just as easily in this manner as can a length of ten 12-ft. sections. It is, of course, unnecessary to dig bell holes in the trench when the pipe is caulked over the trench. Surface caulking also improves the alignment of the pipe.

BUILDINGS

Method of Constructing an Eight-Story Reinforced Concrete Warehouse Using Special Column Forms and Concreting Plant.

(STAFF ARTICLE.)

Methods of construction showing interesting variations from the common were employed recently in constructing a reinforced concrete warehouse in Chicago for the Larkin Co., soap manufacturers. The contractors were the Leonard Construction Co. of Chicago. The building is eight stories high and is 202x123 ft. in plan, with circular interior columns spaced to make panels 22 ft. 2 ins. x 20 ft. The floors were designed for a load of 225 lbs. per square foot and consist of a flat slab, which is 9 ins. thick except over the columns where there is a rectangular panel 8 ft. square, which is 6¾ ins. thicker. This floor construction is known as the Cantilever Flat Slab system and the designers are the Concrete Steel Products Co. of Chicago. The reinforcing steel in the floor slab consists of ½ in. round bars. A test of this floor was made by Mr. Arthur R. Lord, the consulting engineer for the contractors, and the results were published in our issue of Jan. 29, 1913. On top of the floor slab a 1½ in. maple floor is laid on sleepers embedded in 3½ ins. of cinder concrete. The columns of the building range from 20 to 34 ins. in diameter.

The construction work was started March 2, 1912, when some plant was delivered to the site. By April 1 the bins for the concrete plant were completed and filled. A Thew revolving shovel was employed about March 15, and in one month it had excavated the entire site to a depth of about 7 ft. below the curb. This material, about 6,000 cu. yds., was loaded on flat cars and on wagons and hauled from the site.

The foundations consisted of wells 5 ft. in diameter, sunk to rock. As rock was reached here by excavating 27 to 30 ft. below the basement level, it was decided that the wells were about as cheap to build as would be spread foundations. They were started about April 10 and completed in two weeks. They were excavated by hand and lagged with 3x4-in. pieces about 4 ft. long and braced with circular steel rings. A windlass on a tripod was placed over the hole and used to hoist the excavated material.

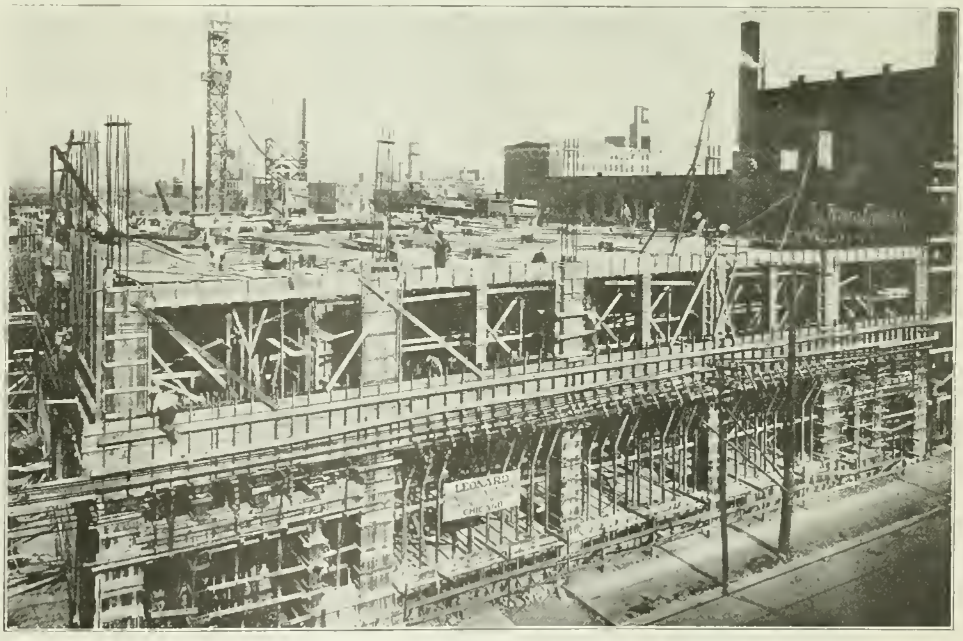


Fig. 1—View Showing Forms and Concrete Shute to Elevator Shaft.

On completion of the wells they were filled with concrete and the basement area was covered with cinders and the floor slab poured. The forms for the side wall were begun at the same time. The forms used by the Leonard Co. for walls and for floor slabs consist primarily of built up panels held in place by a falsework or by waling timbers. The panels consist of 1x6-in. boards from 12 to 20 ft. long, held together by 2x6-in. studs. There are from four to six boards to a panel. For walls the panels are set up against studs braced by wales made of 4x4-in. timbers. The wales consist of two pieces tied together with a small spacing block between to leave space for the bolts which pass between to the opposite side of the form. These bolts usually consist of three sections joined by sleeve nuts just inside the concrete faces of the wall. Cast iron washers are used to span the space between wale timbers. For very thin walls the bolts are made in one piece and pass through the wall.

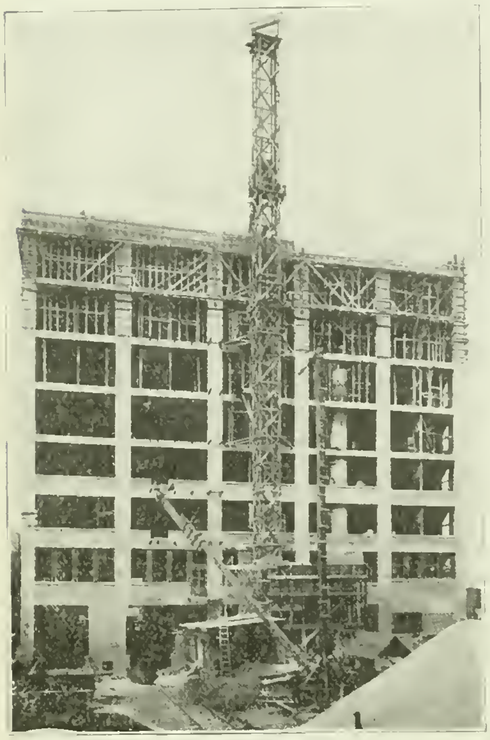
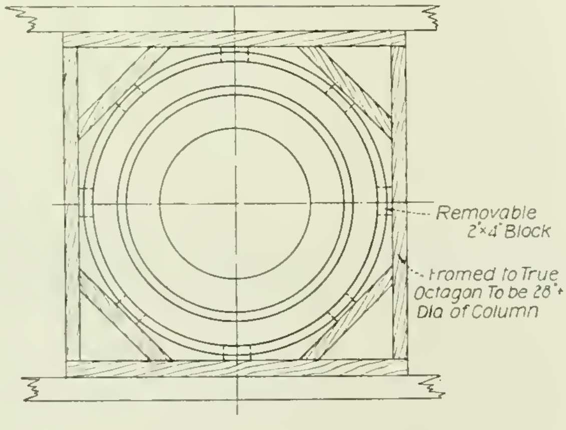
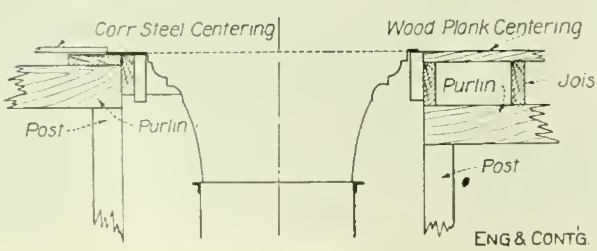


Fig. 2—View of Concrete Plant Used in Constructing Larkin Warehouse, Chicago.

The floor slabs were also constructed by using a falsework and laying these panels on top. The columns were molded by steel forms set up by a sub-contractor, who followed the erection of the floor falsework. This falsework consisted of 4x4-in. posts with a cross piece on top to form a T. The arrangement is indicated by Figs 1 and 2. These posts were set up in rows and the 2x12-in. joists laid upon them. The panels were then laid on the joists. At each column a square hole, 8 ft. each way, was left for the drop form. This was a built up panel which was made in two sections, so that it would fit into the space left and rest on blocks nailed to the joists which formed the sides of this depressed form. This form was also supported by 4x4-in. posts placed beneath it.



PLAN OF FRAMING



VERTICAL SECTION

Fig. 4—Sketch Showing Column Head Form.

As the column cap is joined to this depressed section, a hole is left in it about 5 ft. square, or the size of the column cap. Corner braces are put into this hole and blocks nailed to them and to the joists at the sides so that when the column cap is dropped into the hole its flanges will be supported on these blocks. The flooring is then laid up to the edge of the square hole and the space left between the column cap and the flooring is covered with galvanized iron flashing cut circular, to cover the opening.

The column sections are put together on the floor and set up in place and bolted to the cap section, which is suspended from above. The column sections consist of galvanized sheet iron of No. 18 gage, adjusted for any size of column from 12 ins. up. For columns larger than 12 ins. an extension section is used with holes placed in it so that the size of the column may be enlarged by increments of 2 ins. in diameter. Holes are also placed to permit the adjustment of the column height. The forms are erected so that the upper sections telescope into the lower ones. They are held rigidly from expanding or swelling from the pressure of the concrete by angle irons bent to the proper radius and clamped around the form. The angle iron is in two parts and is joined at one side by a splice bar riveted to one angle and keyed to the other. On the other side the angles are pulled together by means of a lever clamp, as shown in the accompanying sketch, Fig. 3. If the lever clamp does not tighten the form sufficiently, the wedge on the opposite side is driven in farther. A circular clamp shown in the sketch is used along the vertical joints of the form to clamp the flanges together.

The men work in pairs and set up about 9 columns per pair per day, including the flared column cap. The cap is increased or reduced in size by the overlapping of the segments of the circle and by changing the pieces which form the lower section of the flared part. Figure 4 shows the dimensions of the caps and the method of changing the size. These forms are patented and were made and erected in place by the sub-contractors, the DesLaurier Column Mould Co., Chicago.

The concrete plant used consisted of bins built over a 17 cu. ft. Austin improved cube mixer, which discharged into a 20 cu. ft. tower hoist bucket. The tower was built at the rear end of the building and the concrete was transporated through a 12x12-in. chute to some point on the floor convenient to the final location, where it was discharged into a wooden hopper set upon legs high enough to discharge into two wheeled carts. This company does not chute the concrete directly to place, as is done in most cases where a chute is used, but prefers to use the carts rather than to shift the chute from time to time.

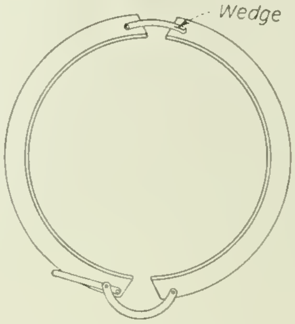
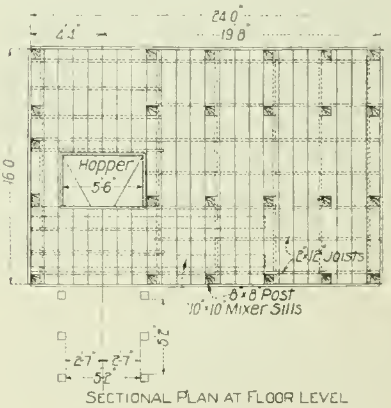
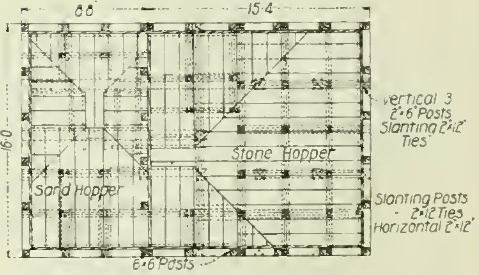


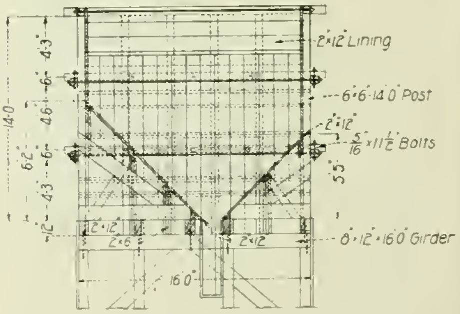
Fig. 3—Sketch Showing Details of Column Form Clamps.



SECTIONAL PLAN AT FLOOR LEVEL



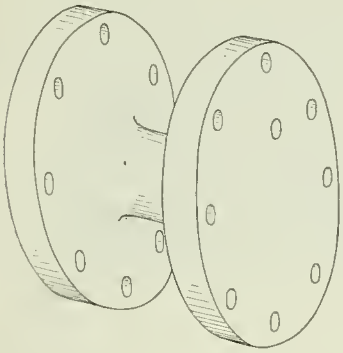
SECTIONAL PLAN THRU SAND & STONE HOPPERS



PART CROSS SECTION THRU STONE HOPPER

Fig. 5—Standard Mixing Plant Bins of the Leonard Construction Co.

When the front half of a floor had been concreted and had set sufficiently the carpenters began to erect the forms for the next floor, so that before the concreting of any floor was completed the form work made it necessary to raise the concrete chute. This was arranged so as to discharge into an auxiliary chute in the elevator shaft. The use of this shaft enabled the concrete men to keep out of the way of the carpenters.



Wire Tightener and Fastener for Wall Forms.

A drawing of the concrete plant is shown by Fig. 5. This is the standard plant used by this company. It is varied at different jobs by the use of a derrick with a clamshell bucket for unloading cars, or by the use of a belt conveyor, to carry materials from a hopper under a grating to the bins. The force required to run this plant is as follows: Two men in car; 1 hoisting engineer; 3 men on mixer; 1 man at top of tower, and 1 man at end of chute.

The men in the car are used to help the hoisting engineer handle the clamshell bucket and to help shift the car. Two men are required to carry cement from the car or from the shed, and one attends to the chute gates from the bins to the mixer and to discharging the mixer. The hoisting engineer runs the tower hoist and also the clamshell bucket. A man at the hopper at the top of the tower attends to the chuting and the man at the lower end of the chute operates the gate to the hopper, which discharges into the two wheeled carts.

The concrete work on the building was completed in October, although a strike delayed the work for about a month during the summer. After the concrete work was completed the brick exterior walls were built up and the mechanical equipment was installed, and the building was occupied by the owners at the end of the year.

During the construction the average number of carpenters employed was from 60 to 75; the average number of laborers was from 200 to 250. There were five hoisting engineers employed almost continuously. The total cost of the building, exclusive of the elevators and sprinkler system, was about $300,000, or $1.50 per square foot of floor space.

Tunnel Construction in Colorado.—A series of tunnels is being driven for an irrigation company, about 26 miles from Fort Collins, Colo., on the North Poudre river. These tunnels will take the place of wooden flume which has cost the company about $5,000 a year to keep up. There will be three tunnels, one 2,347 ft. long, one 461 ft., and the third 2,015 ft., with 100 ft. of open cut between the first and second, and 50 ft. of cut between the second and third. The tunnels will be 6½ ft. high and 8 ft. wide. The plant consists of a Fairbanks-Morse 80-HP. crude oil engine and an Ingersoll-Rand 9-12 by 15 compressor. Power distillate is used in the engine, and is giving satisfaction. The Swan-Patterson Co. of Livermore, Colo., has the contract and is driving about 700 ft. a month.

A Wire Tightener and Fastener for Wall Forms.

(STAFF ARTICLE.)

The usual method of wiring wall forms is to use a loop of two wires which are tightened by twisting. Often two wires are not necessary for strength and there is also frequent danger of the strand becoming untwisted and where this occurs it is not always easy to make it taut again. To overcome these objections to the ordinary wire tie for wall forms, the wire tightener and fastener shown by the accompanying sketch has been placed on the market by the Northern Cement Construction Co. of Minneapolis, Minn.

The tightener is a cast iron spool with the flanges drilled, as indicated. Two of these spools may be used for each tie or an anchor and one spool may be used. In either case the forms are bored for a single wire—not for a loop of two wires. If an anchor and one spool be employed, one end of the wire is twisted about the block or spike serving as the anchor and the other end is threaded through the wall forms and the wire is given a turn around the neck of the spool and passed through the single hole located nearest the neck. The spool is set against the form like a wheel—not endwise—and the tie is tightened by turning the spool with pinchers, so as to wind the wire onto the neck. When taut enough, a nail is slipped through two opposite flange holes and over the wire to prevent the wire from unwinding. The tie is loosened by withdrawing the nail. When two spools are used the fastening of the anchor spool is the same as just described.

Proposed New Boulevard for Pittsburgh.—A new boulevard connecting the business portion of Pittsburgh with the Oakland and Squirrel Hill residence sections is proposed by the City Planning Commission. This boulevard will be known as the Monongahela, and will be about three miles in length. According to present plans it will follow the bluffs on the Monongahela river for part of the distance and will therefore afford a very fine view of the river and neighboring hills.

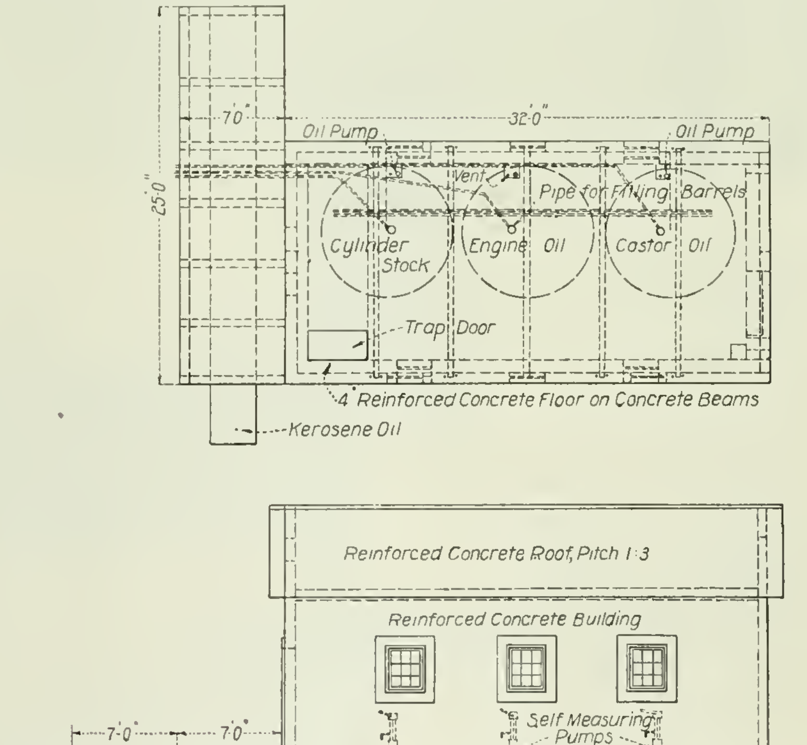
Plans and Cost of a Reinforced Concrete Oil House.

The plan and elevation in the accompanying drawing illustrate the main structural features of a reinforced concrete oil house for mine workings. The house is of one story and a basement with a front platform along the railway tracks. The basement and the space under the platform provide for the storage tanks as shown; these tanks are filled by pipes extending to the front of the platform where connection can be made with tank cars. From the tanks the oil is raised by pumps to the first floor for distribution. The other fittings are shown by the drawings.

The building is constructed entirely of plain and reinforced concrete and its cost was as follows:

	Cost.
Building:	
Surface labor	$ 504 94
Carpenter labor	131.24
Machinist and smith	184.30
Teaming	60.28
Total labor	$ 880.76
Cement	297.77
Sundries	277.70
Total materials	$ 575.47
Total building	1,456.23
Equipment:	
Tanks (except kerosene)	556.13
Pumps	150.00
Total equipment	$ 706.13
Grand total	$2,162.36

These costs are taken from a paper by Mr. W. M. Davis before the Lake Superior Mining Institute.



Plan and Elevation of Reinforced Concrete Oil House.

Hudson Bay New Department Store Building.

The contract for a new department store building in Vancouver for the Hudson Bay Co. has been awarded to Rourke, MacDonald & Moncrief, building contractors, 142 Hastings St., West, Vancouver. This store will cover an area of 150 ft. by 260 ft., will be ten stories in height and have two basement floors. It will be of steel and reinforced concrete throughout. It will have its own heating, lighting and refrigerator system, obtaining water from artesian wells, and it is intended to make it a modern department store in every respect. An up-to-date system of ventilation will be installed by which fresh air will be drawn from the outside, passed through a filter and purifier and circulated through the building, having previously been heated or cooled according to the season. The estimated cost of the building is $2,500,000.

SEWERAGE AND SANITATION

The Design and Operating of the Institutional Sewage Treatment Plant at Julietta, Indiana.

The first Indiana sewage treatment plant incorporating the Imhoff principle was that built at the Hospital for the Incurable Insane at Julietta. This plant was designed by and built under the supervision of Mr. Charles Brossmann, consulting engineer, of Indianapolis, Ind. In a recent paper before the Indiana Sanitary and Water Supply Association, Mr. Brossman described the design and operation of the plant. His paper is here published practically in full.

The Julietta plant has now been in operation about five months. It is designed to treat the sewage of 200 people, the present population of the institution. Provision was made for the future, however, in proportioning the component parts of the plant. The estimated flow of sewage varies from 50 to nearly 100 gals. per capita. The maximum flow occurs on wash days, which usually are Monday and Tuesday. The general layout of the plant, with a longitudinal section through the entire plant and a transverse section through the Imhoff tank, is shown in Fig. 1. The operation of the tank is described, briefly, as follows:

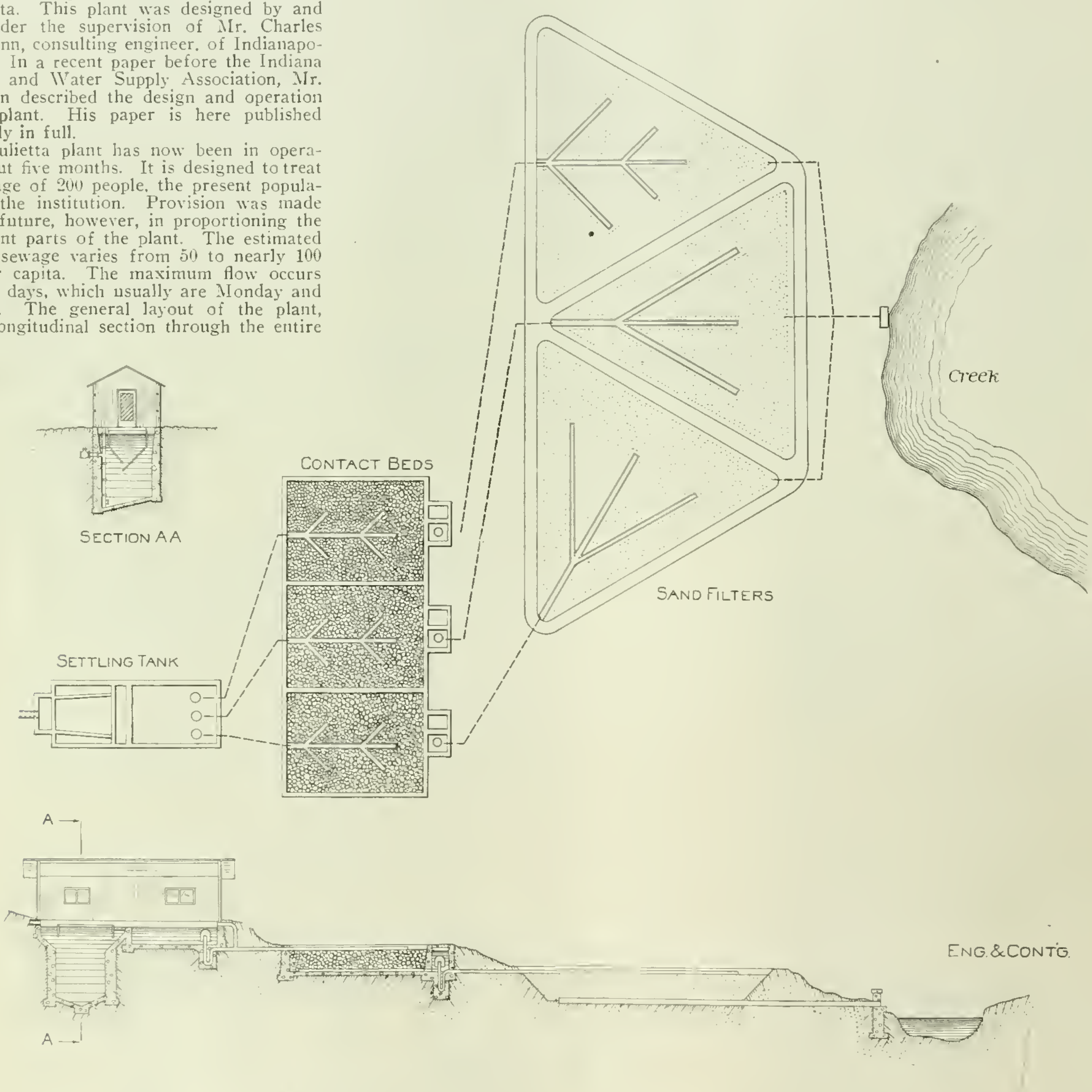


Fig. 1—Plan and Sections of Institutional Sewage Treatment Plant at Julietta, Indiana.

OPERATION.

The sewage first flows to a tank of the Imhoff type which consists of a settling and a reduction chamber. The tank is so arranged that fresh sewage flowing through the settling chamber deposits the greater portion of the suspended matter and the solids into the chamber below. This reduction or digestion chamber is so arranged that the gases given off do not disturb the flow of the liquid above in which the settling is constantly going on. In this lower chamber before mentioned a great mass of putrifactive organisms or anaerobic bacteria develop. They liquefy and gasify the greater portion of solid matter deposited in the tank. These anaerobic bacteria develop and thrive and attain their greatest activity in the absence of light, air and agitation. It will thus be seen that there is a constant reduction or digestion of matter in the lower tank, changing portions of it into gas and liquid and leaving only such residue as cannot be attacked by the anaerobic bacteria. This residue is thrown off from the tank through a blow-off at certain intervals, which in the present case is about once every six or eight months. After drying this sludge can be burned or can be used for filling in ground.

After the liquid leaves the tank proper it flows into the dosing chamber and from thence to the stone contact beds. The liquid on leaving the settling tank has already undergone a great change. It is then free from solid and suspended matter and is somewhat cloudy in appearance. It is then ready to undergo the second stage of bacterial action which takes place in the contact beds. In the contact beds the bacterial action takes place through the action of aerobic bacteria. These organisms thrive in the presence of air. The contact beds are filled and allowed to stand for about two hours full and then are allowed to stand about six hours empty. This brings the liquid in contact with the stone material in the bed and afterwards allows a period of resting for the bed. The liquid as it leaves the contact beds is further relieved of its original harmful properties and is now ready for the third stage of its treatment. The sewage as it leaves the contact beds is still clearer and contains less organic material than did the influent. It now flows to the sand filters which form the final stage of treatment in this plant. The filter beds are of coarse sand and the liquid is released and flows upon them, covering the surface to a depth of about 2 ins. The final retention of bacteria and straining action takes place in this bed. The liquid flowing out is discharged through under drains and comes out without odor and as clear as crystal. In fact, it is practically a pure water.

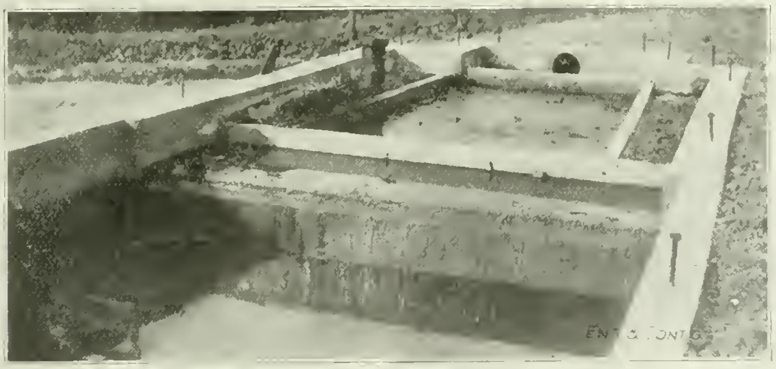


Fig. 2—View of Settling Tank, Julietta Plant, After Three Month's Operation.

DESIGN.

The chief features of the design of the plant are as follows:

Imhoff Tank.—The tank is of the Imhoff type with some modifications, described later. The tank proper is 13 ft. deep, 11 ft. long, and 8 ft. wide, and has a central settling chamber. At the rear end of the tank is a dosing chamber with three 5 in. syphons, furnished and installed by the Pacific Flush Tank Company of Chicago. This dosing tank has a capacity of about 2,500 gals. The settling chamber is about 12 ft. long with an average width of 6 ft. and a depth of 5 ft. The rate of flow through the settling tank is about 4 lineal feet per hour. A view of the tank is shown in Fig. 2.

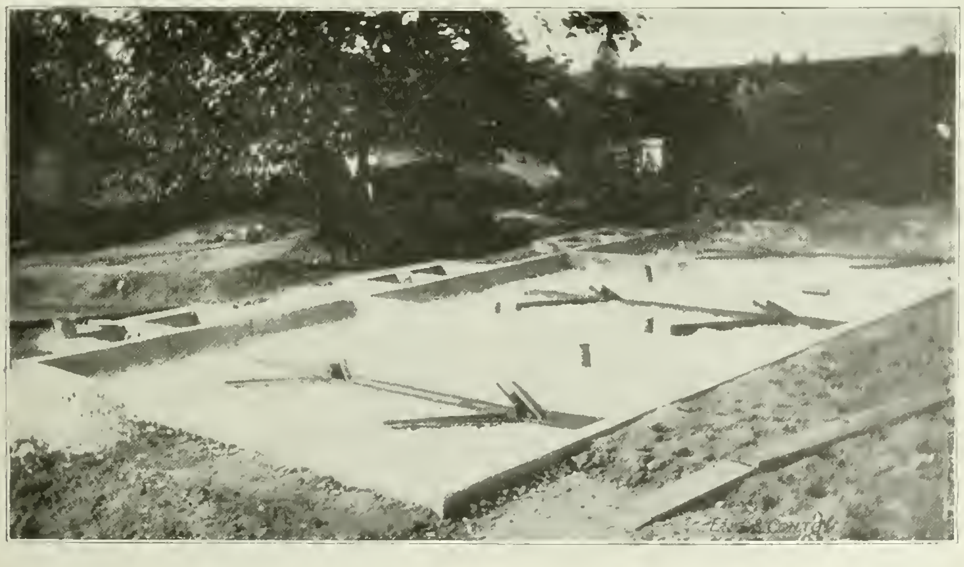


Fig. 3—View of Contact Beds at Julietta Plant.

The portion of sludge chamber below the settling tank has a capacity of about 350 cu. ft. which should ordinarily take care of about six months' run before blowing off, but Mr. Brossmann does not believe that this will serve that long owing to the large amount of foreign matter, such as vegetable slops, paper, etc., which seems to be discharged in considerable quantities.

The settling tank is built with vertical sides, and with a sloping bottom. The angle of the slope is 45°. This inclination allows solids to slide into the chamber below. The width of the settling chamber was also made greater at the outlet end. The sewage on coming in, passes a baffle at the front end; and at the rear end of the settling tank a baffle is thrown across the sewage flowing upward and out through an adhesion screen made of ¾ in. by 10 in. plank, ¾ in. apart. The top of the screen is submerged about 2 ins. below water level. The purpose of this screen is to prevent anything from being carried over into the dosing chamber, and thence into the contact beds, and also to serve as an adhesion rack to catch and retain any minute floating material until it has attained sufficient weight to slide off, when it will drop to the sludge chamber below.

The tank has not as yet been in operation a sufficient length of time to determine to what extent the screen serves its purpose, but it is noticed that already there is considerable matter adhering to it. The plant has been in operation about four months, and at the present time a thick heavy scum over 1 ft. in depth, has formed at the top of the sludge chamber. The sludge chamber as will be noticed in the plan, Fig. 1, has its opening on each side of the settling chamber, and the sludge is forced up at the top probably 10 ins. higher than the water level of the settling chamber.

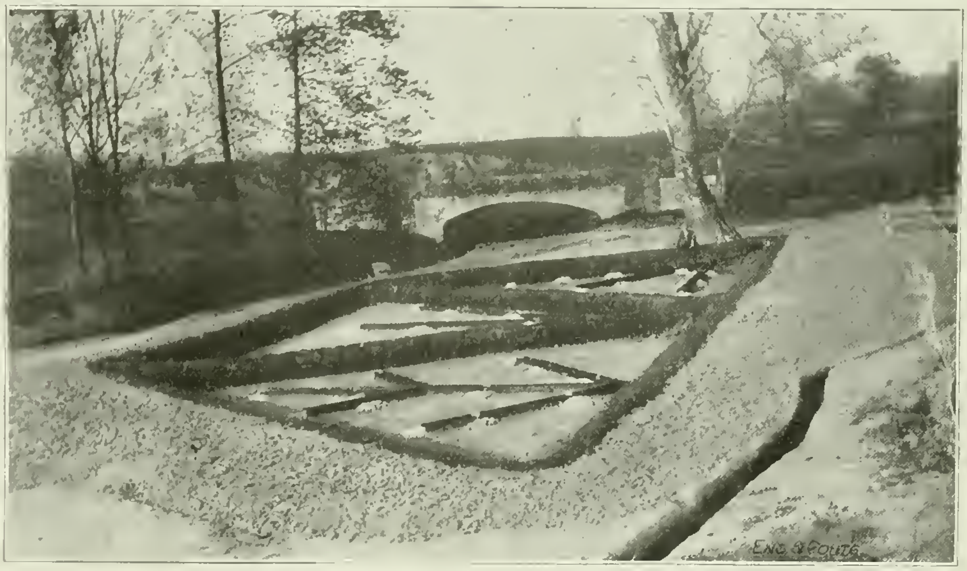


Fig. 4—View of Sand Filters at Julietta Plant.

A blow-off pipe made of 6 in. vitrified tile is placed on one side of the sludge chamber, the bottom part being a 6x6x6 in. tee, with side outlet open. The tanks slope toward this tee which is placed in the bottom and the sludge can be drawn off by opening the sludge valve which is placed on the outside and about 4 ft. below the top of the tank. The arrangement of the blow-off is shown in the section of the tank, Section A-A, Fig. 1. A small sludge bed is to be built later on to care for the sludge.

The effluent from the tank is good, being fairly clear and with little suspended matter. The odor is very slight and is not noticeable in the road, which is 50 ft. away. It is the intention to construct a building over the tank which will, no doubt, localize all odor. Bacterial action is active as is evidenced by the sludge mat being raised quite a little above the surface of the settling liquid. Gas bubbles can be seen rising and getting through the scum but no offensive odors are given off.

No scum mat has formed in the settling tank but some lighter particles such as vegetables and coffee grounds are seen floating on the surface of the settling tank.

Contact Beds.—The sewage after passing from the dosing chamber is discharged into three contact beds filled with broken stone, varying in size from ½ in. to 2 ins. The depth of stone is about 2 to 9 ins. The beds are rectangular in shape, each being 16 by 22 ft. in plan. They are made of concrete reinforced with ⅜ in. square twisted bars. Each contact bed has a 6 in. Pacific Flush Tank Company's time controlled syphon, which discharges from the contact bed to the sand filters.

The distributors to the contact beds are made of heavy plank painted with asphaltum. The underdrains are of vitrified tile 4 ins. and 6 ins. in diameter, laid with open joints. A view of the contact beds is shown in Fig. 3.

Sand Filters.—The sand filters are three in number. They are equilateral triangles, each side being 50 ft. in length. The depth of sand is 2 ft. 6 ins. Below the sand is placed gravel ranging in size from ⅛ in. to 1 in. The underdrains are of vitrified tile laid with open joints and are covered with large broken stone. The distributors are made of 1½ in. plank, painted with asphaltum, and they have notches cut out every 6 or 8 ft. Around these notches on the outside is placed broken stone so that the surface of the sand will be disturbed as little as possible by the influent. A view of the filters is shown in Fig. 4.

The underdrains from the sand filters discharge into a small creek. The effluent is perfectly clear and without odor and no deposit of any kind has as yet been noticed. Immediately below the old sewer outlet in this small creek, before the plant was built, the sewage had been retained in the creek until a regular septic tank had been formed which on warm days was very offensive, a constant ebullition being present. The appearance of the creek at this point was a black bubbling mass which if stirred with a stick would give off such a stench that it was impossible to remain near it. Further down the creek everything was coated and small septic holes could be found for some distance below. Ducks swimming in this water died and the farmers below took the matter up with the State Board of Health, who ordered that the sewage be disposed of in some suitable manner. Since the plant has been started all nuisance has disappeared and the water in the creek is now clear and fresh. The hole just below the plant, which was formerly a nuisance and menace to health, is now perfectly clear.

A large part of the labor was done under the supervision of Dr. Potter, Supt. of the Institution. The labor was performed by the inmates of the asylum who did all such work as excavation, grading, sodding and hauling the material.

The Present Status of the Septic Process Patent Litigation.

(STAFF ARTICLE.)

The editors of Engineering and Contracting have received several letters within the past few days asking various questions relative to the present status of the septic process patent litigation. These inquiries were made, of course, following press notices of the recent decision of the United States Supreme Court in the case of the Cameron Septic Tank Co. vs. the City of Knoxville, Ia. That the matter is by no means settled at this time is shown by the letters to the editors of this journal which are herein quoted by way of telling both sides of the story. The first letter presents the present views of the attorneys for the city of Knoxville with reference to the patent claims of the Cameron Company. We quote it as follows:

Sirs:

On Jan. 20, 1913, the United States Supreme Court affirmed the decision rendered by the United States Circuit Court for the Southern District of Iowa in the case of Cameron Septic Tank Company vs. the City of Knoxville, and held that United States Patent No. 634,423, expired by limitation Nov. 8, 1909, with the expiration of a British patent granted Nov. 8, 1895, for a term of 14 years.

The claim is being generally made by the Cameron Septic Tank Company that the effect of this decision is confined to the Knoxville case, just terminated after more than three years of litigation. In this conection, it will be of interest to municipalities which have used sewage treatment works wherein some septic action has occurred, and to the engineering world generally, to ascertain the facts in connection with this claim.

The following letter, written by Mr. Wallace R. Lane of Chicago, who argued the Knoxville case before the United State Supreme Court in behalf of the City of Knoxville, will be of interest:

Chicago, Ill.

S. H. Crosby,
Denver, Colo.

Dear Sir:

Answering your letter of recent date, relative to the stipulation in the Knoxville case, I do not have before me, the statement of Geo. W. Fuller in his recent work on Sewage Disposal, but call your attention to the stipulation made in the Knoxville case which reads:

"That the allegation in the plea to the effect that the invention patented in the United States Letters Patent, issued to Edwin Cameron, et al., on a process of and apparatus for treating sewage, No. 634,423, dated Oct. 3, 1899, set forth in said bill, had been previously patented in a foreign country by said patentee, towit: in the United Kingdom of Great Britain, by Letters Patent, dated Nov. 8, 1895, and that the said last mentioned patent of Great Britain, expired on the 8th day of November, 1909, being the expiration of the term for which it was granted, may be taken as true."

This stipulation between the parties, when taken in conjunction with the admission on the face of the Cameron et als. patent, No. 634,423, dated Oct. 3, 1899, that it was for certain new and useful improvements in the process of and apparatus for liquefying and purifying sewage (for which the patentees had received Letters Patent, in England, No. 21,142, dated Nov. 8, 1895, also in a large number of other countries), it seems to me, should dispose of any claim on the part of the Cameron Company that the patent in the foreign country which has expired, was for any different or other invention than that of the United States patent, and it seems to me, **such claim should not receive serious consideration by any other court** before whom the matter is presented.

In fact, in my opinion, **such admissions as are made by the complainant in this case, and on the face of the patent, should be conclusive against the complainant company.**

Yours very truly,
(Signed) WALLACE R. LANE.

As there are numerous suits pending against various municipalities for the collection of royalties claimed under the Cameron patent, it is quite possible that the Cameron Septic Tank Company may urge the claim referred to above in court. It is particularly for this reason, that I wish due publication to be given at this time, to Mr. Lane's letter, which we believe correctly states the legal aspects of the case.

Very truly yours,
S. H. CROSBY.

Denver, Colo., Jan. 28, 1913.

The present position of the Cameron Company with reference to the present status of its patents, and with special reference to the arguments set forth in the above letter, are stated in the following letter from Mr. H. D Wyllie, General Manager of the Cameron Septic Tank Company. Mr. Wyllie's letter is quoted as follows:

Sirs:

We note in recent press reports that the U. S. Supreme Court has not sustained the contention we made in our so-called "Knoxville case" that the mere Treaty of Brussels made the 17-year term of our Cameron United States patent independent of whether the foreign Cameron patents were for the same or a different invention. This simply diverts us to our fundamental position, that as a matter of fact none of the foreign patents cover the Septic Process but merely certain apparatus, and therefore it is wholly inconsequent whether the foreign patents have expired or not, and our United States patent, being for the process, is still in force to the end of its 17-year term, Oct. 3, 1916. Thus the decision in the Knoxville case benefits only the one defendant, the City of Knoxville, Iowa, and the other infringers are in no way benefited or relieved from liability to the end of the full 17-year term. We stated this fact a year or so ago in a printed pamphlet entitled "The Septic Tank." (See pages 27 and 28, copy enclosed.)

In this connection we have recently seen published in several of the technical journals a letter from S. H. Crosby, of Denver, referring to the above-mentioned decision of the Supreme Court and quoting a letter written him some time ago by Wallace R. Lane, of Chicago, who argued the Knoxville case before the U. S. Supreme Court in behalf of the City of Knoxville.

This undated letter from the attorney for Knoxville, quoted by Mr. Crosby, is mistaken in its statement as to the "stipulation" in that case being of benefit to other infringers. The stipulation was merely one made between counsel for the purpose of **that one case,** to expedite appeal to the Supreme Court on the single question of law as to the effect of the Treaty of Brussels, and did not in any manner bind us to admit in any other case an allegation that is not true. Counsel merely stipulated that the "allegation" of the plea in that case, that the foreign patent was identical with our United States patent, "might be taken as true." In all other instances we shall insist upon the actual fact that the foreign patents are merely for **apparatus** and do not contain our **process** claims. And this is in no manner inconsistent with the mention our United States patent makes of the foreign patents as being for the "same invention," for our United States patent contains many separate claims and some of the **apparatus** claims are for the same invention as the foreign patents, but none of the **process** claims are, and it is always open to us to insist this plain fact, in view of which it is wholly inconsequent, to other infringers of our **process** claims, whether the Treaty of Brussels affected our patent or not.

Very truly yours,
H. D. WYLLIE.

Chicago, Feb. 19, 1913.

The portion of the printed pamphlet entitled "The Septic Tank" to which Mr. Wyllie refers in the foregoing letter, is here quoted:

Full 17-Year Term of the Cameron Patent Secure Regardless of the Knoxville Case.

For the purpose of expediting a decision of the Supreme Court on the effect of the Treaty of Brussels, our attorneys in the Knoxville case agreed to a mere stipulation that the allegation of identity between the earlier British patent and the United States patent might be taken as true in that particular case, because a favorable decision on the simple point of Treaty law would end all discussion; but a contrary decision would avail no one but Knoxville, for all other infringers would still be bound by the real fact—which is altogether independent of the Treaty question—that the foreign letters patent never did and never could affect our United States patent, because they are actually distinct, in that, among other differences, the foreign letters patent were for **apparatus** only, while the **process** was **for the first time covered by the five process claims of our United States patent** —and this is a conclusive distinction in view of the recent decision rendered by the Supreme Court of the United States in Leeds & Catlin Company vs. Victor Talking Machine Company, 213 U. S. 301, in which the question of the expiration of an United States patent by reason of the prior expiration of a foreign patent was considered; the portion of the decision pertinent to the present case is stated in the syllabus as follows:

> A patent may embrace more than one invention, Steinmetz v. Allen, 192 U. S. 543, and it may embrace a process and the apparatus by which it is performed.
>
> Where dependent and related inventions are patented separately a foreign patent for either does not affect the other under section 4887, Rev. Stat., and the same rule applies if such inventions are embraced in one patent.

In the Saratoga case the Circuit Court of Appeals made a clear distinction between the **apparatus** and the **process** claims of the United State patent, holding the **apparatus** claims invalid but sustaining the validity of the **process** claims, thus emphasizing the fact that the foreign letters patent, which cover apparatus only, can have no limiting effect on the process claims of the United States patent.

The Supreme Court further says:

> A process and an apparatus by which it is performed are distinct things. They may be found in one patent; they may be made the subject of different patents. So may other dependent and related inventions. If patented separately a foreign patent for either would not affect the other. Why should such effect follow if they are embraced in the same patent? What

policy of the law would be subserved by it? * * * * It is not intended to confound rights and to make one invention free because another is made so. * * * * Each invention is given the full period of 17 years, which the statute prescribed for it. If limited at all, it can only be by a prior foreign patent identical with it. Nor can confusion result. Why should it? It does not result from analogous applications of the patent laws. Claims are independent inventions.* * * * is it [referring to a prior foreign patent on an instrument or apparatus] identical with the invention of claim 5 or claim 35 of the patent in suit? It is not of claim 5, for that is for a method, and a method is independent of the instruments employed to perform it. (213 U. S. 318, 319, 320.)

The force of the distinction thus established by the Supreme Court is obvious when applied to all the process claims of our United States patent, and also to at least some of its apparatus claims.

A Cost and Efficiency Comparison of Sewage Treatment and Water Purification for Duluth, Minn.

In illustrating the principles discussed in his paper on sewerage and sewage disposal, Mr. John Wilson, City Engineer of Duluth, Minn., made a cost and efficiency comparison of sewage treatment and water purification for that city. The following matter is taken from Mr. Wilson's paper, which was presented before the recent annual convention of the Minnesota Surveyors' and Engineers' Society.

A comparison of the cost and results of sewage treatment and water purification for the city of Duluth is interesting since that city discharges its sewage into and takes its water supply from Lake Superior.

SEWAGE TREATMENT.

The shore line of the city is about 15 miles in length, very steep and rugged, making the run-off very rapid and complete. The average temperature of Lake Superior being lower than that of Lake Michigan, disposal of sewage by dilution is more favorable at Duluth than at Chicago where the amount of dissolved oxygen in the water will necessarily be less. While conditions are very favorable for this form of disposal in Duluth, they are very unfavorable for artificial methods of treatment. During rainstorms the whole shore line is more or less polluted by the washings from barn-yards, street gutters, storm sewers, cess pools, etc. A great deal of storm water is admitted to the sanitary sewers, which only tends to increase the difficulty of treatment. Then the difficulty of picking up all the various outlets along the shore, or of installing individual plants at each outlet would be considerable.

The use of ordinary septic tanks would be entirely out of the question at Duluth, as each would tend to increase rather than diminish the nuisance at the various points, and as far as improving the bacteriological condition of the lake is concerned, the change resulting from the use of such tanks could probably not be detected.

The most favorable method of treatment would no doubt be by Imhoff tanks followed by disinfection of the tank effluent with calcium hypochlorite. The first cost of such a scheme would possibly be about $300,000, with an annual cost about as follows:

Payment into sinking fund to redeem bonds in 20 years, interest at 4 per cent	$10,074
Interest on first cost at 4 per cent	12,000
Chemicals at 1½ cts. per lb.	6,750
Labor and maintenance	10,000
Total	$38,824

This treatment might result in a removal of about 96 per cent of the organisms; but there might still remain a "resisting minority" of about 150,000,000 in every gallon of the effluent. In time of storm, however, we could not expect to secure results as good as this. In addition the pollution from the street wash, cess pools, barnyards, etc., would still give us quite a problem to deal with, and the protection offered by the sewage purification plants at such times would not be very great. Then, too, calcium hypochlorite like all other forms of disinfectants has its selective peculiarities, and it is quite possible that a great many of the organisms destroyed by its use are soon killed off any way by natural causes shortly after reaching the lake water.

Duluth's intake is several miles from where the greater portion of the sewage is discharged, and rarely is there any suspended matter in the water. The bacteriological count is very low, rarely exceeding, I am told, 25 per c. c. But colon have been found quite frequently in 100 c. c. amounts, and the water is now being treated with calcium hypochlorite at the rate of 0.13 parts per 1,000,000 available chlorine. And this very small quantity removes about 75 per cent of the organisms, leaving an average count of about 5 per c. c., and colon seldom present in 100 c. c. amounts. The cost of the above treatment is of course practically nothing, and consumers cannot detect its presence.

WATER PURIFICATION.

If in the near future the increase in the pollution from all sources should be such that the above treatment would seem not sufficient to safeguard the city against infection, and it should be advisable to install a filter for the water; the first cost would possibly be about $300,000, with an annual cost as follows:

Payment into sinking fund to redeem bond in 20 years, interest at 4 per cent.	$10,074
Interest on first cost	12,000
Cost of chemicals	150
Operation	6,000
Total	$28,224

This is more than $10,000 per year less than the cost of treating the sewage, and the results will not admit of a comparison.

Duluth's attitude in this matter at present is the right one; the water is being treated as the amount of pollution demands. As the city grows in the vicinity of the pumping station care must be exercised that sewer outlets do not encroach on the intake. In the course of time conditions may arise, most probably along the bay, when it will be necessary to treat the sewage for the purpose of preventing a local nuisance. But not unless the science of sewage treatment is wonderfully advanced over what it is today will it be for the purpose of protecting the water supply. The Royal Commission has but recently advised a repeal of England's present laws, and the adoption of standards for sewage treatment more in accordance with the present possibilities.

Of course there are many cases where sewage should be treated for the protection of water supplies; but the object should be to remove an overburden from the water purification plant rather than take its place.

I do not wish to minimize in any way the importance of sewage treatment; my purpose is to point out some erroneous ideas that are only too prevalent. The attitude of many in Duluth in advocating sewage treatment in preference to the simple yet efficient treatment the water is now receiving, is a very common one. They think when we say "purification" we mean "purification"; whereas the word is used in a comparative sense only, and does not imply purity either from a chemical or a biological standpoint.

While this matter has been discussed a great deal in our technical magazines of late, it must be remembered that these are seldom found in the hands of laymen, and not as often as they should be in the hands of city officials and health officers. It would seem well therefore if the word purification could be superseded by some word more nearly expressing the thought intended.

Before closing I want to take up another phase of sewage disposal, that of maintenance and supervision. Every sewer system requires some attention, and a sewage disposal plant requires a good deal of intelligent attention, if results are to be expected from the standpoint of public health or any other. What can we expect when the care and operation of a sewage disposal plant is turned over exclusively to an official, whose major duties require him to catch all stray dogs, empty the cuspidors at the city hall and see that the saloons are closed at twelve o'clock; which is the case in many of our smaller communities.

I once complained to an official in regard to a neglected disposal plant; and he stated that as soon as the potatoes were all dug he expected to be in a position to give the matter some attention.

If, as has been often suggested, the attendants at such plants were instructed in regard to making some simple tests, and if these results were reported regularly to, preferably, state officials, and if certain standards were demanded by these officials, who should also visit such places periodically for the purpose of giving instructions as well as for inspecting the operation, we would have reason to expect good results. For this reason I believe that state supervision of sewerage and sewage disposal plants is equally important to that of highway construction. Under such supervision engineers would be in a position to design and lay out their work with the assurance that it would be properly cared for and operated after it is turned over to cities.

RAILWAYS

Electrification of the Melbourne Suburban System of the Victorian Railways—High Tension Direct vs. Single Phase Alternating Current System.

One of the most important as well as one of the largest electrification projects in the history of the railway industry is that which is about to be undertaken in connection with the suburban steam railways of Melbourne, Australia. Probably the most comprehensive comparison of the single phase and high tension direct current systems ever made, has been made in connection with this project. As a result of the special study made the direct current system of 1,500 volts was selected.

The advisability of this electrification has been under consideration for a number of years. In 1908 Mr. Charles H. Merz of the firm of Messrs. Merz & McLellan, of Victoria Street, Westminster, London, presented a comprehensive report on the subject to the Victorian Railway Commission. In this report Mr. Merz, acting as consulting engineer on the scheme, went very fully into the whole question of the substitution of electric traction on steam railways.

Since that time a number of important railways have been electrified in all parts of the world, and experience has demonstrated the great advantages and economies which result from this mode of operation. In this particular case, the rapid growth of the suburban business in and out of Melbourne was also a decisive factor that emphasized forcibly the need for electrification. Recent practice especially has shown that the adoption of the high voltage direct current system by a number of roads has resulted in eminently successful and exceptionally economical operation both for suburban and through service.

In a later report, embodying a comparative analysis of the merits of both the single phase alternating current and high voltage direct current systems, based on the bids submitted, Mr. Merz points out that the adoption of the high tension direct current system for this application would mean a saving of about $3,500,000, or nearly 30 per cent, in the cost of installation over that of the single phase system. Accordingly, in view of this initial saving and a further operating economy, as indicated by Mr.

Merz, of about $350,000 per annum, or nearly 28 per cent, he recommended very strongly the adoption of the high tension direct current system for the Melbourne railways and the Victorian Government accepted his recommendation.

Melbourne, the capital of the State of Victoria, is situated in the southern part of eastern Australia on the Yarra river, eight miles from its mouth at the head of Port Philip. The river is accessible for vessels drawing 22 ft. of water, and all larger vessels are easily accommodated at Port Melbourne in Hobson Bay. Along the river are large docks, shipyards, foundries and manufacturing plants representing a number of industries. The city has a population including its suburbs of over 500,000, and is the most important municipality and the greatest trade center in Australia.

The electrification of the Melbourne Suburban Railways is of exceptional interest because it will be one of the largest projects of its kind in the world, involving heavy rolling stock equipment with overhead collectors. The magnitude of the undertaking from the standpoint of equipment and service may be compared with that on the third rail electrified section of the New York Central Railroad out of New York City, and ranks with the Oakland, Alameda & Berkeley electrification of the Southern Pacific Railroad at San Francisco.

The great size of the project attracted worldwide competition. Among the leading manufacturers of electrical apparatus submitting bids are included the Allgemeine Electricitaets Gesellschaft, Berlin; British Westinghouse Co., Manchester; Dick Kerr & Co., Ltd., London; Ferranti, Ltd., Hollinwood; Siemens Bros. Dynamo Works, Ltd., London; General Electric Company of New York, and others. After an exhaustive study and consideration of the relative merits of the several propositions, Mr. Merz approved in his report the recommendations of the General Electric Company of New York as to choice of system and economical features of operation, and the Victorian Government awarded that company the contract for the rolling stock apparatus equipment, comprising 400 motor car equipments, consisting of four motors each; 800 control equipments, 400 of which are for trailer cars, and 400 air compressor equipments. This is the largest single order ever placed for electric railway apparatus.

The mileage of the suburban lines included in the scheme is made up of 150 route-miles, or 289 track-miles of running roads, and 34 miles of sidings. The potential selected for this direct current system is 1,500 volts. Power will be supplied from a central station at Yarraville, a suburb of Melbourne, in the form of three phase alternating current at 25 cycles per second and will be transmitted at 20,000 volts to twelve sub-stations at various points on the system, where it will be converted into the operating direct current of 1,500 volts.

The high tension transmission is by underground cables from the power house to the important sub-stations in the central area, and by overhead wires erected on the same structures which carry the railway track conductors, to the outlying sub-stations. Overhead conductors will be used throughout the system for supplying current to the trains, which will be equipped with roller pantograph collectors. The complete equipment of the railways involves the expenditure of $12,000,000 in round numbers, and Mr. Merz figures the saving of electric operation will amount to about $600,000 in 1915 over the former steam operated lines.

Normal trains, weighing about 180 tons, will consist of two motor coaches and two trailer coaches. The track sare 5 ft. 3 ins. gage. The suburban traffic amounted to 70,000,000 passengers in 1908; the figure the past year exceeds 90,000,000; and in 1917, when it is expected that the conversion to electric operation will be entirely completed, it is estimated that the suburban lines will carry 150,000,000 passengers per annum. The present plans are accordingly based on provision for this probable increase in the passenger traffic; but all parts of the electrification scheme are arranged so as to be capable of extension from time to time, as the traffic subsequently grows. Handling heavy traffic during the rush hours of morning and evening will be provided for by increasing the length of trains, although for this initial service it is the intention to have the maximum train consist of six coaches.

The motors, numbering 1,600 in all, which will be installed in the 400 motor coaches, will be of new design throughout and will embody the most modern developments that the General Electric Company has introduced in the railway motor construction. They will be known as Type GE-237, will have inherent ventilation and be provided with commutating poles. They will be rated 140 H.P. at 725 volts and will be operated two in series on 1,500 volts.

The method of self-ventilation which will be incorporated in the design of these motors will assure exceptionally effective and uniform cooling. This will be accomplished by a broad-bladed centrifugal fan cast integral with the pinion end armature core head. Fresh air is drawn into the interior through a screened opening on the upper side of the motor frame at the pinion end. This is circulated over the armature and field coils, under and through the commutator, through longitudinal holes in the armature core, and thence exhausted to the exterior through openings in the pinion end bearing head.

Scientifically correct in principle, this method of ventilation has been demonstrated through service tests to be the most successful manner of securing evenly distributed cooling; for without complication it circulates effectively a large volume of cool air throughout the motor and keeps all parts at a uniform temperature, eliminating the possibility of "hot spots." The service capacity of the motor, due to its ventilation, is rendered much greater than that of an ordinary motor of the same nominal rating. At the same time, the weight per horsepower is greatly reduced without sacrificing mechanical strength, durability or electrical efficiency.

The service on the lines calls for both local and express schedules. The motors will therefore be arranged for tap field control, which will allow a free running speed of 52 miles per hour over level track for the suburban cars on express runs. This method of auxiliary control was introduced by the General Electric Company a number of years ago, but due to commutating limitations of earlier motors, it was eventually abandoned. Its successful application to commutating pole motors is therefore modern.

The principal advantages to be derived from tap field control are increased operating efficiency, continuous saving of power, economy effected through decrease in the weight of the equipment and an increase in the service capacity. The practical effect of tapping the field is to eliminate one resistance step and to secure the desired accelerating effort throughout from start to full speed with a lower current input.

The 800 control equipments for both motor and trailer cars will be the well-known Sprague-General Electric Type M relay-automatic control and do not require description. They provide for multiple unit operation and control of the train from the platforms of any motor or trailer car. Type M control has been in operation on heavy traction work for many years, notably on the subway and elevated divisions in New York and other large cities, and has demonstrated its simplicity, low maintenance and reliability.

It is interesting to note that two of the principal factors that apparently influenced Mr Merz and the commissioners to decide in favor of the high tension direct current system, rather than the single phase alternating current system, were the lower maintenance of the rolling stock equipment and the saving in energy consumption. They found that the greater number and complexity of the electrical parts carried on the coaches in the case of the single phase equipments not only causes these equipments to be initially more expensive, but also renders them more costly to maintain; and when routine inspection is taken into account, and also the fact that repairs are necessarily subject to the exigencies of traffic requirements, the maintenance of single phase equipments would exceed that of direct current equipments in a slightly higher proportion than that governing their respective first costs.

The GE-237 direct current motor selected for these equipments is designed especially to obtain low energy consumption. This comparison of energy consumption is included in Mr. Merz' report in the number of kilowatt-hours required by a four-coach train making a round trip between Sandringham and Broadmeadows. Based on the several manufacturers' guarantees, Mr. Merz arrives at an economy of 23 per cent in energy consumption in favor of the high tension direct current equipment.

Other points that were brought out as being adverse to the single phase system for this application might be mentioned, as follows: Slightly reduced seating capacity of the trains on account of the extra amount of room required by the single phase equipments; the extra wear on the track rails due to the extra dead weight of the single phase motors, and the extra amount of spare plant required in connection with the single phase scheme on account of the greater complexity of the equipments. Mr. Merz came to the conclusion that the direct current system would show an increasing advantage over the single phase system as the traffic becomes greater year by year.

Electrification of steam roads both here and abroad has emphasized the fact that the conversion to electrical operation is always accompanied by a faster and more frequent train service, and because of greater convenience, comfort and cleanliness, a general improvement in suburban traveling conditions is effected, while the reduction in working cost and the increased earnings of the line combine to produce larger profits.

Notes and Suggestions on the Economic Location of Railways.

Many helpful comments and useful suggestions relative to the economic location of railways, were made by Mr. W. F. Tye in a recent address to the Canadian Society of Civil Engineers. The suggestions made relate in part to conditions in Canada, but in general Mr. Tye's comments will prove helpful to railway engineers in other countries. The following excerpts are taken from the address:

Transportation is one of Canada's greatest problems: our country is of vast area, the distances are great, the population sparse, and the traffic light; making the mileage and cost of railways high per head of population. On the other hand, the growth of the country is and will continue to be rapid. A great problem is thus presented: how to build our railways that they may not be too expensive for our present requirements, and yet be capable of improvement to fit our future needs. Economics of railway location is, therefore, of even more than usual importance to Canada. The subject is so vast that it is only possible in such an address to touch its outer fringe; but it is so important to us all that even a few rudimentary remarks may be interesting.

While railways are built to serve the traffic requirements of the country, the immediate object of the promoters and builders is to make a profit, either on the construction or operation. This is undoubtedly true when built by private parties. When built by a Government, it is with the end in view that the people may make money either directly through the operation of the railway, or indirectly by the reduction of rates. It is, therefore, of prime importance that the engineer, whether he be working for private parties or for a Government, locate and construct the most economic road. The most economic road is not necessarily either the cheapest or most expensive, neither is it necessarily the one which may be operated at the least cost—it is in reality the one which is the most effective commercially or the one which will enable its owners to transport the largest amount of traffic at the lowest cost.

In order to ascertain that a railroad is most effective commercially, the features which underlie its commercial effectiveness should be understood. These are: Gross Earnings, Operating Expenses, and Fixed Charges; and are of importance in the order named. Gross Earnings, which depend on the amount of traffic handled, is undoubtedly first. It is never advisable to build a railway unless there is or will be sufficient traffic to pay the Operating Expenses and the Fixed Charges, no matter how cheaply or how well it can be built.

In new countries, such as most Canadian railways are built through, there is rarely sufficient traffic in sight to justify the construction of a road, so the promoters—whether they be a Government or private parties—must have faith in the project and must be able to justify to themselves, and to the investing public, the possibilities of paying dividends.

Engineers are sometimes, though rarely, consulted in the early stages of the project to report on the traffic possibilities of the route. The usual way is for the promoters to decide for themselves that a road between certain terminals is commercially desirable, and that there is or will be sufficient traffic on such a route to justify its construction. Engineers are then employed to survey and construct the road. The question should at once arise with the engineer—how the railway can be so located as to make it the most effective commercially, or how to get for the promoters the most profitable traffic. No matter how this problem is stated, it finally resolves itself into this:—if the promoters be private parties, how can the road be so located and built that the most interest can be earned on the money invested—or if a government, to transport the most traffic at the least cost? The answer in either case would be the same, for, if it is so located that it may handle the most traffic at the least cost, it will, if properly managed, make the most interest on the money invested.

The first problem the engineer has thus to face is how he can so locate the road between the given terminals as to get the most profitable traffic. The route which takes in the greatest number of towns, or which goes through the best land, if the country be unsettled, should be the first examined. A mistake frequently made is to locate the road within a mile or two of an important town in order to decrease distance or avoid expense. The cost of handling traffic is the total cost from the door of the consignor to the door of the consignee, and rates on that basis must be equal. The added charge for cartage is at times so large as to wholly destroy the business of the badly placed line and give it to a competitor more favorably situated, or if it be not wholly destroyed, the additional cartage and delivery charges eat up the profits.

Where traffic is light, and train loads less than the rated capacity of the locomotive, the cost of handling additional traffic is much less than is the ordinary train mile cost. It should be figured in equating the value of a change in location which increases traffic at 50 per cent of the usual train mile cost. In this respect it should be remembered that deviations from the direct route do not always materially add to the length of the line.

In order to locate a railway so that it may be commercially effective it is first necessary to know what the volume of traffic is likely to be, whether it is immediately available, and at what rate it is likely to grow. The best way to ascertain this is by comparison with roads through the same or a similar country. A road through a country most nearly approximating that to be traversed should be selected for examination, and its traffic for previous years studied. If, for any reason business is likely to be materially greater or less than on the road under examination, due allowance should be made.

All railways are now required to make yearly reports to the Government, and such statistics should be examined as well as those published in the Railway Companies' Annual Reports. The average train load and the ruling grade should be studied, and finally the average number of trains per day should be ascertained. It must be remembered that though the traffic is rarely balanced, that is, that there is seldom as much tonnage moving one way as the other, the number of trains each way must within narrow limits be the same. It is not always easy for an outsider to ascertain the number of trains over any given railway, as railway statistics are not published in this form, but every effort should be made to arrive at it as closely as possible.

Having obtained this information, and having determined how the traffic on the proposed road will compare with that on the road under examination, some approximation of the ruling grades on the road in view should be arrived at. If different from those on the route with which comparison is being made, the number of trains per day each way on the proposed road should be increased or diminished accordingly.

While this method of ascertaining the number of trains per day is only approximate, it is certainly much more accurate than to attempt to make an independent estimate of the gross tonnage on the new road. The rate of growth of traffic should be similarly ascertained, as a railroad should be built not only to take care of the present traffic but also that of the road in the reasonably near future.

Cost per train mile is the basis of all economic comparison, as the effect of the number of trains on the cost of operation is much more direct than is the actual tonnage handled. The cost per train mile should thus be ascertained with reasonable accuracy. The Annual Reports published by the Railway Companies usually give these figures; if not, the reports of the Interstate Commerce Commission give this information for every railroad in the United States. From this mass of statistics the train mile cost of the most nearly similar road should be taken and assumed as the train mile cost of the proposed road. It must also be remembered that these costs are increasing rapidly, the average for the whole United States for the year ending June 30, 1896, being 95 cts., while for the year ending June 30, 1910, it had increased to $1.49.

Equipped with this information as to the sources of traffic, the estimated average number of trains per day, and the probable cost per train mile, the engineer is ready to make a reconnaissance of the country to be traversed. The reconnaissance should always be of an area rather than a line. An area wide enough to take in any possible line should be examined. All combinations of probable lines should be studied. As the reconnaissance proceeds a map of the country should be made showing the details of the topography by contours 10 to 50 ft. apart; the elevations of controlling points should be shown with the greatest attainable accuracy. From such a map carefully prepared all lines and combinations of lines can be studied. Approximate condensed profiles can be drawn, and distances, grades and costs can be approximately ascertained. With such information, the choice of routes can usually be narrowed down to one or two, or in rare instances to three lines over which it is necessary to run surveys.

The value of a proper reconnaissance cannot be too strongly insisted upon. It is owing to the lack of it that the graver errors of location are usually due, such as the selection of an improper route or ruling grade, passing of traffic centres, etc. There is no way in which money can be so profitably spent. Great pains should be taken to secure the most expert engineer for this class of work. In engineering and economic importance reconnaissance far outranks location or construction. It is not an exaggeration to say that for every dollar which an engineer can save on construction, he can save five on location, and ten on reconnaissance.

The really essential factor in a location made for freight traffic is the ruling grade. The maximum is not always the ruling or limiting grade, as it might be operated by the aid of a helper engine, in which case it may not limit traffic. A very long grade of a lower rate may, by taxing the boiler capacity, become the ruling grade instead of a shorter steeper one. To ascertain the economic value of any change in grade, or to compare two different grades, the number of round trips per day required to handle the given or estimated traffic should be ascertained. The difference will be the saving in trains each way per day. This multiplied by the ascertained cost per train mile, by twice the length of the division in miles and the number of days in the year, will give the annual saving. Capitalizing at the proper interest rate will give the capitalized value of the better grade. If the additional cost is not greater than the capitalized value when properly equated for distance, rise and fall, curvature, etc., then the lighter grade is an economic one, and should be adopted.

As many items of expense will not be affected by changes in the number of trains, the saving per train mile for a train eliminated is not as great as the cost per train mile for the entire traffic. The saving is in reality in the neighborhood of 50 per cent and this percentage of the ascertained total train mile cost should be used in estimating the economy due to a difference in ruling grade.

In figuring on the economics of a grade reduction on an old road where the traffic and the average number of trains per day are known, it is essential that the actual loads hauled by each locomotive be determined and compared with their rated capacities. This difference is due to the inability of the operating officials to get perfect results. This "personal equation" must be taken into consideration in figuring the number of trains per day with the new grades, as they will no more be able to get the best results under the new conditions than they were with the old. In making a reduction from a high rate to a low, for instance, from a 1 per cent to a 0.3 per cent or 0.4 per cent, it must not be forgotten that the proportion of the actual loads to the theoretical rating will be lower on the low grades than on the high. Time is an essential factor. On a 1 per cent grade in good weather, the actual loading may usually be made 90 per cent of the theoretical, while on 0.3 per cent it is unlikely that more than 75 per cent of the rating can be hauled if time is to be made.

The proportionate amount of ruling grade on the Division has also an important bearing on the loading of trains, the greater the proportion its length bears to the length of the Division the lighter the actual train loads must be, and this too must be taken into consideration in determining the average number of trains per day required to handle the traffic on the proposed new grade.

Serious error would undoubtedly arise if the theoretical number of trains required to handle the traffic on the proposed new grade were compared with the actual trains on the present one.

While fixed charges—which are largely determined by the cost of construction are of lesser consideration than operating expenses, they are still of prime importance. No road can pay dividends to stockholders, or afford to reduce freight rates until its fixed charges are met. So it is of the greatest importance that the engineer introduce no features that will increase the cost of construction without reducing the operating expenses by at least as great an amount as the interest on the added cost. The cost of moving a given tonnage being the sum of the operating expenses and the fixed charges—it follows that a reduction in the cost which does not increase the operating expenses is only of less importance than one which reduces the operating expenses without increasing the cost. Such a reduction in cost is a practical improvement to the standard of the road, as it increases the margin between receipts and expenditures, and so permits of an increase in dividends, or has a tendency to permit of a reduction in freight rates, if that be the object aimed at.

In Canada most of the new construction is through districts which at the time of completion furnish but little traffic: much railway has been built on which the traffic did not justify even one daily freight train per day each way. It is a safe statement that 80 per cent of the mileage constructed in Canada would not furnish at the date of completion traffic sufficient for two freight trains each way per day. Under such conditions, the receipts are low and the operating expenses high, and it is of the utmost importance that the construction cost be kept low. On the other hand, the country is growing fast, and traffic is increasing rapidly. It is thus necessary that the engineer keep always in view the almost certain necessity of a good road in the future. He should, therefore, so locate and construct his line that the first cost be low, and that the standard may be raised, when necessary, without unduly increasing the total expenditure. In order to get the very best results, the line giving best grades, alignment, etc., should always be first located. From this, as a standard, the engineer should work to the final or economic location. Working from a poor to a better is apt to lead to grave errors.

Where low construction costs are necessary, and it is probable that a high standard will be required in the future, it is much more effective and advisable to use short sections of temporary line with steep grades, sharp curves, etc., on the heavy or difficult sections, maintaining the higher standard for the light or easy portions of line, than it is to adopt a generally lower standard for the whole route. The first cost of the former will probably be less; it may be operated with helper engines as the traffic increases, and may be improved when advisable, while the cost of improving a generally poor road is frequently prohibitive.

The use of sharp curves with short tangents is often a very effective means of reducing cost without materially increasing the operating expenses.

The effect of moderately sharp curvature is essentially different from steep grades, inasmuch as it is not limiting in its effect. The use of one sharp curve does not justify the use of another just as sharp—whereas the use of one ruling grade on a division does justify another as steep.

The use of curves up to 14° does not increase the maintenance or operating expenses. A mile of road in which there are 100° of 10° curve, the balance being tangent, does not cost any more to maintain and operate than the same length of road with 100° of 2° curve—in fact, if there is any difference, it is in favor of the sharper curvature.

Unless the curvature is so sharp as to be limiting in its effect, there is no serious objection even on the best class of road to a few sharp curves where the amount saved by their use is sufficient to justify their introduction. The conditions which cause curves to be limiting are when they are so sharp as to prevent the use of the higher grades of modern equipment, and when they limit the haulage capacity of the locomotives, or their speed.

Modern equipment is so constructed as to traverse safely 14° curves, and much sharper with guard and hold up rails. The standard compensation for curvature on grades is 0.04 ft. per degree. A 10° curve is thus equivalent, as far as resistance is concerned, to a 0.4 per cent grade; and a 15° curve to a 0.6 per cent grade. On a 0.4 per cent it is only necessary that the grade on a 10° curve be made level in order that the resistance be not increased. The same thing applies to a 15° curve on a 0.6 per cent grade. It is, therefore, evident that on a road whose ruling grades are 0.4 per cent 10° curves are not limiting to the haulage capacity of the locomotives, nor are 15° curves on a 0.6 per cent grade.

The easy riding speed is dependent on the amount of the allowable elevation of the outer rail. If the maximum be set at 6 ins., this speed per hour would be:—

on a	3°	curve	60	miles per hour
"	4°	"	50	"
"	6°	"	40	"
"	8°	"	35	"
"	10°	"	30	"

The safe or allowable speeds would be 10 miles per hour greater.

With the track properly elevated, equipped with tie plates kept in good line and surface, and curves provided with proper easements, 10° curves are no more disagreeable to ride over at speed of 30 miles per hour than are 3° curves at 60 miles per hour.

The reduction in speed for one mile from 50 to 30 miles per hour only means the loss of 0.8 minutes. To take an extreme case—the Twentieth Century Limited runs from New York to Chicago, 980 miles in 20 hours, or at an average of 49 miles per hour. The introduction of 100 10° curves each one of which required a slacking of speed to 30 miles per hour for a distance of one mile would increase the running time of such a train by 1 hour and 20 minutes. Such an increase on a road 1,000 miles long would in nine cases out of ten have no ill effect. A 10° curve so long as to require the reduction of speed to an average of 30 miles per hour for a mile would in practice be a very rare occurrence.

It is evident the use of curves as sharp as 10° does not prohibit the employment of modern equipment or limit the haulage capacity of the locomotives. It has no effect on the speed of freight trains, or on passenger trains where the average speed including stops is not greater than 30 miles per hour. A few such curves only slightly affect the running time where speeds are high.

It is thus clear that a few curves not sharper than 10° are not objectionable on the very best roads where their use results in large savings. As they are not limiting, the use of one such curve is no justification for a second. The introduction of many of them preventing the employment of high speeds for long distances would certainly be objectionable, but an occasional one where large savings result is justifiable on even the highest class of road.

View of Turner Tubular Gasoline Torch Removing Ice and Snow from Interlocking Connections.

Wooden trestles to replace heavy rock borrow embankments should be used. Such trestles may be designed to safely carry the heaviest class of equipment. When protected by the installation of the best available water supply they are quite safe, and are good for ten years. Such temporary construction also gives time to ascertain the correct requirements for water ways in new countries where there is frequently a dearth of information as to rainfall, flow of streams, etc., and where unless unduly large water ways are left there is danger of washouts. This danger may be even greater than the danger from fire to wooden trestles. Their use instead of heavy rock borrow embankments is of great importance from an economic point of view. One dollar at 5 per cent compound interest amounts in ten years to $1.63. If rock borrow costs on the original construction say $1.75 per cu. yd. it will in ten years' time have amounted with interest to $2.85. While, under anything like ordinary conditions train-hauled earth embankments on an operated road, made when the trestles require replacement, do not cost over 30 cts. per cu. yd., or less than 1-9 of the total cost of a permanent rock embankment made during construction.

Momentum grades are a great source of saving in cost without increasing the operating expenses. The use of momentum in overcoming short stretches steeper than the ordinary ruling grade is almost always justifiable. The exception is where the traffic is so congested that the possibility of a delay due to the failure of an occasional train to surmount the grade is more important than the undoubted saving in interest charges which they insure. It will probably be many years before conditions prohibiting their use prevail on any portion of our Canadian railways.

The foregoing are a few of the more important considerations which the locating engineer should keep in view. He should always remember that railways are commercial enterprises, are built for profit, and that the investors are looking for and are entitled to satisfactory interest on their money; and so far as the returns on their investments depend on location they will for a given traffic be the greatest when the sum of the operating expenses and fixed charges is the least amount.

A New Hot Blast Tubular Gasoline Torch for Thawing Ice and Snow from Railway Interlocking Connections.

(STAFF ARTICLE.)

A new hot blast tubular gasoline torch, recently placed on the market, has a promising field of usefulness in railway, municipal, and general construction service for thawing out frost, ice and snow. The accompanying illustration, showing the torch in use for thawing out the ice and snow from around the switch point of slip switch, operated by an interlocking plant, will serve to show the general appearance, form and proportions of the torch.

The tank of the torch is made of heavy gage brass tubing 2 ins. in diameter and 5 ft. long. There is a burner at one end of the tube and a gasoline valve and pressure pump at the opposite end. There is also a controlling valve inside the tube which regulates and controls the flow of the gasoline. The long tube holds the gasoline supplied to the burner. The size of the blast flame is regulated by the control valve. The torch and flame can be pointed in any direction desired.

The tank has a capacity of three quarts. The consumption of gasoline is one quart per hour when the flame is 2 ins. in diameter at the burner and 12 ins. long. The length of the tool over all is 5 ft. 9 ins., and it weighs about 8 lbs. The tool operates on the same principle as the ordinary gasoline blow torch. It gives a heat production equal in amount to that of six ordinary blow torches.

For removing snow and ice from railway tracks, especially around the movable portions of the track actuated by interlocking plants, these torches will prove very useful and economical. Following a recent severe sleet and rain storm in Chicago and vicinity, which froze up the movable parts of railway tracks, a single torch of the character here described was sufficient to take care of the large number of switches in the Chicago transfer yard of the Chicago Great Western R. R. The work formerly done by five or six men by old methods was, in this case, performed by one man with one of these torches.

The torch is also well adapted to thawing frozen water pipes and hydrants. It is also useful in melting the lead out of bell and spigot joints on water mains where a section or two of pipe must be removed for any cause. The device possesses other obvious fields of application, particularly on construction operatings in cold weather.

The torch is manufactured by the Turner Brass Works of Sycamore, Ill. It sells for $10 f. o. b. Sycamore. The torch is also sold by the Specialty Sales Co., 1305 Norwood St., Chicago, Ill.

NEWS SECTION

Editorial Comment—Personals—Society Meetings—Trade Notes—Catalog Reviews—Contract News, Embracing Bids Asked, Work Projected, Contracts Let and Contract Prices on All Classes of Civil Engineering Construction Work.

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The Doings of the Week.

Railroad construction, as regards the letting of new work, has been particularly quiet during the last few days. No contracts of any size appear to have been let. In New York City Chairman Edward E. McCall of the Public Service Commission for the First District, who has been devoting most of his time since his appointment to the study of the subway situation and the contracts prepared by the Commission for the operation of the Dual System of rapid transit, has announced that he believes he will be ready this week to vote upon the contracts. If there is no further interruptions by litigation, therefore, the subway contracts probably will come before the Commission for final adoption or rejection before the end of the week. If the contracts are adopted it is probable that there will be little delay in inviting bids on the work. An encouraging feature of the railroad situation is the statement that new railroad bond issues aggregating more than $100,000,000 were brought out last month and readily absorbed. This is good evidence that the bond market has begun to show expansion.

Except in Maryland and California, very little state highway work is now up for bids. In New York state plans have been prepared for 1,000 miles of improved roads to cost about $10,000,000 and to be constructed under the new $50,000,000 bond issue. The construction of these highways will close up uncompleted gaps in a number of state routes. If the legislature appropriates the money in time the letting of contracts will take place next month so that contractors may have the entire summer and fall for construction.

A number of good sized municipal paving contracts have been let in the past few days. The city of Greenville, Tex., has awarded a contract for 95,000 sq. yds. of vitrified brick pavement. The borough of Turtle Creek, Pa., has let a $185,000 contract for paving, grading, filling, etc. City of Canton, O., has awarded contract for about $150,000 worth of paving.

In the way of bridge work about the largest contract of the past week appears to be the one received by Skene & Richmond, Brockport, N. Y. This calls for•the construction of a lift bridge and a fixed bridge over the Erie Canal at Little Falls, N. Y. The contract price was $127,707. A good sized bridge contract is now being advertised by the city of Baltimore, Md. This calls for a steel truss highway bridge consisting of two spans, 297 ft. center to center of end piers, to be erected over Loch Raven. The town of Norwalk, Conn., is calling for bids until March 20 on the construction of a 965 ft. long, 65 ft. wide bridge. It is to be mainly of reinforced concrete construction with a double leaf bascule over the channel.

A considerable number of drainage contracts have been let recently. Most of these, however, are small and are mainly for tile work. Contracts for an open ditch through Hancock, Henry, Wood and Putnam Counties, Ohio, have been let as follows: Chapman Brothers, Celina, O., 10 miles of dredge work at $29,750; the Brush Creek branch to J. E. Dull of Arcanum, for $7,425; the Yellow Creek branch to D. G. Watson of Malinta, for $8,195, and the John Laern branch to Ira Baker of Arcanum, for $9,480.

The U. S. Reclamation Service has received authority to expend $600,000 in the development of Lake Keechelus as a storage reservoir during 1913. The total cost of the Lake Keechelus work is estimated at $1,125,000 and about $75,000 was spent there last year.

In the way of sewer work the following items are of interest: City of Chicago, Ill., is asking bids until March 14 on the construction of a brick sewer system to cost about $450,000; Everett, Wash., has awarded a contract for a trunk sewer to cost about $162,500.

Bids on two good sized contracts for the construction of standard revetments were opened last week by the U. S. Engineer at Kansas City, Mo., McGuire, Stanton & Jones, Leavenworth, Kan., at $8.74 per lin. ft., were low bidders on 12,000 lin. ft. of revetment at Pinckney Bend; Fox & Bristol, St. Louis, Mo., at $9.30 per lin. ft., were low on 12,000 lin. ft. of revetment at St. Ambert eBnd. The following bids on rock excavation in Beverly Harbor, Mass., were received Feb. 15 by Col. Frederic V. Abbott, U. S. Engineer, Boston, Mass.: Gilbert H. Harries, Boston, Mass., $29.35 per cu. yd.; Eastern Dredging Co., Boston Mass., $28.37 (awarded contract); Johnston & Virden, Lewes, Del., $28.90.

Bids on two contracts for barge canal work in New York state are now being asked. One of these calls for the improvement of the Erie Canal from the west end of Contract No. 9 to east end of Contract No. 64, at Medina, a length of 2.31 miles The other contract calls for the completing of the excavation of a channel in the Hudson River, and covers a length of 4.1 miles.

The Dominion Dredge Co. has been awarded the contract by the Harbor Commission of Quebec for dredging the St. Charles River from the east end of the breakwater extension of the river to the west end of the north embankment of the Princess Louise docks at Quebec, the line on which the new bulkhead pier in connection with the harbor improvements will be built.

U. S. 8-Hour Bill.

The Government bill limiting the hours of daily service of laborers and mechanics employed upon public works and all persons employed in constructing, maintaining and improving rivers and harbors has been approved by Congress and last Saturday was sent to President Taft for his approval. It is expected that he will sign it this week. The labor law of 1892 was enacted to cover the kind of work for which this bill will provide. The Supreme Court of the United States, however, in the case of Ellis vs. the United States, took dredge workers and others from under the provisions of the law of 1892. The present bill has been framed in such form that it is believed that the Supreme Court will enforce the 8-hour law as applied to dredge workers and those working upon scows and otherwise engaged in river and harbor improvements. In conference the bill was amended so as to exempt from its operation persons employed in connection with government dredging or rock excavation while not directly operating dredging or rock excavating machinery or tools. The law does not apply to persons engaged on the construction or repairs of levees or revetments necessary for protection against floods or overflows.

We Note That—

The Texas organization of the Stone Masons' and Brick Layers' Union has served official notice on all contractors in the state that after March 1 individual drinking cups and private dressing rooms must be provided the men at all places where they are employed. A new wage schedule of $8 per day for foremen and $7 per day for the other men is demanded.—Also a delegation from a small town in Ohio inspected the pavements of Cleveland last week for the purpose of gathering data for a projected street improvement. The officials of Cleveland were not so flattered when they learned that their city had been selected only after the mayor of the small town had been unable to secure volunteers to visit a dry municipality to inspect pavement.—An employer in a Portland cement plant is now in the hospital at St. Louis under treatment for "cement" nose. Both nostrils are stopped up with cement and the physicians are drilling and chipping with a view to removing the obstruction The cement dust became hardened and is now attached to the skin as though it had grown there.

News from the Isthmus.

Nothing of importance regarding the construction of the Isthmian Canal escapes the watchful eye of the newspaper correspondents at Panama. For example, a recent press dispatch announces that "spiders will play a part in the completion of the canal. It is learned that Colonel Goethal has placed a man in charge of six large spiders from whose cocoons thread will be taken for use in all of the engineers' transit." Brief and to the point is the news item, but it leaves too much to the imagination. What are the duties of the official keeper of spiders? Is his time to be spent in catching flies for his charges, giving them baths and constitutionals and tucking them snugly in bed? Arduous though the duties of the position may be, there are undoubtedly many brave privates in the army of hungry office seekers now advancing on Washington, who will be only too willing to act as guardian for the "six large spiders" of the Isthmian Canal Commission.

The Wisconsin Road School.

The second annual Road School of the Wisconsin Highway Commission was held in Madison, Wis., Feb. 18-21 inclusive. The school is conducted for the purpose of bringing together the county highway commissioners and others interested in their work. Work of the past year is discussed under various assigned subjects, which cover the interesting and instructive features. The school does much toward standardizing the methods pursued by the county commissioners and in the co-operation induced between the county commissioners and the engineers of the state commission a great deal of money has been saved and better roads have been built.

The meeting was opened on the afternoon of Feb. 18.

Mr. W. C. Hotchkiss gave a talk on the classes and distribution of road materials found in the state.

In the evening several subjects were discussed, including the quantity and quality of labor and prices, boarding men and teams, housing machinery and so forth.

In the discussion regarding the storing of machinery, Mr. Hurlbeast of Green County told of a portable wooden building which was used in winter for the storage of machinery and in summer for the housing of men. This building was made of built up panels, bolted together, and contained about 4,500 ft. of lumber. Its construction required seven days work for one man and the cost was about $140. This is a good way to handle the machinery storage and the men's quarters, as the building is in service the year round. It also developed in the discussion that a building was necessary for housing the men—that tents were unsatisfactory and that men were hard to keep unless they were housed well. The men in the road work are paid from $2 to $3 per 10-hour day in different parts of the state and the rate is about 25 cents higher during harvest season than earlier in the year, on account of the necessity of competing with the farmers for labor. The average rate is $2. Good foremen are scarce. The state officers during the year made special efforts to obtain the names of all foremen in the state and found that they probably could not secure 25 first class foremen.

The cost of boarding men at work on the road amounted to 17.7 cts. per meal in one camp where about 20 men were employed. In grading work in Rusk County, Mr. F. M. Sergeant emphasized the need of running a line of levels over a road before setting a grade and in setting enough stakes so that there will be no possibility of leaving longitudinal sags in the grade between stakes. The cost of grading in easy working material which could be plowed with a two-horse team was about 6 cts. per cubic yard in his county, and where hardpan was encountered and a rooter plow was necessary the cost sometimes ran as high as $1 per cubic yard. They built a 24 ft. road grade with a 6-in. crown and put on 18 ft. gravel roadbed. The amount of dirt moved was about 880 cu. yds. per mile, and a good day's work was about 80 rods.

Mr. V. M. Weeks of the E. I. duPont de Nemours Powder Co. gave some valuable information on the methods of handling dynamite to insure safety. He stated that a rule of thumb method for determining the quantity of dynamite necessary for ordinary quarry blasting was to multiply the yardage to be moved by 5 cts., which would represent the cost of the dynamite necessary. This was figured to be 40 per cent dynamite, which is the kind most generally used for such quarry work.

In the discussion on contract vs. day labor both sides were represented, but the sentiment of the majority seemed to be in favor of having the option of letting the work by contract or closing it by day labor. In some cases it was advantageous to do the work by day labor where there was an outfit owned by the county, a good foreman could be secured, and where it was desirable to have the work under direct control. The efficiency of a contractor's force, however, was acknowledged to be a great factor in making the work as cheap as by day labor work. In Rock County it was stated contractors were more satisfactory than day labor. It is usually best to estimate the cost of the work by day labor then call for bids. If the bids are less than the estimate, the work should be let and if they are more and the commissioners are sure they can build the road for less than the best bid, they should build it by day labor.

In Milwaukee County it was stated that the average cost of contract work was six cents per cubic yard higher than by day labor.

Mr. F. M. Balsley of the Wisconsin Highway Commission gave a very complete talk on the methods of building a macadam road. He illustrated his talk by use of sketches on a blackboard, and went through the description of the work of building a 9 ft. road. First the shoulders are plowed up, making clear furrows about 10 ins. deep along each side, with the earth thrown outside. Outside of these shoulders the width of the embankment should be about 5½ ft., making altogether about a 20-ft. roadbed with 9 ft. of macadam in the center. After the side furrows are plowed up the grader is used to shape up the subgrade and ditches are dug out through the shoulders of the grade on each side at intervals to drain the subgrade. The largest size of crushed stone is put in the bottom of these trenches and covered with pieces of grass sod turned top side down over the stone. The drains may then be covered. In setting line and grades iron stakes are considered best and enough are used to line up two or three days' work.

The stone is pulled on in dump wagons, preferably of a type which can be made to dump and spread the load along the center of the roadside such a distance as the load is required to cover. The drop gates of wagons are sometimes fitted with special chains to prevent them from opening to full width, and thus insuring even distribution of the load. The stone is leveled down with the grader and given such a crown as desired. It is then rolled, care being taken to keep the roller away from the dirt shoulder. Screenings are hauled and dumped alongside, not on the road —and the loads are spaced so that 1 cu. yd. may be at hand to cover 300 sq. ft. of surface. Square pointed shovels are used for throwing the screenings over the rolled stone base. The surface is covered in light layers and is rolled continuously during the placing of the screenings. Stress was laid on the wetting of the road during the final rolling. The sticking of wet screenings to the wheels of the roller was a point which was brought up and it was stated that there was need for the provision by manufacturers of some sort of scraper. If a patch of screenings is lifted by the roller it is always a good plan to back the roller up immediately, so as to relay the patch in its original position, otherwise it is difficult to resurface the place so that it will not be noticed.

The construction of gravel roads was taken up by J. T. Donaghey of the Highway Commission, who contended that gravel roads which were built with as much care as usually taken with macadam would be just as serviceable and satisfactory and would cost about 60 per cent of the cost of macadam. He divided gravel roads in three classes, including roads of pit run, screened and crushed and screened gravel. The methods of constructing the subgrade he advocated were similar to the methods for constructing a macadam road as described above. He advocated the use of screened material laid in two courses and described the use of clay for a binder and the use of a peg tooth harrow for mixing or dragging the clay into the gravel. Then a grader is again used for smoothing up the surface and it is then thoroughly rolled. Large stones are thrown out as fast as they appear on the surface during the harrowing. Water is put on to soak up the clap in the binder, but not enough to soften the subgrade. The first course consists usually of 3 in. gravel with clay binder and the second of 1½ or 1¾ in. gravel topped with fine material. Crushed and screened gravel roads were defined as roads made of material from pits which contained a large amount of stone from 3 ins. to the size of a man's head.

For keeping the cost data on the work a set of forms is prepared by the commission, and this was explained to the County Highway Commissioners by Mr. Hirst, chief engineer. The report sheets consist of a daily time sheet and weekly summary, prepared by the road foreman, several forms of requisition for materials, for payment of wages, etc., and forms for use of the county highway commissioner in keeping a record of money paid out and a final form showing the unit cost of work, total work and money expended, which is submitted to the chief engineer. These reports are made for each road and the work is classified as earthwork, culverts, gravel or materials (delivered) and laying. These four classifications are made to embrace the whole cost of any one road job. In discussing various items which would come up for classification the removal of plant was mentioned. This was to be charged to its division of the work in arriving at unit costs. It was the general opinion that the cost of moving should be charged half to the preceding job and half to the new job, in order to balance up the costs between long and short hauls and satisfy tax payers in the different towns contributing to the work. The cost of moving 21 times in Sauk County cost $2,000, while in La Crosse County it was estimated by the commissioner that the cost of moving was about $30 per move.

The plans made by the engineering department of the commission for the construction of roads were explained by Mr. Hirot and their use by the commissioners was described. They consist of a plan and profile to be followed and show the simple scheme of staking out the work in the field as done by the engineers for service of the commissioners.

Mr. M. W. Torkelson, bridge engineer of the commission, read a paper on "State and County Aid Bridge Construction."

The meeting was attended by about 200 commissioners and other delegates. The meeting was very successful and showed throughout the earnest attention and enthusiasm.

The legislature has increased the state aid appropriation for this year from $350,000 to $800,000, which, with the county and town portions, makes $2,500,000 available for this year's work. About $500,000 will be spent in Milwaukee County.

Construction Work in South Australia.—A loan bill was recently passed in the South Australian Parliament for expenditure of $28.845,000 for carrying out various works in South Australia, as follows: Railways—Rolling stock, locomotives, machinery and appliances for locomotive work shops, etc., $3,200,000; railway construction, $8.800,000. Harbors—Outer harbor and deepening and improvement of harbors at Port Adelaide, Port Pirie and at outposts, $2.000.000; Murray River improvements, $600.000. Water supply work in districts of country, Beetalo, Bundaleer, Barossa, Millbrook, and Warren, $4.000.000. Drainage works—Drainage works in the southeastern district, $250.-000; Adelaide sewers, including Port Adelaide and Semaphore district, $250.000. Jetties and lighthouses, $300.000. Buildings—Erection of school houses, $250.000; explosives, magazines, $10.000; produce stores at Port Adelaide, $100.000; Parliament buildings, $125.000. Miscellaneous works—Irrigations and reclamation of swamp land, $1.240.000; land repurchase, etc., $1.200.000; advances to settlers' and home funds, $6.200.

Bridge Construction in Tokyo.—The municipality of Tokyo, Japan, is planning extensive repairs or rebuilding of 47 bridges. At least two new bridges will be built, one 105 ft. long and 72 ft. wide, costing about $89,000; the other 102 ft. long and 72 ft. wide costing about $77,500. Concrete bridges built by American firms have given satisfaction in Japan and the use of concrete in structural work, particularly in government buildings, seems to be increasing in favor.

PERSONAL

Mr. William D. Sohier was reappointed by Governor Foss as a member of the Massachusetts State Highway Commission.

Mr. M. B. Germond, for two years City Engineer of Roseburg, Ore., has been appointed General Road Engineer for Douglas County, Oregon.

Mr. George N. Brown has been elected Superintendent of Public Works for Princeton, N. J. Mr. Brown is a member of the civil engineering firm of Brown & Tobish.

Mr. W. C. Drake, formerly superintendent of the water and light plant at Terrell, Texas, has been appointed superintendent of the water and light plant of Greenville, Texas.

Mr. Watson Townsend has been appointed city engineer for Omaha, Neb. Mr. Townsent was formerly assistant engineer for the Minneapolis, St. Paul & Sault Ste. Marie Ry., and later for the Union Pacific Ry.

Mr. Thomas E. Collins, who was Assistant Engineer on the revaluation of railroads and canals for the state of New Jersey has been elected city engineer of Elizabeth, N. J., succeeding Mr. W. H. Luster, who recently resigned.

Mr. F. P. Parr was appointed as permanent engineer for the municipality of Kildonan, Manitoba. Mr. Parr, who came to America from England last August, has had wide experience in road, sewer and bridge construction.

Mr. John M. Goodell, of the Engineering Record, and a consulting engineer of New York City, delivered a lecture on "Essentials of Technical Writing" before the graduate students in highway engineering, Columbia University, Feb. 20.

Mr. Morris L. Cooke, director of the Department of Public Works, Philadelphia, delivered a lecture, Feb. 18, on "Scientific Management as Applied to Highway Engineering" before the graduate students in highway engineering at Columbia University.

Professor Frank Soule, emeritus professor of civil engineering at the University of California, died at his home in Berkeley, Cal., Feb. 14, aged 68. Professor Soule has been connected with the department of civil engineering at the university since its establishment in 1872.

Mr. Richard Wilson of the Cowan Construction Co., of Winnipeg, Can., died at his home in Winnipeg, Feb. 15, aged 54. Mr. Wilson was a native of England, but had been in western Canada since 1882, and has been engaged in railway construction work all through that country. He has been sub-contractor for the Cowan Co. for nine years past.

Mr. William Horrigan, president of the Horrigan Contracting Co., has formed a partnership with Mr. Harry L. Maier, first assistant engineer of the Street and Sewer Department, Wilmington, Del., for a consulting engineering practice. The name of the firm is Maier & Horrigan, and the offices are in the Ford building, Wilmington. The firm will specialize in municipal improvements and preparation of reports on public utilities.

Mr. Robert D. Hennen, Civil Engineer, and Mr. G. B. Hartley, Civil and Mining Engineer, have combined their offices under the firm name of Monogahela Valley Engineering Co., Mr. Hennen removing from the Farmers & Merchants Bank Bldg. to the third floor of the Brock, Reed & Wade Bldg., Morgantown, W. Va., where the firm occupies the offices formerly occupied by Mr. Hartley. The firm will engage in the practice of general engineering.

Mr. William Danforth of the firm of Fraser & Danforth, was elected president of the Minnesota Society of Surveyors and Engineers at their recent meeting in St. Paul. Mr. Danforth has long been engaged in railway engineering and construction work, and has been city engineer of Red Wing, Minn., and of Eau Claire, Wis. The senior member of the firm, William C. Fraser, formerly city engineer of Rorchester, Minn., is the retiring president of the society. Mr. William F. Brooks of Mankato, Minn., is elected vice president and Mr. Charles A. Forbes, secretary and treasurer.

Mr. A. S. Cheever, for many years superintendent of the Fitchburg division of the Boston & Maine R. R., and more recently assigned to special duty under Mr. A. J. Horn, operating vice-president of the Boston & Maine system, died suddenly at his home in Somerville, Mass., Feb. 17, aged 56. Mr. Cheever was born in Chelsea, Mass. He entered the railroad service in 1880 as clerk in the general superintendent's office. He soon became an assistant engineer, and in 1887 was made division engineer. In 1890 he became chief engineer of the Fitchburg division, and in 1900 was made assistant chief engineer of the entire system.

INDUSTRIAL

Mr. F. H. Allison has been appointed General Purchasing Agent in charge of all office and factory supplies for the American Vanadium Co. and the Flannery Bolt Co.

Owing to the increased amount of business handled by its New York office, the Blaw Steel Construction Co. has moved its present suite on the 10th floor of 165 Broadway to a considerably larger suite on the 15th floor.

The Raymond Concrete Pile Co. of New York and Chicago, through its northwest office at Portland, Ore., has been awarded the contract for placing standard Raymond concrete piles for the foundation of the new freight house at Seattle, Wash., for the O. W. R. R. & N. Co.

CATALOGUES

Rock and Crusher Handling Machinery.—Paper, 6x9 ins., 40 pp. T. L. Smith Co., Milwaukee, Wis.

This catalog illustrates and describes the Symons Rock Breakers for stationary and portable equipment; also cylindrical screens and portable stone bins. The Smith Jaw Crusher is also shown. Line drawings are given showing the general dimensions of both crushers. The Symons Gyratory Crusher is of a new type in which the main shaft is stationary.

Wood Water Pipe.—Paper, 6x9 ins., 60 pp. Eastern Manufacturing Co., 557 E. Clinton St., Elmira, N. Y.

Illustrations and descriptions of wooden water pipe, showing its manufacture and its use, are given in this catalog. There is also considerable information useful in the design of pipe for various capacities and pressures. Tables and specifications are given.

Cold Weather Concreting.—Paper, 6x9 ins., 12 pp. Universal Portland, 72 W. Adams St., Chicago, Ill.

This book is entitled "Concreting in Cold Weather" and is prepared especially for the farmer and rural contractor. It outlines methods whereby concreting can be carried on throughout the winter months, making possible much new construction at a time when rural labor would be otherwise unproductive.

A Dynamite Test.—Paper, 5¼x7½ ins., 44 pp. Independent Powder Co., Joplin, Mo.

This booklet contains the description of a remarkable test of a permissible powder (Bental), made at Mine No. 7 of the Girard Coal Co., Bradley, Kan.

Portable Drilling Rigs.—Paper, 6x9 ins., 16 pp. Sullivan Machinery Co., People's Gas Bldg., Chicago, Ill.

This bulletin describes the Sullivan Portable Drilling Outfits, designed for removing rock in highway construction, trenches for sewer pipes and water mains, blockholing in stone quarries and other work in which the rock to be excavated is scattered and too small in quantity to warrant a fixed compressor and drill plant.

Studebaker Dump Wagons.—Paper, 8x9 ins., 10½ ins., 20 pp. The Studebaker Co., South Bend, Ind.

Catalog 805 shows the details of construction of Studebaker Dump Wagons and illustrates a number of types of dump bodies. Two-wheel carts are also shown.

Channon's Review.—Paper, 6x9 ins., 32 pp. H. Channon Co., Chicago, Ill.

Handling Coal in Modern Boiler Room is the title of the article contained in this issue of the Review.

Baker Road Machinery.—Paper, 6x9 ins., 64 pp. Baker Manufacturing Co., 337 W. Madison St., Chicago, Ill.

This catalog contains a number of interesting illustrations showing the methods of preparing country roads and the machinery which is used for road making. The catalog includes ditchers, graders, drags, floats, rollers, scarifiers, corrugated culvert forms, plows, slip and wheel graders, grader plates, dump wagons and hand tools for street cleaning, gasoline-kerosene tractors, concrete mixers, etc.

Westrumite Asphalt Pavements.—Paper, 6x9 ins., 32 pp. The Westrumite Co., Whiting, Ind.

Westrumite Pavements are laid cold. This is described in the catalog which shows a number of illustrations of Westrumite Pavements completed and under construction.

Kissel Kar Trucks.—Paper, 6¼x9¾ ins., 32 pp. Kissel Motor Car Co., Hartford, Wis.

This catalog illustrates and describes Kissel trucks for various services from ¾ ton to 5 ton capacity.

Speedwell Motor Trucks.—Paper, 6x9 ins., 16 pp. Speedwell Motor Car Co., Dayton, O.

This catalog illustrates and describes the Speedwell trucks which are built in three models of 2, 4 and 6 tons, respectively. Complete specifications are given accompanied by illustrations.

White Trucks.—Paper, 4x9 ins., 20 pp. The White Co., Cleveland, O.

This catalog illustrates and describes the end dump and side dump White heavy service trucks. The truck illustrated shows the handling of clay, crushed stone, etc.

Schub's Metal Molds.—Paper, 9¼x11¼ ins., 4 pp. C. H. Schub, 1947 Broadway, New York City.

Pamphlet No. 107 gives an illustration of a monolithic concrete residence, elaborately decorated. It is built with Schub's Unit System of Interchangeable Metal Molds.

Electrical Machinery.—Paper, 8x10 ins. General Electric Company, Schenectady, N. Y.

The following bulletins are the latest publications issued by the General Electric Company. Bulletin A4072, 24 pp. This bulletin is in colors and contains reproductions and photographs of signs of various styles and sizes located in different cities of the United States, and describes different lamps used in connection with this method of advertising.

Bulletin A4070 illustrates and describes the electrically operated remote control switch, Type R, Form C2. Bulletin A4083 covers Type US-13 Roller Bearing Trolley Bases. Bulletin A4086 is devoted to the subject of Circuit Breakers for Railway Service, Type MR. It supersedes the company's previous bulletin on this subject. Bulletin A4081, Reversing Motors for Planers, Slotters, etc. Bulletin 4085 describes the company's Battery-Charging Motor-Generator Sets for railway signaling.

RAILWAYS

Alabama.

The Northern California Railroad & Navigation Co. has been incorporated with a capitol stock of $1,100,000. The incorporators are George W. Bartle, Oscar G. Bartle, J. D. Rhodes, Swin Swinson, Roy H. Hayworth and M. C. Messick.

A survey had been completed for the construction of a new railroad from a point on the Birmingham & Southeastern, 6 miles from Tuskegee, Ala., through that place and on to Dadeville, and it is expected that grading will be started soon. This road will ultimately be extended to Anniston, directly connecting Tuskegee with both Anniston and Birmingham.

Information has been given out at Birmingham, Ala., that the Louisville & Nashville R. R. intends constructing another line from Calera, 30 miles south of Birmingham, to near the gulf, saving 43 miles in the distance from Birmingham to New Orleans and cutting down the distance from Birmingham to Pensacola. The work is not to be attempted during the early part of this year, and probably not this year, all attention being given to the double tracking work from Nashville to Calera, through Birmingham.

Arizona.

The Southern Pacific Ry. Co. is said to be contemplating the construction of a new cutoff through Box Canyon in Arizona. No definite information concerning this improvement has as yet been obtained.

Arkansas.

The first 12 miles of the line now under construction by the Ashley, Drew & Northern R. R. has been completed, and it is expected to have trains operating into Monticello, Ark. It is rumored that the company now contemplates the extension of the road to Sheridan, Ark. R. O. Roy, Monticello, Ark., is President and General Manager of the company.

California.

Construction work has been started by the Santa Fe System on a branch line from Oceanside through the San Luis Rey Valley. According to present plans, the line will be constructed this year as far as Bonsall, about three miles south of Fallbrook.

The Glendale & Eagle Rock Ry., M. V. Hartranft, President, Los Angeles, proposes the construction of five miles of electric railway from Glendale to Los Angeles Blvd., at the new town of Montrose, in La Crescenta Valley. About $65,000 is to be expended.

It has been announced that bids for the construction of the Southern Pacific passenger station, Los Angeles, Calif., will be asked on or about March 15 and that actual construction work will be commenced about May 1. The new station building, with its track accessories, will cost around $750,000. It will face Central Ave., where the Southern Pacific has 800 ft. frontage on either side of Fifth st. Arrangements are being made with the city whereby Fifth St., from Central Ave. to the entrance to the present station, will be turned over to the railroad company.

The Northern Electric Ry. Co., E. R. Lilienthal, President, Alaska Commercial Bldg., San Francisco, has extensive construction plans under consideration. These include the building of 349 miles of new line, including the following: From Sacramento through Woodland, Arbuckle and Colusa, to Hamilton city, 108 miles; from Chico to Red Bluff and Redding, 76 miles; from Vallejo through Napa, Cordelia, Fairfield, Cement, Davis and Broderick to Sacramento, 62 miles; from Fairfield to Suisun, branch line of two miles; from Suisun through Vacaville and Winters to Woodland, 35 miles; from Davis to Woodland by a circuitous route, 17 miles; from the main Vallejo-Sacramento line a branch to Dixon, three miles; from Sacramento to Folsom, 20 miles; from Colusa to Yuba City, 26 miles.

Colorado.

Engineers of the Denver & Rio Grande R R. are said to have started preliminary work on the proposed new line from Trinidad, Colo., to Cokedale. It is also rumored that the company contemplates the removal of the shops from Elmora to Trinidad.

Articles of incorporation have been filed at Dover, Del., by the Colorado Mines, Railways & Utilities Corporation, with an authorized capital of $25,000,000, shares of the par value of $5 each. It was filed through the Registry & Transfer Co. of New York City. The incorporators are Clarence J. Jacobs, R. Boyd Cooling and Harry W. Davis, all of Wilmington, Del. The company will take over the Golden Cycle & El Paso mines. From the title it would appear that the concern will be permitted by its charter to own and operate railroads, as well as mines and mills, but the fact that it will for the present issue only $10,000,000 of the authorized capitalization of $25,000,000 indicates that the promoters have no immediate intention of invading the railway field. Allen L. Burris, President of the El Paso company, will be elected President of the new concern. Joseph C. Helm of Denver has been retained as General Counsel and Richard A. Parker, formerly associated with Cecil Rhodes and John Hays Hammond in connection with the Goldfields Consolidated of South Africa, has been appointed Consulting Engineer. John H. Nichols, Superintendent of the El Paso, will be the Engineer in charge of the development work on all the properties.

District of Columbia.

The Capital Traction Co., 36th and M Sts., N. W., Washington, D. C., is reported to be considering the construction of a street railway line on 17th St. from U street to Pennsylvania Ave. and on 18th St. west from G St. southward to and into Potomac Park.

Florida.

The Jacksonville-St. Augustine Public Service Corp. is reported to have completed arrangements for placing a $2,000,000 bond issue with English capitalists, and it is stated that construction work on its projected electric railway will be started by May 1. The company plans to build about 55 miles of line, extending from South Jacksonville to St. Augustine. Amos W. Corbett, St. Augustine, Fla., is President; Thomas R. Osmond, St. Augustine, is General Manager.

Georgia.

Regarding the proposed terminals of the Central of Georgia Ry. at Macon, we are advised that plans for this have not yet been completed. Nothing further than studies, showing proposed location of station and tracks, have been prepared.

Illinois.

The Chicago, Rock Island & Pacific Ry. is contemplating the construction of some second track during the present year but the amount and location have not been decided upon.

Promoters of the proposed steam railroad to extend from Reynolds, Ill., to Muscatine, Ia., have placed maps and blue prints of the proposed route on display in the windows of the banks at Muscatine, Ia.

Engineers who have been working out of Freeport, Ill., west, resurveying the line of the Illinois Central, have established new headquarters at Dubuque, Ia. It is believed that work on change of grade and alignment will be started soon.

The Tri-State Traction Co., projecting a line from Hamilton to Warsaw and Quincy, has partially completed its surveys and has secured part of the construction capital. No date has been set for letting construction contracts. R. O. Marsh, Warsaw, Ill., is Chief Engineer and President.

The Alton & Eastern Electric Ry. Co. has secured the capital for a proposed extension of about 1 mile from the Alton City limits to site of new insane asylum. The construction work will be done by company forces. L. C. Haynes, Alton, Ill., is President.

The Santa Fe System will make the following minor improvements along its lines: Albuquerque Division, between Crookton and Ash-Fork, estimated cost $25,131; Arizona Division, constructing a second main track through the yard at Needles, estimated cost $89,275; rebuilding bridge No. 576, estimated cost $2,533; Illinois Division, Joliet, Ill., renewing water proofing on track elevation bridges, estimated cost $7,123; Galveston Division, provid-

Indiana.

The Vincennes North & South Traction Co. has applied to the City of Vincennes for a franchise. This company proposes a line from Vincennes to Indianapolis by way of Bicknell, Sullivan, Clay City, Linton, Cataract in Owen county, Eminence in Morgan county, and Mooresville. Gilmer Bray is interested.

Iowa.

The United Light & Ry. Co., Chicago, Ill., has acquired the Mason City & Clear Lake Ry. (electric) and the light, heat and gas plants at Mason City.

The Chicago, Rock Island & Pacific Ry. is to expend about $300,000 for improvements on the east side of Des Moines. These will include a roundhouse, repair shops and railroad yard.

The Chicago, Rock Island & Pacific Ry. will this year lay 100-lb. rails from Metz to Valley Junction, 30 miles. The same improvement is to be made to a 38-mile stretch of road between Avoca and Council Bluffs. The work will include the complete reballasting of the tracks to be improved.

The Chicago, Milwaukee & St. Paul Ry. will probably expend about $1,500,000 this year on third track work between Savanna and Chicago.

S. G. Durant, Dyersville, Ia., President of the Iowa Northern R. R., 7 miles of which is now in operation between Dyersville and New Vienna, is promoting a new line to the south. The new line would tap the Great Western and Illinois Central lines, probably at Dyersville.

Kentucky.

Work is progressing nicely, according to advices from Bristol, Tenn., on the extension of the Carolina, Clinchfield & Ohio R. R. to Elkhorn City, Ky., where a connection will be made with the Chesapeake & Ohio. The work will cost $6,000,000 and when completed will include tunnels, one of which will be 2 miles long. Ward Crosby, Johnson City, Tenn., is Chief Engineer.

The Rock Castle R. R. Co., of Livingston, has been chartered with a capital stock of $10,000, the incorporators being N. U. Bond, Oakland, Md.; H. W. Bowman, Livingston, Ky.; C. C. Williams, J. W. Brown, W. L. Richards and E. S. Albright.

The Louisville & Nashville R. R. has surveys under way at Lexington, Ky., for the purpose of enlarging its yards. An expenditure of about $500,000 is proposed for the enlargement of terminal facilities at that place.

Louisiana.

The New Iberia, Lafayette & Northwestern R. R., H. A. Genung, President, New Iberia, La., has completed its surveys, and it is hoped to close a deal within 60 days whereby the company will be in shape to receive bids on the work.

The Southern Pacific, according to reports, is contemplating the construction of a line from Port Barre, La., on the New Iberia-Beaux Bridge line through St. Landry Parish and Avoyelles Parish, to Moreauville and Marksville. As soon as this line is completed the tracks will be extended through La Salle, Caldwell and Ouichita Parishes to Monroe, traversing one of the richest sections of the state of Louisiana.

Surveys have been completed for the proposed line of the New Iberia & Gulf Ry. from New Iberia, La., to the salt miles at Weeks Island. Construction work will be started within 30 days. Right of way has been secured for some time. Henry J. Cox & Co., New Iberia, La., are the engineers and constructors.

The North Louisiana Electric Ry. Co., which filed its charter two weeks ago, proposes the construction of a 100-mile line from Shreveport to Monroe via Minden, Homer and Ruston. The company will have a capital stock of $1,000,000, and will be financed, it is understood, by the business men along the proposed route in conjunction with a group of Chicago capitalists. The officers named in the charter are A. B. Blevins, of Shreveport, president; A. Kinnebrew, of Homer, vice-president, and Glenn H. Walker, of Shreveport, secretary-treasurer. Major A. B. Blevins, president of the new company, is the promoter of the Louisiana-Texas interurban line which was granted a franchise by vote of the people of Shreveport some weeks ago. It is stated that all of the plans for the building of Louisiana-Texas line are now practically complete and work will be started on the construction of the line in the immediate future.

Massachusetts.

The Boston & Albany R. R. is reported to have negotiations under way for securing additional lands at Springfield, Mass., for the establishment of a large freight yard at that city.

The Massachusetts Northern Rys., J. A. Taggart, General Superintendent, Greenfield, Mass., is planning to begin work in the spring on the construction of its connecting electric railway between Orange and Millers' Falls.

The New York, New Haven & Hartford R. R. has completed surveys for a short extension of its Hanover Branch to a connection with the South Shore Division at Greenbush. It is expected that application will be made shortly to the State Railroad Commission for permission to make the extension.

Michigan.

A conference was recently held by the stockholders of the proposed Battle Creek, Coldwater & Southern R. R., with F. F. Walker, Manager of the Bond Department of the National Trust & Credit Co., Chicago, Ill., regarding the financing of the road. The initial capital is $300,000 and it is planned to increase the capitalization and go ahead with the construction of the line connecting Battle Creek and Coldwater, Mich.

It is practically assured that the Grand Rapids & Northwestern R. R. Co. will commence active construction shortly on the proposed line between Grand Rapids, Mich., and Ludington. The company plans to market immediately $3,500,000 of bonds to finance the work. It is reported that a contract has been placed with the Great Lakes Engineering Co., Detroit, Mich., for the construction of three car ferries. At the annual meeting of the company, just held, the following were elected officers: President, J. M. Tittemore of Chicago; Vice President, Walter S. Syrett of Chicago; Treasurer, S. M. Earling of Chicago; Chairman of the Board of Directors, Marshall F. Butters, Ludington; General Counsel, George Clapperton of Grand Rapids. ing improved fuel oil facilities at Galveston, estimated cost $6,513; constructing septic tank and sewer line, estimated cost $1,413, and rearranging the 42nd St. yard, estimated cost $62,975; extending the passing track and constructing a storage track at Bay City, estimated cost $8,356; Kansas City Division, making improvements on the elevator at Argentine, estimated cost $322,226; raising the grade and rearranging the tracks in connection with the new Kaw River dike, estimated cost $109,000; Los Angeles Division, increasing the trackage at the material yard at National City, estimated cost $11,158; installing automatic block signals between Keen Brook and Summit, estimated cost $20,176; building a new wheel shop and necessary tracks at San Bernardino, estimated cost $27,990; Missouri Division, constructing a new reservoir and baring, estimated cost $83,023; Lexington Junction, extending trackage facilities $13,010; Northern Division, constructing a fuel oil track at Ardmore, estimated cost $2,021; driving sheet piling to protect reservoir at Byars, estimated cost $9,322; Rio Grande Division, extending the side track at Ernest, estimated cost $1,600; extending the mine track and providing a new scale track at Hanover, estimated cost $20,276; Southern Division, repairing the dam at Clifton, estimated cost $1,522; purchasing a new locomotive train at Summerville, estimated cost $8,000; constructing a new stock yards track at Temple, estimated cost $2,888; Valley Division, replacing bridges 1181 and 1087, estimated cost $6,800; installing improved water facilities at Richmond, estimated $10,995; constructing a new pavement at Hanford, $1,890.

Minnesota.

The Minnesota & International Ry. will, as soon as the weather permits, relay with new steel 25 miles of the road at various points between Brainerd and Bemidji. The former 56-lb. rails will be replaced with 72-lb. steel.

Montana.

The Great Northern R. R. Co. has completed arrangements for extending its line on east of Lewistown, Mont. Permission has been secured from the Council to cross Main St. near the mill, and the rails will go down to the tunnel sites, several miles east of town. The tracks will be continued on from the other side of these sites and pushed on to Grass Range. When the tunnels are completed next fall, they will connect with tracks laid on each side of them. Engineer George Eddy, who succeeds Engineer P. S. Hervin, promoted to Minot, is already in charge of Lewistown.

Nebraska.

Preliminary route has been selected for a projected 32 mile railroad west from Hemingford, Neb., and negotiations are under way for securing the construction capital. The company to operate the line has not been organized as yet. K. L. Pierce, Hemingford, Neb., is interested.

Articles of incorporation are to be filed shortly by the Hemingford & Western R. R. recently organized to construct a railroad from Hemingford, Nebr., to Eastern Wyoming. D. W. Butler, Hemingford, Nebr., has been elected President and General Manager.

Residents from all southern Holt and northern Wheeler and Garfield Counties recently held a mass meeting at Chambers, Nebr., for the purpose of taking action to induce the Chicago, Burlington & Quincy R. R. to build a railroad through that territory.

Nevada.

A project is under consideration for the construction of an electric tramway for the transportation of ore and supplies from Oreana to Rochester. Joseph Nenzel, Reno, Nev., is interested.

New Hampshire.

A bill is before the State Legislature providing for an extension of the Sullivan County R. R., a subsidiary of the Boston & Maine R. R., from Windsor to Cornish, N. H., and thence to Hartland. Such an extension of trackage would parallel the existing lines of the Central Vermont R. R., which the Boston & Maine R. R. at present uses between Windsor, Vt., and White River Junction, Vt.

New Jersey.

The American Railways Co. of Delaware has been incorporated to carry on the business of constructing and equipping railroads of all kinds. The company's property is to be operated wholly without the state of Delaware. The capital stock is $25,000,000. The incorporators are Charles U. Martin, J. F. Shrader and George S. Stein, all of Philadelphia, Pa. This company was chartered in New Jersey in 1899. The new charter is stated to have been taken as a precautionary measure, so that if it is found that the business cannot be transacted under the restrictive clauses of the New Jersey legislation, the charter in that state will be surrendered.

New York.

Track paving and re-routing improvements contemplated by the International Railway Co. will cost, according to reports from Buffalo, N. Y., about $2,700,000. T. W. Wilson, Endicott Square, Buffalo, N. Y., is General Manager of the company.

North Carolina.

The Kinston Carolina R. R. & Lumber Co., C. T. Williard, President, Norfolk, Va., has purchased and will operate the Kinston & Snow Hill R. R., a 15-mile line.

Surveys are reported under way for an extension of the Durham & Southern Ry., J. E. Stagg, Vice President, Durham, N. C., into Sampson.

The Virginia & Eastern Carolina R. R. Co. will probably let contracts in about 60 days for the construction of its proposed line from Henderson to Wilson or Rocky Mountain, N. C. J. C. Cruikshank, Henderson, N. C., is Chief Engineer.

The Raleigh, Western & Atlantic R. R. Co. has applied for a charter and the bill is now pending in the General Assembly. The company will not be organized until after the charter is obtained. It is proposed to build a connecting line between the Atlantic Coast Line and the Norfolk & Western R. R. As projected, the line will be about 52 miles long. James H. Pou, Raleigh, N. C., is interested.

North Dakota.

⊙The Cook Construction Co., St. Paul, Minn., has been awarded the contract by the Northern Pacific Ry. for grading of the line from Stanton west up Knife River and Spring Creek, a distance of 68 miles.

⊙The Cook Construction Co. of St. Paul, Minn., has secured the contract for another 100 miles of line on the north branch of the Northern Pacific, from Stanton. The line at present runs to Stanton, in Mercer County, and will be extended up the Knife River to the south end of the Kildeer Mountains. All sections of the line near the river will be riprapped.

Press reports state that the Great Northern Ry. contemplates purchasing the Northern Pacific line from Carrington to Turtle Lake, N. Dak., and constructing an extension from Carrington to Glenfield, 20 miles distant, on the Fargo-Minot cutoff, and make the line a part of the new extension to Lewistown, Mont. The purchase of this line would do away with about 100 miles of construction work.

Ohio.

⊙The West Virginia & Ohio Construction Co., Dayton or Ashland, O., as previously noted in this column, has the contract for constructing a standard gage railroad from Wellington to Lorain, O., 22 miles, for the Lorain, Ashland & Southern R. R. All of the work will be sublet, but the contractors are not ready as yet to receive propositions from subcontractors.

Oklahoma.

The City Council of Cushing, Okla., has submitted to the vote of the citizens an ordinance granting the Cushing & Oil Field Electric Ry. Co. a franchise to transverse the business district of the city and the oil field at once and for an extension later through Stillwater to Perry. The promoters include C. R. Strong, Clinton, Okla., and T. J. Nance, Clinton, Okla. Both of these men are officials of the Clinton, Oklahoma & Western Ry., a 52-mile steam line.

The promoters of the projected interurban line from Muskogee to Oklahoma City are reported to have made good progress in securing the necessary construction capital. The company is backed largely by Muskogee capitalists. It proposes a line with a 4-hour schedule between the two cities, connecting at Oklahoma City with the interurban west to El Reno and at Muskogee with the one east to Fort Gibson. The plan is to build the power plant either at Muskogee or in the coal fields in the vicinity of Muskogee. The road will enter Muskogee on its own right of way.

Pennsylvania.

⊙The Keystone Contracting Co., Keystone Bldg., Pittsburgh, Pa., has taken sections A and B of the Montour R. R. from McDonald to North Star, Pa., as a subcontract under Mr. John Marsch, Chicago.

⊙The John A. Kelley Co., 512 Pennsylvania Bldg., Philadelphia, Pa., will begin work in about a month on its contract at Kennerdell, Pa., on the Allegheny Division of the Pennsylvania R. R., mentioned in our Feb. 12 issue. This contract calls for grading, masonry, track and double-track tunnel for proposed change of line. It includes 2,000 cu. yds. earth excavation, 200,000 cu. yds. excavation for tunnel approaches, 3,350 ft. of rock tunnel, and 3,400 cu. yds. concrete masonry. None of the work is to be sublet.

Practically all right of way has been secured for the extension of the Pittsburgh, Harmony, Butler & New Castle Ry. (electric), S. H. Waddell, Secretary, 701 Diamond Bank Bldg., Pittsburgh, from Ellwood City to Beaver Falls, and it is probable construction work will be started in the early spring. In connection with the extension the company will erect a bridge over the Beaver River at Rock Point.

The Baltimore & Ohio R. R., F. L. Stuart, Chief Engineer, Baltimore, Md., is reported to have plans under consideration for improvements to be made this year in Somerset County, which will call for an expenditure of about $10,000,000. It is probable that the greater part of this sum will be expended for work on the Somerset & Cambria Division, the main features of which will be double-tracking between Rockwood and Somerset and possibly its extension on to Johnstown via Boswell, Jenner and Jerome.

The Western Allegheny R. R., Van Horn Ely, Receiver, Commonwealth Bldg., Pittsburgh, Pa., is reported to be contemplating building a 7-mile extension from Kaylor, Pa., to the Allegheny River, opposite Mahoning, Pa., where a connection would be made with the Pittsburgh, Shawmut & Northern Ry.

Rhode Island.

The Rhode Island Co., D. F. Sherman, Vice President, Providence, R. I., has made surveys and has the capital for construction of a projected 12-mile extension from Centerdale to Chepachet. The date for awarding construction contracts has not been determined, as a vote of the citizens along the route is yet to be taken.

South Carolina.

According to recent reports from Greenville, S. C., actual construction work will be commenced on the Greenville & Knoxville Ry. extension from that city to Knoxville within 90 days. A number of contractors, including C. W. Lane of Lane Bros., Altavista, Va., recently inspected the route, accompanied by J. R. Cothran, Greenville, S. C., Chief Engineer of the railroad. The road will be built by the Gap Creek route, which will take it by Brevard, but it has been rumored that a route by Asheville and Hendersonville will be surveyed also. The grade for the road by Brevard is only 1.6 per cent.

South Dakota.

James D. Small, Otis Bldg., Chicago, Ill., Secretary of the Midland Continental R. R., according to advices from Leola, S. Dak., recently conferred with the citizens of that place relative to the construction of the proposed road through that city. The company has now in operation a line between Edgeley and Jamestown, N. D., and has let a contract for building an extension 25 miles long north of Jamestown. After that, they expect to build from Edgeley, south to Leola. Mr. Small is now engaged in securing the right of way for the Edgeley-Leola branch.

Tennessee.

Right of way is being secured for the proposed interurban electric line, to extend through Sullivan, Carter and Washington Counties, between Bristol and Johnson City. It is believed that the Tennessee Eastern Electric Co., Benjamin L. Dulaney and New York capitalists are behind the project.

Texas.

Surveys are being made under the direction of A. B. Axtell, C. E., Dallas, for the projected interurban line from Austin to San Antonio via Lockhart and Seguin. John W. Maxey, C. E., Houston, Tex., E. W. Brown, Orange, Tex., and Walter Crawford, Beaumont, are interested in the corporation which proposes to build the line.

It has been announced by Walter H. Denison, General Contractor, that track laying on the Texico cutoff of the Santa Fe will be started about March 1. About 90 per cent of the grade is now completed and ready for steel. The incomplete 10 per cent is between Littlefield and Texico. Ballasting crews will follow the track layers, and when the last rail has been put down the road will be complete to the extent of ballast. The Santa Fe expects to have through-train service by the middle of August.

Plans are understood to have been completed for resuming the construction of the Temple Northwestern Ry., work on which was suspended about two years ago. It is reported that new capital has been interested and that the line will be completed into Gatesville and perhaps beyond that point. The roadbed into Gatesville from Temple has been graded and about four miles of steel laid. The name of the company is to be changed to Temple, Northwestern & Gulf Ry. W. S. McGregor, Temple, Tex., is interested.

Virginia.

The contract for constructing the Richmond, Washington & Chesapeake R. R. from Doswell to Sandy Point, a distance of 80 miles, has not been awarded. It was reported that this work had been let to Lane Bros. Co. Channing M. Ward, 1106 E. Main St., Richmond, Va., is President and Chief Engineer of the railway.

Washington.

Plans have been prepared by W. C. Raleigh, City Engineer, Tacoma, Wash., for a municipal street car line from 11th and A Sts. to the Chicago, Milwaukee & St. Paul Ry. Co.'s dock and shops. The estimated cost is approximately $84,000, and this includes everything to put the line in first-class running condition. The plans provide for a car barn and repair shops, switches, roadbed, trolley wires and the cost of a feeder from the city sub-station. Power would be furnished from the new Nisqually plant.

The engineering department of the Chicago, Milwaukee & St. Paul Ry. is engaged in making plans for the construction of switching and storage yards on the tide flats at Tacoma. It is impossible to say, however, at this writing when bids will be asked for or the work started.

Secretary Fisher of the Interior Department, Washington, D. C., has extended the time originally allowed the Wenatchee Northern R. R. to complete its line through the Colville Indian Reservation, Washington, on condition that the company complete 50 miles from Oroville by June 1 and then complete the line from Oroville to Pateros by Sept. 15, and the whole line by Dec. 31.

West Virginia.

The Trans-Appalachian Ry. Co. has been incorporated with a capital stock of $50,000 and proposes the construction of a line connecting Parkersburg, W. Va., with Covington, Va. As proposed the line would cross the Chesapeake & Ohio R. R. at Marlinton, thence running to Covington. It would be 150 miles in length and traverse some of the rich mining and timber lands in two states. The incorporators are Harrison B. Smith and J. D. Steele of Charleston, H. M. Lockbridge of Huntersville, Charles E. Dice of Lewisburg and R. S. Turk of Staunton, Va.

Wisconsin.

The directors of the Wisconsin & Northern R. R., W. Cambier, Chief Engineer, Oshkosh, Wis., have voted to extend the line southward from Crandon this summer for at least 8 miles. It is probable the line will be completed this year through to Shawano.

Advices from Green Bay, Wis., state that the Chicago & Northwestern R. R. contemplates improvements at that place to cost approximately $350,000. The work will include new roundhouse of 40 stalls, railroad shops, machine shops, coal sheds, etc. W. H. Finley, Chicago, Ill., is Assistant Chief Engineer.

The Chicago & Northwestern is planning the double tracking of its line between Friendship, Wis., and Wyeville according to reports. The work is to be started and rushed through to completion during the present season. W. H. Finley, St. Paul, Minn., is Assistant Chief Engineer.

The Ontario & Northern R. R. Co. has filed with the Register of Deeds a mortgage deed for $75,000 in favor of the Wisconsin Trust Co., Milwaukee, Wis., to protect an issue of first mortgage 6 per cent gold bonds. It is believed that work will be commenced on the line immediately. The officers of the railway company are L. R. Walker, President; C. M. Sandon, Vice President; L. R. Abbot, Treasurer, and E. E. Lord, Secretary, all of Ontario, Wis. The directors are Ed Stackman, E. E. Lord, L. R. Walker, L. R. Abbot, A. T. Saundes, C. M. Sandon, Ontario; E. E. Hill, Wonewoc, and Howard Teasdale, Sparta, Wis.

Canada.

✣Bids will be received until noon, March 1, by T. Martin, Moose Jaw, Sask., Division Engineer, Canadian Pacific Ry., for labor and material for the following buildings: Class A2 Stations at Penzance, Dilke, Froude, Trossachs, Khedive, Ernfold, Hitchcock, Kandahar, Mozart, Plunket, Biggar, Cadogan, Czar, Stranraer, Denzil, Herschel, Sovereign, Rockhaven, Bounty, Rokeby. Boiler and machine shop at Wilkie. Plans and specifications and forms of tender may be obtained by applying to J. G. Sullivan, Chief Engineer, Winnipeg; T. Martin, Division Engineer, Moose Jaw; W. T. Daniel, Resident Engineer, Regina; R. C. Smith, Resident Engineer, Moose Jaw; J. V. McNab, Resident Engineer, Saskatoon.

Advices from Winnipeg, Man., state that the Manitoba Government is planning an extensive scheme of railroad building to serve the northern part of the province, official announcement of which will be made shortly. The proposed lines largely center around La Pas, which is to be the terminal of the two roads from Winnipeg, one on each side of the lakes. Two lines more are planned for New Manitoba to circle Lake Winnipeg and connect with the federal government's Hudson Bay line from the Lake Winnipeg line to Fort Churchill. The government will turn over the work to the Canadian Northern under a mileage bond guarantee.

A bill has been introduced in the House of Commons authorizing the Canadian Pacific to construct five branch lines as follows: From Snowflake, Manitou, westerly 9 miles; from the terminus of the Gimli branch northerly 60 miles; from Cayley, southerly to Burmis; from the Kleinburg-Sudbury branch westerly to a point on the Ontario & Quebec Ry. near Campbellville, and from Montreal, northerly to L'Epiphante, P. Q.

A bill has been introduced in the legislature of British Columbia to guarantee the bonds of the Canadian Northern Ry. for an additional $10,000,000 for terminals. The bill provides for guarantee for terminals to be constructed at Vancouver, Port Mann and Vic-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

toria and for a branch line from Port Mann to a point near Stevenson, on the Fraser River.

Conditions will probably be started early in the spring on the proposed line of the Regina & Moose Jaw Electric Street Ry. Co. J. Friedman, Moose Jaw, Sask., is one of the promoters.

A bill has been introduced in the House of Commons to permit the Imperial Traction Co. to build an extension of its already authorized line from Smithville, Ontario, to Bridgeburg and from Hamilton to Toronto, and giving the company two years to begin construction and five years to complete the work.

The Canadian Pacific Ry. is to expend about $175,000 this season for new yard tracks at Moose Jaw, and $200,000 for new shops.

A bill has been reported to the House of Commons for the incorporation of the Manitoba & Ontario Ry. Co. This company proposes to build a railway from Fort William to Winnipeg, the proposed line to run between the C. P. R. and C. N. R. lines. The Lake of the Woods would be crossed at Falcon Island. The provisional directors of the company are: J. P. Jones, Dr. W. H. Hamilton, J. T. Horne, W. A. Dowar, Fort William, and J. H. Drew of Guelph, Ont. The head office of the company would be at Fort William.

About $16,000,000 is to be expended this season by the Canadian Pacific Ry. on its eastern lines. Of the sum about $10,000,000 will go for work commenced last summer. The greater part of the new work will be double-tracking various parts of eastern lines, which will cost in the vicinity of $6,000,000. The main line from Islington to Guelph Junction on the London sub-division will be double-tracked for a distance of 30 miles, and it is expected the work will be finished by November. It is proposed to double-track between Romford. Another work to be commenced this year is the double-tracking of a small stretch of 15 miles between Agincourt and North Toronto.

ROADS AND STREETS

Alabama.

⊙Nixon & Smith, Wetumpka, Ala., have been awarded the contract by the Commissioners of Elmore County, Wetumpka, for grading, draining and graveling one mile and grading and draining four miles of the Tuscaloosa Road for $5,000. Bids were opened Feb. 17.

The Board of Revenue, Mobile County, Mobile, Ala., has not as yet awarded the contract for furnishing and delivering at Saraland and Dorf Landing on the Southern Railway, approximately 2,500 cu. yds. of clay gravel for road work. All bids have been held in abeyance. Bids were opened Feb. 10.

Arkansas.

The Board of Trade of Paragould, Ark., has declared in favor of the enactment of a special law authorizing the creation of improvement districts for the purpose of issuing bonds to build roads in Greene County, Ark., of which Paragould is county seat.

California.

⊙The City Trustees of Colusa, Calif., have awarded the contract for paving Market St. from A to Third and Eighth to 12th; also Fifth from Oak to Main Sts., to Clark & Henery.

⊙The Parnessa Construction Co., of Los Angeles, Calif., has been awarded the contract for the paving of the streets in the downtown section of Colton, Calif. Work will be started at once.

⊙U. F. Kester, of Salinas, Calif., has been awarded the contract for the construction of the Monterey end of the Coalinga-Parkfield road, for $5,605. The road extends from the Fresno county line to the mouth of Pine Canyon in the Little Cholame Valley, a distance of 3.96 miles. The culverts will be eliminated from the contract.

⊙The California State Highway Commission, Sacramento, has awarded the contract to construct a portion of the main coast line, between Ridgwood and Willitts, a distance of seven miles, to Fairbanks & Baechtel, for $29,958. At the same time the Commission rejected all bids received for building part of the state highway in Butte County, between Lindo channel, a point 1½ miles north of Chico, and the northerly county line, and for the road between San Luis Obispo and Santa Margarita. The lowest bid on the former road was $60,632 and on the latter $52,961.

⊙The City Council of Oakland, Calif., has awarded contracts as follows for street paving: Grove St. from 40th St. to the city line, to the Barber Asphalt Paving Co., for $74,465; Broadway from 34th St. to College Ave., to the Oakland Paving Co., for $72,600; Telegraph Ave. from 40th to 52nd Sts., to Ransome-Crummey Co., for $38,875.

The City Council of Oakland, Calif., has adopted plans and specifications for the following street improvements: W. J. Baccus, commissioner of streets: 83rd Ave., from 14th St. northerly; Foothill Blvd., between 35th and 40th Ave.; Harper St., between 35th Ave. and Minnesota Ave.

The Board of Trustees of Newport Beach, Calif., has started preliminary work to have a paved road constructed from the Santa Ana River bridge to Main St., Balboa, a distance of about three miles. The road will be of a concrete base and asphalt binder.

Petitions have been circulated in Red Bluff, Calif., asking the City Trustees to pave Walnut St. from Main to Jackson Sts.

Mayor J. J. Gill of San Leandro, Calif., has launched a campaign for the calling of a bond election for $30,000. The scheme would appropriate $20,000 for street improvements and $10,000 for the equipment of a modern fire-fighting apparatus and the installation of a fire alarm system.

Colorado.

The Mesa County Commissioners, Grand Junction, Colo., have created the Glade Park road district, to be known as District No. 17.

Delaware.

The Delaware Legislature on Feb. 19 passed a bill authorizing the Town Council of Georgetown to borrow $5,000 for street improvements.

Florida.

✣Bids will be received until 10 a. m., March 4, by Board of County Commissioners, Orange County, Orlando, Fla., for furnishing all labor, material, etc., for the construction of approximately 140,000 sq. yds. of brick paving with all necessary drainage and curbing in Road and Bridge District No. 1, Orange County. Plans and specifications may be seen at the office of the Clerk, B. M. Robinson, and at the office of H. S. Jaudon Engineering Co., Atlanta and Savannah, Ga.

⊙The Board of Public Works of Tampa, Fla., D. B. McKay, Mayor, has awarded the contract for 2,000,000 brick to the Westport Paving Co., of Baltimore, Md., and 3,000,000 brick to the Southern Clay Mfg. Co., of Chattanooga, Tenn. These contracts are in addition to the one recently let to the Westport Co. for 5,000,000 brick.

The Board of Hillsboro County Commissioners, Tampa, Fla., recently held a meeting with the Board of Trade of that city, for the purpose of discussing plans for the laying of brick paving on the principal highways leading out of the city. For paving the three principal thoroughfares leading out of the city for a distance of four miles each, the sum of $205,000 will have to be raised. Brick pavement is proposed.

The Columbia County Commissioners, Lake City, Fla., plan to use all the county prisoners in the building and repair of the road leading into Lake City.

The city of Jacksonville, Fla., rejected all bids received Feb. 10 for the construction of 98,826 sq. yds. of street paving on a concrete base. The work is to be re-advertised. L. D. Smoot is Chief Engineer. H. Gaillard is chairman of the committee on public works.

Georgia.

⊙Lewis & Stafford, Augusta, Ga., have been awarded the contract by the Board of Aldermen, Waycross Ga., for laying 6,000 sq. yds. of asphalt blocks on Albany Ave., and for constructing 4,500 ft. of curbing for $3,790. Bids were opened Feb. 18.

⊙The public works committee of the County Board, Atlanta, Ga., has awarded a contract to Samuel E. Finley for the patroling of 30 miles of macadam and asphalt roads in the county. The roads are to be treated with a liquid petroleum asphalt for $0.06½ per sq. yd. for the first treatment, and $0.03½ per sq. yd. for subsequent treatments.

The Grand Jury of Bartow County, Cartersville, Ga., has recommended that an election be held in that county for the purpose of voting on the issuance of bonds to the amount of $400,000 for the construction of public roadways.

Illinois.

✣The city of Berwyn, Ill., will receive bids until March 4, 1913, for constructing concrete sidewalks in the following streets: 26th St., Hiawatha Ave. to Ridgeland Ave; Ridgeland Ave., 27th Pl. to 31st St.; Ridgeland Ave., 36th St. to 22nd St., comprising 5,000 lin. ft. 5 ft. wide, assessment available $4.368. Plans and specifications on file with A. B. Wolfe, 602 N. Y. Life Bldg., Chicago, Ill. Cash or certified check of 10 per cent must accompany proposal.

✣Bids will be received until 7:30 p. m., March 3, by Matt Berscheid, City Clerk, Joliet, Ill., for furnishing one motor-driven combination ambulance and patrol wagon.

✣Bids will be received until 2 p. m., March 8, by Commissioners of Highways, Lawrence, at their office, Court House, Lawrenceville, Ill., for the grading, draining, graveling, macadamizing and building concrete culverts, retaining walls and otherwise improving what is known as State Road, Mt. Carmel Road and Russellville Road in said Town of Lawrence, according to the plans and specifications now on file with the Town Clerk of said Town of Lawrence, at his office in the court house at Lawrenceville, Illinois, and at the office of J. S. Spiker, civil engineer, at Vincennes, Indiana. The approximate length of said roads to be improved, as aforesaid, is 8½ miles. Money or certified check for $1,000 or ten per cent of the amount of each bid, must accompany each proposal.

✣The city of Berwyn, Ill., will receive bids until March 4, 1913, for constructing concrete sidewalks in the following streets: 26th St., Hiawatha Ave. to Ridgeland Ave., Ridgeland Ave., 27th Place to 31st St., Ridgeland Ave., 36th St. to 22nd St., comprising 5,000 lin. ft., 5 ft. wide, assessment available $4,368. Plans and specifications on file with A. B. Wolfe, 602 N. Y. Life Bldg., Chicago, Ill. Cash or certified check of 10 per cent must accompany proposal.

✣Bids will be received until 8 p. m., March 3, by the Board of Local Improvements, Cicero, Ill., Geo. Comerford, President, for furnishing and delivering labor, materials, etc., necessary to construct concrete sidewalks in the following streets: W. 19th St., W. 21st St. and W. 21st Pl. from 46th St. to 48th Ave. Cash or certified check for 10 per cent of bid must accompany proposal.

⊙The following contracts for furnishing and delivering labor, materials, etc., necessary in the construction of pavements have been awarded by the Board of Local Improvements, Chicago, Ill.: W. 52nd St., Morgan St. to Loomis St., granite concrete combined curb and gutter, 7,320 sq. yds. asphaltic concrete, $18,206.80, R. F. Conway Co., 133 W. Washington St.; 57th St., State to S. Park Ave., granite concrete combined curb and gutter, 9,760 sq. yds. asphaltic pavement, $24,112, F. P. McCormick Co., 133 W. Washington St.; Hoyne Ave., Washington Blvd. to Harrison St., 11,400 sq. yds. asphaltic concrete pavement, $23,280, F. P. McCormick Co., 133 W. Washington St.; Lime St., Archer Ave. to 27th St., gravel concrete combined curb and gutter, 2,920 sq. yds. asphaltic pavement, $6,177.90, F. P. McCormick Co., 133 W. Washington St.; Leland Ave., Claremont Ave. to Sheridan Ave., granite concrete combined curb and gutter, 3,720 sq. yds. asphalt pavement, $9,277.90, F. P. McCormick Co., 133 W. Washington St.; Prairie Ave., Augusta St. to Division St., granite concrete combined curb and gutter, 3,900 sq. yds. asphaltic pavement, $10,126.50, H. G. Goelitz, Oak Park, Ill.; Peoria St., 49th Place to 57th St., granite concrete combined curb and gutter, 4,970 sq. yds. asphalt pavement, $12,223.70, R. F. Conway Co.; Sawyer Ave., Balmoral Ave. to Foster Ave., concrete combined curb and gutter, 3,700 sq. yds. asphalt pavement, $7,660., Central Paving Co., 179 W. Washington St.; Springfield Ave., 15th St. to 16th St., granite concrete combined curb and gutter, 1,950 sq. yds. asphalt pavement, $5,105.30, Standard Paving Co., 9 S. LaSalle St.; St. Louis Ave., Fillmore St. to 12th St., granite concrete combined curb and gutter, 1,700 sq. yds. asphalt pavement, $4,247, Standard Paving Co., 9 S. LaSalle St.; Tripp Ave., Hirsch St. to North Ave., granite concrete combined curb and gutter, 4,100 sq. yds. asphalt pavement, $9,560, F. P. McCormick Co., 133 W. Washington St.; Pensacola Ave., Western Ave. to 540 ft. west of Campbell Ave., Campbell Ave., Pensacola Ave. to Montrose Ave., sandstone curbing, 5,900 sq. yds. asphaltic macadam, $10,948; John McGarry Co., 189 W. Madison St.; Christiana Ave., Elston Ave. to Irving Park Blvd., Kimball Ave., Grace St. to Irving Park Blvd., Bernard St., Elston Ave. to Irving Park Blvd., Eberly Ave., Elston Ave. to Irving Park Blvd., Grace St., Christiana Ave. to Elston Ave., Byron St., Christiana Ave. to Elston Ave., sandstone curbing, 29,900 sq. yds. asphaltic concrete, $44,582, F. P. McCormick Co., 133 W. Washington St. The work includes preparation of the sub grade 6-in. Portland cement concrete foundation, sewer, manhole and catchbasin construction and adjustment, etc. Edward J. Glackin, Secretary of the Board.

⊙Studebaker Corporation. Chicago, Ill., has been awarded the contract by the city of Sioux City, Ia., P. J. Wells, City Clerk, for furnishing one street flushing machine. Bids were opened Feb. 15.

The Board of Local Improvements of Joliet, Ill., has been petitioned for the paving of South Chicago St. and McDonough St. Brick and bituminous concrete are being considered as the material to be used. Wm. S. Welch is secretary.

The Board of Local Improvements of Lincoln, Ill., has adopted a resolution to have an ordinance drafted to pave one block on Broadway, from Kickapoo to Chicago, with creosoted wood block.

The Board of Local Improvements of Waukegan, Ill., has adopted a resolution calling for the paving with asphaltic concrete of Julian, Ash, First and Third Sts. The pavement is to be 30 ft. wide. M. J. Douthitt is City Engineer.

The Street Department, Chicago, Ill., has accepted the bid of H. Levinberg, 1950 Potomac Ave., Chicago, for furnishing approximately 1,400 doz. street brooms at $7.15 per doz. It has been recommended that the contract be awarded.

The City Council of Belvidere, Ill., has passed an ordinance providing for the macadamizing of Whitney St., from Logan Ave. to South St. a distance of 4,746 ft. The total estimated cost is $14,850. The top coating is to be of granite chips with asphaltum binding. The Council also passed an ordinance for the paving of the public alley from State to Whitney Sts., with brick. The estimated cost is $1,200. W. M. Mareau is City Engineer.

Indiana.

✣Bids will be received until 10 a. m., March 14, by Commissioners of Marion and Hendricks Counties, at Indianapolis, Ind., for the construction of free gravel road on Pike Brown township line. W. T. Patten is Auditor of Marion County Indianapolis, Ind., and L. W. Borders is Hendricks County Auditor.

✣Bids will be received until 10 a. m., March 6, by Board of Batholomew County Commissioners, Columbus, Ind., for the construction of macadamized road in Rock Creek township. P. J. Sater is County Auditor.

✣Bids will be received until 10 a. m., March 4, by Commissioners of Howard County, Kokomo, Ind., for the construction of a gravel road in Harrison township. E. B. Swift is County Auditor.

✣Bids will be received until 2 p. m., March 3, by Board of Owen County Commissioners, Spencer, Ind., for the construction of gravel roads known as the W. A. Bucklew et al. and the John Brinson et al. roads. George W. Stwalley is County Auditor.

⊙The County Commissioners, Vincennes, Ind., have awarded contracts for road work as follows: M. A. Downey et al. gravel road, to John C. Rogers, for $7,997; Morton Fox et al. gravel road, to George Morgan, for $5,137; Louis Anleitner et al. gravel road, to H. F. Jones, for $4,490, and Carl Schmidt et al. gravel road, to John Hunckler, for $1,375.

⊙The County Commissioners, Marion, Ind., have awarded the contracts for the construction of four highways in Grant County, as follows: W. K. Frazier road, Van Buren Township—Wimmer & Fox, $6,876. Martin Boots' road or 26th St. of Marion—A. Lindsey, $9,377. Alva J. Atkins road, Monroe Township—Miles & Shaffer, $7,287, and William Greenlee road, Monroe Township—Lora R. Tudor, $7,450.

⊙The County Commissioners, Rockville, Ind., have awarded the contract for the construction of the Peanut Road in Washington Township to J. L. Humbert, for $3,969. Ireland Bros. secured the contract for Parke and Sill Sts., in Rockville, for $1,798.

The Board of Public Works of Richmond, Ind., is asking bids for the improvement of Eighth St., which will include the bricking of the street from North E St. to South H St., and the laying of cement curb and gutter at all places where these improvements have not already been made. Fred R. Charles is City Engineer.

City Engineer Benj. F. Deardorff of Muncie, Ind., has filed his estimates for the cost of making proposed improvements in paving streets as follows: Power St., from Council to Kilgore Ave., $12,377; High St., from Charles south to the alley between Howard and Seymour, $5,728; Franklin St., from Washington to Howard, $10,745; Washington St., from Mulberry to C. I. & E. tracks, $55,913; Jefferson St., from Main to Big Four tracks, $9,157; Madison St., from Main to Kirby Ave., $11,115; Nine St., from Main to Kirby Ave., $1,732; Plum St., from Main to Jackson, $1,444, and Ohio Ave., from Main to Washington, $1,204.

Iowa.

✣Bids will be received until March 3, it is reported, by City Council of Mason City, Ia., for paving Jackson and South Main St.

The city auditor of Waterloo, Ia., is asking bids for the paving of the following streets with asphalt: Fifth St. from Locust to Baird; Baird St. from Fifth to Fourth, and Eighth, Ninth and 10th Sts. from Sycamore to Franklin. C. A. Roby is City Engineer.

✣Bids will be received until 10 a. m., Feb. 28, by Paul J. Wells, City Clerk, Sioux City, Ia., for furnishing all material and labor necessary for constructing paving on Nineteenth St. from the east line of Pierce St. to the west line of Nebraska St., and from the east line of Nebraska St. to the west line of Jackson St., including intersections and spaces opposite alleys, with concrete, in accordance with plans and specifications prepared by the city engineer and on file in the office of the city clerk. Said work shall be completed on or before August 1, 1913. Each bid must be accompanied by a certified check or draft on some bank in Sioux City, Ia., made payable to the city treasurer of said city, in the sum of five per cent of the amount of bid.

✣Bids will be received until 10 a. m., Feb. 28, by Paul J. Wells, City Clerk, Sioux City, Ia., for furnishing all material and labor necessary for constructing paving on Riverside Ave. from the east line of Center St. to the east line of John St., including intersections and spaces opposite alleys, with concrete in accordance with plans and specifications prepared by the city engineer and on file in the office of the city clerk. Said work shall be completed on or before June 1, 1913. Each bid must be accompanied by a certified check or draft on some bank in Sioux City, Ia., made payable to the city treasurer of said city, in the sum of five per cent of the amount of bid.

Kansas.

✣Bids will be received until Feb. 27 by the City Commissioners of Topeka, Kan., it is said, for the construction of 74 blocks of pavement. The cost is estimated at $200,000.

Kentucky.

The Henry Bickel Co., of Louisville, Ky., has submitted the lowest bid to the Board of Public Works of that city, for the paving of Third St. from Broadway to Main St., with asphalt. The bids on this work, as well as other bids on six different lettings, were received Feb. 11. The seven contracts call for approximately 106,235 sq. yds. of material.

The Lexington & Eastern Railroad Co. is preparing to start the work of rebuilding the county roadways in most places along its route in Letcher County, Ky. The first work will be an entirely new road, on a new route, from Mayking via Sergent and Craftsville to Kona.

⊙John W. Blice, of Fredericksburg, Ind., has been awarded the contract by the Board of Harrison County Commissioners, Corydon, Ind., for the construction of a free gravel road, for $6,382. Bids were opened Jan. 13.

⊙The Board of Public Works of Louisville, Ky., D. R. Lyman, Chief Engineer, has awarded the following contracts for the construction of new alleys to cost $33,400: J. W. Gosnell Co.—Two alleys between Magnolia and Hill and Seventh and Ninth Sts.; one alley between Levering and Seventh and Magnolia and Hill; two alleys between Haldeman and Coral and Frankfort and Letterle; one alley between Shelby and Hoertz, north of Burnett; one alley west of Shelby, between Baroness and St. Catherine; one alley between Baxter and Moss Rose and Winzer and Rosewood. Henry Bickel Co.—One alley between Colvin and Maple Sts., west of 18th; one alley between St. Catherine and Oak Sts., east of Brook. L. R. Figg Co.—Alley between 29th and 30th and Kentucky and Greenwood Sts.; alley between 22nd and 23rd and Duncan and Griffiths; alley between 26th and 28th and Kentucky and Greenwood; alley between Gallagher and Bismarck and 17th and 18th; alley between 23rd and 24th and Duncan and Griffiths; alley between 15th and 16th and Oak and Dumesnil; alley between 33rd and 34th and Western Parkway and Rudd. Vitrified brick is to be used in the construction. The board also awarded the contract for the improvement of Broadway, from 32nd to Lincoln Court, to the American Standard Asphalt Co. It will cost $21,107.

Following bids were received Feb. 11 by the Board of Public Works, of Louisville, Ky., D. R. Lyman, Chief Engineer, for street paving contracts, as follows: Letting No. 480, Asphalt Reconstruction, Garvin Pl., Oak to Ormsby—Bickel Asphalt Paving Co. (Trinidad, $5,397; Jefferson County Cons. Co. (California), $5,896; Louisville Asphalt Co. (California), $6,332; American Standard Asp. Co. (California), $6,436; S. S. Saxton Co. (California), $6,688. Oak St., 4th to 7th—Jefferson Co. Construction Co. (California), $12,399; Bickel Asphalt Paving Co. (Trinidad), $12,595; Louisville Asphalt Co. (California), $13,270; American Standard Asp. Co. (California), $13,589; S. S Saxton Co. (California), $15,135. Oak St., Brook to 3rd—Jefferson County Cons. Co. (California), $13,718; Bickel Asphalt Paving Co. (Trinidad), $13,936; Louisville Asphalt Co. (California), $14,687; American Standard Asp. Co. (California), $15,037; S. S. Saxton Co. (California), $16,725. Letting No. 481, Vitrified Block reconstruction, Market, from Campbell to Johnson—G. W. Gosnell Co. (Carlyle), $17,436; Henry Bickel Co. (Peebles), $17,594; F. G. Breslin (Bannon), $19,851. Oak, Logan to Swan—L. R. Figg Co. (Carlyle), $3,002; G. W. Gosnell Co. (Portsmouth), $3,243; F. G. Breslin (Bannon), $3,297; Henry Bickel Co. (Peebles), $3,345. Oak, from 10th to 11th—L. R. Figg Co. (Carlyle), $1,404; G. W. Gosnell Co. (Medora), $1,519; Henry Bickel Co. (Peebles), $1,587; F. G. Breslin (Bannon), $1,606. Market, from 26th to 23rd—L. R. Figg Co. (Medora), $13,288; G. W. Gosnell Co. (Medora), $14,240; Henry Bickel Co. (Peebles), $15,041; F. G. Breslin (Bannon), $15,612. Letting No. 479, Third St., from Broadway to Main, Asphalt Pavement—Bickel Asphalt Paving Co. (Trinidad), $31,176; Louisville Asphalt Co. (California), $32,147; S. S. Saxton Co. (California), $35,903; Jefferson County Construction Co. (California), $36,115· American Standard Asphalt Co. (Trinidad), $36,629. Wood Block Pavement—Bickel Asphalt Paving Co. (Ayer & Lord), $46,493; Louisville Asphalt Co. (Ayer & Lord), $46,545. Vitrified Block Pavement—Bickel Asphalt Paving Co. (Peebles), $28,628; Louisville Asphalt Co. (Carlyle), $29,772. Fourth St., from Jefferson to Market—Asphalt Pavement, Louisville Asphalt Co. (California), $5,331; Bickel Asphalt Paving Co. (Trinidad), $5,776; Jefferson Co. Construction Co. (California), $5,889; American Standard Asphalt Co. (Trinidad), $5,959. Wood Block Pavement—Louisville Asphalt Co. (Ayer & Lord), $6,878; Bickel Asphalt Paving Co. (Ayer & Lord), $6,967. Vitrified Block Pavement—Louisville Asphalt Co. (Carlyle), $4,382; Bickel Asphalt Paving Co. (Peebles), $4,404.

Michigan.

No bids were received recently by the Road Commissioners of Macomb County, Mt. Clemens, Mich., for the construction of 16 miles of highway at an estimated cost of $67,000. The roads are to be built in all townships of the county, except three. It is probable the work will be done by day labor.

Approximate estimates for the improvement of Henry Ave., were recently submitted at a meeting of the Board of Public Works, Grand Rapids, Mich. The estimates call for an expenditure of $11,700 if brick surface is placed on the thoroughfare, and $8,840 if macadam is used. L. E. Stevens is City Engineer.

Minnesota.

✤Bids will be received until 10 a. m., March 3, it is reported, by Board of Ramsey County Commissioners, St. Paul, Minn., for the grading and improving of the Dodd Road. George Ries is County Auditor.

⊙Joseph Baker, of Maple Plain, Minn., has been awarded the contract by the County Commissioners, Minneapolis, Minn., for furnishing the labor and material for graveling 4,007 ft. of Road No. 93, commencing at the intersection of Road No. 23, in the town of Independence. Bids were opened Feb. 3.

The St. Louis County Commissioners, Duluth, Minn., have been asked for an appropriation of $3,000 to complete the Getchell highway, connecting the St. Louis river and Morris roads.

Citizens of West End, Duluth, Minn., will petition the City Commission after April 14 for the paving of several thoroughfares. Some of the streets it is proposed to pave are: First, Third and Fifth Sts., and 23rd and 25th Aves.

Mississippi.

The Yazoo County Board of Supervisors, Yazoo City, Miss., has called an election for March 1 to determine whether or not Yazoo County will issue $300,000 of 4-year bonds for the construction of practically 100 miles of gravel roads in the county.

Missouri.

⊙The Kansas City Terminal Railway Co., Kansas City, Mo., has awarded a contract to E. J. Wetterstrom of Chicago, Ill., and Memphis, Tenn., to furnish approximately $75,000 worth of wood blocks, which are to be laid on all the viaducts erected by that company, about 30 in all.

City Engineer C. E. Phillips, of Springfield, Mo., will prepare plans and specifications for numerous paving, curbing and sidewalk contracts.

Montana.

City Engineer G. C. Pruitt of Miles City, Mont., has prepared a new set of specifications for the Main St. pavement. The Council will select the material from 12 kinds of pavement.

The City Council of Bozeman, Mont., has passed an ordinance creating improvement districts that will provide for the paving of Cleveland St. from Central Ave. to Seventh Ave.

New Jersey.

✤Bids will be received until March 6 by Mayor Henry Hershfield and Council, Borough of Pompton Lakes, Passaic County, N. J., for the construction of sidewalks as follows: Concrete sidewalks to be laid on certain portions of each of the following streets: Wanaque Ave., Hamburg Turnpike, Passaic Ave., Pompton Ave., Barthold Ave., Lenox Ave. and Ramapo Ave. Bluestone sidewalks will likewise be laid on certain portions of Lakeside Ave. The total work to be figured on will be approximately 35,000 sq. ft. of concrete and 10,000 sq. ft. of bluestone together with the necessary grading and filling on each of the above-named streets. Contractors may bid on either the bluestone flags or the concrete sidewalks or on both kinds of sidewalks.

Bids will be received until 8 p. m., March 3, by Town Council, Westfield, N. J., for improving sections of certain streets. The engineer's approximate estimate of the amounts of work to be done is as follows: 500 cu. yds. of earth excavation, 10,100 sq. yds. of water-bound macadam, 5,720 lin. ft. of concrete curb and gutter, 1,370 lin. ft. of stone curb reset, 4,350 sq. yds. of sidewalk dressed for seeding, 370 lin. ft. of concrete culverts, 100 sq. yds. of Belgian block gutter. Each proposal must be accompanied by a certified check for $500 drawn to the order of the Treasurer of the Town of Westfield, N. J., signed by the bidder and without condition or endorsement of any kind, as an evidence of good faith, and the successful bidder will be required to furnish a surety company bond in a penal sum equal to the estimate cost of the work to guarantee the faithful performance of the contract. Forms of proposal, specifications, contract and bond may be obtained from A. W. Vars, Town Engineer, Town Hall, Westfield, N. J.

New York.

✤Bids will be received until 2:30 p. m., March 5, by Charles A. Muller, Commissioner of Public Works, Schenectady, N. Y., for about 100,000 sq. yds. of 6-in. 1-3-6 concrete pavement with a 2-in. asphalt surface. F. E. Johnson is secretary Board of Contract and Supply.

✤Bids will be received until noon, March 4, by Board of Park Commissioners, Buffalo, N. Y., for paving and repaving Niagara St., 36 and 42 ft. wide, from the northerly curb line of O'Neil St., and all necessary connections (exception street and railroad tracks), with dressed block, stone, brick or asphalt, on a concrete base; also, all necessary grading of sidewalks and other work, according to plans and specifications on file in the office of the Park Commissioners, No. 13 City and County Hall. Also, for paving and repaving Lafayette Square with asphalt pavement, on a concrete base; and all necessary connections; and for grading and constructing concrete walks, granite curbing, granite coping, sewers and drains, etc., etc., according to plans and specifications on file in the office of the Park Commissioners, No. 13 City and County Hall. George H. Selkirk is Secretary.

✤Bids will be received until March 4 by Common Council, Dunkirk, N. Y., for cleaning the streets for a period of three years. The city now has 285,000 sq. yds. of pavement, an increase of 100,000 square yards over 1910. The old contract price was $.0216 per square yard per season.

⊙Michael R. Spino, of Fishkill Landing, N. Y., has been awarded the contract for the construction of the new roadway at Quaker Hill in the town of Pawling, N. Y., for $13,775.

City Engineer Geo. W. Hackett, of Utica, N. Y., has completed plans and specifications for the paving of a number of streets, work upon which, it is expected, will begin in the spring. Ordinances are now before the Common Council for the improvements.

The People's Paving Co. of Buffalo, N. Y., on Feb. 14 submitted the lowest bid to the Department of Public Works of Buffalo for the annual contract for repairing sidewalks, as follows: $0.07-98/100 a sq. ft. for sidewalks on a concrete base, 3 ins. deep, and $0.20 a sq. ft. on a 5-in. base.

Plans for 1,000 miles of improved roads to cost about $10,000,000 have been prepared by direction of C. Gordon Reel, state superintendent of highways, Albany, N. Y., under the new $50,000,000 bond issue. The construction of these highways will close up uncompleted gaps in a number of state routes. If the legislature appropriates the money in time the letting of contracts will take place next month so that contractors may have the entire summer and fall for construction. The principal routes to be completed this year under these plans are: From Albany by way of White Plains and along the eastern boundary line of the state to Albany. From New York along the eastern bank of the Hudson through Poughkeepsie, Rhinebeck and Hudson to Albany. From the New Jersey line via West Point, Newburg, Kingston and Catskill to Albany. From Highland Falls through Orange, Sullivan and Delaware counties, Binghamton and the southern tier to Lake Erie. From Kingston via the Ashokan dam and reservoir through the Catskill mountains to Oneonta. From Albany along the barge canal to Buffalo. From Albany through Berne, Cobleskill and Oneonta to Binghamton. From Albany through Saratoga, Glens Falls, Lake George and Plattsburg to the Canadian line at Rouse's Point. From Utica to Watertown. From Niagara Falls through Rochester, Oswego, Watertown and Saint Lawrence, Franklin and Clinton counties, to the Canadian line at Rouse's Point. The Boston post road from New York to Connecticut. On Long Island through the counties of Nassau and Suffolk, via Freeport, Babylon, Patchogue, Riverhead, Centerville and Port Jefferson to the Queens county line. From Nyack through Rockland and Orange counties connecting with Highland Falls—Lake Erie route.

North Carolina.

The Edgecombe County Commissioners, Tarboro, N. C., will submit a bond issue of $200,000 for good roads in that county to a vote of the people this spring.

The Board of Aldermen of Asheville, N. C., has taken steps looking to the extension of Cumberland Ave. to Haywood St. B. M. Lee is City Engineer.

Ohio.

✤Bids will be received until noon, March 7, by W. J. Springborn, Director of Public Service, Cleveland, O., for paving the portion of Lake Ave. N. W., affected by the separation of grades of said street and the tracks of the L. S. & M. S. Railroad. Each bid must be made in accordance with the specifications and plans which may be seen at the office of the Chief Engineer, Room 305 City Hall.

✣Bids will be received until noon, March 12, by Director of Public Service, Newark, O., for the construction of pavement on the following streets: Union St., Maholm St., Granville St., Buckingham St., South Fifth St., and Cedar St. The work will include 51,961 sq. yds. of pavement, 25,143 lin. ft. of curb, 1,694 ft. of edging, 1,020 ft. of curved curbing, 28,240 cu. yds. of excavation. Bids will be received and considered on any kind of pavement when accompanied by complete specifications. C. H. Wells is City Engineer.

✣Bids will be received until 10 a. m., March 3, by Board of Stark County Commissioners, Canton, O., for the construction of the Wooster Road Extension Improvement, in accordance with the plans, specifications and estimates now on file in the office of the Auditor of Stark County. The following are the estimated quantities to be used in constructing said road, viz.: 15,769 cu. yds. grading, including approaches, 41,446 lin. ft. concrete curb (flush), 16 lin. ft. concrete marginal curb, 28,538 sq. yds. 4 in. concrete base, 34,539 sq. yds. 4-in. repressed or wire cut brick pavement with tar filler, 28,538 sq. yds. 6-in. slag base, 990 lin. ft. 18-in. vitrified pipe laid, 300 lin. ft. 12-in. vitrified pipe laid, 51 lin. ft. 6-in. vitrified pipe laid, 30 lin. ft. 10-in. vitrified pipe relaid, 1,772 lin. ft. 12-in. vitrified pipe relaid, 30 lin. ft. 18-in. vitrified pipe relaid, 24 lin. ft. 12-in. cast iron pipe relaid, 50 cu. yds. crushed slag placed, 150 lin. ft. 4-in. vitrified field drain. Each bid must be accompanied by a certified check in the sum of $500, payable to the Board of Stark County Commissioners. J. H. McConnell is County Auditor.

✣Bids will be received until 10 a. m., March 5, by Board of Stark County Commissioners, Canton, O., for the construction of what is known as the Ely Street and Harrisburg Road improvement on Rockhill Ave. to Buckeye Ave. in Lexington Township, in accordance with plans and specifications now on file in the office of the Stark County Auditor. The following are the estimated quantities of work contained in said improvement: 5,522 cu. yds. excavation, including approaches, 3,968 lin. ft. straight 5x18-in. stone curb, 72 lin. ft. circle curb 5x18-in. stone curb, 118 lin. ft. standard marginal concrete curb, 4,120 lin. ft. 4-in. vit. curb drain pipe (if needed), 6,908 sq. yds. 6-in. crushed slag foundation, 6,908 sq. yds. 4-in. vit. block paving cement or tar filler, 4 standard catch basins, 90 lin. ft. 15-in. vit. pipe furnished and laid complete, 247 lin. ft. 6-in. vit. pipe relaid, 5 additional trees removed and destroyed. Each bid must be accompanied by a certified check in the sum of $500, payable to the Board of Stark County Commissioners. J. H. McConnell is County Auditor.

•The Board of Control of Canton, O., has awarded the contract for the paving of a number of streets, as follows: Aultman Ave., Preston Campbell, $20,730; Linden Ave., F. A. Downs Construction Co., $31,431; East Lake St., L. D. Burd, $33,894; Cassilly St., P. J. Hahn, $17,300; Dueber Ave., F. A. Downs Construction Co., $32,257; North Dewalt St., Preston Campbell, $5,435; East South St., P. J. Hahn, $8,368. Cement filler will be used in all the work except in the paving of Deuber Ave. and North Dewalt St., where tar will be used. Metropolitan brick will be used on all the streets except Linden Ave. and Cassilly St., where Big Four block will be used.

•Geo. B. Herring & Son of Cleveland, O., have been awarded the contract for paving North St., in Chardon, O., for $16,119. Brick will be used.

•The White Co., Cleveland, O., has been awarded the contract by the Department of Public Safety, Cleveland, for furnishing two emergency patrols for the Police Department, at $2,425 each. The Peerless Motor Co. secured the contract to furnish three emergency patrols for the Police Department, at $2,200 each. Charles W. Stage is director.

⊙H. F. Green, of Ravenna, O., has been awarded the contract by the State Highway Department, Columbus, O., James R. Marker, Commissioner, for grading and paving with brick for heavy traffic the Ravenna-Youngstown Road, in Palmyra Township, Portage County, for $30,202. The road is 11,960 ft. long and 12 ft. wide. Bids were opened Feb. 19.

⊙Houston & Henderson, of Logan, O., have been awarded the contract for the paving of a number of streets, for $30,000. The work includes 16,500 sq. yds. of paving brick on a 6-in. slag foundation, concrete curbing and 12,000 ft. of 12-in. sewer. Bids were opened Feb. 14.

⊙The City Council of Canton, O., has adopted a resolution ordering the preparation of plans for the paving of Washington Ave. between Cherry St. and Mahoning St. City Engineer Phil Weber has estimated the cost of paving Maryland Ave. at $11,385.

The citizens of Litchfield Township, Medina County, O., on Feb. 18 voted the issuance of bonds to the amount of $50,000 for road improvements. Medina is the county seat.

Plans are now under way at Carey, O., for the paving of Main St. from Wyandot Ave. to the Northern Ohio railroad, about 1½ miles in length. D. C. Angus is City Clerk.

Service Director W. J. Springborn of Cleveland, O., has recommended the paving of Carnegie Ave. with asphalt instead of creosoted wood block.

The citizens of Middlefield, O., will vote March 8 on the proposition to issue bonds to build two miles of 16-ft. roadway this summer, of tar-concrete. B. F. Hewitt, Geneva, O., is Engineer.

Following low bids were recently received by John S. Lewis, Director of Public Service, Youngstown, O., for six street improvement contracts, as follows: Jackson St. paving—Mullen & Quinn, $19,983; Ingles St., paving—James McCarron, $3,319; Pine St., paving—Fleming & Platt, $6,239; Marion Ave., paving—Mullen & Quinn, $6,759.

A committee of city officials of Ada, O., are visiting Cleveland, O., inspecting pavement in that city with a view to adopting similar pavement in Ada. T. J. Smull is City Engineer.

Oklahoma.

Bids for the paving of Broadway Ave. from the M. K. & T. Railroad to Pawnee St. with vitrified brick block will be received by the City Council of Cleveland, Okla., about March 15. The Benham Engineering Co., Oklahoma City, Okla., have been retained to draw plans and specifications and supervise the work of construction.

Petitions are being circulated in the city of Henryetta, Okla., for the paving of the business district, and it is likely that considerable paving work will be done. The Benham Engineering Co., Oklahoma City, Okla., has been retained as Consulting Engineers.

Oregon.

The Jackson County Commissioners, Jacksonville, Ore., have authorized preliminary surveys for an improved road over the Siskiyous, south of Ashland, Ore.

Following bids were received Feb. 14 by the City Council, Portland, Ore., for street improvements: E. 47th St. from Lincoln to Division: Grading and concrete curbs and walks—Cochran, Nutting & Co., $1,759; Linden-Kibbe Construction Co., $1,875; Oregon Independent Paving Co., $1,486. E. 22nd St. from Multnomah to Weidler: Hassam—Oregon Hassam Paving Co., $5,341; asphalt—Barber Asphalt Paving Co., $5,373; Oregon Independent Paving Co., $4,828; bitulithic redress—Warren Construction Co., $4,376; Oregon Independent Paving Co., $4,345. E. 11th St. district: Hassam—Oregon Hassam Paving Co., $6,010; gravel bitulithic—Barber Asphalt Paving Co., $6,593; Warren Construction Co., $6,609; Oregon Independent Paving Co., $6,298. E. 22nd St. from Clinton to Woodward: Hassam—Oregon Hassam Paving Co., $4,247; gravel bitulithic—Warren Construction Co., $4,239; Oregon Independent Paving Co., $3,804. Asphalt—Barber Asphalt Paving Co., $4,598; Oregon Independent Paving Co., $3,996. E. 37th St. from Schiller to Steel: Grading and concrete curbs and walks—Miller & Bauer, $2,558; Joplin & Meeks, $2,666; Oregon Independent Paving Co., $2,215. E. 37th St. from Hancock to the north line of Rossmere: Asphaltic concrete—Montagne-O'Reilley Co., $8,646. Asphalt—Oregon Independent Paving Co., $8,964; Barber Asphalt Paving Co., $10,148. Gravel bitulithic—Oregon Independent Paving Co., $8,485; Warren Construction Co., $9,208. Hassam—Oregon Hassam Paving Co., $9,174. E. 39th St. from Division to Woodward: Asphalt—Barber Asphalt Paving Co., $7,834; Oregon Independent Paving Co., $6,770. Bitulithic redress—Warren Construction Co., $6,482; Oregon Independent Paving Co., $6,425. Hassam—Oregon Hassam Paving Co., $7,778. E. 39th St. from Woodstock to Windsor: Grading and concrete curbs and walks—Manning & Co., $3,082; Keenan Bros., $3,410; Carter Bros., $3,632; Oregon Independent Paving Co., $2,814; Joplin & Meeks, $3,391. E. 49th St. from Hawthorne to the south line of Newport addition: Gravel bitulithic—Barber Asphalt Paving Co., $3,710; Warren Construction Co., $3,595; Oregon Independent Paving Co., $3,352. Hassam—Oregon Hassam Paving Co., $2,666. Bitulithic redress—Oregon Independent Paving Co., $2,863. Concrete—Linden-Kibbe Construction Co., $3,220. E. 49th St. from Newport addition to E. Harrison St.: Linden-Kibbe Construction Co., $949; Cochran, Nutting & Co., $984; Oregon Independent Paving Co., $952. E. 6th St. from Hawthorne to E. Washington: Hassam—Oregon Hassam Paving Co., $19,304. Bitulithic—Warren Construction Co., $20,009. Asphalt—Barber Asphalt Paving Co., $19,261; Oregon Independent Paving Co., $15,589. Asphaltic concrete—Barber Asphalt Paving Co., $15,871. E. 13th St. from Holman to Columbia Heights: Grading and Concrete curbs and walks—Giebisch & Joplin, $610; Bechill Bros., $514; Peterson Bros., $541. E. 64th St. from Sandy to Klickitat: Asphalt—Barber Asphalt Paving Co., $3,643; Oregon Independent Paving Co., $3,113. Gravel bitulithic—Warren Construction Co., $3,208; Oregon Independent Paving Co., $2,943. E. 35th St. from Hawthorne to E. Stark: Asphalt—Barber Asphalt Paving Co., $14,609; Oregon Independent Paving Co., $12,687. Bitulithic redress—Warren Construction Co., $12,023; Oregon Independent Paving Co., $11,783. Hassam—Oregon Hassam Paving Co., $13,242. E. 18th St. from Division to Clinton: Asphalt—Barber Asphalt Paving Co., $4,219; Oregon Independent Paving Co., $3,750. Hassam—Oregon Hassam Paving Co., $3,863. Gravel bitulithic—Warren Construction Co., $3,892; Oregon Independent Paving Co., $3,576. E. 18th St. from Prescott to Mason—Grading and concrete curbs and walks—Bechill Bros., $3,393; Peterson Bros., $2,712; Giebisch & Joplin, $3,175; Oregon Independent Paving Co. $2,527; Joplin & Meeks, $3,171. Congress St. from Portland Blvd. to Morgan St.: Grading and concrete curbs and walks—Bechill Bros., $3,975; Giebisch & Joplin, $4,231; Oregon Independent Paving Co., $3,990. E. 70th St. from Powell Valley road to Foster road: Grading and concrete curbs and walks—Manning & Co., $8,500; Carter Bros., $9,212; Oregon Independent Paving Co., $7,821; Joplin & Meeks, $9,533. E. 8th St. from Webster to Alberta: Grading and concrete curbs and walks—Giebisch & Joplin, $1,123; Bechill Bros., $1,117; Joplin & Meeks, $1,038.

Pennsylvania.

✣Bids will be received until 7 p. m., March 3, by Town Council, Jermyn, Pa., for doing the Borough's share of grading Washington Ave., in the Borough of Jermyn, in preparation for the County Road. The portion to be graded is in the improved section of the town and is about 4,500 feet in length. All bids are to be on blanks furnished by the Borough Secretary, Robert Hall, Jermyn, Pa., or by the Borough Engineer, Oliver F. Peasnall, No. 33-34 Burr Bldg., Scranton, Pa.

✣Bids will be received until 1:30 p. m., March 1, by Borough Council, East McKeesport, Pa., for the improving of Woodmont Ave. from 5th Ave. to Broadway. Approximate quantities are: 5,000 cu. yds. of grading

2,500 lin. ft. of curb and gutter, 100 lin. ft. of 36 in. sewer, 700 lin. ft. of 18 in. sewer, 420 lin. ft. of 15 in. sewer and 3,100 sq. yds. of paving. Also for the improving of 5th Ave. from Coal alley to Alcote St. Approximate quantities are: 3,200 cu. yds. of grading, 3,000 lin. ft. of curb, 2,300 lin. ft. of curb and gutter, 476 lin. ft. of 36 in. sewer, 70 lin. ft. of 30 in. sewer and 4,000 sq. yds. of paving. Also for the improving of Punta Gorda Ave. from Josephine St. to Ocala St. Approximate quantities are: 2,300 cu. yds. of grading, 2,250 lin. ft. of curb and gutter and 2,700 sq. yds. of paving. Also for the improving of Punta Gorda Ave. from Ocala St. to Broadway. Approximate quantities are: 1,900 cu. yds. of grading, 1,650 lin. ft. of curb and gutter and 2,050 sq. yds. of paving. Also for the improving of Josephine St. from Broadway to Punta Gorda Ave. Approximate quantities are: 1,300 cu. yds. of grading, 620 lin. ft. of curb and gutter and 720 sq. yds. of paving. Also for the improving of Broadway from De Sota St. to Punta Gorda Ave. Approximate quantities are: 9,700 cu. yds. of grading, 3,300 lin. ft. of curb and gutter and 5,500 sq. yds. of paving. Also for the improving of Broadway from Greensburg Ave. to De Sota St. Approximate quantities are: 3,800 cu. yds. of grading, 3,600 lin. ft. of curb and gutter, 420 lin. ft. of 18 in. sewer and 5,500 sq. yds. of paving. Also for the improving of Broadway from Ludwick St. to Greensburg Ave. Approximate quantities are: 4,800 cu. yds. of grading, 3,000 lin. ft. of curb and gutter and 4,900 sq. yds. of paving. Certified checks, as called for in the bidding blanks, must accompany each proposal. All proposals must be sealed and addressed to E. P. Churchfield, Secretary of Council, East McKeesport, Pa., and have the words "Street Improvement Proposal" marked on the outside of the envelopes. Plans and specifications may be seen and bidding blanks and all necessary information may be had at the office of Douglass & McKnight. Boro. Engineers, 1709 Union Bank Bldg., Pittsburgh, Pa.

✣Bids will be received until noon, March 5, by Fred H. Gates, City Clerk, Wilkesbarre, Pa., for cleaning 35 miles of paved streets.

✣Bids will be received until 8 p. m., March 24, by Borough Clerk, Chambersburg, Pa., for the paving of approximately 15,700 sq. yds. of street. Bidders will submit their own specifications for the wearing surface, to be laid on a concrete base, plans and specifications for which are on file at the Borough Engineer's office. These plans and specifications may be had upon receipt of a fee of $5, which will be refunded upon their return in good condition. R. M. Huber, Borough Engineer. C. H. Patterson is Borough Clerk. Official advertisement will be found elsewhere in this issue.

⊙A. V. Purnell, of Pittsburgh, Pa., has been awarded the contract for street improvements, including paving, grading, filling, etc., at Turtle Creek, Pa., for $185,000. Bids were opened Feb. 7.

Rhode Island.

⊙C. W. Blakeslee & Sons, of New Haven, Conn., have been awarded the contract by the Pawtucket & Central Falls Grade Crossing Commission, Providence, R. I., for the construction of all masonry work in connection with the building of abutments, piers, sewers and necessary street work in the plans approved for the elimination of grade crossings in the twin cities.

South Dakota.

Bids will be received until 10 a. m., March 17, by Board of City Commissioners, Aberdeen, S. Dak., at the office of F. V. Raymond, City Auditor, Aberdeen, S. Dak., for paving with creosote block, brick or concrete 1st Ave., southwest from 2nd St. to 4th St. Each bid must be accompanied by a certified check for $1,000.

Texas.

✣Bids will be received until noon, March 10, by Dan C. Smith, Jr., City Secretary, Houston, Texas, for the grading and paving of Prairie Ave. from its intersection with the west line of Milan St. to its intersection with the east line of Smith St. with vitrified brick pavement, as prayed for in petition, and in accordance with specifications adopted by the City Council. Each bid must be accompanied by a certified check on any bank in the City of Houston for 10 per cent of the cost of constructing said pavement, said check being made payable to H. B. Rice, Mayor. Specifications and all necessary information can be obtained upon application at the office of F. L. Dormant, City Engineer.

✣Bids will be received until noon, March 10, by Dan C. Smith, Jr., City Secretary, Houston, Texas, for the grading and paving of Avondale Ave. from its intersection with the west line of Baldwin St. to its intersection with the east line of Ariel St. with bitulithic pavement, as prayed for in petition, and in accordance with specifications adopted by the City Council. Each bid must be accompanied by a certified check on any bank in the City of Houston for 10 per cent of the cost of constructing said pavement, said check being made payable to H. B. Rice, Mayor. Specifications and all necessary information can be obtained upon application at the office of F. L. Dormant, City Engineer.

⊙The City Council of Greenville, Tex., A L. Donaldson, City Engineer, has awarded the contract for the construction of 25,000 sq. yds. of asphaltic concrete pavement to Levy & Levy, of Muskogee, Okla.; also 30,000 lin. ft. of combination curb and gutter, for $0.60 per lin. ft., and 15,000 cu. yds. of excavation for $0.28 per cu. yd. Bids were opened on Feb. 11.

⊙F. P. Dellone & Co. have been awarded the contract by the City Council of Greenville, Tex., for the construction of 95,000 sq. yds. of vitrified brick pavement, for $1.70 per sq. yd.; 30,000 cu. yds. of excavation for $0.32 per cu. yd.; 60,000 lin. ft. of curb, for $0.38 per lin. ft. Bids were opened Feb. 11. A. L. Donaldson is City Engineer.

⊙The Texas Bitulithic Co. has been awarded the contract by the City Council of Houston, Tex., for paving Burlington St. from West Alabama to Hawthorne with bitulithic at $2.43 per sq. yd.

The Eureka Construction Co. submitted the only bid to the City Council of Houston, Tex., on Feb. 17 for the paving of Courtland Blvd. from Ariel to Stuart Sts. with asphalt. The bid was $1.74 per sq. yd. for paving without a guarantee and $1.79 per sq. yd. with a 5-year guarantee.

The city of San Benito, Tex., will put in 48,419 sq. yds. of creosoted wood block paving this year on a concrete foundation. B. S. Gentry is City Engineer.

Road Engineer J. C. Travilla, court house, Fort Worth, Tex., expects to have plans, profiles and estimates for the Tarrant County road system ready for submission to contractors in March. This county voted bonds to the amount of $1,000,000 for road work.

The citizens of Longview, Tex., have voted bonds to the amount of $60,000 for street paving. It is probable that bids will be called for within six weeks. The pavement will be installed this spring and summer. The Aetna Engineering Bureau, 17 N. La Salle St., Chicago, Ill., are Engineers.

Virginia.

The Board of Supervisors of Wise County, Wise, Vt., has sold to Weil, Roth & Co., of Cincinnati and Chicago, the $260,000 of road bonds voted by the Gladeville and Richmond magisterial districts on Dec. 31, 1912.

The City Council of Alexandria, Va., is considering ordinances providing for the improvement of streets with modern roadways, nine squares of the 12 to be improved by the city at a cost of $41,200.

Washington.

⊙The Lewis County Commissioners, Centralia, Wash., have awarded the contract for the new hard surface road about one mile long, between the store on Cowlitz Pl. and Toledo, to Chas. Henriot, of Tacoma, Wash., for $3,469. The road will be part of the Pacific highway.

⊙F. K. Ffolliotte, of Everett, Wash., has been awarded the contract by the City Commissioners, Everett, for the improvement of Oakes Ave., from 16th to 22nd Sts., for $17,018. The work includes asphalt pavement and cement sidewalks.

The County Commissioners, Dayton, Wash., are proceeding to take steps to improve a stretch of highway, extending from the westerly limit of Main St. for three miles.

The City Commission of Centralia, Wash., has ordered the paving of Main and Bridge Sts. from Iron St. to the west city limits. Bids will be asked on this work shortly. Stanley Macomber is City Engineer.

The Chehalis County Commissioners, Montesano, Wash., are asking bids for clearing a portion of the Hoquiam-Lake Quiniault road, which when completed will cost approximately $150,000. The Cramer survey made by the state will be used in the construction of the road.

Wisconsin.

City Engineer P. J. Hurtgen, of Burlington, Wis., is preparing plans and specifications for the following work in Delavan, Wis.: 8,912 sq. yds. of brick pavement with an asphalt filler; 1,940 lin. ft. of cement curbing, and 3,190 lin. ft. of combination cement curb and gutter.

The finance committee of the City Council, Milwaukee, Wis., has recommended the purchase of seven automobiles as follows: Three for the city engineering department, at $1,200 each; a five-passenger car for the public works department, to cost $1,800; one for the street construction department, $1,200, and two trucks for the waterworks department, to cost $3,300.

Canada.

✣Bids will be received until 5 p. m., March 7, by City Commissioners at the office of J. M. Miller, City Clerk, Calgary, Alta., for the supply of one vacuum street cleaning machine. Further information may be had by addressing W. H. Cuddie, Supt. of Street Cleaning, Calgary, Alta.

✣Bids will be received until Feb. 28, 4 p. m., by H. Thompson, Secretary-Treasurer, Kildonan, 215 Chambers of Commerce, Winnipeg, Man., for the construction of pavements on the whole or a portion of the East Kildonan Road and Main St., West Kildonan. Plans and specifications may be seen at the office of the Highway Commissioner, Parliament Buildings.

City Engineer Geo. Janin of Montreal, Que., has reported to the Controllers the need of spending $4,000,000 for improvement work, as follows: For the laying of new pavements, sidewalks, sewers and water pipes within a radius of two miles from the city hall, or in that section lying between Sherbrooke, Atwater Ave. and Iberville St. The cost of the pavement accounts for $1,700,000.

The Canadian Government estimates for the coming fiscal year call for an expenditure of $179,152,183. The larger items of capital expenditure are as follows: $19,000,000 for the National Transcontinental Ry., $4,500,000 for the Hudson Bay Ry. construction $3,000,000 for the Quebec bridge, $2,000,000 for the Welland ship canal, $7,239,650 for the Intercolonial Ry., including $2,500,000 for terminals at Halifax and $1,000,000 for rolling stock; $1,000,000 for a car ferry to Prince Edward Island, $2,000,000 for the new departmental buildings at Ottawa, $1,000,000 for the new Dominion building at London, England, $2,600,000 for St. John Harbor, $2,000,000 for Port Arthur and Fort William Harbors, $1,500,000 for Quebec Harbor, $1,000,000 for the new Levis dry dock and $500,000 each for Toronto, Vancouver and Victoria Harbors and for the French River waterway improvements.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

BRIDGES

Alabama.

The Board of County Commissioners at a recent meeting at Bay Minette, Ala., authorized the advertising for bids for the erection of three steel bridges near Stockton, a town ten miles north of here. The residents of that section have been agitating the matter for some time, but as the erection of these bridges would represent the outlay of a considerable sum of money, the commissioners have hesitated before taking any step.

California.

The Board of Napa County Supervisors, Napa, Calif., has rejected as too high, the bid of George W. Porta, $6,389 for the construction of a stone bridge at Zinfandel.

A. G. Wilson, Manager of the San Joaquin Light & Power Co., has submitted to the Board of County Supervisors, Fresno, Calif., a proposition for a bridge over the San Joaquin River near Power House No. 1, Crane Valley.

The Board of Butte County Supervisors, Oroville, Calif., has instructed County Surveyor Polk to prepare plans and specifications for the construction of a reinforced concrete bridge to replace the present Nord ave. bridge over Big Chico Creek.

Colorado.

According to an announcement by the Board of Public Works, Denver, Colo., work will be commenced on the proposed Colfax viaduct by April 15 or May 1. The estimated cost has been placed at $715,000. This figure is $85,000 less than the first estimate. The Denver City Tramway has agreed to the plans, in which it is concerned, and has signed a contract to carry out its share of the work. The cost assessed against it is $152,000. The Denver & Rio Grande will be assessed $88,000; the Colorado & Southern $203,000 and the Burlington $69,000. The Rio Grande and the C. & S. have agreed to their share. The Burlington has also practically accepted the city's estimate. The city's assessment will be $203,000. This is solely for construction work and what additional is required for right of way will have to be added to the estimated cost of $715,000. The construction will be of reinforced concrete. It will commence at Colfax Ave. and Boulevard F., and run to 1st and Larimer Sts., where it will branch and one part run to Larimer and 8th St., and the other to Colfax Ave. and 8th St. There will be a short branch running off to Jerome Park in West Colfax.

The following bids were received by the City of Grand Junction, Colo., for the construction of two steel bridges in Plateau Canon: Patterson-Burkhardt Construction Co., $11,707; J. J. Lumsden, Grand Junction, Colo., $12,495; Colorado Bridge & Construction Co., $12,769; Pueblo Bridge Co., Pueblo, Colo., $12,733; Missouri Valley Bridge & Iron Co., $12,957; United States Bridge Co., $12,837. City Engineer J. H. Fisk recommended that the contract be awarded J. J. Lumsden, the second lowest bidder.

Connecticut.

✣Bids will be received until 2 p. m., March 20, by Bridge Committee, Fairfield County Savings Bank Bldg., 51 Wall St., Norwalk, Conn., for the construction of the Washington St. bridge. The proposed bridge will be mainly of reinforced concrete construction, with a double leaf bascule over the channel, have a width of sixty feet, and a total length of about nine-hundred and sixty-five feet, with brick paving on the roadway and cement sidewalks. The work of construction will be divided into three sections, and separate bids are requested for each section. Section I—The Concrete Work with all Foundations. Section II—The Bascule Bridge Superstructure. Section III—All Paving, etc. Plans and complete data are on file in the office of the Secretary of the Bridge Construction Committee, and in the office of J. E. Greiner, Consulting Engineer, Fidelity Bldg., Baltimore, Md. A complete set of plans, specifications, instructions to bidders, etc., will be furnished by the Consulting Engineer upon the receipt of a deposit of $10 for each set of each section, which amount will be returned upon the return of the sets in an undamaged condition. A certified check for $1,000 will be required with each bid as a guarantee of good faith.

A resolution has been adopted by the City Council, Hartford, Conn., providing for an appropriation of $35,000 for the construction of a bridge over the Park River on Capitol Ave.

Georgia.

It has been decided by the City of Columbus, Ga., to construct a subway under the tracks of the Central of Georgia R. R. at 11th St., to cost about $80,000.

Idaho.

Two bridge bills were passed by the Idaho State Legislature Feb. 12, one providing for a bridge over Snake River at Mussell Ferry in Clearwater County and the other providing for a bond issue of $25,000 to pay part of the cost of constructing a $35,000 bridge over Snake River at Homedale.

Illinois.

✣Bids will be received up to 11 a. m., March 5, 1913, at the Town Hall, Worden, Ill., for the construction of two reinforced concrete bridges to be built in Olive Township, Madison County. Wm. Andrews, Town Clerk, New Douglas, Ill. John Lamb Bridge: Span, 16 ft.; roadway, 18 ft.; height, 12 ft. Estimated total concrete, 51.2 cu. yds.; reinforcing steel, 4,864 pounds. Nearest railroad station, Worden, about 2 miles. No local concrete material available. Present bridge wood, span, 12 ft. Low water, 1½ ft. deep; 5 ft. wide. High water about 6 ft. deep. Excavation to be carried about 4½ ft. below stream bed through black loam. Average excavation, east side, about 5 ft.; west side, about 11 ft. Paske Bridge: Span, 30 ft.; roadway, 20 ft.; height, 13 ft. Estimated total concrete, 126.4 cu. yds.; reinforcing steel, 13,620 pounds. Nearest railroad station, Livingston, about 1 mile. No local concrete materials available. No present bridge. Low water flow dry; high water about 6 ft. deep. Excavation to be carried about 4 ft. below stream bed through sandy loam. Average excavation about 9 ft. Engineer's estimate for the John Lamb, $700; for the Paske, $1,800. Work to be completed on or before June 25, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received until 3 p. m., March 31, by Board of Local Improvements, 107 Washington St., Waukegan, Ill., for the construction of the proposed Genesee Ct. viaduct. The cost of the structure is estimated at $69,891. Official advertisement will be found elsewhere in this issue.

⊙W. H. Shons, Freeport, Ill., has been awarded the contract at $1,279 for the construction of a reinforced concrete bridge between West Point and Winslow in Stephenson County, Ill. The Melloy Const. Co., Libertyville, Ill., bid $1,485 for the work. Bids were opened Feb. 15.

The Secretary of War has approved the plans submitted by the Illinois Central Railroad for the reconstruction of its bridge crossing the Galena River. The bridge will be a jack-knife structure with a clear draw of 80 ft. The work is to be completed by Jan. 13, 1916.

Indiana.

✣Bids will be received until March 5, by Board of Noble County Commissioners, Albion, Ind., for the construction of 19 bridges. J. C. Kimmell is County Auditor.

⊙The Vincennes Bridge Co., Vincennes, Ind., has been awarded the contract for the construction of 6 steel bridges in Union County, Ark., at $8,760. All work must be completed by Nov. 1, 1913.

The Board of Allen County Commissioners, Fort Wayne, Ind., has instructed engineers to prepare plans for the construction of a new concrete structure to span St. Joseph River at Leo, replacing the old wooden bridge. The Council has appropriated $20,000 for the structure.

Iowa.

⊙The Iowa Bridge Co., Des Moines, Ia., has been awarded the contract for steel bridge work in Hand County for the year.

⊙The Iowa Bridge Co., Des Moines, Ia., has been awarded the contract for all bridge work in Spink County, S. Dak., during the ensuing year. H. R. Wood, Redfield, S. Dak., opened bids Feb. 11.

⊙The contract for the construction of seven bridges in Cerro Gordo County has been let to William Kenkel, Mason City, Ia., at $11,077. The work will include five concrete bridges and two steel structures with concrete floors. Other contractors who bid on all the work were as follows: Keerl & Stevens, $15,960; N. M. Stark & Co., $15,125. George E. Frost, Mason City, Ia., is County Auditor.

The Department of Streets, Des Moines, Iowa, will erect two new bridges this summer at a cost of $12,000. The Youngstown bridge will be replaced at a cost of $3,500 and a new bridge will be erected over Walnut Creek on the new road to Valley Junction at a cost of $7,500. John Budd is City Engineer.

The City Council, Marshalltown, Ia., will have work started on the proposed $75,000 viaduct over the Chicago & Northwestern and the Minneapolis & St. Louis Railroads, as soon as damage suits are settled with property owners. According to the plans the structure will be 1,159 ft. long with 24 ft. roadway and clearance above tracks of 22 ft.

It has been announced by the City Council of Fort Madison, Ia., that the County Supervisors will construct the proposed new bridge over French Creek on Front St. Plans and specifications were prepared by the City Engineer of Fort Madison.

It has been recommended that the City Council take action on the proposition to construct two reinforced concrete bridges on Falls Ave., Waterloo, Ia. As proposed, the structures would have driveways 28 ft. wide with walks on each side. C. A. Roby is City Engineer.

Kansas.

✣Bids will be received until April 10 by J. W. Thomburgh, County Clerk, Jetmore, Kan., for the construction in Hodgeman county of two concrete bridges, one 80 ft. long and the other 30 ft. in length. The work will include concrete sub-structures and reinforced concrete superstructures.

⊙The following bridge contracts were recently let by the Board of County Commissioners, Wichita, Kan.: For the construction of a 152 ft. bridge over Chisholm Creek, between Sections 4 and 9 in Kechi Township, C. E. Carr, $990; for the construction of a 52-ft. bridge over Chisholm Creek in Rockford Township, C. E. Carr, $330; for the construction of a 32-ft. concrete bridge over the drainage canal at Seneca St. to the Kansas Construction Co. for $1,100; for the construction of a pile bridge over the drainage canal between Sections 8 and 17 in Riverside Township, to E. P. Martin, $253; for the moving of the 70-ft. steel bridge over the drainage canal at Lawrence Ave. placing over the slough between Sections

3 and 10 in Delano Township, the Kansas Construction Co., $721; for the construction of a tile bridge over Chisholm Creek at Franklin Ave., to the Missouri Valley Bridge Co., $349; for the filling of the old creek bed at Franklin Avenue, to N. C. Barnhill, $100.

Kentucky.

Milton H. Smith, President of the Louisville & Nashville R. R., held a conference recently with the City Commissioners, Lexington, Ky., in regard to the plans for the construction of two viaducts at that place. The W. Main St. viaduct, according to the plans proposed, will be 680 ft. long, 496 ft. of which is to be re-enforced concrete, with retaining walls covering the approaches. This viaduct will be 22 ft. high, 40 ft. wide with a roadway 30 ft. wide through the center, and a footwalk for pedestrians on either side, each of the width of 5 ft. The Jefferson St. viaduct will be approximately 900 ft. long, also constructed of re-enforced concrete. It is to be 34 ft. wide, with a roadway 24 ft. wide and footwalks on each side of the same width as the Main St. viaduct. More width is allowed for the Main St. viaduct from the fact that it will be used by the street car. The total cost of the construction of the two viaducts, as figured by the L. & N. engineering department, is $117,180. The Jefferson St. viaduct will cost a little more than the W. Main St. structure, being estimated at $58,780, while the other one is put down at $58,400.

Maine.

A bill is now before the Legislature of Maine providing for the reconstruction of the Bay Bridge at Bath, Me.

Maryland.

✣Bids will be received until 11 a. m., March 5, by Board of Awards, Baltimore, Md., for furnishing and erecting a steel truss highway bridge consisting of 2 spans 297 ft. center to center of end piers, carrying a 20-ft. roadway over Loch Raven, Baltimore County, Md. The spans to be erected on pier and abutments provided therefor by the Water Board. Plans and specifications may be obtained at the office of the Water Engineer, City Hall, Baltimore, Md., on and after Feb. 15, 1913. A charge of $5 will be made for each set of plans and specifications; this amount will be refunded upon their return in good condition on or before March 8, 1913. Specifications used in making a bid will be considered as returned. A certified check of the bidder on a Clearing House Bank, made payable to the order of the Mayor and City Council of Baltimore, for the sum of $2,000 will be required with each bid. Ezra B. Whitman is Water Engineer. James H. Preston is President Board of Awards.

Minnesota.

⊙The Independent Bridge Co., Minneapolis, Minn., has been awarded a contract at $9,090 for the construction of a bridge over the Cannon River in Welch, Minn.

The City Council of Faribault, Minn., has instructed the Rock Island and the Great Western Railroads to construct a steel bridge at that place. According to the plans the structure will be 988 ft. long, including 32 19 to 138 ft. spans with an 18 ft. roadway paved with concrete and creosote block. The substructure will be of concrete and steel consisting of 62 piers 5x5x7 ft. The estimated cost of the superstructure is $37,600. F. W. McKellip is City Engineer.

An approximate estimate has been prepared by M. A. Adams, Engineer, of the cost of building a bridge over the mouth of the Ramsey River at Redwood Falls, Minn. It is thought that the work could be done for about $5,000.

Missouri.

A number of petitions have been filed with the Circuit Court of Grundy County, Trenton, Mo., for the construction of bridges, one of which is to be near Hickory.

The City Council of Joplin, Mo., has passed an ordinance authorizing Mayor Osborne to enter into a contract with the Union Depot Co. and the Southwest Missouri Railroad Co. for the construction of a reinforced concrete viaduct on Broadway. C. B. Anderson is City Engineer.

Montana.

⊙The contract for the construction of the bridge over the Clarks Fork, according to advices from Laurel, Mont., has been let to the Security Bridge Co., Minneapolis, Minn., at $3,500.

Nebraska.

✣Bids will be received until noon, March 5, by Board of Jefferson County Commissioners, Fairbury, Nebr., for the construction and erection of the superstructure, the substructure and approaches of all bridges of the length of 16 ft. and over and for the furnishing of all material in connection with the same, to be built within and by the said county in the period of one year as hereinafter specified. Said bridges to be built under contract to commence on the 11th day of March, 1913, and terminate on the 10th day of March, 1914. The number, location and size of such bridges to be hereafter determined by the County Commissioners, and each bridge to be completed within 60 days from date of notice as to location and size. Bids for the construction of said bridges shall be according to the plans and specifications, this day adopted and on file and open to inspection in the office of the County Clerk, in Fairbury, Nebr. All bids must be on full sawed material used, and each bidder will be required to deposit with his bid cash or a certified check for $100, payable to the order of C. H. Schaffer, County Clerk.

⊙The Standard Bridge Co., Omaha, Nebr., has been awarded the contract for building and repairing bridges in Stanton County during the coming year.

New Jersey.

⊙Henry B. Richman, Woodstown, N. J., has been awarded a contract at $1,910 for the construction of a new bridge over Beaver Creek in Oldman's Township.

New York.

⊙Skene & Richmond, Brockport, N. Y., have been awarded the contract for the construction of the lift bridge at Little Falls. The contract price was $127,471.

⊙The contract for the construction of two reinforced concrete bridges, one at Fulmer Creek, Mohawk, N. Y., and the other at Steele's Creek, Ilion, N. Y., in the town of German Flatts, Herkimer County, N. Y., has been let to the B. F. S. Co., Herkimer, N. Y., at $14,952. Fred Sayles is Town Clerk, Mohawk, N. Y.

A bill has been introduced by Senator Thomas B. Wilson, at Albany, N. Y., appropriating $15,000 for the reconstruction of the bridge over the outlet of Lake Keuka at the foot of Liberty St. in Penn Yan. The bill provides that the work shall be under the direction of the Superintendent of Public Works, D. W. Peck, and that plans and specifications be prepared by the State Engineer and Surveyor.

John Dorsey, representative of the West End Business Men's Association, Syracuse, N. Y., recently visited Albany, in interest of the. Walters-Daley bill appropriating $15,000 for the proposed new bridge over the Erie Canal in West Genesee St., Syracuse, N. Y. The bill calls for an appropriation by the State of $15,000, to be made available when the city of Syracuse and the New York Railways each deposit to the credit of the State $15,000. The city and the railway company have agreed to appropriate their shares.

The following bids were opened Feb. 14 by Maurice B. Patch, Chairman, and Edward B. Guthrie, Engineer, of the Grade Crossing Commission, Buffalo, N. Y., received the following bids for the construction of a subway to eliminate the crossings at grade of the Erie, and the Lackawanna Railroads at Delaware Ave.: Joseph F. Stabell Co., stone masonry, $39,883.30; concrete masonry, $36,923.30; John Johnson Construction Co., stone masonry, $43,352.85, concrete masonry, $39,579.35; Henry P. Burgard Co., stone masonry, $45,592.12, concrete masonry, $43,138.15; Frederick J. Mumm, stone masonry, $46,711, concrete masonry, $43,461.23; Constantine Construction Co., stone masonry, $46,551.77, concrete masonry, $42,911.77; Eastern Concrete Steel Co., stone masonry, $48,128.84, concrete masonry, $45,572.84. These bids will be submitted to the Common Council by Chairman Patch with recommendation that the bid of the Joseph F. Stabell Co. on concrete masonry be accepted. The commission hopes to start this work in the nevry near future and have it well along before the opening of spring.

A bill has been introduced into the New York Legislature reappropriating $30,000 of money appropriated last year for a bridge over the Black River Canal at Lyons Falls and appropriating an additional $20,000, the total to be used by the Superintendent of Public Works, D. W. Peck, Albany, in constructing a reinforced concrete arched bridge over the Black River and Moose River at Lyons Falls, in Lewis County, on the highway crossing the bridge over the Black River Canal constructed under the act of last year. The work is to be done according to plans and specifications prepared by the State Engineer and Surveyor.

North Carolina.

✣Bids will be received until 8 p. m., Feb. 26, by Executive Board, Charlotte, N. C., for the construction of a reinforced concrete bridge over the tracks of the Southern Railway at East Moorehead St. A certified check for 5 per cent the amount bid must accompany each proposal. A. H. Wearn is City Clerk and Treasurer. Joseph Firth is City Engineer.

A resolution has been passed by the Board of Aldermen of Charlotte, N. C., authorizing the City Attorney to draw up an ordinance providing that work on the new bridge on Morehead St. be started at once by the Southern R. R., the Seaboard Air Line and the Charlotte electric.

North Dakota.

✣Bids will be received until 2 p. m., March 5, by Board of Ransom County Commissioners, Lisbon, N. Dak., for corrugated steel culverts. Bids are to be filed with a certified check for $200 with Roy A. Mills, County Auditor.

✣Bids will be received until 3 p. m., March 4, by Board of County Commissioners, Washburn, N. Dak., for furnishing of culverts for McLean County as follows: 30 18-in. 22 ft. long, 15 pounds per ft.; 30 24-in., 22 ft. long, 19¾ pounds per ft.; 30 30-in., 22 ft. long, 30½ pounds per ft. One-third to be delivered at Washburn, one-third to be delivered at Turtle Lake, one-third to be delivered at Garrison. T. E. Thompson is County Auditor.

Ohio.

The City Council of Urbana, O., has authorized Director Flaugher to enter into a contract for the construction of a reinforced concrete bridge over the town branch on Miami St.

Plans and specifications have been prepared for the proposed new concrete bridge over the river at Keowee St., Dayton, O., and it is believed that the work will be advertised by Director of Public Service Hoglen, shortly. Charles A. Gross is Secretary.

A plan has been laid before the residents of Avondale, Mt. Auburn and a part of Walnut Hills by Peter Haberkorn, Councilman of the Ninth Ward, Cincinnati, O., calling for the construction of a new bridge to replace the present structure spanning the Reading Road. The cost of the improvement is estimated at about $45,000.

Pennsylvania.

⊙The Commissioners of Bucks County, at Doyleston, Pa., have awarded the contract for the construction of a reinforced concrete bridge over Durham Creek, to the Riegelsville Construction Co., at $4,437.

Plans for the proposed new bridge over the

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Monongahela River at Brownsville, Pa., which were recently endorsed by Commissioners of Fayette and Washington Counties, have been submitted to the United States War Department, Washington, D. C., for approval. Washington, Pa., is county seat of Washington County.

Plans have been completed and bids are being taken by the Latrabe, Helia Street Railway Co. for the construction of a 454 ft. electric railway bridge at Whitney, Pa. The structure will consist of 11 30-ft and one 124-ft. span resting on a concrete substructure. The abutments will be 15 ft. in height. J. L. Fritsch, Connellsville, Pa., is Engineer.

The Board of Viewers have recommended to the Chester County Board that a new bridge be erected over Doe Run Creek between Londonderry and Highland Townships on the road between Cochranville and Derry. Chester C. Campbell, West Chester, Pa., is one of the viewers.

It is believed that the Board of County Commissioners, Wilkesbarre, Pa., will employ David A. Keefe, Athens, Pa., to prepare plans for the construction of the proposed bridge over the Nanticoke River. The cost of the improvement, it is estimated, will amount to about $300,000.

The final plans for the bridge to be erected over the Chester River at 5th St., Chester, Pa., have been approved by the Board of Delaware County Commissioners. The structure, as planned by H. H. Quimby, Philadelphia, Pa., will be 178 ft. long and will be built of concrete.

South Dakota.

✣Bids will be received until 1 p. m., April 1, by William M. Look, Kingsbury County Auditor, De Smet, S. Dak., for the construction of county bridges per lin. ft. on steel and reinforced concrete. Each bid must be accompanied by a certified check for $100. Plans and specifications are on file with the County Auditor.

✣Bids will be received until 2 p. m., April 3, by Board of Sully County Commissioners, Onida, S. Dak., for the construction of steel bridges in the county during the year ending March 31, 1914. All bids are to be for bridges per lin. ft. and must be filed with the County Auditor. Plans and specifications may be obtained of the Auditor, J. I. O'Donnell.

✣Bids will be received until 2 p. m., March 4, by Board of Minnehaha County Commissioners, Sioux Falls, S. Dak., for the construction of bridges, also concrete flooring, in Minnehaha County, South Dakota, for the ensuing year, according to plans and specifications on file in the office of the County Auditor. Each bid must be accompanied by a certified check in the sum of $1,000 on a local bank to guarantee that the successful bidder will enter into a contract according to the terms of his bid. E. H. Shenkle is County Auditor.

✣Bids will be received until 2 p. m., April 2, by Board of Brookings County Commissioners, Brookings, S. D., for furnishing all material and labor and building all bridges of steel, concrete, or pile construction, and building all repair work that may be ordered by said Board during the ensuing year. Such bridges to be located and built at places as designated and ordered by said Board. Each bid must be per lin. ft. of bridge and must be according to plans and specifications on file at the County Auditor's office. All bidders must accompany their bids with a certified check filed in a separate envelope for the sum of $1,000, and made payable to the order of the Board of County Commissioners. O. J. Otternes is County Auditor.

⊙The Board of Brown County Commissioners, Aberdeen, S. Dak., has awarded the contract for the construction of five bridges to W. C. Kiernan Co., Aberdeen, S. Dak., at $10,000.

Tennessee.

The Hamilton County, Chattanooga, Tenn., at a recent meeting discussed the proposition to construct a bridge over the Tennessee River at Saunders' Creek.

Texas.

Surveys are now in progress looking to the construction of a causeway and bridge at Corpus Christi, Tex. The matter may come up for official action within the next two months. H. A. Stevens is City Engineer.

Washington.

An amendment has been introduced by Senator Martin of Virginia to the army appropriation bill providing for the construction of a magnificent memorial bridge over the Potomac connecting the site of the proposed $2,000,000 Lincoln memorial in Potomac Park, Wash., with Arlington on the Virginia side.

Wisconsin.

⊙The City Council of Tomah, Wis., has awarded the contract for the construction of the new reinforced concrete bridge over the Lemonware River at the north end of Superior Ave. to Garnock & More, Eau Claire, Wis.

The Wisconsin State Railroad Commission has instructed the city of La Crosse, Wis., to build a viaduct over the Rose St. crossing, and it is said that the Board of Public Works will immediately take the matter up for consideration.

Advices from Oshkosh, Wis., state that a hearing was held before Assistant Engineer L. M. Mann, regarding the proposed temporary bridge at West Algoma. No objection was raised, thus clearing the way for early work on the new bascule structure to replace the present bridge.

Canada.

✣Bids will be received until noon, March 3, by Frank Barber, Township Engineer, 57 Adelaide St. East, Toronto, Ont., for the construction of concrete abutments for a bridge at Old Yonge St., Township of York.

✣Bids will be received until March 1, by William Purves, Township Clerk, Columbus, Ont., for building four reinforced concrete bridges in the Township of East Whitby. Bowman & Connor, Civil Engineers, 36 Toronto St., Toronto, Ont.

The City Council of Medicine Hat, Alta., has received a proposition from the Hunt Engineering Co., offering to erect a large cement plant south of Medicine Hat, to build a steel and cement bridge over Seven Persons Creek at a cost of approximately $100,000 and give the city free use of it for three years and the option to buy it at net cost any time in two years if the city will give roadway and right for a boulevard through industrial site. The majority of the Council favors the idea if legal entanglements can be overcome.

DRAINAGE AND IRRIGATION

Colorado.

⊙Bids were opened Jan. 6 at the office of the U. S. Reclamation Service at Denver, Colo., for 210,000 bbls. Portland cement to be delivered as required by the United States to May 1, 1914. Contracts were awarded as follows on Feb. 18: 31,000 bbls. to Colorado Portland Cement Co., Ideal Bldg., Denver, Colo., f. o. b. Portland, Colo., at $0.99 per bbl., for North Platte (Neb.), Uncompahgre Valley and Grand Valley projects, Colorado; 50,000 bbls., Southwestern Portland Cement Co., El Paso, Tex., f. o. b. Courchesne, Tex., at $1.40, for Rio Grande project, New Mexico; 50,000 bbls., Three Forks Portland Cement Co., Ogden, Utah, at $1.15, f. o. b. Trident, Mont., for Blackfeet, Flathead, Fort Peck, Lower Yellowstone, Milk River, St. Mary's Storage Unit of Milk River, and Sun River projects, Montana, and the Shoshone project, Wyoming. Other awards to be made later.

The Swan, Patterson Co. has a contract on the North Poudre River, 26 miles from Fort Collins, Colo., for driving a series of tunnels for an irrigation company. Three tunnels are to be driven: One 2,347 ft. long, one 461 ft., and one 1,015 ft. There are 100 ft. of open cut between tunnels 1 and 2 and 50 ft. of cut between tunnels 2 and 3. The tunnels are to be 6½ ft. high and 8 ft. wide. The contractors are using an 80-h.p. Fairbanks-Morse crude oil engine and a 9x12x15 Ingersoll-Rand compressor. The contractors are using two machines at the breast and are shooting twice every 24 hours, making a progress of about 10 ft. each portal. About 700 ft. of tunnel will probably be driven this month. John S. Patterson, Livermore, Colo., is Manager for the contractors.

Florida.

✣Bids will be received until 10 a. m., March 4, by Orange County Commissioners, Orlando, Fla., for the construction of three drainage canals and necessary laterals in Black Hammock Drainage District. Bids will be received as follows: First, for construction of one drainage canal and laterals, 12.35 miles long, requiring 177,912 cu. yds. of earth; for one drainage canal and laterals, 3.28 miles long, requiring 27 174 cu. yds. of earth; for one drainage canal and laterals, 3.2 8miles long, requiring 27,174 cu. yds. of earth; second, for clearing about 19 miles of right of way for drainage canal and laterals above mentioned; certified check for 5 per cent amount of bid, made payable to B. M. Robinson, clerk, from whom plans, specifications, etc., can be obtained.

Illinois.

✣Bids will be received by Commissioners of Drainage District No. 1, Mosquito, at the First National Bank, Mt. Auburn, Ill., until 11 a. m., March 6, for furnishing, hauling, trenching and laying the following vitrified tile drain: 1,060 ft. of 27-in., av. depth 5.2 ft.; 2,000 ft. of 24-in. tile, av. depth 5.3 ft.; also taking up and relaying 72 rods of 24-in. tiles, av. depth 5.6 ft. A certified check for $100 must be filed with each bid. J. W. Dappert, Taylorville is Engineer.

Indiana.

⊙Bids were opened Feb. 14 by Don Heaton, County Drainage Commissioner, Fowler, Ind., for constructing the Logue Ditch, the contract being awarded to A. P. Hansen, Brookston, Ind., at $1,761. The work includes 4,700 ft. 14-in. tile, 1,400 ft. 12-in. tile and 1,400 ft. 10-in. tile.

Louisiana.

Funds are being raised by private subscriptions at Roseland, La., for the digging of a large drainage ditch on the west side of the Illinois Central Road, which will connect with the one completed on the east side running through the Herwig place to the Tangipahoa River.

Michigan.

✣Drain No. 1 in Newark and Arcadia Townships, consisting of two sections of four miles each, will be let March 20, 1913, at public auction at the residence of Azum Robert, 1 mile north and 2½ miles west of Ithaca. These two sections have different outlets and at their upper ends are separated by about 40 rods. The larger part of this job will be cleaning out of an old drain but some straightening will be done and about two miles of new channel constructed. The drain will have a 10-ft. bottom and cuts are from 4 to 8 ft. from hubs. Mr. J. W. Harrod and Mr. Miller are special commissioners appointed on this drain. E. W. Redman, Ithaca, Mich., is County Drain Commissioner.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

⊙The following contracts were let recently for drainage work in Gratiot County, for which E. W. Redman, Ithaca, Mich., is County Drain Commissioner; Drain No. 291, consisting of 310 rods of open work and 345 rods of tile, was let to Fred Bradford and Guy Horton, respectively. The open work was let for $2.50 a rod. The drain is to have a 4-ft. bottom with an average cut of about 4.5 ft. from hubs. The tile work, which includes all labor only, was let for $1.89 a rod. The lower 128 rods is to be 15-in. tile; 120 rods of 10-in., and the remainder 8-in. and 6-in. tile. Cuts on tile work average about 4.5 ft. The contract for laying includes furnishing material and construction of three catch basins and one head wall. The tile and hauling were let as separate contracts. Drain No. 293, consisting of 495 rods of tile, was let to Henry Fuller of Ithaca, at $1.53 a rod for labor and furnishing material for and construction of three catch basins. The lower 68 rods is to be 12-in. tile; 308 rods of 10-in. and the remainder of 8-in. and 6-in. tile. The cuts will average about 5 ft.

Minnesota.

✣Bids will be received until 11 a. m., March 17, by A. P. Erickson, County Auditor, Minneapolis, Minn., for the construction of Judicial Ditch No. 20, Hennepin County, Wright and Carver Counties. The main ditch will include approximately 28,170.6 cu. yds. and branches A and B about 1,418.3 cu. yds.

✣Bids will be received until 11 a. m., March 17, by A. P. Erickson, Hennepin County Auditor, Minneapolis, Minn., for the coustruction of Ditch No. 24. The main ditch will include approximately 57,864.7 cu. yds. and branches A, B, C and D about 10,255 cu. yds.

⊙Jacob Kohler, Warroad, Minn., has been awarded the contract at $30,125 for constructing Judicial Ditch No. 4 of Koochching County, bids for which were opened Feb. 20 by L. H. Slocum, County Auditor. The ditch is to be over 12 miles long, requiring 107,920 cu. yds. of excavation.

⊙Bids were opened Feb. 20 by the County Auditor, at International Falls, Minn., for constructing Judicial Ditch No. 5, the contract being let to Jacob Kohler, Warroad, Minn., at $34,720. The ditch is to be about 14 miles long, requiring 132,813 cu. yds. of excavation

⊙Contract for construction of Judicial Ditch No. 8, bids for which were opened Feb. 20, by the County Auditor at International Falls, Minn., has been let to Mablon Bell, Rochester, Md., at $37,000. The ditch will be about 18 miles long and will require 191,000 cu. yds. of excavation.

Petition has been filed with the County Board at Fairmont, Minn., by C. N. Peterson and others for the construction of a ditch.

Hearing will be held at Bemidji on March 4 on establishment of Ditch No. 7 of Koochiching County.

Commissioners of St. Louis County have instructed E. K. Coe, County Road Engineer, Duluth, to make a survey of the proposed ditch to be built so as to drain an area near Wallace, near the Duluth, Missabe & Northern R. R. right of way, and to report at the April meeting.

New York.

⊙The Atlanta Construction Co. has been awarded the contract, at about $9,000, for constructing a 4-mile, 4-ft. deep, 17-ft. wide ditch through the muck land of Arkpuort and Burns.

Ohio.

⊙Contracts for constructing the open ditch through Hancock, Henry, Wood and Putnam Counties, have been let as follows: Chapman Brothers, Celina, O., 10 miles of dredge work at $29,750; the Brush Creek branch to J. E. Dull of Arcanum, for $7,425; the Yellow Creek branch to D. G. Watson of Malinta, for $8,195, and the John Laern brahch to Ira Baker of Arcanum, for $9,480.

Tennessee.

⊙Fred Morgan has been awarded the contract at about $60,000 for work for the Obion River Drainage District No. 2, of which J. A. Coble, Union City, Tenn., is Secretary. The contract includes 314,800 cu. yds. of levee work and 178,000 cu. yds. ditch work, cleaning and grubbing 6 miles of levee base, and constructing two concrete sluiceways with automatic back water gates. Bids were opened Feb. 21.

Texas.

✣Bids will be received until 2 p. m., March 3, by J. L. Malone, Receiver, Mission Canal Co., Mission, Texas, for dredging canals and laterals including approximately 120,000 cu. yds. of material. A certified check for $500 must be filed with each bid.

Washington.

The U. S. Reclamation Service has received authority to expend $600,000 in the development of Lake Keechelus as a storage reservoir during 1913. The total cost of the Lake Keechelus work is estimated at $1,125,000 and about $75,000 was spent there last year. C. H. Swigart, North Yakima, Wash., is Supervising Engineer.

Wisconsin.

The petition for the Rat River Drainage District, mentioned in our Feb. 5 issue, is now being circulated. The construction work will not be let until next November at the very earliest. The district will call for the excavation of about 30 miles of main ditch and laterals. Preliminary plans and estimates have been made by Prof. E. R. Jones, Madison. Wis., the Engineer.

The Commissioners of the Yorkville-Raymond Drainage District, Racine County, Wis., P. J. Hurtgen, Burlington, Wis., Engineer, are about to file their report. The work consists of cleaning out and deepening the old Yorkville-Raymond Drainage Ditch, and the construction of a number of lateral ditches. The work will consist of 112,190 cu. yds. of excavation, 500 lin. ft. of 18-in. tile drains, 1,950 lin. ft. of 16-in. tile drains, 10,120 lin. ft. of 12-in. tile drains, 745 lin. ft. of 10-in. tile drains. Contracts for the above work will probably be let some time in April.

Canada.

✣Bids will be received until noon, March 29, by A. S. Dawson, Chief Engineer, Department of Natural Resources, Canadian Pacific, Calgary, Alta., for the construction of a concrete paving on the dams of Lake Newell Reservoir, and amounts to about 11,200 cu. yds. of concrete paving and 8,700 cu. yds. of gravel base. Construction materials, except forms and water for concrete, will be supplied by the company. All labor, plant and material for forms must be furnished by the contractor. Plans and specifications and all information may be obtained on application to A. S. Dawson. A deposit of $25 will be required as a guarantee of good faith before plans, etc., will be given out, which will be refunded on the receipt of a bona fide tender. All proposals must be accompanied by a certified check payable to A. S. Dawson for $5,000.

WATER WORKS

California.

Plans have been prepared by Chief Engineer Burdett Moody of the water department, Pasadena, Calif., for a new house at the pumping plant at 355 Blaine Ave. The estimated cost is $700.

The City Council of San Diego, Calif., returned all bids recently received for the making of improvements to the waterworks. New bids will not be asked until the $175,000 worth of bonds for the work have been sold. H. R. Fay is superintendent of water.

The City Council of San Diego, Calif., is reported to have retained Engineers Smith, Emery & Co., 1747 Kearny St., San Francisco, Calif., to test the purity of the city water and recommend improvements.

The citizens of Tulare, Calif., have voted against the purchase of the water plant from the Tulare City Water Co., at a price of $44,000. The citizens recently ratified a bond issue of $100,000 for the construction of a municipal plant.

Mayor J. J. Gill of San Leandro, Calif., has launched a scheme calling for an election to vote bonds to the amount of $10,000 for the equipment of a modern fire-fighting apparatus and the installation of a fire alarm system.

An election will probably be called in Visalia, Calif., soon for the purpose of voting on the question of municipal ownership of the water system.

Colorado.

⊙Fraser & McCabe, of Boulder, Colo., submitted the lowest bid Feb. 21 to the city of Greeley, Colo., for the furnishing of materials for and the construction of Distribution Reservoir No. 2 of the water works of the city. The bid was $11,210. Other bidders were: Sherman Construction Co., Greeley, $12,235; John S. Morrison, Greeley, $12,866. The work includes 1,560 cu. yds. of concrete lining for wells, etc., for reservoir, to be 232 ft. by 256 ft. by 11 ft.

Delaware.

The Delaware Legislature on Feb. 19 passed a bill authorizing the town of Georgetown to borrow $35,000 for a system of water works.

The Public Service Commission has passed an order granting permission to the Delmar Water Co., Delmar, Del., to issue $34,000 of stock and $35,000 of 6 per cent bonds to extend its mains and make other improvements to enable it to better supply Delmar with water.

Florida.

Bids will be received until 10 a. m., March 4, by Board of Bond Trustees, Fort Meade, Fla., for furnishing the following material and machinery, delivered f. o. b. cars Fort Meade, Fla.: 650 ft. 10-in. C. I. or Matheson joint steel standard water pipe; 1,900 ft. 8-in. C. I. or Matheson joint steel standard water pipe; 8,420 ft. 6-in. C. I. or Matheson joint steel standard water pipe; 6 tons special castings; 2,200 ft. 2-in. galvanized iron pipe; 11,900 ft. 1½-in. galvanized iron pipe; 2 10-in. hub end gate valves and boxes; 4 8-in. hub end gate vales and boxes; 11 6-in. hub end gate vales and boxes; 21 1¼ and 2-in. gate valves and boxes; 27 standard hydrants; 10,000 lbs. lead; 500 lbs. hemp; 1 75,000-gal. steel tank on 75-ft. tower; 1 75,000-gal. compound steam pump; 17,500 ft. 8-in. sewer pipe; 3,100 ft. 10-in. sewer pipe; 3,900 12-in. sewer pipe; 650 8x6-in. Ys; 105 10x6-in. Ys; 100 12x6-in. Ys; 61 manhole covers; 13,200 lbs. reinforcing steel; 365 bbls. Portland cement; 94,000 all hard brick.

Right is reserved to reject any or all bids W. E. Arthur is Secretary Board of Bond Trustees, Fort Meade, Fla. The J. B. McCrary Company, Atlanta, Ga., are Engineers.

Georgia.

✣Bids will be received until 11 a. m. March 5, for furnishing and delivering to the city plumbing shops, 14th St. and Indiana Ave., 50 white porcelain drinking fountains of the bowl and pedestal type. Fountain shall stand 30 in. high from floor to rim of bowl, and 32½ in.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

high to rim of bubbling cup; diameter of base 12 ins., diameter of bowl, 13 ins. Fountains to have concealed iron pipe size of brass supply pipes with self-closing regulating stop valve and heavy lever handle. Cash or certified check for $100 must accompany proposal. L. E. McGann, Commissioner of Public Works, Chicago, Ill.

✣Bids will be received until 11 a. m., March 4, 1913, by L. E. McGann, Commissioner of Public Works, for furnishing and delivering lubricating oil as follows to the various pumping stations, cribs, shops, pipe yards, etc., cylinder oil, 9,300 gals; engine oil, 6,950 gals.; dynamo oil, 50 gals; gas engine oil, 2,350 gals; steam turbine oil, 1,000 gals. Prospective bidders are requested to familiarize themselves with the various clauses in the specifications governing the particular brand upon which they are desirous of bidding. Cash or certified check for $200 must accompany proposal.

✣Bids will be received until 11 a. m., March 3, 1913, by L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering to 14 pumping stations and 2 shops all tools, materials, labor, etc., necessary to apply non-conducting covering as is required. All covering on all pipes from ½-in. to 2 ins. in diameter shall be made of a cover of 85 per cent asbestos fibre, 3-ft. sections with an 8-oz. cover of canvas duck, other size pipes requiring various kinds and sizes of covering as shown in specification. Cash or certified check for $500 must accompany proposal.

⊙R. D. Cole, Mfg. Co., Newman, Ga., has been awarded the contract by the Board of Aldermen, Waycross, Ga., for one boiler of the horizontal return tubular type without dome, for $1,653. Bids were opened Feb. 18.

The City Council of Valdosta, Ga., has appointed a special committee to handle the waterworks proposition, which includes the expenditure of $60,000 for enlarging the waterworks plant.

The Columbus Water Supply Co., Columbus, Ga., has commenced improvements on the waterworks system which will cost in all about $150,000. The first improvement is the laying of a 6-in. main through East Highlands and Wynnton.

Illinois.

✣Bids will be received until 11 a. m., March 5, for furnishing and delivering to the city plumbing shops, 14th St. and Indiana Ave., 50 white porcelain drinking fountains of the bowl and pedestal type. Fountain shall stand 30 ins. high from floor to rim of bowl and 32½ ins. high to rim of bubbling cup; diameter of base 12 ins., dia. of bowl 13 ins. Fountains to have concealed iron pipe size brass supply pipes with self-closing regulating stop valve and heavy lever handle. Cash or certified check for $100 must accompany proposal. L. E. McGann, Commissioner of Public Works, Chicago, Ill.

⊙The Village of Riverside Ill., has awarded the contract for furnishing and installing two deep-well pumps to the Luitweiler Pumping Engine Co., 140 S. Dearborn St., Chicago, Ill.

⊙The Village Board of Pipe City, Ill., has let the contract for the sinking of two wells for the waterworks system to Townsell & Hart, of Streator, Ill., at about $800. The Council has adopted an ordinance for the purchase of a pump and engine for the system and the erection of a steel tower and tank and building.

⊙H. Channon Co., 154 N. Market St., Chicago, Ill., has been awarded a contract for furnishing and delivering 50,000 ft. of 2½-in. double jacket, rubber lined cotton fire hose, with couplings, at 79½c per lin. ft. Chas. F. Seyferlich, Fire Marshal.

⊙The New York Continental Jewell Filtration Co., New York, N. Y., has been awarded the contract by the city of Decatur, Ill., for the construction of a filter plant for $129,899. Wm. G. Clark, The Spitzer Bldg., Toledo, O., is Engineer. Bids were opened Feb. 11.

It is reported that bids will be received in the near future by the State of Illinois for constructing a complete waterworks system including filter plants, ten or twelve-inch cast iron pipe line, transmission line, concrete and earth dam, concrete reservoir and pumping station, etc., for the State Hospital at Anna, Ill. Estimated cost, $120,000. D. H. Maury Co., 1137 Monadnock Blk., Chicago, Ill., Engineer in Charge.

The citizens of Paris, Ill., at a recent election voted against the issuing of bonds to the amount of $36,000 for the installation of a filter.

Mr. Douglas Graham, Chief Engineer, D. B. Maury Company, 1137 Monadnock Blk., Chicago, Ill., is desirous of purchasing for installation at Riverside, Ill., an automatic fire alarm system, the same to be installed in conjunction with the construction of high-pressure water system water works tower, etc.

Indiana.

⊙The Commercial Club committee on Lakes and Parks, Richmond, Ind., has re-let the contract for the building of the dam in the Whitewater river at 17th St., to Isaac Smith, for about $20,000. John Mueller, of New Castle, Ind., is Engineer.

The town of Hebron, Ind. (population 821), has voted to contract for water supply at an estimated cost of $34,000. The wells and pressure tank system will probably be used. F. W. Pickens, Kankakee, Ill., is Engineer. Correspondence invited from contractors and public utility companies for construction and financing by B. F. Nichols, President of the Town Board.

Iowa.

The citizens of Hedrick, Ia. (population 978), have been holding public meetings to consider the proposed installation of a water works system. A committee of citizens is now making investigations.

Kansas.

The city of Moline, Kans., will hold an election March 25 to vote on the question of issuing bonds to the amount of $40,000 for water works and an electric light plant. The Benham Engineering Co., Oklahoma City, Okla., are Engineers.

Louisiana.

The City Council of Crowley, La., plans further municipal improvements, as follows: Universal installation of water meters, extension of water mains, additional sewerage and the building of a reservoir that will distill the sandy sediment.

Maryland.

Consulting Engineer Alfred M. Quick, Baltimore, Md., has submitted a report to the Burgess and Commissioners of Williamsport, Md., on the proposition to establish waterworks in that town. The estimated cost of an underground supply of water has been placed between $16,000 and $20,000.

Massachusetts.

The Selectmen of the town of Easthampton, Mass., have decided to expend $4,850 in the laying of new water pipe in the new section off Northampton St.

Minnesota.

The Water & Light Board of Chisholm, Minn., on Feb. 17 met with J. G. Hirsch, representing Daniel W. Mead, Consulting Engineer of Madison, Wis., and reviewed the proposition for an electric pumping of village water, also the rebuilding of the pumping station and enlarging the filter plant.

A proposition is now before the Village Council of Roseau, Minn. (population 644), to put in waterworks for fire protection.

The Oscar Claussen Engineering Co., 514 German Am. Nat. Bank Bldg., St. Paul. Minn., is preparing plans and specifications for the installation of a waterworks system at Warroad, Minn.

The Oscar Claussen Engineering Co., 514 German Am. Nat. Bank Bldg., St. Paul, Minn., is making a report on the proposed installation of water works and electric light plants at New Ulm, Minn.

The Oscar Claussen Engineering Co., 415 German Am. Nat. Bank, St. Paul, Minn., is making a report on the proposed installation of water works and electric light plants at Lake City, Minn.

Mississippi.

⊙The Hinds County Board of Supervisors, Jackson, Miss., have contracted with Hamilton Johnson for the installation of a new system of waterworks at the county courthouse and jail.

Missouri.

The Atchison, Topeka & Santa Fe Railroad Co. has made an appropriation of $88,000 for a reservoir at Baring, Mo. The company has negotiated for the purchase of 160 acres of land south of town.

The Springfield Water Co., Springfield, Mo., will extend the mains to the W. P. Andrus addition near the state normal school within a short time. R. L. Pate is manager.

Montana.

The Town Council of Twin Bridges, Mont. (population 491), will call an election shortly for the purpose of voting on the issuance of bonds for the installation of a waterworks system.

Nebraska.

The Board of Trustees of Silver Creek, Nebr., has called an election for March 11 to vote on the question of issuing bonds to the amount of $8,000 to construct a system of waterworks for the village.

New Jersey.

⊙Patridge & Burke, of Hohokus, N. J., have been awarded the contract by the Borough Council of Belmar, N. J., C. O. Hudnut, Clerk, for the construction of about 4½ miles of 4 to 10-in. water pipe, including hydrants, valves, etc., for $18,371. Bids were opened Feb. 15. Clyde Potts, 30 Church St., New York City, is Engineer.

New York.

✣Bids will be received until 11 a. m., March 7, by Department of Public Works, Buffalo, N. Y., for work and material required for the erection and completion of the venturi meter and valve house of the New Pumping Station, located at the foot of Porter avenue, Buffalo, N. Y. Francis G. Ward, Commissioner of Public Works. Plans and specifications and estimate of quantities can be seen, and printed forms of proposals, and any desired information, can be had on application at the office of Esenwein & Johnson, 777 Ellicott Square.

The Board of Trustees of Waterloo, N. Y., has decided to submit to the citizens the question of the adoption of the new franchise and contract of the Waterloo Water Co. The company proposes the installation of a double filtration plant capable of furnishing 1,000,000 gals. of water every 24 hours; also the erection of a standpipe near the purifying station 100 ft. high, with a capacity of 100,000 gals. Charles H. Ross is superintendent.

North Carolina.

⊙The Board of Water Commissioners, Charlotte, N. C., has let the contract for the construction work on a new water extension from Avondale to the city limits in East Dilworth, to Johnston, Porter & Peck, at $681.

An election is to be held in Cherryville, N. C., soon for the purpose of voting on the issuance of bonds to the amount of $10,000 for the installation of a water works system.

Ohio.

✣Bids will be received until noon, Feb. 28, by W. H. Kirby, Secretary to the Director of Public Service, Cleveland, O., for brick for the water department of the city. Specifications may be obtained of the Water Department Superintendent.

⊙The American La France Fire Engine Co., Inc., Elmira, N. Y., has been awarded the contract by the Department of Public Safety, Sidney, O., for furnishing a triple combination pumping chemical engine and hose motor car, to have a carrying capacity of not less than 1,200 ft. of 2½-in. fire hose and one 40-gal. chemical tank, for $9,000. Bids were opened Jan. 22.

The Board of Health of Canton, O., has recommended to the City Council the construction of an underground basin to store pure well water. The estimated cost is $80,000. The proposed plans provide for a reservoir 320 ft. long, 143 ft. wide and 25 ft. deep, made of concrete and covered.

The City Council of Toledo, O., has approved a plan to extend city water mains to Wildwood addition, south of the city, plotted by the Wiltsie Realty Co.

Oklahoma.

⊙The Missouri, Kansas & Texas Railroad Co., has purchased 260 acres of land east of the station at Reynolds (P. O. Braden), Okla., where a reservoir, comprising 139 acres and with a capacity of 500,000,000 gals. of water, will be built immediately. The contract has been awarded to the Bell Construction Co. Other improvements contemplated are the building of an intake tower, with a concrete spillway to carry away the waste water, and a 10-in. pipe from the tower to the track two miles distant. Approximately $50,000 will be spent at Reynolds.

The Missouri, Kansas & Texas Railroad Co., F. H. Van Craenbroeck, McAlester, Okla., Division Engineer, plans the construction of water reservoirs at Crowder and Atoka, Okla., costing about $20,000 and $30,000, respectively.

Plans and specifications for a system of waterworks for Foraker, Okla., are being prepared by the Benham Engineering Co., Oklahoma City, Okla. Bonds to the amount of $25,000 have been voted for the improvement.

Bids for the construction of waterworks and electric lighting system will be received by the town of Hinton, Okla., about April 1. The exact date will be announced later. The Benham Engineering Co., Oklahoma City, Okla., has been employed as Consulting and Supervising Engineers.

Oregon.

The Board of Fire Commissioners of Roseburg, Ore., has recommended that the City Council purchase 500 ft. of hose and a half dozen lanterns for the fire department and that they also appropriate $500 for the purpose of making preliminary surveys and getting specific information and data relative to establishment of a municipal water plant.

The City Council of Sandy, Ore., recently appointed a special committee to investigate the cost of installing a waterworks system. The proposed improvement will include an 8-in. main and reservoir. The committee will make its report on March 3.

Pennsylvania.

Hydraulic Engineers Chester & Fleming, Pittsburgh, Pa., have been employed by the Johnstown Water Co., Johnstown, Pa., to review all data in connection with cost of water to consumers.

The citizens of the borough of Coudersport, Pa., will shortly be asked to vote on the issuance of bonds to the amount of $45,000 for the installation of a new water plant. R. R. Lewis is Borough Solicitor.

The citizens of Mount Joy, Pa., at a special election voted against the issuance of bonds to the amount of $42,000 for a filter plant.

South Dakota.

The citizens of Pierpont, S. Dak. (population 314), at a special election voted the issuance of bonds to the amount of $4,000 for improvements at the waterworks.

The Town Board of Ramona, S. Dak. (population 312), will sell bonds on March 11 to the amount of $3,000 for the improvement and extension of the waterworks.

Tennessee.

The finance committee of the City Council, Nashville, Tenn., has recommended for passage a bill appropriating $79,800 for tapping machines for water mains; $2,000 to purchase fire alarm wire and poles; $3,000 to purchase fire hose and $17,000 to purchase two motor combination fire engines, chemical and hose carts.

The City Council of Nashville, Tenn., has set May 29 as the date for the submission for ratification of the $2,000,000 bond issue for the construction of the city reservoir.

The city of Dresden, Tenn., has a bill before the legislature calling for authority to call an election for the purpose of voting on the issuance of bonds to install a water works and an electric light plant.

Texas.

✣Bids will be received until noon, March 17, by City Clerk, Austin, Texas, for furnishing a standard motor-driven combination hose and chemical wagon for the Fire Department of the city. Said wagon to have a capacity of not less than 1,000 ft. of 2½-in. hose ano a 40-gallon chemical tank, with other full standard equipment. James P. Hart is Supt. of Police and Public Safety.

L. L. Stephenson of Sweetwater, Tex., has purchased the holdings of the Yoakum Improvement Co., Yoakum, Tex., involving the electric light and waterworks plants. Improvements and additions are to be made at an estimated cost of over $30,000.

The City Council of Longview, Tex., has decided to sink an artesian well to the depth of 2,500 ft. for the purpose of improving the city's water supply.

The citizens of Frankston, Tex., have organized an electric light and water company and are now figuring with contractors for the sinking of a deep well.

The City Council of Paris, Tex., has accepted the bid of Smith & Whitney and the Briggs-Weaver Co. of Dallas, Tex., for three pumps and four motors to be used in installing electric pumping at the city lake.

The Attorney General at Austin, Tex., has approved the $30,000 bond issue of the city of Sulphur Springs, Tex., for the making of improvements to the waterworks.

The city of Big Springs, Tex., plans the laying of three miles of cast iron water mains at an estimated cast of $40,000. No plans have as yet been prepared. Water will be secured from deep wells. Theo. Jones, Big Springs, is Engineer.

Utah.

The City Commissioners of Ogden, Utah, have decided to immediately locate the pipe line to South Fork canyon in connection with the city reservoir system. Engineer H. J. Craven suggested that the line begin at a point just below the confluence of the right and left-hand forks and continue to the Cobble Creek dam.

Washington.

Following bids were received by the Board of Public Works, Seattle, Wash., on Feb. 14, for the construction of water mains on 10th Ave., W. et al.: John W. Johnson, $13,649; Dicken & Rightmire, 2728 33rd Ave. S., Seattle, $12,481; Ferguson-Coit Co., $12,784; Washington Construction Co., $12,677; Jahn Construction Co., $12,978; E. J. Rounds Construction Co., $12,991, and Erickson Bros., $12,924.

Wisconsin.

✣Bids will be received until 8 p. m., March 12, by H. J. Johnson, City Clerk,. Boscobel, Wis., for the drilling of a 12-in. well 700 ft. deep; the furnishing of 300 tons of 6-in. and 8-in. c. i. pipe, class B; 13,000 special castings; 43 hydrants; 14 8-in., 6-in., and 4-in. valves and boxes, and the construction of a reinforced concrete reservoir 35 ft. in diameter by 15 ft. deep. The work of laying the water pipe will not be let until after it is determined that a sewerage system will be put in. Certified check for 5 per cent. W. G. Kirchoffer, Engineer, Madison, Wis.

✣Bids will be received until 2 p. m., March 1, by Board of the Village of Waterford, Wis., A. C. Scheele, Clerk, for the construction of water mains, set hydrants, valves and valve boxes, for the water works system. The work includes approximately the laying of 6,318 lin. ft. of 6-in. water pipe; 2,294 lin. ft. of 4-in. water pipe; setting 20 hydrants; setting 17 valves and valve boxes. The village will furnish pipe, lead, hydrants, valves and valve boxes, etc., for the work. A certified check for 5 per cent of the amount bid must accompany each proposal. P. J. Hurtgen is Engineer.

Preliminary plans and estimates for a waterworks system for the village of Sheboygan Falls, Wis., to cost $20,000, have been prepared by W. G. Kirchoffer, Sanitary & Hydraulic Engineer, Madison, Wis. A sewerage system is also under ocnsideration.

W. G. Kirchoffer, Sanitary & Hydraulic Engineer, Madison, Wis., has been engaged to prepare plans for a waterworks system for Boscobel, Wis., to cost about $24,000. Mr. Kirchoffer will also make estimates on a sewer system.

Canada.

✣Bids will be received until 8 p. m., March 19, by John Lyle, Town Clerk, Bowmanville, Ont., for the several works in connection with a waterworks system and a sewerage system for the town: Contract A (1)—Laying water mains in Town; Contract A (2)—laying sewer pipes; Contract B—constructing pump house; Contract C—constructing three reservoirs; Contract D—furnishing iron pipes; Contract E—furnishing hydrants, valves, etc.; Contract G—furnishing electrically-operated booster pump; Contract M—laying gravity conduit line about eight miles in length; Contract S—furnishing sewer pipes; Contract X—constructing sewage disposal works. Plans and specifications may be seen at the office of Chipman & Power, Engineers, Mail Bldg., Toronto, Ont.

✣Bids will be received until Feb. 28 by George P. Campbell, Town Clerk, Transcona, Man., for drilling three wells.

✣Bids will be received until noon, March 17, by the Town Council, at the office of the City Secretary-Treasurer, Swift Current, Sask., for the supply of the following material: 37 6-in. valves and boxes; 3 8-in. do.; 3 10-in. do.; 3 12-in. do.; 22 6-in. fire hydrants. Specifications and forms of tender may be had on application to George D. Mackie, town engineer.

✣Bids will be received until noon, March 17, by Town Council, Swift Current, Sask., for the supply of 8,566 ft. of 6-in. cast iron or steel pipe, 141 tons; 2,230 lin. ft. of 8-in., 50 tons; 5,346 lin. ft. of 10-in., weight 160 tons; 6,214 ft. 12-in., 249 tons. George D. Mackie, Town Engineer, has plans and specifications on file.

✣Bids will be received until 11 a. m., March 3, by Chairman Board of Control at the office of M. Peterson, Secy., Winnipeg, Man., for the supply of the construction plant and the performance of all labor necessary for the construction of a reservoir having a capacity of 18,000,000 imperial gallons. Plans, specification and form of tender together with conditions that govern tenders as prescribed by by-law may be obtained at the office of the City Engineer, 223 James Ave.

✣Bids will be received until 11 a. m., Feb. 27, by Chairman Board of Control at the office of M. Peterson, Secy., Winnipeg, Man., for the following materials, required for the construction of a reservoir having a capacity of 18,000,000 imperial gallons, namely: (a) Reinforcing steel; (b) 20,000 to 25,000 barrels of cement; (c) waterproofing compound. Specifications and forms of tender together with conditions governing tenders as prescribed by by-law may be obtained at the office of the City Engineer, 223 James Ave.

✣Bids will be received until noon, March 5, by City Commissioners, Moose Jaw, Sask., for the following: 1—Copper and iron wire; 2—cedar poles; 3—fir cross-arms; 4—pole line hardware; 5—miscellaneous line supplies. Each tender must be accompanied by an accepted cheque or cash deposit equal to at least five per cent of the total amount of tender.

Specifications and full information may be obtained upon application to J. D. Peters, Electrical Superintendent, Moose Jaw, Sask.

✣Bids will be received until 11 a. m., March 6, by Chairman Board of Control, at the office of M. Peterson, Secy., Winnipeg, Man., for supply of quantity of cast iron water pipe, and gate valves for the domestic waterworks system. Specification and form of tender, together with conditions governing tenders as prescribed by by-law may be obtained at the office of the City Engineer.

✣Bids will be received until noon, March 17, by town council at the office of Secretary and Treasurer, Swift Current, Sask., for sinking a gas well approximately 2,000 ft. in depth. Specifications may be obtained of George D Mackie, Town Engineer. A deposit of $10 is required with each application. All bids are to be accompanied by a marked check for $2,000.

Sir Alexander Binnie and Dr. A. C. Houston, of England, have submitted their report to the city of Ottawa, Ont., relative to the best source of water supply. The report recommends Gatineau Hills as the best place to secure pure water, with the Ottawa River as an alternative, the water from which would have to be purified by chemical treatment. After details of the cost and feasibility of bringing water from the various lakes have been worked out a final report will be made.

The water works committee of the City Council, Vancouver, B. C., has decided to call for bids for the supply of 6,000 ft. of 6 and 8-in. pipe for immediate use. Bids were recently received on 12,000 ft. of 2-in. wire cable in two legnths of 6,000 ft. to haul the four 18-in. mains across the Second Narrows.

SEWERAGE AND SANITATION

Arkansas.

Residents of the Rose Hill section of the West Side, Texarkana, Ark., have decided in favor of the installation of a sewer system in that section of the city. Mayor John P. Kline is official in charge of sewers.

California.

⊙J. W. Terrell of Chico, Calif., has been awarded the contract by the city of Oroville, Calif., for the construction of the storm water sewer system, for $20,907. Other bidders were: Chambers & Heafey, $22,793; O. H. Siebel, $27,817, and W. C. Hunter, $28,202.

⊙J. D. Kneen Contracting Co. of Santa Monica, Calif., has been awarded the contract for the construction of a sewage disposal plant at Soldiers' Home, Calif., for $19,800.

⊙The buildings and grounds committee of the Panama-Pacific International Exposition Co., San Francisco, Calif., has awarded the contract for the construction of sewers in the main roadway of the concession district to Philip Schuyler, for $4,870.

The City Council of San Bernardino, Calif., has adopted plans and specifications for a sewer on Spruce St., from I to Mt. Vernon, and for a sewer on Kingman Ave., from I to Mt. Vernon. The Council also adopted a resolution of intention for the sewer on Sixth St., from I to Mt. Vernon.

Dr. Julius Koebig of Los Angeles, Calif., recently consulted with the Board of Health of Long Beach, Calif., regarding the proper method of sewage and garbage disposal, preparatory to the issuance by the city of Long Beach of sewer bonds for $350,000.

Connecticut.

A bill has been introduced in the Connecticut Legislature authorizing the borough of Southington to install a system of sewerage. Providing the bill is passed the citizens of the borough will be asked to vote on the proposition.

Delaware.

The Town Council of Milton, Del., has asked that the bill now before the legislature authorizing the construction of a sewer system in that town at an estimated cost of $20,000 be amended so as to allow an expenditure of $30,000 on the system.

The American Construction Co., Wilmington, Del., has been incorporated with a capital stock of $50,000, to construct sewerage systems of all kinds. The incorporators are: R. Boyd Cooling, Clarence J. Jacobs, Harry W. Davis, all of Wilmington.

District of Columbia.

✣Bids will be received until 2 p. m., March 17, by Commissioners of District of Columbia, Washington, D. C., for the construction of sewers in the district.

Georgia.

The city of Conyers, Ga., plans to begin work within the next month on the installation of a modern waterworks and sewerage system. Bonds for the improvement have been voted and issued.

George G. Earl of New Orleans, La., has been engaged as Consulting Engineer to assist the Drainage Commission of Savannah, Ga., in the extension of the house drainage system.

Idaho.

✣Bids will be received until 3 p. m., March 20, by City of Idaho Falls, Ida., for furnishing and laying 7,300 ft. of 8-in. sewer in Local Lateral No. 1, and 1,320 ft. of 12-in. sewer and 14,560 ft. of 8-in. sewer in Local Lateral District No. 2. Frank Beach is City Engineer.

Illinois.

✣Bids will be received until 11 a. m., March 14, 1913, by the Board of Local Improvements, Chicago, Ill., for furnishing and delivering the labor, materials, etc., necessary to construct a brick sewer system in the following streets, estimated cost, $450,000: S. Albany Ave., Chicago River to W. 30th st., 610 lin. ft. 9-ft. brick sewer, 18-ft. cut; 30th St., Albany Ave. to Troy St., 310 lin. ft. 9-ft. brick sewer, 17-ft. cut; Troy St., W. 30th St. to W. 26th St., 1,990 lin. ft. 9-ft. brick sewer, 18-ft. cut; W. 26th St., Troy St. to Turner Ave., 1,360 lin. ft. 9-ft. brick sewer, 16-ft. cut; S. Turner Ave., 26th St. to 22d St., 2,600 lin. ft. 9-ft. brick sewer, 16-ft. cut; Turner Ave., 26th St. to 16th St., 2,710 lin. ft. 8-ft. brick sewer, 16-ft. cut; 16th St., Turner Ave. to Spaulding Ave., 310 lin. ft. 8-ft. brick sewer, 16-ft. cut; Spaulding Ave., W. 16th St. to W. 13th St., 1,960 lin. ft. 7½-ft. brick sewer, 16-ft. cut; W. 13th St., Spaulding Ave. to Polk St., 233 lin. ft. 7-ft. brick sewer, 15-ft. cut; Polk St., Spaulding Ave. to Homan Ave., 670 lin. ft. 7-ft. brick sewer, 15-ft. cut; Homan Ave., Polk St. to alley north, 160 lin ft. 6½-ft. brick sewer. 15-ft. cut; Homan Ave., alley north of Polk St. to Van Buren St., 1,490 lin. ft., 6½-ft. brick sewer, 16½-ft. cut; Homan Ave., Van Buren St. to Colorado Ave., 580 lin. ft. 6-ft. brick sewer, 16-ft. cut; Homan Ave., Colorado Ave. to Monroe St., 950 lin. ft., 4-ft. brick sewer, 15½-ft. cut; Monroe St., Homan Ave. to Central Park Ave., 1,320 lin. ft. 4-ft. sewer, 15-ft. cut; alley north of Polk St., Homan Ave. to Central Park Ave., 1,360 lin. ft. 4-ft. brick sewer, 15-ft. cut; Van Buren St., Homan Ave. to Central Park Ave., 1,370 lin. ft. 4-ft. brick sewer, 15-ft. cut; 16th St., Turner Ave. to Central Park Ave., 1,710 lin. ft., 4½-ft. brick sewer. 15-ft. cut; 16th St., Spaulding Ave. to Kedzie Ave., 710 lin. ft. 4-ft. brick sewer, 11-ft. cut; Colorado Ave.. Homan Ave. to Kedzie Ave., 1,460 lin. ft. brick sewer, 16-ft. cut; 13th St., Spaulding Ave. to Homan Ave., 670 lin. ft. 4½-ft. brick sewer, 15-ft. cut; alley north of 13th Place, Homan Ave. to Central Park Ave., 1,370 lin. ft 4½-ft. brick sewer, 15-ft. cut; Homan Ave., 13th St. to alley north of 13th Place, 55 lin. ft. 4½-ft. brick sewer, 15-ft. cut; 1 concrete bulkhead, 215 manholes, 20 catch basins and wing sewers in intersecting streets as follows: 70 lin. ft. 6.0-ft. brick sewer, 40 lin. ft. 5-ft. brick sewer, 25 lin. ft. 3-ft. brick sewer, 90 lin. ft. 18-in. tile pipe, 420 lin. ft. 20-in. tile pipe, 100 lin. ft. 18-in. tile pipe, 640 lin. ft. 15-in. tile pipe, 940 lin. ft., 12-in. tile pipe. The work requires the removal of all existing sewers, re-connection of present house drains, catch basins, etc.; unit bids for construction of new catch basins and manholes must be submitted. The work requires tunneling under the C., B. & Q. right of way, and the paving of the C. T. T. R. R. subway; $2.50 will be deducted for each sq. yd. of asphalt pavement removed, said pavement to be replaced by the Bureau of Streets. Cash or certified check for 10 per cent of bid must accompany proposal. E. J. Glackin, Secretary of the Board.

✣Bids will be received until 2 p. m., March 3, by Board of Local Improvements, Flora, Ill., for the construction of lateral sewers and water mains in the Fair Addition to the city. The plans and specifications for said system of sewers are to be found at the office of the Board of Local Improvements of said city of Flora, Ill., and a copy thereof has also been deposited at the office of J. S. Spiker, Civil Engineer, Court House, Vincennes, Ind. The contractor for said work will be paid therefor in improvement bonds issued by said city. in anticipation of the collection of the special assessment for the cost of said work, which said assessment has been confirmed by the County Court of Clay County, Illinois, the said bonds to bear 5 per cent interest from their date, payable annually. Bids will be received for the whole work of construction aforesaid. including the furnishing and delivering of all materials, all excavating and laying of said sewer and water mains; save and excepting a part of said work which has already been done. All proposals or bids shall be accompanied by cash or by a check for 10 per cent of the amount bid, payable to the order of W. A. Karr, President of the Board of Local Improvements.

⊙The city of Berwyn, Ill., has awarded to the Ryan Co., 10 S. La Salle St., Chicago. the contract for constructing a brick sewer with necessary manholes, catch basins, house drain connections, as follows: 9,336 lin. ft. 5-ft. brick sewer, 839 lin. ft. 4½-ft. brick sewer, 1,190 lin. ft. 4-ft. brick sewer, 860 lin. ft. 3½-ft. brick sewer, 485 lin. ft. 3-ft. brick sewer. Contract price, $86,337.

⊙Carson & Payson have been awarded the contract by the City Council of Danville, Ill., for the construction of the sanitary sewer and laterals in that territory bounded by Seminary, Griffin, Main and Bowman Ave., and which will be three miles in length.

⊙The Moline Heating & Construction Co., Moline, Ill., has been awarded the contract by that city, Lyle Payton, City Engineer, for the construction of sewers and water mains in Street District No. 25, for $7,246 and $12,319, respectively. Bids were opened Feb. 18.

The City Council of Belvidere. Ill., has passed an ordinance providing for the laying of a sanitary sewer in E. Fourth, E. Second and other streets in that section, to cost about $1,050; also a sanitary sewer in Julien St., Caswell St., Warren Ave. and parts of various other streets in that section, to cost approximately, $4,600. W. M. Mareau is City Engineer.

City Engineer Myron Tarble of Aurora. Ill., is preparing plans for a new sewer district to take in practically all of the territory known as the Oak Park Addition, also the Arlington Heights territory.

The Board of Local Improvements of Dixon, Ill., has passed a resolution originating a scheme for the construction of a vitrified tile pipe sewer with manholes, lamp holes, storm water inlets and house connection laterals on Galena Ave., from the present man-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

hole in Seventh St. to the center line of 10th St. On 10th St., from a manhole to be constructed at the intersection of Galena and 10th to a point 235 ft. west.

The Board of Local Improvements of East St. Louis, Ill., has under consideration two new sewer districts to cost about $600,000. The proposed system will serve Winstanley and Lansdowne. The plans and specifications for the Winstanley sewer are completed. It will cost about $340,000. City Engineer Edwin F. Harper is working on the plans for the Lansdowne section, which will cost about $250,000. William R. Roddenberger is President of the board.

Members of the village boards of Maywood, Melrose Park, Forest Park and River Forest, Ill., recently held a meeting to consider the advisability of incorporating within the Sanitary District so as to be able to build a unified sewerage system.

Hayes Bros. of Kankakee, Ill., have submitted the lowest bid to the Village Board of Bradley, Ill., for the installation of a new sewer system. The estimated cost of the work is $45,000. Bids were opened Feb. 25.

Indiana.

⊙The Board of Public Works of Richmond, Ind., has awarded the contract for the construction of the Reeveston sewer system to F. F. Slick, for $21,523. The work calls for a trunk sewer and lateral branches draining almost 40 acres of ground.

City Engineer William Moore of South Bend, Ind., has submitted an estimate of $3,300 to the City Council as the cost of the Eddy St. trunk sewer.

The Board of Public Works of Evansville, Ind., has passed resolutions for the following sewers: In and along New York Ave., from a sewer in Walnut St., 300 ft. north; local sewer in and along an alley in block 4, Southern enlargement, from a sewer in Bell St. to Mulberry St., between Grant and Line Sts.; a local sewer in and along Morris Ave., from Walnut St. to Olive St., east along Olive St., 300 ft.; local sewer in and along William St., commencing at an alley 400 ft. east of Morris Ave. and running thence east 350 ft.

Iowa.

✣Bids will be received until 10 a. m., Feb. 28, by Paul J. Wells, City Clerk, Sioux City, Ia., for furnishing all material and labor necessary for constructing a sanitary sewer in Vine Ave., from South Newton St. to South Mulberry St., in accordance with plans and specifications prepared by the City Engineer and on file in the office of the City Clerk. Said work shall be completed on or before May 15, 1913. Each bid must be accompanied by a certified check or draft on some bank in Sioux City, Ia., made payable to the City Treasurer of said city, in the sum of 5 per cent of the amount of bid.

The Town Council of Riceville, Ia. (population 844), is considering the advisability of installing a system of sewerage.

The Town Council of Sibley, Ia. (population 1,330), has decided to install a system of sewerage.

The City Council of Eldora, Ia. (population 1,995), has approved the recommendations of the City Engineer as to the extension of sewer and water mains. The estimated cost is $12,000 and $4,000, respectively. The proposition will be submitted to a vote of the people.

Kansas.

The City Commission of Topeka, Kans., on Feb. 20 adopted a resolution providing for the construction of a sewer including all laterals, to be three miles in length. The approximate cost is estimated at $20,000. A. R. Young is City Engineer.

City Engineer G. L. McLane of Hutchinson, Kans., has been instructed by the City Commission to prepare plans for a sewer to serve three blocks on E. C St., between Elm and Cleveland Sts.

Michigan.

✣Bids will be received until 1 p. m., March 17, by Board of Public Works, Ludington, Mich., for about 3,500 ft. of vitrified pipe sewers. Dean Thompson is City Clerk.

The sewer committee of the City Council, Three Rivers, Mich., has reported favorably on the extension of the sewer main in First Ward. Chas. Loudiel, Superintendent of Waterworks, will prepare plans, diagrams, specifications and estimates for the improvement.

The City Council of Dowagiac, Mich., has decided to run the terminus of the proposed trunk sewer outlet down the Indian Lake pike to the creek near the bridge.

The Village Council of Union City, Mich. (population 1,340), has ordered the submission of the question to bond the town to raise money to establish a system of public sanitary sewerage. The election will be held March 10. The estimated cost of the system is $30,000.

Prof. W. C. Hoad of the University of Michigan, has presented plans to the Sewer Commission and Council of Flint, Mich., for a complete system of storm water and sanitary sewers. The approximate cost of the system is estimated at $200,000. H. E. Terry is City Engineer.

The City Council of Bad Axe, Mich. (population 1,559), has employed Engineer R. W. Roberts of Saginaw, Mich., to make a map preliminary to the proposed installation of a sewerage system.

Missouri.

✣Bids will be received until noon, March 7, by Board of Public Improvements, W. T. Findly, Secy., St. Louis, Mo., for the construction of Forest Park Storm Water Channels under Letting No. 10849. The work will embrace the following: Channel (Line B) about 1,930 ft. in length—unlined; section of same 2 ft. wide at bottom with side slopes, 2 horizontal to 1 vertical, average depth about 11 ft. Channel (Line C) about 1,200 ft. in length—unlined; section of same 4 ft. wide at bottom with side slopes 1½ horizontal to 1 vertical, average depth about 15 ft. Extension of 8-ft. inside diameter sewer in concrete, about 22 ft. in length; also concrete head walls and outfall chamber. With all necessary appurtenances. Deposit required, $625. Plans and specifications and forms of contracts may be seen at the offices of the Board of Public Improvements and the Sewer Commissioner. Copy of plans and specifications will be furnished to parties giving two days' notice in advance and upon deposit of $10 in each case, which sums will be returned to depositor upon the return of such plans and specifications.

✣Bids will be received until noon, March 7, by Board of Public Improvements, W. T. Findly, Secy., St. Louis, Mo., for the construction of sewers in Macklind Ave. Sewer District No. 1, under Letting No. 10848. The work will include: Brick and Portland cement mortar sewers—737 ft. of 30x45-in. inside dimensions; 226 ft. of 28x42-in. inside dimensions; 649 ft. of 26x39-in. inside dimensions. Vitrified clay pipe sewers—816 ft. of 24-in. inside diameter; 301 ft. of 21-in. inside diameter; 663 ft. of 18-in. inside diameter; 1,798 ft. of 15-in. inside diameter; 7,267 ft. of 12-in. inside diameter. With sewer inlets, manholes and all other appurtenances. Deposit required, $800.

✣Bids will be received until noon, March 7, by Board of Public Improvements, William T. Findly, Secy., St. Louis, Mo., for the construction of sewers in Claise Creek Sewer District No. 7, under Letting No. 10847. The work will include the following approximate quantities: Brick and Portland cement mortar sewer—400 ft. of 50-in. inside diameter. Vitrified clay pipe sewers—450 ft. of 33-in. inside diameter; 424 ft. of 24-in. inside diameter; 424 ft. of 15-in. inside diameter; 1,075 ft. of 12-in. inside diameter. With sewer inlets, manholes, and all other appurtenances. Deposit required, $463.

✣Bids will be received until 2 p. m., March 6, by City Clerk, Richmond, Mo., for the construction of sewers. Instructions to bidders may be obtained of Worley & Black, Engineers, Reliance Bldg., Kansas City, Mo.

⊙The Board of Public Works of St. Joseph, Mo., has awarded contracts for the construction of sewers in District No. 132 to Olsen-Smith Construction Co., and to E. F. Mignery for a sewer in District No. 103.

Property owners in Springfield, Mo., have asked that the sewer mains east of the territory included in the State Normal district to take in the Sheppard addition be extended. C. E. Phillips is City Engineer.

The City Council of St. Joseph, Mo., is reported to have rejected the two bids received recently for the construction of the lower Whitehead sewer extension, for which $20,000 was appropriated by Council. It is probable the work will be done by day labor.

Montana.

⊙The City Council of Dillon, Mont., has awarded the contract for the construction of sewers in District Five and A. to Lindstrom & Oren, of Butte, Mont., for $11,798. They also secured the contract to construct sewers in District No. 6, for $3,832.

Nebraska.

✣Bids will be received until 4 p. m., Feb. 28, by Leslie Neubauer, Village Clerk, Sidney, Nebr., for the construction of a sewer system, main and laterals, and a disposal plant. The approximate quantities of work to be done, as follows (main and lateral sewer system): 16,470 lin. ft. of 8-in. vitrified pipe sewer; 4,586 lin. ft. of 10-in. vitrified pipe sewer; 3,100 lin. ft. 12-in. vitrified pipe sewer; 120 lin. ft. 10-in. cast iron pipe sewer; 156 lin. ft. pipe line; 58 manholes; 10 flush tanks; (disposal plant) 410 cu. yds. excavation; 110 cu. yds. reinforced concrete; 2 manholes; 6 valves; 782 lin. ft. pipe line; 2,400 lin. ft. 6-in. ½ round tile; (feed and discharge apparatus) 320 lin. ft. fence. The engineer's estimate of cost is $20,720. Each bid must be accompanied by a certified check for $1,000, made payable to the Village of Sidney, Nebraska, as a guarantee of good faith. Plans and specifications may be seen and proposal blanks obtained at the office of the Village Clerk, or at the office of the engineers, Grant & Fulton, 402 F. & M. Bldg., Lincoln, Nebraska. Bidders desiring plans and specifications for their own use may obtain the same from the engineer upon payment of $5.

Plans have been completed for the construction of a sewerage disposal system in the city of Broken Bow, Nebr. The system will comprise three air-tight compartments. Work is to begin at once.

New Jersey.

Engineer Robert Gaw has completed plans and specifications for the installation of a sewer system in North Bergen (P. O. Jersey City), N. J. Adolph Asmus is Mayor.

New York.

✣Bids will be received until 2 p. m., March 11, by Passaic Valley Sewerage Commissioners, Essex Bldg., Newark, N. J. J. S. Gibson, Clerk for the construction of the northerly portion of Section 6 of the main intercepting sewer in the city. The work will include the following approximate quantities: Item 1.—Earth excavation and refilling, in trench, for 150-in. sewer, 3,000 lin. ft. Item 2.—Concrete masonry, in trench, Portland cement mortar, 9,000 cu. yds. Item 3.—Brick masonry, in manholes, laid with Portland cement mortar, and appurtenant work, 100 cu. yds. Item 4.—Rock excav., in trench, 500 cu. yds. Drawings, form of contract, specifications and blank form for proposal may be obtained at the Commissioners' office from William M. Brown, Chief Engineer.

✣Bids will be received until 2 p. m., March 11, by Passaic Valley Sewerage Commissioners, J. S. Gibson, Clerk, Newark, N. J., for the construction of the southerly portion of Sec. 6 of the main intercepting sewer. The work will include the following approximate quantities: Item 1.—Earth excavation and refilling, in trench, for 150-in. sewer, 2,600 lin. ft. Item 2.—Concrete masonry, in trench, Portland cement mortar, 8,000 cu. yds. Item 3.—Brick masonry, in manholes, laid with Portland cement mortar, and appurtenant work, 100 cu. yds. Item 4.—Rock excavation, in trench, 10,000 cu. yds. Drawings, form of contract and specifications and blank form for proposal may be obtained at the Commissioners' office from William M. Brown, Chief Engineer.

City Engineer Julius F. Frehsee of Lockport, N. Y., has prepared plans for the construction of a garbage disposal plant in that city. It is estimated that the plant will cost between $8,000 and $10,000.

The Village Board of Liverpool, N. Y. (population 1,388), is considering the advisability of installing a sewerage system. The proposition will probably be submitted to the vote of the people.

The Chamber of Commerce of Perry, N. Y., is advocating the holding of an election for the purpose of voting on the issuance of bonds to the amount of $25,000 for the installation of a sewerage system at and around Silver Lake.

North Carolina.

⊙The American Light & Water Co., of Chicago, Ill., will start work at once on the construction of the extension to the municipal sewerage system of Wilmington, N. C. The contract price is $151,000.

Ohio.

✣Bids will be received until noon, Feb. 27, by Charles E. Stage, Director of Public Safety, Cleveland, O., for furnishing materials and labor for the construction of the sewer work in connection with the buildings of the new City Hospital group, to be erected on Scranton Road S. W., Cleveland, Ohio. Plans and specifications may be seen at the office of Myron B. Vorce and E. J. Willingdale, Associated Architects, Garfield Bldg., and at the office of the City Engineer, City Hall.

✣Bids will be received until noon, March 6, by W. J. Springborn, Director of Public Service, Cleveland, O., for the construction of sewers in the following named streets: Harvard Ave., S. E., between E. 123rd St. and E. 127th St.; E. 127th St., between Harvard Ave., S. E., and Erie R. R.; Marston Ave., S. E., between E. 27th St. and E. 136th St.; E. 136th St., between Crennell Ave., S. E., and Miles Ave., S. E.; E. 131st St., between Marston Ave., S. E., and Caine Ave., S. E.; Woodworth Rd., N. E., between St. Clair Ave., N. E., and Coit Rd., N. E.; Sellars Ave., N. E., between E. 112th St. and E. 117th St.; E. 103rd St., between St. Clair Ave., N. E., and Marlowe Ave., N. E.; St. Clair Ave., N. E., between E. 103rd St. and 700 ft. E. of E. 105th St. Each bid must be made in accordance with the plans and specifications which may be seen at the office of the chief engineer, room 305 City Hall. W. H. Kirby is Secretary.

✣Bids will be received until noon, March 12, by Director of Public Works, Newark, O., for the construction of the following sewers: Union St., drainage sewer; Maholm St., drainage sewer; North St., drainage sewer; North St., sanitary sewer; Granville St., drainage sewer; Columbia and Seventh Sts., sewer; Baker and South Third Sts., sewer. The work will include 650 ft. 30-in. sewer; 2,676 ft. 24-in. sewer; 1,279 ft. of 20-in. sewer; 637 ft. of 18-in. sewer; 1,188 ft. of 15-in. sewer; 4,688 ft. of 12-in. sewer; 956 ft. of 10-in. sewer; 812 ft. of 8-in. sewer; 1,114 ft. of 6-in. sewer; 31 manholes, 33 catch basins, 43 inlets, 8 lampholes, 107 12x6-in. Ys; 5 10x6-in. Ys, 12 30x6 Ys, 75 24x6-in. Ys, 22 15x6-in. Ys, 25 20x6-in. Ys, 12 18x6-in. Ys, 2 8x6-in. Ys; also ½ cu. yd. of concrete and 72 lin. ft. 16-in. C. I. pipe. C. H. Wells is City Engineer.

Oklahoma.

⊙Following contracts have been awarded by the City Commission of Tulsa, Okla., for the construction of sanitary sewers, as follows: District No. 79, Wells Franklin Co., $8,125; District No. 80, Joe T. Lantry, $6,993; District No. 81, Joe T. Lantry, $6,214; District No. 82, Dunn & McDonnel, $1,820; District No. 83, Wells Franklin Co., $5,670; District No. 84, Wells Franklin Co., $12,593, and District No. 85, Joe T. Lantry, $4,503. C. O. Frye secured the contracts for the outlet sewer for the above sewers at $1,076 and $613 and $1,560, respectively.

The city of Henryetta, Okla., has employed the Benham Engineering Co. of Oklahoma City, Okla., to draw plans and specifications and supervise the construction of a system of sanitary sewers for which bonds will be voted upon. The amount of the issue will approximate $50,000.

Oregon.

⊙Contracts for sewer work have been awarded by the sewer committee of the City Council, Portland, Ore., as follows: Hancock St. from East Twenty-eighth to East Thirty-third—Bechill Brothers, $2,720; East Forty-ninth St. from Hancock to Sandy—Reliance Construction Co., $2,720; East 49th St. from Hancock to Sandy—Reliance Construction Co., $1,185; Tillamook St. from East Twenty-seventh to East Thirty-third—Y. Rickard, $2,803; Broadway St. from East Twenty-eighth to East Thirty-third—Bechill Brothers, $2,921; East Fifty-first St. from Tillamook to Sandy—Joe Chelich, $847; East Thirtieth St. from East Harrison to East Sherman—Consolidated Contract Co., $643; Schuyler St. from East Twenty-eighth to East Thirty-third—Bechill Brothers, $2,477; East Fiftieth St. from Hancock to Sandy—Reliance Construction Co., $1,178.

Pennsylvania.

✣Bids will be received until 8 p. m. March 6, by Borough Council, Carlisle, Pa., for the construction of a sewage disposal plant, outfall sewage and portion of sewer system. The work to be done will be let in three separate contracts, entitled Contracts "A," "B," and "C," and proposals may be submitted for one or more, but each will be considered a separate proposal. Contract "A" embraces the construction of a complete sewage disposal plant including 2,000 ft. of 24-in. terra cotta effluent pipe. Contract "B" embraces the construction of 2,833 ft. of 18-in. terra cotta pipe, sewer, 4,800 ft. of 24-in. terra cotta pipe sewer and 24 manholes. Contract "C" embraces the construction of 37,500 ft. of terra cotta pipe sewers with manholes, flush tanks and other accessories, and 4,300 ft. of storm water drains with street inlets and appurtenances. Each proposal submitted for either contract must be accompanied by a certified check drawn upon a national or state bank, or trust company, and to the order of the Borough of Carlisle, for the sum of $1,000.

Specifications and blank forms of proposal may be obtained after February 21, either at the office of John T. Hiteshew, Borough Engineer, or T. Chalkley Hatton, Chief Engineer, Wilmington, Del. Full sets of plans can be seen at either of the above offices, and a full set of blue prints may be obtained from the Chief Engineer upon the payment of $5, such sum to accompany the order. Paul Willis is Borough Secretary, Carlisle, Pa.

Mayor John P. Longenecker of Lebanon, Pa., and the City Paving Commission have recommended to City Councils that the proposition of increasing the city's bonded debt by $300,000 for house and storm sewerage and street paving be submitted to the voters at a special election.

The Board of Public Works of Reading, Pa., has authorized City Engineer E. B. Ulrich to advertise for bids for storm sewers for which the plans and specifications have been prepared.

South Dakota.

The City Council of Howard, S. Dak. (population 1,026), has taken steps toward installing a sewerage system.

The citizens of Frankfort, S. Dak. (population 408), on Feb. 19 voted the issuance of bonds to the amount of $700 for the extension of the sewerage system.

Tennessee.

A bill is now pending in the Tennessee Legislature authorizing the town of Park City, Tenn., to issue bonds to the amount of $10,000 for the construction of sewers.

Texas.

The city of El Paso, Tex., proposes to have the deep sewer line constructed first from the recently sold $400,000 bonds The surveys for the line have been completed. Herbert Nunn is City Engineer.

Tennessee.

Bids as follows were received Jan. 31 by Maj. E. M. Markham, U. S. Engineer, Memphis, Tenn., for furnishing 10,000 cu. yds. of rip rap stone on Government barges: W. B. Arnold, Cape Girardson, Mo., $1.05 per cu. yd.; quarry 1½ miles above Heely's Landing, Mo. C. C. Huthmacher, Grand Tower, Ill., $.95 (recommended for acceptance); quarry opposite Grand Tower, Ill. C. B. Hoeller, Cape Girardson, Mo., $1.33; quarry Brainbridge, Mo. J. B. Miles, Jr., Helena, Ark., $1.67½; delivered on barges at Helena, Ark.

Washington.

⊙The Jahn Contracting Co., of Seattle, Wash., submitted the only bid to the City Commissioners of Everett Wash. for the construction of the Harrison St. trunk sewer. The company secured the contract on a bid of $162,500.

Wisconsin.

✣Bids will be received until 4 p. m., Feb. 28, by Board of Public Works, Sheboygan, Wis., for the necessary labor and material for the construction of sewers including approximately 1,036 ft. of 10-in. vt. pipe; 858 ft. 15-in., 668 ft. 12-in., and 200 ft. of 20-in. vit. pipe sewer; 13 manholes. A certified check for $1,200 must be filed with each bid. John Kummer is Comptroller.

✣Bids will be received until 7 p. m., March 1, by Board of Public Works, Prairie du Chien, Wis., for the construction of sewers, manholes, lampholes, etc. W. H. Turbitt is City Clerk.

⊙Mulholland-Kuehn & Co. have been awarded the contract by the city of New London, Wis., for the construction of a sewer on Cook St., between Wyman and Dorr Sts., and on Dorr St., between Cook and Wolf Sts. Bids were opened Feb. 18.

The City Council of Marinette, Wis., has voted to again submit to the voters at the election April 1 the question on bonding for $20,000 for an addition to the main brick sewer to drain portions of the Fifth Ward.

The city of Lake Geneva, Wis., will lay sewers in two districts this coming season. Plans for the same will be revised by W. G Kirchoffer, Sanitary & Hydraulic Engineer, Madison, Wis.

The city of Park Falls, Wis., proposes to lay about one mile of sewer this year and have plans prepared for the balance of the city. W. G. Kirchoffer, Sanitary & Hydraulic Engineer, Madison, Wis., is making a preliminary estimate.

Sanitary & Hydraulic Engineer W. G. Kirchoffer, Madison, Wis., has been engaged by the city of Boscobel, Wis. (population 1,552) to make estimates on a sewer system.

The village of Sheboygan Falls, Wis. (population 1,630), has under consideration the installation of a sewerage system. W. G. Kirchoffer, Madison, Wis., is Engineer.

Canada.

✣Bids will be received until noon, March 4, by H. C. Hocken, Chairman, Board of Control, Toronto, Ont., for the construction of sewers on the following streets: Main St., Kingston Rd. to Gerrard St.; Gerrard St., Morton Rd. to Wayland Ave. Specifications and tender forms may be obtained upon application at the office of the Sewer Branch, Department of Works, City Hall, Toronto.

BUILDINGS

Illinois.

The City Council of Chicago has appropriated $150,000 for constructing an addition to the Lawson school, containing 12 class rooms, assembly hall, gymnasium, manual training room, etc.; $150,000 for constructing addition to the Ryerson school, containing 12 class rooms, etc.; $100,000 for constructing an addition to Chicago Lawn school; $350,000 for constructing an addition to the Austin high school, containing laboratories, gymnasium, swimming pool, mechanical drawing rooms, etc.

Indiana.

✣Bids will be received until 2:30 p. m., March 10, by Melvin Chapman, School Trustee, Pendleton, Ind., for the construction and completion of a new addition to the Pendleton high school.

✣Bids will be received until 10 a. m., April 8, by Commissioners of Adams County, Decatur, Ind., for the construction of a soldiers' monument. T. H. Baltzell is County Auditor.

Kansas.

✣Bids will be received until 3 p. m., March 31, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring interior lighting fixtures and approaches, of the United States post office at Concordia, Kan. The building is two stories and basement and has a ground area of approximately 4,750 sq. ft. First floor only fireproof; stone facing and tin roof. Drawings and specifications may be obtained from the custodian of site at Concordia, Kan., or at the discretion of the Supervising Architect. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 3 p. m., April 4, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction, complete, including plumbing, gas piping, heating apparatus, electric conduit and wiring and lighting fixtures, of the United States post office at Ottawa, Kan. The building is one-story and basement, with a ground area of approximately 4,800 sq. ft. Fireproof construction; stone facing; tin roof. Drawings and specifications may be obtained from the custodian of site at Ottawa, Kan., at the discretion of the Supervising Architect.

✣Bids will be received until 10 a. m., March 18, by R. V. LaDow, Supt., Prisons, Department of Justice, Washington, D. C., for furnishing and delivering at the U. S. Penitentiary at Leavenworth, Kan., sash weights, chains and pulleys required for the hospital building, U. S. Penitentiary.

Maryland.

⊙L. C. Culler, Frederick, Md., has been awarded the contract at $33,165 for constructing a state armory at Frederick, bids for which were opened Feb. 15. The contract includes plumbing, but does not include heating, electric wiring and fixtures.

Missouri.

✣Bids will be received until 3 p. m., April 1, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction, complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures and approaches, of the United States post office at Rolla, Mo. The building is two stories and basement, and has a ground area of approximately 3,960 sq. ft. First floor only fireproof, stone and brick facing and slate roof. Drawings and specifications may be obtained from the custodian of site at Rolla, Mo., or at the discretion of the Supervising Architect.

New Jersey.

✣Bids will be received until 7 p. m., March 6, by New Jersey Sanatorium for Tuberculous Diseases, Glen Gardner, N. J., for the erection of buildings, as per plans and specifications in the offices of the Commissioner of Charities and Corrections, State house, Trenton, N. J., and the sanatorium superintendent at Glen Gardner, N. J. Each bid must be in a separate envelope, with its contents plainly designated, and accompanied by cash or certified check, payable to E. J. Burke, treasurer, for 10 per cent of the estimate, which will be returned to the unsuccessful bidders immediately following the award of the contract. The successful bidder will file with the managers within a specified time a surety bond for double the amount of the contract, guaranteeing faithful fulfillment of the same. For further information, plans and specifications, address Commissioner of Charities and Corrections, State house, Trenton, N. J., or Dr. Samuel B. English, Sanatorium, Glen Gardner, N. J.

New York.

✣Bids will be received until 3 p. m., March 21, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for fire escapes and elevator shaft enclosures for the U. S. Appraiser's Warehouse at New York, N. Y., in accordance with drawing No. 236 and this specification, copies of which may be had at this office, or at the office of the Chief Engineer and Superintendent of Repairs, 727 Custom-House Bldg., New York, N. Y., at the discretion of the Supervising Architect. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 3 p. m., March 25, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for four pick-up tables in the new United States post office building, New York, N. Y., in accordance with the specification, copies of which may be obtained at the discretion of the Supervising Architect.

✣Bids will be received until 3 p. m., March 21, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for a controllable standpipe or sprinkler system at the United States Appraisers' Warehouse, New York, N. Y., in accordance with the specification and drawings enumerated therein, copies of which may be obtained from the Supervising Chief Engineer, New York, N. Y., or at the discretion of the Supervising Architect.

North Dakota.

All bids received Feb. 14 for constructing a dormitory for state normal school at Minot, N. Dak., exceeded available funds and action was deferred until the next meeting of the Board in March. The lowest bids were as follows: D. A. Dinnie, Minot, N. Dak., general contract, $72,071; Minot Plumbing & Heating Co., plumbing and heating, $15,115; Olson-Boettgie Electric Co., St. Paul, Minn., electric wiring, $1,425. A. G. Crane, Minot, is President of the school.

Ohio.

The American Steel & Wire Co., Cleveland, O., is to expend about $600,000 installing new mills for the enlargement of its cold roll and flat wire department at its Cuyahoga plant, Cleveland.

Pennsylvania.

✣Bids will be received until noon, Feb. 28, by Board of Public Education, 725 Fulton Bldg., Pittsburgh, Pa., for repairing and remodeling the 12th Ward School No. 2. George W. Gerwig is Secretary.

The American Sheet & Tin Plate Co. is to expend about $500,000 in increasing its capacity for high-grade streets and specialties at its plant at Farrell, Pa.

South Carolina.

✣Bids will be received until noon, March 3, by S. R. Boylston, Secretary, Board of Trustees, Blackville, S. C., for furnishing all labor and material necessary to erect and complete a two-story brick school building with basement, to be erected at Blackville, S. C., in accordance with plans and specifications prepared by G. Lloyd Preacher, architect and engineer, Augusta, Ga., from whom plans can be secured by depositing $10, guaranteeing same to be returned in good condition. Proposals for heating, plumbing and electric work will be received later under separate contract.

Texas.

✣Bids will be received until 3 p. m., March 22, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction of a pole line, exterior lighting system, interior wiring system and lighting fixtures for the United States Quarantine Station at Galveston, Tex., in accordance with drawings and specification, copies of which may be obtained at the office of the custodian at Galveston, Tex., quarantine station, at the discretion of the Supervising Architect

Virginia.

Bids as follows were received Feb. 10 by the U. S. Engineer, Norfolk, Va., for removing wreck of the Italian Barge, Rosalia D'Ali, from Hampton Roads, Va., (1) being bid for removing wreck bodily, (2) for removal by use of explosives: Baxter Wrecking Co., 308 Spring St., New York, N. Y., (1) $22,460; F. Staud Ximenez, care I. W. Trautwein, City Dock, Annapolis, Md., (1) $24,960 (informal); T. A. Scott & Co., Inc., 229 Pegnot Ave., New London, Conn., (1) $25,325 (informal); King & Wetherspoon, Inc, 149 Broadway, New York, N. Y., (1) $24,745; Merritt & Chapman Derrick & Wrecking Co., 17 Battery Pl., New York, N. Y., (1) $21,550; Johnston & Virden, Lewes, Del., (1) $28,000, (2) $14,500; Lewis W. Blix, 363 47th St., Brooklyn, N. Y., (2) $12,900 (informal).

Wyoming.

✣Bids will be received until 2 p. m., March 15, by Commissioner of Indian Affairs, Washington, D. C., for furnishing the necessary labor and material for the construction of a frame day school building at the Arapaho Indian Day School, Shoshone Reservation, Wyo.

Canada.

✣Bids will be received until noon, March 5, by J. H. Puntin, Architect, 308 Darke Bldg., Regina, Sask., for work and material in all trades (except plumbing, heating and ventilating) required in the erection and completion of a Public School building. Each tender must be accompanied by a marked cheque for five per cent of the amount of the tender.

✣Bids will be received until 5 p. m., March 6, by the Winnipeg Public School Board, R. H. Smith, Secretary-Treasurer, Winnipeg, Man., for electrical machinery, equipment and tools required in connection with the Kelvin and St. John's Technical High Schools. For specifications, form of tender or further information desired, apply direct to J. B. Mitchell, Commissioner of Supplies, School Board Office.

✣Bids will be received until 4 p. m., March 4, by R. C. Des Rochers, Secretary, Department of Public Works, Ottawa, Ont., for the construction of Armory, Port Arthur, Ont. Plans, specification and form of contract can be seen and forms of tender obtained at the office of the City Clerk at Port Arthur, Ont.; at the office of H. E. Matthews, Esq., Superintending Architect of the Dominion Public Buildings, Winnipeg, Mann.

⊙The Department of Public Works of Canada has awarded the contract for addition and alteration to public building at Oshawa, Ont., to S. F. Whitham, Belleville, Ont.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

RIVERS AND HARBORS

Connecticut.

✣Bids will be received until 2 p. m., March 22, by Maj. G. B. Pillsbury, U. S. Engineer, New London, Conn., for dredging Branford Harbor, Conn.

Delaware.

Bids as follows were received Feb. 11 by Maj. K. R. Raymond, U. S. Engineer, Wilmington, Del., for dredging about 15,500 yds. sand, gravel and some bog iron from Appoquinimink River, Delaware: Atlantic Dredging Co., Philadelphia, Pa., 44.9 cts. per cubic yard; River & Harbor Improvement Co., Philadelphia, Pa., 43 cts.; The Rickards Dredging Co., Philadelphia, Pa., 29 cts.

District of Columbia.

✣Bids will be received until noon, April 21, by contract one destroyer tender (No. 2). the Navy, Washington, D. C., for constructing by contract one destroyed tender (No. 2).

✣Bids will be received until 2:30 p. m., March 6, by Maj. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under canal circular 763-A pig iron, pig lead, sheet brass, annealed copper, hoisting cable, chain, rope clips, dies, vices, drills, files, chain blocks, etc.

Georgia.

✣Bids will be received until noon, March 6, by City Council of Augusta, Ga., for furnishing all labor and material, cofferdams and other necessary work and constructing, complete, a reinforced concrete bulkhead across the tail race of the Sibley Mill. Approximate quantities: 3,750 cu. yds. of concrete, 1,900 cu. yds. earth excavation, 2,000 cu. yds. rock excavation, 45 tons of reinforcing steel, 6 gates, forms and controlling apparatus complete. Also, at the same time and place, bids will be received for the construction of reinforced concrete bulkhead and gates across the tail race of the King Mill. Estimated quantities: Concrete, 2,950 cu. yds.; earth excavation, 2,100 cu. yds.; rock excavation, 1,500 cu. yds.: reinforcing steel, 40 tons, 5 gates and controlling apparatus complete. The two jobs will be let as separate contracts, and bids must be made in lump sum for each, but one bidder may submit proposal on both. The work will be paid for in cash on monthly estimates. And a construction bond in amount one-quarter of the contract price will be required. Proposal blanks, plans and specifications may be had on application to the chief engineer. Nisbet Wingfield is Chief Engineer, 747 Broad St., Augusta, Ga.

✣Bids will be received until noon (Eastern Standard time), March 19, by Col. D. C. Kingman, U. S. Engineer, Savannah, Ga., for furnishing and placing stone for raising low places in jetties at Cumberland Sound, Ga., and Fla., and in Jekyl Creek, Ga., and for raising and extending the jetty in Brunswick Harbor, Ga.

The wharves and other property on the water front at Savannah, Ga., destroyed by fire on Feb. 2, with a loss of about $1,000,000, are to be at once rebuilt. The wharves were owned by the Merchants' & Miners' Transportation Co., the Ocean Steamship Co., and the Central Ry.

Hawaii.

✣Bids will be received until 11 a. m., March 22, by Bureau of Yards & Docks, Navy Department, Washington, D. C., for one 200 kw. motor generator set and switch board accessories at naval station, Pearl Harbor, H. T. H. R. Standford is Chief of Bureau.

✣Bids will be received until 11 a. m., April 15, by Bureau of Yards and Docks, Navy Department, Washington, D. C., for 30 20-yd. air dump cars at the naval station, Pearl Harbor, Hawaii. H. R. Stanford is Chief of Bureau.

Illinois.

The Illinois and Michigan Canal Commission, with headquarters at Lockport, Ill., has made final preparations for presenting to the State Legislature its bill asking for an appropriation of $1,000,000 for the rehabilitation of the channel constructed 60 years ago.

Maryland.

The Northern Central Ry., J. H. Nichol, Principal Assistant Engineer, Williamsport, Pa., is reported to be planning the construction of two large freight piers along the lines of its deep waterway docks at Canton.

Massachusetts.

⊙Bids as follows, per cubic yard, were received Feb. 15 by Col. Frederic V. Abbott, U. S. Engineer, Boston, Mass., for road excavation in Beverly Harbor: Gilbert H. Harries, Boston, Mass., $29.35; Eastern Dredging Co., Boston, Mass., $28.37 (awarded contract); Johnston & Virden, Lewes, Del., $28.90.

Missouri.

Bids as follows were received Feb. 17 by Maj. Herbert Deakyne, U. S. Engineer, Kansas City, Mo., for constructing 12,000 lin. ft. of standard revetment at Pinckney Bend:

	Per lin. ft.
Fox & Bristol, St. Louis, Mo	$ 9.30
Rust & Swift, St. Louis, Mo	10.15
Dewitt & Shobe, Glasgow, Mo	9.90
J. W. McMurray Contracting Co., Kansas City, Mo	9.90
McGuire, Stanton & Jones, Leavenworth, Kansas	8.74

The following bids were received Feb. 17 by Maj. Herbert Deakyne, U. S. Engineer, Kansas City, Mo., for 12,000 ft. of standard revetment construction at St. Aubert Bend:

	Per lin. ft.
Fox & Bristol, St. Louis, Mo	$ 9.30
Rust & Swift, St. Louis, Mo	9.79
Farney, Morsman Construction Co., Kansas City, Mo	11.15
J. W. McMurray Contracting Co., Kansas City, Mo	10.90
McGnire, Stanton & Jones, Leavenworth, Kansas	9.47

New Jersey.

Bids as follows were received Feb. 13 by Maj. R. R. Raymond, U. S. Engineer, Wilmington, Del., for dredging Alloway Creek, N. J.: Atlantic Dredging Co., Philadelphia, Pa., 15.4 cts. per cubic yard: River & Harbor Improvement Co., Philadelphia, Pa., 17.5 cts.; The Rickards Dredging Co., Philadelphia, 17.5 cts.

The following bids were received Feb. 11 by Maj. R. R. Raymond, U. S. Engineer, Wilmington, Del., for dredging about 90,000 cu. yds. of sand and gravel from the Maurice River: The Rickard Dredging Co., Philadelphia, Pa., 15½ cts. per cu. yd.; River & Harbor Improvement Co., Philadelphia, Pa., 18 cts.; Atlantic, Gulf & Pacific Co., New York City, 17.94 cts.

Bids as follows were received Feb. 11 by Maj. R. R. Raymond, U. S. Engineer, Wilmington, Del., for dredging about 90,000 cu. yds. of mud and sand in Absecon Creek: Hill Dredging Co., Atlantic City, N. J., 10½ cts. per cu. yd.; The Rickards Dredging Co., Philadelphia, Pa., 14 cts.

The Rickards Dredging Co., Philadelphia, Pa., at 14½ cts. per cu. yd. was the only bidder Feb. 8 for dredging about 21,000 cu. yds. of mud, sand and gravel in Raccoon Creek for the U. S. Government.

Bids as follows were received Jan. 31 by Col. Wm. T. Rossell, U. S. Engineer, New York City, for dredging in Hackensack River, N. J.: Atlantic, Gulf & Pacific Co., Park Row Bldg., New York City, 19.9 cts. per cu. yd.; John A. Seely, 30 Church St., New York City, 45 cts.; Standard Engineering Co., Howard K. Stokes, Propr., 11 Pine St., New York City, 16 cts.; John & Joseph McSpirit, 118 Wayne St., Jersey City, N. J., 50 cts.; P. Sanford Ross, Incorporated, 277 Washington St., Jersey City, N. J., 36½ cts.

Bids as follows for dredging in South River, N. J., were received Jan. 31 by Colonel Wm. T. Rossell, Corps of Engineers: Frank W. Mankowski, Jr., Old Bridge, N. J., 34 cts. per cu. yd.; Atlantic, Gulf & Pacific Co., Park Row Bldg., New York City, 13.89 cts.; John A. Seely, 30 Church St., New York City, 54.9 cts.; Standard Engineering Co., Howard K. Stokes, Propr., 11 Pine St., New York City, 14.33 cts.; Coastwise Dredging Co., Norfolk, Va., 23.9 cts.; John H. Gerrish, 81 New St., New York City, 55½ cts.; P. Sanford Ross, Incorporated, 277 Washington St., Jersey City, 36½ cts.

New York.

✣Bids will be received until noon, March 18, by D. W. Peck, Superintendent of Public Works, Albany, N. Y., for improving the New York State Canals as follows: Contract No. 65, Erie Canal, Section 10—For the improvement of the Erie Canal from the west end of Contract No. 9 to the east end of Contract No. 64 at Medina. Length, 2.31 miles. Contract No. 72-A, Champlain Canal, Section 1—For completing the excavation of a channel in the Hudson River and performing work incidental thereto, from Lock No. 2 to Lock No. 4, and for completing the construction of the upper approach wall of Lock No. 3. Length, 4.1 miles. Plans may be seen and detailed specifications, engineer's estimate of quantities, proposal blanks, form of contract and bonds required, and other information for proposers may be had at the office of the Superintendent of Public Works at Albany, N. Y., at the office of the Assistant Superintendent of Public Works for the Middle Division at Syracuse, N. Y., at the office of the Assistant Superintendent of Public Works for the Western Division at Rochester, N. Y.; and at the canal office, Spaulding's Exchange, Buffalo, N. Y. Copies of detailed plans or drawings may be obtained from J. A. Russel, State Engineer and Surveyor at Albany, N. Y., upon payment to him of the cost of producing them.

⊙D. L. Taylor & Co., Utica, N. Y., has been awarded the contract, at $126,834, by the State Department of Public Works, for the construction of the barge canal terminal on Lake Champlain at Plattsburg, N. Y.

Bids will be received at once by William Fitzgerald, Kirk Bldg., Syracuse, N. Y., for subcontract for Improvement of Onondaga Creek, Syracuse, N. Y. The work to be done includes 5,400 cu. yds. excavation and 10,500 cu. yds. of concrete masonry. Plant consists of steam shovel, dinkey, dump cars, pumps, concrete mixers, etc., on hand.

Ohio.

The Great Lakes Dredge & Dock Co., Cleveland, O., was low bidder, Feb. 19, at 17.9 cts. per cubic yard, for dredging river for the city of Cleveland. About $60,000 is available for the dredging work.

Oregon.

✣Bids will be received until 11 a. m., March 10, by Jay J. Morrow, Maj. U. S. Engineer, Portland, Ore., for furnishing 100,000 bbls. cement.

Pennsylvania.

✣Bids will be received until 9 a. m., March 7, by J. B. Baker, Supt., Pennsylvania R. R., 32nd St. and Powelton Ave., Philadelphia, Pa., for pumping ashore all silt dredged from the railroad company's docks on the west side of the Delaware, including approximately 350,000 cu. yds. The railroad will do all dredging and deliver the material to the blower.

Canada.

⊙The Department of Public Works of Canada has awarded contracts for improvements at Hamilton, Ont., including wharf or retaining wall and dredging for improvements of harbor to John Taylor, W. H. Poupore, J. W. Hennessy & W. H. Dwyer, care John Taylor, 183 Slater St., Ottawa, Ont.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ENGINEERING AND CONTRACTING

**Devoted to the Economics of Civil Engineering Design
and to Methods and Cost of Construction**

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Consolidated Subgrades for Roads and Streets.

In spite of the fact that authorities on highway construction are a unit in advocating rolling subgrades, there is so little study given to this feature of road construction that no general improvement in subgrade work has occurred in twenty years. True it is that specifications call for rolling of earth road beds "to the satisfaction of the engineer," and equally is it true that the engineer is usually satisfied if a smooth roller irons the earth by a few passes to and fro, without effecting any marked degree of compaction.

Let the engineer who questions this assertion that subgrades are not well compacted by smooth rollers try a simple experiment. The test may consist in attempting to drive a sharp two-by-two-inch stake into the subgrade that has been rolled. If the stake can be driven three inches deep without shattering the wood, then the subgrade is not as compact as it should be. Of course sand is excluded from such a test, for no amount of rolling of dry sand can make it compact.

If the stake-driving test is applied to the average subgrade that is supposed to have been compacted by rolling, it will be found that the ground offers no great resistance to the penetration of the stake. But, it will be asked, can earth be easily compacted to such a degree that a wooden peg cannot be driven into it? A simple experiment will answer the question. Let the experimenter place some loose earth in a box, to a depth of 8 or 9 ins. Sprinkle the earth and then thrust an iron railroad spike into it, head down until the spike head reaches the bottom of the box. Withdraw the spike and repeat this operation again and again, varying the places where it is thrust down. The earth will begin to harden at the bottom of the box as this process continues, and then the spike should be struck with a hammer each time it is thrust down. The hammering of the earth with a tamper that penetrates to the bottom of the loose earth effects a consolidation that is astonishing to any one who has never made an experiment of this sort. It will be found that moist earth compacted in this manner is so dense that a wooden stake cannot be driven into it. No other method known to the writer will invariably and quickly accomplish this result. But can the result be attained at small cost?

The writer recently saw the subgrade of a road that had been compacted in this manner at a cost of 1 ct. per sq. yd. This included harrowing the plowed soil, sprinkling with water and rolling with a "rolling tamper" (a roller provided with projecting lugs or tampers). The road is one just outside of Los Angeles, and is being built by the Los Angeles County Highway Commission. So compact was the earth subgrade thus "tamped" that a hardwood stake could not be driven into it. Upon the subgrade thus compacted there was laid a 5-in. concrete pavement surfaced with asphaltic oil and screenings. The writer believes that this 5-in. pavement on such a base will support a much greater load than a 6-in. pavement on a subgrade rolled with a smooth roller. In fact, it would not be surprising were it to be found that 4 ins. of concrete on a "tamped" earth base would support as great a load as 6 ins. of concrete on the ordinary subgrade "rolled to the satisfaction of the engineer." Since a square yard of concrete an inch thick ordinarily costs about 15 cts., and since the compacting with a "rolling tamper" costs 1 ct., it is evident that the saving of even an inch of thickness of concrete by this tamping results in a very great gain in economy of pavement construction.

Engineers have devoted much time to experimenting with road surfaces. How much time have they spent experimenting to effect consolidation of subgrades?

California's pioneer experiments in this line have received more or less public notice, but the importance of the success achieved in California is scarcely known outside of that state.

The Protection of and the Elimination of the Shallow Well.

Realizing that the shallow well is a potent agency in spreading typhoid fever, it is, at first thought, rather hard to understand why the elimination of such wells is so difficult to attain, both in rural and urban communities. There are several considerations, however, which cause the owner of the shallow well to cling to it in preference to another water supply. Chief among these considerations are those arising from faith in the purity of the water in the well, and sentimental and financial considerations.

It is difficult for the layman to realize that water which presents a very good physical appearance may still be unfit for domestic use. He is consistent in his belief that good looking water is always potable as is shown by his insistence that filtered water shall be clear and sparkling.

This faith in the purity of all ground waters is accompanied, in the case of the shallow well, with certain strong sentimental considerations. The farmer often says, and believes, that the water in his well is clearer, colder and tastes better than the water in any other well in his community. He is proud of his well and it is closely associated with all of his thoughts of home.

So thoroughly does the average man believe in his well, and so much does he think of it, that it is very difficult even in direct conversation to shake his faith in the purity of the water drawn from it, and he is very likely to take offense when told that his well water is contaminated and unfit for use.

There are, of course, the usual financial considerations which cause the owner of a shallow well to continue to use it rather than go to the expense of putting down a deep well in the county, or of connecting with the public supply in town.

In the Indiana State Water Survey work every well is classed as a shallow well, whether dug or driven, and regardless of depth, unless it passes through an impervious stratum. It thus happens that under the Indiana classification some wells of 100 ft. depth are classed as shallow wells, and others only 10 ft. deep are classed as deep wells. Of 3,057 shallow well waters examined in the last few years by the Indiana Survey, only 1,331 were classed as good, while 1,391 were classed as bad and 335 doubtful. This means that 56.8 per cent of the shallow well waters are impure.

Wells examined by the Illinois Water Survey are classified according to depth as follows: Less than 25 ft., 25-50 ft., 50 to 100 ft., and unknown. During the past six years the percentage of the water sent to the Water Survey for analysis and subsequently condemned, is as follows: Of those less than 25 ft. in depth, 76 per cent were condemned; of those 25 to 50 ft. deep, 63 per cent were condemned; and of those from 50 to 100 ft. deep, 32 per cent were condemned. The foregoing figures are given because we do not think it is generally known, even among engineers, that the percentage of contamination of shallow wells is so high.

Of course, shallow wells cannot be entirely eliminated, for in some places the only available supply is the ground water within 50 ft. or less, of the surface. In rural districts where shallow wells cannot be dispensed with they should be protected near the surface by concrete curbing and by a concrete platform over the well. They should, of course, be protected from the infiltration of polluted water from the usual sources of pollution. Such contamination can be prevented only by removing the contaminating agencies.

Our chief interest in this matter, however, is to see all shallow wells eliminated in cities and towns where a public supply is installed and is accessible to the owner of the shallow well. Health officers should close such wells when the water is of doubtful quality. They have the power to take such action and they should have the courage to close all bad or doubtful wells. Water departments can assist the health department by advertising the advantages of flowing water under pressure, as well as by posting diagrams, in conspicuous places, showing the manner in which well water is polluted by infiltration.

ROADS AND STREETS

Street and Railway Track Paving With Asphalt Blocks at Oshawa, Ont.

In 1911 the town of Oshawa, Ont., decided to improve two of its main streets by the construction of a permanent pavement. Asphalt blocks on a concrete base were selected, and a total yardage of 14,300 sq. yds. was laid. Owing to the fact that the streets were occupied by car tracks, the construction of this pavement involved a number of interesting features, which are described in a paper presented on Feb. 6 before the Canadian Society of Civil Engineers by Mr. Frank Chappell, the engineer in charge of the work. The following description of the methods employed in constructing this pavement are abstracted from Mr. Chappell's paper:

The streets to be paved in Oshawa were the two main thoroughfares, which intersect each other at right angles in the center of the town. The street railway track lies along both streets. In order that the contractors might have every facility for carrying their work to a successful issue, the work was divided into four blocks or sections, and all adjacent street intersections were closed to traffic while any particular section was being constructed. In each case the work was started at the extreme end of a section and progress was made towards the center. The traffic was thus but little inconvenienced, for while the last portion was being completed in the center, the other streets and intersections were open for traffic. Moreover, by closing the street against traffic of any kind, it was possible to make a more satisfactory job of the track work, as well as giving the road a greater period for setting and seasoning before use. The first step taken in construction was to make all sewer, water and gas connections, even vacant lots being connected. The whole of his work was well filled in and soaked down with water.

Grade stakes were set out on each side of the street and driven to the proposed elevation of top of curb. This was also the new elevation of each rail. In the meantime the track was completely dismantled, and the old ties hauled away, while the rails and angle bars were thrown on the boulevard. Excavation was proceeded with to a sub-grade 8 ins. below the finished surface of the pavement. In the center, corresponding with the street railway allowance a shallow trench, 9 ft. 6 ins. wide, was excavated 18 ins. below the finished surface. This would allow 8 ins. of concrete to be deposited below the ties, and about 1 ft. beyond the ends.

Concrete in the specified proportions of 1 to 9, but actually nearer 1 to 7 (an alteration necessary on account of the grading of the gravel), was placed in this trench to a depth of 6 ins. Within 24 hrs. the ties were laid on this and after the rails had been spiked and jointed, were brought to grade with wooden shims, about three or four to the rail. This left a 2-in. space to be filled with concrete. Great care had of necessity to be observed, in order to pack the concrete under the ties, and a very wet concrete was used, entirely free from large stones. This was done as it was believed that the ties would be more securely bedded in the concrete than if the whole 8 ins. had been filled at once. Furthermore the track was more easily and accurately brought to grade with this 2 ins. of play.

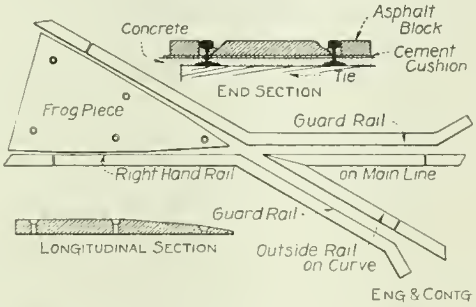

Fig. 1—Frog Piece for Asphalt Block Paving.

The method of laying the ties and rails and subsequently raising to grade on the first 6-in. layer of concrete is avoided by contractors because of traversing the work twice with concrete mixers, etc. In over a mile of similar work done later this method was insisted upon, however, and is still believed to be a far better plan than to lay the concrete all at once. The rails and ties if graded up to their proper position are so easily disturbed by gravel teams, wheel barrows, etc., while a much longer period is necessary for the setting of such a thickness of concrete—longer than is permissible in street paving work. The second application of concrete was made at the same time that the base was being laid for both sides of the road. The curbs were also prepared at the same time, the base and sides thus being practically monolithic.

As far as track construction is concerned it is not pretended for one moment that the work described in this paper is by any means ideal. The company insisted on using old 56-lb. T-rails, 4 ins. deep, which had been in constant use for nearly 20 years. New ties were provided of Norway pine, but the old angle bars were used. The ties were laid at 2 ft. centers with additional ties thrust under the joints. With the second layer of concrete, the ties became perfectly embedded at the ends, sides, and over the top.

The whole base was now ready for block laying and this took place usually within about three days of the concrete base being laid. A slightly dampened mixture of cement and sand in the proportions of 1 to 3 was distributed over the concrete surface to a uniform thickness of ½ in. Between the rails allowance was made so that a crown of ½ in. could be given the blocks. The blocks were laid upon this cushion of cement and sand, and then rolled with a heavy hand roller of from three to four tons' weight. The surface was then minutely inspected for any imperfectly bedded blocks, which were at once removed with specially shaped tongs, and a small portion of cement cushion placed so that the block would not rock. The blocks were laid between the rails in the same line as the rail. This is a nice looking piece of construction and it also has the advantage of being very easy to lay, and, furthermore, the number of "bats," or broken blocks, is considerably reduced.

It was noticed, however, that where cars have been derailed the tendency is to open up the unbroken course for a considerable distance, should the car wheel strike the longitudinal joint. It is a question that would be well to note, as to whether any greater advantage is gained over this method by the more expensive work of cutting and fitting blocks within the track, at right angles to the line of traffic. The fact that the blocks were laid in the same line as the rail is another regrettable instance of the overruling of the professional man by the lay man. Two and one-half inch blocks are too small for railroad work in the first place. The street car wheels abrade a place for themselves assisted by external traffic to a depth of about 1½ ins. This then leaves but 1 in. of block to resist any lateral pressure which may be brought to bear by vehicles crossing a street diagonally. The result is that a block becomes loosened when laid in the same line as the rail by reason of the open surface offered by its longer side. As soon as one block is thrown out it is less difficult to loosen others. If the blocks had been laid in this instance as specified, at right angles to the rail, there would have been at least greater holding surface.

After all blocks had been rolled, examined and found to "bed" properly, the surface was sprayed with water from a fine nozzle. A cement grout was then prepared in equal proportions of cement and sand. This was poured over the blocks and brushed well into all joints and interstices. As this grout dried out it settled until the joints were only about three parts full. A second application of a stronger grout was then applied, two parts cement to one part sand, and this mixture was brushed into the joints until they were packed full.

As the rails in the track were T-rails, a space about 2 ins. wide was left on the inside of each rail to be worked into a groove for the flanges of the car wheels. A concrete of crushed granite and cement was packed well into this space and shaped with a tool to the required width and depth. This has proven a very satisfactory piece of work. The car wheels crush and abrade the concrete and the edges of the blocks to an extent necessary for clearance and after a little wear, a smooth uniform groove is made. The blocks are soft enough to yield to the abrading action of the car wheels without loosening the joints, while the little inequalities in the concrete groove are subject to direct crushing.

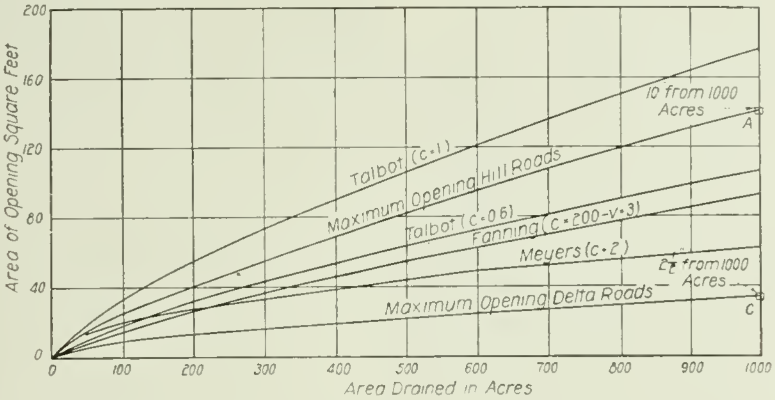

Fig. 1—Culvert Opening Area Curves for Drainage Areas Up to 1,000 Acres.

The concrete groove between the blocks and the rail would probably have shown to greater advantage had a thicker block been used, say 3 or 4 ins. This, of course, was not possible on account of the 4-in. rail in use. There is this about the concrete groove, however, that when abrasion occurs the dust that is produced washes away and the groove has that much less material. To overcome this the writer has since tried on over a mile of road, a groove filler of a mixture of bitumen and broken stone. This is almost a ductile composition and it is possible that in warm weather, at any rate, the bituminous mass will accommodate itself to the groove, and give better results than similarly placed cement.

In connection with turnouts and switches, the triangular space facing the frog gave considerable difficulty. Blocks were in the first place cut and fitted and grouted in. The space was so narrow, however, that the wheels would push them out of place. Concrete of the same consistency as the groove was next tried, being 1 part cement, 1 part sand and 3 parts crushed granite. This, in some instances, lasted no longer than the blocks, while even where car traffic was infrequent, although the life was much longer the result was not satisfactory. A plate of hard gray cast iron, called by the author a "frog piece" (Fig. 1), was at last substituted and drilled and spiked to the ties with countersunk spikes. The blocks were paved up to this and the whole cemented in.

This cast iron frog piece is, as far as the writer knows, entirely original and has proven a distinct success. Neither the castings nor the adjacent blocks have moved in the least, and this method was adopted at seven different turnouts. Three turnouts were left without such provision and blocks, concrete, etc., were tried out, but without success. These will now be fitted with cast iron plates. The pavement, except for the street railway work, has shown up very satisfactory so far. The blocks appear to be uniform and there are no inequalities in the pavement, the only trouble being with the before-mentioned blocks in the track allowance.

The diamond used in the center of the town is of an altogether too light and flimsy nature. It consists simply of rails 4 ins. in depth, bolted together on plates at the corners and with cross braces in the center. This should at least have been made of heavier rails of the "girder" type, although there are cast steel diamonds made which have given great satisfaction, and are undoubtedly to be preferred. The result of using the poor diamond above described has been to loosen all the blocks inside and the blocks for a distance of about four feet outside the rails. Repairs are being made on this work at the time of writing.

All headers at street intersections were made of granite concrete, as for curb, and extended 12 ins. beyond and to the full depth of the pavement base. This has proven very satisfactory, although the writer believes that it should be carried further—say 2 ft. beyond the pavement, where the intersecting street is unpaved.

The following data may be of interest:

Price of gravel, deposited on work by teams at contract price, cu. yd.	$ 1.00
Price of cement deposited in shacks, barrel	1.52
Superficial Prices:	
Excavation and grading, sq. yd.	.17
Concrete base, 5-in., sq. yd.	.17
Block laying and ½-in. cushion, sq. yd.	.22
Blocks—teamed on to the work (freight, Windsor to Oshawa, inclusive), sq. yd.	1.57

Cubic Yard Prices for Work Under Track:	
Excavation, cu. yd.	.50
Concrete base, cu. yd.	4.68
Curb and gutter, per lin. ft.	.56
Average cost of catch basins, each	24.00
Total cost per lin. ft. of 40-ft. road	14.84
Total cost per lin. ft. of 35-ft. road	12.98
Total cost per lin. ft. of 30-ft. road	11.12

These measurements are taken from face to face of curb.

This last table of total costs includes paving the street, laying curb and gutter, paving the track allowance, extra concrete under the ties, the dismantling and relaying of the track, together with all catch-basins, etc., required.

The total yardage of the pavement was 14,300 sq. yds., and the total cost including the foregoing incidentals was $47,750.

Curves for Determining Areas of Openings for Road Culverts and Bridges.

Curves for determining maximum bridge and culvert openings for hill and delta roads, respectively, are given in the report of the Drainage Committee of the Illinois Society of Engineers and Surveyors, an excerpt from which we publish as follows:

In undertaking the design of culverts for roads, one naturally turns to the formulas used by railroads for determining the sizes of openings. Comparing results, he is struck with their very wide variation; also with the fact that many of these formulas appear to take no account of differences in topography and precipitation.

These formulas frequently give much higher rates of run-off from smaller areas than those used for designing ditches for land drainage One need not seek far for the logic of this. If a farm ditch should overflow for 24 or 36 hours, usually no very great harm will result. If a culvert through a road or railroad is too small to discharge at the greatest rate at which water can reach it, and any land is submerged as a result, the county or railroad company, as the case may be, will promptly be sued for damages. Again, if the embankment intercept water flowing down a steep slope, it may be banked up until it will break over it, resulting in washouts.

In connection with the design of road culverts and bridges, the accompanying curves, Figs. 1 and 2, were platted.

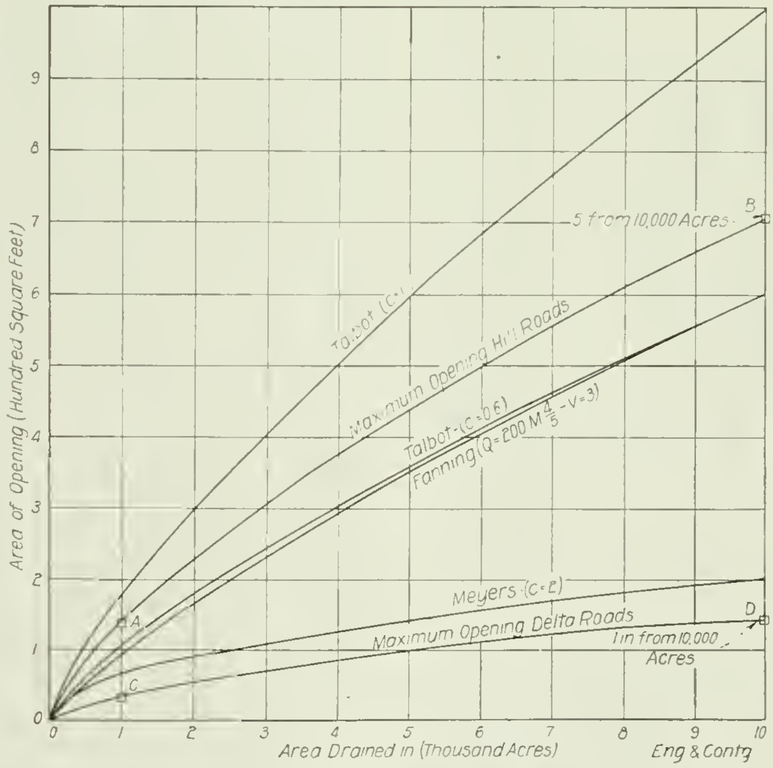

Fig. 2—Culvert Opening Area Curves for Drainage Areas Between 1000 and 10,000 Acres.

After platting the curves from Talbot's, Myers' and Fanning's formulas, those marked "Maximum Opening" were drawn arbitrarily to pass through points, *A*, *B*, *C* and *D*. Points *A* and *B* are on the curve used for the hill roads where the country is quite rough. Point *A* was determined on the assumption that the maximum rate at which the drainage from 1,000 acres will reach its outlet is equivalent to 10 ins. depth per 24 hours; Point *B* represents a maximum rate from 10,000 acres of 5 ins. per 24 hours. It is to be noted particu-

TABLE I.—COMPARISON OF RESULTS FROM RUNOFF FORMULAS—AREA OF OPENINGS FOR DRAINAGE AREA 10 SQUARE MILES.

Name of Formula	Formula	Values of "c"	Value of "c" used	Area of opening (sq. ft.)
Talbots	$a=c\sqrt[4]{A^3}$	Flat land 0.6 Mod. slope 0.85 Steep " 1.1	0.9	643
(Coefficients	as used by M. K.	& T. R. R.)		
Myers	$a=c\sqrt{A}$	Flat land 1.0 Hilly " 1.6 Mountains 4.0	1.6	128
Peck (Mo. Pac.)	$a=\frac{A}{c}$	4 to 6	5	1280
Wentworth	$a=A^{\frac{2}{3}}$			345
(Applicable	to conditions on N	orfolk & West'n	R.	R.
C., B. & Q.	$Q=\frac{3000M}{3+2\sqrt{M}}$			644
Cooley	No. 1 $Q=200M^{\frac{2}{3}}$ No. 2 $Q=180M^{\frac{2}{3}}$			186 168
Tidewater (Va.) Ry. Co.	$a=0.62A^{\frac{7}{10}}$			286
El Paso & Southw'n Ry.	$Q=12\sqrt{\frac{8000}{M}}$			68
O'Connell	$Q=\frac{1421M}{0.311\sqrt{M}}$			820
Kuichling	$q=\frac{44,000}{M+170}+20$ $q=\frac{127,000}{M+370}+7.4$	(For occasional floods) (Forrare floods)		528 682
Murphy	$q=\frac{46,790}{M+320}+15$			314
Gray	$q=5.89M^{\frac{2}{4}}$			66
Fanning (As corrected by letter from the author.)	$Q={}^{*}c\,M^{\frac{5}{6}}$ *c here substituted for 200 given in formula.	For New England and Appalachian Watersheds 130 to 200. For Eastern Middle States Watersheds, 60 to 100. For Western tributaries of Miss. north of Missouri River 12 to 50.	200	252

M=Area Watershed in square miles.
A= " " " acres.
Q=Maximum discharge entire Watershed.
q= " " per square mile.
c=Coefficient.
a=Area opening required in sq. ft.
(In reducing from Q to a in above, velocity 5 is used.)

larly that the above points and curve through them are taken to represent the *maximum opening*, being that necessary to be provided when the water reaches the road on a steep slope and has, therefore, no place for a few hours' storage.

Points C and D fix the sizes of openings for rate of 2½ ins. and 1 in. from areas of 1,000 and 10,000 acres respectively, in the flat "Delta" land, where the drainage facilities are not likely to be sufficient, for many years, to bring the water to the road culverts at any higher rates.

Where the conditions in each special instance warranted, the sizes were made smaller than those shown. In many cases the storage facilities justified the use of openings from one-half to three-fourths the areas shown by these curves.

These curves assume a velocity of 3 ft. through the openings. For small culverts at points where it is not permissible to create much head against the embankment, it is believed that this is a high enough velocity to figure on. With large culverts the velocity will be higher where moderate heads are permissible.

It is of interest in this connection to compare results from the various formulas devised for determining the sizes of openings for railroads.

A number of such formulas are given in "Engineering and Contracting" for March 29, 1911. Below are repeated some of these formulas, and the size of opening figured by each, for an area of 10 square miles. (Table I.)

The details given for the section of proper co-efficients for various conditions will not all be repeated here, but an effort has been made to select that co-efficient (where latitude is allowed) which was intended by the author (as far as can be inferred) to apply to such topographic conditions as pertain to the hill country in northwest Mississippi.

The following symbols are used throughout:

Q—Maximum discharge from entire watershed in second feet;

A—Area of opening in square feet;

M—Area of watershed in square miles;

A—Area of watershed in acres.

These letters have for uniformity been substituted in the several formals where others were used by their authors. Where the formula gives the discharge instead of the area of opening, a velocity of 5 ft. per second has been used in arriving at size of opening.

In conclusion, to estimate the probable runoff from any given area with fair confidence, one must usually modify the rule established by observations on other areas to suit the altered conditions with the most careful judgment, backed by as much experience and general information on the subject as he can acquire by devoting to it the hours when his neighbors are on the golf-links or taking their "beauty sleep."

A Test of the Supporting Power of a 4-in. Concrete Base.

On some 100 miles of the California state highway, now under contract, a concrete base composed of broken stone, sand and cement has been specified of a minimum thickness of 4 ins. Provision is made in the contracts that whenever it appears to the Highway Engineer that the sub-grade is not suitable the concrete base shall be increased in thickness at his discretion.

The specifications call for a rich mixture of concrete, consisting of 1 part of Portland cement, 2½ parts of sand and 5 parts of broken stone. One and three-tenths barrels of cement are actually being used to each cubic yard of concrete in this work, and an unusual strength should be expected.

The question has been asked whether a concrete pavement of the type referred to has sufficient strength under traffic to successfully span possible burrows by animals, or old trenches which settle subsequent to the building of the road.

To demonstrate its strength, some crude tests were recently made on the highway leading to the north from Fresno City. The concrete at this place was 35 days old at the time of the tests, but no bituminous wearing surfaces had then been applied. We are indebted to Mr. A. B. Fletcher, State Highway Engineer, for the following description of these tests.

Before the tests, the supporting earth was removed from under the concrete for a width of 2 ft. and extending in 4 ft. from the edge of the concrete. The tests were made with a 10-ton Kelly-Springfield roller which is so designed that one-third of the load is on each rear wheel. The rear wheels are 20 ins. wide.

In the first test the roller was run along the road, its rear wheel crossing the unsupported concrete 12 ins. clear of the edge of the pavement. The second test was like the first except that the wheel was but 6 ins. clear of the edge of the pavement. In the third test the roller was stopped and started with the rear wheel on the unsupported concrete, 6 ins. from the edge of the pavement. There was no noticeable effect on the concrete in any of the first three tests.

In the fourth test the wheel was passed over the unsupported concrete with its side even with the edge of the pavement, and in the fifth it was made to pass over a block of wood, 2-in. x 4-in. x 8-in., laid flat, 12 ins. from the edge of the pavement and lengthwise with the road. A slight deflection was noticeable in both the fourth and fifth tests as the roller passed over the opening, but the concrete regained its original position immediately after the passing of the roller.

Assuming that the weight on the block of wood was 3⅓ tons, only (weight probably nearer 4 tons, since the roller was supplied with water and fuel), the load in the fifth test was equivalent to 1,666 lbs. per inch of width of bearing. Looking at it another way, the concentrated load was the equivalent of a wagon with four wheels, each with 4-in. tires, carrying a load of 13 tons equally distributed over the four wheels.

The heaviest load likely to pass over the state highways is the 20-ton traction engine. Assuming that the two rear wheels carry two-thirds of the weight, each wheel would carry 13,300 lbs., and if the wheels are only 24 ins. wide the weight per inch of bearing is 550 lbs. per inch. The weight used in the tests, therefore, was more than three times as great per inch of width of tire as the heaviest load to which the pavement is likely to be subjected.

As a final test, the block of wood was moved to within 6 ins. of the edge of the pavement so that when the roller wheel ran up on the block it overhung the edge of the concrete by about 2 ins. In this position the combined weight and the shock due to running the roller onto the block cracked the pavement.

Notes on Road and Street Work.

(STAFF ARTICLE.)

Snow Removal in New York City in 1910-11.—The total snow fall in the Boroughs of Manhattan, The Bronx, and Brooklyn, New York City, in 1910-11, according to the report of the Department of Street Cleaning for 1911, was 24.7 ins. The total area cleaned was 17,570,655 sq. yds., and the amount of snow removed was 2,629,203 cu. yds. The total cost of removing the snow was $1,475,-986, or about 56 cts. per cubic yard. The length of streets cleaned of the 24.7-in. snow fall was 497.73 miles; the cost per inch-mile was $120.05. The mileage of streets cleaned by street railroad companies was 49.19.

Average Area per Hand Sweeper in New York City.—The paved area in the Boroughs of Manhattan, The Bronx, and Brooklyn, New York City, on Dec. 31, 1911, was:

	Sq. yds.
Manhattan	9,153,584
The Bronx	3,341,811
Brooklyn	11,624,836
Total	24,120,231

To clean these areas during 1911 there was employed on the brooms 2,875 sweepers, as follows: Manhattan, 1,700; The Bronx, 275, and Brooklyn, 900. This gives the average area allotted to each sweeper as 8,390 sq. yds.; or by boroughs: Manhattan, 5,384 sq. yds.; The Bronx, 12,152 sq. yds.; Brooklyn, 12,916 sq. yds. To augment the work of hand sweeping there was used in 1911 an average of 43 horse-drawn sweeping machines in the borough of Manhattan, 1 machine in The Bronx, and 19 machines in the borough of Brooklyn.

An English Motor Vacuum Street Cleaning Machine.—A patent motor vacuum street cleaning machine has been used in working demonstrations in a number of English cities. The mechanism of this new sweeper, according to The Surveyor, from which this note is taken, consists of a cylindrical brush composed of a series of small brushes, which revolve in an air-tight sheet iron shell in the opposite direction from the wheels of the car. The sweeping roller rotates at a circumferential speed of 4,950 ft. per minute, and in turning through two-thirds of a revolution inside the shell raises the sweepings and discharges them into boxes in the receivers at the back of the vehicle through an opening contrived for the purpose. At present the receiver is a part of the machine from which the boxes can be removed readily and emptied, but it is proposed eventually to make this part of a detachable trailer which can be released and replaced by an empty one when necessary. In a trial at Southport an area of 2,933 sq. yds. of roadway in the principal street of the town is stated to have been swept in slightly over 18 mins., some 2 tons of refuse being collected during that time. The cost of petrol consumed was 2½ cts., and the combined wages of the chauffeur and an attendant were put at 13½ cts. Adding 8 cts. as 50 per cent of the initial cost, depreciation, upkeep, etc., of the machine, the total cost of sweeping and collecting over the above area was 24 cts., or at a rate of $1.04 per 12,000 sq. yds. It is stated that the trials have proved so successful that the Southport and Glasgow have placed orders with J. & P. Hill, Ordinance Works, Sheffield, England, for machines.

Sand Clay Road Construction in South Carolina in 1912.—The following tabulation, extracted from the 9th annual report of E. J. Watson, Commissioner of Agriculture, Commerce and Industries of South Carolina, shows the mileage and cost of sand clay road construction in 18 counties in that state in 1912:

Counties.	Sand clay, miles.	Average number of convicts used per day.	Cost of maintenance convict labor per day.	Av. wages per day for free labor.	Total cost per mile of construction.
Abbeville	..	18	.....	.....	....
Anderson	100	30	.....	.....	$500.00
Berkeley	..	15	$0.68	$1.00	180.00
Calhoun	40	15	.60	.....	200.00
Cherokee	..	20	.50	.....	....
Chester	..	20	.35	.75	....
Darlington	24	28	.30	1.00	175.00
Fairfield	65	30	.50	1.00	172.00
Jasper *	50	..	.....	.....	100.00
Kershaw	30	24	.30	1.00	500.00
Laurens	..	30	.55	.75	....
Lee	14	16	.56	.....	500.00
Newberry	10	15	.40	.75	300.00
Orangeburg	102	45	.79	1.00	....
Pickens	..	10	.50	1.00	....
Richland	44	60	.63	1.00	....
Spartanburg	5	70	.80	1.00	200.00
Union	..	20	.30	.85	800.00
Williamsburg	25	25	.40	1.00	400.00

*Repair work only.

Cost Data on Macadam Construction.—Five sections of Road No. 1 (Younge St.) of the Road System of York County, Ontario, were completed by day labor. The road is surfaced with water-bound macadam 8 ins. thick after rolling, and has an average width of metal of 15 ft. On Divisions 11 and 12 2-in. granite and limestone screenings were used. The granite cost $1.75 per ton f. o. b. railway sidings. The limestone screenings cost $1.95 per ton. Granite was also used on Divisions 13, 14 and 15. On the last mentioned 10,365.6 tons of stone were used. On the basis of 2,600 lbs. to the cubic yard, this amounts to 7,973½ cu. yds. On Divisions 11 and 12 11,990 tons of stone or 9,223 cu. yds. were used. On these divisons a Waterous double-cylinder 12½-ton steam roller was employed in 1911; while in 1912 a 12½-ton Kelly-Springfield double-cylinder gasoline roller was used. Some details of the cost of these roads are given as follows in the report of the County Highway Commissions for 1912:

	Divisions 11 and 12. Per cu. yd.	Divisions 13, 14 and 15. Per cu. yd.
Grit, stone and granite	$2.270	$2.270
Labor	.586	.522
Teams	.332	.339
Coal, gasoline and wood	.049	.041
Oil and accessories per roller	.007	.007

Common labor was paid at the rate of 20 cts. per hour; teams 50 cts. per hour.

Road Construction by Convict Labor in the Canal Zone.—Practically all road construction under the direction of the Isthmian Canal Commission is done by convicts. One of the most elaborately constructed highways in the canal zone was completed recently by this class of labor. This highway extends from Empire to the Zone boundary, the total length constructed being 5⅓ miles. The road consists of a 6 to 10 ins. thick telford base, a 4-in. course of 1½-in. rock, and a 2-in. course of screenings. In the other roads which the commission has constructed no telford base has been used, the macadam being placed on the graded and shaped earth subgrade. These roads have given satisfaction under the rather light traffic to which they have been subjected, but are in need of continual repair owing to their foundations not being stable. The standard cross-section of the Empire Road is 24 ft. between gutters, consisting of 4-ft. earth shoulders and a 16-ft. macadam section. The crown is ¾ in. to the foot. The gutters are 1 ft. deep and 3 ft. across the top, the outer side having a slope of ¾ on 1. The width of the base through cuts is 30 ft. and on fills 27 ft. Two reinforced concrete bridges were built in connection with the road. For culverts 120 lin. ft. of 48-in., and 1,919 lin. ft. of 18-in. concrete pipe were manufactured on the ground, and 431 lin. ft. of 12-in. vitrified pipe were imported. Clearing of timber and brush through the route amounted to 37.88 acres. There were 98,742 cu. yds. of excavation and 17,540 cu. yds. of fill. Bridges and culverts required 886 bbls. of cement, and 9,113 cu. yds. of crushed rock was used for concrete and the macadam. All the labor, except some skilled work in the bridge and culvert construction, was performed by Canal Zone convicts. During the construction of the first 1¾ miles of road they were quartered at Culebra Penitentiary. Later they were moved to a stockade 4⅓ miles from Empire, which remained their headquarters until the completion of the road. During most of the time since March, 1911, when the work was started, the number of convicts employed has been about 125.

Municipal Asphalt Plants: Cost of Operation and Estimates for the Establishment of a Plant for the District of Columbia.

An investigation of the desirability and cost of establishing a municipal asphalt plant for the District of Columbia has been made under the direction of the District Commissioners by Mr. David E. McComb, formerly assistant engineer on surface work and superintendent of sewers for the District, and more recently chief engineer of paving and sewer work in Havana, Cuba. Mr. McComb submitted his report to the Commissioners under date of Dec. 30, 1912, his conclusion being that the installation and operation of a municipal asphalt plant for all new and repair work would be advantageous to the District. The Board of Commissioners of the District of Columbia concurred in his conclusion and have recommended that an item of $90,000 to provide such a plant be included in the estimates for the fiscal year 1914. In connection with his studies Mr. McComb visited the following cities in which municipal asphalt plants have been established: Detroit, Mich.; Brooklyn, N. Y.; Cincinnati, O.; Kansas City, Mo.; Toledo, O.; Columbus, O.; Omaha, Neb.; Hamilton, Ont.; Toronto, Ont.; Dayton, O.; Denver, Colo.; Pittsburgh, Pa.; and Cleveland, O. Information was also obtained from other cities which have municipal plants. The following data on the operation of these plants are abstracted from Mr. McComb's report:

OPERATION OF MUNICIPAL ASPHALT PLANTS IN 20 CITIES.

Detroit, Mich.—The Detroit municipal plant was installed in 1904 and the average cost of work performed for 8 years, including interest on the investment, depreciation, and other overhead charges, was: Resurfacing work $0.95399, new work and repaving $0.95531, patching and cut work $1.07556 per square yard. The overhead charges, consisting in interest on investment, including plant site, at 5 per cent; depreciation and loss on equipment, salaries of expert and assistants, renewals, and sundries aggregater $114,137.22. The expenditures for labor and materials aggregated $1,209,941.51. The number of square yards of asphalt pavement laid was 1,359,446.61. The amount of overhead charge to be added to labor and material cost equals $0.084 per square yard—$0.029 per cubic foot of plant product, or 9.4 per cent of the cost of labor and materials. During the four weeks from June 5 to July 2, 1912, the cost of surfacing work aggregating 51,888 cu. ft. of binder and 73,248 cu. ft. of topping, including overhead charge on the basis of overhead cost for 8 years, was $0.2109 per cubic foot of binder and $0.3358 per cubic foot of topping, which is equivalent to $0.7991 per square yard of asphalt pavement consisting of 1½ ins. of binder and 2 ins. of topping.

TABLE I.—OPERATIONS OF DETROIT ASPHALT PLANT, FOR 8 YEARS, 1904-1911.

Capital expenditures—		
Buildings	$ 2,803.28	
Plant	25,927.22	
Portable plant, loss in sale of	4,716.39	
Equipment	12,956.37	
Small tools	2,007.28	
Office and laboratory equipment	1,188.94	
		$49,599.48
Estimated value of plant site		20,000.00
Investment		$69,599.48
Interest on investment for 8 years, 5 per cent		$23,590.92
Operating expenses—		
Salaries of expert and assistants	$27,374.51	
Sundry expense items	3,243.21	
Repairs and renewals	26,385.50	
		57,003.22
Depreciation		33,543.08
Overhead charge for 8 years		$114,137.22
Product—		
1,359,446.61 sq. yds. of pavement laid, overhead charge per sq. yd		$ .08396
Expenditures for labor and material, 8 years—		
Resurfacing work, 884,170.20 sq. yds.		$ 725,753.10
Paving and repairing, 304,995.26 sq. yds.		265,757.62
Patching and cut work, 220,281.15 sq. yds.		218,430.79
Total (1,359,446.61 sq. yds.)		$1,209,941.51
Overhead charge, $114,137.22 ÷ $1,209,941.51 = 9.4 per cent.		
Overhead charge against plant product—		
Buildings	$ 2,803.28	
Plant cost	25,927.22	
Loss on portable plant	4,716.39	
Office and laboratory equipment	600.00	
Site	20,000.00	
		$54,046.89
Interest on investment for 8 years, $23,590.92 × $0.777		$18,330.14
Operating expenses—		
Salaries of expert and assistants	$27,374.50	
	2	
	$13,687.25	
Repairs, renewals, sundries	23,021.51	
Depreciation	26,062.97	
		62,771.73
		$81,101.87
Plant product, 1,359,446.61 sq. yds.; 3,942,395 cu. ft.		
Overhead cost per cu. ft., $0.020572.		
Overhead charge against street work—		
Equipment	$8,637.58	
Small tools	2,007.28	
Office and laboratory equipment	500.00	
		$11,144.86
Interest on investment for 8 years, $23,590.92 × $0.16		$ 3,774.55
Salaries of experts and assistants		9,124.83
Repairs, renewals, sundries		4,404.80
Depreciation		4,986.74
		$22,290.92
Plant product, 3,942,395 cu. ft.		
Overhead cost per cu. ft., $0.005654.		
Overhead charge against transportation—		
Equipment	$4,318.79	
Office and laboratory equipment	88.94	
		$ 4,407.73
Interest—		
Interest on investment, 8 years, $23,590.92 × $0.063		1,486.23
Salaries of experts and assistants		4,562.43
Repairs, renewals, sundries		2,202.40
Depreciation		2,493.37
		$10,744.43
Plant product, 3,942,395 cu. ft.		
Overhead cost per cu. ft., $0.002725.		
		$0.02057
		.00565
		.00273
Total overhead cost, per cu. ft.		.02895
Total overhead cost, per sq. yd.		.08396

This cost may be subdivided as follows:

	Cost per sq. yd.	Per cent.
Labor, per sq. yd.	$0.1836	23.0
Fuel, per sq. yd.	.0194	2.4
Haul, per sq. yd.	.0928	11.6
Materials, per sq. yd.	.4166	52.1
Overhead ($0.0840-$0.0027)	.0867	10.9
Totals	$0.7991	100.0

Further details of the cost of operating the Detroit plant as given in Tables I and II.

Brooklyn, N. Y.—The Brooklyn, N. Y., municipal asphalt plant was installed in 1907 and is used for patch and cut work. The nominal

TABLE II.—WORK PERFORMED BY DETROIT PLANT FROM JUNE 5 TO JULY 2, 1912.

Resurfacing and new work—

Product: 51,888 cu. ft. of binder; 73,248 cu. ft. of topping; total, 125,136 cu. ft.

Overhead cost is on basis of operation of plant for eight years.

Plant cost—		
Labor	$3,523.09	
Fuel, etc.	428.00	
		$3,951.09

Product: 125,136 cu. ft. of binder and topping.

Cost per cu. ft. $\frac{\$3,951.09}{125,136} = \$0.0316$.

Cost per cu. ft. charged up on account of labor expense during shut-down period in winter on basis of previous year's output $\frac{\$729}{781,660} = \$0.0009$		$0.0325
Overhead		.0206
Total		$0.0531
Street cost—		
Labor	$4,394.81	
Fuel, etc.	409.50	
		$4,804.31
Cost per cu. ft.		$0.0384
Overhead		.0057
Total		$0.0441
Hauling—		
Cost per cu. ft.		$0.0320
Overhead		.0027
Total		$0.0347
Plant, street and hauling cost		$0.1319
51,888 cu. ft. of binder—		
Cost of materials	$0.0790	
Cost of plant, street, etc.	.1319	
		.2109
73,288 cu. ft. of topping—		
Cost of materials	$0.2040	
Cost of plant, street, etc.	.1319	
		.3359
Cost per sq. yd. of pavement, 1½-in. binder, 2-in. topping		.7991

	Per cent.
Cost of labor per sq. yd., $0.1836	23.0
Cost of fuel per sq. yd., $0.0194	2.4
Cost of hauling per sq. yd., $0.0928	11.6
Cost of materials per sq. yd., $0.4166	52.1
Cost of overhead per sq. yd., $0.0867	10.9

Total, $0.7991.

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capacity is 270 cu. ft. of surface mixture and 100 cu. ft. of binder per hour, equal to 2,960 cu. ft. of both per day (eight hours). The price paid was $38,280.18. The current cost of the output is given as follows:

Plant operations per cu. ft.	$0.045
Hauling	.058
Street work	.178
Overhead, including interest on investment, depreciation, upkeep, office expenses and general supervision, per cu. ft.	.087
Estimated cost of materials for topping	.126
Total per cu. ft.	$0.494

The minimum wage rate is fixed by law at $2.50 per day, and that rate is paid to rakers, tampers, as well as the lower classes of laborers. The city owns the wagons used to transport the asphaltic materials and hires the horses and drivers. Two-horse team and driver is paid $6 per day of eight hours.

The force consists of:

	Per day
Superintendent	$3,000*
Chauffeur	3.00
Plant foreman	4.50
Stationary engineer	4.50
3 stokers, at $3	9.00
12 asphalt laborers, at $2.50	30.00
Eight street gangs:	
4 foremen, at $4.50	18.00
4 foremen, at $4	16.00
8 rollermen, at $4.50	36.00
96 asphalt laborers, at $2.50	240.00
16 watchmen, at $2.50	40.00
Total	$350.00

*Per annum.

During the winter of 1911-12 the plant was shut down for 6 weeks, when the following force at the plant was carried:

Foreman, at $4.50; engineer, at $4.50; 4 laborers, at $10; total of $19 per day for 36 days	$684
2 watchmen, at $5 per day for 42 days	210
Total	$894

The cost of material:

Asphalt, Mexican, per ton	$15.25
Dust, per ton	3.00
Sand, per cu. yd	.58
Flux, per gal	.075

Cincinnati, O.—The Cincinnati municipal asphalt plant is used ordinarily for patching and for repair cuts. The plant product may be secured by contractors for new work, and in this way provision is afforded for competition by contractors who have no plant. The nominal capacity of the plant is 1,000 sq. yds. of 2-in. topping per day, and its cost was $21,000. The plant site is leased at a yearly rental of $1,000.

The plant output for 1911 was 77,859 cu. ft. of asphaltic topping on repair and restoration (cut) work and 11,628 cu. ft. of bitulithic mixture, making a total of 89,487 cu. ft.

The daily average on the basis of 200 days per year was 447 cu. ft., less than one-third of the plant capacity.

The cost of asphalt work performed in 1911 was:

Plant cost:		
Product, 77,859 cu. ft. of topping.		
Labor, $7,148.26; per cu. ft.		$0.0918
Materials, $18,716.85; per cu. ft.		.2404
Total, per cu. ft.		$0.3322
Overhead cost, not including interest:		
On investment	$11,442.48	
Interest on $21,000 at 5 per cent	1,050.00	
	$12,492.48	
Total product, 89,487 cu. ft.; cost per cu. ft.		.1396
Repair work, 35,893 sq. yds. equal 56,934 cu. ft.		
Street work, including haul, $14,546.89; per cu. ft.		.2555
Plant cost		.3322
Overhead cost		.1396
Total cost per cu. ft.		$0.7273
Cut work (restoration), 13,191 sq. yds. equal 20,925 cu. ft.		
Street work, including haul, $6,139.40; per cu. ft.		$0.2934
Plant cost		.3322
Overhead cost		.1396
Total cost per cu. ft.		$0.7651

The bitulithic mixture, 11,628 cu. ft., used on repair and cut work cost:

Plant cost:	
Labor and materials, $3,066.59; cost per cu. ft.	$0.2637
Street and haul costs, $3,031.44; cost per cu. ft.	.2607
Overhead cost	.1396
Total cost per cu. ft.	$0.6640

The cost of work performed during the first five months of 1912 was:

Repair work, 14,218 cu. ft.:	
Plant cost of labor and materials per cu. ft.	$0.3192
Street and haul cost	.2085
Overhead cost (taken as for 1911 work)	.1396
Total	$0.6673
"Cut work" (restoration), 4,232 cu. ft.:	
Plant cost of labor and materials per cu. ft.	.3192
Street and haul cost	.2718
Overhead cost	.1396
Total	$0.7306

The asphaltic composition used is:

	Per cent
Sand	78
Dust	10
Asphaltic cement	12

For asphaltic topping, river and lake sand are used in equal proportions of each. The lake sand is brought from Sandusky and costs about $1.25 per cu. yd. The plant has been operated for five years. It was purchased by the city from a former contractor and appears to be fairly efficient.

There are two heater drums; one is used for sand, the other for binder stone or bituminous macadam stone. There are three open kettles so situated that the A. C. flows by gravity to the measuring buckets. The asphalt is heated by superheated steam of low pressure. The A. C. is forced by compressed air to the pipe line above the kettles. The asphalt is transported from ground level to the platform at the level of the kettles by a barrel hoist. A dust collector is connected with the drums. Bituminous macadam is now being mixed and is used for patching.

The plant appears to be well managed, but Mr. McComb was informed that the management is not altogether free from the necessity of employing a certain amount of labor of limited efficiency because of political pressure.

The following rates of pay exist:

	Per day
General foreman	$ 6.00
Foreman at plant	3.00
Foreman on street	3.50
Engineer at plant	4.16
Fireman at plant	2.40
Laborers	2.00
Drivers	2.25
Rakers	2.50
Tampers	2.25
Hired teams	4.50
Roller engineer	*25.00

*Per week.

The 8-hour day prevails. City owns equipment of horses, harness, and wagons, but occasionally finds it necessary to hire teams. Asphalt used is a mixture of 60 per cent Trinidad and 40 per cent California.

Kansas City, Mo.—The Kansas City municipal asphalt repair plant was installed in April, 1910.

Cost of plant	$39,531
Estimated value of site	5,000
Total	$44,531

Product: Binder and topping. The pavement is usually made up of 1½ ins. each of binder and topping after compression.

Capacity of plant, 1,200 sq. yds. of 2-in. topping.

Output for 1911, 23,778 cu. ft. of topping and binder.

Overhead cost, including interest on investment, upkeep of plant, office expenses, and general supervision, is $19,532 per year, charged against 257 working days, equal $76 per day. This amount is charged against the plant product on the basis of $0.06 per square yard of pavement laid.

The cost of product (including overhead charges) upon 1912 work is given:

	Per sq. yd.
Cost at works	$0.11
Cost of haul	.04
Cost of street work	.03
Cost of street work on patching, including cost of cutting out	.15

On basis of 1½-in. thickness each square yard will require 1.125 cu. ft. of material, and the above costs reduced to cubic feet will be:

	Per cu. ft.
Cost at works	$0 0978
Cost of haul	.0356
Cost of street work	.0267
Cost of patchwork	.1333

During the three winter months when the plant is shut down the following force is carried:

Manager, $2,000 year	$ 500.00
Foreman, $125 month	375.00
Engineer, $26.40 week	343.20
Timekeeper, $2.50 day	185.00
Watchman, $2.50 night	185.00
Total	$1,588.20

During the working season the plant force consists of:

	Per day
Manager, $2,000 per year	$ 6.67
Foreman, $125 per month	5.00
Engineer, $26.40 per week	4.40
Timekeeper, $2.50 per day	2.50
Tankman, $3 per day	3.00
9 to 12 laborers (2 hours overtime), $2.50 per day	30.00
Hoisting engineer, $4.40 per day	4.40
Oiler, $2.88 per day	2.88
Drum fireman, $2.40 per day	2.40
Total	$61.25

Recent work on 15th St. between Virginia and Woodland Aves. (bituminous macadam), 10,565.7 sq. yds.; total cost, $17,130.04, $1.62 per square yard, includes overhead charges as above. The 15th St. work finished June 12, 1912. Average haul about ¾ mile. Includes concrete base, the actual cost of which was 48 cts. per square yard. Concrete base usually costs 50 cts. per square yard. The pavement has 1½-in. binder and 2-in. top when compressed.

Thirtieth St. between Wyandotte and Maine, completed June 22, 1912; 1,689.45 sq. yds.; cost $2,816.84, $1.67 per square yard. Average haul, 2 miles. Same character of work as 15th St. except that asphalt surface was placed over old brick pavement. Average haul, 1½ miles; 3,843.8 sq. yds.; cost $3,155.06, $0.82808 per square yard.

A small amount of new work is done, most of the work being repairs and cuts. The bulk of the work is done by contract, that being preferred by the boards of aldermen and council.

St. Louis, Mo.—The work performed by the St. Louis plant consists in the repair of streets upon which the guaranty has expired, amounting to an aggregate area of 559,000 sq. yds. The plant was installed in March, 1912, and the cost is given as $20,000. The capacity of the plant is 1,500 sq. yds. of 2-in. topping per day of 8 hours. The cost output averages 29 to 31 cts. per cubic foot, not including overhead charges. If these be added on the basis of 9.4 per cent, the cost will be $0.317—$0.339 average equals $0.328 per cubic foot of topping. Because of its recent installation the average cost of work performed, based on operation for a full season, cannot be given.

On all work excepting the small patches and cut work a burner is used to aid in the removal of the old stuff, and is operated in advance of the work of placing the new materials, ordinarily the night before. An asphaltic paint coat is sprayed over the surface to be patched in addition to its use for painting the edges.

According to city ordinances, not exceeding ½ block may be resurfaced by administration. This restriction results in higher unit costs of work than would otherwise be possible.

The plant force consists of:

	Per day
Foreman, at $100	$ 4.00
Day engineer, at $90	3.46
Night engineer (required by local ordinances)	3.46
7 laborers, at $2.43 per day	17.01
	$27.92
Two street gangs:	
2 roller men, at 50 cts. per hour	8.00
4 gang foremen, at $100 per month	16.00
4 rakers, at $2.56 per day	10.24
2 tampers, at $2.24 per day	4.48
10 laborers, at $2.16 per day	21.60
	$60.32
Transportation, eight 2-horse teams, at $4 per team	$32.00

Toledo, O.—The Toledo municipal asphalt plant is used for patching and "cut" work repairs. It is of the railroad type, with nominal capacity of 1,000 sq. yds. of 2-in. topping per day of 8 hours. It has been in operation since the spring of 1912, but has not been operated to its capacity. The cost of work performed, including cutting work, interest on investment, depreciation, and other overhead charges, is stated to be about $0.72 per square yard—$0.48 per cubic foot of asphaltic topping. The asphaltic cement used is a mixture of California asphalt 1 part, Texas asphalt 2 parts.

The plant force consists of:

	Per day
Foreman, $100 per month; engineer, $75 per month; fireman, $60 per month; watchman, $50 per month; total, $285	$11.40
3 laborers, at 25 cts. per hour, $2.25 per day	6.75
	$18.15

9-hour day at plant, 8-hour day on street.

Street force:	
Foreman, at $100 per month	4.00
1 raker	3.50
1 raker	2.75
4 laborers, at $2 per day	8.00
1 tamper	2.50
1 rollerman	3.50
	$24.25

Teams, at 75 cts. per hour.

Cost of asphalt, California, per ton	22.00
Cost of asphalt, Texas, per ton	20.00
Cost of lake sand at dock, per load of 128 cu. ft.	3.50
Cost of haul, ½ mile, per cu. yd	.74
Cost of bank sand delivered, per ton, $0.75 cu. yd.	.60
Cost of dust, per ton	4.20

Columbus, O.—The municipal asphalt plant at Columbus, O., was installed in 1907, and is used ordinarily for minor repairs to asphalt pavements and for "cut work." Jobs exceeding $500 in cost are performed by contract, except when special authority may be given the municipal authorities to do the work by administration.

The plant capacity is 1,000 sq. yds. of 2-in. topping per day. Its cost was $11,825 and that of the equipment was $3,175 additional, making a total cost of $15,000. This does not include the value of the site, which probably is worth at least $5,000. If this amount be included in the plant cost, the total investment may be stated as $20,000.

The past report of work obtainable, that for 1910, gives as the output of the plant 13,671 sq. yds. (20,507 cu. ft.) of topping on patching and cut work at a cost for labor and materials of $11,426.17; 2,060 sq. yds. (3,090 cu. ft. of topping and 3,666 cu. ft. of binder) on resurface work at a cost for labor and materials of $2,121.39; 245 cu. yds. (6,615 cu. ft.) of asphaltic concrete at a cost of $1,473.80. The number of cubic feet of plant product aggregates 33,871 and the cost of labor and materials aggregates $15,024.36.

If 5 per cent be added for interest on the investment and 10 per cent for plant depreciation (not including site) as overhead cost, the actual cost will be $17,524.36. The addition is 16⅔ per cent of the aggregated material and labor cost. With the addition of the overhead cost indicated, the cost per cubic foot of plant product as laid on the street was $0.518.

The large overhead cost is due to the small plant output, which averaged, on the basis of 200 working days per year, 169 cu. ft. per day.

Indianapolis, Ind.—The municipal asphalt plant at Indianapolis is used for patching and repair of cuts. It was installed in June, 1908, and the reported cost is $20,557.68. The site is rented at $500 per year.

The nominal capacity is 1,000 sq. yds. of 2-in. topping per day. The plant cost of product is given as $2.12 per box, equal to $0.265 per cubic foot. The street-labor cost is given as 16 cts. per square yard, equal to $0.1067 per cubic foot. The total cost, including plant, haul, street and overhead charges, is given as $0.547 per square yard, equal to $0.3647 per cubic foot. No interest charge is made and only 5 per cent is allowed for depreciation.

During the winter, when the plant is shut down, the following force is carried:

Plant foreman, $100 per month	$ 400
Plant engineer, $100 per month	400
Plant fireman, $15 per week	255
Bookkeeper, $100 per month	400
Street foreman, $4 per day	360
Roller engineer, $3.50 per day	315
4 laborers at plant, $8 per day	720
Total	$2,850

This expenditure is large for the period when no construction work is in progress.

Mr. McComb was informed that according to official precept laborers and other employes must be capable and efficient to insure retention; also that since the installation of the plant there has been no delay in making repairs required to the pavements. Formerly it was said to be practically impossible to secure prompt repair work, especially so on streets under guaranty. From other sources he was told that politics enters largely into the municipal work, and that all the plant employes were removed when the present administration was installed, including those who had attained proficiency in the work.

The latest available statistics of cost which he was able to secure covers the work of the year 1910. If to the cost therein stated interest on the plant at 5 per cent be added and depreciation be increased to 10 per cent, the cost of the plant product will be as follows:

Year's product, 159,565 cu. ft.:		
Salaries and wages		$34,212.54
Materials, fuel, oils, and waste		36,500.73
		$70,713.27
Repairs, rents, insurance and sundries	$2,711.21	
Depreciation of plant, 10 per cent of $20,557.68	2,055.77	
Interest on investment, 5 per cent of $20,557.68	1,027.88	
		5,794.86
Total		$76,508.13

Cost per cu. ft., $0.4792.

Omaha, Neb.—The Omaha municipal plant is used for repair work, a small amount of resurfacing work being included. The plant consists of a drier, a mixer, three closed kettles, and the ordinary appurtenances. A Noyes crusher is used to pulverize old asphaltic topping which is used in the repair work. The mixture used consists of:

	Lbs.
Sand heated to a temperature of about 400° F.	500
Crushed asphaltic topping, cold	400
Dust	7
Asphaltic cement	80

Old material has been used for work performed by the plant for two years, and surfaces examined were in good condition.

Two years ago an alley was surfaced with a composition consisting of old asphaltic topping enriched with 25 lbs. of asphaltic cement per 900 lbs. of old stuff. Mr. McComb made a careful examination of this pavement and formed the opinion that the surface compares favorably with ordinary asphaltic paving work of the same age.

The work recently performed costs per square yard of 2-in. surface $0.46. If to that cost we add 9 4-10 per cent for administration, the cost will be $0.503 per square yard.

The Wentworth Ave. job of resurfacing (2,000 sq. yds.) consisted of binder 1½ in. to 2 in. thick and topping 1½ in. thick (old and new materials mixed); cost, $1.15 per square yard; the haul was 3 loads per day. If to that cost we add 9.4 per cent for administration, the cost will be $1.258 per square yard.

Hamilton, Ont.—The city of Hamilton, Ont., has a small plant, which is used for new work as well as for repair and maintenance work. It was acquired from a contractor in 1905. California asphaltic cement is used in the plant output. When the work was visited operations had been suspended. The cost of patching work (2-in. topping) varied from $0.90 to $1 per square yard. Formerly the cost by contract averaged in cost about $1.40 per square yard. The average cost of 2-in. topping (new work) laid in 1911 was $0.71; 60,070 sq. yds. were laid.

The asphalt paving work performed in 1911 consisted of a top surface 2 in. thick, after compression, laid upon a concrete base, without a binder course. The authorities now consider this procedure was faulty and the use of a binder course is now the rule.

In many places the top coat flowed badly, yet in others no flow was observable.

Toronto, Ont.—The Toronto municipal plant is used principally for patching and repair work, although a relatively small amount of new work is performed. The nominal capacity of the plant is 1,500 sq. yds. of 2-in. surface per day of 9 hours, and the amount invested was $33,522. It is situated on the harbor front, adjacent to the railway, and appears to be well managed.

The information received as to the overhead cost, viz, $10,439.11 per year, covers interest, depreciation, upkeep, office and general supervision force carried on yearly basis, and coal consumption on basis of 162,000 cu. ft. of yearly output—$0.0644 per cubic foot of output.

The reported cost of labor and materials are:

2-in. topping, at plant, $0.44 per sq. yd	$0.2933
Haul and street work for 2-in. topping and 1-in. binder, $1 per sq. yd	.4444
Overhead cost	.0644
Total	$0.8021

Average haul equals 1½ miles.

The rates of pay are:

Two-horse teams, driver and harness (wagon owned by city) per hour	$ 0.60
Rakers, per week, full time allowed in working season, per week	16.00
Ordinary labor, per hour	.25

9 hours constitutes a day's work.

Dayton, O.—The municipal plant in Dayton, O., is used only for patching and repair work. Its capacity is about 200 to 240 cu. ft. of product per day of eight hours. When visited in August last, Mr. McComb was informed that the plant had not been operated since November, 1911, at which time there was a change in the personnel as a result of the municipal election. He was informed that when, as a result of a political change, a new force took charge of the plant, extensive repairs were necessary. These were not completed at the time of his visit.

Milwaukee, Wis.—The work performed by the Milwaukee municipal plant consists in patching and "cut work."

A stationary plant with capacity of 250 sq. yds. of 2-in. topping per day of eight hours furnishes materials for the greater portion of the work, and a portable plant of 100 sq. yds. per day capacity furnishes materials for the work in remote sections of the city. The materials used consist of old topping materials removed from streets, the pavements of which have been resurfaced. This material is crushed and heated in a revolving drum, asphaltic cement being added, the amount of which is determined by the plant foreman.

The operation is slow, the provision for handling material are defective, and as a whole it is a poor outfit. Mr. McComb was told that the previous administration had upset things generally and that the present officials were just beginning to get to work on a business basis, with resources depleted, however, because of the maladministration of former officials. The cost of work performed during the month of July, 1912, was given as $0.55 per square yard of 2-in. topping, including plant, haul and street charges, but nothing for overhead cost.

If 10 per cent be added for overhead cost as a reasonable estimate of the same, the cost per square yard of 2-in. topping will be $0.605—or $0.4033 per cubic foot of output.

	Per day
Ordinary labor wage is	$2.00
Rakers	$3.00 and 3.50
Smoothers	2.75
2-horse team and driver	5.00

Denver, Colo.—The Denver municipal asphalt plant was installed in 1910, and its operation was commenced Aug. 5 of that year. The cost of the plant was $30,488.11, and its capacity is rated at 1,000 sq. yds. of 2-in. topping per day, but the capacity is not reached in its ordinary work. The plant is of the ordinary stationary type and is poorly situated in the yard for economical handling of materials, a large amount of rehandling being necessary. There are two open kettles fitted for agitation by means of compressed air and one closed kettle with mechanical agitator.

There is one heating drum and one mixer. Sand is measured in an 8-ft. box, dust is measured in bulk, and the asphaltic cement is weighed. Flux is stored in two large tanks just outside the housing of the plant and is forced by compressed air to a weighing tank near the melting kettles.

California and Texas asphalts mixed half and half are used for the asphaltic cement. The drum and kettles are heated by coal. The work performed consists in the resurfacing and repair of existing pavements. New work is performed under contract system. Repair and renewal work is paid for from the general fund.

All new work is assessed against abutting properties. The total number of square yards of pavement laid during the year 1911 was 72,193, which included 38,734 sq. yds. of patching and cut repair work.

Larimer St. and Broadway were the only two pieces of work of any considerable size. On Larimer St. 16,296 sq. yds. of pavement, consisting of binder 1 in. and topping 2 ins., were laid. The cost of this work, including 5 per cent for overhead cost, is reported as $16,535.05, or $1.0146 per square yard. On Broadway 14,468.7 sq. yds. of pavement, consisting of binder and topping, the same as that laid on Larimer St., were laid. The cost of this work, including 5 per cent overhead cost, is reported as $15,163.98, or $1.048 per square yard. The 5 per cent added to cover overhead cost appears to be an assumption in the absence of definite records of the same. If it is assumed that the overhead cost will be as much as the Detroit overhead cost—viz, 9.4 per cent—cost of the two jobs above noted will be $1.057 per square yard for Larimer St. and $1.091 per square yard for Broadway.

The prices paid for labor on the basis of 9 hours per day are:

Superintendent, per month	$175.00
Plant foreman, per month	100.00
Street foreman, per day	4.50
Roller engineer, per day	4.00
Plant engineer, per day	3.50
Drum foreman, per day	3.00
Kettle man, per day	2.50
Tampers and smoothers, per day	$2.50 and 2.75
Rakers, per day	3.00
Ordinary labor, per day	2.25

During the three months when the plant is shut down, the following force is carried:

Superintendent, $175 per month	$525.00
Plant foreman, $100 per month	300.00
2 watchmen, $2.35 each per day	423.00
	$1,248.00

The current prices of materials are:

California asphalt, per ton	$21.00
Texas asphalt, per ton	23.50
Sand, per cu. yd	$1.30 and 1.40
Dust, per ton	4.50
Binder stone (1-in. to ⅛-in.), per cu. yd.	2.50
Fuel oil, per gal	.04
Texas flux, per gal	.06

Minor repair work is reported to cost 80 cts. per square yard for 2-in. topping, including overhead charges. If in this case the overhead charges be increased from 5 per cent to 9.4 per cent, the cost would be 83.4 per square yard.

The information given was that political influence with the work was not harmful, but that in the past the force had been unduly augmented at election times. The present force was appointed by the existing administration, succeeding the force which existed under the previous administration.

New Orleans, La.—The New Orleans municipal asphalt plant was installed in 1906 for repair and maintenance of asphalt pavements. Its nominal capacity is 1,000 sq. yds. of pavement consisting of topping 2 ins. thick and binder 1½ ins. thick. The cost of the plant as given in the report of Aug. 31, 1909, was $77,202.46, not including the value of the site.

The work performed in the first year of operation is reported as 88,947 cu. ft., 44,301 sq. yds of wearing surface; in the second year 86,004 cu. ft., 31,631 sq. yds.; and in the third year 19,105 sq. yds. of wearing surface. The number of cubic feet is not given. The report states that "two lots of asphalt wearing surface mixtures were shipped to Mobile, Ala., for which a charge of $2,374.54 was made." If the ratio between cubic feet of topping material and square yards of pavement laid be taken as the same reported in the operations, for the first year the plant output used on the street work will appear to have been 38,370 cu. ft.; if the ratio for the second year be taken the plant output will appear to have been 52,759 cu. ft.

The cost of work performed cannot be determined from the statements in the annual reports, for the reason that the cost of works of different kinds, such as grading, culverts, drains, curbs, footwalks, etc., are so grouped that the cost of the asphalt work cannot be segregated.

However, it is apparent that the volume of work done is much below the plant capacity and was well within the capacity of a portable plant which might have been secured for an amount not exceeding $10,000 and with plant force very much less expensive than that employed.

The plant depreciation at 10 per cent and interest at 5 per cent alone amount to $11,580.37 per year, equal per cubic foot of plant product, for the work of the first year, $0.130; for the work of the second year, $0.135; for the work of the third year, $0.219.

The plant depreciation and interest charges for a plant costing $10,000 would have been $1,500, and this indicates that $10,080.37 per year has been expended more than was necessary to accomplish the results attained. To this should be added an amount representing the excessive cost of personnel.

Pittsburgh, Pa.—The old plant which has recently been abandoned was installed about five years ago and was used only for minor repair work; the new plant has been in service only for a few months and several changes have been made since its first operation, so that its economic value is yet to be demonstrated. It has a capacity of 3,000 sq. yds. of top and binder per day, and is available for resurfacing and for new work. A railway trestle runs directly across the yard and carload lots of stone, sand, asphalt, etc., are delivered; the sand (of two grades) and stone into piles below the trestle and the asphalt on a platform at upper level of structure where the kettles are situated; for storage it is chuted to ground level. The flux is discharged into the tank just below the trestle; it is heated by steam and forced by compressed air to the measuring bucket. A belt conveyor is used to transport the sand from the sand piles to the elevator, by which it is carried to the dryer. Men shovel the sand from the sand piles onto the belt conveyor, the mixture of the two different sands being proportioned by the number of men working at each pile. Two men shovel the sand into the boot of the dryer elevator. The stone pile is abreast of the conveyor to the stone dryer. There are two Cummer dryers which are heated by natural gas, one for sand, the other for binder stone or stone for asphalt macadam, or both may be used for sand. The asphalt is heated by superheated steam. There are three open kettles placed on the level of the railway trestle and the A. C. flows by gravity to the mixing kettle. There are two mixers; above each is the bin for sand or stone and the measuring box of 15 cu. ft. of capacity. The mixers are discharged by the operation of a gate actuated by steam. A slide from railroad trestle for skidding asphalt packages consists of two 6-in. channel irons spaced 18 ins. apart, slope of 30° from platform to a point 2½ ft. above ground surface, thence horizontal for 12 ft. This lower section is of 3-in. angles. The boiler house section is inclosed by brick walls, the remaining portion by corrugated iron sheeting. Trestle is 22 ft. above ground level and is at same elevation as floor of kettle shed. There are three motor trucks used to transport hot stuff each of 6½ tons capacity. They have been used for a short time only and have been satisfactory. Load is discharged at sides, the bin having a sloping bottom. It could be readily arranged to have load separated into two or four parts. There are on each side two gates operated by rack and pinion.

Ordinary labor, 25 cts. per hour.

Rakers, $2.50 for eight hours, full time.

Tampers, $2.25 for eight hours, full time.

Roller engineer, 50 cts. per hour.

$5.50 per day for two horses, wagon and driver.

Three 6½-ton auto trucks, average haul, 4 miles; maximum haul, 10 miles (20 miles round trip).

San Francisco, Cal.—The San Francisco municipal asphalt plant was installed in 1909 at a cost of $17,000. The annual report of work performed in 1911 indicates that the plant product was used for repair and replacement work; 328,820.64 cu. ft. of wearing surface and 72,126 cu. ft. of binder, total 400,946 cu. ft., was the amount of plant product for the year. The cost of labor, fuel, repairs and power at the plant was $48,021.53, equals $0.1198 per cubic foot.

The cost of street labor and hauling was $85,316.96, equals $0.2128 per cubic foot. The cost of matcrials for wearing surface was $80,520.20, equals $0.245 per cubic foot, and the cost of materials for binder was $10,097.64, equals $0.140 per cubic foot.

The charge for depreciation, 10 per cent of plant cost	$1,700.00
The charge for interest on investment, at 6 per cent	1,020.00
Total	$2,720.00

$0.0068 per cu. ft. of plant product.

The estimated charge for general supervision and office expenses on basis of Detroit work for eight years equals $0.0144 per cubic foot; overhead cost, $0.0068, divided by $0.0144 equals $0.0212 per cubic foot.

Cost of wearing surface per cubic foot:

Labor, fuel, repairs to plant	$0.1198
Street labor and hauling	.2128
Materials	.2450
Overhead cost	.0212
Total cost per cu. ft	$0.5988

Cost of binder per cubic foot:

Labor, fuel, repairs to plant	$0.1198
Street labor and hauling	.2128
Materials	.1400
Overhead cost	.0212
Total cost per cu. ft	$0.4938

Spokane, Wash.—The Spokane municipal asphalt plant has been operated since the spring of 1911. The nominal capacity is 1,600 sq. yds. of 2-in. topping per day of eight hours. The cost was $21,599.36. The output of the plant is used mostly upon repair work, although a certain amount of bituminous macadam work has been performed. The reported cost of work performed, including 10 per cent of labor and material costs as overhead charge, is:

Repairs, including 2-in. topping and 1½-in. binder, $1.30 to $1.40 per square yard.

Resurface work, including removal of old surface and haul of same to dump, $1.10 per square yard.

The material prices are:

Asphalt, per ton	$17.50 to $18.00
Sand, per cu. yd	1.00
Broken stone, per cu. yd	1.00

The labor prices are (per 8-hour day):

Common labor	$3.00
Tampers and smoothers	3.50
Rakers	4.00
Engineer	5.00
Foreman	6.00
Asphalt mixer men	3.50
Teams, including drivers	6.00

Seattle, Wash.—The Seattle municipal asphalt plant is used for new work as well as for repair and replacement work. The nominal capacity is 1,000 sq. yds. of pavement per day and the cost is given as $14,135.

The cost of laying 7,280 sq. yds. of asphalt pavement on Holgate Street viaduct, 2½-in. topping on ½-in. binder, is given as follows:

Binder, per cu. ft	$0.2314
Overhead, 10 per cent	.0231
Cost per cu. ft	$0.2545
Topping, per cu. ft	.3911
Overhead, 10 per cent	.0391
Cost per cu. ft	$0.4302
Cost of materials:	
Asphaltic cement, ton	$20.00
Sand, cu. yd	.75
Clinker for binder, cu. yd	1.00
Dust, lb.	.0033
Cost of labor per day:	
Foreman	$5.00
Engineers	3.50
Rollermen	3.50
Rakers	3.00
Firemen	3.00
Plantman	3.00
Laborers	2.50

Winnipeg, Man.—The municipal asphalt plant at Winnipeg was installed in 1899 and is used for repairs, resurfacing and new work. There are two units—a stationary one with nominal capacity of 2,500 sq. yds. of pavement (2-in. surface and 1½-in. binder) and a portable one with nominal capacity of 1,500 sq. yds. of 2-in. surface per day.

Surface batch consists of 1,216 lbs. of sand, 240 lbs. of dust, and 175 lbs. of asphaltic cement and will lay 8.5 sq. yds. per batch.

Binder batch consists of 900 lbs. of stone, 50 lbs. of asphaltic cement, and will lay 6.5 sq. yds. per batch. Cost of labor and material at works per square yard of pavement:

Binder and surface	$ 1.03
Cost of haul (average, 1½ miles)	.06
Cost of street work	.10
Overhead cost	.10
Total cost, per sq. yd	$ 1.29
Unit cost of materials:	
Broken stone, per cu. yd	1.75
Sand, per cu. yd	1.10
Asphaltic cement, per ton	21.64
Limestone, per cu. yd	1.15
Unit cost of labor, per hour:	
Rakers and tampers	$0.35-$0.40
Asphalt-plant labor	.25- .30
Common labor	.25

Cleveland, O.—The Cleveland municipal asphalt plant is used only for repair work. The capacity is about 325 cu. ft. per day. Old asphaltic topping removed from streets which have been resurfaced is broken into small fragments and an amount of asphaltic cement, determined by the plant foreman, is added. The ingredients are mixed and heated in a revolving drum. A burner is used to aid in the removal of old material when patching is to be performed. The work which Mr. McComb inspected was lacking in efficiency, a large portion of time of the street gang being spent in waiting for asphaltic materials. The work at the plant was open to the same criticism, i. e., the operations lacked a reasonable degree of activity. The cost of work performed is given as $0.85 per square yard of 2-in. topping, not including charges for deterioration, interest, and other overhead charges.

The material Mr. McComb saw laid on the street was considerable less than 2 ins. thick.

If 10 per cent be added for overhead cost, which is probably below the actual cost, the price given ($0.85) will be augmented and become $0.935 per square yard.

ESTIMATES FOR ESTABLISHMENT OF MUNICIPAL ASPHALT PLANT FOR THE DISTRICT OF COLUMBIA.

The site proposed for the municipal asphalt plant at Washington, D. C., is located about 2½ miles from the center of volume of the asphalt paving work. It is provided with water and rail transportation facilities, so that materials required for the work may be economically received and the hauling from the plant may be made over well paved streets. The following estimates on the operation of this plant are taken from Mr. McComb's report:

Taking as a basis the work performed in the fiscal year 1911-12 in the District of Columbia, it may be assumed that new paving, replacement, and resurfacing work will be concentrated within a yearly period embracing 185 working days and will require an average plant output of 2,742.5 cu. ft. per day; that minor repair and cut work will be performed during 220 days of the year and will require an average plant output of 711.8 cu. ft. per day. In order that all classes of asphalt work may be provided for, the average plant output for 185 days should be 3,454.3 cu. ft. per day, and for 35 days it should be 711.8 cu. ft. per day, with yearly output of 663,958 cu. ft.

The average age of the existing asphalt pavements is about 12.9 years. If the amount of new work, replacement and resurfacing work shall be equal to that performed in the last fiscal year, the average age of the pavements will be lowered and within the next four years the age will become about 10½ years, after which the annual expenditures for resurfacing and replacing may be reduced. The minor repair work should not expand much above its present volume, for although the paved area will be increased, within the period of the life of the plant about 9 per cent, all the older pavements will have disappeared. An increase of 4½ per cent is conservative. It may be assumed that the capacity of a plant for all asphalt paving work in Washington need not exceed 5,800 cu. ft. of output, equal to 2,000 sq. yds. of pavement (top and binder) per day.

The estimated cost of the municipal asphalt plant is shown in Table III.

The operating cost of the plant on the basis of an average output of 3,454.3 cu. ft. per day for 185 days and of 711.8 cu. ft. per day for 35 days, is estimated as follows:

Estimated cost of plant, excluding street and transportation equipment	$56,897.00
Plant depreciation per year, 10 per cent of $45,012 (no depreciation on cost of preparation of site, bulkhead, grading and railway siding)	4,501.20
Interest on investment of $56,897, at 3½ per cent	1,991.40
	$ 6,492.60

TABLE III.—ESTIMATE OF COST OF MUNICIPAL ASPHALT PLANT.

Site: Wharf property south side of Water street, S. W., between Thirteen-and-a-half street and Philadelphia, Baltimore & Washington Railroad.

Dryers, kettles, mixers, and operating machinery	$32,000.00	
Office and shed	3,000.00	
Sand and stone bins	1,500.00	
Conveyors	3,000.00	
Unloading equipment, 250 ft. of track, at $1.50	375.00	
Track derrick, 50-ft. boom, with 1 cu. yd. grab bucket	5,000.00	
Fencing	137.00	
		$45,012.00
Preparation of site—		
Bulkhead	$ 8,750.00	
Grading	1,750.00	
Railway siding	1,385.00	
		11,885.00
		$56,897.00
Three steam rollers and equipment for top and binder work		7,000.00
Four motor trucks for transportation of hot asphaltic materials		19,400.00
Three concrete mixers with equipment for concrete work		6,000.00
		$89,297.00
Plant depreciation, 10 per cent per year on $45,012		$ 4,501.20
Interest on investment, 3½ per cent per year on $56,897		1.991.40
Plant depreciation and interest per year		$ 6.492.60

With yearly output of 663,954 cu. ft., plant depreciation and interest will cost $0.0098 per cubic foot of output, operating for 185 days with average daily output of 3,454.3 cu. ft.

Plant force:

Foreman, at $1,500 per annum, pro ratio	$ 1,333.80
Clerk, at $1,000 per annum, pro ratio	889.20
Load marker, 185 days, at $3	555.00
Engineer, 210 days, at $4	840.00
Hoisting engineer, 185 days, at $3	555.00
Watchman, 352 days, at $1.50	487.00
2 stokers, 200 days, at $2.50	1,000.00
Tank man, 185 days, at $2.25	416.25
2 mixer men, 185 days, at $2.25	832.50
20 laborers, 185 days, at $1.50	5,550.00
	$12,458.75
Output, 639,045 cu. ft	$0.0195
Depreciation and interest	.0098
	$0.0293

Operating for 35 days with average daily output of 711.8 cu. ft.:

Plant force—

Foreman, at $1,500 per annum, pro ratio	$ 166.20
Clerk, at $1,000 per annum, pro ratio	110.80
Engineer, 65 days, at $4	260.00
Hoisting engineer, 10 days, at $3	30.00
Watchman	60.50
1 stoker, 65 days, at $2.50 1 stoker, 35 days, at $2.50	250.00
Tankman, 35 days, at $2.25	78.75
Mixerman, 35 days, at $2.25	78.75
8 laborers, 35 days, at $1.50	420.00
	$1,455.00
Output, 24,913 cu. ft., per cu. ft	0.0584
Depreciation and interest	.0098
Plant labor cost, depreciation, and interest, per cu. ft	.0682
Estimated cost of street gang on resurfacing and new work—	
1 foreman, at $4.50 per day	$ 4.50
1 assistant foreman, at $3.50 per day	3.50
1 water boy, at $0.75 per day	.75
1 watchman, at $1.50 per day	1.50
2 rollermen, at $4 per day	8.00
3 rakers, at $1.80 per day	5.40
2 tampers, at $1.75 per day	3.50
2 smoothers, at $1.60 per day	3.50
12 laborers, at $1.50 per day	18.00
1 cart, at $2.50 per day	2.50
	$50.85
Average work of gang, based on 185 days of work in fiscal year 1911-12, cu. ft	2,742
Average cost per cu. ft. of material laid	$0.0185
Average cost per sq. yd. of pavement laid	.0537
Estimated cost per sq. yd. of asphalt pavement with Bermudez asphalt cement, 1½-in. binder and 2-in. topping on 6-in. concrete base—	
Concrete base (labor and materials)	$0.6187
Binder materials	.1646
Topping materials	.3339
Fuel at plant, $0.0139; on street, $0.0137; (Detroit record), $0.0276	.0280
Plant labor, including plant depreciation and interest, 0.0293 cu. ft	.0850
Street labor, including plant depreciation and interest, $0.0537, $0.0165	.0702
Haul of hot stuff (5-ton auto truck) 2½ miles (0.0133 × 2.9) + 10 per cent	.0424
Haul of hot stuff by wagon (0.01875 × 2.9) + 10 per cent = 0.0598.	
Cost of fine grading	.0300
Barricades, lighting, etc	.0150
Superintendence	.0150
	$1.4028

Haul of materials required for concrete base is assumed to be by wagons, and for asphaltic binder and topping by auto trucks.

Cost of 6-in. concrete base, per sq. yd	$0.6587
Cost of binder, per cu. ft., $0.2023; per sq. yd	.2832
Cost of topping, per cu. ft., $0.3073; per sq. yd	.4609
	$1.4028

TABLE IV.

	A.	B.	C.
Using lake pitch asphalt—			
Standard asphalt pavement, per sq. yd	$1.7142	$1.4028	......
Standard asphalt surface, per sq. yd	.6550	.4609	......
Standard asphalt binder on resurface work, per cu. ft.	.2940	.2023	......
Standard asphalt surface on minor repair work, per cu. ft	.5840	.5003	$0.5409
Standard asphalt binder on minor repair work, per cu. ft	.4440	.3953	.4342
Using any brand of asphalt conforming with specifications for asphalt—			
Standard asphalt surface on minor repair work, per cu. ft	.5540	.4184	.4562
Standard asphalt binder on minor repair work, per cu. ft	.4340	.3701	.4057

MINOR REPAIRS TO ASPHALT PAVEMENTS.

Estimated cost of hauling asphaltic materials—By carts, one-half volume; by auto trucks, one-half volume.

Average haul by carts, 1¾ miles, cost per cu. ft.	$0.0286
Average haul by auto trucks, 3 miles, cost per cu. ft.	.0407
Mean cost of hauling, per cu. ft.	.0347
Cost of street labor, including cutting out and hauling old materials from street, spreading, tamping, rolling, barricading, foremen (record of recent day-labor work) ($0.0854, $0.0943, $0.0146)	.1943
Fuel, oils, waste, etc	.0097
Average plant labor	.0355
	$0.2742

Cost of materials for binder, per cu. ft.	$0.1176
Cost of hauling, labor, fuel, per cu. ft.	.2742
Cost of binder laid, per cu. ft.	$0.3918
Cost of materials for topping, per cu. ft.	$0.2226
Cost of hauling, labor, fuel, per cu. ft.	.2742
Cost of topping laid, per cu. ft.	$0.4968

Estimated cost, using carts for hauling all materials—

Cost of hauling, per cu. ft.	$0.0382
Cost of street labor, as above	.1943
Fuel, oils, waste, etc	.0097
Cost of plant labor	.0355
	$0.2777
Cost of materials for binder, per cu. ft.	$0.1176
Cost of hauling, labor, fuel, etc., per cu. ft.	.2777
Cost of binder laid, per cu. ft.	$0.3953
Cost of materials for topping, per cu. ft.	$0.2226
Cost of hauling, labor, fuel, etc., per cu. ft.	.2777
Cost of topping laid, per cu. ft.	$0.5003

Table IV is a comparison of prices in proposal of April 22, 1911, upon upon which current contract for paving repair work was based, with cost of inspection added (A); with estimated cost of the work if performed by District employes and use of municipal plant (B); with cost of minor repair work performed by District employes using a portable plant in November, 1912 (C).

GENERAL ARTICLES

Cost of Clearing Land for a Large Estate on Long Island.

Contributed by A. S. Malcomson, Freeport, N. Y.

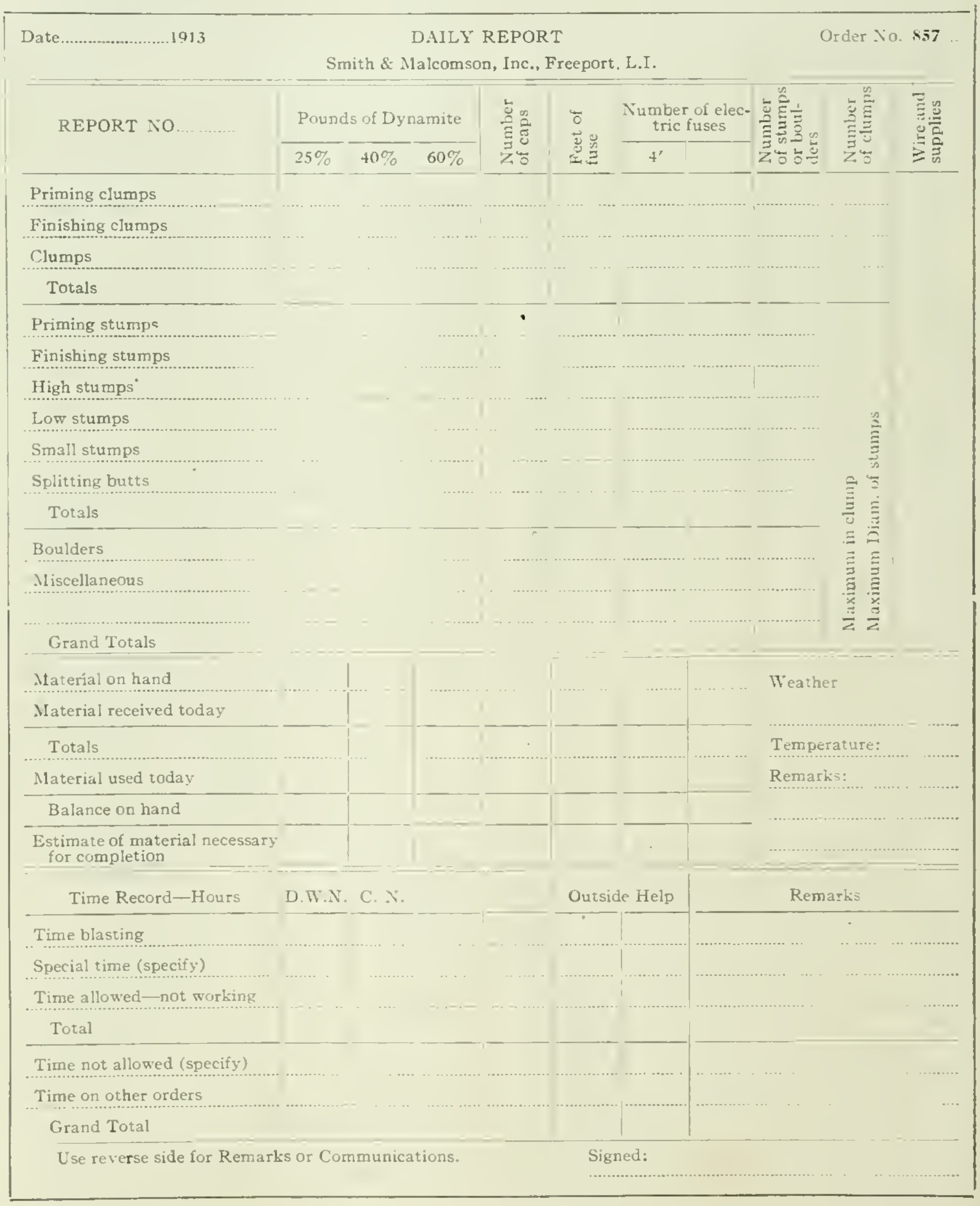
The work was clearing land for a large estate at Oyster Bay, Long Island. The writer believes the information to be as accurate as is possible on this kind of work. The data have been compiled from a record kept daily of the amount of material used; number and general size of stumps, and time consumed, with a certain allowance made for lost time which occurs on all work. The accompanying Fig. 1 shows the form of daily report made out by the blaster on the work. The cost of this work was 46 cts. per stump, exclusive of overhead expenses, but this figure would perhaps be increased on jobs of less consequence when dynamite would be bought in smaller quantities. Table I shows the number of stumps and the material used for blasting them. The "miscellaneous" item includes priming preliminary to the main blasts, and taking out pieces of roots left after the same; also splitting up the butts and a few boulders. When this material was disposed of by the men connected with the estate, the ground was ready for cultivation. The following are the itemized expenses of the work:

EXPENSES.

Blaster and helper	$ 140.00
Two laborers, boring holes	94.50
Insurance	21.50
5,200 lbs. 40% Red Cross dynamite at $0.12½	650.00
1,150 caps at $0.7225 per 100	8.30
2,800 ft. fuse at $0.4185 per 100 ft	11.76
1,719 electric fuses at $2.975 per 100	51.05
Demonstration and supervision	50.00
Total	$1,027.11

TABLE I.—NUMBER OF STUMPS AND MATERIALS USED ON LAND CLEARING CONTRACT

	Number of stumps.	Pounds of dynamite.	Number of caps.	Feet of fuse.	Number of fuses.
277 clumps	812	2,251.5	21	52.5	1,133
Large single stumps	290	1,089.5	110	225	446
Small single stumps	695	1,042	570	1,425	118
Totals	1,797	4,383	701	1,752.5	1,697
*Miscellaneous	451	809	453	1,070	22
	2,248	5,192	1,154	2,822.5	1,719



Date..........1913 DAILY REPORT Order No. 857

Smith & Malcomson, Inc., Freeport, L.I.

REPORT NO.....	Pounds of Dynamite 25%	Pounds of Dynamite 40%	Pounds of Dynamite 60%	Number of caps	Feet of fuse	Number of electric fuses 4′	Number of electric fuses	Number of stumps or boulders	Number of clumps	Wire and supplies
Priming clumps										
Finishing clumps										
Clumps										
Totals										
Priming stumps										
Finishing stumps										
High stumps										
Low stumps									Maximum in clump Maximum Diam. of stumps	
Small stumps										
Splitting butts										
Totals										
Boulders										
Miscellaneous										
Grand Totals										

Material on hand					Weather
Material received today					
Totals					Temperature:
Material used today					Remarks:
Balance on hand					
Estimate of material necessary for completion					

Time Record—Hours	D.W.N.	C. N.		Outside Help		Remarks
Time blasting						
Special time (specify)						
Time allowed—not working						
Total						
Time not allowed (specify)						
Time on other orders						
Grand Total						

Use reverse side for Remarks or Communications. Signed:

Fig. 1—Form for Daily Report.

Subaqueous Foundation Construction by Driving Piles Through Thawed Holes in the Ice.

(STAFF ARTICLE.)

Pile driving using the ice as a working platform is being carried on at Superior, Wis., in constructing the foundations of an ore dock for the Northern Pacific R. R. The area occupied by the dock will he 800x116 ft. This is to be enclosed by a sheet pile cofferdam made of 12x12-in. timbers with 3x4-in. strips fastened to them to form tongue and groove piling. The foundation proper will consist of bearing piles driven over the area inside the cofferdam on about 3-ft. centers, and sand will be filled in to the bottom of the concrete slab floor which will be placed upon the sand and piles.

In carrying out this work the contractor conceived the idea of driving the piles and sheeting through the ice, by melting spaces large enough to allow the piles to be dropped through. A 50-h.p. boiler is set up on the ice near the point of operation and a 1¼-in. steam hose is connected to it. For clearing a channel in which to drive sheet piles, the steam hose is used to cut two parallel lines in the ice about a foot apart. The ice left between is then broken up and removed from the channel and the pile driver follows, filling this space with the sheet piles. For the bearing piles round holes large enough to admit the piles are cut in the ice with the steam hose. In this way the pile spacing can be made very accurate. Some of the piles are required to be driven on frozen ground and in order to thaw the ground for each pile an ordinary keg is used. It is placed over the spot where a pile is to be driven and steam is admitted. To thaw the ground requires about twice as long as to thaw the ice.

The thawing requires only two men, a fireman and a hose man. About 125 lin. ft. of channel, or about 100 round holes, is considered a good average day's work.

After the piles are driven and open water is desired, the enclosure, which is divided into two parts 800x58 ft., will be kept melted by running live steam into it.

The work is being carried on for the Northern Pacific Co. by the Siems-Carey Co. and Peppard & Fulton of St. Paul and Minneapolis.

Annual Convention North Dakota Society of Engineers.

Contributed by E. F. Chandler, Secretary.

The fifth annual convention of the North Dakota Society of Engineers was held in Bismarck, N. D., on Feb. 13 and 14, 1913, with an attendance of about 25 members and many visitors. The sessions were held during the morning, afternoon and evening of the two days.

The officers for the year ending were: President, H. G. Lykken of Grand Forks; Vice-Presidents, T. R. Atkinson, Bismarck, and Samuel F. Crabbe of Fargo.

After the usual routine of business, the program began with the report of the committee on concrete tests, of which Prof. A. J. Becker of the University was chairman. Report was made on a series of tests of the bonding strength of reinforcing bars in concrete, as made under the direction of the committee; the special feature of this report was the fact that in the concrete mixture, ordinary bank gravel was used, as secured from one pit or another, rather than the crushed rock that is ordinarily used for such work. There were also other papers on the chemical composition of cement and similar topics, and general discussion.

A committee on specifications for roads, Chairman H. G. Lykken, City Engineer of Grand Forks, reported on a set of model specifications adopted for the ordinary roads of the Red River Valley that had been prepared and published under the direction of the committee during the 12 months just past.

State Engineer T. R. Atkinson of Bismarck spoke on the advantages of the centralization of engineering work for bridges and highways. In particular he urged the more general adoption of the cash payment system for road taxes in place of the day labor system of working out road taxes.

H. C. Frahm, County Surveyor of Ward County, summarized a considerable number of court decisions that control the work of surveyors in the location of farm property lines. He emphasized the facts that the work of a surveyor on a re-survey is presumptively accepted, but does not give final title; that an erroneous line, if accepted by all parties through a considerable period of years, cannot later be changed; and that the original government monuments, if still visible or to be found, are the final evidence in all questions depending on the government land survey. He distinguished between lost corners and obliterated corners. G. W. Heinmiller, County Surveyor of Foster County, spoke on the same question. H. B. Schmidt, County Surveyor of Mountrail County, enlarged upon the necessity for establishing maximum grades for the different roads in hilly regions, and then adhering religiously to these grades even though departure from the section lines was thereby necessitated. There was a general discussion of many other similar questions arising in the field work of the county surveyors.

W. R. Veigel, City Engineer of Dickinson, who was for 20 years a United States Deputy Surveyor engaged in making the original township and subdivision surveys, and in that time did all the work of surveying several hundred townships in the region of the Little Missouri Bad Lands, explained the methods found most practicable there. On account of the almost impassable character of much of this region, the ordinary methods for subdivision of townships as directed by the Land Office Manual were impracticable. By the use of a 40-rod steel wire tape and by a system of running random lines six miles long completely through from one side of the township to the other and then correcting the random corners, more accurate results were secured than are obtained by the ordinary methods in ordinary prairie land.

At an evening session an illustrated lecture on the Panama Canal, with views showing the equipment and methods employed in the excavation and in the construction of locks and other important features of the work was given by Prof. A. J. Becker of the University.

The topic of one session was the lignite of the state, and the methods for its utilization. Only one or two states in the Union have a greater area underlain by coal than North Dakota. Dr. A. G. Leonard, the state geologist, spoke of the geological structure and occurrence. Dean C. H. Crouch of the College of Mechanical Engineering of the University, submitted a paper reporting the results of recent tests of the coal made by him in a producer-gas power plant, and Dean E. J. Babcock, of the School of Mines of the University, described the experiments carried on under his direction at the Mining Experiment Station at Hebron, in the utilization of lignite, in the development of illuminating and fuel gas from it, and in the briquetting process. The briquetting process has now been carried on almost through the experimental stage at the Mining Experiment Station. Briquettes are being turned out on a scale that would be commercially profitable, and the details of this method and its processes are almost ready for publication and distribution.

R. W. Livingston, U. S. Surveyor, Mandan, discussed the advantages of the present method for the survey of public lands, the work being now done by civil service employes, instead of under the old contract method that was abandoned two years ago. The change in method would not have resulted in any advantage if all deputies under the former system had been as careful and as competent as some were, but it has been found that by the present system more uniform results are secured at about the same expense as previously, and that all the surveys are now of the same quality as the best surveys previously. Frank L. Anders, City Engineer of Fargo, discussed the new filtration and water softening plant that has been completed this winter at Fargo. The city of Fargo takes water from the Red River, a stream which is turbid and is bacteriologically unfit for domestic use. From the new plant good results are being secured at a not unreasonable price.

Samuel F. Crabbe, Drainage Engineer of Cass County, spoke in full of the defects of the present drainage laws of the state, and outlined modifications which, it is suggested, will facilitate the extension of drainage work without working injustice to anyone. Papers were also presented by W. H. Brown, Manager of the Red River Power Co., Grand Forks, on the "Problems of Public Utility Corporations," and by Thor G. Plomasen, County Surveyor of Billings County, on the "County Superintendent of Highways." There was a lively general discussion on all these topics and others.

Different matters to be submitted to the legislature were fully discussed, including revision of the laws on drainage improvement and road improvement, and a new act providing for the licensing of land surveyors. This bill, which was drawn up by a committee of the society and unanimously approved by the society, provides that none except land surveyors holding a license received after suitable examination shall be qualified to hold the office of County Surveyor or to file plats, maps or surveyor's certificates in any state or county office; this bill is before the present session of the legislature, but as this is the first time that it has been proposed in the state it is not likely to pass at this session.

At the close of the session these officers were elected for the coming year as the executive committee of the society: President, W. A. Baker, City Engineer of Wahpeton; Vice-Presidents, E. J. Thomas, City Engineer of Minot, and W. R. Veigel, City Engineer of Dickinson.

The Executive Committee reappointed as Secretary-Treasurer of the society Prof. E. F. Chandler (postoffice address, University, N. D.), and committees on such matters as concrete, drainage, irrigation and rivers, roads, highway bridges and culverts, surveyor's field methods, municipal improvements, industrial development, etc. The next annual meeting will be held at Fargo.

Motion Pictures of the Steel Industry.—Motion pictures have been made for Rogers, Brown & Co., of Cincinnati, showing the mining of iron ore in that company's mines in the Lake Superior region, the operations of blast furnaces and all the processes of steel production down to the making of steel rails. These pictures are being exhibited under the name "From Mine to Molder," and were recently shown to an audience of officials and representatives of various large manufacturing companies in the auditorium of the Engineering Societies Bldg., New York City.

Paving and Drainage in San Juan Bautista.—The Common Council of the city of San Juan Bautista, Mex., will soon award contracts for the drainage and pavement of the streets. Preliminary surveys are now being made, and the estimated cost is between $400,000 and $500,000 (gold).

BRIDGES

Stresses and Moments in a Rigid Frame.

Sirs: In my article, published Feb. 19, there is a typographical error which I wish to correct. The formula as printed reads as follows:

$$M_0 = P(h-a)\left[\frac{(h^2-a^2)I_1+2hbI_2}{h(hI_1+2bI_2)} - i\right]$$

It should read as follows:

$$M_0 = P(h-a)\left[\frac{(h^2-a^2)I_1+2hbI_2}{h(hI_1+2bI_2)} - 1\right]$$

Hoping that you will make this correction as soon as possible, I am

Respectfully yours,
GEORGE PAASWELL, C. E.,
154 Nassau St.
New York, N. Y., Feb. 21, 1913.

A Simple Practical Method for Determining the Stresses in a Hingeless Elastic Arch.

The computation of arches by the usual processes of the elastic theory is so laborious that simpler methods are being sought by engineers having much arch computation. One of these simplifications was explained in some detail in our issue of Jan. 22, 1913. The following is another which has been worked out by Mr. T. J. Wilkerson, Division Engineer, Bureau of Construction, Pittsburgh, Pa., and was recently described by him in a paper before the Engineers' Society of Western Pennsylvania. This method is not claimed to be absolutely mathematically correct, but that it is sufficiently near correct for all practical purposes for arches whose span is under 350 ft. and where the center line of the rib follows very closely the load line for dead loads. Also the errors from the method will be small when compared with that due to assumptions for live loads and the unit stresses for the various materials used in construction. In some cases where the results from this method have been checked by the more laborious methods it has been found the errors are very slight and are in all cases on the side of safety.

General.—As the hingeless elastic arch is particularly applicable to a reinforced concrete structure I have selected for my example, in describing the method, the Murray Avenue Bridge over Wm. Pitt Boulevard. This method, however, could be used for a steel rib with slight modifications as to proportioning of sections, and doubtless the errors would be less than for concrete ribs, as the moment of inertia of the rib would more nearly conform with the fundamental law of increase of moment of inertia from the crown directly with the secant of the angle of deflection. In the following example I have carried the work out in detail to a much greater extent than is necessary in the usual design.

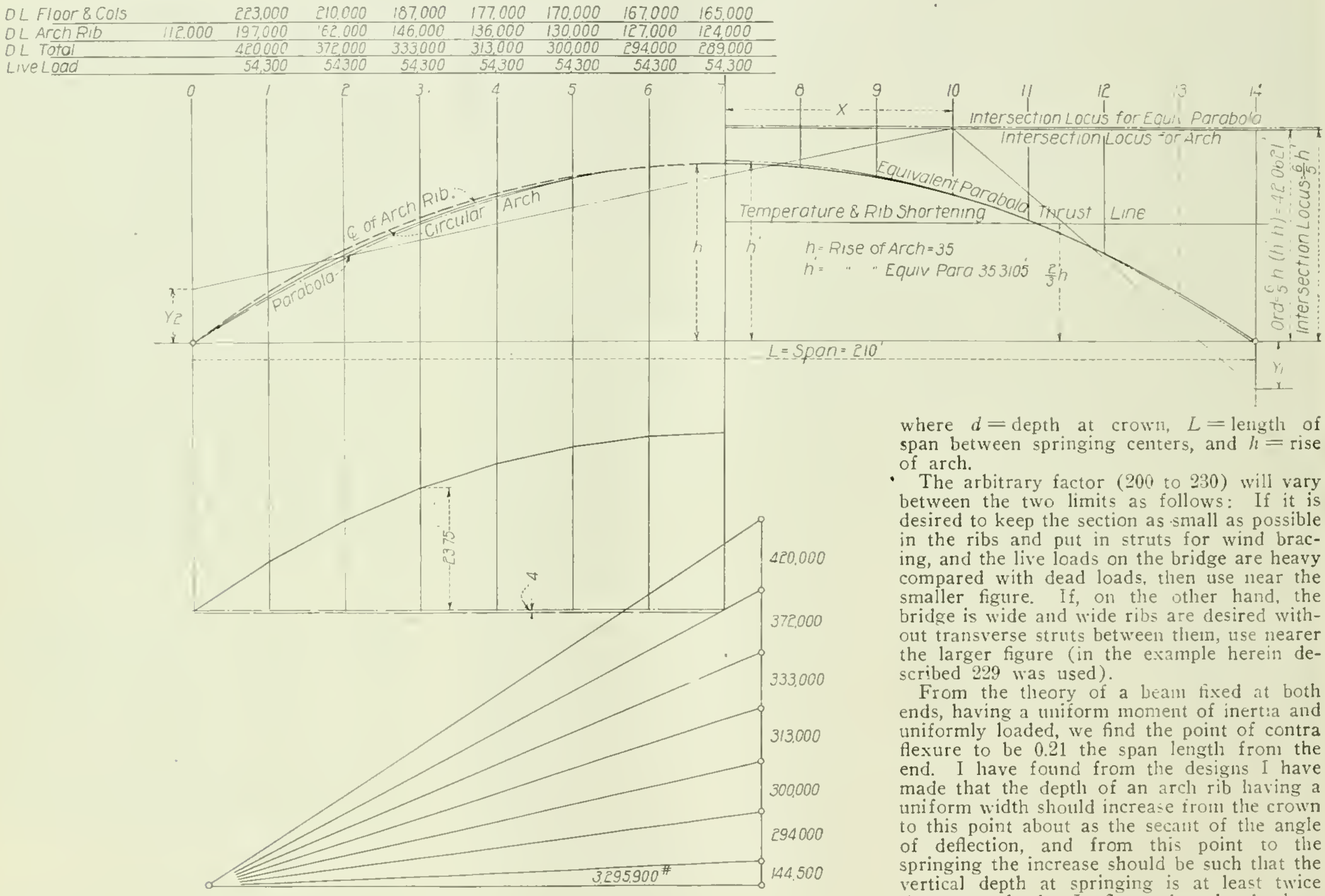

D L Floor & Cols 223,000 210,000 187,000 177,000 170,000 167,000 165,000
D L Arch Rib 112,000 197,000 162,000 146,000 136,000 130,000 127,000 124,000
D L Total 420,000 372,000 333,000 313,000 300,000 294,000 289,000
Live Load 54,300 54300 54,300 54,300 54300 54300 54,300
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
X
Intersection Locus for Equiv. Parabola
Intersection Locus for Arch
Ⅽ of Arch Rib
Circular Arch
Parabola
Equivalent Parabola
Temperature & Rib Shortening Thrust Line
h
h'
h = Rise of Arch = 35
h' = " " Equiv Para 35.3105
2/3 h
Y2
Y1
L = Span = 210'
Ord = 6/5 h (h h') = 42.062
Intersection Locus 6/5 h
23.75
4
420,000
372,000
333,000
313,000
300,000
294,000
144,500
3,295,900#

Fig. 1.

Loading.—In addition to all dead loads the structure was designed to carry the following assumed live loads:

Floor system and columns: A continuous line of 35-ton trolley cars on both tracks, a 15-ton truck having 10 tons on rear axle with axles spaced 10 ft. center to center, 5-ft. gage, on any part of roadway floor, and a uniform load of 125 lbs. per square foot on all roadway floor not occupied by cars or truck, and on sidewalks a concentrated load of 2,500 lbs. at any point or 100 lbs. per square foot of floor. In all cases the loading giving the maximum stresses were used.

For arch ribs: The equivalent uniform load for a continuous line of 35-ton trolley cars on each track, which is 1,570 lbs. per lineal foot of each track, and in addition a uniform load of 125 lbs. per square foot on that part of roadway not occupied by cars, and 75 lbs. per square foot of floor on sidewalks, making a total of 7,240 lbs. per lineal foot of bridge.

Modulii of Elasticity.—Throughout the design it was assumed that the modulus of elasticity of steel was fifteen times that of concrete.

Modulus of Elasticity.—Throughout the desion on steel 1,400 lbs. per square inch, compression on concrete 600 lbs. per square inch, shear on concrete 30 lbs. per square inch.

Arch ribs: Compression on concrete in semi-hooped ribs under maximum possible conditions of loading and temperature stresses 800 lbs. per square inch; under probable loading and temperature stresses not over 700 lbs. per square inch. Tension on steel not to exceed 14,000 lbs. under any conditons. Shear on concrete not to exceed 60 lbs. per square inch under maximum possible conditions.

Temperature.—Provisions were made for a change of temperature of 60° in the arch ribs, assuming that they would be subjected to a rise of 20° and a fall of 40° from the temperature at which the ribs are constructed.

Determining Length of Span.—Owing to there being the boulevard and a street passing under this bridge it was necessary, if one span was used, that it has at least a 200-ft. clear span, so as not to encroach upon the boulevard or street. If two spans were used a tall pier would have to be used between them. It was therefore found more economical to use the one long span, which was made 210 ft. long between spring centers, and the floor system was made in 14 panels, each 15 ft. long.

Floor System.—The next step is to design the floor system and columns. For this part of the work any of the many sets of formulas may be used, as they all give about the same results.

Depth of Rib.—From the design of the floor system the depth from grade line to bottom of floor beam was determined, and, desiring to place the floor beam at the crown of the arch on top of the rib, the rise of the arch could be determined.

TABLE I.—ORDINATES.

$$Y_1 = \frac{2h}{15}\left(\frac{L-10x}{L-2x}\right), \quad Y_2 = \frac{2h}{15}\left(\frac{L+10x}{L+2x}\right)$$

Point.	Y_1	Y_2
1	—108.284′	+13.399′
2	— 42.372′	+12.555′
3	— 20.401′	+11.554′
4	— 9.416′	+10.357′
5	— 2.825′	+ 8.890′
6	+ 1.569′	+ 7.062′
7	+ 4.708′	+ 4.708′

To determine the depth of the rib at the crown use the following formula:

$$d = \frac{L^2}{hx\ (200 \text{ to } 230)}$$

where d = depth at crown, L = length of span between springing centers, and h = rise of arch.

The arbitrary factor (200 to 230) will vary between the two limits as follows: If it is desired to keep the section as small as possible in the ribs and put in struts for wind bracing, and the live loads on the bridge are heavy compared with dead loads, then use near the smaller figure. If, on the other hand, the bridge is wide and wide ribs are desired without transverse struts between them, use nearer the larger figure (in the example herein described 229 was used).

From the theory of a beam fixed at both ends, having a uniform moment of inertia and uniformly loaded, we find the point of contra flexure to be 0.21 the span length from the end. I have found from the designs I have made that the depth of an arch rib having a uniform width should increase from the crown to this point about as the secant of the angle of deflection, and from this point to the springing the increase should be such that the vertical depth at springing is at least twice the crown depth. In flat arches the depth at springing will be somewhat greater.

The theory of the arch proves that for a uniform load and a rib having its moment of inertia increasing from the crown directly with the secant of the angle of deflection, its curve will be a parabola. As neither of these conditions exist it is evident the curve of our rib will not be a true parabola, though it will in most cases approach it very nearly; hence for obtaining the weights to be used for dead loads it is close enough for us to use a parabola for this purpose.

I next assumed a width of 10 ft. and calculated the panel dead loads.

Now treating the structure as a non-elastic arch, the crown thrust from dead loads will be 3,295,900 lbs. and from live loads will be 570,100 lbs. The sum of these loads gives a compression of 475 lbs. per square inch for a plain concrete rib. The moment of inertia for a section at the crown without reinforcement is 3,752,480. The thrusts caused by a fall of temperature of 40° and the rib shortening will be 86,340 lbs. and 87,100 lbs., respectively, and their sum multiplied by their lever arm 11⅔ ft. = 2,073,440 ft. lbs. The extreme fiber stress due to this moment is the moment multiplied by 6, and this result divided by the sectional area in square inches multiplied by the crown depth in feet, which equals 285 lbs. per square inch, which added to 475 lbs. per square inch gives 670 lbs. per square inch as the maximum fiber stress, which is below our allowed maximum.

Curve for Rib.—To determine the curve to use, lay out a dead load force polygon and force line for a non-elastic arch as shown in Fig. 1. As the rib shortening and falling temperature combine in producing compression in the extreme fiber on the top side of rib at the crown, it is desirable that the dead load force line should fall below the center line of the rib, so the dead load moment produced thereby will tend to equalize those produced by the rib shortening and falling temperature. Therefore, to properly equalize the stresses on the top and bottom sides of the rib, the moment caused by the dead load at the crown should be equal that caused by rib shortening and half the fall in temperature.

To satisfy this condition the dead load force line should fall .45 ft. below the center line of the rib. However, to use this amount would throw the force line rather low at the springing, thereby increasing very materially the compression on the bottom side of the rib and give tension to the top side at that point; hence, I used .4 ft. as the desired distance from the crown, now drawing a line parallel to the chord and .4 ft. above same, we find the ordinate for the curve at panel point No. 3 to be 23.75 ft. Now having the springing, panel point No. 3 and crown points on the curve, we can construct a three-centered curve passing through these points, which is the center line used for the arch rib. In the left-hand half of Fig. 1 are shown three curves, from which we see that the center line of the rib falls between a circular arc and a parabola. For arches with smaller rise than this example, the rib curve will approach nearer the parabola, and for higher rises the circular arc.

TABLE II.—DEAD LOAD STRESSES.

Point.	d=depth of rib in ft. a=transferred area in sq. ins.	Side of rib.	Moment in ft. lbs. M.	Axial thrust in lbs. at	$\frac{M \times 6}{a \times d}$	$\frac{At}{a}$	Max. extreme fiber stress.
0	d = 9.15	Top	+2,779,700	—3,970,000	+131	—284	—153
	a = 13,950	Bottom	—2,779,000	—3,971,000	—131	—284	—415
1	d = 7.50	Top	+ 977,000	—3,896,000	+ 67	—337	—270
	a = 11,574	Bottom	— 977,000	—3,896,000	— 67	—337	—404
2	d = 6.55	Top	000	—3,686,000	0	—360	—360
	a = 10,206	Bottom	000	—3,586,000	0	—360	—360
3	d = 6.00	Top	000	—3,573,000	0	—376	—376
	a = 9,414	Bottom	000	—3,573,000	0	—376	—376
4	d = 5.75	Top	+ 685,000	—3,420,000	+ 79	—377	—298
	a = 9,054	Bottom	— 685,000	—3,420,000	— 79	—377	—456
5	d = 5.62	Top	+1,005,000	—3,345,000	+121	—377	—256
	a = 8,867	Bottom	—1,005,000	—3,345,000	—121	—377	—498
6	d = 5.55	Top	+ 823,700	—3,290,000	+101	—375	—274
	a = 8,766	Bottom	— 823,700	—3,290,000	—101	—375	—476
7	d = 5.50	Top	+1,146,200	—3,270,000	+144	—376	—232
	a = 8,694	Bottom	—1,146,200	—3,270,000	—144	—376	—520

Ordinates.—We next calculated the area enclosed between the center line of rib and the chord passing through the points of springing and find the rise of a parabola of equal area.

We can now find the ordinate for the intersection locus for the equivalent parabola, as it is 6/5 the rise. As the rise of the equivalent parabola is .3105 ft. greater than for the center line of rib, the intersection locus for the rib will be that much below that for the Equivalent Parabola.

In the right hand half of Fig. 1 is shown the center line of the rib, the Equivalent parabola and the location of the intersection locus for each. The true intersection locus will lie between the two shown as straight lines and will coincide with that shown for the arch, excepting for the end panel points, and as the variation from the straight line is so slight the error made by using the straight line is very small.

The Ordinates Y_1 and Y_2 are found by the following formulas:

$$Y_1 = \frac{2h}{15} \cdot \left(\frac{L - 10x}{L - 2x}\right), \quad Y_2 = \frac{2h}{15} \cdot \left(\frac{L + 10x}{L + 2x}\right)$$

Where L = length of span, X = distance from crown to point for which ordinates Y_1 and Y_2 are desired and h = rise of Equivalent parabola.

By the application of these formulas the ordinates for all the panel points were found and tabulated, Table I.

Dead Load:—Lay out center line of arch rib Intersection locus for arch and the ordinates Y_1 and Y_2 and draw the force lines as shown on Fig. 2. Then lay off the panel loads and draw their reaction components parallel to the force lines.

Then draw the component polygon. The vertical to the horizontal *U. P.* through *V* should equal the vertical end reaction and can be scaled to check the accuracy of the drawing.

Then assume any point *P* as a pole. (I find it more convenient to locate this point on the horizontal line through *U* at its intersection with a line through *V* drawn perpendicular to the force line for panel point 13). We can now construct the reciprocal polygon beginning at any convenient point on the vertical line through the springing. Draw *U-P*, *A-P*, *B-P*, etc., parallel to their corresponding rays of the component polygon. We can now draw in the force lines in Fig. 2. Draw a line through *U-V* in the component polygon and parallel to this line draw a line through the intersection of *U-P* with *V-P* and we have the location and direction of the reaction and from the component polygon we can get its intensity.

By this method we can find the stress in any section, regardless of the other sections. We will now find the stress in section *X-X*. The forces passing through the section will be the left hand reactions from loads 3 to 13

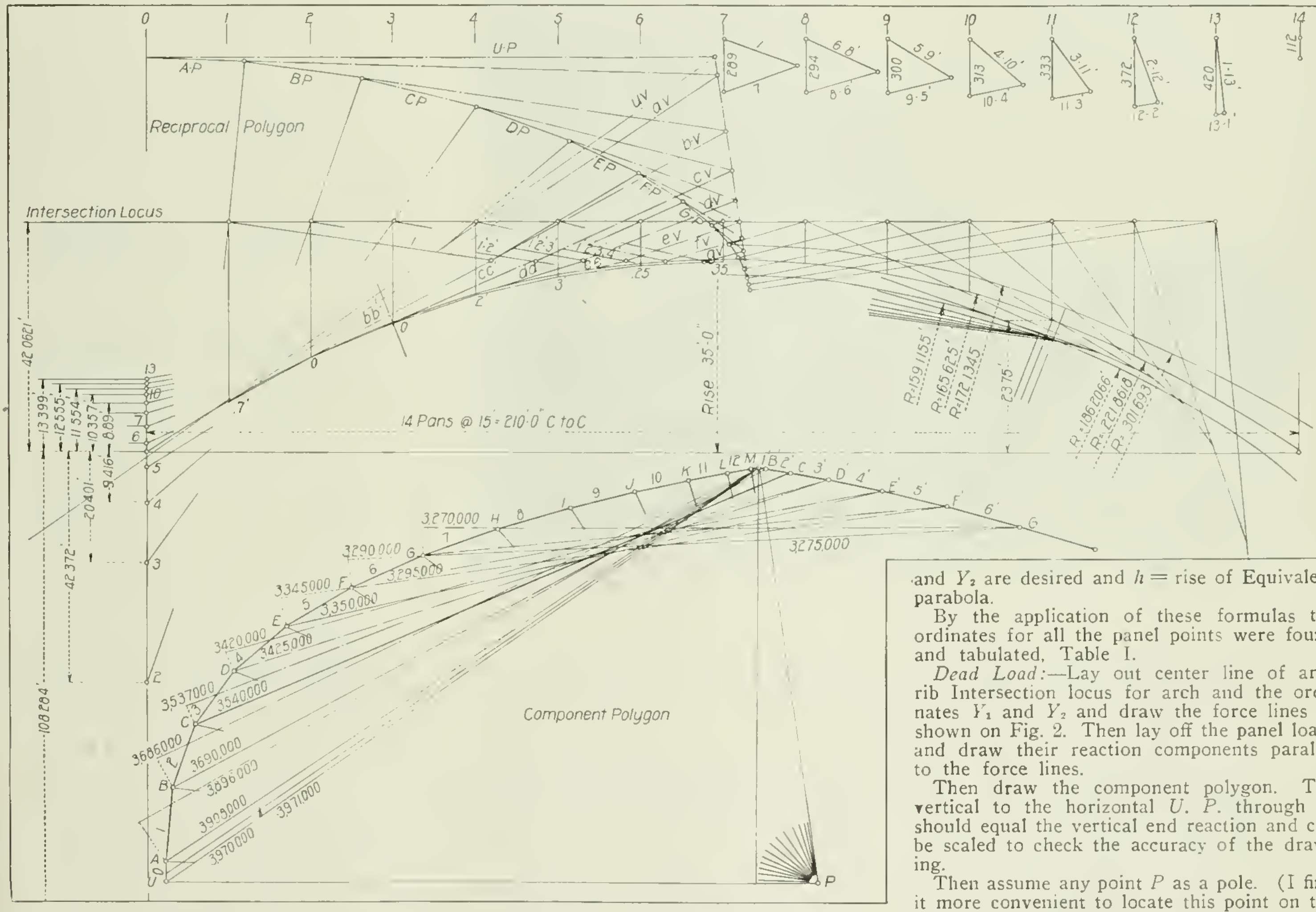


Fig. 2.

TABLE III.—LIVE LOAD STRESSES.

Point.	d=depth of rib in ft. a=transferred area in sq. ins.	Side of rib.	Moment in ft. lbs. M.	Axial thrust in lbs. at	M×6 / a×d	At / a	Max. extreme fiber stress.
0	d = 9.15	Top	—2,960,000	—349,000	—139	—28	—167
	a = 13,950	Bottom	—2,963,600	—276,000	—139	—20	—159
1	d = 7.50	Top	—1,160,000	—354,000	— 80	—31	—111
	a = 11,574	Bottom	— 920,000	—316,000	— 64	—27	— 91
2	d = 6.55	Top	— 845,000	—120,000	— 76	—12	— 88
	a = 10,206	Bottom	— 578,600	—525,000	— 52	—51	—103
3	d = 6.00	Top	—1,296,000	—209,000	—138	—22	—160
	a = 9,414	Bottom	—1,180,000	—413,000	—125	—44	—169
4	d = 5.75	Top	—1,500,000	—188,000	—173	—21	—194
	a = 9,054	Bottom	—1,405,000	—414,000	—162	—46	—208
5	d = 5.62	Top	—1,405,000	—253,000	—169	—28	—197
	a = 8,867	Bottom	—1,340,000	—334,000	—161	—38	—199
6	d = 5.55	Top	—1,155,000	—266,000	—142	—30	—172
	a = 8,766	Bottom	—1,038,000	—310,000	—128	—35	—163
7	d = 5.50	Top	— 945,000	—227,000	—119	—26	—145
	a = 8,694	Bottom	— 780,000	—348,000	— 98	—40	—130

inclusive and the right hand reactions of loads 1 and 2. Produce the line *C-P* in the reciprocal polygon until it intersects *V-P*. Through their intersection draw *c-v* parallel to a line through *C-V* of the component polygon until it intersects the line *1′ 2″* drawn tangent to the tangent curve and parallel to a line through *V-C′* of the component polygon and through this intersection draw *c-c′* parallel to a line through *C-C′* of the component polygon. This line gives the location and direction of the component of all forces producing stress in the section, and the line *C-C′* of the component polygon will be its intensity.

The Axial Thrust due to this component is shown by a line drawn through *C′* of the component polygon, parallel to a tangent to the center line of the arch rib at the point where section is taken, and intersecting a line through *C′* drawn perpendicular to the Axial thrust line.

Having carried out the same operations for all the panel points, the results can be tabulated and the resultant extreme fiber stress found for the top and bottom sides of the rib at each panel point, as shown in Table II.

Live Loads:—Lay out the center line of rib, Intersection locus, force lines, component and reciprocal polygons same as was done for dead loads. Then determine in the following manner what panels should be loaded to produce maximum compression in the top and bottom sides of the rib at the several panel points:

For the top side of the rib, say at point 3, we see that the left hand reaction rays for points 1-2-3-4 and 5 pass above the center of the rib, so these panels only should be considered loaded for maximum stress in top of rib, and for the bottom side of the rib, panels 6 to 13 inclusive should be loaded, as their rays pass below the center line at point 3.

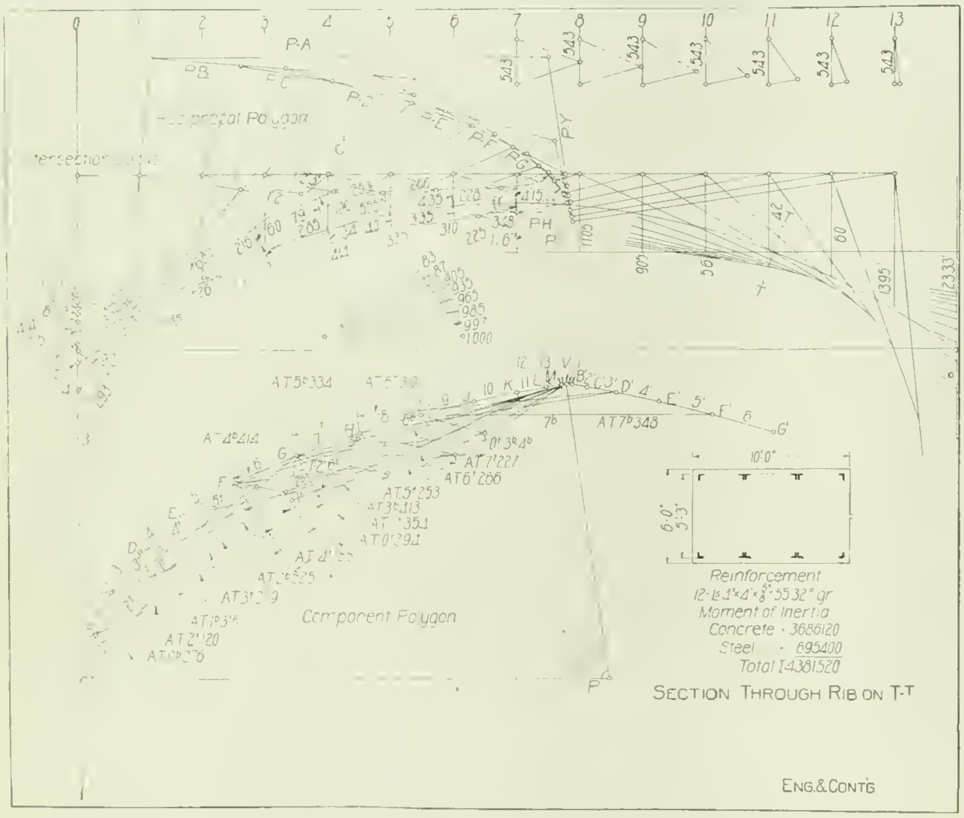


Fig. 3.

It is quite convenient to tabulate, as shown by Fig. 3, showing how the span is to be loaded for both sides of rib for each panel point.

We can now proceed with our stresses. Taking a section at *X-X* just to the left of panel point No. 3. From our tabulation we see that to produce maximum compression in top side of rib, panels 1 to 5 inclusive will be loaded; as loads 1 and 2 are to left of section,

TABLE IV. — PANEL POINTS LOADED TO GIVE MAX. COMPRESSIVE STRESSES IN ARCH RIB.

Point.	Side	Loads at
0	Top	6-7-8-9-10-11-12-13
	Bott.	1-2-3-4-5
1	Top	1-7-8-9-10-11-12-13
	Bott.	2-3-4-5-6
2	Top	1-2-3-12-13
	Bott.	4-5-6-7-8-9-10-11
3	Top	1-2-3-4-5
	Bott.	6-7-8-9-10-11-12-13
4	Top	1-2-3-4-5
	Bott.	6-7-8-9-10-11-12-13
5	Top	1-2-3-4-5-6
	Bott.	7-8-9-10-11-12-13
6	Top	4-5-6-7
	Bott.	1-2-3-8-9-10-11-12-13
7	Top	6-7-8
	Bott.	1-2-3-4-5-9-10-11-12-13

TABLE V.

		Temperature Stresses for —40° and +20° Change.							
Point.	Side of rib.	Moment in ft. lbs. M for —40°	Axial th'st in lbs. at for —40°	M×6 / a×d for —40°	At / a for —40°	Max. ext. fiber str. for —40°	M×6 / a×d for +20°	At / a for +20°	Max. ext. fiber str. for +20°
0	Top	+2,869,000	+102,000	+135	+ 7	+142	—67	—4	—71
	Bottom	—2,869,000	+102,000	—135	+ 7	—128	+67	—4	+63
1	Top	+1,715,000	+107,000	+118	+ 9	+127	—59	—5	—64
	Bottom	—1,715,000	+107,000	—118	+ 9	—109	+59	—5	+54
2	Top	+ 738,000	+111,500	+ 66	+11	+ 77	—33	—6	—39
	Bottom	— 738,000	+111,000	— 66	+11	— 55	+33	—6	+27
3	Top	— 52,000	+115,000	— 6	+12	+ 6	+ 3	—6	— 3
	Bottom	+ 52,000	+115,000	+ 6	+12	+ 18	— 3	—6	— 9
4	Top	— 687,000	+118,500	— 79	+13	— 66	+39	—7	+32
	Bottom	+ 687,000	+118,500	+ 79	+13	+ 92	—39	—7	—46
5	Top	—1,112,000	+121,000	—134	+14	—120	+67	—7	+60
	Bottom	+1,112,000	+121,000	+134	+14	+148	—67	—7	—74
6	Top	—1,358,000	+122,500	—168	+14	—154	+84	—7	+77
	Bottom	+1,358,000	+122,500	+168	+14	+182	—84	—7	—91
7	Top	—1,435,000	+123,000	—180	+14	—166	+90	—7	+83
	Bottom	+1,435,000	+123,000	+180	+14	+194	—90	—7	—97

		Rib Shortening Stresses.				
Point.	Side of rib.	Moment in ft. lbs. M.	Axial thrust in lbs. at	M×6 / a×d	At / a	Max. extreme fiber stress.
0	Top	+2,405,000	+ 85,600	+113	+ 6	+119
	Bottom	—2,405,000	+ 85,600	—113	+ 6	—107
1	Top	+1,335,000	+ 89,800	+ 93	+ 8	+102
	Bottom	—1,335,000	+ 89,800	— 93	+ 8	— 85
2	Top	+ 619,000	+ 93,500	+ 56	+ 9	+ 65
	Bottom	— 619,000	+ 93,500	— 56	+ 9	— 57
3	Top	— 43,400	+ 96,500	— 5	+10	+ 5
	Bottom	+ 43,400	+ 96,500	+ 5	+10	+ 15
4	Top	— 577,500	+ 99,500	— 66	+11	— 55
	Bottom	+ 577,500	+ 99,500	+ 66	+11	+ 77
5	Top	— 933,000	+101,500	—112	+11	—101
	Bottom	+ 933,000	+101,500	+112	+11	+123
6	Top	—1,139,000	+102,700	—141	+12	—129
	Bottom	+1,139,000	+102,700	+141	+12	+153
7	Top	—1,201,000	+103,200	—151	+12	—139
	Bottom	+1,201,000	+103,200	+151	+12	+163

		Summary.					
				Temperature			
Point.	Side of rib.	Dead load.	Live load.	—40° change.	+20° change.	Rib shortening.	Max. compressive stresses
0	Top	—153	—167	+142	—71	+119	—272
	Bottom	—115	—159	—128	+63	—107	—809
1	Top	—270	—111	+127	—64	+102	—343
	Bottom	—404	— 91	—109	+54	— 85	—689
2	Top	—360	— 88	+ 77	—39	+ 65	—422
	Bottom	—360	—103	— 55	+27	— 57	—575
3	Top	—376	—160	+ 6	— 3	+ 5	—534
	Bottom	—376	—169	+ 18	— 9	+ 15	—539
4	Top	—298	—194	— 66	+32	— 55	—613
	Bottom	—456	—208	+ 92	—46	+ 77	—633
5	Top	—256	—197	—120	+60	—101	—671
	Bottom	—498	—199	+148	—74	+123	—648
6	Top	—274	—172	—154	+77	—129	—729
	Bottom	—476	—163	+182	—91	+153	—567
7	Top	—232	—145	—166	+83	—139	—682
	Bottom	—520	—130	+194	—97	+163	—584

their right hand reaction components pass through the section, and for loads 3-4 and 5 their left hand reaction components pass through the section. In the reciprocal polygon produce *P-C* and *P-F* until they intersect. Through their intersection and parallel to a line through *C* and *F* in the component polygon draw *cf* until it intersects with a line $1' 2'$ drawn tangent to the tangent curve and parallel to a line through V'-C' of the component polygon. Then in the component polygon from the point *F* draw a line parallel and equal to the component V'-C' and through *C* and the terminus of this component draw line 3^t, and parallel to this line and through the intersection of $1'$-$2'$ and *e-f* draw the resultant location and direction line. The line 3^t of component diagram gives the intensity of the force.

For the bottom side of the rib we see all the loads are on the left of the section, so only the left hand reaction components will pass through the section.

Produce *P-F* until it intersects *P-V*, and through their intersection draw *f-v* parallel to a line through F-V' of component polygon, which is the resultant location and direction of the forces, and F-V' of the component polygon is the intensity of the force.

Carrying out the same for all panel points, and determining the Axial thrusts in the same manner as described for dead loads, we can now tabulate our results and calculate the resultant extreme fiber stresses, as shown in the Table III for Live Load stresses.

Temperature and Rib Shortening:—There seems to be a diversity of opinion among the authors as to what section of the rib should be considered when calculating the temperature and rib shortening thrusts. Some say, use a section at the crown, and others say, use an average section. It seems to me that a section taken where the thrust line intersects the center line is the proper location.

In Fig. 3 is shown a section through the rib at this point, giving the reinforcement, which is the same throughout the rib and its moment of Inertia. The temperature thrust is calculated by using the formula

$$H_t = \frac{45\ EI\ wt}{4h^2}$$

Where $E =$ modulus of elasticity of concrete, $I =$ moment of Inertia, $W =$ coefficient of expansion for 1° change in temperature, $t =$ number of degrees change in temperature, and $h =$ rise of arch in inches.

The rib shortening thrust by the formula:

$$H_s = \frac{45\ IS}{4h^2}$$

Where I and h are same as for temperature formula and $S =$ average compressive stress per square inch, due to all loads. We can now determine the bending moment in the rib at the several panel points by multiplying the thrust by its lever arm.

To determine the Axial thrust we lay out a horizontal thrust of unity and components for each of the panel points; then by multiplying the horizontal thrusts from temperature and rib shortening by the panel point components we obtain the Axial thrusts, which are tension for rib shortening and falling Temperature and Compression for rising Temperature.

As we have found the stresses, due to loads, temperature and rib shortening, it only remains to summarize them and finally analyze our results and determine if they are satisfactory.

References:—While developing this method, I referred often to the following books: Elastic Arches, by Jos. W. Balet; Roofs and Bridges, by Merriman & Jacoby; Modern Framed Structures, by Johnson, Bryan and Turneaure, and principally the first mentioned author, whose graphical method I have attempted to simplify as much as possible.

Details of Design:—Perhaps a few words on the design of details would be of interest as an appendix to the determining of the stresses.

One point I desire to call attention to is the location of the expansion joints in the floor system of long spans. On the Meadow St. Bridge these joints were located at the main piers, directly over the springing point of the ribs. Observations show that the first two columns adjacent to the main piers have been severely stressed by temperature. Owing to this fact it was thought advisable to change the location of those on the Larimer Ave. Bridge, so the expansion would be in the panel over the point in the rib where the temperature thrust line crosses the center line of the rib. Our observations so far shows that the expansion joints show movement and no columns show any signs of being unduly stressed. Hence I am satisfied that this is the proper location for the expansion joints.

Throughout our concrete bridges we have used bronze plates for sliding bearings, as steel plates would likely rust together, owing to the movement being small; they would also likely discolor the concrete from their corrosion.

Rib Reinforcement:—Owing to it being impossible to prevent settlement in the falsework for ribs, the steel should be built in sections and practically all the concrete in the ribs placed before the field joints between sections are made, thus preventing an undue amount of initial compression in the steel.

It should be borne in mind that nearly all brands of cement shrinks in setting, hence columns and walls should be so detailed that their caps and coping can be placed after the body has set.

In all cases care should be exercised to design the work so that settlement of falsework or springing of forms (which often cannot be prevented) will not cause injury or weakness to the finished structure.

A Reinforced Concrete Highway Bridge with Five 161-Ft. Arch Spans.

(STAFF ARTICLE.)

The bridge illustrated by the accompanying engraving was constructed in 1912 across the Catawba River, near Charlotte, N. C. The entire bridge is of reinforced concrete, is 1,920 ft. long, over all, and has a roadway of 18 ft. in width. There are five arch spans 161 ft. c. to c. of piers, over the river, and 40-ft. beam and slab spans for the approaches, over the adjoining lowlands, except three 50-ft. arch spans on the west side of the river. The bridge has a slight camber but the approaches are level, with the floor arranged so as to give good drainage.

The arches over the river are of the ribbed type, the ribs being spaced 10 ft. 3 ins. c. to c., and carry a solid spandrel wall supporting the floor slab, which is 14 ft. above the 31-ft. high water mark and extends as a cantilever over the spandrel walls. The spandrel walls were built monolithic with the ribs and are tied together at intervals of about 20 ft. with transverse walls. Expansion is provided for by a joint over each pier, extending down through the spandrel wall to the arch rib.

The river at this point is about 400 ft. wide and, normally, about 5 ft. deep, but very rapid and subject to sudden rises. Its bed is composed of gravel underlaid at a depth of a few feet with decomposed gneiss, soft at the top but gradually increasing in hardness with depth. All of the river piers and abutments are founded on this gneiss, the excavation being carried a sufficient depth to provide for possible erosion. In one case it was found necessary to excavate 20 ft. below the river bed before the solid rock was reached.

The piers are hollow, the cavity being filled with sand to give weight, with a solid breakwater on the upstream side and are anchored to bed rock with 60-lb. rails. The abutments are of solid type, one being carried to a depth of 44 ft.

The floor system of the approaches is carried by two girders which are supported by columns spaced 40 ft. center to center. There is an expansion joint in the floor and girders at every third bent. The columns rest on spread reinforced footings carried to firm soil of sand and clay.

Sloan's Ferry Bridge Across the Catawba

In concreting the river spans, framed timber centers were used, designed to be used as three-hinged arches, supported entirely at the piers, or as trusses, with a supporting tower at the center of each span. These were put in place and removed by an overhead cableway, and wedged between piers which was sufficient anchorage to withstand ordinary high water.

The cableway which was 900 ft. long extended diagonally across the bridge, from towers 80 ft. high placed as near as practical to the line of the bridge. It was used in placing the coffer dam and crib work, which was built up in sections on land; it also handled the excavated material, forms, and concrete.

Sand and gravel were dredged from the river bed, contiguous to the work, a gold dredge being leased for the purpose. Material was screened and washed at the dredge, delivered on scows, pulled to shore by a towline, unloaded by derrick into bins which fed directly into a 1-cu.-yd. batch mixer. The mixer being placed under the cableway, which carried the concrete to the various parts of the work, made it possible to handle material by machinery alone. The material used was Southern States Portland cement, Birmingham steel, and lumber furnished by a local mill.

The bridge was designed by Wilbur J. Watson & Co., and was built entirely by C. W. Requarth Co., engineers and contractors, Mr. C. W. Requarth, President and Manager. We are indebted to the engineers and contractors for the information from which this description has been prepared.

The Designing and the Methods and Cost of Constructing a Flat Slab Reinforced Concrete Highway Bridge.

Contributed by E. W. Robinson, City Engineer, Webb City, Mo.

The bridge described (Fig. 1) is located on one of the principle highways entering into Webb City, and is subject to considerable heavy traffic. For about 300 ft. on each side of the stream which the bridge spans the roadway is carried on a 9-ft. fill, and while the stream in question carries no water at all during dry weather, at times of freshets a large volume of water collects very quickly and the 15-ft. opening provided is none too large to let the water through the embankment fast enough and not injure the roadway. One reason why so much water reaches this point in such a short time after the beginning of a rain is because about half of the storm water from the paved street of the city drains through this opening. However, as the abutments were constructed several years ago and the masonry is still in good condition, it was not thought expedient to go to the expense of widening the span at present, but should conditions in the future ever warrant more waterway it would pay to put another opening through the embankment near by. The bridge which the present structure replaced was constructed entirely of 3x12-in. oak lumber, both for stringers and flooring, and had been in use some six or seven years. Though it had been repaired several times during that period, several of the stringers were completely rotted and broken through at the ends, and the floor was pretty badly worn along the main traveled track of the roadway. It would have cost about $75 to replace it with the same material, possibly more, for the reason that the local lumber yards do not now carry oak lumber of that size and length and a special order might have been necessary. The first estimate for a reinforced concrete top on the old abutments was $150 (though some changes in the plans increased the cost about $150), and it was decided that is was the economical thing to do because of the increased strength gained as well as the permanent nature and no maintenance charges.

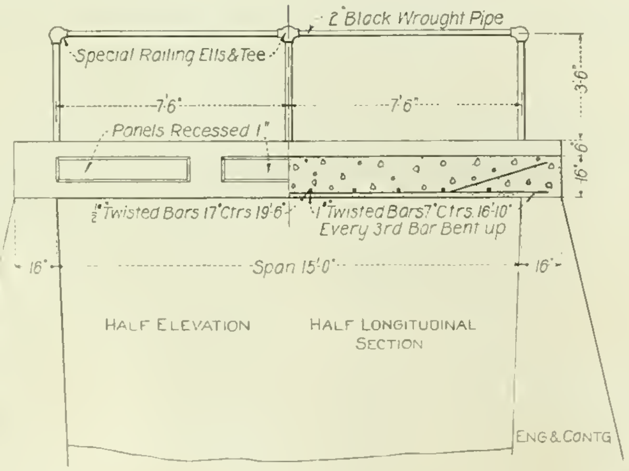

2" Black Wrought Pipe
Special Railing Ells & Tee
7'6"
7'6"
3'6"
Panels Recessed 1"
16"
6"
1/2" Twisted Bars 17" Ctrs 19'6"
1" Twisted Bars 7" Ctrs. 16'10" Every 3rd Bar Bent up
16"
Span 15'0"
16"
HALF ELEVATION
HALF LONGITUDINAL SECTION
ENG & CONTG

Fig. 1—Sectional Elevation of Reinforced Concrete Slab Highway Bridge.

DESIGN.

Some authorities state that about 12 ft. is the maximum economical span for a slab bridge, and that over that length a combination of the slab and girder type is cheaper to build for same strength. However, many place the economical length at about 18 ft., so that in this case it would have been necessary to make an actual design of both types to decide. For the lack of time the writer did not do this, but believes there would have been little difference, if any, in favor of the girder type, for the following reasons: In the first place, the length of span was so near the economical length of the slab type that there could not have been much difference in cost; in the second place, a design of the girder type would have necessitated using more new material for forms, and would have thus cost more proportionately, especially had the through girder been used, which would have been necessary to secure the same waterway as for the slab type.

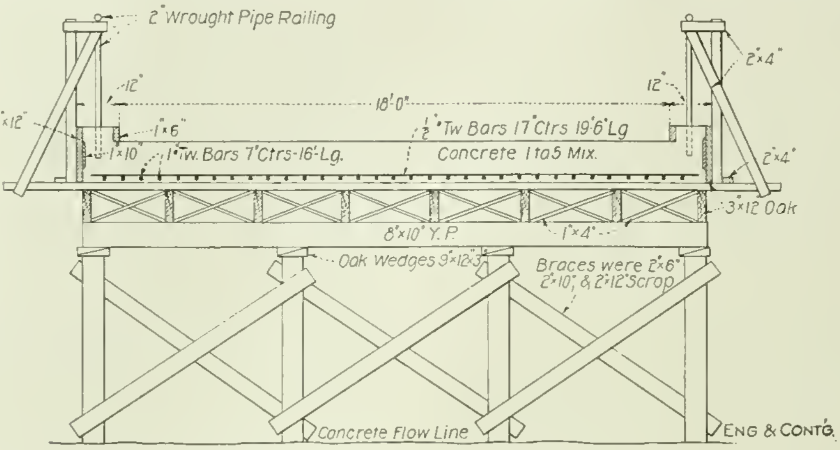


Fig. 2—Transverse Section of Reinforced Concrete Slab Bridge Showing Form Work.

The slab was designed for a 20-ton road roller, and the working stresses used were 14,000 lbs. and 600 lbs. per square inch in the steel and concrete, respectively. This gave an effective depth of 13.9 ins., or a total depth of 16 ins., allowing for a covering of 1½ ins. over the steel. One per cent of steel was required and 33 1-in. twisted square bars were chosen, spaced 7 ins. c. to c., tied together with ten ½-in. square bars to hold the main reinforcement in place and to assist in transmitting the transverse stress. Every third longitudinal bar was bent up at the one-sixth point to provide for any shear. This was considered more as an additional precaution than a necessity. The low side walls were not considered in the design, but were merely added to assist in anchoring the pipe railings and to hold the road metal in place on the slab. The design was figured twice and checked by comparison with several other designs for slabs of the same span and approximately the same loading found worked out in the various steel and cement trade publications.

CONSTRUCTION.

As much as possible of the old bridge lumber was used in the forms. While most of the oak stringers were in a fair state of preservation, except at the ends where they rested on the masonry, it was deemed best to put in a middle bent so as to reduce the span length one-half and not consider them as continuous beams. The sketch of transverse section (Fig. 2) shows the arrangement followed for the forms. The whole design of the forms may appear unnecessarily strong to one not familiar with the conditions. Everything was figured carefully, but it was a case of using as much of the old material that was on hand as possible, all of which had been used many times for various purposes, and could not be considered nearly as reliable as new timber. So ample allowance was made for any overlooked defects that might exist in any of the pieces and yet made considerable saving over using new lumber. No apparent deflection or settlement took place when concreting was done. The posts were braced longitudinally by nailing horizontal pieces at top and bottom and allowing them to butt against the masonry. The 3x12-in. flooring was covered with building paper to give a smooth finish to the under side of the slab.

The reinforcement was laid in place and tied securely with wire, and kept off of the floor the proper distance by means of small chips of stone until the concrete could be spaded under the rods. The concrete was mixed with a Coltrin, No. 9, continuous mixer, which, together with a man to feed it, was rented for job at the rate of $1 per hour for the time it was taken from the owner until it was returned. The total time of mixing the 19 cu. yds. of concrete was five hours, though it could have been done in three had there not been unexpected delays working with the engine and extra handling of the materials. Although the temperature stood at 50° there was considerable frost in the gravel, due to the fact that a frozen crust had formed on some of the gravel hauled first and which had been covered up so that it had not thawed out. Care was exercised to see that no frozen lumps were placed in the concrete, though after being exposed to the air a few minutes it completely thawed out and was used. The concrete was mixed in the proportion of one part of Sunflower Portland cement to five parts of mine chats or gravel, and to such consistency that it quaked slightly when thoroughly tamped. The gravel ranged in size from 1/16 to ¾ in., and was so well graded that no sand was added, it producing a very dense concrete as it came from the pile. The amount of water used was about 7 per cent of the total weight of the cement and gravel, but the gravel was so damp as to cut down the amount of water necessary to no small extent. As the weather is susceptible to sudden changes the concrete was covered with manure as soon as finished and kept covered over a week.

Traffic was allowed over the bridge three weeks after it was finished, the first two of which the days were warm and well suited to the hardening of the concrete. The forms were removed between four and five weeks after construction. The side forms were removed the following week after construction, and a rough or stucco finish was given to all the side except the recessed panels, which were plastered smooth with a 1 to 2 mortar. This gave a very pleasing effect.

COST.

The following gives the actual cost to the city, exclusive of superintendence, as well as the material used in the forms for which no cost is given. Of the material for which a salvage of 100 per cent is given, the 8x8-in. and 8x10-in. pieces were returned to the lumber yard from which the cement was purchased with no cost for use, and the rest was immediately used by the Street Department for purposes for which they were as well suited as new material, and where, in fact, it replaced new material. No cost was allowed for the old oak lumber which came out of the old bridge, though the cost of handling and hauling it to town was allowed. It will be noticed that the gravel cost nothing at the pile, and the cost of hauling is all that is charged to it. The labor and teams were rated so cheaply for the following reasons: The teams belonged to the city and their time was figured on a basis of a cost of $1.25 per day, which is actual cost, including all feed and upkeep and depreciation and interest on investment. Three of the men were regular employes of the city and their wages were on a straight time basis the year around:

Labor:		
Placing forms, 3 men, 33 hrs., at $0.22	$ 7.26	$0.382 cu. yd.
Bending and placing steel, 3 men, 17 hrs., at $0.22	3.74	0.197 cu. yd. or 0.185 100 lbs.
Mixing and placing concrete:		
1 man and machine, 8 hrs., at $1.		
1 man, feeding cement and water, 5 hrs. at $0.22.		
2 men, shoveling gravel, 8 hrs. at $0.22.		
1 man, shoveling concrete, 5 hrs. at $0.22.		
1 man, placing and tamping concrete, 5 hrs. at $0.22.		
Total	13.06	0.687 cu. yd.
Finishing side walls, 2 men, 12 hrs. at $0.22	2.64	0.041 sq. ft.
Removing forms, 3 men, 12 hrs. at $0.22	2.64	0.139 cu. yd.
Miscellaneous, covering with manure and hauling, 3 men and 2 teams, 18 hrs. at $0.22, 4 hrs. at $0.15½	4.58	
Hauling lumber to town, 3 men and 2 teams, 6 hrs. at $0.37½, 3 hrs. at $0.22	2.91	
Total labor	$36.83	$1.938 cu. yd.

Materials:	
Cement, 113 sacks at $0.40; man and team hauling, 1¼ miles, 4 hrs., at $0.37½	$ 46.70
Gravel, 20 loads; 4 days, man and team at $3	12.00
Water, 80 cu. ft. at $0.06 per 100; man and team hauling, 2 hrs. at $0.37½	.80
Steel, 2,022 lbs., $58, f. o. b. Webb City; two men and team hauling, 1½ hrs. at $0.60	58.90
Oak wedges, lumber at $2.75 per 100 ft. B. M.; sawing and planing, $0.60	1.59
One roll building paper	.75
Railing, 2-in. wrought pipe and ells and tees, cut and fit	10.41
Lumber used, no salvage, at $2.75 per 100 ft. B. M.; 4 2x4, 12 ft.; 7 1x4, 12 ft.; 1 bundle of shingles at $0.75	2.40
Hauling lumber, railing; two men and team, 4 hrs., at $0.60	2.40
Total material used	$135.95
Cost per cu. yd. concrete	7.155
Total cost of bridge, labor and material	172.78
Total cost per cu. yd. of concrete	9.09

Material used for which there was 100 per cent salvage:
2 8x 8, 20 ft.
1 8x10, 20 ft.
4 2x 6, 18 ft.
4 2x12, 18 ft.
2 1x10, 16 ft.

Old material used:
10 oak ties and cedar posts, 7 ft. long.
8 3x12 15-ft. stringers, oak.
20 3x12 20-ft., floor, oak.

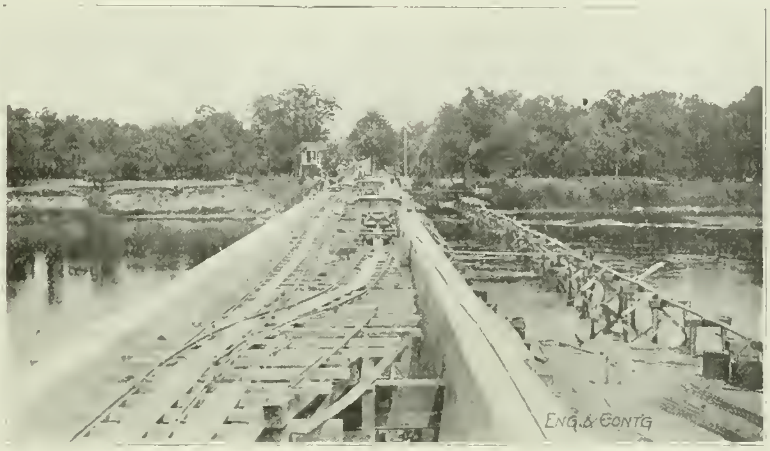


Fig. 2—View Showing Service Tracks and Traveling Derrick Track, Elk Run Bridge.

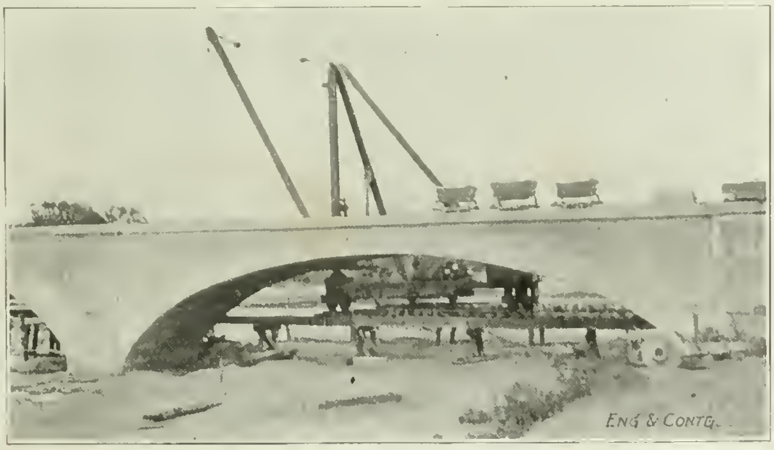


Fig. 1—Typical Arch Span Showing Traveling Derrick Used in Construction, Elk Run Bridge.

Method of Constructing a Reinforced Concrete Arch Bridge of Six 70-ft. Spans for Electric Railway Service.

(STAFF ARTICLE.)

The Elk Run Bridge of the Waterloo, Cedar Falls & Northern Ry. is located about four miles south of Waterloo, Ia., and consists of six 70-ft. reinforced concrete arches of the five-centered elliptical type. The La Porte City extension of this railway makes a 90° crossing of Cedar River just north of the mouth of Elk Run and necessitated the building of a permanent structure. While this line is to be operated as an electric interurban, other portions of the company's property handle freight traffic as well, and it has been the policy to build permanent structures on the extension with the view of future use as a steam railway. Therefore, the bridge at Elk Run is designed for such service, in accordance with standard practice. Cooper's E-60 loading, obtained by two 215-ton locomotives coupled together and followed by a train load of 6,000 lbs. per lineal foot, was used in preparing the plans.

The arches have a rise of 16 ft., and clear span of 70 ft., with a crown thickness of 27 ins. and a width of arch ring of 16 ft. The piers are 8 ft. thick by 17 ft. long and are protected by ice-breakers, having nosing irons of 6x6-in. angles held in place by ¾-in. hook bolts at 1 ft. intervals. The appearance of the structure is balanced by extending the downstream ends of the piers to correspond in shape with the ice-breakers. The pier footings are 16 ft. wide by 25 ft. long and are carried on 70 piles 20 ft. long, in each pier. The bed of Cedar River at this point contains gravel from 3 to 5 ft. in depth, and below this is stiff blue clay, into which the pier excavations were carried from 5 to 7 ft.

The abutment foundations are carried to the same depth as the piers, and measure 17 ft. wide by 25 ft. long, the latter dimension being the length of the abutment. Each abutment foundation rests upon 75 piles 20 ft. long. The total length of bridge is 510 ft.

The foundations are reinforced by longitudinal ¾-in. square spaced 12 ins. on centers. Vertical bars of the same spacing extend from the footings up into the piers above the springing line of the arches. The arches contain 1⅛-in. bars on 16-in. centers in the extrados and ¾-in. bars on 8-in. centers in the intrados, with ¾-in. lateral bars. All bars are laced together with ½-in. round stirrups. Vertical ¾-in. rods extend from the arch-ring up through spandrel walls, which also contain two ¾-in. longitudinal bars in the coping. All splices in reinforcement are lapped 30 diameters and wraped with No. 16 wire, and all intersections are tied with wire ties, made fast by Curry bag tying tools. The spandrel walls over each abutment are tied together with three reinforced concrete beams at an elevation about 3 ft. below the copings. Two 4-in. galvanized drain pipes are placed in each pier, with the outlets below water, and the bridge is filled entirely with gravel, so that excellent drainage should result. Pipes 10 ins. in diameter have been placed vertically in the copings over the pier, and the overhead trolley system will be carried on metal poles to be set in these pipes.

Construction of this bridge was commenced in May, 1912, by installing a side-track for delivery of materials and equipment, this track being located on the main line of the Chicago, Rock Island & Pacific Ry., about 1¼ miles west of the crossing, from which point everything except gravel was hauled by teams to the bridge site.

The contractor's plant consisted principally of a traveling stiff leg derrick and a No. 11 Austin improved cube concrete mixer, with the usual complement of pumps, pumping engine and hoists. The derrick was equipped with drop-hammer and pile-cap, operating in swinging leaders suspended from a mast-crab, and the hammer line and boom falls were carried on a double drum hoisting engine. The boom swung by a bull-wheel operated from a swinging attachment on this engine. This derrick drove all the sheet-piling and foundation piling, and did most of the excavating. It also placed the arch centering and drove its own false-work across the river.

An excellent grade of gravel was obtained from a pit opened up just at the west end of the bridge and this was used both for concrete and for filling the bridge. A timber trestle incline was built from a height of about 18 ft. near the bridge and running down into the gravel pit, and a hoisting engine pulled three-car trains of 18 cu. ft. side-dump, steel cars to the top of the trestle, where one man dumped the loads and the cars then gravitated back to the pit, over-hauling the wire rope cable for the next train as they descended. This stock pile supplied material to the cube mixer, which was installed on timber bents of a height which permitted dumping mixed concrete into cars running on narrow-gage track above the level of the finished copings on the bridge. The side-loader of mixer was extended to the ground, and the material was measured into it with 3-ft. wooden mortar barrows on level run-ways, and hoisted into the mixer with the hoisting-drum on the mixer.

Concrete was mixed in the proportion of 1:3:6 for foundations and 1:2:4 for arch rings and spandrel walls. It was assumed that the former mixture required 5 bags and the latter mixture 7 bags of cement per cubic yard of concrete, and to avoid all disputes regarding mixture, the construction contract contained a clause providing that any variation from this proportion would involve a corresponding increase or diminution of the contract price, of a fixed amount per barrel for the actual excess or deficiency in the amount of cement used, as determined at the completion of the contract. This proved to be such a fair and satisfactory arrangement that it is mentioned here as a method which may practically be adopted on many contracts, to eliminate a source of frequent disagreements between the employes of the owner and of the contractor.

Concreting was begun on Elk Run Bridge June 6, 1912, and completed Sept. 6, 1912, the stage of the river having varied through an extreme range of only 27 ins. during that time. The arch rings in every case were poured in a continuous run, early breakfast being served in the camp and work begun at 5:30 a. m., permitting completion from 4 to 5 p. m., and thus allowing the finishers time to complete their work in daylight. After concreting, all arch-centering was left in place for 20 days before striking.

The Waterloo, Cedar Falls & Northern Ry. Co. is handling the construction of this extension through a subsidiary company called the Cedar Valley Railway Construction Co. Mr. T. E. Rust is vice-president of the latter and chief engineer of both companies. The bridge was designed under his direction and built under the supervision of Mr. F. E. Bostwick, assistant engineer. The contractor was The Gould Construction Co. of Davenport, Ia.

RIVERS AND HARBORS

Typical Quay and Pier Construction for the New Port Works of Portland, Oregon.

Portland, Ore., is situated at the head of deep water navigation on the Willamette River, 12 miles above its confluence with a Columbia River and distant 112 miles from the sea. Portland harbor is, therefore, a river harbor, and including both river banks and the available shores of the adjacent islands there is a water frontage of 25 miles of which 15 miles are considered suitable for deep-water shipping. Of this harbor frontage, some five miles have been developed by private interests, and the city of Portland through its Commissioner of Public Docks has begun an extensive program of development following plans recommended by a Board of Consultation composed of Charles W. Stanford, chief engineer; W. J. Barney, second deputy commissioner Department of Docks and Ferries, New York, and E. P. Goodrich, consulting engineer, New York. The Commission has now available by bond issue a sum of $2,500,000 with which it has started work. The total expenditures called for by the full development will be not far from ten times this preliminary appropriation.

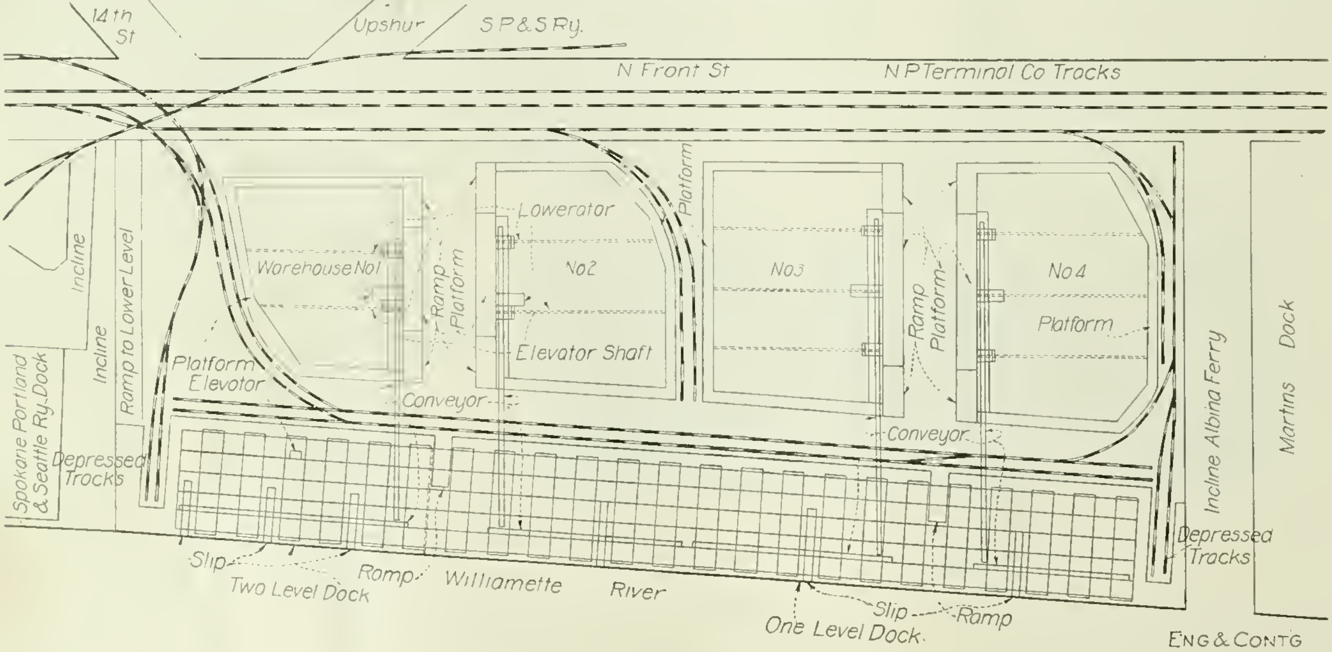


Fig. 1—Plan of Quays, Sheds and Warehouses, New Harbor Improvements at Portland, Ore.

The preceding notes of the new Portland harbor works and the description which follows have been taken from a paper by Mr. G. B. Hegardt, M. Am. Soc. C. E., before the Oregon Society of Engineers, Nov. 14, 1912, and which is published in the "Journal of the Association of Engineering Societies" for January, 1913.

CONSTRUCTION CONTEMPLATED.

The structures to be built comprise some 32,000 lin. ft. of quays and piers on both sides of the river with a common trans-shipping terminal, and a belt line railway joining all. Special provision is made for grain shipment. Grain shipments by water, such as undoubtedly will be received when the upper reaches of the Columbia River are improved, will be received in the rear of the grain elevators, there picked up by the usual suction pipes and delivered by overhead conveyor to the elevator plant. Outward shipments of grain after having been cleaned, separated, sorted, etc., in the elevator, will be delivered by belt conveyor to the piers assigned to this class of freight.

Provision has also been made for the shipment of lumber from timber areas not on streams or rivers affording logging transportation to tide water, and a considerable storage area, which may be readily increased, set aside for that purpose. One or two piers adjacent to the lumber storage area can be utilized in the cargo shipment of such lumber.

Another important feature should also be mentioned in connection with these improvements. A location has been provided for a large coal handling plant and coal yard, from which direct delivery to large ships is obtained. A space is reserved for ground storage of coal to be subsequently delivered in coal barges for distribution to any point in the harbor.

The completed improvements contemplate also a freight assembling, switching and storage yard with a capacity of 1,500 cars, and the public belt line railroad already referred to will connect all the public dock and pier units in the harbor with each other and with the trackage and terminal yard of the railroads.

In all future improvements included in the comprehensive plan, the same class of construction is provided for as outlined for the public docks and warehouses now to be constructed, that is, fireproof construction, with such mechanical freight handling devices as the service to which the improvements are assigned may demand.

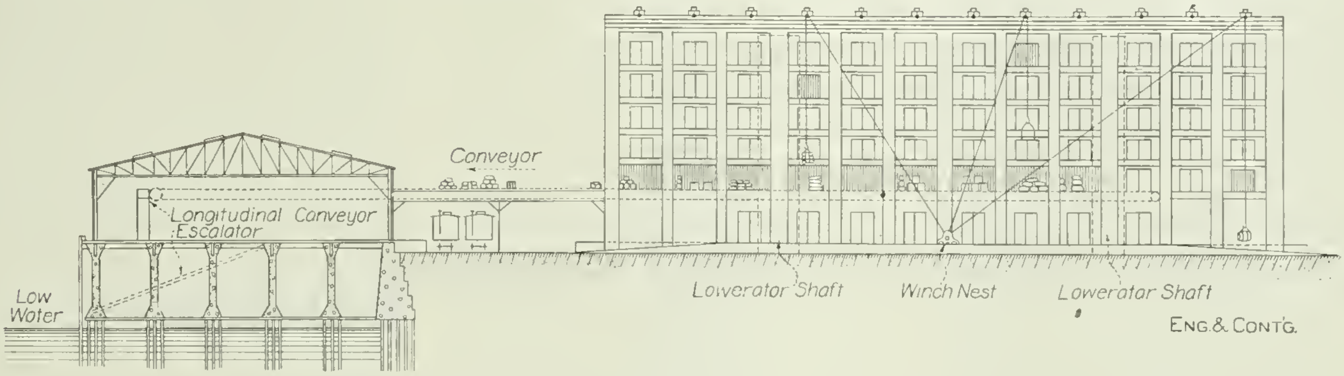


Fig. 2—Sectional Elevation of Quay, Sheds and Warehouses.

The drawings show a typical plan of what the Commission proposes to construct for pier and slip development in the harbor under the comprehensive plan, the piers, sheds and warehouses to be in general as shown, with ample provision for loading and storage tracks, and such mechanical freight handling facilities as will be required for each unit at the time of its completion.

TYPICAL QUAY CONSTRUCTION.

To illustrate the quay construction which will be followed selection is made of one of the two quays now planned for immediate construction. A plan of this quay is shown by Fig. 1 and Fig. 2 is a sectional elevation. These two drawings schedule the several structural features so completely that only a few words further explanation are needed. On one portion of the quay the street has two decks, there being in addition to the main deck for ocean steamers a lower deck for river boats. The construction consists of a reinforced concrete platform wharf, supported upon concrete columns founded upon timber grillages resting on piles cut off 5 ft. above mean low water. At the back of the wharf is a concrete bulkhead wall with its top at the level of the wharf, the area back of the wall to be filled by earth or other suitable material up to grade of the street. Without loss of permanency, this combination obviates the necessity of concrete piles or concrete subaqueous foundations which add so much to the cost of dock structures when used. The column supports are placed on 20-ft. squares and connected at the grillage level by braces for lateral support.

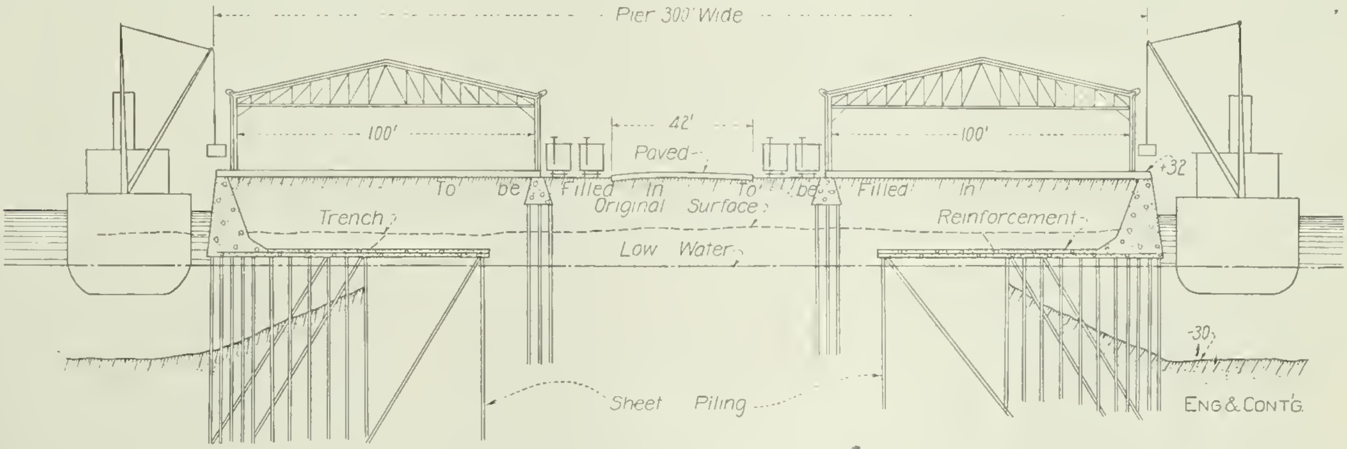


Fig. 3—Transverse Section Showing Standard Pier Construction.

At the wharf level, or levels, for the support of the deck, there is a system of girders and floor beams composed of steel I-beams, encased in concrete for protection against fire and rust. This deck system further stiffens the structure. Between the deck beams are self-supporting reinforced concrete slabs, forming the deck, which in turn is covered with wooden block or vitrified brick pavement.

The concrete columns and their pile cluster foundations in the outside bents support the steel shed columns at 20-ft. intervals, while the shed columns on the inside face are founded on the bulkhead wall. The shed of the same width as the dock will be of steel of a clear span of 100 ft., and the warehouses of reinforced concrete throughout.

TYPICAL PIER CONSTRUCTION.

The standard pier construction is indicated by Fig. 3. Concrete walls carried on piles enclose an earth fill which carries the pier structures. The several stresses are indicated clearly by the drawing.

INTER QUAY FREIGHT HANDLING.

The notable feature of the new Portland quays is the equipment for handling freight. This is described briefly as follows:

> The double-decked section of the dock is equipped with two adjustable slips on each level. Those on the lower level have a maximum drop of 10 ft. for a length of 55 ft., a gradient slightly less than 20 per cent, or one up which a man can wheel a hand truck with a light load, or up which a stevedore and helper can wheel a full load. The maximum grade is readily mounted by a dock auto fully loaded.
>
> When the slip is dropped 7½ ft. or less, the grade is such (13½ per cent) that one man can readily trundle a full load. Therefore, at practically every stage of the river up to 18 ft., from the lower level to boats and vice versa, freight may be removed over these slips, full loads transported in every case on the dock auto, and at most times also on hand trucks. Few river boats have less than 3 ft. of freeboard even when loaded. Hence a river stage of less than 5 ft. would have to occur before the necessity would arise of a gangplank extension of these slips to reach the freight dock of a river craft. By such extension for 10 ft. the same grade can readily be carried to a boat deck at the 6-ft. level. This level minus the 3-ft. freeboard would mean a water level of 3 ft. The combination of less than 3 ft. water stage and a 3-ft. freeboard would be too infrequent to justify further cutting of the dock surface to permit of a longer slip with a lower drop.
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> The upper slips are also 55 ft. in length with a maximum drop of 10 ft., thus presenting the same range of grades as the lower slips, the ascendable grade for fully loaded hand trucks prevailing when the drop is 7½ ft. or less. These slips cover fully every stage of the river from 18 to 32 ft., in the matter of handling freight to and from river crafts, since at the 17-ft. stage when the use of the lower level is discontinued a free board of 3 ft. places the boat deck at the elevation of 20 ft., or 2 ft. below the edge of the upper slip at its maximum drop, yet readily reached by a gangplank extension.
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> The 713 ft. of high level dock is provided with two mechanical slips or freight conveyors known as escalators. These conveyors have a maximum drop of 22 ft., with a length of 65 ft. The maximum grade of this slip is, therefore, 33.8 per cent. A slip of similar nature is now in operation on the Oregon-Washington Railway and Navigation Company's Albina dock.
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> Access from the street to the lower level is afforded at the southern end by a team ramp from Front street on a 5 per cent grade. For extra heavy loads an electrically operated snatch tackle winch may be provided. On the west side of the lower level is installed one elevator, with a loading platform 6 ft. by 12 ft., with a lifting capacity of 7,500 lbs. This elevator is for the direct transference of merchandise between the two levels. The platform is of sufficient size to accommodate one fully loaded dock auto. The elevator is to have a speed of 55 ft. per minute. Allowing for delays incident to loading and unloading of dock autos, the elevator can make a round trip per minute. Therefore, considering freight as moving only in one direction, for example, from the lower to the

upper level, the elevator can transfer one loaded dock or auto per minute, or 120 tons per hour. If freight is moving in both directions, the amount transferred is estimated at 1½ times as much, or 180 tons per hour.

The following description of freight handling devices in connection with public docks is taken from the report of the Board of Consultation:

Reference has been made to the dock autos. They are electrically operated motor trucks of several types, capable of running loaded from 4 to 6 miles per hour, of carrying loads from 1 to 2 tons; dimensions running from 3½ to 3 ft., 9 in. in width, and from a length of 7 ft. 1 in. to 12 ft. Their wheel base is sufficiently short to permit loaded trucks to enter and turn in box freight cars. Their power is sufficient, even when loaded, to negotiate grades from 20 to 30 per cent. One charge of electricity will operate a truck for an entire day or night at a total cost of but a few cents for power. Their operation is most simple. In practice they are generally operated with equal efficiency forward or backward by porters or even unskilled labor. They range in cost from $1,000 to $1,500. The special type of auto truck which will probably be used combines chassis with "flat-board" bodies. This type of dock auto will carry freight from a ship to any place on the dock or marginal way or warehouse platform, yet at the same time permit of the elevation by winches of the loaded body to any floor of the warehouse without delaying the dock auto, the chassis returning to the loading point for another "flatboard" or load. On the ramps provided, the dock auto can enter the port of a ship, take on its load without additional manual handling, and transfer the same directly to the interior of freight cars on the service tracks at the rear of the dock shed

Careful consideration and investigation have been given other systems of mechanical handling of freight. A telpherage installation has been considered for this dock, providing service to each of the warehouses and continuously along the front and rear of the dock shed. The cost of such a system, with a sufficient number of telphers to meet fully the requirements, when two ships are unloading, has been estimated at $75,000. Under certain conditions the same facilities for transferring freight can be rendered by dock autos for $13,000.

Telpherage may be economically installed when the volume of freight is fairly constant, when the freight is transferred regularly and given directions between given points, and when more or less regular tiering is required to heights greater than 8 feet, between points which shall not be in close proximity. Floor space must be especially valuable to warrant such an installation.

Dock autos have a decided advantage in handling of general freight on account of the flexibility in installation and service, as the service can be increased by small units from time to time as experience and the volume of business justifies.

Another type of freight handling device considered is belt conveyors and moving platforms, technically termed freight carriers, which would be installed between the warehouses and the dock front.

The freight carrier could be installed at the second floor level, running along the front of a gallery, crossing the marginal way over the freight tracks at the back of the dock shed, passing across the shed to the dock front, where the merchandise could be delivered by chutes into longitudinal freight carriers. From these longitudinal freight carriers the freight could be delivered by chutes to any point on the dock front, to be picked up by slings and placed in the hatches of the ship.

Each warehouse will be equipped with two lowerators, each placed in a well. This installation would be solely for outbound cargo and could be made greatly to facilitate both the loading of the ship and the unloading of inward cargo. This system of freight delivery from each warehouse would serve some 350 ft. of dock, to any point of which delivery could be made.

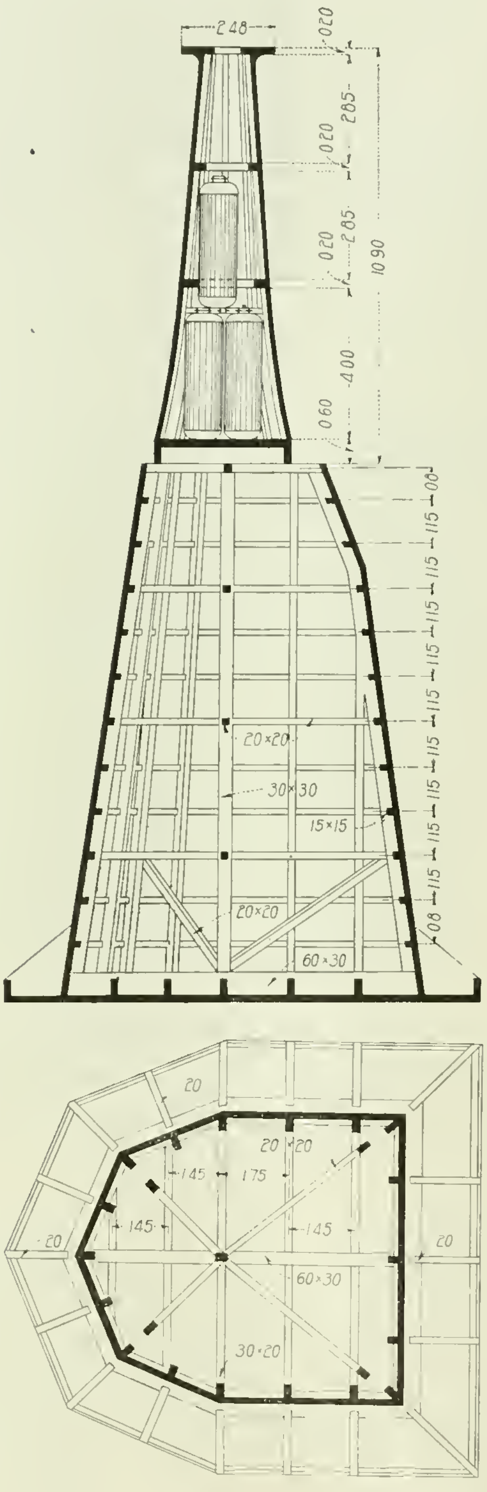
Immediately in rear of the dock shed two loading tracks have been provided to care for the direct lateral movement of freight between ships and railroad cars. Between these tracks and the dock shed is provided an unloading platform 12 feet wide. Such a continuous platform makes unnecessary a continuous door installation in the dock shed and the care in the stopping of freight cars so that the doors of the same and the doors of the shed may coincide. A more weighty reason is that in the transference of freight between the ships and cars by dock autos, such autos are most effective where free passage is provided for their rapid movement, the dock autos leaving the ship by one of the slips provided directly across the dock surface to the platform in the rear and thence northward or southward to the railroad car to which its freight is conveyed.

In rear of these two service tracks is provided a marginal way of 30 ft. in width, primarily designed as a place for direct unloading between teams and the eastern chambers of the four warehouses; hence the width of only 30 ft.

Fines to Be Used for Testing Road Materials.—A bill has been introduced in the State Legislature of New Jersey which provides for the use of part of the fines received for the purpose of making test of road materials and of examining pavements.

Reinforced Concrete Lighthouse Tower Constructed by Launching, Towing to Site and Sinking.

A lighthouse tower was in 1911 constructed at the Port of Alexandria, Egypt, by the unusual process of towing to place and sinking a reinforced concrete structure weighing some 300 metric tons. The tower structure is indicated completely enough by the accompanying drawing, remade from "Annales des Ponts et Chaussees" for Nov.-Dec., 1912, to which we are also indebted for the following notes on construction:



Sectional Plan and Elevation of Reinforced Concrete Light Tower, Alexandria, Egypt.

The tower is entirely of reinforced concrete and was founded on a dredge leveled site on soft rock in 9.5 m. (31.2 ft.) of water. Its total weight in position, without equipment, is about as follows:

	Trusses.
Base, shell and pruning	302
Tower proper	35
Interior concrete filling	1,055
Filling base plunge pockets	150
Total	1,542
Upward pressure of water	533
Net weight	1,009

The shell thickness and sizes of interior bracing are indicated on the drawings, all being in centimeters. Round bars of 6 and 8 millimeters diameter were used for reinforcement. The concrete was proportioned: 450 kilos. cement, 400 dcm. sand and 850 dcm. gravel. The total volume of reinforced concrete was 135 cu. m., and the total weight of reinforcement was 37 metric tons, which is 3½ per cent of volume of concrete. No serious leakage of water through the shell occurred except in one or two places where careless workmanship allowed segregation of gravel and made a spongy spot.

The base up to a height of 7 m. was constructed on boat ways and launched when completed. This section was then slung between two barges, the slings being capable of adjustment to preserve the level of the base during the addition of its remaining height and the placing on it of the lower shaft, which had been separately molded. It was intended to tow the complete tower slung between the barges to its proposed location and it was safely towed some 3 kilometers or 1.8 miles to the mouth of the port where it was to be held awaiting favorable weather for towing to its location in the open sea. By some misunderstanding the second stage of the journey was undertaken without the engineer's authority and before proper precautions had been made for safety. The result was the partial breaking loose of the tower from the base. The tow was returned to port and the tower was removed, and plans were changed. The new plan was to tow the base to its site and sink it and then build the new tower directly on the base.

The base without the tower was towed 4½ kilometers to its site in 2.35 hours. It was oriented by swinging the barges and sunk by pumping water into the shell. The sinking proper took 50 minutes. Barges loaded with dry concrete materials were swung alongside and these dry materials were filled into the shell—directly into the water it contained—until a height of 6 m. was reached. Then the water was pumped from the shell and the remaining concrete was placed. The building of the tower on the base was accomplished by the usual method of falseworks and forms. The tower was completed in six months after beginning work and this time included nearly two months' time lost due to the accident mentioned. The total cost of the tower with its equipment was 60,000 francs or, say, $12,000.

Progress Toward Completion of the Culebra Cut, Panama Canal.

Seven months is estimated to be the time remaining for dry excavation at Culebra Cut, Panama Canal. The channel excavation will not by that time be completed but remaining excavation can be done by floating plant. The following program for the seven months more of steam shovel work is given in the "Canal Record" for Feb. 12, 1913:

The lake level will be brought up to plus 50 by July 1, 1913. On and after July 1, the lake will be permitted to rise continuously, and steam shovel work in the cut can continue as long as the height of the Gamboa dike will suffice to hold back the water of the lake. The top of the dike is about elevation plus 78. Inasmuch as with a season of average rainfall, an elevation of plus 74 may be expected to be reached about Oct. 10, the dry excavation may be continued in the cut until Oct. 1, 1913. It may be necessary to flood the cut at any time thereafter. This program has been laid out so as to obtain a lake elevation of 85 ft. above sea level on Dec. 1, 1913, and in accordance with it, Gorgona Shops will be flooded out about Sept. 15.

On Feb. 1, there had been dug out of Culebra Cut 88,592,307 cu. yds. of rock and earth, and there remained to be excavated approximately 4,000,000 cu. yds., not including present slides. The work is now practically confined to three out of the nine miles of the cut.

On the south end the excavation is completed from Pedro Miguel Locks north to a point beyond Paraiso, except that the widening of the canal immediately north of the locks to make an anchorage basin will not be completed for about two months, and that the incline on the east side at Paraiso, up which spoil is hauled out of the canal, cannot be removed until the steam shovel work is over. On the north end the completed section extends from the Chagres River to a point near Empire. In both of these sections there is a small amount of cleaning up to be done, but this is unimportant. The six miles of canal represented in these two sections are practically completed.

The section in which the work is being carried on is that between stations 1680 and 1845, that is, from a point near Empire, one-fourth mile south of the angle at Cunette, to a point near the old hamlet of Cucuracha, about one-half mile north of Paraiso. This includes the channel in front of Empire, Culebra, Rio Grande, Gold and Contractors' Hills, and a short distance south. In accordance with the original plans the work is being prosecuted so as to keep the highest point in the cut somewhere about half way between the ends to assist in drainage, and to make it possible for loaded spoil trains to run down grade in going through the canal. The summit in the pioneer or lowest cut is now between stations 1762 and 1769, about opposite the administration building at Culebra, and here the excavation is down to 61 ft. above sea level, 21 ft. above the bottom of the canal. From there it slopes gradually on both sides to the bottom at 40 ft. above sea level. The drainage is continued as heretofore, through the main culvert of Pedro Miguel Locks, on the south end, and into the sump at Gamboa at the north end, whence it is pumped into the Chagres.

At present 37 steam shovels are at work, and when emergency demands some of them are run on double shift, making twelve hours a day. Recent instances of this are two shovels at work on the slide opposite Empire, and two on Cucuracha slide. The daily excavation in January averaged over 50,000 cu. yds., and this is being maintained at the present time. The equipment engaged in hauling the spoil includes 124 locomotives, 1,512 flat cars of 19 yds. capacity, 199 steel dump cars of 17 cu. yds., and 136 dump cars of 10 cu. yds. capacity.

Digging has not increased the difficulty as the bottom is neared, and the use of dynamite has become increasingly economical. At present the hardest material to blast is the cemented gravel met with opposite Empire, where it is necessary to follow the primary or deep blasting with surface or "doby" shots in order to break the material into sizes that can be handled by steam shovel. The trap rock encountered in the Gold Hill dike, the face of which is about 1,000 ft. long on the canal, is very hard, but requires less surface blasting than the cemented gravel does. At all other points the material requiring blasting is soft rock that crumbles readily under the force of the initial explosion. In blasting work 359 drills are employed, and in January 396,250 lbs. of dynamite were used; about 0.35 lb. per cubic yard of material excavated.

New Dipper Dredges for the Panama Canal.

Two 15-cu.-yd. dipper dredges are contracted for to be used on the Panama Canal excavation and channel maintenance work. The contract price for the two dredges is $517,000 or $258,000 each, and they are to be delivered on the Atlantic Coast in November and December of the present year. Since these dredges are strictly modern in their requirements, a summary of these requirements will be of interest.

This dredge will dig to a depth of 50 ft. below the surface of the water; the machinery throughout will be constructed to withstand maximum pull of the engines when working with 125 lbs. steam pressure at the engine and condensing. The dipper will be hoisted by a single part steel wire cable. All parts of the machinery will be designed especially with a view to rapidity of work and convenience in operation.

Hull.—The hull will be of steel, approximately 136 ft. overall length; 44 ft. width; 15½ ft. deep at bow, 13½ ft. deep at stern. The bottom plating will weigh 17 lbs. per square foot except outer strakes, which will be 20 lbs.; side plating bilge strake, 17 lbs.; sheer strake, 20 lbs.; bow and stern plating, 20 lbs.; deck plating, 12½ lbs. except outer strakes, which will be ⅜-in. diamond or checker plates, raised pattern. Frame spacing approximately 24-in. centers; floor beams, 12-in., 25-lb. channels; deck beams, 5-in. x 3¼ x 5/16-in. Z bars 11.6 lbs. per foot; frames 6x 3½ x ⅜-in. Z bars. Every fifth frame to be ⅜-in. web frame, about 30 ins. deep with 3½ x 3½ x ⅜-in. angles; intercostal stringers of 15-in. 33-lb. channels will be set between web frames to support Z frames. A heavy structural steel truss will be built into the hull with cross trusses between spud wells, the trusses will also be arranged at the bow to support the swing circle. An intermediate cross truss will be located at about frame 24 and a transverse water-tight bulkhead between boiler and engine rooms. A wooden house will cover the machinery and main deck, and on the upper deck there will be cabins for the crew.

Main Engines.—The main engines will be twin tandem compound with cylinders 16x28 ins. in diameter and 24-in. stroke; crankshaft of forged steel 12 ins. in diameter with journals 9¼ ins. in diameter and 14 ins. long. Link motion of the Stephenson type with 6-in. diameter steam actuated reverse.

Hoisting Drum and Gears.—The hoisting drum will be of differential type and cast of steel, small diameter 55 ins., large diameter 84 ins. at the bottom of the grooves; grooved for 3-in. diameter wire rope. The hoisting shaft is to be of forged steel about 14½-in. diameter, with journals 11¾-in. diameter by 18 ins. length. Power will be applied to the drum by means of two outside woodlined band frictions, one on each side of the drum, both being operated by means of a single steam cylinder 14 ins. in diameter, placed at one end of the drum shaft and attached to a thrust spindle passing through the center of the shaft. This thrust spindle operates the friction band through a system of bell cranks and toggles.

A single lowering brake 12 ins. wide, same diameter as the clutch frictions, will be provided on one end of the hoisting shaft. The brake band will be controlled by steam friction. A ratchet and pawl will be provided to hold up the dipper when not running.

The drum will be driven by two gears, one at each side meshing with the corresponding pinions on the intermediate shaft. The intermediate shaft will be driven from the crankshaft through a single gear which will have steel casting rim bolted to a heavy cast steel spider arranged so that the rim can be replaced without stripping the shaft.

Bearings for the intermediate shaft will be bolted directly upon engine bed plates. The bed plate, which also contains the drum shaft bearings, will be a heavy steel casting, and will form an extension of the engine bed plate, securely bolted to the same and to the structural base built into the hull. The drum shaft bearings will be of the quarter box type with wedge adjustment.

Boom.—The boom will be of structural steel about 62 ft. long, with curved top and bottom chords, all parts of ample section for the stresses they must bear; the boom feet will be heavy steel castings with webs and flanges of sufficient length to provide ample rivets. The shipper shaft bearings will be bolted to the top chords.

Shipper Shaft and Brakes.—The shipper shaft on the bottom will be hollow and cast of nickle chrome steel, not less than 9½-in. diameter in the middle, and 8-in. diameter in the bearings. Pinions and flanges will be cast in one piece with the shaft. The brake wheels will be steel casting 75 ins. in diameter with 12-in. face, and will be bolted to the flanges on each end of the shipper shaft. The brakes will be of the double-acting differential type, and will be operated by means of a combined hand lever and foot treadle.

Base Plates.—The boom will be stepped into a steel casting pivot bearing formed with sockets to receive the boom feet. This pivot will rotate on a heavy cast steel base plate securely bolted to the hull and having flanges extending over the front of the hull. The pintle will be bushed with bronze, and a bronze wearing plate or washer will be provided between the boom step collar and the base plate. The base plate on which the swing circle will rotate will be a heavy steel casting, with pintle bushed with bronze, and bronze wearing plate or washer between the base plate and the center casting of the swinging circle.

A-Frame.—The A-frame will be of structural steel properly proportioned to carry all the loads that may come upon it, each leg of box section. The head and feet and the base castings which support the frame, will be of cast steel; pins in the feet will be of forged steel not less than 7 ins. in diameter, and the pin in the frame, for connecting the back guy equalizer, not less than 6½ ins. in diameter. An equalizing arrangement consisting of two U-shaped forgings to carry sheaves and two heavy steel plates for connecting the U straps to the A-frame head, will be provided to equalize the load on the back guy ropes. In the U-shaped forgings there will be two sheaves grooved for 3-in. rope, and of 37-in. diameter at the bottom of the groove.

Swinging Circle.—The swinging circle will be of structural steel 24 ft. in diameter, and mounted upon the hull truss. Connection to the boom will be made by means of two heavy, built-up girders extending out from the circle, one on each side of the boom. The center will be a heavy steel casting securely bolted to the circle.

Swinging Machinery.—The swinging machinery will be operated by an independent double engine having cylinders 12 ins. in diameter by 16-in. stroke with link reversing gear. The engine and drum will be mounted upon heavy structural steel bases built into the hull. The links will be reversed by a steam thrust cylinder, controlled by the same lever that operates the throttle. The swinging drum will be of cast steel 42-in. pinch diameter and grooved for 2-in. diameter wire rope, and will carry on one side a housing for a wood-lined band brake, on the other a cast iron spider for the driving gear. The brake will be actuated by a steam thrust cylinder with compensating valve motion. The drum shaft will be 7½ ins. in diameter with journals 6½x12 ins. running in cast steel babbitted bearings. The intermediate shaft will be 7 ins. in diameter with journals 6½x12 ins. running in cast steel babbitted bearings. The sheaves, for guiding the swinging ropes from the swinging circle to the swinging drum, will be located on top of the hull truss, will be 42 ins. in diameter, and grooved for 2-in. rope.

Spuds and Spud Machinery.—There will be two forward spuds of Oregon fir timbers, plated on four sides with steel plates 1 in.

thick, 72 ft. long and 48 ins. square over the plating. The forward spuds will be operated by an independent double 12x16-in. engine with link motion reverse, operated by steam thrust cylinder, controlled by same lever that operates throttle valve. The drums will be of not less than 42 ins. diameter, grooved for 2¼-in. wire ropes. The dredge will be "pinned-up" and the spuds lifted by 2¼-in. wire ropes passing around the top and bottom of each spud; the load to be taken by four parts of rope. Wood lined band brakes will be provided, operated by a suitable steam cylinder to hold the dredge when "pinned-up." A suitable friction clutch, operated by a steam thrust cylinder, will be provided for disconnecting the drum from the engine to allow the dredge to rise and fall with the tide, when not in use. Sheaves for guiding the ropes to the drums will be not less than 45-in. pitch diameter. Each forward spud will be provided with a collapsible spud foot, consisting of two heavy steel castings that will form a foot about 7x9 ft. when open.

There will be one stern spud of Oregon fir, plated like the forward spuds, and about 80 ft. long and 30 ins. square over the plating. The machinery will be arranged for a trailing spud. The spud will be hoisted by a wire rope and a winding drum driven through two gear reductions by a 9x9-in. double engine located on deck at the foot of the stern spud casing.

The dredge will be equipped with backing machinery, the drum to be operated by a 12x 16-in. double, nonreversing engine.

Operating Levers.—Levers for controlling the dredging machinery will be mounted on the main forward deck, grouped for convenient operation. They will include a lever for operating the main hoisting engine throttle valve, for the steam cylinder actuating the main hoisting frictions, for the steam cylinder actuating the main lowering brake, for the steam cylinder for reversing the main engine, for the combined throttle and reversing links of the swinging engine, for the steam cylinder actuating the swinging drum brake, for the combined throttle and steam cylinder actuating the friction clutch of the backing engine, for each of the combined throttles and reverse links of the forward spud engines, for operating each of the steam cylinders actuating the forward spud clutches, for operating each of the steam cylinders actuating the forward spud brakes; pulley and rope with handle for operating the pawl for engaging with the ratchet on the main hoist, pulleys and rope with handle for operating the steam whistle. Levers for controlling the stern spud machinery will be mounted at the stern, and levers for controlling the scow moving winches at the end of each winch.

Dippers.—There will be two dippers, one of 15-cu.-yds. capacity and one of 10-cu.-yds, the latter especially adapted for digging in rock. They will be dumped; that is, the door will be unlatched, by a steam cylinder mounted upon the boom with the necessary guide sheaves, bearings and brackets.

The 15-yd. dipper will be built with shell plate front and sides ¾-in. thick, back plate ¾-in. thick, door 2 ins. thick steel plate, top band 2x14-in. steel bar around the front and sides projecting back beyond the dipper to support pin for the back brace, bottom band 2x16-in. steel bar around front and sides. On the back of the dipper will be two heavy steel castings, the lower one with a double set of lugs to carry the pins for the hinges and for the handle hinge in double shear, the upper casting, a channel shaped girder. The hinges will be of forged steel 10 ins. deep and 6 ins. wide in heaviest section. The lip will be of manganese steel 50 ins. high over all at the center and 9½ ins. high at the back edge of the sides, 2 ins. thick at the bottom edge, tapering down to 1¼-in. thick at the top of the deepest section. The latch bar will be forged steel not less than 4 ins. wide by 5 ins. deep; latch keeper also of forged steel 20 ins. wide and 4 ins. thick at the lower end and 12 ins. wide and 2 ins. thick at the upper end; lower end recessed to receive hardened steel wearing bar and thickness of latch increased to 5½ ins. at this point. This dipper will not have teeth.

The 10-yd. dipper will be interchangeable with the 15-yd. and will be used in rock excavation. It will have shell plates ¾-in. thick, back plate ¾-in., door of 2-in. steel plate, top band 2x12-in. steel bar around front and sides to project beyond the back of the dipper to support the pins for the back braces, bottom band 2x10-in. steel bar around front and sides. Heavy steel castings on the back will serve the same purpose as those on the 15-yd. dipper. The hinges will be of forged steel, 8 ins. deep by 5 ins. wide in heaviest section. The lip will be of forged steel 2½ ins. thick by 27 ins. high overall at center and 9½ ins. at the back edge. This dipper will have four heavy forged teeth with hardened steel points.

The dipper handle will be of Oregon fir about 72 ft. long, reinforced with 2x12-in. bars top and bottom and by 1x22-in. plates on both sides of each dipper stick. The racks will be nickel chrome steel castings, 3-in. pitch, 12 ins. wide, shrouded to pitch line.

Boilers and Fittings.—Two boilers of the Scotch marine types, each having a total heating surface of approximately 2,700 sq. ft., working pressure of 150 lbs. per square inch, will supply steam. Each will have a Morrison suspension furnace, and a double stack with 2-in. air space, to stand about 50 ft. high above the top of the boiler. There will be also one vertical donkey boiler about 54 ins. in diameter and 10 ft. high, built for 150 lbs. steam pressure.

One surface condenser having approximately 1,500 sq. ft. of cooling surface, independent air pump of suitable size, and an 8-in. centrifugal circulating pump, driven by an independent engine, will also be provided.

Other Equipment.—The specifications provide for an electric lighting plant equipped with one 10-k.w. 110-volt, direct current generator and a complete lighting system; fuel oil tanks with a capacity of 18,000 gals. of fuel oil; fresh water tanks with 18,000 gals. capacity, and a 5,000-gal. tank for use of the galley; pumps for boiler feed, general service, fresh water, fire service and pumping bilge water; deck fittings, wire ropes and guys, feed water heater, oil feed pumps, ash ejectors and a complete system of piping. The contract for both dredges has been awarded to the Bucyrus Co., South Milwaukee, Wis.

The Illinois Waterway: The Projects for a Barge Canal From Chicago to the Mississippi River.

Recent agitation for the improvement of the Illinois and Michigan Canal, completed in 1848 and with a history as outlined in a previous issue of this journal, leads new importance to the larger waterway planned in 1906-7 by the Illinois Improvement Commission to connect Lake Michigan at Chicago with the Mississippi River. We give here, therefore, the parts relating to its construction features of an outline of the new waterway by Mr. Isham Randolph of the Rivers and Lakes Commission of Illinois:

This project covers the construction of a lock at the plant of the Sanitary District in Lockport, utilizing the channel excavated by the Sanitary District south of its power house as far as its depth is adequate; deepening the same where its depth is inadequate and excavating the upper basin in Joliet and the channel below Dam No. 1 to secure a depth of 24 ft. and a width of 300 ft. throughout the upper basin and through the city. Below Dam No. 1 it is proposed to carry the channel between walls and embankments to a site at or near Brandon's road in Will county, where it is proposed to build a dam, a lock, power house and regulating works. It is proposed to hold the water in the pool formed by the works just described up to the present level formed by Dam No. 1. The water surface at the Brandon Road Dam will be about elevation 545 (Memphis datum). The available head at this dam will be 21 ft.

TABLE I.—ESTIMATE OF QUANTITIES AND COST, LOCKPORT TO UTICA.

Item.	Quantity.	Unit price.	Cost.
Lock No. 1	......	....	$ 1,185,938
Excavation.			
Lockport to Brandon's rd.:			
Rock, cu. yds	698,750	$ 2.50	1,746,875
Concrete, cu. yds	8,277	2.00	16,554
Retaining walls	104,777	1.00	104,777
Concrete retain. walls	248,560	6.00	1,543,360
Earth & rock, back fill	456,518	50	229,259
Removal dam No. 1	......	Lp. sum	10,000
Removal canal lock	......	do	5,000
Rebuilding bridges, 2 railway, 7 highway	......	....	797,463
Power house	......	....	900,000
Lock	......	....	1,185,938
Sewer diversion	......	....	50,000
Total			$ 7,775,164
Brandon's rd. to Dresden island:			
Excavation, channel, cu. yds	97,777	25	24,444
Levees, cu. yds	351,155	30	105,346
Concrete dam, cu. yds.	7,750	15.00	116,250
Retaining walls	135,000	6.00	810,000
Crib, lin. ft	7,500	10.00	75,000
Lock	......	....	1,185,938
Power house	......	....	900,000
Bridges, 2 highway	......	....	137,052
Total			$ 3,354,030
Dresden island to Bell's island:			
Excavation, channel, cu. yds	285,259	25	71,315
Marseilles canal	2,862,865	30	858,859
Rip rap	......	....	189,150
Lock	......	....	1,185,938
Dam	......	....	117,000
Power house	......	....	900,000
Bridges, 3 highway, 2 railway	......	....	321,585
Total			$ 3,643,847
Bell's island to Utica:			
Dredging, cu. yds	684,165	25	171,041
Excavation and levees	1,744,052	30	523,215
Dams	5,000	15.00	75,000
Lock	......	....	1,185,983
Power house	......	....	900,000
Bridges, 1 highway, 1 railway	......	....	174,963
Total			$ 3,030,157
Right of way			340,000
Contingencies, 10 per cent			1,814,319
Grand total			$19,957,517

DRESDEN HEIGHTS LEVEL, LAKE JOLIET TO BIG DRESDEN ISLAND, 14 MILES.

The channel of the Des Plaines will be utilized as far as the mouth of the Kankakee River and minimum depth of 14 ft. will be secured and a channel width of 300 ft. From the high round on the east of Riley's Creek a levee will be built through on the south side of the Des Plaines River to the Kankakee River and the material for this levee will be taken from a channel south of and parallel with its location, through which channel Riley's Creek will be diverted and discharged into the Kankakee River. The embankment just described will be joined on to a concrete wall or dam which will be built downstream in the bed of the Illinois River to the north end of Big Dresden Island, where a third lock, second dam and second power plant will be erected. The concrete wall just described will form the south side of the channel which will convey the waters of the Des Plaines River to the lock and power plant. The water level at this dam is to be at elevation 518.9 ft. and the drop will be 18 ft.

MARSEILLES LEVEL, BIG DRESDEN ISLAND TO BELL ISLAND, 27 MILES.

The channel of the Illinois River will be used until Ballard's Island is reached. An overflow dam will be built from the eastern end of Ballard's Island to the north bank of the river. A channel will be cut southwesterly across the eastern end of the island and the excavated material will be used to close the channel on the south side of the island; a channel 300 ft. wide will be carried along the southerly side of the river to a point opposite Bell's Island, where a fourth lock and a third dam and power house will be constructed. The channel between Ballard's Island and Bell's Island will be partly through cut and partly between high ground on the south and heavy embankment on the north. The water level at the dam site will be 495.5 M. D. and the head 26 ft.

UTICA LEVEL, BELL'S ISLAND TO UTICA, 15 MILES.

The channel of the Illinois River will be used as far as the north end of Delbridge Island; wherever necessary to secure a depth of

TABLE II.

Location.	Head—feet.	Horse power produced— By 10,000 C. F. S. Gross.	Net.	By 14,000 C. F. S. Gross.	Net.
No. 1. Brandon's rd	24	27,272	21,818	38,182	30,546
No. 2. Dresden's island	18	20.455	16,364	28,636	22,909
No. 3. Bell's island	26	29,545	23,636	41,364	33,091
No. 4. Plum island	20	22,727	18,182	31,818	25,454
Total		99,999	80,000	140,000	112,000

14 ft. and a width of 300 ft., excavation will be made. Delbridge Island, Leopold Islands, numbers one, two and three, and Plum Island extend for a distance of about 4¼ miles down stream. Any project for water power at the south end of this stretch would involve overflowing these islands; under the project now being considered, it is proposed to secure these islands and run a canal through them lengthwise, using the necessary excavation to make the sides of the canal which will flow through a channel partly excavated and partly embanked. It is proposed to join the easterly entrance of this canal with the northern and southern banks of the river by permanent dams which would guide the normal flow of the river into the artificial canal, but over which floods would discharge into the old river channels on either side of the islands. This construction relieves the bottom lands on each side of the river from overflow except in times of excessive flood and it also preserves the natural conditions around Starved Rock and vicinity. It is proposed to erect a fifth lock and fourth dam and power house at the westerly end of Plum Island. The height of water above this dam to be 466.5 M. D., and the ordinary head 20 ft.

RESULTS TO BE OBTAINED.

The results to be attained by the execution of the project described are the creation of a navigable waterway in the Des Plaines and Illinois Rivers which shall have a minimum depth of 14 ft. and a channel width of 300 ft. A through waterway would thus be provided from Lake Michigan to the head of the present slack water navigation in the Illinois River, 98 miles from the mouth of the Chicago River. Four valuable hydro-electric powers would be created, utilizing 88 ft. of the 100 ft. of fall from the Sanitary District power plant at Lockport to Utica and yielding an efficiency of 80 per cent and a flow of 10,000 cu. ft. per second, 80,000 net electrical horse power. Should the Sanitary District at any time send down 14,000 cu. ft. per second, the net potentiality would be 112,000 h.p.

It is proper to state that in the estimates, Table I, the cost of locks used is $1,185,938 and that this figure is the average cost of the five locks to be built. The lock at the Sanitary District power plant will be the most costly, as it must be built to meet a maximum lift of 40 ft. In like manner the cost of power houses is taken as $900,000, this, too, is an average of the cost of the four power houses to be built and that figure covers the hydro-electric equipment. The estimate used for right of way is adopted from the report of the United States Engineers, submitted Aug. 25, 1905, covering a 14-ft. waterway from Lockport, Ill., to the Mississippi River. This estimate for right of way will be varied from to whatever extent the riparian owners can make good their claim to compensation on the basis of water power rights.

The sufficiency of the construction estimates has been questioned. In support of these estimates it is proper to state that on Sept. 10, 1910, the Secretary of War appointed a Board of Engineers "for consideration of a waterway from Lockport, Ill., by way of the Des Plaines and Illinois Rivers to the mouth of the Illinois River." The members of this board were W. H. Bixby, chief of engineers, United States army; C. McD. Townsend, colonel corps of engineers; C. Keller, major corps of engineers; John Bogart, civil engineer. The governor appointed the chairman of the Internal Improvement Commission of Illinois, Mr. Isham Randolph, as the "authorized agency to confer with this board of engineers." Being thus commissioned, Mr. Randolph submitted the project of the Internal Improvement Commission for a waterway from Lockport to Utica with all maps, plans and estimates in detail to the board with which he was authorized to confer. After a careful consideration of these plans and estimates, that board in its report dated Jan. 23, 1911, says:

> The board believes that the state is more generous in its provisions for navigation than necessity requires, that the locks it proposes are larger than will be utilized and that its original agreement would be amply fulfilled if it constructed locks 600x80x11 ft. and reservoir at each lock ground for an additional lock should it ever be required, but it is also of the opinion that the state should be permitted to expend its own funds in such manner as it deems proper. With locks such as suggested by the board, the $20,000,000 authorized to be appropriated by the state should complete this part of the waterway; and unless large expenditures are required for power rights, even the larger locks could be constructed for that amount.

In a later paragraph of that report occurs this language:

> Should the State of Illinois be unable to complete the locks suggested by the board or the bridges required for navigation, the United States might then properly undertake these parts of the project, but as the authorized appropriation of $20,000,000 by the state is considered sufficient for all work above Utica, no estimates are submitted for these parts.

In the letter of General Bixby, chief of engineers, transmitting the report, from which we have quoted, to the Secretary of War, occurs this language:

> In the opinion of the Board of Engineers for Rivers and Harbors, no expenditures should be made by the United States on this section of the waterway (Lockport to Utica). In the opinion of the Special Board, the $20,000,000 authorized to be appropriated by the state should be sufficient to entirely complete this section of the waterway; but if, through unforeseen contingency, the funds prove insufficient, the United States would be warranted in assisting the state by contributing such part of the cost as might eventually be found necessary to complete construction of suitable locks in the dams below Lockport and of bridges over this section of the waterway.

The confirmation of the estimates made by the Internal Improvement Commission by the Board of Engineers, from whose report we have quoted, should set at rest all doubts as to the sufficiency of those estimates.

THE WATER POWER.

The water power which can be developed at the four power sites is shown in Table II.

The net horse power shown is figured on an efficiency of 80 per cent.

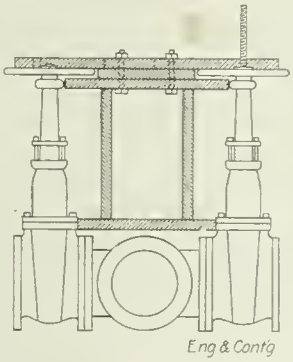
WATER WORKS

The Danger of Physical Cross Connections Between Public and Private Water Supply Systems—A Suggested Mechanical Safeguard.

The danger arising from the physical connection between a pure public water supply and a contaminated private water supply system has been the subject of considerable discussion among water works men of late. Almost every superintendent of water works, in cities large enough to have important industrial plants, has had the disturbing experience of discovering that the public and often grossly polluted private supply at some industrial plant were in direct contact and thoroughly intermingled. This fusion of the two supplies is due to the careless opening and closing of gate valves and the failure of check valves to remain tight. A very clear statement of the problem and a suggested solution of it were given by Mr. H. E. Jordan, Superintendent of Filtration for the Indianapolis Water Company, in a paper before the Indiana Sanitary and Water Supply Association on Feb. 26, 1913. The paper is here given in full.

In the problems connected with the operation of a public water supply system there is one, not located at the purification or pumping plant, that may affect the quality of the supply as delivered to some of the consumers.

Ample precautions may be taken to so purify a surface supply as to render it wholesome; adequate provisions may be made to insure its delivery by the pumping department without having received any after pollution, but the distribution system may be so cross connected with various private supplies as to render them sources of financial loss to the water company or sources of dangerous pollution that may affect the health of some of the consumers.



Sketch Showing Method of Interlocking Rising Stem Gate Valve.

There is in every town or city having a public supply a certain factory or group of factories or industries, which for some reason or other, furnish their own water supply. Without a lengthy discussion as to the various reasons that lead to this situation, the fact must be admitted that no matter how good the public supply may be from a sanitary standpoint (which very seldom enters into consideration in these cases) or how good it may be for boiler water or industrial uses, or how ample or cheap it may be, there will be met industrial organizations who prefer to furnish their own water supplies; and at times the magnitude of these organizations and their large use of water may make them (even in a city of 100,000 people) maintain an excellent pumping plant with a capacity 25 per cent as great as the total daily public use.

On account of the possible use for fire protection, the pumps may be capable of developing high pressures, and there may be installed water tanks or towers capable of storing and delivering under moderately high pressure a considerable quantity of water.

With these installations in place, it is practically the rule that in order to provide a supply when the factory plant is shut down, or to provide better fire protection, connection of the factory system to the city water mains is desired and made, and although the use of city water may be small, the private system in some measure becomes a part of the public system.

The ordinary method of closing off city mains is by a gate valve—sometimes sealed—generally manipulated by some employe of the factory. Further care to prevent surreptitious use or contamination of the city supply, or a mixture of the two, may be taken by the use of double gate valves or check valves, whose duty it is to prevent back flow to the city mains.

It does not seem practicable for a water company to exercise any sort of censorship over the quality of such factory supplies. They may be taken from wells or polluted streams—these purified or not—if their quality meets the industrial needs of the plant, and no objection can be made. If the employes use such supply for drinking purposes and become ill therefrom, its abandonment for such uses comes under the jurisdiction of the health department. The duty of the public water supply organization is the prevention of water from such supplies from entering its distribution system and the protection of its consumers from nuisance and disease caused thereby.

There are three typical instances of the danger of these cross connected systems that may be mentioned.

(1) Inadequate protection of the connecting valves may result in the use of the public supply without payment being made for same. The list of water thieves and the ways of stealing water on a small or large scale has its members and examples in every town.

In this connection it is worth while to mention the case of an industrial plant that used unpurified water from a power canal for washing and boiler uses. This canal was drained in order that some repairs could be made, and water was furnished from the city supply. When the repairs were completed, the valve to the canal was opened, but the city supply was not closed. As a result, the higher pressure forced the city water not only through the washers and to the boilers, but a portion of it flowed into the canal.

(2) Such connections may cause a nuisance to water consumers. An illustration of trouble occupying from this source is typified in the case of a gas works in a certain western city, having double valves at the connection—supposed to be kept closed except when city water was being used. A water tank was connected to the system in which not only fresh water, but at times water from ammonia washers was stored. It was supposed that the pressure in the city mains was at all times higher than that developed in the private system. During hours of heavy draft, however, such was not the case, and this mixed water flowed back into the city mains. Frequent complaints were made as to the high color and offensive odor of the water delivered to the houses in the immediate neighborhood. Investigation disclosed the source of the trouble and steps were taken to prevent it. On account of the pollution being industrial and not sewage, and the physical characteristics so unpleasant, the water was not used for drinking purposes and no illness occurred.

(3) The simplicity of the details and ease of pollution in both these cases, and the known fact that in many cases the factory supplies are from polluted streams, makes it apparent that the pollution of a public supply with disease bearing organisms is possible; in fact, there is no question that many such cases have occurred and the lack of collected information is due only to a failure to appreciate the possibilities of the case and lack of adequate investigations.

The case of an unknown cross connection between the Winnipeg, Manitoba, high pressure and domestic systems is very much to the point. Winnipeg maintains two water supplies—one softened and filtered, of high sanitary quality, and delivered at a pressure of 40 to 50 lbs.—the other is taken directly from the Red river, highly polluted, intended for fire protection only, and delivered at pressures varying from 150 to 300 lbs. In October, 1908, considerable typhoid began to appear among employes of the Canadian Pacific R. R. Investigation of the 26 cases showed nothing in common but the location of their work. It was found that both supplies were available in the yards—the high pressure supply being used for the locomotive boilers. Study developed the constant presence of B. Coli in the water in one building, and it was found that early in October the man in charge of this department had connected the two so that should one fail the other would be available. The connection was broken Nov. 19, and no cases occurred after Nov. 30. While this is not a direct example of pollution of public by private supply, its conditions are very similar, and it illustrates the ease with which a private supply delivered under high pressure might, through failure to properly separate the systems, be forced out into the mains and thence to the immediate consumers of the public supply.

Briefly summarizing, it is shown by these examples that a public supply may be wasted and nuisance or disease brought to its consumers by inattention to these connections and the valves controlling them. The duty of a water supply organization ends not with purification and delivery to the mains of this purified supply, but extends to the point of maintaining the purity of this supply until it reaches the consumer.

The protection of its distribution system from localized pollution is essentially a part of this, and the methods of attaining this end may be stated as follows:

The distribution system in the industrial plant should receive its supply from both public and private sources through a common pipe. This pipe should end in a tee connection, from one side of which enters the public supply and from the other the private supply. Immediately adjoining this tee, on both sides, *rising stem* gate valves should be installed.

Any pumps and storage tanks used in the plant should be on the upstream side of the private supply valve, so that they would have no connection with the system when the city supply was in use.

The valves controlling the two supplies should have an attached framework constructed of metal, built and installed so that any tampering with same would be apparent upon inspection. The framework should have at the top a flat metal bar with two holes drilled in it in such a way as to permit the stem of one valve to rise and the valve to open, but the hole over the other valve stem in such a position as to prevent its being opened in any degree at the same time. The whole device is planned with the idea of making it absolutely necessary for one valve to be completely closed and the top bar slid into position before the other one can be opened. Any arrangement permitting both valves to be partly open defeats the end in view.

Finally, the valve system should be subject to regular inspection by employes of the water department, and service furnished only when the rules of the department are agreed to and followed by the owners and employes of the plant installing such a system.

The Design of the Rapid Water Filtration Plant at Columbus, Indiana.

The conditions which called for water filtration at Columbus, Indiana, and the details of the design of the filtration plant which is now under construction, were described in a paper by Mr. Philip Burgess, Mem. Am. Soc. of C. E., in a paper before the Indiana Sanitary and Water Supply Association, at the annual convention held in Indianapolis, on Feb. 26, 1913. The paper is here given in full.

The city of Columbus, the county seat of Bartholomew County, is situated in the south central part of Indiana near the point of confluence of the Flat Rock and Drift Wood Rivers, and the point of beginning of the East branch of the White River. According to U. S. Census reports, the city had a population of 8,813 in the year 1910. The water works were first installed in 1871 by the Holly Water Works Company at a cost of $53,729 and comprised a direct intake into the White River, a pumping station, and distribution system. On account of the generally flat topography of the city, no suitably elevated site is available at Columbus for the storage of water in a distribution reservoir, so that the original Holly system of pumping directly into the mains is retained at the present time.

Throughout the entire history of the water plant, however, there have been complaints among the consumers due to the fact that the city water is frequently very turbid and objectionable for domestic use. As early as April, 1895, John A. Cole of Chicago was retained by the City to investigate the question of obtaining a better water supply. In view of the present status of the art of water purification, it is of interest to note Mr. Cole's statement in regard to the desirability of installing mechanical filters to improve the public water supply at Columbus. He states in his report: "Upon this point there can be but one opinion. No device for filtering water can be depended upon to remove the germs of disease or poisonous substances from a large body of water. The only safe course is to utterly discard such waters from the city supply." Mr. Cole, therefore, recommended that the intake of the water works be moved up the river to a point above local pollution.

Subsequently investigations were made by the Board of Trustees of the city in 1903 and 1905, especially to determine whether or not a better water supply could be obtained from ground sources. These investigations indicated, however, that, while there was available an ample quantity of water in the gravel deposits, the quality of the water was very unsatisfactory, especially on account of its hardness and objectionable odor. About five years ago, a filter gallery was installed in the river but was not satisfactory because it clogged up rapidly and did not deliver the necessary quantity of water. Previous to the installation of the rapid filter plant now nearing completion at Columbus, further investigations were made in 1911 to determine the availability of a suitable ground water but as in former instances, these attempts were not met with success. Consequently in 1912 the city authorities decided that the best means of obtaining a pure water supply at Columbus was to cintinue the use of the White River water and to install suitable purification devices.

In Table I is shown an average of 8 analyses made at intervals during the years 1908 to 1911 by representatives of the Indiana State Board of Health.

TABLE I.—AVERAGE ANALYSIS OF WATER SUPPLY AT COLUMBUS, IND.
(Parts per 1,000,000).

Turbidity	Very slight.
Sediment	Very slight.
Ammonia as Free Ammonia	.125
As Albuminoid Ammonia	.140
Nitrates	.725
Nitrites	.003
Chlorine	6
Total Solids	321
Fixed Solids	246
Total Hardness	241
Total Iron (as Fe)	.22
B. Coli present in 1 c. c.	63%

Some of the above samples were taken from the river and some from different parts of the distribution system. The analyses indicate that, at the time of sampling, the water supply was comparatively clear and hard but was polluted and unfit for domestic use, as indicated by the presence of B. Coli.

The present water works at Columbus comprises a direct intake into the White River, a forebay, two high service pumps of the Holly type, one of 3,000,000 and the other of 5,000,000-gals. daily capacity, a boiler plant, and a distribution system. In July, 1912, a contract was let for the new purification plant which is now under construction and which comprises a raw water pump house containing two centrifugal pumps; two coagulating or preliminary treatment basins; four gravity rapid filters; a filter house containing apparatus for the preparation of the chemicals in solution, together with a laboratory and locker room; and an outside covered clear well. The filters, pipe gallery, operating floor and chemical building, together with all controlling devices of the filters and coagulating basins, are contained within a brick superstructure, covered with a reinforced concrete slab roof.

DESIGN OF FILTER PLANT.

An important feature of the design of the Columbus plant is the arrangement of the four filters in a row parallel to one end of the coagulating basins, and the pipe gallery between the filters and the basins containing all the apparatus required to control the operation of the filters and of the basins. This arrangement permits the use of uncovered coagulating basins without any inconvenience in the winter due to freezing.

Raw Water Pump House.—On account of the fact that room was not available in the present pump house to install the raw water pumps, they are placed in a separate building constructed between the forebay and the present pump station. The raw water pumps are of the centrifugal type each of 4,000,000-gals. capacity daily, the one driven by a steam turbine and the other by an electric motor. The water from the pumps is discharged through a 16-in. cast iron force main approximately 450 ft. long, leading to the filter plant which is located on a lot 150 ft. square, one block distant from the pump station. No suitable land was available nearer the present pump station. A 16-in. Venturi meter is placed in the raw water force main in order to measure all water delivered to the filter plant.

Devices for Preparing and Applying the Chemical Solution.—An important feature in the design of any rapid filter plant is the apparatus provided to prepare and apply the chemicals in solution. The devices provided at Columbus to introduce the alum comprise a concrete dissolving tank, two solution storage tanks, two solution pumps, a chemical feed regulator, a raw water weir box, and all necessary solution piping.

The chemicals are stored in a room 24 ft. wide by 36 ft. long in which is placed also the mixing tank. Beneath the latter are constructed two reinforced concrete solution storage tanks, each 5 ft. 6 ins. by 6 ft. 4 ins. by 8 ft. deep, containing 2,080 gals. The solution pumps have a capacity of 10 gals. per minute and lift the solution from the tanks into the chemical regulator, located in the pipe gallery near the raw water weir box. An overflow carries the excess of solution back to the storage tanks.

The regulating devices are of the type covered by letters patent owned by the L. M. Booth Company and permit an application of the alum solution in quantities proportional to the discharge of raw water into the coagulating basins. The devices comprise four parabolic weirs located in a weir box into which the raw water is pumped and a float connected by a crank to a slide valve which controls the size of the discharge port in a compartment of the chemical regulator into which the alum solution is pumped from the storage tanks. A constant depth of solution is maintained in this compartment by the overflow mentioned above.

In order to obtain a straight line control, the cross section of the weirs is such that the quantity of water discharged over the weirs and into the basins varies directly with the head of water on the weirs. The float is in a compartment connected to the weir box so that its height varies directly with the height of water on the weirs.

The principal of control, therefore, permits the use of a solution of constant strength so that variations of the quantity of chemicals applied are accomplished by variations in the quantity of alum solution introduced into the raw water. This quantity varies with the size of the discharge opening of the port of the chemical feed regulator which is controlled by the sliding valve and is automatically maintained of a size directly proportional to the quantity of raw water flowing over the weirs.

From the chemical feed regulator, the alum solution flows by gravity into the raw water at the entrance to the coagulating basins.

While it is thought that the purification plant will produce satisfactory results without the use of hypochlorite of lime, devices are provided for using the hypochlorite in the event that it proves necessary, or economical. The devices provided for preparing and applying the hypochlorite in solution comprise two reinforced concrete solution tanks, each holding 480 gals., a chemical solution controlling device, and the necessary solution piping which is of lead. The tanks are located on the floor of the chemical storage room and the solution flows by gravity through the controlling device into the main effluent pipe which conveys the discharge from the filters into the clear well.

Coagulating Basins.—The coagulating basins are two in number, each 106 ft. 8 ins. long, 78 ft 6 ins. wide, with an average available depth of 15 ft. 4 ins. The basins are built of reinforced concrete and are uncovered. The total capacity of the two basins is 955,000 gals., equivalent to 5.7 hours' treatment on the basis of 4,000,000 gals. daily capacity.

Each basin is divided longitudinally by a reinforced concrete baffle into two equal compartments so that the length of flow through each basin is 213 ft. Consequently, the maximum velocity of flow through the basin is 0.6 ft. per minute. Even if complete displacement is not obtained, the velocity of flow through the basins should never be excessive.

The basins are designed to operate semi-continuously and there is provided a sludge disposal system in each of the first compartments to provide for the removal of sludge without emptying the basins. Each sludge disposal system is divided into two sections and comprises 6 lines of 4-in. double strength soil pipe drilled with ⅝-in. holes 30 ins. apart. Each of the four sections discharges through an 8-in. pipe controlled by an 8-in. quick-opening valve, located in the pipe gallery of the filter house.

It is thought that the sludge disposal system will remove the bulk of the sludge which will accumulate in the first compartment of the basins and will permit less frequent cleaning of the tanks. They should also secure a higher efficiency of bacterial removal by the plant than is possible without some such device for the daily removal of sludge and bacteria which otherwise would accumulate in the basins and carry over into the filters.

For the further removal of sludge and for the complete emptying of the basins, there are provided four 8-in. inlets into a 12-in. main drain.

The inlet to each basin is a 16-in. cast iron pipe leading from the raw water weir box to the center of the first compartment and controlled by a gate valve located in the pipe gallery. Each basin discharges at the top through 15 4-in. round openings extending across the entire section of the compartment and leading into a reinforced concrete trough in the pipe gallery. A 16-in. pipe with four 12-in. branches carries the treated water to the filters.

Filters.—The filters are four in number, each 29 ft. 9 ins. by 20 ft. 10 ins. by 10 ft. 6 ins. deep. The tanks were built monolithically of reinforced concrete. Each is divided into two sections by a central gutter 18 ins. wide. Each filter has a total sand area of 350 sq. ft. and a nominal capacity of 1,035,000 gals. when operated at a rate of 125,000,000 gals. per acre daily.

Probably the most important feature in the design of any rapid filter is the method provided for washing. The principal adopted at Columbus is that developed by Mr. Ellms at Cincinnati and is based on an upward flow of wash water at a rate of 24 ins. rise per minute. No agitation other than the high rate of washing is provided.

The strainer systems comprise concrete channels 12 ins. apart covered with perforated brass plates and are of a design similar to that developed at Cincinnati except that the concrete channels extend laterally instead of longitudinally across the tanks. Beneath the central gutter of each filter is a main effluent channel of reinforced concrete 18 ins. square and the discharge from this main channel is through 42 2-in. wrought iron nipples extending into each channel of the strainer system. This arrangement is similar to that used in the filter plant at Niles, Ohio, which was described in ENGINEERING & CONTRACTING of October 23, 1912, and provides a very good distribution of the wash water principally because there is a considerable loss of head both at the 2-in. nipples and also at the openings in the strainer plants. The latter are perforated with 48 3/32-in. round holes per lineal foot. It will be noted that the entire strainer system is accessible and of permanent construction.

For the removal of the dirty wash water there are provided in each filter four lateral gutters each with a total depth of 17 ins. and a width of 10 ins. A feature of design that was developed at Niles, Ohio, is the use of notches, or weirs, in the gutters which are built of reinforced concrete. This arrangement permits, first, a better construction of the gutters because slight differences in elevation of the weirs produce but little variations in the amount of wash water removed and, again, the weirs permit a measurement of the rate of application of the wash water. The weirs are of such a depth and length that they will remove when flowing full just the proper quantity of wash water. This feature is of importance because no controlling device other than hand operated valves is provided in the wash water lines, and because the pressure of wash water available is sufficient to damage the filters if applied carelessly.

Another feature of a somewhat unusual design adopted by the speaker at Niles, Ohio, is the use of a considerable depth of filter gravel of large size. The total depth of gravel provided is 18 ins. and the lower layer comprises 10 ins. of gravel ranging in size from 3 ins. to 1½ ins.; upon this is placed 4 ins. of gravel from 1½ ins. to 1 in., 3 ins. of gravel from ½ in. to ¼ in. and 1 in. of gravel from ¼ in. to ½ in. The more usual design with the high rate of washing requires the use of a less depth of gravel, of considerably smaller size, and fastening down by a wire screen. This method is believed to be objectionable because it introduces an unnecessary loss of head and is expensive; moreover, the use of the screen is covered by patents and can be adopted only on payment of royalty. Experience at Niles, Ohio, indicates no displacement of the gravel even when the wash water is applied at high rates.

Above the gravel is placed the filter sand which is 30 ins. deep and which is to have an effective size of from 0.32 to 0.38 mm. Its uniformity coefficient is to be less than 1.6.

In order to furnish the required quantity of wash water, there is provided a 60,000-gal. steel tank and tower supplied by a 2-in. connection to a 4-in. main of the distribution system. The bottom of the tank is 18.4 ft. above the gutters in the filters. The tank is of the so-called "railroad" type with an elliptical bottom and a 4-in. riser pipe. In order to maintain a constant depth of water in the tank and to prevent its overflow, an automatic altitude-controlling valve, manufactured by the Golden-Anderson Valve Specialty Company, is provided in the 2-in. supply line.

An indicating and recording loss of head gage and rate controller are provided for each filter. The valves controlling the filters are hand-operated with indicator floor stands and are constructed with double-pitch screws for quick opening. They are thought to be much more satisfactory than hydraulically operated valves for medium sized plants and are much cheaper.

Clear Well.—The clear well is constructed beside the coagulating basins and is a rectangular reinforced concrete tank covered with a concrete slab roof. It is 110 ft. 3 ins. long by 47 ft. wide and has an available depth of 14 ft. Its total capacity is 534,000 gals. and in order to make the entire storage available, the inlet to the discharge pipe is placed in a sump 4 ft. by 3 ft. deep. When the plant is operated at full capacity the period of storage available in the clear well is 3.5 hours, and the elevation of high water in the clear well is such that there is a minimum available head of 9 ft. on the filters.

Filtered water is conveyed from the clear well to the present pumping station through a 20-in. cast iron suction line, approximately 470 ft. long, constructed at large expense, because the trench is for a considerable distance over 20 ft. deep.

COST OF CONSTRUCTION OF PURIFICATION PLANT.

The contract for the filter plant was awarded in July, 1912, to the Roberts Filter Mfg. Co. of Philadelphia, Pa., which sublet the concrete work to the Nicola Building Company of Pittsburgh. In the following table are shown the costs of the several items comprising the work:

1. Coagulating basins, filters, pipe gallery, chemical laboratory, and office building, filter building together with all necessary inside pipes, valves, etc..	$38,454
2. Clear Well, complete....................	6,600
3. All outside cast iron and tile pipe lines, including raw water force main, high service suction, main wash water line, and all drains....................	7,700
4. 60,000 gal. steel tank and tower furnished and erected by the Chicago Bridge & Iron Works..............	2,150
5. Raw water pump house, including foundations and erection of the raw water pumps and changes in present suction lines	2,713
Total contract price........................	$57,617

The raw water pumps, which have a capacity of 4,000,000 gals. daily against a maximum lift of 55 ft., were furnished by the Dravo-Doyle Company of Cleveland, Ohio. The motor-driven pump has a guaranteed combined efficiency of 65.5 per cent and cost $940. The steam turbine-driven pump has a guaranteed duty of 36,500,000 ft.-lbs. when operated non-condensing, and of 64,600,000 ft.-lbs. when operating condensing, and cost $1,228.

The plant was designed by Mr. Philip Burgess, Consulting Engineer of Columbus, Ohio, and has been constructed under the immediate direction of William H. Rights, City Engineer of Columbus as resident engineer, and of Mr. Burgess as consulting engineer.

The Suitability of Internal Combustion Engines for Service in Small Water Works Plants.

Contributed by George A. Main, M. E., Superintendent of Water Works, Daytona, Florida.

It is within the last few years only that there has existed occasion to raise a question as to the form of power to be employed for pumping at water works under contemplated construction. Where a city was not so fortunate as to possess a gravity supply, steam was considered the only available power reliable enough to be entrusted with the important task of providing fire protection and water for domestic use. But now the internal combustion engine has arrived, and arrived to stay, and city and town councils, designers of water supply enterprises, and others upon whom the duty of choosing the source of power to be used in the new enterprise devolves, are being continually called upon to decide as to the form of power to be used in the proposed plant. Indeed, so rapid have been the strides in the field of the internal combustion engine, that having once chosen this as the form of power it is still no small task to choose from this large field the kind of fuel and style of machine best adapted to the requirements of the plant in question.

In this article the writer will not attempt to give exact figures covering the relative costs of the several methods of pumping water.

Cost of fuels and other local conditions vary too much to make this feasible. It is the purpose of this article rather to suggest the line of thought which followed out may assist in wisely choosing for the plant in question and incidentally to chronicle the experiences of Daytona, Florida, as her experiences bear on the topic.

It is the writer's belief that few water works systems have been designed to more closely fit the particular conditions under which they are to operate than the water works of the City of Daytona. This water works system was designed by and constructed in 1909 under the superintendency of Clarence M. Rogers, of the firm of D. D. & C. M. Rogers, Civil Engineers. The pumping and power units were constructed in duplicate and consist of two 50-hp. internal combustion engines direct connected by friction clutches to two triplex pumps.

Assuming that steam is still the proper power for plants which are of such magnitude as to require practically continuous pumping, although this is bidding fair to become a debatable question, then the problem discussed in this paper may be simply stated in the question as to the size of water works below which it is most economical to use the internal combustion engine and above which it is better to employ steam. Or, from the consumer's point of view, what is the daily consumption above which it is better to pump by steam and below which it is more feasible to employ the internal combustion engine?

When the Daytona water works was installed it was generally conceded that it was constructed chiefly for fire protection for the city.

Even at that time the internal combustion engine had demonstrated its reliability for such uses. Of the 600 or so buildings within the limits of the original water distributing system, virtually all were supplied with miniature water works. A small flowing well, a small ram, an elevated tank, and the requisite piping were all the equipment required to supply the building with an abundance of *hard* water. An artesian well with a static head of about 12 ft. above the ground is procurable at a very small cost and nearly every one had a flowing well either with or without the tank. With water so easily procurable, little patronage for the proposed water works from private parties was anticipated and the requirements of the underwriters determined the size and capacity of the pumping units.

In purchasing a commodity, two things ordinarily influence one's choice of market viz., quality and price. Quality, when referred to city water, may be a function both of analyses and pressure.

The pressure on the city mains was considerably better than that from house tanks and far better than from the flowing wells direct. Furthermore, the city water is chemically treated for the elimination of the hardness, the obnoxious gases, and other impurities found in the raw water. So as far as quality was to be considered, the city water had the decided advantage. The annual cost of the city water is less than the usual interest and depreciation on the house outfits so common at that time, no one is required to purchase more water than he wishes, and faster than rams, tanks, etc., are giving out the houses have connected with the city mains until now the monthly pumpage in gallons is several million. This consumption of course includes that used by 40 or more hotels located in Daytona, a famous and popular winter resort.

This consumption is on the steady increase. New services are steadily going in. Early patrons are now using the city water exclusively where at first it was used only as a part of the supply. And yet it will be a long time before we will pump so near continually as to again raise the question as to the wisdom of the internal combustion engine power for this plant. Following is the approximate daily routine:

The elevated tank holds 75,000 gals. The first thing in the morning the tank is filled, the pumping lasting about one and a half hours. By nine o'clock in the forenoon, the all-round-man, engineer, tapper, etc., has the pumping done and can devote his time until the next pumping time on street or other work. Here is one of the keynotes of the advantages of the internal combustion engine over the outfit requiring constant attention to maintain steam, or possibly also constant attention in the engine room, as may be the case where no elevated tank is used.

Shortly after the noon hour a second pumping is done. The balance of the working day may then be devoted to connections, etc. A final pumping before retiring leaves a full tank for the night.

The chief object in noting the above approximate daily routine is to emphasize the economy of labor possible with the internal combustion outfit which would not have been possible with the steam outfit. There is, however, another feature of the intermittent pumping which makes it particularly adapted to this plant. Our purifying plant is an intermittent one and is operated by the same power and at the same time as the pumps. While this would not be an argument in all cities, water purification plants for city water supplies are rapidly gaining in favor and it is worth considering in connection with the design of the plant.

Softening plants having a capacity of much less than 300,000 gals. per day have been made of the so-called continuous type, and still it seems to be pretty well recognized that for these small plants the intermittent type of softener gives fully as good if not better results than the continuous. Certainly the intermittent type fitted our conditions the better.

In handling the softening plant with the pumps, the plan of procedure is as follows: the pump is first started, and then the lime and soda are weighed out and mixed for the reservoir, then filled with raw hard water. An air compressor driven by the same engine that drives the pump is made to agitate the hard water and chemicals for about 45 minutes. Pumping almost always lasts longer than this, which fact allows the softener to work without any additional outlay for labor in consequence thereof. Sludge removal and other items of course require some time, but the softening operation and the pumping operation are done simultaneously, with a consequent very decided economy in operation.

The internal combustion engine has long since passed the experimental stage. The first cost of this type of motor is very attractive and depreciation is not rapid. Attention required is so small that other work can be carried on by the attendant during pumping. The time intervening between pumpings may be devoted to tapping street mains or other more or less distant work, and in case of a fire the engineer can reach the plant and provide increased direct pressure in as short a space of time as the average fire department can get to the scene of the conflagration and in readiness to use water. The size of water works which can feasibly employ the internal combustion engine is increasing as advance is made in the design of these machines, and time spent in careful investigation of their possibilities in the case of water works in embryo will be time well spent.

A Discussion of the Problems Connected with the Effort to Establish Standards for the Hygienic Purity of Public Water Supplies.

For several years those who are interested in testing and in purifying water have been considering the desirability and the possibility of adopting standards of hygienic purity for public water supplies. Within the general problem stated there are, of course, two large problems, namely, the adoption of standard tests, and the selection and standardization of methods for making such tests. The whole matter was discussed in a very interesting manner by Mr. Joseph W. Ellms, Consulting Engineer of Cincinnati, O., in a paper read on Feb. 26, 1913, before the Indiana Sanitary and Water Supply Association. The paper, in full, follows:

In 1905 there was issued by the American Public Health Association a "Report of a Committee on Standard Methods of Water Analysis." This report was the outcome of efforts begun as early as 1894 to secure uniform and efficient methods for water analysis; and was the immediate result of the labors of some of the active workers of that time in the chemistry and bacteriology of water and sewage. The writer was privileged to be a member of that Committee, and mentions it because of his personal knowledge of the attitude of the members toward the subject of standards in general, and for the reason that certain instructive comparisons may be drawn between the conditions existing then and now. The following quotation from the Committee's letter of transmittal accompanying this report will serve to show their attitude:

> It is said by some that standard methods within the field of applied science tend to stifle investigation, and that they retard true progress. If such standards are used in the proper spirit this ought not to be so. The committee strongly desires that every effort shall be continued to improve the technique of water analysis, and especially to compare current methods with those herein recommended, where different, so that the results obtained may become still more accurate and reliable than they are at present. . . . The methods of analysis presented in this report as "standard methods" are believed to represent the best current practice of American water analysts, and to be generally applicable in connection with the ordinary problems of water purification, sewage disposal and sanitary investigations. Analysts working on widely different problems manifestly cannot use methods which are identical and special problems obviously require the methods best adapted to them; but, while recognizing these facts, it yet remains true that sound progress in analytical work will advance in proportion to the general adoption of methods which are reliable, uniform and adequate.

The rapid advance of sanitary science in the past ten years has made available a large amount of knowledge which we are using with marvelous effect in the practical problems of sanitation. Bacteriology in particular has enabled us to deal effectively with many diseases, because we now know their origin and the manner in which they become disseminated. The remarkable results obtained by the purification of many public water supplies in the diminution of water borne diseases is a good example of the aid sanitary science has been to dealing with a practical problem intimately related to our every day life.

The improvement in bacteriological technique did not stand still, as some feared it might, because of the adoption of uniform methods of examination. In point of fact the effect has been rather to stimulate research by subjecting all new methods to rigid comparisons with the adopted methods. The latter have been regarded more as the best available, but only tentative standards of measure that we possessed, and ones which by common consent would be quickly dropped, provided a better standard could be found. Five years after the adoption of these "standard methods" a revised set of methods was issued by a second committee of the American Public Health Association. These revised methods, like the first suggested, will have to bear the test of time, and in due season will be revised again to bring them to the forefront of analytical practice.

It is evident that unless there are fairly accurate methods of measurement for the purity of a drinking water, and that unless these methods are reasonably uniform, the results obtained will only lead to confusion and bitter disputes. The question, therefore, resolves itself into this form: Are our modern standard bacteriological methods sufficiently reliable to properly measure the hygienic purity of a water? It is difficult to answer this question without qualifications. Without hesitation one may say, that as we can only find specific disease germs in natural waters with a great deal of difficulty, and that if found a knowledge of their number and virulency are of prime importance before the water can be absolutely condemned, it does not appear that our methods are as yet entirely adequate. On the other hand the circumstantial evidence easily and readily obtained by examining the water for the presence of organisms which may be and usually are associated with disease germs, would lead one to declare that some of our methods at least were quite sufficient to establish the degree of impurity which might exist.

Quite apart from bacteriological methods of examination we know by observation that settlement, filtration or disinfection of public water supplies lead to a reduction in certain diseases which appear to be derived from drinking polluted water. Indirectly, therefore, it becomes possible to establish a relation between the bacterial content of such waters before and after any method of purification. A polluted water which has had 99 per cent of the bacterial life removed from it, can be reasonably agreed upon as safe under most conditions. But whether that water shall not contain more than 100 bacteria per cubic centimeter after purification, or whether it shall not have more than 5 per cent of one cubic centimeter samples giving evidence of the presence of the Bacillus coli, to be considered hygienically safe, is a matter upon which "doctors are likely to disagree."

It seems to the writer that if this subject of standards of purity is investigated in an open frame of mind, and with the same spirit of impartiality that the subject of standard methods of analysis was approached, it will be possible to establish tentative standards of purity. These standards will of necessity be subject to modification by local conditions, and may have to be frequently revised. If it is kept in mind that a drinking water is hygienically pure when it does not produce disease nor disturb in any way the normal physiological processes of those who drink it, it will not be difficult to agree upon what shall constitute the safe limits of bacterial and chemical purity.

Standards of purity for public water supplies will have little value unless some central authority has power to enforce them upon backward and reluctant communities. Some of our States have vested considerable authority in matters pertaining to water supplies and sewage disposal in their State Boards of Health. Where such authority is properly exercised and subject to review by legally appointed scientific experts, the best of results may be obtained, i. e., an ignorant or parsimonious community could be protected against its own disregard of sanitary laws. There is a broad field for the exercise of the national government's authority in matters relating to the pollution of interstate and international waters, which may be used as sources of public water supply. If the now scattered bureaus of the national government, which pertain to public health, were consolidated in a National Department of Health much might be done toward establishing standards of purity for public water supplies, even though the national government was unable to supervise supplies exclusively within the jurisdiction of the States.

The writer believes that the angle from which the subject of standards of purity is viewed is of fundamental importance for a practical solution of the problem, and has endeavored to set forth this phase of the matter, instead of attempting to state what such standards should be. The whole question is one which is intimately related to the extent of permissible pollution of natural waters, and must be considered in connection with it. By what method these problems shall be attacked is perhaps open to question; but the writer would suggest that it may be gotten underway by the appointment of delegates from each of our large engineering societies, water works and sanitary associations, who shall meet to formulate a plan of procedure. These delegates may work in conjunction with any existing committees now in the field, or with any State or United States departments which have already given this matter some attention.

Some of the points which such a body should discuss are as follows:

1. What diseases may be legitimately regarded as water borne?

This involves a consideration of the Mills-Reincke phenomenon and the Hazen theorem as set forth by Prof. W. T. Sedgwick and Mr. J. S. MacNutt and the ideas of chronic intestinal tract infection advanced by Messrs. N. S. Hill, Jr., and L. R. Whitcomb. It means a careful analysis of all the available and reliable vital statistics of those communities having impure water supplies as well as those having pure supplies.

2. A clear definition of what really constitutes a pure drinking water.

This means that much light is needed upon the relative numbers and kinds of bacteria, and of the nature and amount of the organic and inorganic matter which may be present in public water supplies, and their significance in the causation of disease. It necessitates the examination of the available bacteriological and chemical data of public water supplies, and its classification in relation to vital statistics.

3. The selection of the maximum limits for the numbers and kinds of bacteria in a drinking water, and the permissible amounts of organic and inorganic matter which such a water may contain.

This selection of course will be the result of the logical conclusions reached from a study of the compiled statistics, and should be adopted only after a careful consideration and free discussion of the evidence.

A Discussion of Water Works Accounting with a Suggested System of Accounts.

It is generally admitted that many water department officials are deceiving themselves as to the financial condition of the water systems of which they have charge. This error comes about as a result of faulty bookkeeping. In some departments the bookkeeping shows that the plant is operating at a profit when, as a matter of fact, if some of the items of expense were included which should be included in the costs chargeable against the property, the plant would be shown to be operating at a loss. All sources of financial leaks are not brought to light unless the system of accounts in force is comprehensive and complete. Good accounting is the starting point of efficient water works management. In a paper before the Indiana Sanitary and Water Supply Association, read on Feb. 25, 1913, Mr. G. S. Olive, Public Accountant of Indianapolis, discussed the general scope of water works accounting and suggested a system for keeping water department accounts. Mr. Olive's paper is here published in full.

In view of the expected enactment, by the General Assembly of Indiana, of a law creating a Public Service Commission for this State,—which Commission will bring under its supervision, along with other public utilities, all water works of the State, whether privately-owned or municipally-owned,—the accounting of water works should be particularly interesting to water works managers, just at this time.

This paper might very well be devoted to an exposition of one of the various circulars issued by public service commissions of other states, or to the report of the committee on Uniform Annual Reports and Accounts of the American Water Works Association, made at the Rochester Convention of the Association in 1911, of which committee Mr. Dow R. Gwinn of this association was a member. This report is an admirable one, based on the best accounting principles, and should be adopted by the various associations auxiliary to the American Water Works Association. Using it as a basis, the accounts of any water works can be kept in such a way that at any stated time the manager may prepare a statement of the Assets and Liabilities of his plant,—with the proprietary interest, whether this proprietary interest is vested in the public or in a person, firm or corporation. This statement of financial conditions of the plant is the Balance Sheet, so called from the fact that the item of proprietary interest is always equal to the excess of assets over the liabilities, the assets therefore balancing the other two items. At the end of any period this item of proprietary interest will reflect the earnings or loss on the operation of the plant during that period, the Balance Sheet showing therefore not only the present financial condition of the plant, but also the results of operating during the last financial period.

The definitions of these three balance sheet items given in the report of the committee of the American Association are as follows:

> Assets—The assets of a water supply system are the properties or wealth in its possession or at its disposal, including rights or actions, franchises and good will or going value.
>
> Liabilities—The liabilities of a water supply system are the amounts of money or money's

worth which it is under legal obligation to pay, deliver or render to others.

Proprietary Interests—The proprietary interests in a water supply system are the property rights or equity of its stockholders or others who constitute the owners or proprietors of the business in the assets or wealth belonging to or employed in or by the business enterprise. These interests are always equal to the excess of the value of the assets over the amount of liabilities.

The reports required by the public service commissions operating in other states are usually based on the balance sheet and the earnings statement for the period covered by the report,—with supporting statements subsidiary thereto. The balance sheet and the earnings statement are the essential parts of any such reports.

Section 15 of the "Shively Spencer Utility Commission Act" provides that the commission shall prescribe the forms of all books, accounts, papers and records required to be kept,—and every public utility is required to keep and render its books, accounts, papers and records accurately and faithfully in the manner and form prescribed by the commission relating to such books, accounts, papers and records.

With such power,—the authority of the Utility Commission over the accounts of all water works will be unlimited. If the commission follows the procedure of those of other states, it will prepare for each class of utilities directions covering the keeping of all accounts and for the preparation of all required reports. It is very desirable that the commission of this state follow, in the case of water utilities, the scheme of uniform accounts given in the report already mentioned. This scheme was the result not only of the work of the committee of the American Water Works Association, but of the efforts of representatives of the U. S. Bureau of the Census, the New England Water Works Association, the American Association of Public Accountants, and the Association of American Government Accountants. It was the outcome of the movement started in 1885 by the adoption by the New England Water Works Association of its form for annual reports, which form has been used by many privately-owned and publicly-owned plants since that time. The scheme of accounts follows in general the regulations prepared by Public Service Commissions of Wisconsin and other states and presents the accounts in such a way as to be applicable to the smallest and to the largest water plants.

Leaving out reference to the account numbers, which are worked out very logically by the Dewey Decimal Method, the essential accounts, arranged as they would be in the balance sheet of a small plant, are as follows:

ASSETS.

Fixed assets and funds.
Current and nominal assets.

LIABILITIES AND PROPRIETARY INTERESTS.

Liabilities.
Proprietary interest.
  Being equity of owners in plant and addition or deduction of excess or shortage of revenue as compared with operating, maintenance and general expense—that is the profit or loss for the period.

The gospel of good accounting has spread so far and opinion has so far crystallized in the past ten years that, with reference to the accounts to be kept, there is now little difference of opinion. The points on which accountants differ today are concerned with the methods of keeping these accounts rather than with what accounts are to be kept.

The four principal books of account for any water works should be the General Ledger, the General Journal, the General Cash Book and the Accounts Payable or Vouchers Payable Journal. The last two books are subsidiary to the first, and the General Journal is the book of original entry for all items not handled originally through the General Cash Book or the Accounts Payable Book. Whatever customers' accounts are kept are also subsidiary to the General Ledger. The General Ledger is the controlling book. In it appear the accounts showing fixed assets and liabilities and a summary of the current assets and of the various revenue and expense accounts, the elements of profit or loss, which added to the net investment in the plant, gives the proprietary interest. The General Ledger should not be a book for details. It should be kept so that at the end of the month, quarter or other period, the vitally important balance sheet, the statement of assets, liabilities, net investment and earnings can be taken from it with the least trouble and in the shortest time. The details of revenue and expense which go to make up the earnings statement can be worked out later; such details call for an analysis of the summarized figures placed on the General Ledger and there is no need holding up the results of operating until it is possible to explain every why and wherefore leading to this result. The writer has personal knowledge of utilities which can present their balance sheets and earnings statements for any month by the fourth day of the following month, and others where it is an absolute impossibility to get these statements until six or seven weeks after the end of the month,—the difference being due entirely to the fact that in the second case the General Ledger is littered with detailed accounts. It seems at times as though managers or accountants think they are beating up a dust of secrecy or impenetrability by such methods, but they are really fooling no one but themselves.

Good accounting should contemplate arranging the records in such a way that they will yield the desired information in the shortest time and with the least trouble.

The accounts given in the balance sheet already shown are the essential accounts to be kept in the General Ledger. These essential accounts may be analyzed and kept in just as much detail as circumstances warrant. Thus the accounts kept in more detail might be as follows:

ASSETS.

Fixed assets and funds.
  Tangible assets.
    Collection system (reservoirs, wells, etc.)
    Purification system.
    Pumping system.
    Distribution System.
    Miscellaneous properties.
  Intangible assets.
    Franchises.
    Going value.
Funds.
  Sinking funds.
  Depreciation funds.
Current and nominal assets.
  Cash.
  Investments.
  Accounts receivable.
  Prepaid accounts.
  Materials and supplies.

LIABILITIES AND PROPRIETARY INTERESTS.

Liabilities.
  Funded debt.
  Customers' deposits.
  Notes payable.
  Accounts payable.
  Accrued interest.
  Accrued tax.
  Reserve for unearned income.
Proprietary interests.
  Capital stock.
  Reserves.
    Depreciation.
    Amortization.
    Bad debts.
  Surplus and undivided profits.

In addition to these balance sheet accounts, the only ones to be kept are the revenue and expense accounts, which accounts show the earnings of the plant and which are closed off at the end of any period through the profit and loss account, into the balance sheet account, "Surplus and Undivided Profit." These accounts are as follows:

Water service revenue.
  Rates for metered water.
  Rates for unmetered water.
  Rates for municipal service.
  Miscellaneous water revenue.
Miscellaneous revenue.
  Rents.
  Interest and discounts.
  Profit from merchandise and sundry sales.
General expense.
  Administrative and commercial expense.
Operating expense (operation, maintenance and depreciation).
  Collection system.
  Purification system.
  Pumping system.
  Distribution system.

The amount remaining after deducting from the total Revenue the General Expense and Operating Expense is the Net Operating Revenue, which may show up either as a profit or as a deficit. From this Net Operating Revenue the fixed charges must be deducted. The fixed charges are Taxes and Interest on Funded Debts, to which should be added in individual cases such items as Sinking Fund or Amortization Reserve charges. The amount remaining after the deduction of the fixed charges is Net Earnings or Deficit and goes as a credit or charge as the case may be to Surplus and Undivided Profit. The accounts given above are meant to be only typical accounts. They cannot, of course, cover the needs of every individual plant. The revenue and expense accounts should cover every current asset and liability;—otherwise,—the net profit or deficit does not show what it is expected to show, the actual result of the operation of the plant.

The fixed charges are ordinarily handled through the general journal direct to the general ledger accounts. The Interest on Funded Debt Account and the Tax Account should be charged, and the Accrued Interest and Accrued Tax account credited monthly with that period's proportion of the annual amount due. The practice with reference to revenue is comparatively uniform. The detailed accounts are kept in the Customers Ledgers and only the totals of the monthly charges and credits posted monthly to customers controlling accounts in the general ledger. The credits are made through the General Cash Book, charging the Cash Account, and the charges, through the General Journal, crediting the Revenue Accounts.

The keeping of the expense side of the accounts is the best field for missionary work in the entire realm of water works accounts. Most managers will agree, I believe, that the revenue will ordinarily take care of itself. A water works plant which does not show a gradual upward trend to its revenue curve is, to say the least, unusual. The expense, on the other hand, needs the most careful watching. Not only the details of the expense need watching, but those details need to be gathered together in such a form that the total expense of the entire plant, as well as of its component parts, can be observed by the manager. It has been the tendency in the past to watch the details without paying much attention to the tendency of the entire costs; the superintendents have taken so much time to watch individual invoices for materials purchased that they have lost sight of the aggregate amount. It should be a first principle in all water works accounting that no cost information should be made up unless it be from an analysis of the general book figures. Accounts or statements made up from any other source are absolutely unreliable.

All liabilities incurred by the plant for General or Operating expense should go to the General Ledger through the Vouchers Payable Journal. The pay rolls, or invoices for material purchased, after being O. K.'d by the authorized official, with information on each invoice sufficient to indicate for what use the material was purchased, should be entered on and attached to a voucher payable which includes all the invoices for any month from any one concern and which shows the accounts to which the items are chargeable. These accounts are either expense, betterment or renewal accounts, the betterments being charged to fixed assets and renewals to the reserve for depreciation.

NEWS SECTION

Editorial Comment—Personals—Society Meetings—Trade Notes—Catalog Reviews—Contract News, Embracing Bids Asked, Work Projected, Contracts Let and Contract Prices on All Classes of Civil Engineering Construction Work.

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The Doings of the Week.

A number of fair-sized railroad construction jobs have been placed under contract in the last few days, and a considerable amount of new work is coming up for letting shortly. One of the largest railroad tunnel contracts of the past few years is now being advertised by the Canadian Pacific Ry. The tunnel is included in the contract for clearing and grading the main line division in the Selkirk Mountains from Six Mile Creek to Glacier, 17 miles. The bore is to be double track and 28,000 ft. long. Bids will be opened on April 15. The Soo Ry. also will probably let contracts in the near future for its two North Dakota extensions, and for a 60-mile extension near Cuyuna, Minn. Among the contracts let recently are the following: Curtis & Shumway, Lynchburg, Va., for the construction of double track between Monroe and Amherst, Va., for the Southern Ry.; Oscar J. Pruett, Montgomery, Ala., for constructing 12 miles of railroad from Eclectic to Vincent in Elmore County, Alabama; O'Connell-Wicks Co., Duluth, Minn., short spur track at Palmer, Minn., for the Duluth, South Shore & Atlantic Ry.; Walsh Construction Co., Davenport, Ia., for work at Delmar Junction, Ia., for the Chicago, Milwaukee & St. Paul Ry.; subcontracts for work on the Powder River-Orin Junction line of the Burlington in Wyoming have been let as follows by Twohy Bros., Portland, Ore.: Gilbert Bros., Denver, Colo., 24 miles; Baker Bros. Denver, Colo., 10 miles; J. Coates, Las Animas, Colo., 6 miles; J. Fred Roberts, Denver, Colo., 10 miles; C. R. Conover, Denver, Colo., 6 miles; P. J. King, Denver, Colo., 6 miles.

In the way of bridge work, practically all of the large contracts placed in the last few days are for work in Canada. A contract has been let at St. Johns, N. B., for a bridge superstructure to cost $275,000; City of Fredericton, N. B., has awarded contract for a large bridge; St. Boniface, Man., has done likewise, the latter amounting to $227,600. At Toronto, Ont., plans have been approved for a $200,000 bridge, and at Cleveland, O., plans and specifications are being prepared for a $1,000,000 structure.

Few large contracts for drainage work have come up for advertising since our last issue. Bids on a number of tile drains are now being asked, but aside from these, little new work appears to be open for proposals. The Sanitary District of Chicago is calling for bids on another section of the Calumet-Sag Channel. The contract includes 650,000 cu. yds. excavation of glacial drift, 135,000 cu. yds. solid rock excavation, and 66,000 sq. yds. of rip rap slopes. New irrigation contracts also are few. It is probable that bids on the $5,000,000 Kittitas high line canal in Washington will be asked soon. Another large project which has come up recently calls for a system to provide for water for about 500,000 acres of land in El Dorado and Sacramento Counties, California. The water is to be obtained from the Cosumnes River, and will be utilized by means of the Diamond Ridge ditches, consisting of about 350 miles of mains and laterals. The project will cost about $10,000,000.

Work will be started this summer on raising and strengthening the levee system at Cairo, Ill. The city last week voted $100,000 of bonds for the purpose; other appropriations will provide $400,000.

The city of Philadelphia, Pa., will be enabled to go ahead with extensive plans for the development of its port if the bill reported last week to the State Senate becomes a law. The bill provides that the General Assembly may authorize the state to issue bonds to the amount of $25,000,000 for the purpose of improving and developing the port of the city and county of Philadelphia by the reclamation of land on the banks of the Delaware and Schuylkill Rivers and land adjacent thereto, the building of bulkheads and the construction of wharves, docks, sheds and warehouses and other buildings necessary for the establishment and maintenance of railroad and shipping terminals along the rivers.

A bill was introduced last week in the State Legislature of Missouri to create the office of land reclamation commissioner at an annual salary of $3,000. The bill provides that the duty of the commissioner is to furnish and diffuse information upon land reclamation, levee work, water power and a wide range of kindred subjects. The bill does not require the commissioner to be an engineer or to possess technical knowledge about drainage or land reclamation. The commissioner may under the bill appoint one stenographer and as many engineers or other employes as he deems necessary.

The Public Service Commission for the First District, New York City, has called a public hearing, to be held March 15th, on the terms of a proposed certificate to be issued to the Interborough Rapid Transit Co., granting the rights to construct and operate third tracks on the Second, Third and Ninth Avenue elevated railroads in Manhattan and The Bronx. The provision of these third tracks is a part of the plan underlying the Dual System of rapid transit, for which the city is preparing to enter into contracts with the Interborough Rapid Transit Company and the New York Municipal Railway Corporation (Brooklyn Rapid Transit). The Commission originally prepared a certificate conveying such rights to the Manhattan Railway Company, which is the owner of the elevated railroads which are operated under a 999-year lease by the Interborough Company. Recently the Manhattan Company objected to the terms of the certificate and refused to accept it. Thereupon the Commission determined to make out the certificate to the lessee, namely, the Interborough Company, and did so.

John R. Price.

Few men have had as extended experience in the railroad construction field as the late John R. Price, of Turon, Kan. He began his career at a time when the pick, the shovel, the scraper, the barrow and the cart were the principal earth moving implements; when hand drilling and black powder were the only means for moving rock. His first railroad work was in 1849, at which time he was superintendent of construction for the Merthys & Abergavenny R. R. in South Wales. He came to America in 1866 from Wales, and six years later began his railroad constructing in this country, his first contract being at Oskaloosa, Ia., for the Morris Valley Line. He was actively engaged as a contractor for 39 years, during which period he is said to have had part in the building of fully 3,000 miles of railroad in the United States, Mexico and Canada. He built a considerable portion of the Atchison, Topeka & Santa Fe Ry., including the A. & P. line through New Mexico and Arizona; the line from Arkansas City through Oklahoma to Texas; 60 miles of the main line to Chicago, and several branches in Kansas, including the line between Independence and Wallington, the Kiowa branch, the line from Florence to Lyons, and the Kinsley cut-off. He also constructed considerable portions of the Iowa Central, Rock Island, Chicago & Alton and St. Louis & Omaha Rys. His firm built the Rock Island into Colorado Springs, constructed sections of the Colorado & Midland and built the carriage road to the top of Pike's Peak. In Mexico he constructed a line from San Luis Potosi to Tampico for the Mexican Central and another from Venandito to Tampico. His last railroad construction work was in Kansas, where he built the line from Osage City to Ottawa as a private proposition, later selling it to the Santa Fe system. He retired from active railway work two years ago, and since that time has been personally managing a large ranch in Reno County, Kan., and operating a flour mill at Turon. He died Feb. 25, at Turon, aged 84 years.

Railroad Construction in Vermont.

Railroad construction prospects in New England are beginning to show signs of life again, and the owner of the only resident steam shovel in the State of Vermont, has commenced to dust off his machine. The Grand Trunk Ry., through a subsidiary company, the Southern Vermont Ry. has filed its maps for a line from Windsor, Vt., to Brattleboro, Vt., while the Boston & Maine R. R., has obtained permission from the Vermont legislature for the construction of two connecting links for its Connecticut River Valley line. One of these is to extend from Windsor to White River Junction; the other from Brattleboro to South Vernon. By the building of the two links the Boston & Maine will avoid using the rails of its hated rival, the Grand Trunk, between the points mentioned; the new line of the latter railway is to be to avoid using the B. & M. tracks. The two roads at present have an agreement for the joint use of the existing track; this can be abrogated by either company when the arrangement proves unsatisfactory. It may be stated on good authority that the Grand Trunk will probably begin construction work this year. Should this happen it will naturally cause the Boston & Maine to start work itself. The new line from Windsor to Brattleboro will be about 50 miles long, while the two links will aggregate possibly 25 miles. No difficult construction will be involved and about the only interesting feature of the work is that it will enable the State of Vermont for the first time in many years to break into the mileage statistics of new railway construction in this country.

PERSONAL

Mr. Alfred W. Dickerson, civil engineer, of Richmond, Va., died Feb. 25, aged 59.

Mr. E. B. Van de Greyn has been appointed chief consulting engineer for the city of Denver, Colo.

Mr. E. M. Bigelow has been reappointed as state highway commissioner for the state of Pennsylvania.

Mr. A. E. Robinson has resigned his office of state engineer of Idaho, his resignation taking effect March 1.

Mr. E. L. Van Epps, formerly city engineer of Olympia, Wash., has opened an office in that city for consulting practice.

Mr. S. J. Van Ornum, formerly city engineer of Pasadena, Cal., has opened an office for consulting practice in the Pacific Bldg., San Francisco.

Dean W. G. Raymond of Iowa City, Ia., was elected president of the Iowa Engineering Society, and Mr. J. H. Mayne of Council Bluffs, vice-president.

Mr. V. B. Chapin, who recently resigned the office of county surveyor of Roseau County, Minnesota, has been appointed state highway engineer of Minnesota.

Mr. Julian Kendrick has resigned as chief engineer of the Rudolph S. Blome Co. of Chicago, and has opened an office for consulting practice in the First National Bank building, Birmingham, Ala.

Mr. C. A. Crane, Secretary of the General Contractors' Association, New York City, on Feb. 24 delivered an illustrated lecture on "Proposals, Contracts and Bonds from the Standpoint of the Contractor," before the graduate students in highway engineering at Columbia University.

Prof. Arthur H. Blanchard, consulting highway engineer, Board of Water Supply, New York City, and professor of highway engineering at Columbia University, gave an illustrated lecture entitled "The Highways of Europe," before the Municipal Engineers of the City of New York.

Mr. Percival Lancaster has been appointed city engineer and architect of Belleville, Ont., and also manager of the Belleville waterworks, succeeding Mr. James G. Lindsay, who recently resigned. Mr. Lancaster was formerly construction engineer for the Canadian Pacific on the Hastings Division.

Mr. Isham Randolph of Chicago and Mr. Charles P. Steinmetz of Schenectady, N. Y., have received the Elliott Cressen gold medals for distinguished achievement in the engineering field. These medals are awarded for notable work done in art, science and mechanics, and are the highest honors in the gift of the Franklin Institute of Philadelphia.

Mr. M. C. Byers, chief engineer of operation for the Frisco System, has resigned to go to St. Paul as assistant to President Carl R. Gray of the Great Northern. Mr. F. G. Jonah, at present chief engineer of construction of the Frisco, will assume the dual duties of chief engineer of construction and of operation, with headquarters at St. Louis.

Mr. Frank M. Williams, formerly state Engineer of New York, has been appointed to the position of chief engineer in charge of construction of about $1,000,000 worth of highways in Portage County, for Daniel R. Hanna of Cleveland, whose company is doing the work. Mr. Williams is also vice-president and chief engineer of the Coleman du Pont Road, Inc., in the state of Delaware, a $2,000,000 undertaking, across the state.

Mr. Charles H. Lee, formerly assistant engineer on the Los Angeles aqueduct, has opened an office in the Union Oil building, Los Angeles, for hydraulic engineering practice. Mr. Lee formerly had charge of extensive water supply investigations in Owens Valley, including a study of underground water conditions in co-operation with the U. S. Geological Survey. He later carried on other underground water investigations for the State Conservation Commission of California and for various water companies, and served as hydraulic engineer for the Cuyamaca Water Co., of San Diego.

Civil Service Examinations.

The United States Civil Service Commission announces examinations as follows:

Senior Highway Engineer, $2,000 to $2,400 per year, March 10.

Civil Engineer, student, office of Public Roads, Department of Agriculture, $720 per year, April 9.

INDUSTRIAL

Manning, Maxwell & Moore, 85-87-89 Liberty St., New York City, have taken on the agency for the Chain Belt Mixer, concrete elevator spouts, and other concrete machinery manufactured by the Chain Belt Co., Milwaukee, Wis.

A contract for standard Raymond concrete piles to support the reinforced concrete arch over Gallagher's Gulch, Tacoma, Wash., has been awarded to the Raymond Concrete Pile Co., through its northwest office at Portland, Ore. Mr. W. C. Raleigh is City Engineer of Tacoma.

Lockwood, Greene & Co., architects and engineers for industrial plants, 60 Federal St., Boston, Mass., announce the opening of a New York office at 320 Fifth Ave. The New York representatives will be Frank A. Wing and John M. Toucey. The opening of this office in the metropolis marks the establishment of the third large branch office of Lockwood, Greene & Co., the other offices being located at Atlanta and Chicago.

CATALOGUES

Haiss Clam Shell Buckets.—Paper, 7x9 ins., 4 pp. Geo. Haiss Manufacturing Co., 139th St. & Rider Ave., New York City.

Pamphlet No. 912 gives illustrations showing the bucket opened and closed and contains a table of dimensions, weights and prices of buckets and teeth from ½ to 3 yd. capacity.

Corr-Products.—Paper, 4½x6¾ ins., 94 pp. Corrugated Bar Co., Buffalo, N. Y.

This very interesting and useful book containing useful data on corr-products such as bars, fabricated units, mesh, tile and plate floors and waterproofing products. Useful designing data are given. The book is well illustrated.

Steel Bars.—Paper, 4x8½ ins., 4 pp. Buffalo Steel Manufacturing Co., Tonawanda, N. Y.

This pamphlet contains a list of physical tests of steel bars for concrete reinforcement showing the results of the tests. Other similar pamphlet illustrates the types and sizes of square, twisted, spiral and rabbet steel bars.

Cling Surface Treatment for Ropes.—Paper, 6¼x9½ ins., 8 pp. Cling Surface Co., Buffalo, N. Y.

Cling Surface Treatment for Ropes is the title of a bulletin describing what is called a "life preserver" for belts. This bulletin shows a number of treated rope drives, gives technical data and carefully describes them all.

Standard Steam Pipe Casing.—Paper, 6x9 ins., 16 pp. American District System Co., North Tonawanda, N. Y.

Bulletin No. 713 on the insulation of underground heating mains describes a wooden casing bound with wire. Catalog describes the methods of manufacture, use, results obtained, etc. Complete illustrations, tables of dimensions, sizes, etc., are given.

Wiard Cloths.—Paper, 6x9 ins., 4 pp. Wiard Plow Co., Swan St., Batavia, N. Y.

This bulletin illustrates and describes road and contractors' plows of various sizes and with a number of attachments.

Wall and Silo Forms.—Paper, 10½x14 ins., 8 pp. Van Guilder Hollow Wall Co., 718 Chamber of Commerce Bldg., Rochester, N. Y.

This folder illustrates and describes a practical system for building hollow concrete walls or silos with a set of galvanized sheet steel forms.

Buffalo Pitts Rollers.—Paper, 9x12 ins., 40 pp. Buffalo Pitts Steam Roller Co., Buffalo, N. Y.

Macadam rollers, tandem rollers, combination rollers, golf rollers, asphalt rollers, road scarifiers are illustrated and described in detail in this catalog. The illustrations show a number of uses and classes of work for which these machines are used.

Another catalog 8x6⅓ ins., 30 pp., contains detailed information on tandem rollers. A third catalog 10¾x7 ins., 16 pp., deals particularly with steam road rollers.

Blasting Pumps.—Paper, 4¼x6¼ ins., 4 pp. Independent Powder Co., 651 Pierce Bldg., St. Louis, Mo.

This pamphlet contains information regarding the blasting of stumps with Independent Stump Powder.

Imperishable Natco Silos.—Paper, 6x9 ins., 48 pp. National Fireproofing Co., Pittsburgh, Pa.

These silos are built with vitrified hollow clay blocks. The book describes a number of erected silos and gives useful information on the cost. The materials and methods of construction are also illustrated and described in detail. Tables of sizes and capacities are given. Several pages are devoted to testimonials from users.

Universal Pipe.—Paper, 3½x6½ ins., 12 pp. Central Foundry Co., 142 Cedar St., New York City.

This booklet illustrates the laying of Universal Pipe. The pipe joint contains two bolts and requires no calking.

Ideal Roadway Box.—Paper, 4x9 ins., 1 p. S. E. T. Valve & Hydrant Co., 54 Church St., New York City.

The Ideal Roadway Box for gate valves of 4 to 16 inches, is designed to take the place of brick and concrete pits with cast iron tops and removable covers. It is built up in sections of flat ribbed cast iron plates dovetailed together.

Chain Belt Mixers.—Paper, 6x9 ins., 8 pp. The February issue of Chain Belt features the construction of a reinforced concrete grain elevator and illustrates several other interesting pieces of concrete work where chain belt mixers are in use.

Weed Killer.—Paper, 3½x6 ins., 6 pp. Horticultural Chemical Co., Bullitt Bldg., Philadelphia, Pa.

One gallon of Weed Killer diluted, is sufficient to cover 100 to 150 square yards; and one application is sufficient for an entire season.

Building Progress:—Paper, 6¾x9¾ ins., 28 pp. The National Fireproofing Co., Fulton Bldg., Pittsburgh, Pa.

The February issue contains interesting articles on industrial villages in England and an article entitled "Mistakes Architects Make." Other interesting information pertaining to building construction with hollow tile is given.

Modern Irrigation Methods.—Paper, 4¼x6½ ins., 79 pp. The Kellar-Thomason Manufacturing Co., 1222 E. 28th St., Los Angeles, Cal.

This bulletin illustrates and describes a concrete pipe system of distribution for irrigation. Complete details, prices, etc., are given.

RAILWAYS

Alabama.

⊙Oscar J. Pruett, Montgomery, Ala., has been awarded the contract for constructing 12 miles of railroad from Eclectic to Vincent in Elmore County. The work is to be completed in five months.

At a recent meeting of the stockholders of the Eufaula & Chattahoochee Valley Railroad Co., at Eufaula, Ala., proceedings were taken to dissolve the corporation. It was proposed to build a line to Pittsview, 21 miles north of Eufaula, in Rusell County, to make connection with the Seaboard Air Line. The latter company has stated finally, however, that it could not take the company's bonds. Effort was made also to connect with the Atlantic Coast Line at Abbeville, 18 miles south of Eufaula, but without avail. As soon as the proper legal steps are taken, the corporation will be dissolved and the paid in capital, amounting to $17,000, will be returned to the 58 stockholders.

Arkansas.

⊙The Withers Construction Co., Joplin, Mo., has the contract for grading for the projected shops of the Missouri & North Arkansas R. R., at Harrison, Ark.

The new owners of the Dardanelle & Russellville R. R., a 5-mile steam line, have elected the following officers: John W. White, Russellville, president; C. E. Hall, Dardanelle, secretary-treasurer. The other directors are: George B. Rose, W. M. Kavanaugh, J. F. Loughborough and B. W. White.

California.

Advices from San Diego, Calif., state that active steps are being taken towards an immediate start on construction of the San Diego & Arizona R. R. between that city and Yuma, Ariz. E. J. Kallright, San Diego, Calif., is Chief Engineer.

The Mexico & San Diego Ry. Co. has been chartered for the ostensible purpose of building a 3-mile line connecting the Imperial Beach and South San Diego. It is reported, however, that the company plans a line from some point in San Diego into Mexico. E. S. Babcock, American Bank Bldg., San Diego, President of the Los Angeles & San Diego Beach Ry., is an incorporator of the new company.

The Board of Supervisors of San Francisco have authorized the construction of a municipal street car line from Market St., San Francisco, to the Panama-Pacific Exposition grounds. M. M. O'Shaughnessy is City Engineer of San Francisco.

The necessary capital for the construction of the San Jose Terminal R. R. is reported to have been promised by an English syndicate and it is stated that active work will be started this spring. This line is to be operated by electricity and it will connect San Jose with the new port on South Bay. A. S. Appleton, San Jose, is reported to be interested.

Colorado.

⊙R. D. Kenyon, Denver, Colo., has been awarded the contract for the grading and construction of the Castle Rock Scenic Ry., at Golden. The road will cost about $15,000.

The Commercial Organization of Durango, comprised of Mormons, is advocating the construction of a railroad from Farmington, N. Mex., to Durango, passing through the new oil fields. It is stated that Mormons of the two cities will raise the funds to build the line. Such a road would cost about $2,500,000.

The Moffatt Tunnel Committee, Denver, Colo., is making arrangements at Denver, Colo., for circulating petitions asking for an election to vote on the proposition of amending the city charter in order that bonds may be issued for driving the proposed tunnel.

Engineers of the General Electric Co. have completed plans for the electrification of the new double track low grade line of the Denver & Rio Grande R. R. around Soldier Summit, Utah, and they will be submitted to the Board of Directors at the March 11 meeting. The matter of the electrification of Tennessee Pass, where the Rio Grande crosses the divide in Colorado, will be taken up next. It is the intention of the Rio Grande to electrify the entire system eventually, but this probably will not be accomplished for a number of years, in the opinion of the officials of the road.

Georgia.

Work will be commenced immediately by the Central of Georgia R. R. on the reconstruction of the Merchants' and Miners' Terminals which were recently destroyed by fire. The plan contemplates the rebuilding of the wharves and general terminals. W. A. Winburn is Vice President of the company, Savannah, Ga.

The Southern Railway Co. will take steps at once towards double tracking the Armour Belt Line, Atlanta, Ga., for a distince of 2¾ miles. The Belt Line was the original main line of the Atlanta and Charlotte Air Line into Atlanta. The new double track upon which work will be soon started, extends from Decatur St. to the intersection of North Blvd. and Tenth St. New sidetracks also will be placed along the revamped right of way. H. N. Rodenbaugh, Atlanta, Ga., is Assistant Engineer of the Southern Ry.

Illinois.

The Chicago & Alton R. R. expects to build in the near future at Glenn, Ill., a 30-stall roundhouse, coaling station of a storage capacity of approximately 500 tons, 90-ft. turntable, cinder pits, and to enlarge the yard to a capacity of about 4,000 cars.

The Michigan Central R. R. will probably have work started in the early spring on the erection of a new roundhouse at Joliet. An addition to the present yards is also planned. This will be built opposite the plant of the Joliet Rolling Mills Co.

A delegation of Calhoun and Jersey County residents recently visited Alton, Ill., to secure aid for a plan to extend the Alton, Jacksonville & Peoria R. R. from Jerseyville to Fieldon and thence to Hardin, in Calhoun County. Calhoun County has no railroad, and the business men and landowners say they stand ready to pledge a large amount of freight and passenger business if the 20 miles of track is built to the Illinois River, opposite Hardin.

Indiana.

Articles of incorporation were recently filed at Indianapolis, Ind., by the Laporte, Logansport & Southern Ry., capitalized at $100,000. Burtis P. Thomas, Laporte, Ind., has been appointed Construction Engineer and under his direction surveys will be run for the road which the company plans will connect Laporte and Logansport. Several routes are under consideration, one of which will run via Culver, and the other to the west, which would put Winamac on the line.

Iowa.

Bids were opened Feb. 25 at Atlantic, Ia., by Receiver E. S. Haslam for the purchase of the Atlantic Northern & Southern R. R. Leslie M. Shaw, for the Blakedell Co., offered $370,000 for the entire line. Robert Abeles, a contractor of St. Louis and a second lienholder, bid $168,000 for the south 38 miles of the line; the first mortgage bondholders (farmers) bid $87,000 for the north 18 miles of the line.

The United Light & Railway Co. of Chicago, Ill., which acquired the Mason City & Clear Lake Ry. (electric) as noted in our last issue, is understood to be planning to carry out the project of the former owners for an extension to Charles City.

The Chicago & Northwestern Ry. is understood to have about completed plans for its new repair shop to be located east of the roundhouse in the west part of Clinton, Ia. The shops and equipment will cost about $500,000. It is probable that the contracts will be let in the near future.

There is a proposition on foot, it is reported, to secure the construction of a Chicago & Northwestern Ry. branch line running from Eldora Junction through Grundy Center, Dike and Cedar Falls into Waterloo, Ia.

Representatives of the Iowa Northern Ry. Co. have filed at the office of the County Recorder, Clinton, Ia., articles of incorporation accompanied by Engineer's profile and map of the company's located line of projected railway out of Clinton to the north. The railway line, as located, runs along the Mississippi valley as far north as Lyons Station and there swings to the west and crosses the Anamosa line of the Northwestern Ry. 16 miles further north at Bryant. From there, the line shows the survey runs through Charlotte and then parallels from there both the Milwaukee and Northwestern R. R.'s several miles into Maquoketa. From Maquoketa, the line runs practically due north into a territory now entirely without railroad transportation and very rich in traffic. Stipulations in the first mortgage bond issue for $4,200,000 call for the above documents to be filed on or before March 4 and representatives of the railway company complied with the necessary provisions. The first mortgage bond issue also, it is understood, calls for the completion of the railway into Clinton from the north by not later than April 1, 1915.

Kansas.

The Arkansas Valley Interurban Ry. Co., Chas. D. Bell, Chief Engineer, Wichita, Kan., will begin work in a few days on a 2-mile extension from the Newton terminus to Bethel College.

A committee of business men from Kansas and Oklahoma cities, headed by William Little, Englewood, Kan., recently held a meeting to agitate the proposition to extend the Englewood Branch of the Santa Fe system to Liberal, a distance of 60 miles.

Louisiana.

The North Louisiana Electric Ry. Co., mentioned in our last issue, will have surveys started shortly for its projected line. This company proposes an interurban from Shreveport to Monroe, via Minden, Homer and Ruston. A. B. Blevins, Shreveport, La., is President.

The Alexandria Electric Ry. Co. of Alexandria, La., operating 8½ miles of line, has been taken over by the Southern Traction & Power Co. with a capital stock of $200,000, the principal stockholders being Dayton, O., capitalists. The officers are: William P. Jenkins, president; Ernest Boehm, vice-president and manager; Erie J. Weaver, secretary-treasurer. It is understood that the car lines will be extended and many improvements made.

Maryland.

The following bids were received Feb. 26 by the Board of Awards of Baltimore, Md., for building an electric railway line from the Harford road tracks of the United Railways & Electric Co. to Lake Montebello for hauling supplies needed in the construction of the filtration reservoirs now under way: Malcolm W. Hill, $11,555; the Whiting-Turner Construction Co., $12,549, and C. W. Lane & Co., $18,043.

Michigan.

⊙O'Connell-Wicks Co., Duluth, Minn., has been awarded a contract for constructing a 2,000-ft. extension track into the mines at Palmer for the Duluth, South Shore & Atlantic Ry.

Minnesota.

The Interstate Traction Co., Chas. B. Dunn, General Manager, 19th St., Park Point,

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Duluth, Minn., is to expend about $30,000 for improvements to the street railway on Minnesota Point. New rails, trolley lines and cables will be installed.

Duluth and Vicinity.

BY PETER E. MEACHER.

Mr. George Lyman, Junior, representing the Taylor, Wharton Iron & Steel Co., was a caller a few days ago. Business is very good in his line.

The trade papers recently have been noting the death of Mr. Shepard of St. Paul, of the firm of Morris, Shepard & Dougherty, railroad contractors of that city. This is not correct. The Mr. Shepard that died was the father of Sam Shepard, who is a member of the firm of Morris, Shepard & Dougherty. The death of his father makes no change whatever in the firm.

C. E. Thomas, chief engineer of the Mesaba Electric Ry. Co., was a caller. This railroad is completed, and at present is in operation, and giving excellent satisfaction. Mr. Thomas left for a visit in the East, and will return in the very near future.

Arthur Mitchell, a contractor, was a caller. He is not doing anything at the present time, and is in the market for some work. He can be addressed care of this office.

C. J. A. Morris, of the firm of Morris, Shepard & Dougherty, St. Paul, Minn., accompanied by Mrs. Morris, has left for a six weeks' trip to Panama, via Key West. This is the first vacation Mr. Morris has had in quite a while, and we trust that both he and Mrs. Morris will have a very enjoyable trip.

Edward Foley of the firm of Foley, Welch & Stewart, contractors, spent a couple of days in Duluth recently, looking over some new work.

C. E. Jamison, the railroad contractor, was a caller, and states that his work in Dakota is progressing very nicely. He has a Bucyrus steam shovel, and a 2-yard car outfit.

Mr. C. C. Smith, the railroad contractor, was a caller, and states that at the present time they have a small contract on the Burlington railroad.

W. A. Kingston, secretary and treasurer of the Roberts Kingston Contracting Co., was a caller, and stated that he and Mrs. Kingston were on their way to Florida to spend about six weeks. We hope they have an enjoyable visit there.

James Harden, representing Broderick & Bascom Wire Rope Co., was a caller, and spent a couple of days in our city. As usual, business is fine with Jimmy, and he is feeling fine himself.

H. A. Johann, western sales manager for the Taylor, Wharton Iron & Steel Co., was a visitor, and spent a couple of days with us recently. Business is fine with the Tisco Line.

P. G. Pastoret, the general contractor, was a caller and stated that the firm of Pastoret & Lawrence Co. had been dissolved, and that he was now in business for himself, and his partner, Mr. Lawrence, will also engage in business for himself. The style of name for the two new firms has not, as yet, been decided upon. We wish both Mr. Pastoret and Mr. Lawrence success in their new venture, and as there is plenty of work up in this country we are quite sure that they both will get all that they will be able to take care of.

The Soo Railway Co. has had engineers out in the vicinity of Cuyuna, Minn., and it is reported that they will build a 60-mile extension of their railroad. The contract, it is announced, will be let very soon, but we presume that the work will be done by Foley Brothers.

J. C. Bader, representing the United States Equipment Co., Chicago, spent a couple of days with us in this vicinity recently.

E. C. Hingeston, representing the Bucyrus Steam Shovel Co., was a caller a few days ago, and reported business fine.

A. J. Perrin of the firm of Carl Hall & Co., railroad contractors, was a caller and stated that they had completed their railroad work on the Great Northern R. R. near Floodwood, Minn., and were in the market for some work.

The outlook for construction work at Duluth and vicinity for the coming season is very bright, and I believe that there will be all kinds of work for sewer, water works,

Joseph Burke, master mechanic for MacArthur Brothers Co., spent a couple of days with us in this vicinity recently.

paving, railroad, mine stripping, concrete, dock and general contractors in this territory.

Labor is very scarce at the present time, and in demand, and unless there are a lot of laborers brought in to this territory, there will be a severe shortage when work opens up in the spring. There are about four jobs for every man here at the present time.

Mississippi.

Governor Brewer, of Mississippi, has authorized the organization of the Mississippi & Northwestern R. R. The terminal points of the proposed line will include Pascagoula and Biloxi, Miss.; Birmingham, Ala., and Omaha, Nebr. It is expected that the road will be completed within the next five years. Walter G. Seaver, Biloxi, Miss., as mentioned in our issue of Feb. 19, is President of the company.

St. Louis Items.

BY A. B. KOENIG.

✣The N. O. Nelson Manufacturing Co. at Edwardsville, Ill., will receive sealed bids at their office up to 3 p. m., March 17, for furnishing approximately 8,000 ft. of 8, 10 and 15-in. sewers. Plans and specifications may be had by writing above company.

⊙The Walsh Construction Co. of Davenport, Ia., secured the Milwaukee work at Delmar Junction, Ia. Chas. Bessenecker will be in charge.

⊙Murray & Corrigan of Kansas City got in on a piece of the Walsh Construction Co. work on the Milwaukee R. R. in Iowa.

Costello Bros. are moving two steam shovels from their Wabash work which they have completed to Aspinwall, Ia., on the Milwaukee.

George E. Moore, president of the Manufacturers' Ry., gave his annual birthday banquet last week at the South Side Bank Bldg., 2925 South Broadway. The guests of honor were the yardmen and enginemen of the company and about 60 of them were present. It is the custom of President Moore to entertain some department of the road each year on these occasions. At the banquet he announced that this was his 51st birthday.

Articles of incorporation were filed at Jefferson City for the St. Louis, Affton & Sunset Ry., with a capital of $300,000. The company proposes to build an electric line from Affton, St. Louis County, to Sunset Inn and Fenton via Sappington. The line will parallel the Gravois road and be about ten miles long. The project is said to be a continuation of the line of the St. Louis, Grant Park and Lakewood Electric Railroad now in operation from the southwestern terminus of the Cherokee line to Affton, St. Louis County. The incorporators of the new line include Victor J. Miller, John M. Storm, J. L. Boehl, James Arbuckle and C. A. Bodwell.

Bill List of List & Gifford passed through St. Louis on his way to Kansas City the other day. At the present time they are grading the land for the Emerson-Brandingham Mfg. Co. at Rockford, Ills. There is over 130,000 yds. of solid rock in this job. They have been troubled with slides and high water on the Gena, La., job but expect to finish this about April 1. They have a good drag line outfit idle that they want work for. Address them New York Life Bldg., Kansas City, Mo.

John Callahan of List & Gifford Construction Co. stopped off a day here last week on his way to Kansas City.

A precedent in the elimination of grade crossings was established last week when the city council passed the bill providing for the erection of the Union Avenue viaduct by the Terminal Railroad Association, but putting the consequential damages on the city. Passage of the bill followed a long debate in which members of the council were charged by fellow-members with having the railroads first in mind instead of the city's interests. The public improvements committee recommended passage of the bill in a majority report, but Dr. Paul R. Fletcher submitted a minority report which was unfavorable. Dr. Lorence E. Lehmberg, chairman of the committee, said the consequential damages would be only a few thousand dollars. Fletcher said passage of the bill would establish a dangerous precedent, and that it would be an injustice to the taxpayers "to admit the city could not force the railroads to do what the courts have held the city can rightfully force them to do."

Otto Harris died at Effingham, Ill., Feb. 17, 1913, at the age of 40 years.

Oliver G. Shands, the popular manager and office man of J. W. Thompson, died suddenly at 10:30 p. m. on Feb. 22 while conversing with his wife on the street corner. Death was caused by heart disease. He was a native of St. Louis and was educated in the St. Louis schools. He was widely known among railroad contractors and was one of the most pleasant and entertaining men in the contracting line.

James C. Travilla, our street commissioner, received a handsome silver service, the gift of the employes of the street department, previous to his departure for Texas. Mr. Travilla has resigned and is going to superintend the structures and highways in Tarrant County, Texas. Mr. Travilla has been with the street department here 17 years.

Nebraska.

The State Railroad Commission has authorized the Omaha, Lincoln & Beatrice Interurban Ry. Co. to issue $850,000 of capital stock and $2,250,000 of bonds for the construction of a line between Lincoln and Omaha. It is stated that the securities are to be turned over to the Northern Construction Co. of Detroit, in pursuance of an agreement entered into between the two companies whereby the construction company is to build the line and accept the securities in payment of the work of construction. The Omaha, Lincoln & Beatrice Ry. Co. at present operates 6½ miles of line between Lincoln and Bethany. It has offices at 1400 O St., Lincoln. Harvey Musser, Akron, O., is President; H. S. Norton, Lincoln is Secretary.

New Hampshire.

The House of Represenatives has passed the bill extending the charter of the Newport & Sunapee R. R. Co., which projects an electric railway, 10 or 15 miles long, between the towns named.

New Mexico.

M. J. Healy, Plainview, Texas, and Robert C. Mason, Coshocton, O., are promoting the construction of a railroad from the Dawson, N. Mex., coal fields through Plainview to Rotan, Texas, where it will connect with the Missouri, Kansas & Texas. The promoters ask the people of Plainview, Tucumcari, Rotan and other towns of the proposed line to subscribe for $500,000 of the stock and bonds of the road, 20 per cent of which is to be available in cash at once.

New York.

The New York Central Lines has prepared plans for a new Union station and improved yard facilities at Utica, N. Y.

The Hornell Traction Co., Hornell, N. Y., operating 9½ miles of line, is contemplating a considerable amount of betterment work this spring, including the laying of new rail.

Plans have been completed for the new shops to be built at Mechanicville for the Boston & Maine R. R.

The Public Service Commission at Albany has received a petition from the New York Central R. R. asking for permission to merge with numerous subsidiary companies. It owns the entire capital stock of these, amounting to $18,000,000. The companies to be merged are the Spuyten Duyvil and Fort Morris R. R. Co., extending from Spuyten Duyvil to 149th St. in the Borough of the Bronx, with a capital of $989,000; the Wallkill Valley R.

R. Co., running from Kingston to Montgomery, with a capital of $330,000; the New York & Putnam R. R. Co., extending from 155th St. in Manhattan to Putnam Junction, with a branch from Van Cortlandt Park Junction to Yonkers, with a capital of $6,500,000; the Gouverneur & Oswegatchie R. R. Co., extending from Gouverneur Junction to Edwards, with a capital of $350,000; the Carthage & Adirondack R. R. Co., extending from Carthage to Newton Falls, with a capital stock of $500,000; the Mohawk & Malone R. R. Co., extending from Herkimer to Maline, with various branches, with a capital stock of $5,000,000; the Mahopac Falls R. R. Co., extending from Baldwin Place to Mahopac Falls, with a capital stock of $100,000; the Tonawanda Island Bridge Co., running a bridge across an arm of the Niagara River at Tonawonda, with a capital stock of $50,000; the New York Central Niagara River R. R. Co., extending from North Tonawanda to Tonawanda Island, with a capital stock of $28,100; the Buffalo Erie Basin R. R. Co., extending from the Buffalo and Niagara Falls Branch of the New York Central to the Erie docks in Buffalo, with a capital stock of $13,503; the Tivoli Hollow R. R. Co., extending from West Albany to Albany, with a capital stock of $32,500, and the New York & Ottawa R. R. Co., extending from Tupper Lake to Nyando, N. Y., with a capital stock of $1,250,000.

North Carolina.

Work is progressing nicely on the construction of the Statesville Air Line R. R. now being built from Statesville to Mount Airy, N. C. It is rumored that the line upon its completion to Mount Airy will be extended into Virginia to a connection with the Virginian Ry. R. L. Greenlee, Marion, N. C., is Chief Engineer in charge of the work.

North Dakota.

The Midland Continental R. R., C. Craig, Chief Engineer, Jamestown, N. Dak., is understood to be planning to let additional construction contracts in the near future.

The Northern Pacific Ry. has an engineering crew working south from Beach, N. Dak., staking a line via Burkey and Carlyle and on to the Montana line. The Chicago, Milwaukee & St. Paul Ry. is also reported to be contemplating an extension from New England to a point south of Beach.

Ohio.

L. R. Stephens, 100 W. Gay St., Columbus, O., receiver for the Columbus, Urbana & Western Electric Ry. Co., has asked permission of the Common Pleas Court to call for bids for the extension of the line from Fishinger's bridge, near the Scioto River storage dam, to the Girls' Industrial School near Delaware. He states in his application that the extension can be built for a price within the $286,000 receiver's certificates authorized some months ago.

The State Public Service Commission has granted permission to the Cleveland, Cincinnati, Chicago & St. Louis Ry. to issue $7,000,000 of 4 per cent bonds for the purpose of paying outstanding indebtedness, making improvements and purchasing new rolling stock.

The Toledo & Indiana R. R., H. C. Warren, General Manager, 408 Superior St., Toledo, O., is reported to be planning to put engineers and right-of-way men in the field early in the spring for an extension of its electric railway from the present western terminus at Bryan to Montpelier.

The Toledo & Western R. R., J. F. Collins, General Manager, Toledo, O., has plans under consideration for an extension of its electric railway from Pioneer in the north part of Williams County to a connection with the St. Joe Valley line at Angola.

Oklahoma.

The St. Louis & San Francisco R. R. is to expend about $500,000 of betterment work on its line east of Ardmore.

The Oklahoma Northern R. R. Co., Vinita, Okla., has been incorporated with a capital stock of $50,000. The incorporators are A. King, Omaha, Nebr.; H. L. Steen, Omaha, Nebr.; W. F. Snodgrass, Centralia, Okla., and J. W. Tolliver, Centralia, Okla.

The Kansas-Oklahoma Traction Co. has been granted a state charter. The capital stock is $100,000, and it is proposed to construct an interurban from Coffeyville, Kan., south to Tulsa via Nowata and Collinsville. The estimated length of the road is 70 miles, and it will cost between $30,000 and $40,000 per mile. Principal offices will be maintained in Nowata and Coffeyville. The incorporators are: D. H. Siggins, Coffeyville, Kan., President of the Southwestren Interurban Ry. Co.; H. A. Siggins of Warren, Pa.; W. E. Ziegler of Coffeyville, J. E. Campbell and E. B. Lawson of Nowata.

The Oklahoma Northern R. R. Co. has been chartered with a capital stock of $50,000 and proposes to build a line from Vinita, Okla., to Coffeyville, Kan., a distance of 42 miles, at an estimated cost of $35,000 per mile. The promoters are: A. King, H. L. Steen and G. D. Meiklejohn, all of Omaha, Neb.; W. F. Snodgrass and J. W. Tolliver, both of Centralia, Okla. Under the terms of its charter the road is allowed to use either steam or electricity for its motive power.

City Council of Henryetta has granted C. H. Kellogg and associates a 25-year franchise to operate electric cars within the corporate limits, subject to the will of the voters at the election April 8. Under the franchise the work is to start within 90 days and the line be in operation within one year. This electric line will connect Henryetta with all outlying mining camps.

Oregon.

City Council of Ashland, Ore., has granted a franchise to M. T. Minney and associates of Oakland, Cal., for an interurban and street railway. The same parties were granted a franchise in Medford, Ore., a few weeks ago.

Pennsylvania.

⊙The Montour R. R., E. J. Taylor, Chief Engineer, Pittsburgh, Pa., has awarded a contract to John Marsch, 105 S. La Salle St., Chicago, Ill., for building a 30-mile extension from North Star through a coal section in Washington and Allegheny Counties to a point south of Homestead. The Keystone Contracting Co., Keystone Bldg., Pittsburgh, as noted in our last issue, has the sub-contract for Sections A and B.

The Pennsylvania Railway Co. will shortly offer to stockholders for subscription at par approximately $45,000,000 worth of stock. The money is to be used for improvements to the road, and a portion probably will be applied towards paying for the new equipment that has just been ordered.

Arrangements are reported to have been completed for securing funds for a considerable amount of electric railway improvements in Warren County. It is stated preparations are now under way for the extension of the lines of the Warren Street Ry. Co., Warren, Pa., to Youngsville, a distance of 9 miles. The Warren and Sheffield line will also be extended to Kane, 28 miles distant, by the construction of 12 miles of new road. It is also announced that the lines of the Titusville Trolley Co. that now reach to Pleasantville will be extended to connect with the Warren and Youngsville line.

Parties interested in the Warren & Jamestown Street Ry. Co., D. H. Siggins, President, Warren, Pa., are reported to be planning the construction of an electric railway from Kane to Sheffield, 16 miles.

The Buffalo & Lake Erie Traction Co., Exchange Bldg., Erie, Pa., is considering building a partial belt line along Taft Ave. at Erie, connecting the 12th St. extension with the Wesleyville line.

Stockholders of the York Rys. Co., York, Pa., will hold a special meeting on March 6 to take action on authorizing an extension of the Prospect St. line at York to Green Hill and Elmwood.

South Dakota.

It is rumored at Brookings, S. Dak., that the Chicago & Northwestern Ry. is contemplating taking over the survey and improvements which were made four years ago for a railroad south of that city for the purpose of extending a line to Sioux City.

The Chicago & Northwestern Ry. is reported to be contemplating the construction of a branch into Sylvan Lake, one of the Black Hills feature resorts 9 miles west of Custer from Fairburn, a point on its Black Hills line from Chadron, Neb. The distance from Fairburn to Sylvan Lake is about 30 miles and the route has already been surveyed.

Tennessee.

It has been announced by J. Wylie Brownlee, President of the Board of Commerce, Knoxville, Tenn., that it is probable that a railway belt line will be constructed around the city connecting factory sites. It is proposed that the city or county own the railway or guarantee the bonds for its construction.

The Birmingham & Northwestern R. R., C. F. Morgan, General Manager, Jackson, Tenn., is reported to be considering building a branch to Brownsville. It is said that the old Holly Springs & Brownsville roadbed may be used for the branch.

Proposition is under consideration for constructing a 50-mile northerly extension of the Nashville-Gallatin Interurban Ry. It is stated that subscription of $200,000 to the capital stock of the company will be asked of the citizens along the proposed route, and in event this subscription is taken a survey will be made and work on the new line will begin at once. H. W. Mayberry, 431 Stahlman Bldg., Nashville, Tenn., is President.

Texas.

Surveyors in charge of Tom C. Banks, District Engineer of the Missouri, Kansas & Texas, Smithville, Texas, are running a line through Mart and Waco, Texas.

The Business Club of Robert Lee, Tex., is making efforts to secure the construction of a railroad into Coke County. It is stated that residents of the city and the county will offer a bonus of $160,000.

Work may be started next month on a projected railroad from Knox City to develope the coal fields in the northern part of Stephens County. It is stated that the road will be built to Crystal Falls, and later will be continued to Fort Worth. The road is to be built by lessees of the coal field, including G. J. Thomason, Wichita Falls, and Y. L. Thomason of Haskell. The estimated cost is $1,650,000.

The International & Great Northern R. R. is to lay 15,000 tons of new steel rail on its line between San Antonio and Laredo.

The Houston & Brazos Valley R. R., Felix Jackson, President, Velasco, Tex., has filed amendment to its charter authorizing the company to construct an extension to its line to Velasco. The proposed extension will be started from Velasco, crossing the Brazos River to the west side, and from thence in a southwesterly direction to a point known as "Bryan Heights." The entire extension, five miles in length, will lie in Brazoria County. Further provision is made in the amendment for the removal of the general offices of the company from the city of Velasco to Freeport, Brazoria County.

Utah.

The Salt Lake & Utah R. R. Co. has filed with the County Clerk at Provo, Utah, a certificate of its organization at Portland, Me., Oct. 5, 1912. The capital stock is $3,000,000 in shares of the par value of $100 each. The following are the incorporators, directors and officers and each has subscribed for one share of capital stock, the remainder being left as unsubscribed stock: Cabot Dyer, President; Isaac W. Dyer, Clerk (both of Gorham, Maine); F. M. Orem of Salt Lake, Clerk; the other directors are: M. C. Connellan, Arthur Chapman, Clifford E. McGlanflin, Harry E. Nixon and H. P. Sweetzer, all of Portland, Me. F. M. Orem is named as attorney for acceptance of process in the State of Utah.

Vermont.

The State Legislature has passed bills permitting the Boston & Maine R. R. to construct two connecting lines to complete its system down the Connecticut River Valley. One bill provides for the extension of the Sullivan County R. R., from Windsor to White River Junction, 14 miles. The other bill provides for the extension of the Vermont Valley R. R. from Brattleboro to South Vernon, 11 miles. The Boston & Maine R. R. at present uses the track of the Central Vermont Ry. between the above mentioned points.

Virginia.

⊙Curtis & Shumeway, Lynchburg, Va., have been awarded the contract for the construction of double track between Monroe and Amherst, Va., for the Southern Ry.

It is reported that the Baltimore & Ohio R. R. is considering building a line from Romney, W. Va., to Harrisonburg, coming through the Alleghenies by way of Lost City, Mathias and the Brooks section of Rockingham county, and connecting with the valley branch at Harrisonburg.

Washington.

Reports from the subcontractors at work on the Great Northern extension known as the Wenatchee Northern, indicate that the entire grade will be ready for steel by June 1. Probably the slowest work is tunnelboring, most of it in solid rock. The longest bore is 750 ft. long, situated opposite Orondo. Over two-thirds of the distance has already been completed and the work is progressing at the rate of 40 ft. per week. About 200 ft. remains on the job and this will require not more than five weeks to finish. Farther up the river all reports confirm the containty that the big job will surely be finished by June 1. On Feb. 10 the 400-ft. tunnel at Camp 34 was completed. Johnson & Larson, subcontractors for a portion between Chelan Falls and Pateros, declare that work is progressing more rapidly than anticipated and that their contract will be completed before June 1. J. D. Riley has another portion extending nine miles south from Pateros. He says that labor has been plentiful this winter, greatly aiding rapid progress. He is taking full advantage of present conditions in order not to be caught by hundreds of men forsaking him at the first sign of warm weather. His contract will be finished well within three month.

West Virginia.

According to advices from Morgantown, W. Va., Engineers of the Buckhannon & Northern R. R. Co., have applied for an extension of its franchises through the Palatine addition of Fairmount which indicates the early extension of the road to Belington, W. Va. A bill is pending in Congress permitting the company to erect a bridge over the Monongahela River at Catawba.

Wisconsin.

The Milwaukee Electric Railway & Light Co., Public Service Bldg., Milwaukee, Wis., has applied to the town board of Mt. Pleasant for a franchise to extend its Northwestern Ave. line, in a northwesterly direction to the Country Club and the Rapids bridge.

The Chicago & Northwestern Ry. is considering improvements to its station at Milwaukee which will call for an expenditure of between $500,000 and $750,000. The improvements to the station will nearly double its capacity as to trackage facilities, waiting room, dining and office rooms. The plan rests more or less on the acceptance of the riparian rights agreement now before the city.

Wyoming.

⊙Twohy Bros., Portland, Ore., general contractors for the Powder River-Orin Junction line of the Chicago, Burlington & Quincy R. R., have let sub-contracts to the following: Gilbert Bros., Denver, Colo., 24 miles; Baker Bros., Denver, Colo., 10 miles; J. Coates, Las Animas, Colo., 6 miles; J. Fred Roberts, Denver, Colo., 10 miles; C. R. Conover, Denver, Colo., 6 miles; P. J. King, Denver, Colo., 6 miles.

Farmers on the south side of the Wheatland flats near Wheatland, Wyo., have made a proposition to the Colorado & Southern Ry. to construct a spur from the Gibson line south and west to the Oxford school house, a distance of about 7 miles. The farmers propose to do the grading and ask the railroad to lay the tracks.

Canada.

✣Bids will be received until noon, April 15, by J. G. Sullivan, Chief Engineer, Western Lines of the Canadian Pacific Ry., Winnipeg, Man., for the clearing, grubbing and grading of a diversion of the main line of the Canadian Pacific Ry. Co. in the Selkirk Mountains, from Six Mile Creek to Glacier, a distance of 17 miles. On this there is included a double track tunnel approximately 28,000 ft. long. Plans and specifications can be seen, either at the office of F. F. Busteed, Kamloops, B. C., or at the office of the Chief Engineer.

It has been announced at Regina, Sask, that the Canadian Pacific Ry. will, during the present year, spend $40,000 on yard improvements at that place. This amount includes the laying of tracks over the new Broad St. Subway which, when completed, will carry more tracks than any other subway in the Dominion.

Mackenzie & Mann, of the Canadian Northern Ry. Co., by purchasing $400,000 of the company's bonds have secured control of the Chatham, Wallaceburg & Lake Erie Ry. It is probable that some improvements are contemplated.

Announcement has been made that the Canadian Northern R. R. will enter Hamilton over the Toronto, Hamilton & Buffalo right of way. Last fall the company bought considerable property in the north end, but it is stated now that they have options on property in the west end, south of Hunter St.

Citizens of Regina, Sask., have voted a by-law authorizing the expenditure of $825,000 for street railway extensions. J. McArthur is City Engineer.

George F. Webb of Hamilton, Ont., has filed plans with the city of Hamilton for an incline railway to be built at Wentworth St. The line will have a grade of about 35 ft. in 100, and will be equipped to carry street cars as well as vehicles and pedestrians. It will pass over the Grand Trunk and T., H. & B. tracks.

ROADS AND STREETS

Alabama.

✣Bids will be received until 3 p. m., March 18, by City Council, Birmingham, Ala., for the construction of street improvements including the following approximate quantities: 15,000 sq. yds. asphalt, bitulithic, asphaltic concrete or bituminous concrete, 15,000 sq. yds. asphalt or bitulithic, 15,000 sq. yds. asphalt, bitulithic or wood block, 10,000 sq. yds. plain concrete. Walter J. Kirkpatrick is City Engineer.

Commissioners of Marshall County, Guntersville, Ala., will probably call an election to vote on issuing $125,000 of bonds for building roads.

The City Council of Madison, Ala., has passed an ordinance to have all of its sidewalks paved.

Arkansas.

Bills are now pending before the Arkansas Legislature for the creation of road districts in many of the Counties of the State. Some of the Counties are Yell, Lonoke and White.

California.

✣Bids will be received until 2 p. m., March 10, by Board of Los Angeles County Supervisors, Los Angeles, Calif., for furnishing 56,000 bbls. (20% more or less, at the option of the Board of Supervisors), of crude petroleum, to carry not less than 75% asphalt; said oil to be delivered cold, carload lots, at the County Oil Pit, near Santa Fe Ave. and Butte St., in the City of Los Angeles. This oil must be free from water and sediment, subject to the centrifugal test, also furnishing 5,000 barrels (20%, more or less, at the option of the Board of Supervisors) of crude petroleum, between 14 degrees and 18 degrees gravity, to be delivered cold, in wagon load lots, at or near the City of Whittier. The oil is to be delivered between the 15th day of March, 1913, and the 15th day of March, 1914, in such quantities and at such times as the Board of Supervisors may select.

⊙According to advices from Salinas, Calif., the contract for the construction of the Monterey end of the Coalinga-Parkfield Road has been let to U. F. Kester, for $5,605. The road extends from the Fresno County line to the mouth of Pine Canyon in the Little Cholame Valley, a distance of 3.96 miles. The culverts will be eliminated from the contract.

⊙The City Council of San Diego, Calif., has awarded street improvement contracts as follows: Jess Knight, grading Texas St., $16,255; also for grading El Cajon Ave., $35,275. Ford & Stout, paving G St., between Seventh and 16th, $21,734.

The City Trustees of El Centro, Calif., have advertised for bids for the construction of approximately five miles of street paving.

Preliminary legal proceedings are being taken by the City Trustees, Eagle Rock (P. O., Glendale), Calif., to do $50,000 worth of street improvement work.

Inspector of Public Works Hansen, of Los Angeles, Calif., has recommended to the Board of Public Works the undertaking by the city of the sprinkling of the city streets instead of letting the work by contract. It is also recommended that the city purchase 40 new street sprinklers at an approximate outlay of $16,000.

The Board of Supervisors and the County Highway Commission, Santa Ana, Calif., have completed a conference concerning preliminary plans for the beginning of good roads work in Orange County. Bonds to the amount of $1,270,000 have been sold and the proceeds will be available within 60 days.

The City Council of Richmond, Calif., has ordered the construction of approximately five miles of street paving. W. S. Farley is City Engineer.

The resolution of intention to construct a tunnel on Fillmore St., from Sutter to Filbert, has been presented to the Board of Supervisors of San Francisco. The tunnel, according to the resolution, will consist of two bores, one for railroads and the other for vehicular traffic and for pedestrians. It is estimated that it will take 14 months to construct the tunnel working at both ends. The cost, it is estimated, will be approximately $2,500,000. The bore will be so constructed that the surface street will be maintained. M. M. O'Shaughnessy is City Engineer of San Francisco.

Colorado.

The Board of Public Works of Denver, Colo., has selected the alleys that are to be paved this year. The total estimated cost is $19,337. A. L. Fellows is City Engineer.

Delaware.

The Delaware Legislature on Feb. 26 passed a bill authorizing the New Castle County Levy Court, Wilmington, to borrow $200,000 for permanent improvement of roads.

District of Columbia.

✣Bids will be received until March 10 by Commissioners of the District of Columbia, Washington, D. C. (readvertisement), for about 17,000 cu. yds. of grading.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

✣Bids will be received until 2 p. m., March 14, by W. M. Hays, Acting Secretary, Department of Agriculture, Washington, D. C., for resurfacing with macadam that section of the Rockville Pike extending from the boundary line of the District of Columbia at Station 0-15 to Station 61-20 at Bradley Lane.

Florida.

⊙The Southern Paving & Construction Co., of Chattanooga, Tenn., has been awarded the contract by the Louisville & Nashville Railroad, for paving and beautifying the vicinity of the new depot at Pensacola, Fla. The contract calls for the paving of a stretch 500 ft. long by 50 ft. wide on the southern side of the depot, extending to the brick wall. In front of the depot the paving will be 150 ft. wide, with a circular grass plot in the center. About 4,000 sq. yds. of creosoted wood blocks will be used. The contract aggregates about $10,000.

Georgia.

The Cobb Realty Co., of Atlanta, Ga., contemplates expending about $35,000 in improvement work in Cobb Park. The work will include cutting, grading and paving streets, laying off residence lots and installing modern City conveniences.

Idaho.

✣Bids will be received until 2 p. m., March 11, by City Council of Boise, Idaho, for furnishing and installing lamp posts, lamps and cutouts, etc., for completion of the luminous arc lighting system. he bids will be received: First—For posts. Second—For lamps and cutouts. Third—For supplying all cables, conduits, labor and everything necessary to the complete installation of the system. Boise City to furnish lamps, cutouts and posts. Fourth—For the whole system complete, including poles, lamps, conduits, cables and everything necessary for the installation of the same. The lighting system to be constructed according to plans and specifications which may be seen at the office of the City Engineer. Each bid must be in accordance with the form of proposal furnished by the Council. and accompanied by a certified check on some local bank, payable to Boise City, for the sum of $1,000, to be forfeited. G. C. Stevenson is City Engineer.

Illinois.

✣Bids will be received until 9 a. m., March 10, by Board of Local Improvements, Town Hall, Rossville, Ill (change of date), for furnishing all labor and material and equipment fon constructing 30,430 sq. yds. of vitrified brick pavement on 5-in. crushed rock foundation. Approximate quantities: 3,386 lin. ft. stone curb, 17,473 lin. ft. combined curb and gutter, 995 lin. ft. stone headers, 59 storm inlets, 2,321 lin. ft. of 12-in. subdrains, 200 lin. ft. of 12-in. sewer and 17,987 cu. yds. of earthwork. Plans and specifications may be seen in the office of the Town Clerk, Rossville. Ill., or the office of Payne & Barr, Engineers. Fischer Bldg., Danville, Ill., and proposal blanks may be obtained at either of these places. Certified check for 10 per cent of aggregate amount of bid required.

✣Bids will be received until 2 p. m., March 20, at the office of the Town Clerk, Granite City., Ill., for hauling stone on the Collinsville-St. Louis Road in Nameoki Township. Madison County. The stone to be delivered is at present stored in piles along the East St. Louis & Suburban Railroad tracks on the Collinsville-St. Louis Road in Nameoki Township, Madison County, and in addition to that which is already stored, there will be additional material unloaded as the work progresses. The total amount of stone to be hauled will be approximately 3,000 tons.

✣Bids will he received until 11 a. m., March 10, 1913, by the Board of Local Improvements, Chicago, Ill., E. J. Glackin, Secretary, for furnishing and delivering labor; materials necesabole, $1,403; 430 sq. yds. brick pavement, Colsary to construct pavements in the following streets: California Ave., Diversey Ave. to Belmont Ave., assessment available, $28,804.00; 4,900 lin. ft. sandstone curbing, 6,600 sq. yds. creosoted wood block pavement, Center Ave., Blue Island Ave. to 14th St., assessment available, $1,403; 130 sq. yds. brick pavement, Colorado Ave., Independence Blvd., to 40th Ave., 1,740 lin. ft. sandstone curbing, 500 lin. ft. to be reset; 3,520 sq. yds. of brick pavement, Elston Ave., Fullerton Ave. to Belmont Ave., assessment available $84,082.00; 15,000 lin. ft. sandstone curbing, 7-in. by 18-in., 19,800 sq. yds. creosote or wood block pavement, Erie St., Fairbanks Court to Lake Shore Drive, assessment available $13,898.00; 2,720 lin. ft. granite concrete combined curb and gutter, 40 lin. ft. concrete gutter, 5,000 sq. yds. asphalt pavement, 43d Ave., C., M. & St. P. Ry. to Humboldt Ave., assessment available, $21,820.00; 5,070 lin. ft. granite concrete combined curb and gutter, 7,850 sq. yds. asphalt pavement, W. 47th St., Paulina St. to 550 ft. west of Hoyne Ave., assessment available, $53,952.00; 6,360 lin. ft. sandstone curbing, 10,340 sq. yds. granite block pavement, 54th St., LaSalle St. to Wentworth Ave., assessment available, $4,500.00; 830 lin. ft. granite concrete combined curb and gutter, 1,420 sq. yds. asphalt pavement, Frankfort St., Oakley Ave. to Western Ave., assessment available, $5,465.00; 1,280 lin. ft. granite concrete combined curb and gutter, 1,930 sq. yds. asphalt pavement, Irving Park Blvd., E. Ravenswood Park to N. Ashland Ave., assessment available $18,894.00; 3,610 lin. ft. sandstone curbing, 1,000 lin. ft. concrete curh wall, 3,850 sq. yds. creosoted wood hlock pavement, 650 sq. yds. brick pavement, Keith St., Huron St. to Chicago Ave., assessment available, $5,154.00; 990 lin. ft. granite, concrete combined curb and gutter, 270 lin. ft. concrete gutter, 1,850 sq. yds. asphalt pavement, Lydia St., Halsted St., 90 ft. east, 190 lin. ft. sandstone curbing, 290 sq. yds. granite block pavement, May St., 21st St. to 22d St., assessment available, $4,977.00; 800 lin. ft. granite concrete combined curb and gutter, 1,670 sq. yds. asphalt pavement, Spalding Ave., Division St. to Grand Ave., assessment available, $10,900.00; 2,430 lin. ft. granite concrete combined curb and gutter, 3,730 sq. yds. asphalt pavement, Talman Ave., Madison St. to Washington St., assessment available $5,414.00; 1,050 lin. ft. sandstone curhing, 1,790 sq. yds. brick pavement, 23d St., Wood St. to Western Ave., assessment available, $37,317.00; 7,120 lin. ft. gravel, concrete combined curb and gutter, 100 lin. ft. concrete gutter, 13,830 sq. yds. asphalt pavement, Wellington St., Lincoln Ave. to Ashland Ave., assessment available $12,915.00; 2,540 lin. ft. granite concrete combined curb and gutter, 4,200 sq. yds. asphalt pavement, Western Ave., Belmont Ave. to Roscoe St., assessment available, $18,500.00; 2,620 lin. ft. sandstone curbing, 7-in. by 18-in., 4,100 sq. yds. creosoted wood block pavement, Western Ave., Montrose Ave. to Lincoln Ave., assessment available $34,238.00; 5,000 lin. ft. sandstone curbing, 7,600 sq. yds. creosoted wood block pavement, Archer Ave. to 22d St., 21st St. Wentworth Ave. to Archer Ave., assessment available, $8,000.00; 1,430 lin. ft. sandstone curbing, 2,460 sq. yds. brick pavement, Montana St., Western Av. to Station St., Oakley Ave., Fullerton Ave. to Station St., assessment available, $13,901.00; 3,120 lin. ft. granite concrete curb and gutter, 5-in. by 18-in., 4,900 sq. yds. asphalt pavement, Roscoe St., Robey St. to Western Ave., Robey St., Roscoe St. to Belmont Ave., assessment available, $5,300.00; 7,050 lin. ft. sandstone curbing, 12,250 sq. yds. creosoted wood block pavement, Houston Ave., 82d St. to 83d St., Commercial Ave., 82d St. to 83d St., Coles Ave., 81st St. to 83d St., 82d St., Exchange Ave. to Ontario Ave., assessment available, $24,868; 7,360 lin. ft. sandstone curbing, on concrete, 600 lin. ft. on limestone blocks, 11,170 sq. yds. asphaltic macadam pavement, all work includes a 6-in. Portland cement concrete foundation, preparation of the subgrade, sewer, manhole and catch basin adjustment, etc., cash or certified check for 10 per cent of bid must accompany proposal.

✣Bids will be received until 11 a. m., March 11, 1913, by L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering according to specifications on file at his office, 3,000 bbls. of Portland cement to the Bureau of Streets; 2,000 bbls. to be delivered to 15th and Laflin Sts., the balance to be delivered to the 7th, 8th and 23rd ward yards. Cash or certified check for $250.00 must accompany proposal.

✣Bids will be received until 11 a. m., March 11, 1913, by L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering approximately 3,000 cu. yds. of clean sharp sand to the Bureau of Streets, the same to be delivered to the Asphalt plant at 15th and Laflin Streets, for use in preparing asphalt for pavements. Cash or certified check for $200.00 must accompany proposal.

✣Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., until 11 a. m., March 11, 1913, for furnishing and delivering to the Bureau of Streets according to specifications on file at the City Hall, 50,000 gals. of fuel oil; the oil to be a pure petroleum oil, free from grit, sand and other impurities, and containing not more than 1 per cent of free water. Cash or certified check for $500.00 must accompany proposal.

✣Bids will be received until 11 a. m., March 7, 1913, by Chas. F. Seyferlich, Fire Marshall, Chicago, Ill., for furnishing and delivering such building cement as is necessary for use during 1913.

✣Bids will be received until 7:30 p. m., March 12, hy Board of Local Improvements. William Wicke, Secy., Des Plaines, Ill., for paving, requiring 24,000 sq. yds. of asphaltic concrete; 20,400 lin. ft. curb and gutter; 15,000 cu. yds. of excavation. Plans, etc., with the Secretary at Des Plaines, and with H. L. Emerson, Engineer, Room 1118 Chamber of Commerce Bldg., Chicago, Ill.

⊙The Board of Local Improvements, Chicago, Ill., Edward J. Glackin, Secretary, has awarded contracts for furnishing and delivering labor, materials, etc., necessary to construct pavements in the following streets: 40th Ave., Fullerton Ave. to Milwaukee Ave., 12,200 lin. ft. vertical concrete curb, 18,500 sq. yds. brick pavement, $56,520, Smith & Brown, 128 N. La-Salle St.; N. 41st Ave., C., M. & St. P. Ry. to Irving Park Blvd., 920 lin. ft. sandstone curbing, 1,340 sq. yds. brick pavement, $4,066.80, Smith & Brown; 42nd St., Vincennes Ave. to Cottage Grove Ave., 3,650 lin. ft. gravel concrete combined curb and gutter, 6,920 sq. yds. asphaltic concrete pavement, $11,929.50, R. F. Conway Co., 133 W. Washington St.; Hoyne Ave., 105th St. to 107th St., 2,700 lin. ft. sandstone curbing, 3,970 sq. yds. asphaltic concrete pavement, $7,961.60, Farr Bros. Co., 356 W. 111th St.; W. 105th St., Throop St. to Prospect Ave., 3,610 lin. ft. granite concrete combined curb and gutter, 5,060 sq. yds. asphaltic macadam, $9,998.80, Farr Bros. Co.; W. 63d St., Western Ave. to 108 ft. east of Irving Ave., 2,530 lin. ft. sandstone curbing, 1,240 sq. yds. brick pavement, $11,967.75, Ready & Callahan Coal Co., 133 W. Washington St.; W. 20th St., Blair St. to Jefferson St., 650 lin. ft. granite concrete combined curb and gutter, 1,010 sq. yds. asphalt concrete pavement, $2,797.40, R. F. Conway Co.; N. Waller Ave., Augusta St to Division St., 2,650 lin. ft. granite concrete combined curb and gutter, 2,970 sq. yds. asphalt pavement, $10,351.20, American Asphalt Paving Co., 133 W. Washington St.; Buffalo Ave., E. 133d St. to E. 136th St., Superior Ave., 132d St. to 136th St., E. 132d St., Ontario Ave. to Superior St., E. 135th St., Ontario Ave. to P. F. W. & C. Ry., E. 134th St., Ontario Ave. to Buffalo Ave., E. 135th St., Ontario Ave. to Buffalo Ave., E. 136th St., Howard Ave. to Buffalo Ave., 15,970 lin. ft. sandstone curbing on concrete blocks, 23,770 sq. yds. asphaltic macadam, $45,481.20, A. J. McAllister, 1542 W. Garfield Blvd.; alley California Ave., Madison St., etc., 1,220 lin. ft. concrete curbing 950 sq. yds. brick pavement, $2,771, Central Paving Co., 179 W. Washington St.; alleys Carroll Ave., St. John's Ct., 750 lin. ft. concrete curbing, 500 sq. yds. brick pavement, $1,457.50, Central Paving Co.; alleys Van Buren St., Halsted St., etc., 970 lin. ft. concrete curbing, 770 sq. yds. granite block pavement $3,002.20; alleys Polk St.,

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Lowell Pl., etc., 2,140 lin. ft. concrete curbing, 1,570 sq. yds. brick pavement, $3,377.50, Central Paving Co.; alley Potomac Ave., Oakley Ave., etc., 1,220 lin. ft. concrete curbing, 950 sq. yds. brick pavement, $2,696.50; alley Elburn Ave., Laflin St., etc., 1,200 lin. ft. concrete curbing, 680 sq. yds. brick. All work includes preparation of the subgrade, 6-in. Portland cement concrete foundation, sewer, manhole and catchbasin construction and adjustment. Bids opened Feb. 10.

The Board of Local Improvements, Chicago, Ill., has awarded the contracts for constructing water supply pipe in the following streets: LaSalle St., W. 108th St. to 300 ft. south, 107th St., N. 42d Ave., Fullerton Ave. to Wrightwood Ave., W. 63d St., Western Ave. to Leavitt St., S. Claremont Ave. to Fulton Ave., Alton Ave. to Bellevue Ave., Bellevue Ave., Fulton Av. to Hamilton St., S. Sangamon St., 96th St. to 99th St., 99th St., Sangamon St. to S. Morgan st., S. Ryan. 2927 W. Congress St., Leland Ave., Elston Ave. to 44th Ct., De Vito & Tutelli, 601 Taylor St.; 63rd St., Hamlin Ave. to 15th Ave., Hamlin Ave., W. 62d St. to W. 63d St., 44th Ave., 44th Ct., 45th Ave., 45th Ct., 59th St. to 63d St., M. Murphy, 5315 Wabash Ave.

The Board of Local Improvements of Pekin, Ill., on Feb. 20 adopted a resolution for the improvement of what is known as the Capitol, Fourth and Fifth St. Paving District. comprising parts of a number of streets. The Board adopted the estimate of City Engineer John R. Seibert for the improvement. which is as follows: 41,000 sq. yds. brick paving on a concrete foundation five (5) in. thick covered with a sand cushion two (2)ins. thick. the interstices filled with a cement grout filler over which there is spread one-half in. of sand, complete in place at $1.60 per sq. yd.; $65,606; 13,700 cu. yds. excavation and filling at 25c per cu. yd., $3,425; 5,000 lin. ft. new concrete curb at 25c per ft., $1,250; 1,000 lin. ft. protection curb at 25c per ft., $250; 14,825 lin. ft. stone curb reset, etc., 10c per ft., $1,483; lawful expenses, making levying and collecting said assessment, $4,300. Total $76,308.

The Board of Local Improvements of Rock Island, Ill., has adopted a resolution recommending the adoption of an ordinance by the City Council for the paving of 11th Ave., between 11th and 23rd Sts. The street is to be paved to a width of 24 ft. between 11th and 15th Sts., and 18 ft. between 22nd and 23rd Sts. The estimated cost is $30,788. Wallace Treichler is City Engineer.

Following are the lowest unit bids submitted to the Board of Local Improvements, Chicago, Ill., on Feb. 24, for furnishing, and delivering labor and materials necessary to construct pavements in the following streets: Dickens Ave., 44th St. to 45th Ave., 6,100 lin. ft. granite concrete curb and gutter, 55 cts., 9,700 sq. yds. asphalt pavement, 79 cts, American Asphalt Paving Co., 133 W. Washington St. Indiana Ave., 51st St. to Garfield Blvd., 5,330 lin. ft. granite concrete combined curb and gutter, 55 cts., 11,000 sq. yds. asphalt pavement. $1.74, American Asphalt Paving Co., 133 W. Washington St. S. Leavitt St., Ogden Ave. to 14th St., 3,000 lin. ft. granite concrete curb and gutter, 55 cts., 500 lin. ft. concrete gutter, 35 cts., 7,300 sq. yds. asphalt pavement, $1.77, American Asphalt Paving Co. E. 73rd St., Bond Ave. to South Shore Ave., 5,300 lin. ft. granite concrete curb and gutter, 55 cts., 2,420 sq. yds. asphalt pavement, $1.92, American Asphalt Paving Co., 133 W. Washington St. Third Ave., Augusta St. to Division St., 2,580 lin. ft. granite concrete combined curb and gutter. 55 cts., 3,900 sq. yds. asphalt, $1.83, American Asphalt Paving Co., 133 W. Washington St. Troy St., Colorado Ave. to Jackson Blvd., 910 lin. ft. granite concrete combined curb and gutter, 1,460 sq. yds. asphalt pavement. $1.84, American Asphalt Paving Co., 133 W. Washington St. Alley, Cottage Grove Ave., 29th St., etc., 380 lin. ft. concrete curbing. 15 cts., 300 sq. yds. brick pavement, $2.50, Ready & Callahan Coal Co., 133 W. Washington St. Alley, Carpenter St., Randolph St., etc., 570 lin. ft. concrete curbing, 15 cts., 240 sq. yds. brick pavement, $3. Central Paving Co., 179 W. Washington St. Alley, Logan Blvd., Milwaukee Ave., etc., 340 lin. ft. concrete curbing, 20 cts., 300 sq. yds. brick pavement, $2.42, Alley, Washington Ave., 60th St., etc., 370 lin. ft. concrete curbing, 18 cts., 300 sq. yds. brick pavement, $2.50, Ready & Callahan Coal Co., 133 W. Washington St. Alley, Langley Ave., St. Lawrence Ave., etc., 1,160 lin. ft. granite curbing, 18 cts., 650 sq. yds. brick pavement, $2.48, Ready & Callahan Coal Co., 133 W. Washington St. Alley, Sheridan Road, Pine Grove Ave., etc., 1,190 lin. ft. concrete curbing, 16 cts., 1,060 sq. yds. brick pavement, $2.50, Jas. A. Sackley Co., 133 W. Washington St. Alley, Flournoy St., Lexington St., etc., 1,400 lin. ft. concrete curbing, 15 cts., 1,150 sq. yds. brick pavement, $2.67, Peter J. O'Brien, 9 S. LaSalle St. Alley, Van Buren St., Center Ave., 1,200 lin. ft. concrete curbing, 16 cts., 870 sq. yds. brick pavement, $2.24, Jas. A. Sackley Co., 133 W. Washington St. Alley, Grand Ave., Sangamon St., etc., 670 lin. ft. concrete curbing, 16 cts., 590 sq. yds brick pavement. $2.24, Jas. A. Sackley Co., 133 W. Washington St. Alley, Augusta St., Marshfield Ave., 150 lin. ft. concrete curbing, 16 cts., 700 sq. yds. brick pavement, $2.24, Alley, Center St., Elizabeth St., 1,000 lin. ft. concrete curbing, 570 sq. yds. brick pavement, $2.29, Jas. A. Sackley Co., 133 W. Washington St. Alley, Madison St., Ashland Ave., etc., 1,280 lin. ft. concrete curbing, 16 cts., 1,000 sq. yds. brick pavement, $2.35, Jas. A. Sackley Co., 133 W. Washington St. Alley, Taylor St., Desplaines St., etc., 2,050 lin. ft. concrete curbing, 15 cts., 1,470 sq. yds. brick pavement, $2.65, Central Paving Co., 133 W. Washington St. Alley, Polk St., Blue Island Ave., etc., 1,270 sq. yds. concrete curbing, 16 cts., 1,390 sq. yds. brick pavement, $2.20, Jas. A. Sackley Co., 133 W. Washington St. Alley, Plum St., Laflin St., etc., 1,200 lin. ft. concrete curbing, 16 cts., 680 sq. yds. brick pavement, $2.30, Jas. A. Sackley Co., 133 W. Washington St. Alley, Polk St., Norton St., 230 lin. ft. concrete curbing, 20 cts., 140 sq. yds. brick pavement, $2.75, Jas. A. Sackley Co., 133 W. Washington St. All work includes a 6-in. Portland cement concrete foundation, preparation of sub-grade, sewer, manhole and catchbasin adjustment. Edw. J. Glackin, Secretary of the Board.

The paving of Main St., St. Charles, Ill., is contemplated. Geo. N. Lamb is City Engineer.

Indiana.

⊙Evans & VanNatta have been awarded the contract by the Newton County Commissioners, Kentland, Ind., for the construction of the McKee stone road for $14,845.

The Indiana Legislature has passed the Hawkins-Spencer Road Bill. The bill provides for the placing of supervision over County roads in the hands of a County Road Superintendent and assistants.

Iowa.

✣Bids will be received until March 10, it is reported, by City Council, Burlington, Ia., for paving 15 blocks of street with brick and 4 blocks with concrete pavement. H. C. Volmer is City Clerk.

✣Bids will be received until 8 p. m., March 11, by C. J. Reusche, City Clerk, Clinton, Ia., for street improvement consisting of the following approximate quantities: 10,900 sq. yds. of concrete or concrete with bituminous topcoating; 3,800 lin. ft. of plain curb. A certified check of $1,000 is required. J. G. Thorne, 317 Howes Block, is City Engineer. Official advertiscment will be found elsewhere in this issue.

✣Bids will be received until 7:30 p. m., March 11, by Mayor and City Council of Hampden, Ia., for necessary labor and material to grade, curb and pave with Portland cement concrete. The work will include 45,600 sq. yds. of pavement and 26,913 lin. ft. of curb. A certified check for $3,000 payable to the City Treasurer must be filed with each bid. Plans and specifications are on file at the office of the Mayor and at the office of A. G. Baker, City Engineer.

✣Bids will be received until March 10, by City of Cedar Rapids, Ia., is is reported, for the construction of pavement on the following streets, avenues, etc.: 14th St. West from 1st to A Ave., Bever Ave. from 19th to 22nd St., 4th Ave. from 16th to 19th St., 5th Ave. from 19th to 21st St., 17th St. from Bever to 5th Ave., Knollwood Drive from 5th Ave. to 21st St., 5th Ave. from 3rd to 5th St., Alley between 1st and 2nd Ave. from 6th to 11th St., 8th Ave. west from H to 9th St., 5th Ave. west from 1st to 6th St., A Ave. west from 13th to 15th St., 3rd St. west from 3rd to 4th Ave., 4th St. west from 3rd to 4th Ave. All of the above paving will be brick block on concrete foundation, except Knollwood Drive, which will be paved with concrete if the present intentions of the Council are carried out.

✣Bids will be received until 10 a. m., March 8, by Paul J. Wells, Sioux City, Ia., for the necessary labor and material for the construction of pavement on W. 3rd St., from Turner St. to Center St. A certified check of 5% the amount of bid must accompany each tender.

⊙The McCarthy Improvement Co., Davenport, Ia., has been awarded the contract by the Board of Public Works of that city for paving Warren St., between Front and Second, Brown St., between Front and Second, Sixth St., between Marquette and Fillmore Sts., and Eighth St., between Fillmore and Marquette Sts. The first two streets are to be paved with brick and the last two with asphalt. The Independent Construction Co. secured the work on Eighth St., between Marquette and Vine Sts; alley, between Fifth and Sixth, Brady to Main St., Judson St., between Summit Ave., and Fulton Ave. and Myrtle St., between Seventh and Eighth Sts., all with brick

⊙Percy P. Smith has been awarded the contract by the City Council of Cedar Rapids, Ia., for the construction of curbing and paving, for $13,268. Other bidders were: B J. Sweatt, $14,938; Ford Paving Co., $14,286, and Frank Hahn, $14,080.

⊙The City Council of Sioux City, Ia., on Feb. 28 awarded contracts for approximately $30,000 worth of paving to E. J. Hanlon and M. L. Flinn. The Flinn Paving Co. will pave Riverside Ave., from Center to John, and Virginia St., from Fourth to 14th Sts. 19th from Pierce to Jackson and 20th from Pierce to Jackson, will be paved by Hanlon.

⊙The Des Moines Asphalt Paving Co., 11th & Vine Sts., Des Moines, Ia., has been awarded the contract by the city of Algona, Ia., S. W. Crowell, City Clerk, for the construction on streets included in Districts Nos. 1, 2, 3 and 4, 24,000 sq. yds. of permanent pavement, 5,000 sq. yds. of which will be on 4-in. concrete base, for $40,200. The McLaughlin & Sons Co., Red Oak, Ia., secured the contract to construct 14,300 lin. ft. of curbing, for $7,885. Bids were opened Feb. 25. Theodore S. DeLay, Creston, Ia., is Engineer.

The City Council of Muscatine, Ia., is preparing for the laying of 54 blocks of paving in that city this year. The material has not as yet been selected. City Engineer C. H. Young has estimated the cost of the work at $275,000. The Council also proposes to pave Weed Park to the city limits, using a 24-ft. road with 8-ft. driveways on each side of the road.

The City Council of Burlington, Ia., has approved plans and specifications of City Engineer H. G. Vollmer for the improvement of sections of North Eighth, Ash, North Ninth, Mark Lane and Corse Sts. Final action will be taken March 13.

Following low bids were received by the city of Belle Plaine, Ia., S. P. Ferres, City Clerk, for paving work: Brick with sand filler—Des Moines Asphalt Paving Co., Des Moines, Ia., $57,896; brick with asphalt filler—Des Moines Asphalt Paving Co., $61,748; Asphaltic concrete—Des Moines Asphalt Paving Co., $54,404; asphaltic macadam—Des Moines Asphalt Paving Co., $52,960. Dolarway—M. Ford Paving Co., Cedar Rapids, Ia., $48,728.

Concrete—Weighton, Sioux City, Ia., $41,780. Bids were opened Feb. 24. The Iowa Engineering Co., Clinton, Ia., are Engineers. Contracts have not been awarded.

The City Council of Davenport, Ia., has ordered the creation of improvement district No. 30, including nearly 65 blocks of street paving and seven blocks of alley paving. The cost is estimated at $300,000.

The City Council of Sioux City, Ia., on Feb. 22 was petitioned to pave First St., from Virginia to Court St., and 24th St., from Pierce to Summit. The Council at the same time passed resolutions for the paving of 13th St., from Jackson to Jennings Sts.; 16th, from Summit to Market, and 26th, from Pierce to Jackson Sts. Fred C. Smith is City Engineer.

Kansas.

✣Bids will be received until 2 p. m., March 15, by Ena Kirkpatrick, City Clerk, Anthony, Kan., for the necessary labor and material for the construction of about 40,000 lin. ft. of curb and gutter. A certified check for $500 must be filed with each bid.

Kentucky.

✣Bids will be received until 2 p. m., March 13, by Board of Public Works, Louisville, Ky., for 2,575 sq. yds. of 2½-in., 16-lb. wood blocks for use on Main St., between Fourth and Fifth Sts. They are to be furnished and laid by the contractor. D. R. Lyman is Chief Engineer.

An election is to be held in Todd County, Ky., on April 12 for the purpose of voting on the issuance of bonds to the amount of $190,000 for good roads construction. Elkton is the county seat.

Louisiana.

⊙C. S. Jackson & Co., of Crowley, La., have been awarded the contract by the Highway Department of the Board of State Engineers of Louisiana, 104 New Orleans Court Bldg., New Orleans, La., for the construction of 11 miles of the Many-Fort Jesup highway in Sabine Parish, for about $24,900. Bids were opened Feb. 25. W. E. Atkinson is State Highway Engineer.

The Louisiana State Highway Department has been requested by Charles J. Blanchard, Secretary of the Police Jury of Assumption Parish, Napoleonville, La., to make surveys in that parish, preparatory to building a line of roads.

The Police Jury, Donaldsonville, La., has created a road district to be composed of Wards 1, 2, 3 and 4, and an ordinance was adopted calling a special election to be held in the district March 25 for the purpose of levying a special tax of 1½ mills for the construction of gravel roads from the Iberville to the St. James line, and on both sides of Bayou Lafourche from Donaldsonville to the Assumption line, a distance of 20 miles. Bonds to the amount of $50,000 are proposed to be issued.

Maryland.

W. H. Clagett, Pikesville, Md., submitted the lowest bid to the Highway Commission, Towson, Md., on Feb. 20, for the construction of a section of the Black Rock road from the end of the improved section to Mount Zion Church, a distance of 1.98 miles. The bid was $19,517.

The Frederick County Commissioners, Frederick, Md., have decided to ask the next Legislature to pass a bill providing for the election of a Road Supervisor in each election district of the county to serve for two years.

Following low bids were received by the Board of Awards of Baltimore, Md., for paving work, as follows: Contract No. 43, vitrified brick—Martin J. Beach, $2.16 per sq. yd. Contract No. 45, sheet asphalt and bituminous concrete—Patrick Flanigan & Co., $1.70 per sq. yd. Contract No. 46, vitrified brick—Patrick F. Redington, $2.24 per sq. yd. Contract No. 47, vitrified brick—Patrick F. Redington, $2.35. Contract No. 48, Belgian block—The George Long Contracting Co., $3.43 per sq. yd. Contract No. 49, Belgian and Masson block—The Masson Contracting Co., and George Long Contracting Co., both bidding $3.35 per sq. yd. Contract No. 50, Fort Ave.—Patrick Flanagan, $1.70 per sq. yd. Contract No. 51, bituminous concrete and sheet asphalt—F. E. Schneider Paving Co., $1.38 for bituminous concrete and $1.85 for asphalt.

Michigan.

✣Bids will be received until 2 p. m., April 15, by J. N. Forshar, County Clerk, Manistique, Mich., for the construction of 3 miles and 66 rods of macadam road in Schoolcraft County, Mich. Official advertisement will be found elsewhere in this issue.

⊙Carpenter & Anderson of Grand Rapids, Mich., have been awarded the contract for the improvement and extension of North Turner Ave., to Comstock Park by the Good Roads Commission, Grand Rapids. The contract calls for the expenditure of about $12,000.

According to advices from Saginaw, Mich., the citizens of Saginawtown voted against the issuance of bonds to the amount of $21,000 to build good roads. The money was to be used to improve the Hill, Mackinaw, River and Shattuck Roads, seven miles in all

City of Hastings, Mich., will construct this year about 1 mile of concrete pavement on Jefferson and Green Sts.

City of Marshall, Mich., will vote this spring on bonding for $50,000 for storm sewers and paving.

Minnesota.

✣Bids will be received until 8 p. m., March 18, by City of Ely, St. Louis County, Minn., for the construction of cement sidewalks, combined curbs and gutters and storm sewers, in accordance with plans on file at the office of J. Wisted, Jr., City Clerk. C. A. Nutter is City Engineer. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 1 p. m., March 14, by Jackson County Board at the office of P. D. McKellar, County Auditor, Jackson, Minn., for grading, graveling and furnishing culverts and bridges for State Roads Nos 6, 13 and 19. Plans are on file with the county auditor and at the office of the State Highway Commission, St. Paul, Minn.

✣Bids will be received until 11 a. m., March 17, by Board of County Commissioners, Minneapolis, Minn., for grading 4,000 lin. ft. of road bed and boulevards on road No. 52, being Nicollet Ave., commencing at the city limits of the City of Minneapolis, and extending south, all according to plans and specifications on file in the office of the County Surveyor. Proposals must be made on blank forms furnished by the County Surveyor, and accompanied by a certified check, payable to the order of the County Treasurer, for 5 per cent of the amount of the bid, as a guaranty for the execution of a contract if awarded. A. P. Erickson is Auditor of Hennepin County.

City Engineer John Wilson of Duluth, Minn., is preparing plans for the paving of 29th Ave., west from Superior St. to Third St.

Missouri.

The City Council of Chillicothe, Mo., has asked for bids for the paving of Vine St., from the south line of Webster St. to First St., with Hassam pavement. Joe Broaddus is City Engineer.

City Engineer Edw. C. Thomes of Poplar Bluff, Mo., is making survey for 40,000 sq yds. of brick pavement, on a 4-in. gravel concrete base, 1½-in. sand cushion and asphalt or cement grout filler; also orders for about two miles of additional pavement. Letting of the first named will be some time in March or April.

Nebraska.

✣Bids will be received until 11 a. m., March 10, by Ed. F. Vrzak, Colfax County Clerk, Schuyler, Nebr., for slip and elevator grader work on the county roads for the remainder of the season of 1913. The work will include about 45,000 cu. yds. of road grade with grader in Rogers and Schuyler Precincts, estimated to cost 10 cts. per cu. yd.; also cut and fill 3,750 cu. yds., estimated to cost 40 cts. per yd.; 16,000 cu. yds. in Stant Precinct at 25 cts. per cu. yd.

An election will be held in Norfolk, Neb., on March 24 to decide whether or not more paving will be put in this season.

Following bids were recently received by the Board of County Commissioners, Omaha, Nebr., for grading the ground formerly occupied by the old court house to street level: Williams & Son, 77½ cts. per yd., 25 days; Partridge-Thompson Co., 70 cts., 50 days; Partridge-Thompson Co., 60 cts., 60 days; Smith Brick Co., 53 cts.; J. P. Jackson, 52½ cts., and Partridge-Thompson Co., 50 cts., 75 days.

The City Council of Lincoln, Nebr., has instructed the Lincoln Traction Co., to lay paving between its tracks in District No. 249, extending from B to Washington on 14th St., and another district from 12th to 16th on G St.

The Board of Local Improvements of Lincoln, Nebr., has adopted a resolution providing for the paving of one block on Broadway, from Kickapoo to Chicago St., with creosoted wood block.

A proposition to vote upon paving intersection bonds in the sum of $40,000 will be submitted to Fremont, Nebr., citizens at the spring election.

New Hampshire.

The town of Exeter, N. H., will vote this month on the purchase of a street sweeper. Newell S. Tilton is Highway Agent.

New Jersey.

✣Bids will be received until 11:30 a. m., March 12, by Board of Chosen Freeholders, Mount Holly, N. J., for furnishing a 10-ten steam or gasoline road roller. Harry Hawkins, Jr., is Clerk of the Board. James Logan is County Engineer.

✣Bids will be received until 8 p. m., March 18, by Common Council of the City of Englewood, N. J., for paving with asphalt blocks, curbing and improving Palisade Ave., from Engle St. to James St. A certified check for $1,000 must accompany each bid. Plans and specifications may be seen and form of tender secured at the office of W. G. Clark, 30 Church St., New York City, or at the office of Robert Jamieson, City Clerk, Englewood, N. J.

✣Bids will be received until 2 p. m., March 10, by Board of Street and Water Commissioners, addressed to John Prout, Chairman, Street Committee, Jersey City, N. J., for the improvement of Spruce St., from Hudson Blvd., to Tonnele Ave., in accordance with specifications on file at the office of E. B. See, Clerk.

⊙The Commissioners of Atlantic City, N. J., on Feb. 27, selected the Mack repressed vitrified block for the paving of 27 streets and alleys. The contract for this work was awarded some time ago to Chas. H. Cramer for $2.35 per sq. yd. on a 6-in. concrete foundation.

On recommendation of City Chemist Howard C. Hottell, the City Commissioners, Trenton, N. J., included in their budget an appropriation for a portable asphalt and repair plant. A plant having a capacity of from 500 to 1,000 sq. yds. a day is planned.

New York.

An ordinance has been introduced in the Common Council, Rochester, N. Y., providing for the improvement of Lake Ave., by the construction of a new pavement between Lyell and Driving Park Aves., and the removal of the car tracks from the sides to the center of the highway. The estimated cost is $157,400.

The Town Board of Canandaigua, N. Y., has appropriated $1,200 for the purpose of continuing the work of building a new highway on Tichenor Hill. The Board has also been petitioned for the improvement of the West Lake Road from Tichenor's Hill southward to the base of the Academy Hill at Foster's.

The Village Trustees of Penn Yan, N. Y., have adopted a resolution authorizing the submission to the taxpayers the proposition to

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

pave Elm St. with brick, 36 ft. wide, with a cement curb, from the limit of the present pavement at Keuka St., to the corporation line, a distance of 2,480 ft., at an estimated cost of $12,000; also to pave Clinton St. with brick, 24 ft. wide, with a cement curb, from Main to Head Sts., a distance of 3,900 ft., at an estimated cost of $16,000. The election will be held March 18.

The City Council of Auburn, N. Y., has decided to pave Franklin St., from the Five Points to the bridge over Hunter Brook with vitrified brick. E. C. Aldrich is City Engineer.

The Village Board of Trustees, Lancaster, N. Y., has engaged County Engineer George C. Diehl to prepare plans and specifications for the paving of Church St. in that village.

Commissioner of Public Works John Smith, Oswego, N. Y., has announced that municipal improvements costing upwards of $300,000 will be started in the spring and that the greater portion of the work will be completed during the season.

An ordinance is before the City Council of Albany, N. Y., authorizing the Commissioner of Public Works to employ an expert or experts to investigate and report upon the best method of collecting and disposing of the garbage, ashes and rubbish of the city. The ordinance carries an appropriation of $2,500. Frank R. Lanagan is City Engineer.

Ohio.

✣Bids will be received until noon, March 31, by Carl A. Palmer, Clerk of the Village of Shaker Heights, O., at his residence on Broxton Road or at his office in the First National Bank, Cleveland O., for furnishing the material and labor necessary for the improvement of Coventry Road, from the north line of Shaker Heights Village southerly and easterly to the east line of said village, by establishing a grade, grading, draining, curbing, paving the same with asphalt brick or block, or vitrified shale brick or block, and constructing sidewalks, according to the plans and specifications on file at the residence of said Clerk on Broxton Road, and at the office of B. W. Willard, Village Engineer, at No. 931 Williamson Bldg., Cleveland, O. Bidders are requested to use the printed form, which will be furnished on application, by said Clerk or at the office of said Village Engineer. Each bid must contain the full name of every person or corporation interested in the same, and be accompanied by a certified check for $10,000.

✣Bids will be received until noon, March 11, by A. F. Samsel, Clerk of the Village of Deshler, O., for furnishing the necessary labor and materials for the improvement of Elm St., from the east line of Vine St. to the west line of Ash St., by grading, paving with brick on concrete foundation and constructing the necessary curbing, sewers and catch basins according to the plans and specifications on file in said office. Each bid must contain the full name of every person or company interested in the same, and be accompanied by a bond or a certified check in the sum of $1,000.

✣Bids will be received until 11 a. m., March 29, by Board of Cuyahoga County Commissioners, Cleveland, O., for the improvement of South Woodland Road No. 3 in accordance with plans and specifications furnished by F. R. Lander, County Surveyor. A certified check for $1,000 must be filed with each bid. Plans, descriptions, bills and specifications for the above work can be seen and are open to public inspection of persons interested therein, at the office of the County Engineer at the new court house on Lakeside Ave., Cleveland, O. J. F. Goldenbogen is Clerk of the Board.

✣Bids will be received until 11 a. m., March 29, by Board of Cuyahoga County Commissioners, Cleveland, O., for the improvement of Prospect Road No. 2 in accordance with plans and specifications furnished by F. R. Lander, County Surveyor. J. F. Goldenbogen is Clerk. A certified check for $1,000 must be filed with each bid. Plans, descriptions, bills and specifications for the above work can be seen and are open to public inspection of persons interested therein, at the office of the County Engineer at the new court house on Lakeside Ave., Cleveland, O.

✣Bids will be received until noon, March 15, by Trustees of Hinckley Township, Medina County, O., for the improving of River Road No. 1, about 7,400 ft. in length. Ira Waldo is Township Clerk. Clyde Harvey, Medina, O., is County Surveyor.

⊙Service Director Cowell of Toledo, O., has awarded the following contracts for street work: H. P. Streicher, for paving Collins St., from Detroit Ave. to Michigan Central railroad, $8,910; Glenwood Ave., from Central Ave. to Castle Blvd., $14,731; Islington St., from Collingwood Ave. to Lawrence Ave., $16,198; Maplewood Ave., from Central Ave. to Castle Blvd., $17,088; Peters Bros., for paving Ewing St., from Vance to Hamilton with vitrified brick, $8,050. M. F. O'Sullivan, for paving Rogers St. from Navarre to Earl, $8,406, with brick; Peter H. Watters, for paving Redwood Ave., from Bowman to Congress Sts., with concrete, $3,546, and Lorain St., from Broadway to the Clover Leaf tracks, with concrete, $5,991.

⊙Geo. Herring & Son, Cleveland, O., have been awarded the contract by the village of Burton, O., A. C. Brown, Clerk, for grading, draining, curbing and paving with concrete North Cheshire St., for $11,809. Bids were opened Feb. 20.

⊙Lee & Gregg, Millersburg, O., have been awarded the contract by the Village Board of Smithville, O., for the paving of Main St., from the Square to the Wheeling Station, for $9,532. Wooster brick on a concrete foundation will be used.

⊙The Kirchner Construction Co., Cincinnati, O., has been awarded the contract by the Village of Lockland, O., for the construction of pavement, curb, gutter, drains and sidewalks on Wyoming Ave. for $53,070. Bids were opened Feb. 24.

⊙The Board of Control of Youngstown, O., has awarded the contract for paving Marion Ave., from Healey St. to South Ave., with concrete and sheet asphalt, to the Cleveland Trinidad Asphalt Co., Cleveland, O. The Board also awarded a contract to Fleming & Platt, at $7,642, for paving Kyle St.

The City Council of St. Marys, O., has instructed the Solicitor to prepare the necessary preliminary legislation for the paving of Clinton St., between Wayne and Ash Sts., and Ash St., between Clinton and High Sts.; also for the construction and repair of a number of sidewalks.

The Stark County Commissioners, Canton, O., plan to let the contract for the paving of the Alliance-Harrisburg Road, a distance of 10 miles connecting the two places, within six weeks. It is estimated that the improvement will cost between $173,000 and $202,000, depending upon the kind of material adopted.

The property owners along the North Market St. extension, between the city limits and Cairo, O., 5½ miles north, at a recent meeting of the Stark County Commissioners, Canton, O., accepted the plans for the improvement of that thoroughfare. It will be a 16-ft. brick pavement for the entire distance with center road construction and either stone or cement curbing. The cost, according to materials selected, will range from $101,886 to $118,943.

The Stark County Commissioners, Canton, O., have decided to pave 2.15 miles of the Alliance-Minerva Road, south from the end of the pavement near Fairmount Children's Home. The roadway will cost approximately $48,000.

The Village of New Concord, O., has made arrangements to spend $30,000 in paving the streets this year.

The City Council of Ashtabula, O., has passed an ordinance to proceed with the paving of Lake St., from the south line of Aunger Ave., to the south line of Erie St. The improvement will cost $60,000.

The Portage County Improvement Association, Ravenna, O., has retained Frank Williams, former State Engineer of New York, to act as Chief Engineer in the construction of about $1,000,000 worth of highways in Portage County. Daniel R. Hanna, of Cleveland, O., is President of the Association.

Oklahoma.

✣Bids will be received until 5 p. m., March 10, by W. H. Staples, City Clerk, Cleveland, Okla., for paving of the business district. Material to be used will be vitrified brick blocks on a concrete base, sand cushion, cement grout filler. Amount of improvement approximately $50,000. Certified check required $2,500. Plans and specifications can be obtained upon remittance of $5 to The Benham Engineering Company. Consulting Engineers 435-7 American National Bank Bldg., Oklahoma City, Oklahoma.

The City Council of Cleveland, Okla., has passed resolutions providing for the paving of Broadway Ave. with brick on a concrete base. Concrete will be let within one month.

Oregon.

⊙Streets Committee of the City Council of Portland, Ore., has awarded street improvement contracts as follows: E. 22d St., from Clinton to Woodward, gravel bitulithic, Oregon Independent Paving Co., $3,804; E. 18th, from Division to Clinton, gravel bitulithic, Oregon Independent Paving Co., $3,576; E. 11th St. district, Hassam, Oregon Hassam Paving Co., $6,010; E. 39th, from Division to Woodward, bitulithic redress, Oregon Independent Paving Co., $6,425; E. 22d, from Multnomah to Weidler, bitulithic redress, Oregon Independent Paving Co., $4,345; E. 35th St., from Hawthorne to E. Stark, bitulithic redress, Oregon Independent Paving Co., $11,783; E. 64th St., from Sandy to Klickitat, gravel bitulithic, Oregon Independent Paving Co., $2,943; E. 49th St., from Hawthorne Ave. to Newport addition, grading and concrete curbs and walks, Oregon Independent Paving Co., $3,352; E. 70th St., from Powell to Foster, grading and concrete curbs and walks, Oregon Independent Paving Co., $7,821; E. 39th St., from Woodstock to Windsor, grading and concrete curbs and walks, Oregon Independent Paving Co., $2,814; E. 37th St., from Schiller to Steele, grading and concrete curbs and walks, Oregon Independent Paving Co., $2,215; E. 49th St., from Newport addition to E. Harrison St., grading and concrete curbs and walks, Linden-Kibbe Co., $949; E. 47th, from E. Lincoln to Division, grading and concrete curbs and walks, Oregon Independent Paving Co., $1,486; E. 18th St., from Prescott to Mason, grading and concrete curbs and walks, Oregon Independent Paving Co., $2,527; Congress St., from Portland Blvd. to Morgan St., grading and concrete curbs and walks, Bechill Bros., $3,975.

The Jackson County Commissioners, Jacksonville, Ore., have authorized preliminary surveys for an improved road over the Siskivous, south of Ashland.

Pennsylvania.

✣Bids will be received until April 1, it is reported, by City of Monongahela, Pa., for the construction of 8,000 sq. yds. of brick pavement.

✣Bids will be received until March 15, it is reported, by G. F. Roess, City Engineer, Oil City, Pa., for the construction of 5,200 sq. yds. of wood block pavement.

✣Bids will be received until 10 a. m., March 7, by Director J. G. Armstrong, Department of Public Works, Pittsburgh, Pa., at the office of the City Controller, for making test borings on the line of proposed Corliss St. tunnel.

✣Bids will be received until 10 a. m, March 7, by J. G. Armstrong, Director of Public Works, at the office of the City Controller, Pittsburgh, Pa., for certain public improvements, as follows: Grading, curbing and paving with blockstone, Craighead St., from Excelsior St. to Kathleen St.; Dyer St., from

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Langtry St. to Woods Run Ave., regrading, repaving with blockstone and otherwise improving, Water St., from Liberty Ave. to Penn Ave. and Exchange Al. and Penn Ave. affected thereby; grading, curbing and paving with asphalt, Hoeveler St., from Collins Ave. to a point 75.65 ft. southwest of Culver St.; Hoeveler St., from Everett St. to a point 62.60 ft. northwest of Omega St.; Devonshire St., from Wallingford St. to Center Ave; Devonshire St., from Ellsworth Ave. to Bayard St.; Tuscarora St., from Braddock Ave. to the city line; grading, curbing and paving with brick, Langtry St., from Shelby St. to Dyer St.; Shelby St., from Hall St. to Langtry St.; Mary St., from Handler St. to a point 201 ft. westwardly; Mulford St., from Hamilton Ave. to Oakwood St.; Rockledge St., from Damas St., to north line of Miles Al.; grading, curbing and paving with blockstone and brick, Merritt St., from Taggart St. to a point 340 ft. northwardly; repaving with blockstone, Grandview Ave., from a point 50 ft. east of Merrimac St. to a point near Cohassett St.

✣Bids are asked until March 7 by Fred H. Gates, City Clerk, Wilkesbarre, Pa., for cleaning the city streets.

✣Fred H. Gates, City Clerk of Wilkesbarre, Pa., has been instructed to call for bids on curbing for N. River St., from North to Courtright Ave., and also for repaving S. Washington St., from Northampton to Hazle St.

⊙The Borough of Greenville, Pa., J. H. Gibson, Chairman of Improvement Committee, has awarded the contract for grading and paving about 30,000 sq. yds. and curbing and guttering 22,150 ft. to Roess & Sisure, of Oil City, Pa., for $72,000. Bids were opened Feb. 24.

⊙Ernest C. Sturts, 2614 Ridge Ave., Philadelphia, Pa., has been awarded the contract by the Department of Wharves, Docks & Ferries, 555 Bourse Bldg., Philadelphia, Pa., for wood block paving and general repairs to the pier at the foot of Chestnut St., on the Delaware River, for $15,500. Bids were opened Feb. 25.

Bids have been asked by the City Council of Millville, Pa., for the paving of the principal streets with vitrified brick.

Tennessee.

The Board of Washington County Commissioners, Jonesboro, Tenn., is considering the construction of a pike road from what is known as the Fork country in Sullivan County, to Johnson City, a distance of 12 miles.

Texas.

⊙The City Council of Houston, Tex., has accepted the following bids for street paving: Creosoted Wood Block Paving Co., for paving LaBlanch St., between Bell and Leeland; Eureka Construction Co., for the paving of Courtlandt Blvd., from the intersection of Lovett Blvd., to Stuart Ave. and Brazos St.; Talbot & Co., for the resurfacing of Washington Ave., between Fifth St., and a line drawn 210 ft. between the west line of Third St., with vitrified brick.

An election is to be held in Road District No. 1 of Colorado County, Tex., on March 26 for the purpose of voting on the issuance of bonds to the amount of $100,000 for road construction. Columbus is the county seat.

The citizens of Precinct No. 4 in Eastland County, Tex., on Feb. 18 voted against the issuance of bonds to the amount of $60,000 for the construction of good roads. At the same time the citizens in Rising Star Commissioners' Precinct also defeated the same proposition. Eastland is the county seat.

Utah.

A bill has been introduced in the Utah Legislature providing for an appropriation of $10,000 for the repairing and improving of the Logan Canyon Road, a distance of 11½ miles, and specifying that the road be taken over as a state highway. The bill also appropriates $15,000 for the construction of a new road from a point about 2½ miles east of the forks of Logan Canyon along the present road, extending in a southeasterly direction to a point intercepting the Blacksmith Fork Canyon Road near Saddle Creek, a distance of about 7 miles.

The Utah Legislature on Feb. 21 passed a bill appropriating $50,000 to aid in the building of the proposed automobile highway from the Utah-Colorado line to Salt Lake City over the route known as the Midland Trail. The bill has already been passed by the Senate.

Virginia.

⊙B. Zandy, of Martinsville, Va., has been awarded the contract by the Board of Managers, J. T. Penn, Chairman, Martinsville, for the construction of 2,000 yds. of granolithic walks, for $0.95 per yd. Bids were opened Feb. 27.

⊙The City Council of Norfolk, Va., is reported to have awarded the contract for the paving of High St., west of Chestnut, with bituminous concrete, to the McGuire Construction Co. of that city. The work will cost about $55,000.

Washington.

✣Bids will be received until 11 a. m., March 25, by Lieut. Herbert O'Leary, Assistant Quartermaster, Fort Flagler, Wash., for construction of granolithic sidewalks at that post.

West Virginia.

The West Virginia Legislature has passed a bill providing for the construction of a system of state roads with convict labor.

Wisconsin.

✣Bids will be received until 2 p. m., March 15, by City of Watertown, Wis., for paving three streets and two alleys with reinforced concrete according to plans and specifications on file at the office of the Board of Public Works. The work will include 23,000 sq. yds. of pavement and 15,100 lin. ft. of combined curb and gutter. Arnold Kraeft is City Engineer. Official advertisement will be found elsewhere in this issue.

The Board of Public Works of Madison, Wis., has decided to improve Williamson St., from South Blair to South Baldwin Sts., at an estimated cost of $8,000. The street is to have a new top dressing.

Bids were received by the City of Columbus, Wis., Walter A. Pierce, City Engineer, on Feb. 25, for the construction of 8,625 sq. yds. of pavement, 5,080 lin. ft. of curb and gutter, and 1,850 yds. of excavation. The bidders were as follows: (1) J. Rasmussen & Sons, Oskosh, Wis.; (2) Thos. E. Woolley, La Crosse, Wis.; (3) Ed. L. Bartlett, Watertown, Wis., and (4) Nelson-Weber Construction Co., Oconomowoc, Wis. All bids submitted were on a one-year guarantee bond. The bids were as follows:

	(1)	(2)	(3)	(4)
Asphalt concrete:				
Penetration method (Bermudez)	$1.50	.....	$1.55	$1.47
Penetration method (any asphalt)	....	1.66	.....	.....
Mixing method (Bermudez)	1.65	.....	1.70	1.63
Mixing method (any asphalt)	....	1.66	.....	.....
Brick:				
Barr	2.04	2.09	2.10	2.01
Danville	....	2.07	.....	.....
Purington	2.06	2.07	2.11	2.03
Concrete:				
One course process	....	.....	*1.55	.....
Excavation	.40	.35	.40	.39
Curb	.45	.35	.47	.40
Curb and gutter	.57	.50	.58	.53

*Also bid $1.50 on plain concrete.

Canada.

✣Bids will be received until noon, March 28, by City Commissioners, Saskatoon, Sask., for the construction of approximately: 265,390 sq. ft. of concrete walk; 5,700 sq. ft. of lane crossings; 28,760 lin. ft. of separate curb; 22,050 lin. ft. of combined curb. All information may be obtained on application to George T. Clark, City Engineer, Saskatoon, Sask.

✣Bids will be received until noon, March 11, by H. C. Hocken, Chairman, Board of Control, Toronto, Ont., for supply of refined asphalt, also 12 asphalt wagons. Specifications may be obtained of the Purchasing Section, Department of Works, City Hall, Toronto.

✣Bids will be received until noon, March 15, by George R. Boyd, Town Clerk, Welland, Sask., for the construction of concrete sidewalks for the present year.

✣Bids will be received until noon, March 28, by City Commissioners, Saskatoon, Sask., for the construction approximately 42,000 sq. yds. of pavement and 12,800 lin. ft. of concrete gutter. All information may be obtained upon application to George T. Clark, City Engineer, Saskatoon, Sask.

Citizens of North Bruce, Ont., have asked Hon. J. O. Reaume, Minister of Public Works, to include a road from Wiarton to Tobermoray in the colonization road estimates for this year. The distance is 50 miles. Part of the road is already constructed and only needs improvement, but five miles lies in a swamp and will cost $50,000 to construct.

The citizens of Regina, Sask., J. McArthur, City Engineer, on Feb. 25 voted by-laws to the amount of $22,000 for road making and road cleaning equipment.

BRIDGES

Alabama.

⊙The Board of Revenue, according to advices from Birmingham, Ala., has let the contract for furnishing the material for the proposed steel bridge on the county road to Bessemer near Grasselli to the Southern Steel & Iron Co.

Arizona.

Plans are being prepared by City Engineer W. H. Thompson, Tucson, Ariz., is preparing plans for the construction of a viaduct over the tracks of the Southern Pacific near the depot.

The House of Representatives of the Arizona Legislature passed without opposition the bill introduced by Fred Wessel appropriating $25,000 to be used in connection with $50,000 appropriated by California and the U. S. Government for the construction of the joint bridge over the Colorado River at Yuma, Ariz.

Arkansas.

A Bridge Improvement District has been formed in Yell and Pope Counties, Ark., for the purpose of erecting a railroad and wagon bridge over the Arkansas River at Dardanelle. The estimated cost of the proposed structure is $400,000. Judge R. B. Wilson, Russellville, Ark., is interested.

California.

✣Bids will be received until 10:30 a. m., March 11, by Board of Stanislaus County Supervisors, Modesto, Calif., for the construction of the proposed new bridge at LaGrange.

The City Council of Pasadena and the Supervisors of Los Angeles County recently met to discuss the proposition of constructing a bridge over the Arroyo Seco at California St. The cost of the structure which will amount to about $20,000 or $35,000, will be divided between the city and the county. S. J. Van-Ornum is City Engineer.

A number of counties in the vicinity of Martinez, Calif., have joined a movement toward forming a district to issue bonds to the amount of $1,750,000 for the construction of a suspension bridge over four miles in length, from Bulkhead point in Martinez to Army point on the Benicia shore line. The proposed bridge will be built 225 ft. over the surface of the straits. Assemblyman T. D. Johnstone of Richmond is to be asked to introduce a bill into the Legislature providing for the bridge district. It is also proposed that the movement request an appropriation from the government and the state. The counties interested are Contra, Costa, Alameda, Solano, Napa, Yolo, Glenn, Colusa and Sacramento.

The City Trustees, Redding, Calif., have engaged Charles T. Dozier to prepare plans and specifications for the construction of a new bridge over the Sacramento River at the northeast end of Market St. The structure will provide an entrance into the city of the state highway.

Petitions are being circulated in Glenn and Colusa Counties asking the supervisors to construct a steel and concrete bridge over the Sacramento River at Princeton replacing the present free ferry at that place. The cost of a new structure would, it is roughly estimated, amount to about $100,000.

Florida.

A number of citizens of St. Augustine, Fla., are planning the construction of a free bridge to Anastasia Island. The structure will include a causeway and a lift span. The cost is estimated at about $20,000. Albert Lewis is interested.

Illinois.

✣Bids will be received up to 11 a. m., March 5, 1913, at the Court House, Quincy, Illinois, for the construction of one reinforced concrete bridge on plain concrete abutments to be built in Keene Township, Adams County. S. M. Ketchum, Town Clerk, Loraine, Ill. Ross Bridge—Span 20 ft.; roadway, 18 ft.; height, 9½ ft.; estimated total concrete, 72.1 cu. yds.; reinforcing steel, 4,475 lbs. Nearest railroad station, Loraine, 2½ miles. It is reported that a good quality of gravel may be obtained from Bear Creek, 1 mile from bridge site at 10 cts. per cu. yd. at pit. No present bridge. Green timber for falsework may be cut near the site. Low water flow dry; high water about 5 ft. deep. Excavation to be carried about 2 ft. below stream bed to rock. Average excavation about 3 ft. Engineer's estimate, $800. Work to be completed on or before July 1, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

⊙Dempsey & Sehlipman, Fowler, Ill., have been awarded the contract for the construction of a reinforced concrete bridge near Coatesville at $507.

⊙Johnson & Warner Construction Co., St. Anne, Ill., has been awarded the contract at Crete, Ill., for the construction of a reinforced concrete bridge, for $644. Bids were opened March 1 by S. Rose, Town Clerk.

According to an announcement work on the $4,500,000 bridge over the Ohio River between Paducah and Metropolis, Ill., will be commenced as soon as the river level becomes normal. W. J. Hills is Vice President and General Manager of the Paducah & Illinois Bridge Co.

All bids received Feb. 21, by Albert Brosi, Town Clerk, Coatsburg, Ill., for the construction of a steel bridge in Honey Creek Township, Adams County, Ill., were rejected.

Indiana.

✣Bids will be received until 10 a. m., March 14, by Board of Madison County Commissioners, Anderson, Ind., for the construction of three steel bridges and one reinforced concrete bridge. J. B. Benefiel is County Auditor.

The Board of Parke County Commissioners Rockville, Ind., has decided upon the construction of a new bridge at Armiesburg to replace the old one now in use. The new structure according to the plans will be of reinforced concrete and will consist of two 75-ft. spans. The cost will amount to about $10,000.

Iowa.

✣Bids will be received by the City of Waterloo, Ia., until March 10, for the construction of two reinforced concrete bridges of the deck girder type over the Blackhawk Creek. The structures will include about 1,320 cu. yds. of concrete and about 102,000 lbs. of steel. Charles A. Robey is City Engineer.

Plans and specifications have been approved for the construction of a reinforced concrete bridge over the Cedar River at Mullan Ave., Waterloo, Ia. The bridge will be of five centered arch type, total length of 756 ft., including tow 58-ft. end arches and seven central arches of 76-ft. span. About 5,275 cu. yds. of concrete and 225,000 lbs. of steel will be included. Charles A. Robey is City Engineer.

The City of Cedar Rapids, Ia., is contemplating the construction of a bridge over the river at F Ave.

The Department of Streets, Des Moines, Ia., will erect two new bridges during the coming season at a cost of $12,000. The Youngstown bridge will be replaced at a cost of $3,500 and a new bridge at Walnut Creek on the new road to Valley Junction will be erected at a cost of $7,500.

All bids received Feb. 12, for the construction of concrete bridges and culverts in Poweshiek County, Ia., were rejected Feb. 21. W. C. McKee is County Auditor, Montezuma, Ia.

Louisiana.

The House of Representatives, Washington, D. C., has passed Broussard's bill providing construction of a bridge across the Mississippi at or near Baton Rouge. Under provisions of the bill authority is granted the Baton Rouge Bridge and Terminal Company to construct and operate a bridge, which in addition to its use for railroad trains and trolley cars, shall have separate roadway and approaches for public traffic. Authority is granted the company to make reasonable toll rates, but it is prohibited from making a rate for passage of a single passenger on a railroad train in excess of 25 cts. An early passage of the bill by the Senate is anticipated.

Minnesota.

✣Bids will be received until 11 a. m., March 24, by Board of Hennepin County Commissioners, Minneapolis, Minn., for the necessary labor and material for repairing the southerly one-half of bridge No. 3, known as the St. Michaels Bridge, over the Crow River in the Town of Hassan. A certified check for 5 per cent the amount bid must accompany each proposal. A. P. Erickson is County Auditor.

✣Bids will be received until 2 p. m., March 18, by Theodore Peterson, Waseca County Auditor, Waseca, Minn., for the construction of one reinforced concrete culvert and repairing three bridges located as follows: Standard reinforced concrete culverts 8x8x24 ft. long to be known as State Bridge No. 772 on State Rd. No. 9 in the Town of Wilton. The addition of steel wing piles and reinforced concrete backing to a bridge located on the State Rd. No. 1 in the Town of New Richland, bridge to be known as State Bridge No. 773. The addition of steel wing piles and reinforcing concrete backing and the replacing of wood with steel stringers on a 56-ft. truss bridge between the towns of Wilton and St. Mary bridge to be known as State Bridge No. 774. The addition of steel wing piles and reinforced concrete backing to a bridge located on State Rd. No. 6 in the Town of Janesville. Bridge to be known as State Bridge No. 771. Plans and specifications may be seen at the above named office or at the office of the State Highway Commission. Each proposal must be accompanied by cash or a certified check for $100 for each bridge, payable to the County Treasurer of said Waseca County.

It is believed that bids will be asked shortly by the Board of Hennepin County Commissioners, Minneapolis, Minn., for the construction of the proposed $6,000 bridge over the Crow River near Rockford, connecting Hennepin and Wright Counties.

The Board of Hennepin County Commissioners has instructed F. E. Haycock, County Surveyor, Minneapolis, Minn., to prepare plans and estimate of the cost for replanking and repairing the Hennepin County side of the bridge over the Mississippi River at Anoka.

Missouri.

✣Bids will be received until noon, March 11, by Board of Public Improvements, Maxime Reber, President., St. Louis Mo., for the construction and installation under Letting 10853, of 31 lamp posts on the Compton Ave. viaduct between Clark Ave. and Chouteau Ave., and of gas mains on the sides of the deck of said viaduct. W. T. Findley is Secretary.

⊙The City of Joplin, Mo., will as soon as funds are available, receive bids for the construction of the proposed Broadway viaduct. It has not been decided definitely, however, that the awarding of the contract will be left to the city, but it is believed to be probable that the Union Depot Company and the Southwest Missouri Railroad Company, both of which are to pay part of the cost of the viaduct, will agree to let the city award it. The bids probably will be considered by both railroads and the city, however, before the contract is let. C. B. Anderson is City Engineer.

Plans and specifications for the construction of the proposed steel foot viaduct at Illinois Ave., St. Joseph, Mo., have been completed and submitted to contractors. The specifications call for a steel viaduct rising at the east line of the right of way of the Rock Island on Illinois Ave. and extending over all the tracks. It will have a floor level 22 ft. above the tracks and will be reached by easy stairs at either end.

The United States Senate, Washington D. C., has authorized the construction of a bridge over the Mississippi River near the mouth of the Missouri River; also a bridge over the Missouri River near Weldon Springs Landing, Mo. The latter structure will permit a connection between the M., K. & T. R. R. and the Rock Island, St. Louis line.

Maryland.

The Committee appointed to investigate the advisability of constructing new steel bridges over the river at Salisbury, Md., has recommended that two lift bridges be built, one at Camden St., and the other at South Division St. It is estimated that the cost of the construction of these two bridges will amount to $40,000. No provision has been made for their construction and it will mean a big increase in the tax rate or a bond issue by the county to provide for the bridges. Salisbury, Md., is County seat of Wicomico County.

A survey is being made of the Broad Creek road to a point where the proposed bridge over Rolle's Creek will be built. The new structure will connect the Broad Creek road with the Church Neck Road which enters St. Michaels. Easton is the county seat of Talbot County, Md.

Nebraska.

⊙The contract for the construction and repair of bridges in Cuming County, Nebr., during the year of 1913 has been awarded to the Standard Bridge Co., Omaha, Nebr.

New Hampshire.

City Engineer Samuel J. Lord, Manchester, N. H., has submitted four sets of plans for the construction of a bridge to span the Piscataquog River at Kelleys Falls. One for a steel bridge to cost $120,000; another for a concrete arch bridge, 970 ft. in length, to cost $175,000, and the two other plans for foot bridges, one of wood, to cost $14,000, the other of steel, to cost from $6,000 to $8,000. The plans were placed on file.

The town of Alstead, N. H., will vote this month on the construction of two small concrete bridges at that place.

New Jersey.

✣Bids will be received until 2 p. m., March 10, by Board of Street and Water Commissioners, at the office of John Prout, Chairman of Committee on Streets, Jersey City, N. J., for repairing and repaving of Mercer St. viaduct. Blank forms must be obtained at the office of the chief engineer. 23 City Hall, Jersey City.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

At a meeting of the Ocean City Automobile Bridge Co., Feb. 27, at Ocean City, N. J., the proposition of the Sutton & Corson Company, of Ocean City, to build the bridge across Great Egg Harbor Bay from Ocean City to Somers' Point was accepted. The company's solicitor was instructed to draw up and execute the contract. The work is to begin as soon as possible and efforts will be made to have it ready for travel next summer.

New York.

✣Bids will be received until 1 p. m., March 6, by A. McKeever, Town Superintendent of Highways, Town of Chautauqua, Hartfield, N. Y., for the construction of two concrete and steel bridges and foundations for same in the town of Chautauqua, N. Y., one in the hamlet of Hartfield over the Chautauqua Inlet and one near the hamlet of Dewittville over Dewittville Creek. Plans may be seen at the office of C. H. Zenns, town clerk, Mayville, N. Y.

Contracts will be let about April 15 or May 1 for the construction of a 500-ft. steel and concrete bridge for the towns of Volney and Oswego, Minetto, Oswego County, N. Y. Concrete-Steel Engineering Co., Park Row Bldg., New York City, are Engineers

The village of Geneseo, N. Y., has passed a proposition to raise funds for the construction of a new steel bridge over the Genesee River between Geneseo and York.

North Carolina.

✣Bids will be received until 9 a. m., March 5, by Board of Cherokee County Commissioners, Murphy, N. C., for furnishing and erecting the following steel bridges: One at Ranger, 100-ft. span across Notla River; one at Kisselburg's, 90-ft. span across Notla River: one across Valley River, near Andrews, 90-ft. span; one across Beaverdam Creek at Unaka, 75-ft. span. Plans, profiles and specifications are on file at the office of County Commissioners and at office of G. W. Scott, engineer, court house building, Murphy, N. C. Correspondence should be addressed to G. W. Scott, engineer, Murphy, N. C. Each bidder must accompany his bid by a certified check or cash to the amount of $500, made payable to the Chairman of the County Commissioners. A. L. Johnson is Clerk to Board of County Commissioners.

⊙The Board of Johnson County Commissioners, Smithfield, N. C., has awarded the contracts for the construction of two bridges as follows: 240-ft. iron bridge to Austin Bros., Atlanta, Ga., at $3,549; 190-ft. iron bridge to Austin Bros., at $1,999. J. W. Curry, Greensboro, N. C., is agent of the bridge company. Bids were opened Feb. 17.

Ohio.

✣Bids will be received until noon, March 27, by Board of Wyandot County Commissioners at the office of Peter Frank, Jr., County Auditor, Upper Sandusky, O., for the furnishing all the material and performing all the labor for the construction of new county bridge over the Sandusky River in Tymochtee Township and known as the Cherokee Ford bridge, or for such parts thereof as the bidders may see fit to bid on. The location of said bridge, the dimensions of same, the nature of the labor and material to be furnished can be ascertained at the office of the County Auditor of Wyandot County, Upper Sandusky, Ohio, where such information is on file and can be seen at all reasonable hours.

✣Bids will be received until 11 a. m., March 26, by Board of Cuyahoga County Commissioners, Cleveland, O., for the construction of repairs to the present Brooklyn-Brighton Bridge per Report No. 3070. J. F. Goldenbogen is Clerk.

✣Bids will be received until March 8, it is reported, by Board of County Commissioners at the office of the County Auditor, Carrollton, O., for furnishing the necessary labor and material for the construction of a concrete bridge and a small iron bridge

⊙A. Q. Thatcher Construction Co., Toledo, O., has been awarded a contract at $30,245 for the construction of the Sumner St. bridge. G. W. Tonson is City Engineer.

A preliminary report on plans for the North Howard St. bridge extension has been filed by consulting engineer, Wilbur J. Watson, Citizens Bldg., Cleveland, O., with the Board of Summit County Commissioners, Akron. O. The issuance of $78,000 of bonds for the work has been authorized and it is expected that contracts will be let in about 30 days.

The Board of Cuyahoga County Commissioners, Cleveland, O., has adopted a resolution authorizing County Engineer Frank R. Lander to prepare plans and specifications for the construction of the proposed $1,000,000 Brooklyn-Brighton Bridge over Big Creek in Brooklyn.

Plans and specifications are being drawn up by Parker S. Bookwalter, at the request of Director of Public Service C. H. Hoglen, for the construction of the proposed Stewart St. canal bridge, Dayton, O. Bids for the structure will be asked as soon as negotiations have been completed for the proposed thoroughfare.

Oklahoma.

✣Bids will be received until 6 p. m., March 14, by Board of Comanche County Commissioners, Lawton, Okla., for the construction of six bridges.

Pennsylvania.

✣Bids will be received until 10 a. m., March 17, by Commissioners of Delaware County, Media, Pa., for the construction of a reinforced concrete arched cantilever structure bridge over Chester River at 5th St. John Griffin is Chief Clerk of the Commissioners.

✣Bids will be received until 2 p. m., March 18, by M. L. Cooke, Director of Public Works, Philadelphia, Pa., for the construction of bridges located as follows: At Montgomery St. over connecting railway. 29th and 32nd Wards, steel girder bridge encased in concrete arch, 40-ft. span, 78 ft. wide, with pavlong, with paving; Sixty-sixth Ave. North over North Penna. Railroad, 42nd Ward, concrete arch, 401ft. span, 78 ft. wide, with paving; Chester Ave. over Phila. and Baltimore Central Railroad, 40th and 46th Wards, steel girders encased in concrete, with extensions of present stone abutments, 70 ft. wide, 100 ft. long; City Ave. over Indian Run-Inter-County, concrete arch, 20-ft. span, with filling, paving and concrete balustrade.

✣Bids will be received until 8 p. m., March 17, by William Provost, Jr., Chairman, Joint Street Committee, Chester, Pa., for the construction of improvements at Ninth St. bridge and Chester River. The work will include reinforced concrete retaining walls, bulkhead and excavation.

⊙The contract for the construction of a reinforced concrete bridge at Ridgway, Pa., has been awarded to Will Dickinson, Ridgway, Pa., at $7,000. The structure will have a 70-ft. arch with 20-ft. roadway, 5½-ft. walk on each side and will include with the wingwalls about 600 cu. yds. F. W. Ward is Borough Engineer. Bids were opened Feb. 10.

The Executive Committee of the Ward Improvement Association has recommended the construction of a new bridge over Schuylkill River, at Philadelphia, Pa.

Upon the presentation of a petition to State Senator J. T. Fisher of Northumberland County, Sunbury, Pa., and representatives of Northumberland and Snyder Counties a bill was drawn up asking for the construction of a bridge between Herdon and Port Trevorton.

The Commissioners of Luzerne County, Wilkesbarre, Pa., have retained David A. Keefe, Athens, Pa., to prepare plans and specifications for the construction of a new bridge over the Susquehanna River at Nanticoke. The cost of the structure is estimated at about $300,000.

South Dakota.

⊙The Pioneer Bridge Co., Mitchell, S. Dak., has been awarded the contract for the construction of bridges in Miner County, S. Dak.

Texas.

⊙The City of Austin, Texas, has awarded to A. A. Mundt a contract for the construction of a culvert over Wall Creek at 11th and Red River Sts. The contract price was $4,164.

The following bids were received Feb. 20 by N. T. Blackburn, U. S. Engineer, for the construction of four highway swing bridges over Inland Waterway between Brazos River and Matagorda Bay, Texas: S. H. Hudgins, Velasco, Texas, $10,800; Spence & Howe Construction Co., Port Arthur, Tex., $11,750; C. Q. Horton, Austin, Texas, $11,400; The Midland Bridge Company, Kansas City, Mo., $16,700; Blodgett Construction Co., Kansas City, Mo., $10,400.

The Texas & New Orleans Railroad Company, which recently took over the property of the Burr's Ferry, Browndel & Chester R. R., is making preparations for the construction of a steel and concrete bridge over the Neches River.

Utah.

✣Bids will be received until March 13 by City Board of Commissioners, Ogden, Utah, it is reported, for the construction of the proposed iron bridge over the Weber River at 33rd St. H. J. Craven is Engineer of the city.

Virginia.

The Board of Harbor Commissioners, Norfolk, Va., has granted the Elizabeth Park & Land Co. a permit to erect a concrete draw bridge over Broad Creek, a few hundred feet north of the Norfolk Southern Electric Line bridge. C. E. Townsend of the Park and Land Company will be in charge of the bridge work.

⊙The Board of County Supervisors, Floyd, Va., has awarded the contract for the construction of a bridge over the south fork of Little River just north of Simpsons to the Roanoke Bridge Co., Roanoke, Va., at $1,700.

Washington.

✣Bids will be received until March 10 by County Auditor, Port Angeles, Wash., for the construction of a bridge over the Elwah River at Port Angeles, to cost about $40,000. Plans, etc., may be seen at the office of J. M. Baird, C. E. White Bldg., Seattle, Wash.

⊙The International Contract Co., Seattle, Wash., has been awarded a contract at $24,213 for the construction of the Ebey Slough Bridge. The structure will include a 700-ft. approach and a 240-ft. Strauss Trunion Bascule bridge. It will be located over Ebey Slough, an arm of the Snohomish River in Lot 4, Section 2-28-5, Snohomish County.

The House of Representatives of the Washington Legislature has passed the bill authorizing the state to enter into a contract with any county, city or state in the erection of a bridge. The bill will open the way for the construction of the proposed interstate bridge over the Columbia River between Portland, Ore., and Vancouver, Wash.

West Virginia.

⊙The Board of Control, Wheeliug, W. Va., has awarded the contract for the construction of a new reinforced concrete bridge over Caldwells Run at Moysten to the Riverside Bridge Co.

The Board of Control, Wheeling, W. Va., has taken up the matter of constructing a steel bridge over Caldwell's Run at 29th and Moysten Sts.

Wisconsin.

The Council Committee on Bridges and Viaducts, Milwaukee, Wis., has directed the Public Works Commissioner, F. G. Simmons, to find out what land would have to be condemned for the purpose of constructing the proposed 35th St. viaduct over the Menomonee Valley. The cost of such a structure is estimated roughly at $350,000. The committee recommended for adoption two resolutions to build concrete bridges over the Kinnikinnic River at Ninth and Tenth Aves. to cost $4,000 each.

The city of Manitowoc, Wis., is contemplating the construction of a new bascule bridge to replace the present structure at 8th St. L. K. Pitz is City Engineer.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Canada.

✣Bids will be received until March 15, by William Purvis, Townsbip Clerk, Columbus, Ont. (extension of time), for the construction of eleven reinforced concrete bridges in the township of East Whitby. Plans and specifications may be obtained of H. Fifford, Reeve, Cedarvale, Ont., and at the office of Bowman & Connor, Civil Engineers, 36 Toronto St., Toronto, Ont.

✣Bids will be received until Noon, March 20, by B. Ripley, Engineer of Grade Separation, Canadian Pacific Ry., Toronto, Ont., for the sub-structure of subways at Davenport Road, Spadina Road, Howland Ave., and Bathurst St., in North Toronto, Ont. Plans and specifications can be seen at the office of the engineer, 262 Avenue Road.

⊙The contract for the construction of the substruction of the Newcastle Bridge over the Miramichi River, N. B., for which bids were opened by Department of Public Works, Fredericton, N. B., Feb. 26, has been awarded to The Foundation Company, Ltd., New York and Montreal, Que. The work includes 5 concrete piers, with a 12-ft. granite belt at tide line, on pile foundation under 57 ft. of water; also two concrete abutments, one on pile foundation and the other on rock. East approach stone embankment 555 ft. long; west approach (stone embankment) 860 ft. long.

⊙Advices from Fredericton, N. B., state that Commissioner Morrissy has awarded the contract for the superstructure of the spandral arch bridge to replace the present suspension bridge at St. John, to the Dominion Bridge Co., Montreal, Que., at $275,000. The superstructure will contain about 4,500,000 pounds of metal, and provision for two street railway services, two driveway services and two sidewalk services. The contract also calls for the construction of a reinforced concrete flooring for the bridge with creosoted block wearing surface on the driveway. The bridge is to be completed and ready for use by June 1, 1914, under the terms of the contract.

⊙MacDonald & McGougan, Winnipeg, Man., have been awarded a contract at $227,600 for the construction of the substructure for the proposed bridge over the Red River at St. Boniface, Man.

The ratepayers of Regina, Sask., on Feb. 25 voted in favor of 16 by-laws, representing an aggregate expenditure of $2,743,000. Among the laws were the following: For the Broad and Albert Subway, $37,000; for the foot bridge at Hamilton St., $35,000. J. McArthur is City Engineer.

The Civic Works Committee, Toronto, Ont., has approved plans for the proposed new Gerrard St. bridge which is to cost about $200,000. The roadway of the structure will be 66 ft. wide with 50 ft. between curbs and two 8-ft. sidewalks.

DRAINAGE AND IRRIGATION

California.

Plans are well along for an irrigation system to provide water for about 500,000 acres of land in El Dorado and Sacramento Counties. The water is to be obtained from the Consumnes River, and will be utilized by means of the Diamond Ridge ditches, consisting of about 350 miles of mains and laterals. The project will cost about $10,000,000. T. G. Patton of Placerville, O. Scribner of San Francisco and Senator C. B. Bills of Sacramento are interested.

Plans are being made by Norman R. Smith, C. E., Red Bluff, Cal., for a system of pipe line irrigation in Tehama County that will supply water to an area of approximately 50,000 acres. A natural site for a storage reservoir has been selected in the low foothills, where a retaining dam less than 300 ft. long will conserve 54,000 acre feet of water. From the reservoir the waters will be carried through wooden stave pipe and broken up into lateral distribution, where light hydraulic mining pipes will be used.

Georgia.

✣Bids will be received until noon, March 6, addressed to the City Council by the River and Canal Commission, Augusta, Ga., for furnishing all labor and material, coffer dams and other necessary work and constructing complete a reinforced concrete bulkhead across the tail race of the Sibley Mill. Approximate quantities, 3,750 cu. yds. of concrete, 1,900 cu. yds. earth excavation, 2,000 cu. yds. rock excavation, 45 tons of reinforcing steel, 6 gates, forms and controlling apparataus complete. Also at the same time and place bids will be received for the construction of reinforced concrete bulkhead and gates across the tail race of the King Mill. Estimated quantities: Concrete, 2,950 cu. yds.; earth excavation, 2,100 cu. yds.; rock excavation, 1,500 cu. yds.; reinforcing steel, 40 tons; 5 gates and controlling apparatus complete. The two jobs will be let as separate contracts and bids must be made in lump sums for each, but one bidder may submit proposal on both. The work will be paid for in cash or monthly estimates. And a construction bond in amount one-quarter of the contract price will be required. Cash or certified check for $300 must be deposited with each bid on each bulk head. Plans and specifications may be had on application to the Chief Engineer, Nisbet Wingfield, 747 Broad St., Augusta, Ga.

Illinois.

✣Bids will be received until noon (standard time), March 27, by Board of Trustees, Sanitary District of Chicago, Room 1500 W. Monroe St., Chicago, Ill., for excavation of Section 6. The work for which said tenders are invited consists of the excavation and collateral work on contract Section six of the Calumet-Sag Channel of the Sanitary District of Chicago, in the Township of Palos, County of Cook, State of Illinois. The approximate quantities to be used in comparison of bids are: (a) 650,000 cu. yds. of excavation of glacial drift. (b) 135,000 cu. yds. of excavation of solid rock. (c) 66,000 sq. yds. of rip-rap slopes. All bids must be made upon blank forms of proposal furnished by the Sanitary District, and shall be made in accordance with and to conform to all the terms and conditions set forth in "Requirements for Bidding and Instructions to Bidders" attached thereto. Specifications, forms of proposal and plans may be obtained upon payment of $5 at the office of the said District. Thomas A. Smyth is President of its Board of Trustees. John McGillen is Clerk.

Indiana.

✣Bids will be received from 2 p. m. until 4 p. m., March 14, by Carl Mishler, Commissioner of Construction, LaGrange, Ind., for furnishing the labor and material for the construction of J. E. Baker Ditch. The work consists of a main line and three laterals, one spur. The main line is about 10,950 lin. ft. of tile and 2,710 lin. ft. of open field ditch. The laterals are from 562 ft. to 350 ft. in length. The spur is 25 ft. The size and number of feet of tile are approximately as follows: 2,722 ft. of 8-in. tile, 2,050 ft. of 10-in. tile, 2,631 ft. of 12-in. tile, 1,964 ft. of 15-in. tile, 2,500 ft. of 18-in. tile, 2,350 ft. of 20-in. tile.

Iowa.

✣Bids will be received until 2 p. m., March 6, by C. N. Urdahl, Worth County Auditor, Northwood, Ia., for the construction of improvements in Drainage District No. 14. The work will include approximately 30,000 lin. ft. of 6 to 24-in. tile. Frank Forbes, Northwood, Ia., is Engineer in Charge.

The County Commissioners, Sioux City, Ia., E. E. Hosmer, Auditor, rejected all bids received Feb. 25 for the construction of the Little Sioux Drainage Ditch, including approximately 482,700 cu. yds. of excavation. C. M. Tinley, American Bldg., Sioux City, is Engineer.

Kentucky.

✣Bids will be received until 11 a. m., March 26 (central time), by J. C. Oakes, U. S. Engineer, Louisville, Ky., for widening the Louisville-Portland Canal at Louisville, Ky. Official advertisement will be found elsewhere in this issue.

Louisiana.

The Fidelity Land Co., Ltd., J. Wilfred Gaidry, Vice-President, 705 Gravier St., New Orleans, La., is now engaged in the reclamation of about 500 acres of wet land, upon which it will need a pumping plant to drain this land and take care of 1½ ins. of rainfall in about 18 hours, on a 12-ft. lift; that is, the canal will be 6 ft. in depth, and the levee or dyke 6 ft. high, over which this water will have to be forced. The Fidelity Company will be glad to receive suggestions and estimates of cost, accompanied by detailed specifications as to sizes and capacities in one or two units, all delivered at Dalcour, La., Plaquemines parish, 22 miles below the city of New Orleans, via the Louisiana Southern Ry.

Michigan.

✣Bids will be received, open or sealed, March 17, at the residence of Frank Howes, 4 miles south and ¾ mile east of Ithaca, Mich., for the construction of Drain No. 294 in Newark and North Stark townships. This drain will have 470 rods of open work, 376 rods of which will be cleaning out of an old drain, and 94 rods through timber. It will also have 21,344 ft. of tile with sizes as follows: 1,320 ft. of 20-in., 3,036 ft. of 16-in., 2,640 ft. of 15-in., 1,376 ft. of 14-in., 2,510 ft. of 12-in., 5,744 ft. of 10-in., and 4,718 ft. of 8-in. The cuts will average about 4.5 ft. on tile work. It is desired to receive open bids from tile manufacturers on tile but sealed bids will be received and considered if bidders cannot be present. Bids on tile must be f. o. b. at Ithaca. Tile to be No. 1 drain tile. E. W. Redman, Ithaca, Mich., is County Drain Commissioner.

⊙Sylvester Thatcher, Swartz Creek, Mich., has been awarded the contract, at $2,700, for the construction of the Davison Drain, 16,764 ft. in length. Bids were opened Feb. 25 by A. H. Reid, County Drain Commissioner, Flint, Mich.

Minnesota.

✣Bids will be received until 2 p. m., March 6, by C. E. Brainerd, Freeborn County Auditor, Albert Lea, Minn., for the construction of County Ditch No. 25. The approximate amount of work consists of making the necessary excavating for and installing the following: 4,350 lin. ft. of 30-in. tile; 4,084 lin. ft. of 24-in. tile; 2,100 lin. ft. of 22-in. tile; 800 lin. ft. of 20-in. tile; 1,654 lin. ft. of 18-in. tile; 485 lin. ft. of 14-in. tile; 2,851 lin. ft. of 12-in. tile; 2,850 lin. ft. of 10-in. tile; 2,425 lin. ft. of 8-in. tile; 40 lin. ft. of 7-in. tile. Also a concrete bulkhead at the outlet of the main ditch and drain. Also the catch basins called for, being 5 in number, and one man hole. The estimated total cost of furnishing the materials and doing the work required for the completion of said ditch is $16,552.55. J. W. Dappert, Taylorsville, Ill., and E. V. H. Brown, Albert Lea, Minn., are Engineers.

✣Bids will be received until 3 p. m., March 18, by P. D. McKellar, Jackson County Auditor, Jackson, Minn., for the construction of Judicial Ditches Nos. 18, 19 and 20. The approximate amount of work to be done, and material to be furnished in the construction of said ditches is as follows: Judicial Ditch No. 18—32,269 cu. yds. of open work contained in 65 stations of 100 ft. each, with an average depth of 8.79 ft., the estimated cost of which is 20 cts. per cu. yd., also 2,800 ft. of 16-in. tile, av. depth 8.1 ft., 4,500 ft. of 15-in. tile, av. depth 8.69 ft., 2,200 ft. of 12-in. tile, av. depth 6.76 ft., 4,800 ft. of 10-in. tile, av. depth 5.68 ft., 5,100 ft. of 8-in. tile, av. depth 6.01 ft., 3,200 ft. of 6-in. tile, av. depth 5.12 ft. Judicial Ditch No. 19—6,900 ft. of 24-in. tile, av. depth 6.15 ft., 2,500 ft. of 22-in. tile, av. depth 7.99 ft., 200 ft. of 20-in. tile, av. depth 4.16 ft., 3,700 ft. of 18-in. tile, av. depth 6.75 ft., 6,600 ft. of 16-in. tile, av. depth 9.26 ft., 3,000 ft. of 15-in. tile, av. depth 6.83 ft., 11,900 ft. of 12-in. tile, av. depth, 5.25 ft., 12,900 ft. of 10-in. tile, av. depth 5.91 ft., 18,450 ft. of 8-in. tile, av. depth 5.47 ft., 12,300 ft. of 6-in. tile, av. depth 4.90 ft. Judicial Ditch No. 20— 5,900 ft. of 22-in. tile, av. depth 8.09 ft., 2,000 ft. of 20-in. tile, av. depth 11.20 ft., 4,900 ft. of 18-in. tile, av. depth 7.41 ft., 1,100 ft. of 15-in. tile, av. depth 4.77 ft., 1,500 ft. of 14-in. tile, av. depth 5.07 ft., 5,700 ft. of 12-in. tile, av. depth, 6.05 ft., 8,600 ft. of 10-in. tile, av. depth 5.14 ft., 28,160 ft. of 8-in. tile, av. depth 4.99 ft., 29,925 ft. of 6-in. tile, av. depth 4.72 ft. Also 17.45 ft. of open work. All tile to be first-class hard burned clay or shale tile. Plans and specifications, maps, etc., are on file in the office of the Clerk of Court of said county, and can be seen there at any time. Work to be done within one year from date of contract. A certified check for at least 10 per cent the amount bid must be filed with each proposal.

✣Bids will be received until 10 a. m., March 19, by P. D. McKellar, Jackson County Auditor, Jackson, Minn., for the construction of Judicial Ditches Nos. 22 and 23. The approximate amount of work to be done, and the material to be furnished in the construction of said ditches is as follows: Judicial Ditch No. 22—279 cu. yds. of open work contained in six stations of 100 ft. each, with an average depth of 2.05 ft., the estimated cost of which is 20 cts. per cu. yd., also 800 ft. of 16-in. tile, av. depth 3.28 ft., 7,300 ft. of 15-in. tile, av. depth 6.58 ft., 1,200 ft. of 14-in. tile, av. depth 7.64 ft., 400 ft. of 12-in. tile, av. depth, 5.23 ft., 8,600 ft. of 10-in. tile, av. depth 5.07 ft., 3,800 ft. of 8-in. tile, av. depth 5.23 ft., 100 ft. of 6-in. tile, av. depth 4.40 ft. Judicial Ditch No. 23—4,100 ft. of 18-in. tile, av. depth 6.36 ft., 2,900 ft. of 16-in. tile, av. depth 7.53 ft., 3,500 ft. of 15-in. tile, av. depth 5.88 ft., 900 ft. of 12-in. tile, av. depth 4.93 ft., 5,200 ft. of 10-in. tile, av. depth, 5.13 ft., 14,100 ft. of 8-in. tile, av. depth, 4.84 ft., 8,200 ft. of 6-in. tile, av. depth, 4.56 ft., 1,087 cu. yds. of open work, contained in 16 sections of 100 ft. each, estimated cost 20 cts. per cu. yd. First class hard burned clay or shale tile to be furnished for each ditch. Plans and specifications, maps, etc., are on file in the office of the Clerk of Court of said county, and can be seen there at any time. Work to be done within one year from the date of the contract. A certified check for at least 10 per cent of amount of bid must accompany each bid, and said check be made payable to the County Auditor of Jackson County, Minnesota.

⊙I. N. Banta, Forest Lake, Minn., has been awarded the contract, at 9.35 cts. per cubic yard, by the State Drainage Commission, for completing Ditch No. 84 in Kittson County. The contract includes 80,273 cu. yds. of floating dredge work, 9,381 cu. yds. of scraper work, 17.3 miles of road leveling and the furnishing and installation of all corrugated culverts.

⊙P. B. Jenninges, Wanda, Minn., has been awarded the contract, at $14,948, for constructing Judicial Ditch No. 12 of Lyon County, bids for which were opened Feb. 25 at Redwood Falls, Minn. The work calls for a ditch about 9 miles long, tiled with 5-in. to 26-in. cement drain tile laid at an average depth of 9 ft. O. H. Sterk, Marshall, Minn., is the Engineer.

Nebraska.

⊙Bids were opened Feb. 26 by John O'Connor, County Clerk, Fremont, Neb., for cleaning out the Winslow Ditch, the contract being awarded to Matzen Bros., at 12½ cts. per cu. yd.

New York.

✣Bids will be received until noon, March 25, by Duncan W. Peck, Superintendent of Public Works, Albany, N. Y., for Terminal Contract No. 22. For constructing a harbor and dock wall on the west side of the Mohawk River just north of the highway bridge at Fort Plain. Contract plans, sheets 1-3. Plans may be seen and detailed specifications, engineers' estimate of quantities, proposal blanks, form of contract and bonds required and other information for proposers may be had at the office of the Superintendent of Public Works at Albany, N. Y., at the office of the Assistant Superintendent of Public Works for the Middle Division at Syracuse, N. Y., at the office of the Assistant Superintendent Public Works for the Western Division at Rochester, N. Y.; and at the canal office, Spaulding's Exchange, Buffalo, N. Y. Copies of detailed plans or drawings may be obtained from the State Engineer and Surveyor at Albany, N. Y., upon payment to him of the cost of producing them.

Washington.

⊙Bids as follows were received Feb. 15 by the U. S. Reclamation Service, North Yakima, Wash., for furnishing f. o. b. Meadow Creek, Wash., hydraulic apparatus for power plant, Yakima storage project: Turbines—S. Morgan Smith Co., York, Pa., $3,680; Trump Mfg. Co., Springfield, O., $4,665.70. Governors for turbines—S. Morgan Smith Co., $895; Trump Mfg. Co., $1.267.35. Impulse wheels and governors—Pelton Water Wheel Co., San Francisco, Cal., $3,871.75. The contract was awarded to S. Morgan Smith Co.

The following bids were received by the U. S. Reclamation Service, North Yakima, Wash., for electrical apparatus for power plant, Yakima Project, Washington, f. o. b. Meadow Creek, Washington: Items 1, 2 and 3, for alternator, exciter and switchboard. (1) Nixon & Kimmel Co., Minneapolis, Minn., $2,332.50; (2) General Electric Co., Fort Wayne, Ind., $1,852.35; (3) Crocker Wheel Co., Ampere, N. J., $3,636.20; (4) Hallidie Machine Co., Ridgeway, Pa., $2,454.60; (5) Allis, Chalmers Co., Milwaukee, Wis., $2,381.20; (6) Westinghouse Mfg. Co., Pittsburgh, Pa., $2,578.60. Items 1 and 2 for alternator and exciter only: (1) Fairbanks, Morse & Co., $1,616.12. The contract was awarded to the General Electric Co.

Wisconsin.

✣Bids will be received until March 20 by Charles Murray, Town Clerk, Deer Creek, Shiocton, Wis., R. F. D. No. 28, for the construction of a town ditch 19,200 ft. long. Plans and specifications can be seen at the office of N. H. Smith, Consulting Engineer, 268 Forest Ave., Oshkosh, Wis. Official advertisement will be found elsewhere in this issue.

WATER WORKS

Alabama.

The Tri-City Gas Co., Gadsden, Ala., is to expend about $25,000 in extending gas mains from Gadsden to Atalla. H. C. Higgins, Centralia, Ill., is President.

Arizona.

City Engineer Frank Brooks of Yuma, Ariz., estimates the cost of the proposed improvements in that city at $300,000. The plan includes a city waterworks system, sewer system, electric light plant and street improvements. It is proposed to call an election to vote on the proposition.

Arkansas.

✣Bids will be received until 2 p. m., March 20, the Improvement Board, C. J. Williams, Chairman, Sulphur Springs, Ark., for furnishing material and equipment and labor and constructing a complete waterworks and lighting plant. Separate bids will be received as follows: 1—For furnishing material and labor and constructing power house, pump house and all concrete work. Certified check, $500. 2—For furnishing f. o. b. cars Surphur Springs all machinery and electrical equipment. Certified check, $200. 3—Hauling and erecting machinery and electrical equipment. Certified check, $200. 4—For furnishing and laying water pipe, hydrants and valves. Certified check, $200. 5—For furnishing and erecting standpipe, 15 feet in diameter and 75 feet high. Certified check, $200. Plans and specifications are on file at the office of the Improvement Board, Sulphur Springs, and at the office of Albert C. Moore, Engineer, Independent Bldg., Joplin, Mo.

The city of Fort Smith, Ark., H. E. Kelley, chairman of the officials in charge, has under way by force account the construction of new waterworks and extensions to the present system, to cost approximately $150,000. The work will include pumps and pumphouse, filtration plant, settling basins, intake and extensions. The Poteau River is the source of supply. W. Kiersted, Kansas City, Mo., is Engineer.

California.

City Engineer E. P. Dewey of Long Beach, Calif., has completed plans for a high pressure salt water fire system. The proposed system is to consist of a two-story pumping plant, a main line 18,700 ft. long, and two lateral lines. The estimated cost is $125,000.

The Trustees of Santa Monica, Calif., have instructed Engineers Qunton & Code to investigate the physical properties of the three water companies now operating in that city with a view to municipal ownership of the water supply and distribution. The city will lay 8-in. and 10-in. mains in the business and amusement section of the city for a fresh-water system. The cost of laying the mains and purchasing fire engines is estimated at $76,000.

Two propositions in the matter of the proposed mountain water supply for the city of Sacramento have been submitted by T. G. Patton of Placerville, and O. Scribner of San Francisco to the sub-committee appointed by the general committee organized by the Chamber of Commerce for the purpose of investigating possible sources of water supply. In one the offer is made to deliver the water at the city limits; in the other the water supply only is offered.

The Riverside Water Co., Riverside, Calif., is to commence work at once on improvements to the local water system that will cost about $8,000. Four miles of vitrified pipe, ranging in size from 18 to 14 ins., will be laid. This pipe will be used for conveying water for irrigation purposes.

The City Council of Los Angeles, Calif., has been asked to pass a resolution authorizing the submission of a $1,000,000 bond issue, to extend the water mains.

According to advices from Los Angeles, Calif., the El Tejon Citrus Land Co. has purchased 5,000 acres of the Tejon ranches. The new owners, it is stated, will spend about $250,000 in the installation of a complete water system for the irrigation of the land.

The city of Tulare, Calif., proposes to install the proposed waterworks system in the near future. Plans have been completed by Consulting Engineers Sloan & Robson of San Francisco, Calif. T. R. McSwain is City Engineer.

Connecticut.

✣Bids will be received until noon, March 18, by Board of Public Works, at the office of William S. Clark, City Engineer, Meriden.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Conn., for an additional water supply for the city. Plans and specifications can be seen and blank forms for proposals can be obtained at said office or at the office of A. B. Hill, Consulting Engineer, No. 100 Crown St., New Haven, Conn.

Delaware.

The Delaware Legislature has passed a bill authorizing the town of Rehoboth, Del., to borrow $50,000 for the purpose of installing an up-to-date water plant. An election is to be held to vote on the proposition.

The citizens of the town of Milton, Del., on March 3 voted on the proposition to install a new waterworks plant and to construct sidewalks.

District of Columbia.

✣Bids will be received until 2 p. m., March 24, by Commissioner of Indian Affairs, Washington, D. C., for furnishing the labor and material for erecting seven frame cottages, frame warehouse, frame pumphouse and concrete guardhouse and the installation of water and sewer system at the Coeur d'Alene Indian Agency.

Florida.

J. E. Lee has filed a petition with the Board of County Commissioners, Jacksonville, Fla., asking permission to lay a system af water mains in Lee's subdivision on the west side of Pearl St., between 21st and 40th Sts.

Georgia.

⊙The City Council of Rome, Ga., has let a contract to Charles Balckstock for the rebuilding of the filter plant, for $875 and $6.25 per cubic yard for such foundation work as is necessary.

The citizens of Rochelle, Ga., at a recent mass meeting declared in favor of installing an electric light and waterworks system.

Illinois.

✣Bids will be received until 7:30 p. m., March 10, by Matt Berscheid, City Clerk, Joliet, Ill., for the laying and construction of a water main on Van Buren St., from Eastern Ave. to the site of the artesian well on the city lot on Van Buren St., between Eastern Ave. and Michigan St. Plans and specifications may be obtained of the City Engineer.

✣Bids will be received until 11 a. m., March 7, by L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering to the meter mechanical shops, 1330 Indiana Ave., velocity water meters, as follows: 20 3-in., 35 4-in., 15 6-in.; the bodies of the meters are to be of a good grade of fine-grained iron castings; the wearing parts to be constructed of high grade phosphorous bronze and hard rubber. Counters to read in cubic feet and within 3 per cent of actual volume of water. Cash or certified check for $200 must accompany proposal.

As recommended by the sub-committee on sewage disposal, appointed by Carter H. Harrison, the various packing house owners have appropriated $4,500 to purchase and install rotary hydraulic screens for filtering waste matter from the stock yards. M. D. Harding represents the packers.

It is expected that plans and specifications for a 12,000,000-gallon mechanical filter plant with appurtenances for Evanston, Ill., will be completed so that bids will be received by Commissioner of Public Works J. H. Moore, during the first week in April, and that copies of the plans and specifications may be obtained by contractors on or before March 15 from the engineers, George W. Fuller, 170 Broadway, New York City, and Langdon Pearse, 76 West Monroe St., Chicago, Ill.

Indiana.

✣Bids will be received until March 10 by city of Mishawaka, Ind., for laying a suction line and connecting 6 10-in. wells thereto. The estimated cost of the work is $4,800. E. F. Crabill is Superintendent of the water plant.

Iowa.

✣Bids will be received until noon, March 15, by the Citizens Water Company, Burlington, Ia., Frank Lawlor, Supt., for the construction of a clear water basin. Alvord & Burdick, Hartford Bldg., Chicago, Ill., are Engineers. Official advertisement will be found elsewhere in this issue.

The citizens of Estherville, Ia., at a recent special election voted against the issuance of bonds to the amount of $25,000 for the installation of a filtration plant.

At a recent election in Boyden, Ia. (population 364), the citizens voted in favor of installing a waterworks system. It is proposed to spend $10,000 on the system.

The citizens of New London, Ia. (population 1,144), at a recent election voted the issuance of bonds for the installation of a waterworks system.

Citizens of Greenfield, Ia. (population 1,379), have circulated a pctition asking a special election to vote on the construction of a city water system.

Kansas.

⊙The contract for the construction of an addition to the city waterworks pump house in Topeka, Kan., has been let to Cuthbert & Sons for $4,575. Other bidders were: Anderson, Nordlund & Tulein, $5,721; Barber & Mills, $6,250; Hoar & Flynn, $6,365; J. A. Nelson, $5,112, and Bowers & Kearns $6,200.

The town of Earleton, Kans., proposes to lay a pipe line from the spring on J. G. Casebier's farm, two miles northwest of the town, to supply water to the citizens.

Massachusetts.

⊙Kennedy Valve & Mfg. Co., Elmira, N. Y., has been awarded the contract by the city of Boston, Mass., J. E. Mullen, Supt., Supply Department, for furnishing gate valves, for which bids were opened Feb. 19. The contract includes 6-in. valves at $32.75, 8-in. valves at $34.20, 12-in. valves at $79.80, and 16-in. valves at $163.75.

Town Engineer John L. Hyde of Westfield, Mass., has recommended the building of a new reservoir for storage purposes in connection with the system at Granville, to cost $300,000.

Senate Committee on Municipal Finance of the State Legislature has reported a bill permitting Weymouth, Mass., to borrow $50,000 for a water loan.

Michigan.

✣Bids will be received until 5 p. m., March 5, by Board of Fire and Water Commissioners, W. J. Johnston, Secy., for the construction of an extension to the existing water mains of the city of Marquette, from the intersection of Presque Isle Ave. and Wright St. west in Wright St., to the northwest corner of the Marquette County Agricultural Fair Grounds. The work consists of laying approximately 2,550 ft. 6-in. and 2,550 ft. 4-in. cast iron water pipe and the setting of the necessary hydrants, valves, specials, etc.

Minnesota.

⊙The East Jersey Pipe Co., 50 Church St., New York City, submitted the lowest bid to the city of Minneapolis, Minn., K. E. Alexander, Purchasing Agent, for furnishing the city with approximately 15,000 lin. ft. of 54-in. steel water main for the season of 1913, for $116,705. Bids were opened Feb. 24.

Mississippi.

Adjutant General Arthur Fridge of the Mississippi Guard has decided that an artesian well was the best method to furnish an increased water supply at Camp Williamson near Vicksburg, Miss.

Missouri.

The Board of Public Works of Maryville, Mo., has retained Consulting Engineer Hiram Phillips, St. Louis, Mo., to prepare plans for the improvement of the waterworks plant and for the construction of a water tower.

The City Council of Cainsville, Mo., has been petitioned to submit the question of issuing bonds for installing a waterworks system to the voters at a special election.

The citizens of Fairfax, Mo. (population 666), are agitating the installation of a waterworks system.

The Board of Aldermen of Monroe City, Mo. (population 1,949), contemplates submitting the proposition of instlling a waterworks system to the citizens.

Montana.

The citizens of Twin Bridges, Mont., (population 491), have signed a petition for the construction of a waterworks system. The Town Council has retained Consulting Engineer H. S. Green, of Spokane, Wash., to make surveys and ascertain the most feasible point of source for the water.

Nebraska.

The citizens of Peru, Nebr., on Feb. 24, voted the issuance of bonds to the amount of $20,000 for the installation of a waterworks system. The plans of the Board of Trustees are to erect a tower reservoir near the normal campus with sufficient elevation to protect the town from fires.

The City Officials of Tecumseh, Nebr., are arranging to do some experimenting near the city in an effort to locate an additional water supply. Springs and wells are being tested as to the purity of the water, samples having been sent to the State University Laboratory at Lincoln and later test wells probably will be put down in some places.

Keyes C. Gaynor, formerly City Engineer of Sioux City, Iowa, addressed a mass meeting of citizens of Wayne, Nebr., urging the expansion of the lighting and water plant and the change from direct to alternating current. Immediately after the meeting petitions for a bond election to secure the change were circulated.

New Jersey.

✣Bids will be received until 2 p. m., March 10, by Board of Street and Water Commissioners, at the office of John Prout, Chairman, Street Committee, Jersey City, N. J., for furnishing and delivering fire hydrants. Blank forms must be obtained of the Chief Engineer, Room 23, City Hall.

✣Bids will be received until 2:30 p. m., March 13, by Board of Commissioners, Atlantic, N. J., for laying a 24-in. and 20-in. cash iron main on Arctic Ave. from Missouri Ave. to Maine Ave. with lateral mains on intersecting streets in accordance with plans and specifications on file in the office of the Water Department. Harry Bacharach is Commissioner.

New Mexico.

According to advices from Tucumcari, N. Mex., the El Paso & Southwestern Railroad Co. has had plans prepared for the construction of a water plant in that city at an estimated cost of $90,000. The plant is to be installed for the local work shops and round houses.

New York.

✣Bids will be received until 11 a. m., March 18, by Board of Water Supply, 165 Broadway, New York City, for Contract 130, for roofing with reinforced concrete tiles, five superstructures for Breakneck gaging chamber and Foundry Brook and Indian Brook siphon chambers. These buildings are on the Catskill acqueduct and are being constructed under another contract. The work is located in the towns of Fishkill, Dutchess County and Phillipstown, Putnam County, New York. Pamplets containing information for bidders and contract drawings can be obtained at the above address by depositing the sum of $10 for each pamphlet. J. P. Morrissey is Secretary of the Commissioners of the Board.

✣Bids will be received until 11 a. m., March 7, by Francis G. Ward, Commissioner of Public Works, Buffalo, N. Y., for work and material required for the erection and completion of the Venturi Meter and Valve House of the new pumping station, located at the foot of Porter Ave., Buffalo, N. Y. Plans and specifications and estimate of quantities can be seen, and printed forms of proposals, and any desired information can be had on application at the office of Esenwein & Johnson, 777 Ellicott Sq.

✣Bids will be received until 1 p. m., April 1, by Board of Trade Trustees, West Winfield,

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

N. Y., for the construction of a municipal waterworks system. The work will include the following approximate quantities: 10-in. pipe, 4,176 ft.; 8-in. pipe, 1,356 ft.; 6-in. pipe, 9,108 ft.; 4-in. pipe, 6,348 ft. Pump house, concrete, stand pipe foundation, concrete. Plans and specifications, etc., can be procured of Dr. C. F. Wood, President of the Village, West Winfield, N. Y., or of W. G. Stone & Son, Engineers, Mann Building, Utica, N. Y. Specifications free. Plans $1.50 per set, not returnable. A. C. Hackley, Village Clerk, West Winfield, N. Y.

The citizens of Lyons, N. Y., are again agitating the installation of a waterworks and a sewerage system, at a cost of $240,000.

Ohio.

✣Bids will be received until noon, March 14, by J. A. Fogle, Director of Public Service, East Cleveland, O., Room 1325 Williamson Bldg., Cleveland, O., for furnishing the necessary labor and material to lay water pipe with all necessary appurtenances and connections for four separate and distinct jobs as follows: First—About 1,700 ft., between property line and curb, in Noble Road, from Euclid Ave. south. Second—About 23,000 ft. in Woodworth Road, from Coit Ave. main to Hayden Ave. main. Third—In Elm Ave., from westerly end of present main to westerly end of street. Fourth—Alder Ave., from westerly end of present main to westerly end of street. The foregoing must be in accordance with the plans and specifications for said work now on file in the office of the Water Works Department of said city, at No. 30 Marloes St.

✣Bids will be received until noon, March 17, by Carl A. Palmer, Village Clerk, Shaker Heights, at his residence on Broxton Road, or at his office, First National Bank, Cleveland, O., for the construction of 6-in. water main in Weymouth Road, Coventry Road, Drexel Road and Elham Road. Plans and specifications are on file with the Clerk or at the office of B. W. Willard, Village Engineer, 931 Williamson Bldg., Cleveland, O.

The Village of Elmore, O. (population 937), has voted bonds to the amount of $20,000 for the purchase of the present water works plant.

Consulting Engineer R. Winthrop Pratt, of Cleveland, O., has been retained to assist Charles S. Latshaw, City Engineer of Fostoria, O., to prepare plans for enlarging and remodeling the purification works of Fostoria.

Oklahoma.

⊙Bash & Gray of Joplin, Mo., have been awarded the contract by the city of Texhoma, Okla., for the construction of a waterworks system, for $20,066. The work includes brick power plant, 10,000 ft. of cast iron pipe, 130 poles, 2,000 lbs. copper wire, oil engine, 50,000-gal. tank, 100-ft. elevators. Bids were opened Feb. 25. W. M. Magruder is Engineer, Liberal, Kans.

Texas.

⊙J. T. Bond has been awarded the contract at Aspermont, Tex., for building a reservoir 1½ miles south of town to cover 150 acres of ground and having a capacity of 190,000,000 gals. of water. Work is to be begun at once and completed by July 1. A company, known as the Aspermont Water Co., has been incorporated for $25,000, with E. V. Sellers as president; N. G. Rollins, vice-president, and D. R. Couch, secretary and treasurer.

Washington.

⊙D. F. Doherty, Vancouver, Wash., has been awarded the contract by the Constructing Quartermaster, Vancouver Barracks, Wash., for removing center boiler of battery of 3, furnishing and installing boiler at pumping plant at that post, for $818. Bids were opened Feb. 25.

Canada.

✣Bids will be received until 8 p. m., April 15, by H. W. Dixon, Secy.-Treas., North Battleford, Sask., for the following works: Contract A—Pipelaying on waterworks and sewers. Contract B—Furnishing cast iron and steel water pipes and specials. Contract E—Fire hydrants and gate valves. Contract S—Furnishing vitrified tile sewer pipe and junctions. Contract T—Constructing concrete sidewalks and curbs. Plans and specifications may be seen at the office of Chipman & Power, Con. Engineers, Toronto and Winnipeg, and at the Town Hall, North Battleford, on and after March 17, 1913.

✣Bids will be received until noon, March 26, by City Commissioners, Moose Jaw, Sask., for the following: One fuel economizer with 7,000 sq. ft. heating surface. One induced draft plant to handle 120,000 cu. ft. of gases per minute. Each tender must be accompanied by a marked cheque or cash deposit equal to at least 5 per cent of the amount of tender. Plans and specifications may be obtained upon application to J. D. Peters, Electrical Superintendent, Moose Jaw, Sask.

✣Bids will be received until noon, April 15, by City Commissioners, Saskatoon, Sask., for furnishing one motor pumping engine of 500 gals. capacity and one motor pumping engine of 1,000 gals. capacity. Prices must include delivery f. o. b. Saskatoon. F. E. Harrison is Chairman of the Commissioners.

⊙The Board of Control of Hamilton, Ont., has divided a $50,000 meter contract amongst the following companies: Canadian Westinghouse, Canadian General Electric and the Chamberlain-Hookham Co. The Westinghouse Co. secured the transformer contract at $30,000.

⊙The town of Sutherland, Sask., Sidney Appleby, Secretary-Treasurer, has awarded the following contracts for improvement work for which bids were opened on Feb. 24, as follows: Supply and delivery of water pipes—Munderlok & Co., Ltd., Montreal, Que., $40,302; for furnishing labor for the laying of water pipes—E. T. Sykes, Minneapolis, Minn., for $25,500.

SEWERAGE AND SANITATION

Arkansas.

⊙The N. S. Sherman Machine & Iron Works, East Main St., Oklahoma City, Okla., has been awarded the contract by the Board of Commissioners of Water & Light District No. 1, Wynn, Ark., for the construction of improvements consisting of the following work, for $68,000: One artesian well, electric motor and pump erected in pump pit, powerhouse extension, 12,000 ft. 8-in. C. I. W. P. line, 11,400 ft. 6-in. C. I. W. P. line, 8,930 ft. 4-in. C. I. W. P. line, 41 standard fire hydrants, 25 valves, 2 high-speed engines, 1 H. R. T. boiler, 2 generators, switchboards, street-lighting system, five miles pole-line construction, transformers and supplies, 5,620 ft. of 15-in. sewer pipe, 3,050 ft. of 12-in. sewer pipe, 2,650 ft. 10-in. sewer pipe, 16,000 ft. 8-in. sewer pipe, 13,200 ft. 6-in. sewer pipe, 73 manholes, 2 special manholes, 40 lamp holes, 24 flush tanks. R. C. Huston & Co., Exchange Bldg., Memphis, Tenn., are Engineers. Bids were opened Feb. 24.

California.

The Town Council of Hermosa Beach, Cal., has instructed City Engineer George H. Achley to make an estimate of the cost of the proposed sewer system, fire protection system, etc. The estimated cost of these improvements is $75,000.

According to advices from San Diego, Calif., the Village of East San Diego plans the complete installation of a sewerage system.

The City Trustees of Dinuba, Cal., have asked for bids for the construction of the new outfall sewer system according to plans and specifications by Engineer Chris. P. Jensen of Fresno, Cal.

The Village Trustees of Visalia, Calif., have approved the estimates of City Engineer L. E. McCabe on the extension of the sewer system into the newly opened tracts. The estimates call for 16,240 lin. ft. at a total cost of $18,724. The board will immediately issue a call for a bond election of $19,000.

The City Council of Long Beach, Calif., has taken steps to call a special election for the purpose of voting on an issue of $1,350,000 for a sewer system.

The street committee of the Supervisors, San Francisco, Calif., has recommended that $23,000 be appropriated for constructing a main sewer in Mission St., from Army to 29th and in 29th St., from Mission to Tiffany Ave. It also recommends that $15,000 be set aside for improving San Bruno, Ave., from 25th St. to Oakdale Ave.

Connecticut.

The sewer committee of the town of Orange, Conn., Attorney Charles J. Martin, Chairman, is reported to have selected a civil engineer to make a survey of the town for use in securing estimates on the cost of laying the sewerage system.

District of Columbia.

✣Bids will be received until 2 p. m., March 24, by Commissioner of Indian Affairs, Washington, D. C., for furnishing materials and labor for the erection of seven frame cottages, frame warehouse, frame office, frame pumphouse, and concrete guardhouse, and the installation of water and sewer systems at the Coeur d'Alene Indian Agency, Idaho, in strict accordance with the plans, specifications and instructions to bidders, which may be examined at the offices of the Supervisor of Construction, Denver, Colo.

Florida.

⊙The Board of Public Works of Tampa, Fla., has awarded the contract for the construction of storm water sewer to E. W. Parker, as follows: Cleveland St., drain, $22,549; Rome Ave., drain, $9,764; Grand Central Ave., drain, $1,831, and Oregon Ave., drain, $2,921. Mr. Parker bid $9,711 for the Westland Ave. drain and $1,712 for the Gray St. drain, but these contracts were not awarded owing to the total amount exceeding the estimate of $40,000.

Illinois.

✣Bids will be received by the Board of Local Improvements, Chicago, Ill., until 11 a. m., March 10, for furnishing and delivering labor, materials necessary to lay 6-in. house drains in the following streets: Ave. H, 107th St. to 108th St., 700 lin. ft., assessment available $394.80; Champlain Ave., 75th St. to 79th St., 1,500 lin. ft., assessment available $957.60; Coles Ave., 81st St. to 82nd St., 800 lin. ft., assessment available $1,384; Colfax Ave., 83rd St. to S. Chicago Ave., 6,000 lin. ft., $2,890.50; East End Ave., 82nd St. to Anthony Ave., 400 lin. ft., assessment available $302; 83rd St., Stony Island Ave. to Anthony Ave., 300 lin. ft., assessment available $196.30; 47th Ct., Leavitt St. to Western Ave., 2,000 lin. ft., $1,232; 50th Ave., Fulton St. to West End Ave., 1,000 lin. ft., assessment available $1,232; Green St., 83rd St. to 84th St., 1,400 lin. ft., assessment available $676; Morgan St., 1,400 lin. ft., assessment available, $676; 93rd St., Colfax Ave., to Jeffery Ave., 5,000 lin. ft., assessment available $9,624; 104th St., Perry Ave. to Indiana Ave., 1,000 lin. ft., assessment available $521; 107th St., Wentworth Ave. to State St., 700 lin ft., assessment available $352; 119th St., Halsted St. to Morgan St., 600 lin. ft., assessment available $528; Park Ave., 50th Ave. to 51st Ave., 1,200 lin. ft., assessment available $643; Peoria St., 83rd St. to 84th St., 1,200 lin. ft., assessment available $606; Sangamon St., 83rd St. to 84th St., 1,400

✣ indicates work now open for bids. ⊙ indicates a oontract let recently.

lin. ft., assessment available $676; Sherman Ave., 83rd St. to 87th St., 4,500 lin. ft., assessment available $2,044; St. Lawrence Ave., 75th St. to 79th St., 3,800 lin. ft., assessment available $1,748; Wabash Ave., 103rd St. to 107th St., 3,000 lin. ft., assessment available $1,367; E. 119th St., Michigan Ave. to 260 ft. east of Calumet Ave., 800 lin. ft., Prairie Ave., 119th St. to 120th St., 600 lin. ft., 119th Pl., Calumet Ave., 260 ft. east, 200 lin. ft., Calumet Ave., 119th to 120th St., 400 lin. ft., assessment available $1,099. Cash or certified check for 10 per cent of proposal must accompany bid. E. J. Glacken, Secretary of the Board.

The City Council of Herrin, Ill., has passed an ordinance providing for the establishment of a sewerage system in the city. R. L. Adams is City Engineer.

Indiana.

✣Bids will be received until 10 a. m., March 10, by Board of Public Works, Indianapolis, Ind., for the construction of improvements in streets and alleys as follows: For the construction of a local sewer in alley south of Raymond St., from alley east of New St. to alley west of Shelby St.; for the construction of a local sewer in Olney St., from Pratt St. to St. Clair St.; for the construction of a local sewer in alley east of Ringgold Ave., from Beecher St. to Pleasant Run Pky.; for the construction of a local sewer in Thallman Ave., from Roosevelt Ave., to Langley Ave.; for the construction of a local sewer in alley east of Cornell Ave., from Thirtieth St. to Twenty-eighth St.

Iowa.

✣Bids will be received until 10 a. m., March 8, by Paul J. Wells, City Clerk, Sioux City, Ia., for the necessary labor and material for the construction of a sanitary sewer in South Alice St., from Dodge Ave. to Chicago Ave. A certified check for 5 per cent the amount bid must accompany each proposal.

Louisiana.

✣The Water & Light Committee of the City Council, Lafayette, La., will advertise at once for bids for a sewerage system. It is proposed to allow the company making the best offer a franchise for that purpose. The plans and specifications are to cover about 45,000 lin. ft. and will provide service for the greater part of the city. Bids are to be opened March 27.

Maryland.

According to reports John H. Richardson, John Hiltz and others of Baltimore, Md., are interested in organization of a company with capital stock of $50,000 to construct sewage disposal system for Highlandtown, Canton and Orangeville.

Massachusetts.

✣Bids will be received until noon, March 6, by Boston Transit Commission, B. Leighton Beal, Secretary, 15 Beacon St., Boston, Mass., for furnishing and delivering 676,000 lbs., more or less, of cast iron pipe and 22,000 lbs., more or less, of cast iron specials (plugs and branches) for sewers for Section B, Dorchester Tunnel.

✣Bids will be received until noon, March 14, by Matthew Gault, Supt. of Sewers, Worcester, Mass., for furnishing about 25,000 bbls. of cement between May 1, 1913, and April 30, 1914.

Minnesota.

City Engineer John Wilson of Duluth, Minn, has submitted plans and profile of sewer system to serve the vicinity of the Finnish college at Smithville.

Montana.

The South Side Improvement Association, Butte, Mont., has appointed a committee to confer with City Engineer Paul A. Gow to discuss the advisability of proceeding with work toward the installation of a sewerage system. Judge J. L. Wines is President of the association.

New Hampshire.

The town of Charlestown, N. H., will vote March 11 on issuing bonds for the construction of a sewer system. Fred Perry is Town Clerk.

North Carolina.

The North Carolina Legislature has granted a charter to the Greenfield Sewerage & Development Co., which has as its object the building and construction of sewers. The authorized capital stock is $10,000. It is proposed to construct sewers in some of the suburbs just opening up south of the City of Wilmington, N. C., and Greenfield Terrace. The incorporators are: R. C. Cantwell, P. L Cantwell, C. L. Myers, Washington Catlett, L. B. Orrell, R. O. Grant, C. K. Davis.

North Dakota.

The City of Langdon, N. Dak., (population 1,214) plans the installation of a sewerage system.

Ohio.

✣Bids will be received until noon, March 11, by S. A. Kinnear, Director of Public Service, Columbus, O., for the necessary labor and material for the construction of the West Side Storm sewer extension. A certified check for $1,000 must be filed with each bid for the work. P. B. Kemper is Clerk.

✣Bids will be received until noon, March 11, by S. A. Kinnear, Director of Public Service, Columbus, O., for furnishing the labor and material necessary for the construction of the sewer in Broad St. from Burgess Ave. to Hague Ave. All bids will be compared on the basis of the engineer's estimate of the quantities of work to be done, as follows: Item 2, 36-in. sewer, 397 lin. ft.; item 3, 30-in. sewer, 636 lin. ft.; item 4, 24-in. sewer, 379 lin. ft.; item 11, manholes, 4; item 14, catch basins, 8; item 15. 12-in. catch basin drain, 320 lin. ft.; item 16, repaving, 1,357 lin. ft. P. J. Kemper is Clerk.

✣Bids will be received until noon, March 11, by S. A. Kinnear, Director of Public Service, Columbus, O., for furnishing the necessary labor and material for the construction of the Clintonville Main trunk sewer. A certified check for $5,000 must accompany each proposal. All bids will be compared on the basis of the engineer's estimate of the quantities of work to be done, as follows: Item 1, 24-in. vitrified pipe sewer, 5,854 lin. ft.; item 2, 15-in. vitrified pipe sewer, 3,795 lin. ft.; item 3, 12-in. vitrified pipe sewer, 1,700 lin. ft.; item 4, 10-in. vitrified pipe sewer, 7,187 lin. ft.; item 5, 24-in. cast iron pipe sewer, 12 lin. ft.; item 6, manholes, 80; item 7, concrete piers, lump sum; item 8, 6-in. penstocks, 50 lin. ft.; item 9, repaving, 2,850 lin. ft. P. B. Kemper is Clerk.

✣Bids will be received until noon, March 7, by Fred Edwards, Director of Public Service, Ashland, O., for furnishing the necessary materials and labor for the construction of the South Highland Relief Storm Sewer, according to the plans and specifications heretofore prepared by the City Engineer and on file in the office of said Director. Each bid must contain the full name of every person or company interested in the same and be accompanied by a bond in the sum of $200.

✣Bids will be received until noon, March 17, by Carl A. Palmer, Village Clerk, Shaker Heights, at his residence on Broxton Rd., or at his office, First National Bank, Cleveland Ohio., for furnishing the necessary labor and material for the construction of sewers in portions of the following roads: Weymouth Rd., Conventry Rd., Drexel Rd., and Elham Rd. Plans and specifications are on file with the clerk or at the office of B. W. Willard, Village Engineer, 931 Williamson Bldg., Cleveland, O.

✣Bids will be received until noon, March 10, by V. T. Price, Director of Public Service, Cincinnati, O., for the construction of main and lateral sewers and drains with appurtenances in the section of the city known as Evanston. The work consists in the construction of combined sewers from 12-in. to 36-in. in diameter, with a total length of about 8,750 ft. This is a system of relief sewers taking the place of existing inadequate sewers, so that the work will include the removal of the existing sewers. Each proposal must be accompanied by a bond in the sum of $2,000 or a certified check on a solvent bank. M. J. Keefe is Clerk. Official advertisement will be found elsewhere in this issue.

The village of Arlington Heights, O., A. J. Orth, Cincinnati, O., Clerk, rejected all bids received Feb. 17 for the construction of sanitary sewers. New bids will be asked later.

Oklahoma.

S. W. A. Dungan, Town Clerk, Cushing, Okla., received bids Feb. 27 for bonds to the amount of $29,000 for sewer work, and $20,000 for the making of extensions to the water works.

Pennsylvania.

✣Bids will be received until 10 a. m., March 7, by Director J. G. Armstrong, Department of Public Works, Pittsburgh, Pa., for the construction of sewers in the following streets, avenues, etc.: Liberty Ave. and Gross St., from Millvale Ave. to present 84-in. brick sewer on Gross St., 24-in. pipe relief. Butler St., from Fifty-fourth St. to McCandless Ave., 24-in. pipe relief. Melvin St. and private property of Fort Pitt National Bank of Pittsburgh, from Melvin St. to present sewer on Pocussett St., with branch sewers on both sidewalks of Melvin St., 15-in. pipe. Mattern St., from a point about 2 ft. south of Halsey Pl. to Marshal Ave., 15-in. pipe. Ridgway St., and Rust Alley, from a point about 600 ft. southwest of Rust Alley to present sewer on Rust Alley, 15-in. pipe. Liverpool St. (south sidewalk), from a point about 40 ft. west of Allegheny Ave. to present sewer on Bidwell St., 12-in. pipe. Ampere St., from a point about 400 ft. north of Elizabeth St. to present sewer on Elizabeth St., 15-in. pipe. McClarren St., from a point about 15 ft. southwest of the southwest line of William B. Hays' plan to the present sewer on McClarren St., 15-in. pipe with 9-in. laterals. Wyman Alley and Wyman St., from Semicir St. to present sewer on Woods Run Ave., with branch sewers on Stimple St., Kreiling Ave. and Semicir St., 15-in. pipe.

Washington.

⊙H. H. Lotter & Co., Vancouver, Wash., have been awarded the contract by the Constructing Quartermaster, Vancouver Barracks, Wash., for the making of extensions to the storm water sewer for $1,890. Bids were opened Feb. 24.

Plans are now being prepared by City Engineer D. P. Wheeler of Sumner, Wash., for a sanitary sewerage system to drain an area of 73 acres, comprising the more thickly settled section of the city. This will form the first unit of a district which will include the entire city. The system will cost between $5,000 and $7,000. Bids will be asked within the next 30 days. R. R. White is Mayor.

Wisconsin.

⊙Mulholland & Coon have been awarded the contract by the City Council of London, Wis., for the construction of a sewer on Dorr St., for $0.75 to $1.10.

The citizens of Palmyra, Wis., (population 649) have petitioned the Village Board to submit the question of installing a sewerage system and water works plant to the people.

Canada.

✣Bids will be received until noon, March 28, by City Commissioners, Saskotoon, Sask., for the laying of approximately 6,525 lin. ft. of storm sewer, 2,100 lin. ft. of catch basin connections and the construction of manholes, catch basins and appurtenances. All information may be obtained on application to Geo. T. Clark, City Engineer, Saskatoon, Sask.

✣Bids will be received until noon, March 13, by Sam Suddaby, Chairman Board of Works, care of the City Clerk, Brantford, Ont., for the supply of sewer pipe required by the city during 1913. Specifications may be had upon application to T. H. Jones, City Engineer.

The citizens of Regina, Sask., on Feb. 25, voted bylaws for improvement work as follows: $240,000 for trunk sewers; $117,000 for health and scavenging departments, and $60,000 for storm water sewers. J. McArthur is City Engineer.

BUILDINGS

Cuba.

✣Bids will be received until 11 a. m., April 5, by H. R. Stanford, Chief of Bureau of Yards and Docks, Navy Department, Washington, D. C., for buildings to be erected at the naval station, Guantanamo, Cuba. The cost of the work is estimated at $11,000.

District of Columbia.

✣Bids will be received until 3 p. m., April 3, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including the electrical protection, conduit and wiring, lighting fixtures, plumbing, heating, and ventilating equipment, of vaults, except vault doors, for the new building for the Bureau of Engraving and Printing at Washington, D. C. The work contemplated is the construction of four interior vaults, of reinforced concrete, having an aggregate floor area of about 7,350 sq. ft., and one exterior vault of reinforced concrete, with a housing of about 4,950 sq. ft. area, fireproof construction, stone faced, tile roof. Drawings and specifications may be obtained at the discretion of the Supervising Architect.

✣Bids will be received until 3 a. m., April 3, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for metal vault equipment for the new building for the Bureau of Engraving and Printing, Washington, D. C. Drawings and specifications may be obtained at the discretion of the Supervising Architect.

✣Bids will be received unutil 10 a. m., March 17, by Depot Quartermaster, Washington, D. C., for steel frame, roofing and plumbing materials.

Idaho.

✣Bids will be received until 5 p. m., March 10, by Board of Trustees of the Independent School District, Boise City, Idaho, for the Lowell School building. R. T. Bickell is Secretary.

Illinois.

✣Bids will be received until 3 p. m., May 2, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures, and approaches, of the United States Post Office at South Chicago, Ill. The building is two stories and basement, and has a ground area of approximately 11,000 sq. ft.; fireproof construction throughout; stone facing and metal and slag roof. Drawings and specifications may be obtained from the Custodian of site at South Chicago, Illinois, or at the discretion of the Supervising Architect. Drawings and specifications will be ready for delivery March 20, 1913.

✣Bids will be received until 3 p. m., April 21, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction, complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures and approaches, of the United States post office at Harrisburg, Ill. The building is to be of one-story and basement, and have a ground area of approximately 4,000 sq. ft.; fireproof construction, stone facing and tin roof. Drawings and specifications may be obtained from the custodian of site at Harrisburg, Ill., or at the discretion of the Supervising Architect. Drawings and specifications will be ready for delivery March 10, 1913.

✣Bids will be received until noon, April 22, by E. E. Fitch, County Clerk, Cambridge, Ill., for the construction of a new infirmary building. The work will include heating and ventilation, plumbing and sewerage and electric wiring. J. Grant Beadle, Galesburg, Ill., is Architect.

Indiana.

✣Bids will be received until 3 p. m., March 15, by F. M. Graves, Trustee of Jackson Township, Boone County, Jamestown, Ind., for the construction of a two story brick school building.

Iowa.

✣Bids will be received until 3 p. m., April 22, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures and approaches, of the United States post office at Le Mars, Ia. The building is to be of one-story and basement and have a ground area of approximately 4,000 sq. ft.; fireproof first floor; stone and brick facing and tin roof. Drawings and specifications may be obtained from the custodian of site at Le Mars, Ia., or at the discretion of the Supervising Architect. Drawings and specifications will be ready for delivery March 10, 1913.

Kentucky.

✣Bids will be received until 3 p. m., April 8, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction, complete (including plumbing, gas piping, heating apparatus, electric conduit and wiring, and lighting fixtures), of the United States Post Office at Lawrenceburg, Ky. The building is two stories and basement, with a ground area of approximately 4,000 sq. ft. Fireproof construction, except roof; brick and stone facing; tin roof. Drawings and specifications may be obtained from the custodian of site at Lawrenceburg, Ky., or at the discretion of the Supervising Architect.

✣Bids will be received until 2 p. m., March 15, by Board of Shelby County Commissioners at the office of Joseph & Joseph, Architects, 307 Commercial Bldg., Louisville, Ky., for the erection and completion of the Shelby County court house. Luther Black is County Clerk.

Michigan.

✣Bids will be received until 3 p. m., May 1, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures and approaches, of the United States post office at Petoskey, Mich. The building is of one-story and basement; and has a ground area of approximately 4,500 sq. ft.; fireproof construction throughout; granite and stone facing and tin roof. Drawings and specifications may be obtained from the custodian of site at Petoskey, Mich., at the discretion of the Supervising Architect. Drawings and specifications will be ready for delivery after March 20, 1913.

Missouri.

✣Bids will be received until 3 p. m., April 11, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures and approaches, of the United States post office at Boonville, Mo. The building will be about 46x88 ft. and one story and basement in height. The entire exterior of the building, including cornices and trimmings, will be of stone. The interior construction up to and including the first-story ceiling will be fireproof. Roof framing will be of wood construction covered with composition roofing. Interior finish will be hard wood, plaster, marble, etc. Building to be heated by low-pressure steam heating. Drawings and specifications may be obtained from Richards, McCarty & Bulford, Architects, Hartman Bldg., Columbus, Ohio, or from the custodian of site at Boonville, Mo., or at the discretion of the Supervising Architect.

✣Bids will be received until March 18 by Board of Public Improvements, St. Louis, Mo., it is reported, for the street improvements. The improvements and their estimated cost follows: Brick—Louisiana Ave., between Neosho and Osceola, $8,017; Penrose St., from Glasgow to Grove, $1,870; Crittenden St., from Pennsylvania to Minnesota, $1,907; Wilson Ave., from Hereford to Cooper, $4,891; Taylor Ave., from Margaretta to Kossuth, $5,055; Taylor Ave., from Clayton to Audubon, $12,701; Bates St., from Alabama north of Bates to Grand, $20,301; Nashville Ave., from Tamm to Louisville, $13,073. Asphalt—Wise Ave., from King's Highway to Hereford, $8,225; Vanderburgh Ave., from Shenandoah northward 311 ft., $2,961; reconstruction of Biddle St., from Fourteenth south of Biddle to Jefferson, $32,173. Bitulithic—Cora Ave., from Natural Bridge to Margaretta, $9,604; Camelia Ave., from Margaretta and Lee, $10,071; West Park Ave., from Billen to Childress, $23,475. Telford Oil Treatment—Bruno Ave., from Forest to western city limits, $4,950; Geraldine Ave., from Florissant westward about 215 ft., $1,331; King's Highway Southeast, from Compton to Grand-King's Highway, $20,926. Improvement of alleys between Gravois, Potomac, Spring and Bamberger, $5,311.

New Hampshire.

✣Bids will be received until 11 a. m., March 22, by H. R. Stanford, Chief of Bureau of Yards & Docks, U. S. Navy Department, Washington, D. C., for quarters for commanding officer, naval prison, Navy Yard, Portsmouth, N. H.

New Jersey.

✣Bids will be received until noon, March 19, by Quartermaster, Fort Hancock, N. J., for addition to bakery.

New York.

✣Bids will be received until 7:30 p. m., March 14, by Board of Village Trustees, Potsdam, N. Y., for building and constructing a fire engine house and village hall in accordance with plans and specifications on file at the office of F. A. Weed, Village Clerk.

North Carolina.

✣Bids will be received until 3 p. m., April 26, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures and approaches, of the United States post office at Oxford, N. C. The building is to be one-story high with a mezzanine at each end and a partially excavated basement and will have a ground area of approximately 3,800 sq. ft.; fireproof first floor; stone and brick facing and tin roof. Drawings and specifications may be obtained from the Custodian of site at Oxford, N. C., or at the discretion of the Supervising Architect. Drawings and specifications will be ready for delivery March 15, 1913.

Ohio.

✣Bids will be received until noon, March 14, by Charles W. Stage, Director of Public Safety, Cleveland, O., for furnishing lead-encased cable, copper wire and signal boxes for Department of Police. Specifications may be obtained at the office of the Director. H. F. Stillman is Secretary.

South Carolina.

✣Bids will be received until noon, March 18, by Courthouse Commission, St. Matthews Savings Bank, St. Matthews, S. C., for the construction of the Calhoun County court house and jail buildings to be erected at St. Matthews. Drawings and specifications may be seen at the office of T. A. Amaker, Secretary, St. Matthews, S. C., and at the office of Wm. A. Edwards, Architect, 632 Candler Bldg., Atlanta, Ga.

Tennessee.

✣Bids will be received until noon, March 24, by Maj. E. M. Markham, U. S. Engineer,

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

Memphis, Tenn., for furnishing and delivering about 613,200 lbs. galvanized wire, silicon bronze wire, wire strand and staples; about 24,000 wirerope clips and about 67,500 lbs. manila rope. Official advertisement will be found elsewhere in this issue.

The Masonic Lodges at Nashville, Tenn., have purchased a site at 25th and West End Aves., Nashville, on which to erect a Greek temple to cost about $150,000.

Texas.

✣Bids will be received until 11 a. m., March 11, by John M. Murch, County Auditor, Galveston, Texas, for installing an ornamental lighting system as above and consisting of 57 ornamental five-light incandescent posts and eight ornamental arc lamp posts, together with all cable, lamps and other material necessary to make the installation complete and ready for use as per plans and specifications governing same on file in the office of the County Auditor.

Virginia.

✣Bids will be received until 3 p. m., April 29, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures and approaches, of the United States post office at Covington, Va. The building is to be of one-story and basement with a mezzanine at each end and will have a ground area of approximately 3,800 sq. ft.; fireproof first floor; stone and brick facing and tin roof. Drawings and specifications may be obtained from the Custodian of site at Covington, Va., or at the discretion of the Supervising Architect. Drawings and specifications will be ready for delivery March 15, 1913. Official advertisement will be found elsewhere in this issue.

Washington.

✣Bids will be received until 11 a. m., March 18, by Maj. J. B. Cavanaugh, U. S. Engineer, Burke Bldg., Seattle, Wash., for building lock-keepers' house at Lock site, Lake Washington, Canal, Seattle, Wash.

West Virginia.

✣Bids will be received until 3 p. m., March 28, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the installation complete of an electric passenger elevator in connection with the extension, United States post office and courthouse at Charleston, W. Va., in accordance with the drawing and specification, copies of which may be had at the discretion of the Supervising Architect.

Wisconsin.

✣Bids will be received until 3 p. m., April 28, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures and approaches, of the United States Appraisers' Stores at Milwaukee, Wis. The building is two stories and basement and has a ground area of approximately 7,200 sq. ft.; pile foundations, fireproof construction; brick facing; composition roof. Drawings and specifications may be obtained from the Custodian of site at Milwaukee, Wis. at the discretion of the Supervising Architect. Drawings and specifications will be ready for delivery March 15, 1913.

Wyoming.

✣Bids will be received until 3 p. m., April 7, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction, complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures, and approaches, of the United States post office at Casper, Wyo. The building is to be of one story mezzanine and basement, and has a ground area of approximately 4,000 sq. ft.; fireproof first floor; stone, brick, and terra-cotta facing and tin roof. Drawings and specifications may be obtained from the custodian of site at Casper, Wyo., or at the discretion of the Supervising Architect.

✣Bids will be received until 3 p. m., April 12, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures and approaches, of the United States post office at Douglas, Wyo. The building is two stories and basement and has a ground area of approximately 4,400 sq. ft. Fireproof construction, stone facing and tin roof. Drawings and specifications may be obtained from the custodian of site at Douglas, Wyo., or at the discretion of the Supervising Architect.

RIVERS AND HARBORS

California.

The State Engineering Department, Sacremento, Cal., contemplates straightening the channel of the Mokelumne River between Reclamation District No. 348 and Staten Island. This work will require the moving of 488,700 cu. ft. of earth at a cost of about $15,000.

A bill is now before the Legislature providing for an appropriation of $100,000 for improvement of the port of San Jose. The bill contains a provision that the city must raise an additional $200,000.

Connecticut.

✣Bids will be received until 2 p. m., March 27, by Maj. G. B. Pillsbury, U. S. Engineer, New London, Conn., for dredging in Mystic River, Conn.

District of Columbia.

✣Bids will be received until 10:30 a. m., March 26, by Maj. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under Canal circular 764, Electric Traveling Cranes, Steel Rail, Angle Bars, Truck Bolts, Switches, Track Frogs, Tie Plates, Track Chisels, Babbitt Metal, Poultry Netting, Steel Wire, Taps, Screws, Cotters, Hammers, Wrench Parts, Pipe Fittings, Valves, Saws, Hinges, Tackle Blocks, Torches, Ladders, Rakes, Oars, Hose, Silica Sand, Foundry Clay, Black Enamel and Lumber.

Florida.

⊙The Trumbo Dredging Co. has been awarded a contract by L. V. Heigleyman for making a fill at Brickells Point, Miami. The contract calls for the removal of 125,000 yds. of sand from Biscayne Bay, to be spread over several acres of land adjacent to the bay.

Hawaii.

✣Bids will be received until 11 a. m., April 12, by H. R. Stanford, Chief of Bureau of Yards & Docks, U. S. Navy Department, Washington, D. C., for 11 15-ton locomotive cranes, with grab bucket equipments, delivered and erected at the naval station, Pearl Harbor, Hawaii.

Illinois.

City of Cairo, Ill., has voted a bond issue of $100,000 for raising and strengthening its levee system. About $500,000 is to be expended, the government and railroads contributing their share. Work will be started early in the summer.

Indiana.

The Park Board of Indianapolis, Ind., has rejected the bids received about two weeks ago for dredging of Fall Creek.

Iowa.

City of Des Moines, Ia., is to at once issue $148,000 of flood protection bonds. Horace Susong is City Clerk.

Michigan.

⊙Price Bros., East Jordan, Mich., have been awarded the contract for building the dam for the Benzie County Power Co. on Benzie River 1½ miles southwest of Benzonia. The contract calls for the completion of the dam by Aug. 15.

Massachusetts.

The Directors of the Port of Boston, 40 Central St., Boston, Mass., have instructed F. W. Hodgdon, Chief Engineer, to prepare proposals for bids for the wooden bulkheading and filling in of 50 acres of the Commonwealth land directly off the foot of Maverick St., East Boston. This work will be a basis from which to proceed, although a general plan for the development of the East Boston section of harbor development will not be decided upon until Henry V. Macksey, the civil engineer engaged to study the East Boston water front, has made his report. The filling material will be taken from the anchorage basin southeast of East Boston and from the Bird Island flats.

Nebraska.

⊙McLaughlin & Sons, Red Oak, Ia., have secured a contract from Kountze Bros., New York City, for the preliminary construction work for the Fremont power canal. A small outfit started work last week about 1½ miles from Linwood.

New Jersey.

✣Bids will be received until 11 a. m., March 21, by Maj. R. R. Raymond, U. S. Engineer, Wilmington, Dela., for removing wreck of tug boat, "Harbor" lying sunk in Maurice Cove, N. J.

New York.

Town Board of Babylon, N. Y. (L. I.) is considering submitting at coming spring election proposition to vote $25,000 for dredging.

A bill is before the State Assembly appropriating $9,500 for the improvement of the dyke across the fourth branch of the Mohawk River between Cohoes and Green Island. The work is to be done under the direction of the Superintendent of Public Works, Albany, N. Y.

South Carolina.

The following bid was received Feb. 26 by Maj. G. P. Howell, U. S. Engineer, Charleston, S. C., for 220,810 cu. yds. from Sampet Bar and River, Wingate Bay, S. C.: P. Sanford Ross, Inc., Jersey City, N. J., 18.8 cts. per cu. yd.; Dredge No. 7, clamshell, to be used in contract.

Virginia.

✣Arthur C. Freeman, Jr., Consulting Engineer, Norfolk, Va., has a contract to let for approximately 15,000 yds. of excavation to be removed by dipper dredge.

✣Bids will be received until 11 a. m., March 22, by H. R. Stanford, Chief of Bureau of Yards and Docks, Navy Department, Washington, D. C., for a three-wire, direct current, engine driven, 125 kw. generator set at the U. S. Naval hospital at Norfolk, Va. The amount available is $5,200.

Washington.

✣Bids will be received until 11 a. m., March 29, by H. R. Stanford, Chief of Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., for pier No. 4 at the navy yard, Puget Sound, Wash. The amount available for the work is $175,000.

Wisconsin.

The city of Algoma, Wis., may take up the matter of constructing a sea wall for the protection of its lake front. Wm. T. Hobus is City Engineer.

ENGINEERING AND CONTRACTING

Devoted to the Economics of Civil Engineering Design and to Methods and Cost of Construction

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(See News Section Index for Prices, Bids Asked, Work Proposed and Contracts Awarded.)

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A Deserved Act of Reparation.

The reinstatement of Mr. C. A. Elliott, Chief of Drainage Investigations, U. S. Department of Agriculture, is an act of justice which is gratifying to the engineering profession despite the length of time it has been delayed. The circumstances which led up to the removal from office of Mr. Elliott; the public manner in which that punishment was inflicted, and the refusal of the accused official to abide the reflection on his professional acts and personal character have been so fully explained by the engineering press that repetition will lead to no further good. The act of reinstatement is in compliance with the direction of the Congressional Committee, which investigated the evidence on which Mr. Elliott was removed from office and rendered a verdict clearing him from all guilt of the charges made by his accusers. It is in all respects an act of justice. Unfortunately it is not, as no such act can be, a full reparation for the injury suffered. Engineers should make it their duty for the good name of their profession as well as an act of justice to a brother engineer, to publish Mr. Elliott's innocence as widely as the charges of his guilt were published by his accusers.

A Critic of Engineers as Superintendents.

> I have tried a good many engineers as foremen and superintendents, but shall do so no more. Engineers seem to lack the ability to handle men. Perhaps their training has been too much in science and too little in human nature. At any rate they make poor foremen.

In essentially these words a contractor condemned the employment of engineers except as designers of structural work. Unquestionably the contractor spoke from experience, but, let us hope, from an experience that is not typical.

Reasoning *a priori* it seems incredible that an engineering training should itself unfit a man to direct other men on construction work. But it should not be forgotten that a habit of thinking in certain ways is quite as essential to success as the possession of scientific knowledge. Perhaps many engineers fail as managers because sufficient repetition has not bred the habit of thinking about *men*, but rather has bred the habit of thinking about *things*—structures, machines, distances, weights, velocities.

"The proper study of mankind is man," and no amount of analysis of forces can serve to impart knowledge of the complexities of the brain. While the engineering student is learning mathematics and mechanics, the man with a shovel is learning not only his own nature but that of his associates—is studying men.

The young engineer is apt to imagine that he can skip this part of the necessary training of a manager of workmen. He is prone to step from a position as timekeeper to a position as foreman, or perhaps he would skip entirely these two grades and become a superintendent at one stroke. Herein is certainly to be found one reason why many engineers fail as contractors' superintendents and as contractors.

A road contractor said to the writer: "I would not have a foreman in my camp who could not run a steam roller, repair a gasoline engine, and work at a forge or with a carpenter's kit. A good foreman must be a handy man with tools. He needn't be an expert with tools, but he must savy them. And another thing—I want no foreman who looks like a dude."

This last statement contains a bit of wisdom that no man is apt to appreciate unless he has had the experience of receiving orders from a dude foreman. A workman resents receiving direct orders from a man who looks too clean to work himself. The young engineer who aims to manage workmen should begin as a workman, dressing and living as workmen live, learning their likes and dislikes, absorbing their humble philosophy.

Not the least valuable part of such experience is the discovery that men are tricky, often for the mere fun of "putting it over the boss," and particularly when the boss looks like a matinee idol.

Most of the colleges of mining engineering have summer schools of mining, where the students spend several months working underground with the miners. This sort of experience is needed by students of civil engineering, particularly so by those who plan to manage construction work. Failing to receive such training at college, the young civil engineer would do well to spend a year or more, after graduation, working at a forge, drilling, running a "donkey," shoveling, and studying men—all the while studying men.

The Piece Work Method of Paying Wages Applied to Sewer Construction.

An interesting application of the piece work method of paying wages on construction work is described in the leading article of the Sewerage and Sanitation Section of the present issue. The sewerage system of Pomeroy, Washington, which is described in the article to which we have referred, was constructed by day labor. The conditions which led to the adoption of day labor in preference to contract work were entirely local, and the adoption of that manner of constructing the sewer was not due to a general belief on the part of the city officials that day labor is preferable, as a rule, to contract work. The controlling condition which finally influenced the officials to have the work done by day labor was that the city was without local contractors and the estimated cost of having the work done by an outside contractor was considered too high. In his letter to the editors the author of the article said:

> The results of the work show that where the city officials are competent and honest and work together in harmony, putting forth as earnest effort on public work as they would if it were their own private enterprise, as great a degree of efficiency and economy may be secured by them with city forces as could be secured by a contractor. As it is undeniable that such conditions can rarely be met with, this cannot be taken as an argument against the general principle that it is best to have public work done by contract.

The article contains matter of interest to sewerage engineers and contractors, to those who are interested in day labor work, and especially to those who are interested in the piece work method of paying wages on construction work. The feature of the work on which we wish to comment especially at this time is the one last named.

The trenching was all done by hand labor, and on the yardage and station basis. That is, a portion of the trench was given to a man to excavate and he was paid at a fixed rate per cubic yard for the material removed in his assigned portion of the trench, 100 ft. in length. The material excavated was classified as earth, hard pan, and loose rock and cement gravel. The prices paid per cubic yard were, 15 cts., 30 cts., and 60 cts., respectively. Bearing in mind that the trenchers alone were paid on the piece rate method it is interesting to note the effect of the hustling of the men so paid upon the output of the men on the work who were paid a flat rate per day regardless of output. We wish to give prominence to that feature and therefore quote the author:

> As the trenchers were paid for what they accomplished, and no more, each one attempted to do as much as possible and so increase his pay check, and the influence of this stimulation was felt throughout the entire force. The engineering crew were kept on the rush to keep ahead of the trenchers; the pipe layers were chasing them all of the time, and a keen rivalry sprang up between the three pipe layers; the roustabout teams were frequent recipients of hurry orders for material, and the crew on the backfill were trying to catch the pipe layers so they could get a breathing spell. . . . The plan proved to be an excellent object lesson on the comparative value of common laborers. The best man on the job was able to accomplish twice as much as the poorest and seemed to do it with no more apparent exertion or persistent application.

The author's comments on the merits of day labor and contract work as given in the quotation here made from his letter express fairly well the general opinion held on this subject. The editors of this journal have stated repeatedly that contract work is, as a rule, preferable to day labor on public work. Nothing here stated modifies our views on that point. It is the success of the piece work method of paying wages on this particular day labor job to which we wish to call the special attention of our contractor readers. If that method proved so successful on day labor work why should it not prove equally successful on contract work? On almost every contract job the conditions are as favorable, as to efficient organization, as that described on this particular day labor job.

It is not an uncommon thing at this time for as many as 15 contractors to bid on the installation of new sewerage systems in towns of 2,000 population. The amount of the contract on such jobs, including a complete sanitary sewerage system and a sewage tank, seldom exceeds $40,000 and is usually about $35,000. On account of the strong competition between bidders on jobs of this size the margin of profit is small, even with favorable weather and other conditions during the construction period.

The laying of pipe sewers is exceedingly simple in principle. That fact is shown clearly by the results secured at Pomeroy with workmen who had had no previous experience on sewer construction. The average laboring man can soon become, if so inclined, very efficient on this class of work. We believe that the adoption of the piece work method of paying wages to the laborers will increase the efficiency and earnings of the men and at the same time very substantially increase the contractor's profit.

ROADS AND STREETS

Concrete Road Construction in Milwaukee County, Wis., and in Winona County, Minn.

The surfacing of country roads with concrete has been undertaken on an extensive scale in Milwaukee County, Wis., and in Winona County, Minnesota. The first mentioned work is under the charge of H. J. Kuelling, C. E., County Highway Commissioner, Milwaukee, Wis.; the other improvement is being carried on under the direction of O. B. Leland, District Engineer of the State Highway Commission of Minnesota. The Winona County work was described by Mr. Leland in a paper presented at a recent meeting of the Minnesota Society of Engineers and Surveyors, and the Milwaukee County work was embodied in a paper read at the 1913 convention of the Wisconsin Society of Engineers. The following matter relating to the Minnesota work is taken from Mr. Leland's paper, while the data on the Wisconsin construction are quoted from Mr. Kuelling's paper:

METHODS AND COST OF CONCRETE ROAD CONSTRUCTION IN MILWAUKEE COUNTY, WIS.

First of all some form of good batch mixer should be used as a failure to properly proportion in a continuous machine means a hole in your pavement. Personally in my country road work, I prefer a machine with a spout discharge rather than either the boom bucket or carts, because I believe the material to be more evenly placed upon the street; because there is not the tendency to disturb your foundation and mix dirt with your concrete, that there is with carts, especially on narrow roads; and because the spout causes less trouble in the placing of the expansion joints. Some will argue that more material can be placed with carts because of the larger and easier source of supply in the piles, but I believe by a little careful placing of the sand and stone that an equal amount can be placed, especially with the large tractor mixers now on the market.

A good practice in mixing concrete as well as any other work is to keep the same man doing the same class of work around the mixer, so that it becomes almost second nature for him to do the right thing at the right time.

The following, I believe, is a fair arrangement for a crew, especially on road work:

1 Foreman.
1 Man to attend to preparing joints.
3 Men to attend to subgrade so that material can be dumped and concrete placed.
2 Form setters.
6 Men who load wheelbarrows.
4 Men who handle the wheelbarrows.
2 Men for handling cement, one who delivers it and one who dumps it into the hopper.
1 Engineman on the mixer.
1 Man at the hoist.
1 Man who handles the spout for placing the concrete on the road.
2 Men for striking off the concrete with a strike board cut to the crown of the road.
1 Man for finishing the concrete and trimming the edges.
1 General utility man.

This gives a total of 26 men whose pay would aggregate about $63. Such a crew should average about 600 sq. yds. of 7-in. concrete per 10-hour day.

As to the relative merits of the one and two-course types of pavements, I prefer the one-course type, mainly for construction reasons although there are many arguments for both sides. Where it is necessary to place reinforcement, which I believe is not often, it is more difficult to get it placed near the surface in the single coat work than it is in the two-coat work. A cheap and satisfactory form of reinforcement is common woven fence wire.

After the concrete is properly placed, it should be well cured. In our work we cover the road with earth or gravel as soon as it is hard enough to carry it. For the first five days it is kept well sprinkled especially in warm weather. As a rule we aim to keep traffic off the road for a period of 20 days, which is really quite an objection to this type of road.

One of the most important problems in the construction of a concrete road or pavement is the matter of proper joints to provide for expansion or contraction. Many types are in use such as a plain filler joint, wood joints, felt joints and steel combined with some of the others, the steel acting as a protection to the joint, and sometimes as a reinforcement across the end of the slab. In Milwaukee County work we have been using a joint consisting of two pieces of asphaltic felt between two pieces of steel. The felt reaches entirely through the slab while the steel is only 2½ ins. deep and is anchored into the slabs by 6-in. wings punched into the steel. After a little practice this joint is easily erected, costing in place, about 5 to 6 cts. per square yard of pavement. These joints are placed at 25-ft. intervals. Engineers differ as to the proper distance apart for joints to be placed, their practice varying from 20 to 50 ft. and even 100 ft., while a few are trying out roads without any provision for expansion. This latter I believe to be a very bad practice. I believe that the further apart the joints are placed, the wider should be the joint and the wider the joint is, the more danger there is of a defect developing in your road. The common practice is to place these joints at right angles with the line of travel, but I believe that a slightly better practice that is being introduced, is to place them at an angle so that two wheels cannot come to the joint at the same time.

As to whether or not a bituminous treatment on a concrete road is economical in all cases, I am unable to say. For certain conditions, however, I believe it is well worthy of consideration for several reasons. It acts as a cushion to traffic, thus making it easier for horses' feet as well as protecting the concrete itself from grinding away. It tends to relieve the glare of the street, and deaden the noise of traffic, thus making the pavement more desirable for residential streets. A fair treatment is about ½ gal. of bituminous compound per square yard. After pouring, the treatment is covered with a sprinkling of coarse sand, as done in oiling an old macadam street.

Such a treatment under a fair traffic would last one or two seasons; the center of the streets for one and the sides for two seasons.

Such a treatment should cost about 1 ct. per square yard for application and not over 5 cts. for material. While being treated, the street should be thoroughly clean and thoroughly dry or the material will peal off under traffic.

As regards the cost of concrete roads or pavements the conditions vary so greatly in different parts of our state that data proper for our Milwaukee County work would be entirely wrong in some other section. Because of the varying cost of sand, stone, men and teams, I can make no definite estimate of a square yard price, but in a general way will state that the pavements have cost us on an average in the neighborhood of $1 per square yard, exclusive of grading. This is divided into about the following proportions:

Cement	$0.33
Gravel and stone	.16
Labor and hauling	.43
Joints	.06
Inspection and water	.02
Total	$1.00

COMBINATION CONCRETE AND MACADAM ROAD CONSTRUCTION IN WINONA COUNTY, MINN.

The road as planned and as it is now being built is a center located single-track concrete road with a macadam road on either side. The concrete is 8 ft. wide 6 ins. thick with a crown of 1 in., laid in sections of 35 ft. in length with ⅜ in. expansion joint. The macadam is 6 ft. wide on each side—the first 4 ft. tapering from 6 ins. of rolled macadam at the concrete to 4 ins. of macadam 4 ft. out—the last 2 ft. feathering off from 4 ins. to nothing. The crown of the finished road is 1 in. in the first 4 ft., 3 ins. in the next 4 ft. and 5 ins. in the last 2 ft. To all practical purposes then we have a 16-ft. road with 2 ft. of crushed rock shoulders on each side. The concrete is a 1:2:4 mix with gravel as the coarse aggregate. The macadam is crushed limestone, 2½-in. stone being used.

On a road of this character, in our locality at least, it might be said that the central portion is imported material while the outside is local product. We readily found limestone quarries alongside of the roads, so that the transportation of crushed rock was a matter of short haul. The material for concrete, however, had to be hauled some little distance. Using the nearest gravel pits possible the average haul on Road No. 1 is 5 miles, that on Road No. 2 is nearly five miles, and on Road No. 3 is just over four miles. An average haul of 5 miles by team means very high-priced material, especially when it is over roads that run up-hill both ways.

Having a limited sum with which to build the roads and a fixed number of miles to cover it was necessary to get all of the cheap methods of construction onto the job. Considering the transportation problem the one whose costs could be most readily cut we put in some little time looking up means of transportation. We got what data we could on auto-truck and traction haul. Our estimates were finally made on a number of cents a yard mile basis and as the contractors bid very close to the estimate they must have given these figures considerable weight.

Bids were received on July 10, 1912, for the improvement of 16 miles of road, on three separate jobs. All three jobs were let on one form as their lump bid was the cheapest received. By Aug. 15th the contractors were on the ground ready to begin work. Grading was commenced on both Rural Highways 1 and 2. The grading on No. 2 was lightest so plans were made to concrete that road first.

Before work was begun on these roads they were ordinary country roads with a roadbed of from 10 to 20 ft. in width. The grading consisted very largely in widening out these roads to a 20-ft. roadbed and in reducing the grades. For the most part the material excavated was cut from one side and deposited in on the other side. Some of the material was hauled for short distances but only at one place has haul been allowed and in this case the material was rock to be deposited on a marshy bed. The excavation was of greatly varying kinds—dirt, clay, hardpan, loose rock and solid rock. The average price of excavation was 40 cts. a yard.

On State Rural Highway No. 1 we had several sand fills. We covered these portions of the road with from 3 to 5 ins. of clay and have had very good roads to haul over during the fall and winter.

The grading on Road No. 2 was very largely scratching and pretty hard scratching it proved to be. The old roadbed was very nearly wide enough as it was, so the yardages run small. The fewer yards per station the more those yards cost. This work was underestimated in our final estimate of the work.

The grading on Road No. 1 ran considerably higher in yards per station. On this work the contractor is making a fair profit on his work at a price that was low on No. 2 although the material in which he is working is considerably harder to work in.

Some delay was experienced by the contractors waiting for machinery. All this equipment was bought new after July 10th and even in rush orders it takes time to get things by freight. The time was needed in grading however so the delay was not as serious as it would have been otherwise.

For transportation gasoline tractors with 3-yard train wagons were used. The cement for two miles of concrete was delivered six miles for a little less than 20 cts. a barrel. As soon as the cement was hauled gravel and sand were hauled to work. Under favorable conditions the contractors would have hauled this material for less than 20 cts. a yard mile, in fact a statement was gotten out by them for the tractor people showing a transportation charge of less than 6 cts. a ton mile. Their figures were taken from one run that was in every way satisfactory. The tractor at 20 cts. a yard mile however is a cheap haul.

In hauling with a tractor, arrangements should be made to deliver material in stock piles, sand material to be delivered at least half a mile ahead of concrete work. This will allow the grading crew to keep the road in condition. In trying to deliver the sand and gravel to the site of the work so that it could be wheeled from piles into mixer the contractors made a serious mistake. The tractors tear the road up badly and then dump the gravel on that portion which they have just torn up and the grading crew cannot repair this road until the concrete crew has hauled the gravel to mixer. This makes it necessary for grading crew and concrete crew to work too close together.

Up to the present time the concrete has been placed directly on the subgrade as preferred by the graders. No sand cushions have been used although the soil is composed very largely of clay. We expect to use a sand cushion only on the extremely bad portions of the road where the soil is such that it retains most of the water getting to it.

The concrete used is a 1:2:4 mix. Both the sand and gravel used so far in the work have been very good. The mix is made in a ⅓-yd. batch mixer with conveyor. Just about all the water that the concrete would stand was used. The concrete set up rather slow as a consequence but it set up hard. The proportion of sand to gravel should run a little in favor of the sand, as a shortness of sand makes a bad mix. The inspector was instructed to keep the men back of the mixer busy with their shovels, as a shovel will take out air spaces that no amount of tamping will correct. The work was floated with a wooden float. The grooving of the concrete on the grades did not prove very successful so that has been abandoned.

The one weak spot in the road as constructed is the joint between the concrete and the macadam. If the macadam is too high water will run down between the concrete and macadam and cause the concrete to crack. If the shoulder is too low the wagon wheels will jar down onto the softer rock from the concrete and the macadam. We have exercised considerable pains to make this joint flush. We also expect to experiment with a strip of road asphalt along the macadam at the concrete. We may use a grout of cement to wash the macadam with also. If we can hold the macadam at this point I am sure we will have a fine road.

In one way at least we have been very fortunate in our work. The concrete work has made very slow progress. The grading work was pushed right along, however. By the time we get ready to lay concrete now these new fills will be thoroughly settled and we will have a good road to build on. I am of the opinion that all grading for concrete roads should be done one year in advance of the concrete.

It is well to close this with a synopsis of the costs. The grading is costing on an average a little over 40 cts. a yard. The concrete culverts cost about $50 each for 18-in., $65 each for 24-in., $85 for 30-in., and $105 for 36-in., placed in the road. The average cost of grading per mile including culverts is $1,500. The macadam costs about 25 cts. per lin. ft. of road and the concrete 90 cts. per lin. ft. of road. We are getting 16 miles of good road for $116,000.

Cost of Operating a Portable Asphalt Plant at Washington, D. C.

(STAFF ARTICLE.)

The Commissioners of the District of Columbia installed last year a portable asphalt plant, the product of which was used for minor repair work. The plant was located in New York Ave., N. E., near the intersection with 2nd St., convenient to the railway. It was, however, remote from the water front and the costs of materials used were high. In addition, the cost of Bermudez asphaltic cement was further augmented because of the relatively small amount purchased. It was decided to use asphalts which might be secured at lower cost, and therefore the amount of work done with Bermudez was a small proportion of the whole. A small amount of topping was turned out in which was incorporated old paving material, removed from streets under repair, but as the plant was not equipped for machine crushing, and as it was necessary to resort to crushing by hand, the resulting economy was not considerable. The installation of a crusher, as projected, will reduce the cost of this class of output. The following data on the operation of this plant from Nov. 11 to Nov. 30, 1912, are abstracted from the report of David E. McComb on the advisability of installing a municipal asphalt plant for the District of Columbia. An abstract of some of the features of this report appeared in the March 5, 1913, issue of ENGINEERING & CONTRACTING.

From Nov. 11 to Nov. 30, inclusive, the portable plant turned out 9,328.5 cu. ft. of plant product, all of which was used upon minor repair work. This is an average of 549 cu. ft. per day, there being 17 working days in the period under consideration. The labor and fuel cost of operations was as follows:

	Total.	Per cu. ft. output.
Plant labor	$231.00	$0.0247
Plant foreman, 18 days at $4	72.00	.0077
Miscellaneous plant labor, including watchman	131.00	.0140
Total	$434.00	$0.0465
Fuel at plant	152.15	.0163
Haul	395.00	.0423
Preparation for patching, cutting out, etc	749.05	.0803
Tool sharpening	47.20	.0051
Street labor, barricading, hauling away old materials, spreading, rolling and tamping	880.17	.0943
2 foremen, street labor, 17 days at $4	136.00	.0146
Fuel in street	90.88	.0097

The following is a summary of the above costs:

	Per cu. ft.
Plant	$0.0465
Haul	.0423
Cutting out	.0854
Street labor	.0943
Street foremen	.0146
Fuel, plant and street	.0260
Total labor cost in place	$0.3091

Of the total product of the plant 3,478 cu.

ft. were binder. This includes 681.5 cu. ft. in which Bermudez asphaltic cement was used, and 2,796.5 cu. ft. in which Texas asphaltic cement (Sunbrand) was employed. The cost of binder materials was as follows:

	Total.	Per cu. ft. Binder.
Broken stone, 131.58 cu. yds. at $1.50	$197.37	$0.0568
Texas A. C., 8,385 lbs. at $0.00916	76.81	.0275
Bermudez A. C., 2,085 lbs. at $0.01829	38.13	.0560

The material cost using Bermudez amounts to $0.1128 per cu. ft.; using Texas A. C., it amounts to $0.0843 cu. ft.

The asphaltic topping product of the plant amounted to 4,065.5 cu. ft. Of this total 3,219.5 cu. ft. were mixed with Texas A. C. and 816 cu. ft. were mixed with Bermudez A. C. The cost of material in the asphaltic topping was:

109.81 cu. yds. sand at $0.935	$102.67
43.99 cu. yds. sand at $1.555	68.40
20,330 lbs. dust at $0.00125	25.41
Total	$196.48

From the above it will be seen that the cost of sand and dust in the topping was $0.0483 per cu. ft. on mixture. In the 3,219.5 cu. ft. of mixture, 30,410 lbs. of Texas A. C. were used, which at $0.00916 per lb. amounts to $278.56, or $0.0865 per cu. ft. of mixture. The total material cost, therefore, with Texas A. C. was $0.0483+$0.0865, or $0.1348 per cu. ft. In 846 cu. ft. of mixture, 7,920 lbs. of Bermudez A. C. were used. This cost $0.01829 per lb., making a total of $144.85, or $0.1712 per cu. ft. for the cement. The material cost with Bermudez was $0.2195 per cu. ft.

The output of the plant also included 1,785 cu. ft. of topping in which was incorporated old paving material removed from streets under repairs. The material cost of this was as follows:

32.88 cu. yds. sand at $0.935	$ 30.74
11.55 cu. yds. sand at $1.555	17.96
5,635 lbs. dust at $0.00125	7.04
8,760 lbs. Texas A. C. at $0.00916	80.24
2,700 lbs. Bermudez A. C. at $0.1829	45.38
22.23 cu. yds. of old material at $0.81*	18.00
	$199.36

*Cost of breaking old material.

The cost of sand, dust and old material amounted to $0.0413 per cu. ft. In 1,356.6 cu. ft. of mixture Texas A. C. were used at a cost of $0.0591 per cu. ft. of mixture; in the remainder of the mixture Bermudez A. C. was used, at a cost of $0.1153 per cu. ft. The material cost with Texas A. C. amounted to $0.1004 per cu. ft.; with Bermudez A. C. it totaled $0.1566 per cu. ft.

The cost of the plant was $6,400. The overhead charges would be:

	Per year.
Interest on investment at 3½ per cent	$ 224
Depreciation, 15 per cent	960
Upkeep per year, estimated	300
Total	$1,484

With an average daily output of 549 cu. ft. the yearly output for 220 working days equals 120,780 cu. ft., and the overhead cost per cu. ft. would be $0.0123.

The following is a summary of the costs, including the overhead charges:

	Per cu. ft.
Cost of fuel, labor at plant and street, and haul	$0.3091
Overhead charges	.0123
Total	$0.3214
Binder with Texas A. C.:	
Labor, overhead charge, etc	$0.3214
Materials	.0843
Total	$0.4057
Binder with Bermudez A. C.:	
Labor, overhead charges, etc	$0.3214
Materials	.1128
Total	$0.4342
Topping with Texas A. C.:	
Labor, overhead charges, etc	$0.3214
Material	.1348
Total	$0.4562
Topping with Bermudez A. C.:	
Labor, overhead charges, etc	$0.3214
Material	.2195
Total	$0.5409
Old Material and Sand Mixture with Texas A. C.:	
Labor, overhead charges, etc	$0.3214
Material	.1004
Total	$0.4218
Old Material and Sand Mixture with Bermudez A. C.:	
Labor, overhead charges, etc	$0.3214
Material	.1566
Total	$0.4780

Effect of Heavy Motor Traffic on Pavements.

The Metropolitan Paving Committee of London, England, having been informed that in order to withstand the greater weight and strain which is now imposed on road foundations due to the increase of motor omnibuses and other heavy mechanically propelled vehicles, it has been found necessary in many cases to increase the thickness of the concrete foundation, invited expressions of opinion from the surveyors of the various metropolitan boroughs on the subject. A digest of the information obtained is included in the 10th annual report of the committee, which was issued last month. The following summary of the replies of borough surveyors is taken from our English contemporary, The Surveyor:

Bermondsey.—In consequence of the motor omnibuses and other heavy mechanically propelled vehicles it has been found necessary to increase the thickness of concrete of the carriageway from 6 ins. up to 9 ins., or even 12 ins. in some cases, thus considerably increasing the cost of construction.

Fulham.—Motor traffic has had the effect of, if anything, decreasing the cost of maintenance of wood-paved roads. A record of the wear is as follows:

Date.	No. of years laid.	Rate of wear per annum.
Fulham Road (near Stamford Bridge):		
September, 1902	10	0.209 in.*
July, 1907	3	0.17 in.
June, 1912	8	0.136 in.
Dawes Road (part):		
(a) September, 1902	7	0.12 in.
(b) September, 1902	11½	0.14 in.†
(a) July, 1907	11	0.12 in.
(a) June, 1912	16	0.103 in.
Lillie Road (a section):		
September, 1902	7½	0.192 in.
July, 1907	11½	0.186 in.‡
June, 1912	5	0.126 in.

*Relaid 1904.
†Relaid 1905.
‡Relaid August, 1907.

On water-bound macadam roads motor traffic has effected considerable damage and disintegrated the surface, but the roads that have been so effected have been re-made with bituminous macadam, and the result is that the cost of maintenance of such treated roads now submitted to motor traffic is not more, if as much, as the water-bound surface previous to the motor traffic coming upon it. The scavenging has been considerably reduced. A record of the manure and refuse taken in one week on the whole of the wood-paved roads in Fulham in 1909 was 85 tons 2 cwts. 3 qrs. According to the meteorological report rain fell on two days to the extent of 0.11 in. and 0.16 in., respectively. In the same month, two years later, the record was 64 tons—that is a reduction of 20 tons, or equal to 1,000 tons per annum. The motor traffic soon finds out any weak spots in the wood paving, and these are repaired immediately. This appears to increase the number of repairs, but, as will be seen from the actual wear in the depth of the material, the life of the wood paving is considerably increased, and more than compensates for the increased cost of repair. The concrete foundations have withstood the motor traffic very satisfactorily, and where there have been any weaknesses the motor traffic very soon discovers it. Except for the making good of these weak places there does not appear to be any cause for complaint.

Finsbury.—The surveyor cannot say that the motor traffic has increased the cost of road maintenance in this borough. Practically the whole of the roads used by motor traction are roads paved with granite, wood or asphalt on from 9 ins. and upwards of Portland cement concrete.

Greenwich.—There is an increasing charge for maintenance of all roads, perhaps not so much on granitesett and wood-paved as macadamized roads. There is no doubt that the greater weight is causing great damage to the old concrete foundations, which were never put in to carry such traffic, and the increased load and speed is causing greater vibration.

Hackney.—Great increase of motor traffic has necessitated constant attention to the roads over which such traffic passes, and the expenditure of considerable sums of money on their maintenance, renewal and repair. Roads which, until the advent of motor traffic, were in good condition are now having their surfaces destroyed and their foundations disintegrated, while others have had to be entirely re-made with more lasting materials. Where this has not been necessary up to the present time it has been found that the usual life of the road has been considerably curtailed—even to the extent of 25 per cent. Foundations of Portland cement concrete, which were sufficient a few years ago, are now quite inadequate; and in all renewals where defects have been found, and in new work undertaken, the foundations are now increased in depth by 50 per cent

Hammersmith.—Since the more general use of motor omnibuses and other heavy mechanically propelled vehicles the Hammersmith Borough Council has increased the thickness of concrete foundation in wood-paved roadways from 6 ins. to 8 ins. The increase of motor traffic has undoubtedly added to the cost of construction of all classes of roads. As regards maintenance, on wood-paved roads the surveyor thinks that time will prove decreased cost, inasmuch as the life of the wood will be slightly lengthened; but on all other roads he considers the expense is largely increased.

Hampstead.—Motor-omnibus traffic has considerably increased the charges for maintenance of all classes of roads. With regard to wood-paved roads, the life of the paving has undoubtedly been reduced one or two years in consequence of this traffic, and the depth of the concrete foundation has had to be increased from 6 ins. to 9 ins. Two new bus routes have recently been opened over macadam roads which are quite unsuited to this traffic, and it will be necessary to at once spend a little over £6,000 in wood and other paving to meet the requirements of this traffic. The additional cost of the road maintenance in this borough for the past two years, caused by motor bus traffic has been about £5,000 per annum.

Holborn.—There is no doubt that motor traffic has increased the cost of the upkeep of roads. Apart from motor omnibuses and motor vehicles used for commercial purposes the main roads have to carry very heavy burdens in the shape of traction engines and lorries, and the foundations of many roads are not strong enough to bear such enormous weights. In place of a concrete foundation 6 ins. thick, which was sufficient ten years ago, the Holborn Borough Council are now putting in Portland cement foundations 12 ins. in thickness.

Lewisham.—There is no doubt whatever that the heavy motor traffic of the present day is very materially increasing the cost of maintenance of roads. The twin-tired vehicles, such as motor omnibuses, create a partial vacuum between tires, and suck the surface of the roads upwards. This, of course, has a bad effect on wood paving, but an infinitely worse effect on water-bound macadam roads, where the surveyor has seen stones pulled out by this influence. The heavier motor traffic, such as steam lorries, is undoubtedly damaging the foundations of many roads, and it has become necessary to increase the thickness of the concrete. Of course, this is impossible in roads which are already paved without breaking up the entire job, but in laying new-paved roads the surveyor is providing an additional depth of concrete.

City of London.—Due to the increase of motor vehicles, the existing foundations of many of the main thoroughfares are not of sufficient strength to withstand the weight and strain now imposed upon them; and the city engineer considers that the minimum thickness of the concrete foundation should be 9 ins.

St. Marylebone.—It does not appear that the cost of maintaining wood-paved roads in this borough has been increased in consequence of their being traversed by motor vehicles, although recently this council has increased the depth of concrete foundations for wood paving in the more important thoroughfares from 6 ins. to 8 ins. and 10 ins. The effect of motor traffic on macadam roads, in the more frequented thoroughfares, has been that the roads have had to be re-coated annually; and in order to counteract this the council has been extensively substituting tar-macadam for macadam. Quite recently the London General Omnibus Co. inaugurated a new service of motor vehicles traversing an important water-bound macadam road in the borough, with the effect that it will have to be repaired within a very short period; and another road, under similar conditions, has had to be dealt with by the council as a matter of urgency.

St. Pancras.—Many wood-paved streets in this borough have either already been injured, or shortly will be, by this traffic breaking up the concrete foundation insufficiently strong to carry the traffic. The St. Pancras Borough Council has recently had to reform the concrete foundation of Seymour St. when repaving it. The original concrete foundation was about 6 ins. thick, and for many years it proved sufficient to carry the very heavy ordinary traffic of the street, but as soon as two services of motor buses began running, the surface in many places showed indication of subsidence, and on examination the concrete was found to be completely broken up, and it was found necessary at the time of repaving the street to form a new concrete foundation which has been put down 12 ins. thick. The additional cost in this street alone of removing the old foundation, carting rubbish to shoot and providing a new foundation, amounted to about £2,600, being about 40 per cent of the total cost of the job. In Great College St. they have a daily and very frequent traffic of a motor steam wagon, and the condition of the granite paving in this case indicates the destruction of the foundation. A short section of this was opened up last summer, and a new foundation formed, and the road repaved but a considerably longer length of this and adjoining streets will require the same treatment at an estimated cost of £1,200, necessitated entirely by this motor traffic. On macadam roads the motor bus traffic is terribly destructive; the increased cost of maintenance will be an item of very considerable amount, and brings one to the conclusion that a water-bound macadam road is entirely unsuitable for motor omnibus traffic, and yet such traffic cannot be forbidden the use of macadam roads. The convenience of motor omnibuses as a means of public traffic is such as to render it improbable that even if the power existed they would be debarred from using such roads. It therefore follows that such roads should be paved with other material than water-bound macadam, so as to carry without destruction this traffic. The cost of repaving these roads is formidable, and hence the claim of the local authorities that grants should be made by the Road Board from the fund provided by the petrol tax towards the necessary expenditure in London as well as on provincial county roads.

Paddington.—In recent years, when renewing wood-paved carriageways, and where the existing concrete foundation, etc., originally about 7 ins. deep, has been found to be defective, they have been replaced with concrete, etc., of a thickness of from 10 ins. to 13 ins. There can be no doubt the increased amount, the greater weight and the greater speed of vehicular traffic have caused an increase in recent years in the cost of maintaining carriageways.

Poplar.—The increase of motor traffic has certainly had the effect of increasing the cost of road maintenance.

Southwark.—The increase of motor traffic has had the effect of increasing the cost of paving and maintaining the roads in this borough, but it is not possible at present to give actual details as to the cost.

City of Westminster.—The city council last year approved an alteration in their specification for paving work to provide for the laying of 8 ins. of concrete foundation and 1 in. of floating instead of 6 ins. of concrete and 1 in. of floating formerly specified—this, of course, only to apply in cases where new concrete foundation is laid. In the opinion of the city engineer the increase of motor traffic prejudicially affects macadam roads, and, perhaps to some slight extent, asphalt roads also; but he does not think that as a result of motor traffic in Westminster there has been any increase in cost of maintaining wood-paved roads originally laid on present-approved methods.

Woolwich.—On the motor bus route from Lee Green to Sidcup through Eltham, which is still an ordinary water-bound macadam and tar-sprayed road, the extra wear has been very considerable, and the Woolwich Borough Council is now considering the advisability of adopting a more durable paving to withstand the modern traffic.

GENERAL ARTICLES

The Improvement of the Neponset River in Massachusetts.

Contributed by Edmund M. Blake, Engineer in Charge.

The Massachusetts State Board of Health received proposals for dredging the Neponset River in the City of Boston and the towns of Milton, Dedham, Westwood, Norwood, Canton and Sharon, on Aug. 26, 1912, based upon the plans and specifications which the Board hoped at that time could be carried out. Three bids were received, the total amount of each being as follows:

Eastern Dredging Company, Boston	$236,900
Michael J. Meehan, Boston	237,000
Barge Canal Construction Co., New York	158,900

The above total amounts are based upon the quantities stated in the advertisement as the basis upon which the bids would be compared. Unit prices varied from 12 cts. to 63 cts. per cubic yard for soft material; from 50 cts. to 75 cts. per cubic yard for hard material; from $6 to $15 per cubic yard for boulders larger than 9 cu. ft. in volume and from $7.50 to $15 per cubic yard for ledge rock. These figures show an unusually wide variation in the bidding prices for this class of work.

It was evident at once that it would be impossible to let a contract under any one of these bids inasmuch as the total appropriation of $150,000 covered not only the work called for in the advertisement but also the work of alteration and repair to bridges and pipe crossings, the engineering charges and all extras, such as overhaul, excess material for filling in cut-offs and the yardage contained in 6 ins. outside of the designated cross sections of the proposed channel. The Board, therefore, rejected all bids and new studies were made forthwith to determine in what particulars the high cost as shown in these bids could be reduced, without material difference in the results to be accomplished.

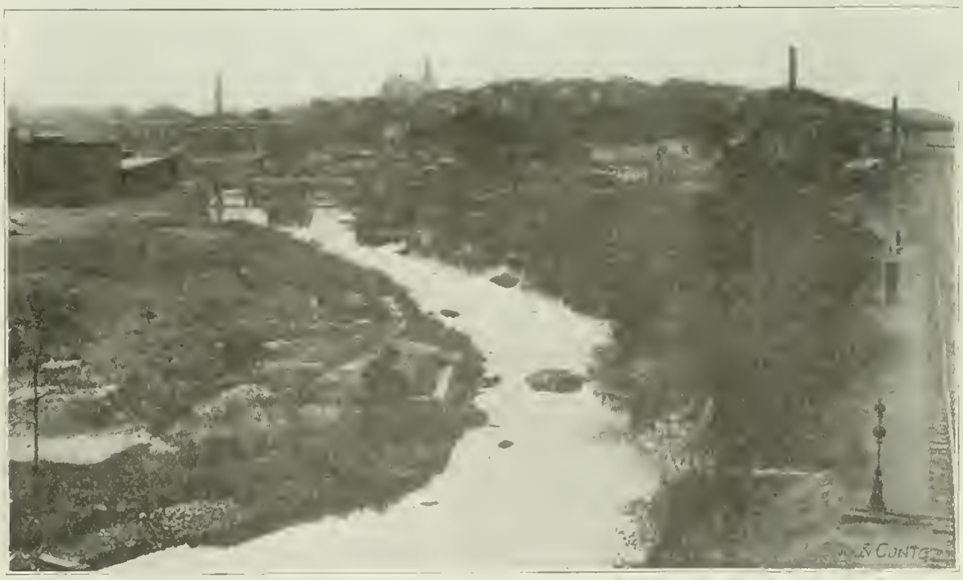

Fig. 1—Upper Ledge Section of Neponset River Through Hyde Park.

In preparation for the bids received on August 26, eleven different complete plans of improvement were studied in detail and full estimates of quantities were made for each plan. In preparation for the second call for bids, five additional plans were studied with the same detail and the specifications were carefully revised to cover the plan finally adopted as the basis for the second call for bids. The principal changes made were as follows:

(1) The time for completing the contract was extended to Nov. 15, 1914, giving the contractor one additional season in which to do the work.

(2) The upper divison of the previous plan in which the river ran in a narrow channel through a thickly wooded area was cut out, thereby reducing the total length of river to be improved by 5,119 ft.

(3) The specification for the disposal of dredged material was changed so that the contractor could place it to a depth of 4 ft. instead of 1 ft., should he so desire, over an area running back 200 ft. from either bank of the river.

(4) The designated cross sections, to which the new channel of the river was to be excavated, were radically changed.

TABLE 1—NEPONSET RIVER IMPROVEMENT; HYDRAULIC DATA FOR PROPOSED NEW CHANNEL.

Drainage division.	Length in feet on center line of channel.	Summary of lengths in feet.	Contributing watershed in square miles.	Maximum discharging capacity of channel in second-feet.	Depth of water in feet.	Approximate average velocity in feet per second.	Surface slope in ft. per 1,000 ft.	Approximate elevation at upper end of division above Boston city base. Bottom	Surface
1....	5,343	......	165.15	660.60	5.0 to 7.0	1.90	.230	38.81	44.81
2....	7,459	12,802	96.28	385.12	6.0 to 7.0	1.42	.138	39.84	45.84
3....	6,894	19,696	93.00	372.00	about 9.0	1.29	.095	37.59	46.59
4....	8,143	27,839	90.00	360.00	about 9.0	1.29	.097	38.38	47.38
5....	7,640	35,479	86.00	344.00	about 9.0	1.31	.101	39.15	48.15
6....	4,366	39,845	78.00	312.00	about 9.0	1.19	.086	39.53	48.53
7....	2,150	41,995	76.00	304.00	about 9.0	1.20	.089	40.41	48.72
7....	2,238	44,233	76.00	304.00	about 8.0	1.27	.105	41.32	48.96
7....	2,258	46,491	76.00	304.00	about 8.0	1.36	.125	42.23	49.23
8....	7,301	53,792	44.00	176.00	about 7.0	1.26	.145	43.29	50.29

Total length ....= 10.188 miles

Elevation at crest of dam..............= 41.83

Head of crest..........................= 1.75

Elevation of surface at dam............= 43.58

Note.—The base widths and side slopes have not as yet been finally determined, but will be such as to give as great a depth of water as possible in periods of dry flow.

(5) The pile bridge in the Hyde Park section which carries eight train yard tracks across the river on about 300 piles was taken out of the work covered by the specifications, provision for any dredging or alteration at this bridge being made under the head of "Extra Work" or supplemental contract.

The second letting was then advertised and six bids were received on Oct. 3. the totals of each being as follows:

William L. Miller, Boston................	$143,000
Bay Dredging & Contr. Co., Brooklyn....	122,200
John H. Cavanagh, Boston...............	122,100
Barge Canal Constr. Co., New York....	115,950
U. S. Drainage & Irrigation Co., New York	181,600
Eastern Dredging Co., Boston..........	134,340

Fig. 2—Flood of Neponset River With Paul's Bridge Built in 1849 in Foreground.

The unit prices varied from 32 cts. to 58 cts. per cubic yard for soft material; from 42 cts. to 72 cts. per cubic yard for hard material; from $7.50 to $14 per cubic yard for boulders over 9 ft. in volume, and from $7.50 to $14 per cubic yard for ledge rock.

The quantities upon which the bids were compared were as follows:

Soft material, cu. yds....................	130,000
Hard material, cu. yds....................	130,000
Boulders, cu. yds..........................	100
Ledge rock, cu. yds.......................	800

Action on these bids was deferred until Oct. 10, upon which date the Board awarded the contract to the Barge Canal Construction Co., 150 Nassau St., New York city, whose bid was as follows:

	Per cu. yd.
Soft material	$0.42
Hard material	0.42
Boulders	7.50
Ledge rock	7.50

The large saving in engineering charges, as well as a probable saving in litigation and disputes, as a result of exactly the same price for both hard and soft material, was evident to the board.

One dipper dredge has been installed just below Pauls Bridge, which is about two miles above the Mattapan Paper Mills Dam, the lower terminus of the present work. In this section, most of the hardest material and all of the ledge rock will be encountered, and there are three railroad bridges, two highway bridges and two footbridges in addition to the pile bridge above referred to; two 10-in. water pipes, one 12-in. water pipe, two 16-in. cast iron sewers and one 4-in. condenser suction pipe from the power house of the Edison Electric Illuminating Co. Any work on pipes and sewers, on the pile bridge and on foundations to all other bridges is to be done by the board and is not included in the contract; but the contractor must remove material from under all of the bridges, except the pile bridge, if so required by the board.

Another dipper dredge or a 10-in. hydraulic suction dredge is to be installed at the upper end of the work near Neponset St. in the town of Norwood, working downstream towards Pauls Bridge. Here two highway bridges, one railroad bridge and one trolley trestle bridge are encountered, from under which the contractor must remove material, if so required by the board. The greater part of the material here is soft and ideal for suction dredging, which would also make its disposal easier and more satisfactory, especially in the filling in of cut-off channels.

Releases for the deposit of dredged material are rapidly being secured from the property owners along the ten miles of river to be improved, with only slight, if any, objection, so anxious are all concerned to see the work speedily carried out. It has been a season of very low flow from the watershed and the conditions have been very offensive and objectionable, aggravated by a break in the sedimentation basin of a large tannery in the town of Norwood which let over 6,000,000 gals. of raw tannery wastes down into the river. Public sentiment appears to be earnestly in favor of carrying out the present contract as speedily as possible, with a moral assurance of additional appropriations, if needed, to complete and extend the work until the entire river is improved and the unsanitary and offensive conditions removed forever.

The hydraulic calculations were based upon a final channel with a discharging capacity at the rate of 4 sec. ft. per square mile of watershed, and so designed that there would be the greatest depth and velocity possible during the low flow period, with a water surface during periods of high flow below the general level of the meadow areas to prevent flooding and subsequent areas of stagnant water. A value of the factor N of 0.035 was decided upon as safe in designing a channel with many sharp bends and the irregular bottom which is always the result of dredging.

The hydraulic tables used are given here as being perhaps of some interest to engineers engaged upon similar work. The elevations are above the Boston City Base. Throughout the many series of calculations, the hydraulic diagrams of Church were found to be of invaluable assistance, the logarithmic checks on the formula of Ganguillet and Kutter showing that long and laborious method not justified or necessary from a practical standpoint, when it is realized that dredged sections in a flowing river can only roughly approximate to theoretical sections designed in the office.

The dam of the Mattapan Paper Mills is located at the lower end of the work. This dam has a clear spillway from one abutment to the other, after omitting for three intermediate flashboard piers, of 116.7 feet. The calculations are based upon the permanent removal of all flashboards at this dam. Table I gives the data.

A total of 742 cross-sections were sounded during the surveys of last winter from 72,248.47 ft. of base line, covering 68,145.07 ft. of river center line. These soundings extended beyond the river to cover 926 acres of meadow land and the cross section lines altogether totalled 298,642 ft. in length. The data obtained included the depth of soft material as far down as a ⅝-in. steel rod could be pushed by 2 or 3 men. Much of this work was done through the ice, the parties being equipped with heavy ice-cutting tools. Permanent bench levels were established and double-checked ahead of the soundings. The cross-sections were plotted on 235 standard sheets, 22x54 ins. in size, to a scale of 10 ft. per inch, both vertical and horizontal. The new channel was plotted on these sheets by the use of bristol board templates and from these the quantities of hard and soft material were determined by volumetric calculations based upon double planimeter readings. The yardage covered by the proposed new chan-

TABLE II.

Drainage division.	Length in feet.	Cubic Yards. Soft.	Hard.	Total.	Cu. yds. per lin. ft.	Depth over length of 200 ft.
1.....	5,343	13,636	3,749	17,385	3.25	0.44
2.....	7,459	10,021	17,865	27,886	3.74	0.50
3.....	6,894	18,443	38,647	57,090	8.28	1.12
4.....	8,143	27,304	40,296	67,600	8.30	1.12
5.....	7,640	18,972	13,050	32,022	4.19	0.57
6.....	4,366	14,512	4,906	19,418	4.45	0.60
7.....	6,646	17,639	7,186	24,825	3.74	0.50
8.....	7,301	10,325	840	11,165	1.53	0.21
Total.	53,792	130,852	126,539	257,391	4.78	0.65

nel is shown in Table II (these figures are approximate).

Morning and afternoon daily gage readings have been taken at six important points on the river since the fall of 1911. Current meter stations have been established and gagings made at frequent intervals since January, 1912. This and much other valuable hydraulic data are being accumulated and studied. While the work of deepening and enlarging the channel is going on, the Board, under legislative authority, is gradually compelling all of the mills and factories on the river to install modern and adequate filtration systems for the treatment of their wastes so that when the improvement of the channel is completed, the new Neponset River will not only care for high flows without flooding the valuable meadow lands, but will also carry down through the various towns and the City of Boston, water free from the offensiveness which characterizes largely the entire length of the river today, with the resultant elimination of unsanitary and unhealthful conditions.

The work is all under the direction of Mr. X. H. Goodnough, Chief Engineer of the Massachusetts State Board of Health, with the writer as Engineer in Charge. The field assistants are Mr. Newton L. Hammond, Mr. E. F. Davis, Mr. H. S. Wright and Mr. W. G. Norteman.

The Barge Canal Construction Company is comprised of Messrs. Charles Longenecker, Louis B. Harrison and George W. Beeman.

Method of Molding Reinforced Concrete Shells for Pier and Wharf Foundations at the Balboa Terminals, Panama.

The new piers and wharves of the Balboa terminals will be supported on concrete caissons, sunk to rock. The large quantity of caisson shell required for this work has caused the construction of a special plant for its manufacture. Its essential feature is a movable mixing plant which can be shunted along a railroad track beside the platform on which the collapsible forms and reinforcement for the sections are set up. The plant has a portable concrete mixer mounted on cribbing on a flat car so that the spout is 14 ft. above the platform. Coupled to the flat car is a box car containing cement, and at the 'flat's" other end are alternate cars of sand and crushed rock. Portable runways for wheelbarrows are laid along the tops of the cars, which are connected in train and moved as a unit. Thus all the materials for the concrete are kept constantly near the mixer, even when the train is in motion from one form to another. It is moved ordinarily by an air winch which draws through stationary sheaves at the ends of the track a ⅝-in. hauling cable with connections to the ends of the train.

When the train has been "spotted" opposite a form which is ready the concrete is poured into it through a chute. As it falls from the chute it is caught on a circular wooden platform set over the inner shell, and distributed to the annual space by men with hoes. The placement is quite simple and proceeds at the rate of mixer output. As soon as the shell has been cast the train is moved to another form. The concrete is allowed to set for 24 hours and then the forms are removed and cleaned at a special platform for their storage, after which they are set up again on the operating platform. The caisson shell is allowed to harden for three days before removal to a storage yard.

The platform on which the forms are set up and filled is 15 ft. wide by 350 ft. long, with an extension 50 ft. in length at the south end on which the reinforcing steel is assembled. As the reinforcing bars are unloaded from the cars they are laid in a stock pile at the end of the platform, next which a set of steel rolls has been placed. The rods are fed from the pile directly into the rolls, which are set to bend them into hoops of a diameter 4 ins. less than the outside diameter of the finished shell. The bars are set up around a wooden cage and tied together, after which the reinforcement is handled as one piece. A light derrick mounted on a truck and hand-operated picks up a set of reinforcement and carries it to one of the erected inner forms for the shells, dropping the reinforcement around it like a cage. Six pipes are then placed vertically around the reinforcement at equal distances to make cores for connecting rods, the outer form is erected and the spaec between forms adjusted with wooden blocks. The completed form is then ready for the concrete.

Each section of shell is 6 ft. high, with an inside diameter of 5 ft. 6 ins. and a thickness of shell of 1 ft., and contains 4⅔ cu. yd. of concrete. In a normal day's work about 16 such sections will be poured from the ½-cu. yd. mixer. During the month of January 1,724 lin. ft. were made with a ⅓-yd. mixer and it is expected that the run during February, with the larger mixer, will approximate 2,200 ft. In all, about 28,000 lin. ft. of concrete caisson will be used in the one pier and the quay wall, the construction of which has been authorized to date. Steel shells will be used in deep water, on account of their greater length, which facilitates driving. Both concrete and steel shells will be filled with concrete containing a well protected reinforcement of steel rails.

The cost of production at the Balboa plant is considerably less than the cost of making shell at other points in the canal construction. No comparison with such work off the Isthmus is available because so great a quantity of shell has not been made elsewhere.

We are indebted for the above information to the "Canal Record" for Feb. 19, 1915.

Miscellaneous Labor Costs of Excavation and Construction for a Manufacturing Plant.

(STAFF ARTICLE.)

The following data are taken from a notebook kept by the writer during the construction of buildings for an electrolytic lead refining plant at Grasselli, Ind. The notes were made by keeping a record of the time of the contractor's men on each of the small jobs.

Engine Foundations.—These foundations consisted of heavy blocks of concrete built in pits excavated in sand to 4 ft. below the level of the ground. The blocks extended 6 ft. above ground level. Excavation and concreting are included in the costs given but not the forms. The work was begun June 7 and completed July 6. The wages were 37½ cts. per hour and the concrete was hand mixed.

Concrete, cu. yds	399 2
Total cost	$946.20
Cost per cu. yd	2.37

Furnace Foundations.—This concrete was placed in small excavations 4 ft. deep and no forms were employed.

Concrete, cu. yds	63
Total cost	$106.80
Cost per cu. yd	1.70

Power House Foundations.—The concrete foundations for the building consisted of a wall about 20 ins. wide and 4 ft. deep in sand under the four walls of the building. No forms were used. The boiler foundations were simply large square blocks of concrete 4 ft. deep.

Concrete, cu. yds., in boiler foundations	53
Concrete, cu. yds., in building foundations	118
Concrete, cu. yds., total	171
Total labor cost	$501.50
Cost of labor per cu. yd	2.93

Pump Foundations.—These were foundations for boiler feed pumps, centrifugal pumps for the condensers, and foundations for the feed water heater. They were small blocks of concrete set in the sand and extending about a foot above the ground. Boxes were made with templates for the foundation bolts.

Concrete, cu. yds	22.4
Total labor	$73.20
Cost per cu. yd. labor	3.27

Brickwork.—The brick walls of the power house were about 34 ft. high and the walls were 13 ins. thick. There were about 240,000 brick laid and the work was done between June 11 and July 19. Ordinary scaffolding was built up and materials were hoisted with a light apparatus operated by a single horse. Wages were 75 cts. per hour.

Brick laid	240,000
Total labor cost	$1,838.12
Cost per M brick	7.66

Scale Foundations.—These foundations were for a narrow-gage track scale of the Howe type and they were built within one of the buildings and required three days' work:

Concrete, cu. yds	23.4
Total cost of labor	$30.80
Cost per cu. yd	1.30

Storage Trestle.—This trestle was built at the rear of the power house and contained bents 16 ft. apart, resting on sills supported by concrete foundation walls. These walls were 4 ft. deep and extended about 6 ins. above the ground level. They were built in four days.

Concrete, cu. yds	40.0
Total labor cost	$82.00
Cost per cu. yd	2.05

Tank House Foundations.—These foundations were about 20 ins. wide and 4 ft. deep and were built to support the walls around a building 72x360 ft. in plan. There were also piers supporting the steel columns at 18-ft. intervals. The excavation amounted to 365 cu. yds. of sand and is also included.

Concrete, cu. yds	287
Total labor	$611.60
Cost per cu. yd	2.13

Tank House Brickwork.—The brickwork for the tank house consisted of walls about 30 ft. high and 13 ins. thick. There were 260,000 bricks in all and they were laid in about 26 days with the same scaffolding that was employed on the power house.

Brick	360,000
Total labor cost	$2,054.20
Labor cost per M	5.07

Railroad Grading.—About one mile of railroad grading was necessary for the trackage serving the plant. All the material was sand and was handled by slip scrapers. Very little plowing was necessary. The length of haul averaged about 200 ft. and the maximum haul was about 400 ft. The teams and scrapers with driver were paid 35 cts. per hour. Common laborers received $1.75 per day of 10 hours. The work was done between March 7 and April 28. The average number of teams per day was 9.8.

Excavation, cu. yds.	15,658
Total labor cost	$1,866.00
Cost per cu. yd., cts	11.9

Data on Rock Drilling Operations at the Kensico Dam, New York Improved Water Supply.

The Kensico dam for the enlarged water supply of New York city is a 1,000,000-cu. yd. cyclopean masonry structure. In building this dam a large rock excavation was necessary for foundations and for quarrying the massive stones for the cyclopean masonry. The drilling operations for this rock excavation are described by Mr. Frank Richards in "Compressed Air Magazine" for March, 1913, and from his description we abstract the following parts of particular interest for the records given:

For the drilling electric-air drills are employed, the entire contract calling for 30 of these machines. The surface affords a good and almost level footing for the tripods. There are no obstructions in moving from hole to hole. The drill and tripod weigh less than air-driven rock drill of equal capacity, and they are easily moved from hole to hole—6 ft. —while the pulsator apparatus is handled almost as easily as a baby carriage, and it is to be remembered that there is no expense or labor required for laying and extending air pipes. The stringing of the wires along the ground comprises the entire power connection between the drill and the power house.

Besides the tripod electric air drills there are also four electric-air "drill wagons" on the job. It carries an electric-air drill of larger size, putting down larger and deeper holes. This machine is entirely self-contained, and is moved along upon a temporary track as the work proceeds. The drill has a vertical power feed of 6 ft., traveling up and down the vertical guides at the right, while the lighter and higher frame at the left is for a power hoist for the steels, taking them out of the hole at a single lift, except for the last steel or two when the holes are getting down to the depth limit.

The electric air drill proves itself to be the full equal, and a little more, of any air operated or other drill of the same capacity; that is in drilling holes of the same diameter and depth in rock of the same character. It strikes a sharper blow, its blows are timed to a uniform and constant rapidity, it avoids sticking in the hole, so that in a day, or any other given time of sufficient length, it shows as much accomplished, or a little more than any other type of drill can show, and in comparisons as to actual performance it requires no allowances or concessions of any kind. The cost of maintenance of each drilling outfit—drill and pulsator—is no more than that of the air drill. The simplicity of the drill unit and its little liability to wear or accident balances the repair and maintenance of the pulsator part.

The electric air drill complete costs more than the air driven drill taken alone, but the air drill, with its share of the compressor which drives it, and the piping and appurtenances, costs much more than the electric air drill, and for mere first cost when installing a plant the latter shows a great advantage. The piping and appurtenances alone for the air drill will more than cover the excess of cost of the electric air drill, and then we might say that there is the cost of the big air compressor plant on the one side and that of the electric generator plant upon the other; but in so many cases, like the present, the generating plant costs nothing, because current can be furnished by the big electric companies cheaper than it could be produced by any isolated plant.

But the most interesting and really the most important question in regard to work of the extensive and protracted character here involved is as to the power consumption and the total cost of operating. Here we have results which can only be characterized as astonishing.

First, as to the drill wagon. One has been in service four months. It is drilling holes to a maximum depth of about 30 ft., using a 5 or 5½-in. starter and bottoming at 4 to 4½ ins., the average depth of holes for 8 hours ranging from 45 to 65 ft. Under test conditions 104 ft. of hole has been drilled per shift.

Any comparison between the performance of this drill and the standard churn or well drill must be based more or less upon assumption, as no well drill has been actually operated in the same rock alongside this apparatus. Competent experts, however, state that the standard well drill could not drill this rock at a rate of more than 10 ft. per shift. Under the best conditions the cost with the well drill would average between $0.80 and $1.00 per foot. The actual cost per foot obtained on the electric pneumatic drill wagon is made up as follows:

Electric power for 8 hours	$0.60
1 drill runner	4.00
Helper	2.50

Basing the cost per foot upon the power and labor charges alone and considering the average daily work as 50 ft., which is very conservative, would bring the cost per foot to approximately $0.14. With a driller representing the builders of the drill this cost was cut in half and it is believed that when the three other machines also are drilling and the usual rivalry develops between the crews the drilling capacity will go up materially, probably from 60 to 75 ft. per shift, and this would bring the cost per foot for power and labor to $0.10 or less.

The wagon is as readily handled as any of the heavy churn drills, and its cost of maintenance is believed to be no greater, but the extraordinary feature is the power cost. This sometimes runs as low as $0.30 per day, and is never higher than $0.75. It is understood that the electric power, 3-phase, 60 cycle, 220 volt, is costing the contractor $0.0125 (1¼ cts.) per k.w. hour.

The power cost of electric air tripod drills is between 30 and 40 cts. per day, drill runner $3.50 to $3.75 per day, and helper $2.50. The holes are 10 to 15 ft. deep, bottoming at 1¾ ins., and the average drilling per shift is 35 to 45 ft. This would make the drilling cost of these machines, based on power and labor (power 35 cts. per day) approximately 20 cts. per foot of hole drilled).

Comparison is suggested between the performance of these electric air tripod drills and that of standard 3½ in. air operated drills. Assuming that the average free air consumption per drill per minute is 150 cu. ft. compressed to 90 to 100 lbs. and taking the air from the highest type of Corliss compound condensing engine driven compressor, with high pressure boiler, etc., would bring the power cost alone to 75 cts. per day. Adding interest charges on the entire compressor installation, cost of appurtenances, pipe lines, etc., maintenance and depreciation would bring this cost of power per drill per day to $1.25 or $1.50, or between three and four times the power cost shown for the electric air drill.

There are also working upon this contract some 3½-in. air driven drills of the type referred to above, which began work before the electric air drills were installed, and it has been found that with both working in the same rock the electric air drills actually average from 5 to 10 ft. per shift more than the air drills.

If instead of assuming the most economical type of compressor for the above comparison, the air had been taken from a straight line compressor of the old and still familiar pattern, working noncondensing with steam below 100 lb., etc., the discrepancy in costs would be much greater. In these installations experience has made it common practice to figure the power cost per drill at $2.50 to $3.00 per day.

Summing up in a sentence it may be stated upon authority that the electric air drill wagon operating under the conditions and in the type of rock as found at Valhalla, is drilling these large blast holes to 30 ft. in depth at about 1-5 to 1-6 of the cost of any other drilling apparatus now known, and the electric air drills are doing their work at ⅓ to ¼ the cost at which it could be done by any standard air-driven drill with the air supplied by the most economical air compressor.

Such a remarkable showing gives the Kensico reservoir contract a special interest to advanced engineers who are studying economical construction.

WATER WORKS

Some Recent Advances in Rapid Filter Design.

Some of the more recent advances in the design of rapid filters were discussed by Mr. F. B. Leopold, General Manager of the Pittsburgh Filter Manufacturing Company, in a short address before the recent annual convention of the Indiana Sanitary and Water Supply Association. The following matter sums up Mr. Leopold's discussion:

One general feature of first importance in rapid filter design in which a rapid advance is now being made, relates to the preparation of the water before it goes to the filters, that is, to the design and arrangement of the sedimentation basins. A great many of the earlier type of basins were designed without any particular regard to efficiency. It was taken as a fact that a basin contained a certain quantity of water, and irrespective of the way it was added to the basin or taken away from it, would give a certain number of hours' sedimentation. Experience has demonstrated the fallacy of that theory. The effectiveness of the basin depends entirely, of course, on the design and arrangement of it. With a short, square basin type, taking the water in one corner and out at the other, there is utilized but a very small percentage of its available or possible sedimentation value. The design of basins has been very rapidly developed and at the present time there are comparatively few mistakes made in the general design of sedimentation basins. But there is still room for considerable improvement in the manner of delivering water to the basin and of taking it away. The usual method probably still is to deliver the water through an inlet pipe at one end and to take it out through an outlet pipe or overflow funnels at another point. In designing water flushing plants with which I have been familiar for a good many years we would not think of adding a chemical solution to the water without some method of thoroughly mixing that solution with the water to get the value of it. In design filter plants, however, we pump the water into the basin through an outlet pipe and then drop the solution in front of the pipe or at some point along the wall, depending upon a mixture in that way. We have lately been designing mixing chambers in which we provide a capacity of anywhere from a half hour to one hour's time. The walls added in the mixing chamber, which is highly baffled, carry the water through and give it a chance to thoroughly mix before it goes to the settling compartment of the sedimentation basin. Our observations indicate that with a properly arranged mixing chamber we could get equal results in a basin three-fourths the size of the basin that was so designed that the water was admitted through a pipe with one, two or three outlets, and I believe that the tendency of plants in the future will be to provide mixing chambers for the proper mixture of the coagulent solutions before they enter the sedimentation basin proper. It will mean economy in the quantity of coagulent used and better efficiency of the same sized basins or equal efficiency of the small-sized basins.

Another feature that is being recognized is the question of proportional application of the coagulent to the water that is being treated. In the small plant this is a matter of comparatively small moment. In the plant of any capacity it is necessary to provide an amount of coagulent necessary for the maximum pumpage and to then run the chance of insufficient treatment. In doing this, there is of course a certain percentage of waste. There have been several types of apparatus designed for the adjustment of coagulent feed in exact proportion to the flow of the raw water to the sedimentation basins. In this way, of course, economy in the use of the coagulent is obtained, and in a plant of ten or fifteen or twenty million gallons' capacity the saving amounts to a good many dollars in the course of a year. The first plant of this kind was the New Orleans plant. Since then there have been a number of them, notably Minneapolis, Grand Rapids, Columbus, Indiana, Erie, Pa., and several other small plants. I believe that will receive more serious consideration from engineers as the economies effected are realized.

Another feature in which there has been considerable progress made is the strainer system. There has been considerable difference of opinion as to the relative efficiencies of different types. The older type was the manifold type of wrought iron, small size, and there was more or less trouble in corrosion and stopping up and necessity for taking them out at intervals and cleaning them out. Those have been favored to a very large extent by a considerable number of engineers. Difficulties have developed in this type of construction, and I am personally inclined to think that some of the engineers who favor that type of construction will come back to the lateral system; not the old type of lateral system, but the present developed system which has lateral pipes made of cast iron with strainers. They won't crumble and break off. If they are made large enough and have plenty of area the corrosive trouble experienced in the old wrought iron systems will not occur.

The matter of low and high velocity of flow in washing is still a problem. We put in plants of either type of wash. The only conclusion that can be reached, as far as the evidence that I have available shows, is that the highest economy in plants operating is being developed by those of low velocity wash.

The question of the strainer over the gravel is one that should be considered. When we consider that the area of the sand bed is nearly 300 times greater than the opening from which the water is discharged into it, it is evident that it is absolutely impossible with any rate that could be legitimately used to disturb a properly arranged gravel bed. This probably originated a number of years ago when sand beds were imposed directly on the strainer systems and the strainers gave a great deal of trouble in stopping up with the sand. Then gravel beds were placed between them from 4 to 6 ins. in thickness. That gravel never exceeded ⅜ ins. in diameter and when the water came through the strainer opened with such velocity at that point that it would shoot the small gravel right out into the sand bed. But with a layer of heavy gravel upon the strainers, gravel anywhere from 1 in. up to 2 ins. in size, it would be absolutely impossible to displace it with the velocity that could be gotten through the wash water system. I believe that several of the large plants that are going to be built in the near future will be built with the concrete lateral system.

The Experience of the State of Illinois With the Shallow Well.

Very few Illinois cities obtain their municipal water supplies from shallow wells. However, many people in cities either from necessity or preference use shallow well water for drinking purposes. Oftentimes the city mains are not extended to new sections. Again in old sections the houses are not connected with the mains, making the use of a shallow wells in the state was described by city water furnished has unpleasant physical characteristics like taste, color, or turbidity which cause people to prefer the clear shallow well water. The general experience with shallow wells in the State was described by Dr. Edward Bartow, Director of the Illinois State Water Survey, in a recent paper before the Indiana Sanitary and Water Supply Association. The paper follows:

In a great measure the relative use of shallow wells in different sections of the state is dependent upon the source and character of the municipal water supplies. In the northern part of the state of Illinois, the majority of the city water supplies are obtained from deep rock wells. In the east central portion of the state the water supplies are obtained from deep drift wells, in the west central and southern part of the state from streams. It is possible to have deep rock wells in the northern part of the state because the St. Peter and Potsdam sandstones which outcrop in the central and northern part of Wisconsin dip to the southward so that they are from a few hundred to 2,000 ft. below the surface in the northern third of Illinois, or rather north of a line drawn from Quincy to Chicago. Because the height above sea level in Illinois is less than in Wisconsin wells which enter these two strata are free flowing or can be easily pumped. Such wells furnish an ideal water for municipal water supply. As the water lies in the water-bearing stratum it is absolutely free from contamination. Proper measures must be taken to prevent contamination during delivery to the consumer from defective casing, from contaminated reservoirs, or from faulty connections with river supplies.

In deep rock wells along or south of a line drawn from Quincy to Chicago there is a strong probability that the water will be very highly mineralized. It is therefore necessary in the central and southern parts of the state to obtain water supplies from sources other than deep wells in rock. In the eastern part of the central area the glacial drift is deep enough and contains gravel coarse enough to furnish a satisfactory water-bearing stratum. We therefore find many of the cities in this area obtaining their water supplies from wells from 100 to 200 ft. in depth. These waters are also perfectly free from contamination in the water-bearing strata and if properly cared for, furnish a perfectly hygienic supply.

In the western part of this area and to the south of a line drawn from St. Louis to Danville, the drift is not deep enough to furnish sufficient reservoir capacity and it is necessary to rely on surface waters for municipal supplies. Very few of the surface water supplies in this section of the state have been filtered. The unfiltered water supplies are not only unattractive for drinking but they may be contaminated or even infected. With unattractive municipal supplies the citizens in this section use water from shallow wells which may be impure.

Under such conditions we expect a higher typhoid fever death rate in the southern part of the state than in the east central and northern parts. A study of the statistics collected by the State Board of Health from 1904 to 1911 shows this to be the case. Dividing the state into two parts, 51 counties to the north and the same number to the south, we find in the northern part of the state but two counties with a rate exceeding 30 per 100,000 and not one county with a typhoid fever death rate of 40 per one hundred thousand. Sixteen of these northern counties had a rate below 10 per 100,000.

In the southern part of the state there were 5 counties with a typhoid fever rate of more than 40 per 100,000 and 12 more with a typhoid fever death rate of more than 30, and but one with a rate below 10 per 100,000. It is gratifying to note that the average for the eight years 1904-11 is better than the average for the five years, 1904-8.

Another reason for typhoid fever in the southern part of the state is the fact that 32 per cent of the towns of more than 1,000 inhabitants have no water supply, whereas in the northern part only 10 per cent are without a water supply. Shallow wells are of course used where there are no water supplies and it is certain that the use of shallow well water is influential in spreading typhoid fever.

We have carefully classified all well waters sent to the Survey for examination during the years 1907-12. The waters received have been classified according to depth as follows: Less than 25 ft., 25-50 ft., 50-100 ft., over 100 ft., and unknown. The variation in the quality of each class from year to year is but slight. The average number condemned decreases with the depth of the well. Of those less than 25 ft. in depth 76 per cent were condemned, of those 25 to 50 ft. 63 per cent were condemned, of those from 50 to 100 ft. 32 per cent were condemned, of those 100 ft. in depth only 15 per cent were condemned, and many of the deepest were condemned because of the excess of the mineral content and not because of the contamination. Of those of unknown origin 45 per cent were condemned. Of all the well waters received during the six years, 47 per cent were condemned. It is gratifying to note a decrease in typhoid fever during the latter part of the period. See Table I.

TABLE I.—PER CENT OF WELL WATERS CONDEMNED ANNUALLY BY THE ILLINOIS WATER SURVEY, ARRANGED ACCORDING TO DEPTH OF WELL.

Depth.		1907	1908	1909	1910	1911	1912	Total.
Less than 25 ft.	No. examined	284	254	242	148	113	168	1,209
	No. condemned	210	192	183	118	74	113	920
	Per cent condemned	85	75	75	79	65	67	76
25 ft. to 50 ft.	No. examined	224	395	354	201	196	353	1,723
	No. condemned	173	250	226	137	122	185	1,093
	Per cent condemned	77	63	63	65	62	52	63
50 ft. to 100 ft.	No. examined	111	192	161	90	89	129	772
	No. condemned	42	66	54	46	8	28	244
	Per cent condemned	37	34	53	51	9	22	32
Over 100 ft.	No. examined	161	312	376	205	171	339	1,564
	No. condemned	22	31	62	43	30	49	237
	Per cent condemned	13	9	16	20	17	14	15
Unknown	No. examined	88	46	72	67	19	27	319
	No. condemned	34	22	38	35	9	6	144
	Per cent condemned	38	47	52	52	47	22	45
Total No. examined		868	1,199	1,205	711	588	1,016	5,587
Total No. condemned		511	561	563	379	243	381	2,638
Per cent of total condemned		60	46	47	53	41	38	47

Without doubt the above does not give the true idea of the actual condition of the water obtained from wells throughout the state. As a matter of fact a majority of samples sent to the Water Survey for examination is sent because of typhoid fever among those using the water. A truer estimate of the actual character of the waters of the state can be obtained from a study of waters collected by representatives of the Survey from typical farm wells. See Table II. The number of samples examined is comparatively small. While 73 per cent of those less than 25 ft. deep were condemned, only 54 per cent of those from 25 to 50 ft., 13 per cent of those from 50 to 100 ft., and none of those over 100 ft. in depth were condemned.

The results of the examination of the water from shallow wells showed three-fourths of them to be contaminated and possibly dangerous. An ideal remedy would be to abolish all shallow dug wells but the ideal cannot be attained in this as in many other matters. As indicated in the discussion of the sources of municipal water supplies in the state, it is impossible in some parts of the state to obtain a satisfactory water from deep wells so that the shallow well is a necessity.

Whenever the water bearing stratum is porous enough to allow free flow, a driven or bored well less than 50 ft. deep should furnish a satisfactory water. In many cases however the flow through the water-bearing stratum is so small that it is necessary to make a reservoir into which the water may slowly percolate and from which it can be drawn as needed. Hence the shallow dug well is a necessity. Granting that it is a necessity, great care must be taken to protect the water. The character of the strata which it penetrates must be taken into consideration. Strata of sand may serve as a filter and purify the water. Strata of clay or other material through which water may flow in crevices or cracks may allow pollution to be carried considerable distances. Wells

TABLE II.—FARM WELLS.

Samples collected by the Survey and should represent average conditions.

	Less than 25 ft. deep.	25 ft. to 50 ft.	50 ft. to 100 ft.	More than 100 ft.	Total.
No. examined	15	41	15	29	100
No. condemned	11	22	2	0	35
Per cent condemned	73	54	13	0	35

should be located on a higher level than cesspools, privies or barnyards and these must be built at a distance from the well. The immediate surroundings of the well must be carefully protected. A surface water should not be allowed to pass through the casing within at least 4 ft. from the top. The cover should be tight so that water from the pump may not flow back into the well carrying with it the dirt and filth from the well cover.

If typhoid fever does break out we wish to emphasize the fact that about the last thing to do is to send water for examination. Typhoid fever infection has taken place from ten days to two weeks before the symptoms are recognized. There are other sources of typhoid fever and even if the water were the cause during the time between infection and the outbreak of the disease the water in the well may have lost its infection. Rather should the patient be so cared for that he may not again infect the well or infect others by contact. The water may be analyzed but it will require from one week to ten days to obtain the results of an analysis and in the meantime infection may have spread through other means. It is the wisest course to protect the well so that infection cannot enter, making the water safe at all times. Dr. Bartow acknowledged the assistance of Carmen F. Harnack and W. F. Langelier in compiling the statistics and arranging the data for his paper.

Method of Estimating the Probable Volume of Silt Deposits in River Storage Reservoirs for the Oklahoma City Water Supply.

The present water supply of Oklahoma City is drawn from the North Canadian River. The supply is filtered. Raw river water is taken from above a concrete impounding dam which extends across the channel of the river immediately adjacent to the pumping station. This dam is about 8 ft. in height and forms a pool for the purpose of covering the intake pipes at extreme low water.

INADEQUACY OF PRESENT SUPPLY.

The principal deficiency in the water supply of the city arises from the fact that in exceptionally dry seasons the North Canadian River practically ceases to flow for several weeks at a time.

There have been several seasons within the history of the present plant when the summer flow only slightly exceeded the demands of the city. In 1911, from July 1 to Aug. 16, insufficient water was available for the plant to operate continuously, and the practice was resorted to of operating the plant only at certain hours each day when the consumers most needed water, meanwhile storing up the accumulation of the very small river flow behind the impounding dam.

At this time the city was in very grave danger from the inadequacy of the fire protection, to say nothing of the inconvenience to the water consumers generally, and actual loss to those needing water constantly. It was made evident to the citizens at this time that it was unsafe to depend upon the present supply for the needs of the present population, and that if the city continues to grow a supply must be found that is adequate for all the needs of the growing city.

The quality of the water heretofore furnished, although ordinarily quite good, has at times been unsatisfactory owing to inadequate purification, probably arising primarily from the inadequate capacity of the purification plant at certain times of heavy draft.

As the present supply is known to be sewage polluted by the city of El Reno, about 25 miles westward, it is important that very effective purification be secured. As far as expense is concerned purification is of minor significance compared to correcting the deficiency in the amount of water available for supplying the city. Such defects as exist in the purification process can be corrected at comparatively small expense by the construction of works capable of meeting the present and future demands in the consumption of water.

STUDIES LEADING TO A NEW SUPPLY.

The problem of securing a new water supply, which will be sufficient for all the needs of the city for some years to come, has been under general consideration by the public and city officers for nearly two years. In July, 1911, Mr. Hiram Phillips of St. Louis, Mr. John W. Alvord of Chicago, and Mr. J. W. Billingsley of Houston, Tex., were chosen to report upon the water supply problem of the city. The report of this board was made to the mayor and commissioners of the city on Feb. 15, 1913. The information given in this article is taken from the report.

The engineers found the problem to be one of unusual difficulty, owing to adverse natural conditions imposed upon them by the hydrograph, geology and topography of the district which must be drawn upon for a water supply, and the considerable growth in population which it seems reasonable to assume must be provided for in the near future in the city. Over 18 different projects were outlined and more or less investigated. Of these, the least promising were pursued no further than necessary to assure the engineers that they were not practicable or economical. The practicable projects have been surveyed, estimated and fully studied and presented in the report.

RECOMMENDED SUPPLY.

As a result of their studies the engineers felt warranted in concluding that a safe, certain and ample source of supply, free from undue contamination and capable of being suitably purified by filtration, will be found in the diversion of the North Canadian River at a point above El Reno; the supply to be conveyed by a gravity canal to the city and its storage against years of drouth in a large reservoir, near the existing waterworks, where it may readily be drawn upon in case of need. For a large portion of the time power can be developed, which will create a saving in the fuel bill at the present plant, though not entirely avoiding the use of steam as now employed.

The principal engineering and physical elements of this project may be briefly described as follows:

The water would be diverted from the North Canadian River above El Reno, where it would be practically free from sewage pollution. At the point of diversion, suitable silt settling basins would be constructed so as to remove from the water all sand and heavy silt and so avoid any objectionable deposits in the diversion canal.

The canal would have a capacity of about 125 cu. ft. per sec. flow, and would convey the water a distance of about 28 miles, to the point of storage, about 3 miles west of the present water works plant, where a large reservoir would be built. This reservoir would cover an area of 688 acres. It involves the construction of a dam with a maximum height of 60 ft. and a length of about 4,000 ft. As finally constructed, the reservoir would have a capacity of 10,200 acre feet with a mean average depth of about 18 ft., amply sufficient for the estimated requirements of the year 1930. From this reservoir, the water would be conveyed by a reinforced concrete acqueduct to the present city water works plant, where it would be filtered for domestic use.

The elevation of the water surface of the reservoir would be about 90 ft. above the level of the North Canadian River below the dam at the present pumping plant, and by means of this head it is intended to develop water power to do most of the city pumping.

The estimated cost of water, filtered and delivered to the city pumps, including interest, depreciation, and operating expenses is, in 1920, $25.45, and in 1930, $18.77 per 1,000,000 gals.

NORTH CANADIAN RIVER SUPPLY.

The average amount of water flowing in the North Canadian River would cover about 200,000 acres 1 ft. deep each year, which is about 20 times the amount of water at present used by Oklahoma City, and about 8 times the amount that will probably be needed in 1930.

An examination of the flow records of the North Canadian River shows that at intervals of six or seven years, drouths occur to such an extent that the stream flow is materially less than the present city water consumption. From this fact it is evident that any source of supply from the river will require storage of water in reservoirs of considerable size for use during such periods of drouth.

As a result of the investigation the engineers have estimated that a reserve storage of 4,500 acre feet would be required for the year 1920 and about 7,500 acre feet for the year 1930.

There are, in general, two methods of storing water applicable to the local conditions. First, direct storage in the bed or valley of the river by a dam across the stream; second, selective storage in reservoirs fed from the river but located outside of the river channel.

In the first case, the total stream flow must pass through the reservoir, and the silt carried in suspension would be deposited therein. In the case of a large reservoir of this character in the North Canadian River, where the capacity is such that the water passing through remains at rest for several days or more, this accumulation of silt is, in the opinion of the engineers, a serious menace to the useful life of the reservoir.

In the second case, water is diverted from the river and stored in reservoirs outside the stream bed, receiving no water except that especially diverted to them, and as the amount of water required for supply is now only about 1/20 of the total stream flow, it is evident that the silt deposited in such reservoirs is not more than 1/20 of that in the case of direct storage, especially when it is considered that the heavier silt can be extracted from the water so diverted, by proper silt settling basins at the point of diversion, and further, a selection can be made, within certain limits, of the water so diverted. It is for this reason that the board has made careful examination of all possible diversion reservoir sites adjacent to the city where selected waters could be stored.

The board's investigation further shows that the Canadian River supply is contaminated by the sewage of Yukon and El Reno, which, especially at times of drouth or small stream flow, is detrimental to a supply taken below these sewer outlets. It is probable that before many years El Reno will have so grown that its sewage discharge will at times be one-third of the total flow of the river, so that in utilizing the North Canadian River as a source of supply, it will be desirable to divert its waters from above El Reno, conveying them to the point of storage, and thence to Oklahoma City.

PROBABLE SILT DEPOSITS IN STORAGE RESERVOIRS.

The balance of this article will be devoted to a general study of the problems arising from the deposition of silt in storage reservoirs, with special reference to the conditions at Oklahoma City. The following paragraphs contain much data of value to engineers who may be called upon to figure on water supply projects in cities in the Southwest.

General.—It is well recognized that, particularly in the southwestern part of the United States, reservoirs which must be frequently filled from the flood waters of the rivers are subject to silt deposits that, in the course of a greater or less period, seriously diminish the reservoir capacities. This difficulty is much less important in the eastern and northern part of the United States, for the reason that the silt carried by the rivers is relatively small, and, further, on account of the plentiful water supply, the maintenance of the volumetric capacity of the reservoirs is of secondary importance; by far the larger majority of the installations being made for water power, in which head is the principal desideratum, and a few feet of the upper part of the reservoir only used for storage purposes. Even where large quantities of silt are carried, the upper portion of most reservoirs located in the thread of the stream (where most water powers are situated), is readily maintained by the velocities incident to food flows and decreased reservoir cross-section through silting.

In the Southwest, however, the reservoir is principally required to store water for use in drouth, either for water supply or irrigation, and as the southwestern rivers are noted for their heavy charge of silt in flood and their extremely small flows in drouth, most storage reservoirs take from the water practically all the silt carried, and where a reservoir is frequently filled, very considerable deposits inevitably result. Examples are not wanting where reservoirs of greater or less capacity, or the storage behind dams, have been substantially filled by these deposits.

Austin Dam.—Perhaps the most striking instance of this loss in reservoir capacity is the reservoir that was formed behind the water power dam in the Colorado River at Austin, Tex. This example is particularly conspicuous on account of the magnitude of the project, and the unfortunate destruction of the dam, which directed public attention to the matter. While the volume of silt deposited was very large, it was probably considerably less in proportion to the volume of water passing through the reservoir than would be occasioned in most storage projects in a river of similar turbidity, for the reason that at Austin the quantity of water passing through the reservoir in seasons of high water was relatively great. The maximum daily flood flow is estimated at about five times the reservoir capacity, and as the reservoir was about 25 miles in length the flow stated would cause a velocity of about 5 miles per hour. Even lesser floods must have carried a very large part of the contained sediment over the dam.

The silt condition immediately following the disaster is described in U. S. Department of Agriculture Bulletin No. 104, as follows:

> The Colorado dam at Austin, Texas, was completed in May, 1893. It was 68 ft. in height, and had a crest overfall of 1,091 ft. The reservoir was formed in a narrow gorge, and when the water was even with the crest of the dam, covered about 2,000 acres, the upper end of the reservoir being something like 25 miles above the dam. The original capacity was very nearly 51,800 acre feet.
>
> In May, 1897, four years after the reservoir was first filled, the measurements showed that 58 per cent of the original capacity of the lake had been filled with silt. These measurements were repeated in February, 1900, and it was then found that the silt in the reservoir occupied 48 per cent of the original capacity. The rate of sedimentation for the first four years was therefore greater than for the whole time, or nearly seven years, about in the ratio of 100 to 74, notwithstanding that the amount of water passing during 1899 and 1900 was greater than during previous years. Indeed it may be that during these last two years the very fact that larger amounts of water were passing prevented the silt from settling as rapidly as when the flow was smaller, especially since the decrease in capacity of the lake would tend to produce a somewhat greater velocity than within the long narrow reservoir.
>
> Sediment was found not to be uniformly distributed over the bottom of the lake. Thus in February, 1900, the greatest deposit appeared to be at Santa Monica Springs, 13.7 miles above the dam, where 78.9 per cent of the original cross-section had been filled with silt. The heavier particles of silt and the sand that may have been rolled along the bottom were deposited near the upper end of the reservoir, but the lighter particles were carried down and deposited all along, even well up against the back of the dam. In February, 1900, as much as 27 ft. of silt had been deposited at one point behind the dam, where the original depth of water had been 66 ft. Toward the upper portions of the lake the deposits shifted with each rise, but it does not appear that this occurred anywhere near the dam.

TABLE I.—RELATION BETWEEN PERCENTAGE OF SEDIMENT BY VOLUMES COMPARED TO PERCENTAGE BY WEIGHT.

U. S. Dept. of Agriculture, Bull. No. 133.
(Volumes from settlement of 1 week.)

		Ratio of per cent by volume to per cent by weight.		
River.	No. of determinations.	Min.	Max.	Numerical average.
Brazos River....	9	2.542	3.157	2.986
Rio Grande......	16	3.345	6.333	3.632
Washita River...	..	....	....	2.21
Colorado River, (Yuma)	..	....	....	3.0

It is estimated that there were 135,000 cu. ft. per second flowing over the dam at the time of the break. This discharge would amount to nearly 267,800 acre feet in 24 hours, or water enough to fill the lake five times over, if we consider its original capacity of 51,800 acre feet.

There is no record of the flow of the river during the time this silt was deposited. The late James D. Schuyler, C. E., in comment upon the Austin reservoir in his Treatise on Reservoirs, makes the following statement:

> There are no definite data available of the total discharge of the river, but assuming it to have been about 50 acre feet annually per square mile of watershed, which is a reasonable assumption for streams of that class (the run-off of New York and New England streams is from 700 to 2,000 acre feet per square mile, while that of the Rio Grande and Gila Rivers is 25 to 35 acre feet per square mile), the total volume of water discharged in the four years must have been approximately 8,000,000 acre feet, or about 160 times the reservoir capacity. The relation of the silt deposited to toal run off would be in the ratio of about ¼ to 1 per cent of this volume, or 2,770 cu. ft. per 1,000,000. The River Po, as determined by M. Tadini, carried as the mean of four months, 3,333 cu. ft. per 1,000,000; the River Ganges 980 as the mean of twelve months, and in flood, 12,300; the Mississippi 291 to 1893; the River Indus, in flood, 2,100.

Turbidity and Sediment.—Until recently there have been but few systematic observations of the gross bulk of the sediment deposited by rivers. Much fragmentary information is available as to suspended matter carried at certain times, and, in a few instances, over long periods, measured, as in ordinary chemical analyses, by the gravimetric method; that is, weight of sediment to weight of water. In converting this sediment to bulk, it has been customary to assume weights per cubic foot approximating the soils found in river valleys, and while this method of computation is of use in estimating the rapidity of soil deposit in such valleys, it is misleading when applied to the decreased capacity of reservoirs, for the reason that many years are required for the conversion of the deposit to the consistency of a valley soil. It involves biological action or decay, that occurs rapidly in thin layers of silt deposit upon land, and slowly and imperfectly, if at all, in the bed of a river excluded from atmosphere and sunlight.

The importance of this matter has been recognized in irrigation districts where storage is particularly valuable, and the U. S. Department of Agriculture, in its investigations of the silt carrying capacity of Texas and New Mexico Rivers, has made careful determinations of the relation between the suspended matter, as determined by weight of sediment to weight of water, compared to volume of sediment to volume of water. The result of this comparison, also including an observation on the Colorado River at Yuma, by the Agricultural Experiment Station of New Mexico is as given in Table I.

Reduction in Volume of Sediment.—The observations previously referred to on the Brazos, Rio Grande, and Washita Rivers, measured the silt volume at the end of one week; the samples were saved, and the volume again measured one year later, showing with remarkable uniformity a reduction of 25 per cent in bulk, about 10 per cent occurring within the first 30 days.

Silt Deposited in the Oklahoma City Sedimentation Basins.—Early in this investigation it was decided to obtain such information as was practicable in relation to the amount of silt deposited in the sedimentation basins of the city filtration plant, and to this end the depths of sediment were systematically measured and reported at six places in each sedimentation compartment each time a compartment was cleaned.

The sedimentation basins are rectangular in shape, with vertical side walls, and are constructed of concrete. The total contained volume in the three basins is about 2,810,000 gals., equivalent to a rest period of 8.7 hours at an 8,000,000-gal. pumpage rate, and 9.7 hours at a 7,000,000-gal. rate. During the period from April 1 to Aug. 31 the daily pumpage ranged from 6,300,000 to 8,000,000 gals. per day. The average pumpage was 7,100,000, corresponding to a rest period of 9.5 hours.

The volume of silt collected, as measured at the time of removal, together with the monthly pumpage, the monthly flow of the river, and the corresponding acre feet of sediment carried by the river, are shown in Table II.

The water is treated by iron and lime just previous to entering the basins. From April to August inclusive a total of 200 tons of iron and lime was used. The total estimated weight of dry sediment collected in the same period is about 18,000 tons, and in the condition in which it was removed from the basins, in semi-fluid mud, 54,000 tons.

The weight of the chemicals therefore, or the resulting weight of the hydrates, bears an insignificant relation to the total quantity of sediment collected. It is probable, however, that it somewhat increases the bulk of the sediment owing to the "flocculent" nature of the precipitate.

Mississippi River at St. Lauis.—Table III shows the amount of sediment that was collected in the settling basins at St. Louis during the eleven years from 1884 to 1895, based on a statement of the yardages and pumpage, published in the Treatise of James H. Fuertes, C. E., on water filtration works.

The yardage removed from the basins by hand have been increased to allow for sediment flushed out in accordance with a statement accompanying the yardage figures.

This water was drawn from the Mississippi River, which is known to contain materially

TABLE II.—AMOUNT OF SEDIMENT REMOVED FROM SETTLING BASINS AT OKLAHOMA CITY WATER WORKS DURING YEAR 1912; ALSO FLOW OF THE RIVER AND CORRESPONDING SEDIMENT CARRIED.

Month.	Pumpage in million gallons.	Cu. yds. sediment.	Sediment, cu. yds. per million.	Sediment, per cent volume of water.	Flow of river, acre ft.	Corresponding acre ft. of sediment.
April, 1912	201.1	11,720	58.27	1.18	43,510	513.4
May, 1912	188.0	16,930	90.05	1.82	50,420	917.6
June, 1912	207.6	7,873	37.92	0.766	16,070	123.1
July, 1912	243.0	6,004	24.70	0.499	11,940	59.6
Aug., 1912	222.3	9,584	43.11	0.871	18,930	164.9
Sept., 1912	204.4	3,214	15.72	0.317	3,486	11.0
Oct., 1912	156.3	500	3.19	0.0644	2,964	1.9
Nov., 1912	173.4	408	2.35	0.0476	1,565	0.7
Dec., 1912	185.4	438	2.36	0.0477	1,796	0.8
Jan., 1913	201.6	272	1.35	0.0272	2,034	0.5
	1,983.1	56,943	*28.71	*0.579	152,715	1,793.5

*Weighted average.

Note—Corresponding per cent of sediment for total period in river water $= \frac{\text{Column 6}}{\text{Column 5}} = \frac{1{,}793.}{152{,}715.} = 1.176$ per cent.

†TABLE III.—SHOWING AMOUNT OF SEDIMENT REMOVED FROM ST. LOUIS SETTLING BASINS FOR A PERIOD OF ELEVEN YEARS.

Year.	Cu. yds. sediment removed from basin by hand.	*Estimated total sediment removed by basins.	Millions of gallons pumped to basins.	Cu. yds. of sediment per million gallons.	Volume of sediment in per cent of water vol.
1884-5	153,000	206,000	9,564	21.5	.435
1885-6	109,000	148.000	9,925	14.9	.49
1886-7	124,000	168.000	10,979	15.3	.31
1887-8	143,000	193,000	11,665	16.5	.343
1888-9	174,000	235,000	11,644	20.2	.408
1889-90.......	144,750	199,000	11,939	16.7	.338
1890-1	207,800	280,000	13,178	21.2	.428
1891-2	210,600	291,000	14,602	19.9	.402
1892-3	160,000	216,000	16,448	13.1	.265
1893-4	148,000	200,000	17,448	11.5	.232
1894-5	208,000	281,000	16,257	17.9	.362
	1,782,150	2,417,000	143,649	16.8	‡.34

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†Information from Water Filtration Works by Fuertes.

*Increased by 35 per cent to allow for sediment "flushed out."

‡This percentage being referred to pumpage is doubtless less than the average percentage of sediment carried by the river, for a large part of the flow occurs in the months of greatest turbidity.

less sediment than the waters of the Southwest.

Brazos River.—Observations of the silt deposit from the waters of the Brazos River at Jones Bridge, Texas, were made by the United States Department of Agriculture covering the period Aug. 1, 1899, to Dec. 31, 1902. These observations included the prevailing flow of the river and the volume of sediment deposited. Care was exercised to make the samples of water collected as representative as possible by collecting the samples at several depths, and although the variations in sediment carried at the different depths was slight, average readings were taken in such manner as to correctly represent the total silt carried by the river.

The observed volume of silt, as compared to the volume of water passing the observation station, is shown in Table IV, in which a summary of the respective years is given, and also the figures by months for the year 1902.

Determinations of sediment volume were made at the end of one week's settlement, and also at the end of one year.

Wichita River.—The same experiments also cover the Wichita River at Wichita Falls, Tex. They were conducted in the manner previously described, and cover the period Feb. 10, 1900, to Dec. 31, 1901. The result of these observations is shown in Table V.

TABLE IV.—SUMMARY OF SILT MEASUREMENTS, BRAZOS RIVER AT JONES BRIDGE, TEXAS.

U. S. Dep't of Agriculture, Bull. No. 133.

Date.	Total discharge. Acre ft.	Silt, one week's settlement. Acre ft.	%	Silt, one year's settlement. Acre ft.	%
Aug. 1 to Dec. 31, '99	1,165,300	10,090	.866	7,567	.649
Jan. 1 to Dec. 31, '00	8,806,986	115,782	1.315	86,837	.986
Dec. 31, '01	976,602	12,328	1.262	9,246	.947
Dec. 31, '02	3,362,991	40,190	1.195	30,142	.896
Total. 41 mo.	14,311,879	178,390	1.246	133,792	.935

Monthly deposit of silt for year 1902:

Month.	Flow in acre ft.	Silt deposit, one-week settlement. acre ft.	Silt deposit. per cent.
January	14,448	.....	....
February	12,944	.....	....
March	69,696	552	.798
April	140,939	2,105	1.494
May	334,692	6,955	2.078
June	174,063	3,216	1.848
July	765,515	11,541	1,508
August	638,370	5,040	.790
September	156,682	847	.541
October	145,767	1,566	1.075
November	633,603	6,910	1.082
December	276,272	1,336	.484
	3,362,991	40,077	1.195

Average for year, 1.195 per cent.
Maximum, month, 2.078 per cent.
Maximum, day, 5.385 per cent.

TABLE V.—SUMMARY OF SILT MEASUREMENTS, WICHITA RIVER AT WICHITA FALLS, TEX.

U. S. Dep't of Agriculture, Bull. No. 119.

Date.	Total discharge. Acre ft.	Silt, one week's settlement. Acre ft.	%	Silt, one year's settlement. Acre ft.	%
Feb. 10 to Dec. 31, '00..	842,453	10,171	1.207	7,628	.906
Jan. 1 to Dec. 31, '01..	297,883	4,639	1.557	3,479	1.168
Total	1,140,336	14,810	*1.298	11,107	*.975

*Weighted mean.
Maximum, day, 3.16 per cent.
Reduction in volume in one year, 25 per cent.

Colorado and Rio Grande Rivers.—The United States Department of Agriculture also carried on similar experiments on the water of the Colorado River at Wharton, Tex., during June, July and August, 1902, and analyzed 17 samples from the Rio Grande at El Paso, Tex., during 1901 and 1902, covering the months of February, May, April and June.

The results of these determinations are shown in Table VI.

TABLE VI.—ESTIMATED SILT CARRIED BY THE COLORADO RIVER AT WHARTON, TEX.

U. S. Dep't of Agriculture, Bull. No. 133.

Month.	Discharge of river, acre ft.	Sediment. acre ft.	Sediment, per cent.
June, 1902..........	81,430	433.2	.533
July, 1902..........	241,092	3,386.8	1 4
Aug., 1902..........	463,087	11,431.8	2.469
Total	785,609	15,251.9	1.942

Maximum, month, 2.469 per cent.
Maximum, day, 3.813 per cent.

Measured Silt in Rio Grande at El Paso, Tex.—Summary of 17 determinations in 1901 and 1902, February, May, April and June. Average per cent of silt, 6.997 per cent; maximum determination, 13.55 per cent; time required to settle clear, 4 to 8 hours.

Colorado River in Arizona.—Relative to silt deposits in the Colorado River at Yuma, Ariz., the following is quoted from a paper by H. T. Cory, C. E., recently read before the American Society of Civil Engineers:

> Professor C. B. Collingwood of the University of Arizona Agricultural Experiment Station examined the silt contents of the Colorado River water at Yuma for a period of seven months, beginning with August, 1892. One pint of water was taken each day and evaporated, and the sum of the daily residues for each month were then weighed and analyzed. The results varied from a minimum of 1 part of sediment to 613 parts of water, in January, 1893, to a maximum of 1 to 97 in October, 1902, and an average of 1 to 388, the ratio of dry material to weight of water being 1 to 277. The corresponding ratio in the Mississippi is 1 to 1,500; the Nile, 1 to 1,900, and the Danube, 1 to 3,060.
>
> Later, Jan. 1 to Dec. 31, 1904, Professor R. H Forbes, now director of the same experiment station, made a careful study of the quantity of silt and the relation of irrigating sediments to field crops. It was found that the quantity of silt varied from 84 to 3,263 parts per 100,000, by weight, and from 250 to 9,800 parts per 100,000, by volume, or, roughly, 1 1,200 to 1/30 part, by weight, and that one acre foot of river water contained from a maximum of 1.14 tons to a maximum of 44.42 tons, and an average of 9.62 tons of silt. Obviously, the total quantity of sedimental material cannot be obtained by multiplying the average sedimental contents by the total annual discharge, but the investigations were carried out in such detail that it was possible to compute the quantity of solid material from the discharge at the time, and in this way it was found that the total solid material carried past Yuma that year was 120,961,000 tons. The total discharge of the river during that year was 10,119,000 acre feet, while the annual discharge for 1894 to 1911, inclusive, was 12,388,000 acre feet. It would seem conservative to estimate that the average quantity of material would be as much larger than that delivered in 1904 as the discharge, on which basis the result would be 148,084,000 tons. The specific gravity of the Colorado sediment is 2.65, and the weight of dry soil is 93 lbs. per cu. ft., so this quantity of material would make approximately 71,800 acre feet, or 112 square mile feet of equivalent dry alluvial soil.

TABLE VIII.—ESTIMATED SILT, NORTH CANADIAN RIVER AT OKLAHOMA CITY; RESERVOIR RECEIVING TOTAL RIVER FLOW.

Year.	Flow of river, acre ft.	Sediment, acre ft. Based on .5 per cent by volume.	Sediment, acre ft. Based on 1.0 per cent by volume.
1903...........	166,600	833	1,666
1904...........	221,100	1,106	2,211
1905...........	129,100	645	1,291
1906...........	239,000	1,195	2,390
1907...........	251,000	1,255	2,510
Total	1,006,800	5,034	10,068
Av. per year	201,360	1,007	2,014

Based on the above figures, it is estimated that the observations of Professor Collingwood in 1893 indicated a percentage of sediment, by volume, of 1.08 per cent average for the period of seven months investigated.

The observations of Professor Forbes in 1904, covering a full year, show a sediment variation of from .8 to 3.26 per cent, by volume, and the computations of Mr. Cory, .58 per cent, by volume, dry material at 92 lbs. per cubic foot, covering the full year of 1904.

SUMMARY OF SILT DETERMINATIONS.

The silt determinations hereinbefore given are summarized in Table VII. These observations show that silt deposits of from .6 per cent to 2 per cent of the water flowing in average years may be expected, maximums of 2 per cent or more may be expected for so long a period as a month, and for a few days, 5 to 10 per cent. It is not thought that the excessively high figures indicated on the Rio Grande at El Paso, ranging from 7 per cent to 13 per cent, are representative of the rivers generally of the Southwest.

Computed Sediment at Oklahoma City.—Table VIII shows the amount of silt that would be collected by a storage reservoir in the valley of the North Canadian River, receiving the entire flow of the river, computed on the basis of .5 per cent of sediment, by volume and also upon 1 per cent, based upon the river flows, as determined by the U. S. Geological Survey in 1902 to 1908.

Period of Retention in Reservoir.—In any reservoir of reasonable capacity in the valley of the North Canadian River, receiving the entire flow of the river, the period of water retention within the reservoir will be sufficient to remove practically all the sediment contained in the water.

In a reservoir of, say, 20,000 acre feet capacity the period of retention within the basin would vary from an average of about

TABLE VII.—SUMMARY OF SILT DETERMINATIONS.

(Weighted averages.)

River.	Place.	Length of period.	Sediment in per cent of water by volume. Maximum.	Sediment in per cent of water by volume. Average.	Authority.
Mississippi	St. Louis	10 years	*.49	†.34	Filtration works by Fuertes
Colorado	Yuma	1 year	3.1	1.08	Year 1893—Collingwood
Colorado	Yuma	1 year	9.8	‡.58	Year 1904—Forbes and Cory
Brazos	Jones Bridge	2½ years	5.4	1.246	1899-1902—Nagle
Wichita	Wichita Falls	2 years	3.16	1.298	1900-1901—Nagle
Colorado	Wharton, Texas	3 months	3.81	1 94	1902—Nagle
Rio Grande	El Paso	4 months	13.55	6.997	1902—Nagle
North Canadian	Oklahoma City	5 months	1.74	1.176	1912—Commission

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*Average for maximum year. †Percentage at St. Louis based upon pumpage and therefore less than corresponding percentage in total flow of river. ‡Percentage refers to dry material at 92 lbs per cu. ft.

TABLE IX.—SHOWING ESTIMATED SILT IN RESERVOIR RECEIVING CITY CONSUMPTION ONLY.

Year.	Pumpage, acre feet.	—Sediment, acre ft.— Based on .5 per cent by volume.	Based on 1 per cent by volume.
1915	10,350	52	104
1920	13,940	70	139
1925	18,200	91	182
1930	22,500	113	225
1935	26,300	132	263

seven days for the month of greatest flow appearing upon the record, to 20 or 25 days in the ordinary flow months. The greatest recorded flow for a period of one day is 3,640 sec. ft., or approximately 7,000 acre feet per day, which corresponds to about three days' subsidence in the assumed reservoir. Under these circumstances it may be assumed that substantially all the sediment will be removed from the water until the reservoir capacity is so depleted and its cross-sections so reduced that the velocities are increased to a point where less sediment will be deposited, and before such a point is reached the effective storage volume in the reservoir would be substantially destroyed.

Reservoir Outside of River Bed.—There is an obvious advantage of locating a storage reservoir, if possible, outside of the river valley in such a manner that only such water is fed to the reservoir as is necessary for the consumption of the city. This is of great importance, for the reason that the total flow of the river exceeds the present water consumption about 20 times, and in 1935 it is estimated nearly 10 times. Assuming that a reservoir site can be found to remove the sediment only from such water as is used by the city, the yearly collection of sediment would be approximately as given in Table IX.

Comparing these sediment volumes with those previously computed for the reservoir in the stream bed, it will be noted that the accumulated sediment is only 1/10 to 1/20 of the amounts computed for the stream bed reservoir.

POWER PLANTS

Cost of Constructing a Turbo-Generator Power Plant, Transmission Line and Substructures.

In 1910 an arrangement was made by which the Copper Queen Consolidated Mining Co. agreed to an enlargement of its power plant at Douglas, Arizona, to supply power for El Tigre mines, 65 miles away, in Mexico. In "Western Engineering" for February, 1913, Mr. James W. Malcolmson, consulting engineer, Kansas City, Mo., describes the new plant and gives in detail the construction costs. We reprint portions of the description and the cost data as follows:

The plant in Douglas consists of two 750-kw. exhaust steam turbo-generators which will work with a 50 per cent underload or overload without any very serious loss of efficiency. The Tigre Mining company receives power at the buss bars at a tension of 2,200 volts. This is stepped up to 44,000 volts by means of three General Electric transformers. At the mine the current is stepped down to 440 volts and distributed to the various circuits in the plant.

The transmission is unusual on account of the small quantity of power being transmitted such a long distance. The current is 44,000 volt, 60 cycle, 3 phase, transmitted over a single line of wooden poles carrying three conductors of No. 4 B & S. gage, medium, hard drawn copper wire with telephone wires below. The poles are 200 ft. apart; at the crossing of the Bavispe River the span is 1,600 ft. The cost of the line from the low tension side of its step-up transformer station at Douglas to the low tension side of its step-down transformer station at El Tigre was $161,121. Not including the transformer stations at each end, their cost was very closely equal to $2,000 per mile. The line, including the transformer stations, was built by Sanderson & Porter of New York. The total cost of the exhaust steam turbo-generator plant including the steam piping, etc., was $71,894, the machinery being installed by the Copper Queen Consolidated Mining Co. During the past year, 6,000 tons of ore has been concentrated monthly and 7,500 tons cyanided at the Tigre mill; an average of 616 hp. is distributed at El Tigre switchboard. The delivered cost is $86 per horse-power per year; the cost at Douglas being 0.95 cts. per kw. hour.

TABLE I.—COST AND ERECTION OF POWER PLANT AT DOUGLAS REDUCTION WORKS BUILT BY COPPER QUEEN CONSOLIDATED MINING CO.

Engineering:		
Engineers' salaries while engaged in drafting, blueprints for foundations, piping, condensers, etc.	$ 477.98	
Foundations:		
Excavation (labor)	$ 96.19	
Anchor bolts (labor and material)	132.58	
Molds (labor and material)	468.93	
Concrete, 127½ cu. yds. (labor and material)	981.97	
		$ 1,679.67
Hot well:		
Excavation (labor)	$ 72.94	
Molds (labor and material)	46.86	
Concrete; 15 cu. yds. (labor and material)	238.95	
Pipe connections (labor and material)	167.14	
Steel reinforcement (labor and material)	34.81	
		$ 560.70
Steam turbo-generator:		
(Bought from General Electric Co.)		
2 A.T.B. 4-750-1800 generators with Curtis steam turbines and accessories	$28,250.00	
4 5-in. compression and vacuum gages	11.20	
Insurance on engine	70.62	
Freight, Schenectady, N. Y., to Douglas	2,143.55	
Labor erecting	906.51	
Material for erecting	320.17	
		$31,702.05
Switchboard:		
(Bought of Westinghouse E. & M. Co., Pittsburgh.)		
1 complete switchboard	$ 2,455.00	
Insurance	3.89	
(Bought of Machado & Roller, New York City.)		
1 Hartman & Braun frequency meter	52.20	
(Bought of Roller Smith Co., New York.)		
2 D.C. voltmeters, range 0-150 volts; 2 D.C. ammeters, range 0-300 amperes; 2 D.C. ammeters, range 0-150 amperes	144.74	
Freight to Douglas on above parts	267.25	
Labor erecting	145.63	
Material erecting	85.54	
		$ 3,154.25
Wiring:		
(Bought of General Electric Co., Schenectady, N. Y.)		
75 ft. 552-lb. 3,250,000 C.M.V.C., 3/32 by 1/16 lead, 7/64 Sec. No. 1, complete; 30 ft. 52-lb 3/8 wire, V.C. 5/64 by 1/16 lead, Sec. No. 1, complete, 175 ft. 155-lb. 4/0 cable, R.C. 5/64 T.B.W., Sec. No. 1, complete, S. O. N. 72143; 22 lb. No. 227 compound	$ 133.40	
Freight on above	24.12	
Labor erecting	117.28	
Material for erecting	18.86	
		$ 293.66
Condensers:		
(Bought of Mesta Machine Co., Pittsburgh.)		
2 72-in. type 'B' Helander patent barometric condensers	......	
2 12 by 24 by 16-in. dry air pumps	$ 7,100.00	
Insurance	3.37	
Freight on above	2,208.47	
Labor erecting:		
Machine shop, 45 hours	22.88	
Blacksmith shop, 6 hours	3.61	
Carpenter shop, 112 hours	55.68	
Rigging gang, 1,245½ hours	332.08	
Electric gang, 384 hours	146.83	
Special gang, 158 hours	33.23	
Construction, 995½ hours	400.52	
	994.86	
Material for erection	133.31	
		$10,440.01
Steam and motor exciters:		
(Bought of B. F. Sturtevant & Co., Hyde Park, Mass.)		
1 standard 30-kw. generator set, consisting of one 9 by 9 V.S. 7 automatic engine, complete with cylinders, lubricators, and full set of wrenches, extended sub-base for direct connection to one No. 10 C. H.P. 8 generator compound wound for 125 volts field rheostat	$ 1,125.00	
(Bought of Westinghouse E. & M. Co., Pittsburgh.)		
1 2-brg. motor-generator set, consisting of one 30-kw. No. 8 'L' type 'S' generator coupled with 125 v. with bed plate and shaft, one No. 11 A.H. 45, 6-hp. type 'C.C.L.' motor, 2300 volts with auto starter and oil	1,000.00	
Insurance	3.87	
Freight	244.27	
Labor erecting	44.40	
Material for erecting	9.29	
		$ 2,426.83
Water piping:		
(Bought of Best Mfg. Co., Pittsburgh.)		
Cost East	$ 3,522.87	
Freight to Douglas	1,644.09	
Labor laying and erecting	408.33	
Material for laying and erecting	110.43	
Material and labor for supports	1.23	
		$ 5,686.95
Exhaust piping:		
(Bought of Best Mfg. Co., Pittsburgh.)		
Cost East	$ 807.94	
Freight to Douglas	336.88	
Labor erecting	83.13	
Material for erecting	33.92	
Supports and hangers (labor and material)	29.11	
		$ 1,290.98
Steam piping and separators:		
(Steam pipe bought of Best Mfg. Co., Pittsburgh.)		
Cost East	$ 7,717.41	
(Separators bought of Griscom-Spencer Co., New York.)		
2 16-in. Stratton separators	1,089.00	
Freight on pipe and separators to Douglas	1,478.87	
Labor erecting	833.30	
Material for erection	234.59	
Supports and hangers	33.73	
(Bought of H. W. Johns-Manville Co.)		
Pipe covering, erected	2,400.00	
		$13,786.90
Air piping:		
(Bought of Best Mfg. Co.)		
Cost East	$ 258.70	
Freight to Douglas	71.16	
Labor erecting	25.25	
Material for erecting	37.05	
Supports and hangers (labor and material)	1.61	
		$ 393.77
Total cost		$71,893.75

(Note.—Pipe bought of Best & Co. was shipped from Scottsdale, Verona, Pa., and Camden, N. J. Weight of pipe and separators, 340,405 pounds.)

TABLE II.—COST OF TRANSMISSION LINE. BUILT BY SANDERSON & PORTER. ENGINEERS.

Poles:		
1. First cost	$ 8,642.18	
2. U. S. freight	4,215.74	
3. Unloading, hauling and delivery along line	3,730.57	
4. Assembling and erecting	1,348.05	
5. Digging holes and setting poles	8,610.97	
6. Customs charges and duties	121.12	
7. Mexican railroad freight (Douglas to Ysabal)	1,397.25	
		$28,095.88
Transmission line—Cross-arms:		
1. First cost	$ 1,422.28	
2. U. S. freight	446.10	
3. Unloading, hauling and delivery along line	614.30	
6. Customs charges and duties	13.78	
7. Mexican railroad freight (Douglas to Ysabal)	112.12	
		$ 2,608.58
Transmission line—Hardware (bolts and braces):		
1. First cost	$ 1,380.55	
2. U. S. freight	429.21	
3. Unloading, hauling and delivery along line	1,017.90	
6. Customs charges and duties	460.90	
7. Mexican railroad freight (Douglas to Ysabal)	87.59	
		$ 3,376.15

Transmission line—Pins:	
1. First cost	$ 1,524.18
2. U. S. freight	326.49
3. Unloading, hauling and delivery along line	167.03
6. Custom charges and duties	184.12
7. Mexican railroad freight (Douglas to Ysabal)	25.26
	$ 2,227.08
Transmission line—Insulators:	
1. First cost	$ 7,312.99
Inspecting and testing	308.90
2. U. S. freight	4,046.93
3. Unloading, hauling and delivery along line	507.48
4. Assembling and erecting	468.25
6. Customs charges and duties	1,006.56
7. Mexican railroad freight (Douglas to Ysabal)	430.11
	$14,081.22
Telephone line—Cross-arms:	
1. First cost	$ 393.00
2. U. S. freight	196.08
3. Unloading, hauling and delivery along line	43.97
6. Custom charges and duties	167.41
7. Mexican railroad freight (Douglas to Ysabal)	63.51
	$ 863.97
Telephone line—Cross-arm hardware:	
1. First cost	$ 240.27
2. U. S. freight	51.36
3. Unloading, hauling and delivery along line	16.51
6. Custom charges and duties	51.60
7. Mexican railroad freight (Douglas to Ysabal)	6.07
	$ 365.81
Telephone line—Pins:	
1. First cost	$ 130.20
2. U. S. freight	70.44
6. Customs charges and duties	4.40
7. Mexican railroad freight (Douglas to Yshabal)	7.02
	$ 212.06
Telephone line—Insulators:	
1. First cost	$ 525.75
Inspecting and testing	18.90
2. U. S. freight	216.59
3. Unloading, hauling and delivery along line	2.58
6. Customs charges and duties	40.44
7. Mexican railroad freight (Douglas to Ysabal)	23.57
	$ 827.83
Pole steps, guying and bracing (eyebolts, guy wires, clamps, anchors, pole braces, etc.):	
1. First cost	$ 895.53
Labor	503.00
2. U. S. freight	138.15
3. Unloading, hauling and delivery along line	168.00
6. Customs charges and duties	176.85
7. Mexican railroad freight (Douglas to Ysabal)	35.78
	$ 1,917.31
Special structures, concrete and cribbing, incident to special construction:	
1. First cost	$ 465.60
Labor	973.10
2. U. S. freight	52.22
3. Unloading, hauling and delivery along line	85.00
6. Customs charges and duties	22.10
7. Mexican railroad freight (Douglas to Ysabal)	20.63
	$ 1,618.65
Painting:	
1. First cost	$ 313.43
Labor	206.00
6. Customs charges and duties	18.61
7. Mexican railroad freight (Douglas to Ysabal)	0.54
	$ 538.58
Transmission line—Wire:	
1. First cost	$18,096.29
2. U. S. freight	2,695.78
3. Unloading, hauling and delivery along line	353.48
4. Assembling and erecting	2,658.75
6. Customs charges and duties	1,968.61
7. Mexican railroad freight (Douglas to Ysabal)	172.90
	$25,945.81
Transmission line—Ties or clamps:	
1. First cost	$ 279.03
2. U. S. freight	21.38
3. Unloading, hauling and delivery along line	1.00
4. Assembling and erecting	7.00
6. Customs charges and duties	23.26
7. Mexican railroad freight (Douglas to Ysabal)	20.40
	$ 5,363.05
Telephone line—Wire:	
1. First cost	$ 3,249.41
2. U. S. freight	388.54
3. Unloading, hauling and delivery along line	96.60
4. Assembling and erecting	1,231.50
6. Customs charges and duties	365.30
7. Mexican railroad freight (Douglas to Ysabal)	31.70
	$ 1,795.92
Telephones:	
1. First cost	$ 1,132.24
2. U. S. freight	138.22
3. Unloading, hauling and delivery along line	50.00
4. Assembling and erecting	401.63
6. Customs charges and duties	21.82
7. Mexican railroad freight (Douglas to Ysabal)	52.01
	$ 739.50
Clearing and trimming:	
Right of way, including easements or real estate and collateral costs incident thereto	$ 1,048.96
Pole signs	129.60
Preliminary work, including payments made by Tigre Mining Co. to J. Langston for services and expenses	4,033.75
Contractors' equipment and tool account	1,040.35
1. First cost	892.83
2. U. S. freight	70.05
6. Customs charges and duties	48.53
7. Mexican railroad freight (Douglas to Ysabal)	19.94
Labor	9.00
Stable—operation and feed	$ 1,373.62
Camp—equipment	817.76
Camp—expenses and repairs	271.00
Subsistence	4,061.57
General engineering and administration (New York)	76.33
General engineering and administration (local office), including surveys	5,476.84
Office	$ 2,436.95
Surveys, including surveys by Tigre company	3,039.89
Traveling expenses and board of general engineers and contractors	597.28
Transportation and expenses incident to placing any labor on job and housing of same	425.89
Medical services and expenses	24.75
Expenses due to insurrection (repairs, etc.)	1,041.57
Trail along transmission line	723.75
Station house on line "fronteras"	62.50
Total, "transmission line"	$112,134.99

TABLE III.—DOUGLAS SUB-STATION.

Excavation, grading, and disposition of excavated material	$ 257.38
Foundations of sub-station 'building (substructure)	142.77
Machinery foundations	191.74
Building (superstructure)	2,398.66
Brickwork	$ 1,400.00
Labor and material (miscellaneous)	998.66
Switchboard and wiring (thereof, thereto, therefrom)	1,903.05
Switchboard	$ 1,300.06
Freight	49.14
Nyelec panel and switches	47.00
Insulators, fittings, clamps, wire, etc.	365.26
Labor	141.65
Underground cable between switchboard and step-up sub-station	1,583.55
Cable	$ 1,270.01
Cable terminals and jointing compound	28.41
Miscellaneous material and cartage	132.99
Labor	152.14
Sub-station step-up transformers	8,401.64
Four 400-kva. step-up transformers	6,207.34
Freight	1,185.30
Drying transformers	266.00
Miscellaneous material	21.00
Labor	722.00
Painting and finishing of machinery	10.02
Plumbing, lockers, and other sub-station furnishing	35.99
Contractors' equipment and tool account	153.84
Traveling expenses and board of general engineers and contractors	20.80
Transportation and expenses incident to placing any labor on job, and housing of same	93.50
Tests of equipment	948.49
Steam and electric power	745.00
Miscellaneous material	203.49
Total Douglas sub-station	$16,141.43

TABLE IV.—EL TIGRE SUB-STATION.

Sub-station proper	$ 5,294.55
Switchboard and wiring (thereof, thereto, therefrom)	5,362.26
Switchboard	3,780.00
Freight, customs charges, and duties	769.47
Nyelec panel and switches	106.00
Insulators, fittings, clamps, wire, etc.	594.94
Labor	111.85
Sub-station step-down transformers	8,899.26
Four 320-kva. step-down transformers	4,989.09
Freight, customs charges, and duties	1,964.24
Miscellaneous material	531.98
Labor	1,413.95
Traveling expenses and board of general engineers and contractors	32.70
Transportation and expenses incident to placing any labor on job, and housing of same	70.00
Tests of equipment	173.58
Total El Tigre sub-station	$19,832.35

TABLE V.—RECAPITULATION OF COSTS.

Transmission line	$112,134.99
Douglas sub-station	16,141.43
El Tigre sub-station	19,832.35
Total	$148,108.77
Fees paid Sanderson & Porter	13,000.00
	$151,108.77

(The total shown above, amounting to $161,108.77, includes disbursements made by Sanderson & Porter amounting to $132,743.48, and as reported by the Tigre Mining Co. amounting to $28,365.29.)

What is the Public Doing Toward Conservation by Developing Water Power?

Contributed by Robert C. Barnet, Consulting Civil Engineer, Kansas City, Mo.

The United States Geological Survey has in one of its recent bulletins called attention to the production of coal in the United States as an index to prosperity. This production is as follows:

1890 (short tons)	157,770,963
1900 (short tons)	269,684,027
1905 (short tons)	392,722,635
1911 (short tons)	496,221,168
1912 (estimated)	550,000,000

As consumption keeps very close pace with production, we may properly assume these figures to fairly represent the annual consumption for the years listed. From these data we may deduce the per capita consumption to be approximately as follows:

1890	2.54 short tons—39.5% increase for 10 yrs., or 3.95% per annum.
1900	3.54 short tons—31% increase for 5 yrs., or 6.2% per annum.
1905	4.63 short tons—14% for 6 yrs., or 2.3% per annum.
1911	5.28 short tons—8.5% for one year.
1912	5.73 short tons—8.5% for one year.

It is thus seen that the per capita consumption is on the increase, but at an irregular rate. The number of observations is too limited to approximate an average annual rate of increase for the per capita consumption, however, from the above table one can get some idea of the range of variation.

This increasing per capita consumption and our increasing population will deplete this great natural resource at a much higher rate in the future and some day, not so very far distant as measured by the lives of nations, we will be confronted with a coal famine. This is admitted by economists and attention has been called to this fact several times.

To delay the coming of this coal famine as long as possible should be one of the objects of our National, State and City Governments. True conservation would lead us to seek a substitute for coal wherever possible and to apply that substitute promptly and assiduously.

The writer has not at hand statistics bearing on the amount of coal annually consumed for the purpose of generating power throughout the country, but believes it to be a considerable fraction of the total consumption, as will be shown later. Such a use of coal could be obviated by a more rapid introduction of hydro-electric power. The following simple calculation will show what an average annual saving could be made per horse power.

With a coal consumption averaging 5 lbs. per horse-power per hour and a ten-hour day for an average, the yearly consumption per horse power would amount to 5 × 10 × 365 = 18,250 lbs. Thus it is seen that a little over nine tons of coal per year could be saved for every unit of steam power displaced by hydro-electric power. Based on the power statistics of 1905, there must now be an annual consumption of about 20,000,000 hp. About 70 per cent of this is generated by steam, or say 14,000,000 hp. If this were all displaced by hydro-electric power, there would result an annual saving of coal of 126,000,000 tons or about 23 per cent of the consumption for 1912. Can we get enough water power to do this?

W. M. Steuart and M. O. Leighton of the United States Geological Survey have estimated that if all the practicable storage sites were utilized and the water properly applied, there might be established eventually a total installation of 200,000,000 hp. So it seems that we have a rather good margin.

This total installation of 200,000,000 hp. would on the above basis displace steam power and thereby effect an annual saving of 1,800,000,000 tons of coal, or more than three times the consumption for 1912. These figures give us an idea of the limits we might approach. True conservation of our coal would impel us to displace steam power with hydro-electric power as rapidly as possible. The coal burned under the boiler is gone for all time. The water that flows through the turbine comes back again in the form of rain or snow and is never exhausted.

The practical question arises what are we doing today to bring about this displacement of steam power with hydro-electric power and thereby truly conserve our coal supply?

What is Congress doing in the way of establishing broad-gaged, fundamental policies looking towards true conservation?

What are our legislatures doing in the way of beneficial legislation to facilitate hydro-electric development?

What are our Departmental heads doing in construing present laws to encourage hydro-electric development?

What are our Engineering Societies doing to impress the importance of this line of conservation upon our legislators?

What are our technical journals doing to arouse an interest among technical men and thus stimulate them to enlighten their fellow citizens?

What are our magazines and the daily press doing to arouse the Commercial Clubs and stir up the people to demand of their representatives in the legislative bodies to take proper action to further this much-needed development?

What are our banks and bonding houses doing to encourage investment in this line of securities?

And so the original question expands into many lines.

Hydro-electric development on a large scale is comparatively recent and so has had to be rather subservient to older institutions. We have grown firmly fixed in the habit of thinking of our streams as serviceable primarily for navigation, forgetting that there may be other and higher uses that will in some cases bring a large amount of satisfaction to the people. We have so long been accustomed to this dominating thought of navigation, that we are prone to overlook the fact that in some cases a stream may have a higher utility as a source of municipal water supply, or for irrigation, or for power.

Our National Government has in the past and is now spending annually large sums for river improvement so that navigation may be aided and encouraged. No burden of direct charge is laid on the navigator for this. Though in a small minority, he receives the benefits of river improvements without diminution of his profits. Would it not be as reasonable and fair for the Government to build intakes for water supply for various companies, or for irrigation projects, or dams and diversions canals for power development companies? Why select a comparatively few navigators as beneficiaries of our government's donations to river improvements and overlook the larger uses to which many of our streams could be put? The money for these improvements comes out of the taxpayer's pocket. Why not expend it in such a way that the maximum utility to the tax-payers will result? That maximum utility may and often does depend on the river being improved so as to be used in several different ways. Therefore, when improvements are projected for any stream either by the government or by private enterprise, they should be so planned that a maximum utility will result to the people.

To hold that a stream which will hardly float a motor boat the big part of the year as a navigable stream and thereby set up artificial and arbitrary restrictions and obstacles in the way of its being used for some other purpose of a higher utility is to inflict a direct and permanent injury on the people in that particular district.

To hold that a stream is solely for the purpose of supplying water for irrigation and to lose sight of its other possible utilities as a municipal water supply, or as a source of power is to rob the people of a benefit they might otherwise have had by proper planning and systematic execution of river improvements.

To hold that a stream is solely for navigation and to ignore its power possibilities is to greatly retard the development of the surrounding country. A very good illustration of this is afforded by the improvement of the Mississippi river at Keokuk, Iowa.

Long before the Government spent $4,500,000 of the taxpayers' money to build a canal nine miles long to pass boats over the Des Moines rapids; Robert E. Lee, then a lieutenant in the old army, made a report to the War Department on the water power present at the Des Moines rapids. However, this seems to have commanded little attention for the demands of navigation later on were allowed to eclipse the power possibilities and a dyke for a canal paralleling the shore was built in place of a shorter dam across the river.

Had the problem of improving the river at that place been attacked at that time on broad, general lines and with a view of getting a maximum utility for all the people instead of a lesser utility for a relatively small number of navigators, the $4,500,000 of the taxpayer's money might have been invested so that instead of being wiped out of existence, it would have furnished a permanent foundation upon which to base future investments when changing economic conditions rendered the same advisable. Had economics been mixed with engineering, there might have been developed along with improved navigation a water power condition similar to that which grew up at Minneapolis and a large industrial center would have grown up on both sides of the river and activity would have replaced stagnation.

As it is today the present water power installation wipes out the old canal and its three locks and gives immensely better navigation conditions along with its development of 200,000 hp. This amount of hydro-electric power will permit of an annual saving of 1,800,000 tons of coal and this at a conservative estimate would be worth $3,600,000 or more than the value of the total tonnage passed by the canal in one year.

From the report of the Chief of Engineers of the United States Army for 1911, Part II, page 959, we find the following:

Expenditures for operating and care of the Des Moines Rapids Canal for the fiscal year ending June 30, 1911:

Office and administration	$ 6,196.21
Canal and locks	20,055.86
	$26,252.07
Dredging canal	36,909.38
	$63,161.38

Also the following summary of the Traffic Statement for the lower locks:

Steam boats and launches—	
Government	182
Commercial	1,238
	1,420
Barges—	
Government	151
Commercial	319
	1,890
Passengers	21,784
Merchandise, tons	8,340
Grain, bus.	11,887
Lumber, feet	3,447,000
Logs, feet	5,330,000
Lockages at the lower lock	1,339

Allowing 60 lbs. to the bushel of grain and 4 lbs. to a foot board measure, we find that the freight tonnage amounts to 26,251 tons.

In short we find that an original investment of $4,500,000 and an annual charge of $63,161.38 has been spent to further navigation for the benefit of 26,251 tons of freight and 21,784 passengers, a probable total tonnage of something like 42,500 tons.

Figuring the interest on the original investment at 4 per cent. we have an annual cost of at least $180,000 + $63,161 = $243,161, or a unit cost of nearly $5.70 per ton. Can any one doubt the low utility of such an improvement? Why should a power project with its immensely greater utility be made subservient to the project of lower utility, especially when the power project will afford as a by-product such greatly improved navigation facilities?

This illustration is chiefly valuable in that it shows every intelligent person how to avoid repeating such a mistake. It also shows the need of larger vision in planning out improvements. It should drive home to every thinking person the need for proper adjustment between the several lines of river utilities, so that a maximum utility will result, and that the interests of the people should be paramount and that nothing should be placed in the way of developing one utility any more than another.

Navigation is not the only use to which a stream may be put, nor is water power development, nor is municipal water supply, nor is irrigation supply. Neither is the reclamation and protection of flooded lands to be ignored when planning for river improvements. Each stream is a problem by itself. The combination of factors that permit a maximum utility in one case may produce opposite results in another case. But so long as our streams are improved at the expense of the taxpayers, the taxpayers should get the best possible returns for their money. All improvements should be planned with a view of ultimately getting the maximum utility.

SEWERAGE AND SANITATION

The Design of and Methods and Cost of Construction, by Force Account and Piece Work, a Sewerage System for a Small Town.

Contributed by J. E. Tupper, City Engineer, Pomeroy, Wash.

The city of Pomeroy, Washington, is the trade center for an agricultural population of 5,000. It is the county seat of its county and the terminus of the only railroad in that county. The present population of the city is about 1,800, of which 1,500 are included in the sewered area described in this article. With the exception of one flour mill there is no manufacturing industry in the city, nor is there any prospect of there being any in the future. It is a city of residences, and because the homes are owned by people who are accustomed to having unlimited space in which to move about the residence lots are large, the average being 120x120 ft. This condition necessitates abnormally long lines of sewers, the average per capita distribution being only 60 per 1,000 ft. of laterals exclusive of main and intercepting lines.

The location of the city is in a narrow valley having an average axial incline of 50 ft. to the mile, toward the west. The hills on either side rise rather abruptly to a height of from 400 to 600 ft. The Pataha Creek flowing through this valley in a deep, and for much of the way artificial channel, forms an ideal central artery for the storm water drainage.

The sub-soil consists mainly of a rather porous clay intermixed in places with considerable gravel and boulders and is underlain at varying depths with thick strata of porous gravel. The sub-surface drainage is exceptionally good. With the exception of two small areas where springs exist, ground water never troubles any part of the city and cellars are universally dry throughout the year. The nature of the sub-soil is such that for the most part trenches can be dug to any reasonable depth without shoring.

The water supply for domestic purposes is ample, 230 gals. per capita per 24 hours. It is obtained from a large mountain spring three miles from town and flows by gravity through a 10-in. steel main to the two storage reservoirs from which it is drawn as needed into the distributing mains. These reservoirs have a combined capacity of 530,000 gals. The only fault to be found with the water system is that the distributing pipes were installed a little at a time without engineering advice or supervision, and without any plan or record.

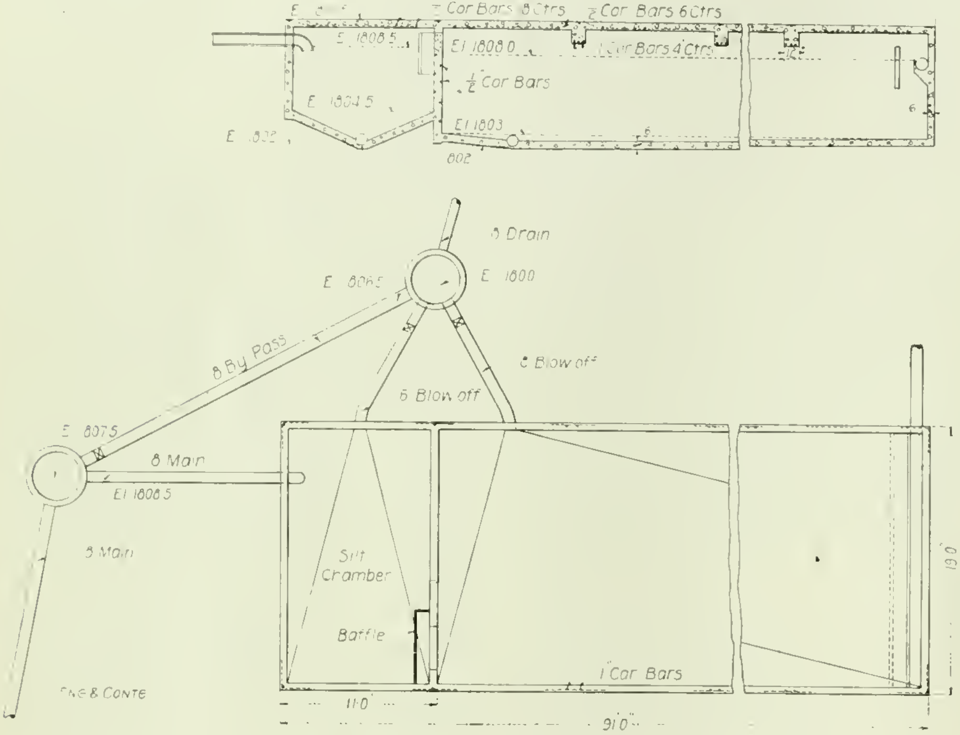


Fig. 1—Plan and Cross Section of Sedimentation Tank at Pomeroy, Wash.

Up to the time of the installation of the present sewerage system there had been no attempt made on the part of the city to control the disposal of sewage in any way. In the majority of cases the old privy vault was in use and the house slops were thrown out on the ground, making ideal breeding beds for flies. Some few parties had installed small septic tanks, quite a number had cesspools sunk to the underlying gravel stratum, while others, and the number was constantly increasing, deliberately turned their raw sewage into the open channel of the creek in the very heart of the town. As during the dry season the flow frequently ran as low as one second foot the result was an unmitigated nuisance.

In the summer of 1911 the city council decided that the time had come when it was necessary to provide a sewerage system for the city. After a trip to nearby cities and an investigation of the sewerage system there in use, they held a consultation with the engineering members of the faculty of the State College and finally employed one of them to come to Pomeroy and plan a system for installation here.

This engineer came here and spent two days looking over the ground, one day being devoted to running level lines. He secured a map of the city and such data as could be found in the office of the city engineer, and returned to his home to prepare the plans. The plan and estimate he submitted to the City Council was only intended to be a preliminary one, requiring a large amount of field work in adjusting it to local conditions. Many of the line locations were unsatisfactory to the council and the location of the disposal works was left undetermined. It was the feeling of the council, too, that the estimate was unnecessarily large.

The entire matter was then turned over to the writer as City Engineer, with instructions to work out the best and most economical system he could. Having had no previous experience in sewer design or construction it was with much diffidence that the work was undertaken.

Certain principles were laid down by the council to govern the design. The branches for house connections were in all cases to be carried to the property line at the expense of the system. As far as possible these branches were to be so located as to provide for the greatest convenience and least expense to the private owner in installing his plumbing system. In general no special effort was to be made to provide sewer service for the basements. This rule was adopted because of the fact that very few of the basements were provided with plumbing fixtures, or indeed were likely to be at any time in the future. Those that were so provided were invariably located on high ground and could be easily connected to a comparatively shallow sewer. The system was to be a strictly separate one and all storm and drainage water was to be strictly excluded.

The disposal works were to consist of a sedimentation tank, a drain conduit through which the sludge could be ejected directly into the creek during flood periods, provision for the installation when needed of filter beds for the treatment of the tank effluent, and provision for the disposal of this effluent for the present, at least, by broad irrigation. The sewage was to be disposed of at one plant, thus requiring one or more creek crossings.

The area to be served by the system has an extreme length of 6,600 ft. and an average width of 1,500 ft. The principal streets and alleys follow very closely the general course of the axis of the valley. The descent from the sides of the valley toward the center is in all cases sufficient for sewer gradient and in those tracts along the hill sides that are suitable for building locations the descent is too abrupt for the best service. It was evident at once that the sewer lines must of necessity run parallel with the axis of the valley and that junction with the trunk line must be made by intercepting lines.

As the location of the trunk line would be dependent to a large extent on the location of the disposal works this was the first point to be taken up and settled. No suitable location could be found on the north side of the valley within a reasonable distance unless dependence was had upon filtration exclusively. On the south side three locations were considered, one being about 700 ft. west of town, one 4,000 ft. and one 6,000 ft. distant. The nearer location was selected and a tract of two acres was secuured. Owing to the relatively slight elevation of this tract above the creek bed into which the sludge must discharge,, in order to avoid pumping it, it was necessary to use a comparatively shallow tank and approach it with a sewer gradient of 0.5 per cent. A plan and section of the sedimentation tank is shown in Fig. 1.

A gradient of 0.5 per cent was taken as the miminmum limit throughout the system. This location of the disposal works, together with the topographical features of the city, determined the location of the trunk line on the south side of the creek, following the course of the stream as closely as the location of the streets and alleys would allow. As the trunk line must serve as a local sewer for the territory through which it passes, the location, with due consideration for the above feature, was also determined with the object in view of getting the maximum amount of local service.

Before proceeding to the location of the laterals it was first necessary to determine, tentatively, at least, the location of the intercepting lines. This was especially true of those connecting with the north side system of laterals as they had to be led across the creek and suitable locations for these crossings could not be found at random.

An examination of the topography of the city showed that the area on each side of the creek is divided into three natural basins by spurs of sufficient elevation to make it inadvisable to attempt to cut through them if such a course could be avoided. It may as well be noted here that no attempt has been made, or is likely to be made, to reduce the streets of the city to a system of uniform grades. The grades of the streets change at each street intersection as a rule, and, as none of the grades on the principal streets exceed 5 per cent, it is not likely that any material change will ever be made.

This natural division indicated the advisability of planning a separate system of laterals for each basin and of locating the intercepting sewers so that they would enter the lowest point in each basin as nearly as other conditions would allow. Provision had to be made for a future extension of the system to the east to include territory that is as yet too sparsely settled to warrant the installation of laterals. A careful survey was made, however, and a tentative plan for two additional lateral systems was prepared. A portion of one of these districts, including the intercepting sewer, was included in the present scheme.

The plan as thus developed called for crossing the creek at four points; that is, with the first, third, fifth and seventh intercepting sewers, and the question of how it would be done presented a serious problem. The stream has its origin in the nearby mountains and in flood times becomes a raging torrent. At the first crossing the stream flows in a recently constructed artificial channel which is being deepened and widened by each flood. Where it would eventually find its permanent bed was so problemetical that it was deemed better to provide a temporary overhead crossing by means of a steel pipe resting on piling. The elevation of the sewer flow line at this point was well above the probable crest of any ordinary flood, and it seemed safer to take the chances of its being broken by an unusually high flood rather than to expend more in the construction of a submerged crossing under the uncertain channel conditions.

The third intercepting sewer was too low to be carried overhead and a submerged crossing was installed. The water in the stream, which was low at the time, was flumed by the location. A trench 2 ft. wide and 3 ft. deep was dug across the channel and a 6-in. vitrified clay sewer pipe was laid in this trench. The trench was then filled with Portland cement concrete to within 6 ins. of the bed of the stream and the filling was completed with hand-placed boulders bedded in the fresh concrete.

The pipe was given a slope of 2 per cent in the direction of the sewage flow, and concrete manholes were constructed on either bank connecting it with the sewer. The bottom of the upper manhole was a decided slope toward the crossing pipe, while that of the lower manhole was sunk 1 ft. below the bottom of the pipe, thus forming a sump for the collection of silt. The depth of this submerged crossing is 10 ft. below the flow line of the sewer and its operation has been very satisfactory. The conditions at the other two crossings were such that it was found advisable to install overhead crossings, using lap weld iron pipe resting on concrete piers.

The most serious problems were met with in locating the laterals. The question of whether the sewers should be located in the streets or in the alleys was a bone of contention. The advocates of the alley location advanced the following arguments. In nearly all cases the plumbing fixtures are located closer to the rear of the house than to the front, and closer to the alley than the street. The alley location would reduce the plumbing expense to a minimum, especially in the item of soil pipe within the building lines. It would also avoid the necessity of disturbing the front lawns, flower beds and shade trees in laying and repairing the pipes, and would be in every way more convenient. The cost of the system would be less. As the service branches were to be constructed to the property line they would be much shorter in a 16-ft. alley than in an 80-ft. street. The inconvenience to the general public would be less, not only during the initial construction, but in case of future repairs or additional installations of service branches. There would be much less disturbance of pavements and sidewalks, and, the branches being shorter, the danger of clogging would be reduced to a minimum.

The advocates of the street location rested their case almost wholly on engineering precedent. Where doctors disagree who shall decide? The only course open was to decide each case on its merits regardless of precedent. For nearly one-half of the system it was evident that the street location must be used, as no alleys were available.

On the other hand, topographical conditions forced us to use the alleys in a large number of cases. In only about 25 per cent of the system was there any choice left and these were decided on the basis of economy of construction and convenience of operation. In the case of the streets that skirt the foothills it was frequently the case that the sewer could be made to serve but one side of the street. Even where by deep trenching both sides could be served it was in many cases cheaper and better to run a sewer along the adjacent alley to serve one side. Take the case of Main St., between Second St. and Third St.: both sides are occupied by business buildings and each side has 10 connections The width of the street is 80 ft., giving a total length of 800 ft. for the branches if both sides are served. The trenches would require an additional depth of 4 ft.

By locating the sewer along the north side of the street just outside the gutter line, we reduced the total length of branches for that side to 150 ft. The sewer in the alley adjacent required 370 ft. of line and 80 ft. of branches, making a net saving of 200 ft. of pipe, besides saving the extra depth of trench. This alley sewer also serves the other half block which otherwise would have to be served by the sewer on the opposite side of the adjacent street with an additional total length of branches of 300 ft. This same reasoning was applied in the case of three laterals that were objected to by the consulting engineers on the ground of lack of concentration of the sewage. This reason appeared to us to lack pertinency. The laterals are readily flushed and kept sanitary even when carrying the minimum amount of sewage, while the service branches can only be flushed through the house fixtures, and cleaning them is a difficult job. Is it not better to keep these branches as short as possible even at the cost of installing extra laterals?

Manholes were placed at each change in either alignment or gradient. Absolutely straight alignment, both vertical and horizontal, between manholes was insisted upon. The maximum distance between manholes was set at 740 ft. This may seem to be rather far, but for a system of this nature and size it was deemed adequate. Where the distance exceeded 400 ft. lamp holes were installed at or near the midway point.

All manholes were constructed of concrete over steel forms designed by the writer, using a 1:3:5 mixture. The concrete was mixed wet, almost sloppy, and carefully spaded next the inside form. Very little and in most cases no patching was required after removal of the forms.

In deciding upon the sizes of pipe to use we proposed to provide for a possible future population of 3,000, and a probable daily discharge of 90 gals. per capita. Allowing the maximum flow to be 300 per cent of the mean, we have a maximum flow of 1.1 sec. ft. As no factories or large users of water are to be provided for, this was considered ample.

No provision was made for ground water seepage into the sewers, and we have been justified in this conclusion by the results. Only in one place was any ground water met with, and this was underdrained for a distance of 2,000 ft. As the smallest size of pipe that we decided to use was 6-in., it was found that none of the laterals or intercepting sewers would ever carry sewage to more than half fill the pipes. Applying the same factors to the trunk line and using Kutter's formula for the velocity, we find that an 8-in. pipe has a capacity of 0.8 sec. ft. and a 10-in. pipe 1.4 sec. ft. As the crest of flow is never as high in trunk lines as it is at times in the laterals, and as it is likely to be many years before the system will be required to serve 3,000 people, we decided to use the smaller size of pipe. We were advised to do this by the consulting engineer who was called in just before the plans were finally adopted. The wisdom of this course may well be doubted, but as only about 1,000 ft. of sewer was involved, replacing it at any time it becomes advisable will not involve a very serious expense.

In planning our sedimentation tank it was thought best to construct it of sufficient size to meet the requirements of the present service and to construct an additional chamber when it became overtaxed. Our present tank has a capacity of 63,000 gals., equal to 12 hours' flow of sewage from a population of 1,400, which will probably be ample for the next 10 years. The use of existing private septic tanks and cesspools is likely to continue until such a time as they become a nuisance.

In providing for flushing the sewers several schemes were considered. Automatic flush tanks in sufficient number to give us efficient service would have cost us $2,000. The discharge from one of these tanks can exert flushing force for only a comparatively short distance and it requires constant care and attention to prevent them from wasting an unnecessary amount of water. This is a vital point with us, as during the summer months all of our surplus supply is needed for irrigating lawns and gardens. One of the consulting engineers proposed the installation of hand-operated dams in a series of manholes by which the sewer could be flushed with retained sewage. This plan was at first favorably considered and provision made for its installation, but after more mature consideration it was finally rejected by the City Council as being hard to install, costly to operate, of doubtful efficiency, and more than all unsanitary. Another suggestion was that the flushing be done with fire hose inserted in the manholes. This was rejected on the score of expense.

The plan finally adopted by the council was that of the writer. At 16 controlling points in the system a 2-in. pipe was connected to the water main, run to the selected manhole and closed inside the manhole with a 2-in. gate valve. When one of these valves is opened it is found that the flow is sufficient to fill a 6-in. sewer pipe to its full capacity, and it can be allowed to run until a perfect flush is secured throughout the entire length of the lateral. The flow is absolutely under the control of the operator and can be continued until he knows the line is clean. After eight months' operation the plan has been found to give perfect results. The cost has been slight, as the work has been done by the employes who are on the monthly payroll.

It is not claimed that this plan would be advisable in all places, but in a system of the size of this it is certainly both efficient and economical.

The lateral system served by the third intercepting sewer, and covering the entire business district, including the public school, the hotels, restaurants, lodging houses, laundries, etc.—is now carrying rather more than 95 per cent of the sewage of the district. It has been found advisable to flush these lines twice a week. In the residence districts one flush a week has been found ample and in some cases once in two weeks is all that is required. The advantages as we see them of this system are a full control of the flush by the operator, an ample supply of water when needed and where needed, and no waste by frequent flushing of lines that carry but little sewage.

There was considerable question about the successful operation of the drain installed leading from the sedimentation tank to the creek. This line is 870 ft. long and could only be given a gradient of 0.5 per cent. A portion at least of this line would be needed in case filter beds should be required to care for the effluent; but we also hoped that we would be able to discharge the sludge through the line without resorting to pumping. Many doubted the feasibility of this course, and one sanitary engineer pronounced it utterly absurd. We decided, however, to give it a fair trial. A manhole was constructed at the head of the line, 20 ft. from the tank, and 8-in. lines with gate valves for closing were run from each chamber of the tank to this manhole. These connecting lines were given a drop of 2 ft. in order that a maximum initial velocity might be given the discharge. The official having charge of the sewers was instructed to open the valves for a short time at least once a month to avoid danger of the sludge collecting in the pipes in sufficient body to effectually seal them. After six months' operation of the system it was decided to give the scheme a test. The main chamber valve was opened and left open until the discharge was quite liquid.

It was then partly closed and the silt chamber valve opened. By a careful manipulation of the two valves he had no trouble in discharging the sludge through the drain line and thoroughly cleaning the tank. The success of the trial exceeded our expectations.

The plans above described were developed by the writer and constructed under his supervision. Due credit should, however, be given to M. K. Snyder of the State College of Washington, and R. S. Deick, Consulting Engineer, of Portland, Ore., for helpful suggestions in connection therewith.

After approving and adopting the plans the City Council decided to install the system by city forces. They were influenced in this decision partly by the past experience of the city with contract and force account work and partly by the itemized estimates of the engineers. They had three itemized estimates and one approximate estimate.

On construction costs, exclusive of rights of way, engineering, financing and contractors' profits, the first estimate was $25,000; one estimate that also excluded the service branches was $21,000, the approximate estimate put it at $24,000 and the City Engineer's estimate was $21,000. The total cost was put at $30,000, $27,000, $28,000 and $24,000 exclusive of contractors' profits.

The street and water commissioner was instructed to proceed with the work by force account under the supervision of the City Engineer. The sewer committee of the council was made the purchasing agent and they practically turned the matter over to the City Engineer.

Practically all of the material had to be shipped in from outside points. The following are the quantities purchased and the unit prices paid for the principal items in the supply account:

Materials:

Item.	Unit cost.
3,525 ft. of 8-in. sewer pipe at......	21 cts.
44,120 ft. of 6-in. sewer pipe at....	13½ cts.
1,100 branches and bends at proportionate rates.	
275 bbls. cement at................	$2.65
5,800 lbs. reinforcing steel at......	3.65 cts.
150 cu. yds. sand at................	$3.00

The following scale of wages was paid for an eight-hour day:

Wages:

Common labor	$2.50 to $3.00
Man and team........................	4.50
Pipe layers and engineer's instrument man	3.50
Foreman	4.00
Street Commissioner	5.00
City Engineer	5.00

The trenching was done by station work on a yardage basis, and the following scale of prices was paid:

Earth, 15 cts.; hard pan, 30 cts., and loose rock and cement gravel, 60 cts. per cu. yd. respectively.

Where unusual conditions exist, such as encountering water mains, tunnelling under railroad tracks, or blasting out solid rock the stations were excavated by the day wage men. The excavation for the tank was done mainly by team and slip scraper, enough men being kept in the excavation to keep the sides trimmed down true. This was essential, as the earth walls of the excavation were used for the outside forms.

The organization of the construction forces was worked out in the following manner. At the head was the City Engineer with an office clerk, and in the field an instrument man was two chain men and a rodman. The field force was provided with transit, dumpy level, self-reading rod, 100-ft. steel tape, stakes, center tacks, hatchets, picks, shovel, carpenter's square, saw and hammer.

At the head of the construction forces was the Street Commissioner with a trench foreman and 15 trench men, more or less, provided with picks and shovels, 6-ft. rods for measuring depth of trench and a supply of steel wire for overhead line; three pipe layers with tender and trench trimmer for each, in charge of the trench foreman; a concrete foreman with a sufficient crew and appliances for hand mixing and placing the concrete; a back-fill foreman with four teams and four to six men, back filling the trenches and also unloading and distributing the supplies and doing the general cleaning up and roustabout work.

It was not until the work was well under way that full crews could be worked. In fact, it took us two weeks to get the force properly organized and working smoothly. Very much of the work was new to the entire crew. This was especially true of the extreme accuracy required in digging the trenches and trimming the bottoms and in the pipe laying.

No experienced pipe layer was available. We had to take green men and train them. To do this we selected the man we considered the most likely to make a good pipe layer and showed him step by step the manner of laying the pipe, watching him constantly for the first day, and keeping more or less close watch of his work for several days. His first day's work was 125 ft. of pipe in a comparatively shallow trench. When he had reached a speed of 300 ft. a day we took his tender and started the latter laying pipe, following later on with selecting the better of the two tenders for the third man. In this way we succeeded in securing an average speed of rather more than 400 ft. a day from each of them, and a maximum day's work of 600 ft. Even in the seemingly simple matter of trenching constant watchfulness was required to keep the alignment and grade true, and we frequently sent men back to complete their stations properly. Extreme accuracy was not required, as a trimmer was kept with the pipe-laying crew to correct all deviations, but if the lines were not kept within reasonable limits the work of the trimmer would be so great as to seriously delay the work. In back filling also the men had to be carefully trained in filling and tamping the first foot of trench so as to get a firm bed around the pipe without disturbing the alignment.

All this training took time, delayed the work, and materially increased the unit costs over what could have been secured could we have employed experienced men at the outset.

CONSTRUCTION METHODS.

Timbers of 4-in. x 6-in. stock, 6 ft. long, were distributed at 25-ft. intervals along the section of proposed trench by the roustabout.

The location of the manhole at each end of the section was determined by ordinary transit methods, a timber bedded at each point and the exact center marked with a center tack. The chainmen then staked out the line, setting a stake every 25 ft. and running always against the flow of the sewer. A hub was driven and carefully centered at the 100-ft. intervals. The chainmen then set timbers across the trench line at each stake, the hub centers being preserved by means of a triangle and transferred to the timber. The men were required to use care in setting the timbers on a firm bed, level both ways, and the earth firmly tamped around the ends. Levels were taken on each of the timbers, the elevation, grade, cut and length of target for each timber were computed, and the rodman proceeded to cut targets out of 1-in. x 4-in. strips and nailed them to the timbers so that the end of the target would be exactly 6 ft. above the trench grade. Where the cut was less than 6 ft. the targets were set 1 ft. from the center of the trench line and a chalk line was stretched over them as a guide for the trench men. Where the cut exceeded 6 ft. the line was run along the top of the timbers and the setting of the targets left until after the trench was partially dug.

For transferring the target lengths to the strips the rodman was provided with a rule graduated to hundredths of a foot and he was required to place the target number on each piece cut to avoid getting them misplaced as well as for the information of the workmen who were to follow.

As the trenching was to be done by station work it was necessary to adopt a system of numbering that could be easily understood by the workmen and readily traced out in the records. The manholes were numbered serially and the dead ends were designated by letters. The targets were designated by three numbers—the manhole or dead end toward which the trench was being dug, the 100-ft. station within that section, and the sub-station ending at that target. Thus, 44.—2.—3. was the third station in the second 100 ft. of the section ending at manhole No. 44.

No transit record was kept, the locations of the lines being determined by street and alley lines rendering this record useless. The only field record was kept in the level book, which was turned into the office every night and the record was transferred by the clerk to the field book.

The yardage of each station and the cost on the earth basis was computed by slide rule and entered, together with the station number. Later the book was taken into the field and the classification noted and the name of the man excavating each station entered. The proper correction for classification was then computed in the office and the corrected amount was credited to each man in a single entry ledger.

When the levels had been taken on a section and the line stretched the trench men were allowed to begin operations. Each man was assigned a station in the order in which they came upon the section, and when one had completed his station he went to the head of the line and took the first vacant place. They were expected to keep a record of the numbers of the stations dug by them as a check on the timekeeper's record. This was found to be a wise measure and enabled us to correct readily any errors that occurred. One mistake we made was in not providing a regular timekeeper. The Street Commissioner attempted to perform this duty, but his other duties occupied so much of his time that he could not do the work properly. In attempting to save the wages of one man we had much trouble with our records. It should have been the duty of one man to keep the time of the day laborers, the stations of the trenchers, and a record of the location of each branch laid in the pipe line.

The trench men were allowed to work as long hours as they pleased, though as a rule they rarely worked more than the eight-hour day, and to take their own time in excavating the station; the only requirement being that they must not leave a station unfinished if by doing so the pipe layers would be delayed. As the trenchers were paid for what they accomplished and no more, each one attempted to do as much as possible and to increase his pay check, and the influence of this stimulation was felt throughout the entire force. The engineering crew was kept on the rush to keep ahead of the trenchers, the pipe layers were chasing them all of the time and a keen rivalry sprang up between the three pipe layers, the roustabout teams were frequent recipients of hurry orders for material, the crew on the backfill were trying to catch the pipe layers so they could get a breathing spell, and if a man was found soldiering instead of discharging him it was suddenly found that there was nothing in particular for him to do just then and he was sent ahead into the trenches.

The men were treated liberally in the matter of classifications and the poorest workers were able to make $2.50 a day. The average wage cannot be accurately determined as no account was kept of the actual time worked; but it was rather more than $3 a day. One man who was on the job from beginning to end, and who kept a record of his time, averaged a little more than $4 for an eight-hour day. The plan proved to be an excellent object lesson on the comparative value of common laborers. The best man on the job was able to accomplish twice as much as the poorest and seemed to do it with no more apparent exertion or persistent application.

As soon as a section of trench was completed the trench foreman changed the targets to the center line of the trench and stretched a steel wire over them, using a set of small pulley blocks threaded with sash cord to take up all slack. Any inequalities in the heights of the targets were adjusted and the wire was brought truly parallel with trench grade and directly over the center line. The trench was then trimmed to the exact grade and the bottom was left even and smooth.

In laying the pipe certain deviations from standard specifications were made. No bell holes were required. The size, length of joint and strength of the pipe, together with the maximum pressure of the earth cover, seemed to demonstrate that they were unnecessary. The additional cost would have been considerable. Much of the way the trench bottom was in hard pan or cement gravel and the bellholes would have had to be dug with a pick. Resting the bell on the trench bottom gave additional room for tamping the backfill under the lower quarters of the pipe where the essential support should come. All these considerations combined were thought of sufficient weight to render the course pursued advisable.

The testing of the grade of the pipe was done from the top of the pipe instead of from the surface of the invert. The deviation of the pipes from a true circle was thought to be no greater than the errors likely to be made in using a testing rod with an arm to insert in the end. No gaskets were used at any point. The trenches were all dry and there did not seem to be any good reason for bothering with them.

In laying the pipe a pat of mortar was placed in the bottom of the bell of the last pipe laid and it was brushed down with the hand to a little more than the thickness of the mortar space. The pipe was then inserted and pressed down to grade, the bell end being brought to grade by trimming or filling under it if necessary. The alignment was tested with a plumb dropped from the overhead wire, and the joint was then filled with mortar by hand and pressed well into place and finished with a bevel surface. A straw-filled sack was kept in the pipe and drawn forward as each joint was made to wipe off any mortar that might have been pressed into the pipe. The mortar used consisted of one part cement to two parts screened sand.

In one instance a storm flooded a trench during the night after the pipe was placed in it, and before the backfill was completed, destroying the alignment and forcing us to take up and re-lay 300 ft. This gave us a good opportunity to examine carefully the perfection of the joints and very little fault could be found with them. In several places it was found that necessary branches had been omitted and we were obliged to take out joints and insert the branches. In every case where the pipe had been laid as long as two days we could only remove a joint by breaking one or two joints of pipe. The mortar could rarely be removed without breaking the bell.

In back filling loose earth was thrown in, filling to about midway of the sides of the pipe, and this was carefully tamped down firm. Enough was then thrown in to fill over the pipe to a depth of about 6 ins. and this was tamped down carefully. The trench was then filled by team work. As this upper filling was left comparatively loose considerable settling has occurred and we have had to go over the lines again in most cases. With us this was not a serious matter, as there was no paving to suffer. Had there been, more care would have been taken with the fill.

The system as completed contains 40,506 ft. of main and lateral sewers, 1,816 ft. of sub-drain, 6,500 ft. of service branches, 74 manholes, 33 lamp or inspection holes, one submerged creek crossing, including the manholes at each end; three overhead crossings of steel pipe, 16 flush valves, and one sedimentation tank. The total yardage excavated in the main trenches and manholes was 14,234.5, at a cost of $3,556.15, or an average unit cost of 24.98 cts. per cubic yard. This is a cost of 8.78 cts. per lineal foot of trench. The cost of trimming trench and laying the pipe was 2.12 cts per foot. Unloading pipe from cars, inspection and distribution cost an average of 65 cts. per foot, running as low as 40 cts. per foot. As it was not possible to get the pipe placed at all times just where it was wanted, there was a further cost for re-distribution which cannot be determined, but which probably brought the cost up to approximately 80 cts. per foot.

Owing to the lack of accurate records from which to compute costs, the cost of backfilling can only be estimated from the meager data at hand. It appears to have been about 1.38 cts. per lineal foot of trench.

The cost of foremanship, engineering force, supervision and office records were 4.14 cts. per lineal foot of trench. Our manhole costs averaged $34.50 each or 6.55 cts. per lineal foot of trench. It is to be regretted that more complete detail records were not kept so that a complete unit cost analysis might have been made. The City Council, however, could not see the utility of such a record and would not authorize the expense.

Ground was broken on the 10th day of April for the tank excavation, trenching for sewers began on the 12th and pipe laying on the 13th. The tank was completed on the 8th of May and work on the manholes began the next day. The main trenches were finished on the 29th of June, the manholes on the 3d of July, and the construction period proper ended on the 13th of July. The service branches were not all in, but as we had installed as many as there was an immediate call for, it was thought best to discharge all but three or four men and put in the branches as they were needed.

The entire cost of the system up to this time was $22,131.42 as itemized below:

Engineering:	
Consulting engineers	$ 399.80
Instrument man, and rod man on preliminary	283.25
Office force	100.25
City engineer	829.00
Total	$1,612.75

The engineering included not only all surveys and supervision, the preparing of all plans and estimates, but also the entire work of preparing the assessment rolls, involving a separate plat of each block included in the system with the location of the adjacent sewer and the valuation of each holding marked thereon, and before final adoption this roll and the plats had to be revised three separate times.

DETAIL OF COSTS.

Engineering	$ 1,612.75
Labor, including foreman	10,191.41
Materials	8,587.91
Tools	365.13
Printing and stationery	237.75
Legal work	40.90
Industrial insurance	360.57
Rights of way	735.00
	$22,131.42

As the entire cost of the system was paid by a bond issue, and as no bonds could be issued until after the final cost had been determined very closely, the financing of the project had to be done by issuing interest-bearing warrants, which were taken up by the local bank at par.

The interest cost was approximately $400, in addition to the above items. Much minor detail work remained to be completed, such as bond issue costs, installation of flush valves, a thorough cleaning of the interior of all sewer lines, the completion of the branches, attention to the settling of trench backfill, etc., some of which work is still in progress, and is being cared for out of the sewer maintenance and extension fund. The probable ultimate cost of the system will be between $24,000 and $25,000, or about 50 cts. per lineal foot, including all expenses connected with its installation. It is also a cost of $16 per capita of present population served. This cannot be considered as an exorbitant cost when it is seen that the area served was 260 acres, and the density of population is only 5.75 per acre.

The unit costs of materials were higher than usually obtain, owing to our isolated location and the consequent high transportation cost, but so far as accurate unit costs of labor could be ascertained, they were lower in comparison with the wage scale than any the writer has seen published.

In view of the low cost attained it is quite evident that the City Council was fully justified in having the work done by force account. There were no local contractors capable of undertaking the work, and outside contractors could hardly be expected to come in and do the work for anything approaching the cost we secured. The work was just as well done as any contractor could have been required to do it, there was no inclination on the part of the men in charge to allow the work to be slighted, and in fact a greater degree of attention to nicety of detail was secured than could have been required of a contractor without causing incessant friction.

The working of the system has been perfect, no weak or inefficient parts have developed, and we have yet to find wherein either the design or the cost could have been improved upon.

BUILDINGS

Structural Details and Cost of Constructing a Reinforced Concrete Sand Bin.

(Contributed by G. A. Flink, Designing and Constructing Engineer, Harrisburg, Pa.)

This article describes a reinforced concrete sand bin built by common labor in the employ of the Lewistown Foundry & Machine Co., of Lewistown, Pa., in conjunction with a sand mill erected for the Berkeley Springs Sand Co., at Berkeley Springs, W. Va. It is a creditable piece of work, and marks the beginning of introduction of reinforced concrete in this field of industry. For a sand bin, no more suitable material could be suggested, even if its initial cost should be higher than that entailed in the construction of the nondescript bins formerly erected. The indisputable features of durability and freedom from danger of destruction by fire are in themselves sufficient arguments in favor of its employment, and in addition it may be pointed out that a properly designed concrete bin looks much better than the type usually employed.

Bids were invited for this work, and ranged from $12,000 to $6,900; this being considered too high, the Foundry and Machine company decided to build the bin themselves. A good superintendent was employed, material ordered and work started, the engineer who prepared the design assuming charge of the work, and keeping in touch with it by means of daily reports, and an occasional visit.

Shoring had to be erected to keep the railroad track in place while excavating for the footings. These latter were under water at times, and 62 hours' labor was spent at the pump. The concrete was a 1:2:4 mixture turned out by a batch mixer, and hoisted to the top on an elevator, from where it was wheeled to the place desired in barrows. Careful spading was kept up at all times. Work was broken on top of the column-footings while the forms for the columns were being placed, and at top of columns while building beam forms and placing the reinforcement. No surface finish was considered needed, the concrete filling the planed forms to perfection, and no objection being advanced to the appearance of the grain of the wood on the concrete surfaces, or to the ridges caused by the joints between the boards.

The bin is divided into four compartments by means of crosswalls 10 ins. thick, reinforced horizontally with ½ in. diameter bars, placed near both faces and spaced 4 ins. c. to c. near bottom, and increasing to 12 ins. at the top. Bars ¾ in. diameter, spaced 2 ft. c. to c., run at right angles to the horizontal bars. Each compartment is 25 ft. long, making the total length of bin 100 ft.; the width is 16 ft., and the clear depth is 17 ft. The bin is supported on 18 columns 24x24 ins. by 26 ft. high, spaced 13 ft. transversely, and 12 ft. 6 ins. longitudinally. The columns are reinforced by means of four bars, ⅞ in. in diameter, one in each corner, and ¼-in. diameter hoops spaced 12 ins. c. to c. Each column stands on a 6-ft. square by 15-in. thick base-slab, reinforced with 18 bars 1-in. diameter; each base-slab has a 3-ft. 2-in. square by 1-ft. 2-in. thick offset on top. The supporting soil is clay. The column bents are, by means of 15-in. kneebraces, connected at the top to the transverse floorbeams, which are 20x16 ins., with twelve bars 1⅛ ins. in diameter. The two end floor beams are only 10 ins. thick, and have only eight bars of 1-in. diameter. Into the floor beams are framed two lines of stringers 12x14 ins., figured as T-beams, in conjunction with the 6½-in. floor slab. These stringers are spaced 5 ft. 4 ins. c. to c., and are reinforced with eight bars, 1 1/16 ins. in diameter. On each side there is a Facia Stringer 9 ins. thick with 5 bars of 1-in. diameter. The floor slab is continuous over all stringers and reinforced transversely with ⅝-in. diameter bars, 4¾ ins. c. to c., and longitudinally with three bars ½-in. diameter in each bay. The sidewalls are 10 ins. thick at the base, tapering to 4 ins. at the top; they are reinforced with ¾-in. bars spaced similarly to the bars in the cross-walls. At the top the sidewalls frame into a horizontal beam 10x28 ins., reinforced with three bars ⅝-in. diameter, and three bars 1⅛-in. diameter. This horizontal beam runs the full length on each side of the bin, and is securely braced into a similar beam at each end of the structure. In each compartment there is a 10x28-in. pilaster on each side; framed into the floor beams at the lower end, and into the horizontal beams at the upper end. This pilaster is reinforced with two bars 1⅛-in. diameter, two bars 1-in. diameter and two bars ⅝-in. diameter. All connections between stringers, beams, posts and slabs are carefully designed to develop the full stress occurring at the particular point. A reinforced concrete slab roof on steel trusses was designed for the bin, but a timber and slate Mansard roof was built in its place.

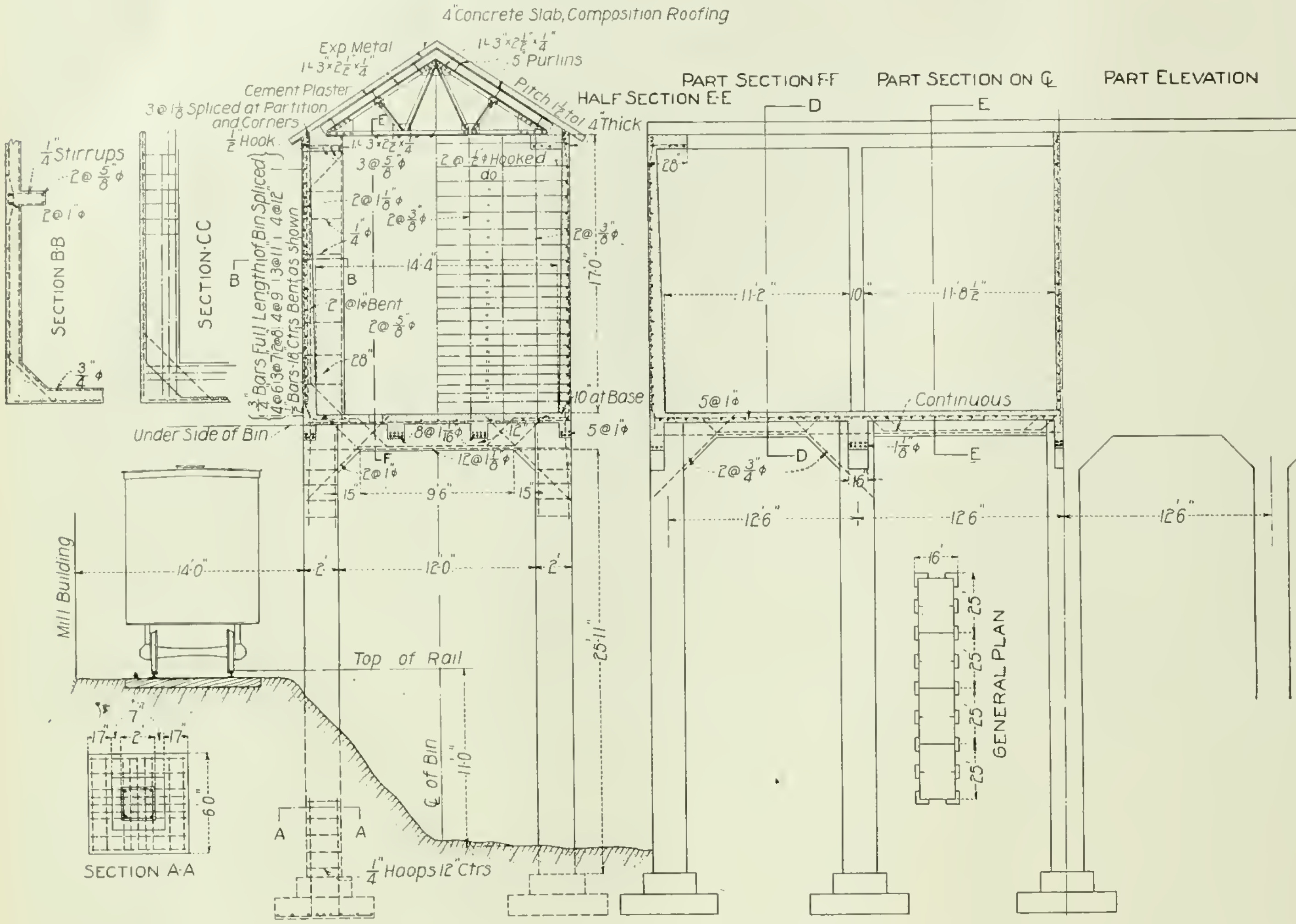


Fig. 1—Reinforced Concrete Sand Bin, General Plan and Details.

The following data show the cost of the structure:

Supervision and labor	$2,655.40
Material (sand, cement, stone, steel and lumber)	2,568.91
Freight and express	195.54
Electric light	7.25
Hauling, telegrams, telephone, mileage, gasoline, oil	185.18
Total cost	$5,612.28

This total cost was distributed as follows:

Supervision (hours)	874
Carpenters (hours)	3,386
Steel gang (bending and placing) (hours)	1,159
Helpers (hours)	110
Laborers (hours)	4,374
Broken stone (cu. yds.)	250
Sand (cu. yds.)	118
Cement (cu. yds.)	415
Reinforcing steel (lbs.)	45,135
Inch lumber (ft. b. m.)	16,700
Timber, ranging from 2 by 4 to 4 by 6 (ft. b. m.)	16,000
Molding, ¼ round, etc. (lin. ft.)	3,000

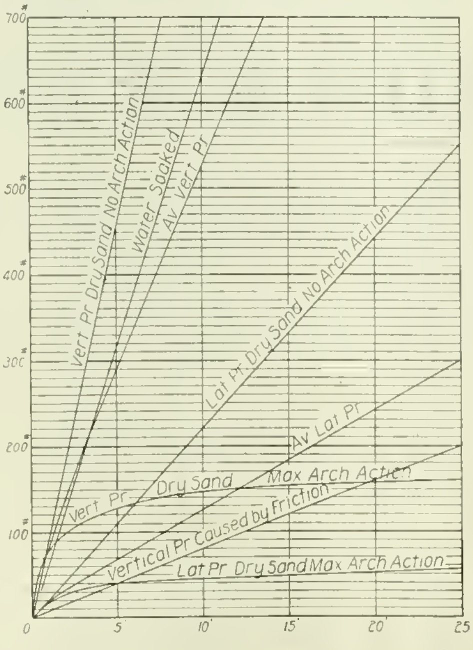


Fig. 2—Pressure Curves Used in Designing Sand Bin.

The design of the slabs, columns, beams, etc., was based on unit working stresses derived from pressure curves determined especially for this case, available data on the subject being somewhat meager. Figure 2 shows the curves used.

Sections were determined by means of the Engineers' own formula $\frac{M}{S} = \frac{by^2}{2}$ where $M =$ bending moment, $S =$ unit stress, $b =$ width of beam, $y =$ distance from top of beam to neutral axis = three-fourths of distance from center of gravity of steel to most remote "fibre" of concrete.

The reinforcing consists of plain round bars as per Manufacturers' Standard Specifications, stressed to 15,000 lbs. per square inch; the concrete is stressed to 500 lbs. per square inch in compression, 50 lbs. per square inch in adhesion and shear. The makeup of sections of beams, slabs and columns is seen in Fig. 1. The sand that this bin is designed to carry is absolutely dry at all times; in fact, part of the duty of the bin is to protect the contents from moisture. The stresses encountered are similar to those in a grain elevator.

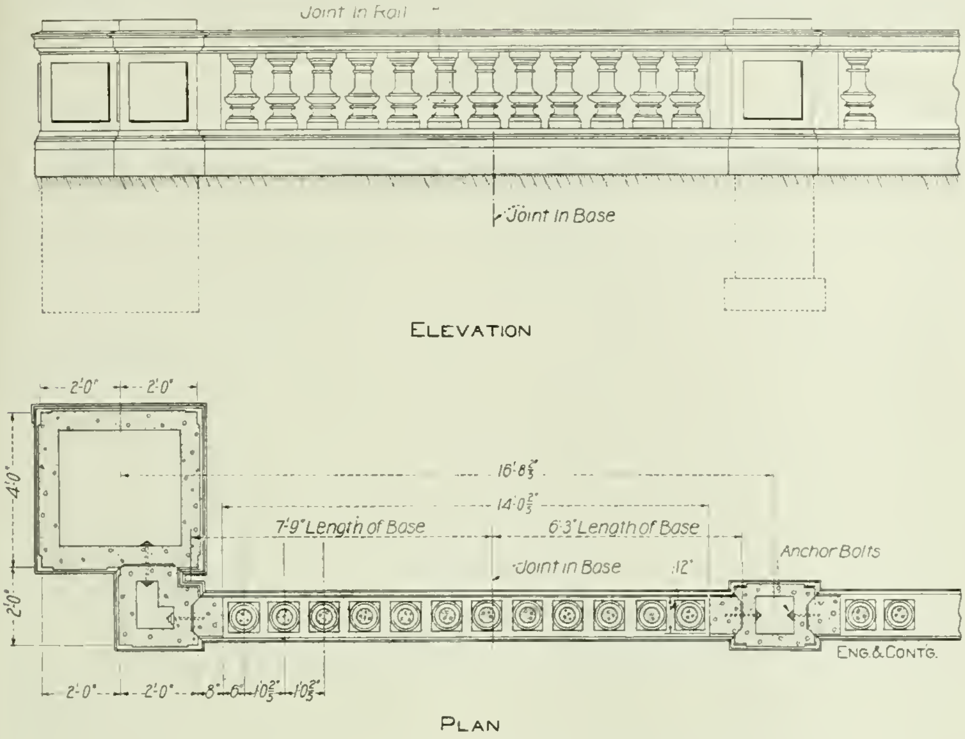
The bin was built, as stated above, by the Lewistown Foundry & Machine Co. of Lewistown, Pa. G. A. Flink, Designing and Constructing Engineer, Harrisburg, Pa., prepared the design.

Anti-Earthquate Construction Exposition.—It is proposed to hold an exposition at Messina, Italy, in the autumn of 1913, coinciding with the sessions of the Congress of Civil Engineers, of the industries allied to anti-earthquake construction.

Concrete Balustrade for Sunken Garden at Washington Park, Chicago.

(STAFF ARTICLE.)

The concrete balustrade shown by the accompanying drawings borders a sunken garden at Washington Park, Chicago, Ill. All dimensions and each of the "parts" comprising the balustrade are shown by the drawings. As will be apparent, it is built up of separately molded parts, base pieces, railing pieces and spindles. The molding was done by the regular shop force employed by the South Park Commission, which operates an ornamental concrete molding plant to supply its various park works. The pieces were hauled from the molding plant to the work by team and erected into the structure. All work was done by force account. Altogether, 894 ft. of balustrade were built at the sunken garden at a cost in place, it is stated, of $7.42 per lineal foot or $1.25 per cubic foot of concrete. The finish of the concrete is the rough and rustic finish standard for the Park Commission's concrete structures.



Concrete Balustrade for Sunken Garden at Washington Park, Chicago.

Test and Inspection of Bulb Pointed Concrete Piles for Building Foundation at North Billerica, Mass.

Contributed by Hunley Abbott, Chief Engineer, MacArthur Concrete Pile & Foundation Co., New York City.

Early last spring work was started on the construction of new railroad shops for the Boston & Maine R. R. at North Billerica, Mass. These shops cover some 150 acres, and consist of 10 large steel buildings, all of the most modern design. The site was an old cedar swamp on which the high spots have been cut down and the low spots filled in to bring the general level of the ground to a proper grade. After a careful comparison of various types of construction it was decided to use concrete pile foundations and the contract for some 3,000 piles and reinforced concrete capping was awarded to the MacArthur Concrete Pile & Foundation Co. According to the contract, four test piles were to be driven and tested to a specified load and then excavated to determine the effect, if any, of the load on the pile. The work was all to be done under the direction of the Boston & Maine R. R. engineers.

It was decided to drive the test piles after the foundations of the paint shop and the transfer pit had been completed. The objects of the tests were as follows: (a) To test the load carrying capacity of the pile. (b) To determine the effect of continued loading on the integrity of the pile column and bulb. (c) To determine the effect of ground water on the symmetry of the pile column. (d) To ascertain the nature of the pile column and pile pedestal as formed in the ground.

On July 15, four test piles were driven. The piles were about 15 ft. long. They penetrated some 6 ft. of sand (which had previously been placed to bring the ground to grade) and several feet of partially rotted stumps and other woody refuse. Below this was a stratum of quicksand, which was underlaid by firmer sand. As above stated, the ground water level came to within 4 ft. of the surface of the ground.

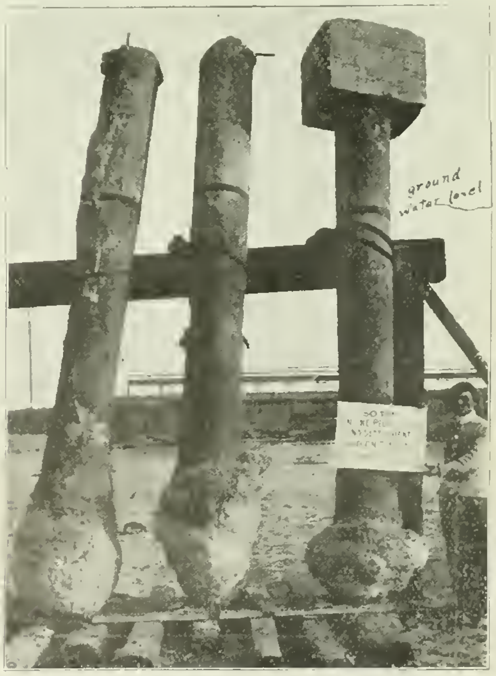
The 16 ft. casing was driven and the bulb and pile stem formed in the way usual for this type of pile. The piles were on 3 ft. centers. No more time was allowed between the driving of the different piles than was necessary to shift the pile driver. The test piles were driven under exactly the same conditions as those driven for the transfer pit and the paint shop. The sand was well compacted and driving was hard and slow, the penetration being for the first 6 ft. of sand, 1 in. to 10 blows of a Vulcan (No. 2) steam hammer, while the penertation for the last 5 ft. of driving was 1 in. to 15 blows. The driving was discontinued when the entire length of casing had been driven.

After the core and casing had been driven the core was removed and concrete of the proper consistency was placed in the casing and rammed out to form the bulb. No ramming in excess of that practiced in forming piles at other parts of the site was allowed by the engineers. The placing of concrete was also done by the same method as was used through the entire job. Concrete of 1, 2, 4 proportion was used and was run from a mixer that was serving other drivers at the same time.

Piles Nos. 1 and 2 had no reinforcing, but had four 1 in. dowels set in the top of the pile stem to form a bond with a 24x24 in. concrete cap, which was cast on the pile three days after driving. Piles Nos. 3 and 4 had a 1 in. rod 15 ft. long, which extended through their entire length.

On Aug. 15, that is, 30 days after the piles were driven, loading was started. A crib of 12x12-in. timbers was set on the pile caps and loaded with 60-lb. timbers and rails laid in transverse tiers. Great care was used in placing the rails on the crib and also in getting them properly distributed and balanced, so as to eliminate tilting. Wedges were driven under the edges of the timbers, so as to prevent any unbalanced loading and consequent tilting during the time that an additional tier of rails was being placed. After 10 tons of rail had been placed, the wedges were removed and levels taken on a bolt head which had been previously set in the concrete cap. There was no settlement under the 10-ton load. After a load of 25 tons had been reached without settlement, levels were taken at the end of each additional 5 tons loading. At a load of 35 tons, ⅛ in. initial settlement occurred. Then the loading was continued until there was a 50 ton load on the pile, an additional initial settlement of ⅛ in. occurring. All the rod readings were carefully checked and in all cases the wedges were entirely removed from under the ends of the timbers. The test load of 50 tons was left on the pile for two weeks and levels were read daily, but no settlement could be detected.

After the load had been on for four weeks all four piles were excavated. As the ground water level came within about 4 ft. of the surface, a cofferdam had to be driven. The first of the old swamp was uncovered at a depth of 6 ft. It was a thick layer of stumps and roots which greatly hindered the driving of the sheet piling. The stems of the piles were found in excellent condition, and when the excavation had been carried down to the bottom of the old swamp a fine water-bearing sand was struck. The water flowed in so freely that it was found necessary to employ a 2-in. steam siphon in addition to the large gasoline diaphragam pump, which had been able to take care of the water before. When the top of the bulbs were exposed both pumps had about all they could do to handle the water. The sand became firmer and firmer as the depth of the excavation increased, until when the bottom of the bulb was reached the sand was found to be very firm and compacted.



View Showing Bulb Pointed Concrete Piles Removed From Ground for Inspection.

After excavation had been completed, a 12x12-in. timber was placed across the top of the cofferdam and the pile stems securely lashed to it. The timber was then raised by jacks at each end. The piles came up very readily. After they were loosened a crane picked up the piles and laid them flat on the ground. The piles were then set up as shown in the illustration.

Pile No. 1 is the one which had been loaded and it showed no sign of deformation of either shaft or bulb. This pile had no reinforcement and when it was raised a piece from the bottom of the bulb was left in the ground. The band on the pile about 4 ft. from the top shows the water level. It is clearly seen that the ground water had no effect whatever on the formation of the pile stem, as it is as good below the band as above. The total length of the pile over all is 14 ft. The length of the pile under water was 9 ft. 3 ins., the diameter of the shaft 17 ins., diameter of the bulb 2 ft. 9 ins.

While pile No. 2 (which had no reinforcement) was being lifted from the excavation the bulb broke from the stem and for that reason was not included in the photograph; it was, however, as perfectly formed in every way as the other test piles.

Piles Nos. 3 and 4 were reinforced as ning their entire length. The dimensions of piles Nos. 3 and 4 are practically the same as that of pile No. 1. Pile No. 3 (reinforced) total length overall, 14 ft. 2 ins.; length of pile in water 9 ft. 11 ins.; diameter of shaft, 17 ins.; diameter of bulb, 2 ft. 6 ins. Pile No. 4 (reinforced), the shaft is perfect and the bulb very symmetrical; length overall, 14 ft. 1 in.; length in water, 9 ft. 9 ins.; diameter of shaft, 17 ins.; diameter of bulb, 2 ft. 7 ins.

None of the piles on the job, except the two test piles mentioned above, were reinforced.

DRAINAGE AND IRRIGATION

The Problem of Interstate Swamp Drainage.

The Dismal Swamp.

Contributed by M. O. Leighton, Chief Hydrographer, U. S. Geological Survey.

This swamp has been, since early colonial times, a well-known geographic feature. The first English colony was located not many miles from its shadow and, in the early development of Virginia, when events that afterwards became of national importance took place all about it, the Dismal Swamp remained a thing apart, undeveloped and almost unpenetrated. It is said that George Washington, who had explored the region to a considerable extent, predicted that, when properly drained, the swamp would become one of the most productive agricultural regions in the country. Some of it—a goodly portion—has been indifferently drained; other parts, naturally less wet than the main swamp body, have long been cultivated notwithstanding the wetness; for the greater part, however, Washington's prediction remains unfulfilled. Yet the Dismal Swamp lies within easy access of transportation routes. It is completely skirted by railroad lines. At its northern edge lie the cities of Norfolk, Portsmouth and Newport News, which form a great shipping center. Cheap and regular water transportation is available to Boston, New York, Philadelphia, Baltimore, Washington and Richmond. The reasons for the swamp's continued primeval state involve considerations outside the purview of an engineering paper. Let it suffice to state that no engineering difficulties have stood in the way of its development.

For the accompanying map the author is indebted to the Office of Drainage Investigations, U. S. Department of Agriculture, S. H. McCrory, Engineer in Charge. It is the most recent map of the area, and was made to accompany the report of Warren and Wade, on the Pleasant Grove Drainage District. It is evidently adapted from the base map made by the late Prof. N. S. Shaler, to accompany his classic work on Fresh Water Morasses of the United States, published in the 10th Annual Report of the United States Geological Survey. It will be noted that the Dismal Swamp lies between Hampton Roads and Albemarle Sound; that about three-fifths of its area lies in North Carolina, and that it is traversed by no river of any size. Fairly deep and navigable embayments penetrate its border at numerous places and across it lie the routes of two intercoastal waterways. The original Dismal Swamp Canal was constructed previous to the year 1800 and is now not used for through traffic, having been superceded by the Albemarle & Chesapeake Canal. Shaler, in the report above referred to, says:

> This canal (The Dismal Swamp Canal) was intended to afford a line of ship transportation suited to the vessels of that age between the bay district of North Carolina and that of the Chesapeake. It was expected to furnish a passage for merchantmen and war vessels between these great systems of inland waters, and this expectation was realized. It was designed, moreover, to provide a means of access to the vast and then untouched forests of juniper, cypress and pine which abounded in this field. This important waterway was one of the most considerable hydraulic works which had been undertaken in that century. For the time when it was executed the Dismal Swamp Canal was a costly and well-contrived work. For three-fourths of a century or more it was an important means of transit between Albemarle Sound and Chesapeake Bay.

This canal has had a more or less deterrent effect on the natural drainage of a part of the swamp. It runs in a north-south direction and generally normal to the direction of natural surface gradient. Its spoil banks lie higher than the land immediately to the west. The drainage of the western portion of the swamp has, therefore, been impeded while that of the east has been facilitated.

The main body of the Dismal Swamp contains about 475,000 acres, the area being bordered by the Nansemond Escarpment on the west and somewhat approximately by the right-of-way of the Seaboard Air Line on the north and that of the Norfolk & Southern R. R. on the east and south. Its elevation is from 15 to 20 ft. above sea level and the general slope runs from the Nansemond Escarpment eastward, at an average of about 0.5 ft. per mile. To the casual observer the surface appears quite uniform, yet there is sufficient unevenness or local differences in elevation to cause somewhat marked differences in the character of the land. This is probably best shown by the types of vegetation. Those portions which are or were covered largely by black gum and cypress are submerged or thoroughly saturated during the entire year. Those covered largely with juniper are so situated that they become partially dry during the summer months. Lumbering has been the principal industry in that region, and the interior canal system, parts of which are more than a century old, was principally projected for log transportation. Besides the tree species above mentioned, the swamp bears red maple, swamp ash, willow oak, poplar, bay, sweet gum, tulip, short-leaf pine and water and white oak. Much of the merchantable timber has long since been harvested.

The soil of Dismal Swamp varies from the black muck, in the more sodden portions, to the sandy loam on the higher parts. Both are agriculturally excellent. Certain other portions of the district are covered with a reddish brown peat soil. The real productiveness of the swamp soil has never been tested, because the farming operations heretofore carried on have not been sufficiently intensive to show its capabilities. Under very indifferent farming operations, the lands have been known to produce 60 to 75 bushels of corn per acre. It has been demonstrated that the conditions are admirably adapted for garden truck.

The origin of the Dismal Swamp is markedly different from the Saint Francis and the Red River (North) basins. The former is an alluvial fill built up by river sediments; the latter is a glacial lake bottom, the water over which was drained off after the glacial retreat.

Dismal Swamp was once a part of an ancient sea bottom which has been elevated to its present position. This was not all done in one epoch, but is the final result of a series of interesting geological events. They are summarized by Shaler as follows:

(1) A subsidence which led to the formation of the pliocene plateau.

(2) An elevation which permitted the carving of that plateau.

(3) A subsidence of the surface which deposited the non-fossiliferous sands on the eroded pliocene surface.

(4) An elevation which permitted the carving of that surface in valleys which could not have been formed at the present height of the land above the sea.

(5) A subsidence in which the Nansemond Escarpment was formed.

(6) A re-elevation during which the valleys of the streams radiating from the swamp were excavated to the depth which they now have.

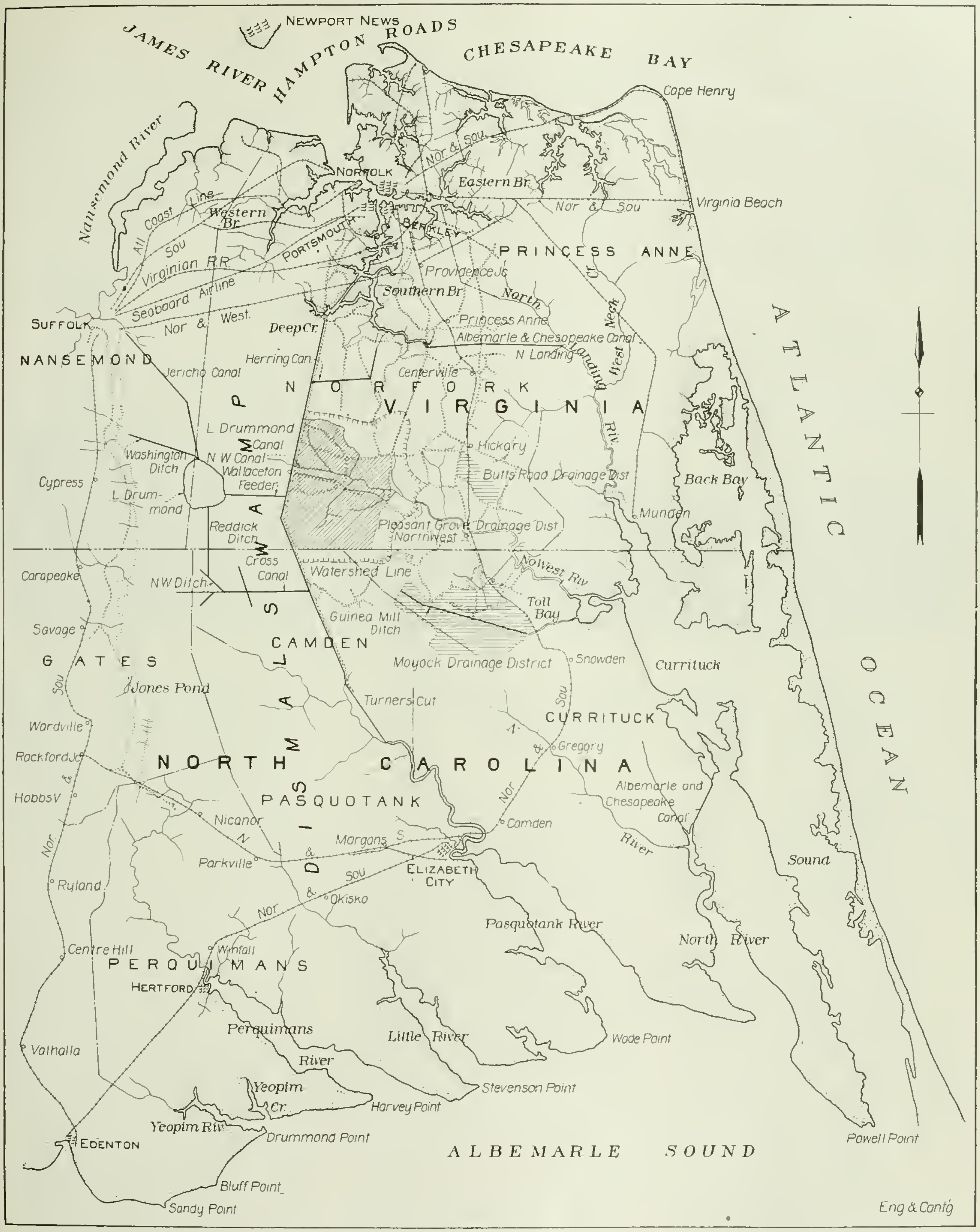
(7) A sinking, now in process of development, which has determined the present shore line.

In other words, Dismal Swamp is a swamp because the final resultant of the geologic events above mentioned is a land of little slope, where the climate is favorable to rapidly growing vegetation, the accumulated debris from which has still further retarded surface run-off and progressively deprived the land of the natural drainage slopes of which it was originally possessed. Lake Drummond, a famous body of water near the center of the swamp, was formed by the gradual obstructions and encroachments of vegetation in this way.

The engineering features of Dismal Swamp drainage are simple. A glance at the map shows a compact body of land, the drainage from which flows north, east and south. No important upland run-off complicates the problem and the task is to determine the route and capacity of canals along the best available grades, shufficient to remove the local water of precipitation. No point within the swamp lies at a great distance from a deep embayment of large carrying capacity, into which discharge the sluggish streams of the region. The divides marking the basin boundaries of these streams are indefinite and in many places imaginary. The location of any system of canals is largely a matter of distance, grade and excavation yardage, rather than that of conforming to basin units. While it appears that the logical system of drainage would consist largely of the enlargement and extension of present natural channels, obscure and otherwise, and the excavation of new channels in conformity therewith, there would be nothing impracticable or unsuitable in a rectangular scheme that would readjust the entire aspect of flow.

Precipitation over the Dismal Swamp largely determines the requisite canal capacity. Hydrometric studies of run-off, so important in certain other swamp areas, are practically unnecessary here, except for purposes of record for application to similar problems in other places, where such knowledge is necessary in adapting the capacity of remote outlets. Any one of the Dismal Swamp embayments would safely carry to the sea an amount of run-off water many times that which could possibly be contributed by the entire area here discussed.

The climatological data, Table I, were compiled from the records of the United States Weather Bureau at Norfolk, Va., by Warren and Wade for the report previously referred



Map Showing Dismal Swamp Sections of Virginia and North Carolina.

to. The location of the observations is on the northern edge of the swamp and at an elevation of 91 ft. It is probable that the precipitation over the entire swamp differs markedly at times from that at Norfolk, but the amount of difference can be determined only by future observations.

From that which has gone before, it is apparent that the interstate complications in the Dismal Swamp drainage problem are of no great engineering moment. It would be possible and even practicable for both states to

TABLE 1.—SUMMARY OF CLIMATOLOGICAL DATA, FROM THE RECORDS OF THE NORFOLK, VA., STATION OF THE U. S. WEATHER BUREAU.

	Length of record.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
							Precipitation.							
	Years.	Ins.	Ins.	Ins.	Ins.	Ins	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
Wettest	41	6.91	7.33	9.13	11.87	8.60	8.36	10.69	11.20	11.90	9.89	6.75	6.09	70.72
Driest	41	1.03	1.15	1.21	0.97	0.54	1.38	2.02	1.74	0.17	0.04	0.23	0.77	38.08
Average	41	3.21	3.68	4.24	3.28	4.03	4.23	5.86	5.99	3.78	3.66	2.45	3.42	48.44
Maximum in 24 hours	25	1.70	1.79	2.50	4.60	3.78	5.97	3.60	5.00	3.23	3.76	5.48	2.52	.....
Average snowfall	39	2.0	3.8	0.4	0	0	0	0	0	0	0	0.5	2.7	9.4
Average No. of days with 0.01 in. or more of precipitation	39	12	11	12	11	12	10	13	12	9	9	9	10	130
							Temperature.							
		F.	F.	F.	F.	F.	F.	F.	F.	F.	F.	F.	F.	F.
Mean highest	28	68.5	71.6	76.2	85.2	91.0	95.7	97.5	94.1	90.8	82.3	75.6	68.6	83.1
Mean lowest	28	17.8	19.7	25.4	35.2	46.0	56.8	62.8	62.8	53.8	41.4	28.8	19.7	39.2
Mean	38	40.7	41.5	48.0	56.4	66.6	74.6	78.8	77.1	71.7	61.1	50.9	42.9	59.2
Absolute highest	38	80.0	81.0	92.0	95.0	98.0	102.0	102.0	100	100	89	80	75	102
Absolute lowest	38	6	2	14	24	38	49	57	56	40	31	18	6	2
							Wind.							
Prevailing direction	38	N	N	NE	NE	S	SW	SW	S	NE	NE	NE	N	NE
Av. maximum velocity in miles per hour		9.7	10.3	11.3	9.7	8.4	8.8	8.0	8.2	9.4	9.8	10.1	9.3	9.4
							Frost.							
	23		Av. date of last killing frost in spring, March 27.			Latest date of killing frost in spring, April 26.			Earliest date of killing frost in autumn, October 15.			Av. date of first killing frost in autumn, November 12.		

hew to the boundary line, regardless of each other. Probably this would not be the wisest way for reasons of public policy, but these are troublesome matters, and without the confines of engineering necessity. The object of this paper is to illustrate a very peculiar case in which, because of local simplicity, an interstate swamp presents no important engineering interstate difficulties.

A Discussion of the Economies of Constructing Cut-Offs Instead of Enlarging Original Channel in River Improvements for Drainage and Flood Control.

The drainage engineer is frequently called upon to provide additional carrying capacity in a river either to meet the new demands to be put upon it by contemplated ditch work or it may be to reduce overflow in times of flood. In a paper before the Minnesota Society of Engineers, Mr. Wm. R. Hoag, Drainage Engineer, Thief River Falls, Minn., discusses the economies of channel enlargement by the alternative methods of constructing cut-offs or of widening and deep-ening the original channel. We publish the following extracts from this discussion:

The purpose of this discussion is little more than to state the problem, without attempting to discuss it scientifically, with the view of proposing a criterion for making a cut-off instead of following the longer way around. I shall briefly analyze an hypothetical case and seek to show how a cut-off under certain conditions may prove economical though when subjected to the usual tests it would seem to involve the more work.

Referring to Fig. 1 let *A*, *B*, *C* be a stretch of river in which it is desired to provide additional discharge capacity. In case that *C* is the lower end of the proposed improvement and the level of water surface at *C* is of no moment which would be true if there were ample fall in the river, the problem, of course, is simple and requires but a determination from that point to the outlet of the amount of earthwork involved in making the enlargement of the old channel to secure the desired capacity and the same for the direct cut-off from *A* to *C*. A comparison of these two quantities shows at once the cheaper route. This is on the assumption that the cost of the excavation on the alternate routes is directly proportional to the yards to be moved.

While this assumption is usually true, it might happen that owing to the added difficulty of excavating the material in the old river bed as compared with the dryer cut-off line, an economy would follow the use of the cut-off route even though it showed the larger yardage; on the other hand, the economy might attend the river route from difficulties incident to the disposition of the excavated material in the waste bank in the larger cut, on the cut-off route. The property interests affected and land values might also claim consideration in fixing upon the most desirable route and, likewise, the availability of suitable excavating machines might determine the preference.

It is of course evident that no set rule can be laid down as to what excess of length of river over the length of the cut-off can be followed in preference to the cut-off (assuming cost of desirability to be controlled by the yardage involved) since this is dependent upon the relative cross-sections of the original river channel and the enlarged channel. Thus with a comparatively small enlargement, to follow the river course might be economical though many times longer than the cut-off and on the other hand with a small original channel which is to be made many times larger, true economy might dictate the cut-off though it be nearly as long as the river route.

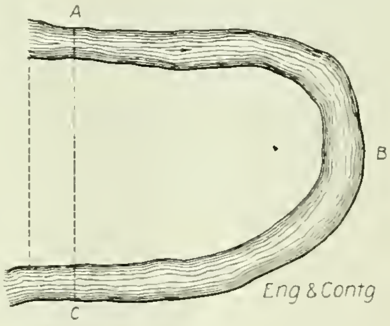


Fig. 1.

But in case the proposed cut-off is but one of many, in a long stretch of the river, which is the more usual, and assuming further that the low banks and small gradient of the river make it necessary to excavate for the full waterway capacity—conditions ordinarily present when a winding river crossing a marsh country needs canalizing—the choice between the rived-bed route and the cut-off ceases to be governed only by the relative yardage involved in the two routes.

The further assumption is made that the improvement must provide a deeper channel than the original river to furnish a lower outlet for tributary main ditches as well as to insure a lower water plane to bordering lands at mean water level under the new conditions.

Since the old river channel made and maintained largely by the natural erosive action of the water is a much shallower waterway than one having the most economic cross-sections, which requires that its depth be one-half as much as its top width, it follows that in increasing the carrying capacity of such rivers it is as a rule economical to increase the depth, relatively, more than its width, to bring it the more nearly to a channel of economic cross-section.

Again let us suppose that the improvement has been started on the upper part of the river where the slopes are ordinarily greater and the necessary increase in the waterway correspondingly less and that as we follow down the river the enlargement increases to meet the local demands cited above of intercepting ditches and to secure a lower mean water level until we reach a point where the river slope, larger natural river channel and higher banks which usually attend, permit us to adopt a gradient less than that of the river bed, which results in gradually lessening the depth of cut in the bottom of the river until it meets the gradient of the river bed which point marks the end of the needed improvement.

While the above line of assumption has been given as a purely hypothetical case it in fact is the statement of the exact topographical conditions obtaining in an actual river enlargement work with which I have been engaged as near as I can briefly give them in general terms without the use of topographic maps and other lengthy, and for my present purpose, unnecessary engineering data. Indeed with some half dozen such cases coming under my professional supervision during the past few years it differs in no importance particular at least in none which would tend to vitiate the conclusion which I shall attempt to draw touching the economy of cut-offs in the hypothetical case.

We will now consider that the cut-off under examination is one located anywhere between the point where the necessary depth of cut in the bottom of the river is the greater and the lower end of the needed improvement. While it is not necessary to thus limit it, I do it with the thought of leading to a better understanding of my point.

These problems of relative economy of cut-offs are not likely to be furnished near the lower end of the improvement since the small amount of yardage here in a given distance between the bottom grade planes would require a very long oxbow with a very short cut-off to even raise the question of relative economy of the cut-off in preference to the river route.

We will then further limit our cut-off problem to that part of the river improvement where the general gradient plane of the river bed is practically parallel with the general gradient plane of the improved channel. This will ordinarily confine it within the middle third of the improvement.

Stated briefly our problem is as follows: Given a river which for a few miles is of moderate slope and comes to require enlargement only as we near the lower part of this stretch. Immediately below this, the river crosses a marsh country having much less slope and below this it enters upon the steeper slope again.

Since the mechanics of the flow of water in open channels is so much involved and results in such complicated expressions when treated algebraically I will now resort to a concrete example to illustrate my proposition that under the above named conditions the relative cost of cut-off and river routes cannot be treated by the usual method and that to so dispose of them, which invariably results in the selection of the river route, is to incur unnecessary expense to secure a desired benefit or what is equally unprofessional to fail to secure for a given expenditure its full measure of benefits.

Suppose the cross-section of the river is for convenience—an equivalent of a 1 to 1 side sloped ditch of 24 ft. base and 6 ft. deep and running 5 ft. deep at maximum stage of flood.

Let us suppose the general slope of the river valley to be 0.2 per 1,000 ft. and that it is required to enlarge the present capacity which is about 300 sec. ft. (by Cutter's formula, calling $N=0.025$ which for $R=3.8$ gives $C=.75$ per cent and $Q=304$ sec. ft.) to 1,150 sec. ft.

Let the length of the cut-off be 1,500 ft. and the distance around be 2,500 ft.

The necessary cross-section for the required discharge, with the assumed slope, is one having 34 ft. base and 10 ft. deep carrying 9 ft. depth of water.

This involves 1,630 cu. yds. per station or 24,450 cu. yds. for the cut-off. The enlargement on the river route following the usual method of comparison, costs in yardage the 1,630 cu. yds. per station less the river channel which here is 666 cu. yds. per station. The difference between these or 964 is the amount to be dug in each station of the enlargement—which for 25 stations equals 24,100 cu. yds.

That is by this comparison the cut-off route involves a few hundred cubic yards (350 cu. yds. in this case) more excavation than the river route—which would ordinarily lead to the selection of the river route upon final location.

But let us examine closely this conclusion.

If the alternate routes in our example are practically identical each must leave the water at the point C in the same condition in all things vital to our problem; that is, its two forms of energy—kinetic and potential—must be the same. The former remains unchanged since it, in both cases, has been moving down the same gradient in a channel of like cross-sections and would necessarily have the same velocity.

The small effect of the bend of the river route is negligible though in favor of the cut-off route. But what of its potential energy? In following the cut-off it lost 0.3 ft. of its potential and on the river route it would lose 0.5 ft. That is the water would be at a 0.2 lower level upon its reaching C by the river route than by the line of the cut-off, and whatever this in its effect would cost us must be added to the cost of the river route before it can be compared with the cut-off route to determine their relative economy.

How shall we evaluate this needlessly lost potential into cubic yards of excavation?

Calling it a power development problem, we could readily convert the 1,150 sec. ft. with this head into horsepower and the market value of this would give our annual loss of continuing this feature in our work of water transportation. But of course this is visionary since it involves the variable flow and needed cost of structures and machines to convert it in some form of marketable energy as well as marketing the same.

A more satisfactory plan might be to find how much this two-tenths added depth to our cut costs us, as we continue to provide the necessary channel on below C.

But this plan involves some difficulty and some inherent uncertainty.

Since the two-tenths additional depth of water at some distance below the cut-off furnishes added cross-sectional area a gradient slightly less than the 0.2 will furnish the required capacity. This would result in a curved gradient, approaching the original 0.2 gradient less and less rapidly but finally (for practical purposes) reaching it, at which point the water would have recovered its lost potential (relative to the 0.2 gradient) and the additional yardage would be that to be added to the excavation by the river route to give its full cost.

But there is a credit due to this added depth, however far it must be continued, both on account of the lower water plane and the added security against overflow at times of extraordinary floods. This credit item can not be readily converted into cubic yards and hence renders this solution unsatisfactory, since it could not be maintained that we must continue this lower gradient unchanged till it intersected the river grade.

The above hint at what might be developed as an example illustrating the truth of my contention relative to the true economy of cut-offs is not offered as having any sure foundation in engineering sciences; the following, however, is believed to be theoretically correct and worthy of the consideration of practical engineers.

Since it is required to establish as definite a relation as possible between the earthwork on the alternate routes it is desirable to proceed on a line of assumptions which will eliminate as far as possible all other modifying factors or considerations having any weight with our problem.

The difficulty of the difference of potential of the water upon its arrival at C by the alternate routes we remove by assuming that the longer route be given the necessary but less gradient so as to meet the elevation of the cut-off route at C and further that its cross-section be so increased in width that it will provide the necessary capacity with this less gradient and new cross-section.

We thus have an enlarged waterway which will deliver the required quantity at C with the same potential as by the cut-off route.

Solving for the necessary width of base with 9 ft. depth of water (slope being 0.12 ft. per 1,000 ft.) gives 43 ft. which for the present cut makes 1,963 cu. yds. for the 2,500 ft. Deducting from this the yardage of the river channel, 16,650 cu. yds., leaves 32,425 cu. yds.

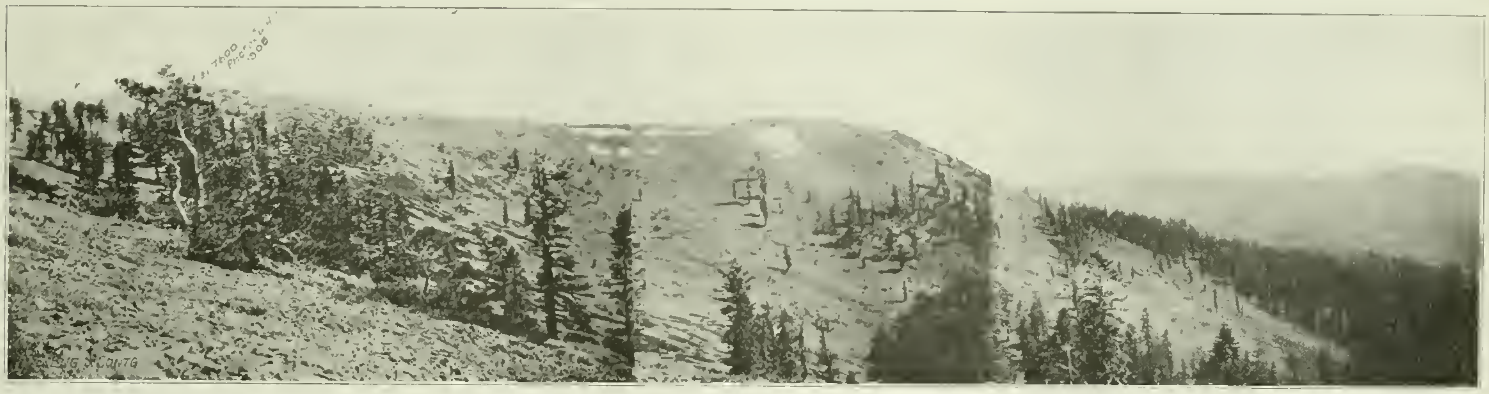
The cut-off route involved 24,450 cu. yds. The difference, or 7,975 cu. yds. represents what must be removed from the river channel, under the assumed conditions, to provide a waterway around the bend in all essentials the equivalent of the cut-off channel.

The above example has been selected at random—indeed approximates closely an actual case—and is offered only as an illustration and of course establishes no general truth.

We believe, however, that it shows beyond question that there is under all similar topographic conditions a large credit due the cut-off route, and which must be applied to it before it can properly be compared with the river or alternate route to determine relative economy.

Conservation of Snow for Irrigation; Its Dependence on Mountains and Forests.

Sirs: Your issue of Feb. 5, 1913, contains a reprint of the discussion and data in the Bulletin of the International Irrigation Congress, by Prof. J. E. Church, Jr., and I find statements and suggestions therein entirely different from opinions which I have formed from observation, and authentic data from various sources, and with a desire to get at the truth respecting all problems of interest and importance, beg to suggest that possible conditions may so vary in different localities, that it would not be safe to depend upon any one investigation in any special locality.


View of Red Mountain, California, Showing Snow in Clearing and Absence of Snow in Wooded Parts.

I enclose you a photograph taken by myself on July 11, 1908, on Red Mountain, near Cisco, Cal. You will notice the snow banks which are on the southwest side of the mountain are in the open, while the timbered section shown in the photo, part of which is at the same elevation of the snow banks and some of it higher, is entirely free from snow. The summit of this mountain is about 7,800 ft., and on the northeast slope, where the arrow points, was a very large and deep snow bank, also entirely in the open. The photo was not taken to show the snow, and that question was not being considered at that time.

Near the head of Coffee Creek in Trinity County, is a point locally known as "Big Flat" at an elevation of 5,000. It is about 1½ miles long, north and south, and ¼ to ½ mile wide; at the northerly end there is a very heavy growth of mammoth yellow pines, while the southerly end is entirely open. I have passed over this flat at all times of year for several years, and the first bare ground to be seen in the spring or early summer, is in the timber.

Altitude has more to do with preserving snow than any other factor. At 5,000-6,000 elevation, no matter how heavily timbered in California, the snow will have all vanished, when at 8,000-9,000 elevation it has barely commenced to run, and there is very little timber above the 6,000-ft. contour in this state.

I find the following in the reprint:

> The development of the national forests to their full capacity means not only the control of the present run-off, but also a large increase in the storage of snow. . . .

Meaning no discourtesy, I must say that if this be true, I have been deceived by my own observations, and I respectfully ask for proof of the statement that development of forests (why *National* forests?) will control the present run-off or the run-off of any other period, and I respectfully refer you to House Document No. 9, 62nd Congress, 1st Session, which is a report of Lieut.-Col. Edward Burr (U. S. Engineers) of an investigation of the Merrimac River Basin in Massachusetts and New Hampshire. Access to rain gages from 1826 were available, and daily gage readings of the river stages since 1849. There is probably not in the United States as favorable conditions for such investigations as were here found. The document consists of 123 pages besides numerous maps and charts. It is well worth reading by any one interested in the subject, and is especially valuable because of the long period covered by the data. In that period the basin was practically deforested, and 25 per cent reforested; and some of the conclusions are herewith appended.

> That any investigation of the subject, based on data not dating back over 40 years, is without sufficient foundation, and sure to lead to erroneous conclusions.
>
> The precipitation for 50 to 90 years at points within the basin, or within a few miles of its borders, shows tendencies or cycles that bear no relation to the changes in forest areas.
>
> The run-off through the river varies with the precipitation over its basin, and the percentage of run-off to precipitation is not appreciably affected by forest changes as great as 25 per cent or more of the basin.
>
> Flood heights have not been decreased by forestation or increased by deforestation, and the principal characteristics of floods are unaffected by forest changes. The duration of flood stages and the amount of run-off during such stages have not been adversely affected by deforestation or beneficially by reforestation.
>
> Variations in stream flow are determined essentially by variations in climatic conditions which move in irregular cycles independent of forest changes.

These expressions based on data of more than 60 years command attention, and cannot be ignored.

I believe it was in 1861 when the great flood came to California, when steamboats sailed across the Sacramento Valley regardless of streams. Very little timber had been cut at that time, but there has been nothing approaching this flood since a great deal of timber has been cut.

The most we can expect from forests is *timber;* and that is sufficient justification for forest reserves. The sooner we conservationists realize this fact, the quicker and better will be our progress. Rain produces trees; not vice versa; the control of flood waters can be accomplished by sufficient storage capacity of reservoirs, and by no other means to any appreciable extent.

Very truly yours,
WILLIAM A. COOPER,
Engineer.

San Francisco, Cal.,
Feb. 13, 1913.

Test Road in Washington.—Work is now under way on the construction of an experimental road between Olympia and Tumwater, Wash. This road is being built by various paving companies, each having a section of from 100 to 400 ft. in length, for the purpose of demonstrating the practicability, stability and other features of the various paving materials which they advocate. The highway will be under the supervision of the state highway commission, and will be maintained by Thurston county.

Four-Mile Tunnel Through the Selkirks.—The Canadian Pacific Railway will build a two-track tunnel, four miles long, through the Selkirk range between Calgary, Alta., and Vancouver, B. C., the estimated cost of which is something over $12,000,000. One object of its construction is the elimination of danger from snowslides which have given a great amount of trouble on the present line through Rogers pass. The tunnel will be operated electrically, and is expected to be completed in about two years.

Methods of Inspecting Farm Tile Drains.

Contributed by F. O. Nelson, Drainage Engineer, Estherville, O.

One of the important though often neglected features of land drainage is the inspection of the work as it is done. Good plans avail but little if poorly executed, and that is what happens to a lot of them. Methods of inspection must vary for different conditions, but a few general rules and some special cases may be of interest and value. We will refer to tile drains.

Assuming the tile to be acceptable, the principal points to be observed are trueness to grade and proper formation of the junction of branches with main lines. The alignment of the tile and the openings between the ends are also of importance, the matter of size of openings being of great importance in some soils but comparatively little in others.

The trueness to grade is usually sufficiently checked by level readings on the tile each 33 ft., or three readings per station of 100 ft., one reading being taken at the stake and the other two between stakes. The object of taking readings in this manner is to get enough readings to tell the degree of care which has been used and to get readings at such points as would be liable to be in error in case of carelessness or incompetence. The readings at the stakes will tell whether or not the workmen have set their line correctly (providing they have worked to the line) while the readings between will probably locate errors due to carelessness in laying to the line or keeping it in place. Having two readings between 100-ft. stations also brings them away from the half station when such are used. Sometimes work is so roughly done that it is necessary to take more readings to determine the extent of the serious shortcomings.

It is well to take notice of the depth of water in the tile and the mud too, as the presence of obstructions in them may be discovered in this way. The presence of mud is undesirable but not necessarily a serious matter even when it nearly fills the tile. The danger comes in the case of poor outlets with very little head water in the branches or the upper ends of the line, and from the fact that it may indicate the presence of some hard obstacle in the tile or of some defect in the grade. Otherwise the mud is usually easily carried out by the flow of water through the tile.

Where the tile have been blinded a ⅜-in. iron prod, made even feet in length for convenience, with a formed handle at the top or fastened to a leveling rod is needed. The separate iron rod is also convenient for locating old tile lines, etc. The reading is then taken by setting the leveling rod on top of the prod when it has been located on the center of the tile. When the reading indicates that the tile are a little too high it is necessary to take a check reading a short distance from the first one, as the high reading may be caused by a bat on top of the tile.

The height of instrument may be obtained by readings on a couple of grade stakes, or more if they do not check as it sometimes happens that they have settled where the ditch banks cave off or have heaved by the frost. With the height of instrument determined and the notes of the line at hand showing the elevations, grades and sizes of tile along the line comparisons may be rapidly made and any indication of error closely examined before leaving that part of the field.

It is very important that junctions made in the field be closely examined because it frequently happens that the workmen are careless or incompetent in this regard, and the capacity of the tile greatly reduced as a result. Not only must the angle of the branch with the main and its outside appearance be noted but the inside of the tile as well, to see that the hole cut into the main corresponds in size with the branch, or that the branch tile does not project far into the main, etc. We have found cases where the area was reduced fully one-third by such carelessness.

It is also profitable to examine the tile around curves to see that the openings at the joints are properly covered, or better still, the tile beveled so as to fit; to keep a sharp lookout for attempts to hide defects, such as the covering of a few tile here and there with dirt where a rock has not been removed or a proper curve established around it.

When the engineer is acting as inspector he should be prepared to prove the truth of his statements to the contractor and landowner. Many tilers are more than willing to correct faults found in their work, but the engineer may meet with a flat contradiction from the contractor which it is desirable to squelch. He may sometimes do this in the case of erroneous grading by asking the contractor to set his line up over the disputed work and then measure to it from the tile, or he may show the variation of the depth of water in the tile as proof. Variations from the specifications are not necessarily serious faults, though rarely commendable, and rough work, increasing friction, is more objectionable than some variation from a true grade. No rule as to allowable variations is practical owing to the variability in shape and size of tile, to the demands upon them, and to the great difficulties encountered in some soils, so these things must be judged for each particular case. It has been demonstrated over and over, however, that tile may be laid correctly to within a few hundredths of a foot even under moderately difficult conditions.

Method of Conducting Topographic Surveys for Drainage Districts.

Topographic surveys in connection with the reclamation of swamp and overflowed lands along the Mississippi and Illinois Rivers are made for the following purposes: 1, the location of levees and main and lateral ditches, and the preparation of estimates of cost; 2, the assessment of benefits and damages. In a paper before the Illinois Society of Engineers and Surveyors, Mr. Walter A. Birket, of the Harman Engineering Co., Peoria, Ill., discusses the purposes of topographic surveys for drainage work and describes methods of conducting them as follows:

For the location of the levee, detail topography should be taken along the river extending back 600 to 1,000 ft. In most cases a ridge of higher land is found near the river, and sometimes the levee location can follow this the entire length of the river front. More often it approaches too near to or recedes too far from the river bank, and then it becomes necessary to cross to another ridge. The question then arises as to where the location should leave the ridge and where the crossing can best be made. If there are other ridges farther from the river that appear to be higher, it is necessary to extend the topography to cover them, as the question will likely arise whether the additional land taken in by the location nearer the river will pay for the additional expense of building the higher or longer levee which would be necessary. With all the possible locations made on a topographical map, and the cost of each route estimated it becomes a simple matter to choose the best route.

For the location of main and lateral drains, it is essential to know the elevation of all sloughs, ponds or other depressions in order that a ditch can be located and a grade established that will drain such places. It is also necessary to have the elevations along the line of the ditch so that an estimate of cost can be prepared, as it is seldom possible to make the best location (without the aid of a topographical map) except by running out several locations, and even then the best location is not always found. From a topographic map, with contours of 1-ft. intervals, it is a small matter to make an estimate on all possible locations, from which the most desirable route can be adopted. For the assessment of benefits, it is essential to know the elevation and extent of all ridges and depressions. The most practicable way to show these features is on a topographic map, with 1-ft. contours. It is also important to know the amount of timber, that part of the land which is prairie and that which is cultivated, and to be able to tell from the maps the amount of land in each tract that will not be reclaimed, if any.

The methods used in 1912 on a survey of 20,000 acres are described below. The levee had been constructed a number of years, so that the extra detail necessary for levee location was not required. The information necessary was for the assessment of benefits, the location of the interior drainage ditches and the diversion of hill streams. The territory covered ranged from two to four miles wide, extending from the river levee to the bluffs, and about 12 miles north and south. A camp was established, with three 14x24-ft. tents. One tent was used for kitchen and dining, one for quartering the rodmen, and the third for the topographers, instrument men and draftsmen. The last was used also as the field office where the plotting was done.

There were two topography crews, each consisting of a topographer, an instrument man and three rodmen. A third crew (instrument man and two rodmen) was organized to run base line. When this crew had finished all the base line that could be run from a given camp, it was disorganized, one rodman being put in each of the topography crews, while the instrument man worked in the office computing and assisting the draftsman. The base line was run from north to south through the center of the district, using the regular stadia methods, except that no topography was taken. Azimuth was carried and checked by deflections right or left from the last line produced. The elevation of stations was carried by differences of elevation, as follows: The height of the telescope above the stakes was determined with a rod graduated in feet and tenths, or by bringing the point of the plumb bob to the top of the stakes, then swinging it over to a graduated leg of the instrument. The difference between the height of the instrument and the rod read on a station when the telescope is level is the difference of elevations of the two stations. As this difference is taken both forward and back from each station it furnishes a check on the work before leaving the station. The average of the two differences is used for the difference of elevation between the stations. No vertical angles were used between stations, and only on side shots when the rod could not be used direct.

The elevations of the base line stations were checked by direct levels with fore and back sights of 300 ft., as nearly as practicable. The distances along the base line were read by stadia and checked by chaining. The chained distances and direct levels were used as correct, in preference to the results obtained by the stadia and difference of elevation methods, providing they did not differ more than could be expected from the different methods used. Where the error was greater than allowable a second check was run. The method gave a base line in which there was little chance of errors, and in which none were found.

The two topography crews were started east and west from the base line. Each ran to the limits of the district (the levee on the west and the bluff on the east), then north half a mile and then back to the base line, making a circuit of about 4½ miles. These circuits were closed on the base line for azimuth and elevation. A tabulation of the circuit was made in which the error in azimuth and elevation was prorated throughout the circuit. This tabulation also included a traverse of the circuit, which was prorated to close. As the error in azimuth was prorated before the traverse was computed, the error in traverse was considered as due to errors in distance and was prorated on that basis. The error in departure was prorated in the east and west lines, and the error in latitude in the lines north and south.

The first lines east and west from the base line were run along a section line and the return lines along a quarter-section line, half a mile from the first line. The next lines were run along a section line one mile north of the first line to the limits of the district, then south half a mile to close on the first circuit. Errors in azimuth, elevation and traverse were corrected and prorated to the correct results for the station tied into. The circuits were run in this manner between the base line and the limits of the district along each section and quarter-section line, and closed on the base line and on the preceding circuit at the limits of the district alternately. This gave a base line north and south about the center of the district, which was checked and free from observable errors; also stadia lines east and west across the district at half-mile intervals, each one being closed back to the preceding circuit at the limits of the district, thus avoiding all chance of small errors accumulating. The allowable errors were 5 min. in azimuth and 0.2 ft. in elevation. We found no trouble in keeping within these limts.

In open country the circuits were run along the section and quarter-section lines and a distance of a quarter-mile used between stadia stations. This was in order that a station would be near each 40-acre corner, making it possible for the topographer or instrument man to make a search for monuments. Rodmen do not realize the importance of tying in monuments and, as a rule, make little if any search for them. Anyone who has sectionized a topographic map of a large area realizes that even if all the information available is plotted, such as monuments and fences, there is little enough from which to correctly plot the section lines. As the areas of fractional tracts within the district are computed to these lines as plotted, and ditch lines are located along them, it is very important to obtain all the information possible that will in any way influence the plotting of the section lines. It is time well spent to keep the work well squared up in such a way that an instrument station is near each 40-acre corner.

In timber it is seldom possible to get stations one-quarter mile apart. Sometimes half this distance can be taken and it will give the same results. Where even this is not practicable, if the stadia line is kept near the section or quarter-section line, the instrument man in passing from one station to the next will pass the corners and can make a search for monuments. In timber country, or where there is a great deal of detail to be taken, it is not possible to cover the ground from lines half a mile apart. Then it is necessary to set spur stations from the main circuit from which to get the detail. To save the time necessary to set off a spur station, if the instrument is set up at a point from which the detail can be got, and oriented by means of the compass; the azimuth, distance and difference of elevation back to a station on the main circuit are read, and the detail then taken in the usual way. By using this method the instrument man is able to pick the position from which the detail can be taken with the least amount of work. For spur stations, the location must be left to the rodman, or a special inspection made by the topographer. Results obtained by this method are as accurate as ordinary stadia or spur stations, but would not be if circuits were run by such methods as would permit errors to accumulate. By closing the circuits by traverse, using a chart from which the latitude and departure of each line was read, time is saved and the results are much better, as the errors can be prorated more nearly in their proper places than can be done by plotting. The errors found are errors in the circuits themselves and do not contain errors of plotting. By plotting the circuits by traverse there can be no accumulation of errors.

Instead of sketching the work in the field book, as is common in topographic work, sketch sheets 8½x11 ins. were used on a board which would take four of these sheets at one time. The board was rounded out to fit a man at the waist, and had a strap from the outside corners passing over the shoulders. This enabled the topographer to work on the board while standing, and also to compare the sketches with the territory while walking over it. The observations taken by the instrument man were recorded in a field-book and also plotted with a half-circle stadia protractor on the sketch sheets by the topographer. The sketches were made to a scale of 1 in. to 400 ft. (the same as the finished drawings). With the shots plotted on the sketch sheets in the field, it is possible to sketch a great deal of the work which would have to be taken by shots if less reliable sketches were used. Enough contours were drawn on the sketches so that they could be used as a guide for the finished maps.

When it is difficult to get the shots, the topographer is able to keep the elevations computed and plotted as fast as they are taken. When the work is done easily the topographer will not be able to keep up. In that case, when the station is worked out, it is necessary to stop and plot the shots before the instrument is moved to the next station. This takes but little time, and as soon as the work is plotted the instrument man takes the book, goes to the next station and starts work. The topographer in going to the next station covers the territory between the circuit being run and the last preceding circuit, sketching the sloughs and swales that are not shown by actual shots, as it is not practicable to take shots at all the crooks and turns. If the topographer works between the line that is being run and the last preceding line, he is able to cover the territory well and keep the sketch up without delaying the instrument man. The latter will be delayed by having to keep his own notes, while the topographer is sketching, but this will be more than offset by the number of shots that will be saved by the sketch method, besides obtaining much more reliable work.

The advantages of this method are: 1, the work is plotted in the field, the sloughs and swales are followed out and are connected up properly; 2, the work is plotted from the balanced notes; 3, the draftsman who has never seen the territory can finish up the maps from notes and sketches and contour them correctly. The advantage over the plane-table is that the transit sets higher and therefore overlooks a great deal of vegetation that would have to be cut if a plane-table were used. Work can be done more rapidly with a transit than with a plane-table. With the sketch method it is not necessary to take more than 75 per cent of the shots that would be necessary with the ordinary stadia method. Sometimes with the latter method the territory is not covered and sometimes it is covered twice, due to the instrument man not being able always to tell the distance between the line he is running and the preceding line, when one or both lines are not straight, on account of timber and the necessity of running an irregular line in order to get the detail. With the sketch method, the topographer is able to tell at all times just how closely the territory is covered, and he can always scale from the nearest known property corner and tell where to look for the next one.

The cost of such a survey as described will vary with the local conditions and the time of year. A district with little timber or brush surveyed under ordinary weather conditions should be finished ready for tracing for from 12 cts. to 14 cts. per acre. A district with 50 per cent of the territory covered with timber and brush, if surveyed under ordinary weather conditions, would cost from 14 to 17 cts. per acre, while for the same territory surveyed under adverse conditions the cost might run as high as 20 cts. per acre.

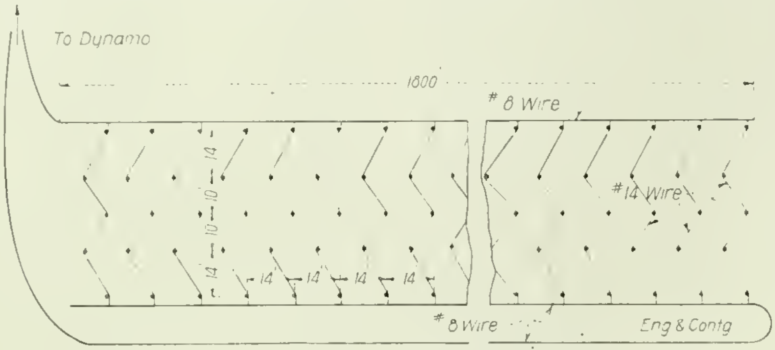
Water Works Construction in South Africa.—Three more new schemes have been added to the list of the numerous municipal water supply projects either under way or proposed in South Africa. One of these is at Napier, Cape Province, one at Cambridge, Cape Province, and one at Jagersfontein, Transvaal.

RAILWAYS

Method of Blasting a Railroad Cut 1,800 Ft. Long with One Shot.

(Staff Article.)

In constructing the Portland, Eugene & Eastern Ry. line in Oregon a rock cut 1,800 ft. long and from 25 to 40 ft. deep was blasted in one shot by the Flagg & Standifer Co., contractors, of Portland, Ore. The roadbed is 20 ft. wide, with side slopes of 1 on 1 and the volume of the cut was estimated at 35,000 cu. yds. Six Star well drilling machines with 4-in. bits were used. They drilled 578 holes at a cost of 27 cts. per foot. The holes were arranged in five parallel lines, a center line, two lines 10 ft. on each side, and two lines 24 ft. on each side of the center line. The holes were placed 14 ft. apart on these lines and staggered. In several soft places a 5-in. well casing was used for drilling. The formation was a fairly soft rock, with a strata 8 to 12 ft. thick of very hard rock running through a part of the cut on a vertical angle of 15°. The holes were chambered with 60 per cent nitroglycerine powder, and some of the holes were loaded from 6 to 8 ft. above the springing line in order to secure a thorough shattering effect. The holes were loaded with 27,275 lbs. of 35 per cent gelatine dynamite and 1,200 lbs. of 60 per cent nitroglycerine powder. A 3-in. tin water pipe—not corrugated—was used to advantage in loading. It eliminated the adhering of powder to the sides of the holes. The loading required eight days.



Sketch Showing Layout of Holes and Wiring for Blasting a Railroad Cut.

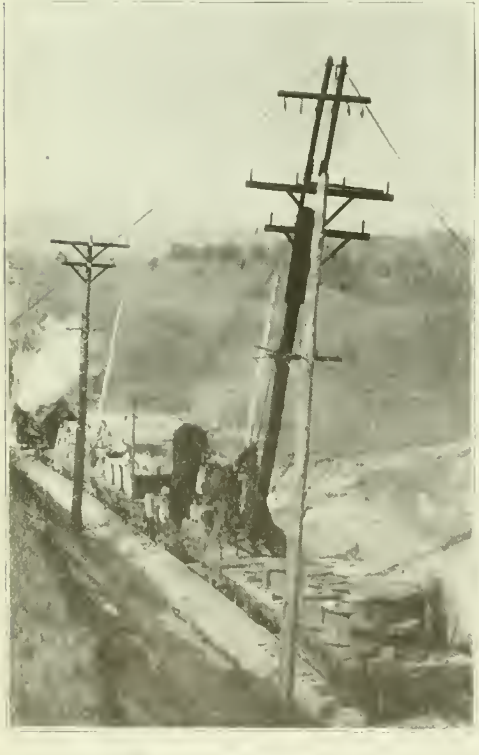


Fig. 1—Equipment for Pole Setting and Wire Stringing Used by Western Massachusetts Contracting Company.

Current for the shot was furnished by a dynamo 6,200 ft. from the site of the blast, and 18,000 ft. of No. 8 wire was used for conducting the current. The multiple system with No. 15 R. C. wire connections from the dynamo lead wires was used as shown by the sketch.

The shot was entirely successful and the material was broken up so as to be readily handled without "bulldozing."

We are indebted to Mr. C. W. Craig of the Flagg & Standifer Co. for the information from which this article has been prepared.

An Efficient Plant for Setting Poles and Stringing Wires for Railways.

(Staff Article.)

A rapid and economical method of setting telegraph and transmission line poles and for stringing wires on them is being used by the Western Mass. Contracting Co. while building the extensions to the lines of the Berkshire Street Railway Co.

The equipment, which is shown by the accompanying illustrations, consists of a locomotive, a reel car, and a pole locating car. The reel car is a flat car with a heavy timber reel stand located to it. The stand holds six reels with one mile of wire per reel. A uniform tension is secured by placing a band brake on each reel, which is adjusted by spring tension.

The derrick car outfit consists of a standard hoisting engine and boiler, a heavy derrick, with a 50-ft. boom for pole setting, and a 20-ft. extension to the boom for wire stringing. The extension piece carries on its outer end a cross-arm holding six single blocks through which the wires pass directly from the reels.

The pole locating car is also a flat car to which is bolted a wooden frame carrying an adjustable arm for accurately locating the poles as shown by Fig. 2.

The poles were all 50 ft. in length and were set 8 ft. in the ground. Each carries an 11-ft. 4-pin arm, and a 9-ft. 2-pin arm besides the feeder, telephone and trolley. The poles were fitted on the ground with arms, braces, and wire attachments.

The regular pole setting crew consisted of ten men, all laborers except the foreman. This crew set from four to five poles per hour.

The six transmission lines were stranded "0" for 33,000 volts. The wires were run from the reels through the six blocks on the boom extensions and were laid directly on the pole crossarms. They were pulled to proper tension with a six-wire equalizer and then tied to the insulators by the lineman and so far as possible with one climbing of the pole. After the transmission and feeders were strung the brackets and trolley wire were placed in the usual way. Eighteen miles were strung per day using four men, a hoisting engineer, and the locomotive. This was done without the lineman except for splicing the wires.

A Successful Use of a New Explosive Gelatin, Which Is Not Easily Affected by Cold Weather, in Railroad Construction Work.

In railroad contracting work, where the holes are generally vertical and are sprung or chambered a number of times so that they will accommodate the required charge, the holes almost always contain water; generally cold water and sometimes ice cold water. When the blaster begins to load these holes, and the dynamite is plunged into this water and is allowed to remain there while the blaster is loading up the other holes and connecting up, getting ready for the blast, the dynamite has a chance to become very much chilled and possibly even frozen; especially is this true of the holes first loaded.

In some recent experiments with the new Du Pont Gelatin, on the work of building a trolley line from Lee to Westfield, Mass., under the direction of Superintendent Frank Lee of the Western Massachusetts Contracting Co., several interesting facts were noted with reference to the action of this explosive when cold. Up to the time that the gelatin was tried, blast holes were spaced on 8-ft. squares about 20 to 22 ft. deep and they were sprung until each hole would take 50 or 60 cartridges loaded up to within 8 ft. of the top of the hole. After the first few blasts with the gelatin, it was noticed that the rock was broken up much better, there was less mudcapping to be done and the steam shovels made better progress.

Eventually the distance between the holes was increased from 8 ft. to 10 ft., and finally 12 ft., using exactly the same charge of explosives per hole as before, without any falling off in the thoroughness with which the rock was broken. This rock was hard mica schist, with the stratification lying at an angle of about 45°, and was very wet. The only explanation possible of this great increase in efficiency was that the new explosive, which has a much lower freezing point than ordinary dynamite or gelatin, lost none of its efficiency by being chilled in the cold water.

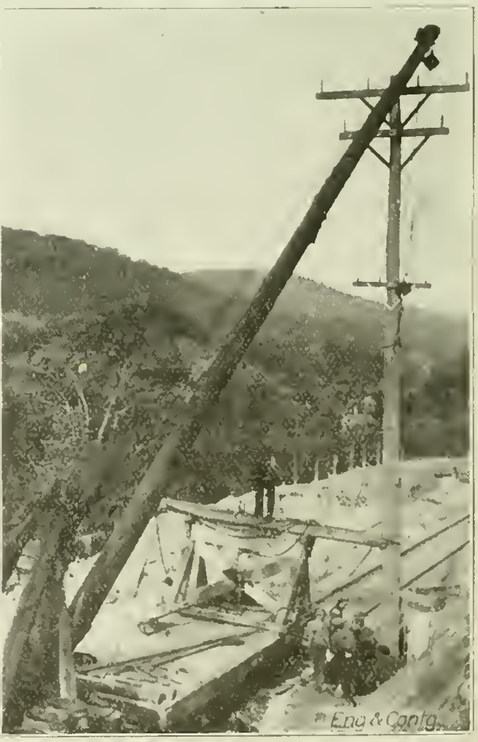


Fig. 2—View Showing Method of Setting Poles.

NEWS SECTION

Editorial Comment—Personals—Society Meetings—Trade Notes—Catalog Reviews—Contract News, Embracing Bids Asked, Work Projected, Contracts Let and Contract Prices on All Classes of Civil Engineering Construction Work.

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The Doings of the Week.

No particularly large railroad construction contracts appear to have been let during the past week. A considerable amount of work, however, is in sight, and it is probably only a question of a few days before some of it at least will be placed. In the South the Georgia, Florida and Alabama Ry. is ready for bids on 20 miles of new line from Local, Ala., Bids are also being taken on 55 miles of new electric railway for the Kentucky, Southwestern Electric Railway Light & Power Co. of Paducah, Ky. In Ohio the receiver of the Columbus, Urbana & Western Electric Ry. Co. is asking proposals for an extension of that road. Unless some unforeseen difficulty intervenes the present week will see the consummation of the negotiations for the building and operation of the dual system of rapid transit which will give to New York City a subway and elevated system having 629 miles of single track and costing, for new work and new equipment, upwards of $300,000,000. The Public Service Commission for the First District adopted the contracts with the operating companies last week, and sent them to the Board of Estimate and Apportionment, which acted upon them at a special meeting on Tuesday of this week. They were then returned to the Public Service Commission for execution. They will be signed by the Chairman and Secretary of that Commission on behalf of the City and by the President and Secretary of each company on behalf of each of the operating companies. The only contract not included is the certificate for the third-tracking of the elevated railroads in Manhattan and The Bronx. This certificate originally was made out to the Manhattan Railway Company, owner of the elevated roads, which refused to accept it. The Commission thereupon made out a new certificate to the Interborough Rapid Transit Company, as lessee of the roads. A public hearing on this certificate will be held next Saturday, March 15, and after that hearing it is expected the certificate will be approved by the Commission and the Board of Estimate and then executed. When all these contracts are signed, the Public Service Commission will push the work of letting construction contracts on such portions of the new system as have not been already awarded. The most important of these are the proposed extenision of the existing subway from Times Square down 7th Ave. to Park Place and under the East River to Brooklyn, and the Broadway-59th St. subway, running from the Queensboro Bridge to 7th Ave. and down 7th Ave. and Broadway to lower Manhattan and a tunnel under the East River to Brooklyn. There are also the tunnel under the East River at 14th St. and its extension through the Eastern District of Brooklyn, and the cut in 38th St., Brooklyn, and the new tracks in Flatbush Ave. necessary to connect the South Brooklyn lines of the Brooklyn Rapid Transit system with the 4th Ave. Subway and Centre St. Loop Subway, now about completed.

Road construction work in the Middle West is beginning to open up. The State Highway Commissioner of Ohio is calling for bids on 16 contracts; and in Stark County, Ohio, the County Commissioners are calling for bids on over 19 miles of brick paved road. The California State Highway Commission has awarded a $55,000 contract for constructing portions of State Highway in Los Angeles County, and has taken under advisement bids on a section in Mendocino County. A number of good-sized municipal paving contracts have been awarded since our last issue. The city of Schenectady, N. Y., has awarded a contract for 100,000 sq. yds. of asphalt pavement; and the city of Portland, Ore., has let a $100,000 contract for gravel bitulithic pavement.

In the way of bridge construction about the largest pieces of work coming up in the past few days are for the Georgian-Harris viaduct at Vancouver, B. C., and for a reinforced concrete arch at Murray Ave., Pittsburgh, Pa. Bids on the last mentioned work are to be opened March 25. Bids on the Vancouver job have been opened and the Council Bridge Committee has recommended that the contract be awarded at $455,000.

A considerable amount of new drainage work has come up for bids in the last few days. The Commissioners of Desoto County, Florida, are calling for bids for the construction of 48 miles of ditches, requiring about 600,000 cu. yds. of excavation; County Supervisors of Woodbury County, Ia., are asking bids for the construction of the Little Sioux Ditch, including about 483,000 cu. yds. Bids on another section of the Calumet-Sag Channel are being asked by the Trustees of the Sanitary District of Chicago. This work calls for 670,000 cu. yds. of excavation of glacial drift; 300,000 cu. yds. of excavation of solid rock; 72,000 sq. yds. of rip-rap slopes; 2,500 lin. ft. of roadway construction; 800 cu. yds. of concrete.

Bids on one of the largest rubble masonry dam contracts of the year are now being asked by the Sacramento Valley Land & Water Co. of Oakland, Cal. The contract calls for the construction of a dam 250 ft. high and 800 ft. long on the crest, containing 350,000 cu. yds. of masonry.

PERSONAL

Mr. A. W. E. Fawkes has been appointed engineer in charge of water works at Calgary, Alta.

Mr. Lloyd McEntyre has been appointed bridge engineer for the New Jersey State Road Commission.

Mr. Michael Gleason has been appointed superintendent of water works for the village of Medina, N. Y.

Mr. Paul G. Gauer has resigned as assistant engineer of the water works pumping station at Madison, Wis.

Mr. Patrick Rourke, water commissioner for Chicopee, Mass., for the past 21 years, has resigned because of ill health.

Mr. V. K. Hendricks has been appointed assistant chief engineer of the Frisco lines, with headquarters at Springfield, Mo.

Mr. M. H. Baker, city engineer of St. Thomas, Ont., has been appointed to the position of city engineer for Prince Albert, Sask.

Mr. William N. Ashplant has been appointed city engineer for London, Ont., succeeding Mr. George Wright who recently resigned.

Oscar Dana Allen, professor of metallurgy and analytical chemistry at Yale University from 1871 to 1887, is dead at his home at Ashford near Mount Tacoma.

Max Boehmer, civil and mining engineer, died Feb. 14 at his home in Denver. Mr. Boehmer was formerly engaged on waterway improvement work on the Missouri and Mississippi rivers.

Mr. Paul Hansen, engineer of the, Illinois state water survey, presented a paper entitled "Improvement of Water Works Management," before the Western Society of Engineers March 3.

Mr. Laurence R. Ebert and Mr. Raymond C. Seitz have been transferred from the U. S. Geological Survey to the U. S. Reclamation Service as junior engineers on the Rio Grande irrigation project.

Mr. Edgar S. Closson, recently assistant engineer for the Public Service Commission of New York, has been appointed town supervisor of Montclair, N. J., in charge of engineering and public works.

Dr. Ernst J. Berg, for the past four years professor of electrical engineering at the University of Illinois, has been appointed professor in charge of the electrical department of Union College, Schenectady, N. Y.

Mr. James E. Ford has resigned as general foreman of the municipal water works system of Fort Wayne, Ind., to accept a position as district agent for the Metropolitan Brick Co. of Canton, O. Mr. George Porsch succeeds him at Fort Wayne.

Mr. R. E. Harrison, who was inspecting engineer for the city of Grand Rapids, Mich., during the construction of its new filtration plant, has resigned and accepted a position with the Roberts Filter Manufacturing Co., with headquarters at Philadelphia.

Lieut.-Col. W. V. Judson, engineer commissioner of the District of Columbia, has been appointed as assistant to Col. Goethals at Panama, and is succeeded at Washington by Major Chester Harding, assistant division engineer, Atlantic division, Panama Canal.

Mr. William H. Connell, chief of the Bureau of Highways and Street Cleaning, Philadelphia, delivered an illustrated lecture, March 4, on "Organization of Municipal Highway Departments" before the graduate students in highway engineering at Columbia University.

Robert Bicknell Seymour, railroad civil engineer, died Feb. 22 at Oak Park, Ill. He was chief engineer for the Chicago, Illinois & Southern Railroad until its absorption by the New York Central system about a year ago. Since that time he had been engaged in private practice.

Mr. Herbert Marean, for the past three years superintendent of irrigation on the Truckee-Carson project in Nevada, died of pneumonia Jan. 28 at Fallon, Neb. Mr.

Marean had recently been assigned to a position as general inspector in the operation and maintenance department, and was preparing to remove to Washington when taken ill.

Mr. William B. King has been appointed third member of the board of water works engineers of the city of Dallas, Tex., succeeding Prof. T. U. Taylor who resigned. Mr. King is general manager of the Fort Worth Stock Yards Co., and vice-president and general manager of the Fort Worth Belt Railway Co.

Mr. E. S. Carman has resigned his position as chief engineer for the Johnson & Jennings Co., Cleveland, where he had charge of the designing, manufacturing and selling of the traveling cranes, hoists, rolling mill machinery, etc., made by that company. He has been appointed to a similar position with the Osborn Co., manufacturer of brushes and foundry supplies.

CIVIL SERVICE EXAMINATIONS.

The Chicago Civil Service Commission announces examinations as follows:

Senior Bacteriologist, $1,600-$1,800 per annum, March 25.

Map Draftsman, $1,080-$1,320 per annum, March 27.

Senior Sanitary Chemist, $1,600-$1,800 per annum, March 28.

INDUSTRIAL

The Raymond Concrete Pile Co. of New York and Chicago, has been awarded a contract for placing 2,047 standard Raymond concrete piles for the foundation of the new Rock Island elevator, Kansas City, Kan. The MacDonald Engineering Co., Chicago, are the General Contractors.

The Industrial Works, of Bay City, Mich., has recently established a Chicago agency in charge of Burton W. Mudge & Co., in the People's Gas Building. This office will handle in the Chicago district the well known Industrial Works' line of wrecking, locomotive and freight station cranes, pile drivers, transfer tables and grab buckets.

The Taylor-Wharton Iron & Steel Co. announce that Mr. H. A. Johann and Mr. Martin O'Shaughnessy, who have been in charge of the Chicago and Middle West territory, having resigned effective March 31 to engage in other business, the Chicago office of the Taylor-Wharton Iron & Steel Co. will be in charge of Mr. Geo. R. Lyman and Mr. J. R. Bolgiano, with Mr. Guy H. Bergen representing the company particularly in the Messabe Range District.

The T. L. Smith Co. of Milwaukee, Wis., on Feb. 26 and 27 celebrated the formal opening of its new office building at Milwaukee. The celebration took the form of a reunion of the out-of-town managers and agents who came to Milwaukee as the guests of the company. While there they were entertained in various ways. The mornings were taken up with trips through the several shops comprising the Smith Company's plant. These excursions were made as instructive as possible by demonstrating the various new machines. The afternoons were spent in listening to instructive talks by various members of the organization.

The American Road Machinery Co., of Kennett Square, Pa., announces the purchase of the entire properties of the following companies: American Road Machine Co., Kennett Square, Pa.; Climax Road Machine Co., Marathon, N. Y.; Indiana Road Machine Co., Fort Wayne, Ind.; Monarch Road Roller Co., Groton, N. Y.; Lima Contractors' Supply Co., Delphos, O. This company was formed to increase efficiency of operation in order that the increased demand for its goods might be promptly handled, and its customers taken care of in a more satisfactory manner. It has taken over all of the assets of the above companies, has assumed all their liabilities, and has materially strengthened its financial position. These companies will be operated along the same lines as they have been hitherto and will manufacture and sell the same line of high standard machinery and under the same trade names as in the past. The active management of these properties will continue without change.

CATALOGUES

Heating, Drying Machinery for Road Builders.—Paper, 6x9 ins., 28 pp. The American Process Co., 62 William St., New York City.

This catalog contains illustrations and descriptions with the details of construction of direct heat dryers, steam heated air dryers, cookers and digesters and special machinery.

Motor Driven Revolvators.—Paper, 3½x6 ins., 12 pp. The New York Revolving Portable Elevator Co., Jersey City, N. J.

This booklet describes and illustrates a machine for handling and piling large boxes or bundles in warehouses. The machine acts as a truck and an elevator on a revolving base.

Impervite.—Paper, 3½x6⅓ ins., 24 pp. Standard Paint Co., 10 William St., New York City.

This booklet deals with an integral waterproofing and waterproof paint for waterproofing concrete. A description of tests and tables of quantities required, etc., are given.

Fillmore Concrete Mixer.—Paper, 6x9 ins., 28 pp. The Fillmore Machinery Co., 512 Race St., Cincinnati, O.

In this catalog three types of mixers are illustrated and described; namely, the Fillmore Continuous, Batch, and Junior machines. Complete details of construction are given.

Clipp-Bar.—Paper, 6x9 ins., 4 pp. Clipp-Bar Manufacturing Co., 2541 Olive St., Philadelphia, Pa.

This bar is a new type of galvanized culvert guard and concrete reinforcement. It is completely illustrated and described.

Torpedo Conveyor.—Paper, 6½x6 ins., 4 pp. Chalmers & Williams, Inc., 72 W. Adams St., Chicago, Ill.

This is a new type of conveyor designed to carry any kind of material. It is constructed of a sheet steel trough in sections, supported on carriages, which run forward and backward by means of wheels on a short track.

Pneumatic Tool Lubrication.—Paper, 6x9 ins., 8 pp. The Chicago Pneumatic Tool Co., Fisher Bldg., Chicago, Ill.

Bulletin No. 130 illustrates and describes automatic oilers for use in connection with pneumatic tools. Grease and oils prepared especially for drills are listed.

Bi-Co-Mac Pavement.—Paper, 3¾x9 ins., 4 pp. Headley Good Roads Co., Real Estate Trust Bldg., Philadelphia, Pa.

Several circulars just issued by this company describe the Bi-Co-Mac Pavements, dust preventives and road binders.

Electric Signs.—Paper, 7½x10¾ ins., 20 pp. The Federal Sign System, 26 E. Monroe St., Chicago, Ill.

This catalog contains a number of letters from users of signs made of letters illuminated with miniature electric lights.

Pulsometer Steam Pumps.—Paper, 6x9 ins., 48 pp. Pulsometer Steam Pump Co., 11 Battery Place, New York City.

This catalog contains complete illustrations of Pulsometer Steam Pumps and shows a number of jobs where these pumps are in use. Descriptions of the various work describing the conditions which the pumps have been required to work in are given. Efficiencies of the pump are given, together with costs of pumping, tables of sizes, prices, etc.

Oliver Plows.—Paper, 6½x9¼ ins., 194 pp. Oliver Chilled Plow Works, South Bend, Ind.

This catalog is an encyclopedia on plows and auxiliary equipment. It is completely illustrated and contains descriptions of each type of plow, with tables of sizes, dimensions, weights, etc. Auxiliary parts are shown and listed very carefully, and a number of special devices are illustrated and described.

Ideal Motor Truck.—Paper, 7¼x10 ins., 24 pp. Ideal Auto Company, High St., Fort Wayne, Ind.

This catalog describes and illustrates the 1913 trucks and gives specifications for various models of 1,500 to 3,000 lbs. capacity.

Silo Forms.—Paper, 3½x6 ins., 8 pp. Polk-Genung-Polk Company, Fort Branch, Ind.

This catalog illustrates and describes the Polk system of movable silo forms and shows very clearly the method of operation. A number of illustrations showing work completed in various parts of the United States are shown.

Lambert Motor Trucks.—Paper, 9x12 ins., 4 pp. The Buckeye Manufacturing Co., Anderson, Ind.

This folder illustrates, describes and gives complete specifications for Lambert trucks of 800 to 4,000 lbs. capacity. Five models are shown.

Clover Leaf Mixer.—Paper, 6x9 ins., 16 pp. Clover Leaf Mixer Co., South Bend, Ind.

This catalog gives illustrations and descriptions of the Clover Leaf Mixer operated by gasoline or steam engines and sets forth in detail several points upon which the manufacturers base claims of superiority. Details of the sizes, capacities, weights, etc., are shown.

Expanded Metal Construction.—Paper, 6x9 ins., 16 pp. Northwestern Expanded Metal Co., Old Colony Bldg., Chicago, Ill.

This is the March issue of this booklet. It contains a number of illustrations of mosaics in Bishop's Mausoleum which were laid in cement mortar plaster on metal lath. A number of other illustrations of stucco work on metal lath are shown.

The Farm Cement News.—Paper, 6x9 ins., 48 pp. Universal Portland Cement Co., 72 W. Adams St., Chicago, Ill.

This is a quarterly devoted to the use of concrete on the farm. It contains a number of interesting articles regarding silo construction, barn floors of concrete, roads, fence posts, concrete residences, etc.

Yellow Strand.—Paper, 7x10 ins., 12 pp. Broderick & Bascom Rope Co., St. Louis, Mo.

This is the March issue of Yellow Strand which contains a number of interesting articles describing work upon which Yellow Strand Wire Rope is in use.

Crushing Machinery.—Paper, 6x9 ins., 48 pp. Kennedy Manufacturing & Engineering Co., 122 Liberty St., New York City.

This is a very complete catalog of rock and ore crushing machinery. Complete illustrations and descriptions of the constructional features found in the Kennedy Gyratory Crushers are given. A number of line drawings, tables of dimensions, etc., are included. The catalog deals also with bin gate bucket elevators, revolving screens and general designs for crushing plants.

Another catalog issued by this company gives complete information with illustrations regarding ore milling, cyaniding and smelting machinery.

RAILWAYS

Alabama.

The Gulf, Florida & Alabama Ry. Co., G. A. Berry, Vice President and Chief Engineer, Pensacola, Fla., is now prepared to let contracts for grading for a 20-mile extension north from Local, Ala., into Monroe County, and will be glad to hear from contractors who want to bid on the work. The grading is through level country and can be handled by station men. There is considerable grubbing and clearing to be done.

Arkansas.

Citizens of Dardanelle and vicinity have raised a $10,000 bonus and secured the right-of-way to the Logan County line for the extension of the Ft. Smith, Subiaco & Eastern R. R., from Scranton to Dardanelle. Henry Stroup, Paris, Ark., is President.

California.

⊙The following bids were received Feb. 26 by the Board of Public Works of San Francisco for track construction on Market St., for the municipal railway: F. Rolandi, $21,990 (awarded contract); F. E. Hilmer, $21,990; Healy-Tibbitts Co., $34,000; R. S. Storrie & Co., $26,000; Contra Costa Construction Co., $25,500; A. J. Raisch, $26,920; Central California Construction Co., $23,800; Union Construction Co., $24,248.

The San Ramon Valley R. R. Co., recently granted a franchise by the supervisors of Martinez County, has applied to the State Railroad Commission for permission to make five railway crossings at grade and one overhead crossing between Walnut Creek and Danville, along the county road through the San Ramon Valley.

The Pacific Electric Ry. Co., Los Angeles, Cal., will start construction work soon on an extension of its Alamitos-Long Beach line to and through Bay City.

The Northern California Railroad & Navigation Co. has been incorporated and proposes the construction of a line from Eureka up the Klamath River to Fort Jones, Siskiyou County. The incorporation includes Ocar G. Bartle, J. D. Rhodes, Swin Swinson, Roy B. Haworth and N. C. Messick, all of Los Angeles.

Advices from Los Angeles, Calif., state that plans are now well under way for financing and constructing the harbor belt line taking in the various industrial centers near the Los Angeles Harbor. A conservative estimate of the cost of equipping and building the line is placed at $1,000,000.

Articles of incorporation have been filed with the Secretary of State, Sacramento, Calif., by the Tamalpais & Muir Woods R. R., with a capital stock of $500,000. It plans to take over the Mill Valley & Mount Tamalpais Scenic Ry., Mill Valley, Calif., and to extend the lines eight miles from West Point to Bolinas bay. The directors are: Joseph K. Lynch, Frank F. Bostwick, Charles V. Cricker, R. H. Pease, Kenneth C. Gillis and W. E. Fitzpatrick.

Georgia.

It has been announced that work will be commenced on the proposed new extension of the Savannah, Augusta & Northern R. R., from Midville to Thomson, Ga., providing the people along the right of way support the proposition. W. J. Oliver, Knoxville, Tenn., is General Manager of the railroad.

Illinois.

It is stated that the Illinois Central R. R. will start work early in the spring on building third and fourth tracks from Matteson to Kankakee, 28 miles.

The Chicago, Burlington & Quincy R. R. will start grading work in a few days for the completion of the double trackway of its Central Illinois line to the coal fields in this state. A second main track was added last year from Concord in Morgan County to Pisgah, a distance of 20 miles. This year the double tracking is to be continued into Virden, the southern terminal of the coal branch in Macoupin County.

The directors of the Belt Ry. Co. of Chicago have given final approval to the plans for the Clearing freight interchange yards at Chicago, and it is probable that construction work will be started in the near future. The old Clearing yard is to be rebuilt and a first unit constructed with a capacity of not less than 10,000 cars a day. Eventually an area ½ mile wide by 5 miles long, running east and west between Argo and Hayford, a junction south of Chicago Lawn and near Marquette Park, will be filled with tracks and surrounded by warehouses and factories and the homes of operatives. E. H. Lee, Dearborn Station, Chicago, Ill., is Chief Engineer.

Good progress is being made with the promotion work for the Evansville, Mount Carmel & Olney Interurban Ry., and it is expected that the portion from Mount Carmel to Olney will be built this season. Gilmer Bray, Indianapolis, Ind., is interested.

The Wabash R. R. is planning a number of improvements at Edwardsville. These include the removal of the main line station to a point on the Alton Road, and the building of a bridge over the tracks at Hunicke St.

The Chicago Rys. Co., Chicago, will build an extension on Armitage Ave., Chicago, from Milwaukee to Elston Ave., during the coming season.

Indiana.

The Tipton-Frankfort Traction Co. has opened offices at Tipton, and is reported to be receiving construction material for its projected line from Tipton to Frankfort.

The Evansville, Chrisney & Eastern Traction Co. of Evansville, now building an electric railway, has elected the following officers: J. P. Chrisney, president; James A. Hemenway, vice-president, and T. H. Tillman, secretary-treasurer. A company will be organized to build a hotel at Degonia Springs, where the new road will touch.

The Chicago, Terre Haute & Southeastern R. R. is preparing to construct a 3-mile switch around the town of Jasonville, Ind., to straighten the route and eliminate heavy grade. The new track will leave the main line south of the town at the Latta yards and intersect it again just above the Green Valley line. E. H. Pfafflin, Chicago, Ill., is Chief Engineer.

Iowa.

The Tabor & Northern Ry., Robt. McClelland, president, Tabor, Ia., is reported to be considering extending its 11-mile line to a connection with the Wabash R. R.

A resale of the Atlantic Northern & Southern Ry. has been ordered for March 21. It is expected that Leslie M. Shaw will again bid for the purchase of the road. It is understood that he will extend the road on toward the north, in case it is acquired, and make a new line from Sioux City and the northwest through Iowa and Missouri to St. Louis. According to plans, it is proposed to extend the northern terminus from Kimballton, an inland town, a few miles to Manning, where connection would be made with three transcontinental lines—the Milwaukee, Great Western and Northwestern, and thence direct into Sioux City. E. S. Harlan, Atlantic, Ia., is Receiver.

Kansas.

The Santa Fe System is reported to be assembling supplies at Santanta, in Haskell county, for the building of a branch northwest from that town, through Grant and Stanton Counties. It is expected work will start this spring on the construction of this branch, which will pass, as now proposed, through or very close to New Ulysses and Johnson City.

An election was recently held in Pratt County, Kan., to submit to the voters the proposition to issue bonds for the construction of the Anthony & Northern Ry. According to O. P. Byers, Hutchinson, Kan., President of the company, a line wil be built first from Pratt to Larned, then from Pratt to Anthony, and then from Larned to Hastings, Neb. This gives an outlet for three trunk lines at Hastings and the east and west roads of Kansas, to the Gulf through the medium of the Anthony and Northern connecting with the Orient and Rock Island at Anthony.

Kentucky.

⊙John O. Kelly, Portsmouth, O., has been awarded the contract for constructing the line of the Big Sandy & Kentucky R. R., from Stafford Station, one mile below Paintsville, Ky., on the Big Sandy division of the C. & O. to the mouth of Green Back Branch of Jerry's creek in Johnson county. This section will be about 10 miles long. W. H. Dawkins, Ashland, Ky., is President.

The Rock Castle R. R. Co., incorporated recently, projects a 25-mile line from Livingston to McKee. Surveys have not been made as yet. N. U. Bond, Oakland, Md., is President. H. W. Bowman, Livingston, Ky., is also inested.

The Louisville & Nashville R. R. is reported to be planning to have work started early in the spring on doubletracking the Cumberland Valley Division from Pineville to Corbin, a distance of 30 miles.

The Kentucky Northwestern Electric Ry. Light & Power Co., W. A. Calhoun, Chief Engineer, Paducah, Ky., is reported to have invited several large contractors to bid on the construction of the first division from Paducah via Mayfield to Murray, Ky., 55 miles. The report states that the proposals are to be received beginning March 10.

The Cincinnati, Licking Valley & Virginia Railroad, which is to be built along the Licking River Valley, has been surveyed and a plat of the survey through Nicholas County has been filed at the office of the Nicholas County Clerk, Carlisle, Ky. The road will enter the county at Blue Lick Springs and will leave just east of the Parks Ferry. It is reported that actual construction work will be commenced in the Spring.

Lousiana.

The Northern Louisiana Electric Ry. Co. has surveys underway for its projected 110-mile line from Shreveport, La., to Monroe, La., via Minden, Hamer and Ruston. The bonds for construction purposes have not yet been underwritten. A. B. Blevins, Shreveport, La., is President; J. T. Hardiman, Shreveport, is Chief Engineer.

Police Jury of Vernon Parish has ordered special elections to be held in Wards One, Three and Six, including Leesville, to decide whether or not a 5-mill tax for five years will be voted to induce the St. Louis Southwestern Ry. (Cotton Belt) to build its line through these wards. The Cotton Belt has entered into an agreement that if the citizens of Wards One, Three and Six would vote a 5-mill tax for five years it would extend the line from White City, Tex., through these wards to Leesville and on the eastern boundary line of Vernon Parish, the work to be completed on or before Dec. 1, 1914.

Maine.

Town of Madison, Me., has voted $5,000 for the proposed line of the Athens-Skowhegan Electric Ry. Co. of Skowhegan. It is reported that this practically assures the construction of the road.

At the annual meeting of the St. John Railway Co. an offer was submitted by an American Syndicate to take over the entire stock of the company for $1,200,000 or $150 per share. The proposition was submitted to a

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

special committee and it is probable that it will not be accepted. The men making the offer are John P. Graham, president of the Bangor Street Ry., Bangor, Me., and the Portland Street Ry., and Henry W. Cushman, president of the Merrill Trust Co., of Bangor, said to represent the largest group of street railway and water power owners in the United States.

Maryland.

The Board of Trade, Cambridge, Md., has adopted a resolution to push the proposition to connect Cambridge with Lower Dorchester by means of the Fox Creek R. R. and a committee was appointed to secure financial backing. Dr. B. W. Goldsborough, George W. Woolford and A. J. Foble are members of the committee.

The Williamsport, Nessle & Martinsburg Ry. Co. has been chartered with a capital stock of $250,000 and proposes the construction of an electric railway from Williamsport to Martinsburg, W. Va., 12 miles. The incorporators are Alexander J. Dildrich, John P. Michael and Eugene P. Hoffman of Baltimore; William Deale of Hamilton, Md., and Alexander Clohan of Martinsburg.

The Middendorf-Williams Co., Bankers, Baltimore, Md., it is reported, are about to purchase the South Georgia & West Coast Ry. It is known they have an option on the road, but so far nothing of their ultimate intentions in regard to the property has been made known. It is said these people are interested in the Florida & Western road and the idea is that the two roads will be combined, and with the Tampa Northern will be eventually developed into a trunk line along the Florida west coast. The road is owned almost entirely by Quitman, Ga., people, prominent among them being J. W. Oglesby, president, and C. T. Tillman, treasurer.

Massachusetts.

Engineers of the Boston & Albany R. R. have prepared plans for underpasses at Dwight and Water Sts., Springfield, Mass.

Missouri.

Contracts for grading and bridging for the proposed Moberly, Huntsville & Randolph Springs R. R. Co. will be let about May 1. This company proposes a line from Moberly, Mo., to Randolph Springs, Mo., a distance of 12 miles. The motive power will be electricity. C. H. Dameron, Huntsville, Mo., is President; Jno. J. Mundinger, Huntsville, is Chief Engineer.

Montana.

The Billings Land & Irrigation Co. of Billings, Mont., is reported to have succeeded in financing the Billings & Central R. R., and it is possible that construction work on the first 20 miles of line over the Billings branch will be started this spring. It is stated that the terminus of the road for the first season will be Crooked Creek, but the line afterward will be extended to a connection with the Milwaukee at Roundup.

Nebraska.

It is rumored that the Union Pacific Ry. Company will extend, during the present year, the Kearney & Black Hills branch from Stapleton west connecting with the main line somewhere west of North Platte, Nebr.

New York.

It was announced recently by Julius W. Pfau, Engineer of Construction, New York Central Railroad, at a meeting with the city officials of Utica, N. Y., that bids had been opened for the construction of the proposed union station at that place, and that the contract would be let within a month. The lowest tender received for the work was over $700,000.

North Carolina.

The fact that the Atlantic Coast Line Co. has awarded contracts for a number of new bridges providing for double tracks, causes it to be believed at Rocky Mount, N. C., that work on building a second track between Selma, N. C., and Fayetteville will be taken up some time in the near future.

A bill has been introduced in the State Legislature for the incorporation of the Beaufort Terminal R. R. Co., with a capital stock of $5,000,000. The company proposes the development of Cape Lookout as a seaport through railroad connections with Beaufort. The construction of piers, wharves, etc., is included in the project. The incorporators are E. C. Duncan, Raleigh, N. C., M. S. Hawkins, Norfolk, Va., and W. R. Rodman, Norfolk, Va. All of the above are officials of the Raleigh, Charlotte & Southern Ry.

North Dakota.

Members of the Commercial Club, Mandan, N. Dak., are contemplating the construction of a stub line railroad from that city to Freda. It is believed that if the road were constructed and placed in operation that the Northern Pacific would take it over.

Ohio.

✣Bids will be received until noon, March 14, by L. P. Stephens, 100 W. Gay St., Columbus, O., receiver of the Columbus, Urbana & Western Electric Ry. Co. for the construction and equipment of the railway, including grading, bridging, drainage, track laying, surfacing, sub-station, pole line, equipment and all material and labor required to complete the same, beginning at its northern terminus at Fishinger's Bridge, in Franklin County, Ohio, and terminating at the Girls' Industrial Home in Delaware County. Bids will be received in two forms. First, for the construction and equipment of the railway, including cost of right of way; second, for the construction and equipment of the railway, exclusive of the right of way. Payments will be made in receiver's certificates heretofore authorized by the Court of Common Pleas of Franklin County, Ohio, in Case No. 62709, on July 18, 1912.

The Toledo, Ottawa Beach & Northern Ry. Co. (electric), Smith & Baker Bldg., Toledo, O., has surveys underway for an extension to Monroe, Mich.

Oklahoma.

It has been announced by J. W. McNeal, Guthrie, Okla., that securities for the Mountain, Valley & Plains R. R. have been sold. This road was projected a couple of years ago to be built from Guthrie west into New Mexico, a bonus of $100,000 having been subscribed by citizens and bonuses having also been subscribed by other cities and towns along the proposed line.

Oregon.

The Kerry Timber Co., Portland, Ore., is understood to be planning to have construction work started in the near future on the Columbia River & Nehalem Valley R. R., which is to be built primarily for the purpose of opening timber lands in Cowlitz County.

Articles of incorporation have been filed for an electric railway to extend through Crook County to Bend. The line will run from stayton across Linn and Crook Counties to the Des Chutes Valley, where it will connect with the Harriman and Hill Lines. G. A. Kyle, Railway Exchange Bldg., Portland, Ore., vice-president of the Oregon Electric Ry. Co., is one of the incorporators.

Articles of incorporation have been filed with the Secretary of State, Salem, Ore., by the Columbia & Nehalem River Railroad Company. It is proposed to construct a steam or electric railroad from Wood's Landing in the eastern part of Clatsop County to the Nehalem Valley. The capital stock of the company is $1,000,000 and the incorporators include J. C. and A. L. Veasie and J. H. Hendrickson.

A committee of citizens of Fossil, Wheeler County, Ore., and vicinity, including the Mayville district in the southern portion of Gilliam County, recently held a conference with J. P. O'Brien, Vice-President of the Oregon-Washington Railroad & Navigation Co., in regard to having the Arlington-Condon branch extended to Fossil, a distance of 20 miles.

Pennsylvania.

The East Berlin Trolley Co. has effected its organization and will have surveys made shortly for its projected line into York. Peter C. Smith, East Berlin, Pa., is President.

The Reading Transit & Light Co. of Reading has applied for a charter. This company has been formed for the purpose of financing the electric railways of Reading, and contemplates the expenditure of about $1,750,000 for extensions and improvements to the system.

The Bloomsburg, Mellville & Northern Ry. Co., is reported to be planning to begin work in the near future on its projected trolley line from Bloomsburg to Millville. Walter A. Hughes, West Berwick, Pa., is President.

The Tioga County Traction Co. is reported to have entered into an agreement with A. D. Pasal whereby he will sell the stock of the company and build and equip the railroad. A line is projected from Wellsboro to Mansfield, and an extension from Wellsboro to Knoxville is under construction. James F. Fisher, Williamsport, Pa., is Engineer.

In the annual report of the Pennsylvania R. R. Co., issued last week, the following statement is made: "The company has in contemplation many important and extensive necessary improvements, a large portion of which should not be charged to capital account and for which the reserve for additions and betterments will be utilized, such as the improvements of Broad street station, Philadelphia, and its approaches and facilities; improvements on the Allegheny division, the elimination of grade crossings and elevation of tracks on the New York division."

The Baltimore & Ohio R. R. is contemplating extensive improvements to lines in the Pittsburgh district. These include the following: Construction of two additional tracks between McKeesport and Connellsville, 42 miles; east of Connellsville, three additional tracks will be constructed to DoGully, W. Va., and two more tracks between Orleans Road and Little Cacapon, a distance of 14½ miles, connecting the three-track sections. On the Ohio River division it is proposed to expend $400,000 for improvements to the Parkersburg terminal and $300,000 for a line to connect that division with the Little Kanawha division. The line through Dawson will be changed in order to secure the necessary right-of-way for additional tracks, the present route through the borough being abandoned and one following the course of the river adopted.

South Dakota.

The Chicago, Milwaukee & St. Paul Ry. is reported to have about completed purchasing the right-of-way for the new line through Big Stone City.

Tennessee.

Negotiations are understood to be about completed whereby new owners will assume control of the Lake View Traction Co. A new charter will probably be taken out under a larger capital and the line extended to Clarksdale, Miss., on the south and to Covington, Tenn., on the north. W. W. Hayden, Lake View, Miss., is Chief Engineer.

The charter of the Nashville Railway & Light Co., Nashville, Tenn., has been amended, authorizing the company to build and operate additional street railway lines over and along certain streets in the city and roads outside of the corporation limits. These embrace parts of Fatherland, 11th, 19th, 20th, Shelby Ave., Rothchild St., from 19th to Shelby Park; 5th St. to Murphy Lane, thence to West End Ave.; 8th Ave., 5th St. to 1st St., thence to West End Ave.; on Harding Road to Sugar Tree Creek to Belle Meade Blvd.

Texas.

Engineers of the Missouri, Kansas & Texas Ry. are making good progress on surveys for the construction of the proposed line between Jewett and Waco, Texas, connecting the "Orphan Branch" with the main line. S. B.

Fisher, St. Louis, Mo., is Chief Engineer of construction.

It has been announced that negotiations are now pending at Kansas City, Mo., for the closing of a deal connecting the Kansas City, Mexico & Orient R. R. with the Southern Pacific tracks at Alpine, Texas.

Reports from Austin, Texas, state that arrangements are being made to have surveys started at once for the proposed line between Birmingham, Ala., and San Antonio, Texas. As proposed the line will touch Philadelphia, Miss., Vicksburg, Miss., and Winnsboro, La., cross the Iron Mountain Railroad at Urania, La., cross the Kansas City Southern line at Many, La., and cross the International & Great Northern line at Navasota, Texas. Holland capitalists are reported to be financing the proposition.

The Quanah, Acme & Pacific Ry., Robert Cray, General Manager, Quanah, Tex., is reported to have completed financial arrangements for continuing the line west from Roaring Springs to Rosswell, N. Mex.

The State Senate of Texas has passed over Governor Colquitt's veto the Missouri, Kansas & Texas R. R. consolidation bill, which would allow the road to merge under one management the Missouri, Kansas & Texas R. R. of Texas, the Wichita Falls & Northwestern, the Wichita Falls & Southern, the Texas Central and the Beaumont & Great Northern roads. The three last named lines are subsidiaries of the Missouri, Kansas & Texas, but have maintained separate offices under Texas charter. The house already had passed the bill over the governor's veto.

The Pecos Valley, Southern Ry., L. W. Anderson, Chief Engineer, Pecos, Tex., is reported to be preparing to extend its line south from San Salmon Springs to Alpine, about 50 miles, and north from Pecos to Tahoka, about 200 miles.

Utah.

A committee of citizens of Provo, Utah, recently conferred with William Ashton, Salt Lake City, Utah, Chief Engineer of the Utah Railroad Co., in regard to having the proposed road run to that city. The proposition will be recommended to W. T. Sharp, President of the company.

The Ogden Rapid Transit Co., Jos. A. West, Chief Engineer, 2378 Washington Ave., Ogden, will start construction work in the early spring on its 24th St. loop at Ogden. This will extend from Washington Ave. along 24th St. to Wall Ave., thence to 25th St. Surveys have been made and maps will soon be in readiness for consideration by the construction department.

Virginia.

⊙Rinehart & Dennis Co., Jefferson National Bank Bldg., Charlottesville, Va., have been awarded a contract for double tracking near Petersburg, Va., for the Norfolk & Western Ry. The contract includes about 500,000 cu. yds. of unclassified excavation and considerable masonry, etc.

It has been announced by R. S. Turk, Staunton, Va., one of the incorporators of the Trans-Appalachian Ry. Co., mentioned in our last issue, that the proposed line is from Parkersburg up the valley of the little Kanawha River, over the Elk River and along the latter into Pocahontas County via or near Marlinton; thence into Virginia, through Rider's Gap.

Washington.

The Pacific Northwest Traction Co., L. R. Coffin, Manager, Bellingham, Wash., will expend about $150,000 for improvements at Bellingham. The work includes double tracking the Dock St. line with heavy rails, and the laying of heavy rails in other streets.

City of Tacoma will vote at a spring election on a proposition to construct an electric railway in South 11th St., from A St. to the Milwaukee terminal, a distance of 8,000 ft. W. C. Raleigh is City Engineer.

Wisconsin.

Citizens of Rockdale, Wis., and vicinity in the town of Christiania are taking steps toward securing the construction of a 2-mile extension of the Chicago & Lake Superior R. R. to Rockdale. B. L. Delamater, Cambridge, Wis., is President and General Manager of the company.

Wyoming.

It is reported that the Chicago, Burlington & Quincy R. R. plans to start work early this spring on the reconstruction of the short line between Guernsey, Wyo., and Hartville Junction.

Canada.

⊙The Canadian Pacific Ry. Co. has let a contract to W. P. Tierney, Vancouver, B. C., for the construction of the standard-gage line on the Kaslo & Slocan Ry. between Kaslo and Whitewater. Work will be commenced at once.

Plans are completed for the Canadian Northern Railway terminals at Port Mann, B. C., and bids for the work will probably be asked some time during the present month. The work will include the extension of the existing dock making the structure a mile in length. M. H. MacLeod, Winnipeg, Man., is Chief Engineer and General Manager of the company.

The Board of Trade, Cornwall, Ont., recently discussed the probability of securing the construction of a railroad from St. Polycarpe, on the Canadian Pacific Ry., to Cornwall. W. Hodge is President of the Board and F. D. McLennan is Secretary.

It is reported at Winnipeg, Man., that H. N. Dunning, a capitalist of New York City, is planning the construction of a 40-mile line from Cassels on the main line of the Canadian Pacific Ry. to Bow River coal mines.

Application is to be made at the present session of Parliament, according to advices from Ottawa, Ont., for an act to incorporate a company under the name of Canadian Northwestern Ry., with permission to build a line of railway from Lethbridge northeasterly by the most feasible route to Winnipeg and on to Le Pas, passing by or near Dominion City, Manitou, Brandon and Grand View; also from Lethbridge northeasterly through Alberta and Saskatchewan to Le Pas via North Battleford and Prince Albert.

Preliminary work will be started at once for the terminal of the Hudson Bay Ry. at LePas on the south side of the Saskatchewan River. Yards with a capacity of 4,000 cars are to be constructed, as well as roundhouses, repair shops, machine shops, etc.

A bill before the Ontario legislature to provide for an increase of capital stock of the Bruce Mines & Algoma Ry. Co., from $300,000 to $12,000,000, and to change the name to the Lake Huron & Northern Ontario Ry. Under the new charter 550 miles of line are projected in the District of Algoma. The Bruce Mines & Algoma Ry. at present operates 17 miles of line. W. H. McCallum, Sault Ste. Marie, Mich., is Chief Engineer.

A bill is before the legislature of Ontario to amalgamate the Ottawa & St. Lawrence Electric Ry Co. and the North Lanark Ry. Co. The combined capital stock of the two companies to be increased from $1,150,000 to $5,000,000, and the time for completing the railway extended for a further period of five years.

The Buffalo & Fort Erie Ferry & Ry. Co., F. J. Weber, President, 922 Ellicott Sq., Buffalo, N. Y., operating 4 miles of steam line, is to apply for permission to increase its capital stock for the purpose of electrifying its line. This line runs from Fort Erie to Erie Beach. There are also some prospects that the road will be extended to meet the new Niagara, St. Catharines & Toronto line being built from Port Colborne toward Fort Erie.

BRIDGES

Alabama.

⊙The contracts for the construction of two 50x16 ft. spans and a 400-ft. metal viaduct in Washington County, have been awarded by the Board of Commissioners, Chatom, Ala., to Austin Bros., Atlanta, Ga., at $7,963. Bids were opened Feb. 25.

Arkansas.

The Curtis bill which was introduced into the Oklahoma State Senate granting the people of Fort Smith, Ark., authority to use ground in Sequoyah County, as approach for the bridge over the Arkansas River, was passed without opposition.

California.

⊙The Napa County Board of Supervisors at a recent meeting awarded the contract for the construction of the proposed new stone bridge over the Napa River to J. B. Newman of that city at $5,450. The new structure will span the stream near Zinfandel Station.

Illinois.

✣Bids will be received up to 1 p. m., March 26, at the Court House, McLeansboro, Ill., for the fabrication of 12 steel superstructures for Twigg and Mayberry Townships, Hamilton County. H. Anderson, Attorney, McLeansboro, Ill. The work to be done consists of furnishing and fabricating the material for the superstructures of 12 highway bridges, and delivering the same f. o. b. cars at Dale, Ill. There are nine I-beam spans as follows: one 27 ft. long; one 31 ft. long; five 35 ft. long and two 43 ft. long. There are three truss bridges as follows: one 50 ft. long; one 60 ft. long and one 70 ft. long. All steel work to be delivered at Dale, Ill., by July 1, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received up to noon, March 20, at the Town Hall, Mode, Ill., for the construction of one reinforced concrete bridge to be built in Holland Township, Shelby County. T. W. Carroll, Town Clerk, Fancher, Ill. Sweitzer Bridge: Span, 40 ft.; roadway, 16 ft.; height, 12 ft. Estimated total concrete, 92.3 cu. yds.; reinforcing steel, 13,810 pounds. Nearest railroad station, Mode, about two miles. No local concrete materials available. No present bridge. Low water flow about 3 ins. deep and 4 ft. wide; high water about 7 ft. deep. Average excavation about 7 ft. through black sandy soil, to be carried about 2½ ft. below stream bed. Piles will probably be necessary. Green timber can be cut near the site. Engineer's estimate, $1,400. Work to be completed on or before July 1, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received up to 2 p. m., April 1, 1913, at the Farmers' Exchange Bank, Chambersburg, Ill., for the construction of one reinforced concrete bridge to be built in Chambersburg Township, Pike County. Edward Pool, Town Clerk, Chambersburg, Ill. Conner Bridge: Span, 40 ft.; roadway, 18 ft.; height, 18.5 ft. Estimated total concrete, 175.2 cu. yds.; reinforced steel, 19,840 pounds. Nearest railroad station, Valley City, 6 miles;

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Perry Springs, 6 miles. It is reported that gravel may be obtained at Doans Place, about 2 miles south of Perry (about 5½ miles from bridge site). This gravel may need washing. It is reported that gravel from Hannibal may be had f. o. b., cars at Valley City for 75 cents per ton. No bridge at new site. Green timber may be cut near the site. Low water flow, 6 ins. deep and 10 ft. wide; high water about 14 ft. deep. Average excavation about 15 ft. deep, through loam and clay to about 3½ ft. below stream bed. Piles will probably be necessary. Engineer's estimate, $2,600. Work to be completed on or before July 15. 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received up to 9 a. m., March 22, 1913, at the Court House, Edwardsville, Ill., for the construction of one reinforced concrete bridge to be built in Pin Oak Township, Madison County. Charles Kuhn, Town Clerk, Edwardsville, R. R. No. 3, Ill. Caple Bridge: Span, 36 ft.; roadway, 18 ft.; height, 17 ft. Estimated total concrete, 128.8 cu. yds.; reinforcing steel, 16,870 pounds. Nearest railroad station, Kuhns, about 1¾ miles. No suitable local concrete materials available. No present bridge. Green timber may be cut near the site. Low water flow, trace; high water about 10 ft. deep. Total depth of excavation will average about 15 ft., to be carried 5 to 7 ft. below stream bed. About 5 ft. of shifting sand in stream bed above shale or hard pan. Engineer's estimate, $2,000. Work to be completed on or before August 15, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

✣Bids for the 12 steel bridge superstructures advertised for letting at 1 p. m., March 22, 1913, at the Court House, McLeansboro, should be addressed to L. E. Lambert, County Clerk, McLeansboro, instead of H. Anderson, Attorney, as indicated in previous notice.

✣Bids will be received up to 2 p. m., March 22, 1913, at the Town Hall, St. Jacob, Ill., for the construction of four reinforced concrete bridges to be built in St. Jacob Township, Madison County, W. P. Sweeny, Town Clerk, St. Jacob, Ill. Ritter, Radcliffe, Noll and Rule Bridges: Spans, 10, 12, 6 and 4 ft.; roadways, 20, 20, 32 and 25 ft; heights, 14, 17, 10½ and 11 ft. Estimated total concrete, 62.5, 85.8, 34 and 21.6 cu. yds.; reinforcing steel, 4,090, 6,975, 3,400 and 2,340 pounds. Nearest railroad station, St. Jacob, 2, 6½, 2½ and 2 miles. No local concrete materials available. Present bridges, wood, 8, 10, 6 and 6-ft. spans. Green timber may be cut near each of the sites, except the Rule. Low water flow at all sites, dry; high water, 6, 6, 5 and 3 ft. deep. Excavation, clay for all bridges. Nos. 1 and 2, excavation to be carried about 4 ft. below stream bed; Nos. 3 and 4 are box culverts, excavation to go about 1 ft. below stream bed. Engineer's estimate for 4 bridges, $3,225. Work to be completed on or before July 1, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received up to 1 p. m., March 20, 1913, at the Rindesbacher Bank, Stockton, Ill., for the construction of one reinforced concrete bridge to be built in Pleasant Valley Township, Jo Daviess County. M. A. Goodmiller, Town Clerk, Stockton, Ill. Forhes Bridge: Span, 50 ft.; roadway, 18 ft.; height, 17 ft. Estimated total concrete, 181.5 cu. yds.; reinforcing steel, 26,330 pounds. Nearest railroad station, Mt. Carroll, 8 miles; Stockton, 13 miles. It is reported that stone may be obtained in a creek bed about 2 miles from bridge site at 25 cents per cu. yd., same will require washing. Sand must be shipped in. Present bridge steel, 35-ft. span, wood backing. New bridge to be built about 500 ft. north of old bridge which must be left in place until new bridge is completed, then removed. Green timber can be cut near the site. Low water flow about 4 ft. deep and 25 ft. wide. Average excavation about 13 ft. deep, at site of new channel. Piles will probably be necessary. Engineer's estimate, $3,400. Work to be completed on or before July 1, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received up to 10 a. m., March 22, 1913, at the Court House, Edwardsville, Ill., for the construction of one reinforced concrete bridge to be built between the towns of Hamel and Pin Oak, Madison County. L. F. Steinman, Town Clerk, R. R. No. 4, Alhambra, Ill. Silver Creek Bridge: Span, 60 ft.; roadway, 18 ft.; height, 22 ft. Estimated total concrete, 276.2 cu. yds.; reinforcing steel, 37,790 pounds. Nearest railroad station, Fruit, about 2 miles. No local concrete materials available. No present bridge. Green timber for falsework may be cut near the site. Low water flow, 6 ins. deep and 2 ft. wide; high water, about 3 feet deep, over bottom lands. Excavation to be carried through mud and clay to a depth of about 5 ft. below stream bed. Average depth of excavation, about 18 ft. Engineer's estimate, $4,000. Work to be completed on or before August 15, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

⊙The contract for the construction of the R. C. Hamil Bridge, New Athens Township, St. Clair County, for which bids were received by D. M. Fullmer, Town Clerk, Belleville, Ill., Feb. 28, has been awarded to Joseph Klein, Freeburg, Ill., at $891. Other bids received were as follows: Miller & Borcherding, St. Louis, Mo., $1,089; Gass Bros., Belleville, Ill., $962; W. C. Johnson, Salem, Ill., $985; Laws & Grantham, Irving, Ill., $999; Melloy Construction Co., Libertyville, Ill., $1,298; C. A. Wever & Son, Clayton, Ill., $920; H. E. Haun, Richview, Ill., $1,155; Rock River Bridge Co., Oregon, Ill., $1,050.

⊙The contract for the construction of the Merrill Bridge in Shilop Township, St. Clair County, Ill., has been awarded to W. C. Johnson, Salem, Ill., at $1,125. Other bids received for the work, Feb. 28, by Richard Schaeffer, Town Clerk, O'Fallon, Ill., are as follows: Miller & Borcherding, St. Louis, Mo., $1,398; Gass Bros., Belleville, Ill., $1,182; Jos. Klein, Freeburg, Ill., $1,100; Laws & Grantham Irving, Ill., $1,275; Melloy Construction Co., Libertyville, Ill., $1,398; C. A. Wever & Son, Clayton, Ill., $1,160; H. E. Haun, Richview, Ill., $1,392; Rock River Bridge Co., Oregon, Ill., $1,200.

⊙The contract for the construction of the Lockhart bridge in Crete Township, Will County, Ill., has been awarded to the Johnson Warner Construction Co., St. Anne, Ill., at $644. Bids were opened March 1.

The date of letting the contract for the four reinforced concrete bridges in St. Jacob Township, Madison County, set for 2 p. m., March 22, has been postponed indefinitely. W. P. Sweeny, Town Clerk, St. Jacob, Ill.

Indiana.

✣Bids will be received until 11 a. m., March 15, by Board of Wayne County Commissioners, Richmond, Ind., for the construction of and repairs on the following bridges and culverts: A concrete bridge at Mordica Doddridge Ford, over Noland's Fork in Washington Township; a concrete bridge at Rummel Ford in Jackson Township; a concrete bridge at Davis Ford, over Morgan's Creek on line between Perry and Green Townships; the John A. Locke bridge over West River in Jefferson Township; and repairs and new steel superstructure over Short Creek in Wayne Township. L. S. Bowman is Auditor.

✣Bids will be received until 10 a. m., March 12, by Board of Allen County Commissioners, Fort Wayne, Ind., for the construction of a reinforced concrete bridge over the St. Joseph River at Leo., Ind. Calvin H. Brown is County Auditor.

⊙The Board of Rush County Commissioners, Rushville, Ind., has awarded the contract for the construction of the Thornberry concrete bridge to the Berk Construction Co., of New Castle, Ind., for $11,000. Bids were opened March 4 by Allen R. Holden, County Auditor.

⊙The Washington County Board of Commissioners, Salem, Ind., has let the contract for the construction of four concrete bridges to Henry H. Fall, Indianapolis, Ind., at $9,987. F. S. Munkelt is County Auditor.

⊙The contract for the construction of four steel bridges over Jungles Ditch and one bridge over Akers Ditch has been let by the Board of Jasper County Commissioners, Rensselaer, Ind., to F. M. Williams, Winamac, Ind., at $3,600. Bids were opened March 4.

⊙The contract for the construction of 60 bridges in Spencer County, Ind., has been let by the Board of Commissioners, Rockport, Ind., to the Vincennes Bridge Co., Vincennes, Ind., at $20,400. Bids were opened March 3.

The Board of Allen County Commissioners, Fort Wayne, Ind., has approved the specifications submitted for the construction of the proposed new steel concrete bridge over the St. Joe River at Leo. The new structure will cost, it is estimated, about $20,000. Bids for the work will be asked shortly it is believed.

Iowa.

The Supervisors of Marshall County, Marshalltown, Ia., contemplate the improvement of a road at Liscomb and the construction of a new bridge to replace two old structures now in service. J. W. Ash, County Surveyor, is already making plans for the work.

Kansas.

The Santa Fe System has filed with the City of Wichita, Kan., plans for the construction of the Kellogg St. viaduct. Bert C. Wells, City Engineer, is to check the quantities to determine the amount of steel and concrete that will be required so that the city can agree with the terminal company on a division of work. The city is to perform one-third of the work and the terminal company two-thirds.

Kentucky.

The annual meeting of the stockholders of the Louisville Bridge Co. was held in the Realty Bldg., Louisville, Ky., March 3. The board of directors and the officers were re-elected. The question of constructing a new bridge to replace the present one which has been in service since 1870 was considered. The structure is 2.46 miles in length. J. M. Morris, Louisville, Ky., is Secretary.

Maine.

A hearing was recently held at the Council Room, Portland, Me., by the Portland Legislative Delegation on the proposition to construct a new bridge between Portland and Knightville in South Portland to replace the present structure. H. M. Moulton, Cumberland, Me., presided at the hearing.

Selectmen of Falmouth, Me., are to report at an adjourned town meeting in April on a proposed bridge over Presumpscott Falls. Algernon Bowie is Selectman.

Maryland.

⊙The State Road Commission of Maryland, W. L. Marcy, 534 N. Howard St., Baltimore, Md., received bids Feb. 27 for the construction of 13 sections of highway and among the contracts let were the follow-ting: Arthur & Boyle, at $2,423, for bridge construction; Luten Bridge Co., York, Pa., at $21,010, for bridge construction.

Massachusetts.

⊙Holbrook, Cabot & Rollins Corporation, Boston, Mass., has been awarded the contract for the reconstruction of the stone bridge at Tiverton, R. I. The contract price was $65,000 and the work is to be completed by July 1.

Town of Somerset, Mass., has voted $1,000 for the Bright St. bridge. A. Borden Davis is Town Clerk.

Michigan.

City Engineer, E. W. Hunt, Battle Creek, Mich., has recommended the construction of a new concrete bridge over Battle Creek River at Elm St. to replace the wooden structure now in service.

Minnesota.

⊙The Commissioners of Goodhue County, Red Wing, Minn., have awarded the contract for the construction of the proposed bridge over the Cannon River in Welch to the Independent Bridge Co., Minneapolis, Minn., at $9,090. All bids received for the Pine Island bridge were rejected. The bids presented are as follows: Joliet Bridge & Iron Co., for the super structure, $6,600; Illinois Steel & Bridge Co., super-structure, $5,270; Pine Island bridge super-structure, $4,990; Illinois Bridge Co., super-structure Welch bridge, $6,000; Iowa Bridge Co., super-structure Welch bridge, $6,290; Twin City Bridge Co., super-structure Welch bridge, $5,980. Central States Bridge Co., super-structure Welch bridge, $6,483; Minneapolis Steel & Machinery Co., super-structure Welch bridge, $6,340.

The Itasca County Board, Grand Rapids, Minn., has authorized the construction of two concrete and steel bridges over Prairie River at Arbo and over the Bigfork at Wirt. The first structure will cost $2,500 and the latter $1,200. The expense will be divided equally between the county and the towns.

Mississippi.

⊙The contract for the construction of four steel bridges over Long Creek, Hotopha Creek, McKinney Creek and Yarbrough & Sanders Ditch, has been let by Board of Supervisors, Sardis, Miss., to the Memphis Bridge Co., Memphis, Tenn., at $4,200. Bids for the work were opened March 3.

Missouri.

✣Bids will be received until noon, March 21, by Board of Public Improvements, Maxime Reber, Pres., St. Louis, Mo., for the removal of the present 12th St. bridge and the construction of the foundations and superstructure of a reinforced concrete Viaduct on 12th St. from Spruce St. to Chouteau Ave.

✣Bids will be received during this month by Commissioners Fulton Special Road District, W R. Heagler, Engineer, Fulton, Mo., for the following concrete bridge work: One 68-ft. reinforced concrete bridge with 24-ft. roadway and sidewalks; two 22-ft. reinforced concrete highway bridges with 22-ft. roadway and sidewalks; one 36-ft. reinforced concrete highway bridge with 22-ft. roadway and sidewalks.

New York.

⊙Drake & Dean Co., Buffalo, N. Y., has been awarded the contract by the State Reservation Commission for the construction of alterations to the Goat Island bridge. The contract price was $20,087, about $500 less than the estimate.

The City of Oneida, N. Y., is being urged to make improvements to the east end of Sands St., and to raise and move the bridge over the Feeder to a point south.

North Dakota.

✣Bids will be received until April 6, by Peter Sjurseth, Nelson County Auditor, Lakota, N. Dak., for the necessary labor and material for the erection of a 60-ft. single span steel bridge over the Cheyenne River at Halverson Crossing, Dayton Township. Plans and specifications are on file with the Auditor.

Ohio.

✣Bids will be received until noon, April 4, by Board of Hamilton County Commissioners. Cincinnati, O., for building under Specifications No. 429, a bridge on the Bogart Road near Kuertz's place, Anderson Township. A certified check for $500 must be filed with each bid. Albert Reinhardt is Clerk of the Board.

✣Bids will be received until noon, April 4, by Board of Hamilton County Commissioners, Cincinnati, O., for the construction under Specifications No. 399, of concrete bridge on Camargo Pike west of the B. & O. S. W. R. R. in the Village of Madeira, Columbia Township. A certified check for $500 must be filed with each bid. Albert Reinhardt is Clerk of the Board .

The Board of Cuyahoga County Commissioners, Cleveland, O., will hold a public hearing at 11 a. m., April 17, on the proposition to erect a bridge on Station Road over Chippewa Creek in Brecksville Township.

Members of the East Side Improvement Club, Youngstown, O., have adopted a resolution asking the City of Youngstown, O., to join with the County Commissioners in constructing a new Lincoln Park bridge.

Oregon.

⊙The contract for the construction of the proposed new wagon bridge over the Willamette River at Ferry St., Eugene, Ore., has been let by the city to the Coast Bridge Co., Portland, Ore., at $34,500. The work will include the concrete substructure and the steel superstructure, and construction will be commenced May 1.

Pennsylvania.

✣Bids will be received until 10 a. m., March 25, by City Controller, Municipal Hall, Pittsburgh, Pa., for the removal of the present bridge and building of a reinforced concrete arch bridge on the line of Murray Ave. over Wm. Pitt Blvd. Bids shall be made from the plans and specifications and on the printed forms to be obtained at the office of Jos. G. Armstrong, Director of the Department of Public Works, 432 Oliver Bldg. Proposals must be accompanied by bond in the amount of $50,000, secured by a surety or trust company, which shall have complied with city ordinances relating thereto. William A. Magee is Mayor.

✣Bids will be received until 11 a. m., March 28, by Board of McKean County Commissioners, A. B. Walker, Clerk, Smethport, Pa., for removing the present bridge and construction of a new 70-ft. span reinforced concrete ribbed arch bridge over Marvin Creek in accordance with specifications on file with the commissioners. Drawings can be secured by addressing G. A. Flink, Consulting Engineer, Commonwealth Trust Bldg., Harrisburg, Pa., at cost of $4.

Bills have been introduced in the State Legislature appropriating $100,000 for the construction of a bridge over Susquehanna River at Duboistown, Pa., and $120,000 for the construction of a bridge at Montgomery.

A Committee of the West Scranton Board of Trade petitioned the City Planning Commission, Scranton, Pa., and the Delaware, Lackawanna & Western R. R. to take immediate action in regard to constructing the proposed bridge at Washburn St. It is hoped that the project will be in shape for receiving bids by the Spring. W. A. Shunk is City Engineer.

Bills have been introduced into the House of Representatives, Harrisburg, Pa., for the construction by the State Highway Department of bridges over the West Branch at the foot of Arch St., Newberry and Montgomery. Each of the bills carries an appropriation of $120,000.

Stockholders of the Minsi Trail Bridge Co. recently held a meeting at the office of the Secretary, W. J. Heller, Bethlehem, Pa. No definite time for constructing the proposed bridge was decided upon but it is believed that action will be taken in the near future.

Further information has been received concerning the proposed reinforced concrete cantilever bridge over Chester River at 5th St., Chester, Pa., for which bids will be received March 17, as mentioned in our last issue According to the plans prepared by Henry H. Quimby, Philadelphia, Pa., the structure will be 160 ft. in length including an 80-ft. clear span 60 ft. wide. The roadway will be 36 ft. wide and sidewalks 12 ft. in width. The substructure will be wood piles and two 16x66-ft. piers. George W. Allen, Media, Pa., is Chairman of the Delaware County Commissioners.

South Carolina.

The Southern Railroad has appropriated funds for the construction of a new steel bridge over the North Main St. cut at Anderson, S. C. A. B. Ilsley, Washington, D. C., is Engineer of Bridges.

South Dakota.

⊙The contract for the construction of all Luten arch type bridges in Davison County, S. Dak., during the year of 1913 has been awarded to Ward & Weighton, Sioux City, Ia. The Pioneer Bridge Co., Mitchell, S. Dak., was awarded the contract for the construction of all other types of bridges. Bids were opened March 4.

⊙The contract for the construction and repair of bridges in Hamlin County, S. Dak., during the ensuing year, has been let by the County Board to the Russell Grader Mfg. Co., Minneapolis, Minn. Bids for the work were opened by E. S. Brown, County Auditor, Castlewood, S. Dak., March 4.

⊙The contract for the painting of the bridges in Clay County, S. Dak., has been awarded to George Gasink, Vermilion, S. Dak., at 65 cts. per lin. ft.

⊙The Board of Lincoln County Commissioners, Canton, S. Dak., has awarded the contract for the construction of new bridges and the repairing of old ones during the year of 1913 to the Western Bridge & Construction Co., Omaha, Nebr.

Tennessee.

At a joint meeting, March 5, of the Chamber of Commerce, Clarksville, Tenn., and a representative delegation from Montgomery County a movement was started to build a bridge across Cumberland River at this place. The Legislature will be asked to authorize the issuance of $500,000 in bonds for this purpose and for a general improvement in highways of the county.

Texas.

The City Council of Houston, Texas, has adopted the plans submitted by City Engineer F. L. Dormant, for the proposed bridge on Franklin Ave. Bids for the structure will be asked shortly.

Bids were received as follows, March 3, by City Council, Houston, Texas, for the construction of the Capitol Ave. bridge over Buffalo Bayou: H. C. Gass, two bids, $103,000 and $104,100; James Stewart Co., two bids, $90,050 and $90,400; W. P. Carmichael Co., two bids, $114,850 and $115,500; E. G. Burns, two bids, $142,900 and $143,900.

Vermont.

At the annual town meeting of Essex Junction at Essex, Vt., the matter relating to the construction of a new bridge over Brown's River on the public highway leading from C. A. Nichol's residence to that of A. D. Garrow, was referred to the selectmen.

Virginia.

✣Bids will be received until noon, March 20, at the office of P. St. J. Wilson, State Highway Commissioner, Richmond, Va., for the construction of a 36-ft. reinforced concrete bridge over Falling Creek, 2 miles from Ashland, on the R. F. & P. Ry. in Hanover County. The substructure will be of plain concrete and stone, gravel and sand can be obtained within one mile of the site. The work on the substructure will include tearing out old bridge. Plans and specifi-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

cations are on file with the Hanover County Circuit Court Clerk or J. L. Saunders, Ashland, Va.

✣Bids will be received until March 15, by G. P. Lewis, Box 815, Norfolk, Va., for the erection of three steel bridges (lift type) sub and superstructure; 1,200 ft. of pile trestle; 1,000 ft. pile bulkhead; 50,000 cu. yds. of suction dredging and other work. Detailed information can be had and plans and specifications seen at 420 Law Bldg., Norfolk, Va.

Bids were received March 3, by the Depot Quartermaster, Washington, D. C., for the construction of the proposed highway bridge at Arlington, Va., as follows: L. M. Johnson, Washington, D. C., $5,185; R. E. Boiseau, Washington, D. C., $7,900.

A hearing was recently held by the Administrative Board on the proposition of the representatives of the Richmond, Fredericksburg & Potomac R. R., the Richmond & Petersburg Connecting Company and the Tredegar Company, joint owners of the 7th St. bridge, to improve the structure instead of replacing it with a concrete bridge.

Washington.

The City Council of Seattle, Wash., has decided to construct eight bridges instead of subways at the following locations: Fremont and Westlake; 15th NW at Ballard; Eastlake and 6th Ave. N.; Mountlake Ave. and University Grounds; Spokane Ave. and West Waterway; Railroad Ave. and East Waterway; Westlake and Stone Way and 3rd Ave. W. at Ross. The bridges will cost $2,000,000.

Wisconsin.

⊙Worden & Allen, Milwaukee, Wis., have been awarded the contract for the construction of the new iron bridge over Pigeon River at Howard's Grove at $2,948. The structure will have a 90-ft. span.

The United States War Department has granted the City of Milwaukee, Wis., permission to construct a new bascule bridge over the Milwaukee River at Buffalo St., replacing the present swing structure. The new bridge will have a draw of 130 ft.

Canada.

⊙The contracts for the construction of the sub and superstructures of the highway bridge at Innisville have been let by the Roads and Bridges Committee, Fall Brook, Ont., as follows: For erecting and furnishing materials of 5 concrete piers and 2 abutments to G. S. Bradford, Almonte, Ont., at $2,975; for supply and erection of 6 spans through low Warren truss type to Dickson Bridge Works, Campbellford, Ont., at $8,191.

The Bridge Committee of the City Council, Vancouver, B. C., has recommended that the contract for the construction of the Georgia-Harris viaduct be awarded to J. McDiarmid & Co., Winnipeg, Man., and Vancouver, B. C., on their bid of $455,000. The lowest bid received for the work was that of Martin Carroll & Co., Kansas City, Mo.

It is understood at Kamloops, B. C., that the government officials will shortly call bids for the construction of the proposed bridge across the Thompson River at Kamloops. The highlever plan, which will probably be adopted calls for a three-main-span viaduct, with 120-ft. spans, central elevation above water, 46.75 ft., costing $60,000 to $75,000.

ROADS AND STREETS

Alabama.

✣Bids will be received until March 18 by City of Birmingham, Ala., for the construction of approximately 75,000 yds. of street paving; alternate bids received on asphalt (open specifications), asphaltic concrete, bituminous concrete, bitulithic, plain concrete and wood block. Specifications may be obtained by addressing Walter G. Kirkpatrick, City Engineer.

The Marshall County Commissioners, Guntersville, Ala., have called an election for the purpose of voting on the issuance of bonds to the amount of $130,000 for the construction of good roads, including the proposed highway from the Madison County line to the Etowah line, passing through Guntersville, Albertville and Boaz.

California.

✣Bids will be received until March 17, by Town Trustees, Mayfield, Calif., for the construction of 4,930 lin. ft. of street paving, estimated to cost $33,000. The paving will consist of a 5-in. concrete base with 1½-in. asphalt wearing service. Concrete gutters and curbs will be included.

⊙John D. Marsh, 154 Wilson Bldg., Los Angeles, Calif., has been awarded the contract by the California Highway Commission, 515 Forum Bldg., Sacramento, Calif., for the construction of a portion of a state highway in Los Angeles County, between Rancho El Encino and Calabasas, Division VII, Route 2, Section B about 10 miles in length, for $55,556. The road is to be built of Portland cement, concrete and bituminized surface. Bids were opened Feb. 28.

⊙The Trustees of LaJolia, Calif., have awarded contracts to S. H. Reese for the grading of Wall St., its full length, and Herschel from Wall to Prospect, a distance of one block.

The Board of Supervisors, Redwood City, Calif., has named a commission which will have charge of road construction and expenditure of funds providing the bonds carry. The bond election will be held April 1.

City Engineer F. W. McCarton, of San Jose, Calif., is preparing plans and specifications for the improvement of Second St., from St. James to Jackson; Third St., from Empire to Jackson; Hensley Ave., from First to Fourth; Empire, from First to Third, and Jackson from First to Third. The streets are to have 4½-in. concrete base and be covered with 1½ ins. of bitumen.

The California State Highway Commission, Sacramento, has taken the bids received Feb. 28, for the construction of a portion of the state highway in Mendocino County, under advisement. The road is located between Ukiah and Forsythe Creek, Division I, Route 1, Section C, about 7½ miles in length, and to be built of gravel foundation and waterbound macadam surface.

Colorado.

The Board of Public Works of Denver, Colo., contemplates the paving of Wynkoop St., from 19th St., to Cherry Creek. The cost is estimated at $26,595.

Connecticut.

✣Bids will be received until 8 p. m., March 18, by Board of Public Works, New Britain, Conn., for the paving of West Main St., from the end of the present pavement to Black Rock bridge including approximately 18,000 sq. yds. A certified check for $3,000 must be filed with each bid. Bids will be received for vitrified brick, wooden block, asphalt, bitulithic and granite block grouted with cement. All pavements to have a 5-in. concrete base. All information necessary, plans and specifications can be obtained at the office of the City Engineer. John E. Moore is President of Board of Public Works.

Delaware.

✣Bids will be received until noon, March 18, by James Wilson, New Castle County Highway Commissioner, 304 Church Bldg., Wilmington, Del., for building a water-bound macadam road, known as the Odessa-St. Georges Road, by way of Boyd's Corner, extending in a northerly direction from Odessa by way of Boyd's Corner, about three miles.

District of Columbia.

✣Bids will be received until 2 p. m., March 25, by Commissioners of the District of Columbia, Washington, D. C., for making repairs to asphalt pavements for two year period, ending June 30, 1915. Specifications and all necessary information may be obtained at the office of the Chief Clerk, Engineering Department, Room 427, District Building.

Col. Downey, Depot Quartermaster, Washington, D. C., has about completed arrangements for building a first-class macadam road, with bituminous surface, about 30 ft. wide, from the south end of the Highway bridge over the Potomac River, to the old county road running from Rosslyn through the Arlington reservation, along the eastern edge of the cemetery. The sum of $44,000 has been appropriated for this road.

Georgia.

✣Bids will be received until April 2, by City of Savannah, Ga., for the construction of 25,000 sq. yds. of pavement. H. S. Jaudon Engineering Co., Savannah, Ga., are Engineers.

Illinois.

✣Bids will be received until 3:45 p. m., March 13, by Board of Local Improvements, Galesburg, Ill., for the following street improvements: 6,800 cu. yds. of earthwork excavation; 3,050 lin. ft. of Portland cement concrete curbing, including circular corners; 75 lin. ft. of Portland cement concrete marginal curbing, 6 in. by 12 in.; 18,600 sq. yds. of brick pavement laid in a Portland cement concrete foundation 6 ins. in depth, with asphalt filler; 4 manholes to be adjusted, brought to grade and provided with cast iron head and cover; 10 manholes to be adjusted and brought to grade. The specifications for said improvement can be found at the office of the Board of Local Improvements in said city.

✣Bids will be received until 2 p. m., March 14, by Board of Local Improvements, F. J. Kern, President, Belleville, Ill., for the following work in the East Main St. paving district: 7,280 sq. yds. of vitrified brick paving on Portland cement concrete foundation, 4 ins. thick, complete in place; 5,100 lin. ft. of pitch expansion joint, complete in place; 1,520 lin. ft. of sandstone curbing, complete in place; 4,300 cu. yds. of excavating and grading.

✣Bids will be received until 2 p. m., March 14, by Board of Local Improvements, Belleville, Ill., for the construction of the following improvements on Seventh St.: 10,900 sq. yds. of vitrified brick paving on Portland cement concrete foundation, 4 ins. thick, complete in place; 7,500 lin. ft. of pitch expansion joints, complete in place; 6,600 lin. ft. of sandstone curbing, complete in place; 6,000 cu. yds. of excavating and grading; 800 lin. ft. of 6-in. vitrified clay sewer pipe, complete in place; 1,960 lin. ft. of 12-in. vitrified clay sewer pipe, complete in place; 1,900 cu. yds. of excavating and refilling sewer trenches; 5 brick manholes with cast iron covers, complete in place; 8 brick catch basins with cast iron covers, complete in place.

✣Bids will be received until 12 m., March 20, by the Board of Trustees, Sanitary District, Chicago, for furnishing and delivering electric street lighting equipment and apparatus. Plans and specifications upon application to John McGillen, Clerk American Trust & Savings Bank.

✣Bids will be received until 11 a. m., March 20, for furnishing and delivering and erecting in place, 16 lamp posts of ornamental design complete with lamps and wiring on the approaches to the Washington St. bridge; details as specified are: 16-bracket fixtures attached to trusses of viaduct, each containing 2 lights; 8-light standards, each containing 4 lights; 4 cluster-light standards, each containing 7 lights, all globes to be made of Alba glass, thick enough to withstand the vibrations of the bridge, lamps to be tungsten filament lamps of 60 watt at 115 volts. Cash or certified check for $100 must accompany proposal. L. E. McGann, Commissioner of Public Works, Chicago Ill.

⊙The Reppert Construction Co., 1718 Lake St., Melrose Park, Ill., has been awarded the contract by the city of Berwyn, Ill., for the construction of concrete sidewalks, for $4,200. Bids were opened March 4. A. B. Wolfe, 602 N. Y. Life Bldg., Chicago, Ill., is Attorney.

⊙The Board of Local Improvements of Bloomington, Ill., has adopted a resolution instructing the City Attorney to prepare an ordinance for the paving of Beecher St., from Park St. to Fell St., with brick. The estimated cost is $5,299.

Proceedings have been started in West Hammond to pave Sibley St., from the state line to Burnham Ave., with asphaltic macadam; Paul Muszelewicz, official in charge.

The Board of Local Improvements of Quincy, Ill., has ordered the paving of Jersey St., between 12th and 24th Sts., with creosoted wood blocks. City Engineer Webster Bushnell has estimated the cost at $38,000.

The City Council of Aurora, Ill., contemplates paving Broadway St. with asphalt in the four blocks between Benton and Spring Sts. Myron J. Tarble is City Engineer.

Property owners on Illinois St., Urbana, Ill., from Race St east to Cottage Grove Ave., a distance of 12 blocks, have signed a petition asking for the paving of that thoroughfare. It is also proposed to pave Cottage Grove Ave., from Illinois St. to Main St.

City Engineer Edmund Hall, of Granite City, Ill., is preparing plans for about $38,000 worth of street paving.

The Board of Local Improvements of Pekin, Ill., John R. Seibert, City Engineer, has adopted a resolution for the improvement of what is known as the Seventh and Eighth Sts. Paving District, comprising parts of Eighth, Seventh, Hillyer Sts., and Tharp Pl. The Engineer's estimate is as follows: 16,800 sq. yds. of brick paving on a concrete foundation 5 ins. thick, covered with a sand cushion 2 ins. thick, the interstices filled with a cement grout filler over which shall be spread ½ in. of clean, sharp sand, complete in place at $1.60 per sq. yd, $26,880; 5,600 cu. yds. of excavation and filling at 30c per cu. yd., $1,680; 600 lin. ft. of new concrete curb (5 in. x 20 in.) at 25c per ft., $150; 320 lin. ft. of protection curb at 25c per ft., $80; 6,500 lin. ft. of curb to reset at 10c per ft., $650; lawful expenses, court costs in making, levying and collecting said assessment, $1,766; total, $31,206.

⊙The following contracts for constructing pavements have been awarded by the Board of Local Improvements, Chicago, Ill.: Dickens Ave., 40th Ave. to 45th Ave., American Asphalt Paving Co., 133 W. Washington St.; Indiana Ave., 51st St. to Garfield Blvd., American Asphalt Paving Co., 133 W. Washington St.; S. Leavitt St., Ogden Ave. to W. 14th St., granite concrete combined curb and gutter asphalt pavement, American Asphalt Paving Co.; 73rd St., Bond Ave. to South Shore Ave., granite concrete combined curb and gutter, American Asphalt Paving Co., 133 W. Washington St.; 3rd Ave., Augusta St. to Division St., Granite concrete combined curb and gutter, American Asphalt Paving Co., 133 W. Washington St.; Troy St., Colorado Ave. to Jackson Blvd., granite concrete combined curb and gutter, American Asphalt Paving Co., 133 W. Washington St.; alley, Cottage Grove Ave., 29th St., etc., concrete curbing, brick pavement, Ready & Callahan Coal Co., 133 W. Washington St.; Randolph St. Carpenter St., etc., concrete curb, brick pavement, Central Paving Co., 179 W. Washington St.; alley, Milwaukee Ave., Logan Blvd., etc., concrete curbing, brick pavement, Jas. A. Sackley Co., 133 W. Washington St.; alley, Barry Ave., Pine Grove Ave., etc., concrete curbing, brick pavement, P. J. O'Brien, 9 S. La Salle St.; alley, 60th St., Washington St., etc., concrete curbing, brick pavement, Ready & Callahan Coal Co.; alley, Van Buren St., Center Ave., etc., concrete curbing, brick pavement, Jas. A. Sackley Co.; alley, Langley Ave. 41st St., etc., concrete curbing, brick pavement Ready & Callahan Coal Co.; alley, Erie St., Morgan St., etc., concrete curbing, brick pavement, Jas. A. Sackley Co.; alleys Augusta St., Ashland Ave., etc., concrete curbing, brick pavement, Jas. A. Sackley Co.; alley, Sinnott Pl., Center Ave., etc., concrete curbing brick pavement, Jas. A. Sackley Co.; alleys, Madison St., Laflin St., etc., concrete curbing brick pavement, Jas. A. Sackley Co.; alleys, Polk St., Blue Island Ave., etc., concrete curbing, brick pavement, Jas. A. Sackley Co.; alley, Plum St., Laflin St., etc., concrete curbing, brick pavement, Jas. A. Sackley Co.; alley, Polk St., Norton St. etc., concrete curbing, brick pavement; the work includes a 6-in. Portland cement concrete foundation, 2-in. sand cushion, sewer manhole and catchbasin construction and adjustment. E. J. Glackin, Secretary of the Board.

Indiana.

✣Bids will be received until March 14, by City of Terre Haute, Ind., for the improvement of four streets as follows: 6th St., including 1,528 sq. yds. of pavement and 93 lin. ft. marginal curb; Wabash Ave., including 9,824 sq. yds. of pavement, 3,798 lin. ft. stone curb, 102 lin. ft. of 6-ft. R. 230 lin. ft. marginal curb, adjusting 10 M. H. and C. B., resetting 10.7 6-ft. R.; Poplar St., including 11,356 sq. yds. of pavement, 151.50 lin. ft. stone curb, 97 lin. ft. 6-ft. R., 590.60 lin. ft. marginal curb, adjusting 16 M. H. and C. B., converting 13 C. B. into C. I., resetting 153 lin. ft. straight curb; 14th St., including 13,604 sq. yds. of pavement, 232 lin. ft. stone curb, 6.28 lin. ft. 4-ft. R., 56.55 lin. ft. of 6-ft. R., 589 lin. ft. marginal curb, adjusting 13 M. H. and C. B., converting 1 C. B. into C. I., resetting 45.5 lin. ft. straight curb. Bids will be taken on brick, bitulithic, wooden block, sheet asphalt, asphaltic concrete (mix), asphalt concrete (penetration). Robert M. Burns is City Engineer.

✣Bids will be received until 2 p. m., April 8, by Board of Knox County Commissioners, Vincennes, Ind., for the construction of six gravel roads. J. T. Scott is County Auditor.

✣Bids will be received until 2 p. m., April 7, by Board of Newton County Commissioners, Kentland, Ind., for the construction of six gravel roads. S. R. Sizelove is County Auditor.

✣Bids will be received until 10 a. m., April 7, by Board of Vermillion County Commissioners, Newport, Ind., for the construction of gravel roads in Helt and Eugene Townships. Roy Slater is County Auditor.

✣Bids will be received until 10 a. m., April 7, by Board of Clark County Commissioners, Jeffersonville, Ind., for the construction of two gravel roads. G. W. Stoneris, County Auditor.

✣Bids will be received until 2 p. m., March 21, by Board of Owen County Commissioners, Spencer, Ind., for the construction of a pike road in Wayne Township. George W. Stwalley is County Auditor.

✣Bids will be received until 3 p. m., April 9, by Common Council, Angola, Ind., for the construction of 7,900 sq. yds. of street improvement. Specifications will be furnished upon application. Roy Hirst is City Clerk. Official advertisement will be found elsewhere in this issue.

⊙Jno. W. Murphy, Greenwood, Ind., has been awarded the contract by the Commissioners of Johnson County, Franklin, Ind., for the construction of a stone road 15,010 ft. in length, for $15,470. Bids were opened March 3.

⊙Scammahovia & Bennett, Rockport, Ind., have been awarded the contract by the Board of Spencer County Commissioners, Rockport, for the construction of a rock road in Ohio Township, for $12,974. Bids were opened March 3.

⊙The Board of Rush County Commissioners, Rushville, Ind., has awarded contracts for the construction of roads in Rushville Township, for which bids were opened on March 1, as follows: Walker & McMahin, Fortville, Ind., Grice Graham et al. gravel road, tarvia-bound, $12,793; James DeGolyer & Co., Seymour, Ind., Charles Alger et al. brick road, $40,844.

⊙W. F. Slattery, Crawfordsville, Ind., has been awarded the contract by the Board of Montgomery County Commissioners, Crawfordsville, for grading, draining and paving, with stone-bound with tar, a road in Jackson Township, for $16,800. Bids were opened March 4.

⊙R. F. Schneider, Montpelier, Ind., has been awarded the contract by the Board of Blackford County Commissioners, Hartford, Ind., for the construction of two roads for which bids were opened on March 3.

⊙H. H. Stewart, Kokomo, Ind., has been awarded the contracts by the Board of Howard County Commissioners, Kokomo, for the construction of three gravel roads in Harrison and Center Townships, at the following bids: Solomon Petty road, $4,434, J. R. Cain road, $1,119, and J. P. Brower road, $3,151. Bids were opened March 4.

⊙The Board of Adams County Commissioners, Decatur, Ind., has awarded contracts for the construction of macadamized roads in Blue Creek, Preble, Hartford, Monroe, Washington, St. Mary and Root Townships, for which bids were opened on March 4, as follows: L. O. Bears, Geneva, Ind.; Chris. Musser, Geneva, Ind.; Michael Miller, Decatur, Ind.; Merryman & Fugate, Monroe, Ind.; Julius Haugh, Decatur, Ind., and J. C. Cowan, Pleasant Mills, Ind.

⊙Earl O. Gilbert, Martinsville, Ind., has been awarded the contract by the Board of Morgan County Commissioners, Martinsville, for the construction of the J. W. Hart gravel road in Jackson Township, for $11,725. Bids were opened March 5.

⊙John S. Crown, of Mitchell, Ind., has been awarded the contract by the Board of Lawrence County Commissioners, Bedford, Ind., for the construction of two gravel roads in Spice Valley Township, for $2,600. Bids were opened March 4.

⊙C. R. Yates, Holton, Ind., has been awarded the contract by the Board of Ripley County Commissioners, Versailles, Ind., for the construction of a macadam road and stone arch bridges in Adams Township for $10,051. Bids were opened March 3.

⊙The Mt. Vernon Construction Co., Mt. Vernon, Ind., has been awarded the contract by the BoafProdpyeo - Pgardjaofi(wV ,sE by the Board of Posey County Commissioners, Mt. Vernon, for the construction of a gravel road on the line between Black and Lynn Townships, for $5,199. Bids were opened March 3.

⊙F. M. William, of Winamac, Ind., and O. C. Shafer, of Royal Center, Ind., have been awarded the contracts by the Board of Pulaski County Commissioners, Winamac, for the construction of a gravel road in Beaver Township, for $4,599 and $4,998, respectively. Bids were opened March 4.

⊙Hastings & Dovis, of Jasonville, Ind., have been awarded the contract by the Board of Greene County Commissioners, Bloomfield, Ind., for the construction of a macadamized road in Wright Township. Bids were opened March 4.

No bids were received on March 3 by the Board of Owen County Commissioners, Spencer, Ind., for the construction of gravel roads known as the W. A. Bucklew et al., and the John Brinson et al. roads. George W. Stwalley is County Auditor.

The Town Board of Bloomfield, Ind., has adopted an ordinance for paving about two miles of the streets of the town with brick. Charles C. Parker is Engineer.

The Board of Public Works of Michigan City, Ind., has approved the plans and specifications of City Engineer H. M. Miles for pavements in Tennessee St., from 10th to Wall; Center, Second to Fogarty; Tremont, York to Lafayette; Hermitage Ave., from

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Washington Park to Shawmut Park Addition; Baltimore, from Franklin to Chicago St. The estimated cost of the proposed improvements is as follows: Tremont, $3,000; Center, $5,500; Tennessee, $9,100; Hermitage Ave., $11,500. Public hearing will be held March 18.

Iowa.

✣Bids will be received until 7:30 p. m., March 17, by A. S. Gaylord, City Clerk, Fort Madison, Ia., for paving Front St. from the west line of Vine St. to the west line of Occidental St.; and Occidental St. from the south line of Front St. to the south line of Des Moines St.; and Des Moines St. from the west line of Occidental St. to the east line of Union Ave., with number one repressed vitrified paving blocks on a cement concrete foundation and curbing and guttering with a cement concrete curb and gutter, about 22,500 sq. yds. of paving and about 11,400 lin. ft. of curb and gutter, more or less, work to begin on or about the 1st day of May, 1913, and to be fully completed on or before the 1st day of December, 1913. Each bid must be accompanied by a certified check for $1,000.

✣Bids will be received until 2 p. m., March 25, by W. E. Gamble, Town Clerk, Mount Vernon, Ia., for about 1 mile of paving. Bids will be taken on brick, creosoted wood block, asphalt, asphaltic concrete, plain concrete and bituminous coated concrete. A certified check for $500 must be filed with each bid. Iowa Engineering Co., Clinton, Ia., Engineers.

✣Bids will be received until 8 p. m., April 8, by Scott McNeil, Town Clerk, Clarence, Ia., for 7,500 sq. yds. of concrete paving. A certified check for $500 must be filed with each bid.

⊙E. J. Hanlon, 1501 Nebraska St., Sioux City, Ia., has been awarded the contract by that city, Paul J. Wells, City Clerk. for the paving of 19th St. from Pierce St. to Jackson St., for $1.14 per sq. yd. Six-in. concrete will be laid. Bids were opened Feb. 28.

⊙M. L. Flinn Paving Co., American Block, Sioux City, Ia., has been awarded the contract by that city, Paul J. Wells, City Clerk. for the paving of Riverside Ave., for $1.14 per sq. yd. Bids were opened Feb. 28.

⊙Bids were opened Feb. 25 by the City Clerk of Algona, Ia., for the construction of 24,000 sq. yds. of pavement for which Theo. S. Delay, Creston, Ia., is Engineer. The contract was awarded to the Des Moines Asphalt Paving Co., Des Moines, Iowa, on asphaltic concrete with ½ in. and under aggregate, natural lake asphalt on 4-in. concrete base for 5,000 sq. yds. and a 5-in. concrete base for 19,000 sq. yds. Bids were received on the following classes of pavement: 1-course Portland cement concrete, 6-in. concrete, the coarse aggregate being granite or quartzite; bituminated concrete consisting of a 5-in. Portland cement concrete, 1 coat construction, with a surface coating ¼ in. thick of bituminous cement and coarse sand or stone chips; surface of vitrified brick passing 18% test on old standard rattler, with asphalt filler and sand cushion on 4-in. and 5-in. concrete base; surface of vitrified brick passing 22% test, remainder of construction as above; 2-in. wearing surface of Sarcolithic mineral rubber pavement laid on concrete foundation; 2-in. asphaltic concrete wearing surface on concrete foundation, the aggregate in wearing surface not to exceed ½-in. in size; 2-in. asphaltic concrete wearing surface on concrete foundation, aggregate not to exceed 1-in. in size; 2-in. bitulithic wearing surface on concrete base; bituminous concrete, ½-in. wearing surface, 1½-in. binder course of stone and asphalt and concrete base. The following is an approximate outline of conditions at Algona: The haul to all parts of the work is practically level. Unskilled labor 20 to 25 cts. an hour. Man and team 40 to 45 cts. Labor unorganized. Surface soil is black loam. Subsoil is joint clay. Some old stone and gravel macadam on four blocks of the work. Paper worth 95 cts. to par. Probably can be placed locally. About two-thirds will be paid in cash by property owners. City Council harmonious; property owners fairly disposed toward paving. City water available on all points of the work. The itemized bids on the various kinds of pavement were as follows:

1-COURSE CONCRETE.

Lake & Mathy, Le Mars, Ia	$1.27
Des Moines Asphalt Paving Co., Des Moines, Ia.	1.50
Lyttle Construction Co., Sioux City, Ia	1.31
Dearborn Construction Co., Waterloo, Ia	1.34
Garland & Schaffer, New Hampton, Ia	1.37
Bryant Asphalt Paving Co., Waterloo, Ia	1.48
Watertown Cement Products Co., Watertown, S. Dak	1.37

BITUMINATED CONCRETE.

Des Moines Asphalt Paving Co	$1.55
Garland & Schaffer	1.41

18 PER CENT BRICK PAVEMENT.

Zitteral & Sullivan, Webster City, Ia	$2.11
J. S. McLaughlin & Sons, Red Oak, Ia	1.99
Dearborn Construction Co	2.02
J. W. Turner Improvement Co., Des Moines, Ia.	1.979
Waterloo Cement Products Co	2.02

22 PER CENT BRICK PAVEMENT.

Zitteral & Sullivan	$2.08
J. S. McLaughlin & Sons	1.99
J. W. Turner Improvement Co	1.94

Extra for 1-in. increase of concrete base (19,000 sq. yds.).

Lake & Mathey	$0.22
Des Moines Asphalt Paving Co	.12
Lyttle Construction Co	.24
Zitteral & Sullivan	.10
J. S. McLaughlin & Sons	.11
Dearborn Construction Co	.15
J. W. Turner Improvement Co	.10
Jas. Horrabin & Co	.15
Bryant Asphalt Paving Co	.15
Waterloo Cement Products Co	.17

Sarcolithic (1) lake asphalt, limestone aggregate, (2) lake asphalt, granite aggregate.

	(1)	(2)
Jas. Horrabin & Co., Des Moines. Ia.	$1.77	$1.83

Asphaltic concrete, ½ in.—(1) lake asphalt, limestone aggregate; (2) other asphalt, limestone aggregate.

	(1)	(2)
Des Moines Asphalt Paving Co	$1.58	$1.50
J. S. McLaughlin & Sons	....	1.48
Jas. Horrabin & Co	1.66	....
Dearborn Construction Co	....	1.48
Bryant Asphalt Paving Co	1.57	1.48

Asphaltic Concrete. 1 in.—(1) lake asphalt, granite aggregate; (2) other asphalt, granite aggregate.

	(1)	(2)
Des Moines Asphalt Paving Co	$1.75	$1.70
Jas. Horrabin & Co	1.87	....
Bryant Asphalt Paving Co	1.78	1.61

Asphaltic concrete, 1 in.—(1) lake asphalt, limestone aggregate; (2) other asphalt, limestone aggregate.

	(1)	(2)
Des Moines Asphalt Paving Co	$1.73	$1.64
Jas. Horrabin & Co	1.81	....
Bryant Asphalt Paving Co	1.72	1.63

Bitulithic—(1) lake asphalt, limestone aggregate; (2) lake asphalt, granite aggregate.

	(1)	(2)
Jas. Horrabin & Co	$2.03	$2.09

Bituminous concrete, binder course—(1) lake asphalt, limestone; (2) other asphalt, limestone; (3) lake asphalt, granite; (4) other asphalt, granite.

	(1)	(2)	(3)	(4)
Des Moines Asphalt Pav. Co.	$1.85	$1.75	$1.81	$1.81

The City Council of Knoxville, Ia., has decided to pave two stretches at the square, the first to run west from Odd Fellows' block past the post office, the other south, past the Carnegie Library.

The City Council of Sheldon, Ia., has taken preliminary steps for the paving of several blocks of streets.

The City Council of Muscatine. Ia., has ordered the plat and schedule of the proposed District No. 30 filed by City Engineer C. H. Young. The territory embraces many streets and the proposed paving is estimated to cost $250,000.

Kansas.

⊙The Shelby-Downard Asphalt Co., Ardmore, Okla., on March 3 secured a contract in Arkansas City, Kans., for the construction of 8,252 sq. yds. of Ardmore rock asphalt paving, for $1.18 per sq. yd.

⊙The J. W. Weaver Construction Co., 1001 Scarritt Bldg., Kansas City, Mo., has been awarded the contract by Maj. J. T. Davidson, Quartermaster, Fort Riley, Kans., for the construction of curbs and gutter at $0.57½ per ft.; catchbasins at $9.80 each, and drain inlets at $7.80 each. Bids were opened Feb. 27.

⊙James R. Ramsey, of Topeka, Kan., has been awarded the contract in that city for 38 blocks of asphaltic concrete paving for this year, for $112,283. The work also includes grading and curbing. Other bidders were: The Kaw Paving Co., Topeka, $119,533; Warner-Quinlan Co., Syracuse, N. Y., $121,135; Heman Construction Co., St. Louis, Mo., $122,591; A. Jaicks Co., Kansas City, Mo., $114,861; Rushmore & Cowdy, Kansas City, Mo., $127,962; Levy & Levy, Muskogee, Okla., $120,957; The Capital City Vitrified Brick & Paving Co., Topeka, $122,336; J. R. Ramsey, Topeka, $112,283; Western Improvement Co., Racine, Wis., $125,272. The City Engineer's estimate was $123,489.

⊙Ritchie Bros., of Topeka, Kan., have been awarded the contract by that city, A. R. Young, City Engineer, for the construction of about 50,000 sq. yds. of brick paving, for $94,219. The largest contract calls for the repaving of Jackson St., bids being as follows: R. L. Gordon & Co., $18,190; The Kaw Paving Co., $17,752; James Stanton, Leavenworth, $20,246; Olson & Schmidt, St. Joseph, $18,534; W. S. Fulton, $18,288; Walton W. Gilmore, $22,040; Ritchie Bros., $15,905; City Engineer's estimate, $19,527. On the brick paving for other streets and alleys for 1913 the following bids were received: Walton W. Gilmore, $92,184; Ritchie Bros., $78,344; Kaw Paving Co., $84,637; James Stanton, Leavenworth, $81,980; The Capital City Vitrified Brick & Paving Co., $90,726; City Engineer's estimate, $85,291.

The City of Concordia, Kan., contemplates street paving. J. L. Doster is City Engineer.

Kentucky.

The Fiscal Court. Shelbyville, Ky., is reported to have approved the proposed construction of 5¾ miles of pike.

Louisiana.

The City of Opelousas, La., plans the paving of several miles of streets and the laying of about 12 miles of sidewalks.

Maine.

A special highway appropriation of $4,150 has been voted by the Town of Topsham, Me. Charles H. Alexander is Road Commissioner.

Town of Richmond, Me., has appropriated $1,400 for concrete walks. L. S. Bray is Selectman.

Town of Bucksport, Me., has voted an appropriation of $2,300 for rock crusher. Frank F. Smith is Selectman.

The following appropriations for road work have been voted by the Town of Brunswick, Me.: Improvement of Maine St., $3,000; repair of State Road, $1,000; improvement of Rocky and Clay Hills, $1,000; Great Island Road, $1,000; Church Road, $1,500; Mere Point Road, $1,600. Thomas E. Dolan is Road Commissioner.

Maryland.

⊙The Maryland State Roads Commission, Wm. L. Marcy, Secy., Baltimore, Md., has awarded contracts for the building of 13 sections of state highway in various counties of the state as follows: McGuire Construction Co., two contracts, $46,636 and $43,189; Elder Paving Co., Baltimore, one contract, $37,796; Carozza, Lavezza & Carozza, one contract, $16,027; Juniata Paving Co., Empire Bldg., Philadelphia, Pa., one contract, $19,900; Allen Engineering & Construction Co., Netcong, N. J., one contract, $47,507. Bids were opened Feb. 27.

✣Bids will be received until 11 a. m., March 26, by the Board of Aldermen, Frederick, Md., for constructing approximately 500 lin. ft. of sewers (6x12-in.) together with the necessary inlets and for paving approximately 5,500 sq. yds., and for furnishing and setting 1,000 lineal feet of curbing. Each bid must be accompanied by a certified check for $500, drawn payable to J. Ed. Schell, Mayor. Plans, specifications, instructions to bidders and forms of proposals may be obtained from E. C. Crum, City Engineer, upon payment of $2.

Massachusetts.

An appropriation of $1,500 has been voted by the Town of Ashburnham, Mass., for good roads. C. Edgar Willard is Highway Surveyor.

Town of Hingham, Mass., has voted to appropriate $2,500 for oil for highways and $2,500 for sidewalks. Walter W. Hersey is Selectman.

Town of Brewster, Mass., has voted $7,500 for new roads. F. B. Crocker is Town Clerk.

Town of Norton, Mass., has voted an appropriation of $2,500 for macadamizing on Mansfield Av[illegible] F. A. Clapp is Highway Surveyor.

Michigan.

✣Bids will be received until 7:30 p. m., March 28, by Common Council, Hastings, Mich., for the necessary labor and material for the improvement of Jefferson St. from Court St. to the south street line of Clinton St., and Green St. from the west line of Jefferson St. to the westerly property line of property owned by Kellar Stem, a length or distance of 5,785 lin. ft. The engineer's estimate includes: 6,880 cu. yds. of excavation, 18,825 sq. yds. of concrete pavement, 11,520 ft. of combined curb and gutter. Plans and specifications may be seen and forms of proposals obtained of James M. Patten, City Clerk, or R. W. Roberts, Engineer, Saginaw, Mich.

✣Bids will be received until 1 p. m., March 15, by Jackson County Road Commissioners, Jackson, Mich., for the improvement of gravel roads in the county as follows: Concord-Jackson Road, No. 12, 5,280 ft. long and 12 ft. wide; No. 5, Jackson-Hanover Road, 5,570 ft. long; No. 1, Jackson-Springport Road, 6,616 ft. long; No. 9, Jackson-Donvill Road 7,592 ft. long; No. 15, Territorial Road, located in Parma Township, 14 ft. wide and 5,280 ft. long.

City Engineer E. W. Hunt, of Battle Creek, Mich., has submitted his report to the City Council, recommending that paving at an estimated cost of $43,000 be laid by the city next summer. The streets to be paved are West Main St., from Kendall St. to Grand Ave., to cost $23,900, and Kendall St., from Upton Ave. to West Main St., to cost $19,100.

The village of Caro, Mich., (population 2,272) plans the construction of about 15,000 sq. yds. of street paving this year. P. O. Riddle is City Engineer.

Minnesota.

The Itasca County Board, Grand Rapids, Minn., has apportioned the road and bridge fund evenly between the five commissioner districts, and is now ready for construction work as soon as the weather will permit.

The Winona County Board, Winona, Minn., has designated state rural highway No. 10, in the western part of the county, from near St. Charles to Elba and Altura, 10 miles. About 22 miles of the new Elwell roads will be completed in this county next summer.

Missouri.

✣Bids will be received early in April, by Fulton Special Road District Commission, for the graveling and hard road finishing of 28 miles of highway. W. R. Heagler, Fulton, Mo., is Engineer of the district.

The City Council of Crookston, Minn., has advertised for bids for the construction of six blocks of Dolarway paving, running north on Broadway for five blocks from the present asphalt paving to Seventh St., past the Court House, and one block east on Seventh St., to Ash. City Engineer E. J. Boyer has estimated the cost at $15,000, or $1.15 per yd.

The Board of Ramsey County Commissioners, St. Paul, Minn., rejected all bids received March 3, for the grading and improving of the Dodd Road because they were above the engineer's estimate. George Ries, County Auditor, will readvertise the work.

Mississippi.

✣Bids will be received until 2 p. m., March 21, by Purchasing Agent A. C. Wright, Kansas City, Mo., for furnishing and delivering asphaltic cement, raw asphalt or raw asphalt and a flux, f. o. b., cars on the railway switch track at the municipal asphalt plant at 20th and Highland in Kansas City. A certified check for 5 per cent of the first $10,000 and 2½ per cent of the balance on the total bid figured on the basis of 1,500 tons, must be filed with each bid.

✣Bids will be received until noon, March 18, by Board of Public Improvements, W. T. Findly, Clerk, St. Louis, Mo., for the construction of street improvements. Bids will be received separately for the following lettings: Letting No. 10862, Wise Ave., from Kingshighway Blvd. to Hereford St.; Letting No. 10863, Vanderburgh Ave., from Shenandoah Ave. northwardly 311 ft.; Letting No. 10864, Cora Ave., from Natural Bridge Ave. to Margaratta Ave.; Letting No. 10865, Louisiana Ave., from Neosho St., to Osceola St.; Letting No. 10866, Penrose St., from Glasgow Ave. to Grove St.; Letting No. 10867, Crittenden St., to Pennsylvania Ave., to Minnesota Ave.; Letting No. 10868, Wilson Ave., from Hereford St. to Cooper St.; Letting No. 10869, Taylor Ave., from Margaratta Ave. to Kossuth Ave.; Letting No. 10870, Bruno Ave., from Forest Ave. to the Wester city limits; Letting No. 10871, Geraldine Ave., from Florrisant Ave., westwardly 215 ft.; Letting No. 10872, improving alleys in City Block 4188, between Gravois Ave., Potomac St., Spring Ave., and Bamberger Ave.

Property owners on Bird St., Hannibal, Mo., at a recent meeting appointed a committee to secure information pertaining to a suitable pavement for that street from Sixth St., west to Maple Ave., and to confer with City Engineer B. F. Smiley and formulate plans, establish grades and prepare specifications.

Montana.

✣Bids will be received until 4 p. m., March 17, by W. R. Call, Town Clerk, Cascade, Mont., for the furnishing of all labor and materials and appliances for the grading of Central Ave., Cascade, Mont., and the construction of cement curbing on said avenue. Plans, specifications, form of bid, contract and bond may be seen at the office of the Town Clerk, Cascade, Mont., or at the office of Swearingen & McCulloh, 60 Tod Bldg., Great Falls, Mont.

Nebraska.

The Board of Public Works of Fremont, Neb., has asked for bids for the paving of Main and Sixth Sts., including 10 blocks of the business section.

New Jersey.

It is the intention of the Mayor and Council of Garfield, N. J., to lay a number of permanent pavements during the coming year. Anton L. Pettersen, Post Office Bldg., Passaic, N. J., is Engineer.

New York.

✣Bids will be received until 11 a. m., March 12, by Department of Public Works, Francis G. Ward, Commissioner, Buffalo, N. Y., for pavement: A separate proposal must be made for the work and supplies included in each descriptive paragraph following: For re-paving Grant St., 32 ft. wide, from a point 295 ft. south of bridge over Scajaquada Creek, to a point 181 ft. south of Amherst St., and to pave 2 ft. wider on each side, so as to create a width of 36 ft. between curbs, except the space occupied by the bridge over Scajaquada Creek, also except the space occupied by the street railway tracks and 2 ft. outside the same, with each kind of pavement for laying of which specifications have been filed by the Commissioner of Public Works. For re-paving Grote St., 24 ft. wide, from the east curb line of Military Road to the west line of the N. Y. C. R. R. right-of-way, and 30 ft. wide from the east line of the N. Y. C. R. R. right-of-way to the west curb line of Elmwood Ave., except the crossing of Bridgeman St., with each kind of pavement for laying of which specifications have been filed by the Commissioner of Public Works. For paving Grant St. 2 ft. wider on each side of the present pavement, so as to create a width of 36 ft., from the south curb line of Bradley St., to a point 295 ft. south of the bridge over Scajaquada Creek, except the space occupied by the N. Y. C. R. R. switch, with each kind of pavement for laying of which specifications have been filed by the Commissioner of Public Works.

⦿Ross & Hollenbeck, of Copenhagen, N. Y., have been awarded the contract by the Onondaga County Board of Supervisors, Frank E. Bogardus, County Superintendent of Highways, Syracuse, N. Y., for the construction of the Baldwinsville-Little Utica-Phoenix County Road 9.36 miles in length, for $51,945. The road will be built of macadam, 10 ft. wide, with a roadway 24 ft. between ditches: also culverts, guard rails, etc. Bids were opened Feb. 24.

⦿John W. Davitt, of Troy, N. Y., has been awarded the contract by the Department of Public Works of Schenectady, N. Y., C. A. Mullen, Commissioner, for the construction of about 100,000 sq. yds. of asphalt paving, as follows: 2-in. stone-filled sheet asphalt wearing surface, per sq. yd., $0.65; 6-in. 1:3:6 Portland cement concrete foundation, per sq. yd., $0.70; 5-year guarantee bond, per square yard, $0.05; total for paving proper, $1.40. Grading, average 8 ins., sandy loam, per sq. yd., $0.16; granite curb, 6x12 ins., set in concrete and backed, $0.80. Bids were opened March 5.

⦿J. G. Wolpert & A. P. Sloan, of Dunkirk, N. Y., have been awarded the contract by the Common Council, Dunkirk, for the sweeping and cleaning of streets for a period of three years, for $0.03¾ per sq. yd. Bids were opened March 4.

The Board of Public Works, Fulton, N. Y., has recommended the paving of West Third St., from the south side of Phillips to the north side of Maple, with concrete, from the north side of Maple St., to the north side of Curtis St., and Phillips from the intersection of West First St., to the tracks of the D. L. & W. Railroad. Schenck St. was recommended to be paved from the west end of the river bridge to the intersection of West First. Worth St., from the intersection of Schenck to the intersection of West First St., and Rochester from First to Second Sts. The Board also instructed the Clerk to obtain prices of street sprinklers suitable for the city streets.

City Engineer E. C. Aldrich, of Auburn, N. Y., on March 4 presented plans and specifications for the paving of James St., with asphalt or vitrified brick to the Common Council. A hearing will be held March 18.

Ohio.

✣Bids will be received until noon, March 19, by Louis R. Schmieder, Village Clerk, Minster, O., for the paving of Main St. from 7th St. to 1st St. and Fourth St., from a point 90 ft. east of Main St. to North St., and for sewers embraced in Resolutions 151, 152 and 153. The specifications and plans are on file with the village Clerk and with George Champe, Engineer, 610 Nasby Bldg., Toledo, O. The approximate quantities included are as follows, (1) standing for Main St., and (2) for Fourth St.:

Grading	15,679 cu. yds.	6,790 cu. yds
12-in. pipe sewer	480 lin. ft.	440 lin. ft.
10-in. pipe sewer	2,725 lin. ft.	1,320 lin. ft.
15 in. pipe sewer	500 lin. ft.	
8-in. pipe sewer	4,115 lin. ft.	110 lin. ft.
6-in. pipe sewer	480 lin. ft.	430 lin. ft.
Manholes	5	4
Catch basins	30	27
Inlets	8	5
Inlets, reset	4	12
Track drains	2	
Straight curb	10,042 lin. ft.	5,130 lin. ft.
Circular curb	383 lin. ft.	560 lin. ft.
Marginal curb	290 lin. ft.	790 lin. ft.
4-in. drain tile	10,000 lin. ft.	5,000 lin. ft.
Extra concrete	50 cu. yds.	50 cu. yds.
Pavement—		
Village portion	18,119 sq. yds.	13,925 sq. yds.
Railroad portion	4,837 sq. yds.	98 sq. yds.
Filler	22,956 sq. yds.	14,023 sq. yds.

✣Bids will be received until noon, March 19, by Jacob Krollmann, Jr., Village Clerk, Cheviot, O., for furnishing the necessary labor and material for the improvement of the following streets: Francis Ave., from Harrison Ave. to Harding Ave., and Lora Ave., from Francis Ave. to the west corporation line, by grading the same, setting cement combined curb and gutters, macadamizing the roadway and rolling the same, and constructing the necessary basins and drains, in accordance with the plans and specifications now on file in the office of the Village Clerk.

✣Bids will be received at the office of the State Highway Commissioner, at Columbus, O., until 2 p. m., March 21, 1913, for grading and paving with water-bound macadam, The Turnpike No. 3 Road. State Highway "A" Pet. No. 515 in Upper Twp., Lawrence County. Length, 6,500 ft., or 1.23 miles. Width of pavement, 16 ft. Estimated cost of construction, $12,112. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner, at Columbus, O., until 2 p. m., March 21, 1913, for grading and paving with water-bound macadam, Sec. 1 The Tiffin Road. State Highway "F" Pet. No. 419 in Richmond Twp., Huron County. Length, 9,850 ft., or 1.87 miles. Width of pavement, 12 ft. Estimated cost of construction, $14,462. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner, at Columbus, O., until 2 p. m., March 21, 1913, for grading and paving with water-bound macadam, The Delta & Swanton Road. State Highway "B" Pet. No. 605 in Swan Creek Twp., Fulton County. Length, 5,280 ft., or 1.00 miles. Width of pavement, 12 ft. Estimated cost of construction, $6,292. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received until 10 a. m., April 7, by Board of Stark County Commissioners, Canton, O., for the construction of the Alliance-Harrisburg road improvement consisting of 9.69 miles of brick pavement in accordance with plans and specifications on file with J. H. McConnell, County Auditor. Bids to be received on the above work as a whole and in two separate sections of 4.81 miles and 4.88 miles, and the following are the estimated quantities to be used in constructing said road (for 9.69 miles): 46,843 cu. yds. excavation, including approaches; 102,326 lin. ft. standard concrete curb; 102,326 lin. ft. of 4x15-in. stone curb; 16 lin. ft. standard marginal concrete curb; 85,272 sq. yds. 4-in. concrete base; 85,272 sq. yds. 6-in. crushed slag base; 85,272 sq. yds. 4-in. vit. brick pavement—tar filler; 85,272 sq. yds. 4-in. vit. brick pavement—grout filler; 85,272 sq. yds. 4-in. vit. brick pavement—sand filler; 492 lin. ft. 6-in. vit. sewer pipe—relaid; 254 lin. ft. 8-in. vit. sewer pipe—relaid; 164 lin. ft. 10-in. vit. sewer pipe—relaid; 66 lin. ft. 12-in. vit. sewer pipe—relaid; 26 lin. ft. 15-in. vit. sewer pipe—relaid; 18 lin. ft. 12-in. cast iron pipe—relaid; 40 trees destroyed and removed. For 4.81 miles—Section No. 1 Lexington & Marlboro Tps.: 28,513 cu. yds. excavation, including approaches; 50,704 lin. ft. standard concrete curb; 50,704 lin. ft. 4x15-in. stone curb; 42,253 sq. yds. 4-in. concrete base; 42,253 sq. yds. 6-in. crushed slag base; 12,253 sq. yds. 4-in. vit. brick pavement—tar filler; 42,253 sq. yds. 4-in. vit. brick pavement—grout filler; 42,253 sq. yds. 4-in. vit. brick pavement—sand filler; 266 lin. ft. 6-in. vit. sewer pipe—relaid; 68 lin. ft. 8-in. vit. sewer pipe—relaid; 36 lin. ft. 10-in. vit. sewer pipe—relaid; 14 lin. ft. 12-in. vit. sewer pipe—relaid; 26 lin. ft. 15-in. vit. sewer pipe—relaid; 18 lin. ft. 12-in. cast iron pipe—relaid; 20 trees destroyed and removed. For 4.88 miles—Section No. 2—Nimishillen Tp.: 18,330 cu. yds. excavation, including approaches; 51,622 lin. ft. standard concrete curb; 51,622 lin. ft. 1x15-in. stone curb; 16 lin. ft. standard marginal concrete curb; 43,019 sq. yds. 4-in. concrete base; 43,019 sq. yds. 6-in. crushed slag base; 43,019 sq. yds. 4-in. vit. brick pavement—tar filler; 43,019 sq. yds. 4-in. vit. brick pavement—grout filler; 43,019 sq. yds. 1-in. vit. brick pavement—sand filler; 226 lin. ft. 6-in. vit. sewer pipe—relaid; 186-lin. ft. 8-in. vit. sewer pipe—relaid; 128 lin. ft. 10-in. vit. sewer pipe—relaid; 52 lin. ft. 12-in. vit. sewer pipe—relaid; 20 trees removed and destroyed. Each bid must be accompanied by a certified check in the sum of $500, payable to the Board of Stark County Commissioners.

✣Bids will be received until 10 a. m., March 24, by Board of Stark County Commissioners, Canton, O., for the construction of the Alliance-Minerva or Fairmount Road Extension Road improvement, including 2.153 miles of brick pavement in accordance with plans and specifications on file with J. H. McConnell, County Auditor. The following are the estimated quantities to be used in constructing said road, viz.: 13,740 cu. yds. excavation, 22,720 lin. ft. standard concrete curb, 22,720 lin. ft. 4x15-in. stone curb, 18,917 sq. yds. 6-in. slab base, 18,917 sq. yds. 4-in. concrete base, 18,917 sq. yds. brick pavement—tar filler, 18,917 sq. yds. brick pavement—grout filler, 18,917 sq. yds. brick pavement—sand filler; 200 lin. ft. 8-in. vit. sewer pipe—furnished and laid, 200 lin. ft. 12-in. vit. sewer pipe—furnished and laid, 20 trees destroyed (6-in. diameter or over). Each bid must be accompanied by a certified check in the sum of $500, payable to the Board of Stark County Commissioners.

✣Bids will be received until 10 a. m., March 31, by Board of Stark County Commissioners, Canton, O., for the construction of the Canton-Cairo North Market St. road improvement comprising 5.667 miles of brick pavement in accordance with plans and specifications on file with J. H. McConnell Stark County Auditor. The following are the estimated quantities to be used in constructing said road, viz.: 30,277 cu. yds. excavation, including approaches: 59,850 lin. ft. standard concrete curb, 16 lin. ft. concrete marginal curb, 59,850 lin. ft. 4x15-in. stone curb, 49,875 sq. yds. 4-in. concrete base, 49,875 sq. yds. 6-in. slag base, 49,875 sq. yds. 4-in. brick pavement—tar filler, 49,875 sq. yds. 4-in. vit. brick pavement—grout filler, 49,875 sq. yds. 4-in vit. brick pavement—sand filler, 48 lin. ft. 24-in. cast iron pipe—relaid, 36 lin. ft. 12-in. cast iron pipe—relaid, 38 lin. ft. 15-in. vit. sewer pipe—relaid, 776 lin. ft. 12-in. vit. sewer pipe—relaid, 157 lin. ft. 10-in. vit. sewer pipe—relaid, 540 lin. ft. 8-in. vit. sewer pipe—relaid, 16 lin. ft. 6-in. vit. sewer pipe—relaid, 20 trees grubbed and destroyed. Each bid must be accompanied by a certified check in the sum of $500, payable to the Board of Stark County Commissioners.

✣Bids will be received at the office of the State Highway Commissioner, at Columbus, O., until 2 p. m., March 21, 1913, for grading and paving with water-bound macadam, The Port Clinton & Locust Point Road. State Highway "B" Pet. No. 479 in Erie Twp., Ottawa County. Length, 6,546 ft., or 1.24 miles. Width of pavement, 10 ft. Estimated cost of construction, $7,009. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the Township Trustees and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner, at Columbus, O., until 2 p. m., March 21, 1913, for grading and paving with bituminous concrete pavement, The Circleville & London Road. State Highway "B" Pet. No. 544 in Darby Twp., Pickaway County. Length, 5,280 ft., or 1.00 mile. Width of pavement, 14 ft. Estimated cost of construction, $9,918. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner, at Columbus, O., until 2 p. m., March 21, 1913, for grading and paving with water-bound macadam, The Bucyrus-Mansfield Road. State Highway "B" Pet. No. 631 in Jefferson Twp., Crawford County. Length, 6,200 ft., or 1.17 miles. Width of pavement, 12 ft. Estimated cost of construction, $7,460.02. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioners.

✣Bids will be received at the office of the State Highway Commissioner, at Columbus, O., until 2 p. m., March 21, 1913, for grading and paving with water-bound macadam, The Angola-Madison Twp. Road. State Highway "E" Pet. No. 575 in Madison Twp., Williams County. Length, 10,599.3 ft., or 2.01 miles. Width of pavement, 14 and 20 ft. Estimated cost of construction, $16,678. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received until noon, March 19, by Jacob Krollmann, Jr., Village Clerk, Cheviot, O., for furnishing the necessary labor and materials for improving Center St., from Wardall St. to the corporation line in Walnut St., 50 ft. in width, 30 ft. between curb lines, by grading the same, setting cement combined curbs and gutters, macadamizing the roadway and rolling the same, and constructing the necessary basins and drains, in accordance with the plans and specifications on file in the office of the Village Clerk.

✣Bids will be received until noon, March 15, by Pike Commissioners of Brooks Free Turnpike Road, at the office of the County Surveyor, Marion, O., for grading, rolling and macadamizing of said Free Turnpike Road, located in Salt Rock and Grand Prairie Townships, Marion County, Ohio, according to specifications, plat, profile, which are on file and may be seen in the office of the County Surveyor. Estimated cost of construction, $13,738.

✣Bids will be received until noon, March 20, by W. J. Springborn, Director of Public Service, Cleveland, O., for the purchase of a motor truck for the street cleaning department. W. H. Kirby is Secretary.

✣Bids will be received until noon, April 7, by Village Council, Matamoras, O., at the office of the Village Clerk, for furnishing the necessary labor and material for the improvement of Cougler St., from the northeasterly line of Fourth St. to the southwesterly line of Main

St., by excavating, grading, filling, preparing foundations, placing of drain pipes, constructing catch basins, constructing a curb on each side of said roadway, and the paving of said roadway with brick paving block to the width of 16 ft., in accordance with the plans, grades, specifications, and profiles of the proposed improvement heretofore prepared by A. F. Cole, as Engineer of said village, and now on file in the aforesaid office of the aforesaid Clerk.

✣Bids will be received until noon, March 18, by W. J. Springborn, Director of Public Service, Cleveland, O., for furnishing creosoted wood blocks and planking. Specifications are on file with the Chief Engineer. W. H. Kirby is Secretary.

✣Bids will be received until noon, April 3, by H. B. Pugsley, Clerk, Chagrin Falls, O., for furnishing material and labor necessary for the grading, draining, curbing and paving of Front and Bell Sts., from the east line of Main St. to the west line of the intersection of Russell Road. Said bids will be received in accordance with the plans and specifications on file at the office of said Clerk and at the office of Wm. H. Evers Engineering Co., 332 The Arcade, Cleveland, Ohio. A certified check for $500 must be filed with each bid.

✣Bids will be received until noon, March 20, by Village Council, Waterville, Lucas County, O., for furnishing the necessary labor and materials for paving with vitrified paving bricks or blocks, asphaltic concrete, bituminous concrete or treated macadam, as the Council may select, together with the necessary curbing and drainage and otherwise improving Fourth St. from the south line of Elm St. to the north line of Wood St., according to the plans and specifications therefor, on file in the office of the Village Clerk. Estimated quantity of paving, 4,400 sq. yds. Each bid must be accompanied by a cash deposit or a certified check on some solvent bank, payable to the order of the Village Clerk, for $500. Plans and specifications can be seen and forms of proposals obtained at the office of the Village Clerk, or the Engineers, The Smith & Boulay Co., 322 The Nasby, Toledo, Ohio. C. J. Fisher is Clerk.

✣Bids will be received until noon, April 4, by Board of Hamilton County Commissioners, Cincinnati, O., for the improvement under Specifications No. 436 of the North Bend Road from Hamilton pike to Carthage in Springfield and Mill Creek Townships. A certified check for $2,000 must be filed with each bid. Albert Reinhardt is Clerk of the Board.

✣Bids will be received until noon, March 20, by Director of Public Service, Cambridge, O., for 6,070 sq. yds. of street paving. Bids will be taken separately on paving block. A large volume of municipal work will follow soon, approximating $125,000. Karl M. Cosgrove is City Engineer.

✣Bids will be received until noon, March 21, by Director of Public Service R. A. Burton, Clerk, St. Marys, O., for the furnishing of the necessary labor and material for the improvement of South St., section 1, from the east line of Perry St. to the west line of Wayne St.; section 2, from the east line of Wayne St. to the west line of Main St.; section 3, from east line of Main St. to the west line of Front St., of the City of St. Marys, O., by grading, paving the roadway with a first-class quality of paving brick, setting curb, constructing the necessary drains, inlets and retaining walls, all in accordance with the plans, profiles and specifications now on file in the office of the Director of Public Service of the City of St. Marys, O. The following is a statement of the approximate quantities required in the improvement of South St: 2,665 sq. yds. brick paving; 2,148.3 cu. yds. excavation; 1,200 lin. ft. new curbing; 650 lin. ft. old curbing reset.

✣Bids will be received until noon, March 21, by Director of Public Service R. A. Burton, Clerk, St. Marys, O., for the furnishing of the necessary labor and material for the improvement of Chestnut St., from north line of Spring St. to the south line of High St., of the City of St. Marys, O., by grading, paving the roadway with a first-class quality of paving brick, setting curb, constructing the necessary drains, inlets and retaining walls, all in accordance with the plans, profiles and specifications now on file in the office of the Director of Public Service of the City of St. Marys, O. The following is a statement of the approximate quantities in the improvement of Chestnut St.: 1,120 sq. yds. brick paving; 637.1 cu. yds. excavation; 252 lin. ft. new curbing; 252 lin. ft. old curbing reset.

✣Bids will be received until noon, March 21, by Director of Public Service R. A. Burton, Clerk, St. Marys, O., for the furnishing of the necessary labor and material for the improvement of Walnut St. from north line of Spring St. to the south line of High St. of the City of St. Marys, O., by grading, paving the roadway with a first-class quality of paving brick, setting curb, constructing the necessary drains, inlets and retaining walls, all in accordance with the plans, profiles and specifications now on file in the office of the Director of Public Service. The following is a statement of the approximate quantities required in the improvement of Walnut St.: 1,130 sq. yds. of brick paving; 555.2 cu. yds. of excavation; 380.4 lin. ft. new curbing; 126.8 lin. ft. old curbing reset.

✣Bids will be received until noon, March 21, by Director of Public Service R. A. Burton, Clerk, St. Marys, O., for the furnishing of the necessary labor and material for the improvement of Spruce St., section 1, from the south line of Canal St. to the south curb line of Bates ave.; section 2 of said Spruce St., from the south curb line of Bates Ave. to the south line of Spring St.; section 3 of said Spruce St. from the north line of Spring St. to the south line of High St.; section 4 of said Spruce St. from the north line of High St. to the north line of Oil St. of the City of St. Marys, O., by grading, paving the roadway with a first-class quality of paving brick, setting curb, constructing the necessary drains, inlets and retaining walls, all in accordance with the plans, profiles and specifications now on file in the office of the Director of Public Service of the City of St. Marys, O. The following is a statement of the approximate quantities required in the improvement of Spruce St.: 10,250 sq. yds. of brick paving; 7,077.8 cu. yds. excavation; 2,600.0 lin. ft. new curbing; 2,800.0 lin. ft. old curbing reset; 1,380.0 lin. ft. 18-in. sewer; 528.0 lin. ft. 10-in. sewer; 5 man holes; 18 catch basins

✣Bids will be received until noon, March 21, by Director of Public Service R. A. Burton, Clerk, St. Marys, O., for the furnishing of the necessary labor and material for the improvement of Main St. from north line of Spring St. to the south line of High St. of the City of St. Marys, O., by grading, paving the roadway with a first-class quality of paving brick, setting curb, constructing the necessary drains, inlets and retaining walls, all in accordance with the plans, profiles and specifications now on file in the office of the Director of Public Service of the City of St. Marys, O. The following is a statement of the approximate quantities required in the improvement of Main St.: 1,952 sq. yds. of brick paving; 956.2 cu. yds. of excavation; 725 lin. ft. new curbing. A certified check for $500 must be filed.

✣Bids will be received until noon, March 26, by Board of Lake County Commissioners, Painesville, O., for furnishing necessary labor and materials for the construction of 3½-mile brick road 14 ft. wide with stone or concrete curb in Willoughby Township. Specifications are on file with the Board. W. A. Davis is Secretary.

✣Bids will be received until noon, March 22, by C. C. Sharp, Director of Public Service, Nelsonville, O., for the improvement of Madison St. from the north side of Washington St. to the south side of Frank St. extended, by grading and constructing upon the roadway thereof an 18-ft. second class vitrified block pavement, setting curb and constructing the necessary catch basins and drainage for said improvement according to the specifications now on file in the office of the Director of Public Service of said city.

✣Bids will be received until noon, March 31, by W. H. Linton, Director of Public Service, Ravenna, O., for the improvement of Cleveland Ave. and North Chestnut St. The approximate quantities included are as follows: (1) standing for Cleveland Ave. and (2) for N. Chestnut St.:

	(1)	(2)
Sq. yds. of paving	6,930	3,280
Lin. ft. of straight curbing	4,805	2,060
Lin. ft. of circle curbing	131	40
Lin. ft. of abutment curbing	176	48
Number of manboles	14	13
Number of catch basins	13	12
Number of small openings	6	6
2-in. drain tile, appr	1,000	1,000
3-in. drain tile, appr	1,200	1,000
Cast iron monument covers	6	4
Sq. ft. of sidewalk relaid, appr	2,000	2,500
Cu. yds. extra excavation, appr	2,000	2,000
Number of private driveways and approaches, approximately	15	20
Cu. yds. reinforced concrete Wahoo culvert	160	..

✣Bids will be received until March 18 by W. J. Springborn, Director of Public Service, Cleveland, O., for paving with creosote wood blocks Eagle Ave., between E. 4th St. and E. 9th St. The cost is estimated at $10,000. W. H. Kirby is Secretary.

✣Bids will be received until noon, March 25, by W. E. Morgan, Clerk, Geneva, O., for the construction of 5,088 sq. yds. of brick pavement on concrete foundation and with Portland cement grout filler. The work will require 2,182 cu. yds. of excavation. Cumings & Downer, Painesville, O., are Engineers.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 o'clock p. m., March 31, 1913, for grading and paving with brick for medium triffic Sec. 1 The Woodsfield Northern road, State Highway "D" Pet. No. 395, in Center Twp., Monroe Co. Length 4,224 ft. or 0.80 miles. Width of pavement 12 ft. Estimated cost of construction, $15,866. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James T. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., March 21, 1913, for grading and paving with water-bound macadam Sec. 2, The Bell Road, State Highway "C," Pet. No. 479½, in Erie Twp., Ottawa Co. Length 4,770 ft. or 0.90 miles. Width of pavement, 10 ft. Estimated cost of construction, $4,620. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the Township Trustees and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the County Commissioners, at Medina, Ohio, until 10 a. m., March 26, 1913, for grading and paving with brick pavement for heavy traffic The Wadsworth Wooster road, State Highway "C," Pet. No. 548, in Wadsworth Twp., Medina Co. Length, 3,891.2 ft. or .74 mile. Width of pavement, 10 ft. Estimated cost of construction, $9,794. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., March 21, 1913, for grading and paving with bituminated concrete The Scotland Station Easterly road, State Highway "E," Pet. No. 537, in Chester Twp., Geauga Co. Length, 5,800 ft., or 1.10 miles. Width of pavement, 14 ft. Estimated cost of construction, $10,966. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the County Commissioners, at Medina, Ohio, until 10 a. m., March 26, 1913, for grading and paving with water-bound macadam Sec. 1, Medina Wooster road, State Highway "D," Pet. No. 546, in Montville Twp., Medina Co. Length, 5,164 ft., or .98 mile. Width of pavement, 10 ft. Estimated cost of construction, $5,673. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until two p. m., March 21, 1913, for grading and paving with water-bound macadam Sec. 2, The Galion road, State Highway "G," Pet. No. 385, in Sandusky Twp., Richland Co. Length, 11,485 ft., or 2.21 miles. Width of pavement, 12 ft. Estimated cost of construction, $9,753. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker, Columbus, O., is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., March 21, 1913, for grading and paving with brick pavement for heavy traffic The Akron-Canton road, State Highway "F," Pet. No. 495, in Springfield Twp., Summit Co. Length, 10,200 ft., or 1.93 miles. Width of pavement, 13-14 ft. Estimated cost of construction, $32,204. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the County Commissioners, at Cleveland, Ohio, until 10 a. m., March 25, 1913, for grading and paving with brick pavement for heavy traffic, The No. 3 Improvement Richmond road, State Highway "D," Pet. No. 374, in Euclid Twp., Cuyahoga Co. Length, 7,000 ft., or 1.33 miles. Width of pavement, 14 ft. Estimated cost of construction, $33,892. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker, Columbus, O., is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., March 31, 1913, for grading and paving with water-bound macadam The Beatty road, State Highway "C," Pet. No. 488, in Cardington Twp., Morrow Co. Length, 10,144 ft., or 1.92 miles. Width of pavement, 14 ft. Estimated cost of construction, $14,315. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker, Columbus, O., is State Highway Commissioner.

⊙John Wilson, Alliance, O., has been awarded the contract by the Stark County Commissioners, Canton, O., for the Ely St. and Harrisburg road improvement, for $17,440. Bids were opened March 5 by J. H. McConnell, County Auditor.

⊙Urbon & Clemintz, Massillon, O., have been awarded the contract by the Stark County Commissioners, Canton, O., for the construction of the Wooster Road extension, for $72,351. Bids were opened March 3 by J. H. McConnell, County Auditor.

⊙Peter H. Watters has been awarded the contract by the Board of Control, Toledo, O., for paving Ewing St., from Vance St. to Hamilton Ave., for $8,122.

⊙The Board of Control of Youngstown, O., has awarded the contract for the paving of South Hazel St., between Front and Boardman Sts., to James McCarren.

The City Council of Wilmington, O., has retained F. H. Beckler, of Athens, O., as paving engineer. The contract calls for an oversight of all engineering work connected with the paving of Wilmington streets. The engineer is to make all surveys, plans and specifications. It is planned to pave South St. from Columbus St. to the Pennsylvania Railroad; Locust St. from Mulberry St. to the railroads; and Main St. from Mulberry to Walnut St.

The City Council of Dayton, O., is considering legislation for the paving, with creosoted wood block, of Grand Ave., between Salem Ave. and Broadway.

The City Council of New Philadelphia, O., has passed an ordinance providing for the paving of Tuscarawas Ave., from the end of W. Fair St. to the Canal Dover corporation line. Bonds in the sum of $23,000 will be issued to pay the city's portion of the paving cost.

Oregon.

✣Bids will be received until March 25 by the City Council, The Dalles, Ore., for the construction of bitucrete, bitulithic, asphaltic concrete, dolarway, or Hassam pavement. C. L. White is City Engineer.

⊙The Warren Construction Co., Beck Bldg., Portland, Ore., has been awarded the contract by the City Council of that city for the improvement of Thompson St. et al., by grading, constructing artificial stone sidewalks and curbs and gravel bitulithic pavement, for $99,819. Bids were opened Feb. 26.

The city of Independence, Ore., plans the construction of hard-surface pavement on several streets this summer.

The City Council of The Dalles, Ore., will shortly advertise for bids for the construction of more than two miles of street paving. Bids are to be asked on bitulithic, Hassam, Dolarway, asphaltic concrete and bitulithic hard-surface. C. L. White is City Engineer.

The City Council of McMinnville, Ore., proposes to pave approximately 50 blocks of streets with a hard-surface pavement. R. W. Jones is City Engineer.

Pennsylvania.

✣Bids will be received until 10 a. m., March 18, by City Controller, Pittsburgh, Pa., for furnishing the Department of Supplies the following: Street flushers, sprinklers, sweepers, dump wagons, one (1) automobile for Bureau of Highways and Sewers, one automobile for Bureau of Building Inspection, two automobiles for Department of Health, buggies, harness, 9,000 ft. more or less street hose, patrol carts and cans, rubbish or waste paper cans and street signs for the Bureau of Highways and Sewers. Bids will also be received for furnishing the following items for the fiscal year: Antitoxin, asphalt and asphalt plant supplies, hauling, disinfectants, telephone service, scrap, castings, rectifier bulbs, sand and gravel, lime, plaster and cement, street signs and posts, stone, sewer pipe and fittings, ice and water, fuel, oils and grease, push brooms, clothing, shoes, sawdust, incandescent lamps, police and fire alarm equipment, yeast, carbons and blue printing. Specifications and blanks for bidding may be secured at the office of the Department of Supplies, 507 Oliver Building.

✣Bids will be received until noon, March 21, by Henry M. Brownback, U. S. Post Office Bldg., Norristown, Pa., for removing the present driveway at this building and laying a granolithic driveway.

⊙G. F. Roess and J. M. Lesher, Oil City, Pa., have been awarded the contract by the borough of Greenville, Pa., for grading, paving and curbing, to cost $70,000.

⊙James McGowan & Co., East End Av., Pittsburgh, Pa., have been awarded the contract by F. E. Phelps, Capt., Acting Quartermaster, Pittsburgh, Storage & Supply Depot, Pittsburgh, Pa., for the construction of concrete sidewalks, driveway and curbing, for $1,109. Bids were opened March 1.

Only two bids were submitted to the Department of Public Works, Philadelphia, Pa., Morris L. Cooke, Director, on March 3, for the building of the Northwest Blvd., the McNichol Paving & Construction Co. of that city being low bidder. The contract awarded last year for this work was declared null and void. There is $1,000,000 available for the construction of the boulevard. The following comparative unit prices asked by the McNichol Co., under the proposals opened March 3 and the prices bid by the concern for the like work under the annulled contract:

	Old contract price.	New bid price.
122,000 sq. yds. bituminous pavement	$1.37	$1.25
223,700 sq. yds. bituminous pavement	1.37	1.20
69,000 cu. yds. waterbound macadam	.97	.94
402,729 cu. yds. grading	.51	.52
59,000 sq. yds. brick gutters (concrete base)	1.85	2.25
68,700 lin. ft. 8-in. steel protected concrete curb	.84	.64
49,200 sq. yds. cement sidewalks	1.09	1.80
431,800 sq. yds. grass seeding	.01½	.01
3,560 ft. 3x2 brick sewers	5.52	3.84
1,420 lin. ft. 3-ft. brick sewers, vitrified shale brick invert	4.76	6.48
945 lin. ft. 3-ft. brick sewers	7.37	7.32
115 lin. ft. 5-ft. brick sewers, stone block invert	8.35	18.78
110 No. 2 inlets	96.00	75.00
144 No. 3 inlets	90.00	68.00
54 standard manholes	50.00	52.20
155 cu. yds. concrete masonry	6.50	7.50
485 cu. yds. rubble masonry	4.25	5.00
375 lin. ft. 4-ft. brick sewers	9.36	8.96
575 lin. ft. 3.6-ft brick sewers, stone block invert, 10-in. vitrified pipe	6.64	10.59
3,760 lin. ft. 2.6x1.8 sewer	5.00	4.56
3,300 lin. ft. guard rail	.30	.69

The bids were laid over to be scheduled. The Hassam company's bid for bituminous pavement was $1.70 per sq. yd.

The City Council of Pittsburgh, Pa., is considering an ordinance authorizing the regrading and general improvement of W. Liberty Ave., from Warrington Ave. to the city line near Dormont. This improvement covers 1½ miles of highway and will connect up the McKinley Park section with the Dormont district with a modern thoroughfare. The estimated cost of the work is about $300,000.

Texas.

⊙The city of Austin, Tex., has awarded a contract for the paving, curbing and gutter-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ing and for constructing walks around the campus of the University of Texas, to Johnson & Miller. The contract calls for 41,904 sq. ft. of sidewalks, 5,238 lin. ft. of gutter and 2,700 ft. of curb. Work will be started at once.

The citizens of Matagorda County, Tex., on March 1 voted the issuance of bonds to the amount of $300,000 for the construction of good roads. Bay City is the county seat.

The Eureka Construction Co. submitted the lowest bid to the City Council of Houston, Tex., on March 3, for the laying of asphalt pavement on Capitol Ave., between Caroline and Chartres Sts. The bid was $1.74 per sq. yd., or $1.79 with a five-year guarantee. Roach-Manigan Paving Co., of Fort Worth, bid as follows for laying creosoted wood paving blocks on both Holman and Lamar Sts.: For 3-in. wood blocks, $2.62 a sq. yd., with five-year guarantee, $2.64; for 3½-in. blocks, $2.89, and with five-year guarantee, $2.90. The same blocks laid on concrete bases: 3-in., $2.58, with five-year guarantee, $2.59; 3½-in., $2.90, with five-year guarantee, $2.91. The Creosoted Wood Block Paving Co. bid as follows on the same streets: 3-in. wood blocks, $2.63, with 5-year guarantee, $2.66; 3½-in. blocks, $2.88, with 5-year guarantee, $2.91. The same when laid on concrete base; 3-in., $2.53¼, with 5-year guarantee, $2.60; 3½-in. $2.84, with 5-year guarantee, $2.87.

Utah.

The Utah Senate on March 1 passed the state highway bill, carrying an appropriation of $97,200.

Vermont.

The town of Brattleboro, Vt., has appropriated $2,500 for the construction of Chestnut Hill Ave. Henry R. Brown is Road Commissioner.

Washington.

✣Bids will be received until 2 p. m., March 21, by Board of Supervisors, Douglas County, Wenatchee, Wash., for the grading and surfacing with water-bound macadam a road 20 ft. wide in from the Columbia River bridge north, in Local Improvement District No. 2.

⊙The Board of Public Works of Seattle, Wash., on March 1 awarded the contracts for grading and constructing cement sidewalks on N. 45th St. to Henry Brice for $1,457 and $1,345. The Independent Asphalt Co. secured the contract to pave 23d St., et al., for $9,264.

The City Council of South Bend, Wash., has laid out the first work that will be attempted by the city with the new municipal paving plant. Ten blocks of concrete are planned, the work being divided into two districts adjoining either end of the paving laid last summer. Cement sidewalks 16 ft. in width are provided for on all streets except A, where 10 ft. walks will be built. V. M. Eager is City Engineer.

Following low bids were received by the city of Centralia, Wash., on March 1, for the paving of Main St.: Cascade Construction Co., North Yakima, $36,229, on 5-in. 2-course concrete; H. C. Malott, Seattle, $35,930, on 6-in. 2-course concrete, and $35,095 on 6-in. Dolarway; Alread & James, Centralia, $33,044 on 6-in. monolithic.

The City Commission of Centralia, Wash., has passed resolution to pave five of the principal residence streets. The Commission also voted to hereafter furnish cement, sand and gravel for all paving contracts let by the city. Stanley Macomber is City Engineer.

West Virginia.

✣Bids will be received until noon, April 10, by Marion County Court, Fairmount, W. Va., for the construction of 32.7 miles road, including grading, etc., in Mannington District, Marion County, according to the plans and specifications prepared by J. Russell Wilson, Civil Engineer, Washington, Pa. Plans and specifications will be found in the office of the Engineer, National Bank of Mannington Bldg., Mannington, W. Va., 163 South Main St., Washington, Pa., and the office of the County Clerk, Fairmont, W. Va.

⊙Freshwater Bros., of Chester, W. Va., have been awarded the contract for paving a mile of the Salineville Road, extending from the corporation line of Wellsville, O. The contract was awarded by the Columbiana County Commissioners, Lisbon, O.

Wisconsin.

⊙George R. Wade of Kenosha, Wis., has been awarded the contract by that city for the construction of brick pavement on Salem Ave., from Howland Ave. to the city limits and Grand Ave., from Brockett St. for $1.70 and $1.68 per sq. yd., respectively. The totals are $24,540 and $7,497. The White Construction Co. bid $6,820 for the contract to construct asphalt pavement on Pearl St.

⊙The Weber-Nelson Co. of Oconomowoc, Wis., has been awarded the contract by the city of Columbus, Wis., Walter A. Pierce, City Engineer, for the construction of 8,625 sq. yds. of pavement, 5,080 lin. ft. of curb and gutter and 1,850 yds. of excavation, for about $22,000. A list of the itemized bids was given in our last issue.

Canada.

⊙F. D. Cummer & Son Co., Cleveland, O., has been awarded the contract by the Board of Control, Winnipeg, Man., M. Peterson, Secy., for supply of steel casing for sand dryer, for $250. Bids were opened Feb. 21.

⊙A. E. Gardner Machine & Motor Co., Saskatoon, Sask., has been awarded the contract by the City Commissioners, Saskatoon, for furnishing one 1,000-lb. electric service trunk, for $3,070. Bids were opened Feb. 28.

⊙The Studebaker Bros. Co., Minneapolis, Minn., has been awarded the contract by the Board of Control, Winnipeg, Man., M. Peterson, Secy., for furnishing 50 dump wagon boxes. Bids were opened Feb. 14.

DRAINAGE AND IRRIGATION

Arizona.

⊙Martin & Gillas, Tempe, Ariz., have been awarded a contract at $32,635 for constructing a 4,500 ft. long concrete penstock for the Crosscut power plant near Phoenix.

California.

The Pacific Gas & Electric Co. has opened headquarters in the Arthur Bldg., High St., Auburn, for its construction work in Placer County. It is stated that the company will have about 2,000 men at work in and around Auburn. A steam shovel has been installed on the Ragsdale ranch between Clipper Gap and Bowman. It is said that the company has in view the location for a large reservoir in the Lone Star district.

The Chamber of Commerce of Galt, Cal., has appointed a committee to find out from the District Attorney whether the county can construct a proposed drainage canal from Galt to Dry Creek, sufficiently large to drain the town, or whether it will be necessary to organize a district to do the work.

The Turlock Irrigation District, Turlock, Cal., has taken bids for work on extension of lateral No. 7 near Esmer and on lateral No. 2½ for the Southern Pacific R. R. to the Ceres Main.

Florida.

✣Bids will be received until April 8, by Board of Desoto County Commissioners, Arcadia, Fla., for the construction of 48 miles of drainage ditches in the Murdock drainage district. The work will include about 600,000 cu. yds. of excavation. Cravens & Kimmel, Arcadia, Fla., are Engineers.

Illinois.

✣Bids will be received until 2 p. m., April 3, by John McGillen, Clerk, Board of Trustess, Sanitary District of Chicago, Ill., 1500, 76 W. Monroe St., Chicago, Ill., for the construction of Section 10, Calumet-Sag Channel. The work for which said tenders are invited consists of the excavation and collateral work on contract, section 10, of the Calumet-Sag Channel of the Sanitary District of Chicago, in the Township of Worth, County of Cook, State of Illinois. The approximate quantities to be used in comparison of bids are: (a) 670,000 cu. yds. of excavation of glacial drift; (b) 300,000 cu. yds. of excavation of solid rock; (c) 72,000 sq. yds. of rip-rap slopes; (d) 2,500 lin. ft. of roadway construction; (e) 800 cu. yds. of concrete; (f) 20,000 pounds of reinforcing metal; (g) erection of 48th Ave. bridge (lump sub). Specifications, forms of proposal and plans may be obtained upon payment of $5 at the office of the said District.

The Internal Improvement Commission of Illinois has completed its survey maps and profile for the improvement of the Kaskaskia River, which runs through the eastern section of St. Clair, Shelby, Fayette, Clinton and Randolph counties. It is proposed to widen, straighten and deepen the channel, so that approximately 162,000 acres of low and submerged lands may be reclaimed. The length of the proposed channel is 148 miles. The amount of excavation necessary to straighten the main stream and tributary channels is approximately 11,000,000 cu. yds.; the total river levee, 16,500,000 cu. yds., and the other levees and ditches approximately 7,000,000 yards, or a total of 34,000,000 cu. yds. of fill and excavation. A general estimate of the cost of the reclamation work is $1,065,312.50. It is declared 160,000 acres of fertile lands above New Athens in the Kaskaskia shoal creek bottoms will be reclaimed.

Indiana.

✣Bids will be received until March 15, by Drainage Commissioner at the office of the Madison County Surveyor, Anderson, Ind., for the construction of the W. S. Diven ditch. Specifications are on file at the office of the surveyor.

✣Bids will be received until 2 p. m., March 22, by C. W. Decker, Supt. of Construction at the office of the Wells County Surveyor, Bluffton, Ind., for the construction of the Arthur Kelly ditch.

Iowa.

✣Bids will be received until noon, April 8 (readvertisement), by Board of Woodbury County Supervisors, Sioux City, Ia., for the construction of the Little Sioux Ditch and laterals in the Little Sioux Drainage District No. 2, including 482,696 cu. yds. of material. Plans and specifications can be obtained by addressing E. E. Hosmer, County Auditor.

⊙Contracts for work for Louisa-Des Moines Drainage District No. 4, bids for which were opened Feb. 26, have been let to R. C. Russell, Burlington, Ia., and John Loftus, Burlington. The work calls for an open ditch of 14,000 cu. yds. excavation and tile drains aggregating 12,000 ft., ranging from 8 in. to 20 in. in size.

⊙The Wagner Construction Co., Des Moines, Ia., has been awarded the contract at $8,466 for constructing Drainage Ditch No. 12 of Douglas Township, the work including 1,465 ft., 16 in. tile, 1,650 ft., 18 in. tile, and 5,720 ft. of 24 in. tile. Bids were opened March 3 by H. B. Frase, County Auditor, Des Moines, Iowa.

⊙Rankin & Cowden, Riverton, Ia., have been awarded the contract at $30,834 for constructing in Plum Creek ditch and laterals,

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

bids for which were opened March 5 by F. B. Jenkins, County Auditor, Sidney, Ia. The work consists of about 8 miles of main ditch of 30-ft. bottom, estimated 325,000 cu. yds. pay dirt. The time limit for completion of this section is May 1, 1914, and it can be cut with either a floating or a dragline dredge. There are two lateral ditches: one 4,600 ft. long with 16-ft. bottom, having about 25,000 cu. yds. of excavation. The time limit on this section is Oct. 1, 1913, and it can be cut with either teams or a dragline machine. One lateral is 15,800 ft. long with 10-ft. bottom, having about 21,900 cu. yds. of excavation. The time limit for completion on this section is Oct. 1, 1913, and it can be cut with teams or with a small dragline machine. Seth Dean, Glenwood, Ia., is Construction Engineer.

Matter of establishment of Joint Drainage District No. 17, Emmet and Palo Alto Counties, is still in the court, and for that reason no contract was let on March 4 for the construction work. Bids for this were to have been opened on the above date by Charles A. Root, County Auditor, Estherville, Ia. Section 1 of this district includes a dam and spillway, while Sections 2, 3, 4, 5, 6, 7, 8, and 9 include open ditches, requiring 959,033 cu. yds. of excavation.

Kansas.

A drainage district is to be organized shortly with a view to clearing and straightening the channel of the Shunganunga from Oakland to Tecumseh. Campbell & Griggs, Topeka, Kan., are the Engineers.

Louisiana.

✣Bids will be received until 11 a. m., March 31, by Capt. C. O. Sherrill, U. S. Engineer, Metropolitan Bank Bldg., New Orleans, La., for constructing 210,000 cu. yds. of earthwork in the Lower Tensas and LaFourche Levee Districts.

Minnesota.

⊙A contract has been entered into with R. W. Hale and L. E. Willhide, of Little Fork, Minn., with the Northern Minnesota Drainage Co., for the clearing of the right-of-way and the construction of six culverts, and one bridge. The right-of-way will be cut full 66 ft. wide. The contract involves 272 acres of cutting and burning even with the ground over 34 miles of ditch location.

No bids were received Feb. 20 by C. B. Howard, Freeborn, Minn., for constructing Township Ditch No. 1. The estimated cost was $14.133. The work requires the following vitrified salt glazed or concrete drain tile: 717 ft. of 6-in., av. depth 6.4 ft.; 247 ft. of 7-in., av. depth 5.5 ft.; 2,869 ft. of 8-in., av. depth 5.5 ft.; 2,862 ft. of 10-in., av. depth 6.5 ft.; 1,800 ft. of 12-in., av. depth 5.5 ft.; 1,047 ft. of 15-in., av. depth 4.6 ft.; 2,900 ft. of 16-in., av. depth 6 ft.; 7,000 ft. of 22-in., av. depth 8 ft.; 2,070 ft. of 24-in., av. depth 7.1 ft.; 1,520 ft. of 26-in., av. depth 5.7 ft. Maximum depth, 9.3 ft. E. V. H. Brown, Albert Lea, Minn., is the Engineer.

Mississippi.

✣Bids will be received until 6 p. m., March 26, by Board of Tate County Commissioners, W. E. Still, Secy., Senatobia, Miss., for the construction in two sections of an open ditch. Section 1 will include 65,000 cu. yds. and Section 2, 55,000 cu. yds.

Missouri.

✣Bids will be received until 1 p. m., March 22, by William M. Morris, Secy., Nodaway Drainage District No. 1, Oregon, Mo., for dredge boat work including not less than 140,000 cu. yds.

Petition has been filed in the Circuit Court of Shelby County for extending the boundary of the Valley Drainage District so as to include 4,100 acres additional. The Commissioners to report on benefit and damages began their work on March 2. The extended ditch, it is supposed, will be five miles long. The court will be in session April 2 to hear any exceptions, if any are filed, to the report of the commissioners, hence it cannot be determined until after that date, definitely, just when bonds may be offered for sale. The ditch in the original Valley Drainage District is six miles long, or is to be when completed. Work is now under way and nearly three miles of it is completed. H. A. Wright, Clarence, Mo., is Attorney for the district.

A bill is before the State Legislature to create the office of land reclamation commissioner at an annual salary of $3,000. The bill provides that the duty of the Commissioner is to furnish and diffuse information upon land reclamation, levee work, water power and a wide range of kindred subjects. The bill does not require the commissioner to be an engineer or to possess technical knowledge about drainage or land reclamation. The commissioner may under the bill appoint one stenographer and as many engineers or other employes as he deems necessary, the only limitation in this regard being that he stay within his appropriation.

New Jersey.

✣Bids will be received from 4:30 until 5 p. m., March 17, by Essex County Mosquito Extermination Commission, 800 Broad St., Newark, N. J., for the cutting of 100,000 ft. or more of ditches on the Newark Meadows. Bids will be open at 5 p. m. Plans and specifications of the work can be seen at the office of the commission. The commission reserves the right to reject any and all bids that may be submitted. Each bidder will be required to furnish to the Essex County Mosquito Extermination Commission a certified check or surety bond of $500, which must accompany the bid.

North Dakota.

Two drainage ditches will be constructed this summer by the commissioners of Trail County. One of these will be located south of Mayville and will be about 7½ miles long. Hillsboro is the county seat.

South Dakota.

The Pierre Valley Irrigation Co. has been incorporated with a capital stock of $5,000, the incorporators being J. H. Johnson and L. B. Johnson, of Fort Pierre, and H. C. Carnagey, of Pierre.

Tennessee.

An organization has been formed at Huntingdon, Tenn., for the purpose of draining a portion of the large section of wet land in Carroll County. The present committee is arranging for the preliminary survey of Beaver Creek, Crooked Creek and the Obiou River with a view to forming a Drainage District. The work will require about 30 miles of canal and some 30,000 acres will be affected. There is a considerable area of wet land in this county which is not included in this district. F. Ray Moomaw, County Surveyor, Huntingdon, Tenn., is Chairman of the Committee.

Texas.

✣Bids will be received until March 26 by George B. Merriwether, Chairman Drainage Commissioners Hidalgo Drainage District No. 1, Donna, Texas, for grubbing and clearing right of way about 500 ft. wide, being 37.9 miles and containing 2,310 acres of land in sections 1, 2, 3, 4, 5, 7 and 8 of district; also for 67,000 cu. yds. excavation, erection of bridge and grubbing and clearing about 117 acres of land in strip 500 ft. wide and 1.9 miles through drainage district for drainage purposes in section 6. Further information is obtainable from Chairman of Drainage Commissioners.

Utah.

The Utah Light & Ry. Co., 133 S. West Temple St., Salt Lake City, Utah, will have work started in the spring on an 8-acre 5 ft. deep reserve reservoir, southwest of its power plant, near the mouth of Ogden Canyon.

The Provo Reservoir Co., Provo, Utah, has filed amended articles of incorporation, increasing the capital stock to $200,000.

City Commission of Salt Lake City has appropriated $3,250 with which to build a 400-ft. steel flume on the Salt Lake & Jordan canal to replace the worn-out wooden structure which has carried the waters of the canal to the Mill Creek farmers for the past 30 years. D. H. Blossom is City Enigneer.

Washington.

Advices from Ellensburg state that ranchers under the Cascade canal have voted to bond their land for $600,000 and to form an irrigating district similar to that of the Kittitas high line canal. The bonds were voted for the purpose of constructing a concrete flume and making other necessary improvements to the ditch.

Papers have been filed at Wenatchee by William F. Scheffel appropriating for hydro-electric and irrigation purposes 25,000 ins. per second from the Columbia River at Rock Island. Scheffel is reported to represent T. J. Perrine, the electrical engineer who installed the hydro-electric plant at Twin Falls, Idaho.

WATER WORKS

Arkansas.

✣Bids will be received until March 28 by Board of Improvement, Water Works District No. 3, Clarksville, Ark., for the following: (1) 380 tons of c. i. pipe and special castings; (2) 40 4-in. to 8-in. d. g. valves and 39 hydrants; tank and tower; pump and motor; (3) for the construction of the water works system. Plans and specifications are on file at the offices of the Secretary and the Engineers. Copies of the plans and specifications of parts (2) and (3) for personal use may be obtained from the Engineers by remitting $1.00 and $2.50 respectively. D. Ward Dunlap, Secretary; Winters & Dove, Engineers, 311 Merchant's Nat'l Bank Bldg., Fort Smith, Ark.

The Hot Springs Water Co., Hot Springs, Ark., has increased its capital stock from $80,000 to $500,000. Improvement work is contemplated.

California.

✣Bids will be received at once by the Sacramento Valley Land & Water Co., Oakland, Cal., for the construction of a rubble dam, containing approximately 350,000 cu. yds. of masonry. This dam will be 250 ft. high, 800 ft. long on the crest, built onto and into the solid rock on the bottom and on both sides. The contractor will be required to take 30-year six per cent gold bonds callable at one five (S105) with interest. Any contractor interested in this should visit the location and fully acquaint himself with the local conditions governing the conditions applicable to this project. The sale of water rights to the water users on 160,000 acres at $20 per acre, builds and completes this project. None of this money is available, however, until after the project is completed, making it necessary to issue bonds, as it will take from 8 to 10 years to irrigate the entire acreage, due to a lack of population, but which is sure to come with the opening of the Panama Canal. R. F. Stone, President. Address branch office, Davis, Cal.

The Pacific Coast Land & Water Co., Los Angeles, Calif., has been incorporated with a capital stock of $50,000. The incorporators are: C. M. Wooster, A. M. Bernhardt, H. W. Bowman, George T. Brown and Cutler Paige.

The Fair View Farms Water Co., Los Angeles, Calif., has been incorporated with a capital stock of $50,000. The directors are:

G. R. Horton, H. P. Jennings, V. E. Risin, R. L. Hanley and C. L. Haskell.

The Inyo County Water & Power Co., Los Angeles, Calif., has been incorporated with a capital stock of $200,000. The directors are: Louis Luchel, James MacLachlan, L. A. Cronk, G. R. Pendell, J. E. Pettijohn and E. T. Lyon.

Connecticut.

✣Bids will be received until noon, March 25 (change of date), by William S. Clark, City Engineer, Meriden, Conn., for the construction of a water works system in accordance with plans and specifications prepared by A. B. Hill, Consulting Engineer, 100 Crown St., New Haven, Conn. The work will be divided in four contracts as follows: (1) Concrete Dam and Culverts and Highway Grading—This contract will comprise, in part, about 16,500 cu. yds. of earth work; 1,200 cu. yds. of rock excavation; 6,100 cu. yds. of concrete, 3,000 sq. yds of rip-rap, and 8,500 bbls. of Portland cement. Bond on proposal, $3,000; on contract, $5,000. (2) Distributing Reservoir—This contract will comprise, in part, about 17,000 cu. yds. of earth and 100 cu. yds. of rock excavation; 5,000 cu. yds. of concrete; 24,000 lbs. of steel for reinforcement, and 7,000 bbls. of Portland cement. Bond on proposal, $3,000; on contract, $5,000. (3) Cleaning Site of Storage Reservoir—This contract will comprise about 160 acres of grubbing; 100,000 cu. yds. of excavation, and 1,000 sq. yds. of rip-rap. Bond on proposal, $5,000; on contract, $10,000. (4) Pipe Laying—This contract will comprise, in part, the laying of about 24,000 lin. ft. of cast iron pipe, 20 in., 24 in., and 30 in. in diameter, and 2,000 cu. yds. of rock excavation. Bond on approval, $1,500; on contract, $3,000.

Delaware.

The Board of Public Works of Rehoboth Beach, Del., will shortly award contracts for the construction of the new water works plant, for which plans have been prepared.

The newly elected Council of Georgetown, Del., has declared in favor of the purchase of the water plant. William F. Tunnell is President of the Council.

District of Columbia.

✣Bids will be received until 2 p. m., April 7, by Commissioner of Indian Affairs, Washington, D. C., for furnishing materials and labor for the construction of an addition to frame school house and the installation of an extension to water system at the Tulalip Indian School, Wash.

Florida.

⊙The town of Zolfo, Fla., recently awarded a contract to the Cameron-Barkley Co., of Tampa, Fla., for the installation of a complete water works system, which is to be completed and ready for service by April 5. Water will be secured from artesian wells.

Illinois.

✣Bids will be received until 11 a. m., March 15th, for furnishing and delivering to the water meter mechanical shops, 1330 Indiana Av., standard iron body, brass-mounted gate valves, as follows: 80 3-in., 100 4-in., 70 6-in., 20 8-in.; valves shall be double gate valves of standard design with iron body, brass mountings and screw ends. They shall be single stem, inside screw valves with hand wheel for opening, and shall open by turning wheel to left. Cash or certified check for $100 must accompany proposal. L. E. McGann is Commissioner of Public Works, Chicago, Ill.

✣Bids will be received until 11 a. m., March 17, for furnishing and delivering to the Harrison St. pumping station one 340 h. p. water tube boiler, with chain grate stoker; stoker engine, breeching, brick setting and auxiliaries and appurtenances, and the complete erection of same upon foundations prepared by the city; general data, working steam pressure 170 lbs. per sq. in. by gage; heating surface, 340 sq. ft. steam seamless tubes, external diameter 3 in.; 2 horizontal steam and hot water drums 36 in. to 48 in. in diameter; 4-in. prop safety valves, encased springs and hinged, locked up bonnets, fitted with bolts for clamping valves; 1 feed water heater, high grade mechanical stoker of the chain grade type with a mean effective area of 64 sq. ft. shall be installed; also 1 stoker engine. Cash or certified check for $500 must accompany proposal. L. E. McGann, Commissioner of Public Works, Chicago, Ill.

✣Bids will be received until 11 a. m., March 18th, for furnishing and delivering to the Fire Department, 5,000 ft. (approximately) of chemical fire hose; details of specifications as follows: cotton duck to be of a quality having a breaking strength of not less than 225 pounds across filler threads, 175 pounds across warp threads, not less than 4 ply; rubber tube and cover must contain not less than 40 per cent pure Para rubber, thickness not less than .045 in., internal diameter not less than lin. Cash or certified check for $200 must accompany proposal. Chas. F. Seyferlich, Fire Marshal, Chicago, Ill.

✣Bids will be received until 11 a. m., March 19, for furnishing and delivering to the city plumbing shops approximately 10,000 lbs. of plumber's solder. Cash or certified check for $100 must accompany proposal. L. E. McGann, Commissioner of Public Works, Chicago, Ill.

✣Chicago, Ill.—Bids will be received until 11 a. m., March 18th, for furnishing and delivering for use in the fire department engine suction hose 11 ft. long; 20 lengths, 4¾-in. suction hose, 11 ft. long; 20 lengths 4-in. suction hose, 10 ft. 6 in. long; 10 lengths 4½-in. suction hose as follows: 10 lengths, 3½-in. suction hose 11 ft. long; 10 lengths 5-in. suction hose, 11 ft. long; the same to be regulation fire suction hose without couplings. Cash or certified check for $200 must accompany proposal. Chas. F. Seyferlich, Fire Marshal.

✣Bids will be received until 11 a. m., March 15th, by L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering cast iron valve basin and vault covers to pipe yards as follows: Avers Av. and Wabansia Av., C. M. & St. P. team tracks; 2352 S. Ashland Av., C. B. & Q. switch track; 49th St. and Union Av., 68th St. and Yates Av., I. C. switch track; 104th Pl. and Harvard Av., C. & W. I. switch track; approximate weight, 500 tons; details as follows: Fire cistern curbs, weight 395 lbs, lid 152 lbs., diameters 21 in. and 23 in.; square of all covers, 42 in. x 38 in. over all; total weight, 715 lbs Tunnel shaft covers, 5 ft. 7½ in. x 1 ft.: weight of curb, 1,134 lbs.; weight of lid, 688 lbs. Cash or certified check for $200 must accompany proposal. Plans and specifications upon application to L. E. McGann, Commissioner of Public Works.

⊙City of Chicago has awarded to Jos. T. Ryerson & Son, 2558 W. 16th St., the contract for furnishing and delivering to the Lake View pumping station, Montrose Blvd. & Clarendon Av. such steel reinforcing rods as are required for use at this plant. Contract price, $1,600. L. E. McGann, Commissioner of Public Works.

⊙City of Chicago has awarded to Thos. Conley & Co., 118 N. La Salle St., Chicago, Ill., the contract for furnishing and delivering such natural cement as is required by the Department of Public Works for use during the ensuing year. Contract price, $4,120, based on specified quantities. L. E. McGann, Commissioner of Public Works.

⊙The City of Chicago has awarded to the United States Cast Iron Pipe Foundry Co., 122 S. Michigan Av., the contract for furnishing and delivering various cast iron pipes and fittings to the Harrison St. pumping station, 734 E. Harrison St. Contract price, 4½c. per lb. L. E. McGann, Commissioner of Public Works, Chicago, Ill.

⊙The City of Chicago has awarded to E. J. Longyear Co., Minneapolis, Minn., the contract for furnishing and delivering 1 diamond drilling machine, exclusive of carbons, having a capacity of 350 ft. of 1⅛-in. core, equipped with a 150 h. p. engine. Contract price, $2,800. L. E. McGann, Commissioner of Public Works, Chicago, Ill.

⊙The City of Chicago has awarded to the Lowenthal Co., 949 W. 20th St., Chicago, the contract for furnishing red brass to the city water works, 2304 S. Ashland Av. Contract price, 13⅝c. per lb. L. E. McGann, Commissioner of Public Works.

Plans are being prepared by Consulting Engineer Arthur M. Morgan, Harris Trust Bldg., Chicago, Ill., for the installation of a new waterworks system in Rockdale (P. O. Joliet), Ill., to cost about $25,000. Water will be secured from wells. An election is to be held in the spring to vote on the proposition.

Chicago City Council has ordered that a 12-in. water supply main be laid in Robey St. from Blue Island Av. southward 1,600 ft., with necessary hydrants, etc., for fire protection. L. E. McGann, Commissioner of Public Works.

Following is the lowest bid submitted for furnishing and delivering 50 white porcelain drinking fountains of bowl and pedestal type to the city plumbing shop, 14th St. and Indiana Av.: Jas. B. Clow & Sons, 534 S. Franklin St., Chicago, Ill. Contract price, $23.50 each. L. E. McGann, Commissioner of Public Works, Chicago, Ill.

Bids will be received until 11 a. m., March 19, for furnishing and delivering to the various pipe yards approximately 300 tons of pig lead, containing not less than 99.5 per cent pure lead; pipe yards located as follows: Avers Av. and Wabansia Av., C. M. & St. P. switch track; 2352 S. Ashland Av., C. B. & Q. switch track; 49th St. and Union Av., Penna. team track; 68th St. and Yates Av., I. C. switch track; 104th St. and Harvard Av., C. & W. I. switch track. Cash or certified check for bond must accompany proposal. L. E. McGann, Commissioner of Public Works, Chicago, Ill.

Following are the lowest bids submitted for furnishings, and delivering to various pipe yards approximately 5,000 tons of cast iron water pipe, consisting of 4,000 pieces of 6-in., 10,000 pieces of 8-in., 2,700 pieces of 12-in: United States Cast Iron Pipe Company, 122 S. Michigan Av., $24.85 per ton. L. E. McGann, Commissioner of Public Works, Chicago, Ill.

The Board of Local Improvements of Rock Island, Ill., on March 10 held a public hearing for the extension of water mains on the hill. It is proposed to lay a 6-in. main on 31st St., between 12th and 14th Aves., and to construct a main of the same size on 12th Ave., between 30th and 31st Sts.

Indiana.

The water works filtration bill of Representative Thornton, of New Albany, Ind., which had passed both houses of the Indiana General Assembly, has been signed by Gov. Ralston. The bill provides that the State Board of Health may order any water company in any city in the State to install a filtration plant if the health of the people that it serves demands it.

Iowa.

✣Bids will be received until 7:30 p. m., March 24, by E. G. Finch, City Clerk, Newton, Ia., for the digging of ditches, laying of water mains, setting of 8 hydrants and the refilling of the ditches. There will be 19 blocks or approximately 6,500 lin. ft. of water mains to be laid, city will furnish water pipe, lead and jute. All bids must be accompanied by a certified check, payable to the City Treasurer, for 10 per cent of the amount of the bid. The successful bidder must give a bond satisfactory to the Council for 1/3 the amount of the contract.

An election will be held in LeMars, Ia., on March 20 for the purpose of voting on the proposition of purchasing the water and light plants now operated by the LeMars Water & Light Co.

The citizens of Lake City, Ia., on March 6 authorized a bond issue to the amount of $12,000 for the making of improvements to the water works system. A new well about 2,000 ft. deep, pump, and extensions of water mains will be let at contract as soon

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Missouri.

✣Bids will be received until 8 p. m., March 14. (see advertisement) by H. J. Bierge, Village Recorder, Pine City, Minn., for drilling of an 8-in. well at least 150 ft. deep. The Oscar Claussen Engineering Co., Nat. Ger. Am. Bank Bldg., St. Paul, Minn., are Engineers. All bids opened Feb. 28 were rejected.

⊙C. A. Peterson, Hutchinson, Minn., has as the plans are completed. A. O. Anderson, Lake City, is Engineer.

The citizens of Farragut, Ia., on March 3 voted against the issuance of bonds to the amount of $8,000 for a water works plant. Plans were prepared by the Des Moines Bridge & Iron Works, Des Moines, Ia.

Kansas.

Consulting Engineers Burns & McDonnell, Smarritt Bldg., Kansas City, Mo., have completed plans and submitted same, for filtration and waterworks improvements for Oswego, Kan., to cost about $25,000. Bond election will be held in April.

Consulting Engineers Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., are preparing plans and estimates for a spring water supply for Herrington, Kan. Bond election for this improvement will be called in April.

Kentucky.

✣Bids will be received until April 2, it is reported, by Board of Public Works, W. J. Dulin, Secy., Madisonville, Ky., for the construction of c. i. water mains, steel tank; also for laying mains and sewers.

Louisiana.

The citizens of Shreveport, La., on March 4 voted the issuance of bonds for the purchase of 11,000 acres of the Cross Lake lands for a permanent city water reservoir.

Maryland.

The town of Hancock, Md., has been offered a site for the construction of a new reservoir.

Massachusetts.

At a town meeting in Agawam, Mass., held on March 5, the proposition to extend the water works system was considered.

Michigan.

⊙Eric J. Johnson, 219 W. Michigan St., Marquette, Mich., has been awarded the contract by the Board of Fire & Water Commissioners, Marquette, for the laying of 2,550 ft. of 4-in. and 2,550 ft. of 6-in. iron water pipe, for $0.39 per ft. The work also includes the setting of all gates, hydrants, specials, etc. Bids were opened March 5.

The Village Council of Ecorse, Mich. (population 1,003) has decided to extend water mains and sewers to the new subdivisions in Maple Heights.

The Board of Public Works, Grand Rapids, Mich., will shortly advertise for bids on 192 tons of lime for the filtration plant.

Minnesota.

The citizens of Deerwood, Minn., did not vote at the regular election on March 11 for the installation of a water works and a sewerage system. A special election will probably be held.

It is reported the village of Wanda, Minn. (population 129), on March 2 voted in favor of the installation of a water works plant.

Official estimates presented to the Water Works Committee of the City Council, Minneapolis, Minn., place the probable expenditure the city will make on its water works system at $759,000.

The Village Council of North Mankato (P. O. Mankato), Minn., has decided to ask the citizens to vote at the coming election on the question of extending the water mains, estimated to cost $4,000. George Fisher is a member of the Council.

been awarded the contract at Gibbon, Minn., for making extensions to the waterworks, for $3,383. Bids were opened March 3.

⊙The Union Machine Co., St. Paul, Minn., has been awarded the contract by the village of Pine City, Minn., H. J. Bierge, Recorder, for the construction of a complete waterworks system, for $16,446, as follows: Division 1, 12,000 ft. of C. L. B. & S. pipe; division 11, 75,000-gal. tower and tank, 100 ft. to the balcony; division 15, 14 ft. x 16 ft. pump house. Bids were opened Feb. 28. The Oscar Claussen Engineering Co., Nat. Ger. Am. Bank Bldg., St. Paul, Minn., are Engineers.

Consulting Engineers Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., have plans in progress for a new waterworks for Monroe City, Mo., estimated to cost $75,000.

Montana.

Consulting Engineers Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., have completed plans for a new municipal waterworks plant, taking water from the Yellowstone river for Livingston, Mont. The plans were submitted to the city officials on March 11. The estimated cost is $200,000. Bond election will be called in April.

New Jersey.

⊙Bids were received at Belmar, N. J., on Feb. 15, for the making of extensions to the waterworks for which Clyde Potts, 30 Church St., New York City, is Engineer. In the table shown below (1) stands for bid of Partridge & Burke, Hohokus, N. J. (awarded contract); (2) T. J. McGovern, Trenton, N. J.; (3) Monmouth Construction Co., Red Bank, N. J.; (4) Antonio Lambo, Waterbury, Conn.; (5) H. K. Corbin, New York City; (6) Antonio Costa, Orange, N. J.; (7) J. J. Hughes, Newark, N. J.; (8) Daniel Donavan, Bayonne, N. J.; (9) Kelley-McFeely, Camden, N. J.; (10) Sutton-Corson, Ocean City, N. J.; (11) Wm. Horne & Co., New York City., and (12) W. F. Norton Co., New York City:

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Cast iron pipe, 415 tons	$ 26.10	$ 26.50	$ 26.50	$ 28.00	$ 25.50	$ 26.50	$ 31.39	$ 28.40	$ 29.21	$ 29.70	$ 28.00	$ 28.00
Specials, 6¼ tons	60.00	50.00	55.00	50.00	50.00	60.00	50.50	100.00	55.55	55.00	70.00	60.00
Laying 4-in. cast iron pipe, 14,200 ft.	.18¾	.20	.19½	.19	.24	.23½	.17	.24	.27	.25	.25	.29
Laying 6-in. cast iron pipe, 6,700 ft.	.20	.25	.22½	.23	.27	.27	.21	.27	.29	.29	.33	.32
Laying 8-in. cast iron pipe	.23½	.30	.26½	.30	.32	.32	.75	.30	.36	.33	.41	.32
Laying 10-in. cast iron pipe, 5,100 ft.	.273	.30	.33½	.30	.37	.36	.28	.30	.36	.35	.46	.40
Furnishing and placing 4-in. valves (30)	10.35	7.00	10.80	10.00	10.50	12.50	12.00	9.30	10.29	13.44	13.25	17.50
Furnishing and placing 6-in. valves (10)	14.70	10.00	14.90	15.00	14.50	17.50	16.50	13.00	14.74	19.16	17.00	20.00
Furnishing and placing 8-in. valves	20.25	20.00	22.00	23.00	21.50	30.00	32.00	18.00	21.34	26.58	25.00	27.50
Furnishing and placing 10-in. valves (8)	28.00	25.00	28.00	28.00	29.00	31.00	27.50	25.60	28.55	35.89	33.50	35.00
Furnishing and placing hydrants (40)	27.20	25.00	29.00	28.00	28.50	30.00	30.00	24.00	32.25	35.00	31.00	35.00
Totals	$18,371	$18,865	$19,183	$19,496	$19,831	$20,353	$20,536	$29,727	$22,057	$22,229	$22,240	$22,702

Governor Wilson, of New Jersey, has approved a $1,000,000 bond issue by the State Water Supply Commission to pay for 110,000 acres of land in Burlington and Atlantic Counties to be purchased for a water shed to provide a water supply for South Jersey.

The Mayor and City Council, of Dover, N. J., have accepted the recommendations of the Board of Water Commissioners and authorized a contract with the Dover, Rockaway & Port Oram Gas Co. for the installation of a pumping plant. The bid calls for the pumping of water for ten years from driven wells to the high and low service reservoirs.

The Common Council of Chatham, N. J., has approved the recommendations of Engineer Charles E. Hewitt and the Board of Water Commissioners concerning changes at the water and light plant at an estimated cost of $25,000. The Council will shortly advertise for bids for the purchase of new hose for the fire department.

New York.

✣Bids will be received until March 15, by Lieut. Col. M. Gray Zalinski, Depot Quartermaster, Army Bldg., New York City, for furnishing under proposal No. 394 4 lavatories, 1 galvanized iron boiler, 600 ft. 2-in. galvanized iron pipe, 235 ft. cast iron soil pipe, 300 ft. ¾-in. galvanized iron pipe, 300 ft. frost proofing, 1 bbl. Portland cement, 2 water closets and 2 galvanized iron sinks.

The Conservation Commission, Albany, N. Y., has approved the petition of the village of Honeoye Falls, Monroe County, N. Y., for the acquisition of a source of water supply and water system. It is proposed to draw the new supply from a well with 40,000 gals. storage.

The Conservation Commission, Albany, N. Y., has approved the plans of the Sodus water district, Sodus, N. Y., for a water supply system.

North Carolina.

The Board of Aldermen of Spencer, N. C., has called an election for the purpose of voting on the issuance of bonds to purchase the water works plant of the Spencer Water Co.

North Dakota.

The business men of Dawson, N. Dak., are advocating a better water supply for fire protection.

Ohio.

⊙The Ohio Valley Drilling Co. has been awarded a contract to drill a 10-in. well at Toronto, O.

⊙Lanese Co., 814 Columbia Bldg., Cleveland, O., has been awarded the contract by the Board of Trustees of Public Affairs, West Park, O., for the construction of water mains, for $12,624. Bids were opened March 3.

The Board of Public Service of Youngstown, O., which intends to erect a reservoir and dam to cost about $500,000, will not begin work until some additonal acreage is secured. Plans have been made by F. M. Lilly, City Engineer.

Oklahoma.

An election will be held in Durant, Okla., on March 18 for the purpose of voting on the issuance of bonds to the amount of $85,000 for the making of extensions to the waterworks and sewerage systems. The work will include new mains, septic tank and incinerator. W. P. Danford, Durant, is Engineer.

Consulting Engineers Hiram Phillips, St. Louis, Mo.,; J. W. Alvord, Chicago, Ill, and J. W. Billingsly, Houston, Tex., have submitted their report to the City Commission of Oklahoma City, Okla., relative to a water supply for that city. It is recommended that water be secured from the North Canadian river at a point above El Reno by a gravity canal and stored in a reservoir near the water works. The complete cost is estimated at $1,525,500.

Oregon.

⊙The Portland Railway, Light & Power Co., Portland, Ore., has been awarded the contract by the City Council of St. Johns, Ore., for lighting the city, for $4.66⅔ L per mo. The contract calls for 94 lights. Bids were opened Feb. 25.

Engineer Louis C. Kelsey, Selling Bldg., Portland, Ore., is preparing plans and specifications for an electric lighting system, new pumping plant and reservoir for the city of Arlington, Ore.

Bids will be opened early in April for constructing a waterworks system for the Town of Linnton, Ore. Bonds amounting to $100,-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

000 have been voted and sold. Engineer Louis C. Kelsey, Selling Bldg., Portland, Ore., is preparing the plans and specifications for the waterworks, which will connect with the Bull Run water supply of the city of Portland. Cast iron pipe will be used throughout.

Chief Engineer Clarke of the Water Department, Portland, Ore., has recommended the installation of the auxiliary system of water mains for fire protection in the downtown business section. Plans and estimates have been prepared for this system of mains, which will be about 4 miles in length, and will cost approximately $50,000. Several large reinforcing mains are also recommended for fire protection along upper Washington and Morrison Sts., at an estimated cost of $76,000.

Chief Engineer Clarke of the Water Department, Portland, Ore., has prepared plans for the lowering of the 24 and 28 in. submerged mains across the Willamette in advance of the dredging of the upper harbor. The estimated cost is $68,300; work to be done by day labor.

Engineer Richardson, of Portland, Ore., is preparing plans looking to the establishment of a municipal waterworks at North Bend, Ore.

Pennsylvania.

✣Bids will be received until 8 p. m., March 24, by W. A. Gibson, Borough Secretary, Tarentum, Pa., for waterworks improvement. The work will embrace concrete clear water well, pump room, filter tubs and coagulating basin; brick boiler room; mechanical dosing and regulating devices for coagulating basin; mechanical equipment for 2 500,000-gal. filter units; 1 300 h. p. water tube boiler; 2 1,000,000-gal. steam pumping engines; 2 1,000,000-gal. motor driven centrifugal pumps; a brick pump pit at the river intake; a 14-in. cast iron pipe line 1,200 ft. long; a submerged 14-in. cast iron pipe line 800 ft. long to be laid in the Allegheny River; a steel stand pipe 20 ft. in diameter by 50 ft. in height. Proposals will be received for either the entire work or for any part of the work as shown in the proposal. General plans and specifications are on file at the office of Leo Hudson, Engineer, McKeesport, Pa. All proposals are to be accompanied by a certified check for not less than 5 per cent of the bid as evidence of good faith.

⊙ Linwood B. Jacobs, of Newark, Del., has secured the contract to construct a water plant on the battlefield at Gettysburg, Pa. It will include 8 miles of pipe and four tanks, each of 50,000-gals. capacity. Work will be started at once and completed by July 1.

Bids have been asked for the construction of a 16-in. cast iron intake pipe for the water works system of the McClintic-Marshall Construction Co., of Rankin, Pa. Plans for this work can be seen at the office of Chester & Fleming, Consulting Engineers, Pittsburgh, Pa. The work will embrace laying 250 ft. of 16-in. pipe under the bed of the Monongahela River and construction of gate house.

The City Council of Coatesville, Pa., will shortly place the proposition to issue bonds in the sum of $185,000 for an improved water supply before the people.

An election is to be held in the Town of Farrell, Mercer County, Pa., on April 8, to vote on the issuance of bonds in the sum of $125,000 for the construction of a municipal waterworks plant.

Engineers A. Johnson, 150 Nassau St., New York City, and Nicholas S. Hill, Jr., 100 William St., New York City, submitted a report to the officials of Allentown, Pa., on Feb. 28, for the proposed improvements to the waterworks system, to cost $175,000. The work includes an 8,000,000-gal. filtration plant, additional pumping facilities, sand filters and low lift pumping equipment and new units in the pump station. Chas. D. Weirbach is City Engineer.

South Dakota.

At a recent mass meeting in Newell, S. Dak., committees were selected and plans are now well under way to get an adequate supply of water for the town. Engineers have made a survey to a deep draw two miles northwest of town, where a dam will be constructed, with filtering tanks and a pipe line laid to connect with water mains through the principal streets of the city. The estimated cost of the system is $20,000.

A special election has been called in Wall, S. Dak. (population 167), to vote upon issuing bonds in the sum of $6,000 for the construction of a waterworks system.

At a recent special election held in Frankfort, S. Dak., bonds to the amount of $7,000 were voted for the installation of a waterworks system.

Estimates are being made of the probable cost of a water works system for Owanka, S. Dak., which it is proposed to install this spring.

Tennessee.

Lenoir City, Tenn., plans the installation of a waterworks system at an estimated cost of $40,000, to include a fire protection system. The source of supply will be secured from the Little Tennessee River. Plans have not been prepared. J. W. Bussell, Sr., is an official in charge.

Texas.

Following bids were received by the Board of Municipal Commissioners, Dallas, Tex., for the construction of a water tower to hold 30,000 gals. for use of the Tuberculosis Hospital: Chicago Bridge & Iron Works, Chicago, Ill., $2,865; Des Moines Bridge & Iron Works, Des Moines, Ia., $2,574, and Smith & Whitney, $2,740.

An election will be held in Fort Worth, Tex., on March 14 for the purpose of voting on the issuance of bonds for the reservoir.

An election was held in Rockdale, Tex., on Feb. 25 for the purpose of voting on the issuance of bonds to the amount of $30,000 to buy and build an improved system of waterworks.

The City Council of Greenville, Tex., has advertised for bids on supplying the city with over 400,000 ft. of water pipe, several thousand feet of sewer pipe and 30 additional hydrants.

Utah.

The Teasdale Water Works Co., Teasdale, Wayne County, Utah, has been incorporated with a capital stock of $10,000. The officials are: Emery King, president; Charles Snow, vice president; F. C. Pectol, secretary and treasurer.

The City Commission of Salt Lake City, Utah, has adopted the recommendations of City Engineer D. H. Blossom and Waterworks Superintendent C. F. Barret, relative to replacing with a steel flume a portion of the old wooden culvert of the Salt Lake and Jordan canal in Mill Creek. The recommendation carries with it the appropriation of $3,250 for the purpose.

Vermont.

A special election will be held in St. Albans, Vt., on March 18 for the purpose of voting on the filtering plant question. Seldon C. Greene is Mayor.

Virginia.

✣Bids will be received until noon, March 21, by Administrative Board, Richmond, Va., for furnishing 500 tons of aluminum sulphate, high basicity for water, clarification containing from 17 to 22 per cent aluminum oxide delivered f. o. b., Korah station, C. & O. Ry., in barrels, at such time and in such quantity as E. E. Davis, Supt., may require; also for furnishing 40 tons of aluminum sulphate high basicity for water clarification, containing 17 per cent aluminum oxide delivered f. o. b. pumphouse siding in barrels, South Richmond.

✣Bids will be received until noon, March 21, by Administrative Board, Richmond, Va., for the following supplies and contract work: Gate valves, cast iron pipe, special castings, three nozzle fire hydrants, valve boxes, meters, meter boxes, pig lead, wiping solder, brass work, lead pipe, hauling, laying and relaying granite or cobblestone paving, cutting and refilling pipe trenches and repaving over pipe trenches. Specifications, plans and information can be obtained at the office of the City Water Works. E. E. Davis is Superintendent.

Washington.

⊙C. H. Green, of Spokane, Wash., has been awarded the contract at Canyon City, Ore., for the installation of a water works system for $6,000.

Wisconsin.

⊙The Water Commission, Janesville, Wis., has awarded the contract for a central air compressor and air lift equipment for six of the artesian wells of the Ingersoll-Rand Co., of Chicago, Ill., for $11,107.

⊙The Chicago Bridge & Iron Works, Chicago, Ill., has been awarded the centract for the construction of a water works tower and tank on a lot in West Waterford, Waterford, Wis., for $3,100.

⊙Birdsall Griffith Construction Co., Racine, Wis., has been awarded the contract by the Board of the village of Waterford, Wis., for the laying of water mains, for $0.29 and $0.26 per ft. The work includes digging trench and laying 6,318 ft. of 6-in. pipe at $0.29, 2,294 ft. of 4-in. pipe at $0.26, setting of 20 hydrants and 12 valves and covering trench. Bids were opened March 1.

The city of Palmyra, Wis., has retained Engineer J. R. Gray, 803 Great Northern Bldg., Chicago, Ill., in connection with the proposed waterworks installation.

The City Council of Appleton, Wis., has ordered 14 miles of water pipe extensions at an estimated cost of $125,000.

The citizens of the village of Palmyra, Wis. (population 649), have presented a petition in the Village Board asking that the question of waterworks and sewerage for the village be submitted to a vote of the people.

It is proposed to ask the citizens of Beaver Dam, Wis., to vote at the special election in April on the proposition of municipal ownership of the waterworks system.

The citizens of Green Bay, Wis., will vote May 6 on the purchase of the plant of the Green Bay Water Co. The railroad rate commission recently placed a valuation of $671,000 on the plant.

Canada.

✣Bids will be received until noon, April 12, by Mayor at the office of the Committee on Works, Halifax, N. S., for the construction of reinforced concrete reservoir and gate house. Plans can be seen at the office of the City Engineer. J. J. Hopewell is Clerk of Works.

Estimates prepared for the proposed fire department in South Vancouver, B. C., embrace the following items: Sites for five stations at $3,000 each, $15,000; five stations at $9,000 each, $45,000; three combination hose and chemical wagons at $2,000 each, $6,000; six horses at $400, $2,400; two pieces combination motor apparatus at $8,000, $16,000; 5,000 ft. rubber line hose, $5,500; chief's auto, $3,000; Gamewell fire alarm system, $5,000. In addition to these the cost of five sliding poles for the fire stations, three double sets of swinging harness and five sets of doorsprings.

The city of London, Ont., plans improvement work in the waterworks department to the amount of $110,000, and in the electrical department to the amount of $94,000. This work will be done by the city by day labor. H. J. Glaubitz is general manager of the waterworks, electrical and parks depts.

The citizens of Regina, Sask., J. McArthur, City Engineer, on Feb. 25 voted by-laws to the amount of $200,000 for waterworks, $60,000 for fire hall and additional fire fighting apparatus, and $25,000 for investigation of gas works and laying of mains.

T. R. Deacon, Mayor of Winnipeg, Man.; Judge Robson, public utilities commissioner of Manitoba, and D. McLean, controller, of the city of Winnipeg, have had several conferences with Premier Whitney and Hon. W. H. Hearst, with a view to arranging for a water supply from Shoal Lake, one of the extreme western bays of Lake of the Woods in the province of Ontario. The cost of bringing the water to Winnipeg from this point will be approximately $10,000,000. The distance is 60 miles.

SEWERAGE AND SANITATION

Alabama.

✣Bids will be received until noon, March 25, by H. Pillans, Commissioner, Mobile, Ala., for the construction of a sanitary sewer through the western part of the city, including 30,000 lin. ft. of 8 to 20-in. vit. pipe. Plans and specifications are on file with Wright Smith, City Engineer.

The taxpayers of Hurtsboro, Ala., have authorized the issuance of bonds for the installation of a system of sanitary sewers.

Arkansas.

Bids will be received until 8 p. m., March 28, by Board of Improvement, Sewer District No. 4, Clarksville, Ark., for furnishing materials and constructing sanitary sewer system and disposal plant as follows: 23,250 ft. 8-in. to 12-in. vit. pipe, 62 manholes, 10 flush tanks and settling tank. Plans and specifications are on file at the office of the Secretary and the Engineers. Copies of the plans and specifications for personal use may be obtained from the Engineers by remitting $3.50. D. Ward Dunlap, Secretary; Winters & Dove, 311 Merchants National Bank Bldg., Fort Smith, Ark., Engineers.

The City Council of Russellville, Ark., will take final action on a petition from property holders on West Main St., including practically all the new residences in the W. J. White addition, at its meeting this month. The petition asks that that section be annexed to Sewer Improvement District No. 1.

California.

✣Bids will be received until 8 p. m., March 13, by Board of City Trustees, Anaheim, Calif., for all work and materials necessary for the construction of about 600 ft. 4-in. vitrified pipe sewer connections for the City of Anaheim, in accordance with certain plans, specifications and ordinances on file in the office of E. B. Merritt, City Clerk of the City of Anaheim.

✣Bids will be received until 8 p. m., March 25, by Board of Trustees, Colfax, Calif., for furnishing the labor and material for the construction of a municipal sewer system. Bids will be received separately as follows: (1) furnishing f. o. b. Colfax, all vit. clay pipe and shapes required; (2) for digging trenches and laying pipe and construction of all manholes, including the furnishing of material; (3) for the labor and material for the construction of a septic tank; (4) for furnishing labor and material required for the construction of a complete sewer system and septic tank as per plans and specifications on file with City Clerk and U. S. Marshal, Engineer, 420 Forum Bldg., Sacramento, Calif. The cost of the work is estimated at $13,000.

Town Engineer F. A. Nikirk, of Los Gatos, Calif., has submitted a map covering the proposed rights of way for the outfall sewer, and several minor matters pertaining to the sewer system to be constructed under the recently voted bond issue. R. R. Bell is Mayor.

City Engineer, N. K. Carpenter, of Oceanside, Calif., has prepared plans and specifications for a sewer system. The proposed district will include 70 blocks or about 900 lots. The drainage will be to a septic tank, to be located near the mouth of the San Luis Rey River.

The City Trustees of Lodi, Calif., will shortly ask for bids for furnishing 11,300 ft. of pipe and 350 Y's to install the proposed extension of water and sewer service to the North School St. district and the Barnhart tract. The estimate also includes 125 bbls. of cement and 40 manhole rings and covers.

Colorado.

The City Council of Canon City, Colo., has created Sanitary Sewer District No. 2, which will be installed at a cost of approximately $10,000.

Connecticut.

⊙Archibald Torrance, of Norwich, Conn., has been awarded the contract for the construction of a sewage disposal plant at the state colony for epileptics at Mansfield, Conn., for about $10,000. The plant is to consist of filter beds and siphon dosing tanks.

Georgia.

The Atlanta Steel Works, Atlanta, Ga., has asked that sewer be put down next to the plant on Rhodes St., to carry off sewage that now flows into a cooling pond used by the foundry. Capt. R. M. Clayton, Chief Engineer of Construction, has estimated the cost of the sewer at $7,000.

Idaho.

⊙William Enoch has been awarded the contract by the City Council of Lewiston, Idaho, for the construction of the sewer in the east end.

Illinois.

✣Bids will be received until 3 p. m., March 17, by the N. O. Nelson Mfg. Co., Edwardsville, Ill., for furnishing approximately 8,000 ft. of 8, 10 and 15-in. sewers. Plans and specifications may be obtained by addressing the company.

✣Bids will be received until 11 a. m., March 17, by Board of Local Improvements, Chicago, Ill., for the construction of tile sewers under 9 separate contracts, the largest being for brick and tile sewer in Racine Ave. and other streets. Edward J. Glackin is Secretary of the Board.

⊙Tetens & Nelson have been awarded the contract by the City Council, Elgin, Ill., for the construction of sewers in parts of Division, Geneva, and Villa-Gifford Sts., for $3,804.

The Board of Local Improvements of Rockford, Ill., has approved estimates of City Engineer Edwin Main for systems of sewers that will cost about $45,000. Sewers are to be laid in West End Court and Montague Sts., North Court St., from Reynolds to Auburn St., Cumberland St., and Royal Ave., and North St., and Royal Ave., from State to Peach Sts.

The city engineering force of Alton, Ill., has been engaged in making the survey for the Upper Alton sanitary sewer. The plans call for two lines of sanitary sewer to run south from Upper Alton, and to meet about at Illinois Ave., where a trunk sewer will carry the sewage on to the river. J. E. Schwaab is City Engineer.

The village of Bradley, Ill., A. H. Beland, Village Clerk, rejected all bids received Feb. 25 for the construction of a main sewer. The lowest bid received was $20,000 higher than the estimated cost. C. A. Voorhees is president of the Board of Local Improvements.

The Board of Local Improvements of Quincy, Ill., has ordered the construction of sewers on Galena Ave., from 7th St. to 10th St., and west on 10th St., to a point 235 ft., and sewers on East Everett St., East Fellows St., and North Jefferson Ave.

The Board of Local Improvements of Moline, Ill., has passed an ordinance condemning certain properties in the east end sewer district lying between 34th and 55th Sts., and from the river to 11th Ave., for the purpose of constructing sewers.

The City Council of Peoria, Ill., has been petitioned to make the Dailey estate part of the fourth sewer district.

The Board of Local Improvements of Wood River, Ill., has ordered the construction of water mains and sewers in the new Chessen-Caldwell addition to the village.

The Board of Local Improvements of Quincy, Ill., has awarded the contract for the construction of a stone and concrete sewer in the territory lying between Front St., and the river and the north line of Payson Ave., and the south line of Ohio St., extended west, to Roeder & Greeman, for $1,987.

The City Council of East St. Louis, Ill., has passed an ordinince providing for the sewering and paving of State St., from 34th to 89th Sts., at an approximate cost of $315,000.

Indiana.

⊙Dowery & Darrick have been awarded the contract by the Board of Public Works, Evansville, Ind., for the construction of four sewers.

⊙Jesse Bedford has been awarded the contract by the Board of Public Works, Evansville, Ind., for the construction of an extension to the Oregon St. sewer, for about $8,000.

The Park Board of Fort Wayne, Ind., has submitted plans to the Board of Public Works for incasing in a concrete jacket the portion of the Vermont Ave. sewer that passes through Delta Lake.

The Board of Public Works of South Bend, Ind., has taken action for the construction of sewers on Fourth from Pine to Cedar Sts.; on Fifth from Merrifield to Laurel Sts.; Fourth from Smith to Logan Sts., and Battell from Sarah to Division Sts. City Engineer William Moore has been instructed to prepare plans and specifications.

The city of Fort Wayne, Ind., H. W. Becker, Clerk, rejected all bids received Feb. 27 for the construction of 23,062 lin. ft. of sewers. All bids were above the engineer's estimate.

Iowa.

✣Bids will be received until 2 p. m., March 29, by Board of Public Works, Davenport, Ia., for the construction of the following sewerage work: Sanitary sewer system in the 13th Sewer District of Davenport, Iowa, comprising outfall, trunk, drainage and main sewers, being sections 1, 2, 3, 4, 5, 6, 7 and 8 as shown on general plan now on file, and consisting approximately of the following quantities: 2,400 ft. of 96-in. drainage sewer, 3,000 ft. of 24-in. sewer, 2,400 ft. of 18-in. sewer, 3,500 ft. of 15-in. sewer, 2,400 ft. of 12-in. sewer, 2,900 ft. of 24-in. sanitary invert, including manholes, Y's, and all appurtenances as set forth in detail plans and specifications. A. W. Compton is Commissioner of Public Works. Official advertisement will be found elsewhere in this issue.

⊙The Lytle Construction Co., of Sioux City, Ia., has been awarded the contract by that city, P. J. Wells, City Clerk, for constructing a sanitary sewer in Vine Ave., from South Newton St. to South Mulberry St., for 44 cts. lin. ft. Bids were opened Feb. 28.

⊙The City Council of Cedar Rapids, Ia., has awarded the contract for the construction of the 21st Ave. west storm water sewer to R. C. DeLa Hunt, for $23,465. Other bidders were: Ford Paving Co., $23,625; Percy P. Smith, $30,432; F. K. Hahn, $28,039, and Dearborn & Jackson, $27,340. The above bids were on a brick sewer. Bids received on a concrete sewer were as follows; M. Tschirgi & Sons, $31,934; Percy P. Smith, $35,145; B. J. Sweatt, $36,162, and Dearborn & Jackson, $36,722.

⊙The City Council of Sioux City, Ia., has awarded a contract to the Lytle Construction Co., for the construction of storm water sewers on East Seventh St., West Third St., and at 19th and 20th Sts., for over $21,000.

⊙J. W. Turner Improvement Co., Des Moines, Ia., has been awarded the contract at Tipton, Ia., for the construction of a sewer system for $69,543. Bids were opened Feb. 26. The Iowa Engineer Co., Clinton, Ia., are Engineers.

An election is to be held in New London, Ia., in the near future for the purpose of voting on the proposition to install a sewerage system and a water works plant.

Resolutions have been introduced in the City Council, Sioux City, Ia., providing for

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

storm water sewers on Douglas St., 25th to 26th Sts., Virginia St., Ninth to 10th Sts., and 10th St., Virginia to Court Sts. Plans for the sewers have been prepared by City Engineer Fred C. Smith.

The citizens of New London, Ia. (population 1,144), at a recent election voted against the issuance of bonds for the installation of a sewerage system.

Property owners in Des Moines, Ia., have petitioned Councilman Joseph Myerly to establish a sewer system to drain the territory north of Grand Ave., between Country Club Blvd. and 56th St.

The City Council of Mt. Pleasant, Ia., contemplates the extension of the city sewerage system for five blocks in the main part of the town.

Kansas.

⊙E. L. Dimick, Laurel, Nebr., has been awarded the contract by the City Council of Hutchinson, Kans., for the construction of certain sewers and water mains and appurtenances for $7,082. The work will include 5,650 ft. of sewer and 4,000 ft. of water main. Bids were opened Feb. 25.

Consulting Engineers Worley & Black, Reliance Bldg., Kansas City, Mo., have been retained by the City of Valley Falls, Kans., to make surveys and prepare plans and specifications for a complete sewer system.

The Alamo Engine & Supply Co., of Omaha, Nebr., has been retained by Scott City, Kans., O. D. Card, City Clerk, to do the engineering work in connection with the proposed installation of a waterworks and an electric light plant.

Kentucky.

✣Bids will be received until March 14, by the Board of Public Works, Louisville, Ky., it is reported, for the construction of 48 blocks of sewers. Roy W. Burkes is Sewer Engineer.

Louisiana.

✣Bids will be received until March 27 by City of Lafayette, La., for the construction and operation of a sewerage system. Plans and specifications must accompany each proposal and must be approved by the State Board of Health.

✣Bids will be received until 3 p. m., April 18, by Sewerage and Water Board, Fifth Floor, City Hall Annex, New Orleans, La., for furnishing and delivering one 150-horsepower motor to be known as Contract 54D. F. S. Shields is Secretary.

The citizens of Shreveport, La., on March 1, voted the issuance of bonds to the amount of $150,000 for public improvements, including paving, graveling and resurfacing, storm sewers and drainage, and the purchase of the Cross Lake lands, 11,000 acres, authorized by the State Legislature, for a permanent city water reservoir.

The Sewerage & Water Board of New Orleans, La., F. S. Shields, Secy., contemplates spending about $2,000,000 this year in the construction of sewers.

Maine.

Town of Farmington, Me., has voted to appropriate $3,500 for sewers at Farmington Village. H. J. Mosher is Selectman.

An appropriation of $2,900 has been voted by the Town of Lisbon, Me., for sewers. A. O. White is Selectman.

Massachusetts.

House Committee of the State Legislature has reported a bill authorizing the Metropolitan Water, and Sewerage Board, Boston, Mass., to construct an additional sewer in the City of Somerville.

A bill has been reported in the State Senate to authorize the City of Medford, Mass., to borrow $75,000 for sewerage purposes. Fred R. Charnock is City Engineer.

Michigan.

✣The City Council of Ironwood, Mich., has awarded the contract for the construction of the Lake St. sewer to Megan & Ross, for $13,528, and $3 extra for rock.

⊙J. P. Burroughs & Son, Flint, Mich., have been awarded the contract by that city, D. E. Newcombe, City Clerk, for furnishing the city such cement sewer pipe, specials and manhole tops and catch basin inlets which may be needed for the year commencing March 1. The sewer pipe will be furnished for 73 per cent off list price, and cement for $1.31 per bbl. Bids were opened Feb. 17.

The Board of Park, Cemetery & Street Commissioners, Marquette, Mich., has made arrangements preliminary to the letting of contract for the new trunk sewer that will serve the district between Ridge St. and Fair Ave. The estimated cost is $50,000. Charles Cummings is City Engineer.

The City Council of Iron Mountain, Mich., has passed a resolution providing that the question of issuing bonds to the amount of $40,000 for the installation of a sewerage system, be submitted to the people.

The citizens of Zeeland, Mich. (population 1,982), will vote April 7 on the proposition to install a sewerage system.

Secretary R. L. Dixon of the State Board of Health and Edward D. Rich, Chief Engineer, of Lansing, Mich., have investigated the condition of the sewer system of Alpena, Mich., and have recommended improvements to the same.

Minnesota.

✣Bids will be received until March 17, by the City Council, St. Peter, Minn., it is reported, for the construction of the Nassau St. and Park Row sewers.

The Council Sewer Committee, Minneapolis, Minn., has recommended the opening up of a sewer on 21st Ave. N., between the river and 1st St.

Missouri.

✣Bids will be received until March 17 by City of California, Mo., for about 4½ miles of sewer laterals. Burns & McDonnell, 321-26 Scarritt Bldg., Kansas City, Mo., are Engineers.

✣Bids will be received until noon, March 14, by Board of Public Improvements, W. T. Findly, Secy., St. Louis, Mo., for the construction of sewers in Manchester Sewer District No. 1, embracing sewers of the materials, lengths and sizes as follows, to-wit: Vitrified clay pipe sewers, 535 ft. of 27-in. inside diameter, 455 ft. of 24-in. inside diameter, 1,040 ft. of 21-in. inside diameter, 1,685 ft. of 18-in. inside diameter, 1,540 ft. of 15-in. inside diameter, 5,885 ft. of 12-in. inside diameter, with sewer inlets, manholes, and all other appurtenances. Deposit required, $800.

✣Bids will be received until noon, March 14, by Board of Public Improvements, W. T. Findly, Secy., St. Louis, Mo., for the construction under Letting No. 10,851, of sewers in Rock Spring Sewer District No. 17, embracing sewers of the materials, lengths and sizes as follows, to-wit: Vitrified clay pipe sewers: 121 ft. 21-in. inside diameter, 1,040 ft. of 18-in. inside diameter, 690 ft. of 15-in. inside diameter, 640 ft. of 12-in. inside diameter, with sewer inlets, manholes, and all other appurtenances. Deposit required $355.

✣Bids will be received until noon, March 14, by Board of Public Improvements, W. T. Findly, Secy., St. Louis, Mo., for constructing under Letting 10,854, sewers in Des Peres Sewer District No. 2, embracing sewers as follows: Vitrified clay pipe sewers: 550 ft. of 24-in. inside diameter, 740 ft. of 21-in. inside diameter, 300 ft. of 18-in. inside diameter, 670 ft. of 15-in. inside diameter, 1,600 ft. of 12-in. inside diameter. Cast iron pipe sewers: 200 ft. of 12-in. inside diameter, with sewer inlets, manholes, and all other appurtenances.

Sewer Commissioner Charles A. Moreno, of St. Louis, Mo., on March 4 submitted his report to the Municipal Assembly, recommending the issuance of $9,000,000 worth of bonds to relieve the overloaded Mill Creek sewer, treat the River des Peres its entire length and re-build other sewers. The estimates are as follows: For relief of inadequate sewers, exclusive of the downtown district, $350,000; Mill Creek sewer relief, $1,800,000; additional public sewers, $500,000; treatment of the River des Peres, $4,350,000; re-building of old downtown sewers, $3,000,000.

The Board of Public Improvements of St. Louis, Mo., Maxime Reber, President, commenced advertising for bids on March 7 for the disposition of all St. Louis garbage collected in the municipal wagons until Sept. 1, 1918. The successful bidder is not expected to take charge of the garbage for at least nine months.

The Board of Public Improvements of St. Louis, Mo., Maxime Reber, President, has temporarily laid aside the plans for a municipal garbage reduction or incineration plant.

Mathews & Forrester, Kansas City, Mo., submitted the lowest bid on March 3 for the construction of sewers in Sewer District No. 9, in Hannibal, Mo., the bid being $22,007. The work will include the following: 14,365 ft. of 6-in. pipe; 1,950 ft. of 12-in. pipe; 1,424 ft. of 16-in. pipe; 950 ft. of 18-in. pipe; 2,200 ft. of 24-in. pipe; 14.265 ft. of trench for 6-in pipe: 6 to 9 ft. deep; 1,500 ft. of trench for 24-in. pipe, 6 to 9 ft. deep; 600 ft. of trench for 24-in. pipe, 9 to 12 ft. deep; 600 ft. of trench for 18-in. pipe, 9 to 12 ft. deep; 400 ft. of trench for 18-in. pipe, 12 to 15 ft. deep: 300 ft. of trench for 16-in. pipe, 9 to 12 ft. deep; 500 ft. of trench for 16-in. pipe, 15 to 18 ft. deep: 300 ft. of trench for 2-in. pipe, 18 to 21 ft. deep: 600 ft. of trench for 12-in. pipe, 6 to 9 ft. deep; 900 ft. of trench for 12-in. pipe, 9 to 12 ft. deep; 300 ft. of trench for 12-in. pipe, 12 to 15 ft. deep; 100 ft. of trench for 12-in. pipe, 12 to 15 ft. deep, 22 manholes and 16 lampholes.

Jacob Althause & Co., St. Louis, Mo., submitted the lowest bid, March 3, for the construction of sewers in District No. 100, in Hannibal, Mo., the bid being $45,072. The work includes the following: 9,200 ft. of 30-in. pipe; 3,800 ft. of 6-in. pipe; 1,300 cu. yds. of concrete; 3,300 ft. ex. for 30-in. pipe, 6 to 9 ft. deep; 2,100 ft. of ex. for 30-in. pipe, 9 to 12 ft. deep: 300 ft. of ex. for 30-in. pipe, 12 to 15 ft. deep; 100 ft. ex. for 30-in. pipe, 15 to 18 ft. deep; excavation, 30-in. pipe, 18 to 21 ft. deep: 200 ft. ex. 30-in. pipe, over 24 ft. deep; 2,300 ft. ex. for 6-in. pipe, 3 to 6 ft. deep; 500 ft. concrete for 6-in. pipe, 6 to 9 ft. deep; 700 ft. ex. for 6-in. pipe, 9 to 12 ft. deep: 300 ft. of ex. for 6-in. pipe, 12 to 15 ft. deep; 16 manholes; 2,600 ft. ex. 30-in. pipe, 3 to 6 ft. deep, and 700 ft. ex. 30-in. pipe, over 24 ft. deep.

Nebraska.

✣Bids will be received until 6 p. m., March 15, by G. L. Shumway, City Clerk, Scottsbluff, Nebr., for furnishing materials and constructing the uncompleted portion of the main sanitary sewer for the City of Scottsbluff, Nebr., in accordance with the plans and specifications on file in the office of the City Clerk of Scottsbluff, Nebr.

⊙D. G. Gordon, 308 First Nat. Bank Bldg., Denver, Colo., has been awarded the contract by the village of Sidney, Nebr., L. Neubauer, Village Clerk, for the construction of a sewer system, mains and laterals, and a disposal plant, for $17,464. Bids were opened Feb. 28.

Plans and specifications are being prepared for the installation of a sewerage system in St. Paul, Nebr. The City Council plans to hold a special election in the near future for the purpose of voting on the question.

Plans and specifications were recently completed by the Towle Engineering Co., of Omaha, Nebr., for the installation of a sewerage system in Bancroft, Nebr., to cost approximately $25,000. It is expected that the contract will be let within a short time.

According to advices from Omaha, Nebr., the Carter Lake Club is contracting to put in a sewer system at Courtland Beach, the new club site, to discharge in the Missouri River more than two miles away, and to install a water system of two miles of main and service pipes, with the 1,000-ft. artesian well as the principal supply and a 12-000-gal. tank.

New Jersey.

The Borough Council of Metuchen, N. J., will hold a special session on March 17 for the purpose of taking up the proposition of submitting to the voters at a special election a bond issue of from $125,000 to $150,000 for a sewer system and street paving.

The Common Council of Rahway, N. J., has instructed City Engineer Franklin Marsh to obtain at once the necessary information relative to sewer elevations and outlets in the city and submit the same to Consulting Engineer Clyde Potts, of New York City. It is thought that a tank system can be installed for about $50,000.

The City Council of Elizabeth, N. J., has retained Consulting Engineer George W. Fuller, 170 Broadway, New York City, to investigate the intercepting sewer question in Elizabeth.

New York.

✣Bids will be received until 10 a. m., March 22, by the Village of Palatine Bridge, N. Y., for the construction of sewer system and sewage disposal plant. Morrell Vrooman, Gloversville, N. Y., is Engineer.

The Village Board of Eastwood, N. Y., has authorized Engineer George Higgins, of Syracuse, N. Y., to prepare plans for the installation of a sanitary sewer system.

Specifications for the construction of the storm and sanitary sewers on both sides of the river, also for the sewage disposal works, are on file with City Engineer Chas. H. Snyder, of Oswego, N. Y.

City Engineer T. A. Brown of Elmira, N. Y., has prepared plans and specifications for sewers to be laid on Roe Ave., Water St. and the sewer for the Morrow plant running from South Main St. Contracts will be let this month.

Bids are to be asked this week by the City of Oswego, N. Y., John Smith, Commissioner of Public Works, on the construction of the proposed storm water sewer in Harbor Brook on the East Side and for the construction of other sewers costing $20,000. Bids are to be in by the latter part of March.

The citizens of the village of Fairport, N. Y., will vote March 11 on a $40,000 bond issue for the purpose of constructing an intercepting sewer and disposal plant in accordance with plans prepared by Engineers Bowerman & Fischer, Fairport.

Citizens of Huntington, L. I., have signed petitions for the proposed Huntington sewer district, which comprises the central or more densely populated section of the village. Steps will now be taken to go ahead with the incorporation of the district and the preparation of detailed plans for the construction of the sewer mains and disposal plant that will cost about $90,000. The territory comprises from the Long Island Railroad north to the Mill Pond, from the High School building on the east to the top of Cold Spring Hill on the west.

North Dakota.

The Town of Langdon, N. Dak., (population 1,214), proposes the construction of a sewerage system.

Ohio.

✣Bids will be received until noon, March 31 by Council, Village of East Youngstown, O., for furnishing the labor and material necessary for the following separate jobs: No. 1, Grading and paving Robinson Road between Wilson Ave. and 12th St. No. 2, Grading 6th St. from Wilson Ave. to Reed line. No. 3, Grading and sewering Reed Ave. from 14th to 12th Sts. No. 4, Grading and sewering 9th St. from Wilson Ave. to Reed's Runs. No. 5, Grading and sewering 10th St. from Wilson Ave. to Gordon Ave. No. 6, Grading and sewering 5th St. from Wilson Ave. to Devitt St. No. 7, Grading 7th St. No. 8, Grading and paving west end of Wilson Ave. from McVey Run to west limits of the village. No. 9, Grading and sewering Madison Ave. No. 10, Grading 8th St. No. 11, Grading and sewering 13th St. No. 12, Grading and Sewering Murray Ave. Said streets to be bid on separately and separate bids should be filed for sewer and separate bids for grading, according to the plans and specifications on file in the office of Village Clerk P. J. Carney.

✣Bids will be received until noon, March 25, by W. E. Morgan, Clerk, Geneva, O., for the construction of 2,692 lin. ft. of 8-in. sewer. Cummings & Downer, Painesville, O., are Engineers.

⊙The Elyria Construction Co., Elyria, O., has been awarded the contract by the Department of Public Service, G. H. Lewis, Director, for the construction of a sewer in 2nd St. from West Ave. to Court St. at $2,700, and in West Ave. at $1,800. Bids were opened Feb. 21.

Consulting Engineer R. Winthrop Pratt, 712 Hippodrome Bldg., Cleveland, O., has been retained by the Director of Public Service, Canton, O., to make a report and general plans for sewage purification plant for Canton.

The Department of Public Service of Cincinnati, O., V. T. Price, Director, decided not to receive bids for the construction of main and lateral sewers and drains with their appurtenances, in right of way and McPherson Ave. from Garfield Ave. and Basset road to W. 8th St., Wells Ave. and etc., for which bids were to have been opened Feb. 21.

City Engineer Robt. L. J. Wagar, of Sandusky, O., has practically completed the plans of the existing sewers of the city and those in contemplation. Tentative plans have also been prepared for a disposal plant.

The Department of Public Service, Cincinnati, O., has rejected all bids received recently for the construction of a sewer on Streng St. The engineer's estimate is $0.90 per lin. ft.

Oklahoma.

The City Commissioners, Sapulpa, Okla., have ordered the construction of a sewer system throughout the east part of the city. Contracts will be let shortly.

Oregon.

The City Council of Portland, Ore., will readvertise for bids for the East Glisan St., section of the East Stark St. sewer. Tom Hurlburt is City Engineer.

Pennsylvania.

✣Bids will be received until April 1, by C. R. Acker, Secy., Scranton Poor District, Room 624 Connell Bldg., Scranton, Pa., for the erection and construction of a sewage, treatment or disposal plant, at Hillside Home, near Clark's Summit, Pa. All to be done in accordance with plans and specifications now on file in the office of the Secretary. A certified check for $500 must be filed with each bid.

⊙E. M. Mullin & Co., of Philadelphia, Pa., have been awarded the contract at East Lansdowne for the construction of sewers, for $18,965.

⊙Pietro Co., Morgantown, W. Va., has been awarded the contract by the Borough Council, Beaver Falls, Pa., for the construction of a sanitary sewer system for $142,577. The work to be done consists of laying approximately 16 miles of sanitary sewers with appurtenances, sewers ranging in size from 8 to 24 ins. in diameter. Leo Hudson, McKeesport, Pa., is Engineer. Bids were opened Feb. 19.

Consulting Engineer R. Winthrop Pratt, 712 Hippodrome Bldg., Cleveland, O., has been retained to make a report upon means for protecting the city of New Castle, Pa., from damage by floods. C. H. Milholland is City Engineer of New Castle.

The Department of Public Health, Harrisburg, Pa., has approved the plans for the proposed sewage disposal plant for Sharon, Pa. It is expected that the citizens will be asked to vote on the proposition shortly. Horace W. Davis is City Solicitor.

Commissioners of Upper Darby Township, Delaware County, Pa., propose to go ahead with sewer building, and $35,000 will be borrowed for the construction of sewers in several districts. First, a sewer system will be installed in Fernwood, the estimated cost of which is $8,000. Drexel Hill, Highland Park, Keystone and other villages in the township also will probably be equipped with sewers. Albert F. Damon, Darby, Pa., is Engineer.

The Borough Council of Mt. Wolf, Pa., is considering the question of a reservoir and sewer system. The estimated cost of digging the wells, building the reservoir and constructing the sewer is $4,500.

The City Council of Meadville, Pa., proposes to issue bonds to the amount of $75,000 for city improvements, mostly paving and sewering.

South Dakota.

The citizens of Howard, S. Dak. (population 1,026), have voted bonds to the amount of $2,500 for the installation of a sewerage system. A septic tank will be located some distance south of town on the Vermillion River.

The citizens of Howard, S. Dak., contemplate the installation of a sewer system.

Tennessee.

✣Bids will be received until 2 p. m., March 24 (postponement of date), by Mayor and Board of Aldermen, Martin, Tenn., for the construction of a complete system of sanitary sewers, consisting of the following: 3,000 ft. of 15-in. sewer; 6,200 ft. of 12-in. sewer; 3,500 ft. of 10-in. sewer; 15,350 ft. of 8-in. sewer; 23,000 ft. of 6-in. sewer. All necessary manholes and flush tanks. The above quantities are approximate only and subject to change. Complete plans and specifications are on file in the office of the Recorder of Martin, Tenn., and in the office of the Consulting Engineers, R. C. Huston & Co., 630-34 Exchange Bldg., Memphis, Tenn. Complete specifications will be mailed upon receipt of $5 to cover cost of same. No bids will be received unless accompanied by a certified check of not less than 5 per cent of the amount of the bid. Check in no case to be less than $1,000.

The Board of Public Works of Nashville, Tenn., has asked the City Council for an appropriation of $6,700 to construct a trunk sewer in Delta Ave. It will be from 33 to 39 ins. in diameter, and of circular construction.

Plans for the establishment of a crematory in the eastern part of Memphis, Tenn., were considered at a conference between Mayor Crump, Dr. Goltman and Building Inspector Newton on March 5. According to the officials an additional crematory is needed to take care of the refuse from the residential portion of the city.

Texas.

⊙The City Commissioners of Dallas, Tex., have awarded the contract for the laying of a sanitary sewer in Grand Ave., from Exposition to Brady Sts., to the Dallas Lime & Gravel Co., at $2,547, with $0.16 a ft. for rock trench and $12.40 for manholes.

Plans and estimate are now being made looking to the installment of a modern sewerage system in Kingsville, Tex.

The City Council of Austin, Tex., has adopted the budget for sewer construction. It is proposed to expend about $26,000 for the installation of new sewers. G. L. Iredell is City Engineer.

Plans and estimate are now being made looking to the installation of a modern sewerage system for Kingsville Tex.

Residents of the Rose Hill section of the West Side, Texarkana, Tex., have decided in favor of the installation of a sewer system in that section. H. W. Runnels is Mayor and official in charge of sewers.

The City Council of Temple, Tex., has set April 1 as the date to hold the special election for the purpose of voting on the issuance of bonds to purchase the present sewerage system.

Utah.

City Engineer D. H. Blossom of Salt Lake City, Utah, has recommended to the City Commission the construction of a storm sewer system to drain all surplus water into the Jordan River.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

The City Commissioners, Ogden, Utah, H. J. Craven, City Engineer, have authorized the engineer to ask for bids for material and the construction of sewer district No. 115.

Vermont.

The town of Brattleboro, Vt., has appropriated $2,500 for the construction of the South Main St. surface drain. Carl S. Hopkins is Clerk of the Selectmen.

Virginia.

The town of Bridgewater, Rockingham County, Va., has voted the issuance of bonds to the amount of $25,000 for the construction of a modern water and sewerage system.

Washington.

⊙The Jahn Construction Co., of Seattle, Wash., has awarded the contract to the Harbor City Glazed Cement Pipe Co., for furnishing all pipe on the $165,000 Everett, Wash., sewer job up to 21-ins. in diameter. They in turn have let to the Washington Portland Cement Co., White Bldg., Seattle, the contract for the supply of 9,000 bbls. of cement.

The Town Council of Sumas, Wash., J. L. Mitchell, Town Clerk, rejected all bids received Feb. 24 for the construction of sewers.

Wisconsin.

⊙C. B. McNamara & Co., Dubuque, Ia., has been awarded the contract by the city of Prairie du Chien, Wis., for the construction of sewers, for $20,482. The work includes the following: 6,427 ft. of 12-in. pipe; 1,241 ft. of 10-in. pipe; 16,444 ft. of 8-in. pipe; 1,298 ft. of 6-in. pipe, 53 manholes, 6 lampholes and 1 bulkhead. Bids were opened March 1.

Canada.

The U. S. Steel Corporation proposes improvement work in its new town known as Pontiac, Ont. Streets are to be laid out, sewers built, water and lighting mains laid, paving and sidewalks constructed before the actual construction of the new city. William Woollatt, of Walkerville, Ont., is Mayor.

BUILDINGS

Alabama.

⊙The F. W. Mark Construction Co., Birmingham, Ala., has been awarded the contract to build the pipe plant of the National Cast Iron Pipe Co. at Boyles. The cost of buildings will approximate $100,000. They include a foundry 480x66 ft., machine and pattern shop 210x66 ft., cleaning shed 30x252 ft., and another cleaning shed 30x126 ft. The construction is to be of steel with concrete base and brick sides and ends and the roof of corrugated iron. The Virginia Bridge Co. will furnish the steel. A. H. Ford, Birmingham, Ala., is President of the National Cast Iron Pipe Co.

Illinois.

✣Bids will be received until 2 p. m., March 24, by Board of Administration at the office of the Supervising Architect, State of Illinois, 1101 Steinway Hall, Chicago, Ill., for converting Cottage No. 5 into a nurses' home at the Kankakee State Hospital, Kankakee. F. D. Whipp is Fiscal Supervisor. Official advertisement will be found elsewhere in this issue.

⊙Jno. B. Kreke, Effingham, Ill., has been awarded the contract for constructing a jail and sheriff's residence at Effingham for the county. Bids were opened March 3. J. W. Gaddis, Vincennes, Ind., is the Architect.

Indiana.

✣Bids will be received until 11:30 a. m., March 22, by Board of Wayne Township Trustees, Montgomery County, at Wayne Township, Ind., for the construction of a 2-story brick school building, with stone trimmings. O. L. Osburn is Trustee.

Iowa.

⊙James Corse, Racine, Wis., has been awarded the contract, at $66,000, for the construction of the U. S. public building at Red Oak, Ia.

Maryland.

⊙Gladfelter & Chambers, Baltimore, Md., have been awarded the contract for the erection of a dormitory building at the Rosewood Training School, bids for which were opened Feb. 12. The cost of the building complete is about $75,000. Ellicott & Emmart, 1101 Union Trust Bldg., Baltimore, Md., are the Architects.

Missouri.

⊙L. W. Dumas, Columbia, Mo., has been awarded the contract at $97,890 for construction of a court house at Chillicothe, Mo., for Livingston County. Bids were opened Feb. 27 by A. M. Shelton, County Clerk.

New Hampshire.

⊙General Constructing Co., 1790 Broadway, New York City, has been awarded the contract at $68,300 for constructing U. S. Post Office at Rochester, N. H.

⊙The H. P. Cummings Construction Co. of Ware, Mass., has been awarded the contract for the erection of the Hitchcock Property Dormitory, Dartmouth College, Hanover, N. H. This is to be a 4-story building of brick and stone (fireproof), 100x40 ft. and wing 40x65 ft., to cost in the neighborhood of $125,000. Charles A. Rich, Architect, 320 Fifth Ave., New York City. The work is to start at once.

New Jersey.

⊙The Turner Construction Co., 11 Broadway, New York City, has been awarded the general contract, by the Vacuum Oil Co., for the construction of five different reinforced concrete structures at its Bayonne, N. J., plant, consisting of a boiler house, railroad trestle, tanks, retaining walls, and fire wall. Work will be undertaken at once.

Ohio.

⊙John G. Unkefer & Co., Minerva, O., have been awarded the contract at about $66,000 for construction complete of the U. S. post office at Bellefontaine, O.

Oregon.

⊙The Brayton Engineering Co., Lumbermen's Bldg., Portland, Ore., has the contract for the erection of a 12-story office building at West Park and Washington Sts., Portland, for Theodore B. Wilcox.

Earl Voghto & T. J. Knapp, Architects, Klamath Falls, Ore., have plans underway for a 3-story brick and concrete Masonic Temple to be erected at Klamath Falls.

Pennsylvania.

✣Bids will be received until March 18 by Board of Education, Johnstown, Pa., for the construction of a $100,000 school building, plans for which were prepared by J. E. Lucas, Johnstown, Pa. The structure will be 3 stories high, measuring 107 by 108 ft., and will cost $100,000.

⊙The Mathews Construction Co., Princeton, N. J., has been awarded the contract at $60,336 for constructing the U. S. Government building at Bristol, Pa.

South Carolina.

The Santee River Cypress Lumber Co., Ferguson, S. C., has had ground plans completed and has detail plans in progress for a planing mill, box shop, dressed and rough lumber sheds to be erected at Ferguson, S. C., by contract. Buildings cover space 350x400 ft.; to have concrete floor and concrete piers for building support, balance wood. The company will let grading and leveling of ground covering approximately 20,000 yards of dirt excavating and filling together with concrete work separately, or the entire job combined.

Texas.

⊙Contracts for a new high school for the city of Houston, Tex., bids for which were opened Feb. 24, have been let as follows: General contract, G. Hartman Construction Co., St. Louis, Mo., $190,000; heating, Keithly Co., Houston, $22,000; plumbing, Collins Plumbing Co., Houston, $10,000; wiring, Barden Electric Co., Houston, $5,000.

Utah.

The Utah Valley Gas & Power Co., of Provo, Utah, has given a trust deed to secure a $500,000 bond issue. Of this sum, $150,000 is to be expended at once in building a plant in Provo and laying mains in the city. Work will probably be started this spring.

Washington.

✣Bids will be received until 2 p. m., April 15, Secretary, General Supply Committee, Washington, for furnishing such stationery, including drafting supplies, hardware, metals, cordage and leather and saddlery, dry goods, cloth bags, flags, notions and wearing apparel, drugs, medicines and chemicals, apparatus, hospital appliances and surgical instruments, electrical, engineering and plumbing supplies, lumber, millwork, packing boxes and sawdust and building materials, paints, oils, glass and brushes, furniture and floor coverings, groceries, provisions and household supplies, photographic supplies and special agricultural department equipment, engraving, printing and lithographic supplies, incandescent electric lamps, incandescent gas lamp supplies, motor trucks, as may be required for use of the executive departments and independent establishments of the government, as indicated under the provisions of section 4 of the act of June 17, 1910, for the fiscal year ending June 30, 1914.

Bids were opened March 5 by the Constructing Quartermaster, Vancouver Barracks, for installation of ventilating ducts in eight barracks, the bid of Henricksen, Sykes & Co., Vancouver, Wash., at $2,323, being recommended for acceptance.

West Virginia.

⊙John G. Unkefer & Co., Minerva, O., have been awarded the contract, at $92,900, for constructing the U. S. public building complete, at Morgantown, W. Va.

Wisconsin.

⊙Contracts for constructing new court house at Medford, Wis., bids for which were opened Feb. 15, were let as follows: The Hutter Construction Co., Fond du Lac, Wis., general contractor for the building, $57,203; G. H. Kallics, Manitowoc, Wis., for heating, including heating the sheriff's house and jail, $7,200; Thill Manning Whalen Co., La Crosse, Wis., plumbing, $1,699; A. O. Anderson, Manitowoc, wiring, $600.

Canada.

⊙The Brown Construction Co., Ltd., Winnipeg, Man., has been awarded the contract by the Department of Public Works of Canada for the construction of a public building at Morden, Man.

Tenders will be asked early in the spring on an 8-story steel and brick office building to be erected in Hastings St., East Vancouver, B. C., at a cost of about $85,000. Parr, McKenzie & Day, Vancouver Bldg., Vancouver, are the Architects.

By-laws authorizing the following expenditures have been voted by the citizens of Regina, Sask.: $425,000 for electric light and power plant; $250,000 for extensions of light and power system; $180,000 for new police station; $134,000 for a new winter fair building; $125,000 for hospital extension. J. McArthur is City Engineer.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

RIVERS AND HARBORS

Delaware.

⊙The Interstate Construction Co., 1170 Broadway, New York City, has been awarded the contract at $69,850 and $2.75 per ton for riprap for rebuilding Brandywine Shoal Light Station in Delaware Bay for the U. S. Government. Bids were opened Feb. 15. The light station is located in Delaware Bay, about 12½ nautical miles from Lewes, Del. The site has a depth of 8 ft. The light house consists of a cylindrical iron foundation pier about 46 ft. high and 35 ft. in diameter. It is to be sunk in the sand shoal about 14 ft. by the pneumatic process. The station supports a 3-story iron dwelling. The lantern will he about 60 ft. above the water.

District of Columbia.

✣Bids will be received until 2 p. m., April 1, by Commissioners of the District of Columbia, Washington, D. C., for furnishing oils and lubricants during the fiscal year ending June 30, 1914, for use in various branches of the government.

✣Bids will be received until 10:30 a. m., March 27, by Maj. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under canal circular 765, railings for spillways and steel doors for entrances to the Operating tunnels of all Locks on the Panama Canal.

Florida.

A project is well advanced at St. Petersburg, Fla., for building a seawall, beginning about 500 ft. from the Beach drive at 6th Ave. and extending as far as 13th Ave. The ground will be filled back of the wall, adding about seven blocks to the city. M. W. Spencer is City Engineer.

Georgia.

All bids received March 4 by Col. Dan C. Kingman, U. S. Engineer, Savannah, for dredging in waterway between Savannah and Fernandina, Fla., Club and Plantation Creeks and harbor at Brunswick Harbor were considered too high and were rejected.

Indiana.

✣Bids will be received until 11 a. m. (central time) April 19, by Maj. J. C. Oakes, U. S. Engineer, Louisville, Ky., for the construction of Lock and Dam No. 43, near New Amsterdam, Ind. Official advertisement will be found elsewhere in this issue.

Louisiana.

✣The Caddo Levee Board, Shreveport, La., has rejected the bids for Red River bank protection and tying ends of levees, and has asked new bids for April 2. The work will cost about $250,000.

Bids will be received until 11 a. m., March 20, by U. S. Engineer, Room 325, Custom House, New Orleans, La., for delivering f. o. b. wharf at the U. S. Engineer Depot, foot of Millaudon St., New Orleans, La., the following machinery, irons, etc., to be used on a gravity swing dredge operating a 1½ cu. yd. orange peel bucket: Lot 1, one 1½ cu. yd. Hayward standard orange peel bucket, complete; lot 2, one set of four boom truss rods without castings for 14x14-in. boom, 75 ft. long; lot 3, one complete set of irons for foot of boom; lot 4, one complete set of irons for top of boom, 14x14 ins., the set to include steel pin, protecting iron, boom fall yoke, links or other means of supporting blocks, shackles to attach boom control line, washers and cotter pins; lot 5, one complete set of irons for the A-frame and stiff leg timbers, to be 12x12 ins., 40 ft. above deck; lot 6, steel rod 2 ins. in diameter with yokes or straws for attaching to A-frame and two steel pins, the rod to be made in convenient lengths, total approximately 62 ft.; lot 7, hog chains, 1½ ins. steel rod, each chain will be in two parts; lot 8, two galvanized iron thimbles for 1-in. wire rope, three thimbles for ¾-in., 6 Crosby drop forged steel clips for 1-in. wire rope and nine do for ¾-in.; lot 9, two heavy wire rope blocks, 2 boom sheaves 2 single sheave brackets and 2 guide sheathes; lot 10, two sets of sister sheaves; lot 11, one engine to have double cylinders, each 10x12 ins. and of approximately 70-horseoower, and 5 drums with 3 auxiliary drums; lot 12, standard stationary locomotive boiler of 100 nominal horsepower, to be supplied with one Lidgerwood projector; lot 13, 2 feed pumps, horizontal duplex double action, pressure 200 pounds; lot 14, feed water heater with oil separator and water purifier, inclosed type. Further information may be had upon application to the U. S. Engineer's office, Custom House, New Orleans, La.

The Caddo Levee Board, Shreveport, La., has authorized President John Sentell to ask bids for digging a drainage channel to divert Twelve Mile Bayou into Cross Bayou, thereby reclaiming probably 100,000 acres of land. This action will hasten developments when permission for the closing of Twelve Mile Bayou is granted by Congress. The work will probably cost $300,000.

Massachusetts.

✣Bids will be received until 11 a. m., April 4, by Lieut. Col. George B. Davis, Constructing Quartermaster, 263 Summer St., Boston, Mass., for the construction of a concrete sea wall at Fort Andrews, Mass. A deposit of $5 is required for plans which can be seen at the office of Chief Quartermaster Eastern Department, Governor's Island, New York Harbor.

Mississippi.

⊙Favre & Francis, Gulfport, Miss., have been awarded the contract at $7.25 per lin. ft. for the construction of 1,500 lin. ft. of sea wall for the city of Bay St. Louis, Miss. The wall is to be constructed of reinforced tongue and groove concrete piling, 20 ins. wide, 9 ins. thick and 21 ft. long; it is to have a concrete coping and an apron. The other bids per lineal foot were as follows: Interstate Construction Co., Mobile, $21.65; Bert Victor, Pascagoula, $10; F. H. Fleming, Mobile, $18.40; Favre & Francis, Gulfport, $7.25; Huntington Construction Co., Huntington, W. Va., $7.70; McLain & Farragut, $8.39; Klendell Bros., Chicago, $27.68.

New Jersey.

✣Bids will be received until noon, March 24, by Lieut. Col. J. E. Kuhn, U. S. Engineer, Witherspoon Bldg., Philadelphia, Pa., for dredging a channel to the wharf at Fort Mott, N. J., involving the removal of approximately 30,000 cu. yds. of material.

New York.

Authorization has been given the city of New York to construct the first of its projected 1,200 ft. piers. It will be constructed at 46th St. and the Hudson River, and will cost about $4,300,000. Calvin Tomkins, Pier A, Battery Pl., New York City, is Commissioner of Docks and Ferries.

North Carolina.

✣Bids will be received until noon, April 5, by Maj. H. W. Stickle, Wilmington, N. C., for furnishing and delivering Portland cement. Official advertisement will be found elsewhere in this issue.

Ohio.

✣Bids will be received until April 8 by Maj. L. H. Rand, U. S. Engineer, 415 Custom House, Cincinnati, O., for repairing Dam No. 4, Muskingum River, O.

Texas.

Bids as follows were received Feb. 18 by Maj. T. H. Jackson, U. S. Engineer, Dallas, Tex., for furnishing about 3,400 tons of one-man stone for guard lock Sabine-Neches canal, Texas. Material to be delivered at Port Arthur, Tex., f. o. b. cars on S. P. spur track: Darragh Bros., Granite Mountain, Tex., $2.50 per ton; specific gravity of stone 2.6249; same granite is now being furnished D. M. Picton & Co. for Sabine Pass jetties. Texas & New York Granite Co., Marble Falls, Tex., $2.10 per ton (recommended for award); specific gravity 2.72 stone from quarry of company at Granite Mountain, Tex. No bids were received for furnishing 8,400 tons of crushed rock or gravel.

Bids as follows were received Feb. 17 by Maj. T. H. Jackson, U. S. Engineer, Dallas, Tex., for furnishing about 9,000 bbls. American Portland cement for guard lock Sabine-Neches canal, Texas: Southwestern States Portland Cement Co., Dallas, Tex.—$1.95 per barrel delivered f. o. b. cars Kansas City Southern Ry. spur track, Port Arthur, Tex.; cement to be "Trinity" brand manufactured by Southwestern States Portland Cement Co. at Eagle Ford, Tex., 10 cts. each allowed for return of sacks. Wm. Parr & Co., Galveston, Tex.—$2.00 per barrel delivered on barges alongside of ship in Sabine-Neches canal at Port Arthur, Tex. (in cooperage); $2.60 per barrel delivered f. o. b. cars Southern Pacific R. R. spur track, Port Arthur, Tex., in sacks, 10 cts. per sack allowed for return of sacks; brand of cement, "Vulcanite," manufactured by Vulcanite Portland Cement Co. at Vulcanite, N. J.; Lehigh brand 5 cts. per barrel higher in both cases. Texas Portland Cement Co., F. R. Bissell, Receiver in Bankruptcy, Dallas, Tex. —$1.94 per barrel delivered f. o. b. cars Southern Pacific spur tracks; $1,94 per barrel delivered f. o. b. cars Kansas City Southern spur track at Port Arthur; 10 cts. per sack allowed for return of each sack; brand of cement, "Lone Star," manufactured by Texas Portland Cement Co. at Cement or Harrys, Tex. Atlas Portland Cement Co., New York, N. Y.—Delivered on barges alongside of ship in Sabine-Neches canal at Port Arthur; $2.00 per barrel in cooperage, $1.96 per barrel in sacks; allowance for return of sacks, 10 cts. each; delivered f. o. b. cars Southern Pacific spur track, Port Arthur, $2.00; delivered f. o. b. cars Kansas City Southern spur track, Port Arthur, $1.98; brand of cement, The Atlas Cement, manufactured by The Atlas Portland Cement Co. at Northampton, Pa. Alpha Portland Cement Co., Easton, Pa.—$2.25 per barrel in cooperage delivered on barges alongside of ship in Sabine-Neches canal at Port Arthur; brand of cement, Alpha, manufactured by Alpha Portland Cement Co. at Alpha, N. J.; 10 cts. per sack allowed for return of each sack. Recommendation has been made that contract be awarded to Atlas Portland Cement Co. at $1.96 per barrel, delivered in sacks on barges alongside ship in Sabine-Neches canal at Port Arthur.

Pennsylvania.

A bill is now before the State Senate to amend the constitution to permit Philadelphia to borrow $25,000,000 for improving the port of Philadelphia. The resolution provides that the General Assembly may authorize the state to issue bonds to the amount of $25,000,000 for the purpose of improving and developing the port of the city and county of Philadelphia by the reclamation of land on the banks of the Delaware and Schuylkill Rivers and land adjacent thereto, the building of bulkheads and the construction of wharves, docks, sheds and warehouses and other buildings necessary for the establishment and maintenance of railroad and shipping terminals along the said rivers.

Canada.

⊙The Pacific Dredging Co., Ltd., Vancouver, B. C., has been awarded the contract by the Department of Public Works of Canada, for dredging False Creek, Vancouver, B. C.

City Council of London, Ont., is considering a by-law to raise $75,000 for a London West breakwater. William N. Ashplant is City Engineer.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ENGINEERING AND CONTRACTING

Devoted to the Economics of Civil Engineering Design
and to Methods and Cost of Construction

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The Proposed Rehabilitation of the Illinois and Michigan Canal in Illinois.

The appropriation of $1,000,000 for the improvement of the Illinois and Michigan canal is provided for by bills introduced on March 12 simultaneously in both houses of the Illinois Legislature. This action is the outcome of new interest in the old waterway named, aroused by the coincidence of one or two successful shipments and a notification from the Federal Government of the obligation to maintain a usable waterway which was assumed by the State of Illinois when the canal was built. The facts are worthy of brief statement.

Surveys for the Illinois and Michigan canal were made in 1820. In 1827 the United States under the land grant act gave the State of Illinois 325,000 acres adjoining the surveyed route to aid the State in financing construction. Work was begun in 1836 and the new waterway was completed in 1848. It cost $6,339,098. The income from land sales and from canal operations has reimbursed the State for this original expenditure and for all subsequent appropriation and given a cash surplus of $346,336. In addition the State still has land holdings valued at some $4,000,000. There is no indebtedness.

As a financial investment by the State, the Illinois and Michigan canal presents a very satisfactory showing. For 20 years, however, traffic on the canal has been decreasing; for the last few years about the only income from the waterway has been water power rents, and the canal structure has remained unkept and the work as an operating waterway has been virtually abandoned. In June, 1912, official notice of this condition was taken by the United States through its Department of Justice. In two letters from the Attorney General the Government's case was presented as follows:

> The Act approved March 2, 1827, c. 51 (4 Stat. 234), granting certain lands to the State in aid of this work, provides that "the said lands shall be subject to the disposal of the legislature of the said State, For the purpose aforesaid, and no other," and also that "said canal when completed, shall be and forever remain a public highway for the purpose of the government of the United States, free from any toll or other charge, whatever, for any property of the United States, or persons in their service, passing through the same."
>
> It would appear that, by the acceptance of the said land grant, together with the enjoyment of the proceeds of the sale of a considerable portion of the land, the State assumed a contractual obligation to the United States to maintain the canal as a public highway for the use of the United States which would be violated if the canal be allowed to become unfit for use or be abandoned. If, therefore, the facts I have stated above be correct, it would seem to be a proper case for some action by the United States to enforce the performance of the contract or to recover the consideration given.

Referring to the final clause in the above quotation it appears from a report made Dec. 27, 1912, by the Commissioners of the Illinois and Michigan canal, that a restoration of the waterway to its original condition would cost "several hundred thousand dollars" and that the alternative of returning the "proceeds from the grant of 1827 together with the lands still remaining in possession of the State" would involve the payment of some $9,000,000. The Commissioners urge that the restoration of the canal to its original condition would not give the State a waterway of practical utility, but that by the expenditure of, in round numbers, $1,000,000, the canal structures could be so enlarged that a profitable development of shipping would result. The bills introduced March 12 into the State Legislature provide for the appropriation and expenditure of this $1,000,000.

The Illinois and Michigan canal has for a decade been so overshadowed by the movement for a deep waterway across the State of Illinois that it is somewhat of an effort to conceive of its service again as a means for modern transportation. As a matter of fact, however, this last century, work is not so materially far behind the Hennepin canal finished six years ago, and with an expenditure of one-seventh, about, of the cost of the Hennepin canal can be made substantially its equal in transportation ability. If the Hennepin canal is a logical construction for modern transportation conditions, then so will an enlarged Illinois and Michigan canal be one. To conclude, however, that the rehabilitation of the Illinois and Michigan canal is a logical modern improvement because it would then become of the same rank as the Hennepin canal, which is a construction of modern times, is obviously to beg the question. Is the Hennepin canal a logical type of waterway construction for modern transportation conditions? Opinion is certainly not in agreement that it is.

It is, however, not now so much our purpose to discuss the fitness of boat canals to occupy a prominent place in present day water transportation lines as it is to present in a favorably fair light the reasons for improvement of the Illinois and Michigan canal which the advocates of this improvement are advancing.

Predicating that the Federal Government is determined in its disposition to enforce the contractual obligations assumed by the State of Illinois in the Acts of 1827, the State must either refund the consideration received amounting, it is asserted, to some $9,000,000, or it must restore the Illinois and Michigan canal to its original condition of usefulness, which will cost "several hundred thousand dollars." It is argued, quite reasonably, that the refunding of so great a sum is an act that should not be contemplated until all alternatives are determined to be unwise, and that merely to restore the canal to its original condition would be to spend a considerable sum with practically no benefit to transportation facilities. The wiser course of action, it is argued, would be to spend a greater sum than bare restoration demands, and by this extra expenditure increase the transportation capacity of the canal from 200-ton to 800-1,000-ton barges, and make it a usable connection of the Hennepin canal.

The wisdom of undertaking this extra expenditure is asserted, first, because it will not exceed twice or three times the cost of bare restoration and in no case exceed $1,000,000, and, second, because there is ample traffic in sight to make certain the return of all the money spent. The assumed total cost of $1,000,000 is based on a special estimate made by engineers of the U. S. Government. The estimate of probably certain traffic is based upon written statements of shippers who have said that they would use the canal at once upon its improvement. The volume of probable traffic is given as about 3,000,000 tons a year.

The preceding outline of the Illinois and Michigan canal problems has been made as brief as possible and yet make its general character clear. Whether or not this waterway has a future usefulness, the State of Illinois is confronted with the necessity of taking some action regarding it. The bills which have just been introduced into the State Legislature will possibly serve the purpose of bringing about the necessary action.

ROADS AND STREETS

Methods and Costs of Constructing Three Types of Paving for Street Railway Tracks.

Contributed by D. B. Davis, Assistant City Engineer, Richmond, Ind.

The proper construction for the tracks of street railways is a question which deserves the attention it is receiving on the part of officials and engineers in various cities. Specifications upon this class of work are many and varied, each setting forth requirements which seem necessary to the author for the best construction. Although the methods are, to a degree, different in each specification, they all tend to secure the same results; that is, the attainment of a track which is uniformly stable and economically permanent.

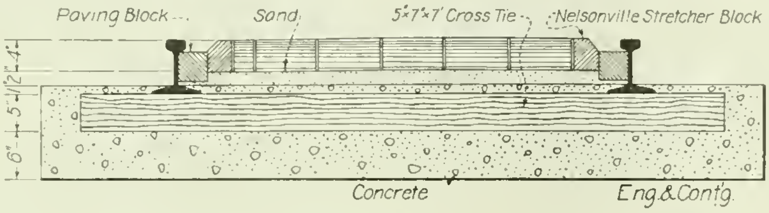


Fig. 1—Type A Paving for Street Railway Tracks, Richmond, Ind.

In general, specifications usually provide for the sub-grade to be excavated to the necessary depth and width, which is usually 6 ins. below and 6 ins. beyond the ends of the ties, then to be rolled with a road roller weighing not less than 10 tons; the track to be so constructed as to bring the rails to a uniform grade; and concrete of a wet consistency to be deposited under and around the ties to within 6 ins. of the top of the rail, the concrete to be well spaded and special care taken properly to bed the ties; the paving material to consist of the following: A filler and a stretcher block, made by the Nelsonville Sewer Pipe Co. or other block of equal quality, to fit next to each rail and the intervening space to be paved with vitrified paving block or other block meeting the requirements of the standard specifications for such materials.

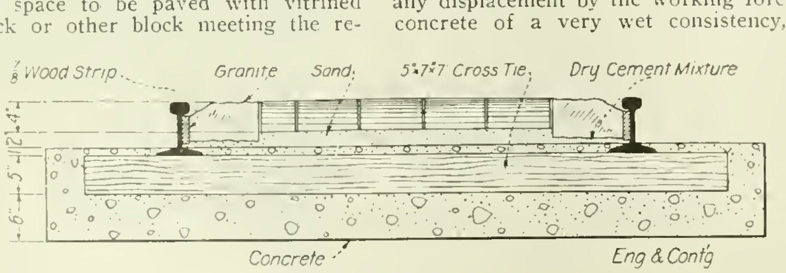


Fig. 2—Type B Paving for Street Railway Tracks, Richmond, Ind.

Usually the street car company, if it so desires and should it give the proper notice to that effect, is given the right to construct its proportion of the improvement with its own forces, in accordance with the plans on file and under the supervision of the city engineer. This clause permits the street car company to pave its portion of the improvement and to furnish the necessary materials for the same.

Different types of construction have been experimented with to determine the one best suited to particular conditions of traffic and in the following will be found a description of the methods and the costs of different types of paving built in Richmond, Ind., last year.

When the excavation is completed and the sub-grade compressed until it is smooth and hard, the ties are distributed and spaced 24 ins. c. to c. upon the sub-grade and the rails spiked thereto. The track after being lined and leveled is securely blocked to prevent any displacement by the working force. Then concrete of a very wet consistency, of the proportion of 1:2:5 is mixed, preferably by machine, and deposited around the ties and brought to within 6 ins. of the top of the rail.

Using a Twentieth Century Mixer, with the gravel distributed close alongside the track, a force of 11 men and a foreman will ordinarily concrete 175 to 180 lin. ft. of single track in 10 hours, the force being divided into:

4 men shoveling gravel at 20 cts. per hr...	$ 8.00
3 men shoveling concrete at 20 cts. per hr.	6.00
2 men spading concrete around ties at 20 cts.	4.00
1 engineer of mixer at 30 cts. per hr.......	3.00
1 foreman at 35 cts. per hr..........	3.50
Total cost	$24.50

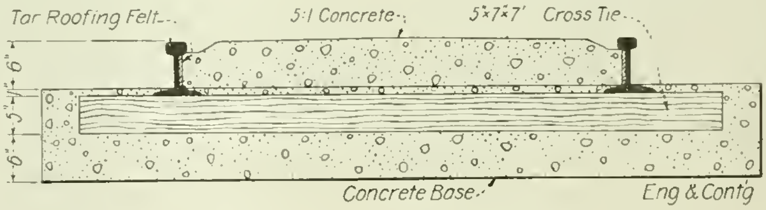


Fig. 3—Type C Paving for Street Railway Tracks, Richmond, Ind.

The cost per lineal foot is 14 cts. for labor.

The types of pavements to be described are: (a) One with a vitrified filler and stretcher block used next to the rail and the intervening space paved with vitrified paving block, the pavement to have a cement filler, Fig. 1. (b) One with a beveled granite block used next to the rail and the intervening space paved with paving block; same to be filled with cement filler, Fig. 2. (c) One constructed wholly of concrete, Fig. 3.

Type (A) Pavement.—When the concrete base has thoroughly set, sand for the cushion is leveled off to a thickness of approximately 2 ins. The filler block are then distributed along each side preparatory to being placed against the web of the rail; under which sand is tamped solidly, until the top of the block is against the ball of the rail. The sand cushion, after being rolled with a hand roller, is struck off by a templet cut to the required shape, the rails being used as guide strips.

Stretcher block, made by the Nelsonville Sewer Pipe Co., were then set against the filler block which had been previously laid. The intervening space was then laid and batted in with vitrified paving block. The defective brick having been removed and good ones put in their place and the track swept clean of spalls and dirt, the brick were tamped until a smooth surface was attained.

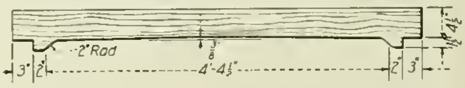


Fig. 4—Templet for Pavement for Street Railway Tracks, Richmond, Ind.

The filler, composed of one part Portland cement to one part clean sand, mixed to a consistency of thin cream, was applied to the pavement by scoop shovels and swept into the joints with street brushes. When it had partially set ½ in. of sand was spread over the pavement to prevent it drying too quickly.

The cost to construct 500 lin. ft. of this type of pavement is as follows:

Labor:		
To making sand cushion, laying, culling and tamping brick preparatory to applying filler, 142 hrs. at 23 cts.		$ 32.66
To applying filler, 24 hrs. at 23 cts.		5.52
Superintendence, 10 hrs. at 35 cts.		3.50
Total cost		$ 41.68
Material:		
Filter paving brick	1,428	
Brick between stretchers	8,937	
Total brick	10,365 at $21 per M	217.67
Nelsonville stretcher block, 1,000 ft. at 3¾ cts. per ft.		37.50
Sand for cushion, filler and covering 20 cu. yds. at $1.25		25.00
Cement for filler, 6.5 bbls. at $1.30		8.45
Total cost		$288.62
Grand total, 500 lin. ft.		330.30
Per lin. ft.		0.67

Type (B) Pavement.—The concrete base was constructed as in Type A and the sand was spread for the cushion in the same manner as before stated. A ⅞-in. wood strip, 4 ins. wide was put against the web of the rail. Then a beveled granite block, measuring about 12 ins. long, 9 ins. wide and 5 ins. thick, was set in a dry mixture of cement and sand, of the proportion of 1:3, level with the top of the rail. Special care was taken properly to bed these block. The sand was spread and rolled, then cut off to grade by a templet pulled over the rails, a notch having been cut out of the templet to allow it to pass over the block. The space between was then paved, culled and tamped and the filler applied.

The cost to construct 500 lin. ft. of this pavement was as follows:

Labor:	
To setting ⅞-in. boards, and bedding granite block in dry-mix cement, 77.6 hrs. at 23 cts.	$ 17.85
Making sand bed, laying, culling and tamping brick preparatory to applying filler, 81.1 hrs. at 23 cts.	18.65
To applying filler, 30 hrs. at 23 cts.	6.90
Superintendence, 10 hrs. at 35 cts.	3.50
Total	$ 46.90
Material:	
Paving block between granite, 7,313 at $21 per M	153.57
Granite block on job, 1,000 ft. at 23 cts. per foot	230.00
Sand, 20 cu. yds. at $1.25	25.00
Cement for filler and dry mix, 14 bbls. at $1.30	18.20
⅞-in. wood strips, 1,000 lin. ft. or 333 ft. B. M. at $30	10.00
Total	$436.77
Grand total, 500 lin. ft.	483.67
Per lin. ft.	0.967

Type (C) Pavement.—In this type of construction the concrete base was swpet with brooms as clean as possible and all dirt scraped from the rails. An expansion joint consisting of four thicknesses of heavy tar roofing felt was placed against the web of each rail, although the Elastite paving joint would have made a much better construction.

Concrete of the proportion of one part Portland cement to five parts clean gravel was mixed to a rather wet consistency and spread upon the concrete base, it being tamped with the back of a shovel to give it a maximum density. A templet as shown by Fig. 4 was drawn over the rails until the surface of the concrete was to a uniform grade, free from holes and conforming to the shape of the templet, care being taken to keep the larger stones below the surface. When sufficiently hard the surface was then gone over lightly with a wooden float until it was comparatively smooth.

The extent of this pavement was very small, as only about 100 lin. ft. were constructed, it being built on an intersection where it will be subjected to the combined traffic of both streets.

This pavement was built in September, 1912, as an experiment. The working force was not organized as it would be for a greater length; consequently no accurate cost data could be secured, although the probability is that it would be more economical in first cost than either of the other two types of pavement.

Some Costs on the Construction of Concrete Pavement.

The following data on concrete pavement work are abstracted from a paper entitled Concrete Pavement—Methods and Cost of Construction, prepared by Carl M. Boynton, Inspecting Engineer, Universal Portland Cement Co., and presented before the American Society of Engineering Contractors. The paper is reprinted on pp. 435 to 450 of the December Journal of the Society.

An analysis of the material costs of one-course and two-course work will show that the difference is so very slight as to be doubtful of estimation. However close an approximation an estimate may be, it cannot be exact, and, therefore, it will readily be seen in the following formulas that the main consideration in choice of type of pavement must necessarily be dependent upon the materials available; and the type chosen will be that to which they are best adapted. This formula is based on Taylor & Thompson's Table of Proportion.

Considering: C equal cost of cement per barrel,
G equal cost of gravel per cubic yard,
S equal cost of sand per cubic yard.

Then, for one-course work of 1:2:3 mix, 7 ins. thick, the material cost per square yard of pavement is $.325C$ plus $.0975S$ plus $.146G$; while for two-course work, 7 ins. thick, composed of 1:2½:5 base, and a 1:1½ top mortar, the material cost per square yard of pavement is $.342C$ plus $.1045S$ plus $.133G$.

These two formulas show the tendency to equalize the cost by small compensating differences in the several quantities and are given here to illustrate this point.

With good equipment and an average gang the actual cost of mixing and placing should not exceed 7 cts. per square yard for 7 ins. of concrete. To this should be added a cost of 3 cts. per square yard for finishing and labor necessary for handling the forms, making a total for one-course work of 10 cts. for mixing and placing. As has been stated, there is a slight difference in the cost of placing single and two-course work, with the advantage in favor of the former.

Placing expansion joints is such a simple operation that 1 ct. per square yard should cover the cost. To this must be added the cost of metal joint and tarred felt delivered on the job, or the cost of filling the joint with a plastic filler.

On city streets the water supply is not a problem; but on country highways, where it is necessary either to haul or to pipe water a considerable distance, it is advisable to make a careful survey of the situation. In estimating the cost of water the amount required for keeping the pavement damp for a period of five days must not be neglected, and as this is an indefinite quantity dependent upon weather conditions, only an approximate cost can be suggested. On the Wayne County, Michigan, work the water for each road is costing $3.50 per day (the wage for a man looking after the pumping), plus oil and gasoline required in operating the engine and pump. Water for the Mukwanago Road in Milwaukee costs 1¼ cts. per cubic yard of pavement. In this case the water is purchased from the city of Milwaukee or its suburbs. In both cases the contractor's and builder's equipment must include the necessary engines, pumps, pipings, etc.

The cost of hauling water for use in constructing country highways of concrete is often an item worthy of careful consideration. The method of supplying water by piping is considered by the majority of contractors as most economical. Where water is available under sufficient pressure the pipe line can be attached directly to the city main, thus eliminiating engine and pump, but where water is taken from a well, creek or river in vicinity of work, an engine and pump will be required. The cost of gasoline engines varies with rated horsepower from approximately $105 for a 2 HP. engine to $320 for a 9 HP. The cost of pumps would vary according to the capacity pressure required and the conditions under which work would be performed.

On one job in the vicinity of Milwaukee, 7,200 lin. ft. of 2-in. pipe at $6.80 per 100 ft. cost $489.60, and the laying, $20 per mile, amounting to $27.20, makes the total cost $516.80, or $0.72 per foot. On the other job 11,200 ft. of 2-in. pipe cost $1,008 laid, or $.09 per foot. For supplying water, the city of Milwaukee received $.005 per cubic yard of concrete mixed and $.005 for each square yard of pavement, making a cost of $.00583 per square yard of finished pavement.

Where the construction is small, the installation of efficient pumping equipment may not be justified, in which case hauling in tank wagons can be resorted to. One team hauling tanks having upwards of 350 gals. capacity will supply a mixer of ⅓ cu. yd. with sufficient water for a day's run, provided the haul is 1½ miles or less. On one job of 4,800 sq. yds. in Wisconsin the water cost $75 for the entire work, plus the cost of hauling and pumping, which was $7 a day for 19 days. Another contract was $10 for water and $4 a day for hauling. This work covered 3,500 sq. yds., but the haul was short and one team working half a day could keep the mixer supplied.

In discussing the cost of concrete pavements, a few examples of actual construction will help to make clear the division of expense. The first pavement was laid recently in a small town in the central part of Illinois, totaling 5,000 sq. yds. The total cost of the work was $3,964.02, excluding cost of equipment, which consisted of a ½ yd. Koehring mixer of the latest type and a 4½ HP. gasoline engine, and also excluding the cost of the water for mixing and sprinkling. The pavement was 45 ft. wide and uniformly 6 ins. thick. The cost of the work was divided as follows:

Superintendence	$ 140.00
1,457 bbls. cement	1,547.15
Sand, stone and gravel	1,284.97
Labor	560.07
Lumber and forms	35.00
Bitumen and creosoted blocks for joints	48.67
Coal and oil for mixer and engine	30.75
Excavation	307.41

A summation of these figures gives the cost of this road as $4.76 per cubic yard or $0.79 per square yard.

During the summer of 1912 Milwaukee County, Wisconsin, constructed several concrete highways to the south and southwest of Milwaukee. Data on a two days' run from one of these jobs were collected. Twenty-four men and a ⅓ yd. Smith mixer of the dumping type were able to place 94.1 cu. yds. or 470 sq. yds. of 9-ft. road 7 ins. thick at a total cost of $364.41, exclusive of cost of grading and interest and depreciation on equipment. The materials were furnished free to the contractor on the siding nearest the work and hauled to the job at his expense.

In figuring the cost of the road, the cost of materials to the county was included with the cost of mixing and placing carried by the contractor, and are itemized as follows:

111.5 bbls. cement	$115.96
93 yds. bank-run gravel	94.86
Water piped from the city	19.27
Baker protection plates for expansion joints	29.07
Coal and oil for engine	4.00
Labor	101.25

This gives a cost per cubic yard of $3.98 and $0.79½ per square yard.

Another piece of construction work for Milwaukee was a road 18 ft. wide and 7 ins. thick. The work was done by 20 men, using a ½ yd. Chain Belt mixer with chute delivery. The water was piped along the road from the city as in the preceding case, but a 4½ HP. gasoline engine was necessary to force the water up to the head required. The work recorded covered a period of four days and cost $1,128.46, exclusive of equipment and grading. The cost of piping and water for this and the preceding job was fully accounted for in a former paragraph. The cost of the work was divided as follows:

414 bbls. cement	$430.92
92 yds. sand and 152.3 yds. gravel	340.84
Water	60.20
Baker protection plates for expansion joints	76.50
Coal and oil for mixer and engine	7.56
Labor	232.50

From these figures we arrive at a cost of $4.70 per cubic yard and $0.91 per square yard for the pavement.

In southwestern Michigan a short strip 798 ft. long, 9 ft. wide and 7 ins. thick of 1:2:4 concrete cost $717.83, exclusive of grading, equipment and water. The equipment consisted of a 7 cu. ft. Clover Leaf mixer, necessary wheelbarrows and shovels and lumber for forms. The gang on this road was much smaller than that of any of the other roads. Details of the cost were:

225 bbls. cement	$234.00
69 yds. sand	37.59
136.35 yds. gravel	196.34
Gasoline and oil for mixer	10.00
Baker plates	96.00
Labor	144.00

This gives a cost per cubic yard of $1.68 and per square yard of $0.91.

In the west central part of Michigan 2,586 ft. of concrete 9 ft. 2 ins. wide and .55 of a foot thick were constructed by a township as an experiment. A gang of 12 men using a 7 cu. ft. side delivery Koehring mixer did the work for a total cost of $3,392.62, divided approximately as follows:

746 bbls. cement	$ 870.00
655.9 yds. sand and gravel	553.28
Baker protection plates and filler	170.12
Labor	1,690.50

These figures give a cost of $7.28 per cubic yard or $1.31 per square yard. Had the cost of grading, excavation and culverts been added to the above, the cost of pavement would have been increased to $8.73 per cubic yard or $1.46 per square yard.

The following work was constructed in the north central part of Illinois during October and part of November of last year. The road is 5,500 ft. long, 12 ft. wide and has a uniform thickness of 6 ins. The total cost, not including water, macadam shoulders and equipment, was $7,089.42. The equipment consisted of a ½ yd. Koehring mixer, road grader, plows, scrapers, road roller and the necessary wheelbarrows and shovels. The cost was as follows:

2,274 bbls. cement	$2,333.65
720 yds. sand	582.49
1,185 yds. gravel	1,787.93
Operative cost of mixer	51.99
Baker plates and creosoted wood blocks for expansion joints	160.03
Labor	2,282.52

The total of these figures determines the cost per cubic yard as $5.80 or $0.96 per square yard. No information was obtained on the cost of water for this work.

Street Cleaning at Chicago, Ill., by a Private Organization.

Certain streets in the central business district of Chicago are cleaned by the Citizens Street Cleaning Bureau—a private organization formed in 1904 by the Commercial Club and the Merchants' Club. The area now covered by the bureau embraces 52 city blocks with the corresponding streets and alleys, which include 118,975 sq. yds. of street surface and 18,000 sq. yds. of alley surface, making 4½ miles of streets and 1.6 miles of alleys. The bureau has two sources of income. The city pays it, under a contract, $36,000 per year, this sum being the proportion of the city funds that the officials estimate would be spent on the street area mentioned if the city did the work. This amount is not sufficient to maintain the high standard of cleanliness set by the bureau, so the remainder of the expense is supplied by a voluntary assessment against the frontages of the tenants and property owners in the district. This assessment is made on the basis of the actual cost of cleaning a particular frontage in which the traffic, kind and condition of pavement, and other factors are considered. This method of providing for street cleaning by a private organization is probably unique in this country at least, and for this reason a paper, presented recently before the Western Society of Engineers by Richard T. Fox, General Manager of the Bureau, is of particular interest. This paper is represented in the February Journal of the Society, and from this source the matter in this article has been abstracted.

The operations of the bureau are in charge of a general manager. An inspector immediately in charge of the foremen of the sections into which the area covered is divided reports to the general manager. The sections are further divided into 42 sweeping routes, the area of each of which depends on the width of the street, the kind of pavement, the density of traffic, and so forth. A man sweeping by hand is assigned to each of these routes which vary from ½ to 2 blocks in length, this man being held to account for the cleanliness of his route. The sweepers are uniformed and numbered and each man has a space at headquarters for his uniform and tools. To avoid confusion and to fix responsibility for the care of the bureau property, this space and each particular implement in the sweeper's care bears his number. The bureau also has its own teams and wagons for hauling sweepings to the dump, the drivers of these teams being uniformed and numbered the same as the sweepers.

The number of sweepers at work and the route covered by each man is followed from the office each day by a special system of checking. A board carrying a large scale map of the district with the different routes shown, and a lot of thumb tacks each having a number on the head, are provided. When the men report in the morning a tack bearing the same number as the number on the cap of the sweeper covering each route is placed on the map. If any men quit work during the day, the office is notified and the tacks on their routes on the maps are removed. In this manner it may be seen with a glance at the map whether any routes are not covered. For the purpose of checking up the men actually at work, the auditors of the bureau are supplied with one of these maps.

The foremen make written reports daily of the number of men employed, the route swept by each man, the number of teams at work, the yards of refuse removed and the condition of their sections at quitting time. The team reports cover the time required to make each round trip, including the time of collection and the return from the dump, and give the number of yards of refuse hauled at each load. If for any reason a street or a portion of a street is not thoroughly cleaned, or if any sweepings are left in the gutters at quitting time, these facts must be noted and explained in the foreman's report. No excuse short of a circumstance entirely beyond the control of the inspector and foreman is accepted for either of these conditions. Failures to perform the work assigned, or other delinquencies are reported on a blank form with the name and number of the sweeper or driver concerned, and a recommendation not to exceed the punishment prescribed in a published code of rules as to the disposition of the case is forwarded to the office of the general manager for final action. The daily reports are checked by the inspector, who forwards them every morning with his own report, covering the entire district, to the office of the general manager. From these reports and from an inspection of the streets the general manager is enabled to keep in close touch with the most minute details of the work.

A daily statement showing the cost, by sections, of the previous day's work is made out and by noon each foreman knows the cost of the work done under his direction as compared with that of the other foremen. The effect of this arrangement is to create a spirit of competition and rivalry, with a consequent beneficial influence on the character and cost of the service. The daily expense reports are made out by the inspector and are approved by the general manager. They cover the cost of supervision and of labor for the sweeping, and the cost of supervision, labor and teams for the carting, the cost of administration, office and miscellaneous expenses being proportioned at the end of longer periods.

The streets are swept thoroughly every day, on an average of ten times each week day and five times on Sundays. The sweeping is done entirely by hand, which is, of course, a more thorough and effective method than machine sweeping, especially on the uneven pavements of the district covered. The hand cleaning can also be done during the day when it is most essential that the streets should be in good condition. The sweepings as they are gathered from the street surface are deposited in metal boxes placed along the curb edge of the sidewalk, for temporary storage between the rounds of the wagons, which are made from time to time during the day. These boxes have a handle on each end and are covered with a hinged lid. They hold about 4 cu. ft. of sweepings and are placed at various intervals along the street, depending on the amount of sweepings obtained from the block. Although these boxes do not add to the appearance of the street, and interfere to a slight extent with the free use of the sidewalks, their use is far preferable to the practice of piling the sweepings in the gutter to be scattered by traffic, blown about by the wind or washed along the gutter by a sudden shower.

The various elements of difficulty which affect the cost of street cleaning were carefully studied by Col. George E. Waring when Commissioner of Street Cleaning in New York, 1895 to 1898. It was found that there were streets of good pavement, light traffic, etc., where one sweeper could keep clean 20,000 sq. yds., while on other streets, in the crowded districts, it was one man's work to keep clean 1,000 sq. yds. In the first case it was necessary to sweep the pavement once only each day. In the latter case seven laborious trips were necessary daily.

The 13 factors which determine the cost of cleaning any pavement are described in Colonel Waring's report as:

(1) Kind of Pavement.
(2) Condition of Pavement.
(3) Amount of Traffic.
(4) Amount of Car Track.
(5) Kind of Car Track Rail.
(6) Amount of Sanding.
(7) Amount of Sprinkling.
(8) Elevated Railroads.
(9) Character of Population.
(10) Presence of Schools.
(11) Existence of Markets.
(12) Push-cart Stands.
(13) Vicinity of Unpaved Streets.

The difficulties here mentioned with which the bureau has to contend in cleaning Chicago's congested downtown streets named in the order of their importance are:

(1) Amount of Traffic.
(2) Character of Population.
(3) Kind of Pavement.
(4) Condition of Pavement.
(5) Amount of Car Track.

A street that has heavy traffic is seen to have more influence on the labor of sweeping than has the kind of pavement. The amount of traffic affects the cost for four reasons:

(1) Because of the amount of horse droppings.
(2) Because of the dirt of one kind and another which comes from the wagons.
(3) Because the passage of horses and wagons effects a solid packing into crevices of the dirt upon which they tread.
(4) Because of the difficulty of giving close attention to his work when the sweeper must devote a considerable portion of his time dodging horses and vehicles.

The effect of traffic on the cost to the bureau of cleaning the congested downtown streets may be illustrated by the fact that of the 42 sweepers now employed, 19, or nearly half of them, are necessary because of continuous movement of horses and vehicles through the streets.

No other single cause contributes so much to the difficulty and expense of sweeping as the action of careless and thoughtless persons in making the public streets the receptacles of all kinds of rubbish of which they wish to be rid, and which a little consideration would induce them to deposit in the boxes provided for the purpose.

Modern pavements with impervious foundations should confine the dirt to be removed by the street cleaning force to the daily accumulation of horse droppings, the materials ground by traffic into the pavement, abraded metal and to any purely accidental litter.

The most notable class of preventable litter consists of newspapers, wrapping paper, paper boxes, fruit skins, excelsior, straw sweepings from sidewalks and buildings, ashes, etc. The time consumed by the whole body of sweepers in gathering this litter from the streets amounts practically to the entire time of four men. This means then that $180 per month, exclusive of cartage, is expended on this item.

Another source of litter which could be easily prevented is the dropping of materials from overloaded or loosely-jointed wagon boxes, such as sand, plastering, steam ashes, cellar dirt, broken stone, lime, brick dust, cement, gravel, sawdust and in fact every kind of finely divided material carted through the streets.

The wagons hauling dirt from excavations for foundations and cellars are responsible for a large part of this litter. The boxes are loaded above the sides, and the wheels pick up dirt as they are hauled out of the excavations, especially if the ground is wet. From these two causes the course of the wagon is marked for several blocks. We estimate that this violation of the city ordinance imposes on us an expense of $90.00 per month.

Improperly-controlled building operations are the source of a great deal of annoyance and added expense. Beginning with the excavating and continuing until the last bit of material is in place, the adjoining street is in a dirty condition and on windy days the air is full of dust. No attempt is made to sprinkle or confine loose material, and the most ordinary provisions of the building permits are in many cases neglected. From observation and data obtained from block to block records of dirt collected, it is estimated that the time of one man, or $45 per month, is expended in keeping the streets in the vicinity of building operations in condition.

All of these three items, which amount to the wages of six men, are properly to be charged against the character of the population. In other words, of the 42 men now employed, six are necessary because of the carelessness and indifference of the people who use the streets.

The kind of pavement affects the cost because a rough pavement such as granite, brick, or other loosely-joined blocks are more difficult to clean than a smooth pavement, such as asphalt, bituminous macadam or creosote block.

In 1904 as much as 75 per cent of the pavements in the district cleaned by the bureau were of granite blocks laid on earth foundations, and in wretched repair. Each year since 1907 some of the granite paving has been replaced by creosote block, until at present the granite block is only 38 per cent of the total. This change in kind of pavement has enabled the bureau, within the past five years, to dispense with nine sweepers.

If the remaining granite paving were replaced by some smooth pavement, four more men could be dispensed with. In other words, four out of 42 sweepers now employed are necessary because of the kind of pavement.

No argument is necessary to show that a street in bad repair is more difficult to clean than one in good condition. If all pavements were in first class condition, the cost of cleaning would be reduced so that the same standard of cleanliness could be maintained as now with four less men.

The amount of car tracks affects the cost of cleaning because of the extra time required to sweep the dirt from between the rails, and the interference of the rails with continuous cleaning. This difficulty is responsible for the employment of two sweepers.

To sum up these elements of difficulty which which affect the cost of street cleaning, we find that

Because of the amount of traffic, 19 men are employed.
Because of character of population, 6 men are employed.
Because of condition of pavements, 4 men are employed.
Because of kind of pavement, 4 men are employed.
Because of amount of car track, 2 men are employed.
Total number of men employed, 35.

This means that of the 42 men now employed in sweeping the streets in the bureau's territory, 35 are necessary because of the unusual conditions presented in the factors named above. In other words, if the street area was in a residential section of the city, for instance, where the pavements are smooth and in good condition, where the traffic is light, and but little refuse finds its way into the street, and where there are no car tracks, it could be kept clean with seven men.

The bureau flushes nightly except Sunday, all the streets within its jurisdiction. For this purpose two flushing machines, provided with pumps, operated by gasoline engines, are employed. It is found that the pressure at the hydrants is not sufficient to give a thorough washing effect, so the auxiliary power is necessary. The object of the flushing is to remove from the street pavements the fine dust which the plush brooms cannot gather up. In other words, it in no sense takes the place of the hand cleaning, but simply supplements it.

The sprinkling of the streets was taken up by the bureau the past spring, and will hereafter be a part of its work.

On days when any wind is stirring, it will be noted that some street refuse, principally papers, is blown from the street to the sidewalks and often from the sidewalks back into the street again, but much of this remains on the sidewalks, except where almost constant attention is given them by the tenant. To remedy this condition as far as possible, the bureau employs men who cover all of the sidewalks from three to four times a day.

Another activity recently acquired by the bureau, is the removal of cinders and rubbish from the downtown stores and office buildings, numbering at present 160. Two-horse wagons of 6 cu. yds. capacity are employed in this work. The cinders are disposed of by sale to builders and others when there is a market, and at other times are given away. At certain times in the winter it is even necessary to pay for their disposal.

The removal of snow from the streets in the district covered by the bureau's forces is also handled by the latter. In the event of a snow-fall, the regular men begin to sweep the snow into piles along the curb where it is out of the way of traffic. If the fall of snow promises to be heavy, extra men are employed to assist the regular men. In the meantime the team owners have been notified and as quickly as teams report the work of removal starts and is continued uninterruptedly, day and night, until the streets are clear. The promptness with which the snow is removed is dependent on the number of available teams. The temporary character of the work, which is also confined to the small area covered, is not a sufficient inducement for a team owner to make special arrangements for it, so dependence can be placed only on the number of teams that happen to be idle at the time.

The uncertainty as to the time of the arrival of the snow, the depth of fall, the accompanying temperatures, and the number of teams available make snow removal a transportation problem very much out of the ordinary. The teams are paid by the cubic yard of snow hauled, rather than by the day, as an incentive to each team to make as many loads a day as possible, and so hasten the work.

When a wagon reports on the work, it is measured and its yardage computed and entered on a blank form, together with the names of the owner and driver. As soon as the wagon is loaded the driver reports to the foreman, who inspects the load, notes the number of yards, punches this number in the margin of a ticket printed especially for the purpose, and, after recording on his report opposite the driver's name the number of the ticket, presents the ticket to the driver as a tally of the indebtedness of the bureau for so much snow. Each foreman has tickets of a distinct color and series. The punch marks of the various foremen also differ, so that in cases of dispute, lost or stolen tickets, attempts to change the face of the ticket, or any dishonest work, the ticket involved can be traced through the owner, driver, and foreman to the day or night and approximately to the hour when it was issued.

The extra laborers required during snow removal are given a ticket each day, and as a check on their time these tickets are punched at intervels during the day. The implements which the extra men take from headquarters are also noted on the ticket and are checked up at night, the holder of the ticket being responsible for any tool he fails to return.

The entire cost of the work of street cleaning for the past five years has averaged $58,758 per year, and the cost of snow removal has averaged $11,886, or a total of approximately $70,000 per year. On this amount the city paid $36,000, the street railway companies approximately $12,000, and the tenants and property owners the balance, or $22,000.

Notes on Road and Street Work.

(Staff Article.)

Life of Street Push Brooms.—In a discussion of a paper on street cleaning in downtown Chicago, presented before the Western Society of Engineers, Mr. Richard T. Fox, General Manager of the Citizens Street Cleaning Bureau, stated that he had found that the average life of a push broom when used in cleaning granite pavement was 7 days. On asphalt the life of a broom ran up as high as 12 to 15 days. On asphalt in addition to the broom, the sweepers use a scraper with which most of the work is done, so that the broom is not in use continuously. The broom generally used by the Citizens Bureau is made of two rows of African bass with a row of Bahia grass on either side. Heavier brooms, made entirely of African bass, have been used, but it was considered that these did not pick up the fine dust as well as brooms with fine fibrous material on the outside.

County Road Construction in Indiana in 1912.—The following statistics, compiled by A. P. Melton, City Engineer of Gary, Ind., show the amount of improved roads constructed in 1912 in a number of counties in Indiana:

County.	Gravel Amount, miles.	Gravel Cost per mile.	Macadam Amount, miles.	Macadam Cost per mile.
Clay	..	.....	32,440*	$0.60†
Clay	..	.....	15,840*	.64†
Dearborn	..	.....	8	3,300
Fountain	8	$3,500	2	5,000
Gibson	6	3,167	¾	4,267
Jennings	..	.....	12	1.00†
Marshall	..	.....	3	.....
Pike	..	.....	8	.....
Pulaski	22	1,000‡	9	3,000
Putnam	9	2,222	20	2,750
Shelby	5¼	.40†	2½	1.30†

*Square yards. †Cost per square yard. ‡$1,000 to $2,000.

In addition, 24,640 sq. yds. of bituminous macadam were constructed in Clay County at a cost of 72 cts. per square yard. In Marshall County 26,400 sq. yds. of brick paved road were constructed at a cost of $1.49 per square yard.

Road Construction in Florida With Brick Laid Flat.—During 1910 and 1911 some 50 miles of brick paved roads were constructed in Duval County, Florida. The following description of the methods of constructing one of these roads is abstracted from a paper presented before the American Society of Engineering Contractors by York Briddell, Superintendent of Construction, Georgia Engineering Co., Augusta, Ga. The roadway was from 16 to 20 ft. in width, and a vitrified curb 4 in. by 9 in. by 18 in. was used along each side as a header. The grading was very light, except at points passing through the swamps where some filling was necessary to bring the road to the proper level. After the grading was completed, the roadway was flooded with water and allowed to settle and pack, after which it was thoroughly rolled by a steam roller of not less than 7 tons weight. In order to obtain water along the road for flooding the subgrade, small wells are often drilled about every ½ mile and pipe lines run along the road, cutoffs being put in wherever wanted. When the rolling was completed, the surplus soil was wasted to the side of the roadway and the sand cushion surfaced to the proper crown by the use of templates. The brick were then laid flat, end to end, in straight course at right angles to the roadway. After the brick were laid the joints were made close and compact by the use of an iron bar applied to the ends next to the curb on every fourth course. The brick were then closed up and the courses straightened by use of a sledge hammer and wooden bar placed against the brick. All bonds were broken at least 3 ins. with adjoining courses. The surface was then rolled with a roller weighing not less than 5 tons, the rolling being started at the curb and continued to the middle, after which the operation was started from the oposite curb. The brick were made of shale and were usually 8½ in. by 4 in. by 3½ in. in size. Mr. Briddell states that throughout Florida brick are laid flat on all county roads and on a great many of the light traffic streets in cities. He adds that brick pavement wears remarkably well in Florida with no other foundation than the sand and nothing but sand as a filler. The contract cost of brick paving in Florida is as follows:

	Per mile.
16-ft. roadway, at $1.50 per sq. yd.	$14,074.50
10,560 ft. of curbing at 18 cts. per cu. ft.	1,900.80
Total	$15,975.30

Concrete Pavement Construction at Charlotte, Mich.—During the past year 11,946 sq. yds. of concrete pavement were constructed at Charlotte, Mich., the work being done by the city under the direction of James R. McCamman, C. E. The pavement was of the two course type, the lower course being a 1:2½:5 mix., 5½ ins. thick, and the top a 1:2 mix., 1½ in. thick. The property owners on each side of the streets paved paid for ⅓ of the pavement abutting their property and for all of the concrete curb and gutter. The city at large paid for the remaining ⅓ of the abutting pavement and for both the pavement and curb and gutter at all street intersections, and also for the inlet and catch basins and their connections. The estimated cost of the work was as follows:

11,945.58 sq. yds. pavement at $1.25	$14,931.98
8,163.06 lin. ft. curb and gutter at $0.45	3,673.38
10 catch basins at $32.50	325.00
47 inlet basins at $17.50	822.50
180 ft. sanitary sewer at $0.60	108.00
1,734 ft. storm sewer at $0.45	780.30
662 ft. header stone at $0.55	364.10
6,002.88 cu. yds. excavation at —	....
Total	$21,005.26

In construction 1 catch basin, 16 inlet basins, all of sanitary sewer, a part of the storm sewer and all of the header stone were omitted. The actual cost of the construction was as follows:

11,945.58 sq. yds. pavement at $0.86¾	$10,252.84
8,163.06 lin. ft. curb and gutter at $0.40	3,273.59
6,002.88 cu. yds. excavation at $0.43	2,581.24
Total	$16,107.67

The cost of catch and inlet basins and their pipe connections are included in the amount $10,252.84.

The above total is made up of:

Cement	$ 4,051.06
Sand, crushed stone and gravel, and fill	2,824.48
Asphalt, freight and cooker rental	482.31
Incidentals and materials used	1,214.24
Pay roll	7,535.58
Total	$16,107.67

The curb and gutter was constructed upon a 6 in. fill or sub base, a 1:2:4 mix being used for the base and back and a 1:2 mix for the face. Expansion was provided for along each curb and every 25 ft. longitudinally from gutter to gutter. The joints were made tapering, being ½ in. at the bottom and ¾ in. at the top. No provision was made for protecting the edges of these joints except by the filler. The material used for the aggregate was bank gravel and some previously forked out stone which were put through a crusher and screened. The greater part of the catch and inlet basins were constructed out of the paving brick taken from the old cross walks that had to be removed. The average cost of excavation per square yard of pavement was about 18.2 cts. The work was done by day labor, the prevailing wage per 10-hour day being:

Common labor	$2.00
Finisher	3.50
Team, with driver	4.00

The cost of material was as follows:

Cement, per bbl.	$ 1.13
Gravel and broken stone, per cu. yd.	.99
Sand, per cu. yd.	.75
Asphalt for expansion joints, per ton	19.00

Some Estimates on Hauling Asphaltic Paving Material by Motor Trucks and Teams.—In connection with his report on a proposed municipal asphalt plant for the District of Columbia, Mr. D. E. McComb submitted the following estimates on the cost of hauling asphaltic material in the District. The estimates are based on a haul over the streets of Washington. For hauling with a 5-ton motor truck, the following assumptions are made: Load = 6 dumps = 90 cu. ft. Cost per day, $12. Speed, 10 miles per hour = 1 mile in 6 min. Estimated time required to load, 9 mins.; unload, 7 mins.; tally, 2 mins.; total, 18 mins. For hauling with wagon and 2 horses the assumptions were: Load = 4 dumps = 60 cu. ft.; rate, $4.50 per day. Estimated time to load, 6 mins.; to unload, 6 mins.; to tally, 2 mins.; total, 14 mins. Estimated speed of team, 2½ miles per hour (1 mile in 24 mins.). The comparative cost per cubic foot of hauling asphaltic paving material for resurfacing and new work is estimated to be as follows:

	Motor truck. Per cu. ft.	Wagon. Per cu. ft.
½-mile haul	$0.0067	$0.0058
1 -mile haul	.0083	.0094
1½-mile haul	.0103	.0150
2 -mile haul	.0121	.0187
2½-mile haul	.0133	.0187
3 -mile haul	.0148	.0250
3½-mile haul	.0167	.0375
4 -mile haul	.0190	.0375
4½-mile haul	.0222	.....
5 -mile haul	.0222	.....

For hauling hot stuff on minor repair work the following estimates are given: Assumed haul by 1-horse cart for distances up to 2½ miles and by 3-ton auto trucks for distances beyond 2½ miles:

Cost of cart haul for average distance of 1¾ miles:

Estimated time required to—	Minutes.
Load	5
Unload	30
Tally	2
Total	37
To make trip and return	84
Grand total	121
Number of trips per day, 4.	Per cu. yd.
$2.50 ÷ 4 × 24 cu. ft.	$0.0260
Add 10 per cent for delays	0.0026
Cost per cu. ft.	$0.0286

Cost of 3-ton auto truck haul for average distance of 3 miles, 12 miles per hour:

Estimated time required to—	Minutes.
Load	7
Unload	45
Tally	2
Total	54
To make trip and return	30
Grand total	84
Number of trips per day, 6.	Per cu. ft.
$10 ÷ 6 × 45 cu. ft.	$0.0370
Add 10 per cent for delays	.0037
Cost per cu. ft.	$0.0407

The estimate for hauling asphaltic paving material for patching work is based on the following assumption: One horse cart: Load = 24 cu. ft. = 3 dumps, 8 cu. ft. each; cost per day, $2.50; estimate of speed, 2½ miles per hour; average haul = 2½ miles.

Estimated time required to—	Minutes.
Load	5
Unload (averaged)	30
Tally	2
Total	37
To make trip and return	120
Grand total	157
	Per cu. ft.
Number of trips per day, 3; cost per cu. ft. = $2.50 (÷ 3 × 24)	$0.0347
Add 10 per cent for delays	.0035
Total cost per cu. ft.	$0.0382

RIVERS AND HARBORS

Design and Construction of a Cofferdam in 50 Ft. of Water.

A cofferdam of 60-ft. steel sheet piling and having a submerged depth of over 50 ft., was built in working out the plans for the Fremantle dry dock being constructed by the Western Australian Government. The foundation being uncertain at the site first selected for the dock it was decided to curtail operations to the construction of one wall of the dock. Briefly it was planned to cofferdam the site of the selected dock wall, and if, upon unwatering and excavation, a satisfactory foundation material was disclosed, to continue with the remaining dock work; if a doubtful foundation material was disclosed another dock site was to be selected and the cofferdam was to be used in founding and building a needed quay wall. The work is described in a paper entitled: "Fremantle Graving Dock: Steel Dam Construction for North Wall," by J. F. Ramsbotham, Proceedings, American Society of Civil Engineers, Vol. XXXIX, p. 215. From this paper we abstract portions relating to the designs and construction of the cofferdam.

Steel Sheet Piling.—The lowest bidder for the steel sheet piling was the United States Steel Products Co., New York City. The material in which the piles were driven consisted of a hard limestone cap, coral, clay, and sandstone, the limestone cap being particularly hard in a portion of the pumping station, where a total of 60 ft. of driving had to be done, or, in other words, each pile had to be driven 60 ft. into the ground. It is worthy of record that, in driving one of the steel piles, a 45-lbs.-per-yd. steel rail was cut into two pieces, one section being found subsequently on excavating within the dam.

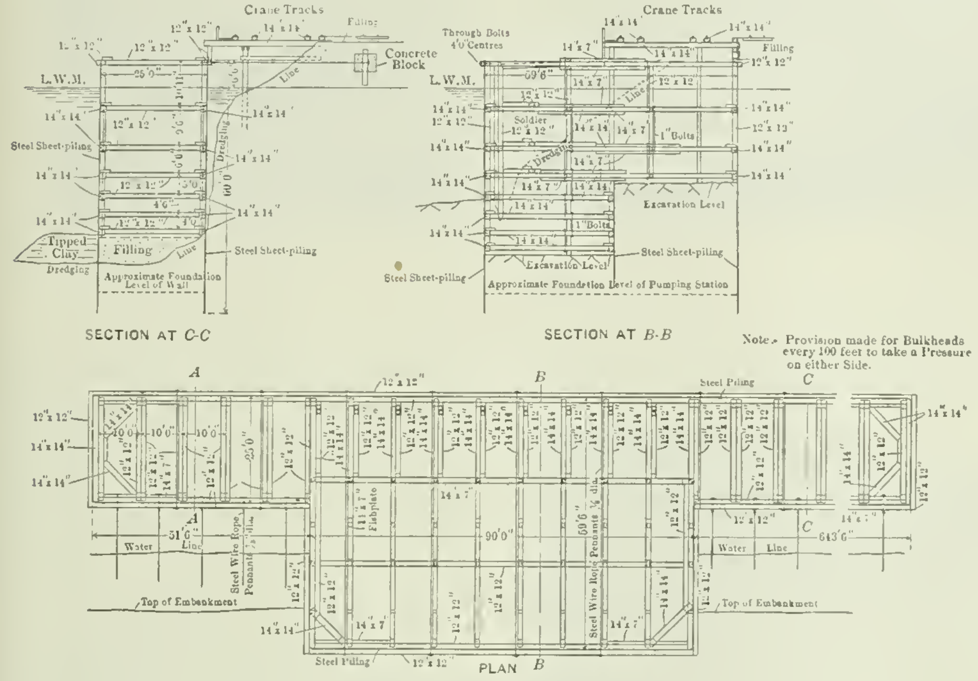
From a driving point of view, these piles are admirable, as the cross-sectional area, or displacement, is small compared with the covering area of the face of the pile. Although whippy, with care very few piles were damaged; and, further, in shipping 1,900 piles, 60 ft. long, from the United States to Western Australia, not one was damaged, and only two were damaged in handling for driving. In handling from the steamer it was found best to have 8x3½-in. fish-plates of Oregon pine, 10 ft. long, with a sling chain around them, placed 20 ft. from one end. In handling, preparatory to driving, a single piece of 7x3-in. Oregon pine, 8 ft. long, was found best, and was slung one-third from one end.

Design of Dam.—The points that require careful watching in designing a dam are: (1) Strength of skin (which can be taken as a beam supported at several points, and to an extent this is advantageous, as benefit is derived from contraflexure); (2) strength of walings or longitudinal beams; (3) strength of shores or transverse columns; and (4) factor of safety on the dam.

Great benefit may be derived from working in water, as it is possible to calculate exactly the loads which the various members of the structure have to carry; and, needless to say, the object is to place the walings and shores so that they and also the skin will have an ample factor of safety.

In designing the dam, a maximum tide of 6 ft. 6 ins. above low-water mark was considered, and the dredged bottom was taken at 49 ft. below low-water mark, thus giving a total calculated head of 55 ft. 6 ins., which in actual work could be taken at 51 ft. Further, clay puddle was tipped to a minimum height of 9 ft. at the skin of the dam, in order to make a seal of the porous rock, and, at the same time, reduce considerably the head on the dam. Assuming that the shores are placed at 10-ft. centers horizontally, the pressure on a strip of dam, 10 ft. wide, is:

$$\frac{55 \text{ ft. } 6 \text{ ins.} \times 10 \times 55 \text{ ft. } 6 \text{ ins.} \times 64}{2 \times 2{,}240} = 440 \text{ tons}$$



Plan and Sections of Steel Sheet Pile Cofferdam for 50-ft. Submergence.

The strength of a jarrah beam, loaded uniformly and supported at each end, is given by the following formula, in which K is a constant which has been ascertained to be 13; B is the breadth, and is assumed to be 14 ins.; D is the depth, and is assumed to be 14 ins.; and L is the length, which is 9 ft., or 108 ins.:

Breaking weight, in hundredweights =

$$\frac{8KBD^2}{L} = \frac{8 \times 13 \times 14 \times 14 \times 14}{108} = 2{,}642$$

cwt. = 132 tons.

Thus, using a factor of safety of 3, the safe load $= \frac{132}{3} = 44$ tons. From this the number of walings or beams required is $\frac{440}{44} = 10$.

It is worthy of note that, in calculating the strength of walings, no allowance was made for the fact that the beams were continuous over several supports, thus giving a greater margin of safety than is shown. The shores or columns were 12 ins. square and 22 ft. 8 ins. long, and were worked out by Gordon's formula in a similar manner, one end being considered rounded and the other fixed, the factor of safety being slightly less than 3.

When the driving of the piles was completed, it was found that it was impracticable to keep them absolutely vertical or in line, due to the hard nature of the ground; and, although the divers packed between all piles and the back of the walings, a certain amount of unquestionable bridging or arching took place. This was so marked that, without any further delay, additional shores were placed alongside those already in, the factor of safety of the walings thus being increased to 3¾ and the shores to almost 4½.

The skin of the dam is important, and the largest span was settled empirically from observations and was a clear span of 8 ft. 8 ins., subjected to an actual head of 17 ft. 7 ins. of water. In the dam in question, the span was 8 ft. 7 ins. between the second and third shores. Between the first and second shores the clear span is 9 ft. 11 ins., and, although allowance was made for a high tide of 6 ft. 6 ins., it is seldom if ever reached. From the writer's experience, a clear span of 8 ft. 8 ins., subjected to a mean head of 16 ft. 8 ins., is quite satisfactory, the total load on a pile being 4.88 tons, and the maximum stress about 10 tons per sq. in.

Practical Construction Details.—First, it is of the utmost importance that the female end of the pile should always be driven over the male, and not the male in the female. If the latter is done, a column of spoil will be compressed under the male in the jaws of the female which will finally end in the bursting of the structure. To enable rapid progress two piles were split down the center and a double male pile manufactured, riveting a 6x3x½-in. T-iron on the back for stiffness. By this means two piling machines were utilized; one was built on an outrigger, with one end supported on staging and the other end on a log on the ground, the piling frame, winch, boiler, etc., being self-contained and easily moved. The other machine was on a barge, and was also self-contained.

In passing, it may be mentioned that the piling winches were made by the Lidgerwood Manufacturing Co., and were capable of working a 2-ton "tup" or hammer. A 30-cwt. tup was found to be best in practice, and a good man can get 20 blows per minute, a 5-ft. drop being quite sufficient. From the plan it will be noticed that provisions were made for subdividing the dam every 100 ft. by using T-piles, a male and female T-pile being left opposite each other; this was done in accordance with the catalogue of the makers of the piling. When the time came to drive, however, difficulties arose, and as they could be overcome very easily by the manufacturers of the piles, the writer mentions them, hoping that he may thus assist others.

First.—By having a female T-pile, it would mean, in the ordinary course, driving a male pile in it; as previously mentioned, if this is done, it will end in disaster, unless the spoil in which it is driven is a fluid mud. To overcome this, a double female pile was made, and on one side a strip of iron, 1 in. wide and ½ in. thick, was tapped on the outside on one jaw in order to make a lock. The jaws were then interlocked, and the pile was driven, there being clearance for any displacement of spoil between the jaws.

Second.—Great care must be exercised in keeping the two T-piles parallel, otherwise obvious difficulties will arise in closing. The manufacturers could overcome this by making an expanding pile with slotted holes, so as to enable the closing pile to vary its width from the top to the bottom.

Third.—Even with parallel piles, it is extremely hard to marry in with the closing pile, and it is desirable to have a few piles of different width.

Fourth.—If a male T-pile is used at each side of the dam, as should be done, a double female pile is required with which to end, and such should be supplied by the manufacturers.

Fifth.—If a male T-pile is urgently required, it can easily be made, and at small cost, by riveting an ordinary 45-lb. rail to an ordinary pile.

Sixth.—In driving the piles, the moment one seems to be hardening up and has not reached the required depth, another should be driven ahead of it, and, if necessary, this should be repeated until there are signs of having reached soft ground again. It is then possible to exert more force, but even then abuse must not be resorted to, as there is grave danger of parting the piles, but if this does happen by having driven ahead, that danger is limited in extent and is only local.

From the cross-section it will be noted that the piles toward the shore were driven on the side of a cliff, which had been left in a very irregular condition by the dredging, and added considerably to the difficulties of the piling gang; it also rather retarded the progress, as some piles had to be drawn. A fair month's work for the two machines, there being two 8-hour shifts on each machine, averaged 370 piles, representing 9,361 lin. ft. of driving.

The first steel pile was driven on July 14, 1911, and pumping was started in Dam Section No. 1 on Nov. 16, the entire dam being framed by the end of that year.

It is interesting to note that 1,872 steel piles were used, representing 47,385 lin. ft., or 9 miles of actual driving. In the first dam section there were 401 piles, which gives 24,060 lin. ft. of joint, representing very nearly 5 miles of joint.

Unique Construction Methods and Devices Employed at Lock and Dam No. 1, Mississippi River Improvement.

(STAFF ARTICLE.)

Because of the novel concrete construction methods employed the Mississippi High Dam —officially known as Lock and Dam No. 1— at Minneapolis, Minn., is a particularly interesting structure. The more unique features are: The removal of a heavy concrete lock floor without disturbing the walls; the raising of concrete walls by filling between concrete slab permanent forms; the use of concrete molds for casting concrete slabs; the combination of separately cast and molded in place concrete dam construction, and special mechanical devices for handling and placing concrete slabs and beams. From information gathered during an inspection of the work and from the engineers in charge, we illustrate and describe the several features as follows:

GENERAL DESCRIPTION.

The Mississippi High Dam is a part of the project for the improvement of navigation between Minneapolis and St. Paul, and for the development of water power aggregating 10,900 k.w., which is available at that point. The structures being built will provide a depth of water of 9½ ft. at the head of navigation in Minneapolis, and below the dam the river will be dredged to provide a channel 6 ft. deep.

Originally the Government had provided for the improvement of this part of the river by the construction of two locks and dams of 13 ft. lift. Lock and Dam No. 2, under the old project, were completed in 1907, and Lock No. 1 was completed except for the gates, but no work had been done on the dam. This project had thus entailed an expenditure of $1,162,593 when it was modified by Congress in June, 1910. The modification was made to provide for power development, and will require an additional expenditure of $650,000, including $180,000 for flowage rights. The modified plan necessitates the partial removal and the flooding of Lock and Dam No. 2. Removal has already been accomplished by cutting off about 5 ft. from the top of the dam to permit navigation over it after the High Dam or Dam No. 1 is completed. The new project increases the depth of the channel below the dam from 5 to 6 ft. and thus required the lowering of the floor of Lock No. 1 and also the raising and widening of the lock walls. At the present time the work has been completed as shown in Fig. 1. The lock walls have been raised 19 ft. and widened and the old floor has been removed and a new one built 6 ft. lower. Cofferdams were built, enclosing the lock and a portion of the dam site on one side of the river, and on the opposite side a cofferdam was built, enclosing the power house site and a portion of the dam. The work is shown by Fig. 1, which also shows the quarry in the background, with an incline leading down to the office and machine shop building, and the bins and mixing plant against the bank between the office building and lock. The concrete work on the power house foundations is shown as brought up to the bases for the three hydro-electric turbines.

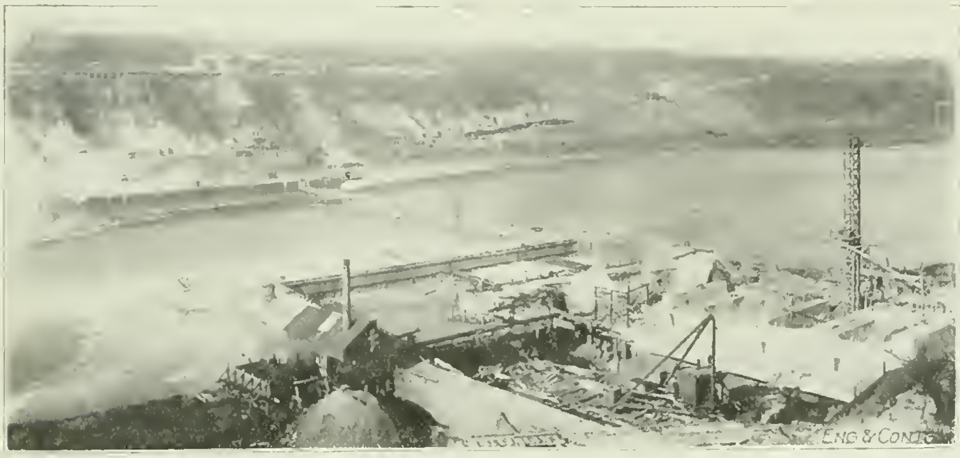


Fig. 1—View of Site and Construction Work, Mississippi High Dam.

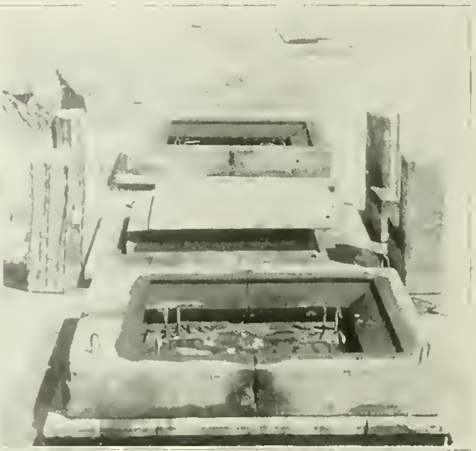


Fig. 3—Concrete Molds for Casting Wall Slabs.

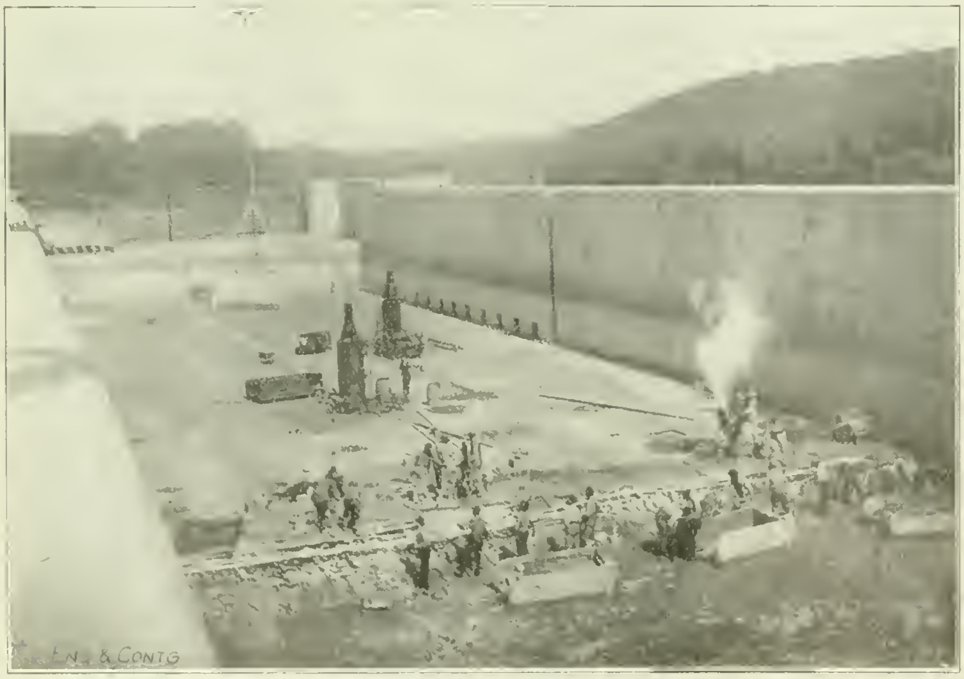


Fig. 2—View Showing Process of Removing Original Lock Floor.

REMOVING OLD LOCK FLOOR.

The first piece of work to be done under the new project was the removal of the lock floor which was $3\frac{1}{2}$ ft. thick and 80x350 ft. in area. The floor was made of cast beams from 5 to 10 ft. in width. The longitudinal reinforcement of the beams was of 1-in. square twisted lug bars, spaced 6 ins. on centers and placed 6 ins. below the top surface. The beams were tied together by similar bars placed 6 ft. apart and by tongue and groove joints between the beams. The floor rested directly upon the bed of the river, which is composed of compact limestone and gravel mixed with limestone slabs. It was underdrained by twelve 12-in. tile drains.

To break up the floor, holes 3 ft. deep were drilled in rows 1½ to 3 ft. apart across the lock. Three steam drills served by two boilers, as shown by Fig. 2, were used for this work. Sometimes several holes were started before one could be drilled without hitting reinforcing bars. Light charges, consisting of two ½-lb. sticks of 40 per cent dynamite, were used to break up the concrete; near the lock walls the charge was reduced to one stick. The fuse was cut to such lengths as would insure firing first the holes in the center of the lock, and last, those near the walls. This method ensured a comparatively straight break across the lock. The steel came out practically clear, and the small masses clinging to it were removed with a hammer. Very often the tongues and grooves at the junction of the floor beams stuck so tightly that the tongues were sheared off by the explosion. The steel was cut apart by means of an oxy-acetylene torch. One workman attended to this work and also assisted the blaster. The time for cutting a 1-in. bar was from 20 to 40 seconds. The broken up concrete was loaded into boxes and removed by cableway. The cost of removing the floor was about $2.62 per cubic yard as follows:

Cu. yds. removed	3,938
Labor	$ 5,499.64
Gas and explosives	924.79
Coal and pumping	2,374.31
Total	$ 8,798.77
Plant, new, $1,012.31 20 per cent	202.46
Shovels and picks	79.50
Repairs to plant	500.00
Engineering and superintendence	750.00
Total	$10,330.73
Cost per cu. yd.	2.62

RAISING LOCK WALLS.

The raising of the old lock walls was accomplished by the use of forms made of slabs of concrete which were set upon the face of the wall and cast into the permanent work. These concrete slabs were made with interlocking edges. They were cast in forms which were also made of concrete and which are shown by Fig. 3. There were two lengths of slabs, 6 ft. and 3 ft. The long slabs were 6 ins. thick, and the short ones, 9 ins. thick. The short slabs had recesses at each end into which the beveled tongues of the long slabs fitted loosely. After being set and lined up on the face of the wall the slabs were braced and tied in place and the joints were filled with grout. A permanent line and grade for the setting of the blocks was established by erecting light steel frames of triangular shape, with their vertical legs plumb and 1 ft. back from the wall face. The frames were set about 50 ft. apart, as shown by Fig. 4; a wooden triangle, movable on the face of the frame, was set at the right height; a nail was driven on line at the top edge, and a cord was stretched from one frame to the other to give the masons a guide.

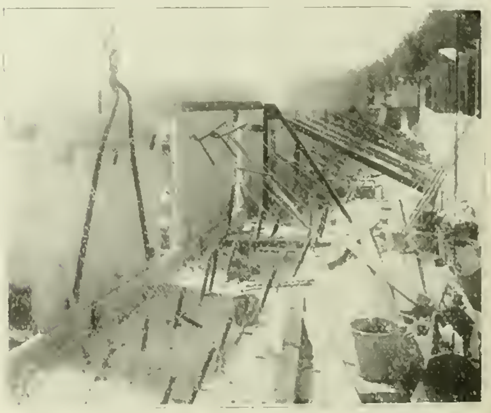


Fig. 4—Method of Setting and Supporting Wall Slabs.

The slabs were handled as shown by Fig. 4, by means of a double hook frame which hooked into "eyes" cast into the block. The upper three "eyes" were cast in and the bar arrangement was set into them as shown in the view, so that when suspended from the derrick the slab would hang in a vertical position and could be easily set in place. The slabs were tied in place by wires fastened to the eyes and tied back to bars previously placed in the concrete wall. "Pig tails" were also used, to insure a future bond between the concrete block and the body of the wall. These were made of short pieces of the reinforcing bars taken from the old floor, and stuck through the eyes and bent over, as shown by Fig. 4.

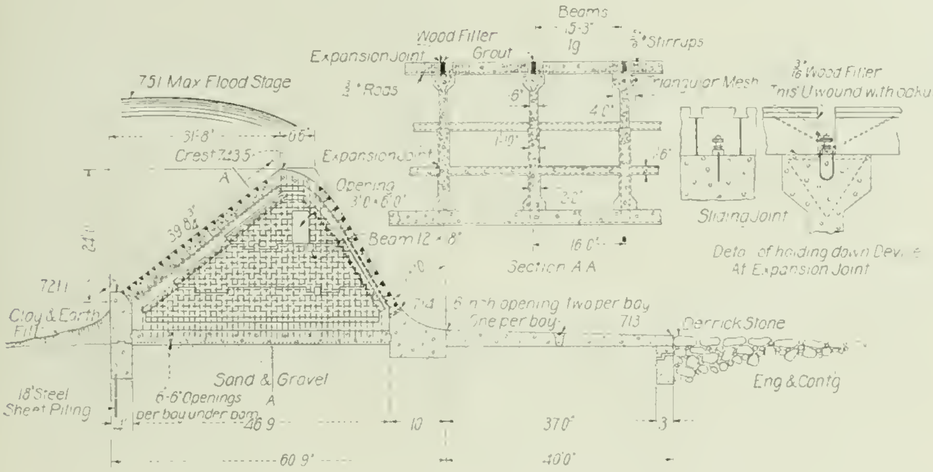


Fig. 5—Section of Ambursen Dam.

MOLDING WALL SLABS.

The concrete molds in which the slabs were cast are shown by Fig. 3. They were simply rectangular, bottomless boxes of concrete laid on wood platforms. They were divided midway between the corners into four L-shaped pieces and were heavy enough to stay in place without bracing while the slabs were being poured. These molds were easily and quickly lined up, and could be readily removed, without injury to the slabs, by prying them away from the green concrete. Paraffin oil was used to paint the forms to prevent the slabs from sticking. Each short slab had four hook eyes cast in it and six were cast in the long slabs. The slabs were handled by these eyes. The cost of the slabs considered as forms was $1.22 per cubic yard of concrete cast. This is perhaps a few cents more than wood forms would have cost, but the additional cost of finishing the wall surface after wood forms were removed, would have equalled the cost of the finished walls.

DAM CONSTRUCTION.

The dam is built upon a pile foundation, as are the other structures, and is of the Ambursen type. A section of the dam is shown by Fig. 5. It consists of a series of buttress walls built upon a concrete slab with concrete beams spanning the spaces between the walls, and forming the faces of the dam. The beams are cast ashore and set in place by the cableway. The buttress walls are reinforced and are braced together with six reinforced concrete struts. There is also a passage way under the dam about 13 ft. below the crest. The buttress walls are 16 ft. between centers. When the beams are set in place a space is left between the ends and a recess in the shape of a dovetail is formed at the longitudinal joint along the top of the beams. These spaces are filled with grout. For handling the beams two loops of cable are embedded about 3 ft. from their ends and so placed that when suspended by the loops the beams hang at the angle at which they are set on the dam. Steel clips, secured to the buttress by embedded U-bolts and slotted to allow for any little variation in width of beams are arranged to hold nuts which receive the threads of a bolt which passes through the loops of the abutting beams. This ties the beam down to the buttress and insures stiffness, and, in the down-stream deck, counteracts any upward pressure which might occur. Expansion and contraction of the beams is provided for by winding the loops with oakum, and by placing thin wooden fillers at the ends. Expansion joints are provided at every other buttress. Three thicknesses of beams are used on the up-stream face. They weigh about 5 tons each and the thinner beams are made wider to keep the weight equalized. The crown piece is cast in place.

The forms for the deck beams are made of two side panels with studs projecting several inches above the form. Slots are cut in the tops of the studs so that tie bolts may be dropped into them to tie the forms across the top, as shown in Fig. 6. Wood spreaders rest on shoulders on the studs immediately under these tie bolts, so that the form is given its proper width when the bolts are tightened. At the bottom of the form on each side an 8-in. I-beam is laid so that the ends project beyond the end of the forms. These beams are tied together by a rod with hooks at each end and a turnbuckle in the center. The turnbuckles are tightened after the top rods have been dropped into the slots at the top of the posts as studs. Loosening the turnbuckles permits the removal of the sides and ends. There are no bottoms to the forms, as the beams are made on the floor of the lock and common brown building paper is laid down to prevent sticking.

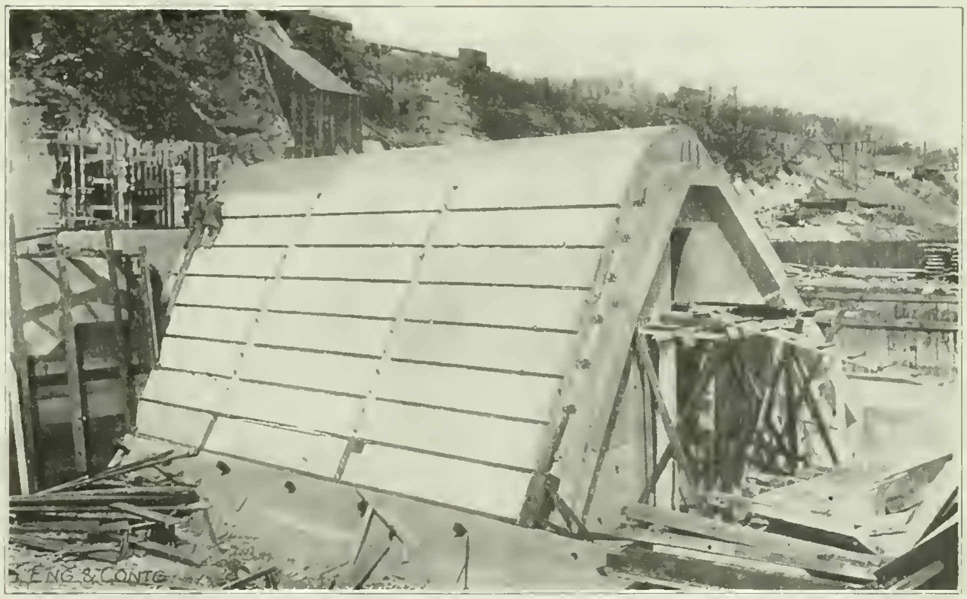


Fig. 7—View of Complete Section of Ambursen Dam.

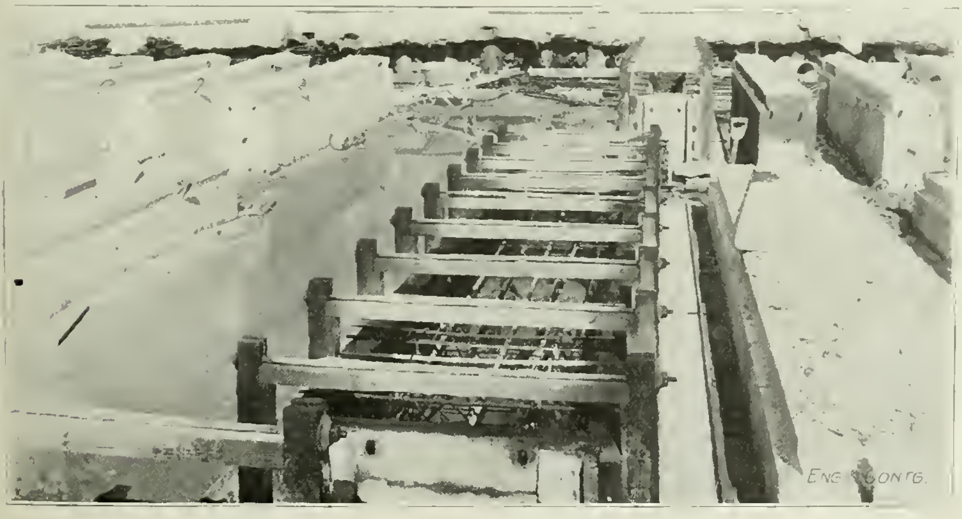


Fig. 6—Molding Beams for Faces of Ambursen Dam.

POWER HOUSE FOUNDATIONS.

The power house foundations were built of mass concrete supported on piles. The concrete plant used was a portable Smith mixer which discharged into a hoist bucket in an Insley tower from which concrete was transported to place by chuting.

COST DATA.

The amount of money expended on the project in the two fiscal years since the work began in 1910 has been $367,707. This includes the raising of the lock walls, lowering

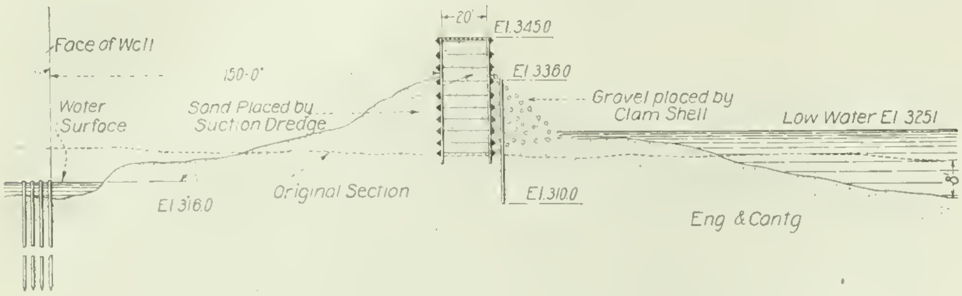


Fig. 1—Typical Section of Cofferdam for Lock No. 48, Ohio River.

the floor, building 48 ft. of the dam, and beginning work on the power house foundations. The amount of work done as given in the annual report of the Chief of Engineers, U. S. Army, includes the following items:

	Units.	Cost.	Unit cost.
Concrete placed, cu. yds.	27,570	$146,612.51	$ 5.32
Excavation, cu. yds.	42,852	33,250.24	0.78
Back fill, cu. yds.	14,875	5,491.37	0.37
Cofferdam, lin. ft.	600	7,036.78	11.73
18 ft. steel piles, No. piles	266	13,892.84	52.23
Round piles, No. piles	1,140	4,271.88	3.75
Removing lock floor, cu. yds.	3,943	10,330.73	2.62
Total		$220,886.35	

The amount charged to pumping during the two years was $36,490 and that for plant was $37,766. Other items for which no units are available are reinforcing steel, cleaning up, tile drains, gates, rabbitting lock wall, royalties on dam, and administration, altogether amounting to approximately $150,000. The work remaining consists of the construction of the lock gates, the dam and a part of the of the foundations for the power house and should be completed in another year.

Method of Constructing Cofferdam on Shifting Bottom; Ohio River Dam No. 48.

The construction of cofferdams on the shifting silt and sand bottom of the lower Ohio River has been affirmed by many river works contractors to be impossible. For this reason the methods which were successful in constructing the cofferdam for Dam No. 48 of the Ohio River improvements are of exceptional interest. They are particularly of interest also because there remain half a score of dams to be constructed with practically the same conditions of bottom.

The following account of the methods followed in cofferdamming the site of Dam 48 are abstracted from a paper by Maj. J. C. Oakes, Corps of Engineers, U. S. A., in "Professional Memoirs," March-April, 1913. Bids were opened for the construction of No. 48 on Sept. 7, 1911, and it was found that only one bidder had sufficient confidence to offer to do the work. The contract was awarded to the only bidder, The Ohio River Contract Co., and during the past season the cofferdam surrounding the lock, enclosing an area of 20 acres has been constructed, pumped out, and the round piles under the river wall driven. Work was shut down for the winter on Dec. 31, 1912, and during January, 1913, this work was submerged by one of the worst floods of record at that site, high water reaching an elevation of 371, which is within 2 ft. of record high water. No particular damage has been done the coffer and it is expected that it will be in as good condition next season as is usual at other sites after the winter floods. It has therefore been proven that safe cofferdams can be constructed, maintained, and pumped out without undue trouble at the sites in question as well as in other parts of the river where better foundations exist.

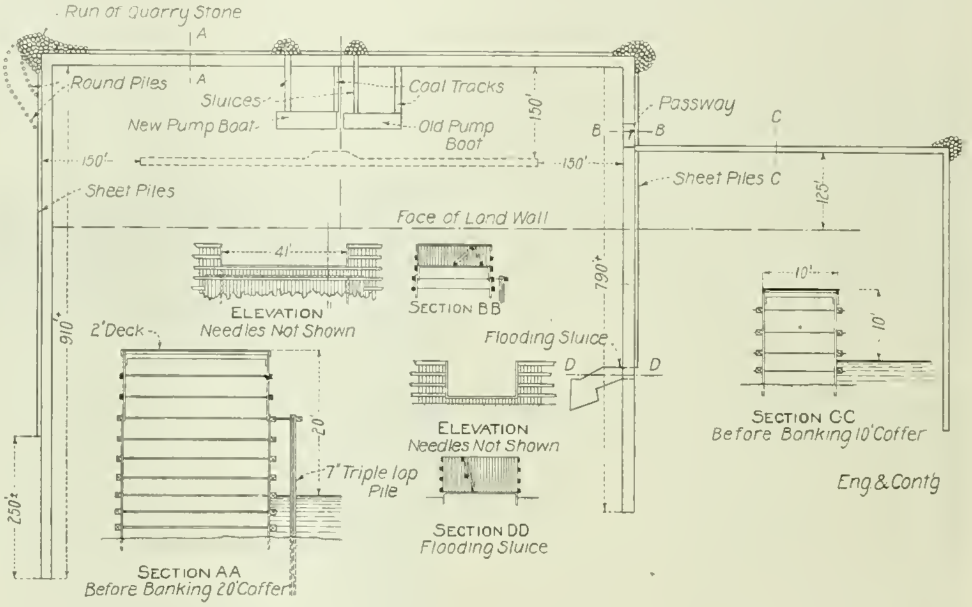


Fig. 3—Details of Cofferdam Structure, Lock No. 48, Ohio River.

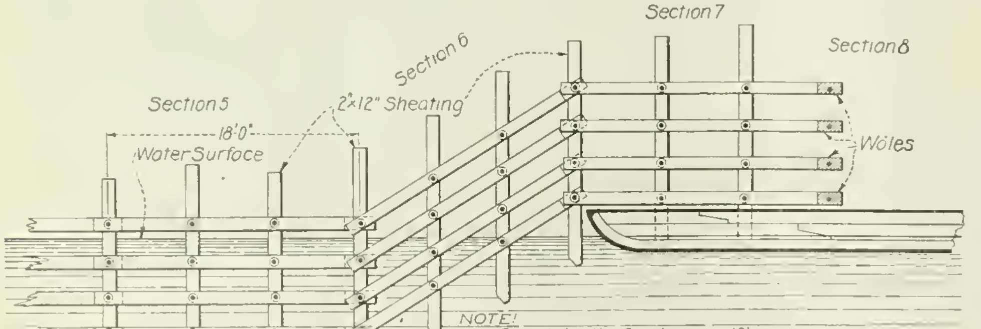


Fig. 2—Method of Building Cofferdam Skeleton on Barge and Launching, Lock No. 48, Ohio River.

The following is an extract of a report of the Government inspector in charge of the work, Junior Engineer Edward H. West, in which the work is described in fuller detail:

The coffer, both inside and out, is heavily banked with sand. A typical cross-section is shown on Fig. 1. Plans were closely followed in construction, the only exceptions being as follows: For a distance of 670 ft. from the land end of the upstream wing and 520 ft. from the land end of the downstream wing, tie-rods were spaced 8 ft. on centers instead of 6 ft. on centers; in some portions of the coffer, instead of 2x12-in. deck joists spaced 24 ins. on centers, 2x10-in. joists were used, spaced 16½ ins. on centers, and in a short portion of the river arm 2x10-in. joists 18 ins. on centers were used. The sheet piles were driven from a floating pile driver, and at times the river was too high to permit the piles to be driven to the proper depth; consequently, such piles do not have quite the penetration intended, the maximum difference between actual and intended penetration being about 3 ft.; at the upstream outer corner the length of a number of sheet piles was increased to 32 ft. for additional safety at the point of supposed greatest weakness; at this corner about 50 round piles were driven as shown on Fig. 3, the area inclosed within them was filled with brush weighted with sandbags. Afterwards the entire corner was protected with derrick-stone piled as high as the top of the coffer. The lower outer corner was also protected by derrick stone and several stone dikes were built along the river side.

On June 20, 1912, the line of sheet piles was commenced, beginning at a point 250 ft. from the land end of the upper wing, and piles were driven on 56 days, an average of 40 piles per day. On a number of these days, however, two pile drivers worked, the average number of piles per day for one driver being not more than 30. These sheet piles were driven rather carelessly, making alinement poor, and leaving the joints not very tight. Better progress could have been made in driving them, but as it was only necessary to keep ahead of the coffer skeleton no great effort was made to push the pile driving. After the driving of sheet piles had been begun, trenches about 2 ft. deep and 20 ft. apart were dug parallel to the sheet piles. In these a skeleton was erected consisting f wales and those pieces of sheeting through which the tie-rods passed, the sheeting being driven about 2 ft. into the sand. All wales were scarfed for 2 ft. at both ends and holes bored for tie-rods through the center of the scarf. Where the spacing of tie-rods was

8 ft., 18-ft. timbers were used for wales and where the spacing was 6 ft., 20-ft. wales were used, thus allowing a lap of 2 ft. at each end. At each tie-rod a temporary separator perpendicular to the wales and 20 ft. long was placed and the nuts on the rod tightened. The remainder of the sheeting was then driven and after the proper cut-off elevation had been marked the ribbing strips were spiked on and the sheeting cut off to grade. Cracks between adjacent pieces of sheeting were closed by 1x3-in. battens nailed on the inside. When the coffer had been extended into water so deep as to prevent further work from land the skeleton was bolted together on a small barge, one section at a time, and as each section was completed it was lifted by a derrick boat until the barge could be moved forward, when it was lowered into the water (Fig. 2). Sheeting was then driven by men standing on the wales. Throughout the construction two gangs of carpenters worked. At times each gang extended both skeleton and sheeting, but better progress was made when one gang worked on skeleton only and the other followed up with sheeting. Each gang contained at different times from 10 to 20 men; it was found that not more than 20 men could work together to advantage. In general, it may be said that the rate of progress depended upon the rapidity with which the skeleton was advanced, no difficulty being experienced in keeping close up with the other work. As a matter of fact, sheeting was frequently delayed in order that the skeleton might be extended. During the season the skeleton was actually extended on about 71 days an average of 38 ft. per day; this value corresponds to two wale lengths, either 36 or 40 ft., depending on the length of the wales being used; it was noted in the field that two wale lengths constituted an average day's work. Sheeting was actually driven on 53 days, an average of 52 ft. per day (double row) from a minimum of 10 ft. to a maximum of 103 ft., but on a great many days on which sheeting was driven much other work was done by the same gang and the above values are not reliable for progress estimates. It is believed that one gang can extend a double row of sheeting 100 ft. per day. The extension of skeleton may be assumed to be work accomplished by a single shift since night work on this portion of the coffer is negligible; sheeting, however, was driven quite satisfactorily at night. After the sheeting had been cut off to proper elevation, the deck joists were laid and spiked to the ribbing strips. This having been done, the discharge pipe of the 10-in. suction dredge was moved into position and the sheeted portion of the coffer filled with sand taken, if possible, from the "pay excavation" for the lock walls. Bulkheads across the coffer were built at convenient intervals as the construction advanced. As the coffer filled, the separators were removed and afterwards used again. At first, a long trough built on top of the deck joists of rough lumber, on a grade of 1 per cent, was used for distributing the sand, but it proved to be very inefficient and was discarded; subsequently the desired distribution was accomplished by moving the end of the discharge pipe. Short time tests of the suction dredge showed that it could place 100 cu. yds. of fill per hour, through 300 ft. of discharge pipe, maximum lift 20 ft. It handled a total of about 100,000 cu. yds. of material. The coffer contains only about 40,500 cu. yds.; the remainder was used for banking. Of the total excavation made, about 50 per cent was within the specified limits of "pay excavation." As shown on Fig. 3, a flooding sluice was built in the lower wing and a passway for removing boats, etc., was also left in the lower wing. Discharge sluices and coal tracks were constructed in the river side near the crest line of the dam. A layer of fine gravel was spread over the whole river side of the coffer-banking to prevent scour as much as possible. It is believed that the one flooding sluice will be all that is necessary, unless very extraordinary conditions arise; in flooding the coffer when the river is near its top and too great a volume of water entering would endanger the permanent work, it is intended to place blocks behind alternate needles, as is often done in regulating pools above needle dams. In the event that this scheme should fail to pass a sufficient quantity of water to fill the coffer before it is topped by a rise, it is intended to use the passway as an emergency opening after constructing a temporary sluiceway.

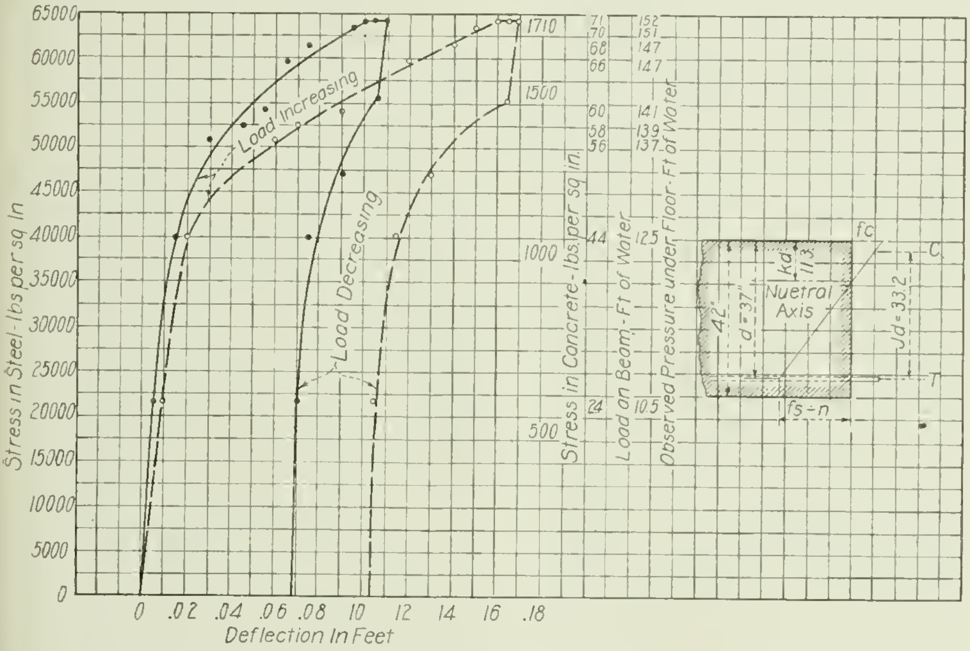


Fig. 1—Diagram Showing Results of Hydraulic Test on a Reinforced Concrete Lock Floor, 80 ft. Wide, 324 ft. Long, and 3½ ft. Thick.

Vermont Society of Engineers.—The annual meeting of this society was held at Burlington, Vt., Mar. 7. Papers were read by Professor Walter L. Upson of Union College on "Transition Points in Electrical Engineering"; A. G. Chapin of Boston on "Hydro-Electrical Development," and W. H. Vorce of St. Albans, Vt., on "Electro-Chemistry." Professor C. S. Carleton of Northfield, Vt., is president; D. Williams of St. Johnsbury, Vt., 1st vice-president; G. A. Reed, Barre, Vt., secretary.

Method and Results of Testing a Reinforced Concrete Floor 80x325x 3½ Ft. for a Ship Lock.

Perhaps the largest scale test ever made on a reinforced concrete structure was conducted in 1910 at Lock and Dam No. 1 of the Upper Mississippi River Improvement. As described in our issue of March 19, 1913, the original floor of the lock had to be removed to make the lock conform to changed plans. It was decided before the old floor was removed to test it against upward hydraulic pressure. The test was conducted by Mr. Adolph Meyer, Consulting Engineer, St. Paul, Minn., and the methods employed and results obtained were described by him in a paper before the Minnesota Society of Engineers and Surveyors at its recent meeting.

The floor consisted of a tight, underdrained concrete slab 3½ ft. thick, reinforced transversely with 1 sq. in. of steel every 6 ins. and longitudinally with 1 sq. in. about every 3 ft. This amount of reinforcement in the direction in which the floor would act as a beam amounted to less than 0.5 per cent of the area of the concrete and it was apparent that the strength of the beam would depend upon the elastic limit of the steel. The floor was built in accordance with the recommendation of the Board of Engineers, using for reinforcement, square, cold-twisted lug bars, having an elastic limit of 38,000 lbs. per square inch before twisting.

There being a steel sheet piling cut-off wall extending around the lock chamber under the river wall and the upper and lower miter sills, and the water outside of the lock standing at an elevation 10½ ft. above the bottom of the lock floor, it was a comparatively simple matter to produce pressure under the floor by pumping water into the twelve lines of tile under-drains connected to a tunnel leading to a sump well. The day before the test was made sufficient water was pumped into the under-drainage system completely to fill it. Then additional water was pumped into the well until it stood at an elevation of 9½ ft. above the bottom of the floor—almost equal to the elevation of the water outside of the lock chamber. This head was maintained practically undiminished through the night. The next day the pressure was gradually increased until the water in the well stood 15.7 ft. above the bottom of the floor. The test consumed about one-half hour and practically the entire head was transmitted almost instantaneously to the upper end of the lock, about 325 ft. from the well and 6 ft. from the nearest drain. In view of the fact, however, that after a head of about 10 ft. had been applied, the floor showed appreciable deflection, this rapid transmission of pressure cannot be attributed entirely to the underdrainage system. The upward deflection of the floor at the center was taken at two points, one about 75 ft. and the other about 280 ft. from the upper end of the lock. The head under the floor was measured by noting the height to which the water rose in a hose connected to a pipe driven through the floor.

It appears from the accompanying curves that yielding occurred when an upward pressure of about 12½ or 13 ft. of water had been applied. My original computations gave the ultimate load as equivalent to a depth of 14½ ft. of water. Inasmuch as this was based on an assumed elastic limit for the reinforcing steel of 55,000 lbs. per square inch, and inasmuch as the steel used was supposed to have an elastic limit of only 38,000 lbs. per square inch before cold twisting, it will be noted that the ultimate load shown by the test agrees substantially with the ultimate load computed by the use of the standard beam formulas. Assuming the weight of a cubic foot of concrete as equal to 145 lbs., the 3½-ft. floor would, by its weight alone, withstand an upward pressure of a little over 8 ft. of water.

The diagram shows the total head of water under the floor and also the load carried as a beam, together with the stresses in the concrete and the steel on the assumption that the coefficient of elasticity of the steel was 30,000,000 lbs. per square inch and that for the concrete 2,000,000 lbs. Should these values be assumed as 30,000,000 and 3,000,000, respectively, the stress in the steel would be reduced 2 per cent and the stress in the concrete increased 16 per cent due to the shifting of the neutral axis to within 9.53 ins. of the compression face. I believe that this latter assumption is more nearly correct than the former.

The curves for decreasing load have the familiar shape characteristic of deformation curves for material which has been stressed beyond the elastic limit.

WATER WORKS

Comparative Advantages of Metal and Rubber Tubing for Conveying Chemical Solutions in Water Filtration Plant Practice.

Contributed by Charles W. Saxe, Chemist in Charge, Newport (Rhode Island) Water Filtration Plant.

The conveying of "Alum" solution to the point of application in mechanical filter plants is attended with trouble from the pipes rapidly clogging up and thus hindering the flow.

At the Newport, Rhode Island, water works prior to August, 1912, the solution was fed through a 1¼-in. lead pipe by gravity a distance of 120 ft. It was very difficult to clean out the deposit and also to make the lead flange joints tight again. Inch and a quarter 2-ply chemical rubber hose was substituted in August and so far, 6 months, has needed no cleaning. When this is desired the two lengths are taken apart and are laid out on a flat surface. The hose is lightly rolled with a short piece of board and is then flushed out. The 3,000 grain per gallon "Alum" solution appears to have no effect on the rubber.

Hypochlorite of lime of ½ per cent strength is best carried in galvanized iron pipe. A thin crust forms inside at first but it does not increase rapidly. The 2 per cent "Soda" solution is being carried in galvanized iron pipe also.

The Present Condition of Small Water Purification Plants in Illinois—Faults in Design and Operation.

In the State of Illinois there are about a dozen water purification plants, with rated capacities of about 2,000,000 gals. per day or less, which involve the use of coagulants, settling basins and filters. Of these, with possibly two or three exceptions, it can be said that none produces an effluent that attains at all times the standard of purity that any municipality should demand for its public water supply.

Some of these plans yield an effluent during the major part of the time which is of quite satisfactory quality, but fall far short of successful operation during periods of excessive turbidity and color in the raw water. Others produce an effluent at no time that is of good appearance and satisfactory from a hygienic standpoint. The present condition of these small water filtration plants, with a discussion of their faults of design and operation, was described by Mr. Ralph Hilscher, Assistant Engineer of the Illinois State Water Survey, in a paper before the Illinois Water Supply Association. Mr. Hilscher's paper is given herewith in full:

The poor results realized are due largely to certain faults in design and operation which are more or less common to these small installations. Many of the plants are of obsolete design and in practically all the plants too great economy was attempted in building and certain essential features were omitted. The operation has usually been deficient, due to lack of experience and expert advice in such matters.

Certain faults largely responsible for the shortcomings of these plants will be taken up separately and discussed with reference to typical examples.

CHEMICAL FEED.

In a small plant the matter of economy in the use of chemicals is not of great importance for the amount that can be saved by the greatest economy along this line is very small in comparison with other costs. What is most desirable is that the chemicals be added at as uniform rates as practicable consistent with simplicity in mode of application. In many plants, however, simplicity seems to have been the foremost consideration and greatly at the expense of uniformity in application. Undue economy also seems to have been attempted in some cases.

Probably the simplest method of chemical feed and the method used in a number of these small plants consists of preparing the chemical solution and applying it in a single continuous operation. This is accomplished by placing the dry chemical in a small tank, through which there is a continuous flow of water, and allowing the overflow carrying chemical in solution to pass to the water receiving treatment.

The uniformity of dose administered by this method depends mainly upon the frequency with which the supply of undissolved chemical is replenished, and may also be materially affected by temperature.

If the quantity of undissolved chemical is approximately the same at all times the strength of solution applied will be fairly constant, but very often operators cannot be depended upon to give this matter proper attention. In one instance a solution of iron sulphate was found to weaken about 15 per cent in one hour, and at this plant it was the practice to recharge the tank only as often as once in about six hours.

The solubilities of chemicals are affected more or less by the temperature of the solvent. For instance, the solubility of iron sulphate in water at 15° F. is only about 66 per cent of what it is at 70°. Alum, on the other hand, is but little affected in solubility by temperature, varying about 7 per cent between 15° and 70°.

Possibly the most reliable simple method of feeding chemical is by the use of a constant head orifice box fed through a float valve from a tank containing a supply solution having a constant strength. By this means the uniformity of dose need be subject to no interruptions so long as the rate of pumping is constant, as is ordinarily the case in a small plant.

SEDIMENTATION.

The period of sedimentation that should be given a coagulated water previous to filtration, to afford the maximum efficiency for the entire plant, depends somewhat upon local conditions, but as a general rule it would seem that a detention period of at least four hours would be desirable with such waters as are found in most Illinois streams.

In 12 small gravity filter plants in Illinois the theoretical settling periods range from zero to about 8.8 hours, and the average is in the neighborhood of 3.5 hours. In addition to these there are a number of pressure filter plants where no sedimentation is provided.

These settling periods, however, figured as the total volume contained between the walls of the basins, are frequently not realized fully on account of improper baffling, which results in considerable dead space.

In two instances there are provided circular basins with radial baffles, and the course taken by the water is around the ends of these baffles, from outside to center of tank, and vice versa successively through the various compartments. With such an arrangement the rates of flow in different parts of the basin must necessarily be widely different, for in each of the compartments there is a large space in one corner that is of almost no service on account of its containing practically dead water.

In a number of other instances there are provided basins of rectangular shape across which the flow is in a diagonal direction. In such a basin also there is dead water in two corners remote from the diagonal line of flow.

To obtain the fullest benefit from the available settling capacity a basin should have such inlet and outlet facilities as will effect a uniform rate of flow throughout the whole cross-section. This may ordinarily be accomplished easily by admitting the water to the basin through numerous small holes in a vertical wall at the inlet end and by drawing it off over a weir extending across the outlet end.

FILTRATION.

A variety of faults may be found with the filters themselves in various plants, especially in the older installations. The most objectionable features ordinarily lie in the method of control, in the facilities for washing the filters and in the character of the filter medium. Other features of importance, such as arrangement of pipes and valves and convenience for operation, are also frequently open to criticism.

A wide variation in the character of filter sands exists in Illinois, the effective sizes ranging from 0.28 m.m. to 0.85 m.m. and the uniformity coefficients from 1.15 to 2.10. These sands are more often too coarse than too fine, a characteristic which makes filtration more economical but less effective.

In a number of plants proper control of the rate of filtration is not possible on account of the absence of automatic controllers on the effluent pipes. Without these the load of the filtration is certain to become unequally distributed between the various units. In two of the smallest of these plants, where but single filter units are installed, some pretense is made at regulating the rate by occasionally adjusting a gate valve on the effluent pipe, but the effectiveness of such control depends wholly upon the skill and watchfulness of the operator, which is undesirable.

In washing filters the ultimate consideration is economy. The main object should be to filter a given amount of water using a minimum amount of wash water, and of air if that be used for agitating the sand during washing.

The majority of plants are not provided with loss-of-head gages so the operators cannot know when the proper time to wash, consistent with best economy, arrives. It is frequently the practice to wash once every 24 hours, regardless of the character of the water treated and of the real filter needs. In one plant the filters are so poorly equipped for washing that the filter medium much of the time is of a muddy, clayey appearance, while, as a matter of fact, when clean this sand is of excellent character for filter needs. The filter runs between washings here are at times only two hours. In another plant the amount of air used in agitating has been so great that the violence of washing has caused about one-third of the original sand to be lifted into the waste gutters and carried away.

OPERATION.

Unfortunately, the small city or water company cannot afford, or at least is not willing, ordinarily, to make the necessary expenditure to obtain expert filter operation. As a result the operation is usually left largely to the pumping station engineer, a man who is possibly a good mechanic and well equipped for his own line of work, but who, frequently, has never even seen any other filter plant than the one of which he has charge.

But very few plants are equipped with laboratory facilities for testing the quality of the filtered water. In the majority of cases the only test is that of appearance, and even in this the standards at some places are surprisingly low. In two or three instances the water has a milky appearance, a large part of the time, but it is not objected to because it is somewhat of an improvement over the water delivered previous to the installation of filters.

In fact, the local authorities have not, as a rule, had a fair understanding of what a purification plant should be able to accomplish and there is rarely anyone who has the time or the inclination to look beyond his own experience enough to really appreciate the fact that the best results under the circumstances are not being obtained.

The Special Features of the Recent Water Works Improvements at Rushville, Ill.

Rushville, Ill., a town of about 2,500 population, has for a number of years secured its water supply from a deep well located near the center of the city and from a small reservoir close to the city. The well water was so heavily charged with minerals and the reservoir was subject to such contamination that the use of either water for domestic purposes was out of the question, and in long continued dry periods the supply was insufficient for even fire-fighting purposes. The special features of the recently made improvements to the town's water supply system were described by Mr. F. H. Coult of the Fuller-Coult Co., Consulting Engineers, of St. Louis, Mo., in a paper read at the fifth annual meeting of the Illinois Water Supply Association. The information here given is taken from Mr. Coult's paper.

The demand for an adequate supply of wholesome water became so great that in 1911 the water committee of the City Council was instructed to take steps toward securing a new supply which would meet all the requirements of the city. This committee, after considerable investigation, decided that the most feasible source for the new water supply was a gravel bed fed by many springs, located at a place known as McElho Branch, about 5½ miles south of the city. In order to make sure that a sufficient quantity of water could be secured from this source a test well 5 ft. in diameter and 20 ft. deep was put down. The first 10 ft. of the well was through a stratum of black sandy soil, the next 2 ft. through a stratum of fine sand, and the remaining 8 ft. through a water-bearing stratum of coarse gravel and sand. By sounding it was found that this stratum of gravel and sand extended 2 ft. deeper and rested upon a bed of shale. A pump was installed in this test well and operated continuously for 42 hours, the rate of pumping being 150 gals. of water per minute. At this rate of pumping the water level in the well was lowered from 3 ft. below the top of the well, the normal level, to within 3 ft. of the bottom of the well, where it remained constant. The water contained some iron, but not enough to be objectionable.

The water committee having satisfied itself as to the quality and quantity of water which could be secured from this gravel bed, made a recommendation to the City Council that this source of supply be developed and utilized by the city.

As a result of the committee's recommendation, the city authorized the construction of water works improvements consisting of a new pumping plant and large shallow well at McElho Branch; a 10-in. pipe line and an electric transmission line from the city limits to the pumping plant; and a booster pumping plant in the city to raise the pressure in the mains, when necessary, for fire-fighting purposes. As the city was fairly well supplied with distributing mains and fire hydrants and had a good standpipe of 100,000 gals. capacity, it was not deemed necessary to make any improvements to this part of the old water works system.

The features of the new installation which may be considered special, either in design or construction, are the well; the pumping installation, the pipe line and the booster pumping plant. These will be briefly described in the order stated:

WELL.

The well was constructed with an inside diameter of 12 ft. and a depth of 22 ft. below the ground surface. The 8-in. wall was built of vitrified brick and was built up above the surface of the ground to a height of 4 ft., so as to be above high water at times of flood. The top was covered with a slab of reinforced concrete. The outside surface of the upper part of the wall was plastered with cement mortar for the purpose of excluding surface water from the well. The bottom six courses of brick were laid in cement mortar, but for the next 4 ft. above the last course so laid the brick were laid without the cement mortar to facilitate the inflow of the water from the gravel bed to the well. Above this 4-ft. section the brick were laid in cement mortar.

In planning the construction of the well, it was not deemed advisable to attempt making the excavation to its full depth before building the wall, owing to the difficulty of keeping the sand and gravel from running in and filling the excavation. In order to avoid this difficulty it was decided to use a method of construction which, although not entirely new, may be of interest to those who are not familiar with it. A hole about 15 ft. in diameter was excavated in the usual way down to the sand stratum. Then in this excavation there was placed a heavy circular wooden shoe having a vertical steel cutting edge and a horizontal upper surface 9 ins. wide for the support of the brick wall. The shoe was carefully leveled and then the building of the brick wall on the shoe commenced. As the sand and gravel were removed from the inside the wall settled by its own weight and also shut off the inflow of sand and gravel from the outside. Excavation, settling and building up of the wall continued until the shoe rested upon the firm shale bed at a depth of 22 ft. below the ground surface. By giving special attention to the excavating, no particular difficulty was encountered in keeping the shoe level and the settlement of the wall uniform.

PUMPING EQUIPMENT AND TRANSMISSION LINE.

The pumping equipment at the McElho pumping station consists of two 3-stage Alberger 4-in. pumps, each having a capacity of 250 gals. per minute against a total head of 300 ft., including pipe line friction. One of the pumps is driven by a 30-hp., 220-volt, 60-cycle, single-phase, direct-connected Wagner motor, equipped for remote control so that it may be started or stopped from the power house in the city. The other pump is connected through gearing to a 30-hp., 2-cylinder, vertical internal combustion Remington oil engine.

Probably the only special feature of this pump installation is that the same type motive power is not used for both pumps.

In designing the pumping plant, cost of operation, efficiency and reliability were all taken into consideration and it was decided that an electric motor-driven pumping installation would be the most feasible, were it not for the ever-present possibility of trouble on the transmission line between the city and the pumping plant, caused by heavy sleet storms or otherwise. The fact was realized that if both pumps were electrically operated such transmission line trouble might, at times, seriously affect the operation of the plant or even put it entirely out of commission. For this reason it was decided to install one motor-driven unit which would be expected to do the bulk of the pumping, and one auxiliary engine-driven pump to be held in reserve for emergency use.

The pumping equipment is installed in a concrete pump-pit extending 6 ft. below the surface of the ground and the concrete walls are carried up to a height of 4 ft. above the ground surface. These walls serve as a foundation for a plain brick superstructure.

There is nothing special about the station pipe work, both pumps being connected to a common 6-in. suction pipe which extends into the well, and to a common 6-in. discharge pipe which connects into the 10-in. pipe line just outside of the pump-pit. The arrangement of the valve is such that either pump may be operated while the other is cut out, or both may be operated at the same time, should this be necessary. The well is 10 ft. from the pump-pit and the suction lift is about 15 ft.

The high tension single phase transmission line from the city to the pumping plant was designed for a working potential of 6,600 volts. At the city limits connection is made to the 1,100-volt system of the local electric light company through a 30-k.w. step-up transformer, and at the pumping plant the potential is reduced from 6,600 volts to 220 volts by a 30-k.w. step-down transformer.

PIPE LINE.

In the construction of the 10-in. pipe line from the city limits to the pumping plant, a marked departure was made from the usual practice in this locality in that wood stave pipe, instead of cast iron pipe, was used. The reason for this was, primarily, that the amount of money which the city could raise for the water works improvements was not sufficient to cover the cost of 5½ miles of 10-in. cast iron pipe line, and it was not considered practicable to install a smaller size because of the increase in the cost of pumping which would result from the additional pipe line friction.

However, the city officials did not decide to use wood pipe until they had satisfied themselves that it was not a makeshift, but that if it was properly constructed and installed it would prove satisfactory in every way.

Washington fir pipe was used, the pipe being formed by the assembling of staves dressed on both sides to the form of segments, which upon being assembled formed a pipe with true circular inside and outside surfaces. The edges of the staves were cut radial and in each edge was cut a tongue and groove. After being assembled the pipe was tightly wrapped with No. 4 double galvanized steel wire. The ends of each piece of pipe were carefully cut for mortise and tenon joints, and the entire outside surface of the pipe was given a heavy coating of hot tar and asphalt, after which the pipe was rolled in fine sawdust while the coating was still hot.

In laying the pipe the tenon end of each length was forced tightly into the mortise end of the last piece of pipe laid, a swinging ram being used for the purpose and a suitable plug being inserted in the end of the pipe to be driven to protect the end of the pipe. It was expected that a good many leaks would occur at the joints when water was first turned into the pipe and this was found to be the case, but in most instances these joints became water tight after the pipe had been filled with water for a sufficient length of time to swell the wood. Such leaks as were not stopped in this manner were repaired by driving small wooden wedges into the openings where the leaks occurred.

The pressure on this pipe line varies from about 50 lbs. per square inch at the highest elevation to 150 lbs. per square inch at the lowest elevation when the pumps are working against the full head of 300 ft. A check valve is installed in the pipe line at the city limits where connection is made to the cast iron main. This valve was installed to protect the wood pipe line from the high pressure to which it would otherwise be subjected, at times, by the operation of the booster pump in the city.

This pipe line has not been in service for a sufficient length of time to justify a definite statement as to the results obtained from its use, but it is confidently expected that they will compare very favorably with those which would have been obtained from a cast iron pipe installation.

BOOSTER PUMPING PLANT.

The booster pumping plant was designed for use at times of fire only. This unit is installed in a building in the city near the base of the standpipe and consists of a single stage Alberger turbine pump direct connected to a 20-hp., 220-volt, 60-cycle, single-phase Wagner motor. The pump has a capacity of 450 gals. per minute against a head of 100 ft. The standpipe discharges into the distributing system through a 10-in. main, and in this line a 10-in. "Iowa" hydraulic valve was installed. This valve is controlled by a three-way hand-operated control valve located in the pump building, a ¾-in. pipe line extending underground from each end of the hydraulic valve cyclinder to the control valve, and another ¾-in. supply pipe connecting the control valve to the water main on the standpipe side of the main valve, so that the full pressure from the water in the standpipe is available for operating the hydraulic valve.

The booster pump suction line connects into the 10-in. main between the standpipe and the hydraulic valve, and the pump discharge connects into the main on the other side of the valve. A 4-in. gate valve is installed in both the suction and discharge lines of the pump. Under normal conditions these two gate valves are closed and the hydraulic valve is open so that the water from the standpipe passes directly into the distributing mains, but in case of a serious fire these two gate valves are opened; a switch is closed which starts the motor and the lever on the control valve is thrown to the position which closes the hydraulic valve. By this arrangement the water from the standpipe reaches the distributing mains by way of the pump, and the pump pressure is added to the standpipe pressure. By the use of this pump all the water in the standpipe becomes available for use at a pressure sufficient for fire-fighting purposes.

Water Hammer Relieved by Air Chambers on Pipe Line at Woodsfield, Ohio.

Contributed by R. W. Kinney, Superintendent of The Woodsfield Water Company.

The Woodsfield Water Company supplies the town of Woodsfield, O., with water taken from an impounding reservoir holding about 40,000,000 gals. The water flows by gravity direct from the impounding reservoir to the suction basins. From the suction basin the water is pumped by a 14x20x8x18 compound duplex Stilwell-Bierce & Smith-Vaile pumping engine running at 100 ft. of piston travel per minute and using steam at 100 lbs. pressure, through a 10-in. cast iron pipe line approximately two miles long, and against a total lift of 400 ft. This pipe discharges into a concrete and brick distributing reservoir 50 ft. in diameter and 30 ft. deep, holding about 420,000 gals., or 14,000 gals. per each foot of depth.

The 10-in. pipe line from the pumping station to the distributing reservoir passes over five steep summits, and from the time of its installation in 1902 until Sept. 15, 1911, had cost on an average of $15 per month for repairing leaks caused by the lead in the joints being forced out by water hammer.

When the writer first took charge of the system in 1910, he was determined to eliminate this expense. At first, it was thought the pipe line became air bound at the summits, and if the line was relieved of air at these points, further trouble would be avoided. Five air relief valves fitted with seamless copper floats were procured from a valve manufacturing company, with the understanding that if they did not give satisfactory results they would be returned. Connections were made at each summit and the air relief valves were placed in position and watched carefully for six months. The air relief valves gave very poor results, conditions being worse after their installation, and they were removed and returned to the manufacturers.

About one mile of pipe line is laid in the county highway and as the repeated uncovering of the joints for the purpose of recalking made the road almost impassable, the county commissioners instituted suit to compel the water company to remove the pipe line from the highway. It was then determined to place larger air chambers on the pump, but before this was done it was decided to experiment by placing an air chamber on the pipe line at one of the summits. This was done by placing a 10-in. tee, in the pipe line, with the branch pointing upward. A 12-ft. length of cast iron bell and spigot pipe was placed upright in the branch of the tee and leaded and calked. Top or bell end of the upright pipe was plugged and calked, and a ⅝-in. tap made close to the bottom of the upright pipe, a ⅜-in. valve being placed in this tap to relieve the line of any surplus air. This air chamber gave the desired results, as no further leaks were discovered on either slope of this summit, therefore air chambers were placed on the four remaining summits. As two of the summits are in the county highway, the air chambers at these points could not be placed directly over the pipe line but the tees were placed with branch pointing to side of road and a 12-ft. length of pipe was laid horizontally with a shoe elbow on the end. In this elbow the air chamber was placed vertically. All air chambers were provided with ⅜-in. valves at the bottom, and surplus air is blown out once each week.

After the air chambers were installed all leaks were repaired, the work being completed on Sept. 15, 1911, and since that time there has not been any leaks in the pipe line. Previous to installing the air chambers, the jar from the stroke of the pump could be heard for a distance of 100 ft. from any point along the pipe line, but now it is impossible to detect the slighest sound or jar along the line. It is very pleasing to note the results obtained from the installation of the air chambers. The county commissioners have withdrawn their suit, a saving of $15 per month as repairs is effected, and a great deal of water saved. This results in the saving of fuel, labor and wear and tear of machinery.

It will no doubt be interesting to compare the figures given in Table I showing the pumping record for the year 1910, or before the air chambers were installed, and the pumping record for the year 1912 or after the air chambers were installed.

TABLE I.—PUMPING RECORD BEFORE AND AFTER INSTALLATION OF AIR CHAMBERS ON PIPE LINE.

	1910.	1912.
Number of hours pumped....	1,897	1,723
Number of revolutions.......	3,631,208	3,228,369
Average number of revolutions per hour.............	1,914	1,873
Average number of revolutions per minute...........	31.9	31.2
Total number of gallons pumped	50,836,912	45,197,166
Average number of gallons pumped per month.........	4,236,409	3,766,430
Average number of gallons pumped per hour..........	26,798	26,232
Average number of gallons pumped per minute........	446	437
Cu. ft. of gas consumed......	4,418,740	3,935,260
Cost of fuel for the year.....	$662.81	$590.40
Average cost of fuel per month, pumping	55.24	49.20
Average cost of fuel per hour, pumping	0.291	0.343
Average cost of pumping 1,000 gallons	0.0131	0.0131
Average daily consumption, gallons	139,279	123,827
Average hourly consumption, gallons	5,803	5,159
Average number of inches used from reservoir per hr.	4.97	4.42

The Importance of Water Waste Investigations in the Smaller Cities and Towns.

During recent years much space has been given in technical papers to discussions of water waste surveys and prevention. Practically all of the literature on the subject relates to water waste in the larger cities and in considering the enormous waste of water in such cities as Chicago, the importance of waste curtailment in small cities and villages has been very generally overlooked. We here give an abstract of the paper read before the Illinois Water Supply Association by W. D. Gerber, consulting engineer, Chicago, which relates primarily to the water waste problem in the smaller municipalities.

The curtailment of water waste is particularly desirable in cities which secure their water supplies from deep or artesian wells. The continual draft on the wells has lowered the ground water level to such an extent that serious problems are presented in getting the water to the surface. With a less severe demand on such wells we may reasonably expect their life to be materially lengthened.

Those cities which draw their supply from rivers or other surface waters, must of course treat such water to render it suitable for domestic purposes. These treatment plants, besides the treatment tanks and filters, usually have connected therewith large clear water reservoirs for the storage of a considerable quantity of the treated water. The capacity of the treatment plant, including the reservoir, is usually designed upon the consumption, and the consumption is usually taken as a factor of the total daily displacement of the pump plungers. If a large percentage of the pumpage is waste, we can readily see that the works will be designed too large for the immediate needs of the community, and with a consequent expenditure of funds that in many cities can be ill afforded.

In the design, then, of new equipment, and, subsequently, if the station is to be operated on an efficient and economical basis, and the supply conserved, all unnecessary pumping should be eliminated.

The causes of this unnecessary pumping or water waste can usually be grouped under five heads: Pump slip, underground leakage, defective plumbing, carelessness, or willful waste and surreptitious connections.

Pump slip is the difference between the volume of the plunger displacement and the volume of water actually discharged for any given period of time, and is usually expressed in percentage or as the ratio of this difference to the plunger displacement. It is caused either by leakage past the plunger or by defective valve operation in the water chambers, the latter being the more common cause, though badly worn pistons or plungers are common enough.

With pumps of the direct acting or non-flywheel type, there is frequent complaint that the pumps pound, and several arrangements have been supplied to produce more of a cushion at the end of the stroke. This cushioning has the effect of shortening the stroke and of course thus reducing the volume of pumpage. The pump counter, however, goes on counting the number of revolutions, and the daily report card shows so many revolutions at full capacity as the volume of water pumped.

Pump slip is not, properly speaking, a water waste, but is rather a waste of pumping effort, and should be kept as low as is practical. Just where this practical limit is we do not know exactly, but undoubtedly the same limit would not apply to all cities or to all types of pumps. About all we can say is that the practical limit is the point where the value of the water gained through close-fitting plunger and valves would be less than the value of the additional power required to overcome the added friction due to the tight packing. However, an allowable slip of 3 to 5 per cent does not seem to be out of line with good operation and practice.

The detection of underground leakage is a very different matter than that of discovering and measuring pump slip. The distribution mains are covered up and we can only guess at what has taken place by a detail study of the pumping chart. The demand or consumption for a few hours after midnight, say from 12 to 4 o'clock, is frequently indicative of the tightness of the system. At this time of the day the consumption is or should be at its minimum, while if the relative demand is high it is an indication that something is wrong.

There is always some leakage from the mains that cannot be checked, and it is usual to allow a loss of 2,000 gals. per mile of 12-in. pipe, while for sizes other than 12 ins., the allowable loss is taken in the same proportion as the ratio of the diameters. One drop a second is not much of a leakage, and yet one drop a second from every joint in a mile of pipe would amount to approximately 1,400 gals. in 24 hours.

Many men employed in the Water Department of our cities will tell you that wherever there is a leak it will show itself very quickly at the surface. They argue that every leak they have had to repair has been found through the surface indication, hence it is so for every leak. Such men may be surprised to know that leaks discharging from 50 gals. to 2,500,000 gals. per day have been discovered when there was absolutely no surface indication, and the location of such losses was a complete surprise to those most interested.

When the volume of consumption is abnormally high, there is reason to suspect that there are unaccounted for losses, and the best way to satisfy oneself on the matter is to have a water waste survey made.

As an instance of what such a survey may accomplish, I wish to cite the results obtained in a city of some 3,500 people, in which the water works is owned by a private corporation. For some years the pumpage had been excessively large. Repeated appeals to the consumers to be more careful brought no apparent relief, and finally an additional source of supply was developed entailing an expenditure of $10,000. This increased the available amount of water, but the volume of the pumpage in no way diminished, but rather increased. During April and the early part of May of last year the average daily pumpage varied from 680,000 to 700,000 gals. per 24 hours. A water waste survey located a blown-out lead joint in an 8-in. main wasting more than 300,000 gals. per day. This leak occurred under a broken stone-filled roadway, and behind a stone arch bridge at a point where the pipe was 14 ft. below the street surface. The water was finding a ready outlet into the creek. Had this waste been discovered and stopped prior to the development of the new supply, the company would have been $10,000 better off in cash, and would have felt much easier in regard to the adequacy of their supply.

Another instance is a city of 2,000 population. The city operates a motor-driven 400,000-gal. triplex pump. From October, 1911, to June, 1912, it was necessary to operate the pump practically all the time to keep up the pressure, and even at that it seemed impossible to fill a 100-ft. standpipe more than half full. A water waste survey was made and a 4-in. pipe was found cracked squarely in two, permitting a leakage of 200,000 gals. per day, which found a ready outlet in an abandoned 12-in. tile storm water sewer, which crossed directly over the crack about 8 ins. above the water main. There was no indication at the street surface of any such leak, though the pipe was laid but 4 ft. deep, in fact the ground was not wet 2 ft. away from the break. Incidentally I might add that the pump slippage was 25 per cent, leaving a consumption of about 100,00 gals. or 50 gals. per capita per day.

The method of making these surveys was substantially the same in both cases. At a point near the standpipe, an opening was made in the ground down to the main, and a 1-in. corporation tap was placed in the pipe in the usual way. A pitometer, which is a portable recording meter, was set up at this point, and a measurement of the flow during the night when the station was shut down was made. The city was then divided off into a number of districts, and during the day all the valves on the boundary line of the districts were closed, except one, which was left open to supply water to the district. That night after one o'clock this last valve in each district was closed, and the time when the valve went down was recorded. The rule was to begin at the outlying district and work toward the instrument. As each district was closed off from the supply the valves between it and the foregoing district were opened, so that when the night work was finished all the valves would be left open.

A comparison of the time each district was closed down, with the chart from the instrument, disclosed the district in which the loss occurred, for the minute the valve went down, which cut off the leak, the instrument recorded a drop in the rate of flow from the standpipe.

With the location of the loss in any particular district, it is generally a comparatively simple matter to locate the point of leakage by using an Aquaphone on the fire hydrants and sill cocks of the residences. Sometimes, however, the final location of the leakage is not so simple, and it is necessary to make a subdivision of the district, in this way usually the suspected territory may be reduced to a few blocks at the most.

The subdivision of a district into its smallest units is usually the method required when the losses are from defective plumbing, and in addition it is necessary to make a house to house inspection of the entire plumbing in each building. Carelessness in making proper plumbing repairs seems to be more prevalent in cities where the water is sold at a flat rate, the installation of meters having a wholesome effect on this class of consumers.

Carelessness as to fixture waste and willful or deliberate waste are like defective plumbing, confined largely to the systems supplying water at flat rates. The sentiment seems to exist that so long as one is paying so much, what is the use of being careful, "We are entitled to all we can get out of the fixtures." This sentiment really reacts against the consumers, for with everyone in the same frame of mind the system becomes virtually a sieve, and of course the pressure is always low, especially in territory some distance from the pumping station. It all comes home to him in case of fire and no pressure.

Where such conditions exist it is sometimes a tedious task to locate and correct such losses, and the only way it can be done successfully is by a minute subdivision of the district, and night tests in the curb cock, together with daylight inspection of the individual premises. The returns in the value of the water saved usually far exceed the cost of doing the work.

Surreptitious or uncharted connections may occur almost anywhere, though they seem to be more frequent in the manufacturing districts of the larger cities. The making of a connection to a city water main by a private person or corporation is, of course, a deliberate intent to get something for nothing. Very frequently such connections are made from the fire service lines, which are extended into the grounds of the individual or company.

Where a survey indicates that there are surreptitious connections, the only way of definitely locating them is to segregate the suspected plant and measure the total amount of water going into the same. This, together with a very careful inspection of the fire lines and legitimate services, will usually produce a solution of the problem. It is needless to mention, however, that such work must be quietly and carefully done that correct results may be obtained.

It is a very unpleasant charge to make, but nevertheless it is true that in many of our cities and villages no record is kept of the location of the house service, and when the top of the curb box gets broken off or covered up, the service is "lost," and in case of repair or an order to shut off the service much time is lost in looking for the old box. In such cases the exact location of the service pipe can be quickly located by the use of a small electrical instrument called "A wireless pipe finder," and with the line of the service located in the ground, the shut-off box can be quite easily located by the use of a miner's compass, or as it is frequently called, a dip needle.

The latter instrument also comes in quite handy in locating street valves on the mains in unpaved streets where the boxes have been covered up by a road grader in crowning or shaping the surface of the street.

An Old Water Main.—A water main which is believed to have been in use for more than 80 years was recently dug up in Lynchburg, Va. This pipe was badly covered with rust, although another pipe which is known to have been in use for 80 years in the same section of the city is still in good condition.

The Efficacy of the Hypochlorite Process Now Established by Sufficiently Long Observation.

So much has been published in the past few years relative to the value of the hypochlorite treatment of public water supplies, and the published figures showing the results of the application of the treatment have so uniformly shown reduction of typhoid fever in communities using hypochlorite disinfected supplies, that it may surprise some readers to learn that the efficacy of the treatment has at times been questioned by the conservative minded.

In an article written some six months ago, Mr. C. A. Jennings, Superintendent of Water Filtration at the Chicago Stock Yards, quoted typhoid fever statistics and bacterial data from some 20 cities which had been using hypochlorite disinfection for periods of time ranging from a few months to two or three years. Diagrams were presented showing the cessation of typhoid fever epidemics following the introduction of hypochlorite, continued low numbers of cases and deaths, and wonderful bacterial efficiencies.

A criticism which seemed to carry considerable weight was made regarding the data and the conclusions drawn. This was to the effect that hypochlorite treatment had been used for such a comparatively short period of time that it could not be said with certainty that it was wholly or even in part responsible for these reductions. It was argued that other factors should have been taken into consideration before drawing conclusions, and that data should be gathered over a longer period of time. Mr. Jennings realized the force of these arguments and decided to continue gathering data. His conclusions based on later data were given by Mr. Jennings in his recent paper before the Illinois Water Supply Association. The data here given are from his recent paper:

The typhoid fever statistics of both Erie, Pa., and Cleveland, Ohio, have been gathered for several years, previous to the installation of hypochlorite disinfection and from that time to March 1, 1913.

There can be no questioning the fact that the numbers of cases and deaths from typhoid fever in Erie have been exceptionally low since May, 1911, compared with previous years. Hypochlorite disinfection began March 15, 1911. The reduction has not been spasmodic, it has been entirely consistent and regular. The average numbers of cases and deaths from typhoid fever per 100,000 population for the years 1900-1910, inclusive, are 304 and 39, respectively. For the years 1907-1910, inclusive, the average figures are 379 cases and 52 deaths per 100,000. The year 1911, during which the epidemic occurred had 1,567 cases and 197 deaths per 100,000 population. This dropped to 125 cases and 8.6 deaths per 100,000 during the year 1912. This gives Erie a typhoid fever death rate of which it can well be proud. It approaches that of European cities, in spite of the fact that the water supply is drawn from Lake Erie without any treatment other than hypochlorite disinfection. The amount of hypochlorite used averages about 8 lbs. per 1,000,000 gals., or 0.3 P. P. M. available chlorine.

Since the epidemic at Erie, the city has grown considerably. As a result of the approval of the State Board of Health of Pennsylvania, of the hypochlorite disinfection, and the weekly publication of the results of analyses of the water, the citizens began to have faith in the treated water. The number of consumers has increased considerably during the past year.

Excluding the year of the epidemic, 1911, it would appear from the average figures, that presumably 21 lives were saved during the year of 1912. Taking the figure of $5,000 as the value of each life saved from typhoid fever, the total is $105,000 saved in one year due to hypochlorite disinfection. The permanent treatment plant with a chemical and bacteriological laboratory, cost less than $5,000.

Typhoid fever cases and deaths in Cleveland, Ohio, from January, 1907, to February, 1913, inclusive, were shown on a diagram. The diagram showed that during each year there was a marked increase in the cases and deaths reported during the months of August, September and October. It was with the idea of doing away with this annual autumnal epidemic of typhoid fever, that hypochlorite disinfection was begun on September 10, 1911. The curves for cases and deaths rise higher in September, 1911, than during any previous month shown. In spite of this fact, October, 1911, showed fewer cases than October of any previous year, showing how quickly and effectively the hypochlorite disinfection did its work. Furthermore, it can be seen what a wonderful work hypochlorite accomplished during the year 1912. The average numbers of total cases and deaths reported each year, 1901-1910, inclusive, were 792 and 145, respectively. The average figures for the four years, 1907-1910, inclusive, were 535 cases and 80 deaths. During 1911 even including 3½ months during which hypochlorite was used, there were 515 cases and 85 deaths from typhoid fever. Hypochlorite has been used continuously since September 10, 1911. As a result, the total numbers of cases and deaths for 1912 were 258 and 37, respectively, giving Cleveland a typhoid fever death rate of 5.9 per 100,000 population, the lowest of any of the larger American cities. It will be noted that although there was an increase in the number of cases in the autumn of 1912, nevertheless the curves for cases and deaths are considerably lower than during any previous years for the same period. It might be mentioned that the number of cases for February, 1913, namely 19, is abnormal and an investigation is now being conducted to determine the source of this infection.

Although it might be said that following an epidemic of typhoid fever, more stringent regulations to prevent the contraction and spread of the disease, are passed and enforced, nevertheless a larger percentage of the actual cases and deaths are reported because of the attention paid to this matter. Weighing all arguments pro and con, it seems to Mr. Jennings that it is only just that credit should be given to the hypochlorite treatment for accomplishing wonderful reductions in typhoid fever cases and deaths. The diagrams for Erie and Cleveland prove this conclusively. Curves showing similar results from other cities using hypochlorite, make certain the statement that hypochlorite is responsible for these reductions, and that sufficient data have been gathered over a sufficiently long enough period of time to leave no room for doubt on this point.

Practical Methods for Obtaining High Efficiency in Water Works Pumping Plants.

It is becoming more and more apparent, even to those who give the subject only casual consideration, that many of the large industries in this country are not being operated at anything like the efficiency which it is possible to obtain. What is true of the large industries is also true, in much higher degree, of the public utilities of the country. Probably only those who have made a study of particular cases appreciate the tremendous losses of material and the unnecessary labor employed in the operation of some utilities. Mr. Seabury G. Pollard, Consulting Engineer, Cincinnati, Ohio, who has made a special study of water works pumping station operation, read a paper at the recent annual convention of the Illinois Water Supply Association, in which he outlined the practical methods of obtaining high efficiency in the operation of such plants. The matter here given is from Mr. Pollard's paper:

Efficiency and economy are not necessarily the same, although efficiency is essential to economy. Take two pumping engines, one a low duty machine capable of attaining a duty of 50,000,000 ft.-lbs., the other a high duty triple expansion engine capable of performing a duty of 150,000,000 ft.-lbs. Assume that in the first case an operating duty of 40,000,000 is obtained and that in the second case the operating duty is 120,000,000 ft.-lbs. The efficiency of operation based upon standard performance would be exactly the same in both cases, namely 80 per cent. On the other hand, the efficiency based upon energy expended or the economy of operation, would be three times as great in the case of the triple expansion engine. Now assume again that these engines are installed in a station close to a coal mine, where fuel is very cheap. In this case it is probable that on account of the lower cost of the first engine, involving lower fixed charges, it would be a more economical machine for the service than the more costly high duty engine which is three times as efficient.

The problem before the engineer may be that of designing and building an entirely new plant, that of adding to a station already constructed or that of establishing an efficient system of control and operation in an existing institution. When a new plant is to be built, careful consideration should be given to both fixed charges and operating costs. It is also necessary to make a careful study of present and probable future operating conditions. Due regard must be given such matters as the comparative cost of different types of engines, boilers, foundations, buildings, auxiliaries, etc. The cost of labor, fuel and supplies must be considered. The interest rate on loans, the efficiency and durability of the machinery, the load fluctuations, the character of the service, the probability of proper handling and many other things must be taken into account before a rational decision as to what will be the most economical plant can be made. Most of these considerations apply equally well in the choice of additional equipment, although other matters such as the space available, the character of the machinery already installed, the question of permanence of supply, the proposed addition of a water purification plant or the serious depreciation of the present plant, which will necessitate complete reconstruction in the near future and the amount of available funds may have a deciding influence.

As it is the purpose of this paper to deal principally with the subject of efficient operation, matters of construction and changes in equipment will only be touched upon when they are incidental thereto.

Let us consider an ordinary every day pumping station such as is in most of our medium sized cities and in many of our larger ones. The buildings are possibly ornate, possibly extremely plain. They are not always practical. The engine room is fairly well equipped, the bright work and brass bands shine attractively, the floor is fairly clean, not much escaping steam is apparent, there are no cracked steam cylinders, the fly wheel is all there, a few records are kept and the engineer is apparently well satisfied with himself and the world in general. The boiler room is usually unattractive. It may be gloomy, dirty and repulsive. Possibly there is an unsightly junk pile in one corner, a delapidated work bench in another or some broken engine parts under the window. The sanitary arrangements consist of a greasy wash pail and a grimy cupboard. Such conditions are reflected in the employes. The fireman in a listless manner now and then fills the furnaces up with coal. He occasionally cleans the fires and takes out the ashes. Possibly more or less steam is escaping through a blown out joint, the heater may be stopped up, the damper will not work, the coal goes on the fire and "the smoke goes up the chimney just the same." Nobody from the manager down considers for a minute that there exist numerous preventable losses all along the line, which in the aggregate may amount to thousands of dollars annually.

To avoid such losses it is necessary, in the first place, to employ only efficient and intelligent labor. If the plant be a new one, one of the first requirements is the selection of an operating force. In most municipal plants the executive is spared this trouble. The employes are selected for him, either arbitrarily because of their effectiveness in their respective wards and precincts, or through the medium of a civil service board. The first method is bad because the qualifications of the appointees are seldom taken into account. The second is often little better because the examining board is not acquainted with the character of work to be done and is therefor incompetent to judge of the fitness of the men. It does not eliminate political favoritism, and the best qualified men, having no difficulty in getting employment, pay no attention to the examinations. Pre-eminently the person best equipped to select the operating force is the engineering executive. A great deal of course depends upon the proper selection of an executive and mistakes may be made, but if the responsibility is placed squarely upon him and he is held absolutely accountable for the results, he will usually either make good or voluntarily make way for some one else. Not one man should be employed without a careful examination into his qualifications and reliability and no discharges should be made except for just cause. Discipline should be strict and every man should be made to understand, at the time of his employment, that he must do his full duty and that he will be fairly and honorably treated. Confidence on the part of the men in the fairness of the executive is a tremendous incentive toward efficiency.

The next important problem before the water works operator is the fixing of operating standards. Duty trials of engines and efficiency tests of boilers are or should be made shortly after the installation of this equipment. At the time of such tests the machinery is usually under the control of experts employed by the builders and has been "tuned up" to the point of highest efficiency. The test records should be somewhat elaborate so as to cover all of the conditions under which the engines or boilers were operated. The city or water company should be represented by competent engineers who should see that all records are strictly accurate. Gages should at this time be tested and made to record correctly and indicator cards should be taken from the steam cylinders and filed with the records. Tests should, if possible, cover not only performances at full capacity, but at half and three-quarters capacity as well. The test records thus obtained should be carefully preserved in a readily accessible place, and should be adopted as efficiency standards for the future operation of the plant. Written instructions for the every day operation of the various engines and boilers should then be prepared by some competent person and the executive should insist that they be acted upon. The writer believes that in this way efficiencies approaching those of the official tests can be maintained over long periods of time.

If for any reason such efficiency trials have not been made or if the results are not available, a competent engineer may be employed to study the conditions existing in the plant, to make such tests as may be necessary or desirable and to establish efficiency standards and proper methods of handling the plant.

To obtain satisfactory results it is necessary that each and every part of the equipment be maintained at all times in the best possible physical condition. In the first place, everything should be kept scrupulously clean. The operators themselves are not to be excused from this requirement. Dirt is a visible sign of inattention and where there is carelessness in this particular it generally permeates the whole station. The lawn should be well kept and a flower bed or two may be added. A picture or two, preferably of up-to-date water works machinery, hung on the engine room wall, a little paint where needed, a neat desk and chair for the engineer and an occasional word of encouragement all assist materially in increasing efficiency. It pays to provide modern sanitary arrangements, including wash room and bath. It pays to provide a light and well ventilated boiler room and to instruct the fireman in the principles of economical firing.

Having made the plant attractive to the men, the next thing is to see that the machinery is kept at its best. The following conditions which are not uncommon in the engine room have no right to exist:

1. Leaky throttle valves, allowing steam to waste through dead engines. 2. Leaky steam traps, allowing steam to waste continuously. 3. Leaky valves in small piping and bleeder valves carelessly or unnecessarily left open. 4. Steam leaks at pipe joints or from stuffing boxes. 5. Leaks around steam pistons, due to loose or worn rings. 6. Leaky steam or exhaust valves. 7. Leaky shut off valves in steam pipe. 8. Jacket pressures carried too high or improperly regulated. 9. Steam valves improperly set. 10. Poor vacuum due to dirty condensers, air leaks or vacuum pump being out of repair. 11. Excess friction, particularly on pump plungers, because of tight or improper packing. 12. Improper lubrication. 13. Improperly adjusted bearings. 14. Slip and leakage around plungers or through pump valves. This is often the most serious loss in the engine room and in some cases tests have shown it to be as high as 30 per cent and 40 per cent. The principal causes are worn out valves, improper valve springs badly worn plungers or packing, lack of valve area and too high speed. 15. Running engines under throttle when they should be operated under cutoff with throttle wide open. 16. Operating duplex pumps short stroke.

Sometimes there are structural defects which can be remedied at comparatively little cost. Such often cause serious losses. Hot water drainage goes to waste when it should be returned to the boilers. Oil is wasted because there is no means for recovering or filtering it. Steam cylinders, steam and hot water pipes are bare or the covering is of poor quality or insufficient thickness. There is a troublesome air pocket in the suction or an unnecessarily large supply pipe has been taken off the discharge main close to the pumps for feeding a railroad tank or street flusher. Air chambers are of insufficient capacity or improperly located, water hammer and imperfect filling of the pumps results Suction pipes have numerous short bends or are laid without regard to grade. Possibly there is a whirlpool at the end of the suction pipe carrying air into the pumps. Perhaps the fly wheel "works loose" and frequent stops are made to drive the key. Why should these things be?

It is probably true that in the average plant the boiler room losses outweigh all others, the principal one being due to improper or unintelligent firing. In some cases the construction of the boiler plant is so defective that even with good firing satisfactory results can not be obtained. Very often the whole boiler plant has suffered from lack of care and things have gone to the bad to such an extent that efficient results can not be expected.

Boiler plants are occasionally constructed in a most haphazard and unscientific fashion. Stacks are too small or too low. Smoke connections are inadequate. The baffling is defective. The grate surface is too small to burn the coal properly. The heating surface is insufficient. The furnace may not be of suitable design for the fuel used. Usually air leaks into the setting through cracks or badly fitting doors.

When the upkeep of the plant is negelected there may be leaky rivets, joints and tube ends, leaky steam traps, leaks around water columns, at nozzles and safety valves, leaks through apparently closed valves into boilers not in use, leaks everywhere and in the most unexpected places. The feed pipe leaks, there are heavy deposits of soot on fire surfaces and scale on inside water surfaces, the blow offs leak, the feed pump is out of order and the tubes in the heater are stopped up.

To return to the matter of firing. Professor Kent says:

> There are some kinds of firing, practiced by ignorant or negligent firemen, which any one who knows anything of the subject can say at once are wrong. Among these are: (1) Putting a large quantity of coal in the furnace at a time, covering the bed so thick that the air supply is choked, and incomplete combustion necessarily takes place. (2) Firing at irregular intervals and occasionally allowing the bed of coal to burn so low that a great excess of air passes through it. (3) Neglecting to cover the whole of the grate surface, and allowing holes to form in the bed of coal.
>
> There are other errors of firing which are not evident on ordinary inspection, which may be practiced by the most careful and intelligent firemen without any suspicion that they are wrong, and which can only be discovered by making a series of boiler tests or by an analysis of the chimney gases. Such errors are the carrying of a bed of coal either too thick or too thin for the size of coal and force of draft, and unskilled regulation of the draft.

The rational way to correct the errors just mentioned, permanently, is to make the necessary tests and analyses, correct the defects and standardize the conditions of operation. Automatic feed water regulators, recording gages, draft gages, flue gas thermometers, CO_2 recorders, Orsat apparatus, gage testers, indicators and the like are very useful and are necessary in making scientific investigations. With one or two exceptions such apparatus unless in competent and experienced hands will do little good.

The principal furnace loss is that due to too much air, furnace temperatures being thereby reduced, and 15 per cent to 25 per cent of the heat of the fuel may in this way be unnecessarily discharged with the stack gases Insufficient air supply is not uncommon. It is mainly due to defective draft and overcrowding the boilers. With irregular firing there are usually periods of insufficient air supply followed by periods of excess air with losses both ways.

By all means the best method of increasing boiler efficiencies is the installation of automatic mechanical stokers. They eliminate to a very large extent the personal element and thus insure more uniform operation. The cost is about $5 per horse power and even in comparatively small plants the saving in fuel will pay a handsome profit on the investment Even with stokers the operation should be in accordance with carefully determined methods and not guess work. Before leaving the subject of boiler operation, attention should be called to the fact that steam pressures should not vary and that the water level in the boilers should not be carried too high. The first causes loss of both boiler and engine efficiencies, while the latter produces wet steam, reduces efficiency and sometimes endangers the engine.

As far as possible, supplies should be standardized. Experience and study will determine the character of those best suited for each particular service. Specifications are desirable, but they should be very definite. It is not ordinarily necessary to purchase the highest priced goods, but exceptionally low prices should usually be viewed with suspicion. Contracts for coal should be made on a heat unit basis.

The care and use of supplies should be as carefully controlled as is their purchase. Suitable store rooms and cupboards painted throughout should be provided. There should be a definite place for everything and it should be kept there. Incoming stores should be carefully inspected and checked with the order and invoice. Outgoing stores should be measured or weighed. Standard quantities of waste, oil, etc., for a day's use may be determined and the stores issued accordingly. A complete running inventory covering everything in the store room is not difficult to keep.

Many things will suggest themselves to the economically inclined engineer. An oiling system in place of the hand regulated cups will save 50 per cent to 75 per cent of the engine oil, reduce the labor of cleaning 50 per cent and eliminate hot journals altogether. A little piping, an oil separator and a filter may save 30 per cent of the cylinder oil. Proper tools conveniently kept help to keep down the repair account.

Having selected a competent force of men, having remedied the structural defects and put everything in good repair, having determined the highest attainable efficiences and conditions incident thereto and having prepared definite instructions for plant operation and put them in force, it is still necessary that accurate and detailed records be kept. Records are the connecting link between standards and actual practice and indicate at once the cause of reduced efficiency.

All steam, water, vacuum, receiver, jacket and other gages, engine counters, floats, etc., should be read, not guessed at, at frequent intervals, and the readings should be entered in a properly ruled book. They should also be recorded upon loose leaf report sheets for the superintendent. Automatic records from recording instruments should accompany the report. All coal and ash should be weighed and a record kept thereof. The duty of engines should be frequently calculated and any falling off be investigated and corrected.

Cost records should be kept at the main office. They should take into account not only cash expenditures, but the actual cost of maintaining the plant for definite periods of time, which is an entirely different matter. The records should carry enough detail to enable the superintendent to determine at once any variation from standards or unusual expense in the upkeep of any part of the machinery.

It is probaible that the water works operator may consider the suggestions made in this paper as impractical, or that they will add to engineering and administrative expense or increase labor. The writer has proven many of them to be eminently practical, and that their adoption materially reduces cost of operation. Less labor is involved with intelligent, efficient operation than with careless, inefficient operation. There is less coal to be shoveled, less ash to be carted away, less oil to handle, less damage to machinery, less repair work to be done, less new machinery to be bought. The only increase involved is that of brain energy, the proper exercise of which makes better executives and better operatives.

BRIDGES

Method and Unit Costs of Constructing Piers and Abutments for a High Steel Viaduct for the Fort Dodge, Des Moines & Southern (Electric) Ry.

Contributed by C. J. Steigleder, Assistant Engineer.

Two and one-half miles north of Boone, Ia., the Ft. Dodge, Des Moines & Southern R. R. parallels the Des Moines River, running along the sides of the high bluffs on the east. These bluffs rise about 300 ft. above the river and are cut by a series of deep ravines. The line alternately cuts through a bluff and spans a ravine. There are five ravines in the course of a mile and all are spanned with wooden trestle bridges, the heights of which range from 40 to 156 ft. and the lengths from 200 to 800 ft.

These bridges were built in 1903 and for the safety of operation and permanent improvement, it was considered wise to fill the smaller ones and to replace the largest with a steel viaduct, the largest trestle being 800 ft. long and 156 ft. high (Figs. 1 and 4). It is supported on oak piling and built up of frame bents of 12x12-in. posts and 12x12-in. caps. It is well braced with 6x8-in. struts and sways and contains a total of 860,330 ft. B. M. of timber, 5,968 lin. ft. of piling and 22.4 tons of iron.

The new bridge is a steel deck plate girder viaduct, 784 ft. long and 156 ft. high, with spans of 32 and 80 ft., designed and erected by the American Bridge Co. of New York, W. M. Hughes of Chicago being the Consulting Engineer. Owing to the two-hour train service, it was necessary to consider what delays the steel erection might cause. After several preliminary surveys were made to determine the amount of grading necessary, it was decided to locate the new structure 14 ft. off center from the old and upon the uphill side of the track, thereby leaving the old bridge open for traffic. Considering alinement, this gave a 5° 15′ curve instead of a 5° curve, just off the south end of the bridge and straightened a 2° 30′ reverse curve on the north end. The 32 and 80-ft. spans were adopted in order that the towers of the steel bridge would come between the bents of the wooden structure, which bents were spaced 16 ft. c. to c.

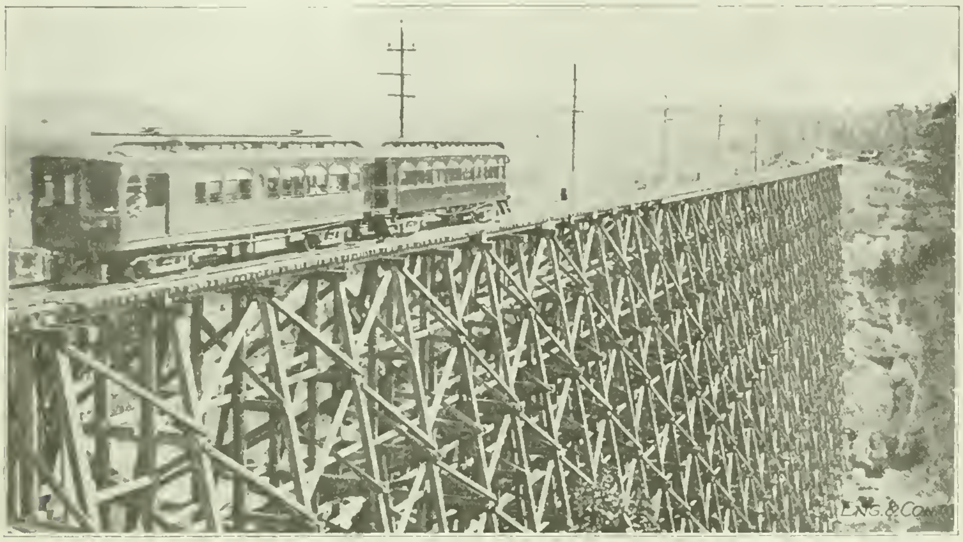


Fig. 1—View of Original Timber Trestle 800 ft. Long and 156 ft. High, Ft. Dodge, Des Moines & Southern R. R.

The nature of the ground at the side of the bridge is complex, being composed of several formations ranging from a soft yellow and blue clay to rock. At the bottom of the ravine and in the bed of the stream, it is large, loose boulders and gravel. Beneath this is a blue-joint clay such as is commonly found over coal measures. The yellow clay being the upper formation, when dry is very hard, but when water is present it becomes very slippery. Evidences of slip can be seen in several places on the hillside.

It was first deemed necessary to drive piling in the footings of the abutments and piers, with the exception of those piers at the bottom of the ravine. However, upon excavating at the pier site, it was found that by going deeper with the foundation, good bearing could be obtained without driving piles. This was done and the excess concrete used over the original plans only amounted to 211 cu. yds. The piers, with one or two exceptions, were designed with a footing 10x10-ft. square by 3 ft. deep, and with a pedestal 4 ft. square at the top, 7 ft. high, and a batter of 2 ins. to the foot on the sides. For the majority of the piers, this gave a bearing area of 100 sq. ft. The safe bearing on hard clay is from 4 to 6 tons per square foot, thus giving an allowable pressure of from 400 to 600 tons per pier. The largest pier placed was No. 9 east, having a footing of 12x12x7 ft. and a pedestal of 11 ft., the total weight being approximately 90 tons.

The forms for the pedestals were made of 2x8-in. lumber, dressed on one side, and were built in four sections, each section forming one side of the pedestal. Two sections were cut to the exact dimensions of the pier, while the others were made to overlap the inside section, giving room enough for a 2x4-in. stop. For the upright studding 2x4-in pieces were used, one placed in the middle of the form section and one at each edge. Where larger forms than 7 ft. were used, they were wired across the inside to prevent bulging. Strap bolts were screwed onto the inside section of the form, corresponding holes were bored in the outside section and hand-nuts were used to keep the forms together. Quarter round molding was placed in the inside corners and the cracks were battened with lath on the outside. Six forms were used on the work, four 7-ft. and two 9-ft. forms. Where forms of other heights were needed, they were made by splicing on or cutting off from the ones already made. Fig. No. 2 shows the details of the forms.

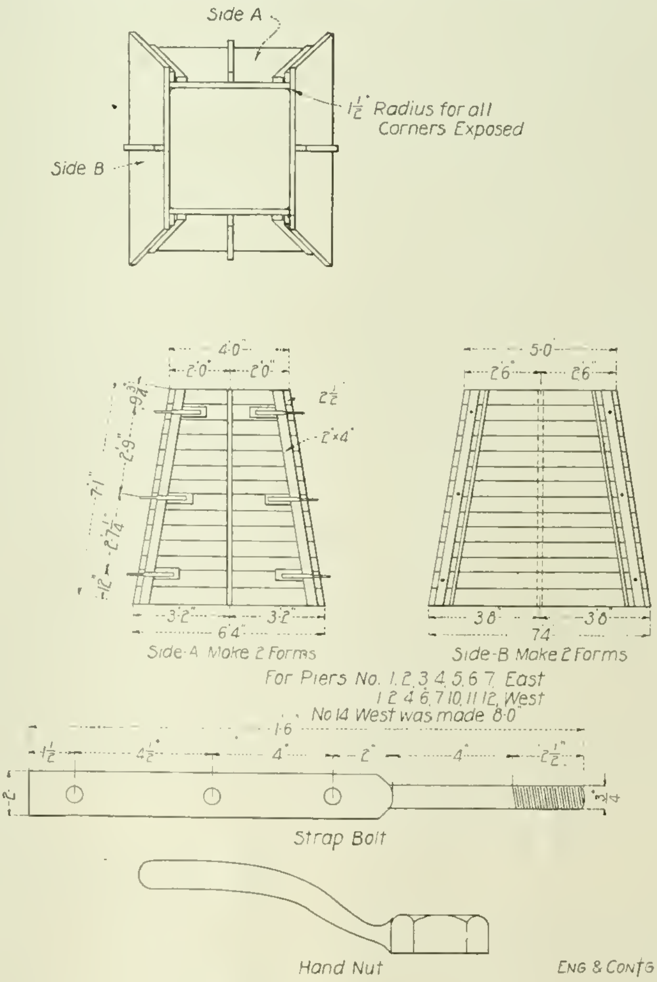


Fig. 2—Details of Pier Forms for Steel Viaduct, Ft. Dodge, Des Moines & Southern R. R.

Specifications called for a concrete mixture of 1:3:6, except for the coping course. The coping course was considered the top foot of the pedestal and was made of 1:2:4 concrete. The stone used with the 1:3:6 measure was from 1 to 2 ins. in the largest dimensions, and for the 1:2:4 mixture not more than 1 in. in the largest dimensions. All stone was screened, no crusher run being used. The stone was secured from Green & Son of Stone City, and was a good grade of limestone rock. The sand used was taken from the Des Moines River, about five miles above the site of the bridge. Hawkeye brand cement was used, and water was secured from a creek in the ravine. A 7-h.p. gasoline pump was used to force the water up the hill into storage barrels at the mixer.

The interesting feature of this work was the manner of placing the concrete. The mixing was done with a Ransom mixer, propelled by a 6-H.P. Stover engine, the engine and mixer both being mounted on the same frame. Owing to the steep slope of the hill, it was impracticable to move the mixer down the slope, or to wheel the concrete to place. The most efficient way was to spout it and this was the method used. One-half of the piers were poured from the north end of the bridge and the other half from the south. The mixer was mounted on blocks and a platform built up around it so that the hopper was above the platform, just about the height of a wheelbarrow. The chute used to convey the concrete was made of No. 23 sheet steel, circular in form, 10 ins. in diameter, and in lengths of 10 and 12 ft. The pipe was attached to a small wooden chute at the end of the hopper, and from here run to any desired point. It was supported at joints by wooden cross-frames, or by brackets tacked to the batter posts on the bridge. At the end of the pipe, a curved connection was used to turn the concrete down into the forms.

This type of spouting proved very satisfactory where the distance was not greater than 250 ft., nor the grade less than 24° with the horizontal (about 1 ft. vertical to 2.3 ft. hori-

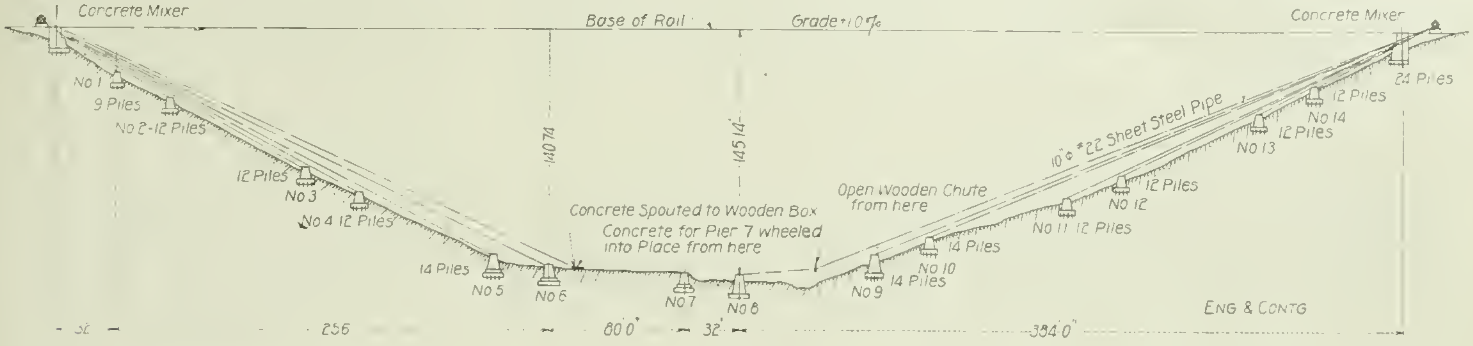


Fig. 3—Diagram Showing Arrangement of Chutes for Concreting Viaduct Piers, Ft. Dodge, Des Moines & Southern R. R.

zontal). When on a less grade than this, the concrete clogged in the pipe and caused considerable trouble. Should it clog so that any amount of weight would come between supports, the pipe will buckle and break, making it worthless for use again. A better type would be one made of similar material, 10 or 12 ins. wide, 16 or 18 ins. deep, open at the top and a small angle iron running along each edge. Occasional spacer angles could be used to stiffen it. This pipe would be easy to handle and it would give access to the concrete that was flowing in it. Another good type of spouting for this kind of work would be a built-up wooden chute in 12 or 16-ft. sections, lined with sheet iron. The advantage of this chute would be the saving on the investment, i. e., after the job was completed, the lumber could be used for some other purpose. Figure 3 shows the location of the concrete mixer and how the piping was carried to the piers.

The concrete gang was composed of 12 men and a foreman; 2 were used in spading the concrete as it was placed, 1 on water and dumping cement, 1 taking care of the mixer, 6 on sand and rock, and 2 carpenters. As far as possible, the concreting on a footing or pedestal was continuous, and only in one or two cases were joints made in either. From four to six footings were run at a time. As soon as the first two of these footings had set, the forms for the pedestal were placed and securely braced. After being braced, the templete for the anchor bolts was centered and tacked to the top of the pier form. The anchor bolts were then placed in the template, plumbed and wired to the form.

The total amount of concrete in the foundation was 932 cu. yds. The time required to place this amount was 40 days. The unit costs of concrete and of excavation were as follows:

EXCAVATION.

	Per cu. yd.
In cut, steam shovels	$0.22
In cut, teams	0.35
For foundations	0.48

Unit Costs for 1 cu. yd. of Concrete.

Cement	$1.16
Rock	0.93
Sand	0.80
Water	0.014
Lumber	0.40
Pipe for spouting	0.25
Train service	0.19
Labor	1.65
Incidentals	0.05
Total	$5.44

The interesting feature in the design of the steel bridge is the number of duplications in the pieces. This was not only true in regard to the spans, but also in regard to the towers. There are six 80-ft. girders, seven 32, one 48-ft. girder on the south, and a 32-ft. girder on the north. The 48 and 32-ft. girders were riveted complete in the shop. The top sections of the bents, five to ten, inclusive, were all made the same, the difference in height of the bent being made on the bottom section.

The cut at the north end of the bridge was excavated with a steam shovel, and about 300 ft. of track was laid on the new alinement. This track was used for unloading the steel and by the derrick car during erection, also to clear the main line for traffic. The erection was started at the north end and carried through to the south. The first 32-ft. span and the first bent of tower No. 1 were erected by the derrick car. The rest of the towers were erected with a locomotive which worked from the old bridge. The tower was first erected and then the girders placed, the ties and rail being laid as the work progressed. The material for the towers was first lowered by the derrick car and then picked up by the crane and brought into place. After a tower was completed, the derrick with a 40-ft. boom placed the 8-ft. girders. These girders weighed approximately 16 tons, but no special apparatus was needed to place them, as the boom on the derrick car was kept straight ahead. Fig. 4 shows derrick car placing an 80-ft. girder on the third span.

No difficulty was experienced in keeping the line open for traffic. All regular trains were cleared ten minutes and in case of extra trains the foreman on the work was notified of their approach by the dispatcher. In order to protect the locomotive crane from the 1,200 volts on the trolley wire, a breaker was put in on the wire and the current was cut off while the crane was working.

The only trouble that was encountered during the erection of the steel was the interference of the bracing of the wooden bridge with the columns or braces on the towers. At the expense of the railroad company the carpenter gang of six men and a foreman were kept busy cutting away the old bridge. The sway braces and struts that were cut were not replaced. When it was necessary to move a post, the cap was jacked up and the post cut and then moved and blocked into place.

The new deck was constructed of 8x8-in. x 10-ft. yellow pine ties, S1S, and sized to 7½ ins. Hook bolts were placed on every other tie and the rails spiked to all ties. The guard rail is 6x8 ins. and is dapped 1 in. over the tie. Three steel guard rails were placed inside the track; the third rail being placed in the center of the track provides an extra precaution should a motor casing drop as the car is crossing the bridge.

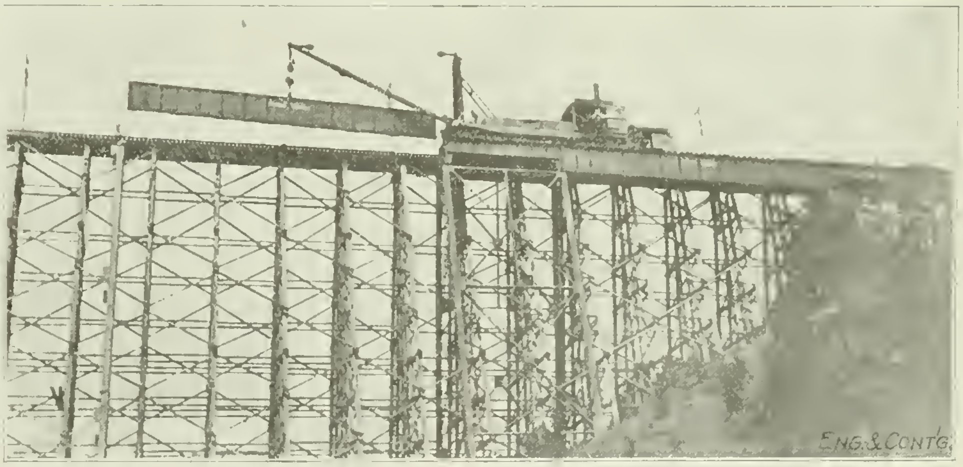


Fig. 4—View Showing Derrick Car Placing 80-ft. Girder, Ft. Dodge, Des Moines & Southern R. R.

The riveting was done with compressed air, the power for the compressor being supplied part of the time by the engine on the derrick car and the rest of the time by a gas engine. From 12 to 18 men were used during erection, and from 10 to 12 during riveting. The entire bridge was erected before the riveting was started. From three to four gangs were used to drive the rivets, the greatest number driven in one day being 1,020, with three gangs working. The time required to unload the steel and erect the bridge complete—this includes placing the ties and rail—was 95 days.

The contract for the foundation was let to A. W. Merrick of Boone, Ia. The excavation was done by the railroad company. The painting was included in the contract for the erection. The old bridge is to be wrecked, the contract for which has not been let. The best of this timber will be milled and then disposed of, while some of it will be used in repairs to other bridges.

Method of Constructing a Vertical Lift Draw Bridge; Economic Comparison of Vertical Lift and Swing Spans.

A cost comparison of swing and vertical lift draw spans is given in a paper before the American Railway Engineering Association by Mr. C. E. Smith, Bridge Engineer, Missouri Pacific Ry. The bridge crosses the St. Francis River near Marianna, Ark. As all but the draw spans could most economically be constructed of deck girders, investigation showed that a considerable saving could be effected by using a single span vertical lift for the opening span.

The cost figures that led to the adoption of the vertical lift span are as follows:

VERTICAL LIFT BRIDGE.

1 162-ft. through riveted truss	$ 20,000
Towers	5,000
All apparatus for raising, including counterweights	15,000
2 rest piers	50,000

12 75-ft. deck-plate approach spans......	24,000
12 deck girder rest piers..................	84,000
Trestle approach	2,000
Grand total for Vertical Lift Bridge...	$200,000
SWING BRIDGE.	
1 350-ft. swing drawspan..................	$ 38,000
Operator's house and machinery.........	17,000
1 swing draw pivot pier..................	31,000
2 draw rest piers........................	42,000
10 75-ft. deck-plate girder spans.........	20,000
10 deck girder rest piers..................	70,000
Trestle approach	2,000
Grand total for Swing Bridge..........	$220,000

(Both of above estimates include transportation at full tariff rates.)

The St. Francis River does not have a swift current, the channel changes very little, nor is there much scour of the river bed, which is composed of sand and gravel overlying blue clay. These conditions caused the decision to use pile foundations, penetration of 35 ft. to 40 ft. being secured below the bottom of the footings by the aid of two 2-in. water jets.

Steel sheet piles were used for the cofferdams of two piers, but considerable difficulty was experienced in pumping them out. Timber cribs were used for all the remaining piers. These cribs were framed on shore or barges, launched and lowered into place. When in place they were built up to the desired height and platforms built on top of them for loading purposes. The excavations within the cribs were made by clam shell or orange peel dredges, the weight for sinking the cribs being provided by dumping excavated material onto the loading platforms. The excavation was usually carried two or three feet below the desired bottom of footing before pile driving commenced.

Piles were then driven to the required depth, the piles having been purchased long enough so that at low water stages it was not necessary to follow them through the water, the required penetration being obtained by driving the piles down until their tops reached the water surface. The practical refusal of the pile to go down under further driving, however, and not an arbitrary depth of penetration, was the condition that had to be met. When it was considered desirable to drive piles during any high stage of the water they were started down without jetting and penetrations of 20 ft. to 30 ft. were secured with a No. 2 Vulcan steam hammer. When the piles refused to go further or the tops reached the water surface they were left to be followed down later. A second driver equipped with a follower and two 2-in. water jets then drove the piles further, usually sending the tops 10 ft. or 15 ft. under water until the desired penetration was secured.

On account of the porous nature of the river bed no attempt was made to pump out any cofferdams until concrete was placed. Immediately upon the completion of the driving the sand that had been brought up by the jets was removed down to the required depth by a water ejector (known on the work as a "sand sucker"). The sealing course of 1:2:3 concrete was then placed through a 10-in. steel pipe tremie, which was very carefully and thoroughly moved around among the pile heads, the concrete being placed from three to five feet deep. When this concrete had set four or five days the cofferdam was pumped out, piles cut off, and pier completed. All concrete placed under water was placed very wet.

At a few piers in the deep water the defective construction of the cofferdams made it impossible to pump them out. They were constructed of 10x10-in. gum timbers, laid horizontally, breaking joints, lapped at the corners and each course drifted to the course below by ¾-in. round drift bolts every three feet. The timber was not surfaced and the openings were stopped by driving shingles between the timbers. It would have been preferable to have sheeted the cofferdams, but had the calking with shingles been well done very little trouble would have been experienced. Hot weather, accompanied by frequent heavy rains, in a construction camp in the lowlands of Arkansas, with its accompanying illness, is not conducive to man's best efforts, however, and consequently the cofferdams were not built as well as they could have been built.

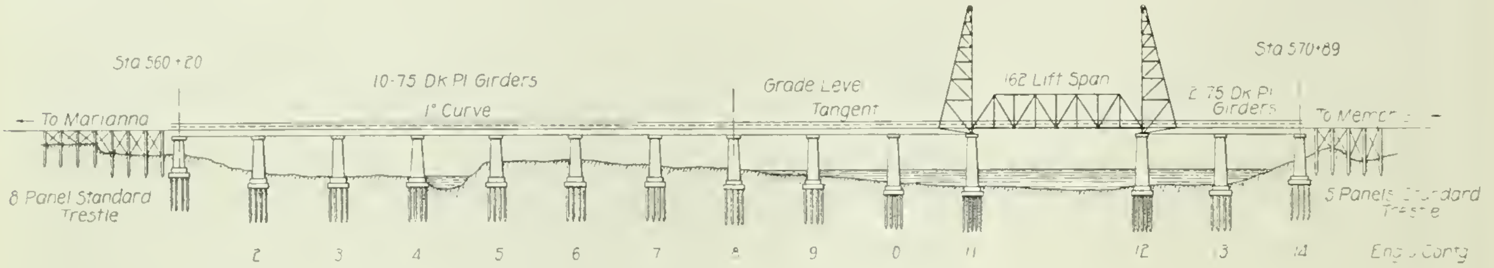
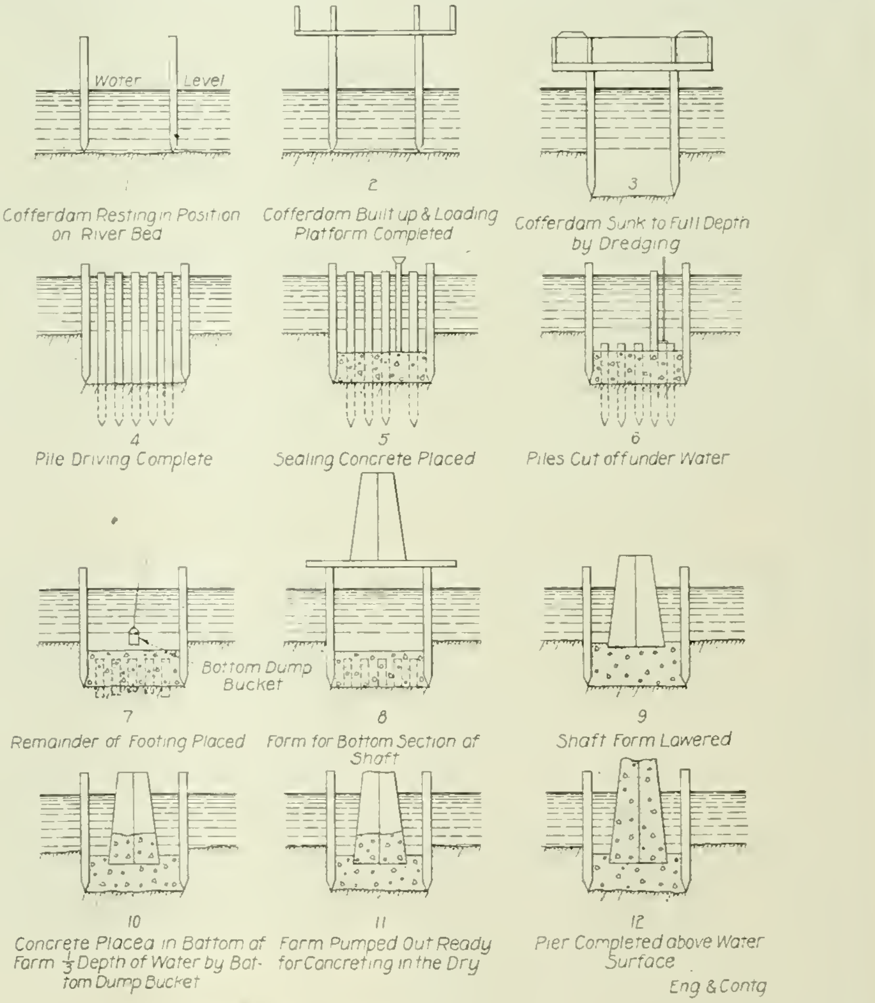


Fig. 1—Diagram Elevation of St. Francis River Bridge With Vertical Lift Draw Span.

Where a cofferdam could not be pumped out after the sealing concrete had been placed it was decided to cut off the pile heads close to the top of the sealing course by means of a circular saw operated by a vertical shaft, place the remainder of the footing course under water by means of a bottom dump bucket and, if considered advisable, make a further effort to pump out the crib. If this second attempt were not successful or not attempted, special form for the lower section of the pier shaft was constructed for lowering down onto the footing. In one case this special form was built out on the river bank, floated out to the cofferdam when water was several feet over its top and lowered onto the top of the footing course. In another case the form was built on supports resting on top of the crib and was lowered by block and falls. Efforts were made to lower this form before the concrete in the footing course had set. When the form rested on the footing about 12 ins. of concrete was placed through a tremie between the outside of the form and the inside of the cofferdam to prevent cement from running out of the concrete to be placed in the forms. Several feet of concrete was then placed within the form by a bottom dump bucket, and allowed to set, after which the form was pumped out and the construction of the pier proceeded with.



1 Cofferdam Resting in Position on River Bed
2 Cofferdam Built up & Loading Platform Completed
3 Cofferdam Sunk to Full Depth by Dredging
4 Pile Driving Complete
5 Sealing Concrete Placed
6 Piles Cut off under Water
7 Remainder of Footing Placed
8 Form for Bottom Section of Shaft
9 Shaft Form Lowered
10 Concrete Placed in Bottom of Form ⅓ Depth of Water by Bottom Dump Bucket
11 Form Pumped Out Ready for Concreting in the Dry
12 Pier Completed above Water Surface

Fig. 2—Sketches Showing Sequence of Operations in Constructing Piers for St. Francis River Bridge.

Before placing new concrete on former concrete placed under water, the laitance, sediment and other accumulated material was washed from the top of the lower concrete and removed by the sand sucker. Sometimes an entire day would be spent in this cleaning process, especially when pile heads projected above the concrete; the cleaning was continued until the sounding rod showed hard concrete over the entire area.

The water level in the St. Francis River at the point of crossing is greatly affected by the stage of the Mississippi River; the level changed so often that the work was greatly delayed.

At the time the contract for the substructure was let the water in the river was very low and no track had been laid. On account of the low stage of the river which gave only 8 ins. to 10 ins. depth of water over a number of long bars it was practically impossible to get the plant to the bridge by boat, so it was hauled ten miles from the nearest railroad station through swamps that could be hauled over only in dry periods. Frequent rains rendered such roads as were these impassable and seriously delayed the assembling of the contractor's plant and camp equipment. Cofferdam lumber and lumber for barges was brought from mills on the river and floated to the bridge. By constant dredging and dragging some of the bars it was possible to handle a small amount of material from a point on a railroad about forty miles up the river. There were plenty of good foundation piles standing in the swamps near the location of the bridge, but the prices asked for them were so high that it was more economical to purchase them elsewhere. They were shipped to the unloading point up the river, unloaded into the river there and floated down. The difficulty in getting plant and material to the bridge seriously delayed the commencement of the work. When track reached the bridge practically the entire plant, cofferdam material and piling had been delivered at the bridge and work was well under way. The principal aid given by the track was in the delivery of cement and gravel and form materials.

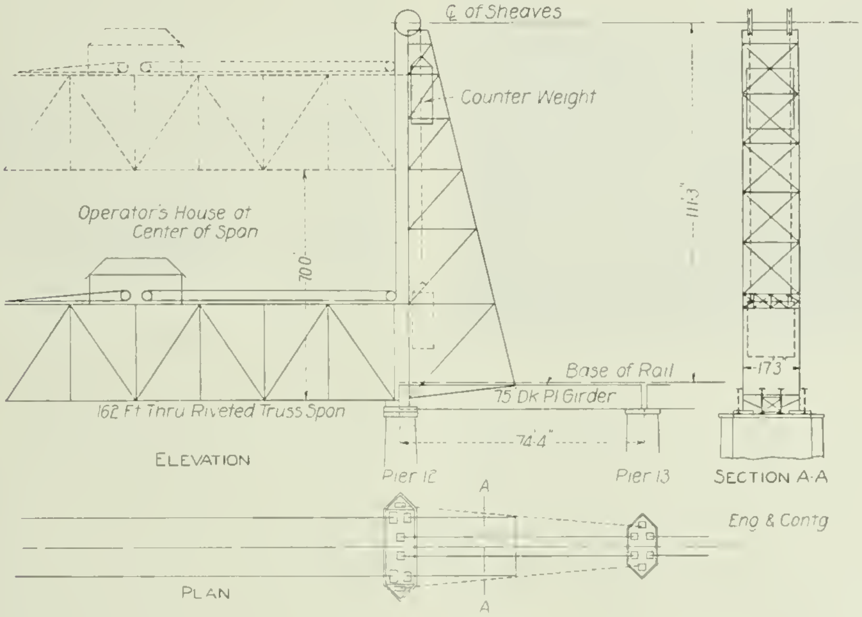


Fig. 3—Sketch Showing Arrangement of Towers, Counterweights and Lifting Mechanism of St. Francis River Bridge Lift Span.

Extreme low water stage was never reached during the construction of the bridge. The lowest water was experienced during the commencement of the work, when it was impossible to take advantage of it on account of insufficient plant and materials. It was also during the hot months, and there were frequent rains, which made it difficult to secure sufficient men.

Track reached the bridge at the beginning of cool weather, but there followed a spell of high water that stopped the work. Then came a spell of comparatively low water, during which a great deal of work was done, and then came the beginning of the spring flood of 1912 that has caused such unprecedented damage in the lower Mississippi Valley, the latter flood effectually stopping all work at the bridge for several months.

When the letter of invitation for the substructure work was being prepared it was realized that it would be impossible for any contractor to estimate the cost of transportation before track reached the bridge; consequently the cost of transporting materials and equipment to the bridge was placed on a force account basis. The remainder of the foundation work was on a unit price basis. This method of payment proved entirely satisfactory to all concerned.

It is the intention to place the approach girders with a derrick car without falsework. For the lift span, pile bents will be driven, and frame bents placed on top of them. This span will be riveted up complete as a simple span and the falsework removed before proceeding with the erection of the towers. The end from which the erection of the lift span and towers will be handled depends somewhat on the progress of track laying east of the bridge, which has been delayed on account of excessive rains. If track reaches the bridge in time erection will commence from the east end and boats will be required to pass between piers 9 and 10 while the channel is blocked, a temporary channel being dredged if necessary. If erection commences from the west end the span between piers 9 and 10 will be installed as a temporary lift span and provided with towers and counterweights. The contract for erection includes a fixed sum (about $350) for installing and dismantling the temporary lifting apparatus and a unit price (about $5) to be paid the contractor for each opening of the temporary lift span to permit boats to pass.

When the great spring flood of 1912 started there was about thirty days' work required to bring all the piers above ordinary water level, after which they could have been brought up as the water rose. On this basis the erection contractor was instructed to have his equipment at the bridge during February; it arrived the same day the rise started and after he unloaded the steelwork he was permitted to ship his equipment away.

If the stage of water during erection is such that large boats and tows use the river it will be necessary to make special arrangements to get them through the narrow opening of approximately 55 ft. clear width between piers 9 and 10. This width is sufficient to permit any single boat to pass through, but will not accommodate them when lashed abreast. It is proposed to assist boats with tows by the use of the tow boat formerly used for transporting materials to the bridge. When tows arrive the barges will be taken through the openings singly and anchored on the other side, after which the steamer will pass through, pick up the barges and proceed.

The twelve 75-ft. deck plate girder spans weigh about 450 tons. The lift span is a 162-ft. single track through riveted truss span, practically a duplicate of a simple span used in another bridge, slight alterations having been made to provide for the necessary attachments. The alterations to the former plans and the details of the towers and lifting mechanism were worked out by Waddell and Harrington, Consulting Engineers of Kansas City, who control the patents of the type of lift bridge used at this point. The lift span with all attachments for machinery comprised 250 tons of structural steel, the towers 140 tons, counterweight frames 10 tons, machinery 40 tons, and 7 tons of cables. The span will be operated by a 25-h. p. gasoline engine. Total lift, 70 ft.

Prior to the design of this bridge it was the practice to attach the tail legs of the lifting towers to masonry or to the hips of adjoining truss spans. In order to avoid the extra expense of additional supports or of approach truss spans that would otherwise have been necessary, it was decided to support the tail legs of the towers on cantilever brackets extending out from the approach girders. The load from the vertical tower legs, the counterweight and the lift span are transmitted directly into the main pier; the load that comes on the cantilever brackets consists of a portion of the weight of the tail legs and bracing and some load from wind pressure and vibration. Should the vibration of the towers on account of the deflection of the approach girder spans under traffic prove excessive or objectionable extra deck girders can be installed to afford additional support for the tail legs.

The entire bridge was designed for Cooper's E-50 loading according to Missouri Pacific specifications, which conform with those of the American Railway Engineering Association.

The foundation work was done by the Kansas City Bridge Company of Kansas City and the fabrication and erection by the Virginia Bridge & Iron Company of Roanoke, Virginia, and Memphis, Tennessee.

Methods of Constructing the Georgetown Bridge Over the Wabash River for Cass County, Indiana.

(STAFF ARTICLE.)

An example of rapid and economical methods of reinforced concrete bridge construction is presented by the construction of the Georgetown Bridge over the Wabash River in Cass County, Indiana. The Georgetown Bridge is 808 ft. long, with a 16-ft. roadway, and has seven arch spans varying from 90 ft. for the end spans to 120 ft. for the center span; the intermediate spans being 100 and 110 ft. The piers are founded in rock and are of uniform length; their widths vary from 5 ft. 6 ins. to 7 ft. 9 ins., according to the requirements of the spans. The railing is composed of spindles made in cast iron molds, then set in place and secured by the top rail, which was poured in place. The bridge was designed by the National Bridge Co. of Indianapolis, and the Luten design of reinforcement was used. The contract was let on June 27, 1912, and the bridge was completed and accepted on Dec. 18, 1912. The contract price was $37,850.

The site of the bridge is 9 miles from Logansport and 2½ miles from Kenneth, which is the nearest shipping point. The cement, steel and lumber were hauled from Kenneth in ordinary farm wagons and the gravel was hauled from a pit 2 miles distant in Studebaker gravel wagons.

The removal of an old wooden structure at the site of the new bridge had been accomplished by the ice during the previous winter, but the old stone piers remained. They were in line with the structure, but generally did not occupy the sites of the new piers and their removal was required at the beginning of the work only to make a clearance for the arch forms and falsework.

A temporary trestle was erected parallel to the site and at an elevation about 15 ft. above water. This trestle carried a narrow-gage track upon which Koppel cars were used to carry forward lumber and concrete to build the piers up to the springing line of the arches.

The water was about 2 ft. deep and the excavation was also only about 2 ft. deep to rock. Small cofferdams were made of two lines of sheeting 12 ins. apart, filled in between with clay. Some of the stone from the old piers was deposted in the footings with the concrete after the rock had been excavated sufficiently to form an anchorage for the piers.

View of Georgetown Bridge Showing Construction Service Trestles.

The forms for the arches rested on a falsework consisting of pile bents, the tops of the bents being about 4 ft. above the springing line. There were 9 piles in each bent set about 2 ft. apart. The piles were tied together with diagonal bracing consisting of 2x 12-in. planks and the bents were tied together by two sets of horizontal planks, one set at the top and the other about half way down to the water. On top of this trestle and set on the caps over each pile, a post was erected to the proper height to support the arch stringer. The stringers were 2x12-in. planks and on their tops were nailed strips cut to conform to the curve of the arch ring. Batter posts carried on the piles to the stringers, divided the spans of these members.

When the lagging was laid upon the arch stringers a temporary trestle was built out over the entire length of the bridge, supported by the arch forms. The trestle was built on a grade and wide enough to support two narrow-gage tracks. At the upper end of the trestle a Smith ¾-cu.-yd. mixer was erected at a height sufficient to discharge into the Koppel cars which carried the concrete by gravity out over the arches.

In concreting the arches, the arch ring 16 ft. wide and containing about 140 cu. yds., was first concreted on each arch. Forms for the spandrel walls were then erected and each wall was concreted complete without intermission. The reinforcing rods used in the arches were plain round bars 1 in. in diameter placed at 6-in. centers. They were held in place by wiring. The concrete surfaces were rubbed with carborundum brick.

The rock removed from the old piers were used for filling on top of the new bridge, as was also the excavation from the abutments.

The construction force consisted of about 40 men, including a gang of about 20 Servians used as common labor. A camp was provided for these men and they were paid 20 cts. per hour. The contract was carried out by the National Concrete Co. of Indianapolis. We are indebted to Mr. Alex R. Holliday of the contracting company for the information from which this article is prepared.

Method of Constructing a Two-Part Reinforced Concrete Arch Bridge With General Unit Costs.

Contributed by Charles P. Hill, Accountant for the Contractor.

The Cedar River, on the two banks of which is situated the city of Cedar Rapids, Ia., is divided by an island opposite the main city center, into two arms of nearly equal length. A part of the plan of city development is to make this island, which is 200 ft. wide and several hundred feet long, the civic center, and to connect the two parts of the city across the island by bridges. One of these bridges was completed some time ago and a second, which is the subject of this paper, has just been completed.

The new bridge is on the line of Third Ave. and replaces a six-span steel bridge built in 1871. Like the old bridge, the new bridge is a two-part structure; that is, two virtually separate bridges cross the two channels, their junction across the island being merely the standard avenue construction. Incidentally, it may be mentioned that the new bridge is substantially a duplicate of the bridge located a block up-stream and mentioned above as having been completed some time ago.

Structural Features.—The two parts of the new bridge are identical. Each consists of three 96-ft. reinforced concrete arch spans carried by two piers and two abutments. A view of one channel crossing is shown by Fig. 1. The roadway is 48 ft. wide and the two sidewalks are each 10 ft. wide. The spandrel walls are solid and as will be observed from Fig. 1, the sidewalks project beyond them. The projection is 3 ft. 11 ins. and is a cantilever, the brackets which are seen being for appearance only and carrying no load. Inside the spandrel walls and under the line where the roadway and sidewalk join on each side of the bridge there is another longitudinal wall or an inner spandrel wall. Between the inner spandrel walls and supporting the roadway there is a sand fill; the two spaces between inner and outer spandrel walls provide for water and gas mains or other service conduits. Over the piers the sidewalks are widened to form coves or wings in which are concrete benches. Another ornamental feature of the bridge is the light standards, a view of one of which is given by Fig. 2. These standards are of reinforced concrete.

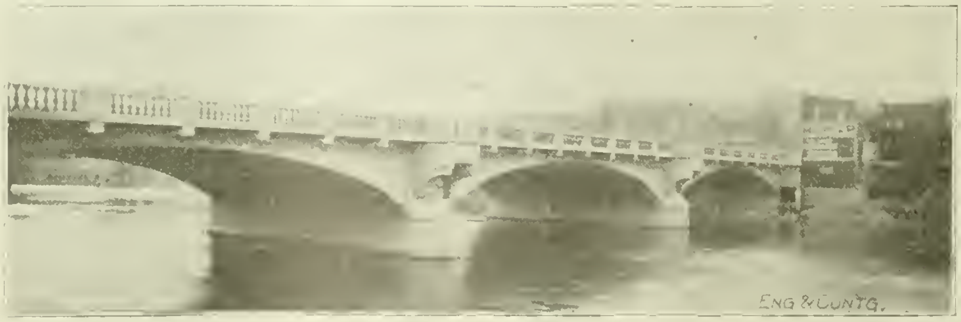


Fig. 1—View Showing West Half of Third Avenue Bridge Over the Cedar River at Cedar Rapids, Iowa.

Removing Old Bridge.—The contract for the new reinforced concrete bridge included also the removal of the old iron bridge and its re-erection at another street crossing of the river. The old trusses were supported on framework, cut apart into three sections, and lifted out and transported 500 ft. to storage using a locomotive crane with a 45-ft. boom. The same crane was employed for removing the old masonry, the stones of which were loosened by hand and chained out and loaded into cars by the crane. The crane gang for the masonry wrecking consisted of 1 straw boss, 1 crane engineer, 1 signalman, 2 men prying the stones loose, 2 men hooking on chains and 1 man on car unhooking chains.

Excavation.—During the removal of the old masonry, cofferdams were constructed enclosing the sites of the new piers and abutments. The sheeting used was 16-ft., 3x 10-in. tongued and grooved material and it was held by inside waling of 12x12-in. timbers. The water was shallow, the bottom was clay and the penetration was only 12 ins., so all sheeting was driven with mauls. An 8-in. electrically driven centrifugal pump handled the seepage into the cofferdams.

The abutment masonry consisted of seven 3¼-ft. longitudinal walls 6 ft. 7 ins. apart and of front and back walls 3¼ ft. thick. The excavation, therefore, consisted of trenches; it was made difficult by the presence of many large boulders but was not otherwise noteworthy.

The foundations for the piers were carried an average of 15.77 ft. below water, and those for the abutments to 19.97 ft. below water. The cost of excavation, $1.52 per cubic yard, was high on account of the hardness of the material excavated. Blue clay was encountered about 2 ft. below the surface and continued all the way down. Eighteen-inch tile spades were used in excavating and their average life was one week. The clay was shoveled into wooden boxes made of 2-in. material and about 4 ft. wide, 6 ft. long and 3 ft. deep. These boxes were handled by the locomotive crane.

Falsework.—The piles for the arch falsework were driven to bed rock. They were driven in transverse rows spaced 8 ft. between piles and were capped with 12x12-in. caps and 6x10-in. false caps. The stringers were 4x14 ins. set at 2 ft. centers, and spanning 14 ft. The lagging was 2x8-in. plank. The piles varied from 18 to 36 ft. in length and the average depth driven was approximately 16 ft. A 2,800-lb. steam hammer, handled by the locomotive crane, was used for the driving.

Arch Reinforcement.—The arch reinforcement consisted of 112 1¼-in. bars 96 ft. long for each arch, together with ½-in. saddle bars spaced 22 ins. apart and reaching to within 2 ins. of the top surface of the concrete. The weight of the reinforcement for each arch was about 67,000 lbs. and in the entire structure the reinforcing material amounted to 600,000 lbs. The metal was tied together at intersections with No. 16 wire. Adjustable turn buckles on the arch rods were used for tightening the rods and keeping them in their proper position while the arch was being poured. The turn buckles prevented the rods from bulging up as the concrete settled under them.

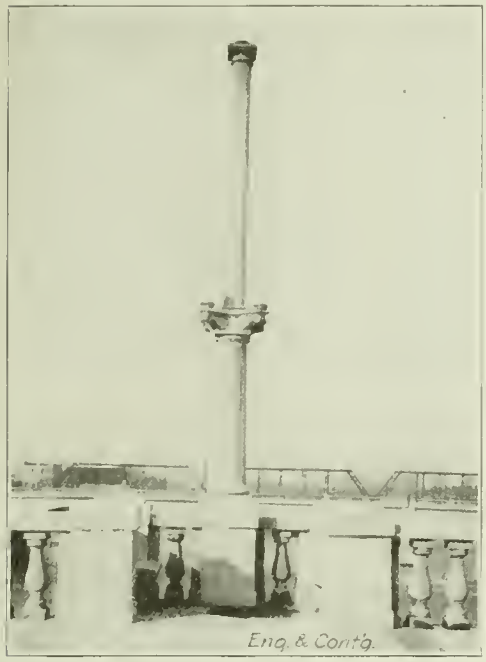


Fig. 2—Concrete Lamp Pole and Railing.

Concreting.—The concrete was run into the pier forms up to the springing line of the arch, a bulkhead being built on each side of the pier. A gravity system was used. The tower was placed on the island as shown by Fig. 3. It was built 110 ft. high. Open troughs 12 ins. in diameter were used. A ¾-cu. yd. mixer was located about 15 ft. below the roadway, and two bins, one of 75 cu. yds. capacity for stone and one of 50 cu. yds. capacity for sand, were built above the mixer and level with the roadway. The stone was unloaded from cars by a one-yard clamshell bucket and dumped directly into the bin. The sand was bought locally and hauled by teams. For operating this plant the average crew of men was as follows:

	Cents per hr.
Foreman	50
Straw boss	35
Mixer engineer	25
Mixer man dumping	30
2 men dumping bins	25
1 man dumping trap from sand wagons	25
2 men in stone bins	25
1 man in sand bin	25
1 man at top of tower	30
1 hoist engineer	45
1 fireman	25
4 spaders	30
2 men dumping	25

The arch rings were concreted in four longitudinal sections of 150 cu. yds. each and each ring was completed in a continuous stretch. The top surfaces of the arches, piers and abutments were given a heavy coat of mortar and for a distance of 15 ft. from the piers and abutments two coats of liquid hot asphaltum were applied.

In the entire bridge approximately 71,000 sacks of cement were used. The proportions of the mixtures were as follows: Piers 1:3:6, arches 1:2:4, sidewalks and ornamental work 1:3. The unit labor cost of the work was as follows:

Mixing and placing concrete, per cu. yd.	$0.671
Building forms, per cu. yd.	0.452
Excavating, per cu. yd.	1.52
Driving piles, per lin. ft.	0.15
Placing reinforcing, per lb.	0.00344

The forms for the lamp and trolley poles were made by a local mill and the poles were poured in place. The spindles for the handrailing were made during the winter in the basement of a nearby building and were set in place when the railing was poured. An iron cast was used for the spindle mold and a dry mixture was used. The forms for the spindles and poles were thoroughly oiled before filling. A paraffin oil and melted paraffin were used for some of the work but the best results were obtained with the use of crude oil and at much less expense.

One serious accident occurred during the winter, which was the loss of the falsework for one-half of the bridge. The ice carried it away during a flood.

The work was carried on under the personal supervision of the contractor, Mr. B. J. Sweatt, and with the inspection of the city engineer, Mr. F. F. McCauley.

Notable Engineering Plans for Crossing the English Channel by Bridge or Tunnel.

By H. G. Tyrrell, Consulting Engineer, Evanston, Ill.

In recent years the increasing use of tunnels in preference to bridges, for crossing deep waterways and harbors, has called especial attention to their comparative cost, particulars of which are not always available when needed. Fair comparison can be made only when natural conditions are the same or nearly so, for variation in the depth of water, geoglogical formation, width of channel, height of shores, etc., will greatly affect the cost of either bridge or tunnel. Estimates for the same locations are, therefore, the most valuable, and results of investigations made for crossing the English Channel are selected for illustration, as this project for more than a century has engrossed the thought and study of many of the world's most successful builders and scientists. These results are especially valuable, because the designs were made at widely different times, often without special reference to the work of their predecessors, by men of different nations, all of whom were acquainted with the best constructive methods in use.

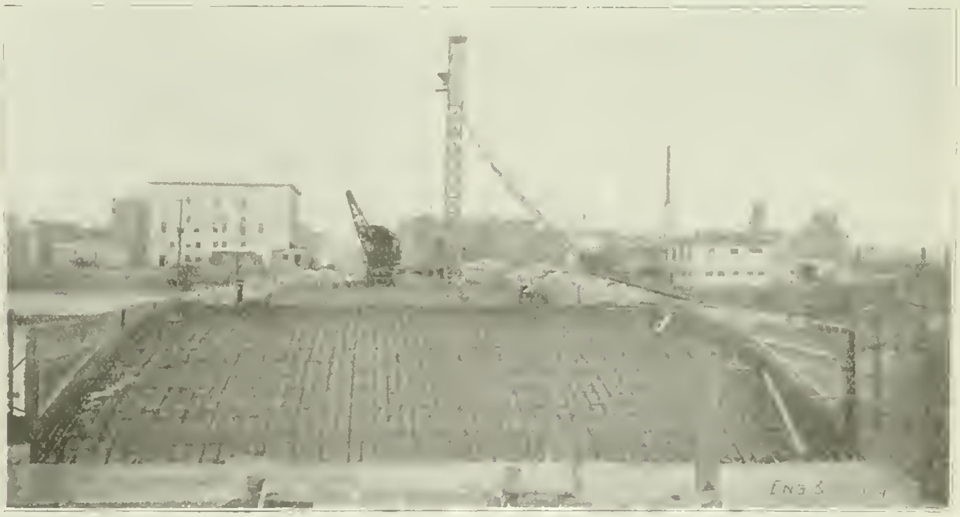


Fig. 3—View Showing Chuting System and Arch Reinforcing.

Bridges in all cases were to stand high enough above the water to permit the largest masted ships to sail beneath them, and in no case were movable spans included or considered. The location is between Dover on the English coast and Calais in France, where the distance across is about 21 miles, and the maximum depth of water 170 ft., and the average depth 118 ft., or about the same as that of the St. Lawrence at Quebec, or the Bosphorus at Constantinople

BRIDGE PROJECTS AND ESTIMATES.

Appreciating the difficulty of sinking piers in water of great depth, a plan for crossing the English Channel was proposed prior to 1830 by Delafons and Littlewort, with floating piers on rows of barges held in place by chains and anchors which would maintain the piers at uniform elevation and prevent their rising or falling with wave or tide. These floating piers were to be surmounted with metal towers supporting the chains of a suspension bridge, which after passing over similar towers on shore were to be securely anchored into the rock.

A few years later (1837) the English engineer, Mr. W. Coppett, outlined plans for crossing the channel either with a bridge or tunnel, and he took his plans to France and laid them before the French government. His bridge contemplated 190 piers in the form of cones like those which had been used at Cherbourg 50 or 60 years before. The bridge was estimated to cost two millions*, but his tunnel scheme with 18-ft. cast iron tubes would cost only half as much.

In 1858 Mr. Charles Boyd proposed a maratime viaduct from England to France, with tubular girders on 190 towers 500 ft. apart and 500 ft. high, the estimated cost being $150,000,000. The piers were to be pyramidal in form, 300 ft. square at the bottom, with sides rising at an angle of 75° to 40 feet above the sea. The tops were then planes 150 ft. square. The piers were to consist of "rocks bolted and lashed together." On these piers Mr. Boyd intended building towers 100 ft. square and 260 ft. high, over the tops of which would be laid a tubular bridge 30 ft. wide and 50 ft. deep.

One of the greatest flights of imagination was attained in 1850 when the French engineer, M. Ferdinand Lemaitre, proposed an aerial suspension bridge to cross from Calais to Dover.

> At distances of 300 ft. apart he would sink four heavily laden barges to which would be fixed a double iron chain of peculiar construction. A formidable apparatus of balloons of inverted form and firmly secured would support in the air the extremities of these chains, which would be strongly fastened to the abutments on the shore by other chains. Each section of 300 ft. would cost 300,000 francs, which would make 84,000,000 francs for the whole. These chains, supported in the air at stated distances, would become the point of support to this fairy bridge on which the inventor proposes to establish an atmospheric railway. The project has been developed at great length by the inventor.

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*A milliard is one thousand million; a "cost of two milliards" is 2,000,000,000 francs, or about $400,000,000.—Editors.

Investigations made in 1860-61 by M. Oudry for building a suspension bridge at another place with spans of 1,000 meters and steel cables, led to the consideration of similar spans for the English Channel, which length would reduce the number of piers from 190 to 30. Oudry was quite confident of the feasibility of such lengths and he built a model one, 100 meters long with steel cables, over the Tiber at Rome. The long span idea was taken up again in 1868 by Charles Boutet, a French engineer, who established offices in Paris and London and began actively to finance his project. Briefly described, he proposed to build 29 piers 390 ft. wide and 260 ft. long at the bottom, sloping up to 200 ft. square at the top, each of which piers would weigh 2,500 tons. These would be spaced 3,282 ft. (1,000 meters) apart and would support spans weighing 14,000 tons, each span being capable of sustaining 24 railway trains. The bridge was to start from a cliff, 360 ft. high, near Dover, and was to be supported by 31 wire cables 2 meters apart, woven into a trellis, with floors at two levels. The estimated cost was $40,000,000. Mr. Boutet made in France, a model 100 meters long and met with some success there, but his plan was severely criticised in England and ridiculed by some of the leading papers and scientific journals to such an extent that it was finally abandoned.

The tubular idea was taken up again in 1872 by Sholto Douglas and plans were prepared with piers of double stone cylinders about 500 ft. on centers, supporting a tubular bridge with four girders 30 ft. deep and three lines of railway between them. Above the tubes and confined between heavy plate railings 6 ft. high, was a highway 50 ft. wide. The difficulty was realized of working in water 170 ft. deep, which was a greater depth than any in which divers had previously labored, and especially with a current of three miles per hour. Mr. Douglas estimated the weight of metal to be: wrought iron, 825,000 tons; cast iron, 37,000 tons, and the cost was placed at $90,000,000, with a required time of four years for completion.

In 1874 Mr. T. O. Lebret outlined a scheme for a channel railway ferry on floating piers anchored to the bottom and he published and circulated a pamphlet describing his invention.

The next bridge project was that of M. Verard de Sainte Anne, a French engineer, who prepared plans with 175 channel piers 200 meters apart. The piers were to be formed by dropping huge masses of rock into the water and consolidating them with Roman cement, as at the Cherbourg breakwater. He intended building solid masonry arches near shore and girders over the central part, and he announced that the total cost would be 300,000,000 francs, while a tunnel would cost 500,000,000 francs. He established offices in London but died while negotiations were in progress. After his death, work was continued by some of his associates and detail plans were prepared by M. H. Hersent in connection with engineers from the iron works of Schneider & Co. These plans were approved in England by the engineers of the Forth Bridge, Sir John Fowler and Sir Benjamin Baker, and their names were added to the plans and project to give it prestige in England. Since the foundations in water 160 ft. deep would be the most difficult part of the undertaking, designs for them were first carefully made and approved. The stone piers with wide base, 57 meters long and 32 meters wide, were to be built hollow and sunk inside of metal caissons 187 ft. long and 108 ft. wide. Masonry was to extend up 47 ft. above high water and the clear height under the bridge was to be 200 ft. The greatest depth of water was shown at 167 ft. and the average depth 118 ft.

A superstructure with a series of cantilevers was then designed, for alternate spans of 100 to 250 meters, 200 to 350 meters, and 300 to 500 meters, the last lengths being used over the deepest water. The whole outline included:

32 spans of 300 and 500 meters, weighing 587,136 tons,

13 spans of 200 and 350 meters, weighing 116,285 tons,

14 spans of 100 and 250 meters, weighing 67,841 tons,

with an average weight of about 6½ tons per lineal foot. As the soundings previously made indicated two reefs in mid channel over which water was only 8 meters deep, to the west of a straight line between the terminal points at Folkstone and Cape Grisner, the bridge was at first laid out in two tangents meeting in mid channel. The original estimate of 1889 showed a cost of $170,000,000, of which 45 per cent was for the foundations and 55 per cent for the superstructure.

Further investigation of the channel bottom revealed the fact that the reefs to the west would permit no saving in construction, and a new location was selected in a straight line, the distance for bridging being thereby shortened to 20½ miles. By using 73 alternate spans of 500 and 400 meters throughout, the number of piers was reduced from 118 to 72 and the average weight of metal, including 18 per cent for details, was 6.2 tons per lineal foot, the dead weight constituting 73 per cent of the whole load. Trusses were to be 197 ft. (60 meters) deep over the piers and the suspended spans 410 ft. long or only about half the usual American practice. Trusses were to be 82 ft. apart at the bottom and were to slope towards each other and meet at their tops. These alterations reduced the estimated weight of metal to 755,000 tons and the cost to $159,000,000. This cost of over $7,165,000 per mile is 25 per cent greater than the cost of the Forth bridge. Seven years was the time allowed for construction, and when completed, the annual traffic was estimated at 1,000,000 passengers and 5,000,000 tons of freight.

A paper describing the project in detail was first read before a meeting of the Iron and Steel Institute, and it was declared by its opponents to be merely an effort to interest English and French steel makers and manufacturers, and to sell their products, regardless of the interests of investors. These opponents of the bridge announced that a tunnel could be built in four years at a cost not exceeding $20,000,000. For twenty years or more, the bridge project has received but litle promise of fulfillment, as improved methods of tunneling and the completion of great ones at New York, Paris and Hamburg have diverted the most serious thought to the construction of a channel railway underground.

TUNNEL PROJECTS AND ESTIMATES.

During the first half of the last century, three regular tunnel projects had been advanced by French engineers, while several others, including two by French and five by English engineers, proposed submerged tubes, and one other preferred an arched roadway on the channel bottom.

The first project for a tunnel under the English channel from England to France, was advanced in 1801 by the French engineer, Mathieu, who prepared plans and presented them to Napoleon. For some time they were on public exhibition but were afterwards lost. In 1837, the english engineer, Mr. W. Coppett, estimated that a tunnel, as he conceived it, with 18-ft. cast iron pipe, would cost one milliard, and a few years later (1845), M. de la Haye proposed wrought iron tubes in sections, which were to be sunk and afterward connected, the estimated cost being $40,000,000.

The most enthusiastic effort up to that time, to build a tunnel under the channel was made by M. de Gammond, who launched his project in 1856-57. A commission which was appointed to examine his plans made a favorable report and recommended an appropriation of $100,000 for experiments. M. de Gammond intended first forming in the channel 13 islands, through which he would afterwards sink shafts and then drive the tunnel right and left. The project was rejected because of its interference with navigation. The promoter gave 10 years to the work and died in 1875 at the age of 69 with no assurance of its success. Other tunnel schemes were advocated by W. Austin, George Remington, Alexander Vacherot and others.

Mr. James Chalmers, in 1861, prepared plans for a double track tunnel to connect the railway systems of England with the continent and used two wrought iron tubes lined with brick, floating at first from their buoyancy, and then anchored down by weight boxes filled with stone. After settling to the channel bottom, the tubes were to be covered with an embankment 150 ft. wide and 40 ft. high, the top of which would be 40 to 120 ft. below the water surface. The tubes were to be circular and air was to be supplied through three vertical shafts at equal intervals through their length, and air circulation was to be forced with fans. Mr. Chalmers published a book describing his project, the cost of which he estimated at $60,000,000. Somewhat similar schemes were afterwards advanced by Charles Marsden, J. F. Bateman, and Zerah Colburn.

A plan was also proposed prior to 1860 by a French engineer, for an arched roadway on the channel bottom, the cost of which was not to exceed $50,000,000. To execute the work, he would require 40 aqueous boats, 4,300,000 cu. yds. of material, and the services of 1,500 men. Instead of laying the tubes on the bottom, Mr. W. H. Barlow explained and advanced a method of using submerged steel tubes on piers, and the scheme was further developed by Mr. P. W. Barlow, but afterwards abandoned. The tube idea was again taken up in 1876 by the celebrated English engineer, Thomas Page, who designed many of the finest bridges in Great Britain. He favored sunken tubes as outlined by Messrs. Barlow, and intended building them in sections and then floating them out and sinking them in their proper places as he had previously done across the harbor at Rio de Janeiro.

In 1875, a French company was given a 99-year concession for a tunnel, conditional on expending $400,000 on the work as a trial, and they were to report within eight years as to whether or not they would hold their concession. At the end of that time, 6,000 ft. of small bore had been driven, but further work was stopped for military reasons. The channel is 21 miles wide and the tunnel length was to be 30 miles. In 1880, the South Eastern Ry. of England entered into agreement with a French company to start work on a shaft between Dover and Folkestone, and the work accomplished showed that it could be driven through chalk with a single oval tube 33 ft. wide and 23 ft. high for two tracks, or preferably with two separate circular tubes 18 to 20 ft. in diameter and 60 ft. apart, connected at intervals of 400 to 500 ft. The cost of two single track tubes 18 ft. inside diameter and 36 ft. apart on centers, was estimated again in 1907 by competent engineers, to cost $40,000,000 for a total length of 34 miles, including the approaches.

The present condition of the project for a tunnel under the English channel, and the attitude of the English people towards it can best be shown by an extract from one of the leading daily newspapers, which reads as follows:

> The old project of a tunnel under the English Channel is being revived with better prospects of success than it ever had before. Public opinion in England, which has always been the chief obstacle, is thought to have been revolutionized gradually. The change is said to be due partly to the continual bettering of Franco-British relations, the strength of which was proven by Germany's Moroccan coup, and partly by arguments advanced by financiers in both countries, who have been pointing out the tremendous mutual commercial advantages that could be gained thereby.
>
> The plans and the capital are in readiness and there remains only to obtain the authorization of the two governments, and it is declared that a great effort will be made to secure it. Incidentally it is understood that the Intercontinental Railroad Co., which is an English syndicate, intends soon to establish between Dieppe and Newhaven the first trans-channel train ferry. In 37 years Franco-German com-

merce has grown 104 per cent and Franco-Belgian commerce 164 per cent. Franco-British commerce, though totaling more than the others, has increased only 33 per cent, and this in spite of the natural commercial alliance between agricultural France and industrial England. The channel alone is to blame for the discrepancy, and only a tunnel can remedy it.

The English people are beginning to see that a tunnel instead of weakening their defensive power in time of war, would really increase it, because it would keep the source of supplies continually open. Continuance of the present state of things and any delay in completing the long-projected link means actual loss to both countries.

TABLE I. COST ESTIMATES FOR BRIDGES AND TUNNELS CROSSING THE ENGLISH CHANNEL.

Date.	Engineer.	Cost.
	Bridges.	
1837.	W. Coppett	Two milliards
1850.	Ferdinand Lemaitre	84,000,000f
1858.	Charles Boyd	$150,000,000
1868.	Charles Boutet	$ 40,000,000
1872.	Shotto Douglas	$ 90,000,000
.....	M. V. de Sainte Anne	300,000,000f
1889.	Hersent and Schneider	$159,000,000
	Tunnels.	
1801.	Mathieu	....
1837.	W. Coppett	One milliard
1856.	M. de Gammond	....
1845.	De la Haye	$ 40,000,000
1861.	James Chalmers	60,000,000
1861.	(Arched roadway)	50,000,000
1907.	American engineers	40,000,000

It would seem that public sentiment in England had been similar to that which dominated the Romans before the period of conquest (B. C. 65-135), when Roman territory was confined to the peninsula of Italy. At that time when the country was still in danger of invasion, many of the border bridges were built with movable decks which could be withdrawn to prevent the advance of opposing armies. But when the Roman republic was extended to include all of Southern Europe, and was the greatest ruling power on earth, fear of enemies was abandoned and permanent bridges were built everywhere, to invite commerce rather than to exclude it. A similar outcome will doubtless terminate the long isolation policy of England with regard to a bridge or tunnel across the English channel.

COMPARATIVE COST OF BRIDGE AND TUNNEL.

Table I gives, as far as they are obtainable, the comparative costs of bridges and tunnels for crossing the English channel, as estimated at different times by French and English engineers.

It appears therefore that a tunnel would cost less than half as much as a bridge of the same capacity, as was reported by W. Coppett in 1837. It will be seen also that the modern method of tunneling by sinking sections of tubes and afterwards connecting them when in place, as used at Detroit and LaSalle St., Chicago, is much the same as that proposed by M. de la Haye in 1845, and afterwards elaborated by others.

RAILWAYS

Economy in Use of Materials in Railway Maintenance of Way Departments.

Contributed by A. Swartz, Engineer Maintenance of Way, Toledo Railways and Light Co., Toledo, Ohio.

The amount of traffic naturally specifies to a great extent the amount of money expended in the maintaining departments, but any decrease in traffic which brings instructions for reduced expenses strikes the maintaining department first and hardest. All maintenance men know, however, that a heavy traffic requires the best of current maintenance. Therefore, reductions caused by a quick falling off of traffic oftentimes causes hardship in maintenance, for the track and rolling stock have been required to bear the brunt of the traffic and are in no condition for reduced maintenance at once. During the progress of heavy maintenance this is often lost sight of and is that much harder to control when it is made absolutely necessary.

The Maintenance of Way departments of all United States railroads spend in round numbers, $1,400 per mile of track, of which about $1,000 is on the track and right of way, excluding buildings and bridges. Of this last amount probably $600 is for labor and $400 for material. These figures are not intended to be absolutely correct, but simply show an average; the eastern roads must use higher figures and some western roads may reduce them.

Taking a track section as six miles of track, it will be seen that a track foreman has probably $6,000 to disburse each year, of which $2,400 is for materials.

Let us take into consideration what it means if each man in the track department wastes one-half cent each day, say for 300 days per year, which, while it means only $1.50 per year for each man, is very great if every man wastes that amount. We will say there are 250,000 miles of track in the United States, with possibly an average of one man per mile of track. This waste would mean per year approximately $375,000, which represents the interest on enough money to build 95 miles of standard single track railroad.

The average trackman thinks nothing of throwing away a wooden tie plug every day, which cost 45 cts. per 1,000. As a whole, it means $37,500 per year if they all do it. Rather a handsome saving if it could actually be made. The loss of one nutlock per man per day would mean about $375,000 per year. How many times have we seen a pair of old angle bars lying alongside the roadway or along some back track. They represent a scrap value of at least 25 cts. per pair. One pair per mile means $62,500 lying idle. None of us think much of burning a pile of old ties and then promptly forgetting about it. Still, in that pile of ashes will be found old spike stubs which are well worth picking up. It has been demonstrated that two men with a push car can pick up enough of such scrap to pay their wages. Of course, this cannot be done day after day, but at the end of the tie renewing season this is a matter well to remember. These are matters of simple thoughtlessness on the part of trackmen which cost railroads a great deal each year.

The writer one time in looking over a scrap pile at his headquarters found two large track jacks that had been placed in the scrap car by a foreman who had been re-ballasting track. The jacks were furnished at the request of this foreman, and for the purpose of demonstrating their usefulness. They were perfectly good when found in the scrap pile.

On a great many roads the ties to be renewed are marked by the foreman and taken out by him without the supervisor ever seeing them. Unless the foreman is very careful he may take out ties that will last another year. A good cedar tie, even though it is badly rail cut, may be good for another year, if there is a good oak tie on either side of it. Cedar ties, when taken out in quantities, will, if split up into fence posts, last a number of years for this purpose, and save buying new ones. One time on my division a number of telegraph poles were broken off by a sleet storm. We made them up into corner posts for wire fences.

Before the rail on a division is worn out, the angle bars generally become bent or worn by the action of salt drippings. By judicious use of new angle bars, the rail may be made to wear possibly two years more. New bars in place will cost approximately $400 per mile of single track. The actual cost of new rail is probably $3,700 in place. The average life, we will say, is ten years, or $370 per year, thus showing a saving of approximately $340 per mile, if new bars are put on at the end of say six years. Besides this, we have the old bars, which can be used on sidings. Here also, is a point sometimes overlooked. It is very essential to have fairly good angle bars on sidings.

Angle bars are often ruined, or at least bent, by not keeping the bolts tight or by failing to renew bolts when they stretch beyond usefulness. This batters the rail ends, which in turn churns the ballast, thus requiring frequent retamping at joints. This condition gradually sets other ties to churning, and soon the ballast is so muddy it needs renewing. In this matter, however, a little study may save money. I once had a lot of muddy ballast that was slated for renewal. We dug away all the old ballast down to the bottom of the tie, with the exception of about 2½ ft. in width between the rails, which was the preparatory step for renewing ballast. I decided, however, to let the sun and wind dry out the grade in good shape before dropping new ballast, and found the track holding its line and surface very well, because the ballast in the center of the track was baked very hard. This track was left this way for two years, and was easier to maintain than before. I do not advocate doing this in all cases, but do say that sometimes this may be done to advantage, as the sub-grade was well dried out when we finally did apply new ballast.

The same principles apply to renewing switches and frogs. If they are well maintained with good bolts, braces and ties, they naturally last longer. A frog or switch not good enough for main track can often be used on sidings. The wing rail on spring frogs wears out first. If taken out of the track before the point is too badly worn a new wing rail can be applied. When scrap frogs are loaded I believe they should be loaded carefully and sent to one central point, where the company maintains a frog shop, or where new parts purchased for that purpose can be applied, and the frog put back into use again. Yet, how often we see a frog thrown promiscuously into a scrap car. It is not always practical to use the old slide plates and braces under a new set of switch points, but they come in very handy in a big yard where we know the tracks are not always provided with the proper amount of new materials. This is a matter to be handled by a supervisor, for unless carefully watched, the foreman is apt to put such material in the scrap car, which later on necessitates sorting at the central scrap yard. It is very probable that our eyes would be opened if we visited the yards of a junk dealer for a great many small railroads buy materials from them.

The writer once put in a requisition for a lot of track bolts to be 4¾ ins. long. This was one of our standards. We were greatly in need of them and could not get them. Having occasion to go to the general storekeeper's headquarters, I saw a great lot of bolts 4⅞ ins. long, and on asking why the requisition was not being filled was told that his order had not yet been filled by the manufacturer. The storekeeper's attention being called to the 4⅞-ins. bolts, he stated, "Well, that is an old standard and I did not suppose you could use them." They had been in stock two or three years, too. Others besides trackmen sometimes do not stop to think.

Sub-drainage of the roadbed plays a very important part of track maintenance, and is a matter often neglected. Too often we allow surface ditches to fill up and thus hold the water in the sub-grade, and in some cases saturate the ballast. In slippery cuts this is a hard matter to overcome, but a judicious use of drain tile is money well spent. I once reported to an officer who was not a believer in drain tile and would not O. K. a requisition for it, except for use near ash pits, and so forth. We had a very muddy spot in a yard where open ditches had to be cleaned out several times a year. The sub-grade would fill up the ditches and then begin to squeeze up between the ties, making it difficult to maintain the track.

I took some 2-in. by 10-in. pine boards and made drain boxes by perforating the sides and top with holes. The boxes were placed in the trench and grass was thrown around each box, so the mud would not fill it up too quickly. This material cost about 30 cts. per ft., whereas 10-in. tile, of the proper capacity, would have cost 20 cts. This stopped the trouble with the sub-grade almost entirely.

The consumption of oil for switch lamps is a big item, and by using long time burners I reduced the consumption of oil at places about 50 per cent. Trackmen oftentimes throw away oil in the founts, instead of simply filling them and leaving in the old oil. This means a big waste, for if the burners are boiled out once in a while it will not matter if the oil is a little thick. Of course, this old oil must sometimes be thrown away, but not as often as is commonly the case. I also made a great saving by providing galvanized tanks for storing oils, where the consumption was more than 25 gals. per month, for there is a great loss on account of leaky wooden barrels. With oil valued at 10 cts. per gal., it does not take long to pay for a $4 galvanized tank.

When I first went to work on a certain small railroad I found a terminal yard in which were scattered here and there various piles of obsolete and scrap rail, frogs, switches and track scrap, some of which had been in this yard for seven or eight years. One of the reasons for not having disposed of it was that some of it might possibly be used for repairs or building spurs. However, such a necessity had never arisen. We also had a spur five miles long, which had been abandoned entirely, and the property reverted back to the original owners. The rail had never been taken up, and with the condition of the roadbed could not have been collected short of $5 per ton. The rail was of a section not in use, and of little value, other than scrap. Authority was obtained for disposing of this material and prices beyond what we expected were offered by junk dealers who loaded all materials. This move brought the company in the neighborhood of $13,000, which was equal to approximately 3 per cent of its net earnings per year.

The moral of this instance is that it seldom pays to keep old material in quantities awaiting a possible chance of being able to use it. This, of course, must be carefully decided before disposing of the materials. In this instance, the money tied up was probably $10,000, as an average for seven years, which at 6 per cent interest meant a loss of probably $4,200.

This also illustrates a habit of a great many section foremen in saving almost everything they find along their section. I will venture the statement that in nearly every section tool house can be found two or three dollars worth of train equipment, such as old markers, marker and classification lamps, journal brasses, engineer's torches, and so forth, which can not possibly do a section man any good. If they were sent to the mechanical department, however, they could quickly be repaired and put back into use.

Tools are another item of great expense in the track department. It is poor policy to have poor tools, but it is worse to have too many of them, for the tendency is not to send them in for repairs as soon as they become dulled. A great amount of money can soon be tied up this way. Of course, a great deal depends on which department repairs the tools. If the mechanical department does it, which is true on probably 75 per cent of railroads, a great deal of time is lost. I will always maintain that better results would be obtained if each supervisor had an extra supply of good tools and at his headquarters had a blacksmith to do this work.

The above instances are cited for the purpose of emphasizing the fact that watchfulness of the small every-day matters is of monetary consequence and must necessarily broaden the usefulness of all employes who exercise it.

Comparative Cost and Serviceability of Wood and Steel Fence Posts on Railways.

The majority of American railways employ wood posts for right of way fencing. Usually the kind of wood employed is that which is native to the locality whether or not it is a wood particularly suitable for such service. These facts, with some discussion of the life and cost of wood fence posts based on the experience of some 44 American railways, are brought out by the recent report of a special committee of the American Railway Engineering Association. We summarize a part of this report and in particular a comparison of steel and wood posts:

WOOD POSTS.

From the data collected the life of wood posts of various kinds actually in use is as follows:

LIFE OF POSTS.

	Years.
Red Cedar	7 to 25
Cedar	10 to 30
White Cedar	12 to 17
Chestnut	10 to 15
Locust	7 to 20
Yellow Locust	15 to 30
Black Locust	10 to 25
White Oak	7 to 15
Bois D'Arc	12 to 45
Catalpa	10 to 25
Juniper	15
Mulberry	15 to 20

Doubtless some give little heed to the particular species of the timber that they use, and assume that any species of that genus has about the same life. This is manifestly incorrect as is demonstrated by the oak family. The inferior grades of oak have a life only of from 2 to 4 years, while a good white oak has a life in our northern climates of from 10 to 12 years at least. Certain classes of oak last much longer in their native regions than in other localities to which they are transported for use. This principle applies with equal force to every other class of timber.

In reviewing the replies of the various roads we find that the consensus of opinion, based upon experience of the users, is that the different classes of timber have an average life as indicated below:

	Years
Red Cedar	18
White cedar	15
Chestnut	12
Yellow locust	20
Black locust	20
White oak	10
Bois D'Arc	25
Catalpa	15
Juniper	15
Mulberry	15

Climatic influences have an important bearing upon this phase of the case, and may lengthen or shorten the life of a particular kind of wood, dependent upon locality in which used. It is not feasible in most cases to recommend any particular kind of timber for a given territory, as the source of supply may be so distant as to preclude its use economically. It is the prevailing practice to use such timber as is native to the country and thus most easily obtainable. According to information received, the cost of the various kinds of wood posts is:

	Range.	Average.
Red cedar	15c to 25c	22c
Cedar	7c to 20c	14c
White cedar	12c to 15c	14c
Chestnut	10c to 27c	20c
Locust	15c to 40c	25c
Yellow locust	20c to 38c	30c
Black locust	15c to 25c	20c
White oak	11c to 40c	20c
Bois D'Arc	13c to 17c	15c
Catalpa	15c to 25c	20c
Juniper	6c to 10c	8c
Mulberry	13c to 17c	15c

It will be observed that the relative cost to life of post ranges from ½ ct. to 2 cts. per year of life, the Bois D'Arc and the Juniper being the cheapest posts, but so rare that a more general use is impossible.

It was of interest to know to what extent wooden posts were subject to destruction by fire. Replies received indicated that this varied by from 1 per cent to 5 per cent, with the exception of one road which reported a loss of 30 per cent from this cause. We think it fair to assume that the average loss by fire is around 3 per cent.

STEEL POSTS.

Only two roads so far as we can learn make mention of having used any metal posts, and then but to a limited extent. In the one case bar iron ¼x2 ins. was used and in the other old boiler tubes. We have reason to believe, however, that quite a number of roads, not replying to our circular, are trying out a proprietary metal post. Several styles of steel right-of-way fence posts are on the market. Their exploitation has just begun in the last year or two, and any statement as to their efficiency and economy could be but vague and from the manufacturers' standpoint alone. Greater experience may demonstrate their utility, but thus far we have no data upon them, and can only give some computations from one of the manufacturers, which might be of interest for study from the viewpoint of railroad economy. These figures, while prepared for a certain style of post only, if reliable, will no doubt be equally accurate for any other style of metal post, built along similar lines, and others are generally so designed. In order that the membership may have the manufacturers' explanation of the merits of the steel post for their further consideration, we give the statement of the case in substance according to one with whom we have had the matter under discussion:

Steel posts cost	23.03 cents
Cost of setting	1.30 cents
Total	24.33 cents
Estimated life	30 years

Based upon above figures, steel posts set one rod apart cost 81 cts. per year.

The cost of setting wood posts is estimated at 5.8 cts. each. The following table is based on wood posts costing from nothing up to 20 cts. each, and is intended to show what the life of wood posts must be at different first costs to be as cheap as the steel posts:

Cost of post. Cents.	Cost of setting. Cents.	Total cost. Cents.	Years it must last to be as cheap as steel. Years.
0	5.8	5.8	7.1
5	5.8	10.8	13.3
8	5.8	13.8	17.
10	5.8	15.8	19.5
12	5.8	17.8	21.9
15	5.8	20.8	25.6
17	5.8	22.8	28.1
18.53	5.8	24.33	30.
20	5.8	25.8	31.8

The above figures would indicate that wood posts costing 15 cts. would have to have a life of 25.6 years and those costing 20 cts. a life of 31.8 years to be as cheap as steel.

The first steel posts are said to have been manufactured about 15 years ago at Bloomfield, Ind. Others, doubtless, of different design unknown to the Committee were manufactured as long ago and perhaps longer, but only during the past twelve years have they been given any serious study with a view to placing them on the market for ordinary right-of-way fencing. Hundreds were taken up and examined to discover signs of rust and deterioration at ground line or elsewhere. They have been in use at Spencer, Worthington, Bloomfield, Ind., and elsewhere in all kinds of soil and under all conditions. The investigations have resulted in placing them on the market during the past year or so.

To be of economic worth for right-of-way protection, a fence post must possess the following qualities: Durability, practicability, efficiency and the price must be right. Inquiry develops that one man can set in a day from 15 to 35 wooden line posts. To be conservative, 30 posts per day per man is assumed as the unit of work. Estimating wages at $1.75 per day places the cost of setting a wood post at 5.8 cts. The cost of post is estimated at 12 cts., resulting in an entire outlay of 17.8 cts. Experience is to have demonstrated that three men can readily set from 390 to 640 steel posts per day, or 130 to 213 per man—130 posts per man is taken as the basis of calculation with wages at $1.75 per day. This places the cost for setting a steel post at 1.3 cts. Cost of steel post 23.03 cts., plus cost of setting 1.3 cts., resulting in entire outlay, 24.33 cts.

COMPARATIVE COST OF STEEL AND WOOD

Entire cost of steel post, 24.33 cts.; estimated life	30 years
Money worth 6 per cent.	
Entire cost of wood post, 17.80 cts.; estimated life	12 years
Expenditure for steel posts	24.33 cents
Expenditure for wood posts	17.80 cents
Difference	6.26 cents

Compound interest on 6.26 cts. for 12 years amounts to 13.06 cts. At the expiration of 12 years wood posts have failed and need renewal. 13.06 cts. has been saved over cost of steel posts. This is equivalent to purchasing 8.8 years more protection with wood. In other words, 24.33 cts. expended for steel gives 30 years of protection, while same amount expended for wood gives 12 years original life, plus 8.8 years' interest on investment, or 20.8 years, a balance in favor of steel of 9.2 years. Viewing the matter from another angle, assuming that posts are set one rod apart, track protection costs per year as follows:

Steel Posts—	
Per rod	$ .0081
Per mile	2.59
Per 100 miles	259.00
Wood Posts—	
Per rod	$ .0117
Per mile	3.74
Per 100 miles	374.00

Balance in favor of steel posts of—

$ .0036	per rod per year.
1.15	per mile per year.
115.00	per 100 miles per year.

Other advantages claimed are no staples used; right-of-way may be burned over from time to time without injury to posts. No loss from accidental fires and no renewal on that account. Special end, corner and gate posts must be used in connection with the steel line posts. No means are provided for bracing them so as to use them as end or corner posts. There is not enough steel in them to stand the strain of stretching a heavy wire fence. The minimum amount of steel is used necessary to meet requirements of a right-of-way fence. The line and end posts are treated as distinct problems. In this they are not unlike posts made of other materials. The demands on the end and corner posts are entirely different from those on the line posts. The line post should possess a certain degree of flexibility, while end and corner posts must be absolutely rigid. The following is the comparative cost of steel and wood end and corner posts:

Cost of end post	$1.62
Cost of corner post	2.30

Assuming it fair to say that twice as many end posts will be needed as corner posts, it places the average of the stretching post at $1.84 each. If $1.84, the cost of the steel corner post, bears the same relation to the cost of a good wooden corner post that the price of the steel line post bears to the price of the wooden post, then the economy is demonstrated. In order to determine whether or not this relation maintains, we resort to the following equation:

$$\frac{12c \text{ (cost of wood line post)}}{23.03c \text{ (cost of steel line post)}} = \frac{x \text{ (cost of wood corner post)}}{\$1.84 \text{ (cost of steel corner post)}}$$

We find x = 96 cts., cost of wooden corner post, which appears to be a conservative estimate of the cost of a good wooden corner post. From a mathematical and perspective point of view, the manufacturer of the steel fence post appears to have made out a case that is worthy of continued and further close investigation. Time alone, under practical service conditions, can demonstrate if the figures are based upon substantial premises, and subject to corroboration. To be efficient and adequate, the steel posts must resist corrosion, must be sufficiently strong to withstand ordinary and accidental hard usage, must not heave from the ground in winter, must remain firm and not loosen up, permitting fence to get out of proper alinement. The speedy extinction of our forest lands, the failure on the part of all concerned to encourage the practice of reforestation, hence its slow progress, which idea will some day receive more earnest consideration than now, but too late for the next generation to profit by it, caused the users of wooden fence posts to seek some efficient substitute. The steel fence post has not yet proved its merit in practice and at this time concrete with suitable reinforcement seems to offer the only solution to the problem. A growing appreciation of the rapid depletion of our woodlands, and the urgency of discovering a suitable material to replace that which is now so near extinction, has during the past several years enkindled a livelier interest in the experimentation with and development of the proper form of concrete fence post. The problem is simply one of design. It is recognized as a primary proposition that in order to secure a post of such weight that it can be readily handled, practically as easily as wood, that it must not be too heavy; hence, reinforcement is necessary to reduce the bulk of concrete. This reinforcement must bear a co-ordinate relation to the concrete and act in harmony with it. To produce this result it must be properly placed, and make a proper mechanical bond with it. It has been demonstrated that while concrete posts are not as strong as wooden ones, yet they are sufficiently so to meet all practical conditions. It has been a generally accepted fact that wooden posts are stronger than necessary, rather than that concrete posts are not strong enough. Furthermore, it is true that there is quite a period of time in the case of wooden posts before they have decayed to such an extent as to actually require renewal, during which they are no stronger, in fact, not as strong as a properly designed concrete post. The latter has the advantage, so far as present investigations have proceeded, that its strength increases with age. It is true that many forms of concrete posts have been put on the market that had no utility whatever. Such, however, has always been the experience with any new development, and we are profiting by the failures of the pioneers in the industry.

Notes on Recommended Practice in Railway Location.

The notes here given relative to recommended practice in railway location with special reference to maintaining the original profile, grade compensation for curvature, super-elevation, spirals, reverse curves, effect of tunnels, and the effect of the length of the grade, are taken from the report of the American Railway Engineering Association's Committee on Economics of Railway Location. This report was published in the Bulletin of the Association for January, 1913, and was presented to the Association at its convention held in Chicago on March 18, 1913.

VALUE OF MAINTAINING ORIGINAL PROFILE.

Railroad profiles change in the course of years. It is a well-known fact that fills settle, causing deep sags in the grade line. The raising of tracks through cuts is cheaper than ditching, but is responsible for summits in the cuts.

In the early days it was not as thoroughly realized as it is at the present time that maintenance of way is chiefly a matter of drainage. Shortage of money was also responsible, in a large measure, for narrow cuts which were difficult of drainage. In the effort to get away from this condition, and to secure a ditch, tracks were raised, thereby causing steeper grades than were originally projected. Every cut being followed by a fill, the sequence of raised cuts and depressed fills has caused a wide variation from the original ruling grade.

On some lines, where the profile has been checked, it has been found that stretches of 0.3 per cent. grade have become 1 per cent. If places of this character occur near a point of heavy resistance, an immediate effect on the tonnage of a train is the result. When an engine is working with its bar well forward, with the fireman tired out, the fire dirty, and the steam pressure dropping, such places will cause the stalling of a train, and in a short time the frequent delays will result in decreased tonnage rating.

Raising tracks is not as economical as the Section Foreman and Supervisor would lead us to believe. While better drainage is undoubtedly secured, it is generally better practice to clean the ballast, and widen cuts to secure a ditch, and to raise track only when it becomes necessary to put roadbed to a proper line and surface. On such occasions, grade stakes should be used to establish the grades.

On many railroads an effort has been made to place permanent monuments, so that the track could be kept at a constant elevation. The difficulty of maintaining monuments along a roadbed is well-known. They are not only likely to be a menace to the lives of the trainmen, but they are constantly settling, and being knocked by sectionmen, and occasionally by derailments. However, the importance of placing permanent monuments cannot be overestimated.

COMPENSATING OLD ROADBEDS.

In the early days of railroading, compensating for curvature was practically unknown. For many years it was probably unnecessary. Compensation for curvature is not vital to small trains running at speed. The resistance due to curvature is principally felt by heavy tonnage trains on ruling grades where the engine is rated at a high percentage of its cylinder tractive power. Various experiments have been made to determine how much reduction in grade would compensate for the added resistance of curvature. It has generally been the practice to compensate this at a stated amount, and, while this method is not as accurate as could be desired, it is very much better than no compensation at all. From considerable observation of the influence of curvature, together with the examination of numerous tests of its effect, it is felt that some rules can be laid down which will improve the present practice. The rules follow:

RULES FOR GRADE COMPENSATION.

1. Compensate .03 per degree:

(a) When the length of curve is less than half the length of the longest train.

(b) When a curve occurs within the first 20 ft. of rise of a grade.

(c) When curvature is in no sense limiting.

2. Compensate .035 per degree:

(a) When curves are between ½ and ¾ as long as the longest train.

(b) When the curve occurs between 20 ft. and 40 ft. of rise from the bottom of the grade.

3. Compensate .04 per degree:

(a) Where the curve is habitually operated at low speed.

(b) Where the length of the curve is longer than ¾ of the length of the longest train.

(c) Where super-elevation is excessive for freight trains.

(d) At all places where curvature is likely to be limiting.

4. Compensate .05 per degree wherever the loss of elevation can be spared.

An illustration will show what can be accomplished by compensation of curvature on old roadbeds:

Take a 0.5 per cent. grade five miles long, with an average curvature of 60° per mile, without compensation. If the maximum curve is 6° and the curve equal in length to the longest train, the curvature will have the same effect in limiting tonnage as a grade of 0.24 per cent. This, added to the 0.5 per cent. grade, would make a ruling grade of 0.74 per cent. The effect of the curvature on the five miles of grade would be 300°, which, at an average of 0.035 per degree, would amount to 10½ ft. If this 10½ ft. is added to the 132 ft. of rise in the five miles of grade, it will be equivalent to 142½ ft., or 28½ ft. to the mile, which is equal to a 0.54 per cent. grade. If this 0.54 per cent. compensated grade is laid so as to be superimposed immediately above the present roadbed, it will be found that by re-ballasting the track to permanent stakes on a 0.54 per cent. grade, a new ruling grade can be established, which will be 0.2 per cent. below the 0.74 per cent. equivalent to the 0.5 per cent. uncompensated grade. On a grade of this length, it will be possible to haul nearly 25 per cent. greater tonnage per train, thereby securing a very large economy in operation for a small expenditure of money.

COMPENSATION OF LOW GRADES.

The effect of curvature on low grades is generally greater than on heavy grades, provided the length of train is what would be justified by the low grade. In speaking of low grades, levels, 0.1 per cent., 0.2 per cent. and 0.3 per cent. grades are referred to.

On double track railroads, particular attention should be paid to curves, whether uphill, downhill, or level, at places where steam is being taken by the engine in moving in either direction. On virtual level grades each track should have its tangents slightly raised and its curves slightly sloping down hill, so that the pull by the engine may be uniform, and the resistance of the line constant. The value of keeping the line resistance constant becomes more important as the length of the train increases. One of the prime objections to hauling a long train is the danger of parting, and in this danger curvature plays an important part. If the line is crooked, having many short curves, it is usual for the slack of the train to be constantly taken up and let out. If the engine runs out on a bit of straight track, when the rear of the train is bunched on the curves, it will accelerate faster than the other end of the train. Unless the engineer is watching, and using the brakes slightly, he may pull out a drawbar. If, on the other hand, the front end of the train is on a curve, and the rear end on straight track, the tendency is for the rear end to run in on the front end, and break a knuckle. It should not be supposed that it is impossible to have different classes of compensation on each track of a double track railroad.

SUPER-ELEVATION.

From a scientific standpoint (not always from a financial view), it is evident that a six-track railroad is the most desirable for a road that handles a three-speed service. This will give a passenger track, a fast freight track, and a slow freight track in each direction. Without attempting to discuss at this time what will be gained by the operation of a six-track railroad, it should be said that as many tracks as possible are justified if a standpoint of super-elevation alone is considered. Of course, it becomes necessary for a train to stop occasionally on a curve, and for that particular case the super-elevation is always wrong.

Inasmuch as no super-elevation at all is necessary at very low speeds, it may be eliminated entirely on tracks that are used exclusively for standing cars, and very low super-elevation, if any, should be used in yard tracks.

On a single-track railroad carrying more than one class of traffic, there are two ways to treat super-elevation:

(1) Make the freight tonnage rating as great as possible, and in accordance with the ruling grade. In this case, it will be necessary to elevate the curves for freight speed, and run the passenger trains slowly over ruling grades.

(2) Use a higher super-elevation for passenger speeds, and decrease the tonnage rating to make up for the increased resistance caused by the wheels of the freight trains binding against the lower rail.

Single-track railroads which are crooked can rarely haul as high a percentage of rating as double-track railroads, on account of the super-elevation being wrong. It is easy to see that every down-grade becomes an upgrade for movements in the opposite direction on a single-track road. Inasmuch as the movement downhill is likely to be faster than it is uphill, the super-elevation must be made for the downhill movement or introduce speed limits on downhill trains.

RESISTANCE, TRAIN, TOTAL, INCLUDING TRACK.

On single lines that are exclusively for freight, super-elevation on ruling grades should be made for not over 15 miles per hour. It is less expensive to slow down the descending movement than to reduce tonnage rating on account of excessive super-elevation.

This is especially true on curves of large central angle. As an example, a curve of 180° is cited. Two engines (one helping) hauling 3,500 tons of coal ordinarily stalled on an 8° 30′ curve with 185° central angle with 5½-in. elevation. The elevation was reduced to 3 ins. and no difficulty was had. This curve was compensated .04 per degree and was an 0.85 per cent. grade.

On many mountain roads a long train may be on seven or eight curves at once, and when such is the case, observation of minor points is of great value when tonnage is the main issue.

SPIRALS.

Without discussing the theory of the spiral as affecting railway grades, it should be said that the object of the spiral is twofold:

(1) To afford a run-off and a run-on from a level cross-section to a super-elevated cross-section.

(2) To ease the horizontal passage from a straight line to a curve.

It is evident that in passing from a level position to a super-elevated position, when the inner rail of the curve is laid at grade, the center of gravity of the mass of the train must be raised through a distance equal to one-half the super-elevation. This is generally a minor rise, but in order to haul uniform tonnage this minor point should be carefully observed, especially where limiting conditions are found, such as places near the end of a long-continued effort. It has been proposed in the past that the inner rail be depressed a distance equal to one-half of the super-elevation, and the outer rail be raised the same amount. While this has been objected to by some railroad men, it can certainly be done and so maintained, and from a tonnage haul standpoint it is desirable. It is submitted that the railway of the future, which is scientifically operated, will find conditions such as these limiting their tonnage unless care is taken. While it might be said that refinements in the track are unimportant, it should be borne in mind that, in order to realize the full value of improvements, these matters must be taken into consideration. A combination of correct conditions results in the most effective operation.

REVERSE CURVES.

Curves that reverse without any tangent between them mean operating expense. Not only must the super-elevation change abruptly, but the trucks must change their position in the same manner. It is considered good practice to leave room between the points of spiral for four freight cars to straighten up after they change direction. On most new construction, provision is made for at least 1,000 ft. between curves, and this practice is recommended unless great expense is involved.

EFFECT OF TUNNELS.

Many railroads are suffering today on account of the fact that during the early days of construction it was not thoroughly realized that a tunnel might be a limiting feature. The following are the causes of the limiting effect of tunnels: (1) A tunnel is dark, making the engine crew less confident. (2) A derailment in a tunnel is almost sure to result in serious damage and loss. (3) The heat in long tunnels, especially if of small section, is intense. (4) The track conditions, such as line and surface, are never as good as on the outside. (5) The rail is generally damp, causing either the excessive use of sand, or the slipping of drivers. (6) Drainage in tunnels is usually bad, and difficult to improve. (7) There are usually speed restrictions in tunnels. (8) It was formerly the practice to carry maximum grades through tunnels in order to shorten them. This serious defect in many cases makes tunnels the ruling points. (9) In tunnels of small section the use of helper engines is undesirable on account of the heat. (10) The smoke and gas add to discomfort of operation. (11) The impracticability of firing in long tunnels causes a drop in steam pressure.

There have been many plans devised for tunnel ventilation. Most of them are successful under some circumstances, but none is successful under all conditions. Long tunnels are generally built by means of shafts, and these shafts are sometimes left open to aid the ventilation. If the heat in the tunnel is greater than that outside, shafts will help when the atmosphere is low in humidity. When the humidity is high, shafts make but little difference in tunnel conditions. This is unfortunate, as tunnels at such times are very foul. Disc fans used in the shaft will operate satisfactorily sometimes, but their efficiency seems to vary about the same as the open shaft. Pure air blown down shafts is successful at times, but if the shaft is near the center, it generally happens that only one end of the tunnel is cleared out, the air remaining stationary at the other.

The Churchill System of ventilation, by which pure air is blown through the tunnel from one end through nozzles fitted at the sides of the tunnel, is successful, if the enginemen operate the locomotive so that the smoke is blown ahead of the engine. If two engines are used ahead on a train, and it is necessary to work the second engine, the position of the front engineer is unbearable. If one engine is used in the rear and one in front, and the smoke and gas from the second engine reaches the first one, the front engine crew are in the same position as in the case of the double-header, but if the train is skilfully handled, the smoke and gas of the rear engine will not reach the head engine. In tunnels where the grade inside is considerably less than the ruling grade, it is sometimes found possible to shut off one engine entirely, and in that case there is no difficulty, provided that the train does not move faster than the air current.

The natural tendency is to drive the engine as hard as possible through the tunnel on a heavy grade in order to get through quickly. The speed of the air currents in the Churchill System of ventilation in a tunnel a mile long usually averages about 8½ miles an hour over the whole distance. If the tunnel is being worked to anywhere near its capacity, the additional time in the tunnel may seriously limit the number of trains that may be put through it. It has been found, however, that if the tunnel is cleaned out by the ventilating apparatus before the passage of each train, there is little difficulty in getting through. As a rule, the engine crews prefer this method.

Double-track tunnels are of sufficient section so that there is little discomfort in a tunnel a mile long, even if the locomotive is fired all the way through. The practice in Europe has always been much better than that in the United States in that even with single-track tunnels their section has been large enough so that they are less uncomfortable than those in this country. Tunnel ventilation in Europe is largely restricted to the dilution of locomotive gas with plenty of fresh air, rather than driving the smoke and gas ahead of the engine.

In the construction of new tunnels, an effort should always be made to reduce the grade in the tunnel considerably below the ruling grade, so that there may be no need of touching the fire during the passage through the tunnel. Ample section to secure good conditions is essential. In this connection it should be noted that the effect of long single-track tunnels of narrow section on the ruling grade is to reduce the tonnage rating in the tunnel by 10 per cent. at least.

Reclamation Work at Bombay.—Reclamation of land at Bombay India, is rapidly progressing. About 525 acres will be recovered from the sea, 163 acres of which will be reserved for the grain, seed and cotton trades. Unloading sidings, warehouses, etc., with a complete system of roads and drainage throughout the entire area are planned. The cost of this work is estimated at over $12,500,000. The reclamation work is carried on by pumping mud from the bottom of the harbor by two self-propelling suction dredges, especially built for the purpose. These dredges are 205 ft. in length, beam 42 ft., and they will dredge 2,700 tons of material per hour each. The spoil is discharged through a floating pipe, 39 ins. in diameter, at a distance of 1,500 ft. from the side of the dredge.

NEWS SECTION

Editorial Comment—Personals—Society Meetings—Trade Notes—Catalog Reviews—Contract News, Embracing Bids Asked, Work Projected, Contracts Let and Contract Prices on All Classes of Civil Engineering Construction Work.

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The Doings of the Week.

Railroad construction prospects at the present time are excellent. A number of good sized contracts have been let recently, and a considerable amount of work is up for the consideration of contractors. One of the largest jobs on which bids have just been taken is for the reconstruction of the Northern Pacific line between Seattle and Sumas, Wash. This work will involve the expenditure of about $4,000,000. In New York City the Public Service Commission for the First District last week adopted and sent to the Board of Estimate and Apportionment a certificate granting to the Manhattan Ry. Co. the right to build and operate certain additional tracks on the Second, Third and Ninth Ave. elevated lines in Manhattan and The Bronx. This is popularly known as the third-tracking certificate, and will enable the Interborough Rapid Transit Co., which leases the Manhattan Ry. Co.'s lines, to complete the third-track on those lines and operate through express service from the southern part of Manhattan to the terminals at the Harlem River and in The Bronx. The grant of the third track privileges to the Manhattan Co. is the last of the contracts necessary for the completion of the dual system of rapid transit to be adopted by the Commission. The Board of Estimate and Apportionment met Monday to take action upon this certificate and all other contracts necessary to put into effect the agreement for the dual system of rapid transit. Among the railroad construction contracts let in the past few days are the following: M. W. Barnard, 401 Globe Bldg., Minneapolis, Minn., 10 miles of new work at Little Fork, Minn., on the Deer River extension of the Minnesota, Dakota & Western R. R.; Foley Bros., Welch & Stewart, St. Paul, Minn., for the Flaxton extension of the Minneapolis, St. Paul & Sault Ste. Marie Ry., 81 miles, and the Plaza extension, 34 miles; C. W. Lane & Co., Atlanta, Ga., for an 8-mile extension of the Carolina & Yadkin River R. R. from Thomasville to High Point, N. C.; W. W. Boxley, Roanoke, Va., for second track from Dispuntanta to Estes, Va., for the Norfolk & Western Ry.; Macdougal & McCluskey, Cochrane, Ont., for a 7-mile spur for the Temiskaming & Northern Ontario, R. R.; Johnson Bros., Port Hope, Ont., for the construction and P. H. Secord & Sons, Brantford, Ont., for the masonry work for the Lake Erie & Northern Ry., in Ontario.

State highway construction will soon be in full swing. In Pennsylvania the State Highway Commissioner is preparing to advertise for bids for as much work as the present funds will cover. The State Senate has passed the constitutional amendment to borrow $50,000,000 for building highways and the resolution now goes to the House. It is probable that it will be ratified there, and in that event it will be submitted to a special election before November. New York State, according to present indications, will not offer as much work as was originally intended. In Wisconsin the State Legislature has passed the Brown bill providing $450,000 for good roads. The State Roads Commission of Maryland is calling for bids on 11 sections of State highway aggregating 21½ miles, and the State Highway Commissioner of Ohio is asking proposals on four sections of highway aggregating 13¼ miles. In the way of municipal paving about the largest job that has come up for bids since our last issue is the work for Philadelphia, Pa. This covers contracts estimated to cost $430,000.

A number of good sized drainage jobs have come up for bids in the last few days. One of the larger of these calls for the construction of a system for the Overcup Drainage District of Jackson and Woodruff Counties, Arkansas. This work involves the excavation of about 30 miles of ditches, requiirng the moving of over 900,000 cu. yds. of earth. Several good sized levee and revetment contracts have also come up for bids recently. The Caddo Levee District, Shreveport, La., is asking bids on 28,000 ft. of revetment, and the Mississippi Levee District is to receive proposals on 500,000 cu. yds. of levee work.

Bids were opened last week by the Passaic Valley Sewerage Commission at Newark, N. J., for two more sections of the Passaic Valley sewers. The bids on one section ranged from $136,400 to $357,900. On the other section they ran from $163,000 to $580,506. The Frawley-Kaufman Contracting Co. Inc., New York City, was low bidder on both sections. The Indiana Legislature has passed the bill creating a sanitary district in the Indiana towns adjoining Chicago. The new sanitary district will embrace the towns of Whiting, Hammond, Gary and 10 surrounding smaller towns in Indiana. The sewerage from the new sanitary district will flow into the Little Calumet River and will double the water supply. The cost of the new district is estimated at $5,000,000.

The State Legislature of Kansas has passed an act creating a state irrigation board, and appropriating $125,000 for its use. Under the terms of the measure 31 Western Kansas counties, upon making tests of the underflow water supply, will be provided by the state with pumping plants for irrigation purposes and experiments. Any county, after making the test and providing a tract of 40 acres of ground for the experiments, will be furnished with a pumping plant.

A plan for the development of the East Boston water front has been submitted to the Directors of the Port of Boston by Henry V. Macksey of New York City, who was engaged by the Port Directors last December to present an outline of a scheme of port development planned with a view to meet the needs of great future expansion of commerce. The plan calls for extension of terminal facilities out over the Noddle Island Flats more and more as the port grows. The first pier mentioned in the plan is to be near the site of the new Immigration Station at Jeffries Point, and from that point the series of piers would stretch out over the flats in a line due east for 5,300 ft. In this area 10 piers would be included, and at this point the terminal would take a slight turn to the right, extending 7,700 ft. in a southeasterly direction across the Apple Island channel and completely covering the island. Thirteen additional piers could be constructed on this area. The construction of 23 piers, each 1,200 ft. in length, 250 ft. in width, and separated by docks 350 ft. wide, and an expenditure of approximately $100,000,000, are involved in the Macksey plan for development.

The New York, New Haven & Hartford is contemplating the construction of a $4,000,000 bridge over the Thames River at New London, Conn., and a bill is now pending in the State Legislature concerning the acceptance of the offer by the State. All the details of the new structure are not yet fully determined.

Manager of a City.

A few weeks ago mention was made in these columns that the city of Sumter, S. C., was advertising for a chief administration officer, to be known as the city manager. It is interesting to note that the City Commissioners received no less than 145 applications for the position, the applicants hailing from all parts of the country. The man selected was a young civil engineer, who was not a resident of Sumter. His duties are to propose and submit an annual budget; to keep the Commissioners advised as to the city's financial condition and needs; to see that the laws and ordinances are enforced; to attend all meetings of the Commission at which his presence is required; to recommend for adoption such measures as he may deem necessary or expedient; to appoint all officers and employes in the classified service of the municipality, subject to the law and civil service act; to propose and submit reports to the Commission, and to perform such other duties as may be required. This method of municipal management promises so well that several states, among them being New York, Iowa and Minnesota, are carefully looking into it. In Ohio a bill has been introduced in the State Legislature providing for the adoption in that state of a somewhat similar scheme. Bisbee, Ariz., is studying the Sumter plan, and a number of other cities will in the near future take the matter under consideration. The adoption of the plan by any considerable number of cities means the opening up of a new and promising field for the engineer.

State Government by Commission.

An adaption of the commission plan to the government of a state has been suggested to the legislature of Kansas by the Governor. His plan proposes the replacement of the present House of Representatives and Senate by a single body composed of representatives from the congressional districts, no district to have more than two members. These representatives would be elected by popular vote. The Legislature would be in session the entire year and thus would devote its entire time to the business of the state. Undoubtedly a small legislative body would be an improvement over the present inefficient and wasteful system of state legislation. Governor Hodges' suggestion is a significant indication of the changes that are sure to come in the near future.

PERSONAL

Mr. W. N. Willis has been appointed city engineer of Spartanburg, S. C.

Mr. Charles J. Bennett, of Hartford, Conn., has been appointed state highway commissioner for Connecticut.

Mr. C. A. Morse, chief engineer of the Santa Fe, has resigned to become chief engineer of the Rock Island lines, in Chicago.

Mr. B. E. Harrison has been appointed supervising engineer of construction for the Roberts Filter Manufacturing Co., of Darby, Pa.

Mr. Hugh Gall has been appointed assistant engineer to Mr. Frank Barber, consulting engineer and county engineer for the county of York, Ont.

Mr. William W. Wiard, vice-president of the Syracuse Chilled Plow Co., has been appointed a member of the Intercepting Sewer Board of Syracuse, N. Y.

Dr. Homer M. Derr, professor of civil engineering at the South Dakota State College, has been appointed state engineer of South Dakota, succeeding Mr. Samuel H. Lea.

Mr. R. E. Snowden, highway engineer of Snowden, N. C., has been engaged to take charge of all construction and maintenance of roads in Craven county, North Carolina.

Mr. George A. Scarcliff, of Janesville, Wis., graduate of the Wisconsin State University, has been appointed as civil engineer with the Brazilian Iron & Steel Co., Ouro Preto, Brazil.

Mr. S. B. Coutts, who was injured in a dynamite explosion while supervising the construction of a bridge near Skiatook, Kas., died in the hospital at Tulsa, Okla. Mr. Coutts was superintendent for the Canton Bridge Co.

Professor F. O. Dufour, of the University of Illinois, delivered an address before the Bridge and Structural Section, Western Society of Engineers, March 10, on "Some Experiments on Highway Bridges Under Moving Loads."

Francis Boradnax of Montclair, N. J., a noted consulting engineer, died at Utica, N. Y., March 14, aged 60. Mr. Boradnax installed the electric lighting system for the world's fair at Chicago, and was a consulting engineer on the Brooklyn bridge.

Mr. John R. Rablin, chief engineer for the Massachusetts Metropolitan Park Commission, Boston, Mass., on March 6, delivered an illustrated lecture on "Metropolitan Park System," before the graduate students in highway engineering at Columbia University.

Mr. Charles H. Garlick, for many years president of the Stationary Engineers' Union of America, and one of the pioneers of the oil industry in western Pennsylvania, was the speaker at the weekly luncheon of the Credit Men's Association of Pittsburgh, March 6.

Mr. R. H. Baldwin has been appointed as assistant to Mr. E. W. McGookin, who is in charge of the Detroit office of the Stewart-Warner Speedometer Corporation. It has been incorrectly rumored that Mr. Baldwin was appointed manager for the company.

Mr. Halford Erickson, of the Wisconsin Railroad Commission, will address the joint meeting of the Electrical Section, Western Society of Engineers, and the Chicago Section, A. I. E. E., at Chicago, March 24, on "The Regulation and Enforcement of the Public Utility Laws."

Mr. George M. Sullivan has been appointed supervising engineer for the new sewage disposal plant, new sewer and other concrete work to be done at Lexington, Ky. Prof. Paul F. Anderson was appointed consulting engineer to investigate and report upon the proposed electric lighting franchise. Mr. P. P. O'Neill has resigned as assistant city engineer.

Mr. Theodore W. Davis, civil engineer, died at his home in Poughkeepsie, N. Y., March 7. Mr. Davis was resident engineer and superintendent of the Poughkeepsie waterworks from 1868 until 1880, when he resigned to accept the position of chief engineer and superintendent of waterworks at St. Joseph, Mo. He later returned to Poughkeepsie and went into newspaper work. He was 69 years of age.

William Arrol, a well-known bridge builder of Glasgow, Scotland, died Feb. 20, aged 74. In 1875 Mr. Arrol erected the famous 727-ft. bridge across the Clyde, without falsework. In the same year he began the bridge at Glasgow, in which he introduced the multiple drill and the hydraulic riveter. He has since been identified with most of the important bridges built in Great Britain. The most famous of his bridges is the one across the Firth of Forth, for which he was knighted.

CIVIL SERVICE EXAMINATIONS.

The United States Civil Service Commission announces examinations as follows:

Mechanical Engineering Inspector, $1,200 to $1,500 per annum, April 16-17, 1913.

Electrical Engineering Inspector, $1,200 to $1,500 per annum, April 2-3, 1913.

Junior Engineer, $1,080 to $1,200 per annum, April 16-17, 1913.

The Illinois State Civil Service Commission will hold an examination as follows:

Junior Engineer, Highway Commission, $75 to $100 per month, April 5.

The San Francisco Civil Service Commission will hold an examination as follows:

Engineering Draftsman, March 29.

INDUSTRIAL

F. W. Hubbard, Secretary of the Kilbourne & Jacobs Manufacturing Co., Columbus, O., died March 2.

H. J. Heinz Co., Pittsburgh, has awarded a contract to the Raymond Concrete Pile Co. for concrete piles and reinforced concrete footings for the new boiler house and tomato product building at the Pittsburgh plant.

The Western Pump & Engineering Co. has been organized and will have its offices at 339-343 Railway Exchange, Chicago. The business of the company will be devoted principally to "McGowan" pumping machinery, air compressors and other mechanical equipment. Joseph E. Bond, formerly Chief Engineer of the B. M. Osburn Co., is President of the Western Pump & Engineering Co., and Royal C. Wise, formerly Mechanical Engineer of Henson & Hubbell, is Secretary.

The Mead-Morrison Manufacturing Co. of Boston, Mass., has purchased some ten acres of land on the Boston & Albany R. R., East Boston, and will erect a large plant at this location to take care of its manufacturing business. The company has been in the market for the past three years for a new location on account of having outgrown present facilities in Cambridge. The machine shops that the Mead-Morrison Manufacturing Co. will erect will be one of the largest shops of their kind in the United States. They will consist of a plate shop, pattern shop, foundries and general offices. Contracts have already been awarded to the McClintic-Marshall Construction Co. of Pittsburgh, Pa., for the machine and erection shop, and to Lovering & Garrigues Co. of Dunellen, N. J., for the plate shop. The New England Foundation Co. has been awarded contract for the foundations, and the Shaw Electric Co. has been awarded the contract for the electric cranes. The shops will be equipped with four 10-ton cranes and one 85-ton crane, and will be completed in 3½ to 4 months. The Mead-Morrison Manufacturing Co. makes a specialty of coal handling machinery and steam and electric hoists and contracts to erect and equip the largest docks for the handling of coal, not alone in the United States but abroad. Orders at the present time are on the books for one year's output and the company will employ in the new plant about 1,000 men. The company is owned and controlled by the same people who established and built up the business and the directors are: William J. Hoyt, Manchester, N. H.; Frank P. Carpenter, Manchester, N. H.; John G. Morrison, Cambridge, Mass.; Willard S. Martin, Cambridge, Mass.; Eugene N. Foss, Boston, Mass.; Arthur P. French, Boston, Mass. Governor Foss is president, Mr. Morrison treasurer, Mr. Gale assistant treasurer, and Mr. Martin vice president and general manager.

CATALOGUES

Bushings & Locknuts.—Paper, 6x9 ins., 2 pp Steel City Electric Co., Pittsburgh, Pa.

This is a loose leaf which is entitled Bulletin A for insertion in the catalog. It contains illustrations with tables of sizes and prices for Star Brass Bushings.

Better Buildings.—Paper, 6x9 ins., 60 pp. The American Sheet & Tin Plate Co., Pittsburgh, Pa.

This is a concise and useful book of information illustrating and describing the uses of formed metal roofing and siding materials.

Schub Concrete Form System.—Paper, 4x9¼ ins., 6 pp. C. H. Schub, 1947 Broadway, New York City.

A number of bulletins are issued which illustrate and describe the Schub Unit System of Interchangeable Metal Molds for concrete residence and other building construction.

Standard Mexican Asphalt.—Paper, 3½x7¾ ins., 16 pp. Standard Oil Co. of New York, Road Oil Dept., 26 Broadway, New York City.

This contains reports of tests on Standard Refined Mexican Asphalt by two firms of consulting engineers.

Bathroom Plumbing.—Paper, 7x10 ins., 16 pp. Standard Sanitary Manufacturing Co., 900 Michigan Ave., Chicago, Ill.

This book contains illustrations showing the exhibit of the company at the show rooms in the Karpen Building.

McKay Concrete Forms.—Paper, 6¼x8¾ ins., 10 pp. McKay Concrete Form Co., Inc., 47 W. 34th St., New York City.

This book contains complete illustrations and descriptions of a metal form for concrete walls and floors.

Sett-Making Machines.—Paper, 6x9 ins., 12 pp. Wern Machinery & Engineering Co., 32 Church St., New York City.

This catalog contains a description of the sett-making machine and its operation and gives testimonial letters and illustrations of pavements made.

Lubrication.—Paper, 5½x8½ ins., 12 pp. The Texas Company, 17 Battery Place, New York City.

The February number of "Lubrication" contains articles relative to the economical use of oil for motors.

Sprague Electric Equipment.—Paper, 8¼x11 ins., 24 pp. Sprague Electric Works, 527 W. 34th St., New York City.

This catalog illustrates and describes a large number of electrical devices for buildings. This is Bulletin No. 115.

Bulletin No. 241, 8x10½ ins., 32 pp., deals with motor drive for electrotyping and stereotyping machinery.

Catalog No. 327 is devoted to electric fans of all types.

Acme Corrugated Culverts.—Paper, 7x10 ins., 56 pp. Canton Culvert Co., Canton, O.

This catalog gives a history of corrugated metal culverts with a description of the "Acme" (Nestable) Corrugated Culverts, the "Imperial" riveted corrugated culverts and the "Duro" perforated corrugated culverts and drains. Complete descriptions and information as to the materials used, tests, etc., are given. The catalog contains a large number of illustrations showing details of construction and showing culverts as completed.

Another catalog, 3½x6 ins., 24 pp., contains illustrations and descriptions of Acme (Nestable) Culverts and gives useful information regarding their use.

Steelcrete Expanded Metal.—Cloth, 8x5 ins., 118 pp. The Consolidated Expanded Metal Companies, Pittsburgh and New York City.

This is a loose leaf catalog which contains a handbook of design with tables, standards and useful information pertaining to the steelcrete system of reinforced concrete. Included is a 16-page booklet giving illustrations of concrete sewers reinforced with expanded metal, and another booklet describing expanded metal construction pertaining to building walls, ceilings and tanks of rectangular and circular construction. Complete designing data are given.

Excavator Buckets.—Paper, 6x9 ins., 32 pp. Jos. F. Kiesler Co., Sangamon & Pratt Sts., Chicago, Ill.

In this catalog are illustrated the Kiesler Patent Clam Shell, Orange Peel and Scraper Buckets adapted to every variety of dredging and excavating. Tables of sizes, prices, and brief descriptions accompany the illustrations. There are also a number of letters from users giving opinions of the buckets.

Locomobile Trucks.—Paper, 8½x11 ins., 4 pp. The Locomobile Co., 2000 Michigan Ave., Chicago, Ill.

This catalog illustrates and describes the advantages of Locomobile power operated removable and dumping bodies used in Chicago in handling freight between the Loop Station and several suburban stations. A schedule of the work of three trucks is given.

Compression Riveters.—Paper, 6x9 ins., 8 pp. Pneumatic Tool Co., Fisher Bldg., Chicago, Ill.

This catalog illustrates and describes a compression or squeeze riveter which may be used advantageously where the riveting to be done is more or less uniform and accessible, and where a large number of rivets are to be driven. This is Bulletin No. 126.

Bulletin No. 129 deals with pneumatic hose, hose couplings and hose clamp tools.

Bristol Automatic Recorders.—Paper, 8x 10½ ins. The Bristol Company, Waterbury, Conn.

Bulletin No. 139, 8 pp., illustrates and describes a mechanical time recorder for showing the time and extent of mechanical movements.

Bulletin No. 138, 15 pp., illustrates and describes an electric time recorder.

Catalog No. 1200, 48 pp., illustrates and describes Bristol's Class II Recording Thermometer.

RAILWAYS

Alabama.

It has been announced at Birmingham, Ala., that the Sea Board Air Line R. R. will shortly construct the extension from the main line into Anniston, Ala.

The Birmingham & Tuscaloosa Railway & Utilities Co., incorporated recently with a capital stock of $3,500, proposes the construction of a railway running from Gadsden to Tuscaloosa via Attalla, Ashville, Birmingham and Bessemer, and the operation of a belt line railway in Tuscaloosa county. In addition, it is planned to operate a boat and barge line on the Warrior River to Mobile and via canal and the gulf to New Orleans, and to build gas plants and other plants in the counties of Etowah, Jefferson and Tuscaloosa. The incorporators are C. R. Carter, 1831 Fifth Ave., Birmingham, Ala., Purchasing Agent of the Birmingham, Ensley & Bessemer R. R.; C. S. Gannon, Birmingham, Auditor of the above railroad, and W. D. Adams.

California.

Commissioners of Shasta County have been asked to grant a franchise over the county roads for an electric railway. City Trustees of Redding have also been asked for a franchise. Albert C. Agnew, Oakland, Cal., is interested.

The Southern Pacific Ry., and the Santa Fe System are reported to have decided to construct an oil pipe line from Bakersfield to Mojave, over the Tekachapi Mountains. The cost is estimated at $1,500,000. E. O. Faulkner, Los Angeles, Cal., is Manager of Timber and Fuel Lands of the Santa Fe.

Plans have been prepared for several miles of additional track at the Calwa yards of the Santa Fe, to cost between $75,000 and $100,000. W. L. Bradley, Fresno, is Division Engineer.

At a recent meeting of the stockholders of the Tidewater Southern R. R. Co., the matter of constructing the road to Turlock and then on to Merced River was discussed. Nothing definite was decided upon, however. J. H. Wallace, Stockton, Calif., is Chief Engineer.

Articles of incorporation have been filed at Los Angeles, Calif., by a company proposing the construction of a railroad between Eureka and Fort Jones, a distance of 110 miles. As proposed the route will follow the Klamath River from the coast to the mouth of Scott River.

The Ocean Shore Ry., A. Williams, General Manager, San Francisco, has applied to the State Railroad Commission for authorization to issue $700,000 first mortgage 6 per cent three year gold bonds. It is set forth that about $250,000 is needed to purchase right of way and to buy new equipment. The company plans to ultimately close the gap between the San Francisco and the Santa Cruz ends of its line.

Connecticut.

The Engineering Department of the New York, New Haven & Hartford R. R., is understood to be working on plans to four track the shore line division, build a tunnel through the city of New London, and construct a four-track bridge at New London.

Florida.

Surveys have been started for the construction of a 1½ mile street car line at Pass-a-Grille. Noel A. Mitchell, St. Petersburg, Fla., is interested.

Georgia.

The Southern Ry. is to have work started shortly on double tracking between Armour and Crosskeys on its main line. The grades will be cut down and the curves reduced.

The Shenandoah & Southern Ry., W. G. Tuten, President, Letford, Ga., has surveys under way for an extension from Wiley to Glenville to connect with the Georgia Coast & Piedmont Ry. A further extension from Glenville to a connection with the Southern near Boxley is also under consideration.

Idaho.

The promoters of the proposed railroad from Twin Falls, Idaho, to Wells, Nev., will probably soon make arrangements for a survey of the route. George D. Aiken, Twin Falls, is interested.

The Pacific & Idaho Northern Ry., E. M. Heigho, President, New Meadows, Idaho, is reported to be planning to extend its line north this year from New Meadows down the Little Salmon to Riggins, Idaho.

The Utah Construction Co., Ogden, Utah, has established a grading camp at Philbin Siding, 3 miles west of Pocatello, Idaho, and everything is ready for commencing work on the double track line of the Oregon Short Line R. R. west of Pocatello to Michaud. Archie Bowman is Superintendent of the work in the vicinity of Pocatello.

The farmers of the Tammany district, between Lewiston, Ida., and Waha, have appointed a committee of five to act in conjunction with the Lewiston Committee in securing subscription and free right of way. The permanent survey will be completed from Lewiston to Vollmer in a short time.

Illinois.

It is expected that the Rock Island Southern Ry. (electric), W. W. McCullough, General Manager, Monmouth, Ill., will make public its plans next month for its proposed extension into Galesburg.

The Peoria Engineering & Contracting Co. has been organized for the purpose of constructing the projected line of the Peoria & Galesburg Interurban Ry. from Peoria to Galesburg. The offices of the railway are at 929 Jefferson Bldg., Peoria.

It has been announced by F. W. Cherry, Princeton, Ill., that French capital has been secured for financing the Milwaukee, Peoria & St. Louis Ry. and that work will probably be started by June. The new road is mapped out to extend from Peoria to Rockford, a distance of 120 miles. The cost of construction will be $18,000 per mile. The roadway, leaving Peoria, will be built through the sloughs and bayous of the Illinois River. It will touch Spring Bay, Lacon, Hennepin and all of the towns of importance between Peoria and Rockford.

J. E. Melick, Springfield, Ill., has submitted a proposition to the residents along the proposed right of way through Calhoun County offering to construct a railroad providing they furnish right of way and bonuses.

The Santa Fe system has announced that the following minor improvements are contemplated: Arizona Division—Extension of the passing track at Klondike, estimated cost, $14,037; purchase of additional machinery at Barstow, $2,700, and at Bakersfield, $4,500. Albuquerque Division—Reducing grades and widening cuts and fills, estimated cost, $2,320. Eastern Division—Providing electric lighting system at Emporia, estimated cost, $2,000. Los Angeles Division—Installing a spur track for W. P. Fuller, at San Diego, changing and extending track to serve San Gabriel River Rock Co., at Davison. Middle Division—Replacing bridge No. A208. Missouri Division—Improvement of track between mileposts 278 and 293, with heavier rail. Panhandle Division—Renewal of bridge No. 48D, S. F. P. & P. lines, extending passing track at Glendale. Southern Kansas Division—Replacing bridge No. 133A, 77E, estimated cost, $4,500; extending trackage at Dewey, $1,414; extending spur track at Fiat, $1,055; renewing bridge No. 89C, $1,133; replacing bridge No. 115C, $1,259; renewing bridge No. 115A, $3,028. Valley Division—Richmond, installing a track for H. Jonson, additional machinery and tools, $7,281; Reedley, installing a spur track for the Union Oil Co.; Antioch, installing and relocating track to serve the California Paper & Board Mills, adjusting the track grades and widening the embankment between mile posts 1121 and 1129.

Indiana.

The Richmond, Portland & Fort Wayne R. R. Co. has been incorporated with a capital stock of $100,000, of which $10,000 has been subscribed, and proposes an interurban line passing through Ft. Wayne, Decatur, Monroe, Berne, Ceylon, Geneva, Bryant, Portland, Winchester, Lynn, Fountain City, Richmond and all intervening cities and towns. The directors of the road are Grant S. Staub, William F. Harbison, Charles F. Harbison, Richard J. McCarty and Chris. H. Frank. The principal office is to be at Portland, Ind.

Kansas.

The Interstate Railroad & Traction Co. has been chartered with a capital stock of $500,000 and proposes a 50-mile line between Arkansas City, Chilocco, Blackwell, Tontkawa and Ponca City. The place of principal business is at Blackwell. Orrin L. Brown, Arkansas City, Kan., is President. The other incorporators are W. L. Cunningham of Arkansas City, Kan.; J. M. VanWinkle and C. B. Harrold, of Ponca City, Okla.

City Commissioners of Iola, Kans., have granted a street railway franchise to D. H. Siggins, Coffeyville, Kan., President of the Union Traction Co. It is stated that the Traction Company will, in the near future, extend its interurban line from Cherryvale to Iola.

Election is to be held in Neodesha Township on April 26, to vote on issuing $10,000 bonds to assist the Independence, Neodesha & Topeka Traction Co. in building an interurban line from Independence to Neodesha. The latter city will vote shortly on issuing $15,000 of bonds for this purpose. Surveys for the line from Neodesha to Independence have been made. Dr. T. Blakesley, Neodesha, is President of the Traction Co.

Kentucky.

The Chicago, Memphis & Gulf R. R. Co. has filed articles of incorporation in Kentucky. This company operates 52 miles of line, its present terminus being at Hickman, Ky. The articles of incorporation are signed by officials of the Illinois Central Ry., which recently acquired possession of the road. Surveys have been made for a continuation of the line from Hickman to Paducah, and there are indications that this stretch of track will be built shortly.

Louisiana.

Surveys have been made by the Texas & Pacific for the construction of two sidetracks, one from each side of the main line, extending from a point 1¼ miles from Willow Glen, La., to a point 1½ miles south of the Hardwood Mill district. The tracks extend through a portion of the palmetto swamp through which the T. & P. passes between Alexandria, La., and Willow Glen Station. C. H. Chamberlain, Dallas, Tex., is Chief Engineer.

Maine.

As noted in our last issue the town of Madison, Me., voted $5,000 toward the Skowhegan-Athens R. R. project. The Maine Central R. R. Co. has given $15,000; Skowhegan has raised $15,000; Athens has raised with town appropriation and private subscription about $30,000; Cornville has raised $3,000 by vote and added about $5,000 in private subscriptions.

Maryland.

State Public Service Commission is considering a petition filed by the Western Maryland Ry. Co. and the Western Maryland Railway Terminal Co., asking permission for the issue of $700,000 of stock by the terminal company and for its purchase by the railway company. The stock is to be issued for the purchase of the land recently secured by the Western Maryland for terminals at Port Covington.

Massachusetts.

✣Bids will be received until noon, March 25, by Boston Transit Commission, B. Leighton Beal, Secy., 9th floor, 15 Beacon St., Boston, Mass., for building Section B of the Dorchester Tunnel, in Summer St. and extending from near Washington St. to near Arch St., a distance of about 500 lin. ft.

It has been announced that the New York, New Haven & Hartford Ry. will rebuild 78 cross-overs on the main line between New York and Boston; also 36 interlocking plants.

⊙The Barrows-Stewart Co., 40 Central St., Boston, Mass., has been awarded the general contract for the construction of a steel and concrete signal tower for the Boston, Revere Beach & Lynn Railroad Co. at Orient Heights, Mass. G. M. Thompson, Chief Engineer. Work will be started immediately.

The State Legislature has granted an extension of 15 months for beginning work on the proposed interurban electric railroad from Boston to Providence. The company was organized three years ago, but its charter rights expired on Dec. 31 last. Locations for the line in this state have been filed and approved by the Railroad Commission. The route practically parallels that of the Providence division of the New York, New Haven and Hartford R. R.

Michigan.

The Gogebic & Iron Counties Railway & Light Co. of Bessemer, Wash., has increased its capital stock from $350,000 to $191,700.

Minnesota.

⊙M. W. Barnard, 101 Globe Bldg., Minneapolis, Minn., has been awarded 10 miles of new work on the Deer River Extension of the Minnesota, Dakota & Western R. R., at Little Fork, Minn. This is all wheelbarrow work and will commence at once.

The Commercial Club of Bemidji, Minn., is to make efforts to secure if possible the construction of a new railroad line connecting that place with Warroad and traversing the Red Lake Indian Reservation. J. J. Opsahl is Chairman of the Special Traffic Committee of the club.

Among the rumors concerning the projected work of the Rock Island System is one to the effect that the company contemplates the construction this spring of a line from Titonka to Fairmont, Minn., by way of Bancroft and Swea City.

An engineering crew of nine men under direction of F. J. Egan, St. Paul, Minn., has started surveys of the proposed route for the Billings & Central Montana Railroad, mentioned in our last issue.

Missouri.

The Bismarck, Bellevue Valley & Western Ry. Co., which is now constructing a 52-mile line from Bismarck to Bunker, has elected the following directors for the ensuing year: J. R. Roycroft, C. E. Hamilton, F. J. Merriam, S. N. Falder, O. S. Meyer, G. M. London and L. L. Tiernan, St Louis, S. J. Bunker, Bunker, Mo.; Redmond Black, Edge Hill, Mo.; Judge Edward T. Eversole, Potosi, Mo., and E. E. Evans, Bismarck, Mo.

Montana.

The Gilmore & Pittsburgh R. R., W. A. McCutcheon, President, Machnesney Bldg., Pittsburgh, Pa., is reported to be planning to extend its line this year from Armstead northeasterly to Twin Bridges, Mont., to a connection with the Northern Pacific.

Nebraska.

Residents of Middle Loup Valley in northern Custer County, Nebr., have plans under way to interest the Union Pacific in a proposition to build a line from Loup City, or Ord, westward to an intersection with the Kearney branch of that system at Stapleton.

New Hampshire.

The management of the Boston & Maine R. R. has appropriated $80,000 for the enlargement of its freight yard at Concord, N. H.

New Jersey.

The Morris County Traction Co., Morristown, N. J., has surveys underway for its proposed line from Morris Plains over the Mountains to a connection with its present route at Dickerson Bridge in Dover.

New York.

The New York State Rys. Co. has appropriated $250,000 for improvements to its Syracuse lines, of which B. E. Tilton, Syracuse, is General Manager. The improvements include the following: Relaying tracks and new work, $200,000; wire replacements, $10,000; rebuilding ten cars to P. A. Y. E. type, $10,000; Liverpool extension, $9,895; additional storage, track, Wolf street yard, $4,045; new Y's, Solvay and Dudley lines, $6,000; renewal of poles, $1,850.

The International Ry. Co. (electric), Ellicott Sq., Buffalo, N. Y., is understood to be planning to begin work early in the spring on double tracking the 16-mile section of its line from Lockport to North Tonawanda. It is reported that the improvement will cost about $500,000.

North Carolina.

⊙C. W. Lane & Co., Atlanta, Ga., are reported to have been awarded a contract by the Carolina & Yadkin River R. R., for building an 8-mile extension from Thomasville to High Point.

The Durham & Southern Ry., J. E. Stagg, Vice President, Durham, N. C., has made preliminary surveys for an extension from Dunn to Mt. Olive.

The North State Ry. Co., chartered early this month, proposes the construction of a railway from Bunn to Raleigh. The Montgomery Lumber Co. and Northern capitalists are reported to be interested.

The Saluda-Hendersonville Interurban R. R. Co., of Kings Mountain, N. C., has been incorporated with a capital stock of $100,000, and proposes to build a line from Saluda to the "Narrows" on Green River and to other points within 50 miles of Saluda.

North Dakota.

⊙Foley Bros., Welch & Stewart, St. Paul, Minn., have been awarded the contract by the Minneapolis, St. Paul & Sault Ste Marie Ry., for an extension of the Flaxton line westerly, 81 miles from the present terminus at Ambrose and for an extension of the Plaza line westerly, a distance of 34 miles. There are no large bridges or trestles, and only the usual amount of grading on these extensions.

Ohio.

✣Bids will be received until noon, March 27, by W. H. Kirby, Secretary, Director of Public Service, Cleveland, O., for the construction of concrete foundations and railroad siding for the municipal electric light plant of the city of Cleveland. Specifications may be obtained at the office of the Engineer of Construction, 310 City Hall.

Legislation is before the City Council of Toledo, authorizing the Toledo Railways & Light Co., Adams and Superior Sts., to construct a double track and loop in Broadway, from St. James Court to the boulevard. About 2,000 ft. of track will be laid, and the cost will approximate $50,000.

The New York Central Lines has purchased 32 acres of land just west of Ashtabula on which to erect a pressed steel car plant to manufacture equipment for the New York Central system. The plans are understood to call for blast furnaces, open hearths and rolling mills. Two buildings, 1,500x150 ft., will be erected. Operations are to commence at once it is said.

Lake Shore & Michigan Southern Ry. has purchased a tract of land at Bergholz on its Alliance branch, and proposes to construct yards there this summer.

Oklahoma.

Proposition has been submitted to the Bartlesville Interurban Ry. Co., Bartlesville, Okla., by H. B. Rodecker, a merchant of Oglesby, Okla., for an extension of the line to Oglesby this summer. As projected the line would run through the Rice Creek and Hogshooter valleys and probably would be built on to Claremore.

Both branches of the State Legislature have passed resolutions for an amendment to the constitution to provide that short lines of railroad built within the state can be leased or

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

sold to interstate railway systems, and operated under their management.

Oregon.

It has been announced by E. M. Chester, Marshfield, Ore., one of the incorporators of the subsidiary company of the Southern Pacific, that work will be started shortly on the proposed line extending from Marshfield to Trinidad Calif., connecting with the Coast Line through Eureka and on to San Francisco, Calif. Bradford Wheeler, Marshfield, Ore., is Engineer in charge.

Pennsylvania.

The Eastern Connecting R. R. of Northampton County, Pa., has been incorporated in Pennsylvania with a capitalization of $200,000.

The Central R. R. of New Jersey is contemplating extensive betterment work this summer on its line between Easton and Northampton, 24 miles. This work includes 4-tracking the road between the points mentioned.

Borough Council of Honesdale has granted a franchise to the Wayne County Traction Co., Honesdale, to lay its track over certain streets.

Stockholders of the York Rys. Co., 27 W. Market St., York, Pa., have authorized the extension of the Prospect St. line to Green Hill and Elmwood.

The directors of the Pennsylvania R. R. have voted to establish an electric system for suburban passenger train service on the main line between Broad street station, Philadelphia, and Paoli, Pa., a distance of 20 miles. It is probable the work of electrification will begin soon, and it is expected suburban trains will be using the system next year. The installing of the system will involve an expenditure of about $4,000,000.

The Miller Construction Co., Lock Haven, Pa., is preparing to start work on the B. P. & R. Ry. contract near Homer City, Indiana County, Pa. Included in the contract is a large trestle and some heavy grading and excavation, involving the moving of about 300,000 cu. yds. of earth.

Application has been made to the Borough Council of Dunmore for a franchise for an electric railway to Lake Ariel. Gerald MacDonald, President of the MacDonald Construction Co., Scranton, is one of the incorporators of the company applying for the franchise.

The Baltimore & Ohio Ry. will expend about $1,500,000 for improvements on the Somerset and Cambria Division, between Johnstown and Rockwood, Pa. The work will be started just as soon as the sanction of the city authorities of Johnstown can be obtained authorizing the railroad company to proceed. The improvements will include modern passenger and freight facilities and large yards in Johnstown, more than doubling the present capacity of the Baltimore & Ohio's facilities there; construction of passenger and freight facilities which will enlarge the capacity of the terminal at Somerset, building long passing sidings and heavy steel bridges on the Somerset and Cambria division, which will provide a double-track on a considerable stretch of the line, new passenger station at Rockwood and the construction of a new low-grade line between that point and Garrett, Pa. Work on the low-grade line between Rockwood and Garrett, over which freight originating on the Somerset and Cambria division will be hauled, has been started. The construction of a third track and elimination of grades will be involved in the improvement. The new line will be nearly eight miles in length and will cost about $500,000. The improvements at Johnstown will call for the expenditure of about $500,000. The passenger station, which will be located on Main St., will be 100 ft. long by 28 ft. wide and of stone construction. The floor of the station will be of tile and the building will be steam heated throughout and lighted by electricity. Brick platforms will surround the station and a driveway for vehicles will be provided. The freight station will be of brick construction, 300 ft. long and 28 ft. wide. It will be at Baltimore and Bedford Sts. The foundations will be of concrete and the floors of the freight house will be wooden blocks. Covered platforms, 200 ft. long by 14 ft. wide, will extend beyond the end of the freight house. The building will be equipped with a modern refrigerator room for protecting perishable freight and a steam heating plant will be installed throughout. Ample protection against fire will be provided. Two freight house tracks will be built and two team tracks will permit loading direct from the cars to drays. There will be a driveway between the team tracks. The assembling yard will be in the Sandyvale cemetery district of Johnstown. The capacity of this yard will be 240 cars. The interchange yard, in which the traffic to and from the Cambria Steel Co. will be handled, will be located north of Center St., on the present site of the passenger and freight stations. The capacity of this yard will be 160 cars. An 80-ft. turntable will be built and a 70-ft. ash-pit for handling the locomotives, also engine-house with store room, oil house, etc. At Somerset extensive facilities will be provided to take care of both passenger and freight business. A large freight yard will be built with a capacity of 500 cars. A large roundhouse and other terminal buildings will be included in the improvements at Somerset, the cost of which will be about $400,000. The exact location of the long passing sidings has not been definitely decided, though this question is now being studied with the view to facilitating the movement of trains in sections where they are considered most urgent. Steel bridges will replace weaker structures at Holsople, Skew, Paint Creek, Hog Back Tunnel and Stony Creek, and these will permit of the operation of the heavy locomotives and cars that will be used on the line.

South Dakota.

All right of way for the new line through Big Stone City, S. Dak., has been purchased by the Chicago, Milwaukee & Puget Sound, and E. F. Leese, the contractor for the work, has established a camp in that city.

Tennessee.

The Paris Clay Co., Paris, Tenn., has been making surveys for a track from Ridley's Tank on the N. C. & St. L. Ry., two miles east of M'Kenzie, to run by the clay banks in Carroll County.

Practicallly all right of way for the new electric interurban railway between Bristol and Johnson iCty has been secured and there is some prospect that construction work will be started shortly. B. L. Dulaney, Bristol, Tenn., is interested.

The Murfreesboro Interurban Co. will probably apply to the April session of the County Court at Nashville for permission to construct an interurban line from Nashville to Woodbury, in Canon County, via Murfreesboro. Richard T. Wilson, of the Wilson Realty Co., Nashville, is managing the project. It is stated that the company hopes to start work on the line in the early spring.

Texas.

The Artesian Belt R. R. has let a contract for the extension of its line from Christian to Crowther, a distance of 17 miles, and work will be started immediately. H. E. Hilderbrandt, San Antonio, Tex., is President, and Jno. P. Jackson, Macedona, Tex., is Chief Engineer.

Since the passing of the Katy Merger Bill, it is taken as an assured fact that the Beaumont & Great Northern R. R. will be extended east from Livingston to Beaumont and west from Weldon to a point on the Trinity & Brazos Valley R. R. near Jewett. It is expected that Trinity, Tex., will be a division point. William Carlisle, Atchison, Kan., is President of the B. & G. N. Ry.

The Southwestern Engineering Co. has finished locating several routes for the first section of the San Antonio & Austin Interurban Ry., and is continuing the work for the other sections. One of the routes will be selected for a 16-mile portion of the line. W. B. Tuttle, San Antonio, Tex., is Vice President of the interurban company.

The Interstate Development Co. has been organized under the laws of Arizona for the purpose of promoting the construction of a railroad between either Dallas or Fort Worth and Port Arthur. The company will acquire right of way, make the necessary surveys, and attend to raising bonuses. The officers of the company are Dr. R. B. Bledsoe, president; W. M. Glenn, vice-president; W. R. McMullen, treasurer and Col. P. A. McCarthy, C. E., secretary. All of the above reside in Lufkin, Tex.

Vermont.

The State Legislature at its recent session, granted a charter for the construction of 18 miles of railroad, to be built for the New England Hardwood Co. This line will extend from Greenfield, Mass., to Wilmington, Vt., by way of Jacksonville. It will be 31 miles long, 13 miles of this being in Massachusetts. Lloyd & Mann, Concord, N. H., are in charge of the engineering work.

Virginia.

⊙Norfolk & Western Ry. is reported to have awarded a contract to W. W. Boxley, Roanoke, Va., for constructing second track from Disputanta to Estes, Va.

Washington.

The Northern Pacific Ry. has taken bids on the reconstruction of its line between Seattle and Sumas. The work will cost about $4,000,000. The following contractors submitted bids on the work: Grant Smith & Co., Henry Bldg., Seattle; Twohy Bros., Wells-Fargo Bldg., Spokane; Porter Bros., Railway Exchange Bldg., Portland, and Sims & Cary, St. Paul.

West Virginia.

The Kuhn interests of Pittsburgh, Pa., the present owners of the Wheeling Traction Co., are reported to have acquired the West Virginia Traction & Electric Co. It is stated that the Morgantown and Dunkard's Valley line, which extends four miles out of Morgantown, in the direction of Wheeling, will also be purchased by the Kuhn interests and that the two cities will be connected by electric lines in the near future.

The West Virginia Traction & Electric Co., Wheeling, W. Va., is contemplating a number of improvements for the coming season. These are understood to include the boring of tunnels at Reymann's Hill and West Alexander Hill for extensions in the greater Wheeling District. Plans for the tunnel work are reported to be about completed.

Press reports state that President Daniel Willard of the Baltimore & Ohio Railroad has announced that improvements are contemplated for 1913 involving an expenditure of $27,000,000. The biggest piece of work contemplated on the whole system and the one involving the largest expenditure will be on the Cumberland division, where $7,000,000 will be spent at Do Gully, W. Va., for the construction of an additional two-track line from Orleans Road to Little Cacapon, a distance of 14½ miles, connecting with the present three-track line. A million will be spent on a third and fourth track from Connellsville to Pittsburgh, while a new bridge will be built across the Allegheny River at Pittsburgh. This will cost approximately $2,500,000. On the Ohio River division $400,000 will be spent for freight house facilities and trade at Parkersburg and $300,000 for a connection between the Ohio River Railroad and the Little Kanawha.

Wyoming.

A project is reported under consideration for the construction of a street car line at Laramie. The Laramie Electric Co., C. E. Van Diest, Manager, Laramie, Wyo., is reported to be interested.

Canada.

⊙Johnson Bros., Port Hope, Ont., have been awarded the contract for the construction of the Lake Erie & Northern Ry. P. H. Secord

& Sons, Brantford, Ont., have the contract for the masonry work.

⊙Foley Bros., Welch & Stewart, St. Paul, Minn., have been awarded the contract for constructing the remaining 425 miles of the Grand Trunk Pacific Ry.

⊙Macdougal & McCluskey, Cochrane, Ont., have been awarded the contract for constructing seven miles of line for the Temiskaming & Northern Ontario R. R., from the main line to Iroquois Falls in the Abitibi River.

The Michigan Central Ry. has plans under way for a new machine shop and power house to be erected this summer at St. Thomas at a cost of $150,000.

The Alberta Interurban Ry. has 25 miles of line graded, ready for track on its first line to Carbon. As soon as the frost gets out of the ground grading will be resumed and track laying started. The surveys for the first 25 miles west, towards Banff, is completed, and it is the intention to start grading on this line also. H. J. C. Zinck, Calgary, Alberta, is Manager.

ROADS AND STREETS

Alabama.

The City Commission of Birmingham, Ala., has ordered 24th St., from Eighth Ave. to 12th Ave., N., and 12th Ave., from 24th to 32d Sts., paved. Walter G. Kirkpatrick is City Engineer.

President Culpepper Exum of the City Commission, Birmingham, Ala., has taken steps to obtain the necessary data upon which ot start preliminary plans for the boulevard from East Lake to Fairview.

Arkansas.

✣Bids will be received until noon, March 24, by George A. Stratman, Secy., Little Rock, Ark., for paving of East Second St. from Main to Byrd, Scott St. from Markham to Third, Cumberland from Markham to Third, Rector Ave. from Fourth to Fifth, Rector Ave. from Markham to Third, Byrd St. from Second to Third. A certified check in the sum of $1,000, made payable to the commissioners of the district, shall accompany each proposal. Plans and specifications can be had on application of the engineer in charge, Henry Levinson; Ike Kempner is Chairman.

Property owners of Conway, Ark., have decided to pave Front St., from Arkway Theater to Main St.; Oak St., from the railway to Court St., and North St., from the railway to Spencer St. Engineers are now at work securing data upon which the cost will be based.

California.

✣Bids will be received from 11 a. m. until noon, March 20, by F. R. Thompson, City Clerk, Oakland, Calif., for considerable street improvement work.

✣Bids will be received from 2 p. m. until 3 p. m., April 9, by Board of Public Works, F. J. Churchill, Secy., San Francisco, Calif., for the construction and completion of a tunnel with approaches and appurtenances thereto in Stockton street, between Sutter and Sacramento streets, in the City and County of San Francisco. Official advertisement will be found elsewhere in this issue.

✣Bids will be received at the office of the California Highway Commission, 515 Forum Bldg., Sacramento, Cal., until 2 p. m. on March 24, 1913, at which time they will be publicly opened and read, for constructing a portion of a state highway in Stanislaus County, between Station 690 + 00, approximately 1½ miles northwest of Ceres and the northerly county boundary; Division III, Route 4, Section B, about 9½ miles in length, to be built of Portland cement concrete and bituminized surface, in accordance with the specifications therefor, to which special reference is made. No bid will be received unless it is made on a blank form furnished by the Commission. The special attention of prospective bidders is called to the "Notice to Contractors" annexed to the blank form of proposal, for full directions as to bidding, quantities of work to be done, etc. The Department of Engineering reserves the right to reject any or all bids or to accept the bid deemed for the best interests of the State. Plans may be seen and forms of proposal, bonds, contract and specifications may be obtained at the said office, and they may be seen at the office of the Division Engineer at Sacramento. Austin B. Fletcher, Highway Engineer.

⊙Following itemized bids were received by the California State Highway Commission, Sacramento, on Feb. 28, for the construction of a section of the state highway in Los Angeles County, Division 7, Route 2, Section B, (1) standing for bid of J. Considine, Los Angeles, (2) Leigh G. Garnsey, Los Angeles, (3) Rogers Bros.' Co., Los Angeles, (4) J. M. Montgomery, Alhambra, (5) Geo. Benson & Son, Los Angeles, (6) Bent & Pennebaker, Los Angeles, and (7) John D. Marsh, Los Angeles (awarded contract):

	Quantities.	Estimate.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Excavation (without classification)	19,400 cu. yds.	$ 0.40	$0.45	$ 0.56	$0.50	$0.80	$ 0.45	$ 0.45	$0.50
Corrugated iron pipe, 12-in.	240 lin. ft.	1.05	1.15	1.60	1.50	1.20	2.00	1.40	1.40
Corrugated iron pipe, 18-in.	244 lin. ft.	1.50	1.55	2.00	1.75	1.45	2.25	2.00	1.60
Corrugated iron pipe, 24-in.	148 lin. ft.	1.90	1.95	2.50	2.50	2.03	2.75	2.50	1.90
Corrugated iron pipe, 30-in.	26 lin. ft.	2.65	3.00	3.45	3.00	2.82	3.50	3.75	2.30
Corrugated iron pipe, 36-in.	52 lin. ft.	3.20	3.50	4.00	4.00	3.80	4.00	4.50	2.60
Cement concrete, Class "B" (culverts and monuments)	60 cu. yds.	10.00	8.00	10.00	9.00	9.00	12.00	15.00	9.50
Cement concrete, Class "B" (paving)	9,900 cu. yds.	4.00	4.60	4.50	4.39	4.10	4.95	7.00	4.00
Asphaltic oil (hauling and placing)	800 bbls.	1.30	2.00	1.50	2.00	1.50	3.00	2.00	0.80
Broken stone screenings	1,260 tons.	1.70	1.75	2.56	2.25	2.27	3.00	2.25	2.40
Guard rail	2,350 lin. ft.	0.35	0.40	0.38	0.50	0.40	0.60	0.25	0.30
Monuments (hauling and setting)	127 each	0.60	4.00	1.00	5.00	1.00	4.00	2.00	0.90
Totals		$61,151	$61,206	$62,999	$61,389	$62,990	$68,288	$85,732	$55,556

⊙The City Trustees, Fullerton, Calif., have let a contract to Fred Osburn of Fresno, Calif., for grading 9½ miles of streets, for $121,200. Asphalt concrete will be used. Work will be started April 1.

⊙The Barber Asphalt Co., of Los Angeles, Calif., has been awarded the contract by the Board of Trustees of El Centro, Calif., for street paving, amounting to about $100,000.

The Chamber of Commerce of Galt, Calif., has under consideration the grading and curbing of I St., from Fourth to the boulevard.

The City Trustees of Merced, Calif., have ordered the paving of 28½ blocks of streets. J. F. McSwain is City Engineer.

The City Trustees of Roseville, Calif., have passed an ordinance calling for an election for the purpose of voting on the issuance of bonds to the amount of $20,000, to build streets to meet the state highway at each end of the town.

Following are the itemized bids as received by the California State Highway Commission, Forum Bldg., Sacramento, on Feb. 28, for constructing a section of the state highway in Mendocino County, Division 1, Route 1, Section C, (1) standing for bid of E. B. & A. L. Stone Co., San Francisco; (2) Fairbanks & Baechtel, Willits, Cal.; (3) David L. Sawyer and Charles White, Willits, Calif., and (4) Raisch Improvement Co., San Francisco:

		Estimate.	(1)	(2)	(3)	(4)
Excavation (without classification)	24,200 cu. yds.	$ 0.45	$ 0.50	$ 0.65	$ 0.66	$ 1.00
Corrugated iron pipe, 12-in	454 lin. ft.	2.00	2.00	2.00	1.56	3.50
Corrugated iron pipe, 18-in	50 lin. ft.	2.25	3.00	2.25	1.92	4.50
Corrugated iron pipe, 24-in	102 lin. ft.	2.50	3.50	2.50	2.61	6.00
Cement concrete, Class "B" (monuments and culverts)	194 cu. yds.	9.00	20.00	20.00	11.00	14.00
Broken stone	11,000 tons.	2.25	2.75	2.90	2.10	3.50
Gravel	7,450 cu. yds.	1.25	1.50	1.75	1.31	3.15
Guard rail	800 lin. ft.	0.25	0.50	0.25	0.33	0.30
Moving and resetting property fences	3 miles	150.00	500.00	333.33	250.00	150.00
Monuments (hauling and setting)	120 each	1.00	1.00	1.00	2.20	2.50
Totals		$56,056	$60,840	$67,143	$53,314	$92,299

The estimated cost of the proposed widening of Belmont Ave., in Fresno, Calif., has been placed at $6,905. Chris P. Jensen is City Engineer.

Connecticut.

✣Bids will be received until 5 p. m., April 8, by J. E. Martin Warden at the office of the Borough Clerk, Wallingford, Conn., for the furnishing of all labor, material, tools, machinery and teams, for the complete construction of about 15,510 sq. yds. of pavements. (All bids must be by the sq. yds. for the pavement, completed.) Alternate bids only will be received and considered for the following pavements on the various sections: Wood block, vitrified hill brick, bitulithic, asfalto, Warrenite, Amesite, 6-in. Hassam or concrete pavement with ½-in. asfalt, Hassamite top. Each proposal must be accompanied by a certified check for 10 per cent of the tendered bid and made payable to the Treasurer of the Borough of Wallingford. W. A. Mackenzie is Borough Engineer.

District of Columbia.

✣Bids will be received until 2 p. m., March 20, by Commissioners of the District of Columbia, Washington, D. C., for furnishing and delivering during the fiscal year ending June 30, 1914, road oils and tar for use in the engineering department of Washington, D. C.

Georgia.

✣Bids will be received until 7:30 p. m., March 25, by Board of Aldermen, Waycross, Ga., for furnishing certain road machinery; road roller or combined roller and traction engine, bottom-dump wagons, road machine, scarifier or combined scarifier and road machine, rooter plow, wheeled scrapers, drag scrapers, road drag. B. H. Klyce is City Engineer.

Illinois.

✣Bids will be received until 11 a. m., March 22, for furnishing and delivering approximately 500,000 gals. of road oil to the Bureau of Streets, details of specifications: Specific gravity 18 to 20 degrees Baume at 77 degrees F.; fixed carbon 8 per cent, flash point 275 degrees F. Cash or

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

certified check for $1,500 must accompany proposal. L. E. McGann, Commissioner of Public Works, Chicago, Ill.

✣Bids will be received until March 22nd for furnishing and delivering approximately 2,000 tons of refined asphalt to the Bureau of Streets, details of specifications as follows: To be delivered f. o. b. cars asphalt plant, 15th Pl. and Laflin St.; asphalt to be crude native mineral bitumen, having a consistency harder than 100 degrees penetration, 98½ per cent of the bitumen which is soluble in coal carbon disulphide shall be soluble in coal carbon tetra chlorides. Specifications may be had upon application t L. E. McGann, Commissioner of Public Works, Chicago, Ill.

✣Bids will be received until 11 a. m., March 22nd, by L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering approximately 75,000 gals. of flux for asphaltic cement to the Bureau of Streets, at the new asphalt plant, 15th and Laflin St., material to be delivered in tank car lots f. o. b. cars; the flux may be a paraffine, an asphaltic or semi-asphaltic residium, which shall be tested and found suitable for use with the asphalt to be used; penetration 350 degrees with a No. 2 needle, at 77 degrees F. Cash or certified check for $500 must accompany proposal.

✣Bids will be received until 11 a. m., March 22nd, for furnishing and delivering to the Bureau of Streets, f. o. b. cars at any public switch track, such bituminous road surfacing material as is required for use during 1913. Cash or certified check for $2,000 must accompany proposal. Specifications may be had upon application to L. E. McGann, Commissioner of Public Works, Chicago.

⊙Geo. W. Prutsman has been awarded the contract by the Board of Local Improvements, Rossville, Ill., for the construction of 30,430 sq. yds. of vitrified brick pavement on 5-in. crushed rock foundation, 3,386 lin. ft. of stone curb, 17,473 lin. ft. combination curb and gutter, 995 lin. ft. stone headers, 59 storm inlets, 2,321 lin. ft. of 12-in. subdrains, 200 lin. ft. of 12-in. sewer and 17,987 cu. yds. of earthwork, for $64,296. Bids were opened March 10.

⊙J. B. McAuley, Commercial Blk., Galesburg, Ill., has been awarded the contract for the construction of 18,600 sq. yds. of brick pavement on Main St., for $40,745 The work also includes 6,800 cu. yds. of earthwork excavation, 3,050 lin. ft. of Portland cement curbing and circular corners, 75 lin. ft. of marginal curbing, 4 manholes adjusted and brought to grade, and 10 manholes adjusted. Bids were opened March 13.

⊙The Board of Local Improvements of East Moline, Ill., has awarded the contract for the paving of High St., from Seventh St. to Eighth Pl., and Eighth Pl. to Sixth Ave., and on Sixth Ave. to 10th Pl., to the Tri-State Flexotile Co., for $7,640. Anton Swenson bid $7,850 on the work.

⊙The Independent Construction Co. has been awarded the contract by the Board of Local Improvements of Rock Island, Ill., for the paving of Third Ave., between 15th and 24th Sts., and the paving of 18th St., between Third and Fourth Aves., for $37,385.

⊙The Board of Local Improvements of Rockford, Ill., has awarded the contract for macadamizing E. State St., from Summit to Prospect St., to the Carrico Stone Co., for $0.50 per yard for macadam and $0.28 per yard for curbing.

The City Council of Peoria, Ill., has passed an ordinance calling for the paving of Cedar St., from Warner Ave. to Brotherson St., with brick. L. D. Jeffries is City Engineer.

The City Council of Rock Island, Ill., has passed an ordinance providing for the paving of 14th St., between Ninth and 18th Aves., with asphalt. The street will be 24 ft. wide and the estimated cost is $19,879. Wallace Treichler is City Engineer.

The citizens of Danville Township, Vermilion County, Ill., will shortly vote on the proposition to pave two roads with brick. One, known as the Potomac road, leading west and north through Hillery to the Amos corner, the other the Covington road. Danville is the county seat.

The Board of Local Improvements of Lincoln, Ill., has decided to pave the following streets: Broadway, from Union to Chicago Sts., estimated to cost $13,016; Chicago St., from Pekin to Clinton Sts., $8,649; Pulaski St., from Kickapoo to Sangamon Sts., $4,579.

The following contracts have been awarded by the Board of Local Improvements, Chicago, Ill., for constructing pavements in the following alleys: Alleys Flournoy St., Central Park Ave., etc., concrete curbing, brick pavement, P. J. O'Brien, 9 S. LaSalle St.; De Koven St., Des Plaines St., etc., concrete curbing, brick pavement, Central Paving Co., 179 W. Washington St.; the work includes such sewer work as is necessary.

Following are the lowest bids submitted on March 11th to the West Park Commissioners, Geo. A. Mugler, Secretary, for furnishing and delivering 1,000 tons of refined asphalt to various points in the West Park system: Standard Oil Co., 72 W. Adams St., $17.75 per ton; R. F. Conway Co., 133 W. Washington St., $18 per ton. The contract has not been awarded.

Following are the lowest bids submitted to the West Park Commissioners, Geo. A. Mugler, Secretary, for furnishing and delivering approximately 500 cu. yds. of crushed granite to various points in the West Park system: Wisconsin Granite Co., 133 W. Washington St., $3 per cu. yd. The contract has not been awarded.

It is reported that the South Park Commissioners will start immediately on the construction of the new lighting system on Jackson Blvd. from Michigan Ave. to the Chicago River. The plan is to erect 88 ornamental light posts, each consisting of six lights along the street. W. I. Bell is chief electrical engineer, 57th St. and Cottage Grove Ave.

Following are the lowest bids submitted to the West Park Commissioners, Chicago, Ill., Geo. A. Mugler, Secretary, for furnishing and delivering 1,600 cu. yds. of bank sand to various points in the West Park district: $1.25 per cu. yd., 1,600 cu. yds. of torpedo sand, $1.75 per cu. yd., American Sand & Gravel Co., 133 W. Washington St. The contract has not been awarded. Bids opened March 11th.

Following is the lowest bid submitted on March 11th to the West Park Commissioners, Chicago, Ill., Geo. A. Mugler, Secretary, for furnishing and delivering approximately 5,000 cu. yds. of crushed lime stone to various points in the West Park district: $1.65 per cu. yd., Producer's Stone Co., 37th and Iron St.

Following are the lowest bids submitted for constructing pavements in Chicago, Ill.: California Ave., Diversey Blvd. to Belmont Ave., sandstone curbing, 87 cts., 660 sq. yds. creosoted wood blocks $3.29, The Ryan Co., 10 S. LaSalle St. Center Ave., Blue Island Ave. to 14th St., concrete curbing, 430 sq. yds. brick pavement, $2.50, John Dillon, 178 W. Washington St. Colorado Ave., Independence Blvd. to 40th Ave., 1,740 lin. ft. sandstone curbing, 2,520 sq. yds. brick pavement, $2.27; A. N. Todd, 179 W. Washington St. Elston Ave., Fullerton Ave. to Belmont Ave., 15,000 lin. ft sandstone curbing, 87 cts, 19,800 sq. yds. creosoted wood blocks, $3.06; The Ryan Co., 10 S. LaSalle St. Erie St., Fairbanks Ct. to Lake Shore Drive, 2,720 lin. ft., granite concrete curb and gutter, 67 cts., 5,000 sq. yds. asphalt pavement, $1.74; F. P. McCormick, 133 W. Washington St. 43rd Ave., Bloomingdale Ave. to Humboldt Ave., 5,070 lin. ft. granite concrete combined curb and gutter, 50 cts., 7,805 sq. yds. asphalt pavement $1.79; R. F. Conway Co., 133 W. Washington St. 47th St., Paulina St. to 550 ft. west of Hoyne Ave., 6,360 lin. ft. sandstone curbing, 75 cts., 10,340 sq. yds granite block pavement, $4.02; F. P. McCormick, 133 W. Washington St. 54th St., 112 ft. east of LaSalle St. to Wentworth Ave., 830 lin. ft. granite concrete combined curb and gutter, 60 cts., 1,420 sq. yds. asphalt pavement, $1.80; R. F. Conway Co., 133 W. Washington St. Frankfort St., Oakley Ave. to Western Ave., 1,240 lin. ft. granite concrete combined curb and gutter, 1,910 sq. yds. asphalt pavement, $1.80; R. F. Conway Co., 133 W. Washington St. Irving Park Blvd., Ashland Ave. to East Ravenswood Park, 2,610 lin. ft. sandstone curbing, 84 cts., 650 sq. yds. brick pavement, $2.29, 3,850 so. yds. creosoted wood block pavement, $3.34; The Ryan Co., 10 S. LaSalle St. Keith St., Huron St. to Chicago Ave., 990 lin. ft. granite concrete combined curb and gutter, 60 cts., 1,850 sq. yds. asphalt pavement, $1.73; F. P. McCormick, 133 W. Washington St. Lydia St, Halsted St. to 90 ft. east, 190 lin. ft. sandstone curbing, 70 cts., 280 sq. yds. granite block pavement, $3.75; John Dillon, 179 W. Washington St. May St., 21st St. to 22nd St., 800 lin. ft. granite concrete combined curb and gutter, 60 cts., 1,670 sq. yds. asphalt pavement, $1.85; American Asphalt Paving Co., 133 W. Washington St. Spaulding Ave., Grand Ave. to Division St., 2,430 lin. ft. granite concrete combined curb and gutter, 50 cts., 3,705 sq. yds. asphalt pavement, $1.78; R. F. Conway Co., 133 W. Washington St. Talman Ave., Madison St. to Washington St., 1,050 lin. ft. sandstone curbing, 83 cts., 1,706 sq. yds. brick pavement, $2.32; Jas. A. Sackley Co., 133 W. Washington St. 23rd St., Wood St. to Western Ave., 7,120 lin. ft. granite concrete combined curb and gutter, 13,830 sq. yds. asphalt pavement, $1.68; R. F. Conway Co., 133 W. Washington St. Wellington St., Southport Ave. to Ashland Ave., 2,540 lin. ft. granite concrete combined curb and gutter, 60 cts., 4,200 sq. yds. asphalt pavement, $1.64; R. F. Conway Co., 133 W. Washington St. Western Ave., Belmont Ave. to Roscoe St., 2,620 lin. ft. sandstone curbing, 87 cts., 4,100 sq. yds. creosoted wood block pavement, $3.33; The Ryan Co., 10 S. LaSalle St. Montrose Ave., Western Ave. to Lincoln Ave., 5,000 lin. ft. sandstone curbing, 84 cts., 7,600 sq. yds. creosoted wood block pavement, $3.06; The Ryan Co., 10 St. LaSalle St. LaSalle St., Archer Ave. to 21st St., 21st St., Archer Ave. to Wentworth Ave., 1,408 lin. ft. sandstone curbing, 78 cts., 2,460 sq. yds. brick pavement, $2.32; Ready & Callahan Coal Co., 133 W. Washington St. Montana St., Western Ave. to Station St., Station St., Oakley Ave. to Fullerton Ave., 3,120 lin. ft. granite concrete combined curb and gutter, 50 cts., 4,870 sq. yds. asphalt pavement, $1.69; R. F. Conway Co., 133 W. Washington St. Roscoe St., Robey St. to Western Ave., Robey St., Roscoe St. to Belmont Ave., 7,050 lin. ft. sandstone curbing, 80 cts., 12,250 sq. yds. creosoted wood block pavement, $3.29; F. P. McCormick, 133 W. Washington St. Houston Ave., 82nd St. to 83rd St., Commercial Ave., 82nd St. to 83rd St., Coles Ave., 81st St. to 83rd St., 82nd St., Ontario Ave. to Exchange Ave., 7,360 lin. ft. sandstone curbing, 78 cts., 11,170 sq. yds. asphaltic concrete on slag foundation, $1.20; F. P. McCormick, 133 W. Washington St. The work includes preparation of the subgrade, 6-in. Portland cement concrete foundation, sewer, manhole and catchbasin construction and adjustment. The contracts have not been awarded. Edw. J. Glackin, Secretary of the Board.

The City Council of Spring Valley, Ill., has called an election for March 22 for the purpose of voting on the question of paving Erie and Cleveland Sts., with brick on a concrete base.

The citizens of Lake Bluff, Ill., on March 8 voted the issuance of bonds to the amount of $2,500 for re-surfacing and oiling the streets.

The City Council of Belleville, Ill., Fred J. Kern, Mayor, has passed an ordinance providing for the paving and construction of sewers on North Church St. City Engineer William Ziehnert has estimated the cost at $17,006.

The Board of Public Improvements of Duquoin, Ill., has recommended two new paving districts, embracing the First and Fourth Wards, and representing an outlay of approximately $90,000. Public hearing was held March 12.

Following is the lowest bid submitted for furnishing 3,000 bbls. of portland cement to the Bureau of Streets for the repair of pavements: Wisconsin Lime & Cement Co., 133 W. Washington St., $1.60 per bbl. L. E. McGann, Commissioner of Public Works, Chicago Ill. The contract has not been awarded.

Following is the lowest bid received on March 11th for furnishing and delivering f. o. b. cars, 500,000 gals. of fuel oil to the Bureau of Streets: Standard Oil Co., 72 W. Adams St., 4.5c per gal. f. o. b. cars. The contract has not been awarded. L. E. McGann, Commissioner of Public Works.

Kane County has appropriated $2,000 for the purchase of road signs. John A. Logan, Geneva, Ill., is Clerk.

Following is the lowest bid submitted on March 11th for furnishing and delivering sand to the asphalt plant for use during the year 1913: 80c per cu. yd., Lake Shore Sand Co., 133 W. Washington St. The contract has not been awarded. L. E. McGann, Commissioner of Public Works.

Indiana.

✣Bids will be received until 10 a. m., March 21, by Board of Public Works, Indianapolis, Ind., for the following street improvement work: For paving Ashland Ave., from 13th St. to 14th St.; for paving 28th St., from Sutherland Ave. to Bellefontaine St.; for paving roadway, Broadway, from 32d St. to 34th St.; for paving roadway of Ashland Ave., from Bellefontaine St. to 28th St.; for paving roadway of 29th St., from Central Ave. to Fall Creek Blvd.

✣Bids will be received until noon, April 10, by Board of Miami County Commissioners, Peru, Ind., for the construction of one road in Butler Township, two in Pipe Creek Township, two in Peru Township. Frank K. McElheny is County Auditor.

✣Bids will be received until 10 a. m., April 9, by Board of Delaware County Commissioners, Muncie, Ind., for the construction of a road in Harrison Township. F. M. Williams is County Auditor.

✣Bids will be received until 2 p. m., April 8, by Board of Monroe County Commissioners, Bloomington, Ind., for the construction of a pike road in Bloomington Township. W. F. Kinsey is County Auditor.

✣Bids will be received until 2 p. m., April 8, by Board of Harrison County Commissioners, Corydon, Ind., for the construction of a gravel road in Taylor Township. J. L. O'Bannon is County Auditor.

✣Bids will be received until 2 p. m., April 8, by Board of Green County Commissioners, Bloomfield, Ind., for the construction of a macadamized road in Stockton Township. C. H. Jennings is County Auditor.

✣Bids will be received until 1:30 p. m., April 8, by Board of Wabash County Commissioners, Wabash, Ind., for the construction of a highway in Noble Township. Dan Showalter is County Auditor.

✣Bids will be received until 10 a. m., April 8, by Board of Howard County Commissioners, Kokomo, Ind., for the construction of a stone road in Jackson Township and three gravel roads in Center Township. E. B. Swift is County Auditor.

✣Bids will be received until 2 p. m., April 8, by Board of Grant County Commissioners, Marion, Ind., for the construction of a stone road in Center Township. E. H. Kimball is County Auditor.

✣Bids will be received until noon, April 8, by Board of Carroll County Commissioners, Delphi, Ind., for the construction of gravel roads in Monroe and Tippecanoe Townships. M. G. Haun is County Auditor.

✣Bids will be received until 10 a. m., April 8, by Board of Adams County Commissioners, Decatur, Ind., for the construction of macadamized roads in Washington, St. Mary's, Blue Creek and Monroe Townships. Thomas Baltzell is County Auditor.

✣Bids will be received until 2 p. m., April 7, by Board of Posey County Commissioners, Mt. Vernon, Ind., for the construction of a gravel road in Black Township. J. R. Haines is County Auditor.

✣Bids will be received until 2 p. m., April 7, by Board of Warren County Commissioners, Williamsport, Ind., for the construction of two public highways. D. H. Moffitt is County Auditor.

✣Bids will be received until 2 p. m., April 7, by Board of Spencer County Commissioners, Rockport, Ind., for the construction of a gravel road. J. T. Stevenson is County Auditor.

✣Bids will be received until 1:30 p. m., April 7, by Board of Washington County Commissioners, Salem, Ind., for the construction of gravel roads in Polk and Washington Townships. F. S. Munkelt is County Auditor.

✣Bids will be received until 11 a. m., April 7, by Board of Putnam County Commissioners, Greencastle, Ind., for the construction of a macadam road in Greencastle Township. C. L. Airhart is County Auditor.

✣Bids will be received until noon, March 28, by Commissioners of Jay County, Ind., and Darke County, O., at the office of J. L. Morgan, Darke County Auditor, Greenville, O., for the construction of a gravel road.

✣Bids will be received until 10 a. m., March 21, by Board of Wells County Commissioners, Bluffton, Ind., for the construction of two macadam and two stone roads in Harrison Township; stone road in Rockcreek Township and gravel road on line between Harrison and Liberty Townships. L. A. Williamson is County Auditor.

✣Bids will be received until 2 p. m., March 25, by Town Council, Mt. Vernon, Ind., for the construction of considerable pavement. Bids will be taken on vitrified brick, creosote wood block, asphalt, asphaltic concrete, cement concrete, bituminous coated concrete.

✣Bids will be received until 10 a. m., March 25, by Board of Public Works, Muncie, Ind., for the paving with asphalt, bitulithic, brick or creosoted wooden block on concrete foundation a number of streets in the city. The work will include curb and gutter. J. R. Kelly is City Clerk.

⊙The Board of Cass County Commissioners, Logansport, Ind., J. E. Wallace, Auditor, at its March term awarded the contract for the construction of the macadam road in Eel Township to A. H. Barnes & Co., of Logansport, for $2,909.

The Board of Public Works of Indianapolis, Ind., has adopted a resolution providing for the paving of Jefferson Ave., from Washington to Michigan Sts., at an estimated cost of $26,526.

The Board of Public Works of Indianapolis, Ind., has adopted resolutions for contemplated street improvements as follows: King Ave., from Michigan to Cavelage St., estimated cost $17,880; 19th St., from Illinois St. to Capitol Ave., $6,187; 33d St., from Central Ave. to Meridian St., $16,478; Broadway, from 34th St. to Fairground Ave., $4,343; 21st St., from Central to Talbott Ave., $10,457; English Ave., from Big Four tracks to Keystone Ave., $25,644; Carrollton Ave., from 38th to 40th St., $13,637; Linwood Ave., from New York to Michigan St., $8,485, and Ray St., from River Ave. to Division St., $11,888. H. W. Klausmann is City Engineer.

The Dubois County Commissioners, Jasper, Ind., have called an election for March 31 to vote on the proposed construction of seven miles of rock roads in Ferdinand Township, at an estimated cost of $25,000.

Iowa.

✣Bids will be received until 10 a. m., March 21, by L. J. Storey, City Clerk, Cedar Rapids, Ia., for furnishing material and labor for the construction of combination curb and gutter, all according to the plans and specifications for said work now on file in the office of the City Clerk of the city of Cedar Rapids, Linn County, Iowa.

✣Bids will be received until 9 a. m., March 20, by City Clerk, Burlington, Ia., for grading, curbing with artificial and paving with cement concrete, 6 ins. thick, South St., from 9th to 12th, and from 12th to Summer Sts. H. G. Vollmer is City Engineer.

✣Bids will be received until 9 a. m., March 20, by City Clerk, Burlington, Ia., for the following road improvement work: To grade, curb with artificial stone and pave with cement concrete, 6 ins. 27 ft. wide between curbs, 10th St., from the north side of Franklin St. to the south side of Iowa St. H. G. Vollmer is City Engineer.

⊙The City Council of Dubuque, Ia., has awarded the contract for the improving of the north end of Couler Ave. to Kenety & Lee, for approximately $68,000. Creosoted wood blocks will be used.

⊙Geo. Gabler, Mason City, Ia., has been awarded the contract by that city, for the construction of 16,444 sq. yds. of cement paving and 715 ft. of cement curb, for $1.35 and $0.35, respectively. Bids were opened March 10.

⊙The Faris-Abramson Construction Co., of Des Moines, Ia., has been awarded the contract at Hampton, Ia., for the construction of 45,600 sq. yds. of Portland cement concrete pavement, for $1.20½ per sq. yd., and for 29,613 lin. ft. of curb, for $0.28½ per lin. ft. Bids were opened March 11.

⊙The M. Ford Paving Co., 208 Second Ave., Cedar Rapids, Ia., has been awarded the contract by that city, for the construction of 40,000 sq. yds. of paving and 8,500 cu. yds. of grading, for $73,765. Bids were opened March 10.

⊙The Kaw Paving Co., Topeka, Kans., has been awarded the contract by the city of Clinton, Ia., for the construction of 10,900 sq. yds. and 16,900 sq. yds. of concrete with bituminous top coat, for $1.18 per sq. yd. Bids were opened March 11.

The City Council of Ottumwa, Ia., has ordered specifications for the paving of Vine St., from the Wabash track to the south approach of the Vine St. bridge and from the north approach of the bridge to the south line of the C. B. & Q. tracks.

Kentucky.

⊙The Board of Public Works of Louisville, Ky., has awarded contracts for street work that will cost about $83,000 as follows: To the L. R. Figg Co., 32d St., from Garland to Bismarck; 29th, from Cleveland to Alford; 28th, from Rowan to Duncan; St. Xavier, from 22d to 23d. To G. W. Gosnell & Co., 28th, from Main to Rowan; O, from Sixth to Seventh; 24th, from Maple to Garland. To Henry Bickel Co., St. Xavier, from 21st to 22d. Vitrified block is to be used in the construction and the average price per square yard is $1.81. Contracts for granitoid sidewalks also were awarded by the Board of Public Works as follows: To G. W. Younger & Co., both sides of Market St., from Campbell to Wenzel. To the American Concrete Construction Co., north side of Oak St., from Dandridge to Swann; west side of Seventh St., from Kentucky to Florence. The average price for this work is $0.73 a square yard, $0.08 lower than the average price per square yard in 1912.

⊙The Louisville Asphalt Co. has been awarded the contract by the city of Louisville, Ky., for the construction of wood block pavement for $7,640. The excavation will cost $0.48 per cu. yd.; wood block paving (16 lbs. 3½ ins.), $2.68 per sq. yd., and granite block track stringers, $2 per sq. yd. Bids were opened March 13.

The citizens of Hart County, Ky., on March

4 voted against the issuance of bonds for the improvement of the turnpike roads of the county. Munfordville is the county seat.

Kansas.

⊙The following table shows the itemized bids received by the city of Clinton, Ia., J. G. Thorne, City Engineer, on March 11, for paving work, the contract for which was secured by the Kaw Paving Co., of Topeka, Kans., (1) stands for the bid of the Kaw Paving Co., (2) bid of the M. Ford Paving Co., Cedar Rapids, Ia., (3) bid of Thos. Carey & Sons, Clinton, and (4) bid of A. Korneman & Co., Muscatine, Ia. Elm St., concrete, with bituminous top coat:

Elm St.—	Concrete with a bituminous top coat. (1)	(2)	(3)
10,900 sq. yds. bitumen top coat	$ 1.18	$ 1.17	
265 sq. yds. vitrified brick paving	.90	1.25	
3,800 lin. ft. concrete curb, 6x18 ins	.29	.40	
400 lin. ft. old curb, relined	.10	.30	
10 catch basins	25.00	30.00	
310 lin. ft. 10-in. vitrified C-basin pipe	.50	1.00	
2 adjacent pavements adjusted	10.00	25.00	
100 cu. yds. excess grading	.50	.60	
Total	$14,717	$15,444	
	Concrete paving		
10,900 sq. yds. concrete paving	$ 1.26	$ 1.45	$ 1.35
265 sq. yds. vitrified brick paving	.90	1.25	1.00
3,800 lin. ft. concrete curb, 6x18 ins	.29	.40	.40
400 lin. ft. old curb, relined	.10	.30	.10
10 catch basins	25.00	30.00	25.00
310 lin. ft. 10-in. vitrified C-basin pipe	.50	1.00	.40
2 adjacent pavements adjusted	10.00	25.00	10.00
100 cu. yds. excess grading	.50	.60	.60
Total	$15,589	$18,496	$16,981

Second Ave.—	Concrete with a bituminous top coat. (1)	(2)	(3)	(4)
16,900 sq. yds. bitumen top coat	$ 1.18	$ 1.17		$ 1.45
560 sq. yds. vitrified brick paving	.90	1.25		1.10
4,500 lin. ft. concrete curb, 6x18 ins	.29	.40		.30
3,300 lin. ft. old curb, relined	.10	.30		.08
8 catch basins	25.00	30.00		20.00
180 lin. ft. 10-in. vitrified C-basin pipe	.50	1.00		.50
200 cu. yds. rock excavation	1.00	5.00		3.00
2 adjacent pavements adjusted	10.00	25.00		11.00
Total	$22,591	$24,703		$27,607
	Concrete paving			
16,900 sq. yds. concrete paving	$ 1.26	$ 1.45	$ 1.17	
560 sq. yds. vitrified brick paving	.90	1.25	1.00	
4,500 lin. ft. concrete curb, 6x18 ins	.29	.40	.40	
3,300 lin. ft. old curb, relined	.10	.30	.10	
8 catch basins	25.00	30.00	25.00	
180 lin. ft. 10-in. C-basin pipe	.50	1.00	.40	
200 cu. yds. rock excavation	1.00	5.00	3.00	
2 adjacent pavements adjusted	10 00	25.00	10.00	
Total	$23,943	$29,465	$23,355	

The city of Erie, Kans., is planning to pave a number of the principal streets during the year.

Maine.

Town of Vinalhaven, Me., has appropriated $2,000 for new sidewalks. O. P. Lyons is Town Clerk.

Town of Winslow, Me., has appropriated $9,600 for state roads. Fred H. Ellis is Road Commissioner.

Maryland.

✣Bids will be received until noon, March 27 by State Road Commission, 534 N. Howard St., Baltimore, Md., for the construction of 11 sections of State Highway aggregating 21.55 miles, as follows: Baltimore County: One section along the York rd., from Linden Ave. to Washington Ave. (through Towson), about .50 miles in length (concrete or Topeka). Carroll County: One section along the road from Fountain Valley to Frizzelburg, about 1.37 miles in length (macadam or concrete); one section along the road from Taneytown toward Frizzelburg, about 2.00 miles in length (macadam or concrete); one section along the road from Manchester toward Cranberry, about 1.12 miles in length (macadam or concrete). Hartford County: One section along the road from McCann's Corner toward Conowingo, about .90 mile in length (macadam or concrete). Montgomery County: One section along the road from Cedar Grove toward Damascus, about 2.12 miles in length (macadam or concrete); one section along the road from Frederick and Howard County line toward Damascus, about 2 miles in length (macadam or concrete). St. Mary's County: One section along the road from Mechanicsville to Oaks, about 5.60 miles in length (gravel or concrete). Somerset County: One section along the road from Crisfield to Marion, about 3.09 miles in length (concrete). Talbot County: One section along the road from Easton to Wye Mills, about 2 miles in length (macadam or concrete). Baltimore County: One section along the Baltimore and Washington road from Winans Ave. to Lansdowne road, about 1.45 miles in length (concrete). Dorchester and Wicomico Counties: Operating machinery and lighting for draw spans of Sharptown Bridge over the Nanticoke River. W. L. Marcy is Secretary.

⊙The U. S. Wood Preserving Co., 165 Broadway, New York City, has been awarded the contract by the Board of Awards, Baltimore, Md., for furnishing the City Engineer's department all the wood blocks needed in street repair work during 1913, for $34.50 per M.

Massachusetts.

Town of Weymouth, Mass., has appropriated $2,000 for permanent sidewalks and $2,500 for a town survey.

Michigan.

The Common Council of Flint, Mich., has added the following streets to the list that will be paved this year: W. Second St., from Brush to Asylum, Asylum St., from Second St. to Glenwood Ave.; Glenwood Ave., from Asylum to Court St.; Court St., from Glenwood Ave. to Durand St.; Water St., from Saginaw to Brush St.; Union St., from Harrison to Clifford St. The citizens are to be asked to vote bonds for the improvements.

The Board of Public Works of Bay City, Mich., has recommended that $100,000 be borrowed this year for the purpose of making public improvements.

The County Road Commission, Houghton, Mich., has asked for bids on the construction of a road through the Sturgeon River bottoms, a distance of about four miles east of Chassell. The Commission is also considering the purchase of a portable steam roller, seven-ton; also 20 dump cars and other material.

Minnesota.

✣Bids will be received until 10 a. m., May 8, by P. D. McKellor, Jackson County Auditor, Jackson County, for grading and graveling State Road No. 6. The bids received March 14 for this work were rejected.

The City Commission of Duluth, Minn., has asked for bids for the paving of Baxter Ave., from Third St. to 21st St.

Mississippi.

⊙The Noxubee County Commissioners, Macon, Miss., have awarded the contract for the construction of about 13 miles of gravel road in District No. 5, including 40 yds. of earth, to Healy Construction Co. of Meridian, Miss. Bids were opened March 5 by Jno. A. Tyson, Chancery Clerk.

The Forrest County Commissioners, Hattiesburg, Miss., are having plans prepared for the construction of 50 miles of roads in Beats Nos. 1 and 2, for which bonds to the amount of $100,000 were voted recently. The money is now available.

The Board of Supervisors of Covington County, Collins, Miss., has taken up the matter of the issuance of $50,000 bonds for District No. 1, to build good roads. The Road Commissioners of District No. 3 let the contract for road maintenance to John C. Thames for four years.

Missouri.

⊙Wm. Trigg, of Fulton, Mo., has been awarded the contract for the rock road work to be done in Fulton Special Road District, Fulton Mo., requiring about 20,000 to 30,000 yds. of crushed rock. The work to commence in May and to be completed by Jan. 1, 1914. The contractor is to crush the rock and deliver and finish the several roads to be improved. Some of the work of improving the roads with gravel has not as yet been awarded. The concrete work to be done during the season has not yet been contracted and possibly the Commissioners will purchase a mixer and do the work with their own organization. W. R. Heagler, Fulton, is interested.

Edward Buxton, chairman of the franchise committee, Joplin, Mo., has recommended to the City Council a plan for the improvement of 20th and Harlem Sts. The Council accepted the recommendation and instructed City Engineer C. B. Anderson to make an estimate of the cost of paving with class F pavement.

State Highway Engineer Curtis Hill of Missouri has recommended to the State Board of Agriculture that both the Platte Purchase Route and the Interstate Trail, two roads connecting Kansas City and St. Joseph, be designated state highways.

Montana.

✣Bids will be received until 5 p. m., April 2, by City Council, at the office of W. A. Willis, City Cler., Butte, Mont., for grading the streets and constructing concrete sidewalks and curbing on the streets within special improvement district No. 137. Approximate quantities are 35,000 cu. yds. of excavation, 8,600 sq. yds. of concrete sidewalk and 15,600 lin. ft. of concrete curbing. Plans, specifications and form of bid can be had at the office of the city engineer. A certified check payable to the city of Butte or cash in the sum of $2,000 must accompany each bid. Paul A. Gow is City Engineer.

✣Bids will be received until 5 p. m., April 2, by City Council of Butte, Mont., at the office of W. A. Willis, City Clerk, for grading the streets and constructing concrete sidewalks and curbing on the streets within special improvement district No. 134. Approximate quantities are 60,000 cu. yds. of excavation, 25,700 sq. yds. of concrete sidewalk and 49,900 lin. ft. of concrete curbing. Plans, specifications and form of bid can be had at the office of the city engineer. A certified check payable to the city of Butte or cash in the sum of $2,500 must accompany each bid to be considered. Paul A. Gow is City Engineer.

✣Bids will be received until 5 p. m., April 2, by W. A. Willis, City Clerk, Butte, Mont., for the construction of vitrified brick pavement in Special Improvement District 135. The work will include about 1,912 sq. yds. A certified check for $1,000 must be filed with each proposal. Plans and specifications can be had of the City Engineer, Paul A. Gow.

Nebraska.

✣Bids will be received until March 22 by City Clerk, University Place, Nebr., for the construction of 15,000 sq. yds. of brick pavement with pitch or asphalt filler on 5-in. concrete foundation. The work will include 4,786 lin. ft. of curb or curb and gutter and about 1,000 cu. yds. of excavation. Adna Dobson, Lincoln, Nebr., is Engineer.

✣Bids will be received until 7:30 p. m., April 3, by city of Fremont, Nebr., for the construction of 19,120 sq. yds. of brick block pavement on stone concrete foundation and with asphaltum filler. The work will include 1,341 cu. yds. of excavation, 2,756 ft. of combined curb and gutter and 3,920 lin. ft. of straight curb. The cost is estimated at $45,825. L. M. Roessln. Fremont, Nebr., is Engineer.

The city of Aurora, Nebr., contemplates the construction of 10 blocks of brick or asphalt pavement on a concrete foundation, with cement curb and sand filler. Plans are being prepared by Consulting Engineers Bruce & Standevin, Bee Bldg., Omaha, Nebr. City Engineer F. M. Johnson is official in charge.

New Hampshire.

An appropriation of $2,000 for oiling and maintenance of state roads has been voted by the town of Hampton, N. H. H. M. Lane is Town Clerk.

Town of Claremont, N. H., has voted the following appropriations for street improvements: Winter St., $1,250; Sullivan and Myrtle Sts., $1,100; Broad St., $2,000. G. A. Tenney is Selectman.

An appropriation has been voted by Exeter, N. H., for street improvement. Clarence Getchell is Selectman.

An appropriation of $9,500 has been voted at Hopkinton, N. H., for state highway. John A. Fuller is Town Clerk.

The sum of $3,000 has been appropriated by Lebanon, N. H., for sidewalks. Joseph C. Smith is Town Clerk.

Town of Andover, N. H., has voted to appropriate 1/4 of 1 per cent of valuation for highways. A. H. Kilburn is Selectman.

An appropriation of $4,000 for state highway work has been voted by the town of Atkinson, N. H. Eugene R. Sawyer is Selectman.

The sum of $2,500 has been voted by the town of Holderness, N. H., for permanent roads. R. P. Curry is Town Clerk.

An appropriation of $1,900 for new roads and railways has been voted by the town of Newbury, N. H. C. L. Perkins is Town Clerk.

Town of Lancaster, N. H., has voted $1,200 for sidewalks and $1,700 for macadam roads. R. J. Brown is Town Clerk.

Town of North Hampton, N. H., has appropriated $3,000 for state roads. Roy R. Rollins is Town Clerk.

An appropriation of $1,600 for repair of highway between East Wakefield and Woodman has been voted by the town of Wakefield, N. H. J. H. Garvin is Town Clerk.

Town of Wilton, N. H., has voted $3,000 for care and permanent improvement of highways. E. A. French is Town Clerk.

New Jersey.

✣Bids will be received until 8 p. m., April 7, by Raymond F. Davis, Secy., Joint Organization of the Bloomfield and the Borough Council of Glenridge, at his office, Bloomfield National Bank Bldg., Bloomfield, N. J., for the grading and paving of Essex Ave., between Comley Pl. and Bay Ave., partly situated in the borough of Glen Ridge and the town of Bloomfield: 2,900 cu. yds. excavation, 900 sq. yds. cobble gutter, 3,300 sq. yds. Telford pavement, bound with asphalt. The above quantities are approximately correct, and are for the purpose of comparing bids only. Work must be completed within 65 working days. All bids must be submitted upon bidding sheets, which may be received and plan and specifications may be seen at the office of Ernest Baechlin, Civil Engineer, Bloomfield National Bank Bldg., Bloomfield, N. J. Each bid must be accompanied by certified check for $300, drawn to the order of the secretary of said joint organization as a guarantee of good faith of the bidder.

✣Bids will be received until 10 a. m., March 26, by Board of City Commissioners, Long Branch, N. J., for paving Second Ave., from a point 160 ft. south of Chelsea Ave. to Cedar Ave., with vitrified brick, asphalt or bituminous concrete, as may be selected by the board. W. R. Warwick is City Clerk. J. W. Seaman, 192 Broadway, is City Engineer.

✣Bids will be received until 8 p. m., March 25, by The Shade Tree Commissioner, Jersey City, N. J., for repair of walks in the several parks of Jersey City in accordance with plans and specifications on file at the office of John T. Withers, 1 Montgomery St., Jersey City, N. J. A. T. Hastings, Jr., is Secretary.

✣Bids will be received until 10 a. m., March 26, by Board of Commissioners, Long Branch, N. J., for paving Rockwell Ave. from Broadway to the New Jersey Southern Division of the Central Railroad of New Jersey. A certified check drawn upon a national or state bank payable to Frank L. Howland, Treasurer, must be filed with each bid. Specifications can be obtained at the office of J. Wesley Seaman, City Engineer, 192 Broadway.

⊙Bids for paving Pacific avenue, Wildwood Crest, N. J., with water-bound macadam, asphaltic concrete, wood block, vitrified brick. Filbertine and Warrenite, amounting to 34,400 sq. yds. of surfacing, were received by Borough Council Monday, March 10th. The bids were as follows: Robert Wright, macadam, $.82, asphaltic concrete $1.68, American wood block $2.49; J. F. Shanley, macadam $.89, asphaltic concrete $1.35, U. S. wood block $2.80; Geo. W. Banks, macadam $.83, asphaltic concrete $1.68, wood block (Wyckoff) $2.47, Mack vitrified block $2.27, Mack second $2.22, Filbertine $1.51; Martinet Bros., macadam $.98, asphaltic concrete $1.64, wood block, American, $2.548, Mack vitrified block $2.35, Mack seconds $2.17, Filbertine $1.55, asphalt macadam $1.325, Warrenite $1.89; Jas. McLinden & Co., macadam $1.30, asphaltic concrete $1.83, wood block, American, $2.62½, Mack vitrified block $2.23, on sand base $1.89, Warrenite $1.92, asphaltic macadam $1.39. The contract was awarded the James McLinden Co. of Anglesea, N. J., on Mack vitrified brick to be laid on a sand base, except between the electric railway tracks where concrete will be used.

New York.

⊙Guy B. Dickinson has been awarded the contract by the Board of Contract & Supply of Syracuse, N. Y., for the paving of Hawley Ave., from Lodi St. to Teall Ave., with asphalt, for $39,265.

The German Rock Asphalt Co., of Buffalo, N. Y., is the probable contractor for paving and making alterations to the Lafayette Square, at $20,900. The work includes paving and repairing Lafayette square with asphalt on a concrete base, and all necessary connections for grading and constructing concrete walks, granite curbing, granite coping, sewers, drains, etc. Bids were opened March 11.

City Engineer G. C. Hill of Fulton, N. Y., is preparing plans for paving W. Third St., from the south side of Phillips St. to the north side of Maple St., and from the north side of Maple St. to the north side of Curtis St. Plans are also being prepared for the paving of Phillips St., from the intersection of W. First St. to the tracks of the D., L. & W. R. R. Specifications are to be prepared for the paving of Schenck St. to the intersection of W. First and Rochester St., from First and Second St.

The Local Board of Newtown, Long Island City, N. Y., has passed resolutions initiating proceedings for 13 public improvements, estimated to cost $128,330. The most important will be the regulating and paving, with a permanent pavement, consisting of improved granite blocks, on a 6-in. concrete foundation, Harris Ave., Long Island City, from Vernon Ave. to Crescent St., and from Prospect St. to Jackson Ave., estimated to cost $55,500.

The citizens of Penn Yan, N. Y., on March 18 voted on proposed street improvements, estimated to cost $30,000.

The City Council of Buffalo, N. Y., has authorized the Department of Public Works to prepare plans and specifications for the widening and repaving of Military road.

The citizens of the village of Medina, N. Y., will vote at the election March 18 on the proposition to issue bonds to the amount of $12,000 for the paving with brick and curbing its portion of W. Center St., commencing in W. Center and extending westerly to the corporation line.

Ohio.

✣Bids will be received until noon, April 1, by S. A. Kinnear, Director of Public Service, Columbus, O., for the improvement of portions of 10 streets and avenues and three alleys. P. B. Kemper is Clerk.

✣Bids will be received until 10 a. m., March 26, by Board of City Commissioners, Long Branch, N. J., for paving Third Ave. from Morris Ave. to Bath Ave. with vitrified brick, asphalt or bituminous concrete. A certified check for $2,000 payable to F. L. Howland, City Treasurer, must accompany each bid. W. R. Warwick is City Clerk. J. Wesley Seaman is City Engineer.

✣Bids will be received until about May 1 by City Council of Middlefield, O., for the construction of 19,194 sq. yds. of concrete pavement on cinder foundation. The work will include 16,327 cu. yds. of excavation and will cost about $34,392. B. F. Hewit, Jefferson, O., is Engineer.

✣Bids will be received until noon, March 24, by J. W. Chrisford, Director of Public Service, Lakewood, O., for furnishing the necessary labor and materials for the grading, draining, curbing, paving with paving brick and improving the following named thoroughfares: Gladys Ave., Marlowe Ave., West Clifton rd., Robin St. The foregoing to be done according to the plans and specifications on file in said office and at the office of C. W. Root, 1033 Society for Savings' Bldg., Cleveland, O.

✣Bids will be received until 11 a. m., April 12, by Board of Cuyahoga County Commissioners, Cleveland, O., for the improvement of Stone Rd. in accordance with plans and specifications prepared by F. R. Lander, and on file at the office in the new courthouse. A certified check for $1,000 must be filed with each bid.

✣Bids will be received until noon, April 8, by G. H. Lewis, Director of Public Service, Elyria, O., for the construction of about 25,000 sq. yds. of pavement and 17,000 lin. ft. curbing. C. M. Theobald, Elyria, O., is Engineer.

✣Bids will be received until noon, March 27, by W. J. Springborn, Director of Public Service, Cleveland, O., for asphalt cement for the paving permit department. Specifications may be obtained of the Superintendent of streets. W. H. Kirby is Secretary to the Director.

✣Bids will be received until noon, March 20, by Director of Public Service, St. Bernard, O., for the improvement of Imwalle Ave., from Ross Ave. to 650 ft. northwardly, by grading, macadamizing the roadway, constructing concrete curb and gutter, laying crosswalks, and constructing the necessary drains, culverts and retaining walls. Plans and specifications and blank proposals can be obtained at the office of the Director of Public Service or at the office of the City Engineer, Henry A. Nunlist, No. 1112 Traction Bldg., Cincinnati, O.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, O., until 2 p. m., March 31, 1913, for grading and paving with waterbound macadam and bituminated concrete, the Columbus Extension Rd., State Highway "E," Pet. No 689, in Hilliar and Milford Twps., Knox County. Length, 9,542 ft. or 1.80 miles; width of pave-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ment, 14 ft.; estimated cost of construction, $19,287. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Deparment. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, O., until 2 p. m., March 31, 1913, for grading and paving with brick for heavy traffic, the Ashland-New London Rd., State Highway "F," Pet. No. 339, in Ruggles Twp., Ashland County, Length, 13,265 ft. or 2.51 miles; width of pavement, 10 ft.; estimated cost of construction, $33,075. A draft or certified check for $300 shall be deposited with each bid The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker, State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, O., until 2 p. m., March 31, 1913, for grading the Lake Shore Rd., State Highway "D," Pet. No. 627, in Black River and Brownhelm Twps., Lorain County. Length, 29,677 ft. or 5.62 miles; width of roadbed, 21 ft.; estimated cost of construction, $9,380. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, July 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, O., until 2 p. m., March 31, 1913, for grading the Pittsfield Wellington Rd., State Highway "C," Pet. No. 503, in Wellington and Pittsfield twps., Lorain County. Length, 17,568 ft. or 3.33 miles; width of roadbed, 22 ft.; estimated cost of construction, $7,954. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, July 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

⊙J. C. Reiff, Eucyrus, O., has been awarded a contract by the city of Fort Wayne, Ind., for the paving of a street one and one-half blocks long, for $45,000.

⊙Withamt Hohnes & Co., Deshler, O., have been awarded the contract by that village for the improvement of Elm St. from the east line of Vine St. to the west line of Ash St., by grading, paving with brick on concrete foundation and constructing curbing, for $18,338. Bids were opened March 11.

Harry and Frank Strodtbeck have been awarded the contract by the city of Middletown, O., for putting in the macadam pavement on Third St., from Sutphen Ave. to the corporation line.

The citizens of Fredericktown, O., at a recent election voted against the issuance of bonds to the amount of $10,000 to pay the village's portion of proposed paving of streets.

The Village Council of Richmond, O., has decided to advertise for competitive bids for cleaning and sprinkling the paved streets the coming season.

Oklahoma.

✣Bids will be received until 5 p. m., March 24 (readvertisement), by City Clerk, Cleveland, Okla., for paving Street Improvement District No. 1. Plans and specifications may be obtained upon the payment of $5 at the office of the Benham Engineering Co., Consulting & Supervising Engineers, 435-7 American National Bank Bldg., Oklahoma City, Okla.

Oregon.

The City Council of Dallas, Ore., has decided to construct 10 blocks of hard-surface pavements during the coming summer.

Pennsylvania.

✣Bids will be received until March 27 by M. L. Cooke, Director of Public Works, Philadelphia, Pa., for the following street paving and repair work: 20,508 cu. yds. of grading, 37,797 sq. yds. of asphalt paving, 16,398 sq. yds. of vitrified block paving, 3,601 sq. yds. of granite block paving, 15,833 sq. yds. of asphalt repaving, 6,324 sq. yds. of vitrified block repaving, 55,670 sq. yds. of asphalt resurfacing, 115,000 sq. yds. of asphalt patching. The total cost of the work to be performed under these contracts is estimated at $430,000.

⊙The McNichol Paving & Construction Co., Philadelphia, Pa., has been awarded the contract by the Department of Public Works, that city, for the completion of the Northeast Boulevard, between Second and Thawn Sts., for $1,317,844. The unit prices are: Grading, $209,419; macadam roadbed and surfacing, $490,885; vitrified brick gutters with concrete foundations, $132,750; top soil for grass plots, shrubbery, etc., $172,720, and cement sidewalks, $88,560. On the basis of unit prices bid and the department's estimates of work to be done, the difference between the McNichol and the Hassam bids was $252,804 in favor of the former. The specifications embraced 117 items on which unit bids were asked.

The Senate, Harrisburg, Pa., on March 11 passed the constitutional amendment to borrow $50,000,000 for building highways.

The City Council of Pittsburgh, Pa., has referred an ordinance authorizing a contract for grading, paving, curbing and sewering West Liberty Ave., to the Committee on Public Works. The work, it is estimated, will cost $382,000.

Rhode Island.

The Common Council of Woonsocket, R. I., has appropriated $15,000 for the paving of Bernon St., from Market Square to Front St., $1,000 for concreting and $5,000 for the construction of curbs.

Tennessee.

A resolution has been introduced in the Shelby County Court, Memphis, Tenn., asking the legislature to authorize a bond issue of $600,000 for the turnpike, dirt road and county bridge departments.

Texas.

✣Bids will be received until noon, March 24, by Dan C. Smith, Jr., City Secretary, Houston, Texas, for the grading and paving of Main St., in the city of Houston, Texas, from its intersection with the north line of Franklin Ave. to its intersection with the north line of Commerce Ave., with creosoted wood block pavement, as prayed for in petition, and in accordance with the specifications adopted by the City Council. Specifications and all necessary information can be obtained upon application at the office of F. L. Dormant, City Engineer.

✣Bids will be received until 2:30 p. m., April 14, by Commissioners' Court, Anderson, Texas, for the construction of a system of macadamized and sand-clay roads, to be built in the Navasota road district of Grimes County; this work will comprise 30 miles of macadam work and 8 miles of sand-clay work, and necessary culverts and bridges; detailed plans and specifications will be mailed from the Navasota office of Civil Engineer J. Gibbons Browne to any party upon receipt of a $5 deposit, said deposit to be returned when plans are returned to said engineer. Reid Rikard is Grimes County Judge.

⊙Max Levy, Galveston, Tex., has been awarded the contract by the County Commissioners, Galveston, for the installation of an ornamental lighting system, for $14,150. Bids were opened March 11.

⊙The Commissioners' Court, Pittsburg, Tex., has let the contract for 35 miles of good roads to Wilson & McElrath, for approximately $400 per mile.

⊙Cobb & Gregory, of Dallas, Tex., have been awarded the contract by the County Commissioners, Greenville, Tex., for the construction of a mile of permanent good road from the end of the pavement on South Wesley St. south.

The road district of Dickens County, Tex., in which the town of Spur is located, on March 8 voted the issuance of bonds to the amount of $100,000 for the construction of good roads.

Specifications of City Engineer F. L. Dormant for paving Main St., between Franklin and Commerce, with creosoted wood blocks, have been approved by the City Council of Houston, Tex. Bids for this work will be received at once.

Following bids were received by the City Council of Houston, Tex., on March 10 for street paving: For paving Texas Ave., between Main and Louisiana, with creosoted wood blocks: Roach-Manigan Paving Co., bidding on 3½-in. wood blocks, with different foundations, submitted the following: $2.99 the sq. yd. without guarantee, $3 with 5-year guarantee, and $2.95 without guarantee and $2.96 with 5-year guarantee; Creosoted Wood Block Paving Co., $3.01 without guarantee and $3.02 with 5-year guarantee, $2.97 without guarantee and $2.98 with 5-year guarantee. For paving Prairie Ave., between Milam and Smith, with vitrified brick: Talbot & Co. submitted bids as follows: $2.54 the sq. yd., with 5-year guarantee $2.63; Roach-Manigan Paving Co., $2.44, with 5-year guarantee $2.49. For paving Avondale Ave., between Baldwin and Ariel, with bitulithic, $298 the sq. yd., with 5-year guarantee $2.43.

Washington.

⊙The Spokane Asphalt Macadam Paving Co., Spokane, Wash., has been awarded the contract for the construction of nearly 5 miles of new road in Whitman County, Wash. The work includes Permanent Highway No. 4, near Rosalia, to be 10,700 ft. in length, of water-bound macadam, and to cost $13,779; Permanent Highway No. 5, running south from Pullman, to be 14,800 ft. in length, of oil-bound macadam, and to cost $23,628. Marshal K. Snell, of Tacoma, Wash., will construct about 1 mile of gravel road at the foot of Rock Lake and the Milwaukee Railroad.

The County Commissioners, Wenatchee, Wash., have appropriated $22,000 for the construction of good roads in the third district, including the northern part of the county.

⊙The Puget Sound Bridge & Dredging Co., Central Bldg., Seattle, Wash., has been awarded the contract for the filling, planking, etc., of Dock St., in Bellingham, Wash., at a cost of about $14,000.

The City Council of Snohomish, Wash., has plans under way for the paving of the streets leading from Cedar St. to the N. P. depot. The streets are Second, between Cedar and Maple, and Third, between Maple and the depot.

Following bids were received March 7 by the Board of Public Works, Seattle, Wash., for the paving of 12th Ave. S.: Ferguson-Colt, $27,793; T. Ryan, Lowman Bldg., $26,961; P. J. McHugh, $27,286; Elliott Construction Co., $27,649; Independent Asphalt Co., $28,464; Barber Asphalt Co., $28,776.

Following bids were received March 7 by the Board of Public Works of Seattle, Wash., for the paving of 27th Ave.: Elliott Construction Co., $12,658; P. J. McHugh, Third & Mercer Sts., Seattle, $12,259; Barber Asphalt Co., $12,741; and Independent Asphalt Co., $12,873. Bids received for paving 18th St. et al., were as follows: Gillis De Flong, $43,248; T. Ryan, $42,790; Russell & Gallagher, $49,217; D. H. Traphagen, Lincoln Hotel, Seattle, $41,085; West Coast Construction Co., $44,060; and S. Lamping Co., $41,545.

Following bids were received by the Board of Public Works of Seattle, Wash., on March 9, for the paving of the Queen Anne Blvd., Sub. No. 2: D. H. Traphagen, asphalt $64,959, Dolarway $52,270; McGuire & Moon, $63,819, $54,980; T. Ryan, $65,206, $59,314; H. C. Mallott, Dolarway $55,931; Independent Asphalt Co., $68,491, $68,491; P. J. McHugh, asphalt $62,008; Barber Asphalt Co., asphalt $63,440.

The city of Walla Walla, Wash., will pave Division St., from Alder to Whitman, at an estimated cost of $75,000.

The Senate and House Roads Committee, Olympia, Wash., have recommended the following appropriations for road work: $25,840 for state road No. 10, between Wenatchee and Knapp's hill; $10,000 for construction work on road No. 10 in Okanogan County. The bill also carries $387,650 for the Sunset highway over the mountains from North Bend in King County, to Cle Elum through the Snoqualmie pass; $85,000 from Wenatchee easterly; $9,905 for maintenance between Wenatchee and Renton in King County. The bill provides for the construction of the Sunset highway from Ellensburg to Cle Elum through Wenatchee to Waterville by the most feasible route.

West Virginia.

✣Bids will be received until 9 a. m., March 27, by Board of Control, Wheeling, W. Va., for the curbing with stone and concrete curb and paving with brick and sheet asphalt or bitulithic on concrete foundation of certain streets of the city. Plans and specifications can be secured of C. B. Cooke, City Engineer, City Building, Wheeling, W. Va.

Wisconsin.

The Milwaukee Electric Railway & Lighting Co., Public Service Bldg., Milwaukee, Wis., has notified the Department of Public Works that it intends to lay a permanent asphalt pavement this summer on 17 streets over which its tracks are running. The work will be awarded to private contractors and is to be done this summer. R. B. Stearns is Asst. Gen. Mgr. in charge of railway department.

The City Commission of Superior, Wis., has passed a resolution instructing the Board of Public Works to advertise for bids for the paving of Baxter Ave., 24 ft. wide, from Third to 21st St. The street is to have a concrete base and a wearing surface of reinforced concrete, sheet asphalt, asphaltic concrete, brick or creosoted blocks.

The Park Board of Milwaukee, Wis., has approved the proposed construction of a driveway park along the lake shore for a mile and a half south of the harbor entrance. Park Commissioner A. C. Clas has submitted plans for the park, which have been approved. The amount available for the work is $40,000.

The city of Jefferson, Wis., will construct one mile of street paving during the coming summer. Brick and concrete will be used.

Following bids were received by the city of Appleton, Wis., on 31,247 sq. yds. of paving, including grading, 15,324 ft. of curbing, 15,590 ft. of 4-in. tile drain, 3,685 ft. of 6-in. sewer, 52 catch basins, 6 combination manholes and catch basins: Frank Bartz, No. 1 concrete, $63,798; No. 2 concrete, $52,237; brick, cement filler, $77,547. Fred Hoffman, No. 1 concrete, $57,038.33; No. 2, $55,855.04; brick, $72,316.32; No. 3 concrete, $86,544.21. White Construction Co., Sheet asphalt, $73,649; asphalt and macadam mixed, $73,649. Fred Eule, No. 1 concrete, $65,719; brick, $74,761; asphalt macadam (penetration), $47,285. John Dittmer & Co., drainage, $4,418.

The Wisconsin State Legislature has passed the Brown bill providing $450,000 for the building of good roads. A. R. Hirst, Madison, is State Highway Engineer.

Canada.

The city of Maisonneuve, Que., is planning extensive street improvements to be commenced this spring. The estimated cost is $600,000.

The municipality of Kaslo, B. C., has appropriated $95,000 for road work, etc.

BRIDGES

California.

⊙The contract for the construction of a new bridge over Big Chico Creek, at Nord Ave., Oroville, Calif., has been awarded by the Board of Supervisors to the Chico Construction Co., at $3,745.

The Mission Promotion Association, San Francisco, Cal., has appointed a committee to appear before the supervisors advocating the construction by the Santa Fe System of a drawbridge over the Islais Creek at Kentucky St. M. M. O'Shaughnessy is City Engineer.

Petitions have been circulated and signed and will be presented to the Supervisors of Sutter and Colusa Counties asking for the construction of a joint bridge over the river at Grimes, Calif. Colusa, Calif., is the county seat of Colusa County.

Colorado.

The Mesa County Commissioners, Grand Junction, Colo., have adopted a resolution authorizing County Engineer James H. Fiske to draw plans and specifications for the reduction in the slope of the Fifth St. bridge hill from 11 per cent to less than 8 per cent. The work will require, it is estimated, 5,000 cu. yds. of excavation and will cost about $4,000.

Florida.

✣Bids will be received until 2 p. m., April 7, by Robert L. Stripling, County Clerk, Perry, Fla., for the construction of a steel bridge over Rocky Creek near Clara, Fla. Specifications can be secured of the Clerk.

Idaho.

✣Bids will be received until April 1, it is reported, by Bannock County Commissioners, Pocatello, Idaho, for the construction of an additional 108-ft. span on the old Tilden bridge and the removal of the structure to a new location a short distance up stream.

Georgia.

✣Bids will be received until noon, March 26, by Canal and River Commission, Augusta, Ga., for the construction of a steel bridge to be erected as an extension of the North Augusta Bridge on 13th St. Plans and specifications can be secured of Nisbet Wingfield, Chief Engineer, 747 Broad St., Augusta, Ga.

Illinois.

✣Bids will be received until noon, March 25, 1913, at the Town Clerk's office, Prophetstown, Illinois, for reflooring one steel bridge of four spans, in Prophetstown Township, Whiteside County. Simon Keiser, Town Clerk, Prophetstown, Illinois. Rock River Bridge—Total length of bridge, 639 ft.; clear roadway, 17 ft. The work to be done consists of removing the existing wood floor and nailing pieces and reflooring with creosoted timber and bituminous wearing surface. The bridge is 1¼ miles from the C. B. & Q. railroad station at Prophetstown, Illinois. Engineer's estimate, $3,000. Work to be completed on or before June 25, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Illinois.

✣Bids will be received up to 2 p. m., March 24, 1913, at the Town Hall, St. Jacob, Ill., for the construction of the Noll and Rule bridges to be built in St. Jacob Township, Madison County. This work was described in a notice sent out under date of March 4, 1913, which included also the Ritter and Radcliff bridges. Letting for the Ritter and Radcliff bridges will be held at a later date upon granting of county aid which has been applied for. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received up to 1 p. m., March 21, 1913, at the Court House, Mt. Carroll, Ill., for the construction one reinforced concrete bridge, to be built in Woodland Township, Carroll County. Henry Toepfer, Town Clerk, R. R. No. 3, Mt. Carroll, Ill. Olive School Bridge—Skew span, 16 ft., at right angles to abutments; height, 12 ft. Estimated total concrete, 104.8 cu. yds. Superstructure, reinforced concrete; abutments, plain concrete. Nearest railroad station, Mt. Carroll, 8 miles. It is reported that stone may be obtained free from a creek bed about 300 ft. from the bridge site, same will require screening and probably washing. Sand will have to be shipped in. Present bridge, wood, 14 ft. Low water flow, dry; high water about 6 ft. deep. Excavation to be carried about 4 ft. below stream bed to rock. Engineer's estimate, $1,550. Work to be completed on or before July 15, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Ill.

⊙The contract for the construction of the Swanson bridge in Atkinson Township, Henry County, Ill., has been awarded to H. S. Wetherell, Morgan Park, Chicago, Ill., at $3,290. Other bids received Feb. 25 for the work were as follows: C. H. Haman, Genesco, Ill., $3,710; Schlachter & Johnson, Streator, Ill., $3,461; John Wheeler Construction Co., Geneva, Ill., $3,362; Geo. A. Quinlan, Chicago, $3,440; C. A. Wever & Son, Clayton, $3,475.

⊙The contract for the construction of the Ross bridge, Keen Township, Adams County, Ill., has been awarded to C. A. Wever & Son, Clayton, Ill., at $650.

⊙The contract for the construction of the John Lamb and Paske bridges, Olive Township, Madison County, Ill., has been awarded to W. C. Johnson, Salem, Ill., at $2,450. Other bids received for both structures were as follows: Rock River Bridge Co., Oregon, Ill., $2,900; C. A. Wever & Son, Clayton, $2,250; Laws & Grantham, Irving, Ill., $2,611; Miller & Borcherding, St. Louis, Mo., $2,814; Wm. Oswald Bros., Alhambra, Ill., $2,600.

Indiana.

✣Bids will be received until 10 a. m., April 7, by Board of Vermillion County Commissioners, Newport, Ind., for the construction of a 150-ft. steel girder bridge with concrete floor and abutments over the Little Vermillion River at Newport. Plans and specifications are on file and can be obtained by addressing John A. Booe, County Surveyor, Cayuga, Ind. Roy Slater is County Auditor.

✣Bids will be received until 1:30 p. m., April 8, by Board of Jefferson County Commissioners, Madison, Ind., for the construction of five bridges. A. M. Taff is County Auditor.

✣Bids will be received until 2 p. m., April 8, by Board of Jasper County Commissioners,

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Rensselaer, Ind., for the construction of five bridges. J. P. Hammond is County Auditor.

✣Bids will be received until 10 a. m., March 31, by Board of Marion County Commissioners, Indianapolis, Ind., for the construction of five culverts. W. T. Patten is County Auditor.

✣Bids will be received until 1 p. m., March 28, by Board of Benton County Commissioners, Fowler, Ind., for the construction of three bridges. Warren Mankey is County Auditor.

✣Bids will be received until April 8 by Board of Noble County Commissioners, Albion, Ind., for the construction of 14 bridges. J. C. Kimmell is County Auditor.

⊙The contracts for the construction of 19 bridges and culverts in Noble County, Ind., were let recently by the Board of Commissioners to the following contractors: J. J. Kime, Lagrange, Ind., 10 bridges and culverts at $2,124; J. C. Veasey, Albion, Ind., 8 bridges at $1,937; F. M. Williams, Winimac, Ind., 1 bridge at $186; Will T. Knox, Albion, Ind., for floor on the Dukes Bridge, $355. Bids were opened March 5. J. C. Kimmell is County Auditor.

⊙The Burk Construction Co., of New Castle, Ind., has been awarded the contract by the Allen County Commissioners, Fort Wayne, Ind., for the construction of a concrete bridge of two spans, each being 92 ft., over the St. Joseph River at Leo, Ind., for $16,980. Bids were opened March 12.

Iowa.

✣Bids will be received until March 26 by Board of Marshall County Supervisors, Marshalltown, Ia., for the construction of concrete bridges in accordance with plans prepared by J. Wesley Ash, County Engineer.

⊙The Mississippi River Power Co., Keokuk, Ia., has awarded a contract to the Clinton Bridge Works, Clinton, Ia., for the construction of a 3-span 300-ft. steel bridge over Devil Creek south of Viele on the Montrose-Fort Madison road.

⊙The contract for the construction of all wooden bridges in Clinton County has been awarded to W. C. Mitchell, Tipton, Ia. F. G. Hansen, Clinton, Ia., is County Auditor.

Plans have been submitted to the Commercial Club of Eldora, Ia., and to the Hardin County Board of Supervisors by F. R. White, Assistant Engineer, Iowa State Highway Commission, Ames, Ia., for the proposed concrete and steel bridge over the Iowa River at Eldora. The bridge will cost between $35,000 and $40,000, will be 500 ft. long, and will be 50 ft. above the river.

Miller-Hey Construction Co., Waterloo, Ia., at $22,576 was low bidder for the construction of two reinforced concrete bridges of deck girder type over the Blackhawk Creek. Bids for the work were opened March 10.

It has been announced that the city of Sioux City, Ia., will construct this year a new concrete bridge over Bacon Hollow on the Correctionville road near the eastern limits of the city.

The Iowa State Highway Commission, Ames, Ia., is designing plans and preparing specifications for the construction of about $150,000 worth of bridges during the coming season. T. H. MacDonald is Chief Highway Engineer.

The City Council of Des Moines, Ia., has fixed the date for the consideration of plans for the proposed Seventh St. bridge over the Raccoon River, April 9. John Budd is Engineer.

Kansas.

✣Bids will be received until noon, April 11, by Board of Riley County Commissioners at the office of G. H. Hungerford, County Clerk, Manhattan, Kan., for the construction of the following named bridges. Plans and specifications will be on file at the office of the county clerk after March 20, or may be obtained from the office of the state highway engineer, K. S. A. C., Manhattan, Kan.: A concrete top bridge across Tabor Creek, Zeandale Township; a concrete top bridge at August Bulk's, Swede Creek; a stone arch or concrete top bridge at Oman's Crossing, Jackson Township; a concrete top bridge at Hessler's Crossing, Wild Cat. A concrete top on Cook's Ditch bridge, Ogden Township, and repairs on the Hatch Bridge, Ashland Township.

The Board of Riley County Commissioners, Manhattan, Kan., will hold a meeting April 11 to consider the advisability of appropriating $1,000 for the construction of a bridge over Walnut Creek in Jackson Township. G. H. Hungerford is County Clerk.

Maine.

Town of Presque Isle, Me., has voted $6,500 for concrete bridge piers. E. I. Waddell is Town Clerk.

An appropriation of $14,000 has been voted by the town of Sanford, Me., for a bridge at Winter St. J. G. Ridley is Road Commissioner.

Massachusetts.

⊙The Baltimore & Ohio Railroad Co. has awarded the contract for the construction of the Lee St. viaduct at Baltimore, Md., to the Vang Construction Co. and work will be started at once. The structure will require about 10,000 cu. yds. of concrete and 18,000 cu. yds. of excavation. The cost is estimated at $150,000.

Senator Johnson of Nahant, Mass., after listening to the statement on the bill to provide for the construction of a new bridge over Lake Quinsigamond, announced that a committee would be appointed to visit Worcester and to hold a hearing on the proposition.

Michigan.

✣Bids will be received until 10 a. m., March 25, by B. W. Church, Highway Commissioner, Kenton, Mich., for the construction of a concrete bridge in accordance with plans on file with the Commissioner and with H. W. Fesing, Houghton, Mich., Engineer.

The Board of Manistee County Supervisors, Manistee, Mich., has decided to hold an election April 7 to submit to the voters the proposition of building a High Bridge over the Manistee River at a cost of $8,000. The bridge is to be where the old Street's Bridge was located. It is one-half mile of High Bridge; 2½ miles from Brethren, through which the county road passes; and is to be erected at the end of the Eastlake road. The bridge will in time be worked into the county highway system.

According to the report of E. U. Hunt, City Engineer, Battle Creek, Mich., the cost of constructing a steel and concrete bridge at Verona St. would be about $8,500 and for erecting the same structure at Elm St. it would amount to about $9,500. At the latter site it would be more difficult to secure a good foundation.

Minnesota.

✣Bids will be received until 11 a. m., April 7, by Al. P. Erickson, Hennepin County Auditor, Minneapolis, Minn., for furnishing and repairing Contract No. 13, being Bridge No. 1, commonly known as the Anoka Bridge, in accordance with plans and specifications on file with the county surveyor.

✣Bids will be received until 10 a. m., March 21, by C. S. Palmer, Duluth, Minn., for the construction of a culvert and fill over Brewery Creek at Sixth Ave. east and Eighth St.

⊙The contract for the construction of the new county bridge at Holyoke, Minn., was awarded to R. J. Wilcox of that city at his bid of $2,321.

Advices from Duluth, Minn., state that the city contemplates repairing or rebuilding the Oneota St. bridge at Fortieth Ave. The structure is said to be in dangerous condition. John Wilson is City Engineer.

Mississippi.

⊙The Board of Marion County Supervisors, Columbia, Miss., has awarded the contract for the erection of a steel bridge over Holliday's Creek near Hammond Mill on the old Purvis-Summit road to the Joliet Bridge Co., Joliet, Ill., at $2,543. C. T. Washer is representative of the company.

A delegation of Vicksburg, Miss., citizens including Maj. Lee Richardson appeared before the Supervisors of Warren County recently to ask that bonds be issued for the construction of a bridge over Big Black River north of the A. & V. R. R. bridge.

Missouri.

The Greene County Court, Springfield, Mo., has been asked to construct a bridge over Asher Creek at Cave Springs Limits. It is believed that a 120-ft. span will be necessary, costing about $5,000.

Montana.

⊙The Board of Yellowstone County Commissioners, Billings, Mont., has awarded the contract for the superstructure of a steel bridge over Wood River near Ten Sleep to the Great Northern Bridge Co., Minneapolis, Minn.

J. W. Hammons, Noxon, Mont., is circulating a petition asking the Sanders County Commissioners, Thompson, Mont., to erect a bridge over Clark's Fork at Noxon.

New Hampshire.

A committee has been appointed at Haverhill, N. H., to confer with town officials of Newbury relative to rebuilding the Haverhill-Newbury bridge. Charles J. Pike, Haverhill, is a member of the committee.

Town of Ossipee, N. H., has appropriated $1,500 for new iron bridges and $1,000 for repairing bridges. Lyle Moulton is Town Clerk.

Town of Hanover, N. H., has appropriated $10,000 for the Connecticut River bridge. Geo. M. Bridgeman is Town Clerk.

New Jersey.

The Board of Freeholders, Paterson, N. J., has approved the plans submitted by the New York, Susquehanna & Western R. R. for the overhead bridge at Charlottesburgh. Passaic County will pay $1,800 toward the cost.

New York.

✣Bids will be received until 3 p. m., March 31, by John R. Baldwin, Town Clerk, Livingston Manor, Sullivan County, N. Y., for the building of a bridge and foundations over the Willowemoc River, State Road Route No. 4, in the Village of Livingston Manor, New York. Plans and specifications can be had of State Highway Department at Albany, N. Y. Bids are to be accompanied by certified check for 5 per cent of the amount of the bid.

Plans are being prepared by City Engineer W. Thomas Worley, Schenectady, N. Y., for the reconstruction of the Cotton Factory Hollow bridge providing for a 24 ft. 6 in. roadway, two sidewalks and trolley tracks. The work which will cost about $25,000 will be of concrete and steel.

The contract will probably be let for the construction of two concrete and steel bridges, one in Hartfield over the Chautauqua Creek, and the other in Dewittville over Dewittville Creek, to A. J. Corrigan & Son, 612 W. Sixth St., Jamestown, N. Y., at $6899. The work will include sub and superstructure. Bids were opened March 6 by A. McKeever, Town Superintendent of Highways of Chautauqua, Hartfield, N. Y.

North Carolina.

⊙The contracts for the construction of five steel bridges in Cherokee County have been let by the Board of Commissioners, Murphy, N. C., to the Virginia Bridge & Iron Co., Roanoke, Va. The locations of the structures are as follows: One at Ranger, 100-ft. span across Notla River; one at Kisselburg's, 90-ft. span across Notla River; one across Valley River, near Andrews, 90-ft. span; one across Beaverdam Creek at Unaka, 75-ft. span.

⊙The contract for the construction of a reinforced concrete bridge over the tracks of the Southern Railway at East Moorhead St., Charlotte, N. C., to Travers Wood Co., Rich-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

mond, Va., at $6,500. Bids were opened by the Executive Board, Feb. 26.

An act has been passed by the North Carolina Legislature providing for the construction of an iron bridge over the Yadkin River between Forsyth and Davie Counties, one mile from the present location of Hall's Ferry. Mocksville, N. C., is County Seat of Davie County.

North Dakota.

⊙The Board of McKean County Commissioners opened bids at Washburn, N. Dak., March 4 and awarded the contract for furnishing culverts to the North Dakota Metal Culvert Co., Fargo, N. Dak., at $1,985. T. E. Thompson is County Auditor.

Ohio.

✣Bids will be received until 2 p. m., April 4, by Board of Hamilton County Commissioners, Cincinnati, O., for the construction under Specifications No. 417 of a concrete bridge on Whiskey Run road, Taylor Creek road, at Zimmerman's place in Springfield Township. A certified check for $500 must be filed with each bid. Albert Reinhardt is Clerk.

✣Bids will be received until noon (standard time), April 11, by Board of County Commissioners, Columbus, O., for the labor and material necessary to construct and complete the following work, to-wit: Engineer's Estimate No. 455—Constructing the approaches to the Denune bridge on Denune and Perdue Aves. in Clinton and Mifflin Townships. Engineer's Estimate No. 463—Reconstructing the Mound St. bridge over the Scioto River in the city of Columbus. Engineer's Estimate No. 466—Constructing a reinforced concrete bridge over Sugar Run on the Reynoldsburg and New Albany Pike, at the Houston farm, in Plain Township. Engineer's Estimate No. 467—Constructing the approaches to the concrete arch bridge over Black Lick Creek on East Broad St., in Jefferson Township, Plan "A." Engineer's Estimate No. 468—Constructing the approaches to the concrete arch bridge over Black Lick Creek on East Broad St., in Jefferson Township, Plan "B." Engineer's Estimate No. 469—Constructing a new floor system on the Clickenger bridge over the Scioto River, in Hamilton and Jackson Townships. The plans, specifications and estimates of quantities for doing this work are on file in the offices of the County Auditor and County Surveyor. F. M. Sayre is Franklin County Auditor.

✣Bids will be received until noon (standard time), March 26, by S. A. Kinnear, Director of Public Service, Columbus, O., for furnishing the labor and material for the construction of reinforced concrete floor, encasement and parapet wall for the South High St. viaduct. Plans and specifications are on file with the Director and with the Chief Engineer, City Hall.

⊙The Board of Lucas County Commissioners, Toledo, O., has awarded contracts for the construction of the bridge over the Miami & Erie Canal on the Dutch road in Waterville Township as follows: Superstructure to the Capitol Construction Co., Columbus, O., at $2,051; substructure to Seymore Renick, Findlay, O., at $1,747.

Plans have been approved for the proposed subway at the Baltimore & Ohio Railroad crossing and the City Council, Lorain, O., will probably start legislation in the near future. The estimated cost of the work is $155,000. C. M. Osborn is City Engineer.

Plans have been completed by Engineer L. A. Dillon for the construction of hoist bridge at Heaton St. over the canal. The Board of Public Works has ordered an estimate of the cost made. E. C. Shafor is City Clerk of Hamilton, O.

Oregon.

✣Bids will be received until 2 p. m., April 14, by Commissioner of Indian Affairs, Washington, D. C., for furnishing the labor and material for the construction of a steel highway bridge over the Deschutes River abutting on the Warm Springs Indian Reservation, Ore.

⊙The contract for the installation of an ornamental system of outline electrical illuminators for the Broadway bridge, Portland, Ore., has been awarded by the Executive Board to the West Coast Engineering Co., at $20,984.

It is reported that the Willamette Pacific Railroad Co. is contemplating the construction of a lift draw bridge over the Umpqua River at Reedsport, Ore., instead of the swing draw as at first planned.

Pennsylvania.

✣Bids will be received until noon, March 22, by Board of County Commissioners, Butler, Pa., for the construction of county bridges as follows: No. 1—In Buffalo Township, over branch of Buffalo Creek, on Freeport pike. Reinforced concrete with brick floor. No. 2—In Adams Township, over Glade Run at Rosebaugh station. Reinforced concrete with brick floor. No. 3—In Clearfield Township, over branch of Buffalo Creek, on St. Joe and Coylesville road. Reinforced concrete. No. 4—Concrete and brick floor on Fenelton bridge at Fenelton. Each bid must be accompanied by a certified check for 10 per cent of the amount of the bid and a satisfactory bond for the full amount of the contract price must be filed by the successful bidder or bidders. Plans and specifications are on file in the County Commissioners' office. The Commissioners reserve the right to reject any or all bids. W. B. Scott is Clerk.

✣Bids will be received until 1 p. m., March 29, by Bradford County Commissioners, Towanda, Pa., for the construction of two steel bridges. One will be located at Towanda, consisting of four 220-ft. spans on remodeled substructure and will have a 20 ft. 2-in. roadway. The other will be located at Athens and will consist of three 183 ft. 4-in. spans with 20 ft. 2-in. roadway resting on remodeled substructure. The flooring will be of concrete and wood block. Plans and specifications were prepared by David A. Keefe, Engineer, Athens, Pa.

✣Bids will be received until noon, April 1, by Fuller R. Hendershot, Controller of Luzerne County, Wilkes-Barre, Pa., for removing wood and iron superstructure of present bridge over Susquehanna River at Pittston, Pa.; certain alterations to present piers and abutments; and furnishing and erecting, complete, five duplicate, pin-connected spans, each 202 ft. long with 25-ft. permanent roadway and two 8-ft. sidewalks. Plans and specifications are on file in the offices of the Commissioners, or may be had from E. R. Troxell, Jr., Engineer, Pittston, Pa., upon payment of $10, $5 to be refunded upon their return complete within ten days after opening of bids. All bids must be accompanied with certified chesk for $5,000, drawn in favor of Treasurer of Luzerne County, which check must be filed with the Chief Clerk or someone in charge of the Commissioners' office.

⊙Eyre-Shoemaker Co., Philadelphia, Pa., has been awarded the contract by the Pennsylvania R. R. Co. for the construction of two reinforced concrete bridges over the North Branch, Sunbury, Pa.

The Commissioners of Carbon County, Mauch Chunk, Pa., have decided to construct a bridge over Hell Creek in Penn Forest Township.

A scheme is again under way to have a bridge constructed over the Stonycreek River joining Horner St. in the Seventh Ward of Johnston, Pa. It is believed a bridge could be erected for about $100,000. M. Lee Masterson is City Engineer.

The Commissioners of Allegheny County, Pittsburgh, Pa., will shortly issue bridge bonds aggregating $526,000 for the following structures: Ewalt, or 43d St. bridge, $120,000; Sharpsburg, or 62d St. bridge, $325,000, and the Boston bridge (above McKeesport), $81,000.

The city of Newcastle, Pa., has offered to vacate Gardner Ave., providing the proposed viaduct be constructed at the expense of the county, the street car company and the railroad. C. H. Milholland is City Engineer.

It is reported that the Baltimore & Ohio Railroad proposes the construction of a new bridge over the Allegheny River at Pittsburgh, Pa. The cost of the structure is said to amount to about $2,500,000.

South Carolina.

✣Bids will be received until 11 a. m., March 20, by T. W. Boyd, County Supervisors, Yorkville, S. C., for the material for four steel bridges. Plans and specifications may be seen at the office of W. W. Miller, County Engineer, Rock Hill, S. C., or at the office of the County Supervisor, Yorkville, S. C., on the day of the letting.

South Dakota.

⊙A. N. Bjodstrup, Mitchell, S. Dak., has been awarded the contract for the construction of all bridges in Davison County during the coming year. The work will amount to about $18,000, the structures being mostly of steel and concrete.

⊙The contract for the construction of all bridges in Minnehaha County during the year of 1913 has been let to the Western Bridge & Construction Co., Omaha, Nebr. Harry H. Hawl, Sioux Falls, S. Dak., is County Auditor.

The meeting for the consideration of bids received March 4 for the construction and repair of bridges during 1913 in Faulk County, S. Dak., has been adjourned until March 31. W. R. Hall, Faulkton, S. Dak., is County Auditor.

Tennessee.

The Memphis & Arkansas Bridge & Terminal Co. has filed with the Commissioner of Public Utilities, Memphis, Tenn., acceptance of the city's ordinance in regard to the new bridge over the Mississippi River. A bonus of $50,000 has also been filed with the city.

Texas.

✣Bids will be received until April 15 (re-advertisement) by Commissioners' Court, San Angelo, Texas, for the construction of a reinforced concrete bridge. Oscar Frink is County Judge.

✣Bids will be received until noon, March 31, by Dan C. Smith, Jr., City Secretary, Houston, Texas for the construction of a reinforced concrete bridge over the Buffalo Bayou at the foot of Franklin Ave., Houston, Texas. Plans, specifications and bidder's blanks can be obtained on application at the office of the City Engineer, F. L. Dormant, City Hall, Houston, Texas. A certified check of the bidder on any bank in Houston, Texas, payable to H. B. Rice, Mayor, for $2,500. will be required to be deposited with each bid.

⊙The Board of Tarrant County Commissioners has awarded the contract for the construction of the 12th St. bridge at Fort Worth to Austin Bros., Dallas, Tex., at $31,100.

Virginia.

✣Bids will be received until noon, March 27, by Board of Sussex County Supervisors, Sussex, Va., for the construction of a 192-ft. steel bridge with 12-ft. roadway on concrete or pile substructure over the Blackwater River 6 miles from Waverly on the N. & W. Sand can be secured within two miles of the site. Gravel, subject to the State Highway Commissioner's inspection, may be used. Plans and specifications are on file with P. St. J. Wilson, Richmond, Va., State Highway Commissioner, or at the office of the County Clerk, Sussex C. H., Va. Blueprints of plans can be obtained of Childrey-Sunday, Richmond, Va., at $0.78.

✣Bids will be received until noon, March 27, by Board of Sussex County Supervisors, Sussex, Va., for the construction of a steel or reinforced concrete bridge on a concrete-pile substructure over the Paddens Mill Stream 2½ miles from Waverly on the Norfolk & Western. Sand can be secured 1 mile from the site. Gravel may be used for the concrete, subject to inspection by the State. The work will include tearing down old bridge. Plans may be secured of P. St. J. Wilson, State Highway Commissioner, Richmond, Va., or at the office of the County

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Clerk, Sussex. Blueprints of plans can be had of Childrey-Sunday Co., Richmond, Ind., at $0.78.

✣Bids will be received until noon, March 27, by Board of Sussex County Supervisors, Sussex C. H., Va., for the construction of a steel bridge on concrete substructure over the Swamp ½ mile from Irmans 4 miles from Homeville on the Southern Ry. The substructure will include tearing down old bridge at the site. Sand and gravel can be secured within 2 miles of the site. Gravel is subject to state inspection. A certified check for $250 payable to State Highway Commissioner is required. Plans are on file with the State Highway Commissioner and the County Clerk. Blueprints of the plans can be secured of Childrey-Sunday, Richmond, Va., at $0.78.

✣Bids will be received until noon, March 27, by Board of Supervisors, Sussex County, Sussex C. H., Va., for the construction of bridges Nos. 1, 2 and 3 over the Nottoway (Blackwater) River 1½ miles from Milton on the Norfolk & Western Ry. The structures will be of steel on concrete pile substructures and will be in length as follows: No. 1, 29 ft., No. 2, 29 ft., and No. 3, 58 ft. 4 ins. The work will include tearing down old bridges at the sites. Sand can be secured within 1½ miles of the sites. Gravel, subject to inspection by the State, may be used in concrete. Plans are on file at the office of the State Highway Commission and the County Clerk.

✣Bids will be received until noon, March 27, by Board of Sussex County Supervisors, Sussex C. H., Va., for the construction of a 29 ft. 3 in. steel bridge concrete substructure over stream 5 miles from Waverly on N. & W. Ry. The substructure will include tearing down old Masons bridge. Sand can be secured within 1½ miles of the site. Gravel, subject to State inspection, may be used in the concrete. A certified check payable to the Commission for $250 must be filed with each bid. Plans and specifications can be seen at the office of P. St. J. Wilson, State Highway Commissioner, Richmond, or at the office of the Clerk of the county. Blueprints of the plans can be secured of Childrey-Sunday Co., Richmond, Va., at $0.78.

✣Bids will be received until noon, March 27, by Board of Sussex County Supervisors, Sussex C. H., Va., for the construction of a 37 ft. 3 in. steel bridge on concrete substructure over Joseph Swamp near Nebletts Mill, 10 miles from Waverly on the Norfolk & Western Ry. Sand can be obtained within 1½ miles of the site. Gravel may be used in concrete, subject to the inspection of the State Highway Commission. A certified check for $250 payable to the Commission must be filed with each bid. Plans and specifications can be seen at the office of the County Clerk, Sussex C. H., Va. Blueprints of plans can be secured of Childrey-Sunday Co., Richmond, at $0.78.

Charles E. Bolling, City Engineer, Richmond, Va., has recommended that the Southern Railway Co. be instructed to build a new concrete bridge to replace the present structure over the dock at 14th St.

The Board of Supervisors of James City County, Williamsburg, Va., has under consideration the matter of building an overhead bridge at the railroad crossing just east of Williamsburg. A survey will be made of the site and a report submitted to the board at the next meeting. F. B. Isaacs, Richmond, Va., is Engineer.

The Administrative Board, Richmond, Va., has instructed the Southern Ry. to commence work at once on the construction of a concrete bridge at the foot of 14th St. over the dock.

Washington.

The following bridge bills having been adopted by the House were recently passed by the State Senate, Olympia, Wash. They provide appropriations as follows: $500,000 for Washington's share of the Vancouver-Portland bridge; $50,000 as Washington's share of the Newport interstate bridge; $40,000 as Washington's share of the purchase price of the Lewiston-Clarkson bridge, now operated on a toll basis.

The City Council of Puyallup, Wash., has instructed the City Engineer to draw up plans and specifications for the construction of a new pile bridge over Clarks Creek.

The Board of Lewis County Commissioners, Chehallis, Wash., has approved plans for the construction of a concrete bridge over Skookumchuck River at Centralia.

The City of Okanogan, Wash., has decided upon the construction of a new bridge over the Okanogan River.

The proposition to issue bonds amounting to $1,600,000 for the construction of bridges was defeated at a recent election held at Seattle, Wash.

The House of Representatives, Olympia, Wash., has passed the McCoy bill providing that the state raise by a special quarter-mill tax to run through the biennium, half a million dollars for the construction of the Pacific Highway bridge across the Columbia at Vancouver. It also passed the Jensen bill, providing for the construction of a bridge across the Pend Oreille River at Newport, the State of Washington to appropriate $50,000 for this purpose, upon condition that the State of Idaho appropriate a like amount. The house appropriated $30,000 to purchase the present Lewiston-Clarkeston bridge, on the double condition that the State of Idaho or portions thereof should appropriate $40,000 and Asotin County appropriate $10,000. The Pend Oreille bill carries no county appropriation.

West Virginia.

A special committee has been appointed by the Committee on Bridges of the Board of Commerce, Parkersburg, W. Va., to discuss the matter of building a bridge over the Ohio River at that place. Data will be secured of Herman Laub, Pittsburgh, Pa., Engineer.

Wisconsin.

⊙Albert Simonson, West Salem, Wis., has been awarded the contract for the construction of three concrete and steel bridges at Hamilton. The cost of the work will amount to about $4,000.

⊙The contract for the construction of five steel and concrete bridges in the town of Burns during the coming summer has been awarded to the Wausau Steel Co., Wausau, Wis., at $5,081.

⊙Frank McHugh of Shields and Adolph Rhode, Williamston, Wis., recently let the contract for the construction of two concrete bridges over Silver Creek to Leschinger & Cowan at $1,492.

A resolution has been introduced into the City Council of Milwukee, Wis., providing for the issuance of $350,000 of bonds for the construction of the proposed 35th St. viaduct over the Menomonee Valley.

Plans have been completed by C. V. Kerch, City Engineer, Janesville, Wis., for the redecking of the Milwaukee St. bridge with creosote block.

Canada.

✣Bids will be received until noon, April 1, by H. C. Hocken, Mayor, Chairman of the Board of Control, Toronto, Ont., for concrete piers, abutments and floor for St. Clair Ave. Bridge, located east of Bathurst St. Specification and tender form may be obtained upon application at the office of the Railways & Bridges Section, Department of Works, City Hall, Toronto.

⊙The contract for the construction of concrete abutments for a bridge at Old Yange St., township of Yorke, has been awarded to D. H. Clemens, Berlin, Ont., at $1,675. Bids were received March 3 by Frank Barber, Township Engineer, 57 Adelaide St., East Toronto, Ont.

DRAINAGE AND IRRIGATION

Arkansas.

✣Bids will be received until 2 p. m., April 4, by Board of Commissioners of the Overcup Drainage District of Jackson and Woodruff Counties, Ark., at the office of Jones & Campbell, Attorneys, Newport, Ark., for the construction of 30 miles of dredge ditches under two contracts as follows: Contract 1, including 18.40 miles of ditches involving 590,573 cu. yds. estimated to cost 8½ cts. per cu. yd.; Contract 2, including 11.56 miles involving 351,200 cu. yds. estimated to cost 8½ cts. per cu. yd. Complete copies of the Engineers' report are on file at the office of the Clerk of the Circuit Court at Newport; with Mr. D. L. Shoffner, Shoffner, Ark., and at the office of the Morgan Engineering Co., 610 Goodwyn Institute, Memphis, Tenn. Requests for information should be directed to the Morgan Engineering Co. Blue prints of the plats of the Engineers' report will be furnished at the following prices: A complete set of maps and profiles, $2.00; a complete set of profiles, $1.00; a small scale map of the district, 10 cts. To examine the district, the Contractor should go to Shoffner, Ark., on the Rock Island Railroad, from either Brinkley or Newport. Other stations within the district are Weldon and Tupelo. About three-fourths of the district is in cultivation, but a much smaller proportion of the ditch line is through cultivated land. Most of the remainder is in flat, wet, bottom land, where the water supply will be continuous throughout the year. The soil is clay and sand, and mixtures of the two, being very similar in character to that of Southeast Missouri. But little of the ditch line is covered with heavy timber, as compared with the timber in Eastern Arkansas. The location, size and grades of this work make it very desirable for two dredges of 1½ or 2-yd. capacity. There are no deep cuts, and no old streams or bayous to follow. All parts of the district are readily accessible by wagon roads, and a railroad runs throughout its length. Payment for the work will be made in cash.

California.

⊙The U. S. Reclamation Service has awarded the following additional contracts for Portland cement under the bids opened Jan. 6: Feb. 25, contract for 20,000 bbls. was awarded the Union Portland Cement Co. of Ogden, Utah, for delivery f. o. b. Devil's Slide, Utah, at 99 cts. per barrel, for the Truckee-Carson project, Nevada. March 8, contract for 30,000 bbls. awarded to Standard Portland Cement Co., San Francisco, Calf., for delivery f. o. b. Napa Junction, Cal., at $1.40 per barrel, for Klamath, Umatilla and Orland projects, Oregon, and Yakima Storage and Okanogan project, Washington.

The Balfour-Guthrie Investment Co., San Francisco, Calif., has applied to the Supervisors of Contra Costa County for permission to construct a 7-mile canal from Indian slough to Brentwood, to be the main feeder of an irrigation system to open up a tract of land in the eastern end of the county. The proposed canal will be 30 ft. wide and will cross six county roads and two railroad lines. The applicants agree to build three concrete bridges along their line and to construct concrete siphons under the railroad crossings.

Colorado.

The Secretary of the Interior has authorized the U. S. Reclamation Service to construct Tunnel No. 2 on the main supply canal of the Grand Valley Project by government forces. The sum of $142,300 has been allotted

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

for the work. J. H. Miner, Grand Junction, Colo., is Project Engineer.

Georgia.

✣Bids will be received until noon, March 26, by Canal and River Commission, Augusta, Ga., for furnishing all necessary outfit and constructing an earth levee along the river bank in Augusta, from Hawks Gully to 6th St. Approximate quantities 250,000 cu. yds. Also at the same time and place proposals will be received for steel bridge span to be erected as an extension of the North Augusta bridge on 13th St. in Augusta. Proposals will also be received for masonry pier on which above span will rest. These will be let as three contracts. $500 must be deposited with bid on earth embankment, $200 with bid on bridge and $100 with bid on pier. The work will be paid for in cash on monthly estimates. Plans and specifications can be had by application to Nisbet Wingfield, Chief Engineer, 747 Broad St., Augusta, Ga.

Illinois.

✣Bids will be received until 1 p. m., March 29, by Commissioners of Fulkerson Drainage District at the First National Bank, Carmi, Ill., addressed to T. W. Hall, Treasurer of District, for the construction of certain ditches according to the plans for the "Fulkerson Drainage District in White County, Illinois"; said ditches being described as follows: Main ditch length, 13,000 ft.; bottom width, 6 ft.; depth ranging from 3½ to 8¾ ft.; sides approximating angles of 45 degrees, containing 33,730 cu. yds. excavations, and one lateral 1,300 ft. in length, whose dimensions are to be about as follows: Bottom width, 4 ft.; top width, 14 ft.; cut, 5 ft.; sides approximating angles of 45 degrees, and containing about 2,166 cu. yds. of excavations. The exact number of cubic yards excavations in main ditch to be paid for are 33,730 cubic yards, but the number of cubic yards in the lateral may be slightly changed when route is surveyed and staked each 100 ft. The total number of cubic yards then to be paid for will be about 35,896 cu. yds. Specifications are on file with White County Clerk, Carmi, Ill.

✣Bids will be received until 1:30 p. m., March 25, by Board of Chariton Drainage Co., Supervisors, A. E. Berry, Secretary, Glenwood, Mo., for the construction of a drainage ditch including about 250,000 cu. yds. The work is to be completed by March 1, 1914. A certified check for $300 must be filed with each bidder.

Hearing will be held March 19 in the County Court at Watseka, Ill., on petition of Frank Fango, Drainage Commissioner of Middleport Drainage District No. 1, for an additional assessment of $26,600 for laying new tile drains and cleaning out old ditches.

Indiana.

✣Bids will be received until March 27, at the office of G. F. Stinchfield, Porter County Surveyor, Valparaiso, Ind., for the construction of the Kemper ditch, including the following quantities: 290,773 cu. yds. floating dredge work, estimate 6 cts.; 79,802 cu. yds. drag line work, estimate 13 cts.; 60,385 lin. ft., 8 to 24-in. drain tile at estimate of $12,095. A certified check for $500 must be filed with each bid.

⊙Davis Bros. Drain Tile Co., Anderson, Ind., has been awarded the contract at $1,700 for constructing the U. S. Diven ditch, bids for which were opened March 15 by W. F. McVaught, County Engineer, Anderson.

Iowa.

⊙Davidson & Gyellafield, Forest City, Ia., have been awarded the contract for furnishing and laying tile for Drainage District No. 18 of Winnebago County, Ia. Contract for 21,300 cu. yds. of open ditch was let to W. H. Lawton, Newell, Ia.

All bids received March 10 by H. B. Frase, County Auditor, Des Moines, Ia., for constructing ditch in Franklin Township Drainage District No. 13, were rejected. The district has appealed to the District Court for establishment and damages and nothing further will be done until a decision of the court is received. The proposed ditch is 2¾ miles long and requires 36,240 cu. yds. of excavation.

Kansas.

A state irrigation board has been created and a legislative act passed appropriating $125,000 for irrigation. Under the terms of the measure 31 Western Kansas counties, upon making tests of the underflow water supply, will be provided by the state with pumping plants for irrigation purposes and experiments. Any county, after making the test and providing a tract of 40 acres of ground for the experiments, will be furnished with a pumping plant.

Louisiana.

✣Bids will be received until noon, April 2, by Board of Commissioners, Caddo Levee District, Shreveport, La., for the following named work for improving drainage, in Caddo Parish, Louisiana, to be done in accordance with the plans and specifications prescribed by the Board of State Engineers, of Louisiana, viz.: Kelly Bayou Drainage Canal; deposit required, $600; bond required, $10,000. Cash or certified check to the amount named as deposit must accompany each proposal. Other information as to location, character of work, manner of submitting proposals, execution of contract and bond, and time of beginning and completing of work, as well as blank forms for submitting proposals, may be had on application to the Board of State Engineers, Rooms 213-215 New Orleans Court Bldg., New Orleans, La., or undersigned. W. A. Kerley, Secretary of Board of Cimmissioners.

✣Bids will be received until noon, April 2, by Board of Commissioners, Caddo Levee District, Shreveport, La., for bank protection work in the following named reaches, Caddo Parish, Red River, Right Bank, viz.: Scott's Slough Reach: approximate length of revetment, 2,500 ft.; deposit required, $700; bond required, $12,500. Rattling Slough Reach; approximate length, 2,500 ft.; deposit required, $700; bond required, $12,500. Havana Reach; approximate length, 2,500 ft.; deposit required, $700; bond required, $12,500. Corner Place Reach; approximate length, 2,000 ft.; deposit required, $600; bond required, $10,000. Fire Point Reach; approximate length, 2,000 ft.; deposit required, $600; bond required, $10,000. Silver Point Reach; approximate length, 2,000 ft.; deposit required, $600; bond required, $10,000. Twelve-Mile Bayou Reach; approximate length, 3,000 ft.; deposit required, $800; bond required, $15,000. Dixie Reach; approximate length, 2,000 ft.; deposit required, $600; bond required, $10,000. Lucas Reach; approximate length, 3,000 ft.; deposit required, $800; bond required, $15,000. Leonard Reach; approximate length, 2,500; deposit required, $700; bond required, $12,500. Long Point Reach; approximate length, 2,000 ft.; deposit required, $600; bond required, $10,000. Campo Bello Reach; approximate length, 2,000 ft.; deposit required, $600; bond required, $10,000. Proposals will be received on any one or more reaches separately, or upon the total number of reaches as a whole. Cash or certified check to the amount named as deposit must accompany each proposal. Other information as to location, character of work, terms of payment, manner of submitting proposals, execution of contract and bond, and time of beginning and completing of work, as well as blank forms for submitting proposals, may be had on application to the Board of State Engineers, Rooms 213-215 New Orleans Court Bldg., New Orleans, La., or to W. A. Kerley, Secretary of the Board.

Michigan.

✣Bids will be received until 10 a. m., March 25, by A. H. Heid, County Drain Commissioner, Flint, Mich., for the construction of the Hartshorn and Extension Drain in the townships of Flint and Mt. Morris, Genesee County, Mich. The total length of the drain and extension is 2,052.68 rods. The work will include 8, 10, 16 and 18-in. tile.

Minnesota.

⊙A. Henriksen, Askov, Minn., has been awarded the contract at $16,900 for constructing Ditch No. 25 of Freeborn County, bids for which were opened March 6 at Albert Lea, Minn. The ditch calls for 4,350 lin. ft. of 30-in. tile, 4,084 lin. ft. of 24-in. tile, 2,100 lin. ft. of 22-in. tile, 800 lin. ft. of 20-in. tile, 1,654 lin. ft. of 18-in. tile, 485 lin. ft. of 14-in. tile, 2,851 lin. ft. of 12-in. tile, 2,850 lin. ft. of 10-in. tile, 2,425 lin. ft. of 8-in. tile, 40 lin. ft. of 7-in. tile.

Mississippi.

✣Bids will be received until March 25, by the Mississippi Levee District, W. J. Shackelford, Chief Engineer, Greenville, Miss., for the construction and completion before Dec. 15, 1913, of the following work: Skinner New Levee, two miles below Greenville—Section 1, Station 80 to 120—embankment, etc., 190,000 yds. Section 2, Station 120 to 154—embankment, etc., 225,000 yds. Section 2, Station 120 to 154—removing sand from base, 85,000 yds. Total, 500,000 yds. All riverside borrow. The old levee is not to be taken down. Contractors are requested to make separate bids on removing sand from base on Section 2. Section 1 will be standard section and grade, with light topping on 8-ft. crown, banquette with 20-ft. crown and five to one slope. Section 2 will be constructed as follows: First the whole base to be occupied by the levee will be stripped of sand and thoroughly grubbed, and a muck ditch cut of such dimensions as may be deemed necessary. The sand thus stripped will be placed behind the levee in the form of a sub-banquette according to stake notes. The back of the riverside pit will then be stripped to the natural surface, and the material placed in the main banquette of the levee; then good approved material will be taken from the pit thus stripped to fill the muck ditch, and to build a "core levee" with an 8-ft crown and one-half to one slopes to the height of the 1903 high water; the levee will then be completed with material from the riverside pits, with four to one slopes, and 8-ft. crown, 4 ft. above 1903 high water. The ground to be occupied by the sub-banquette will be grubbed, but sand not removed. Average fill on Section 1 is about 17 ft., and on Section 2 it is about 23 ft.

✣Bids will be received until March 25, by Mississippi Levee District, W. J. Shackelford, Chief Engineer, Greenville, Miss., for the construction and completion before Dec. 15, 1913, of the following work: New Warfield Levee, 6 miles below Greenville—Station 321-15 to 335—embankment, etc., 43,000 yds. Average fill on this levee will be about 15 ft. It will be of the standard section and grade. If any of the old levee at the upper end is taken down there must be a spur 200 ft. long left next to the levee, and all the remainder of the old levee taken down; otherwise it must all be left intact above Station 330 on the old levee, but it may be taken down below this point. The old levee cannot be taken down at this loop until July 1, 1913. All riverside borrow.

Montana.

Bids will be asked in a few days for excavating the main canal, 45 miles long, of the Sun River Project, of the U. S. Reclamation Service. The diversion dam, 140 ft. high, and the diversion tunnel will be constructed by government forces. The Department of the Interior has entered into a contract with the Great Falls Power Co. of Montana whereby the latter will furnish electrical energy for use in connection with the construction work. J. B. Bond, Fort Shaw, Mont., is Project Engineer.

New Jersey.

⊙The Hudson County Mosquito Extermination Commission of Jersey City, N. J., has awarded a contract to Jesse P. Manahan, Red

Bank, N. J., for digging 10,000 ft. of drainage ditches at 2½ cts. per foot, and cleaning and repairing 300,000 ft. of old ditches at ½ ct. per foot. Bids were opened Feb. 21.

The County Board of Freeholders, Atlantic City, N. J., have appropriated $26,000 for ditching of marshes and oiling of ponds for the extermination of mosquitoes. The money will be expended by a commission of physicians headed by Dr. W. Edgar Darnall of Atlantic City.

New York.

✣Bids will be received until 2 p. m., April 7, by Quartermaster, West Point, N. Y., for draining and filling swamps on Constitution Island.

Ohio.

⊙E. A. Fishback, Horatio, O., has been awarded the contract at $11,600 for constructing the Whitewater Ditch, bids for which were opened March 8 at Greenville, O.

Texas.

Peytons Creek Irrigation District of Matagorda County has voted a $60,000 bond issue for extending the irrigation system.

Mexico.

The date for receiving bids for the construction of an irrigation canal near Esperanza, Sonora, Mexico, which were to have been opened April 1, has been indefinitely postponed by Compania Constructora Richardson, S. A. Esperanza.

WATER WORKS

California.

✣Bids will be received until 11 a. m., April 7, by Lieut. C. A. Lohr, Quartermaster, Fort Rosecrans, Calif., for laying pipe line and installing oil-burning apparatus in buildings at that post.

The City Trustees of Woodland, Calif., plan to expend approximately $12,000 in the construction of sewers and $15,000 to extend the water mains and enlarge the same. It is also proposed to erect a new steel tower at the new waterworks at an estimated cost of $6,500.

The Pacific Gas & Electric Co., John A. Britton, General Manager, plans improvement work to the waterworks system in Grass Valley, Calif. F. M. Miller is City Engineer.

The Chamber of Commerce, Perris, Calif., on March 8 decided to support the proposed issuing of bonds to the amount of $20,000 for the installation of a city water system.

Florida.

✣Bids will be received until 6 p. m., March 25, by Board of Public Works, Sarasota, Fla., for the construction of water works improvements as follows: Furnishing material and laying the following approximate quantities: 2,480 ft. 8-in. Class B, C. I. water mains; 4,630 ft. 6-in. Class B, C. I. water mains; 2,455 ft., 4-in. Class B, C. I. water mains; 5,700 ft. 2-in. galvanized service pipe. Sumbit bid both on AWW x Std. and Universal joint, 5 tons specials, 21 fire hydrants, 4 8-in. gate valves, 4 6-in. gate valves, 10 4-in. gate valves, 12 2-in. gate valves. Excavating a drainage ditch approximately 3,000 ft. long with an estimated yardage of 7,600 yds. W. A. Sumner is Chairman of the Board.

Georgia.

Consulting Engineers J. B. McCrary Co., Atlanta, Ga., have prepared plans for the construction of a waterworks and an electric light plant for Marshallville, Ga., estimated to cost $20,000. Bonds are to be voted upon March 27 and if carried the contracts will probably be awarded in April. J. O. Booton is Mayor.

Illinois.

Hydraulic Engineer J. Rollin Gray, 803 Great Northern Bldg., Chicago, Ill., has been retained by the Village of Bensenville, Ill., to prepare preliminary plans for a waterworks system.

The city of Springfield, Ill., has appropriated $50,000 for the purchase of motor apparatus for the fire department. J. E. Dressendorfer, City Clerk.

Following are the lowest bids submitted to L. E. McGann, Commisisoner of Public Works, Chicago, Ill., for furnishing, delivering and placing such fireproof covering as is required at the various pumping stations, cribs and shops. Illinois Fireproof Covering Co., 154 W. Randolph St. has not been awarded.

Following are the lowest bids submitted to L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering to the Bureau of Engineering velocity water meters: 20 3-in. meters, $1,180; 104 4-in. meters, $3,640; 15 6-inch meters, $3,300; total, $8,120. The contract has not been awarded.

The city of Springfield, Ill., has appropriated the following amounts for the improvement of the water works system, new cast iron mains $6,000, new meters, $5,000, new equipment $5,000, boilers, piping and auxiliaries, $5,000, contract to drive wells, $7,000, power transmission and flow lines, $1,000, 1 turbo generator, $20,000, miscellaneous, $5,000. J. E. Dressendorfer, City Clerk.

Indiana.

The City Council of Logansport, Ind., has appropriated $60,000 for the construction of a filtration plant.

Iowa.

✣Bids will be received until March 25, by J. J. Hamiltotn, Town Clerk, Epworth, Ia., for the construction of a complete water works plant. Plans and specifications are on file with the clerk.

⊙W. E. Middleton, of Kansas City, Mo., has been awarded the contract by the Board of Trustees of the Muscatine City Water Works, Muscatine, Ia., for the construction of a distributing reservoir on the waterworks property between Cook St., and Kindler Ave. and north of Lucas St., for $18,381. Bids were opened March 10.

The citizens of Woodbine, Ia., at a recent special election voted the issuance of bonds to the amount of $28,000 for improvement work. Of the amount, $8,000 will be used to improve the present waterworks system and $20,000 for a sanitary sewerage system.

A special election is to be held in Ledyard, Ia. (population 222), for the purpose of voting on the issuance of bonds for the installation of a waterworks system.

The citizens of Lake City, Ia., on March 6 authorized a bond issue to the amount of $12,000 for the making of improvements to the waterworks system. A new well about 2,000 ft. deep, pump, and extensions of water mains will be let at contract as soon as the plans are completed. A. O. Anderson, Lake City, is Engineer.

The City Council of Fontanelle, Ia., has called an election for April 9 to vote on the issuance of bonds for the installation of a waterworks and an electric light plant.

The citizens of Farragut, Ia., at the recent special election voted against the issuance of bonds to the amount of $8,000 for a waterworks system.

Kansas.

An effort is being made in Jetmore, Kan., to raise $20,000 for a lighting plant and water system to be owned by the municipality.

Maine.

In his inaugural address Mayor Emery O. Beane, of Hallowell, Me., called attention to the need of a better water supply.

Maryland.

The City Council, Frostburg, Md., is considering the installation of a waterworks system.

Engineer Ezra B. Whitman of the Water Board, Baltimore, Md., proposed to have plans for the filtration plant to be erected at Lake Montebello completed by the latter part of this month. The contract for its construction will be awarded, in all probability, about the latter part of April. The estimated cost of the plant is $1,731,819.

Massachusetts.

A committee of which Walter C. Perkins is a member has been appointed in Saugus, Mass., to consider the erection of a standpipe on Baker's Hill.

Town of Easthampton, Mass., has appropriated $8,000 for an auto for the fire department. F. E. Lyman is Selectman.

The Town of Chelmsford, Mass., contemplates establishing a waterworks system at the Center village.

Michigan.

✣Bids will be received until March 20, by Charles Cummings, City Engineer, Marquette, Mich., for 9,500 ft. of 12 to 30-in. pipe sewers. The cost is estimated at $50,000.

The Board of Public Works of Jackson, Mich., has asked for bids for a new pumping engine, at a cost of $20,000.

Hydraulic Engineer J. Rollin Gray, 803 Great Northern Bldg., Chicago, Ill., has submitted plans and a report on the proposed installation of a waterworks in Fennville, Mich., for which bonds were voted March 10.

The Fire and Water Committee of the City Council, Ironwood, Mich., has recommended the purchase of a modern motor truck, equipped with all the latest chemical and other modern apparatus. The recommendation has been adopted by the Council.

The citizens of the Town of Reed City, Mich., on March 10, it is reported, voted bonds to the amount of $3,000 for the extension of water mains to the east of the town.

Minnesota.

⊙J. F. McCarthy, Minneapolis, Minn., has been awarded the contract by the village of Pine City, Minn., for drilling a well at least 150 ft. deep for $770. Bids were opened March 14.

The Commercial Club of Carlton, Minn., is agitating the proposition of establishing a system of waterworks. An engineer will be employed to prepare plans and estimates.

The City Council of Eveleth, Minn., has under consideration the following improvements to the waterworks plant: The installation of an additional pump and the lowering of all the pumps some 20 ft.; the covering of the supply main and the building of a reservoir of some 5,000,000 gals. capacity on the hill near the water tank.

Montana.

An election is to be held in Billings, Mont., on March 25 for the purpose of voting on the issuance of bonds to the amount of $575,000 for the construction of a waterworks system and the acquiring of the water supply.

Nebraska.

✣Bids will be received until 8 p. m., March 24, by Mayor and City Council, Wisner, Neb., for the extension and improvement of the city water works in accordance with plans and specifications on file with C. S. Deily, City Clerk.

⊙The Nebraska Construction Co., Lincoln, Neb., has been awarded the contract for the rearrangement of the waterworks system of Creighton, Neb., for $5,875. The work includes sinking wells sufficient to supply 275 gals. of water a minute, the relaying of some of the old mains and about 420 ft. of new mains. C. A. Killian, of Morse Bluffs, Neb., is Engineer.

The City Council of Ord, Nebr., has employed an engineer to prepare new plans for the installation of a steam pumping plant. Civil Engineer L. D. Wright, Fremont, Nebr., is interested.

The Town of Elgin, Neb., will shortly commence work on the improvement and extension of the waterworks system. Bonds to the amount of $5,000 have been voted for the work.

The City Council of Columbus, Neb., on March 7, considered a proposition to submit to the people for the issuance of bonds to the amount of $10,000 for extending and improving the waterworks. The sum of $10,000 is now available.

C. A. Pierason, of Axtell, Neb., has purchased the Flatonia Ice, Water & Electric Co., Flatonia, Tex., and contemplates expending several thousand dollars on improvements.

A special election will be held in Blue Hill, Neb. (population 761), to vote on the extension of the city waterworks system.

The citizens of Benkelman, Neb. (population 538), will vote on a $20,000 proposition for a waterworks system and $5,000 for municipal electric light plant.

New Hampshire.

Town of Wilton, N. H., has voted to purchase a high power automobile for the fire department. E. A. French is Town Clerk.

A committee to investigate matter of a water system has been appointed at Greenville, N. H. V. L. Parker is a member of the committee.

An appropriation of $400 has been voted by the Town of Pembroke, N. H., for survey for extension of waterworks. H. K. Rogers is Selectman.

New Mexico.

✣Bids will be received until 6 p. m., April 4, by Quartermaster, Fort Bayard, N. M., for furnishing and delivering three transformers and one motor.

New Jersey.

⊙The Kennedy Valve Co., Elmira, N. Y., secured the contract at Atlantic City, N. J., for furnishing the water department with 6-in. to 24-in. valves, for $3,766. Bids were opened Febr. 14.

New York.

⊙The Bison Construction Co., Builders' Exchange, Buffalo, N. Y., will probably be awarded the contract by that city, Henry L. Lyon, Deputy Water Commisisoner, for work and material required for the erection and completion of the Venturi meter and valve house new pumping station, at the foot of Porter Ave., for $155,152. Bids were opened March 7.

Following low bids were received by the Board of Contract & Supply of Syracuse, N. Y., on March 10 for supplies for the Water Department: Two hundred gate stones, $3.50 each, Hays Bros.; 2,500 lbs. of wiping solder, 20¾c a lb., John Weeks & Sons; 1,600 curb boxes, Pierce, Butler & Pierce Mfg. Co., $1,001; 79,000 lbs. of pig lead and lead piping, $3,783, Pierce, Butler & Pierce; 2,080 corporation and curb cocks, $906, Edward Joy; 150 gate boxes and covers, Empire Foundry, $255; 435 tons cast iron pipe and special iron casts, Standard Cast Iron Pipe & Foundry Co., Bristol, Pa., $114.

Ohio.

✣Bids will be received until noon, March 24, by J. W. Chrisford, Director of Public Service, Lakewood, O., for furnishing the necessary labor and materials for water mains with all the necessary valves, boxes, tees, etc., for the following named thoroughfares: Warren Road, between Bayes Ave. and Fisher Road; McKinley Ave. The foregoing to be done according to plans and specifications on file in said office and at the office of C. W. Root, 1033 Society for Savings Bldg., Cleveland, O.

⊙Jno. A. Roeblings Sons Co., Cleveland, O., has been awarded the contract by the Department of Public Safety, Cleveland, for furnishing copper wire for the police department, for $679. Bids were opened March 14.

⊙Following bids were received at Willoughby, O., on Febr. 22, for the construction of the rapid water filter plant, for which Burgess & Long, Columbus, O., are Engineers. (1) stands for bids on filters, basins, building and equipment; (2) bid on clear well, and (3) bid on outside piping: Albert Russo & Bro., Willoughby, O., (1) $18,290; (2) $2,712; (3) $940, (awarded contract). B. F. Hewitt, Jefferson, O., (1) $17,500; (2) $4,200; (3) $1,420; Lanese Co., Cleveland, (1) $14,000; (2) $6,500; (3) $1,837. The Pitt Construction Co., (1) $17,700; (2) $3,800; (3) $2,000. J. W. Danforth Co., Buffalo, N. Y., (1) $20,806; (2) $5,988; (3) $973. Nicola Building Co., Pittsburgh, Pa., (1) $23,210; (2) $4,525; (3) $2,215. Gail-Wilson Co., Inc., Buffalo, N. Y., (1) $29,091; (2) $6,740; (3) $1,555.

The Trumbull Water Co., according to advices from Youngstown, O., will construct a reservoir in Squaw Creek, just north of Avon Park, during the present year. The reservoir is to have a capacity of 600,000,000 gals. Plans have been prepared by Civil Engineer D. M. Wise, 223 W. Wood St., Youngstown. It is the intention of the company to supply soft, pure water for commercial purposes for Girard and other villages in Trumbull County.

Oklahoma.

The citizens of Durant, Okla., on March 18 voted the issuance of bonds to the amount of $85,000 for making extensions to the water and sewer systems, and the installation of an electric pump in the waterworks station.

Oregon.

According to advices from Reedsport, Ore., preparations are being made to begin active development work on the Clear Lake gravity water supply, and plans are about completed for the Loon Lake hydro-electric power.

An election is to be held in Eugene, Ore., for the purpose of voting on the issuance of bonds in the sum of $100,000 for the construction and extension to the waterworks system.

Pennsylvania.

⊙The U. S. Cast Iron Pipe & Foundry Co., Morris bldg., Philadelphia, Pa., has been awarded the contract by the Water Department, Atlantic City, N. J., for furnishing 48-in. cast iron pipe and special castings, for 50,782. The Rensselaer Valve Co., 180 Broadway, New York City, secured the contract for furnishing 42 and 48-in. gate valves, for $3,197. Bids were opened Febr. 20.

Plans have been prepared by City Engineer R. J. Gillis, Carbondale, Pa., for the making of extensions to the waterworks system, estimated to cost $50,000. Contracts will be let in the summer. H. J. Likelay is official in charge.

The Board of Water Commissioners of the City of Danville, Pennsylvania, have employed Chester & Fleming, Hydraulic Engineers of Pittsburgh, Pa., to prepare plans and specifications for a reinforced concrete settling basin to be located at the filter plant of the city. This work will be ready for bids in April.

The borough of Rochester, Pa. (population 5,903), plans the erection of a municipal waterworks system. C. C. Thayer, Rochester, is interested.

A delegation of citizens from Elizabethville, Pa., on March 7 appeared before the State Commissioner of Health, Samuel Dixon, in regard to the State's effort to secure improvement in the water supply in that portion of the Lykens Valley, Dauphin County.

The plant of the Mohnsville Water Co. was sold on March 10 at Reading, Pa., for a consideration of $110,000. The new owners decided to extend the service to the suburbs in the vicinity of Mohnton and Shillington. The new officers are: President, Allen E. Hildebrand; Vice President and General Manager, James T. Niland; Secretary, Thomas E. Pickerell.

Rhode Island.

The Common Council of Woonsocket, R. I., has appropriated $45,000 for waterworks construction. Arthur F. Ballon is Superintendent of Waterworks.

South Carolina.

✣Bids will be received until 11 a. m., March 21, by Board of Richland County Commissioners, Columbia, S. C., for furnishing Richland County the following: Approximately $5,000 worth of concrete pipe to be delivered as required on various orders until January 1, 1914. Sizes will be 18 ins., 24 ins., 30 ins., 36 ins., 42 ins., 48 ins., and 60 ins. Specifications shall be submitted by the bidder. No bids will be considered for pipe unless manufactured by the "Wet Process." A. Patterson, Jr., Supervisor; W. C. Thomas is Clerk of Board.

The candidates for Mayor and Aldermen of Winnsboro, S. C., have pledged themselves to install a complete system of waterworks and sewerage.

Consulting Engineer J. Newton Johnston, Florence, S. C., has prepared plans for the installation of a waterworks system in Manning, S. C., at an estimated cost of $30,000. The work will include 24,600 ft. of pine, 32 gate valves, 45 hydrants, two 100 h. p. boilers, one 1,000,000-gal. steel tank, service pumps, brick station and reservoir. Water will be secured from deep wells.

South Dakota.

The City Council of Hurley, S. D., has adopted plans for the extension of the waterworks. The work will commence in the near future.

The Town Board of Volin, S. D. (population 286), has been authorized by the citizens to bond the town for a waterworks.

In accordance with a special election held at Willow Lakes, S. D., steps will be taken at once to install a waterworks and electric light plant.

Tennessee.

The Shelbyville Water Co., Shelbyville, Tenn., is to be sold on April 1.

The City Council of Jackson, Tenn., has authorized a bond issue of $25,000 for improvements in the city water department. More mains will be laid and the pumping capacity will be increased.

The City Council of Columbia, Tenn., has taken the preliminary steps toward the appraisal of the waterworks system for the purpose of taking it over.

Texas.

Engineer F. H. Kilburn, Woodward, Okla., has prepared plans for the installation of a waterworks system in Canadian, Tex., at an estimated cost of $27,000. Water will be secured from wells. The work is to include wells, pipe line and standpipe, and will be done by the city by day labor.

Engineer A. R. Seckei, Bay City, Tex., has prepared plans for extensions to the water works system, to cost about $6,000. The mains and fire hydrants will be extended. Work is to be done by day labor. J. Sutherland is Mayor.

The Town of Spur, Texas, will shortly let contracts for the installation of a waterworks system, for which bonds to the amount of $25,000 have been voted.

The citizens of Rockdale, Texas, at a recent special election voted the issuance of bonds to the amount of $30,000 for the purpose of buying and building a system of waterworks.

The East Side Water Co., Del Rio, Texas, has been incorporated with a capital stock of $6,000. The incorporators are: M. H. McKinney, W. E. Weathersbee, L. O. Weathersbee.

Utah.

The citizens of Hyrum, Utah (population 1,833), have voted the City Council authority to issue bonds for the installation of a waterworks system. It is estimated that the im-

✣ **indicates work now open for bids.** ⊙ **indicates a contract let recently.**

provement will cost between $50,000 and $60,000.

Commissioner W. H. Korns and Supt. C. F. Barrett, Salt Lake City, Utah, have prepared plans for cleaning the city water mains. The estimated cost of this work is $25,000.

The Utah Light & Railway Co., Ogden, Utah, has purchased eight acres of land southwest of the company's power plant, near the mouth of Ogden canyon, for the purpose of building a reservoir.

Washington.

The citizens of Omak, Wash., at a recent special election voted the issuance of bonds for the construction of a waterworks system. Plans and specifications will be prepared at once.

The citizens of Seattle, Wash., at a recent election, voted the issuance of bonds for extending the water and lighting system. This work will cost about $500,000.

The proposed election to be held in Kirkland, Wash., for the purpose of voting on the proposition to install a waterworks system has been postponed until April 5.

Wisconsin.

✣Bids will be received until 10:30 p. m., April 24, by Department of Public Works, F. G. Simmons, Commissioner, Milwaukee, Wis., for furnishing all materials and doing all the work necessary and required to construct a waterworks tunnel 12 ft. in diameter, for a distance of approximately 4,000 ft. out into and under Lake Michigan, from a point on the lake shore on the center line of Linwood Ave. extended; 1 lake shaft, including connections and steel cylinders: one shore shaft, including 2 gate wells and all connections, and approximately 150 cu. yds. of rock excavation, according to plans and specifications on file in this office. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until March 21, by City Engineer, Madison, Wis., it is said, for the construction of water mains in the Highland Park District and on West Johnson St.

The Village Council of Mukwonago, Wis., rejected all bids received Febr. 24 for furnishing about 130 tons of cast iron water pipe, in 4, 6 and 8-in. sizes, and about 2½ tons of special castings, together with 22 fire hydrants and 10 gate valves with extension boxes. The bids were considered March 12. J. Rollin Gray, Great Northern Bldg., Chicago, Ill., is Engineer.

The citizens of Palmyra, Wis., have voted bonds to the amount of $19,000 for the installation of a waterworks system. Plans are now being prepared by Hydraulic Engineer J. Rollin Gray, 803 Great Northern Bldg., Chicago, Ill.

Wyoming.

The Town Council of Powell, Wyo., has called a special election for the purpose of voting on the issuance of bonds to the amount of $6,500 for the installation of a waterworks system.

Canada.

✣Bids will be received until noon, April 2 (not April 12) by Committee on Works, Halifax, N. S., for the construction of a reinforced concrete reservoir and gate house. Specifications can be had at the office of the City Engineer.

⊙Willans & Robinson, Rugby, England, have been awarded the contract by the city of Moose Jaw, Sask., for furnishing a 1,500 K. W. steam turbine and generator, for $30,505. Bids were opened Febr. 10.

⊙The Des Moines Bridge & Iron Works, Des Moines, Ia., has been awarded the contract by the Canadian Northern Ry. for furnishing the water tanks and towers for the Pacific coast branch the company will build from Lethbridge, Alta., to the coast. The contract involves the expenditure of $250,000.

The Sidney Water & Power Co., Sidney, B. C., has been granted permission from the Provincial Government to install a thoroughly up-to-date water system from a reservoir to be constructed at Mount Newton, with a capacity of 200,000 gals.

SEWERAGE AND SANITATION

California.

⊙The Board of City Trustees, Elsinore, Calif., has awarded the contract for the construction of a sewerage system to the Westlake Construction Co., of Los Angeles, Calif., for $18,053. Vitrified pipe will be used.

The City Trustees of Fullerton, Calif., have rejected the two bids received March 5 for the construction of sewers and have ordered the work readvertised. The lowest bid received was $50,000.

The City Council of Grass Valley, Calif., has accepted plans and specifications for the construction of a sewer along Marshall St.

City Engineer F. W. McCarton of San Jose, Calif., is preparing plans and specifications for the construction of sewers as follows: 19th St., from Washington to Mission: 21st St., from Julian to Taylor: 15th St., from Jackson to Taylor.

The City Council of Long Beach, Calif., contemplates calling an election for the purpose of voting upon bonds for public improvements totaling in cost $1,408,000. Among the improvements contemplated are: Extension of sewer system, $350,000; water distribution system, $100,000, and incinerator, $30,000.

Florida.

✣Bids will be received until 6 p. m., March 25, by Board of Public Works, Sarasota, Fla., for the construction of the following sewer work: Furnishing and laying the following approximate quantities: 1,890 ft. 12-in. terra cotta sewer. 5,742 ft. 10-in. terra cotta sewer. 3,857 ft. 8-in. terra cotta sewer, 7,539 ft. 6-in. terra cotta sewer. 40 manholes, 4 flush tanks. W. A. Sumner is Chairman of the Board.

Illinois.

✣Bids will be received until 11 a. m., March 22d, for furnishing and delivering repressed vitrified salt glazed of the hub and spigot pattern, made up as follows: 15,000 pieces of 4-in. 800 pieces of 6-in., 800 pieces of 9-in., 100 pieces of 12-in., delivery points as follows: Pipe yards Avers Ave. and Wabansia Ave., C. M. & St. P. switch track; pipe yard 2352 S. Ashland Ave., C. B. & Q., switch track; pipe yard, 49th St. and Union Ave., Penn. team track; pipe yard, 68th St. and Yates Ave., I. C. switch track. Cash or certified check for $100 must accompany proposal. Specifications upon application to L. E. McGann, Commissioner of Public Works, Chicago, Ill.

✣Bids will be received until 11 a. m., March 22, by L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering repressed vitrified sewer pipe of the hub and spigot pattern, details as follows: 15,000 pieces of 4-in., 800 pieces of 6-in., 800 pieces of 9-in., and 100 pieces of 12-in., delivery points as follows: Pipe yard, Avers Ave. and Wabansia Ave., C. M. & St. P. switch track; pipe yard, 2352 S. Ashland Ave., C. B. & Q. switch track; pipe yard 49th St. and Union Ave., Pennsylvania team track; pipe yard, 68th St. and Yates Ave., I. C. switch track; pipe yard 104th Pl. and Harvard Ave., C. & W. I. switch track. Cash or certified check for $100, must accompany proposal.

Following are the lowest bids submitted to the Board of Local Improvements, Chicago, Ill., on March 10, for furnishing and delivering labor and materials, etc., necessary to construct house drains in the following streets: Champlain Ave., 75th St. to 79th St., 1,509 lin. ft., 30 cts., J. J. Lynch. Ave. H, 107th St. to 108th St., 700 lin ft., 20 cts., G. Barry, 4761 Shields Ave. Coles Ave., 81st St. to 82d St., 800 lin. ft., 35 cts., S. Ryan, 2927 W. Congress St. Colfax Ave., 83d St. to S. Chicago Ave, 6,000 lin. ft., 23.5 cts., G. Barry. East End Ave., 82d St. to St. Anthony Av., 35 cts., G. Barry. 83d St., Stony Island Ave. to Anthony Ave., 300 lin. ft., 55 cts., A. Scully, 4892 Our St. 47th St., Leavitt St. to Western Ave., 45 cts., G. Barry. 50th Ave., Fulton St. to West End Ave., 1,000 lin. ft., 44 cts., G. Barry. Green St., 83d St. to 84th St., 1,400 lin. ft., 29 cts., G Barry. Morgan St., 1,400 lin. ft., 30 cts., G. Barry. 93d St., Colfax Ave. to Jeffry Ave., 33 cts., S. Ryan. 104th St., Prairie Ave. to Indiana Ave., 1,000 lin. ft., 33 cts., G. Barry. 107th St., Wentworth Ave. to State St., 70 lin. ft., 39 cts., M. Murphy, 5315 Wabash Ave. 119th St., Halsted St. to Morgan St., 600 lin. ft., 44 cts., A. Mancini, 900 W. Taylor St. Park Ave., 50th Ave. to 51st Ave., 1,200 lin. ft., 40 cts., A Mancini. Peoria St., 83d St. to 84th St., 1,200 lin. ft., 29.5 cts., G. Barry. Sangamon St., 83d St. to 84th St., 1,400 lin. ft., 29.5 cts., G. Barry. Sherman Ave., 83d St. to 87th St., 4,500 lin. ft., 23.5 cts., G. Barry St. Lawrence Ave., 75th St. to 79th St., 35 cts., J. J. Lynch. Wabash Ave., 103d St. to 107 St., 3,000 lin. ft., 29 cts., G. Barry. 119th St., Michigan Av. to 260 ft east of Calumet Ave., 800 lin. ft. Prairie Ave., 119th St. to 120th St., 600 lin. ft. Calumet to 260 ft. east, 200 lin. ft. Calumet Ave., 119th St. to 120th St., 400 lin. ft., 28.5 cts., G. Barry. All drains to be 6-in in diameter; the contracts have not been awarded. Edw. J. Glackin, Secretary of the Board.

Indiana.

⊙The Board of Public Works, South Bend, Ind., has awarded the contract for the construction of the proposed Eddy St., trunk sewer to Hoban & Roach, for $2,710.

Iowa.

✣Bids will be received until 8 p. m., March 31, by J. A. Dougherty, City Clerk, Carroll, Ia., for the construction of sanitary sewers of vitrified sewer pipe and sub-drains of vitrified agricultural drain tile, including appurtenances, in parts of the said City of Carroll, Ia., as per plans and specifications prepared therefor by the City Engineer and approved by the City Council and now on file in the office of said City Clerk, and include the following: About 15,000 ft. of 8-in. sewer; about 3,230 ft. of 6-in. sub-drain; 25 man holes; 12 combined man holes and flush tanks; 6 lamp holes. Work to begin on or before the first day of May, 1913, and to be entirely completed on or before the 1st day of October, 1913.

It is reported that the citizens of Woodbine, Ia. (population 1,538), on March 10 voted the issuance of bonds to the amount of $20,000 for a sewer system, and to the amount of $8,000 for extensions to the waterworks.

The City Council of Mt. Pleasant, Ia., contemplates the extension of the city sewerage system for five more blocks in the main part of town. A hearing will be held March 25.

City Engineer E. F. Stimson of Council Bluffs, Ia., will communicate with consulting engineers, preliminary to preparing plans for the west end sewerage system.

Residents of West Morningside and Greenville have petitioned the City Council of Sioux City, Ia., for a sanitary sewer system. The proposed route of the sewer would drain Rustin, Dace, Helen, Leech, Cecelia and Euclid Sts. and Aves., and would open into the Correctionville Road main. The sewer would be 12 blocks in length.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Kansas.

The City Council of Great Bend, Kans., has employed H. A. Rowland, McPherson, Kans., to prepare plans for a gravity cutfall sewer. Contract to be let this season.

The City of Valley Falls, Kan. (population 1,129), plans the installation of a sewerage system.

Kentucky.

The City Commissioners of Newport, Ky., on March 6 visited Lexington, Ky., to inspect the crematory. Newport expects to adopt this method of disposing of garbage.

Maine.

Town of Sanford, Me., has appropriated $8,000 for sewer extension.

An appropriation of $3,125 has been voted by the Town of Skowhegan, Me., for new sewers. C. M. Lambert is Town Clerk.

Maryland.

⊙Carozza, Levezza & Carozza, 2016 Pennsylvania Ave., Baltimore, Md., have been awarded the contract by the Board of Awards, Baltimore, for the construction of a section of the new sanitary sewers, for $92,698. P. T. Barry Co., secured the contract for the reconstruction of the plumbing and drainage systems at the Court House, for $2,229.

Massachusetts.

✣Bids will be received until 10 a. m., March 21, by Department of Public Works, Melrose, Mass., for furnishing the City of Melrose, Public Works Department, with Edgestone and Flagging, Standard Akron sewer pipe and cast iron water pipe; information and specifications can be had on application. George O. W. Servis, Engr. and Supt. Public Works, Melrose, Mass.

✣Bids will be received until 2:30 p. m., March 28, by the Metropolitan Water and Sewerage Board, I Ashburton Place, Boston, Mass., for constructing in earth and rock trench a 24-in. by 36-in. concrete sewer, Section 70 of the New Mystic Sewer, North Metropolitan System, in Winchester, from a point near the existing sewer westerly through Boston and Maine railroad location, private lands and Cross street, in accordance with the forms of contract and specifications to be furnished by the Board. Some particulars are estimated to be as follows: Length in trench 3,535 ft.; 60 cu. yds. of Portlnad brick masonry; 2,050 cu. yds. of concrete masonry in trench; 1,800 cu. yds. of rock excavation in trench; 600 lin. ft. of spruce piles in place. Plans can be seen and specifications and forms of contract can be obtained at the above office. Each bid must be accompanied by a certified check for $2,000, payable to the Commonwealth of Massachusetts and a bond in the sum of $15,000 will be required from the successful bidder. Frederick D. Smith, Engineer of Sewerage works, William N. Davenport, Secretary.

An appropriation of $24,876 has been voted by the Town of Easthampton, Mass., for sewers. L. H. Campbell is a member of the Board of Public Works.

Michigan.

✣Bids will be received until 9 a. m., April 12, by Board of Public Works, Iron Mountain, Mich., addressed to Sol Beauparlant, City Clerk, for the construction of about 1,650 ft. of 48-in. Jackson pipe reinforced concrete sewer on Kimberly Ave., from alley between Ludington and Hughitt Sts., to Ludington St., thence east on Ludington St. to a point where open ditch crosses said Ludington St., together with necessary manholes, catch basins, 616 ft. of 6-in. laterals and 366 ft. of 8-in. catch basins drains, and for the furnishing of all labor and material necessary therefor; also for the laying of about 1,650 ft. of 12-in. iron drain pipe alongside of said sewer, according to plans and specifications therefor prepared by the City Engineer and now on file in the office of the City Clerk. Bids must include 48-in. sewer and the laying of 12-in. drain pipe in one lump sum and must be accompanied by a certified check for $500.

Minnesota.

✣Bids will be received until 7:30 p. m., March 24, by City Council, Albert Lea, Minn., for the construction of a number of sanitary sewers. C. J. Dudley is City Clerk.

✣Bids will be received until 10 a. m., March 21, by C. S. Palmer, City Clerk, Duluth, Minn., for the construction of Sanitary sewer in Winona St., certified check for 10 per cent the amount bid must be filed with each proposal.

A special election is to be held in Deerwood, Minn., on March 26 for the purpose of voting on the issuance of bonds to the amount of $10,000 for a sewerage system and $15,000 for a waterworks system.

Missouri.

✣Bids will be received until noon, March 25, by Board of Public Improvements, St. Louis, Mo., for the construction of Rocky Branch Joint District Sewer. Maxime Reber is President of the Board.

⊙The Loundu Construction Co., Kansas City, Mo., has been awarded the contract for the construction of trunk sewer and a septic tank in Richmond, Mo., for $12,199. Bids were opened March 6. Worley & Black, Kansas City, are Engineers.

⊙The City Council of Hannibal, Mo., has awarded the contract for the construction of sewers in District No. 100 to Jacob Althouse of St. Louis, Mo., for $45,072. Mathews & Forrester, of Kansas City, Mo., secured the contract to construct sewers in District No. 9, for $22,007.

The Board of Public Works, Kansas City, Mo., E. J. McDonnell, Secy., has postponed the award of contract for the construction of a refuse disposal plant of 75 tons daily capacity until March 18. Bids were opened March 11.

The City Council of Hannibal, Mo., has been asked to pass an ordinance providing for the construction of a system of sewers in the Fourth Ward.

Nebraska.

Consulting Engineer Keyes C. Gaynor, Sioux City, Ia., has prepared plans for the construction of vitrified pipe sewers and manholes in Bloomfield, Nebr., estimated to cost $8,000. Contracts will be let as soon as possible.

City Clerk H. E. Clifford, Grand Island, Neb., will advertise at once for the construction of Sewer District No. 33, at an estimated cost of $2,134, and for the construction of Sewer District No. 34, estimated to cost $2,417.

New Hampshire.

A committee has been selected at Durham, N. H., to consider construction of a new sewer in lower section of town. Charles Wentworth is Town Clerk.

Lebanon, N. H., has voted $2,000 for additional sewers. Joseph C. Smith is Town Clerk.

Town of Charlestown, N. H., has voted to bond for not exceeding $15,000 for a sewer system. James L. Briggs is Selectman.

Town of Exeter, N. H., has voted to extend its sewers. Fred S. Fellows is Town Clerk.

New Jersey.

✣Bids will be received until 8:30 p. m., April 14, by Borough Council and Mayor of Cliffside Park, Bergen County, N. J., for the construction of Sections 2, 3 and 4 of the Tunk Sewer lines to be constructed in the Borough. Section No. 2 extends from the southerly end of the Borough in the Gorge Road, north on Gorge Road and Anderson Ave. to Lafayette Ave., also north from the junction of Gorge Road and Pallisade Ave. on Pallisade Ave. to Neumann's Lane. Section No. 3 extends from Laird Ave. and Gorge Road, south in Laird Ave. and Palisade Ave. to the south of boundary line of the borough. Section No. 4 extends from Laird Ave. and Palisade Ave. in Palisade Ave. north to Edgewater Road. Plans, specifications and forms of proposal for said work are now on file in the office of the Borough Engineers, in the Borough Hall of the Borough of Cliffside Park. Myles J. Murphy is Borough Clerk.

New York.

✣Bids will be received until 1:30 p. m., March 24 by Board of Contract & Supply, Syracuse, N. Y., for furnishing materials and constructing a 12-in. pipe sewer in North Geddes St., the terminus of the present sewer north of Belden Ave. to W. Genesee St. in the city of Syracuse, N. Y., in accordance with the plans and specifications of the City Engineer, on file in office of the Board of Contract and Supply. George J. Metz, City Clerk.

✣Bids will be received until 10 a. m., March 22, by Board of Village Trustees, Palatine Bridge, N. Y., for the construction of 6,000 ft. of sewers and concrete settling tank. A certified check for $1,200 must be filed with each bid. Plans and specifications at the office of the Board.

⊙The Common Council of Johnstown, N. Y., is reported to have awarded the contract for the construction of the Littauer trunk sewer extension and laterals to Albert Banker, of that city, for $10,531. Other bidders were: Charles Crane, Schenectady, N. Y., $12,972, and Kallum & Shaffer, Schenectady, $11,184.

The Board of Trustees of the Village of East Syracuse, N. Y., has appropriated $3,000 for sewer maintenance during 1913.

The Board of Estimate of New York City, Nelson P. Lewis, Chief Engineer, has voted the sum of $1,125,000 for the construction of the first section of the Classon Ave. system of relief sewers.

The citizens of Norwich, N. Y., have voted to construct a sewer on Canasawacta St., at an expenditure of from $2,300 to $3,200; for a sewer on Wait, Berry and State Sts., providing for an expenditure of from $1,700 to $2,300, and for a sewer on South Broad St., between Division and Hayes, at an expenditure from $3,600 to $5,000.

The citizens of the Village of Spring Valley, N. Y. (population 2,353), will be asked to vote at the coming election on the question of appropriating $500 for a preliminary survey for a sewer system in the village.

Ohio.

⊙John A. Coraus, R. H. Sheppard and Joseph Hinkle, all of Ashland, O., have been awarded the contract by the Board of Public Control of that city, for the construction of the South Highland relief storm sewer, for $7,373. The work includes 1,370 lin. ft. of 36-in. sewer and 1,625 lin. ft. of 30-in. sewer.

⊙Following contracts were awarded by the Department of Public Service, S. A. Kinnear, Director, Columbus, O., for the construction of sewers, for which bids were opened on March 11: Grogan Main Trunk No. 1, J. C. Beasley, 640 S. 22d, Columbus, $9,441; Broad St.-Burgess-Hague, I. O. Jones, 707 Grove St., $5,331; Arcadia, A. W. Adams, etc., I. O. Jones, Columbus, $2,671; Neff Ave.-Wall-T. & O. C. Ry., I. O. Jones, Columbus, $494; A. W. Miller, etc., J. F. Ryerson, 906 W. Mound, $2,237; West Side Storm Sewer, I. O. Jones, $1,696; Clintonville Sewer No. 2, J. F. Ryerson, Columbus, $36,838.

Bids will be received until noon, March 24, by J. W. Chrisford, Director of Public Service, Lakewood, O., for furnishing necessary labor and materials for sewers in the following named thoroughfares: Warren Road between W. Madison Ave. and Fisher Road; Athens Ave.; McKinley Ave.; Nicholson Ave.; Webb Road. The foregoing to be done according to plans and specifications on file in said office and at the office of C. W. Root, Society for Savings Bldg., Cleveland, O.

City Engineer B. M. French of Salem, O., has submitted his report to the City Council in regard to the sewer proposition. According to the report a sanitary sewer not to interfere with the storm water sewer would cost

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

about $60,000 and a storm water system about $35,000. The proposition will be submitted to a vote of the people.

The City Council of Piqua, O., has passed a resolution authorizing the construction of sanitary sewers along South, Kitt, Gordon, Miami and Roung Sts., with lateral branches.

The North Side Business Club, Cincinnati, O., has adopted a resolution asking the city to extend the Badgely run sewer 3,000 ft. along Kirby Road.

Pennsylvania.

✣Bids will be received until noon, March 25, by W. J. Springborn, Director of Public Service, Cleveland, O., for the construction of sewers in Yale Ave., N. E., between St. Clair Ave., N. E. and East 93d St. Plans and specifications are on file with the Chief Engineer, 305 City Hall. W. H. Kirby is Secretary.

✣Bids will be received until March 25, by Borough of Mulhall, Pa., for the construction of a one-story concrete and brick garbage disposal plant near Summit on the Bessemer and Lake Erie Railroad to cost $25,000.

⊙S. P. Angle, of Hagerstown, Md., has been awarded the contract by the city of Carlisle, Pa., John C. Hiteshew, City Engineer, for the construction of the sewage disposal plant, for $38,467. J. I. Dick, Scottdale, Pa., secured the contract to construct the sewer outfall, for $13,098, and H. C. Brooks, Martinsburg, W. Va., will construct laterals and storm sewer, for $87,170. Bids were opened March 6. Contract awarded March 13.

⊙J. A. Cairnes of Ashland, O., secured the contract for the construction of the South Highland relief sewer in that city, for $7,700. Bids were opened March 7.

⊙The Standard Cast Iron Pipe & Foundry Co., of Bristol, Pa., has been awarded the contract by the Boston Transit Commission, B. Leighton Beal, Secretary, 15 Beacon St., Boston, Mass., for furnishing and delivering 676,000 lbs. of cast iron pipe and 22,000 lbs. of cast iron specials (plugs and branches) for sewers for Section B, Dorchester Tunnel. The contract price is $14,070. Bids were opened March 6.

According to advices from Warren, Pa., Robert H. Winger, George Mackay and George Culver intend to incorporate a company to be known as the City Disposal Co., to dispose of the city garbage. The company is to be capitalized at $15,000.

The Borough Council of Jenkintown, Pa., proposes the installation of a modern sewerage system.

Emilio Pascuzzi submitted the lowest bid to the Department of Public Works, Philadelphia, Pa., for the reconstruction of old sewers in various streets, at $23,340.

South Carolina.

Consulting Engineer J. Newton Johnston, Florence, S. C., has prepared plans for additions and extensions to the sewer system of Manning, S. C., estimated to cost $5,000. The work will include 8,000 lin. ft. of 8-in. terra cotta pipe, and 22 manholes and 10 five-in. flushing siphons. Contracts will be let as soon as bonds are voted.

South Dakota.

At a recent special election in Howard, S. D. (population 1,026), the city officials were ordered to go ahead and build a sewerage system. A meeting was held March 11 to select an engineer to prepare plans.

Texas.

The Commercial Club of Alvarado, Texas, advocates the installation of a sewerage system and the laying of additional concrete sidewalks. It is probable bonds will be voted for the improvements.

An election is to be held in Temple, Texas, on April 1 for the purpose of voting on the issuance of bonds to the amount of $75,000 for the acquirement of the existing sewer system.

The City of Killeen, Texas, plans to commence work shortly on the installation of the proposed sewerage system. The proceeds of the $16,000 bond issue for this purpose are now available.

Utah.

✣Bids will be received until 10 a. m., March 24, by H. J. Craven, City Engineer, Ogden, Utah, for the construction of sewers in Sewer District No. 115, being Van Buren Ave., from 26th to 27th Sts.; Patterson Ave., from Washington to Grant Aves., and Lincoln Ave., from 26th to 27th Sts.; under plans and specifications prepared by the City Engineer and approved by the Board of City Commissioners.

✣Bids will be received until 10 a. m., March 25, by Board of Commissioners, Salt Lake City, Utah, for the construction of pipe sewers in Sewer Extension No. 321, Fifth East St., from 10th South to 12th South Sts. Noble Warrum is City Clerk.

Wisconsin.

⊙E. L. Bartlett of Watertown, Wis., has been awarded the contract by the Board of Public Works of that city, for the construction of a storm sewer in North Eighth St., for $2,276.

The Board of Public Works of Fond du Lac, Wis., will receive bids this month for the construction of the new West Side sewer system, estimated to cost $58,000. The contract will be awarded at the April session of the Board. J. S. McCullough is City Engineer.

The City Trustees of the Village of Lodi, Wis., have decided to extend the water and sewer mains to the northern portion of the city, covering a distance of 3,022 ft.

The citizens of Kenosha, Wis., will vote at the coming city election on the question of issuing bonds to the amount of $75,000 for the building of a trunk sewer for the north and northwest sides.

BUILDINGS

Arkansas.

Gov. Oldham has signed the bill appropriating $1,500,000 to complete and furnish the new State Capitol.

California.

⊙The California Construction Co. has been awarded the contract at $177,867 for the fabrication and erection of steel for the municipal auditorium of Oakland, Cal.

The Pacific Gas & Electric Co., San Francisco, has been awarded the contract by the Panama-Pacific Exposition Co. for the World's Fair Grounds. The company will erect a generating plant on North Beach.

Colorado.

The United Commercial Travelers of America is to erect a 10-story hotel at 1747 to 1755 Welton St., Denver, at a cost of $300,000. Watt G. Sheldon, attorney, with offices in the Equitable Bldg., Denver, Colo., and a member of the board of directors of the association, will have charge of the contracts.

Connecticut.

⊙The Barrows-Stewart Co., 40 Central St., Boston, Mass., has been awarded the general contract for the rebuilding of the rendering plant of the C. M. Shay Fertilizer Co., at Groton, Conn., brick and concrete fireproof construction throughout. Work will be started immediately.

District of Columbia.

✣Bids will be received until 3 p. m., April 10, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D C., for the construction complete of the vault entrances for the new building for the Bureau of Engraving and Printing at Washington, D. C.

Georgia.

The King Lumber Co., Charlottesville, Va., at $277,158, was low bidder for constructing the Y. M. C. A. building at Atlanta, Ga., bids for which were opened in that city on March 10.

Bids were opened March 3 by the Supervising Architect, Treasury Department, Washington, D. C., for the construction of the U. S. court house and postoffice at Augusta, Ga. J. E. & A. L. Pennock, Land Title Bldg., Philadelphia, Pa., at $242,800 on limestone and $249,000 on sandstone being the low bidders.

Hawaii.

✣Bids will be received until 11 a. m., May 10, by H. R. Stanford, Chief of Bureau of Yards and Docks, Navy Department, Washington, D. C., for naval hospital buildings at the Naval Station, Pearl Harbor, Hawaii. $280,000 has been authorized for the work.

Illinois.

✣Bids will be received until 2 p. m., March 24, by Board of Administration, Capitol Bldg., Springfield, Ill., for the installation of conduits, wiring, electric lights, etc., at the Illinois Industrial Home for the Blind, 1900 Marshall Blvd., Chicago, Ill. Official advertisement will be found elsewhere in this issue.

The City of Springfield, Ill., has appropriated $400,000 for the erection of a new City Hall or a construction of an addition to the present City Hall. J. E. Dusseldorfer, City Clerk.

✣Bids will be received until 4 p. m., March 25, by the West Chicago Park Commissioners, Chicago, Ill., at their office in Union Park, for furnishing and delivering labor, materials, etc., necessary to erect a locker and dressing room house, swimming pool, pergola, walls and fences for the new Garfield Park Natatorium. The contract will be let in two parts, general work and (plumbing and sewerage). Plans and specifications on file at the office of W. C. Zimmerman, Architect, 1101 Steinway Hall, 64 E. Van Buren St., Chicago. Cash or certified check for 5 per cent of total bid must accompany proposal. Geo. A. Mugler, Secretary.

Iowa.

✣Bids will be received until noon, April 7, by Township Trustees of Crescent Township at the office of J. A. Pratt, Township Clerk, Crescent, Ia., for the construction of a township hall. Specifications are on file with the Clerk.

Plans have been completed by H. W. Whitsitt, Architect, Moline, Ill., for a 9-story hotel to be erected at 14th St. and 5th Ave., Davenport, Ia., at a cost of about $400,000.

Kansas.

✣Bids will be received until 10 a. m., March 27, by Constructing Quartermaster, U. S. Military Prison, Fort Leavenworth, Kan., for furnishing f. o. b. cars terminal station, Fort Leavenworth, Kan., lumber as specified below: 20,000 ft. clear Western pine, rough, 2½ ins. thick, 16 ft. long, random widths, and 18,000 ft. do 2½ ins. thick. Alternate propositions are requested on sugar pine A or best grade cypress.

✣Bids will be received until 10 a. m., March 24, by Lieut. Col. Thomas H. Slavens, Constructing Quartermaster, U. S. Military Prison, Fort Leavenworth, Kan., for furnishing and delivering f. o. b. cars Fort Leavenworth 1,713 steel bars for grading for cell wing Nos. 6 and 7 and rotunda.

Michigan.

Plans have been completed by D. H. Burnham & Co., Architects, 80 E. Jackson Blvd., Chicago, Ill., for a 18-story office and mercantile building to be erected at the juncture of Woodward Ave., Washington Blvd, and West Grand Circus Park, Detroit, Mich., by the Whitney Realty Co., Ltd. The exterior finish of the first floor will be stone and the upper stories will be a combination of light-colored brick with terra cotta trimmings.

New York.

✣Bids will be received until April 2, by Commissioners of the Palisades Interstate Park, 31 Nassau St., New York, for the construction of a shelter building, together with two separate buildings to be used respectively for laundry, kitchen and toilet building. A certified check for $1,000 must be filed with each bid. Charles W. Leavitt, Jr., 220 Broadway, New York City, is Engineer.

Neville & Bragge, Architects, 215 W. 125th st., New York City, are preparing plans for a 12-story office building to be erected at 329 Fourth Ave., New York City, by the Polo Construction Co.

Pennsylvania.

An apartment building to contain 14 suites will be erected at Clyde and Ellsworth Aves., Pittsburgh, by H. F. Gabel, 633 Clyde St., that city. The building will be eight stories high, covering an area of 10x135 ft., built of brick, reinforced concrete and structural steel. About 50 baths will be required. Architect C. E. Willoughby, 424 Fourth Ave., Pittsburgh, is preparing the plans. The building will cost about $200,000.

Plans are now being made by Architects Janssen & Abbott, Renshaw Bldg., Pittsburgh, for the new Masonic Temple, to be erected in Fifth Ave., Schenley Farms. The building will cost $900,000.

Jarvis Hunt, Architect, 53 W. Jackson Blvd., is preparing plans for the new department store building of the Rosenbaum Co., to be erected in Sixth St., Pittsburgh, at a cost of $1,500,000. The building will be 150x200 ft., of brick, stone and terra cotta and 12 stories high.

The Pennsylvania Marble & Mosaic Co., Jenkins Arcade Bldg., Pittsburgh, Pa., received the contract for the marble work to be used in the remodeling of the Allegheny County Court House at Pittsburgh, made necessary by the removal of the "Hump." William F. Trimble & Sons, Penn Ave., Pittsburgh, are the general contractors.

The Pittsburgh Lodge No. 11 of Elks has adopted the plant of F. C. Sauer, Architect, 804 Penn Ave., Pittsburgh, for a 3-story club house, to cost $200,000.

Texas.

✣Bids will be received until 4 p. m., March 26, by City Council, Gonzales, Tex., for the construction and completion of a 2-story and basement brick school building and the remodeling of present school building for the city of Gonzales; a certified check in the sum of $250 payable to the order of W. L. Gardien, Mayor, is to accompany all bids as evidence of good faith on the part of the bidder. A certified check for $25 must be deposited guaranteeing the safe return of the plans. Plans and specifications can be had by applying to Mayor W. L. Gardien, Gonzales, Tex., or at the office of Henry T. Phelps, Architect, 707-719 Gunter Bldg., San Antonio, Texas.

Virginia.

⊙P. J. Moran, Salt Lake City, Utah, has been awarded the contract for building the National Elks' Home at Bedford, Va. It will cost about $300,000.

Washington.

Plans and estimates for the proposed municipal dock building at Tacoma have been submitted to Mayor Seymour by Frederick Shaw, Architect, 3105 S. Union Ave., Tacoma. It is estimated that an 8-story reinforced concrete structure will cost about $173,975.

West Virginia.

W. H. Fissell & Co., 1133 Broadway, New York City, at $111,000, was low bidder March 6 for construction of U. S. postoffice at Grafton, W. Va.

Canada.

Excavation work will be started next month for a large store building to be erected at Brandon for Gordon, Mackay & Co., Ltd., of Toronto, Ont.

RIVERS AND HARBORS

California.

✣Bids will be received until March 24, by Board of Public Works, Los Angeles, Calif., for the construction of 3,050 ft. of bulkhead on the east and south sides of Pier A on the west side of Mormon Island Channel, and for 90 piles to be driven for the foundations of the warehouse back of that point.

The Mutual Water Co. of Palo Verde, Imperial County, is planning the construction of 4 miles of levee as an extension to its present dike.

Charles Stansbury, Los Angeles, Cal., at $28,762, was low bidder, March 1, for constructing a reinforced concrete bulkhead and dock for the city of Venice,, Cal.

Special election is to be held at Los Angeles on April 15, to vote on a bond issue for continuing the harbor development. In anticipation of the approval of the bond issue by the people the Harbor Advisory Board is making preparations for hill razing at various projects at San Pedro Harbor, included in the general scheme of harbor development. Harbor Engineer Jubb has submitted a report showing that in addition to the purchase of steam shovels there would be necessary an equipment that will include four locomotives, estimated at $12,320; 42 6-yard dump-cars, $12,210; rails, spikes, etc., $3,480; ties, $1,920; repair shop and equipment, $6,000, making a total of $36,530. The board has recommended that the Board of Public Works purchase two steam shovels one for $9,000 and the other for $8,000, and that it advertise for bids for the furnishing of the other equipment desired. Homer Hamlin is City Engineer of Los Angeles.

Canal Zone.

✣Bids will be received until 11 a. m., April 12, by H R. Stanford, Chief of Bureau of Yards and Docks, Navy Department, Washington, D. C, for steel towers for high power radio station to be erected at Caimito, Canal Zone, including radio equipment under cognizance of the Bureau of Steam Engineering.

District of Columbia.

✣Bids will be received until 2 p. m., March 19, by Maj. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing malleable iron castings for flat and dump cars.

✣Bids will be received until 10:30 a. m., April 5, by Maj. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under Canal Circular 766, reversing motor planer equipments, motors, structural steel, galvanized roofing, steel pipe, cast iron pipe and fittings, babbit metal, sheet lead, lead pipe, solder, nails, nuts, wrenches, hacksaw blades, valves, cocks, stable brooms, hammer handles, candles, soap and canvas.

Hawaii.

✣Bids will be received until 11 a. m., April 19, by H. R. Stanford, Chief of Bureau of Yards and Docks, Navy Department, Washington, D. C., for two coal-hoisting towers for the Naval Station at Pearl Harbor, Hawaii.

Indiana.

The Board of Park Commissioners, of Indianapolis, Ind., has instructed J. H. Lowry to revise plans and specifications for dredging Fall Creek from 30th St. to the Fairgrounds bridge, and from Northwestern Ave. to the Big Four bridge, and to readvertise for bids for work.

Massachusetts.

✣Bids will be received until noon, April 10, by Col. F. V. Abbot, U. S. Engineer, Boston, Mass., for the construction of riprap sea wall at Fort Health, Winthrop, Mass.

✣Bids will be received until 11 a. m., April 4, by Lieut. Col. G. B. Davis, Constructing Quartermaster, 263 Summer St., Boston, Mass., for the construction of a concrete sea wall at Fort Heath, Winthrop, Mass.

New Hampshire.

Town of Hampton, N. H., has voted $2,000 for a breakwater at Hampton Beach. H. M. Lane is Town Clerk.

New Jersey.

Two bids were received early this month by the Standard Geodetic Survey, Trenton, N. J., for the Shark River improvement. The low bid exceeded the appropriations available by $22,000. If ,the work is to be done additional state aid will be necessary and the state will be asked to make a further appropriation of $15,000. The appropriations available amount to $53,000.

New York.

✣Bids will be received until 3 p. m., April 4, by Inspector, Third Lighthouse District, Tompkinsville, N. Y., for furnishing one sloop and two combined row and sail boats.

A bill has been introduced in the State Assembly to appropriate $200,000 for the purpose of straightening and deepening the Canisteo river between Hornell and Addison, a distance of about 30 miles.

The State Assembly has passed the bill appropriating $10,000 for widening, deepening and cleaning out Sawyer Creek from the Ruie road to the barge canal.

A bill is before the State Legislature to appropriate $20,400 for dredging the outlet of Owasco lake and for repairing and building a breakwater at the foot of the lake. The bill calls for repairing the west pier of the lake, putting in concrete and deepening the channel of the outlet from the lake north to the state gates on the upper dam.

North Carolina.

✣Bids will be received until noon, April 5, by Maj. H. W. Stickle, U. S. Engineer, Wilmington, N. C., for furnishing and delivering Portland cement.

Texas.

✣Bids will be received until noon, April 10, by Maj. T. H. Jackson, U. S. Engineer, Dallas, Texas, for furnishing about 9,000 barrels of American Portland cement.

The Texas City Transportation Co. of Texas City, is understood to be contemplating a considerable amount of improvement work for the present year. This will include extensive enlargements to the wharves, warehouses and terminal yards and possibly the construction of a new pier.

Virginia.

✣Bids will be received until noon, April 7, by Lieut. Col. W. C. Langfitt, U. S. Engineer, 305 Southern Bldg., Washington, D. C., for repairing and extending riprap jetties in Urbanra Creek and Milford Haven, Va.

Wisconsin.

Citizens of Kenosha, Wis., are to vote on issuing $40,000 of bonds for building a breakwater at north end of Lake Ave. Geo. W. Harrington is City Clerk.

The Portage Levee Commission has submitted an estimate of $24,000 as the cost of proposed improvements of the Caledonia, Lewiston, Roehm and government levees for the coming year.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ENGINEERING AND CONTRACTING

Devoted to the Economics of Civil Engineering Design
and to Methods and Cost of Construction

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A Growing Educational Force of Interest to Engineers.

One of the leading daily papers of Chicago is now conducting a general campaign of education by means of a series of special articles. An article is published each day upon some subject of interest to the city as a whole. One subject which has been considered in two articles thus far is that of water waste. Engineers are, of course, familiar with the situation here so far as the use, loss and waste of water are concerned. The facts have been stated repeatedly in the technical journals and in engineers' society proceedings. The annual report of the Department of Public Works has recited the facts again and again. As a result of this reiteration of facts and figures a water waste survey organization was formed within the Department, and performed much commendable work which resulted in the curtailment of some of the waste. However, the pitometer survey work has been discontinued, "for some reason which does not seem to be generally understood."

The newspaper articles on water waste give the usual figures and recommend meterage as the best way of stopping the careless waste of water on private premises. Figures are given to show the effects upon total consumption, water rates, water department income, and the general health of the public in Cleveland and Milwaukee following the adoption of meterage by those cities.

It will be interesting to note the effect produced by *The Tribune's* articles on water waste in Chicago. Meterage may not immediately follow, but its coming will be hastened. The point of interest about this whole matter to engineers generally is that a great metropolitan daily will now take up matters other than those of a sensational or political character, and will strive to educate the public for the common good. In their educational work engineers' societies may now hope to secure co-operation from the popular press. If they can do so the notoriously slow process of education will be greatly accelerated.

Two Recent Conventions Which Show the Value of State Water Works Associations.

A few months ago we published an editorial in which we endeavored to show the possibilities for state associations of water works' men. In that editorial, it will be recalled, we stated that the local association makes a strong appeal to the rank and file of water works officials in two chief particulars, namely, the invariable nearness at hand of the convention city, and in the nature of the problems discussed. Those points were fully discussed in the former editorial.

Since that editorial was written the writer has attended two state water works conventions and is more enthusiastic than before about the possibilities of such organizations. The two conventions to which we refer were those held by the Indiana Sanitary and Water Supply Association and the Illinois Water Supply Association. In both cases the delegates appeared to be in search of knowledge and while they doubtless gained pleasure from attending the conventions the entertainment features were properly subordinated to the business in hand. In this connection the following quotation from the address of President F. C. Jordan of the Indiana Association serves well to express the views of the officers and members of the two associations:

> If this meeting simply means a junket trip, with a little something other than that which we sell day after day; with a passing consideration of the papers presented, and with no change in our business methods as the result of the meeting, it would be well for us to ring down the curtain at the close of this act and say that the play was not worth while. But if, on the other hand, we can have an organization in which we have representatives from all of the more important cities throughout our state—men who will give careful consideration to the subjects discussed; able men who will come in contact with other able men and brush up on their ideas of proper management—an organization, in fact, which in its workings will tend to make every section of our state more livable, then, in that case, we can assure ourselves that we have a reasonable excuse for existence.

The foregoing very adequately sets forth the ideals and indicates the spirit which pervaded the conventions. It is gratifying to note that the proceedings of the conventions were of such character and high order of merit that the visitor could not doubt that the ideals of the organizations will be attained. Many of the papers read before the conventions have since been published in full or in abstract in this journal and the reader can form his own estimates of their value.

All of the more populous states should follow the lead of Indiana and Illinois in this matter. Twenty water works officials, co-operating with state health officers, can easily form a state organization of water works men and sanitarians which will grow in a few years, if energetically managed, to a membership exceeding 200. The quality of the papers presented before the two associations herein discussed bears evidence of the good work which has been done by the program committees during the past year.

ROADS AND STREETS

Street Cleaning Methods in European Cities.

The Bureau of Foreign and Domestic Commerce, having received a number of inquiries as to street cleaning methods in Europe—particularly in regard to the use of suction street sweeping devices—requested the U. S. Consuls in several of the larger European cities to report on the manner in which the streets were cared for in their respective districts. The information furnished by these men is published in a recent consular report, from which we have abstracted the matter that follows:

LONDON.

The cleaning of the streets and roads of Metropolitan London is done under the direction of the councils of the several cities and boroughs comprising Greater London. In the city of London proper, that section bounded by the walls of ancient London, the method of cleaning is very thorough. Throughout the day boy scavengers are employed to keep the streets clean; they are provided with small scoops and hand brushes, by means of which the refuse and litter is constantly collected and deposited in refuse boxes placed at convenient intervals on either side of the street. These boxes are emptied periodically, the contents being taken away in refuse wagons which are fitted with four sectional metal tops so constructed that when a section is full it can be closed.

At night the streets are cleaned with water applied by means of hose attached to fire hydrants. Drains into sewers serve as outlets for the foul water. Squeegees or hand-pushed scrapers are employed to complete the work.

In wet weather men are employed in the daytime to clear the mud and surplus water with squeegees, each gang of cleaners working in stair-step formation, the front cleaner taking the middle of the street and driving the mud and water before him until the end of the section is reached, when the accumulation is turned into the drains.

This method is also adopted in case of slight snowfalls, but if the fall is heavy common unrefined yellow salt is thrown over the surface to hasten the melting. In case of exceptionally heavy falls the snow is temporarily banked along the roadside with a space between the banks and the curb, and with openings every few yards to enable the melted water to run freely into the drains. Salt is used; but if the temperature is too low to allow melting, the surplus snow is removed in wagons. The methods just described are of course suited especially to smooth surfaced streets, such as asphalt, and are necessarily modified to suit the streets with rough surfaces. The streets in the city are chiefly of asphalt and wood blocks.

In those streets where the traffic is heaviest horse-drawn rotary brooms and horse-drawn scrapers are most commonly used, but in the more residential streets in the suburbs hand brooms are generally used, the refuse being swept into heaps on either side of the street and afterwards picked up with long-handled shovels, dumped into wagons, and hauled away to refuse depots.

Snow in the suburbs, if slight, is swept into heaps in the gutters and left to melt, but if heavy it is shoveled into wagons and conveyed to low-lying unused ground. In several of the borough districts additional gangs of men are employed to collect loose paper and litter, which they do by means of pronged sticks, and which they carry away in bags slung over their shoulders.

In the city proper, and in the immediately adjoining boroughs, the streets are sprinkled in dry weather. In the suburban districts this watering usually covers the entire width of the road, if of macadam or stone blocks; but if of asphalt or wood, it is confined to 2 or 3 ft. near the curb, to avoid rendering the surface slippery and dangerous to traffic. In very hot weather disinfectant is mixed with the water.

Suction sweeping as a method of street cleaning does not obtain in London.

GLASGOW.

All domestic refuse and garbage from hotels, restaurants, etc., in the city is collected during the night concurrently with the street sweeping done by the sweeping machines. Bins are sunk in the pavement at regular intervals, in which are deposited the sweepings of the day staff. These bins are emptied nightly and the contents, together with the sweepings left at the street side by the sweeping machines, are carted away.

Private streets and back courts, after being swept when required, are cleaned by the use of 1½-in. I. R. hose attached to the street fire plugs. The court washings in the city average nearly 1,000 per day. The owners of these properties are assessed 2 cts. per $4.86 of the annual rental to meet the expense of this work.

After a heavy snowstorm salt is used to melt the snow on the tram tracks and is followed shortly afterwards by the sweeping machine which spreads the brine, created by the action of the salt on the snow, over the entire width of the streets. The snow and slush is then rapidly carted and tipped into the Rivers Clyde and Kelvin or the most convenient of the various tips round the outskirts of the city.

In general, the cities and towns throughout Scotland have well-regulated cleaning departments similar to that of Glasgow, except that the smaller towns and cities have no furnaces for destructive purposes. Some burn their garbage at county furnaces, and others are obliged to cart it into the country.

The sweeping machines drawn by horses are the kinds that have been in general use here for many years, but at present experiments are being made with machine brushes or rotary brooms propelled by motor power. These are used in certain residential districts to obviate the noise caused by horses.

The Corporation last year experimented in flushing streets with a horse-drawn water tank with an air chamber of English make. This method was satisfactory when the tank was full of water, but as the water lowered the force decreased rapidly with unsatisfactory results. It was also found that the tank emptied in about 7 mins. and that more injury resulted to the pavements than under hose flushing, and tank flushing was abandoned.

A committee from the Corporation visited cities throughout Great Britain and the Continent where motor-driven sweeper suction machines were in use, but found them unsatisfactory, in that while they would pick up an object not to exceed the weight of half an ordinary brick, they would leave light articles such as string and pieces of paper lying flat.

BRADFORD.

The city of Bradford, with a population of 289,618, has 239 miles of streets and roadways, 117 miles of which are paved with granite and Yorkshire stone sets, the remaining 122 miles being macadamized roadways.

The street cleaning department of the city is in charge of a superintendent, who is under the control of a subcommittee of the city council. For street cleaning purposes the city is divided into 13 districts, each being supplied with its own necessary appliances, for which it is responsible. These districts are divided into four principal districts, each of which has three subdistricts, and one orderly district in the center of the city.

Twelve ordinary one-horse rotary brushes are used, 7 ft. 6 ins. wide, with a sweep of 5 ft., made by H. Wadsworth & Sons, of Halifax, each costing $131 to $155 according to the quality and fittings. They travel at the rate of 3 to 4 miles per hour.

The orderly or central section is swept at 6:30 a. m. and is covered again four times throughout the day during week days, and twice on Sundays, at 6 a. m. and 2:30 p. m. In the other sections the principal streets are swept daily, secondary streets on alternate days during the week, by-streets which have fairly heavy traffic twice a week, and all others once a week. The brush machine sweeps the accumulation into the gutter as it proceeds, and men following with brooms clear the gutter and pile the dirt into small heaps which are collected into carts and removed to various centers, where it is sorted and allowed to stand for three to six months. Some 22,000 to 25,000 cartloads are thus treated annually.

It is stated that four-fifths of the sweepings are used for fertilizing purposes, the remainder being used as "tips" for leveling up the ground where required. In dry weather, to keep the dust from rising, the sweepers are preceded by a watering cart. Sand is used on the greasy surface of sidewalks and paved streets, and on two or three short stretches of roadway laid with wood blocks in the center of the city, small granite is used to prevent slipping and side skids. The principal sidewalks and crossings are also "squeegeed" in wet or dirty weather.

The street cleaning department employs a regular staff of 147 men, including 2 inspectors, at $7.30 per week of 49½ hours, 13 foremen sweepers, at $6.56, and 2 foremen trappers (street grids), at $6.25. The ordinary men receive $5.83 per week. Forty-two outfits, each consisting of horse, cart and driver, are employed regularly at $12.56 each per week. The total cost of the street cleaning is about $80,000 per annum, which includes salaries of officials, wages of workmen, and all expenses.

A special plant is used for treating the refuse from the wholesale fish market. This fish refuse is thoroughly broken up and dried in a steam-jacketed pan in which radial arms revolve, and it is then put through a crushing mill and made into a manure. The vapor is led away into the main combustion chamber, and so the escape into the air of an offensive odor is avoided. The analysis of this fish manure is as follows: Moisture, 4.44 per cent; phosphoric acid, 7.66 per cent; tricalcium phosphate, 16.7 per cent; nitrogen, 9.20 per cent; ammonia, 11.20 per cent. The manure is packed in bags weighing a hundredweight each, and is being sold at about $33.46 per ton.

The corporation has also established a machine, described as a "digester," costing $1,358, for extracting fats from condemned meats and carcasses. Formerly these were destroyed by burning, but as it was learned that in Germany the extraction of the fats has been highly successful, this experimental machine has been installed. The fat is used for making common soap, and it is said that at Edinburgh the residue is sold for manure at $4.87 per ton.

NOTTINGHAM.

Nottingham has a population of 260,000, extends over an area of 10,000 acres, and has 230 miles of streets. The cost of street cleaning is between $90,000 and $100,000 per year. From 50 to 70 rotary brushes are employed, according to the state of the weather, and the number of carts increases or diminishes from the same cause; 120 hand sweepers are used.

Motor sweepers and motor watering vans are not used in Nottingham. All important thoroughfares are cleaned every 24 hours, the less important streets being cleaned two or three times a week. The horse brushes, immediately preceded by watering carts (except when a freezing temperature prevails), are started to work at midnight and continue until 9 a. m. An interval of ½ hour is allowed for breakfast and feeding the horses. The hand sweepers begin at 4 a. m. and do nine hours of actual work, with ½ hour for breakfast and the same for lunch. The force is reduced to one-half the usual number on Sundays, the men taking alternate turns at Sunday work. Both drivers of horse sweepers and hand scavengers earn an average of $6.56 per week.

In the event of a fall of snow, carts are sent out to sprinkle salt on all important thoroughfares, followed by plows and brushes. Snow in the city seldom exceeds 3 or 4 ins. in depth, although a fall of 9 ins. has been noted. Snow, if clean, is tipped into the sewers; otherwise permission is obtained to deposit it on vacant ground on the city borders.

Refuse from the streets, such as large scraps of paper, or orange and banana peels, are picked out by hand from the sweepings and burned; the ordinary accumulation is placed in piles and given away free to such farmers as care to remove it. The more valuable manure collected during the day is sold at 50 cts. per load of 3,000 lbs.

In Leicester all the tramway routes are watered by three electrically-driven tramway tanks holding 1,800 gals. each. One-half of the road is covered at a time. The remaining paved roads are sprinkled with ordinary watering carts and on macadamized roads calcium chloride, either in granular form or dissolved in water tanks, is used. When necessary tar and wood paved roads are sprinkled with granite crushed to ⅜ in., or crushed pit gravel of a similar size.

HAVRE.

The city of Havre has one automobile watering cart constructed by De Dion, Bouton & Co., at a cost of $3,860, and an automobile sweeper made by the same firm, costing $3,088. Experiments are being made with these before giving up the old horse-drawn watering carts and sweepers. The watering cart sprays on either side of the street from two apertures at each side instead of sprinkling the water through a series of small holes. The sweeper is similar to those used in many American cities.

At Cherbourg the cleaning of the streets formerly had to be done by the owners or tenants of houses, who were obliged to sweep, or have swept at their expense, the sidewalk and street in front of their residences or stores. On Jan. 1, 1893, the city undertook to perform the work, granting to the farmers of the vicinity the privilege of purchasing at a low price the refuse of the streets. The receipts from this source were about equal to the cost of the sweeping.

At the end of 1902 the contracts with the farmers were not renewed, as the latter, instead of offering to pay for the mud and refuse, demanded a certain sum for removing it. The city then made a contract of 10 years' duration with the firm of Bretel Bros., of Valognes, by which the latter agreed to do the cleaning and remove all refuse for the sum of $10,500. This contract is on the point of expiring. One of the conditions of renewal is that the inhabitants must have proper receptacles for garbage and that the contractor must see to the proper emptying of the same instead of dealing with mere heaps of refuse. The sweeping is done between 4 and 7 a. m., partly by machines drawn by horses and partly by hand. The machines were manufactured by the firm of Durey-Sohy, of Paris.

LYONS.

The work of street cleaning is divided, in general, into four processes—sweeping the streets, removal of refuse by carts, scrubbing the streets after this removal, and thorough flushing by hose. The staff of workers consists of street cleaners proper, cleaners of the sewers, caretakers of the bridges (there are 9 bridges over the Rhone, in Lyons, and 13 over the Saone, exclusive of railroad bridges), and persons engaged by contract to remove refuse in carts.

Not only are the streets cared for by these men but also the sidewalks of public squares, those in front of public buildings and monuments, and all public urinals. Owners of private buildings are required to look after the sidewalks in front of their respective properties. The bridges are cared for in the same manner as the streets and are cleaned at the same hours. The men in charge of the sewers clean them on certain specified days and otherwise as occasion demands.

The force engaged in the work of cleaning is uniformed by the city. Each man is allowed one hat a year, a cap every two years, and a full corduroy suit every three years. The uniforms provided must be worn during working hours, and every man is charged with the duty of keeping his outfit in good condition.

The street cleaners are allowed 14 days' leave of absence a year. In addition to this, the regulations governing sick leave are very generous, especially where the sickness is incurred in the public service. Neglect of duty is met with punishments, such a reprimands, deductions of pay, and, finally, dismissal, according to the gravity of the offense.

The different grades of this service as given in the municipal budget for 1913 are shown in the following table:

Kind of workmen.	Number.	Annual pay.
Street cleaners:		
First class	117	$322.69
Second class	233	311.12
Auxiliary	56	270.20
Sewer cleaners:		
First class	29	322.69
Second class	59	311.12
Auxiliary	4	270.20
Bridge cleaners:		
First class	5	322.69
Second class	6	311.12
Auxiliary	1	270.20

The auxiliaries may become second-class men after two years of continuous service if their work meets with entire satisfaction. The second-class men are promoted to the first class according to length of service and merit.

A small amount is deducted from each man's pay and this goes to form a central fund, to which the municipality adds an equal amount. Every man over 50 years of age who has been in the service 25 years is retired on a suitable pension from this fund.

It will be seen that this branch of the municipal service has been established and is managed with careful regard both to the city's welfare and to that of the workmen. These positions are eagerly sought; there is generally a long waiting list, and the men, once appointed, do their best to stay in the service.

The removal of refuse is done altogether by contract and the refuse is sold by the contractors to the farmers in the outlying districts. In fact, they often make subcontracts with these farmers to do the work of removal themselves. The contracts call for rounds to be made through the principal streets of the city every morning, rounds through certain streets every afternoon, and finally special rounds on certain days of the week after open markets have been held. The contractors must remove not only the dirt collected by the street cleaners, but also the garbage which the inhabitants of the city are privileged to leave in proper covered receptacles on the edge of the sidewalk before the time arranged for the morning round.

A newly designed cart for removal of rubbish is now being tried by the city of Lyons, and 30 of these carts have been bought by the municipality as an experiment. They are of metal and covered, and each is provided with a simple mechanical contrivance for handling the refuse. The pail is hung on hooks at the end of the wagon, and by turning a crank is carried into the cart, emptied and returned again, and in this way practically no dirt falls on the street. However, these carts have not been long enough in use to judge of their practicability.

HAMBURG.

The city of Hamburg owns horse-drawn sweepers only, although for about nine months two electric-motor sweepers have been in use. These, however, do not yet belong to the city, and are being employed experimentally. They have not given satisfaction and have been under repair more than three months. These motor-driven sweepers fail to work well in this city because the pavements, as a rule, are not very smooth, and the mechanism of the sweepers is deranged by the shaking it receives. Recently the front wheels of these sweepers have been provided with rubber tires, and they have worked more satisfactorily.

The Hamburg street cleaning department cleans, and when necessary, sprinkles all city streets, makes repairs, maintains relief stations, removes dust, garbage and waste matter generally from streets, houses, wharves, ships and markets, and operates also a garbage-burning plant. At present the department cleans 1,290 streets with their adjacent sidewalks, having a length of 291.4 miles. The roadways cleaned covered about 5,656,970 sq. yds., and the sidewalks about 4,177,990 sq. yds. The work is carried on under the supervision of 12 superintending establishments. Thirty main thoroughfares are cleaned six times weekly at night by means of rotary brooms and all other streets, with few exceptions, twice weekly. In the center of the city the streets are also cleaned six times weekly during the day and in other parts of the city four times weekly during the day.

Asphalt street surfaces are looked after by specially trained men. They are swept and drenched with water, and, in icy weather, are sprinkled with pebbles. Of late, complaints have been made by the owners of motor cars that these pebbles damage the tires of their vehicles so that now this material is strewn only when strictly necessary. The pebbles used are mud free and from ⅕ to ⅖ in. in diameter. In 1910, 865.85 cu. yds. of these pebbles were utilized. The Hamburg street cleaning department owns 50 cleaning machines, 54 snow plows, 101 water wagons, 100 garbage carts (for waste from private houses), 60 garbage carts (for waste from ships, quays, etc.), 850 snow wheelbarrows, and 321 garbage wheelbarrows.

Night work begins at midnight and ends when the streets are in order. Twelve squads work under the direction of 12 different posts. These posts are in charge of an inspector for day work and a sub-inspector for night work. The jurisdiction of each post is divided into 10 subdivisions, so that in the event of emergency work can be taken up simultaneously at a moment's notice at 120 different points. First the broom machines, of which there are 26, sweep the roadways, while the sidewalks are cleaned at the same time by special men. Another squad follows the sweepers to heap up the dirt swept to the roadside, and, finally, carts and garbage wagons follow. The night work never lasts more than eight hours. Householders are required to burn all the garbage possible and to store the rest in sheet-iron cans with covers, which are deposited at the edge of the sidewalk twice a week, not before 9 p. m. The cans are emptied by the garbage gatherers and must be taken in from the sidewalk by the householders before 8 a. m.

Day work begins at 6 a. m. and continues until 6 p. m., except with the men who work on the asphalt streets, who remain on duty until 7 p. m. A 2-hour intermission is allowed at noon. Recently 10 small iron boxes and 10 wire-netting paper boxes have been placed on trial in different parts of the city to facilitate the work of the street cleaning department. If they answer the purpose satisfactorily a large number will be provided hereafter.

On some streets it is also the practice, where there is a sufficient grade to enable the water to carry off the waste matter through the gutters, simply to scour the roadway with a strong stream of water.

During 1910 the amount of water used by the street cleaning department for scouring and sprinkling and for the use of the relief stations amounted to 1,055,589 cu. yds. During the same year the following quantities of materials were handled by the department: Snow, 661,694 cu. yds.; house garbage, distributed as fertilizing material, 204,663 cu. yds.; house garbage transported to the garbage-destruction plant, 239,147 cu. yds.

At the garbage-burning plant of the city in 1910 the following quantities of material were burned: House garbage, 73,176 tons; wharf garbage, 4,216 tons; ship garbage, 3,360 tons; market waste, 680 tons; waste delivered by private persons and public institutions, 1,541 tons; total, 82,973 tons. From these quantities of waste matter the city obtained 44,987 tons of cinders and 675 tons of old metal, all of which had substantial commercial value.

The regular Hamburg street cleaning force consists of 800 to 900 men, but as snowstorms are frequent in winter, it is often necessary to increase the force to as many as 3,500 men with the utmost celerity. A situation of this kind is met in the following manner: Not later than the month of October the street cleaning department distributes to all laborers applying for them at the proper registry office a card stating where the applicant is to report for work in the event of heavy snowfall. When the need presents itself, men holding cards of this kind obtain employment first. They are paid as much as $2.50 per day, the standard rate being 2.4 cts. per barrow load of snow removed. However, those who fill the barrows are paid at the rate of 8 cts. per hour. Barrows are used if snow has to be transported not more than 820 ft. In other cases, carts of 2.61 cu. yds. capacity are employed. The street cleaning department is thoroughly informed in regard to the labor situation, and as the number of masons and other outdoor artisans without employment is very great when there is ice and snow, it is easy to obtain a sufficient number of men to meet all purposes. The chief object is to have the organization so well in hand that working forces can be distributed as soon as the necessity for their employment presents itself. One-third of the quantity of snow accumulated is dumped into the Elbe River, or Alster basins, one-third into the large sewers, and one-third upon certain large fields and parks in the city. The department has an emergency fund of $32,844 available, and can obtain more very quickly in case of necessity. In the event of a heavy snowstorm the expenses per day amount to $8,092. For 27 years there has been no serious disturbance of traffic in Hamburg on account of heavy snowfall.

BERLIN.

Berlin proper is a city of somewhat more than 2,000,000 population. On March 31, 1912, the aggregate area of its streets regularly cleaned by the municipal street cleaning department was 8,235,620 sq. yds., and of its sidewalks regularly cleaned by the same department 5,143,096 sq. yds. Of this combined area of 13,378,716 sq. yds. regularly cleaned, 8,841,831 sq. yds. received daily cleaning. On March 31, 1912, there were 4,056,373 sq. yds. of stone and 3,658,109 sq. yds. of asphalt pavement. The stone predominated in sidewalk paving and asphalt in the street paving.

For the cleaning work proper 99 foremen, 1,430 laborers, and 557 boys were employed during the report year 1911-12. In addition the department had 21 motor-vehicle drivers and 59 sundry employees on its pay roll. On the average each man kept clean about 6,410 sq. yds. of pavement, of which about 4,235 sq. yds. were cleaned daily. To each boy was assigned about 6,566 sq. yds. of asphalt street pavement.

The daily wages paid to the Berlin street cleaning force are at present as follows: Boys—start, 47.6 cts.; after two years, 53.55 cts.; after four years, 71.4 cts. Men—start, 92.82 cts.; after three years, 98.77 cts.; after six years, $1.07; after nine years, $1.11. Foremen received $1.19 at the outset and $1.25 after three years' service. Motor-vehicle drivers receive $1.25. The workday is from 8 to 9 hours and overtime is paid for at rates varying from 6⅔ cts. an hour for a boy receiving regularly 47.6 cts. a day to 17⅓ cts. an hour for a man receiving $1.10 a day. Provision is made for accident, sickness and old-age insurance.

The equipment of the street cleaning department includes, besides the appropriate supply of brooms, wooden and rubber scrapers, handcarts, etc., 111 sweeping machines, 16 scrubbing machines, and 28 washing machines (combined sprinkling and scrubbing). In 1911-12 the sweeping machines used 1,559 roller brushes, a roller lasting on the average 21.4 workdays.

Of the washing machines 18 are motor driven and 10 horse drawn. The former are found to be the more efficient. In the course of the report year under consideration 6 horse-drawn machines were equipped with motor drives and 6 additional motor machines were purchased for use in the current year. The type of motor machine used is manufactured by Hentschel & Cie., Zossenerstrasse 55, Berlin.

The department has published the following figures bearing on the relative efficiency of motor and horse washing machines. The figures given represent the cost of operation per 8-hour workday:

Electric-driven machine:	
Driver's wage	$1.25
Electricity consumed (on an average 1.716 k. w. per hour at 3.808 cts. per kilowatt) in eight hours	.52
Insurance of accumulators against deterioration at $130.90 per year, or, per day ($130.90 ÷ 300)	.44
Repairs, figured on hasis of past experience	.63
Amortization, figured at 15 per cent	1.49
More rapid consumption of rubber rollers owing to higher speed	.08
Total	$4.41
Horse-drawn machine:	
Driver's wage	$1.12
Two horses, at $1.51 per horse	3.02
Repairs	.19
Amortization, figured at 10 per cent	.24
Total	$4.57

Commenting on these figures, the department points out that an electric machine cleans in an hour 6,937 sq. yds. of street surface or in a day of eight hours 55,496 sq. yds. at a cost, as shown, of $4.41, while a horse-drawn machine cleans in the same time only 44,013 sq. yds. at a cost of $4.57.

In Berlin, except on the heaviest traveled streets, the sweepings are collected by boys with handcarts and conveyed to cast-iron boxes set on the curb, in which they are deposited against final carting away. On the busiest streets, where handcarts, etc., would add to the congestion, subsurface receptacles or cisterns are provided, into which the street cleaners sweep the refuse directly. The refuse is swept through a rectangular orifice about 2 ft. long by 6 ins. high in the vertical surface of the curb. It falls into a sheet metal box, which rests on a framework in the upper part of the cistern. The box is perforated, and in the course of the day the water which is swept in, or which comes from natural precipitation, accumulates in the bottom of the cistern, whence in most cases it drains into the surface sewage mains. Daily, between midnight and morning, the boxes are raised from the cisterns and the dry refuse they contain is dumped into wagons and carted away.

The collection and disposal of the refuse from both the surface and subsurface receptacles are not carried out directly by the street cleaning department, but by contract. The existing contracts run until 1915. During 1911-12, 13,076 cartloads of waste were removed monthly at a cost to the city of about $1.88 per cartload. The refuse must be hauled a long distance before it can be disposed of.

The street cleaning department is dissatisfied with the existing system for disposing of the street refuse and is formulating plans against the expiration of the current contracts. It is proposed to have the street cleaning department itself collect the refuse from the various temporary receptacles. This, it is planned, would be done by horse-drawn wagons, as motors are not considered so efficient when constant starting and stopping is necessary. The refuse would be taken in these wagons to central points, where it would be loaded in large trucks, which would when filled be hauled by gas-motor tractors to the various pumping stations, which the sewage department of the city maintains for pumping the city sewage to the far outlying sewage farms, where it is disposed of. Here, it is planned, the street waste would he mixed with the sewage and be pumped with it to the sewage farms. This is a purely tentative plan.

It is announced that the utilization of the street waste for fertilizing purposes without mixing with sewage is impracticable, as chemical analyses have shown that on the average it contains but 0.34 per cent of nitrogen, 8.12 per cent of phosphates, and 0.14 per cent of potash salts. Neither is the plan of burning it practicable, as similar analyses have shown that it contains 64 per cent to 74 per cent of noninflammable material.

With reference to the sprinkling of streets, the Berlin department reports that during 1911-12, 2,074,207 cu. yds. of clean water were used for this purpose. The equipment consists of 289 one-horse sprinkling carts equipped with Willer patent sprays, and holding each 396 gals. of water. The work is carried on by contract, the city paying $1.51 per horse per day and $1.07 per driver per day. The upkeep of the equipment is looked after by the city.

Besides the clean water mentioned above, a 33 per cent solution of "antistaubit" (chlorine magnesium lye) was used to some extent, and, the department reports, resulted in a saving as compared with clean water sprinkling. For the sprinkling of asphalt and wood-paved streets a 1 per cent westrumite solution is also frequently employed.

NUREMBERG.

With the begining of 1911 the street cleaning area of Nuremberg comprised 3,170,562 sq. yds., and during the year this increased to 3,280,074 sq. yds., comprised mostly of the following: Stone-block pavement, 971,748 sq. yds.; macadam, 870,312 sq. yds.; asphalt and wood, 37,609 sq. yds.; paved sidewalks, 1,114,104 sq. yds.; sanded sidewalks, 84,402 sq. yds.; schoolhouse yards, 92,448 sq. yds.

The regular street cleaning force for 1911 numbered 254 men, including 1 superintendent, 8 inspectors, 25 foremen, 1 storekeeper, 7 mechanics, 9 teamsters, and 203 laborers. Now and then extra laborers had to be employed on account of snow, but only on 21 days during the year, all in January and February. The highest number of extra men on any one day was 749 on Jan. 20, and the total number of work days for the year by extra men was 7,794. The total number of work days in the street cleaning department for the year was 74,365. Up to the present, the fire chief has been exofficio chief of the street cleaning service, but recently the city magistracy has voted to appoint a separate chief for the street cleaning department. The employees of the street cleaning department, like all other city employees in the civil service, are entitled to pensions upon disability or after certain periods of service and to sick benefits when ill. The wages of a laborer begin at 8.8 cts. per hour, and increase to 11.7 cts. after 18 years' service; inspectors begin at 9.3 cts. and increase to 12.1 cts.; foremen and mechanics at 11.2 cts. and increase to 14 cts. For extra time the hour before and after the regular hours is paid at 25 per cent additional; other extra time and Sundays at 50 per cent additional. On Saturdays and holidays work ceases at 4 o'clock in the afternoon with pay for full hours. After 3 years' continuous service employees are entitled to 3 to 6 days' vacation annually with full pay, the length of the vacation depending upon the length of service.

The city is divided into eight cleaning districts, each of which is again divided into two to four subdistricts, each under a foreman with six to ten laborers. In summer the work begins at 4 a. m. and in winter at 6 a. m., so that by 7 or 8 o'clock the sweeping, flushing and hauling is usually completed. All day long sweepers, with brooms made of twigs, and laborers with handcarts are at work gathering up the litter, which is assembled and unobtrusively hauled away. These street sweepings are utilized mainly for the fertilization of city parks and gardens, and to some extent are sold to nearby farmers. It is notable, however, that the entire sale of such street sweepings during 1911 totaled only $175.

The cost of summer street cleaning for 1911 was as follows: Wages, $66,166; brooms and tools, $6,900; hauling, $5,082; maintenance water plugs, $1,903; total, $80,141. The item of wages contains $1,138 vacation wages $1,547 wages paid during sickness, and $493 paid for free shower baths for street laborers. The cost of cleaning the central market square and the fruit market for 1911 was as follows: Wages, $2,511; hauling, $1,141; tools, $36;

total, $3.688. The cost of the winter cleaning was as follows: Wages, $14.307; hauling, $4,527; tools, $1,570; dumping places, $341; total, $20,745. To the cost of winter cleaning must be added also the cost of keeping the public fountains free of ice and strewing sand on specially icy days as follows: Wages, $821; hauling $1,084; tools, $604; total, $2,509. This brings the total cost of the street cleaning service in Nuremberg to the following totals: Summer cleaning, $80,136; winter cleaning, $23,254; rent storage places, $146; cleaning market place, $3,688; salaries office force, $1,815; collecting tax, $2,077; cost of water, 5,355; total, $116,471.

The inventory of the department at the close of the year shows the following machinery, vehicles and tools belonging to the street cleaning department: 10 horse sweepers, 1 hand sweeper, 6 iron refuse wagons, 103 two-wheeled iron pushcarts, 74 two-wheeled wooden pushcarts, 26 four-wheeled hand wagons, 15 snowplows, 127 sand boxes, 32 rubber scrapers for asphalt pavements, 192 sprinkling cans, 2,350 snow shovels, 1,200 ice picks, 790 shovels and hoes, 212 hose nozzles, and 435 yards of hose.

The department has figured out that the cost of cleaning the paved streets, gutters, and sidewalks averaged 3.48 cts. per square yard; of gathering refuse on macadamized streets, 0.93 ct. per square yard; and of cleaning the asphalt paved streets and squares 12.9 cts. per square yard. There were used during the year 8,610 twig brooms and 37 revolving sweepers. A total of 38,749 cu. yds. of street sweepings and 7,594 cu. yds. of snow were removed from the streets during the year. The cost of removing snow and ice averaged 0.84 ct. per square yard.

ZURICH.

The total area of street to be cleaned amounts to 3,311,274 sq. yds., of which 2,639,402 sq. yds. are macadamized. Smooth hard surface pavements, however, are being laid in the business sections of the city. The streets are watered in summer by means of large sprinkling wagons and swept with rotary sweepers drawn by horses. In summer the sidewalks are watered with hand sprinkling carts.

A street cleaner's equipment consists of a two-wheeled pushcart with a capacity of a little more than ⅓ cu. yd.; a large shovel; a scraper for use in removing ice in winter; a heavy broom; and a water can for sprinkling the street before sweeping, to lay the dust. When the handcart is full it is taken to the large collecting wagons stationed in the various districts and then the refuse is carted out of the city and burned or otherwise disposed of. In the business sections there are also larger carts, drawn by horses, which are used for gathering the greater part of the rubbish.

The city equipment includes 24 rotary sweepers, 9 road scrapers, 56 sprinklers of 215 to 530 gals. capacity, 2 motor sprinklers on the street car lines of about 2,000 gals. capacity and a large number of handcarts, snowplows and collection wagons.

The workmen give 2.9 per cent of their wages to a sick and accident fund, and in case of death the family receives the full wages of the deceased for six months. The workmen receive suits and overcoats and even in some cases shoes from the city. The total cost of street cleaning in 1910 was $98,572 or less than 3 cts. per square yard of street surface, and of sprinkling in summer $17,440, or ½ ct. per square yard. Some 10,000 brooms are used annually, costing over $1,000, and 22 to 25 rotary brooms for the sweepers, costing about $350.

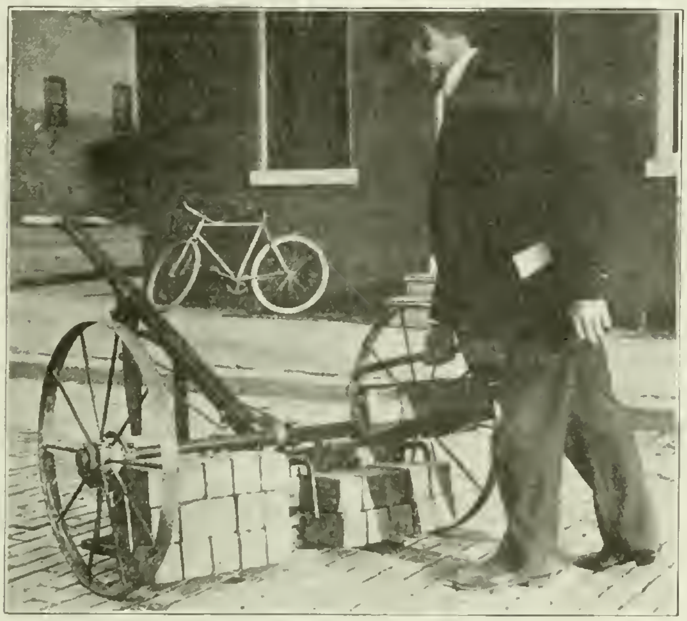


Fig. 1—Cart Being Loaded with Hand Tongs.

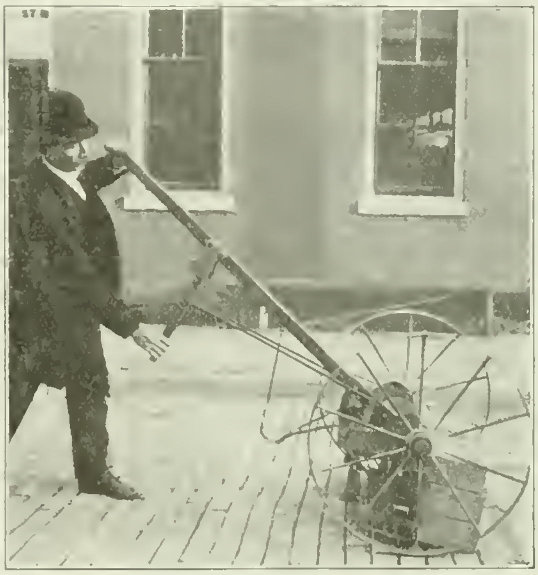


Fig. 2—Cart Depositing Brick on Paving Line.

A Cart System for Conveying Paving Brick.

(STAFF ARTICLE.)

A device for transferring paving brick from the side piles to the setter that is claimed to effect a decided saving in labor and material costs is shown in the accompanying illustrations. Fig. 1 shows the cart being loaded by the hand-tongs ready to be run to the paving line where the brick are deposited in suitable piles ready for the paver. No stacking at this point is necessary, as would be the case if the brick were conveyed in barrows and dumped in the street. The manner of depositing the brick in the street is shown in Fig. 2. By pulling the lever the cart is pushed back from the brick and they are left in place. In this way all chances of chipping or breaking the brick are eliminated.

On an ordinary width of street four carts are used—two for each side. Two men load the cart while a third man acts as wheeler. A cart carries from 27 to 30 bricks, or 36 blocks. As the carts stack the bricks for the setter, the bricks are kept best side up, and the least possible attention need be given them in laying.

The carts are made in three styles, suitable for different methods of setting paving brick. The number 1 cart deposits its load in a solid pile, three bricks high, for the single-handed method of setting. The number 2 cart places the brick in two piles with 8-in. spacing between—this system is adapted for the two-handed method of laying. The number 3 cart is designed to place the bricks in alternate tiers, three bricks high. These carts are manufactured by the Sterling Pattern Works, Sterling, Ill.

A Classification of Road Building Rocks.

An interesting classification of road building rocks by a single grouping that makes connection with common petrographic terms and the typical geologic factors of origin and occurrence was given in a paper presented at the Cleveland meeting of Section D of the American Society for the Advancement of Science by Charles P. Berkey, Assistant Professor of Geology, Columbian University, New York City. An abstract of Prof. Berkey's paper follows:

It frequently falls to the lot of a petrographer to classify stone that it is proposed to furnish for a special piece of work and to give an opinion as to its fitness or its likelihood of meeting the requirements of specifications. In most cases these specifications are very far from being specific in the petrographic sense; i. e., precise rock names are rarely used, whereas some general term or some phrase descriptive of the quality is common. The commonest term is "trap." A few quotations from specifications covering regular contracts under departments and bureaus of highways are given as representative of this usage:

(a) Only broken stone . . . of a hard and compact texture and of uniform grain will be allowed. . . . Disintegrated and rotten stone . . . will not be accepted.

(b) The trap rock shall be of satisfactory quality, equal to that used in . . . for macadam roads.

(c) The mineral aggregate used shall consist of trap rock, newly broken, of uniform quality throughout, free from slaty and flat pieces, soft or disintegrated stone, dirt and other objectionable material.

(d) The stone . . . must be trap or approved native rock. It must show a fresh crystalline surface.

(e) All stone must be . . . the same kind and quality, equally as good in every particular as that shown in the Engineer's office.

(f) Only good, solid stone shall be used. . . . Bidders will name the kind of stone they propose using in said work, also its location.

(g) . . . shall consist of first quality trap rock. . . . Mineral aggregate shall be clean crushed trap rock of approved quality.

(h) Crushed stone shall have a coefficient of wear, according to the Duval test, of not less than 8, and a cementation value of not less than 50.

(i) The first course shall consist of sound rock. . . . Unless otherwise specified, the stone of the second course shall be trap rock. . . . For the third course other material than trap rock screenings may be used if approved by the Engineer.

(j) Stone for macadam shall consist of approved local stone, trap rock, or a combination of local stone and trap rock. . . .

(k) The crushed stone shall be trap or other suitable rock, satisfactory to the office in charge.

(l) The macadam shall be of limestone of approved quality. . . . The stone must be of good and uniform texture.

(m) All stone for concrete shall be hard limestone, sandstone, trap, furnace slag, quartzite, or granite acceptable to the Chief Engineer. Broken stone must be quarried from massive ledge, and any stone which shows a tendency to break into flat, thin pieces will be rejected.

(n) The broken stone shall be trap, granite, or limestone, or such other stone taken from the line of work as shall be satisfactory in the judgment of the Engineer.

Such a summary is probably fairly typical. From it two or three generalities may be made. For example: (1) The standard, so far as there is a standard, with which all rocks are compared in highway work is "trap."

(2) Trap is usually specified by name wherever there is any reasonable hope of furnishing it for the contract.

(3) Wherever substitutes are encouraged they are either indicated by name, or are described in efficiency terms, or the responsibility is placed directly on the Engineer in charge.

It is the general opinion, based on experience, that the "traps" are pre-eminently satisfactory for highway uses. But trap is not a very definite petrographic term. In a very broad way this means that the basic igneous rocks of massive structure and a tendency to diabasic or closely interlocked habit of the mineral constituents are the best road material. The acid igneous rocks are not so successful, especially when there is heavy traffic sufficient to test the toughness of the rock. The metamorphic rocks as a class are not regarded with much favor. The clastic or fragmental rocks as a rule are not recommended, but limestones are very serviceable where hardness is not a prime essential. In every large class of rocks there are special types that prove to be of acceptable grade, but no large class compares with the basic igneous rocks for general efficiency under the most exacting conditions.

In spite of this apparent reduction to such simple terms in the matter of range of rock types regarded as acceptable, there is, as a matter of fact, a great variety of rock actually used and quite worthy of serious consideration. Many factors enter into the question of choice. It is not always so simple. There is little excuse for a state like Ohio to demand trap in any except the most critical cases, for there is not a single trap ledge in the state or anywhere near its borders. It may well happen in many cases that the increased efficiency is more than counterbalanced by the extra cost over local stone. In the average case everywhere local stones merit serious consideration, and a little judicious discrimination will usually discover an acceptable one.

But here is where some critical knowledge of rock variation will be found useful. Names of rocks alone are not as useful as might at first appear, because all types vary greatly in minor points of texture, structure, chemical and dynamic modification and consequent efficiency. No amount of mere classification can take the place of careful discrimination of structural variety within the principal types themselves.

It may be useful, however, to consider briefly the range of types coming within observation for such uses, and indicate their petrographic grouping. Probably no publication of rock for highway uses has given any fuller list of varieties than Bulletin 44 of the Office of Public Roads, U. S. Department of Agriculture, Washington.

The following list has been compiled from this and other sources and the terms are classified under the commonly used headings familiar to all students of natural rock materials. In it there is no attempt to indicate relative value for actual use. For reasons suggested in an earlier paragraph it is certain that particular varieties of a type that is usually considered of poor quality may very well prove to be much superior to the more faulty varieties of rock types that are generally regarded as high grade.

I.—Igneous rocks:
  (a) Volcanic fragmental materials:
    1. Volcanic ash.
    2. Volcanic breccias.
    3. Rhyolite tuff.
    4. Andesite tuff.
    5. Basalt tuff.
  (b) Surface flows (crystalline lavas, felsitic and slightly porphyritic in texture and showing flowage structure):
    6. Rhyolite and rhyolite breccia.
    7. Felsite and brecciated felsite.
    8. Trachyte.
    9. Andesites:
      Augite andesite.
      Hornblende andesite.
      Andesite breccia.
    10. Basalt:
      Vitreous basalt.
      Olivine basalt.
      Chloritized basalt.
  (c) Intrusive masses (dikes, sills, etc.; strongly porphyritic or intimately interlocked in texture):
    11. Granite porphyry.
    12. Syenite porphyry.
    13. Camptonite.
    14. Diabase ("trap" of highest grade):
      Hypersthene diabase.
      Uralitic diabase.
      Olivine diabase.
      Augite diabase.
      Gabbro diabase.
      Meta diabase.
    15. Diabase porphyry.
    16. Peridotite.
    17. Pegmatite.
  (d) Plutonic masses (deep-seated in origin; granitoid in texture and massive structure):
    18. Granite:
      Hornblende granite.
      Porphyritic granite.
      Muscovite granite.
      Micro granite.
      Gneissoid granite.
    19. Syenite:
      Augite syenite.
      Quartz syenite.
    20. Granodiorite.
    21. Diorite:
      Quartz diorite.
      Augite diorite.
      Basic diorite.
      Porphyritic diorite.
    22. Gabbro:
      Hornblende gabbro.
      Hypersthene gabbro.
      Uralitic gabbro.

In the above grouping the field relations are indicated in the sub-headings and under each the rock types whose names have been found mentioned in road tests or rock lists for such purpose have been arranged approximately in order from the more acid to the more basic in composition.

II.—Sedimentary (clastic) rocks and associated organic accumulations and aqueous precipitates, together with special modifications:
  (e) Simple sediments (arranged from fine to coarse grain):
    23. Shale:
      Clay shale.
      Ferruginous shale.
      Carbonaceous shale.
      Calcareous shale.
    24. Sandstone:
      Argillaceous sandstone.
      Calcareous sandstone.
      Ferruginous sandstone.
      Chloritic sandstone.
      Feldspathic sandstone.
      Arkose sandstone.
      Kaolinized sandstone.
      Biotite sandstone.
      Indurated sandstone.
      Metamorphosed sandstone.
      Conglomeritic sandstone.
    25. Conglomerate.
  (f) Organic in origin, with or without sedimentary intermixture, and usually with some modification:
    26. Limestone:
      Shell limestone.
      Fossiliferous limestone.
      Clay limestone.
      Argillaceous limestone.
      Bituminous limestone.
      Siliceous limestone.
      Nodular limestone.
      Oolitic limestone.
      Cherty limestone.
      Dolomitic limestone.
    27. Dolomite:
      Argillaceous dolomite.
      Arenaceous dolomite.
      Siliceous dolomite.
  (g) Precipitates:
    28. Traverstine (tufaceous limestone).
    29. Gypsum.
  (h) Special segregations, etc.:
    30. Quartz.
    31. Chert:
      Calcareous chert.
      Dolomitic chert.
    32. Flint.
    33. Hematite.
    34. Phosphate rock.

III.—Dynamic fragmental materials:
  (i)
    35. Breccia:
      Quartz breccia.
      Quartzite breccia.
      Brecciated felsite.

IV.—Metamorphic (rocks that have been recrystallized and have lost most of their original structural habit and in part their mineralogic habit. As a rule they have a foliate structure and break much more readily in one direction than in others.):
  (j) Fine-grained types (with good rock cleavage):
    36. Slate or argillite:
      Clay slate.
      Siliceous slate.
      Calcareous slate.
      Indurated slate.
  (k) Medium grained (rather massive and comparatively little foliate habit):
    37. Quartzite:
      Calcareous quartzite.
      Sericitic quartzite.
      Feldspathic quartzite.
      Chloritic quartzite.
      Micaceous quartzite.
      Pyroxene quartzite.
      Epidote quartzite.
      Hornblende quartzite.
    38. Graywacke.
  (l) Strongly foliated and usually of medium grain (commonly of abnormal composition, i. e., some mineral other than feldspar in excess):
    39. Schist:
      Quartzite schist.
      Mica schist.
      Biotite schist.
      Quartz mica schist.
      Hornblende schist.
      Mica hornblende schist.
      Hornblende mica schist.
      Chlorite schist.
      Hornblende chlorite schist.
      Garnet hornblende schist.
      Quartz hornblende schist.
      Tremolite schist.
      Talc schist (soapstone).
  (m) Foliated structure, medium to coarse grain, sometimes banded and of normal composition (i. e., the usual feldspathic mineral makeup):
    40. Gneiss of unstated relations:
      Quartz gneiss.
      Sericite gneiss.
      Hornblende gneiss.
      Arkose gneiss.
      Chlorite gneiss.
      Muscovite gneiss.
      Biotite gneiss.
      Pyroxene gneiss.
    41. Granite gneiss.
    42. Syenite gneiss.
    43. Diorite gneiss.
    44. Gabbro gneiss.
  (n) Massive types:
    45. Marble:
      Dolomite marble.
    46. Serpentine:
      Hornblende serpentine.
    47. Amphibolite.
    48. Eclogite:
      Mica eclogite.
    49. Epidosite.

This list represents in reality a very wide range. It is certain that many of them are of very low efficiency, but in spite of that they have been found worthy of consideration and test. Numbers 10, 13, 14, 15 and 21 are the prominent "trap" representatives. Diabase, No. 14, is the type usually meant when the term is used in specifications. But it is not a closely defined petrographic term and is often more loosely used.

No doubt it would be a great convenience for highway engineers if a special classification in which the prominent efficiency factors were given chief place could be devised. The chief difficulties with such a scheme are:

1st. That it is an attempt to simplify a mass of data that are essentially not simple.

2nd. That its basis could not coincide at all with that of any other rock classification, and therefore,

3rd. That the terms used in classification could not agree closely with those in common use.

The result would be, it seems to me, that we should have another classification to become familiar with instead of accomplishing a simplification. On the whole there is as yet no better suggestion than that the commonly used terms for description and naming should be thoroughly mastered and that the nature of the structural and textural basis of difference in quality should be fully understood, and that the geological and petrographic principles underlying the history of rocks should be a part of one's professional equipment.

Steel Protectors for Expansion Joints in Concrete Roads and for Concrete Curbs.

One of the chief sources of trouble in concrete roads and pavements is the chipping of the edges of the expansive joints under traffic. Various methods of protecting the pavement at this point have been employed. On much of the more recent and larger pieces of work the edges of the joints have been faced with specially prepared steel plates. One of the latest types of these steel joint protectors is shown in the accompanying sketch. This is known as the Trus-Con Armor Plate. It is manufactured by the Trussed Concrete Steel Co. of Detroit, Mich. The plate is made of high-grade open hearth steel, of the right composition to take the extra heavy wear at the joint, and to wear down with the roadway. It is used in connection with asphaltum felt or plastic asphaltum. The installation is accomplished by clamping the two bars together with a layer of felt of desired thickness between, the felt cutting the entire thickness of the pavement. When filler is used, a steel plate is placed temporarily between the two armor plates, and is removed after the concrete is formed, the space then being filled with the plastic asphaltum. The assembled plates are held in place at the exact grade line by being attached temporarily to side grade boards and supported by pins driven into the sub-grade.

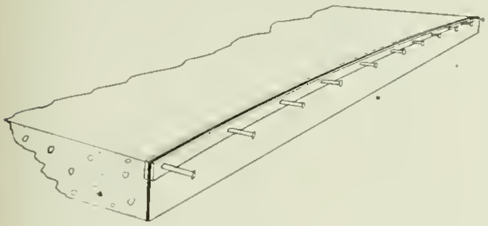


Fig. 1—Expansion Joint Protector.

The Trussed Concrete Steel Co. has also developed a concrete edge protector for use on curbs and all exposed corners of concrete construction. This protector consists of two pieces of open hearth steel securely welded together and hot galvanized after forming. Two designs have been developed. In one of these the plate is ¼ in. thick, with a periphery of 2½ ins., the anchor bolt is 7/16 in. in diameter and 1 ins. long. In the other the plate is 3/16 in. thick, with a periphery of 1¾ ins.; the anchor bolt is 7/16 in. in diameter and 2½ ins. long. The standard lengths for both of these bars are 8, 10 and 12 ft.

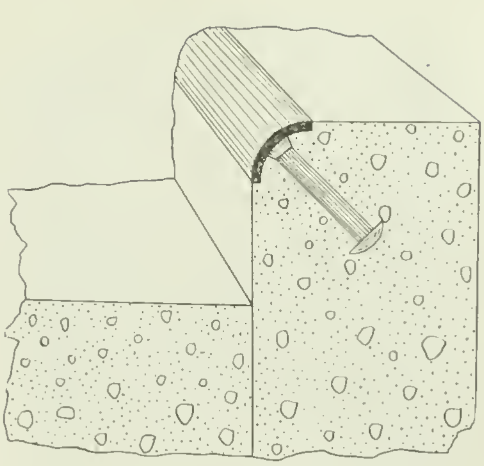


Fig. 2—Concrete Edge Protector.

GENERAL ARTICLES

The Bench Round Method of Sinking a Rectangular Shaft.

The accompanying drawing shows an unusual form of blasting round for shaft sinking which is described by Claude T. Rice in "Engineering and Mining Journal" for March 8, 1913.

Drilling is done only on day shift; two No. 9 Leyner drills are used on a 9-ft. bar, and two men work on a drill. Ground is broken about 20 ft. long and 10 ft. wide. Sinking is done by taking a cut toward one end of the shaft, a bench about 6 ft. wide being left along one end from which the drilling is done. This cut is alternated from one end to the other, because of the tightness of the ground, which, under average conditions, will not allow much more than 2½ ft. of burden to be put on the toe of a hole. From 12 to 18 holes are required to a round. The machines each put in from 30 to 50 ft. of hole in a shift, and average about 40 ft. It takes two shifts to drill the round illustrated. Generally the back holes are drilled from 6 to 7 ft. deep. About 17 lbs. of dynamite is used per foot of shaft sunk.

The longest drill is 9 ft. long. The starters are 2 ft. 9 ins. long, and each following drill is 12 ins. longer. The gage on the starter is 2⅝ in., and changes 3/16 in. for every gain of 1 ft. in the length of the drill. Generally a drill is used only once, and can be run ahead only 12 ins., because of the hardness of the ground. The water for the Leyner drills is held in two 50-gal. barrels on a stage in the manway 80 to 100 ft. from the bottom of the shaft. The barrels are filled from the sump in the station by a ½-in. pipe. The barrels last the two machines through a shift.

Cost of Year's Operation of Marine Plant for Construction of Lincoln Park Extension, Chicago, Ill.

(STAFF ARTICLE.)

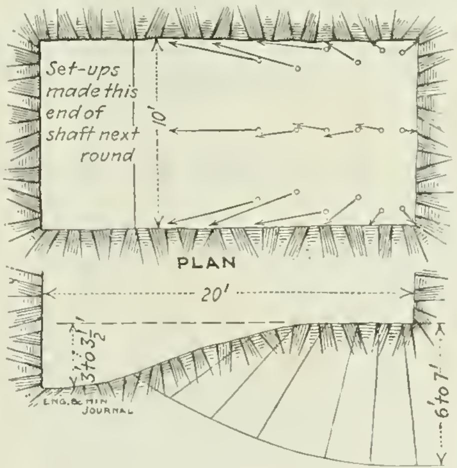
The cost of operation and repairs during the year 1912 for three tug boats, a pile driver, a derrick and a motor boat is given in the accompanying tables. This plant was used in connection with the dredging and breakwater construction for the extension of Lincoln Park, Chicago.

The tug "Keystone" is the largest of the three tugs and is rated at 94 gross tons. She was built in 1891 and has a steel hull, 87½ ft. long, 19-ft. beam, and 11 ft. deep. She is equipped with one fore and aft compound condensing engine with 18x34-in. cylinders of 30-in. stroke, and one fire box marine boiler 30 ft. long by 102 ins. in diameter.

TABLE I.—OPERATION AND REPAIRS—TUG "KEYSTONE."

In commission 2,125 hours.

Operation:	Totals.	Cost per hr.
Labor	$ 5,284.74	$2.49
Fuel	3,469.15	1.63
Supplies	1,105.12	0.52
Insurance	147.00	0.07
Miscellanecus	1.93	0.00
Total	$10,007.94	$4.71
Repairs:		
Labor	$ 2,975.45	$1.40
Material	4,239.04	1.99
Service of other plant	485.63	0.23
Total repairs	$ 7,700.12	$3.62
Total operation and repairs	17,708.06	8.33



Bench Round Used in Sinking a Michigan Mine Shaft.

The tug "Richard B" was built in 1906. She has a wood hull 76 ft. long, 17-ft. beam and 7 ft. in depth, and is rated at 63 gross tons. Her engine is fore and aft compound condensing, with 10x20-in. cylinder, and 14-in. stroke. Her boiler is of the Scotch Marine type, 14 ft. long by 96 ins. in diameter.

The tug "Hausler" was built in 1893 of wood and was purchased for its present work in 1908 for $10,500. She is rated at 61 gross tons and is equipped with one vertical non-condensing engine, 22x44 ins., 24-in. stroke. She has one fire box marine boiler, 14 ft. long by 96-in. diameter, and carries 135 lbs. of steam. The other tugs each carry 125 lbs. of steam.

TABLE II.—OPERATION AND REPAIRS—TUG "RICHARD B."

In commission 2,963 hours.

Operation:	Totals.	Cost per hr.
Labor	$ 4,619.47	$1.56
Fuel	1,467.45	0.49
Supplies	713.06	0.24
Insurance	114.50	0.04
Total operation	$ 6,914.48	$2.33
Repairs:		
Labor	$ 1,061.00	$0.37
Material	1,493.37	0.50
Service of other plant	47.95	0.01
Total repairs	$ 2,602.32	$0.88
Total operation and repairs	9,516.80	3.22

TABLE III.—OPERATION AND REPAIRS—TUG "HAUSLER."

In commission 5,730 hours.

Operation:	Totals.	Cost per hr.
Labor	$ 9,532.94	$1.66
Fuel	3,464.30	0.60
Supplies	1,112.14	0.20
Insurance	288.25	0.05
Total	$14,397.63	$2.51
Repairs:		
Labor	$ 1,628.05	$0.29
Material	1,692.74	0.29
Service of other plant	151.57	0.03
Totals	$ 3,472.36	$0.61
Total operation and repairs	17,869.99	3.12

Pile driver No. 1 is a floating driver which was used for constructing breakwater. This piece of plant was in commission 878 hours and Table IV shows the expense incurred.

TABLE IV.—OPERATION AND REPAIRS—PILE DRIVER NO. 1.

In commission 848 hours.

Operation:	Totals.	Cost per hr.
Labor	$ 4,601.92	$5.24
Fuel	176.59	0.21
Supplies	217.37	0.24
Insurance	97.00	0.11
Total	$ 5,092.88	$5.80
Repairs:		
Labor	$ 1,255.20	$1.43
Material	239.72	0.27
Service of other plant	76.32	0.09
Total repairs	$ 1,571.24	$1.79
Total operation and repairs	$ 6,664.12	$7.59

TABLE V.—OPERATION AND REPAIRS—PILE DRIVER NO. 2.

In commission 717 hours.

Operation:	Totals.	Cost per hr.
Labor	$ 3,809.62	$5.31
Fuel	127.30	0.18
Supplies	163.08	0.23
Insurance	97.00	0.13
Total operation	$ 4,197.00	$5.85
Repairs:		
Labor	$ 1,121.55	$1.56
Material	183.94	0.26
Service of other plant	107.83	0.15
Total repairs	$ 1,413.32	$1.97
Total operation and repairs	$ 5,610.32	$7.82

The cost of the season's work of Pile Driver No. 2 is shown in Table V.

The derrick was in commission 1,910 hours and served to handle stone from barges, and for handling materials on all parts of the work. The cost for the season is shown in Table VI.

TABLE VI.—OPERATION AND REPAIRS TO DERRICK.

In commission 691 hours crew of 2 men.
In commission 200 hours crew of 4 men.
In commission 1,019 hours crew of 6 men.

Operation:	Total.	
Labor, watching	$321.67	
Fuel	288.06	
Supplies	226.31	
Insurance	22.00	
Total	$798.04	
Repairs:		
Labor	$345.60	
Material	236.93	
Total	$582.53	
Total operation and repairs:		
Except operating labor	$1,380.57	$0.723
Total with 2 men 691 hrs	771.13	1.116
Total with 4 men 200 hrs	502.70	3.236
Total with 6 men 1,019 hrs	3,391.87	4.051

The motor boat which served all the work was in commission eight months. This boat was purchased by the ark Commission in 1907 for $1,150. Its cost for the season is shown in Table VII.

TABLE VII.—COST OF OPERATING MOTOR BOAT.

Operation:	Totals.	Cost per day.
Labor operating	$ 496.10	
Labor watching	80.42	
Supplies	546.91	
Total	$1,123.43	$4.68
Repairs:		
Labor	$ 247.95	
Material	299.05	
Tug and derrick	35.16	
Total	$ 582.16	$2.42
Total operation and repairs	$1,705.59	7.10

Municipal Garbage Plant for Rio de Janeiro.—A 300-ton crematorium is proposed for the city of Rio de Janeiro, Brazil, which the contractors undertake to put up in 12 months at a cost of $660,000 and others for 100 tons at $260,000 each.

Methods and Cost of Constructing a Small Concrete Dam.

Contributed by Fred J. Wood, Brookline, Mass.

A piece of concrete of unusual intrinsic value was built last fall in the construction of a dam for E. V. Earle, in the improvement of his water power at Paris, Maine. The broken stone aggregate was composed of imported emery ore, from Asiatic Turkey, valued at about $75 per ton, probably 12 to 14 tons being built into the dam. A score of years ago a company proposed to use this water power in the manufacture of emery wheels, and a cargo of ore was procured, much of which still remains, useless, on the premises.

The job was so small, its situation so remote from supplies, and its being built by unskilled help, hastily recruited, and not long enough together even to get acquainted with each other, it seems to be a fair guide for similar work and a description and statement of cost may be of interest.

The dam has a total length, on the top, of about 48 ft., of which only 20 ft. are of the full height of 3 ft. A further item of interest is that this dam, only 3 ft. high, develops a head of 40 ft. at a point 200 ft. down stream. The section being so small, a 32-in. base, bringing the resultant within proper limits, the dam was made rectangular in section and of that width. No other engineering problems were involved; the foundation was a solid ledge without a sign of a seam, and the location was between two ledge walls which narrowed as they stretched down stream. A friend of the owner, a man of many years' experience as a contractor's foreman, who had had charge of some concrete construction, composed the whole "expert" force. He was told to build the dam on the lines outlined above and left to his own devices. The river, as measured by the United States Geological Survey in 1905, has a flow of from 28.72 to 83.70 sec.-ft., the minimum occurring that year between October 1 and 11. The dam was built October 2 to 9, 1912, while the river was very low.

First, a diversion dam was built of feed sacks full of sand, placed above the dam site and at a point to turn the river flow through the canal leading to the mill. The canal was cleared of rubbish, all gates opened wide, and the end of the penstock taken off, by all of which means nearly the entire flow was diverted from the new work. Some water however found its way back into the river bed, above the dam, through a leak in the canal wall and there was some seepage through the bag dam. At no time, however, was there more water than would pass through a 4x10-in. hole, left in the form for that purpose.

Much difficulty was found in securing laborers, the corn packing shops being in full operation, and apple packers engaging all the remaining help. Only by offering nearly double wages could a gang of ten men be secured for two days. With the help of one laborer, a handy man with carpenter tools, and a horse, the river had been diverted, the site cleared, and the form built by the night of Oct. 6, and a full gang of ten men reported on the morning of the 7th.

An adjacent pile of old railroad ties was soon transferred into a cob house trestle across the river bed adjoining the form and about a foot above its top. This planked over, formed the mixing platform and the runways. The sand, previously hauled from a bank a mile away, had been dumped on the bank at the west end of the dam, with the emery ore immediately behind it. Not enough water ran past the work to provide the amount needed for mixing, so a supply was brought and placed in barrels. Mixing and placing concrete began about 10 o'clock and occupied the rest of the day and about four hours of the next day.

The form was simply built with longitudinal top and bottom stringers, tied across the top at intervals and braced from the outside, with vertical boarding on their inside faces.

The following data may be of interest, as showing what can be done by persons, unlearned in the art, and under the disadvantage of temporary help at exorbitant prices. Laborers were paid $2.50 per day, one dollar more than the customary rate in that section, being necessary as already stated. The cement was one of the standard brands of Portland obtained from a local dealer, the sand was locally secured, and the concrete was mixed in the proportions of 1:2:4.

A retired business man, living in the vicinity, was much interested in the work, and volunteered to act as timekeeper. To him we are indebted for the following tabulation of costs:

Distribution.	Cost.	Per cu. yd.
Labor:		
Filling sacks and building diversion dam	$ 14.375	$ 1.65
Cleaning diversion channel	4.50	.52
Clearing site	4.225	.49
Building forms	16.50	1.90
Building mixing platform and runways	6.45	.74
Handling material to the mixing platform	13.60	1.57
Mixing and placing	27.70	3.18
Cleaning up	13.25	1.52
Time lost by rain	2.65	.30
Total for labor	$103.25	$11.87
Material:		
Emery ore (at price quoted for trap rock)	$ 30.00	$ 3.45
Cement, delivered	35.00	4.02
1,500 A.B.M. boards for forms, delivered	30.00	3.45
10 lbs. 8d. wire nails at 4 cts.	.40	.05
20 loads of sand at 5 cts.	1.00	.11
Hauling sand, 2½ days at $3	7.50	.86
Total for material	$103.90	$11.94
Total for labor	103.25	11.87
Grand total	$207.15	$23.81

BRIDGES

Method of Enlarging a Single Track Swing Bridge Substructure to Carry a Double-Track Span.

The enlargement of a circular pivot pier, rest piers and abutments for a bridge consisting of one swing span and one approach span is described by Mr. C. E. Smith, Bridge Engineer, Missouri Pacific Ry., in a paper before the American Railway Engineering Association. The enlargement of the piers and abutments consisted in extending them up and down stream a sufficient distance to provide supports for the new double track bridge; in addition a thin shell of reinforced concrete was placed on each side of each pier and on the faces of the abutments for the purpose of connecting the extensions. This made the pivot pier elliptical in plan, the coping being 28 ft. measured along the bridge and 40 ft. measured up and down stream. The piers and abutments were enlarged and reinforced up to the bridge seats without the use of falsework and without placing the draw span out of commission. Fortunately this work was carried out during a low stage of water that reduced navigation to a minimum.

The plans of the old masonry indicated that the pier footings rested on rock 51 ft. below the rail and 15 ft. below water. Borings indicated cemented gravel at that level, below which 6 ft. of gravel and 9 ft. of silt were encountered before rock was reached. The result of these borings led to the idea that the old piers extended deeper than shown on the original plans and either rested upon rock or were supported on foundation piling. Both of these assumptions, however, were later found to be incorrect. The increased depth of rock led to an increase in the sizes of the new footings. Steel sheet piles were driven down to rock around the pivot pier and the material within the cofferdam was excavated down to the bottom of the old pier. Investigation disclosed that the bottom of footing was at the elevation shown on the original plans, but that the footings rested directly on the cemented gravel without pile foundation. Foundation piles to the number of 88 were driven to rock around the old piers and the entire area within the cofferdam, 42 ft. wide and 55 ft. long, was covered by a concrete footing course 4 ft. thick heavily reinforced to distribute the load as uniformly as possible over the piles. To prevent the concrete footing from floating around and into the interlocking heads and grooves of the steel sheet piling and thereby causing trouble in pulling them, the concrete was separated from the steel sheeting by boards 1 in. thick laid horizontally and in contact with the grooves.

Above the footing the pier was completely enclosed in a reinforced concrete shell varying in thickness from 9 ins. on the channel sides to 6 ft. 9 ins. on the up and down stream ends. The up and down stream extensions were necessary to provide support for the center wedges of the new draw trusses, which are 30 ft. 4 ins. center to center. The shell was reinforced by horizontal reinforcing rods 1 in. square 9 ins. apart near the bottom and ¾ in. square 14 ins. apart near the top of the pier. One-half the bars passed around close to the surface of the old pier and one-half close to the surface of the reinforced concrete shell. The shell on the channel sides was made thin to avoid encroachment on the channels; it was particularly for the purpose of embedding the horizontal rods that joined the extensions of the piers, but it also gives the pier a uniform appearance, inasmuch as the entire stone work is buried in concrete.

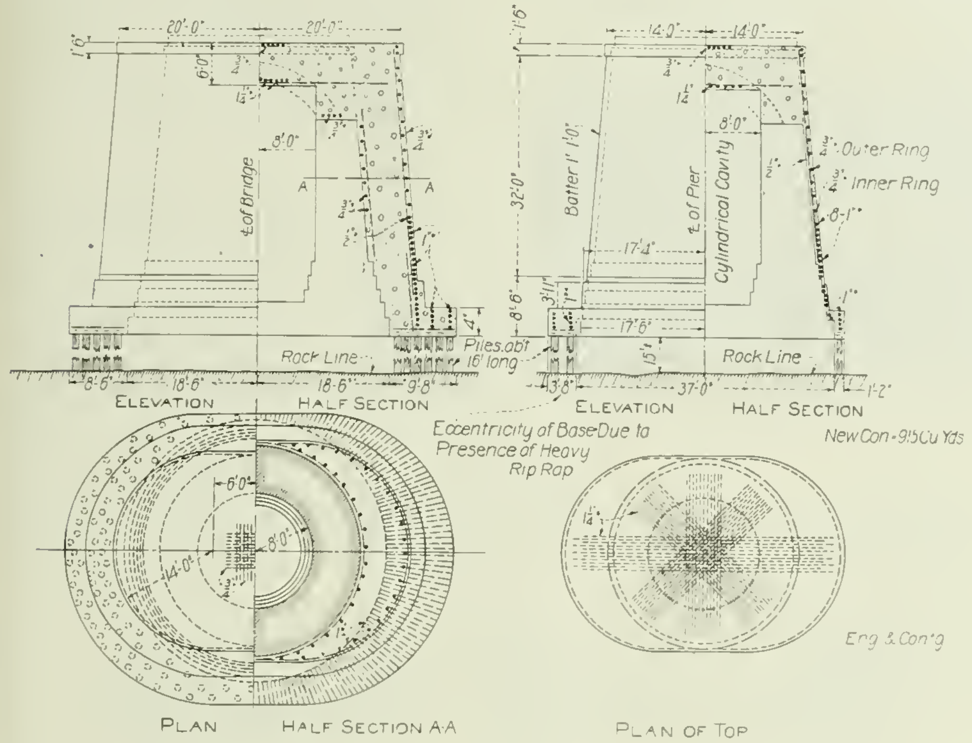


Fig. 1—Plans Showing Manner of Enlarging Pivot Pier, Little Red River Bridge.

The former draw span having been rim bearing, the old pier was hollow, having a cylindrical cavity 16 ft. in diameter surmounted by a dome, which in turn was covered by solid masonry, forming a continuous bridge seat. The new draw span being pivot bearing necessitated the reconstruction of the center of the pier to enable it to carry the weight of the span and such live load as will reach the center. The filling of the pier with solid concrete was contemplated, but the idea was abandoned as it was desired to avoid such an increase in the weight of the foundation, consequently the old masonry was torn down 12 ft., which entirely removed the old dome. It was then built up with concrete, the slab over the 16-ft. cylindrical cavity being made 6 ft. thick and reinforced with 44 1¼-in. square bars placed in four sets of eleven each at angles of 45° each with the next set.

The steel work of the new draw span is wider than the top of the pivot pier measured along the bridge, so that when the draw span is turned the trusses overhang the pier. They do not encroach on the channel more than the pier, however, as the sides of the old pier were battered to such an extent that a vertical line from the outside of the steel work when turned at 90° intersects the battered side of the pier at about low water line.

Approximately 1,000 cu. yds. of concrete and 88 piles were used in the reconstruction of this pier. It supported the old draw span ready for turning during the entire reconstruction except when the top was being rebuilt, which was done during the erection of the steel work. If a new pier had been constructed it would have been necessary to have removed about 1,000 cu. yds. of old masonry and to have placed about 2,500 cu. yds. of new concrete and 250 new piles or to have increased the cost by going to rock with the footing. In addition the bridge would have been on falsework for a long period, which would have added to the cost and hazard of the work. If a new pivot pier had been proposed it is probable that the government would have demanded a wider channel, as the War Department was undoubtedly influenced in its approval of the plans by the reasonable contraction of the channel asked for by the railway company and by the comparatively slight expense at which the foundations could be adjusted to a new double track bridge as compared with the cost of complete reconstruction.

The reconstruction of the rest pier and of the abutments was similar to that of the pivot pier. The reinforced shell along the sides of the old rest pier and on the faces of the old abutments was made 9 ins. thick and anchored to the old masonry by ½-in. square anchor rods placed 5 ft. c. to c. in each direction. The extensions of the pier and of the abutments were placed on piles. The end extensions are about 8 ft. long. The new steel bridge seats, which necessitated cutting down work required a different arrangement of the old rest piers and abutments. This work was done during the erection of the steel work and the entire length of bridge seat was built in one operation and heavily reinforced.

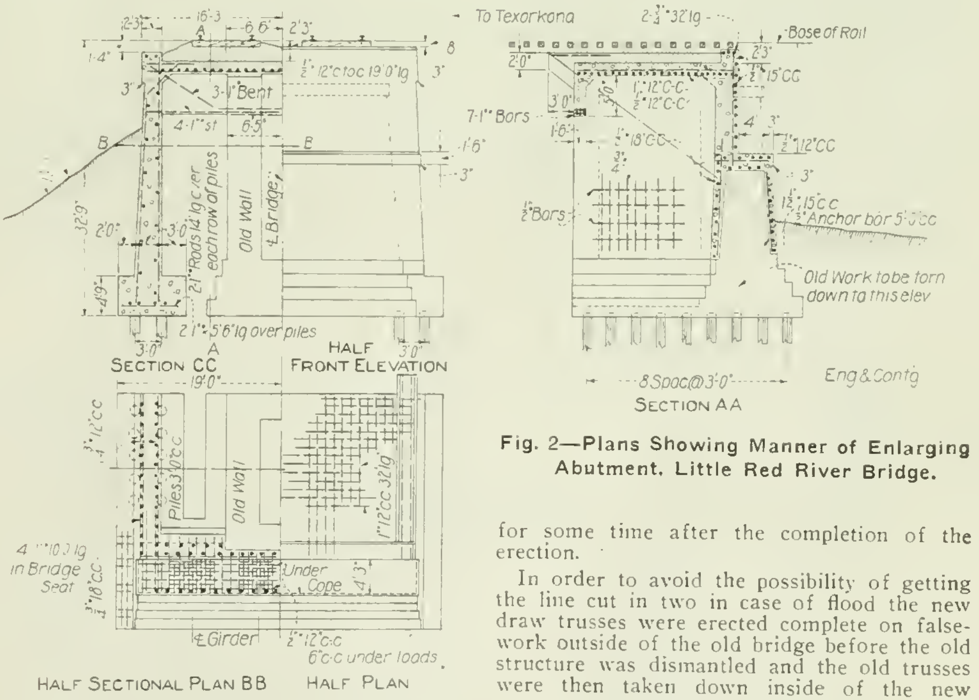


Fig. 2—Plans Showing Manner of Enlarging Abutment, Little Red River Bridge.

In order to avoid the heavy expense of building gravity wings for the abutments on piling it was decided to continue the abutments as U-shaped structures. For this purpose new tail walls were built parallel with the track outside of the old abutments. The tail walls rest on footings 8 ft. wide at the base and 5 ft. deep. The tail walls were made 3 ft. thick at the bottom and 2 ft. thick at the top and heavily reinforced with ¾-in. square bars 12 ins. to 18 ins. c. to c. A reinforced concrete slab 18 ins. thick was then built for the support of the ballast and track, this slab extending back about 20 ft. from the back wall. The slab rests on four supports, two of which on the outside are provided by the new reinforced tail walls and two on the inside are provided by the old masonry tail walls.

The specifications for erection provided that the expense of caring for navigation would be borne by the railway company. Amicable arrangements were made with the government to close the channel with the exception of a 50-ft. opening which was provided in the falsework by the use of a second-hand deck plate girder span, which opening was large enough to permit the passage of the stone barges used by the government, but would not permit the passage of their steam towboat. The railway company hired a small towboat to assist the government in getting the barges to and from the rock quarry. The railway company's towboat handled the empty barges from the bridge up stream to the quarry and handled the barges loaded with rock from the quarry down stream to the bridge. The government towboat handled the empties to the bridge and took the loaded barges away. The arrangement proved to be entirely satisfactory. The deck plate girders in the approach span were placed one at a time on falsework after the old through truss span had been taken down and for a time track was supported on the two inside girders, as it was necessary to maintain single track across the bridge in its old location for some time after the completion of the erection.

In order to avoid the possibility of getting the line cut in two in case of flood the new draw trusses were erected complete on falsework outside of the old bridge before the old structure was dismantled and the old trusses were then taken down inside of the new trusses.

The draw span is a 12-panel riveted disc center-bearing swing span of ordinary construction operated by a 40-h.p. Fairbanks-Morse gasoline engine in a reinforced concrete house over the center pier.

The bridge was designed for Cooper's E-50 loading according to the specifications of the Missouri Pacific Ry. Co., which conform with those of the American Railway Engineering Association. The weight of structural steel in the two 113-ft. deck-plate girder spans amounts to 175 tons and in the draw span 620 tons, and of the machinery 75 tons. The total cost of the bridge amounted to about $125,000. Substructure work and steel erection were performed by the Kansas City Bridge Co. of Kansas City, Mo., and the steel work was fabricated by the Virginia Bridge & Iron Co. of Roanoke, Va., and Memphis, Tenn.

The Cost and Construction of a Concrete Girder Bridge at Monett, Missouri.

(Contributed by W. C. Davidson, State Highway Engineer's Office, Columbia, Mo.)

The recent completion of a concrete girder bridge at Monett, Mo., virtually marks the introduction into Barry County of concrete for highway bridges. This structure is of the girder type, Figs. 1 and 2, built in three spans of 25 ft. each, making a total length of 75 ft. A retaining wall 89 ft. long was also constructed to prevent the flood waters from washing an earth approach which was necessary at the north end of the bridge. The work was done under the direction of the Monett Special Road District with funds derived from the regular road and bridge revenues of the district.

Mr. Fred L. Appleby, bridge engineer, of Kansas City, Mo., designed and built the bridge which was proportioned in accordance with the Missouri State Highway Department's Specifications. These specifications provide for a live loading of 125 lbs. per square foot of total floor surface, this loading being equivalent to a 16-ton traction engine with axles 10 ft. on centers and 6-ft. gage, two-thirds of the load to be carried on the rear axle and distributed over 12 ft. in width. The structure was designed in accordance with the following unit stresses:

	Lbs. per sq. in.
Shearing, steel	10,000
Tension, steel	16,000
Shearing, concrete	50
Bearing, concrete	400
Tension, concrete	...
Compression, concrete	500

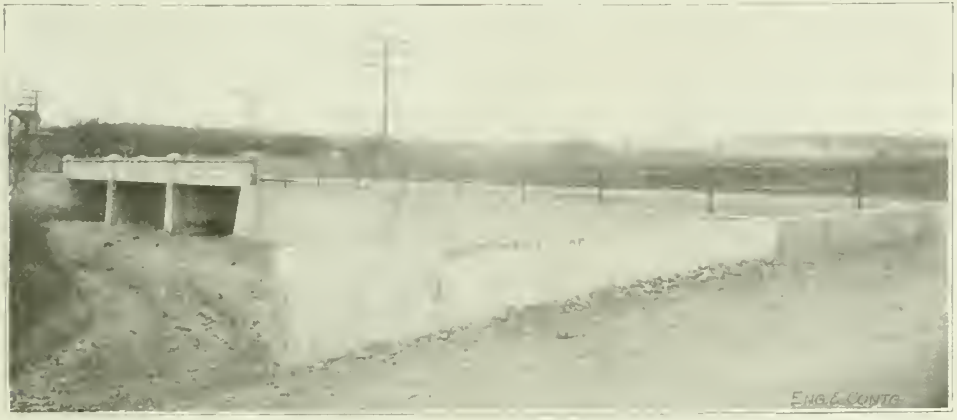


Fig. 1—View of Reinforced Concrete Girder Bridge and Approaches; Monett, Mo., Special Road District.

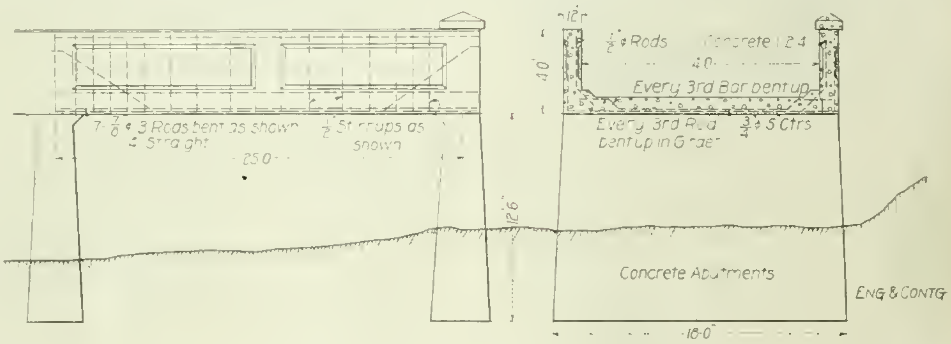


Fig. 2—Details of Girder Span, Monett Bridge.

The site of the bridge is situated at the outer edge of the city limits of Monett, where one of the main traveled roads crosses Kelly Creek. This stream, except during a rainy period, has no appreciable flow, but owing to the character of the soil and slope, over the watershed, the percentage of run-off is large. As a result a much larger bridge is necessary than would ordinarily be required for a drainage area of a similar size where the soil was of a more porous nature.

In view of the fact that Kelly Creek runs parallel to the road for a short distance before passing under the bridge, it was found necessary to construct an 89-ft. retaining wall to prevent the water from washing away the approach at the north end of the bridge. An accompanying sketch of the site, Fig. 3, shows the location of the new girder bridge, the retaining wall, an existing 30-ft. span concrete arch bridge, Kelly Creek and another small creek, the drainage from both of which must pass under the new structure. When it is understood that the ground for 150 to 200 ft. at the north end of the structure is low, the necessity of a retaining wall is at once apparent.

There was abundance of gravel properly graded for an aggregate close to the site of the bridge. The gravel also contained sufficient sand. The concrete for the floor slab and girders was mixed in the proportion of 1:2:4, while for the abutments, retaining wall, and wing walls, the mixture was 1:3:6. All reinforcement in the bridge was round rods. A provisionary clause was placed in the specifications which permitted the contractor to use rubble concrete in the abutments. Expansion joints were provided over each middle pier. Owing to the gravelly character of the soil at the site, it was not found necessary to extend the footings to any great depth below the surface. The concrete was hand-mixed and after the forms were removed the surface of the concrete, where exposed to view, was given a brush finish. The cost of bridge and retaining wall was as follows:

Freight	$ 138.38
Lumber	171.66
Reinforcement	165.48
Cement	252.80
Tools and hardware	73.80
Labor	746.00
Gravel	36.00
Hauling	98.35
Insurance	20.00
Traveling and sales expense	103.10
	$1,805.87
Profit (gross)	193.23
Contract price	$1,999.10

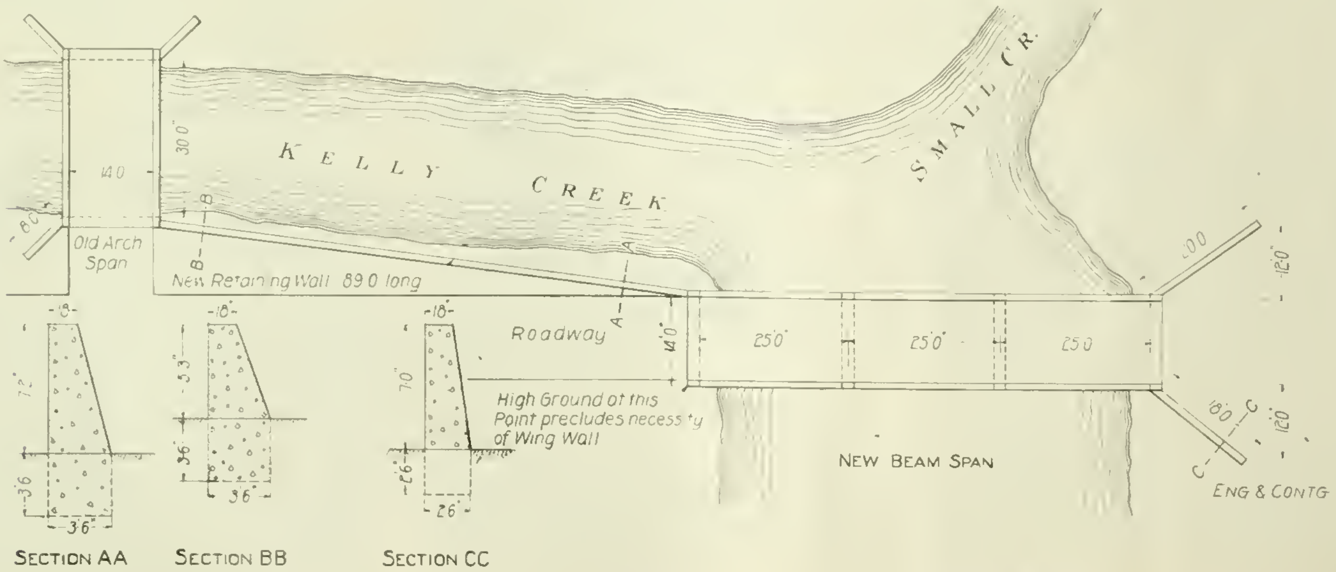


Fig. 3—Plan and Section of Retaining and Wing Walls, Monett Bridge.

There was a total of 250 cu. yds. of concrete in the structure and the cost per cubic yard was $8.

Method of Constructing a Bridge Substructure on Soft Bottom.

Bridge pier reconstruction on a bottom so soft that the driving of adjacent piling caused movement of the old pier is described by Mr. C. E. Smith, Bridge Engineer, Missouri Pacific Ry., in a paper presented to the American Railway Engineering Association. The work described was located on the White River, near Augusta, Ark. We have redrawn the original illustrations and abstracted the paper as follows:

The former bridge, consisting of one 162-ft. pin-connected through truss span, one 267-ft. pin-connected rim bearing through truss draw span, a masonry pivot pier and steel shell concrete filled cylinder rest piers, two 65-ft. deck plate girder approach spans on pile piers, and pile trestle approaches, was replaced on the same center line by through riveted truss spans, having the same length as the old spans, and two 60-ft. deck plate girder approach spans, the cylinder piers having been converted into ordinary masonry piers, as described hereinafter. Both old and new bridges were designed for single track.

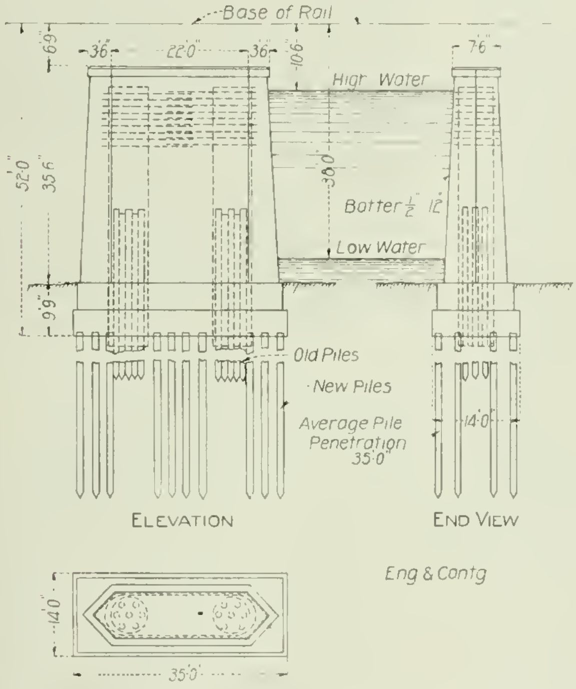


Fig. 1—Method of Embedding Old Cylinder Piers in Concrete, White River Bridge.

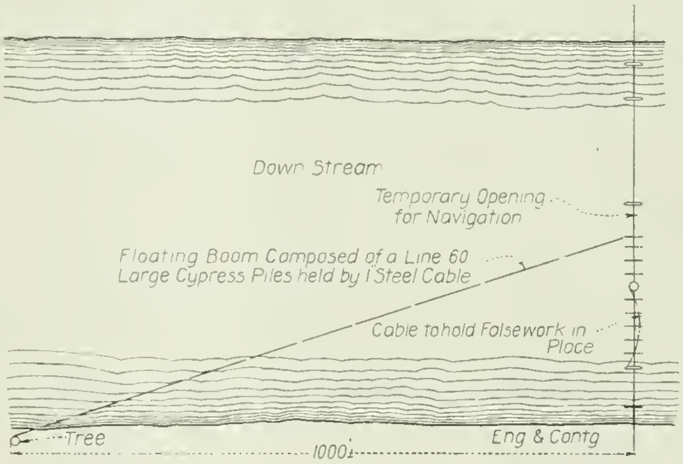

Down Stream
Temporary Opening for Navigation
Floating Boom Composed of a Line 60 Large Cypress Piles held by 1 Steel Cable
Cable to hold Falsework in Place
Tree
1000 ft
Eng & Contg

Fig. 2—Sketch Showing Location of Cable to Hold Falsework in Line and Floating Boom to Deflect Driftwood from Falsework, White River Bridge.

The old bridge had been in place 26 years when replaced, and no complaint had ever been made of boats having experienced difficulty in passing through the draw openings. Practically no change had taken place in the bank lines during that period, consequently the plan prepared for new bridge contemplated no change in location or length of draw span, but required a slight decrease in the width of the channels to permit the reinforcement of the old cylinder piers. The change in the length of deck plate girder approach spans was made for the purpose of permitting the new pile piers to be constructed in front of and in the clear of the old pile piers; these spans are simply for the purpose of spanning the sloping banks in which it is difficult to hold pile trestle, and the exact length of the girders is not important. Abutments were unnecessary on account of the necessity for long trestle approaches to accommodate floods.

The United States Engineer officer held that the very slight decrease proposed in clear opening was not of great importance, and approved the plans as first prepared. The formal approval of the Secretary of War soon followed.

The substructure reinforcement proposed at this bridge was of such a nature as to necessitate no interference with navigation, as it was decided to carry the spans and traffic on the old piers while they were being reinforced.

Each of the three old rest piers consisted of two steel cylinders 7 ft. in diameter, extending down 55 ft. to 60 ft. below the rail, which placed them about 15 ft. deep in the sandy river bed, each cylinder being supported on 7 piles, the heads of which were embedded in the concrete filling within the cylinder; the penetration of the piles was about 14 ft. below the bottom of the cylinders. The writer has never met with a better example of the supporting power of sand when confined than in the case of these cylinders; according to our present standards the cylinder piers did not have sufficient supporting power for the former bridge which they had supported without settlement for 26 years. It was decided, however, not to overload them by placing the newer and heavier bridge upon them.

Additional supporting power was secured by driving 56 new timber piles within a cofferdam 14x35 ft. surrounding each pair of the old cylinders, the piling having been driven to an average penetration of 35 ft. with the aid of the water jet. The new piles extend down 15 to 20 ft. below the bottom of the old piles.

The driving of the first new foundation pile with the aid of the jet caused settlement of the cylinder nearest the pile. Alarm was felt when this trouble was first encountered until it was found that the settlement immediately stopped with cessation of driving and jetting and the pier remained stationary until their resumption. Experiment disclosed that the driving of a pile with the aid of a jet near the other cylinder would cause the pier to right itself, although slightly lower than formerly. The actual height of the tops of the old piers was no longer of any importance, so driving was resumed. Piles were driven alternately at one end, then at the other, as the necessity for righting the piers arose. The tipping was permitted to go on until the tops of the piers were 3 ins. out of line, when the driving would be changed to the other end until the pier became 3 ins. out of line in the other direction. No trouble was encountered in the location of the piers in the direction of the bridge, practically no motion in that direction having been detected. This was probably due to the fact that they were guided in their settlement by the weight and stiffness of the spans resting on them.

A small amount of difficulty was encountered in keeping the track in condition for operation. The easiest condition was found at the east pier, which supported the east end of the 162-ft. approach truss span and the west end of the girder span. Here the ends of the spans were permitted to move from side to side and down with the pier.

At the west pier, which supported the west end of the draw span and the east end of the girder span, the draw span was permitted to swing free from the pier and the end of the girder span followed the top of the pier when it moved. Here it was necessary to keep the end of the girder span in line and level with the end of the draw so that trains could always cross. The ends of the draw span were supported on oak wedges during the passage of trains.

At the pier which supported the east end of the draw span and the west end of the approach span, the approach span was permitted to move from side to side and down with the pier, while the end of the draw span swung free. Track connections at the end of the draw span were maintained by shimming under the bridge ties on top of the stringers at the end of the approach span and by sliding the bridge ties from side to side on top of the steel stringers of the approach span by the assistance of steamboat ratchets.

After the completion of driving at each pier the spans were jacked up and over, where necessary, to bring track to line and level. The work was delayed very little by the necessary adjustments to track and spans. The maximum settlement of any pier during the pile driving was 13 ins.

Before the commencement of work considerable riprap surrounded the old cylinder piers, and this riprap was expected to interfere with the placing of the cofferdams. This material was excavated by dredging around the old piers down to the bottom of footing, after which the sheet pile cofferdams, and then the foundation piles, were driven. The sand that was brought up by the jets and other sediment within the cofferdams was then removed by a sand pump and the lower portion of the concrete footing placed around the pile heads under water by means of a tremie. The cofferdams were then pumped out, the piles cut off at the top of the concrete and the piers built in the ordinary manner up to the bridge seats.

The bridge seat course for the east pier was placed during erection while the east truss span was down; the approach girders and falsework stringers were supported on the new concrete below, the supports being moved to permit the completion of the new bridge seat in sections.

The draw rest piers were also completed while the east span was under erection. The cylinders of these piers were cut down and crossover beams placed while the draw span was swung. The ends of the crossover beams were supported on frame bents that rested on the footing projections of the piers. The bridge seats were finished off under the beams.

The question, "Why was the bridge not supported on falsework during this work on the foundation?" naturally presents itself. This was considered and also the advisability of taking down the old piers, but the fear of losing the falsework and spans in a flood caused the determination to go ahead as described. The White River is subject to sudden rise and carries much driftwood at high velocity. When this driftwood comes in contact with falsework it accumulates too rapidly to be successfully removed, with the result that it makes a mat extending the entire length of the falsework from water surface down to the bottom of the river. The pressure of the current is great and the scour of the current going under the drift very dangerous. The accumulation usually results in the bents being pushed out of line or being undermined, either condition resulting in delays to trains.

The files disclosed that in the reconstruction of another bridge across this river the above condition caused so much damage to the falsework that the bridge was out of service for about two weeks, during which time all trains were compelled to detour.

It was realized that partial falsework could have been put in and protected by floating booms, but that would have interfered with the floating equipment of the foundation contractor.

The old pivot pier was of ordinary solid masonry construction supported on grillage and piles, the piling being heavily protected by riprap; no settlement or other trouble had ever been experienced. As the former draw span was rim bearing and the new draw pivot bearing it was decided to remove the coping (using the stone for additional riprap around the footings) and replace it with a thicker slab of reinforced concrete designed to distribute the load from the new span uniformly over the pier, this reinforced concrete coping being placed between the taking down of the old draw span and the erection of the new. The experience in attempting to adjust claims from boat owners for the closing of the Black River indicated that it would be best to make provision for navigation continuously during erection. The contractor was awarded a unit price per ton for the erection of the steel, a lump sum for installing a temporary deck girder lift span, and a fixed price for each time he had to open the bridge.

At this bridge towers and counterweights were not installed, but arrangements were made to lift the entire span out by the erector's derrick car which would move back with the span. Although no trouble had been experienced at Black River, it was seen that on account of the limited amount of lift that could practically be provided at reasonable expense on temporary supports, the arrival of a large boat at extreme high water might find the lift span in its highest position too low, and it was to avoid such a contingency that the span was handled with a derrick car at White River.

Unusual high water obtained for long periods during the entire reconstruction. The substructure work was delayed by high water during the ordinary low-water period so that the erection started immediately before the ordinary high-water period, making it necessary to put in and maintain falsework during high water. Falsework was first placed under the 162-ft. east approach span, the old span taken down and the new span erected. On account of this being a riveted span, the falsework was used longer than usual, as the span could not be swung free until all connections except direct compression splices had been fully riveted. While the riveting was under way the river rose and carried much driftwood against the falsework, where it accumulated in spite of the efforts to keep it going. Upon completion of the riveting this falsework was removed at once; all the blocking and stringers and all but three bents were successfully removed by the bridgemen, those three bents having been pushed horizontally out from under the bridge without tipping by the pressure of the drift and undermining of the piles. Immediately below the bridge the bents tipped over, mingled with the driftwood and passed on down the river.

Falsework was next placed under the west arm of the draw span and the accumulation of driftwood was such as to necessitate taking unusual precautions. To hold the falsework temporarily a steel cable was passed through the bents in a long curve, the ends of the cable being attached to the upstream ends of the pivot and west piers.

An opening 50 ft. wide was left in the east draw channel just west of the east rest pier and a heavy pile bent was driven for the support of the temporary girders to be used for spanning that opening. Heavy pile bents were also constructed on each side of the pivot pier for the support of a deck girder span over that pier to facilitate the reconstruction of the coping course. To prevent more drift from accumulating against the falsework a floating boom was constructed reaching from the west pile pier of the temporary channel opening to a tree on the west bank of the river about 1,000 ft. upstream from the bridge. The boom consisted of a 1-in. steel cable to which was attached a line of 60-ft. large cypress piles, a surplus of which was on hand for use in case of emergency.

The boom did more than was expected of it. The angle between it and the current was so slight that all the large driftwood followed the boom down to the temporary opening and passed through. The small portion that passed under the boom caused no trouble whatever.

When everything was in readiness a quick change was made by removing two panels of the old draw span at the east end and installing the temporary girder span over the channel. This change consumed about two days and no boats were delayed. The dismantling of the old span, reconstruction of the pivot pier and erection of the new span out to the temporary channel was carried out carefully with the realization that unusual speed was not necessary. It was the first intention to erect and rivet up the west arm of the draw as a simple span and to remove the falsework from under that arm before completing the erection of the draw. The floating boom was so effective, however, that this was not necessary. The draw was erected and riveted with the exception of the two east panels, after which another quick move was made in the removal of the temporary deck plate girder span and completion of the erection of the draw span, which was ready for turning a few days after the deck girder span was removed.

The new deck plate girder spans were installed at odd times during the erection. During the final extension of the new draw span over the temporary channel the river was out of its banks and this high water made it possible to permit boats to pass through the end openings, the east deck girder span being removed for that purpose when necessary.

The installation of the temporary deck plate girder span over the east temporary channel cost about $400.

Each time the bridge was opened during erection cost the railway company $10.

For a period of about five years this bridge had been opened from five to ten times per month. During the erection of the new draw it was necessary to open the bridge nearly every day for the passage of boats.

The draw span of this bridge is a duplicate of the Black River draw and the various parts of the work were carried out by the same contractors. The weight of the 162-ft. through riveted truss span is about 200 tons. and of the two 60-ft. deck plate girder spans 50 tons. The total cost of the bridge was about $90,000.

WATER WORKS

A Study of the Efficiency of Coagulating Basins.

Coagulating basins form an essential part of every plant for the treatment of turbid waters. A notable installation of coagulating basins is that of the St. Louis water works. The plant comprises a coagulant house ample for treating with lime and iron sulphate more than 160,000,000 gals. per day, with a series of unbaffled basins. There are no filters. There are six basins of about 25,000,000 gals. capacity, one of 40,000,000 gals., and two of 20,000,000 each, through all of which, in series, the treated water flows. The combined capacity of the system is 230,000,000 gals.; the combined area, about 52 acres.

Shortly before the World's Fair at St. Louis, as an emergency measure, coagulation with iron sulphate and partial softening with lime were added to the system of plain sedimentation which had been in use for years. The scheme made such a manifest improvement in the appearance of the effluent that it was accepted by the local public as the last word in water purification. At times the effluent has been excellent in every way; again of doubtful character. It is only within the past year that the suggestion has been entertained to supplement with a filter plant the abridged form of treatment now in use.

A summary of the facts bearing upon the efficiency of coagulating basins was made by W. F. Monfort, chemist of the St. Louis Water Department, in his recent paper before the Illinois Water Supply Association. Without doubt everyone in charge of the operation of a filter plant has experienced trouble from all the disturbing influences described by Mr. Monfort in his paper which is here given practically in full:

CAPACITY OF THE PLANT.

It has been popularly assumed that the plant as now constituted is ample for the adequate treatment of an indefinitely large volume of water. One writer estimates the capacity of the plant at 250,000,000 gals. per day. Operating results warrant a much lower estimate based on the degree of success attained in treatment of varying quantities of different waters, ranging in suspended solids from 14 to more than 8,000 parts per million.

There is reason to believe that even in the first year of operation the clarifying system was overtaxed. The records of this laboratory afford but twelve determinations of suspended solids in river and clear well samples during the year 1904-1905, of which two must be discarded for obvious reasons. All are given in Table 1 with consumption for their respective dates.

TABLE 1.—CLARIFICATION RESULTS FOR FIRST YEAR OF OPERATION, ST. LOUIS BASINS.

	Suspended solids.		Daily consumption in million gallons.
1904-1905:	River.	Clear well.	
April 1	2,442	97.5	67.5
May 30	1,717	25.0	74.5
June 30	3,753	32.5	87.9
July 30	1,694	43.6	95.6
August 30	800	15.0	89.8
September 30	1,268	22.0	91.1
October 31	578	12.0	81.7
November 30	376	2.0	77.3
December 31	208	10.0	71.2
January 31	181	—9.2	79.8
February 28	2,478	—4.4	73.7
April 1	990	0.0	70.4

In the absence of any evidence to the contrary it is assumed that the scattered analyses are representative of the working of the plant. Treatment was begun on March 22, 1904; the first recorded result nine days later suggests the inadequacy of the plant, which then comprised but the six basins in series, to clarify 67,000,000 gals. per day when the suspended matter was 2,400 p. p. m. For 97.5 p. p. m. of suspended matter in the finished water indicates the introduction into the distribution system on the corresponding day, April 1, 1904, of 27.5 tons of suspended solids. It is possible that this result was abnormal, since mud previously deposited in conduits and clear well may have been loosened by the flow. The second result two months later shows improved working, but suggests that 75,000,000 gals. could not be handled properly when the suspended solids in the river exceeded 1,700 parts. According to present standards the only passable results in the first twelve months of operation are those of November 30, and April 1, 1905, when river solids were less than 1,000 parts and the daily consumption was under 80,000,000 gals. Under other conditions the finished water contained notable amounts of solid matter. High consumption during the World's Fair period overtaxed the new clarification plant the entire summer. Still these results show a vast improvement over conditions in the year prior to introduction of the lime-iron method, when the public was expected to make no complaint when 450 p. p. m. of suspended matter appeared in the tap water.

In the second year of operation results are generally better. However, of 130 recorded determinations of suspended matter in clear well samples, 40 gave negative results. Figures given in Table II are averages of 130 determinations for river and 90 for clear well. Average daily consumption for each month is from high service pumping.

Compared with the new standard set by the previous year, these results are good. Apparently lower consumption favored better operation; although the occurrence of so many impossible results (negative quantities) makes interpretation difficult. The records show that from June to January, inclusive, high caustic alkalinity was carried in the treated water. This is perhaps the explanation of the high suspended solids recorded, which seem to indicate somewhat less than 80,000,000 gals. per day as the maximum capacity of the plant when the river was carrying 1,800 p. p. m. suspended solids.

The writer specifically disclaims any responsibility for the foregoing results of operation and analytical data. Results for subsequent years were determined under his direction and are believed to represent with a fair degree of accuracy the working of the plant. Averages are used in lieu of reciting the full detail of determinations made on all save holidays. Inasmuch as total displacement of water in the entire basin system requires from 7 to 15 days, the averages by months of operation better represent the blended waters issuing from the clear wells to the distribution system. They are platted in Fig. 1, in sequence with those of 1905-1906.

The diagram shows graphically that when suspended solids in the raw water were below 1,500 p. p. m. and consumption did not exceed 75,000,000 gals. per day, the average suspended solids in the clear well water were usually not more than 1 or 2 p. p. m., increasing slightly with a rise in either river solids or consumption, and greatly with concurrent rise in both.

TABLE II.—CLARIFICATION RESULTS FOR SECOND YEAR, ST. LOUIS BASINS.

1905-1906:	Average suspended solids. Parts per million. River.	Clear well.	Average daily consumption million gallons.
April	....	...	67.0
May	1,962	12.7	69.5
June	1,809	2.7	78.4
July	2,845	7.4	75.8
August	1,950	12.0	77.9
September	2,056	11.0	73.7
October	1,015	5.8	68.7
November	603	5.2	64.0
December	386	9.0	63.0
January	611	9.2	62.6
February	649	7.1	65.2
March	641	7.7	62.2
	1,320	8.2	69.0

It is noticeable that when pumpage was much above 75,000,000 gals. and river solids greatly exceeded 1,500 parts the quality of the treated water was seriously changed for the worse. In general the curves of suspended matter in the treated water reflect the effect of high river solids and high consumption, following one or both in extreme cases, and illustrating the fact that these uncontrollable factors produce conditions which the present plant cannot meet. It appears that a raw water carrying not more than 1,500 parts of suspended matter can be made acceptable to the public of Saint Louis so long as consumption does not exceed 75 to 80 million gals. per day, but that the capacity of the plant varies inversely with the suspended matter.

The diagram further shows that from 1905 to 1910 consumption exceeded 75,000,000 gals. per day only in the summer and fall months, while in 1911 and 1912 the average daily consumption has rarely fallen below this figure at any time. The rise in river stage caused by rains of the late spring and summer brings high average suspended solids in the raw water; for suspended solids vary with the stage. Coincident with these times of high turbidity comes the heaviest draught upon the distribution system, when lawns are to be sprinkled and the greatest waste of water occurs. It is unfortunately true that periods of highest turbidity are generally periods of greatest consumption.

EFFICIENCY OF CLARIFICATION.

There is abundant evidence that efficiency of clarification and bacterial reduction are conditioned by: Rate of flow through basins; amount of sludge already deposited; character and quantity of suspended solids in the raw water; temperature of water in river and basins; wind velocity and direction.

When a water properly treated is passed through the settling basins, 97 to 99 per cent of the suspended matter is precipitated in the first basin, the percentage removal depending upon the character and quantity of solids contained, the temperature, wind velocity and direction, and the amount of sludge in the filling basin. In passing succeeding basins the remaining suspended matter undergoes a further reduction of one-half or one-sixth; corresponding to a few hundredths of 1 per cent reckoned on suspended matter in the raw water, likewise dependent upon velocity, size of particles, wind and temperature. The major portion of clarification is, however, accomplished in the filling basin of 25,000,000 gals. working capacity. There is no provision for applying chemicals after water enters the basins. Efficiency of the plant, therefore, depends primarily upon the volume of water which can be satisfactorily clarified in the filling basin.

The weight of suspended matter in the effluent of successive basins varies with the weight of solids carried by the raw water. The percentage is approximately constant; the actual weight of solid matter remaining in the finished water is proportional to that originally present in the river water.

The results in Table III are from the records of periods when pumping was constant. Since the course of currents will vary with changing rates, and the velocity and consequent carrying power of currents increases with increase in pumping, the weight of suspended matter carried over the first weir is subject to wide fluctuations. A change in pumping from a rate of 60 to 90 million gallons per day has increased the suspended matter in the treated water (clear well) by from 2 to 7 p. p. m., and a further sudden increase to 120,000,000 gals. per day has caused a further rise of 10 to 13 parts, which was carried through the entire series of basins and conduits to the clear well, where 25 to 30 parts of solids in suspension occurred.

Slight changes in temperature suffice to alter the course of currents through the basins. In the spring, when the temperature of water in the river and basins is rising, the sludge is less subject to disturbance than in the fall and early winter, when, with falling temperature, the influent water, more dense than the warmer water of the basins, passes downward over the sludge, causing it to carry over weirs.

In the fall, with lowering atmospheric temperatures, the sludge and water in the bottom of the basins are sometimes 1° F. or more warmer than surface water of basins and river. Circulation is then effective in changing the course of influent water currents, making them deeper and increasing the scour.

The sludge is further subject to disturbance by wave action when high winds prevail, a frequent occurrence in March. In such case the amount of suspended matter carrying over the weir from the filling basin shows a marked increase. Our basins have a working depth of about 14 ft. Similar effects of wave action have been noted in other reservoirs 18 ft. deep.

The basins at the Chain of Rocks (52 acres) are all uncovered, all used in series, and therefore, subject to disturbance by each of the agencies affecting their successful working.

CHARACTER OF SLUDGE.

Suspended matter with the coagulum produced by chemical treatment subsides rapidly, undergoing a change in volume during its accumulation in the bottom of basins. When freshly formed it is loose, disseminated through the full volume of water in which it forms; under average conditions after 1½ hours it occupies about 3 per cent and after 24 hours about 2 per cent of the original volume. After this lapse of time only the newly precipitated portions are disturbed by gentle currents.

Opening mud gates at 8-hour intervals seems to reduce the sludge only near the gates, since it follows in a general way the contour of the bottom of the basin and is of such consistency that it does not flow readily over the compact material of earlier subsidence. The tendency is for each new deposit to collect more thickly upon the highest points of previous deposits.

BACTERIAL REMOVALS.

Bacterial purification, as shown in Table IV, is proportional to the degree of clarification, falling a little below the percentage removal of suspended solids for the reasons which are cited below.

TABLE IV.—REMOVAL OF BACTERIA WITH SUSPENDED SOLIDS.

	Suspended solids. Parts per million.	Per cent removal.	Bacteria per cu. cm.	Per cent removal.
River	1,444	....	57,000	...
Basin 1	14.0	99.01	933	96.1
Basin 2	12.1	99.16	....	...
Basin 3	8.4	99.4	500	99.1
Basin 4	7.1	99.5	...	...
Basin 5	5.8	99.6	100	99.8
Basin 6	5.6	99.6	...	...
Clear well	2.6	99.8	42	99.99

TABLE III.—SUSPENDED SOLIDS IN EFFLUENT OF SUCCESSIVE BASINS.

	Parts per million.	Per cent removal.	Parts per million.	Per cent removal.	Parts per million.	Per cent removal.	Parts per million.	Per cent removal.
River	1,444	....	3,000	...	4,500	...	1,000	....
Basin 1	14.0	99.01	47	98.5	95	98.0	25	99.75
Basin 2	12.1	99.16	21	99.3	50	98.8	20	99.80
Basin 3	8.4	99.4	14	99.5	35	99.2	10	99.9
Basin 4	7.1	99.5	12	99.6	20	99.5	10	99.9
Basin 5	5.8	99.6	10	99.7	15	99.7	5	99.95
Basin 6	5.6	99.6	10	99.7	15	99.7	5	99.95
Basin 7	..	...	..	...	..	...	5	99.95
Basin 8	..	...	..	...	..	...	5	99.95
Pumpage	70		80		80		120 million gal.	

Bacteria entangled in the natural sediment of the water, and gathered into coherent masses with the coagulum, concentrate in the sludge to the extent of 1,000,000 or more per cu. cm.; they are subject to disturbance and dissemination through basin contents by varying curents, however produced, and are easily carried through latter basins to the clear well.

It has been observed that slight changes in temperature of the influent water, causing almost infinitesimal differences in the density from that of water at different levels in the basins give rise to turbid, polluted effluents from each basin in series, as the less compact layers of sludge are moved; that overturning, which in large bodies of deeper water occurs but twice a year, may occur several times a week when warm and cold days alternate in spring and fall; and that with a slight rise in suspended matter carried from the older sludge in the filling basin may come an altogether disproportionate increase in bacteria, by reason of alterations in the rate of pumping, or the currents produced by high winds sweeping along the surface of a half mile of water. When it is considered that the combined surface of water exposed to winds and temperature changes is more than 52 acres it will not seem idle to refer to what might at first appear as entirely negligible factors. See Table V.

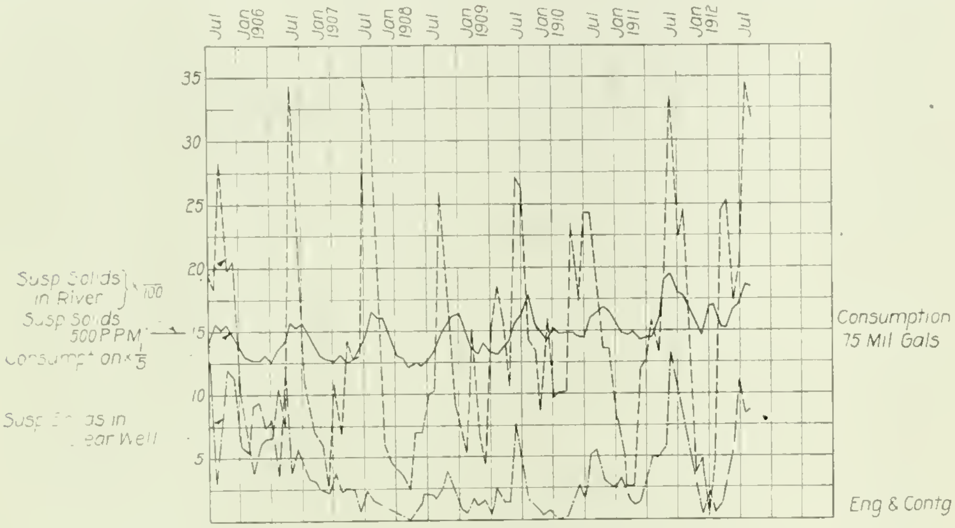


Fig. 1—Diagram Showing Relation of Consumption to Classification, St. Louis Water Works.

An abrupt change in the rate of flow through basins may cause the sludge to carry its burden of bacteria through successive basins; e. g., on August 17, 1912, such a change occurred, followed on the 19th by the appearance in the clear well samples of contamination with organisms of the B. coli group.

Change in the direction of flow incident to cleaning and restoring a basin to service affects both suspended solids and bacteria per cubic centimeter in the finished water. Basin 1 was thus put in service June 6, 1912. The rise of bacteria in clear well samples was from 150 per cubic centimeter on the 6th, to 3,300 in the following week. In this case irregular pumping (at rates ranging from 70 to 120 million gallons per day) was a factor in producing bad results.

It is apparent that bacterial reductions are subject to disturbance from too many factors to give constant results. We have no safeguard against turbid, contaminated water under these conditions. Table VI shows the disproportionate increase of bacteria released by stirring previously deposited sludge.

TABLE V.—EFFECT OF HIGH WINDS ON BACTERIAL COUNTS.

	Feb. 17.		Feb. 24, 1909.	
	Bac. per ccm.	Per cent removal.	Bac. per ccm.	Per cent removal.
River	24,500*	....	33,700*	....
Basin 1	1,550*	93.67	2,470*	92.68
Basin 3	1,000	95.92	890*	97.36
Basin 5	338	97.80	820	97.57
Drawing gate	720	97.06	2,960	91.22
Terminal chamber	1,325	94.59	3,475	89.70
Tap	6,563	73.21	13,750	56.26

*Note—Bacteria of the B. coli group present.

TABLE VI.—BACTERIAL INCREASE IN CLEAR WELL AFTER BASIN CLEANING.

1912.	Suspended solids.	Bacteria per ccm.	Percentage removal.
June 6*	15	150	99.6
" 7	12	250	99.6
" 8	14	300	99.4
" 9	..	....	....
" 10	11	775	98.2
" 11	12	1,100	97.2
" 12	10	475	98.6
" 13	11	2,075	93.0
" 14	9	1,500	94.8
" 15	10	3,300	92.9

*Note—Filling basin restored to service after cleaning June 6.

River samples usually give evidence of the presence of bacteria of the B. coli group in 1/100 cu. cm. The finished water has given counts of more than 30,000 bacteria per cu. cm. on gelatine at 20° C., and members of the B. coli group have been found in 6 per cent of tests on 1 cu. cm. samples in a single month.

In reviewing bacteriological results for past years there is noticed a very wide divergence at any one sampling point, and extremely irregular counts for a given period at various points in the clarification system. The utmost we can hope for is a large percentage reduction of bacteria. We can have no assurance that the water which enters the distribution system will be free from pathogenic organisms regularly. While the improvement in the character of the effluent since the introduction of the clarification scheme seems to have reduced the typhoid death rate, the quality is still far from that of a good filter plant.

RESIDUAL SOLIDS IN DISTRIBUTION SYSTEM.

Water leaving the clear well contains small quantities of suspended and dissolved iron compounds, small particles of calcium and magnesium compounds, and larger quantities of silt and silicious matter too fine to be deposited during rapid flow through the sedimentation system. The amount of this material daily introduced into the distribution lines during the first year of operation, calculated from suspended matter and daily consumption, was as high as 27.5 tons, averaging 8.7 tons per day for the ten analyses referred to above. See Table VII.

This material is intermittently discharged from taps over the city in a very irregular way. At the laboratory of the City Chemist samples are collected daily for analysis. Comparison of suspended solids in the clear well and at this tap illustrates the extent of this irregular deposition and displacement, as shown in Table VIII.

It is a matter of common observation that after unusual draught upon the mains in a portion of the system, very high turbidity appears, local, or affecting large sections of the city, according to the degree of the disturbance. Following a large fire complaints of turbid water are very numerous. So long as our practice continues sedimentation in the mains, the department cannot resent protests of consumers at turbid water when the accumulated solids are intermittently flushed out.

TABLE VII.—AVERAGE WEIGHT OF SUSPENDED MATTER IN DAILY SUPPLY.

	Solids, in tons.	Consumption in million gals.
1904-1905	8.7	79.0
1905-1906	2.35	69.0
1906-1907	1.05	70.1
1907-1908	0.31	68.9
1908-1909	0.5	70.7
1909-1910	0.34	75.4
1910-1911	0.92	76.1
1911-1912	1.74	83.5

INCRUSTATION IN DISTRIBUTION SYSTEM.

Because ours is a partially softened water there is always a certain variable amount of calcium carbonate present in the finished product. The softening process is completed slowly at summer temperatures and in winter is incomplete even when the water passes to the distribution system. There is, therefore, more or less deposit of calcium carbonate in mains and service pipes. Even with high bicarbonate alkalinity in the filling basin the water leaving the sixth or ninth basin is still supersaturated with calcium carbonate.

Connection with a 7-ft. steel flow line was made in January, 1908, and the city supply drawn through it for 74 days. Examination at the end of the period disclosed a deposit, principally of calcium carbonate, 1/16 in. thick when moist, which shrank to 1/32 in. in drying. The water had an average total alkalinity of 59 p. p. m., of which 25 were due to neutral carbonates and 34 to bicarbonates. Temperatures ranged from 32° to 47° F.

During the earlier years of operation there were notable deposits in meter gears, fishtraps and the like.

While the deposit in the distribution system does not now seem to be increasing rapidly, there is still some incrustation in progress, due to the blending of unequally softened waters. Trouble from this source can be lessened by longer storage, which will equalize the quality of the water before passing the high service pumps—a very costly expedient; or by so regulating the degree of softening that the finished water shall show a high degree of uniformity—a difficult matter when the raw water is changing quickly. Lower regular velocity through the settling basins would allow longer time for softening reactions; this entails the use of several filling basins, instead of but one with the rest in series. Finally, further reduction of this trouble could be effected by changing the order of chemical treatment, adding lime first and agitating the treated water before the charge of iron sulphate is applied.

There are several methods of arriving at a standard of judgment for considering the efficiency of coagulating basins as full and final preparation of water for distribution to consumers; comparison of the quality of the effluent with respect to clarity and bacterial content (a) with that of the previous supply, (b) with untreated water from day to day, or (c) with the effluent of a well operated filter plant.

TABLE VIII.—INTERMITTENT SEDIMENTATION IN MAINS. SUSPENDED SOLIDS IN PARTS PER MILLION.

	Clear well		Tap—City Chemist's laboratory.	
1905-1906.	Max.	Av.	Max.	Av.
April	..	..	8	6
May	40	13	22	21
June	6	3	25	15
July	21	7	162	81
August	34	12	20	16
September	26	10	20	17
October	19	6	12	8
November	7	6	13	11
December	30	9	12	12
January	15	9	4	2
February	14	7	0	0
March	12	8	12	6

During the first year of operation at Saint Louis the weight of solid matter carried into the distribution system averaged 25 p. p. m. —ranging from none to 97 parts; the reduction was about 98 per cent reckoned on the weight of solids in the raw water. While this was a decided improvement over conditions prior to treatment the introduction of an average of 8.7 tons of suspended matter per day into the mains left much to be desired if one compares this result with the standard set by a satisfactory filter plant, whose effluent contains no weighable quantity of solid matter in suspension, and shows no visible turbidity or opalescence in bright sunlight.

The local standard of purity has advanced from year to year since the clarification system has been in operation. Prior to 1904 sedimented water containing 60 to 450 p. p. m. of solids in suspension was accepted, if not approved. Compared with that standard the quality of water furnished in 1904-1905 was excellent. The next year showed a marked improvement, and established in turn a standard for comparison of the succeeding year's supply. With each subsequent year the quality of water furnished has been progressively better, until 1910-1911, when consumption so far exceeded the plant's capacity that there was a falling off in the quality of the effluent, although it was still superior to that supplied before 1907-1908. The capacity of the present plant must be increased. The extensions and changes made must provide a better effluent than the present public has been educated to demand.

It is apparent that the addition of a filter plant to the coagulating basins is essential if the residual sediment is to be finally removed, and the high color which sometimes characterizes the raw water is to be reduced to an acceptable degree. Operations under prevailing conditions in a plant of this size and character do not admit of the close control possible in a filter plant, where the units (filters) are small, subject to immediate supervision and washing, and their output regulated by rate controllers. Furthermore, with filters the solid matter collected with entangled bacteria is quickly and permanently removed from water passing through them; whereas coagulating basins give too frequently only a temporary separation. It is manifestly impossible to interrupt the flow through any one basin at will, should the water in it prove unfit for use, without seriously affecting the contents of other adjacent units by altering the course of currents through them. Nor is it possible to wholly eliminate the previously accumulated sludge in filling and sedimentation basins, so that after cleaning the first water passing through them shall be faultless.

With seven filling basins and six additional new reservoirs for sedimentation, as considered in a report made by the writer, there would be effected at best only a percentage reduction of suspended solids and bacteria, with no assurance of a safe, clear, sparkling effluent. Irregularities incident to a plant of this character, where pumping and drawing and the consequent period of sedimentation are subject to wide variations directly affecting the finished water, can be avoided only by filtration.

The abridged form of treatment adopted prior to the World's Fair has beyond question served a very useful purpose. The question has arisen whether the present system of partial softening, coagulation and sedimentation shall be extended by adding further sedimentation basins to the already existing plant, or supplemented by a filter plant which shall afford a perfectly clear water at all times, with fairly constant bacterial removals and the possibility of immediate control of operating conditions. The cost of constructing two basins of 40,000,000 gals. capacity each was about $7,500 per 1,000,000 gals. capacity.

It is hardly possible to make the necessary changes in present basins and add the required reservoir capacity to provide for clarification of the volume of water which will certainly be consumed within the next ten years at a cost of less than $1,500,000. Whereas a filter plant added to the present basins with certain changes outlined comprising 40 filters of a normal rating of 44,000,000 gals. in 24 hours, can be constructed at a cost of about $1,250,000.

There are locations where basin construction is cheaper, where prolonged sedimentation in very large reservoirs may be advantageously used in producing an acceptable effluent for a time—until the public forgets its earlier satisfaction with an improved water supply, and clamors for further betterment. Before such installations are begun there is need of very careful study of the quality of the untreated water, to show its adaptation to coagulation methods and good judgment as to arrangement of the plant with a view to the ultimate addition of filters.

The Principal Features of Design and Construction of the New Water Supply System for Moose Jaw, Saskatchewan.

The city of Moose Jaw is situated on the main line of the Canadian Pacific Railroad about 420 miles west of Winnipeg. Its present population is about 25,000. The rapid growth of the city during the past few years has rendered inadequate the public service properties of the city, including the water supply system. Up to a few weeks ago this was obtained partly from a well in the city near the confluence of Thunder Creek and Moose Jaw Creek, which is fed by an infiltration gallery receiving water percolating from the creeks through the soil; and partly from Snowdy Springs, so-called, seven miles distant in a southwesterly direction, the supply flowing by gravity through a 10-in. wooden main. Two years ago a deep well was bored at a point adjacent to the present city power house in the hope of locating natural gas. On reaching a depth of some 1,200 ft. the drilling was temporarily abandoned, a heavy flow of water having beeen encountered. This water is saline and by itself not potable. In cases of fire it was the custom to pump raw creek water and gas well water into the distributing system, the subsequent draining of which by hand having been relied upon to free the mains from water unfit for domestic use. Of late years the supply has proved inadequate to the needs of the citizens, so much so in fact, that at times water was available in the service pipes for an hour only three times a day. The steps taken to secure a new supply and the salient features of that supply are here described. The description is based on information abstracted from an article by Mr. P. Gillespie which was published in Applied Science for February, 1913.

In the spring of 1911, Mr. Walter J. Francis of Montreal was asked by the municipality of Moose Jaw to investigate the entire situation and to recommend a water supply for the city. Mr. Francis began his investigation early in May. This involved a study of some ten suggested sources, most of which were found to be impossible because of one or more of three reasons, viz., insufficient quantity, unsatisfactory quality or prohibitive cost. Among the sources investigated were the Moose Jaw Creek, Last Mountain Lake, the Snowdy Springs, the South Saskatchewan River and Sandy Creek. For the reasons indicated above, all were rejected for immediate development, save the last mentioned, Sandy Creek, a stream near Caron, some 20 miles west of the city, along the main line of the C. P. R.

Mr. Francis' report in brief suggested that the city proceed at once to conserve its supply by installing a separate high pressure fire system in the business district. This would enable the city to cease using the limited domestic supply for such purposes as street watering, most manufacturing processes, and fire fighting. The city was also advised to proceed at once to make a thorough exploration of the valley of the Sandy Creek. The indications at the time the report was prepared were that there was available there 1,000,000 gals. of water per day. If this by subsequent investigation should be confirmed it would mean that this quantity together with the supply at that time serving the city, would be sufficient for a city of 30,000 people. The ultimate source, it was obvious, must be the Saskatchewan River, in event of the population very much exceeding the limit indicated. Moreover, if the Sandy Creek project were to be developed, much of the necessary installation would become a part of the Saskatchewan development since both sources lie in the same direction from Moose Jaw. The expense involved in utilizing the Saskatchewan necessarily placed it beyond the immediate reach of any single municipality as far distant as Moose Jaw, but a suggestion was made that the city combine with other interests and prepare at once for the use of the Saskatchewan River water at a time not far in the future.

The city council of Moose Jaw immediately voted an appropriation for the investigation of Sandy Creek. This investigation was conducted during the summer months of 1911. Weirs were installed in eight different places on the creek, from which daily readings covering several months were obtained. A number of deep test wells were drilled in various places across the wide valley of the creek, revealing the presence of a lower supply of water, apparently separated from the upper by an impervious stratum of clay, the analyses of which were markedly different from those of the surface water. The knowledge acquired during the exploration tended to confirm the earlier opinion as to quality and quantity and Mr. Francis' firm were authorized to proceed with the preparation of final plans and specifications, and the supervision of the work. The contracts for the work were awarded during the early months of 1912, and construction was actually begun in April of that year. The water was in use in Moose Jaw before the end of November or within eight months.

The works consist of an infiltration or collecting gallery terminating in a main well over which is constructed a headworks pumping station, a pressure main, a headworks reservoir of 500,000 gals. capacity, a gravity main 96,200 ft. long, extending from Caron to Moose Jaw, a storage reservoir of 2,000,000 gals. capacity in the city, a second pumping station, and an elevated tank.

THE INFILTRATION GALLERY.

The infiltration gallery will consist, when finished, of 4,000 lin. ft. of 20-in. glazed tile laid with semi-open joints in the water bearing sand of the valley of Sandy Creek, at a depth of about 16 ft. Manholes are provided every 800 ft. or wherever changes in direction occur. The invert of the pipe has a gradient of 0.4 per cent and is approximately parallel with the natural surface of the ground in which it lies. The lower semicircumference of each joint is sealed with a cotton sack filled with what was originally dry cement and sand. This is carefully placed in the invert of the bell when the pipe is laid. This sack adapts itself to the irregularities of the tile, while still soft, and later on prevents the admission of sand to the pipe. The upper half of the joint is protected by a depth of 1 ft. of graded gravel which, for the sake of economy, is confined in a cheaply constructed box of spruce lumber scribed to the curvature of the tile. This also prevents the entrance of sand into the interior of the pipe. It will be seen from this that the gallery is intended to drain the surface stream and that it may lower the level of the ground water down to but not below the axis of the pipe.

The laying of this gallery in a water-bearing gravel and quicksand presented some special difficulties. Two parallel rows of 9-in. U. S. Steel Company's interlocking steel sheet piling 18 ft. long were driven one on either side of the proposed center line of the gallery and distant 2 ft. therefrom. This was accomplished without special trouble with the aid of a 2¼-in. McKiernan-Terry pile hammer fitted with special driving cap, and by a liberal use of the water jet. The first 6 ft. of depth of excavation was done by hand after which a 6-in. Goulds centrifugal dredging pump was put into service and the remainder of the excavation was made therewith. Sufficient water to render this operation possible was admitted meanwhile to the pit from the creek above. Bulkheads and transverse shoring were placed as the work progressed. The pulling of the piles was accomplished by the aid of a Yale & Towne 3-ton triplex chain block for starting and an ordinary pair of triple blocks with a 1-in. fall and a steady team of horses for the rest of the operation. A generous application of axle grease to both bulb and channel sides of the pile during the driving greatly aided the pulling afterwards. The greatest difficulty met with was the prevention of water coming into the trench from underneath the piling especially where the line led across lagoons as it did in a portion of the work.

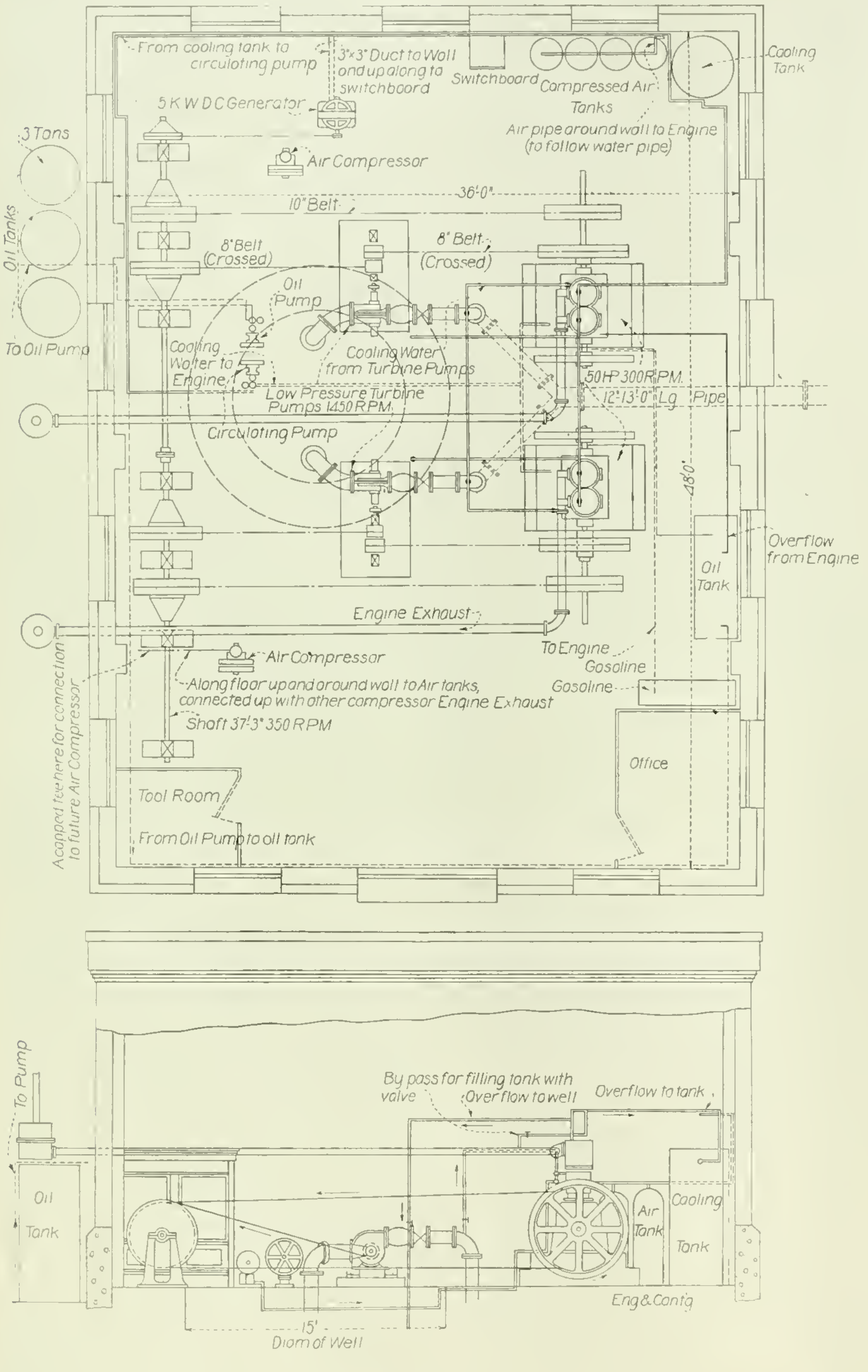


Fig. 1—Plan and Section of the Headworks Pumping Station, Moose Jaw, Saskatchewan, Water Works.

The infiltration gallery terminates at its lower extremity in a main well circular in plan, 15 ft. in diameter and 29 ft. deep and is constructed of concrete. An adjunct of this well is a valve chamber through which the water passes on its way to the well and admission to which from the gallery is controlled by a 16-in. gate valve operated from the floor above. This valve chamber is provided with a permanent metal weir enabling the operator at any time to determine the quantity of water being received from the gallery. The excavation for this well was made entirely by the dredging pump. Over the well stands the headworks pumping station.

HEADWORKS PUMPING STATION.

The headworks pumping station is a brick structure 48x36 ft. in plan, with concrete foundations, base, floor and roof. It is shown in plan and section in Fig. 1. The mechanical equipment includes two Fairbanks-Morse two-cylinder, four-cycle 50-hp. vertical oil engines belted through a line shaft to two Boving centrifugal pumps, each of 600 gals. per minute capacity. The arrangement is such that either or both pumps may be operated by either engine. The nominal speed of the engines is 300 R. P. M. and that of the pumps 1,450 R. P. M. The two discharge pipes join with the 18-in. pressure main in a special wye outside of and below the pumphouse wall. Each pump is protected by a check valve set in the discharge main and priming, when necessary, is done by a by-pass connecting the pressure main beyond this valve with the pump casing. In addition to the engines and pumps there is a 5 K.W. generator for lighting purposes, an air compressor and air storage tanks for starting, and oil and water pumps for fuel and cooling, respectively. Ultimately when it is decided to install the deep wells for the purpose of obtaining the water in the low-lying strata of gravel, an air-lift equipment will be employed and the compressor capacity will be increased. Provision for such increase has been made in the layout of the station. The usual storage tanks for oil, gasoline and water are provided and complete the equipment.

THE PRESSURE MAIN.

The pressure main has a diameter of 18 ins. It consists of welded steel tubes ¼ inch thick and of average length of 17 ft. The ends are plain and the joints are made by the Custer method. A sketch of this joint is shown herewith in Fig. 2. The joint mechanism consists of a collar sufficiently large in diameter to slip over the ends to be connected, two followers or gland rings, two rubber gaskets and ten track bolts. The collar is 10 ins. long and on its interior are two projecting buttons which insure half the collar covering each of the two ends to be connected. A special Custer wrench is used for tightening the bolts. The advantages of this joint are that it is slightly flexible after being laid, that it can be made under water and that a change in direction equal to 3° at each connection can be secured with 18-in. pipe. With 10-ft. lengths it will be seen that a 30° curve could be followed if necessary. Experience has shown that if proper care be taken in the jointing, absolute water-tightness can be secured. The specification for laying required that as soon as the pipe was connected up, backfilling to a depth of 1 ft. over the pipe, it should be carefully rammed. The objects of this were to avoid injury to the pipe in case of caving-in, and to prevent the pipe floating in wet situations where water could not enter the free or open ends of the pipe. Part of this pipe had to be laid at a depth of 14 ft. and over owing to the regular nature of the ground through which it passed and the advisability of avoiding summits in the profile of the pipe.

HEADWORKS RESERVOIR.

The headworks reservoir is an all-concrete structure circular in plan, 75 ft. in diameter and holding, when full, 17 ft. of water. The roof, which is of the girderless type, is supported by nine columns placed in three rows of three each. Admission of water to the reservoir and discharge therefrom are controlled by 18-in. gate valves. The admission valve is protected by an 18-in. check valve. The roof is about 8 ft. above the normal level of the ground. Back filling against the exterior walls and over the roof slab adequately protects against frost. The concrete was the equivalent of a 1:2:4 mixture thoroughly well mixed and carefully tamped. No other waterproofing precaution was employed and when after construction, the reservoir was tested full for 24 hours a leakage of less than ¼ of 1 per cent occurred. The difference in level between the normal water in this reservoir and that of the storage reservoir at Moose Jaw is 57 ft. The infiltration gallery, headworks pumping station, pressure main and headworks reservoir were built by day labor instead of by contract, it having been felt that the many uncertainties to be anticipated rendered this procedure advisable.

THE GRAVITY MAIN.

The gravity main from the headworks or Caron reservoir to the city is of 18-in. welded steel with Custer joints of the type already described. The invert is laid at an average depth of 9 ft. To facilitate examination and repairs, it is divided by gate valves into sections averaging 1⅔ miles in length. The entire pipe is laid on either a rising or a falling gradient, the objects being to permit entrapped air to rise to the summits where air valves are provided. At each air valve there is provided also a poppet inlet valve for the purpose of admitting air whenever a section of the line is drained. Six-inch drains are provided at all depressions and are controlled by 6-in. gate valves. These will permit the main to be unwatered in sections when necessary.

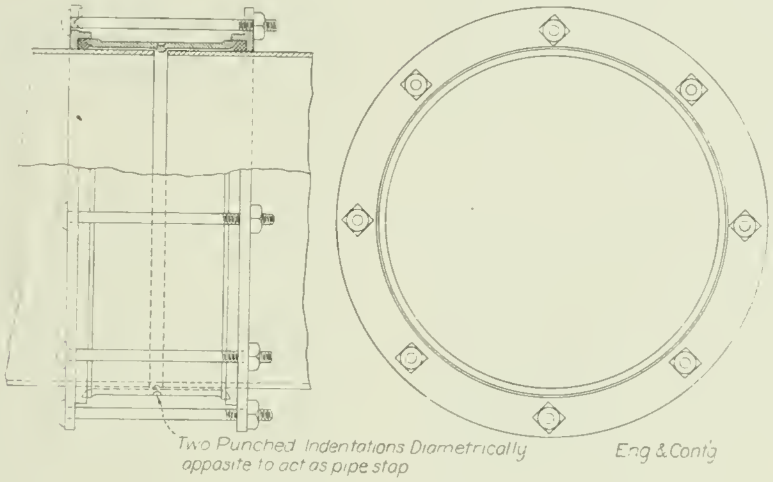

Two Punched Indentations Diametrically opposite to act as pipe stop
Eng & Contg

Fig. 2—Detail of Custer Pipe Coupling.

STORAGE RESERVOIR.

The storage reservoir at Moose Jaw has a capacity of 2,000,000 gals. It is rectangular in plan and is divided transversely by a partition into two equal parts. The 18-in. gravity supply main from Caron divides at a point exterior to the wall and an inlet branch goes to each half. Each branch is equipped with a Mason, float-operated, balanced valve which controls the admission of water. Except at such times as the demand of the city services exceeds the capacity of the gravity supply, this arrangement will insure a full reservoir always. The reservoir is of reinforced concrete throughout, the floor having a thickness of 10 ins. The exterior walls consist of panels 18 ft. high spanning between counterforts spaced 9 ft. on centers. The partition wall is similarly constructed, except that it is designed to resist a full head of water in either direction. The roof is of the girderless type, supported on columns spaced 18 ft. both ways, the slab proper having a thickness of 7½ ins. A 5-ply felt and gravel covering overlies the concrete roof and on this, in turn, a filling of 2 ft. of earth is placed.

THE MOOSE JAW PUMPING STATION.

The Moose Jaw pumping station is of the same general style of construction as the headworks pumping station. Its equipment consists of two Canadian Boving centrifugal pumps direct connected to two Siemens 35 HP. motors which receive their power from the supply mains from the city's central power station. These pumps lift the water to the elevated tanks a height of upwards of 110 ft. They will ordinarily draw from the storage reservoir but the piping arrangements will permit water to be drawn direct from the Caron gravity main. In addition to this, either pump can draw from either side of the reservoir. Finally the piping system will permit of water being fed from the reservoir without pumping, or from the gravity main into the city's distributing system, either of which would give a moderate pressure over all of the city except the highest parts. If desired, the elevated tank may be cut out and the pumps made to discharge direct into the mains. The motors are equipped with Cutler-Hammer switches operated by a float in the elevated tank. This is intended to keep the tank practically full at all times. The pumping station is supplied with a heating boiler with circuits through the reservoir and the riser of the elevated tank to provide against unusual frost conditions.

THE ELEVATED TANK.

The elevated tank is a steel structure of 75,000 gals.' capacity, and is carried on four posts. It is provided with a riser 6 ins. in diameter. The bottom is elliptical in section. The tank is provided with a mercury pressure indicating gage and with floats operating the motor switches in the pumping station. The elevated tank, the Moose Jaw pumping station and the storage reservoir stand close together on what is practically the highest ground in the vicinity of the city.

As stated previously, the infiltration gallery, the headworks pumping station, the pressure main and the headworks reservoir were all done by day labor. The Wm. Newman Company, Limited, Maurice S. Holmes, and the Moose Jaw Construction Company, Limited, were the contractors for the laying of the gravity pipe line, the pipe itself having been supplied by the National Tube Company through the U. S. Steel Products Company. The storage reservoir and the Moose Jaw pumping station were constructed by the Moose Jaw Construction Company, Limited. The Chicago Bridge and Iron Co. supplied the elevated tank. Drummond, McCall & Company supplied all valves, fittings and specials. The mechanical equipments at the headworks and Moose Jaw pumping stations were supplied by the Canadian Boving Company, Limited, and the Canadian Fairbanks-Morse Company, Limited.

At the present time the infiltration gallery is laid for only about half its contemplated length, and the system of deep wells across the valley to tap the lower supply has not been constructed. The reason for this is that it was considered best to test out the supply this winter with only part of the gallery in operation. Then, if the conditions require it, the balance of the gallery and the deep wells are to be constructed next season. It is quite likely that the present works will be extended so as to include the whole of the development originally contemplated at the headworks. Mr. Gillespie was in charge of the general supervision of the whole work.

The Use of Permutit in Water Softening.

Permutit is the name chosen to designate an artificial zeolite recently produced and patented by Dr. R. Gans of the Royal Prussian Geological Institute of Berlin. The use of permutit is comparatively new and its commercial possibilities have been investigated only to a small extent. The important characteristics of permutit and its possible uses in the industries were discussed by Mr. J. F. Garrett in a recent paper, before the Illinois Water Supply Association, which is here given in abstract.

Permutit is prepared by smelting aluminum silicates with sodium carbonate and sand and washing out the excess of sodium carbonate with water. Its chemical formula is $2SiO_2Al_2O_3\ Na_2O + 6H_2O$. The most important characteristics of this compound are:

1. Its property of interchanging bases. This property is very significant, as by replacing the sodium base by other bases it is possible to make a permutit of almost any metallic combination. Those of greatest interest, however, are the exchange of sodium for calcium or magnesium by which the hardness of water can be reduced to zero. The iron, manganese and organic matter can also be removed from the water in a similar way.

2. Its property of regeneration. Upon passing hard water through permutit, the sodium content of the latter will eventually become exhausted, it being replaced by the calcium and magnesium contained in the water, hence it is necessary to regenerate it. This can be done by passing a 10 per cent solution of common salt (NaCl) through the permutit.

3. Its length of life. It is claimed that permutit can be regenerated an unlimited number of times without loss, hence it is never necessary to renew the charge in the filter.

The permutit filter consists of a steel shell made in various sizes for the treatment of various quantities of water, this shell being fitted with pipes and valves in order to give the necessary mechanical treatment to the water and also enable washing and regeneration with a salt solution. Inside this shell a layer of permutit is placed between two layers of gravel, through which the water to be purified is passed at a comparatively rapid rate, see Fig. 1. During its passage the calcium and magnesium salts react with the permutit, turning the sodium permutit into calcium and magnesium permutit.

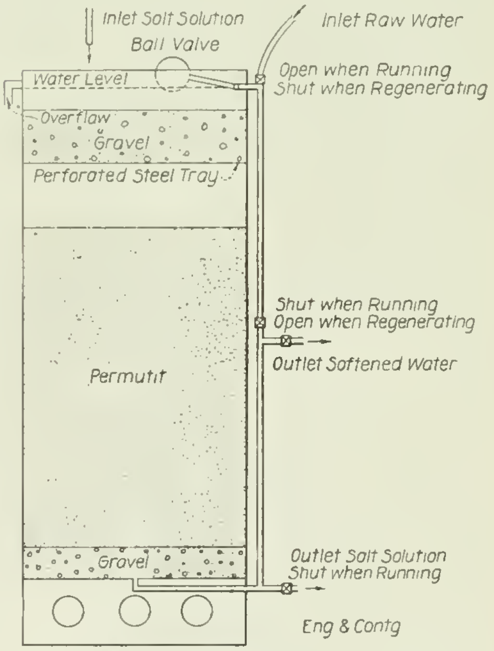


Fig. 1—Essential Features of the Apparatus Used in the Permutit System of Water Softening.

This process differs from most water softening processes in that an excess of insoluble reagent is used instead of a small amount of a soluble one.

Permutit may be used in practice in two forms, namely: (1) sodium permutit for the removal of calcium and magnesium, and (2) manganese permutit for the removal of iron, manganese, and organic matter. The sodium permutit is perhaps of greatest commercial importance because of the large number of industries that require water free from calcium and magnesium. The sodium-permutit filter will reduce the hardness of almost any water to zero, and at a very low cost. Hence the advantages of permutit-treated waters for boiler purposes, dyeing, bleaching, and laundry work are undoubtedly very great.

The manganese-permutit is prepared by passing $MnCl_2$ through sodium permutit and then washing with calcium or potassium permanganate. This treatment forms the higher oxides of manganese which cling mechanically to the granules of permutit, thus exposing a very large, highly oxidized surface, which will remove the iron, manganese and organic matter from the water.

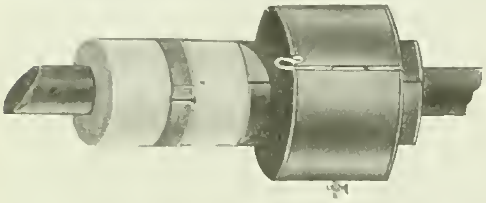


Fig. 1—Removable Casing in Closed Position for Service.

The essential difference in the action of the sodium-permutit and the manganese-permutit is, that in softening water by sodium-permutit the substances eliminated from the water actually enter into combination with the permutit and consequently there is no precipitation and no clogging up of the filter, but in the manganese-permutit the oxidizable substances in the water are actually precipitated and tend to clog up the filter.

The regeneration of the sodium-permutit filter requires about eight hours. A 10 per cent solution is run into the filter and let stand for about six hours, after which it is drained out and the filter washed. The filters must be regenerated once every 24 hours. This can be done at night, enabling the filter to be used every day. The capacity of the filter does not deteriorate with use; that is, the capacity of the filter at the end of a year's run is the same as at the beginning. Hence, after the cost of installation the only expense is the cost of salt for regeneration, which is about 2 cts. per 1,000 gals. for water of 350 p.p.m. ($CaCO_3$) hardness in this section of the country. Of course, the cost of salt will vary in different localities which will cause variation in the cost of treatment.

In order to regenerate a manganese-permutit filter it is necessary first to break up the filter bed and wash out the accumulation of iron oxide, etc., that has been oxidized and precipitated in the filter. After this has been done, the filter is reoxidized by means of a solution of calcium or potassium permanganate.

The following brief abstracts show the possibility of the use of the process in practice in a few industries:

Basche, in an article on "The Use of Permutit to Purify Boiler Feed Waters" states that the presence of alkali in water prevents the corrosion of iron but causes foaming; and that the presence of NaCl counteracts the effect of alkali. Hence water treated with permutit causes foaming and yet does not prevent corrosion because of the presence of small quantities of NaCL. However, other writers state that at least 50 boiler plants in Germany and over 1,000 in Germany, France, England and the United States are employing this system of treatment and none of them have had any trouble with corrosion, scale or foaming since this process was introduced.

It is claimed that for dyeing and bleaching purposes, water treated by the permutit method is equal to distilled water and is much cheaper.

The use of permutit for laundry purposes has many advantages over the lime and soda process. Water cannot be softened to less than 3½ grains per gallon or 60 parts per million (CaCO +) hardness by the lime and soda process, while it can be softened to zero by means of permutit. The cost of treatment is approximately the same with either method. The permutit treated waters also contain a considerable quantity of bicarbonates which aid in cleasing and are ordinarily added to waters used for laundry purposes. Another important advantage of the permutit filter for laundries is that it automatically adjusts itself to waters of varying degrees of hardness. The mechanical adjusters used on the lime and soda softeners are efficient for a short time, although they require constant attention, but the action of lime soon throws the gears out of adjustment and hence the water is not properly treated. All these difficulties are avoided in using a permutit softener.

In conclusion some of the advantages claimed for the use of permutit are quoted by Mr. Garrett as follows: (1) Any water may be softened to any degree of hardness by regulating a flow; (2) the filter works automatically; (3) variations in the feed water do not affect the filtrate; (4) the number of regenerations of the filter is unlimited; (5) iron, manganese and organic matter may be removed by using manganese-permutit; (6) the process may be used in other industries; for example, to recover potassium from the waste of sugar refineries.

From his investigations Mr. Garrett has determined: (1) that calcium and magnesium can be completely removed from the University of Illinois tap water; (2) that iron can be removed from the water by passing through sodium permutit in the presence of air; (3) that the normal rate of flow (33-gal.-hour) can be nearly doubled without affecting the quality of the filtrate; (4) that the filter can be completely regenerated; (5) that there is a small loss of permutit in washing the filter. However, this loss is purely mechanical and by exercising a little care in flushing can be reduced to a minimum.

Although there has been, up to the present time, very little investigation of permutit the results obtained both in this country and abroad all show the high efficiency and low cost of treatment of this method of water softening and point toward a large industrial application of the process in the future.

A New Removable Casing for Pipe Line Specials.

(STAFF ARTICLE.)

A removable casing has just been placed on the market by the Removable Flange Casing Company, 492 Fulton St., New York City. The casing is made to cover flanges, tees, Y's, valves, bends and universal joints. The accompanying illustrations show the general form and appearance of the casing. Fig. 1 is a view of the casing in position for service. The pet cock shown at the bottom of the casing is added, at the request of the purchaser, to facilitate drainage. Fig. 2 shows the casing in open position. The form shown is fastened around the pipe by means of the pin shown at the top of Fig. 2. Any type of fastening, whether pin, hasp, hinge or thumb screw, can be furnished as desired.

The casing is easily removable. It is lined, when so ordered, with asbestos and therefore forms a continuation of the asbestos covering on the pipe line. It is made for service in all sizes, corresponding to the various standard sizes of pipe.

A Rapid Preliminary Test of Water for Sewage Contamination.

Modern scientists have long been searching for a rapid scheme for detecting evidence of the contamination of drinking water by sewage. The advantage of such a method is readily appreciated. To have a complete analysis made is often a matter of considerable deliberation, expense and delay. For full information a sanitary analysis is necessary, but there are often times when one would like to have a rough, quickly-learned idea as to the presence or absence of contamination. These rough qualitative tests have been more or less popular from the earliest times. Historically, there are numerous references. In his recent paper before the Illinois Water Supply Association, Dr. Adolph Gehrmann, of the Columbus Laboratories of Chicago, discussed such accelerated tests in general and described a rapid method which he has used in his practice for many years. His paper is here given:

The points in question are as to the utility of any such preliminary testing and as to present-day understanding permitting of a more reliable interpretation of the tests.

The same is true here as in all sanitary water analysis: What we desire is to quickly ascertain the presence of specific disease microorganisms as a basis for a sanitary opinion.

To enumerate and pass upon all the schemes proposed is impossible here. We can only treat of them in general groups.

(a) Evidence of decomposition. The breaking-down of a water at body temperature is extensively used in connection with sewage examination and is only good when a water is grossly polluted. Here may also be recalled the enrichment methods by which the contained bacteria are made to increase in numbers and then give evidence of decomposition, either in changes in color or by developing an odor. The restraint of saprophytes is sometimes accomplished by the addition of small amounts of carbolic acid or mineral acid. These tests are very crude and usually end in showing only decomposition.

(b) Chemical qualitative tests cover a wide range of principles, as: Tests for oxydizable matter. Example: Permanganate of potassium. Tests for organic matter (ammonia). Example: Nessler's reagent. Tests for nitrates and nitrites. Example: Sulphanilic acid and naphthylamine. Tests for mineral constituents, especially chlorine. Example: Silver nitrate solution.

The reagents for some of these tests have been arranged in tablet form and in this way may be readily and quickly applied. All of these tests come into the same interpretation as the usual sanitary chemical analysis; a determination of degree rather than a certainty of contamination or not.

(c) More recent than the chemical tests are the presumptive bacteriological tests. These are for the essential intestinal bacteria: Colon group bacilli. These tests require some cultivation method that will show a more or less characteristic change, as fermentation tests; acid formation under conditions; action on dyes changing color. Some of these can be used to an advantage as a preliminary qualitative test for sewage bacteria.

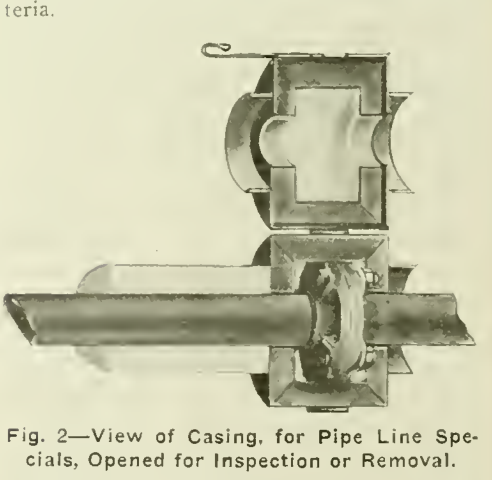


Fig. 2—View of Casing, for Pipe Line Specials, Opened for Inspection or Removal.

Quite rightly, all of these single tests have given way to complete water analysis, from which exact deductions can be drawn. However, of all steps in water analysis the fermentation test for colon group organisms takes first place. As a rough or as an exact procedure it gives the most trustworthy information as to the presence of fecal contamination. A water that will ferment glucose actively and regularly must be condemned as being contaminated. I have used the following as a preliminary test for B. coli in the urine as well as an easy means for the detection of a contaminated water, either at home or in the field:

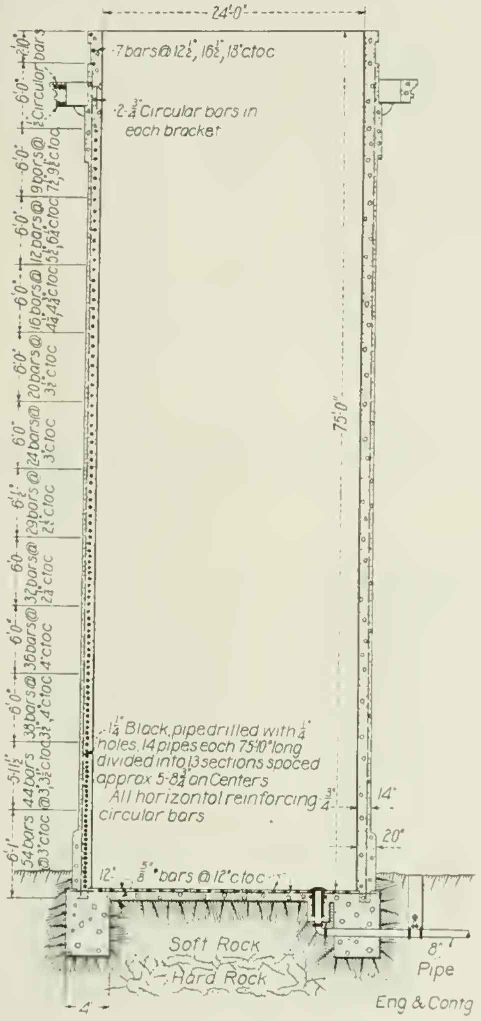

24'-0"
7 bars @ 12½, 16½, 18" c to c
2-¾ Circular bars in each bracket
75'-0"
1¼ Black pipe drilled with ¼ holes, 14 pipes each 75'-0" long divided into 13 sections spaced approx 5-8¾ on Centers
All horizontal reinforcing ¾ circular bars
14"
20"
12"
⅝ bars @ 12" c to c
Soft Rock
Hard Rock
8" Pipe
4'
Eng & Contg

Fig. 1—Vertical Section Through Reinforced Concrete Standpipe at Belton, Tex.

As bouillon media cannot be easily handled except in a laboratory, I use solid media. The chief difficulty in making these preliminary tests is the necessity for incubation. A temperature slightly above body temperature is best, but body heat will do. To make this test possible without laboratory or incubator, the body warmth under the clothing may be used. The culture medium, consisting of nutrient agar, with 2 per cent dextrose, with or without litmus or neutral red, or with or without carbolic acid or bile as restraining agents, may be used, filled into 1 or 2-oz. prescription bottles about half full. These are sterilized with corks and cotton and tin foil tops. In using the bottles the cork is loosened and they are placed in a cup of water and melted by boiling. Then allowed to cool until they can be held in the hand without discomfort. The suspected water is run in to about half the remaining space in the bottle and mixed with the medium by tilting and gently shaking. It may then be put in an inside pocket. At night it may be placed in the nightshirt pocket, and as it is corked there is no danger of leaking. I have never had a bottle break while being carried. Fermentation will be shown by gas bubbles appearing in 12 to 24 hours. Color reactions are usually shown later. In like manner we have for many years used body warmth in the cultivation of diphtheria bacilli and pus cocci or blood serum in tin or aluminum boxes containing blood serum media. This rough test for colon group bacilli can be made by anyone without laboratory facilities, but should be verified by a more technical examination, if a positive fermentation is noticed.

The Design and Construction of a Reinforced Concrete Standpipe at Belton, Texas.

The water supply of Belton, Texas, is obtained from deep wells. A steel standpipe for years furnished the requisite storage and pressure for domestic service. When the pressure so provided became insufficient the height of the standpipe was increased 30 ft. Several years ago the upper half of the enlarged structure was torn off by the wind. This accident resulted, it is thought, from the weakness of the plates which formed the top portion of the original standpipe. The portion of the standpipe which remained standing after the accident was too short to give a satisfactory pressure, so the construction of a new standpipe was decided upon. The conditions which made the adoption of reinforced concrete desirable as the material to be employed in building the new structure, and the design and construction of the new standpipe, were described by Mr. Thomas L. Fountain, of the Fountain-Shaw Engineering Company, of Dallas, Texas, in the March issue of the Cornell Civil Engineer. The following matter is taken from Mr. Fountain's article.

The chemical contents of the well water at Belton is such that it rapidly corrodes steel, but has no deleterious effect upon concrete. The cement mortar coat on the interior of the storage basin at the pumping plant is as sound as when put on 20 years ago, whereas service pipes and fittings all over the city deteriorate rapidly. On this account estimates for the proposed new standpipe were secured on the basis of using much thicker steel plates than would be required ordinarily. No bids were taken, but the lowest quotation for a steel standpipe 24 ft. in diameter and 75 ft. high was over $7,000. At this juncture the Fountain-Shaw Engineering Company was employed to prepare plans for the proposed water works improvements. Believing that a reinforced concrete standpipe could be constructed at a lower first cost which would last indefinitely without any expense for maintenance or repairs, the design shown in Fig. 1 was submitted to the city, and, upon its approval, work was immediately commenced.

DESIGN.

In the design of this standpipe, certain assumptions were made which resulted in securing its construction at a cost very much less than for a steel standpipe of the same dimensions. However, since its completion, important facts bearing upon the design of the concrete standpipes have been brought out by Mr. Hyram B. Andrews in a paper read by him at a meeting of the Boston Society of Civil Engineers. Had the design been carried out in accordance with his recommendations, the cost would have been nearly as great as for a steel standpipe. A wall thickness of 14 ins. was decided upon, as a result of a study of concrete standpipes, previously constructed, this thickness being ample to transmit the stress to the reinforcing steel and to secure imperviousness with the concrete proportions used. The working stress assumed for the steel was 16,000 lbs. per sq. in. No mechanical bond was used to fasten the bars to each other. They were lapped 36 ins. and bound in position with wire. Laps in adjacent rings were not allowed to come in the same vertical line.

When next designing a reinforced standpipe, it is the writer's intention to follow closely the lines laid down by Mr. Andrews in the paper mentioned above, the most important of which are briefly as follows: (1) The use of a very rich mixture of concrete, (2) a thickness of wall sufficient of itself to prevent the rupture of the concrete when the standpipe is full, (3) vertical reinforcement between the base and walls to distribute the bending moment and shearing stress, (4) a steel dam at each horizontal joint, in addition to the usual "keyings" to prevent seepage.

It is of fundamental importance that a standpipe designed and constructed on the assumption that the tensile stress is to be carried by the concrete alone with the reinforcing bars added as a guaranty of safety, should be allowed to stand at least 60 days after completion before being filled so that the concrete can secure its full tensile strength.

The ornamental cornice and other decorative work at the top and base of the standpipe were added to relieve the severe lines of the structure, as the standpipe occupies the crest of the highest hill in the vicinity and can be seen for many miles. It has a much more dignified and interesting appearance than a plain cylinder of steel. No manhole is provided in the wall near the base as in a steel standpipe, as the construction difficulties of furnishing such an opening are hard to overcome for a concrete standpipe. The 8-in. inlet pipe is brought up through the bottom for the same reason.

CONSTRUCTION PLANT.

The steel forms for the outside of the standpipe were made from the drawing shown in Fig. 2. Two complete rings were used in order that one might be assembled on top of the other without waiting for the concrete to acquire a hard set, and to secure a better bond at the joints by pouring fresh concrete on that still "green." The cost of these forms delivered at Belton was $423.

The concrete was mixed in a 3 cu. ft. batch Smith hand mixer, which discharged into a steel elevator bucket of the same capacity, arranged to run in vertical guides and to dump automatically into a combined bin and chute set above the working platform. The bucket was hoisted by a team, used for other purposes when the pouring was not in progress. The wheelbarrows used in placing the concrete were filled by opening a wooden gate at the lower end of the bin. The outside scaffolding was made of 3-in. by 10-in. discarded bridge flooring cross braced with 1-in. by 8-in. ship lap. It was erected in sections as the work progressed.

The inside working platform was supported on double rows of 3-in. by 8-in. joists projecting radially from a short central post to which they were rigidly attached. Each pair of floor joists was separated by wooden blocks allowing the 4-in. by 4-in. vertical guide and support studs to pass between them. These studs were set back 2½ ft. from the inside of the wall to give room for the wheelbarrows. The only inside flooring was that laid between these studs and the wall. The stud joints were mitered and fastened with bolts.

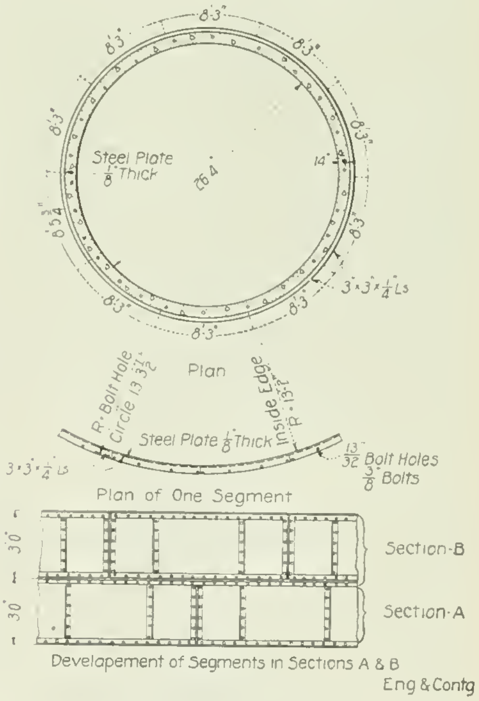


Fig. 2—Design of Steel Forms for Reinforced Concrete Standpipe at Belton, Tex.

Six feet below the working platform a similar arrangement of joists supported the wooden inside forms, which were made up in sections 6 ft. high, or double that of a single set of outside forms. Each of these systems of floor joists was supported by iron pins set in holes bored in the vertical studs at any level required.

CONSTRUCTION METHODS.

Excavation for the foundation revealed rather soft rock at the depth originally determined upon for the bottom of the standpipe and wall footings. The excavations for the wall footings was, therefore, deepened 4 ft., stopping on solid rock. The concrete for the wall foundation was poured to within about 1 ft. of the lower side of the bottom of the standpipe. The remainder of the wall foundation and the bottom were next placed at one pouring. Keys were left for the walls as shown in Fig. 1. During this pouring, 1-ft. lengths of 1¼-in. pipe, threaded on the upper end and provided with sleeves, were set vertically around the periphery in the soft concrete.

The steel forms shown in Fig. 2 were used for the outside of the thicker wall at the base as well as for the remainder of the vertical shell. The increase in the circumference required for the first 6 ft. from the bottom was obtained by bolting the plates in each ring against vertical wood spreaders.

The 1¼-in. pipes used for supports for the reinforcing bars came upon the ground cut into sections of the exact length shown in Fig. 1, threaded and drilled. Each 6-ft. section was screwed into place as it was reached with the concrete.

The reinforcing bars were bent to the approximate curvature required before hoisting them to position. At each vertical pipe each bar was spaced and held by passing a wire through the ¼-in. holes in the pipe and around the bar. When the work on the walls was first started, only one 3-ft. section of concrete could be poured in two days on account of the large amount of reinforcing steel which had to be placed. After a height of 24 ft. was reached a 3-ft. section was poured each day. When the pouring of a section once started, it was finished regardless of the time required, the work frequently running well into the night on account of the difficulties encountered in raising the inside platform. Each pouring of a 3-ft. section required about three hours, 9 cu. yds. of concrete being placed in that time. The concrete was mixed soft but not sloppy and was distributed in wheelbarrows in layers 12 ins. thick, care being taken to equalize the pressure against the forms by uniform distribution. As soon as each pouring of a 3-ft. section was finished large V-shaped wooden keys were placed in the soft concrete. Before the pouring of another section was begun these keys were removed, the whole exposed surface of the concrete was wire brushed and washed, and the space occupied by the key filled to overflowing with 1 :2 mortar.

As soon as the inside forms for each 6-ft. section were removed; the inside wall was thoroughly wet and painted with a thick neat cement grout.

Since the center of the standpipe was occupied by the joint produced by the abutting radial floor joists, the walls were kept vertical by a center secured through the use of a 30-in. wooden circular disk the exact size of a circle drawn upon and concentric with the concrete bottom of the standpipe. Three corresponding points 120° apart were set on the disk and circle. The disk was then set in approximate position and adjusted accurately by shifting until plumb bobs dropped from the three points were directly above the corresponding points on the circle below. In order to dampen the plumb bob swing without hiding the three points on the floor circle, glass tumblers filled with water were placed over them.

The entire cornice and brackets are monolithic. The forms for this part of the work were supported on the tops of the outside verticals which were cut off at the proper height for this purpose. The tablets below the cornice were moulded on the ground, hoisted to position, and grouted into recesses left in the wall.

The construction force consisted of 1 foreman, 1 carpenter with 2 helpers, 1 driver with team, and 7 laborers. After the completion of the standpipe the outside was scraped, washed and painted with cement grout mixed with sufficient sand to make it spread readily. When the standpipe was first filled some leakage occurred, due to the development of fine vertical cracks in the concrete as the steel elongated under its working stress. This leakage has gradually decreased, until at present it is an immeasureable quantity. The total cost of the standpipe was $6,000, $500 of which amount was spent upon the cornice and ornamental work.

CONCRETE.

The gravel and sand used for the concrete occur mixed in the same bank which is located about two miles from the standpipe. The sand varies from rather fine to coarse. In order to secure as dense a concrete as possible for the amount of cement used, sufficient fine sand from a sand pocket in the gravel pit was added to fill the voids in the unscreened mixture of combined gravel and sand. Cement was then added to the proportions of 1 part of cement to 6.33 parts of the aggregate, the entire proportion being as follows: 1 part cement, 2.4 parts coarse sand, 3.6 parts gravel, 0.33 parts fine sand. All gravel and sand particles passing through a ⅜-in. mesh inclined screen were classed as coarse sand. The resulting concrete was very rich in appearance. Cut into some time after the erection of the standpipe, it was found to be hard and dense.

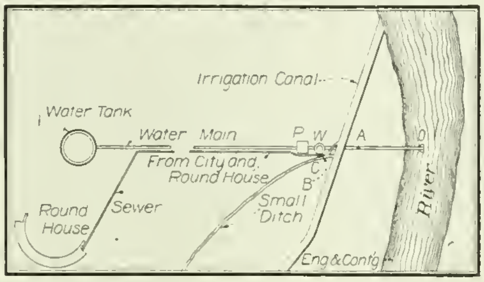


Fig. 1—Sketch Plan of Water Supply System in Railroad District of Laurel, Mont.

The Detection of Uncalked Joints in an Intake Pipe Line by Determining Solids and Sulphates in the Water.

There are two water systems supplying the City of Laurel, Montana. One furnishes water to the people living in the original townsite, and the other furnishes water to the residents of a new addition built by the Northern Pacific Railroad Company. During the summer of 1909 a typhoid fever epidemic broke out among the railroad employees living in the new addition. There were about 100 cases of the fever in the railroad addition while the older part of town was practically free from the disease. This fact and other circumstances quickly indicated that the water supply of the railroad addition was the source of the infection. The methods employed in fixing the exact location and cause of the infection were described by W. M. Cobleigh, Professor of Chemistry, Montana State College, in a paper, before the Illinois Water Supply Association, as follows:

The details of this water system are shown by Fig. 1. The Yellowstone River is the source of the water supply with the intake near the shore at O. A cast iron pipe line O A supplies the large brick-lined well at W from which the water was pumped by an electric pumping plant P to water tanks in the railroad yards a mile away. The tanks supplied water for engine use and for drinking by employees in the shops, roundhouse and the company hotel. A complete sewer system was also constructed with its outlet at B which is only a few feet away from the well, W. The sewage was discharged into a small ditch which in turn empties into an irrigation canal as shown. It will be observed, therefore, that the sewage passed directly over the intake pipe line, and naturally contaminated the soil near the well. The ditch and canal sometimes overflowed their banks, thus contaminating a large area surrounding the well and pipe line.

The intake pipe at O became partially clogged with sand, and there was in consequence a shortage of water in the well. To increase the water supply in the well, the small ditch was tapped at C, a point above the sewer outlet, and surface water was run directly into the well for a few days only. In two or three weeks after this was done a typhoid epidemic was on. The infection could have come from this surface water, or more likely from seepage water contaminated by sewage entering the intake pipe through uncalked joints, a discovery made by the aid of chemical analyses after the writer was called to inspect and report on the sanitary condition of the water system. A few of the analyses which led to the discovery of this condition are reported below.

Samples were taken of the river water at the intake O and from one of the water tanks in the yards. The results are as follows:

	Parts per million. River at intake O.	Parts per million. Water tank.
Total solids	164.	740.
Free ammonia	.03	.13
Albuminoid ammonia	.17	.09
Nitrogen as nitrites	Trace	.0091
Nitrogen as nitrates	Trace	.22
Chlorine	6.1	14.8
Sulphates as SO_4	25.0	350.4

A comparison of the foregoing results indicates very plainly that the pumps were not delivering river water to the tanks. The high solids, sulphates and chlorides indicated that ground water was entering the system in large quantities and that it was no doubt contaminated as shown by the high free ammonia and nitrites. In this connection it should be stated that the well, W, and the intake pipe line were located in wet ground highly charged with "white alkali," which is high in sulphates. In a report to the railway company the writer stated that the ground water entered the system either by seepage into the well or by leaks in the intake pipe line. The company officials having confidence in the construction of the pipe line decided that the well was the cause of the trouble and therefore eliminated the effects of the well by running the intake pipe through it, and then pumped water directly from the river. When this change was completed samples were again taken as before with the following results:

	Parts per million. River at intake O.	Parts per million. Water tank.
Total solids	182.	611.
Free ammonia	.05	.05
Albuminoid ammonia	.13	.15
Nitrogen as nitrites	0036	.0024
Nitrogen as nitrates	Trace	.23
Chlorine	1.5	9.5
Sulphates as SO_4	12.1	300.4

Again the results proved that ground water was still entering the system and that a faulty pipe line was no doubt the cause. Consequently, an experiment was tried to locate the position of the leaks in the line. The pumps were stopped and water from the tanks was allowed to flow through the pipe to the river. In a few minutes the water appeared on the surface of the ground at A and filled a depression 10 ft. long and 3 ft. wide. The pumps were then started and in a few minutes the water at A had been drawn into the system again.

The pipe line from A to O was then dug up and it was discovered that the cast iron pipe had been laid for a distance of about 400 ft. without calking the joints and that instead of pumping river water as was intended, the supply of contaminated ground water was taken instead.

In establishing the connection between the typhoid epidemic and the leaky pipe line, it should be noted that there was a big leak in the line at A which was flooded with sewage-contaminated water from time to time and that the water was drawn into the system as shown by the experiment referred to above.

That the leaky pipe line and not the surface water that was run into the well for a few days was the source of infection is indicated at least by the following experience. As soon as the epidemic started, the railway company supplied pure water for their employees by shipping water from a distance in engine tanks. It took some time to repair the pipe line because the work was discontinued during the winter months, and the employees became impatient and disobeyed the order not to use water from the pumping system for drinking. The writer made frequent tests of the water and in the spring after the ground was thawed out, the analyses indicated a sudden and great increase in free ammonia, nitrites, and nitrates over any test obtained while the ground was frozen. This indicated a dangerous condition and notice was sent to the division headquarters which was not very effective in stopping the use of the water. About three weeks after the report was made, there were 80 cases of severe enteritis among the railroad men who had been drinking from the pumping system.

In the spring the leaky joints in the pipe line were calked and finally the pumping plant was in shape to deliver to the tanks river water which was not contaminated by ground water. The system has been in use for domestic purposes now for several months and no typhoid fever, or enteritis, has been reported since the repairs were completed.

In justice to the engineer who put in the water system for the railway company, it should be said that when the plant was first started, it was intended to supply water for engine use only. The intake pipe line was not calked because it was intended to be used as a gravity line, but the fact that this line was in wet ground high in white alkali was overlooked as was also the possible effect of the sewage disposal system on the purity of the water.

BUILDINGS

Shearing Strength of Construction Joints in Stems of Reinforced Concrete T-Beams, as Shown by Tests.

In reinforced concrete construction, the importance of lessening the cost of forms has long been recognized. A recent effort in this direction has resulted in a system of construction in which columns and stems of beams and girders are cast on the ground. These units, when hard, are hoisted into place and set in mortar or grouted. The concrete skeleton or frame work thus erected supports the forms for the floor slab, which is then cast in place. The slab rests on the beam and girder stems, and is secured to them by the customary web reinforcement—stirrups and bent-up or trussed tension rods.

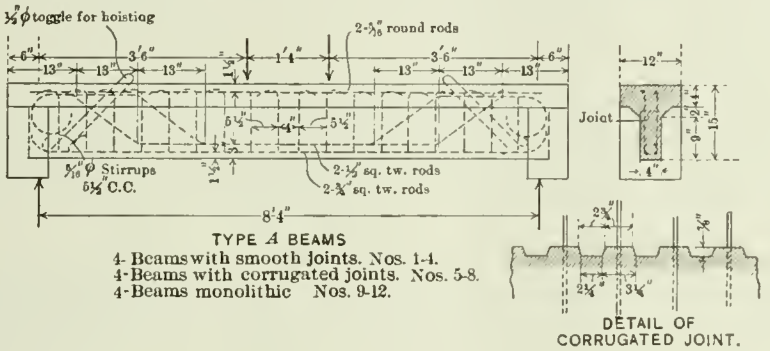


Fig. 1—Type A Beam Tested for Shearing Strength of Construction Joint.

In the ordinary beam and girder type of floor, the slab, besides receiving the live load and distributing it to the beams, performs the important function of acting as compression flange for the beams and girders. In the system just described, however, a horizontal construction joint exists between the slab or flange and the stem below, due to the lapse of several days between the casting of the two. This forces to the front the question whether this joint can transmit safely the horizontal shear necessary to make the slab and stem act together as a beam, as in an ordinary monolithic floor.

In answer to this question Messrs. L. J. Johnson and J. R. Nichols present a paper in Proceedings, American Society of Civil Engineers, vol. XXXIX, p. 201. This paper is a record of tests which, among other things, seems to show clearly that, under conditions readily met in practice, the answer to this question is in the affirmative. These results are so strikingly at variance with ideas previously widely held that a full account of the conditions of the tests must be included.

These tests were undertaken under the following circumstances: In December, 1911, a Boston company had contracts for two buildings on which it was proposed to use the unit construction. J. R. Worcester and L. J. Johnson, members, Am. Soc. C. E., were retained as consulting engineers on the general design of the unit construction work. At their instance a series of tests was undertaken by the writers, in the laboratory of the School of Engineering at Harvard University, to investigate the strength in shear of the horizontal joint between stem and floor slab necessarily involved in this type of construction. As work on one of the two buildings had to go on without delay, it was agreed, pending the completion of the tests, to introduce the precautionary measure of increasing the shear resistance of the construction joints by corrugating the tops of the stems in a manner similar to that shown in Figs. 1 and 2. Thus work was begun. The tests soon made it clear, however, that the corrugations were unnecessary, and they were omitted in subsequent construction.

Objects of Tests.—The specific objects of the tests were three: (1) To determine whether the type of construction going into the building, involving the corrugated joint between the stem and the slab, was safe; (2) to determine whether it would be safe to dispense with the corrugations and use instead a smooth, that is, an ordinary, untreated joint, and (3) to discover, if possible, how high a shearing stress such a smooth joint can resist.

Types of Test Beams.—For the tests, three types of beams, *A*, *B* and *C*, were made.

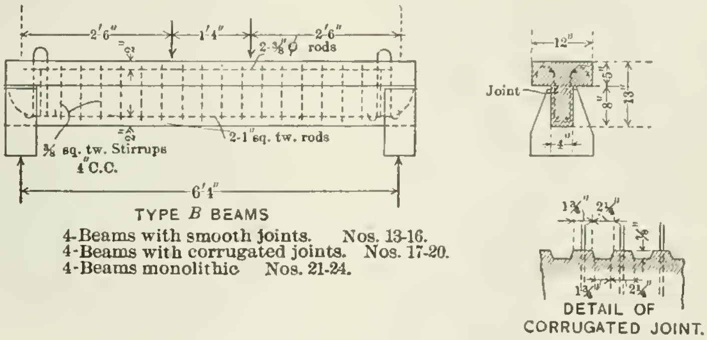


Fig. 2—Type B Beam Tested for Shearing Strength of Construction Joint.

Type *A* beams were designed by the Boston company primarily for the first and second objects stated. Accordingly, their design was similar to that of the beams going into the buildings.

Type *B* beams, designed by the authors, were intended primarily for the third object, and all the stresses were kept low in comparison with the shearing stress in the stem, in order that the shear on the joint might reach a high value before the beam failed from any other cause.

Type *C* beams, made and tested at the request of the patentees of this system of unit construction, were four in numbers (Nos. 25 to 28). They differed from the Type *A* beams in putting the larger rods of the main reinforcement in the upper of the two layers and turning them up for diagonal web reinforcement, instead of having the smaller rods in this position. They differed further in having smaller rods for the stirrups. In other words, the significant difference between Types *A* and *C* is in the web reinforcement, Type *C* having more steel in the diagonal bars and less in the stirrups than Type *A*.

Twelve beams of Type *A*, numbered 1 to 12, and twelve of Type *B*, numbered 13 to 24, were made—four of each type with smooth joints, four with corrugated joints and four cast without joints, that is, of the usual monolithic type. Of Type *C*, two beams were made with smooth joints and two were cast monolithic.

The designs of the three types, with the essential dimensions, are fully shown in Figs. 1 to 3. The positions of the loads and supports are also shown.

Materials.—The coarse aggregate consisted of broken slate of only fair quality, dusty and somewhat scaly. In size it was 1 in. and less. The sand was of good quality, and very similar in appearance to the Plum Island sand in common use about Boston. Lehigh Portland cement was used. A test of the cement showed it to meet the specifications of the American Society for Testing Materials. The main steel reinforcement was of square twisted rods, said to be cold-twisted. Measurements of the deformation of the steel during the test of the beams indicated an elastic limit in the neighborhood of from 45,000 to 50,000 lbs. per square inch. The steel for each beam was assembled and wired together in a frame before being placed in the forms The forms were of 2-in. plank, designed so as to be easily stripped and reassembled. Four beams or stems were cast at a time. The forms were oiled each time before the steel frame was placed.

TABLE I.—RESULTS OF TESTS OF T-BEAMS.

Type	Joint	Beam No.	Stem age, in days	Slab age, in days	Maximum load	Computed Unit Stresses at Maximum Load. Based on design. Steel	Based on design. Concrete	Based on design. Shear	On measurements*. Steel	On measurements*. Concrete	On measurements*. Shear	Apparent immediate cause of failure.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10	(11)	(12)	(13)
A	Smooth.	1	46	37	49,500	57,100	2,770	555	59,700	2,950	578	Comp. in flange.
		2	46	37	54,300	63,000	3,040	610	66,000	3,270	638	Comp. in flange.
		3	101	92	50,960	59,000	2,850	572	58,600	2,820	568	Comp. in flange.
		4	45	36	48,000	55,600	2,690	539	55,500	2,680	538	Comp. in flange.
		Average...			50,700	58,750	2,840	569	59,950	2,930	580	
	Corrugated.	5	44	35	41,000	47,500	2,300	460	48,700	2,400	472	Comp. in flange.
		6	101	92	48,300	56,000	2,700	542	58,400	2,890	565	Comp. in flange.
		7	100	91	52,100	60,500	2,920	585	61,500	2,990	594	Comp. in flange.
		8	101	92	48,700	56,500	2,730	547	59,200	2,940	573	Comp. in flange.
		Average...			47,500	55,100	2,660	534	56,950	2,805	551	
B	Monolithic.	9	41	41	50,000	58,000	2,800	561	59,400	2,920	575	Broke in support.
		10	41	41	52,400	60,800	2,930	589	61,100	2,950	592	Comp. in flange.
		11	97	97	51,000	59,200	2,860	573	59,200	2,860	573	Comp. in flange.
		12	41	41	45,800	53,100	2,560	514	53,900	2,620	522	Broke in support.
		Average...			49,800	57,800	2,790	559	58,400	2,840	566	
	Smooth.	13	43	34	50,000	40,600	2,440	676	39,700	2,350	661	Main rods slipped.
		14	97	88	50,000	40,600	2,440	676	43,200	2,720	719	Main rods slipped.
		15	98	89	55,700	45,200	2,720	754	46,100	2,820	771	Main rods slipped.
		16	97	88	51,400	41,700	2,510	695	42,200	2,560	702	Main rods slipped.
		Average...			51,800	42,000	2,530	700	42,800	2,610	713	
	Corrugated.	17	97	87	59,900	48,600	2,930	810	47,500	2,820	792	Main rods slipped.
		18	97	87	63,250	51,400	3,090	856	50,800	3,030	846	Main rods slipped.
		19	97	87	63,600	51,600	3,110	860	53,200	3,280	888	Main rods slipped.
		20	42	32	55,600	45,100	2,720	752	46,500	2,870	776	Main rods slipped.
		Average...			60,600	49,200	2,960	820	49,500	3,000	826	
	Monolithic.	21	102	102	57,140	46,400	2,790	773	46,900	2,840	781	Main rods slipped.
		22	85	85	55,400	45,000	2,710	750	44,000	2,610	734	Main rods slipped.
		23	87	87	55,650	45,200	2,720	752	44,700	2,670	744	Main rods slipped.
		24	84	84	54,000	43,800	2,640	730	43,300	2,590	722	Main rods slipped.
		Average...			55,550	45,100	2,710	751	44,700	2,680	745	
C	Smooth.	25	29	25	42,500	50,800	2,590	492	51,100	2,620	495	Comp. in flange.
		26	100	96	43,750	52,300	2,670	506	53,700	2,780	520	Comp. in stem.
		Average...			43,100	51,650	2,630	499	52,400	2,700	508	
	Monolithic.	27	27	27	45,700	54,600	2,790	529	55,000	2,830	533	Comp. in stem.
		28	98	98	47,000	56,200	2,870	544	57,700	2,990	559	Comp. in stem.
		Average...			46,350	51,400	2,830	536	56,350	2,910	546	

*Taking into account the actual placing of the steel.

Construction of Test Beams.—The concrete was mixed by hand in small batches, the materials being measured carefully. The mixture was what is commonly known as 1:2:4 by volume, that is, 2 cu. ft. of sand and 4 cu. ft. of stone to a bag of cement. Enough water was used to make the mass wet all through, easy to handle and spade in the forms, but not sloppy.

In order to get the main reinforcing rods into the narrow 4-in. stem they had to be placed so close to one another that the stone could not be tamped or spaded down between them. Clear mortar, mixed 1:2, was accordingly used in the bottom of the stem, up to the top of the main rods. The concrete was placed on top of the mortar and puddled with trowels and small rods, in order to eliminate voids and secure thorough bond with the steel. The top of the stem was leveled off in the case of the "smooth joint" beams, but not troweled. To make the corrugations shown in the design, beveled blocks of wood were pressed down into the forms, flush with the top of the stem, and the concrete between the blocks was leveled off.

The surfaces of the joints were not subsequently brushed, or scraped, or treated in any way, except that they were thoroughly wet just before placing the concrete of the slab. The stems of the jointed beams of Types *A* and *C* were set in concrete, end-supporting blocks, in pockets and grouted before the slab was poured. The bottom of the slab, when it was poured, came in direct contact with the tops of these blocks. The beams of Type *B*, however, were set in mortar in the concrete, end-supporting blocks, after the slab was hard.

The forms were usually removed in from 20 to 24 hours. The beams were stored in the basement, where they were made, and no special provision was made for keeping them wet.

The workmanship was of commercial grade, perhaps somewhat, though not significantly, better than is secured in most reinforced concrete work. The workmen were carpenters experienced in concrete work, one of them a general foreman for reinforced concrete building construction. Although no laboratory refinements were used in the manufacture of the test beams, the workmen knew the purpose for which they were being made, and, accordingly, were careful. On the other hand, they were pushed to a time schedule of four beams a day, which required the utmost speed of which they were capable, and which in the later stages was impossible of attainment, due to the slow hardening of the concrete. To this hurry are due slight imperfections in workmanship which appeared later. These imperfections were of three kinds: (1) The steel was sometimes slightly misplaced; (2) in a few of the Type *B* beams it was observed that the slab was not exactly perpendicular to the stem, and (3) a slight curvature of the beam in plan was noticed in one or two cases.

Testing.—The beams were tested in two groups. Eleven beams were first tested, which sufficed to show that the type of construction going into the building was safe, and that the joints did not need to be corrugated. The remaining beams were reserved to allow the concrete to become stronger.

The beams were tested in the 200,000 lb. Olsen testing machine in Pierce Hall, Harvard University. The beam supports consisted of rockers, which ensured a vertical reaction at the ends of the beam in all cases except that of Beam 2. During the test of this beam the supports rocked back to the flat portion of the rocker, giving the reaction sufficient horizontal component toward the center of the span to cause the concrete supporting block to spall off with a vertical crack above the rocker. This may have contributed somewhat to the high result with this beam, but the writers do not believe that the error involved is large, and the beam has accordingly been averaged with the rest without modification.

Between the rocker and the concrete was interposed in each case a steel plate and a cushion of ⅞-in. whitewood to distribute the pressure.

The rate of application of the load was from 2,500 to 3,500 lbs. per minute for beams of Types *A* and *C*, and from 5,000 to 5,500 lbs. per minute for Type *B* beams, the increase in rate being due to the greater stiffness of the shorter beams. For some beams the load was removed after reaching the maximum, and reapplied at a rate, for the second and subsequent applications, some four times as fast as for the first loading.

Discussion of Test Data.—Columns 1, 2 and 3 of Table 2 need no explanation. Columns 4 and 5 give the ages of the stem and slab, respectively, when the beam was tested. The difference between the two in any one line gives the age of the stem when the slab was cast. Column 6 gives the total load carried by the beam, exclusive of its own weight.

The unit stresses shown in Columns 7 to 12 are computed from the maximum load, as given, on the assumptions ordinarily used in the design of reinforced concrete beams. These include the assumption of straight line or planar distribution of stress in the concrete, and a value of 15 for the ratio of modulus of elasticity of steel to that of concrete. Columns 7, 8 and 9 are based on a beam cross-section in accordance with the design. It was observed, however, that the position of the main rods varied somewhat from that intended. The actual position of these rods was carefully ascertained, and the stresses on the actual cross-section thus determined are given in Columns 10, 11 and 12.

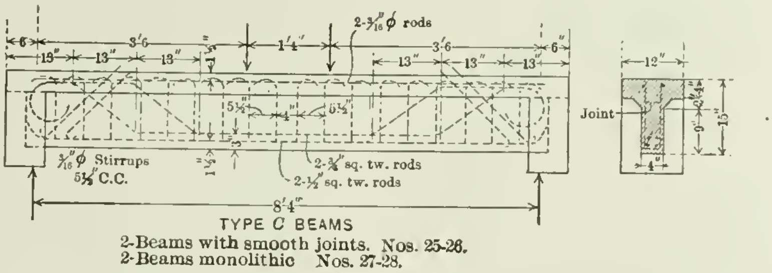
The columns headed "Steel" record the unit tension in the main rods. Those headed "Concrete" give the maximum unit compression in the concrete at the top of the slab. The columns headed "Shear" give the unit horizontal and vertical shear in the stem. This is also the intensity of the shear on the joint between the stem and the slab (in those beams which have a joint), the strength of which it is the purpose of these tests to investigate, and the intensity of the diagonal tension in the web, as ordinarily computed.

From the unit shear may be obtained, if it is desired, the unit adhesion on the two straight rods by multiplying the shear for Type *A* beams by ⅔, for Type *B* beams by ½ and for Type *C* beams by 1. It will be observed that both the adhesion and the shear ran high, the former to 559 lbs. per square inch, the latter to 888 lbs. per square inch.

Cause of Failure.—Type A.—The last column of the table gives what appeared to be the immediate cause of failure. It is often difficult to determine with certainty the one feature in the design of a beam which would most need strengthening in order to increase the strength of the beam. While most of the failures of Type *A* beams are ascribed to crushing of the concrete, for the reason that the crushing was the immediate visible forerunner of the maximum load attainable in the testing machine, yet it seems certain that in all cases the elastic limit of the steel was overstepped, leading to a rising neutral axis, a diminishing compression area and a consequent premature crushing. To what extent the stretch of the steel was responsible for failure cannot be told, but it probably was the prime cause in all cases. It is not essential to this investigation to know. Two of the Type *A* beams failed in the supports, as noted, by spalling off the lower corner of the stem below and outside of the curve of the lower rods.

Cause of Failure.—Type B.—The primary cause of failure of the Type *B* beams was probably slipping of the main tension rods, although this was not observed in all cases before the maximum load was attained. The further destruction of the stem and slab by cracking and crushing under continued application of the load cannot be regarded as the cause of failure. There is every probability that, if the same amount of steel had been secured with a larger number of smaller rods, the strength of all the Type *B* beams would have been materially increased.

Cause of Failure.—Type C.—In Beam 25 it was not observed whether the maximum load was passed before the crushing of the flange began. The failure appeared to be due to this crushing, but the stem was also badly cracked and had begun to crush diagonally, especially in the lower turn of the truss rods. Furthermore, the elastic limit of the main steel was doubtless overstepped.



2-Beams with smooth joints. Nos. 25-26.
2-Beams monolithic Nos. 27-28.

Fig. 3—Type C Beam Tested for Shearing Strength of Construction Joint.

In the case of the other three beams of Type *C*, the maximum load had clearly been reached before the flange began to crush, but the crushing of the stem was coincident with or preceded the maximum load. How far the failure of the concrete in bearing at the turn of the truss rods, and the consequent straightening and yielding of the rods themselves, reduced the effectiveness of the web reinforcement, and thus became the primary cause of failure, cannot be told. Neither can the effect of passing the elastic limit of the main rods be estimated.

Further evidence that the steel was the limiting factor in the strength of the beams lies in the fact that there is only a very slight difference in strength between beams 40 days old and those 90 days old. If the concrete were the primary cause of failure, this difference should have been more marked.

General Results.—Horizontal shear or slipping on the joint was looked for in all the beams with great care, but was never observed. In fact, the jointed beams, both smooth and corrugated, withstood the test as well as the monolithic. There was not the slightest evidence that the joint contributed in any way to the failure of the beams, though the shearing stress on the joint reached values greatly in excess of four times the 120 lbs. per square inch allowed by the joint committee in beams reinforced for shear.

Conclusions.—In view of the striking uniformity, both in the general behavior of the beams during the test and in the numerical results attained, these tests would seem to justify the following conclusions:

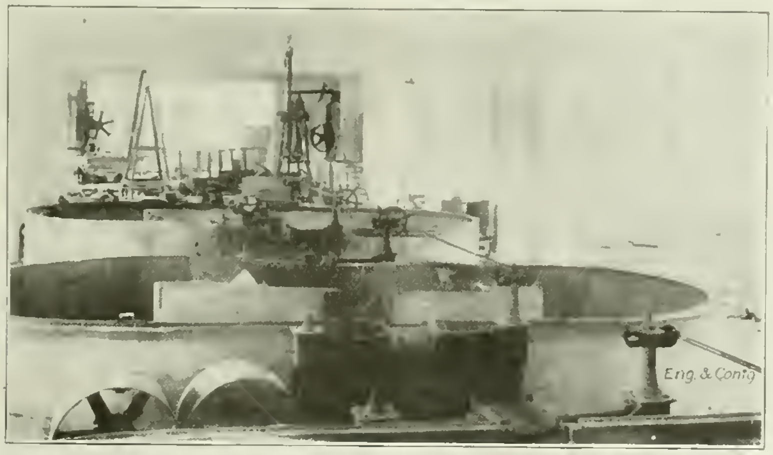


Fig. 1—View Showing Appearance of Reinforced Concrete Beating Engine Tubs.

(1) That the type of construction used on the buildings was safe;

(2) That the joints did not need to be corrugated, and

(3) That a smooth or unroughened joint, constructed in the same manner as the joints tested in a beam suitably reinforced for shear (or diagonal tension), is capable of transmitting with ample factor of safety any shear that could safely be permitted in a monolithic beam of the same cross-section and having the same reinforcement.

Reinforced Concrete Beating Engine Tubs, Milton Leatherboard Co. Mills.

Contributed by I. W. Jones, Engineer, Milton, N. H.

Reinforced concrete beating engine tubs, the first that have been built in the United States, were adopted for the new reinforced concrete mill of the Milton Leatherboard Co. at Milton, N. H. The drawings of Fig. 3 show plans and sections of the reinforced concrete construction.

The tubs already installed are three in number, two right hand and one left hand, the inside dimensions of which are 26 ft. long by 12 ft. 6 ins. wide and are rated at 2,100 lbs. capacity. They are built on a solid ledge foundation which was carefully leveled to the proper elevation before construction was begun.

After the calculations for reinforcement were made, the bars were carefully bent to the desired shapes, assembled and securely wired together in a complete network, and located in final position. Twisted bars were used. Neatly made forms were constructed conforming to the shapes and dimensions of both the inside and outside of the tubs. The forms were set up and firmly secured by bracing and by suspension timbers overhead into correct position.

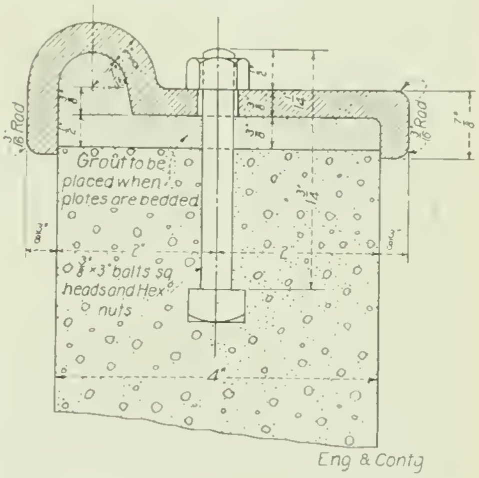

⅜" Rod
⅜" Rod
Grout to be placed when plates are bedded
2"
⅝"×3" bolts sq heads and Hex nuts
4"
Eng & Contg

Fig. 2—Steel Capping for Tops of Beating Engine Tubs.

In casting each tub, the pouring was done continuously until completed, thus forming a monolithic body. This did not apply to the midfeather or backfall, which was cast after the tub forms were removed. Preparatory to casting the midfeather, when the tub bottoms were cast, a wood screed of the same dimensions in plan as the midfeather was embedded in the bottom, and afterwards removed, leaving a socket for the midfeather casting. Through perforations in the screed the vertical reinforcing bars for the midfeather were extended and anchored into the tub bottom. The concrete used in this work was a mixture of one part Portland cement, two parts sharp sand and four parts crushed trap rock of dimensions which would pass through a 1-in. ring.

Much care was exercised in placing the concrete in the small space afforded for the sides and midfeather, thin paddles being used to force the coarser material toward the center and allow the mortar only to come in contact with the forms. The result was eminently satisfactory; when the forms were removed, the tubs were remarkably smooth and symmetrical. Nevertheless, the whole outer and inner surfaces of the tubs were at once skilfully dressed by rubbing with carborundum bricks in conjunction with a wash coat of pure cement.

The backfalls are provided with cast iron facings, and these were set in position and acted as partial forms for the work, thus insuring a solid bearing on the concrete beneath. Special cast iron packing boxes were provided in such manner as to obtain the strongest possible bond with sides of tubs. Cast iron bed plate casings and sand boxes were properly embedded in the tub bottoms, as were also brass emptying valves which connect with under-floor conduits to stock chests and washout drains.

After the forms were removed and tubs finished, the engine room floor was cast around them. This floor was laid on ledge throughout. The stands carrying the beater rolls were set on concrete bases resting on the ledge and are independent of connection with tubs.

In casting the tubs, small anchor bolts were embedded in the top of the sides for fastening the capping. Elongated holes were cast in the capping allowing some adjustment of the sections. They also served for escapement of surplus mortar during the process of embedding the capping. This was accomplished by first depositing a generous coating of mortar on the top of tub curbing, next by placing the sections of capping in place and forcing them down over the anchor bolts until the nuts could be put on, after which they were screwed down until the capping assumed the proper elevation. The cast iron capping and cement filling are shown in detail by Fig. 2.

The tubs when completed presented a most pleasing and artistic appearance, and in point of construction are a perfect success. They have not, as yet, however, been operated and their future behavior, under all the conditions to which they will be subjected, will be watched with much interest. In the accompanying illustration, Fig. 1, is a view of the tubs taken from stairway in mill looking south. The tubs, as well as the mill, were designed and plans were furnished by I. W. Jones, Engineer, Milton, N. H.

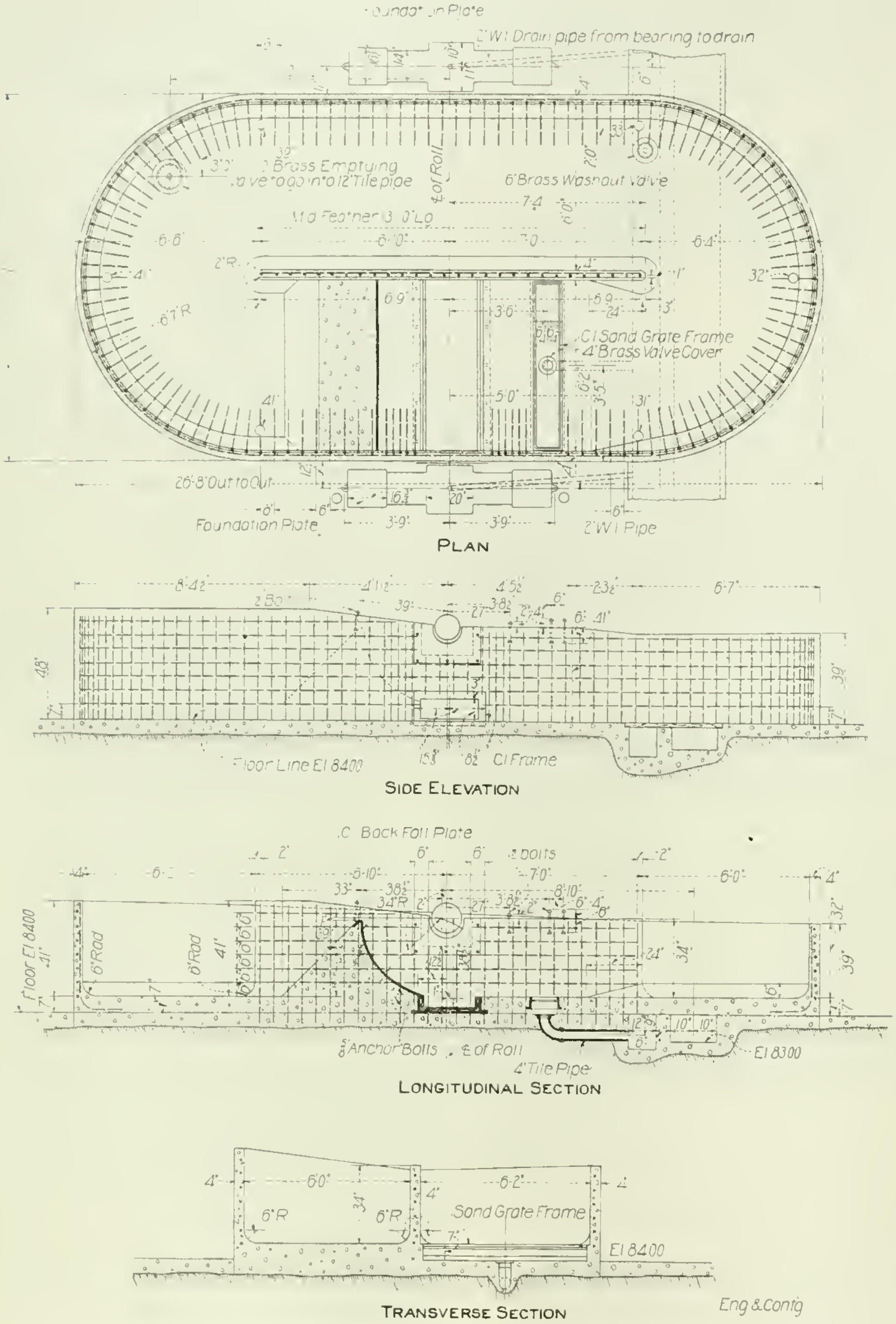


Fig. 3—Plan and Sections of Reinforced Concrete Beating Engine Tubs.

Irrigation in Iloilo.—The installation of the Santa Barbara irrigation system in the Province of Iloilo, P. I., has been authorized, and an appropriation of $125,000 granted for present use. The estimated cost of the whole system is $380,000. The system will accommodate 10,000 acres of cultivated land, and it is said, will double the producing capacity at an annual cost of less than $1 per acre. The construction will include 66 miles of main canals, distributing canals, laterals, etc.

New Irrigation Works in Argentina.—A large amount of irrigation work is under way in all the provinces of Argentina. All irrigation work in that country is now under the sole direction of the Minister of Public Works. At least ten projects have been actually started and eight new ones are being planned. The largest of these is the Rio Tercero project, which will irrigate 77,000 hectares or about 242,500 acres. The reservoir will have a capacity of 300,000,000 cu. metres, and the system will cost $7,900,000.

SEWERAGE AND SANITATION

Increasing the Efficiency of Small Sewage Treatment Plants.

The following matter is taken from a paper by Paul Hansen, Engineer Illinois Water Survey, presented before the latest annual convention of the Illinois Society of Engineers and Surveyors. Mr. Hansen's paper also discussed small water works plants. The excerpts follow:

To one who has had occasion to visit a large number of small water works and sewage treatment plants, the impression received most strongly is the unsystematic, inefficient and generally slipshod manner in which these utilities are operated. Many are of excellent design, but this is entirely negatived through unintelligent management. The employment on an annual basis of consulting experts to supervise the operation of such plants is therefore urged.

The expert exercises the character of supervision which is herein considered: (1) through instructions given to the locally employed men regarding their respective functions; (2) by visiting the works under his supervision at stated intervals, which may be semi-monthly, monthly or perhaps quarterly, and (3) by the regular review and study of monthly operation reports prepared by the local employes in accordance with methods prescribed by the expert.

There should be no overlapping of function between the expert and the local engineer in general practice, for their respective fields are entirely different. On the contrary, there should be a hearty co-operation between them, for the expert generally finds it advantageous to work through and with the general practitioner, and the latter should be the first in the community to recognize when the services of an expert are needed.

The advantages to be derived from the expert supervision of water works and sewage treatment plants are of three kinds: First, the increase in the efficiency of operation; second, the improvement in detailed design as a result of the experience gained by the designer in connection with operation; and third, the extension of the activities of consulting experts in a profitable and legitimate way.

SEWAGE TREATMENT PLANTS.

The most discouraging experiences are encountered in connection with the operation of municipal sewage treatment plants. Of half a dozen small sewage treatment plants that the writer has visited in the State of Illinois, not a single one was producing acceptable results, primarily because of neglect. This condition is no doubt brought about by the fact that sewage treatment plants are generally not popular with the community that pays for their installation and maintenance. They are forced upon a community by injured riparian owners in a down-stream direction. If such works are built, it seems to be the general policy of a community to provide for their operation at the least possible expense. This in many instances results in total neglect until the community is again stimulated to action by threatened or actual damage suits. A neglected sewage treatment plant cannot be placed in shape in a day, and as a result it becomes necessary to expend large sums of money for overhauling and in part for reconstruction, which might have been avoided if the plant were under regular and intelligent management.

Poor supervision over small sewage treatment plants has led to a tendency on the part of State Boards of Health and other bureaus having supervision over the installation of such works to demand larger proportions for such works in anticipation of probable neglect and reluctance on the part of communities to increase the size with the growth of population. This, of course, adds materially to the cost and might be avoided if there existed the general practice of maintaining sewage treatment plants under the supervision of competent specialists.

IMPROVEMENTS IN DESIGN.

It is well known that the advantage of a particular detail of design is not demonstrated until the opportunity is afforded for "seeing how it works out." The consulting engineer who designs and supervises the construction of plants usually ceases his connection therewith, just as he is coming to the point where he may see how his designs work out, and if he has any curiosity on this point he must make all subsequent visits and investigations at his own expense.

Referring specifically to sewage treatment plants, it may be said that there is a great lack of accurate knowledge regarding the behavior of small installations of this character, because of the almost universal tendency to neglect them, and this, in turn, reacts on our knowledge regarding proper design. As a matter of fact, a surprisingly large number of small sewage treatment plants are improperly designed and unsuited to the particular service which they must perform. There is a tendency among engineers to apply experience gained in the operation of large treatment plants (because this is the only experience available based upon careful operation) to the design of small works, and this almost always results in serious misfit.

The Public Control of Non-Navigable Streams from a Sanitary Standpoint.

The two most frequently advocated methods of securing and maintaining public control of streams in this country are, first, to enlarge the powers of the various State Boards of Health and at the same time to invest these bodies with authority sufficient to enforce such regulations as they may see fit to enact; and second, to form a National Board of Health, to exercise national control of inland streams as one of its chief functions, thereby relieving the State Boards of their duties or responsibilities in connection with stream control. In a paper before the Cleveland Engineering Society, Prof. H. N. Ogden of Cornell University, discussed these two forms of stream control and their ability to deal with the question. He considered the relative merits of these two bodies and of another method of control which seemed to him to be better fitted than these two for the purpose. Prof. Ogden has interested himself in this problem because of the evident demand on all sides for some adequate control that shall bring order out of the present chaotic methods of dealing with stream regulation, and because the methods of meeting such demands have been so varied. The problem is the same in all parts of the country and consists in essence of assuring to the public at large the maintenance of their rights in streams, whether it be for irrigation, power or other use, and of curbing the individual avarice which forgets the public rights in its own greed. Prof. Ogden does not believe that either the State or National Board of Health is best qualified to handle the stream pollution problem. He offered a method of control which he considers more reasonable and more likely than either to bring about a just distribution of the material values resident in even the smallest streams. The major portion of his paper is here given as published in the journal of the society for January, 1913.

In the first place, let us briefly review the present needs and difficulties which seem to indicate that the common law method of protecting the rights of riparian owners and at the same time safeguarding the interests of the public is inadequate, and needs reinforcement from some centralized authority. The various points which should be considered in this connection may be grouped under five heads, namely, first, the rights of riparian owners to water for the purpose of irrigation; second, the rights of riparian owners in the regulation of streams, through the construction of reservoirs, for power purposes; third, the need of riparian owners for help against flood flows which have resulted in large part from changed conditions of the watersheds outside of their control; fourth, the needs of adjacent municipalities for the water of the streams for the purpose of municipal water supply; and fifth, the rights of municipalities to use natural waterways for the purpose of drainage.

WATER USED FOR IRRIGATION.

In all states where the common law has not been recently amended, the owners of lands abutting on bodies of water are accorded by that law certain specific rights, differing from those belonging to the public generally, and known as riparian rights. Such owners may use for domestic purposes the water in the streams on which their lands border. The courts have established their right to demand that the natural flow of the stream be unimpeded, and that the quality of the water be maintained in its original degree of purity, modified only by such interference as may be inevitable through the reasonable domestic use by other owners, farther up-stream. Such owners are entitled to the right of access, that is, the right to erect wharves to reach the navigable portion of the stream. They may use the shore immediately adjacent, as, for instance, for ferry purposes or for drawing nets. They may anchor boats in front of their property even if such anchorage interferes somewhat with public navigation. Many other judicial decisions might be cited to show the protection which the courts have given to these favored property owners.

Yet, apparently, of late years, there is a tendency to encroach upon these individual rights for the benefit of the public as a whole; and the growing inclination on the part of courts to restrict the operations of corporations, if it appears that the welfare of the public is affected, and to protect the people from extortion by the legal establishment of reasonable profits, marks the growth of the same paternalistic spirit.

Riparian rights in a stream have always been in conflict with the needs of water for irrigation purposes and apparently the Roman doctrine of "appropriation for beneficial use" has been recognized in the western states as of more import than the Common Law rulings on riparian rights. As Mr. Lewis, State Engineer of Oregon, puts it: "By the former doctrine, water is treated as a wild thing which becomes the property of him who captures it first. It can only be retained by him so long as he puts it to beneficial use. If, among a series of water-takers, the supply is not sufficient for all, the ditch of the last appropriator is closed to protect the prior appropriators." In a review of irrigation laws in *Mills Irrigation Manual*, it is pointed out that it seems to have been an accepted fact that water in streams was the property of the public and that, when the necessities of the people required, it should be conducted from the stream and applied to the soil for the production of crops and that the right of the public to such use was unquestionable. But, by the common law doctrine, no water for irrigation could be used if its withdrawal interfered with the full enjoyment of riparian rights down-stream.

In the development of the recent irrigation law in the State of Oregon, the high ground is taken that a comprehensive plan for the development of the state's water resources is essential if waste is to be avoided and the public good promoted. The law takes the position that public necessity demands that water be put to the highest use and ignores completely the riparian owners, whose rights as individuals had hitherto been so tenaciously guarded. In case of conflict between power development and irrigation the Board of Control has authority to forbid the use of the water for power purposes when public necessity demands its withdrawal for agricultural purposes. The law, in contradistinction to that of riparian rights, even grants titles and records rights to definite volumes of water in streams without regard for the common law theory which would give to riparian owners down-stream the right to the full measure of the flow unrestricted in quantity. This modification or entire change of attitude is very suggestive because it points the way to other modifications of riparian rights provided the public good can be shown to be better served by some other way of using the streams.

Even, however, under the new Oregon law, a difficulty arises from the fact that the streams used for irrigation are not always entirely within the boundary of a single state. Already in the West difficulties have arisen and suits have been brought by citizens of one state demanding that the volume of flow in an interstate stream be not reduced in the up-stream state, because the waters to their full volume were wanted by the citizens of another state. As an example, the case of Kansas vs. Colorado may be cited, in which the decision of the United States Supreme Court abolishes riparian rights in water, at least so far as interstate streams are concerned.

The citizens of Kansas insisted that large quantities of water were being diverted from the Arkansas River by the inhabitants of Colorado, a large number of whom claimed to be prior appropriators and were diverting the water to non-riparian lands, as against Kansas, a lower riparian proprietor. In Kansas, the modified doctrine of riparian rights prevailed, while in Colorado prior appropriation was, and is, recognized as the governing doctrine. The court refused injunctive relief to Kansas, and dismissed the bill, stating in substance that if the riparian doctrine should prevail in Kansas as against Colorado and against the non-riparian users whose rights were involved therein, Oklahoma and its citizens lower on the Arkansas River might invoke the same rule in opposition to citizens of both Kansas and Colorado, to their great injury, which doctrine, it is observed, would be ruinous in its effects. The court, in dismissing the bill, indicated that no injunction would lie until a more substantial injury could be shown, although at the same time, the court found that the interference by a large number of appropriators above in the State of Colorado materially depleted the flow to the riparian lands of the plaintiff.

Mr. Lewis comments on this decision by saying that there can be no misunderstanding of the clear intent of the Supreme Court to permit of the diversion of water in an upper state by non-riparian proprietors, even though such diversions materially deplete the flow to riparian lands in the lower state. "From the definition of a riparian right, as heretofore given," he says, "we observe that it is a property right inseparably annexed to the soil and passes with it, not as an easement, or appurtenance, but as a part and parcel of the land.

It is, therefore, a vested right to private property, which, under the Constitution of the United States, the owner cannot be deprived of without due process of law, nor taken for public use without just compensation. We must assume that this recent, able and carefully considered opinion of the Supreme Court is not in violation of this section of the Constitution, and that it is applicable alike to all states. Therefore, we cannot escape from the conclusion that the common law doctrine of riparian rights, which has been assumed as the law by the courts in many of the Western and doubtless all of the Eastern states, is not the law, and therefore never has been the law, notwithstanding many decisions of the State courts to the contrary, at least as to interstate waters. If it is not the law as to interstate waters within the State, it is difficult to conceive of any theory on which the State courts could maintain such doctrine for those streams which are wholly within the State and are not tributary to navigable waters."

When the question of water rights was first considered in the State of Nevada, the court held that the patentee of the government succeeded to all of its rights and among these was the right to have the water of a stream, theretofore diverted, returned to its natural channel. But this case was overruled in Jones vs. Adams. And in Reno vs. Stevenson (20 Nev., 269) it was unequivocally declared that the common law doctrine of riparian rights was unsuited to the conditions of that State. In the leading case of Clough vs. Wing (2 Ariz., 371) it is said that "the common law, so far as the same applies to the use of water, has never been, and it is not now, suited to conditions that exist here."

If this same line of reasoning can be applied to all States of the Union, so that the atmosphere can be cleared for the enactment of a comprehensive system of titles to water for the United States as a whole, and if, therefore, riparian rights are not considered as vested rights by the Supreme Court, then the inevitable conclusion must be that water is the property of the public, and that Congress, under the domestic tranquillity and general welfare clauses, has power to adopt a comprehensive system of titles to water which will obviate the present turmoil and confusion as to water rights and will promote the general welfare of the nation by assigning to each stream that duty or function which it is best fitted to perform and making use of it for irrigation, for power, for drinking or drainage, as may seem to meet the best needs of the greatest number of people.

WATER USED FOR POWER PURPOSES.

The use of a stream for the development of power has generally been based on the common law and has involved ownership of the stream on which the power plant may be situated and of the lands which may be flooded by the back water of the dam. A long series of court decisions have established certain principles governing the reasonable use of such mill properties and indicate the legal rights of the different owners on the same stream. A number of such decisions deal with the detention of waters by dams and have established the fact that the owner of a mill property may not, for the purpose of operating his mill at certain times, withhold, through temporary storage, the ordinary run of water from the stream below. Many decisions upon the right of a power owner to flood other lands than his own have been rendered, based particularly on the effect of freshets in the stream. Nor must the operation of another mill up-stream nor the drainage of land in the vicinity be interfered with.

Many other principles might be given to show how general has been the practice of the Courts in limiting the development of power to those sites where the ownership of riparian lands made it possible. Of late years, however, the agitation in favor of conservation of natural resources has taken into account the question of water power and throughout the United States there is manifested a tendency to assume the ownership of water powers by the government, or by one State, and to exploit the same for the benefit of the people. In the West, the major portion of the undeveloped water powers are not located on private lands, but on the National Reserves, and although each State exercises control of public waters within its borders, it is impossible to use the water for power development without access to the stream and this must be given by the United States government, under whose control the national forest reservations are placed. It has already been suggested by ex-President Taft in his message of February 2, 1912, that the United States government proceed on a generous scale, through co-operation with the several States, to develop such water powers and that the revenue derived from such development be made sufficient to cover the cost of administration.

In the article by Mr. Lewis, already referred to, the writer advocates the development of water power by the government, but strongly urges that the cost for such services should be that of maintenance plus interest on the development. Already the United States Reclamation Service in Idaho is developing power and selling it at low rates—so low that electricity is used for heating purposes in competition with coal. In New York State, the State authorities have considered the development of water powers in the Adirondack Reserve, but are restricted through earlier legislation which has prohibited, along with cutting timber, any flooding of State lands, so that the greater value of the water is lost by the desire to preserve the Adirondack wilderness inviolate.

In the argument for State or National control of water powers, it has been pointed out that effective competition between water powers is becoming more and more improbable. It has been shown that there has been a marked concentration of water power control in private hands and that this process is advancing rapidly. Indeed, the country was thoroughly aroused a few years ago by the newspaper prominence given to the fact that certain firms had acquired a succession of water powers and the editors took occasion to point out that just as the coal mines had fallen into the hands of corporations, which absolutely control the prices of this public necessity, so the consolidation of water powers in the hands of a few corporations would inevitably eliminate that competition of water powers with coal power, which now allows manufacturers to introduce some restriction on the unlimited demands of the coal barons.

In States where government lands do not exist, so that governmental development of water power is not feasible, it has been proposed in the interests of the public to tax existing water powers, either on the basis of the volume of water flowing over the dam, or of the actual horsepower developed, and the argument in favor of this sort of taxation is, that for the State to receive no compensation of any kind for the utilization of such great natural wealth producers as waterfalls, is to bring into existence the greatest possible factor of injustice in the matter of general taxation. Of all the States, New York has, perhaps, taken the most advanced stand in the matter of State control of its water powers, largely because of the vast extent of State lands on which these water powers are located. There are, however, beside those for State land sites, other plans for development on private lands.

In the bill known as the Fuller Bill, passed in 1907, it was enacted that the State Water Supply Commission should collect information relating to all the water powers of the State and should devise plans for the development of such water powers as it deemed available. It contemplates the construction of power plants by the State and the selling of such water power to individuals at such revenues as may be necessary, for defraying the cost of necessary lands and riparian rights, for meeting the annual cost of maintenance and depreciation, and for such sinking funds as may be necessary to pay off the whole cost of construction with the interest thereon. Under this act, many surveys have been made, designs for dams and water power plants made, but no actual construction has as yet been undertaken. Some storage reservoirs have been built in the Adirondacks and the cost of construction met by a State bond issue, to be paid by the power companies benefited through an annual rental per horsepower.

Pennsylvania also has a Water Supply Commission with extensive power in certain directions. The enabling act provides that no application for the charter of incorporation for the development of storage or for transportation of water for commercial and manufacturing purposes shall be approved until the same has received the sanction of the Commission.

The State of Wisconsin, with its usual broadminded attitude toward public questions, has considered the question of water power control and in a report to the Legislature in 1909 a bill was proposed embodying the following features:

(1) Declaring the use of water for power purposes to be a public use and subject to the control of the State for the greatest public good;

(2) Repealing all water-power franchises, subject to repeal, granted prior to the passage of the act, and providing for their re-issue under the new act;

(3) Providing for sale of surplus power developed;

(4) All holders of new franchises to pay to the State an annual fee on the franchise value of the horsepower put to beneficial use at a rate of not less than 10 cents nor more than $2 per annum;

(5) No franchise to hold longer than for a period of 40 years; rights then to revert to the State exclusive of physical property which may be removed or condemned;

(6) Providing for forfeiture of franchise if annual fees are not paid, failure to develop power, or failure to comply with terms of franchise;

(7) On the termination of the franchise, the State reserves the right to acquire the water powers by purchase, lease or condemnation proceedings, and further reserves the right to manage, regulate and control the use and distribution of the power and the rates at which the power is sold.

(NOTE.—This bill has since been enacted and later been declared unconstitutional by the Courts.)

It will not be necessary to elaborate any further the tendency already pointed out in the matter of irrigation towards limiting the right of private companies to exploit water in streams for individual purposes. The same feeling that has led to the establishment of irrigation laws based on the greatest beneficial use of the water to the surrounding communities is rapidly growing to include the rights of the State in the use of water for power purposes before which the rights of the individual must give way. Ownership of the stream and ownership of the riparian rights is not proof against the right of the State in eminent domain. It has long been understood that for public utilities, such as water works or transportation, the Legislature could and did grant with the franchise the right for the incorporating company to seize private lands, leaving for the owner no redress except such monetary compensation as the Courts or their agents might award. The change in attitude really consists in recognizing water powers as public utilities, in which the public good requires the sacrifice of private rights. The principle is apparently established that the good of the people as a whole requires state control if not state ownership of water powers and so the common law doctrine of riparian rights disappears. The policy which has been established by the Supreme Court of the United States, namely, that any State or municipality has a right to fix charges in the case of a public utility company, selling its products within the limits of such State or municipality, then controls.

WATER FOR STORAGE.

A third instance of the growing interference by State or governmental authority in private rights is to be found in the regulation of flood flows of torrential streams. With the urban and agricultural development of lands hitherto uncultivated, if not protected by forests, comes more rapid run-off and marked soil erosion. It is maintained by members of the Geological Survey that flood tendencies have increased in this country, due almost entirely to recent modifications in surface conditions. Obviously, the complexity of the problem and the impossibility of assigning to any one act the direct responsibility for any specific flood damage absolutely prevent action by any riparian owner at common law to secure the normal stream flow unaffected by flood flows. If injuries to property become unbearable, the only recourse is through private construction of dikes which will give the protection, forced upon the riparian owner by the behavior of his up-stream neighbors.

The national government, through its interest in navigable streams, has long since assumed certain responsibilities for flood conditions in the larger rivers of this country. Many million dollars have been spent along the Mississippi and each year seems to show that the expenditures must continually increase so long as the present methods are adhered to. But on non-navigable streams the national government has no interest and great anxiety is being aroused to devise adequate means for public relief. The most popular plan is found in the construction of storage reservoirs that shall store up the flood volumes in large amounts and pay-out the same at times of low water. This, of course, adds largely to the value of the water powers on the stream and should appeal to the mill owners sufficiently to bring about the construction as a private enterprise. But the small jealousies between manufacturers and the practical difficulties involved in securing concerted action by the several varied interests involved, make such a method of indirect control of freshets practically impossible. In New England, however, there has been a large installation of reservoirs for water power purposes that has undoubtedly resulted in a substantial reduction in flood damages in the lower reaches of the rivers on which such reservoirs are located. Mr. Leighton, of the United States Geological Survey, estimates that probably 10 per cent of the flood waters that originate in New York and New England are saved by storage in artificial reservoirs, lakes and ponds. In Minnesota, at the head of the Upper Mississippi River, practically the entire flood drainage from an extensive area is conserved. In the arid West, there has been an extensive installation of reservoirs, some of which store practically all the flood waters on their respective basins.

Although the New York State Commission, as constituted by the Fuller Bill, exists primarily for the better development of the water resources of the State, yet the Commission has not overlooked the fact that great artificial lakes, created primarily for power purposes, will operate to mitigate the severity of floods. On the Genesee River extensive surveys have been made with a view to the construction of a large impounding reservoir near the celebrated Portage viaduct, where, with the primary intention of preventing a repetition of the extensive damages committed by floods in times past, a profitable source of power may also be provided. On the Canaseraga Creek the powers of the Conservation Commission to improve existing conditions by the construction of impounding reservoirs have been thoroughly tested in the courts. The highest judicial authority of New York State has ruled that the action of the Commission was justifiable and that the contentions of the plaintiffs would not stand. Acting under the provisions of Chapter 734 of the Laws of 1904 and at the instance of certain persons possessing riparian rights in the creek who represented that the present regulation of the stream was insufficient, the Water Supply Commission proceeded a few years ago to make the necessary surveys and to enter into a contract for the work required for improvement and regulation. The claim was made by one riparian owner, whose land was seized for the purpose of improvement, that such taking of property was unconstitutional in that just compensation was not given and on the further ground that the Commission was not entitled to acquire lands by the exercise of the power of eminent domain. The Court of Appeals ruled that the action of the Commission was within the Constitution, that the interests of the State were sufficient to justify the right of eminent domain, and that the method adopted for compensating the riparian owners for their properties was reasonable and sufficient.

It is interesting in this connection to find that in France and in Switzerland those interested in the development of water powers under the rights of their charter or license are thereby allowed to seize any lands needed for reservoir or storage purposes and that the compensation therefor is determined by the same power granting the concession. This last feature is of interest as tending to prevent extortionate demands on the part of owners who see in the proposed construction an opportunity of bleeding the manufacturers. It is also of interest to remember that in France the Bureau of Hydraulics is a most important arm of the governmental service. This organization polices, patrols and guards all the waters of the country, whether publicly or privately owned. In the mountainous parts of France most extensive and important enterprises have been carried out in certain regions exposed to the ravages of torrents. In Germany, on the other hand, the regulation and correction of streams is in the hands of the provincial governments. Each of the provinces has a "stream-building" commission with a chief engineer at its head, which controls design, construction and operation for each river flowing through several districts, so as to obtain uniform results for the entire river, and much work in the way of regulation of freshets and in the protection of banks has been done under their direction.

WATER FOR DOMESTIC USE.

In the matter of water supplies for domestic purposes the tendency, already noted in the case of irrigation, to make the State supreme and, in case of water power companies, to overrule the individual ownership for the sake of the public at large, has not been so manifest. The old theory of riparian rights has generally prevailed and the inducements by which investors have been persuaded to undertake the task of water works construction have come, either from the hope of profit in the case of the private company, or from the actual needs of the community, in the case of municipal ownership. Since water works for supplying cities and towns with water are for municipal purposes, the Legislature may confer authority to condemn private property, may, subject to Federal approval for interstate streams, authorize the erection of a dam in a navigable river and may allow water in quantity to be taken from public streams or ponds.

Full compensation must be granted to all riparian owners whose rights are in any way interfered with and, except in the cases where the supply is taken from large rivers or lakes, the indemnity demanded for the withdrawal of water becomes a large factor in the cost of construction. Thus, the City of Syracuse, which in 1894 built a supply main from Skaneateles Lake to the city, was forced to construct a dam for storage purposes and therefore to interfere with the normal flow in the lake outlet. Under condemnation proceedings, the city was obliged to pay the 36 mill owners along the outlet the sum of $462,000 as compensation for the water power withheld. The State of New York also, wherever the natural flow of any stream has been interfered with for canal purposes, has been forced by the riparian ownership theory to make heavy returns for the water taken away.

The right of the State to overrule private ownership for public purposes is unquestioned, but generous compensation is always exacted. Thus, in the case of the Barge Canal in New York State, now under construction, a large dam has been built on the Mohawk River above Rome at the little village of Delta, wiping out the village and obliging residents, much against their wills in many cases, to accept the stipulated compensation and find a new home. The amounts of money that the city of New York has paid or is to pay for interference with riparian rights, because of the construction of the Catskill aqueduct and the diversion of the waters of the Esopus Creek, are so great as to leave no question of the justice of the compensation. The point of interest is that the city has full legal powers to so interfere with apparent vested rights on many miles of river.

Until recently, there has been no attempt to go beyond the needs of the single city in its search for water and to consider as a substitute the greater economy to be obtained by the union of several communities. A large city on the lake shore may reasonably extend its water intake pipe several miles into the lake in its search for pure water. A small village, on the other hand, may be equally in need of the same water and altogether helpless, financially, in the matter of obtaining it. A most interesting problem is now being worked out in New York State, where the Conservation Commission is undertaking the modest task of providing a public water supply for some 60 villages. In that region, there is none available at reasonable cost, so the State has undertaken to develop in storage reservoirs a sufficient supply and to distribute it through about 200 miles of pipe.

There have been a few examples of water supply districts, such as the Boston Metropolitan District, where a commission has been duly authorized to proceed to develop a water supply for a city and its suburbs, but for a state to consider the needs of a community, unasked, is quite unique. This method, however, of supplying a community with water through the agency of the State is in direct contrast to the community method which has been practiced in some localities and which has also been utilized as a method of securing irrigation. In fact, Mr. Leighton reports that the acreage of land irrigated by community installations is altogether greater than that irrigated by private companies or by the government under the Reclamation Act.

WATER FOR SEWAGE DILUTION.

In the matter of sewage disposal, the riparian rights theory has almost unanimously been accepted, the one exception being through Legislative permission granted in Massachusetts, by which certain streams are dedicated to the use of the public and to perpetual pollution by manufacturing wastes. Until the State Boards of Health have within the last few years become active, all attempts to purify sewage have been made at the instigation of, and through pressure brought by, riparian owners. A suit at common law to obtain damages, on account of a polluted stream passing the property of a riparian owner, or an injunction obtained from a court to prohibit pollution shown to be objectionable, has resulted in numerous cases in the construction of sewage treatment plants, which, in many cases, have been absurdly disproportionate in cost to the amount of damage inflicted. Thus, the City of Columbus has been obliged to spend over $1,000,000 to purify the sewage of the city because of a suit at common law by some farmers down-stream, whose continued damage could not have been more than a few thousand dollars at most.

The concentration of population in this country is growing so rapidly and the value of the manufacturing interests and the needs of the urban centers are so great that the matter of usefulness of streams can no longer be considered as formerly when only farm lands and their interests were involved in any controversy between riparian owners. Perhaps no better example of the relative importance of the values involved can be cited than to refer to some of the streams of the Adirondack region of New York State, where pulp mills discharge sulphite liquor into the streams. This liquor is a weak sulphurous acid containing in solution a relatively small amount of lignin, dissolved from the spruce pulp. By reason of the great quantity of this waste discharged, the lignin becomes a nuisance in the streams, clinging to the rocks, forming a carpet on the bed of the stream, and, if exposed to the hot sun, decomposing and smelling bad. Some years ago, Justice Hughes, then Governor of New York State, was appealed to, under that provision of the Health Law of the State which requires the Governor to investigate complaints and to take such action as may seem to him necessary to restore the sanitary conditions violated. Through the investigations made by his direction, it seemed plain that a nuisance existed and that it was undoubtedly due to the discharge of the pulp mill wastes. However, no action was taken by the Governor, presumably because no efficient method of treating such sulphite wastes was known and because an order to purify such wastes before discharge into the streams would have resulted, in effect, in an order to close the mills, for the benefit of the small property owner who was the original complainant. No other action than that taken could have been found reasonable in view of the large interests involved, and while the rights of the riparian owner were undoubtedly interfered with, the continuance of the nuisance was undoubtedly of greater benefit to the public as a whole.

SUPERVISION OF QUALITY OF WATER.

There has, as yet, in this country been no centralized authority competent to pass judgment on the relative importance of the interests concerned in sewage pollution. In the case of irrigation and water power, we have seen that state authority has been invoked by which relative interests of the communities, the rights of riparian owners and the relative importance of various propositions to use the water have been passed upon, so that the greater interests of the public have been conserved. In the matter of water works and sewage, however, this same authority has as yet not been constituted and we have only indications of the direction in which the tendency toward this same centralized authority will move. Boards of Health, indeed, in some states have authority to pronounce on the adequacy of proposed methods of sewage disposal and may insist upon a universal rule of purification to a fixed standard under all conditions of locality and stream flow. They may, indeed, privately consider the advisability of dedicating certain streams or lakes to the uses of a public water supply, and of giving up others to carry off waste matter, but no such public and reasonable dedication is in evidence. In New York State, as already pointed out, at Linden, we have an example of State assumption of centralized power invoked for the good of the community in the matter of water supply. On the other hand, we have examples, as with the Passaic valley sewage, where a number of villages and towns have, without any assistance on the part of the centralized authority, proceeded on their own account to dispose of sewage, the community plan being presumably cheaper than separate action.

There still remains, however, to consider the question of the propriety of the methods of disposal which may have been adopted, and this introduces a new element when compared with the problems heretofore considered. In irrigation questions, in water power questions, and in flood prevention questions, the legal rights involved are paramount and the engineering questions are left to the engineer in charge, who may solve them in the best possible way or not, according to his ability. In the case of water works, the element of quality enters and something more than the mere legal right to the water must be considered. Therefore, there is manifest the need for the disinterested advice or sanction of some higher authorized body. It is not enough for a central authority to find that public necessity for drinking water demands an overruling of private right It must not allow a private company or municipality to furnish to its public impure or polluted water, and surely this last function is as important as the first. No standard practice, however, has as yet been devised. In some states the State Board of Health has advisory powers In New York State, the matter is brought before the Conservation Commission, although in rather a secondary way, the important points considered by it being legal rights, financial ability of the constructing company and non-interference with the rights of the public. In Massachusetts, the State Board of Health has perhaps greater power than in any other state and its status is so well established that it is not likely that any water works company selecting a source of supply would depart from the advice of the Board. The good quality is further maintained by the practice of State Boards of Health in making periodic examinations of the quality of water after construction and in reporting the same to the communities interested. The law of self-preservation operates, then, to force those responsible for bad waters to improve the same. There is no authority, however, which can compel a water company forthwith to improve a supply.

The same thing is true of the disposal of sewage. Boards of Health have power to approve plans for sewage disposal plants and presumably consider the quality of the river water into which disposal is to be made as one of the factors in determining the degree of purification required. The recent English decision by which the City of Birmingham was upheld in its contention that so long as the effluent from its disposal plant was as good as the water of the river into which that effluent discharged, the law governing the purity of the stream was not broken and the purposes of the plant were being carried out, is of interest. If this were to hold generally, all that would be needed in the way of central authority would be a chemist to compare the qualities of sewage effluent with the waters of streams and a police force to insure modifications to produce equal qualities.

Having imperfectly reviewed present conditions of stream ownership, we may assert, as *the first item* in our conclusions, that there seems to be a well developed tendency for the State, acting through Commissioners or Boards of Control, to assume the duty of supervision and of direction as to the use to which non-navigable streams should be put. The tendency has advanced farthest in the West with streams used for irrigation, although the conservation movement has given a great impetus in the same direction in the East with streams used for water power.

As a second item, we may assert, equally confidently, that the old rigorous tenacity with which the rights of riparian owners were believed in and enforced, is weakening. And if the rapid growth of the country is considered, it is not difficult to see the reason why. Under rural conditions, the rights of the individuals are most jealously guarded. No law suits are more bitter than those between farmers who believe their sacred rights are invaded. Each family is almost independent and any extreme central authority is unnecessary, burdensome and rejected. As the same communities become more urban and the former conditions change, the need for a representative authority to adjudge the various interests becomes more and more acute as the interdependence increases. In much this way have the private legal rights, established at the expense of so much litigation, been outgrown and one might hopefully expect a recognition of these changed conditions except for the conservatism of the courts. They are always most unwilling to violate precedent and to give any new interpretations which are in defiance of old rulings.

As a third item, we may say that as sewerage is the last of the many municipal improvements undertaken by a city, so the need of extending the modern conception of public ownership in water to include the soiling of such waters is, or will be, the last to be released from the old riparian rights grip. Yet, such extension is inevitable and must not be overlooked when laws are being framed for more advanced and more comprehensive public rights in streams.

PLAN PROPOSED FOR STREAM CONTROL.

With some diffidence I venture to suggest that, among the many experiments already made, the most reasonable plan for the control of non-navigable streams has not yet been tried. State Commissions fail in the important particular that they have no jurisdiction beyond the State boundaries. Control by Boards of Health fails because they can have no interest except in the quality of the water, and so are indifferent to, or even in conflict with, the use of the stream for power or for irrigation. Community voluntary agreement theoretically is a most promising method, but, due to the inertia of individuals and the difficulty of reconciling the various interests, most unlikely to be of general success.

In place of any of the above, the plan of control by river districts commends itself to me. Then each stream is considered by itself and its various needs and possibilities weighed one against the other. It would be considered as a unit from headwaters to the mouth. Such a control would have to be authorized by the Legislatures of the several States concerned and the Federal government. The initiatory motion would come from any group of persons or interests along the river. The actual authority would be lodged in a commission appointed by the Federal government, made up of representative men. The mill owners, the steamboat companies, the State Boards of Health, the agricultural interests and the conservation interests would all be represented. Such a commission might safely be entrusted to develop the highest usefulness of the water. They would have power to undertake improvements, to build storage reservoirs, to improve channels, to construct dikes, to locate dams, to pass judgment on the propriety of withdrawing water for domestic purposes and to decide on the degree of purification needed before sewage is admitted. Then there would be uniform and consistent regulation for the entire river and its tributaries. We should not see unpurified sewage discharged just above a water works intake, but we should see a progressive program intelligently adhered to after a comprehensive consideration of all the interests, with a view of giving to the public the best value the stream possesses.

It is not a new plan. In spite of the respect for centralized authority in Germany, such localized commissions are found to be the most efficient means of enforcing broadminded policies. The recent organization of the Emschergenossenschaft is a good example of a most successful solution of a perplexing sewage disposal problem by combining all the factors of the entire Emscher Valley. One of the eminent lawyers of Germany in a recent article in *Stahl und Eisen,* in commenting on the new Prussian law for the Control of Water in Streams, sums up his discussion by saying, "The fundamental thought which runs through the entire bill is that the public welfare is of supreme importance in the use of waterways."

In England, after years of unsuccessful struggle to preserve the purity of their streams either by the action of the centralized authority, the Local Government Board, or by the action of the County Councils, it has been found that the greatest success is had by the establishment, under the direction of the central government, of Joint Committees or other bodies, representing all the counties through or by which a river or any tributary thereof passes and the conferring on such body all the powers of a sanitary authority. Largely through the efforts of the conservation enthusiasts, we of the United States have been partly awakened to the permanent needs of the people and there is seen a stirring up of a sense of trusteeship in the guardians of public interest. We recognize the interdependence of the several states. The fundamental principle of equity and law that each shall so use his own as not to injure others is felt to apply not only between man and man, but between State and State throughout the entire Union. And it is felt as never before that each State owes a sacred duty to each other commonwealth in connection with each resource. No longer, then shall selfish and individualistic interests prevail. The public need replaces the personal rights. The exact evaluation of such needs in the case of rivers must come, it is maintained, by constituting local commissions which shall have full authority over the many conflicting public uses which may be made of that particular stream under their jurisdiction.

NEWS SECTION

Editorial Comment—Personals—Society Meetings—Trade Notes—Catalog Reviews—Contract News, Embracing Bids Asked, Work Projected, Contracts Let and Contract Prices on All Classes of Civil Engineering Construction Work.

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The Doings of the Week.

A considerable amount of railroad work has been put under contract since our last issue, and present indications are very favorable for an excellent construction year in this line. Bids on several good-sized jobs are now under consideration by the officials of the larger railroads, and quite a bit of new work is being figured on. In New York City it is now only a question of a short time before additional rapid transit contracts will come up for letting. Last week the Public Service Commission for the First District signed the contracts for the Dual System of rapid transit for New York City, which had been duly approved by the Board of Estimate and Apportionment after their adoption by the Commission. The new rapid transit system provided by these contracts will be about three times the capacity of the existing lines. It will have more than 600 miles of single track, and will cost for construction and equipment about $325,000,000. The cost of construction will be borne jointly by the City of New York and the companies, and all the new roads, other than the extensions of privately owned elevated lines, will be owned by the city, but each company will get a lease of the roads allotted to it for 49 years. After the payment of operating expenses and other charges, the companies must share profits equally with the city. For the construction of city-owned lines the city will contribute about $163,000,000, the Interborough Rapid Transit Co. $58,000,000, and the Brooklyn Company $14,000,000. Each company must bear the entire cost of equipment, as well as the cost of construction of the privately owned elevated railroads. Of the city's contribution, contracts have already been awarded for about $75,000,000, so that there is yet to be let on the city-owned lines work to cost about $160,000,000. All construction contracts are to be awarded by the Public Service Commission, which is now increasing its engineering force for the purpose of properly handling the new work. The engineering department of the Commission now numbers about 750 employes, and it is expected that 200 or 250 more will be necessary to recruit it to the required strength. Five thousand men are now at work on the contracts already awarded, and it is expected that this number will be doubled within a year or two. The new system is to be completed and ready for operation by Jan. 1, 1917, but the contracts provide for the operation of parts of the system as they are completed.

Among the railroad construction contracts awarded recently are the following: Frederick & Barnard, 401 Globe Bldg., Minneapolis, Minn., for grading 50 miles of the Midland Continental R. R. from Jamestown, N. Dak., north; Burns & Jordan, Spokane, Wash., for 60 miles of the Kootenay Central Ry. in Western Canada; Boomer & Hughes, Spokane, Wash., 20 miles of Kootenay Central; W. W. Boxley & o., Roanoke, Va., for the "High Bridge" work for the Norfolk & Southern Ry., including 300,000 cu yds. of excavation and about 10,000 cu. yds. of masonry; Cook Construction Co., Sudbury, Ont., 30 miles second track work on the Lake Superior Division of the Canadian Pacific Ry.; Dominion Construction Co., Toronto, Ont., 84 miles second track work on the Lake Superior Division of the Canadian Pacific Ry.; Jones & Girourad, Ottawa, Ont., 30 miles of second track work on the Ontario Division of the Canadian Pacific Ry.; McQuaig, McCaffrey & Cochrane, 22 miles of second track work on the Lake Superior Division of the Canadian Pacific.

Not much new state highway work has come up for bids since our last issue. The Ohio State Highway Commission has called for bids on six contracts, and in Maryland the Kent County Commissioners are taking bids on 4 miles of state and road. In Texas the Grimes County Commissioners are calling for bids on 30 miles of macadam and 8 miles of sand clay, while the Commissioners of Calhoun County, Texas, will let a contract on March 28 for 30 miles of gravel improved highway. Two good-sized brick pavement contracts have been let in the past few days. The city of Orlando, Fla., awarded a contract for 140,000 sq. yds. of vitrified brick pavement; and the city of Sidney, O., awarded work amounting to about $140,000.

Bids on two large contracts in connection with the New York State Barge Canal were opened last week. For the work at Medina, N. Y., the Maryland Dredging Co., Baltimore, Md., at $1,000,000, was the low bidders; for the work near Waterford, N. Y., James Stewart & Co., New York City, at $1,534,603 was low bidder.

It is probable that New York City will expend $15,000,000 this year for dock improvements. Estimates have already been prepared by Calvin Tomkins, Dock Commissioner, Pier A, Battery Pl., New York, for a 1,200-ft. pier at the foot of West 46th St., and for a half-pier of equal length at the foot of West 44th St. The estimated cost of the piers, which will provide berths for three ships, is $5,816,000.

Trees, Moths and Mosquitoes.

Appropriations for out of the ordinary purposes are common in the eastern states. For example, at the recent town meetings in New Hampshire many communities voted funds for the preservation of shade trees. This work consists in thinning the branches, cutting off dead limbs and stopping decay. In Massachusetts at the annual March meetings nearly all of the towns voted appropriations for the suppression of moths, the sums provided ranging from $25 up to $3,000. Some of the towns have a regular department for preventing damage to foliage by moths, and in a number of these places the appropriation voted for this purpose exceeded that provided for the maintenance of the Fire Department. In New Jersey a number of the counties have commissions for the purpose of exterminating mosquitoes, by ditching marshes and oiling stagnant bodies of water. The commission of Essex County recently let a contract for digging 100,000 lin. ft. of ditches, and a short time ago Bergen County awarded the contract for excavating a like amount of new ditches, and the cleaning out of 310,000 lin. ft. of old ditches. The mosquito budget of Atlantic County for the present season amounts to $26,000. Last week the New Jersey legislature refused to pass a bill amending the county mosquito extermination act by limiting the amount of money to be provided therefore to 1/16 of a mill in every dollar of assessed value.

A Change of Name.

The attention of the Society for the Preservation of Ancient Landmarks is respectfully called to the assault and battery committed on the name of the beautiful little pond that lies in the town of Webster at the junction of the boundaries of Rhode Island, Connecticut and Massachusetts. With no excuse, save the trivial one of saving space, the map makers have agreed to call the body of water that made Webster famous by the last six syllables in its name. As it now graces the maps the pond bears the title of Chaumunagungamaug. Local authorities will still insist on calling it Lake Chawyermothersgingerbread, but the name originally given it by the boss bullfrog, Char - gogg - a - goog - man - changg - a-gogg-chaum-un-a-gung-amaug, will only be remembered by the oldest inhabitant who has carefully chalked the 44 letters on his barn door.

Female Commissioner of Works.

History is being made in Oklahoma. A suffragette has filed her name on the Democratic ticket in one of the larger cities as a candidate for the position of Commissioner of Public Works. If elected she will have direct charge of all public construction, will be boss of the city engineer and will have the last word over the street cleaning department. She is especially well qualified for the position, inasmuch as she has been matron of the police department, a candidate for the nomination for county clerk, and a leader of a "votes for women" parade around the county court house.

O. Tamm, Road Enthusiast.

O. Tamm was a resident of Alexander County, Illinois, for many years. He had occasion to do much traveling over the highways, and he knew how bad a so-called good road could be at times. He died a short time ago, and when his will was read it was found that he had left the bulk of his estate, valued at $100,000, for the building of improved thoroughfares in the county. The will provides that the first road to be built shall be from Tamms to Cairo, and that the Trustees may build such other roads as they elect leading into Tamm. It is provided that the roads must be surfaced with gravel or some better material. All of which goes to show that he was a Tamm good roads enthusiast.

PERSONAL

Mr. Walter T. Lemon has been elected president of the Board of Public Works of St. Paul, Minn.

Mr. George H. Biles, of Harrisburg, Pa., has been appointed superintendent of maintenance of state highways for Pennsylvania.

Mr. H. F. McDonald and Mr. C. D. Brown have opened offices at 904 Confederation Life building, Winnipeg, Man., as consulting engineers and land surveyors.

Lieutenant James B. Howell, of the United States Navy, has resigned to become associated with the U. G. Clark Engineering Corporation of San Francisco.

Mr. Philip Henry Coombs, city engineer of Bangor, Me., died at his home in Bangor, March 6, aged 56. Mr. Coombs had been city engineer for nearly 30 years.

Mr. Charles V. Seastone has been taken into partnership with Professor Daniel W. Mead of the University of Wisconsin in his consulting engineering practice at Madison, Wis.

Mr. W. L. Ulrich has resigned as highway commissioner of the town of Manchester, Conn., to accept a psoition on the staff of the State Highway Commissioner of Connecticut.

Mr. D. H. Blossom has resigned as city engineer for Salt Lake City, Utah, which position he has held since the commission form of government went into effect in that city last year.

Mr. Arthur H. Blanchard, professor of highway engineering at Columbia University, has been appointed by Governor Sulzer as a member of the Advisory Commission on Highways for the State of New York.

Mr. Hermann Russell, chairman of the general safety committee of the Rochester Railway & Light Company, delivered an address before the Rochester Engineering Society March 18 on the pulmotor.

Michael Roche, a well known contractor of Rockford, Ill., died suddenly March 13, aged 53. Mr. Roche was a street and railroad contractor and had recently been engaged on several large contracts at Gary, Ind.

Mr. Franz Schneider, Jr., instructor in biology and public sanitation at the Massachusetts Institute of Technology, has resigned to become sanitarian to the Department of Surveys and Exhibits of the Russell Sage Foundation.

Mr. J. F. Jacqueman has resigned as superintendent, and Mr. Read as managing director of the Bisbee-Naco Water Company, Bisbee, Ariz. Mr. H. W. Hall, an engineer of Douglas, Ariz., will take the position of manager for the company.

Mr. John B. Williams, for the past four years superintendent of the water department, Houston, Tex., has resigned and will join the staff of the Columbia Iron Works of Chattanooga, Tenn., as western sales manager, with headquarters at Houston.

Mr. A. W. Dow, chemical and consulting paving engineer, New York City, on March 11, delivered an illustrated lecture on the "Manufacture of Wood Paving Blocks," before the graduate students in highway engineering at Columbia University.

Mr. Nelson P. Lewis, chief engineer, Board of Estimate and Apportionment, New York, delivered an illustrated lecture entitled "Methods of Paying for the Construction of Street Pavements," March 13, before the graduate students in highway engineering at Columbia University.

Mr. George F. Barton of the Seneca Falls Engineering Company, of Montour Falls, N. Y., read an illustrated paper on "Concrete Steel Structures" before the Rochester Engineering Society, at its first meeting in the new quarters, 328 East Main street, Rochester, N. Y., March 14.

Mr. Peter S. Archibald, civil engineer and formerly chief engineer of the Intercolonial Railway of Canada, died at his home at Moncton, B. C., March 16, aged 65. Mr. Archibald joined the Intercolonial construction staff in 1876, and was assistant and resident engineer at Moncton for the road from 1879 until 1898, when he retired to private practice as a consulting engineer.

INDUSTRIAL

C. A. P. Turner, M. Am. Soc. C. E., Minneapolis, Minn., announces that Shipley and Rasinsky, Consulting Engineers, 605 Miles Greenwood Bldg., Cincinnati, O., have been appointed duly authorized representatives for The Mushroom System in Cincinnati.

The City of Batavia, Ill., has awarded the contract to the Chicago office of the American Engine Co., of Bound Brook, N. J., for an American-Ball angle-compound engine to drive direct connected to a Westinghouse 250 kva. generator, with a direct-connected exciter.

The Universal Portland Cement Co., a subsidiary of United States Steel Corporation, has started work on the construcrion of Plant No. 7, at Duluth, Minn. This plant will cost about $1,700,000 and will have an output of 1,400,000 bbls. of Universal Portland cement per annum. The plant will be electrically operated throughout, requiring about 5,000 hp. Mr. Edward M. Hagar, President, states that work will be pushed as rapidly as possible, and it is expected that the plant will be in operation in 1914. With its present plants at Chicago and Pittsburgh this will give the company a total output of 45,000 bbls. a day, or, 13,500,000 bbls. a year.

After a series of interference contests covering a period of about four years in the patent office in Washington, D. C., patent No. 1,055,806 on corrugated metal culverts of spiral construction was on March 11th, 1913, granted to J. H. Schlafky, president of and assignor to The Canton Culvert Co., of Canton, O. In every contest without exception priority was awarded to Schlafly. During this period of litigation spiral corrugated metal culverts have been manufactured by two or three companies in the United States probably under misapprehension as to their rights in the premises. The Canton Culvert Co., however, now announces that it intends—in fact has already taken steps—to protect its interests in connection with the patent it now exclusively controls on spiral corrugated metal culvert construction.

CATALOGUES

Automatic Shoveling and Conveying Machine.—Paper, 10¾x8¼ ins., 12 pp. Kindl Vessel Unloading Co., 413 Bakewell Bldg., Pittsburgh, Pa.

This catalog illustrates and describes a machine which may be called a combination steam shovel and skip-hoist. It may be used for digging trenches for pipe lines and sewers, excavating caissons and other similar work where excavations to considerable depths are required.

Big Creek Development.—Paper, 8x10½ ins., 20 pp. Stone & Webster Construction Co., Boston, Mass.

This is a report to the Pacific Light & Power Corporation as of January 1st, showing the progress and main features of the initial development on Big Creek, including four concrete dams, two tunnels, two power houses, two 240-mile transmission lines, sub-station and 56-mile railroad.

Big Hole Blasting to Quarry Work.—Paper, 7x9½ ins., 68 pp. The Cyclone Drill Co., Orrville, O.

Bulletin No. 4, entitled "The Application of Big Hole Blasting for Quarry Work," contains reprints of papers by Mr. Sanderson and Mr. Russell read before the National Lime Manufacturers' Association at New York City, and contains also illustrations of machines which have been installed in various quarries throughout the country, with letters from the users. This is a valuable publication.

The Triumph Chronicle.—Paper, 6¾x9¾ ins., 16 pp. The Triumph Electric Co., Cincinnati, O.

This is the March-April number of this chronicle which contains articles on electrical equipment used in refrigeration plants, and on the care of commutators.

Channon's Review.—Paper, 6¾x9⅓ ins., 32 pp. H. Channon Co., Market and Randolph Sts., Chicago, Ill.

The March issue contains the list of changes in prices for contractors' tools and equipment and illustrates, describes and gives prices for a great variety of equipment.

Universal Bulletin.—Paper, 6x9 ins., 20 pp. Universal Portland Cement Co., 72 W. Adams St., Chicago, Ill.

This issue contains articles describing the construction of a concrete bridge grandstand, green house, factory and several residences and public buildings where Universal Cement has been used.

Dipper Dredges.—Paper, 9½x6¼ ins., 106 pp. Fairbanks Steam Shovel Co., Marion, O.

This catalog illustrates and describes steam and gasoline dredges, hydraulic dredges, steam shovels, etc. Line drawings and tables of standard dimensions of dredges and illustrations of dredge engines and parts are contained. There are also a number of illustrations showing the operation of dredges and various dredge and canal extension work.

Concrete Builder.—Paper, 6x9 ins., 40 pp. Chicago Portland Cement Co., 30 N. La Salle St., Chicago, Ill.

This is an artistic publication devoted to the construction with concrete of pergolas, pavements and buildings.

Highway Bridge and Culvert Design.—Paper, 7¾x5½ ins., 16 pp. The Consolidated Expanded Metal Companies, Braddock, Pa.

This is an insert to the catalog entitled "Highway Bridges and Culverts." It contains standard plans with tables of dimensions, quantities, etc., for highway I beam bridges with right angles and with skew wing walls, highway box culverts, etc.

Tents and Awnings.—Paper, 4x6 ins., 96 pp. Hanley-Puddell Tent & Awnings Co., 922 Wabash Ave., Terre Haute, Ind.

This is a very complete little book, giving illustrations accompanied by tables of sizes, weights and prices for tents, awnings, flags, paulins, etc.

American Steel Dredges.—Paper, 3¾x6⅜ ins., 16 pp. American Steel Dredge Co., Fort Wayne, Ind.

This little booklet contains valuable points which should be borne in mind in purchasing dredges and equipment. A general description with illustrations of 1-yd., 1½-yd., and 2½ yd. dredges are given.

Machinery List.—Paper, 3¾x6¼ ins., 60 pp. A. H. Hitchcock, 1220 Caxton Bldg., Chicago, Ill.

This is a monthly reference list for buyers of saw mill and wood-working machinery.

Castings.—Paper, 4x6 ins., 40 pp. The Gardner Printing Co., Caxton Bldg., Cleveland, O.

This is a monthly reference list for buyers of foundry equipment and supplies.

How to Avoid Concrete Failures.—Paper, 3½x6 ins., 8 pp. The American Bureau of Inspection and Tests, Monadnock Blk., Chicago, Ill.

It is the object of this pamphlet to demonstrate that the failures of concrete are due to causes easily obviated.

RAILWAYS

Alabama.

The Central of Georgia Railroad, according to advices from Eufaula, Ala., is preparing to make numerous improvements on the Eufaula and Ozark branch, a distance of 60 miles. The work will include improvement of roadbed, bridges, etc.

Arkanasas.

The Commercial Club of Clarksville, Ark., has renewed its offer of $50,000 cash bonus and the donation of a right of way from Fallsville to that city providing the St. Louis & Pacific R. R. will build a line between these cities.

California.

Arrangements are now underway for securing the necessary franchises and right of way for an extension by the recently completed Easton car line, south along the foot hills to San Mateo. F. J. Rodgers, San Francisco, is interested.

The regular annual meeting of the stockholders of the Riviera Beach & Western Ry. Co. will be held at the offices of the company, Riviera, Texas, Tuesday, April 29, for the purpose of electing directors and considering improvements for the coming year. T. F. Koch is President.

The Southern Pacific Railroad Co. has applied to the California State Railroad Commission for authority to construct a spur track at grade across Middlefield Road, in the Town of Bestos, San Mateo County, to construct a spur track at grade across the county road in the Town of Flint, Placer County.

The Trona Ry. Co. has been incorporated with a capital stock of $200,000, of which $32,000 has been subscribed and $3,200 paid in, and proposes to build a railway from Searles in a northeasterly direction through Kern and San Bernardino Counties to the southerly boundary of Inyo County, at the border of Searles Lake. The total estimated length is 32 miles and the road is to be built to open up potash deposits. The incorporators are Joseph K. Hutchinson, an attorney of San Francisco; Walter Slack and W. R. Whyte, of Oakland.

The Mill Valley & Mt. Tamalpais Scenic Railway and the Mt. Tamalpais & Muir Woods Railway joined in an application to the California State Railroad Commission for the sale of the former to the latter. It is stated in the application that the Mt. Tamalpais & Muir Woods Ry. proposes to take over the property and to expend a great deal of money on its improvement and development. The details of the proposed improvements are not set forth. The incorporators of the Mt. Tamalpais & Muir Woods Ry. are Jas. K. Lynch, Frank F. Bostick, Charles H. Crocker, Charles E. Green, R. H. Pease, Jr., Kenneth C. Gillis and N. E. Fitzpatrick.

The Assembly, Sacramento, Calif., on March 11 passed the bill authorizing the State Board of Harbor Commissioners in San Francisco to extend the Belt Line Railroad through Fort Mason to the Exposition grounds and the Presidio. The bill was introduced by Assemblyman Victor J. Canepa of San Francisco. The measure now goes to the Senate.

A hearing was recently held on the application of the Stockton Terminal & Eastern Ry. for permission to issue bonds amounting to $378,800.

Delaware.

The State Legislature has passed a bill giving trolley companies the right for 15 years to lay tracks on West Ninth St., Wilmington, from Union St. to the fair grounds. The bill is designed to allow the Wilmington & Philadelphia Traction Co. to lay the tracks.

The Durham Light & Traction Co. has been chartered by W. S. Cook and Walter P. Carrow of Dover, with a capital of $1,000,000, to buy, build and operate electric and gas power plants.

Florida.

The Jacksonville Traction Co., Hardy Croom, Manager, Jacksonville, Fla., is considering six new extensions to its line at Jacksonville. These new lines were recommended by the City Council and the company is looking over the ground and making estimates of the cost and the possible revenues to be derived from the lines if laid.

Surveys are to be made for a new railroad that is to entr St. Petersburg from a connecting point with the Seaboard Air Line about 20 miles north of Tampa. It is stated that the promoters have disposed of the bonds and that construction work will be undertaken this year. C. H. Lutz, Odessa, Fla., Secretary of the Tampa & Gulf Coast Ry., is reported to be interested.

Idaho.

The Lewiston-Clarkston Valley Ry. Co. has filed its articles of incorporation with the County Auditor at Lewiston. The capital stock is $1,000,000, and the company is authorized to construct and operate street railway and interurban and suburban systems in Idaho and Washington, and do generally an electric railway business and carry on such transactions as are incidental to that business. The company is understood to be planning to have cars in operation between Lewiston and Clarkston by Aug. 1. The incorporators are: F. L. Sturm, C. F. Osmers, E. L. Alford, J. E. Nickerson, Dr. J. B. Morris, all of Lewiston; J. E. Hoober, of Clarkston, and E. S. Florence, of Asotin.

The Oregon Short Line R. R. is reported to be planning to begin work this spring on the extension of its Twin Falls branch from Rogerson to Wells, Nev., where a connection would be made with the Southern Pacific.

The Oregon Short Line R. R. has under way at the present time construction of second track as follows: Dingle to Pescadero, 13.2 miles; McCammon to Lava, 13.8 miles; Pocatello to Michaud, 8.4 miles, total 35.4 miles. Each piece of work is contracted to the Utah Construction Co., Ogden, Utah. These stretches of double track are for the purpose of facilitating the handling of trains in and out of district terminals or congested junction points. There is already in operation double track between Pocatello and McCammon. Authority for constructing a considerable mileage of double tracking between Pocatello and Mountain Home has been asked, but approval for this request has not yet been received.

Illinois.

The Decatur, Sulllivan & Mattoon Transit Co., J. A. McFall, Secretary, Mattoon, Ill., has been granted a franchise by the Supervisors of Clark County to build an interurban line from Decatur via Mattoon, Westfield, Martinsville and connecting with the Springfield & Central Illinois Traction Line near Martinsville.

The East Side Electric Ry. Co. has been incorporated with a capital stock of $25,000 and principal office at Centralia, and proposes to construct a line from the City of Centralia, Marion County, Ill., to Irvington, Washington County, Ill. The incorporators and first Board of Directors are C. F. Lender, H. C. Higgins, Centralia, Ill.; G. L. Pittenger, S. A. Frazier, W. M. Grisson, W. F. Bundy, Robert Rohl.

Final surveys are under way for the projected 53-mile line of the Peoria & Galesburg. The construction capital has been secured and contracts will be let when the surveys are completed. The road will be built by the Peoria Engineering & Construction Co., Peoria, Ill. L. L. Summers & Co., Chicago and Peoria, are the consulting engineers; Horace Clark, Peoria, is President of the railway; and C. B. Coffeen, Peoria, is President of the construction company.

Indiana.

⦿Scott & Son Construction Co., St. Louis, Mo., has been awarded the contract for building a 2-mile spur of the Bloomington Southern Ry. into the Ohio Stone Co. holdings near Victor. William Kizer has secured a subcontract for the work.

Construction work is to be resumed early next month on the traction line from Boonville to Chrisney, and from Boonville to Lynnville. E. E. Watts is the Engineer.

The Baltimore & Ohio R. R. is understood to have under consideration the expenditure of about $800,000 for establishing yards at Miller, Ind.

It has been announced at Elkhart, Ind., that the New York Central Budget includes an appropriation of $750,000 for completing the Lake Shore's new shop system at that place.

Iowa.

Plans and specifications have been completed by the engineering department of the Chicago, Rock Island & Pacific Ry. for new roundhouse and switching yards at East Des Moines.

City of Cedar Rapids, Ia., has voted to grant 25-year franchise to Iowa Railway & Light Co., Wm. G. Dows, President, Cedar Rapids, As a result the company will build eight extensions and undertake a considerable amount of double tracking this year.

Kansas.

The Salina Street & Interurban Ry. Co., Salina, Kan., is contemplating a number of extensions to its lines at Salina the coming summer.

Preliminary work is well under way for the proposed new Union Depot at Salina, Kan. The building proper will cost not less than $100,000 while the track changes, etc., necessitated by the improvement, will amount to about $500,000. The structure will be located at 12th and North Sts., facing 12th, and it will be used by the Santa Fe, Union Pacific, Missouri Pacific and the Rock Island roads.

Kentucky.

City Council of Owensboro, Ky., has extended franchise of the Owensboro & Rockport Bridge & Terminal Co. for one year for beginning work in the city limits.

D. B. Lacy & Son, contractors for the double track work between Paris, Ky., and Shawhan, on the Louisville & Nashville, have shipped their equipment to Winchester where they have about three months' work. When that job is completed they will reconstruct the South yards at Paris.

Maine.

The Bangor Ry. & Electric Co., John R. Graham, President, 86 Harlow St., Bangor, Me., is to build a 1½-mile extension to its Hampden line this spring. Residents of Winterport are now asking that the extension be continued for 7½ miles to that place.

The Grand Trunk R. R. is rumored to be considering building a branch line from Yarmouth to Bath, passing through Freeport and Brunswick.

Michigan.

Citizens of Walkerville, Mich., have raised a bonus of $20,000 to secure, if possible, the construction of the proposed line of the Grand Rapids & Ludington Ry. through that village.

Franchises for an electric railway have been granted by the Village Council of Iron River and Stambaugh and the township branch of Iron River. It is stated that the projected line will be built this summer. The Appleyard interest of Boston, Mass., which control the Ashland Light, Power & Street Ry. Co., are interested. M. M. Reid, Ironwood, Mich., is President.

Minnesota.

⦿Olson & Tully, Aitkin, Minn., have the contract for grading 17 miles of railway from

Deer River to Little Fork for the Backus lumber interests. About 20 miles of line south from Little Fork into the woods to Backus Camp No. 5 have been built. The road now runs from Deer River to Craig. The new work calls for filling the gap between Little Forks and Deer River.

The Duluth & Northern Minnesota Ry., J. W. Bayley, Secretary, Duluth, Minn., now has track laid to about 60 miles northeast of Two Harbors and has graded about 10 miles further up to Temperance River. As soon as weather conditions permit construction gangs will be put to work for extending the line. It is possible that 70 miles of road will be built this season, completing the line to the Canadian head of the lakes.

It is reported that the Northern Pacific, in addition to the construction of a new station at Aitkin, Minn., this summer, will move the coal dock from McGregor to that place, and will also yard all iron ore on side tracks there.

The Chicago, St. Paul, Minneapolis & Omaha Ry., C. W. Johnson, Chief Engineer, St. Paul, Minn., is reported to be planning to take over the right of way of the proposed Scandinavian Ry., which has been surveyed from Lake Stretch to Ruthton. It is stated that the Omaha will extend its branch from Currie northwest a distance of 30 to 40 miles.

Duluth and the Iron Ranges.

BY PETER E. MEAGHER.

W. Q. Kingston, of the Roberts Kingston Contracting Co., steam shovel operators, was a caller. He has just returned from a 30 days' trip to Florida, and stated that he had a very enjoyable visit, and is now in fine shape for the season's work. They have two steam shovels in operation and recently purchased a number of 12-yard Western air dump cars.

John Bergman, the contractor, was a caller. He is engaged at the present time on a rock contract that he sub-let from Morris, Shepard & Dougherty, on the Milwaukee R. R., in the southern part of Minnesota.

J. Hankinson, Division Engineer for the Soo Ry. Co., was a caller. At the present time he has a large engineering crew in the field, and this system contemplates doing quite a bit of work the coming season.

James J. Byers, the Michigan contractor, was a caller, and states that he has two or three contracts that he expects to start on very soon.

J. H. Flick, of the J. H. Flick Construction Co., Chicago, Ill., was a visitor recently and spent a couple of days with us here. Joe states that they are figuring on quite a bit of work at the present time and hopes to be successful in landing some of the contracts. They have not finished up their work on the Milwaukee in Upper Michigan, but expect to be through about April 1. Joe looks fine and states that he is pleased with the outlook for the coming season.

K. P. Grant, the contractor from St. Paul, was a caller last week, and went up on the Range with the writer. This was his first trip to the iron region, and he was very favorably impressed with the magnitude of the dirt moving operations in this vicinity.

A. J. Brown, Vice-President of the Roberts Kingston Contracting Co., has returned from a 30 days' trip to lower Canada, and states that he is eager to start moving dirt.

Arthur and Will Powell, of the Powell Mitchell Co., Michigan Contractors, were callers last week. They are figuring on one or two jobs and hope to be successful in landing them.

Guy Bergan, representing the Taylor Iron & Steel Co., was a visitor a few days ago, and left for a trip to the Iron Ranges.

J. E. Morrisey, traveling representative for Beall Brothers, manufacturers of shovels and track tools, spent a day with us here recently, and reports business very fine.

A. C. Stansill, traveling representative for Kilbourne & Jacobs, car manufacturers, spent a couple of days in this vicinity recently.

W. D. Foulke, Treasurer of the Western Wheeled Scraper Co., dropped in to see us a few days ago. He reports business for 1912 the best that they have ever had in their history, and believes that business in general will be good for 1913.

W. L. Rogers, of Bates & Rogers Construction Co., and one of their Superintendents, C. R. Smith, came in to se us recently. They have quite a bit of work up in this vicinity, and it is progressing very nicely.

Hugh Steele, general contractor, was a caller. He has a rock contract at Ashland for the United States Government and some sewer work in Duluth.

E. C. Coons, of the Butler Coons Contracting Co., came in to see us and stated that his ditch contract was getting along very fine.

P. G. Pastoret was a caller, and left for Marquette, Mich., to figure on a large sewer job that is coming up in that city.

Harry Roberts, President of the Roberts Kingston Contracting Co., who has been spending the winter in the South, has returned and has gone to his home in Houghton, Mich., to rest up until about May 1. Mr. Roberts has been very ill for the last nine months, but we are glad to say that he is improving quite rapidly, and now looks like his usual self.

Ben. Finch, of Finch Brothers, the tie and piling people, was a caller, and stated business was fine in his line.

J. B. Rhodes, traveling representative for the Western Wheeled Scraper Co., spent a few days with us here recently and then left for the South.

Ed. Hingeston, representing the Bucyrus Steam Shovel Co., was a caller and stated that shovels were going as fast as they could make them.

The writer received a letter from C. J. A. Morris, senior member of the firm of Morris, Shepard & Dougherty. Mr. Morris is at the present time in Florida, and judging from his letter, is having the time of his life, and he is certainly entitled to it, as he has been a hard worker.

Wick O'Connell, the contractor, is in the city at the present time, and is doing some work for the South Shore Railway in Michigan.

The outlook for construction work in this vicinity is very good, but the labor situation has not loosened up any as yet and the outlook for the future not very good. Jobs plentiful and men scarce. There is considerable work to be done in this vicinity the coming season, but contractors will be quite handicapped on account of the shortage of labor.

Missouri.

The Legislature of Missouri has passed an act providing for a constitutional amendment authorizing the City of St. Louis to become indebted to the extent of $30,000,000 for construction of a municipal subway. The matter will go to the people for ratification at the fall election of 1914. Under the proposed amendment, Kansas City also is authorized to vote subway bonds.

The Missouri Pacific Ry. is to build a sidetrack from the main line to the property of the St. Elmo Marble Co., west of Springfield, Mo.

The Missouri State Board of Railroad Commissioners has instructed the St. Louis-San Francisco R. R. Co. to improve the line from Kansas City to Springfield, Mo., by way of Clinton. The order requires that the track be nut in proper shape and that the steel be not less than 75-lb.

St. Louis Items.

BY A. B. KOENIG.

⊙Mike Conroy secured a job of grading 150,000 yds. of property work in Granite City, Ill. This job just suited Mike, for his outfit has been lying idle in Granite City for the past 60 days.

⊙The St. Louis County Court has awarded contracts for improving streets in incorporated municipalities, but the amounts to he apportioned have not been determined. A recent law makes it the duty of the court to pay back to each town at least 65 per cent of the road taxes paid into the county treasury on property in the incorporated limits. Last year only about 80 per cent of the levy was paid in most of the towns, and the court is inclined this year to appropriate the 65 per cent of the 80 per cent, to which the towns are objecting. They want 65 per cent of the full amounts levied. Last year a basis of about 90 per cent was used, which County Clerk William Seibel claims was more than they were entitled to. On the 80 per cent basis, Kirkwood would receive this year about $3,274; Webster Groves, $5,523; University City, $5,458; Maplewood, $2,798; Ferguson, $1,000, and Florissant, $278. The work in Kirkwood has been awarded to G. A. Heman, Webster Groves, Glencoe Lime & Cement Co.; University City, Nicholas Lamb; Maplewood, Big Bend Quarry Co.; Fergus and Florissant, Bambrick Bros. Construction Co.

The City of East St. Louis last week took its first official action toward paving State St., the Belleville-St. Louis rock road, for about 7 miles. A petition was filed in the Circuit Court at Belleville to levy a special assessment. The move means eventually the construction between Belleville and East St. Louis of what will be one of the finest boulevards in Illinois. It will be 14 miles long and the estimated cost of the improvement is $300,000. The tracks of the East St. Louis and Suburban Railroad are to be placed in the center of the street. The paving will be extended to Edgemont, to which Belleville proposes to pave the street as soon as all legal objections can be overcome.

Murphy & Miller bought a new steam-shovel outfit last week and are in the market for some of this kind of work. Box 300, North Manchester, Ind., will catch them.

W. B. Goien has 300,000 yds. of machine and fresno work in Wyoming to let. Free transportation from Kansas City or Omaha for labor and outfits. Address him care of Koenig's Labor Agency, 1320 Dodge St., Omaha, Neb.

The J. A. Ware Construction Co. has started on its steam-shovel work at Missouri City, Mo., on the Wabash R. R.

John Marsch has made a flying start with his Wabash R. R. work in northern Illinois and is going to keep up his reputation of finishing work ahead of contract time.

Costello Bros. are cleaning up their work at Edwardsville, Ill., on the Wabash R. R., and moving 2 shovels from there to Iowa on the Milwaukee R. R.

W. F. Woodruff, Watson Road and Fyler Ave., St. Louis, Mo., has 5 teams idle.

Cravens & Murphy expect to finish their work on the Northwestern R. R. in Illinois within the next 30 days.

Harrington Bros. have a crackerjack 30-team outfit idle near Clayton, Mo. Are in the market for a good piece of grading.

Announcement has been made by President J. D. Houseman, St. Louis interurban traction line builder, that the directors of the steam line had agreed to either sell or lease the St. Louis & Hannibal road to his traction companies, the St. Louis Belt, Illinois & Eastern Traction Co., and the St. Louis & Western Traction Co. A meeting was held at Hannibal for the purpose of making legal acceptance of Mr. Houseman's proposition for the St. Louis & Hannibal road to abandon steam operation and sell or lease the roadway and all other property save the rolling stock to the Houseman Co. While the officials of the Houseman lines cannot name the terms on which the steam line will become a part of their system, they said that Blair & Co., New York bankers, who own the steam line, have agreed to the merger and that in all probability the St. Louis & Hannibal securities will be converted into the securities of the traction system. The steam line has $1,000,000 of stock authorized, of which $462,000 is outstanding and $630,000 bonds, of which $380,000 are first mortgage 7 per cent and $250,000 income fives. The first named are due in 1936 and the incomes are due in 1933. The road was chartered in 1873 and built from Gilmore, Mo., to Hannibal, 85 miles, being opened for business in 1882. Later an 18-mile branch from Ralls Junction to Perry, Mo., was built, making the road 103 miles long of main line. The Houseman enterprise will have a capitalization of cling the two Bristols with a view to providing additional factory sites. The new line is being promoted by the Board of Trade.

Texas.

The Guadelupe Valley Traction Co. has been chartered with a capital stock of $100,000 and proposes to construct and operate a traction line within the cities of Austin and San Antonio and through the intervening cities, towns and villages. The business of the corporation will be conducted in San Antonio and Austin, but the principal office of the corporation will be in Seguin. The first board of directors are named: W. B. Dunlap and Walter J. Crawford of Beaumont; E. W. Brown of Orange, and J. M. Abbott and J. M. Abbott, Jr., of Seguin.

The Houston & Brazos Valley Terminal Co. has been chartered with a capital stock of $300,000 fully paid in. The operations of the company will be in and adjacent to the towns of Freeport and Velasco, Brazoria County. The business will be transacted at Freeport. The first board of directors of the road will be Felix Jackson, Velasco, Tex., President of the Houston & Brazos Valley R. R., a 23-mile steam line; James A. Baker and C. N. Schaff of Houston; E. R. Cobb of Freeport and W. A. Webb of Dallas.

Ordinance is before the City Council of Houston to grant the Houston Belt & Terminal Ry., J. J. Flynn, General Manager, Houston, a franchise to construct 13 tracks across certain streets in the eastern section of Houston to be used for yard purposes. The company in return will expend about $85,000 for creosoted wood block pavement.

The San Antonio, Uvalde & Gulf R. R., A. R. Ponder, General Manager, San Antonio, Tex., has filed a charter amendment increasing the capital stock from $280,000 to $315,000, and changing the principal office from Crystal City to San Antonio. The increase in capital stock is made for the purpose of procuring funds with which to make extensions authorized by previous amendments.

A delegation of the Young Men's Business League, Waco, Texas, recently visited Mount Calm and Prairie Hill for the purpose of investigating the feasibility of building a railroad from Waco to the latter place.

Utah.

The Salt Lake & Utah R. R., now building an interurban line from Salt Lake to Provo, has elected the following officers: W. C. Orem, Salt Lake City, President; H. C. Joy and James G. Berryhill, Vice Presidents; F. M. Orem, Secretary and Treasurer; P. H. Cook, General Traffic Manager; W. R. Armstrong, Assistant General Manager; G. F. Arentz, Chief Engineer; and Henry R. Moore, General Attorney.

Virginia.

The Norfolk & Western Ry. is reported to have completed plans for the electrification of a 30-mile stretch of its road into the Pocahontas coal district. It is stated that a 30,000 H.P. power plant will be erected.

Washington.

Reports from Wenatchee, Wash., state that contracts are to be let at once for the construction of about 40 miles of railroad to complete the line of the Great Northern to Vancouver, B. C. The G. N., the V. V. & E. and the C. P. R. will unite in financing the road, which will involve a large outlay. The new section will be built from Cold Water summit, to which point the Great Northern is now constructing its line, and its western end will be at Hope, B. C. It will pass through much rugged country. With the completion of this link midway between the Coast terminus and the western extension of the V. V. &E., built out from Oroville, the Great Northern will have a new through line to the Coast running from its main line at Wenatchee.

Wyoming.

A plan is under consideration by W. H. Lyman and associates of Kewanee, Ill., who recently purchased the 13-mile railroad of the McLaughlin Tie & Timber Co., to extend the line 20 miles to Sundance, Wyo. The line at present extends from Belle Fourch, S. Dak., to a point three miles in Wyoming.

Canada.

✣Bids will be received until noon, June 21, by L. K. Jones, Secretary Department Railways and Canals, Canada, Ottawa, Ont., for the grading of a double track railway from Rockingham to the Halifax Ocean Terminal. Plans, specifications and form of contract may be seen and full information obtained at the office of the General Manager of Government Railways, Moncton, N. B., at the office of the Engineer at Halifax, N. S., and at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, Ont.

The Great Northern R. R. is reported to have acquired the charter of the Western Dominion Ry., covering the construction of a line through the country southwest of Calgary through the lands now being prospected for oil.

The Canadian Northern Ry. is reported to have negotiations under way for acquiring the franchise of the Alberta & Great Waterways Ry. The sale would have the effect of releasing the $6,000,000 deposit of proceeds from the bond sale now being held by the Royal Bank, and $1,000,000 held by the Union and Dominion Banks, while the appeal has been before the privy council.

ROADS AND STREETS

Alabama.

✣Bids will be received until 12:30 p. m., June 27, by Board of Revenue, Jefferson County, Birmingham, Ala., for macadamizing part of the old Stouts Road at about the 13th mile post. The expenditure is estimated at $4,000. A certified check is required with each bid. W. S. Keller, Montgomery, Ala., is State Highway Engineer.

✣Bids will be received until noon, June 23, by Board of Revenue, Montgomery County, Montgomery, Ala., for the grading and graveling of the following roads: (1)—3 miles of the Macon County Road from Cecil to County Line. (2)—4½ miles of the Sprague Junction Road from Sprague to Oakwood. (3)—2½ miles of the Fannin's Mill Road from Ramer Grady Road to Huffman Road. Profile and specifications may be had at County Engineer's office. Each bid must be accompanied by a certified check of $100. Thos. H. Edwards is County Engineer.

✣Bids will be received until noon, July 1, by Board of County Commissioners of Calhoun County, Anniston, Ala., for grading, draining and surfacing with macadam approximately 1½ miles of the Piedmont & Jacksonville Road, beginning at the corporate limits of Piedmont. Expenditure $4,000. Certified check $400 required with each bid. W. S. Keller is State Highway Engineer.

Arizona.

✣Bids will be received shortly by the Board of Greenlee County Supervisors, Clifton, Ariz., for the construction of the Duncan-Richmond Road in accordance with plans and surveys prepared by H. O. Tunis, County Surveyor.

✣Bids will be received until July 7 by Board of Greenlee County Supervisors, Clifton, Ariz., for the construction of the Clifton-Morenci highway. The work will be done in accordance with plans and survey of H. O. Tunis, County Surveyor.

Arizona.

There is a force of engineers under the direction of Asst. State Engineer John Barlow of Arizona making a survey and estimate at present for a portion of the state highway between the town of Clifton and Solomonville. Bids for this work will be received in the latter part of July.

Arkansas.

⊙R. Mobley of Little Rock, Ark., has been awarded the contract at Argenta, Ark., for the construction of street paving in Districts Nos. 15 and 16, for approximately $150,000. Lund & Hill, Little Rock, are Engineers.

California.

✣Bids will be received until 2 p. m., June 30 (postponement of date), by California State Highway Commission, Forum Bldg., Sacramento, Calif., for the road work mentioned in the June 11 issue of ENGINEERING & CONTRACTING.

⊙The City Council of San Diego, Calif., W. M. Rumsey, City Engineer, has let the contract for grading Fay St. to C. H. Tingey for $6,840.

⊙The contract for the improvement of Fremont Ave. has been awarded by the City Council of Santa Monica, Calif., to the Ira Hodson Co. of Los Angeles for $140,000. The contract calls for widening of the avenue to 80 ft., paving and the placing of an ornamental lighting system from the ocean three miles to the easterly city limits.

⊙The Board of Public Works of Los Angeles, Calif., has awarded the contract for the improvement of East Eighth St. from Main St. to Central Ave. to Fairchild-Gilmore-Wilton Co. of that city for $57,277. The contract calls for asphalt pavement, granite block gutters and cement sidewalks.

⊙Following contracts have been awarded for the installation of a rock crushing plant at Fort McDowell, Calif., Capt. James Longstreet, Constructing Quartermaster, for which bids were opened June 4: Allis Chalmers Co., San Francisco, transformers and motors, $1,389; Pacific States Electric Co., San Francisco, wattmeter, wire, conduit, etc., $195; Orenstein-Arthur Koppel Co., San Francisco, railway supplies, $699; Davis-Rogers Co., bunkers and machinery, $11,929.

The Board of Trustees of Oroville, Calif., has decided to pave Meyers St. from the Exposition Bldg. to High St. this summer.

The committee appointed by the Colusa County Supervisors, Colusa, Calif., to look into the cost of the needed improvements in the county has made its report to the Supervisors. The report was made to the effect that the cost of all the improvement would be $573,684.

Delaware.

✣Bids will be received until noon, July 8, by Levy Court, New Castle County, at the office of the County Engineer, Wilmington, Del., for two 10-ton road rollers driven by either gasoline or steam. Benjamin A. Groves is President of the Levy Court.

District of Columbia.

✣Bids will be received until 2 p. m., June 20, by A. S. Burleson, Postmaster General, Washington, D. C., for furnish 20 or more 4-wheeled and 20 or more 3-wheeled motor-driven vehicles for use in the postal service.

Florida.

The Board of Public Works of Sarasota, Fla., will shortly call for bids for the furnishing of approximately 1,000,000 paving bricks. The city will spend $55,000 in sewers, water mains and paving this year.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Idaho.

The Ada County Commissioners, Boise, Ida., have taken up the question of spending $150,000 in macadamizing a road in that county.

Illinois.

✣Bids will be received until 3 p. m., June 19, by Board of Local Improvements, Pekin, Ill., for the construction of the improvement of Seventh and Eighth Sts. paving district. The Engineer's estimate for labor and material is as follows: 16,730 sq. yds. of brick paving on a concrete foundation 5 ins. thick covered with a sand cushion 2 ins. thick, interstices filled with cement grout covered with one-half inch sand and provided with the necessary expansion joints; 5,600 cu. yds. excavation and filling; 600 ft. concrete curb 6x20; 6,500 lin. ft. curb reset and 960 sq. ft. cross walks. Said improvement shall be constructed in accordance with the ordinance for the same and plans and specifications on file in the office of the City Engineer.

✣Bids will be received until 2 p. m., June 19, by Board of Local Improvements, Pekin, Ill., for the construction of street improvement in the Capitol, Fourth and Fifth Sts. Paving District. The Engineer's estimate for labor and materials is as follows: 41,000 sq. yds. brick paving on a concrete foundation 5 ins. thick covered with a sand cushion 2 ins. thick, interstices filled with a cement grout and provided with necessary expansion joints; 13,654 cu. yds. of excavation and filling; 5,000 lin. ft. concrete curb 6x20 ins.; 900 ft. protection curb 5x8x16 ins., and 14,825 lin. ft. curb reset.

✣Bids will be received until 4 p. m., June 24, by Board of Local Improvements, Ottawa, Ill., for furnishing the labor and material for the grading, draining and paving with vit. brick on 4-in. concrete foundation the streets in the South Ottawa District. The work will include about 60,966 sq. yds. of pavement. Specifications, etc., may be had on application to George L. Farnsworth, Public Engineer, Ottawa, Ill. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until noon, June 26, by John McGillen, Clerk, Sanitary District of Chicago, Ill., for sewer outlet, South 56th and South 52d Aves. A certified check for $5,000 must be deposited with each bid. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 11 a. m., June 23rd by the Board of Local Improvements, Chicago, Ill., for furnishing all labor and materials necessary to construct pavements in the following streets and alleys: Bittersweet Place, Clarendon Ave. to 1,050 ft. east, assessment available, $7,365.75, 2,130 lin. ft. sandstone curbing, 900 cu. yds. concrete retaining wall, 3 510 sq. yds. asphaltic concrete pavement, Ainslee St., Evanston Ave. to Sheridan Road, assessment available $9,392.29, 2,200 lin. ft. graphite concrete combined curb and gutter, 3,500 sq. yds. asphalt pavement; 56th Pl., Stewart Ave. to C. & W. I. R. R., assessment available, $6,052.25, 2,130 lin. ft. sandstone curbing, 2,440 sq. yds. asphaltic macadam pavement; Gladys Ave., 47th Ave. to 48th Ave., assessment available, $7,000, 1,380 lin. ft. granite concrete combined curb and gutter, 2,060 sq. yds. asphalt pavement; 21st St., Troy St. to Kedzie Ave., assessment available, $4,000, 700 lin. ft. granite concrete combined curb and gutter, 1,200 sq. yds. asphalt pavement; Robey St., 12th St. Blvd. to 18th St.; Warner Ave., 48th Ave. to Milwaukee Ave., assessment available, $5,500, 1,700 lin. ft. granite concrete combined curb and gutter, 2,100 sq. yds. asphaltic concrete pavement; Wilson Ave., C. M. & St. P. R. R. to Clark St., assessment available, $35,382, 1,950 lin. ft. granite concrete combined curb and gutter, 100 lin. ft. concrete gutter, 10,900 sq. yds. asphaltic concrete pavement; Cornelia St., Milwaukee Ave. to Ashland Ave., Holt St. Cornelia St. to Augusta St., assessment available, $20,899.50, 950 lin. ft. concrete curb, 3,440 lin. ft. concrete gutter, 7,200 sq. yds. asphalt pavement, alley Sunnyside Ave., Racine Ave., Wilson Ave., Clifton Ave., assessment available, $3,240, 1,310 lin. ft. concrete curbing, 1,030 sq. yds. brick pavement; alley 48th St., 49th St., Champlain Ave., Langley Ave., assessment available, $3,000; 1,200 lin. ft. of concrete curbing, 350 cu. yds. of cutting, 930 sq. yds. of brick pavement; alley 49th St., 50th St., Champlain Ave. and Langley Ave., assessment available, $3,168.50, 1,200 lin. ft. of concrete curbing, 600 cu. yds. of cutting, 940 sq. yds. of brick pavement; alley Polk St., May St. and Norton St., 420 lin. ft. of concrete curbing, 130 cu. yds. earth cutting, 300 sq. yds. brick pavement; alley Oakley Ave., Western Ave., Armitage Ave., Milwaukee Ave., assessment available, $4,069, 1,650 lin. ft. concrete curbing, 460 cu. yds. of earth cutting, 1,290 sq. yds. brick pavement; alley Ashland Ave., Cornelia St., Cornell St., assessment available, $1,791.25, 550 lin. ft. of concrete curbing, 200 cu. yds. earth cutting, 580 sq. yds. brick pavement; alley North Ave., Ewing St., Hoyne Ave., etc., 1,880 lin. ft. wood curbing, 850 cu. yds. earth cutting, 1,780 sq. yds. brick pavement; alley Logan Square, Albany Ave., Shubert Ave., etc., assessment available, $3,133.95, 1,220 lin. ft. concrete curbing, 225 cu. yds. earth cutting, 1,025 sq. yds. brick pavement; alley Belden Ave., Fullerton Ave., Seminary Ave., etc., assessment available, $2,862.90, 1,150 lin. ft. concrete curbing, 300 cu. yds. earth cutting, 890 sq. yds. brick pavement; alley 66th St., 64th St., Kimbark Ave., etc., assessment available, $5,826, 1,000 cu. yds. earth cutting, 2,800 lin. ft. concrete curbing; alley Polk St., Hope St., Blue Island Ave., etc., assessment available, $2,177.50, 1,300 lin. ft. concrete curbing, 400 cu. yds. earth cutting, 600 sq. yds. brick pavement. The work includes preparation of the sub-grade sewer, manhole and catch basin construction and adjustment, sidewalk construction and 6″ Portland cement concrete foundation, unless otherwise specified. Plans and specifications on file with E. J. Glackin, Secretary of the Board.

⊙I. D. Lain, Bloomington, Ill., has been awarded the contract by that city for the laying of the pavement on what is known as the East Side system, being on Mercer Ave. from Clay St. to Washington; on Vale St. from Clay to Grove, and on Clay St. from State to Mercer. The contract calls for Barr or Danville brick at $1.97 per sq. yd., or a total of $57,000.

⊙The Board of Local Improvements of Normal, Ill., has let the contract for the pavement on Fell Ave. and Mason St. to Roy L. Williams for $15,586.

⊙The McCarthy Improvement Co. of Davenport, Ia., has been awarded the contract by the Board of Local Improvements of Rock Island, Ill., for the paving of 14th St. from Third to Ninth Ave., with asphalt, for $1.99½ per sq. yd. and $0.64 for curb and gutter.

⊙Gund & Graham of Freeport, Ill., have been awarded the contract by the Board of Local Improvements of Dixon, Ill., for the paving of Commercial alley and tributary streets for $23,053.

⊙John Fair has been awarded the contract by the City Council of Belvidere, Ill., for resurfacing South State St. from the Northwestern tracks to Logan Ave., and West Pleasant St. from State to Pearl Sts.

⊙The Board of Local Improvements of Quincy, Ill., has awarded a contract for the paving of Fifth St. between Hampshire and Vermont Sts. with creosoted wood blocks to Frank Rees for $3,000.

The Board of Local Improvements of Silvis, Ill., proposes to pave Eighth St. and Eleventh St. and open Ninth St.

⊙R. F. Conway Co. of Chicago, Ill., has been awarded the contract by the City Council of Kewanee, Ill., for constructing the new pavement on Prospect St. from Elm to East, McKinley Ave. from Main to Vine, and Elliott St. from Prospect to Division St. for $34,035.

The Illinois State Legislature, Springfield, Ill., has passed a bill providing for a system of state aid roads throughout the state, carrying an immediate appropriation of $700,000 annually for the next two years for hard road construction.

The Board of Local Improvements of Dixon, Ill., has adopted a resolution providing for the paving of River St. from Galena Ave. east to Ravine Ave. City Engineer Charles F. Nesbit has estimated the cost of the improvement at $24,000.

The City Commission of Moline, Ill., has passed an ordinance providing for the paving with brick of 11½ St. from 11th Ave. to the alley and in the alley from 11½ to 12th Sts., and on 6th St. from 3d to 10th Ave.

Following are the lowest bids submitted to L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering creosoted timber and paving blocks for north Kedzie Ave., Forest Glen Ave. and 56th Ave. fixed bridges: 17,100 ft. B. M. 4x6 creosoted yellow pine timber, $731.02; 12,900 ft. B. M., 2x8, 2x10, 2x12 creosoted yellow pine timber, $577.27; 630 sq. yds. creosoted wood paving blocks, $1,127.70. The Kettle River Co., Minneapolis, Minn. The contract has not been awarded.

Following are the lowest bids submitted to the Board of Local Improvements, Chicago, Ill., on June 6th, for furnishing labor and materials necessary to construct pavements in the following streets: Ada St., W. 51st St. to W. 52nd St., 1,300 lin. ft. granite concrete combined curb and gutter, 60 cts., 2,020 sq. yds. asphaltic concrete on concrete, $1.44, R. F. Conway Co., 133 W. Washington St., Cornell St., Milwaukee Ave. to Ashland Ave., 3,950 lin. ft. granite concrete combined curb and gutter, 20 cts., 8,300 sq. yds. asphalt pavement, $1.64, F. P. McCormick, 133 W. Washington St.; Cortez St., N. Leavitt St. to N. Western Ave., 2,500 lin. ft. granite concrete combined curb and gutter, 59 cts., 3,970 sq. yds. asphalt pavement, $1.82, American Asphalt Paving Co., Diversey Ave., Elston Ave. to 300 ft. east of Oakley Ave., 1,850 lin. ft. granite concrete combined curb and gutter, 55 cts., 3,820 sq. yds. asphalt pavement, $1.69, American Asphalt Paving Co., W. 52nd St.; Wentworth Ave. to P. F. W. & C. Ry., 1,720 lin. ft. granite concrete combined curb and gutter, 60 cts., 2,700 sq. yds. asphalt pavement, $1.69, W. Harrison St., S. Albany Ave. to S. Kedzie Ave., 1,000 lin. ft. sandstone curbing, 30 cts., 230 lin. ft. to be reset, 30 cts., 1,770 sq. yds. brick pavement, $2.16, Citizens Construction Co., 133 W. Washington St.; W. Harrison St., California Ave. to Albany Ave., 3,000 lin. ft. sandstone curbing, 30 cts., 600 lin. ft. to be reset, 30 cts., 6,200 sq. yds. brick pavement, $2.16, Citizens Construction Co.; Larretta Ct., Van Buren St. to Congress St., 600 lin. ft. sandstone curbing, 80 cts., 1,280 sq. yds. brick pavement, $2.50, P. J. O'Brien, 8 S. La Salle St. The contracts have not been awarded; the work includes preparation of sub-grade, 6-in. Portland cement concrete foundation, sewer, manhole and catchbasin construction and adjustment.

Indiana.

✣Bids will be received until 10 a. m., July 8, by Board of Cass County Commissioners, Logansport, Ind., for the construction of a highway in Eel Townshio. J. E. Wallace is County Auditor.

✣Bids will be received until 2 p. m., July 8, by Commissioners of Grant County, Marion, Ind., for the construction of five highways in Center Township and one in Washington Township. E. H. Kimball is County Auditor.

✣Bids will be received until 11:30 a. m., July 8, by Board of Clay County Commissioners, Brazil, Ind., for the construction of a highway in Brazil Township. E. A. Stagg is County Auditor.

✣Bids will be received until 11 a. m., July 7, by Board of Scott County Commissioners, Scottsburg, Ind., for the construction of gravel roads in Lexington, Johnson, Jenning and Vienna Townships. Robert Blunt is County Auditor.

✣Bids will be received until July 7 by Board of Rush County Commissioners, Rushville, Ind., for the construction of Louden road in Walker Township. A. R. Holden is County Auditor.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

✣Bids will be received until 11 a. m., July 7, by Board of Jennings County Commissioners, Vernon, Ind., for the construction of highways in Geneva and Lovett Townships. G. H. Bernhart is County Auditor.

✣Bids will be received until 1 p. m., July 7, by Board of Martin County Commissioners, Shoals, Ind., for the construction of a gravel road in Perry Township. Lorenzo D. Haga is County Auditor.

✣Bids will be received until 2 p. m., July 7, by Board of Newton County Commissioners, Kentland, Ind., for the construction of highways in Iroquois and Jefferson Townships. S. R. Sizelove is County Auditor.

✣Bids will be received until 2 p. m., July 7, by Board of Johnson County Commissioners, Franklin, Ind., for the construction of a gravel road in Hensley and Union Townships. H. L. Knox is County Auditor.

✣Bids will be received until 10 a. m., July 1, by Board of Allen County Commissioners, Fort Wayne, Ind., for the construction of two highways. Calvin H. Brown is County Auditor.

✣Bids will be received until 2 p. m., June 30, by Board of Rush County Commissioners, Rushville, Ind., for the construction of roads in Walker and Union Townships. A. R. Holden is County Auditor.

✣Bids will be received until 10 a. m., June 27, by Board of Hamilton County Commissioners, Noblesville, Ind., for the construction of four public highways. George Griffin is County Auditor.

✣Bids will be received until 9 a. m., July 9, by Board of Trustees, Town of Geneva, Ind., for the construction of 7,218 ft. of 10 to 36-in. pipe sewers. A certified check for $525 must be filed with each bid. Copies of plans and specifications may be obtained of W. A. Wells, Town Clerk. J. T. Gillig, Decatur, Ind., is Engineer.

✣Bids will be received until 10 a. m., June 26, by Board of Floyd County Commissioners, New Albany, Ind., for the construction of a gravel road in New Albany township. Julian T. Miller is County Auditor.

✣Bids will be received until 2 p. m., July 8, by Board of Harrison County Commissioners, Corydon, Ind., for the construction of a road in Washington township. J. L. O'Bannon is County Auditor.

✣Bids will be received until 10 a. m., July 8, by Board of Howard County Commissioners, Kokomo, Ind., for the construction of gravel roads in Ervin, Taylor and Honey Creek townships. E. B. Swift is County Auditor.

✣Bids will be received until 2 p. m., July 9, by Board of Monroe County Commissioners, Bloomington, Ind., for the construction of highways in Richland and Van Buren Townships. W. F. Kinser is County Auditor.

✣Bids will be received until 11 a. m., June 14 by Board of St. Joseph County Commissioners, South Bend, Ind., for the construction of a highway in Lincoln township. Clarence Sedgewick is County Auditor.

✣Bids will be received until 10 a. m., July 8, by Board of Gibson County Commissioners, Princeton, Ind., for the construction of highways in Barton and Montgomery townships. W. T. Roberts is County Auditor.

✣Bids will be received until 1 p. m., July 8, by Board of Marshall County Commissioners, Plymouth, Ind., for the construction of highways in Bourbon township. G. F. McCoy is County Auditor.

✣Bids will be received until noon, July 8, by Board of Morgan County Commissioners, Martinsville, Ind., for the construction of a brick road in Washington township. J. S. Whitaker is County Auditor.

✣Bids will be received until 2 p. m., July 8, by Board of Harrison County Commissioners, Corydon, Ind., for the construction of a road in Taylor township. J. L. O'Bannon is County Auditor.

✣Bids will be received until 1:30 p. m., July 8, by Board of Wabash County Commissioners, Wabash, Ind., for the construction of a gravel road in Pleasant township. Dan S. Showalter is County Auditor.

⊙Sela Smith has been awarded the contract by the Board of Public Works of Gary, Ind., for the improvement of Ridge road for about $51,000.

⊙Frank Jean of Petersburg, Ind., has been awarded the contracts to construct the Cart and Sand rock roads in Madison Township, Pike County, for $13,532.

⊙The Whitley County Commissioners, Columbia City, Ind., have awarded the contract for the construction of the Diffendarfer road in Smith Township to W. W. Hatch & Sons of Goshen, Ind., for $15,290. The road is 6,800 ft. long and 18 ft. wide and will be constructed of macadam.

⊙The Clinton County Commissioners, Frankfort, Ind., has awarded contracts for the construction of gravel roads for which bids were opened June 5, as follows: J. F. Dryer Road, Frankfort Construction Co., Frankfort, Ind., $4,615; E. Worline Road, Frankfort Construction Co., Frankfort, Ind., $1,760; J. T. Newbold Road to Wm. D. Kelly, Frankfort, Ind., $5,067; George Dorner Road to Nees and Seaman of Frankfort, Ind., $2,177; O. W. Edmonds Road to Nees and Seaman of Frankfort, Ind., $4,570; J. B. Smith Road to Nees and Seaman of Frankfort, Ind., $11,241; G. B. McCaughy Road to Nees and Seaman of Frankfort, Ind., $2,388; O. Coyner Road to Lee and Keller of Frankfort, Ind., $4,300; G. T. Williams Road to Maxwell and Kelly of Michigantown, Ind., $3,100; J. A. Like Road, to Maxwell and Kelly of Michigantown, Ind., $1,473; W. E. Lee Road to Maxwell and Kelly of Michigantown, Ind., $3,723.

⊙Quebleman & Pillars, New Salisbury, Ind., have been awarded the contract by the County Commissioners, Corydon, Ind., for the construction of a road in Harrison Township, for $4,450. Bids were opened June 13.

⊙Jene Boyd, Mitchell, Ind., Geo. H. Miller, Mitchell, Miles Standish, Bedford, John Burns, and Jene J. Bairbian, Heltonville, have been awarded contracts by the County Commissioners, Bedford, for the construction of gravel and macadam roads for which bids were opened on June 2.

⊙Fred Davenport, Kokomo, Ind., has been awarded the contract by the County Commissioners, Kokomo, Ind., for the construction of the Jackson road, for $7,800. Bids were opened June 3.

⊙The Mt. Vernon Construction Co., Mt. Vernon, Ind., has been awarded the contract by the County Commissioners, Mt. Vernon, for the construction of gravel road extension in Black Township, for $6,394. Bids were opened June 6.

Iowa.

⊙The J. W. Turner Improvement Co. of Des Moines, Ia., has been awarded the contract by the City Council of Belle Plaine, Ia., for the construction of brick pavement on three blocks of Main or 12th St.

⊙Bids were received at Greenfield, Ia., on June 10 for paving work, for which Charles P. Chase, Clinton, Ia., is Engineer. In the following table (1) stands for bid of J. S. McLaughlin & Sons, Red Oak, Ia. (awarded contract); (2) Des Moines Engineering & Contracting Co., Des Moines, and (3) D. W. Wright, Bedford, Ia:

	(1)	(2)	(3)*
Excavation, 3,000 cu. yds...	0.35	$0.40	$0.395
New concrete curb, 8,700 lin. ft.	0.31	0.335	0.28¾
Plain concrete, 11,300 sq. yds.	1.34	1.36¾	1.35
Reinforced concrete, 11,300 sq. yds...	....	....	1.55
Totals	$18,889	$19,567	$18,941

*Bid $21,201 on reinforced concrete.

⊙Zitterell & Sullivan, Webster City, Ia., have been awarded the contract by that city, C. H. Currie, City Engineer, for the construction of 13,160 sq. yds. of Class A asphalt concrete pavement, for $1.71 per sq. yd.; 34,000 lin. ft. of curb and gutter, at $0.59 per lin. ft., and curb, at $0.38 per lin. ft. Bids were opened June 4.

Kentucky.

✣The city of Louisville, Ky., is asking for bids on street work as follows: 6,740 sq. yds. of concrete; 18,000 sq. yds. of wood block paving; 47,000 sq. yds. of asphalt, and 46,000 sq. yds. of vitrified block sidewalks. The whole will cost about $263,000.

⊙Carey, Reed & Co., Lexington, Ky., have been awarded the contract by the city of Mt. Sterling, Ky., for the construction of 9,440 sq. yds. of asphalt pavement, for $2.35 per sq. yd. The work includes 6-in. concrete base, 2-in. asphalt, all excavation; concrete curb and gutter, at $0.70 per lin. ft. Bids were opened June 3.

Louisiana.

Two elections were held in Red River Parish June 17, one on a proposition to vote a parish-wide 5-mill road tax for five years, and the other to vote an additional 5-mill road tax for five years in Wards 4, 5 and 6, the three river wards. Coushatta is the parish seat.

Maryland.

✣Bids will be received until 8 p. m., June 26, by L. James Tull, Chairman, Pocomoke Street Improvement Commission, Pocomoke Md., for furnishing labor and material for grading, curbing and otherwise improving certain streets. The work includes 30,000 sq. yds. of concrete, brick, bituminous concrete or asphalt pavement, 1,500 sq. yds. granolithic, 29,000 ft. of concrete curb, 50 storm water inlets, 4,000 ft. of 12, 15, 18, 20, 24 and 36-in. pipe. Each proposal must be made on form furnished by the Commission, and must be accompanied by a certified check for $2,000 made payable to E. James Tull. The complete plans can be seen and specifications and blank forms can be obtained at Pocomoke from E. James Tull, or at the office of Herbert W. Hatton, Consulting Engineer, Equitable Building, Wilmington, Delaware.

⊙The Board of Awards of Baltimore, Md., has awarded the contract for paving Bernard St., from 26th St. to 30th St., with bituminous concrete to Patrick Flanigan & Sons, of that city, for $7,809. Thomas Mullan secured the contract to pave 27th St., from Huntington Ave. to Sisson St., with vitrified brick, for $7,649.

⊙The Eastern Paving Co., of Philadelphia, Pa., has been awarded the contract by the Board of Awards of Baltimore, Md., for paving West St. between Light St. and Riverside Ave., with sheet asphalt, for $6,555.

The Paving Commission, Baltimore, Md., has decided to pave Collington Ave. from Baltimore St. to Orleans St. with sheet asphalt.

Massachusetts.

⊙The Road Committee, Athol, Mass., has let the contract for the construction of a permanent road from the South Main St. iron bridge to the Athol fair grounds, a distance of over two miles, to R. F. Hudson of Melrose for $44,490.

Michigan.

⊙Carpenter & Anderson of Grand Rapids, Mich., have been awarded the contract by the Board of Public Works of that city for resurfacing Monroe Ave. between Pearl and Michigan Sts. with sheet asphalt for $12,303.

The Improvement Association of Owosso, Mich., has asked the City Council to submit the question of issuing bonds amounting to $80,000 for the paving of the business section to the people. Brick is proposed.

✣Bids will be received until 7 p. m., June 30, by City Council, Sturgis, Mich., for constructing about 5,000 sq. yds. of brick pavement and about 1,500 lin. ft. of combined curb and gutter. Charles W. Coye is City Clerk.

Minnesota.

✣Bids will be received until 1:30 p. m., June 30, by H. C. Nolte, Martin County Auditor, Fairmont, Minn., for constructing the east two miles of State Road No. 8, beginning at the east quarter corner of Section 11, in Pleasant Prairie Township, Martin County,

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Minn. Also one mile on State Road No. 7, beginning at the northwest corner of Section 7, Tenhassen Township, running thence south on the town line between Tenhassen and Lake Belt Townships to the southwest corner of said Section 7 of Tenhassen Township. Plans and specifications of the work and material to be furnished are on file and may be seen at the office of the County Auditor.

The Board of Public Works of St. Paul, Minn., has passed the preliminary order for paving Summit Ave. from Lexington Ave. to River Blvd. Creosoted wood blocks are favored.

✣Bids will be received until 1:30 p. m., June 30, by H. C. Nolte, County Auditor, Fairmont, Minn., for the construction of East 2 miles of State Road No. 8, also one mile of State Road No. 7.

⊙C. E. Jones, Tenstrike, Minn., has been awarded the contract by the County Commissioners, Bemidji, Minn., for clearing, grubbing, grading and ditching about one mile and a quarter of state road No. 28, for $907. Bids were opened June 10.

⊙Ross K. Nobles, Blackduck, Minn., has been awarded the contract by the County Commissioners, Bemidji, Minn., for clearing, grubbing and grading one mile of state road No. 26 and grading and ditching 2½ miles of road, for $1,170. Bids were opened June 10.

⊙D. B. Dougherty, Willmar, Minn., has been awarded the contract by the County Commissioners, Willmar, for grading state road No. 6, for $1,024. Bids were opened June 5.

All bids received June 3 by Charles Purnell, Town Clerk, Palisade, Minn., for the construction of the Palisade-Waukenabo road from the river to Olson Crossing of the railroad have been rejected.

Mississippi.

⊙The Lauderdale County Road Commissioners, Meridian, Miss., has awarded the contract for the construction of $100,000 worth of good roads to J. J. Mittel, of Nashville, Tenn.

Missouri.

⊙The Board of Public Improvements of University City (P. O. St. Louis), Mo., has let a contract for paving Delmar Ave. from Vassar Ave. to Hanley road to the Grant Construction Co. for $37,600. The pavement will be telford with a concrete top dressing.

⊙The Board of Public Works of St. Joseph, Mo., has let a contract to Reinert Bros. Construction Co. for macadamizing a highway from Fourth and Cedar Sts. to Florence road and Exchange St., connecting the Main part of the city with the stock yards district by means of a bottom road.

✣Bids will be received until 7:30 p. m., June 30, by City Council, Poplar Bluff, Mo., for grading, curbing and paving with vit. brick Main, Vine and Pine Sts., including about 36,201 sq. yds. Plans and specifications may be seen at the office of E. C. Thomas, City Engineer, and may be obtained for $5. H. H. Wilcox is City Clerk. Official advertisement will be found elsewhere in this issue.

⊙The Board of Public Improvements of St. Louis, Mo., has awarded contracts for the following street reconstruction work: Wood block—Reconstructing Pine St. from 12th to 19th, Ruecking Construction Co., $19,898. Brick—Reconstructing O'Fallon St. from 7th to 14th, William H. Redemyer, $20,082; reconstructing Mullanphy St. from Broadway to 12th, John McMahon, $18,200; reconstructing Mullanphy St. from 12th to Hogan, John McMahon, $22,968.

Montana.

⊙J. C. Maguire, Butte, Mont., has been awarded the contract by the city of Missoula, Mont., Fred E. Buck, City Engineer, for paving Pattee St., and Stevens St., including 18,180 sq. yds., for $55,777. The work includes grading, curbing, walks, sewer catch basins, inlets and bitulithic pavement on 5-in. concrete base. Bids were opened June 4.

Nebraska.

⊙Abel & Roberts, First Nat. Bank Bldg., Lincoln, Nebr., have been awarded the contract by the City Council of that city for the laying of asphaltic concrete pavement for $89,792. The district includes South 27th St., South St., A, Washington and Sumner Sts.

⊙The Offerman Construction Co., Omaha, has been awarded a contract by the County Commissioners, Omaha, Neb., for the paving of West Dodge St. with brick for $64,512.

The City Council of Omaha, Nebr., has passed an ordinance ordering the repaving of Farnam St. from 18th to 24th Sts.

The County Commissioners, Lincoln, Nebr., have decided to pave a part of the West P St. road this season. County Engineer Scott has estimated the cost at $28,000.

New Jersey.

✣Bids will be received until 4 p. m., June 25, by Mayor and City Council, Hoboken, N. J., for the repaving and reimproving of the following streets: Willow Ave., between 15th and 17th Sts.; Clinton St., from 4th to 5th Sts., and 6th to 11th Sts.; Grand St., from Newark to 3d St.; Monroe St., from 4th to 5th St.; Jefferson St., from 4th to 7th St.; Jackson St., from Newark St. to Paterson Ave., and from 1st to 4th St., in the city of Hoboken, N. J., in accordance with the plans and specifications on file in the office of the City Clerk. James N. Londrigan is City Clerk.

New York.

✣Bids will be received until 5 p. m., June 23, by E. M. Hall, City Clerk, Solvay, N. Y., for furnishing work and materials for paving Milton Ave. in said village, in accordance with the plans and specifications on file in the Clerk's office. A certified check for 5 per cent of the total amount of each proposal, payable to the order of W. H. North, Village Treasurer, must accompany each proposal.

⊙The Board of Contract & Supply of Binghamton, N. Y., has let the contract for repaving of Henry St. with bitulithic on a new base from Chenango to Carroll Sts., and for resurfacing the street with bitulithic on the present base from Carroll St. eastward, to the Warren Bros. Co. of Boston, Mass., for $2.40 and $1.60, respectively.

The citizens of Gowanda, N. Y., on June 10 voted on the proposition to pave Chestnut and Water Sts.

⊙The Board of Public Works of Hornell, N. Y., has let the contract for the paving of Church St. to the Greenfield Construction Co., and for paving Collier, Jane, West and Hornell Sts. to Witt & Blades.

⊙Read-Coddington Engineering Co. has been awarded the contract by the Board of Public Works of Niagara Falls, N. Y., to pave Walnut Ave. with asphaltic concrete for $2.35 a sq. yd.

✣Bids will be received until 5 p. m., June 24, by D. J. Coutant, City Clerk, Newburgh, N. Y. (readvertisement) for furnishing the labor and material for the paving of Liberty St. from Broadway to South St. and between South St. and North St. The approximate quantities are as follows: Between Broadway and South Street, about 10,800 sq. yds. pavement; about 4,750 lin. ft. curbing; catch basins, manholes, etc. Between South and North Streets, about 11,300 sq. yds. of pavement, excluding street railway portion; about 14,650 sq. yds. of pavement, including street railway portion; about 7,130 lin. ft. of curbing; catch basins, manholes, etc. Each bid must be accompanied by a certified check or cash to the amount of $1,000. Plans and specifications may be seen and form of proposal obtained at office of City Engineer.

North Dakota.

⊙S. Birch & Sons Construction Co. of Fargo, N. Dak., has been awarded the contract by the City Commissioners of that city for paving Main and 1st Sts. with creosoted wood blocks for $40,135.

Ohio.

✣Bids will be received until 10:30 a. m., June 26, by Board of Wakeman Township Trustees, at the town hall, Wakeman, O., for the improvement of four sections of roads. Plans and specifications for this' work, together with the bidding blanks for same, may be obtained at the office of L. C. Herrick, County Engineer, Norwalk, Ohio. Each bid shall be accompanied with cash or certified check in the sum of $200, payable to the Clerk of Wakeman Township.

✣Bids will be received until noon, June 28, by Township Trustees of Smith, Mahoning County, at the town hall, Sebring, O., for furnishing the necessary labor and material for the improvement of the Johnson Road for a distance of 3½ miles. Harry Jenkins is Clerk.

✣Bids will be received until noon, June 25, by W. J. Springborn, Director of Public Service, Cleveland, O., for paving the portion of Madison Ave. N. W. affected by the separation of grades of said treet and the tracks of the L. S. & M. S. Railroad. Each bid must be made in accordance with the specifications and plans, which may be seen at the office of the Chief Engineer, Room 305 City Hall. W. H. Kirby is Secretary to the Director.

✣Bids will be received until 2 p. m., June 30, by Board of Lorain County Commissioners, F. L. Ellenberger, Clerk, Elyria, O., for the necessary labor and material for grading, draining and macadamizing of the Kipton-Wakeman Road from the first four corners south of Kipton vallage, west therefrom to the first four corners on said road, in all a distance of about three-fourths miles, in accordance with the forms of contract and specifications to be furnished by T. L. Gibson, County Surveyor.

✣Bids will be received until noon, June 24, by Director of Public Service, E. C. Yochem Clerk, Galion, O., for furnishing the labor and material necessary for the construction of about 18,210 sq. yds. of street pavement.

✣Bids will be received until noon, June 21, by Fred Edwards, Director of Public Service, Ashland, O., for furnishing the necessary materials and labor for the improvement of West Main St. from the end of the present pavement to the east line of Lyndale Ave., in the city of Ashland, O., by grading, curbing and paving the same with brick, asphalt, asphalt block, or other suitable material, and constructing the necessary drainage, according to the plans and specifications now on file in said office. Edgar Koehl is Clerk of Director.

✣Bids will be received until noon, June 21, by Fred Edwards, Director of Public Service, Ashland, O., for furnishing the necessary materials and labor for the improvement of East Washington St., from Center St. to the west line of Arthur St., in the city of Ashland, O., by grading, curbing and paving the same with brick, asphalt block or other suitable material, and constructing the necessary drainage, according to the plans and specifications now on file in said office. Edgar Koehl is Clerk of said Director.

✣Bids will be received until noon, June 23, by A. W. Pelton, Director of Public Service, Conneaut, O., for furnishing the necessary labor and materials for grading, draining, curbing and paving with shale block on Mill St. from the south line of Liberty St. southerly and westerly to the east abutment of the covered bridge crossing Conneaut Creek, according to plans and specifications on file in said office. Floyd Stoneman is Clerk of the Department.

✣Bids will be received until noon, July 11, by Board of Hamilton County Commissioners, Cincinnati, O., for repairing under specifications No. 479 Reading Road through the village of Reading, in Sycamore Township. Plans and specifications are on file at the office of the Board. Albert Reinhardt is Clerk.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 o'clock p. m., June 27, 1913, for grading and paving with waterbound macadam the Perry County, State Highway E, Pet. 697, Zanesville-New Lexington road, Inter-County No. 350, in Harrison Township. Length, 7,316 ft. or 1.38 miles. Width of pav., 14 ft. Estimated cost of construction, $12,640. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, October 1. 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., June 27, 1913, for grading and paving with concrete the Putnam County, State Highway C, Pet. 789, Kalida-Lima road, Inter-County No. 134, in Sugar Creek Township. Length, 2,175 ft. or 0.41 miles. With of pav., 16 and 20 ft. Estimated cost of construction, $5,422.72. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, October 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highwav Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., June 27, 1913, for grading and paving with waterbound macadam the Champaign County, State Highway G, Pet. 722, Urbana-Sidney road, Inter-County No. 192, in Salem Township. Length, 5,280 ft. or 1.00 miles. Width of pav., 14 ft. Estimated cost of construction $8,658. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, August 31, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker, State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., June 27, 1913, for grading and paving with concrete the Huron County, State Highway G, Pet. 739, Oberlin-Norwalk road, Inter-County No. 290, in Townsend Township. Length, 13,710 ft. or 2.60 miles. Width of pav., 14 ft. Estimated cost of construction, $31,595. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, October 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., June 27, 1913, for grading and paving with concrete the Sandusky County, State Highwav D, Pet. 255, Sec. 3 Port Clinton road, Inter-County No. 227, in Sandusky Township. Length, 5,780 ft. or 1.09 miles. Width of pav., 16 ft. Estimated cost of construction $16,569. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, October 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., June 27, 1913, for grading and paving with waterbound macadam the Clinton County, State Highway B, Pet. 749, Wilmington-Xenia road, Inter-County No. 248, in Liberty Township. Length, 17,419 ft. or 3.3 miles. Width of pav., 14 ft. Estimated cost of construction, $20,639. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, October 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., June 27, 1913, for grading and paving with waterbound slag macadam the Lorain County, State Highway C, Pet. 503, Pittsfield-Wellington road, Inter-County No. 144, in Pittsfield and Wellington Townships. Length, 12,350 ft. or 2.34 miles. Width of pav., 12 ft. Estimated cost of construction, $17,176. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, October 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., June 27, 1913, for grading and paving with bituminous bonded macadam the Holmes County, State Highway C, Pet. 482, Sec. No. 4 Millersburg-Berlin road, Inter-County No. 341, in Berlin Township. Length, 7,325 ft. or 1.39 miles. Width of pav., 14 ft. Estimated cost of construction, $17,462. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, October 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., June 27, 1913, for grading and paving with brick for heavy traffic the Wayne County, State Highway G, Pet. 458, Doylestown-Barberton road, Inter-County No. 96, in Chippewa Township. Length, 5,634.9 ft. or 1.07 miles. Width of pav., 10 ft. Estimated cost of construction, $16,157. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, October 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., June 27, 1913, for grading and paving with brick for medium traffic the Meigs County, State Highway G, Pet. 647, Chester road, Inter-County No. 161, in Chester Township. Length, 5,280 ft. or 1.00 miles. Width of pav., 12 ft. Estimated cost of construction, $725. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, August 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., June 20, 1913, for grading and paving with waterbound macadam the Harrison County, State Highway G, Pet. 691, Steubenville-Cambridge road, Inter-County No. 26, in Cadiz Township. Length, 6,665 ft. or 1.26 miles. Width of pav., 12 ft. Estimated cost of construction, $9,005. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, August 31, 1913. Plans and specifications are on file in the office of the County Commisisoners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., June 20, 1913, for grading and paving with brick for heavy traffic the Muskingum County, State Highway H, Pet. 658, Zanesville-Dresden road, Inter County No. 344, in Falls Township. Length, 5,995.5 ft. or 1.14 miles. Width of pav., 16 ft. Estimated cost of construction, $21,053. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, September 1, 1913.

Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., June 20, 1913, for grading and paving with brick for heavy traffic the Medina County, State Highway E, Pet. 548, Sec. No. 2 Wadsworth-Wooster road, Inter-County No. 97, in Wadsworth Township. Length, 3,459.2 ft. or .66 mile. Width of pav., 10 ft. Estimated cost of construction, $10,110. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, August 15, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

⊙Garrigan Bros. Co. has been awarded the contract by the Board of Control of Toledo, O., for the paving of Summit St. from Cherry to the Perry St. bridge, with creosoted wood blocks, for $41,317. H. P. Streicher secured the contract for paving Cherry St. from Summit to Bancroft, for $29,744, using asphalt surface over the present Medina stone pavement. Albert Gryzbowski was awarded the contract for paving Central Ave. from Hartman to Elm Sts., for $4,441, using vitrified brick.

⊙Wilson & Bowres, Athens, O., have been awarded the contract by the State Highway Commission, Columbus, for grading and paving with brick for medium traffic the Athens-Logan road, Athens Township, Athens County, for $25,200. The road is 9,978 ft. long and 16 ft. wide. Bids were opened June 6.

⊙Wilson Engineering & Construction Co., Xenia, O., has been awarded the contract by the State Highway Commission, Columbus, for grading and paving with waterbound macadam and concrete the Piqua-Urbana Extension No. 1 road, Urbana Township, Champaign County, for $7,398. The road is 3,125 ft. long and 14 and 16 ft. wide. Bids were opened June 6.

⊙Samuel W. Wrightsel, Logan, O., has been awarded the contract by the State Highway Commission, Columbus, for grading and paving with waterbound macadam the Urbana-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

West Jefferson road, Union Township, Champaign County, for $8,960. The road is 5,280 ft. long and 12 ft. wide. Bids were opened June 6.

⊙Bowers & Wilson of Athens, O., have been awarded the contract by the Board of Control of Lancaster, O., Julian Griggs, Engineer, for the paving with brick of Sixth Ave. from Forest Rose Ave. to East St., aggregating 25,800 sq. yds., for $33,060. Other bidders were: I. B. Clover, Lancaster, $40,445; C. F. Justus, Lancaster, $36,796, and Rosser & Harper, Bremen, $42,744.

⊙Haines & Miller of Akron, O., have been awarded the contract by the Stark County Commissioners, Canton, for paving the Alliance-Marlboro road for a distance of four miles for $77,646.

⊙The City Council of Follansbee, O., has let the contract for the paving of Neville St. to Michael McMahan.

⊙Yount & Jackson of Dayton, O., have been awarded the contract to pave Main St. in Circleville, O., for about $52,000.

⊙Henderson Bros. of Coshocton, O., have been awarded the contract by the Trustees of Mill Township, Tuscarawas County, O., for paving of the Park Valley road, at $31,985.

The City Council of Amherst, O., has completed necessary legislation for the paving of a number of the village streets.

The City Council of Uhrichsville, O., has passed a resolution declaring it necessary to improve Walnut St. between Trenton Ave. and Newport Ave., and 10th St. from Water St. east to the first alley, by grading, paving and curbing.

✣Bids will be received until noon, July 5, by Village Council, Amherst, O., for furnishing the labor and material necessary for draining, grading, curbing and paving Main St., Church St., Elyria St., Tenney St., West Railroad St., North Railroad St., West St., and South Railroad St. Henry Miller is Clerk of Council. C. W. Courtney, 1150 Leader-News Bldg., Cleveland, O., is Village Engineer.

⊙Roush & Woolum, Ironton, O., have been awarded the contract by the State Highway Commission, Columbus, for the construction of the McArthur-Hamden road in Vinton County, for $14,899. Bids were opened June 13.

⊙Lee Griggs & Anderson, Millersburg, O., have been awarded the contract by the State Highway Commission, Columbus, for constructing the Ashland-New London road in Ashland County, for $36,000. Bids were opened June 13.

⊙W. M. Gray, Bowling Green, O., has been awarded the contract by the State Highway Commission, Columbus, for grading and paving with bituminous macadam the Central Ave. Extension road, Lucas County, for $12,300. Bids were opened June 13.

⊙T. A. Gruber, Caledonia, O., has been awarded the contract by the State Highway Commission, Columbus, for the construction of the Mansfield-Lexington road in Richland County, for $32,350. Bids were opened June 13.

No bids were received on June 13 by the State Highway Commission, Columbus, O., for the construction of the Doyleston-Barberton road, Wayne County.

⊙Wilson & Bowers, Athens, O., have been awarded the contract by the State Highway Commission, Columbus, for the construction of the Athens-Logan road, Athens County, for $25,200. Bids were opened June 6.

⊙Samuel W. Wrightsel, Logan, O., has been awarded the contract by the State Highway Commission, Columbus, for the construction of the Urbana-West Jefferson road, Champaign County, for $8,960. Bids were opened June 6.

⊙O. D. Curry, 2525 Ashland Ave., Cincinnati, O., has been awarded the contract by the County Commissioners, Cincinnati, for the improvement of the Mill road, for $22,693. Bids were opened June 6.

Oregon.

⊙The County Court, Eugene, Ore., has awarded the following contracts for the construction of between five and six miles of macadam road: From McVey's Point to Goshen, Eugene Construction Co., $22,889, or about $5,530 a mile; two sections of road three-quarters of a mile each, near Cottage Grove, Ambrose-Burdsal Co., $10,035.

⊙The City Council of Hood River, Ore., has awarded the contract to improve the highway leading from the city to the west side fruit section with oil-bound macadam to E. O. Hall for $25,000.

Pennsylvania.

✣Bids will be received until 7 p. m., June 24, by L. L. McKay, Borough Secretary, for the complete construction and furnishing of materials for grading, curbing and paving, with brick, asphaltic concrete or asphaltic macadam, Madison St. and Woodland Ave., in the Borough of Grove City, Pa., consisting of the following approximate amounts: 3,000 cu. yds. excavation, 8,500 sq. yds. paving, 6,500 lin. ft. curbing. No bids will be considered which are not on the form of proposal furnished by the borough. A certified check of $500 must be enclosed with each bid. Information to bidders, plans, specifications, form of proposal, contract and bond, may be had on application to L. E. Burnside & Co., Borough Engineers, Grove City, Pa.

⊙The Department of Public Works, Philadelphia, Pa., has awarded the contracts for repairing 24 streets to the Eastern Paving Co. of that city for approximately $125,000. Of this sum about $40,000 is for repairing asphalt streets, the prices ranging from $1.08 to $1.25 a sq. yd. The same company also received a contract to pave 11 streets with asphalt at prices ranging from $1.07 to $1.19 a sq. yd., totaling $27,000. Contracts aggregating $24,500 for paving four streets with vitrified brick were divided between the Mack Paving & Construction Co. and the David McMahon estate.

James O'Connor, Philadelphia, Pa., landscape architect and engineer, is preparing plans for landscape development of a tract of land on West Chester pike above Leon road. The property is about 48 acres in extent. The new work will consist of laying streets and cement pavements and setting out shrubbery and shade trees.

✣Bids will be received until 5 p. m., July 1, by F. J. Huffman, Borough Clerk, Crafton, Pa., for paving a section of McMunn Ave. and Bloomer St. Plans and specifications are on file at the office of M. H. Stevenson, 432 Diamond St., Pittsburgh, Pa. James S. Haring is Borough Engineer.

Bids will be received until 7:30 p. m., June 27, by Council, of Franklin, Pa., for the repaving of Liberty St., from Moffet's Alley to Fifteenth St., also for the curbing and paving of Twelfth St. from Elk to Otter St., plans and specifications of which may be seen at the office of the city engineer; bidders to file with their respective bids bonds or certified checks in the sum of $1,000 on Liberty St., and $200 on Twelfth St. Phil Engelskirger is Controller.

South Carolina.

⊙The Board of Supervisors, Columbia, S. C., has let a tentative contract for the proposed Shandon highway to Weston & Brooker of that city. An appropriation of $18,000 was made for the improvement.

South Dakota.

✣Bids will be received until 2 p. m., June 28, by C. E. Ackerman, County Auditor, Huron, S. Dak., for grading the roadway on the county line between Beadle and Hand

Tennessee.

⊙The Murray Construction Co. of Knoxville, Tenn., has been awarded the contract by the City Commission of that city for the paving of Forest Ave. between 4th St. and 9th St. and one block on 3d Ave. for $18,433 and $9,445, respectively.

⊙The finance committee of the County Court, Chattanooga, Tenn., has awarded the contract for completing Missionary Ridge tunnel by laying the flooring and a single car track and making other interior repairs to I. C. Mishler, of Chattanooga, for $18,111.

Texas.

The City Commissioners of Mart, Tex., have set June 28 as the time for voting on a bond issue to pave the streets of the city.

The Fred A. Jones Co., 602 Praetorian Bldg., Dallas, Tex., has been retained as engineers of the proposed construction of good roads in the Corsicana district, Navarro County, Tex., a $400,000 bond issue having been voted for that purpose.

An election will be held in the Barry District of Navarro County, Tex., on June 28 for the purpose of voting on the issuance of bonds to the amount of $75,000 for road improvements. Corsicana is the county seat.

The Nueces County Commissioners' Court, Corpus Christi, Tex., has called an election for July 19 at which time voters will decide whether or not to issue bonds to the amount of $500,000 for the purpose of building 200 miles of modern county roads.

Washington.

⊙McKim & Addison have been awarded the contract by the City Council of Puyallup, Wash., for paving 5th Ave. northwest, and northeast from 5th St. northwest, and 5th St. northeast, from 5th Ave. northeast, to the county bridge, for $17,456.

⊙The City Council of Spokane, Wash., has let the contract for the paving of Mission Ave. from Division St. to the river bridge to Mitchell Bros. of that city for $39,764.

⊙R. E. Nelson of Prosser, Wash., has been awarded the contract for the construction of the state road near Washtucna for $19,920.

⊙The Board of King County Commissioners, Seattle, Wash., has awarded the contract for the construction of four miles of warrenite surface and two miles of brick, with concrete base, on the north trunk road to Andrew Peterson for $147,250.

⊙T. Ryan, Seattle, Wash., has been awarded the contract by the Board of Public Works of that city for paving Grand Ave. and other streets in the district between Madrona Park and the Denny-Blaine Park Addition, including the roadway on Hugo Pl., for $46,314. Brick, concrete and asphaltic concrete will be used.

⊙The Washington Paving Co., Savage-Scofield Bldg., Tacoma, Wash., has been awarded the contract at Sedro Woolley, Wash., for the construction of asphalt and Dolarway pavements for $59,000.

⊙The Atlas Construction Co., of Everett, Wash., has been awarded the contract by the City Commisisoners of that City, for the improvement of Lombard Ave. from Hewitt Ave. to 16th St., using asphalt, for $61,050.

⊙Jacob Hunziker has been awarded the contract by the County Commissioners, Bellingham, Wash., for clearing, grubbing and grading of 4,000 ft. of the Woodlawn road between Silver Beach and Woodlawn, for $2,280.

Wisconsin.

⊙Peterson & Holm have been awarded the contract by the County Board, Superior, Wis., for the paving of the Greenwood road with macadam for $12,000.

The City Council of Depere, Wis., has ordered that 13 city blocks be paved with concrete.

⊙The City Council of Antigo, Wis., has voted to pave two blocks, one on Superior St. from 5th to 4th Ave., and one block on 5th Ave. from Superior St. to Field St. The contract was awarded to L. P. Tradewell for $11,897.

⊙J. F. Icke & J. R. Cullinane, Madison, Wis., have been awarded the contract by that city, for the construction of 30,000 sq. yds. of asphalt mixed macadam, including curb and gutter, surface drainage, etc. Bids were opened June 11.

Canada.

⊙McCutcheon & McConnell, Oshawa, Ont., have been awarded the contract by that municipality, for the construction of 15,000 sq. yds. of concrete pavement and 1,500 ft. of

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

curbing, at $1.12 per sq. yd. Bids were opened June 7.

A special committee has submitted a report to the Essex County Council at Sandwich, Ont., relative to the construction and maintenance of 142 miles of permanent roads in Essex County within the next 10 years at a cost of approximately $1,000,000.

The Parks Commissioner Chambers, Toronto, Ont., plans to make a start this summer on the construction of a complete system of boulevards, 42 miles long, costing $7,000,000, and reaching right around the city.

BRIDGES

Alabama.

A committee of the City Council, Mobile, Ala., has inspected the city bridge over Back Bay with a view to determining what repairs will be necessary. Bids for the work will probably be asked in a short time. Wright T. Smith is City Engineer.

California.

The following bids have been received for the construction of the proposed new bridge over the Sacramento River at Reid's ferry at Redding, Calif.: Jenkins & Wells, Sacramento, for a steel bridge, $40,000; Reynolds & Whitman, Sacramento, for a steel bridge, $39,000, for a concrete bridge $48,000; Hellis C. Inman, Oakland, for a concrete bridge, $45,000; W. P. Day, San Francisco, for a concrete bridge $46,000.

The Board of County Surveyors, Sacramento, Calif., has approved plans and specifications for the construction of the proposed new bridge one-half mile west of Clay Station. The structure, which will cost $1,500, will consist of wooden trestle and concrete abutments.

Plans have been completed by Martin C. Polk, Butte County Engineer, Oroville, Calif., for the construction of a new steel bridge to be built over Butte Creek, west of Gridley in Butte and Colusa Counties. The cost of the structure is estimated at $5,000. Bids will be received for the work shortly.

The Board of Supervisors, Oakland, Calif., has received a recommendation from A. C. Rush of Los Angeles, Calif., for the construction of a suspension bridge across the bay in conjunction with the proposed harbor improvements to be made by the Federal Government. He suggests a bridge with a span of 9,370 ft., reaching from San Francisco to Yerba Buena Island, and a span of 3,000 ft. linking the bridge with the island and the east shore. The communication was filed without comment.

Georgia.

✣Bids will be received until 10 a. m., July 1, by Commissioner of Roads and Revenues, Pulaski County, Hawkinsville, Ga., for the furnishing of iron material for and repairing bridge over the Ocmulgee River at Hawkinsville, Pulaski County, Georgia. Plans and and specifications and all information necessary can be had upon application to the office. Bids to be sealed and a certified check for $300 to accompany bids. H. C. Brown is Clerk.

⊙The contract for the erection of a steel bridge over Ogeechee River at Jewel, Ga., has been awarded by the Board of Roads and Revenues to the Roanoke Bridge Co., 1627 Candler Bldg., Atlanta, Ga., at $3,200. Bids for the structure were opened June 4.

Illinois.

✣Bids will be received up to 10 a. m., June 27, 1913, at the Town Hall, Mascoutah, Illinois, for the construction of three reinforced concrete bridges to be built in Mascoutah Township, St. Clair County. Charles Stock, Town Clerk, Mascoutah, Ill. Sauter, Ruth and Klingelhoefer Bridges: Spans, 18, 8 and 24 feet; roadways, 20 feet; height, 15, 7 and 10 feet. Estimated total concrete, 160.2 cubic yards; reinforcing steel, 16,621 pounds. Nearest railroad stations, New Baden 1¼ and 4¼ miles and Mascoutah 2½ miles. No local concrete materials available. Present bridges wood. Low water flow, trace-dry-dry; high water about 8, 3 and 4. Excavation will average about 8, 3 and 10 feet, through clay, loam and loam, to about 6, 2 and 5 feet below stream bed. Township orders payable April 1, 1914, without interest, will be issued for this work. Engineer's estimate, $2,525. Work to be completed on or before November 1, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office, or may be obtained upon application, in writing, from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received up to 1 o'clock p. m., June 21, 1913, at the Town Clerk's office, Paxton, Illinois, for the construction of five reinforced concrete bridges to be built in Patton Township, Ford County. V. E. Johnson, Town Clerk, Paxton, Ill. Dwyer, Johnson, Funkhauser, Youngree and Larson Bridges: Spans, 8, 18, 18, 12 and 10 feet; roadways, 21, 16, 16, 16 and 16 feet; height, 5, 10, 11, 8 and 8.5 feet. Estimated total concrete, 195.2 cubic yards; reinforcing steel, 14,702 pounds. Nearest railroad station, Paxton, 2½, 4½, 4, 3 and 4½ miles. Westbrook gravel pit (quality not known), 15c at pit, 1½, ¼ and ¼ miles. It is reported that good gravel may be had f. o. b. cars at Paxton at about $1.10 per cubic yard. Present bridges wood spans, 6, 14, 14 and 11 feet. Low water flow dry; high water about 2½, 6, 6, 4 and 4 feet deep. Excavation, black loam, to be carried from 6 inches to 3½ feet below stream bed. Engineer's estimate, for the five bridges, $2,575. Work to be completed on or before November 1, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application, in writing, from the Illinois Highway Commission, Springfield, Illinois.

✣Bids will be received up to 2 o'clock p. m., June 26, 1913, at the Town Hall, Hoyleton, Illinois, for the construction of two reinforced bridges to be built in the Town of Hoyleton, Washington County. F. Wm. Grote, Town Clerk, Hoyleton, Ill. Rixman and Westerfeldt Bridges: Spans for both bridges, 35 feet; roadways for both bridges, 16 feet; height, 13 and 14 feet. Estimated total concrete, 194.6 cubic yards; reinforcing steel, 24,427 pounds. Nearest railroad station, Rixman bridge about 2½ miles. It is reported that crushed stone may be had f. o. b. cars at Hoyleton at obout $1.10 per ton, and sand about $1.50 per cubic yard. The following applies to Rixman bridges only. Data for Westerfeldt bridge not of record: Low water flow, trace; high water about 8 feet deep; excavation clay, averages about 6 feet deep, to be carried about 4½ feet below stream bed. Engineer's estimate for both bridges, $3,350. Work to be completed on or before November 1, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application, in writing, from the Illinois Highway Commission, Springfield, Illinois.

⊙At a special meeting of the Board of Supervisors at Canton, Ill., the contract for the construction of a bridge over Potato Creek in Bernadotte township was let to E. E. Buck, Springfield, Ill., at $1,300.

⊙The Board of Fulton County Supervisors, Lewistown, Ill., has awarded the contract for the bridge in Bernadotte township to E. E. Buck, at $1,300.

The City Council of Hoopeston, Ill., has decided to open Lincoln St. from Fourth to Sixth Ave., necessitating the construction of a bridge over the Big Ditch. W. S. Dillon is City Engineer.

The City Council of Pekin, Ill., is said to be contemplating taking up the proposition to build a viaduct over the Big Four and Santa Fe tracks at Eighth St. J. R. Siebert is City Engineer.

Indiana.

✣Bids will be received until 1 p. m., July 8, by Irvin Young, County Auditor, Knox County, Mt. Vernon, Ind., for all labor and material necessary to repair or construct complete, as the case may be, the following bridges: Greer Bridge on Mohican River, Jefferson Township; Robinson Bridge on Mohican River, Jefferson Township; Brink Haven Bridge on Mohican River, Union Township; Hunter Bridge on Mohican River, Union Township; Race Bridge on Thompson Mill Race, Union Township; Howard Bridge on Kokosing River, Howard Township; Jackson Bridge on west branch Kokosing River, Morris Township; Simons Bridge on north branch Kokosing River, Middlebury Township. The plans, estimates, quantities and specifications for doing this work as per county plans are on file in the office of the county auditor.

✣ Bids will be received until 11:30 a. m., June 30, by Board of Clay County Commissioners, Brazil, Ind., for the construction of concrete abutments and removal and repairs of two steel bridges. Edgar A. Stagg is County Auditor.

✣Bids will be received until 10 a. m., July 5, by Board of Shelby County Commissioners, Shelbyville, Ind., for the construction of two steel truss bridges and repair of a number of concrete culverts. Frank W. Fagel is County Auditor.

✣Bids will be received until noon, July 8, by Board of Pulaski County Commissioners, Winomac, Ind., for the construction of 15 bridges. William Munchenburg is County Auditor.

⊙The Board of Shelby County Commissioners, Shelbyville, Ind., awarded the following contracts for bridges to replace the ones destroyed by the March flood: Geneva bridge superstructure, Central States Bridge Company of Indianapolis, $7,980; Morristown bridge superstructure, same company, $7,485; Geneva bridge substructure, Raymond & Howard, $527; Morristown bridge substructure, James A. Parrish, Greenfield, $1,700; Brandywine bridge substructure, Gageby & Craig, Greensburg, $4,274; Franklin grade, William Ogden, $7,137.50, and Flatrock grade, William Avery, $1,613.

⊙W. J. Lewis, Fairmont, Ind., has been awarded the contract for the construction of a new concrete bridge over Arch Creek in Howard County, near Kokomo, Ind., at $3,250.

⊙The Board of Pike County Commissioners, Petersburg, Ind., has awarded the contracts for the construction of a number of bridges as follows: B. F. English, 15 bridges, at $3,082; A. H. Kinman, 6 bridges, $850; Vincennes Bridge Co., one bridge, $1,190.

⊙The contracts for the construction of five bridges in Cass County have been awarded by the Board of Commissioners at Logansport, Ind., to the National Concrete Co., of Indianapolis, Ind., at $150,965. The bridges will be of concrete and are to be constructed at Cicott St., Third St. and Burlington Ave., in Logansport; at Lewisburg, and at Pipe Creek. With the exception of the bridge across Pipe Creek, all the bridges will span the Wabash, and will replace the ones swept away in the flood this spring.

⊙Advices from Covington, Ind., state that the Board of Commissioners has awarded a number of bridge contracts as follows: The Hibbs concrete bridge in Fulton Township, to Rufus Dodson, for $590.00. Wilmer N. Foster received the contract for the repair of the Perrysville grade, in Wabash Township, at $749.00. J. H. Sowers was awarded the contract for the building of the following bridges: Bodine Bridge, Wabash Township; Hunt Bridge, Troy Township; Coats Bridge, Hutts Bridge, Steam Corner Bridge, Fletcher Bridge and the Harveysburg Bridge, all located in Millcreek Township. His bid was $2,835. The contract to build and fully construct the abutment and repair to the Wabash River Bridge was awarded to George Galloway for $3,485.

⊙The Board of County Commissioners, Vincennes, Ind., has awarded to the Vincennes Bridge Co. the following bridge contracts: No. 1.—H. Roadenhouse Bridge, $1,596. No. 2.—Brown Road Bridge, $973. No. 3.—Grizzle Road Bridge, $1,229. No. 4.—Grizzle Road Bridge, $455. No. 5—Shelt Johnson Bridge, $1,430. No. 8.—Latshaw Bridge, $362. No. 9.—Henry Traband Bridge, $1,649. No. 10.—Henry Decker Bridge, $459.

⊙The Jefferson County Commissioners, Madison, Ind., have awarded the contracts for two bridges to the St. Louis Bridge Co., at $4,180; also a contract for one bridge to the Vincennes Bridge Co., at $3910.

The Commissioners of Tippecanoe County, Lafayette, Ind., have decided to build a $250,000 bridge over the Wabash River at Main St. The new structure, which will be of concrete, will be 740 ft. long, with four piers and two abutments. The roadway will be 40 ft. wide. Plans for the bridge were prepared by Prof. W. K. Hatt, Prof. Albert Smith of Purdue and E. B. Vawter of West Lafayette. The contract for the work will probably be let about July I.

The Commissioners of Allen County, Fort Wayne, Ind., have decided to construct a new bridge to replace the present structure at Columbia St. The repair work on the old bridge has been discontinued.

At a joint meeting of the Commissioners of Hamilton County, Cincinnati, O., and Dearborn County, Ind., at the site of the east approach to the old suspension bridge over Whitewater River at Harrison, O., it was decided to replace the old bridge with a concrete structure estimated to cost $75,000.

The Lake County Council, Crown Point, Ind., has under consideration the proposition to build a bridge over the Indiana Harbor Ship Canal at Dicky Place, Indiana Harbor. The structure, it is estimated, would cost about $75,000.

The Board of Allen County Commissioners, Fort Wayne, Ind., has decided to rebuild the Gustin bridge over a creek in Maumee Township. The cost of the improvement will amount, it is estimated, to about $3,000.

A committee of citizens of Hazleton, Ind., is advocating the construction of a bridge over the White River and an effort will be made to have the Board of County Commissioners take favorable action on the proposition.

At a meeting of the County Council, New Castle, Ind., the Board of Commissioners will ask for the appropriation of $25,000 for the repair of bridges.

Iowa.

⊙The Board of Story County Supervisors, Nevada, Ia., has awarded the contracts for the construction of four new bridges to G. W. Koss, Des Moines, Ia. The total of the contract prices was $10,349.

⊙The Board of County Supervisors, Council Bluffs, Ia., has awarded the contract for the construction of a 70-ft. pony truss steel bridge with concrete floor and abutments over Mosquito Creek to the Omaha Structural Steel Works, Omaha, Nebr., at $3,610. Other bids received for the work were as follows: Western Bridge & Construction Company, Omaha, $3,858; John Gilligan, Lincoln, Nebr., $3,908; Lana Construction Company, Council Bluffs, $3,790; Mid-West Bridge Company, Omaha, $3,899; Wilson Concrete Company, $4,451.58; Clinton Bridge Works, Clinton, Ia., $4,960; Standard Bridge Company, Omaha., $4,500; Des Moines Bridge & Iron Works, Des Moines, $3,888; Blodgett Construction Company, Kansas City, Mo., $3,718.20; George C. Wise, Council Bluffs, $4,320; Midland Bridge Company, Kansas City, Mo., $4,003.

⊙Henry France was awarded the contract by the Board of Supervisors, Tipton, Ia., for the construction of the Massillon Township bridge west of Lowden on the Trans-Continental road. The contract price was $2,080. Other bids received were as follows: Des Moines Bridge Co., $2,650; Clinton Bridge Co., $2,490.

Plans and specifications are being prepared by F. C. Smith, City Engineer, Sioux City, Ia., for replacing the bridge over Powlesson Creek on Powlesson Road with a concrete culvert to cost $1,000.

A petition signed by residents in the district of 38th St. and the Perry Creek intersection has been presented to the City Council of Sioux City, Ia., asking for the construction of a new bridge at that point. Fred C. Smith is City Engineer.

Michigan.

✣Bids will be received until June 27, by the City Clerk, Flint, Mich., it is reported, for the construction of a bridge between Begole St. and Moon Island and from Moon Island across the channel to the other main land. The cost of the improvement is estimated at $10,000. H. E. Terry is City Engineer.

⊙Advices from Petoskey, Mich., state that the contract for the repair of the washout on the Charlevoix Road has been awarded to Jake Grauel at $3,100. The work will include a culvert and fill.

⊙Advices from Ironwood, Mich., state that the contract for the construction of the new bridge over the Montreal River at Van Bushkirk has been let to the Worden-Allen Co., Milwaukee, Wis., at $2,240. The structure will have a 46-ft. span with 16 ft. roadway and will be a through-truss type.

A petition is being circulated in Grand Haven, Mich., asking the Common Council to again authorize a special election to vote on the bridge bonding proposition. The Spring Lake bridge is reported to be in bad condition and a new $20,000 concrete structure is contemplated to replace it.

City Engineer, H. E. Terry, Flint, Mich., has estimated the cost of the proposed new bridge over Thread Creek at Second St. for the new Fourth Ward Car line at $33,820. The cost of a bridge across the Flint River on the line of Oakland Ave. east of Fairview, which is proposed as a way of connecting the sections on either side of the Pere Marquette by street car is $47,500. For the construction of a new bridge over Thread Creek on Saginaw St. a cost of $6,000 is estimated.

Minnesota.

⊙The Widdell Co., according to advices from Mankato, Minn., has been awarded the contract by the Great Northern Ry. for about $300,000 worth of bridge and tunnel work in Montana.

Mississippi.

The Board of Warren County Commissioners, Vicksburg, Miss., received the following bids for the construction of the proposed bridge over the Big Black River at Holt's ferry: W. T. Young Bridge Co., $21,975; Vicksburg Boiler & Iron Co., $21,218; Virginia Bridge & Iron Co., $21,400.

Montana.

⊙The County Commissioners have awarded the contract for the reconstruction of the bridge over the Bitter Root River at Hamilton, Mont., to O. E. Peppard, Missoula, Mont., at $3,100.

The lowest bid received by the Board of County Commissioners at Great Falls, Mont., for the construction of the bridge over the Missouri River at Ulm was that of the Lange Engineering & Construction Co., at $42,760. All bids were rejected and the work will be readvertised.

New Jersey.

✣Bids will be received until 2:30 p. m., June 23, by Board of Chosen Freeholders, New Brunswick, N. J., for rebuilding three wooden bridges over Manalapan Brook, in the Township of Monroe, according to plans and specifications on file at the office of Alvin B. Fox, 137 Smith St., Perth Amboy, N. J., and at the office of Thomas H. Hagerty, New Brunswick, N. J. A deposit of five dollars will be required for copies of specifications, which will be refunded upon the return of same in good condition to either of the above offices. Each bid must be accompanied by a certified check in the amount of $300, payable to the order of Thomas H. Hagerty, County Collector.

New York.

✣Bids will be received until noon, July 7, by Town Clerk, Canton, N. Y., for furnishing the necessary labor and material for constructing a concrete bridge and abutments for the same, and an iron bridge with concrete abutments and floor for the same, across Little River on the Russell Road near said Village of Canton, according to plans and specifications on file in said Clerk's office. A. H. Wiggins is Supervisor.

⊙The Board of Public Works, Hornell, N. Y., at a recent meeting decided to award the contract for the construction of a 3-span concrete bridge to the Oswego Bridge Co., Oswego, N. Y.

⊙The Board of Public Works, Elmira, N. Y., has awarded the contract for the construction of a new bridge on West Second St. over Hoffman Creek, to Holleran Bros., at $2,425.

The Town Board of Moreau and the Town Board of Fort Edward, N. Y., have adopted a resolution instructing the County Superintendent, Hudson Falls, N. Y., to make preparations for advertising for bids for the construction of the proposed bridge at Fort Edward.

The Concrete-Steel Engineering Co., Consulting Engineers, Park Row Bldg., New York City, has been retained by the City of Amsterdam, N. Y., to design the new concrete bridge over the Mohawk River to replace the steel bridge recently destroyed by the floods in that section.

The Concrete-Steel Engineering Co., Consulting Engineers, Park Row Bldg., New York City, has been retained to design a concrete bridge over the Hudson River at Glen Falls, N. Y., which will replace a steel bridge destroyed in the spring freshets.

Plans are now being prepared by the City Engineer of Albany, N. Y., for the repair of the carriage way of the steel bridge over the New York Central yards at West Albany.

North Dakota.

✣Bids will be received until 1:30 p. m., July 8, by W. W. Felson, Pembina County Auditor Cavalier, N. Dak., for the construction of 10 bridges in accordance with plans and specifications on file at the office of the county auditor. Bids must be accompanied by a certified check for $500 payable to J. R. Gibson, County Treasurer. Further information will appear in our next issue.

Ohio.

✣Bids will be received until noon, June 27, by Board of Summit County Commissioners, Akron, O., for the construction of the substructure and superstructure of a steel plate girder bridge, located on East North St., Akron, O., to replace a structure washed out by the recent floods. Bids must be made on forms which may be obtained at the office of the County Commissioners. Plans and specifications are on file at the office of the County Commissioners, the County Surveyor and at the office of Wilbur J. Watson & Company, Bridge Engineers, Leader Building,

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Cleveland, Ohio. Plans and specifications may be obtained from Wilbur J. Watson & Company on deposit of $10, which will be refunded upon the return of same on or before the date of receiving bids.

✣Bids will be received until 11 a. m., July 9, by Board of Cuyahoga County Commissioners, Cleveland, O., for the construction of bridge work, per Report No. 3147, Concrete Arch, Brecksville Road, over Chippewa Creek, Brecksville Township, in accordance with the form of contract and specifications to be furnished by Frank R. Lander, County Surveyor. Plans, descriptions, bills and specifications for the above work can be seen and are open to public inspection of persons interested therein, at the office of the County Engineer, at the New Court House on Lakeside Ave., Cleveland, Ohio. J. F. Goldenbogen is Clerk of the Board.

✣Bids will be received until noon, June 30, by Board of Ross County Commissioners at the office of R. D. Alexander, County Auditor, Chillicothe, O., for the furnishing of all necessary labor and materials to make the improvement known as the construction of Ebush Bridge substructure, located in Twin Township, Ross County. The plans and estimates and specifications for the above work are now on file in the office of the County Auditor and County Surveyor.

✣Bids will be received until 10 a. m., June 24, by Board of Lucas County Commissioners, Toledo, O., for furnishing the labor and material for doing the described work under the following resolutions: Res. No. 515, concrete abutments and creosoted wood block floor for bridge on county road No. 106½ over Blue Creek, about 20 rods south of the east ¼ of section 9, T. 6 N., R. 9 E., Providence Township; Res. No. 519, new abutment, center pier, repair and erection of bridge on Harroun Road over Ten Mile Creek, just north of the center of section 10, T. 9 S., R. 6 E., in Sylvania Village; extension of culvert on Monroe turnpike (state highway No. 4), over Delaware Creek, Adams Township. Plans and specifications are on file at the office of C. J. Sanzenbacher, County Auditor.

✣Bids will be received until 11 a. m., June 23, by Board of Warren County Commissioners, Lebanon, O., for the labor and furnishing the material necessary to erect: No. 1, one single span high truss steel bridge 300 ft. long with one 5-ft. sidewalk with creosoted plank and block floor over the Little Miami River at Foster, Ohio. Also for one new concrete abutment; for facing and raising one old abutment with concrete over the said river and also for piling under above masonry. No. 2—To construct a concrete roadway 250 ft. long by 24 ft. wide at Round Pond on the Lower Carlisle and Franklin Road in Franklin Township. Plans, descriptions, bills and specifications thereof heretofore approved by the Board can be seen at the office of the County Auditor at Lebanon, Ohio. T. C. Patterson is County Auditor.

✣Bids will be received until 1 p. m., June 30, by Board of Lorain County Commissioners, Elyria, O., for furnishing the labor and material for the construction of the Howk Culvert No. 322 in Pittsfield Township located on Pittsfield-Wellington Road 2⅓ miles south of Pittsfield Center in accordance with plans and specifications furnished by T. L. Gibson, County Surveyor. F. L. Ellenberger is Clerk of the Board.

✣Bids will be received until 11 a. m., July 2, by Board of Cuyahoga County Commissioners, J. F. Goldenbogen, Clerk, Cleveland, O., for the construction of bridge work per report No. 3141, concrete bridge, Albion Road, Strongsville Township, in accordance with the form of contract and specifications to be furnished by Frank R. Lander, county surveyor. Plans, descriptions, bills and specifications for the above work can be seen and are open to public inspection of persons interested therein, at the office of the county engineer at the new court house on Lakeside Ave., Cleveland.

✣Bids will be received until June 28 by Board of Hancock County Commissioners, Findlay, O., for the construction of a 160-ft. steel bridge consisting of two 80-ft. spans with 16-ft. roadway, resting on concrete substructure, on Bishop Farm, Sections 26 and 35, Jackson Township. The piers are to be 25 ft. long, 15 ft. high and will include 70 cu. yds.; the abutments will be 15-ft. high and will include 80 cu. yds. Elmer Hilty, Findlay, O., is Engineer.

✣Bids will be received until noon, July 11, by Board of Hamilton County Commissioners, Cincinnati, O., for the construction under Specifications No. 484-B, of new superstructure for the wrought iron truss bridge on Elliott St. over West Fork of Mill Creek in Springfield Township. Plans and specifications are on file at the office of the Board. Albert Reinhardt is Clerk.

✣Bids will be received until noon, July 11, by Board of Hamilton County Commissioners, Cincinnati, O., for the construction, under Specifications No. 482-B, of a new superstructure for the wrought iron truss bridge on Clark and Davis St. over East Fork of Mill Creek in Sycamore Township. Plans and specifications are on file at the office of the Board. Albert Reinhardt is Clerk.

✣Bids will be received until noon, July 11, by Board of Hamilton County Commissioners, Cincinnati, O., for the construction, under Specifications No. 476, of a culvert on Union Cemetery Road at Armstrong's Place in Symmes Township. Plans and specifications are on file at the office of the Board. Albert Reinhardt is Clerk.

✣Bids will be received until noon, July 11, by Board of Hamilton County Commissioners, Cincinnati, O., for the repair, under specifications No. 480 of east end of north abutment of bridge on Springfield pike, over Mill Creek near the Fair Grounds in Springfield Township. Plans and specifications are on file at the office of the Board. Albert Reinhardt is Clerk.

✣Bids will be received until July 7, by Board of Tuscarawas County Commissioners, New Philadelphia, O., for the following bridge work; Steel superstructure of the Guadinhutten bridge, 490 ft. long and 19 ft. wide; steel superstructure and concrete substructure of Reids Run Bridge, 325 ft. long and 18 ft. wide; reinforced concrete causeway at New Philadelphia, 448 ft. long and 40 ft. wide. Edward Stingel is Engineer.

⊙The Board of Darke County Commissioners, Greenville, O., has awarded the contract for the construction of an abutment for the Gettysburg bridge over Greenville Creek to Alexander Bros., North Star, R. F. D., O., at $1,900. Bids for the work were opened June 7.

⊙The Board of Montgomery County Commissioners, Dayton, O., has awarded the contract for the construction of the bridge over the River at Little York to the Brookville Bridge Co., Brookville, O., at $12,850 for the superstructure and $6.40 per cu. yd. for the concrete substructure.

⊙The Toledo Bridge & Crane Co., Toledo, O., has been awarded the contract for the superstructure of the bridge at Bancroft St., Toledo, O., at $5,750. The contract for the substructure went to Snider Bros., Defiance, O., at $6.97 per cu. yd. Bids for the work were opened by the Board of Lucas County Commissioners June 6.

⊙The Board of Morgan County Commissioners, McConnelsville, O., has awarded the contract for the construction of repairs to the Stockport bridge over the Muskingum River to E. J. Landor, Canton, O., at $34,975. The work will include 617 ft. of superstructure. Bids for the contract were opened June 9. J. E. Patterson is County Auditor.

⊙The Capitol Construction Co., Columbus, O., has been awarded the contract for the erection of a new steel bridge at Frost to replace the wooden structure which was swept into the Hocking River during the March flood. The contract price was $5,137.

All bids received June 9 by Board of Warren County Commissioners, Lebanon, O., for the construction of a steel bridge over the Little Miami River at Kings Mills, O., have been rejected. T. C. Patterson is County Auditor.

Oklahoma.

A petition is being circulated at Frederick, Okla., asking the Commissioners of Tillman County to act in conjunction with the Jackson County Commissioners in building a bridge across the North Fork of the Red River one mile south of the base line. Altus, Okla., is county seat of Jackson County.

Pennsylvania.

⊙The contract for the construction of a steel girder bridge with reinforced concrete floor and stone substructure near Jones Bridge in London Britain Township, Chester County, has been awarded by the Board of Commissioners to the York Bridge Co., York, Pa., at $2,648. Other bids for the structure, which has a 39 ft. span, were as follows: George Dole, $2,699; McLimans & Criswell, $2,895; D. E. O'Connell & Son, $3,140.50.

⊙Dunleavy Bros., Coatsville, Pa., have been awarded the contract by the Board of Chester County Commissioners, West Chester, Pa., for the construction of a 47-ft. steel girder bridge with reinforced concrete floor and stone substructure at East Brandywine township near Bondsville. The contract price was $2,665. Other bids received for the work were as follows: George Dole, $2,950; Williams & Co., $3,306; Corcoran Construction Company, $2,995; York Bridge Company, $2,783; Stine & Kirkpatrick, $2,939; W. I. Pollock, $2,875.

⊙The Board of Chester County Commissioners, West Chester, Pa., was awarded the contract for the construction of a 24-ft. span stone bridge with reinforced concrete floor and standard I beams in West Pikeland Township near Upperman's Store to Stine & Kirkpatrick, Downingtown, Pa., at $1,261. Other bids received for the work were as follows: Corcoran Construction Company, $1,463; York Bridge Company, $1,266; George Dole, $1,495.

⊙The contract for the construction of the bridge over Mahoning Creek, Mack's Fording, Armstrong County, Pa., has been awarded to J. A. Lord, Hastings, Pa., at $11,995. H. S. McDevitt is Secretary of the Board of Commissioners of Public Grounds and Buildings, Harrisburg, Pa.

Pennsylvania.

⊙The contract for the construction of a concrete arch bridge over Second Creek at Dickson's Ford has been let to the Lutin Bridge Co., of York, Pa. The structure, which will be paid for jointly by Monroe and Greenbrier Counties, Va., will consist of two 60-ft. arches. J. S. Crawford, Lewisburg, Va., Clerk of Court. Bids were opened June 3.

Washington.

All bids received June 3 for the construction of the proposed 220-ft. steel span bridge near Chehalis, Wash., were rejected.

Wisconsin.

⊙The Wood County Bridge Committee and the Town Board of Lincoln have awarded the contract for the construction of two bridges over the east and west branches of the Yellow River to Worden-Allen Bridge Co., Milwaukee, Wis., at $1,865.

Canada.

✣Bids will be received at once by H. C. Hocken, Chairman, Board of Control, Toronto, Ont., for the construction of the reinforced concrete Bloor St. viaduct. Bidders may prepare and submit without any expense to the city, plans and specifications for the structure.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

DRAINAGE AND IRRIGATION

California.

The Midland Counties Irrigation Co. has been incorporated with a capital stock of $1,000,000 and proposes to transact business in connection with irrigation and the buying and selling of real estate. The incorporators are Robert M. Hardin, Hollister; William Nunlist, J. J. Weib, W. A. Simmons, Stephen C. Ashill and W. C. Crittenden, all of San Francisco, and W. F. Broadman, of Berkeley.

The Daly Water Co., of Riverside, Cal., has been incorporated with a capital stock of $318,000 for irrigation purposes. The incorporators are Eugene Daly, Redlands; Eugene Howell Daly and Edwin Howell Daly, of Riverside.

The Power & Irrigation Co., Clear Lake, Cal., has filed suit to condemn land in Lake County for a dam site and reservoir.

The West End Water Users' Co., Laton, Cal., has been incorporated with a capital stock of $20,000. L. Y. Montgomery, Hanford, Cal.; J. O. McIntyre, E. Heflebower, E. S. Allen and M. F. Bingham of Laton, Cal., are the incorporators.

Improvements to cost about $75,000 are planned for the irrigation system of the Riverside Water Co., Riverside, Cal. These will include the lining with concrete of about five miles of the upper canal.

Illinois.

⊙Contracts for drainage construction in Sub-District No. 2 of the Martinton Drainage District No. 3, Iroquois County, bids for which were opened June 9 at Watseka, Ill., have been let as follows: Tile, National Drain Tile Co., Terre Haute, Ind., at $1,955; laying tile, E. H. Cowan, Taylorville, Ill., at $1,794. The work includes 1,900 ft. 20-in. tile, 500 ft. 18-in., 3,600 ft. 16-in., 400 ft. 14-in., 1,000 ft. 12-in., 1,725 ft. 10-in., 1,660 ft. 8-in. and 150 ft. 6-in. Benj. Jordan, Watseka, Ill., is Engineer.

Indiana.

✣Bids will be received at 10 a. m., and 2 p. m., June 21, by C. W. Decker, Superintendent of Construction, at the office of the County Surveyor, Bluffton, Ind., for the construction of Gaskell and Steffen ditches.

✣Bids will be received until 11 a. m., June 21, by Drainage Commissioners, at the office of the Montgomery County Surveyor, Crawfordsville, Ind., for the construction of the Davis Ditch which will be 4,330 ft. long. M. L. Nees is Drainage Commissioner.

✣Bids will be received until 2 p. m., June 21, by G. C. Winslow, Superintendent of Construction, at the office of the County Surveyor, Greenfield, Ind., for the construction of the Harper Drain in Hancock County.

⊙Fred C. Morgan, Vincennes, Ind., has been awarded the contract at 8.1 cts. per cubic yard, for constructing the Rider Ditch and branch, bids for which were opened May 29 at Brownstown, Ind., by Samuel Carr, Engineer-Superintendent.

Iowa.

✣Bids will be received until noon, June 20, by E. L. Marriage, County Auditor, Eldora, Ia., for material and work of constructing Drainage District No. 39. S. B. Gardner, Eldora, Ia., is Engineer.

✣Bids will be received until 10 a. m., June 28, by J. L. Hanrahan, Webster County Auditor, Fort Dodge, Ia., for the construction of tile branches known as Sections 8, 9, 16, 17, 18, 19, 20, 21 and 22 of Drain 96. The cost is estimated at $38,143. Official advertisement will be found elsewhere in this issue.

Kansas.

The State Board of Irrigation will call for bids shortly for the construction of the first irrigation demonstration plant to be installed under the $125,000 state appropriation. The first plant will be installed at Dighton in Lane County. It will consist of wells, concrete reservoir and windmills. B. P. Walker, Osborne, Kan., is Secretary of the Board.

Louisiana.

⊙Subdistrict No. 1 of the North Caddo Drainage District, according to advices from Shreveport, La., has awarded a contract to W. G. Burt for clearing Alligator and Dooly Bayous and Glassell ditch near Gilliam. The improvement will cost about $6,500.

Minnesota.

⊙Contracts for constructing County Ditch No. 14, bids for which were opened June 6 by Jesse L. Herring, County Auditor, Blue Earth, Minn., have been let as follows: Mulgrew-Boyce Co., Dubuque, Ia., open work at $6,500; L. P. Axelsen, Clear Lake, Ia., tile work, at $59,500.

No bids were received June 11 by H. J. Welte, County Auditor, Crookston, Minn., for finishing ditches 63 and 64.

New Mexico.

✣Bids will be received until 2 p. m., June 25, by U. S. Reclamation Service, Elephant Butte, N. Mex., for furnishing sluice and penstock gates and accessories for Elephant Butte Dam, Rio Grande project, New Mexico-Texas. For particulars address the U. S. Reclamation Service, at Elephant Butte, N. Mex., or 307 Wright & Callendar Bldg., Los Angeles, Cal. Official advertisement will be found elsewhere in this issue.

Ohio.

Petition has been filed with the Logan County Commissioners, Bellefontaine, O., for re-dredging Mad River, as a result of the floods of March.

Oklahoma.

Geo. A. & H. A. McWilliams, 28 E. Jackson Blvd., Chicago, Ill., were the low bidders for constructing the Salt Creek Drainage Ditch, bids for which were opened June 4 at Shawnee, Okla.

Virginia.

⊙Brett Engineering Co., Wilson, N. C., has been awarded the contract for constructing about 10 miles of drainage canal, involving 262,000 cu. yds. of excavation, for Parksville Drainage District No. 1. Bids were opened June 11 at Norfolk, Va.

WATER WORKS

California.

⊙Dunn & Sargent have been awarded the contract for drilling an auxiliary well for the city waterworks at Porterville, Calif.

The citizens of Dinuba, Calif., have voted $5,000 for the purpose of building an auxiliary pumping plant.

The California State Railroad Commission has granted the application of the city of Sisson, Siskiyou County, to purchase the water system of the Sisson Development Co., for $12,000.

The citizens of Daly City, Calif., will vote on whether or not they shall establish their own water system. The election will be held June 21. It is proposed to vote bonds in the sum of $100,000.

Florida.

⊙The City Council of Newberry, Fla., has awarded the contract for the construction of a new waterworks and electric light plant to J. B. McCrary Co., of Atlanta, Ga., for $26,000.

The Commissioners of Pass-a-Grille, located on the island of Long Key, Fla., has sold bonds to the amount of $5,000 for the installation of a waterworks system.

Georgia.

An ordinance has been introduced in the City Council of Columbus, Ga., calling for a bond election for $450,000, to be used in building a system of waterworks.

Idaho.

The citizens of Twin Falls, Ida., have offered to purchase the system and plant of the Twin Falls Waterworks Co., for $71,000.

Illinois.

✣Bids will be received until 11 a. m., June 23, by the Board of Local Improvements, Chicago, Ill., for the construction of water supply pipes in the following streets: Bittersweet Pl., 750 ft. east of Clarendon Ave. to 1,000 ft. east; Wallace St., 87th St. to 88th St.; Wilson Ave., Racine Ave. to Clifton Ave.; Hamlin Ave., Lawrence Ave. to Argyle St.; Prairie Ave., Division St. to Hirsch St.; Vernon ve., 109th St. to 111th St. Cash or certified check for 10 per cent of bid must accompany proposal. E. J. Glackin, Secretary of the Board.

✣Bids will be received until 11 a. m., June 23, by the Board of Local Improvements, Chicago, Ill., for the construction of water service pipes in the following streets: Adams Ave., 68th St. to 69th St.; Chicago Ave., 40th Ave. to 48th Ave.; Emerald Ave., Vincennes Road to 90th St.; 40th Ave., Montrose Ave. to Argyle St.; 50th Ave., Augusta St. to Chicago Ave.; Kedzie Ave., Lawrence Ave. to Foster Ave. Cash or certified check for 10 per cent of bid must accompany proposal. E. J. Glaskin, Secretary of the Board.

✣Bids will be received until 11 a. m., June 20, for furnishing and delivering to the department of electricity, Chicago, Ill., electric supplies consisting of conduit reflectors, service boxes, rubber covered and braided wire, etc., according to plans and specifications on file with Ray Palmer, City Electrician. Cash or certified check for 5 per cent of bid must accompany proposal.

✣Bids will be received until 7:30 p. m., June 27, by City Clerk, Altamont, Ill., for furnishing the labor and material for the construction of Municipal water works improvements as follows: One 40,000 gal. steel tank on a 100 ft. steel tower; 132' 4-in. Class B. Cast Iron Pipe; 2,484' 8-in. Class B. Cast Iron Pipe; 3,700 lbs. Special Castings; 7 Fire Hydrants; 7 8-in. Gate Valves with Boxes. Each bid must be accompanied by certified check for five (5) per cent of amount of bid. Cash payments will be made monthly. Frank Schumacher, Mayor. Fuller-Coult Co., Chemical Bldg., St. Louis, Mo., Engineers.

⊙The State Board of Administration, Springfield, Ill., has awarded the contract for the 50,000-gal. capacity steel tank and tower, to be erected at the farm colony of the Peoria State Hospital, South Bartonville, Ill., to the Des Moines Bridge & Iron Co., Des Moines, Ia., for $3,680.

⊙The Citizens' Waterworks Co., Quincy, Ill., has awarded a contract for a new water purification plant complete, with sedimentation basins, baffle chambers, and clear well to the New York Continental Jewell Filtration

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Co., of New York City. The plant is to have a net capacity of 6,000,000 gals. per 24 hours and the contract price is $99,484. The excavation is being done by the water company.

⊙The Keystone Driller Co., Monadnock Blk., Chicago, Ill., has been awarded the contract for furnishing a deep well pumping outfit to the Borden Condensed Milk Co., at Virgil, Ill.

⊙The City Commission of Springfield, Ill., has awarded a contract to the Westinghouse Electric & Mfg. Co., for the purchase of one turbo-generator, including condenser and switchboard complete, and installation at a cost of $18,848, and also transformers and installation at a cost of $5,025.

The Chicago & Alton Railroad Co., plans to drill two additional wells near the well now owned by the company on Lee St., Bloomington, Ill.

The city of Virden, Ill., has appropriated $145,000 for corporation purposes for the next 12 months, including $115,000 for a system of waterworks.

Mayor Hez G. Henry of Camp Point, Ill., has started a movement to obtain a waterworks system for the village.

Iowa.

A committee of three in Winfield, Ia., has circulated a petition to the City Council calling for a special election to vote on the proposition to issue bonds of $12,500 for a waterworks system.

Kansas.

The town of Highland, Kans., is to have a waterworks system, including a 90-ft. tower that will have a tank with a capacity of 50,000 gals. The system will cost $16,000.

At a recent mass meeting held in Strong City, Kans., (population 762) the citizens voted in favor of installing a waterworks system. The City Council has been asked to call a special election to vote bonds for the improvement.

Maine.

The Portland Water District Trustees, Portland, Me., plan the installation of a hypochlorite plant for chemical purification of the water supply in the plant at Sebago Lake, James M. Caird is Engineer.

Massachusetts.

The Water Commissioners, Springfield, Mass., have decided to build an extension of the Little River System into the northeast part of Longmeadow, in accordance with agreement with that town.

Michigan.

Supt. E. L. Dunbar of the waterworks, Bay City, Mich., has advertised for bids for a new high duty pump, with a capacity of 5,000,000 gals. daily, to be installed at the west side pumping station.

Minnesota.

⊙Ben Benson, Willmar, Minn., has been awarded the contract by the town of Raymond, Minn., for the construction of an additional 4-in. water main about 350 ft. with one hydrant 7 ft. deep along Spicer Ave., for $373. Bids were opened June 7.

Mississippi.

The Harrison County Board of Supervisors, Gulfport, Miss., has advertised for bids for the sinking of a new well on the courthouse grounds at Gulfport.

Missouri.

⊙The city of Maryville, Mo., F. L. Flynt, supt. of construction water dept., has let contracts for improvements at the waterworks, as follows: Furnishing of all pumps, heater and generator, Merkle-Hines Machinery Co., Kansas City, Mo., $5,200; two pressure filters, Pittsburgh Filter Co., Kansas City; repairs to tower, Chicago Bridge & Iron Works, Chicago. Bids were opened June 2.

The town of Owensville, Mo., has voted $12,000 in bonds for the purpose of building a waterworks system. J. P. Davis, Windsor, Mo., is Consulting Engineer.

It is probable an election will be held in Hopkins, Mo., soon for the purpose of voting on the issuance of bonds to the amount of $12,000 for the installation of a waterworks system.

The citizens of Stanberry, Mo., have voted bonds to the amount of $4,000, to be used in reorganizing the water plant and putting it in first class condition.

Plans have been worked out by Mayor Still and the Council of Kirksville, Mo., for a complete rehabilitation and extension of the city water works system.

Montana.

Bonds in the sum of $17,500 have been voted for the construction of a waterworks system at Twin Bridges, Mont.

Nebraska.

⊙The Keystone Driller Co., Monadnock Blk., Chicago, Ill., has been awarded the contract by the city of Hildreth, Nebr., for furnishing Downie deep well pumping machinery

New Jersey.

The Mayor and City Council of Paterson, N. J., have approved of an election for bonding the borough to the amount of $10,000, which sum is to be used in the extension of the water mains.

New York.

Water Supt. Howard M. West, Glens Falls, N. Y., has been authorized by the Water Commission to make extensive reinforcements to the spillway walls of the concrete dam of the Keenan reservoir.

Ohio.

✣Bids will be received shortly by J. R. Morris, Director of Public Service, Lima, O., for laying complete, the city furnishing the material, 14,830 lin. ft. of 20-in. cast iron water main. J. A. Crayton is City Engineer.

⊙B. F. Hewitt, Jefferson, O., has been awarded the contract by the Trustees of Public Affairs, Geneva, O., for the construction of a reinforced concrete dam 325 ft. long and 8 ft. high, with end walls, for $14,960. Burgess & Long, Columbus, O., are Engineers. Bids were opened June 6.

⊙The William Tod Co., Youngstown, O., has secured the contract for the installation of a 10,000,000 gal. reciprocating pump in the Akron, O., city waterworks, for about $78,000.

⊙The contract for the building of the dykes at the Kent reservoir, Akron, O., has been awarded to P. T. McCourt, Akron, for $154,321. Construction work will be begun at once and completed about Jan. 1, 1914. E. G. Bradbury is Engineer.

The finance committee of the City Council, Columbus, O., is considering an ordinance providing for a bond issue of $100,000 for the laying of water mains on streets to be improved.

The City Council of Painesville, O., has passed an ordinance authorizing the building of the new filtration plant. Plans have been prepared.

Oklahoma.

⊙The N. S. Sherman Machine & Iron Works, Oklahoma City, Okla., has been awarded the contract for the construction of the government pipe line from Fort Sill, Okla., to a point connecting it with the 16-in. main running from Lake Lawtonka to Lawton. The work will cost about $35,000.

⊙C. J. Burbank, Enid, Okla., has been awarded the contract for the construction of a 5,000-gal. wooden storage tank, furnishing motor driven pump, etc., at Fort Sill, Okla. Bids were opened May 26.

Oregon.

⊙The city of Arlington, Ore., has awarded the following contracts for constructing an electric lighting plant and pumping station, for which bids were received June 3: Power house, H. W. Lang, Arlington, $1,750; filter, California Jewell Filter Co., San Francisco, $2,506; engines, generator, switchboard and pump, Fairbanks, Morse & Co., Portland, Ore., $5,125; electrical distribution system, Fairbanks, Morse & Co., Portland, Ore., $1,375. Louis C. Kelsey, Portland, is Engineer.

Pennsylvania.

✣Bids will be received until 8 p. m., June 20, by Al Lotz, Secy., of Council, Borough of Evansburg, Butler County, Pa., for the construction of a brick and concrete reservoir, capacity 200,000 gallons; plans and bidding blanks may be had at the borough clerk's residence Evans City, Pa., or at the office of the Engineers. A certified check for $100 must accompany all bids. McBride Surveying & Engr. Co., Ltd., 331 Fourth ave., Pittsburgh, Pa.

⊙The contract for the new force mains from the reservoir to the city of Greenville, Pa., has been awarded to I. R. Fike, Jr., of Uniontown, Pa. The work is under the supervision of Chester & Fleming, Hydraulic Engineers, Pittsburgh, Pa. Construction of a new reservoir will be begun at an early date.

The State Senate, Harrisburg, Pa., has passed a bill authorizing the water supply commission to construct a reservior at the headwaters of the Youghiogheny river.

The Water Commissioners of Altoona, Pa., have decided to lay a pipe line to the Prospect Hill Park.

South Carolina.

The Secretary of State of South Carolina has issued a charter to the Harris Springs Water Co. of Laurens County with a capital stock of $50,000. The officers are: C. H. Pettus, president and treasurer; E. C. Stulb, vice-president, and H. H. Alexander, secretary.

Tennessee.

Investigation has been made by parties at Alamo, Tenn., for the proposed installation of a waterworks system. It is understood construction work will be started shortly.

R. C. Huston & Co. of Memphis, Tenn., have completed surveys for the installation of a waterworks system in Walnut Ridge, Ark. Preparations have been made by the Commissioners to float the bonds to commence construction work.

The citizens of Nashville, Tenn., on June 5 defeated the proposition to issue bonds in the sum of $2,500,000, for the construction of a new reservoir.

Texas.

The Attorney General, Austin, Tex., has approved the $25,000 bond issue by the town of Spur, Tex., for the installation of a waterworks system. Preliminary plans have been approved by the City Commissioners and it is proposed to commence construction work at once.

Water Engineer M. L. Minter has filed his report with Mayor Mill of Coleman, Tex., relative to the survey of a reservoir site on Indian Creek. The report carries a recommendation that the city erect a dam 40 ft. high at what is known as the upper site. The work will require 68,300 cu. yds. of excavation and the reservior will hold 336,000,000 gals.

The City Council of Belton, Tex., has called an election to be held July 2 for the purpose of passing upon an issue of $74,000 in bonds, of which $50,000 is for permanent street improvements and $24,000 for waterworks improvements and extensions.

The City Council of Waxahachie, Tex., has called an election to be held July 7 to vote on the proposition of issuing bonds in the sum of $34,750 for public improvements, to be apportioned as follows: For waterworks improvement, $22,500; for permanent street improvements, $10,000; for the public schools, $2,500.

Plans have been prepared for extensions to the waterworks system of Haskell, Tex., to cost approximately $3,500. Contract will be let by July 1. T. C. Cohiee is Mayor.

Utah.

The City Commission of Ogden, Utah, has authorized the immediate resumption of work at the South Fork dam site. This marks the

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

first active preparations to erect the $300,000 dam and reservior under the joint arrangement entered into by the city and the Ogden River Reservior Co. H. J. Craven is City Engineer.

Virginia.

⊙The National Meter Co. is reported to have been awarded the contract by the Board of Control of Norfolk, Va., for furnishing the water meters during the year, for about $20,000.

The city of Richmond, Va., plans the extension of a 12-in. water main from the east end of Broad St. eastwardly to supply citizens residing on Fulton Hill with city water. E. E. Davis is superintendent of the waterworks.

Washington.

The City Council of Tacoma, Wash., has voted to appropriate $10,000 or more if necessary to construct a by-pass around the reservoir at McMillan, one of the units in the city's new gravity water system, and to cover the expense of repairing several leaks in the bottom of the bowl.

Bonds have been sold for the construction of a waterworks system in Ilwaco, Wash.

The citizens of the town of Endicott, Wash., have voted bonds in the sum of $12,000 for the building of a waterworks system. C. H. Green is Engineer.

Wisconsin.

⊙Keystone Driller Co., Monadnock Blk., Chicago, Ill., has been awarded the contract for furnishing a deep well pumping outfit to the institution at Oneida, Wis.

Canada.

✣Bids will be received until 11 a. m., July 2, by Chairman Board of Control at the office of M. Peterson, Secy., Winnipeg, Man., for the manufacture, delivery and installation of Two Horizontal two-stage turbine pumps, direct coupled to a slow constant speed induction motors, switching gear and starter panel. Each pump to be capable of delivering 3,600 imperial gallons per minute, against a pressure of 150 pounds per sq. in., or 1,800 imperial gals. per minute against a pressure of 300 pounds per square inch. Plans, specifications and form of tender together with conditions governing tenders as prescribed by by-law may be obtained at the office of the City Engineer, 223 James Ave.

The city of Winnipeg, Man., plans the construction of a new waterworks system at an estimated cost of $14,000,000. The system would require 98 miles of pipe. R. N. Ruttan is City Engineer.

SEWERAGE AND SANITATION

Alabama.

⊙The City Commission of Birmingham, Ala., has let contracts for the $200,000 sewer extension connecting the North and South Sides, as follows: Southern Asphalt Construction Co., Sections 1, 2 and 3, for $70,940, $26,945 and $70,052, respectively; A. C. Brooks, Section 4, for $27,845.

Arkansas.

Supt. of Public Works Henry Levinson, Little Rock, Ark., is preparing data pertaining to the old state sewer, which it is proposed to enlarge. It is estimated that it will cost about $35,000 to make the improvement.

California.

Consulting Engineers Olmsted & Gillelen, Wright & Callender Bldg., Los Angeles, Calif., have completed plans for the proposed outfall sewer system for the San Gabriel Valley Intercity Commission. The estimated cost is $3,000,000.

The Chamber of Commerce of Sangar, Calif., has started a movement for the installation of a municipal sewerage system and waterworks plant. A petition has been circulated asking that an election be held to vote bonds for the improvements.

A bond election will be held in San Rafael, Calif., to vote on an issue of $200,000 for municipal improvements. Of this amount $110,000 will be devoted to rebuilding the streets of the town. The remaining $90,000 will be divided as follows: $25,000 for bathing park, $25,000 for an incinerating plant and $40,000 for the improvement of the San Rafael Canal.

Georgia.

⊙Bids were received June 10 by R. M. Clayton, Chief of Construction, City of Atlanta, Ga., for constructing Group 6 of lateral sewers, about 5 miles in all. The contract was awarded to B. F. Meeks, Atlanta, at $12,143. The unit prices were as follows: (1) Bid of Dysard Construction Co., (2) bid of J. R. Colhran, (3) B. F. Meeks, (4) L. R. Brine, (5) Cement Stone & Tile Co.

Item.	(1)	(2)	(3)	(4)	(5)
80,000 brick	$16.50	$16.00	$14.00	$16.50	$15.00
10 cu. yds. rubble masonry	4.75	4.00	3.00	5.00	6.00
10 cu. ft. cut stone	1.00	1.00	1.75	1.00	2.00
15 sq. ft. cut flagging	0.75	0.75	0.80	1.00	1.00
1,500 ft. B. M. lumber	18.00	17.00	15.00	17.50	18.00
13,000 cu. yds. excavation and back filling, 10 ft	0.60	0.60	0.48	0.57	0.60
2,500 cu. yds. excavation and back filling, 15 ft	0.75	0.75	0.60	0.70	0.80
600 cu. yds. excavation and back filling, 20 ft	1.10	1.00	0.80	0.87	0.95
200 cu. yds. excavation and back filling, 25 ft	1.30	1.20	1.00	1.25	1.10
200 cu. yds. solid rock excavation	3.50	3.00	2.50	3.00	4.00
800 cu. yds. semi-decomposed rock excavation	0.80	1.00	0.75	0.65	1.15
10 cu. yds. plain concrete	5.00	4.50	4.50	6.00	5.00
40,000 ft. 6x8-in. vitrified pipe laying	0.05	0.05	0.03	0.03	0.05
2,500 ft. 10x12-in. vitrified pipe laying	0.06	0.06	0.03½	0.04	0.06
1,000 ft: 15x18-in. vitrified pipe laying	0.07	0.07	0.05	0.06	0.07
100 ft. 20x22-in. vitrified pipe laying	0.09	0.10	0.06	0.08	0.10
100 ft. 24-in. vitrified pipe laying	0.12	0.12	0.08	0.12	0.12
10 cu. yds. broken stone	2.00	3.00	2.50	3.00	3.00
Total	$15,662	$15,599	$12,143	$13,943	$15,954

⊙Bids were opened June 10 by R. M. Clayton, Chief of Construction, City of Atlanta, Ga., for constructing Group 7 lateral sewers, about 5 miles in all. The contract was let to B. F. Meeks, at $14,064. The unit prices were as follows: (1) Bid of Dysard Construction Co., (2) Case & Cothran, (3) B. F. Meeks, (4) L. R. Brine, (5) Cement Stone & Tile Co.

Item.	(1)	(2)	(3)	(4)	(5)
100,000 brick	$16.00	$17.00	$14.00	$16.50	$15.00
10 cu. yds. rubble masonry	4.00	5.00	3.00	5.00	6.00
10 cu. ft. cut stone	1.00	1.00	1.75	1.00	2.00
15 sq. ft. cut flagging	0.75	0.75	0.80	1.00	1.00
2,000 ft. B. M. lumber	16.00	17.00	15.00	17.50	18.00
15,000 cu. yds. excavation and back filling, 10-f	0.60	0.60	0.48	0.57	0.60
3,000 cu. yds. excavation and back filling, 15-ft	0.75	0.75	0.60	0.70	0.80
800 cu. yds. excavation and back filling, 20-ft	1.00	1.00	0.82	0.87	0.95
200 cu. yds. excavation and back filling, 25-ft	1.25	1.20	1.00	1.25	1.10
200 cu. ft. solid rock excavation	3.00	3.00	2.50	3.00	4.00
1,000 cu. yds. semi-decomposed rock excavation	0.75	1.00	0.75	0.65	1.15
10 cu. yds. plain concrete	5.00	4.50	4.50	6.00	5.00
41,000 ft. 6x8-in. vitrified pipe laying	0.05	0.05	0.03	0.03	0.05
3,000 ft. 10x12-in. vitrified pipe laying	0.05	0.06	0.03½	0.04	0.06
1,000 ft. 15x18-in. vitrified pipe laying	0.06	0.07	0.05	0.06	0.07
100 ft. 20x22-in. vitrified pipe laying	0.08	0.10	0.06	0.08	0.10
100 ft. 24-in. vitrified pipe laying	0.10	0.12	0.08	0.12	0.12
10 cu. yds. broken stone	2.00	3.00	2.50	3.00	3.00
Totals	$17,691	$18,092	$14,064	$16,126	$18,363

⊙The Bond Commission of Cordele, Ga., has let the contract for an extension of the sewerage system, including 9,000 ft., to Frank Moore & Co., for $2,500.

Illinois.

✣Bids will be received until 11 a. m., June 23, by the Board of Local Improvements, Chicago, Ill., for the construction of brick and tile pipe sewers in the following streets: Cullom Ave., Milwaukee Ave. to 52nd Ave.; Edmunds St. to Higgins Ave.; Higgins Ave., Edmunds St., 900 ft. northwest; 48th Ct., West End. Ave. to Park Ave.; 52nd St., Robey St. to 1,240 ft. west; 52nd Ave., Division St. to Augusta St.; Hamlin Ave., Lawrence Ave. to Argyle St.; 52nd Ave., Lawrence Ave. to 342 ft. south of Leland Ave.; Giddings St., 52nd Ave., 300 ft. west; Princeton Ave., 37th St. to 600 ft. north; Bensley Ave., 103rd St. to 105th St.; 64th St. to 66th St.; 44th Ave., Lawrence Ave. to Elston Ave.; Elston Ave., 180 ft. south of Lawrence Ave. to 43rd Ave.; Lowell Ave., Elston Ave. to Wilson Ave.; 43rd Ave., Elston Ave. to Wilson Ave.; 52nd Ave., 12th St. to Madison St.; Madison St., 52nd Ave. to Willow Ave.; Willow Ave., Madison St. to Division St.; 52nd Ave., 12th St. to 22nd St. The work includes construction of catch basins, manholes, etc. Cash or certified check for 10 per cent of bid must accompany proposal. E. J. Glackin, Secretary of the Board.

✣Bids will be received until 11 a. m., June 23, by the Board of Local Improvements, Chicago, Ill., for the construction of house drains in the following streets: Chicago Ave., 40th Ave. to 48th Ave., 4,000 lin. ft; Cornelia St., 48th Ave. to 50th Ave., 1,800 lin. ft.; Drake Ave., Franklin Blvd. to the C. & N. W. R .R. 400 lin. ft.; 87th St., S. Chicago Ave. to South Chicago R. R. 400 ft.; Escanaba Ave., Baltimore Ave. to 87th St. 1,000 lin. ft; 40th Ave., Montrose Ave. to Argyle St. 4,000 lin ft.; 44th Ct., Montrose Ave. to Elston Ave. 2,200 lin. ft.; 45th Ave., Milwaukee Ave. to Irving Park Blvd. 500 lin. ft.; 46th Ave., Wilson Ave. to Lawrence Ave. 800 lin. ft.; 47th Ave., Wilson Ave. to Lawrence Ave., 1,000 lin. ft.; 47th St., Lawrence Ave. to Sunnyside Ave., 1,800 lin. ft.; 55th Ave., Leland Ave. to Higgins Ave. 500 lin. ft; Grace St., 48th Ave. to 46th Ave. 900 lin. ft.; Hamlin Ave., Elston Ave. to Montrose Ave. 900 lin. ft.; Houston Ave., Baltimore Ave. to 87th St. 1,200 lin. ft.; Kedzie Ave., Belmont Ave. to Addison St. 900 lin. ft.; Lafayette Ave., 106th Pl. to 108th St. 1,200 lin. ft.; Lafayette Ave., 119th St. to 120th St. 600 lin. ft.; LaSalle St., 119th St. to 120th St. 800 lin. ft.; Lawndale Ave., Grace St. to Avondale Ave. 1,200 lin. ft.; Lawndale Ave., Belle Plaine Ave. to Montrose Ave. 1,800 lin. ft.; Lexington Ave., 91st St. to 94th St. 2,400 lin. ft.; Perry Ave., 106th Pl. to 108th St. 800 lin. ft.; 73rd Pl., Laflin St. to Ada St. 2,300 lin ft.; Union Ave., 103rd St. to 104th St. 1,000 lin. ft. All drains to be 6 ins. in diameter. Cash or certified check for $105 of bid must ac-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

company proposal. E. J. Glackin, Secretary of the Board.

⊙The Board of Local Improvements of Herrin, Ill., has awarded the contract for the construction of a sewer in District No. 1 to the Foulkes Contracting Co., of Terre Haute, Ind., for $49,987. The work includes 16,302 lin. ft. of vitrified clay sewer pipe, 127 manholes, 33 flush tanks, 5 lampholes and a sewage disposal plant.

Indiana.

City Engineer H. W. Klaussman of Indianapolis, Ind., has been instructed to prepare a resolution and specifications for the construction of a sewer in Howard St. from Kentucky Ave. to Harding St.

The City Council of Angola, Ind., has instructed the city engineer to make plans and specifications for the proposed north side sewer.

Iowa.

✣Bids will be received until 8 p. m., June 23, by W. F. Weary, City Clerk, Sac City, Ia., for the construction of 2,800 ft. of No. 1, 8-in. vit. pipe sewer, including 8 brick manholes. Plans and specifications are on file with the City Clerk.

✣Bids will be received until 7:30 p. m., June 23, by City Council, Cedar Falls, Ia., for furnishing the labor and material necessary for the construction of a sanitary sewer in accordance with plans and specifications on file with the City Clerk, the work on the sewer requiring approximately 6,040 lin. ft. of 8-in. vit. sewer pipe, 700 lin. ft. of 12-in. vit. sewer pipe, 19 manholes, 6 flush tanks, together with the necessary Y's and appurtenances, said pipe to be laid in properly covered trench. W. H. Merner is Mayor and C. H. Streetor is City Engineer.

⊙Potts Bros., of Des Moines, Ia., have been awarded the contract for the laying of sidewalks and the construction of an underground sewer system at the state fair grounds. The sidewalks will cost $0.09 a sq. ft. and the sewer $3.25 a lin. ft.

⊙H. J. Cathroe & Co., 503 Ware Blk., Omaha, Nebr., have been awarded the contract by the city of Chariton, Ia., for the construction of 17 000 ft. of sewer, including manholes, dropholes, Y's, etc., for $16,049. Bids were opened June 6.

The City Council of Clarinda, Ia., has approved the recommendation of Engineers Hall & Adams for the construction of a sewer to drain Water and Grant Sts. from 15th St. east. The work will include the following: 2,720 ft. of 10-in. pipe. 1,430 ft. of 8-in. pipe, 930 ft. of 6-in. pipe, 12 manholes. The estimated cost is $3,592.

The City Council of Fort Dodge, Ia., has passed resolutions providing for the construction of nearly three miles of sewers, both storm and sanitary. Chas. H. Reynolds is City Engineer.

Kansas.

City Engineer G. L. McLane of Hutchinson, Kans., has prepared plans and preliminary surveys for the proposed extension of the city sewer mains to the Arkansas River.

Maryland.

The Maryland Board of Health has had surveys made to extend the sewerage system of the District of Columbia so as to embrace Rock Creek and the Anacostia River Valleys as far as Rockville.

Massachusetts.

⊙G. M. Bryne Co., 166 Devonshire St., Boston, Mass., has been awarded the contract by the Metropolitan Water & Sewerage Board, Winchester, Mass., for building section 68 of the New Mystic Valley sewer for $67,535. Bids were opened June 6.

The Massachusetts State Senate has passed a bill adding to the appropriation for state institutions an item of $75,000 for connecting the sewerage system of Worcester State Hospital with the system of Worcester.

Michigan.

⊙The City Commission of Pontiac, Mich., has awarded contracts for sewers in 17 streets to the Gray-Robinson Construction Co., of Manitowoc, Wis., for $18,387.

Prof. E. D. Rich, Ann Arbor, Mich, will prepare plans and specifications for a comprehensive sewerage system for Alpena, Mich.

City Engineer Herman H. Eymer of Saginaw, Mich., has recommended that the city take action toward installing a sewage disposal plant to prevent the pollution of the river.

Engineer E. H. Christ, Norris bldg., Grand Rapids, Mich., has prepared plans for a new sewerage plant for Harbor Springs, Mich.

The citizens of the village of Grosse Pointe Park, according to advices from Detroit, Mich., have voted to construct a sewer in Jefferson Ave., to cost $150,000.

City Engineer C. L. Herron of Hillsdale, Mich., has run levels for the proposed sewer from the end of Manning St. to Howell St.

Minnesota.

✣Bids will be received until 8 p. m., June 20, by Common Council, Austin, Minn., for the construction of sanitary sewers in accordance with plans and specifications now on file at the office of Frank Cronon, City Recorder, and O. F. Weisgerber, City Engineer.

✣Bids will be received until 8 p. m., June 27, by W. H. Quist, City Clerk, Thief River Falls, Minn., for constructing sewers in Districts 3 and 4. Complete copies of plans and specifications are on file at the office of the City Clerk and at the office of the City Engineer, of Grand Forks, N. Dak.

City Engineer Oscar Claussen of St. Paul, Minn., has asked the Assembly for $250,000 for the construction of main sewers.

Mississippi.

⊙The City Commissioners of Laurel, Miss., have awarded contracts for the construction of storm sewers in the residence districts where street paving is to be laid this summer to Dabney & Wetmore, of Meridian, Miss.

Missouri.

✣Bids will be received until noon, June 20, by Board of Public Improvements, St. Louis, Mo., for constructing under Letting No. 10903 sewers in Harlem Creek Sewer in District No. 10, as authorized by Ordinance No. 27079, embracing sewers of the materials, lengths and sizes as follows, to-wit: Vitrified clay pipe sewers 1,060 ft. of 21-in. inside diameter, 240 ft. of 18-in. inside diameter, 1,715 ft. of 15-in. inside diameter, 1,880 ft. of 12-in. inside diameter; with inlets, manholes and all other appurtenances. Deposit required, $438. W. T. Findly is Secretary.

Montana.

✣Bids will be received until 8 p. m., July 1, by L. E. Torrence, City Clerk, Billings, Mont., for the construction of an 8-in. sewer in District No. 86. The work for which bids are invited consists of 380 ft. of 8-in. sewer, more or less, with one flush tank and one flush tank remodeled into a combination manhole and flush tank. Each bid must be made on blanks furnished by the City Engineer and accompanied by a certified check on some responsible bank of the City of Billings for $100, and made payable to the City of Billings.

New Hampshire.

Surveys are being made under the supervision of the Board of Public Works, Manchester, N. H., for a sewer in Amoskeag, for which an appropriation of $18,000 was made by the Common Council.

New Jersey.

✣Bids will be received until June 30 by Board of Sewerage, Hammonton, N. J., for the construction of about 11 miles of sewer pipe line and sewage disposal plant.

⊙Chas. Ippolito, Orange, N. J., has been awarded the contract by the Board of Contract & Supply of Schenectady, N. Y., for the construction of 8,050 lin. ft. of rectangular sewer for $79,207. Bids were opened June 11.

The Town Council of Belleville, N. J., proposes to have work started on the sanitary sewerage system as soon after June 18 as practicable. The plans for the system have been prepared by Town Engineer Frank Shepherd. Under the ordinance contracts may be made with Newark, Nutley and adjoining municipalities.

The Common Council of Orange, N. J., has passed a resolution announcing the intention of the city to join with East Orange and Montclair in the location of an Imhoff plant in Belleville and Bloomfield. John C. Fineran is president of the Council.

New York.

✣Bids will be received until 2 p. m., July 21, by Frank J. Hoyle, Chairman of the Bronx Valley Sewer Commission, 2 Grand St., White Plains, N. Y., for furnishing the labor and material necessary for the construction of a sewage, settling, reducing or screening plant to be located at the intersection of Bronx Valley sewer with Tibbet's Brook, City of Yonkers, County of Westchester, New York, and work incident thereto.

⊙Vrooman & Perry of Gloversville, N. Y., and Amsterdam, N. Y., are preparing plans for 22 miles of sewers and sewage disposal plant for the village of Northport, L. I.

⊙Lain & Morrison, Fairport, N. Y., and Morrally & Ingersoll, Rochester, N. Y., submitted the lowest bids to the Storm Sewer Commission, Watervliet, N. Y., for the construction of the earthen fill dam and a concrete dam across Dry River, together with overflow and outlet works, concrete and brick conduits and storm drains. Solomon, Norcross & Keis, Candler Bldg., Atlanta, Ga., are Engineers. Bids were opened June 10.

Consulting Engineers Vrooman & Perry, of Gloversville, N. Y., have been retained to prepare a map and plans for the proposed sewerage plant for Northport, L. I.

The Board of Sewer Commissioners, Ilion, N. Y., has purchased lands north of the West Shore Railroad, containing about 12.15 acres, also a right of way from the north end of East St. to the West Shore Railroad, a distance of 807 ft. On this site will be built a sewage disposal plant as ordered by the State Board of Health.

Engineer F. E. Calwell, representing Consulting Engineer Clyde Potts, New York City, has estimated the cost of installing a sewerage system and disposal plant in Goshen, N. Y., at from $50,000 to $80,000.

North Carolina.

The Town of Hamlet, N. C., plans the installation of a new sewerage system at an estimated cost of $15,000. H. P. Austin is official in charge.

The Town Council of Dunn, N. C., has instructed Consulting Engineer Gilbert C. White, of Charlotte, N. C., to prepare plans and specifications and advertise for bids for a completed sewerage system for the town.

Ohio.

✣Bids will be received until noon, June 24, by Director of Public Service, E. C. Yochem, Clerk, Galion, O., for the construction of the 10th District Sanitary Sewer. Said improvement requiring approximately the following labor and materials: 17,080 ft. of 8 and 10-in. vitrified sewer pipe, 3,632 ft. of 12-in. vitrified sewer pipe, 1,040 ft. of 15-in. vitrified sewer pipe, 20,661 ft. of sub-drain pipe, 13.5 tons of cast iron pipe, 75 manholes, 22,054.2 yds. of excavation.

✣Bids will be received shortly by J. R. Morris, Director of Public Service, Lima, O., for building 1,200 lin. ft. of 12 and 15-in. sewer. J. A. Crayton is City Engineer.

✣The City Council of Trenton, Mo., has approved the plans and specifications prepared by City Engineer Harvey O. Garst for the construction of Sewer District No. 9. Bids for this work will be received by the City Clerk until June 24.

⊙The city of Youngstown, O., has awarded the contract for the construction of Section

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

1 of the Brier Hill sewer to Harris & Kidson, for $25,817, and for Section 2 to Charles Harris, for $28,483.

⊙Logan D. Burd has been awarded the contract by the Board of Control of Canton, O., for the construction of the McDonald, Harrisburg and Oaklawn Ave. storm sewer, for $7,600.

⊙William Graham, of Columbus, O., has been awarded the contract by the City Council of Marysville, O., for the installation of the proposed sanitary sewerage system, for $59,933. The contract for the disposal plant was awarded Frank Mulligan, of Bellefontaine, O., and William Epps, of Marysville, for $42,054.

Plans for the installation of a sewerage system in the village of West Park, O., are on file in the office of Village Clerk Fred Feuchter.

The City Council of Mt. Vernon, O., has decided to build a $40,000 sewage disposal plant in that city.

Oregon.

The Elliott Construction Co., at $69,412, submitted the lowest bid to the City Council of Portland, Ore., for the construction of the Lambert sewer system in Sellwood, using lock-joint sewer pipe. William Lind, at $64,658, bid low on the work, using monolithic pipe.

Pennsylvania.

✣Bids will be received until 10 a. m., June 24, by City Controller, Municipal Bldg., Pittsburgh, Pa., for the following improvements: Repaving with blockstone, Forbes St., from Sixth Ave. eastwardly to a point near Gist St.; Grant St., from 3rd Ave. to 4th Ave. Relief sewers, Broad St. and Rebecca St., from Graham St. to present brick sewer on Liberty Ave., 24 in. T. C. pipe and 36 in. and 42 in. brick sewers. 40th St., from Butler St. northwestwardly to the Allegheny River, with a branch sewer on Valley St., from Almond Alley southwestwardly to 40th St., 20 in. and 30 in. T. C. pipe sewer. Retaining walls, reconstruction of concrete retaining wall at North Ave. and Irwin Ave. Erection of steel and reinforced concrete foot-bridge and steps. Lang Ave., over P. R. R. tracks. J. G. Armstrong is Director of Public Works.

⊙Willauer & Co., of Pottstown, Pa., have been awarded the contract to build the sewers in that borough.

Texas.

✣Bids will be received until 10 a. m., June 20, by J. W. Foster, Commissioner of Streets, Sewers and Public Improvements, Waco, Texas, for furnishing all labor and material to construct a sewer line along the Brazos River bank, from the present Jefferson St. main to North Fourth and Proctor Sts., to include approximately 3,000 lin. ft. of 15-in. tile pipe in place, 3,000 lin. ft. 8-in. tile pipe in place, 1,000 lin. ft. 6-in. tile pipe in place, 1,150 lin. ft. 16-in. cast iron pipe in place, together with necessary trestle work, especials and excavation, etc. Certified check on some local bank, payable to the Mayor of Waco, Tex., for 5 per centum of the amount of bid, shall accompany each proposal to insure the making of bond and closing contract before any bid will be awarded. Specifications, profiles and plans will be ready for inspection at the City Engineer's office, Waco, Tex. G. E. Byars is City Engineer.

⊙The City Council of Jacksonville, Tex., has awarded the contract for the installation of the proposed sewerage system to the Cardwell Construction Co., of Texarkana, Tex. Bonds to the amount of $25,000 were voted for this improvement.

Utah.

✣Bids will be received until 10 a. m., June 24, by H. J. Craven, City Engineer, Ogden, Utah, for the construction of sewers in Sewer District No. 116.

Virginia.

✣Bids will be received until noon, June 27, by W. L. Craft, City Clerk, Roanoke, Va., for the construction of the sewer to accommodate the property abutting on the south side of Ferdinand Ave., S. W., north of Highland Ave., north side of Riverside Boulevard, between Seventh St. and Day Ave., south side of Day Ave. between Seventh St. and Riverside Boulevard. Plans and specifications are on file at the office of F. L. Gibboney, City Engineer.

Wisconsin.

✣Bids will be received until 7:30 p. m., June 25, by Board of Public Works, Two Rivers, Wis., for the construction of a sewer system in that city. Otto Gass is a member of the Board.

✣Bids will be received until 4 p. m., June 20, by J. Hay, County Clerk, Racine, Wis., for constructing certain sewers and a sewage treating plant for the County Institutions at Gatliff, Wisconsin, in accordance with the plans and specifications, which may be seen and blank proposals obtained at the office of the County Clerk in Racine and at Room 1201 Hartford Building, Chicago. Proposals for constructing sewers and a sewage treating plant shall be made separately.

✣Bids will be received until 7:30 p. m., June 18, by J. F. Blanchard, City Clerk, Park Falls, Wis., for constructing the following sewers: 839 ft. 6-in. vit. pipe sewers 4 ft. deep, 2,094 ft. 10-in. vit. pipe sewers, 8 ft. deep, 9,332 ft. 8-in. vit. pipe sewers, 7.3 ft. deep, 289 ft. 8-in. C. I. pipe sewers, 5 ft. deep, 37 manholes, 6 lampholes. Certified check 5 per cent. Bond 25 per cent of contract price. Plans may be seen at the office of the Western Builder, Milwaukee; The Improvement Bulletin, Minneapolis; 31 Vroman Bldg., Madison, Wis., and at the office of the City Clerk.

⊙The Russell Bros. Construction Co. has been awarded the contract for the laying of the Fifth Ward sewers by the Board of Public Works of Superior, Wis., for $4,551.

⊙The City Council of Menasha, Wis., has let the contract for the construction of the Second and Manitowoc Sts. sewer to Quella & Jensen, of Menasha.

⊙The Board of Public Works of Chippewa Falls, Wis., has let the contract for the construction of city sewers to the Pastoret Construction Co., of Duluth, Minn., for $6,358.

Canada.

The citizens of Trenton, Ont., have voted a by-law to extend the sewerage system and to pave Front and Dundas Sts., including a total expenditure of $75,000.

BUILDINGS

Georgia.

✣Bids will be received until 3 p. m., July 21, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction, complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures, and approaches, of the United States post office at Cartersville, Ga. The building is 1 story and basement and has a ground area of approximately 4,400 sq. ft.; stone, stucco, and terra cotta facing, tile roof. Drawings and specifications may be obtained from the custodian of site at Cartersville, Ga., or at the discretion of the Supervising Architect.

Illinois.

⊙J. L. Flinn & Son, Peoria, Ill., have been awarded the contract for erecting a 7-story 260x168 ft. storage and warehouse building in South Washington St., Peoria, to be used by the International Harvester Co.

Indiana.

⊙The Bedford Stone & Construction Co., Traction Terminal Bldg., Indianapolis, Ind., has been awarded the contract for the erection of the new addition to the Cole Motor Car Co. plant at East Washington and Davidson Sts., Indianapolis. The work will involve an expenditure of $175,000 exclusive of furnishings. The building is to be a 4-story reinforced concrete structure.

Iowa.

✣Bids will be received until June 30 by A. H. Paddock, Secretary of School Board, Independent School District, Clinton, Ia., for the construction of certain cement walks at the Lincoln School in said city, totaling about 4,000 ft., more or less, and at the Hawthorne School in said city, totaling about 3,300 ft., more or less. The plans and specifications for said work are on file in the office of the Secretary and can be examined by all desiring to do so. Said work must be fully completed not later than August 30th, 1913.

Michigan.

⊙T. S. Banhagel of Lansing has been awarded the contract for the general construction of a new building at the Michigan School for the Deaf at Flint, to replace the one destroyed by fire in May, 1912. Contract price, $167,201.

⊙Richard Collins, Alpena, Mich., has been awarded the contract at $57,468 for constructing U. S. post office at Petoskey, Mich.

Missouri.

⊙Rogers & Kaiser, People's Gas Bldg., Chicago, Ill., have been awarded the contract at $60,990 for constructing U. S. post office at Brookfield, Mo.

New Jersey.

⊙The Webb Granite Co., Worcester, Mass., has been awarded a contract at $418,000 for supplying stone for the completion of the Sacred Heart Cathedral, Park Ave., Newark, N. J. E. M. Waldron, Inc., 845 Sixth Ave., Newark, N. J., has been awarded the contract for the mason and plumbing work and setting the granite.

Ohio.

✣Bids will be received until noon, July 9, by the Ohio State Board of Agriculture at the office of A. P. Sandles, Secy., Columbus, O., for furnishing the labor and material required to build and erect a fence around the race track and part of the ground enclosure fencing at the Ohio State Fair grounds, Columbus. According to plans and specifications prepared by Dawson & Holbrook, Architects, 14 E. Broad St., Columbus, O.

✣Bids will be received until 2 p. m., July 2, by Ohio Board of Administration, Hartman Bldg., Columbus, O., for remodeling an addition to the Domestic Building at the Ohio Soldiers and Sailors' Home, Sandusky, Ohio. Plans and specifications are on file and may be seen at the offices of the Board of Administration, Columbus, Ohio, and at the office of the Commandant of the Home, Sandusky, Ohio. For information address W. R. Burnett, Commandant, Ohio Soldiers and Sailors' Home, Sandusky, Ohio.

✣Bids will be received until noon, July 5, by the Adjutant General's Department, Columbus, O., for the materials and labor required for remodeling and refurnishing office of the governor, adjutant general and auditor of state, Columbus, Ohio, according to the plans, descriptions, bills, estimates and specifications, which are on file at the office of the Adjutant General. General G. H. Wood is Adjutant General of Ohio.

South Dakota.

✣Bids will be received until noon, June 23, by State Board of Charities and Corrections, Dr. G. C. Redfield, Secy., care Training School, Plankinton, S. Dak., for the erection of an addition to the girls' dormitory at the State Training School at Plankinton, S. D., according to plans and specifications made by John Chapman, Architect, Sioux Falls, S. D., copies of which are on file at Dr. G. C. Redfield's office at Rapid City, S. D.; Builders' Exchange, Minneapolis, Minn.; at office of Superintendent of Training School at Plankinton, S. D., and at Architect's office, Sioux Falls, S. D.

Canada.

⊙Purdy & Henderson, 470 Granville St., Vancouver, B. C., have been awarded the contract for erecting two hotel buildings for the Grand Trunk Pacific Ry. One is to be built at Fort George at a cost of about $200,000, and the other at Willow River. Holabird & Roche, 104 S. Michigan Ave., Chicago, Ill., are the Architects.

RIVERS AND HARBORS

Arkansas.

✣Bids will be received until noon, July 12, by Directors of the Plum Bayou Levee District at the office of the Levee Board, England, Ark., for the construction of about 6,000 ft. of new levee containing approximately 100,000 cu. yds. Certified check in the sum of $800, payable to the secretary of the district, must accompany each proposal. Plans and specifications will be on file at the office of the Secretary, England, Ark., and at the office of Dickinson & Watkins, Engineers, State Bank Bldg., Little Rock, Ark. J. T. Lipscomb is Secretary.

Delaware.

✣Bids will be received until 2 p. m., June 20, by Maj. H. W. Stickle, U. S. Engineer, Wilmington, Del., for furnishing 1,000 tons riprap stone.

Illinois.

✣Bids will be received until 10 a. m., June 28, by Lt. Col. Geo. A. Zinn, U. S. Engineer, Chicago, Ill., as noted in our last issue, for constructing a timber concrete dock in the North Branch Turning Basin, Chicago River. It will be built along the west, north and east sides of the basin, south of North Ave. The substructure will consist of one row of front piles and another row 10 ft. back of the front row; cap timbers over each of these two rows; double lap sheeting, trimmers and stringers; a row of anchor piles and anchor rods connecting the front piles with anchor logs placed back of the anchor piles. The dock along the west bank of the basin will be about 300 ft. in length; that along the north bank 296 ft. and along the east bank 397 ft., including a "return" at the north end, or about 993 ft. in all. The superstructure will consist of a continuous concrete structure built in separate sections over the substructure. The approximate aggregate bill of labor and materials in the dock proper is as follows: 993 lin. ft. of trench for front piles; 993 lin. ft. of dock filling; 4 pile clusters to be removed; 1,361 cu. yds. of concrete; 199 white oak piles, 35 ft. long; 139 cypress or hardwood piles, 25 ft. long; 199 cypress or hardwood piles, 20 ft. long; 993 lin. ft. Oregon fir back logs; 26,214 ft., b. m., 12x12 in. white oak cap timbers; 7,944 ft., b. m., 4x12 in. filler and top stringers; 2,980 ft., b. m., 3x12 in. waling strips; 180,726 ft., b. m., Oregon fir sheeting, 3 and 4 ins. long, 26 ft. long; 5,958 ft., b. m., 6x12 in. pine or fir stringers; 7,944 ft., b. m., 8x12 in. pine or fir stringers; 8,150 lbs. drift and anchor bolts; 199 lbs. steel anchor rods, 1⅜ in. by 30 ft., with nuts, washers, etc.; 19,660 lbs. steel rods and screw bolts with nuts, washers, etc.; 990 lbs. spikes and lag screws; 6 mooring posts. In the pile protection the approximate quantities are 199 Oregon fir or Norway pine piles, 35 ft. long; 30,190 ft., b. m., Oregon fir timber; 8,440 lbs. steel plates; 4,170 lbs. screw bolts; 400 lbs. drift bolts.

Louisiana.

⊙Bids were opened June 9 by Capt. C. O. Sherrill, U. S. Engineer, New Orleans, La., for 615,000 cu. yds. of earth work in Ingefield Levee and Vancluse Levee, in the Lower Tensas Levee District. Contract for Vancluse Levee, Lots 1 and 2, was awarded to Francis T. Constant; contract for Ingefield Levee, Lots 2, 3 and 4, was awarded to R. T. Clark & Co., Natchez, Miss. The unit bids received on the work were as follows: (1) bid on Lot 2 Ingefield Levee, 131,000 cu. yds.; (2) bid on Lot 3 Ingefield Levee, 120,500 cu. yds.; (3) bid on Lot 4 Ingefield Levee, 129,500 cu. yds.; (4) bid on Lot 1 Vancluse Levee, 173,000 cu. yds.; (5) bid on Lot 2 Vancluse Levee, 168,000 cu. yds.: Francis T. Constant, Alexandria, La., (2) 35 cts.; (3) 35 cts.; (4) 34 cts.; (5) 34 cts. Donovan & Daley, Lake Providence, La., (1) 31.70 cts.; (5) 47 cts. Bartlett Brothers, New Orleans, La., (4) 55 cts. Jackson, Pickett & Cooper, Natchez, Miss., (1) 32.90 cts.; (2) 39.50 cts.; (3) 31.90 cts.; (4) 52.90 cts.; (5) 35.90 cts. N. C. Williamson, New Orleans, La., (1) 32½ cts.; (2) 44 cts.; (3) 42 cts. Junkin Bros., Natchez, Miss., (5) 19.74 cts. R. T. Clark & Co., Natchez, Miss., (1) 29.16 cts.; (2) 29.16 cts.; (3) 29.16 cts.; (4) 48.90 cts.; (5) 48.90 cts.

Massachusetts.

⊙The State Board of Harbor and Land Commissioners, Boston, Mass., has awarded the following contracts, bids on which were opened May 28: Saugus River, dredging a channel—To Bay State Dredging Co., Ltd., 247 Atlantic Ave., Boston: Item 1, dredging material including boulders of 1 cu. yd. or less, 33.9 cts. per cu. yd.; Item 2, dredging boulders of not over 5 cu. yds., $5 per cu. yd. Lynn Harbor, dredging an anchorage basin—to J. P. O'Riorden, 6 City Square, Charlestown, Mass.: Item 1, as above, 20⅞ cts. per cu. yd.; Item 2, as above, $11 per cu. yd. Manchester Harbor, widening channel and dredging anchorage basin—To Eastern Dredging Co., 247 Atlantic Ave., Boston: Item 1, as above, 23.9 cts. per cu. yd.; Item 2, as above, $8 per cu. yd. South River, Salem, dredging channel—To Eastern Dredging Co., 247 Atlantic Ave., Boston: Item 1, as above, 35 cts. per cu. yd.; Item 2, as above, $8 per cu. yd.

New Jersey.

Property owners of Longport, a suburb of Atlantic City, N. J., are raising a fund of $20,000 for the construction of jetties to protect the Thoroughfare side of the resort from being washed out by storm tides.

Bids as follows were received June 19 by Lt. Col. Joseph E. Kuhn, U. S. Engineer, Philadelphia, Pa., for dredging a channel in the Delaware River from Lalor St. to the upper railroad bridge, Trenton, N. J., about 4,500 lin. ft., requiring about 450,000 cu. yds. excavation: Atlantic, Gulf & Pacific Co., Park Row Bldg., New York 69½ cts.; John A. Seeley, 30 Church St., New York City, 80 cts. In view of the fact that there is only about $150,000 available for payment to the contractor, it is not expected that award of contract will be made under the above mentioned bids.

New York.

✣Bids will be received until noon, July 7, by Col. S. W. Roessler, U. S. Engineer, 39 Whitehall St., New York City, for dredging in Bay Ridge and Red Hook Channels, New York Harbor. The funds available for payments under contract are about $275,000. The specifications provide for dredging to a depth of 40 ft. below mean low water within the limits of the project adopted in 1899 and to the extent that the available funds permit. It is proposed to do the work in substantially the following order as nearly as can be anticipated (a) Widen Bay Ridge Channel above 44th St. to 1,200 ft. (b) Deepen Red Hook Channel to 40 ft. with width of 1,200 ft. for the first 800 ft. from Bay Ridge Channel. (c) Widen Bay Ridge Channel to 1,200 ft., from 44th St. to its outer end (about 91th St.). (d) Deepen Red Hook Channel to 40 ft. for its full length, beginning at its eastern edge and widening to the west as far as the funds permit.

✣Bids will be received until 11 a. m., July 3, by Col. J. G. Warren, U. S. Engineer, Buffalo, N. Y., for dredging at Ogdensburg Harbor, N. Y.

Pennsylvania.

✣Bids will be received until noon, July 14, by Lieut.-Col. J. E. Kuhn, U. S. Engineer, Philadelphia, Pa., for furnishing and placing about 15,000 tons of riprap stone in dike and revetment at Reedy Island, Delaware River, about 40 miles below Philadelphia.

Rhode Island.

✣Bids will be received until 11 a. m., July 12, by Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., for building for heating plant at the naval hospital reservation, Newport, R. I. The cost is estimated at $30,000.

Tennessee.

✣Bids will be received until July 1, by B. G. Covington, Chief Engineer, St. Francis Levee District, 664 Randolph Bldg., Memphis, Tenn., for 5,000,000 cu. yds. of levee work.

Texas.

Bids as follows were received June 6 by Maj. T. H. Jackson, U. S. Engineer, Dallas, Tex., for furnishing about 3,000 bbls. of American Portland cement for lock and dam at Hurricane Shoals, delivered at Crockett, Tex., (1) pine per bbl., (2) allowance for return of sacks, (3) brand, (4) manufactured by, (5) manufactured at, (6) weight per sack: Texas Portland Cement Co., F. R. Bissell, Trustee, Dallas, Tex., (1) $2.38; (2) 10 cts.; (3) Lone Star; (4) Texas P. C. Co.; (5) Harrys or Cement, Tex.; (6) 95 lbs. The Atlas Portland Cement Co., New York, N. Y., (1) $2.59; (2) 10 cts.; (3) Atlas; (4) the Atlas P. C. Co.; (5) Northampton, Pa.; (6) 94 lbs. net. Southwestern States Portland Cement Co., Dallas, Tex., (1) $2.38; (2) 10 cts.; (3) Trinity; (4) S. W. States P. C. Co.; (5) Eagle Ford, Tex.

Virginia.

Bids as follows were received June 7 by Lt. Col. E. Eveleth Winslow, U. S. Engineer, Norfolk, Va., for about 100,000 cu. yds. scow measurement dredging for approaches to harbor at Cape Charles City, Va.: Coastwise Dredging Co., Norfolk, Va., 20 45/100 cts.; Norfolk Dredging Co., Norfolk, Va., 21 2/10 cts.

Canada.

✣The Department of Railways and Canals, L. K. Jones, Secretary, Ottawa, Ont., will open bids on July 17 for the first three miles of the new Welland Canal, starting from the Lake Ontario end. The total cost of the canal will be about $55,000,000.

⊙Roger Miller & Sons, Toronto, Ont., have been awarded the contract for the construction and erection of 40 double lock gates on the Trent Canal between Trenton and a point 40 miles further up the canal. The contract amounts to about $250,000.

CALLS FOR BIDS

Rate, $2.40 an inch, single column. **Copy received until Monday noon.**

PROPOSALS INVITED.
THE SANITARY DISTRICT OF CHICAGO.
56th Avenue and 52nd Avenue.

SEWER OUTLET AND APPURTENANCES.

To Contractors.

Sealed proposals endorsed, "Proposals for Sewer Outlet, South 56th and South 52nd Avenues," will be received by the Clerk of the Sanitary District of Chicago at the office of said District, 700,900 South Michigan avenue, Chicago, Ill., until 12 m., standard time, on Thursday, June 26, 1913, and will be publicly opened by the Board of Trustees of said District at a meeting to be held that day or at the first meeting thereafter.

The work for which said tenders are invited includes the construction of a concrete sewer outlet from existing sewers on South 56th and South 52nd avenues, with a common outfall at the main channel of the Sanitary District of Chicago. The contract includes an outfall at the main channel and two crossings of the Ogden Ditch. The work is largely concrete and excavation.

The work is located along the line of West 39th street, extended, and along the line of South 52nd avenue, extended, and is partly in the town of Cicero and partly in the township of Stickney, County of Cook, State of Illinois.

The work covered includes excavation, concrete, reinforcing steel, miscellaneous items covering sewer pipe connections, iron castings, structural steel, outlet and outfall. A certified check for five thousand dollars ($5,000.00) is required as a deposit with the bid.

All bids must be made upon blank forms of proposal furnished by the Sanitary District, and shall be made in accordance with and to conform to the terms and conditions set forth in "Requirements for Bidding and Instructions to Bidders" attached thereto.

Specifications, forms of proposal and plans may be obtained upon deposit of five dollars ($5.00) at the office of the said District, which sum so deposited will be refunded if said plans and specifications are returned on or before July 10, 1913.

The Board of Trustees reserves the right to reject any or all bids.

THE SANITARY DISTRICT OF CHICAGO.
(Signed) By Thomas A. Smyth,
President of its Board of Trustees.
Attest:
(Signed) John McGillen,
Clerk.
Chicago, June 10, 1913.

TREASURY DEPARTMENT, Office of the Supervising Architect, Washington, D. C., June 10, 1913.—Sealed proposals will be received at this office until 3 o'clock p. m. on the 17th day of July, 1913, and then opened, for a new hoistway, an electric freight lift, etc., in the United States post office and court house, Fresno, Cal., in accordance with the drawing and specification, copies of which may be had at this office at the discretion of the Supervising Architect. O. Wenderoth, Supervising Architect.

NOTICE TO PAVING CONTRACTORS.

Ottawa, Ill.

Sealed proposals will be received by the Board of Local Improvements of the City of Ottawa, Ill., until four (4) o'clock p. m., June 24, 1913, for the complete construction and furnishing of materials for grading, curbing and paving with a vitrified paving brick on a four (4) inch concrete foundation, in the South Ottawa District, consisting of the following approximate amounts:

30,215	cubic yards excavation.
41,406	lineal feet concrete combined curb and gutter.
5,510	lineal feet of curb to be reset and constructing concrete gutter along same.
2,244	lineal feet concrete crossing curbs.
204	crossing plates of cast iron.
6,706	cubic yards concrete for foundation.
4,064	cubic yards sand for cushion.
60,966	square yards vitrified brick pavement and grout filler for the same.
58	tons asphalt for expansion joints.

All bids must be accompanied by certified check to the amount of ten (10) per cent of bid.

Information to bidders, specifications, form of proposal, contract and bond, may be had on application to George L. Farnsworth, Public Engineer, Ottawa, Ill.

The Board reserves the right to reject any and all bids.

GEORGE L. FARNSWORTH,
Secretary Board of Local Improvements.

RAILROAD CONTRACT.

The Virginia-Carolina Railroad has just awarded us contract for building forty miles of their railroad out from Abingdon, Va. The work comprises a fine lot of cart and car and also nice team work. Contractors desiring to communicate with us about same can write us at our home office, Knoxville, Tenn., and we will make arrangements for them to meet our superintendent at our branch office at Abingdon, Va., who will show them over the work. The entire forty miles is now ready for construction, and we expect to let this work at once.

For prices and further particulars, write or wire Callahan Construction Co., Empire Building, Knoxville, Tenn.

TILE BRANCHES.

Sealed bids for labor and material necessary for the construction of tile branches known as Sections 8, 9, 16, 17, 18, 19, 20, 21 and 22 of Drain 96 will be received at the office of the Auditor of Webster County at Ft. Dodge, Ia., up to the hour of 10 a. m., June 28, 1913. All tile and labor must comply with standard specifications on file in the County Auditor's office at Ft. Dodge, Ia. Total estimated cost of labor and material, $38,143.20.

Dated June 12, 1913.

J. L. HANRAHAN,
County Auditor.

VITRIFIED BRICK PAVEMENT.

Poplar Bluff, Mo.

Sealed proposals will be received by the City Council of the City of Poplar Bluff, Mo., until 7:30 o'clock p. m., Monday, June 30, 1913, at the Council Chambers in said City of Poplar Bluff, Mo., for improving by grading, paving with vitrified brick and curbing and guttering the following streets: Main street, Vine street and Pine street, total amounts consisting of about 36,201 square yards of vitrified brick on a 4-inch concrete base and a 1½-inch sand cushion, asphalt filler; 18,996 lineal feet of combined 6-inch curb and 18-inch gutter; 1,969 feet of protection concrete headers; 10,531 cubic yards of excavation; 770 feet of 12-inch pipe; 120 feet of 8-inch pipe; 16 catch basins. Bids may be on each street separately, all streets or less number.

Proposals must be accompanied by cash or certified check for 5 per cent of the aggregate proposal, payable to R. G. Felts, Mayor of the City of Poplar Bluff, Mo.

Plans and specifications may be seen at the office of the City Engineer, Edward C. Thomes, or copies may be obtained upon receipt of $5.00.

The right is reserved to reject any or all bids.

H. H. WILCOX,
City Clerk.

DEPARTMENT OF THE INTERIOR.—U. S. Reclamation Service, Washington, D. C., May 22, 1913.—Sealed proposals will be received at the office of the United States Reclamation Service, Elephant Butte, New Mexico, until 2 o'clock p. m., June 25, 1913, for furnishing sluice and penstock gates and accessories for Elephant Butte Dam, Rio Grande project, New Mexico-Texas. For particulars address the U. S. Reclamation Service, Elephant Butte, New Mexico; 307 Wright & Callendar Building, Los Angeles, Calif., or Washington, D. C. F. H. Newell, Director.

Notice.—The date for opening hids on the above work has been postponed to July 10, 1913.

TREASURY DEPARTMENT, Office of Supervising Architect, June 10, 1913.—Sealed proposals will be received at this office until 3 o'clock p. m. on the 27th day of June, 1913, and then opened, for supplying to the various public buildings under control of the Treasury Department, lubricating oils during the fiscal year ending June 30, 1914, in accordance with the specification, copies of which may be had at this office at the discretion of the Supervising Architect. O. Wenderoth, Supervising Architect.

PROPOSALS FOR ICE AND REFRIGERATING PLANTS. Mississippi River Commission, 1st and 2d Districts, U. S. Engineer Office, Custom House, Memphis, Tenn., May 22, 1913. Sealed proposals for furnishing and delivering three ice and refrigerating plants, complete, will be received at this office until 12 m., June 23, 1913, and then publicly opened. Information on application. E. M. Markham, Maj., Engrs.

U. S. ENGINEER OFFICE, CHICAGO, ILL., May 28, 1913.—Sealed proposals for constructing timber-concrete dock in North Branch Turning Basin, Chicago River, Ill., will be received here until 10 a. m., June 28, 1913. Information on application. Geo. A. Zinn, Lieut.-Colonel Engineers.

ENGINEERING AND CONTRACTING

Devoted to the Economics of Civil Engineering Design and to Methods and Cost of Construction

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STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC.,

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F. P. Burt, General Manager.

Sworn to and subscribed before me this 24th day of March, 1913.

(Seal) C. E. Meinders,
Notary Public.

(My commission expires June 7, 1916.)

A Correction.

Credit for conducting the tests of the concrete lock floor described in our issue of March 19, p. 319, was given to Mr. Adolph Meyer, Consulting Engineer, St. Paul, Minn. Mr. Meyer informs us that we should have said further that he was, at the time the tests were made, Junior Engineer, U. S. Engineer Office, and that the tests were made under the direction of Mr. Geo. W. Freeman, Assistant Engineer, under Lieut.-Col. Potter, Corps of Engineers, U. S. A.

The Pressure of Concrete on Forms.

Knowledge of the exact pressure of concrete on forms is important. It would be vital were forms generally designed closely to exact loadings, so that the smallest necessary amount of lumber would be used. Where no other consideration than supporting strength prevails, good engineering indisputably demands the computation of loadings and strengths of forms. Indeed, when other conditions demand more lumber than supporting strength alone necessitates it may often be better to calculate the forms and then modify the sizes so obtained to meet these other conditions. On several counts, therefore, it is important to know the pressure of concrete on forms.

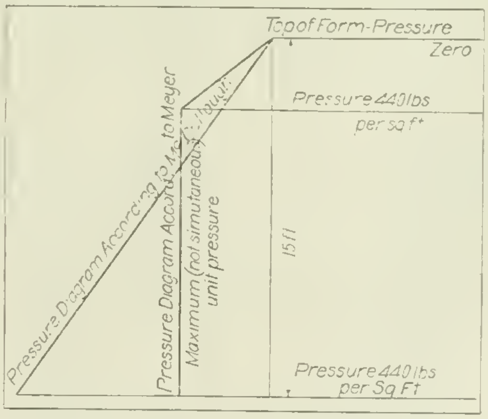
Top of Form-Pressure
Zero
Pressure 440 lbs
per sq ft
Pressure Diagram According to McCullough
Pressure Diagram According to Meyer
Maximum (not simultaneous) unit pressure
15 ft
Pressure 440 lbs
per Sq Ft

Fig. 1—McCullough's and Meyer's Curves of Pressure of Concrete.

Published results of concrete pressure tests are few. We recall only those of five tests. The earliest of these were the tables worked out by Mr. Ernest McCullough, from tests very briefly described in another column. Mr. McCullough concluded from his tests that safe and economical form designs would result if the pressure of concrete on form was assumed equal to a fluid weighing 80 lbs. per cubic foot. On this assumption he computed a table of pressures for each foot of depth, from 1 ft. to 24 ft. inclusive. A pressure diagram, according to Mr. McCullough's table, is shown in Fig. 1. The comparison diagram is one based on the tests made by Mr. Adolph Meyer, which are fully described in another column.

Meyer's tests were made under the direction of the U. S. Engineers having charge of the construction of Lock 1, between St. Paul and Minneapolis on the Mississippi River, and they were first published in a paper by Maj. Francis R. Shunk. This paper was reprinted in our issue of Aug. 25, 1909. Since the original paper further results have been secured, and all of the new data are given and compared with the data from other tests in the article which we publish in this issue.

The third set of tests results in order of publication are those secured at the University of Illinois by Mr. L. E. Ashley. The average pressure curve from these tests is given in the article in this issue, and is there compared with other curves developed from Meyer's tests. It need not be further considered here.

The three sets of concrete pressure tests so far mentioned include those that have had most consideration in America. Continuing our scheduling, however, we may note tests conducted by Mr. H. St.G. Robinson in England, and noted by him in Proceedings of the Institution of Civil Engineers, and finally some tests made by Mr. S. Tomomatsu of the Kure Naval Station in Japan. Mr. Robinson gives the diagram shown in Fig. 2, on which two sets of tests are indicated. The tests are described as follows:

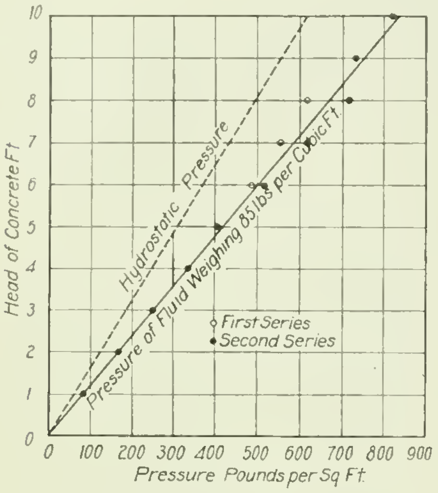

Fig. 2.—Robinson's Curves of Pressure of Concrete.

> The first series of tests was made during the building of a long wall about 3 ft. thick, constructed of concrete weighing 140 lbs. per cubic foot and composed of slow-setting cement, sand and crushed granite in the proportions of 1:3:6, by volume. In mixing, sufficient water was used to bring it to a thoroughly plastic condition, requiring little or no tamping to consolidate. The concrete was laid more rapidly than is usual in this class of work, being carried up as rapidly as the mixing and placing would permit to a height of 8 ft. above the center of the pressure face, during which time a light, iron bar provided with a turned-up end was used for churning the semi-liquid mass. Four complete sets of readings were taken, and each point on the curve represents the average value at that head
>
> The second series was carried out on large piers 4 ft. square, the concrete in this case being a 1:2:4 mixture of cement, sand and Thames ballast, weighing 145 lbs. per cubic foot. The conditions as to mixing and laying were similar to those of the first tests, and the concrete was carried up to a height of 10 ft. above the center of the pressure face. Each point of this second series represents the average of six readings.
>
> In the first series the temperature was fairly uniform throughout, while in the second considerable variation was experienced; but the effect of the differences in temperature on the lateral pressure cannot be traced, and would appear to be very small.
>
> The general conclusion to be drawn from these and other experiments is that the lateral pressure of concrete for average conditions is equivalent to that of a fluid weighing 85 lbs. per cubic foot. For concrete in which little water is used in mixing, the pressures are rather less, having an equivalent fluid value as low as 70 lbs. per cubic foot in very dry mixtures.

It will be noted that Robinson's pressure diagram is essentially like that of McCullough, as indicated by Fig. 1; it is the pressure curve of a fluid weighing 85 lbs. per cubic foot, or 5 lbs. per cubic foot more than McCullough concluded from his tests to be a safe weight for form design.

From his tests, which are not described, Mr. Tomomatsu concludes that, when wet or "sloppy," concrete develops a hydrostatic pressure expressed (Eng. News, Aug. 17, 1911) by the formula

$$P = \frac{w\,h^2}{2}\left(\frac{1 - \sin\phi}{1 + \sin\phi}\right)$$

Where

P = the resultant pressure in lbs. per sq. ft. acting at point ⅓ of the height of the concrete above the bottom of the form.

w = the weight in lbs. of concrete per cu. ft.; in wet mixtures say 140 lbs.

h = the depth in ft. of concrete poured in one continuous operation.

ϕ = the angle of repose of the wet concrete varying from 10° to 20° according to the amount of water used in the mix.

The value of ϕ or the angle of repose of the concrete must be determined in any case by experiment. Assuming three angles of repose, as indicated, the pressure curves for each is indicated on the diagram, Fig. 3.

It has been our purpose here merely to assemble such test data on concrete pressures as we recall. In considering these or any data of the same sort the reader has only to bear in mind that: Whatever the conclusions as to weight may be the pressure of wet concrete can be full hydrostatic pressure only till initial set begins.

Effects of Depth of Trench Upon the Cost of Handling Spoil with a Trench Machine.

Proof of the value in trench excavation of handling the spoil by trench machines is found in various published records. The article on sewer work at Moundsville, W. Va., which we publish elsewhere in this issue adds another bit of evidence to these records. This article is also unusually commendable for the manner in which the cost data are made completely significant by careful description of all local conditions which influenced costs. One of the commonest arguments against the direct usefulness of cost data is that one which enlarges upon the difficulty of transmitting a knowledge of such local conditions. The author of the article mentioned here, it will be seen, has succeeded very well in this task and has not consumed excessive space in the performance. Our main purpose here, however, is to speak of another feature of these Moundsville cost records.

It is commonly considered that the cost of operating a trench machine is substantially a constant amount per cubic yard of material moved, in a given kind of soil, regardless of variation between rather widely separated limits in depth of trench. The costs obtained from the Moundsville work indicate that cost varies with depth of trench. For the shallower trench from 14 to 30 ft. deep, the sum of the bucket loading and conveying costs was 52 cts. per cubic yard. For the trench of a uniform depth of 31 ft. the corresponding cost was 66 cts. per cubic yard. It may also be noted that the yardages handled per man per day were for the two trenches respectively 6.8 cu. yds. and 4.6 cu. yds. No other cost records that we have of trench machine work touch upon exactly this feature, and the present instance is therefore worthy of notice.

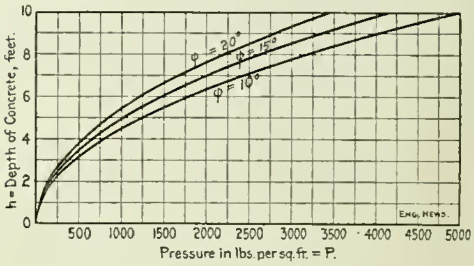

Fig. 3.—Tomomatsu's Curves of Pressure of Concrete.

GENERAL ARTICLES

Method and Cost of Constructing a 7x8 Ft. Rock Tunnel 6,235½ Ft. Long.

The very complete costs given in the accompanying tabulations are costs of a rock tunnel completed in October, 1912, in the Kerber Creek mining district in Colorado. The cross-section of the tunnel was made 8x7 ft. inside; Fig. 1 shows the timbered cross-section. Work was begun May 7, 1911, and was finished in October, 1912. It is described as follows, in abstract, in "Transactions of American Institute of Mining Engineers," March, 1913, by the engineers, F. M. Simonds and E. Z. Burns, of New York City.

The first work was to build a camp for from 30 to 50 men. In a general way we planned to locate the power house, blacksmith shop, tool house, etc., as close to the portal as practicable, and so arranged as to involve the minimum amount of labor in handling steel, pipe, tools, etc. The bunk houses and boarding houses were placed as nearly on a level with the portal as possible, and just so far away that the men when off shift could sleep undisturbed by the handling of steel, dumping of rock and other noises. Attention to these and similar small details saved thousands of dollars during the course of the work.

The power plant consisted of one 80-h.p. return tubular boiler, with one 40-h.p. return tubular boiler in reserve; one Rand Imperial type No. 10 compressor (all of which were on hand); one No. 3 Root blower (capacity 7.75 cu. ft. per rev.) direct connected to a 9x9-in. upright engine. For drilling, we used two No. 8 Leyner drills, with crossbar, keeping one extra drill (and later on, two) in reserve, and maintaining also an abundance of extra parts always on hand. In the blacksmith shop we had one No. 2 Leyner steel-sharpening machine, operated by compressed air at 100 lbs. pressure. Next to the steel-sharpener was placed a No. 8 Bradley coke-furnace for heating the steel, operated by a steam-driven turbine-blower, 12 ins. in diameter, and furnishing at normal speed about 8 ozs. pressure.

The cross-section of the tunnel was made 7x8 ft. in the clear, and where timbering was necessary the same dimensions were maintained inside the timbers. The arrangement of track, ditch and pipes is shown by Fig. 1.

The grade of the tunnel was fixed at 0.5 per cent. For track, 18-in. gage, 16-lb. steel rails were used, placed on ties 2.5 ft. apart. At frequent intervals, ties were placed across the ditch to support the pipes. Switches were provided at intervals of about 1,500 ft. for the passage and storage of cars. For fuel, wood was purchased from the Forest Reserve, at points so located that the haul to the tunnel portal would be down-grade. For blasting, 40 per cent dynamite was used almost exclusively.

The tram cars used were 4x2x2 ft., body of 0.25-in. steel, with double bottoms, boxes reinforced around rims and centers with 0.5x2-in. steel, and with turn-table dump, mounted on chilled iron wheels. The cars had a continuous draw-bar and were coupled by means of three long links, giving considerable slack for facilitating the starting of a train. Mules were used for tramming, and by reason of this slack between the cars, one mule could start a train of 8 or 10 cars. The labor for this work was organized as follows:

	Rate wages per day.
One superintendent.	
One surveyor-bookkeeper.	
One foreman	$6.00
One shift-boss per shift	5.00
Two machine men per shift	4.50
Two machine helpers per shift	3.75
Three to four muckers, per shift	3.50
One swamper per shift	3.00
One to more pipe-, track- and ditch-men, as required	3.50
One trammer per shift	3.50
One blacksmith	4.50
One head mechanic	4.50
Two power-house men (two shifts)	4.00
One car greaser, dump-, and powder-man per shift	3.00
One wood-hauler	3.00
Timber-framer, as required	4.00
One roustabout	3.00
One cook and helper.	

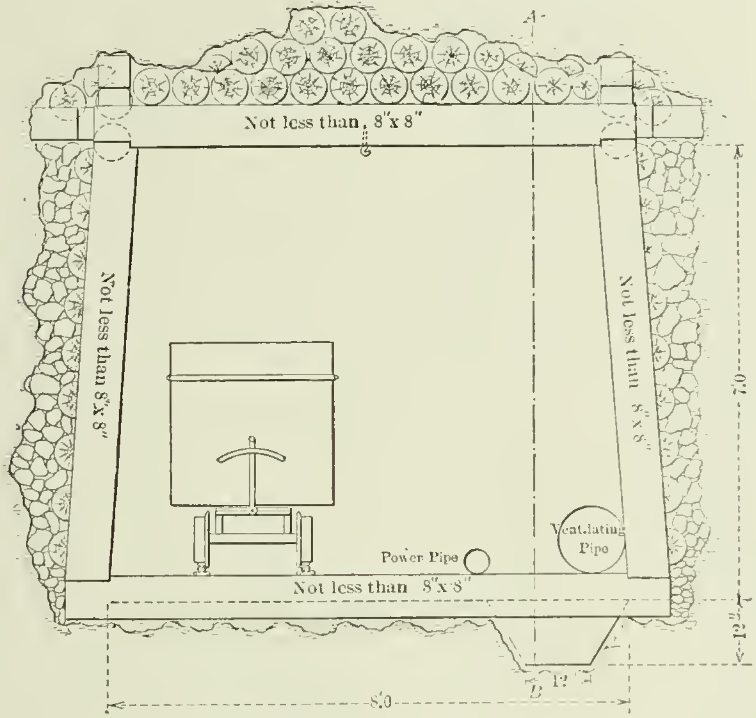

Fig. 1—Arrangement of Track, Ditch and Pipe.

The above gives a fair representation of the working force; and, with uniform rock formation, little change in number or arrangement would be required. Unfortunately, however, the rock proved to be anything but uniform. At any moment, the andesite might change from a very soft material, full of slips and requiring to be timbered close to the face, to a very tough, hard rock, highly silicified. This silicified rock, largely jasper, carried sometimes 30 per cent of pyrite, and would eat up steel faster than the blacksmith could get it sharpened. One day so much muck would be brought down that we could not put muckers enough in the tunnel to get it out on time, while perhaps, on the next day, two or three muckers per shift would be ample.

This irregularity of the rock formation had far-reaching effects. By reason of it, no system of drill-holes was possible, and, from day to day, each shift had to lay out the holes in such a way as seemed best to the foreman or the shift boss. Moreover, in the use of powder, no attempt could be made to determine a point of maximum efficiency, as would have been possible with uniform ground. The sequence in the operations of driving the tunnel, when everything was in proper running order, was about as follows:

Just before shooting, the compressed air was turned on through a small nozzle pointed directly at the place where the muck pile would be. At the same time the blower was speeded up. After a round had been fired, the blower cleared the air by suction from the face sufficiently to allow the men to begin work, an operation requiring about 20 minutes. The foreman and drill-men would then begin picking down roof and face. When the roof was in a safe condition, the drillers, or helpers, would "muck back" sufficiently to allow the bar to be set up in its upper position. This mucking, as a rule, took a few minutes only, and simply amounted to trimming off the top of the muck pile. During this time and while the bar was being set up, helpers would be connecting up hose and muckers bringing up empty cars. The hose was never allowed to lie along the bottom of the tunnel and on the muck pile, where it would be constantly exposed to damage, and would interfere more or less with the mucking. To avoid this we put near the roof, at frequent intervals, cross-pieces over which the hose was hung. The cross-pieces consisted of two pieces of pipe, telescoped, and with a set-screw, permitting them to be put up and taken down with great facility. In order to have the bar set up each time at the same height above the grade-line of the tunnel, iron hangers were hung from the last two survey points, for example, 100 and 300 ft. from the face, respectively. By means of wire at the top, these hangers were adjustable; and, as a hanger was moved forward to a new station, its length was calculated exactly, so that its bottom, shaped like a stirrup and carrying a candle, would be at the same height above the grade-line as the bar was required to be set. As the survey points were exactly along the center-line of the roof, the foreman, by standing back and sighting towards the face, could, in about a minute, signal to the driller at the face both the center-line and the height at which to set the bar. This operation was performed before each set-up, and no difficulty was experienced in keeping the alignment and grade almost perfect.

As soon as the condition of smoke permitted, mucking began. The sequence of the various operations of mucking was about as follows:

Empty train arrived and was pulled as near to muck pile as practicable.

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	Shift bosses.	Machine men.	Machine helpers.	Number of holes.	Total feet drilled.	Actual drilling time.	Total working time, machine men.	Total working time, muckers.	Rounds shot.	Missed holes.	Distance gained.	Sticks powder used.	Approximate weight of powder in pounds.	Number of caps.	Feet of fuse.	Muckers.	Swampers.	Trammers.	Animals employed underground.	Cars trammed.	Pipe, track and ditch men.	Timbermen.	Timber helpers.	Distance timbered.	Car greasers, dump and powder men.	Blacksmiths.	Boiler and compressor men.	Woodmen and timber rustlers.	Teamsters.	Other laborers (Miscellaneous).	Wood consumed for 24 hours.	
7 A. M. Shift........																																
3 P. M. Shift........																															Cords	Feet
11 P. M. Shift........																																
Totals																																

Number of employes underground..
Number of employes on surface..
Total crew (exclusive of boarding house and office)..................
Distance gained for month..Feet
Total length of tunnel..Feet
Distance timbered for month..Feet
Total timbering in tunnel..Feet
Total wood consumed for month..............Cords..........Feet
Total powder consumed for month, 40 per cent..............Pounds
Total caps consumed for month..
Total fuse consumed for month..Feet

Remarks:—
....
....
....
....
....
....
....Manager.

Fig. 2.—Form of Daily Tunneling Report.

Empties were turned on sides.

Down-tunnel end-car of empties righted on track, and pushed to muck pile.

Mucking began.

Full car pushed down beyond last empty.

Next empty car righted and pushed to muck pile.

Same order as above was followed, until train of empties was all loaded.

Another train of empties arrived and was hauled a short distance from loaded train.

RAWLEY MINING COMPANY.

No. 12 Tunnel.

Monthly Report.

Underground— Month ending........19...	
Drilling and Firing—Labor........	$........
Powder, fuse and caps..........	....
Supplies and repairs..........	....
Mucking—Labor	....
Supplies	....
Tramming—Labor	....
Supplies	....
Track and Pipe—Labor..........	....
Supplies	....
Timbering—Labor	....
Supplies	....
General Labor	....
Supplies	....
Supplies (paid for but not yet used)	....
Surface—	
Power Plant—Labor..............	....
Supplies and repairs..........	....
Fuel	....
Blacksmith—Labor	....
Supplies	....
General—Labor	....
Supplies	....
Supplies (paid for but not yet used)	....
General Expenses—	
Salaries	....
Office, traveling, etc..........	....
Freight, haulage and express, not otherwise distributed..........	....
Permanent Plant—	
Previously reported	....
Increased this month by	
Labor	....
Supplies	....
Boarding House—	
Disbursements—	
Labor	$........
Supplies	....
Credits	....
Results—	
Advance previously reported......	....
Advance for this month..........	....
Total cash previously received......	....
Total cash received this month....	....
Total cash previously disbursed.....	....
Total cash disbursed this month....	....
Remarks—	
Signed,........................	

Fig. 3.—Form of Detailed Monthly Costs.

Mule was detached from train of empties and hauled loaded train back towards dump as far as practicable.

Train of empties was hauled as near loaded train as practicable.

Empty train was turned over on side.

Loaded train started for portal.

The foregoing data give the full cycle of events as regards mucking; but perhaps a few additional remarks may be appropriate. When the rock breaks well and the advance is regular and rapid, the rate of advance becomes a question of disposing of the muck. Hence the system as above outlined must be carried out with almost mechanical precision. It is here that attention to small details is of great importance. Consider, for instance, the question of whether men are right-handed or left-handed. Suppose you have four men shoveling into the car. The ideal condition in that case is to have two right-handed and two left-handed men. Located so far from an adequate labor supply, we found it, at times, impossible to fulfill this condition; but it was constantly kept in mind when employing new men.

Beginning June 14, 1911, and continuing throughout the course of the work, a daily report, shown in Fig. 2, was sent to the New York office. From these daily reports various details were calculated and the data tabulated for each month. Table I is a summary of these monthly tabulations.

At first we operated on the basis of two 8-hour shifts per day. Each shift drilled one full round with the view of "pulling" 8 ft.

TABLE I.—DATA COMPILED FROM DAILY REPORTS.

Summary.

Month and year. (Using 2 drills.)		No. of drill-holes.	Total feet drilled.	Actual time drilling (hours).	Pounds powder per month.	Advance gained (feet).	Feet drilled per minute.	Pounds powder per foot of drill-hole.	Feet of drill-hole per foot advanced.	Pounds of powder per foot advanced.	Av. time of drilling one foot in minutes.	Number of shifts.	Av. rate advanced per shift (feet).
June,	Totals..........	..	5,901.0	185.5	2,867.0	218.5	Total advance form, 280 ft.					33.	....
1911.	Averages........	..	....	....	....	....	0.530	0.486	27.0	13.1	1.89	...	6.62
July,	Totals..........	..	11,323.0	396.5	5,785.0	414.0	.....	.....	....	....	....	59.	....
1911.	Averages........	..	....	....	....	....	0.476	0.511	27.35	13.97	2.10	...	7.02
Aug.,	Totals..........	..	11,059.0	427.5	6,935.0	403.0	.....	.....	....	....	....	62.	....
1911.	Averages........	..	....	....	....	....	0.431	0.627	27.2	17.2	2.32	...	6.5
Sept.,	Totals..........	..	7,850.0	345.0	4,182.5	280.0	.....	.....	....	....	....	48.	....
1911.	Averages........	..	....	....	....	....	0.379	0.533	28.0	14.9	2.64	...	5.83
Oct.,	Totals..........	..	8,703.0	475.5	6,043.5	351.5	.....	.....	....	....	....	61.	....
1911.	Averages........	..	....	....	....	....	0.305	0.694	21.9	17.2	3.28	...	5.76
Nov.,	Totals..........	..	9,676.0	444.5	6,154.5	393.5	.....	.....	....	....	....	60.	....
1911.	Averages........	..	....	....	....	....	0.363	0.636	24.3	15.4	2.76	...	6.64
Dec.,	Totals..........	..	5,037.0	280.0	2,408.0	282.0	.....	.....	....	....	....	46.	....
1911.	Averages........	..	....	....	....	....	0.289	0.478	17.9	8.6	3.33	...	6.13
Jan.,	Totals..........	..	9,673.0	396.0	5,186.0	461.5	.....	.....	....	....	....	62.	....
1912.	Averages........	..	....	....	....	....	0.407	0.536	20.9	11.2	2.45	...	7.44
Feb.,	Totals..........	..	9,176.0	329.5	4,559.3	402.5	.....	.....	....	....	....	53.	....
1912.	Averages........	..	....	....	....	....	0.464	0.497	22.8	11.3	2.15	...	7.6
Mar.,	Totals..........	..	10,539.0	365.0	5,656.5	472.0	.....	.....	....	....	....	56.	....
1912.	Averages........	..	....	....	....	....	0.484	0.537	22.4	12.0	2.08	...	8.4
April,	Totals..........	..	1,210.5	51.5	326.5	40.0	.....	Plus 62 ft. cross cut				...	....
1912.	Averages........	..	....	....	....	....	.....	.....	....	....	....	...	....
May,	Totals..........	..	6,069.0	310.	3,011.2	205.0	.....	.....	....	....	....	62.	....
1912.	Averages........	..	....	....	....	....	0.326	0,496	29.6	14.7	3.06	...	3.3
June,	Totals..........	..	11,888.0	442.0	6,768.0	488.0	.....	.....	....	....	....	83.	....
1912.	Averages........	..	....	....	....	....	0.448	0.569	24.4	13.9	2.23	...	5.9
July,	Totals..........	..	10,480.0	439.0	5,448.5	555.0	.....	.....	....	....	....	80.	....
1912.	Averages........	..	....	....	....	....	0.398	0.520	18.9	9.8	2.51	...	6.9
Aug.,	Totals..........	..	8,049.0	311.5	3,201.5	421.0	.....	.....	....	....	....	69.	....
1912.	Averages........	..	....	....	....	....	0.431	0.398	19.1	7.6	2.32	...	6.1
Sept.,	Totals..........	..	7,296.0	299.0	3,163.5	390.0	.....	.....	....	....	....	68.	....
1912.	Averages........	..	....	....	....	....	0.407	0.434	18.7	8.1	2.45	...	5.7
Oct.,	Totals..........	..	3,302.0	125.5	894.0	185.5	.....	.....	....	....	....	37.5	....
1912.	Averages........	..	....	....	....	....	0.439	0.271	17.8	4.8	2.28	...	5.0
Grand totals	....	..	137,231.5	5,623.5	72,590.5	5,963.0	.....	.....	....	....	....	939.5	....
Grand averages	....	..	....	....	....	....	0.407	0.529	23.0	12.17	2.46	...	6.35
Total length of tunnel	....					6,235.0	.....	.....	....	....	....	...	....

While following this plan our best month was July, 1911, in which our progress was 414 ft. We have taken this month, therefore, as typical of the most successful operation of the method. The maximum progress in any shift was 15.5 ft.; and it is safe to conclude that more than 16 ft. was not possible.

With the view of devising a method which would at least render possible a greater progress per two shifts, we studied the problem carefully, on the basis of the data already obtained (such as the average feet drilled per minute, etc.), and came to the conclusion that two drillers and helpers, in good drilling ground, could put in two rounds of from 4.5 to 5.5 ft. in one 8-hour shift, which would make it possible under favorable conditions to advance from 18 to 22 ft. per day. The work of mucking under this method would be very much facilitated, because fully 25 per cent more muck could be landed on the muck-plates, and, if necessary, a third shift of muckers could be used.

It is one thing to lay out a carefully worked out plan, but it may be very difficult to inaugurate the plan under favorable auspices. A good plan may easily fail by not having the enthusiastic support of the men essential to its success.

The following statement of the progress per month shows that September, October, November and December were comparatively poor months. This was in part due to very difficult ground, containing a large amount of the jasper before mentioned. Nevertheless, in our opinion, a much hetter record could have been made had the plan of short rounds been adopted during this time:

PROGRESS PER MONTH.

Month.	Year.		Feet.
May,	1911	Last 24 days of month..	111
June,	1911	Working two shifts.....	380
July,	1911	Working two shifts.....	414
August,	1911	Working two shifts.....	403
September,	1911	Working two shifts.....	280
October,	1911	Working two shifts.....	351.5
November,	1911	Working two shifts.....	393.5
December,	1911	Working two shifts.....	282
January,	1912	....	461.5
February,	1912	....	402.5
		(Three days in this month lost on account of accident to man.)	
March,	1912	....	472
		(Struck big flow of water on March 29, stopping all progress.)	
April,	1912	....	40
		(Practically had to stop work the whole of this month and part of May, on account of great flow of water and bad ground.)	
May,	1912	....	205
June,	1912	....	488
July,	1912	....	555
August,	1912	....	421
September,	1912	....	390
		(Much timbering required.)	
October,	1912	....	185.50
		(Much timbering required.)	
Total length of tunnel		....	6,235.5

PERMANENT PLANT

For No. 12 Tunnel.

Complete to...............19....

All labor	$ 4,300.05
Drills and fixtures..................	647.01
Drill-sharpener and fixtures........	1,031.17
Engine and blower..................	800.46
Air-pipe for blower and fixtures....	3,254.04
Compressor air-pipe	1,543.91
Drill-steel	916.48
Buildings and building supplies....	933.45
Steel rails, bolts and spikes........	1,849.78
Tram-cars	2,576.69
Mules and harness..................	756.21
Steel plate for muck..............:	84.44
Telephone line	77.93
Freight, express, etc................	392.24
Compressor and boilers.............	335.77
Water-pipe	391.52
Miscellaneous	305.01
Total	$20,196.20

Fig. 4.—Monthly Form With Final Cumulative Costs.

The tunnel reached the vein on Oct. 23 at a point 4 ft. from our calculation.

There was no favorable opportunity for trying out the plan of shorter rounds until Dec. 22, 1911. On that date we advanced 21 ft.; and, after this demonstration of the possibilities of the plan, there was no further trouble putting it in force.

In applying this method, we found that the drill-men on an 8-hour shift had to work overtime on an average of perhaps 1 hour, for which they were paid an extra amount. The drill-men and their helpers were glad to get this overtime. We found that with this method, in fairly good ground, two 8-hour shifts of drill-men could pull as much ground as three 8-hour shifts of muckers could handle. The method produced very efficient results all along the line. But we were not long permitted to derive benefit from it. Towards the end of March, we were notified by our attorney that a late decision of the Colorado courts made the working of men longer than 8 hours (even though desired by the men) an offense punishable by fine and imprisonment. This had very much the appearance of putting a premium on inefficiency, for we were forced to employ two extra drill-men and helpers for 8 hours in order to do 2 hours' work. This is the law in a State which, during the past few years, has been loud in its lamentations over the decline of mining. Under this mandatory condition we could gain little, if any, efficiency and economy over our original method.

Towards the latter part of March, as noted in the foregoing statement of progress, a large flow of water was encountered, which almost stopped our progress for about six weeks. This sudden influx of water was interesting, but very expensive. About March 25 we struck a zone of faulting. In this zone the rock is full of slips and very much ground up. The tunnel was perfectly dry for a distance of about 40 ft. in this formation. On March 29, a round of holes was put in, the bottom of each hole being perfectly dry. When this round was fired a flood of water came with it. The ground-up material of this formation seemed to disintegrate in contact with water and filled the entire face of the tunnel. It was roughly estimated that the volume of water amounted to more than 1,000 gals. per minute. After trying in vain to catch up the ground at the face, the Superintendent came back about 50 ft. in the tunnel, and started a cross-cut at an angle to encounter the water some distance from the face, and thus divert the flow, or most of it, from the main tunnel. This plan succeeded; enough water was diverted to enable us to proceed with the driving of the main tunnel, although for many weeks it was only with the greatest effort that any progress whatever was made.

There is an interesting feature in connection with this matter, outside of the difficulties in the prosecution of the work. As we understand it, the zone of faulting constituted in effect a watertight dam. Penetrating this dam with the tunnel, a point was finally reached where the pressure of water broke down the barrier remaining. That there was an actual hydraulic pressure back of this zone seems to be clearly indicated by the fact that after several weeks of flow the force of the incoming water grew very rapidly less, and within a short time the flow became quite negligible.

No serious difficulty was encountered during the construction of the remainder of the tunnel, but progress during the latter part of August and during September and October, 1912, was much impeded by reason of the timbering required.

The maximum advance for any one month was 555 ft., made in July, 1912. However, we were forced, as already remarked, to use three full shifts of drillers as well as muckers during that month, and so do not consider that it equaled in economy and efficiency either January, February or March; during which month's two shifts of drillers were used.

We were much in error in our original estimate of the amount of timbering that would be required. All told, it was necessary to timber 1,618 ft., most of which required full sets, instead of only 500 ft., as we had expected. Moreover, much of the timbering in August, September and October, 1912, had to be done so close to the face as to hinder seriously, and at times entirely stop, the progress.

Each month, as the work progressed, we had two forms filled out, as shown in Figs. 3 and 4.

Form No. 1, Fig. 3, gives the detailed costs; Form No. 2, Fig. 4, the costs chargeable to the permanent plant. There were two reasons for keeping the record in this way. In the first place, bills for the various items under "Permanent Plant" came in very irregularly, and would have greatly delayed making out the monthly cost-sheet. In the second place, it was convenient in the end to have the various items of the "Permanent Plant" kept separate, so that the apparatus and material could be charged back to the general mine equipment at a proper figure. We have charged back in this way the following items at 50 per cent of their cost:

Drills and fixtures	$ 647.01
Drill-sharpener and fixtures	1,031.17
Engine and blower	800.46
Air-pipe for blower and fixtures	3,254.04
Compressor air-pipe	1,543.91
Drill-steel	916.48
Steel rails, bolts and spikes	1,849.78
Tram-cars	2,576.69
Mules and harness	756.24
Steel plate for muck	84.44
Water-pipe	391.52
Total	$13,851.74

Taking 50 per cent of the $13,851.74 above given, and which represents that part of the permanent plant to be salvaged, and dividing by 6,235.5, the length of the tunnel, we have $1.111 to take from the total cost of $20,986 per ft. of the tunnel, making the actual cost per ft. $19.875.

TABLE II.—ITEMIZED COST OF DRIVING TUNNEL IN ROCK.

	Total cost.	Cost per ft.
Underground:		
Drilling and firing—		
Labor	$17,604	$2.823
Powder, fuse and caps	12,506	2.006
Supplies and repairs	2,642	0.423
Total	$32,752	$5.252
Mucking—		
Labor	$13,317	$2.136
Supplies	142	0.022
Total	$13,459	$2.158
Tramming—		
Labor	$ 6,277	$1.006
Supplies	765	0.123
Total	$ 7,042	$1.129
Track and pipe—		
Labor	$ 2,741	$0.439
Supplies	19	0.003
Total	$ 2,760	$0.442
Timbering—		
Labor	$ 5,418	$0.869
Supplies	1,955	0.313
Total	$ 7,373	$1.182
General—		
Labor	$ 7,278	$1.168
Supplies	1,717	0.275
Total	$ 8,995	$1.443
Surface:		
Power plant—		
Labor	$ 6,648	$1.066
Supplies	1,100	0.176
Fuel	8,202	1.315
Total	$15,950	$2.557
Blacksmithing—		
Labor	$ 812	$0.131
Supplies	3,733	0.598
Total	$ 4,545	$0.729
General—		
Labor	$ 4,200	$0.673
Supplies	1,000	0.160
Total	$ 5,200	$0.833
*General—		
Salaries	$ 7,100	$1.138
Offices, traveling, etc.	2,938	0.471
Total	$10,038	$1.609
Freight—		
Haulage, etc., not otherwise distributed	$ 19	$0.003
*Permanent plant—		
Labor	$ 2,086	$0.334
Supplies	14,750	2.365
Total	$16,836	$2.700
Boarding house—		
Labor	$ 2,513	$0.402
Supplies	8,753	1.403
Total	$11,266	$1.805
Credits	$11,043	$1.779
Balance	$ 223	$0.036
Advance, ft.	6,236	

*Expenses previous to May, 1911: General, $2,313; salaries, $1,150; office, traveling, etc., $1,163; permanent plant, $3,260; total, $5,573.

Our original estimate on the cost of driving this tunnel was $21.12 per ft. After deciding to construct the tunnel, we prepared plans and specifications, and advertised for bids. The lowest responsible bid received was $26.50 per ft., and this did not include the timbering. The itemized costs of the work are given in Table II.

It is to be noted in analyzing these figures that there are some seeming inconsistencies. For instance, the cost of mucking gradually increased throughout the course of the work. Theoretically there should be no difference in the cost of shoveling rock into a car whether it is 5,000 ft. from the portal or 500 ft. The explanation for this increase is threefold: First, the labor cannot be maintained in exact ratio to the progress (if three men can muck a maximum of 8 ft. per shift, four men must be used to muck 9 ft.); second, if the tunnel breaks large there is more muck per foot advanced, and the cost per foot increases; finally, the efficiency of the mucking crew decreased, in our opinion, for various reasons, as the work progressed.

Another apparent inconsistency is the gradually-increased cost of track and pipe work. This was very probably due to the fact that with every foot advanced there was 1 ft. more of track, pipe and ditch to maintain and keep in repair.

We submit the foregoing discussion of the mining problem, together with the complete data regarding the driving of the tunnel, in the hope that it will have value to those who may be confronted in the future with somewhat similar situations. As regards the tunneling data, we have tried to make them complete, and consequently it is a record of unsatisfactory as well as satisfactory results. We trust it may serve both as a warning against uneconomical methods and as an aid to securing greater efficiency in work of this character.

In conclusion, we wish to pay a deserved tribute to the men whose labors contributed in large measure to any success attained. No more fitting comment can be made than the statement that the work throughout was delayed less than 30 minutes on account of trouble with the power plant, and this statement simply illustrates the efficient service rendered in every department. To Will C. Russell, who had charge of this work, and to Charles E. Beckwith, his assistant, unstinted praise is due for their unflagging zeal, fidelity and vigilance

The Significance of Dynamite Grade Marking.

(Contributed by F. H. Gunsolus, Manager, Technical Division, E. I. Du Pont de Nemours Powder Co.)

The meaning of the grade distinctions or "per cent strength" mark on dynamite is somewhat of a puzzle to many consumers, and often a source of misunderstanding between manufacturer and customer. Originally a 40 per cent dynamite meant that the dynamite contained 40 per cent actual nitroglycerin by weight, but as modern dynamites do not always contain this proportion as marked, a short description of modern practice of grading may be of interest. A slight knowledge of the history of the manufacture of high explosives may also help to explain the situation.

The dynamite first manufactured by Alfred Nobel on a large scale was called "No. 1 Dynamite" and consisted of 75 parts by weight of nitroglycerin and 25 parts by weight of "Kieselguhr," an inert infusorial earth, which is full of microscopic tubes and shells, and which has the property of absorbing three or four times its weight of nitroglycerin. This was truly a 75 per cent nitroglycerin dynamite, but it was not as strong as the 40 per cent strength dynamites made today, which contain even less than 40 parts in a 100 by weight of actual nitroglycerin. The Kieselguhr acts only as an absorbent. It does not assist at all in the explosion and it does not permit the making with it of more than one grade of dynamite, that in which the Kieselguhr holds nearly all the nitroglycerin it can. If more nitroglycerin is added, the dynamite leaks nitroglycerin to a dangerous extent, and if less nitroglycerin than 75 per cent is used the dynamite becomes insensitive, so much so that a mixture of 40 per cent of nitroglycerin and 60 percent of Kieselguhr cannot possibly be detonated at all. This property is taken advantage of in the transportation of nitroglycerin for medicinal purposes. The Kieselguhr is chemically inert. A pound of 75 per cent Kieselguhr dynamite will do exactly as much work and no more than 0.75 lb. of pure nitroglycerin.

The dynamites which are in use at present in the United States were originally known as "active base" dynamites in contradistinction to the Kieselguhr dynamites which had an inert base.

The active base dynamites at first substituted a crude gunpowder for the Kieselguhr, but as the gunpowder was not a very good absorbent, it was not possible to make a dynamite containing more than 30 per cent or 40 per cent of nitroglycerin; so a mixture of wood meal and nitrate of soda was used instead of the crude gunpowder. With these two ingredients, dynamites could be made in different proportions of absorbent to nitroglycerin, so that dynamites containing as much nitroglycerin as 75 per cent or as little as 20 per cent could be made, worked packed and exploded.

It was also found that with an active base like wood meal and nitrate of soda a dynamite having only 40 per cent nitroglycerin would develop as much power or more than a 75 per cent Kieselguhr dynamite. A pretty definite proportion of wood meal to nitrate of soda existed to make an explosive not too wet to leak nor yet too dry to be "punched" into the paper shells. More wood meal and less nitrate were used in dynamite with more nitroglycerin, and more nitrate and less wood meal of less absorbing capacity like fine-grained sawdust, were used in the dynamites containing less nitroglycerin. Using these three ingredients with minute proportions of other non-explosive substances required to stabilize the dynamite, a type of high explosives known as "straight dynamite" was made which when thoroughly incorporated by well-dried and pulverized ingredients, constitute the standard of strength against which all other dynamites are graded.

When other explosive substances are incorporated into dynamites they increase the power over the straight dynamite and it is then necessary to reduce the amount of nitroglycerin and otherwise modify the formula so that the new compound will develop as much power in actual work as the standard dynamite. For instance, when gun cotton is dissolved in nitroglycerin it makes a sticky, jelly-like substance, which, when added to the wood meal and nitrate of soda, makes an explosive much more powerful than one in which nitroglycerin alone is used. If such an explosive were graded according to its actual content of nitroglycerin, it would be so much more powerful than the standard grade of dynamite that it would not be safe to use in work where the blasters were accustomed to using that standard grade, as it would break the material too fine and throw it too far and do a good deal of damage.

When other active ingredients in the absorbent or dope were employed, it was found necessary to reduce the amount of nitroglycerin until the mixture developed the same strength as the Straight N. G. dynamite it was graded against.

There are many explosives in the market now that contain no nitroglycerin at all, some of them being equal to a 40 per cent straight nitroglycerin dynamite, and these are graded against the straight nitroglycerin dynamite as described above. There are other very powerful explosives widely used that contain only small amounts of nitroglycerin—from 5 per cent to 10 per cent sometimes, which nevertheless develop as much power, weight for weight, as 50 per cent and 60 per cent straight nitroglycerin dynamites. It is readily seen therefore that a customer should not feel that he has been injured when he finds that the dynamite he has been buying as 40 per cent strength has actually less than 40 per cent nitroglycerin in it.

While the straight nitroglycerin dynamites are still on the market, they are the only ones that actually contain the same percentage of nitroglycerin as the per cent strength marked. In many ways they are distincly inferior to later explosives containing less nitroglycerin, but more of the other active ingredients in the absorbent. The straight nitroglycerins are too quick for a good deal of work and are much more sensitive to rough handling than explosives which have been developed more recently.

When a dynamite contains less nitroglycerin than the per cent strength as marked on it, that difference is made up by other explosive substances so that a given weight of the dynamite is equal in strength, as developed in the ballistic pendulum and in active field trials, to a straight dynamite which contains that percentage of actual nitroglycerin.

Experiments to Determine the Pressure of Concrete on Forms.

A series of tests of concrete pressure on forms was made in 1908, under the direction of the army engineers in charge of the construction of Lock No. 1 in the Mississippi River, between St. Paul and Minneapolis. The results of these tests, as outlined by Francis R. Shunk, then Major, U. S. Engineer Corps, were published in our issue of Aug. 25, 1909. This first series of tests was conducted by Mr. Adolph Meyer, and was followed by similar tests which considerably extended the results and which are summarized by Mr. Meyer and compared with other tests in a paper before the Minnesota Society of Surveyors and Engineers. The engineer in charge of the lock work, and under whose general direction the testing was carried on is Mr. Geo. W. Freeman, Assistant Engineer, under Lieut.-Col. Charles L. Potter, Corps of Engineers, U. S. A.

The apparatus employed by Mr. Meyer for determining concrete pressure on forms was described in our article of the date stated above, and it need not be mentioned here further than to remark that it consisted of a piston working in a short cylinder inserted in the side of the form and operating a lever arm. The following is abstracted from Mr. Meyer's paper:

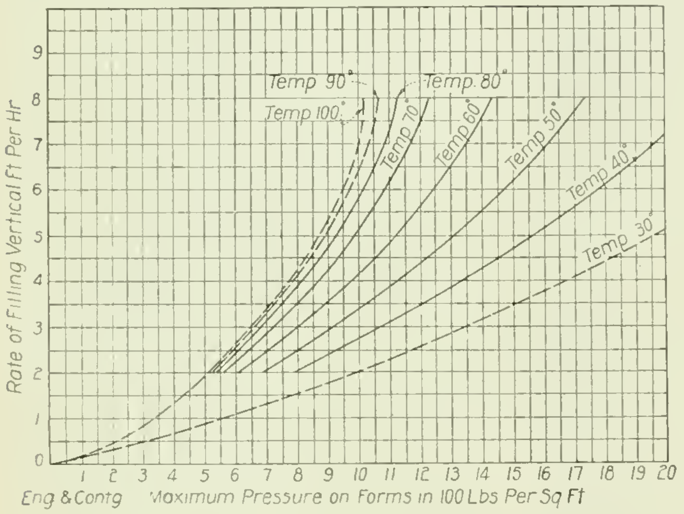


Fig. 1.

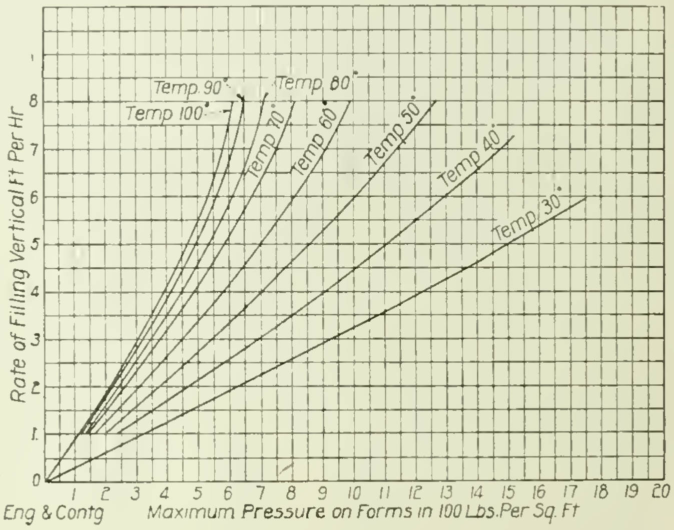


Fig. 2.

It was found in the tests made in 1908, that the concrete exerted pressure equivalent to the pressure of a liquid weighing about 150 lbs. per cubic foot for a time dependent upon temperature, rate of filling, and the depth of the layer which was continually being disturbed by puddling, spading, walking, and the deposition of additional concrete in large batches. The time of deviation from fluid pressure, on the basis of a top layer of 2½ ft. in depth being continually disturbed, and thus kept from setting, was found to be given by the following formula:

$$T = C + \frac{150}{R}$$

T = Time in minutes when concrete begins to show strength—setting and arch action combined.

R = Rate of filling in vertical feet per hour.

C = A constant varying with the temperature, as follows:

Values of C.	Temp., dry, Fahr.
20	80
25	70
35	60
42	55
50	50
70	40

Assuming that the top layer which is being continually disturbed is limited to about 6 ins. in depth, the above formula becomes,

$$T = C + \frac{30}{R}$$

The 1908 curves (full lines in Fig. 1), giving the maximum pressure which concrete will exert against the form for various rates of filling and temperatures, are for use in designing forms for walls of heavy section, i. e., for mass construction. They are based on the assumption that a top layer of about 2½ ft. of concrete is continually being disturbed, that the concrete is mixed *very* wet, that a rich, dense mixture is used and a slow setting cement, and that the concrete is being deposited in large batches and thoroughly puddled. The wet concrete actually used at the Government Lock weighed, according to a number of tests, from 151 lbs. to 153 lbs. per cubic foot.

From an additional study of the original experimental data, curves, Fig. 2, have been drawn, giving the maximum pressure of concrete on forms for walls of light section such as are commonly used in reinforced concrete construction.

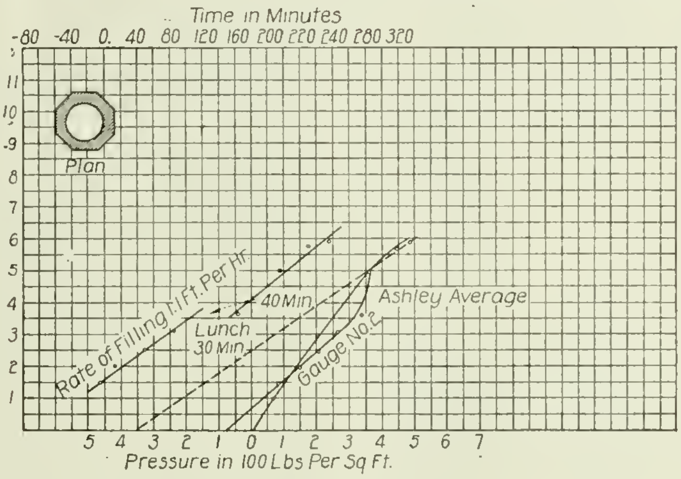


Fig. 3.

In Fig. 3 are plotted the records of concrete pressure on forms as given by Mr. L. E. Ashley's Gage No. 2 (Eng. News, June 30, 1910), together with his "Average" curve. There is also shown, drawn through the plotted points, what the author considers a rational curve, taking cognizance of the lunch interval. A marked similarity between this latter curve and one of the curves of Fig. 1, is apparent. It will also be noted that Mr. Ashley's curve, instead of being headed toward the axis of "Head," is actually headed toward the axis of "Pressure." This is irrational and impossible, inasmuch as concrete, in setting, at least does not expand, but does continually gain in ability to maintain its shape without support from the form. The rapid increase in pressure shown just before the close of Mr. Ashley's test merely indicates the manifestation of accumulated pressure which had previously not been exerted on the piston. The curve drawn through the lower four points indicates fluid pressure due to a liquid weighing about 120 lbs. per cubic foot, and the broken line drawn through the upper three points indicates fluid pressure of about 140 lbs. per cubic foot. Considering the fact, that inasmuch as Mr. Ashley refers to "unequal tamping" as a probable cause for the variation (36 per cent at 3.7 ft. head) shown in the pressures recorded by his two gages, it would be reasonable to assume that the concrete used in the Illinois experiments was not mixed as wet as that used on the Government Lock. Moreover, a 1:4:4 mixture of such material as is customarily used in concrete work would contain considerable voids and consequently would exert less pressure because of its lower unit weight and diminished fluidity. In view of these considerations the author holds that Mr. Ashley's tests bear out his own conclusions.

Referring to the experiments by Mr. Ernest McCullough, it is to be noted that Mr. McCullough's tables assumed fluid pressure up to a depth of 25 ft., corresponding to an elapse of over 6 hours in time, when concrete is being deposited at the rate of 4 ft. per hour. For this rate of filling at a temperature of 100° the author's curves for mass construction give a maximum pressure of 775 lbs. per square foot corresponding to deviation from fluid pressure after 1¼ hours. According to the curves for walls of light section deviation from fluid pressure under the above conditions occurs in less than 40 minutes. Mr. Ashley's gages 1 and 2 recorded rates of increase in unit pressure of 147 and 141 lbs. per square foot, respectively, per foot increase in head, 4½ hours after beginning to deposit concrete. For rates of filling and temperatures equivalent to those of the Ashley test the author's curves show deviation from fluid pressure after 3½ hours and 2 1/6 hours, respectively.

Mr. McCullough's tables are based on the assumption that the pressure of wet concrete on the form is equivalent to the pressure of a liquid weighing 80 lbs. per cubic foot, and that it increases directly as the depth, at least up to 25 ft. That is as far as his tables extend. He in nowise indicates that differences in temperature or variation in rates of filling have any effect on the pressure which the concrete will exert on the form. Yet his experiments were limited to temperatures around 100° and rates of filling of 1 to 4 ft. per hour. About 30 measurements were made of the head of concrete in a bin 1 ft. 6 ins. x 5 ft. required to break a 1-in. board 8 ins. wide and 5 ft. long, bolted at the ends, closing an opening in the side of the bin. The unit pressure of the concrete was computed from the resisting moment of these boards as determined from actual tests on similar boards.

The deflection of the boards used in Mr. McCullough's tests, previous to rupture, must unquestionably have increased the arch action of the stone above the opening, and by yielding these boards must have been relieved of a portion of the pressure. To what extent these factors influenced the results obtained it is impossible to say, but to show that they do influence the pressure exerted by the concrete, the author would cite two observations:

(1) While building the lock walls of Lock No. 1 in monoliths 8x18 ft. at the base, decreasing to 8x6 ft. at the top and 25 ft. 9 ins high, it happened several times that rods tying the forms together, broke, but the concrete not being freely moving fluid, relieved slightly by the yielding of the form, was partially supported by internal arch action, and the form, though weaker than before the breaking of the rods, withstood the remaining pressure.

(2) On Oct. 1, 1908, while filling between two alternate monoliths previously built, the isolated monolith was suddenly tipped over about 4½ ins at the top. Had the concrete acted as a freely moving fluid, the monolith, having once started, would of course have been tipped completely over. The slight motion, however, together with the friction against the face of the overturning monolith relieved the pressure sufficiently so that the monolith again reached a stage of stable equilibrium.

The facts above cited, would indicate that concrete is never a freely moving fluid and that it does not exert fluid pressure for any great length of time at least. This is entirely in accordance with the facts shown in the author's tests.

Given the temperature conditions under which concreting is to be done, and the rate in vertical feet per hour at which the concrete is to be deposited, the author's curves give the maximum pressure for which the forms should be designed. From zero at the top of the form the unit pressure should be taken as increasing at the rate of about 150 lbs. per foot until the depth corresponding to the maximum pressure is reached. Below this point the form should be designed for the maximum value given by the curve. For example, assume a rate of filling of 3 ft. per hour at a temperature of 60° F. in a form for a reinforced concrete wall 15 ft. high. The maximum pressure to be expected under these conditions as given by the curve for walls of light section is 440 lbs. per square foot. The form, then, should be designed for a pressure increasing from zero at the top to 440 lbs. per square foot at a distance of about 3 ft. from the top, and for a pressure of 440 lbs. per square foot from this point to the bottom of the form.

A New Machinists Scale.—A new rule has been placed on the market which eliminates the difficulty of accurately reading measurements in 64ths of an inch. One side of this rule is graduated in 32nds and 16ths, and this takes care of all of the "even" 64ths. The other side takes care of the "odd" 64ths. On one edge of this side the first graduation mark is 1-64 of an inch from the end of the rule, and is marked "1"; the next is 5-64 of an inch from the end of the rule and is numbered "5"; the next "9"; the next "13," etc., up to the first inch mark, and then repeated in each inch. Thus there is a jump of 4-64ths between each line. Between 1-64 and 5-64ths would come one odd 64th, i. e., the 3-64 in. mark. Between 5 and 9 the 7-64 in. mark, etc. All of these odd 64ths appear on the other edge of this side of the rule; that is the first graduation mark there is 3-64 in. from the end of the rule and is numbered "3." The next, "7," etc., in each inch. Every second graduation mark on each side of the rule is slightly lengthened. Thus the figures can be placed in two rows and can be made large enough to be easily read. The rule is ¾ in. wide and comes in the two thicknesses known as the tempered and the semi-flexible. The rule is known as the "Allen Improved Scale," and is manufactured by the Lufkin Rule Co., Saginaw, Mich.

Railway Advertising Sign.—One of the largest electric signs in the world has been erected on the Chicago River at the Rush street bridge, Chicago, by the Chicago & Northwestern Ry. The sign represents a locomotive with realistic smoke pouring from its stack, and part of a train approaching an automatic semaphore signal. The signal indicates danger and the train stops. After a moment the signal changes to clear and the train goes on. The standard colors of the Chicago & Northwestern trains and signals are used. The trade mark of the road, also in regulation colors, surmounts the sign.

Costs of Breakwater Construction at Lincoln Park, Chicago.

(STAFF ARTICLE.)

In connection with the extension of Lincoln Park by the reclamation of land from Lake Michigan there has been built during the past season 1,950 lin. ft. of rock-filled breakwater for the protection of the hydraulic filling pumped by the dredge into the enclosed area. The breakwater consists of a double line of piles which support wales for Wakefield sheet piling. The interior is filled with loose rock. The costs of similar work in 1910 and 1911 are given in "Engineering & Contracting" for Feb. 22, 1911, and for June 19, 1912.

TABLE I.—COST OF BREAKWATER WEST DOCK PICNIC ISLAND.
64 lin. ft.

	Totals.
Driving piles:	
Pile driver	$ 189.75
Tug, Richard B.	9.63
Tug, Hausler	24.96
Scow service	25.00
Total	$ 249.34
Cost per lin. ft.	3.90
Driving sheeting:	
Pile driver No. 1	$ 60.72
Pile driver No. 2	149.82
Derrick	5.53
Tug, Richard B.	3.21
Scow service	25.00
Total	$ 244.28
Cost per lin. ft.	3.82
Bolting cap:	
Tug, Richard B.	$ 6.42
Tug, Hausler	12.49
Labor	98.50
Total	$ 117.41
Cost per lin. ft.	1.83
Miscellaneous:	
Pile driver No. 1	$ 45.54
Derrick	1.83
Motor boat	50.00
Labor	38.65
Total	$ 136.02
Cost per lin. ft.	2.12
Piles: Material.	
19 oak piles 20 ft. long at $4.97	$ 94.43
14 oak piles 30 ft. long at $4.97	69.58
Total	$ 164.01
Cost per lin. ft.	2.56
Sheeting:	
82 pieces 6-in. Wakefield 18 ft. at $4.01	$ 328.82
Cost per lin. ft.	5.13
Lumber:	
1,520 ft. B. M. oak	$ 60.80
Cost per lin. ft.	0.95
Hardware:	
14 dock rods, 1⅛ in. x 17 ft.	$ 17.64
28 dock rod washers	0.84
20 bolts ⅞x22x28 ins.	2.40
40 C. I. washers	1.20
100 round washers	1.00
¼ keg boat spikes	1.09
14 drift pins	2.10
Total	$ 26.27
Cost per lin. ft.	0.41
Grand total	$1,326.95
Cost per lin. ft.	20.72

A summary of Table I gives Table II.

TABLE II.—SUMMARY COST OF WEST DOCK PICNIC ISLAND BREAKWATER.

		Per lin. ft.
Pile drivers	$ 445.83	$ 6.97
Derrick	7.36	0.11
Towing	56.71	0.89
Motor boat	50.00	0.78
Scows	50.00	0.78
Labor	137.15	2.14
Piles	164.01	2.56
Sheeting	328.82	5.13
Lumber	60.80	0.95
Hardware	26.27	0.41
Total	$1,326.95	$20.72

As Table I shows in detail the cost of items entering into the breakwater work, Tables III to VII, of the other jobs of the same class of work give the summaries only.

TABLE III.—COST OF EAST DOCK PICNIC ISLAND BREAKWATER.
341 lin. ft.

		Per lin. ft.
Pile drivers	$1,000.20	$ 2.94
Derrick	4.07	0.01
Towing	41.65	0.12
Motor boat	50.00	0.15
Scows	100.00	0.29
Labor	570.01	1.67
Piles	829.30	2.43
Sheeting	1,612.11	4.73
Lumber	304.16	0.89
Hardware	161.98	0.47
Total	$4,673.48	$13.70

TABLE IV.—COST OF FULLERTON PIER EXTENSIONS.
19 lin. ft.

Pile drivers	$ 368.63	$19.40
Derrick	19.44	1.02
Towing	101.38	5.34
Motor boat	50.00	2.63
Scows	50.00	2.63
Labor	134.25	7.07
Piles	202.46	10.66
Sheeting	347.43	18.28
Lumber	46.94	2.47
Hardware	15.03	0.79
Stone	103.94	5.47
Total	$1,439.50	$75.76

TABLE V.—COST OF S. E. CORNER PICNIC ISLAND BREAKWATER.
127 lin. ft.

Pile drivers	$ 756.62	$ 5.96
Derrick	287.61	2.26
Towing	147.52	1.16
Motor boat	50.00	0.39
Scows	100.00	0.79
Labor	302.25	2.38
Piles	464.34	3.66
Sheeting	1,644.52	12.95
Lumber	298.90	2.35
Hardware	90.56	0.71
Stone	848.16	6.68
Total	$4,990.48	$39.29

TABLE VI.—COST OF NORTH END PICNIC ISLAND BREAKWATER.
565 lin. ft.

Pile drivers	$ 1,735.00	$ 3.07
Derrick	709.08	1.26
Towing	665.01	1.18
Motor boat	226.40	0.40
Scows	200.00	0.35
Labor	1,499.52	2.65
Piles	1,689.51	2.99
Sheeting	6,781.55	12.00
Lumber	1,189.92	2.11
Hardware	415.27	0.73
Stone	4,422.76	7.83
Total	$19,534.02	$34.57

The work of the past season completes all the breakwater construction contemplated. Work was begun on April 30 and continued until Sept. 30. There were many delays owing to unfavorable weather for work in the open lake. The piledriver crew in addition to the breakwater work was employed to build a part of a motor boat dock at the south end of Picnic Island; to repair a dock at the ship-

TABLE VII.—COST OF BREAKWATER NORTH OF CORNELIA AVE.
584 lin. ft.

Pile drivers	$ 2,239.62	$ 3.84
Derrick	983.29	1.69
Towing	1,013.04	1.73
Motor boat	226.40	0.39
Scows	200.00	0.34
Labor	819.80	1.40
Piles	1,857.33	3.18
Sheeting	7,247.17	12.41
Lumber	1,319.04	2.26
Hardware	417.71	0.72
Stone	5,722.04	9.79
Total	$22,045.44	$37.75

TABLE VIII.—COST OF YACHT HARBOR REVETMENT.
250 lin. ft.

Pile drivers	$ 692.25	$ 2.77
Towing	220.92	0.88
Motor boat	50.00	0.20
Scows	150.00	0.60
Labor	449.33	1.80
Piles	513.00	2.05
Sheeting	1,539.99	6.16
Lumber	232.35	0.93
Hardware	169.92	0.66
Supplies	60.00	0.24
Total	$4,071.76	$16.29

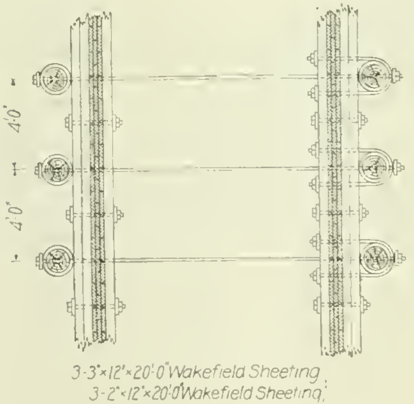
TABLE IX.—COST OF PILES.

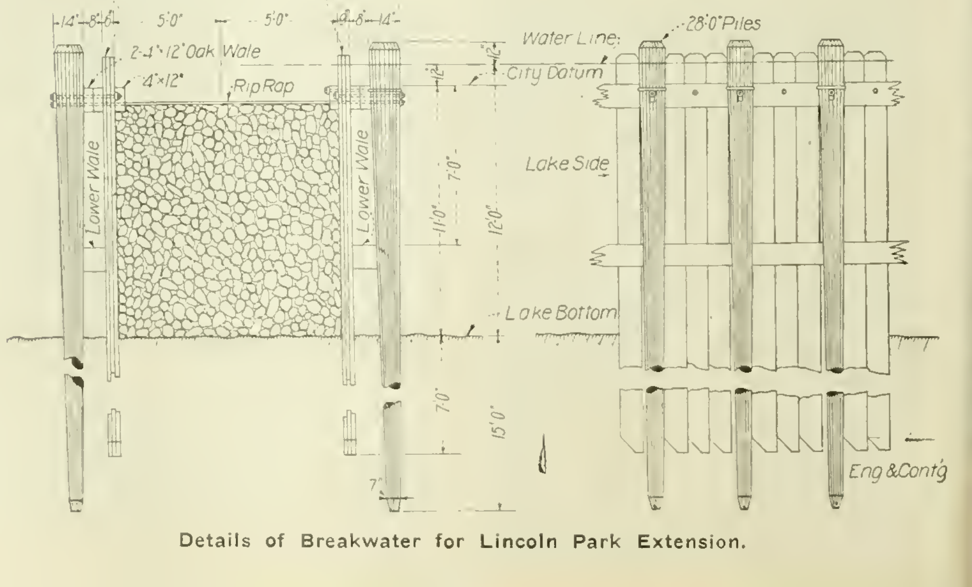
Piles received:	
47 piles 30 at 13 cts. per ft.	$ 183.31
366 piles 30 at 14 cts. per ft.	1,537.20
89 piles 35 at 13½ cts. per ft.	420.52
554 piles 35 at 15 cts. per ft.	2,908.50
108 piles 40 at 16 cts. per ft.	691.20
1,164	$5,740.73
Loading labor 36 cts. per pile	$ 414.45
Towing 44 cts. per pile	511.96
Total	$6,667.14

Cost per pile:	30 ft.	35 ft.	40 ft.
Timber	$4.17	$5.18	$6.40
Loading	0.36	0.36	0.36
Towing	0.44	0.44	0.44
Total	$4.97	$5.98	$7.20

TABLE X.—COST OF WAKEFIELD SHEETING.
3,323 pieces.

		Cost per piece.
280 pieces 6-in. sheeting 18 ft. long:		
Labor	$ 258.34	$0.92
Hardware	33.60	0.12
Lumber	831.60	2.97
Total	$ 1,123.54	$4.01
1,219 pieces 6-in. 24 ft. long:		
Labor	$ 1,124.69	$0.92
Hardware	170.66	0.14
Lumber	4,912.57	4.03
Total	$ 6,207.92	$5.09
374 pieces 9-in. 18 ft. long:		
Labor	$ 345.06	$0.92
Hardware	44.88	0.12
Lumber	2,000.90	5.35
Total	$ 2,390.84	$6.39
1,404 pieces 9-in. 24 ft. long:		
Labor	$ 1,295.37	$0.92
Hardware	196.56	0.14
Lumber	9,097.92	6.48
Total	$10,589.85	$7.54
46 pieces 9-in. 28 ft. long:		
Labor	$ 42.44	$0.92
Hardware	6.90	0.15
Lumber	382.72	8.32
Total	$ 432.06	$9.39


4'0"
4'0"
3-3"×12"×20'0" Wakefield Sheeting
3-2"×12"×20'0" Wakefield Sheeting



Details of Breakwater for Lincoln Park Extension.

TABLE XI.—COST OF STONE FILLING FOR BREAKWATER.

12,769 cu. yds.

Loading at Lemont:		
Labor	$ 4,282.70	
Supplies	1,156.97	
Total	$ 5,439.67	$0.43
Towing:		
Tug, "Keystone"	$ 4,083.35	
Tug, "Richard B."	491.32	
Tug, "Hausler"	594.29	
Scows	1,292.84	
Total	$ 6,391.80	$0.50
Unloading:		
Derrick at Island	$ 852.01	
Derrick at Cornelia	1,194.58	
Total	$ 2,046.59	$0.16
Stone Boxes:		
Labor	$ 994.35	
Material	446.62	
Total	$ 1,440.97	$0.11
Grand total	$15,279.03	$1.20

yard: to drive clumps of piles for tying up a part of the fleet during the winter, and for various repair jobs.

The breakwater work was located at seven different points on the work and the amount of work done at these points varied from 19 lin. ft. of breakwater in extending the Fullerton Ave. Pier to 584 lin. ft. at the work north of Cornelia St. The cost of this work varied from $13.70 per lin. ft. to $75.76 per lin. ft. as is shown by Tables I to XI.

The revetment built at the mouth of the yacht harbor is a continuation of the previous year's work. This work differs from the breakwater construction merely in the omission of one side of the timber work.

The cost of the piles, loaded on the scows at the shipyard was as given in Table IX.

The cost of material and labor for making the Wakefield sheeting is shown in Table X. The sheeting was prepared in the park shipyard by carpenters.

The stone filling for the breakwater was brought from the spoil bank of the Chicago Drainage Canal at Lemont, Ill. It was handled in stone boxes by means of a derrick and transported on scows. The cost of this work was as given in Table XI.

Water Meter Decision in Alabama.—The Supreme Court o. Alabama recently decided that the owner of a building in which a single water meter was placed was absolutely responsible for the water bills of all the tenants. This has created a difficulty in Montgomery, where a firm has complained that there were two other tenants in the building, and all were using the same water meter. The commissioner of water works was appealed to, but because of this decision of the Supreme Court could grant no relief.

ROADS AND STREETS

Average Unit Prices of Pavements Constructed in 1912 in 568 Cities.

Data on street paving work in 1912 in some 568 cities of the United States and Canada are shown in the accompanying tabulations. These tables were compiled from information furnished by officials of the cities represented. They give the yardage, the average unit price and some details of the more common types of street pavements. In addition, tables are given showing the prevailing local prices for labor and materials in the cities in which the pavements were laid. A considerable amount of macadam construction was also reported, but owing to the difficulty of separating properly the various classes of this pavement no attempt has been made at this time to compile these data. Statistics relating to asphalt pavement construction have also been omitted. Tables showing the paving work done in previous years were published in our issues of March 27, 1907; April 1, 1908; April 6, 1910; April 5, 1911, and April 3, 1912.

On the blanks sent to the city officials information was asked on the pavements more commonly used, and on these general statistics only were requested. In a number of cities, however, various types of pavement, other than those mentioned in the tables, were constructed. In the following notes some of these pavements are described briefly:

Nineteen cities reported that asphalt block pavement had been laid in 1912. The yardage and average price of these pavements were as follows:

	Sq. yds.	Av. price per sq. yd., including base and grading.	Total thickness pavement, ins.	Concrete thickness, ins.	Base proportion.
New York—					
Jamestown	13,408	$2.94[1]	10	5	1:2½:5
Niagara Falls	56,619	3.20[1]	8½	5	1:3:6
Port Chester	7,117[2]	2.13*	..	4½	1:3:6
Rye	9,800[4]	2.56	..	5	.....
Rye	18,500[2]	2.20	..	4	.....
New Jersey—					
W. New York.	4,800[3]	2.65	..	4½	1:3:5
Ohio—					
Ashland	3,800[2]	1.94	..	5	1:2½:5
Michigan—					
Highland Park	5,083[4]	2.25*	8½	6	1:3:5
Mt. Clemens	19,000[4]	2.08	8	5½	1:3:4
Georgia—					
Savannah	51,830	1.73	..	..	.....
Waycross	6,000	2.10	..	..	.....
Canada—					
Kingston	5,992[4]	2.95	..	4	1:3:6
Toronto	13,580	3.42	7½	4	1:3:7
Regina	6,185	2.65	..	..	.....

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*Does not include grading. [1]Includes curbs. [2]2-in. block. [3]3-in. block. [4]2½-in. block.

TABLE SHOWING AMOUNT, AVERAGE PRICE AND SOME DETAILS OF BRICK PAVEMENT LAID IN 1912 IN 257 CITIES.

(For prices of labor and materials on this work see other tables elsewhere in this issue.)

	Sq. yds.	Kind of filler.	Depth of sand cushion. Ins.	Av. price per sq. yd. including base and grading.	Guarantee. Years.	Price per cu. yd. for grading if paid separately.	Total thickness pavement. Ins.	Portland Cement Concrete Base: Thickness. Ins.	Portland Cement Concrete Base: Proportions.
New England Division:									
Massachusetts—									
Cambridge	......	....	...	$3.00	..	..	....	5[1]	1-2½-5
New Bedford	2,852	....	...	2.82	..	..	....	..	....
Springfield	133	Sand	1	3.00	0	..	....	..	....
Middle Atlantic Division:									
New York—									
Albany	53,705	Grout	1¾	2.03	5	.30	11¾	6	1-3-6
Binghamton	31,931	Cement	1½	2.11	5	..	11½	6	1-2-5
Elmira	15,367	Grout[2]	1½	2.25	5	..	11½	6	1-3-6
Fulton	37,093	Grout	2	2.10*	5	.50	12	6	1-3-6
Jamestown	25,611	Pitch[3]	2	2.14	..	.55	11	5	1-2½-5
Lestershire	......	....	1½	1.89	..	..	11½	6	....
Little Falls	5,400	Cement	1½	2.50	5	..	10½	5	1-2½-5
Niagara Falls	1,658	....	...	2.92	5	..	9½	5	1-3-6
No. Tonawanda	2,500	Grout	1½	2.78[4]	5	..	11½	6	1-6
Ogdensburg	8,500	Grout	1½	2.35	..	..	10½	5	1-2½-5
Olean	9,744	Grout	...	1.59*	1	.35	10	5	1-6
Port Chester	504	Cement	1	3.07*	5	.55	9½	4½	1-3-6
Rochester	111,873	Grout	1½	2.06	5	..	11½	6	1-3-6
Schenectady	4,000	Grout	1	....	5	.40	13	6	1-3-6
Syracuse	5,179	Grout	1	2.20	10	..	11	6	1-3-6
Troy	15,000	Cement	1½	2.10	..	.50	....	6	1-5
Utica	3,000	Cement	1½	2.25	5	..	9	5	1-3-7
Westfield	......	Tar	2	....	5	.50	12	6	....
White Plains	9,766	Cement	1½	2.33	..	..	9½	4	1-3-5
New Jersey—									
Bayonne	2,224	Cement	2	2.05*	5	.40	11	5	1-3-6
Jersey City	20,197	Sand	1½	2.30	5	.40	11½	6	1-3-5
Newark	62,626	....	...	2.08	5	..	....	..	....
Trenton	5,812	Grout	1½	2.25	1	..	9½	4	1-3-6
West Hoboken	3,562	Cement	1½	2.80*	5	.73	11½	6	1-3-7
West New York.	2,400	Cement	1½	2.67	1	..	10½	5	1-3-7
Pennsylvania—									
Ashland	8,443	....	2	2.33	5	..	....	..	....
Beaver Falls	19,000	Sand	2	1.40*	..	.55	14	..	....
Bellwood	100	....	...	1.08	..	..	....	..	....
Clairton	......	Sand	2	1.47	1	.40	14[7]	..	....
Connellsville	12,091	Ashes	2	1.60*	..	.60	14	..	....
Corry	3 350	Cement	1½	1.55	3	..	....	..	....
DuBois	6,036 .	Sand	2	1.94	5	..	12	6	1-3-6
Ellwood City	4,000	Pitch	2	1.44*	..	.40	14[9]	..	....
Erie	4,686	Cement	4	1.60	5	..	8	4	1-3-8
Freeport	2,000	Sand	4[10]	.70*	5	.48	14[11]	..	....
Freeport	1,128[11]	Sand	4[10]	1.25*	5	.75	....	..	....
Harrisburg	4,074	Cement	1½	1.91	5	..	11½	..	....
Hazleton	14,076	Cement	2	2.21	5	..	12	6	1-3-5
Homestead	1,319	Sand	1	1.59*	0	.58	13[12]	..	....
Ingram	8,754	Sand	2	1.29*	2	.33	14	..	....
Kingston	......	Cement	2	2.15	3	..	....	6	1-3-5
Meadville	3,708	Pitch	2	1.96	3	..	11	5	1-3-6
Monongahela City	15,400	Sand	1½	1.45*	1	.70	12	..	....
New Brighton	25,000	Gravel	2	1.40	0	..	14	..	....
North Braddock	......	Sand	2	1.90	..	.85	11	5	1-3-6
Pittston	5,000	Cement	2	2.25	5	..	....	6	1-3-5
Portage	12,500	Grout	2	1.72*	..	.65	12	6	1-2-4
Pottstown	2,643	Cement	2	1.11	..	..	12	..	....
Punxsutawney	10,632	Sand	2	1.50	3	..	12	5	1-3-5
Rankin	4,000	Sand	2	1.35	1	.45	14	..	....
Sayre	15,486	Asphalt	2	2.11*	10	.40	12	6	1-2½-6
Shamokin	700	Cement	2	2.03	5	..	12	6	1-3-5
Somerset	2,200	....	2	1.84	..	..	16[14]	..	....
Swissvale	39,852	Sand	2	1.37*	1	.51	14	..	....
Tarentum	3,378	Sand	2	1.45*	1	.45	15	..	....
Tyrone	1,850	Sand	1	2.15	5	..	11	6	1-2½-5
Verona	5,000	....	1	1.40*	0	.65	....	10[15]	....
Warren	......	Cement	1½	2.23	0	.40	11½	6	1-3-6
Wilkesbarre	15,892	Cement	2	2.18	5	.50	12	6	1-2-5
Wilkinsburg	12,805	Sand	2	1.50	0	.50	....	8[16]	....
Williamsport	11,953	Cement	2	2.05	1	..	12	6	1-3-7

In New Haven, Conn., 5,806 sq. yds. of asphalte was laid at an average cost of $1.40 per sq. yd. The pavement had a 5-year guarantee, and was 6-in. thick, consisting of a 4-in. broken slime base and a 2-in. asphalte surface.

Trenton, N. J., laid 13,972 sq. yds. of asphalt without binder, the average cost per square yard being $1.38½. The pavement had a 1½-in. top surface and a 4-in. 1:3:6 concrete base. It has a 5-year guarantee.

Amiesite was laid in Nazareth and South Bethlehem, Pa. At the later place 6,000 sq. yds. was constructed, the average cost being $1.80 per sq. yd. The pavement had a thickness of 7-in., which includes a 4-in. 1:3:5 concrete base; the guarantee is for 1 year. At Nazareth the Amiesite was laid on an 8-in. macadam foundation and the wearing surface was 3½ in. thick. The average cost per square yard was $1.61.

Two cities reported the construction of Westrumite. In Wichita, Kan., 9,839 sq. yds. was laid at an average unit price of $1.84. The total thickness was 7 in., this including a 5-in. 1:3:6 concrete base. At Grand Rapids, Mich., 5,204 sq. yds. of pavement with a Westrumite top was contracted. The total thickness was 8 in., which included a 6-in. 1:3:6 concrete base, and the average unit cost was $1.53 per sq. yd.

Sioux City, Ia., and Columbus, Kans., reported the construction of Sarcolithic. In the latter city the total yardage was 9,068, and the average price per square yard, $1.63. The pavement was 6 in. thick, this including a 4-in. concrete base. The work at Sioux City, Ia., consisted of 10,594 sq. yds. of resurfacing. The unit cost of this was $1.23 per sq. yd. The 2 ins. of surface was laid on an old 5-in. 1:3:5 National cement concrete base.

At Aberdeen, Wash., 9,638 sq. yds. of plank surfacing was constructed at an average cost of 48 cts. per sq. yd. This consisted of 3 in. decking and 1, 3 on 3x10 stringers, 2½ ft. 6 to 6, on 3x12 in. sills.

Port Arthur, Tex., last year paved about 6 miles of streets with 7 in. of oyster shell and 4 in. of clam shell. The sub-grade was thoroughly rolled with 8-ton and 12-ton rollers. The 7 in. of oyster shells were then spread and rolled thoroughly, after which the clam shells were placed and smoothed off. Mexican crude oil, containing about 70 per cent of asphalt was then applied at the rate of 1½ gal. to the square yard, and the surface sprinkled over with sand and thoroughly rolled.

LENGTH OF WORKING DAY AND PREVAILING RATES OF WAGES IN 1912 FOR LABOR, FOR STREET PAVING WORK IN A NUMBER OF CITIES.

	Working day, hours.	Common labor.	Paver.	Team with driver.
New England Division:				
Maine—				
Augusta	8	$2.00	$3.50	$4.00
Bangor	9	2.00	4.50	4.50
Gardiner	9	....	....	....
Lewiston	9	2.00	....	5.00
Portland	9	2.00	3.50	5.00
New Hampshire—				
Laconia	9	1.75	3.00	4.50
Vermont—				
Bellows Falls	9	2.00	5.00	4.50
Massachusetts—				
Cambridge	8	2.25	....	6.00
Easthampton	9	2.00	....	5.00
Everett	8	2.25	4.50	4.50
Haverhill	8	2.30	....	5.00
Lawrence	8	2.25	5.00	5.00
Leominster	8	2.00	2.75	4.50
Lowell	8	2.00	4.00	5.25
Lynn	8	2.40	2.80	5.28
Manchester	8	2.40	....	....
Medford	8	2.25	3.00	5.00
New Bedford	8	2.25	2.75	4.50
Somerville	8	2.15	....	5.00
Smithbridge	9	2.00	....	4.50
Springfield	8	2.25	....	5.25
Watertown	8	2.25	....	....
Westfield	8	2.00	5.00	..
Whitinsville	9	2.00	....	5.00

	Sq. yds.	Kind of filler.	Depth of sand cushion. Ins.	Av. price per sq. yd. including base and grading.	Guarantee. Years.	Price per cu. yd. for grading if paid separately.	Total thickness pavement. Ins.	Portland Cement Concrete Base Thickness, Ins.	Portland Cement Concrete Base Proportions.
East North Central Division:									
Ohio—									
Akron	......	Grout	2	....	2	.30	....	6	1-2-4
Alliance	30,000	Cement	2	1.65	1	.35	12	6	1-3-6
Ashland	9,000	Asphalt	2	1.44	1	..	14[16]	..	....
Ashtabula	5,556	Asphalt	2	1.50*	5	.30	11	5	1-3-7
Bellefontaine	7,300	Cement	1	1.37*	5	.26	11	6	1-8
Bellevue	13,700	Sand	2	....	..	..	....	8[17]	....
Cambridge	8,900	....	1½	....	5	..	9½	4	1-2-4
Canton	106,000	Tar	2	1.65	1	.30	11	5	1-3-6
Dayton	143,000	....	...	1.56	5	..	....	..	....
Delaware	14,000	Cement	2	1.57*	5	.30	12	6	1-3-6
Fostoria	36,162	Grout	2	1.63*	2	.38	12	6	1-3-6
Fremont	5,000	Sand	2	2.10	5	.35	10	4	1-3½-7
Galion	32,467	Grout	2	2.00	5	.35	11	5	1-3-6
Lakewood	42,000	Grout	1½	1.45*	3	.40	9½	4	1-3-6
Lima	3,291	Cement	1½	1.64*	..	.35	11½	6	1-3-6
London	9,084	Cement	2	1.64	5	..	11	5	1-2-5
Lorain	3,896	Grout	1½	2.19	5	..	11½	6	1-3-6
Marion	7,767	Tar[18]	2	1.79*	5	..	12	6	....
Montpelier	24,000[19]	Cement	2	1.59	5	..	12	6	1-5
Mt. Vernon	......	Pitch	1	1.50*	5	.30	11	6	1-4-8
New Lexington	4,401	Sand	2	1.25*	5	.30	14	..	....
Niles	10,100	Cement	1½	1.53*	5	.45	9½	4	1-3-6
Oberlin	11,400	Cement	2	1.59*	1	.40	11	5	1-3-7
St. Marys	17,000[20]	Cement	2	1.50*	5	.30	12	6	1-3-5
Salinevilwle	11,00	Sand	2	1.31	1	.33	12	..	....
Sandusky	1,775	Asphalt[21]	1	1.50*	3	.60	11	6	1-2½-5
Steubenville	......	Sand	2	1.52	1	.40	....	4	1-2-6
Tiffin	13,593	Grout	2	....	5	.45	13	..	....
Union City	11,000	Cement	2	1.70	5	..	12	6	1-2-5
Wellsville	8,000	Sand	2	1.22*	1	.33	12[22]	..	....
Willoughby	13,900	Cement	1½	1.52*	3	.30	10½	5	1-5
Wooster	3,705	Asphalt	2	1.90	3	.20	....	5	1-3-6
Youngstown	189,366	Grout	2	1.70	..	..	....	6[23]	1-3-6
Indiana—									
Anderson	352	Grout	1	1.80	5	..	11	6	1-5
Argos	22,255	....	...	1.49	..	..	....	4½	....
Atica	14,500	Cement	2	1.08*	3	.35	12[24]	..	....
Bloomington	20,000	Cement	2	1.90	5	..	12	6	1-3-5
Brazil	5,000[25]	....	...	1.22	..	..	....	..	....
Camden	12,200	Cement	2	1.49	5	..	11	5	1-4-5
Crawfordsville	10,331	....	...	1.38	..	..	....	4	....
Delphi	720	Cement	1	1.20	5	..	11	..	....
Fort Wayne	34,573	Grout	2	1.78*	5	.50	12	6	1-3-6
Frankfort	22,236	Cement	2	1.50	5	..	10	4	1-3-6
Gary	6,617	Cement	2	1.96*	..	.40[26]	....	6	1-3-5
Gary	56,431	Cement	2	1.63*[27]	..	.40[26]	....	7[28]	....
Gary	20,443	....	...	1.32[29]	..	..	....	..	....
Indianapolis	17,592	Cement	2	2.10	5	..	....	6	1-8
Kiehlin	10,339	Cement	2	1.59	5	..	11	5	1-4-5
Kokomo	24,000	Cement	1	1.50	5	..	....	..	....
Lafayette	1,760	....	...	1.54	..	..	....	..	....
La Porte	11,332	Grout	2	2.10	5	..	11½	6	1-3-5
Logansport	22,630	Cement	2	1.65	0	..	11	5	1-3-7
Michigan City	1,648	Sand	1	1.78	..	..	9	4	1-3-5
Mishawaka	19,102	....	...	1.68	..	..	....	5	....
Nappanee	16,000	Cement	2	1.68	4	..	....	4	1-7
Newcastle	5,500[30]	....	...	1.40	..	..	....	..	....
Newcastle	36,671	....	...	1.50	..	..	....	5	....
Noblesville	8,054[31]	Cement	2	1.00	5	..	16[32]	..	....
Portland	7,740	....	...	....	..	..	....	4	....
Richmond	18,479	Cement	2	1.64	1	..	12	..	....
South Bend	43,752	....	...	1.27	..	..	....	..	....
South Bend	17,197[33]	....	...	1.52	..	..	....	..	....
Veedersburg	8,000	....	...	1.75	..	..	....	4	....
Veedersburg	1,300[35]	....	...	1.00	..	..	....	..	....
Warsaw	25,611	Cement	2	1.14	4	..	....	..	....
Winchester	20,000	Cement	2	1.60*	5	.25	12	6	1-3-5
Winemac	8,414	....	...	1.53	..	..	....	..	....
Illinois—									
Alton	52,030	Sand	3	1.23	2	..	11	..	....
Alton	3,385	Cement	...	1.79	2	..	9½	4	1-3-6
Aurora	14,600	Grout	2	1.80	1	..	11	5	1-7
Belleville	30,000	Cement	1½	1.65	..	..	10	4	1-3-7
Bloomington	8,713	Cement[21]	2	1.88	10	..	10[36]	4[37]	1-3-5
Canton	6,125	Sand	2	1.28	5	.40	10½	..	....
Canton	8,769	Asphalt	...	1.70	5	.40	10½	5	1-9
Carlinville	3,000	Asphalt	2	1.78	..	..	11	5	1-3-6
Chicago	311,680	....	...	....	..	..	....	..	....
Chicago Heights	12,650	Asphalt	2	1.90	0	..	12	6	1-3-6
Cicero	15,400	Coal tar	2	2.08	5	..	12	6	1-3-6
Cicero	11,776	Sand	2	1.93	5	..	12	6	1-3-5
Cicero	15,156	Sand	2	2.00	5	..	14[38]	..	....
Du Quoin	37,262	Cement	1½	1.82	..	..	10	5	1-3-6
East St. Louis	32,255	Grout	1½	1.81*	..	.37[39]	11½	6	1-3-6
East St. Louis	9,447	Grout	1½	2.16*	..	.37[39]	13½	8	1-3-6
Edwardsville	20,079	Grout	1½	1.90	..	..	10½	5	1-3-5
Elgin	15,300	Sand	2	....	..	..	11	5	1-3-6
Evanston	24,462[40]	Sand	2	1.90*	2	.80	12	6	1-2-5
Granite City	9,100	Grout	2	1.90*	..	.17[41]	12	6	1-3-5
Jacksonville	8,000	Asphalt	2	1.90*	2	.22	11	5	1-3-6
Joliet	6,520[42]	Asphalt	1½	1.30	2	..	....	..	....
Kankakee	18,000	Cement	2	1.87	0	.55	12	6	....
La Grange	10,000	Cement	2	1.37	2	.20	14	..	....
Lincoln	20,000	Grout	2	1.65*	5	.25	11	5	1-3-5
Mattoon	39,000	Cement	1½	1.45*	..	.30	10½	5	1-10
Maywood	4,832	Sand	2	1.53	5	.20	12[43]	..	....
Monmouth	37,800	Asphalt[44]	1	1.45*	1	.35	11[45]	..	....
Murphysboro	23,000	Asphalt	2	1.75*	0	.50	11	5	1-3-6
Newton	6,850	Cement	2	1.60*	5	.30	12	6	1-8
Normal	7,400	Asphalt	2	1.77*	1	.30	11	5	1-2½-5
Oak Park	19,043	Asphalt	½	2.11	5	..	12	6	1-3-6
Odell	13,000	Cement	2	1.87*	5	.38	11	5	1-3-6
Pana	33,287	Cement	2	1.62*	..	.20	11	5	1-8
Paris	5,867	Cement	2	....	..	.25	12	6	1-9
Pekin	47,100	Grout	2	1.70	0	.25	11	5	1-3-5
Peoria	90,743	Grout	2	1.70	2	.50	11	5	1-3-6
Quincy	24,074	Grout	2	1.85	5	..	11	5	1-3-6
River Forest	8,382	Sand	2	1.65	5	.20	14[46]	..	....
Rochester	31,000	Asphalt	2	1.87*	5	.32	10	4	1-3-6

	Working day, hours.	Common labor.	Paver.	Team with driver.
Woburn	8	2.00	....	....
Connecticut—				
Ansonia	8	2.00	4.50	5.00
Bridgeport	8	1.75	3.50	6.00
Derby	10	2.00	....	5.00
Greenwich	10	2.00	....	5.00
South Norwalk	9	1.80	4.00	5.50
Rhode Island—				
Cranston	9	2.00	....	4.50
Pawtucket	9	....	....	....
Middle Atlantic Division:				
New York—				
Albany	8	2.00	4.00	6.00
Binghamton	8	1.75	2.25	4.50
Elmira	8	1.75	2.50	4.50
Fairport	8	1.60	....	5.00
Fulton	8	2.00	5.20	4.50
Gloversville	8	2.00	....	5.00
Jamestown	8	2.00	2.50	5.00
Johnstown	8	2.00	3.50	4.50
Lestershire	8	1.75	....	....
Little Falls	8	1.75	....	5.00
Niagara Falls	8	2.25	2.75	6.00
North Tonawanda	8	2.25	3.00	5.50
Norwich	8	2.00	....	5.00
Ogdensburg	8	2.00	....	4.00
Olean	8	1.60	4.00	4.50
Plattsburg	8	1.50	5.00	4.00
Port Chester	8	....	....	....
Rochester	8	2.00	3.20	5.50
Rye	8	1.75	2.25	5.00
Schenectady	8	2.00	....	5.00
Syracuse	8	1.75	4.00	5.00
Troy	8	2.00	4.00	5.00
Utica	8	1.50	4.00	4.00
Walden	9	1.75	....	4.50
Watertown	8	2.00	....	4.00
White Plains	8	1.65	3.00	5.00
New Jersey—				
Bayonne	9½	1.85	4.50	6.00
East Orange	8	1.75	4.50	6.00
Hoboken	10	2.00	....	....
Newark	..	2.00	....	....
Plainfield	8	1.75	....	5.00
Ridgewood	9	2.00	....	5.00
Trenton	9	2.00	4.00	6.00
Washington	8	1.40	....	4.50
West Hoboken	9	2.00	....	6.00
West New York	9	2.00	5.00	6.00
Pennsylvania—				
Ashland	9	1.75	4.25	4.75
Beaver Falls	10	2.00	....	6.00
Bellwood	10	2.00	4.00	4.00
South Bethlehem	10	1.75	3.00	5.00
Catasauqua	10	1.65	....	....
Clairton	10	2.00	3.50	6.00
Connellsville	9	1.75	3.00	5.00
Corry	10	2.00	3.50	4.50
Du Bois	9	1.75	2.00	4.00
Ellwood City	9	2.00	3.00	5.00
Erie	10	2.00	....	5.00
Farrell	9	2.00	3.00	5.00
Freeport	10	2.00	4.00	5.50
Hanover	10	1.50	....	....
Hazleton	10	1.75	4.00	5.00
Homestead	10	1.75	3.50	6.00
Ingram	10	2.00	2.50	5.50
Meadville	10	2.00	3.00	4.50
Monongahela	10	2.00	2.50	6.60
Nazareth	8½	1.25	....	4.00
New Brighton	9	1.70	....	....
North Braddock	10	2.00	2.25	2.10
Perkasie	10	1.65	....	....
Pittsburgh	10	2.00	....	6.00
Pittston	9	2.00	3.60	4.00
Portage	9	2.00	....	4.50
Pottstown	10	1.60	....	....
Punxsutawney	9	1.75	....	....
Rankin	10	2.00	2.50	6.00
Sayre	9½	2.00	3.00	4.50
Scranton	10	2.00	2.50	5.00
Shamokin	9	1.70	4.00	5.00
Sharpsville	9	1.70	....	4.50
Somerset	10	1.75	2.25	4.00
Swissvale	10	2.00	3.50	6.00
Tarentum	10	2.00	3.50	5.00
Tyrone	10	1.75	....	4.00
Verona	10	2.00	....	5.00
Warren	8	2.00	2.50	5.00
Wilkes-Barre	9	1.75	3.60	5.00
Williamsport	10	1.75	3.00	4.50
York	10	1.75	....	4.50
East North Central Division:				
Ohio—				
Akron	10	2.25	4.00	6.00
Alliance	9	2.00	4.00	5.00
Ashland	9	2.00	3.50	4.00
Ashtabula	10	2.00	3.00	5.00
Bellefontaine	10	2.00	4.00	4.00
Bellevue	10	2.00	3.00	5.00
Bowling Green	10	1.75	....	4.50
Cambridge	9	2.00	....	....
Canton	10	2.25	4.00	5.00
Delaware	10	1.75	2.50	4.00
Fostoria	10	2.00	3.00	5.00
Fremont	10	2.00	4.00	4.50
Galion	10	2.00	4.00	4.50
Lakewood	10	2.25	....	6.00
Lima	10	2.00	4.00	4.00
London	10	1.75	2.50	3.50
Lorain	10	2.00	....	5.00
Marion	10	2.25	5.00	6.00
Monpelier	10	1.75	3.50	4.00
Mt. Vernon	10	2.00	2.50	4.00
New Lexington	9	1.75	3.00	4.50
Newark	9	1.75	2.25	4.50
Niles	9	2.00	....	5.00

								Portland Cement Concrete Base	
	Sq. yds.	Kind of filler.	Depth of sand cushion. Ins.	Av. price per sq. yd. including base and grading.	Guarantee. Years.	Price per cu. yd. for grading if paid separately.	Total thickness pavement. Ins.	Thickness. Ins.	Proportions.
Rock Falls	8,111	Sand	2	....	..	..	....	..	....
Rockford	41,204	Asphalt	1½	1.72*	5	.135	10½	5	1-3-6
Rock Island	24,271	Pitch	1½	1.90*	..	..	10½	5	1-2-5
Springfield	48,280	Asphalt	2	1.64	5	..	12	6	1-3-5
Streator	20,527	Sand	2	1.42	..	..	11	..	....
Urbana	75,000	Asphalt	2	1.64*	5	.25	12	6	1-7-5
Vandalia	16,050	Asphalt	1½	1.92	..	.35	12	6	1-3-6
Waukegan	3,700	Sand	1½	1.75*	2	.40	10½	5	1-3-6
Wilmette	12,358	Sand	2	1.73	5	.30	12	..	....
Michigan—									
Battle Creek	18,860	Cement	1½	1.63	0[52]	..	11	6	1-2½-5
Coldwater	5,154	Cement	2	1.70	..	..	11[49]	5[50]	1-6
Grand Rapids	24,885	Cement	1½	1.73*	5	.50	11½	6	1-3-6
Holland	6,000	Cement	2	1.68	0[52]	.28	12	6	1-3-7
Kalamazoo	10,870	Asphalt	1½	1.82	5	..	11½	6	1-8
Pontiac	19,511	Grout	1½	1.39*	10	.48	11½	6	1-6
Saginaw	2,414	Cement	1	1.50*	..	.45	11	6	1-3-5
St. Johns	1,298	Grout	2	1.58*	5	.32	12	6	1-5
Wisconsin—									
Beloit	7,000	....	2	1.30	..	..	....	..	....
Eau Claire	1,100[53]	Cement	1½	1.36	..	..	....	..[54]	....
Janesville	7,581	Grout	2	1.88*	0	.40	12[55]	..	....
La Crosse	1,535	Asphalt	2	2.15	..	..	11	5	1-3-6
Madison	6,025	Grout	2	2.00*	0	30	12	6	1-2½-5
Neenah	2,784[56]	Grout	3	....	..	.	....	..	....
Racine	33,048	Asphalt	2	1.76	5	..	11	5	1-3-5
Reedsburg	7,000[54]	....	2	1.27	..	..	6	..	....
West North Central Division:									
Minnesota—									
Duluth	3,173	Asphalt	2	2.07*	..	.50	11	5	1-3-6
Mankato	800	Cement	2	2.50	5	..	12	6	1-3-6
Minneapolis	37,200	Asphalt	2	2.10	..	..	....	..	....
Iowa—									
Albia	11,010	Cement	1½	1.96	5	..	10½	5	1-3-6
Carroll	27,000	Cement	2	1.80*	5	.37	11	5	1-3-5
Cedar Rapids	17,048	Sand	2	1.67*	1	.40	10	4	1-3-5
Clinton	14,756	Pitch	1½	2.00	1	..	10½	5	1-6
Davenport	46,336	Pitch	2	1.84*	2	.40	12	6	1-3-5
Dubuque	9,575	Asphalt[57]	2	2.29*	1	..	12	5	1-7
Fort Dodge	4,500	Sand	1½	2.14	5	..	10½	4	1-2-5
Fort Madison	25,500	Sand	2	1.49*	2	.33	10	4	1-3-5
Glenwood	6,200	Grout	2	1.30[58]	1	..	12	6	1-3-5
Independence	26,000	Cement	2	1.69	..	..	....	5	1-7
Muscatine	12,438	Sand	2	1.79	..	.35	10½	5	1-6
Sioux City	9,857	Cement	1	2.27	0	..	9	4	1-2-3
Missouri—									
Chillicothe	7,900	....	2	1.82*	2	.30	10	4	1-3-4
Columbia	21,886	Grout	2	1.57*	0	.38	10	4	1-3-5
Fulton	2,300	Asphalt	2	1.96*	0	.40	11	5	1-3-5
Kansas City	54,471	Grout	1	1.92	5	..	11	6	1-3-6
Kirksville	7,340	Asphalt	2	2.21	5	..	11	5	1-3-5
Liberty	3,700	Cement	2	1.85	..	..	11	5	1-2½-5
Moberly	8,777	Sand	4	1.40*	0	.30	11	..	....
Nevada	3,000[52]	Asphalt	1½	1.45*	..	..	11[57]	..	....
Pine Bluff	32,000	Asphalt	2	2.20*	2	.35	12	6	1-3-5
Richmond	7,570	Cement	2	1.99	5	..	....	4	1-2-4
Sedalia	18,000	Asphalt	2	1.70	5	..	10	4	1-3-6
Warrensburg	25,000	Asphalt	1½	1.80	5	..	9½	4	1-3½-7
Nebraska—									
Grand Island	16,000	....	2	1.91	5	..	10	4	1-5
Lincoln	21,763	Asphalt	2	2.25	1	..	11	5	1-3-6
Kansas—									
Chanute	14,430	Asphalt[57]	1½	1.50	..	..	11½[60]	.	....
El Dorado	25,000	Asphalt	2	....	..	..	....	..	....
Fort Scott	38,090	Sand	2	1.43	5	.30	10	4	1-2-5
Fredonia	11,000	Asphalt	1½	1.55	1	.35	10½	5	1-2-5
Hutchinson	50,000	Asphalt	2	1.85*	1	.35	10½	5	1-3-6
Junction City	17,980	Asphalt	2	1.83*	5	.57[61]	11	5	1-3-5
Mankato	42,500	Asphalt	1½	1.95*	1	.32	10½	5	1-3-5
Newton	6,000	Asphalt	1½	1.92*	1	.40	10½	5	1-3-6
Olathe	3,000	Grout	2	1.75*	5	.35	10	4	1-3-5
Osage City	6,666	Pitch	2	1.94	..	..	12	6	....
Ottawa	5,557	Sand	1½	1.35*	2	.35	9	4	1-3-5
Parsons	19,000	Asphalt[62]	7½	2.00	2	.46	10½	5	1-3-5
Pittsburg	7,826	Asphalt	1½	1.58*	0	.35	10½	5[63]	1-1-5
Pittsburg	8,678	Asphalt	1½	1.50*	0	.35	9½	4[63]	1-1-4
Pittsburg	29,209[64]	....	...	1.30*	0	.35	12	..	....
Topeka	70,000	Asphalt	1½	1.55*	..	.30	9½	4	1-2½-5
Wichita	97,871	Asphalt	1½	1.75*	5	.45	10½	5	1-3-6
South Atlantic Division:									
Virginia—									
Danville	11,000	Pitch	1½	1.90	..	..	....	..	....
West Virginia—									
Clarksburg	8,300	....	1½	1.72	..	..	15½[66]	..	....
Moundsville	8,251	Sand	2	1.15*	..	.30	....	..	....
Parkersburg	10,000	Cement	2	1.55	5	.30	10	4	1-3-6
Princeton	10,000	Sand	2	1.75*	..	.45	14	..	....
North Carolina—									
Asheville	1,300	....	...	2.75	..	..	....	5	1-2½-5
South Carolina—									
Columbia	24,500	Pitch	2	2.19	5	..	11	5	1-3-5
Georgia—									
Albany	7,000	Cement	2	1.98	0[52]	..	11	5	1-3-6
Bainbridge	......	Cement	3	....	..	..	....	..	....
Brunswick	12,727[67]	Sand	2	1.58	2	..	....	..	....
Columbus	24,800	Cement	1½	1.86	5	..	11½	6	1-6
Lagrange	1,000[68]	Tar	3	1.78	..	.30	7	..	....
Savannah	720[68]	Sand	...	1.70	..	..	....	..	....
Florida—									
Jacksonville	130,000[69]	Sand	...	1.73	0	..	....	..	....
Gainesville	4,500[69]	Sand	3	1.50	..	.25	....	..	....
Palatka	15,000[69]	Sand	...	1.20	0	..	....	..	....
East South Central Division:									
Kentucky—									
Dayton	4,200	Grout	1½	1.98	5	.40	....	6	1-2-5
Louisville	70,051	Cement	2	1.83*	5	.52	....	6	....
Mayfield	......	Grout	3	....	..	..	....	..	....
Mississippi—									
Vicksburg	7,784	Grout	1½	2.23*	5	.45	11½	6	1-3-6
West South Central Division:									
Arkansas—									
Fort Smith	6,38[70]	Sand	...	.82	..	..	8	..	....
Helena	15,570	Asphalt	1½	2.03*	5	.35	16½	5	1-3-5

	Working day hours.	Common labor.	Paver.	Team with driver.
Norwood	10	2.10	....	6.00
Oberlin	10	2.00	2.75	5.00
St. Mary's	8	1.75	....	4.50
Salineville	10	2.00	....	8.00
Sandusky	10	2.00	4.00	5.00
Steubenville	9	2.00	3.00	5.50
Tiffin	9	2.00	3.00	4.50
Union City	10	2.00	4.00	4.00
Warren	8	2.00	4.00	5.00
Wellsville	9	2.00	3.50	5.00
Willoughby	10	2.40	3.50	5.50
Wooster	10	2.50	3.00	5.00
Youngstown	10	2.00	3.00	6.00
Indiana—				
Anderson	10	2.00	....	4.00
Attica	10	2.00	....	4.00
Auburn	10	1.90	....	4.00
Bloomington	10	2.00	2.50	4.00
Connersville	10	2.00	....	4.00
Covington	10	2.00	5.00	4.50
Crown Point	10	2.00	....	4.50
Delphi	10	2.00	....	4.00
Fort Wayne	10	2.25	3.00	5.50
Frankfort	10	2.00	3.00	4.00
Gary	10	2.50	3.50	6.00
Greencastle	10	1.75	....	4.00
Huntington	10	2.00	2.50	4.50
Indianapolis	10	2.00	2.50	6.00
Jeffersonville	10	1.75	....	4.00
Kendallville	10	2.00	....	....
Kokomo	10	2.00	3.00	4.00
Lafayette	8	2.00	3.00	3.60
Laporte	10	2.50	4.00	5.50
Lebanon	10	1.75	2.25	4.00
Logansport	10	2.00	5.00	4.00
Nappanee	10	2.00	3.50	4.00
Noblesville	10	2.00	....	4.00
Richmond	10	2.00	3.50	4.00
Terre Haute	8	1.60	2.40	3.20
Wabash	10	2.00	....	4.00
Warsaw	10	2.00	3.50	4.00
West Lafayette	9	1.80	....	3.60
Winchester	10	2.00	3.50	4.00
Illinois—				
Alton	9	1.75	2.50	4.00
Aurora	10	2.25	....	....
Belleville	8	2.56	4.00	4.80
Brookfield	8	2.25	....	....
Canton	9	1.75	2.50	4.50
Carlinville	8	2.25	4.00	5.00
Chicago Heights	9	2.50	.06[1]	5.00
Cicero	8	2.80	....	6.00
Dixon	9	2.50	....	4.50
Du Quoin	9	2.00	....	4.00
East St. Louis	10	2.00	3.50	5.00
Edwardsville	9	2.25	4.00	6.00
Effingham	9	1.75	....	5.00
Evanston	9	3.20	6.00	6.00
Granite City	10	2.00	3.50	5.00
Jacksonville	9	1.75	....	....
Joliet	9	2.25	....	5.50
La Grange	8	3.00	....	6.00
Lake Forest	8	2.50	....	6.00
Lincoln	10	2.00	3.00	4.50
Marion	9	1.80	3.60	4.50
Mattoon	10	2.25	2.50	4.00
Monmouth	10	2.00	3.00	4.50
Murphysboro	10	2.00	3.00	....
Newton	9	1.75	3.00	3.50
Normal	10	2.00	....	4.00
Odell	10	2.50	4.00	5.00
Pana	8	2.20	2.20	4.00
Paris	10	2.00	2.50	3.50
Pekin	9	2.50	....	4.00
Peoria	10	2.00	3.00	6.00
Quincy	10	2.00	2.50	5.00
Rochelle	10	2.50	4.00	5.00
Rock Falls	9½	2.00	....	....
Rockford	10	2.25	4.25	4.50
Springfield	9	1.80	2.25	4.75
Streator	8	2.00	3.00	4.50
Urbana	10	2.00	3.50	5.00
Waukegan	9	2.70	3.60	6.00
Wilmette	8	2.40	....	6.40
Michigan—				
Alpena	10	1.75	....	4.00
Ann Arbor	9	2.25	....	4.50
Battle Creek	10	2.50	4.00	5.00
Charlotte	10	2.00	....	4.00
Coldwater	10	2.00	3.00	4.00
Dowagiac	10	2.00	....	4.00
East Jordan	10	2.00	3.00	4.00
Grand Rapids	10	2.25	3.50	5.50
Highland Park	10	....	....	....
Hillsdale	10	2.00	....	4.00
Holland	9	2.00	....	4.00
Kalamazoo	9	2.00	....	4.50
Menominee	10	1.75	....	4.00
Monroe	10	2.50	....	5.00
Mt. Clemens	10	2.50	4.00	5.00
Pontiac	10	2.50	6.50	5.00
Port Huron	10	2.00	4.00	5.00
Saginaw	9	2.25	....	5.00
St. John's	10	2.00	....	4.00
Traverse	10	1.75	....	4.50
Wisconsin—				
Antigo	10	2.00	....	4.50
Appleton	10	2.00	....	4.50
Beloit	10	2.25	6.00	5.00
Columbus	10	2.00	....	3.50
Eau Claire	10	1.75	2.25	4.00
Edgerton	10	2.25	....	4.00
Janesville	10	2.25	4.00	5.50
Lacrosse	10	2.00	2.50	4.50
Madison	9	2.25	....	5.00
Neenah	10	2.00	4.00	6.00
Oconto	10	1.75	....	3.50

	Sq. Yds.	Kind of filler.	Depth of sand cushion. Ins.	Av. price per sq. yd including base and grading.	Guarantee. Years.	Price per cu. yd. for grading if paid separately.	Total thickness pavement. Ins.	Portland Cement Concrete Base Thickness. Ins	Portland Cement Concrete Base Proportions.
Jonesboro	500	Sand	2	2.00*	..	.27	12	..	....
Little Rock	......	Asphalt	2	2.25*	5	.50	....	5[71]	1-3-5
Louisiana—									
Shreveport	13,668	Grout	1	2.14	5	..	9	5	1-3-5
Oklahoma—									
Bartlesville	14,200	Grout	1½	2.07	0	..	11½[72]	..	....
Muskogee	2,890	Grout	1½	1.65*	5	.30	10½	5	1-3-6
Nowata	12,973	Asphalt	1½	2.22*	5	.42	9½	4	1-2-4
Nowata	4,638	Grout	1½	2.10*	5	.33	9½	4	1-2-4
Tulsa	20,000	....	...	1.86*	5	.33	....	5	1-2½-5
Texas—									
Fort Worth	66,841	Cement	1½	2.06	..	..	10½	5	1-9
Houston Heights	47,000	Asphalt	1½	2.20*	5	.30	10½	5	1-3-6
Tyler	8,000	Asphalt	1½	2.25	..	.25	9½	4	1-2½-5
Mountain Division:									
Montana—									
Helena	10,000	Pitch	2	3,00*	7	.50[73]	11	5	1-3-6
Pacific Division:									
California—									
Oakland	3,408[74]	Cement	...	3.50*	..	.21[75]	....	,6	....
Oregon—									
Portland	1,612	Cement	1½	2.90*	5	..	11½	6	1-3-6
Washington—									
Pullman	5,000	Asphalt	1½	2.85*	..	.60	....	..	....
Seattle	68,751	Grout	1½	2.55*	..	.50	9⅝[75]	4	1-4-7
Tacoma	23,834	Cement	2	2.00*	..	..	11	5	1-3-6
Canada:									
Ontario—									
Niagara Falls	2,300	Grout	1½	2.75	2½	..	....	5	1-4
Oshawa	5,638	Cement	¾	3.45	5	..	19	14	1-2-5
Stratford	4,100	Cement	1½	2.45	5	..	11	5	1-7
Toronto	25,971	Grout	2	2.76[76]	5	..	11½[77]	6	1-3-7
Welland	12,959	Grout	1½	2.47	5	.40	11½	6	1-6
British Columbia—									
Vancouver	22,692	Grout	1½	3.90	5	.80	11⅜	6	1-2½-5

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* Does not include grading.

[1] 5 to 6 in.; [2] 6,167 sq. yds. with pitch; [3] pitch, also grout; [4] includes curb, etc.; [5] without base; [6] gravel base; [8] includes 8-in. broken slag base; [9] includes furnace, slag foundation; [10] 4-in. slag; [11] slag foundation; [12] includes 8-in. gravel base; [13] 2,403 sq. yds. street car track section at $2.46; [14] 4 in. brick, 2 in. sand, 4 in. slag, 6 in. broken stone; [15] 5 in. broken stone, 4 in. gravel, 1 in. sand; [16] 8-in. gravel base; [17] 8-in. macadam base; [18] also grout; [19] laid in 1911; [20] for 1913; [21] asphalt, also grout; [22] includes slag base; [23] 6 in. on business streets, 4 in. on residence streets; [24] includes roller gravel base; [25] crushed brick base; [26] 25 cts. to 40 cts.; [27] $1.63 to $2.08; [28] 7-in. macadam base; [29] $1.32 to $1.45 for brick on natural sand foundation; [30] on 8-in. macadam base; [31] number 2 paving brick; [32] includes gravel base 12 in. deep; [33] gravel base; [34] on earth base; [35] sand base; [36] 10 in. and 12. in.; [37] 4 in. and 6 in.; [38] includes 8-in. macadam oase; [39] 37 cts. for excavation removed, 53½ cts. for fill; 44 cts. for excavation placed in fill; [40] considerable 2 cts. on resurfaced macadam, prices quoted are full brick pavement; [41] per sq. yd.; [42] on old base; [43] includes 6-in. macadam; [44] sand and asphalt; [45] includes 6-in. gravel base. [46] includes limestone macadam base 8 in. in depth; [47] sand and pitch; [48] $1.90 and $2.00; [49] 11 to 12 in.; [50] 5 in. to 6 in.; [51] per lin. ft. of street; [52] day labor work; [53] 3-ft. gutters on asphalt streets; [54] laid on sand base; [55] includes macadam base; [56] between rails of street car track; [57] sand and asphalt; [58] brick laid on an old concrete pavement; [59] includes 6-in. cinder base; [60] includes 6-in. crushed stone base; [61] old macadam; [62] sand, cement and asphalt; [63] Joplin chats for coarse aggregate. [64] Double course bank; 4 in. cinders, platen course of bank 1½ in. fine cinders and brick wearing surface. [65] 10½ to 11½; concrete base 5 in. and 6 in. [66] Includes 2 in. gravel, 8 in. stone. [67] On natural sand foundation. [68] Natural base. [69] Sand foundation. [70] 6.38 miles on 4 in. sand foundation. [71] 5 in. and 6 in. [72] Includes broken stone base. [73] 50 cts. to $1. [74] Gutters only. [75] Per sq. yd.; 9⅝in. to 12⅛ in.; 4 in to 6 in. base. [76] Also $2.53⅞, $3.02 and $3.21. [77] 9½ in. to 11½ in.; 4 in. to 6 in. concrete base. [78] $2.47 outside contracts; $2.39 track allowance.

TABLE SHOWING AMOUNT, AVERAGE PRICE AND SOME DETAILS OF CONCRETE PAVEMENT CONSTRUCTED IN 1912 IN 140 CITIES.

	Sq. yds.	Type.	Total thickness. Ins.	Av. cost per sq. yd., including grading.	Guarantee. Years.	Bottom Course. Thickness. Ins.	Bottom Course. Proportions.	Top Course. Thickness. Ins.	Top Course. Proportions.
New England Division:									
Maine—									
Gardiner	4,500	Bit-Top	5¼	$1.30	..	5	1-2½-5	...	....
Portland	24,905	Bit-Top	...	1.33	..	...	....	...	....
Massachusetts—									
Haverhill	7,720	Bit-Top[7]	5	1.65	5	3½	1-3-6	...	....
Lynn	14,088	1-course	6	1.34	..	...	....	...	....
Somerville	8,501	Bit-Top[1]	8	1.71	..	5	1-3-6	...	....
Connecticut—									
Greenwich	6,300	Bit-Top	6	1.32	1	6	1-2-4	...	....
South Norwalk	11,000	Bit-Top	6½	1.27	0	6	1-2½-4½	...	....
Middle Atlantic Division:									
New York—									
Albany	1,244	Bit-Top[1]	6	1.65	2	...	....	...	....
Binghamton	1,593	Bit-Top	8	1.16	5	...	1-2-5	...	....
Fulton	25,339	Bit-Top	6[2]	1.60*	5	6	1-2½-5	...	....
Gloversville	38,000	Bit-Top	6½	1.50	0	6	1-2½-5	...	....
Niagara Falls	32.261	Hassam	7	2.68	5	...	....	...	....
Troy	3,000	Hassam	...	2.10	5	...	....	...	....
Troy	7,000	Bit-Top	...	2.35	5	...	....	...	....
Watertown	7,000	Bit-Top	6	1.32	..	6	1-4	...	....
New Jersey—									
Trenton	3,241	2-course	6	1.08	1	...	....	...	....
Washington	1,500	Dolarway	6	1.34	5	...	....	...	....
Pennsylvania—									
Bellwood	858	....	4	1.36	..	...	....	...	....
Bethlehem	.....	1-course	5	1.10	..	...	....	5	1-3-5
Erie	404	2-course	5	1.39	5	3½	1-3-8	...	....
Hanover	565	Bit-Top	6½	1.10	..	6	1-2-5	...	....
East North Central Division:									
Ohio—									
Norwalk	2,338	1-course	...	1.27	..	...	....	...	....
Norwood	5,000	1-course	6	1.10	1	...	....	6	1-2½-5
Tiffin	7,824	Bit-Top	6¼	....	5	6	1-2-4	...	....

	Working day, hours.	Common labor.	Paver.	Team with driver.
Oshkosh	10	2.00	....	....
Racine	10	2.50	....	6.00
Superior	10	2.50	3.00	5.50
Two Rivers	10	2.00	....	4.00
West Allis	9	2.50	....	5.00
West North Central Division:				
Minnesota—				
Chisholm	10	2.50	....	6.00
Duluth	10	3.00	6.00	6.00
Faribault	10	2.00	3.00	4.50
Hibbing	10	2.25	....	....
Mankato	10	2.00	4.00	4.00
Minneapolis	8	2.40	3.00	5.00
Owatonna	10	2.25	....	4.50
Red Wing	10	2.00	....	4.00
Rochester	10	2.25	....	....
St. Cloud	9	2.00	....	4.50
Stillwater	10	2.00	....	5.50
Virginia	10	2.50	....	5.50
Iowa—				
Bloomfield	8	2.00	3.75	4.00
Burlington	10	2.00	3.00	5.00
Carroll	10	2.50	....	5.00
Cedar Falls	10	2.50	....	5.00
Cedar Rapids	9	2.00	3.00	5.00
Chariton	10	2.00	....	4.00
Charles City	10	2.25	4.00	4.00
Clinton	10	2.00	....	4.00
Davenport	10	2.25	3.00	5.50
Dubuque	10	2.20	2.50	5.50
Fort Dodge	10	2.75	5.00	5.00
Fort Madison	10	2.00	4.00	5.00
Glenwood	10	2.00	5.00	3.50
Independence	10	2.00	....	4.00
Marshalltown	10	2.25	5.00	4.00
Mason City	10	2.50	4.00	4.50
Muscatine	9	2.10	3.00	4.50
Oelwein	10	2.50	....	4.00
Sioux City	10	2.25	5.00	5.00
Waterloo	10	2.25	....	4.50
Missouri—				
Chillicothe	9	2.00	3.00	4.00
Clinton	..	1.75	....	3.50
Columbia	10	1.75	2.00	3.50
Eldorado Springs	9	1.75	....	....
Fulton	10	1.75	3.00	4.00
Jefferson City	10	2.00	3.00	3.50
Kansas City	8	2.25	4.00	5.00
Kirkville	9	1.80	2.50	4.00
Liberty	10	2.25	3.00	4.50
Moberly	10	2.00	3.50	4.50
Nevada	9	1.75	2.50	3.50
Poplar Bluff	10	1.75	2.50	3.00
Richmond	10	2.25	5.00	4.00
Sedalia	10	1.75	3.00	4.00
Warrensburg	10	1.75	....	3.50
North Daktoa—				
Fargo	10	3.00	....	6.00
Minot	10	2.25	....	4.00
South Dakota—				
Lead	8	2.50	5.00	6.00
Mitchell	10	2.25	4.00	4.00
Sioux Falls	10	2.50	....	4.50
Nebraska—				
Holdrege	10	2.00	....	4.00
Lincoln	10	2.25	3.00	5.00
South Omaha	10	2.50	4.00	5.00
Kansas—				
Abilene	8	1.75	2.00	4.00
Arkansas City	8	1.60	....	3.20
Chanute	8	2.00	....	3.50
Columbus	8	2.00	....	4.00
Concordia	8	2.00	....	3.50
Eldorado	8	2.00	....	....
Fort Scott	8	1.60	2.00	3.20
Fredonia	8	1.75	3.00	3.50
Hutchinson	8	2.00	....	3.50
Junction City	8	2.00	....	4.00
Manhattan	8	1.75	2.25	4.50
Newton	8	2.00	5.00	4.50
Olathe	8	2.00	....	3.50
Osage City	8	2.00	....	4.00
Osawotomie	8	1.75	....	3.50
Ottawa	8	1.60	2.40	3.20
Parsons	8	2.00	3.20	3.50
Pittsburg	8	2.00	2.50	3.50
Salina	8	1.75	2.50	3.50
Topeka	8	1.75	4.00	3.50
Wichita	8	1.75	2.50	3.50
South Atlantic Division:				
Maryland—				
Annapolis	8	1.50	4.80	2.50
District of Columbia—				
Washington	8	1.50	3.50	4.00
Virginia—				
Danville	10	1.25	1.50	3.50
Pulaski	10	1.25	....	3.50
West Virginia—				
Charleston	10	1.60	....	4.50
Clarksburg	10	1.75	2.50	5.00
Mannington	9	2.00	2.00	5.00
Moundsville	9	1.50	2.50	4.50
Princeton	10	1.50	....	4.00
North Carolina—				
Asheville	8	1.25	....	3.00
Lumberton	10	1.25	2.50	3.00
Raleigh	10	1.50	3.00	4.50
Salisbury	10	1.25	....	3.50
Statesville	10	1.25	....	....
Winston-Salem	10	1.25	1.35	3.50
South Carolina—				
Charleston	9	1.35	3.00	2.50
Chester	10	1.00	....	....
Columbia	10	1.25	....	4.00
Florence	10	1.25	....	5.00
Georgetown	10	1.00	....	....

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[1]Per sq. yd.

	Sq. yds.	Type.	Total thickness. Ins.	Av. cost per sq. yd., including grading.	Guarantee. Years.	Bottom Course.		Top Course.	
						Thickness. Ins.	Proportions.	Thickness. Ins.	Proportions.
Indiana—									
Anderson	340	1-course	6	1.35	1	...	....	6	1-4
Connersville	70,000	2-course	6½[3]	1.05	5	...	....	...	....
Fort Wayne	20,373	Bit-Top	8	1.59*	5	6[4]	1-3-6	...	....
Frankfort	1,625	Bit-Top	7	1.20	5	6¾	1-2½-5	...	....
Huntington	21,500	Dolarway	5⅛	1.09*	5	5	1-4	...	....
Kendallville	11,000	Dolarway	6¼	1.35	5	6	1-2-3	...	....
Warsaw	.....	2-course	...	1.14	4	...	....	...	....
Illinois—									
Carlinsville	4,000	2-course	7	1.28½	..	5	1-3-5	...	....
Chicago	12,892	....	...	....	..	...	....	...	....
Chicago Heights.	3,300	Dolarway	7[5]	.82	..	...	1-2-4	...	....
Edwardsville	8,396	2-course	7	1.42	..	5	1-3-5	2	1-1-1
Edwardsville	1,200	Bit-Top	6	1.42	..	6	1-3-5	...	....
Effingham	60,000	2-course	6½	1.66	..	4	....	2½	....
Evanston	13,569	Bit-Top	8	.95*	..	...	....	...	....
Lincoln	2,000	1-course	6	.78*	1	...	....	...	....
Mattoon	5,000	1-course	6	1.03*	..	...	....	6	1-1½-4
Newton	8,400	1-course	7	1.05*	5	...	....	7	1-2-3
Quincy	18,802	Bit-Top	6¼	1.06	5	6	1-1½-3	...	....
Springfield	614	1-course	8	1.14	5	...	....	8	1-6
Michigan—									
Alpena	6,700	2-course	8	1.15	..	6	1-2-4	...	....
Ann Arbor	11,537	Bit-Top	7	.90*	..	5	1-8	2	1-2
Charlotte	11,946	2-course	7	1.07	..	5½	1-2½-5	1½	1-2
Dowagiac	3,297[6]	Bit-Top	6	.95	..	4	1-7	2	1-2
East Jordan	10,000	2-course	7	1.06*	5	5	1-6	2	1-2
Highland Park	12,565	Bit-Top	7	1.35*	5	5	1-3-5	2	....
Kalamazoo	3,000	2-course	7	1.20	5	...	....	...	....
Menominee	750	2-course	8	.85*	0	6	1-3-5	2	1-1
Monroe	3,800	1-course	6	.80*	0	...	....	6	1-3-5
Monroe	23,000	2-course	8	1.30*	3	6	1-3-5	2	1-2
Mt. Clemens	400	Bit-Top	8	1.35*	5	...	....	...	....
Port Huron	11,000	2-course	7	1.22	5	...	....	...	....
Saginaw	846	1-course	6	1.00*	..	...	....	6	1-2-4
St. Johns	14,741	2-course	7	.90*	5	5	1-5	2	1-2½
Wisconsin—									
Appleton	10,000	Bit-Top	7	1.30	..	5	1-3-6	2	1-2½
Columbus	2,827	Dolarway	6†	1.22*	5	6	1-2½-4	...	....
Oshkosh	4,410	....	.	1.12	5	...	....	...	....
Sheboygan	25,600	2-course	8½	1.25½	0	...	1-3-5	...	1-1½
Superior	20,050	2-course	7½	1.30*	8	6	1-2½-4	1½	1-1-1
West North Central Division:									
Minnesota—									
Duluth	861	2-course	7½	1.30*	5	...	1-3-5	...	1-2
Duluth	5,237	Bit-Top[9]	6½	1.30*	5	5	1-3-6	...	....
Mankato	225	2-course	7	1.32	5	5	1-3-6	...	....
Minneapolis ffi	9,900	1-course	7	1.18	..	...	....	7	1-2-4
Owatonna	715	2-course	6	.85*	0	5¼	1-4	¾	1-2
Red Wing	769	1-course	6	.86	..	...	....	6	1-4
Iowa—									
Atlantic	10,000	1-course	...	1.12	5	...	....	...	....
Burlington	9,371	1-course	6	.96½	1	...	....	6	1-2-3
Cedar Falls	27,863	2-course	7	1.16[10]	1	5	1-5	2	1-2
Cedar Rapids	7,471	2-course	7	1.20*	1	5	1-2-4	...	....
Centerville	3,806	1-course	6	1.41	3	...	....	6	1-2-4
Clinton	4,670	2-course	7	1.00	1	5	1-6	...	....
Davenport	49,843	2-course	7	1.17*	2	5	1-3-5	2	1-1-1
Dubuque	552	2-course	8	1.20*	1	...	1-7	...	....
Marshalltown	60,000	2-course	7	1.08	0	5	1-2-5	...	....
Mason City	49,800	2-course	7	1.08	5	5	1-2-5	2	1-2
Muscatine	2,000	1-course	7	.87	..	...	....	7	1-4½
Perry	14,000	....	...	.94	..	...	....	...	....
Sioux City	9,857	1-course	6[11]	1.40	0	...	....	6	1-2-3
Waterloo	1,300	2-course	6½	1.25*	..	4½	1-5	...	....
Missouri—									
Chillicothe	8,000	Hassam	5	1.50*	5	...	....	...	....
Clinton	5,000	1-course	7	1.36	3	...	....	7	1-2-3
Columbia	3,461	1-course	7	1.30*	0	...	....	7	1-2-4
Eldorado Springs	15,000	1-course	6	.86	3	...	....	6	1-5[12]
Kansas City	214,150	1-course	6	1.05[13]	5	...	....	6	1-2½-4½
Kansas City	38,500[14]	1-course	6	1.03	..	...	....	6	1-2½-4½
Liberty	35,865	2-course	6½	1.15	5	5	1-2½-5	...	....
Nevada	6,000	Bit-Top	6	1.10*	2	...	....	...	....
Sedalia	1,802	2-course	6½	.92	5	5	1-2½-5	...	....
Webster Groves	30,000	Dolarway	6½	1.50	3	6	1-2½-4	...	....
South Dakota—									
Mitchell	26,831	2-course	7	1.50	3	5½	1-2-4	1½	1-¾-¾
Sioux Falls	5,888	....	...	1.10*	1	...	....	...	....
Nebraska—									
Grand Island	7,000	Dolarway	5†	1.45	5	5	1-5	...	....
Lincoln	1,070	2-course	6	1.45	2	4½	1-3-6	...	....
Kansas—									
Fredonia	12,000	2-course	6	1.05	1	4½	1-2-5	1½	2-3
Junction City	40,540	Dolarway	6†	1.17*	5	6	1-2½-4½	...	....
Manhattan	3,000	Bit-Top	6†	1.14*	5	5	1-3-5	1	1-2
Newton	5,000	1-course	7	1.00	1	...	....	7	1-2-4
Olathe	900	1-course	7	1.50*	5	...	....	7	1-2-4
Pittsburg	4,351	1-course	6	.98*	0	...	....	6	1-1-4[15]
Wichita	24,590	1-course	5[16]	.90*	1[17]	...	....	5	1-2-4
Wichita	14,513	Hassam	5	1.67*	5	...	....	...	....
East South Central Division:									
Mississippi—									
Brook Haven	1,350	....	5	.90	5	4	1-2-5	1	....
South Atlantic Division:									
West Virginia—									
Charleston	3,500	1-course	7	1.33	2	...	....	7	1-2-4
North Carolina—									
Raleigh	14,500	Bit-Top	6¼	1.24	5	6	1-2-4	...	....
South Carolina—									
Union	.....	....	6[18]	.80	..	6	1-3-5	...	....
West South Central Division:									
Arkansas—									
Fort Smith	662[19]	1-course	6	.68	0	...	....	6	1-2-4
Little Rock	.....	2-course	6	.90*	..	...	1-3-5	...	1-2-4
Little Rock	.....	Bit-Top	6	1.25*	5	...	1-3-5	...	1-2-4
Louisiana—									
New Orleans	8,872	Granitoid	8	2.37*	5	...	....	...	....
Shreveport	10,500	2-course	7	1.64	5	5	1-3-5	2	1-3-5
Oklahoma—									
Haileyville	1,700	1-course	4	1.00*	..	...	....	4	1-2-4
McAlester	2,945	....	6	1.20*	..	...	....	...	....
Muskogee	3,740	1-course	6	1.05*	5	...	....	6	1-2-4

	Working day, hours.	Common labor.	Paver.	Team with driver.
Greenville	10	1.25	1.50	4.00
Rock Hill	10	1.25	3.00	....
Union	10	.80	2.00	3.00
Georgia—				
Albany	10	1.25	2.00	4.00
Brunswick	9	1.50	3.00	5.00
Cedartown	10	1.25	....	3.00
Columbus	10	1.25	3.00	4.00
Gainesville	10	1.25	....	4.00
LaGrange	10	1.25	3.00	4.00
Savannah	10	1.50	3.00	....
Waycross	10	1.50	2.00	5.00
Florida—				
Jacksonville	9	1.50	....	4.50
Gainesville	9	1.25	2.50	4.00
Palatka	10	1.35	3.50	4.50
East South Central Division:				
Kentucky—				
Dayton	10	1.75	2.50	6.00
Louisville	9	1.75	4.00	4.00
Ownesboro	10	1.75	2.50	4.00
Tennessee—				
Jackson	9	1.50	....	3.50
Knoxville	10	1.35	....	3.50
Paris	9	1.50	3.00	3.50
Springfield	..	1.50	....	....
Alabama—				
Dothan	10	1.50	....	5.00
Roanoke	..	1.25	....	3.00
Selma	10	1.25	....	....
Mississippi—				
Brookhaven	9	1.25	....	....
Greenwood	10	1.50	....	....
Vicksburg	10	1.35	2.00	4.00
West South Central Division:				
Arkansas—				
Fort Smith	10	2.00	4.00	3.50
Helena	10	1.50	2.00	3.50
Jonesboro	10	1.75	....	....
Little Rock	10	1.75	2.25	5.00
Mena	8	1.50	....	3.00
Louisiana—				
New Orleans	10	1.75	4.00	7.00
Shreveport	10	1.50	....	5.00
Oklahoma—				
Bartlesville	8	2.00	....	5.00
Haleyville	8	2.00	4.00	4.00
Lawton	8	2.00	....	4.00
McAlester	9	1.75	....	3.50
Muskogee	8	1.75	2.25	4.00
Nowata	8	2.00	....	4.50
Okmulgee	8	2.00	3.00	4.00
Tulsa	8	2.00	3.50	4.00
Texas—				
Brownsville	10	1.00	3.50	3.50
Eagle Pass	10	1.25	2.00	3.00
Fort Worth	9	1.75	3.50	4.00
Houston Heights	10	1.75	2.50	5.00
Paris	10	1.75	2.50	3.50
Sweetwater	..	2.00	4.00	4.00
Waco	8	1.65	2.00	3.50
Weatherford	..	1.50	....	3.00
Mountain Division:				
Montana—				
Billings	8	3.00	4.00	6.00
Bozeman	8	3.00	....	6.00
Glendive	10	2.50	....	5.00
Great Falls	8	3.00	....	6.00
Helena	8	3.00	6.00	6.00
Miles City	8	3.00	4.00	6.00
Idaho—				
Boise	8	2.50	....	5.00
Idaho Falls	10	2.50	3.50	5.00
Nampa	8	2.50	....	4.50
Pocatello	8	2.50	....	5.00
Wallace	8	3.50	....	7.00
Weiser	8	2.50	....	5.00
Utah—				
Ogden	8	2.50	4.00	5.00
Salt Lake City	8	2.25	....	5.00
Wyoming—				
Casper	10	3.00	....	5.50
Colorado—				
Boulder	8	2.25	....	4.50
Colorado Springs	8	2.00	3.50	4.00
Denver	8	2.50	5.00	5.00
Fort Collins	8	2.00	....	....
Glenwood Springs	8	2.50	4.00	5.00
Grand Junction	8	2.40	3.00	5.00
New Mexico—				
Raton	8	1.75	....	5.00
Arizona—				
Phoenix	8	2.00	....	....
Pacific Coast Division:				
California—				
Alhambra	9	2.00	4.00	5.00
Coalinga	8	2.50	....	7.00
Corona	9	2.00	....	4.50
Eureka	8	2.50	....	5.00
Fresno	8	2.25	4.00	4.00
Los Angeles	8	2.50	4.50	5.00
Lodi	8	2.50	5.00	4.50
Monrovia	9	2.25	....	5.00
Napa	8	2.25	3.50	5.00
Oakland	9	2.50	....	6.00
Orange	9	2.25	4.00	4.00
Palo Alto	8	2.25	4.00	4.00
Pasadena	..	2.25	....	5.00
Pittsburgh	8	2.25	....	4.00
Pomona	9	2.00	....	5.00
Salinas	8	2.50	....	4.00
San Bernardino	8	2.50	....	4.50
San Francisco	8	2.50	6.00	6.00
San Mateo	8	2.50	....	....
South Pasadena	8	....	....	....
Upland	9	2.00	....	4.50

	Sq. yds.	Type.	Total thickness, ins.	Average cost per sq. yd., including grading.	Guarantee, years.	Bottom course.		Top course.	
						Thickness, ins.	Proportion.	Thickness, ins.	Proportion.
Okmulgee	8,000	2-course	6	1.60*	5	4	1-3-6	2	....
Texas—									
Fort Worth	17,650	Blome	7	2.06	..	5½	1-9	1½	....
Fort Worth	7,312	........[20]	6	1.85	..	...	....	6	1-5
Waco	3,500	Bit-Top	4½	1.40	5	4	1-2-4	...	....
Mountain Division:									
Montana—									
Billings	335	1-course	7	2.25	2	...	....	7	1-2-4
Great Falls	3,061	....	...	1.73	..	...	....	...	....
Idaho—									
Boise	4,618	1-course	6	1.10*	5	...	....	6	1-3-5
Utah—									
Ogden	1,995	2-course	8	1.84	..	6	1-2-5	2	....
Colorado—									
Boulder	177[21]	....	...	1.06	..	7	1-3-5	...	....
Colorado Springs	445	1-course	5	1.44	0	...	....	5	1-2-5
Grand Junction	10,000	2-course	7	2.20	..	...	1-3-6	...	1-3-6
Pueblo	1,700	....	...	....	..	...	....	...	....
Pacific Division:									
California—									
Pomona	578[21]	Bit-Top	4½	1.17	0	4	1-2-4	...	....
San Francisco	116,059	Bit-Top	8	2.34*	0	6	1-3-7	...	....
Oregon—									
Portland	58,261[22]	2-course	6	1.24*	5	3½	1-3-5	2½	1-2-4
St. Johns	.....	1-course	6	.98*	..	...	....	6	1-3-4
Washington—									
Aberdeen	4,367	2-course	6	1.40*	0	4	1-7	2	1-2
Aberdeen	7,200	2-course	8	1.65*	0	...	....	...	....
Montesano	3,772	2-course	6	1.00*	..	4	1-3-6	2	1-1-1
North Yakima	2,110	1-course	6	1.35*	..	...	....	6	1-2-4
Tacoma	5,285	2-course	7	2.00*	..	5	1-3-6	2	....
Canadian Division:									
Ontario—									
Chatham	1,730	1-course	6	1.37	0	...	....	...	....
Vancouver	17,834	Granitoid	7	3.00	5	5½	1-2½-5	...	....
Niagara Falls	6,320	1-course	7	1.50	2½	...	....	7	1-2½-4
Peterborough	975	....	8	.98	..	...	....	...	....
Toronto	14,193	1-course	6	1.25	5	...	....	6	1-3-7
British Columbia—									
New Westminster	23,500	Hassam	6	2.25	5	...	....	...	....
Vancouver	2,870	2-course	7	2.00	5	5½	1-2½-5	1½	....

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[1] Concrete with bituminous surfacing on 8 in. cinder foundation. [2] 6 in. concrete on 6 in. gravel base. [3] 6½ in. to 8½ in. [4] 5 in. and 6 in. [5] 5 in. at side; 7 in. at crown. [6] Painted over with Tarvia, ⅓ gal. per sq. yd. [7] 6½ in at curb; 8½ in. at crown. [8] 60 days. [9] Toncan. [10] 92 cts. to $1.16. [11] 5 in. and 6 in. [12] Joplin chats; engineer reports result not satisfactory, as pavement is cutting badly. [13] $1.05 on streets; $1.10½ on alleys. [14] Work put in by private contract. [15] Joplin chats for coarse aggregate. [16] 5 in. and 6 in. [17] 1 year and 2 years. [18] 6 in. and 8 in. [19] Miles. [20] Vibrolithic. [21] Experiment by city. [22] Includes concrete with bituminous top.

TABLE SHOWING AMOUNT, AVERAGE PRICE AND SOME DETAILS OF STONE BLOCK PAVEMENTS LAID IN 1912 IN 47 CITIES.

	Sq. yds.	Kind of filler.	Average price per sq. yd., including base and grading.	Guarantee. Years.	Total thickness pavement. Ins.	Portland cement concrete base.	
						Thickness. Ins.	Proportions.
New England Division:							
Maine—							
Lewiston	.....	Gravel	$1.75	..	....	...	......
Portland	1,004	Cement	2.30	..	....	...	......
Vermont—							
Bellows Falls	1,995	Sand	2.18	0	....	...	....
Massachusetts—							
Cambridge	.....	....	3.50	..	....	6	1-2½-5
Everett	5,162	....	3.94	..	....	5	1-2-5
Lawrence	30,704[1]	1:1 grout	2.72	0	7½	...	....
Lawrence	559[2]	1:1 grout	2.67	5	12	6	1-3-6
Leominster	2,268[3]	Pitch	2.47	..	....	4	1-3-5
Lowell	22,418	Cement[4]	3.15	..	12	6	1-4-11
Lynn	5,617[2]	Cement	2.90	..	14	6	1-2-4
New Bedford	12,310	Cement	1.90*	..	10	4[5]	....
Somerville	2,216	Grout	2.77	..	12	5	1-3-6
Westfield	6,197	Cement	3.30	1	8½	4	1-3-6
Connecticut—							
Ansonia	1,500	Sand	2.10	..	12	5	1-3-6
Derby	650	Sand	1.98	..	13	6	1-3-5
Rhode Island—							
Woonsocket	724[7]	....	5.00	..	....	...	......
Middle Atlantic Division:							
New York—							
Albany	2,260	Sand	2.52	2	21½[8]	...	....
Rochester	42,700[9]	Grout	3.18	5	13[10]	6	1-3-6
Syracuse	849[11]	Grout	3.40	10	14	6	1-3-6
Troy	4,000	Cement	3.35	5	....	6	1-5
Utica	1,260	Cement	3.50	5	12	5	1-3-7
New Jersey—							
Bayonne	1,194	Cement	3.16*	1	12	5	1-3-6
Jersey City	19,479[12]	Sand	1.50	..	12	...	....
Jersey City	14.951[13]	....	1.80	..	15	6	1-3-6
Newark	75,735	....	3.03	5	....	...	....
West New York	5,000	Tar[15]	2.00	1	....	...	....
Pennsylvania—							
Scranton	1,688	Sand	2.10	5	9[16]	...	....
Wilkes-Barre	2,156[17]	Cement	2.70	..	12	6	1-2-5
East North Central Division:							
Ohio—							
Akron	.....	Pitch	3.00[18]	2	11[19]	4	1-2-4
Illinois—							
Chicago	47,210	....	....	..	....	...	....
Wisconsin—							
Superior	10,078	....	2.52*	5	13	5	1-3-5

Oregon—				
Eugene	10	2.25	5.00	6.50
Hood River	8	2.25	....	6.00
Klamath Falls	10	2.50	....	5.00
La Grande	9	2.50	4.00	5.00
McMinnville	10	2.75	....	5.00
Newberg	10	2.50	4.00	5.00
Portland	9	2.50	....	6.00
St. John's	9	2.50	5.00	6.50
Washington—				
Aberdeen	8	2.75	4.00	7.00
Montesano	8	2.50	....	6.00
North Yakima	8	2.50	....	4.80
Pullman	8	2.50	....	5.00
Seattle	8	2.75	6.00	7.00
Sedro Woolley	8	....	....	....
South Bend	8	2.25	4.00	7.00
Tacoma	8	2.50	5.00	6.00
Canada:				
Prince Edward Island—				
Charlottetown	10	1.35	....	3.50
Nova Scotia—				
Halifax	9	1.62	....	2.50
Quebec—				
Montreal	10	2.10	3.50	3.25
St Lambert	10	2.00	....	6.00
Ontario—				
Chatham	10	2.00	2.50	4.50
Hamilton	10	2.20	2.60	5.50
Kingston	9	1.80	....	2.50
Niagara Falls	10	2.00	5.00	4.50
North Bay	9	1.75	....	....
Oshawa	10	2.00	3.00	4.50
Ottawa	9	2.19	4.00	5.30
Petersborough	10	1.75	2.50	4.00
Port Arthur	10	2.50	3.50	6.00
Rockland	10	1.75	2.00	2.50
St. Catharines	10	2.25	....	4.50
Stratford	10	2.25	....	5.00
Toronto	9	2.25	2.48	5.40
Williard	10	2.25	3.50	4.50
Manitoba—				
St. Boniface	10	2.25	....	6.00
Saskatchewan—				
Prince Albert	10	2.75	....	6.00
Regina	10	3.00	....	7.00
Saskatoon	10	2.75	....	6.00
Alberta—				
Edmonton	10	3.00	....	6.00
Medicine Hat	10	2.50	....	6.00
British Columbia—				
New Westminster	8	3.00	5.00	7.00
Vancouver	8	3.00	5.00	7.00

						Bottom Course.		Top Course.	
	Sq. yds.	Type.	Total thickness. Ins.	Av. cost per sq. yd., including grading.	Guarantee. Years.	Thickness. Ins	Proportions.	Thickness Ins.	Proportions
West North Central Division:									
Minnesota—									
Duluth	23,146[20]	Grout		2.68*	5	13		5	1-3-6
Minneapolis	7,900[21]	Grout		2.75	..	....		...	....
Missouri—									
Kansas City	13,248	Grout		3.10	5	13		6	1-3-6
South Atlantic Division:									
Georgia—									
La Grange	5,000	Tar		1.75	0	10		...	....
Savannah	597[23]	Sand		1.71	..	....		...	....
West South Central Division:									
Louisiana—									
New Orleans	4,119	Cement		3.95	3	14		6	1-3-6
Pacific Coast Division:									
California—									
Oakland	11,455	Cement		4.00*	0	...		6	....
San Francisco	21,565[25]	Gravel		3.50*	..	7[26]		...	....
Orgeon—									
Portland	3,914[22]	Cement		3.45	..	12[2]		6	1-3-6
Washington—									
Seattle	17,436	Grout		3.50*	..	13½[28]		6	1-3-6
Tacoma	11,002[21]	Cement		2.50*	..	11½		6	1-3-6
Canadian Division:									
Quebec—									
Montreal	48,000	....		3.65[29]	..	12		6	1-3-6
Montreal	57,823[30]	....		3.72[31]	..	11		6	1-3-6
Ontario—									
Ottawa	10,041[32]	Grout		3.78	5	13		6	1-3-6
Saskatchewan—									
Saskatoon	16,662	Grout		5.10	5	11		5	1-7½
British Columbia—									
Vancouver	55,359	Grout		4.50	5	13		6	1-2½-5

[1] Laid by city; [2] Hassam block; [3] 1,701 sq. yds. on 4-in. concrete base, pitch filler, 567 sq. yds. sand base, grout filler; [4] cement, pitch, sand; [4] $1.90+$1.65; [6] Hassam; grout 1:4; [6] old blocks recent; [7] laid on a bridge; [8] includes sand foundation; [9] Medina block; [10] 13 in. and 14 in.; [11] sandstone laid in combination with asphalt; [12] on 6-in. sand base; [13] repaving old blocks on 3-in. cushion on concrete base; [14] traprock laid in sand; total thickness 6 in. to 8 in.; [15] tar and gravel; [16] laid on sand base; [17] red sandstone; [18] $3 to $3.50; [19] 11 in. to 13 in.; [20] 4 in. to 6 in.; [20] Kettle River sandstone; [21] sandstone; [22] 5-in. x 4-in. x 7-in. block laid on natural foundation; [23] no base; [24] basalt block gutter mainly; [25] basalt; [26] 7 in.-9 in.; [27] $3.50 for sandstone; $3.75 for granite; [28] 10½ in. to 13½ in.; 4 in. to 6 in. concrete base; [29] by contract, $3.86 by day labor; [30] Scotia blocks; [31] by contract; $3.76 by day labor; [32] Nepean sandstone.

TABLE SHOWING AMOUNT AND AVERAGE PRICE OF BITULITHIC PAVEMENT CONSTRUCTED IN 1912 IN 60 CITIES.

						Portland cement, concrete base.	
	Sq. yds.	Average price per sq. yd., including base and grading.	Guarantee, years.	Price per cu. yd. for grading if paid separately.	Total thickness of pavement, ins.	Thickness. ins.	Proportions.
New England Division:							
Massachusetts—							
Cambridge	......	$2.65	5	...	..	5	1:2½:5
New Bedford	17,941	2.30*	5	$0.15	6	4	.....
Springfield	952	2.50	..	...	..	4½	1:3:6
Westfield	7,703[1]	1.64	1	...	6½	..	.....
Connecticut—							
Greenwich	12,500	2.42	5	.75	7	5	1:3:6
Rhode Island—							
Pawtucket	9,400[2]	2.00	..	...	6½	4½	1:3:6
Middle Atlantic Division:							
New York—							
Niagara Falls	1,658	2.92	5	...	9½	5	1:3:6
Schenectady	14,468	2.25*	5	.40	8	6	1:3:6
Troy	19,000[3]	1.90	5	...	..	..	.....
Utica	3,300	2.25	5	...	8	5	1:3:7
New Jersey—							
East Orange	24,000	2.31	5	...	8½	6	1:3:6
Hoboken	10,340	1.77	5	...	8	6	1:3:6
Long Branch	3,000[4]	1.56	5	...	..	..	.....
Newark	109,191	2.10	5	...	..	..	.....
West New York	6,000	2.40	5	...	7	5	1:3:6
East North Central Division:							
Ohio—							
Lorain	44,066	2.00	5	...	8[5]	6	1:3:6
Illinois—							
Joliet	36,000[6]	.90	2	...	..	..	.....
Michigan—							
Hillsdale	9,000	1.50*	3	.30	8	6	1:7
Wisconsin—							
West Allis	36,357[7]	1.39*	..	.40	8	6	1:3:5
West North Central Division:							
North Dakota—							
Fargo	34,843	1.70*	5	.40	7	5	1:6
South Atlantic Division:							
South Carolina—							
Columbia	38,300	2.12	5	...	7	5	1:3:5
Florence	40,000	1.95	5	...	6	4	1:3:6
Georgia—							
Gainesville	38,000	2.00	5	...	..	..	.....
West South Central Division:							
Arkansas—							
Helena	6,431[1]	1.65*	5	...	7	5	1:3:5
Louisiana—							
Shreveport	49,500	2.00	5	...	7	5	1:3:5
Oklahoma—							
Bartlesville	50,600	2.36	5	...	6	4	1:3:6
Muskogee	6,212	1.69*	5	.37	7	5	1:3:6
Texas—							
Fort Worth	87,533	2.09	1	...	7	5	1:9
Waco	10,000	2.09	5	.40	6	4	1:3:6
Mountain Division:							
Montana—							
Bozeman	42,000	1.96*	5	.65	6	9	.....
Great Falls	8,800	2.53	5	...	6	4	.....
Idaho—							
Idaho Falls	20,000	2.25*	5	.60	6	..	.....
Pocatello	32,900	2.24*	5	.50	6	..	.....
Weiser	3,500	1.69*	5[10]	.60	5½	..	.....

Instructions of the Bureau of Highways, Manhattan Borough, New York City, for the Guidance of Its Inspectors of Street Paving.

The Commissioner of Public Works of Manhattan Borough, New York City, has issued recently a book of instructions for the guidance of the inspectors of street paving of the Bureau of Highways. The instructions were prepared at the suggestion of Mr. E. P. Goodrich, Consulting Engineer of the Public Works Department, and were gotten out with the object of not only securing full compliance with the contract and specifications, but also for obtaining first class work by the contractor in such minor details as are not specifically mentioned, but implied, by the contract and specifications. These instructions are of such interest that they are reprinted below in full:

The following instructions and suggestions are intended for your guidance in the discharge of your duties. They are to be considered as supplementing, but in no case as taking the place of or modifying the specifications, and must be strictly followed unless modified in any special case by instructions from the engineer to whom you report or the Chief Engineer of the Bureau of Highways. In any case where compliance with these instructions appears to be impossible, impracticable or inadvisable, or in any case where you do not fully understand them, you are to ask special instructions from the assistant engineer and must await instructions from him. Ignorance or misunderstanding of the specifications or of these instructions will not be accepted as a sufficient excuse for your failure to comply with them.

The object and intent of these instructions is to secure full compliance with the contract and specifications and the performance of first-class work by the contractor in such minor details as are not specifically mentioned, but implied, by the contract and specifications.

GENERAL INSTRUCTIONS.

You are to report to and be under the control and direction of the Chief Engineer of the Bureau of Highways and his authorized assistants, and will be responsible to them for the proper performance of your duties.

You are to obtain at the beginning of your duties upon any street a copy of the contract and specifications for the work and carefully read and make yourself familiar with them. You will also have a contract blueprint, with the details of which you must make yourself familiar, a note-book, a badge, rule, tape and a supply of daily report blanks with cover.

You are to assume that the contract and its specifications are entered into by the contractor in good faith and with a full understanding of the requirements; and that he may be and must be held to a strict compliance with them, unless you receive instructions to the contrary from your superior officers.

You will be held strictly responsible for the enforcement of the contract and specifications so far as these relate to the quality of the materials used and the manner of doing the work of which you are inspector.

In case the contractor, or his agents or employes shall refuse or fail to comply with the contract or specifications, or to perform the work in accordance with the instructions from the assistant engineer in charge, or in a proper manner, you will direct him to suspend the particular work at fault and will report the facts immediately to the assistant engineer and will not permit the work to proceed in disobedience of your requirements until instructions are received from the assistant engineer, which instructions you will comply with and enforce.

You will make out the daily reports on the forms provided and give them to the assistant engineer for transmission to the main office. One set must be filled out for each block under your charge while work is in progress. Entries must be made as called for on the forms and must show legibly, accurately and in detail the history of the work for each day. You should also keep in the note-book provided for each contract a detailed record of each day of the work, which must contain the following:

1. The date of assignment to the contract and date of actual commencement and completion.
2. Detailed force account for each working day and amount of material used.
3. Condition of weather each day.
4. Delays, reasons for, and the period of duration.
5. Railroad or other subsurface work being done within the limits of the contract, whether by corporations or individuals, the date of beginning of such work and the date of completion.
6. Condition of the sidewalks within the limit of the contract at the commencement of the work.
7. Accidents: Date of accident, names of persons concerned and witnesses of any circumstances governing the case.
8. Quantity of new and old curbstone set and location of same.
9. Any neglect or refusal on the part of the contractor to comply with the contract specifications.
10. Damages to persons or property by reason of any act or omission on the part of the contractor.
11. Oral instructions or orders received from the engineer in charge of the work and all other matters appertaining to the contract that might be worthy of record.

You must be present on the work assigned to you at all times when any work is in progress unless excused by your superior officer. You must wear your badge in a conspicuous place while on the work and must make yourself known to your superior officers whenever they are present.

Your time-sheet must be placed in the mail not later than the night of the tenth, twentieth and last day of each month, and under no conditions are you to leave the work to present this sheet in person at the office.

Leaves of absence can only be obtained

	Sq. yds.	Average price per sq. yd., including base and grading.	Guarantee, years.	Price per cu. yd. for grading if paid separately.	Total thickness of pavement, ins.	Portland cement. concrete base. Thickness, ins.	Proportions.
Utah—							
Salt Lake City	8,941	2.28	5	.60	6	..	.....
Arizona—							
Phoenix	100,000	2.15	..	...	7	5	1:3:6
Pacific Division:							
Oregon—							
Eugene	45,532[11]	1.62	..	...	5	..	.....
Klamath Falls	85,000	2.20*	..	.75	6	..	.....
La Grande	50,000	1.47½*	6	.50	5	..	.....
Newberg	19,300	1.64	5	.50	5	..	.....
Pendleton	16,123	2.10*	5	...	6	..	.....
Pendleton	24,060	1.45*[4]	5	.50	4	..	.....
Portland	160 925	1.85*	5	...	6	..	.....
St. Johns	6,000	1.85*	5	.60	6	..	.....
Washington—							
Aberdeen	1,244[12]	1.40*	..	.50	5	..	.....
Pullman	15,000	1.79*	..	.60	..	..	.....
South Bend	11,300	2.50*	..	.75	8	6	1:3:6
Tacoma	10,335	....	..	...	..	..	.....
Canadian Division:							
Ontario—							
Chatham	9.300	2.38	5	...	7	5	1:6
Oshawa	15.494	2.45	5	...	7	5	1:2:5
Port Arthur	15,482[12]	2.70	5	...	7	5	1:3:7
St. Catharine	15.000[13]	2.40	10	...	7	5	1:2½:3½
Toronto	89,215	2.15	5	...	6	4	1:3:7
Wallaceburg	4,659	2.38	5	...	7	5	1:2:4
Manitoba—							
St. Boniface	24,031	3.00	5	...	8	6	1:6
Saskatchewan—							
Regina	57,455	3.00	5	...	7	5	1:2:5
Saskatoon	68,644	2.94	5	...	7	5	1:7½
Alberta—							
Edmonton	98,780	2.85	5	...	8	6	1:3:7
British Columbia—							
New Westminster	12,500	2.25*	5	...	6	..	.....
Vancouver	22,682	3.00	5	...	8	6	1:2½:5

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*Does not include grading.

[1] Endurite. [2] Warrenite, laid by day labor. [3] Resurfacing; price does not include base. [4] Resurfacing. [5] 8x8½ ins. [6] Natural gravel foundation, 1-in. crushed stone, rolled. [7] "Under ½ in., stone; 2-in. top." [8] Bitucrete. [9] Bituminous base. [10] 5-year; contract for 5 additional years at $350 per year. [11] Gravel bitulithic. [12] Laid on old gravel base. [13] Includes 6,910 sq. yds. on street railway track at $330; concrete 6 ins. below ties. [14] Bitulithic and Westrumite.

TABLE SHOWING AVERAGE PRICE AND SOME DETAILS OF WOOD BLOCK PAVEMENT LAID IN 1912 IN 50 CITIES.

	Sq. yds.	Kind of filler.	Av. price per sq. yd., including base and grading.	Guarantee, years.	Total thickness pavement, ins.	Portland cement. Concrete base. Thickness, ins.	Proportions.
New England Division:							
Maine—							
Bangor	1,700	Pitch	$3.88	5	9½	6	1:3:6
Massachusetts—							
Cambridge	......	......	4.00	..	..	5[1]	1:2½:5
Springfield	12,949	......	3.13	0	..	..	.....
Connecticut—							
Bridgeport	10,000	Sand	3.10	5	..	6	1:3:6
Greenwich	1,900[2]	Asphalt	2.90	5	10	5	1:3:6
South Norwalk	3,400	Sand	3.19	5	9½	5	1:3:5
Rhode Island—							
Pawtucket	560[3]	Sand	2.50	..	..	..	.....
Middle Atlantic Division:							
New York—							
Niagara Falls	77	Asphalt	3.50	5	7½	5	1:3:6
Plattsburg	1,979[4]	Sand	3.08	3	10	6	1:3:6
Port Chester	2,770	Sand	....	..	..	6	1:3:6
Rochester	8,392	Sand	3.32	5	10½	6	1:3:6
New Jersey—							
Jersey City	11,891	Sand	3.00	..	9½	5	1:3:5
East North Central Division:							
Ohio—							
Akron	......	Sand[4]	2.75[6]	2	8[7]	6[8]	1:2:4
Illinois—							
Chicago	115,782	......	....	..	..	..	.....
Granite City	10,100	Pitch	2.54*	..	10½	6	1:3:5
Joliet	7,343	......	2.68	2	10½	6	1:3½:7
Peoria	9,686	......	2.60*	2	11	6	1:3:6
Quincy	9,171	Asphalt	2.66¼	5	9½	5	1:3:6
Michigan—							
Highland Park	530	Sand	....	..	..	..	.....
Wisconsin—							
La Crosse	880	Asphalt	3.47	..	9	5	1:3:6
Madison	2,596	Pitch	2.80*	0	12	6	1:2½:5
Oshkosh	3,164	Pitch	2.52½	5	11	6	1:3:6
Oshkosh	7,722[9]	Pitch	1.35	5	12½	6	1:3:6
Division:							
Minnesota—							
Chisholm	12,435[10]	Asphalt	2.69	5	9½	5	1:3½:6
Duluth	9,568	Asphalt	2.27*	5	10½	5	1:3:6
Faribault	15,946	Pitch	1.91[8]	2½	9	5	1:7
Hibbing	44,668	Asphalt	2.77	5	9½	5	1:3:6
Mankato	7,175	Pitch	2.37	5	10	6	1:3:6
Minneapolis	130,000	Pitch	2.43	..	..	..	1:3:6
Owatonna	29,184[11]	Pitch	2.29*	5	9½	5	1:8
Rochester	18,038[12]	Tar	2.40	5	..	5	1:3:5
Virginia	22,854	Pitch	2.69*	5	10½	6	1:2:4
Iowa—							
Burlington	22,000	Asphalt	2.77	5	10½	6	1:3:6
Missouri—							
Kansas City	1,021	Sand	2.95	5	11	6	1:3:6
Kansas—							
Hutchinson	4,000	Asphalt	....	..	..	..	.....
Wichita	1,511	Asphalt	....	..	11	6	1:3:6
East South Central Division:							
Kentucky—							
Louisville	1,518[13]	Sand	2.84*	5	..	..	.....
Missisippi—							
Greenwood	25,000	Bitumen	2.42*	5	11	6	1:3:5
South Atlantic Division:							
South Carolina—							
Charleston	9,000[4]	......	2.72	5	8	4	1:3:5
Georgia—							
Albany	10,000	Sand	2.18	..	9	5	1:3:6
West South Central Division:							
Arkansas—							
Fort Smith[12]	......	Sand	....	5	11[14]	..	.....
Little Rock[12]	......	Asphalt	2.40*	5[15]	..	5	1:3:5

upon written application. Absence due to sickness not immediately followed by a doctor's certificate will be considered as absence without leave. Absence without leave, unless satisfactorily explained and excused, will be considered as proper ground for removal, or may be deducted from salary or charged against vacation period.

It will be your duty to familiarize yourself with the local conditions affecting the contract to which you are assigned, in order that the work at all stages may be so carried on as to cause the least possible inconvenience to the property owners on the street and to the general public using the street. The street must not be unnecessarily obstructed, and the contractor must provide temporary bridging or passageways at crossovers and wherever else necessary.

All materials as they are brought on the street must be piled compactly and neatly on planks or metal boards in the roadway, or upon the sidewalk, at such points as you designate. You must see that all loose material and excavated matter, such as broken curbstone, old paving blocks, old asphalt and earth, are removed from the site of the work as soon after being excavated as possible. All unused or waste material of every sort must be removed from the roadway and sidewalk of any completed portion of the street at the time it is opened to traffic.

If these instructions are followed, the work will at all times present an orderly and workmanlike appearance. You will accordingly be held strictly responsible for the appearance of the work done under your charge.

You must see that barricades and "Street Closed" signs are erected and that suitable and sufficient lights are placed along the closed portion of the contract at the end of each day.

You must see that city monuments and benchmarks are preserved from injury by the contractor, and in case of any displacement or disturbance of such marks must notify the assistant engineer in charge.

You will examine the material as it is brought on the work and see that it conforms to the specifications before permitting it to be used. It will be part of your duty to notify the office of the chemist at the different stages of construction in due time to take the necessary samples of the different materials in each block. Should you at any time suspect that the material used is not in accordance with the specifications, samples must be taken by you with a record of the location, and the office of the chemist notified immediately.

PREPARATION OF THE SUBFOUNDATION.

Where earth excavation or embankment is necessary to bring the subgrade to proper grade, the important things to be looked after are:

a. To bring the subgrade to the true and proper grade and contour required for the pavement.

b. To properly consolidate the subgrade, so that it will furnish a firm support for the pavement and its foundation.

You must see that the excavation and grading are done in accordance with the lines and grades furnished by the survey party and that all unsuitable material is removed and replaced by good earth. When grading stakes are set for the guidance of the contractor, you are to see that the surface of the subgrade is made to comply with them and that no humps or depressions occur between the stakes.

It is particularly important that the surface shall not be higher than intended, because in that case there will not be room for the full thickness of concrete foundation and pavement surface designed.

The fine grading must be done with a pick and shovel, and the surface brought carefully to true grade. If embankment or filling is required the filling material must be deposited in regular layers not more than 4 ins. thick, and each layer must be compacted by rolling or tamping before the next layer is applied.

	Sq. yds.	Kind of filler	Av. price per sq. yd., including base and grading.	Guarantee, years.	Total thickness pavement, ins.	Portland cement. Concrete base. Thickness, ins.	Portland cement. Concrete base. Proportions.
Louisiana—							
New Orleans	18,401	Pitch	3.00*	3	10	6	1:3:6
Shreveport	54,000	Sand	2.24	..	8	5	1:3:5
Texas—							
Brownsville	29,000	Sand	2.70	..	..	..	.....
Mountain Division:							
Montana—							
Miles City	4,500[4]	Asphalt	3.20*	3	9	5	1:6
Canadian Division:							
Ontario—							
Hamilton	12,000[16]	......	2.85	..	10	6	1:3:6
Toronto	2,357[17]	......	.75	5	..	..	.....
British Columbia—							
New Westminster	2,700	Pitch	3.75*	5	10	6	1:6
Vancouver	189,875	Pitch	3.20	5	10½	6	1:2½:5

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*Does not include grading. [1] 5-in. to 6-in. [2] Short leaf pine. [3] Day labor, on sand base. [4] 3-in. block. [5] Pitch or sand. [6] \$2.75 to \$3. [7] 8-in. and 10-in. [8] 4-in. and 6-in. [9] Cedar blocks. [10] 3½-in. tamarac blocks; 16 lbs. treatment. [11] 3-in. block; 16-lb. [12] 3½-in. block; 16-lb. [13] Yellow pine. [14] On old natural cement concrete base. [15] 5-10 years. [16] 20-lb treatment. [17] 6-in. cedar blocks on existing cement.

The surface when brought to grade, whether by excavations or filling, must be thoroughly compacted by rolling. If after such compression the surface is above or below the true grade, it must be trimmed, or additional material added and rerolled and rammed, so that the completed surface will conform to the proper grade and contour of the subfoundation with no variations exceeding ½-in. A heavy horse street roller, if approved by the Chief Engineer, or a steam roller may be used, and the rolling must be continued until the subfoundation is firm and dense. On soft or clayey soils the rolling of the subsurface should not be continued until the material becomes plastic and yields in wavelike form under the roller. Soft or spongy spots or areas that do not consolidate under the roller shall be dug out to a depth of not less than 6 ins. and refilled with sand, gravel or other good material while the rolling is in progress.

You must see that all city or corporation manhole heads and water boxes are set on masonry foundations to the required grade. Where new standard manhole heads are to be provided, you must see that all the worn heads are removed and replaced by new heads. Should any of the old heads be of the standard type and in good condition, they must be left in the street.

You must see that the operation of fine grading shall be kept at least 50 ft. in advance of the concreting and that grade stakes are set at the crown and at each quarter at intervals of not more than 15 ft., the tops of which should indicate the finished surface of the concrete base.

CURBING.

Care must be taken to carry out the specifications relating to the redressing and resetting of old curb. The tendency is always to slight this work, to use old curbing not fully up to the required dimensions and to allow laxity in redressing the stones to the standard specifications. Each stone should be examined before it is set and those not up to the requirements marked on top with paint, so that they may be recognized if set by mistake or otherwise. You must, however, see that all the old curbstone that can be redressed to specification dimensions is so dressed and used, careful record being kept of the quantity and location of the same.

Careless workmanship frequently results in layers of dirt between successive layers of concrete. When the concrete is to be deposited back of the curb, you must make sure that it will rest on a clean foundation, be directly in contact with the curbstone, and of full specified thickness.

In setting curbstone the important points to be looked after are:

a. To see that the stones are set to the true grade and position.

b. To see that the full space for concrete under and around the stone is provided.

c. That the concrete used around the stone is of the specified quality.

d. That the concrete is placed and compacted so as to fill all the space under and around the stone as specified.

e. That no foreign material, either dirt or broken bits of flagging, be permitted to become mixed with the concrete.

The tendency of the workmen is usually to consider the above details as unimportant and to slight them.

CONCRETE FOUNDATION FOR PAVEMENT.

You must see that the requirements for this work are strictly complied with. Upon the quality and integrity of the concrete foundation largely depends the satisfactory surface of the pavement. The thing to be most carefully looked after is the quality of the materials. This is described in sufficient detail in the specifications.

The quality and kind of Portland cement delivered on the street will presumably have been approved by the Chief Engineer before actual work is begun. You are to ascertain whether or not this is the case. Any change in the kind or apparent quality of the cement brought upon the work must be reported to the assistant engineer and his approval secured before it can be used. You will occasionally make balls of stiff mortar from the neat cement and set them aside for observation. If in 8 hours these balls do not set up hard the fact should be reported.

The sand and stone delivered will naturally vary somewhat from time to time but should not differ materially from the requirements of the specifications. Stone that contains any considerable quantity of foreign matter or refuse or fine material that obviously will pass through a screen of ½-in. meshes, or that is larger than the specification requirements, or that is not hard and sound, should be rejected.

Cement must be effectually protected from water or dampness. Packages of cement which, when turned out, contain hard lumps should be rejected. The provision that sand, stone and gravel must be stored on planked floors on the street must be enforced. If not so stored on planked floors it is likely, particularly in rainy weather, to get mixed with street dirt and mud.

The proportion of stone or gravel, sand and cement prescribed by the specifications must be strictly adhered to. A barrel of cement will be considered as 4 cu. ft. and a standard bag of cement as 1 cu. ft., and the stone and sand proportioned accordingly.

The contractor often desires to measure the sand and stone by wheelbarrow loads. In such cases you will measure the capacity of the barrows used and determine the size and number of loads required for one batch of concrete, and thereafter insist that the loading conform to this standard size. As a check, you should frequently keep account of the bags of cement and the barrow loads of sand and of stone used during, say, 2 hours and measure the quantity of concrete made and determine from this data the ratio of the materials used. In any case your returns for the amount of material used during the day on your daily report must give exact quantities as counted by you both as to bags of cement and cubic yards of sand and stone used, and must not be estimated from calculations based on the amount of concrete laid.

One hundred square yards of 1:3:6 concrete foundation, laid 6 ins. thick, requires:

450 cu. ft. or 16⅔ cu. yds. of stone or gravel,
225 cu. ft. or 8⅓ cu. yds. of sand,
18¾ bbls. or 75 bags of cement.

Mixing the Concrete.—See that the directions of the specifications are followed. The method of gauging the proportions must be accurate, and the operation of mixing, if by hand, must be done on suitable mixing boards. The ingredients must be thoroughly incorporated. You must see that the concrete is deposited as quickly as it is mixed.

When a machine mixer is used you must acquaint yourself with the theory and principle of operation of that particular type of mixer and be able to detect any change in the proportions or uniformity of the mixture at any time.

When the mixer is of the automatic feed type you must test it at least once during each day's work, at times unexpected by the foreman, by feeding measured quantities of cement, sand and stone in the proportions of one, three and six into their respective hoppers. If the mixer is gauged properly and feeding freely the measured quantities of materials will be exhausted simultaneously. Should some cement be retained in the cement hopper after the sand and stone are exhausted, it is sufficient indication that the mixer is either improperly gauged or that the cement feed is clogged. Whatever the trouble it must be corrected before the mixer is allowed to continue.

When the contractor employs a machine mixer into which the materials are not loaded in batches, you are not to depend for the securing of the proper proportions on the accuracy of machine gauging or the proportion of shovelers used. The materials must be placed in properly proportioned piles, not containing more than 10 cu. yds. in the case of sand, broken stone or gravel, and you must see that the machine exhausts all materials simultaneously. Should it be impossible to obtain these results, due to improper piling of material, you must require the use of measuring boxes for proportioning the charge for the mixer.

Use sufficient water to make what is called a *wet* mixture, but not so much that free water will drain from the mixed batch before ramming.

The test for the degree of mixing or turning will be that all the fragments of stone are fully covered with mortar.

Placing and Ramming the Concrete.—Before any concrete is deposited you must see that the sub-grade conforms to the elevation given by the engineer, and that the grade stakes are in place. Any considerable amount of dust or loose earth must be removed. In frosty weather the frost must be removed from the ground by fires, the use of pavement heaters, or other suitable method.

The concrete must be so handled as to prevent the separation as far as practicable of the water from the stone.

You must see that the concrete is deposited in a straight line from curb to curb perpendicular to the line of the street; that it is shaped to the required grade and crown by means of raking, or screeds if required; that it is thoroughly rammed until all voids are filled; and that its thickness at any point is not less than 6 ins.

Grouting of concrete after it has been laid or the application of neat mortar to the surface and the sweeping of the surface with street brooms to make it smooth or to cover up defects must not be permitted. Concrete made of fine stone in the stated proportions of mixture may be used for leveling up depressions.

The proper ramming of the concrete is very generally neglected and should receive your careful attention. If it is properly done until the water flushes to the top, a smooth surface will result.

When old concrete is encountered as a subfoundation, you must notify the engineer, who will examine it and, if found satisfactory, will so inform you. But no fresh concrete is to be placed thereon until the old concrete is so examined, accepted and has been measured. Old concrete, wherever met, either as a subfoundation or at street intersections, must be cleaned thoroughly and wetted, and, if smooth, must be scrabbled before fresh concrete is joined with it.

Care is necessary to have the completed surface of the concrete conform to the true grade and contour of the street. This is especially important for asphalt pavement. Variations in the thickness of the asphalt caused by irregular concrete surface permit different amounts of compression under travel in hot weather and thus start incipient depressions in the surface of the asphalt pavement, which increases with age. The grade stakes for the surface of the concrete should therefore be carefully set and followed, and bumps or depressions between the stakes should be carefully avoided.

The finished surface of the concrete must be adapted to the character of pavement that is to be laid thereon. Should the pavement be sheet asphalt, the finished surface must be roughened by slightly raking the top of the concrete while it is fresh. For all other classes of pavement the smoothest possible finish must be obtained.

In the streets that contain railroad tracks you must see that the contractor confines his work to that portion of the street on one side of the track. The tracks must not be obstructed by the hauling and handling of material, and cars must not be unnecessarily delayed in their passage. You must examine the track and report to the engineer any irregularities found, such as loose rails, depressions, crooked alignment, etc. Should any old concrete exist in the railroad area, you must enter in your record book the location, thickness and extent.

You must see that the concrete is protected from injury while setting, and that no hauling or trucking over it is done except on planks, and only after a proper hardness has been reached.

The period during which the concrete must be allowed to harden will depend largely upon the character of the pavement that is to be laid and the weather conditions. It should not under any condition be less than 5 days for sheet asphalt pavement nor less than 3 days for wood block, asphalt block and granite block pavement, unless otherwise directed by the engineer. In hot dry weather the concrete must be kept damp until it has set

SHEET ASPHALT PAVEMENT.

If proper care has been taken at the mixing plant the mixture will not arrive on the street at too high a temperature. Your principal care will be to see that it is not laid at too low a temperature. The minimum temperature permitted by the specifications is 250° F. While the main or interior mass of a wagon load may be well above that temperature, the top and outer part of the load may be, particularly in cold weather, too cold to be safely used. Some of this colder portion may be sufficiently re-heated by mixing it with the hotter material if properly handled in unloading; but any material that is so cold as to be lumpy when unloaded or, more particularly when being raked out, should be discarded. This applies to both surface and binder mixtures. The best practical guide is the manner in which the mixture behaves is raking. It must always be so hot that it will, under the rake, break up into a uniform crumbling or powdery mass. If it does not do this it is too cold whatever its temperature may be.

Preparation of Street Surfaces.—Before the binder is laid, all loose material, rubbish, street dirt and other matter foreign to the concrete surface shall be removed and the concrete surface swept, if necessary to properly clean it, with street brooms.

Neither binder nor surface mixture shall be laid upon wet surfaces. Before the spreading of the surface mixture on the binder, the latter must be cleaned of all foreign matter and, if necessary, swept. If the binder course already laid has become covered with mud from wagons or other travel, it must be swept clean. No loose fragments of binder material must remain on the surface. Any part of the binder course that may have become broken or loosened must be taken up and new material laid in its place with the same care as the original.

Laying Binder Course.—The binder mixture must be carefully spread by hot shovels and rakes in a continuous layer, stretching from curb to curb, perpendicular to the center-line of the street, and rolled until all the voids are filled. It should then present a uniform layer whose thickness is not less than 1½ ins., and whose upper surface is parallel with the finished surface of the pavement and not less than 1½ ins. at any point below the same. The tendency is to lay the binder course carlessly and to roll it insufficiently.

Nearly the same care in raking and equally as careful rolling as for the surface course should be insisted upon. If the binder is not thoroughly compressed and becomes cold before the surface course is laid, it is likely in future hot weather to soften and yield under heavy travel, and thus start small depressions in the pavement.

Laying the Surface Course.—The requirements of the specifications should be rigidly enforced in the laying of the surface course. The joints against a cold edge of previously laid surface must be cut back until solid, fully-compressed material of full thickness is reached, and the raw edge completely but thinly painted with liquid bitumen. No masses or fragments of cold mixture must be allowed to remain on the surface of the binder in advance of the placing of the surface course to be covered up by the latter. Such cold masses will not be compressed by the roller but will later, under a hot sun and heavy travel, yield and start depressions in the pavement. The raking requires to be properly and skillfully done. The tines of the rake must penetrate to the binder, so that the raked material will be a uniform mass from top to bottom.

Rolling.—You must insist upon the rollers being placed upon the freshly raked surface just as soon as the material will bear them without being squeezed out or displaced laterally. The tendency is to keep the roller off too long, thus permitting the chilling of the surface and preventing its proper compression. Do not take the contractor's word as to how soon the rolling may be begun, but have trials made until you are able yourself to judge. The rolling by the heavy roller should be very thorough; keep the roller at work constantly until the surface is too cold to be impressed. In operating the roller lengthwise of the street begin at the gutters and work toward the center of the street whenever practicable. Cross rolling and diagonal rolling must be insisted upon wherever the width of the street will permit it.

Proper Thickness and Surface.—While the completed surface is still warm enough to permit it, measure the thickness of the surface course by forcing the graduated spatula through it to the binder. Also test the trueness of the finished surface with the straight edge, and if found defective in either thickness of pavement or trueness of surface, insist on heavier and more careful raking on the further work. Try the completed gutters with water to see that they are so truly laid that puddles of water will not stand in them.

Asphalt surface must not be laid when rain or snow is falling or so long as the surfaces are wet. Surface mixture raked out and caught in a shower, before it is well enough rolled to exclude water must be taken up and discarded.

Measure and record each day the area of pavement laid and the quantity (number of batches) of surface mixture used, and note any lack of uniformity in the area laid per batch.

GRANITE BLOCK PAVING.

The more important things for the inspector to look after are:

a. The quality and shape of the blocks,
b. The sand cushion,
c. The setting of the blocks,
d. The ramming of the surface,
e. The filling of the joints.

a. The Blocks.—Assuming that the general quality of the granite has been approved, you will need only to observe and reject blocks made from soft or weathered or otherwise defective stone. Any material divergence of the blocks from the correct form or from the sizes specified as permissible will be readily caught by the eye as they are brought to the street, and can then be thrown out. The proper dressing of the blocks is important and should be watched carefully. While you are not expected to examine each individual block, close observation of the blocks as they are handled and laid will enable you to detect and reject those that are materially defective in shape or dressing; or excessively wide joints will call attention to them as they are set.

b. Sand Cushion.—Screened sand must be used for the cushion bed. It should be moderately coarse and must be fairly clean and pure. The tendency with contractors is to use any dirty sand or sandy loam available on the street. Such material, especially if it becomes filled with water, will yield under the blocks and will not support them properly. The sand bed should not vary materially in thickness. It should be laid and graded not more than fifty nor less than twenty feet in advance of the setting of the blocks.

c. Setting the Blocks.—The blocks upon being brought to the work must be compactly piled along the sidewalks, due care being exercised to leave openings in front of business houses, stables, etc.

Blocks of uniform width and depth must be selected for each course, and each block must be laid upon a full bed of sand and "struck in" at the base so as to bring the stone in close contact with its neighbor in the preceding course and thus insure the closest possible joint. You must see that the joints in the line of traffic are close, and must see that the alignment of the courses is true. This is most important, as a crooked or wavy course lessens the chances of getting close joints, not only along that particular course, but also along the courses that are to follow. You must see that all joints are broken by a lap of at least three inches. The operation of ramming is not to be permitted to approach within 20 ft. of the paving. After ramming the surface of the pavement may look somewhat wavy and uneven. You must see then that it is back-rammed. All blocks below the general plane of the surface must be raised and more sand placed thereunder, and the blocks rammed again to an even bearing.

Bond stones with their upper surface set exactly to the grade or contour of the paving before ramming must be set in lines across the street at intervals of not more than 6 ft. and with at least three such stones in each line on a 30-ft. roadway and five on a 60-ft. roadway. Care in setting these stones and in paving to the lines defined by them will prevent the completed surface of the pavement having the wavy appearance so often to be seen.

d. Whether sand or grit is used for partly filling the joints before the paving cement is poured, care must be exercised in placing the sand or grit in the joints. Dumping a wheelbarrow load on the surface and then sweeping the joints full is absolutely forbidden.

Sand or grit or gravel should be dried before being used and put into the joints to as nearly as possible a uniform height as called for in the particular class of granite block pavement.

c. Ramming the Surface.—This part of the work is likely to be slighted unless carefully watched. The important thing is to have each block equally and sufficiently rammed to bring it to a solid bearing on the sand, as well as to bring its top to the proper grade. The rammers will be disposed to touch lightly blocks or areas which, if thoroughly rammed, would be driven below the true surface of the pavement, and subsequent travel may force these down, making depressions in the surface. You must give this item of the work special attention.

ASPHALT BLOCK PAVEMENT.

Care should be exercised to make the mortar bed of uniform thickness and give uniform compression while striking it. This will give the blocks uniform support and to some extent prevent an irregular surface. The pavers should always strike each block on top to bed it thoroughly; another block about to be laid commonly being used for this purpose. The joints should be as close as it is possible to make them while keeping the courses straight. To secure this the courses should be driven close every fifth course or thereabout.

WOOD BLOCK PAVEMENT.

The specifications for the laying, on the street, of wood block pavement are unusually full, explicit and plain, and very little additional instruction is necessary for your guidance.

However carefully the lumber may have been inspected before its manufacture into blocks, the subsequent seasoning, treating and handling will develop many defects, and you will need to observe the delivered blocks closely and reject those that do not comply with the specifications.

Under certain conditions the blocks will develop a great many "season cracks" which should not condemn them unless the cracks open for the full depth and to more than one-third of the thickness of the block. What are called "shakes" result from the separation of the wood along the growth-rings, and if well defined or open, should condemn the block, though, in many cases, the block after the defective part has been trimmed off may be used.

As each city block is completed, you must compare the condition of the sidewalks with the recorded condition of same as entered in the field book at the beginning of the work, and must see that they are at once restored to the same condition as described in said record.

Before turning in the contract as completed, you must go over the finished work and make a careful inspection. You must see that no depressions exist; that the flow toward the catch basins is unobstructed; that no water lies in the gutters and that all manhole heads are flush with the surface of the pavement.

You must see that all adjacent pavements, curb or flagging are immediately adjusted to meet the grade of the new work; that all sidewalks are restored to their original condition, and that all materials, tools and equipment are removed from the street.

INSTRUCTIONS TO DISTRICT INSPECTORS.

Wear and Tear Reports.—You will inspect your district and report on the form provided, all wear and tear requiring attention, giving the details called for.

You should adopt a regular system of patrolling your district and adhere to your system. Add remarks you think necessary, such as bad depression, dangerous, cave-in, etc.

Report all openings made without permit and all details obtainable of any accident happening at, or due to a defect in the pavement or sidewalk.

Plumbers' Openings.—Notification of the issuance of a permit for plumbers' openings will reach you on a form known as a Preliminary, the heading of which will give the location and purpose for which the permit is granted. Should the permit be used for a period longer than six days after the date of its issue, a report should be sent every sixth day during the life of permit prior to the turning in of the preliminary form.

Indicate on your reports the date on which the opening was made and on the Preliminary the date when the opening was filled up by the plumber.

Should any undermining be done by the permittee and he fails to break down the pavement except under a sub-structure, you will notify the office, giving the location as for W. & T. patches by diagram, showing the cut and the undermined area, each being distinctly indicated. Turn in Preliminary form only when said undermined pavement is properly broken down, and give the measurements so that an order may be issued for the restoration of the entire area to be restored.

Building Materials.—Notification of the issuance of a permit for placing building materials will reach you on a form similar to that for Plumbers' Openings. On receipt of this form which must be retained until work under the permit is completed, you will report so that information will be received at the office not later than three days after the issuance of permit, the report describing the condition of the pavement as found by you in front of the premises for which the permit is issued, noting any cuts that may exist, the permit number which they were made and the location and extent of any and all depressions you may find. This is to be indicated by diagram on the reverse side of form. In addition to this, every twelfth day from date of issuing the permit, a report must be made showing and describing the area covered by building material, the location of any cuts that may exist and the permit numbers under which they were made. If in any previous report you have indicated a cut within the area covered by Building Materials' permit, repeat the note as to cut until said cut is restored, then give the date of such restoration and by whom repaired in next succeeding report.

If, upon your first examination, you find Building Material upon the street covering any part of the area for which the permit was issued, report such conditions as you find them, stating the area so covered.

When the work under this permit has been completed, turn in the Preliminary form stating such damage, if any, as may exist at that time.

Corporation Permits.—For all Corporation Permits issued, a Preliminary form will be forwarded to the Division Office with location of cuts as in the case of Plumbers' Openings. A report must be made every 6th day from the date of issue and the same data called for under Plumbers' Openings must be reported, as to undermining, etc.

Cave-Ins.—All cave-ins must be reported by diagram, showing location and extent of same. State whether or not it is over previous openings of any kind. If over an opening, report under what permit the opening was made and what company made the repairs.

INSTRUCTIONS GOVERNING SIDEWALK REPAIRS.

As the work progresses at each location all rubbish and dirt must be removed from the site.

All work must be done according to specifications, but as expeditiously as possible.

In giving locations of the work done, give the house number; if the work is at a corner, give the corner location as well as the house number of the street or avenue.

Accurate account must be kept of the dimensions and class of all work done.

The inspectors must use their judgment as to which class of work is required at each location.

If a broken sidewalk is found around fire hydrants, except those of the High Pressure System, in the vicinity where the contractor is working, have repairs made at these points also.

High Pressure Hydrants have four hose

connections with a top valve stem for each. Do no work around these without special instructions from the office.

Where curb is dropped for driveways, work must be done according to the requirements of the permit and the standard drawings, both as regards curb and adjacent sidewalk.

When in doubt as to these instructions or specifications telephone to the office.

SIDEWALK PERMIT SLIPS.

Note carefully and locate by house number if the curbstone or street pavement has been disturbed in fixing the sidewalk. If these have been disturbed, take accurate measurement of damaged area. Breaking of seal between curb and pavement is a damage.

On the back of the slips give a report of what you find.

All rubbish and dirt must be cleared away from the site.

If any damaged pavement is found immediately adjacent to permit location, make report of same.

Date all reports.

INSTRUCTIONS TO INSPECTORS OF REPAIRS ON OLD PAVEMENTS.

The following supplementary rules will be observed when you are assigned to the inspection of repairs:

You are directed to be present when the repair gang starts its daily work and to continue with it until the close of the day's work. Should the gang be laid off you will report in person at the office, unless otherwise directed, and on rainy days or when the gang is not working report at the office of the Engineer in Charge at 9 A. M.

You will keep in the note book a daily account of the work which must include the following: Force at work, days when gang worked and when gang did not work; the reason therefor and a record of the circumstances of any accident which may occur on the work to which you are an eye-witness.

Return the note book to the office when full, or at end of year, or on leaving the service.

Your especial attention is required in the matter of enforcing compliance with the specifications of the contracts for repairs to all pavements in the Borough of Manhattan, and should the contractor fail to do the work in accordance therewith, you are directed to report that fact at once, giving full details.

You will mark out the pavement to be repaired and see that such marks cover all the repairs needed and that the work is done in accordance therewith.

When a stone or concrete foundation is laid in openings, you must see that it is laid at such depth below the top of the asphalt as to allow a thickness of 3 ins. of asphalt pavement.

Where surface heaters are used, the curbs and adjoining asphalt surface must be protected with asbestos mats.

The inspector must co-operate with the foreman and so arrange the work that all the patches cut out in one day are filled up before the close of work and all debris removed.

Debris from the patches must be placed in such a position as to cause a minimum amount of obstruction to traffic and where traffic is very heavy only one-half of street is to be repaired at a time.

Where combination loads of asphalt and binder are delivered on the work, you must see that the material which has become mixed is not used.

The joints of the stone foundation must be cleaned, and the loose material removed to a depth of two inches, and no asphalt laid on a wet foundation.

You must fill out all details called for in headings on repair slips.

For each intersection use a slip and for each block use another; do not put measurements for a block and an intersection on same sheet.

Be careful to use the proper sheets for City Maintenance and Guarantee Maintenance.

Make no repairs where a cave-in has occurred unless you receive a blue slip from foreman of gang to which you are assigned. This slip has a diagram on back giving the location of said cave-in. Where the base is old stone, measure area reset and record on slip; where concrete is the base, lay concrete six (6) inches thick and record measurements on slip.

Do not copy figures from the diagram of order but measure the repair actually made.

Report must be made of all pavements repaired; note on slips the nature of repair, that is, when a special slip for the kind of work is not provided mark same Railroad Area, Cuts or Order. At times repairs in Railroad Area are made under an Order to a Contractor; then mark slip Railroad Area for such work.

Where repairs are made by burner method mark those so made under heading of Net Area with a "B."

When repairs are made along header adjoining a new pavement, inquire if an order has been given to company making said repair by the concern that laid new pavement; if so, mark slip accordingly.

When you receive a pink or gray slip from the foreman to repair a cut and the entire area cannot be repaired at the time, send to office a report on a maintenance form showing the work actually done, giving permit number and the Check Order number; (both are to be found on face of the above colored slips). Return the pink or gray slip, as the case may be, to the foreman, so that when the remaining area is restored the inspector present at that time may get said slip.

The sheets for each day's work must be sent to this office so as to be received not later than noon of the following day.

Place date of repair on all sheets used, including those received from foreman of gang.

Locate all repairs made to base and state whether stone or concrete, and report depth of concrete laid on old concrete base to bring to grade.

All material put in place during storms must be measured and the facts reported.

GENERAL INSTRUCTIONS.

You will be expected to be civil and courteous to citizens, and must answer all questions respectfully and fully to the best of your knowledge.

You must report to the engineer in charge of the work any neglect or failure on the part of the contractor to observe the contract specifications.

Any neglect on your part to follow any one of the above instructions will be considered ample and sufficient cause for dismissal.

You must bear in mind that the foregoing instructions are general and intended as a guide to be used in conjunction with and as a supplement to the contract form and specifications. You must not conclude that because no mention is made of some specification provisions in these instructions, they are of minor importance and may be neglected or violated. You must remember that the contract specifications and plans govern in every case, and you will be held to strict accountability for the enforcement of every and all provisions contained therein.

PREVAILING PRICES IN 1912 FOR MATERIALS USED IN PAVEMENT CONSTRUCTION IN A NUMBER OF CITIES.

	Portland cement, per bbl.	Broken stone, per cu. yd.	Sand, per cu. yd.	Paving brick, per sq. yd.	Asphalt, per ton.	Creosoted wood block, per sq. yd.	Granite block, per sq. yd.	Gravel, per cu. yd.
New England Division:								
Maine—								
Augusta	...	$0.82	$0.40	.	...	...	...	...
Bangor	$1.65	2.00	1.75	..	.	$2.00	...	$1.50
Lewiston	1.50	2.20	1.00	...	..	...	$1.00	1.00
Portland	1.36	1.50	1.00	$1.05	...	...	1.27	1.00
New Hampshire—								
Laconia	1.45	1.20*	0.15	.	...	..	...	0.15*†
Vermont—								
Bellows Falls		...	0.50	...	...	...	1.50	...
Massachusetts—								
Cambridge	1.05	2.00	1.00	30.00†	..	2.30	1.50	1.25
Easthampton	...	1.40	0.15	...	.	...	...	...
Everett	1.56	1.25	0.95	...	.	...	1.48	0.95
Haverhill	1.44	0.65*	0.30	...	...	...	...	...
Lawrence	1.18	1.30*	0.75	...	...	...	1.47½	1.50
Leominster	1.34	2.25	0.80	...	...	...	1.35	...
Lowell	1.56	1.80	2.67	...	...	..	1.24	...
Lynn	1.47	1.20	0.88	...	...	...	1.47	...
Medford	1.67	2.00	2.00	...	...	...	...	...
New Bedford	1.27	1.10*	1.00*	...	...	...	1.65	...
Somerville	1.00	1.10*	0.67	12.90†[1]	...	...	60.00†[2]	0.67
Southbridge	1.65	1.25	1.75	...	...	...	...	1.20
Springfield	1.40	1.25	1.00	...	...	1.94	...	...
Westfield	1.60	1.20	0.80	...	35.00	...	1.65	...
Whitinsville	1.60	2.00	1.00	...	...	...	...	...
Woburn	...	...	...	...	...	...	...	0.75
Connecticut—								
Ansonia	1.55	1.25	1.00	...	..	...	...	0.25
Bridgeport	...	1.05*	0.75	...	..	1.80	...	...
Derby	1.65	1.25*	1.25	...	...	...	...	...
So. Norwalk	1.30	1.00	1.25	...		1.96	..	1.25
Rhode Island—								
Cranston	...	0.80	...	...	...	...	...	0.10
Pawtucket	1.30	1.50	0.85	...	30.00	...	1.70	...
Middle Atlantic Division:								
New York								
Albany	1.40	2.00	1.25	1.10	...	...	2.00	1.30
Binghamton	1.35	...	1.00	25.00†	...	...	...	1.00
Elmira	1.20	1.25	1.50	0.90	...	...	...	1.00
Fairport	1.25	1.00	1.00	...	...	...	...	1.00
Fulton	0.96	1.60[4]	1.00[5]	1.15[6]	...	...	1.40[7]	1.15[8]
Jamestown	1.13	2.00	2.00	0.78	...	...	...	1.50
Johnstown	1.45	1.75	0.75	...	0.131[9]	...	...	0.75
Little Falls	...	1.35	1.00	1.25	...	...	...	...
Niagara Falls	1.50	1.75	1.75	...	...	...	...	1.75
N. Tonawanda	1.40	1.25	1.00	0.80	...	...	...	1.00
Norwich	...	2.10*	2.00	...	...	...	...	...
Ogdensburg	1.46	1.25[10]	1.00	0.80	...	...	...	1.15
Olean	1.00	...	1.60	0.81	...	...	...	1.00
Plattsburg	1.40	1.35	0.50	...	...	1.69	...	...
Rochester	1.25	2.50	1.25	0.90	18.00	2.00	1.66	1.50
Rye	...	2.00	1.50	...	...	...	...	...
Schenectady	1.30	1.30	0.75	2.42	...	...	...	...
Syracuse	1.04[11]	1.50[12]	1.25[13]	1.05	30.00	...	1.50	1.50[14]
Troy	1.10	1.25	0.80	25.00†	...	...	60.00†	...
Walden	...	...	1.25	...	...	...	...	1.00
Watertown	1.20	0.90	1.00	...	...	...	...	...
White Plains	1.60	...	1.00	26.00†	...	...	...	...
New Jersey—								
Bayonne	1.12	0.90[15]	0.52	...	30.00	...	72.00	0.85
East Orange	1.65	1.60*	1.70[16]	...	...	...	...	...
Newark	...	...	...	2.25	...	3.60	3.10	...
Plainfield	...	1.90	...	...	...	...	...	...
Ridgewood	1.40	1.75	1.00	...	...	...	...	1.00
Trenton	1.40	1.60	1.00	1.25	28.00	...	...	1.00
Washington	...	1.20*	0.90*	...	...	...	...	...
W. New York	1.50	1.50	1.50	32.00†	...	...	...	...
Pennsylvania—								
Beaver Falls	...	...	...	0.57	...	...	...	...
Bellwood	...	...	...	0.40	...	...	...	...
S. Bethlehem	1.00	1.75	1.75	...	...	...	...	...

	Portland cement, per bbl.	Broken stone, per cu. yd.	Sand, per cu. yd.	Paving brick, per sq. yd.	Asphalt, per ton.	Creosoted wood block, per sq.yd.	Granite block, per sq. yd.	Gravel, per cu. yd.
Catasauqua	...	0.90*	...	...	...	...	...	...
Clairton	1.08	...	0.90	0.66	...	...	...	0.85[17]
Connellsville	1.35	...	2.00	0.75	...	...	...	...
DuBois	1.50	1.00	1.00	0.65	...	...	...	...
Ellwood City	...	...	0.65*	...	...	...	...	...
Erie	1.40	1.30*	0.35*	...	...	...	...	...
Farrell	...	...	...	15.00†	...	...	...	...
Freeport	...	...	1.25	...	...	...	...	...
Hanover	1.40	1.35	1.08	...	...	...	...	...
Hazleton	1.35	1.20	1.50	0.99	...	...	...	...
Homestead	...	...	0.05[18]	0.80	...	...	...	0.05[19]
Ingram	1.10	2.00	...	0.67	...	...	...	...
Meadville	1.20	...	0.75	0.80	...	...	...	0.75
Monongahela	...	0.90	1.25	0.70	...	...	...	...
Nazareth	...	0.90*	...	...	...	...	...	...
NewBrighton	1.40	0.50	1.50	0.50	...	...	...	...
N. Braddock	1.17	...	...	...	...	...	...	...
Pittston	1.10	0.85*	1.00	1.05	...	...	...	...
Portage	1.15	1.75	2.25	0.91	...	...	...	...
Punxsutawney	...	1.80	1.80	0.80	...	...	...	...
Sayre	1.10	1.25	1.25	22.00†	0.20[20]	...	...	1.25
Scranton	1.20	1.50	1.50	0.90	26.00	...	1.52	...
Somerset	...	...	1.50	0.67	...	...	...	1.06[21]
Swissvale	...	2.40	...	...	...	...	...	...
Warren	1.12	1.00	1.00	0.79	14.00	...	...	1.00
Wilkes-Barre	1.25	1.25	0.90	1.00	...	...	1.50	...
Williamsport	...	1.20	0.75	...	...	...	...	...
York	1.35	1.00	1.25	...	...	...	...	...
East North Central Division:								
Ohio—								
Akron	1.30	1.25	1.00	1.60	22.00	2.75	3.00	1.00
Alliance	1.00[22]	1.50	1.50	0.55	...	...	...	...
Ashland	1.10	1.05	1.00	0.67	...	...	...	0.80
Ashtabula	1.20	...	...	0.68	...	...	...	0.80[23]
Bellefontaine	1.25	1.00	1.00	...	...	...	...	0.60
Bellevue	1.05	0.60	...	0.68	...	...	...	...
BowlingGreen	1.50	0.75	...	...	...	...	...	...
Canton	...	0.80[24]	1.50	0.65	...	...	...	0.85
Fostoria	1.10	0.60	0.95	0.70	...	...	...	...
Fremont	1.10[25]	1.20	1.20	0.72	...	...	...	...
Galion	...	1.25	...	...	...	...	...	...
Lima	1.30[26]	1.10	1.20	18.00†	...	...	...	...
London	1.05	...	1.00	0.42	...	...	...	1.00
Lorain	1.12	0.75[27]	1.00[28]	...	...	...	...	...
Marion	1.40	1.20[29]	1.25	...	...	...	...	1.25
Montpelier	1.12	1.90	1.00	...	...	...	...	...
Mt. Vernon	1.32	...	1.10	0.72	...	...	...	0.90
New Lex'gt'n	1.75	0.90	0.70	1.06	...	...	...	...
Newark	...	1.00*	0.60	0.62	...	...	...	0.50
Niles	...	...	0.85	0.67	...	...	...	0.80
Norwood	1.25	2.00	1.50	1.50	...	2.50	3.00	1.50
Oberlin	1.25	1.35	1.10	0.65	...	...	...	...
St. Marys	1.35	1.25	1.30	0.75	...	...	...	0.55
Sandusky	1.05	0.75	2.00	0.90	...	2.50	...	2.00
Steubenville	1.38	...	0.80	0.62	...	...	...	0.70
Tiffin	1.20	1.25	1.30	0.94	23.00	...	...	...
Union City	1.10	...	0.90*	0.80	...	...	...	0.90*
Warren	1.50	1.80	1.60	0.70	...	1.70	...	1.60
Wellsville	...	...	...	1.22	...	...	...	...
Willoughby	1.12	1.20	1.25	0.75	...	...	...	0.15
Wooster	...	1.00[33]	1.25	17.00†	...	...	...	1.00
Youngstown	...	...	0.80	...	...	...	...	...
Indiana—								
Anderson	1.20	1.10	0.85	0.72	20.00	1.50	...	0.75
Attica	1.25	...	0.75	0.66	...	...	...	0.50
Auburn	...	1.23[34]	...	...	...	...	...	...
Bloomington	1.25	1.00	1.50	0.70	...	...	...	...
Connersville	1.02	...	0.50	...	...	...	...	0.45
Covington	1.25	1.25	1.00	0.70	...	...	...	1.00
Crown Point	...	1.10	1.00	...	20.00	...	...	1.05
Delphi	...	0.65	0.10	0.46	22.50	...	...	0.10
Fort Wayne	0.95	0.85[35]	1.25	0.83	26.00	...	...	...
Frankfort	1.35	0.90	0.85	0.72	...	...	...	0.85
Gary	...	0.85	1.05	21.50†	...	...	...	0.85
Greencastle	1.00	0.70	1.00	...	...	...	...	1.00
Huntington	1.00[36]	...	...	...	...	...	...	1.00
Indianapolis	1.50	1.15	1.08	2.00	21.00	3.00	...	1.50
Jeffersonville	1.40	0.95	0.90	1.56	...	...	...	...
Kendallville	1.10	1.25	0.80	...	...	...	...	...
Kokomo	1.15	0.90	1.25	...	...	...	...	...
Lafayette	1.20	0.62½	1.00	10.00†	...	...	...	0.75
La Porte	1.10	1.50	1.00	0.90	26.00	...	...	1.50
Lebanon	...	1.25	0.85	...	...	...	...	0.75
Logansport	1.40	1.00	1.00	...	...	...	...	...
Nappanee	...	...	1.45	...	...	...	...	1.40
Noblesville	...	...	1.00	0.59	...	...	...	...
Richmond	1.30	0.90	1.00	0.80	...	0.95	...	0.95
Terre Haute	...	1.25[37]	1.00[38]	0.80	30.00	...	...	1.00[39]
Wabash	1.30	0.70	0.10[40]	...	...	...	...	0.10[41]
Warsaw	...	...	0.55	...	...	...	...	0.55
W. Lafayette	1.10	1.10	1.00	...	...	...	...	...
Winchester	1.35	...	1.10	0.80	...	...	...	1.20
Illinois—								
Alton	1.35	0.65*	0.75	0.67	...	...	...	...
Aurora	...	...	1.60	0.78	...	...	...	1.00
Belleville	1.60	...	...	...	...	...	...	...
Brookfield	...	1.10	...	...	...	...	...	...
Canton	1.40	3.75	1.45	...	...	...	...	1.65
Carlinville	1.25	1.50	1.50	0.80	...	...	...	1.00
ChicagoHghts	1.50	1.10	0.50	0.85	25.00	1.90	...	0.80
Cicero	0.75[43]	1.00[44]	0.90[45]	...	...	...	...	...
Dixon	...	1.15	1.00	...	...	...	...	...
E. St. Louis	1.20	1.25	1.15	0.80	...	...	...	...
Edwardsville	1.25	1.00	0.90	0.75	...	...	...	...
Effingham	...	1.15	1.05	...	...	...	...	...
Granite City	1.25	1.40	0.85	0.72	...	1.50	...	1.75
Jacksonville	1.30	1.10*	0.90	...	...	...	...	0.90*
Joliet	1.50	1.10	1.50	...	...	...	...	...
La Grange	1.35	0.90	1.75	...	...	...	...	...
Lake Forest	1.50	1.35	1.25	...	...	...	...	...
Lincoln	1.20	1.25	1.00	...	...	...	...	1.25
Marion	1.25	1.25	0.90	...	...	...	...	1.35
Mattoon	1.00	1.30[47]	1.00[47]	0.68	16.00	...	...	1.00[47]
Monmouth	1.25	1.75	0.80	0.80	...	...	...	1.20
Murphysboro	1.20	1.20	1.10	0.70	...	...	...	...
Newton	1.05	1.50	1.00[48]	0.70	...	...	...	1.50[48]
Normal	1.00	1.20	1.15	...	...	...	...	...
Pana	0.90	...	0.90	0.74	...	...	...	1.30
Paris	1.25	1.10	0.80	...	...	...	...	0.80
Pekin	...	1.20	1.00	...	...	...	...	1.00
Peoria	1.20	1.25	1.00	0.75	...	1.50	...	1.00[49]
Quincy	1.10	1.35	1.00	0.72	17.00	1.55	...	...
Rochelle	1.20	1.15	1.25	0.88	22.00	...	...	...
Rock Falls	...	...	0.50	...	...	...	...	1.00
Rockford	1.84[50]	0.75	1.00	...	...	...	...	1.00
Streator	1.60	1.75	1.00	0.80	...	...	...	1.17
Urbana	1.50	1.25	1.00	0.72	18.00	...	...	1.00
Waukegan	1.35	1.35	1.25	0.85	20.00	1.20[51]	1.95	1.20
Wilmette	0.90	1.25	2.00	...	24.00	...	...	...
Michigan—								
Alpena	1.00	1.30	0.65	...	...	...	...	1.30
Ann Arbor	0.92	...	...	...	21.80	...	...	0.90
Battle Creek	0.90	...	0.60	0.80	...	...	...	0.80
Charlotte	1.10	0.90	0.75	...	...	...	...	...
Coldwater	1.20	...	1.50	0.80	22.50	...	...	0.10[55]
Dowagiac	1.19	...	...	...	...	...	...	0.67
East Jordon	...	...	...	...	...	...	...	0.90
Grand Rapids	1.30	0.75	0.75	1.00	20.00	...	...	1.00
Hillsdale	...	...	...	...	...	...	...	0.65
Holland	1.20	1.20	0.90	...	...	...	...	1.15
Kalamazoo	1.04	1.50	0.75	0.84	26.00	...	...	0.75
Menominee	1.50	1.65	0.25	...	...	...	...	...
Monroe	0.95[55]	...	...	...	...	...	...	...
Mt. Clemens	1.25	...	...	...	...	...	...	1.25
Pontiac	1.20	...	...	0.89	...	...	...	1.00
Port Huron	1.00	1.15	1.00	...	...	...	...	1.00
Saginaw	0.99	1.65	1.15	0.77	...	...	...	1.15
St. Johns	1.05	2.25	1.25	...	...	...	...	1.00
Traverse City	1.375	...	0.60	...	20.00	...	...	0.75
Wisconsin—								
Antigo	1.60	1.25	0.60	...	...	...	...	0.60
Appleton	1.20	1.40	1.25	...	...	...	...	...
Beloit	...	0.75	0.75	0.90	...	...	...	0.75
Columbus	1.20	...	1.60	...	...	...	...	1.75
Eau Claire	1.25	1.50	0.50	1.02	0.07[57]	...	...	0.50
Egerton	...	1.20	1.00	...	...	...	...	1.00
Janesville	1.15[58]	0.90	0.60	...	...	...	...	...
La Crosse	1.10	1.35	0.50	24.00[59]	...	...	...	...
Madison	...	0.60	1.50	...	...	...	1.25[60]	1.25[60]
Neenah	1.65	1.25	1.25	...	...	...	...	...
Oconto	1.50	1.25	1.00	...	...	...	...	1.00[61]
Oshkosh	...	1.25	1.25	...	...	...	...	...
Racine	1.40	1.60	...	0.88	...	...	...	...
Superior	1.35	1.65	0.75	1.05	28.00	1.18	...	1.10
Two Rivers	1.15	1.10	1.00	...	...	...	...	1.00
West Allis	1.05	1.28	1.12½	...	...	...	...	1.12½[62]
West North Central Division:								
Minnesota—								
Chisholm	1.34	2.30[30]	1.25	...	...	...	...	...
Duluth	1.55	...	1.00	...	23.00	...	...	1.10
Faribault	1.40	...	1.00	...	...	1.55	...	0.65
Mankato	1.60	1.25	0.75	...	...	1.55	...	0.75
Minneapolis	0.86	1.75	0.75	1.00	...	1.15	...	...
Owatanna	1.50	...	1.00	...	...	...	...	0.65
Red Wing	0.94	...	...	...	...	...	...	0.55
Rochester	1.40	1.75	1.00	...	...	...	...	1.00
St. Cloud	...	...[32]	...	...	...	...	...	...
Virginia	...	...	1.50	...	...	2.69	...	1.75
Iowa—								
Bloomfield	1.26	...	1.35	...	28.00	...	...	...
Burlington	1.25	2.00	1.20	0.85	...	...	...	1.75
Cedar Falls	1.10	1.40	0.75	...	...	...	...	0.87
Cedar Rapids	1.25	1.10	0.80	0.95	...	...	...	...
Charles City	1.50	1.90	0.60	...	...	...	...	...
Clinton	1.15	...	1.00	0.85	...	...	...	1.00
Davenport	1.00	0.90	0.80	0.90	...	...	...	...
Dubuque	1.10	1,50	1.50	0.90	...	...	...	1.50
Fort Dodge	1.25	1.50	1.25	...	...	...	...	...
Fort Madison	1.34	1.40	1.00	0.80	...	...	...	...
Glenwood	1.10	...	0.90	20.00†	...	...	...	...
Independence	...	...	...	...	...	...	...	0.70
Marshalltown	1.10	...	...	...	...	...	...	1.00
Mason City	1.00	1.30	0.75	...	...	...	...	...
Muscatine	1.20	...	0.40	0.96	...	...	...	0.70
Sioux City	1.00	2.10	1.50	...	...	...	...	1.50
Waterloo	0.95	1.50	1.00	...	...	...	...	...
Missouri—								
Chillicothe	1.35	2.00	1.25	0.76	...	...	...	...
Columbia	1.20	1.60	1.50	...	...	...	...	1.60
Eldorado Spgs	1.30	...	...	...	...	...	...	...
Fulton	1.20	1.50	1.50	0.90	...	...	...	...
Jefferson City	1.40	1.30	1.00	0.86	...	...	...	...
Kansas City	1.25	1.40	1.25	0.85	22.50	1.85	2.05	...
Kirksville	1.30	2.00	1.40	0.88	21.50	...	...	...
Liberty	1.35	2.00	1.25	0.81	...	...	...	...
Moberly	1.30	2.60	1.10	15.00†	...	...	...	...
Nevada	1.44	1.40	1.50	0.85	...	...	...	...
Poplar Bluff	1.40	1.75	1.00	0.98	20.00	...	...	1.50
Richmond	1.90	1.00	1.80	...	...	...	...	...
Sedalia	1.10	1.35	...	0.90	...	...	...	1.35
Warrensburg	...	1.50	1.50	...	...	...	...	...
North Dakota—								
Fargo	1.80	3.00	1.25	...	...	...	...	...
Minot	2.25	...	0.70	1.56	...	1.92		0.50
South Dakota—								
Lead	2.60	2.00	3.00	3.85	...	...	...	1.75
Mitchell	1.40	2.25	0.60	...	...	...	...	0.60
Sioux Falls	1.35	1.90	1.25	...	...	...	...	2.00
Nebraska—								
Holdrege	2.40	4.00	2.75	...	...	...	...	2.70
Lincoln	1.30	1.75	0.50	0.94	24.00	...	...	...
South Omaha	1.40	2.75	1.60	0.90	...			...
Kansas—								
Abilene	1.20	1.70	1.10	...	25.00	...	...	...
Arkansas City	...	0.75	0.60	...	...	...	...	0.60
Chanute	1.00	0.90	1.60	1.50	20.00	...	...	1.00
Columbus	...	...	...	...	...	...	...	0.60
Concordia	1.60	2.00	1.00	...	...	...	...	...

	Portland cement, per bbl.	Broken stone, per cu. yd.	Sand, per cu. yd.	Paving brick, per sq. yd.	Asphalt, per ton.	Creosoted wood block, per sq. yd.	Granite block, per sq. yd.	Gravel, per cu. yd.
Eldorado	1.10	0.75	0.47	20.00†	20.00	...	...	...
Fort Scott	1.20	0.75	1.08	0.72	...	...	...	...
Fredonia	1.25	1.25	1.65	0.60	15.00	...	...	...
Hutchinson	...	1.60	0.75	0.90	20.00	1.60	...	...
Junction City	1.24	1.40	0.95	...	...	...	...	...
Manhattan	1.50	1.65	0.50	20.00†	30.00	...	...	...
Newton	1.10	1.25	0.90	0.88	...	...	...	...
Olathe	1.40	1.00	0.10	0.90	...	...	...	0.10
Ottawa	1.60	1.50	1.00	0.65	17.00	...	...	...
Parsons	1.35	1.30	1.90	0.80	20.00	...	...	...
Pittsburgh	1.20	1.00[42]	1.47	0.67	...	...	...	...
Salina	1.50	1.65	1.25	1.00	21.00	...	...	1.75
Topeka	1.14	1.80	0.75	0.75	21.00	...	...	...
Wichita	1.32	1.65	1.00	0.90	90.00	1.90	...	...
South Atlantic Division:								
Maryland—								
Annapolis	1.60	1.30	1.00	...	...	...	...	2.00
District of Columbia—								
Washington	0.94	1.50	0.345	0.93	...	...	...	...
Virginia—								
Danville	1.20	1.50	0.75	1.10	20.00	...	1.50	...
Pulaski	1.70	1.10	1.25	...	...	...	...	...
West Virginia—								
Charleston	1.45	1.25	1.20	0.75	...	...	...	1.25
Clarksburg	...	2.00	0.10[18]	20.00†	...	...	...	...
Mannington	...	...	...	0.84	...	...	...	...
Moundsville	...	...	0.45	0.59	...	...	...	0.45
North Carolina—								
Asheville	1.70	1.75	0.60	...	...	...	...	...
Lumberton	1.45	...	0.30	...	...	...	...	0.90
Raleigh	2.10	1.40	1.00	...	...	...	...	1.25
Salisbury	1.50	1.35	0.75	...	...	...	...	...
Statesville	1.60	1.50	0.75	...	...	...	...	...
Winston	...	...	0.75	...	...	...	0.62	...
South Carolina—								
Charleston	0.34[46]	2.00*	1.00	...	...	...	...	...
Chester	2.08	1.50	1.00	...	...	...	...	...
Columbia	1.60	2.25	1.00	1.00	...	...	...	...
Florence	1.85	2.50	1.20	...	...	...	...	...
Georgetown	...	2.50	...	...	...	...	...	...
Greenville	1.67	2.35	0.75	...	...	...	...	...
Rock Hill	1.80	2.00	1.00	...	...	...	...	...
Union	2.00	1.50	0.70	...	...	...	...	...
Georgia—								
Albany	1.50	1.35	0.85	1.00	...	...	...	1.45
Brunswick	1.85	3.25	0.80	1.54	...	...	...	1.50
Cedartown	1.35	1.25	1.20	...	...	...	...	1.20
Columbus	1.65	2.00	0.75	0.90	...	...	...	1.70
Gainsville	2.00	1.80	0.75	...	...	...	...	...
La Grange	1.60	1.00[24]	0.65	...	...	...	1.22	1.40
Waycross	...	3.00	1.00	1.10	...	...	...	...
Florida—								
Jacksonville	1.80	...	1.00	1.04	...	...	...	...
Gainesville	2.40	3.00	1.00	1.65	...	...	...	...
East South Central Division:								
Kentucky—								
Dayton	1.35	1.25	1.00	0.72	...	...	...	1.10
Louisville	1.15	1.10	1.00	16.50†	7.45	2.80	2.80	1.00
Owensboro	...	1.15	...	...	0.085[52]	...	...	...
Tennessee—								
Jackson	0.60[53]	1.35	0.50	...	...	...	...	0.90
Knoxville	1.50	1.35	1.00	...	...	...	...	...
Paris	...	...	0.40	...	...	...	...	0.80
Springfield	...	1.60	1.25	...	...	...	...	...
Alabama—								
Dothan	1.85	...	1.00	...	...	...	...	2.10
Roanoke	2.00	...	0.75	...	...	...	...	...
Mississippi—								
Brookhaven	1.60	..	1.50	...	...	...	...	1.50
Greenwood	1.50	...	...	...	...	...	...	...
Vicksburg	2.40	...	0.90	2.23	1.89	2.50	2.07	1.00
West South Central Division:								
Arkansas—								
Fort Smith	1.50	1.25	0.90	0.72	...	...	...	1.35
Helena	2.00	1.85	0.75	1.00	...	...	...	...
Jonesboro	1.95	1.60	1.60	1.15	...	...	...	0.85
Little Rock	1.60	2.00	0.75	...	...	...	...	3.00
Mena	3.25	...	...	...	...	...	...	...
Louisiana								
New Orleans	1.50	...	1.50	1.30	22.00	1.91	1.50	2.25
Shreveport	1.80	1.75	0.60	...	...	...	...	...
Oklahoma—								
Bartlesville	1.30	1.30	1.60	0.81	...	...	...	...
Haileyvill	1.50	...	1.50	...	...	...	...	1.50
McAlester	1.75	...	1.75	...	...	...	...	...
Muskogee	1.70	1.25	0.70	0.63	30.00	...	...	0.80
Nowata	1.40	2.25	1.60	0.31	23.00	...	...	...
Okmulgee	1.00	1.30	1.60	0.66	25.00	2.17	...	1.60
Tulsa	1.38	1.60	1.25	15.00†	...	...	...	...
Texas—								
Brownsville	2.25	2.75	1.90	...	...	...	...	2.00
Eagle Pass	...	0.60	0.05	...	...	...	...	...
Fort Worth	1.60	...	1.50	0.94	...	...	...	1.25
HoustonHhts.	1.60	2.25	1.50	1.25	...	...	1.40	1.75
Paris	...	1.75	1.00	...	...	...	...	1.45
Sweetwater	...	0.89	...	...	23.60	...	...	...
Waco	2.30	2.50	1.10	...	...	...	...	1.25
Mountain Division:								
Montana—								
Billings	2.00[64]	2.25	1.35	1.85	...	1.83	...	1.50
Bozeman	2.48	...	2.25	.	...	...	...	1.65
Glendive	...	1.25	...	.	...	...	...	...
Great Falls	2.00	2.75	1.25	...	...	...	...	...
Helena	2.38	1.00	1.50	1.55	...	...	...	1.50
Miles City	2.50	...	..	..	25.00	1.80	...	0.75
Idaho—								
Boise	2.65	1.25	1.25	..	25.00[65]	..	...	1.00
Idaho Falls	...	...	...	.	...	.	...	1.50
Nampa	3.50	3.00	1.00	...	..	.	...	1.50
Pocatello	2.60	...	1.00	..	..	.	...	1.10
Wallace	3.10	0.50	1.00	...	...	.	...	...
Weiser	2.55	...	0.90	...	...	..	...	0.90
Utah—								
Ogden	1.90	...	1.00	...	25.00	...	...	1.00
Salt Lake City	1.75	...	0.25[66]	...	25.00	...	...	0.25[66]
Wyoming—								
Casper	0.70[67]	...	1.00	...	...	...	...	...
Colorado—								
Boulder	2.40	1.50	1.00	...	...	...	...	0.75
Colorado Spgs	1.25	1.40	0.75	...	18.00	...	...	0.75
Denver	1.57	1.85	1.25	0.90	22.00	...	1.30[68]	1.50
Fort Collins	2.00	1.25	1.00	...	...	...	...	...
GlenwoodSpgs	2.60	1.25	1.10	...	...	...	...	1.10
Grand Junc.	2.52	1.50	1.00	...	40.00	...	...	1.00
New Mexico—								
Raton	2.25	...	1.50	...	...	...	...	1.00
Arizona—								
Phoenix	3.00	...	...	...	...	...	...	1.00
Pacific Division:								
California—								
Alhambra	2.50	1.30*	...	...	...	...	...	...
Coalinga	2.90	1.50	1.66	...	16.00	...	...	1.50
Corona	2.40	0.95*	1.25	...	...	...	...	0.95
Eureka	...	1.75	...	...	...	...	...	...
Fresno	2.80	0.60	0.60	...	15.00	...	...	0.50
Glendale	2.15	1.25*	...	...	...	...	...	...
Lodi	2.25[69]	1.00	1.00	...	14.00	...	...	...
Monrovia	2.65	...	...	...	...	...	...	...
Napa	2.40	1.12	1.12	...	...	...	...	...
Oakland	1.60	1.25	1.00	...	11.00[70]	...	...	...
Orange	2.80	...	0.67	...	22.00[71]	...	...	0.67
Palo Alto	2.05	1.90	1.50	...	...	...	...	1.50
Pasadena	2.40	...	...	...	...	...	...	1.25
Pittsburg	2.80	1.05	1.50	...	...	...	...	...
Pomona	2.50	1.75	1.10	...	...	...	...	1.10
Salinas	3.00	1.35	1.35	...	...	...	...	1.50
San B'n'dino	2.45	1.65	1.25	...	...	...	...	1.00
San Francisco	2.10	1.50	1.25	...	5.00	...	...	2.00
Upland	3.40	0.90	1.25	...	...	...	...	...
Oregon—								
Eugene	2.40	1.25	1.25	...	20.00	...	...	1.25
Hood River	2.60	1.75	1.75	...	...	...	...	...
KlamathFalls	4.40	2.25	1.50	...	...	...	...	...
La Grande	3.00	1.40	1.00	...	...	...	...	1.00
McMinnville	2.25	1.65	2.50	...	20.00	...	...	1.65
Portland	1.80	1.00	.65	1.50	14.00	...	2.10	.65
St. Johns	1.90	1.20	1.10	...	...	...	...	1.00
Washington—								
Aberdeen	2.25	...	1.35	1.60	...	...	...	1.35
Montesano	2.10	...	1.35	...	...	...	...	1.05
No. Yakima	2.60	...	1.35	...	...	...	...	1.35
Pullman	2.20	1.50	2.25	...	17.00	...	...	...
Seattle	2.00	1.10	.75	1.20	11.00	1.30	2.00	.75
South Bend	2.30	1.40	1.25	...	...	...	...	1.25
Tacoma	2.10	.75	1.26	...	...	...	...	.75
Caradian Division:								
Prince Edward Island—								
Charlottetown	2.40	2.50	1.00	...	...	...	...	2.50
Nova Scotia—								
Halifax	1.60	1.30	.88	...	24.00	...	2.16	1.00
Quebec—								
Montreal	1.60	1.70	1.50	...	26.75	...	1.53	1.75
St. Lambert	1.55	2.16	1.62	...	...	...	...	1.62
Ontario—								
Chatham	1.55	...	.80	...	...	...	...	1.00
Hamilton	1.40	2.10	1.80	...	27.00	1.82	...	1.80
Kingston	1.54	.81	1.00	...	.148[72]	...	...	...
Niagara Falls	1.50	1.00	.90	32.00*	...	...	...	.90
Oshawa	1.60	1.40	1.00	...	...	...	...	1.25
Ottawa	.50½[67]	1.28	1.10	...	27.80	...	...	...
Peterborough	1.65	1.25	.90	...	...	...	...	.90
Port Arthur	1.60	1.75	1.50	...	...	...	...	1.75
Stratford	1.50	1.20*	1.30	28.50*	...	...	...	1.00
Toronto	1.53	1.32*	1.05	21.00*	19.63	2.15	5.79*	1.15
Willand	1.65	1.00	.95	32.00	...	...	...	.95
Manitoba—								
St. Boniface	2.10	2.40	1.65	...	...	...	...	1.65
Saskatchewan—								
Prince Albert	2.70	2.00	1.00	...	...	...	...	1.75
Regina	2.85	4.00	1.75	...	40.00	...	...	2.25
Saskatoon	2.90	4.00	2.00	...	25.00	...	...	2.50
Alberta—								
Medicine Hat	2.83	...	.80	...	...	...	...	1.00
British Columbia—								
N'w West'ster	2.65	1.70	1.25	...	...	...	...	1.50
Vancouver	2.50	1.60	1.25	2.15	16.50	1.35	2.15	1.35

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* Per ton. † Per M. *† At pit.

[1] Paving brick per M on cars, $12.90; vitrified brick on cars. $27.00. [2] $60 to $80 per M. [3] $0.75 for gravel delivered. [4] $1.60 on work. [5] $1.00 on work; [6] $1.15 on work; [7] $1.40 on work; [8] $1.15 on work; [9] $0.131 per gal. [10] $1.25 at crusher; [11] $1.15 f.o.b. Ogdensburg; [11] $1.04-$1.26 per bbl.; [12] $1.50-$1.75 per cu. yd.; [13] $1.25-$1.50 per cu. yd.; [14] $1.50-$2.00 per cu. yd.; [15] $0.90-$1.00 per. cu. yd.; [16] $1.70 per cu. yd. delivered; [17] $0.80 per cu. yd. for slag; [18] per bu.; [19] $0.05 per bu.; [20] $0.20 per sq. yd. for asphalt; [21] slag $1.06 per cu. yd.; [22] $1.00 to $1.30 per bbl.; [23] $0.45 per ton f.o.b. for sand, $0.80 per ton at pit for gravel; [24] price on broken slag; [25] $1.10 to $1.40 per bbl.; [26] $1.30-$1.80 per bbl.; [27] price on broken slag; [28] $1.00 to $1.15 per cu. yd.; [29] $1.20 per cu. yd. delivered; [30] per cu. yd. f.o.b. per cu. yd.; [31] $0.55 to $1.25 per cu. yd.; [32] at cost of crushing; [33] price on crushed slag per cu. yd.; [34] $1.05 per cu. yd., for slag; [35] $0.85-$0.95 per cu. yd., for broken stone; [36] $1.00 to $1.09 per bbl.; [37] $1.25 to $1.50 per cu. yd.; [38] $1.00 to $1.10 per cu. yd.; [39] $1.00 to $1.10 per cu. yd.; [40] in pit; [41] $0.10 to $0.15 in pit; [42] Joplin chats; [43] $0.75 to $1.50 per bbl.; [44] $1.00 to $1.65 per cu. yd.; [45] $0.90 to $1.50 per cu. yd.; [46] per cwt.; [47] on cars; [48] at work; [49] $1.00 to $1.25 per cu. yd.; [50] $1.84 to $2.00 per bbl.; [51] $1.20 for 3-in. block, plant in city; [52] price per gal. on asphalt binder; [53] per sack; [54] f.o.b. cars; [55] in bank; [56] $0.95 to $1.20 per bbl.; [57] per gal.; [58] $1.15 to $1.80 per bbl.; [59] $24.00 per M.; [60] $1.25 per sq. yd. at quarry; [61] $1.25 per sq. yd. delivered at center of town; [63] pit run; [63] $1.12½ to $1.15 per cu. yd.; [64] $2.00 to $3.00 net; [65] $20.00 to $25.00; [66] at bin; [67] per 100 lbs.; [68] sandstone; [69] car load lots; [70] $1.60 net for 1912; $2.00 for 1913; [71] $11.00 to $12.00 in barrels; $9.00 to $10.00 in tank cars; [72] $22.00 to $26; [73] Bermudez. per gal.

TABLE SHOWING MILEAGE OF PAVEMENT LAID IN 1912 IN A NUMBER OF CITIES AND MILEAGE OF PAVEMENT PROPOSED FOR 1913.

		Pavement Laid in 1912		Pavement to be Laid in 1913	
	City Engineer.	Miles.	Total Cost.	Miles.	Total Cost.
New England Division:					
Maine—					
Augusta	A. G. Norcross	.1	$......	.....	$......
Bangor*		....	6,590	(?)	....
Gardiner	L. M. Barnard	.25	5,850	.....	....
Lewiston	John A. Jones	....	3,000	.....	....
Portland	Bion Bradbury, Jr.	1.84	37,128	.....	....
New Hampshire—					
Laconia	Chas. A. French	.25	....	.....	15,000
Vermont—					
Bellows Falls	B. A. Robinson	.12	4,354	.....	....
Massachusetts—					
Cambridge	L. M. Hastings	4.85	....	.....	....
Easthampton	W. C. Tammatt, Jr.	.1	700	.5	4,500
Everett	Christopher Harrison	1.5	31,263	.....	25,000
Haverhill	Louis C. Lawton	2.14	38,353	.....	....
Lawrence	Arthur D. Marble	2.47	96,390	.....	61,500
Leominster	Gates & Ray	....	5,602	.....	....
Lowell*	Stephen Kearney	....	....	.....	....
Lynn	Wm. L. Vennard	.98	35,167	3	115,000
Medford	Fred R. Channock	1	....	.....	....
New Bedford	Geo. N. Nye	8.67	....	.....	....
Somerville	E. W. Bailey	2.5	50,323	.....	....
Southbridge	J. A. Whitaker	1.25	18,000	.....	35,000
Springfield*	Chas. M. Slocum	....	....	.....	290,000
Watertown	W. F. Leaned	....	....	1.5	....
Westfield	John L. Hyde	3.2	50,206	2.5	40,000
Whitinsville	T. F. McGoven	....	3,800	.....	....
Woburn	Wm. B. Jones	1.6	....	.....	....
Connecticut—					
Ansonia*	V. B. Clarke	....	....	.....	....
Bridgeport	Alfred H. Terry	....	31,000	.....	....
Bristol	C. W. Buell	....	....	1	40,000
Derby*	V. B. Clark	....	8,000	.....	....
Greenwich	S. E. Minor	1.75	51,600	.....	....
New Haven	F. L. Ford	1.72	....	.....	....
Putnam	Geo. W. Perry	.5	1,500	.33	1,500
South Norwalk	S. W. Hoyt, Jr.	1	30,000	1.50	45,000
Wallingford	Wm. A. MacKenzie	1.25	30,000	1	36,000
Rhode Island—					
Cranston	E. F. Durfee	6	25,000	6	25,000
Pawtucket*	Geo. A. Carpenter	....	20,000	(?)	....
Woonsocket	Frank H. Mills	....	....	.....	16,000
Middle Atlantic Division:					
New York—					
Albany	Frank R. Lanagan	3.39	251,687	6	450,000
Amsterdam	F. E. Crane	....	....	.....	30,000
Binghamton	J. A. Giles	1.32	74,719	2	80,000
Canton	H. M. Townsley	1.25	....	.....	....
Carthage	J. P. Brownell	....	....	2⅓	....
Elmira	T. A. Brown	0.78	38,382	2	100,000
Fairport	E. R. Bowerman	....	....	0.15	....
Fulton	G. C. Hill	3.50	155,000	2¼	108,000
Gloversville	Morrell Vrooman	1.5	60,000	½	20,000
Jamestown	C. G. Jones	2.48	94,551	2	75,000
Johnstown	W. E. Natonson	0.35	4.000	3.1	145,000
Lestershire	S. M. Baird	0.11	38,382	.....	....
Little Falls	O. J. Dempster	1.9	36,200	.....	....
Niagara Falls	F. S. Parkhurst, Jr.	5.64	309,575	4	250,000
North Tonawanda	A. P. Smith	0.08	5,000	¾	20,000
Norwich	C. E. Harris	....	3,700	.....	....
Ogdensburg	Geo. A. Tate	0.42	19,975	.....	....
Olean	H. E. Bunce	0.55	21,144	1	....
Plattsburg	H. J. Langlois	0.20	8,381	0.3	10,000
Port Chester	C. A. Studwell	0.5	16,706	.....	....
Rochester	E. A. Fisher	24.78	1,200,000	.....	....
Rye	John A. Ehler	....	....	17	120,000
Schenectady	W. T. Wooley	1.0	92,500	6.5	250,000
Syracuse	H. C. Allen	2.90	151,863	5.13	243,295
Troy	Paul Schultze	2.25	65,000	8.1	175,000
Utica	Geo. W. Hackett	2.8	127,000	3	130,000
Walden*	F. H. Tupper	....	....	.....	....
Watertown	E. W. Sayles	2.35	35,740	2.5	....
Westfield	Clyde C. Hill	0.16	2,100	2	80,000
White Plains	J. Y. Lavery	0.875	35,184	.....	....
New Jersey—					
Atlantic City	J. W. Hackney	1.50	50,000	1.9	40,000
Bayonne	S. J. Harwi	3.40	20,300	3	200,000
East Orange	W. D. Willigerod	1.50	73,000	.....	....
Hoboken	R. Beyer	0.708	24,796	.....	....
Jersey City	C. A. Van Keuren	6.80	135,027	7.5	150,000
Long Branch	J. W. Seaman	0.15	4,680	4	210,000
Newark	Wm. A. Howell	13.566	823,282	12	900,000
Penns Grove	Wm. A. Summerile	....	....	1	10,000
Plainfield	Andrew J. Gavett	2.25	16,000	2	20,000
Ridgewood	F. W. Simonds	0.15	1.500	2	25,000
Trenton	Abram Swan, Jr.	2.52	71.277	6	180,000
Washington	R. P. Howell	0.03	2,000	.....	....
West Hoboken	Jos. Schmitt, Jr.	1.13	62.694	.....	....
West New York	Carl Griesbach	1.00	450,000	2.5	120,000
Pennsylvania—					
Ashland	Wm. S. Pugh	0.4	19,672	.....	....
Beaver Falls	Carl S. Donaldson	0.9	26,600	.....	....
Bellwood	C. Dengate	0.16	4,670	.....	....
Bethlehem*	R. E. Neumeyer	....	....	0.5	13,000
Catasauqua	L. J. H. Grossart	0.375	7,035	0.4	....
Chambersburg	R. M. Huber	....	....	0.5	....
Clairton	C. D. Supplee	0.50	19,325	.....	....
Connellsville	C. F. Heist	0.60	20,138	.....	....
Corry	N. R. Dickson	0.3547	7,369	0.3905	14,900
Du Bois	A. L. Bouton	0.6	17,046	1.5	50,000
Ellwood City	Alex. Main	0.2	6,311	0.8	35,000
Erie	B. E. Briggs	2.87	74,891	3.5	....
Farrell	J. F. Thomas	....	....	1.5	40,000
Freeport	D. E. Taylor	0.156	8,715	.....	....
Greenville	Ray Vosler	....	....	2.16	75,000
Hanover	A. E. Kohr	0.28	622	.....	....
Harrisburg	M. B. Cowden	7.128	168,974	3.5	11,000
Hazleton	B. E. Youngman	0.6	39,998	.....	....
Homestead	A. H. Trautman	0.12	2,642	0.16	5,300
Ingram Boro	John S. Murry	0.674	22,600	.....	....
Kingston	Young & Wintermute	0.25	16,000	0.5	18,000
Meadville	B. F. Miller, Jr.	0.28	9,330	5	225,000
Media	Edw. Minton	0.459	....	.....	....
Monessen	A. W. Johns	....	....	1.5	75,000
Monongahela City	J. A. Morrow	0.75	15.600	1.5	36,000
Nazareth	S. A. Becker	0.121	3,896	.....	....
New Brighton	Harry T. Barker	1.25	35,000	.....	....
North Braddock	Geo. F. Siefers	2.00	30,000	.....	....
Perkasie*	J. Y. Baringer	....	....	.....	....
Pittsburgh*	W. E. Gelston	....	....	.....	....
Pittston	Jas. F. Langan	0.25	11,250	1.0	44,000
Portage	P. F. Campbell	0.625	21,500	.....	....
Pottstown	Ralph E. Shaner	0.15	2,823	.....	....
Punxsutawney	R. G. Van Renssalaer	0.9	17,571	.....	....
Rankin	U. G. Duvall	0.3	8,000	0.5	....
Red Lion	J. B. Herrman	....	....	0.16⅔	3,000
Ridgway	F. W. Ward	....	....	0.8	36,000
Sayre	N. F. Walker	1.125	40,203	0.375	13,000
Scranton	Wm. J. Schunk	3.09	128,902	4.5	274,753
Shamokin	Samuel E. May	0.035	1,421	.....	....
Sharpsville	S. H. Phelps	0.625	21,210	0.8	32,000
South Bethlehem	R. E. Neumeyer	0.20	10,000	1.0	50,000
Swissvale	E. M. Watt	1.82	100,508	1.13	62,350
Tarrentum	Alf. Thompson	0.447	5,572	0.435	....
Tyrone	R. A. Zentmyer	0.925	3,978	.....	....
Verona	Frease & Sperling	0.25	7,000	.....	....
Warren*	D. F. A. Wheelock	0.5	....	0.25	....
Wilkes-Barre	B. K. Finch	2.2	106,364	.....	....
Wilkinsburg	Frease & Sperling	0.8	35,206	0.5	20,000
Williamsport	John B. Otto	0.9	21,050	.....	....
York	Geo. A. Warner	0.5	19,850	20.0	....
East North Central Division:					
Ohio—					
Akron	J. A. Gehres	16.60	....	20	....
Alliance	A. A. Kotte	2.5	85,000	3.0	95,000
Ashland	T. Brindle	.79	25,300	.62	20,000
Ashtabula		.40	11,793	1.63	75,000
Bellefontaine	Clair A. Inskup	.42	14,500	.....	....
Bellevue*	John Laylin	....	....	.....	....
Bowling Green	C. L. Moyer	1.25	22,837	.25	4,500
Cambridge	Karl M. Cosgrove	.50	....	1	100,000
Canton	Phil H. Weber	6	....	7	....
Conneaut	T. F. Lininger	....	....	.50	....
Coshocton	A. M. Fisher	....	....	.45	12,000
Crestline	L. P. Michaeles	....	....	.50	21,759
Dayton	Gaylord C. Cummin	7.78	245.000	2	50,000
Delaware	J. S. Irwin	.75	....	.....	....
Fostoria	Charles Latshaw	2.37	79,100	2	85,000
Fremont*	William F. Schepfin	....	....	.....	....
Galion	A. Theobald	1.50	76,590	1	....
Lakewood	Charles W. Root	3	....	.....	....
Lima	J. A. Crayton	1.43	39,669	.....	....
London	J. H. Asher	.50	14,897	1	85,000
Lorain	C. M. Osborn	2.32	105,998	3.50	125,000
Marion*	E. A. Scott	....	....	.....	....
Montpelier*		....	....	.....	....
Mt. Vernon*	Ray S. Blinn	....	....	.....	....
New Lexington*	John Avery	....	....	.....	....
Newark		....	....	51.96	75,000
Niles*	F. M. Brewer	....	....	.....	....
Norwalk*	John Laylin	....	2.965	.....	....
Norwood	J. A. Stewart	1	32,000	3	250,000
Oberlin	W. F. Schickler	.87	24,600	.....	....
St Marys	F. C. Kenthan	....	....	1	37,000
Salineville		.50	22,000	.60	30,000
Sandusky*	Robert L. Wager	....	....	.....	....
Sidney	W. R. Blake	....	....	4	65,000
Steubenville	J. N. Leech	2.61	41,000	2.50	40,000
Tiffin*	C. J. Peters	....	....	.....	....
Union City	R. P. Mannix	.50	18,700	1.3	56,000
Warren	Bert C. Smith	....	....	3	100,000
Wauseon	John C. Grim	....	....	1	37,000
Wellsville	J. N. George	.50	9,760	.....	....
Willoughby	R. L. Pike	1	29,000	1.25	....
Wilmington	Howard Collett	....	....	1.25	....
Wooster	Tom P. Brown	.25	6,652	.26	70,785
Youngstown	F. M. Lillie	12.71	363,303	12	363,000
Indiana—					
Anderson	George A. Lanphear	.06	1,436	.....	....
Argos		....	33,161	.....	....
Attica	D. R. Young	.75	15,550	.....	....
Auburn	Philip Holman	.62	3,588	.....	....
Bloomington	Ulysses S. Hanna	2.25	60,000	4	100,000
Brazil		....	6.075	.....	....
Camden		....	18.178	.....	....
Connersville	W. F. Ridpath	3	....	.....	....
Covington	J. G. B. Short	....	....	2	25,000
Crown Point	F. S. Knight	.75	21,000	1.50	30,000
Delphi	F. C. Smith	1.75	28,500	1	33,000
Fort Wayne	F. M. Randall	7.14	292,343	6	252,000
Frankfort	H. M. Hockman	1.25	33,427	1.50	50,000
Gary	A. P. Welton	....	225,100	.....	....
Greencastle*	A. A. Lane	....	....	.....	....
Huntington	H. H. Wagoner	1.50	33,600	.....	....
Indianapolis	H. W. Klaussman	15	487,515	15	487,515
Kendallville	F. L. Kirebler	.50	16.123	.....	....
Kirklin		....	18.178	.....	....
Kokomo	Jackson Morrow	1	40,000	1.37	50,000
Lafayette	H. F. Kessener	3.50	27,720	3.50	27,720
La Porte	Ezra C. Shoecraft	....	55,286	.....	60,000
Lebanon	Oliver Clark	.62	14.677	.....	1,177
Logansport*	H. H. Thompson	....	....	.....	....
Michigan City	H. M. Miles	1.55	56.292	2.25	76,000
Mishawaka		....	78,061	.....	....
Nappanee	G. W. M. Carter	1.50	....	.....	....
Noblesville*	C. J. Collingham	....	....	.....	....
Portland		....	11,300	.....	....
Richmond	Fred R. Charles	....	51,620	1	28,400
South Bend		....	114,514	.....	....
Wabash	James B. Chapler	.44	6,760	.....	....
Warsaw	George W. McCarter	2.25	35,000	2	30,000
West Lafayette	Everett B. Vawter	.50	16,000	.50	2,500
Winchester	Walter M. Batcheler	1.50	30,000	2	40,000
Winemac		....	12,875	.....	....
Vedersburg		....	15,300	.....	....
Illinois—					
Alton	G. E. Schwaab	2	70,796	3	92,400
Aurora	Myron J. Tarble	3.55	....	3.50	....
Belleville	William Ziehnert	3	74,703	.....	500,000
Bloomington*	Elmer Folsom	....	....	5	....
Brookfield	A. L. Porter	....	65,000	.....	....
Canton	E. F. Motsinger	.90	1,497	.....	....
Carlinsville	W. D. P. Warren	....	....	.50	8,000
Chicago	John Erickson	98.53	....	.....	....
Chicago Heights	Allen L. Fox	1	36,000	2.50	120,000
Cicero	Louis Mongreig	4.12	87,686	.....	....
Dixon	Charles F. Nesbit	.25	2,000	4	100,000
Du Quoin	John C. Gibson	2	84.787	2.50	95,000
East St. Louis	E. F. Harper	2.06	107,600	10	685,000
Edwardsville*	Charles Sheppard	....	....	.....	....
Effingham*		....	....	.....	....

	City Engineer.	Pavement Laid in 1912 Miles.	Pavement Laid in 1912 Total Cost.	Pavement to be Laid in 1913 Miles.	Pavement to be Laid in 1913 Total Cost.
Elgin	M. H. Brightman	2	....	5	240,000
Evanston	J. H. Moore	2.58	74,944	....	....
Granite City	Edmund Hall	1.46	62,160	.75	38,000
Greenville	H. N. Baumberger	....	....	....	12,000
Hoopeston	W. S. Dillon	....	....	?	....
Jacksonville*	E. M. Henderson	....	....	....	....
Joliet*	C. D. O'Callahan	....	....	....	....
Kankakee*	Robert D. Gregg	....	....	....	....
La Grange	Edwin Hancock	.75	23,000	....	....
Lake Forest*	James Anderson, Jr.	....	....	3	....
Lincoln*	W. C. Bates	....	....	....	32,000
Marion	P. B. Wilson	....	....	.75	10,000
Mattoon	Claude L. James	3.2	86,000	2.5	75,000
Maywood*	Robert E. Williams	....	....	6	165,487
Monmouth	....	3	78,000	1.5	40,000
Murphysboro	R. A. Rolla	1.3	51,000	.8	32.000
Newton	S. A. Connor	1.25	28,000	.50	14,000
Normal	G. C. Broghill	.50	17,301	.75	30.000
Oak Park	W. F. Sargent	3.87	155,410	14.50	647.000
Odell	Aetna Eng. Co.	1	37,000	1.5	35.000
Pana	A. C. Stanfield	2.25	74,634	?	....
Paris	C. P. Lycon	....	11,839	....	....
Pekin	J. R. Seibert	.6	90,000	?	....
Peoria	L. D. Jeffries	6.9	300,000	6.9	300,000
Quincy	W. P. Bushnell	2.34	89,702	3	110,000
River Forest*	Robert E. Williams	....	....	2.25	60,000
Rochelle	Aetna Eng. Co.	2	80,000	....	....
Rock Falls*	Edward O. Hills	....	....	....	....
Rock Island*	Wallace Treichler	....	....	....	....
Rockford	Edwin Main	1.89	84,732	2	115,847
St. Charles	G. N. Lamb	....	....	?	....
Springfield	W. D. Seeley	3.8	131,903	5	175,000
Streator	Fred H. Renz	2	29,149	1.50	221,000
Urbana	Alfred M. Danely	2	60,000	?	60,000
Vandalia*	J. R. Waddell	....	....	....	....
Waukegan	M. J. Doughitt	....	45,000	....	75,000
Wilmette	Charles N. Roberts	3.20	86,023	....	90,000
Michigan—					
Alpena	Joseph W. McNeil	.25	7,705	.37	12,500
Ann Arbor	Manley Osgood	.50	13,703	3	55.000
Battle Creek	E. V. Hunt	.76	30,816	.55	19,000
Caro	F. O. Riddle	....	....	?	....
Charlotte	J. R. McCamman	.76	16,108	?	....
Coldwater	Gardner Legg	.34	10.641	?	....
Dowagiac	M. C. Taft	....	4,270	....	....
East Jordan	H. L. Winters	....	13,800	.25	5,500
Grand Rapids	L. E. Stevens	6.4	220,849	6	218,000
Highland Park	L. D. Beckley	2.25	68,500	5	....
Hillsdale	C. L. Herron	....	18,000	....	....
Holland	H. A. Naberhuis	1	23,075	2	50,000
Kalamazoo	A. Lenderink	1.6	....	....	....
Menominee*	Albert Hass	....	....	....	....
Monroe	C. S. McKee	3	80,000	....	....
Mt. Clemens	John W. Irwin	.62	....	....	....
Pontiac	William J. Fisher	1.33	68,821	....	....
Port Huron	E. R. Whitmore	3.50	45,000	....	20,000
Saginaw	Herman H. Eymer	2	64,794	3	113.000
St. John	E. G. Hulse	.80	22,044	.25	9.700
Sturgis	....	....	....	.50	18,000
Traverse City	D. C. Tabor	....	....	1.25	31,350
Wisconsin—					
Antigo	Alex. Deleglise	.25	10,600	.75	25,000
Appleton	C. H. Vinal	.62	16,000	2.50	60,000
Beloit	Robert Caldwell	....	9,000	....	....
Columbus	Walter A. Peirce	.50	17,721	.49	17,500
Eau Claire	A. R. Jarnock	1	11,500	?	....
Edgerton	W. F. Mobbett	.50	14,106	.50	10,000
Janesville	C. V. Kerch	2	26,500	1	....
La Crosse	G. P. Bradish	1.50	30,300	....	....
Madison	E. E. Parker	6.2	243,433	5	240,000
Neenah	John LeTourneaux	.62	24,275	....	....
Oconto	W. B. Hall	.68	....	....	....
Oshkosh	G. H. Randall	1.73	....	3.50	90,000
Plymouth	....	....	....	?	....
Portage	C. E. Corning	....	....	1.50	30,000
Racine	P. H. Connolly	1.7	65,416	?	....
Reedsburg	H. E. French	.62	8,000	.62	6,000
Sheboygan	C. V. Boley	1.6	46,660	4	125,000
Superior	E. B. Banks	3.76	162,563	4	175,000
Two Rivers	Otto Gass	2	27,500	2	25,000
West Allis	C. T. Moritz	2.5	96,898	4	....
West North Central Division:					
Minnesota—					
Chisholm*	F. C. Lang	....	....	....	....
Crookston	E. J. Boyer	....	....	.9	15,000
Duluth	John Wilson	4.16	174,266	4	180,000
Faribault	F. W. McKellip	4.6	17,745	6.1	27,000
Hibbing	E. F. Remer	1¾	125,751	....	140,000
Mankato	H. F. Blomquist	.35	19,300	1	45,000
Minneapolis	Andrew Rinker	16	530,000	....	....
Owatonna	Harvey S. Dartt	1⅛	72,012	....	....
Red Wing*	Wm. Geisheker	....	....	....	....
Rochester*	J. C. Utton	....	....	....	....
St. Cloud	C. H. West	....	....	1.1	22,000
Stillwater*	Lewis W. Clarke	....	....	?	....
Virginia	E. F. Johnson	2	120,000	2	120,000
Winona	....	....	....	1½	29,000
Iowa—					
Albia	....	....	21,580	....	....
Atlantic	J. H. Mayne	....	11,200	2	40,000
Centerville	....	....	5,366	....	....
Bloomfield	....	2½	78,000	1½	....
Burlington	H. G. Vollmer	.57	11,481	2	20,000
Carroll	H. M. Hanssen	1	52,000	....	....
Cedar Falls	C. H. Streeter	5	156,679	....	....
Cedar Rapids	T. F. McCauley	1.52	39,245	2	60,000
Chariton	F. W. Trost	....	....	....	....
Charles City	W. S. Beattie	1.75	89,200	....	....
Clinton	J. G. Thorne	.64	39.544	3	166 500
Davenport	J. A. Ryan	6.66	219,359	3	155,000
Dubuque	C. H. Baumgartner	2.65	75,942	5	....
Fort Dodge	Chas. H. Reynolds	1	10.000	....	....
Fort Madison	M. E. Bannon	1.35	44.138	1.15	35,000
Glenwood	....	½	11,000	....	....
Independence	Chas. E. Boyack	....	43,940	½	....
Knoxville	W. B. Savage	....	....	2	....
Marshalltown	W. H. Steiner	3½	76,600	....	....
Mason City	F. P. Wilson	3.8	69.630	1½	38,200
Muscatine	C. H. Young	.71	31,280	4.2	93,000
Oelwein	I. E. Odendahl	2¼	90,000	....	....
Oskaloosa	E. F. Bridges	....	....	1	30,000
Perry	....	....	13,160	....	....
Sioux City	Fred C. Smith	9.41	283,560	10	285.000
Waterloo	C. A. Robey	.6	27,375	....	....
Missouri—					
Chillicothe	J. Broaddus	....	26,418	....	....
Clinton	H. C. Allen	....	8,200	7	....
Columbia	J. Paul Price	1.23	47,021	2	37,610
Eldorado Springs	D. L. Haggard	....	12,900	....	....
Fulton	P. D. Shurmond	....	14,883	....	3,332
Jefferson City	Phil C. Harding	3	90,186	8	200,000
Joplin	W. R. Shanklin	....	....	1	....
Kansas City	Louis R. Ash	31.3	685,849	35	750,000
Kirksville	S. M. Tobey	....	....	....	25,815
Liberty	E. H. Collins	2	48,674	2	50,000
Moberly	Swan McDonald	....	12.288	....	18,200
Nevada	John W. Clack	....	10,500	1¼	....
Poplar Bluff	Edw. C. Thomes	1½	82.000	3	60,000
Richmond	W. A. Mullin	¾	1,664	1	....
Sedalia	F. T. Leaming	1	27,590	....	....
Springfield	C. E. Phillips	15.45	412,259	....	....
Truxton	Harvey O. Garst	....	....	.5	18,000
Warrensburg	J. H. Scarborough	2	40.000	3	60,000
North Dakota—					
Fargo	F. L. Anders	....	275,000	....	....
Minot	E. J. Thomas	....	....	¼	20,000
South Dakota—					
Aberdeen	R. B. Easton	....	....	¾	....
Lead	L. D. Lea	¾	....	¾	1,000
Mitchell	S. H. Smith	5.7	40.212	....	....
Sioux Falls	S. B. Howe	¾	7,479	2	21,000
Nebraska—					
Grand Island	H. W. Kibbey	....	40,790	2	....
Lincoln	Adna Dobson	4.54	208,606	....	....
Norfolk	H. H. Tracy	....	....	3	95,000
South Omaha	Herman Beal	....	....	7	250,000
University Place	Walter E. Payne	....	....	?	....
Kansas—					
Abilene	Kenyon Riddle	3	105,000	....	....
Arkansas City	S. K. Titus	....	....	2	....
Chanute	Chas. Pratt	1.9	38,000	....	....
Columbus	C. M. Cooper	¼	16,755	....	....
El Dorado	C. W. Buskirk	1¼	....	....	....
Fort Scott	C. R. Fisher	2¼	62,800	1½	50,000
Fredonia	H. S. McFadden	1½	30,000	....	....
Hutchinson	G. L. McLane	....	99.900	?	....
Junction City	W. Van Buck	3	100,380	3½	150,000
Manhattan	O. E. Noble	....	112,755	....	45,000
Newton	F. E. Devlin	....	16,520	....	100.000
Olathe	Roy Murray	....	6.600	....	....
Osage City	Gust Johnson	....	12,932	....	....
Osawatomie	B. L. Prier	1	30,000	1	56,000
Ottawa	Claude S. Pugh	1.44	28,230	.6	18,500
Parsons	R. T. Wells	1.48	54,000	1	35,000
Pittsburg	L. E. Curfman	2.63	73,572	3.9	90,000
Rosedale	H. C. Botsford	....	....	3	100,000
Salina	P. G. Wakenhut	4.5	32,000	½	....
Topeka	A. R. Young	9	236,600	7	222,000
Wichita	Bert C. Wells	6.85	314,993	5	150,000
South Atlantic Division:					
Maryland—					
Annapolis	J. B. Logan	0.175	12,500	0.2	5,000
District of Columbia					
Washington	C. B. Hunt	5.6	225,000	5.6	225,000
Virginia—	(Eng. of Highways.)				
Danville	J. O. Magman	1.0	33,000	....	....
Newport News	T. E. Pearse	0.5	....	....	....
Pulaski	M. S. Hudgins	2.0	10.200	0.5	5,000
West Virginia—					
Charleston	G. S. Brown	0.175	4,655	....	....
Clarksburg	D. D. Britt	0.415	14,276	....	....
Moundsville	Alex. Purdy	0.412	9,489	....	....
Parkersburg	B. F. Stewart, Jr.	0.5	15,500	....	....
Princeton	S. A. Obenshain	0.5	17,500	....	....
North Carolina—					
Asheville	B. M. Lee	0.065	3.575	....	....
Goldsboro	W. E. Gelirez	....	....	0.9	30.000
Lumberton	Ira B. Mullis	0.25	....	0.25	....
Raleigh	R. B. Seawell	1.3	17,980	....	....
Salisbury	J. W. Webb	0.35	6.860	0.5	....
Statesville	R. L. Greenlee	1.5	58,000	1.0	25,000
Winston Salem*	G. F. Hinshaw	....	....	4.0	....
South Carolina—					
Charleston	J. H. Dingle	0.45	24.480	....	....
Chester	James Hamilton	1.0	7,200	....	....
Columbia	John McNeal	1.7	150.900	1.2	93,000
Florence	D. G. Adams	2.0	90,000	0.75	....
Georgetown	D. W. Fraser	0.15	3,300	....	....
Greenville	C. P. Ballinger	3.00	117,556	2	75,000
Rock Hill	W. W. Miller	1.25	44,000	....	....
Union	R. A. Easterling	1.00	16,000	1	16,000
Georgia—					
Albany	R. J. Edgerly	0.85	35,660	....	....
Bainbridge	E. N. Edwards	1.00	25,000	....	....
Brunswick	J. Low Zachry	0.50	20,100	....	....
Cedartown	H. N. Van Devander	0.52	18,716	....	....
Columbus	W. C. Campbell	1.41	46,000	1.90	64.600
Gainesville	C. L. B. Sanders	2.00	76,000	....	....
La Grange	S. B. Slack	0.05	13,000	....	....
Savannah	W. O'D. Rockwell	2.00	101,812	....	....
Waycross	B. H. Klyce	0.30	12.600	0.75	45,000
Florida—					
Gainesville	G. H. Cairns	0.50	7,000	3.00	105,000
Jacksonville	L. D. Smoot	6.15	242,384	5.00	....
Live Oak	A. J. Hawkins	....	....	1.9	80,000
Palatka	S. C. Stallings	0.75	18,000	....	....
Sanford	Fred T. Williams	....	....	0.75	20,000
East South Central Division:					
Kentucky—					
Dayton	W. L. Glazier	0.27	4,000	....	30,000
Louisville	D. R. Lyman	6.39	239,951	....	....
Ludlow	Wm. R. Purcell	0.12	2,160	....	....
Mayfield	Voris Gregory	0.33⅓	11,000	....	....
Owensboro	H. M. Talbott	1.11	18,788	....	....
Tennessee—					
Jackson	John L. Williams	0.98	27,635	....	....
Knoxville	J. W. Thompson	....	....	0.9	15,260
Paris*	M. W. Younkin	1.5	....	....	....
Alabama—					
Gadsden	Chas. L. Marsh	....	....	0.95	....
Roanoke	E. M. Moore	1.5	3,168	2.0	4,224
Selma	Julian Smith	0.6	1,860	....	....

		Pavement Laid in 1912		Pavement to be Laid in 1913	
	City Engineer.	Miles.	Total Cost.	Miles.	Total Cost.
Mississippi—					
Brookhaven	Eugene McCormick	0.057	1,215	....	....
Greenwood	J. S. Allen (con. eng.)	1.25	60,500	....	....
Grenada*	W. C. Hudson	....	....	0.5	25,000
Vicksburg*	C. F. Twiss	0.5	....	....	....
West South Central Division:					
Arkansas—					
Fort Smith	Geo. Myers	13.0	187,500	2.5	380,000
Helena	L. R. Parmelee	1.1	57,000	2.46	130,000
Jonesboro	C. Vogt	0.1	1,645	2.00	....
Little Rock	H. Levinson	14.5	600,000	20.00	900,000
Mena	Fred. Wigstrand	0.5	1,850	1.00	3,000
New Orleans	W. J. Hardee	2.02	116,483	....	....
Shreveport	Geo. R. Wilson	9.33⅓	247,570	2.20	....
Oklahoma—					
Bartlesville	E. D. Kirkpatrick	3.0	181,000	0.2	....
Haileyville	J. W. McLaughlin	0.085	1,700	....	....
Lawton	Frank B. King	2.0	41,585	2.0	84,212
McAlester	W. P. Halliday	0.16⅔	4,824	0.16⅔	4,000
Muskogee	Chas. Schultz	3.0	91,150	....	20,000
Nowata	Frank L. Tyrrell	2.25	71,238	0.12	12,000
Okmulgee	Jas. G. Lyons	0.5	18,000	5.0	....
Salpulpa	O. K. Howard	....	....	0.75	....
Tulsa*	T. C. Hughes	8.0	....	....	....
Texas—					
Abilene	H. J. Bradshaw	....	....	6.0	54,375
Brownsville	J. W. Davis	1.5	78,000	0.5	28,000
Bryan	A. B. Carson	....	....	....	60,000
Eagle Pass	B. E. Mourse	0.125	1,340	....	....
Fort Worth	F. J. Von Zuben	14.32	632,424	12.0	530,000
Houston Heights	Howe & Wise	2.0	118,000	....	....
Paris	J. W. Crook	1.5	48,000	3.0	90,000
Port Arthur	Bruno L. Durst	6.0	....	7 or 8	....
Sweetwater	A. O. Dreyer	1.25	29,312	0.5	11,063
Tyler	Jo. J. White	0.4	18,000	0.5	23,500
Waco	G. E. Byars	1.0	28,880	8.9	361,000
Mountain Division:					
Montana—					
Billings	C. E. Durland	0.016	754	1.0	50,000
Bozeman	C. C. Widson	....	....	2.1	82,320
Glendive*	C. W. Bowles	10.0	....	....	....
Great Falls	M. L. Morris	0.59	27,642	....	....
Helena	Wm. Jordan, Jr	0.5	35,000	....	....
Livingston	S. H. Crookes	....	....	1.00	71,000
Miles City	G. C. Pruette	0.09	14,400	....	....
Idaho—					
Boise	C. C. Stevenson	0.14	5,838	....	....
Idaho Falls	Frank Beach	1.0	45,000	....	....
Pocatello	W. P. Havenor	1.4	85,000	1.00	60,000
Weiser	R. J. Wood	1.75	58,150	0.75	66,000
Utah—					
Ogden	H. J. Craven	0.442	24,746	0.57	48,000
Salt Lake	S. H. Blossom	1.56	128,927	5.8	....
Colorado—					
Boulder*	H. E. Phelps	0.9	....	....	....
Colorado Springs	F. F. Mallow	2.5	110,000	....	....
Denver	B. Van De Greyn	2.0	68,679	2.5	85,000
Fort Collins	Arthur E. Lamb	....	....	3.0	25,000
Glenwood Springs	Theo. Rosenberg	0.151	640	0.5	2,111
Grand Junction	E. R. Romberg	0.75	50,000	1.0	60,000
Pueblo	D. P. Gaymon	0.08	....	....	....
Arizona—					
Bisbee	R. A. Ziesemer	....	....	0.25	....
Phoenix	F. N. Holinquist	3.0	250,000	5.0	400,000
Pacific Coast Division:					
California—					
Alhambra*	R. H. Blacklidge	....	53,418	....	....
Coalinga	F. J. Boland	1.5	90,000	....	....
Corona	C. Cully	4.0	37,194	10.5	174,600
Fresno	C. P. Jensen	2.4	133,000	2.5	135,000
Glendale	Edw. M. Lynch	....	....	4.5	260,000
Lodi	J. W. McAfee	1.08	48,384	0.5	35,000
Los Angeles					
Monrovia	H. S. Gierlich	1.1	1,386	4.0	28,000
Napa*	L. L. Jordan	....	....	....	....
Oakland	P. F. Brown	24.086	999,910	26.0	....
Orange	C. C. Bonebrake	0.875	42,000	1.5	55,000
Oroville*	S. J. Morris	....	....	1.75	....
Oxnard	S. G. Bennett	....	....	1.0	18,000
Palo Alto	J. F. Byxbee, Jr	0.163	6,800	0.163	6,800
Pasadena	L. E. Smith	31.55	20,300	10.00	....
Pittsburgh	Geo. T. Oliver	1.5	34,467	....	....
Pomona	Clarence E. Bayley	6.77	164,000	....	....
Roseville	M. S. Marshall	....	....	....	20,000
Salinas*	D. F. Davies	1.0	....	....	....
San Bernardino	K. F. Tuttle	3.8	93,760	5.0	150,000
San Francisco	M. M. O'Shaughnessy	12.0	698,554	....	....
San Mateo	D. Bromfield	1.0	50,000	2.0	100,000
South Pasadena	John MacMillan	1.7	71,000	2.48	....
Upland	F. C. Froehde	1.5	50,000	....	....
Oregon—					
Ashland*	F. H. Walker	....	....	....	....
Eugene	H. D. Forneri	4	141,472	5	35,000
Hood River	P. M. Morse	....	....	2.0	50,000
Klamath Falls	D. J. Zumwalt	4.25	187,000	....	....
La Grande	R. R. Neal	2.5	100,000	2.5	120,000
McMinnville	R. W. Jones	1.0	42,653	3.0	125,000
Newberg	R. A. Lockwood	1.0	32,000	....	....
Pendleton	Geo. Kimball	1.85	91,108	....	....
Portland	T. M. Hurlburt	48.7	2,145,529	30/45	....
St. Johns	C. E. Andrew	2.7	71,125	....	....
The Dalles	C. L. White	....	....	2.5	....
Washington—					
Aberdeen	C. W. Ewart	2.949	125,000	5.0	195,000
North Yakima	N. A. Gilman	0.25	4,887	....	....
Montesano	G. W. Gauntlett	0.5	9,550	0.5	10,000
Pullman	L. V. Edwards	1.0	41,100	....	....
Seattle	A. H. Dimack	12.38	576,168	14.0	650,000
Sedro-Woolley	A. G. Mosier	....	....	2.0	36,000
South Bend	V. M. Eager	0.5	28,250	1.0	35,000
Tacoma	W. C. Raleigh	8.21	348,421	....	....
Canada:					
Prince Edward Island—					
Charlottetown*	J. P. Nicholson	....	....	....	....
Nova Scotia—					
Halifax	F. W. W. Doane	0.05	1,250	....	....
Quebec—					
Montreal	Geo. Janin	13.5	757,443	....	....
St. Lambert	E. Drinkwater	1.552	65,877	3.758	119,636
Ontario—					
Chatham	F. P. Adams	0.93	24,400	1.0	25,000
Hamilton	A. F. MaCallum	9.0	180,000	8.0	160,000
Kingston	R. J. McClelland	0.543	27,936	1.5	....
Niagara Falls	J. C. Gardner	0.75	35,000	1.5	65,000
North Bay	I. H. Shaw	3.0	50,000	2.0	33,000
Oshawa*	Frank Chappell	1.05	....	....	....
Ottawa	F. C. Askwith	6.04	388,818	4.5	300,000
Petersborough	T. A. S. Hay	0.077	953	1.75	24,000
Port Arthur	L. M. Jones	1.2	69,997	1.9	148,767
Rockland	W. Langton	4.0	3,500	4.0	6,000
St. Catharines	R. A. Brown	0.75	36,000	5.0	50,000
Stratford*	A. B. Manson	1.6	....	2.0	....
Toronto	R. C. Harris	38.547	938,834	50.	1,250,000
Wallaceburg	I. A. Bell & Son	1.00	8,500	....	....
Welland	D. G. Black	6.00	39,526	3.0	....
Wingham	....	....	....	1.0	15,000
Manitoba—					
St. Boniface*	M. P. Blair	1.59	....	....	....
Saskatchewan—					
Regina	F. McArthur	6.7	388,754	7.5	524,000
Saskatoon	Geo. T. Clark	3.1	440,351	2.2	255,000
Alberta—					
Edmonton	....	11.43	748,163	....	....
British Columbia—					
New Westminster*	J. M. Blackman	2.18	....	3.81	....
Vancouver	F. L. Fellowes	20.81	1,791,383	....	....

WATER WORKS

Method and Cost of Constructing in Earth a Circular Brick-Lined Water Works Tunnel 8 Ft. in Diameter and 1,216 Ft. Long.

(STAFF ARTICLE.)

The Chicago Avenue Tunnel connection, completed in March, 1913, for the Chicago Water Works, is an example of day labor construction which is creditable both for the moderate costs obtained and for the good quality of the work. The tunnel is 8 ft. in diameter; is lined with three rings of brick, and is 1,216 ft. long. It cost $34.82 per lineal foot. This is a moderate figure, considering the quality of the work done; the length of the tunnel; the curves and grades upon which it is built; that air pressure was used, and that engineering and inspection costs are all included. The new tunnel joins the lake section of the 7-ft. Cross Town Tunnel with the 8-ft. Blue Island Avenue Tunnel, which was completed in 1909. It will furnish the Twenty-second St. Pumping Station with an independent supply from the two-mile crib in Lake Michigan. Since the abandonment of the land section of the old 7-ft. Cross Town Tunnel, the Twenty-second St. Station has been taking its supply from the tunnels which supply the Chicago Avenue Pumping Station and the result has been an inadequate supply for both stations. These conditions were remedied on March 6th, 1913, when new tunnel was placed in service. The immediate result of placing the lake section of the old Cross Town tunnel again in service was to raise the water levels in the wells at four pumping stations. From these figures and the total annual pumpage it is calculated that the annual saving in coal will be $4,031.33 per year. This is accomplished by the expenditure of $50,556.29, the total cost of the new tunnel.

The location of the tunnel connection is shown by Fig. 1. It parallels the curb 10 ft. away on LaFayette Court for a distance of 721 ft. It has a compound curve at the south end consisting of one arc 308.5 ft. long on a radius of 175 ft. and one arc of 55 ft. radius and 141.2 ft. long, which connects with the lake end of the old Cross Town Tunnel. At the north end the main tangent is deflected 30° on a curve of 12 ft. radius, to avoid making a right angle connection with the Blue Island Ave. Tunnel. From this curve the tangent continues about 30 ft. to the juncture with the Blue Island Tunnel with which it makes an angle of 60°.

The grade on which the tunnel is built is level between the construction shaft and the Blue Island Avenue Tunnel, then rises at a rate of 1.3 per cent from the shaft south to the point of curvature whence it dips at a rate of 6 per cent on a curve to the junction with the lake end of the old Cross Town Tunnel. The rising grade is introduced to provide a safe clearance between the new tunnel and three other tunnels which pass under the new bore as indicated by Fig. 1. The first of these tunnels is a 7-ft. tunnel and passes 16½ ft. below the new tunnel 503 ft. from the construction shaft; the second is a 5-ft. tunnel 103 ft. south of the first and it passes 18 ft. below the new tunnel; the third tunnel, 82 ft. farther south, lies 14½ ft. below the new tunnel. There also is a fourth tunnel lying 17.8 ft. below the new tunnel, which was crossed at a point 148 ft. from the shaft, but this tunnel was not necessarily considered in laying out the grades for the new tunnel.

SHAFT CONSTRUCTION.

Construction was commenced on May 20, 1912, with the erection of the office building and tool house. The following month was occupied in building a cement shed and men's dressing house; the head house framing; the frames and sheeting for starting the excavation for the shaft; in assembling the 1-cu. yd. tunnel cars, which were built at the city water works shops, and in setting the 100-hp. firebox boiler, and building under it a foundation and ash pit. The preparations for active work excavating the shaft were continued during the early part of July and the actual excavation was started July 15, 1912, when a hole 15 ft. square was started. This had been carried about 10 ft. below the surface using 2x10-in. sheeting held in place by three sets of timber frames spaced 3 ft. apart vertically, when water was encountered. The excavation was then interrupted until the first sections of the steel shell could be placed.

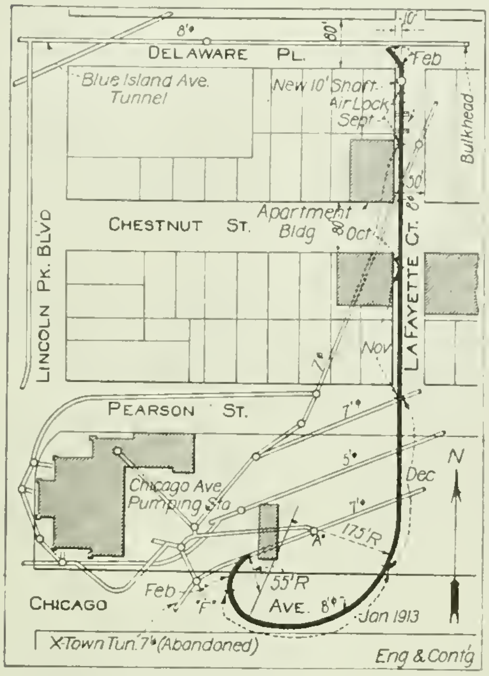

Fig. 1—Plan of Chicago Avenue Tunnel Connection for Chicago Water Works.

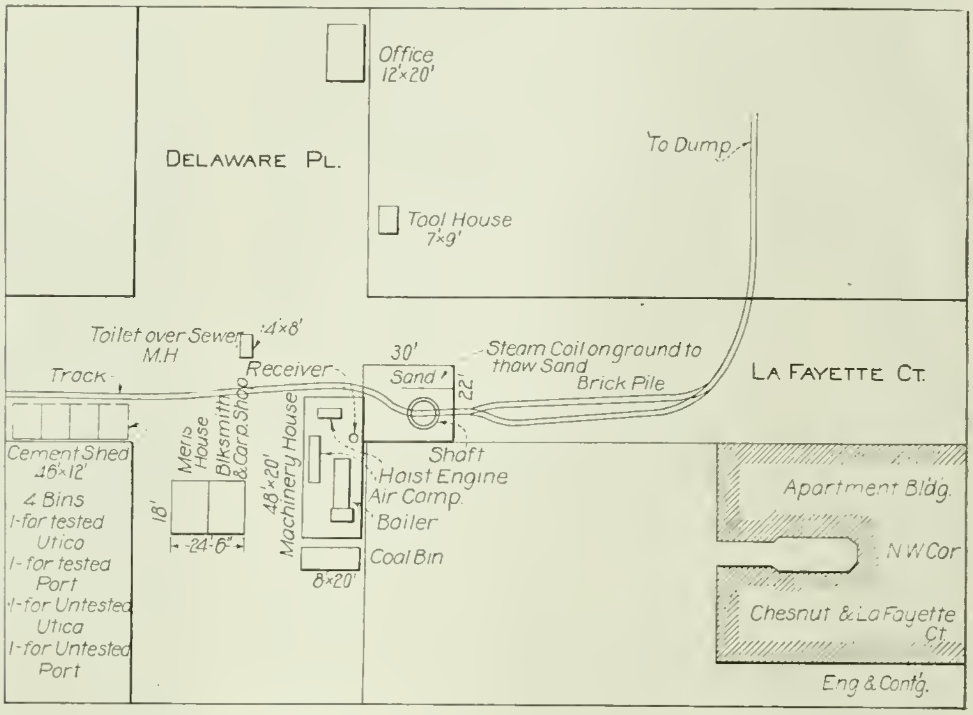

Fig. 2.—General Plan Showing Arrangement of Construction Buildings and Plant.

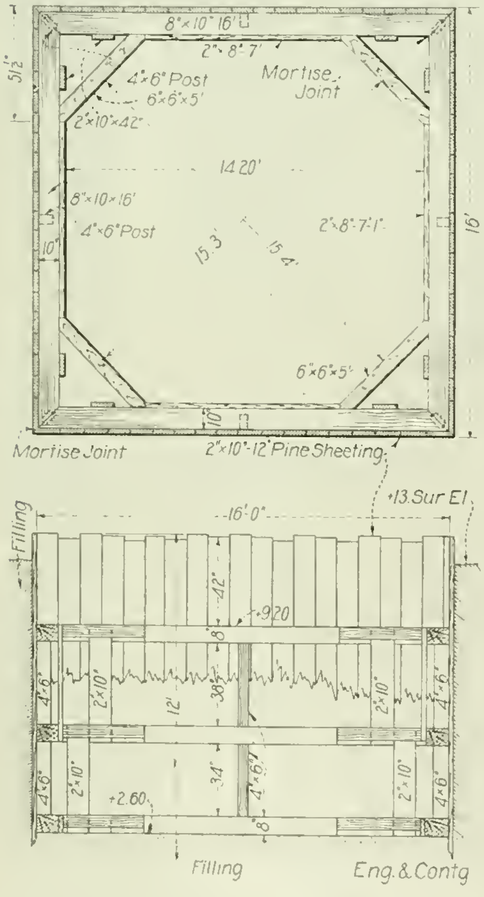

Fig. 3.—Sketch of Timber Sheeting at Mouth of Shaft.

The shell was built by John Mohr & Sons, Chicago, and delivered in place for $930. It consisted of five sections each 11 ft. 5 ins. in diameter and 6 ft. high, made of ⅜-in. boiler plate. The two bottom sections were riveted together in the shop and provided with a beveled cutting edge stiffened around the inside with an additional plate and a 6x8x½-in. angle 1 ft. above the cutting edge. The total weight of the shell was 21,385 lbs. with the rivets. Its cost delivered was, therefore, 4.35 cts. per pound. Each section was thoroughly calked and all the rivets were countersunk on the outside of the shell. By July 26 the two bottom sections had been placed and another 6-ft. section had been riveted and calked. The shell had also been lined up by vertical guide timbers placed on four sides. The brick lining was then started, the 6x8-in. angle serving as a footing; and on July 30 had been carried to a height of 14 ft. With this additional weight the shell was forced down to elevation —4 or 16.6 ft. below the street grade. Preparations were then made to sink the 18 ft. of erected shell deep enough to permit the erection and riveting of the remaining two sections.

All the material removed from the shaft was taken on cars running on a narrow-gage track to a dump on the east side of the street where, by previous arrangement, the city had obtained permission to fill in vacant property to the level of the street. A No. 4 Nye pump was suspended in the bottom of the shaft at this time as the material encountered was a water-bearing stratum of lake sand. This sand was 13 ft. deep, overlying the soft blue clay through which the balance of the shaft was sunk.

By Aug. 8, 1912, the last two sections of the steel shell were erected and the brick lining was then completed to within 6 ins. of the top of the shell. The excavation was next resumed and the shell gradually sank, with the weight of the brick lining, until it reached an elevation of —13 or 25.6 ft. below the street, when it became necessary to add weight to sink it further. About 20 tons of pig iron were loaded on 10x10-in. timbers placed across the top of the shell. With this additional weight the cutting edge was sunk 4 ft. or to elevation —17. As more weight was necessary some heavy bridge counterweights were brought from storage at the Twenty-second St. Station. These, with light rails, sand bags, etc., were added to the previous load and the shell was finally sunk to elevation —24.20 as shown by Fig. 6. The total weight used to sink the shell was 163,646 lbs. With the weight of the timbers the entire load amounted to 82 tons.

To estimate the friction between the soil and the shell we have:

	Pounds.
Load	184,000
Shell	21,385
Brick lining	126,904
Total weight	312,289

The total area of the shell in contact with the soil when it reached its final position was 970 sq. ft. Dividing the total weight by 970 gives approximately 322 lbs. friction per square foot of contact area. Comparing this figure with the friction indicated when the shell was sunk to elevation —4, we find that at that time the weight of the shell and its brick lining was about 116,000 lbs. and that the area of contact between the shell and the soil was approximately 240 sq. ft. This indicates that a friction of 480 lbs. per square foot existed when the shell ceased to sink at —4. In this case the shell was forcing its way through sand, the area of contact with sand being 145 sq. ft. and with earth fill about 94 sq. ft. In its final position the shell was forcing its way through clay and was in contact with 405 sq. ft. of clay, 471 sq. ft. of sand, and 94 sq. ft. of earth fill. This indicates that the coefficient of friction was reduced as the percentage of area of the shell in contact with clay increased.

The excavation of the shaft was carried 20 ft. below the cutting edge to the top of the tunnel bore and the brick lining from 13 to 18 ins. thick was placed after each day's excavation. The brick lining was suspended by eight 1 in. hanging rods having plate washers. Each rod, as shown by Fig. 8, had an eye at its lower end, which supported the plate and provided for hooking on the next rod below. In the 6x8-in. angle which supported the brick work for the steel shell, small eye bolts were placed before any brick work was started, and to these were attached the first set of rods. The shaft was carried down to tunnel grade, and the two tunnel "eyes" excavated 10 ft. each way from the shaft and lined during the last four days of August. A sump also was built, as shown by Fig. 5, with ledge projecting 4 ins. inside the 10 ft. diameter of the shaft to support the cage landing and the floor built over the sump.

The total cost of the material and labor for the construction of the shaft including the two tunnel eyes and the brick lining was $4,675, or $66.79 per lin. ft., as follows:

39,288 brick at $7	$ 275.00
34 cu. yds. beach sand at $1.05	35.70
96 bbls. Utica cement at $0.90	86.40
48 bbls. Portland cement at $1.39	66.72
3,000 ft. lumber at $25	75.00
Steel sheet	930.00
Hanging rods	50.00
Labor	2,981.18
Teaming, for pig iron	175.00
Total, 70 lin. ft.	$4,675.00
Cost per lin. ft.	66.79

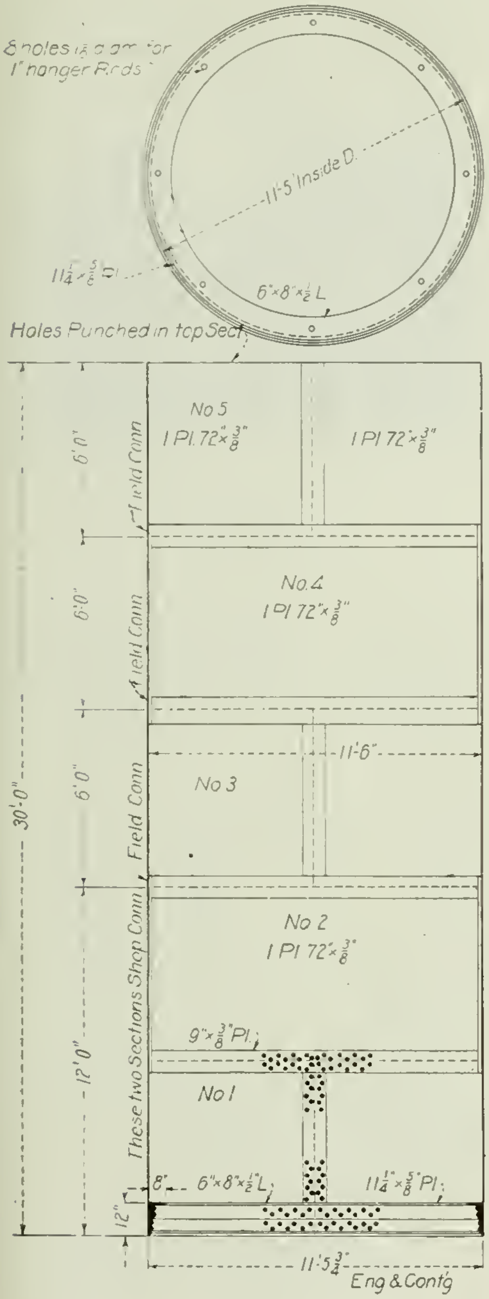

Fig. 4.—Sketch of Steel Shell.

The cage used for the balance of the work was operated by a cable from the hoisting engine in the power house. The cage consisted of a light platform suspended in a frame, as shown by Fig. 6. The home-made safety device on the cage is shown in this view and its details are given by Fig. 9. The device consists of two ba[illegible]tached by a hinge to the eyebolt which [illegible]nects with the cable. A coil spring is placed on this eyebolt underneath the timber crosspiece through which the eyebolt passes. When tension is placed on the cable the spring closes and the two chisel pointed bars, which run from the hinge through the cage posts, are pulled away from the cage guides. When tension is released the spring forces the bars against the guides and prevents the cage from falling. The device operated successfully on one occasion when the cage would otherwise have fallen.

TUNNEL CONSTRUCTION.

Mining was begun in the south heading on Sept. 5, 1912. The bore of the tunnel was made 10 ft. 2 ins. to accommodate the 13 in. brick lining laid in cement mortar. Labor troubles at this time caused a suspension of mining for four days, during which time a new gang was organized, and an air compressor installed. Air pressure on the tunnel was provided as a precautionary measure to prevent leaks from the four water tunnels over which the new tunnel passed and to prevent damage to the apartment buildings near which the tunnel passed. A Laidlaw-Dunn-Gordon compressor, 12x18x18 ins. of 626 cu. ft. capacity at 50 lbs. pressure was installed in the power house. It was at first rented for $100 per month, and later was purchased for $800.

The air locks were not installed until Sept. 25, when the mining and lining had proceeded to a point 107 ft. from the shaft. The driving tunnel was then stopped for five days during the installation of the airlock diaphragms. These were placed 21 ft. 7 ins. apart, the nearest one being 63.2 ft. from the shaft. The lock was not quite long enough for these cars on account of the space needed to swing the outer door. The assembling and bricking in of the diaphragms required five days' time. Two colliars, 3 ft. 6 ins. wide and 2 ft. 9 ins. deep, were left in the brick lining in anticipation of the placing of the diaphragms. The diaphragms were supported on timbers passing through the doorways, while the invert to support the diaphragms was being placed. The ends of the timbers passing through the door openings were supported on crosstimbers hitched into pockets cut in the brick lining.

To insure tightness of the lock, a slot was cut through the tunnel lining about 2 ft. south of the south diaphragm and the soil around the south end of the lock was grouted. The lock walls and the walls of the tunnel for 35 ft. south from the diaphragms were washed with Portland cement grout. Tests were made to determine air leakage and the Portland cement grout was put on during a pressure of about 18 lbs. No trouble was had because of leakage throughout the work and the compressor was able to maintain 10 to 15 lbs. pressure running at its lowest speed.

About 135 ft. from the shaft the character of the ground changed from a hard blue clay, that required picking, to a soft clay with a tendency to swell. After this point was reached clay knives were used. This work proceeded without change from this time until the end of the tunnel was reached on February 8, 1913.

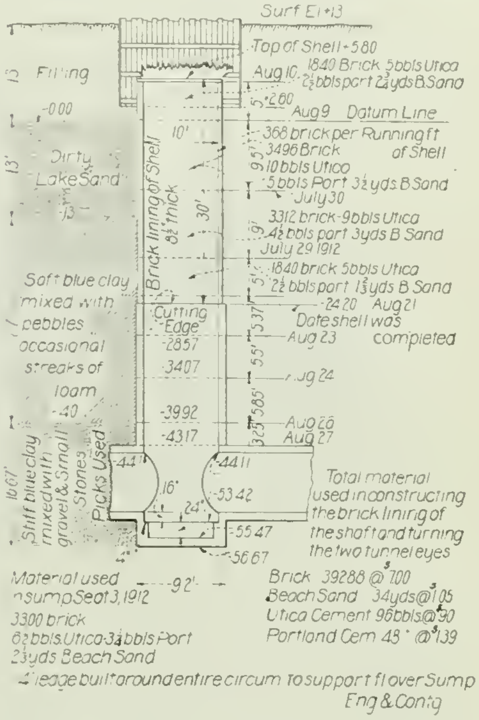
Surf El +13
Top of Shell +5.80
Aug 10. 1840 Brick 5bbls Utica 2½ bbls port 2¾ yds B Sand
15'
Filling
5' +2.60
Aug 9 Datum Line
-0.00
10'
368 brick per Running ft of Shell
3496 Brick
9.57'
10 bbls Utica
5 bbls Port 3½ yds B Sand
July 30
13'
Dirty Lake Sand
Brick lining of Shell 8½" thick
30'
-13
3312 brick-9bbls Utica
9'
4½ bbls port 3yds B Sand
July 29 1912
1840 brick 5bbls Utica
5'
2½ bbls port 1⅔ yds B Sand
Soft blue clay mixed with pebbles occasional streaks of loam
-24.20 Aug 21
Cutting Edge
5.37'
Date shell was completed
-28.57
Aug 23
-34.07
5.5'
Aug 24
-40
-39.92
5.85'
Aug 26
-43.17
3.25'
Aug 27
16.67'
Stiff blue clay mixed with gravel & Small Stones Picks Used
-44.11
-44.11
16'
-53.42
24'
-55.47
-56.67
Total material used in constructing the brick lining of the shaft and turning the two tunnel eyes
Material used in sump Sept 3, 1912
9.2'
3300 brick
6½ bbls Utica-3¼ bbls Port
2⅓ yds Beach Sand
Brick 39288 @ $7.00
Beach Sand 34yds @ $1.05
Utica Cement 96bbls @ $.90
Portland Cem 48 " @ $1.39
4" ledge built around entire circum to support fl over Sump
Eng & Contg

Fig. 5.—Sketch Showing Completed Shaft.

The average progress made during October was 7.98 ft. per day, during November 8.25 per day, during December 11.8 ft. per day and during January 13.58 ft. per day. After Dec. 12, to the end of the work, two shifts per day were worked. The progress per shift during this time was 7.8 ft. for December and 6.79 ft. for January. The work slowed up, it will be noted, on the long curve on a —6 per cent grade.

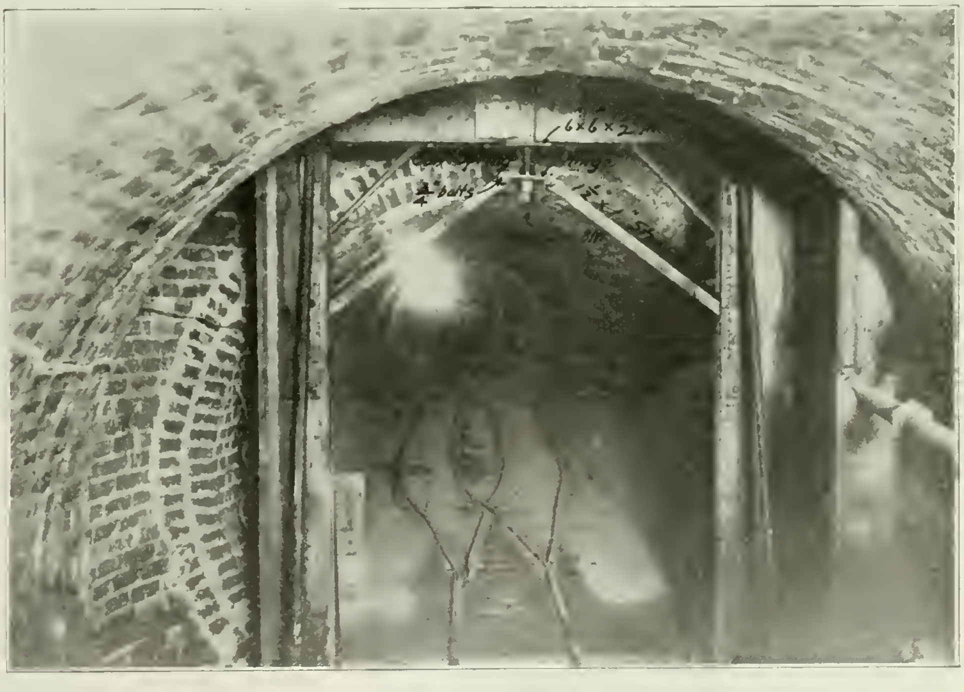

Fig. 6.—View of Cage Showing Arrangement of Safety Device.

A device used to give the center line of the tunnel for the bricklayers and for measuring cross sections of the excavations is shown by Fig. 12. It consists of a wood bar, with a pair of set screws at one end, which may be clamped horizontally across the tunnel, and of a vertical bar fastened at the center of the other by a strap hinge. To this fixed center point a line is fastened and carried ahead to a form set on center line at the face of the drift. Measurements are then taken from the line to determine the cross sections.

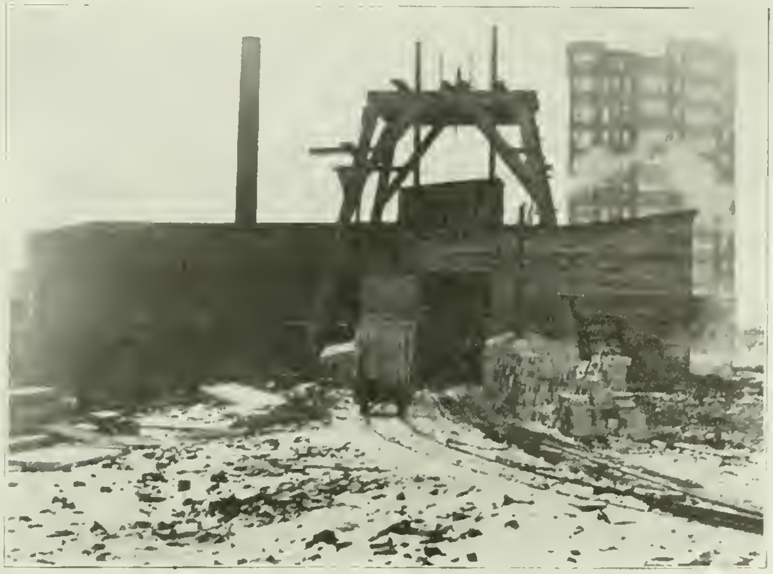

Fig. 7.—View of Head House Showing Power House at Rear.

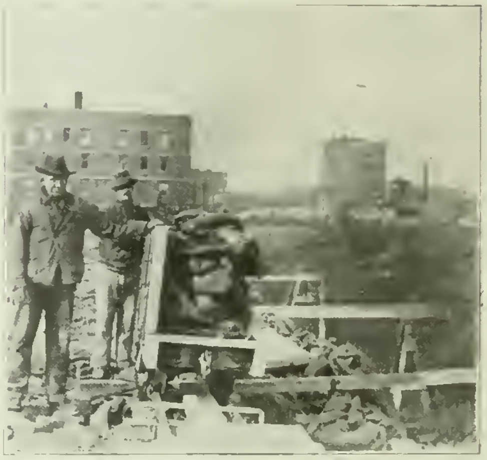

Fig. 10.—View Showing Car and Excavated Clay at the Dump.

The south end of the tunnel joins the lake end of the old crosstown tunnel at a point midway between two 10 ft. shafts which are about 200 ft. apart. These shafts are indicated on Fig 1 by *A* and *F*. This short section of tunnel was cut out by closing a gate at each shaft. To overcome any leaks around the gate in Shaft *F*, this shaft was filled with soft blue clay to elevation —22.

When the drift was excavated to within a few feet of this tunnel, a hole was drilled through to the old tunnel and a suction pipe connected. The pump was then started and the air pressure run up to from 42 to 48 lbs. to aid the pumping. After the water was pumped out about 10 lbs. air pressure was maintained while the remainder of the excavation was made and the connection bricked up. The material excavated in making the tunnel connections was thrown back into the abandoned tunnel towards Shaft *F*.

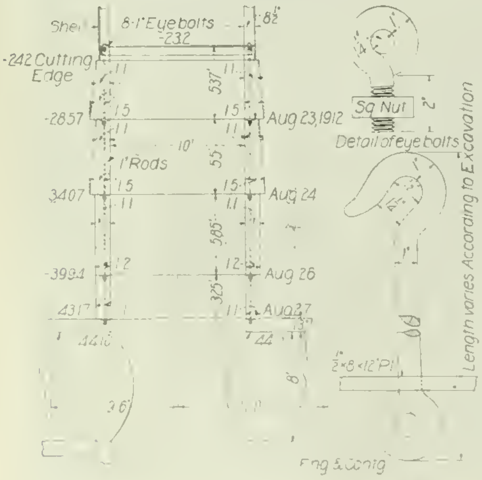

Fig. 8.—Sketch Showing Shaft Lining Below Steel Shell.

The work in the north drift had been extended 12.6 ft. or to 23.6 ft. from the shaft by two days' work during the month of September. It was resumed on Feb. 11, and completed to a point 55.4 ft. from the shaft and 13.8 ft. from the connection with the Blue Island tunnel. A gate shaft about 350 ft. west of the connection permitted the closing of this section of the Blue Island tunnel as the end of this tunnel is about 100 ft. east of the connection. The tunnel was pumped out and the connection made. As the Blue Island tunnel is lined with concrete, this material was used to make the connection and was carried back in the connecting tunnel for a distance of 14.55 ft.

TABLE I.—TOTAL AND UNIT COSTS.

	Shaft.		Tunnel.		Grand total.
	Per lin. ft.	Total.	Per lin. ft.	Total.	
Engineering and inspection	$10.12	$ 708.04	$ 2.05	$ 2,434.47	$ 3,142.51
Labor	34.97	2,447.96	24.90	29,529.06	31,977.02
Materials	21.70	1,519.00	7.02	8,320.27	9,839.27
Plant	8.22	582.05	4.23	5,015.44	5,597.49
Total	$75.11	$5,257.05	$38.20	$45,299.24	$50,556.29

The compressor was shut down on Feb. 9 and the pressure allowed to give out by the working of the air lock during the work of tearing up track. The lock shields were removed and the slots, left in the lining by their removal, were concreted. By Feb. 28 both drifts were entirely cleaned out and a cover of steel beams and concrete was placed on the shaft. The equipment and construction buildings were then removed, leaving the site clear by March 15.

The total itemized labor time in days, and of labor costs are shown in Table II. This includes the time of all men and teams for the work from the commencement of operations until March 17 when all plant and buildings, with the exception of the office building, had been removed. The total labor cost as given is $50,556.29.

Table I gives the total and unit costs for the work as distributed for the various classes of work on the shaft and on the tunnel. The unit cost for the shaft is given in this table as $75.11 as compared with $66.79 given previously. The difference is due to the addition of a proportionate charge to the shaft work of the total cost of the plant. The plant included in this charge is as follows:

Machinery, cars, etc	$3,757.51
Rails and switches	464.59
Lumber	773.52
Pipe fittings	138.98
Miscellaneous	462.89
Total	$5,597.49

The plant has been charged entirely into the work according to the figures in Table I and distributed between the shaft and tunnel proportionately to the total costs of those items. This charge is an arbitrary charge and should perhaps be reduced by charging only the depreciation of the plant against the work. To do this 2 per cent of its value should be charged against the work each month, or 20 per cent for the ten months. This would reduce the plant charge on the shaft by $6.64 making the total cost of the shaft $68.47 per lin. ft., and would reduce the cost of the tunnel $3.38 per lineal foot making this item $34.82 per lineal foot instead of $38.20. In calculating the unit cost of the tunnel 1,186 lin. ft. was used as the total length, as 30 ft. of the length of the tunnel is included in the construction of the shaft and in the turning of the eyes, and this length was charged to the shaft construction.

The materials used per lineal foot of tunnel are indicated by the following table which is prepared from a record of materials used from Oct. 4 to Jan. 16, during which time 840 lin. ft. of tunnel were built:

Number brick per lin. ft. of tunnel	522.5
Barrels Utica cement per lin. ft.	.92
Barrels Universal cement per lin. ft.	.50
Cu. ft. sand per lin. ft.	1.14

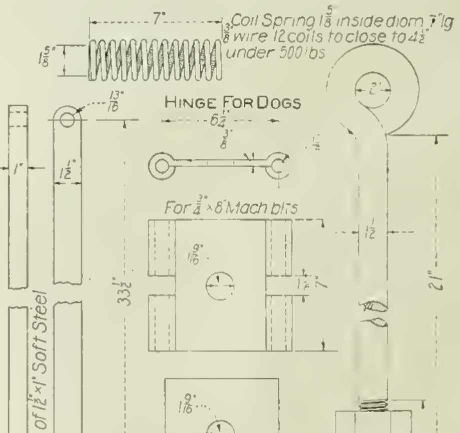

Fig. 9.—Details of Safety Device for Cage.

The tunnel was constructed by the City by day labor under the supervision of the construction division of the Bureau of Engineering. The City Engineer, Mr. John Ericson, is the responsible head of the Bureau

TABLE 11.—TOTAL ITEMIZED LABOR COST OF CHICAGO AVENUE TUNNEL CONNECTION.

	Rate per day.	May 20-31.		June.		July.		August.		September.		October.		November.		December.		January.		February.		March.		Total.	
		Time.	Amt.	Time.	Amt.	Time.	Amt.	Time.	Amt.	Time.	Amt.	Time.	Amt.	Time.	Amt.	Time.	Amt.	Time.	Amt.	Time.	Amt.	Time.	Amt.	Time.	Amt.
Asst. engineer	$5.61	..	....	...	....	20	$112.20	mo	$174.00	mo	$174.00	mo	$174.00	mo	$174.00	mo	$174.00	mo	$174.00	mo	$174.00	9	$ 50.49	227	$1,380.69
Rodman	2.96	4	$11.84	mo	$91.66	mo	91.67	mo	91.67	mo	91.66	mo	91.66	mo	91.67	mo	91.67	mo	91.66	mo	91.66	...	....	240	836.82
Mining inspector	5.00	..	....	...	....	...	....	27	135.00	25	125.00	28	140.00	25	125.00	27.	135.00	29	145.00	24	120.00	...	....	185	925.00
Supt. and foreman	8.06	..	....	...	....	17	137.02	...	....	...	....	...	....	...	....	...	....	...	....	...	....	...	....	.....	....
Supt. and foreman	*250.00	..	....	...	....	...	....	...	....	...	....	mo	250.00	mo	250.00	mo	250.00	mo	250.00	mo	250.00	...	....	147	1,387.02
Bricklayer foreman	11.00	..	....	...	....	2	22.00	7	77.00	24	264.00	24	264.00	25	275.00	24	264.00	19	209.00	8½	93.50	...	....	.....	....
Bricklayer foreman	*250.00	..	....	...	....	...	....	mo	250.00	mo	250.00	...	....	...	....	...	....	...	....	...	....	...	....	186½	1,968.50
Tunnel miners	4.00	..	....	...	....	48	192.00	108¾	435.00	125	500.00	157	628.00	150¼	601.00	209	836.00	257½	1,030.00	178	712.00	...	....	1,233½	4,934.00
Muckers	3.50	..	....	...	....	...	....	...	....	41	143.50	80½	281.75	78	273.00	155	542.50	275	962.50	111	388.50	...	....	740½	2,591.75
Laborers	3.00	..	....	...	....	39	117.00	138	414.00	171	513.00	152	456.00	177	531.00	205½	616.50	260⅛	780.38	159	477.00	122	366.00	1,423⅝	4,270.88
Hoist engineers	5.80	..	....	...	....	3	17.40	36⅔	212.78	50½	292.90	57½	333.50	53	307.40	72⅛	418.33	86	498.80	53⅜	309.58	4	23.20	416 1-6	2,413.89
Firemen	*90.00	..	....	...	....	...	....	...	....	2 mo	180.00	2 mo	180.00	2 mo	180.00	2 20/31	238.06	3 mo	270.00	3 mo	270.00	...	....	.....	....
Firemen	2.90	..	....	...	....	5	14.50	56	162.58	...	....	...	....	...	....	...	....	...	....	...	....	32	92.80	475	1,587.94
Carpenters	5.20	19	98.80	52	270.40	50	260.00	27	140.40	28½	148.20	28	145.60	29	150.80	30	156.00	33	171.60	30½	158.60	9	46.80	336	1,747.20
Blacksmith	5.00	..	....	...	....	11	55.00	27	135.00	28	140.00	27	135.00	29	145.00	29	145.00	27½	137.50	24½	122.50	13	65.00	216	1,080.00
Watchmen	2.50	29	72.50	60	150.00	62	155.00	62	155.00	60	150.00	62	155.00	60	150.00	20	50.00	...	....	28	126.00	...	....	443	1,163.50
Heading boss	4.50	..	....	...	....	...	....	...	....	19	85.50	27½	123.75	25	112.50	37	166.50	51	229.50	66	264.00	...	....	225½	981.75
Lock tender	4.00	..	....	...	....	...	....	...	....	...	....	43	172.00	54	216.00	66	264.00	60½	242.00	13	130.00	...	....	236½	1,024.00
Bricklayers	10.00	..	....	...	....	2½	25.00	19	190.00	25	250.00	24	240.00	25	250.00	42	420.00	51	510.00	33 4/5	338.00	...	....	222⅓	2,223.00
Laborers	2.75	11	30.25	30	82.50	29	79.75	...	....	...	....	...	....	...	....	2	5.50	...	....	...	....	...	....	72	198.00
Bricklayer tenders	4.00	..	....	...	....	18	72.00	57	228.00	96	384.00	84	336.00	73	292.00	95	380.00	155¼	621.00	3¼	17.88	...	....	581½	2,330.88
Mule and driver	5.50	..	....	...	....	...	....	...	....	...	....	...	....	...	....	...	....	69.2	380.46	...	....	...	....	69.2	380.46
Electrician	6.00	..	....	...	....	...	....	8⅝	51.75	¼	1.50	...	....	...	....	...	....	...	....	...	....	...	....	8⅞	53.25
Double teams	5.50	..	....	...	....	...	....	5	27.50	20½	112.75	...	....	24½	134.75	82	451.00	79	434.50	14	77.00	3	16.50	228	1,254.00
Asst. foreman	6.00	..	....	...	....	...	....	...	....	...	....	...	....	...	....	22	132.00	33¾	202.50	8¾	52.50	...	....	64½	387.00
Totals	....	..	$213.39	...	$594.56	...	$1,350.54	...	$2,879.68	...	$3,806.01	...	$4,106.26	...	$4,259.12	...	$5,736.06	...	$7,340.40	...	$4,172.72	...	$660.79	7,977.65	$35,119.53

*Month.

of Engineering, and Mr. Henry W. Clausen, Engineer of Waterworks Construction, is the responsible head of the construction division. Mr. E. P. Scott, Assistant Engineer, was in immediate charge of the work.

The Use of Motor Trucks in the Distributing Department of Gas Supply Systems, with Some Costs.

In a recent paper before the Indiana Gas Association, Mr. George M. Dolley, Manager of the Logansport Division of the Indiana Lighting Co., discussed the use of motor trucks in the distributing department of gas supply systems. The hauling done in such departments is fairly comparable with the lighter hauling done by water departments in repair work. Mr. Dolley stated that his experience with motor vehicles was that such vehicles are not practical in plants where only one horse and wagon are required for the work in the distributing department. The paper follows:

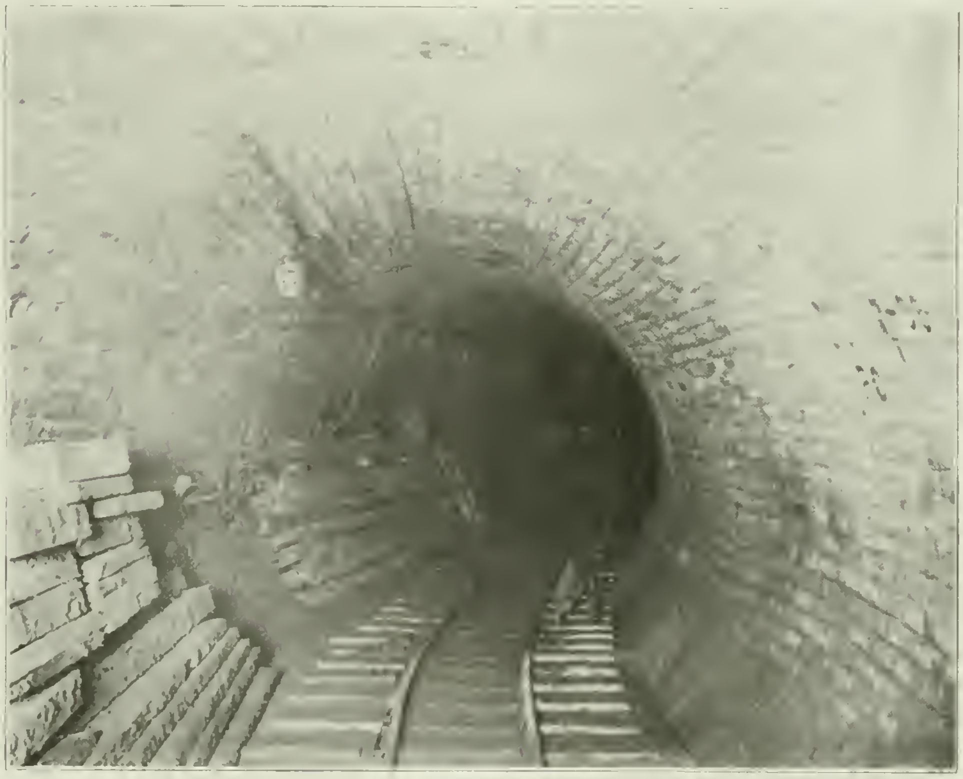

Fig. 11.—View of Completed Tunnel on Curve and 5 Per Cent Grade.

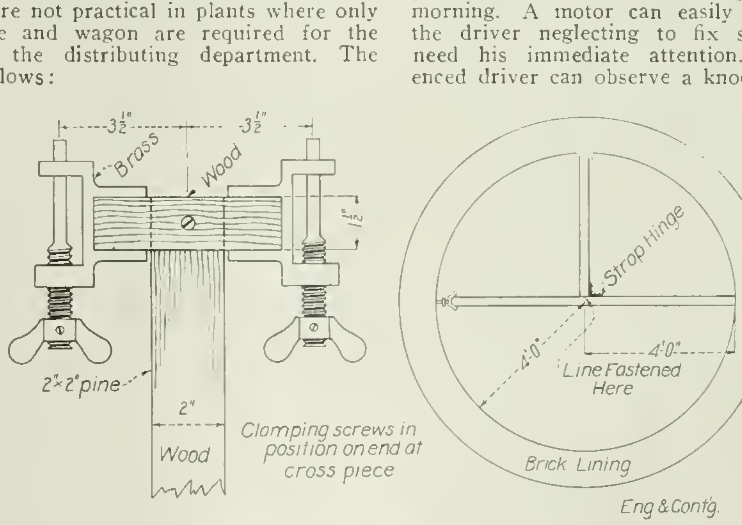

Fig. 12—Sketch of Device Used for Giving Center Line.

A truck, with the proper management should do the work of two or three horses and wagons. It is necessary to have a driver to operate the truck who is thoroughly familiar with the workings of the machine, so that any time the machine gets out of order the driver can repair it without the expense of taking it to the garage. It is also necessary that a truck be given the proper care and at least one-half day each week should be devoted to general cleaning and oiling all parts, including engine and gear. Too much stress cannot be put on the instructions to the driver to keep his machine in working order, as it is one of the most important things in holding up the efficiency and prolonging the life of the truck.

It is up to the driver to keep the truck in repair and out of the repair shop. He must oil his car every morning and be sure that all parts intended to be oiled get proper lubrication. Taking the motor first, which is the most important part of the truck, the driver should see that all nuts, bolts, or any part which have a tendency to work loose are perfectly tight before starting out in the morning. A motor can easily be ruined by the driver neglecting to fix such parts as need his immediate attention. An experienced driver can observe a knock or any unusual sound that might occur while running. At times a driver gets 15 to 30 minutes while waiting to move a fitter, and that gives him time to adjust or fix anything that might need his attention, as 15 minutes will accomplish a

TABLE I.—MOTOR TRUCK DATA FOR GAS SUPPLY DISTRIBUTION SYSTEM SERVICE.

Trucks outside of state. Reference No.	Miles run.	Gals. gasoline.	Cost.	Oil, qts.	Cost.	Tire cost.	Repairs and sundries.	Total expense.	Cost per mile.	Miles per gallon gasoline.	No. cylinders.	H.P.	Size of truck. Ton.
1	2,004	346	$42.30	102	$19.14	.....	$ 11.89	$ 73.33	$0.036	5.8	2	18	..
2	3,000	173	19.61	21¼	2.34	.....	90.37	112.32	.037	17.3	4	22.5	..
3	3,643	599½	53.27	80	8.69	$ 39.98	15.58	117.52	.032	6	2	10	..
3	3,501	640	69.19	174	33.48	.....	74.40	177.07	.05	5.4	2	10	..
4	5,126	610	54.89	181	24.89	159.50	6.53	245.72	.048	8.4	2	20	..
2	3,258	167	14.57	52	6.46	34.94	4.55	60.52	.018	19.5	4	20	..
5	4,246	759	68.09	227	28.18	116.20	102.60	315.07	.074	5.5	2	16	..
3	1,076	147	16.67	36½	4.11	......	18.50	39.28	.036	7.3	2	10	..
4	1,745	245	26.91	80	8.81	......	36.82	72.54	.042	7.1	2	10	..
2	9,476	991	94.57	268	30.37	46.50	229.82	401.26	.042	9.5	4	20	..
6	5,801	705	64.16	150	......	51.50	31.25	164.82	.028	8.2	3	15	..
Indiana Cars.	6 Months.												
7	3,007	332	44.82	132	8.96	......	51.72	105.50	.035	9	..	..	1
7	3,381	432	58.32	111	7.54	......	33.74	99.60	.029	7.8	..	..	1
8	4,447	...	......	...	......	......	.....	456.27	.103	...	..	..	..
8	5,649	...	......	...	......	......	.....	539.13	.096	...	..	..	..
8	4,513	...	......	...	......	......	.....	581.11	.128	..	..	..	..

great deal towards keeping the truck in repair.

Another very important point in the care of the truck is to see that it is never loaded above its rated capacity or driven at too high a speed. It might seem that it would be all right to put a load of two or three tons on a truck, even if the rating capacity is only one ton. One might argue that the excessive depreciation which is the inevitable result of overloading, is as much the business of the owner as insufficient lubrication or other neglect. This, however, is not true. A man who overloads his truck, driving it over the public highways, jeopardizes public safety in exactly the same proportion as he exceeds the rated loading capacity of the truck.

The most efficient method of operating a truck for the distribution department in my experience is: First, to have a driver who has some knowledge of piping, then to furnish each fitter with a complete kit of tools. The foreman after sorting the orders turns them over to the driver, the driver loads the material necessary for the work on the truck, and with the fitter who is to do it, proceeds to the job. After each fitter is placed, the driver should know about how long it will take to do the work, so that when it is completed he should have the material ready for another job, get the fitter and tools and take him to the next one. In this way one truck and driver can take care of at least six or eight fitters. In some cases with the right kind of a driver, he could also be utilized for inspecting work done by the fitters.

There is no doubt in my mind but that the motor truck will eventually come into general use by gas companies to displace the horse. It will be sometime before the smaller companies will find it to their advantage to replace the horse with the truck owing to the first cost and cost of operation. But with the progress that is being made in the manufacture of trucks, it will not be long before the smaller companies will fall in line and find that they will be able to get their work out to better advantage with the truck than with the horse. Regarding the difference in cost of operation between the motor truck and the horse, it is impossible at this time to give accurate figures, for the reason that at the present time there are only eight companies in the State who are using trucks and these companies were not in a position to give any conclusive figures on the operation. In reply to circular letters sent out to these companies we received data from only three, the balance of five were unable to give any information. I have also obtained data from several companies outside of the state. The complete data obtained are given in Table I.

The Experience of the State of Indiana with the Shallow Well.

During the last six years Dr. H. E. Barnard, Chemist of the Indiana State Board of Health, has analyzed 5,000 well waters. Out of the mass of data collected he has determined that the well supply of the cities and towns of Indiana is polluted in rather more than 50 per cent of all cases. After stating that fact in his recent paper before the Indiana Sanitary and Water Supply Association, Dr. Barnard continued, in part, as follows:

If such a statement had been made the first or second year of our work, it would undoubtedly have been pointed out that the waters analyzed did not represent average conditions, and that the samples sent in were from wells suspected of being impure; and that while many of these samples did prove to be polluted, by far the greater number of wells were pure and safe. But as year after year we have tabulated the results of our work, we have noticed the very singular fact that our results varied very little indeed. In fact, the percentage of bad and doubtful well waters in the year 1912 is almost exactly the percentage reported the first year of our work in 1906. It is impossible to believe that the health officers, after studying the well supplies in their community for many years, are still sending in only the worst waters, or that the individual owner is not asking for an analysis save when he suspects the purity of his supply. I am convinced that of the 2,000,000 wells furnishing water to the citizens of Indiana, at least 1,000,000 are not furnishing pure water, but a water contaminated by the wastes of the home and community. Of 4,959 wells examined in the last few years, 3,051 have been classified as shallow wells, and 1,908 as deep wells. This classification is not perfect, for it is frequently impossible to get data sufficiently adequate to place a well in its proper class. We classify all dug wells as shallow wells, and all driven wells as shallow wells when it is evident that the well does not pass through an impervious stratum. In some parts of the State a layer of clay or hard pan may lie so close to the surface that a driven well not more than 10 ft. deep may, in fact, reach second water, and so entitle it to be classed as a deep well.

In other parts of the State, especially where sand and gravel deposits are deep, a well may be 75 or 100 ft. in depth and still tap only surface water. Obviously, when we do not know all the facts, our classification is subject to some inaccuracies. Nevertheless, it is significant that of the 3,057 shallow wells used as private supplies, but 1,331 were good; that 1,391 were classified as bad and 335 as doubtful. Since a doubtful well water is bound sooner or later to pass the danger line, in the interests of safety it should be viewed with suspicion, and classed with the bad waters. This means that 56.5 per cent of the shallow wells are impure. Of the 1,377 deep wells used as private water supplies, 1,091 furnished pure water, 160 bad water and 126 doubtful water. In other words, more than 79 per cent of all the deep wells furnish a pure water. The difference in the quality of the deep and shallow well is thus strikingly shown. If the actual facts were at hand, I have no doubt but what the proportion of deep wells of satisfactory character would be greatly increased. There is no real reason why every properly cased well which passes through an impervious stratum should not furnish pure water, save in the isolated instances where sewage is poured through sink holes or abandoned gas wells into the lower levels. Such conditions do obtain in the cavernous regions in the southern part of the State, and they are not unknown in the so-called gas belt.

Is the time not soon to come in Indiana when the health officer, knowing as he does, that more than 50 per cent of the surface wells are polluted, will take definite, positive and final steps toward closing them and compelling the community to use the public water supply of guaranteed purity? We are legislating for sanitary school houses where our children are gathered for months of the year. We are going farther than that, we are requiring by law that there shall be no unventilated and unlighted rooms. Is not the next step legislation which will prevent the unwise citizen from quenching his thirst by the effluents of his backyard?

The medical staff of our army recognizes the danger of the well. When a regiment recently made its march from Fort Benjamin Harrison to French Lick, Indiana, and back, the soldiers were under strict orders not to drink from any well along the road. That was official recognition of the danger of the well, and apparently the situation was in the hands of those who could control it. I believe the health officers of our communities have just as great powers as do the officers of the medical corps, if they would only use the courage of their convictions. If it were possible I should say to every health officer in the state, close every surface well in your community. If that is not possible at the present time because a pure public supply is not available, determine by examination at least once each year that every well is potable, and whenever a report is made to you that the water is receiving sewage effluent, close the well. At the time of examination it may still be potable, the solid content may be increasing, the nitrates may be high, but the evidence showing present pollution may be wanting. Remember, however, that any heavy rain may obsolutely upset the conditions which have kept the water potable and flush into the well not only the filth from the surface, but debris accumulated in the earth.

The Treatment of the Water Works Reservoir at Quincy, Illinois, for Algae—Amount of Copper Sulphate Used.

The water works distribution reservoir at Quincy, Illinois, constructed in 1881-2, is 415 ft. by 317 ft. in plan at the water level. The depth of water is 26 ft. The material excavated was utilized to make the embankments which have slopes of 1 on 1½. The inside slope was puddled to a depth of 9 ins., and a dry limestone wall 1 ft. deep was laid on the puddle. The sandy clay bottom was puddled to a depth of 1 ft. There is little if any leakage from the reservoir. A vegetable growth has given considerable trouble during the summers, especially since the water has been filtered before pumping it into the reservoir. The treatment of the water in this reservoir for algaecidal growths during the last six years was described by Mr. W. R. Gelston, Superintendent of the Citizens Water Works Company of Quincy in a recent paper before the Illinois Water Supply Association. The major portion of the paper follows:

In July, 1907, the gate valve controlling the flow of water into the reservoir was closed and the water was treated with copper sulphate in the proportion of 1 part of $Cu SO_4$ to 365,000 parts of water. It was allowed to stand 30 hours and was then drained through a pipe provided for that purpose. An attempt was made to clean the interior, but it was not very satisfactory on account of the mud in the bottom. No trouble, due to algae occurred during that season.

Beginning in the spring of 1908, we adopted the policy of treating the reservoir with a dose of about 1 part of copper sulphate to 5,000,000 parts of water and repeating the treatment every four weeks during the warm season.

Table I shows that there were eight or nine treatments each year, the first treatments being given in March or April, and the last in

TABLE I.—TREATMENT OF RESERVOIR FOR ALGAE.

Year.	Number treatments.	First treatment.	Last treatment.	Total gals. treated.	Total lbs. Cu SO_4 used.
1908	9	Apr. 22	Oct. 23	109,286,000	192
1909	9	Mar. 25	Nov. 2	98,700,000	179
1910	8	Mar. 23	Oct. 11	91,786,000	161
1911	8	Apr. 7	Oct. 31	90,300,000	152
1912	9	Apr. 24	Nov. 14	103,600,000	178
Average	8.6	Apr. 8	Oct. 29	....	1.74 *

*Lbs. per million gals

October or November. There was an average of 8.6 treatments each year; the average date of the first treatment was April 8th, and of the last was Oct. 29th, and an average dose of 1.74 lbs. of Cu So_4 was used per 1,000,000 gals.

These treatments were always given as early in the day as possible, after the pumps were started, and without shutting off the reservoir from the distribution system. The pumping plant was then kept in operation about 36 hours, so as to hold the treated water in the reservoir until there was no danger of the consumers noticing an unusual taste.

This method of treatment has been very satisfactory, and until the latter part of the summer of 1912 there was no evidence of any objectionable growths of any kind. The first indication of objectionable growths came in August and September, when there were a few small patches of floating vegetable matter, none of them larger than 3 or 4 sq. inches in size and the rip-rapped slopes were covered just under the water with a thin layer of green moss, from which bubbles were rising to the surface. At this time, the water had no disagreeable taste or odor. We continued the regular treatments and detected no change in the condition until a week after a treatment which was given Oct. 8th. At this time there was a distinct odor which was quite noticeable in the street adjacent to the reservoir, and the surface of the water had an oily appearance. Another treatment was given Oct. 18th and conditions were much improved. The odor was eliminated and the water was quite palatable after this treatment.

There were very few, if any, complaints because of this condition of the water. It is possible that only the water near the surface was affected, and that none of the algae-laden water was drawn out into the distribution system. During this period, we were pumping 12 to 14 hours each day, and not much water was used from the reservoir, and the stored water did not reach all portions of the city.

Our serious trouble came during the holidays when the consumption of water decreased considerably and we were not obliged to keep the pumps running full time, to maintain the supply. After a shut-down of one day, complaints began to come in from all sections of the city. Some of the complaints were due to a taste of bleaching powder, but most of them were undoubtedly due to some other cause. The water in the reservoir looked good and tasted good. We therefore decided that the mains needed flushing. A very thorough flushing of the mains in a certain district south of the reservoir only increased the disagreeable taste and odor. A sample of water was then obtained from near the bottom of the reservoir, and it had a very disagreeable taste. There was some ice in the reservoir, but this was broken up and the water was given a dose of 1 part of copper sulphate to 3,000,000 parts of water. This treatment put the water in excellent condition again, and all complaints ceased after flushing the mains thoroughly around the edge of the system to draw out the dead water in the mains.

Since our treatment of the reservoir was essentially the same in 1912 as during the four previous years when we had no indications of algaecidal growths in it, we have been unable to explain satisfactorily, the reason for this trouble. Perhaps the weather conditions were more favorable for such growths in 1912 than in previous years.

Perhaps a water coagulated with sulphate of alumina is more susceptible to such growths than a water coagulated with sulphate of iron and lime. If this is true, we have probably found the reason, because we discontinued the use of the iron and lime treatment in March, 1912, and with the exception of a few days, have used alum ever since.

It is also quite possible that this trouble came from organisms in the river water, which found their way through the filters and eventually reached the reservoir. As we did not have the necessary equipment for making the microscopic examination, no attempt was made to identify any organisms.

Our filter wash records for the year, however, indicate an unusual clogging of the filters from some cause, during the latter part of October, November and the first 15 days of December. During a part of this period, the average length of time of operation between washes, was reduced over one-half, and it was necessary to wash some of the filters, which contain fine sand, every three hours.

During the five years covered by this report, this reservoir has been well stocked with fish. It is possible that the spawn is killed, but even the heavy dose of one part of $CuSo_4$ to 3,000,000 parts of water, 2.77 lbs. per 1,000,000 gals., given recently, did not kill the fish.

From our experience, we believe that we can safely increase the proportion of $CuSo_4$ used, and should increase it to about one part of $CuSo_4$ to 4,000,000 parts of water. This is equivalent to 2.08 lbs. of copper sulphate per 1,000,000 gals. of water.

SEWERAGE AND SANITATION

Cost of Sewer Trenching With a Carson Machine at Moundsville, W. Va.

Contributed by A. W. Peters, Engineer in Charge of Construction.

In a contributed article published in Engineering and Contracting of Feb. 28, 1912, the writer gave the cost of trenching with a sewer excavator in Moundsville, W. Va. The costs given in that article were for excavation in lateral or shallow trenches, with an Austin trench excavator. The present article deals with a part of the deep trench work, on which a Carson machine was used, and in which the soil conditions were similar to those encountered by the Austin excavator. In order to interpret these costs the soil conditions, although explained fully in the article above mentioned, will be again briefly stated. (The Austin machine mentioned is an excavating machine, while the Carson machine is used to convey in buckets on a cable material which is excavated by hand tools.)

On the two sections for which costs are quoted, the soil consisted of fine sand mixed with loam and unstratified yellow clay. In the shallow trenches this material could be excavated for a depth of 8 ft., and the ditch left open for several days in ordinary weather without endangering the banks, although in general verticals and trench braces were used. When the contractor opened up his deep ditches in this material he decided to use 8-ft. lengths of sheeting, placed without driving, in the excavated 8-ft. depth. In this way a section of trench 8 ft. deep would be excavated and the sheeting placed; then the next lower 8 ft. of material would be removed, and the second set of sheeting placed with its top butting up against the bottom of the upper section, the banks being carried down approximately plumb. In backfilling, 8 ft. of sheeting would be knocked out and the trench filled, the material being tamped against the trench side wall and not against the sheeting, as is ordinarily necessary.

Of course, these Moundsville conditions are particularly favorable to low sheeting costs, and all that that means in deep trench work, so that the results as derived in Table II should be considered in that light.

The material in these two sections was usually picked before shoveling into the buckets, as it could be handled more rapidly in that way. The general progress of the truck work seemed to be fairly good. The buckets were loaded rapidly, the best men being placed at this work. The machine was handled efficiently and the buckets were run back and forth at a fairly high speed.

Regarding the items of which the total cost is comprised a few explanations will be given:

Excavation.—The first 3 or 4 ft. were thrown upon the bank and not loaded into buckets. For the remaining depth two men shovelled into each bucket, usually loosening the material before shoveling.

Machine.—The sub-heading "moving" is made up principally of the cost of moving the machine along the ditch, which required tracklaying, anchorages and hitches ahead.

TABLE I—QUANTITIES ON SECTIONS 1 AND 2, MOUNDSVILLE SEWER TRENCHES.

	Length, ft.	Depth, ft.	Total excavation, Cu. yds.	Excavation per lin. ft. Cu. yds.	Actual mach. days.	Excav. per actual mach. day. Cu. yds.	Cu. yds. per man-day.
*Section 1	296.0	31	1,529	5.2	28	55	4.6
†Section 2	135.0	14-16					
"	65.0	16-18					
"	40.0	18-20					
"	50.0	20-22					
"	42.0	22-24					
"	53.8	24-26					
"	137.0	26-28					
"	92.8	28-30					
	615.6		2,526	4.1	31	82	6.5

*Uniform depth of 31.0 ft.
†Average depth of 22.1 ft.

TABLE II.—TRENCH COSTS ON SECTION NO. 1, UNIFORM DEPTH, MOUNDSVILLE SEWERS.

Item.	Cost.	Per cent total.	Cost per lin. ft.	Cost per cu. yd.
Cost bucket loading	$ 559.80	35.2	$1.88	$0.36
Machine moving	$ 13.96	0.9	$0.05	$0.01
" engineer	80.40	5.0	0.27	0.05
" signal	52.60	3.3	0.18	0.03
" coal	18.00	1.1	0.06	0.01
" rental	300.00	18.9	1.01	0.20
Cost, conveying	$ 464.96	29.2	$1.57	$0.30
Sheeting	$ 231.42	14.6	$0.78	$0.15
Tamping	97.06	6.1	0.33	0.06
Teams	40.50	2.6	0.14	0.03
Pavem't removal	15.12	1.0	0.05	0.01
" replacement	41.20	2.6	0.14	0.03
Superintendent	133.45	8.7	0.47	0.09
Cost, misc.	$ 563.75	35.6	$1.91	$0.37
Grand total	$1,588.51	100.0	$5.36	$1.03

TABLE III.—TRENCH COSTS ON SECTION NO. 2, VARIABLE DEPTH, MOUNDSVILLE (W. VA.) SEWERS.

Item.	Cost.	Per cent total.	Cost per lin. ft.	Cost per cu. yd.
Cost bucket loading ....$	639.89	31.7	$1.04	$0.26
Machine moving .$	62.56	3.1	$0.10	$0.03
" engineer .	100.33	5.0	0.16	0.04
" signal	58.25	2.9	0.09	0.02
" coal	10.20	0.5	0.02	....
" rental	416.00	20.6	0.68	0.17
Cost, conveying $	647.34	32.1	$1.05	$0.26
Sheeting ....$	117.06	5.8	$0.19	$0.05
Tamping	145.12	7.2	0.24	0.06
Teams	155.25	7.7	0.25	0.06
Pavem't removal.	52.42	2.6	0.08	0.02
" replacement	85.00	4.2	0.14	0.03
Superintendent...	175.19	8.7	0.28	0.07
Cost, misc.....$	730.04	36.2	$1.18	$0.29
Grand total..$	2,017.27	100.0	$3.27	$0.81

Coal.—Due to the nearness of the bituminous mines, three within the city limits, coal could be bought for 5 cts. a bushel at the mine or 7 cts. a bushel delivered. This fact makes the coal item very low.

Sheeting.—Method of placement described under general soil conditions above. Thickness of sheeting 2 ins.; stringers 4 ins. x 6 ins. The cost as given includes placement, removal and depreciation.

Tamping.—This gang consisted of six men, one shoveller and five tampers. The men did not use the heavy iron tampers, but were provided with pieces of 4 ins. x 6 ins., about 2 ft. long, with an old shovel handle set into one end. Better results were secured with these wooden tampers than with the iron ones.

Teams.—This item is made up principally of the cost of removal of surplus dirt, and cost of evening up inequalities in trench depth. On Section 2 the cost of this item is greater than on Section 1, because the trench depths were increasing as the machine moved ahead, so that when the backfill was made under these conditions, a surplus resulted which necessitated the team expense.

Pavement.—Brick on both sections laid on 1-in. sand cushion with 6 ins. of gravel foundation. Very little of the base was saved, so that in the replacement of paving new gravel was necessary. A great many brick were broken on removal or afterwards lost.

Labor.—The wages on these ditches varied from $1.85 to $2.00, about 70 per cent of the men getting $1.85 per day, and the remainder $2.00.

COST ANALYSIS.

Referring to the tables it will be seen that Table I is a general table of quantities with unit quantities reduced. Table II gives the trench costs for uniform depth, and Table III presents the costs on a ditch of variable depth:

For a trench ranging in depth from 14 to 30 ft. in Moundsville, the "Digging Cost," equal to cost of bucket loading and conveying, was found to be 52 cts. per cu. yd., as shown by the sum of "Bucket Loading" and "Conveying" costs in Table III.

For the trench with uniform depth of 31 ft., the "Digging Cost" at Moundsville equals 66 cts per cu. yd. See Table II.

Referring to Table I we see that the yardage per man-day for the variable ditch was 6.8, while for the uniform ditch it was 4.6.

These results, without any further study of the tables, show that we cannot quote a uniform price for all depths of excavation, as is done by the machine people and some authors.

A moment's thought will show that the difference between the lengths of haul in a 10-ft ditch and a 35-ft. ditch may vary by as much as 15 per cent.

It will also be noticed that the three main divisions of the total cost are approximately equal in each table, both in the case of the ditch of uniform depth as shown in Table II, and in the ditch of variable depth as shown in Table III. This fact would seem to offer an approximate method of estimating trench costs, by using the "Cost of Bucket Loading" as a starting point. It would seem that this ratio ought to hold in soil conditions different from those encountered at Moundsville, because the three main divisions contain items that are more or less dependent upon each other, so that a change in one would cause a corresponding variation in the others. For example, suppose that a wet ditch is being excavated. It will then take longer to load the buckets and the cost will therefore, be greater; the Conveying Costs will be similarly increased because the Machine Rental, which is a large item, will be greater. It can readily be seen that the Miscellaneous Costs will be increased and the item of Pumping will be added.

In the two Moundsville ditches quoted, the cost of bucket loading varies with the depth, and is almost numerically equal to it. The expression $(D + 4)$ where (D) is the depth of trench in feet, would give the cost per cu. yd. of Bucket Loading for both trenches.

For a trench in "ordinary earth," such as the Moundsville trenches, with either a uniform or average depth, D, the total cost per cubic yard of trench work would then be given by the expression $3(D + 4)$.

It is usually the case that excavation in hardpan costs approximately double the excavation of ordinary earth. With a hardpan trench, therefore, the expression for total cost per cubic yard would become $6(D + 4)$.

Of course, it is not expected that this expression will serve as other than an approximate check on estimated costs of deep trench work; neither is it expected that it will meet the demands of a quicksand ditch; but for the ordinary run of ditches it is believed that it will check up in fairly good shape providing the Bucket Loading cost is selected with some care and judgment.

The contractor on the Moundsville work was B. F. Sweeten & Son, of Camden, N. J. Chas. E. Collins, of Philadelphia, was designing and consulting engineer, and the writer was the engineer in charge of construction.

Some Notes on the Disposal of Sewage Tank Sludge.

The notes here given with reference to the disposal of sewage sludge are abstracted from the paper read by Mr. Charles Brossmann, Consulting Engineer, Indianapolis, Ind., before the recent annual convention of the Indiana Sanitary and Water Supply Association.

THE SLUDGE PROBLEM.

The real problem in sewage disposal plants is the sludge problem. Engineers are just learning how to make sludge, but as yet have not found a satisfactory solution, in most cases, for disposing of it. In large plants the sludge question is the stumbling block. Sludge may be roughly divided in two classes: That from shallow tanks and that from deep tanks. Sedimentation tank sludge is a black, semi-liquid mass which, on being exposed to the air, becomes offensive, giving off much gas and odor. The water contained in such sludge is usually 90 to 95 per cent. The sludge from septic tanks ranges all the way from 8 to 45 cu. yds. per 1,000,000 gals. of sewage. Septic sludge which has been retained in tanks for a number of months undergoes a great change. The organic matter is attacked and partly gasified and liquefied, reducing the amount of sludge. Such sludge in well operated tanks is a concentrated very black mass containing from 80 to 90 per cent of water. There is not as much odor to septic tank sludges as to the fresh sludge from the plain settling tanks.

CENTRIFUGAL DRYERS.

A short description of methods of dewatering sludge by the centrifugal machine is of interest, as this method seems to have possibilities, although at the present time it is not the cheapest method in use. It is being used successfully at Frankfort, Germany, and several other cities. In the Shaffer-ter-Meer plant the sludge flows into the machine from a receiver placed above the inlet. The heavier particles of sludge are thrown outward toward the outer part of the chamber in the machine, the water being forced inward and flowing out into a water chamber. This process is kept up until the entire chamber is filled. The sludge inlet is then cut off and the entire mass is whirled around for the proper period required to dry the sludge. This dry sludge is then thrown out by centrifugal force, the impact against the walls breaking it up. The sludge then falls down and is conveyed away by an automatic conveyor. The machine runs about 750 r. p. m., and it takes from two to five minutes for one operation and from 2½ to 5 cu. yds. can be dewatered per hour. The sludge thrown off is loose and dries easily and weighs about 1,500 lbs. per cu. yd. The cost of operation of such a plant with the electric current at 1¼ cts. per kilowatt hour is about 60 cts. per ton of the dried product. This price includes all wages, current and depreciation. This is slightly higher than filter presses would be under the same conditions. It must, however, be remembered that this machine as described is entirely automatic and the manual handling of the sludge is entirely done away with. Consideration should also be given to the fact that the sludge is somewhat different from sludge from a filter press which has used chemical for precipitation.

FILTER PRESSES.

Pressing sludge by filter presses in order that it may be formed into a cake has been used largely in plants using chemical precipitation. This method, however, is not entirely satisfactory, as it is hard to dewater the sludge in a uniform manner. In comparison, pressing the sludge into cakes in English and German plants being as low as 65 cts. to 85 cts. per ton, it is of interest to note that the filter presses used at Frankfort, Germany, have been substituted for centrifugal machines. The cost of filter pressing, however, varies greatly, as at Worcester, Mass., it runs as high as $3.50 per ton of solids. Probably a fair average would be from 60 cts. to $1.20 per pressed cake per ton. Columbus, Ohio, stores its sludge until the river has a freshet or a large enough volume to allow its being dumped in the river without being a nuisance. Mansfield's (Ohio) septic sludge is dried in lagoons.

At the Philadelphia experiment station the wet sludge was mixed with equal parts of anthracite coal and was burned under boilers, but no efficiency tests were taken. However, an evaporation of approximately 4½ lbs. of water per pound fuel was realized, the fuel having approximately 11,000 B. t. u. per pound. It would seem that the disposing of sludge in this manner would justify experimenting, especially at such points where sewage would have to be pumped and where the sludge would have to be disposed of.

Mr. Brossmann took up the question of burning sludge in gas producers and was advised by one manufacturing company that they could burn the sludge in a proportion of one part of coal to five of sludge. This method of burning sludge in gas producers has been tried in Europe; in some cases with fair success and in others with rather poor results, but there is no doubt that to insure successful burning in producers the proportion of sludge should not be too high, and thought should also be given to the quality of coal for its effect as regards the clinker, etc. In such localities where drying is expensive and cities are located near the sea, the sludge can be loaded into barges or tank steamers and transported a sufficient distance from the coast and then dumped. The cost of such transportation varies from 7½ to 30 cts. per ton in English cities, which includes loading, etc.

NEWS SECTION

Editorial Comment—Personals—Society Meetings—Trade Notes—Catalog Reviews—Contract News, Embracing Bids Asked, Work Projected, Contracts Let and Contract Prices on All Classes of Civil Engineering Construction Work.

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The Doings of the West.

Very little of importance has developed during the past week in the railway construction field. Few large contracts appear to have been awarded, and scarcely any new work of size has made its appearance. The disastrous floods in the middle west and the tornadoes in Nebraska and Iowa have caused great damage, and will result in much construction work. In Dayton, O., alone, it is estimated that 15,000 houses and business buildings must be rehabilitated, and 2,000 houses and other structures, or what remains of them, must be pulled down. Many dams and bridges have also been destroyed. Among the railroad construction work let recently is the following: Walker & Curley, Pittsburgh, Pa., for roundhouse, shop, storeroom and power house at Dickerson Run for the Pittsburgh & Lake Erie R. R.; Patton & Russell, Wayne Hotel, Detroit, Mich., for work for the Michigan Central Ry.; Hugh Nawn Contracting Co., 82 Lavin St., Boston, Mass., at $351,048, for constructing Sec. B of the Dorchester tunnel at Boston, Mass.; John B. Lindsey, Pomeroy, O., for grading for an extension of the Hocking Valley R. R. through Keers Run into the Nease Settlement; W. Z. Williams, Macon, Ga., for concrete masonry work for second track for the Atlantic Coast Line from Parkton to Selma, N. C., 63 miles; F. H. Clements & Co., Philadelphia, Pa., for grading and putting in extra track at Bethlehem Steel Works for the Lehigh Valley R. R. One of the largest contracts of the week is reported to have been awarded to the Seattle Construction Co., of Seattle, Wash. This calls for reconstructing the Northern Pacific line between Seattle and Sumas, at a cost of about $4,000,000. The Seattle Construction Co. is probably composed of Grant Smith & Co., Seattle and Stillwell.

A considerable amount of Government river and harbor work is now being advertised in various sections of the country. Bids on one large Government job were opened March 26 by the U. S. Engineer at Louisville, Ky. This work called for widening the Louisville and Portland Canal, and involved, 770,000 cu. yds. common excavation and 205,000 cu. yds. rock excavation. Henry Bickel Co., Louisville, Ky., at $656,095 was the low bidder. Two large contracts for work in connection with the New York State Barge Canals have been let as follows: Contract 65, Maryland Dredging & Contracting Co., Baltimore, Md., at $1,000,098; Contract 72-A, James Stewart & Co., Inc., 30 Church St., New York City, at $1,534,603; Contract 65 calls for the improvement of the Erie Canal for the west end of Contract No. 69 tothe east end of Contract No. 64 at Medina; its length is 231 miles. Contract No. 72-A calls for completing the excavation of a channel in the Hudson River and for completing upper approach wall of Lock No. 3. The length covered is 41 miles.

In the way of levee work the largest contracts awarded since our last issue appear to be the ones secured by Stacey & Crittenden, Greenville, Miss., and by A. J. Twiggs & Son, Augusta, Ga. The latter contract amounts to $101,000 and calls for 250,000 cu. yds. of construction work for the River and Canal Commission of Augusta. The Stacey & Crittenden work calls for 528,000 cu. yds. of levee construction at 19.37 cts. per cu. yds., for the Mississippee Levee Commissioner of Greenville, Miss.

The State Legislature of Michigan has passed a bill providing for the submission of the question of bonding the state for $3,000,000 for the trunk line highway project to the vote of the people. In Iowa the House of Representatives has passed an act to create a state highway commission. The act also provides that the supervisors of each county shall appoint a highway engineer. The duties of the state highway commission include the devising and adopting of plans of highway construction and maintenance suited to the needs of the different counties of the state and the furnishing of standard plans to counties in accordance therewith.

Bids on a good-sized concrete masonry dam are now being asked by the Alexandria Water Co., of Alexandria, Va. The work is located about six miles northwest of Alexandria, Va., and embraces approximately 16,000 cu. yds. of earth excavation, 1,600 cu. yds. of rock excavation, 17,500 cu. yds. of concrete masonry, 1,150 cu. yds. of rubble masonry, gate house, and setting of pipes, gate valves, sluice gates and appurtenances.

Bids were opened March 22 by Maj. G. B. Pillsbury, U. S. Engineer, New London, Conn., for dredging in Brantford Harbor, Conn. The bids per cu. yd., on an estimated yardage of 34,500 were as follows: Atlantic Dredging Co., 81 New St., New York, N. Y., $0.229; Maritime Dredging Co., 80 Broad St., New York, N. Y., $0.195; John A. Seely, 30 Church St., New York, N. Y., $0.25; The T. A. Scott Co., Inc., New London, Conn., $0.1975.

Railroad Work in New England.

New England, which a few months ago promised so much in the railway construction line, and then failed to keep its promise, is once more on the point of large improvements—in the newspapers. The latest report has it that "In a war of competition for the enormous grain carrying traffic of Canada improvements on a gigantic scale have been begun or are now projected by the Grand Trunk and the New York, New Haven & Hartford Railroad, with New London as the principal outlet on the New England seaboard. The cost of these improvements will exceed $30,000,000." According to this report the Grand Trunk will expend $5,000,000 in building grain elevators at New London, and in double tracking the Central Vermont from that point to St. Albans, Vt., a distance of 300 miles, and its own line from the Vermont city to Montreal. The New Haven's projected improvements involve an expenditure of more than $25,000,000. Of this $10,000,000 will be spent in shortening and improving the route to Montreal from New York and from New London, including the extension of the New York, Westchester and Boston road from White Plains to Danbury, Conn., and the double tracking and straightening of the Berkshire division. Almost $8,000,000 will be spent in improvements in and near New London. These include the construction of a new bridge across the Thames River, the double tracking and shortening of the route between Niantic River, nine miles west of New London, and Westerly, R. I., nineteen miles east; the elevation of the tracks through New London and the construction of new passenger and freight stations. The building of a new passenger station in New Haven, the elimination of the cut through which the present station is approached and collateral improvements will cost $6,000,000. The installation of new signal systems and minor improvements will cost $2,000,000 more.

Centralized Purchasing for Cities.

All railroads and the larger corporations centralize the buying and distribution of supplies by means of purchasing departments. A few cities also have a purchasing agent, or designate a certain official, to buy supplies and material for the various municipal departments. In the majority of municipalities, however, each department purchases its own supplies and as a result pays practically retail prices. A plan for unifying purchases and promoting efficiency in buying, inspection and audit has been submitted to the Board of Estimate of New York City by Controller Prendergast. The plan provides for the organization of a board of purchase to consist of the mayor, the controller, and the president of the Board of Aldermen. By the new plan it is hoped to save from $3,500,000 to $4,000,000 a year principally by taking advantage of wholesale prices. The chief objection urged in the past against the adoption by New York City of a centralized purchase plan for supplies has been that vesting in a single official the authority to make all purchases might lead to gross and serious abuses of that power. The organization of the proposed department of purchase removes the objection, it is claimed, by giving to the heads of the 14 largest purchasing departments in the city supervision over every act of the general purchasing agent.

Electrically Operated Excavators.

The Department of the Interior has executed a contract with the Great Falls Power Co., of Montana, for electrical energy for use in connection with the construction of the Sun River Irrigation Project. The contract calls for 2,500 K. W. of power throughout a period of six years. The power company will transmit the electricity a distance of 100 miles and deliver it to the reclamation service at a number of substations, from which it will be distributed to the principal features of the work. Electrically operated machinery for excavating work has been used in New York City, and on the Calumet-Sag channel near Chicago, but the use of electricity for excavating the canals of the Sun River project marks a new departure in this sort of construction.

PERSONAL

Mr. A. E. Robinson has resigned as state engineer for Idaho.

Mr. Joseph E. Dore, city sanitary engineer for Montreal, recently died in that city of a lingering illness.

Mr. John V. Fitzgerald has been appointed superintendent of streets for Revere, Mass., succeeding Mr. W. A. Sancrie.

Mr. Rodney Smith has been re-elected as city engineer, and Mr. F. E. Bisbee as superintendent of water works at Auburn, Me.

Professor William Kent on March 20 addressed the Cincinnati section of the American Society of Mechanical Engineers, on "Engineering and Common Sense."

Mr. Charles McGonigle, formerly designing and contracting engineer for Millikin Brothers, Inc., has opened an office as consulting structural engineer in the Chamber of Commerce Building, Portland, Ore.

Mr. Chester R. McFarland, superintendent for the Tampa Water Works Co., Tampa, Fla., has been promoted to general manager for the company. His son, O. S. McFarland, will succeed him as superintendent.

Mr. B. C. Brennan, for the past two years assistant city engineer for Kenosha, Wis., has been elected city engineer and superintendent of the water works. Mr. Alfred H. Wood of Milwaukee, was elected as assistant city engineer.

Mr. Walter H. Kelley, supervising foreman of bridge construction for the Oregon Short Line, at Pocatello, Idaho, has resigned to accept a position with the Great Falls Development Co., on dam construction at Great Falls, Mont.

Mr. C. R. Allen, Jr., has resigned as deputy engineer at Mechanicsville, N. Y., for the New York State Highway Department, to enter private practice as consulting engineer, with offices at 16 Knickerbocker Building, Albany, N. Y.

Mr. E. A. Kingsley, civil engineer of Little Rock, Ark., has been appointed engineer in charge of street paving work for street improvement district No. 1 in Woodruff county, Arkansas, where plans are made for over 30 miles of road construction.

Mr. John A. Bensel, New York State Engineer, Albany, N. Y., on March 20, delivered an illustrated lecture on Inter-relationship of "Highways, Waterways and Railways," before the graduate students in highway engineering at Columbia University.

Ira N. Hollis, who has been professor of engineering at Harvard University since 1893, will on July 1 become president of the Worcester Polytechnic Institute, succeeding Dr. L. L. Conant. Professor Hollis is president of the Engineers' Club of Boston.

Rollin D. Salisbury, professor of geology at the University of Chicago, who has recently returned from a trip to Patagonia on March 31 gave an illustrated lecture on his geological investigations in that region, before the Western Society of Engineers, Chicago.

Thomas J. Foley, manager and partner in the Municipal Contracting Co. of Kansas City, died of paralysis in that city, March 18, aged 46. Mr. Foley's home was in Cleveland, but he had been engaged for the past two years in construction work on the Kaw river dikes at Kansas City.

CIVIL SERVICE EXAMINATIONS.

The United States Civil Service Commission announces an examination as follows:

Examiner of Surveys: $1,200 to $1,500 per annum: April 23.

INDUSTRIAL

Mr. C. W. Blue, of the Terry & Tench Co., Inc., New York City, has just returned from New Orleans, where he secured contract for the construction of a 75-ton steel derrick, barge type, fitted with a 100-ft. boom, for Mr. Henry Peters.

The J. W. Paxson Co., manufacturer of foundry facings, supplies and equipment, has introduced a new method of showing its wares at the works of its patrons or at the most available hotel where a sheet may be hung, or a white wall be found. This is accomplished by a new electric stereopticon that may be attached to any electric lamp socket (direct or alternating current) when those interested may see the enlarged pictures on the screen, showing in detail the article itself in elevation and cross section, inside and out, and how made from the raw material to the finished product.

Mr. H. Struckmann, General Manager of Iola Portland Cement Co., has placed contracts for two 95 C Bucyrus shovels, four 10x16 Davenport dinkies, and one 36x60 Fairmount crusher, for the Iola plant. This installation will be followed by the installing of five 10-ft. x 185 ft. kilns with modern wet grinding equipment consisting of No. 85 cominoters and large tubemills. The Iola Company when this work is completed will have one of the most modern plants in the country with a capacity of 5,000 bbls. a day from the new plant and 4,500 bbls. a day from the present 7-ft. 6-in. x125-ft. kilns, which are now all changed to coal burning and running very successfully.

The Wheeling Mold & Foundry Co., of Wheeling, W. Va., announces that after May 1st it will offer both a 5 and 7-ton tandem road roller in connection with its present complete line of stone crushing machinery. This roller is already favorably known. It was designed by two engineers of wide experience in road rollers, and for the last two years has been controlled by the John A. Donahue Co., Great Northern Bldg., Chicago. Mr. Donahue will continue to sell the roller through his present organization. The Wheeling Company has a plant well and completely equipped for the manufacture of heavy machinery of this kind, and the same rigid inspection that has been enforced by the Government of the large amount of machinery built by the company for the Panama Canal will be enforced in the construction and operation of the road machinery they are making. Leroy A. Kling is Sales Manager of the Road Machinery Department.

CATALOGUES

Steam Machinery.—Paper, 9x12 ins., 32 pp. Steam Machinery Publishing Co., Duluth, Minn.

This is a monthly magazine of machinery and methods for contractors, excavators and railroad builders published by the advertising division of the Clyde Iron Works.

Dolarway Pavement.—Paper, 6x9 ins., 32 pp. Dolarway Paving Co., Whitehall Bldg., New York City.

This catalog contains a number of illustrations of Dolarway Pavement in various stages of construction, and information as to maintenance, costs, descriptions of work and letters from users.

Road Oiling Machinery.—Paper, 10½x6⅞ ins., 40 pp. The Good Roads Machinery Co., Arcade Bldg., Philadelphia, Pa.

Included in this catalog are illustrations and descriptions of machinery for oiling earth and stone roads. A description of the details and method of operation of the Monarch Distributor is given with complete illustrations. There is also shown the Champion Trailor Distributor Attachment, the Champion Heating Distributor, the Fort Wayne, Good Roads and the Climax Distributors. Other auxiliary machinery is shown.

Corr-Mesh.—Paper, 6x9 ins., 48 pp. The Corrugated Bar Co., Buffalo, N. Y.

This is a very complete book, giving illustrations of design with tables for walls, roofs, ceilings, partitions, etc., constructed of concrete or stucco, using corrugated bars or units as reinforcing material.

Peerless Motor Trucks.—Paper, 3¾x8½ ins., 12 pp. The Peerless Motor Car Co., Cleveland, O.

This folder illustrates and describes the use of the Peerless Motor Truck in hauling ice and shows a truck driven 18,000 miles with the original chain sprockets, giving no indication of wear.

Another folder illustrates and describes the construction of the chassis of the 3, 4 and 5 ton Peerless Trucks.

Wood Rock Drills.—Paper, 4x9 ins., 6 pp. Wood Drill Works, 31 Dale Ave., Paterson, N. J.

This bulletin is entitled "Talks by the Drillmaster," and gives practical information as to the development of the drill, with descriptions of work upon which it is being used.

Independent Dynamite.—Paper, 5¼x7½ ins., 90 pp. Independent Powder Co., 652 Pierce Bldg., St. Louis, Mo.

This book contains a number of illustrations with descriptions of blasting operations for mining, quarrying, blasting stumps, tree planting, road building, etc. Useful information as to the methods of handling dynamite is included.

Road Building Machinery.—Paper, 10x6¾ ins., 60 pp. Russell Grader Mfg. Co., 2209 University Ave. S. E., Minneapolis, Minn.

This catalog illustrates and describes a large line of road building and earth handling machinery. Specifications are given. The catalog includes graders, elevating graders, drag scrapers, wheel scrapers, drags, snow plows, scarifiers, plows, corrugated culvert pipe, small steel beam bridges, etc.

Electrical Machinery.—Paper, 8x10½ ins., 8 pp. General Electric Co., Schenectady, N. Y.

Bulletin A4092 describes and illustrates type I-10 Thomson Watthour Meter. This bulletin supersedes the previous bulletin on this subject.

Bulletin No. A4087 illustrates and describes direct current motor starting panels for heavy service. This bulletin supersedes the company's previous bulletin on this subject.

Northwestern Concrete Machinery.—Paper, 10¾x8¼ ins., 24 pp. Lansing Co., Lansing, Mich.

This catalog illustrates and describes the Northwestern Cone Batch Mixing Machine, showing the details of construction. There is also included the Northwestern Twin Screw Continuous Mixer, the Triangular Sidewalk Batch Mixer and the Triangular Hand Batch Mixer. Two types of gasoline engines are shown.

White Trucks.—Paper, 8x10 ins., 28 pp. The White Co., Cleveland, O.

This catalog gives a large amount of information with illustrations and descriptions of White Motor Trucks for heavy service, trucks of 3 and 5 ton capacities, with various types of bodies.

Lakewood Concrete Machinery.—Paper, 6x9 ins., 12 pp. Ohio Ceramic Engineering Co., Cleveland, O.

This catalog illustrates and describes concrete mixing and distributing plants, including mixers, hoists, steel towers, chutes, buckets, cars, buggies, etc.

RAILWAYS

Alabama.

The Birmingham-Tuscaloosa Ry. & Utilities Co. has a location party in the field for its projected 54-mile line from Birmingham to Tuscaloosa, via Bessemer. Norris Bros., bankers, Philadelphia and New York City, are financing the line. It will be built by the Tidewater Construction Co., of Birmingham, Ala. The incorporators include C. S. Gannon, W. S. Adams and C. R. Carter, Birmingham, Ala.

Arkansas.

The city of Mt. Ida, county seat of Montgomery County, Ark., has subscribed a bonus of $30,000 and provided terminal facilities for the railroad to be constructed from that city to a connection with the Iron Mountain at Womble, a distance of 12 miles. G. C. Godman, Webber Falls, Okla., is promoting the project.

California.

The Peninsular Ry. Co., F. E. Chapin, Manager, 143 S. Market St., San Jose, proposes the construction of a 5-mile electric railway over Alum Rock Ave., from the easterly city limits of San Jose to the new San Jose Golf and Country Club.

The Petaluma & Santa Rosa Ry. Co., E. M. Van Frank, President, Petaluma, Cal., has applied to the State Railroad Commission for authority to issue $80,000 of bonds and notes in the sum of $64,000. The proceeds from the sale of the bonds and notes, are to be used to construct a trolley line from Liberty station to a new station to be called Two Rock, 5½ miles west, with side tracks, stations and other appurtenances.

The Pacific Electric Ry., Geo. E. Pillsbury, Chief Engineer, Los Angeles, has completed a survey for an extension of the Franklin Ave., Los Angeles, line through Beachwood Park, Hollywood, to connect with the present Brush Canyon line by loop.

Plans have been approved for double-tracking the Santa Fe System from Victorville to Summit, a distance of 19 miles. It is probable, however, that the work will not be started until fall.

The Tidewater & Southern R. R., J. H. Wallace, Chief Engineer, 25 S. Sutter St., Stockton, Cal., will start work this month upon the construction of its line between Modesto and Turlock.

The San Diego & Arizona Ry., E. J. Kalbright, Chief Engineer, San Diego, will probably start construction work this fall at the present terminus west of Dixieland and build 15 to 20 miles of line.

The Ocean Shore R. R., A. Williams, General Manager, San Francisco, has requested the Board of Public Works of that city to approve its plans for a track from 12th St., between Mission and Howard, to the south half of the block bounded by Mission, Market, 11th and 12th Sts., which the company has acquired for terminal purposes. The intention is to put down only a single track at present; 9-in. girder rail is to be used and first-class track construction is proposed.

It is reported that the Chowchilla Pacific Railroad Co., with offices at San Francisco, Cal., has let the contract for the construction of its line and that actual work will be commenced at once.

The Central Pacific Railway Co. has applied to the Railroad Commission for authority to extend its Melrose-San Leandro extension and its Fruitvale "Y" across several streets and highways to the southeasterly boundary line of the city of Oakland.

The Board of Public Works of San Francisco has adopted the modified specifications of M. M. O'Shaughnessy, City Engineer, for the construction of the roadbed of the municipal railway from 33rd Ave. and Geary St. to the beach. The cost of construction under these specifications is estimated at $54,400 and a bonus of $150 a day for not more than 20 days is to be allowed for completion ahead of the contract time, bringing the possible expenditure up to $57,400, which sum the Works Board has requested the Supervisors to set aside.

The Northern California R. R. & Navigation Co. proposes the construction of a line from Snoden on the Southern Pacific through Eureka to Fort Jones, with a branch from the latter place through Etna and on to Calahans; also a branch from Fort Jones to Greenville, Oro Fino and Quartzville. The main line will continue from Fort Jones down Scott River to the Klamath and on down to Happy Camp, the present terminus. Later the line will be extended to the coast with Eureka or Crescent City, or both, as the terminals. The approximate length of the completed line will be 350 miles. The first 110 miles is to be started shortly. Preliminary survey has been made. No contracts will be let. G. W. Bartle, 604 Exchange Bldg., Los Angeles, Cal., is President.

Colorado.

City Council of Canon City, Colo., has granted an extension of time to May 1 to Frederick B. Smith, New York City, for beginning construction work on the proposed electric car line from the city to the top of Royal Gorge. The franchise was granted about a year ago. It is expected that Mr. Smith will be in Canon City early this month.

Final agreement on plans for improved passenger terminal facilities of the Denver Union depot is reported to have been reached by the executives of the interested railroads. It is now stated that work in rearranging the trackage will be started this summer. About $2,000,000 is to be expended in remodeling the old depot and rearranging trackage. The present depot company is controlled by the Union Pacific with a three-fifths ownership, the Colorado & Southern and the Rio Grande each a one-fifth owner.

Connecticut.

The Business Men's Association of Meriden, Conn., has voted to have a survey made for a proposed trolley line to Kensington and New Britain.

Georgia.

The Savannah & Southern Ry. has surveys under way for an extension from Willis to Glennville, Ga., 16 miles. An extension from Speirs, via Clyde, to Savannah, is also contemplated. Stewart Carr, Letford, Ga., is General Manager.

Illinois.

It is reported that the Illinois, Iowa & Minnesota Railroad contemplates the construction of a line from Rockford, Ill., to Beloit, Wis.

The Illinois Northern Utilities Co., John H. Gulick, Secretary, 120 W. Adams St., Chicago, owner of the Sterling, Dixon & Eastern Electric Ry., is considering building an extension from Sterling to Morrison in the near future.

The Illinois Central R. R. is reported to have completed plans for the extension of its four-track system from Matteson to Kankakee, a distance of 28 miles.

The Chicago, Milwaukee & St. Paul R. R. began work last week on the elevation of its tracks on Bloomingdale Road, near Ashland Ave., Chicago. The elevation will extend from Ashland Ave. to North Lawndale Ave., a distance of 2½ miles; 35 grade crossings, which have been a menace, will be abolished, including the crossings at Milwaukee Ave. and Humboldt Park Blvd. The work will cost about $2,500,000.

Indiana.

The Richmond, Portland & Fort Wayne R. R. Co. has filed its articles of incorporation with the Recorder of Adams County. The company purposes the construction and operation of an interurban line through Ft. Wayne, Decatur, Monroe, Berne, Ceylon, Geneva, Bryant, Portland, Winchester, Lynn, Fountain City, Richmond and intermediate points. The company is incorporated for $100,000, of which $10,000 is subscribed by the following five directors: Grant S. Staub, $9,600; and $100 each by William F. Harbison, Charles F. Harbison, Richard J. McCarthy, Chas. H. Frank.

The Grand Rapids & Indiana Ry., E. H. Barnes, Chief Engineer, Grand Rapids, Mich., will, it is reported, eliminate a heavy grade south of Decatur this summer. This work would probably require a cut ½-mile in length and over 10 ft. deep in places.

Iowa.

The Illinois Traction Co., H. E. Chubbuck, Manager, Peoria, Ill., is reported to have completed negotiations for the purchase of the stock of the Oskaloosa Traction & Light Co. and the Oskaloosa & Buxton Interurban Co.

The Minneapolis & St. Louis R. R. is reported to be contemplating building this year a line from Ruthven to Terrill, thus shortening the route to Des Moines.

The Creston, Winterset & Des Moines R. R. of Creston, Ia., will have a considerable amount of ditching, cut widening and track surfacing to do during the coming season and will probably be in the market in the near future for the lease or purchase of a used steam shovel, dump cars and light locomotive, or to contract the work to parties having an outfit of this kind.

Bids were opened March 21 by E. S. Harlan, Atlantic, Ia., Receiver of the Atlantic Northern & Southern Ry., for the purchase of the road. The three highest bids were as follows: S. C. Pedersen, $119,000, for the north end of the road; Robert Ables, $174,800 on the south end; The Blakedale Co., by Leslie M. Shaw, $293,000 on the whole road.

Kansas.

The Midland Valley R. R., A. A. Lefeber General Manager, Muskogee, Okla., is reported to have floated a loan of $15,000,000. Of this sum it is believed that the company will set aside $10,000,000 for the extension of the line from Wichita into Colorado and on into Denver, and that the remaining $5,000,000 will be used for modern equipment.

Kentucky.

Surveys are under way and construction work will probably be started soon on the branch line to be built from Paducah to the Paducah Metropolis bridge by the Paducah & Illinois R. R. This is a subsidiary of the Nashville, Chattanooga & St. Louis R. R. W. J. Hills, Paducah, Superintendent of the Paducah-Memphis Division of the latter road, is Vice-president and General Manager of the Paducah & Illinois R. R.

Louisiana.

The Kansas City Southern Ry. is placing a number of improvements in this state and in Texas. The principal work will be done at Lake Charles, La., and Port Arthur, Tex. The yards at Lake Charles and Beaumont, Tex., will also be enlarged.

Maryland.

The State Public Service Commission has granted permission to the Western Maryland Ry. Terminal Co. to issue $300,000 in stock. The terminal company is a subsidiary of the Western Maryland Ry. Co., organized to acquire yards, depots and terminal facilities. All the issue authorized will be purchased by the railroad company under permission from the commission.

Stockholders of the Frederick Electric Ry. Co., Frederick, Md., have voted in favor of the proposed merger of that road with the Hagerstown Ry. Co. and subsidiaries, and the

Frederick Gas & Electric Co. In all six electric railway companies, one power company and one lighting company are to be merged into the Hagerstown & Frederick R. R. Co., with a capitalization of $3,000,000 of preferred and common stock and $10,000,000 of first mortgage bonds.

Massachusetts.

⊙Hugh Nawn Contracting Co., 82 Lavin St., Boston, Mass., has been awarded the contract, at $351,048, for the construction of Section B of the Dorchester Tunnel. Bids were opened March 25 by the Boston Transit Commission, Boston, Mass.

The Engineering Department of the New York, New Haven & Hartford R. R. is working on plans for the elimination of 13 grade crossings between Readville and East Junction and for four-tracking the line between these points. It is probable that the plans will not be completed ready for construction much before next September.

Michigan.

The Grand Rapids & Indiana Ry. will rebuild its roadbed between Haines Siding and Walton Junction, a short distance north of Cadillac. This minor improvement will reduce some heavy grades and will involve the expenditure of about $50,000.

Plans are well advanced for the proposed electric railway from Owosso to Pontiac, with a branch from Fenton to Flint. It is probable that the line will be built from Linden, the source of power, to Fenton and thence to Flint this year. W. B. McLaughlin and Dr. O H. Lau, Detroit, Mich., are interested.

The State Railroad Commission is reported to have authorized the Battle Creek, Coldwater & Southern R. R. Co. to issue $450,000 of capital stock. This company, which has been in the promotive stage for some time, proposes the building of an electric railway from Battle Creek to Coldwater. The new promoters state that work will be started this year.

The Wabash R. R. has purchased the Detroit & Western Ry., extending about 2 miles in Oakwood in the rear of Fort St. west and according to reports the new track will be developed into additional terminal facilities.

Minnesota.

The Chicago, Milwaukee & St. Paul R. R. is reported to have engineers in the field working on the surveys for a proposed new line between Hutchinson and Montevideo, a distance of 83 miles, which will run through a lake region.

The Northern Pacific R. R. will start preliminary work shortly for a large freight terminal and roundhouse at Carlton and for a similar improvement at White Bear. The cost of these improvements will be about $1,000,000. Details of car capacity of the yards and locomotive capacity of the roundhouses to be built have not been fully determined.

St. Louis Items.

BY A. B. KOENIG.

✣The Shelby County R. R., with headquarters at Shelbina, Mo., has 22 miles of grading to let. This is principally slip work. Write L. B. Houck, President, at Shelbina or Cape Girardeau, Mo.

✣The President of the Board of Public Improvements, Room 300 New City Hall, St. Louis, Mo., will let a contract for the reducing of garbage for the city of St. Louis, Mo., for a term ending Sept. 18, 1918. Specifications, form of contract and other information can be had at the above office.

✣The City of St. Louis will let contracts on April 18 for construction of an intake tower, tunnel and screen chamber; also constructing the chain of rock filter for the water department here. Plans, specifications and form of contracts may be obtained at the office of the Water Commissioner, Room 312, New City Hall Bldg., St. Louis. Maxime Reber is President of the Board of Public Improvements and Wm. T. Findly is Secretary.

⊙Patton & Russell were awarded the Michigan Central work and have established headquarters at the Wayne Hotel, Detroit, Mich. This firm bought $120,000 worth of cars last week to be added to their outfit on this work.

Mike Conroy's work across the river here has been laid up the past week on account of rain and bad weather. He is working on a 100,000-yd. job of town site grading.

M. J. Cole, Jr., 2416 W. 13th St., Little Rock, Ark., has 20 railroad teams and a good grading outfit idle.

Chas. Grant has finished his work at Harrisburg, Ill., and wants work for a 19-team outfit.

Wm. Brothers has been in here several days from Bird's Point, Mo., looking for work for his 20-team outfit. Brothers has just finished a piece of levee work, but wants to get away from the river.

G. W. Condon's camp at 42nd and Harney Sts., Omaha, was entirely blown away by the cyclone that struck that town last week. His grading machinery and wagons were lifted up and scattered about the adjacent territory, but most of it was only a little injured. There were 20 men in the camp at the time. One man was killed outright and three were seriously injured. With the exception of five mules, which were killed, the 70 head of horses and mules in camp were unhurt. Condon's loss to his camp and equipment will amount to about $5,000.

The heavy rain which fell in this part of the country the past week caused overflows and washing away sections of tracks of very nearly every railroad running into St. Louis. The trouble, however, was only temporary, as the labor market in St. Louis is very easy at the present time and all railroad companies immediately got busy repairing damage. No trouble to get all the labor they wanted for this work.

The J. A. Ware Construction Co., Houser Bldg., St. Louis, Mo., has some clearing to let in the Woodriver Drainage District near East Alton, Ill. They have opened a camp there and are going to do the grading—$181,000 is to be expended on this job. The Ware Construction Co. has some nice team work to let near Missouri City, Mo., on the Wabash. They can also use a small team outfit on the Woodriver Drainage District near East Alton, Ill.

Burke & Joseph Construction Co. had the misfortune to lose $6,000 worth of lumber and their tool house, which was washed away by the River Des Peres, alongside of which they are building the sewer in the southern part of the city, raising from 10 to 20 ft. very suddenly last week after the heavy rains.

The Frisco R. R. Co. is going to build a new freight house at Calhoun and Kentucky Sts., Memphis, Tenn. The approximate cost will be about $100,000.

The Cotton Belt R. R. Co. has improved the old Iron Mountain Passenger Depot in Memphis and is now using it for freight purposes.

The Illinois Central R. R. Co. expects to have the concrete abutments for the elevated tracks and fills completed by May 1, and then will be ready to let its contracts in connection with this work in Memphis.

Major E. M. Markham, U. S. Eng. Mississippi River Commission 1st and 2nd Districts at Memphis, Tenn., is asking for proposals for furnishing and loading about 25,000 cu. yds. of riprap stone on government barges. Bids will be opened in Memphis on April 26, 1913.

Montana.

Engineers of the Great Northern Ry. are said to have started work on the proposed 500-mile line from Collins, Mont., on the Great Falls-Shelby line north along the eastern boundary of the Glacier National Park into the Canadian coal fields.

New York.

Work will probably be started in a short time on double-tracking the Staten Island Rapid Transit Ry., from Prince Bay to Pleasant Plains on the Amboy Division. W. B. Redgrave, St. George (S. I.), N. Y., is Engineer Maintenance of Way.

The Buffalo, Rochester & Pittsburgh Ry. is understood to be planning to let contracts in the near future for laying second track between Rochester and Scottsville, N. Y., 12 miles. Contracts will be let for a classification yard two miles outside of Rochester, in which 10 miles of track will be laid.

The New York Public Service Commission has authorized the financing of the Belt Line Railway Corporation, including the old Central Park, North & East River Co., and its absorption in the Third Ave. Railway system. It received permission to issue $431,300 capital stock and $1,750,000 first mortgage 5 per cent bonds, payable on Jan. 1, 1943, and redeemable as an entirety at 105. The Third Avenue Railway Company was likewise authorized to buy the entire stock and bond issues on condition that it guaranteed the principal and interest on the bonds. Conditions were attached to the bond issue. The company had to procure authorization for the issue of $600,000 of stock and could not sell its bonds for less than 95 per cent and accrued interest. It had to devote the proceeds of the sale of stocks and bonds to refunding Edward Cornell the $1,676,706 he spent on the purchase of the road, to paying $397,406 for taxes and other liens on the property, and to defraying the obligations incurred by the Belt Line Corporation to the amount of $19,687. In order to provide for the discount on the bonds, which the commission reckoned at $87,500, $2,916 must be set aside each year out of income. The Third Avenue Railway Company after it has purchased the bonds of the Belt Line Corporation is also prohibited from selling them for less than 95 per cent of their face value, and must undertake to provide for the amortization of the discount out of earnings.

North Carolina

⊙W. Z. Williams & Co., Macon, Ga., are reported to have been awarded the contract for constructing concrete masonry for second track from Parkton to Selma, N. C., 63 miles, for the Atlantic Coast Line Ry.

North Dakota.

The Montana Eastern Railway Co., subsidiary to the Great Northern, has filed at the Government Land Office, Fargo, N. Dak., papers for right of way purposes for the new branch line west of New Rockford. The right of way as shown is from New Rockford to the Sheridan County boundary line about 12 miles north of the Turtle Lake branch line of the Northern Pacific Railroad. This is from township 149, range 67, to township 148, range 74. Throughout the whole length of the right of way the proposed road proceeds in an almost straight line west, until near the western end when it makes a gradual drop of 2 miles.

Ohio.

⊙John B. Lindsey, Pomeroy, O., has been awarded the contract for grading for an extension of the Hocking Valley R. R. through Keers Run into the Nease Settlement, opening up undeveloped coal territory east of Hamden.

The Cleveland Interurban R. R. Co., of Shaker Heights (a suburb of Cleveland) has been incorporated with a capital stock of $5,000, the incorporators being W. D. Turner, L. M. Henders, M. G. McAlleman, B. E. Robertson, E. D. Comer.

Oklahoma.

Arrangements are reported to have been made for completing the Estacado & Gulf R. R. of Texas, from McCaulley on the Orient, to Roby, Tex., 12 miles distant. About 7 miles of track are already laid. L. C. Eastland, Oklahoma City, Okla., is President.

The citizens of Beaver, Okla., have submitted a proposition to the officials of the Santa Fe System offering to raise a substantial bonus and furnish free right of way pro-

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viding the company will build a line from Englewood, Kan., through Odee, Kan., and Forgan, Okla., to Beaver.

Pennsylvania.

⊙Walker & Curley, Pittsburgh, Pa., have been awarded the contract for a roundhouse, shop, storeroom and power house, to cost $75,000 and to be erected at Dickerson Run, Pa., for the Pittsburgh & Lake Erie R. R.

⊙F. H. Clement & Co., Land Title Bldg., Philadelphia, Pa., has been awarded the contract for grading and putting in additional tracks at entrance to the Bethlehem Steel Works, South Bethlehem, Pa., for the Lehigh Valley. The work will cost about $50,000.

It has been announced that engineers of the New York Central Lines will have completed plans by April 15 for the abolishment of grade crossings at Parade, Peach and Sassafras Sts., Erie, Pa. A new Union depot is also under consideration.

It is reported that work will probably be started this summer on the new electric railway between Erie and Corry, via Waterford, Le Bœuf and other points. Some grading work was done a number of years ago for this line. The rights have recently been purchased by F. F. Curtz, Erie, Pa., President of the Erie Traction Co., and C. M. Hatch, Erie, General Manager of the same company.

South Carolina.

The Carolina, Clinchfield & Ohio Ry., Ward Crosby, Chief Engineer, Johnson City, Tenn., plans to construct coal terminals on the upper water front at Charleston.

South Dakota.

It is rumored that the Great Northern will shortly start construction work on the new line between Sioux Falls, S. Dak., and Platte. Surveys of the route were made last winter.

The Sioux Valley & Northern R. R. Co. has been chartered with a capital stock of $1,000,000 and proposes a 100-mile line to extend from Watertown, through Codington, Grant and Roberts Counties to the northern edge of the state. The directors include F. F. Heathcote, Summit, S. D.; John Maxwell, Ortley, S. D.; F. J. Klix, Summit, S. D.

Tennessee.

Advices from Memphis, Tenn., state that the contract for the construction of the proposed new Illinois Central station at Calhoun Ave. and South Main St. will be let within a few days. Plans and specifications are now said to be ready for the contractors.

Texas.

It is reported that capitalists interested in the coal fields of Northern Stevens County are contemplating the construction of a railroad from Knox City to Fort Worth, Tex., a distance of 125 miles.

The citizens of Coke County recently held a mass meeting at Robert Lee, Tex., and definite plans were discussed for securing the extension of the Kansas City, Mexico & Orient R. R. A large bonus is to be raised.

It is rumored that the reorganized Kansas City, Mexico & Orient Railroad contemplates the construction of an extension from Knox City to Fort Worth. C. W. Thomason, Haskell, Tex., is said to have stated that the new line would be built by the road as soon as it was reorganized. The extension will traverse Parker, Palo Pinto, Throckmorton, Stephens and Tarrant Counties. It is understood that capitalists backing the reorganizing of the Orient are endeavoring to secure control of the undeveloped coal field, using the extension as a means for assuring the marketing of the output.

The Missouri, Kansas & Texas R. R. will probably expend about $2,000,000 this year for improvements to its lines in Texas. The work to be undertaken in the near future will most likely include the construction of a line from Dublin through Eastland County to the coal fields in Palo Pinto County, and the extension of the Texas Central west from Rotan through ten counties, a distance of 200 miles, to a point on the Texas-New Mexico boundary. It is further planned that the Katy is to have a Gulf outlet at the mouth of the Brazos, having closed a deal for the purchase of the Houston & Brazos Valley R. R., running between Houston and Freeport, the new gulfport being financed by the Swensen interests and the National City Bank of New York officials.

Virginia.

It is rumored that engineers of the Virginian Railroad Co. are surveying a route for a cut-off line from Rich Creek to a connection with the Piney Creek Railroad, a line connecting the Virginian at Lester with the Chesapeake & Ohio at Prince. H. Fernstrom, Norfolk, Va., is Chief Engineer.

Washington.

⊙The Seattle Construction Co. is reported to have been awarded the contract for reconstructing the Northern Pacific line between Seattle and Sumas, at a cost of about $4,000,000. The Seattle Construction Co. is probably composed of Grant Smith & Co., Seattle and Stillwell.

Wisconsin.

The Great Northern R. R. will build a 1¾ miles trolley line to its new shops and terminal between Allouez and Sanders, for the purpose of transporting its employes.

The State Railroad Commission has granted the Chicago, St. Paul, Minneapolis & Omaha R. R. authority to straighten its right-of-way, reduce its grades and double-track its road from Knapp to Northline, a distance of 50 miles, in the northwest part of the state.

The Chicago & Northwestern Ry. has made surveys, and there is some probability that work will be started in the spring on an extension from Koepenich to a point north of Lily, opening up timber lands in the northern and eastern part of Langlade County.

Farmers of Hale, Pigeon and Northfield, Wis., recently held a meeting at Whitehall, Wis., and decided to organize and incorporate the Pigeon Valley Railroad Co. with a capital of $5,000 to construct a railroad through the above towns.

Wyoming.

Arthur & Potter, Pueblo, Colo., have shipped a grading outfit to Orrin Junction, Wyo., for work on their subcontract on the Burlington.

Canada.

Shareholders of the Central Ry. Co. of Canada will meet at Montreal on April 22 to consider an issue of first mortgage bonds on the company's line between Montreal and Midland, the redemption of outstanding bonds and to increase the share capital of the company.

A special meeting of shareholders of the Campbellford, Lake Ontario & Western Ry. Co. will be held at Montreal April 16th, for the purpose of considering the proposed lease of the company's railway to the Canadian Pacific.

ROADS AND STREETS

Alabama.

✣Bids will be received until April 7, by City Council, Gadsden, Ala., for the construction of 1,334 sq. yds. concrete sidewalk, 3,000 lin. ft. 8-in. curb, 36-in. gutter, 200 lin. ft. 6-in. gutter, 200 cu. yds. excavation and taking up of 15 trees. Plans and specifications are on file in office of Charles L. Marsh, City Engineer.

City Engineer Walter G. Kirkpatrick, of Birmingham, Ala., has recommended that the 3rd Ave. route for the proposed Ensley-East Lake Blvd. be selected.

Arizona.

⊙The Board of Supervisors of Greenlee County, Ariz., recently let a contract for the construction of the Clifton-Metcalf Road to Vandrecook & Black of Clifton, Ariz., for $31,711. Work is to be completed Sept. 4. This road will be graded and macadamized. Work was started March 25. H. Ogle Tunis, Clifton, is Engineer.

The City Council of Tucson, Ariz., has ordered Congress St. paved with bitulithic.

California.

⊙T. K. Beard, of Modesto, Calif., has been awarded the contract by the Tuolumne County Supervisors, Sonora, Calif., for the grading and reduction of the grade of Priest's Hill on the Big Oak Flat Road. The work to be done includes about five miles of road. The grade of the hill at present is about 15 per cent, and it is to be reduced to 5 per cent. The amount of the contract is $16,000.

⊙Considine & Bates Co., Los Angeles, Cal., has been awarded the contract at $32,389 for constructing Sec. B, Route 4, of Division 3 of the Stanislaus County section of State Highway, bids for which were opened March 24.

City Engineer J. J. Jessup, of Berkeley, Calif., has submitted estimates to the City Council for the paving of Dwight Way from Shattuck Ave. easterly. Estimated cost of oil macadam is: Curb, 65 cts.; concrete gutter, 60 cts.; regrading, 20 cts.; pavement, 80 cts.; crossings and incidentals, 50 cts. Of asphalt: Curb, 65 cts.; concrete gutter, 30 cts.; regrading, 27 cts.; pavement, $1.80; crossings and incidentals, 60 cts.

The Board of County Supervisors, Bakersfield, Calif., a commission to determine the plans for a system of good roads to make a net work of fine highways over Kern County. It is planned to issue bonds for $2,000,000 to $2,500,000, and the election will be set for an early date.

Connecticutt.

⊙The Union Paving Co., Schenectady, N. Y., has been awarded the contract by the Board of Public Works of New Britain, Conn., for the paving of West Main St., from the end of the present pavement to Black Rock bridge, including approximately 18,000 sq. yds., at $3.38 for wood block and $2.56 for brick. Bids were opened March 26.

Delaware.

⊙The Horrigan Contracting Co., Wilmington, Del., has been awarded the contract by James Wilson, New Castle County Highway Commissioner, 304 Church Bldg., Wilmington, for the construction of a water-bound macadam road on the Odessa-St. George Road, for $27,500. The road is three miles in length. Bids were opened March 18.

District of Columbia.

The Engineering Department of Washington, D. C., has ordered extensive street repairs calling for a total expenditure of approximately $100,000. In all, 26 roadways are to be repaired or resurfaced, the cost to be met out of the general fund of the department. The thoroughfares are as follows: F St. northwest between 17th and 18th Sts., at an estimated cost of $3,200; 10th St. southwest between B and C Sts., $4,000; New Hampshire Ave. northwest between L and M Sts., $6,600; 3rd St., northeast between R and T Sts., $6,800; 4th St. northeast between S and T Sts., $3,700; East Capitol St. between 1st and 6th Sts., $11,500; Maryland Ave. northeast between 14th and 15th Sts., $7,600; S St. northeast between 3rd and 4th Sts., $2,600; Seaton St. northeast between 3rd and 4th Sts., $2,600; R St. northeast between Eckington Pl. and 3rd St., $5,800; T St. northeast

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between 3rd and 4th Sts., $1,800; 6th St. southeast between East Capitol and B Sts., $6,200; 18th St. northwest between K and L Sts., $2,800; on the east side of 9th St, northwest between E and F Sts., $1,100; on the east side of 9th St. between F and G Sts., $1,650; on the east side of Connecticut Ave. northwest between S St. and Florida Ave., $400; on D St. southwest between 7th and 9th Sts., $4,000; Marion St. northwest between P and Q Sts., $3,400; M St. northwest between New Hampshire Ave. and 21st St., $2,200; M St. northwest between New Jersey Ave. and 6th St., $7,600; John Marshall Pl. northwest between Pennsylvania Ave. and D St., $9,400; 17th St. southeast between Minnesota Ave. and Good Hope Road, to be repaired with old material, $150; 8th St. northwest between Florida Ave. and Euclid St., to be resurfaced with old street material, $200; granite block roadways of 7th, 12th and 14 Sts., where they intersect park roads through the Mall, to be relaid, $375.

Florida.

Engineer C. L. Craven, Arcadia, Fla., is preparing plans for the construction of brick pavement on a sand foundation, with granite curb. The estimated cost is $40,000. Contracts will be let in about 60 days. J. L. Jones, Secy., Board Trustees, is official in charge.

Georgia.

The citizens of Athens, Ga., on March 25 voted the issuance of bonds to the amount of $100,000 for schools and $75,000 for street paving. The entire issue is to be expended during the coming summer and fall.

Idaho.

At the recent city election in Moscow, Ida., delegates favorable to street paving were elected.

Illinois.

✣Bids will be received until 11 a. m., April 11, by the Board Local Improvements,,Chicago, Ill., for furnishing the labor and materials necessary to construct pavements in the following streets: Alley, Cortez St., etc., assessment available $790, 320 lin. ft. concrete curbing, 260 sq. yds. brick pavement; alley, Beldon Av., Fullerton Av., etc., assessment available $1,675, 730 lin. ft. concrete curbing, 530 sq. yds. brick pavement; alley, Archer Av. State St., etc., assessment available $2,000, 400 lin. ft. concrete curbing, 400 sq. yds. granite block pavement; alley, Calumet Av., 30th St., etc., assessment available $1,725, 750 lin. ft. concrete curbing, 600 sq. yds. brick pavement; alley, Michigan Av., 42d St., etc., assessment available $3,671, 1,182 lin. ft. concrete curb, 1,182 sq. yds. brick pavement; alley, Madison Av., Washington Av., assessment available $1,600, 630 lin. ft. concrete curbing, 500 sq. yds. brick pavement; alley, Paulina St., Washington Blvd., etc., 550 lin. ft. concrete curbing, 550 sq. yds. brick pavement; alley, Grand Av., Carpenter St., etc., assessment available, $1,715.75, 650 lin ft. concrete curbing, 580 sq. yds. brick pavement; alley, Kedzie Av., Milwaukee Av., etc., assessment available $2,778, 1,082 lin. ft. concrete curbing, 370 sq. yds. brick pavement; alley, Cottage Grove Av., 12d St., etc., assessment available $1,180.25, 500 lin. ft. concrete curbing, 370 sq. yds. brick pavement; alley, Vernon Park Pl., Norton St., etc., assessment available $922, 740 lin ft. concrete curbing, 250 sq. yds. brick pavement; alleys, Taylor St., Center Av., etc., assessment available $3,942.50, 1,550 lin. ft. concrete curbing, 250 sq. yds. brick pavement; Berteau Av., 52d Av. to 53d Av., assessment available $7,000, 1,370 lin. ft. granite concrete combined curb and gutter, 2,270 sq. yds. asphalt pavement; 40th Av., Fillmore av. to 16th St., assessment available $33,898, 2,100 lin. ft. sandstone curbing on concrete, 4,300 lin. ft. to be reset, 11,850 sq. yds. brick pavement; 43d Pl., Union Av. to Canal St., assessment available $13,500, 2,800 lin. ft. granite concrete combined curb and gutter, 4,150 sq. yds. asphalt pavement; 51st Ct., Irving Park Blvd. to Berteau Av., assessment available $9,400, 2,650 lin. ft. granite concrete combined curb and gutter, 3,450 sq. yds. asphaltic concrete; Marshfield Av., 67th St. to 72d St., assessment available $29,261, 5,990 lin. ft. granite concrete combined curb and gutter, 9,790 sq., yds. asphalt pavement; Ohio St., Western Av. to Campbell Av., assessment available $6,941.80, 1,300 lin. ft. sandstone curbing, 1,150 cu. yds. cutting, 2,280 sq. yds. brick pavement; Paulina St., 67th St. to 72d St., 6,700 lin. ft. granite concrete combined curb and gutter, assessment available $32,061, 10,930 sq. yds. asphalt pavement; Wood St., 67th St. to 72d St., assessment available $32,314, 6,690 lin. ft. granite concrete combined curb and gutter, 10,920 sq. yds. asphalt pavement; Troy St., Irving Park Blvd. to Montrose Av., Albany Av. to Irving Park Blvd. to Montrose Av., Belle Plaine Av., Kedzie Av. to Sacramento Av., Berteau Av., Kedzie Av. to Sacramento Av., Cullom Av., Kedzie Av. to Sacramento Av., assessment available $61,056.50, 17,500 lin. ft. sandstone curbing, 29,730 sq. yds. asphaltic concrete pavement; 114th St., Stewart Av. to Yale St., Yale St., 113th St. to 115th St. Princeton Av., 113th St. to 115th St., Harvard Av., 112th St. to 115th St., assessment available $29,017, 9,100 lin. ft. sandstone curbing, 13,370 sq. yds. asphaltic macadam pavement. The work includes a 6-in. Portland cement concrete foundation, sewer manhole and catchbasin construction and adjustment; cash or certified check for 10 per cent of bid must accompany proposal.

✣Bids will be received April 9 by Board Local Improvements, Champaign, Ill., for the construction of 35,100 sq. yds. of brick pavement. L. N. Sizer is City Engineer.

✣Bids will be received until 11 a. m., April 11, by L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering a complete portable asphalt plant for use of the Bureau of Streets. Cash or certified check for $500fi must accompany proposal.

⊙The City of Belleville, Ill., has awarded the contracts for the paving of 7th St. and East Main St., to Hoeffken Bros., of that city, for $26,393, and Reeb Bros., also of Belleville, for $16,090 respectively.

⊙Valentine Wolf, Elgin, Ill., has been awarded the contract at Jerseyville, Ill., for the construction of brick pavement on Main St. for about $50,000.

The Business Men's Association, of Sidney, Ill., has appointed a committte to investigate the proposed paving of three blocks of the main street. J. P. Rankin is interested.

The City Council, of Champaign, Ill., has passed an ordinance providing for the paving of West Hill St. and North McKinley Ave. at an estimated cost of $12,000.

The City of Elgin, Ill., plans a considerable amount of improvement work during the coming season at an estimated cost of $340,572. Approximately six miles of pavement is proposed, to cost about $214,867, and 18 miles of sewers, estimated at $125,705. M. H. Brightman is City Engineer.

Following are the lowest bids submitted to the Sanitary District of Chicago, for furnishing and delivering electric lighting street supplies during the year 1913: From 2,000 to 5,000 cast iron posthead with reactance coil and equipment, $3.66 each, W. F. Cummings Co., Chicago, Ill.; 2,000 to 5,000 cast iron postheads with series receptacle and equipment, $2, the J. Lang Electric Co., Chicago; 2,000 to 5,000 glass lamp globes, $1.66, Gleason Tiebott Glass, Brooklyn, N. Y.; 1,000 to 3,000 arc lamp counter weights, $1.20 each, the J. Lang Electric Co., Chicago; 1,000 to 3,000 coal doors and pulleys, $1.70 each, the J. Lang Electric Co. Chicago; 50 to 250 gray iron manhole frames and covers, delivered on streets, $14 each, delivered at store house, $13 each; 1,000 to 10,000 cast iron pole tops, $.295 each; 3,000 to 10,000 cast iron pole bases for 6-in. poles, $1.39 each, for 5-in. poles $1.23 each, Green Engineering Co., Chicago, Ill.; 100 to 500 ornamental pole base and collars, $28.80 each, Dearborn Foundry Co., Chicago, Ill; 100 to 750 arc lamp windlasses, $2.98 each, Delta Star Electric Co., Chicago; type A tubular pole, 26 ft. long, from 4-in. to 6-in. pipe, $10.64 each; type B poles 30 ft. long, 4-in. to 6-in. pipe, $17.70 each; type D poles 30 ft. long, 5-in. to 4-in. steel pipe, $10.30 each; type E poles 30 ft. long, $14.50 each, Electric Railway Equipment Co., Cincinnati, O.; 200,000 to 500,000 duct ft. clay conduit single duct, $.0372, Clay Products Co., Chicago; 2 duct conduit, $.035 per ft., Chicago Stone Conduit Co., 3 duct conduit delivered on street $.044, delivered on team track $.041; 4 duct conduit pipe delivered on street, per duct ft. $.044, delivered on team track $.041; 6 duct conduit pipe delivered on street $.048, delivered on team track $.041, Grand Ledge Clay Products Co., Chicago, Ill; from 300,000 to 1,000,000 lin. ft. single conductor armored cable $.202 per lin. ft., American Steel & Wire Co., Chicago; 150,000 to 300,000 lin. ft. single conductor, lead covered cable, per lin. ft. $.115; 25,000 to 100,000 lin. ft. of No. 4 paper insulated lead covered cable $.32 per lin. ft., American Steel & Wire Co., Chicago: No. 8 conductor insulated paper lead covered cable for multiple conductor 12,-volt, varnished cloth insulated lead covered cable, 25,000 to 100,000 lin. ft. required, size B. & S. gauge No. 6, $.577; No. 5, $.610; No. 4, $.651; No. 2, $.702; No. 1, $.753; 0, $.383; 00, $.907; 000, $.1106; 0000, $1.241 per lin. ft., Standard Underground Cable Co., Chicago, Ill. The contracts have not been awarded. John McGillen, Clerk.

The City Council of Arcola, Ill., has passed an ordinance for $68,000 worth of paving. The West Main St. district calls for paving on West Main St., Arcola Ave. and West Washington St., at a cost of $25,355. The East Jefferson district calls for paving on East Jefferson, Sheldon, Adams, Pine and East Washington Sts. at a total cost of $42,978.

Preliminary surveys are being made by A. H. Hunter of the Illinois State Highway Commission, under direction of the highway commissioners of Edwardsville Township, Edwardsville, Ill., for three miles of hard road to be constructed this summer. A special tax levy has been voted to build 22 miles during the next five years. This summer Troy Road, south from Edwardsville, and St. Louis Road, passing the Fair grounds, will be improved. Bituminous macadam, concrete and brick are the materials being considered.

Following are the lowest bids submitted to the Aetna Engineering Bureau, 17 N. LaSalle St., Chicago, for constructing pavements and sewers by private contract in the third addition to Chester Highlands: 10,000 lin. ft. concrete combined curb and gutter, $0.56.5; 16,000 cu. yds. excavation, average haul 600 ft., $0.55; 14,000 sq. yds. tar macadam pavement, $1.26; 38 new catch basins, $44 each; 2,100 lin. ft. 12-in. tile pipe sewer, $1.48; 2,100 lin. ft. 15-in. tile pipe sewer, $1.59; 3,200 lin. ft. 6-in. tile pipe sewer, $0.43; 62,000 sq. ft. cement sidewalk, $0.13¾; 5,000 sq. yds. alley pavement, $0.51; total, $52,660. John A. McGarry Co., 179 W. Washington St., Chicago. The contract has not been awarded.

Indiana.

⊙Dan. J. Dalton, Anderson, Ind., has been awarded the contract for building sidewalks on four streets in Markleville, Ind.

Bids will be received until 2 p. m., April 3, by City of Frankford, Ind., H. M. Hockman, Engineer, for the following improvements: East Boone St., 1,600 lin. ft. sidewalk, 1,700 lin. ft. curbing, 2,375 sq. yds. brick roadway. Gentry St., 4,400 lin. ft. curbing, 4,400 lin. ft. sidewalk, 7,100 sq. yds. brick roadway, 235 lin. ft. 10-in. vit. sewer pipe, 400 lin. ft. 12-in. vit. sewer pipe, 18 curb inlets, 1 manhole. South Columbia St., 3,200 lin. ft. curbing, 3,000 lin. ft. sidewalk, 5,864 sq. yds. brick roadway, 423 lin. ft. 10-in. vit. pipe, 430 lin. ft. 15-in. vit. pipe, 420 lin. ft. 12-in. vit. pipe, 11 curb inlets, 1 manhole. Rossville Ave., 125 sq. yds. concrete alley crossings, 4,370

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

lin. ft. curb and gutter, 450 lin. ft. curb without gutter, 4,250 lin. ft. sidewalk, 2,800 sq. yds. stone roadway, 300 lin. ft. 10-in. vit. pipe, 400 lin. ft. 12-in. vit pipe, 17 curb inlets, 1 manhole. Oak St. sidewalks, 1,060 lin. ft. sidewalk. Oak St. sanitary sewer, 2,360 lin. ft. 8-in. vit. pipe, 800 lin. ft. 6-in. vit. pipe, 5 manholes, 3 lampholes, 1 flush tank. Meredith St., sanitary sewer, 540 lin. ft. 8-in. vit. pipe, 280 lin. ft. 6-in. vit. pipe, 2 lampholes, 1 flush tank.

The Board of Public Works of Indianapolis, Ind., has adopted plans for paving Fairground Ave. from Central Ave. to Coliseum Ave. The estimated cost, based on wood block material, is $26,068.

Iowa.

⊙The McCarthy Improvement Co., of Davenport, Ia., has been awarded the contract by the Board of Public Works of that city for the paving work on Eighth Ave. between Ainsworth and Marquette Sts.

⊙J. S. McLaughlin & Sons, Red Oak, Ia., have been awarded the contract for the paving of Warren Av. with brick at University Place, Nebr., for $35,037. The work calls for Purington brick, with asphalt filler and concrete combined curb and gutter. Bids were opened March 22.

F. W. Gunther, 1111 Oak St., Burlington, Ia., submitted the lowest bid March 20 to the City Clerk of that city, for grading, curbing with artificial and paving with cement concrete, 6 ins. thick, South St., from 9th to 12th, and from 12th to Summer Sts., at $1.09 per sq. yd.

Plans and estimates have been prepared for grading, paving and curbing Division St. from the north line of 7th St. to the south line of South St., City of Davenport, Ia. The estimated cost is $21,424. Hugo Moeller is City Clerk.

The City Council of Muscatine, Ia., has passed an ordinance creating Paving District No. 30, including about 13 streets and a number of alleys.

Kentucky.

The City Commissioners of Newport, Ky., have ordered the reconstruction of the following thoroughfares: 10th, from Washington to York; York, from 9th to 12th; John, from 9th to 10th; 9th, from Columbia to Saratoga; 8th, from Saratoga to Monmouth; 6th, from Brighton to Patterson; Robert, from 6th to 8th, and 7th, from Columbia to Central Ave., all with brick; Park, from 3rd to 9th, with asphalt, and York, from 8th to 9th, with wood block and granite.

Citizens of Laurel and Clay Counties, Ky., have in process of organization a stock company which will build a toll turnpike from London to Manchester, a distance of 24 miles. The sum of $22,000 has been subscribed by citizens of Clay County, and it is expected to get an equal amount in Laurel County.

Louisiana.

The City Council of New Iberia, La., has passed an ordinance instructing the City Engineer to prepare specifications for 12 miles of concrete sidewalks. Bids will be asked at once by the Mayor.

Maryland.

✣Bids will be received until noon, April 17, by Highway Commission, Baltimore County, Towson, Md., for the construction of a 50-mile section of the state aid road through Baltimore County, along Falls Road north from Beaver Dam Run. All bids must be made upon blank forms to be obtained of the State Roads Commission at its office, 534 North Howard St., Baltimore, Md., must give the prices proposed both in writing, and in figures, and must be signed by the bidder, with his address. Each bid is to be accompanied by a certified check for $200, payable to the Highways Commission of Baltimore County, said check to be returned to the bidder unless he fails to execute the contract should it be awarded to him. Plans can be seen and forms of specifications and contract may be obtained at the office of the State Roads Commission, Baltimore, Md. E. Stanton Bosley is Secretary of the Commission.

The Board of Awards of Baltimore, Md., has approved specifications for three paving contracts aggregating $125,000. The contracts call for vitrified brick, granite block and sheet asphalt. The streets are as follows: Contract No. 52—McMechen St. from Pennsylvania Ave. to McCulloh, Preston St. from Jones' Falls to Valley St., Guilford Ave. from Jones' Falls to Lanvale St. and Park Ave. from Laurens St. to North Ave. Contract No. 53—Hill St. from Sharp to Charles, Franklin St. from Guilford Ave. to Calvert and Sharp St. from Hill to Ostend. Contract No. 54—Mosher St. from Park Ave. to Mount Royal and Linden Ave. from Biddle St. to Dolphin.

Michigan.

✣Bids will be received until 10 a. m., April 7, by Board of Public Works, Jackson, Mich., for the construction of cement sidewalks and curbs in the City of Jackson. J. F. Harrison is Superintendent of Public Works.

✣Bids will be received until 10 a. m., April 7, by Board of Public Works, Jackson, Mich., for furnishing one street flushing wagon. A certified check for 5 per cent of the amount bid must accompany each bid. J. F. Harrison is Superintendent of Public Works.

The business men of Caro, Mich., are advocating the paving of the main streets at an estimated cost of $35,000.

The Township of Colfax, Huron County, Mich., will submit to the electors on April 7 the proposition to bond for $20,000 for the purpose of procuring better roads. Bad Axe is the county seat.

The Michigan Legislature has passed a bill providing for the submission of the question of bonding the state for $3,000,000 for the trunk line highway project to the vote of the people.

Minnesota.

✣Bids will be received until 11 a. m., April 14, by A. P. Erickson, County Auditor, Minneapolis, Minn., for grading 3,700 ft. of Road No. 8, being Contract No. 14, commencing at the westerly limit line of the city of Minneapolis and extending northwesterly, all in the village of Robbinsdale, according to plans and specifications on file in the office of the County Surveyor.

✣Bids will be received until 10 a. m., April 11, by William Lincoln, County Auditor, Fergus Falls, Minn., for furnishing certain corrugated steel culverts and certain road machinery.

✣Bids will be received until 2 p. m., April 15, by the County Board of Pipestone County, Minnesota, at the County Auditor's office, Pipestone, Minn., for grading for State Roads numbered 3, 9 and 10, and graveling State Road number 2, as per plans on file in the office of County Auditor, at Pipestone, Minn., and with the Highway Commission, St. Paul, Minn. State Road No. 3—Grading north one-half mile between Sections 34 and 35-106-44. State Road No. 10—Grading north one-half mile between Sections 2 and 3-106-44. Grading one mile between Sections 34 and 35-107-44. Grading two miles between Sections 26 and 27 and 34-35-108-44. State Road 9—Grading one mile between Sections 1 and 12-107-45 State Road No. 2—Graveling north one-half mile between Section 1-107-46 and Section 6-107-45. Estimated cubic yards, 400, include hauling 60 to 80 rods.

✣Bids will be received until 2 p. m., April 15, by C. L. Kennedy, County Auditor, Mankato, Minn., for constructing State Rural Highway No. 1, the work calls for the moving of 48,554 cu. yds. of earth and the placing of 5,966 cu. yds. of gravel.

⊙August A. Bodin, 1112½ Garfield Av., Duluth, Minn., has been awarded the contract by that city for the construction of culvert and fill over Brewery Creek at Sixth Av. E., for $2,461. Bids were opened March 22.

⊙The Town Board of Nashwauk Township, Itasca County, and the Board of Stuntx Township, St. Louis County, Minn., have awarded the contract to construct the Goodlands judicial road to Edward Grogan of Marble, Minn., for $3,645.

⊙Bids were received by the City of Ely, Minn., Chas. A. Nutter, City Engineer, on March 18, for the construction of sidewalks and curbs: (1) standing for bid of C. J. Mott and H. Nelson, Coleraine, Minn.; (2) K. S. Johnson, Biwabik, Minn.; (3) Kircher Bros., Gilbert, Minn.; (4) Eveleth Construction Co., Eveleth, Minn.; (5) Gus Linder, Hibbing, Minn.; (6) Bodin & Son, Duluth; (7) Russel Construction Co., Superior, Wis.; (8) A. A. Mitchell & Co., Bovey, Minn.; (9) Lawrence & McCann, Duluth; (10) E. A. Dahl, Duluth; (11) Ed. Johnson, Superior, Wis.; (12) C. S. Rogers Co., Duluth; (13) D. H. Clough & Co., Duluth, (awarded contract):

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Earth material, per cu. yd	3,400 yds.	$0.90	$0.58	$0.80	$0.70	$0.52	$0.65	$1.25	$0.50	$0.75	$0.50	$0.70	$0.60	$0.60
Rock excavation, per cu. yd	....	8.00	8.00	10.00	8.00	7.00	8.00	8.50	8.00	8.00	9.00	6.00	3.00	3.00
Sidewalk, per sq. ft	120,056 ft.	0.145	0.10⅓	0.11	0.11	0.105	0.12	0.12	0.12	0.114	0.125	0.11	0.11	0.105
Driveways, per sq. ft	6,048 ft.	0.175	0.17⅔	0.15	0.15	0.145	0.18	0.175	0.15	0.15	0.17	0.13	0.15	0.135
Cross-walks, per sq. ft	8,400 ft.	0.175	0.17	0.15	0.15	0.145	0.18	0.17	0.15	0.15	0.17	0.13	0.16	0.135
Curb and gutter, per lin. ft	16,742 ft.	0.57	0.59	0.50	0.50	0.48	0.60	0.68	0.51	0.49	0.65	0.52	0.55	0.47
Curb, per lin. ft	....	0.22	0.30	0.35	0.30	0.30	0.40	0.50	....	0.42	0.65	0.30	0.40	0.25
3-in. tile drain, per lin. ft	......	0.08	0.06	0.06	0.08	0.05	0.08	0.20	0.09	0.07	0.15	0.08	0.05	0.04
Totals	....	$32,548	$26,752	$26,464	$26,124	$24,505	$29,263	$32,628	$26,812	$26,607	$30,045	$26,194	$26,705	$24,465

The Hennepin County Commissioners, Minneapolis, Minn., have taken steps toward building six miles of concrete pavement on the extension of Lake St. Blvd., from the west end of St. Louis Park toward Deephaven. The preliminary estimate of the cost is $60,000.

The City Council of Minneapolis, Minn., has acted favorably on the projects for widening 7th and 9th Sts. North, and extending 7th St. from Hoag to Lyndale Aves. The preliminary estimate of the cost of 7th St. is $200,000.

The Minnesota State Highway Department, under the direction of J. H. Mullen, Deputy of Roads, has 55 engineers in the field making preliminary surveys for road construction and improvements involving an expenditure of $1,500,000 by the State during 1913.

The Legislative Committee of the St. Paul, Minn., City Council has approved of the bill providing for a bond issue of $15,000 by Ramsey County, in which St. Paul is located, to assist in the construction of the highway from St. Paul to Faribault.

Missouri.

✣Bids will be received until 10 a. m., April 4, by Board of Commissioners of the Campbell St. Special Road District of Green County, Mo., at the Union National Bank Bldg., Springfield, Mo., for constructing and improving Campbell St. road. Plans and specifications may be seen at the office of W. J. McDaniels at the Union National Bank in the City of Springfield, Mo.

✣Bids will be received until 7:30 p. m., April 7, by Board of Aldermen, at the office of the City Clerk, Webster Groves, Mo., for furnishing the labor and material necessary for the curbing, grading and paving of Gray Ave.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

from Lockwood Ave. to the Big Bend Road. A certified check for $1,200 must be filed with each bid. Fuller-Coult Co., Chemical Bldg., St. Louis, Mo., are Consulting Engineers.

⊙Following contracts were awarded March 21 by the Board of Public Improvements of St. Louis, Mo., for street and alley work, as follows: Bitulithic—Camelia Av., between Margaretta Av. and Lee Av., Granite Bituminous Paving Co., $9,667; West Park Av., from Billon Av. to Childress Av., Granite Bituminous Paving Co., $21,894. Brick—Taylor Av., from Clayton Av. to Audubon Av., John McMahon, $10,620; Bates St., from Alabama Av. running north of Bates St. to Grand Av., Ruecking Construction Co., $16,375; Nashville Av., from Tamm Av. to Louisville Av., Skrainka Construction Co., $11,057; Louisiana Av., between Neosho St. and Osceola St., Eyermann Construction Co., $6,449; Penrose St., from Glasgow Av. to Grove St., Peter J. Houlahan, $1,611; Crittenden St., from Pennsylvania Av. to Minnesota Av., Eyermann Const. Co., $1,745; Wilson Av. from Hereford St. to Cooper St., Davies Contracting Co., $4,082; Taylor av., from Margaretta Av. to Kossuth Av., Timothy E. Cavanagh, $4,448. Asphalt—Wise Av., from Kingshighway Blvd. to Hereford St., Foxhall P. McCormick, $8,186; Vanderburgh Av., from Shenandoah Av. north 311 ft., Foxhall P. McCormick, $2,911. Reconstruction—Biddle St., from 14th St. running south of Biddle St. to Jefferson Av., Aqua Contracting Co., $33,549. Telford—Kingshighway, southeast from Compton Av. to Grand Kingshighway, Wm. R. Bush Construction Co., $19,847; Bruno Av., from Forest Av. to western city limits, Aqua Contracting Co., $4,380; Geraldine Av. from Florissant Av. west for a distance of about 215 ft., Bambrick Bros. Construction Co., $1,348. Alley—Alleys in C. B. No. 4188, between Gravois Av., Potomac St., Spring Av. and Bamberger Av., Davies Contracting Co., $4,604. All contractors are residents of St. Louis.

The City Council of Maplewood, Mo., has passed the necessary legislation for the construction of the Laclede Station Road south from the Manchester to the Meramec Highlands car line, at an estimated cost of $7,000.

City Engineer C. Phillips, of Springfield, Mo., is preparing plans and specifications for the paving of four thoroughfares in various parts of the city. The plans call for the following improvements: Sarcolithic mineral rubber paving on Grant St. from College to Walnut St. Asphaltic concrete paving on West Elm St. from Evans to Fort Sts. Concrete paving on Winfield St. from Campbell to Main St. Concrete paving on Phillips St. from Campbell to Grant St. Concrete paving on Sherman St. from Commercial to George Sts., also from George St. to the north line of Center St.

W. C. Davidson, Deputy State Highway Engineer, has completed his estimate on the new road that is to be built at Branson, Mo. A bond issue will be voted on by the Branson special road district for the purpose of building the road. It will connect the town with the dam now being built on White River.

The Missouri Legislature has passed a bill providing for a system of 7,000 miles of road to connect every county seat in the state. This system is to be laid out within the next three months.

Montana.

✣Bids will be received until 8 p. m., April 7, by J. A. Mattson, City Clerk, Helena, Mont., for one 4-horse street grader to be delivered f. o. b. Helena, Mont.

✣Bids will be received until April 8, by City Clerk, Butte, Mont., for the paving of about 1,500 sq. yds. of streets in District No. 135.

Nebraska.

The City Council of University Place, Nebr., has received bids on 15,500 sq. yds. of brick paving from nine contractors. E. R. Bing of Lincoln, Nebr., appears to have submitted the lowest bid, at $35,532. Other bidders were: Grant Construction Co., $37,820; Burke-Cochran, $36,338; George L. Campen, Omaha, $36,530; J. L. McLaughlin & Son, $35,609; Offerman Construction Co., $41,842; Ford Paving Co., $36,643; National Construction Co., $35,784, and Abel & Roberts, $36,193.

New Hampshire.

A bill is before the New Hampshire Legislature providing for the establishment of a state highway connecting the Merrimack Valley with the Massachusetts highway at the Massachusetts state line at Salem, N. H.

New Jersey.

✣Bids will be received from 8 until 8:30 p. m., April 14, by Borough Council, Cliffside Park, N. J., for the construction of Sections 2, 3 and 4. Section No. 2 extends from the southerly end of the Borough to the Gorge Road, north on Gorge Road and Anderson Ave. to Lafayette Ave., also north from the junction of Gorge Road and Palisade Ave. on Palisade Ave. to Neumann's Lane. Section No. 3 extends from Laird Ave. and Gorge Road, south in Laird Ave. and Palisade Ave. to the south of boundary line of Borough. Section No. 4 extends from Laird Ave. to Palisade Ave. in Palisade Ave., north to Edgewater Road. Each bid for Section No. 2 must be accompanied by a certified check on National Bank or Trust Co. of the State of New Jersey for $1,200, or a like amount in cash. Each bid for Section No. 3 must be accompanied by a certified check on National Bank or Trust Co. of the State of New Jersey for $900, or a like amount in cash. Each bid for Section No. 4 must be accompanied by a certified check on National Bank or Trust Co. of the State of New Jersey for $700, or a like amount in cash. Myles J. Murphy is Borough Clerk.

The Common Council of Rahway, N. J., has passed an ordinance to pave Irving St. with brick or block, from Poplar St. to Grand St. Bids will be received at once by the City Engineer.

New York.

✣Bids will be received until 3:30 p. m., April 7, by Board of Contract & Supply, Yonkers, N. Y., for grading and paving and otherwise improving Nepperham Ave. from Lake Ave. to the north line of the late Village of Yonkers. Plans and specifications were prepared by W. H. Baldwin, Deputy City Engineer. The work proposed to be done is the grading, paving and otherwise improving of Nepperham Ave. from Lake Ave. to the north line of the late Village of Yonkers, including bluestone curb, excavation, embankment and filling, monuments, etc., and the paving of said avenue with one of the following pavements: Macadam, Telford macadam, granite blocks standard size, small granite block wearing surface, Hassam compressed concrete, asphalt blocks, vitrified brick, sheet asphalt or bitulithic. Bidders must state the kind of pavement they propose to furnish and the number of days in which they will agree to complete the work. Copies of the form of proposal, specifications and contract for the aforesaid work may be obtained at the office of the Secretary of the Board of Contract and Supply and only such bids as are made upon said forms will be accepted. James V. Mahony is Secretary.

⊙The Board of Contract & Supply of Rochester, N. Y., has awarded the contract for the repairs to asphalt streets to the Rochester Vulcanite Co., at $48,000. The contract calls for 48,000 sq. yds. of asphalt pavement. Julius Friedrich & Co. secured the contract for an asphalt pavement in Curlew St., at $25,064, and Whitmore, Rauber & Vicinus have been awarded the contract to construct an asphalt pavement in Scio St. for $8,238.

The taxpayers of the village of Spencerport, N. Y., have voted an additional sum of $2,700 to be used to pave Union St. with brick instead of bituminous macadam, making a total of $8,200 for the work. It was also voted to resurface Amity St. at a cost of $1,200. William R. Barrett is President.

City Engineer John A. Giles, of Binghamton, N. Y., is preparing plans and specifications for bitulithic, hassamite, brick and asphalt pavements for a number of streets, including Carroll.

The Street Board, Canandaigua, N. Y., has decided to macadamize Brook and Sly Sts. Bids are to be asked at once.

North Dakota.

✣Bids will be received until 3 p. m., April 8, by T. E. Thompson, County Auditor, Washburn, N. Dak., for furnishing the following mentioned number of road scrapers and road plows or as many additional plows and scrapers as the Board may deem necessary to purchase at the time of the opening of bids: 20 No. 2 Fresno road scrapers, five No. 6 road plows.

Ohio.

✣Bids will be received until 11 a. m., April 26, by Board of Cuyahoga County Commissioners, Cleveland, O., for the improvement of the Barton Road in accordance with plans and specifications furnished by Frank R. Lander, County Surveyor. A certified check for $1,000 must be filed with each bid. John F. Goldenbogen is Clerk of the Board.

✣Bids will be received until 11 a. m., April 26, by Board of Cuyahoga County Commissioners, Cleveland, O., for the improvement of Gardner Road, No. 2, in accordance with plans and specifications prepared by Frank R. Lander, County Clerk. A certified check for $1,000 must be filed with each bid. J. F. Goldenbogen is Clerk.

✣Bids will be received until noon, April 24, by Board of Franklin County Commissioners, Columbus, O., for the labor and material necessary for the construction of the following work: Engineer's estimate No. 456 for improving and macadamizing the New Albany and Reynoldsville Road, located at Truro, Jefferson and Plain Townships. Engineer's estimate No. 458 for improving and macadamizing the Boehm Road, located in Blendon and Plain Townships. Engineer's estimate No. 460 for improving and macadamizing the Kidner and Taylor Road, located in Blendon and Plain Townships. Engineer's estimate No. 462 for improving and macadamizing the Godown Road, located in Perry Township. The plans, profiles, specifications and estimates of quantities for doing this work, as per county plans, are on file in the office of the County Surveyor of Franklin County, O., for inspection by all persons interested in the same. John Scott is Clerk of the Board.

⊙Withern & Holmes, of Deshler, O., have been awarded the contract by that village for the paving of Elm St. for $18,338. Other bidders were: H. S. Enck, Lima, O., $20,911; Gluss Bros. & Co., Hamler, O., $19,108; C. B. Hall & Son, Findlay, O., $21,757; Minick & McClaron, Newcastle, Ind., $21,741; McMahon & Spain, Toledo, O., $21,233; Ross & Morris, Frankfort, Ind., $20,347, and Ritz & Johnson, Napoleon, O., $22,163. George Champe, 610 The Nasby, Toledo, O., is Engineer.

⊙Seiple & Wolf, Toledo, O., have been awarded the contract by Pultney Township Trustees, at the office of W. J. Campbell, Township Clerk, Union St., Bellaire, O., for scarifying and reconstructing the pikes 15½ miles in length, using Glutrin macadam, for $80,000. Bids were opened March 19. D. A. Elkin, Zweig Bldg., Bellaire, is Engineer.

⊙Ryan & Roach, Maumee, O., have been awarded the contract by the State Highway Commission, Columbus, O., for grading and paving with water-bound macadam the Delta & Swanton Road, Swan Creek Township, Fulton County, for $5,800. The road is 5,280 ft. long and 12 ft. wide. Bids were opened March 21.

⊙L. R. McMichael, Bucyrus, O., has been awarded the contract by the State Highway

Commission, Columbus, O., for grading and paving with water-bound macadam the Bucyrus-Mansfield Road, Jefferson Township. Crawford County, for $7,290. The road is 6,200 ft. long and 12 ft. wide. Bids were opened March 21.

⊙Harman Brokate, Port Clinton, O., has been awarded the contract by the State Highway Commission, Columbus, O., for grading and paving with water-bound macadam Sec. 2, the Bell Road, Erie Township, Ottawa County, for $4,615. The road is 4,770 ft. long and 10 ft. wide. Bids were opened March 21.

⊙Petrie & Lang, Logan, O., have been awarded the contract by the State Highway Commission, Columbus, O., for grading and paving with water-bound macadam the Turnpike No. 3 Road, Upper Township, Lawrence County, for $11,800. The road is 6,500 ft. long and 16 ft. wide. Bids were opened March 21.

⊙Harman Brokate of Port Clinton, O., has been awarded the contract by the State Highway Commission, Columbus, O., for the construction of the Port Clinton & Locust Point Road, Erie Township, Ottawa County, for $6,890. The road is 6,546 ft. in length and 10 ft. wide. The road will be built of water-bound macadam. Bids were opened March 21.

⊙P. Brewer of Chillicothe, O., has been awarded the contract by the State Highway Commission, Columbus, O., for grading and paving with bituminous concrete pavement, the Circleville & London Road in Darby Township, Pickaway County, for $9,700. Bids were opened March 21.

⊙The Kelly Construction Co., of Bryan, O., has been awarded the contract for the construction of the Tiffin Road in Richmond Township, Huron County, O., with water-bound macadam, for $13,957. Bids were opened by the State Highway Commission, Columbus, on March 21.

⊙Ryan & Roach, Maumee, O., have been awarded the contract by the State Highway Commission, Columbus, for grading and paving with water-bound macadam, the Angola-Madison Twp. Road, in Williams County, for $15,600. Bids were opened March 21.

⊙Chas. Vorkes of Nelsonville, O., has been awarded the contract by the Director of Public Service, C. C. Sharp, Nelsonville, for the grading and paving with brick of Madison St., for $.30 and $.89, respectively. Bids were opened March 22. Bids will be asked in about 30 days for the paving of two additional streets.

A petition has been filed with the City Council of Toledo, O., for the paving of Manhattan Road from Cherry St., West Toledo, to New York Ave., Manhattan. A tar macadam pavement is asked for and the entire length of the improvement will be 16,000 ft., at a cost of $2.45 per ft.

The City Council of Carey, O., has taken preliminary steps for the paving of Main St. at an estimated cost of $66,000. Bonds are to be issued.

No bids were received on March 26 by the County Commissioners, Medina, O., for the improving of two strips of road, namely, Wadsworth-Wooster Road, Wadsworth Township, and Medina-Wooster Road, Montville Township. The roads are 3,981.2 ft. long and 10 ft. wide, and 5,164 ft. long and 10 ft. wide, respectively. Clyde Harvey is County Surveyor.

No bids were received on March 21 by the State Highway Commission, Columbus, O., for grading and paving with brick pavement for heavy traffic the Akron-Canton Road, Springfield Township, Summit County. The road is 10,200 ft. long and 13-14 ft. wide.

No bids were received on March 21 by the State Highway Commission, Columbus, O., for grading and paving with bituminated concrete the Scotland Station Easterly Road, Chester Township, Geauga County. The road is 5,800 ft. in length and 14 ft. wide.

No bids were received on March 24 by State Highway Commissioner James R. Marker, Columbus, O., for grading and paving with water-bound macadam Sec. 2, the Galion Road, Sandusky Township, Richland County. The road is 11,485 ft. long and 12 ft. wide.

Oklahoma.

⊙Swatek & Parker, Oklahoma City, Okla., have been awarded the contract for the construction of seven blocks of pavements in Cleveland, Okla., for $39,955. The work includes 18,200 sq. yds. of pavement, 6,000 cu. yds. of earth excavation, 100 cu. yds. of rock excavation, 4,400 lin. ft. of straight concrete curb, 500 lin. ft. of radius concrete curb, 32 crossing covers in place, and 650 lin. ft. of 3-in. oak header. Bids were opened March 24. The Benham Engineering Co., Oklahoma City, Okla., are Engineers.

Oregon.

Linden-Kibbe Construction Co., 501 Selling Bldg., Portland, Ore., submitted the lowest bid March 25 to the Council of Dalles City, Ore., C. L. White, City Engineer, for the construction of 49,332 sq. yds. of pavement and about 5,500 ft. of curb. Bids are to be acted upon April 4.

Pennsylvania.

The Councilmanic Committee on Public Works, Pittsburgh, Pa., has recommended the repaving of the following streets: Neville St. from Fifth Ave. to Ellsworth St., Tioga St. from Brushton Ave. to a point near Oakwood St., Forbes St. from 6th Ave. to a point near Seneca St., Shady Ave. from 5th Ave. to the bridge over the Pennsylvania Railroad, 5th Ave. from 220 ft. west of Burnham St. westwardly, 35th St. from Butler St. north, 47th St. from Hatfield St. one block south; Holley alley, Penn Ave. from 26th St. to 32nd St., Liberty Ave. from 21st St. to 23rd st., Greenfield Ave. from Frank St. to a point near Melbourne St., Morewood Ave. to be resurfaced from Wallingford St. to Ellsworth Ave. The total cost of the work selected will amount to approximately $150,000.

The City Council of Hathoro, Pa., plans the macadamizing of the Jacksonville Road as far as the borough line, a distance of 700 ft., running west from York Road, at an estimated cost of $5,000.

The City Council of Wyomissing, Pa., has adopted the recommendations of the street committee for paving and curbing as follows: Reading Blvd. to Trent Ave., Belmont Ave. to Lincoln Ave., Lincoln Ave. to Berks Pl., Terrace Ave. to Trent, Trent to Fairview, Fairview to Belmont. Ordinances are being considered for the macadamizing of a number of streets on the two-thirds plan.

South Carolina.

City Engineer J. H. Dingle, of Charlestown, S. C., is preparing specifications for several different types of paving for various localities in the city.

Tennessee.

Commissioner John W. Flenniken, of Streets and Public Improvements, Knoxville, Tenn., has presented four improvement districts in the City Council for creation. They are: Forest Ave. from 4th St. to 9th, one block on North 3rd Ave., 2nd St. one block and White Ave. one block. Two of these districts will be asphalt and two will probably be tarvia paving.

Citizens of Montgomery County, Tenn., recently held a meeting at Clarksville, the county seat, to consider the question of issuing bonds to the amount of $500,000 for road and bridge purposes. A committee has been appointed to draft a bond bill.

The Sevier County Court, Sevierville, Tenn., H. D. Bailey, Chairman, will sell bonds April 5 in the sum of $185,000 for road improvements.

Texas.

✣Bids will be received until noon, April 7, by Dan C. Smith, Jr., City Secretary, Houston, Tex., for the grading and paving of Fannin St. in the City of Houston, Texas, from its intersection with the south line of McGowen Ave. to its intersection with the north line of Eagle Ave. with creosoted wood block pavement, as prayed for in the petition, and in accordance with specifications adopted by the City Council. Each bid must be accompanied by a certified check on any bank in the City of Houston for 10 per cent of the cost of constructing said pavement, said check being made payable to H. B. Rice, Mayor. Specifications and all necessary information can be obtained upon application to the office of F. L. Dormant, City Engineer.

⊙The City Commissioners of Galveston, Texas, have awarded the contract for paving Broadway with concrete, from 14th to 24th Sts., and from 10th to 14th Sts., and from 27th to 29th Sts., to Isaac Heffron of that city for $70,373 and $39,594 respectively.

Consulting Engineer J. C. Travilla, for Tarrant County, Texas, has submitted his report to the Commissioners' Court, Fort Worth, on the proposed $1,000,000 worth of roads. The total estimated cost of the system of roads proposed is $830,520. The average cost per mile is $6,297. Asphalt macadam and waterbound macadam are the two kinds of roads recommended. According to the report 210,952 tons of stone and 134 carloads of oil, tar and asphaltic cement will be required. About 79,230 cu. yds. of gravel will be necessary.

The City Secretary of Waxahachie, Tex., is advertising for bids for the paving of West Main St. from Monroe St. to the Katy railroad crossing, a distance of nearly one mile. The specifications cover all kinds of paving material.

It is reported that the west side of Hardin County, Texas, on March 15 voted the issuance of bonds to the amount of $100,000 for road improvements. This section includes the City of Cove.

Utah.

The City Commissioners of Ogden City, Utah, have approved the recommendation of Commissioner J. C. Nye for the paving of Madison Ave. on the west side from 24th to 25th Sts., and that street on the east side of Liberty Park from 21st to 22nd, with concrete.

Virginia.

✣Bids will be received until 4 p. m., April 5, by T. M. Pepper, Mayor and Street Committee, Norton, Va., for street improvements. About two to three miles of macadam, with some grading. Town owns steam roller and stone crusher, which may be leased. Plans, profiles and specifications are on file at Mayor's office and can be seen by applying to Mayor T. M. Pepper, Dr. T. M. Cherry or H. E. Hyatt. Bids must be accompanied by certified check for $500, as evidence of good faith.

✣Bids will be received until 10 a. m. April 1, by City Engineer, Danville, Va., for the construction of six and one-half miles of macadam and thirty-seven and one-half miles of soil road in Dan River District of Pittsylvania County, Va. Plans and specifications on file at the Clerk's office, Chatham, Va.; at the City Engineer's office, Danville, Va., and at the State Highway Commissioners' office, Richmond, Va. A certified check for $250 to accompany each bid for one road, or $500 for two or more roads.' Specifications can be obtained from the State Highway Commissioner, or the Engineer on the ground. Blueprints can be secured from Childrey-Sunday Co., Richmond, Va., at $3.55 per set. P. St. J. Wilson is State Highway Commissioner.

The finance and the public improvement committees of the City Council, Petersburg, Va., approved the ordinance appropriating $48,700 for the River St. improvement. This sum includes the cost of raising River St., from Rock alley to Third St., of raising Second St., and of laying a storm sewer in River St., from Pike St. to Third St.

Following bids were received by the Administrative Board of Richmond, Va., for the construction of 70,000 sq. yds. of smooth paving, 65,000 sq. yds. of granite spall paving, 16,000 lin. ft. of granite curbing, and 10,000 lin. ft. of granolithic curbing and guttering, in all sections of the city: Standard sheet asphalt—Union Paving Co., $1.98 per sq. yd.; Cleveland Trinidad Paving Co., $1.90; Atlantic Bitulithic Co., $1.95. Warren's bitulithic formula—Atlantic Bitulithic Co., Southern sales agents, $2.56. Asphaltic concrete—Union Paving Co., $1.90; Cleveland Trinidad Paving Co., $2.03; Atlantic Bitulithic Co., $2.04. Topeka bituminous—Union Paving Co., $1.94; Robert G. Lassiter, $2.12; Atlantic Bitulithic Co., $2.09. Romanite bituminous concrete—Union Paving Co., $2.04. Asphaltic macadam, mixing method—Robert G. Lassiter, $1.95. Bituminous macadam, penetration method—R. G. Lassiter, $1.80; A. L. Phillip's Sons, $1.40. Asphalt block, on concrete—Washington Asphalt Block and Tile Co., $2.83. Asphalt block, 4-in. blocks on sand—Washington, Asphalt Block & Tile Co., $2.38. Wood block—United States Wood Preserving Co., $3.49. New granite spall paving; prices varying according to location of various streets to be paved—J. C. Cheatwood, $1.24 to $1.40; John J. Curley, $1.49 to $1.50; T. A. Barry & Co., $1.38 to $1.44; John C. Weinbrunn, $1.35 to $1.45; I. J. Smith & Co., $1.43 to $1.52; Charles Gasser, $1.40 to $1.53. New granite curbing, per linear foot—I. J. Smith & Co., $.92; American Stone Co., $.90; C. M. Weinbrunn, $.85; Albin Netherwood, $.85 to 91.

Washington.

✣Bids will be received until April 8, by Board of County Commissioners, Ellensburg, Wash., for the construction of about 12,000 sq. yds. of paving on Permanent Highway No. 2.

⊙Gilles DeFlong of Seattle, Wash., has been awarded the contract by the Board of Public Works of that city, for the construction of brick and asphalt pavement on Fremont Ave., for $69,176. S. Lamping Co., Burke Bldg., Seattle, secured the contract to construct concrete walks, grade and curb 18th Ave. S., et al., for $41,545.

The City Council of Tacoma, Wash., has ordered the improvement, by paving, of North 26th St., from Union to Proctor St., and of Proctor St., from 26th to 29th St.

Wisconsin.

✣Bids will be received until 10:30 a. m., April 4, by Department of Public Works, Milwaukee, Wis., for the construction of improvements on the following streets: Grand Ave., from Milwaukee River to alley between Fourth and Fifth Sts. Wells St., from West Water St. to Sixth St. West Water St., from Sycamore St. to Cedar St. Second St., from Sycamore to West Water St. Third St., from Sycamore St. to Cedar St. Approximate estimate of quantities—Creosoted block pavement, 22,670 sq. yds. Sandstone block pavement, 4,550 sq. yds. New concrete, 4,000 cu. yds. New filling, 2,100 cu. yds. Old asphalt to be removed, 8,800 sq. yds. Old stone blocks to be removed, 2,400 sq. yds. Old concrete to be removed, 6 ins. thick, 1,460 sq. yds. New curb needed, 5,750 lin. ft. Old curb to be reset, 1,300 lin. ft. New radius curb, 242 lin. ft. J. P. Sherer is Deputy Commissioner of Public Works.

Edward L. Bartlett, at $45,753, submitted the lowest bid to the City Council of Watertown, Wis., for the paving of Western Ave., from Fifth St. to Richard's Ave., Dewey Ave., from Main St. to Division St., North Eighth St., from Main to Division St., and two alleys in the block bordered by Main, Madison, North First and North Second Sts.

The Douglas County Supervisors, East End, Ind. Sta., Superior Wis., plan the purchase of a rock crushing plant and site for $25,000.

BRIDGES

Alabama.

✣Bids will be received until April 5, by Baldwin County Commissioners' Court, Bay Minette, Ala., for the construction of a steel bridge at Aiken's Lake, Ala., on the road between the county seat and Stockton.

Plans have been filed with James Weatherly, Commissioner of Streets, Birmingham, Ala., by the Tidewater Railroad for the construction of a viaduct over the Frisco tracks at Pratt City. The new structure, is is said, will be of steel.

Arkansas.

⊙Advices from Paragould, Ark., state that W. G. Johnson, of Sugar Creek Township, has been awarded the contract for the construction of 12 wooden bridges over ditches in Green and Lawrence Counties Drainage District. The work will cost $1,100.

The Surveyor of Pulaski County, Little Rock, Ark., is preparing plans for the construction of a 90-ft. concrete bridge over the Fourche on the Mabelvale Pike. The bridge will be built to the east of the present structure, at the foot of the hill just across from the Fourche Island and the curve in the road will be reduced. The other wooden bridges on the Mabelvale Pike between the iron bridge and the 19th St. pike will be renewed with new concrete structures or repaired, and the three wooden bridges on the 19th St. pike, between the penitentiary and the Neimeyer railroad crossing, will be renewed with concrete structures. This work will be done at once.

California.

⊙Wimson & Foster, Oakland, Calif., have been awarded the contract for the construction of a 560-ft. steel bridge over the Tuolumne River at LaGrange, Calif., at $24,133. The structure will include a 240-ft. trestle approach and two 160-ft. steel spans. The other bids were: T. K. Beard, $27,000; M. B. White, Stockton, $32,500; Ross Construction Co., Sacramento, $27,336; Midland Bridge Co., Kansas City, Mo., $30,107; O. A. Wilson, San Francisco, $29,316, and Chico Construction Co., Chico, $30,280.

The Board of Public Works, Los Angeles, Calif., is in charge of the proposition to construct a bridge over San Gabriel River connecting Terminal Island with Long Beach. An effort will be made to secure the co-operation of the latter municipality.

At a meeting of the Board of Public Works, San Francisco, Calif., in regard to the drawbridge to be constructed by the Santa Fe and the Southern Pacific Systems over Islais Creek at Kentucky St., it was announced by Capt. A. H. Payson that the Santa Fe engineers had been instructed to prepare plans and specifications for the bridge, and that as soon as these were ready the Board of Supervisors would be requested to modify the ordinance granting a franchise to the Santa Fe so as to amend the company's route, it having been found that the bridge could not well be located exactly on the route prescribed in the ordinance.

Delaware.

Advices from Dover, Del., state that the House has passed the bill authorizing the New Castle County Levy Court to borrow $250,000 for the construction of a new bridge over the Christiana River at 3rd St., Wilmington. It is reported that a roller lift [illegible] will be installed.

Florida.

✣Bids will be received until 2 p. m., April 17, by R. L. Stripling, County Clerk, Perry, Fla., for the erection of a steel bridge over Rocky Creek near Clara, Fla. Specifications are on file with the clerk.

Georgia.

⊙The River Canal Commission, Augusta, Ga., has awarded the contract for the bridge span in connection with levee construction to Virginia Bridge & Iron Co., Roanoke, Va., at $15,454. Nisbet Wingfield is the Chief Engineer.

Illinois.

✣Bids will be received until 11 a. m., April 5 by County Clerk, Urbana, Ill., for a highway bridge across the Sangamon River about 1½ miles south of Fisher, Illinois. A certified check for $100 payable to the order of the chairman of the supervisors of Champaign County, will be required with bids sent by mail or presented in person. Bridge to be completed on or before September 1, 1913. Liquidated damages of $25 per day for each day thereafter. The plans and specifications call for (1) two reinforced concrete floor steel spans of 128 ft. 3 in. span, roadway 18 ft., with a new center pier, on piles if necessary, the old abutments being widened 6 ft. and used; or (2) a reinforced concrete girder bridge of approximately five 52-ft. spans, containing 603 cu. yds., more or less, of concrete and 74,000 lbs. of reinforcement, more or less, if found necessary, 2,600 lin. ft., more or less, of 20-ft. piles. Bidders are, in case of the steel spans, requested to submit a price for the structure complete, and also for sub and for superstructure only. Plans and specifications are on file at the County Clerk's office, Urbana, Ill., or may be obtained from the Engineer upon request by mail. J. D. Holtermann is Chairman Bridge Committee; F. O. Dufour, Engineer, Urbana, Ill.

✣Bids will be received up to 10 a. m., April 10, 1913, at the Town Hall, Freeburg, Illinois, for the construction of one reinforced concrete bridge to be built in Freeburg Township, St. Clair County. John Sintzel, Town Clerk, Freeburg, Ill. Baltz Bridge: Span, 20 ft.; roadway, 24 ft.; height, 16 ft. Estimated total concrete, 109.7 cu. yds.; reinforcing steel, 9,420 lbs. Nearest railroad station, Freeburg, about 1 mile. No local concrete materials available. Present bridge, "steel leg," 24-ft. span. Low water flow, dry; high water, about 8 ft. deep. Foundation to be carried about 3½ ft. below stream bed. Piles will probably be necessary. Average depth of excavations, south side, about 5 ft.; north side, about 16 ft. The work includes back fill, approach grades, an earth dam with concrete spillway, across a side ditch adjacent to the north wing and a concrete spillway adjacent to south wing. Engineer's estimate, $1,500. Work to be completed on or before July 10, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received until 11 a. m., April 9, for furnishing and delivering and erecting at the viaduct span of the Washington St. bridge the following fixtures for street lighting, complete with wires, lamps, etc.: 16 bracket fixtures, attached to the trusses of the viaduct, each containing 2 lights, 8-light standards, each containing 4 lights, 4 cluster light standards each containing 7 lights, all fixtures to be made of ornamental cast iron, all globes to be of Alba glass, of proper thicknesses to withstand the vibrations of the bridge, all lamps to be wire drawn filament lamps. Cash or certified check for $200 must accompany proposal. L. E. McGann, Commissioner of Public Works, Chicago.

✣Bids will be received up to 1 o'clock p. m., April 22, 1913, at the County Clerk's office, Ottawa, Ill., for the construction of one reinforced concrete bridge to be built in Freedom Township, La Salle County. Leslie McClure, Town Clerk, R. R. No. 43, Earlville, Ill.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Peterson Bridge: Two spans, each 45 ft. in the clear; roadway, 16 ft.; total height, 17 ft. Estimated total concrete, 249.6 cu. yds.; reinforcing steel, 33,490 lbs. Nearest railroad station, Baker, about 3 miles. It is reported that gravel from Sheridan, Ill., may be had F. O. B. cars at Baker for $1.25 per cubic yard. Present bridge, steel, King arch, about 80-ft. span on stone abutments. Old bridge to be kept in service until new bridge is opened to traffic. New bridge located north of old structure and clears same, excepting the north wing of old abutment, which must be removed before building new structure. Low water flow about 1 ft. deep and 60 ft. wide; high water, about 12 ft. deep. Stream bed clay. Piles will probably be necessary. Excavation for east abutment will average about 14 ft. deep; west abutment about 8 ft. deep. Footings to go about 3½ ft. below stream bed. Engineer's estimate, $5,000. Work to be completed on or before Oct. 1, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

⊙The contract for the construction of 12 bridges in the North Fork Drainage District, Hamilton County, Ill., has been let to the Vincennes Bridge Co., Vincennes, Ind., at $6,374. The others bids received March 26 were as follows: Miller & Borcherding, St. Louis, Mo., $6,770; E. St. Louis Bridge Co., E. St. Louis, Ill., $6,650; Rock River Bridge Co., Oregon, Ill., $7,548; Blodgett Construction Co., Kansas City, Mo., $7,200; Stupp Bros., St. Louis, Mo., $6,525; Rock Island Br. & Iron Works, Rock Island, Ill., $7,800; J. G. Berger, Fort Branch, Ind., $6,648; O. H. Hyatt, Broughton, Ill., $7,250; Baker Mfg. Co., Chicago, Ill., $7,720.

⊙The St. Jacob Lumber & Hardware Co., St. Jacob, Ill., has been awarded the contract for the construction of the Noll, Rule, Radcliff and Ritter bridges in St. Jacob Township, Madison County, Ill. The contract price was $2,363. Other bids submitted March 24 for the work were as follows: Laws & Grantham, Irving, Ill., $3,162; W. C. Johnson, Salem, Ill., $3,125; Stoker Gravel & Concrete Co., Highland, Ill., $3,480; Rock River Bridge Co., Oregon, Ill., $3,200; C. A. Wever & Son, $3,095.

⊙The contract for the construction of the Caple bridge in Pin Oak Township, Madison County, Ill., has been awarded to Albert Fahrig, Edwardsville, Ill., for $1,925. Other bids received March 22 for the work were as follows: G. R. Hyten, Edwardsville, Ill., $2,300; M. C. Bartels, St. Louis, Mo., $3,181; Driscoll-McCalman Co., Decatur, Ill., $2,549; Jos. Klein, Freeburg, Ill., $1,957; W. C. Johnson, Salem, Ill., $2,250; Laws & Grantham, Irving, Ill., $2,240; Miller & Borcherding, St. Louis, Mo., $2,335.

⊙Joseph Klein, Freeburg, Ill., has been awarded the contract for the construction of the Silver Creek bridge between Hamel and Pin Oak Townships, Madison County, at his bid of $3,739. Others bids received for the work March 22 were as follows: Miller & Borcherding, St. Louis, Mo., $4,198; Laws & Grantham, Irving, Ill., $4,250; W. C. Johnson, Salem, Ill., $4,500; G. R. Hyten, Edwardsville, Ill., $4,900; Joseph Klein, Freeburg, Ill., $3,739; Driscoll-McCalman Co., Decatur, Ill., $5,100.

⊙The contract for the construction of the Forbes Bridge, Pleasant Valley Township, Jo Daviess County, Ill., has been let to George A. Quinlan, Chicago, Ill., at $3,110. Other bids received for the work March 20 were as follows: Melloy Construction Co., Chicago, Ill., $3,278; Geo. A. Quinlan, Chicago, $3,110; J. F. Meffley, Galena, Ill., $3,489; C. A. Wever & Son, Clayton, $3,389; W. H. Shons, Freeport, Ill., $3,389.

The following bids were received and rejected March 21 for the construction of the Olive School Bridge, Woodland Township, Carroll County, Ill.: Geo. A. Quinlan, Chicago, Ill., $1,460; Elkhart Bridge Co., Elkhart, Ind., $1,639; Northern Steel & Concrete Co., Freeport, Ill., $1,447; Freeport Bridge Co., Freeport, $1,259; Emil Uppenberger, Mt. Carroll, $1,150.

Commissioner Hamilton, according to advices from Springfield, Ill., has started work on plans and specifications for the construction of a bridge over the Sangamon River 3 miles southwest of Rochester. The structure, as proposed, will consist of a 150-ft. steel span on concrete piers.

The Chicago & Joliet Electric Railway Co., Joliet, Ill., contemplates the construction of a bridge over Fiddyment Creek just north of Lockport, Ill., in connection with curve elimination work.

Indiana.

✣Bids will be received until 10 a. m., April 9, by Board of Allen County Commissioners, Fort Wayne, Ind., for the construction of approach to the Vanzile bridge on the East Line of Section 24, Perry Township. C. H. Brown is County Auditor.

The Miami County Board of Commissioners, Peru, Ind., has approved plans and specifications for the construction of abour 14 small concrete bridges and arches throughout the county during the coming summer.

Iowa.

✣Bids will be received until 2 p. m., April 3, by George A. Poeppe, Carroll County Auditor, Carroll, Ia., for the construction of concrete bridges in the county.

The City Council of Muscatine, Ia., has decided upon the improvement of Second and Ninth Sts. bridges and has also instructed the City Engineer to prepare an estimate for the construction of a new concrete bridge at Monroe St., to replace the present structure. C. H. Young is City Engineer.

The Board of Hardin County Commissioners and City of Eldora, Ia., are planning the construction of a $35,000 bridge over the Iowa River east of the city. The city will furnish $10,000 and the county the balance of the expense.

Kansas.

✣Bids will be received until noon, April 9, by John E. Merriam, Smith County Clerk, Smith Center, Kan., for the following bridges: Bridge No. 12: located south of S.W. ¼-section 25, Washington Township, near George Woods, consists of moving new bridge straight with the road, pulling and redriving eight 8-in. "H" piling. Estimated cost, $490. Bridge No. 30: located near the N.W. corner of Section 34, Washington Township, known as the Clark bridge, consisting of erection of I beam deck bridge 30 ft. long, with 18-ft. roadway, concrete abutments and floor. Estimated cost, $970.04. Bridge No. 6: located 1½ miles south of Gaylord, consisting of furnishing and erecting two 30-ft. approaches on the north end and one 20-ft. approach on the south end of a new bridge recently erected at this site. Estimated cost, $1,189.20. Bridge No. 31: located near the N.E. corner of N.E. ¼ Section 30, Pleasant Township, near A. Ostoff place, consisting of placing steel joists on a 30-ft. bridge and building concrete abutments at each end of bridge. Estimated cost $399. Bridge No. 32: located between Sections 15 and 22, Pleasant Township, consisting of erecting a 20-ft. steel deck span with concrete abutments at each end of bridge. Estimated cost, $390. Board reserves the right to reject any or all bids.

✣Bids will be received until April 12 by Board of Sedgwick County Commissioners, Wichita, Kan., for the construction of a new bridge over Spring Creek between Sections 21 and 28.

✣Bids will be received up to noon, April 11, 1913, at the office of the County Clerk in the Court House at Manhattan, Kansas, for the construction of 5 bridges in Riley County. A deposit of $50 must accompany each bid. Tabor Bridge: A reinforced concrete superstructure of 30-ft. span and 16-ft. roadway on a stone substructure. Estimated quantities, 36.9 cu. yds. reinforced concrete, 6,067 lbs. of steel reinforcement and 42.5 cu. yds. of stone masonry. Sand can be had at the river, haul about 5 miles. Nearest station Zeandale, 5 miles. Hunter Island Bridge: A 36-ft. approach I-beam span and one stone abutment. Excavations will be in sand about 7 ft. deep. About 37 piles 25 ft. long will be required. The location is in Manhattan Township about 1 mile from the U. P. and C., R. I. & P. R. R. stations at Manhattan. Hessler Bridge: Over Windy River in Wild Cat Township. A reinforced concrete superstructure 18-ft. span and 16-ft. roadway on a stone substructure. Estimated quantities: 21.2 cu. yds. reinforced concrete, 2,268 lbs. of steel and about 65 cu. yds. of stone masonry. Location is about 4 miles from the C., R. I. & P. R. R. station at Keats. Oman Bridge: Over Walnut Bridge in Jackson Township. A reinforced concrete superstructure, 22-ft. 6-in. span, 18-ft. roadway on plain concrete substructure. Estimated quantities: 30.3 cu. yds. reinforced concrete, 3,765 lbs. of steel and about 51.6 cu. yds. plain concrete. Location is 2 miles from Walsburg and 5½ miles from Leonardville stations on the L. K. & W. R. R. Bulk Bridge: Over Dry Creek in Swede Creek Township. A reinforced concrete superstructure on a stone substructure. Estimated quantities: 14.9 cu. yds. reinforced concrete, 1,550 lbs. of steel and 58.9 cu. yds. stone masonry. Location is 11 miles from the U. P. R. R. station at Randolph. Plans and specifications are on file in the County Clerk's Office, and copies of the same may be had by mailing $2 to the State Engineer, Manhattan, Kan.

✣Bids will be received up to noon, April 8, 1913, at the office of the County Clerk in the Court House, Dodge City, Kansas, for the construction of 4 reinforced concrete bridges. A deposit of $50 must accompany each bid as required by law. Bids must be enclosed in a sealed envelope and plainly endorsed "Proposal for construction of concrete bridges in Richland, Concord and Bucklin Townships, Ford County, Kansas. Bridge No. 1, in Richland Township: A reinforced concrete superstructure on a plain concrete substructure; 18-ft. span and 18-ft. roadway. Abutments are 11 ft. 9 ins. high, wings 8 ft. and 10 ft. long. Location is about 3½ miles south of Dodge City. Bridge No. 2, over Mulberry Creek in Concord Township: Same dimensions as No. 1. Location is about 11 miles south of Dodge City. Bridge No. 3, over Rattlesnake Creek in Bucklin Township. A reinforced concrete superstructure 20-ft. span and 20-ft. roadway on a plain concrete substructure. Abutments about 12 ft. high, wings 8 ft. and 12 ft. long. Sand and gravel can be delivered at site for about 50c per cu. yd. Bridge is over a dry channel. Location is 1 mile from the A., T. & S. F. and C., R. I. & P. R. R. stations at Dodge City. Plans and specifications are on file with the County Clerk and copies of the same may be obtained by mailing $2 to the State Engineer, Manhattan, Kan.

The engineering force of the Wichita Union Terminal Co. is checking with City Engineer Bert Wells, Wichita, Kan., the estimates of work and material required for the construction of the proposed Kellogg St. viaduct. It is believed that work will be started within a short time.

The City Commission of Hutchinson, Kan., has passed the ordinances providing for raising $20,000 for the construction of two concrete bridges over Cow Creek on First Ave., and the other on Avenue B.

The Commissioners of Labette County, Oswego, Kan., have located nine new bridges as follows: Over Pumpkin Creek, west of Parsons; over Pumpkin Creek, 2½ miles north of Angola; one bridge south and one east of Altamont; one 3 miles north of Labette; one southwest of Laneville; one 1½ miles north of Chetopa; to move a 74-ft. steel span bridge a mile north of the Hoke ice plant at Parsons, a distance of three-fourths mile northwest and replace it with a cement bridge 110 ft. long.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Kentucky.

⊙The Board of Jefferson County Commissioners, Louisville, Ky., has awarded the contract for the construction of an iron bridge over Little Indian Creek at St. Mary's ford in Lafayette township to the Attica Bridge Co., Attica, Ind., at $1,335. The work includes concrete abutments and 50-ft. iron span.

Maryland.

There has been recommended to the Wicomico County Commissioners, Salisbury, Md., the construction of two lift bridges 60-ft. clear span, 22-ft. roadway, two 5-ft. sidewalks, loading 15-ton road roller and 100 pounds per sq. ft. on remaining sections. H. M. Clark, Salisbury, Md., is Roads Engineer.

Massachusetts.

Surveys have been made and plans are being prepared by George M. Tompson, Consulting Engineer of the Central Bridge Commission, Lawrence, Mass., for the construction of the proposed new bridge at that place. John O. Battershill is Secretary of the Commission.

Minnesota.

✣Bids will be received until 8 p. m., April 7, by J. H. Twitchell, City Clerk, Hastings, Minn., for furnishing lumber for replanking the High Wagon Bridge, as follows, to-wit: 1,080 plank, 2x10 ins., 14 ft. long; 500 plank, 2x12 ins., 14 ft. long; 30 plank, 2¾x12 ins., 18 ft. long; 30 plank, 2¾x12 ins., 12 ft. long. All to be good, sound Washington fir plank of full dimensions as specified, not kiln-dried, and bid must be for delivery f. o. b. Hastings. Time of delivery to be specified in bid.

⊙The Board of Waseca County Commissioners, Waseca, Minn., has awarded the contracts for the construction of bridges as follows: Grand Bridge Co., South St. Paul, Minn., Nos. 771 and 774, at $1,190; Concrete Culvert Co., Winona, Minn., No. 772, at $400; Burtness & Nelson, New Richland, Minn., No. 775, at $569.

It has been decided by the County Board and the City Council of Redwood Falls, Minn., to construct a newbridge over Redwood River near the city to replace the one recently condemned. The structure, which will be of steel and concrete, will cost about $10,000.

The City of Faribault, Minn., is taking steps to induce the Chicago, Rock Island & Pacific R. R. and the Great Western R. R. to construct a bridge over the tracks at Second St.

The Improvement Committee of the Park Board, Minneapolis, Minn., recently conferred with representatives of the Minneapolis & St. Louis R. R., relative to the construction of a bridge over the canal now being constructed between Cedar Lake and Lake of the Isles.

Mississippi.

✣Bids will be received until noon, April 7, by Chancery Clerk, Vicksburg, Miss., for the construction of a steel bridge over Clear Creek on Link No. 2, 11 miles from Vicksburg in Warren County.

✣Bids will be received until noon, April 7, by Chancery Clerk of Warren County, Miss., Vicksburg, Miss., for building a steel bridge over Clear Creek, on Link No. 2, 11 miles from Vicksburg, as per plans and specifications now on file in the Chancery Clerk's office. A certified check on some local bank or on any national bank for the sum of $500 payable to J. D Laughlin, Clerk must accompany each bid.

Missouri.

✣Bids will be received until 5 p. m., April 11, by Harvey O. Garst, County Highway Engineer, Trenton, Mo., for the construction complete and ready for public travel, including all labor and material whatsoever and according to general plans and specifications filed with the County Clerk of Grundy County for the construction of the following bridges: One over Grand River, to be known as the Kemp Bridge in Sec. 17, Twp. 60, Rg. 24, main span of 105 ft., truss 17.5 ft., clear roadway 14 ft. and two 30-ft. approach spans truss 6 ft. and clear roadway 14 ft.; one bridge over Thompson Fork of Grand River, known as the Graham Ford Bridge in Sec. 12, Twp. 61, Rg. 25, main span same as the Kemp Bridge and one approach same as Kemp Bridge approaches; one bridge over Thompson Fork of Grand River known as Fulkerson Bridge, near the section corner of Sections 21, 22, 27 and 28, Twp. 62, Rg. 25; main span same as Kemp Bridge and no approaches; one bridge 48-ft. span over Honey Creek in Sec. 21, Twp. 60, Rg. 24, truss 8 ft., clear roadway 14 ft. Official advertisement will be found elsewhere in this issue.

The lowest bid received by the Board of Public improvements, St. Louis, Mo., for tearing down the old 12th St. viaduct and replacing it with a new steel and concrete structure was that of Fruin-Colnon Construction Co., St. Louis, $327,600. The new structure will be 79 ft. 6 ins. wide, nearly the width of Twelfth St. at Spruce St. The viaduct will come to grade at Chouteau Ave. on the south and at a point 125 ft. north of Spruce St. on the north.

New Jersey.

The New Jersey Interstate Bridge & Tunnel Commission has recommended to the New Jersey State Legislature that a new suspension bridge to span the Hudson River from 58th St. to Weehawken and two vehicular tunnels to run under the river from Canal St. to Jersey St. be constructed.

New York.

✣Bids will be received until April 9, by the Board of Contract & Supply, Schenectady, N. Y., for the reconstruction of the Cotton Factory Hollow viaduct.

⊙J. M. Fitzgerald, Sackett Harbor, N. Y., has been awarded the contract for the construction of a concrete bridge over Delaware turnpike at Normansville, at $12,989. Holler and Shepard, Rochester, N. Y., bid $13,200 for the work.

It was decided at a recent meeting between the Secretary of War and the representatives of the city of Buffalo, N. Y., in regard to the proposed Bird Island Pier that a period of 60 days be allowed for the International Bridge Co. and the Ferry Company to reach an agreement.

The Board of Saratoga County Supervisors, Ballston Spa, N. Y., has passed a resolution for the erection of a bridge over the Mohawk River at Vischer Ferry.

At the recent election in Brook Haven, N. Y., the following propositions were voted upon by the citizens: To issue bonds amounting to $15,000 for a bridge over Stony Brook to West Meadow Beach; to issue $15,000 of bonds for a drawbridge over Mill Creek, Port Jefferson.

North Carolina.

Among the bills passed by the North Carolina legislature is one instructing the Commissioners of Surry and Yadkin Counties to erect a steel bridge over the Yadkin River at the site of the present wooden bridge connecting Elkin and Jonesville. Contract for the work will probably be let shortly. Dobson, N. C., is county seat of Surry County.

Contracts will be let some time this month by the Board of Wake County Commissioners, Raleigh, N. C., for the construction of two steel bridges. One of the bridges will be built at Rand's mill in Swift Creek township and will have a 60-ft. span. The other one, which will be 120-ft. span and twice as large as the one at Rand's mill, will be built on the site of the old Baucom bridge on Neuse River. It is the aim of the commissioners to replace all the old wooden and other bridges that are inadequate to meet the requirements with new and modern steel bridges and probably other steel structures will be built upon the completion of the two mentioned above.

Ohio.

✣Bids will be received until 10 a. m., April 9, by W. W. Crawford, County Auditor, Hamilton, O., for the construction of a new bridge and appurtenances therefor over the Miami & Erie Canal at Heaton St., Hamilton, O.

✣Bids will be received until noon, April 18, by Board of Hamilton County Commissioners, Cincinnati, O., for the following county work: Under Spec. No. 441, for concrete bridge over Muddy Creek, on Lower River Road, near Addyston, in Miami Township. The work to be done according to the plans and specifications now on file in the office of the Board of County Commissioners. All bids must be made on blank forms, to be had at the office of the Board of County Commissioners, and be accompanied by a bond in the sum of $2,000, with two good and sufficient sureties, that the bidder will enter into the contract to perform the work in case same is awarded to him. Albert Reinhardt is Clerk.

✣Bids will be received until noon, April 4, by Board of Hamilton County Commissioners, Cincinnati, O., for the construction under Specifications 431, of a concrete culvert on Delhi Pike, about 200 ft. west of the corporation line of Cincinnati, O. A bond for $500 must be filed with each bid. Albert Reinhardt is Clerk.

✣Bids will be received until noon, April 24, by Board of Summit County Commissioners, Akron, O., for the construction of a reinforced concrete arch bridge over the Cuyahoga River on North Howard St. extension. Wilbur J. Watson & Co., Cleveland, O., are consulting engineers. C. L. Bower is clerk of the board. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until noon, April 18, by Board of Hamilton County Commissioners, Cincinnati, O., for the construction under Specifications No. 418, of a concrete culvert for Shawnee Run near Wooster Pike in Columbia township. A bond for $2,000 must be filed with each bid. Specifications are on file with the board. Albert Reinhardt is clerk.

⊙F. C. Waldmann, Wapakoneta, O., has been awarded the contract for the construction of a concrete bridge at Minster at his bid of $1,619.

Oklahoma.

✣Bids will be received until April 19, by W. S. O'Neal, Clerk of Pittsburg County, McAlester, Okla., for erecting bridges: Bridge No. 39, over North Boggy Creek, 8 miles from Kiowa, 50-ft. steel span and 47-ft. wood approach; one pier, concrete, with wing walls, other pier tubular; same bridge, No. 39, same location, 60-ft. span, reinforced concrete spandrel, rib arch, with wing wall; same bridge, No. 39, same location, 50-ft. span, concrete piers, with 47-ft. approach. Bridge No. 40, over Coal Creek, 8 miles from McAlester, 124-ft. 3-in. steel span and 109-ft. wood approach, one pier concrete, with wing walls, other tubular; same bridge, No. 40, same location, double 70-ft. span, reinforced concrete spandrel, rib arch, with wing walls; also same bridge, No. 40, same location, 124-ft. 3-in. span, concrete piers, with 47-ft. wood approach. Bridge No. 41, over Long Town Creek, near Bower, 75-ft. steel span and 125-ft. wood approach, piers tubular; same bridge, No. 41, same location, 10-ft. span, reinforced concrete spandrel, rib arch, with wing walls; also same bridge, No. 41, same location, 75-ft. wood span, concrete piers and 125-ft. wood approaches; plans and specifications in clerk's office; certified check 10 per cent amount each bid. P. S. Lester, Chairman County Commissioners.

Oregon.

⊙The Pacific Coast Bridge Co., Portland, Ore., has been awarded a contract at $83,000 for the construction of the bridge over the Willamette River between Marion and Yamhill Counties. The structure will be of cantilever type.

Pennsylvania.

✣Bids will be received until 10 a. m., April 7, by D. H. Koch, County Controller, Reading, Pa., for making general repairs to Heinly's bridge, which crosses Saucony Creek, in Richmond Township, said repairs consisting of masonry and cement work. Specifications can be had at the County Commissioners' office, at Reading, Pa., for which a deposit of five dollars must be made, which will be refunded when the same are returned. All bids must be accompanied with a certified check equal to 10 per cent of the aggregate amount of the bid.

✣Bids will be received until 10 a. m., April 7, by D. K. Hoch, County Controller, Reading, Pa., for making repairs to Schofer's bridge, which crosses Saucony Creek, in Richmond Township, said repairs consisting of masonry and cement work. Specifications can be had at the County Commissioners' office, at Reading, Pa., for which a deposit of five dollars must be made, which will be refunded when the same are returned. All bids must be accompanied with a certified check equal to 10 per cent of the aggregate amount of the bid.

The State Water Supply Commission, Harrisburg, Pa., has granted permission to the Commissioners of Luzerne County, Wilkes-Barre, Pa., to construct a bridge over the Susquehanna at Pittston, and the Commissioners of Westmoreland County, Greensburg, Pa., to build a bridge over Loyal Hanna Creek at Latrobe.

⊙The Steir-March Contracting Co., Philadelphia, Pa., has been awarded the contract by the Philadelphia & Reading R. R. for the construction of a 4-track bridge over Stony Brook. The structure will be of concrete and steel.

The Buffalo, Rochester & Pittsburgh R. R. Co. has been granted permission by the Water Supply Commission of Pennsylvania, Harrisburg, Pa., to construct a bridge over Yellow Creek in Centre Township, Indiana County. E. W. Fair, Du Bois, Pa., is Supervisor of Bridges.

The Philadelphia Bureau of Surveys opened bids recently for the construction of the intercounty concrete bridge on the line of City Ave. over Indiana Run, which is the boundary line. The new bridge will be 100 ft. long and 80 ft. wide, and replace an old bridge which was but 17 ft. in width. It is to be located about one-half mile from Overbrook. Philadelphia set $10,000 aside as its portion, but the low bid exceeded by twice this amount. The bidders were P. J. Lawler, $21,492; Nelson Meredith, $24,800; James Kelly, $24,100; M. and J. B. McHugh, $34,980; Ferris Concrete Company, $28,261; Joseph Fernan, $26,500; Stier-March Constructing Company, $25,800.

Representatives of the Bureaus of Construction and Survey and the Department of Public Works, Philadelphia, Pa., recently met a delegation of the Beechview Board of Trade relative to the location of the proposed Beechview-Mount Washington bridge. It is estimated that about $150,000 will be spent for the improvement.

Utah.

The County Engineer has been authorized by the Board of County Commissioners, Logan, Utah, to advertise for bids for the construction of a steel bridge to be erected over Bear River near Cache Junction and Newton.

The Board of Salt Lake County Commissioners, Salt Lake, Utah, has decided upon the construction of four bridges in various parts of the county at a cost of about $1,000 each and to build culverts costing about $1,200. One bridge is to be located at the mouth of Little Cottonwood canyon, another on Sixteenth South east of Murray across the Big Cottonwood Creek, another across the Jordan near Union, and the fourth on Mill Creek. The culverts will be scattered throughout the county.

Tennessee.

✣Bids will be received until April 7, by Wilson County Bridge Commission, J. N. Adams, Chairman, Lebanon, Tenn., for the construction of two bridges, one 70 ft. concrete bridge 60 ft. wide at Lebanon and the other 225-ft. steel structure at Liberty, Tenn.

Washington.

An election is to be held at Aberdeen, Wash., and a proposition will be submitted to the voters to issue $100,000 of bonds for the construction of a bridge over the Wishkah River. Charles Ewart is City Engineer.

Wisconsin.

✣Bids will be received until 4 p. m., April 19, by Board Public Works, John Kummer, Comptroller, Sheboygan, Wis., for furnishing all the material and doing all the work in and about the construction and completion of a bridge over the Sheboygan River at New Jersey Ave., consisting of two fixed spans and the necessary abutments and center pier. Bonds to accompany bids required in the penal sum of $6,000, or in lieu thereof the bidder may deposit with the Board of Public Works the sum of $6,000 in money, or certified check.

⊙The LaCrosse County Board of Supervisors, LaCrosse, Wis., has awarded the contract for four steel bridges in Burns Township to the Wausau Iron Works, Wausau, Wis., at $5,081, and a contract for three steel bridges in Hamilton Township to Albert Simonson Co., West Salem, Wis., at $3,946.

The Commission Council of Oshkosh, Wis., has adopted a resolution authorizing the Board of Public Works to advertise for bids for 10,000 ft. of 3-in. rock elm bridge plank 6 ins. and wider and 12 ft. long, for replanking the Wisconsin Ave. bridge.

Plans have been prepared by State Engineer A. W. Hall, of Madison, Wis., for the construction of a new steel bridge over Duncan Creek in the town of Tilden. Work will probably be started as soon as the weather permits.

Canada.

The ratepayers of St. Catherines, Ont., at the election March 25 voted down the by-law to build a viaduct across the old Welland Canal to the Grand Trunk station.

The Department at Ottawa, Ont., has approved the plans for the Second Narrows bridge, at Vancouver, B. C., prepared by John Wolfe Barry for the Burrard Bridge & Tunnel Co. and it is believed that the work will be in shape for tenders some time this month. The estimated cost is $2,100,000.

It has been announced by the Minister of Railways and Canals at Ottawa, Ont., that a new bridge to accommodate pedestrians and highway and railway traffic over the Welland Canal at Killaly St., Port Colborne, Ont., will be constructed.

DRAINAGE AND IRRIGATION

California.

The Supervisors of Colusa County, Colusa, Cal., are considering a bond issue for drainage, bridges and possibly a new Hall of Records.

Colorado.

⊙The Hess Flume Co., Denver, Colo., has been awarded the contract for flume work for the La Junta Suburban Land Co., of La Junta, Colo.

Illinois.

Following are the lowest bids submitted to the Board of Trustees of the Sanitary District of Chicago for constructing Section 6 of the Calumet Sag Channel of the Sanitary District: 650,000 cu. yds. of glacial drift, 44⅞ cts.; 13,500 cu. yds. solid rock, 82½ cts.; 6,000 sq. yds. rip rap slopes, $1; Green & Son, 133 W. Washington St., Chicago. The contract has not been awarded. J. McGillen, Clerk.

Indiana.

⊙The following have been awarded contracts for the construction of the Kemper ditch in Porter County, Ind., for which bids were opened by County Surveyor G. F. Stinchfield, Valparaiso, Ind., on March 27: Wm. Brown, Hebron, Ind., 390,773 cu. yds., at $4.99; C. I. Jones, Boone Grove, Ind., 79,802 cu. yds., at $9.99, and North, Frazier & Co., Bluffton, Ind., 60,385 ft. of tile, at $11,643. About 290,773 cu. yds. will be floating dredge work and 79,802 yds. drag line work.

⊙C. A. Williamson, Montpelier, Ind., has been awarded the contract at $4,660 for constructing the Arthur Kelly Ditch, bids for which were opened March 22 by C. W. Decker, Superintendent of Construction, Bluffton, Ind.

Iowa.

✣Bids will be received until 3 p. m., April 8, by Board of Sac County Supervisors, Sac City, Ia., at the office of J. Wilbur Neal, County Auditor, for the construction of the improvements in drainage district No. 42 of Sac County, Ia. Bids will be received as follows: First—For the furnishing of the tile delivered along the line of ditch, which bids must include the tile and sewer pipe for the catch basin, each of which requires one 24-in. sewer pipe, 30-ins. long, one 6-in. 90-degree sewer pipe elbow, and 12 ft. of 6-in. tile. Second—For the doing of all construction work and the furnishing of all material except tile necessary for the completion of said tile drains. All bids must be submitted, received, and acted upon separately as to the main drain and each of the laterals. Complete plans and specifications showing all necessary details may be seen at the office of the County Auditor. The contract or contracts will be let to the lowest and best bidder therefor, considering the main drain and each lateral as a whole, or by sections as to the main drain and each of the laterals as may be deemed best by the Board. The right to reject any and all bids and readvertise the work is especially reserved. The successful bidder will be required to make an itemized statement of his bid, and the contract will be made on that basis, payment being made for work actually done and material actually furnished. Each person bidding shall deposit in cash or certified check an amount equal to 10 per cent of the amount of his bid, said deposit to be returned to him if unsuccessful, and if successful to be retained only as a guarantee of his good faith in entering into said contract. The successful bidder will be required to execute a bond for the use and benefit of said drainage district No. 42 for 25 per cent of the estimated cost of the work so let. The approximate amount of work to be done and time within which said work shall be commenced and completed is as follows:

Drain.	Size, inches.	Length, feet.	Depth, feet.
Sec. 1, main	20	300	4.00
Sec. 1, main	18	850	5.40
Sec. 1, main	20	3,150	7.10
Sec. 1, main	18	1,100	6.50
Sec. 1, main	16	1,400	5.70
Sec. 1, main	15	1,800	6.30
Sec. 1, main	10	1,300	5.20
Sec. 1, main	8	1,293	4.80
Sec. 1, main, deepen old ditch		100	0.30
Sec. 2, lat. No. 1	7	986	4.60
Sec. 3, lat. No. 2	6	894	4.30
Sec. 4, lat. No: 3	7	628	5.20

Section No. 1 has 2 catch basins and 1 bulkhead. Section No. 2 has 1 catch basin. Section No. 1 to be commenced May 1, 1913, and to be completed October 1, 1913. Section No. 2 to be commenced July 1, 1913, and to be completed August 1, 1913. Section No. 3 to be commenced August 1, 1913, and to be completed September 1, 1913. Section No. 4 to be commenced September 1, 1913, and to be completed October 1, 1913.

⊙Bids were opened March 27 by B. E. Norton, Auditor Kossuth County, Algonia, Ia., for the construction of Drainage Districts

78 and 79, contracts being let as follows: Drain 78, 11,800 ft. open ditch, 8 ft. base, av. depth 7 ft., 45,000 cu. yds. to Interstate Drainage and Investment Co., Britt, Ia., at 11.1 cts. per cu. yd.; tile work, Drain 78, 40,000 ft., 8 to 26 ins., to Charles Christensen, Forest City, Ia., at $21,768. Drain 79, 12,200 ft., open ditch, 6 ft. base., av. depth, 6.6 ft., 45,000 cu. yds. to Moeller Bros., Knierim, Ia., at 12.49 per cu. yd.; tile work Drain 79, 54,620 ft. of 8 to 28 ins., the Groettinger Tile Works, $29,491.

Minnesota.

⊙ Rolf Schmidt, Lakefield, Minn., has been awarded the contract at $7,225 for constructing Judicial Ditch No. 22 of Jackson County, bids for which were opened March 19 by P. D. McKellar, County Auditor, Jackson, Minn. The ditch calls for the following: 800 ft. of 16-in. tile, av. depth 3.28 ft.; 7,300 ft. of 15-in. tile, av. depth 6.58 ft.; 1,200 ft. of 14-in. tile, av. depth 7.64 ft.; 400 ft. of 12-in. tile, av. depth 5.23 ft.; 8,600 ft. of 10-in. tile, av. depth 5.07 ft.; 3,800 ft. of 8-in. tile, av. depth 5.23 ft.; 100 ft. of 6-in. tile, av. depth 4.40 ft.

⊙Contract for Judicial Ditch 23 of Jackson County, bids for which were opened March 19 by P. D. McKellar, County Auditor, Jackson, Minn., has been let to John Peterson, Clear Lake, Ia., at $10,230. This ditch calls for 4,100 ft., 18-in. tile, av. depth 6.36 ft.: 2,900 ft., 16-in. tile, av. depth 7.54 ft.; 3,500 ft. 15-in. tile, av. depth 5.88 ft.; 900 ft. 12-in. tile, av. depth 4.93 ft.; 5,200 ft. 10-in. tile, av. depth 5.13 ft.; 14,100 ft. 8-in. tile, av. depth, 4.84 ft.; 8,200 ft. 6-in. tile, av. depth, 4.56 ft.; 1,087 cu. yds. of open work.

⊙Mulgrew-Boyce Co., Dubuque, Ia., at 17.95 cts. per cu. yd., have been awarded the contract for the open work for Judicial Ditch No. 18 of Jackson County. Tile work was let to Sedgley & Parrish, Washington, Minn., at $8,975. The open work requires 32,269 cu. yds. of excavation. The tile work calls for the following: 2,800 ft. of 16-in. tile, av. depth 8.1 ft.; 4,500 ft. of 15-in. tile, av. depth 8.69 ft.; 2,200 ft. of 12-in. tile, av. depth 6.76 ft.; 4,800 ft. of 10-in. tile, av. depth 5.68 ft.; 5,100 ft. of 8-in. tile, av. depth 6.01 ft.; 3.200 ft. of 6-in. tile, av. depth 5.12 ft. Bids were opened March 18 by P. D. McKellar, County Auditor, Jackson, Minn.

⊙John Christensen, Garner, Ia., has been awarded the contract, at $28,483, for constructing Judicial Ditch No. 19 of Jackson County, bids for which were opened March 18 by P. D. McKellar, County Auditor, Jackson, Minn. This work includes 6,900 ft. of 24-in. tile, av. depth 6.15 ft.: 2,500 ft. of 22-in. tile, av. depth 7.99 ft.; 200 ft. of 20-in. tile, av. depth 4.16 ft.; 3,700 ft. of 18-in. tile, av. depth 6.75 ft.; 6,600 ft. of 16-in. tile, av. depth 9.26 ft.; 3,000 ft. of 15-in. tile, av. depth 6.83 ft.; 11,900 ft. of 12-in. tile, av. depth 5.25 ft.; 12,000 ft. of 10-in. tile, av. depth 5.91 ft.; 18,450 ft. of 8-in. tile, av. depth 5.47 ft.; 12,300 ft. of 6-in. tile, av. depth 4.90 ft.

⊙Wm. Neuman, Lakefield, Minn., has been awarded a contract for constructing Judicial Ditch No. 20 of Jackson County, bids for which were opened March 18 by P. D. McKellar, County Auditor, Jackson, Minn. This ditch calls for the following: 5,900 ft. of 22-in. tile, av. depth 8.09 ft.; 2,000 ft. of 20-in. tile, av. depth 11.20 ft: 4,900 ft. of 18-in. tile, av. depth 7.41 ft.; 1,100 ft. of 15-in. tile, av. depth 4.77 ft.; 1,500 ft. of 14-in. tile, av. depth 5.07 ft.; 5,700 ft. of 12-in. tile, av. depth, 6.05 ft.: 8,600 ft. of 10-in. tile, av. depth 5.14 ft.; 28,160 ft. of 8-in. tile, av. depth 4.99 ft.: 29,925 ft. of 6-in. tile, av. depth 4.72 ft.

Missouri.

⊙Frank B. Stevens, Geneseo, Ill., has been awarded the contract for work in Nodaway Drainage District No. 1 calling for 140,000 cu. yds. of excavation.

Utah.

⊙The Lynch-Cannon Engineering Co., Salt Lake City, has been awarded the contract for repairs to the concrete-lined ditch of the Davis & Weber Counties Canal Co., of Ogden.

WATER WORKS

Arkansas.

⊙Peter Huggler, of Russellville, Ark., has been awarded the contract for rebuilding the wall of the Russellville Water & Light Co.'s dam on Illinois River. About 300 cu. yds. of concrete will be required.

Both Houses of the Arkansas Legislature have passed a bill providing for the creation of an improvement district in Walnut Ridge, Ark., for the purpose of installing a waterworks system.

The Waterworks Commission, Fort Smith, Ark., has purchased 17 acres of land on the Greenwood Road as a site for proposed high pressure basins to be used when the city increases in size.

California.

City Engineer Givan, of Sacramento, Calif., is completing estimates of the cost of installing a high pressure water system, and for making extensions to the system. This work will cost close to $1,000,000.

City Engineer Miller, of Grass Valley, Calif., is completing plans for the construction of a reservoir for the city waterworks.

The City Trustees, of Fullerton, Calif., have awarded the contract for the new city water system to John F. Blair and A. O. Stovall.

Delaware.

The citizens of Georgetown, Del., have voted to bond the town for the purpose of purchasing the water system now owned by the Georgetown Water Co.

The citizens of Rehoboth Beach, Del., have voted in favor of the installation of a municipal waterworks plant.

District of Columbia.

✣Bids will be received until 10:30 a. m., April 19, by Maj. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under Circular 770 induction and direct current motors, copper Louvre panels and rubber valves.

Florida.

✣Bids will be received until noon, April 22, by A. E. Langford, Clerk Water and Gas Committee, Pensacola, Fla., for the construction of a reinforced concrete reservoir at the city pumping station. The work contemplated consists of the construction of a reinforced concrete reservoir approximately 100 ft. by 150 ft., and 8 ft. deep, covered with galvanized iron roof supported by timber trusses. Plans, specifications and blank form of proposal, contract and bond can be obtained by application to Earle Thornton, City Engineer.

Georgia.

The City Council of LaGrange, Ga., has retained Consulting Engineer James Nesbit Hazlehurst of Atlanta, Ga., to prepare plans and specifications for a new waterworks plant to cost $140,000.

Illinois.

✣Bids will be received until 11 a. m., April 4, for furnishing and delivering rubber hydrant valves and gaskets as may be required until Dec. 31, 1913, to the water works shops, 2304 S. Ashland Ave. Details of specifications: 1,000 rubber gaskets ⅛-in. thick, 6 11/16-in. inside diameter, 8 15/16-in. outside diameter; 4,000 rubber gaskets ⅛-in. thick, 7-in. inside diameter, 9⅛-in. outside diameter; 1,000 rubber valves, 4 11/16-in. outside diameter, 2-in. inside diameter, weight 19 oz.; 2,000 rubber valves 6 9/16-in. outside diameter, 2 15/16-in. inside diameter, weight 22 ozs.; 4,000 rubber valves ⅞-in. internal diameter, 4 ⅞-in. outside diameter, weight 10½ ozs.; 20 rubber valves 1 1/32-in. inside diameter; 3 15/16-in. outside diameter, weight 9½ ozs. All valves and gaskets shall conform in hardness and elasticity to those samples on file in the office which have proven successful in the service and are to be constructed of up river fine Para rubber. Cash or certified check for $500 must accompany proposal. L. E. McGann, Commissioner of Public Works, Chicago, Ill.

✣Bids will be received until 11 a. m., April 11, by the Board of Local Improvements, Chicago, Ill., for furnishing the labor and materials necessary to construct water service pipes in the following streets: Champlain Ave., 75th St. to 79th St.; Franklin Ave., Augusta St. to Division St.; Langley Ave., 75th St. to 79th St.: Leland Ave., Milwaukee Ave. to 56th Ave.; Milton Pl., 48th Ave. to C., M. and N. W. R. R.; 93d St., Anthony Ave. to Jeffry Ave.: St. Lawrence Ave., 75th St. to 79th St.; Drexel Ave., 92d St. to 93d St.; Ellis Ave., 91st to 93d; Dobson Ave., 91st to 93d; Greenwood Ave., 91st to 93d; Lexington Ave., 91st to 94th; Woodlawn Ave., 91st to 93d; Washington Ave., 91st St. to 93d St.; 91st St., Chauncey Ave. to I. C. R. R.; 92d St., Drexel Ave. to I C. R. R.; 92d Pl., Drexel Ave. to I. C. R. R.; 93d St., Drexel Ave. to Stony Island Ave. Cash or certified check for 10 per cent of bid must accompany proposal. E. J. Glackin, Secretary.

✣Bids will be received until 11 a. m., April 8, for furnishing and delivering steam hoisting engine, with boiler, 1 set of derrick irons, 4 dump buckets, 600 lin. ft. of wire cable, steam pump with fitings and 2 jacks, engine to be of the type known as double cylinder, double friction drum hoisting engine with boiler and fixtures of a size rated as 16 h. p., mounted on skids and ready for use. Cylinders to be 6¼ in. x 102, drum 18 in., diameter 22 in. face; boilers 36 in. to 38 in. in diameter and 84 in. to 81 in. in height, with 65 to 68 2-in. tubes steam pump to have a capacity of 100 gallons per minute under a head of 25 ft. Cash or certified check for $100 must accompany proposal. L. E. McGann, Commissioner of Public Works, Chicago, Ill.

✣Bids will be received until 11 a. m., April 4, for furnishing and delivering one 12-in. lathe to the 68th St. pumping station, 68th St. and Yates Ave., the same to be a 12-in. geared head lathe, with 8 mechanical changes of speed, 4 spindles of driving shaft to run at constant speed, etc. Cash or certified check for $100 must accompany proposal. L. E. McGann, Commissioner of Public Works, Chicago.

⊙L. E. McGann, Commissioner of Public Works, Chicago, Ill., has awarded to the United States Cast Iron Pipe & Foundry Co., People's Gas Bldg., Chicago, the contract for furnishing cast iron pipe as follows: 4,000 pieces of 4-in., 10,000 pieces 6-in., 2,700 pieces of 12-in.; contract price, $24.85 per ton.

⊙L. E. McGann, Commissioner of Public Works, Chicago, Ill., has awarded to the H. R. Worthington Co., Old Colony Bldg., Chicago, the contract for furnishing 29 3-in., 35 4-in., and 15 6-in. velocity water meters to the meter shops, 1330 Indiana Ave.; contract price, $8,120.

⊙L. E. McGann, Commissioner of Public Works, Chicago, Ill., has awarded to the Badger Manufacturing Co., Milwaukee, Wis., the contract for furnishing to the

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

city such disc water meters as are specified.

Washburn, Ill., is contemplating the construction of a water works system, estimated to cost $18,000. J. R. Gray, 20 W. Jackson Blvd., has been retained to prepare plans and specifications.

The special committee of the City Council, Rockford, Ill., has approved suggestions of Supt. G. G. Crane, of the Water Department, to issue bonds in the sum of $416,000 for the reinforcement of the water supply and distribution system. The proposed improvements are as follows: 12-in. mains in 17th Ave., 11th St., 12th St. and North Church St., and providing many smaller extensions and closing dead ends, $125,000; for construction of another supply reservoir at waterworks pumping station, capacity 1,000,000 gals., $19,000; for erection of stand-pipe, or presure reservoir, 175 ft. high, capacity 500,000 gals., $20,000; for installation of dual system of mains with 20, 16 and 12-in. mains to carry river water to factory and business districts for fire fighting purposes only, with two pumping equipments, $205,000; for installation of new well in Peach St., near Fair Grounds Park, capacity 2,000,000 gallons, $18,000; for booster stand on high point near Rockford Electric Co. plant to give additional pressure to river supply, $10,000; for making the present waterworks station entirely fireproof, and other incidentals, $19,000.

Following is the lowest bid submitted for furnishing and delivering the labor and materials necessary to construct one 340 h.p. water tube boiler complete with all accessories, brick setting for boiler, furnishing and erecting on track beams prepared by the city one chain grate stoker complete with engine and shafting, furnishing and erecting smoke flue with connections to boiler and into stack, furnishing and connecting blow off piping, valves and fittings, through rear brick wall, $10,247, Oil City Boiler Works, Oil City, Pa. The contract has not been awarded. L. E. McGann, Commissioner of Public Works, Chicago.

Following is the lowest bid submitted to Ray Palmer, City Electrician, Chicago, Ill., for furnishing and delivering approximately 10,000 lin. ft. electric light cable: Standard Underground Cable Co., 20 S. La Salle St., Chicago, 14.6 cts. per lin. ft. The contract has not been awarded.

Bids will probably be opened for the construction of a water works system at Carpentersville, Ill., at an estimated cost of $35,000. J. R. Gray, 20 W. Jackson Blvd., Chicago, is Consulting Engineer; M. J. Baldwin, City Clerk.

Indiana.

The Board of Public Works, Marion, Ind., plans the installation of another reservoir of 2,000,000-gal. capacity.

Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., have completed plans and specifications for the electric lighting improvements for Goshen, Ind., and will be presented for approval on April 7. The improvements contemplate an expenditure of $30,000.

Iowa.

✣Bids will be received until 2 p. m., April 10, by Charles Allen, Town Clerk, Miles, Ia., for the construction of waterworks system at that place. The work will include 75 ft. 8-in. C. I. pipe, 3,600 ft. 4-in., 3,600 ft. 6-in., 30,000-gal. steel tank on steel tower; brick pump house, triplex pump, gasoline engine. Check $500. Bond 50 per cent. Plans and specifications $2, at the office of Chas. P. Chase, of Iowa Engineering Co., Clinton, Iowa, Consulting Engineer.

⊙J. C. Anderson, Marshalltown, Ia., has been awarded the contract by the city of Newton, Ia., for the laying of 6,500 ft. of water mains, for $0.16 per ft.; also 88 hydrants at $2 each, and where mains are to be cut, $3. Bids were opened March 24.

The City Council of Holstein, Ia., has advertised for bids for the laying of about 5,000 ft. of new water mains, with a view of extending the water system to all parts of town south of the railroad track. The estimated cost of the work is $3,500.

The citizens of Valley Junction, Ia., have voted bonds to the amount of $65,000 for the installation of a municipal water and light plant.

Kansas.

The citizens of Moline, Kans., on March 25 voted the issuance of bonds for the installation of a water works and an electric light plant. It is expected that plans and specifications for this work will be ready by May 1. The Benham Engineering Co., Am. Nat. Bank Bldg., Oklahoma City, Okla., are Engineers.

Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., have completed plans and specifications for water works improvements and extensions at Harper, Kans., covering an expenditure of approximately $20,000. Bond election has been called to vote bonds.

An election was held in Oswego, Kans., on April 1 to vote on the issuance of bonds in the sum of $8,000 for water works improvements, including filtration. Burns & McDonnell, Scarritt Bldg., Kansan City, Mo., have completed plans.

Kentucky.

The City Council, of Lancaster, Ky., has retained Prof. Mark, State Sanitary Engineer, to prepare plans for a new filter to replace the one recently installed at the waterworks.

The Louisville Water Co., Louisville, Ky., is having plans prepared by Engineer Theodore A. Leisen, 435 Third St., Louisville, for extensions to the filter plant, to cost about $200,000. The work will include 12 filter beds of 3,000,000 gals. capacity each.

Maine.

⊙The Trustees of the Rumford & Mexico Water District, Rumford, Me., have awarded the contract for the water supply system on Mt. Zircon to James McGregor Bros., of Rumford, for about $100,000. The contract includes the building of a 110,000,000-gal. reservoir, an 800-ft. dam on Mt. Zircon and the laying of four miles of pipe line.

Massachusetts.

At a special meeting of the Fire District, Greenfield, Mass., provision was made for having an additional source of water supply for the Greenfield Fire District by the installation of a ground water pumping system. The sum of $50,000 was placed at the disposal of the water commissioners by the vote of the meeting, for the purpose of installing a sunken well and necessary pumping apparatus and pipe connections.

Consulting Engineer Robert S. Weston, 14 Beacon St., Boston, Mass., will have plans and specifications ready about April 1 for improving and constructing additions to the present water works system of Middleborough, Mass., estimated to cost $14,000. The work will include an aerator, two slow filters, basin, etc. Contracts will be let this month.

Michigan.

The Fire Protection Committee of the City Council, Detroit, Mich., has approved an estimate calling for an appopriation of $50,000 with which it is proposed to begin the initial work on a high pressure system.

The City Council, of Benton Harbor, Mich., at the next election will submit a proposition to the citizens of voting on a bond issue of $100,000 for waterworks.

The City Council, of Grand Rapids, Mich., has adopted a resolution providing for the extension and improvement of the water mains and distributing pipes in the city, and the purchase of a pump or pumps of 12,000,000 gals. capacity. The improvements will cost approximately $100,000.

The City Commissioners, of Port Huron, Mich., are considering a resolution providing for the issuance of bonds in the sum of $30,000 for the construction of a water main across Black River, providing a second 20-in. communication with the south section.

Fennville, Mich., is contemplating the construction of a water works system, to cost approximately $12,000. J. R. Gray, 20 W. Jackson Blvd., Chicago, has been retained as Consulting Engineer.

Minnesota.

✣Bids will be received until 8 p. m., April 7, by Village Council, Morgan, Minn., for the construction of a waterworks system, viz: Steel tower 120 ft. in height, steel tank with a capacity of 50,000 gals., well with a capacity of 120 gals. per minute, power station with both gasoline engine and motor power, approximately thirteen (13) blocks of mains. J. Hartwick is Village Recorder.

The citizens, of Walters, Minn., have voted the issuance of bonds for the installation of a waterworks system.

The citizens of Lake City, Minn., at a recent mass meeting voted in favor of the construction of a concrete reservoir, together with the extension of the water mains to the Jewell Nursery grounds. It is proposed to vote bonds to the amount of $15,000 for the improvements this spring.

Mississippi.

✣Bids will be received until 2 p. m., April 15, by J. L. Donald, Town Clerk, Tutwiler, Miss., for the construction of waterworks and sanitary sewers. The city reserves the right to purchase the materials direct or to let the same out by general contract. The work consists of the following: 2 miles of 4, 6 and 8-in. water pipe; 19 hydrants, 12 gate valves; steel tower and tank; receiving basin; combination gasoline engine and underwriters' fire pump; plain wood building; sanitary sewers, approximately 1 mile, 8, 10 and 12-in. sewers; 8 manholes; 4 flush tanks. The above quantities are approximate only and are subject to change. Plans and specifications are on file with the Town Clerk of Tutwiler, Miss., or at the office of R. C. Huston & Co., Consulting Engineers, 630-34 Exchange Bldg., Memphis, Tenn. Contracts will be let subject to the sale of bonds, and no bid will be received unless accompanied by a certified check of not less than 5 per cent of the amount of the bid, said check in no case to be less than $500.

Missouri.

✣Bids will be received until April 18, by Board of Public Improvements, Maxime Reber, President, St. Louis, Mo., for the construction of an intake tower, tunnel and screen chamber; also for a rock filter for the water department. Specifications, etc., can be obtained of the Water Commissioner, Room 312 City Hall Bldg., St. Louis.

Montana.

An election will be held in Livingston, Mont., on April 24 for the purpose of voting on the issuance of bonds to the amount of $225,000 for a complete water works system, including filtration. Plans have been completed by Burns & McDonnell, Scarritt Bldg., Kansas City, Mo.

The citizens of Billings, Mont., have voted bonds to the amount of $575,000 for the installation of a complete water works plant, including filtration. Plans are being prepared by Consulting Engineers Burns & McDonnell, Scarritt Bldg., Kansas City, Mo. As soon as bonds are sold bids will be asked.

Nebraska.

✣Bids for a waterworks system will be received by the Board of Trustees of the Village of Ralston, Nebr., until 10 a. m., April 15th, 1913, at the office of the Towl Engineering Co., 1123 City National Bank Bldg., Omaha, Nebr., and then opened, read and tabulated. The Village Board will meet at 8 p. m., April 15th, 1913, at the school house in the Village of Ralston, where the tabulated bids will be considered. The village reserves the right to reject any or all bids. A certified check in the sum of five per cent of the amount of each bid will be required. Bidding blanks and further information may be obtained from the Towl Engineering Co. of Omaha. The approximate requirements are as follows: Cast iron mains; 50 ft. 8-in. pipe; 9,800 ft. 6-in. pipe; 21,500 ft. 4-in. pipe; valves, one 8-in. valve; ten 6-in. valves; thirteen 4-in. valves; hydrants, 50 2-nozzle 4-in. hydrants; one stand pipe, 12 ft. by 80 ft. high; one pump house; one deep well pump—capacity, 200 gals. per minute for well 130 ft. deep —50 ft. to water working pressure 150 lbs.; one 20-horsepower motor or internal combustion engine. C. M. Skinner, Chairman Village Board.

New Jersey.

✣Bids will be received until 3 p. m., April 8, by Essex County Park Commission, 810 Broad St., Newark, N. J., for the construction of storm water drainage system on Park Ave. in East Orange, Essex County. The Engineer's estimate of the work to be done and by which the bids will be tested, is as follows: 600 lin. ft. 8-in. vit. pipe, 700 lin. ft. 12-in. vit. pipe, 350 lin. ft. 15-in. vit. pipe, 250 lin. ft. 18-in. vit. pipe, 250 lin. ft. 20-in. vit. pipe, 260 lin. ft. 24-in. vit. pipe, 260 lin. ft. 24-in. reinforced concrete pipe, alternate bid; 260 lin. ft. 27-in. reinforced concrete pipe, 260 lin. ft. 30-in. reinforced concrete pipe, 56 lin. ft. 39-in. reinforced concrete pipe, 837 lin. ft. 60-in. reinforced concrete pipe, 3 reinforced concrete catch basins, 6 ft. deep; 40 cu. yds. brick masonry, 5,500 lbs. cast iron. 200 lbs. wrought iron. The above quantities are approximate only, and the Essex County Park Commission expressly reserves the right of increasing or reducing any of the said quantities, as in its opinion becomes necessary. A certified check for $500 payable to the Essex County Park Commission.

✣Bids will be received until 8 p. m., April 16, by Edward E. Mathes, Town Clerk, Belleville, N. J., for the following coated cast iron water pipe and special castings: 335 short tons (2,000 lbs.) 12-in. water pipe (Class B), 7 short tons (2,000 lbs.) special castings. All f. o. b. cars Belleville, N. J., according to specifications which will be furnished upon application at the office of Mr. John DeGraw, No. 11 Clinton St., Newark, N. J., Attorney for the Town of Belleville, N. J.

New York.

✣Bids will be received until 2 p. m., April 8, by Board of Managers, Craig Colony for Epileptics, Sonyea, N. Y., for the improvement of the water supply. Proposals shall be accompanied by a certified check in the sum of five per cent of the amount of bid, and the contractor to whom the award is made will be required to furnish surety company bond in the sum of five per cent of the amount of contract within 30 days after official notice of award of contract and in accordance with the terms of specifications No. 12152. The right is reserved to reject any or all bids. Drawings and specifications may be consulted and blank forms of proposal obtained at Craig Colony of Epileptics, Sonyea, N. Y., and at the office of the State Architect. Complete sets of plans and specifications will be furnished to prospective bidders upon reasonable notice to and in the discretion of the Acting State Architect, Charles A. Sussdorff, Capitol, Albany, N. Y.

✣Bids will be received until 3 p. m., April 3, by Park Board, Department of Parks, Arsenal Bldg., New York City, for furnishing, delivering and laying new cast iron water mains and appurtenances in Prospect Park, Borough of Brooklyn. The time allowed for the completion of this contract will be 90 days. The amount of security required is $15,000. Bids will be compared and the contract awarded at a lump or aggregate sum. Blank forms may be obtained at the office of the Department of Parks, Borough of Brooklyn, Litchfield Mansion, Prospect Park Charles B. Stover is President.

⊙The Florence Iron Works has been awarded the contract by the Board of Contract & Supply, of Rochester, N. Y., for supplying the water department with cast iron pipes and castings, for $21,000.

The citizens of Victor, N. Y., at the village election, voted to raise $600 for the purpose of extending and installing the water mains on High St.

The citizens of Lyndonville, N. Y., on March 18, it is reported, voted additional bonds to the amount of $12,000 for the installation of the proposed waterworks system. Bonds amounting to $25,000 for this work have already been voted.

The Diamond Rock Springs Water Co. has been incorporated in the state of New York with $15,000 capital. The directors are: Albert C. Tuttle, William L. Ortner and Dethloffs E. Klein, all of Buffalo.

North Carolina.

Consulting Engineer Gilbert C. White, Charlotte, N. C., has submitted his report to the Board of Aldermen of Durham, N. C., relative to the installation of a waterworks plant. The estimated cost is $258,570.

North Dakota.

The Village Council, of New Leipzig, N Dak., will shortly call an election for the purpose of voting on the issuance of bonds to the amount of $4,000 for a waterworks system.

Ohio.

✣Bids will be received until noon, April 8, by W. H. Kirby, Secretary to the Director of Public Service, Cleveland, O., for furnishing Portland cement and crushed slag for the city water department. Specifications may be obtained at Room 319 City Hall.

✣Bids will be received until noon, April 8, by R. M. Pillmore, Director of Public Service, Akron, O., for the construction of the Cuyahoga River dam. The contract includes about 9,230 cu. yds. of concrete with the necessary excavation, steel reinforcement and other contingent work. A bond or certified check for $10,000 must accompany each bid. A bond for $75,000 will be required of the successful bidder. Plans and specifications can be seen at the office of the Director.

The City Council, of Defiance, O., has instructed the City Solicitor to prepare the necessary legislation to give the people an opportunity to vote on building a municipal waterworks plant, to cost approximately $190,000.

Oklahoma.

The citizens of Durant, Okla., on March 18, voted bonds to the amount of $13,000 for the purpose of making extensions to the waterworks. B. M. Head is City Clerk.

Pennsylvania.

. ⊙The contract for the new intake for the waterworks at Rankin, Pa., of the McClintic-Marshall Co., has been awarded to the Dravo Contracting Co., of Pittsburgh. Chester & Fleming, Pittsburgh, are Engineers for the work.

⊙Bennet & Randall, of Greensburg, Pa., have been awarded the contract for the construction of the Girard Estate reservoir in the Catawissa Valley. The contract calls for a reservoir having a capacity of 260,000,000 gals., with a depth of 50 ft. and covering an area of 37 acres. It will be 600 ft. across the breast, and this breast will be a thickness of 250 ft. at the bottom, sloping to 20 ft. at the top. The contract also includes the laying of the pipe line to Reservoir No. 3.

Engineers Charles D. Weirbach, George A. Johnson and Nicholas S. Hill, have submitted their report to the City Councils of Allentown, Pa., on the proposed additional water supply of the city. The estimated cost is about $133,000.

South Carolina.

The citizens of Camden, S. C., have voted the issuance of bonds to the amount of $125,000 for the erection of a municipal water and light plant. Gilbert C. White, Charlotte, N. C., is Engineer.

South Dakota.

The citizens of White, S. D., will vote April 15 on the proposition of issuing bonds to the amount of $13,000 for a system of waterworks, and $5,000 for an electric lighting system.

Tennessee.

⊙The Board of Public Works, of Nashville, Tenn., has awarded the contract for furnishing 100 fire hydrants to R. D. Wood & Co., Philadelphia, Pa., for $21 each. Keith, Simmons & Co. secured the contract for 200 6-in. water gates, for $2,324. Nashville Plumbers' & Mill Supply Co. will furnish 200 cast-iron valve boxes, for $520. The U. S. Cast Iron Pipe & Foundry Co., 500 tons of cast-iron pipe, 100 6-in. tees and 25 6-in. crosses, the pipe at $22.22 a ton and the tees and crosses at $47 a ton. The General Chemical Co. will furnish filter sulphate of alumina for the year beginning April 1, for 99½ cts. a cwt.

A committee of business men of Memphis, Tenn., has reported to the City Commissioners in favor of introducing a bill in the legislature providing a bonds issue of $500,000 for the improvement of the Memphis Water Co. It is planned to extend the mains of the company through the expenditure of about $185,000.

The Town Council, of Henry, Tenn., has ordered a public well sunk. The town proposes the installation of a waterworks system.

Texas.

The North Summit Water Co., of Dallas, Tex., has been incorporated with a capital stock of $3,000. The incorporators are: George A. Smith, J. M. Oram, W. W. Caruther.

The Anderson Gin & Water Co., Anderson, Tex., has been incorporated with a capital stock of $10,000. The incorporators are: Reid Reikard, W. S. Brown, and R. B. Mallard.

Utah.

Residents of Forest Dale, Salt Lake City, Utah, have asked for the installation of a new distributing system for that section. The cost of such a system would be from $45,000 to $50,000.

Roswell Snow, Supt. of Waterworks, Provo, Utah, has recommended the installation of a 15-in. cast-iron main on 8th East St.

Virginia.

✣Bids will be received until 1 p. m., April 15, by David J. Howell & Son, Civil Engineers, Union Trust Bldg., Washington, D. C., for building a concrete masonry dam for the Alexandria Water Co. at Alexandria, Va. The entire work is to be let in one contract. Each bid must be accompanied by a certified check for $5,000, payable to Alexandria Water Co. The check will be returned to the bidder unless he fails to execute the contract should it be awarded to him. A bond for $40,000 will be required for the faithful performance of the contract, the sureties to be a substantial surety company satisfactory to the Alexandria Water Co. and authorized by law to do business in the State of Virginia. No personal surety will be accepted. The person or persons to whom the contract may be awarded will be required to appear, with the sureties offered by him or them, at the office of the Alexandria Water Co., Alexandria, Va., and execute the contract within five days from date of notification of such award, and in case of failure or neglect to do so, he or they will be considered as having abandoned the proposal, and the check accompanying the same will be forfeited to the Alexandria Water Co. The work is located about six miles northwest of Alexandria, Va., and em-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

braces approximately 16,000 cu. yds. of earth excavation, 1,600 cu. yds. of rock excavation, 17,500 cu. yds. of concrete masonry, 1,150 cu. yds. of rubble masonry. Gate house, and setting of pipes, gate valves, sluce gates and appurtenances.

⊙Following contracts have been awarded by the Administrative Board, Richmond, Va., for supplies for the water department for the year; Hunter B. Frischkorn, pig lead, $4.64 per cwt.; Smith, Courtney Co., 10 special hydrants and 30 Richmond fire hydrants, at $37.50 and $30 each; Haines, Jones & Cadbury Co., lead pipe, at $5.40 per cwt.; Sydnor Pump & Well Co., wiping solder, at $21.60 per cwt.; O. G. McGee & Son, valve and meter boxes, at $5.50 and $1.48 each; Smith-Courtney Co., lathe contract, at $783; H. L. Whitlock, by-pass valve, $230; Waterworks Equipment Corporation, 36x8-in. sleeve valve, at $80; W. E. Carter, for general hauling, at 93 cts. per ton of 2,000 lbs.; Harrison Bros., Inc., for aluminum sulphate for settling basin, at $1.06 for 17 per cent alum, and $1.39 for 22 per cent alum.

An election is to be held at Round Hill. Va., on April 22, for the purpose of voting on the question of bonding the town in the sum of $12,000 for improving and macadamizing the streets and for the installation of a new system of waterworks.

Washington.

The Washington Oil Co., represented by Gerard-Fillio Co., Inc., Eitel Bldg., Seattle, Wash., plans the construction at once of a concrete and steel reservoir with a capacity of 1,000,000 gals. of oil at their works near Forks, Wash.

The Keystone Water Users' Association, Sprague, Wash., has perfected a permanent organization, with H. W. Goff, J. G. Kanzler, Fred Busher, R. J. Stone and Arthur Funk as trustees. Machinery will be installed this year, and ditches and reservoirs will be constructed.

Consulting Engineer Louis C. Kelsey, Selling Bldg., Portland, Ore., has prepared plans and specifications for the construction of a lighting and waterworks system for Arlington, Wash.

Wisconsin.

⊙The Board of Water Commissioners, of Madison, Wis., has awarded the contracts for laying water mains for the Highland Park extension and on West Johnson St., to John T. Blake, for $7,260.

The proposed election to be held in Green Bay, Wis., for the purpose of voting on the question of purchasing the Green Bay Water Co.'s plant, has been postponed until May 6.

The City Council of Dodgeville, Wis., has voted to build another water reservoir with a capacity of 150,000 gals.

Palmyra, Wis., is contemplating the construction of a water works system, estimated to cost $19,000. J. R. Gray, 20 W. Jackson, Blvd., Chicago, has been retained to prepare plans and specifications.

SEWERAGE AND SANITATION

California.

⊙The Capital Sewer Pipe Co., of Sacramento, Calif., has been awarded the contract by the Trustees of Lodi, Calif., for furnishing 1,300 ft. of 10-in. salt-glazed vitrified sewer pipe and 10,000 ft. of 6-in. pipe, for $1,260.

⊙R. C. Lowell of Monrovia, Calif., has been awarded the contract for the installation of a sewer system in Fullerton, Calif., for $46,000.

⊙The Board of Trustees of Colfax, Cal., has awarded the contract for the installation of a sewer system to James Shauley of Sausalito, Cal., and for furnishing the pipe, etc., for same to J. H. Muddux of Sacramento. The total contract price is $13,033. Bids were opened March 25.

⊙The Board of City Trustees of Dinuba, Cal., has awarded the contract for the construction of a sewerage system to Hall & Hunt, of Fresno, Cal., for $32,469. Vitrified pipe will be used.

Consulting Engineers Olmsted & Gillelen, 604 Wright & Callender Bldg., Los Angeles, Cal., are preparing plans and specifications for the construction of a sanitary sewerage system for South Pasadena, Cal.

An election is to be held in Sacramento, Calif., on April 19 for the purpose of voting on public improvements for which plans have been prepared by City Engineer Givan. The proposed improvements will include the installation of sewers at an estimated cost of $2,000,000.

The Board of Health of San Francisco, Calif., has recommended to the Supervisors the immediate construction of a number of sewers in the outlying districts.

The citizens of Berkeley, Calif., will vote April 12 on proposed public improvements to cost $805,000, as follows: Sewer system, including interception and extension sewers, $475,000; fire department improvement, including houses and engines. $95,000; playgrounds for schools, in different parts of the city, $235,000.

District of Columbia.

⊙The Warren S. Brenizer Construction Co., of Washington, D. C., on April 1 commenced work on the Zoological Park section of the Rock Creek main sewer interceptor. The cost will be approximately $40,000. The tunnel, at its greatest depth, will be about 100 ft. below the surface of the ground. It will extend about 400 ft. west of the Zoo buildings.

Florida.

✣Bids will be received until 6 p. m., April 6, by City Council, Arcadia, Fla., for the construction of the extension of the Sanitary Sewer System in said city. The estimated quantities are as follows: Two thousand five hundred feet and eighteen inches vitrified sewer pipe, six manholes. Plans, etc., may be seen at the office of the City Clerk, or at the office of City Engineer. Specifications may be obtained upon application. Guy Harward is City Clerk. C. L. Cravens is City Engineer.

A movement for a $250,000 bond issue has been launched in Daytona, Fla., for a system of sewers and other improvements. An election will soon be called.

Illinois.

✣Bids will be received April 8, by Board of Local Improvements, Champaign, Ill., for the construction of a storm water sewer.

✣Bids will be received until 11 a. m., April 11, by L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering approximately 500 covers for garbage boxes according to specifications. Cash or certified check for $750 must accompany proposal.

✣Bids will be received until 11 a. m., April 11, by the Board of Local Improvements, Chicago, Ill., E. J. Glackin, Secretary, for furnishing and delivering the labor and materials necessary to construct 6-in. house drains in the following streets: Exchange Ave., Baltimore Ave. to 87th St.; 51st Ct., Irving Park Blvd. to Berteau Ave.; Lowe Ave., 103rd St., 550 ft. south; 103rd Pl., Harvard Ave. to State St. Cash or certified check for 10 per cent of bid must accompany proposal.

✣Bids will be received until 11 a. m., April 19, for furnishing and delivering to the Bureau of Engineering, 1 trench excavator. Accompanying proposal must be the following information: Type, engine, speed, type and size of boiler, weight frame, traction wheels, traction speed, steering digging apparatus, conceyors, etc. Cash or certified check for $300 must accompany proposal. L. E. McGann. Commissioner of Public Works, Chicago.

✣Bids will be received until April 15, it is reported, by City of Fulton, Ill., for the construction of a sewer system. including about 25,000 lin. ft. of 8 to 30-in. vit. pipe.

The following contracts for constructing sewers at Chicago have been awarded: Hayes Ave., 150 lin. ft. 9-in., alley east of Southport Ave., 1,150 lin. ft. 9-in., $1,852, G. Pontarelli, 904 Forquer St. E. 95th St., 3,801 lin. ft. 15-in., $718.20; W. 96th St., 370 lin. ft. 12-in., $518, D. Fosco, 1814 Des Plaines St. E. 119th Pl., 300 lin. ft. 12-in., $272; Parkhurst St., 870 lin. ft. 15-in., 730 lin. ft. 12-in., $2,272.40, G. Pontarelli. LaSalle St., 670 lin. ft. 15-in., 630 lin. ft. 12-in., 72 6-in. house drains, $3,095.50. 39th St., 750 lin. ft. 15-in., 750 lin. ft. 12-in.. 72 6-in. house drains, $2,997, N. Mancini, 900 W. Taylor St. 44th Ave., 360 lin. ft. 20-in. tile pipe, 340 lin. ft. 15-in. tile pipe; Nevada St., 670 lin. ft. 15-in. tile pipe, 650 lin. ft. 12-in. tile pipe; Wrightwood Ave., 670 lin. ft. 15-in. tile pipe, 650 lin. ft. 12-in., $4,364.50, S. Ryan, 2927 W. Congress St. 63rd St., 670 lin. ft. 30-in. double invert brick sewer, 670 lin. ft. 24-in. single ring brick sewer; 67th St., 670 lin. ft. 30-in. double invert brick sewer, 670 lin. ft. 24-in. single ring brick sewer; Troy St., 670 lin. ft. 15-in., 1,340 lin. ft. 12-in., 670 lin. ft., 15-in.; Albany Ave., 1,340 lin. ft. 15-in., 1,340 lin. ft. 12-in.; Whipple St., 1,340 lin. ft. 15-in., 1,340 lin. ft. 12-in.; Sacramento Ave., 1,340 lin. ft. 15-in., 1,340 lin. ft. 12-in., $21,989.40, P. J. McNulty Co., 4345 Prairie Ave. Racine Ave., 1,990 lin. ft. 4-ft. double-ring brick sewer; Sunnyside Ave., 730 lin. ft. 24-in. double strength tile pipe, 390 lin. ft. 18-in. double strength tile pipe; Wilson Ave., 750 lin. ft. 20-in. double strength tile pipe, 400 lin. ft. 18-in. double strength tile pipe, 640 lin. ft. 15-in. tile pipe; Leland Ave., 810 lin. ft. 20-in. double strength tile pipe, 410 lin. ft. 19-in. double strength tile pipe, 670 lin. ft. 15-in. tile pipe; alleys between Malden and Beacon Sts., Malden and Magnolia, Beacon and Dover and Clark and Dover, 100 lin. ft. 12-in. tile pipe, $29,123, M. Pontarelli, 4817 W. Dakin St. E. J. Glackin, Secretary of the Board of Local Improvements.

⊙The Carson-Payson Co., of Danville, Ill., has been awarded the contract by the City Council of that city for the building of the Oaklawn-Elmwood Park sanitary sewer, for $64,716. The sewer will be 50,000 ft. in length and will be constructed of glazed tile ranging from 8 to 18 ins. in diameter.

⊙The Board of Local Improvements of Jacksonville, Ill., has awarded the contract for the construction of a sewer on Doolin Ave., Cox and Dunlap Sts. to Simeon Fernandes Sons, for $1,657. The specifications call for 2,595 ft. of sewer pipe with 86 6x10 Y's and 6 manholes.

Following are the lowest bids submitted for furnishing and delivering to various pipe yards throughout the city of Chicago, Ill., sewer pipe as follows: 15,000 pieces of 4-in. f. o. b. cars, $.07 per ft.; 6-in. sewer pipe f. o. b. cars, $.1115, by wagon $.14; 9-in. pipe f. o. b. cars, $.20 by wagon $.28; 12-in. sewer pipe f. o. b. cars $.28, by wagon $.35, W. E. Dee Co., 133 W. Washington St., Chicago. The contract has not been awarded. L. E. McGann, Commissioner of Public Works.

Consulting Engineer W. A. Fuller, Chemical Bldg., St. Louis, Mo., has submitted plans and estimates for the installation of a sewerage system to the city officials of Cuba, Ill. The estimate of a sanitary sewer with water tower pumping station and hydrants for fire protection has been placed between $28,000 and $30,000.

The city of Engin, Ill., proposes to construct approximately 18 miles of sewers during the coming season, at an estimated cost of $125,705. M. H. Brightman is City Engineer.

It is announced that bids will be received during the month of April by Pontiac, Ill., for constructing a tile pipe sewer in various streets, estimated cost $45,000. A. T. Maltby, 20 W. Jackson Blvd., is Consulting Engineer.

Indiana.

The city of Mt. Vernon, Ind., contemplates installing a 5-ft. sewer 2,500 ft. in length, to be of brick.

City Engineer Aug. Pfafflin of Evansville, Ind., has completed plans and specifications for the construction of a sewer in Blankenberg at an estimated cost of $10,000.

City Engineer E. C. Shoecraft of LaPorte, Ind., is preparing plans for a sewage disposal plant to be erected this year.

Iowa.

The City Council of Chariton, Ia., has ordered plans for 20,000 lin. ft. of sewer. F. W. Trost is City Engineer.

The Civic Improvement League of Onawa, Ia., advocates the installation of a sewerage system.

Kansas.

Engineer Fred Eckert of Larned, Kans., has completed preliminary surveys and plans for sewers in Dodge City., Kans., and the same will be submitted to the State Board of Health for approval. A $40,000 bond issue is to be made for the trunk lines. It is thought fully 20 miles of laterals will be built in the next three years.

Kentucky.

A delegation of citizens of Salem, Ky., recently visited New Albany to investigate the cost of sewer and street construction with a view of constructing a sewer system and a number of squares of brick in that town.

Maryland.

✣Bids will be received until 11 a. m., April 9, by Board of Awards at the office of the City Register, Baltimore, Md., for the construction of certain miscellaneous sanitary lateral sewers. Approximate quantities: 6,600 lin. ft. of vitrified pipe sewer, 8 in. to 10 in. in diameter; 1,900 lin. ft. of vitrified pipe house connections. The successful bidder on this contract will be required to give bond and comply with the city charter respecting contracts. Harry W. Rogers is Secretary of the Sewerage Commission, and Calvin W. Hendricks is Chief Engineer.

⦿Chas. H. Klipp has been awarded the contract by the Board of Aldermen of Frederick, Md., for constructing approximately 500 lin. ft. of sewers, together with necessary inlets, and paving about 5,500 sq. yds. and 1,000 ft. of concrete curb, for $11,000. Bids were opened March 26. E. C. Crum is City Engineer.

Massachusetts.

Tony Ross, Winchester, Mass., at $37,555, submitted the lowest bid on March 28 to the Metropolitan Water & Sewerage Board, 1 Ashburton Pl., Boston, Mass., for constructing in earth and rock trench a 24-in. by 36-in. concrete sewer, Section 70 of the New Mystic Sewer, North Metropolitan System, in Winchester. The work includes 3,535 ft. of concrete sewer.

The Massachusetts Legislature has authorized the city of Fall River to make a loan of $250,000 for extensive sewer construction. It is proposed to complete the Laurel St. sewer from Tucker to Stafford road and construct the Charlton Mill and Woodman St. sewers.

Michigan.

✣Bids will be received until 9 a. m., April 12, by Sol Beauparlant, City Clerk, Iron Mountain, Mich., for the construction of about 1,650 ft. of 48-in. Jackson Pipe reinforced concrete sewer on Kimberly Ave. from alley between Ludington and Hughitt Sts. to Ludington St., thence east on Ludington St. to a point where open ditch crosses said Ludington St., together with necessary manholes, catch basins, 616 ft. of 6-in. laterals and 366 ft. of 8-in catch basin drains, and for the furnishing of all labor and material necessary therefor; also for the laying of about 1,650 ft. of 12-in. iron drain pipe alongside of said sewer, according to plans and specifications therefor prepared by the City Engineer and now on file in the office of the City Clerk. Bids must include 48-in. sewer and the laying of 12-in. drain pipe in one lump sum and must be accompanied by a certified check for $500.

⦿Herman Stenseud, Marquette, Mich., has been awarded the contract by that city, Charles Cummings, City Engineer, for the construction of a trunk sewer, for $39,285. The work includes 2,240 ft. of 30-in. pipe, 4,200 ft. of 24-in. pipe, 1,010 ft. of 20-in. pipe, 1,600 ft. of 12-in. pipe, 600 ft. of 8-in. pipe, 25 manholes. Bids were opened March 20.

The City Commissioners of Port Huron, Mich., are reported to have adopted a resolution providing for the issuance of bonds to the amount of $10,500 for the construction of a sewer to drain Gillett and 16th Sts., and all of that section of the city subject to floods.

The City Council of Escanaba, Mich., has instructed the Board of Public Works to prepare plans for the building of a sanitary sewer in the southwestern part of the city.

The citizens of Union City, Mich., at a recent election voted against the issuance of bonds for the installation of a sewerage system.

City Engineer Harry N. Beck of Muskegon, Mich., has recommended that the Council build its new 36-in. sewer for the business district only as far as Third St., or Fourth St., draining it to the lake from Muskegon.

Minnesota.

⦿John Hedberg, 717 N. 58th Ave. W., Duluth, Minn., has been awarded the contract by that city for the construction of a sanitary sewer in Winona St., for $1,364. Bids were opened March 22.

⦿Ilstrup & Olson, 220 Security Bank Bldg., Minneapolis, Minn., have been awarded the contract by the city of Albert Lea, Minn., C. J. Dudley, City Clerk, for the construction of lateral sewer No. 10, about two miles in length, for $15,447. The work includes 10,955 ft. of sanitary sewer, 6 to 20 ft. deep, 40 manholes, 3 drop manholes, 251 house Y's, and 482 ft. of house connections. Bids were opened March 26.

⦿John Hedberg, Duluth, Minn., has been awarded the contract for the construction of a sanitary sewer in Winona St., to a connection with the sewer in Rundle Ave., Woodland, city of Austin, Minn., for $1,364.

⦿Bids were received Mar. 18 by the city of Ely, Minn., Chas. A. Nutter, City Engr., for storm sewer construction. In the table shown below (1) stands for bid of Pastoret Construction Co., Duluth; (2) K. S. Johnson, Biwabik, Minn. (awarded contract); (3) Kircher Bros., Gilbert, Minn.; (4) John Hedberg, Duluth; (5) Eveleth Construction Co., Eveleth, Minn.; (6) Gus Linder, Hibbing, Minn.; (7) Russel Construction Co., Superior, Wis.; (7) A. A. Mitchell & Co., Bovey, Minn.; (8) Lawrence & McCann, Duluth; (9) E. A. Dahl, Duluth; (10) Ed Johnson, Superior, Wis.; (11) C. S. Rogers Co., Duluth; (12) D. H. Clough, Duluth:

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Earth excavation, per cu. yd	2,800 yds.	$0.78	$0.54	$0.70	$0.75	$0.80	$0.93	$1.10	$0.95	$0.82	$0.75	$0.80	$1.00	$0.85
Rock excavation, per cu. yd	100 yds.	8.80	8.00	8.50	8.00	8.00	9.00	8.50	8.00	7.50	9.00	7.50	6.00	8.00
15-in. pipe, in place, per lin. ft	3,524 ft.	0.62	0.46	0.60	0.58	0.60	0.67	0.68	0.65	0.72	0.70	0.52	0.75	0.63
12-in. pipe, in place, per lin. ft	996 ft.	0.45	0.34	0.42	0.45	0.40	0.53	0.47	0.55	0.52	0.50	0.35	0.55	0.47
8-in. pipe, in place, per lin. ft	900 ft.	0.30	0.22	0.22	0.32	0.30	0.42	0.31	0.30	0.36	0.25	0.26	0.40	0.35
Manholes, each	13	34.00	41.00	35.00	40.00	35.00	63.00	90.00	42.00	30.00	38.00	31.00	40.00	40.00
Catch basins, each	36	35.00	48.00	35.00	40.00	29.00	53.00	90.00	40.00	32.00	38.00	26.00	68.00	36.00
Totals		$7,669	$6,731	$7,256	$7,640	$7,322	$9,498	$13,163	$8,554	$7,967	$8,050	$6,744	$9,919	$7,999

Mississippi.

✣Bids will be received until 2 p. m., April 15, by J. L. Donald, Town Clerk, Tutwiler, Miss., for the construction of sanitary sewers, as mentioned under Water Works in this issue. R. C Huston & Co., Memphis, Tenn. Engineers.

Missouri.

⦿V. I. Inman of California, Mo., has been awarded the contract by that city for approximately 4½ miles of sewer laterals. Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., are engineers.

Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., are preparing plans and specifications for approximately five miles of sewer laterals at Hermann, Mo. Date for receiving bids will be set within about three weeks.

Residents of Park Place, Hannibal, Mo., have petitioned the City Council to create Sewer District No. 63, to be bounded as follows: Paris St., along Section St., to Bird St., thence west on Bird St. and Grand Ave., to the alley west of Olive St., thence north through said alley to Paris Ave., and along Paris Ave. to Section St.

City Engineer C. E. Phillips of Springfield, Mo., has completed plans for the construction of about six miles of sewer extensions through the southeast part of the First Ward. The new sewer will cost in the neighborhood of $30,000. The districts will be known as Nos. 1 and 2 of Section No. 8.

Plans have been perfected for the installation of a system of sewerage in Olney, Mo., to cost $78,000.

New Jersey.

✣Bids will be received until 2 p. m., April 15, by the Passaic Valley Sewerage Commissioners, Essex Bldg., Clinton St., Newark, N. J., for the construction of Section 11 of the Main Intercepting Sewer, in the town of Nutley. The work includes: Earth excavation and refilling, in trench, for 120-in. sewer, 6,500 lin.ft.; concrete masonry, in trench, Portland cement mortar, 13,000 cu. yds.; brick masonry, in manholes, laid with Portland cement mortar, and appurtenant work, 100 cu. yds.; rock excavation, in trench, 100 cu. yds. Drawings, form of contract and specifications, and blank form for proposal may be obtained at the Commissioners' office from William M. Brown, Chief Engineer.

The sewer committee of the Town Council, Bloomfield, N. J., has recommended the construction of sewers in the following streets: Franklin Ave., Chapman St., Morris Pl., Beach St., Elm St., Church St., and a part of Oak St.

The engineering department of the city of East Orange, N. J., has filed plans and specifications with the Board of Assessment Commissioners for the construction of a storm water sewer in the Third Ward. The estimated cost is $260,000.

The Borough Council of Metuchen, N. J., has called a special election on the establishment of a sewerage system, covering the entire borough and leading to a disposal plant in Millbrook Valley, near Bonhamtown. The estimated cost is placed between $73,000 and $80,000.

Bids as follow were received March 11 by the Passaic Valley Sewerage Commissioners, Newark, N. J., for constructing the northerly portion, Sta. 26-Sta. 56 of Section 6 of the main intercepting sewer, (1) standing for bid of Donlon Contracting Co., Brooklyn, N. Y.; (2) bid of Booth & Flinn., Ltd., Pittsburgh, Pa.; (3) bid of Dock Contractor Co., Hoboken, N. J.; (4) bid of Oscar Daniels & Co., New York, N. Y.; (5) bid of Frawley-Kaufman Contracting Co., Inc., New York, N. Y.

			(1)	(2)	(3)	(4)	(5)
Earth excavation and refilling, in trench, for 150-in. sewer	3,000	cu. yds.	6.00	9.00	7.93	8.00	7.50
Concrete masonry, in trench	9,000	lin. ft.	$175.00	$128.50	$85.13	$84.00	$27.00
Brick masonry, in manholes, and appurtenant work	100	cu. yds.	15.00	20.00	15.00	15.00	15.00
Rock excavation, in trench	500	cu. yds.	0.01	6.00	3.50	6.00	2.00
Special steel and timber sheeting, etc., sta. 26 + 75 to 28 + 75, lump			......	3,000	13,200	11,500	12,000
Totals			$580,506	$474,500	$343,210	$340,000	$163,000

New York.

⊙Edward S. Downes, Syracuse, N. Y., has been awarded the contract by that city for the construction of a 12-in. pipe sewer in North Geddes St., for $465. Bids were opened March 24.

W. W. Chadsey, Schenectady, N. Y., at $9,262 submitted the lowest bid to the village of Palatine Bridge, N. Y., for the construction of the proposed sewer system. Martin & Miller, Passaic, N. J., at $9,129, submitted low bid on the disposal plant. Morrell Vrooman, Gloversville, N. Y., is engineer. Bids were opened March 22.

The voters of Fairport, N. Y., at a recent election adopted the proposition to construct a sewerage system and a disposal plant.

The Board of Contract & Supply of Schenectady, N. Y., has advertised for bids for the laying of 30,000 ft. of sewers in the city streets.

A special meeting was held in the village hall, Mount Morris, N. Y., on March 24 for the purpose of letting the taxpayers decide whether the Board of Trustees shall proceed at once with the installation of the waterworks and sewers.

The village of Bennington, N. Y., has appropriated $700 to pay for plans and surveys for a surface water sewer system. A special meeting will be held to discuss the matter of appropriating a sum for the extension of the sewer system.

Mayor Waldorf of New Rochelle, N. Y., on March 21 held a conference with officials of nearby towns to discuss plans for the trunk sewer for the villages along the sound from Pelham to Port Chester. It is proposed to construct a trunk sewer and sewage disposal plant at some point about midway between New Rochelle and Port Chester, in the vicinity of Mamaroneck.

Ohio.

✣Bids will be received until noon, April 3, by V. T. Price, Director of Public Service, Cincinnati, O., for the construction of main and lateral sewers and drains, with their appurtenances, in Steiner St., from existing sewer in W. Sixth St., 1,122 ft. northwardly, and from existing sewer at Hartman St. 1,044 feet northwardly. Plans, specifications and blank proposals can be obtained at the office of the Chief Engineer, Department of Public Service. Each proposal must be accompanied by a bond in the sum of $2,000, or a certified check on a solvent bank, as a guarantee that if the proposal be accepted a contract will be entered into. M. J. Keefe is Clerk.

The City Council of Wooster, O., has advertised for bids for the installation of sewers in the Board of Trade allotment.

The city of Piqua, O., plans the construction of over 22,000 ft. of sanitary and storm sewers this spring and summer.

The contract for the construction of a sewer in the city of Elyria, O., along Riverside Court, for which bids were opened March 27 by G. H. Lewis, Director of Public Service, has not been awarded.

The City Council of Urbana, O., has passed legislation providing for the construction of storm sewers on the public square.

Stephen Leflar has been awarded the contract by the Village Council of Arlington Heights, O., for the construction of a sanitary sewer for $8,177. Thomas P. Strack bid $8,939 on the work.

Oklahoma.

An election was held in Henryetta, Okla., on April 1 for the purpose of voting on the issuance of bonds to the amount of $50,000 for the construction of a sanitary sewer system. The Benham Engineering Co., Am. Nat. Bank Bldg., Oklahoma City, Okla., are engineers.

The citizens of Durant, Okla., on March 18 voted the issuance of bonds to the amount of $27,000 for the construction of sewers and $13,000 for waterworks extension.

Pennsylvania.

City Engineer E. B. Ulrich of Reading, Pa., has advertised for bids for the construction of storm water sewers under the $300,000 loan. The sewers are to be laid on North Sixth, in the vicinity of the High School athletic field first, and then the Second and Elm Sts. sewer. The laterals for the northeast intercepting sewer in the section of the city along Mt. Penn are also to be advertised immediately.

Dr. Samuel G. Dixon, state commissioner of health, has estimated that it will cost $44,000,000 to build the municipal sewage disposal plants outside of Pittsburgh and Philadelphia. It is proposed to ask the state to appropriate one-half the cost.

The Town Council of South Bethlehem, Pa., has decided to start proceedings condemning six acres of land near the Lehigh river, on which it is proposed to erect a $100,000 sewage disposal plant.

Bids were opened March 18 by the Director of Docks of the city of Philadelphia, for furnishing an 86-ft. tugboat, a 35-ft. or 38-ft. gasoline launch and an 18-h.p. gasoline engine and two steel drop-bottom scows for use in connection with the dredging, surveying and inspecting work of the department. The low bids were as follows: Tug, $33,400, in 58 working days, Theodore Smith & Sons, of Brooklyn; launch, hull and cabin, $1,195 if 35 ft. long, $1,495 if 38 ft. long, George C. Norris, of Holyoke, N. J.; scows, $11,500 for one, $22,750 for two, by Ira S. Bushey, of Brooklyn; for gasoline engine, $1,025, by Carman & Bowen.

South Dakota.

The City Council of Howard, S. Dak., has had plans prepared for the installation of a sewerage system. Bonds were recently voted for this work.

Tennessee.

⊙The Board of Public Works of Nashville, Tenn., has awarded the contract for the construction of a trunk sewer in Delta Ave., from Cheatham to Buchanan St., to T. V. Simpkins, for $5,244.

Texas.

✣Bids will be received until noon, April 7, by Dan C. Smith, Jr., City Controller and Secretary, Houston, Texas, for the following work: Contract No. 1—For the performing of all labor and furnishing of all the material required for the construction of 1,850 lin. ft. 72-in. storm sewer, 1,780 lin. ft. 84-in. storm sewer, 1,340 lin. ft. 102-in. storm sewer, 4,520 lin. ft. 108-in. storm sewer, 27 manholes, 108 catch basins, 2,000 lin. ft. 15-in. catch basin connections. Contract No. 2—For the performing of all labor and furnishing of all material required for the construction of 800 lin. ft. 24-in. lateral storm sewer, 5,440 lin. ft. 36-in. lateral storm sewer, 760 lin. ft. 42-in. lateral storm sewer, 1,260 lin. ft. 48-in. lateral storm sewer, 4,300 lin. ft. 54-in. lateral storm sewer, 32 manholes, 128 catch basins, 2,300 lin. ft. 15-in. catch basin connections. Specifications, plans, bidding blanks and form of contract can be obtained upon application at the office of the City Engineer, City Hall, Houston, Texas. A certified check on any bank in Houston, Texas, payable to the order of H. B. Rice, Mayor, for the respective amounts shown below, will be required to be deposited with each bid: For contract No. 1 a certified check for $9,000; for contract No. 2 a certified check for $4,000.

✣Bids will be received until noon, April 7, by Dan C. Smith, Jr., City Secretary, Houston, Texas, for furnishing of all material and labor necessary for the construction of 3,000 lin. ft. of 15-in. sanitary sewers and nine manholes, on McKinley Ave. east of York St. Plans, profiles, specifications, bidding blanks and form of contract can be obtained upon application at the office of the City Engineer, City Hall, Houston, Texas. A certified check on any bank in Houston, Texas, payable to H. B. Rice, Mayor, for $700, will be required to be deposited with each bid.

Citizens of the western part of Brownsville, Tex., have asked the City Council to extend the sewer system to that part of the city.

Consulting Engineers Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., have appraised the valuation of the sewerage plant in operation at Temple, Tex., at $46,000. An election will be held April 1 to vote on a bond issue of $75,000 to purchase the plant and make improvements to the same.

Utah.

⊙J. P. O'Neill Construction Co., of Ogden, Utah, has been awarded the contract by that city, H. J. Craven, City Engineer, for the construction of sewers in District No. 115, being portions of Van Buren Ave., Patterson Ave., and Lincoln Ave., for $2,698. Bids were opened March 24.

Citizens of South Fifth East St. have asked the City Commissioners of Salt Lake City, Utah, to install a system of sewers in that section.

Virginia.

The finance and public improvement committees of the City Council, Petersburg, Va., have approved the ordinance providing for the improvement of River St. and vicinity and have recommended the same for adoption. The ordinance appropriates $48,700 for the raising of street grades, the construction of sewers, etc.

Wisconsin.

✣Bids will be received until 8 p. m., April 15, by S. J. Brew, Village Clerk, West Allis, Wis., for furnishing all the necessary material and doing all of the work necessary and required to construct and build complete sewage purification plant, in accordance with plans and specifications on file with the village clerk of the village of West Milwaukee, Wis., and at the village hall, corner 40th Ave. and Scott St., and at the office of the Engineer, G. A. Geiger, 20 Mack block, Milwaukee, Wis.

✣Bids will be received until 8 p. m., April 15, by Village Board of West Milwaukee, Wis., for furnishing all the necessary material and doing all of the work necessary and required to construct and build complete sewage purification plant, in accordance with plans and specifications on file with the Village Clerk of the village of West Milwaukee, Wis., and at the village hall, corner 40th Ave. and Scott St., and at the office of the Engineer, G. A. Geiger, 20 Mack Blk., Milwaukee, Wis. S. J. Brew is Village Clerk.

E. R. Harding of Racine, Wis., submitted the lowest bid to the city of Fond du Lac, Wis., J. F. Hohensee, City Clerk, for the construction of the west side sewer system. Bids were opened March 25.

BUILDINGS

Arizona.

Plans are under way for the erection of a $300,000 hotel in Phoenix. Judge H. W. Wells, Prescott, Ariz., is interested.

District of Columbia.

✣Bids will be received until noon, April 26, by Maj. W. J. Barden, U. S. Engineer, Washington Barracks, D. C., for constructing an engineer school building with power house annex.

Georgia.

✣Bids will be received until noon, April 10, by Hugh H. Alexander, Chairman, Chronicle Building Committee, Augusta, Ga., for removal of present buildings from site, and furnishing all labor and material necessary to erect thereon a 10-story and basement fireproof office building in Augusta, Ga., in accordance with plans and specifications prepared by C. Lloyd Preacher, Architect and Engineer, Augusta, Ga., and W. L. Stoddart, Associate Architect, New York City, from whom general contractors may secure plans at discretion of architects, upon deposit of $50 to guarantee that proposal will be submitted and plans returned in good condition, when deposit will be returned. Sub-contractors may secure plans under same condition, except that $25 will be retained to cover cost of duplication. Plans and specifications are on file for inspection at architects' offices in Augusta, Ga., and 30 West 38th St., New York City, also at Atlanta Builders' Exchange, Candler Bldg., Atlanta, Ga. Each proposal must be accompanied by certified check or bidders' bond in the amount of $10,000, payable to Chronicle Building Company, to guarantee that contract will be entered into and satisfactory bond given in event proposal is accepted.

Iowa.

✣Bids will be received until 3 p. m., May 6, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction, complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures, and approaches, of the United States Post Office at Iowa Falls, Ia. The building is 1 story and basement and has a ground area of approximately 3,920 sq. ft. First floor only fireproof, stone and brick facing, and tin roof. Drawings and specifications may be obtained from the custodian of site at Iowa Falls, Ia., or at the discretion of the Supervising Architect.

Michigan.

⊙The Small Bros. Co., Benzonia, Mich., has been awarded the general contract for the construction of a reinforced concrete bank building at Beulah, Mich., by the Central County Bank of Benzonia.

New York.

✣Bids will be received until 11 a. m., April 11, by Francis G. Ward, Commissioner of Public Works, Buffalo, N. Y., for the labor and material necessary for the construction of a 16-room fireproof school building in District No. 57, to be located on Sears St., near Broadway. A separate and distinct proposal must be made for each of the following divisions of the work: (a) Masonry, concreting, cut stone, plastering, etc. (b) Structural iron and steel work, stairways, etc. (c) Fireproofing, floors, partitions, roofs, etc. (d) Carpentry, mill work, painting, glazing, hardware etc. (e) Roofing, sheet metal work, etc. (f) Electrical work, telephone system, lighting fixtures, etc. (g) Heating, ventilating, radiation, etc. (h) Plumbing, drainage, gas fitting, etc. No proposal will be considered unless it be accompanied by a certified check, payable to the order of the Commissioner of Public Works, such check to be 10 per cent of the amount named in the proposal; or by a bond conforming to law, such bond to be 50 per cent of the amount named in the proposal. Plans and specifications will be on file and may be examined by contractors or sub-contractors at the office of the Deputy Building Commissioner, Room 6, Municipal Bldg.

North Dakota.

Bids as follows were received last week for the completion of the County Court House at Grand Forks, N. Dak.: Ingemann Bros., St. Paul, Minn., $167,440; Charles Schooglun, St. Paul, $180,000; Dinnie Bros., Grand Forks, $185,846; John Lauretzin, Fergus Falls, Minn., $192,000; C. E. Goodhand, Sidney, Neb., $195,000; Alex Nelson, Perham, Minn., $199,775.

Ohio.

⊙The Tidewater Construction Co., New York City, has been awarded a contract for a 10-story addition to the Halls Bros. Co. building at Euclid Ave. and E. 12th St., Cleveland. The structure will be of steel and concrete construction with terra cotta exterior and will cost about $1,000,000.

⊙The Reaugh Construction Co., 516 Garfield Bldg., Cleveland, O., has been awarded the contract for hospital building No. 2 of the sanitarium group at the city farm, Warrensville, and for building the woman's building at Correction Square. The price is $144,000.

The Chandler Motor Car Co., F. C. Chandler, President, Cleveland, O., has purchased six acres of sand along the Belt Line R. R. north of St. Clair Ave., on which it will erect a 420x120-ft. reinforced concrete factory building.

Pennsylvania.

✣Bids will be received until 11 a. m., April 26 by Bureau Yards and Docks, Navy Department, Washington, D. C., for marine barracks at the navy yards, Philadelphia, Pa. Amount available, $175,000. Plans and specifications can be obtained on application to the bureau or to the commandant of the navy yard named, subject to a deposit of $25 to insure their return.

Plans have been completed by Oliver Randolph Perry, Architect, 1723 Chestnut St., Philadelphia, for a 90x255-ft. 3-story and basement, reinforced concrete dairy building, to be erected for the Wills-Jones-McEwen Co., at its 26th St. plant in Philadelphia.

Texas.

✣Bids will be received until noon, April 7, by Dan. C. Smith, City Secretary, Houston, Tex., for the construction of a fireproof arch in the city auditorium. Plans are on file with the City Engineer.

T. Block, of Beaumont, Tev., has had tentative plans prepared for an 8-story steel and reinforced concrete building to be erected at Pearl and Fannin Sts. Beaumont.

Arrangements are under way for the erection of a 10-story hotel building on W. 6th St., Austin, at a cost of about $500,000. H. E. Ford, H. C. Pitts and C. O. Smith, Austin, are interested.

Washington.

⊙W. W. Hess, Philadelphia, Pa., has been awarded the contract for the construction of a $100,000 gas plant for the Wenatchee Gas & Electric Co., of Wenatchee, Wash.

RIVERS AND HARBORS

Connecticut.

✣Bids will be received until 2 p. m., April 12, by Maj. G. B. Pillsbury, U. S. Engineer, New London, Conn., as noted in our last issue, for maintenance dredging in the Connecticut River below Hartford, Conn. The work to be done is in the nature of annual maintenance dredging and dredging shall be done wherever the contracting officer may direct. The exact location of the dredging, the amount to be done at each locality, and the order in which it will be done, depend upon the conditions found after the river subsides from its annual spring freshet, which is ordinarily about May 20, but sometimes it is necessary to begin dredging much earlier. It is expected that the conditions this spring will be approximately the same as in the past, and as a guide the following information is given: During the past 17 years the total amount of annual dredging each year between Hartford and Middletown has ranged from about 50,000 to 99,000 cu. yds. and has averaged about 68,000 cu. yds., the two extremes being rarely reached; the total number of places where dredging is likely to be done is about ten, but in the past 17 years the number of places where dredging was done in any one year has never exceeded seven nor been less than five and has averaged six; the amount dredged at each locality in any one year has varied from about 44,000 to 800 cu. yds.

✣Bids are asked until 2 p. m., April 21, by Maj. G. B. Pillsbury, New London, Conn., as noted in our last issue, for removing riprap dike in Connecticut River about 5 miles above Hartford, Conn. The work to be done is to remove a dike of rubble stone and to place the material removed upon a second dike. The dike to be removed was constructed in 1871, and originally extended out from the eastern bank about 500 ft. into the river. The bank has since cut away so that there is a narrow channel between the dike and the river bank. Little, if any, of this dike lies above the plane of mean low water. This dike is to be entirely removed to a depth of 7 ft. below mean low water. The stone removed is to be placed on a dike located on the same side of the river and about 2,200 ft. downstream. This dike is about 600 ft. long, and has now an irregular top, the upper portions of which are about at the level of mean low water. Beginning at the inshore end this dike is to be raised to a height of 4 ft. above mean low water, with top width of 3 ft. and side slopes of 1 on 1, for such distance as the amount of material will permit. The stone to be removed from the upper dike and placed on the lower dike is small riprap stone, probably brownstone. It is believed that most of it is what is commonly known as one-man and two-men stone.

✣Bids will be received until 2 p. m., April 19, by Maj. G. B. Pillsbury, U. S. Engineer, New London, Conn., as noted in our last issue, for constructing timber and brush dikes at Press Barn Bar, Connecticut River. The proposed work is on the northerly bank of the Connecticut River, at Press Barn Bar, 7 miles by river channel below Hartford and nearly 45 miles above the mouth of the river. The work consists in furnishing the necessary material and building seven spur dikes of piles, timber and brush. These dikes, ranging in length from 36 to 222 ft., and aggregating in length 1,110 ft. The top of the inshore end of these dikes will be at an elevation of 7 ft. and the top of the outer end at 2 ft., above mean low water. The inshore end of each dike will be located at about the

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

mean low water line, and the depth of water at the outer end will be from 2 to 8 ft. at mean low water. The approximate quantities required are as follows: Piling: 483 piles, 14 to 20 ft. long. Lumber: 15,000 B. M., 6 in. x 12 in.; 6,750 B. M., 8 in. x 10 in. Wrought iron rods, bolts, drift bolts, nuts and washers: 192 tie rods, 1 in. x 8 ft. 1 in., with nuts; 99 bolts, ¾-in. x 24 in., with nuts; 356 bolts, ¾-in. x 14 in., with nuts; 712 washers for ¾-in. bolts; 384 drift bolts, ⅞-in. square x 24 in. Cast iron washers: 198 for ¾-in. bolts; 384 for 1-in. bolts. Brush, 280 cords; stone, 160 long tons.

✣Bids will be received until 2 p. m., April 28, by Maj. G. B. Pillsbury, U. S. Engineer, New London, Conn., for dredging in Connecticut River, below Middletown, Conn.

✣Bids will be received until 2 p. m., April 29, by Maj. G. B. Pillsbury, U. S. Engineer, New London, Conn., for dredging and rock removal in Southport Harbor, Conn.

Bids as follows were received March 27 by Major G. B. Pillsbury, U. S. Engineer, New London, Conn., for 16,200 cu. yds. of dredging in Mystic River, Conn.: J. S. Packard Dredging Co., Providence, R. I., 20 cts.; The T. A. Scott Co., Inc., New London, Conn., 18 cts. (recommended for acceptance).

Bids per cu. yd, as follows were received March 15 by Maj. G. B. Pillsbury, U. S. Engineer, New London, Conn., for dredging in New Haven Harbor, (1) Sec. 1, 350,000 cu. yds., (2) Sec. 2, 92,000 cu. yds., (3) Sec. 3, 23,000 cu. yds. (all the above for the work as a whole); (4) Sec. 1, (5) Sec. 2, (6) Sec. 3 (alternate bids for sections separately): John A. Seely, 30 Church St., New York, N. Y., (1) $0.1525, (2) $0.17, (3) $0.44, (4) $0.1555, (5) $0.175, (6) $0.45; The Taylor Dredging Co., Ft. of Communipaw Ave., Jersey City, N. J., (1) $0.135, (2) $0.14, (3) $0.49, (4) $0.135 (accepted), (5) $0.14 (accepted), (6) $0.49; Coastwise Dredging Co., Norfolk, Va., (1) $0.15, (2) $0.15, (3) $0.15; J. S. Packard Dredging Co., Providence, R. I., (1) $0.1459, (2) $0.1459, (3) $0.1459; The T. A. Scott Co., Inc., New London, Conn., (5) $0.16, (6) $0.22 (accepted); P. Sanford Ross, Inc., 277 Washington St., Jersey City, N. J., (1) $0.1534, (2) $0.1534, (3) $0.1534; Atlantic, Gulf & Pacific Co., Park Row Bldg., New York, N. Y., (4) $0.149; Atlantic Dredging Co., 81 New St., New York, N. Y., (5) $0.165, (6) $0.23.

Delaware.

✣Bids will be received until 11 a. m., April 15, by Maj. R. R. Raymond, U. S. Engineer, 6th and King Sts., Wilmington, Del., as noted in our March 26 issue, for dredging Little River, Delaware. About 85,000 cu. yds. of mud, sand and gravel are to be dredged. Little River enters the Delaware Bay about 45 miles below Wilmington. Little Creek Landing the present head of steamboat navigation, is about 3¼ miles above the mouth. It is proposed to dredge, as far as available funds will permit, a channel 5 ft. deep at mean low water, 60 ft. wide across the flats at the mouth and 40 ft. wide, widening at sharp turns, between the mouth and Little Creek Landing, including three cut-offs of an aggregate length of about 1,230 ft. The depth of cutting will be from 0 to 10 ft.

District of Columbia.

✣Bids will be received until 10:30 a. m., April 12, by Maj. F. C. Baggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under Circular 768 Sheet Iron or Steel, Wire Cable, Chain, Babbitt Metal, Yellow Metal, Sheet Brass, Bronze Bars, Brass Tubing, Bronze Wire Cloth, Nuts, Cast Iron Washers, Nails, Screws, Tacks, Cotters, Shovels, Hose, Grandstones, Tackle Blocks, Valves, Belt Lacing, Emery Cloth, Sandpaper, Sash Cord, Railway Flags, Mop Heads, Ship's Felt, Marline, Paper Clips, Pins,. Rules, Paper, Lime and Beeswax.

✣Bids will be received until 10:30 a. m., April 15, by Maj. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under Circular 769 Induction Motors, Autostarters or Compensators, Automatic Oil Switches, Copper Cable, Journal Bearings, Brake-Rod Connection Pins, Steel Keys for Brake Shoes, Bolts for Brake Shoes, Pig Iron, Aluminum Pig, Ferrosilicon, Ferromanganese and Lumber.

✣Bids will be received until noon, April 23, by Lieut. Col. W. C. Langfitt, U. S. Engineer, 305 Southern Bldg., Washington, D. C., for furnishing and unloading riprap on Anacostia River Flats, D. C.

Florida.

✣Bids will be received until noon, April 7, by Maj. J. R. Slattery, U. S. Engineers, Jacksonville, Fla., for breaking up the wreck Dover at the entrance to St. Johns River, Florida.

✣Bids will be received until 11 a. m., April 19 by the Bureau Yards and Docks, Navy Department, Washington, D. C., for two portable gasoline tanks for the naval station, Key West, Fla. Estimated cost, $1,300.

Georgia.

✣Bids will be received until noon, May 1, by the Constructing Quartermaster, Fort Screven, Ga., for dredging in vicinity of government wharf.

⊙Bids were opened March 26 by the River and Canal Commission, Nisbet Wingfield, Chief Engineer, for work in connection with levee construction at Augusta, contracts being awarded as follows: 250,000 cu. yds. earth work, A. J. Twiggs & Son, Augusta, Ga., $101,000; bridge span, Virginia Bridge & Iron Co., Roanoke, Ca., at $15,454; pier construction, McKinzie Construction Co., Augusta, Ga., $3,200.

⊙Canal and River Commission of Augusta, Ga., has awarded a contract to A. J. Martin, Danville, Va., for the construction of the bulkhead at the King Mill to form a part of the new levee system being built by the city.

Indiana.

A resolution has been introduced in the City Council of Gary, Ind., providing for the appointment of a committee to report and investigate upon the advisability of building a ship canal from Gary harbor to the Little Calumet River.

Louisiana.

Bids were opened at the U. S. Engineer's Office, Vicksburg, Miss., on March 20 for 25,000 cu. yds. of subbanquette levee at Salem, the Outpost Planting Co., Alsatia, La., at 24 cts. per cu. yd., being the low bidder.

Mississippi.

⊙Stacey & Crittenden, Greenville, Miss., have been awarded the contract for 528,000 cu. yds. of levee work for the Mississippi Levee Commissioners, bids for which were opened March 25 by W. J. Shackelford, Chief Engineer, Greenville, Miss. The contract price was 19.37 cts. per cu. yd.

Letting of contracts for the small loop—the Wakefield new levee—was deferred by the Mississippi Levee Commissioners. Bids for this work were to have been opened March 25, at Greenville, Miss.

New Jersey.

✣Bids will be received until noon, April 18, by Col. Wm. T. Russell, U. S. Engineer, 39 Whitehall St., New York City, as noted in our March 26 issue, for dredging in Woodbridge Creek, Matawan Creek, Shoal Harbor and Compton Creek and Shrewsbury River, N. J. Woodbridge Creek is a small crooked tidal stream about 5 miles long, running through flat marshes for most of its length and emptying into the west side of Arthur Kill or Staten Island Sound 2 miles north of Perth Amboy. The project for improvement covers a distance of about 1⅞ miles from the mouth inland. The amount available is about $5,000. Matawan Creek is a small tidal stream in the eastern part of New Jersey which discharges into Raritan Bay through Keyport Harbor. The project for improvement covers the lower part of the river from the mouth to the New York & Long Branch R. R., a distance of about 2 miles. About $5,000 is available. Shoal Harbor is on the south shore of Raritan Bay, 5 miles from Sandy Hook. Compton Creek is a narrow stream emptying into it. The project covers the inner part of the harbor and the lower end of the creek. About $4,000 is available. Shrewsbury River is a large tidal basin in the eastern part of New Jersey and consists of two basins known, respectively, as the north branch or Navesink River and the south branch, and a channel called the main stem, which unites the two branches at their eastern ends and extends northwardly to the outlet in Sandy Hook Bay. The project covers the improvement through the main stem and in the north branch to Oceanic, about 5 miles, and in the south branch to the vicinity of Seabright, about 5½ miles from Sandy Hook Bay. The amount available is about $9,000.

⊙Post & McCord, 44 E. 23rd St., New York City, have been awarded the general contract for the complete superstructure of Pier No. 5, at Weehawken, which is being erected by the Phoenix Construction Co., of 41 Park place, New York, for the New York Central & Hudson River R. R. Co. The work will cost $108,300, and under the terms of the contract, must be completed by Oct. 1 next.

New York.

✣Bids will be received until noon, April 25, by Col. S. W. Roessler, U. S. Engineer, Army Bldg., New York City, for dredging an inlet to Sheepshead Bay.

⊙Contracts for New York State Barge Canal work, bids for which were opened March 18 by D. W. Peck, Superintendent Public Works, Albany, N. Y., have been let as follows: Contract 65, Maryland Dredging & Contracting Co., Baltimore, Md., at $1,000,098; Contract 72 A, James Stewart & Co., Inc., 30 Church St., New York City, at $1,534,603; Contract 65 calls for the improvement of the Erie Canal for the west end of Contract No. 9 to the east end of Contract No. 61 at Medina; its length is 231 miles. Contract No. 72-A calls for completing the excavation of a channel in the Hudson River and for completing upper approach wall of Lock No. 3. The length covered is 4.1 miles.

North Carolina.

✣Bids will be received until noon, April 25, by Maj. H. W. Stickle, U. S. Engineer, Wilmington, N. C., for furnishing about 16,000 tons of crushed stone or gravel.

Oregon.

An ordinance is before the City Council of Florence, Ore., providing for the issuing of $7,000 of bonds for building a 420,-ft. wharf.

Texas.

City Council of Houston has authorized the Peden Iron & Steel Co., Houston, to construct a wharf on the north side of Buffalo Bayou.

Virginia.

✣Bids will be received until noon, April 26, by Lieut. Col. E. Eveleth Winslow, U. S. Engineer, for furnishing or constructing two wooden quarterboats.

✣Bids will be received until noon, April 24, by Lieut. Col. E. Eveleth Winslow, U. S. Engineer Office, Room 2, Custom House, Norfolk, Va., for the removal of the steel whaleback barge Bangor, sunk in Hampton Roads, Va.

Canada.

⊙The U. S. Steel Products Co., New York City, has been awarded the contract for furnishing the structural and reinforcing steel for the $3,000,000 Grand Trunk Pacific dry-dock at Prince Rupert, B. C.

⊙The Department of Public Works of Canada has awarded the contract for constructing two locks and dam in Quebec Harbor to Quinlan & Robertson, Montreal, Que.

The Richelieu & Ontario Navigation Co. contemplates the expenditure of about $1,000,000 for improved and increased wharfage facilities at Toronto

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

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A Correction.

In our issue of March 26, 1913, we published a short description of the new removable casing for pipe line specials which has recently been put on the market by the Removable Flange Casing Co. Unfortunately the address of the company was incorrectly stated. The correct address is 490 Fulton street, Jamaica, New York. Having had in mind that Jamaica is a part of Greater New York, the desirability of referring directly to the Jamaica post office was overlooked.

Federal Reclamation of Swamp Lands.

When its work so far undertaken is done the Government will have reclaimed 3,000,000 acres of arid land at a cost of perhaps $90,000,000. There are in the United States 75,000,000 acres of reclaimable swamp land. There are more than 50,000,000 acres in overflow bottom lands along our great rivers. There are between Chicago and the Gulf of Mexico alone some 25,000,000 acres of swamp and overflow lands. A great bulk of the country's population in cities is located on the streams by which these lands are overflowed. All of these lands are more advantageously situated for commercial reclamation than are those which are being reclaimed in the arid region by reservoirs and canals. They lie at lower altitudes. They are along the water courses, along the main railway lines, which largely follow the valleys, where they have low grades for transportation. They have greater variety of production.

At the National Drainage Congress to be held in St. Louis, Mo., this week, Federal direction of land reclamation by drainage and river control will be urged. If the Federal reclamation of arid lands be wise and logical then so is Federal reclamation of swamp and overflow lands. There is no physical improvement which is so nearly country wide; there is none which will more greatly reduce economic waste than will the control of rivers, the prevention of floods and the reclamation of land. The loss in property and industrial production from the spring floods not yet over would go far toward meeting the most generous of reclamation expenditures that has ever been contemplated. Combined with all this there are, besides lands reclaimed, the utilization of water power, the increased possibilities of water transportation, and the increase in healthfulness of whole regions, all coming directly from river control and flood prevention. From the standpoint of economics, there is no argument against river control and land reclamation on the largest scale that has ever been suggested.

Should the Federal Government finance and direct this reclamation work? We believe that it should. Who else can direct it so successfully? Who else can provide for the expenditures demanded? Who else can adjust the questions of interstate ownership, of conflicting riparian rights, of eminent domain, of property damages and benefits? There are obstacles; the Government has no proprietary interest in swamp and overflow lands such as it has in the arid lands; unlike arid land reclamation, where the extension of benefit to any individual area can be withheld without interfering with the enjoyment of such benefit by an adjoining area, reclamation by drainage and flood protection does not permit of individual extension or withdrawal of benefit at will. None of these obstacles is, however, insurmountable. There is a way to surmount each, once the states are determined to work together at the task.

The National Drainage Congress deserves, we believe, support in its task of securing Federal direction of flood control and land reclamation.

Flood Control in the Sacramento Valley.

Flood control work on the Sacramento River is given a full section of this issue. Few American streams of no greater length and drainage basin have a flood control problem so nearly approaching in magnitude that of the great alluvial rivers of the middle western plains. In the intensity of its floods the Sacramento River is perhaps surpassed by no American River having an equal drainage area. With a drainage basin nine times as large, the Columbia has a maximum flood discharge less than two and a half times as great. The maximum run-off per unit of drainage area of the Mississippi system is only one-tenth that of the Sacramento. Imagine Mississippi flood conditions with the present unit run-off multiplied by ten.

The article on Sacramento River flood control which we publish in this issue is so comprehensive that it allows of no useful elaboration in this limited space. About the only service to be rendered here, therefore, is to urge a careful study of the article. Nowhere else can there be found so compact an assembling of the data and conclusions that have resulted from a number of separate studies during a period of 30 years of the problem of flood control on the Sacramento.

Influence of Forest Cover on the Flow of Streams.

The belief that forests have a moderating influence on floods has borne many attacks in recent years. Numerous reports have been made and great volumes of figures collected to demonstrate that no relation exists between the presence or absence of forest cover and the frequency and intensity of floods. A new school of belief, whose followers deny the ancient dogma, has grown up, and during the last dozen years this school has had rather the more exploitation in engineering journals. This last fact seemed to us somewhat unfortunate, because of its tendency to lead to the notion that the older dogma has been more completely discredited than is actually the case. Therefore in our issue of Feb. 5, 1913, we freely gave space to the data collected by Prof. J. E. Church, Jr., and indicating that forests conserved snowfall and moderated run-off. With the same thought we published in our issue of March 13, a criticism of Prof. Church's statements. Again in this issue we give space to a third presentation of data on the influence of forest cover on stream flow. This time the argument is in favor of forest regulation.

The article in this issue deserves attention for two especial reasons. It contains a notable criticism of the character of most of the data that have been presented in recent years to show the relation of forest cover to stream flow. It furnishes the most direct comparison of which we know between the run-off of forested and deforested areas similar in all factors influencing run-off save in the one factor of vegetative covering.

A Stupendous Appraisal.

One of the last official acts of President Taft was the signing of a bill providing for the appraisal of all the "common carriers" in America. Before the first of May, the Interstate Commerce Commission must begin the most extensive "inventory" ever undertaken. The steam railways alone have more than a quarter of a million miles of roadbed capitalized at eighteen billion dollars.

An appropriation of $500,000 is available for the initial expenditures on the work of valuation. What the ultimate cost will be no one can more than guess. It is commonly said that it will cost the government $3,000,000, and that the railway companies will spend fully as much more. As previously stated in these columns, the cost of appraising large public service companies, street railways, light and power companies, etc., has frequently exceeded $1 per $1,000 of appraised cost of reproduction. The tendency has been for the cost of appraisals to rise. So much is at stake where a valuation is to be used as a basis for rate making, that it is wise to leave no stone unturned in the effort to ascertain the full and true value of the property. We shall be surprised if the same tendency does not soon manifest itself in the appraisal of railways. It seems probable that the railway companies themselves will spend fully $50 per mile of roadbed in this appraisal, and that the government will spend $20 per mile, so that the grand total outlay will be nearer $18,000,000 than the $6,000,000 that forms the basis of recent estimates.

Up to the present, only one state has completed an appraisal of railways in approximately as much detail as is called for under the law just enacted by Congress. We refer to the state of Washington, for Washington is the only state that has secured and analyzed practically all the original costs of construction plus additions and improvements. This itself is no small task. We note that contemporary engineering journals are almost unanimous in condemning this feature of the law, for they fail to see any use in "antiquarian delving into old records." However, no appraisal engineer who has consciously "delved" in this manner is likely to object to the provision of the law that makes it necessary to do so. Indeed, we are certain that unless some such analysis is made of the old records, millions upon millions of dollars' worth of property will fail to be inventoried at all. In this connection it may be added that the Supreme Court of the United States has never reversed its ruling in the historical Smyth vs. Ames case, wherein it is stated that "the original cost of construction, the amount expended in permanent improvements, the amount and value of its bonds and stock, the present compared with the original cost of construction" are all matters for consideration in a railway rate case.

It is likely that individual states will cease making extensive appraisals of steam railways, for the new law provides that the appraisals made under the direction of the Interstate Commerce Commission shall be such as to give recognition to state boundaries. This will somewhat complicate the work of the I. C. C., but it will greatly lessen the work of state commissions in so far as railways are concerned. However, state appropriations for rate regulating purposes will continue to grow larger, for the work of appraising public utilities has scarcely begun.

RIVERS AND HARBORS

Methods and Costs of Building Shore Protections on the Upper Mississippi River.

Contributed by Charles W. Durham, Principal Assistant Engineer, Upper Mississippi River Improvement, Rock Island, Ill.

The shore protections or bank revetments on the upper Mississippi River, between the mouth of the Missouri River and Minneapolis, form an essential part of the river regulation inaugurated by the Government in 1878, with a view to securing 4½ ft. at low water. In 1907, by act of Congress, the minimum depth was fixed at 6 ft.

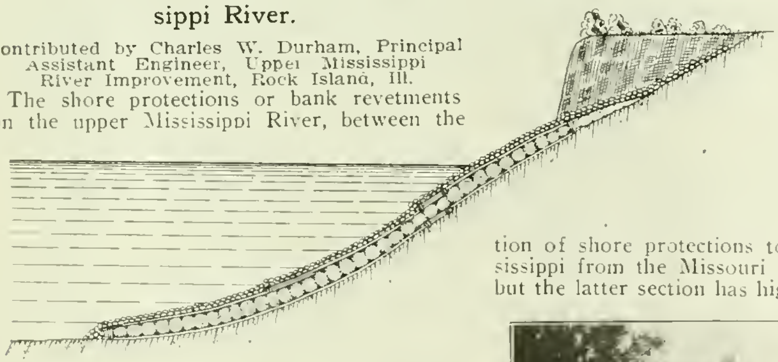

Fig. 1—Cross Section of Shore Protection, Upper Mississippi River.

In ENGINEERING AND CONTRACTING the bank revetment of the lower Mississippi, of the middle Mississippi and of the Missouri have been fully described, but so far little has been said concerning the upper Mississippi, on which stream shore protection work has progressed, it is believed, to a greater extent as regards length than on any other river in this country and perhaps in the world.

The upper Mississippi differs greatly in character; the methods employed are very dissimilar and are much cheaper. It is also believed that the work on the upper Mississippi is of a more durable character, and naturally so, because this stream has a gentler current, the banks are lower and more stable, and the water in the channel of less depth. There are very many streams in this country of comparatively similar character to that of the upper Mississippi to which its methods are or can be applied with success.

There is a certain similarity in construction of shore protections to that of the Mississippi from the Missouri River to the Ohio, but the latter section has higher banks, swifter current and deeper water, requiring a much wider apron mat, a heavier covering of rock and more difficult grading, so that the cost is much greater. The shore protection on the upper Mississippi is adequate and very seldom requires repairs and then only when damaged by ice, or, as in a few cases, where badly constructed with too steep a slope, too narrow a mat, or insufficient rock covering.

The abrasion of unprotected banks on the upper Mississippi is gradual and never excessive as on the Missouri and lower Mississippi. The water is never very deep, seldom deeper than 15 ft. at low water, so that mats of from 20 to 40 ft. in width only are needed, as compared with 120 to 125 ft. in the middle Mississippi.

The distance from St. Paul to the mouth of the Missouri River, measured by the low-water channel, is 658 miles, or about 1,316 miles of shore line, considering both sides. Of this distance about three-fifths is or will be protected by wing dams, or is rocky, or

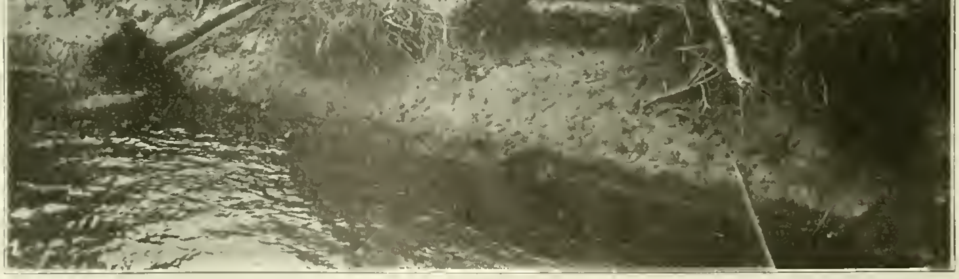

Fig. 2—View of a Low Cutting Bank Showing the Removal of a Tree.

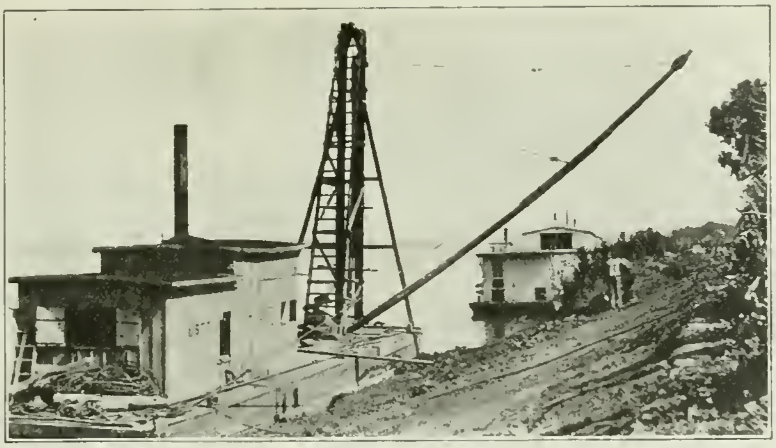

Fig. 3—View of Combined Bank Grader and Pile Driver.

for other reasons does not need protection. Of the remaining two-fifths, 526 miles, about 223 miles have already been protected, so that there now remain for future work about 300 miles which may need protection. There were used in the construction of the 223 miles of shore protection, 1,928,941 cu. yds. riprap rock and 1,837,367 cu. yds. of brush; total material 3,766,308 cu. yds. The number of pieces of shore protection, which vary in length from 100 to 18,000 ft., is 678, not including the necessary protections at ends of wing and closing dams, which are considered parts of the dams.

It appears from Table I that the average quantity of material per lineal foot of shore protection is 1.658 cu. yds. rock and 1.579 cu. yds. brush; total material 3.237 cu. yds. The quantities vary on different sections of the river, depending on height of bank and width of mat, which latter depends on the depth and stage of water. The quantity of material used on the lower section—Hannibal to the Missouri River—is the greatest, which, together with greater labor in clearing and grading, increases its cost.

The table shows the average cost per lineal foot to be $3.43, figures running from $2.65 to $4.15. The percentage of repairs varies from 1 to 10, the average being 6 per cent, for a period of 35 years, during which shore protection has progressed. The unit cost of material in place is taken at $1.50 per cubic yard for rock and 60 cts. for brush, which is a fair average price.

It will be noted that the proportion of rock and brush is practically equal, which conforms to adopted regulations. At the above mentioned unit prices, the shore protection on the upper Mississippi has cost to Dec. 31, 1911, about $4,000,000, or $18,000 per mile.

In building shore protections the bank must be cleared and graded, the apron mat built and launched and the mat and graded bank covered with riprap rock (Fig. 1). These operations are usually carried out in the order named, which is preferable, although occasionally the mat has been sunk first and the bank graded down on it, and occasionally when brush was not at hand, the bank has been both graded and rocked prior to the sinking of the mat.

CLEARING AND GRADING.

The clearing and grading have always been done by hand, except in the lower part of the river between Hannibal and the Missouri River, where the banks are higher and where a derrick-boat with scraper has been largely used in grading (Fig. 2). In clearing, the trees are cut and hauled back, the small roots and stumps dug out by hand and the larger stumps destroyed by dynamite or "rackarock." The latter and low grade dynamite are the best explosives for this purpose. Care is taken to remove all snags and stumps in and under the water, so that the mat may lie on a smooth surface, which, as is manifest, is a very important consideration.

In grading, the bank is given a slope of 2 on 1, or even flatter when it is sandy. A flat bank is the best, as on such a bank the rock resists more successfully the action of ice and floods, but, of course, the flatter the slope the more rock is required to cover it, and the cost is therefore greater. In the early years the slope was 1 on 1½, but this in many cases was found to be too steep to hold the rock. For many years brush was carried up the bank, but of late years it is only carried up to the water's edge, except that in some cases the fascine binders are cut and the loose brush is used to fill cavities on very soft, sandy banks, but this practice, although quite inexpensive, is not considered by the writer advantageous.

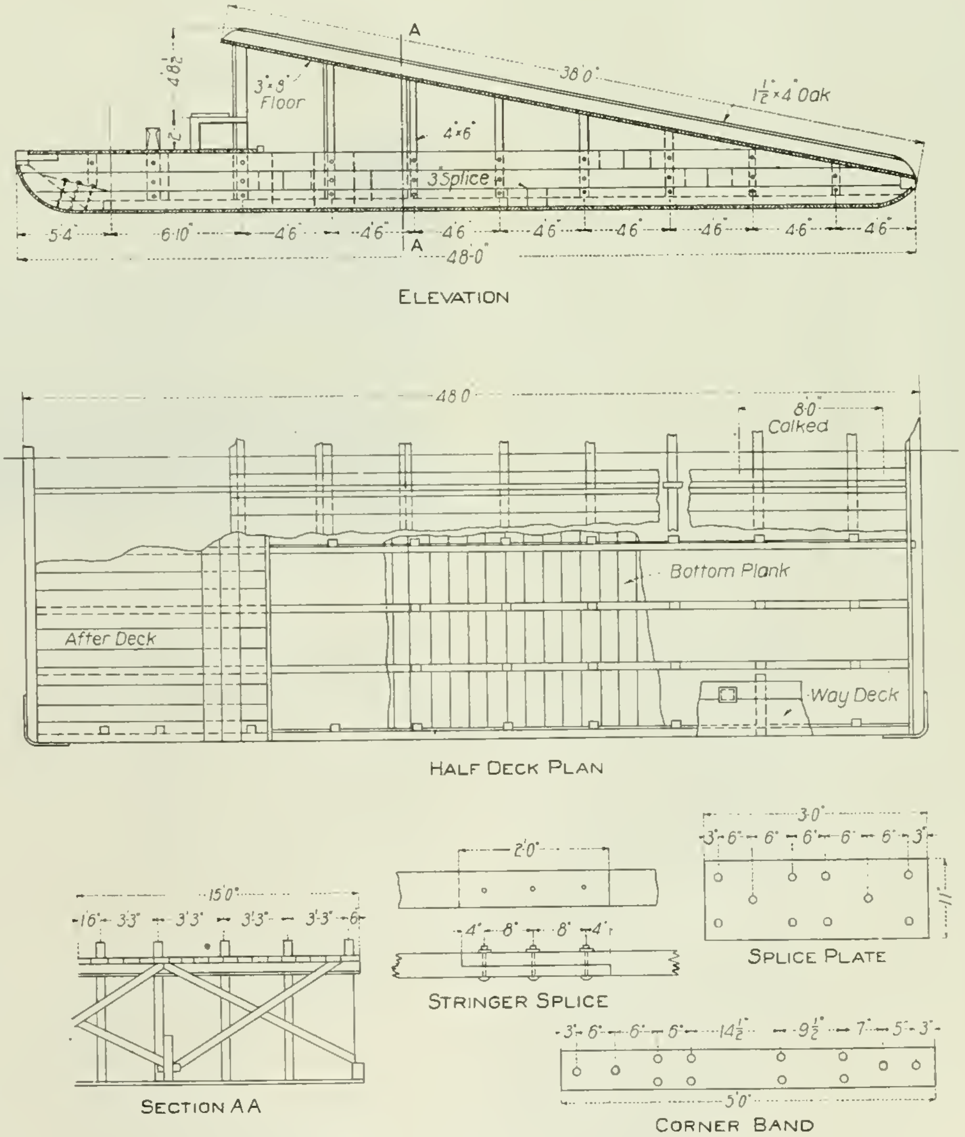

Fig. 4—Details of Grasshopper Barge (30x48x3 ft.).

In removing stumps a great saving over grubbing by manual labor or stump machine is made by use of explosives. All the tools necessary are a wood auger, a dirt auger and a wood tamping rod. A hole is bored diagonally under the stump, the charge prepared and inserted in the usual manner, and exploded by fuse or friction battery. Judgment and experience determine the size of the charge, and when it is properly applied the stump is torn into fragments which can be easily handled, heaped and burned. The manufacturers of explosives furnish printed instructions for blasting stumps. Fifty stumps, the diameter of the smallest being 15 ins. and of the largest 54 ins. at the top, were destroyed as follows:

No. of stumps	50
No. lbs. of dynamite	63¼
Cost of dynamite at 20 cts	$12.65
Cost of caps and fuse	$1.00
Average cost per stump	$0.27

The great saving by this method of removing stumps is readily seen. The first use of a derrick-boat and scraper for grading banks was made in 1897 by Contractor A. Kirchner, to whom the credit is due for this simple and generally economical application of ordinary tools to this class of work. Of late years, as his work has been chiefly in the upper part of the river where the banks are lower, he has done all of his grading by hand. While there can be no doubt that the operating cost of this machine is much less than the cost by manual labor, it must be kept quite continuously at work to overcome the cost of the machine itself and its upkeep. The apparatus in use by Kirchner, Short and by the Rock Island office is about as described below.

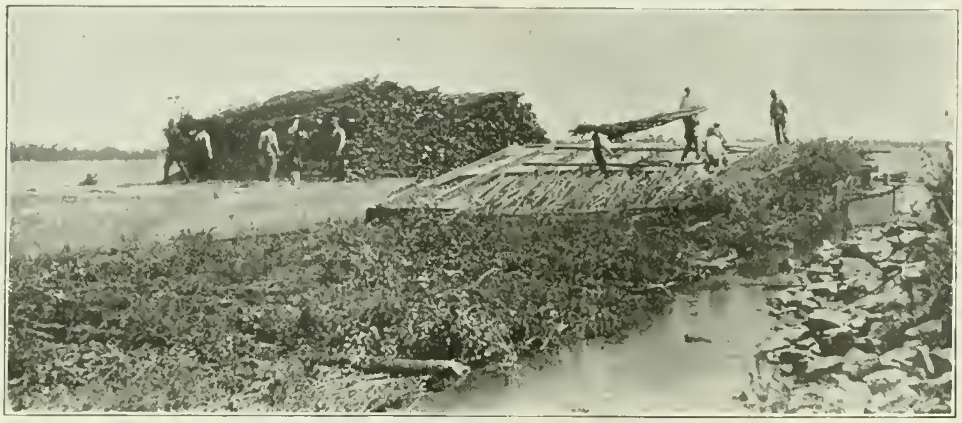

Fig. 5—Method of Building Shore Protection Mat.

It is an ordinary road scraper operated by the engine and lines of a floating derrick. This derrick with its engine and boiler is mounted on a barge about 80x20x4 ft. and has a 60-ft. boom. The scraper is attached to the fall—a single whip line hooking into the back of the scraper pan—by which it is hoisted and swung to the top of the bank after each cut. A tail line is made fast to the boom and runs to snubbing posts or trees at about 50-ft. intervals on the bank at or back of the slope line. The main drag line (¾-in. wire hoisting rope) is made fast to the scraper bail and, running over the bank and through a snatch block on the deck or scow, passes to the hoisting engine. A crew of six men (sometimes five) is required—on the barge an engineer and two men to handle the engine and boiler and the lines used in shifting and securing the scow; on the bank one man is required at the tail rope and snubbing post to control the swing of the boom and to land the scraper when hoisted after a cut, and two men are required to manage the scraper, to set it in the cut and follow it through. The engine is run at fair speed, the scraper fills rapidly and carries its load well into the river beyond the water line. The surface left by it is smooth and ready for placing the rock, it being entirely free from the guttering left by hydraulic grading. In Fig. 3 is shown a grader combined with pile driver and a pump for sinking mushroom anchors.

In Table II are shown some comparative figures from work done in 1912, of cost of grading by hand and by mechanical grader. In all of these cases it is manifest that the operating cost of the grader would have been cheaper than manual labor, but in the cases of low banks, soft material and plenty of labor, which cases generally prevail above the Des Moines Rapids and the comparatively small amount of grading to be done, it has not so far been considered economical to build and operate a mechanical grader.

TABLE II.—GRADING BANK IN 1912.

Locality.	Length, ft.	Material, cu. yds.	Cost per ft.	Cost per yd.
Harris Island [1]	3,860	1,830	$0.0654	$0.138
Saverton Island [1]	2,235	894	.0574	.156
Cottel Island [1]	2,650	1,060	.0509	.127
Squaw Island [2]	3,270	4,255	.0690	.053

[1] By hand. [2] By grader.

The bank at Squaw Island, where the grader was used, was higher and harder, and the quantity of material per lineal foot was much greater, and it is conclusively shown that the grader is much cheaper in operating cost on banks of that character. Besides there is a great saving in time, and especially when laborers are scarce.

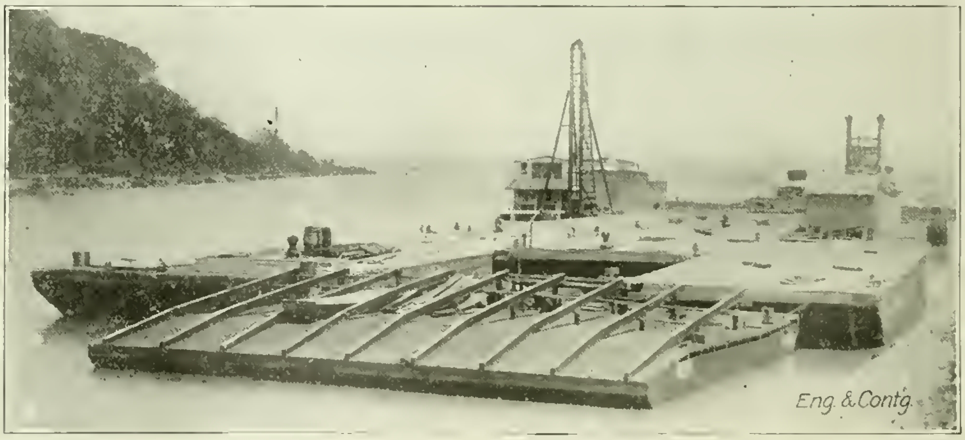

Fig. 6—View of a Shore Protection Plant.

Contractor, A. Kirchner, made a test in 1897 on the shore protection below Sterling Island, where the bank is high and was graded to a slope 2 on 1. He found that with 3 men and the grader he could do the work of 30 laborers. As most of his work since that time has been on low banks, where little shoveling was needed, he has discontinued the use of the grader. The grader to be economical must have sufficient work to do to pay for cost and depreciation of the machine. If combined with a dipper for handling rock on shore protection, as is now proposed, continuous work can be found for it, and the work of grading and riprapping banks will be much cheapened.

TABLE I.—SHORE PROTECTIONS, UPPER MISSISSIPPI RIVER, MISSOURI RIVER TO ST. PAUL, TO DEC. 31, 1911.

(Cost estimated on basis of $1.50 per cu. yd. for rock and 60 cts. for brush in place.)

Section.	Length of section miles.	Length of shore protection, feet.	Av. height of bank, feet.	Av. width of mat, feet.	Construction materials. Rock, cu. yds.	Construction materials. Brush, cu. yds.	Av. rock per lin. ft. Cu. yds.	Av. brush per lin. ft. Cu. yds.	Av. cost per lin. ft.	Percentage of repairs.
St. Paul to Lake Pepin	56	141,651	9	20	190,462	148,491	1.345	1.048	2.65	2
Lake Pepin to Winona	39	112,120	8	20	168,410	130,711	1.502	1.165	2.95	8
Winona to Wisconsin River	96	164,186	9	25	267,864	314,191	1.632	1.914	3.58	8
Wisconsin River to Le Claire	136	145,000	10	30	240,116	257,347	1.656	1.775	3.55	6
Rock Island to Montrose	109	172,592	10	25	255,174	218,271	1.478	1.271	2.98	10
Keokuk to Hannibal	56	142,543	12	25	242,281	204,656	1.700	1.437	3.39	9
Hannibal to Missouri River	118	284,989	13½	34	564,634	563,700	1.979	1.978	4.15	1
Totals	...	1,163,081	..	..	1,928,941	1,837,367	1.658	1.579	3.43	6

THE APRON MAT.

Building and launching the apron mat require the use of a small boat with inclined ways or fingers at one end, locally called a "grasshopper," on which the mat is built and gradually slid into the water so as to make it continuous for the entire length of shore protection desired. Grasshoppers were formerly built only 16 ft. wide, on which, by side projection, a mat 20 ft. in width could be made. To build wider mats two "hoppers" were lashed together. Grasshoppers are now built from 30 to 48 ft. in width.

Figure 5 shows complete plans of a hopper 30 ft. wide, 48 ft. long and 3 ft. deep, and a bill of material and cost is given in Table III. On this hopper any width of mat up to 34 ft. can be built.

The mat varies in width from 20 to 40 ft. and is occasionally somewhat wider. The intention is to have the mat extend down the slope from the water's edge to deepest water and a foot or two beyond. It will thus be seen that the proper width of mat depends on the depth of water, and shore protection is not built, except rarely, when the stage is over 5 ft. Shore protection is most successful when built at a low stage, as the bank can be sloped to better advantage, it being almost impracticable to slope it under water.

It has been noted in many cases that the bank, although cut vertically near the top, has a regular 2 on 1 slope under water. In such cases, shore protection has been built at high stages, but with a very much increased width of mat.

Brush specifications require that the fascines, of which the mattresses both in shore protections and dams are made, shall be of live brush sufficiently trimmed and choked to form a compact mass 20 ft. long and from 9 to 12 ins. in diameter, and tied with four bands of lath yarn of not more than 130 strands, or with wire not smaller than No. 18. When made into mats they are closely packed and secured by at least three pairs of binding poles, joined by ties of lath yarn or wire about 2 ft. apart. Mats are from 9 to 12 ins. thick and continuous. Binding poles are of straight wood at least 20 ft. long and approximately 3½ ins. in diameter at butts and 1½ ins. at the small end (Fig. 5).

In building the mat the fascines are laid with tips upstream, as offering less resistance to current, ice and debris moving along the bottom. The early practice was to lay them at right angles to the shore line butts to the bank, but in this position the stone on steep slopes had a tendency to slip down as though on skids.

As shown in the drawings, the grasshoppers have ways or skids running fore and aft, usually scantling rounded and smoothed on the upper edge. They are given an angle of about 30° with the water surface to facilitate launching the mat and extend over the forward end nearly to the water surface. As the work is always begun at the up river end, the force of the current aids the launching, so that ordinarily all that is necessary is to slack off the lines and allow the hopper to drop down. When a length of mat equal to the length of ways has been constructed, the hopper is dropped down river for about 20 ft., a corresponding length of the mattress sliding into the river. Fascines and binding poles are again added, the tips lapping over about 4 ft., and the work proceeds without a break, so that a continuous mattress is made of the length desired (Fig. 6).

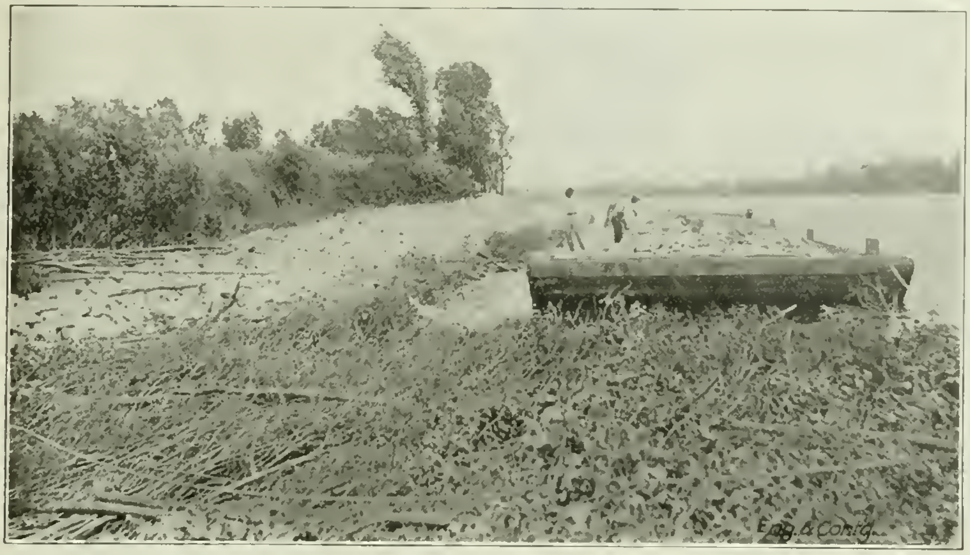

Fig. 7—View Showing Method of "Rocking" or Sinking the Mat.

In making the mat on the "hopper," as described by Assistant Engineer Richards, who uses a "hopper" 40 ft. wide, two sets of poles are placed about 8 ft. apart and perpendicular to the bank. The fascines are then laid on these poles with the butts down stream to the desired width, usually 20, 30 or 40 ft. Another set of poles is then laid on top of the fascines, directly over the first set. The two sets of poles are then bound together by lath yarn or wire, passing around the lower poles up between the fascines and twisted around the upper poles. These are put in between alternate fascines. When a sufficient section of the mat is completed, the hopper is dropped down stream until the part built is nearly in the water, then another piece is added, allowing the tops of the fascines to lap over about 4 ft., and this operation is continued until a continuous mat is made for the entire length of proposed revetments.

The inside edge of the mat is held snugly against the bank by ¾-in. lines, called slip lines, until the mat is sunk. They are placed about every hundred feet, and fastened with a round turn so that the line may be recovered when one end is let go.

The mat is "rocked" and sunk by placing a loaded rock barge at the up-stream end against the outside of the completed mat. (Fig. 7.) The laborers string out along the edge of the barge next to the mat, throw rock over on the mat, which gradually sinks in place on the river bottom. When about half of the rock is thrown off the barge, it is turned around and rock is taken from the other side. This manipulation saves much labor in carrying. After such portion of the mat is sunk as can properly be done without breaking connection with that portion of the mat still on or near the hopper, a loaded barge is started again at the upper end and rock is distributed evenly over the mat, as evidenced by the sounding pole. Only a sufficient quantity of rock is used to barely cover the mat, as no heavier covering than about 6 ins. is found to be necessary.

The rock used on shore protection and in dams is specified as hard, durable and of a kind that will not disintegrate on exposure to the action of the water or atmosphere and in pieces weighing from 5 to 100 lbs.

"ROCKING" THE BANK.

In "rocking" the bank after the mat is sunk, a loaded barge is placed along shore and wheel plank (3x14 ins.x24 ft.) are run out from the barge to the top of the bank. The laborers load the rock on wheelbarrows and dump it where desired until sufficient rock is used to cover the bank to a thickness of from 12 ins. at the water's edge to about 8 ins. at the top. The plank are then hauled in and the barge moved. Laborers level and place the rock as it is dumped. (Fig. 8.)

In loading rock barges great care must be taken in order not to "hog" or twist the barge, and piles are started at both ends and in the middle the intervals being gradually filled and the barge kept trimmed. In measuring brush, 3 measurements of height are taken at each end of the load. Two intermediate measurements of height are taken at the butts and two at the tops by forcing the measuring stick down through the brush. The average height of these ten measurements is taken as the height of the load, which multiplied by the length and by 20, the prescribed length of the fascines, gives the cubic contents.

In measuring rock, ten measurements (or less for a short barge) are taken at equal intervals along each edge of the load and ten down through the center of the load where the deck crowns. These latter are doubled and the mean of the 40 measurements is the height of the load, which, multiplied by the uniform width and the length, gives the cubic contents.

The following is a statement of cost, including all charges, of a piece of shore protection on Souaw Island, near the mouth of the Illinois. (Fig. 9.) The bank was high—13 to 16 ft.—and the rock carried to its top. The material was hard, the slope 2 on 1, length 3,270 ft., of which 3,100 ft. was graded. Width of mat, 40 ft.

COST PER LINEAL FOOT.

Clearing and grading (mechanical grader)	$0.1369
Rocking bank	.2922
Building mat	.1294
Sinking mat	.0494
Rock on band, 1.55 yds. at 80 cts	1.2400
Rock on mat, 0.41 yds. at 80 cts	.3280
Rock on mat, 1.76 yds. at 25 cts	.4400
General supt. and office, 0.028 cts. per yd.	.1042
Plant charge, 19 cts. per yd	.7068
Total	$3.4269

During the last two years considerable shore protection has been built with mats made of cull lumber. This action has become necessary owing to scarcity of brush and the desire to save it for use in dams. The large increase of work over former years keeps the brush fields cut and does not afford them time to grow of sufficient size. Lumber mats made of 1-in. culls are, however, at present prices cheaper than brush and equally good. The subject of lumber mats, their construction and cost, will be taken up in another article.

Concrete Superstructure Over the Detached Breakwater, Michigan City Harbor, Indiana.

Contributed by G. A. M. Liljencrantz, U. S. Assistant Engineer, Chicago, Ill.

Michigan City Harbor, Indiana, is located on the southeasterly shore of Lake Michigan. In this position it is more exposed to severe northerly and northwesterly gales than any other harbor on the Great Lakes. Thus, it is subjected to a sweep of the lake of about 300 miles, and to resist the effects of such violent seas, the harbor structures must be given exceptional strength and stability, and quite serious damages have resulted from inadequacy in these respects.

In the storm that raged on Jan. 30, 1909, about 100 lin. ft. of the northeasterly end of the detached breakwater were torn loose from

TABLE III.—BILL OF MATERIAL FOR GRASSHOPPER 30x48x3 FT., SHOWN BY FIGURE 4.

Pieces.		Ft. B. M.	
2	10"x10"x32'	533	Fir, S4S.
4	6 x12 x30	864	Y. P., S1S1E.
1	8 x12 x12	96	Y. P., rough.
4	6 x12 x12	288	Fir, S1S2E.
4	4 x12 x32	512	Fir, S1S2E.
4	4 x12 x30	480	Fir, S1S2E.
4	4 x12 x30	480	Y. P., S1S2E.
6	4 x12 x24	576	Fir, S1S2E.
4	4 x12 x14	224	Y. P., rough.
2	4 x12 x10	80	Fir.
12	4 x 6 x28	672	Fir, S4S.
15	4 x 6 x10	360	Fir, S4S.
25	4 x 6 x10	450	Y. P., S1S1E.
2	4 x 8 x 9	48	Y. P.
56	3 x12 x30	5,040	Fir, S1S2E.
2	3 x12 x30	180	Fir.
50	3 x12 x20	3,000	Fir, S1S2E.
16	3 x12 x18	864	Y. P., S1S2E.
33	3 x12 x12	1,188	Fir.
12	3 x 6 x20	360	Fir.
4	2 x 4 x16	43	Fir, S4S.
1	6 x 8 x 8	32	Oak.
1	6 x 6 x12	36	Oak.
2	6 x 8 x12	96	Oak.

12 lbs. 4x7-in. boat spikes.
322 lbs. 60d. wire spikes.
3 lbs. 40d. wire spikes.
20 lbs. 30d. wire spikes.
15 lbs. 20d. wire spikes.
15 lbs. 10d. wire nails.
2 lbs. 8d. wire nails.
3 lbs. 3d. wire nails.
2 lbs. ⅝"x18" carriage bolts.
4 lbs. ⅝ x13 carriage bolts.
3 lbs. ⅝ x12½ carriage bolts.
1 lb. ⅝ x12 carriage bolts.
14 lbs. ⅝ x 5 carriage bolts.
10 lbs. ¾ x11 carriage bolts.
4 lbs. ¾ x10 carriage bolts.
7 lbs. calking cotton.
2 lbs. ¾x9 carriage bolts.
2 lbs. ¾x8 carriage bolts.
48 lbs. ¾x7 carriage bolts.
72 lbs. ¾x5 carriage bolts.
2 lbs. ½x17 carriage bolts.
4 lbs. ½x14 carriage bolts.
12 lbs. ½x13 carriage bolts.
47 lbs. ½x11 carriage bolts.
6 lbs. ½x10½ carriage bolts.
14 lbs. ½x10 carriage bolts.
20 lbs. ½x9 carriage bolts.
90 lbs. ½x8 carriage bolts.
2 lbs. ½x12 carriage bolts.
2 lbs. ½x8½ carriage bolts.
1 lb. ½x6½ carriage bolts.
39 lbs. ½x6 carriage bolts.
12 lbs. ⅝x6 carriage bolts.
16 lbs. ⅜x8 carriage bolts.
166 ¾x19 drift pins.
300 ¾x32 drift pins.
8 lbs. ¾x16 machine bolts.
4 lbs. ¾x10 machine bolts.
6 lbs. ¾x9 machine bolts.
2 lbs. ¾x9½ machine bolts.
3 lbs. ¾x6 machine bolts.
4 lbs. ⅝x7½ machine bolts.
6 lbs. ¾" cut washers.
23 lbs. 1" cut washers.
28 lbs. ⅝" cut washers.
7 lbs. ½" cut washers.
1,390 lbs. ¼x4 flat iron.
125 lbs. ⅜x6 flat iron.
522 lbs. ¼x10 flat iron.
3½ gross 2½" drive screws.
½ lb. tacks.
569.6 gals. creosote oil.
8 gals. headlight oil.
4 gals. engine oil.
1-7 B. B. Capstan.
2 gals. trop. oil.
182 lbs. oakum.

Cost of labor	$ 467.19
Cost of material	691.19
Total	$1,158.38

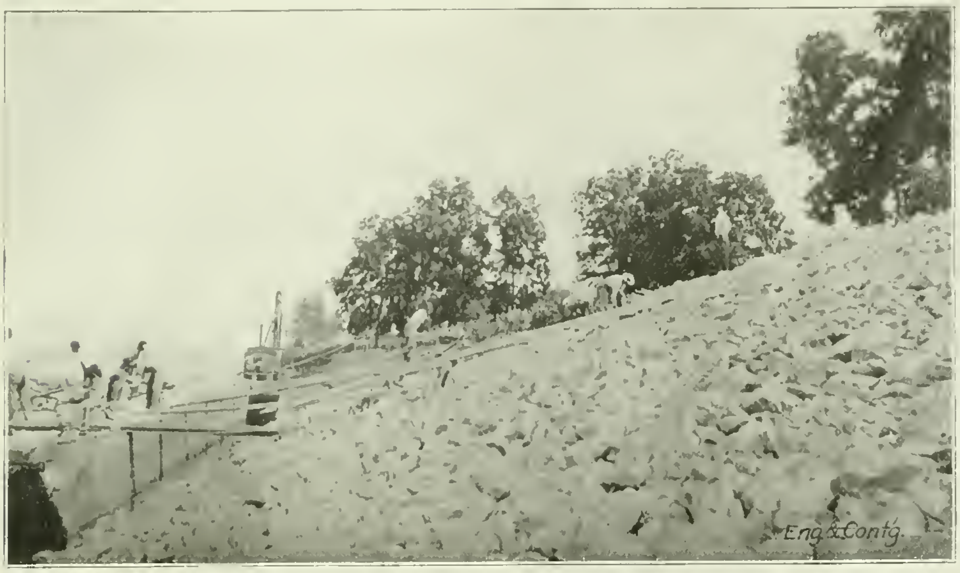

Fig. 8—View Showing Method of "Rocking" the Bank.

the adjacent part of the structure and thrown bodily a distance of about 30 ft. from the southerly alignment of the work. The breakwater was composed of cribs 100 ft. long by 30 ft. wide, placed end to end, in juxtaposition, and covered with an 8 ft. high timber superstructure built continuously—thus connecting the cribs in the substructure—the whole filled with riprap stone and covered with 6x12 in. deck timbers.

The violence of the high sea will be appreciated when it is remembered that before the individual crib was thrown out of its position, as stated, the heavy timbers of the 8 ft. high superstructure were torn into fragments. The original cribs were placed on a level stone foundation, with its top about 26½ ft. below low water, and with beams from 8 to 10 ft. in width on each side of the crib. After the cribs were sunk in place riprap was placed along their sides to increase their holding power and stability.

In planning to replace the destroyed part of the work it was decided to substitute a new crib with increased stability on the old stone foundation, properly leveled off, and to place thereon a superstructure of concrete, which, with sloping surfaces on both sides, would diminish the vertical area of resistance to the heavy seas and facilitate the passage over it of the high waves.

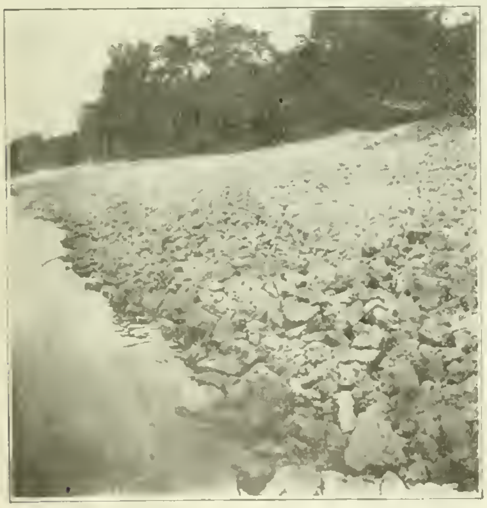

Fig. 9—View of a Completed Shore Protection.

Accordingly a new crib was built and secured in place on Sept. 20, 1909. This crib had the same width as the one destroyed, 30 ft., but at its bottom an apron was formed on each side by the extension of the two lower courses of cross-ties and by placing timbers between these tie-ends. These aprons were covered with heavy riprap, thereby considerably increasing the stability of the crib.

The crib was so built that, when sunk, its top side timbers reached nearly to the mean lake level. It was then filled to the top with riprap and covered over with two courses of 3-in. plank, laid diagonally, and so that the planks in the upper course crossed those in the lower course at nearly right angles. In this condition it was allowed to remain until the beginning of June, 1911, on purpose to give the stone foundation ample time to settle before placing the permanent superstructure over it.

On June 3, 1911, the decking and the top timbers, which latter had served in the interim to protect the timbers next below from damage by floating ice, were removed, leaving, however, the drift-bolts in place to form a bond with the concrete when this should be placed around and above them. The decking served to prevent loss of the stone filling. These parts having been removed, preparations were made for the construction of the concrete work. The mode of procedure was as follows:

Oak plank, 3x12 ins., were spiked to each side of the crib in such a manner that the upper edges, which had been planed smooth and in a perfectly straight line, were in the desired elevation, 1 ft. above Chicago city datum. This planking was to serve two purposes, viz., to form a support for the concrete molds at the specified elevation, and to protect the top timbers against floating ice. The planking, having been fastened in the exact position with spiking, was further secured to the timbers with lag screws.

The stone filling in the crib was covered with spall and gravel up to city datum and leveled off, forming an even foundation for the concrete, and this surface was covered with 8-in. burlap.

The concrete molds were made in advance, advantage being taken of weather unsuitable for work on the lake. These molds were composed of four wooden walls, two for the sides and two for front and back. They were held together with ¾ in. steel rods in both directions. The longitudinal rods holding the sides of the molds together were provided with screw ends and nuts; the transverse rods, joining the front and back walls, had sleeve nuts at each end reaching to within 1 in. of the wall, and had screws fitted into them by means of which the walls were held together, said screw bolts having ordinary nuts outside of the forms for that purpose. The object of the sleeve nuts will be shown later on.

All the preliminary preparations having been made, the forms were brought out as early as practicable on the first day of promising weather conditions, placed on the work by means of a derrick and adjusted in proper alignment, after which the concrete was deposited in the mold from bottom to top in the usual manner. All exposed surfaces were given a smooth finish.

The concrete work was built in alternate blocks, 10 ft. in length, along the crib, 30 ft. in width (the width of the crib), and, at the upper level, 9 ft. in height. The alternate blocks were placed 10 ft. apart, except in the northeasterly end of the work, as will be described later on.

Between the alternate blocks intermediate blocks of the same dimensions were built and connected with the former by means of the longitudinal rods as described later on.

Each of these blocks contained 64.4 cu. yds. of concrete, composed of 1 part cement to 2 of sand and 5 of broken stone, all measured by volume without compacting.

The concrete was required to remain in the molds at least 48 hours. When entirely set, the mold walls were removed, leaving the steel rods in the concrete mass as re-enforcement. The screws in the sleeve nuts on the transverse rods were removed and the holes filled up with a plastic grout, thus preventing any rust on the faces from protruding rods. The nuts on the ends of the longitudinal rods, having been taken off for the removal of the wall, were replaced to serve another purpose, as shown hereafter. As before stated, these concrete blocks were built alternately and 10 ft. apart.

After two or more of the blocks had been made and the forms removed, as described above, the intermediate blocks were formed substantially in the same manner, except as follows: Only the front and rear walls of the forms were used, the sides of the completed blocks taking the places of the side walls. These fronts and backs were held together with rods in the same manner as on the alternate blocks, but the longitudinal (connecting) rods were bent into loops at each end in such a manner that they could be hung on the protruding screw ends of the longitudinal rods in the adjacent blocks, and back of the nuts by means of which the rods were tightened in their respective positions. The concrete was then deposited as in the alternate blocks.

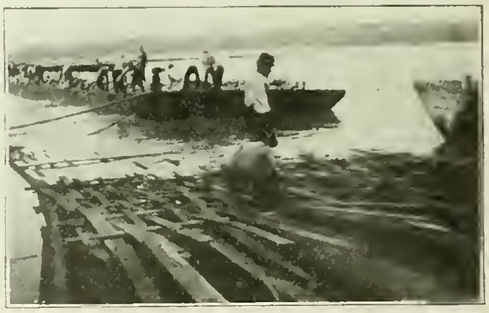

Fig. 10—View Showing the Construction of a Plank Mat for Shore Protection.

The blocks were made in one solid mass, as stated above, except on the 20 lin. ft. at the northeast end. The end of this having a similar slope to that on the lake face of the general cross section would have brought the 10-ft. division directly at the top of the slope, giving the concrete at this place the form of a sharp angle, which would be prohibitive. The last 20 ft. were, therefore, divided into two horizontal sections, as shown on the drawing. The lower section reached up to the 2-ft. berm on the outer sides, but with a 6-in. step down, 2 ft. back from the race. From the bottom of this step the concrete mass was given a slope with a rough surface up to the bottom of the 5-ft. square well, designed for the lower portion of a lighthouse tower. To strengthen the bond between the upper and lower sections, 1½ in. bolts, swedged in both ends, were inserted half way into the lower section while the concrete was yet wet.

The upper section was molded, in other

respects, in a similar manner to the 10-ft. long sections, though special forms had to be made for this. A well, 5 ft. square and 5 ft. deep, was made in the 20-ft. section, and a lighthouse tower was later built herein by the U. S. Lighthouse Department. Three steps were built near the lighthouse well, from the lower slope to the upper level on the harbor side, and ring bolts were placed in the concrete on that side, about 20 ft. apart, for mooring boats.

As this work was not extensive, covering only 100 lin. ft. of breakwater in all, and as cement and other materials had to be brought a long distance, the prices were necessarily abnormally high and the total cost therefore much higher in proportion than what may be expected for similar work, if built over a pier of considerable length.

The officer in charge of the district, under whose general direction the work was built, was Maj. Thos. H. Rees, Corps of Engineers, U. S. Army. The FitzSimons & Connell Co. of Chicago, Ill., were the contractors, and Mr. Fred H. Ketcham was the inspector in local charge.

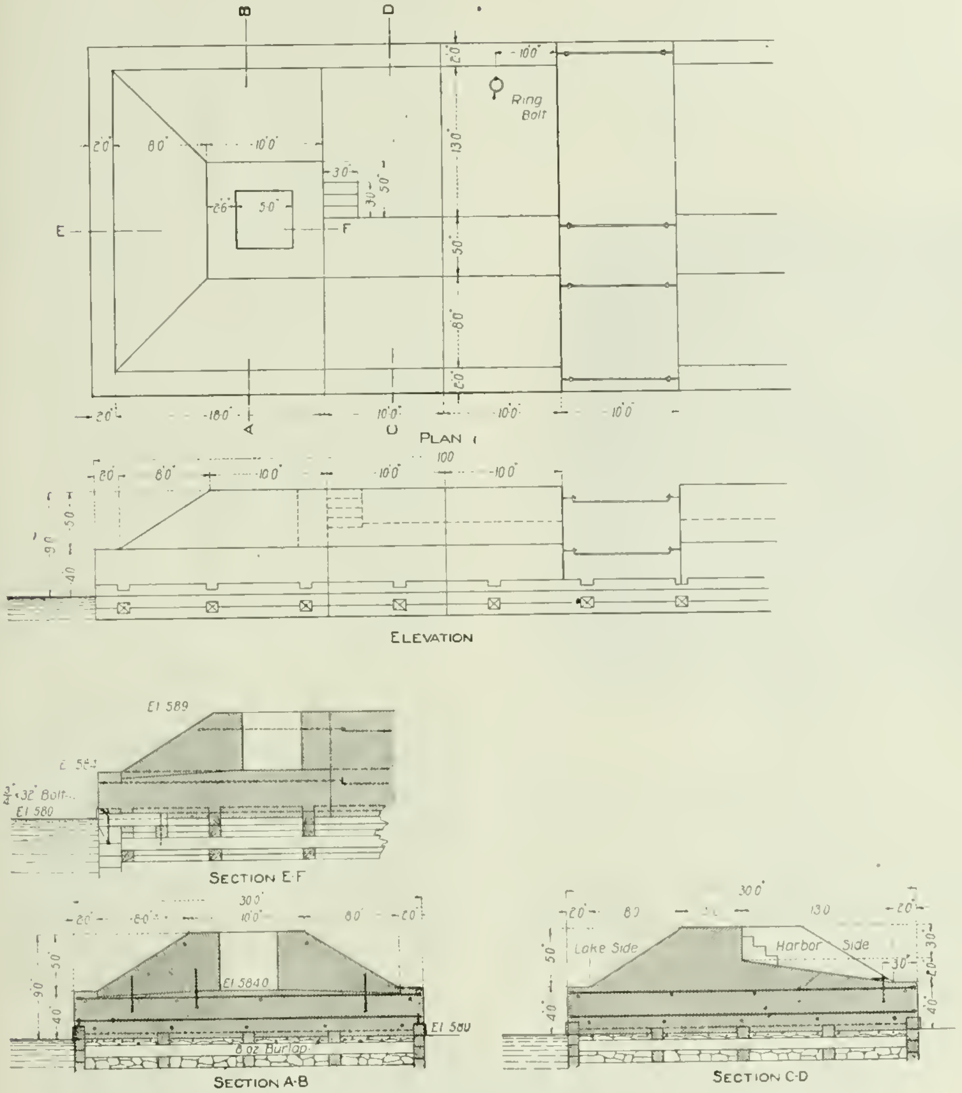

Fig. 1—Details of Michigan City Breakwater Concrete Superstructure.

Cost of Hydraulic Dredge Fill at Lincoln Park, Chicago.

(STAFF ARTICLE.)

A total of 3,662,525 cu. yds. of hydraulic dredge fill has been completed in the work of reclaiming for Lincoln Park, Chicago, an area of 200 acres from Lake Michigan. The average cost of this fill has been 14½ cts. per cubic yard. Altogether 139.06 acres have been reclaimed. As indicated by the map, Fig. 1, the reclamation work includes a number of items in addition to the dredging. Several of these other items will be considered in other articles; this article gives from official records the cost of dredging operations in 1912.

The dredging was done by the 30-in. hydraulic pipe line dredge built in 1907 and described in our issue of Dec. 25, 1907. This dredge was in commission from April 8 to Nov. 16, 1912, a period of 4,524 hours, of which 2,954 hours, or 65 per cent of the time, was employed in pumping. The weather throughout the season was very unfavorable for dredge operation outside of the breakwater and work was confined within the yacht harbor about half the season. The map, Fig. 1, indicates the fill made by the dredge in 1912. The yardage dredged was 899,701 cu. yds. The time report of the dredge may be summarized as follows:

Total working hours		4,524
Hours delay:		
Weather, 10 per cent	451	
Other causes, 25 per cent	1,119	
Total delays, 135 per cent		1,570
Time pumping		2,954

TABLE I.—COST OF DREDGE OPERATION, ATTENDANCE AND CURRENT REPAIRS FOR 899,701 CU. YDS. DREDGED.

	Total.
Labor, operating	$16,506
Commissary:	
Labor	1,500
Supplies	5,560
Total	$ 7,065
Repairs:	
Labor	$ 3,873
Materials	8,444
Total	$12,317
Attendance:	
Tug service	$18,804
Motor boat	853
Scows	410
Teams	40
Derrick	1,703
Total	$21,810
Fuel	17,901
Dredge supplies	4,783
Administration	2,473
Insurance	4,250
Grand total	$87,105

The cost of operating the dredge is given by Table I. In this table the items "repairs" include only those repairs made during the operating season. The cost of the more extensive overhauling repairs made during the season during which the dredge was out of commission are shown in Table II.

The items for tug service, derrick, motor boat scows, etc., are prorated from the accounts showing the cost of operating these pieces of plant. The cost of operating a derrick, or a tug, for example, is kept account of throughout the season and the cost per hour is obtained. Its time is then distributed to the various jobs upon which it has served and charged against each job at its calculated cost per hour.

The work of extending Lincoln Park is being done under the direction of the Lincoln Park Commissioners Mr. A. S. Lewis is Superintendent and Mr. W. T. Colman is Engineer in Charge of the marine work.

TABLE II.—COST OF OVERHAULING REPAIRS DURING WINTER.

Item.	Total.
Labor	$ 8,667
Fuel	1,195
Materials	4,587
Dredge supplies	443
Commissary supplies	564
Service, tugs, derrick, teams	782
Total repairs	$16,238
Cost per cubic yard excavation	1.8 cts.

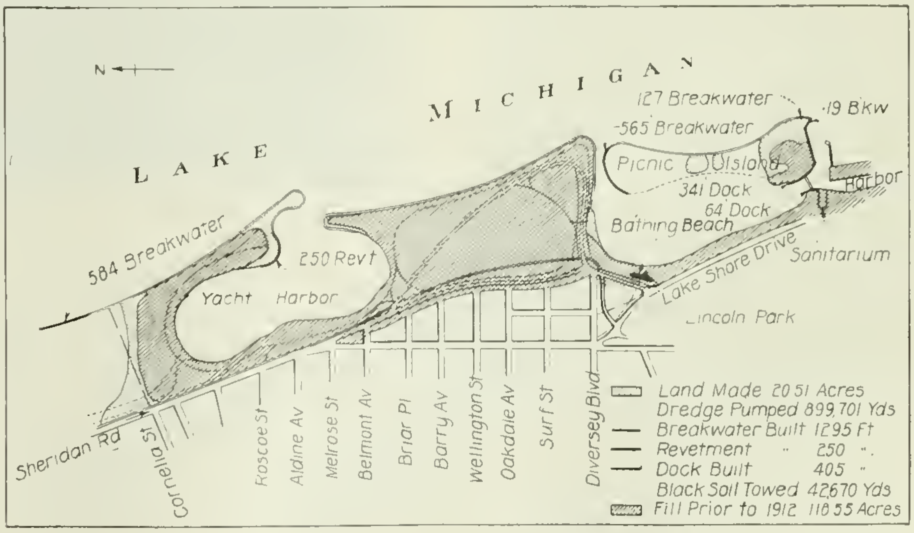

Fig. 1—Map Showing Progress of Work on Lincoln Park Extension, Chicago, Ill.

SACRAMENTO RIVER FLOOD CONTROL

Flood Control in the Sacramento Valley, California.

Contributed by Fred H. Tibbitts of Haviland, Dozier & Tibbitts, Consulting Engineers, San Francisco and Sacramento, Cal.

Areas in the Sacramento Valley.—The term "Sacramento Valley," as generally used, refers to the level land in the valley of the Sacramento River, as that area is bounded on the south by the Cosumnes, Mokelumne, and San Joaquin rivers, and the crest of the Montezuma and Denverton Hills, and bounded on the west, north and east by the lowest foothills of the Coast Range and the Sierra Nevada Mountains (see Fig. 1). The total area thus included is about 2,720,000 acres, of which about 36,000 acres are high hills (Sutter Buttes, near the center of the valley), leaving a total level area of about 2,684,000 acres. About 1,677,000 acres of this are composed of comparatively high land above the margin of the flood plane, leaving about 1,007,000 acres subject under normal conditions to periodical or occasional inundation. About 182,000 acres of this 1,007,000 acres are relatively high, and overflowed only rarely at extreme high water, or from tributaries of the Sacramento River. The balance, or 825,000 acres, under normal conditions, is all periodically overflowed. About 25,000 acres of this is in the channel surface of perennial streams. The remainder or about 800,000 acres compose the swamp and overflow land in the Sacramento Valley, which is generally capable of profitable reclamation, except perhaps for such portions as must be permanently sacrificed for flood control channels.

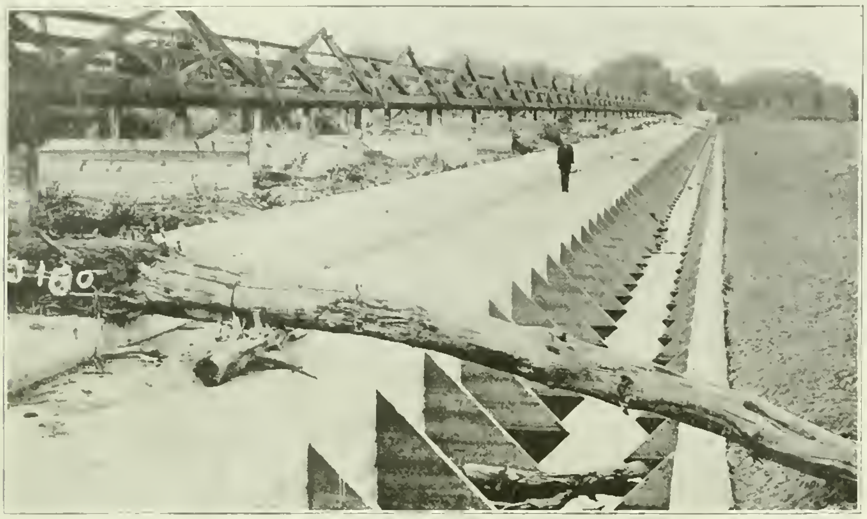

Fig. 1—Tisdale Weir. A Concrete Structure With Reinforced Concrete Water Cushion.
(Timber bridge carrying county roadway on left.)

Most of this land in its natural state is covered, during the winter and spring, with shallow water, and in the late fall is dry and bare. In the early part of the season there is a rank growth of tules which dry out and are frequently burned after the first frosts at the beginning of the winter. The land has only a speculative value, as, except for seasons of unusual drought, it is capable of yielding only a nominal revenue for a few months pasturage. When, however, the same land is protected from overflow, farming operations are attended with surprising success, because of unusually favorable climatic conditions, because it is readily possible to control the level of the ground water and the moisture content of the soil, and because of the fact that the soil formed by river overflow is of remarkable fertility.

SACRAMENTO VALLEY TOPOGRAPHY.

In order to comprehend properly the problems involved in the reclamation of the swamp and overflow land, it is necessary to consider, briefly, the topography and flood conditions of the entire Sacramento Valley.

The Sacramento Valley, which forms the northern portion of the great central valley of California, is bordered on the east by the high Sierra Nevada Mountains and on the West by the Coast Range. It has an area of over 4,000 square miles, in general of alluvial formation. From Stony Creek, near its upper end, to the mouth of the Sacramento River, a distance of about 200 miles, the river has the characteristic elevation of banks, with depressed basins or shallow troughs on either side, which is generally found with large rivers heavily laden with silt. These basins have been formed by the gradual building up of the banks of the river from sand and silt, deposited as the water overflowed its natural channel. The slope of the ground is generally rapid from the vicinity of the river, toward the axes of the troughs, which lie from two to seven miles distant and are depressed from 6 to 20 ft. below the river banks.

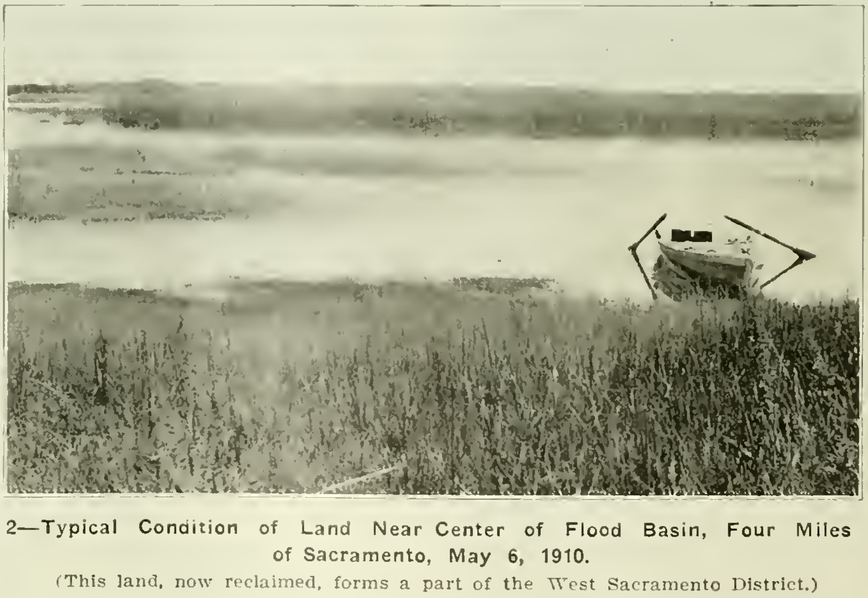

Fig. 2—Typical Condition of Land Near Center of Flood Basin, Four Miles West of Sacramento, May 6, 1910.
(This land, now reclaimed, forms a part of the West Sacramento District.)

The two troughs, one on either side of the river, are not continuous, but are separated by low ridges, normal to the axis of the valley, which have been built up by overflow from tributary streams. Thus the west side trough is divided into two basins by the Knights Landing Ridge, formed by deposits from Cache Creek, the upper portion being called Colusa Basin and the lower portion Yolo Basin. The depression on the East side is separated into four basins by the interposition of the Sutter Buttes, and by the Feather and American rivers. From south to north these are the Sacramento Basin, most of which has been reclaimed; the American Basin, lying between the American and Feather rivers, at present being reclaimed by the Natomas Company; Sutter Basin, between the Sacramento and Feather rivers, and the Sutter Buttes, and Butte Basin, immediately north of the Buttes. All of these flood basins are bordered by large areas of plains, rising gently from the margin of the high water limits to the edge of the foothills.

The area of 1,007,000 acres below the margin of the flood plane can be conveniently segregated as follows:

SACRAMENTO VALLEY FLOOD BASINS; AREAS TO MARGIN OF FLOOD PLANES.

	Acres.
(1) Delta Region (Sherman, Twitchel, Brennan, Andrus, Tyler, Grand Ryer and Sutter Islands and surfaces of adjacent streams)	74,000
(2) Sacramento Basin (south to Cosumnes and Mokelumne Rivers and Tyler Island)	71,000
(3) Yolo Basin	196,000
(4) American Basin	152,000
(5) Sutter Basin	169,000
(6) Colusa Basin	198,000
(7) Butte Basin	147,000
Total	1,007,000

FLOOD CONDITIONS.

The Sacramento Valley, with its area closely circumscribed by a mountainous water shed, in which at times there is heavy and prolonged precipitation, is subject to severe flood conditions. The total area of the water shed is approximately 27,000 square miles, and the measured flood discharge in the 1907 and 1909 floods was in the neighborhood of 600,000 sec. ft. The abnormal rate of this run-off can be appreciated by comparing it with the Columbia, another great western river, which, with a water shed over nine times as large, has a maximum flood discharge less than two and a half times as great. The maximum rate of run-off in the Mississippi River per unit of drainage area is probably not over one-tenth as great as in the Sacramento. Engineers unfamiliar with Pacific Coast conditions find difficulty in appreciating the fact that the measured run-off of large tributaries of the Sacramento River has exceeded 100 sec. ft. per square mile of drainage area.

In seasons of heavy rainfall the flood basins or troughs are filled by run-off from the adjacent plains and hills, and by water from the main river flowing over the banks or through breaks or crevasses in the levee. The basins usually discharge through sloughs back into the main channel or into the next lower flood basin. In times of great and prolonged floods these basins perform a dual function, acting as large, shallow flood water channels, and as temporary storage or equalizing reservoirs, absorbing the peak of the floods. The river channel has deteriorated until its capacity in the lower 150 miles will hardly average more than 20 per cent of the total discharge of the valley. The remainder of the floods is absorbed for a time in the storage capacity of the several basins and is finally by-passed through these basins into the lower reaches of the river and thence into tide water in Suisun Bay. At such times the flood basins become vast moving seas of water which gradually drain away as the river recedes, usually requiring several months. The drainage of the basins is imperfect so that there are numerous large, shallow lakes from which the water can completely escape only by evaporation. In times of general floods the waters usually rise to such a height that the various flood basins are closely connected by water overtopping the river banks; or flowing through sloughs or large breaks. By the maintenance of levees along the west side of the Sacramento River, however, Colusa Basin has been somewhat segregated from the other flood basins and has not usually been called upon to assist in the passage of river floods down the valley. The Sacramento Basin, including the city of Sacramento, has also been protected by continuous levees for many years, so that, except for occasional breaks, it has not been subject to overflow except from back water, at the lower end.

Flood conditions in the Sacramento Valley are gradually becoming more critical. Reclamations are constantly being formed by surrounding portions of the flood basins with continuous levees. Each additional reclamation in the overflow basins tends to aggravate conditions both by eliminating a portion of their normal storage capacity, and by obstructing and reducing their channel capacity. The effect of all such work is gradually to raise the flood plane so that the same amount of water produces higher stages at present than in the past.

GENERAL FLOOD CONTROL PROJECTS.

A number of comprehensive projects have been worked out in more or less detail, with the object of improving the navigable river channel, and at the same time of either reclaiming or making it possible to reclaim the bulk of the overflow land in the valley. Two general methods of treatment have been advocated. The first method proposed is to enlarge the present river channels to such an extent that they will carry all of the flood waters which may enter them. This method will be called the *Main Channel Plan*. The second method proposed is to use the present river channel, after enlarging and straightening it, to convey as much of the flood waters as practicable, and to by-pass the remainder through channels formed by parallel lines of levees in the lower parts of the flood basins. This will be called the *By-pass Plan*. Engineering opinion as represented in the reports of various engineering boards composed chiefly of members of the U. S. Army Engineer Corps seems to have oscillated with a fair degree of regularity, between the two methods of treatment.

Hall Plan of 1880.—The first comprehensive report upon flood control made in 1880, by William H. Hall, State Engineer, in consultation with a board, consisting of Gen. Alexander and Col. Mendall, of the Engineering Corps, and Mr. J. B. Eads, reported in favor of the main channel project, recommending relief channels for temporary use only, until the main channel should be dredged and scoured to a sufficient cross-section.

Monson-Grunsky By-pass Plan.—The second report in 1894 by Marsden Manson and C. E. Grunsky, consulting engineers, to Mr. A. H. Rose, Commissioner of Public Works, advocated the by-pass project, recommending that the river be straightened and leveed to improve its navigability, and that surplus water be diverted over weirs, into by-passes. A double line of by-passes was advocated for the upper valley. The by-passes in general were designed to be located on grade lines toward the outer margin of the flood basins, that is on the side of the center or trough of the flood basins, farthest from the river. This location permits the interception of the hill drainage before it reaches the lower portions of the flood basins, from which it is impracticable to remove it except at low stages of the river. At this time there were no accurate data regarding the maximum amount of flood water to be provided for. The size of the channels was estimated on the basis of 200,000 sec. ft., a figure which probably seemed excessive at the time, although the first comprehensive measurements made 23 years later by the Geological Survey showed that provision should be made for three times that amount.

Dabney Commission Plan.—The third general flood control project again advocated the main channel method of treatment, using by-passes only as a temporary measure, until the river channel should have been properly scoured out. This plan was worked out in de-

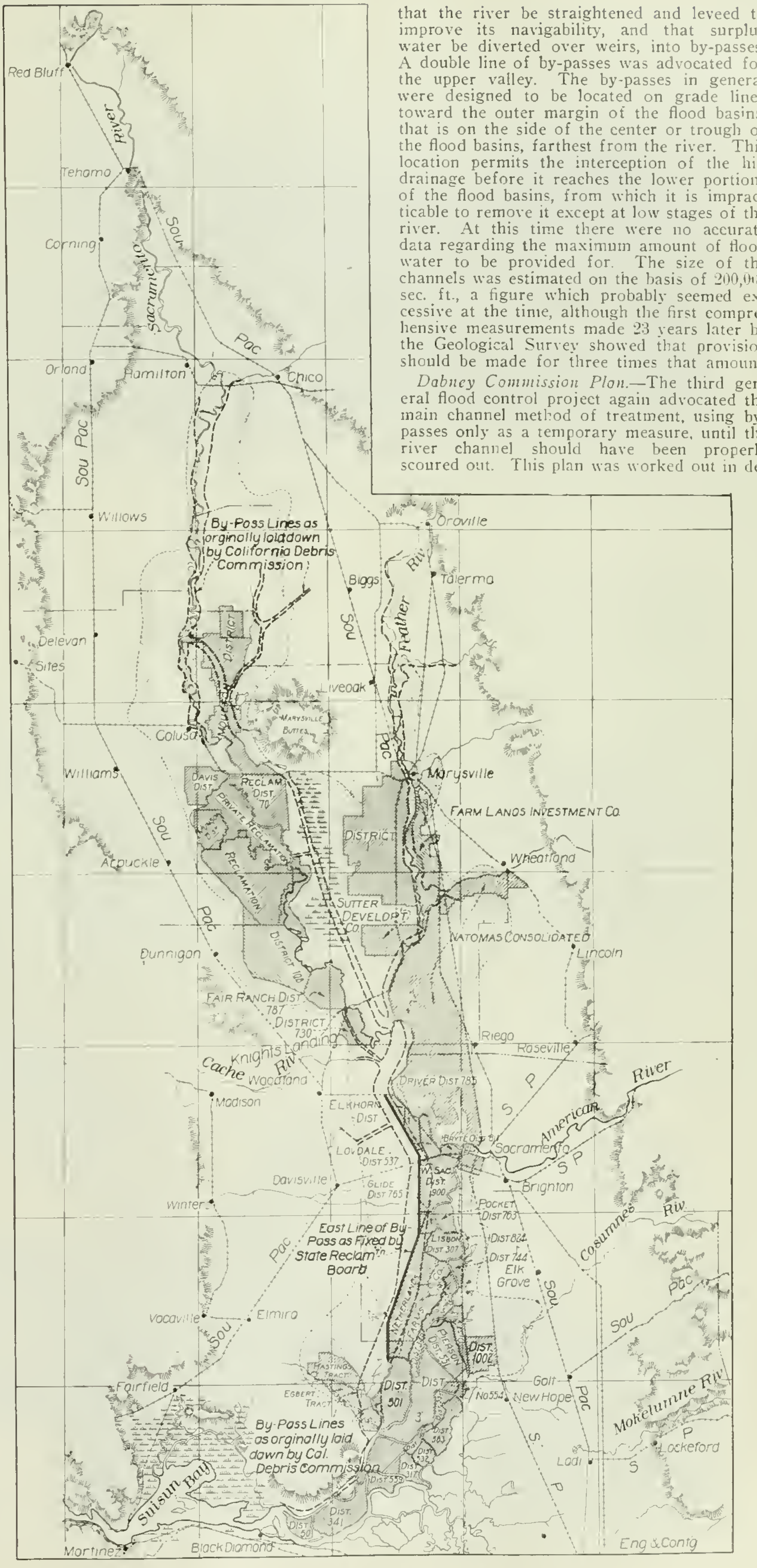

Fig. 3—Map of Sacramento Valley, California.

tail in 1904 by a Commission of Engineers, known as the Dabney Commission, consisting of Major T. G. Dabney, Major H. B. Richardson, Major H. M. Chittendon and M. A. Nurse.

Fig. 4—Center of Lower Yolo Basin, About Two Miles West of Courtland, Sept. 30, 1912.
(Timber in background is along Sutter Slough, a delta branch of the Sacramento River. Land now being reclaimed by the Netherlands Farms Co.)

This plan represents the most complete and detailed consideration which has been given to the main channel project. The estimated cost of the work was $24,000,000. It was assumed that of the total volume of earth required to be ultimately moved, one-third only need be excavated by mechanical means, and that the remaining two-thirds would be moved by the increased scouring capacity of the river, which would be obtained by concentrating the flood flow in the main channel. Provision was made for intercepting hill drainage by canals along the outer rims of the basins. The areas below these canals were to be drained by pumping plants. The insufficiency of the pumping plants can be well inferred from the fact that the estimated capacity for Yolo Basin was but 160,000 gals. per minute. The intensive use to which this land is put demands much more perfect control of seepage and drainage water, so that, although much less than half of Yolo Basin is now reclaimed, it has already been necessary to provide for pumping plants of a capacity in excess of 500,000 gals. per minute. The maximum amount of water to be cared for in the main channel was assumed at 250,000 sec ft. in the lower reaches of the river. No accurate measurements had ever been made up to that time. Gagings by the U. S. Geological Survey in the 1907 and 1909 floods showed that in place of the 250,000 sec. ft. there should be provided sufficient capacity for 600,000 sec. ft.

It seems probable that this greater amount of water makes the main channel project impracticable, and uneconomical. From the standpoint of public policy, one of its most attractive features is the conserving of the large areas of valuable land which must be permanently sacrificed, at least as regards settlement and intensive cultivation, in any by-pass project.

The Sacramento Drainage District, containing about 1,000,000 acres, or practically all of the overflow land in the valley, was formed by legislative enactment, March 29, 1905, with the object of carrying out the Dabney Commission plan. Funds were to be provided by assessing the land according to benefits derived, the assessments to be conditioned upon contributions either by the State of California or by the United States or by both. Nothing ever came of this plan. The Dabney Commission project was shown by the 1907 flood to be inadequate and the Sacramento Drainage District act was repealed.

CALIFORNIA DEBRIS COMMISSION PLAN.

The latest and most thorough study of flood control in the Sacramento Valley reverts again to the by-pass method of treatment. This plan has recently been worked out in much detail by the California Debris Commission, consisting of Lieut.-Col. John Biddle, Corps of Engineers, Capt. Thos. H. Jackson, Corps of Engineers, First Lieut. Chas. T. Leeds, Corps of Engineers, in a report submitted June 29, 1911. The original plan has been modified and enlarged in the light of accurate data showing the abnormally large flood discharge. It represents the most recent, careful and thorough study of the entire problem. It proposes to convey about 20 per cent of the water discharged into the valley in the main river channel and the remainder in a very large by-pass, which returns the water into the river through Cache Slough, a short distance above Rio Vista. The proposed by-pass is to run the entire length of Yolo Basin, through the lowest portion thereof, across the Sacramento River near the mouth of the Feather River, and from thence up through the center of Sutter Basin, through Bute Slough, into Butte Basin, and up Bute Basin to Moulton's Weir. As it is desirable at all times to make the river carry as much water as possible, in order to properly maintain its navigability, it is proposed to draw off the excess of flood water only at relatively high stages and over long, low weirs of masonry. The upper one is to be located at Moulton's Break, about ten miles above Colusa, the second at the present location of the Tisdale Weir about three miles below Winship's Landing, the third and much the largest of all, opposite the mouth of the Feather River, and the fourth a short distance above the mouth of the American River, at Bryte's Bend. The type of weir used will probably be similar to the Tisdale Weir, which was recently constructed by the State, about 20 miles below Colusa, and is now acting as an easement to pass excess flood water from the Sacramento River into Sutter Basin. (See Fig. 1.)

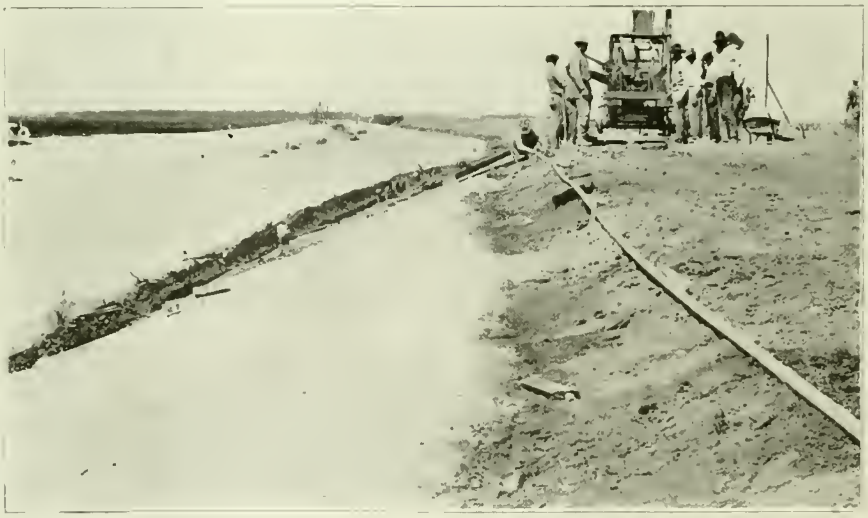

Fig. 6—Placing Reinforced Concrete Facing on the South Levee of the Lisbon District, About Two Miles south of Sacramento.
(This is an earth levee about 20 ft. in height with a 15-ft. crown width and 1 on 2½ side slopes. The facing is of concrete 4½ ins. thick, reinforced with Clinton wire mesh.)

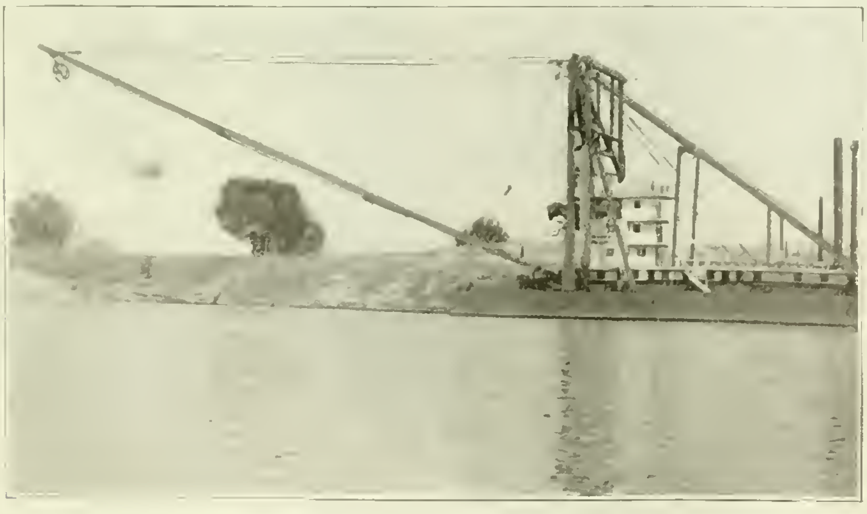

Fig. 5—Clam Shell Dredge "Hercules," of the Ajax Dredging Co.
(Said to be the largest of its type. Hull, 140 ft. x 70 ft. x 13 ft.; boom, 205 ft. long; bucket capacity, 6 cu. yds.)

It is probable that some or all of the weirs may be constructed with movable crests, in order that the river, especially on falling stages, may be kept as high as possible. The by-passes would be formed in the lower portions of the basins by constructing large parallel lines of levees varying from 1,900 to 12,000 ft. apart.

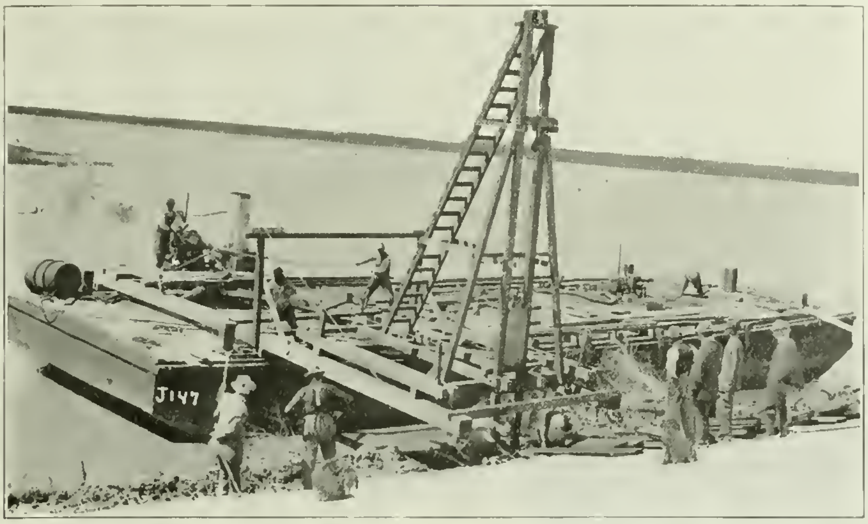

Fig. 7—Driving 2x12-in. by 6-ft. Tongue and Groove Sheet Piling to Hold Lower Slope of Reinforced Concrete Facing, Lisbon South Levee.

A possible weak feature of the project is the crossing with the by-pass, of the Sacramento River near the mouth of the Feather River, at the upper end of Yolo Basin. At this point, the great Freemont Weir is designed to divert 400,000 sec. ft., leaving in the river itself, only about 50,000 sec. ft. The weir is to be a masonry structure, 8,000 ft long, with its sill 10 ft. below the adopted high water grade line. As the river above and below this point is only a few hundred feet in width, the difficulty of navigating past the weir when in operation is obvious. It also seems inevitable that large amounts of silt will be drawn over the crest of the weir, and deposited in the by-pass and that there will be extensive shoaling immediately below. The report of the Board of Engineers for Rivers and Harbors states that the Board is inclined to the opinion that further study should be given to the question of "whether it might not be preferable * * * to keep the auxiliary channel wholly on the west side of the river," that is, through Colusa Basin. If this were done, it would require a very large and costly cut through the Knights Landing Ridge, and would permanently solve the flood control problem in Colusa Basin. Reclamation work has now advanced so far in Colusa Basin, however, that it is too late to consider this possibility.

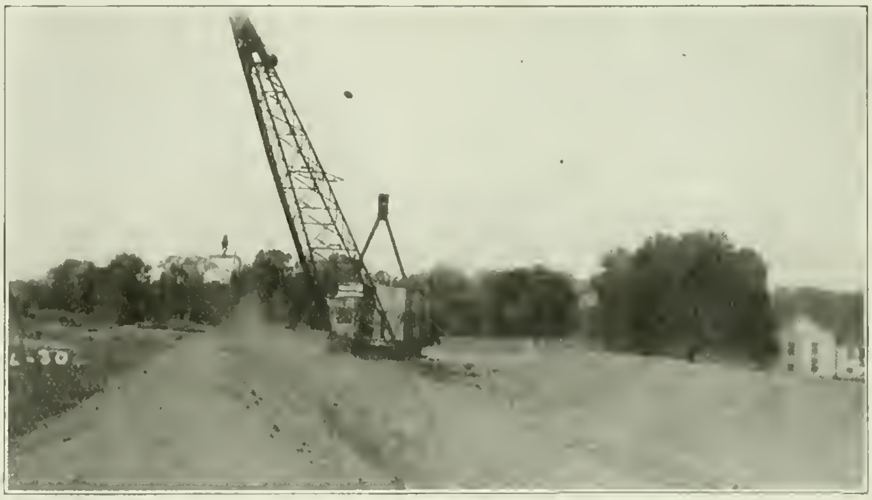

Fig. 9—Drag Line Scraper Constructing Natomas Levee Along Sacramento River, Below Vernon; Center Trench to Be Back Filled with Suction Dredge.

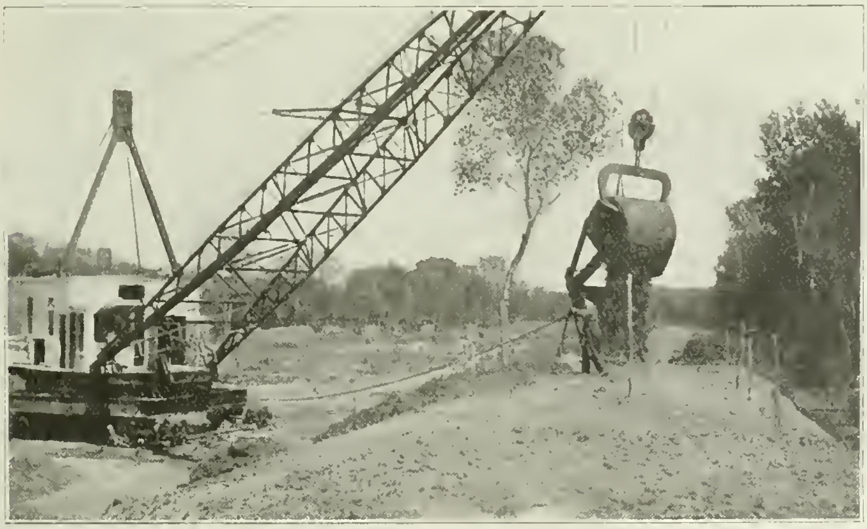

Fig. 8—Bear River Levee of the Natomas Co., Constructed with Large Drag Line Scrapers.

Reservoir Control.—The Debris Commission report considers at some length the feasibility of partial flood control by mountain storage. Analysis is given of the cost, and flood-retarding effect, of three large reservoir sites, one of which has a capacity of over 3,000,000 acre feet. It is shown that the cost of flood control by reservoirs is from 1½ to 10 times as great as by the by-pass method. The writer of this paper does not believe that control of flood water by mountain storage under Western conditions is founded on correct engineering or economic principles, and that on a large scale it will never prove practicable, unless the time comes when the science of meteorology has been developed to such a point that accurate predictions of precipitation can be made several weeks in advance. If reservoirs were constructed for the purpose of flood control, it would probably be found that their use for storage of water for irrigation and power development would, in the end, prove to be of paramount importance. This use requires the reservoirs to be kept as nearly full as possible, and is directly antagonistic to their use for flood control purposes, which requires them to be kept empty as far as possible. It is probable, however, that the incidental construction of storage reservoirs for other purposes will eventually have a retarding effect upon flood discharge, which will be of some benefit, except, perhaps, at times of extreme floods.

Possible Methods of Accomplishing the Work.—It is proposed to finance this project by aid from the State, the National Government, and the property owners, each of the three paying a third of the estimated cost of $33,000,000. The report has been approved by the Board of Army Engineers, which has recommended that the National Government contribute its third.

The general plan was approved by the last State Legislature and a State board created whose duty it is to see that no new reclamation work is permitted which will prevent the ultimate consummation of the entire project. It is unfortunate that at the present time no funds are available from any public source for the main features of the work.

Modification of Debris Commission Plan.—The plan proposed seems well adapted to accomplish the desired results subject, as stated in the report, "To such changes as further study or experience in the course of execution may show to be desirable or necessary." It is understood that the exact location of the various features was not accurately determined because of the impossibility of securing detail surveys over such a large territory with the funds available. It is believed, however, that if the project is put into execution, without much delay, that only unessential modification will be necessary to adapt it to such improvements as may be advantageously used when the time for actual construction arrives. As the general plan has been adopted by the Legislature and a State board appointed to enforce it, it appears to be in a measure a part of the statutory law of the State, subject to such modifications as the Reclamation Board and the State Engineer may authorize.

A fund of $10,000 was placed at the disposal of the State Engineer and he was directed to "Procure data and make surveys and examinations for the purpose of perfecting the plans contained in the Debris Commission Report." This work is actively under way by the State Engineer, who as directed by the statute, is advising the Reclamation Board, together with the executive officer of the California Debris Commission. It is unfortunate that the sum appropriated for the immediate field work is in no way commensurate with the magnitude of the work involved. It seems probable, however, that the detailed information obtained will be supplemented by private surveys, made by parties or districts interested in work which comes under the jurisdiction of the Reclamation Board. An accurate location in the field of the by-passes is of fundamental importance. In general, the preliminary location of these channels, as shown by the approximate contour maps available, appears to have been established in the deepest portions of the flood basins, with little reference to existing or probable improvements, or to the character of the land occupied. It is doubtful if this was either good policy or good engineering. The by-passes are essentially large canals for the conveyance of water from one portion of the valley to portions lower down. Conventional engineering practice does not usually locate such canals in a direct alinement from one end of a valley to another, but rather follows grade contours in order that the slope and velocity in the canal may be uniform and the tendency to silt be reduced to a minimum. In the case of the Sutter Basin by-pass, for example, a considerable portion of the bottom of the channel is below a grade line joining the upper and lower ends. This requires levees of unnecessary height, and increases the tendency to silt. With the low velocities obtained in the by-pass, it seems inevitable that silting will occur though the process may be exceedingly slow. Experience with the Elkhorn weir indicates the danger of large amounts of sand and silt being drawn up over the sill of such a structure.

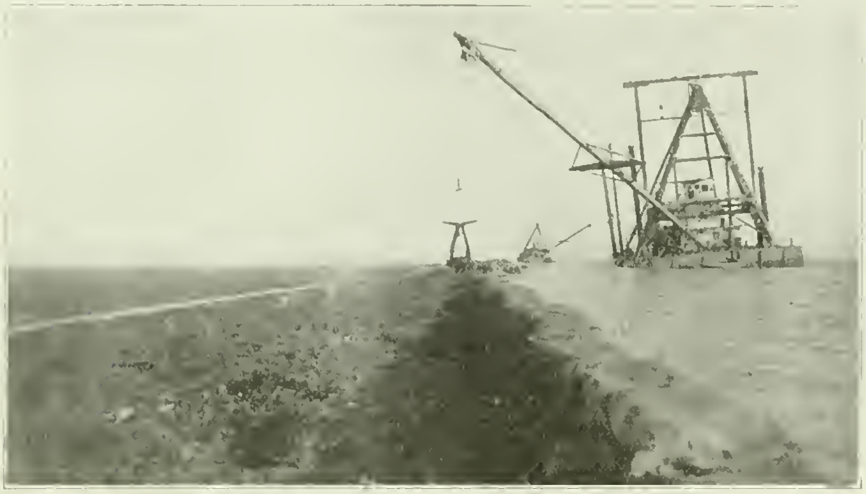
Fig. 10—Topping the Howell's Point Levee (South Levee of Dist. No. 108 in Colusa Basin) at the Crest of the March, 1911, Flood.

As previously shown, the original location of the by-passes in the Manson-Grunsky report was not in the trough of the basins, but was toward the outer margins. For the large by-passes planned by the Debris Commission this effects an important saving in earth work, because of the fact that the land at the rim of the flood basins rises rapidly. If the by-passes are so located that their outer edges follow approximately this rim, then the outer levee, because of being located on higher ground, becomes much smaller. In many places it is possible to locate the by-passes so that this outer levee will protect only a narrow margin of land so high that it would not be flooded except for brief periods during the few years that the by-passes would reach their maximum discharge. In such cases still further economy can be obtained by omitting the outer levee, and recompensing the owners of adjacent land for the nominal damage caused by occasionally flooding their land for brief periods.

In the lower portions of the flood basins there is a rank growth of tules, reaching a height of from 3 ft. to 7 ft., but toward the margins of the basins there is nothing but a sparse growth of very short grass. Figures 3 and 4 indicate the typical appearance of the flood basins in the early summer and late autumn. In the upper flood basins, it is usually possible, late in the fall after the first frosts, to burn the tules close to the ground, but this is occasionally prevented by early floods. In the lower flood basins, where the land is only a few feet above tide level, it is usually impracticable to burn the tules, except in alternate years, when the dead growth of the preceding year is matted close to the ground. The green tule shoots start growing rapidly with the first warm days in January and February, so that there may be a dense growth several feet in height before the time of maximum flood has passed, about the first of April. Wherever this tule growth exists it is equivalent, so far as the water carrying capacity of the by-passes is concerned, to raising their floor to the approximate height of the top of the tules. This gives another strong reason for locating the by-pass toward the outer margin of the flood basins, where the land is clear of the tule growth.

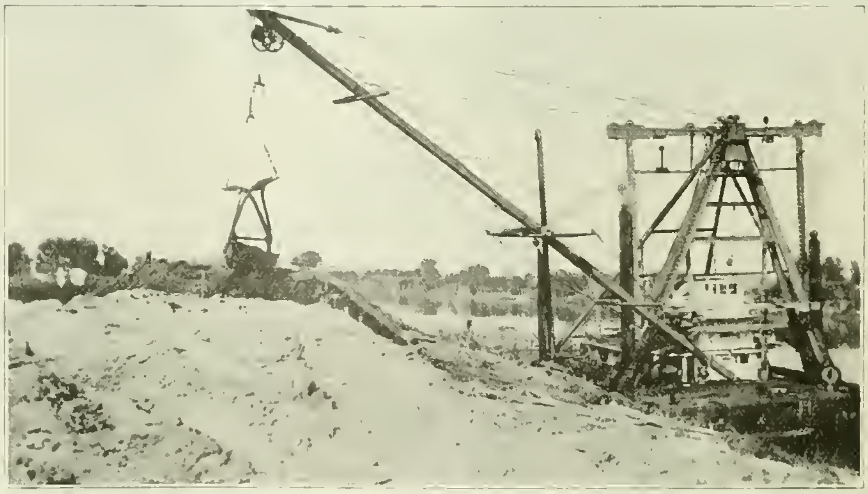
Fig. 11—Clam Shell Dredge "Grand Island," Completing West Sacramento Company River Levee at Chickory Reach, 5 miles Below Sacramento.

(Levee has a 40-ft. crown with 1 on 2 and 1 on 1½ side slopes. Height, 22 ft. Dredge has a 185-ft. boom, and 5 cu. yd. bucket.)

The by-pass, as sketched on the maps of the Debris Commission, required the permanent sacrifice of about 80,000 acres of land, most of it among the most valuable land in the State, land which, if thoroughly reclaimed, should have a value within a few years of $500 or more per acre. It is true that this land would not be entirely useless, as the construction of the weirs would be such that it would be overflowed for only a brief period, and much of it could probably be used for pasturage or late crops. This does not apply with so much force, however, to the Yolo Basin by-pass in its original location, as it must convey at all times any water from the large drainage areas of Cache, Willow and Putah Creeks. At the lower end, much of the Yolo Basin by-pass is so low that independent of flood conditions, it can not be highly developed without levees and drainage pumps, or at least tide gates. If the value of the land sacrified in the by-passes will be ultimately $400 or $500 per acre, less than the adjoining land, reclaimed, settled and under intensive cultivation, then the present scheme requires the condemnation of land which will ultimately have a value of from $30,000,000 to $40,000,000, or greater than the entire estimated cost of the whole project. It would seem that very careful consideration in the ultimate solution of the problem should be given to a study of whether the by-pass might not be made narrower by constructing higher levees, thus adding to the wealth of the State more of the very valuable reclaimed land.

In line with the ideas advanced above, it would seem that very careful consideration should also be given to the character of the land to be occupied by the by-pass, with the end that it might be located on land of the least value. It is conceded by those familiar with the situation that there is a very great variation in the value of the land both in Yolo and Sutter basins, for agricultural purposes. Under modern and scientific methods of soil analysis, this is a matter which can be determined with a sufficient degree of accuracy, to warrant its consideration as one of the most essential features in the ultimate location of the by-pass. In general the land on the riverward side of the trough of the basins has been built up by river overflow, and is exceedingly fertile, while the land on the opposite side of the trough is apt to have the surface soil washed away and to be strongly alkaline, and hence of relatively little value.

Location of Lower Yolo By-pass.—The final location of the Yolo Basin by-pass, except for a few miles at either end, has recently been fixed by acts of the State Reclamation Board, from Elkhorn to Ryer Island, a distance of about 28 miles. The original location proposed by the Debris Commission was in the deepest part of the trough of the basin. This would have thrown into the by-pass large portions of reclaimed and highly improved land in reclamation districts No. 785 and No. 765. It would also have included still larger portions of Districts Nos. 150 and 900, which were formed between the time of making the report and the time at which it was approved and placed under the jurisdiction of the State Reclamation Board. Such a location would have involved the condemnation of a large area of valuable reclaimed land, as well as the distruction of about 16 miles of excellent levees and their re-location near the river. The final location of this portion of the Yolo Basin by-pass and its position relative to the original location is shown on the accompanying map. From the Sacramento Woodland R. R. south for about 13 miles, the east line will be formed by the west levees of the existing reclamations, most of these levees being already completed in a first-class manner. The next 15 miles to the corner of Ryer Island will be located along the outer margin of the basin, so that the by-pass will occupy poor land usually west of the tule growth. For the next eight miles, to the lower end, the east edge will be formed by the exceptionally massive and well protected levees of Ryer Island. This much of the location of the by-pass has been definitely approved by the State Reclamation Board, upon advice of its consulting engineers, Major S. A. Cheney, of the California Debris Commission, and State Engineer W. F. McClure. The final location appears to establish the precedent of the important engineering principles involved, of locating the by-passes toward the outer margin of the flood basins, rather than in the deepest portions of the trough. It was reached only after an exhaustive study had been made of the relative merits of various locations founded on detailed soil analyses by the State Engineer's office and on topographic maps with 1-ft. contours on a 1,000-ft. scale of practically the whole of Yolo Basin. The essential features of the by-pass project of the California Debris Commission are given in Tables I to III.

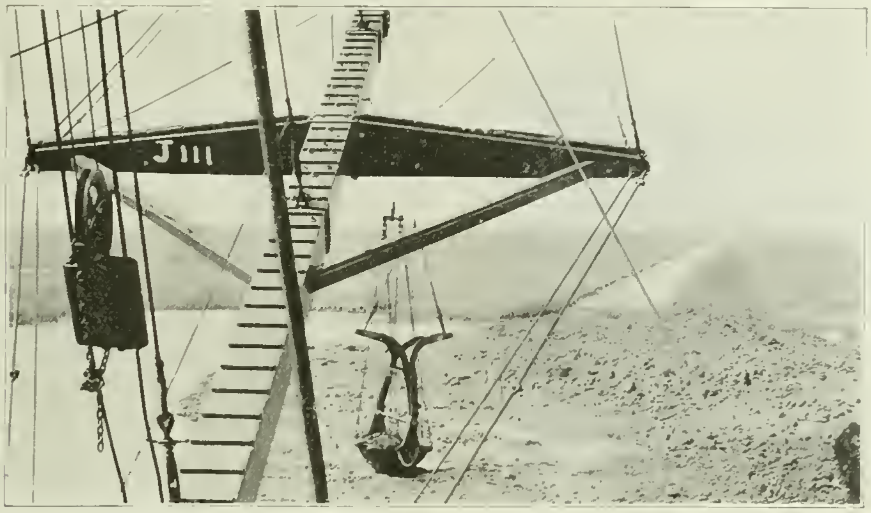

Fig. 12—Starting Construction of West Sacramento Co. Back Levees.
(Muck ditch 6 ft. by 20 ft. constructed by small gasoline clam shell dredge in background. Boom and bucket of "Dredge Vulcan" on berm. "Dredge Vulcan" has 5¼ cu. yd. 12-ton bucket and 175-ft. boom.)

LEGISLATIVE ACTION AFFECTING FLOOD CONTROL

It is important to recognize that the title to swamp and overflow land in California, carries with it the obligation to reclaim and hence to put to useful purposes such swamp and overflow land. The swamp lands first came into the possession of the State in 1850, by Act of Congress, conveying the lands with the idea that they would thereby enable the construction of the necessary levees and drains to reclaim them. This act directs that the proceeds of the sale of the lands should be applied exclusively to their reclamation. In 1873 the Supreme Court of California confirmed the theory that in accepting these lands the State was bound in good faith to effect their reclamation. The Legislature has at all times recognized that the sale of the land to private owners did not exempt it from the power of the Legislature to enforce its reclamation. Mr. E. T. Adams summarizes the legislative action in California with reference to swamp and overflow lands in Vol. 2, No. 5, the transactions of the Commonwealth Club as follows:

(1.) A short period of entire neglect of the obligation to reclaim.

(2.) The years from 1851 to 1861, in which the state granted lands to individuals for reclamation virtually by such methods as they might devise, either individually or in association with others.

(3.) The period from 1861 to 1866, in which the state undertook to supervise and control the work of reclamation districts.

(4.) The period from 1866 to 1868, in which the state, having transferred the swamp and overflow lands to the counties in which they were situated, and washed its hands of the whole business, permitted the organization and operation of districts under the imperfect laws then in force.

(5.) The period from 1868 to the present time (1909), when under workable laws, gradually modified and perfected, the districts have continued to operate under the general oversight of the County Boards of Supervisors, but with no direct responsibility to any central authority. Under this law each district has looked out for itself, regardless of others, or of the interests of navigation, except as compelled to do so by the federal authorities, or of the general welfare.

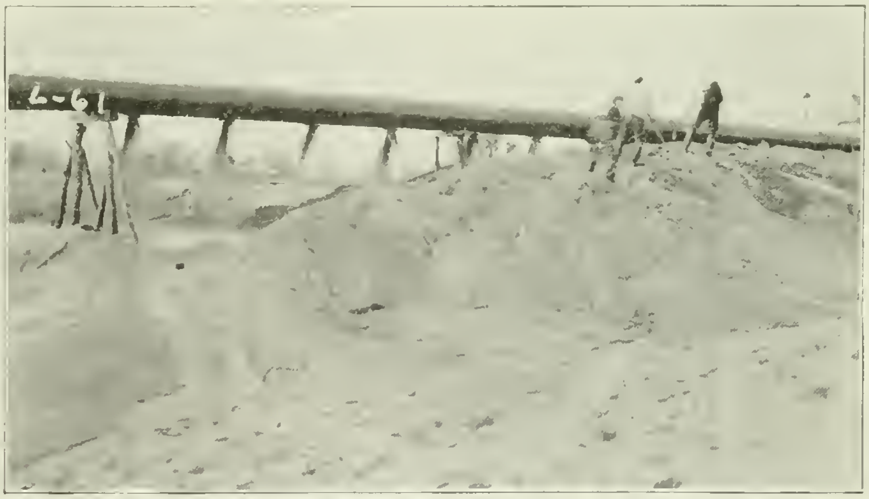

Fig. 13—Constructing River Levee of Sand by Means of Suction Dredge with Trap Pipe Opposite City of Sacramento.

CALIFORNIA RECLAMATION BOARD.

The latest and most important legislation is the act passed by the last Legislature approving the report of the California Debris Commission, and directing the State Engineer to procure data and make surveys and examinations for the purpose of perfecting the plan and creating a Reclamation Board to which must be submitted any future original plan of reclamation. The board has the power to prevent the construction of any levees, embankments or canals not in conformity with the Debris Commission's plan as perfected by the State Engineer. The approved plan required the permanent sacrifice of about 80,000 acres of land for by-passes. The exact location of this land to be so sacrificed is discretionary with the Reclamation Board, acting upon the advice of its engineers. It would seem that the first step should be the accurate location of the by-pass and the purchase and condemnation of the fee in the land, or at least of an easement for the purpose specified.

RECLAMATION BOARD'S POSITION DIFFICULT.

The lack of funds for acquiring such lands places the Reclamation Board in an unenviable position. It appears to be its duty to locate imaginary lines defining the edges of the by-pass throughout the length of the flood basins of the Sacramento Valley, and to state that the land inside such imaginary lines must be permanently sacrificed for the public good, while the land outside may be reclaimed and improved at the option of the owners.

Somewhere in one of the flood basins, for example, Mr. Smith and Mr. Jones both own large tracts of overflow tule land. Under present conditions this is never used and has only a speculative value. Both of these gentlemen, however, are now able and anxious thoroughly to reclaim their land, and if their purpose is accomplished for each acre which they reclaim there will be added to the assessed valuation of their county and to the resources of the commonwealth from $200 to $500. Unfortunately, however, the imaginary line defining the edges of the by-pass leaves Mr. Smith's land inside the by-pass, and Mr. Jones' land outside. Mr. Smith's commendable ambition to improve his property is hence thwarted by the Reclamation Board, who tell him that because his land is inside the imaginary line it must be left forever unimproved, although they have no money to pay him even the speculative value which his land has at present, much less the ultimate value which he could otherwise create for the land. To the fortunate Mr. Jones, however, they state that, inasmuch as his land is outside of the imaginary line, he can immediately proceed to reclaim it and make his fortune and live happily ever after. It is evident that neither Mr. Smith nor Mr. Jones are in any way responsible for the location of the imaginary line which makes such a difference in their relative position, and that they both acquired the land in equally good faith, assuming that they would be permitted to improve it. Also that there are many possible locations of the by-pass, any one of which would accomplish the work satisfactorily. It would seem that, from the standpoint of equity alone, the position of the Reclamation Board as illustrated above, is untenable, at least until such time as funds are provided for the purchase or condemnation of the lands for the by-passes.

RECLAMATION BOARD SHOULD BE SUPPORTED.

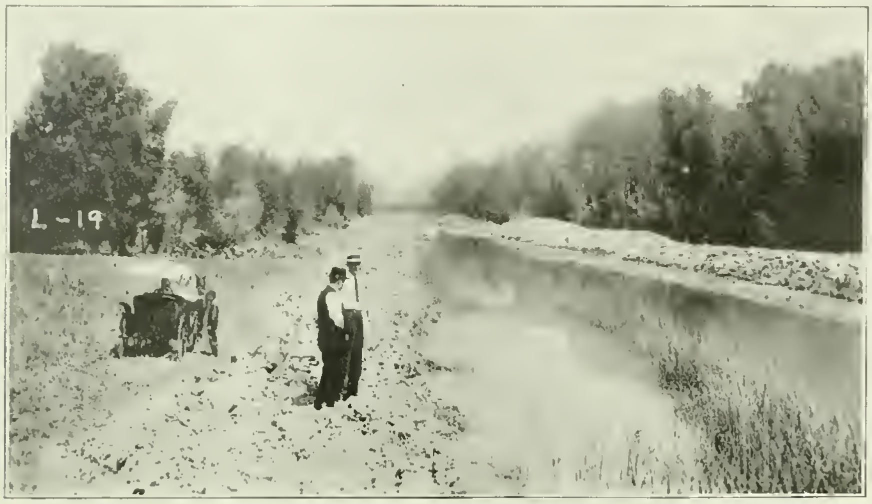

Fig. 14—Main Line Drainage Canal Through Center of West Sacramento Company Property, 3 Miles West of Sacramento.

(Drainage canal about 6 ft. by 30 ft., terminates in pumping plant with about 100,000 gals. per minute capacity.)

The above is written without consideration of the legal problems involved and solely in the hope that the conclusions, if correct, and if generally realized, may assist in securing sufficient funds to assure the success of the State Reclamation Board and of the Debris Commission's project. Everyone interested in the development of the Sacramento Valley should assist in advancing the Debris Commission's plan, in order that the work of reclamation may proceed along orderly lines, and with proper consideration for the best interests of the entire region. The only satisfactory way of accomplishing this is to have the by-passes immediately located and the land to be sacrificed for the public good, immediately acquired. When this is accomplished, the actual construction of the levees, defining the by-passes will proceed rapidly and systematically by private endeavor. The remaining features of the Debris Commission's project, namely, the widening of the river, and particularly the construction of the diverting weirs, which are chiefly for the purpose of confining to the river channels all the extreme floods, are desirable chiefly for their benefit upon navigation in the river. This matter should accordingly be left to Federal and State authority. It is not particularly pressing, because navigation in the river is improving under present conditions. The matter of acquiring the lands for the by-passes, however, is immediate and urgent, in order to prevent the menace of private reclamations, irreparably blocking the flood relief channels so necessary for the safety of the entire valley.

A bill is now before the legislature of California with the object of organizing the entire body of overflow land, amounting to approximately 1,000,000 acres, into the Sacramento Drainage District. This bill, which was prepared by Mr. A. L. Shinn, has the sanction of most of the leading reclamation attorneys, and owners of swamp land. If it becomes law means will be provided whereby the land in the by-passes may be acquired and possibly necessary construction work performed with funds provided by assessments distributed over the entire district, according to benefits derived.

TABLE I.—CAPACITY OF PRESENT RIVER CHANNEL AND OF PROPOSED RECTIFIED RIVER CHANNEL AND BY-PASS.

Sacramento River—	Present cap., sec. ft.	Future channel, sec. ft.	By-pass, sec. ft
Above Stony Creek	......	250,000	......
Stony Creek to Jacinto	......	260,000	......
Jacinto to Moultons Break	140,000	260,000	......
Moultons Break to Cobbs Bend (above Colusa)	100,000	65,000	185,000
Cobbs Bend to Butte Slough	70,000	65,000	185,000
Butte Slough to Tisdale Weir	60,000	65,000	185,000
Tisdale Weir to Feather River (including Knights Landing)	23,000	30,000	220,000
Feather River to Elkhorn Weir	62,000	50,000	400,000
Elkhorn Weir to American River	36,000	50,000	430,000
American River to Kripp Break	127,000	100,000	430,000
Kripp Break to head of Steamboat Slough	75,000	100,000	500,000
Steamboat Slough	34,000	46,000	500,000
Old River	49,000	54,000	
Cache Slough to Three-mile Slough	300,000	......	.....
Below Three-mile Slough	200,000	600,000	......

Note: These amounts represent approximately the quantities which were actually delivered in 1907 and 1909, as obtained from measurements of the United States Geological Survey.

RECLAMATION WORK ACCOMPLISHED.

Up to a few years ago the success of swamp land reclamation work in California was by no means assured. The reclaimed land was of very great value for agricultural purposes, but its usefulness was greatly impaired by the constant and growing uncertainty and danger from flood waters. The usual practice had been to completely enclose in levees districts varying in size from a few acres to 50,000 acres. These levees acted as barriers to the spread of flood water, reduced the storage capacity of the flood basins and tended to block their channel capacity. Every reclamation of this sort in the valley tends to raise the flood plane at all other points, and to make more difficult the position of all other reclamations. This condition has necessitated the constant raising and enlargement of all of the levees. Complete protection for any one district could only be obtained by completely enclosing it in a levee system higher than the levees of any neighbors. Harmonious action by neighboring districts has been impracticable because of the conflicting interests and because of the magnitude of the problem. In general those who believed their position stronger than that of their neighbors, preferred directing their efforts toward maintaining their relative advantage at their own expense to a participation in a comprehensive scheme of more general benefit. The levee systems had grown intermittently and irregularly from small hand levees to large dykes 10 to 15 ft. or more in height. The pioneers had a very inadequate conception of the magnitude of the problems involved, little realizing that they were facing the greatest engineering problem on the Pacific Coast. Little use had been made of engineering skill or study, and machinery in use was of insufficient capacity to properly construct the necessary levees. The location, design and construction of most of the reclamation work was costly and inefficient.

The last decade has put an entirely different aspect upon this situation. Flood control problems have been studied thoroughly and scientifically and the best engineering talent available has been concentrated on the large reclamation districts. Heavy dredging machinery has been developed further in some lines than anywhere else in the world. The great clam-shell dredges now in use in California are unsurpassed in capacity or length of reach.

The levee cross sections have been gradually enlarged and improved and construction methods perfected until it is doubtful if there are any larger or better levees anywhere. Figure 15 shows a number of typical cross sections of the more important reclamation districts in the Sacramento Valley. For comparative purposes there are also shown to the same scale two cross sections of the Mississippi River levees. As compared with larger river systems, like the Mississippi, for example, the maintenance of river levees is much easier in the Sacramento Valley, because of the much briefer duration of the floods, which are hardly long enough to permit of the saturation of the levee sections. On the other hand, the back levees, located in the flood basins, in many cases have a terrific exposure to wave wash during the winter storms. The growth of willows is generally encouraged on back levees and climatic and other conditions are so favorable that where there is a proper berm it is frequently possible to get a dense covering in a short time. In some cases, however, this has been found to be inadequate and at least one district (Lisbon) has faced its back levees with solid concrete, while others (W. Sac. Co.) are planning the same construction.

TABLE II.—CALIFORNIA DEBRIS COMMISSION PROJECT: DIMENSION OF BY-PASSES AND ADOPTED HIGH-WATER PLANE.

Location—	High-water elevation.	Width of channel. ft.	Capacity required, sec. ft.
Mouth of Cache Slough	15	12,000	500,000
S. P. bridge below Bryte by-pass	*27	12,000	
Mouth Colusa Basin Drainage Canal. 24,000 ft. from Fremont Weir	34.5	8,000	400,000
Fremont Weir	40 (Sill at 30)	8,000	400,000
Three miles below Tisdale by-pass	45	4,100	220,000
Opposite Butte Slough	57		
Moultons Weir	86 (Sill at 79)	1,900 to 4,100 (Moultons Weir 2,840 ft.)	185,000
Tisdale Weir by-pass	54 (Sill at 50)	(Tisdale Weir 1,140 ft.)	35,000
Bryte by-pass	35.6 (Sill at 30.6)	(Sacramento Weir 1,670 ft.)	70,000

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*Changed by the final location of the Yoto Basin by-pass to ahout 29.

Most of the levees in the Sacramento Valley have grown in an irregular and intermittent fashion; many of them have been quickly destroyed by successive floods and abandoned; but meanwhile new projects are constantly under way, so that it is impossible to give an accurate estimate of the amount of the land reclaimed or partially reclaimed at any given time. The best estimates available at the present time indicate that the area of reclaimed land wholly in the flood basins and which could be said under normal conditions to be submerged with each moderate or large flood, is about 145,000 acres north of Sacramento and about 110,000 acres south of Sacramento, making a total of 255,000 acres, or about 30 per cent of the total 800,000 acres.

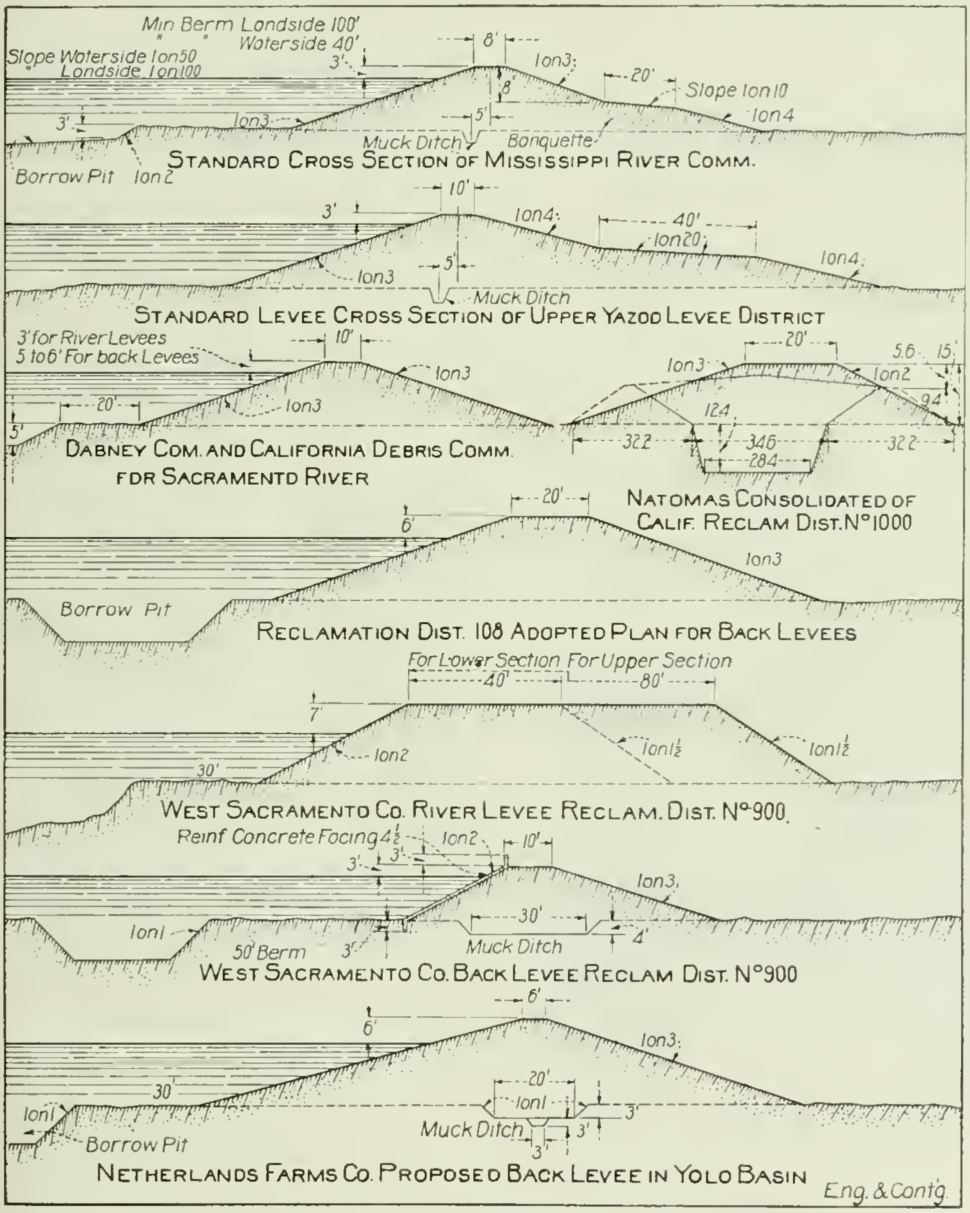
Min Berm Landside 100'
" " Waterside 40'
Slope Waterside 1on50
" Landside 1on100
8'
3'
1on3
20'
Slope 1on10
8'
5'
1on4
3'
1on3
Muck Ditch
Banquette
Borrow Pit
1on2
STANDARD CROSS SECTION OF MISSISSIPPI RIVER COMM.
10'
3'
1on4
40'
1on20
1on4
5'
1on3
Muck Ditch
STANDARD LEVEE CROSS SECTION OF UPPER YAZOO LEVEE DISTRICT
3' for River Levees
5 to 6' For back Levees
10'
1on3
20'
1on3
5'
DABNEY COM. AND CALIFORNIA DEBRIS COMM. FOR SACRAMENTO RIVER
20'
1on3
5.6
15'
1on2
94'
124
322
346
284
322
NATOMAS CONSOLIDATED OF CALIF. RECLAM DIST. N°1000
20'
6'
1on3
Borrow Pit
RECLAMATION DIST. 108 ADOPTED PLAN FOR BACK LEVEES
For Lower Section For Upper Section
40'
80'
7'
1on2
1on1½
1on1½
30'
WEST SACRAMENTO CO. RIVER LEVEE RECLAM. DIST. N°900.
Reinf Concrete Facing 4½
1on2
10'
3'
3'
1on3
1on1
30'
4'
50' Berm
3'
Muck Ditch
WEST SACRAMENTO CO. BACK LEVEE RECLAM DIST. N°900
6'
6'
1on3
30'
20'
1on1
3'
1on1
Borrow Pit
Muck Ditch
3'
3'
NETHERLANDS FARMS CO. PROPOSED BACK LEVEE IN YOLO BASIN
Eng. & Contg.

Fig. 15—Standard Levee Cross-Sections Employed in Sacramento and Mississippi Valleys.

Principal Projects at Present Under Way—Reclamation work in the Sacramento Valley is proceeding at present at a wholly unprecedented rate. Actual construction work is being actively pushed on tracts aggregating over 180,000 acres or nearly one-fourth of the total. All of these projects should be completed within the next two years. This means that the present period of say three years, will see nearly three-fourths as much land reclaimed and put under cultivation as the entire period preceding since the settlement of the valley. In addition to this it seems certain that work will be begun immediately upon two more large projects, one in Sutter Basin and one in Yolo Basin, aggregating another 100,000 acres. If this be true, the present five-year period will more than double the total area of reclaimed land. A few of the large projects on which construction is now actually under way, may be briefly mentioned as follows:

Natomas Consolidated.—The work of the Natomas Consolidated of California includes the reclamation of practically the entire American Basin lying along the eastern side of the Sacramento River, between the American and the Feather Rivers, the total area of the tract aggregating about 60,000 acres. The river levee extends for many miles, following the Bear River downward from a point near Wheatland to its junction with the Feather River, then following the Feather to its mouth at Vernon, then the Sacramento River to a point near the mouth of the American.

The construction of a large drainage canal with parallel lines of levees will divide the American Basin into two portions and will conduct the hill drainage from the high plains on the east into the Sacramento River below Vernon. The construction of the main levee along the Sacramento River involves several novel features. The levee is located some distance back from the river bank, protected from wave wash and direct current scour, by trees on the berm. Drag line scrapers have been used for excavating a deep trench along the axis of the levee and piling the excavated material in high, narrow ridges on either side of the trench. The space thus created is back filled by suction dredges, pumping in sand and gravel from the river, after which the levee will be graded into its final cross section. This construction makes it possible to locate the levee back from the river bank and to give it a sand core which is not subject to the attack of burrowing animals.

TABLE III.—HIGH WATER MARKS IN THE SACRAMENTO RIVER.

(Present records and adopted flood plane of the California Debris Commission.)

Location.	Miles from mouth of river.	H. W., 1907.	H. W., 1909.	H. W., Gov. est., max.
Collinsville	0	8.0	9.0	7.0
Rio Vista..........	13.3	17.3	....	13.3
Courtland	35.2	21.5	....	24.0
Sacramento	58.6	30.00	32.7	34.4
Elkhorn	71.0	34.5	35.3*	37.4
Vernon	79.9	37.9	....	40.0
Knights Landing..	92.6	39.86	39.9	44.1
Kirkville	107.9*	44.5	....	49.2
Tisdale Weir	122.6	49	....	54.0
Grimes	130.6	56.2	....	58.5
Meridian	138.6	62.6	....	63.0
Kent	142.2	66.2	....	65.1
Colusa	148.6	69.9	....	68.6
Moultons Break...	162.2	82.5	....	86.0
Butte City.........	174.6	96.0	....	105.8
Jacinto	185	114.0	....	122.0
Stony Creek.......	195.6*	133	....	135.8
Chico Landing	200	139	....	141.54
Red Bluff	246	266	....	.....

*Estimated.

Note.—Estimated high-water marks in the lower river will be lowered by the work to be done immediately in widening out the mouth of the river.

Reclamation District No. 108.—Reclamation District No. 108 occupies the major portion of lower Colusa Basin, and is one of the largest districts in the State. The boundary lines have been changed a number of times. About 30,000 acres have been reclaimed and have been under cultivation for some years. The district has had a varied and uncertain history. A heroic fight has been maintained for years to protect the Howell's Point levee from severe exposure to wave wash and to maintain the river levee for many miles entirely outside of the district.

The recent enlargement includes about 25,000 acres of rich tule land and will involve the construction of an exceptionally large and high levee. Five large dredges are now working on this project, which is well under way, and should be completed within the next year. Colusa Basin flood control is intimately connected with the situation at Knights Landing Ridge, which has been the subject of much unfortunate litigation. The final solution of this difficult problem, insuring the success of District No. 108 and other reclamations in this vicinity, as well as the possibility of completing the reclamation of the balance of Colusa Basin, seems now to be assured by the project for the construction of the Knights Landing Cut. This project, involving an expenditure of about $500,000, has long been recognized as a necessity. Complete detailed plans for the work have been provided by a general committee of interested property owners, and it seems probable that the work will be undertaken immediately.

West Sacramento Company.—The holdings of the West Sacramento Co., involving about 12,000 acres, are directly across the river from the city of Sacramento. The strategic value of the location is such that an unusually thorough and costly reclamation is under way. The river levees are being finished with a top width of from 40 to 80 ft., and all of the back levees are to be faced with reinforced concrete.

The north levee has been constructed by raising the Southern Pacific R. R. double track embankment above the high water plane in the river. A portion of the river levee which cannot be reached by clam-shell dredges is being built with a 20-in. hydraulic dredge. The discharge pipe is supported on trestles 2 ft.

above the grade of the levee and the sand and silt dredged from the river as it travels along the bottom of the pipe is discharged into the levee through small rectangular openings fitted with iron shutters.

The property is being highly improved by the construction of roads, bridges and drainage ditches and will be subdivided and sold in small holdings.

Netherlands Farms Company.—The Netherlands Farms Co. has recently started work on the reclamation of the balance of the valuable tule land in Yolo Basin, below Sacramento and east of the by-pass. This will make an entirely new district, containing about 30,000 acres of the most valuable tule land. The central location of the project makes the land of especial value and it is proposed to immediately reclaim and improve it, subdivide it and sell it in small holdings. Transportation will be provided both by electric railway and by water. The west levee, which will form the east levee of the by-pass, will be of unusually massive construction, averaging about 24 ft. in height and reaching a maximum of about 26 ft. The cross section, as shown on Fig. 15, will make the base width about 175 ft. This work involves the moving of about 7,000,000 cu. yds. of earth.

City of Sacramento.—A municipal bond issue approximating $900,000 has recently been approved for flood control work. The levees around the city are to be raised and strengthened wherever needed, and the Sutterville cross levee, protecting the city from the south, to be constructed to grade. The principal feature of the project is the immediate construction of the Sacramento Weir of the California Debris Commission, about 2½ miles above the mouth of the American River. When work now under way is finished, the levees of the city of Sacramento and of the West Sacramento Co. to the west, and the Natomas Co. to the north, will be finished 7 ft. above the estimated high water marks in the river, and will be of unusually massive construction. Their completion will absolutely force the construction of the Sacramento Weir or of an easement for flood water somewhere in the vicinity. The certainty of this conclusion is demonstrated by the following facts: The capacity of the Sacramento River at flood stages below the city of Sacramento is only about 85,000 sec. ft., and even after the improvements suggested by the Debris Commission are completed, the Sacramento River delivers at Sacramento in times of flood about 65,000 sec. ft. The flood discharge of the American River was estimated by the Debris Commission at 120,000 sec. ft. Messrs. Givan and Grunsky, however, have shown that the actual maximum is over 50 per cent in excess of this estimate. Hence it is perfectly evident that the Sacramento River cannot carry the amount of water delivered at the mouth of the American without breaking through the levees somewhere in the vicinity. An easement into Yolo Basin is the only practical solution. The City Engineer, Mr. Givan of Sacramento, recommends that this easement be placed immediately below the city of Sacramento, instead of 2½ miles above. It will probably be found, however, that the costs of right of way for this location would now be prohibitive. According to present plans the construction of the weir will be undertaken at once by the city. The weir will be built with a collapsible crest, so as to keep at all times the maximum amount of water in the channel, thus deriving the greatest benefit from the scouring effect.

Sacramento is also giving $75,000 for the acquirement of rights of way and spoil beds for the government project of widening out the mouth of the river.

Egbert and Hastings Tracts.—In the extreme lower end of Yolo Basin, and south of Cache Slough, about 15,000 acres are included in the Egbert and Hastings tracts, which have recently completed low-tide levees. These are sufficient to protect the land in a season of less than normal rainfall, and even in flood seasons should generally permit late crops after the floods have subsided. They are not intended to provide complete protection against large floods, however, in their present condition.

Moulton Project.—The Moulton project in the lower end of Butte Basin has recently reclaimed a large amount of land by the construction with teams of moderately high levees. It is planned to add to this work and to improve the lower portions with low levees which will enable late crops to be put in after the floods have subsided.

Reclamation Dist. No. 1002.—This district, containing over 6,000 acres, is about 18 miles south of Sacramento on the east side of the river. It lies between the high railway embankments of the Western Pacific and the Sacramento Southern R. R., which embankments will form about half of its levee system, the balance being cross levees joining the two railway embankments. The exposure is only from back water from the Cosumnes and Mokelumne rivers.

Sutter Basin.—There is another large new project with plans so far advanced that construction work will probably be started in a very short time. This includes the reclamation of most of the remaining unreclaimed land in Sutter Basin, except that to be permanently occupied by the by-passes. The area to be reclaimed is estimated to be from 60,000 to 70,000 acres, mostly in the southern part of the basin. It will be divided into two portions by the Sutter Basin by-pass, formed by the construction of large parallel lines of levees through the center of the basin.

PRESENT CONDITION OF FLOOD CONTROL.

The passage of the 1907 and 1909 floods down the Sacramento Valley was each attended by a direct loss of over $5,000,000. Below the city of Sacramento the only districts of importance which were not submerged were Merritt, Grand, Randall, Sutter and Sherman Islands, and Districts Nos. 744 and 545. Prior to the 1909 flood many of the levees had been strengthened and the area submerged was not as great.

It is probable that another flood of the same magnitude would cause still greater damage. There are at least four different and widely separated points where the flood channels are so restricted that it would be impossible for a flood wave to travel down the valley without widespread destruction at each of these four points. The first of these constricted points is at the extreme lower end of the river from its mouth to the lower end of the Yolo Basin by-pass, a short distance above Rio Vista. The present constricted river channel, especially opposite Sherman Island, is the greatest menace to reclamation in the lower end of the Sacramento Valley, including the city of Sacramento itself. The most critical portion of this work popularly known as "removing the cork" of the river, is now being undertaken jointly by the United States Government and the city of Sacramento. This work will consist of the partial dredging of the lower channel by two large suction dredges now being finished at Antioch.

The second critical point is opposite the city of Sacramento, where, as explained in discussing the present plans of the city, the construction of the Sacramento Weir easement into Yolo Basin is absolutely required for the protection of the large urban population of the city itself.

The third danger point is at the Knights Landing Ridge, where it is impossible to safely pass the large volume of hill drainage tributary to Colusa Basin without constructing the Knights Landing Cut. The overtopping of the Knights Landing Ridge leaves the district immediately below entirely defenseless, and the situation of the Colusa Basin districts would be precarious if the water were sustained at this height for any length of time.

The fourth critical point is at the foot of the Sutter Buttes. Floods should pass this point safely in the River and in the large channel of Butte Slough, connecting Butte Basin and Sutter Basin. This is a large by-pass channel, about one mile wide by seven miles long. If kept clear, it has ample capacity to pass the largest floods at a safe height below the levees. It is now, however, so obstructed with timber and undergrowth that under present conditions it is impossible for a great flood to pass down the Sacramento Valley without overtopping and destroying the levees somewhere in this vicinity, with disastrous results.

FUTURE OF RECLAMATION WORK IN THE SACRAMENTO VALLEY.

It will be noticed that most of the projects under way, or proposed for immediate construction, are relatively large; economical considerations make it more profitable to reclaim a large body of land than a small one. The recent organization of the State Reclamation Board and the comprehensive plan of the California Debris Commission, insure future reclamation following an orderly and legitimate plan, best adapted to the ultimate development of the vast resources of this region. The large reclamation districts are employing the best engineering and executive talent available, and under a broad and far reaching financial policy are insisting upon the most thorough and substantial construction work. The disastrous mistakes of the past are not being repeated. The reclaimed lands are being provided with transportation facilities, and are being rapidly settled and put under intensive cultivation.

The work of reclaiming the balance of the rich swamp lands is proceeding so rapidly, and the future is so full of promise that the next decade should see practically all of this land under cultivation. Too much credit can not be given to the men behind the great projects now nearing completion who, in the face of previous disasters, have staked vast fortunes on the transformation into an empire of a wilderness of tules.

DRAINAGE AND IRRIGATION

Rockfill Diversion Dam With Concrete Core Wall, Minidoka Irrigation Project, Idaho.

Contributed by P. M. Fogg, Project Engineer, U. S. Reclamation Service, Rupert, Idaho.

The Minidoka Irrigation Project of the United States Reclamation Service reclaims an area of approximately 130,000 acres of arid land, and is situated in Lincoln and Cassia counties on the Twin Falls Branch of the Oregon Short Line R. R. in Southern Idaho. The Snake River divides the tract naturally into two units, nearly equal in size, and is the source of the water supply for irrigation purposes. Investigations of the feasibility of the project were begun about 1903, and construction work on the diversion dam and controlling works was commenced in 1904. Water was first delivered to lands within the project in the season of 1907.

The site for the diversion dam was chosen at the head of the Minidoka rapids in the Snake River, 6½ miles south of Minidoka, Ida., the nearest railroad point. The greater part of the project, situated south of the river, lies at an elevation too great to be watered feasibly by gravity, while the north side lands are lower, and for the most part are readily irrigated without pumping. In providing for the diversion of the water to the project, it was, therefore, found advisable to design the dam for power development also with the ultimate purpose of generating energy for pumping water to the south side lands. This feature was the more feasible from the fact that a considerable portion of the natural flow of the river is required to pass this point at all times during the year in order to satisfy prior water rights below, and hydrographic data indicated that the river's flow was insufficient at its low stage for adequate power development. The north end of the dam site formed a wall of lava rock rising abruptly from the river channel; beyond the channel of the stream the lava, thinly covered with sandy loam, stretched away to the south in an undulating plain for more than a half mile. The construction of the dam has formed an artificial lake 32 miles long, covering an area of 11,000 acres, known as Lake Walcott. The water level at the dam is raised from 40 to 50 ft. above its former level.

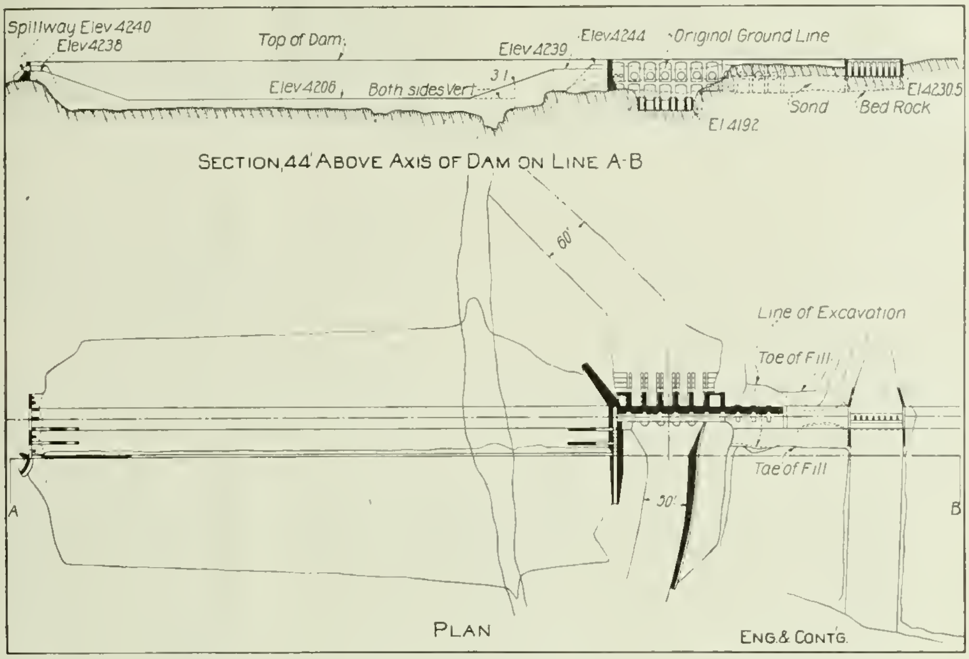

Fig. 1—General Plan and Elevation of Minidoka Dam and Headworks.

The type of structure, Fig. 1, finally selected was rockfill with a concrete corewall 13 ft. high, and with heavy earth and gravel facing, the rockfill to be flanked at the south end by a gravity type of concrete spillway about 2,400 ft. long, and at the north end by a concrete wall suitably designed for a power station, beyond which were located the north canal headgates. The plan also includes a canal heading at the south end of the spillway, Figs. 1 and 2, and beyond this a smaller rock and earth embankment, Fig. 3, runs out to the ground surface. The maximum height of the rockfill occurs in the river channel, and is about 86 ft. The upstream slope of the earth and gravel fill is 3 to 1, Fig. 4, protected for a vertical height of 15 ft. from the top with rock paving, and the downstream slope of the rockfill is 1½ to 1; the crest is 25 ft. in width, and 664 ft. long.

The crest of the dam was built 10 ft. higher than that of the spillway, thus allowing ample flood capacity for the river, the discharge of which at certain periods reaches 40,000 sec. ft. The alinement of the spillway, Fig. 5, is not straight, but follows the high points of rock, and the structure varies in height from 2 to 15 ft. As stated above, it has a gravity section with rounded crest and toe, and like the rockfill, rests throughout its entire length upon the solid lava rock.

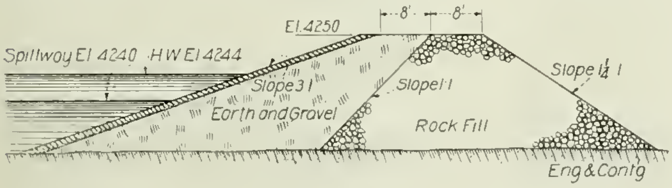

Fig. 3—Section of Main Rockfill and Earth Dam.

The rockfill is enclosed at each end by heavy concrete retaining walls with cut-off walls extending longitudinally into the fill. The northerly of these forms the south end of the concrete portion of the dam. At this point a channel was excavated in the rock for diverting the flow of the river during the construction of the rockfill, and across the channel was built a series of heavy concrete buttresses and piers with curtain walls. Five 8x12-ft. coffin sluicegates were installed at low water level to regulate the flow, and above these ten penstock openings 10 ft. in diameter provided for future power development. This wall now forms the upstream side of the power station generating at present 10,000 h.p. The canal headings were built of heavy concrete, reinforced over the arches with railroad rails, and provided with nine 5x9-ft. cast iron gates on the north side and room for 12 gates at the south heading.

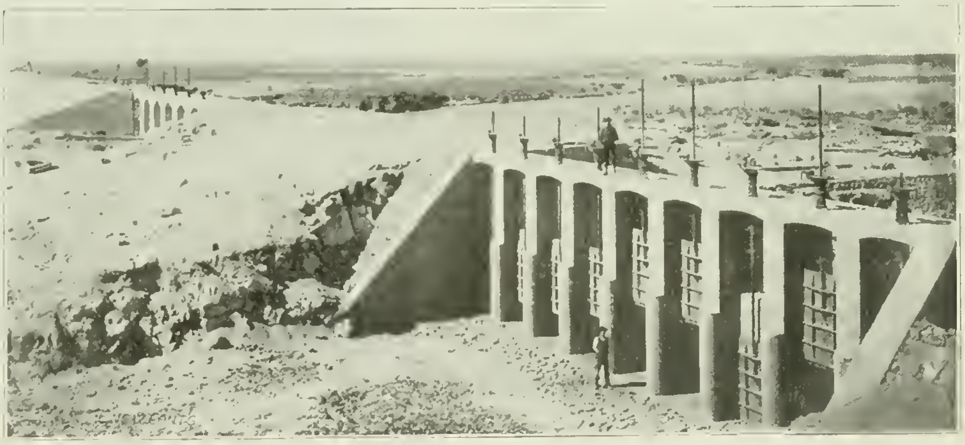

Fig. 2—Minidoka Dam Showing Canal Headworks in Foreground.

Contract for the work was awarded to Bates & Rogers of Chicago on Sept. 17, 1904, and work began the following month, continuing without serious interruption until completion in October, 1906. The contract included the excavation of a portion of the north canal in rock sections, and this excavation, together with that in the diversion channel, was all heavy work. The rock was taken out in lifts of from 16 to 20 ft. and was handled by the two cableways which formed a part of the plant. These cableways, Fig. 6, had a span of 1,150 ft. and carried a safe load of 7 tons, the towers being 81 ft. high, and mounted on trucks which moved in lines perpendicular to the axis of the dam. Practically all of the material excavated from the diversion channel and canal was used in the rockfill, being transported in the 3-cu.-yd. steel skips by the cableways and dumped from a height of 10 to 60 ft. by the engineman, thus creating a very compact mass. Where the cableways were unable to reach the excavated rock directly, it was hauled for distances varying from 450 to 900 ft. in skips mounted on trucks and drawn by horses. Seven-eighths of all the rock was hauled in this way to within reach of the cableways.

In excavating for the foundation of the dam but little solid rock was encountered, most of the material being that which was washed into the narrow deep channel of the river during the construction of the cofferdam. Two sets of sheet piling were driven ahead of the excavation for the full depth, and pumping was required continuously. A break in the cofferdam occurred when the excavation was very nearly completed, and this occasioned some delay and additional expense.

For depositing the earth and gravel fill on the upstream face of the dam, a double trestle was constructed parallel to the dam, in such way that the dump cars were unloaded directly over the rockfill, and the material was washed into the voids of the rock until a water-tight structure resulted. This was accomplished by permitting the river to back up against the fill as the work proceeded. The top of the trestle was 20 ft. below the top of the dam and when it no longer could be used the material was dumped from a track laid on the crest. The earth and gravel were obtained from borrow, pits 1,200 to 1,800 ft. from the nearest point on the dam, and were loaded into steel dump cars of 1-cu.-yd. capacity. These were drawn by horses to the dam, one team hauling a train of three cars.

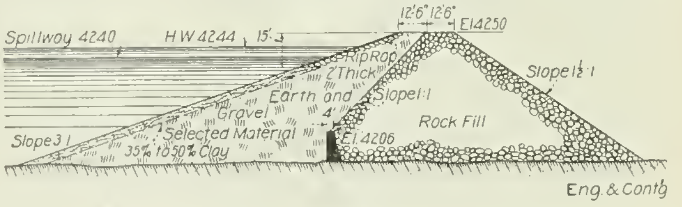

Fig. 4—Section of Rockfill and Earth Embankment South of Canal Headworks.

The concrete in the corewall was placed without reinforcement, and this work was very simple. Gravel was delivered in cars to a point near the mixer, which was set up at the south end of the dam. A derrick delivered the gravel to the mixer, and the concrete was then hauled in cars to a point where the cableway could handle and deliver it. All concrete was mixed in the proportion of one part of Portland cement to seven parts of mixed aggregate.

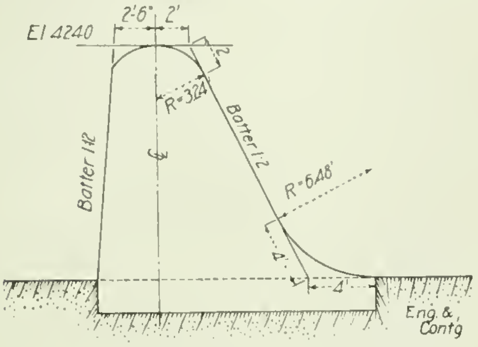

Fig. 5—Section of Concrete Spillway.

The heavy wall section across the diversion channel was reinforced above the sluicegate openings and above and below the penstock openings with I-beams and railroad rails. For this part of the work two derricks were employed to handle the concrete. A small flat car conveyed two dump buckets from the Smith mixer to the derricks. The freezing temperature which prevailed during this construction necessitated heating all of the water for the concrete. The five 8x12-ft. sluicegates in the diversion channel weighed 13 tons each, and were hauled from Minidoka and erected before the concrete was placed around the frames. Lifting devices and stems were set after the wall had been completed.

The spillway was built with a gravity section without reinforcement and keyed into solid rock. Gravel was deposited from wagons at convenient points along the site of the work, and a mixer was then moved from place to place and the concrete deposited in the forms from wheelbarrows. A portion of the concrete was mixed by hand.

For the earth and rock embankment beyond the south canal heading, rock was quarried near the site, and a portion of the fill was built of loose rock picked up near by and hauled in wagons. The earth was borrowed from pits close at hand and hauled with fresno scrapers.

Upon completion of the dam in September, 1906, the water was backed up against the structure, and a slight leak developed at the north end near the canal heading. This was quickly remedied by lowering the water and driving a row of sheet piles at the point of leakage.

Since that time there has been no serious seepage through the structure; a flow of approximately 2 to 3 sec. ft. along the toe of the rockfill is usually in evidence, but always runs clear.

The weather conditions were rather favorable for the work during construction, although the spring flood in 1906 was unusually high and occasioned some anxiety as to its probable behavior before the river lowered. Sufficient prior work had been done, however, to prevent any difficulty of a serious nature. Labor conditions were satisfactory during the early stages of the construction and the class of men was fairly efficient. Before completion this condition was changed and wages were twice increased, to the amount of 25 per cent, with a corresponding lowering of efficiency.

The total cost of the work to the United States, including the excavation of 2,000 ft. of the main canal, was $509,683, this also including engineering and supervision. All cement was furnished at Minidoka by the United States.

The contractors were Bates and Rogers, as above mentioned. Mr. F. H. Newell was Chief Engineer of the Reclamation Service, Mr. D. W. Ross, Supervising Engineer, and Mr. F. C. Horn, Construction Engineer, in actual field charge for the United States.

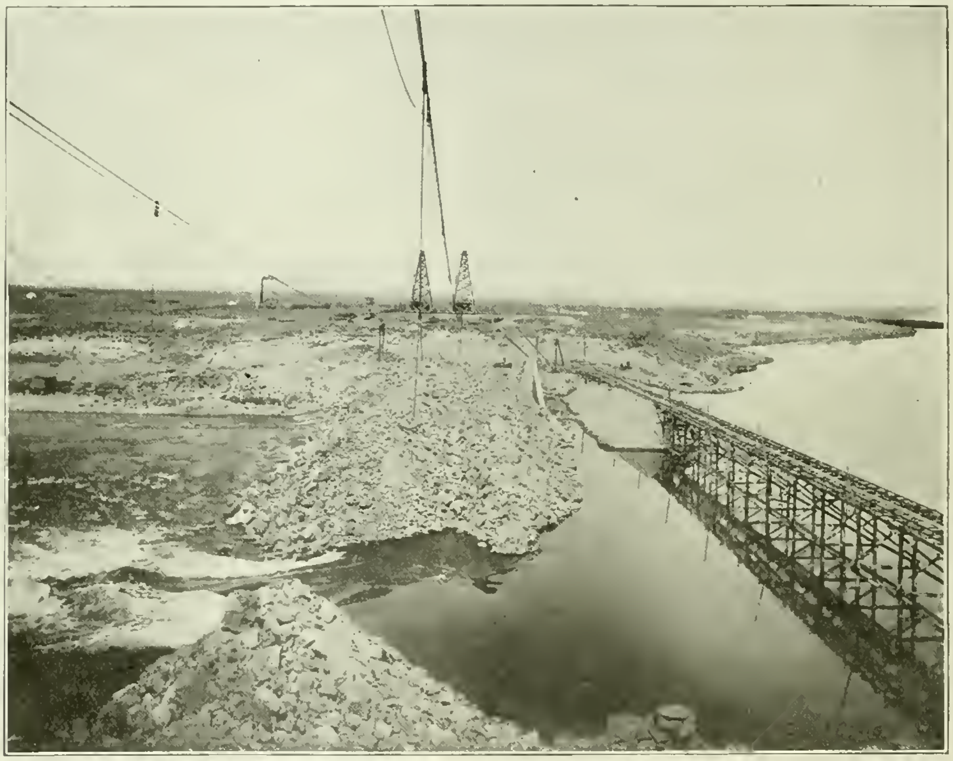

Fig. 6—View Showing Cableway and Trestle for Filling Main Dam.

Hydrometric Investigations to Determine the Influence of Forest Cover on the Flow of Streams of the White Mountains.

The U. S. Geological Survey begun in 1911 an unusually careful study of the White Mountains to determine such relations as might exist between forest cover and stream flow. The results given in a preliminary report are such, as we note elsewhere, as to indicate several things not commonly known, and we, therefore, give space here to a discussion of these things prefaced by a description of the work undertaken. All that follows is reprinted from the report:

The geologic field investigation was made by Arthur C. Spencer, geologist, who contributes the discussion of the geologic features. The hydrometric work was planned by Marshall O. Leighton, chief hydrographer, who is directly responsible for the preliminary statement of results presented in this report. John C. Hoyt, Engineer in Charge of the Division of Surface Waters, contributes the observation of snow conditions, made while he was in immediate charge of the field work. The necessary topographic surveys of the areas covered by the detailed hydrographic studies were made under the supervision of Frank Sutton, geographer of the Atlantic division. The director of the Survey visited the field parties three times during the investigation.

The examination by the Geological Survey has included a general geologic study directed to the consideration of the relation between control of these forest lands and the protection of the streams rising on these watersheds, and an intensive hydrometric investigation directed to the consideration of the relation between land control and stream regulation. The results of the former study are largely negative, yet contributed materially to the planning and execution of the hydrometric investigation which has yielded what is believed to be indisputable evidence of an actual and measurable relation between forest cover and stream regulation.

This report is preliminary; it contains final analysis of only a part of the evidence made available by the investigation. That part is sufficient in itself to support firmly the findings made herein. The remainder of the evidence has, however, been carefully scrutinized and has been found to concur in all respects with that given below. The work as a whole has established or suggested much more of practical hydraulic value than was originally believed possible. Suitable analysis of the data available will require an extensive period of study, after which a final report will be made.

PRINCIPLES UPON WHICH HYDROMETRIC STUDIES WERE BASED.

The hydrometric investigation begun by the Geological Survey in May, 1911, has been directed to the collection of quantitative data by which may be determined whether forest cover in the White Mountains has an influence, beneficial or otherwise, on the flow of streams draining those watersheds.

Before discussing the work and its results, it will be advisable to state the principles which determined the course of the investigation. Nearly all previous analyses of hydrometric data made to show the relation of forest cover to stream flow have consisted of summaries of long-term records of precipitation and river discharge. Annual or monthly rainfall records have been compared or contrasted with contemporary records of floods or low water. The former have been erroneous except for certain small areas, because they have been extended and generalized to cover adjacent or remote areas over which the precipitation was unquestionably different, and in large part unmeasured. The latter have been modified and complicated by many factors outside of or unrelated to the immediate area under consideration. The net result has been a comparison of general averages in which local influences and variations have been completely masked. In many such reviews, even the rainfall records have been neglected. Such a method is not adapted to the determination of the facts necessary to solve the problem.

Reputable authorities have thus been led to conclude that there is no basis for the contention that forests exert any influence on stream flow, and they have frequently contended that the records must be maintained during a century or more before they will furnish a basis for conclusions. In other words, these observers have based their hopes on the possibility that average results of long-term records will show general tendencies.

One of the most notable recent examples of the foregoing method is a report under the direction of Lt.-Col. Edward Burr, Corps of Engineers, U. S. A., on the Merrimac River, published as House Document, No. 9, 62d Congress, First Session. This report illustrates the unsoundness of the method. It is mentioned for two reasons: First, because it is one of the most careful of recent efforts which exemplify the futility of endeavoring to find positive results by a summation of averages of precipitation and run-off over a long period of years; and second, because it treats of a stream which has its source in the White Mountain region and includes some of the minor basis upon which the Survey's investigations were conducted.

The data used by Colonel Burr as the basis of diagrams from which his conclusions were derived consist of estimates of annual precipitation on the Merrimac drainage area, during the period 1850-1909, computed from the results of observations made at comparatively few points. These estimates have been compared with the annual discharge of the Merrimac at Lawrence, Mass. The figures are grouped in several conventional ways in an attempt to show whether the changes in forest cover on the whole drainage area have made any progressive change in the relation of annual rainfall to annual discharge. The results are negative. There is no well established claim that an alteration of these relations is caused by a change in forest cover, and if there were the fact would not be of importance in the present consideration. Colonel Burr also compares the relative height and duration of floods occurring at Lawrence from 1852 to 1909 and finds no basis for any conclusions. Inasmuch as the storms causing these floods are not appraised nor accounted for in any way the data have no value as a measure of the relation of forest cover to stream flow.

The matter will not at present be pursued in further detail, but it should be observed that if the deforestation on the Merrimac were exceedingly effective in changing the flood characteristics of that stream, it would be an accident and nothing more if the facts were not entirely masked by the method that Colonel Burr has used. The case may be aptly illustrated by the following:

Assume the case of an individual carrying on a business, wherein he receives from his patrons varying amounts of money and in their behalf purchases certain commodities. Throughout a period of years his transactions have averaged $120,000 annually, or $10,000 per month. During some years the business falls as low as $100,000; during others it rises to $140,000. The disbursements vary with the deposits of the patrons. A review of the annual reports of this business would indicate a firm and steady condition of trade. The monthly record of transactions and earnings would vary with the business, but viewed as a whole there would be no progressive tendency toward diminished or increased profits.

Assume now the well-known market condition in which trade, though as voluminous in the long run becomes irregular or "spotty." The deposits might be as regular as in normal times, but the broker, having his client's interests in mind would watch the market and buy or sell according to the prevailing conditions. In one week or two he might transact practically no business, and then on a single day, or within a single hour his trading might equal or exceed in volume that of a normal week or two weeks. The footings on the annual or monthly balance sheets would not show this; they would indicate the same steadiness as before, but the character of the business would have been entirely changed. To show this change it would be necessary to consult the daily records and not the monthly or annual footings.

In the report of Colonel Burr, the footings alone are considered. While it is true that he has made a study of flood frequency at Lowell, it is also true that no account has been taken of the individual storms causing those floods. The foregoing illustration is in all essential respects truly analogous to the train of events in a river basin. It is not contended here that deforestation changes rainfall occurrence. It is true that some observers make such a claim, but the truth or falsity thereof is of no consequence in this discussion. Therefore, the occurrence of precipitation may truly be likened to the deposits of the broker's clients. Of course, there are great variations in both. Equally analogous are the fluctuations of the broker's trading in accord with market conditions and the river's run-off in accord with basin conditions. The essential point is that in tracing a change in run-off characteristics on any river basin the logical way is not to group together a long series of combined units nor to draw conclusions from a series of averages. The real question is, "Does a storm of known depth produce different run-off characteristics on a forested basin from those occurring on a similar basin deforested?" If the study be reduced to the storm-unit basis, the facts are shown contemporaneously and the oft-expressed necessity for century-old records is shown to be without foundation. On the foregoing principles and interpretation this report is based.

TABLE I.

Period.	Snow accumulation, ins.	Snow residuum, ins.	Difference, ins.	Run-off in period, ins.	Per cent of run-off.	Max. flood flow, thousandths ins. per hour.	Name of area.
12 m. April 2 to 12 m. April 9	10.5	8.9	1.6	1.26	79.0	26.6	Shoal Pond
	9.3	7.0	2.3	2.008	96.0	58.4	Burnt Brook
12 m. n. April 14 to 12 m. n. April 17	10.9	8.0	2.9	1.780	61.4	64.5	Shoal Pond
	9.2	5.0	4.2	2.864	68.0	92.6	Burnt Brook
12 m. April 22 to 12 m. April 29	6.6	4.3	2.3	3.438	149.4	47.7	Shoal Pond
	6.1	2.1	4.0	8.002	200.0	71.4	Burnt Brook

FACTORS INFLUENCING FLOW OF STREAMS.

The flow of streams is influenced by several factors, viz.: (1) rainfall, (2) climatic conditions, (3) slope of drainage area; (4) geologic conditions, (5) vegetative cover, (6) storage, natural or artificial. All of these factors have been included in, or for good reasons eliminated, from the findings.

Rainfall.—The rainfall, including snowfall equivalent, has been intensively determined by observation at numerous points and under all conditions of elevation and exposure. It is not believed that there has ever been an investigation previously reported in which so many and so well distributed observations of precipitation have been made on so small an aggregate area. The amount of water that has descended from the clouds has been determined with a high degree of refinement.

Climate.—The climatic conditions do not enter into these considerations as an individual factor, for the basins under examination are all located closely together and cover only a small aggregate area. Therefore, the conditions from day to day are common to all the basins and the results require no adjustment on account of them.

Slope.—The slope of the drainage basin has been determined by accurate topographic mapping and, as the relation of slope to rapidity of flow is a well-established hydraulic axiom, no difficulty is offered in the application of the well-known formulas to the observed results, so that all the basins are reduced to a common basis with respect to slope.

Geological Conditions.—The geologic features of the White Mountains present a general simplicity, which is recognized as a very favorable condition for the attainment of reliable results from comparative studies of stream flow or run-off under varying states of vegetative cover. The studies which form the basis of the present report were confined to the southerly and westerly portions of the mountain group where no other rock than coarse granite is to be noted. It, therefore, appears that the only geological variants which need to be considered are those depending upon differences in character and irregularity in distribution of such loose materials as may exist from place to place. These variants are noted in the descriptions of the several basins.

Storage Reservoirs.—There are no large storage reservoirs on any of the basins here considered. On a few of them there are very small shallow ponds which exert no steadying influence on the stream flow.

Vegetative Cover.—The vegetative cover in each case has been well determined and this is the variable on which the final conclusions are based. Every other factor is accounted for, or eliminated, and the variations shown in rapidity of run-off from the several basins that enter can therefore be attributed to the vegetative cover.

The following paragraphs contain descriptions of the areas considered in this report.

EAST BRANCH PEMIGEWASSET RIVER.

The East Branch of Pemigewasset River (Plate I) joins the North Branch at North Woodstock, N. H. It is an uninhabited area of about 110 square miles, owned by the J. E. Henry & Sons' Lumber Co. The lumbering in the region has been carried on progressively so that the area at the present time possesses minor basins in various conditions of cover. Two of these basins will be discussed in this preliminary report.

Shoal Pond Brook.—This basin has a drainage area of 5.165 square miles. Along its northeastern border it has been deforested, the lumbering operations having been maintained contemporaneously with those on Burnt Brook, a basin adjoining that of Shoal Pond Brook on the north, which will be described later. In the lower part of the area and adjoining the stream on the west, a comparatively small area was cleared during the past winter. The remainder of the basin, representing about 80 per cent of the area, is covered by virgin forest. Shoal Pond lies at the extreme upper part of the basin and its capacity and drainage are so small as to be insignificant in flow regulation. On Aug. 25, 1911, a station was established at Stillwater, equipped with automatic recording gage, and the conditions of channel were corrected and adjusted to conform with well-known hydraulic requirements, so that the rate of flow could be determined with a high degree of accuracy. Within the basin were set seven rain gages, and on the approach of winter 20 snow gages, the frequent observation of which made it possible to compute by standard methods the amount of water that fell from the clouds during each storm and the amount represented in the accumulated snow during the winter period. The average slope of the Shoal Pond Brook basin is 8.4°.

Burnt Brook.—This basin drains an area of 4.75 square miles. Except for a very small area along the northeastern border of the basin, the entire area has been cut over and subsequently burned. It is therefore practically without forest cover, though a relatively close cover of brush has taken place over the greater part. Willey Pond lies near the eastern border of the basin, but by reason of its small storage capacity and drainage area, its effect on the flow of Burnt Brook is negligible. A flow-measurement station, similar to that described for Shoal Pond Brook, was established Jan. 25, 1912. There were also established 9 rain gages and 18 snow gages, the purposes of which have already been described. The basin has an average slope of 9.33°.

COMPARISON OF RESULTS ON BURNT BROOK AND SHOAL POND BROOK.

It will be noted that Shoal Pond and Burnt brooks are similar in all respects except that of vegetative cover. Both streams rise and flow through granite areas, and both are largely floored by debris of glacial origin made up of boulders intermixed with rock fragments. The two basins are therefore similar, geologically speaking, even as they are similar in other points of "aspect," such as altitude, average slope, and orientation. The difference in the mean slope of the two basins is less than one degree, which is not sufficient to produce any measurable difference in the rate of run-off. Being thus similar in so many features, the fact that the two basins are in decided contrast as to vegetative cover, affords an ideal opportunity for securing really significant data upon the problem at hand. Besides affording a contrast between the run-off characteristics on forested and deforested areas, the studies made will show whether there is any virtue in the oft-repeated claim that brush cover affords the same measure of stream uniformity as does forest cover.

Comparative records on these two streams are at present available only during the period February-April, 1912. Though the Shoal Pond station was established Aug. 26, 1911, that on Burnt Brook was not in operation until Jan. 20, 1912. The winter and spring comparative period is, however, more significant than that of the remainder of the year in this particular case. It affords comparison between the basins during the greatest flood periods of the year. Moreover, it is during this period that ground storage reaches its highest point of saturation and therefore the smallest proportion of melted snow may be expected to enter and be held in the ground. In addition to this the ground is supposedly in a more or less frozen condition, which can not fail to markedly diminish the receptive capacity of the soil. In other words, it is during such a period that forest cover might naturally be expected to exert the least influence on stream flow. An unquestionable showing for such a period will therefore establish the principle for all other and more favorable periods.

The winter of 1912 in the White Mountains was unusually severe and as a result the flow of the streams did not vary greatly. Throughout the period January-March the flow slowly decreased or remained stationary and not until after April 1 was there any event of run-off significance. A light thaw took place about March 16, but it was of short duration and had no important result. The winter's snow accumulation largely disappeared during three periods in April, though sufficient remained thereafter to contribute markedly to a final flood in May, the records of which are not yet available. The three April storm periods above mentioned are: (1) April 2, at 12 M. to April 9 at 12 M., (2) April 14, at 12 MN. to April 17 at 12 MN. and (3) April 22, at 12 M. to April 29 at 12 M. The results of observations during these three periods are given in Table I.

The headings of this table may be defined as follows:

(1) Snow accumulation means the number of inches of water equivalent to the layer of snow on the ground at the beginning of the period, *plus the precipitation that fell either as rain or snow during the period.* All water equivalents of snow given in this report are the result of actual determinations.

Snow residuum means the water equivalent in inches of the accumulated snow on the ground surface at end of period.

Difference represents the amount of water that disappeared during the storm period, either into the stream to be recorded as run-off, into the ground as stored water, or into the air as aqueous vapor. The proportion evaporated is unknown, though probably an inconsiderable amount; so that any differences can be disregarded as not affecting the conclusions.

Run-off inches, means the equivalent of water that passed the measurement station, while percentage of run-off is the percentage relation of the amount measured in the stream to that which disappeared from the surface of the ground. If evaporation be disregarded, the difference between percentage of run-off and 100 per cent may be taken as the amount that went into ground storage in the first and second periods, or was drawn therefrom in the third period.

Maximum flood discharge expresses the high point of each flood in terms of a common unit so that a direct comparison is afforded.

The figures in the table show:

First, that at the beginning and at the end of each period there was more snow on the forested than on the deforested basin.

Second, that the amount of water disappearing from snow storage during each period is approximately 70 per cent on Shoal Pond Brook of that which it is on Burnt Brook and that during the three periods the total disappearance on the former is 6.9 ins. against 10.5 ins. on the latter.

Third, that the rate of run-off from Shoal Pond Basin is 63 per cent, 62 per cent, and 43 per cent, respectively, of that which took place on Burnt Brook, and that during all three periods the discharge from the latter was twice that of the former.

Fourth, that the maximum flood flow on Shoal Pond Brook is 45.5, 71 and 67 per cent, respectively, of that on Burnt Brook.

Fifth, that considering the precipitation during the entire period the Shoal Pond area added to ground-water storage, while the Burnt Brook drew upon that storage in large amount.

The foregoing comparisons show striking and consistent differences in regard to snow-melting and run-off. The comparisons are direct and of particular significance because the observations are simultaneous. The areas selected for the study are closely similar in every way excepting in regard to the single aspect of forestation. One area which is still in an essentially natural state shows certain run-off characteristics, while the other area which has been both cut over and burned over (from one to three times in different parts), shows characteristics which are in every way dissimilar. It is held as beyond doubt that the differences in respect to run-off are due to the fact that one basin is covered with a good forest growth accompanied by a deep mat of vegetable soil, while the other basin has not more than 20 per cent of its area in a forested condition, and the natural ground mat has been materially reduced in depth by successive fires.

During the period of 27 days from April 2 to April 29, Burnt Brook contributed a much greater volume of water to the Pemigewasset than did Shoal Pond Brook. The latter is observed to be the steadier stream, and in proportion to its drainage area, it tends (at least during the spring months) to promote a steady flow of water in the master stream of which it is a tributary.

THE EFFECT OF FOREST COVER ON THE DISAPPEARANCE OF SNOW.

Snow-scale readings and special examinations made on certain streams in the headwaters of the East Branch of Pemigewasset River drainage basin during the winter and spring of 1912 showed conclusively that there is a pronounced difference in the rate of disappearance of snow from forested and cut-over areas. Observations were made on four drainage basins, namely, Covert Brook, Anderson Brook, Shoal Pond Brook, and Burnt Brook. The forest conditions of the last two areas have been stated in previous pages.

The spring break-up in these areas started with the thaw of April 5 and the rainstorm of April 7. Between March 15 and this date there had been several rainstorms, but they had little effect on the streams, as they were followed by falling temperatures, so that the rain was taken up and held in the snow. This not only solidified the snow, but raised the water equivalent, as shown in Table II.

At the beginning of the break-up, as shown in Table 11, snow had accumulated on the various areas, ranging from 35 ins. to 45 ins. in depth, with a water equivalent density of about .22 ins. At the time of the break-up the density and amount of accumulation on the areas was quite uniform.

On the cut-over areas the snow began to disappear in patches, first from the lower elevation and then extending back to the drainage lines. In the forest, however, the disappearance of the snow was uniform and, with the exception of small cut-over exposed areas, the depth remained quite uniform.

CONCLUSION.

The comparison between two adjacent basins during critical periods is presented in this preliminary statement as a sufficient showing for the purposes of the National Forest Reservation Commission.

The results of the Burnt Brook-Shoal Pond Brook studies are held to show that throughout the White Mountains the removal of forest growth must be expected to decrease the natural steadiness of dependent streams during the spring months at least. The foregoing conclusion forms a strong basis for arguing the desirability of painstaking methods of administration in respect to forest lands in the White Mountain region. Deforestation followed by fires, as in the Burnt Brook basin, results in conditions unfavorable to natural spring storage because conducive to rapid snow melting and stream run-off. Control of White Mountain lands that would reduce fires to a minimum and promote normal reforestation must result in a great improvement over present tendencies and this improvement in forest cover can logically be expected to favorably effect stream regulation to the extent quantitatively indicated in the comparison of the forested Shoal Pond Brook with the deforested Burnt Brook.

While the intensive hydrometric work was confined to a few headwater tributaries of the Connecticut and Merrimac rivers, the basins studied were selected as typical for the whole White Mountain area, and the field examinations over this area have shown the tracts now under consideration for purchase to be similar to the basins here reported upon. Therefore the favorable showing of this report is of general application in the White Mountain area.

TABLE 11. — MEAN SNOW AND WATER EQUIVALENT ON SHOAL POND AND BURNT BROOK DRAINAGES.

Depth of snow. Ins.	Water equivalent. Ins.	Date.
		Shoal Pond.
8	...	Dec. 24 ano 25, 1911
9	...	Dec. 30 and Jan. 1, 1912
13	2.0	Jan. 6 and 7
22	3.4	Jan. 13-15
29	5.1	Jan. 21-22
28	5.3	Jan. 27-29
31	5.9	Feb. 3-6
31	6.2	Feb. 10-13
31	5.8	Feb. 17-20
36	6.6	Feb. 23-27
46	8.5	Mar. 1-5
43	7.1	Mar. 11-12
43	6.7	Mar. 16-18
45	9.8	Mar. 22
45	9.6	Apr. 1-4
38	8.9	Apr. 8-9
34	10.6	Apr. 14-15
27	8.0	Apr. 17-18
21	6.2	Apr. 22-23
14	4.3	Apr. 29
		Burnt Brook.
6	...	Dec. 23-25, 1911
10	...	Jan. 1, 1912
13	2.1	Jan. 7-8
24	4.5	Jan. 15-16
26	5.0	Jan. 22
25	5.2	Jan. 29
26	5.8	Feb. 6
26	5.4	Feb. 13
28	5.9	Feb. 20
37	5.5	Feb. 27
37	8.0	Mar. 5
38	6.5	Mar. 12
39	6.3	Mar. 17
34	6.5	Mar. 26
37	7.9	Mar. 31-Apr. 3
30	7.0	Apr. 8
25	8.9	Apr. 14
18	5.0	Apr. 17-18
14	5.0	Apr. 22
6	2.1	Apr. 29

The National Aspect of the Reclamation of Swamp and Overflowed Lands.

The argument for national direction of swamp and overflow lands as seen by Mr. Edmund T. Perkins, National Drainage Congress, is given in the Journal of the Western Society of Engineers for February, 1913. The following extracts summarize the argument:

The national problem of controlling and regulating the Mississippi, is only a part of the problem of our swamp and overflowed land of approximately 74,000,000 acres lying in almost every state in the Union. The vast benefits to be derived from the reclamation of this great area are too obvious to require comment. It is generally known that these acres possess wonderfully fertile soil, capable of producing great crops for many years without defertilization to any marked degree.

The U. S. Department of Agriculture touched on this subject in Circular No. 76, Office of Experiment Stations, on "Swamp and Overflowed Lands in the United States," issued in 1907. The circular (basing the acreage to be reclaimed at 77,000,000) states:

> In those states where large areas of swamp land have been thoroughly drained by open ditches and tile drains, the cost ranges from $6 to $20 per acre, while in places where tile drainage was not required the average cost has not exceeded $4 per acre. Judging from the prices which prevail in a large number of these districts where work of this kind is being carried on, it is safe to estimate that the 77,000,000 acres of swamp can be thoroughly drained and made fit for cultivation at an average cost of $15 per acre. The market value of these lands in their present shape ranges from $2 to $20 per acre, with an average of probably $8 per acre. Similar lands in different sections of the country that have been drained sell readily at $60 to $100 per acre at the completion of the work, and in many instances, when situated near large cities, they have sold as high as $400 per acre. To determine whether or not it will pay to drain these lands, we have but to consider the following figures:
>
> | | | |
> |---|---|---|
> | Cash value of 77,000,000 acres after thorough drainage, at $60 per acre | | $4,620,000,000 |
> | Present value of this land at $8 per acre | $ 616,000,000 | |
> | Cost of drainage at $15 per acre | 1,155,000,000 | |
> | Value of land and cost of draining | | 1,771,000,000 |
> | Net increase in value | | $2,849,000,000 |
>
> These figures, though large, are not fanciful, but are based on results obtained in actual practice in different sections of the country where work of this kind has been done.

Since this circular was issued by the Department of Agriculture in 1907 many swamp and overflow acres have been reclaimed; the cost of reclamation undoubtedly has risen with the general increase in cost of things, but the value of the land also has risen, so it may be conservatively supposed that the net result as figured in 1907 is approximately the proper figure for today, upon the assumption that 100 per cent of these lands could be reclaimed, which of course we know to be impossible.

Now, the reclamation of the great bulk of these swamp and overflowed acres is largely dependent upon the control and regulation of the Mississippi and its tributaries.

From the headwaters of this great river system to its mouth, as in every other stream, it is not possible to reclaim or correct one part without at the same time exerting some influence, either for good or bad, upon the other portions. It is the same wherever we go. There is only one drainage problem in the valley of the Red River of the North, where the swamp lands are partly in Minnesota and North Dakota; one problem in the Okefinokee swamps of Georgia, which must be drained across Florida; one problem in the drainage of the Great Dismal Swamp of Virginia and North Carolina; one problem in the Sacramento Valley of California.

This is a natural fact. When we try to subdivide one of the problems and solve each subdivision from our own limited viewpoint, and for our personal, selfish interests, we are making trouble for ourselves or someone else, or both. We are doing more; we are violating the laws of Nature which, before the arrival of man, established these drainage basins and provided these drainage problems for us to solve. There is only one right solution to every problem; there may be found ways to find many answers, but only one of these can possibly be the best.

Can we establish arbitrary boundaries, often in ignorance of existing physical conditions, ignoring natural problems and necessities, and say: "Here, this political body shall have jurisdiction, and there, that one?"

No set of resolutions or legislative enactments can change the physical characteristics and drainage necessities of such an area as the St. Francis basin, which man has decreed shall be partly in Missouri and partly in Arkansas. Yet the Missourians are "showing" the Arkansans and draining their part of this basin, sending the surplus waters into Arkansas to the detriment of that state.

How can the matter be adjusted under two interested jurisdictions? You may say that common purpose and mutual agreement will succeed. Where is your shining example? A third part, unprejudiced and uninterested, must arbitrate to obtain a logical and successful result, and between the sovereign states there can be but one common authority—which is the Federal Government.

Physical, economic, social reasons demand that the reclamation of these 75,000,000 acres of swamp and overflowed lands, and the control of the waters that cause them, must be undertaken in a broad and comprehensive way—in a national way—and this cannot be done offhand.

There is no cure-all, no panacea. Careful investigation and study must be had that there may be developed a plan founded upon justice, equity, and good engineering. It must be constitutional, not only as regards the nation but as regards each state affected. In addition, every beneficiary, nation, state, corporation, individual, must in due proportion bear the expense of the improvement producing that benefit, either direct or indirect. With the insufficient data available I would hesitate to accept or reject at this time any particular plan.

But how shall we put into effect this general plan after we shall have formulated it?

The several states were granted all swamp and overflowed lands remaining unsold within their borders after Sept. 28, 1850, for the specific purpose that the proceeds of their sale should be used in reclaiming them. So far as I know, Florida is the only state that is complying with the provision of the act, and except in Florida, practically all of these swamp lands have passed into private ownership in lots ranging from a few acres to many thousands, with the owners scattered about the world.

This condition of ownership is one of the difficulties that must be contended with. The Reclamation Act was designed to reclaim the federal lands of the West, and when private holdings were taken into a project it was by mutual consent and on a partnership basis. The Government brings the water to the land after a certain percentage of the land owners in the project have agreed to join in its reclamation. No one is compelled to accept the use and benefit of this water if he has not so agreed, nor is he apt to be benefited individually unless he does pay.

In the case of swamp and overflowed lands, however, it is not practical to drain or levee part of the land without affecting the rest; each tract of land will be benefited whether the owner desires such benefit or not, or whether he wants to pay his share of the cost of reclamation. For this reason most of the states containing swamp and overflowed lands have passed drainage laws allowing certain majorities either of lands or owners, to form drainage districts and so compel all persons owning lands within the district that may be benefited, to help pay the costs of reclamation.

Just as the states can help the individual land owners to organize their drainage districts, so can the Federal Government, in planning a complete system covering the entire drainage basin, by means of complete surveys and plans, work out efficient and harmonious plans for each individual project, if desired, and have each individual project harmonize with the general plan covering the entire drainage basin. This, I hold, is a national duty and a national necessity.

ROADS AND STREETS

Topeka Specifications; Binder Course.

Sirs: The Association for Standardizing Paving Specifications at its fourth annual convention held at Pittsburgh, Pa., Feb. 24 to 27, 1913, after careful consideration unanimously determined that fine bituminous mixtures like the "Topeka" specifications should be laid on a binder course in the same way as other sheet asphalt sand mixture surfaces.

The report of the committee of the above association on bituminous concrete paving specifications, which was unanimously adopted by the association, referring to such fine mixtures under the heading, "Binder Course," contains the following:

> The binder course for macadam base shall be composed of a layer of coarse, clean stone of a size to pass a 2 or 2½-in. ring and be retained on a 1-in. ring; it shall be evenly distributed over the surface of the macadam base described above and 1½ ins., or practically only one stone deep, and rolled until the stones are practically level and forced partially into the macadam base. The rolling should be comparatively light, only enough to partially imbed the stone and set them firmly in place without crushing them or forcing the fine material up from below to completely fill the voids. This rolling should be done while the macadam base is still moist and comparatively soft. The stone of the binder course may be laid on without any coating or application whatever or second, with an application of light bitumen after laying and rolling or third, coated with a bituminous cement before being laid; when a concrete base is used the binder course should be laid as called for under the standard specifications for sheet asphalt pavements.

The above association in standardizing and insisting upon the use of a binder course under all sheet asphalt surfaces, including the fine mixture asphaltic concrete or so-called "Topeka" specifications, is acting in accordance with what actual practice has demonstrated to be the most standard forms of street pavement construction.

It has been my experience with the above type of wearing surface that creeping and shoving will take place even under moderate traffic unless a binder course is used. The binder not only prevents this displacement but adds support and stability to the wearing surface, which, owing to its composition being mostly sand, does not have the traffic-resisting qualities within itself.

The value of the binder course was brought out very clearly in a paper read before the American Society of Municipal Improvements in Dallas, Texas, by Mr. Isaac Van Trump, Engineering Chemist of Chicago, in which he says, in effect:

> On streets where traffic is medium too heavy, sheet asphalt pavements or even fine stone as-

phaltic concrete wearing surface now being laid in many localities will frequently creep and shove alarmingly when laid without a binder course.

The committee appointed by the League of California Municipalities to make a study of the best practices in pavement and roadway building made an exhaustive study of the merits of the binder course and reported strongly in its favor for the type of wearing surface now under discussion and so it appears to me that the practice of eliminating the binder course in asphaltic pavements in order to slightly reduce the first cost of the pavement, is one that is not in accordance with the best practices in street pavement construction.

Very respectfully,
F. N. BINGHAM,
Engineering Chemist.
Portland, Ore., March 17, 1913.

Some Notes on Asphalt Pavement Construction in 1912.

(Staff Article.)

The accompanying tabulation shows the yardage and average unit price of asphalt pavement laid last year in 88 cities in this country and Canada. The table also gives details as to the thickness of binder and surface, the length of guarantee, the thickness of concrete base and its proportions. Some idea of the practice of these cities, especially as regards the thickness of binder and top, can be deduced from the details.

Of the 88 cities reporting this type of construction, 30 reported that the pavement was constructed with a 1-in. binder and a 2-in. surface; in 16 cities a 1-in. binder and 1½-in. surface was used; in 11 a 1½-in. binder and a 1½-in. surface, and in 6 a 1½-in. binder and a 2-in. surface. Muskogee, Okla., reported the construction of 22,069 sq. yds. of pavement with a 1½-in. binder and a 1-in. surface; Napa, Cal., 20,980 sq. yds. with 3-in. binder and 1½-in. surface; Oakland, Cal., 90,517 sq. yds. with 2-in. binder and 1½-in. surface; Eugene, Ore., 44,288 sq. yds. with a ½-in. binder and a 1-in. surface; and Ottawa, Ont., 95,291 sq. yds. with a ¾-in. binder and 2-in. wearing surface.

Eleven cities stated or indicated that their pavements were laid without a binder course. At Trenton, N. J., 13,972 sq. yds. were constructed in this way at an average price per square yard of 1.38½ sts. The top surface was 1½ ins. thick; Bermudez asphalt at $28 per ton was used. At West Allis, Wis., 15,628 sq. yds. of this type of asphalt was constructed, the average price per square yard being $1.44. Greenville, S. C., Rose Hill, S. C., and Cedartown, Ga., also indicated that no binder course was employed in the construction of their pavements. In each of these cities the surface was 2 ins. thick.

Two cities, Lawton, Okla., and Kansas City, Kan., reported the use of rock asphalt in the construction of their pavements. In the former city, the rock asphalt base was 4 ins. thick and the top 2 ins. thick. About 24,600 sq. yds. was laid at an average price of $1.69 per square yard. The cost of the rock asphalt is stated to have been $2.50 per ton for the base and $3.25 per ton for the top. The Kansas City pavement consisted of a 2-in. surface on a 4-in. or 5-in. 1:3:6 concrete base. Some 30,000 sq. yds. was laid at an average price of $1.93 per square yard.

Palo Alto, Cal., reported the construction of 3,111 sq. yds. of pavement composed of a 4-in. bituminous concrete base and a 1½-in. asphaltic wearing surface. The average cost per square yard was $1.71. At Hoboken, N. J., 1,328 sq. yds. of asphalt surface was laid on Belgian block, at an average cost of $1.77 per square yard, with a 5-year guarantee. Baltimore, Md., constructed 133,231 sq. yds. of 1½-in. binder, 2-in. top asphalt pavement on cobble and concrete base, at an average cost of 90 cts. per square yard. Medford, Mass., reported the construction of 1,300 sq. yds. of pavement consisting of a 2-in. asphalt surface and a 5-in. tarvia base. The average cost was $1.17 per square yard. At New Haven, Conn., 5,806 sq. yds. of "asfalte" were constructed at an average cost of $1.40 per square yard with a 5-year guarantee. This pavement was 4 ins. thick, made up of a 4-in. broken stone base and a 2-in. "asfalte" surface. These two last mentioned pavements should probably be more properly classified under the head of bituminous concrete.

Practically all of the cities reported that the pavements were under a 5-year guarantee. Three cities, however, gave the period of guarantee as 10 years; one city gave it as 20 years, and two cities as 2 years. In four cities no guarantee was required.

The prevailing local prices for labor and materials in the various cities that constructed asphalt pavements were given in the April 2 issue of ENGINEERING & CONTRACTING.

TABLE SHOWING AMOUNT, AVERAGE UNIT PRICE AND SOME DETAILS OF ASPHALT PAVEMENT LAID IN 1912 IN 88 CITIES.

	Sq. yds.	Thickness binder, ins.	Thickness surface, ins.	Average price per sq. yd., including base and grading.	Guarantee, years.	Concrete thickness, ins.	Base proportions.
New England Division:							
Massachusetts—							
Medford	1,300	..	2	$1.17	..	5 [1]	.....
Connecticut—							
Hartford	9,675	1½	1½	2.17	5	6	1:3:6
Middle Atlantic Division:							
New York—							
Rochester	224,921	1	2	1.91	5	6	1:3:6
Schenectady	12,600	1	2	2.20*	5	6	1:3:6
Syracuse	42,528	1	2	2.06	10	6	1:3:6
Troy	10,000 [2]	..	..	1.95 [3]	5	6	1:3:6
Utica	25,000	1	2	1.80	5	5	1:3:7
New Jersey—							
Atlantic City	14,245	1	2	1.73	5	4	1:3:6
Bayonne	71,300	1	1½	1.70*	10	5	1:3:6
Hoboken	1,328	..	..	1.79	5	..	.....
Jersey City	3,668	1	1½	1.90	5	5	1:3:5
Trenton	2,355	1	2	1.61	5	4	1:3:6
Trenton	13,972	..	1½	1.38½	5	4	1:3:6
Pennsylvania—							
Erie	39,765	1½	1½	1.41	5	5	1:3:8
Harrisburg	77,871	1	2	1.52	5	6	.....
Scranton	44,531	1	2	1.79	5	6 [11]	1:3:7
Wilkes-Barre	24,083	1	2	2.10	10	6	1:2:5
York	11,028	1	2	1.80	5	6	1:3:5
East North Central Division:							
Ohio—							
Dayton	1,893	..	..	1.99	5	..	.....
Lorain	4,527	1	1½	2.18	5	6	1:3:6
Marion	9,540	1	1½	1.59*	5	6	1:2:4
Indiana—							
Fort Wayne	68,467	1	1½	1.76*	5	6	1:3:6
Indianapolis	138,936	1	2	2.36	5	6	1:8
Kokomo	20,000	1½	2	2.00	5	6	1:2:4
Michigan City	25,092	1	1½	2.02	..	4	1:3:5
Illinois—							
Aurora	43,580	1½	1½	1.75	5	5	1:7
Chicago	672,030	..	..	....	..	..	.....
Peoria	15,386	1½	1½	1.60*	2	6	1:3:6
Rock Island	19,597	1½	1½	2.00	5	5	1:2:5
Springfield	16,886	1	1½	1.67½	5	6	1:3:5
Michigan—							
Highland Park	7,294	1	1½	1.75*	5	6	1:3:6
Saginaw	21,049	1	1½	1.33*	5	6	1:3:5
Wisconsin—							
Madison	591	1½	2	2.15	5	6	1:2½:5
Oshkosh	8,660	1	2	2.05	5	6	1:3:6
Superior	49,816	1	1½	1.72*	5	5	1:3:5
West Allis	15,628	..	2	1.44*	..	6	1:3:5
West North Central Division:							
Minnesota—							
Duluth	9,684	1½	2	1.90*	5	5	1:3:6
Iowa—							
Boone	15,000	1	2	1.83	5	5	1:6
Cedar Falls	72,815	1	1½	1.60 [5]	5	5	1:6 [6]
Charles City	12,800	1	1½	1.70	5	5	1:3:6
Charles City	32,200	1	1½	1.85	5	6	1:3:6
Davenport	18,033	1½	1½	1.89*	5	5	1:3:6
Waterloo	11,362	1	2	2.20*	5	6	1:3:6
Missouri—							
Kansas City	107,692	1½	1½	1.92	5	5	1:3:6
Nebraska—							
Lincoln	53,785	1½	1½	1.75	5	5	1:3:6
Kansas—							
Kansas City	30,026 [7]	..	2	1.93*	5 [8]	4	1:3:6
Wichita	12,850	1	1½	1.80*	5	5	1:3:6
East South Central Division:							
Kentucky—							
Louisville	56,215	1	1½	1.91*	5	6.	.....
South Atlantic Division:							
Maryland—							
Baltimore	22,986	1½	2	1.62*	5	4	1:3:7½
Baltimore	60,229	1½	2	1.71*	5	6	1:3:7½
Baltimore	133,231 [9]	1½	2	0.90*	5	..	.....
Washington, D. C.	26,000	1½	1½	1.70*	5	6	1:3:7
South Carolina—							
Greenville	55,450	..	2	1.57*	5	4	1:3:6
Rose Hill	22,000	.. [10]	2	1.80*	5	4	1:3:6
Georgia—							
Cedartown	10,456	..	2	1.79	5	4	1:2:4
West South Central Division:							
Arkansas—							
Little Rock	......	1	2	1.75*	5	5	1:3:5
Louisiana—							
New Orleans	9,050	1½	2	2.65*	5	6	1:3:6
Shreveport	59,000	..	..	1.71	5	5	1:3:5
Oklahoma—							
Lawton	24,607 [7]	..	2	1.69	5	..	.....
Muskogee	22,069	1½	1	1.70½*	5	5	1:3:6
Tulsa	150,000	1½	1½	1.75*	5	5	1:2½:5
Texas—							
Fort Worth	104,326	1	2	1.95	5	5	1:9
Mountain Division:							
Utah—							
Ogden	6,957	1½	1½	3.03	5	6	1:2:5

Durax Pavement and a Machine for Cutting the Blocks.

(Staff Article.)

A type of stone block pavement made up of small granite cubes is in quite common use in European countries. In Germany this pavement is known as Kleinpflaster, while in England the small sets are called Durax blocks. One of the chief features of this type is the manner of laying the small blocks with as close joints as possible in concentric interlocking segments. As a consequence, there are no joints at right angles to the moving lines of traffic, these joints being either radical or circular. A sketch showing the manner in which the blocks are sometimes placed is shown in Fig. 1.

Satt Lake City	23,281	1½	2	1.90	5	6	1:3½:7
Colorado—							
Colorado Springs	96,000	1	2	1.40*	5	5	1:3:6
Denver	13,037	..	..	1.60	5	5	1:3:6
Pacific Coast Division:							
California—							
Napa	20,980	3	1½	1.44	..	..	.....
Oakland	90,517	2	1½	1.82*	..	6	1:3:6
Orange	23,100	1¼	1¾	1.44	10	4	1:3:6
Pasadena	3,250	1	2	1.86	..	4	1:3:6
Pomona	20,277	1	2	1.50	..	5	1:3:6
Palo Alto	3,111	..	1½	1.71*	..	..	.....
San Bernardino	36,924	1½	2	1.53	..	4	1:3:6
San Francisco	126,066	..	..	2.34	..	6	1:3:7
San Mateo	20,000	1	2	1.50	20	4	1:2:6
Upland	16,150	1	2	1.50	..	4	1:3:6
Oregon—							
Eugene	44,288	½	1	1.80	..	5	1:3:6
McMinnville	22,888[10]	..	2	1.70	5	4	1:2½:5
Portland	371,364	1	2	1.63*	5	5	1:3:5
Washington—							
Seattle	115,866	1	2	1.55*	..	6[11]	1:4:7
Aberdeen	27,600	1	2	1.90*	..	6	1:7
Tocoma	70,371	..	2	1.55*	..	5	1:3:6
Canadian Division:							
Montreal, Que.	115,870	..	..	2.35[12]	2	6	1:3:6
St. Lambert, Que.	20,048	1	1½	1.83*	5	5	1:3:5
Hamilton, Ont.	80,000	1	2	1.25	..	6	1:3:6
Ottawa, Ont.	95,291	¾	2	....	5	6[13]	1:3:6
Toronto, Ont.	148,621	1	2	2.02	5	6[14]	1:3:6
Saskatoon, Sask.	15,189	1	2	2.85	5	5	1:7½
Regina, Sask.	53,250	1	2	2.90	5	5	1:2:5
Edmonton, Alta.	98,780	1	2	2.85	5	6	1:3:7
Vancouver, B. C.	17,807	1	2	1.85*	5	5	2:2½:5

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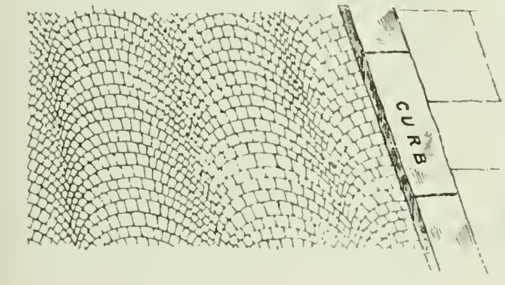
*Does not include grading. [1]5-in. Tarvia (macadam) base. [2]Repairs. [3]Without base. [4]2 in. of asphalt on old Belgian block. [5]Some at $1.44, $1.60 and $1.69. [6]Also 1:3:6 stone. [7]Rock asphalt. [8]4-in. or 5-in. base. [9]Laid on cobble and concrete. [10]El Oso asphalt. [11]Paint coat. [12]Also some on 4-in. base. [13]By contract; $2.14 by day labor. [14]8-in. under tracks. [15]Some on 5-in. base.

The blocks are irregularly shaped cubes. The sides taper slightly so that the base is approximately two-thirds the area of head. The general size used is 2¾ in. to 3½ in., but for special purposes other sizes are made. In the common European practice for city streets the blocks are evenly bedded on ½-in. of granite chips upon a concrete foundation (not less than 6 ins.) with the top surface carefully smoothed off to conform to grade. After the blocks have been placed, the joints are filled into clear granite chips, and the stone thoroughly rammed. Additional granite chips are then brushed into the joints until they are full. They are then grouted with hot coal tar pitch, and the surface covered with ½-in. of clean, sharp sand. In some cases the blocks are placed in a bed of asphaltic mastic and the joints filled with asphaltic filler.

For country roads the blocks are evenly bedded on a layer of about ¾ in. of sand, the old road being used as a foundation. After all depressions have been filled and the surface rammed and rolled until it is hard and uniform, the joints are filled with sand and the blocks thoroughly rammed. Additional sand is then rammed into the joints until they are completely full, and as a finish ½ in. of sand is spread over the surface.



Arrangement of Durax Blocks.

While this system of paving has been in extensive use in Germany, Austria, France, Sweden, Denmark and Great Britain for a number of years, few attempts have been made to employ it in the United States. New York City in the construction of an experimental pavement last year on Second avenue, proposed to lay a short section with Durax blocks. Specifications were prepared and contracts advertised, but no bids were received, and so the attempt was abandoned for the present. Bids were taken last fall by the Navy Department for paving at the Navy Yard at Brooklyn, N. Y. Four classes of pavement were specified — Durax granite blocks, 4-in. granite cubes, oblong granite blocks and creosoted wood blocks. The bids received on the 4-in. cubes were $5.53 and $7.23 per sq. yd.; on the oblong blocks the bids were $5.93, $5.80, $4.05 and $3.98 per sq. yd, the last mentioned being for the cost under New York City specifications. For the Durax block, the bid was $4.10 per sq. yd. All of these bids include the foundation. It will be seen from this that the price bid on the Durax pavement compares very favorably with the prices in the other types of granite blocks.

For cutting the Durax blocks a special machine is used extensively in Europe, and is now being introduced in this country by the Wern Machinery & Engineering Co., of 32 Church St., New York City. One of these machines has been installed at the plant of the Harris Granite Quarries Co., of Salisbury, N. C. The machine is essentially a belt-driven friction drop hammer. The anvil on which the stone to be split is placed, consists of a steel chisel, so fixed in the anvil block that it can be removed easily for sharpening. The machine is erected in the quarry in such a way that the blocks can be delivered in the most direct manner possible down a chute and so onto a platform within easy reach of the operator. This man lifts one of the blocks onto the chisel, arranging it in the place he wishes it to be split. He then gives the block two or three light blows with the hammer in order to mark the desired line of cleavage. The hammer is then raised to the required height and a heavier blow given to split the stone. The output is about 7 tons of large setts only per 9-hour day, or about 4½ to 5 tons when making setts of mixed sizes.

The long edged chisels which are held on the anvil blocks require sharpening about two to three times per day, while the hammer head requires touching up once every week or fortnight. The power required to drive the machine is about 1½ h. p., the transmission being by one open and one crossed belt. The weight of the machine complete is about 2½ tons.

Motion Pictures at the Drainage Congress.—Motion pictures of the recent break in the levee at Beulah, Miss., will be shown at the Third National Drainage Congress which convenes at St. Louis, April 10. The object of this congress is the starting of a definite plan for the drainage and reclamation of the 75,000,000 acres of swamp lands in the United States, and the utilization of these lands for agricultural purposes. Mr. Edmund T. Perkins is chairman of the executive committee.

Completion of Railroad Over the Alps.—The Loetschberg R. R. through the central Alps, which connects north and south Europe by way of the famous Loetschberg and Simplon tunnels, was completed Feb. 28

Notes on Road and Street Work.

(Staff Article.)

Average Cost Per Mile of Improved Roads in New Castle County, Delaware.—During 1911 and 1912 28.24 miles of improved roads were constructed in New Castle County under the direction of the New Castle County State Highway Commissioner. The average cost per mile of these roads, according to the last annual report of the Commissioner, was as follows:

Name of road.	Material.	Depth stone bed, ins.	Width, feet.	Cost per mile.
Telegraph Road,	trap rock	6	*	$11,506
Hillside Mills Road,	trap with local stone	6	12	9,353
Paper Mill Road,	trap rock	6	16	13,740
Depot Road,	resurfaced with bit-top	3	14	6,653
Creek Road,	local stone	8	12	7,322
Delaware City,	trap rock	6	12	6,592
Namaan's Creek,	local stone	8	14	10,334
Newark-Elkton,	trap rock	6	14	9,337
State Road South,	trap rock	8	14	11,626
Newark-Elkton,	trap rock	6	12	7,782
Wilmington-New Castle,	trap rock	8	14	9,957
Clayton,	trap rock	6	12	8,283
Philadelphia and Baltimore,	trap rock	6	12	9,328
Marshalltown,	trap rock	6	12	9,860
Lancaster,	trap and local stone	6	†	10,574
New Castle,	trap rock	6	14	7,435
Kennett Sq. Road,	trap rock	6	12	11,657
Kirkwood,	trap rock	6	12	7,614
Wilmington and Philadelphia,	bituminous surface	8	16	16,250
Ginn's Corners,	limestone	6	12	7,324
West. Chester,	trap rock	6	12	11,234
Tybout's Corner,	trap rock	6	12	6,335
State Road,	limestone	6	12	12,786
State Road,	limestone	6	12	12,144

*12-16 ft. †12-16 ft.

Some Costs on Earth Road Construction With an Elevating Grader.—The data relate to an object lesson road constructed at Redfield, S. Dak. The work was begun on Oct. 17 and completed on Oct. 26, 1911. The principal feature was grading with an elevating grader hauled by a traction engine. Slip scrapers, spike tooth and disk harrows, and a road grader were also used. Farmers furnished labor free. The natural soil from Sta. 0 to Sta. 5 was sand-clay; from Sta. 5 to Sta. 20, black loam and gumbo; from Sta. 5 to Sta. 46, sand-clay; and from St. 46 to Sta. 52+80, black soil and gumbo. The average haul was 400 ft., the maximum haul 1,000 ft., the maximum fill, 2½ ft., and the maximum grade was reduced from 4 per cent to 3 per cent. One corrugated metal culvert, 24 ft. long, was built with cement rubble masonry end walls 5½ ft. by 5 ft. by 2 ft. 1½-in. thick. The culvert cost $21.60 and the end walls $24.08. The total length graded was 5,280 ft., the width 40 ft. and the area 23,466 sq. yds. The crown was made ¾-in. to the foot. The grading amounted to 870 cu. yds. of earth and 6 cu. yds. of rock. The cost of the road was $378.31, which gives a cost of $0.016 per square yard. The principal items in this cost were as follows:

Shaping, 23,466 sq. yds., at 15 cts.	$ 40.37
Grading, 870 cu. yds., at 32.4 cts.	282.01
Rock excavation, 6 cu. yds., at $1.08	6.50
Trimming shoulders and ditches	3.75

The cost of the traction engine, including coal, water, repairs, etc., was $30 per day.

Some Costs on Macadam Construction.—In August, 1911, one mile of road at Summerville, Ga., was improved under the direction of the U. S. Office of Public Roads. The road was surfaced for a width of 14 ft., the material used being chert. This material, the largest stones of which were 4 ins. in diameter, was spread 8 ins. deep in one course, and compacted to 6 ins. About 1,440 cu. yds. of the material were used. Some of the items of cost were as follows:

	Total.	Per cu. yd. Amt.
Loading at pit	$ 77.50	$0.053
Hauling from pit to road	405.00	.29
Spreading	25.00	.017

The average haul from the pit was one mile. The spreading was done with shovels. Labor cost $1 per day; teams $3, and supervision $2. The following data relate to an object lesson road constructed in 1911 near Berea, Ky., under the direction of the U. S. Office of Public Roads. The natural soil was yellow clay with a subsoil of disintegrated shale rock. Slat-bottom wagons and 1-yd. dump carts were used for hauling, and the material was spread upon the road with shovels. The haul by wagon for the stone was 2,600 ft. Water was obtained from a hydrant on the work. The material used for surfacing was dolomite and limestone; this material is suitable for light traffic only. The area surfaced was 3,123 sq. yds. The bottom course was 2½ ins. deep and was filled with screenings, making a total depth of 3 ins. The stone of the bottom course was ¾ in to 1¼ in. in diameter, and the screenings from ½ in. to dust. The surfacing material amounting to 415 cu. yds. cost $475 f. o. b. The cost of hauling from the cars to the road was $163.50 or about 40 cts. per cubic yard; the cost of spreading and sprinkling was $70.45 or about 17 cts. per cubic yard, while cost of rolling was $234.50 or about 56 cts. per cubic yard. The rolling cost includes the following:

Rollerman, 21 days, at $3	$ 63.00
Rent of 15-ton roller, 23½ days at $5	117.50
Loading, unloading and freight of roller	39.50
Coal, 2.9 tons at $3.50	10.15
Oil, 1½ gals., at $1	1.50
Total	$231.65

Labor cost $1.25 per day, and teams $2.50 per day.

WATER WORKS

The Appraisal of Water Works Properties, with Special Reference to the Reproduction Method.

Water works properties are appraised for three purposes—for purchase, for rate-making and for the issuing of securities. The method to be employed in finding value is sometimes determined by the purpose for which the appraisal is made, but, as the true value is fixed, the results to be achieved can affect only the method to be employed and the degree of accuracy to which it is carried. The object of the paper read by Douglas A. Graham, Consulting Engineer, Chicago, before the Illinois Water Supply Association, was to outline the methods which have found most general recognition in water works valuation work and to describe more fully the essential facts and theories involved in the reproduction method. An interesting feature of Mr. Graham's paper, which is here given in full, is the enumeration and discussion of the various steps involved in the appraisal of a privately owned water works property, whether for purchase or rate-making or for reasons connected with the operation or financing of the plant.

At the outset it is well to emphasize the fact that the result obtained by any series of computations and estimates is not the *value* of the utility under consideration, but is rather a *measure* of that value. A logical value can only be obtained by a comprehensive study of the results found by the application of as many theories as possible, together with all the conditions of environment, service and special characteristics of the plant and city, which have a bearing on the problem. Scientific men are prone to be misled by the results of formulas, without giving sufficient consideration to the broader aspect of a problem.

This fact demands that, to arrive at a fair measure of value, the appraisal by each method must follow a definite theory throughout and be carried to a logical conclusion, without digression and without confusion with the theories belonging to other methods. If a confusion of methods is permitted the results cease to have any meaning or foundation on logic.

There are four distinct methods which have been employed in the appraisal of water works properties and which have been quite generally recognized by the courts and appraisal boards as giving an indication, at least, of the true value of a property.

First, and perhaps of least importance, is the method of estimating the value of a plant by means of the market value of its stocks and bonds. This method would, of course, not be applicable to a municipally owned plant, and the instances are rare, in the West at least, where a continuing and representative market for such securities can be said to exist. Furthermore, the value of securities is generally based on the earning power of the utility, and where limited franchises and municipal control prevail, such a basis would render the estimate of little value.

Another method, also based on generalities, is what might be termed the "Commercial or Comparative" method. This involves a consideration of the value of the plant in question as compared to averages of the values of other plants in general and to the values of individual plants in which all conditions affecting value are known to be similar. This is the method most available to the ordinary business man and, when used intelligently, gives useful results. It must be used with caution, however, and without prejudice, as individual plants differ widely in characteristics and values.

Next in importance comes the Past Cost method. Where the data can be accurately obtained, the past cost undoubtedly furnishes an excellent and, in some respects, a fair measure of value. Unlike reproduction cost it involves no estimation of depreciation, but, to offset this, no credit is given for the appreciation of land, material and labor values. Its chief objection lies in the difficulty usually encountered in obtaining reliable audits of the construction accounts, as few water companies have kept their early books in sufficiently complete detail to permit an accurate separation to be made between construction and operation accounts. Its chief advantage is that Past Cost represents actual expenditures and, when the plant has been wisely managed according to the local laws and requirements, the actual cost would seem to give a very fair measure of the true value of the plant to the community.

Last, and in most general use because of its universal adaptability, is the Reproduction Method. This method is in keeping with our common methods of trade appraisal and, in the hands of skilled appraisers, it furnishes a very excellent measure of value. This method involves the hypothetical construction, step by step, of an exactly similar Comparative Plant, the hypothesis being carried successively through all the stages of origination, construction and business development which would be necessary in the actual construction of a water works system. The structures, machinery, pipes and the general or overhead items are estimated at what it would reasonably cost to reproduce them at the existing normal price of material, labor and money, and the reproduction costs are then reduced by the amounts of depreciation the plant has suffered from all causes.

The Reproduction Method is not as simple in application as is commonly supposed. The ability of the appraiser must be precisely that required in actually planning and constructing a new plant. Though the estimator has before him full-sized plans and specifications, in the form of the existing plant and a complete inventory of the details involved, yet there are many items, such as temporary structures and conditions of hazard, which must necessarily disappear from view upon the completion of the plant, yet which must be estimated and included in the total cost of the work.

This method has both advantages and disadvantages. It requires a detailed study of the conditions involved and a logical reason for each step or theory adopted. It, therefore, tends to eliminate guess work and the effect of prejudice as far as possible. On the other hand, detailed estimates tend to lessen the probability of a broad consideration of the subject and to substantiate small errors in unit prices which, because they are many times multiplied in the total, may materially effect the final result. Also it is difficult to apportion properly the incidental costs, such as waste, extras, supervision and profit, to the unit prices, and it is generally known that detailed estimates rarely provide enough money for the completion of a constructive enterprise unless ample allowances have been made to cover these incidental costs.

The items to be appraised are pretty generally agreed upon, there being but few differences of opinion on these matters. One item, the inclusion of which has been the subject of much debate, is the cost of taking up and replacing pavements which have been laid subsequent to the laying of the mains.

This controversy can only be settled by resorting to the principle of the reproduction theory, which is essentially a hypothetical reproduction of the property. As the pavements now exist, strict adherence to this theory leaves no course open but to include the extra cost due to their presence. Here again it must be remembered that the whole method is only a theory, and if a digression is permitted in one instance, why not in another, until the results obtained are but a compilation of arbitrary estimates and by no means the reproduction value of the plant? In the Past Cost Method pavements laid after laying the mains are not considered, but in the Reproduction Method they cannot be overlooked.

It has been suggested that pavements may be included when valuing for purchase but not for rate-making, but, as rates might be fixed immediately after purchase, the same values must be used in both instances. This is one of the appreciations which offset the depreciations also estimated, and consideration must be given to both or neither.

Let us now consider the steps involved in the appraisal of a privately owned water works property, whether for purchase or rate-making or for reasons connected with the operation or financing of the plant.

The first step in the appraisal is the preparation of the inventory. Properly prepared the inventory is quite different from that ordinarily made by business houses, where the object is to list up and describe articles which have a recognized market value. It should be a complete record of the details of the plant and should give the history of the plant, the laws or ordinances which might affect value, the conditions which would be met with during reconstruction and lists of the materials involved in convenient form for use in making estimates. It should contain such drawings and photographs as may be necessary to fully explain and verify the quantities given. The cost of a thorough and complete inventory is never wasted, for, besides greatly increasing the probabilities of a fair appraisal, it saves much valuable time when the actual estimates are undertaken. Furthermore, a complete inventory is a great help in the intelligent financing and operation of a plant, by giving the managers an intimate knowledge of the property under their care.

The actual appraisal begins with the estimation of the time element. The time available is of almost equal importance with the cost of materials, as the cost of construction, lands, water rights, etc., increase when the time available for construction is limited, and the amount of the general costs, such as interest during construction and going value, decreases under the same conditions. It is essential therefore at the beginning that a careful program of construction and business development be planned, and that all values be estimated with the time element clearly in view.

The item of costs preliminary to construction comes next. In any new enterprise the general scheme must first be originated, and much preliminary engineering investigation and legal work accomplished before construction can be begun. Such costs are generally grouped under one heading, and estimated according to the experience of the appraisers in such matters. Lands and other real estate are usually valued by local men, as few engineers would be sufficiently well versed in local land values to pass upon this point.

Then follows the estimates of cost to reproduce the pumps, pipes and other physical parts of the plant. These items are estimated from the lists of material and labor involved, using what might be termed the "normal" prices of each class of work in the locality considered. In most instances the "normal price" will be the prevailing market price, as most materials entering into the construction of a water works do not suffer appreciably from market fluctuations. In the case of some items, however, notably cast-iron pipe, the fluctuations, even in a single year, may be so rapid as to make it entirely unreasonable to adopt the price at any one moment.

For example, if it is desired to find the value of a plant for the purpose of fixing rates, it is the value of the plant for future service that must be considered. Should the price of materials be extremely high or unusually low at the moment, the resulting value would only be the value of the moment, and rates based upon such a value would be neither fair nor reasonable. It is obvious, therefore, that only by the use of an average or normal price can justice be done to both the city and the company.

After the construction estimates have been made there are certain general items which must be considered, namely Engineering, Legal, Administrative and Contingent costs, during the construction period, and the interest on the various expenditures until operation begins and the fixed charges can be carried to operating accounts. These items may be estimated in different ways and included either with the items of construction or in lump sums as separate items. They are just as much a part of the physical value of the plant as its buildings, machinery and pipes.

After the reproduction cost of the physical property has been found the estimates must be reduced to present worth by the deduction of an amount which will represent the loss in value the plant has suffered by reason of its past service, and its possible inadaptability to the service which will be demanded of it in the future. If the appraisal is for rate-making purposes, depreciation must be considered in connection with the proper allowance to be made as fair return, as the courts have held that a public utility is entitled to provide a fund which will keep its investment intact.

Water works depreciation may properly be divided into three general divisions, viz: Ordinary, Functional and Contingent Depreciation, the latter being considered only in operating accounts.

By Ordinary Depreciation is meant that decrease in the service value of a machine or structure which takes place by reason of ordinary wear and tear. The rate of loss in value from this form of depreciation increases as time goes on, being small at first and rising rapidly as the end of the life of the structure or machine approaches. Ordinary depreciation is very small in cast-iron pipe and in earthen and masonry reservoirs, and large in machinery and most metal construction.

By Functional Depreciation is meant that decrease in value which comes from obsolescence, due to changes in conditions or in the art of construction, or to any things which make a structure or apparatus unsuitable for the service it is called upon to provide. This form of depreciation is especially noticeable in machinery which has become inefficient or inadequate, and in the distribution system when small mains must be replaced by larger ones, owing to the growth of the city, or where incrustation has reduced the original capacity of the pipes.

Contingent Depreciation is estimated only for use as an operating account, and does not affect the reproduction value of the plant. It is simply a device for spreading certain extraordinary expenses over a period of years. Such expenses occur in the operation of every plant, and, when no special provision is made for them, they make it difficult to understand properly and provide for the ordinary expenses of operation. Examples of Contingent Depreciation are the costs involved in the bursting of mains with consequent damage to private property, electolysis of mains and the lowering of mains when street grades are changed.

Ordinary Depreciation is commonly estimated by one of two methods, viz., the "Sinking Fund" and the "Straight Line" methods. The choice of the proper estimating method to be used has been given much attention, and there are several valuable discussions of the subject in print. It is therefore not intended to enter into an extended explanation of the two methods in this paper.

The "Sinking Fund" method assumes the depreciation at any time to be equal to the accumulation of a sinking fund begun at the time of construction and estimated to be equal to the value of the structure at the end of its life. The per cent of "Straight Line" depreciation is found by taking a direct ratio of the age to the total estimated life of the structure considered. Either method is arbitrary and the results give widely different measures of the actual depreciation. It appears to be quite generally agreed that the "Sinking Fund" method, because of the similarity of its results to the losses in value actually observed, gives the best results for appraisal purposes, and that the "Straight Line" method is more suitable for operating charges, because of its simplicity.

"Functional Depreciation" is purely a matter of judgment and is based upon a prediction of future conditions. Contingent Depreciation is found from a study of past experience.

After the appraisal of the plant has been carried to this point, there remains only the reproduction of the business and income of the plant. This is commonly termed the "Going Value" or "Growing Concern Value" and its existence and the necessity of including it in a complete appraisal, have been almost universally recognized by the courts.

Many attempts have been made to find a simple method for estimating Going Value but with little success, and it may be said that there are but two methods in general use. One, the Reproduction method, involves a comparison of net incomes, either actual or estimated on the basis of fair rates, between the existing plant and the comparative hypothetical plant. The other, the Past Cost method, is based upon a computation of the deficits in operation and fixed charges during the entire life of the plant. The former should be used in a reproduction estimate and the latter only as an addition to the cost of construction as found by the Past Cost method. Here again it should be remembered that the results by either one of these theories give us, not the value of the income, but one measure of that value. The assumptions to be made in the estimation of Going Value, and the detailed procedure involved make too large a subject to be discussed in this paper.

When all the items mentioned above have been estimated and included the Reproduction Value is complete, and there remains only a broad review of the problem, and the fixing of the final or Service Value of the property. If the data are available the value of the plant should be estimated by all of the methods outlined above, and the final value fixed by a comprehensive study of the several values obtained.

The Hydraulics of Fire Streams from Small Hose and Nozzles.

The importance of adequate fire protection has become so well recognized that most buildings even of moderate size are equipped with some sort of fire apparatus for immediate service in case of fire in the interior of the building until the city fire department arrives. The ordinary water buckets and portable chemical fire extinguishers have in a large measure been supplemented with small fire hose. Very little data are available concerning the hydraulics of small fire streams. Many inquiries about the discharge from small nozzles and the loss of head in small hose lead to the tests which are herein described. These tests were made under the direction of Virgil R. Fleming, Associate in Theoretical and Applied Mechanics at the University of Illinois, and were described by him in a recent paper before the Illinois Water Supply Association as follows:

The tests were undertaken with the object of acquiring data and putting it into such workable form that an owner or builder might be able to compute the quantity of water delivered by a nozzle of the size ordinarily used in the fire protection of the interior of buildings or the pressure necessary in the mains to give an effective fire stream with such nozzles, and also to throw some light upon the quantity of water which would be considered sufficient for temporary protection.

The tests were conducted at the University of Illinois under the direction of the writer by A. O. Korsmo and A. B. Neininger of the class of 1911 as thesis work. Much credit is due them for the care and thought given the problem and the thoroughness with which they did their work.

In 1888 Mr. John R. Freeman conducted an extensive series of tests upon 2½-in. fire hose and nozzles. The results of these tests are reported in an article "Experiments Relating to the Hydraulics of Fire Streams" in the Transactions of the American Society of Civil Engineers, 1889, Vol. XXI, p. 304. Deductions from these tests are given in Turneaure and Russell's "Public Water Supplies," p. 250.

In general, Mr. Freeman arrived at the following conclusions: Smooth conical nozzles give coefficients of discharge as high as any other form of nozzle, the jets reach farther and the streams remain solid for greater distances than for any other form of nozzle of the same size of opening and with the same pressure at the base of the nozzle. For smooth conical nozzles 1⅛ or 1¼ ins. in diameter, a coefficient of discharge of 0.977 may be taken with great confidence that this will not be more than one-half of 1 per cent in error. The coefficient will be slightly larger for smaller nozzles. The nozzle makes a very convenient method of measuring water. The friction is but slightly more in smooth rubber-lined hose than in clean iron pipe of the same diameter. The friction in unlined linen hose is about 2⅓ times as much as in smooth rubber-lined hose. A hose elongates from 2 per cent to 5 per cent with a pressure of 50 lbs. per sq. in. This elongation produces a sinuosity which increases the loss of head about 6 per cent. Care should be exercised that there is no abrupt change of section in the hose couplings and that no washers or gaskets are so left as to impede the flow of water. It is frequently recommended that a 250-gal. per min. fire stream be used in business districts while a 175 or a 200-gal. stream may be used in a residential district. These discharges correspond to a nozzle pressure of 40 to 50 lbs. per sq. in. and a hydrant pressure of 80 to 110 lbs. per sq. in. These values refer to outside service.

The data given in Tables I to III, inclusive, on 2½-in. hose and nozzles are taken from Freeman's tables and are convenient for making calculations for outside fire protection.

The tests at the University of Illinois to determine the loss of head in hose due to friction and the tests to determine the coefficients of discharge of the nozzles were conducted in the Hydraulic Laboratory. The tests to determine the height and distance the jets would reach were carried on out of doors. The water for all the tests was drawn from the University mains. All tests were made upon 1½-in. hose and nozzles.

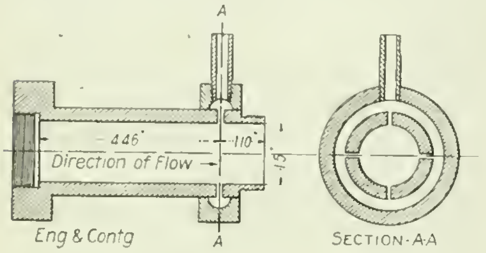


Fig. 1—Detail of Piezometer Coupling.

Rubber-lined cotton and unlined linen hose were used in these tests. The hose was taken from the racks in the University buildings and is representative of hose of this size commonly in use. The discharge was measured with a calibrated nozzle and the loss of head was measured with a differential mercury gauge over a 50-ft. length of hose. The average pressure at a section of the hose was obtained with a piezometer coupling of the Freeman type. A section of one of these couplings is shown in Fig. 1.

The curves on Fig. 2 show the friction factors for each kind of hose and for velocities ranging from 4 to 8 ft. per sec. This covers the range of velocities which would be met in ordinary use. The friction factor is computed from the formula

$$h = \frac{f l v^2}{d\,2g}$$

h=head lost in feet of water.
f=friction factor.
l=length of hose in feet.
d=diameter of hose in feet.
v=velocity of the water in the hose in ft. per sec.
g=acceleration due to gravity in ft. per sec. per sec.

The loss of head in the rubber-lined hose varies almost directly as the square of the velocity and is about the same as the loss of head in clean iron pipe of the same diameter. The friction factor for the unlined linen hose decreases as the velocity increases or in other words the loss of head does not vary directly as the square of the velocity, the ratio of the lost head to the square of the velocity being larger for the lower velocities. In general the lost head in the unlined linen hose is about twice as great as in the rubber-lined cotton hose. If an average value of the friction factor (0.06) is used for the unlined linen hose no great error will enter into the results under ordinary circumstances. The length of hose will ordinarily not be more than 100 ft. and for this length about 10 lbs. per sq. in. will be the maximum loss of head in the unlined linen hose under working conditions with nozzles up to ½ in. in diameter. An error as large as 10 per cent in the calculation of the loss of head in the hose would affect the nozzle pressure not more than 1 lb. per sq. in.

TABLE I.—1-IN. NOZZLE, 2½-IN. HOSE.

Pressure, base of nozzle.	Discharge.	Loss of head in 100 ft. of hose. Rubber lined.	Loss of head in 100 ft. of hose. Unlined linen.	Vertical height of jet for good fire stream.	Horizontal distance of Jet for good fire stream.	Horizontal distance of Extreme drops at level of nozzle.
Lbs. per sq. in.	Gals. per min.	Lbs. per sq. in.	Lbs. per sq. in.	Ft.	Ft.	Ft.
20	132	5	10	35	37	77
30	161	7	15	51	47	109
40	186	10	20	64	55	133
50	208	12	25	73	61	152
60	228	15	30	79	67	167
70	246	17	35	85	72	179

TABLE II.—1⅛-IN. NOZZLE, 2½-IN. HOSE.

Pressure, base of nozzle.	Discharge.	Loss of head in 100 ft. of hose. Rubber lined.	Loss of head in 100 ft. of hose. Unlined linen.	Vertical height of jet for good fire stream.	Horizontal distance of Jet for good fire stream.	Horizontal distance of Extreme drops at level of nozzle.
Lbs. per sq. in.	Gals. per min.	Lbs. per sq. in.	Lbs. per sq. in.	Ft.	Ft.	Ft.
20	168	8	16	36	38	80
30	206	12	25	52	50	115
40	238	16	33	65	59	142
50	266	20	41	75	66	162
60	291	24	49	83	72	178
70	314	28	57	88	77	191

While the loss of head in the unlined linen hose is about twice as great as the loss of head in the rubber-lined hose, the linen hose has several points of advantage. It is much lighter to handle, will fold up in less space on the wall racks, its cost is but about 50 per cent to 60 per cent of the cost of rubber-lined hose and in an ordinary building its life is much longer.

Three sizes of openings of 1½-in. smooth conical nozzles were tested. The first nozzle had a diameter of 5/16 in. The second nozzle had a diameter of 0.428 in. This is approximately 7/16 in. and in compiling the tables corrections were made so as to apply to a 7/16-in. nozzle. The third nozzle had a diameter of ½ in. The coefficients of discharge of the nozzles are plotted in Fig. 3. The coefficient of discharge is the ratio of the actual discharge to the ideal discharge. The actual discharge was weighed and the volume computed from the weights. The ideal discharge was computed from the formula

$$q = A\sqrt{2gh}$$

q=discharge in cu. ft. per sec.
A=area of the opening of the nozzle in sq. ft.
g=acceleration due to gravity in ft. per sec. per sec.
h=pressure at the base of the nozzle in feet of water. The pressure at the base of the nozzles was measured with calibrated gauges.

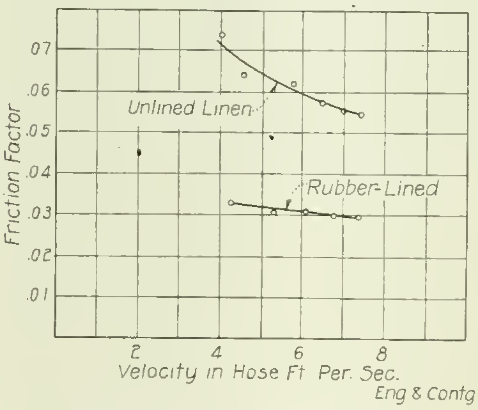


Fig. 2—Friction Factor in Hose.

TABLE III.—1¼-IN. NOZZLE, 2½-IN. HOSE.

Pressure, base of nozzle.	Discharge.	Loss of head in 100 ft. of hose. Rubber lined.	Loss of head in 100 ft. of hose. Unlined linen.	Vertical height of jet for good fire stream.	Horizontal distance of Jet for good fire stream.	Horizontal distance of Extreme drops at level of nozzle.
Lbs. per sq. in.	Gals. per min.	Lbs. per sq. in.	Lbs. per sq. in.	Ft.	Ft.	Ft.
20	209	12	25	37	40	83
30	256	19	38	53	54	119
40	296	25	51	67	63	148
50	331	31	63	77	70	169
60	363	37	76	85	76	186
70	392	43	88	91	81	200

TABLE IV.—5/16-IN. NOZZLE, 1½-IN. HOSE.

Pressure, base of nozzle.	Discharge.	Loss of head in 100 ft. of hose. Rubber lined.	Loss of head in 100 ft. of hose. Unlined linen.	Vertical height of jet for good fire stream.	Horizontal distance of Jet for good fire stream.	Horizontal distance of Extreme drops at level of nozzle.
Lbs. per sq. in.	Gals. per min.	Lbs. per sq. in.	Lbs. per sq. in.	Ft.	Ft.	Ft.
20	12	.7	1.3	28	15	53
30	15	1.1	1.9	32	18	63
40	17	1.5	2.6	34	21	71
50	19	1.8	3.2	35	23	78
60	21	2.2	3.9	36	26	84
70	23	2.6	4.5	37	28	90
80	24	2.9	5.2	38	29	96
90	26	3.3	5.9	39	30	102
100	28	3.7	6.5	40	31	107

The coefficient of discharge for the 7/16-in. and the ½-in. nozzles is nearly constant for all pressures and averages 0.98. The coefficient is slightly lower for the 7/16-in. nozzle for the higher pressures. The 5/16-in. nozzle gives a coefficient of 0.95. The 5/16-in. nozzle is 12 ins. long, while the other two are but 6 ins. long and this greater length adds somewhat to the friction and lowers the coefficient of discharge for the 5/16-in. nozzle.

The 5/16-in. and the 7/16-in. nozzles were rough on the interior surfaces, having been left just as they came from the molds. The tips had been smoothed slightly by running a drill through the opening, but the cylindrical portion made by the drills was very short in each case and the nozzles gave streams which sprayed badly a short distance away. The ½-in. nozzle was made from a 7/16-in. nozzle. The entire inner surface was first machined out in the hope that it would prevent the spraying of the jet, but in this condition the nozzle gave a stream which appeared no better than before machining. Then a 15/32-in. reamer and finally a ½-in. reamer were run through the opening, each reducing the spraying. The ½-in. reamer made the cylindrical portion of the opening ½-in. long and the resulting nozzle gave a very good stream. An opening larger than ½-in. could not be made in the nozzle because of the thinness of the walls.

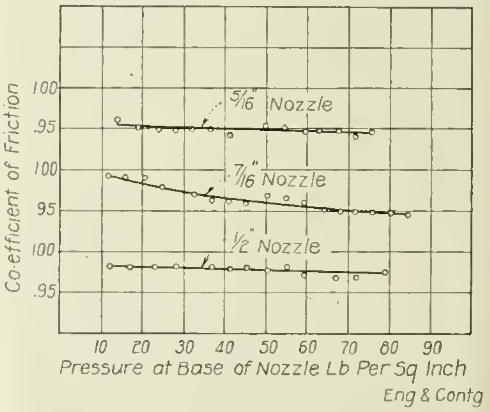


Fig. 3—Coefficient of Discharge for Nozzle

The data to determine the height and distance the streams would reach were taken when a moderate wind was blowing which interfered with the streams considerably. A stream was considered good for such a distance that most of the water would pass through a circle whose diameter was 18 ins. This value was an arbitrary selection and the streams might be considered by some as effective for greater distances than given in

TABLE V.—7/16-IN. NOZZLE, 1½-IN. HOSE.

		Loss of head in 100 ft. of hose.			Horizontal distance of	
Pressure, base of nozzle. Lbs. per sq. in.	Discharge. Gals. per min.	Rubber lined. Lbs. per sq. in.	Unlined linen. Lbs. per sq. in.	Vertical height of jet for good fire stream. Ft.	Jet for good fire stream. Ft.	Extreme drops at level of nozzle. Ft.
20	25	2.8	5.1	23	10	45
30	30	4.2	7.7	27	13	54
40	35	5.6	10.2	30	16	63
50	39	7.0	12.8	32	18	70
60	43	8.5	15.3	33	20	77
70	47	9.8	17.8	34	21	84
80	50	11.1	20.3	35	23	94
90	53	12.7	22.9	36	24	99
100	56	14.1	25.5	37	25	106

these tests. The streams, however, beyond the sections chosen diverged rapidly and the selection of any circle larger than 18 ins. would have added but a few feet to the distances obtained in these tests in any case.

Tables IV to VI, inclusive, give the pressures at the base of the nozzles, the discharges, the loss of head in the 1½-in. hose and the vertical and horizontal distances of the jets are compiled from the results of the tests.

Small fire hose and nozzles should be used as a temporary protection and brought into play until greater relief is at hand. They must necessarily operate under ordinary working pressures in the mains more often than under fire pressures. Taking 40 lbs. per sq. in. as an average pressure in the mains, we should have, after deducting for losses in the hose and connecting pipes, about 30 lbs. per sq. in. at the nozzle. Of course, this pressure would be still further reduced if the nozzle used was at a higher elevation than the main. At a nozzle pressure of 30 lbs. per sq. in. the ½-in. nozzle will discharge 40 gals. per min., the 7/16-in. and the 5/16-in. nozzles will discharge 30 and 15 gals. per min. respectively. It is felt that the discharge from the two smaller nozzles is not great enough for effective work. It is true that the pressure at the nozzle for the smaller sizes for a given pressure in the main will be somewhat greater than for the ½-in. nozzle due to the decreased velocity in the hose which will give a smaller loss of head, but this will not be enough to increase the discharge materially for an ordinary length of hose. The discharge from the 5/16-in. nozzle is too small to be very effective even at high pressures. The discharge for a pressure of 100 lbs. per sq. in. is but 28 gals. per min. It is recommended that ½-in. nozzles be used with 1½-in. hose. For nozzles larger than ½-in. the discharge would become greater and increase the loss of head in the hose to such an extent that there would not be enough nozzle pressure left to produce a stream which would carry any distance.

The tests show clearly the importance of a smooth cylindrical opening at the tip of the nozzle. An examination of the results of the tests on the 7/16-in. and the ½-in. nozzles for vertical heights and horizontal distances of the jets will show this difference. The appearance of the jets showed a much greater difference than the data would indicate. It must be remembered that the two nozzles were alike and gave streams which appeared to be the same before one was reamed out to a larger size. The condition of the interior surface of the nozzle to within ½-in. of the end does not seem to affect appreciably either the quantity of discharge or the quality of the stream.

TABLE VI.—½-IN. NOZZLE, 1½-IN. HOSE.

		Loss of head in 100 ft. of hose.			Horizontal distance of	
Pressure, base of nozzle. Lbs. per sq. in.	Discharge. Gals. per min.	Rubber lined. Lbs. per sq. in.	Unlined linen. Lbs. per sq. in.	Vertical height of jet for good fire stream. Ft.	Jet for good fire stream. Ft.	Extreme drops at level of nozzle. Ft.
20	33	5.2	9.5	34	15	63
30	40	7.7	14.4	37	20	79
40	46	10.2	18.8	38	25	91
50	52	12.8	23.8	39	30	102
60	57	15.4	28.5	40	33	111
70	61	18.0	32.7	41	37	120
80	65	20.5	38.4	42	40	127
90	69	23.0	42.0	43	43	134
100	73	25.6	47.0	44	46	140

With the aid of the tables the discharge for any of the nozzles may be readily computed for any pressure in the mains. If the nozzle is at a higher elevation than the main, subtract from the pressure in the main an amount equal to 0.434 times the difference in elevation between the nozzle and the main in feet. Take a discharge from the table for any pressure at the base of the nozzle for the size of the nozzle used, then take the corresponding value of the head lost in the kind of hose used, multiply this by the length of hose in feet used and divide by 100. This gives the total loss in the hose for the assumed discharge. If there is any connecting pipe, determine the loss in it for the assumed discharge. If it is 1½-in. pipe the loss in it will be the same as the loss in a corresponding length of rubber-lined hose. Add the losses in the pipe and hose to the pressure at the base of the nozzle for the assumed discharge to obtain the pressure at the elevation of the nozzle necessary to produce this discharge. The discharge varies as the square of the sum of all the losses. Let q' = the assumed discharge, P' = the pressure at the elevation of the nozzle which will nroduce this discharge, q = the discharge to be determined. P = the actual pressure in the mains and H = elevation of nozzle above the main in feet. Then we have the relation

$$q = q' \frac{\sqrt{P - .434H}}{\sqrt{P'}}$$

which gives us the required discharge.

To illustrate the use of the formula we will make the following assumptions. Pressure in mains = 60 lbs. per sq. in., 80 ft. of linen hose, 50 ft. of 1½-in. connecting pipe elevation of nozzle above main 30 ft. and ½-in. nozzle used.

Assume a discharge of 46 gals. per min., and from the table we obtain the following values:

Nozzle pressure 40 lbs.

$$\text{Loss in hose} = \frac{80 \times 18.8}{100} = 15.0 \text{ lbs.}$$

$$\text{Loss in pipe} = \frac{50 \times 10.2}{100} = 5.1 \text{ lbs.}$$

Total .... 60.1 lbs.

Substituting in the formula

$$q = 46 \frac{\sqrt{60 - .434 \times 30}}{\sqrt{60.1}}$$

q = 40.7 gals. per min.

The following method may be used to determine the discharge for any size of nozzle for any pressure in the mains: Assume any pressure at the base of the nozzle h' in feet of water. The discharge for this pressure may be determined by the formula

$$q' = cA\sqrt{2gh'}$$

q' = discharge in cu. ft. per sec.

c = coefficient of discharge and may be taken as .98.

A = area of opening of nozzle in sq. ft.

2g = 64.4 ft. per sec. per sec.

Determine the velocity in the hose for this discharge from the formula

$$v = \frac{q'}{a}$$

v = velocity in hose in ft. per sec.

a = area of hose in sq. ft.

Determine the loss in the hose from the formula

$$h_2 = \frac{fl}{d} \frac{v^2}{2g}$$

h_2 = head lost in feet.

f = friction factor which may be taken as .03 for rubber-lined hose or .06 for unlined linen hose.

l = length of hose in feet.

d = diameter of hose in feet.

v = velocity in hose in feet.

2g = 64.4 ft. per sec. per sec.

If there is any pipe connecting the hose to the main the loss for it may be computed by the same formula as for the hose, using .03 for the friction factor for 1½-in. pipe. Call this lost head h_3.

The pressure in the main to give the assumed nozzle pressure is $H' = h' + h_2 + h_3$. This pressure will be in feet of water. Then using the relation $q = q' \frac{\sqrt{H}}{\sqrt{H'}}$ we get the required discharge. If the main is below the nozzle subtract the difference in elevation in feet from H in the formula.

It is recognized that the above method is not absolutely correct since the head does not vary exactly as the square of the discharge, but the results obtained will be close enough for practical use.

In conclusion it seems well to call attention to the need of having larger openings in nozzles than are ordinarily provided and also to the importance of having the tip of the nozzle well reamed out for a distance of at least ½ in. It is believed that the data of the tables and the diagrams will be of value in making calculations for interior fire protection.

Notes on the Water Supply Problem in Railroad Operation.

Not many years ago, the load of freight trains ranged from 300 to 500 tons, and an engine tender with a water storage capacity of 2,500 gals. was considered ample, but today freight trains on important trunk lines of low gradients are loaded with 2,000 to 4,000 tons, and engines with tender storage capacity of 9,000 gals. are quite common. The consumption of water has greatly increased and has made it necessary to raise the standard of water supply, both as to quantity and in quality in order to meet traffic conditions. The nature of the present day water supply problem in railroad operation was discussed by Mr. C. R. Knowles, General Foreman of Water Works, Illinois Central Railway, in a paper before the fifth annual meeting of the Illinois Water Supply Association. The major portion of Mr. Knowles' paper is here given:

In former years it was the practice to erect a tank and establish a water station at any point where water of any kind was most convenient, with little regard for quality or future requirements. This has necessitated many changes to meet the changing conditions and added requirements, the re-locating of the water stations with due regard to curvature, gradients and the many previously unknown expedients of operation.

To accomplish the desired result it is often necessary to pipe water from a considerable distance, or if an ample supply is not otherwise available, to sink wells, or to construct a reservoir impounding a storage supply. In the event that the available supply is not satisfactory in quality, it is often necessary to erect treating plants for converting it into a suitable water for locomotive purposes.

All these changing conditions and increased requirements have made it necessary for railroads to maintain a water works department organization, the duties of which are similar to that of a city water works department. Constant vigilance on the part of this organization is necessary to maintain an uninterrupted supply of water at all times.

The amount of water required by a railroad 6,500 miles long, over the entire system, for all purposes, is approximately 16,500,000,000 gals. per annum. Only part of the water consumed is metered, as a large part of it is furnished on a flat rate, or pumped by facilities, owned and operated by the railroad, consequently the figures given are estimated, the estimates being based on comparative figures at other points where meters show the actual amount used.

The consideration of first importance in railway water supply, both in quantity and in quality, is water for locomotives. A water which would be ideal for this purpose would be one that would not scale, would not corrode, and which would not foam or prime. Unfortunately Nature does not supply such a water; consequently, where these evils do not cause too much trouble they are tolerated, and where they are excessive the water is treated. In the State of Illinois alone, on 2,000 miles of railroad, there is consumed annually 4,236,838,000 gals. of water for locomotives alone; 1,751,790,000 gals. of the above amount is purchased from municipal and privately owned water works plants, and 138,645,000 gals. is treated by purifying plants owned by railroad companies. It is necessary to maintain 123 water stations to distribute this water to locomotives at points where required.

The washing and filling of locomotive boilers at terminals require a large amount of water in addition to the above, which amounts to approximately 950,000,000 gals. per annum and is of course supplied by the same facilities as water for locomotives with additional facilities for maintaining the desired pressure for washing and the necessary pipe lines for distribution of the water under pressure.

There is also the consumption of water by stationary power plants which is approximately 300,000,000 gals. per annum, including water used for condensing engines, 125,000,000 gals. of which is city water. Other uses for water are for sanitary purposes at shops, roundhouses, offices and stations. This requires an additional estimated amount of 250,000,000 gals., 200,000,000 gals. of which is city water, or a grand total of 5,736,838,000 gals. used for all purposes in Illinois alone, 2,476,790,000 gals. of which is purchased from city plants.

It is interesting to note that 43 per cent of the water used in the State is purchased from municipally owned or private water works plants, and it would seem that the railroads of the State form such a large portion of the various water companies' patronage that rates for water purchased from city plants could be made sufficiently attractive as to secure even more of what would appear to be very desirable business, but as a matter of fact the city rates in a great many instances are so high that the railroad companies have found it cheaper to install and operate their own stations wherever it is possible to do so.

The use of superheaters on locomotives and modern washout plants, where the water is blown off from locomotives into the washout system and used again for washing and heating fresh water for refilling, have effected economies in the use of water, but the consumption of water has increased to such an extent on account of the large business being handled that the result of these economies is not perceptible in the grand total of water consumed.

Method and Cost of Removing Heavy Growth of Vegetable Matter from Reservoir Bottom at Xenia, Ohio.

Contributed by George F. Cooper, Secretary and Treasurer, Xenia Water Company.

The reservoir of the Xenia Water Company at Xenia, Ohio, was made by building a dam 500 ft. long across two small ravines in which there were a great many springs of the purest water. This reservoir holds 3,000,000 gals. After it was in use for a short time, a very dark green moss commenced to grow and covered the whole bottom like a carpet of fine plush, and it did not seem to make any difference whether the weather was hot or cold, the moss grew just the same. In a short time it was nearly 2 ft. high, and the water had a bad taste. The company was fortunate in having a blow-off at each end of the reservoir so, by building a dam through the center, the water could be pumped from either side by shutting down a gate. The reservoir was first cleaned by using a flop rake with pulley and rope fastened to a post in the top of the dam. This was operated by a pair of horses walking along the top of the dam. This was not satisfactory, as the rake being pulled up inside of the dam loosened the stones in the riprap.

The reservoir is now cleaned, after drawing the water all out, by having twelve men rake the moss into piles as near little streams as possible. When the moss is all raked up, the bottom of the reservoir looks like a hay field full of hay cocks. A horse is then lead into the empty reservoir, hitched to a stone boat of the kind stone masons use to haul stone around a building. The boat is drawn in the bottom of the reservoir where there is little water to help it float. The moss is piled on this stone boat and is drawn down to the blow-off, where it goes out under the dam, and there two men pitch it, a little at a time, into the blow-off pipe, taking care not to feed it too fast, for if fed in too fast it would stop up the pipe. On the outside of the dam, at the outlet of the blow-off, two men pitch the moss out as it comes through. A 2½-in. pipe was laid up through the center of the reservoir and after the moss is all out, a fire hose is attached at different places along this line, starting to flush from the upper end and washing everything down through the blow-off. After the washing is finished, the bottom of the reservoir is as clean as a cistern, the gravel all being turned over by the fire stream. Each side of the reservoir is cleaned in April and September. It was thought, as the moss was so heavy, it would be a good fertilzer for the engineer's garden, but after it was put on the ground it soon dried out and blew away, being of no value whatever. It costs to clean the reservoir each time:

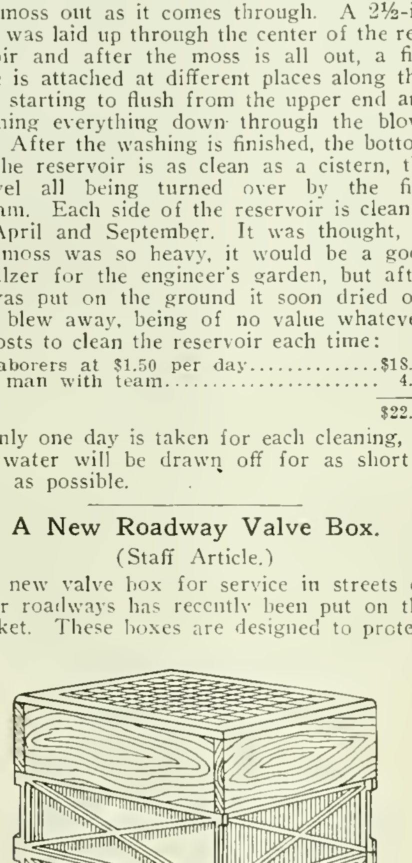
12 laborers at $1.50 per day	$18.00
One man with team	4.00
	$22.00

Only one day is taken for each cleaning, so the water will be drawn off for as short a time as possible.

A New Roadway Valve Box.

(Staff Article.)

A new valve box for service in streets or other roadways has recently been put on the market. These boxes are designed to protect gate valves of 4-in. to 16-in. size, and their general exterior appearance is shown by the accompanying cut.



A New Roadway Box for 4-in. to 16-in. Gate Valves.

This box is offered as a substitute for the brick or concrete valve chamber commonly used for valves of the size above mentioned. It is built up in sections of flat ribbed cast iron plates that dovetail together when essembled. The lower section of the box rests upon and is held in position by a cast iron base that covers the top of the valves. The cast iron plates are made in two widths to permit adjustments of the box to the requirements imposed by the depth of the pipe line upon which the valve is installed.

The cover is designed to carry heavy traffic safely. It rests upon a hardwood frame which in turn is supported by the top section of the box. This wooden frame acts as a shock absorber. The box is constructed without bolts or nuts, and is easily transported. It is marketed by the S. E. T. Valve & Hydrant Co., New York City.

Cost of Lagging Steam Pipe with Standard Magnesia Pipe Covering.

The following costs of applying pipe covering are given by R. K. Stockwell in "Engineering and Mining Journal" for March 22, 1913:

The costs were figured from daily records made while covering a high-pressure steam-heating line 2,400 ft. long, running from the power house to the concentrator, and the steam and feed-water lines around two 450-boiler hp. reverberatory-furnace waste-heat boilers, at McGill, Nev., in October, 1909. The men who did the work were pipe fitters, rated at 50 cts. per hour, and helpers rated at 37½ cts. per hour. Each fitter had two helpers working with him.

The covering was standard magnesia pipe-covering, purchased from the H. W. Johns-Manville Co., and put on in strict accordance with their specifications, the high-pressure covering being 1½ ins. thick, held away from the pipe by bands of magnesia 1 in. thick, spaced 18 ins. apart. The covering for 10-in. pipe and larger came in keystone-shaped strips; this was placed on the magnesia bands, bound together with wire netting, all cracks plastered with magnesia mud and cement, and the whole covered with canvas; brass bands were then clamped over the canvas at intervals of 30 ins. and then the whole was painted with a mixture of tar and gasoline. The high-pressure covering for pipe smaller than 10 ins. came in half-cylinders, instead of keystone-shaped strips.

The low-pressure covering, which in this case was all for pipe less than 8 ins. in diameter, came in half-cylinders, 1 in. thick, and was placed directly on the pipe, without space rings. The finish was the same as for the high-pressure covering.

The magnesia covering for fittings, valves, expansion joints, and pipe bends, did not come shaped to fit, but had to be sawed and fitted to the work by hand, from magnesia strips and slabs. This was slow and expensive work. It is to be understood that in the table, where a fitting covering is listed, the flanges are not included, all flanges are figured separately as part of flange unions.

LABOR COSTS OF APPLYING MAGNESIA COVERING TO PIPES AND FITTINGS.

High-pressure covering:	Cost per lin. ft.
4-in. pipe	$0.17
8-in. pipe	.38
10-in. pipe	.79
12-in. pipe	1.25
8-in. pipe bends	1.03
	Cost, each.
1½-in. elbows	$1.30
8-in. elbows	3.30
8-in. elbows	3.58
12-in. elbows	4.90
4-in. expansion joints	2.60
10-in. expansion joints	5.63
12-in. expansion joints	6.15
1½-in. flange unions	1.03
4-in. flange unions	1.25
8-in. flange unions	3.19
10-in. flange unions	3.40
12-in. flange unions	5.49
1½-in. valve bodies	1.60
8-in. valve bodies	3.28
10-in. valve bodies	3.60
12-in. valve bodies	4.90
8-in. valve bonnets	3.25
10-in. valve bonnets	3.60
12-in. valve bonnets	3.70
Low-pressure covering:	Cost per lin. ft.
2½-in. pipe	$0.10
4-in. pipe	.12
	Cost, each.
2½-in. flange unions	$1.15
2½-in. tees	1.30
4-in. tees	1.75
2½-in. elbows	1.30
2½-in. valve bonnets	1.98

NEWS SECTION

Editorial Comment—Personals—Society Meetings—Trade Notes—Catalog Reviews—Contract News, Embracing Bids Asked, Work Projected, Contracts Let and Contract Prices on All Classes of Civil Engineering Construction Work.

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The Doings of the Week.

Railroad construction work, as regards the letting of contracts, has been unusually quiet during the past week. Few if any large contracts appear to have been let, and little new work has made its appearance. Bids on a fair sized job will be opened next week at Wellington, O., the work calling for the construction of 24 miles of railroad between that city and Ashland.

Among the contracts awarded recently are the following: James McGraw Co., Philadelphia, Pa., and the Duquesne Contracting Co., Pittsburgh, for changing single track line of the Pennsylvania R. R. between Glyden and Corry on the Buffalo Division; Keasal Construction Co., Tacoma, Wash., for reconstruction of Northern Pacific line between Kirkland and Woodinville, Wash; Caughren & Woldson, Spokane, Wash., for reconstruction of Northern Pacific line between Seattle and Sumas, Wash.

Nothing much is doing at present in the way of state highway work. Massachusetts is calling for bids on one or two small pieces of construction, and is the first of the New England states to begin this work. The New York state work seems to be tied up for the present and it is probable that several weeks will elapse before bids are asked on the first work to be done under the new $50,000,000 bond issue. In Pennsylvania the legislature has taken a step which seems to assure the ratifying by the voters of the proposed $50,000,000 good roads bond issue. This step consists in the passage of a bill providing that all money appropriated to the State Highway Department for the improvement of state roads be expended in each county in proportion to the total mileage of unimproved state highways in the county. In California the State Highway Commission has been authorized to call for bids on another batch of highways. About 38½ miles of road are included. A good sized road contract in Tennessee was awarded recently to Oliver & Hill of Maryville, Tenn. This calls for the construction of roads in Sullivan county, at an estimated cost of about $200,000.

A number of fair sized drainage contracts have been awarded since our last issue. One of the largest of these is for the work in the Overcup Slough Drainage District in Arkansas. This contract calls for the construction of about 30 miles of dredge ditches. Forrestal & Feyen, St. Paul, Minn., secured the work at about $75,000.

The U. S. Reclamation Service is calling for bids for a considerable amount of work in the Sun River Project in Montana. Proposals are asked for the construction of the Pishkun Reservoir supply canal, the Sun River slope canal and tunnels No. 2 and No. 3, of the Pishkun Reservoir supply canal, involving the excavation of about 2,400,000 cu. yds. of material and the construction of about 3,215 lin. ft. of concrete lined tunnel. Two large irrigation projects in the state of Washington may come up for bids in the near future. The Kittitas Reclamation project is now negotiating for the sale of its bonds, and as soon as this is accomplished it is the intention to advertise for bids on the construction work. Something like $5,000,000 is to be expended. The Brewster Irrigation District has placed the financing of its project in the hands of representatives of the Great Northern Ry. and it is hoped to have a favorable report in the near future.

A large bank protection contract has been let by the Caddo Levee Board to Doullut & Williams, 1029 Maison Blanche Bldg., New Orleans, La. The work is to be done on the Red River in Caddo Parish, La. The protection consists of subaqueous mats and concrete pavement above the water line. The Levee Board will expend about $500,000 and the contract is for cost plus 10 per cent in amounts up to $300,000; cost plus 8 per cent up to $500,000 and 6 per cent on all over $500,000.

A good sized dock job was awarded last week by the Central of Georgia Ry. The work calls for the reconstruction of the docks and sheds at Savannah, Ga., for the Merchants & Miners' Transportation Co. James Stewart & Co., Ins., New York City, secured the work.

Waddell & Harrington, Consulting Engineers, Kansas City, Mo., have submitted to the Joint Bridge Committees of Clark and Multnomah Counties, Ore., specifications for a bridge over the Columbia River to cost not more than $1,700,000.

The Committee on Harbors and Public Lands of the Massachusetts Legislature has recommended an appropriation of $5,000,000, to be expended at the rate of $1,000,000 per year for harbor work.

Following low bids were received recently by the city of Edmonton, Alta., A. J. Latornell City Engineer, for sewer construction, divided into six contracts: Contract No. 3—D. McGarry Co., $53.35 per lin. ft., on concrete block for 8-ft. sewer; $43.00 per lin. ft., for 6-ft. 6-in. sewer, and $25.65 for 4-ft. sewer; total, $398,150. Contract No. 4—Lyall Mitchell, $24.25 per lin. ft., for 4-ft. concrete block sewer; total, $177,931. Contract No. 5—H. Ulen, $36.90 per lin. ft., for 6-ft. concrete block sewer, and $29.90 per lin. ft., for 5-ft. concrete block sewer; total, $247,174. Contract No. 6—Lyall Mitchell, $36.50 per lin. ft., for 6-ft. concrete block sewer; $30.50 per lin. ft., for 5-ft. concrete block sewer; $25.25 per lin. ft., for 4-ft. 6-in. concrete block sewer, and $24.25 per lin. ft., for 4-ft. concrete block sewer; total, $318,298. Contract No. 7—Lyall Mitchell, $24.25 per lin. ft., for 4-ft. concrete block sewer, and $30.50 per lin. ft., for 5-ft. concrete block sewer; total, $223,643. Contract No. 8—H. C. Ulen, $36.90 per lin. ft., for 6-ft. concrete block sewer; $29.90 per lin. ft., for 5-ft. concrete block sewer, and $24.90 per lin. ft., for 4-ft. concrete block sewer; total, $404,633.

Road Bonds and Construction.

That there are upwards of $400,000,000 of good roads bonds issued and outstanding is indicated by the Good Roads Year Book of the United States, the 1913 edition of which has just been issued, containing a resume of the whole road situation. It is evident that whatever may be the faults in methods of construction and maintenance money is being spent in sufficient amount to bring about a vast improvement in the public roads. The Year Book shows $137,000,000 of state aid road bonds authorized, and $156,500,000 of county bonds outstanding on January 1, 1913, making a total of $293,500,000. As this is based on reports from about 75 per cent of the counties in the United States, and as a large number of the individual townships have not reported, it is estimated that the amounts not reported would run the aggregate up to probably $350,000,000 to which should be added ten or fifteen million dollars of the bonds voted in 1912 which have not yet been issued. Gratifying progress in road construction during the past few years is indicated by the Statement in the Year Book that while the percentage of all road improvement in the United States at the close of 1909 was 8.66 per cent the revised statistics to Dec. 31, 1911, show an improved mileage of 10.1 per cent, or a net gain of 1.44 per cent. This does not sound so impressive in terms of percentage but it means that in the two-year period more than 34,000 miles of improved roads were constructed, or 10,000 miles more than the entire mileage of national roads in France.

Work in the Middle West.

The unfortunate disasters from winds and floods in the Middle West will furnish a large amount of unexpected work for the architect, the engineer and the contractor. It is estimated that fully $100,000,000 of capital will be employed to restore normal conditions. Thousands of new buildings will have to be rebuilt, and as many thousands of other structures will have to be restored as a result of their inundation. Bridges, dams and levees also have been washed out and will have to be restored. The disaster comes in the guise of a benefit to the building trades in some of the eastern cities, where for several months a more or less serious tension has been in existence because of a lack of sufficient quantity of new construction. In one eastern city alone more than a dozen architectural firms and as many contractors and builders are preparing to send or have sent representatives through the Middle West to look over the new work.

Peddling Water.

Peculiar platforms, as regards municipal improvements, were a feature of the recent local elections in Colorado. In Grand Valley, Colo., the mayor was elected on a platform pledging the construction of concrete sidewalks. At Debeque, Colo., the issue of the election was over the municipal water works. The system was installed last year. During last summer and fall street peddlers of water gave such keen competition to the municipal plant that the town faced a serious loss. The aldermen elected at the recent election are pledged to prohibit the sale of water from house to house by pedlars.

PERSONAL

Mr. W. D. Beers of Salt Lake City has been appointed state engineer of Utah.

Mr. H. A. Brazier has been appointed assistant city engineer for London, Ont.

Mr. John E. Field has been appointed state engineer of Colorado, succeeding Mr. C. W. Comstock.

Mr. Thomas J. Ehrhart of Centerville, Colo., has been appointed state highway commissioner for Colorado.

Mr. H. D. Beaumont has been appointed as manager of the city electric light and waterworks system of Hearne, Texas.

Mr. John Stuart Elliott, civil and mining engineer of New York city, died March 25. Mr. Elliott had been engaged in railroad work in Jamaica.

Mr. W. W. Kruse, superintendent of the water, electric light and sewer plants of Vineland, N. J., has resigned to accept a position at Sunbury, Pa.

Mr. J. K. McGrath, chief draftsman of the Maryland State Roads Commission, has been appointed principal assistant to the chief paving engineer of Baltimore.

Mr. Edward O'Brien has been appointed street commissioner; Mr. Irving G. Rowley, water commissioner, and Mr. Eugene Walsh, sewer commissioner for Medina, N. Y.

Mr. Floyd G. Dessery announces the removal of his offices to Suite 511-14 Central building, Los Angeles, Cal., where he will continue practice as a civil and hydraulic engineer.

Mr. Mellis Ferguson has resigned as city engineer for Guelph, Ont., and is succeeded by Assistant City Engineer Holland. Mr. Ferguson has been appointed city engineer for St. Thomas, Ont.

Mr. H. A. Kleugal, formerly chief construction engineer for the Hilo Railroad Co. in the Hawaiian Islands, has returned to the States, and for the present will make Oroville, Cal., his headquarters.

Mr. DeWitt V. Moore, formerly associated with the W. C. Halstead Co. of Indianapolis, has opened an office in the Merchants' Bank building, Indianapolis, for practice as consulting engineer and architect.

Mr. C. F. Felt, now chief engineer of the Santa Fe railroad, proper, will succeed Mr. C. A. Morse, as chief engineer of the entire Santa Fe system. Mr. Morse recently resigned to go to the Rock Island.

Mr. Arthur H. Blanchard, professor of highway engineering in Columbia University, on March 31, delivered an illustrated lecture on, "Highway Engineering in Europe and America," before the Institute of Arts and Sciences.

Mr. C. H. Baumgartner, for the past three years city engineer for Dubuque, Iowa, died in that city March 20, aged 37. Mr. Baumgartner was a graduate of Lima College, Lima, Ohio, and was for over two years engaged on Mississippi River surveys for the U. S. War Department.

Mr. Curtis Hill of Columbia, Mo., has been appointed provisionally to succeed Mr. L. R. Ash as city engineer of Kansas City, Mo. Mr. Hill has been state highway engineer of Missouri for some years. Mr. W. C. Davidson, Mr. Hill's assistant, has also resigned to become instructor in engineering at the University of Missouri.

Mr. John W. Wright, Jr., a railroad contractor, shot himself in his office at Gainesville, Ga., March 28. Mr. Wright was well known in Georgia, having been engaged on various Southern roads, and was practically builder of the Gainesville & Northwestern. It is believed that worry over financial troubles and ill health caused his action.

Civil Service Examinations.

The Civil Service Board of the West Chicago Park Commissioners will hold the following examination, No. 38:

Building Inspector, Class A, Grade II. Pay $100 to $125 per month. Original entrance. To be held April 23, 1913, at 9 a. m., at the Garfield Park Pavilion.

Subjects: Special subject, weight of 6; experience, weight of 3; educational, weight of 1.

Special subject, to include written and oral questions on the proper methods of concrete, brick, cut-stone, steel and timber construction, on the installation of plumbing and heating equipment, on reading building plans, making sketches and estimates and on interpreting building specifications.

The duties of Building Inspector are to inspect the construction of park buildings, swimming pools and other structures, and to see that all provisions of the specifications and the plans are carried out in a proper and workmanlike manner.

Applications for the above given examination must be filed in the office of the Board in Union Park before 5 p. m. of April 22, 1913.

The State Civil Service Commission of New York announces examinations as follows, to be held May 3, 1913. Application must be filed before April 25:

Junior Engineer (leveler), $1,201 per annum.

Bridge Draftsman, $4 to $5 per day.

Architectural Designer, State Architect's office, $1,500 to $2,500 per annum.

Architectural Draftsman, $1,000 to $1,500 per annum.

Engineering Inspector, State Architect's office, $2,250 per annum and traveling expenses.

Superintendent of Construction, State Architect's office, $1,800 per annum.

INDUSTRIAL

The F. C. Austin Drainage Excavator Co., Chicago, Ill., has been awarded a contract by the city of Minneapolis, Minn., for furnishing its Sewer and Water Department with an Austin No. 10 Trench Excavator.

The Raymond Concrete Pile Co., New York and Chicago, has been awarded a contract for placing standard Raymond concrete piles for the foundation of a new building for the Sheffield Farms-Slawson Decker Co. at 165th St. and Webster Av., New York City. Frank W. Rooke, Architect. A contract also has been awarded to the Raymond Concrete Pile Co., for 958 standard Raymond concrete piles for the foundation of a new warehouse for Dodge Brothers, Detroit, Mich. Smith, Hinchman & Grylls, Architects.

The Duff Manufacturing Co., manufacturer of Barrett lifting jacks, etc., has moved into its new plant and general office building, located on Preble Ave., N. S. Pittsburgh, the old works on Marion Ave., Pittsburgh, having been dismantled. The new factory building comprising approximately 68,000 sq. ft. of area is one of the most modern in the country, and is located on a tract of ground approximately five acres with Pennsylvania and B. & O. sidings, and near the plants of the American Locomotive Co., Pressed Steel Car Co., Standard Sanitary Mfg. Co., and Riter Conley Co. The Duff Mfg. Co. plans the erection of a plant in the Chicago district and expects to have this factory in operation by next fall, the question of location being under final consideration at this time. Also a Canadian factory will be equipped during the coming summer to be in operation by the early fall of 1913. The Canadian factory will be located at Windsor or Hamilton, Ontario. The product of the Duff Mfg. Co. comprises Barrett jacks, ball-bearing screw jacks, Duff-Bethlehem forged steel hydraulic jacks.

CATALOGUES

Dependable Power.—Paper, 9x5½ ins., 8 pp. A. B. Farquhar, Ltd., York, Pa.

This is the title of a bulletin describing and illustrating Farquhar Road Engines. Both gasoline and steam tractors are shown. Specifications for Farquhar Engines are included.

Turret Head Boring Mills.—Paper, 8x10½ ins., 2 pp. Gisholt Machine Co., Madison, Wis.

This is a loose leaf for the catalog containing an illustration and description of the Gisholt Vertical Boring Mill with a revolving Turret Head.

Dragline Cableway Excavators.—Paper, 6x9 ins., 20 pp. Sauerman Bros., 1139 Monadnock Block, Chicago, Ill.

This catalog illustrates and describes the Shearer & Mayer Dragline Cableway Excavator designed for digging and conveying material from under water or from dry pit, loading cars or wagons, and delivering to storage piles.

Dump Wagons.—Paper, 4x9½ ins., 4 pp. The Bull Dog Manufacturing Co., 205 Boston Bldg., Kansas City, Mo.

This folder illustrates and describes very completely a dump wagon which is very simple in construction and operation and built upon lines indicating durability.

Air Compressors.—Paper, 3½x6¼ ins., 16 pp. The Pennsylvania Pneumatic Co., Erie, Pa.

This folder contains a number of illustrations of Barr "Unit-Compound" Air Compressors which show the various types of steam, belt and electric drive compressors.

Zyro Metal Silos.—Paper, 7x10¼ ins., 36 pp. The Canton Culvert Co., Canton, O.

This is catalog No. 7, which is confined principally to the arguments of superiority and the advantages of anti-corrosive "Zyro" Metal Silos. The details of construction are illustrated and described. A table is given to show the stock numbers, tonnage and capacities of silos of various sizes made of this metal. Letters from users are given.

Austin Improved Cube Mixer.—Paper, 6x9 ins., 64 pp. Municipal Engineering & Contracting Co., Railway Exchange Bldg., Chicago, Ill.

This interesting catalog contains a number of full-page illustrations of mixing plants at Panama with records of the Austin Improved Cube Mixers on that work as compiled from data in the Isthmian Canal Commission Report. There are also illustrations of other large construction plants where these mixers are installed. Detailed illustrations of concrete mixers, hot mixers, and tables of sizes, dimensions, etc., are given.

Imperial Duplex Power Driven Air Compressors.—Paper, 6x9 ins., 20 pp. Ingersoll-Rand Co., 11 Broadway, New York City.

Form No. 3312 illustrates and describes the "Imperial XB" Duplex Air Compressors which are suitable for contractors' plants, as well as for shop and foundry equipment.

Form No. 3008, 6x9 ins., 40 pp., illustrates and describes class "PE" Duplex Direct Connected Electrically Driven Air Compressors designed especially for mining and manufacturing service. These compressors embody the most advanced practice, both electrically and mechanically.

Form No. 575, 6x9 ins., 28 pp., is a book of instructions for installing an operating class "PE" Direct Connected Electrically Driven Air Compressors. There is included a duplicate part list.

RAILWAYS

Alabama.

According to information received from Birmingham, Ala., the Louisville & Nashville R. R. will start work a little later in the season on the improvement of the yards at Boyles. The work will include the addition of a number of side, switching and storage tracks.

The Seaboard Air Line Ry. is to build a branch from Wellington to Legard, where a cement plant is to be located. It is possible that the branch will be continued 10 miles to Gadsden.

Arkansas.

City council of Little Rock, Ark., has granted a franchise to the Little Rock & Hot Springs Interurban R. R. Co. for the use of certain streets of the city.

Surveyors under Col. Henry Stroup, President and Chief Engineer of the Fort Smith, Subiaco & Eastern Ry., Paris, Ark., are now working on the locating survey of the proposed extension from Scranton to Dardanelle. It will be made in two sections, from Dardanelle to Blaine and from Blaine to Scranton or some other point upon the present line. The right of way from Dardanelle to Blaine has already been donated by the property owners of Yell and Logan counties who are very much alive to the advantages of getting a railway through that section to develop it. The railway is expected to be completed and in operation by July 1, 1914.

California.

The San Pedro, Los Angeles & Salt Lake R. R., according to reports, has surveyors in the field near Etiwanda, and it is believed that the company contemplates starting work shortly on the cut off from Ontario to Cajon Pass.

The Nevada County Narrow Gauge R. R., operating 21 miles of line, is to apply to the State Railroad Commission for permission to issue bonds to the amount of $662,000, the money to be used to make the line broad gauge from Colfax to Nevada City. Chas. P. Loughbridge, Grass Valley, Cal., is General Manager.

The Santa Fe system is reported to be planning to begin work in the near future on an extension from Cutler through Orosi and Orange Grove and thence in a northwesterly direction to the Anandale Colony and on to Minkler, where a connection will be made with the Piedra branch.

The Santa Fe system is reported to be purchasing right of way and land for station sites for a projected branch line to run from Cutler south to Porterville. The new line will probably run from Cutler, through to Woodlake district, thence almost parallel to the Visalia electric line to Exeter and thence due south through Lindsay to Porterville.

The Southern Pacific Ry. is reported to be planning to begin construction work soon on a new line from Calexico to the Gulf of California. The route according to the preliminary survey runs west from Calexico around Signal Mountain, then follows the south side of the delta, crosses the Colorado River and continues in a southeasterly direction.

Advices from Fresno state that the Santa Fe system is contemplating extending the Wahtoke branch from its present terminus at Piedra along the Kings River into the high Sierras, tapping the lumber district around Pine Ridge.

Colorado.

The San Luis Valley Sugar Beet Co., Monte Vista, Colo., has awarded a contract for constructing 12 miles of railroad from the factory in Monte Vista through the beet fields to Center. About 16 small bridges and culverts will be constructed on the line.

The Denver Tramway Co., Denver, Colo., is considering building this summer a 2-mile extension of the Sixth Ave. car line eastward from the present terminus at Madison St. Other extension and construction work in different parts of the city are also under consideration.

The promoters of the Plateau Valley R. R. Co. are reported to have financed the projected 48-mile line from Grand Junction to Collbran. A. J. Halter, Denver, Colo., is interested.

Connecticut.

Hearing has been held by the Legislative committee on railroads on the application for an act extending the time for construction of the Windsorville & East Hartford Street Ry. Co. The company wants its charter rights, which expired in 1912, restored until Dec. 14, 1914, and if then 25 per cent of the construction work has been accomplished, until the opening of the General Assembly of 1915.

Florida.

Engineers of the Tampa & Gulf Coast Railroad are now at work on a survey for a line from a point on the Tampa Northern Ry., near the Hillsborough River, to Clearwater and on to St. Petersburg. Charles H. Brown, Tampa, Fla., is President.

Georgia.

The Bainbridge Northwestern R. R. Co. of Bainbridge has applied to the State Railroad Commission for authority to issue 5 per cent bonds, purposing to construct a railroad between Bainbridge and Apalachicola.

An amendment to the charter of the Waycross & Western R. R. Co., permitting the company to increase the capital stock from $350,000 to $710,000 has been filed with Philip Cook, Secretary of State, Atlanta, Ga. It has been stated that the increase is for the purpose of obtaining funds with which to build a 35-mile extension. At present the road runs from Waycross, in Ware County, to Sirmans, in Clinch County, a distance of about 35 miles. It is proposed to extend it from Sirmans, through Berrien and Lowndes Counties, to a point on the Georgia, Southern & Florida Railroad.

Idaho.

The Lewiston-Clarkston Valley Ry. Co. proposes an 18-mile line from Lewiston to Clarkston and Asotin, Wash., and to Lewiston Orchards. P. P. Oehler, Clarkston, Wash., is Chief Engineer and F. L. Sturm, Lewiston, Idaho, is President.

It has been announced by Col. E. R. Place, promoter of the Boise-Winnemucca-San Francisco R. R. which it is proposed to build from Winnemucca, Nev., to Boise, Idaho, that rights of way and depot site together with $1,000,000 toward capitalizing road have been assured by capitalists of Boise, Idaho.

The Benewah Valley Railway Co., with principal office at Coeur d'Alene, Idaho, has been incorporated with a capital stock of $25,000 of $100 shares and proposes to construct and operate a railroad in Kootenai County through Heyburn Park, connecting with the Chicago Milwaukee & St. Paul Ry., a distance of 24 miles. The incorporators are Maurece S. Parker, St. Maries, Idaho; Herbert S. Boomer and William A. Monroe, Spokane, Wash.

Illinois.

The Chicago & Western Indiana Ry. Co. is now engaged in the reconstruction and rearrangement of the Clearing Yard to conform to plans which have been approved by the new owners of the Belt Ry. Co. of Chicago. The work will consist largely of sand embankment, track rearrangement, and construction, most of which will no doubt be done by company forces, following the policy usually pursued by the company. There probably will be a few thousand yards of grading which will be let by contract.

The receivers of the Wabash R. R. have asked the Federal District Court at Chicago for permission to expend $7,489,500. Of this sum $3,525,000 is for cars and engines, $1,010,000 for new rails and $2,954,500 for double track and track elevation. In connection with this work of double tracking the road asks permission to start condemnation proceedings on certain short stretches of land at various points alongside the present right of way.

Indiana.

The Chicago, Indianapolis & Louisville Ry. is planning the expenditure of about $110,000 for the construction this summer of improved terminal facilities at Michigan City, Ind. These will include the erection of new station and the establishment of a new freight yard near the extreme southerly limit of the city.

Kansas.

Among the rumors concerning the work contemplated by the Rock Island System is one to the effect that the company intends building a cut off from Pratt, into Wichita, Kan., paralleling the Wichita & Western Tracks.

Louisiana.

The Monroe, Louisiana & Gulf Ry. Co. incorporated last week with a capital stock of $1,000,000, proposes constructing or purchasing a railroad from Monroe in a southwesterly direction to Winnfield, with New Orleans connections. Financial arrangements are understood to have been made for the completion of the new road. The new line will probably be an extension of the Arkansas, Louisiana & Gulf Ry. J. M. Parker, Monroe, La., General Manager of the latter road, is President of the new company.

The Santa Fe system is reported to be considering building into the Vinton oil field and on the east as far as the sulphur mines.

Michigan.

⊙Charles Forden has been awarded the contract for grading for the branch line of the Detroit, Bay City & Western R. R. from Akron to Schewaing.

⊙Phil O. Sheridan, Houghton, Mich., has been awarded a contract for the construction of a spur for the South Shore R. R. into the Volunteer mine near Negaunee.

Minnesota.

The Chicago Great Western Ry. is to expend about $87,000 for track improvements between Hayfield and St. Paul.

Mississippi.

The Mississippi Central Railroad, according to advices from Natchez, Miss., has applied to the Board of City Commissioners for additional right of way through Duncan Memorial Park. The request is approved by the Park Commissioners and was referred to the board as a committee of the whole board to visit the park with the railroad officials before taking action. It is understood the company wants to double-track the road from the park to the local depot, a distance of 1 mile. R. K. Smith, Hattiesburg, Miss., is Vice-President and General Manager.

Missouri.

Preliminary surveys are being made for the projected line of the Kingston-Excelsior Electric Ry. Co. Capt. Steven Rogers, Kingston, Mo., is interested.

As the result of the action taken by the Chamber of Commerce, Carrollton, Mo., with reference to the new railroad promoted by Fred Morck, Warren, Pa., a survey of the proposed route will be commenced at once and plats and profiles will be prepared. A committee will be appointed by the Chamber of Commerce to secure the right of way between that city and Chillicothe.

The St. Louis, Afton & Sunset Hill R. R. Co., an electric line operated by the St. Louis, Lakewood & Grant Park Ry., 424 Rialto Bldg., St. Louis, Mo., has made surveys and plans and has secured the right of way for an extension from its present terminus near Lakewood Park to Afton and points beyond. A loan of $300,000 has been obtained to build the extension.

Montana.

The Minneapolis, St. Paul & Sault Ste. Marie Ry. is going ahead with its plans for its projected line through Montana to a connection with the Canadian Pacific Ry. The State Land Board has granted recently the application of the Soo for a right of way through state lands in Sheridan County for nearly 100 miles along the Canadian border. It is probable that the arrangements for financing the new line will be made in London. One report has it that the line will cost $25,000,000 and that $10,000,000 of this sum will be provided for this year.

Nebraska.

The Belmont & Northern Traction Co. has been organized by residents of Belmont, a suburb of Lincoln, and propose the construction of a street car line from 13th and P Sts., at a cost of about $400,000. George Towne, a property owner of Belmont, is interested.

New York.

⦿Contracts for changing the single track line of the Pennsylvania R. R. to a double track on the Buffalo Division between Glyden and Corry have been let to the James McGraw Co., Philadelphia, Pa., for Section 1, and to the Duquesne Contracting Co., Pittsburgh, Pa., for Section 2.

A bill is before the State Legislature to grant permission to the Hudson River Connecting R. R. Co. to build a bridge over the Hudson River at point between Castleton and Schodach. Under the provisions of the bill construction work must be started on or before May 1, 1914. The Hudson River Connecting R. R. Co. was incorporated recently, as noted in our March 26 issue, for the purpose of providing a more direct and better graded route for the freight traffic of the New York Central Lines. By the erection of the bridge the company can connect its Boston, Albany, Harlem and Hudson divisions of the Central road and West Shore line, taking up the West Shore route at Feura Bush.

The Terminal Commission of the City of Buffalo, N. Y., has directed its secretary to notify the New York Central & Hudson River R. R. to submit any plans that it has bearing upon the construction of a new station in Buffalo. The committee of the commission is making good progress on the Lackawanna station project at the foot of Main St.

North Dakota.

Information has been received from Jamestown, N. D., concerning improvement work contemplated by the Northern Pacific as follows: A greater part of the main line tracks between Jamestown and Mandan are to be relaid with 100-lb. steel rails and the present 90-lb. rails taken up. On the James River Valley Branch, between here and Oakes, the light steel will be replaced by 70-lb. rails. The capacity of the Jamestown yards is to be increased at least 25 per cent to avoid the congestion of freight traffic that existed here last fall when the main line and three branch lines were dumping cars of grain in here too rapidly for their shipment East.

The Northern Pacific R. R. has secured right of way for the greater part of its proposed extension into Dunn County and it is likely probable that the grading contracts will be let shortly. Most of the right of way from Golden Valley in Mercer County to Melby in Dunn County has already been purchased.

Ohio.

✣Bids will be received until noon, April 15, 1913, by the West Virginia & Ohio Construction Co. for the construction of 24 miles of railroad between Wellington, O., and Ashland, O. Specifications and full information may be obtained at the Chief Engineer's office, Wellington, O. The company reserves the right to reject any or all bids. J. P. Ramsey is Chief Engineer.

Oklahoma.

It has been announced that the St. Louis & San Francisco R. R. will commence work some time in May or June on the proposed improvements, including a 22-stall roundhouse and 20 separate tracks at Tulsa, Okla. The cost of the work will amount, it is estimated, to about $250,000.

Oregon.

Porter Bros., contractors, Portland, Ore., have engineers in the field making preliminary surveys for a railroad to extend from Lebannon southeast up toward the headwaters of the Santiam. The line will open up timber lands along the Santiam and on the western slopes of the Cascades, purchased recently by Porter Bros.

According to advices from Marshfield, Ore., Porter Bros. have established another construction camp north of the Umpqua River, preparatory to working from the north end of the Copenhagen contract toward Siuslaw. This is the first work to be started between Siuslaw and Umpqua River, and it seems to indicate that the Willamette Pacific work is to be hastened toward Coos Bay.

Pennsylvania.

The Pottstown & Reading Street Ry. Co., Ralph Shaner, Chief Engineer, Pottstown, Pa., has opened bids for grading from Lower Pottsgrove Township to Linfield for the extenson to Spring City. Bids will be asked soon for the bridge over the Schuylkill River at Linfield.

Properties along the Beaver River front from Rochester to New Brighton are being purchased by the Granite Improvement Co., a real estate subsidiary of the Pennsylvania R. R., and it is believed that the latter is contemplating a four-track system, reaching Beaver Falls via a bridge over the Beaver River, and occupying the site of the old Penn bridge works which the railroad has bought.

The Chambersburg & Shippensburg Ry. Co. of Chambersburg, Pa., has been chartered with a capital stock of $250,000 and proposes a line to run from Red Bridge Park, Chambersburg, north and east through Greene and Southampton townships, Franklin county, following in a general direction the line of the Harrisburg, Carlisle and Chambersburg turnpike road, to the western line of Shippensburg, a distance of nine miles. Thad. M. Mahon, Chambersburg, is president, the other directors being W. H. Fisher, C. P. Miller, William Alexander, H. B. McNulty, J. G. Schaff, Chambersburg; J. Bruce McCreary, R. C. Johnston, Shippensburg, and J. F. Shank, Waynesboro.

South Dakota.

Farmers at Strouseton and vicinity are taking steps to organize a company to be known as the Sioux Valley & Northwestern R. R., with a view to building a 20-mile line to Watertown, S. Dak. Frank Heathcote and J. C. Maxwell are interested.

South Dakota.

It is expected that the Minneapolis & St. Louis will shortly start work on the proposed extension from Leola, S. D., northward into North Dakota and on to some point in Canada.

Texas.

Bids are reported to have been opened by representatives of Stone & Webster, 147 Milk St., Boston, Mass., for grading, fencing, bridges and culverts for the Jefferson County Traction Co.'s 16 mile line between Beaumont and Port Arthur.

The State Railroad Commission has been advised that the Missouri, Oklahoma & Gulf R. R. has received financial backing in France for the construction of an extension of its line south from Denison to some point on the Gulf of Mexico. Recently representatives of the French syndicate, which has agreed to take the bonds to be issued for this extension made an inspection trip over the completed part of the road between Waggoner and Denison, accompanied by President William Kenefick of Kansas City.

The Santa Fe is understood to have plans under consideration for extending its Slaton-Lamesa branch line to Sterling City, Tex., a distance of 100 miles.

The Brownsville Street & Interurban Co., S. A. Robertson, President, Brownsville, is to construct a 2-mile extension to the Country Club grounds near the city.

Citizens of Motley County, according to advices from Matador, have organized the Motley County Ry. Co. and propose to build a line north from Matador to White Flat and on to Memphis, Tex.

Among the improvements contemplated by the International & Great Northern is the relaying of the line from San Antonio to Laredo with heavy steel. The contract has been let for the rail, which will be rolled in the mills at Birmingham, Ala., and delivery thereof will begin at an early day. The line south is in excellent condition as far as ties are concerned and is also well ballasted. The relaying work will be pushed rapidly. Other betterments will be the reballasting of the main line between Taylor and Longview.

The Memphis, Dallas & Gulf Ry., which recently completed several links in Arkansas, has notified the Texas State Railroad Commission that the line is to be extended as rapidly as possible to Dallas and Fort Worth via Clarksville, Texas. Grading is now in progress on the division of this proposed system between Hot Springs and Murfreesboro, Ark. The Texas division will run from the Red River, crossing near Ashdown, Ark., to Dallas, thence to Fort Worth, passing through a number of thriving towns in the northeastern part of the state. The plans of the promoters call for the construction of approximately 350 miles of track. The general offices of this road will be situated at Nashville, Ark. W. N. Brown is President.

The Santa Fe System, in addition to the extensive division terminal facilities that have already been established at Slaton, Texas, is preparing to make enlargements and improvements in order to be prepared to properly care for the heavy traffic which is expected to result from the opening of the new cutoff line that will connect its present transcontinental division with the Gulf System. Plans have been adopted for a new passenger station and general office building. The operating department of the Santa Fe's West Texas line will be located there. It is at Slaton that this cutoff road connects with the branch line that runs south to Lamesa and which latter road is to be extended south to connect with the line that runs north from San Angelo to Sterling City.

Virginia.

George Craig & Sons, 1300 Morris Bldg., Philadelphia, Pa., are extending their logging railroad at Winterburn, W. Va., three miles this season. This is a continuance of the nine miles built last year. W. J. Dermott, Winterburn, is in charge of the work.

Good progress is being made with the grading for the extension of the Virginia-Carolina Ry. from Green Cove Creek. Four contractors are working on the 9 miles of this extension. The road will be continued on to Boone, N. C., and probably to Blowing Rock. It is stated that bids on 45 miles of work in North Carolina will be asked shortly. P. W. Early, Abingdon, Va., is Chief Engineer.

Washington.

⦿It was recently announced that the Keasal Construction Co., Tacoma, Wash., has been awarded a contract by the Northern Pacific R. R. for the reconstruction of that portion of the line between Kirkland and Woodinville, Wash.

⦿The Northern Pacific Railroad Co., W. L. Darling, St. Paul, Minn., Chief Engineer, has awarded the contract for the reconstruction of the portion of the company's line between Seattle, Wash., and Sumas on the international boundary to Caughren & Woldson, Spokane, Wash. The contract will involve some heavy work especially in the building of a new line between Edgecomb and Kurtz, on the Great Northern, and the new trackage between Sedro-Woolley and Wickersham. This, however, is but a small portion of the work which will eventually place Everett on the main line between Tacoma and Vancouver, B. C. About seven miles of Great Northern trackage will carry the Northern Pacific trains from Kurtz to Everett. The road plans to reduce grades to permit the carrying of heavy train loads of forest products from the North direct to Auburn, at which point eastbound traffic by trainload will be made up.

West Virginia.

The Williamsport, Nessle & Martinsburg Ry. Co. has been chartered with a capital stock of $250,000 and proposes to build an interurban line between Williamsport and Martinsburg, W. Va. The incorporators include Alexander J. Dilrich, John P. Michael and E. P. Hoffman, of Baltimore, Md.

The Shenandoah Valley Ry. Co., projecting a new railroad in the Shenandoah Valley, has elected the following officers: Gray Silver, Martinsburg, W. Va., president; C. W. Watson, Fairmont, W. Va., vice president; Frank E. Wilson, Martinsburg, secretary; J. O. Watson, Fairmont, W. Va., general manager of the Monongahela Valley Traction Co., treasurer; and Duddley D. Britt, Clarksburg, W. Va., chief engineer.

Wisconsin.

It is probable that the Chicago, Milwaukee & St. Paul Ry. will start construction work next month on the elevation of its tracks in Milwaukee. The cost is estimated at about $1,900,000.

The Chicago, St. Paul, Minneapolis & Omaha Ry. is to expend about $150,000 for improvements at Altoona. These will include a 30-stall roundhouse and the laying of additional yard tracks.

Business men on the north side of Milwaukee have organized the Milwaukee Traction Co. with a capital stock of $25,000, and proposes to establish a street car service from the end of the street railway company's terminal at Green Bay and Keefe Ave. to a point 2½ miles north. Lorenz Wagner, Milwaukee, is interested.

BRIDGES

California.

The City Trustees of Redding, Calif., are contemplating the construction of a new bridge over the Sacramento River at Reed Ferry. The cost is estimated at $35,000 for a steel bridge and $50,000 for a concrete structure.

The City Trustees of Redding, Calif., have definitely decided to call an election for the purpose of deciding the question of issuing $60,000 of bonds for the erection of a concrete bridge over the Sacramento River at the north end of town to accommodate the state highway. The election will probably be held in May.

Among the improvements considered by the recently appointed committee of which County Surveyor J. W. Kaerth is a member, are the construction of two river bridges, three trough bridges and culverts, in Colusa County of which Colusa, Calif., is County Seat.

Plans for a new $200,000 steel draw bridge over Islais Creek at Kentucky St., San Francisco, Calif., by the Santa Fe and the Southern Pacific R. R. Companies in accordance with the order of the Board of Supervisors, are now in preparation. A conference concerning the work was recently held with City Engineer M. M. O'Shaughnessy by Bridge Engineers of the roads.

The Board of Supervisors, according to advices from Martinez, Calif., awarded the contract for the construction of the reinforced concrete bridge over San Pablo Creek on the tunnel road near Bryant Station to G. H. Field Co., at $3,465.

Colorado.

Acting City Engineer E. B. Van de Greyn, representative of the Board of Supervisors and Board of Public Works and Mayor Arnold, Denver, Colo., recently inspected the site of the proposed Colfax viaduct. It is the intention of the Supervisors to introduce an ordinance for a bond issue to be submitted at the May election. Under the Colfax viaduct agreement, the city will bear $152,000 of the total cost of the structure. The Tramway's apportionment is $215,000, the state's $50,000 and the railroads' $298,000. The total cost of the viaduct will be about $715,000.

The East Side Improvement Association, Pueblo, Colo., recently held a meeting to discuss the plans for the construction of the proposed viaduct across Eighth St. at the Denver & Rio Grande R. R. tracks. John Lynch is Secretary of the association.

Connecticut.

The Central New England Ry., which is owned by the New York, New Haven & Hartford R. R., is reported to have under consideration the construction of 30 new bridges on the Eastern division, replacing the lighter structures. W. J. Backes, Hartford, Conn., is Chief Engineer of the Central New England Ry.

The following bids were received March 20, by the Bridge Construction Committee, South Norwalk, Conn., for the construction of the Washington St. bridge, for which J. E. Greiner is Consulting Engineer. (1) standing for bid on reinforced concrete bridge, (2) Scherzer bascule superstructure, (3) Strauss bascule superstructure, (4) Davis bascule superstructure, (5) paving the bridge:

	(1)	(2)	(3)	(4)	(5)
Conner Bros. Co	228,348	50,242	58,191	......	26,604
D. F. Toomey	286,402	55,000	58,000	......	14,000
Frawley, Kauffman Co	235,000	57,225	......	......	......
McHarg, Barton & Co	204,000	48,900	47,200	......	......
Snare & Triest Co	204,100	......	......	......	......
Lupper & Remick Co	....	......	......	53,600	......
Scherzer Rolling Lift Co	....	32,927	......	......	......
Penn Bridge Co	....	43,300	47,400	......	......

Illinois.

✣Bids will be received until 2 p. m., April 15 (postponed from April 1), at the Farmers' Exchange Bank, Chambersburg, Ill., for the construction of one reinforced concrete bridge to be built in Chambersburg Township, Pike County. Edward Pool, Town Clerk, Chambersburg, Ill. Conner Bridge: Span, 40 ft.; roadway, 18 ft.; height, 18.5 ft. Estimated total concrete, 175.2 cu. yds.; reinforced steel, 19,840 lbs. Nearest railroad station, Valley City, 6 miles; Perry Springs, 6 miles. It is reported that gravel may be obtained at Donas Place, about 2 miles south of Perry (about 5½ miles from bridge site). This gravel may need washing. It is reported that gravel from Hannibal may be had f. o. b. cars at Valley City for 75 cents per ton. No bridge at new site. Green timber may be cut near the site. Low water flow, 6 ins. deep and 10 ft. wide; high water about 14 ft. deep. Average excavation about 15 ft. deep, through loam and clay to about 3½ ft. below stream bed. Piles will probably be necessary. Engineer's estimate, $2,600. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received until April 16 (readvertisement), by John F. Fisher, Civil Engineer, Danville, Ill., for the construction of two reinforced concrete bridges of 2 spans each, to-wit: One of two 70-ft. spans and 16-ft. roadway over the North Fork of the Vermilion River at the Poke Mill Ford in Newell Township; the other of two 75-ft. spans and 16-ft. roadway over the Middle Fork of the Vermilion River at the Johnson Ford in Oakwood Township. The nearest railroad station is West Newell, 2 miles for the former, and Brothers Station, 4 miles for the latter bridge. The former is on the main line of the C. & E. I. R. R. and the latter is on the Rossville and Sidell branch of the same road.

✣Bids will be received up to 3 p. m., April 19, 1913, at the Town Hall, Hooppole, Ill., for the construction of one reinforced concrete bridge to be built between the towns of Yorktown and Alba, Henry County. F. R. Summers, Town Clerk, Hooppole, Ill. Vandermoon Bridge—Skew span, 50 ft., parallel to roadway; roadway, 16 ft.; height, 14 ft. Estimated total concrete, 148.8 cu. yds; reinforcing steel, 21,770 lbs. Nearest railroad station, Hooppole, on the H. Y. & T. railroad, about 2 miles. It is reported that gravel from Buda may be had f. o. b. cars at Hooppole at $1.45 per ton. Present bridge, 50 ft. span, wood. Low water flow about 1 ft. deep and 10 ft. wide; high water about 3 ft. deep. Stream bed sandy clay; piles will probably be necessary. Excavation to be carried about 3½ ft. below stream bed. Engineer's estimate, $2,300. Bids will be received on basis of completing the work by July 1, 1913, and also on basis of completing August 15, 1913. Entire cost is covered by a bond issue of Yorktown Township. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the town clerk's office or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received until 1 p. m., April 22, by Joint Committee of Commissioners of Highways of the town of Freedom, Ill., and LaSalle County, Ill., for the construction of a bridge over Big Indian Creek, in the town of Freedom, in the county of LaSalle and state of Illinois. The superstructure of which is to be of steel, the floor and abutments to be of concrete. The bids to be on plans and specifications for said bridge now on file in the county clerk's office for the county of LaSalle and said state.

✣Notice is given that the letting of the contract for reflooring the bridge across Rock River in Prophetstown Township, Whiteside County, will be held at the town clerk's office, 12 noon, April 18, 1913. At the previous letting the bids submitted were not opened on account of the absence of a majority of the bridge committee because of high water. Work to be completed on or before July 25, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the town clerks office or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received up to 1 p. m., April 21, 1913, at the Town Clerk's office, Barry, Ill., for one reinforced concrete bridge to be built in Barry Township, Pike

County. Harry Ware, Town Clerk, Barry, Ill. Triplett Bridge—Span, 40 ft.; roadway, 18 ft.; height, 14 ft. Estimated total concrete, 108.9 cu. yds.; reinforcing steel, 16,540 lbs. Nearest railroad station, Barry, about 2½ miles. It is reported that a good quality of gravel may be had free in the stream bed, about 150 ft. from bridge site. No present bridge. Low water flow about 6 ins. deep and 5 ft. wide; high water about 7 ft. deep. Green timber for false work can be cut near the site. Average depth of excavation, about 6 ft.; to be carried about 4 ft. below bed of stream, through sandy clay and gravel. Engineer's estimate, $1,500. Work to be completed on or before August 15, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Ill.

⊙The City Commission of Rock Island, Ill., has awarded the contract for the replanking of the city's bridges over the Rock River to C. L. Ritchey of Ritchey & Hawes.

All bids received March 21 at the Court House, Mt. Carroll, Ill., for the construction of reinforced concrete bridge in Woodland Township, Carroll County, have been rejected. Henry Toepfer, R. R. No. 3, Mt. Carroll, Ill., is Town Clerk.

Bridge committees representing Baldwin and Prairie recently appeared before the Randolph County Board, Chester, Ill., to secure the construction of a bridge over the Okaw River between Red Bud and Baldwin. The cost of the structure, it is roughly estimated, would not exceed $1,200.

Indiana.

✣Bids will be received until 11 a. m., April 12, by Commissioners of Parke County, Rockville, Ind., for the repair of Rockville bridge. J. E. Elder is County Auditor.

✣Bids will be received until 10 a. m., April 15, by Board of Hendricks County Commissioners, Danville, Ind., for the construction of concrete arches and flat top bridges. L. W. Borders is County Auditor.

The date for opening bids for the construction of the three bridges in Benton County, has been postponed. Warren Mankey, Fowler, Ind., is County Auditor.

The County Council and city officials of Indianapolis, Ind., are already making preparations for repairing and rebuilding the bridges damaged by the recent flood. It is roughly estimated that the expense will run into the hundreds of thousands.

At a recent meeting of the Lake County Council at Crown Point, Ind., the matter of making an appropriation for the construction of a bridge over the Little Calumet River at Calumet Ave., Hammond, Ind., was taken up for consideration. Appropriations for bridges over the canal at 141st St. and 151st St., East Chicago, Ind., are also contemplated.

Iowa.

✣Bids will be received until 11 a. m., April 10, by Board of Winnebago County Supervisors at the office of the County Auditor, Forest City, Ia., for the construction of a concrete steel bridge over Lime Creek where the present highway crosses between Section 32, Norway Township, and Section 5, Center Township, Winnebago County, Ia. A certified check for $1,000 must accompany each bid.

✣Bids will be received until April 14, by Board of Polk County Supervisors, Des Moines, Ia., for the construction of 29 permanent bridges in Third, Fourth and Fifth Districts during the coming year. According to Charles W. Keller, Supervisor from the Third District, 28 of the bridges will be constructed of concrete and one of steel with a concrete floor. It is not believed the average cost of the bridges will exceed $1,000.

It is reported that the Union Pacific Ry. contemplates the construction of a new bridge over the Missouri River at Council Bluffs, Ia. A double deck structure, costing $1,000,000, will probably be built. This bridge would put the passenger tracks on the upper deck, the bridge to contain four tracks on each deck. A walk for pedestrians on the upper deck and a wagon road on the lower deck are also features of the tentative plans. Another plan is for a single deck bridge with six tracks to be built at the side of the present structure, the bridge to be about 100 ft. wide. A third plan is to construct an addition to the present bridge, but it is said this plan is not being seriously considered owing to the condition of the bridge now in use.

Kansas.

The Commissioners of Butler County, Eldorado, Kan., have awarded the contract for the construction of the bridge over the Dry Creek west of Potwin.

Maryland.

✣Bids will be received until 11 a. m., May 3, by H. R. Stanford, Chief of the Bureau of Yards and Docks, Navy Department, Washington, D. C., for a highway bridge over Dorsey Creek at Naval Academy, Annapolis, Md. The amount available for this work is $50,000. Plans and specifications can be obtained of the Bureau for $10.

The lowest bid received by the Board of Awards, Baltimore, Md., for the construction of the bridge over the dam at Lock Raven, near Peterson Run, Baltimore County, was that of the Roanoke Bridge Co., Roanoke, Va., $50,925.

Michigan.

At the next township meeting at Green Oak, according to advices from Howell, Mich., the electors will be asked to vote on the question of bonding that township for $9,900 for the purpose of building four bridges, known as the Carl Woods, Sutherland, Osborn and Marshall bridges.

The Grand Rapids & Indiana Ry., according to reports, is planning the construction of a new bridge over the Manistee River on the line between Hare Siding and Walton Junction, near Cadillac, Mich. E. H. Barnes, Grand Rapids, Mich., is Chief Engineer and General Manager.

Minnesota.

✣Bids will be received until 10 a. m., April 11, by William Lincoln, Auditor, Otter Tail County, Fergus Falls, Minn., for furnishing certain corrugated steel culverts and certain road machinery.

At a joint meeting of the County Board and the City Council of Redwood Falls, Minn., it was decided to build a new bridge over the Redwood River, near the city, to cost about $10,000.

Missouri.

The House of Delegates has passed the bill introduced into the Council by the Board of Public Improvements, requiring the Missouri Pacific and the St. Louis & San Francisco R. R. to erect a viaduct over their tracks to eliminate the Tower Grove grade crossing. The costs of constructing the viaduct are to be borne by the railroads, the city assuming the consequential damages. The bill provides that the railroads shall depress their tracks 12 ft. The grade of the street will be elevated 10 ft., to make the clearance over the tracks 22 ft. The Vandeventer and Southampton cars will use the viaduct.

It has been announced by George F. Moore of the Manufacturers' Railway Co. that he will introduce a bill in the Municipal Assembly, St. Louis, Mo., providing for the construction of the southern approach to the Free bridge.

The City Council of St. Louis, Mo., has passed the bill providing for the construction of a viaduct over Delmar Boulevard by the Wabash Railroad. The cost of the structure will amount to about $100,000.

New Jersey.

⊙The Board of Freeholders has awarded contracts for the construction of two concrete bridges to William Y. Holt, Flemington, N. J. One bridge will be located near Packer's Island and will span the South Branch of the Raritan River and the other will span Wickcheoche Creek near Prallsville.

⊙Two bridge contracts were recently let by the Board of Freeholders, Middlesex County, New Brunswick, N. J., as follows: For the erection of the approach to the Cheesequake Creek bridge to Conrad Sebolt, New Brunswick, N. J., $5,856.56; for the erection of a concrete bridge over the south branch of the Rahway River was awarded to Carman & Smith, Metuchen, $1,692.

The following bids were received by a joint committee of the city of Salem, N. J., and Gloucester County, N. J., for the construction of a new bridge at Nortonville: Bridgeton Construction Co., $29,850; Long & Broadhurst, $34,500; Owego Bridge Co., $29,900; H. C. Eisenhise Co., $35,820.

New Hampshire.

A meeting was held at Hinsdale, N. H., April 5, at which the proposition to improve or replace the old wooden bridge over the Ashuelot River or Depot St., was considered.

New York.

✣Bids will be received until 3 p. m., April 30 (readvertisement), by John R. Baldwin, Town Clerk, Livingston Manor, Sullivan County, N. Y., for the building of a bridge and foundations over the Willowemoc River, State Road Route No. 4, in the village of Livingston Manor, New York. Plans and specifications can be had of State Highway Department at Albany, N. Y. Bids are to be accompanied by certified check for 5 per cent of the amount of the bid.

The Board of Managers of the Chamber of Commerce, Watertown, N. Y., has adopted a resolution instructing President S. R. Cleveland to arrange for a membership meeting of the organization to which the public would be invited for a discussion of the proposed double deck bridge at Court St. and the structures at the east and west ends of the city.

It is said that the New York Central Interests have provided for an expenditure of $7,000,000 for the construction of a bridge over the Hudson River from a point opposite Stuyvesant. The right to build the bridge has already been secured. This work will be done in connection with the new railroad to connect the West Shore with the Hudson River R. R. and the Boston and Albany R. R.

Advices from Ilion, N. Y., state that all arrangements have been completed for the construction of the Fulmer Creek bridge at Mohawk and the Sleete's Creek bridge at Ilion on Main St. and active construction work will be commenced at once. The railroad company's share of the cost of the two bridges will be $6,379.57; Town of German Flatts' share, $5,381.89; the share of the Village of Mohawk will be $1,168.74, and that of the Village of Ilion $1,121.72. The work will be under the supervision of the Wilbur J. Watson Engineering Company of Cleveland, O.

Ohio.

✣Bids will be received until 1 p. m., April 21, by Board of Tuscarawas County Commissioners, New Philadelphia, O., for the construction of a creosote block floor for Third St. bridge, Uhrichsville; bridge over Mud Run, near Sharon Church, Warwich Township, according to plans and estimates on file in the County Auditor's office. Each bid must be accompanied by a cash deposit of $200 for bridge floor and $100 for Mud Run bridge or certified check payable to W. C. Shott, Auditor of said county.

✣Bids will be received until 10 a. m., April 19, by Board of Shelby County Commissioners, Sidney, O., for furnishing all material and labor necessary for the construction and superstructure for the following bridges: One steel highway bridge over Loramie Creek in Van Buren Township, at Rumley, 84-ft. span, 16-ft. roadway; one steel highway bridge over Turtle Creek in Turtle Creek Township south of Hardin, 84-ft. span, 16-ft. roadway; one steel highway bridge over Loramie Reservoir,

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

west of McCartyville, Van Buren Township, 82-ft. span, 16-ft. roadway. Plans and specifications for same are on file at the office of the County Auditor, H. T. Ruese.

✣Bids will be received until 1 p. m., April 17, by Board of Lorain County Commissioners, Elyria, O., for furnishing the necessary labor and material for the repair of the East Erie Ave. Bridge over Black River at Lorain, O., by constructing a creosoted wood block floor on creosoted plank upon said bridge in accordance with the plans and specifications to be furnished by T. L. Gibson, County Surveyor. F. L. Ellenberger is Clerk of the board.

✣Bids will be received until noon, April 11 (postponed on account of flood), by S. A. Kinnear, Director of Public Service, Columbus, O., for the concrete floor for South High St. viaduct. All bids received March 24 were returned unopened.

✣Bids will be received until noon, April 16, by W. J. Springborn, Director of the Department of Public Service, Cleveland, O., for furnishing fabricated structural steel work for repairs to Columbus Road bridge and Martin-Praha bridge. Each bid must be made in accordance with the specifications, which may be seen at the office of the Chief Engineer, Room 305, City Hall. No proposals will be entertained unless made on the proposal blanks furnished by the Chief Engineer, and delivered at the office of the Director. W. H. Kirby is Secretary.

According to a rough estimate by Frank R. Lander, Cuyahoga County Surveyor, Cleveland, O., the county sustained bridge damages during the recent flood amounting to $100,000. Five bridges are completely down and hopelessly wrecked. They are: the Olmsted Falls steel bridge and the West View bridge over Rocky River, the Willow bridge over the Cuyahoga River, the steel bridge on Highland Road and the Grayton bridge in Middleburg Township. The W. Third St. bridge, which was demolished by the freighter William H. Mack ramming the draw, may be rebuilt by the county, inasmuch as W. Third St. is a county road, formerly being known as Seneca St.

The City Council of Akron, O., at a recent meeting, passed an ordinance providing for the issuance of $26,000 in bonds of which $25,000 will be used for repairing streets and bridges and $1,000 will be used by the Charities and Correction Organization for relief work among the flood sufferers.

The Board of Cuyahoga County Commissioners, Cleveland, O., has decided upon the construction of a bridge over the Chippewa Creek in Brecksville Township on the Station Road and a hearing will be held 11 a. m., April 17 at the office of the board. J. F. Goldenbogen is Clerk.

Oregon.

The Commissioners of Polk County, Dallas, Ore., will shortly let contracts for the construction of four bridges in various parts of the county. These will be located as follows: Over the Yamhill at Willamina; in Kings Valley over the Big Luckiamute, to replace the Grant bridge; below Falls City over the Little Luckiamute to replace the Ellis bridge; an entirely new one to span the La Creole at Bowersville, east of Dallas.

Waddell & Harrington, Consulting Engineers, Kansas City, Mo., have submitted to the Joint Bridge Committees of Clark and Multnomah Counties, Ore., specifications for a bridge over the Columbia River to cost not more than $1,700,000. Among the members present at the meeting were E. G. Crawford, Portland, Ore., and H. L. Moody, Vancouver, Wash.

Pennsylvania.

✣Bids will be received until noon, April 10, by Washington County Controller, Washington, Pa., for the construction of the following highway bridges: Three-plate girder bridges of 57 ft., 75 ft. and 57 ft. spans, respectively. One pony truss bridge of 39 ft. span. Three concrete and I-beam bridges, each of 30 ft. span. All the above bridges are to have concrete and brick floors with a 16 ft. roadway. Also six reinforced concrete arches of the following spans: 42 ft., 50 ft., 80 ft., 60 ft., 50 ft. and 60 ft. Bids will also be received for the repair and re-erection of the Smith, Star and Centerville station bridges. Plans and specifications may be seen at the County Engineer's office or will be mailed on receipt of $10 deposit for the return of same. John H. Moffitt is County Controller. Chaney & Armstrong are County Engineers.

⊙The Commissioners of Philadelphia and Montgomery Counties have awarded the contract for the construction of a concrete bridge over Indian Run along City Ave., Lower Merion, to P. J. Lawler, Philadelphia, Pa., at $21,942.

⊙The Board of County Commissioners, Butler, Pa., awarded contracts for the construction of bridges for which bids were received March 22 as follows: Bridge No. 1 over branch of Buffalo Creek on Freeport Pike in Buffalo Township, to N. J. Boyer, Butler, Pa., at $500 for superstructure and $6.50 per cu. yd. for concrete substructure; superstructure of Rosebaugh bridge to J. D. Fleming, Chicora, Pa., at $874, and substructure to F. J. Winters at $6.74 per cu. yd. for concrete; floor of Fenelton bridge at Fenelton, to N. J. Boyer, at $343.

Plans and specifications are now being prepared by Ralph E. Shaner, Pottstown, Pa., Chief Engineer of the Pottstown & Reading Ry. Co., for the construction of a new bridge over the Schuylkill River at Linfield. Bids for the work will probably be asked in a short time.

The Commissioners of Northumberland County, Sunbury, Pa., have decided to advertise May 2 for bids, for the erection of a bridge over Shamokin Creek at Mount Carmel. The view was made some time ago by a board of viewers and a favorable report was made to the court with the recommendation that the structure be built.

The following bids have been received for the construction of the proposed reinforced concrete bridge at Murray Ave., Pittsburgh, Pa.: Charles M. Neeland Co., $99,500; Dravo Contracting Co., $97,500, and the Duquesne Contracting Company, $140,000. The estimated cost of the bridge is $125,000.

The following bids were received March 25 for the construction of the Murray Ave. concrete bridge at Pittsburgh, Pa.: Charles M. Neeland Co., $99,500; the Dravo Contracting Co., $97,500, and the Duquesne Contracting Co., $140,000. The estimated cost of the structure was $125,000.

A bill has been introduced into the Pennsylvania Legislature providing for the construction of a new bridge over the Susquehanna River connecting Middletown with a point in Newberry Township, York County, a short distance above Goldsboro. The bill provides that the cost should not exceed $200,000. York, Pa., is County Seat of York County.

The Board of Viewers have reported favorably on the erection of a bridge over the Catausauqua Creek at Lower Catausauqua which was recommended by the Grand Jury at Allentown, Pa., last November.

All bids received for the construction of two steel bridges, one at Towanda and the other at Athens in Bradford County, have been rejected by the Board of Commissioners, Towanda, Pa., because they were above the estimate of David A. Keete, County Bridge Engineer, Athens, O. The work will be re-advertised and bids will also be considered for concrete structures. The bids submitted were as follows:

TOWANDA BRIDGE.

	Concrete, per cu. yd.	Superstructure.
Nelson-Meredyth Co.	$8.51	$91,600
Penn Bridge Co.	8.50	79,940
York Bridge Co.	8.50	87,960
Owego Bridge Co., Prop. A.	8.50	89,986
Owego Bridge Co., Prop. B.	8.50	87,286
Penn Steel Co.	8.50	88,800

ATHENS BRIDGE.

	Concrete, per cu. yd.	Superstructure.
Nelson-Meredyth Co.	$8.00	$56,450
Penn Bridge Co.	8.00	46,840
York Bridge Co.	9.50	54,571
Owego Bridge Co., Prop. A.	7.50	51,953
Owego Bridge Co., Prop. B.	7.50	49,653
Penn Steel Co.	8.00	54,800

Plans have been completed by the engineers of the Delaware, Lackawanna & Western R. R. for the construction of a new steel bridge over Seventh Ave., Scranton, Pa., west of the Jersey Central tracks, and work will be commenced as soon as the Lackawanna and Jersey Central reach an agreement. The cost of the structure is estimated at $30,000. L. L. Tallyn is Division Engineer, Scranton, Pa.

The Commissioners of Lawrence County, Newcastle, Pa., have decided to set aside all bridge work proposed and to take immediate steps toward replacing some of the structures washed out by the recent flood. Two new structures will be built at Newcastle, one at Grant St. and the other at Gardener Ave.

A bill has been presented to the State Legislature by J. W. Swartz, of Snyder County, Pa., Legislature, providing for the building by the State Highway Department of a bridge across the Susquehanna River between Herndon and Port Trevorton. He asks for an appropriation of $250,000 and some of the leading business men of Port Trevorton and Herndon will appear before the committee.

The Commissioners of Berks County, Reading, Pa., have approved the proceedings for a new county bridge over the North Branch of Swamp Creek at Bechtelsville.

The following bids were received March 28 for the construction of the Mechanics St. bridge at the Borough of Smethport, McKean County, Pa., for which G. A. Flink, Harrisburg, Pa., is Consulting Engineer:

Name, lump sum and time required.	Concrete.	Excavation.	Brg. piles.	Rfg. bars.	Stone masonry.	Sheet piles.
G. W. Ensign—$6,650; 80 days	R'f'd, $16.00 Plain, 14.25	Dry earth, $0.75 Dry rock, 2.00 Wet earth, 4.00 Wet rock, 6.00	$0.98	$0.05	$12.00	$0.825
Curwensville Constr. Co., Curwensville, Pa.—$8,880; 120 days	14.00 7.00	2.00	1.25	0.05	8.00	0.20
Applegate & Son, Bradford, Pa.—$7,000; alt., $6,700; 100 days	10.00	3.00	0.75	0.06	10.00	0.75
Nelson-Meredyth Co., Chambersburg, Pa.—$7,992; 150 days	15.00 8.00	2.00 1.00	1.00	0.03	12.00	0.60
Ferro Concrete Co., Harrisburg, Pa.—$6,980; 150 days	12.00	2.00	1.50	0.05	7.00	0.20

Virginia.

✣Bids will be received until noon, April 15, by Board of Pulaski County Supervisors, Pulaski, Va., for the construction of two bridges over Peak Creek 3 and 3¼ miles from Pulaski on the Norfolk & Western Ry. One structure will consist of one 60-ft. span and two 30-ft. spans and the other of one 97-ft. span and two 30-ft. spans. Both will have a 12-ft. roadway and will be of steel construction. The substructures have been built by the county. Plans and specifications are on file with the Clerk of the Circuit Court, Pulaski, and blueprints of plans can be secured from Childrey-Sunday Co., Richmond, Va., at $0.28 and postage.

⊙The Board of Patrick County Supervisors, Salem, Va., has awarded the contract for the construction of a bridge over the river at the depot, Stuart, Va., to the Roanoke Bridge Co., Roanoke, Va.

Washington.

The City Council of Tacoma, Wash., has instructed the City Engineer to draw up plans for the construction of a concrete or pile bridge over Clarks Creek to replace the present pile structure. A concrete bridge, it is believed, will cost about $2,478.

Wisconsin.

At the election held April 1, the City of Eau Claire, Wis., voted to issue bonds to the extent of $75,000 for the construction of a bridge over the Chippewa River at that place. A. R. Garnock is City Engineer.

At a mass meeting held at Lodi, Wis., recently it was voted to raise the necessary funds for the construction of a bridge by taxation.

An ordinance has been passed by the City Council, Wis., providing for an election this spring to submit to the voters the proposition to issue $75,000 of bonds for the construction of a bridge over the Chippewa River from the east end of Water St. to Summit Ave. A. R. Gamock is City Engineer.

The Chicago, Milwaukee & St. Paul Ry., according to advices from Fond du Lac, Wis., has decided to replace the old pile bridge over the east branch of the river on South St. with a new steel span. N. H. LaFountain, Chicago, Ill., is Assistant Superintendent of Bridges and Buildings.

ROADS AND STREETS

Alabama.

✣Bids will be received the latter part of April by the city of Birmingham, Ala., for approximately 7,000 sq. yds. asphalt paving on North 24th St., and 16,000 sq. yds. asphaltic concrete on 12th Ave., 14th Ave., Ash and Beech Sts. (open specifications); also 15,000 sq. yds. creosoted wood blocks on 19th St., 2nd Ave. and Morris Ave.; also 20,000 sq. yds. of relaying granite blocks in certain alleys. Walter G. Kirkpatrick is City Engineer.

✣Bids will be received until noon, April 22, by Marshall County Court, Guntersville, Ala., for the grading, draining and surfacing with gravel or macadam part of the Guntersville and Warrentown Road. Expenditure $5,000. Also for grading, draining and surfacing with sand clay a section of the Albertville and Boaz Road; expenditure, $4,000. Certified check of $500 required with each bid. W. S. Keller, Montgomery, Ala., is State Highway Engineer.

⊙The City Commissioners of Birmingham, Ala., have let the contract for the paving of two of the principal streets in the business district to the Creosoted Wood Block Paving Co., of New Orleans, La., for about $40,000. Wood block will be used.

⊙Shelby & Bateman, Little Rock, Ark., have been awarded the contract for the construction of 25,000 sq. yds. of creosoted wood blocks, with curbs and drains in Improvement District No. 214, Little Rock, for $2.37 a sq. yd. Bids were opened March 24.

The City Commission of Birmingham, Ala., has authorized approximately $80,000 worth of paving improvements. The list of streets, with the price for the work, follow: Southern Wood Block Paving Co., 19th St., from First Ave. to Third Ave., $13,354; Second Ave., from 19th St. to 21st St., $18,543; Morris Ave., from 19th St. to 20th St., $4,176. Southern Bitulithic Co.: Eighth Ave., from 12th St. to 17th St., $17,042. Southern Asphalt & Construction Co.: 24th St., from Eighth Ave. to 12th Ave., $13,630; Beech St., from Highland to 14th St., $2,542; 14th Ave., from Beech St. to 20th St., $5,873; Ash St., from 14th Ave. to Highland Ave., $1,439; total, $79,004.

Plans are being worked out by the Mayor and Board of Aldermen of Dadeville, Ala., for the macadamizing of the main streets. The first work to be undertaken will be on La Fayette St., from the Central of Georgia Depot to the Methodist church and three blocks on Broadnax St., east of the county court house. The work will cost about $15,000.

Arkansas.

According to Col. A. S. Fowler, Commissioner of the Louisiana Street Improvement District, Little Rock, Ark., work will be started the latter part of this month or early in May on the proposed street paving. The streets included are Louisiana from Ninth to 23rd, and from Main to Center St., on all cross streets now unpaved. Creosoted wood blocks will be used.

California.

⊙Bids were received by the California Highway Commission, Sacramento, on March 24, for the construction of a section of the state highway in Stanislaus County, Division 3, Route 4, Section B. In the following table (1) stands for bid of McGillivary Construction Co., Sacramento, (2) E. O. Burge, Sacramento; (3) Geo. W. Martin & Son, Sacramento; (4) A. Teichert & Son, Sacramento, and (5) Considine & Bates Co., Los Angeles, (awarded contract). Steel, cement, oil, screenings, gravel and sand are to be furnished by the state:

	(1)	(2)	(3)	(4)	(5)	Engineer's estimate.
Excavation without classification, 50,000 cu. yds.....	$ 0.50	$0.50	$ 0.55	$ 0.50	$0.50	$0.40
Monuments and culverts, 14 cu. yds..................	12.00	7.00	10.00	10.00	7.00	7.00
Cement concrete paving, 9,500 cu. yds...............	2.90	2.90	2.50	3.24	2.35	2.50
Asphaltic oil (hauled to place), 750 bbls..............	2.00	1.25	1.50	1.50	0.95	0.75
Broken stone screenings, 1,600 tons...................	1.50	1.00	0.80	1.20	1.00	1.00
Monuments, hauling and setting, 77...................	1.00	1.00	1.00	2.00	2.00	0.50
Totals	$39,195	$37,763	$34,622	$41,619	$32,390	$36,856

The City Council of San Diego, Calif., has approved the plans and specifications prepared by City Engineer W. M. Rumsey for the paving of 30th St., along the route of the street railway line.

The Advisory Board of the State Engineering Department of California has approved the proposed building of the 38½ miles of state highways in different parts of the state. The State Highway Commission has been authorized to ask bids for building a road from San Jose to Edenvale, 4½ miles; San Mateo to Beresford, 2 miles; from southern boundary of Ventura County to Newberry Park, 8 miles; from Morrison's crossing, Yuba County, to Marysville, 8 miles, and from Turlock to Ceres, 16 miles.

Connecticut.

⊙Daly & Merritt, Port Chester, N. Y., have been awarded the contract by the city of Greenwich, Conn., for the construction of 2,700 sq. yds. of Dolarway pavement.

District of Columbia.

✣Bids will be received until 11 a. m., April 11, by Lieut. Col. G. F. Downey, Depot Quartermaster, Washington, D. C., for furnishing 200 cu. yds., 2,550 lbs. to the yard, of crushed hard limestone; 2,000 gals. of coal tar binder and 100 cu. yds. limestone screenings, delivery of binder to be made at Antietam Station on the Norfolk & Western R. R., the balance of materials to be delivered at such points on the Antietam roadway as designated by the Superintendent.

✣Bids will be received until 2 p. m., April 10, Commissioners of the District of Columbia, Washington, D. C., for furnishing and delivering five motor patrol wagons for use in the police department.

Florida.

The citizens of Plant City, Fla., at a recent special election voted the issuance of bonds in the sum of $35,000 for paving.

The citizens of Fort Myers, Fla., at a recent election voted the issuance of bonds in the sum of $47,000 for street paving.

Illinois.

✣Bids will be received until 10 a. m., April 14, by Board of Local Improvements, William S. Welch, Clerk, Joliet, Ill., for the improvement of Eastern Ave., by the construction therein of a bituminous pavement, asphaltic concrete, etc.

✣Bids will be received until 10 a. m., April 17, by Board of Local Improvements, Cairo, Ill., for the construction of a number of street improvements. This work is the same as was advertised in the March 26 issue of ENGINEERING & CONTRACTING. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 11 a. m., April 14, by L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing, delivering and erecting at the municipal asphalt plant, 15th and Laflin Sts., a portable municipal asphalt plant for the utilization of old wearing surface for the Bureau of Streets, the plant to be equipped to economically disintegrate and mix a sufficient amount of old asphalt mixture; capacity 800 sq. yds. in 8 hours; plant must be equipped with a Noyes crusher for breaking down old asphalt. Cash or certified check for $500 must accompany proposal.

✣Bids will be received by J. N. Neil, Secretary of the South Park Commissioners, until 12 m., April 16, for furnishing and delivering 320 street signs, same to be placed on electric light posts. Plan and specifications may be had upon application at office, 57th St. and Cottage Grove Ave.

⊙The Board of Local Improvements of Galesburg, Ill., has awarded the contract for the construction of pavement on Beecher Ave., to P. H. Tiernan, of Macomb, Ill., for $19,085. Other bidders were: Brereton Cement Walk Co., $19,599; M. Heckard & Sons, Canton, Ill., $19,981; J. B. McAuley, $19,115, and the McCarthy Improvement Co., of Davenport, Ia., $19,659.

Following are the lowest bids submitted to the Board of Local Improvements for constructing pavements in the following streets: Belmont Ave., 71 ft. W. of Rockwell St. to Milwaukee Ave., 15,600 lin. ft. sandstone curbing, 87 cts.; 23,800 sq. yds. creosoted wood block pavement, $2.86; The Ryan Co., 10 S. La Salle St. Fifth Ave., 12,800 sq. yds. creosoted wood block pavement, $3.74; The Ryan Co.. Forty-second Ave., 22d St. to Ogden Ave., 1,370 lin. ft. granite concrete combined curb and gutter, 65 cts.; 2,200 sq. yds. asphalt pavement, $1.79; H. G. Goelitz, Oak Park, Ill. W. 53d St., Halsted St. to Union Ave., 1,270 lin. ft. granite concrete combined curb and gutter, 50 cts; 2,070 sq. yds. asphalt pavement, $1.90; R. F. Conway Co., 133 W. Washington St. Lauretta Ct., Van Buren St. to Congress St., 600 lin. ft. sandstone curbing, 80 cts.; 1,280 sq. yds. brick pavement, $2.58; R. F. Conway Co. Lyndale Ave., Lawndale Ave. to Hamlin Ave., 1,280 lin. ft. granite concrete combined curb and gutter, 68 cts.; 1,870 sq. yds. asphalt pavement, $1.71; F. P. McCormick, 133 W. Washington St. Montrose Ave., Elston Ave. to Avondale Ave., 7,500 lin. ft. sandstone curbing, 79 cts.; 11,900 sq. yds. brick pavement, $2.09; Citizen's Construction Co., 133 W. Washington St. Prairie Ave., Lake St. to Chicago Ave., 4,450 lin. ft. sandstone curbing, 60 cts.; 6,050 sq. yds. asphalt, $1.70; H. G. Goelitz. W. 26th St., 40th Ave. to 46th Ave., 7,730 lin. ft. sandstone curbing, 81 cts.;

15,130 sq. yds. creosoted wood block pavement, $3.09; J. A. McGarry, 179 W. Washington St. Twenty-eighth St., 43d Ave. to 44th Ave, 1,140 lin. ft. granite concrete combined curb and gutter, 65 cts.; 1,840 sq. yds. asphalt pavement, $1.80; H. G. Goelitz. Thirtieth St., 43d Ave. to 44th Ave., 1,140 lin. ft. granite concrete combined curb and gutter, 65 cts.; 1,840 sq. yds. asphalt, $1.80; H. G. Goelitz. Thirty-ninth St., State St. to Cottage Grove Ave., 6,850 lin. ft. sandstone curbing, 77 cts.; 15,530 sq. yds. creosoted wood block pavement, $3.17; The Ryan Co. Wabash Ave., Washington St. to Congress St., 11,700 sq. yds. creosoted wood block pavement, $3.48; The Ryan Co., Washington St., La Salle St. to Franklin St., 2,300 sq. yds. creosoted wood block pavement, $3.60; J. A. McGarry Co. Wilcox St., Oakley Ave. to Western Ave., 1,230 lin. ft. sandstone curbing, 83½ cts.; 1,530 sq. yds. creosoted wood block pavement, $2.25; Haines St., Halsted St. to Hooker St., 1,500 lin. ft. sandstone curbing, 77 cts.; 3,260 sq. yds. granite block pavement, $3.71; Ready & Callahan Coal Co., 133 W. Washington St. The work includes preparation of the sub-grade 6-in. Portland cement concrete foundation, sewer, manhole and catchbasin, construction and adjustment. The contracts have not been awarded. E. J. Glackin, Secretary of the Board.

The City Council of Princeton, Ill., has adopted an ordinance providing for the paving of Peru St., with bituminous macadam, with concrete curbs on each side. The estimated cost is $18,287.

The Board of Local Improvements of Peoria, Ill., has recommended the paving of Glendale Ave., from Jackson to Spring St. City Engineer L. D. Jeffries will prepare plans for a brick pavement on a gravel foundation. Estimates are also to be prepared for the improvement of Linn St., from Nebraska to McClure.

The City Council of Kewanee, Ill., has adopted an ordinance providing for the improvement of Elliott St., by laying a pavement from Prospect south to Division St.

The City Council of Lincoln, Ill., has passed an ordinance for the repaving of 15 blocks in the business district.

Indiana.

✣Bids will be received until 10 a. m., April 14, by Board of Public Works, Indianapolis, Ind., for the construction of the following street improvements: For the improvement of 18th St., from the e. property line of Montcalm St. to a point 147 ft. e. of e. property line of Milburn St., by grading, graveling and rolling the roadway; for the improvement of Samoa St., from s. e. property line of Brookside Ave. to n. w. property line of Coyner Ave., by grading, graveling and rolling the roadway; for the improvement of Samoa St., from s. e. property line of Brookside Ave. to n. w. property line of Coyner Ave., by grading and paving the sidewalks; for the improvement of Ralston Ave., w. s., from the n. property line of 32d st. to the s. property line of 34th St., by grading and paving the sidewalks; for the improvement of Hovey St., from the n. property line of 32d st., e. s., and from the n. curb line of 33d St., w. s., to the s. property line of 34th St., by grading and paving sidewalks; for the improvement of College Ave., e. s., from s. property line of 43d St. to the s. property line of 44th St., by grading and paving the sidewalks; for the improvement of Arsenal Ave., from the n. property line of 30th St. to the s. property line of 34th St., by grading, graveling and rolling the roadway; for the improvement of Arsenal Ave., from the n. property line of 30th st. to the s. property line of 34th st., by grading and paving the sidewalks.

✣Bids will be received until 11 a. m., April 12, by Board of Wayne County Commissioners, Richmond, Ind., for the construction of a road in Wayne township. L. S. Bowman is County Auditor.

⊙Following contracts have been awarded by the city of Terre Haute, Ind., for paving work, for which bids were opened March 14: N. 14th St., with bitulithic, Kokomo Asphalt Co., Kokomo, Ind., $25,716; Wabash Ave., with brick, Foulkes Contracting Co., $19,538; Poplar St., with brick, Foulkes Contracting Co., $20,480. and S. 6th St., with brick, Greenleaf Construction Co., $2,569.

⊙Following bids were received at Frankfort, Ind., on April 3 for street improvements, H. M. Hockman, City Civil Engineer: Gentry St.—Nees & Seaman, $11,551 (awarded contract); Frankfort Const. Co., $11,873; C. C. Huffine, $11,784; Wm. Coin, $11,608. Columbia St. Improvement—Neese & Seaman, $9,902; Frankfort Const. Co., $9,972; C. C. Huffine, $9,557; Perry McKinsey, $9,638; Wm. Coin, $9,300; (award not made). Boone St. Improvement—Nees & Seaman, $4,392; Frankfort Const. Co., $4,811; C. C. Huffine, $4,321 (awarded contract); Perry McKinsey, $4,433. Rossville Ave. Improvement—Nees & Seaman, $7,064 (awarded contract); Frankfort Const. Co., $8,332; Perry McKinsey, $7,074. Meredith St. Sewer—Frankfort Const. Co., $614.60; C. C. Huffine, $572 (awarded contract); John Snow, $588; Perry McKinsey, $573. Oak Street Sewer—Frankfort Const. Co., $2,288; C. C. Huffine, $2,160 (awarded contract); John Snow, $2,303; Perry McKinsey, $2,277. Oak St. Sidewalks—Neese & Seaman, $795; H. Maxwell, $583 (awarded contract); Frankfort Const. Co., $636; C. C. Huffine, $689; Elmer Clark, $710; Samuel Rogers, $702.

⊙Hoban & Roach have been awarded the contract by the Board of Public Works of South Bend, Ind., for the construction of a concrete pavement on Garfield Court, for $1,066.

Acting City Engineer Ben E. Wise, Goshen, Ind., together with Acting Mayor Rimpler, Chairman of the Streets and Alleys Committee of the Council have taken measurements of a number of city streets for the purpose of preparing plans and specifications for paving. It is the intention to pave the following streets: Madison St. from Main east to 11th; Third St. from Lincoln Ave. south to Jefferson and from Clinton north to Pike; Clinton St. from Fifth east to Sixth; Jefferson St. from Third east to Main and from Fifth east to Sixth; Monroe St. from Main east to Sixth; Douglas St. from Main east to Sixth.

The Board of Public Works of Indianapolis, Ind., has adopted a resolution for the paving of Eddy St. and other streets as follows: King Ave., from Michigan to Calvelage Sts.; 33rd St., from Central Ave. to Meridian St.; Ray St., from River Ave. to Division St.; English Ave., from the Big Four Railway tracks to Keystone Ave.; Carrollton Ave., from 38th to 40th Sts.; 21st St., from Talbott to Central Aves.; 19th St., from Illinois St. to Capitol Ave.; Linwood Ave., from New York to Michigan Sts., and Broadway from 34th St. to Fair Ground Ave.

Iowa.

✣Bids will be received until 7:30 p. m., April 14, by R. L. DeGon, City Clerk, Waterloo, Ia., for paving, curbing and guttering certain streets in the city. A certified check for $200 must be filed with each bid.

⊙Young & Buescher, S. 7th St., Burlington, Ia., have been awarded the contract by that city for grading, curbing and paving Gunnison and Amelia Sts., at the following prices: Paving, $1.17 a sq. yd.; grading, $0.36 a cu. yd., and curbing, $0.30 a lin. ft. Bids were opened March 31.

⊙Young & Buescher, S. 7th St., Burlington, Ia., have been awarded the contract by that city for grading, paving and curbing 8th, 9th, Ash, Mark Lane, etc., at following prices: Paving, $1.15 a sq. yd.; grading, $0.39 a cu. yd., and curbing, $0.30 a lin. ft. Bids were opened March 31.

⊙The Dolarway Paving Co., Marshalltown, Ia., have been awarded the contract by the city of Washington, Ia., for the construction of 12,000 sq. yds. of pavement.

⊙The City Council of Sioux City, Ia., has let the contract for the paving and extras on 25th and 27th Sts., between Pierce and Jackson Sts., to E. J. Hanlon, for $1.10 a sq. yd., for the paving and $0.36 for the curbing.

⊙The Cedar Rapids Construction Co. has been awarded the contract by the City Council of Cedar Rapids, Ia., for the construction of concrete sidewalks during the year, for $0.09½ per sq. ft. The contract will aggregate $15,030.

⊙The City Council of Cedar Rapids, Ia., has let the contract for the construction of 14,000 lin. ft. of combined curb and gutter and 1,000 yds. of grading to the Concrete Construction Co., at $0.58, or a total of $8,470.

Askin & Flutter have submitted the lowest bids to the City Council of Des Moines, Ia., for sidewalk construction during the year, as follows: Cement walks in business district, $0.105 per sq. ft.; cement walks in residence district, $0.10 per sq. ft. J. L. Hansman was low on brick walks at $0.095 per sq. ft.

Kansas.

⊙The City Council of Hiawatha, Kan., has awarded a contract to O. C. Chapin, of Leavenworth, Kan., for the paving of 14 blocks of street with Dolarway. The work includes 21,000 sq. yds.

Kentucky.

The Fulton County Fiscal Court, Fulton, Ky., has asked for bids for the system of good roads for that county. The work will be divided into four sections. Engineer P. Hawkins, of Hickman, Ky., will have general supervision of the work.

I. H. Goodnight, Chairman Committee, Franklin, Ky., rejected all bids received March 10, for building and macadamizing the Lincoln-Jackson Way through Simpson County. The work will probably be re-advertised this fall.

The City Council of Fulton, Ky., has sold bonds in the sum of $40,000 for street improvements recently ordered by the city.

Louisiana.

At a recent election in the first road district of Ascension Parish, La., the Police Jury was authorized to issue bonds to the amount of $35,000 for good roads construction. A total of $50,000 is to be spent in gravel road construction. Donaldsonville is the parish seat.

Maryland.

The City Council of Baltimore, Md., proposes to pave sections of 51 streets during the year. The streets have been selected by the Paving Commission.

Massachusetts.

✣Bids will be received until April 26 by H. R. Stanford, Chief of the Bureau of Yards and Docks, Navy Department, Washington, D. C., for the construction of a roadway at the naval hospital, Chelsea, Mass. The amount available for this work is $15,000. Plans and specifications can be obtained of the Bureau of the Commandant at the Navy Yard, Boston, Mass.

At the annual town meeting, Randolph, Mass., $3,000 was appropriated for highways.

At the annual town meeting, Shutesbury, Mass., $1,200 was appropriated for highways and bridges.

At the annual town meeting, Kingston, Mass., $4,000 was appropriated for highways.

Michigan.

⊙The Board of Public Works of Bay City, Mich., has let the contract for the construction of brick pavement on a number of streets to Patrick Ryan, of that city, and for asphalt pavements to the Cleveland Trinidad Paving Co., of Cleveland, O.

⊙The Iron County Road Commissioners, Crystal Falls, Mich., have let the contract to gravel the Tully road to D. F. Boyle & Co., of Crystal Falls, for about $9,000.

⊙O. B. Howland, of Charlevoix, Mich., has been awarded the contract by the City Council of Hastings, Mich., for the construction of 18,225 sq. yds. of paving on Jefferson and Green Sts., for $23,369, or about $1.30 a yd.

The voters of Flint, Mich., have endorsed a bonding issue by the city for public improvements, including one of $40,000 for street pavements. It has been decided to construct

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

a series of gravel pavements. The contract for furnishing the gravel has been awarded to the Huron Gravel Co.

The citizens of Emmet County, Mich, on April 7 voted on the issuance of bonds to the amount of $225,000 for the improvement of roads throughout the county. Petoskey is the county seat.

The Board of Estimates of Bay City, Mich., has allowed $100,000 for public improvements for this year, this amount being recommended by the Board of Public Works.

City Engineer H. H. Eymer, of Saginaw, Mich., is preparing plans for the paving and sewer work ordered by the Common Council. The work will cost, on present estimates, $110,000 for paving and from $40,000 to $50,000 for sewers.

Minnesota.

✣City Clerk C. S. Palmer, of Duluth, Minn., is calling for bids for street paving contracts aggregating approximately $200,000. Streets to be improved and materials with which they will be paved are: First St., from First Ave. East to Sixth Ave. East, brick, sandstone or creosote; Fourth St., from Sixth Ave. East to 14th Ave. East, asphalt, concrete or bitulithic; 17th Ave. East from Fourth St. to Sixth St., bituminous concrete, concrete, bitulithic or macadam; Sixth St. from 18th Ave. East to Woodlawn Ave., asphalt or concrete; 23rd Ave. West, from Michigan St. to Piedmont Ave., brick, sandstone or macadam; Victoria St., from Woodlawn Ave. to Hartley Road, gravel, macadam or bituminous concrete; Fifth St., from 38th to 43rd Ave. West, gravel. Bids also have been asked for paving 22nd Ave. East, from Fourth to Sixth Sts.

The City Council of Minneapolis, Minn., has appropriated $20,000 for the purchase and equipment of a municipal asphalt plant.

Missouri.

✣Bids will be received until 7:30 p. m., April 21, by City Council, Poplar Bluff, Mo., for improving by grading, paving with vitrified brick and curbing and guttering the following streets: Main St., Vine St. and Pine St., total amounts consisting of about 28,175 sq. yds. of vitrified brick on a 4-in. concrete base and a 1½-in. sand cushion; asphalt filler; 18,790 lin. ft. of combined 6-in. curb and 18-in. gutter; 1,963 ft. of protection concrete headers; 7,575 cu. yds. of grading; 400 ft. of 12-in. pipe; 80 ft. of 8-in. pipe; 8 catch basins and 4 curb boxes; bids may be on each street separately, all streets or less number. Proposals must be accompanied by cash or certified check for 5 per cent of the aggregate proposal, payable to H. H. Wilcox, City Clerk of the City of Poplar Bluff, Mo. Plans and specifications may be seen at the office of the City Engineer, Edward C. Thomas, or copies may be obtained upon receipt of $5. Official advertisement will be found elsewhere in this issue.

⊙J. M. Clack has been awarded a contract by the city of Nevada, Mo., for the construction of 17,000 sq. yds. of Dolarway pavement. Contract awarded April 1.

Montana.

The City Commissioners of Missoula, Mont., have planned a considerable amount of paving for the coming summer. The plans now outlined will include Pattee St., from East Front to Railroad St.; Stevens. from West Front to Pine St.; Main St., from Pattee to Woody.

Nebraska.

⊙Parks and Lefler, 2415 North St., South Omaha, Neb., have been awarded the contract by the city of Fremont, Neb., for paving and curbing in Districts Nos. 19, 20 and 21. The work includes 4,048.81 sq. yds. of paving with asphalt filler, at $2.03; 5-in. x 20-in. straight curb, at $0.30 per lin. ft.; 18-in. combined curb and gutter, at $0.43 per lin. ft., and 15,071.19 sq. yds. of paving with asphalt filler, at $2.07. Bids were opened April 3.

New Jersey.

✣Bids will be received until 11:45 a. m., April 16, by Committee, Board of Chosen Freeholders, Belvidere, N. J., for the construction of about 4½ miles of waterbound macadam road running from about 1 mile west of Blairstown, Warren County, N. J., toward Columbia to the Knowlton township line. Each bid must be accompanied by a certified check in the sum of $1,000, payable to the Director of the Board of Chosen Freeholders of Warren County, N. J. Plans and specifications are on file at the State Road Commissioner's office in Trenton, N. J., and with the County Engineer and the Director of the Board of Chosen Freeholders at Washington, N. J.

✣Bids will be received until 10 a. m., April 16, by Board of City Commissioners, Long Branch, N. J., for paving Rockwell Ave., from Broadway to the New Jersey Southern Division of the Central Railroad of New Jersey, with vitrified brick, asphalt, macadam or bituminous concrete. No proposal will be received or considered unless accompanied by a certified check upon a National or State bank or trust company, drawn to the order of Frank L. Howland, Treasurer of the City of Long Branch, for the sum of $1,000. Specifications, forms of contract and notices to contractors, estimates of quantities, etc., are on file and can be seen at the office of J. Wesley Seaman, City Engineer, 192 Broadway, and at the office of the City Clerk, City Hall, between the hours of 9 a. m. and 12 m. and 2 to 4 p. m., until the date of the bidding.

✣Bids will be received until 8 p. m., April 14, by Harry Trippett, Town Clerk, Montclair, N. J., for furnishing broken trap rock, or a stone of equal hardness, for use in repairing the streets of Montclair during the present year. The sizes of the stone will be 1½-in., ¾-in., and screenings, samples of each size of stone to accompany the bids. Bids to specify the price per net ton, f. o. b. Montclair; at the quarry; or delivered on the streets of Montclair at points to be designated by Edgar S. Closson, Town Engineer. The estimate of amount of stone to be required under this contract is 5,000 tons.

✣Bids will be received until 10 a. m., April 16, by Board of City Commissioners, Long Branch, N. J., for paving 3d Ave., from Morris Ave. to Bath Ave., with vitrified brick, asphalt or bituminous concrete. A certified check for $2,000, payable to F. L. Howland, City Treasurer, must accompany each bid. W. R. Warwick is City Clerk.

✣Bids will be received until April 16 (readvertisement) by Board of City Commissioners, Long Branch, N. J., for the paving of 2d Ave., from a point 160 ft. south of Chelsea Ave. to Cedar Ave., with vitrified brick, asphalt or bituminous concrete. W. R. Warwick is City Clerk.

✣Bids will be received until 9 p. m., April 16, by Edward E. Mathes, Town Clerk, Belleville, N. J., for furnishing and sprinkling the streets with road oil. The bidders will state price per square yard and by the gallon. Approximately 20,000 gals. will be required.

⊙H. A. Crane & Bro., Inc., 79 Montgomery St., Jersey City, N. J., have been awarded the contract by the Shade Tree Commission of that city, for repairing the walks in parks, as follows: At Van Vorst Park, about 6,800 ft. of concrete walks and 6,800 sq. ft. of asphalt walks to be removed; Columbia Park, about 100 sq. ft. of concrete walks and 100 sq. ft.. to be removed; Lafayette Park, about 436 sq. ft. of concrete walks and 436 sq. ft., to be removed. The prices were $0.13 for walks and $0.02 for removal. Bids were opened March 25.

Following bids were received by the Board of City Commissioners, Long Branch, N. J., for permanent street paving and rebuilding gravel roads: James Campbell, Jr.—Morris Ave., $3,100; Sairs Ave., $2,014; Park Ave., $1,525. J. Walter Butcher—Morris Ave., $3,682; Sairs Ave., $2,312; Park Ave., $1,940; Rockwell Ave., $932. Frank C. Byram—Morris Ave., $4,605; Sairs Ave., $2,902; Park Ave., $2,065; Rockwell Ave., $1,239. J. William Jones—Sairs Ave., $2,765; Morris Ave., $4,200; Park Ave., $2,032; Rockwell Ave., $1,232. The bidders for permanent paving were M. C. Burns, Long Branch; Haslim Paving Co., Newark Paving Co., Newton Paving Co., the Standard Bitulithic Co., of Newark, and O'Gara & Guire, also of Newark. Vitrified block, M. C. Burns, $2.54; Haslim Paving Co., $2.67; Newark Paving Co., $2.78; Newton Paving Co., $2.49; O'Gara & Guire, $2.60. Asphalt, Newton Paving Co., $2.07. Warrenite, Standard Bitulithic Co., $2.08 for Second Ave.; $2.02 for Third Ave., and $2 for Rockwell Ave.

Following bids were received by the City Council of Bridgeton, N. J., for street paving work: T. J. McGovern—Material, McGovern, $2.35. Eastern Construction & Paving Co.—Material, Metropolitan, $2.45; Bessemer, $2.45; Medal "D," $2.45; Mack, $2.44. Shilling, Loller & Gray—Material, Metropolitan, $2.53; Bessemer, $2.51; Medal "D," $2.53; Mack, $2.56. Kelley-McFeeley Co.—Material, Metropolitan, $2.49; Bessemer, $2.49; Mack, $2.49; Martinet Bros.—Material, Metropolitan, $2.53½; Bessemer, $2.53½; Medal "D," $2.53½; Mack, $2.53½.

New York.

✣Bids will be received until 8:30 p. m., April 11, by Commissioners of Public Works, Olean, N. Y., for the construction of a vitrified brick pavement on concrete foundation in Green St., from the west line of Third St. to the east line of South 4th St. Plans and specifications may be examined, bid blanks procured and further information may be obtained at the office of the City Engineer, City Building, Olean, N. Y.

✣Bids will be received until April 15, by Common Council, Dunkirk, N. Y., for paving six streets. Specifications furnished by J. M. Hackett, City Engineer.

⊙The Warner-Quinlan Paving Co. has been awarded the contract at Syracuse, N. Y., for the paving of Veverly Road from Stolp Ave. to Crossett St., for $1,094. Asphalt paving with stone curbing will be used.

Mayor McEwan, of Albany, N. Y., has signed an ordinance providing for the improvement of Spruce St., from Eagle St., westerly; grading of North Lark and Van Woert Sts.; fixing the grade of Erie St., from Myrtle Ave. to Warren St., and appropriating $1,000 for an automobile for the health bureau.

Controller Prendergast of New York City has approved an application made to the Board of Estimate for $1,300,000 in corporate stock for the laying of a 40-mile road of vitrified brick in the Catskill aqueduct region around the Ashokan Reservoir.

Following low bids were received March 24 at the Borough Hall, Long Island City, N. Y., for various improvements in Queens: E. E. Buhler Co., $14,613, for furnishing and delivering to the Bureau of Highways 500,000 vitrified paving blocks; Barrett Mfg. Co., $13,938, for furnishing and delivering to the Bureau of Highways 150,000 gals. of bituminous road-surfacing material (tar or asphalt), as directed; Barber Asphalt Paving Co., $5,230, for furnishing and delivering to the Bureau of Highways 100,000 asphalt paving blocks; Borough Asphalt Co., $10,250, for repairing sheet asphalt thereto in the First and Third Wards; Borough Asphalt Co., $18.050, for repairing sheet asphalt, in the Second and Fourth Wards; New York Traprock Co., $66,920, for furnishing and delivering to the Bureau of Highways, 28,000 cu. yds. of broken stone and screenings of trap rock; Good Roads Machinery Co., $9,674, for furnishing and delivery to the Bureau of Highways five 10-ton steam road rollers, as directed: Good Roads Machinery Co., $6,875, for furnishing and delivering 10 distributing wagons, in the Corporation Yard, Nott Ave., near Vernon Ave., Long Island City.

The Common Council of Yonkers, N. Y., has directed City Engineer to prepare plans for the paving of Warburton Ave., from the end of the present asphalt to the north line of the city and also for the paving of North Broadway from a point 150 ft. north of Baldwin Pl. to the north city line.

Ohio.

✣Bids will be received until noon, April 16, by W. J. Springborn, Director of Public Serv-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ice, Cleveland, O., for furnishing creosoted wood paving blocks and planking. Specifications may be seen at the office of the Chief Engineer, room 305 City Hall.

✣Bids will be received until noon, April 18, by Board of Hamilton County Commissioners, Cincinnati, O., for the following work: Under Spec. No. 437 for improvement of Chester Ave., from Sharon Ave. to the Butler County line, in Sycamore Township. The work to be done according to the plans and specifications now on file in the office of the Board of County Commissioners. All bids must be made on blank forms, to be had at the office of the Board of County Commissioners, and be accompanied by a bond in the sum of $1,000. Albert Reinhardt is Clerk of the Board.

✣Bids will be received until noon, April 28, by Fred H. Shoaff, Village Clerk, Euclid, O., for furnishing material and labor necessary for the improvement of Dunham Ave., from the north line of Euclid Ave. to the south line of the N. Y., C. & St. L. R. R. right-of-way, by establishing a grade, grading, draining and paving same with brick, according to plans and specifications on file at the office of said Clerk at the Town Hall, and at the office of the F. A. Pease Engineering Co., at 931 Williamson Bldg., Cleveland, Ohio.

✣Bids will be received until noon, April 25, by Board of Hamilton County Commissioners, Cincinnati, O., for the improvement under Specifications 443 of the San Run Road from the State Road to the Indiana state line in Whitewater Township, the work to be done according to the plans and specifications now on file in the office of the Board of County Commissioners. All bids must be made on blank forms, to be had at the office of the Board of County Commissioners, and be accompanied by a bond in the sum of $500. Albert Reinhardt is Clerk of the Board.

✣Bids will be received until noon, April 25, by Board of Hamilton County Commissioners, Cincinnati, O., for the improvement under Specifications 439 of the Rapid Run Pike from the Cincinnati corporation line to Neeb Road in Delhi Township. The work to be done according to the plans and specifications now on file in the office of the Board of County Commissioners. All bids must be made on blank forms, to be had at the office of the Board of County Commissioners, and must be accompanied by a bond in the sum of $1,000. Albert Reinhardt is Clerk.

✣Bids will be received until noon, April 22, by H. H. Canfield, Village Clerk, Cleveland Heights, for the furnishing of one steam roller for the village. Specifications and plans are on file with F. A. Pease Engineering Co., 931 Williamson Bldg., Cleveland, O.

✣Bids will be received until 1:30 p. m., April 14, by Commissioners of Road District No. 1, Frank Agnew, Secy., Court House, Youngstown, O., for the improvement of the following roads located in Youngstown Township, viz.: Belmont Ave. extension from the Youngstown city limits to the Trumbull county line, a distance of 4,450 ft.; said improvement to be made of brick and two stone curbs. The Hubbard road from the east rail of the Erie R. R. tracks to the Trumbull county line, a distance of 5,221 ft.; said improvement to be made of brick and two stone curbs. The McGuffey road from the Youngstown city limits to the Coitsville Township line, a distance of 2,517 ft.; said improvement to be made of brick and two stone curbs. Each separate proposal must be accompanied by a certified check for $500 by a bank located in Mahoning County and made payable to the order of Frank Agnew, Secretary of said Road Commissioners, and mailed or delivered at their office, third floor of the Court House. Plans and specifications will be on file at the office of the County Auditor after April 7, 1913, and will be furnished to the bidder on application to E. S. Smith, Engineer, third floor, Court House, Youngstown, O.

✣Bids will be received until noon, April 25, by Board of Hamilton County Commissioners, Cincinnati, O., for the improvement under Specifications 447 of Country Club Road from Ridge Ave. to Ohio Ave., Silverton, in Sycamore and Columbia Townships. All bids are to be accompanied by a certified check for $2,000. Albert Reinhardt is Clerk of the Board.

✣Bids will be received until noon, April 18, by Board of Hamilton County Commissioners, Cincinnati, O., for the improvement under Specifications No. 427, of the Batavia Pike, from the Ohio Pike to the Clermont County line in Anderson Township. Plans and specifications are on file with the board. A bond for $5,000 must be filed with each bid. Albert Reinhardt is Clerk of the Board.

✣Bids will be received until 11 a. m., April 30, by Board of Cuyahoga County Commissioners, Cleveland, O., for the construction of improvements of Solon Road Extension in accordance with form of contract and specifications furnished by F. R. Lander, County Surveyor. A certified check for $1,000 must be filed with each bid. J. F. Goldenbogen is Clerk.

✣Bids will be received until April 15, at noon, by Mayor, at the office of Village Clerk, Shreve, O., for the furnishing of necessary materials and labor for the improvement of Market St., by grading, setting curbing and paving with vitrified paving block on concrete foundation. Plans and specifications can be seen at the office of the Village Clerk and at the office of L. E. Chapin, Engineer, Canton, O. Estimated cost of the improvement, $19,342. Clem Morgan, Corporation Clerk.

⊙F. D. Cummer & Son, of Cleveland, O., have been awarded the contract for the construction of a new asphalt plant for the city of St. Paul, Minn., for $10,950. Hetherington & Bremer Co., Indianapolis, Ind., bid $13,235 on the work.

⊙Stifel & Wolf Co., Toledo, O., has been awarded the contract by the Pultney Township Trustees, Belmont County, O., for the resurfacing and repairing of the roads in that township. Bonds in the sum of $75,000 for this work have been sold to Spitzer, Rorch Co., of Toledo.

⊙The Village Council of Geneva, O., has let the contract for the construction of brick pavement on Walnut St., for $11,593. The work includes 2,182 cu. yds. of excavation; 5,088 sq. yds. of brick pavement on concrete foundation; 2,880 lin. ft. of curbing; 1,050 ft. of 12-in. sewer pipe; 170 ft. of 10-in. inlet basin pipe; 3 manholes and 10 inlet basins. Other bidders were: Ohio Engineering Co., Lorain, $12,782; B. F. Hewitt, Jefferson, O., $12,534; Freshwater & Sons, West Virginia, $12,101, and Lininger & Bennett, Conneaut, O., $13,351.

⊙H. L. Hastings, Caldwell, O., has been awarded the contract by the State Highway Commission, Columbus, O., for grading and paving with brick for medium traffic Sec. 1 of the Woodsfield Northern road, Center Township, Monroe County, for $15,865. Bids were opened March 31.

⊙J. M. Stone, Marion, O., has been awarded the contract by the State Highway Commission, Columbus, O., for grading and paving with water bound macadam, the Beatty Road, Cardington Township, Morrow County, for $14,201. Bids were opened March 31.

⊙Thos. P. Fitzgerald, Ashtabula, O., has been awarded the contract by the city of Geneva., O., for paving Walnut St. with brick, including 5,088 sq. yds., for $11,281. Cumings & Downer, Painesville, O., are Engineers. Bids were opened March 25.

⊙Thos. Burton & Son, Wellington, O., have been awarded the contract by the State Highway Commission, Columbus, for grading the Pittsfield-Wellington Road in Wellington and Pittsfield Townships, Lorain County, for $7,899. Bids were opened March 31.

⊙Elyria Construction Co., Elyria, O., has been awarded the contract by the State Highway Commission, Columbus, O., for grading the Lake Shore Road in Black River and Brownhelm Townships, Lorain County, for $9,325. Bids were opened March 31.

⊙J. P. Long, Centerburg, O., has been awarded the contract by the State Highway Commission, Columbus, O., for grading and paving with waterbound macadam and bituminated concrete the Columbus Extension Road, Hilliar and Milford Townships, Knox County, for $19,284. Bids were opened March 31.

⊙C. N. Danenhower, Elizabeth St., Cincinnati, O., has been awarded the contract by the city of St. Bernard, O., for improving Imwalle Ave., by construction of macadamized roadway, concrete curb and gutters and necessary drains and tiling, for $3,307. Bids were opened March 20.

⊙Turner & Olson, Youngstown, O., have been awarded the contract by the Village Council of East Youngstown, for paving Robinson Road, for $4,617. E. Deora secured the contract to pave 5th St. Bids were opened March 31.

⊙J. W. Scott, Marion, O., has been awarded the contract by the State Highway Commission, Columbus, O., for grading and paving with waterbound macadam Section 2 of the Maysville-Marion Road, Clairbourne Township, Union County, for $2,919. Bids were opened March 31.

⊙Bope & Polumbo, 1710 N. High St., Columbus, O., have been awarded the contract by the State Highway Commission, Columbus, for grading and paving with waterbound macadam the Cincinnati-Chillicothe Road, in Miami Township, Clermont County, for $20,560. The road is 24,200 ft. long and 14 ft. wide. Bids were opened March 31.

⊙Baldwin, Little & Williams, Willoughby, O., have been awarded the contract by the State Highway Commission, Columbus, O., for grading and paving with bituminous surface treated concrete, the Weeds Corner Ext. Road in LeRoy Township, Lake County, for $25,010. The road is 11,686 ft. long and 12 ft. wide. Bids were opened March 31.

⊙Following contracts have been awarded by the village of East Youngstown, O., P. J. Carney, Jr., Clerk, for street improvements: Wilson Ave. paving—Kennedy Bros., of Youngstown, $36,974; Robinson Road paving—Turner & Olson of Youngstown, $4,617; Fifth St. grading—E. Deora of Youngstown, $1,841; Sixth St. grading—J. McCaren of Youngstown, $1,712; Seventh St. grading—J. McCaren, $936; Eighth St. grading—Gallagher & Erran of Youngstown, $1,036; Ninth St. grading and sewering—E. Deora of Youngstown, $3,189; Tenth St. grading—E. Deora of Youngstown, $1,548; Tenth St. sewer—E. Deora of Youngstown, $291; Reed Ave. grading—Gallagher & Erran of Youngstown, $1,516; Reed Ave. sewer—Gallagher & Erran of Youngstown, $2,315; Madison St. grading—Gallagher & Erran of Youngstown, $347.

No bids were received on March 31 by the State Highway Commission, Columbus, O., for grading and paving with a bituminous concrete pavement the Columbus Road, in Scioto Township, Ross County. The road is 5,280 ft. long and 16 ft. wide.

No bids were received on March 31 by the State Highway Commission, Columbus, O., for grading and paving with waterbound macadam the New Market Road in Franklin and Washington Townships, Brown County. The road is 13,200 ft. long and 10 ft. wide.

The City Council of Toledo, O., has adopted a resolution declaring it necessary to pave Jefferson Ave., from Ontario St. to Collingwood Ave.

The City Council of Toledo, O., has passed an ordinance declaring it necessary to borrow $15,000 for constructing sidewalks during the year.

The City Council of Amherst, O., has retained Engineer C. W. Courtney, of Cleveland, O., to draw plans and specifications to pave, drain and grade Main, Elyria, Church and a number of side streets to the freight depot. A preliminary estimate places the cost at $43,500.

The City Council of Upper Sandusky, O., has decided to pave Eighth St., from the Pennsylvania Railroad north to Bigelow St.

Heffner & Son, of Celina, O., submitted the lowest bid to the City Council of St. Marys, O., for the construction of 20,000 sq.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

yds. of pavement. Lambert Bros. & Wert, of Delaware, O., were second lowest.

The Deshler Construction Co., of Deshler, O., is reported to have submitted the lowest bid to the Village Council of Minster, O., L. R. Schmieder, Clerk, for street paving. Other bidders were: T. J. Mulligan & Son, Lima, O.; G. H. Heffner & Son, Celina, O.; Curtin & Co., Dayton, O.; Case & Meyers, Wheeling, W. Va.; H. F. Enck, Lima; Fitzmaurice & Bird, Portland, Ind.; Henry Huffine, Franklin, Ind.; Lambert Bros. & Wert, Delaware, O.; Lowery, Mannix & Hayes; Midland Construction Co., Lima; Drake & Son, and W. J. Howell, Minster.

City Engineer F. H. Wyatt, of Cuyahoga Falls, O., has completed estimates of the cost of paving, installing sewers and laying sidewalks on West Portage St., Tallmadge and Northampton Aves.

Oklahoma.

⊙Bids were received at Cleveland, Okla., on March 24 for paving work for which plans were prepared by the Benham Engineering Co,. of Oklahoma City, Okla. In the table shown below (1) stands for bid of Swatek & Parker, Oklahoma City (awarded contract), (2) Connelly Construction Co., El Reno, Okla., (3) R. R. Fuller, Oklahoma City, (4) Dudley Paving Co., Stillwater, Okla., and (5) Cleveland-Trinidad Co., Cleveland, Ohio:

	(1)	(2)	(3)	(4)	(5)
Vitrified brick block, 4-in. concrete base (1-3-6), 1½-in. sand cushion, cement filler, 18,200 sq. yds.	$ 1.82	$ 1.83	$1.97	$ 1.97	$ 2.02
Earth excavation, 6,000 cu. yds.	0.30	0.40	0.20	0.35	0.35
Rock excavation, 100 cu. yds.	0.70	2.50	0.20	2.00	0.50
Straight concrete curb, 4,400 lin. ft.	0.49	0.46	0.40	0.50	0.60
Radius concrete curb, 500 lin. ft.	0.65	0.50	0.40	0.55	0.65
Crossing covers in place, 32	15.00	14.00	8.00	20.00	15.00
3-in. oak header, 650 lin. ft.	0.15	0.22	0.15	0.15	0.30
Totals	$38,053	$38,821	$39,388	$41,367	$42,554

Oregon.

⊙The E. W. Geiger Construction Co., Leavenworth, Kans., and U. S. Bank Bldg., Salem, Ore., has been awarded the contract by the City Council of Salem, Ore., to grade, curb, drain and pave with concrete three streets aggregating 22 blocks in length.

The Umatilla County Commissioners, Pendleton, Ore., have decided to construct a 10-mile road near Pendleton at a cost of about $50,000. The sum was recently appropriated for the work.

The City Council of Condon, Ore., has retained Engineer J. W. Morris to superintend the surveying of the streets and the laying of the proposed pavement. It has been decided to pave five blocks on Main St.

Bids were received at Dalles City, Ore., C. L. White, City Engineer, on March 25, for the construction of pavements. In the table shown below (1) stands for bid of Linden-Kibbe Construction Co., Selling Bldg., Portland, Ore.; (2) J. G. Baker, The Dalles, Ore.; (3) Ambrose-Birdsall Co., 716 Board of Trade Bldg., Portland, Ore.; (4) D. A. Williams Co., 608 Savage Scofield Bldg., Tacoma, Wash.; (5) J. C. Maguire, Salt Lake City, Utah; (6) Montague-O'Reilly Co., 45 Fourth St., Portland, Ore.; (7) C. G. Hedges, The Dalles, Ore.:

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Asphaltic concrete, 2-in. top on 4-in. concrete base	49,332 sq. yds.	....	....	$ 1.35	$ 1.46	$ 1.47	$ 1.55	....
Asphaltic concrete, 2-in. top on 3-in. rock base	49,332 sq. yds.	$ 1.15	....	1.20	1.26	1.31	1.36	....
Asphaltic concrete, 1½-in. top on 4-in. concrete base	49,332 sq. yds.	....	....	1.30	1.40	1.40	1.44	....
Asphaltic concrete, 1½-in. top on 3-in. rock base	49,332 sq. yds.	1.13	....	1.15	1.20	1.22	1.25	....
Asphaltic concrete, 2-in. top alone	49,332 sq. yds.	0.95	....	0.95	0.90	1.15	....	....
Asphaltic concrete, 1½-in. top alone	49,332 sq. yds.	0.90	....	0.90	0.85	1.07	....	....
Bitucrete, 2-in. top on 5-in. concrete base	49,332 sq. yds.	1.70	....	....	....	....	....	....
Bitucrete, 2-in. top on 4-in. concrete base	49,332 sq. yds.	1.55	....	....	....	....	....	....
Bitucrete, 1½-in. top on 4-in. concrete base	49,332 sq. yds.	1.38	....	....	....	....	....	....
Bitucrete, 1-in. top on 4-in. concrete base	49,332 sq. yds.	1.25	....	....	....	....	....	....
Dolarway, 5-in. concrete, ¼-in. bitumen surface	49,332 sq. yds.	....	$ 1.17	....	1.44	....	....	....
Excavation	10,928 cu. yds.	0.60	0.50	0.60	0.70	0.60	0.55	....
Straight curb	5,292.5 ft.	0.35	0.37	0.35	0.28	0.38	0.35	$0.35
Circular curb	262.9 ft.	0.60	0.55	0.55	0.48	0.40	0.45	1.00
6-in. vitrified sewer pipe, laid	154 ft.	0.60	0.50	0.80	0.40	0.50	0.60	....
Catch basins	12 each	15.00	12.00	20.00	12.00	15.00	10.00	....
Rock excavation		3.50	2.85	2.00	2.50	3.00	2.00	....

The Warren Construction Co., Journal Bldg., Portland, Ore., submitted the following bids for the construction of 49,332 sq. yds. of bitulithic pavement:

Bitulithic, 2-in. top on 5-in. concrete	$ 1.96
Bitulithic, 2-in. top on 4-in. concrete	1.81
Bitulithic, 1½-in. top on 4-in. concrete base	1.71
Bitulithic, 1½-in. top on 3-in. rock base	1.51
Bitulithic, 1½-in. top alone	1.21
Bitulithic resurface (excavation included)	1.49
Excavation	0.45
Straight curb	0.35
Circular curb	0.50
6-in. vitrified sewer pipe, laid	0.60
Catch basins	10.00
Rock excavation	2.50

Pennsylvania.

⊙The Select Council of Wilkes-Barre, Pa., has awarded the contract for the cleaning of the streets of the city to Curnow & Murray.

Bids were received on March 24 by the Borough of Chambersburg, Pa., R. M. Huber, Engineer, for the construction of 15,700 sq. yds. of pavement and about 3,100 lin. ft. of curbing. The low bids on the various kinds of pavement are as follows: Stucker Bros., Porter brick, $2.32; American brick, $2.32; Central Construction & Supply Co., Mack brick, $2.24; Saxton brick, $2.10; Pennsylvania brick, $2.12; Patton brick, $2.10; Fairmont brick, $2.19; Patterson brick, $2.15; Clearfield brick, $2.18; Grafton brick, $2.15. Stucker Bros., V. S. Co.'s 3-in. wood block, $2.88. H. C. Brooks Co., Wykoff 3-in. wood block, $3.02. Nelson-Merydeth Co., Credone wood block, $3.34. Central Construction & Supply Co., Barber's 3-in. wood block, $3.00. Nelson Merydeth Co., Dolarway, $1.65. Hassam Paving Co., Hassam, $1.29; Hassamite, $1.64. Chas. P. Walters, Warrenite $2.23; Warrenite with Walter's base $2.12. Atlantic Westrumite Co. Westrumite $1.73. Central Construction & Supply Co., asphaltic concrete, $1.71; asphaltic macadam, $1.77; sheet asphalt, $1.85. Field, Barker & Underwood, Roman road, $1.49. A list of the bids received on curbing and sidewalks for the pavement is shown in the following table, (1) standing for bid of H. C. Brooks Co.; (2) Atlantic Westrumite Co.; (3) Hassam Paving Co.; (4) Nelson-Merydeth Co.; (5) Central Construction & Supply Co.; (6) Chas. P. Walters; (7) Progressive Realty Co.; (8) Field, Barker & Underwood; (9) J. B. Trexler, and (10) Stucker Bros.:

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Granite curbing, 500 ft.	$1.20	$1.26	$1.27	$1.50	$1.09	$0.90	$1.10	$1.82	$1.32	$1.00
Granolithic curbing, 500 ft.	0.70	0.70	0.60	0.30	0.47	0.35	0.60	0.46	0.39	0.70
Steel-bound granolithic, 1,000 ft.	0.90	0.90	0.75	0.50	0.62	0.60	0.80	0.70	0.61	0.88
Resetting curbing, 900 ft.	0.35	0.40	0.15	0.50	0.40	0.15	0.30	0.71	0.44	0.20
Sidewalk, concrete, 200 ft.	0.15	0.22	0.20	0.15	0.10	0.05	0.125	0.15	0.15	0.20
Sidewalk, brick, 200 ft.	0.22	0.20	0.20	0.16	0.15	0.05	0.125	0.18	0.16	0.20

✣Bids will be received until April 14, by R. Mackenzie, City Controller, Oil City, Pa., for about 13,000 sq. yds. of brick, bituminous concrete, asphalt block or wood paving block and for about 8,000 ft. of sewers. B. B. Weber is City Engineer.

✣Bids will be received until noon, April 28, by G. F. Greiner, secy. Town Council, Ridgway, Pa., for grading, paving and curb setting in accordance with plans and specifications now on file at the office of F. W. Ward, Borough Engineer, Room 10, Masonic Temple, Ridgway, Pa. Official advertisement will be found elsewhere in this issue.

⊙Contracts for road material and hauling were awarded by the Allegheny County Commissioners, Pittsburgh, Pa., on April 4. James Creese, William Grew, Charles Vere, Central Supply Co., A. G. Rothey, John Bardoner and L. Z. Hodil were awarded hauling contracts at prices ranging from $.73 to $1.77 a ton. The Donald McNeil Co. and the Pittsburgh Amiesite Co. were given contracts for asphalt concrete at from $8.46 to $9.62 a ton. The Clydesdale Stone Co. will furnish ballast at from $1.23 to $1.33 a ton. C. P. Mayer was awarded contracts for brick block at prices ranging from $15.45 to $16.95 a ton, and the Rodgers Sand & Gravel Co. was awarded sand and gravel contracts.

Tennessee.

⊙The City Council of Morristown, Tenn., has awarded the contract for paving two residence districts, West Main and West Second North Sts., to the Murray Construction Co., for $1.90 for asphalt and $0.50 for grading per sq. yd.

⊙Oliver & Hill, of Maryville, Tenn., have been awarded the contract by the Sullivan County Commissioners, Blountville, Tenn., for the construction of good roads at about $200,000. Work will be started at once on the Kingsport Road, to be built to connect Bristol and Kingsport.

Texas.

⊙N. H. Dawson, Seadrift, Tex., has been awarded the contract by the Calhoun County Commissioners, Port Lavaca, Tex., for the construction of about 30 miles of gravel surfaced highway in Road District No. 2. Bids were opened March 28.

Mayor H. W. Runnells and the City Council of Texarkana, Tex., will shortly submit a proposition to the voters for the issuance of a series of improvement bonds to aggregate $250,000, for paving the streets and otherwise improving the city and suburbs.

The Midland County Commissioners, Midland, Tex., have set April 22 as the date of election to decide whether the county shall issue $50,000 bonds for the construction of good roads.

The citizens of Road District No. 1, Nueces County, Tex., on March 22, voted bonds to the amount of $100,000 for good roads construction. The district comprises over 70,000 acres of land and about 50 miles of roads. Corpus Christi is the county seat.

Washington.

✣Bids will be received until April 25, by board of Whatcom County Commissioners, Bellingham, Wash., for the construction of two permanent highways, under the Permanent Highway Act, as follows: The northeast diagonal road from the city limits to the city of Bellingham, northeast 8,400 ft.; and the northwest diagonal road, from a point about 1 mile northwest of the said city limits, northwest 9,800 ft. These two old roads will be cleared to full width of right of way (60) and the roadbed widened to 24 ft. Permanent culverts of concrete will replace old culverts and a concrete pavement 6 ins. in thickness and 16 ft. wide be constructed entire distances mentioned. Concrete pavement will be built in one course of proportions of one part cement, two parts coarse sand, and three and one-half parts of gravel. Expansion joints every 50 ft., the edges of concrete at joints protected with ½-in. soft steel plates. Four-ft. gravel shoulders on each side. Square yards of pavement on Northwest Diagonal Road, 17,422, on Northeast Diagonal Road, 14,611. Lump sum bids will be required, accompanied by certified check amounting to 10 per cent of amount of bid. Specifications, plans, etc., in office of the County Engineer, C. M. Adams.

William Ollar, of Tacoma, Wash., submitted the lowest bid to the County Commissioners, Tacoma, Wash., for concreting permanent highway No. 2 and the Tacoma-Puyallup Road, at $39,400 and $35,573, respectively.

Following bids were received by the Lincoln County Commissioners, Davenport, Wash., for the paving of seven miles of road out of the city of Davenport: A. S. Emery & Co., Spokane, Wash., $37,000; Mitchell Bros., Spokane, Wash., $37,200; Spokane Asphalt Macadam & Paving Co., $34,000; John T. Costella & Co., $35,700.

West Virginia.

⊙The Board of Control of Wheeling, W. Va., C. B. Cooke, City Engineer, has awarded the following contracts for the curbing with stone and concrete and paving with brick and sheet asphalt or bitulithic on concrete foundation of certain streets in the city, for which bids were opened April 4: L. G. Hallock & Son Co., Coss & Meyers, J. A. Jacworthy, Wheeling, Ward & Patrick, Wellsburg, W. Va., and Vincent Vercellotti, Wheeling.

The City Council of Parkersburg, W. Va., has adopted a resolution calling a special election to be held on May 8, when a $200,000 bond issue to provide for street paving improvements will be voted upon.

Wisconsin.

✣Bids will be received until 8 p. m., April 14, by Board of Public Works, West Allis, Wis., for paving parts of 73d, 65th and 63d Aves., and part of Elm. St. in said city. Bids will be received for 6-in. concrete foundation, and four following kinds of wearing surface, to wit: Brick, sheet asphalt with binder, sheet asphalt without binder, and creosoted wood block; also for stone curbing and combination cement curb and gutter and necessary grading. Approximately 28,000 sq. yds. of pavement, 16,000 lin. ft. of combined curb and gutter, and 8,000 cu. yds. of grading. Plans, specifications and forms for bidding and contract on file with L. F. Fish, City Clerk. Work to be done under 5-year guaranty and to be completed in 75 days from signing contract.

✣Bids will be received until May 15, it is reported, by Board of Public Works, Wausau, Wis., for laying seven blocks of permanent pavement. Vitrified brick is under consideration.

⊙The City Counsel of Menasha, Wis., has let the contract for the pavement of Broad St., from Racine to Manitowoc St., to the Kasel Construction Co., of that city, for $11,801. Other bidders were: Fred Eul, Menasha, $12,858, and Christ Johnson, Oshkosh, Wis., $13,038.

The City Council of Beaver Dam, Wis., has ordered an election held for the purpose of voting on the proposed paving of Park Ave., West Front St. and South Spring St. It is also proposed to pave Madison, N. Center and Washington Sts.

The City Council of Janesville, Wis., has ordered curbs and gutter laid on parts of Glen St., Prospect Ave. and Forest Park Blvd.

The Brown County Board of Supervisors, Green Bay, Wis., has made an appropriation of $6,000 for the purchase of road machinery.

Wyoming.

⊙The Dolarway Paving Co., of Oregon and Washington, Seattle, Wash., has been awarded the contract by the city of Sheridan, Wyo., for the construction of 21,850 sq. yds. of pavement.

Canada.

⊙The Western Pavers, Ltd., Winnipeg, Man., has been awarded the contract by the city of Saskatoon, Sask., for the construction of concrete sidewalks, curbing and crossings for $63,966. The work includes 265,390 sq. ft. of concrete walks, 5,700 sq. ft. of lane crossings, 28,760 lin. ft. of separate curb, and 22,050 lin. ft. of combined curb. Bids were opened March 29.

DRAINAGE AND IRRIGATION

Arizona.

⊙Bowen & Shumway, Mesa, Ariz., have been awarded a $15,000 contract for constructing bridges and other concrete work on the High Line Canal south of Tempe.

Arkansas.

⊙Forrestal & Feyen, St. Paul, Minn., have been awarded the contract at about $75,000 for constructing 30 miles of dredge ditches for the Overcup Drainage District of Jackson and Woodruff Counties, bids for which were opened April 4 at Newport, Ark. The work is divided into two contracts as follows: Contract 1, including 18.40 miles of ditches involving 590,573 cu. yds.; Contract 2, including 11.56 miles involving 351,200 cu. yds. About three-fourths of the district is in cultivation, but a much smaller proportion of the ditch line is through cultivated land. Most of the remainder is in flat, wet, bottom land, where the water supply will be continuous throughout the year. The soil is clay and sand, and mixtures of the two, being very similar in character to that of Southeast Missouri. But little of the ditch line is covered with heavy timber, as compared with the timber in Eastern Arkansas. The location, size and grades of this work make it very desirable for two dredges of 1½ or 2-yd. capacity. There are no deep cuts, and no old streams or bayous to follow. All parts of the district are readily accessible by wagon roads, and a railroad runs throughout its length. Payment for the work will be made in cash. The Morgan Engineering Co., Memphis, Tenn., is the engineer.

Illinois.

✣Bids will be received until April 22, by the Illini Drainage District, Warrensburg, Ill., for the construction of a drainage system near Latham, Macon County, requiring 7,400 lin. ft. 24-in., 1,000 lin. ft. 22-in., 1,400 lin. ft. 16-in., 1,400 lin. ft. 15-in. and 1,300 lin. ft. 14-in. drain tile. P. T. Hicks is Engineer, Decatur, Ill. Charles Faith is Supervisor, Warrensburg, Ill.

⊙Leach Bros. have been awarded the contract at 11½ cts. per cu yd., for constructing ditches for the Fulkerson Drainage District of White County. The work requires about 35,896 cu. yds. of excavation. Bids were opened March 29 at Carmi, Ill.

Indiana.

✣Bids will be received until April 17, by Louis Meyer, Engineer and Commissioner of Construction, Booneville, Ind., for the construction of the Homer F. Totten Ditch in Skelton Township, Warrick County, Ind. The main ditch will be about 25,090 ft. long and will require about 233,600 cu. yds. of floating dredge work. One steel bridge will be removed and replaced.

✣Bids will be received until 11 a. m., April 19, by Milton L. Nees, Drainage Commissioner, at the office of the County Surveyor, Crawfordsville, Ind., for the construction of a drain 8,650 ft. in length.

⊙Contracts for construction of the Kemper drain in Porter County have been awarded to the following contractors: Wm. Brown, Hebron, Ind.; C. Jones, Boone Grove, Ind.; North, Frazier & Co., Bluffton, Ind.

Iowa.

✣Bids will be received until noon, April 28, by H. B. Frase, County Auditor, Polk County, Des Moines, Ia., for the construction in accordance with the plans, drawings and specifications of the Engineer of Drainage Ditch No. 14, Lincoln and Crocker Townships, Polk County, Iowa, said ditch being embraced wholly within one section and requiring the excavation of approximately 1,100 cu. yds. of earth, digging trenches, laying tile and back filling ditch, and the laying of 4,000 ft. of 22-in. tile, average depth 5.6 ft.; 2,500 lin. ft. 20-in. tile, av. depth 5.6 ft.; 7,600 lin. ft. 18-in. tile, av. depth 6.4 ft.; 7,900 lin. ft. 16-in. tile, av. depth 6.4 ft.; 7,300 lin. ft. 14-in. tile, av. depth 5.8 ft.; 7,600 lin. ft. 12-in. tile, av. depth 5.8 ft.; 9,380 lin. ft. 10-in. tile, av. depth 5.4 ft.; 20 lin. ft. 10-in. ¾-in. cast iron pipe; 1 concrete bulkhead, containing approximately 3 cu. yds. of concrete. Length of ditch, 8.75 miles; longest haul, 2.50 miles; shortest haul, .25 mile. For further and more detailed information as to work, etc., see the plans, drawings and specifications of the Engineer, now on file in the office of the Auditor of Pork County at Des Moines, Iowa.

⊙Contracts for work in five drainage districts in Hardin County have been let as follows: Ditch No. 36, four miles north of Hubbard, Hawkeye Construction Co., at $1,990; Ditch No. 37, 3½ miles west of Alden, tile contract to the Eldora Pipe & Tile Co., at $2,066, and the labor to the Blackhawk Construction Co. Ditch No. 39, west of Alden, tile let to Eldora Pipe & Tile Co., at $4,972; labor to the Blackhawk Construction Co., at $5,150. Ditch No. 40, west of Alden; all labor bids were rejected, but the Eldora Pipe & Tile Co. secured the contract for the tile at $361. Ditch No. 41, 1½ miles from Racine; labor bids were rejected and the tile contract let to the Eldora Pipe & Tile Co., at $2,731.

Louisiana.

⊙R. W. Chappell, Crowley, La., has been awarded the contract for constructing several miles of canal for the Louisiana Irrigation & Mill Co., in the Fifth Ward of Acadia Parish, in the Mermentau section.

Michigan.

⊙Contracts for constructing the Hartshorn and Extension Drains in Flint and Mt. Morris Townships, bids for which were opened March 25 by A. H. Heid, County Drain Commissioner, Flint, Mich., have been let as follows: Open work, John Smaley, Lapeer, Mich., $5,000; tile work, Claude Green, Goodrich, Mich., $1,690; tile, J. P. Bourroughs & Son, $2,200.

⊙Contracts for constructing a state drain 14 miles long in the northern part of Calhoun County have been let as follows: Dredge work, Wolmar Construction Co., Sandusky, $15,990; steel work, Beach Manufacturing Co., Charlotte, $2,384; concrete work, C. B. Mead and Frank Stultz, $3,347.

Minnesota.

✣Bids will be received until 10 a. m., April 11, by E. J. Brandt, Douglas County Auditor, Alexandria, Minn., for repairing and cleaning out Judicial Ditch No. 2 from Station 501 to Station 330 and from Station 173 to Station 125. The work involves 48,844 cu. yds. of excavation and will cost, it is estimated, about $12,200.

✣Bids will be received until 2 p. m., April 17, by M. J. Parcher, County Auditor, Owatonna, Minn., for the completion of Ditch No.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

I. A certified check for 10 per cent the amount bid must accompany each proposal.

Plans have been completed by S. S. Chute, County Surveyor, St. Cloud, Minn., for County Ditch No. 32. The ditch covers 23.6 miles and runs through the towns of Lake George, Getty, Raymond and North Fork. The cost is about $26,600 and will reclaim 5,000 acres of land.

Missouri.

All bids received March 25 by A. E. Berry, Glenwood, Mo., Secretary Chariton Drainage Supervisors, were rejected. The work calls for 36 miles of open ditch requiring 256,000 cu. yds. of earth excavations.

Montana.

✣Bids will be received until 2 p. m., April 30, by the United States Reclamation Service, Great Falls, Mont., for furnishing 5, more or less, 70-ton electric power shovels for use on the Milk River and Sun River projects, Mont.

✣Bids will be received until 2 p. m., April 28, by U. S. Reclamation Service, Babb, Mont., for furnishing two, more or less, 70-ton steam shovels for use on the Milk River project, Mont.

✣Bids will be received until 2 p. m., April 30, by U. S. Reclamation Service, Great Falls, Mont., for the construction of the Pishkun Reservoir Supply Canal, the Sun River Slope Canal and Tunnels No. 2 and No. 3, of the Pishkun Reservoir Supply Canal, involving the excavation of about 2,400,000 cu. yds. of material and the construction of about 3,215 lin. ft. of concrete lined tunnel. The work is situated on the north side of Sun River, 25 to 70 miles west of Great Falls, Mont., and near the line of the Sun River branch of the Great Northern Railway. For particulars address the United States Reclamation Service, Washington, D. C.

New Mexico.

The Carlsbad Plantation Co., according to advices from Carlsbad, N. Mex., has completed plans for the extension of its main canal to the lower part of the 2,000-acre tract east of the Pecos River.

Ohio.

⊙W. H. Ralston, R. F. D., Salem, O., has been awarded the contract at $26,160 for constructing Salem Ditch No. 3 in Perry Township, bids for which were opened April 1 by B. M. French, County Surveyor, Salem, O. The work includes 28,250 cu. yds. earth excavation, 24,926 cu. yds. earth and rock excavation, 789 cu. yds sewer trench excavation, 1,700 lin. ft. 24-in. sewer pipe, 1 catch basin, 1 manhole and 17 cu. yds. masonry.

Texas.

✣Bids will be received until 11 a. m., April 19, by Commissioners of Drainage District No. 6, Harris County, at Room 304 Commercial Bank Bldg., Houston, Texas, for the construction of drainage ditches. Blank forms for bidders and detailed plans and specifications will be furnished by the Secretary, G. Bohmert, East Houston, Texas, or by J. S. Burk, Drainage Engineer, Room 304, Commercial Bank Bldg., Houston, Texas. J. O. Ralston is Chairman of the board.

⊙Contracts for work for the Hildago Drainage District No. 1, bids for which were opened March 26 by George B. Merriwether, Chairman Commissioners, Donna, Tex., have been let as follows: Grubbing and clearing right-of-way, Beatty & Evans, Pharr, Tex., at $13.85 per acre; excavation, H. P. & J. S. McNeal, Mercedes, Tex., at 12¾ cents per cubic yard. The excavation amounts to 67,000 cu. yds. The grubbing and clearing is for a right-of-way about 500 ft. wide for a distance of 39.8 miles and totals about 2,427 acres.

Washington.

The contract with the government for supplying water for the Kittitas Reclamation District has been signed and surveys and plans for the canals have been completed. The directors of the district are now negotiating for the sale of the bonds. As soon as the bonds are sold it is the intention to advertise for bids on the construction work. Frank C. Kelsey, Ellensburg, Wash., is Chief Engineer of the District.

The Brewster Irrigation District has been organized, has collected its first annual assessment for administrative expenses and is about to enter its second year under a new board of directors. The financing of the project has been placed in the hands of the Great Northern Ry. representatives, and it is hoped to have a favorable report in the near future. The district may call for bids on a cash basis only, or it may be that bids will be called for on the basis of bonds in lieu of cash. The preliminary survey was made by Marvin Chase, of Wenatchee, Wash.; D. C. Henny, of Portland, and A. J. Wiley, Boise, Idaho, have also acted as Consulting Engineers. Frank H. Phipps, Brewster, Wash., is Secretary of the District.

WATER WORKS

Arkansas.

⊙R. M. Galbraith, of Pine Bluff, Ark., has been awarded a contract by the city of Sulphur Springs, Ark., to construct an electric light and water plant. The contract price is $21,346. A. C. Moore, Joplin, Mo., is Engineer.

⊙The Fountain-Shaw Engineering Co., of Dallas, Tex., has been awarded the contract for the construction of a waterworks system and a sewerage system at Clarksville, Ark. The American Cast Iron Pipe Co., of Birmingham, Ala., will supply the cast iron pipe; the Columbian Iron Works, of Chattanooga, Tenn., the valves and hydrants; the Chicago Bridge & Iron Works, of Chicago, Ill., the tank and tower, and Reeves-McKinney Machine Co., of St. Louis, Mo., the pumps. The estimated cost of the systems is $25,000 and $20,000, respectively.

California.

The Sacramento-Sierra Water Co. has offered to furnish the city of Sacramento with water from the mountains in Amador County, 50 miles distant. Edward Records is President of the company.

Mayor Heitzeg, City Trustee, and W. M. Robson, City Engineer, of Tulare, Calif., recently inspected the old water system, gathering data for the plans for the new municipal water system.

The city of Tulare, Cal., is calling for bids on material and labor necessary to install a distributing system, and also on a 150,000 gal. steel tank and tower. Bids will be opened the last of April or first of May. Sloan & Robson, Nevada Bank Bldg., San Francisco, Cal., are Engineers, and specifications may be secured from them or from the city clerk at Tulare.

Colorado.

The citizens of Johnstown, Colo., have voted the issuance of bonds in the sum of $20,000 for the construction of a waterworks system. William Parkin is Mayor.

Connecticut.

Bids have been received by the Meriden Water Commission, Meriden, Conn., for the construction of a concrete dam, a concrete distributing reservoir, 24,000 ft. of pipe line, and for cleaning the present reservoir. The Pierson Engineering & Construction Co. was one of the low bidders.

Delaware.

The Pure Water Still Co., of Wilmington, Del., has been incorporated with a capital stock of $250,000. The incorporators are: G. G. Stiegler, E. S. Hellings and W. M. Pyle, all of Wilmington.

Florida.

The citizens of Fort Myers, Fla., at a recent election voted the issuance of bonds in the sum of $7,000 for waterworks extension and fire protection.

Georgia.

✣Bids will be received until 3 p. m., April 24, by J. T. Roberts, Mayor, and Council, Valdosta, Ga., for the construction and erection of a Corliss cross compound condensing pumping engine, 3,000,000 gals. capacity. At the same time and place above, mayor and council will receive bids for one 3,000,000 gals. semi-rotative triple expansion dulpex pumping engine. Both engines to be equipped with condenser of sufficient capacity to take care of 1,500 lbs. steam per hour in addition to full capacity of pump. Submit your specifications for triple. Show guaranteed duty on both machines on full load, three-quarter load, one-half load and one-quarter load. It is the intention of the mayor and council to purchase one of above machines, not both. All proposals, contracts, specifications and bonds shall be made upon the blank forms as prescribed in pamphlet (for crank and fly wheel machine), which pamphlet may be had on application to D. S. Quarterman, Supt. Water Works, Valdosta, Ga.

An election has been called in Whigham, Ga., for April 18 to vote on the issuance of bonds in the sum of $6,000 for the erection of an electric light plant, and to the amount of $2,000 for improving the present water system of the town.

The City Council of Valdosta, Ga., has decided to advertise for bids on new machinery for the water plant. The estimated cost is $10,000.

The City Council of LaGrange, Ga., has let a contract with James Nesbit Hazlehurst, Engineer of Atlanta, Ga. to draw the plans and specifications for a new waterworks plant to cost $140,000.

Illinois.

✣Bids will be received until 2 p. m., April 14, by Commanding Officer, Rock Island Arsenal, Rock Island, Ill., for furnishing one centrifugal pump, one 30-h.p. motor and one oil circuit breaker. The pump shall test 800 gals. actual delivery with 7-in. suction and 6-in. discharge.

William Tunney, of Joliet, Ill., submitted the lowest bid to the City Council of that city for furnishing pumping machinery for the new Van Buren St. artesian well, the bid being $7,200.

Indiana.

⊙The Harrisburg-Fleming Engine Co. has been awarded the contract by the city of Lawrenceburg, Ind., for furnishing engines for the municipal lighting plant, and the Fort Wayne Electric Works, Fort Wayne, Ind., secured the contract to furnish generator for the plant. The contracts amount to $4,299. Paul H. White, Union Trust Bldg., Indianapolis, Ind., is Engineer. Bids were opened March 24.

Iowa.

⊙C. W. Roland Co., Des Moines, Ia., has been awarded the contract by the city of Epworth, Ia., for the installation of a water works plant for $9,300. Bids were opened April 1.

The citizens of Guthrie Center, Ia., have voted the issuance of bonds for the extension of the water mains to give fire protection to all within the corporation.

Kansas.

✣Bids will be received until 7 p. m., April 21, by O. E. White, City Clerk, Jewell City, Kan., for furnishing f. o. b. cars to Jewell City, Kan., the following material and machinery, also for furnishing tools and labor required to construct and install a waterworks system in Jewell City, Kan. Bidders are invited to be present, and to submit bids on the following items: 317 tons of cast iron pipe, sizes 4, 6 and 8-in.; 14,660 lbs. of special castings, 16,750 lbs. of lead and 400 lbs. of jute, 8,300 lin. ft. 2-in. galvanized wrought iron pipe, 41 fire hydrants, miscellaneous list of 2, 4, 6 and 8-in. valves, and one 12-in. sluice gate, 50,000-gal. elevated steel tank, complete, including foundations; two 20-h.p. gasoline engines, two 250 G. P. M. triplex pumps, two 250 G. P. M. centrifugal pumps, low lift. Furnishing the mechanical equipment of a 200,000-gal. filter plant. Also for furnishing all the tools, labor and material required to excavate trenches, lay mains, set valves and hydrants, install pumps and engines, and install the filter plant. Complete plans and specifications are on file with the City Clerk, or may be seen at the office of the Consulting Engineer, E. E. Harper, 911 Grand Ave. Temple, Kansas City, Mo. Bidding blanks will be furnished by the Engineer. Parties desiring separate copies of the plans and specifications for their own use may obtain same from the Engineer on the payment of $3.00 to cover cost of blueprints, etc. Each proposal must be accompanied by a certified check of not less than 5 per cent of the amount bid, made payable to J. Otis Lafier, City Treasurer.

Maryland.

✣Bids will be received until April 30 by Board of Awards at the office of the City Register, Baltimore, Md., for the mechanical filtration plant. Ezra B. Whitman is Water Engineer. Official advertisement will be found elsewhere in this issue.

Massachusetts.

The Board of Selectmen of East Long Meadow, Mass., F. C. Burton, Chairman, will ask for bids at once for the construction of a waterworks system, at an estimated cost of $40,000. The work will include 32,000 ft. of 6 and 8-in. cast iron pipe, with valves, hydrants and meters.

The City Council of Quincy, Mass., has appropriated $50,000 for the extension of the water system.

The citizens of Randolph, Mass., have voted that the Water Commissioners be authorized to extend the water main from its present terminus on Pond St. to North Main St., and thence to connect with the main on Old St., and that they jointly with Holbrook purchase a new boiler and pump and install the same at the Great Pond pumping station, the expense to the town for both of the above not to exceed $6,000.

The citizens of Lanesboro, Mass., have voted an appropriation of $200 to investigate a source of water supply. Julius S. Pierce is Selectman.

The Massachusetts Legislature has granted the town of Peabody permission to obtain an additional water supply from the Ipswich River. Engineer Guy C. Emerson has estimated the cost of obtaining the supply at $60,911 for a period of 30 years. The total cost of construction, or the development with a temporary station below Humphrey's Brook, estimated for 20 years' service, is $374,300. This includes an item of $205,000 for filters of 4,000,000 gals. capacity.

Minnesota.

⦿John P. Greene, North Broadway St., Albert Lea, Minn., has been awarded the contract by that city, C. J. Dudley, City Clerk, for extending the water mains to Oakwood for $4,456. The work includes 3,804 ft. of 6-in. cast iron mains, 4 steamer connections, fire hydrants, 7 gate valves, 10 tees, 1 cross, 8 plugs, 11 bends, 3 flexible ball joints, etc. Bids were opened March 31.

⦿Chas. Emmerich has been awarded the contract by the city of New Ulm, Minn., A. J. Meyers, City Clerk, for placing gates and hydrants on Fifth, North St., from Garden St. to the Loretta hospital, for $1,424. Bids were opened March 28.

Following bids were received by the City Council of Faribault, Minn., for furnishing 97 tons of water pipe, 6 and 8-in.: U. S. Cast Iron Pipe & Foundry Co., $26.55 per ton; National Iron & Steel Co., $26.60; American Cast Iron Pipe Co., $27.50; James B. Clow Co., $27.50.

The Village Council of Morgan, Minn., J. Hartwick, Recorder, on April 7 received bids for the drawing of plans and specifications for the construction of a waterworks system, viz.: Steel tower 120 ft. in height, steel tank with a capacity of 50,000 gals., well with a capacity of 120 gals. per minute, power station with both gasoline engine and motor power, approximately 13 blocks of mains.

Missouri.

✣Bids will be received until noon, April 18, by Board of Public Improvements, St. Louis, Mo., for the construction of the following waterworks improvements: Letting No. 10,877—For furnishing all tools, materials and labor for the construction and completion of an intake, tower, tunnel and screen chamber at the Chain of Rocks, in accordance with plans and specifications, approved by the Board of Public Improvements, and now on file in the office of said Board. Deposit required, $11,475. Letting No. 10,878—For furnishing all tools, materials and labor for the construction and completion of the Chain of Rocks filter equipment, in accordance with plans and specifications, approved by the Board of Public Improvements, and now on file in the office of said Board. Deposit required, $9,600. Letting No. 10,879—For furnishing all tools, material and labor for the construction and completion of the Chain of Rocks filters, in accordance with plans and specifications, approved by the Board of Public Improvements, and now on file in the office of said Board. Deposit required, $9,600.

✣Bids will be received until 7:30 p. m., April 11, by J. E. Hoover, City Clerk, Altamont, Mo., for drilling well or wells for a water supply for the city. Fuller Coult Co., Chemical Bldg., St. Louis, Mo., are Engineers. Official advertisement appeared in our last issue.

✣Bids will be received until 7 p. m., April 30, by Kennett, Mo., for the construction of two 10-in. wells. Proposal must be mailed to Sam G. Fisher, City Clerk, Kennett, Mo. Certified check for $200 on a local bank to accompany proposal. The board reserves the right to reject any or all bids. Specifications may be obtained from Frank L. Wilcox, Consulting Engineer, Chemical Bldg., St. Louis., upon a deposit of $5, to be returned upon the return of the specifications. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until noon, April 28, by Board of Public Works at the office of F. L. Flint, Supt. of Construction, Maryville, Mo., for repairs to water tower, also for two return tube boilers of 100 hp. each. Each bid to be accompanied by a certified check for an amount equal to 2 per cent of the bid, payable to John D. Richey, City Treasurer. Plans and specifications are on file at the office of Supt. of Construction, and also at the office of Hiram Phillips, Consulting Engineer, Liggett Bldg., St. Louis, Mo. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 7 p. m., April 30, by J. D. Spence, Mayor, Kennett, Mo., for the construction of water works and sewerage in accordance with plans and specifications preoared by Frank L. Wilcox, Engineer, Chemical Bldg., St. Louis, Mo. The water works consist approximately of 8½ miles of 4 to 8 in. cast iron water pipe, 76 hydrants, 64 valves with boxes, 70,000 gals. tower tank and pumping station complete. Separate bids wanted on two 10 in. deep wells. Official advertisement will be found elsewhere in this issue.

⦿Jas. A. Pringle, Carthage, Mo., has been awarded the contract by the city of Bennington, Kans., for the installation of a water works system for $13,610. The following is an approximate list of items required: Street mains—2,850 ft. of 6 in. standard weight cast iron pipe, 10,100 ft. of 4 in. standard weight cast iron pipe, 6,500 lbs. of cast iron specials. Hydrants and valves—26 4-in. hydrants, 3 6-in. valves and boxes, 11 4-in. valves and boxes. Tower and tank—50,000 gal. tank on a 100 ft. tower. Pumping plant—One 100 g. p. m. motor driven turbine pump, brick pumping house, 44 in. x 45 ft. well with casing. Bids were opened March 31.

The right to reject any and all bids is expressly reserved. Plans, specifications and form of contract may be obtained at the office of the Water Commissioner, Room 312 New City Hall, upon deposit of $15 in each case, which sum will be refunded upon the return of such plans, specifications and form of contract.

The citizens of Brookfield, Mo., on April 1 voted the issuance of bonds to the amount of $10,000 for the extension of the city water system.

A proposition to vote a bond issue of between $7,000 and $10,000 for the building of an electric light and water plant at Forsyth, Mo., is being advocated and probably will be submitted to the voters within a short time.

Nebraska.

The citizens of Johnson, Neb., are agitating the installation of a waterworks system. Plans and estimate of cost will be made within the near future.

The citizens of Blue Hill, Neb. (population, 761), it is reported, voted in favor of the extension of the water system last week.

New Hampshire.

✣Bids will be received until noon, April 18, by Board of Water Commissioners, Claremont, N. H., for water works improvement. The work to be done consists in laying about 7,000 ft. of 20 in. cast iron water pipe, about 3,000 ft. of 8 in. cast iron water pipe, about 500 ft. of 8 in. tile, the placing of about 1,000 cu. yds. of reinforced concrete, including about 40 tons of steel, moving and placing about 27,000 cu. yds. of earth. Plans and specifications will not be mailed, but may be seen at the office of the said Board of Water Commissioners in Claremont, N. H., or at the office of E. E. Davis, Engineer, at Northampton, Mass., on or after April 9, 1913. James L. Rice is Superintendent of the Board.

New Jersey.

⦿The Atlantic Construction & Supply Co., Atlantic City, N. J., has been awarded the contract by the City Council of Asbury Park, N. J., for the making of improvements to the waterworks system for about $75,000.

⦿The City Commissioners of Atlantic City, N. J., have awarded the contract for the building of the Arctic Ave. water main to E. L. Bader for $43,781. Kelley, McFeeley Co. bid $43,318.

New York.

✣Bids will be received until 8 p. m., April 11, by Board of Water Commissioners, Olean, N. Y., for furnishing approximately 2,700 ft. 4-in. cast iron pipe, 700 ft. 6-in. cast iron pipe, and special castings. All bids must conform with the standard specifications of the American Waterworks Association. All pipe shall be hydraulically tested for a head of 300 feet and shall be subject to a hammer test under this pressure.

✣Bids will be received until 2 p. m., April 11 (readvertisement), by Board of Sewer Commissioners, Sharon Springs, N. Y., for sprinkling filters and settling tanks. Morrell Vrooman, Gloversville, N. Y., is Engineer.

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

The Village Board of Fayetteville, N. Y., is considering a proposed contract for the extension of the town's water supply to the home of the Onondaga Golf and Country Club. The estimated cost of constructing the main is $6,000.

Ohio.

✣Bids will be received until noon, April 28, by Fred H. Shoaff, Village Clerk, Euclid, O., for furnishing the material and labor necessary for the improvement of Lock St. from the north line of Euclid Ave. to the south line of the N. Y., C. & St. L. R. R. right of way, by constructing a 6-in. water main therein, according to the plans and specifications on file at the office of said Clerk at the Town Hall and at the office of the F. A. Pease Engineering Co., 931 Williamson Bldg., Cleveland, O.

✣Bids will be received until noon, April 10, by W. H. Kirby, Secretary, Director of Public Service, Cleveland, O., for steam engine and generator for the Collinwood station of the Municipal Electric Light Plant. Each bid must be made in accordance with the specifications, which may be obtained at the office of the Engineer of Construction, Room 319 City Hall.

⊙The Board of Control of Alliance, O., has awarded the contract for the construction of the storage reservoir at Westville to the J. S. Devine Co., of Alliance.

Oklahoma.

The Drumright Water Co., of Drumright, Creek County, Okla., has been incorporated with a capital stock of $2,000. The incorporators are: W. E. Nicodemus, Aaron Drumright, O. C. Elliott, W. B. Childers and F. P. Stebbins, of Drumright.

The Town Board of Grandfield, Okla., has signed a contract with E. R. Kerby, an Engineer of Lawton, Okla., to furnish 24,000 gals. of pure, soft, domestic drinking water to the town, for $2,600.

Oregon.

Engineer Frank C. Kelsey, of Portland, Ore., has submitted his report to the City Council of Pendleton, Ore., on the sources of water supply investigated for the city and the cost of the different plans proposed, and requested that the Council take immediate steps to sell the bonds voted. The following is a brief summary of the report: Estimated cost of Thorn Hollow plan, $199,773. Estimated cost of annual operation, $11,500. Estimated cost of filtration plant with capacity of 2,000,000 gals. daily, $50,000; of 5,000,000 gals. daily, $118,750. Estimated cost of operation for plant of former capacity, $12,153 annually.

McKay Creek flow inadequate. Present source of supply is Umatilla River. Maximum amount used now, 1,500,000 gals. daily. Unsafe because of openness to contamination.

Estimated cost of North Fork plan, $326,000. Best plan, but too expensive at present time. Thorn Hollow line could eventually be extended to North Fork. Daily flow of Thorn Hollow springs since development, 2,000,000 gals. daily.

Estimated cost of Cayuse springs plan, $135,000. Daily flow in 1908, 2,500,000 gals. Elevation below proposed distributing reservoir. Location makes them subject to inundation during winter.

Pennsylvania.

✣Bids will be received until 7:30 p. m. April 15, H. R. Wiley, Secy., Blairsville, Pa., for an air compressor of the stage type that will develop 1,000 ft. of air per minute with R. M. P. not exceeding 125. A certified check for $500 must be filed with each bid.

⊙The recently organized Chinchilla Water Co., which plans to furnish Chinchilla, Clark's Green and Clark's Summit with water, has awarded the contract for drilling the first artesian well from which the first supply is to be secured to K. W. Van Auken, of Laceyville, Pa. The work will begin at once, and it is expected that by July 1 the reservoir will be completed and pipe lines ready to be put in use. The reservoir will have a capacity of 15,000 gals. per day. R. B. Carr is President.

Chester & Fleming, Hydraulic Engineers, of Pittsburgh, Pa., have been employed by the city of Meadville, Pa., to make examinations and a report on increasing the supply from the well system for the city waterworks.

The town of Wall, S. Dak., is advertising for the sale of $6,000 bonds for the installation of a system of waterworks this spring.

Tennessee.

The proposed election in Henderson, Tenn., for the purpose of voting on the issuance of bonds for the construction of a water works system has been postponed until April 26. J. I. Galbraith, Henderson, is interested.

Commissioner of Public Property George P. McTeer, Knoxville, Tenn., has asked for an appropriation out of the water fund of $25,000 to construct four additional filtration basins at the filtering plant.

Texas.

At a recent mass meeting of citizens of Coleman, Tex., it was proposed and recommended that a dam be erected across Indian Creek, three or four miles north of town. The Mayor and Council have been asked to secure a competent engineer and consider any proposition feasible for securing a permanent water supply.

Utah.

The citizens of Fountain Green, Utah (population, 875), at a recent election voted the issuance of bonds to the amount of $5,000 to complete the construction of the waterworks system.

West Virginia.

The Jeanette Light & Water Co., of Anawalt, McDowell County, W. Va., has been incorporated to build and operate water, light and heat plants. The authorized capital is $10,000. The incorporators are: R. L. Johnson, A. C. Davis, J. J. Stuart, Powell Short, W. C. Morris, G. M. Woody, J. H. Burks, all of Anawalt, W. Va.

Wisconsin.

⊙The Village Trustees of Waterford, Wis., have let the contract for building the new power house and laying the foundation piers for the water tower to James A. Kilpatrick, of Rochester, Wis.

The Water Committee of the City Council, Milwaukee, Wis., has recommended the purchase of a new 12,000,000-gal. per day capacity triple expansion engine at a cost of $75,000 for the high-pressure pumping station at North Point.

Wyoming.

The citizens of Glenrock, Wyo., at a recent special election voted the issuance of bonds in the sum of $10,000 for the construction of a system of waterworks

Canada.

✣Bids will be received until noon, April 12, by T. Martin, Division Engineer, Saskatchewan Division of the Canadian Pacific, Moose Jaw, Sask., for furnishing the necessary labor and material in connection with trenching and backfilling 8-in. wooden pipe line from Swan Lake to Stoughton, Saskatchewan, a distance of approximately nine miles. All particulars, plans and forms of tender may be obtained by applying to the following: J. G. Sullivan, Chief Engineer, Winnipeg; T. Martin, Division Engineer, Moose Jaw; W T. Daniel, Resident Engineer, Regina.

⊙James E. Kane, of St. Johns, N. B., has been awarded the contract by that municipality for the construction of a 12-in. water main from Marsh Bridge to Ballast Wharf to supply the Atlantic Sugar Refinery Co., for about $75,000. Henry Holgate, Richelieu Bldg., Victoria Square, Montreal, Que., is Engineer

The citizens of Yorkton, Sask., will shortly be asked to vote on a by-law for the construction of a waterworks system, including reservoir, pipe lines, etc., estimated to cost $100,000. Talbot Crosbie is Engineer.

The City Council of Prince Albert, Sask., plans extensions to the waterworks system at an estimated cost of $135,000. C. O. Davidson is Engineer.

The City Council of Moose Jaw, Sask., plans extensions to the water mains and sewers of the city at an estimated cost of $173,000. Over 25,000 ft. will be laid.

It is reported City Purchasing Agent Stuart, of Vancouver, B. C., has called for bids for water meters for the Water Department. It is expected the purchase price will be between $17,000 and $18,000.

SEWERAGE AND SANITATION

Alabama.

✣Bids will be received until May 6 by the city of Birmingham, Ala., for "South Side trunk sewers," comprising approximately 3,000 ft. 8x12-ft. concrete sewer, 5,000 ft. 8-ft. circular brick sewer, 3,000 ft. small brick sewers and 10,000 ft. pipe laterals. Plans and specifications on file in the office of Walter G. Kirkpatrick, City Engineer.

⊙The city of Mobile, Ala., has let the contract for furnishing material to be used in the construction of the western storm sewer to Sullivan, Long & Hagerty, for $42,836.

A garbage incinerator will be constructed at Avenue G and 11th St., Ensley, with concrete chimney, for the city of Birmingham, Ala. Walter G. Kirkpatrick is City Engineer.

Plans have been made for the construction of a rendering plant for the city of Birmingham, Ala., to be erected near 40th and 15th Ave., North East. Walter G. Kirkpatrick is City Engineer.

The city of Hurtsboro, Ala., will sell bonds April 10 for the installation of a sewerage system. Plans and specifications will be prepared immediately after the sale of the bonds. Wheeler Williams is Mayor.

Arizona.

The city of Phoenix, Ariz., contemplates issuing bonds for the installation of outlet storm sewers. It is thought these sewers would cost about $200,000.

Arkansas.

Petitions have been circulated among the property owners residing on Cane Hill, northwest section of the city of Van Buren, Ark., for the formation of an additional sewer improvement district. City Engineer Bell has estimated the cost at $2,500.

California.

The Board of Supervisors, Richmond, Calif., has called a special election to be held in the Stege District May 15 for the purpose of organizing a sanitary sewer district. It is the purpose of the residents of that section to provide needed sewers.

The City Trustees of Visalia, Calif., have decided to sewer the entire city. By this decision the extension of the present sewer system will run to 25,000 ft. instead of 18,000 ft. The new bond issue that will be submitted to the people will call for $25,000 rather than $19,000.

Connecticut.

✣Bids will be received until 8 p. m., April 14, by Borough of Torrington, Conn., C. A.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Patterson, Borough Engineer, for furnishing, excavating and laying 1,237 ft. of 18-in. tile; 312 ft. of 15-in. tile, 180 ft. of 8-in. tile, 725 ft. of 8-in. tile, 9 manholes, 5 catchbasins, 33 cu. yds. of concrete.

At the annual meeting of the Sanitary Sewer District, Plainville, Conn., held on April 7, Engineer Joseph MacKernan presented plans of the proposed sewer system with changes from the original ones.

The Street Board of the City Council, Hartford, Conn., has recommended the construction of the Homestead Ave. intercepting sewer northerly from Albany Ave. at an estimated cost of from $17,000 to $18,000.

Delaware.

The citizens of Delmar, Del., have voted to issue bonds in the sum of $30,000 for the installation of a sewerage system and foı permanent street improvements.

Florida.

The citizens of Plant City, Fla., at a recent special election voted the issuance of bonds in the sum of $25,000 for sewerage, $5,000 for drainage and $35,000 for paving.

The citizens of Fort Myers, Fla., at a recent election voted the issuance of bonds in the sum of $6,000 for sewerage extension.

Georgia.

⊙The J. B. McCreary Co., of Atlanta, Ga., has been awarded the contract at Winston, Winston-Salem, N. C., for putting down the water and sewer mains in West Highlands.

Drainage Engineer George G. Earle, of New Orleans, La,, has submitted his report to the Drainage Commission of Savannah Ga., relative to the proposed sewerage system for which plans have been prepared by the H. S. Jaudon Engineering Co., of Savannah. The report approves the plans and also recommends the installation of a storm sewer in the western part of the city, at an estimated cost of $20,000.

Illinois.

✣Bids will be received until 8 p. m., April 7, by Board of Local Improvements, Morton Grove, Ill., for cleaning out certain parts of the Demster St. sewer system. The specifications for such improvement and blank proposals therefor will be furnished at the office of the secretary of the Board of Local Improvements, in said village and at the office of the village engineer, Edgar A. Rossiter, 526 Reaper Blk., Chicago, Ill. The contractor will be paid in cash and bonds, which bonds will draw interest at the rate of five per centum per annum. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 11 a. m., April 14, by L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering 500 sheet steel covers for garbage boxes to the yard at Chicago Ave. and the Chicago River. Cash or certified check for $200 must accompany proposal.

The Rivers & Harbors Commission has instructed the Village Board of Plainfield, Ill., to build a purifying tank to take care of the sewerage.

The City Council of Milan, Ill., plans the installation of a complete sewer system, having the same empty into Mill Creek. Clyde S. Walker is City Attorney.

The Board of Local Improvements of Monmouth, Ill., has ordered the construction of a new sewer system in the southeast part of the city, which will be known as the Southeast sewer system. The sewer will range from 48 to 54 in. in diameter.

The city of Danville, Ill., plans to build a sewer in the northern part of the city to take care of the water which may come down from Roselawn, to be 6 ft. in diameter.

Indiana.

✣Bids will be received until 1 p. m., April 14, by Board of Park Commissioners, La Porte, Ind., at the office of Samuel Fox's Sons for the construction of a sewage disposal works, together with its appurtenances, to be located in Fox Memorial Park. All work to be done in the construction of said sewage disposal works shall be in accordance with the plans and specifications now on file in the office of said Board of Park Commissioners and according to contract which will hereafter be entered into by the successful bidder. A certified check for $100 shall accompany each bid.

⊙The Moellering Co., Fort Wayne, Ind., has been awarded the contracts by the Board of Public Works of that city for building a sewer in Murray St., at $5.31 a lin. ft., and in Liberty St., for $1.16, and in the alley between Winter and Lillie Sts., for $1.56 a lin. ft.

The Board of Public Works of Hammond, Ind., has adopted a resolution fixing the boundary lines of the proposed sewerage district. April 18 has been fixed on which the Board will hear remonstrances on the profiles, details and specifications. P. J. Lyons is City Engineer.

F. L. Knight & Sons, Surveyors, Crown Point, Ind., are asking prices on the following approximate quantities of pipe: Land tile: 8-in. 2,000 ft., 10-in. 2,000 ft., 12-in. 2,200 ft. This will be independent from the following: Sewer pipe or land tile for sizes up to and including 24-in.: 12-in. 600 ft., 15-in. 900 ft., 18-in. 736 ft., 22-in. 750 ft., 24-in. 720 ft., 33-in. 1,620 ft., 36-in. 1,000 ft. Concrete, metal or wood—40-in. 650 ft., 45-in. 750 ft., 48-in. 2,600 ft., 54-in. 3,660 ft., 60-in. 3,700 ft. Quotations may be submitted for either of the materials mentioned, on any or all of the above sizes, f. o. b. Crown Point, Ind. Please specify which is given. Decision will probably not be made before the first week in May.

Iowa.

✣Bids will be received until 9 a. m., April 28, by City Council, Fort Dodge, Ia., for furnishing all material and labor for constructing the following sanitary sewer, to-wit: 1. Beginning at 8th Ave. South and Park Blvd., thence east to 18th St., thence north on 18th St. to point 50 ft. south of 7th Ave. South; also beginning at 18th St. and 8th Ave. South, thence south on 18th St. to point 100 ft. north of 10th Ave. South, to be 8-in. pipe with two manholes, six lampholes and two flushtanks. 2. Also beginning at 15th St. and 8th Ave. South, thence west to point 50 ft. east of center of 13th St., with one manhole, three lampholes and one flushtank complete. W. L. Tang is City Clerk.

⊙The Hydraulic Concrete Construction Co., Davenport, Ia., has been awarded the contract by the Board of Public Works of that city, for the construction of a sanitary sewer system in Sewer District No. 13, for $61,620. Bids were opened March 29.

The city of Carroll, Ia., J. A. Dougherty, City Clerk, rejected all bids received March 31, for the construction of sanitary sewers of vitrified sewer pipe and sub-drain tile, including the following approximate quantities: About 15,090 ft. of 8-in. sewer; about 3,230 ft. of 6-in. sub-drain; 25 manholes; 12 combined manholes and flush tanks; 6 lamp holes.

The Town Council of Odebolt, Ia. (population, 1,283), plans the installation of a sewerage system.

A petition has been circulated in Schaller, Ia. (population, 646), asking that a special election be held for the purpose of submitting to the voters the question as to whether the town shall proceed with the work of constructing a sewer system.

The City Council of Sioux City, Ia., has passed a resolution calling for the construction of the storm sewer in the vicinity of the St. Anthony's Orphanage. This improvement will cost about $25,000.

An election is to be held in Postville, Ia. (population, 952), on April 15 for the purpose of voting on the issuance of bonds in the sum of $20,000 for the construction of a sewer system.

Maine.

✣Bids will be received until 2 p. m., April 26, by Board of Selectmen, Kennebunk, Me., for constructing a system of sewers at Kennebunk, York County, Me. Proposals shall be accompanied by a certified check in the amount of one hundred dollars. The successful bidders will be required to furnish a surety bond to the amount of twenty-five per cent of the contract, within ten days after official notice of the award of such contract. Plans and specifications may be consulted and blank forms of proposals obtained at the office of the Town Clerk, Kennebunk, Me. The above work consists of the following approximate quantatives: 8,000 ft. of 6-in. pipe; 3,200 ft. of 8-in. pipe; 1,100 ft. of 10-in. pipe; 1,400 ft. of 12-in. pipe; 1,500 ft. of 15-in. pipe; 40 manholes; 30 catch basins; 20 cu. yds. of concrete masonry.

Maryland.

✣Bids will be received until 11 a. m., April 16, by Board of Awards at the office of the City Register, Baltimore, Md., for the construction of lateral sewers and house connections in District 16-B, Sanitary Contract 110, as shown on plans on file with Calvin W. Hendrick, Chief Engineer of the Sewerage Commission, and at the office of the Secretary, 904 American Bldg., Baltimore, Md. The work will include the following approximate quantities: 14,500 lin. ft. of vit. pipe house connections, 17,500 lin. ft. vit. pipe sewer, 8 to 18-in.

Michigan.

✣Bids will be received until 1:30 p. m., April 21, by city of Pontiac, Mich., for the construction of the following sewers: Auburn Ave., from manhole in main sewer, easterly 330 ft.; Cooper St., from north line of Gladstone Pl. to Mathews St., 350 ft.; Park Pl., from O'Riley St. to Center St., 360 ft.; Patterson St., from main sewer west to Garland St., 350 ft.; Wessen St., from Saginaw St. west to D., G. H. & M. Ry., 286 ft. Certified check for 10 per cent of each bid must accompany each bid.

✣Bids will be received until April 18 by Board of Public Works, Mt. Clemens, Mich., for the construction of three trunk sewers on North Ave. and Clemens and Church Sts.

⊙The Park, Cemetery and Street Commission of Marquette, Mich., has awarded the contract for the construction of the proposed eastern trunk sewer to Herman Stensrud, of that city, for $39,285. Work is to be completed by Dec. 24, 1913.

Minnesota.

⊙Thornton Bros. have been awarded the contract by the Board of Public Works of St. Paul, Minn., for the construction of a sewer on Western Ave., between Front and Cook Sts., for $2,387.

Following were bidders on the proposed construction of storm sewers in Faribault, Minn.: Pastonet Construction Co., St. Paul; Thomas & Clement, John Kasper and P. J. Gallagher. The bids were held over until April 3.

Missouri.

✣Bids will be received until 7 p. m., April 30, by Mayor J. D. Spence, Kennett, Mo., for the construction of sewerage and water works, in accordance with plans and specifications prepared by Frank L. Wilcox, Engineer, Chemical Bldg., St. Louis, Mo. The sewerage work consists approximately of 8½ miles of 8-in. to 15-in. pipe, 95 manholes, 62 flush tanks, sewage treatment works and sewage pumping equipment. Official advertisement will be found elsewhere in this issue.

⊙Frank C. Rand, of St. Louis, Mo., has been awarded the contract by the Board of Public Improvements of that city, for the construction of the Rocky Branch sewer, for $450,663.

Montana.

Residents of the south side of Butte, Mont., recently held a meeting to consider ways and means of securing a sanitary sewerage system for that part of the city.

New Jersey.

✣Bids will be received until 8 p. m., April 21, by Jay Y. Krout, Borough Clerk, Audubon, N. J., for the construction of sanitary sewers and sewage disposal plant for the Borough of Audubon, Camden, County, New Jersey, and then opened before Council of the Borough of Audubon for consideration. Approximately the work consists of the following: 66,000 lin. ft. of vitrified sewer pipe, with manholes and flush tanks; 15,000 ft. agricultural tile drain, in sewer trench; pump and pumping outfit; sewage disposal works complete. Certified check for $5,000 will be required from each bidder, and Council of the Borough of Audubon reserves the right to reject any or all bids. Plans and specification can be obtained by addressing the Borough Clerk, Audubon, N. J. J. J. Albertson is Borough Engineer.

The borough of Red Bank, N. J., has decided to extend the sewer system on the southern end of Shrewsbury Ave. Bids will be asked at once.

New York.

✣Bids will be received until 2 p. m., April 15, by Board of Sewer Commissioners, Albion, N. Y., at the office of R. R. Fernow, Engineer, Albion, N. Y., for the construction of a sewer system and sewage disposal plant. The plans and specifications for this work may be seen at the office of R. R. Fernow, Engineer for the Board, or copies may be obtained upon making a deposit of $25, which will be refunded upon the return of the plans and specifications in good order. The work to be done consists of laying about 16 miles of terra cotta sewer pipes, varying in size from 8-in. to 20-in., and building a sewage disposal plant. All bids must be made upon blank forms, to be obtained at the office of R. R. Fernow, Engineer, Albion, N. Y. Each bid is to be accompanied by a certified check on some national bank or state bank, within the state of New York, for $10,000, payable at sight to the Board of Sewer Commissioners of the village of Albion.

✣Bids will be received until 7 p. m., April 17, by Board of Education of Cobleskill, N. Y., at the office of Seward H. Van Ness, Secretary, Cobleskill, for the erection and construction of the new high school building according to plans and specifications prepared for the same by William T. Towner, Architect, 320 5th Ave., New York City, from whom all further information can be obtained. Bids will be received at the same time and place for the heating and ventilating, plumbing and electrical work.

✣Bids will be received until 2 p. m., May 2, by Department of Public Works, Oswego, N. Y., for construction of trunk and lateral sewers and sewage disposal plant. John Smith is Commissioner of Public Works and C. H. Snyder is City Engineer.

✣Bids will be received until 2:30 p. m., April 16, by Board of Contract & Supply, Schenectady, N. Y., for a garbage disposal plant apparatus and equipment. W. Thomas Wooley is City Engineer. F. E. Johnson is Secretary of the Board.

✣Bids will be received until 8 p. m., May 7, by City of Oneonta, N. Y., for the construction of a main line intercepting sewer from Rose Ave. to Lyman Ave. in said city. The following is the engineer's approximate estimate of quantities: Excavation, 4,800 cu. yds.; 10-in. vit. tile sewer, 1,920 lin. ft.; 12-in. vit. tile sewer, 4,020 lin. ft.; 18-in. vit. tile sewer, 1,500 lin. ft.; 21-in. vit. tile sewer, 1,710 lin. ft.; 30 concrete manholes; 150 lin. ft. wood stave pipe. Each proposal must be accompanied by a certified check, payable to the City Chamberlain of Oneonta, N. Y., equal to 5 per cent of the amount of proposal. Plans and specifications may be seen at the office of the City Engineer, Oneonta, N. Y., or a complete set of the plans and specifications may be had for the sum of $3 upon application to the City Engineer. Sheldon H. Close is City Clerk.

⊙Martin & Muller, Passaic, N. J., have been awarded the contract by the village of Palatine Bridge, N. Y., for the installation of sewers. Bids were opened March 22.

Commissioner Maxwell E. Briggs, of the Department of Public Works, Lackawanna, N. Y., is preparing a list of the streets where construction of sewers is necessary.

The Common Council of Middletown, N. Y., has ordered a trunk line sewer constructed through the eastern part of the city. This sewer is to be 12,000 ft. long and 20 ins. in diameter.

The Dolgeville, N. Y., Village Council has decided to spend several thousand dollars the coming summer in extending its sewer system along streets recently opened up.

Consulting Engineer Clyde Potts, of New York City, is investigating the conditions in and around Daytona, Fla., in order to determine the best system of sewerage that can be employed there and the probable cost of the same.

City Engineer E. W. Sayles, of Watertown, N. Y., has recommended a 20-in. sewer through Arlington, St., to connect with the Central St. sewer. The estimated cost is $12,000.

City Engineer A. P. Smith, of North Tonawanda, N. Y., has submitted plans and specifications to the Board of Public Works for the last section of sewers to be built in the Rumbold Ave. district, North Tonawanda, under the $35,000 appropriation. The streets on which the sewers are still to be constructed are East Robinson and Cramer Sts.

Following bids were received by President Connolly, of Queens, Borough Hall, New York City, for 11 sewer contracts, the lowest aggregating $138,581: Nott and Anable Ave., Long Island City, from Van Dam to Hulst St. and Hulst St. from Anable to Nott Ave.; Sigretto & Co., $22,161. On Hamilton Ave., from Liberty to Jerome; Walnut St., from Liberty to Jerome Ave.; Briggs Ave., from Liberty to Jerome; Church St., from Liberty to Jerome Ave.; Kimball Ave., from Stoothoff to Lefferts, Richmond Hill; Place Bros., $17,770. Cypress Ave., from Cooper St. to Vermont Ave., Ridgewood; Tenth Ave. Construction Co., $22,759. Lefferts Ave., Richmond Hill, from Liberty to Atlantic; Sigretto & Co., $23,467. On Liberty Ave., from Stoothoff Ave. to Chester St.; on Cedar Ave., from Liberty to Kimball, and on Chestnut St., from Liberty to Kimball Ave., Richmond Hill; Place Bros., $9,122. Decatur St., from Myrtle to Forest Ave., Glendale; Mortimer Miranda, $4,639. On Jerome Ave., from Ocean Ave., east side, to Greenwood Ave.; on McCormack Ave., from Beaufort to Jerome; on Oxford Ave., from Beaufort to Jerome; on Seattle St., from Beaufort to Jerome Ave.; on Portland Ave., from Beaufort to Jerome, and on Herald Ave., from Jerome to Crown, 265 ft. north, Richmond Hill; Joseph Bennedetto, $33,924. Hulst St., from Greenpoint Ave. to Anable Ave., Long Island City; Mortimer Mirando, $1,956. On Madison St., from Myrtle to Wyckoff Ave.; on Wyckoff Ave., from Madison to Halsey St., and on Halsey St., from Wyckoff to Irving Ave., Ridgewood; Joseph Bennedetto, $2,234. Receiving basins, northeast corner of Willow St. and North William St. and Jackson Ave. and southeast corner of Honeywell St., Long Island City; Clancy & Van Alst, $545.

Ohio.

⊙The city of Geneva, O., has awarded the contracts for the construction of 2,692 ft. of 8-in. sewer to Hukri & Koski of Ashtabula, O., for $2,238, and Thos. P. Fitzgerald, of Ashtabula, for $2,600. Cumings & Downer, Painesville, O., are Engineers. Bids were opened March 25.

R. Winthrop Pratt, Consulting Engineer, 712 Hippodrome Bldg., Cleveland, O., has been retained by the City Council of New Philadelphia, O., to assist Geo. E. Arnold, City Engineer, in the preparation of plans for sewage treatment works for the city.

R. Winthrop Pratt, Consulting Engineer, Cleveland, O., has been retained by the City Council of Akron, O., to prepare a report and general plans for proposed sewage treatment works for the city.

Oklahoma.

The citizens of Henryetta, Okla., on April 1 voted the issuance of bonds in the sum of $50,000 for the construction of a sanitary sewer as per plans and specifications, which will be prepared by the Benham Engineering Co., 435-7 American Nat. Bank Bldg., Oklahoma City, Okla. Bonds have been sold.

Pennsylvania.

✣Bids will be received until 2 p. m., April 22, by the Board of Public Works at the office of City Clerk L. S. Ramsey, Reading, Pa., for the construction of concrete storm sewers known as West Elm Street Relief Sewer; North Sixth Street Sewer, and the Third Street Sewer, with branches; also for about 13,500 ft. of pipe sewer, varying from 15 in. to 30 in., situated on the various streets in the northeastern section of the city. The above work is divided into 3 contracts and the total approximate estimate is $170,000, payment of which is provided by a loan of $300,000 for storm sewer work. Bids for the balance will be asked for as soon as plans and specifications can be prepared. Each bid must be accompanied by a proposal bond or certified check for the sum of $2,000, and the successful bidder will be required to enter into a contract bond for the sum of 40 per cent of the amount of contract awarded. Blank forms of proposals, proposal bonds and specifications may be obtained at the office of the City Engineer, City Hall. Plans may be obtained by making a deposit of $10 for each set, which deposit will be remitted to bidders upon return of plans before April 26, 1913.

✣Bids will be received until April 14 by R. Mackenzie, City Controller, Oil City, Pa., for the construction of about 8,000 ft. of sewers. B. B. Weber is City Engineer.

✣Bids will be received until 4:30 p. m., April 17, by Board of Commissioners, H. M. Johnson, Secretary, Mount Lebanon township, Allegheny County, Pa., for the construction of 11 miles of pipe sewers in Painters Run, Big Sawmill Run and Little Sawmill Run districts of the township. All proposals must be on forms furnished by the township and accompanied by a certified check for $300 for each district. Approximate quantities are as follows: 3,040 ft. 20-in. sewer, 2,695 ft. 18-in. sewer, 4,825 ft. 15-in. sewer, 5,390 ft. 12-in. sewer, 4,485 ft. 10-in. sewer, 36,935 ft. 8-in. sewer, 190 manholes and 50 lampholes. Plans may be seen, specifications and forms of contract and proposals may be obtained at the office of McCully Engineering Co., Township Engineers, 709 Berger Bldg., Pittsburgh.

⊙Stucker Bros. Construction Co. has been awarded the contract for rebuilding the sewer in Catharine and 15th Sts., in Harrisburg, Pa., for $2,749.

⊙C. M. Reilly, of Wilkesbarre, Pa., has been awarded the contract by the Borough Council of that city for the construction of a number of sewers for $30,089. Other bidders were: R. M. Rosser, $34,804; B. G. Coon Construction Co., $48,149; Penn Sewer Co., $30,860, and Curnow & Gates, $30,367.

⊙The City Council of Chester, Pa., has awarded the contracts for the straightening of Chester River above Ninth St., the work calling for the construction of Walls Nos. 1 and 4, to James Kelley, of Philadelphia, Pa., for $3,650 and $14,980, respectively.

The Borough Council of East Lansdowne, Pa., has passed an ordinance providing for extending the sewerage system beyond the limits of the borough to Cobb's Creek.

Consulting Engineers Metcalf & Eddy, of Boston, Mass., are preparing plans and specifications for sewage disposal plant which it is proposed to erect, this year, in South Fitchburg, by the city of Fitchburg, Pa.

South Carolina.

⊙Waston & Brooker, Inc., 704 Nat. Loan & Exchange Bank Bldg., Columbia, S. C., have been awarded the contract by the Board of Richland County Commissioners, Columbia, for furnishing the county with approximately $5,000 worth of concrete pipe. Bids were opened March 21.

Tennessee.

⊙T. I. Curtis & Son, Nashville, Tenn., have awarded the contract for the building of the sewer at 16th Ave. and Hamilton St., Nashville, for $1,967.

Utah.

⊙The City Commissioners of Ogden, Utah, have awarded the contract for building sewer No. 115 to J. P. O'Neill Construction Co., for $2,698. Other bidders were: Wheelwright Co., $3,328, and Continental Co., $3,250.

Washington.

✣Bids will be received until 11 a. m., April 16, by Capt. J. R. Pourie, Constructing Quartermaster, Fort Worden, Wash., for the construction of 230 lin. ft. of 10-in. drain and of extension to a sewer manhole at Fort Worden.

Wisconsin.

⊙E. R. Harding Co., of Racine, Wis., has been awarded the contract by the Board of Public Works of Fond du Lac, Wis., for the construction of the west side sewer system and the new purification plant, for $65,008.

City Engineer E. B. Banks, of Superior, Wis., has completed plans for the construction of a sewerage system in Allouez. The city also plans a number of extensions to the sewer system during the year.

The Common Council of Milwaukee, Wis., has recommended the construction of a storm sewer to increase the facilities for taking the surface drainage east of 3rd St., at an estimated cost of $3,500.

Canada.

⊙The Board of Control of Montreal, Que., has awarded the following sewer contracts: Julian Toussaint & Co., Sherbrooke St., between Guy and Fort Sts., $62,010; M. P. D. Frascarelli, Hingston St., $2,255, Godfrey St., $2,622, Notre Dame de Grace St., $1,105, Robin St., $778, Votre St., $2,259, Arcade St., $2,120; Gilbert & Paye, Sherbrooke St., from Fort to city limits, $52,194, Notre Dame St., from Carillon to Mercier Sts., $17,807; Messrs. Rici & Co., Souligny St., $4,501, Hector St., $15,617, Carillon St., $10,502; H. M. Bertrand, Rolette St., $2,516, Juliette St., $1,370, and Seminary St., $3,457.

BUILDINGS

Alabama.

Plans will be ready April 15 for a 25-story building to be erected at Birmingham, Ala., for the American Trust & Savings Co. Wm. L. Welton, Empire Bldg., Birmingham, Ala., is the Architect.

California.

⊙The Contra Costa Construction Co., San Francisco, has been awarded the contract, at $23,590, for grading site in the civic center for the proposed new $3,500,000 city hall of San Francisco.

Tentative plans are under consideration, according to B. F. McLouth, President Western Industrial Development Co., Los Angeles, for the establishment of a cotton factory near Long Beach. It is stated that about $500,000 will be invested in the site and factory buildings.

Work will be started soon on the erection of a 25-story building at 4th and Market Sts., San Francisco, for John D. Spreckels, of that city. The structure will be reinforced concrete and will cost about $1,500,000. Reid Bros., Claus Spreckels Bldg., San Francisco, are the Architects.

District of Columbia.

✣Bids will be received until 2 p. m., May 15, by Post Office Department, Washington, D. C., for the removal of debris from the Post Office Department buildings.

Indiana.

✣Bids will be received until 10 a. m., April 17, by R. L. Dillon, Trustee, Middle School township, Hendricks County, Pottsboro, Ind., for the erection of a 2-story brick and stone school building.

✣Bids will be received until 10 a. m., April 19, by Jacob J. Clary, Trustee, White River township, Johnson County, at Farmers' State Bank, Franklin, Ind., for the conctruction of a grade school near New Bargersville, Ind.

✣Bids will be received until noon, April 22, by Library Board, Plymouth, Ind., for the construction of a public library building. W. L. Humrichouser is secretary of the board.

Minnesota.

Plans will be completed this month by Keer & Colburn, Architects, Donaldson Bldg., Minneapolis, Minn., for a building to be erected at 5th St. and 5th Ave. N., Minneapolis, for the Ford Automobile Co The structure will be of reinforced concrete construction with red pressed brick exterior and terra cotta and Bedford stone trimmings. It will cost about $300,000.

Nebraska.

✣Bids will be received until 2 p. m., April 21, by Richard Goehring, Secy., Grand Island Brewing Co., Grand Island, Neb., for the erection of a brewery building at Grand Island. Plans, specifications, etc., are on file with the Secretary.

New York.

✣Bids will be received until 4 p. m., April 11, by Frank H. Cleveland, Secretary, St Lawrence University, Canton, N. Y., for the construction, heating, plumbing and electric work for green house and shop building at the State School of Agriculture, St. Lawrence University. Drawings and specifications may be consulted and blank forms of proposal obtained at the State School of Agriculture, St. Lawrence University, Canton, N. Y., and at the office of the State Architect. Complete sets of plans and specifications will be furnished to prospective bidders upon reasonable notice to and in the discretion of the Acting State Architect, Charles A. Sussdorff, Capitol, Albany, N. Y.

⊙Barrows-Stewart Co., New York City, has been awarded the general contract, at $134,855, for the erection of the Nurses' Home at the Albany Hospital, Albany, N. Y.

Pennsylvania.

✣Bids will be received until 7 p. m., April 14, by School District of the Borough of Marysville, Pa., for the erection and completion of certain additions and alterations to the Maple Avenue School Building in said Borough, drawings and specifications for which can be seen at the offices of Hauer & Mowere, Architects, in Philadelphia and Lebanon, Pa., and at the office of John L. Hain, Secretary of the Board.

It is probable that the plans for the new Masonic Temple, to be erected in Schenley Farms, will be completed by Architects Janssen & Abbott, Pittsburgh, by May 1. The building will be a 4-story stone, brick and terra cotta structure, 210x200 ft., with stone foundations and Spanish tile roofing, marble hardwood floors, etc. The building alone will cost about $900,000.

The Board of Trustees of the Carnegie Institute, Pittsburgh, Pa., have approved plans for the enlargement of the women's school of the Carnegie School of Technology. There will be spent on the women's school $250,000, the work to be begun soon. The addition will be known as the north wing and will have a frontage of 230 ft. The south wing is now occupied by the school. In keeping with the other buildings of the group, the new building will be of cream colored brick with white terra cotta trimmings. The new building is the one projected at the extreme eastern end of the group, as originally planned by the architects. Henry Hornbostel will personally supervise the construction of the new building. While the plans for the building have been completed for some time, no bids from contractors have been asked. This step will, however, be taken soon.

Architect J. A. Giesey, 514 Smithfield St., Pittsburgh, has plans in progress for a four-story brick fierproof research laboratory to be constructed in O'Hara St. for the University of Pittsburgh. The building will cost $150,000.

⊙Architect Edward Stotz, Monongahela Bldg., Pittsburgh, awarded to D. T. Riffle, Keenan Bldg., Pittsburgh, the contract for constructing the 7-story granite, terra cotta and vitrified brick bank and office building in Federal St., North Side, for the Dollar Savings Fund & Trust Co. The work will cost $150,000.

The Uniontown Methodist Episcopal church congregation, Uniontown, Pa., is having Architect A. P. Cooper, Uniontown, prepare plans for a fireproof stone building 85x138 ft. Bids will be asked about May 1. The work will cost about $125,000. In addition a parsonage will be erected.

Texas.

Plans are stated to have been completed for the erection of a hotel to cost $500,000 and a theater costing $200,000 at the corner of Sixth and Lavaca Sts., Austin, the work of construction to begin about July 1. H. E. Ford, C. O. Smith and H. C. Pitts, of Austin, and William C. Bruce, of San Antonio, are reported to be interested.

Utah.

✣Bids will be received until 11 a. m., April 17, by Board of Education Jordan School District, Midvale, Utah, for the erection and partial finishing of an 8-room school building at Midvale, Salt Lake County, Utah. Plans and specifications can be seen at the office of the Architect, N. Edw. Liljenberg, 402 Newhouse Bldg., Salt Lake City, Utah, and at the office of the Board of Education of the Jordan School District at Midvale, Salt Lake County, Utah. Separate bids will be received on mason work and carpenter work, later including plastering, painting and wiring. All bids must be accompanied with a certified check for 5 per cent of the amount of the bid, made payable to the Jordan Board of Education.

Vermont.

✣Bids will be received until 3 p. m., May 15, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures, and approaches, of the United States Post Office at Bennington, Vt. The building is to be of one story, basement and mezzanine, and have a ground area of approximately 5,000 sq. ft.; fireproof construction throughout, except roof; stone or marble facing and tin roof. Drawings and specifications may be obtained from the Custodian of site at Bennington, Vt., or at the discretion of the Supervising Architect.

Virginia.

✣Bids will be received until 3 p. m., April 30, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for interior painting of the United States Post Office, Court House and Custom House at Richmond, Va. The work contemplated is painting of walls and ceilings generally

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

throughout the first, second, third and fourth stories, and certain portions in the basement. Drawings and specifications may be obtained from the Custodian of the building at Richmond, Va., at the discretion of the Supervising Architect.

Wyoming.

✣Bids will be received until 11 a. m., April 10, by Quartermaster, Fort D. A., Russell, Wyo., for furnishing necessary labor and material for construction of approximately 12,550 lin. ft. of barbed wire fence.

✣Bids will be received until 2 p. m., April 26, by Quartermaster, Fort Yellowstone, Wyo., for the re-roofing of the Post Exchange Building at the fort.

RIVERS AND HARBORS

California.

✣Bids will be received until 11 a. m., April 14, by Lt. Col. Thos. H. Rees, U. S. Engineer, 401 Custom House, Oakland, Cal., as noted in our last issue, for dredging in Oakland Harbor. This work is located in Oakland Harbor east of the west line of Webster St., and consists of dredging a channel 500 ft. long, 115 ft. wide on the bottom, and 30 ft. deep through the north draws of the Webster St. and Harrison St. bridges; a channel 4,680 ft. long, 300 ft. wide on the bottom, and 30 ft. deep from Harrison St. to Brooklyn Basin; and a channel 5,940 ft. long, 200 ft. wide on the bottom, and 25 ft. deep through the south or Alameda Channel to the tidal canal. The total quantity of material to be excavated is estimated at 1,038,450 cu. yds. The material to be removed is believed to be hardpan, soft clay, sand and mud.

⊙Board Public Works of Los Angeles, Cal., has awarded a contract to the Mercereau Bridge & Construction Co., Los Angeles, at $9,741, for the foundations for wharf sheds and the bulkhead on the east and south side of Pier A at Wilmington.

The Standard American Dredging Co., San Francisco, was low bidder March 28 for dredging of slips Nos. 1 and 5 of the Wilmington Basin and the filling of adjacent lands at Wilmington, under specifications No. 28 for the Board of Public Works of Los Angeles. The low bid was as follows: 13¼ cts. per cu. yd. for dredging material from Slip No. 1 and depositing it back of the Pier A, and 14 cts. per cu. yd. for dredging in Slip No. 5 and depositing the dredgings in areas A, B and C. The bidders agree to begin the work within 30 days after signing the contract and to prosecute it at an average minimum rate of 150,000 cu. yds. per month. The contract calls for the dredging of 1,300,000 cu. yds. from the two slips.

Florida.

Profile and estimates have been filed with the City Council of Kissimmee, Fla., by R. H. Ludlam, City Engineer, for the construction of a city dock. The estimated cost is $19,300, this including 40,000 cu. yds. of filling, to cost $8,000, a retaining wall to cost $7,800 and a dock building to cost $3,500.

Georgia.

⊙The Central of Georgia Ry. Co. has awarded the contract for the reconstruction of docks and sheds of the Merchants & Miners' Transportation Co., which were destroyed by fire at Savannah, to James Stewart & Co., Inc., of New York. The contract was let on April 3 and work was to be commenced within 10 days and completed by Sept. 1. Dock 1,120 ft. in length will be constructed of concrete and filled up to floor of warehouses. Warehouses will be of timber construction with corrugated iron sheathing, creosoted plank floor.

⊙Roderick G. Ross, Jacksonville, Fla., has been awarded the contract for furnishing and placing stone for raising low places in jetties at Cumberland Sound and in Jekyl Creek, Ga., for the U. S. Government. The contract prices were as follows: Cumberland Sound jetties, 1,500 tons, at $3.87; Jekyl Creek jetties, 1,000 tons, at $2.83; Brunswick Harbor jetties, 1,500 tons at $2.83.

Kentucky.

Bids as follows were received March 26 by the U. S. Engineer, Louisville, Ky., for widening Louisville and Portland Canal at Louisville, (1) standing for bid of Henry Bickel Co., Louisville, (2) J. H. Cahill, Louisville, (3) The Callahan Construction Co., Knoxville, Tenn., (4) Mason & Hanger Co., Richmond, Va., (5) Asheville Construction Co., Asheville, N. C.:

Items.	Quantities.	(1)	(2)	(3)	(4)	(5)
Common excavation	770,000 cu. yds.	$ 0.45	$ 0.45	$ 0.50	$ 0.45	$ 0.40
Rock excavation	205,000 cu. yds.	0.90	0.95	0.80	1.10	1.25
Drilling bolt holes	550 lin. ft.	1.00	0.25	0.50	0.80	0.60
Stone paving	24 cu. yds.	3.00	10.00	7.00	7.00	4.50
Reinforced concrete	490 cu. yds.	20.00	7.00	10.00	12.00	11.00
Plain concrete	16,951 cu. yds.	5.00	5.50	6.50	5.75	7.40
Channeling	48,300 sq. ft.	0.30	0.30	0.40	0.40	0.38
24-in. cast iron culvert	385 lin. ft.	8.00	5.00	4.00	8.00	7.00
16-in. cast iron culvert	24 lin. ft.	6.00	3.00	2.50	4.50	4.00
Reinforcing rods	58,000 lbs.	0.05	0.05	0.04	0.04	0.07½
Iron check posts	1,536 lbs.	0.10	0.07	0.10	0.08	0.09
Macadam roadway	12,200 sq. yds.	0.75	1.25	1.00	1.00	1.80
Total of bid		$656,095	$673,033	$700,118	$713,107	$743,109

Louisiana.

⊙D. B. Gore Co., Inc., New Orleans, La., has been awarded the contract at 14.75 cts. per cu. yd. for constructing the Kelly Bayou Drainage Canal for the Caddo Levee District. Bids were opened April 2.

⊙Doullut & Williams, 1029 Maison Blanche Bldg., New Orleans, La., have been awarded a contract by the Caddo Levee Board for bank protection work on Red River in Caddo Parish, La. Protection consists of subaqueous mats and concrete pavement above water line. The board will spend about $500,000. Contract is for cost plus 10 per cent on amounts up to $300,000; 8 per cent up to $500,000 and 6 per cent on all over $500,000.

⊙Bids as follows were received March 31 by Capt. C. O. S. Neville, U. S. Engineer, New Orleans, La., for (1) the Inglefield levee, 140,000 cu. yds. in Lower Tensas Levee District, and (2) the Louisa Levee, 70,000 cu. yds. in the La Fourche Levee District.: W. M. Scott, Lallulah, La., (1) 18.90 cts.; J. W. Noble, Fayette, Miss., (1) 19.65 cts.; Hamilton & Howell, St. Francisville, La., (1) 31.97 cts., (2) 21.90 cts.; John Reiss, New Orleans, La., (2) 21 cts.; J. M. Sullivan, Montgomery, Ala., (1) 23.40 cts., (2) 19.39 cts.; Lambert Bros., St. Rose, La., (2) 22.48 cts.; R. T. Clark & Co., Natchez, Miss., (1) 21.80 cts., (2) 17 cts.; Montz & Kearney, New Orleans, La., (2) 25 cts.; F. T. Constant, Alexandria, La. (1) 36.70 cts., (2) 20 cts. Contract for the Ingefield Levee was awarded to W. M. Scott, Tallulah, La. Contract for the Louisa Levee was awarded to R. T. Clark & Co., Natchez, Miss.

The Caddo Levee Board, W. A. Kerley, Secretary, Shreveport, La., has rejected the bids received April 2 for tying ends of levees at Twelve Mile Bayou.

Maine.

✣Bids will be received until noon, May 1, by Lieut. Col. W. E. Craighill, U. S. Engineer, Congress St., Portland, Me., for ledge excavation in Saco River, Me., South Bristol, Me., and Sullivan Falls, Me.

✣Bids will be received until noon, May 1, by Lieut. Col. W. E. Craighill, U. S. Engineer, Portland, Me., for ledge excavation in Portland Harbor, Me.

✣Bids will be received until noon, May 1, by Lt. Col. W. E. Craighill, U. S. Engineer, 537 Congress St., Portland, Me., for ledge excavation in Saco River, South Bristol and Sullivan Falls, Me. The work in the Saco River is located at Twin Islands, and consists in ledge excavation to obtain a least depth of 7½ ft. at mean low tide. About 191½ cu. yds. of rock will be removed. At South Bristol Harbor about 274 cu. yds. of rock will be excavated, the average cost to the required grade being about 27 ft. and the maximum cost about 10 ft. At Sullivan Falls about 301.6 cu. yds. of rock are to be removed.

✣Bids will be received until noon, May 1, by Lt. Col. W. E. Craighill, U. S. Engineer, 537 Congress St., Portland, Me., for ledge excavation in Portland, Me. The work is located in the entrance channel to Back Cove, between the Grand Trunk Ry. and Tukey's Bridges. The work to be done under this contract consists in removing from the entrance channel to Back Cove, between the Grand Trunk Ry. and Tukey's Bridges, all material projecting above a plane 14 ft. below mean low tide. This channel, as laid out for improvement, is about 1,440 ft. long, with a general width of 320 ft. diminishing at each end as it approaches the openings of the drawbridges. The greater part of the area of the channel is now of sufficient depth, but it is obstructed by a number of shoals, mostly ledge. The ledge has been cleared of overlying material so far as it could be done with a light clam-shell bucket, but there is still a comparatively small quantity of material remaining. The estimated quantity of solid ledge rock to be removed from each ledge or group of ledges, the area of each, and the average and maximum depths of cutting to the required grade are as follows:

Group.	Cu. yds. in situ.	Sq. yds., area.	Av. depth of cut, ft.	Max. cut, ft.
Ledge A	537.8	1,099	1.47	4.7
Ledge B	957.8	1,909	1.51	4.7
Ledge C	99.4	328	0.90	2.4
Ledge D	806.7	996	0.92	2.9
Ledge E	761.1	1,223	1.87	5.2
Total	2,662.8	5,555	1.44	

Massachusetts.

✣Bids will be received until noon, April 16, by Directors of the Port of Boston, 40 Central St., Boston, Mass., for making water jet borings and soundings on the Commonwealth's flats east of Jeffries Point, East Boston. The work to be done is the making of 65 water jet borings and 113 rod soundings on the Commonwealth's flats at East Boston. All proposals must be made upon blank forms, which may be obtained at the office of the Directors, where plans and specifications and other information relating to the work may be obtained. Frank W. Hodgdon is Chief Engineer.

✣Bids will be received until noon, April 30, by Directors of the Port of Boston, 40 Central St., Boston, Mass., for the construction of a wooden bulkhead on the Commonwealth's flats east of Jeffries Joint, East Boston. The work to be done is the building of about 3,300 lin. ft. of oak pile bulkhead and 8,200 lin. ft. of spruce pile bulkhead on the Commonwealth's flats at East Boston east of Jeffries Point. All proposals must be made upon blank forms which may be obtained at the office of the Directors, where plans and speci-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

fications and other information relating to the work may be obtained. Frank W. Hodgdon is Chief Engineer.

The Committee on Harbors and Public Lands of the State Legislature has recommended an appropriation of $5,000,000, to be expended at the rate of $1,000,000 per year for harbor work. The money to be expended for improvements outside of the Boston Harbor District and the work will be under the direction of the State Harbor and Land Commission, Capitol, Boston, Mass.

Michigan.

✣Bids will be received until Noon, May 1, by Lieut. Col. Mason M. Patrick, U. S. Engineer, 337 Federal Bldg., Detroit, Mich., for dredging Alpena Harbor, Mich.

Mississippi.

✣Bids will be received until noon, April 14, by Maj. J. A. Woodruff, U. S. Engineer, Vicksburg, Miss., for furnishing sand and gravel and broken stone near Little Callao Landing, Big Sunflower River, Miss.

New York.

The City of Dunkirk has acquired a dock site and has applied to the State Land Board for water rights. It is probable that work will be started early this summer on its $100,000 public dock. J. M. Hackett is City Engineer.

Board of Public Works of Ithaca, N. Y., has appropriated $4,000 for work on Six Mile and Cascadilla Creeks and for repairs to the walls.

Leary & Morrison Co., Fairport, N. Y., at $25,860, was the low bidder for constructing the barge canal terminal at Fort Plains. The work calls for the construction of a harbor and dock wall on the west side of the Mohawk River, just north of the highway bridge at Fort Plain.

North Carolina.

✣Bids will be received until noon, April 25, by Maj. H. W. Stickle, U. S. Engineer, Wilmington, N. C., for furnishing about 16,000 tons of crushed stone or gravel.

Ohio.

✣The date for opening bids for reconstructed top of Dam No. 4, Muskingum River, originally advertised for April 8, has been deferred until 10 a. m., April 15. Bids are to be received by Maj. L. H. Rand, U. S. Engineer, Room 415, Custom House, Cincinnati, O.

✣Bids will be received until 1 p. m., April 15, by Williams & Patterson, 118 East Mill St., Athens, O., for the construction of a 9-ft. dam across the Hocking River, at mill site known as Barth's Mill, with fore bay wheel house and all necessary connections and appliances suitable for milling purposes. Plans and specifications can be had at our office for said dam, to be built of concrete or wooden structure, and bidders can bid on either or both plans. Said dam to be completed by Sept. 20, 1913.

✣Bids will be received until noon, April 17 (change in date from April 8), by R. M. Pillmore, Director of Public Service, Akron, O., for Contract 24, for the Cuyahoga River Dam. Official advertisement appeared in ENGINEERING & CONTRACTING April 2.

All bids received March 31 by L. A. Dawes, Director Public Service, Lorain, O., for constructing timber bulkhead dock on the Black River and dredging were rejected.

Pennsylvania.

✣Bids will be received until 11 a. m., April 26, by Bureau of Yards and Docks, Navy Department, Washington, D. C., for dredging at the United States Navy Yard, Philadelphia, Pa. The estimated cost of the work is $9,900. Plans and specifications can be obtained of the Bureau or of the Commandant of the navy yard.

⊙James Kelly, Philadelphia, Pa., has been awarded a contract by the City Council of Chester, Pa., for straightening the Chester River above 9th St.

The Hughes Terminal Co. has been incorporated with a capital stock of $10,000,000, the incorporators being F. R. Hansell and P. J. Hughes, Philadelphia, Pa., and G. H. B. Martin, Camden, N. J.

Report was submitted last week to the city of New Castle, Pa., by R. Winthrop Pratt, Consulting Engineer, Cleveland, O., on the protection of the city against floods from the Neshannock Creek. The recent flood of March 25, 1913, caused considerable damage in that city. New Castle, having a population of about 40,000, is located in the valleys of the Shenango River and Neshannock Creek, just above the confluence of these streams. The Shenango and Mahoning Rivers unite to form the Beaver River at a point about four miles below the city. The watershed of the Neshannock Creek, which covers about 250 sq. miles, has a hilly topography and the bed of the stream has a steep slope. The run-off is hence rapid and at times of excessive rains the banks are overflowed within the city. The immediate causes of damage from floods at New Castle are the deposits in the stream bed, the low elevation of the banks in the upper part of the city, and the obstruction to flow caused by several bridges and a dam within the city limits. Also the backwater from floods in the Shenango River sometimes pass up the Neshannock Creek channel and overflow the low banks in the lower part of the city. The general plans for protection of the city, recommended in the report, include the dredging of the existing deposits in the bed of the stream; widening the channel in places; building reinforced concrete retaining walls and earth-filled dykes to elevations above possible future flood-levels; removing the Rosena dam; improving the channel in the vicinity of the E. Washington St. bridge by modifying the approaches to same and placing a concrete floor in the bed of the creek; and raising or lengthening the railroad bridges near the mouth of the creek.

Tennessee.

✣Bids will be received until noon, April 26, by Maj. E. M. Markham, U. S. Engineer, Custom House, Memphis, Tenn., for furnishing and loading about 25,000 cu. yds. of riprap stone on Government barges.

✣Bids will be received until 11 a. m., April 28, by Maj. E. M. Markham, U. S. Engineer, Custom House, Memphis, Tenn., for furnishing about 35,000 tons of riprap stone, rail delivery.

Virginia.

✣Bids will be received until noon, May 1, by Lieut. Col. Eveleth Winslow, U. S. Engineer, Norfolk, Va., for dredging Thimble Shoal.

Washington.

✣Bids will be received until 11 a. m., May 3, by Bureau of Yards and Docks, H. R. Stanford, Chief, Navy Department, Washington, D. C., for four electric traveling bridge cranes and two electric traveling wall cranes for the general foundry navy yard, Puget Sound, Wash. Plans and specifications can be obtained of the Bureau or of the Commandant at the navy yard.

Bids as follows were received March 29 by the Bureau Yards and Docks, Navy Department, Washington, D. C., for construction of Pier No. 4 at Puget Sound Navy Yards: Penn Bridge Co., Washington, D. C., item 2, $176,739; Parson Construction Co., New York Bldg., Seattle, Wash., $177,228; International Contract Co., Central Bldg., Seattle, Wash., $196,683; $184,533; Graff Construction Co., Seattle, Wash., $233,909 and $175,000; Erickson Construction Co., Downs Bldg., Seattle, Wash., $166,332.

Wisconsin.

The Wolf River Improvement Co., of Appleton, Wis., has been incorporated with a capital stock of $300,000.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

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A Public Service Commission that Employs 1,000 Men.

The Public Service Commission of the First District of New York will soon have an engineering staff that will be a regiment in numbers. In order to get out plans for the new subways in New York, the present staff of 764 will be increased to 1,000.

This year's appropriation for this commission is $1,673,000. These figures serve to indicate the magnitude of the work of regulating the public utilities in the largest city in America, and they also give a hint of the extent to which engineers will soon be employed in this sort of work throughout the country.

Lack of Working Data for Designing Structural Brickwork.

The tests of brick piers which are briefly described elsewhere in this issue are notable chiefly because of the size of the piers tested. They indicate about the same conclusions that small pier tests have previously indicated. They show substantially the same unit strength as have tests of small piers. For all practical purposes, therefore, tests of brick piers 12 to 15 ins. square are as useful as tests of piers 48 ins. square, and, of course, the cost of testing the smaller piers is much less. This point is made because of the intimation in the discussion which followed the description of large pier tests before the National Brick Manufacturers' Association, that it would give valuable data if similar large piers built by local masons of local materials, could be shipped to the Government laboratory and tested. Every engineer will wish that data thus obtained were available. They are badly needed, so badly that it seems a little absurd to limit or curtail their possible number by testing a few large piers when for the same money many smaller piers could be tested and nothing lost in the quality and measure of the results secured.

Brick manufacturers complain rather querulously of the lack of attention received by brick work in the testing laboratory. They point, in comparison with the occasional testing of brick piers, to the great array of tests and test data on concrete beams and columns. They note that the steel workers have their manuals of designing data, that the cement users are coming almost to equality with the steel users in amassed and codified information, and yet brick workers are without such manuals and even without the facts from which to prepare them. There is good reason for discontent with these conditions. They are not good conditions. They have, however, a reason for being and they are largely the brickmakers' fault.

Concrete has come largely into use in places where it competes with brick, that is, in piers or columns, in arches, and in walls, first, because it has as legitimate a place there as has brick, and, second, because its advocates have developed its convenient use. They have not merely exploited it as a material—they have made its use highly convenient. They have not only said, concrete is a good column material or a good arch material, but they have tested columns and arches of concrete and amassed all the data and formulated the computation methods needed to make the designing of concrete columns and arches most easy. The engineer because of this work of the concrete advocates can design a concrete column or arch with far more ease and with far greater scientific certainty than he can design a brick pier or arch, and the years of concrete are only as the generations of brick.

There has been, we believe, no greater force in advancing the use of concrete where formerly brick alone was employed than this provision of rules and data for making its use easy and certain. There has been no greater retardant to the increased use of brick than failure to make its use easy and certain by collated strength, cost and working data. There are many advocates of brick who perceive these facts and are laboring to remedy conditions. The discussion which followed Major Howard's paper referred to above was chiefly valuable because it demonstrated the new spirit. Certainly something more needs to be said of brick to the modern engineer than that they built ancient Babylon.

It will be understood that in what we have said we are referring to the use of brick in structural engineering alone. It is in this field that neither useful nor usable data can be found with either the ease or the confidence in its reliability that one can find data on structural concrete strengths and costs. In making this statement we do not forget that we have a considerable number and perhaps enough strength tests of brick. Neither do we overlook the good work done under Major Howard's direction, at the University of Illinois, and by a few others in testing brickwork piers, but when all these tests are collated what do we know further than that brickwork gains strength by stronger brick, stronger mortar, age, and careful workmanship, all of which might have been concluded without a test ever having been made, and that brickwork has a crushing strength from a tenth to one-third that of brick and of 500 to 3,000 lbs. per square inch? Of the strength of brickwork arches we have no data of worth, and this is as true of small arches as it is of larger ones.

Does the above summary underestimate the available working data on structural brick work? As we write we are told that it does. Until we search, which we have not done, all the scattered literature on brick work, we cannot assert with certainty that we have missed nothing, but we can assert that nothing more can be obtained from the two most recent civil engineers' pocket books or from other recent books on masonry, and this fact is one of the matters we are emphasizing. There are for brick work design no convenient and reliable data in any such array as is at the hand of the designer in steel or in concrete. Until this lack is remedied it will not aid much in advancing the use of structural brick work to glorify its past history or to exploit every failure of concrete.

We are speaking frankly because we believe that brick work has a prominent place in structural engineering and is being too much crowded out of this place. We believe that every unbiased engineer will on thought assert the same belief. We also wish to see engineers provided with complete working data for designing brick work. The brick manufacturers can aid immeasurably in securing these data. The Bureau of Standards will, it is intimated by leading officials, welcome the opportunity to test specimen brick-work piers representative of local materials and workmanship. The same bureau is awaiting from Congress the privilege to construct and equip an already planned laboratory for testing brick arches. Only a few years ago the cement interests won such a laboratory from Congress and saw by their exertions the adoption of an elaborate plan for Government tests of concrete and of concrete structural units. It is equally within the power of brick manufacturers to accomplish as much for their product.

BRIDGES

Trunnion Bascule Bridges with Fixed Counterweights.

Contributed by Henry Grattan Tyrrell, C. E., Evanston, Ill.

With very few exceptions, all of the early bascule bridges belong to this classification, and were supported on trunnions. These include the two leaf railroad bridge of 1839 over the Ouse at Selby; the Fijeencord bridge of 1878, at Rotterdam; the Tower bridge at London, and many smaller bridges such as those over the Forth and Clyde canal, of which, prior to 1860, there were at least forty with double leaves in spans of 20 to 22 ft., and 10 to 14 ft. wide. These bridges revolved on cast iron axles and were balanced with weights on the rear arms.

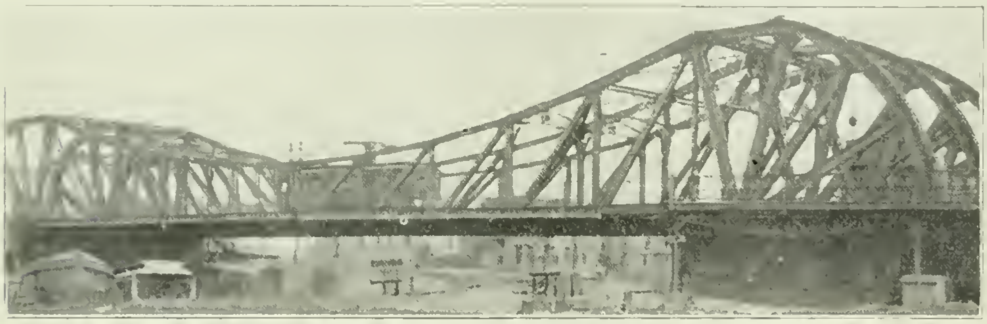


Fig. 1—Western Ave. Bascule Bridge, Chicago, Ill.

The first design for a large bascule in America was made for Duluth in 1892 by Mr. J. N. Ostrom, the hydraulic lifting machinery being developed by Mr. T. E. Brown, who was then engineer for the Otis Elevator Co. The competition at Duluth awakened interest in the type and the cities of Chicago and Milwaukee began at once to consider this form for their busy harbors. Within ten years thereafter, Chicago had many of the new type installed, most of them trunnion bridges with fixed counterweights, representing an expenditure of several million dollars. They were designed and executed under the able direction of Mr. John Ericson, City Engineer, and Edward Willmann, City Bridge Engineer, who was afterwards succeeded by Mr. Thos. G. Pihlfeldt.

Bridges for the cities of Chicago and Milwaukee are mostly of the trunnion type, and in Chicago are designed in the office of the city engineer, that at Clybourn place being established some years ago as a standard type for future ones. Milwaukee has generally adopted a different policy and invites competitive designs and bids on a submitted specification as Chicago formerly did, and the results have been excellent, for the Broadway bridge at Milwaukee is longer and wider than that at Clybourn place and yet cost much less, the difference being caused to some extent, by more favorable foundations. The "Borg" bridge, an example of which is at Franklin street, in Michigan City, is simply a modification of the trunnion type. Milwaukee in 1910 had not less than six bascules with fixed trunnions and three other folding ones.

Form or Outline.—Trunnion bascules have many features common to other types and in choosing between the various forms, it will in most cases, be found that simple trunnions are the best, though they are less widely advertised than some other forms which are patented. They are extremely simple, being nothing more than a balance with enough machinery and power to overcome wind, friction, and eccentric or other loads such as that from snow.

The outline of trunnion bridges with fixed counterweights is usually affected greatly by the height of floor above the water. As the bridge opens, the tail ends with their weights revolve down, and if they should go below water level, pits are usually needed. Since the center of gravity of the whole moving weight must be at the trunnions to maintain equilibrium, when the position of either trunnion or counterweights is established, location of the other is likewise determined. If the counterweigh is arbitrarily raised, the trunnions must also be raised to correspond. Some of the early trunnion bridges in Chicago had their center of gravity above the trunnions and slightly in front of them, and air buffers were needed, but later bridges in that city are exactly balanced. This type of bridge usually requires at least twice as much counterweight as those previously described, which are raised by cables from shore towers.

Many bascule forms of unusual interest have appeared both in America and Europe, including that of 1850 by Schwedler for crossing the Rhine at Cologne, and the similar one of 1869 by Thomas Page for the Hooghly River at Calcutta. Both of these had central openings between fine ornamental towers, and that for Cologne showed suspension spans of 188 meters over the water at each side, resembling the one afterwards erected at London. While the designs just mentioned are fine examples of aesthetic treatment other types have appeared which are quite the opposite as that at Dublin over the Royal canal which was recently replaced.

An advantageous form of bridge for busy channels is that with double moving decks one above the other. For the passage of small craft, the lower floor only need be lifted, leaving the upper one in continued service to be opened only for large vessels or those with masts. The scheme was proposed in 1885 by H. H. Bridgman for a vertical lifting bridge at London, and it appeared also in bascule form at Liverpool and in some recent American plans. The upper deck on the Tower bridge at London intended for use when the bascule spans are open, is not so generally used as was anticipated, since five or six minutes are required to cross the upper platform and it is quicker to wait on the lower deck for the draw to close. In other cases, heavier elevators might be installed to carry horses and general street travel.

Modern bascules in Holland are, in outline, much like those at Grand Ave. and Broadway, Milwaukee, excepting that at Rotterdam and Amsterdam the opening span at the center crosses only about one-third of the channel, the remaining width being covered by stone arches, leaving space at each side for ships at the docks. The bascules at Amsterdam cost about $7,000 for the superstructure and $14,000 to $15,000 for the substructure, or a total of $21,000 to $22,000. The large one at Rotterdam was somewhat more expensive, costing $26,000 to $27,000. Those at Rotterdam had, in 1894, been in use for twenty years, little or no cost having been incurred during that time for repairs. They were worked continuously throughout the year and opened thirty to fifty times per day. The annual cost of operating the Copenhagen bascule of 1869 was about $2,000. These and other early ones required little repairs or maintenance cost. A recent one containing much artistic merit, was placed over the Oder River at Stettin in 1905. The central towers very appropriately mark the position of the channel and the through arches at each side leave full clearance beneath them and give the bridge an individuality of its own and a pleasing appearance.

Advantages of Trunnion Bascules.—Trunnion bascules are easy to design and build, and when completed and with well oiled bearings the resistance to moving is small. Stresses are definitely known and easily determined, and the purchaser has no patent royalties to pay nor is he or the designer subject to the anxiety or annoyance of threatened law suits for patent infringement. The loads on the foundation are fixed and definite, the bridges can be quickly opened and closed, and the maintenance cost is a minimum. Their durability is proven by the old bridge of 1839 at Selby, which continued in use for over fifty years. The counterweighting of plate girder trunnion bridges is extremely simple, as weight boxes can be attached to the rear end of the girder webs. On the Anacostia bridge at Washington, the weight on each girder forms a solid block 5x10x10 ft.

Design.—When outlining a design, it should be remembered that the clear span is the distance between fenders rather than that between abutment faces, and this must conform to the requirements of the War Department or the local specifications. Trusses and framing should be well braced with stiff members, since the life of moving bridges depends to a great extent upon their rigidity. As previously stated, the outline of the structure will be affected by the height of floor above water, and if this is small the cost will be increased and the outline rendered unsightly. The floor elevation is, in fact, one of the chief factors in the evolution of a design. The center of gravity of all moving parts must be at the trunnion which is usually placed at or just above the floor line, and the center of gravity of each leaf is usually 45 to 50 per cent of the span length from the pivot. If the leaf is not exactly balanced by counterweight on its rear arm, work is performed at each operation of opening, and the amount of this work, in addition to overcoming friction, is the product of the weight into the height to which it is lifted. Enough power with a large reserve, should be supplied to overcome these resistances.

Trunnions.—The axles of most of the early trunnion bridges were of cast iron, those of 1815 at Kingston and of 1839 at Selby being 8 and 9 ins. square, respectively. They usually went clear across the structure from one side to the other, as illustrated by the Selby Bridge and that of 1867 at Copenhagen, the axles of which had six supports or bearings. On the Tower Bridge of 1894, solid forged shafts were used, 21 ins. diameter and 48 ft. long supported in eight journal boxes with steel rollers 4 7/16 by 22½ ins. long in cast steel sockets, the roller bearing feature not being generally favored in America and not often found elsewhere even in Europe.

Short axles were used in England by Mr. Price prior to 1879 and are preferred in America. Those on the bridges at Clybourn place, Chicago, are 15 ins. through and 6 ft. 10¼ ins. long, and are fastened to the girders by four 1½ in. keys, the girder webs being reinforced. They bear in cast steel boxes which are lined on the lower side with phosphor bronze. The two "Page" bridges in Chicago have hollow cast steel axles, those at Ashland Ave. being 20 ins. in diameter, while for the railway bridge of that type they are 24 ins. in diameter with 17 in. center holes.

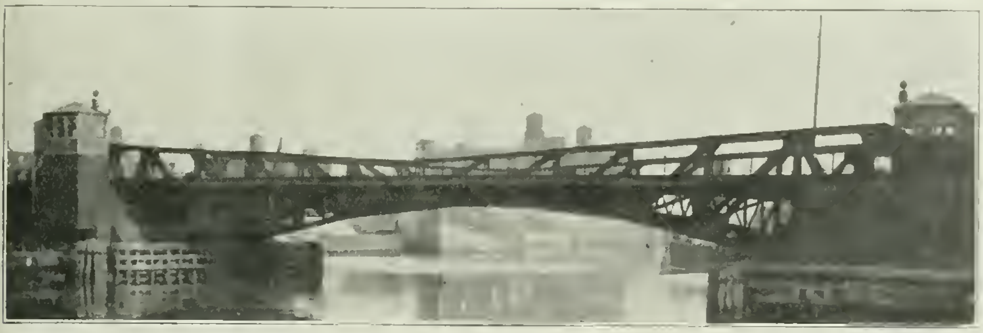


Fig. 2—Erie St. Bascule Bridge, Chicago, Ill.

Trunnions for the Broadway bridge at Milwaukee, are forged steel, 25 ins. through at the center and 8 ft. 8 ins. long, with 16x16 in. bearings in cast steel boxes with phosphor bronze bushings. They bear on the projecting end of approach girders which stand on steel columns and cantilever out 6½ ft. to hold the girders of the moving leaves. This arrangement loads the foundation uniformly and avoids uplift. On the Anacostia bridge at Washington, the trunnions are forged steel 20½ ins. diameter and 8 ft. long, with 2¾ in. holes through the center, the girder web being reinforced to a thickness of 2⅜ ins. Continuous trunnions or axles are used on the new bascules in Europe at Copenhagen and Portsmouth, the former being a turned shaft with six girder bearings at equal intervals.

Quite a new kind of trunnion was introduced in the bascule at Franklin St., Michigan City, completed in 1908, for there the axles are a part of cast steel members which fit in between the double webs of the heavy end cross beams to which they are riveted. These beams support one end of the approach floor and rest on standards outside of the moving trusses, the weight of which is carried to the axles through steel castings with double webs and phosphor bronze bushings to which the radiating truss members are attached.

Racks.—Trunnion bridges offer a very simple and easy method of operating by racks and pinions. Most of the recent applications are modifications of that used on the Selby Bridge of 1839, where a single rack stood in the center at each end between the two tracks and above the floor. On the Tower Bridge, cast steel racks are bolted to structural steel quadrants fastened to the tail end of the two outer girders, and on each rack are two pinions with a pitch of 5.9 ins. Several of the best American designs, such as those at Grand Ave., Milwaukee, the Anacostia Bridge, Washington, and Franklin St. at Michigan City, have their racks fastened to the lower side of the girders concentric with the trunnions, but the usual practice in Chicago with open web trusses is to place the rack on the heel quadrants above the floor and to make them of cast steel bars between the chord web plates, 6x9½ ins. being the usual pitch and width. They are built up in segments, each of which has twelve teeth worked by a 23-in. pinion. The openings between the rack teeth prevent the collection or formation of dirt and ice. The reverse method of installing racks was tried on a small bridge at Mott Haven, New York, where the racks are attached to the masonry and the pinions to the moving leaf, but the arrangement is not desirable as the contact betweent rack and pinion is not easily adjusted. The proper way is to fasten the racks to the bridge and the pinions to the abutments.

Counterweighting.—Counterweighting is an objectionable feature of any bridge and should be avoided wherever possible, for it adds expense, not only for the material itself, but also for the heavier framing and foundation to support it, and power to overcome the extra resistance of friction and inertia.

If the counterweights dip down into water when opening, as they did on the bascules at Selby and Drumsna, their effective weight is reduced by an amount equal to the weight of the water displaced, and some system of compensating must be introduced, or power supplied to overcome the lack of balance. To partially avoid this difficulty, the tail ends when in air might be made a little heavier than the leaf. This trouble from submergence, in districts where the land and water are nearly at the same level, leads to the use of overhead beams in Holland, and precisely the same principle in patented form has since been exploited in America for larger spans.

Composition of Counterweight.—Many kinds of heavy material have been used, including water, stone, cast iron, lead and concrete. Masonry counterweight was used in 1861 on the short ends of the double swing bridge at Brest, but as cast iron weighs three times as much as stone in equal bulk, it next came into favor. Recent competitive designing has caused a demand for a cheaper material, and concrete, the cost of which is only one-seventh that of cast iron, is now the prevaling one. When made with trap rock or limestone it weighs 145 to 155 lbs. per cubic foot. Slag concrete weighing 180 lbs. per cubic foot, in a skeleton frame, is often used, as on the Kinzie St. bridge at Chicago, the combination costing not more than one quarter that of cast iron. But concrete alone is suitable only when a comparatively small amount is needed, for on heavy spans it would be very bulky. It should preferably be enclosed in a metal frame or box, and the mixture of cement, sand and stone should then be in the proportion of 1 :3 :6, but when otherwise applied without metal supports, the ratio should be 1 :2 :4.

Heavier material at greater cost may be made of a combination of concrete and old rails, iron punchings, or pig iron, the weight of which will be from 300 to 350 lbs. per cubic foot. It was used on the Huron St. Bridge, Milwaukee, in 1897, and is now generally favored. The counterweight for the Tower Bridge at London consists of 290 tons of lead and 75 tons of cast iron, and was very expensive.

Methods of Applying Counterweight.—Counterweight is applied to bascules in many ways, some of which are patented. Its connection to the tail end of beams should preferably be rigid. On some patent bascules such as that at Ashland Ave., Chicago, the approach spans at each end constitutes the counterweight, and for this purpose the floor is made very heavy with vitrified brick paving on concrete. Bridges with unequal arms are sometimes balanced by using steel trough flooring with concrete filling and brick paving on the short arm, and plank floor on the longer arm, as on the highway swing at Ruhorter Hafen.

Water Ballast.—Buoys may be used in place of counterweights, with flotation equal to the required balance, the principle being applied on a bascule over the Tiber near Rome. On the moving part of this bridge are two segments 9 ft. 8 ins. diameter, over which pass flat steel ropes connecting with floating counterweights 3½x10 ft., inside the cylinder piers. To open the draw, water is let into the floating cylinders and the leaf rises, and to close the bridge, water is withdrawn. Water ballast in a metal tank has often been installed in direct lifting bridges, and it was also applied in 1873 on a bascule at Dublin, but has not often been repeated.

Position of Counterweight.—The position of the counterweight depends on the primary design. In trunnion bridges with the hinges near the floor, the counterweight is usually below the platform, and it is so placed on the Tower Bridge, where the lead and iron lie within a transverse box. A similar position with larger boxes for old rails and concrete is used on recent bridges in Chicago, and in 1893 on the old Canal St. folding bridge. In other cases, separate blocks may be attached to the girders at the rear end as on the Anacostia bridge at Washington.

Elevated counterweights are used on bridges with elevated trunnions, as in the Brayton type, or on those with lower trunnions where head room above the floor required it. On bridges of the Strauss patent, transverse elevated counterweights descend in their lowest position to within 8 ft. of the highway floor, leaving space beneath for pedestrians, but on railroad bridges they are lowered to the rails and form a substantial barrier against accident. Patents for an overhead counterweight was granted to Mr. F. G. Borg in February, 1906. On comparatively small swing spans, counterweight can be applied on the deck at the rear end, in the form of heavy iron newels, the arrangement producing quite an ornamental effect as illustrated by the bridge of 1873 at Hull where the newels weighed 47 tons.

Adjustment of Counterweight.—As early as 1830 it was found that the tail counterweight on a bascule at Hull did not exactly balance, and a compensating chain weight was added, and later, the Fijeenoord Bridge at Rotterdam of 1878 had a system of moving weights on the tail end. Adjustable weights are, however, uncertain in their action, and are not desirable. When boxes are used, material can easily be added or removed as required.

Amount of Counterweight.—The amount of counterweight varies with the design, several patents having been granted on bascules which require none whatever. One such, invented by Mr. F. C. Hall, was once accepted for the Harrison St. Bridge, Chicago. When counterweight is used its amount will vary inversely as its movement, large weights being needed on short arms and lighter ones on long arms. The same rule applies to bascules raised by ropes or chains over sheaves on shore towers, where the weight is usually 1½ to 2¼ times that of the bridge. The cost of many modern bridges is greatly increased by their large balance weights, some recent ones containing more than 1,000 tons.

Trunnion and Other Bridges Compared.—Trunnion bascules are sometimes more expensive by 10 to 25 per cent than rolling ones, because the axis of rotation must be far enough back from the water that the floor and upper end of leaf may clear the channel when the bridge is open. This makes the span length greater than a rolling leaf, the bearing of which may be close to the channel. If the counterweight on trunnion bridges is of cast iron or other heavy and expensive material, this may further increase the cost by another 10 to 20 per cent.

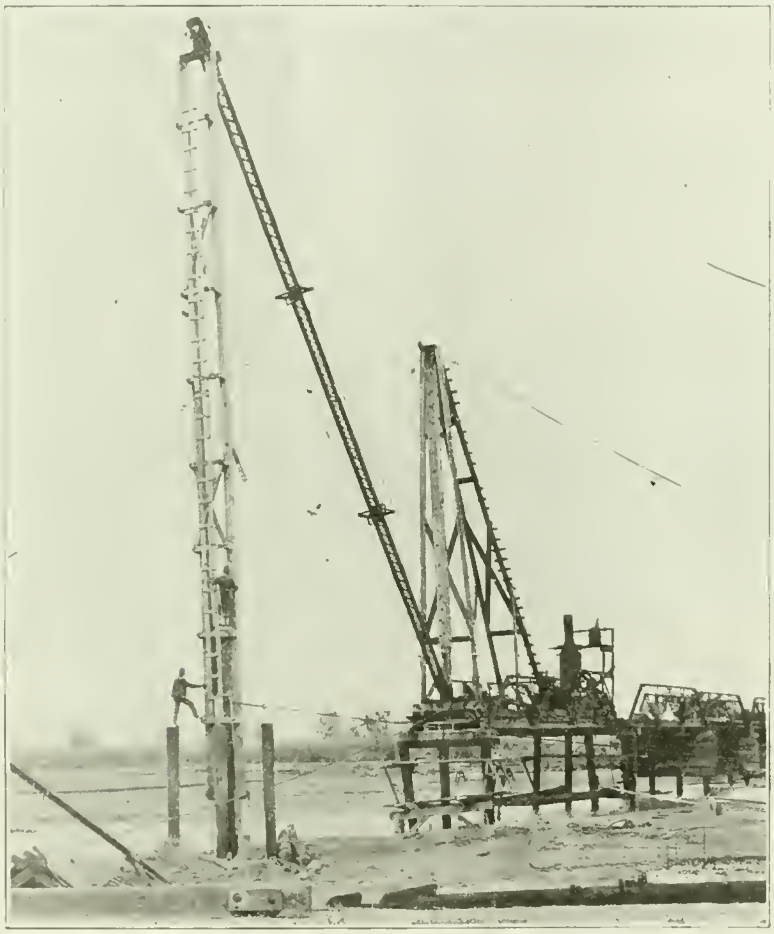
In comparison with direct lifts it will be found that the amount of counterweight in lifts is only equal to that of the bridge, while with bascules it is often 1½ to 2½ times as much.

Power.—Experience at Chicago shows that the amount of power needed to operate trunnion and rolling bascule bridges is about the same, or approximately 50 amperes, though on some of the city trunnions it is as low as 20 amperes. Both of them require small power compared to the "Page" bridges in the same city, which require an average of 70 amperes with a maximum of 200. The amount of power needed for any bascule bridge is affected largely by the weather, and the nature of the floor or pavement. In rainy seasons, wood flooring becomes water soaked causing an overbalance which may not be rectified immediately. In northern cities subject to ice and snow in winter, the leaves must usually be kept well over counterweighted.

Combination Pile Driver and Bridge Erection Derrick.

(STAFF ARTICLE.)

In constructing bridges crossing Rio Grande, near El Paso, Tex., the combination pile driver and erection derrick shown by the accompanying cut was used. The bridges had substructure consisting of pile bents. As the stream bed from bank to bank is quicksand, the ordinary method of temporary staging for pile driver and span erection could not be employed. The device illustrated, resting on a finished span, drives the piles for the bent ahead and then picks up and places the assembled spans, after which it is moved ahead for another span. The engine and derrick mechanism are mounted on rigid frame 54 ft. long, which sits between the erected trusses and is mounted on rollers for every movement ahead. The mast is 48 ft, long and the boom is 80 ft. long. The swinging leads at the end of the boom are 68 ft. long and the horizontal distance from center of leads to center of mast is 51½ ft. The piles used are 60 ft. long and they weigh about 3,000 lbs. each. They are driven to a penetration ranging from 52 to 58 ft. The whole device was designed for a working capacity of eight tons. The hammer is a 5,500-lb. steam hammer, with a rated capacity of 578,000 ft. lbs., striking 130 blows per minute. The time required for sinking the piles averaged about one hour continuous driving per pile. This erection device is being used by the El Paso Bridge & Iron Co., El Paso, Tex., Mr. W. E. Robertson, manager. We are indebted to Mr. Robertson for the information from which this note has been prepared.



Combined Pile Driver and Bridge Erection Derrick.

Bridge Foundation Construction on Soft Bottom Adjacent to Existing Piers.

A bridge foundation in an alluvial stream involving problems in current regulation, and bottom scour and also constructional difficulties due to possible undermining of adjacent piers and to soft bottom, is described by Mr. C. E. Smith, Bridge Engineer, Missouri Pacific Ry., in a paper before the American Railway Engineering Association. We have redrawn the principal illustrations and abstracted this paper as follows:

The former bridge, consisting of one 103-ft. 6-in. combination span and a 206-ft. 6-in. Phoenix draw span on pile piers with trestle approaches, was replaced on the same center line by a 267-ft. draw span on concrete piers and 60-ft. deck plate girder on pile pier, with trestle approaches, both bridges providing for single track.

When the first bridge at this location was constructed the east rest pier was placed on the east bank of the river, which was on the outside of a long curve. The erosion of the current and caving banks moved the bank line east about 85 ft. for about one-half mile above the bridge, with the result that the east rest pier and east trestle approach were located on a point projecting sharply out into the river. This point deflected the current abruptly and caused a swift cross-current through the east channel that made navigation very difficult at this point. The upstream bank of the point was heavily protected by riprap and by piling and heavy timber sheeting.

The pivot pier again deflected the current so as to cause much boiling, whirlpools and eddies immediately below the bridge, which gradually cut back the east bank until it very nearly lined up with the east bank line above the bridge. Further effect of the turmoil was indicated by excessive scour under and downstream from the bridge, causing a depth at low water of about 40 ft., while the average low water depth of the river at other points was about 5 ft.

The effect of the bridge on the current at this point is indicated by the cross-sections, Fig. 1. At a point 100 ft. above the bridge the deepest part of the river and swiftest current were about 150 ft. east of the pivot pier, under the bridge they were directly in the main channels on two sides of the pivot pier, while at a point 100 ft. below the bridge they were about 100 ft. west of the pivot pier.

To eliminate the above objectionable conditions it was decided to place the new east rest pier on the east bank line, to excavate down to 8 ft. below low water on the river side of the pier and to construct pile trestle approach 70 ft. long east of the pier, excavating the material and riprapping the slope to prevent scour. As boats had successfully passed through the bridge for a number of years under the objectionable conditions that prevailed, it was thought the straightening of the channel would so improve conditions that very little if any increase in the width of channel opening would be required. The former opening had 86 ft. clear width; the first new plan proposed an opening 90 ft. wide, provided by using a through plate girder draw span 210 ft. long.

The boat men demanded a larger opening. As a compromise the U. S. Engineer officers required that the piers be placed 135 ft. c. to c., calling for a draw span of 267 ft. providing clear channels 118 ft. wide. A 60-ft. dock space sufficed to reach the west bank line and the remainder of the opening was reconstructed as pile trestle.

Placing the new east rest pier on the bank line about 85 ft. east of the old rest pier brought the pivot pier practically in the center of the east channel and the new west rest pier just east of the old west rest pier, the relative location of the old and new piers being such that construction of the new could be completed without interfering with the old except as to the danger from undermining.

The locaton of the new pivot pier within the east channel effectually blocked that channel to boats, making it necessary for them to use the west channel. In that channel the opening temporarily was reduced to 66 ft. after the completion of the new west pier. As it was very difficult for boats to reach and pass through the west channel the specifications required that the west pier be completed and cofferdam removed down to the top of the footing course before construction of the pivot pier could commence and that during the construction of the pivot pier the contractor would help boats to pass through the west opening.

It was realized that the work of preparing the new foundations had to be carefully done to avoid damage to the old pile piers. The old west pier had previously settled and leaned toward the draw span about 10 ins. and it was necessary to avoid undermining it. No record of the length of piles in the old pivot pier was available, but it was thought that the bottom of the piles was considerably above the bottom of the river in the deep channels on each side of the old pivot pier, the piles being held by the large mound of riprap around that pier. The riprap extended out into the east channel to the location of the new pivot pier and it was necessary to dredge out a large amount of rock before pile driving for that pier could be prosecuted with any hope of success. This dredging and the scour of the channel tended to weaken the old pivot pier, but no movement was noticeable during the work. Later on it developed that the bottoms of the old piles were very high and the piles had only a few feet penetration into the riprap, so little, in fact, that the erection contractor removed about sixty of them in one day.

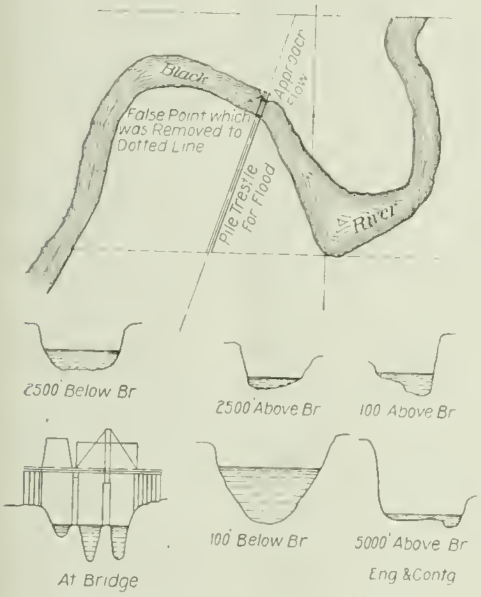


Fig. 1—Abutment and Cross-Sections of Black River, Showing Effect of Bridge Piers.

Construction of the west pier presented no unusual features. Open crib cofferdam was used, the sinking being accomplished by dredging through the water. Before any attempt was made to pump out the cofferdam, the foundation piles were driven, with the aid of a water jet, to an average penetration of 40 ft., and a depth of 8 ft. of concrete was deposited through a tremie around the pile heads which projected considerably above the top of this sealing course. When the sealing course had set the cofferdam was pumped out, piles cut off 6 ins. above the top of the concrete and the pier finished.

The east rest pier is a duplicate of the west pier. The construction was somewhat unusual in that the bottom of footing was required to be placed 57 ft. deep in the solid ground under traffic. The excavation was accomplished by driving pile bents for the support of the track and replacing them by others driven deeper as the excavation progressed. Sheeting was used to reach the bottom of the excavation before the surrounding material was excavated to the water level. This was done to keep the hole as dry as possible. The piles were driven to an average penetration of about 40 ft. with the aid of the water jet and the pier was finished in a manner similar to that used on the west pier.

The construction of the pivot pier was unusual and extremely difficult on account of the swift current in the east channel opening, accompanied by eddies, whirlpools and deep scour, and the large amount of driftwood that reached this opening during every rise in the river.

On account of the great depth of water under and immediately downstream from the bridge, indicating deep scour, the use of pneumatic foundations was discussed. Borings indicated hard blue shale about 130 ft. below the rail, about 100 ft. below average low water and about 125 ft. below extreme high water. Investigation developed that piles driven into the river bed without the water jet and protected by riprap had supported pivot piers of former bridges at this point for over 30 years without settlement. The Black River is normally throughout its entire length a comparatively quiet stream, and although subject to sudden rise, it does not cut its banks rapidly nor scour to any great depth except where subjected to sudden changes in direction as at the east end of the old bridge. Even if pneumatic foundations were used it would be necessary to protect the east bank above the bridge to prevent cutting and to avoid a recurrence of the bad conditions obtaining at the old bridge. The above facts led to the decision to use pile foundations instead of going to the heavy expense of pneumatic work. In addition it was confidently expected that cutting away the point at the east end of the bridge would restore conditions to normal and cause much sediment to deposit and fill up the deep holes eroded by the turmoil in the current, and this filling started immediately after the current was permitted to pass unobstructed.

It was expected that during the construction of the pivot pier more scour would take place and it was difficult to decide how deep to place the footing of this pier. It was finally decided to extend the network 8 ft. below low water and to make the footing 10 ft. deep, placing the bottom of footing 57 ft. below rail. Any space below that level caused by scour was to be filled with riprap. It was impossible to foretell how deep the river would scour when the channel was further obstructed by a large cofferdam, or to what extent the old piers would be endangered. The contractor decided to drive the foundation piles and place the riprap around them before placing the cofferdam.

The piles were driven with the aid of a water jet to an average penetration of 40 ft. below the bottom of the footing. Long piles were used to avoid the necessity of following them down through the water, which would have been very difficult, as the deep water and swift current rendered it almost impossible to hold short piles with followers. After the piles had all been driven, which, as a rule, placed the tops of the piles level with the water surface, the piledriver barge was equipped with a circular saw revolving in a horizontal plane and attached to the bottom of a vertical shaft which was held and guided by the piledriver leads. This saw cut off all the piles about 16 ft. below the water surface.

After the piles had all been driven and cut off under water about 2 ft. above the bottom of the footing course, the riprap was deposited among and around the piles up to about 1 ft. below the bottom of the footing and forming a shoulder about 5 ft. wide all around the piles. On top of this a layer of "pit run" gravel about 1 ft. thick was placed to bring the level up to the bottom of the footing. The cofferdam (open timber crib construction) was then launched and landed on top of the layer of gravel. About 8 ft. of concrete was then placed by means of bottom dump buckets, allowed to set, cofferdam pumped out and pier finished in the ordinary manner. Riprap was later deposited around the footing course, making a shoulder about 5 ft. wide entirely around the pier. The expectation that the river would deposit material to fill the deep holes has been realized and the riprap is now deep within the bed of the river.

The pivot pier was built cellular, Fig. 2, to reduce the weight on the pile foundation. The rest piers were built solid.

The specifications for erection provided that the expense of caring for navigation would be borne by the railway company. It was calculated that the falsework could be placed, the old span taken down and the new span erected and adjusted ready for turning in about six weeks. A canvass among the owners of boats that passed through the bridge indicated that their claims for damages for that length of time would certainly amount to from $15,000 to $20,000, and would probably greatly exceed that sum, as other boats would be drawn by the opportunity.

The large claims that could be foreseen caused the decision to install at the east end between the old and new east piers a second-hand deck plate girder span with timber towers and old rail counter-weights for a vertical lift bridge. This was installed ready for operation before the old draw was placed out of service. The completion of the falsework, taking down the old span, and erecting the new draw span, including riveting and adjustment of machinery, out to the temporary lift bridge were carried out at leisure without any interference with boats. At an opportune time the lift span was taken down and the new draw span extended. During the latter operation the river was blocked a few days, which constituted the only time the river was blocked during the reconstruction of the bridge. In spite of all these precautions, however, claim for damage due to delay was filed by the owner of a boat which arrived at the bridge during the final extension of the draw span.

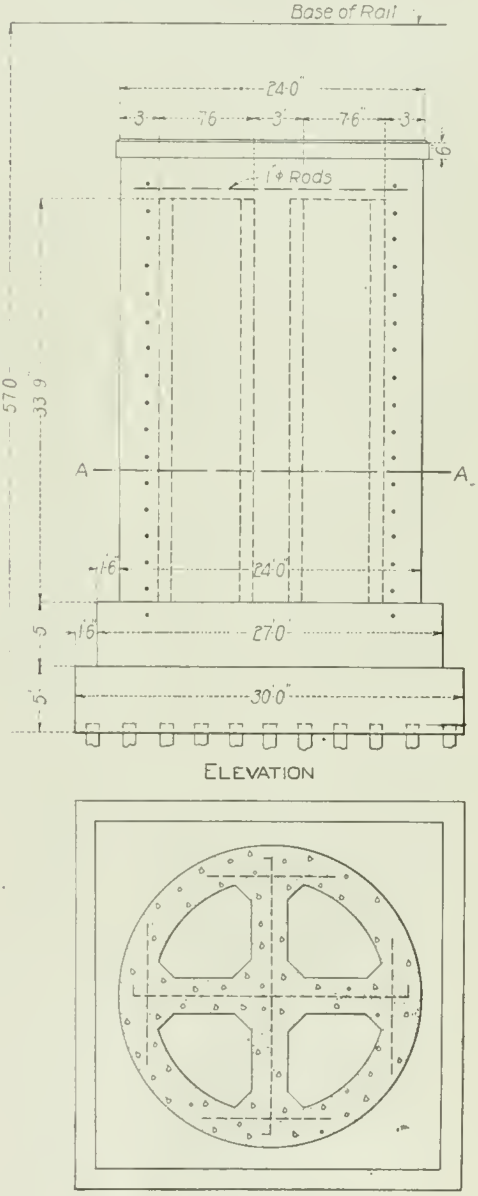


Fig. 2—Cellular Concrete Pivot Pier for Draw Span of Black River Bridge.

This boat arrived at the bridge at 12:30 p. m. on the 8th and passed through at 5:30 a. m. on the 10th. The total delay amounted to 41 hours, for which claim was made for $5 per hour, making a total of $205. It was pointed out to the boat owners that it is customary for such boats to tie up to the banks of these small rivers at night, which reduced the delay to about 20 hours. It was also pointed out to the owners that the same boat and crew had a short time before been employed by the railway company for towing purposes at $25 per day for 10 hours' work. On this basis the actual loss was 20 hours at $2.50 per hour, and an offer to settle for $50 was made. Payment of $75 finally settled this claim.

On account of the temporary opening at the east bank being located in the bight of a bend the driftwood that was brought down passed through and caused little trouble except during the rise. One evening when the workmen left the bridge the current was flowing slowly upstream due to backwater, and was overflowing the bank. During the night the water rose high enough to float all logs and other loose timber along the low lands and swamp adjoining the river and then the current turned and brought the entire mass against the falsework, covering the river for its entire width for a half-mile above the bridge. On account of the slow current no damage was done other than the delay; the drift was very readily passed through the falsework.

The erection of the steelwork was let on a unit price basis. The installation and removal of the temporary lift span was an extra, the price being agreed upon in advance between the contractor and the railway company as $1,400.

The opening of the temporary lift span was done by the contractor on a force account basis. This was found to be very unsatisfactory, as it was always very difficult to separate the cost of this work from the remainder of the job, and it was impossible to determine to what extent the contractor was entitled to allowances on account of delay to the other work caused by the men having to open the bridge.

In later contracts this difficulty is avoided by getting, in the original bid from each bidder, a price for each opening.

The draw span is a 12-panel, riveted, disc center-bearing span of ordinary construction operated by a 25-h.p. horizontal Fairbanks-Morse gasoline engine in a reinforced concrete house over the center pier.

The bridge was designed for Cooper's E-50 loading, according to the specifications of the Missouri Pacific Ry., which conform with those of the American Railway Engineering Association. The weight of structural steel is 360 tons, and of machinery 40 tons. The total cost of the bridge, including the excavation of the east bank, removing old bridge and piers and all incidental expense, amounted to about $100,000.

The substructure work was performed by the Missouri Valley Bridge & Iron Co. of Leavenworth, Kans.; the steel was fabricated by the McClintic-Marshall Construction Co. and erected by the Union Bridge & Construction Co. of Kansas City, Mo.

Cost of Erecting Timber Trestle and a Steel Truss Span on the Central Paraguay R. R.

(Staff Article.)

The following notes are the cost of steel bridge and timber trestle erection, while lacking somewhat in specific detail, are interesting because of their source. Paraguay is a country with which the average contractor is cheerfully unacquainted, but he will nevertheless welcome a word from a brother American who is playing the game in a strange country. These notes are from a letter to us from Mr. C. F. Mead of C. F. Mead & Co., of Borja, Paraguay.

The bridge consisted of a 60-metre (196.8 ft.) Pratt truss span, and a timber trestle 140 metres (459.2 ft.) long. The data given include labor and inspection costs only. The work was done under average conditions as found in Paraguay, the men used being unexperienced peons who had never before seen a steel bridge.

The timber trestle was supported on piles of native woods, known as urunday-mi and curupay, and the stringers were made of lapacho. The piles were driven with a hand pile driver to an average penetration of 4.3 metres (14.1 ft.) through a fine sand with an occasional stratum of other soft material. The trestle bents were delivered framed and were erected with a 5-ton Wilson traveling crane.

The pin truss was erected on pile falsework. All steel was erected with the 5-ton single rope crane. The cross-girders, stringers and track were laid in the order mentioned. The columns with wind bracing were rivetted and set up in pairs and the lower pins were packed as each pair of columns were placed. Then the main chord numbers were placed in position, working from the center toward the ends.

The steel work was delayed four days by a strike and new men were obtained. Floods carrying log rafts also threatened the falsework and the temporary railroad bridge built on the upstream side.

The cost of the labor and inspection for the trestle, the falsework for the steel truss, and the erection of the steel truss is given below.

COST OF TIMBER TRESTLE.

(26 bents and 1 abutment.)

Piling:	
Labor, 639¾ peon days	$ 697.12
Inspection, 23 days	97.02
Total	$ 794.14
Timber used, ft., b. m.	78,649
Cost per M. ft., b. m.	$ 10.097
Bents, stringers and track:	
Labor, 501 peon days	$ 450.88
Inspection, 27 days	100.15
Total	$ 551.03
Timber, ft., b. m.	198,896
Cost per M. ft., b. m.	$ 2.73
Falsework for steel truss:	
Labor, 576 peon days	$ 572.57
Inspection, 3 days	11.00
Total	$ 583.57
Timber in falsework, bd. ft	143,670
Cost per M. ft., b. m.	$ 4.06
Erection of truss:	
Labor, 491¼ peon days	$ 642.85
Inspection, 29 days	103.00
Riveting and clearing out falsework:	
Labor, 206½ peon days	$ 264.78
Inspection, 15 days	55.00
Painting, and removing staging on truss:	
Labor, 86½ peon days	$ 124.00
Inspection, 4 days	15.00
Total, erection of truss	$1,205.45
Cost per ton (120 tons)	10.05

RAILWAYS

Some Notes on the Scientific Management of Labor in Railway Maintenance of Way Departments.

Contributed by A. Swartz, Engineer Maintenance of Way, Toledo Railways & Light Company, Toledo, Ohio.

As stated in the writer's article entitled: Economy in the Use of Materials in Railway Maintenance of Way Departments, which was published in ENGINEERING & CONTRACTING of March 19, 1913, the track department spends about $600 per mile of track per annum for labor. About $400 per mile of track per annum is spent for the labor of carpenters, water station and interlocking men. With the advent of block signals on many railroads there is a considerable amount added to the foregoing costs. On some roads, however, the maintenance of way department is not charged with the block signal expense account.

To illustrate the value of doing well any work done by the track department the following incident is related: A yard foreman on my territory was one day repairing the track at a turnout where a derailment had occurred and because of a rush of other work and short force slighted the repairs in a minor particular. I called him aside and explained to him how he had slighted it. He saw my point, which was that if left in that condition it was a question of not less than a week or so before he must necessarily return to it at a time which might find him more rushed with other work. The chances are that had he gone back to this work it would have cost at least an additional hour's labor. This would have been nothing short of simple waste.

There are plenty of manufacturing concerns in this country which have a certain routine that an article must go through before it is completed. Every man who handles the article has just so many movements to go through with to complete his part of the work. In some cases the position of the article in the machine is specified as well as the actual movements of the operator's hands.

While this may seem very theoretical, it may safely be said that certain track work can be done in a methodical way, the same as machine work; that is to say, certain movements systematically followed will accomplish the work in the least time.

A great many of us know of an engineer and builder who invented a brick mason's scaffold, the use of which requires but a certain minimum number of arm movements on the part of the mason with remarkable results in the quantity and quality of brick laying. Also of an engineer in a steel mill who regulated the size of the shovel each man used in handling a by-product which resulted in 200 per cent saving.

Whenever necessary to replace a large bridge the work is all carefully planned with respect to every movement to be made. Nearly every man on the work is carefully coached as to just what he shall do so that when the time comes everything will work easily and one man will not get in another's way. In a similar way the work of a track foreman can be planned to a great extent. One man should be required to do this and another one to do that; in this way each man will necessarily take more pride in his work than where this division of labor does not exist.

In street railway work the renewal of frogs, switches, etc., must necessarily be made quickly, for the public will not stand for much delay, and if a car through some unforeseen happening is derailed, it takes only a few minutes to block traffic so completely as to take three or four hours to get back on schedule. For steam road men it would be a good lesson to watch how carefully and methodically such work is done. These special pieces are heavy and hard to handle by hand and yet the work is done quickly. A good many companies have derrick cars which help greatly in this work.

This brings up a point worth mentioning in connection with steam road work, namely the wrecking derrick can oftentimes be used for heavy maintenance work, such as handling frogs, rails, etc., at storage piles. Also in renewing crossings it will sometimes pay to run a wrecking derrick as far as 100 miles to do this class of work. A new crossing can be put in place in seven or eight minutes with the aid of the wrecking derrick and perhaps eight men to put the angle bars on the ends of the legs. When installing slip switches, the whole installation may be put in at one time with a very great saving of time.

A certain railroad recently specified that in handling ties two men should raise one end by means of a stick under the tie while the third man should carry the other end. There were various reasons for this. One was that foreigners sometimes take four men to a tie. Another was that if one or two men in a gang had been in the habit of handling a tie, the balance of the gang would take advantage of it and also that these one or two men would tire quicker and be of less service when emergency demanded heavier work.

Nearly every road has a specified number of men to lay new rail or new ballast, assigning so many men to each class of work. The number varies with different roads and naturally different results are obtained.

The assignment of men, however, to certain work can quickly lead to trouble, as shown by the following incident. While relaying rail one of my foremen wanting to close up a stretch of rail just laid in place told the tong men to spike up behind. The Italian interpreter promptly told the foreman that the men were not supposed to do anything but handle rail. They were told to do the work or quit right then. They would not go to work nor leave the division till the division engineer (myself) came to hear their trouble. Knowing the foreman and supervisor to be somewhat prejudiced and getting but meager information over the wire, I went there to hear the trouble. On being told by the supervisor just what had occurred (he was there when the trouble arose), I told him to give the men twelve hours to get off the division and they "got." This incident came about by the men knowing that so many men were specified for each class of work, which, of course, was meant to be followed only in a general way.

One of the greatest difficulties in connection with labor is in handling large gangs of men to the best advantage. I therefore advocate separating the men into small squads so far as possible and then by various means create a spirit of rivalry between the various squads. A man is very much like a child in this respect, and if not handled by a slave driver much more work can be accomplished than where a spirit of competition does not exist.

Trackmen sometimes in doing extra gang work, and to further their own work, delay freight trains. This practice results in decreased efficiency in the transportation department. This causes a delay which is costly not only to the train delayed, but perhaps to other trains waiting on this one. It also costs actual money to start and stop a train. Naturally the trackman will say, "We always get the worst of it and cannot give our department a full day's work." This will not be remedied until each extra gang is equipped with a portable telephone by means of which they can keep in touch with the dispatcher. This is now being done on some roads and will be universal in a few years.

The "Safety First" question also comes in at this point, for that above all things must be the motto of trackmen. To be positively safe means the track must be in readiness for all trains. If trains are off their schedule this means lost time to the trackmen. Many times if they had the 10, 20 or 30 minutes which a train is late in which to work greater results could be obtained. Telephones would remedy this. Think of the saving in time of work trains alone, which could be made if telephones were used. Many times have I had work trains start out with a chance for a fair day's work only to close the day with not more than 2 or 3 hours out of 12 actively engaged in working. Co-operation on the part of all concerned will, of course, bring better results, but often we find the other department trying to take the advantage.

A live section foreman can save money for the company in doing things not ordinarily considered trackmen's work. Take, for instance, minor repairs around platforms, stations, water stations, interlocking, etc. When he sees something out of repair he often can remedy it in a few minutes and save the expense of sending a high price workman perhaps 100 miles to do 15 or 20 minutes work. This particular thing was quite common on a good many roads some years ago, but the recent economy movement has changed it.

I once had a bridge inspector who also tested fire extinguishers and scales, repaired mail cranes, train order signals, small station repairs, etc. Signal maintainers may also be charged with inspections of other matters and emergency repairs of various kinds. Safety being the motto, every employe can find time to do emergency work of other departments, thus effecting economy.

A very small matter which means a great deal of lost time and money in the aggregate in a year's time is the habit of one man tending switch lamps in the morning while the rest of the gang waits on the hand car. The other men might better be cleaning out cinders which accumulate at the end of all passing tracks, or be perfecting drainage around switches, tapping down loose spikes, etc.

In the spring when distributing ties for renewals, time is gained by laying the ties on the bank at right angles to the track so they may be handled quickly and easily when putting them in. If they are piled in the fall or winter it surely saves time to pile them in small quantities. This saves excess trucking when renewing ties. A fair sized gang of men can throw off a great quantity of ties while a train is moving very slowly, thus saving expense for both the transportation and maintenance of way departments.

It seems a poor policy to put in new ties and not spike them at once, for it means not only going over the same territory twice, but adds more strain on the old ties and spikes than they should rightfully take. Nor is it good track work to put in new ties without squaring up the old ones that are skewed. Nothing keeps track in better line and surface than squared up ties well spiked. When one thinks of the enormous weight of present day equipment he cannot help but realize the necessity for the best of track conditions.

We one year had our weed mowing done by contract at a general average cost of 10 per cent more than the cost of doing this work by company forces. This, however, we considered a great saving, as we had the services of our trackmen on track work during this time. There are numerous other ways of contracting, such as ditching, building fences and disposing of old ties (where farmers will not take them for firewood). That custom is still followed on this road. They also contract repairs to buildings, painting of buildings and bridges, building sidewalks, etc. This will oftentimes result in reducing the average number of workmen of this class who must naturally spend a great deal of time in traveling.

Time is saved in picking up small scrap the same day it is made, and on reaching the tool house separating the useable from scrap spikes, nuts, etc. This answers a double purpose, for it teaches and demands cleanliness on every one's part, which results in a good advertisement for the railroad.

One of the finest things that ever befell trackmen is the motor handcar, as its use gives the foreman a better chance to pick his men. By using these motors the men are not tired out before they begin work and this makes section work more attractive. Some roads have increased the length of sections after adopting motor cars, but I believe they will see later on that it is a mistake. However, such a great saving in time is made that it is only fair to assume a foreman can handle the same percentage more of track as the percentage of time saved by the use of the motor car. These cars also give the foreman a chance to observe with more care the general condition of his section.

A Study of the Causes of Railroad Accidents with Suggested Remedial Measures.

Accident Bulletins Nos. 42 and 43 of the Interstate Commerce Commission list the railroad accidents which occurred in this country from October, 1911, to March, 1912, inclusive. During that period 7,249 train accidents occurred on the interstate steam railroads in the United States, resulting in 447 deaths and 8,383 injuries to persons. The principal causes of railroad accidents and their resulting casualties were discussed and remedial measures were suggested by D. F. Jurgensen, Engineer of the Minnesota Railroad and Warehouse Commission, in a paper before the Civil Engineers' Society of St. Paul. The paper is here given practically in full as published in the Journal of the Association of Engineering Societies for March, 1913:

It is apparent from a study of the causes to which these mishaps are attributed, that they may first be classified under two heads, namely: Preventable and Non-Preventable.

Preventable Accidents—Under this head should be placed all accidents caused by collisions, spread rails, soft track, bad ties, irregular track and negligence of employes. The responsibility for them can be directly placed; they are attributable to carelessness, human fallibility, false economy or failure to provide safe means on the part of the companies. Thus in each case some duty has been neglected because of which the casualty occurred.

Non-Preventable Accidents.—Non-preventable accidents are those caused by latent defects of equipment, broken rails, unforeseen and malicious obstructions on track, etc., the responsibility for which cannot be directly placed.

Tables I and II list the railroad accidents which occurred on interstate steam roads in the United States from October, 1911, to March, 1912, inclusive.

TABLE I.—PREVENTABLE ACCIDENTS.

Causes—	Number.	Persons Killed.	Persons Injured.
Collisions	3,100	267	4,804
Spread rails	145	4	167
Soft track	188	3	93
Bad ties	30	0	17
Irregular track	258	6	327
Misc. roadway defects	168	8	204
Negligence of employes	214	7	224
Totals	4,103	295	5,836

It is shown by Table I that preventable accidents are responsible for 4,103 or 56.6 per cent of all the mishaps, 295 or 66.0 per cent of all the deaths, 5,836 or 69.6 per cent of all the injuries, 6,131 or 69.4 per cent of all the casualties.

Collisions—Collisions alone of all the preventable accidents are found to be responsible for 3,100 or 75.5 per cent of the preventable accidents, and 42.7 per cent of all accidents; 267 or 90.5 per cent of the deaths from preventable accidents and 59.7 per cent of deaths from all accidents; 4,804 or 82.3 per cent of the injuries from preventable accidents and 57.3 per cent of injuries from all accidents; 5,071 or 82.7 per cent of the casualties from preventable accidents and 57.4 per cent of casualties from all accidents.

Collisions, in particular, have featured in railroad casualties during the past year and early relief therefrom must be secured to the public which is demanding the safe service to which it is justly entitled. If this single cause can be eliminated an important step will have been taken toward making railroad travel safer.

Of all classes of railroad accidents, collisions appear to be the least excusable. From a study of the rules, regulations and other safeguards thrown around operation of trains by the companies, it is impossible to foresee how a collision could occur if strict compliance therewith be rigidly observed, but they do occur with appalling frequency and are the direct cause of a majority of the casualties.

Cause of Collisions—It is difficult to see any value in a rule which is not enforced; if, therefore, we find that each collision resulted from a failure by someone to observe a rule made to prevent such an occurrence, our problem is simplified to finding some means for the establishment and enforcement of proper rules, for there is no industry in existence more dependent upon the human element for its safe operation than is a railway. In none of the ordinary walks of life, generally, are employes so well compensated for their services. Their hours of labor and rest have also been regulated by legislation to their advantage. They may and should be held to a high degree of efficiency.

There is apparently a sharp division of opinion as to responsibility for the non-observance of rules between the managers and general officers who formulate the rules, and the employes who are required to obey them. It is a familiar claim that employes are at times expected to violate written rules and if the required operations are to be conducted within the time allowed, such violations are unavoidable. This is denied by the officers who claim that observance of the rules, though earnestly desired by them, is impossible of enforcement, because of the negligence of their employes, and that the fault for such violations is chargeable to the individual employe.

TABLE II.—NON-PREVENTABLE ACCIDENTS.

Causes—	Number.	Persons Killed.	Persons Injured.
Defects of equipment....	1,981	38	698
Broken rails	277	22	768
Unforeseen obstructions on track	214	35	273
Malicious obstructions on track	33	6	127
Miscellaneous	639	50	665
Sun kink	2	1	16
Totals	3,146	152	2,547
Grand totals	7,249	447	8,383

Without attempting to say which of these contentions is true or whether the truth lies between them, the mere fact that the rules are violated, and that each class asserts their observance is prevented by the activities of the other class, demonstrates the necessity that the state more powerful than either and representing the public, must in some manner assert its authority and secure both the establishment and the observance of proper methods of operation.

Steel Cars vs. Wooden Cars—In our effort to eliminate the causes of collisions, we should confine ourselves strictly to questions which are pertinent to the problem. In my judgment, the wreck-resisting qualities of steel and wooden cars should not enter into consideration, because to anticipate the continuation of this lamentable feature of railroad operation with a view toward the construction of wreck-proof cars and equipment, would be equivalent to a suggestion to the public that they should not expect to obtain satisfactory relief from preventable railroad accidents.

Automatic Control of Trains—Automatic mechanical devices for controlling train operation have been suggested as being the only possible means for checkmating collisions on the railways in this country.

The necessity for automatic control of trains is not established until we have exhausted all means for prevention of errors in train operation now at our command. Some justification will then exist for seeking other fields for a remedy.

The fact that European managers do not consider such mechanical means essential for safe operation of trains should induce us to exercise caution in recommending measures of this character for adoption. It might be preferable to emulate the methods of our foreign neighbors whose enviable record of comparative freedom from preventable accidents in railroad operation, has attracted wide comment and approval, even in our own country.

The automatic train control device, if its utility could be established, would at the very best be only an auxiliary to and of secondary importance to the signal systems, and past experiences have proven that practices, not essential to the safe operation of trains are, as a general rule, not given the careful attention that the primary measures receive.

Automatic Train Control vs. Automatic Coupler—Notwithstanding that the inventive genius of man has not yet been able to devise an automatic train control device that will work with absolute precision under all climatic and other conditions arising in train operation, arguments have been advanced to the effect that legislation should be enacted making the adoption of such means compulsory on the part of the railway companies within a limited period of time; the point in view being that such action would tend to spur the railway companies into hastening the perfection of such means. Legislation, resulting in the adoption of the automatic coupler and other safety appliances, pertaining to cars and locomotives, is cited as an example of what may be accomplished in this direction by the passage of such laws. However, this legislation requiring the railway companies to adopt the automatic coupler was not made effective until many years after the device had been perfected.

Its practicability, absolute reliability and worth had been established beyond a question of doubt by severe service tests in actual railroad practice, and it had already been adopted by many of the leading railroad companies in this country. In this regard, there is positively no similarity between the two propositions. The elimination of the old type "link and pin coupler" for the automatic type, presented an entirely different problem from the removal of the human equation from train operation. The former concerned the employe's safety while in the act of performing his prescribed duties, while the problem in hand contemplates largely the passengers' safety from the employe's failure or error in performing his prescribed duties.

Except perhaps in a very few conceivable special cases, it is a question whether grave danger does not lurk in the introduction of a mechanical means that tends to make an automaton of a railway employe. This device is likely to make the employe careless of the responsibilities which he has assumed. It may cause him to feel that he is a mere supernumerary who has been practically relieved of responsibility in the handling and control of the train, vigilance over track, signals, flags, and in fact will, to a certain extent encourage the omission of many of the duties and requirements so essential and necessary to insure the maximum of safety in train operation.

The automatic train control device might shift the responsibility of safe train operation from the high grade and long experienced engineman or train operator to the less experienced maintainer of mechanical devices. The successful working of any piece of mechanism is solely dependent at all times on the hand and mind creating it, so it follows that if the human agency fails, either directly as in the first instance or indirectly as in the second case, a calamity will result.

Mechanical Precision vs. Human Precision—Even if we were to realize the ideal automatic mechanical control of trains, it would still be extremely doubtful if such beneficial results could be obtained from the automaton as would be possible from the best efforts of the human agency, because it has been well demonstrated in the past that the skill of the human hand is capable of producing results which the most accurate machinery cannot accomplish. No system of mechanical safeguards can be devised that will dispense entirely with human responsibility. Man's genius, with all its vast accomplishments in mechanical perfection, has not yet succeeded in developing the "fool proof" machine, but in every operation there appears at some point the dominating influence of the human mind. Let it relax or waver for an instant and all mechanical perfection is at naught.

No railways in the world are better equipped with mechanical devices for safeguarding human life than are the railways of this country. Cars and locomotives of the most modern construction equipped with air brakes of the most efficient design, are in general use. Highly perfected automatic signal systems, designed to preclude the possibility of collisions, are in use on many lines.

Their use is being extended, although not so rapidly as might be. Yet, with all these mechanical measures, lives are snuffed out by the score, because some man failed to perform his duty. With all our perfection in this direction, it begins to appear as though we are encouraging carelessness among employes through over-confidence in mechanical perfection.

Investigations of Collisions—A notable feature is practically every report of collisions is the recital that one or several employes failed to do something which they should have done, and if they had obeyed the rules of the company, the collision and resulting casualties would not have occurred. In this regard, there is a marked contrast in sensibility to duty and appreciation of responsibility to society between the railway employes of this country and those of European railways. Whenever the European railway employe fails in performing his prescribed duty in train operation, and his failure of duty results in death or injury to persons, he is held accountable to the state, and it is an interesting fact that there are even less fatalities in connection with the operation of railways in Germany than with that of the agricultural pursuits of that country.

RAILWAY EMPLOYES.

It is doing the American employe an injustice to contend that he is inferior, mentally and physically, to his European brother and, therefore, that it is necessary to devise mechanical means to perform the services to which society is entitled and which the employe is in duty obligated to render. If it is possible for the European railway manager, the American manufacturer, business man, contractor, and the Government, to obtain absolute reliability and precision from their employes, it ought not to be impossible for the American railway companies to get the same attention to duty and precision from their employes.

The railway employe should understand that a railway is a quasi-public corporation and that when he accepts employment with it, he becomes a quasi-public servant and owes the same duty and responsibility to society as the company that employs him.

Since the foregoing statistics show that human fallibility is responsible for 59.7 per cent of the deaths and 57.4 per cent of the casualties, resulting from all accidents, for the period under consideration, it is apparent that serious investigation must be made to find an effective remedy. This is especially true since it has been demonstrated that it is not impossible to obtain reliability and precision from such employes in other countries and from employes in the other industries of this country.

Relations Between Railway Managers and Employes—There should be closer working relations between the managers and employes of railways for the purpose of encouraging open and free discussion on the subject of safety. The problem of making men trustworthy and dependable, if approached in the right direction, will not be found the hopeless task it is often assumed to be. Some of the railway companies have already formed "safety committees," with this very object in view. Their slogan is "safety first." They co-operate with all the employes in devising measures of safety for the protection of life and limb in all branches of railway operation. Methods of this kind should be extended and encouraged.

Railway Employes of All Grades Should be Amenable to State—Much has been accomplished by Germany and other European countries in checkmating preventable accidents in railroad operation by making railroad employes amenable to the state for negligence in the performance of their duties. Thus far, however, when effective disciplinary measures have been suggested as a deterrent to carelessness in operation, the difference in the sociological and political conditions existing here and in European countries has been cited as an insurmountable obstacle to such methods even though a majority of the European countries are in advance of us on this question, a start has only been made in the direction of eliminating the human equation from railroad operation. The American people, the most efficient on earth, could accomplish much in this same direction if they but tried. A new idea cannot be perfected without some experiment, and until an honest attempt is made to find out how far the methods in vogue in the European countries may be relied upon in this country, it will not be known to what extent sociological and political conditions enter as factors into this problem.

The Railway Employes' Interest in Corrective Measures—The operation of railway trains is fast developing into an important and superior vocation, and all right-minded employes are beginning to realize the necessity of the introduction of effective means to protect them personally from the dangers attendant on the negligent acts of incompetent, careless or indifferent employes. It is conducive to their own interests and safety to encourage and advance such projects.

REMEDY FOR FALLIBILITY IN RAILWAY EMPLOYES.

To accomplish this purpose, it may be necessary for the state to go beyond the corporate entity and its executive officers and hold each individual employe responsible for the proper and safe performance of his individual duty. This may be brought about in many different ways and it is suggested that it may be effected in the following manner:

Employes engaged in train operation should be required by law to serve an apprenticeship of a sufficient duration to qualify themselves for the position they seek. Before the applicant is permitted to serve in any capacity in train service, he should be examined by a competent state board of examiners as to his physical and mental qualifications. Such examinations and tests should be graduated so as to meet the requirements of the different grades of the service, and a license should define the kind of service the applicant may perform. The state to reserve the right to revoke the license for good cause, which should be renewed only upon satisfactory showing.

Most of the states have legislation of this character as to physicians, lawyers, dentists, undertakers, electricians, horseshoers, plumbers, stationary enginemen, barbers and others, for no other purpose than to protect society, and it is needless to add that excellent results have been secured. As far as the public is concerned, it is difficult to understand how the ability and requirements of the horseshoers, barbers or plumbers are of greater importance to society than that of railway employes, and if it is possible to reduce indiscretions and incompetency in the classes mentioned by effective legislation, it should not be difficult to extend similar legislation to railway officials, managers and employes, with corresponding benefit.

STATE LAWS BEARING ON OMISSIONS OF DUTY.

Some of the states of the Union now have laws upon their statute books making the omission of duty of railway employes a misdemeanor. The Minnesota law reads as follows:

> OTHER VIOLATIONS OF DUTY.—Every engineer, conductor, brakeman, switchtender, train dispatcher or any other officer, agent or servant of any railway company, who shall be guilty of any wilful violation or omission as such officer, agent or servant, by which human life or safety shall be endangered, for which no punishment is specially prescribed, shall be guilty of a misdemeanor.

The Minnesota law, however, makes it incumbent upon the county in which the accident occurred, to prosecute. Very often the counties do not prosecute, and it may be desirable to have these laws broadened so as to make it obligatory on the state, through the attorney general, to aid when advisable in the prosecution for any omissions of duty whereby persons are either killed or injured.

DEFECTIVE ROADWAY.

Table I also shows that 789 of the preventable accidents were caused by defective track, resulting in 21 deaths and 808 injuries to persons. Insignificant, you might properly say, compared with the casualties resulting from collisions; however, they would not have occurred if the railway companies had provided a safe roadway for the operation of their trains. The fact that 14 per cent of the casualties from preventable accidents are due to this very cause, is of sufficient moment to merit earnest consideration, and it is suggested that careful thought be given the matter of requiring state supervision of all railway roadways, including track, ties, switches, bridges, etc.

Broken Rails—Table II shows that broken rails were the source of 277 of the non-preventable accidents, causing 22 deaths and 768 injuries to persons, or a total of 790 casualties. Compared with the 4,103 preventable accidents which caused 295 deaths and 5,836 injuries to persons, or a total of 6,131 casualties, it demonstrates beyond question that rail failures are not the main agent of railway disasters, as the public has been led to believe.

There is probably no topic associated with railroads that has been or is at the present time being subjected to such thorough study, experiment and research, as is that of railroad rails. Several eminent bodies, composed of the ablest engineers and metallurgists in this country, have been for sometime past and are still conducting experiments and tests for the purpose of getting the ideal rail, and their efforts have been marked by considerable progress.

Investigations of Rail Failures—Many investigations have been made of rail failures. It is not claimed that rails break from their own inherent shortcomings, and it does not seem that rails which have safely stood shipment from the mills, handling and placing in the track, should fail from their own innate weakness.

These examinations indicate that breakings occur in rails constituted of good as well as poor quality metal. The failures are largely caused by unusual strains which are induced by severe and abnormal service conditions to which rails are subjected, in which may be included shocks from broken or flat wheels, defective counterbalances, wheels out of round, defective track, improper fastening of rails upon ties and other like circumstances that would tend to produce such strains. Approximately 55 per cent of rails broken may be classified as being of good metal; the remaining 45 per cent consists of comparatively poor quality metal.

By term "poor quality" is meant rails which prove themselves defective after having been subjected to service and the term covers such defects as segregation of constituents, unsoundness, brittleness, faulty rolling, including pipe, old seam, flow of metal, split head, crushed head, split web, broken base and other shortcomings, many of which defects it would be impossible to discover at the mill.

Rail Failures During Cold Weather—These examinations also show that the largest number of rail failures occur during the winter months and especially during periods of extremely cold weather. This being the case, it appears railroad travel might perhaps be rendered safer if the speed of heavy passenger trains was restricted within moderate limits during at least the era of extreme temperatures.

American Rails vs. European Rails—While rail breakages are practically unknown on European railways, the foreign rails are not by any means superior to American rails; however, the European roadbed, as a general rule, is far superior to the American roadbed because it is much better built and drained. The rails are screwed in well-preserved ties and these are bedded with utmost care to secure that permanent evenness and smoothness of surface that is so essential for adequate and proper support for the rails and loads.

Wheel Loads on Railroad Rails—In England, the greatest allowable or safe weight per driving wheel to be borne by rail, for the Atlantic (4-4-2) and American (4-4-0) types of locomotives is 22,400 lbs.; for the Pacific (4-6-2) and Prairie (2-6-2) types, 19,000 lbs.

On the state railways of Germany and Italy, the allowable or safe weight per driving wheel is 18,150 lbs. Tests and experiences of these foreign railways were their guides in determining the safe limits of wheel pressures.

In the United States the average wheel load has increased from about 22,000 lbs. in 1885 to 28,000 lbs. in 1907, although many driving wheels carry more than 29,000 lbs., and some of the Atlantic type (4-4-2) carry over 30,000 lbs. per driving wheel; the loading just given, viz., 28,000 lbs., represents probably as nearly as may be the average driver loading of American locomotives, as used on main steam railways. During the same period the weight of rail in main track has increased from about 65 to 75 lbs. per yard to 85 and 100 lbs. per yard, which heavier weights now generally predominate.

The very marked contrast just cited between the wheel loading on rails in Europe and this country indicates that the effect of the wheel load on rail might be a very profitable topic for further consideration and study.

The Interstate Commerce Commission in its report of the accident on the Lehigh Valley Railroad, near Manchester, N. Y., August 25, 1911, states:

> These examinations * * * should take up the securing of measurements in the track of the actual fiber stresses which are caused by new types and weights of locomotives, and under the different wheels of these locomotives, in order to obtain information from which to judge of the severity of the strains to which the track is daily subjected; in fact, track conditions as they exist at the present time should be dealt with even to the most minute detail.

Rails Must be Properly Supported.—It is well recognized that rails must be properly supported and held in place, i. e., the ties supporting the rails must be of sufficient size and number to safely carry the loading intended; they must be so firmly and substantially bedded as to prevent rails from being submitted to any abnormal strains by deflections induced by passing wheels.

That this point is important is demonstrated from a study of the causes of broken rails from which it is found a great many breakages have occurred right at or near places where tie renewals had just been made. Old bed is often disturbed more or less in putting in new ties and not sufficient attention is given in all cases to tamping and bedding new ties which omission results in an irregularity in the surface of the bed of the rail, so that enough shock is induced by a passing wheel to cause the rail to break.

Rails Must Not be Mistreated—Rails are of a molecular structure and should not be unnecessarily submitted to blows from hammers, track mauls or otherwise. Such practices should especially be avoided in cold weather.

If the effective work now being done by those engaged in the preparation of the ideal rail was augmented by a similar effective educational work treating with the proper care of rails and roadbed among the track forces of the railway companies, the prospects for the elimination of rail failures would indeed be bright, and this end may be accomplished by co-operation with the forces preparing the new standard specifications for rails.

DEFECTS OF EQUIPMENT.

It will also be noted from Table II that defects of equipment caused 1,981 or about 63 per cent of all the non-preventable accidents. They were the source of 38 deaths and 698 injuries to persons; 16 more deaths occurred from this source than from broken rails. This class of accidents leads by far all the classified causes under the heading, "Non-Preventable Accidents," and as it is well known, defective equipment frequently causes broken rails. It appears this feature of our railroad practice also merits serious consideration and study. It is suggested that measures be devised for a more thorough and efficient system of inspection of all equipment. These methods of inspection should be so thorough that it would prevent any but good order cars and locomotives to be placed in trains.

ERRORS IN RAILROAD OPERATION.

When effective remedies have been devised and introduced for correcting the several foregoing defects in our railway operations, viz., collisions, defective track, broken rails and defective equipment, relief will have been obtained from 87.7 per cent of all railroad accidents; 79.4 per cent of all deaths and 87.1 per cent of all injuries to persons resulting from such accidents, and when these ends have been accomplished, it will then be time enough to devise means for the elimination of the remaining 12.3 per cent of the non-preventable accidents that have not then removed themselves by sympathetic contact with the effective application.

AUTOMATIC BLOCK SIGNALS.

Wonderful progress has been made in the development and perfection of the automatic block signal, a device designed to safeguard the movements of trains. The efficiency and reliability of this method of signal protection can probably best be illustrated by reference to the experience gained from such installation by one of our Western railways. The company referred to has 451 of these signals in use; they afford protection to 100 miles of single track roadway and to 331 miles of double track roadway.

During the year 1911 these signals performed 8,426,990 movements in actual service, out of which number only five false clear indications resulted, and as these false indications were immediately discovered by those in charge of their maintenance, the safe movements of trains were not affected by the failures. One of the failures was caused by defective lubrication of mechanism, the other four were attributed to faulty construction. This is indeed a very remarkable showing and emphasizes in the strongest terms that the possibility of obtaining a false clear signal indication from the present perfected system of signaling, is very remote.

That most gratifying results are obtainable from the use of automatic block signals, properly designed and installed, is demonstrable from the experience of all who have used them in train operation, because their use reduces to a certain extent the opportunities for the human agency to err, and as their use also affords adequate protection to train movements, they are of inestimable value in safeguarding these movements.

Many miles of the improved type of automatic block signals have been installed and placed in use by the railways in this country for no other reason than that of availing themselves of the advantages obtainable by the adoption of such means for safeguarding and expediting train movements.

No question now remains but that the public's interest in the safe operation of trains would be materially furthered and safeguarded if the introduction of the modern efficient automatic block signal systems was required to be extended to include all lines of railways where the prevailing traffic conditions could be materially improved thereby. These extensions should also include all lines that are now handling important traffic with inadequate, obsolete or antiquated signaling devices.

INTERLOCKING PLANTS.

There are probably no safety devices of greater importance to the public welfare in railroad operation than those protecting and safeguarding train movements over railroad crossings and through junction points at grade and over draw bridges. While it is true that various states have in the past interested themselves very effectively in seeing to it that ample protection was afforded from errors in train operation at these points, traffic conditions have changed so materially during the past decade that as a general proposition the states' efforts in this direction have not kept pace with the changed operating methods.

In this connection it is extremely desirable and to the mutual benefit of both the public and the railway companies if the rules and regulations affecting the construction and maintenance of these safety devices be uniform in the essential features. These rules and regulations when finally prepared must be flexible enough so as to be workable and practical under all varying operating conditions, and it appears that this end can best be accomplished by the co-operation of those who are familiar with the operating conditions existing in the various parts of the country.

With this object in view, the railway commissions of the states of Indiana, Illinois, Wisconsin and Minnesota, through their engineers and signal experts, have been at work for the past 18 months in the preparation of a uniform system of rules and regulations for the construction, operation and maintenance of interlocking plants. The last conference was held in the office of the Minnesota Railroad and Warehouse Commission, in St. Paul, on Sept. 27, 1912. The work is now so far advanced that it will be submitted to the four above named commissions for approval at an early date.

LAWS AFFECTING RAILWAY OPERATION.

Laws regulating the number of men constituting train crews, or the experience these men must have before they may enter the train service, have been enacted in 21 states of the Union.

Laws regulating the number of hours of service of the employes engaged in train service have been enacted in 25 states and by the Federal Government.

Laws regulating the kind of cabooses to be used in train operations have been enacted in 16 of the states.

Laws regulating the kind of headlights to be used on locomotives have been enacted in 14 states.

Locomotive boiler inspection legislation has been enacted in 7 of the states and also by the Federal Government.

Ostensibly, the purpose of these and other laws regulating train operation, is to protect society from the effects attendant upon the occurrence of errors in such operations and it is probable if all these laws were rigidly enforced, that some measure of additional safety might be realized in this direction. It is a fact, however, that the legislation now existing for the public safety, has had very little effect toward removing the most prolific cause of railway fatalities, viz., human fallibility, and unless more effective means are devised whereby this weak point in our railway practice be eliminated, and this is susceptible of accomplishment, our efforts toward approximating perfect safety in railroad operation must impress the public as not having been earnestly or intelligently undertaken.

STATE LAWS.

The lack of uniformity and the varying degrees to which state laws affecting railroad operation are enforced in the different states is very marked. The measure of safety which the public is demanding from errors in railroad operation cannot be expected to be realized without uniform and concerted action on the part of the different states whose duty it is to care for the public interests in this respect.

The advisability and fairness of some of the state laws now existing and affecting train operations are also open to question.

Because of the confusion which now exists in the different state laws, it appears that botn the interests of the public and the railway companies in the matter of safety from errors in railroad operation would be materially advanced if all legislation pertaining to railroad operation was made uniform insofar as the basic principles are concerned and, necessarily, in the preparation of corrective measures of this character, the local or varying conditions, climatic or otherwise, must be carefully studied and considered to the end that these rules and regulations when finally prepared, be expedient, fair and practical. Thus, it would appear that wonderful results may be accomplished for the welfare of society in this direction by the earnest co-operation of the different states.

The Piecework or Unit System of Handling Ties and Timbers in the Timber-Treating Industry.

The handling of ties and timbers on a "Piecework" or "Unit" basis is not universally practiced in the timber-treating industry. Some plants follow the practice to a greater or lesser extent under one system or another. The practice of the Chicago, Burlington & Quincy Railroad in the use of the piecework system in handling ties and timbers was described by Mr. W. W. Eldridge in a paper before the American Wood Preservers' Association. An abstract of the paper follows:

The Chicago, Burlington & Quincy Railroad has been using the piecework system of handling ties and timbers at both its plants for several years with what we consider the best of results, and my remarks will be confined to the efficient operation of a timber-preserving plant from a physical standpoint only.

A short time ago I asked a friend what he thought of the "piecework system," and he replied: "Piecework is the only thing for the timber-treating plant." This opinion is backed by thirty-odd years of practical experience in the handling of material, principally ties, piling and lumber, and men of all kinds, under both the "day work" and "piecework" system.

The question arises, "What is the object of piecework, and what are the advantages to be derived therefrom?" The object of piecework is to get one dollar's worth of labor for one dollar, and to give one dollar for one dollar's worth of labor, or, in other words, to increase the efficiency in handling ties and timbers to the maximum so as to get the largest possible output at the least cost.

The advantages of the piecework system are numerous. In the first place it reduces by approximately one-third the number of men required to do the work, and hence makes a corresponding decrease in the amount of supervision needed.

It enables you to get the "cream" of the laborers to do your work. There is no place for the "drone" in the piecework system, as he will be pushed aside and eventually crowded out. It systematizes the work and assists materially in the accounting, figuring costs, etc. It places each individual workman in business for himself, and enables him to secure pay for what he does. Being paid for what he does, it is natural for him to combine mental ability with physical strength in order to accomplish all possible.

The installation of the "piecework system" is no small task. A great deal of tact and good judgment must be exercised, and unless it is established on good business principles it will be a failure rather than a success. There are a good many things to be taken into consideration along this line.

First, be open and above board with your men in everything you do in connection with their work, as it is of the utmost importance that the men fully understand what you expect of them, and what they can expect of you in return. Second, treat your laborers as men, and be fair and square with them at all times. Be ready and willing to counsel with them and explain any points that are not quite clear to them.

We have at one of our plants a gang of nine or ten men loading trams with ties for treatment. In this gang is one man who will average 16 trams per day, another who will average 14, while the poorest man in the gang averages 8 to 9 trams. How long would the 16 tram man continue to load 16 trams if his compensation for the day's work was no more than that of the 8-tram man? Why is this man able to load 16 trams and his co-worker only 8 or 9? In this case it is partly due to his superior strength, but in a great measure it is due to his superior ability in other ways to handle ties. He has studied out all the short cuts and knows just how to pick up a tie, how to shoulder it, and how to land it on the tram where it will require the least possible shifting to properly load the tram.

To what degree do men become efficient? To illustrate this I will give you the benefit of one or two of my own personal experiences. On this occasion we received an extra heavy consignment of ties in cars that were badly needed for commercial loading. The regular force was not large enough to release these cars as quickly as desired by the management, consequently they diverted two or three extra gangs to help out. The regular men were working piecework at ⅝ ct. to ¾ ct. per tie, and averaged from 25 cts. to 30 cts. per hour. The extra gang were working for $2 per day, and unloaded their portion at a cost of 3½ cts. to 4½ cts. per tie. Why this cost? Because the men were working for a stipulated rate of wages, and because they had absolutely no knowledge of how to handle a tie, and furthermore were physically unable to cope with the regular men, due in a great measure to their habits of living. I will leave it to you to figure out which was the best paying proposition to either the company or the men.

The installation of piecework would, of a necessity, need to be worked out to fit conditions peculiar to each individual plant, hence it would be useless for me to attempt to tell you what rates should be applied, but there are several important underlying principles that should apply to all.

First. The selection of competent supervision, or foremen. A man to be a good foreman must be wide awake and energetic at all times. He should be familiar with every detail of the work assigned to him, as also the most practical way to handle ties and timbers so that he can impart it to his men. He should have a knowledge of handling men and be on the ground all the time. He should not be a slave driver, but should be firm and diplomatic in all his relations with his men. These men should understand that his word is law, but if for any reason they deem his demands unreasonable they should be at liberty to put the case up to the general foreman or other higher authority for final decision. In my opinion the superintendent or manager personally should make the final decision, if necessary to carry it that far.

Second. Care should be exercised in perfecting your organization to place your men to the best advantage, and to see that there are no more men in the gang than needed, and yet enough to handle the work without delay to other parts of the organization. You would not hitch a draft horse and a donkey to the same wagon and expect to get efficiency. This is a feature that should be considered in the personnel of your organization.

Third. Schedules should be made to cover each and every operation. These schedules may be based on any of the following units, depending entirely upon your own views and the existing conditions.

Ties—Per tie, or per team loaded.

Lumber, Switch Ties and Crossing Plank—Per 1,000 ft. B. M.

Piling—Per pile, or per lineal foot.

We have found the following a very good plan:

Unloading and storing ties on ground—Per tie.

Loading trams for treatment—Per tram.

Unloading treated from trams to cars—Per tram.

Unloading treated from trams to ground—Per tram.

Piling, when handled with derrick—Per pile.

Piling when handled by hand—Per lineal foot.

Paving Blocks—Per square yard.

Lumber—Per 1,000 ft. B. M. in all cases.

Fourth. In wording your schedules particular attention should be given to the phraseology to see that it is clear, concise and easy to understand, so there will be no chance for any dispute to creep in under the guise of a technicality, and last, cover all the work which you expect the men to perform under any schedule.

In handling ties and lumber of all kinds a distinction should be made between hard and soft wood as follows:

Oak or hardwood.

Pine or softwood.

This for the reason that pine or fir weighs approximately 3 lbs. per ft., while oak weighs 5 lbs. per ft. You would not expect any man to handle 5,000 lbs. for the same price as 3,000 lbs.

A competent man should be selected to make the schedules and establish the rates of pay. In order to get the best results he should have a knowledge of handling men and material. He should be competent to recommend practical changes or improvement of conditions, tools or other devices that will facilitate the handling of the ties or timbers. Oftentimes a dollar judiciously spent to improve conditions means many in return. In establishing prices it is important that all the facts and figures bearing on the operation be accumulated in order that prices may be established on an intelligent basis. To accomplish this the party getting the information should be on the ground personally, watch the operation from start to finish, and make notes as to number of men, kind of material handled, how handled, time consumed by each man, degree of efficiency, or anything else that would have an important bearing on the wording of the schedule or the base rate. Prices should be based on three things: The authorized hourly rate, degree of efficiency obtained under the day rate system, and the conditions and tools furnished.

All prices should be made on a basis that is fair to the employer and the employe. Once a price is established it should never be changed unless there is a change in conditions. Suitable blanks should be provided for keeping the time and checking material in and out. These will be turned in to the timekeeper daily to figure up and enter on the pay roll.

In establishing piecework a good plan is to start in with some one gang. Advise them daily of their earnings and arrange it so that the rest of the men working on a day rate will know what this gang is earning. They will immediately begin to get interested and ask for the piecework system, and in a short time your entire force is working on the piecework basis. There will perhaps be days when, due to some peculiar unforeseen condition or nature of the material, the men will fall below their former day rate, while there will be other days when they do exceptionally well, hence only the average for the month would be a fair comparison.

Foremen should be on a monthly basis, the rates to be fixed according to your own ideas. In no case should a foreman have supervision over more than twelve men, and eight or nine men is better, in my opinion, when handling ties or lumber by hand. The duties of the foreman are to instruct his men what to do, give them the benefit of his experience in handling material, keep them supplied with work at all times, see that it is properly done, and keep track of their time and material handled, checking same personally in all cases.

When unloading ties to season, also loading trams for treatment, each man works as an individual. When handling treated ties the men generally work in pairs or gangs of three, each man getting an equal proportion of the earnings of the gang. If a man is taken out of the gang during the day and another put in his place, the foreman should take proper record so that the earnings can be properly apportioned. With us when unloading ties to season no effort is made to sort them. The sorting as to kind of wood and grade is done when loading them to trams. When unloading switch ties by hand we find four men to the gang the best, and handling switch ties, piling and lumber with a locomotive crane three men in addition to the engineer. In all cases I would advocate the same rate from start to finish of an operation, unless some unusual condition arises. The man gets the same for the last tie as for the first.

There is a maximum to all things when efficiency is considered. In storing ties to season, piling them eight to one, the maximum height of the pile should be 16 to 18 ft. Treated ties when piled on the ground should be in solid square piles 8 to 10 ft. high.

CONCLUSION.

Someone has said that the efficiency of a timber-treating plant should be based on the number of retort hours worked out of the total possible retort hours. In obtaining efficiency in plant operation the fact must not be lost sight of that good and effective treatment is the first or primary object, and at the same time your supervision, your organization, and your system of physical handling must be the best possible. This is what we claim to have under the "piecework system." During the year 1912 at our Galesburg plant we obtained on the above basis 98¾ per cent efficiency, or, in other words, each of the three retorts were in actual operation 98¾ per cent of the time. This means that out of a total of 7,488 possible retort hours for each retort they were operated 7394.4 hours, holidays excluded.

Cost of Northern White Cedar Poles and Butt-Treatment of Same.

(Staff Article.)

In Engineering and Contracting of Feb. 5, 1913, some cost data were given for western few cedar poles and butt-treatment of same. The data given in the previous article related to poles 8 ins. in diameter and varying in length from 35 ft. to 60 ft. by 5 ft. increments.

Table I of the present article gives the cost of northern white cedar poles, butt-treated, and relates to poles from 5 to 7 ins. in diameter and from 20 to 35 ft. in length. The table also gives the number of years added to the life of the pole necessary to pay the entire cost of treatment. The figures are from a quotation recently made by the Page & Hill Co. of Minneapolis, Minn. The quotation is for the upright tank method of treatment.

TABLE I.—COST OF NORTHERN WHITE CEDAR POLES AND BUTT-TREATMENT FOR SAME.

Diameter and length of pole	Ins. Ft. 5 20	Ins. Ft. 5 25	Ins. Ft. 6 25	Ins. Ft. 6 30	Ins. Ft. 7 30	Ins. Ft. 6 35	Ins. Ft. 7 35
Price of pole, f. o. b. central Iowa rate of freight	$0.89	$1.13	$1.95	$4.15	$5.10	$ 6.35	$ 8.65
Cost of setting	0.72	1.87	1.87	2.59	2.59	3.89	3.89
Total cost in line	$1.61	$3.00	$3.82	$6.74	$7.69	$10.24	$12.54
Cost per annum, using U. S. average, 12 years life	0.13	0.25	0.318	0.56	.49	0.85	1.04
Cost of butt-treatment according to Specification A, highest grade wood preserver	0.45	0.55	0.90	1.10	1.25	1.35	1.50
Cost of butt-treatment according to Specification AA, creosote	0.35	0.40	0.70	0.85	1.00	1.05	1.20
Number of years added life necessary to pay entire cost of treatment:							
Specification A	3.6	2.2	2.8	1.9	2.5	1.58	1.0
Specification AA	2.7	1.6	2.2	1.5	2.04	1.2	1.1
Probable increase of life, 12 to 15 years.							

Third International Congress of Refrigeration.—At Washington, D. C., on September 15, will occur the formal opening of the Third International Congress of Refrigeration, followed by a reception by the President and Secretary of Agriculture. The delegates will leave Washington on the 16th for Chicago, where the sessions will begin Sept. 17. The Exposition of Perishable Foods will open at the Coliseum at 8 p. m. on Sept. 17, and will continue for two weeks. Half daily sessions will be held and the other half of each day will be spent in visiting various cold storage plants, refrigerating equipment manufacturing plants, the stock yards and other industries of interest to the delegates. The evenings will be filled with entertainments, banquets, the exposition, etc. An excursion to Milwaukee is planned and a banquet at which will be served only foods and beverages which have been preserved by refrigeration. The Congress will close on Sept. 24. Numerous other excursions are planned for the delegates following the Congress, including one to the Panama Canal. Mr. J. F. Nickerson, 431 S. Dearborn St., Chicago, is Secretary-General of the Congress.

WATER WORKS

The Design, Construction and Operation of the Baltimore High-Pressure Fire Service System.

The great fire in Baltimore in 1904 was the result of the simultaneous occurrence of a warehouse fire which gained headway unobserved on a Sunday morning, a high wind, inferior building construction, and inadequate fire-fighting equipment. There was no scarcity of the water supply. The fire raged for 30 hours, covered 150 acres, and caused a loss of $100,000,000. It finally burned itself out when the wind changed and drove the flames toward the open harbor. The fire led to the installation of a high-pressure fire service which was described by Mr. James B. Scott of Baltimore, Mem. Am. Soc. M. E., in a recent paper before the American Society of Mechanical Engineers. The information here given is taken from Mr. Scott's paper.

The topography of Baltimore shows elevations ranging from 6 to 460 ft. above mean low tide, and to prevent excessive pressure in the low lying sections of the city, or a deficiency in those higher up, the supply is divided into five separate zones of service. The low and middle services are fed by gravity; the three higher services are supplied by pumps and high storage reservoirs. Suitable by-passes are provided so that in an emergency any service can be supplied from the next higher.

At the time of the great fire there was available a total reservoir capacity of over 1,750,000,000 gals., in addition to pumps of 63,000,000 gals. capacity. At that time the consumption for domestic and industrial purposes was about 60,000,000 gals. daily, and the draft from the reservoirs for fighting the conflagration was approximately the same amount, or a trifle over 3 per cent of the available reservoir capacity. In addition to the reservoir draft, about two hours after the fire started the two 17,500,000-gal. pumps in one of the high-service pumping stations were by-passed into the "middle" or upper gravity service. The fire originated in the middle service district and shortly afterward extended into the low service district. As soon as this occurred the by-pass between the two was opened, and the pressure was maintained at 80 lbs. during the remainder of the fire.

The operations against the conflagration demonstrated that, for effective fighting of a dangerous fire, large volumes of water must be delivered on the fire with the least possible delay, and at suitable pressures. To meet these requirements a separate high-pressure fire service was designed and installed, covering the greater portion of the congested value districts of the city.

Characteristics of the Congested Value Districts.—The corporate limits of Baltimore embrace an area of 31½ square miles, with a density of population of 17,720 per square mile, a density greater than any other of the larger American cities. The congested value districts cover approximately 300 acres, the area at present covered by the high-pressure mains is about 175 acres, or assuming that the territory for 200 ft. outside the mains is protected, the high-pressure district may be considered to be 245 acres.

The elevations of the congested value districts vary from 6 ft. to 100 ft. above mean low tide, about one-half of the area being below elevation of 50. The pump centers at the high-pressure station are at about elevation 12.5.

The character of the building construction in the congested value districts varies from first-class modern fireproof structures to converted residences, except in the rebuilt burned district, where a better type of construction exists. In the districts in question all electric wires have been placed underground in conduits owned by the city, with the exception of the street railway trolleys. Before rebuilding the burned district, several narrow and congested streets were widened and plazas established around important public buildings, so that the conflagration hazard in that section has been considerably decreased.

DESIGN OF THE HIGH-PRESSURE SYSTEM.

The Time Element.—High-speed automobile hose wagons are provided, housed at convenient locations, in order that the minimum time possible may be consumed in reaching the scene of a fire after the alarm is received. Each wagon is equipped with a four-cylinder four-cycle motor of sufficient power to develop a speed of 30 miles an hour through the streets of the city, with a load of 5,000 lbs. Each body is 50 ins. by 34 ins. by 12 ft. inside, and carries 2,000 ft. of 3-in. hose. Each body is equipped with one 2,000-gal. Morse Invincible monitor nozzle and two 1,100-gal. monitors.

The Pressure Element.—The pressure required for effective work varies widely according as conditions demand the flooding out of a basement fire or fighting on the top floor of a modern skyscraper. At times both extremes may be required simultaneously.

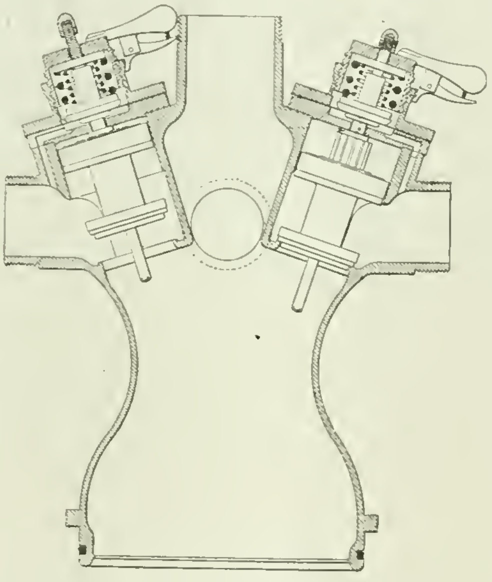


Fig. 1—Section of Portable Head for Hydrants, Baltimore High-Pressure Fire Service.

To meet efficiently these conditions requires the maximum pressure to be available at each hydrant, with means for the separate control of the pressure on each hose line. The specifications called for a combination operating valve and regulator capable of adjustment from shut-off to 50, 75, 100, 125, or 150 lbs., or if desired, to the full line pressure of 300 lbs. The pressures were to be plainly marked on the valve by notches to be used by the operator as a guide for setting the handle. Regulators were to hold the pressures steadily within 10 lbs. of the set amount, whether the play pipe were open or closed. The regulator was also to be provided with a lock whereby the handle could be prevented from passing the 150 lbs. notch, but after unlocking could be moved to the full line position. When wide open under the maximum pressure of 300 lbs. the valve was not to show a loss of head in excess of 15 lbs. The hydrant head was to contain four horizontal outlets and one vertical outlet, each horizontal outlet to be provided with a regulator, and the complete head, including four regulators, was not to weigh over 110 lbs. The head and regulators were to be designed for 300 lbs. working pressure and were to be tested with a static pressure of 600 lbs.

While the above requirements may seem simple enough, only one of the valves submitted by different makers met the requirements in all essential points, a regulator designed especially for the purpose by the Ross Valve Mfg. Co. of Troy, N. Y. A section of the portable head is given in Fig. 1.

The main regulating valve is inserted in an opening just over the hose connection, and is inclined outward at an angle of 20°. The opening is closed with a plate carrying a pilot valve and a guide for the main valve. The pilot valve with its diaphragm is covered with a spring chamber, the whole being held in place by cap screws. The main valve is balanced and is provided with a flat seat and leather face. The upper part of the main valve acts as an operating piston, being provided with a cup leather packing. The pilot valve is balanced against the delivery pressure by the regulator springs, which are made double to secure a wide range of pressure in a short length. The top of the spring chamber is revolved by the operating handle attached to it, and being provided with a coarse square thread screw, less than one revolution is sufficient to give the full range of pressure on the springs from full open to closed. The pilot valve is held positively in the two extreme positions independently of the springs by stops at the top and bottom of the stem. The full hydrant pressure is admitted to the operating chamber of the main valve through a small tube projecting below the seat of the valve. This tube is extended in order to keep the entrance clear of the varying velocity near the valve seat, which would tend to vary the flow of water to the operating chamber. When the pilot valve is open, water wastes from the operating chamber, the pressure is lowered and the main valve is opened by the unbalanced pressure below. When the pilot valve is closed the full hydrant pressure is maintained in the operating chamber, and as the area of the operating piston is somewhat larger than the area of the main valve, the pressure is unbalanced in the opposite direction and the main valve is closed. Intermediate positions of the pilot valve are followed by corresponding movements of the main valve, maintaining the delivery pressure within a few pounds of the amount indicated by the notch at which the operating handle is set. The main valve when fully opened presents an unobstructed waterway. The entire mechanism is simple in design, easy to operate and has proved entirely satisfactory in service.

Quantity of Water Available.—The National Board of Fire Underwriters after a careful study of the situation recommended that a total delivery of 15,000 gals. per minute should be available within an area not exceeding 100,000 sq. ft., at a pressure of not less than 200 lbs. at the hydrant. As installed, each hydrant has four 2½-in. horizontal and one vertical outlet for mounting a monitor nozzle. At present the 3-in. hose is connected through reducer couplings, but in the future all hydrants will be equipped with 3-in. outlets and connections to 2½-in. hose will be made through reducers.

The quantity of water which can be delivered through a hydrant is a function of the number, length and size of hose lines attached, and the diameter and type of nozzles. Assuming four lines of 3-in. rubber-lined hose each 100 ft. in length, and 200 lbs. at the hydrant, with 1¾-in. smooth nozzles, each hydrant would deliver 3,800 gals. per minute, or the requirement of the underwriters would be met by four hydrants. At least twice that number of hydrants are available for every unit of area mentioned. If 2-in. nozzles were used, other conditions remaining the same, the discharge would be 4,400 gals. per min. at a pressure of 86 lbs. at the base of the play pipe, as compared with 108 lbs. in the former case.

At present 226 hydrants have been installed, staggered on opposite sides of the streets, averaging about 170 ft. lineal spacing. In addition to the normal locations at street and alley intersections, the fire chief placed a number of hydrants at special positions, to meet local conditions of exposure, extra hazard or specially congested values.

Design of Hydrant.—The type of hydrant to be used was given careful study. It was considered especially desirable in view of the experience gained in fighting the conflagration, to be able to place a monitor or special flat nozzle directly on the top of the hydrant, to form a water curtain for the protection of exposed property on the opopsite side of the street. Street intersections form a specially desirable location for such a purpose, but usually the corner of the footways is pre-empted for various other structures, such as sewer inlets, lamp posts, trolley poles, police and fire-alarm boxes, etc. It was soon evident that if restricted to the ordinary post type of hydrant, it would be impossible to secure suitable locations, and the water-curtain feature would have to be abandoned. The flush hydrant with portable head seemed to meet all the conditions admirably. By the use of this type, hydrants could be located almost without restrictions, either in the driveway or any part of the footway. The portable head was also admirably adapted to the use of the regulating valves on the hydrant, as the entire operating mechanism, other than the main valve, could be kept in the firemen's quarters, instead of being exposed to frost or other injuries on the street.

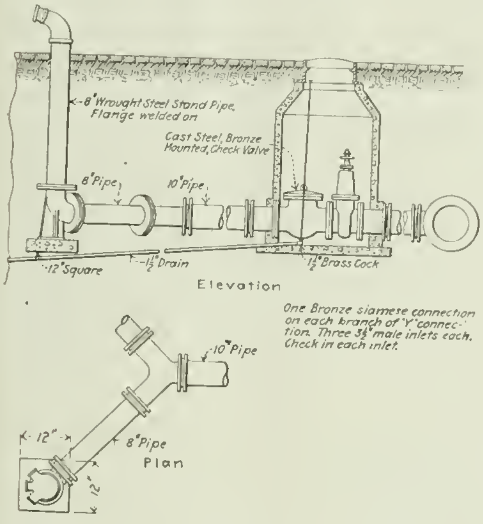

8" Wrought Steel Stand Pipe, Flange welded on
Cast Steel, Bronze Mounted, Check Valve
8" Pipe
10" Pipe
12" Square
1½" Drain
1½" Brass Cock
Elevation
One Bronze siamese connection on each branch of 'Y' connection. Three 3½" male inlets each. Check in each inlet.
10" Pipe
12"
8" Pipe
Plan
12"

Fig. 2—Plan and Elevation of Fireboat Connection.

The portable head as designed, complete with four regulating valves, weighs 110 lbs. In order to provide against any delay in attaching the head to the hydrant, a special "bayonet" joint was designed. The head slips loosely into the barrel of the hydrant, and by a twist of 22½°, a series of interlocking lugs on the head and barrel engage each other, and the full section of these bronze lugs is in shear to resist the water pressure. The water joint is made by means of a square soft rubber packing ring placed in a square groove on the outside of the lower portion of the head. The groove is somewhat larger than the packing ring, and at very low pressures water leaks past the ring. At higher pressures, however, the water presses the rubber closely against the barrel, and the joint is absolutely tight at all pressures between 20 and 1,000 lbs. The action is entirely automatic, there being no screws nor glands of any kind to be manipulated. When the water is shut off, the ring contracts and the head can be lifted out of the barrel without the slightest resistance. To illustrate the extreme simplicity of the device, and the ease of handling, a recent test by the engineers of the National Board of Fire Underwriters may be cited. The head and operating key were laid in the center of the street, 20 ft. away from the hydrant. Two firemen selected at random, picked up the head and key, ran to the hydrant, removed the two loose covers, placed the head in position and turned the water on, all in the space of 18 seconds by a stop-watch.

A small cast-iron cover is laid over the top of the barrel to protect it from dirt and injury, and over this is placed a larger cast-iron cover flush with the pavement. As practically all the hydrants are located on the sidewalks the cover is made quite light, and if it should become frozen in, it can be broken instantly by a blow from the operating key.

The hydrant proper is designed for a clear waterway of 28 sq. ins. through the main valve. The main valve closes with the pressure, and an auxiliary is provided, actuated by the main valve stem. This auxiliary valve opens in advance of and equalizes the pressure before the main valve starts to open. A drip valve is arranged so that as the main valve opens the drip is closed and vice versa, but both valves cannot be open at the same time. Both the main and auxiliary valves have conical leather faces and bronze seats. The barrel of the hydrant is of soft gray iron, and all nuts and fittings, stuffing-boxes, etc., are of bronze. The main valve stem is Tobin bronze, and the operating spindle is of forged steel. All pressure parts are designed for a working pressure of 300 lbs. with a factor of safety of twelve. After erection a field test of 600 lbs. was made.

HIGH-PRESSURE PIPE LINES.

General Plan.—The general plan of the system is a gridiron of 16-in. mains crossing at intervals of approximately 1,200 ft. in each direction, with 10-in. laterals in the intermediate streets spaced approximately 400 ft. apart. A 10-in. branch is provided at the harbor front for connection with the fireboats, see Fig. 2. All hydrant branches are 8-in. There are no dead ends on mains or laterals in the entire system, with the exception of an extension of one street which will be connected up at the next addition to the system. From the pumping station two 24-in. mains discharge into the intersections of the 16-in. mains. In the pumping station the 24-in. mains are looped around the rear of the pump foundations, thereby avoiding dead ends and by equalizing the stresses render unnecessary any heavy anchorages. Individual 14-in. pump discharges deliver directly into the 24-in. mains through welded necks. Three 24-in. valves and an 18-in. cross connection in the station, serve to sectionalize the large main, so that any portion may be cut out without putting more than one pump out of commission. A large rolled steel air chamber 30 ins. in diameter by 20 ft. high is placed on each 24-in. discharge main.

Cast-Iron Versus Steel Pipe.—For the service in view it was believed that cast-iron pipe, usually employed for city water mains, was not a scientific application of material for the stresses involved. On the other hand, commercial rolled steel lap-welded pipe meets the structural conditions much more satisfactorily. With this material the pipe system becomes an engineering structure, all tensile and bending stresses are taken up by the pipes themselves and the system would be entirely safe if laid on the surface of the ground.

The principal objection urged against the use of steel for this purpose is the liability to corrosion, especially when complicated by electrolysis in city streets. After a careful study of the problem, it was decided that the advantages of this material outweighed the objections, for the following reasons:

(a) If the entire pipe system had to be renewed every ten years, the steel would still be more reliable and hence more desirable than cast iron, as the latter is liable to fail by breakage without previous warning. When deterioration of the steel pipe does occur, it makes itself known by increase of leakage, which can be detected and repairs made gradually, as occasion offers. By way of reductio ad absurdum it might be argued that if absence of corrosion by the controlling feature in the selection of a material, a glass pipe would be the ideal, as it would last forever if not broken by shock or bending stresses.

(b) The study of corrosion of steel has reached a point where it is possible to say that corrosion is not inevitable, but is due to more or less direct violation of certain well defined principles. If steel can be protected from the simultaneous action of moisture, air and acids, the causes of rusting or corrosion are to a great degree removed, regardless of the particular chemical theory held by the investigator. Protecting the steel from the action of these three agents is mainly a mechanical proceeding. A permanent, impervious, elastic coating, which will adhere closely to the metal is the requirement. High-grade asphalt applied when both the steel and the coating are hot and clean, seems to meet these conditions satisfactorily. The specifications for the chemical compositon of the asphalt used were very exacting. Among other conditions it was required that a cubic centimeter of the material should show no action when exposed for one year in any or all of the following solutions: 25 per cent hydrochloric acid, 25 per cent sulphuric acid, 25 per cent potassium cyanide, 25 per cent caustic soda, saturated solution of ammonia. The pipes were thoroughly cleaned and heated to a temperature of 300° F. and while hot were dipped vertically in the bath of asphalt, which was maintained at a temperature of from 350 to 400° F. The pipe was held in the bath for a sufficient length of time and was then drawn out slowly. at the rate of 5 to 10 ft. per minute, so that a coating of 1/32 in. thickness was evenly distributed over the entire surface of the pipe. Any damage to the coating during shipment or erection was repaired by the application of the same material dissolved in a suitable solvent, and applied in several coats at intervals, until a satisfactory thickness was obtained. All bolts and nuts were dipped in the same solution before being inserted in the flanges.

(c) Electrolysis is due to an electrical difference of potential between the metal and the earth in contact with it, of sufficient magnitude to cause a current flow from the pipe to the earth. Since the conflagration of 1904 the city of Baltimore has required all electrical wires to be placed in the municipal conduits, and to protect the cables from electrolytic action the city's electrical commission made a careful study of the local situation. As a result the street railway was compelled to rebond a large part of its tracks, copper cables being carried around all special work. In addition a supplementary copper return covering the entire district was installed, consisting of three bare copper cables having an aggregate cross-section of 6,000,000 circular mils. An entirely separate copper return was also installed as a protection for the cable sheaths, nothing but lead cables being bonded to this. The cross-section of this latter varied from 1,000,000 to 6,000,000 circular mils. As a result of this large amount of copper in the return circuit, the difference of potential between the various underground structures has been reduced to a nominal figure.

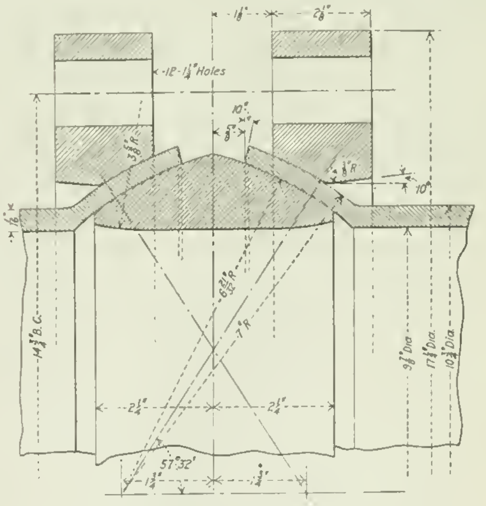


Fig. 3—Detail of 10-in. Pipe Joint.

The special joint designed for the Baltimore Steel pipe line has a resistance equal to 6 ins. of the pipe on the 10-in. size, and equal to 9 ins. on the 16-in. pipe. The resistance of a bell and spigot lead joint is often equal to 4 or 5 ft. of the pipe.

(d) Finally, the current flow from the pipe to the earth may be made very small if a high resistance covering be placed around the entire pipe system. In the present instance the asphalt coating furnishes the necessary high resistance envelope.

While it is still too early to offer definite evidence regarding the life of the pipe in question, pipes which have been in the ground for two years have recently been exposed by excavations for other work, and have shown absolutely no signs of deterioration, the coating being in perfect condition.

Pipe.—The specifications called for lap-welded pipe made of soft open hearth steel having the following qualities:

	Per cent.
Carbon, not exceeding	0.10
Phosphorus, not exceeding	0.04
Sulphur, not exceeding	0.05
Manganese between	0.35—0.45

Ultimate tensile strength between 50,000 and 55,000 lbs. per sq. in.; elastic limit at least ½ ultimate; elongation not less than 20 per cent in 8 ins.; cold and quench bend 180° flat.

The weld in the lap was to be perfect and capable of standing the strains incident to the manufacture of bends and forming of joints, without distress or rupture.

The thickness of pipe, in inches, was as follows:

24-in. outside diameter	1/2
16-in. outside diameter	7/16
10-in. inside diameter	7/16
8-in. inside diameter	7/16

Bends were generally of a standard radius of five diameters of pipe. Length of pipe, in feet, laid was:

24-in.	1,275
16-in.	17,052
10-in.	28,229
8-in.	7,137
Total	53,693 = 10.2 miles

Joints.—For the present service it was desired to avoid the use of rubber gaskets, which would tend to increase the electrical resistance of the joint. Copper gaskets or other metals dissimilar to the metal of the pipes, in the presence of moisture and the acids or salts of the earth, would form a voltaic cell, and tend to increase the corrosion due to electrical action. A joint was therefore designed to avoid altogether the necessity for a gasket or joint cement of any kind.

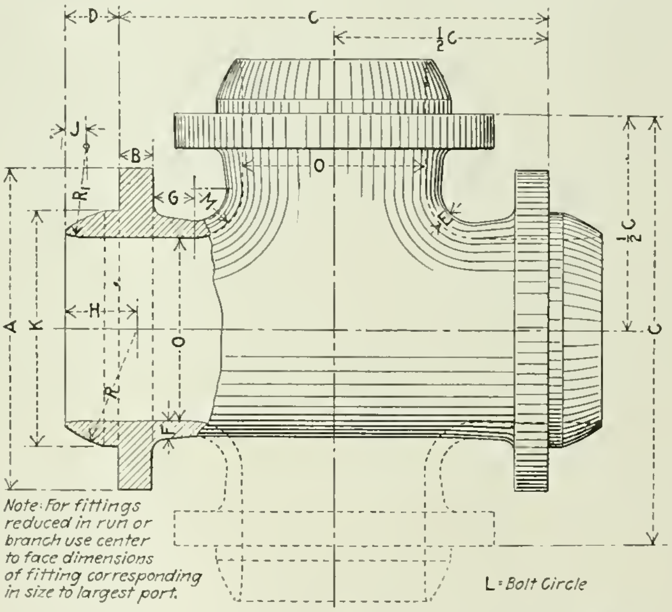
The Baltimore design is a form of universal joint, see Fig. 3. The end of the pipe is flanged out into a bell forming a zone of a sphere. A soft cast-iron ring is accurately turned in the shape of a torus, having the same curvature on its exterior surfaces as the interior of the bell on the pipe ends. Loose flanges are placed on the pipe back of the bell, and when bolted up, draw the pipe bells up on the torus ring. The pressure secured by the wedging effect on the spherical surfaces is enormous. If the curve of the surfaces be too flat, the metal of the pipe may be cold rolled, and the flanges may be pulled over the ring. By suiting the degree of the curvature to the diameter of the pipe, a safe combination is secured, and with the proper thickness of loose flange, a joint is secured, which is absolutely water tight until pressures are reached which exceed the elastic limit of the pipe or bolts. On the 10-in. size this pressure is about 2,200 lbs. per square inch. In the field testing, during the installation of the pipe, the specified test pressure was 600 lbs., but during the early stages of the work, this pressure was often largely exceeded.

The joints are designed for a deflection of 10°, or about 3 ft. 6 ins. in a 20-ft. length. On the 10-in. size this amount of deflection is easily obtainable, but on the larger sizes a smaller amount was used, though sufficient to be of considerable value in city work. A line of 10-in. pipe was made up of seven 20-ft. lengths, and while the pressure was on, one end of the line was raised 5 ft. by means of a crane. While suspended in the air, supported only at the two ends, 140 ft. apart, there was practically no leakage at any of the joints. It is evident that at least that amount of trench might be washed out without interfering with the operation of the pipe system in the least degree. In laying the pipe it was possible to deflect it to pass an obstruction and in one instance, after the completion of the work, owing to a change of grade in the sidewalk, a hydrant branch 50 ft. long was jacked up 5 ins. at one end, simply by loosening the bolts at one joint. Upon tightening these bolts, the line tested free of leaks at 600 lbs.

The fact that the pipe was laid in 20-ft. lengths means that the number of joints was reduced 40 per cent in comparison with cast iron.

For deflections greater than could conveniently be made by the joints, pipe bends were used. A bending table was installed on the work by the contractor, and about 1,500 bends were made, or 150 per mile of pipe laid. Bends of 16-in. pipe and smaller were made on the work, the 24-in. bends were made at the factory before shipment.

For make-up pieces at intersections and in blocks between valves or tees already installed, straight line welded joints were used. A special joint was devised for this service, made up as follows: The end of one pipe was accurately expanded sufficiently to permit of its being shrunk over the end of the pipe to which it was to be joined. Holes were cut around the circumference of the outer pipe or bell, and after being heated it was shrunk on in place. The holes were then flowed up with metal by the oxy-acetylene blowpipe, and the end of the bell was also welded to the enclosed pipe. With this type of joint the weld is in shear and not in tension, and it is entirely feasible to make bends in the pipe with the weld in the arc of the curve. Approximately 1,500 of these straight line welds were made on the work, or about 150 per mile of pipe.



Note: For fittings reduced in run or branch use center to face dimensions of fitting corresponding in size to largest port.

SIZE	A	B	C	D	E	F	G	H	J	K	O	R	R₁	L	M	BOLTS NO.	BOLTS DIA.	BOLTS HOLE DIA.
10"	17¼"	2⅛"	23½"	3"	13/16"	1⅛"	2¼"	4"	1⅛"	12 27/32"	10"	6 21/32"	3⅝"	14¾"	2⅝"	12	1⅛"	1¼"
16"	23½"	2½"	30"	4⅜"	7/8"	1¼"	2½"	6"	1½"	20 13/32"	15⅛"	9 29/32"	6¼"	21"	2¾"	16	1⅛"	1¼"
24"	33"	2¾"	41"	3⅞"	1 1/16"	1½"	3"	8⅜"	2¼"	27"	23"	14 19/32"	7"	30"	3"	24	1¼"	1⅜"

Fig. 4—Detail of Tees and Crosses.

Flanges.—The loose ring flanges were of medium open hearth steel, ultimate tensile strength 60,000 to 68,000 lbs. All flanges were accurately machined and were drilled to template.

Fittings.—The use of steel pipe made it possible to reduce the number of fittings to a minimum. The hydrant branches were made by welding necks to the mains and laterals. A special neck weld was used, made up as follows: A hole was cut in the pipe, smaller than the size of the neck, and radial cuts were made forming four narrow lugs which were left projecting into the hole. The wider alternate lugs were bent back to make an opening large enough to receive the neck piece. The smaller straight lugs formed a support for, and held the neck rigidly in place during the welding process. The whole joint was then flowed with metal by an oxy-acetylene blow-pipe, forming a joint as strong as the original pipes.

The only specials required were the tees and crosses at the intersections of the gridiron, and a valve connection piece used to give a straight face flange at the valves. By the use of the latter it was possible to use standard commercial valves, and the valves may be easily removed when necessary. All fittings were made of low carbon open hearth cast steel. Details of tees and crosses are shown in Fig. 4, and details of valve connecting piece by Fig. 5.

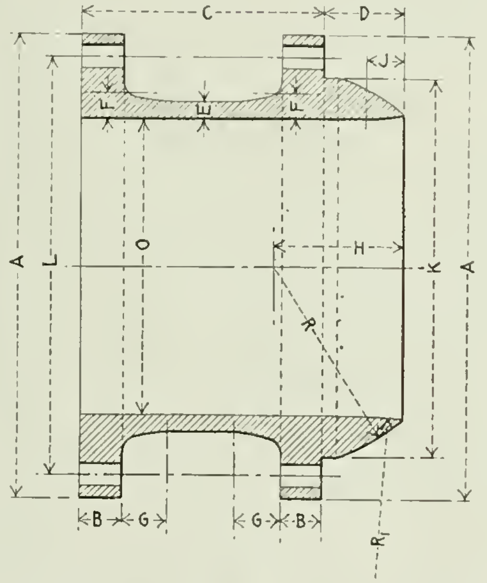
Valves.—All valves are double-disc parallel seat gates. Bodies are low carbon open hearth steel of the same specifications as for fittings. Bonnets, discs, gearing brackets, glands and packing boxes are of semi-steel. Stems are of Tobin bronze, not less than 53,000 lbs. tensile strength. Seats, wedge mechanism and glands are of bronze. The 16-in. and 18-in. valves are geared. All street valves are provided with a stem nut and a forged steel key is placed in each valve box. An interlocking arrangement is provided so that the key can be removed from the nut only when the valve is wide open. This prevents the valves being left closed or opened only a few turns, except in an emergency or intentionally, as the valve box cover cannot be replaced while the key is on the nut. The 24-in. valves are in the pumping station and are hydraulically operated. All valves were subjected to a shop test of 800 lbs. when open, and 600 lbs. when closed.

Valve Boxes.—The street valves are treated as pieces of mechanism, subject to derangement, and hence are placed in concrete boxes or manholes, 42 ins. inside diameter, where they can be inspected and repaired without disturbing the street paving. The floor was first laid of plain concrete, with suitable drainage connection; then the section enveloping the pipe or fitting was laid up with concrete blocks molded to the standard radius. The upper clear section was built of reinforced concrete rings, laid up without mortar, as they are provided with interlocking projections on the top and bottom faces, which make the rings self-centering. The upper portion is made of conical shaped rings, forming the roof, and supporting the cast-iron cover frame. The blocks and rings were made up in quantities in metal molds and seasoned before being used. They were quickly and easily assembled in the trench by unskilled labor. The holes were back-filled and the street repaved in a remarkably short time, an item of considerable importance in a business thoroughfare, as there was no time required for setting of the concrete. See Fig. 6.

LOW-PRESSURE WATER SUPPLY.

Two separate 40-in. mains from two different river systems, run direct to and form the normal supply for the high-pressure pumping station. The normal pressure available with the high-pressure draft included is from 30 to 50 lbs., but if by-passed from the middle or high-service mains, the pressure can be carried at 70 lbs. A 30-in. cast-iron branch is taken to the station where it changes to a 30-in. rivetted steel pipe inside the building.

An auxiliary supply of brackish water from the harbor may be secured through a reinforced concrete conduit 3 ft. sq. inside. The conduit is provided with a large screen chamber at the dock, and has fine and coarse screens sliding in inclined frames, and both in duplicate, so that one set of each can be in service while the other set is out for cleaning. The screen chamber is also provided with stop logs so that the chamber and conduit can be pumped dry for cleaning out sediment. At the station end the conduit terminates in a large suction chamber located beneath the basement floor and between the pump foundations. The dimensions of this chamber are 8 ft. wide, 7 ft. deep and 70 ft. long. The gravity suction pipes enter the suction chamber through cast-iron thimbles built into the floor of the basement, as the basement floor is 8 or 9 ft. below flood tide level.



SIZE	A	B	C	D	E	F	G	H	J	K	R	R₁	O	L	BOLTS NO.	BOLTS DIA.	BOLTS HOLE DIA.
8"	14¾"	1⅞"	10½"	2 15/16"	¾"	1⅛"	2¼"	3¼"	1"	10 9/16"	5¼"	3½"	7¾"	12¼"	8	1⅛"	1¼"
10"	17¼"	2⅛"	11½"	3"	¾"	1⅛"	2¼"	4"	1⅛"	12 27/32"	6 21/32"	3⅝"	9⅞"	14¾"	12	1⅛"	1¼"
16"	23½"	2½"	13"	4⅜"	⅞"	1¼"	2½"	6"	1½"	20 13/32"	9 29/32"	6¼"	16"	21"	16	1⅛"	1¼"
24"	33"	2¾"	14½"	3⅞"	1 1/16"	1½"	3"	8⅜"	2¼"	27"	14 19/32"	7"	23"	30"	24	1¼"	1⅜"

Fig. 5—Detail of Valve Connecting Piece.

A by-pass from the high-pressure discharge main is led into the suction chamber for flushing it, and also forms a convenient discharge for the pumps during tests.

INSTALLATION OF PIPE LINES.

Tunnels.—A considerable amount of tunneling was done, especially at street intersections, where double track crossings of the street railway were frequently encountered. On several of the busiest streets it was found necessary to tunnel for many blocks at a stretch. In a large number of instances it was thought desirable to tunnel for the hydrant branches, as the hydrants being staggered on opposite sides of the street, it was necessary on every alternate hydrant to cross the street, thus crossing also the railway tracks, pipes, sewers, electric conduits, etc. A segregation of these tunnels into groups is as follows:

	Lineal feet.
Intersections	5,122
Straight line	4,623
Hydrant connections	2,630
Total tunnels	12,375

Leakage.—For field tests during the installation of the pipes, the contractor furnished a portable testing set consisting of a 3-HP. 4-cycle gas engine, driving through a Morse chain a triplex plunger pump of a capacity of 5 gals. per minute at a pressure of 1,000 lbs. per square inch. Each street section between valves was tested as the work was installed, and made absolutely tight, at the specified pressure of 600 lbs. The section to be tested was filled from the ordinary fire hydrants, after which the test pump was connected through a 1-in. flexible steel hose. In the early stages of the construction, the workmen would frequently carry the pressure up to 800 lbs. and sometimes to 1,000 lbs., to show interested spectators what the new joint would stand. Afterwards a relief valve set for about 610 lbs. was placed on the pump, and the testing became almost automatic.

After the pipe lines had been completed, but before the system had been put into commission, a pressure of about 300 lbs. was put on the pipe lines by the main pumps. There being no hydrants open, the water was being wasted through a by-pass to reduce the pressure. A suggestion was made to close the pipe system off from the pumps to determine how long the pressure would remain. The main 24-in. valves were accordingly closed, while the pressure was at 125 lbs. After a lapse of 16 hours the gage registered 95 lbs., indicating that the leakage was practically nothing.

A duplex pump of 1,000 gals. capacity was installed to keep up the pressure and take care of the leakage on the system. Since the equipment has been put into regular service it has been necessary to keep the by-pass valves open continually on this pump in order to permit the plunger to move.

CHOICE OF MOTIVE POWER.

General Considerations.—In the preliminary studies for the project, careful attention was given to the design of similar plants in other cities, notably New York and Philadelphia. In the former, as is well known, electric driven centrifugal pumps are used. In Philadelphia, gas engine driven, geared triplex plunger pumps were installed. In the following discussion it should be remembered that local conditions often exercise a controlling influence in the decision as to the best form of motive power for such a plant.

In Baltimore the fundamental principle governing the design of the entire project was considered to be reliability under the most adverse conditions liable to be encountered. When it is considered that the safety of hundreds of millions of dollars worth of property is dependent upon the accurate functioning of each element, it is evident that no considerations of economy, either in first cost or operating expense, should be allowed to enter, if simplicity and certainty of operation are thereby subordinated.

Gas Engines.—The gas engine is subject to certain limitations, which in the case of fire service, place it at a distinct disadvantage.

(a) The load factor of the service is extremely low, being less than 5 per cent per annum, so that the opportunity to profit by the high fuel economy is negligible.

(b) Inability to carry more than a small percentage of overload.

(c) In the hands of expert operators, a well designed modern gas engine is perhaps subject to no more accidents or delays than is a steam equipment, but certainly it is not subject to any *less* than steam. On the contrary, however, in the hands of operators of only average intelligence or experience, the number of apparently trivial causes which can result in serious delays or damage is surprisingly large in a gas engine plant. In the case of a municipal plant of this type it is useless to plan for ideal operating conditions, or to assume that only the highest grade operating force will be employed.

Electric Motors.—In spite of its many known advantages, a large electrical distributing system is essential in unstable equilibrium, and subject to complete interruption from very slight causes, either natural or malicious. Dependence for prompt renewal of the service after a shutdown must be placed in duplicate lines and equipment in the stations. But even with these a considerable period must elapse before large electrical machines can be started up and brought into synchronism. A delay of this character during the first critical minutes of a bad fire would be fatal to the usefulness of an important fire-fighting system. The fact that a vital feature of the fire-fighting system would be under the control of employes of an outside corporation and not subject to the discipline of the fire department, with the possibility of a conflict of authority at a crucial moment, are all matters that must be considered.

Like the gas engine, the electric transmission, especially the underground system, requires for its commercially profitable conditions a high load factor, but for a different reason. To justify the large investment needed, requires a uniform load as near as possible to its capacity, in order that the fixed charges shall not be out of proportion to the earnings. Owing to the extremely low load factor of a fire station, its load is a very "undesirable" one to a commercial electrical supply corporation, unless a "demand" charge is made sufficient to justify holding in reserve a definite proportion of the entire equipment from the coal pile to the electric cables. Electrical plants require the installation of sufficient equipment all along the line to supply the maximum annual peaks. As a fire is no respector of anybody's peaks, it follows that a fire station load demands its own separate power plant investment, whether the equipment is located in a commercial central station, or in an isolated plant for its own use.

A commercial plant is designed with a definite load factor in view, ranging usually from

30 to 50 per cent. For these conditions the most efficient equipment is justified, with all the refinements of modern fuel and labor saving auxiliaries in a large plant. If a load factor of only 5 per cent had been imposed, however, a very different type of equipment would have been selected, at a very much smaller investment.

The various links in the chain of an electrical supply equipment (not considering a long distance transmission) would be as follows: (a) Coal handling apparatus, (b) boilers and auxiliaries (stokers, stacks, economizers, heaters, etc.); (c) steam turbines and auxiliaries, (d) high-tension generators, (e) high-tension switching apparatus, (f) high-tension cables; and at the receiving end: (g) high-tension switches, (h) high-tension motors, (i) centrifugal pumps.

If a long distance transmission were included, there would be added step-up transformers, aerial lines, a substation with step-down transformers and switching apparatus. If low-tension motors were used, additional transformers would be required.

An isolated steam pumping station, designed for the purpose, eliminates at once five of the above links, namely, items d, e, f, g and h, and concentrates the entire operation in one building, under the direct control of the fire fighters themselves.

Finances of Steam and Electrical Operation.—Expressed in dollars and cents the argument becomes as follows:

Electric Pumps (New York Type)

Investment	
5 motor driven pumps (rated capacity 3,000 gals. per min.), switchboard, etc.	$112,500
Building and pump foundations	84,000
	$196,500
Operation	
Maintaining pressure continually 8,760 hr. less 100 hr. = 8,660 hr. at 100 kw	866,000 kw-hr.
Fire service, 100 hr. per annum 3,150 kw. demand	315,000 kw-hr.
	1,181,000 kw-hr.
Service charge, maximum demand=3,150 kw.	
Central station investment, 3,150 kw. at $75	$236,000
Underground cable (Baltimore conditions)	40,000
Cash requirements	276,000
Underwriting at 90	31,000
Total investment	$307,000
Fixed charges on $307,000	
Interest at 5 per cent	
Depreciation at 5 per cent	
Profit at 5 per cent	
Total 15 per cent	$46,000
Underground conduits, duct rental (Baltimore conditions)	1,300
Total service charge	$ 47,300
Operating expenses	
Service charge	$ 43,700
Meter charge, 1,181,000 kw-hr. at 1 ct.	11,810
Salaries, station operating force	10,650
Supplies, lubrication and repairs	1,000
	$ 67,160
Fixed charges on $196,500	
Interest at 4 per cent	$ 7,860
Depreciation at 5 per cent	9,825
	$ 17,685
Total annual expense, electrical plant	$ 84,845

Steam Pumps

Investment	
Four 4,000-gal. pumps and auxiliaries	$ 86,000
Boilers and auxiliaries	70,000
Piping, steam and auxiliary water	30,000
	$186,000
Building and machinery foundations	125,000
	$311,000
Operation	
Coal consumption	
Banking fires, 8,760 hr.—100 hr. = 8,660 hr. = 360 days at 6 tons per day	2,160 tons
Fire service 100 hr. per annum at 5 tons coal per hour	500 tons
Total	2,660 tons
Operating expenses	
Coal, 2,660 tons at $3.30	$ 8,778
Salaries, station operating force	13,350
Supplies, lubrication and repairs	2,000
	$ 24,128
Fixed charges on $311,000	
Interest at 4 per cent	$ 12,440
Depreciation at 5 per cent	15,550
	$ 27,990
	$ 52,118

Summary

Total annual expense, electrical plant	$ 84,845
Total annual expense, steam plant	52,118
Total annual saving	$ 32,727

This saving capitalized at 9 per cent represents an investment by the city of $363,630, considerably more than the first cost of the steam plant in the above comparison.

STEAM PUMPING STATION.

Pumps.—The Baltimore plant is designed for four main units of 4,000 gals. per minute rated capacity, at a piston speed of 300 ft. per minute and making 50 r.p.m. Three main engines have been installed and are in operation at present; the fourth unit will be added in the near future.

In line with the policy of designing all parts of the system with a first requisite of simplicity and reliability, the main units each consist of a horizontal, twin, simple, non-condensing, crank and flywheel, plunger pumping engine. The water ends are attached directly to the engine frames, at opposite ends from the steam cylinders, the crank shaft being in the center, as shown by Fig. 7.

The steam cylinders are fitted with standard Corliss valve gears, having double eccentric long range cut-offs. The cut-offs of both cylinders are under the direct control of the speed and pressure regulators, and are also provided with hand control.

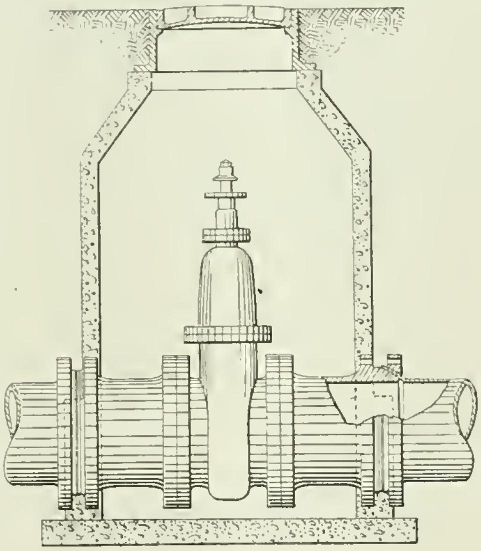


Fig. 6—Concrete Valve Box With Valve in Place.

Each engine was liberally designed for a continuous working pressure of 300 lbs. per square inch on the water ends, with a test pressure of 600 lbs. static. Injection parts were designed for a variation of pressure from 70 lbs. direct to a suction lift of 15 ft. of salt water. All steam parts were designed for maximum working pressure of 200 lbs., but the normal working pressure is only 125 lbs.

Each engine is fitted with speed and pressure governors. The speed governor is driven by a noiseless chain belt, and acts directly on the cut-off valves of both cylinders The pressure governors are identical in principle with the regulating valves used on the hydrants, and were also furnished by the Ross Valve Mfg. Co.

The net effective valve area between the openings of the valve seats on each suction and discharge deck is 308 sq. ins. or 220 per cent of the cross sectional area of the plungers. The valves are 3½ ins. in diameter and are composed of rubber with brass backing plates; the seats are of bronze, screwed into the valve decks on a taper and faced off after being placed in the decks.

Auxiliaries.—To take care of the leakage in the pipe system and maintain a pressure of 150 lbs. as well as to provide for the first draft from the hydrants before the main pumps are in action, a 1,000-gals. per minute pump was installed. This is a horizontal, duplex, direct-acting, compound, non-condensing, center-packed plunger pump, giving its rated capacity at a piston speed of 100 ft. per minute. While the pump was designed for a normal working pressure of 150 lbs. on the water end, and for 125 lbs. on the steam end, all pressure parts were designed to withstand a continuous pressure of 300 lbs. on the water end and 200 lbs. on the steam end, so that the pump could be left in service under the maximum pressures of the main pumps without injury. Owing to the leakage on the system being so small, the pump is inconveniently large for the purpose intended, and it has been necessary to keep the delivery by-passed continuously in order to keep the plunger in motion.

In order to maintain the air in the delivery air chambers, there are provided two steam driven, crank and flywheel, two-stage air compressors, each having a capacity of 50 cu. ft. of free air per minute against a pressure of 450 lbs. There is also provided a wrought steel storage tank 30 ins. in diameter by 5 ft. high. There are two large air chambers on the 24-in. discharge mains, in addition to those on the pumps. The former are made of lap-welded rolled steel pipe, ½ in. thick, 30 ins. in diameter and 20 ft. high. The ends are bumped, riveted and welded to the pipe. Two sets of glass gages are attached through bosses welded on the sides.

For priming purposes, when lifting from the harbor, there is provided one vertical, steam driven, crank and flywheel single-stage, dry vacuum pump, 6-in. steam, 10-in. air and 6-in. stroke. This pump is connected to the harbor suctions through a large separator tank at the top of a 40-ft. riser, to prevent water being drawn over into the air cylinder.

The plant is provided with a four-motor, electric traveling crane, main hoist 20 tons capacity, auxiliary hoist 5 tons. For lighting the station and for the operation of the electrically driven auxiliaries, there are provided two non-condensing steam turbo-generators.

Tests and Duty Trials.—The specifications for the pumps provided for an endurance and capacity test of 24 consecutive hours.

A normal load duty trial was also specified, covering a period of 12 hours; steam pressure at the throttle 125 lbs. The steam consumption was to be based on the feedwater supplied to a separate boiler blanked off from all other sources of supply. The measured consumption was to include all jacket steam, but not that required for boiler feed pumps and other auxiliaries, nor separator condensation and drips from the steam piping on the boiler side of throttle.

In order to avoid the insertion of a water meter in either the main suction or discharge lines, a venturi meter is by-passed around a gate valve in the 30-in. city water supply. As the pump discharge can be accurately measured from the record of the pump strokes for a given period, when the slip is known, in this case the venturi meter is only used to calibrate the slip of a single pump, and therefore has a capacity only equal to one pump.

The duty specified is 70,000,000 ft.-lbs. per 1,000 lbs. of dry steam, under normal operating conditions of 3,000 gals. per minute discharge, against a head of 250 lbs., with 30 lbs. pressure on the suction, and 125 lbs. of steam at the throttle.

Boilers.—The plant is designed for four boilers, each set singly, and each provided with a separate stack carried on structural steel supports directly over the setting. At this time only three boilers have been installed; the fourth will be added in the near future.

The boilers are of the horizontal, inclined, straight tube type, with forged steel water legs reinforced with hollow staybolts. Each boiler contains 6,800 sq. ft. of heating surface and three 36-in. drums. All pressure parts are designed for 200 lbs. working pressure. Each boiler is capable of a continuous evaporation of 45,000 lbs. of water from and at 212° F. into commercially dry steam, when burning semi-bituminous coal of approximately 4,500 B. T. U., with forced draft not exceeding 3 ins. of water in the ashpit, or the equivalent of 1 boiler h.p. from 3.77 sq. ft. of heating surface.

As the actual time during which the boilers will be in active service will probably average only about 100 hours per annum, the plant was designed for carrying banked fires for a large proportion of the time, with the least possible loss from radiation. The top, sides and rear of each boiler are enclosed in an airtight steel plate casing. The hotter portions of the side walls, amounting to about 20 per cent of the area of these walls, are covered with 2 ins. of magnesia blocks inside the casing. The casing plates are supported on a framework of steel angles, attached to the structural steel members supporting the boilers and stacks. These angles act also as buckstaves for the settings. Access and dusting doors are provided where necessary, which are hinged at the top and close tightly on inclined faces.

The boilers are set in the reverse direction from the usual method; that is, with the low end of the tubes over the furnace. The front portion of the furnace is covered with a flat fire brick arch, made of split tiles encircling and supported by the lower row of tubes. When under fire, there is presented to the furnace gases an incandescent firebrick surface, instead of the customary cool iron surface of the tubes. The first pass of the gases between the tubes is at the extreme rear of the boiler, thus providing a furnace area equal to the entire floor space occupied by the boiler inside the setting, and making it possible to force the boiler to 90 per cent over the customary rating without imperfect combustion. A special grade of firebrick was used for the furnace lining, which under a change of temperature of 3100° F. shows an expansion or contraction of less than 0.01 in. per foot.

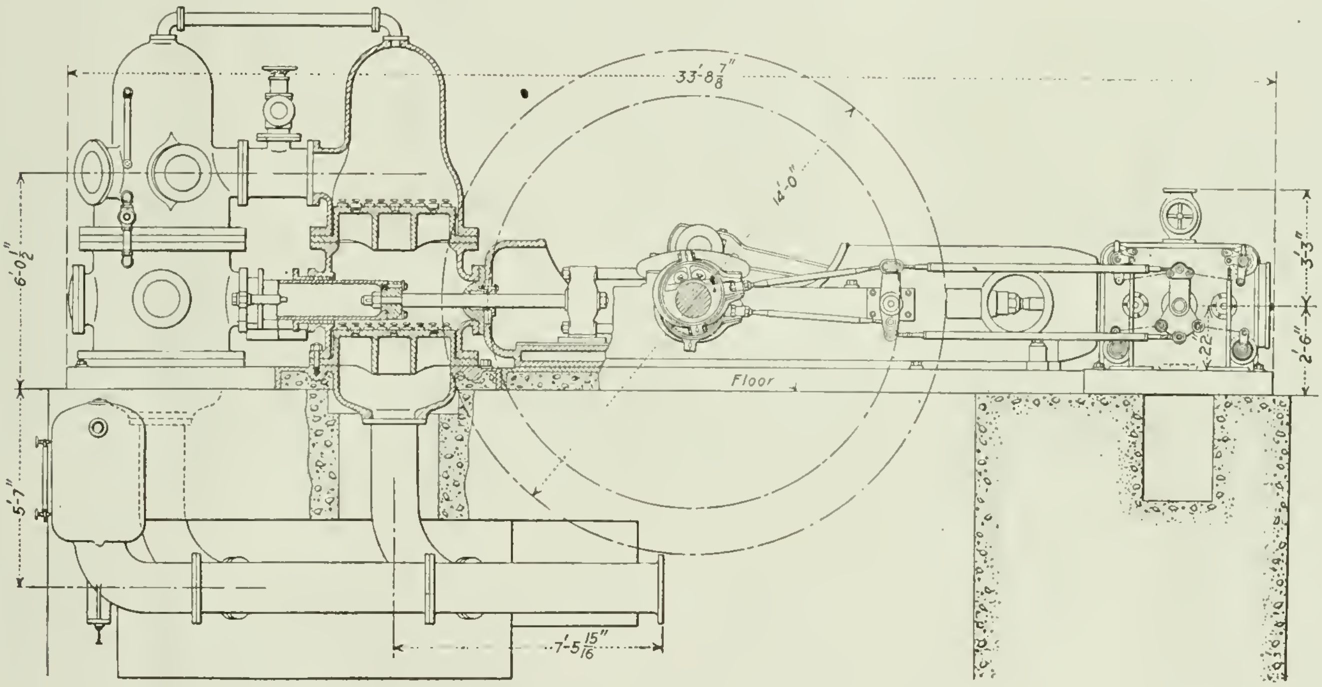


Fig. 7—Elevation of Steam Pump, Baltimore High-Service Fire System.

Forced Firing.—The conditions of fire service require that the boilers shall be capable of changing from banked fires to the maximum capacity in the shortest possible time. The intervals specified were as follows: One-half rated capacity in 5 minutes; full rated capacity in 12 minutes; overload of 75 per cent in 20 minutes.

Choice of Fuel.—The above conditions made imperative the use of a gaseous fuel, or fuel oil, or forced draft with coal. The possibility of the use of a combination of two of these was also considered. With gas at 90 cts. per 1,000 ft., this material was abondoned. The use of crude oil was given careful study. Due to the fact that economy of operating expense was not the primary consideration, the problem was somewhat simplified.

As the plant is located in a wholesale district where high values of stock are common, it would have been necessary to have stored the main supply of oil underground. Ample space for this purpose existed in the wide water front street about 200 ft. from the station. On the other hand, experience has demonstrated that oil should be fed to the burners only by gravity from an overhead storage of suitable capacity. Experience has also shown that in spite of all precautions, an oil storage tank will in all probability, sooner or later, take fire. It was, of course, possible to design a fireproof barrier which would prevent the fire doing damage to adjoining property. It was believed, however, that in a plant designed for fighting conflagrations, the possibilty of an oil fire, with its huge volumes of dense black smoke, would not tend to popularize the system, even if the fire proved to be entirely harmless. In spite of its recognized advantages in case of handling and quick firing, the use of fuel oil was therefore definitely abandoned, and coal was adopted. The introduction of natural gas from the West Virginia fields has been under consideration for some years, and if this should be accomplished, it would make an admirable fuel for the purpose, either alone or as supplementary to the coal furnaces.

Automatic Mechanical Stokers.—The use of coal made necessary also the use of forced draft. In addition, it was desirable that during the periods of banked fires, there should be maintained a full bed of ignited coal, requiring only the air blast to force the fire to the highest rate of combustion. The underfeed type of stoker seemed to meet these conditions very satisfactorily. A large body of coal, approximately 1,000 lbs., can be carried in each furnace, a part of this coal incandescent, a part coked and a part in the process of coking. This represents about 14,500,000 B. t. u. in storage ready for use on a few minutes' notice. As a further heat storage, the steam pressure, which is ordinarily carried at about 150 lbs., can be raised to 200 lbs., immediately upon the receipt of an alarm. As the normal operating pressure is only from 125 to 150 lbs. at the pump throttles, by the time the hose companies can reach the hydrants and attach the hose, and put a sufficient draft on the pumps to pull the steam down to normal, the furnace fires will be ready to respond to any demand.

Each boiler is equipped with four underfeed stokers, and each stoker unit is capable of burning efficiently, without smoke, 1,000 lbs. of coal per hour. For the four boilers a duplicate blower equipment is installed, each consisting of a full housed steel plate fan of sufficient capacity to operate the four boilers at 75 per cent overload. Each blower is driven by a direct coupled vertical steam engine. Each blower is connected to the main air pipe line, and by means of dampers either blower can be used to serve any or all the boilers.

To regulate the supply of both fuel and air in the proportion required for complete combustion under all rates of firing, the stokers are provided with automatic regulators actuated by the boiler pressure. Provision is also made for hand regulation, so that it is possible to anticipate sudden demands for steam upon receipt of an alarm, and also for decreasing the supply of both fuel and air when the demand for forced firing has passed.

Stacks.—Each boiler is provided with a separate steel stack located directly over the boiler which it serves. Each stack is 72 in. diameter by 125 ft. above the boiler room floor, and is carried by structural steel framing from the boiler foundations. The stacks are unlined.

Coal Handling and Storage.—Semi-bituminous run of mine coal is used almost entirely for steaming purposes in the vicinity of Baltimore. In this instance the coal is delivered in carts, the total annual consumption being too small to justify mechanical handling under existing conditions. The coal is dumped on a grating over an opening in the sidewalk, the mesh being 4 in. sq. Large lumps are broken up with a maul, as with the type of stoker in use there is no necessity for the coal to be crushed to smaller sizes. Below the grating there is a dumping hopper which receives the coal and delivers it to the lower run of a bucket elevator. The elevator is a double strand link belt with V-shaped buckets, 16 ins. by 15 ins. dumping by gravity. The outfit has a capacity of 25 tons per hour with uniform feed.

The coal is delivered into reinforced concrete bunkers with inclined bottoms, located directly over the fireroom. The bunkers have a capacity of 150 tons without trimming, or sufficient to operate the entire plant at its maximum capacity for 30 hours. Coal can also be delivered from carts directly on to the boiler room floor, so that the operation of the plant is not dependent upon the coal handling equipment nor the storage supply.

Boiler Feedwater.—Boiler feedwater is normally supplied from the city mains under 30 to 50 lbs. pressure, sufficient to deliver to the open heaters in the gallery of the engine room, without pumping. In the event of an interruption to the city supply, the feedwater can be taken from a reserve supply stored in steel tanks in the basement under the boilers. For lifting from the storage tanks and delivering to the heaters a duplicate set of low-service duplex steam pumps is provided.

To avoid the loss of efficiency in the boilers due to scale, and the necessity for taking the boilers out of service for considerable periods while removing the scale, a double unit hot process purifier and heater of the Cochrane type was installed, each half of ample capacity to handle the consumption of the entire plant.

The heaters are located in a gallery in the engine room, directly over the boiler feed pumps, thereby providing a gravity head of 25 ft. for the hot water to the pump suction. There are three duplex, outside end packed boiler feed pumps, brass fitted and with pot valves, designed for 300 lbs. pressure.

In addition to the above, each boiler is provided with a Metropolitan Model O No. 17½ injector, capable of supplying the maximum evaporation of the boiler when lifting from the storage tanks in the basement.

Foster excess governors are provided on the feed pumps, and Williams regulators on the boilers.

Piping.—A 12-in. steam header forms a closed ring around the plant, with long radius expansion bends at all changes in direction. A sufficient number of gate valves are placed in the header to sectionalize it, so that any portion may be cut out without disabling more than one boiler or one pump. Pipe is full weight, lap welded, soft open hearth steel. To provide an independent header for the station auxiliaries, a 6-in. cross connection is made across the center of the main header, which is capable of being fed from either side of the main header, in case of accident to the other. No fittings whatever are used in the main line, all branches being taken from interlocked welded necks. Boiler branches are provided with non-return valves at the boiler nozzles and gates at the header end. Van Stone flanges are provided for connections to the valves and receivers, which are located so as to avoid as far as possible the necessity for any additional joints in the line. Wrought steel receiver type separators are installed at the low points on each side of the header.

The exhaust system is extremely simple, a multi-port back pressure valve on the 18-in. riser serves to turn all the exhaust into the heaters at light loads, and provides a direct path to the atmosphere when the steam is in excess of the heater requirements.

Building.—The site of the pumping station is a lot 69 ft. front by 137 ft. deep, running back to a 16 ft. alley. The property immediately adjoining on the two sides is occupied by warehouses carrying more or less inflammable stocks. On the opposite side of the alley the same conditions exist. All foundations for the pumping station and machinery were designed to rest on caissons carried to the gravel, so that it was necessary to underpin the walls of both the adjoining buildings.

All structural portions of the building, including columns, girders, beams, floor and roof slabs, and all walls except the front, are of reinforced concrete. The adjoining buildings on the sides are from 10 to 20 ft. higher than the station roof, so the roof girders, beams and slabs were designed to withstand the shock of falling walls in case of fire. The side walls are not less than 8 ins. thick in any part, and have no openings whatever. The rear wall is the same, except that there is one door at the level of the boiler room floor.

For access to the men's quarters an automatic push-button electric elevator is installed, in addition to the stairway. Standard brass sliding poles are also provided for quick response to an alarm. The quarters are located over the front of the engine room, and include a dormitory, dressing room, bath, toilet and reading rooms. In addition, a private bedroom, bath, parlor and office are provided for the chief engineer.

In addition to the fireproof construction of the building, further fire fighting equipment for the protection of the station consists of a water curtain for the exposed front and rear, and two 8-in. standpipes, to be fitted with monitor nozzles. A dangerous fire in the immediate vicinity of the station could thus be effectively fought from the roof as well as from the ground.

Signaling System.—In addition to the regular fire alarm circuit, a separate telephone circuit runs to the pumping station from fire alarm headquarters, fire department headquarters, and the chief's night quarters. This circuit connects to contacts for portable telephones in each fire-alarm box in the high-pressure district. In addition to the regular Morse key and sounder there are contacts for a telephone connection in each box, over the fire alarm circuit. Finally there is available the regular public telephone service.

CONSTRUCTION COSTS.

Portable Equipment	
2 automobile hose wagons at $5,000....	$ 10,000
8,000 ft. 3-in. hose at $1..............	8,000
30 portable heads and regulators at $385	11,550
Total	$ 29,550
Pipe System	
Material delivered Baltimore	
Hydrants, 226 at $100..................	$ 22,600
8-in. pipe, 7,137 ft. at $2.35..........	16,700
10-in. pipe, 28,229 ft. at $3.10........	87,700
16-in. pipe, 17,052 ft. at $5.25........	89,600
24-in. pipe, 1,275 ft. at $10..........	12,750
8-in. gate valves, 6 at $100..........	600
10-in. gate valves, 193 at $130........	25,000
16-in. gate valves, 90 at $210........	18,900
18-in. gate valves, 2 at $300..........	600
24-in. gate valves, 3 at $1,000........	3,000
Air and relief valves.................	200
Low pressure gates, 2 30-in...........	500
Suction pipe, 400 ft. cast iron, 30-in., at $4..........................	1,600
Steel air chambers, 2 30-in., at $500..	1,000
Venturi meter	500
Cast steel specials....................	17,500
	$298,750
Installation	
Laying pipe, including placing valves, fittings, hydrants, etc.	
8-in. pipe, 7,137 ft. at $0.70........	$ 4,996
10-in. pipe, 28,229 ft. at 0.75........	21.200
16-in. pipe, 17,052 ft. at 1.15........	19.600
24-in. pipe, 1,275 ft. at 1.75........	2,230
Pump connections in station..........	6,000
Laying 30-in. c. i. suction............	3,400
Tapping 40-in. main...................	1,500
Concrete valve boxes, 293 at $30......	8,790
Excavation, back filling and rubble paving	
41,318 ft. open trench, at $3.84......	158,600
12,375 ft. tunnel, at $4.08............	50,400
Improved paving, 6,650 sq. yds., at $1.50	10,000
Superintendence, use of tools, etc....	50,000
	$336,716
	$635,466
Pumping Station	
Site and preliminary work..........	$ 37,730
Building, including machinery foundations and men's quarters............	124,800
Harbor intake and screen chamber....	10,000
Equipment	
Four 4,000-gal. pumps...............	$ 82,000
One 1,000-gal. pump..................	3,500
Auxiliary pumps	4,250
Feedwater heaters and purifiers.....	4,750
4 boilers and settings, 27,200 sq. ft. heating surface	33,000
16 underfeed stokers, blowers, air piping, etc.	18,000
4 steel stacks and supports..........	8,000
Coal handling apparatus............	7,000
Turbo-generators and switchboard..	4,500
Electric crane	4,000
Steam and auxiliary water piping....	30,000
	$199,000
	$371,530
Miscellaneous	
Signal system, cables, etc...........	$ 1,500
Furnishings for men's quarters......	500
Incidentals	5,000
	$ 7,000
Engineering	50,000
Total cost of construction..........	$1,093,546

OPERATION.

Operating Department.—The Board of Fire Commissioners is the executive head of the operating department, acting through the department chief. The operation and maintenance of the pumping station and the maintenance of the pipe lines, hydrants and portable heads are directly under the supervision of the department superintendent of machinery, Thomas H. Meushaw. The maintenance work for the pipe line is in charge of a general foreman, John Rudolph, who was chief inspector for the city during the early part of the installation, and general foreman for the contractor during the latter portion of the work.

The operating force at the pumping station is in charge of a resident engineer and five assistant engineers, with four stokers and two general assistants, all organized as a fire company. Two additional stokers have been recommended by the superintendent of machinery, and will probably be added in the near future, making a total station operating force of 14 men. Of these an engineer and stoker are on active duty at all times, with a four-hour watch. Immediately upon the receipt of an alarm all hands report on the operating floor. As a pressure of 150 lbs. is maintained during the standby period, orders have been issued that in the event of the pumps automatically speeding up without an alarm, the plant shall be shut down immediately. This course is taken to avoid water damage, should a break occur. Up to this time no occasion has arisen to require the execution of this order, however.

TESTS.

Opening Demonstration.—The system was formally placed in operation on May 20, 1912, with a public demonstration on the Court House Plaza. At first 24 1¾-in. streams were used from single hose lines held by tripods. Later seven 2½-in. streams were thrown, from monitor nozzles on the wagons. About 13,000 gals. per min. were delivered.

Underwriters' Tests.—A readiness test was made June 7, readings being taken by a stop-watch.

4.30.00 a. m.	Fire alarm box pulled; one engineer and one stoker on duty at station.
4.31.00 a. m.	Chief engineer with four additional engineers and three additional stokers had responded from sleeping quarters.
4.31.15 a. m.	Two large pumps started up, pressure increased from 150 to 190 lbs.
4.33.00 a. m.	Pressure 280 lbs. Hose company turned water on to two 3-in. hose lines siamesed into one 2½-in. monitor nozzle.
4.34.00 a. m.	Discharge was 1,050 gals. per min.
4.37.40 a. m.	Two additional 2½-in. nozzles in service, total discharge 4,000 gals. per min.

A second company was then ordered into service at another point, with three 2½-in. nozzles, bringing the total discharge up to 7,100 gals. per min.

A general performance test was made June 7, from 9.45 to 10.15 a. m. Pumps were started and stopped, and hydrants were opened and closed as rapidly as possible to test the ability of the pumps and governors to take care of abnormal operating conditions.

Individual pump tests were made the same date, from 10.15 to 10.45 a. m., with the following results:

Steam at throttle, lb......................	146
Water pressure, discharge, lb..............	199
Water pressure, injection, lb..............	41
Water pressure, net, lb....................	158
Revolutions per minute....................	55
Discharge, gals. per min..................	4,592

A general capacity test was made 10.45 to 11.40 a. m., with the following results (three pumps in service):

Steam throttle (average), lb..............	145
Water, discharge, lb......................	240
Water, injection	?
Water, net	?
Discharge, gals. per min..................	12,770

During the latter test six 2½-in. nozzles and six 2-in. nozzles were in use, discharging into the harbor.

RESULTS OF OPERATION.

The department chief is enthusiastic over the efficiency of the entire system as a modern fire fighting equipment. He makes the statement that during the two months which it has been in operation, three bad incipient fires have been literally "drowned out" by the system. The probable losses from these fires, under former conditions, would more than have equalled the entire cost of the high-pressure service. By the time the department arrived on the scene at one fire, the smoke was so dense that from the middle of the street it was impossible to locate any window or door openings in the building. Three 2½-in. monitor streams were blindly turned on the building. The water reached the fire, but not through windows or doors. When the smoke had cleared away, three holes were discovered in the 18-in. brick walls, bored straight through the masonry by the high-pressure streams.

The engineers of the National Board of Fire Underwriters, after a thorough test and a special search for weak points, reported as follows:

> The distributing system has been installed for two years and shows no signs of deterioration. The slight leakage, absence of electrolytic action and total freedom from breaks or other troubles appear to justify the departure from the usual design of such systems. . . . The valve and hydrant distribution is excellent, and the pipe sizes and gridironing are sufficient to enable a good concentration of flow without serious loss of pressure. . . . The separate hydrant head permits the use of regulator valves permanently attached, giving excellent control of the pressure on hose lines. The hydrant head under test showed sufficiently low friction loss. . . . The operation of the pumping plant is prompt and reliable.

As a result of the installation of the high-pressure system, the underwriters have announced a rebate of 5 cts. in the insurance rate on all property in the district covered. While no exact summary has been made of the aggregate saving which will result from this reduction, it is roughtly estimated that the amount will be approximately $40,000 per annum, which will be increased almost in direct proportion with the extension of the mains.

The executive head of the project is the Board of Fire Commissioners. To act with the chief of the department the board appointed a consulting engineer, D. B. Banks, who in collaboration with the writer, designed the system. After the general plans had been drawn, but before the construction had been begun, the board employed two additional consulting engineers to pass upon the general features of the design. R. C. Carpenter and Frederick H. Wagner, chief engineer of Bartlett & Hayward Company, Baltimore, were chosen, and after a careful study these engineers approved the general plans and the details as far as completed. The architectural features of the station were designed by Henry Brauns, the veteran power plant architect of Baltimore. General supervision of the construction was exercised by Wm. McCallister, Jr., assistant to the consulting engineer. Before the construction work was completed, the department chief, George W. Horton, was retired, and the deputy chief, August Emerich, was promoted to the head of the department.

The contract for the portable heads and regulators and the main pump governors was awarded to the Ross Valve Mfg. Co., of Troy, N. Y.

The contract for the hydrants and high pressure water pipe lines was awarded to the Pittsburgh Valve Foundry & Construction Co., of Pittsburgh. Many of the working details of the system were designed by J. Roy Tanner, chief engineer, and Charles Fitzgerald, superintendent of construction for the contractor. A sub-contract for the supervision of the trenching was awarded by the general pipe contractor to E. Saxton, of Washington, D. C., one of the most experienced contractors in the vicinity on sub-surface structures in city streets.

The contract for pumps was awarded to the Allis-Chalmers Co., of Milwaukee, although this concern was not the lowest bidder. A subcontract for the 1,000-gal. direct acting pump and the boiler feed pumps was awarded to the Epping Carpenter Co., of Pittsburgh.

The contract for boilers was awarded to the Edge Moor Iron Co. of Wilmington, Del. A sub-contract for the stokers, blowers and regulators was awarded to the Underfeed Stoker Company of America, Chicago.

BUILDINGS

An Inexpensive Timber Shed Construction.

The design and construction of a timber shed of universally low cost is described in a paper by Mr. E. S. Pennebaker before the Western Society of Engineers. This shed was built on one of the Mobile wharves of the Mobile & Ohio R. R. and is employed principally for the storage of cotton. The construction is indicated by the drawings of Fig. 1. The shed is 135x410 ft. and was built by labor contract, the railway company furnishing all materials. The work was done under the supervision of the construction department and completed in approximately 60 working days at a cost of 22.2 cts. per square foot of floor area, exclusive of fire line and lighting, or at a total cost of 27.5 cts. per square foot of floor area. This structure covers a floor area of nearly 1 1/3 acres, has a capacity of 7,000 bales of compress cotton piled single tier, is provided with ample fire protection, is electric lighted with Tungsten lamps, and is served with well-arranged track facilities which reduce to a minimum the cost of shipside delivery as stipulated in the contracts with the various steamship lines loading at the Mobile docks.

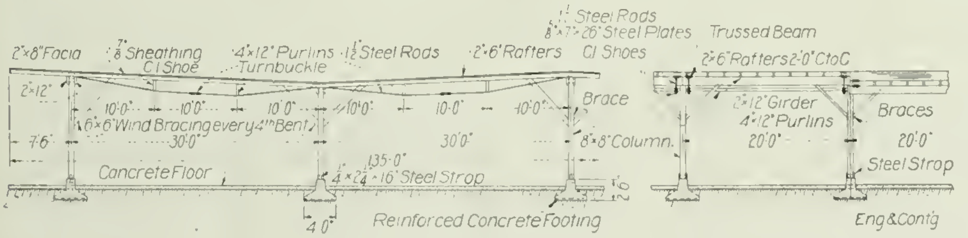


Fig. 1—General Details of Timber Shed for Cotton Storage.

DESIGN OF SUPERSTRUCTURE.

There are some unique features incorporated into the design of this timber structure. These features were adopted by the company's architect with a view of securing the maximum usable value of the money invested—in other words, with the idea of securing an efficient design with a minimum of waste space and waste material. The comparatively low construction cost of this shed, and the satisfactory all-around service realized from its use during the past season, has seemed to indicate that the type of construction adopted has accomplished the desired results.

As will be seen from the illustration, the butterfly type of roof has here been utilized to advantage, thus permitting the employment of low-pitch, shallow-truss construction, effecting maximum economy in roof-framing, sheathing and roof-covering, and affording ample clearance for cars on the tracks paralleling the building on either side. In addition, the high eaves afford excellent light along the outside bays, and provide much better light throughout the interior bays than is ordinarily secured in buildings of similar width and height, with skylights. The employment of this type of roof also obviates the necessity of any guttering whatsoever, the roof drainage being taken care of through downspouts in the valleys and subdrainage to the river.

A roof loading of 30 lbs. per square feet, or about 20 lbs. per square foot less than the ordinary recommended practice for structures of this type, was assumed in the design of this shed. This 20 lbs. per square foot deficiency represents the snow and sleet load to which buildings farther north are subjected in the winter season. This snow load can safely be eliminated along the Gulf Coast, and the design economized to that extent. The various items which combine to make up this loading, together with the weights of each per square foot, are listed below:

Material.	Weight lbs. per sq. ft.
Sheathing, ⅞ in. hy 6 in. T. & G., L. L., Y. P.	4.00
Composition roof—felt, asphalt, gravel....	10.00
Wind load—40 lhs. per sq. ft. on 1/25 pitch	1.60
Dead load—rafters, purlins, rods, etc......	6.00
Excessive rain, downspouts clogged, at....	8.40
Total	30.00

The roof is carried on shallow trusses, or trussed beams of built-up section bolted together. These trussed beams have a span, center to center of columns, of 30 ft. each, and are tied together the full width of the building in series of four trusses each. These series-trusses are spaced 20 ft. on centers, this arrangement of column spacing giving a 7½-ft. overhang of the eaves on the sides of the shed, and a 5-ft. overhang at each end.

In order to eliminate waste ceiling height and reduce the height of columns to an economical minimum, the 4x12-in. purlins, in addition to performing their primary function, act as struts for the trussed-beams. It will be noted that the main compression members of this truss consist of four pieces of 2x6-in. material, bolted together through the columns and through fillers over the purlins. One of these 2x6-in. pieces is a rafter moved a few inches from the regular spacing and bolted to the beam to insure additional strength. The use of a beam of this type and of the same depth as the rafters, was primarily necessary as a detail of the type of construction adopted. It also accomplished economy in material and facilitated erection. In addition, it aided in securing the prompt delivery of material for the building, the 2x6-in. timbers being stock size, readily available at practically all mills for quick delivery, and at a reasonable price. As orders were not placed for the material for this shed until the last week in August, only 30 days prior to the opening of the cotton shipping season, quick delivery of material, especially the lumber, was a most important requirement.

All timber used in the structure is longleaf yellow pine, selected under the Square Edge and Sound specifications of the Yellow Pine Manufacturers' Association. The columns, purlins, and girders were specified to be 80 per cent heart stock.

The tension in the trussed-beams is carried by 1½-in. round steel rods, which support the purlins on cast-iron bearing knees, and are connected with clevis-nuts and cotters at the ends to ⅝-in. steel plates, which are supported by the 2x12-in. longitudinal girders. Turnbuckles in the center of each span afford a means of adjusting the tension in the rods after the roof is swung. The four spans in the series-truss are securely tied together and fastened at the ends of the outside bays by a combination of a square nut and heavy cast washer, where the rods pierce the outside longitudinal girder.

The depth of the truss center of beam to center of tension rod, is 19 ins. The 4x12-in. purlins with the 2x12-in. girders are spaced 10 ft. on centers. The column spacing of 20 ft. longitudinally was adopted largely because the limiting length of the purlin and girder designed for a roof loading of 30 lbs. per square foot is approximately 20 ft. The rafters were arbitrarily spaced at 2-ft. centers.

The columns are 8x8-in. timbers, dressed four sides. Theoretically, a much smaller column would safely support the load, but owing to the liability to injury or displacement by heavy trucks or by drays when unloading cotton under the shed, it was thought best to adopt the 8x8-in. column The average man's practical sense of right or proportionate sizes for the various component parts of a simple structure of this kind, had some influence here, also.

Longitudinal 2x8-in. bracing is provided at every column, bolt-connected both through the columns and through the two girders. Wind bracing of 6x6-in. timbers is provided for at every fourth series-truss, as shown by Fig. 1. Eave-ties of 2x8-in. timbers have been placed at each of the outside columns on either side, the full length of the building.

In proportioning sizes for the timber truss members—purlins, girders and columns, and the rods used in tension—the following safe unit stresses, adopted as standard by the Mobile & Ohio R. R. Co. for building construction, were used:

TIMBER.

In Tension: 2,325 lbs. per square inch, deflection not considered. This is based on a bending strength at rupture of 7,750 lbs., and a factor of safety of 3 1/3. Material air dry assumed at 18 per cent moisture.

In Compression: 1.500 lbs. per square inch, using the following column formula:

$$f = \frac{1500}{I + \frac{l}{700 + 15\frac{l}{d}}\left(\frac{l}{d}\right)^2}$$

where f = Allowable working stress for long columns.
l = Length in inches.
d = Least cross-sectional dimension in inches.

Steel Rods: 16,000 lbs. per sq. in. of net area

The column footings are constructed of slag concrete, mixed in proportions of 1:2½:5. They are designed for a safe crushing strength of concrete masonry assumed at 8 tons per square foot and an allowable foundation pressure of slightly over ½ ton per square foot. As a precautionary measure, due to the character of the foundation, which is largely pumped-in river sand over clay and sand, and confined within timber bulkheads, the bases of these footings, which are 4 ft. sq., were reinforced with ⅜-in. steel rods arranged in two laminations at right angles to each other, the rods in each spaced 6 ins. c. to c.

The concrete floor consists of a 4-in. slab of slag concrete mixed in the proportions of 1:3:6, with a 1-in. top of cement mortar, smoothly finished. The slab is cut into sections 10 ft. square to prevent cracking, and sufficient asphalt expansion joints are incorporated for safety. So far, the floor has stood up in fine shape under very heavy trucking.

Construction Costs.—Detailed cost data were secured in connection with the construction of this shed, and below are given a few of the unit costs covering material in place in the building, which may be of interest as indicative of gulf coast costs for work of this character. All common labor used was negro labor. The figures given do not include freight:

Reinforced concrete column footings, $3.93 per cubic yard.

Concrete floor, slag concrete, $0.6296 per square yard.

Lumber in place in superstructure, $20.73 per 1,000 ft. B.M.

Steel rods, plates, etc., in place, 4.61 cts. per pound.

(In the discussion which followed this paper the fact was brought out that the costs given for slag concrete did not include freight on slag, which amounted to about $1 per ton.—Editors.)

The Construction of Foundations for a Large Boiler House.

Contributed by Alden W. Welch, Brooklyn, N. Y.

This article describes a contract which covers the excavation for and building of the foundations for the boiler house of a power station. In subsequent articles there will be described the structural steel and the masonry contracts. The present article, dealing particularly with the excavation, is a typical illustration of work of this character. A digest of the specifications follow:

General Description of the Work.—The work to be performed under the contract includes the furnishing of all labor and material required for excavation, back filling, sheet piling, shoring, concrete work and pumping should this be necessary, together with the assembling and setting of all grillage beams for the foundation of the boiler house, as shown on the drawings. All sectional steel piling and all spruce piles as required by the engineer, and also all steel sheet piles required in addition to those shown on the drawing are to be furnished and driven at the unit prices mentioned in the contract. The contract is also to include the construction of all trenches, elevator pit sump holes and the basement floor. The company will remove the present building occupying the lot down to the level of the cellar floor excepting the outside walls, which will be removed down to the grade of the adjacent streets or yards. The contractor is to remove all other portions of this building—foundations, footings, basement floors, etc.—and also all rubbish, etc., left by the wrecking contractor.

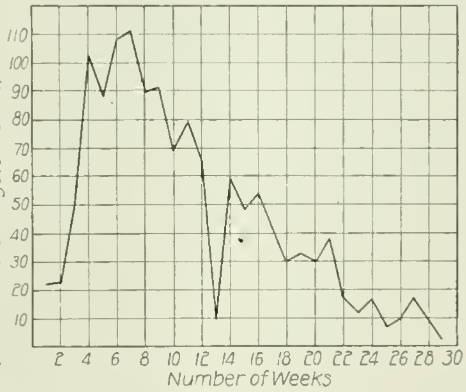


Fig. 1.

The company will furnish the pipe for one of the electrical duct runs indicated on the drawing. The other duct run is now in place. They will be installed in place by the company, but the contractor is to hold them in place and grout around each duct with concrete or cement mortar as may be required to secure the complete surrounding of each duct. The company will furnish the ash tracks complete with steel ties, turn tables, etc., and the drain piping and will erect them in place, grouting around them with concrete. The grillage for the columns will be furnished and set in place by the company, the contractor to fill around and between all grillage beams with concrete.

Excavation and Sheet Piling.—The contractor is to take out and remove from the premises all parts of the foundation and basement floor of the old building which will interfere with new construction and is to do all other excavation necessary to install the concrete shown on the drawings. On the F and L street sides of the building the contractor is to protect the excavation with wooden sheet piling properly braced, which he is to leave in place after the completion of his work. Braces are to be placed as directed by the engineer in such a manner that they will interfere as little as possible with the building of the brick walls of the basement at a later date. The bracing is to be exceptionally strong and rigid, so that it will hold the piling in place without deflection. The sheet piling is to extend from not less than 2 ft. below the bottom of the footings to a height of 7 ft. above grade, so that it will form a fence, completely enclosing the property. The piling is to be of yellow pine 3 ins. in thickness and is to be properly tied together by suitable longitudinal pieces spaced not more than 4 ft. apart, vertically.

Around the four sides of each of the individual piers shown for the column foundations and along both sides of the concrete foundation wall, the contractor is to drive wooden sheet piling not less than 2 ins. thick to a depth which will properly retain the adjacent earth, the area inside this sheeting to be then excavated down to the bottom of the footings. At the northwest corner the contractor is to drive steel sheet piling, as indicated on the drawing. This sheet piling is to be 5 in. piling and is to be driven to such a depth that it will enter at least 2 ft. into good sand and is to be properly braced. The steel sheet piling used is to be of make satisfactory to the engineer, and is to remain in place after the completion of the foundations.

In the event of water appearing in the excavation, the contractor is to do all necessary pumping, and if necessary, in the opinion of the engineer, where not possible to pump the excavation dry, the contractor is to first seal the bottom of the foundation with concrete placed under water by means of a box or pipe to prevent the washing away of the cement. The excavation is then to be pumped dry before proceeding with the work.

Piling.—Where required by the engineer the contractor is to drive sectional hollow steel piling 12 ins. in diameter with ⅜ in. walls, open at the bottom. The material inside the piling is to be washed out as the sinking progresses and the piles filled with concrete after having reached the proper depth. When the piles have been sealed at the bottom and partly filled with concrete they are to be given a little additional driving so as to make sure they have brought up good and hard on the sand. Steel piles are to enter the good sand strata (old beach sand) not less than 15 ft.

Timber piles are to be sunk by the water jet method to a depth of not less than 12 ft. in the good sand strata underlying the fill. The piles are to be good spruce piles not smaller than 6 ins. at the point and 10 ins. at the large end where cut off. These piles in any cases are not to be less than 25 ft. long.

Concrete and Forms.—The contractor is to furnish all forms necessary for confining the concrete to the dimensions shown on the drawings. All forms are to be well braced to prevent distortion under the ram. All forms (excepting the steel sheet piling) are to be withdrawn after the concrete, in the opinion of the engineer, has set sufficiently.

The concrete for the entire foundation is to be composed, by measure, of one part best American Portland to 2½ parts of clean, sharp sand and five parts of 2 in. broken stone or gravel (except that for filling steel piles, which shall be ¾ in. broken stone), the gravel to be clean, hard stone free from clay or other foreign substances. The contractor will be required to furnish and use throughout the work measuring forms for determining the proportion specified for the mix.

The cement and sand shall be thoroughly mixed dry, the proper quantity of clean water shall then be mixed in and the clean, moistened gravel shall then be added and the whole thoroughly amalgamated. All concrete shall be thoroughly rammed in place in the forms, and shall be of such consistency that water will show freely under the ram.

The mixing of the concrete is to be done by a mixing machine whenever possible, or as directed by the engineer. Whenever a mixing machine is not used the concrete is to be mixed on plank platforms in small and convenient quantities, and immediately deposited in the work. For the wall foundations it shall be laid in sections and in horizontal layers not exceeding 9 ins. in thickness and must all be thoroughly rammed. In no case is any concrete to remain in the work if it has begun to set before the ramming of same is completed.

All concrete on the inside of pits and other exposed concrete is to be left plumb and true and free from projections and voids. Any imperfections in this respect are to be remedied by plastering with cement mortar or rubbing with a coarse stone.

Setting of Grillages.—The company will furnish, but the contractor is to assemble and erect, all grillage beams and carefully grout them in place, filling in with concrete between all beams, to be grouted by the contractor.

Concrete Floor.—After the completion of the construction of the concrete piers and the removal of the forms, the contractor is to back fill with earth over the entire area between adjacent piers and along the walls. The earth is to be thoroughly tamped to a level within 12 ins. of datum line. The contractor is then to fill the spaces between the column bases and the entire area inside the wall foundation with a layer of concrete, the top surface of this and the top of the concrete footings being 1½ ins. below the finished floor, the top surface being sloped to conform to the finished floor slope. The top surface of this concrete is to be left rough to permit of good bond between this and the finished floor when placed at a later date. The company will furnish and install all of the floor finish.

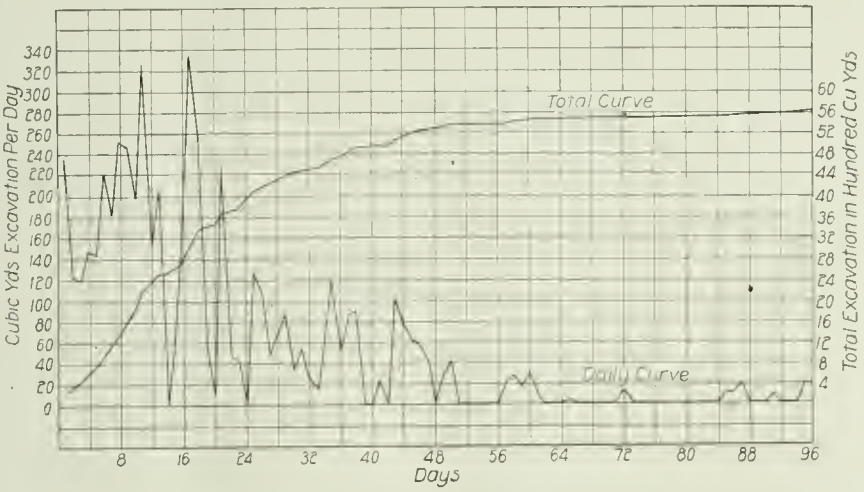


Fig. 2.

The Contract.—The contract called for the construction of foundations for structural steel work and walls, including excavation, shoring, piling, concrete work, etc., of a boiler house capable of housing 16 boilers.

The work was to be commenced within one week from receipt of advice from the engineer that the site was ready; the piling to be complete and foundations ready for grillage eight weeks thereafter.

The price for all work as per drawings and specifications, with the exception of the steel and wooden piles, was $28,000. The special prices are as follows:

12-in. steel piles (not over 25 ft. in length driven in place) per lineal foot..........	$5.00
6-in. to 8-in. spruce piles, ditto............	.35
Excavation below 7 ft. 6 ins. and not over 12 ft. 6 ins. below datum, including sheathing, bracing and pumping, per cu. yd.	3.00
Concrete placed below 7 ft. 6 ins. and not over 12 ft. 6 ins. below datum, per cu. yd.	6.50
6-in. sheet piling not over 25 ft. in length driven in place, per lineal foot............	.50

The terms of the payment stated that on the first day of each month the engineer shall make an estimate of the value of all material delivered and work performed by the contractor, and the company shall pay to the contratcor 90 per cent of said estimate, less any previous payments on this contract. At the expiration of 30 days after the completion of all work called for in the annexed plans and specifications, and upon acceptance by the engineer, the company will pay to the contractor the remaining 10 per cent.

Progress of Construction.—To obtain an idea as to how this contract was handled as a whole, I would direct attention to the curve, Fig. 1. The ordinates represent the average number of men working eight hours per day who were on the job throughout the week. These values are plotted against the duration of the job in weeks. The maximum number of men were at work during the seventh week. From thence on there was a decline which was most precipitous from the twelfth to the thirteenth week. This sudden and heavy dip was due to the fact that material ran low. This condition was speedily remedied and the curve shoots up to 60 for the fourteenth week. From this point on, although the decline is not uniform, it is continuous. The duration of the total contract was twenty-nine weeks.

Curve Fig. 2 is of great interest and value as showing how the excavation itself progressed. It also gives a good idea of the dimensions of the job. The total excavation amounted to about 5,600 cu. yds. After the sixteenth day the daily curve, on the same sheet, varied greatly. Had the digging and removing of the earth been the only part of contract, this curve would have indicated poor management, but the specifications called for a large amount of piling and shoring also.

The curve on the first sheet showing the progress of the total job shows that the work as a whole did not vary as indicated by the daily curve on sheet number two. The discrepancy between these two curves is explained by the fact that when the digging was not in progress, the men were engaged in shoring.

Test to Destruction of Brick Piers Four Feet Square and Twelve Feet High.

The testing of two brick piers of unusual size is described by Maj. J. E. Howard, Engineer Physicist, Bureau of Standards, in a paper before the National Brick Manufacturers' Association. We have redrawn the diagram showing the test results and with it publish here the portion of the paper relating specifically to the tests. The piers were about 4 ft. square by 12 ft. high, weighing a little over 13 tons each. They were built of common, hard burnt, wire cut building brick from one of the yards of Messrs. Booth & Flinn, Pittsburg. One pier was laid in 1:1 cement mortar, the other in 1:3 lime mortar. The brick were selected with a view of laying a pier which would display a crushing strength of about 3,000 lbs. per square inch when laid in cement mortar, provided this pier of nearly 190 cu. ft. volume had a strength per square inch of cross sectional area proportional to one of 8 cu. ft. volume. The pier actually displayed an ultimate strength of 2,917 lbs. per square inch, indicating substantially the same strength in each size. Similarly the pier which was laid in lime mortar was expected to have an ultimate strength somewhat less than 900 lbs. per square inch. It failed at 757 lbs. per square inch.

Owing to their great size the piers were built in the testing machine, where they seasoned until the time of testing. The test of the cement mortar pier was completed when four weeks and three days old. Ten gauged lengths in all of 20 ins. length each were established on the four sides, the extremities of which were defined by small metal plugs cemented in the bricks. As loads were applied and advanced the compression of the pier was measured on these 20-in. lengths by means of a strain gage, in practically the same manner as thermal effects on cement filled brick pavements are being observed by means of that instrument. The compression of the lime mortar pier was measured when it was 25 days old.

The results of the tests were as shown by Table I.

In failing, along the middle of their heights, the sides opened laterally. Frictional resistance at the ends, between the brickwork and the platforms of the testing machine, strengthened the piers against lateral deformation and probably influenced the pyramidal shapes assumed after rupture. The manner of failure of these large piers was the same as that witnessed in piers of smaller dimensions.

Diagrams are presented to illustrate the behavior of these piers during test and at their ultimate strength. Figure 1 shows the compression curves of the two piers as loads were successively applied. The pronounced difference is in their rate of compressibility is well indicated. This difference is, of course, due to the difference in the mortars used. These curves represent the total compression of the brickwork, which in the case of the lime mortar pier was chiefly permanent set. But that of the cement mortar pier at 1,000 lbs. load was about one-third permanent set and two-thirds elastic compression, or, stated differently, the cement mortar pier would recover about two-thirds of the observed compression upon release of load.

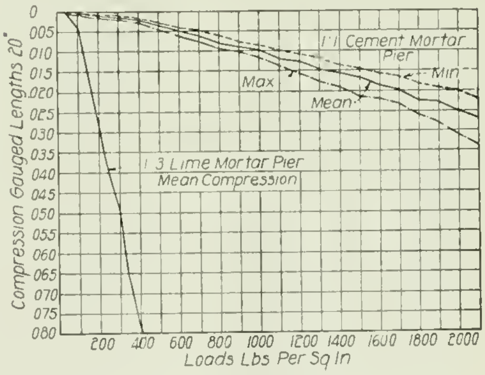


Fig. 1—Curves Showing Relative Compressibility of Brick Piers Laid in Cement Mortar and in Lime Mortar.

Three curves are given for the cement mortar pier, one representing the mean compression, one representing the minimum com-

TABLE I.

Pier laid in	Dimensions. Height.	Cross-section.		Sectional area, sq. ins.	Average thickness of joints.	First crack. Total lbs.	Total lbs.	Ultimate strength. Lbs. per sq. in.
1:1 cement mortar.......... ..	12 ft.	47.5 ins.	47.5 ins.	2,256	5-16 ins.	4,737,000	6,580,000	2,917
1:3 lime mortar................	12 ft.	47.5 ins.	47.5 ins.	2,256	5-16 ins.	676,800	1,710,000	757

pression of the several gaged lengths and one gaged length which displayed the maximum compression. Since the ends of the pier were in contact with and were moved by the rigid platforms of the testing machine this difference in the amount of compression on the several gaged lengths, which were established along the middle of the height of the pier, represents unequal compression locally, and would occasion bending stresses in the bricks and lead to the formation of transverse fractures.

SEWERAGE AND SANITATION

Additional Data on the Amount of Ground Water Infiltration Into Sewers.

In Engineering and Contracting of Jan. 15, 1913, an article was published entitled: Some Data on the Amount of Ground Water Infiltration Into Sewers, with Suggested Usage of Terms in Recording Such Infiltration. The information given in that article was taken, it will be recalled, from a paper by John N. Brooks before the American Society of Civil Engineers. Additional data on the quantity of such infiltration were presented in the discussion of Mr. Brooks' paper. The data here given are from the discussions of Messrs. G. L. Christian and E. Kuichling, as published in the Proceedings of the American Society of Civil Engineers, Vol. xxxix, pp. 592-600. The discussion by Mr. Christian follows:

The infiltration of ground water into a sewer depends on so many variable conditions, none of which is exactly similar in any two sewers, that it would seem to be quite impossible to establish a standard of construction from which to determine definitely the degree of impermeability of any two sewers constructed in exactly similar ground, the depth of the ground water being the same in both cases. It also makes a great difference whether the sewer is a sanitary one, pure and simple, or is part of a combined system. If the former, it is usually desirable to reduce the infiltration to a minimum, the joints being generally tightly caulked with oakum, then filled with cement mortar, and wound with cheese cloth to hold the mortar in position until it is well set; spurs with loose covers are the exception, rather than the rule. In a combined system, the ends sought are, in a measure, quite different, part of its province being to lower the ground water level permanently; the joints in pipe sewers are not caulked, being filled with mortar only. For many years it was the custom in the Borough of The Bronx, New York City, to put in a spur on all sewers every 3 ft., except at block intersections. Some years ago this practice was changed, and the distance is now 6 ft. These spurs have loose vitrified covers, and are capable of lowering the ground water level permanently, regardless of the impermeability of the concrete or brick, or of the joints in pipe sewers.

The design of a combined system of sewers is based, primarily, on the intensity and duration of the maximum rain storm, or on the average of a series of heavy storms, in a given locality, and it is evident, therefore, that the quantity of ground-water infiltration in such a design is so small that it becomes negligible. As to the skill in doing the work, cementing the joints, mixing and placing the concrete and character of the aggregate, etc., if one is to depend on the contractor's opinion, it will be first-class in every particular. On the other hand, if the decision is left to the engineers in charge of the work, there are likely to be as many opinions as there are engineers. The character of the trench, as to whether it is wet or dry, is also a relative term, and is likely to be colored by local conditions, that is, what would be termed a wet trench in a region where ground-water is generally high, might mean something quite different if recorded by an engineer doing work in a region where the ground-water seldom appears in the trenches.

A little more than ten years ago, the Sewerage and Water Board of New Orleans, La., made some careful observations, from which it was found that the actual infiltration into the sewers practically checked previous assumptions—that the quantity of ground-water to be provided for would be equal to 0.003 cu. ft. per second per acre, which is equal to 1,250,000 gals. per square mile in 24 hours. It might be said, in passing, that the ground-water level in New Orleans is very high, and all the sewers are below it. On the foregoing basis, there would be 32 miles of streets in one square mile, assuming it to be laid out in blocks 400 ft. long and 200 ft. wide, with streets uniformly 60 ft. wide. The infiltration, therefore, would average 39,000 gals. per mile per 24 hours. This figure is also used by the Borough of Brooklyn, New York City; in the Borough of Queens, the assumption is 75,000 gals. per mile per day. Since these observations were made, New Orleans has built some hundreds of miles of pipe sewers, and as all, or substantially all, of its sewage has to be pumped, it is possible to measure quite accurately the quantity of infiltration. It was the speaker's good fortune to witness the laying of some of the pipe, and he noted that the utmost care was taken to make the work water-tight. It was also noted that spurs were put in on each side, every 30 ft., opposite vacant property, the covers being tighty cemented inside the bell. Notwithstanding the care used, there is still considerable infiltration, the actual quantity being shown by the following figures:

GROUND-WATER FLOW, STATION A.

Year beginning	Ground-water per mile of sewer, per day, in gals.
1907	55,000
1908	53,000
1909	51,000
1910	51,000
1911	48,000
1912	42,000

The author describes a concrete sewer in which the infiltration amounted to 0.8 gal. per day per square yard of interior surface, which amounts to 7,300 gals. per mile per 24 hours. From the speaker's experience with the construction of concrete sewers he would regard this as rather high, unless there was some leakage at the joints, or where each day's work joins that previously laid; and he suggests that a careful inspection would find that to be true.

In conclusion, it may be said that the design of a system of sanitary sewers in any town is a law unto itself; and, in designing such a system, it is wise to consider that the ground-water may have to be taken care of whether one wants to or not. Indeed, in the early stages of such a system, with only a few connections, and many of the sewered streets sparsely populated, it is often desirable to have many unconnected spurs through which water may enter, in order to assist in flushing the sewer. As the district is built up and the houses one by one are connected with these spurs, the need for the ground-water will cease, the house sewage taking its place. Coincident with the building up of the district, it might be assumed that the paving of streets and of court yards is taking place, which would probably mean a corresponding lowering of the ground-water and a reduction of infiltration into the sewer.

The major portion of Mr. Kuichling's discussion follows: The principal factors which influence the amount of infiltration are the character of the soil, the extent to which it is saturated with ground-water, the elevation of the surface of this water above the top of the sewer and the manner in which the sewer itself is built. An extensive stratum of sandy or gravelly soil often contains and yields a large volume of water, whereas little is delivered from clayey deposits; and in rocky strata seams are frequently encountered which deliver water very copiously. The quantity of water in the subsoil also varies with the daily and seasonal rainfall and the magnitude of the absorptive territory exposed thereto. It is obvious that much more ground-water will be found in the sandy soil at the bottom of a broad valley than in a similar soil on a narrow ridge.

One of the benefits usually claimed as resulting from a comprehensive system of sewers in a community is the permanent lowering of the existing ground-water table to the level of the sewers, thereby attaining dry cellars automatically and much less dampness of the air in dwellings. Observation has proved that this claim is well founded, and that in most cases shallow wells, in premises adjacent to streets provided with comparatively deep sewers, become permanently dry, even when the utmost care has been taken to make the sewers watertight. Various reasons for this occurrence have been given in the case of sewers not equipped with under-drains. A common explanation is that the ground-water escapes by flowing along the smooth exterior surface of the main and lateral sewers and finally reaches the outfall; another one is that much less care is given to the construction of the numerous small lateral sewers, whereby the ground-water is enabled to enter through many defective joints and thus find its way into the well-built main sewer, and a third one is that, in the course of a year or two, many small cracks will develop in the entire sewer system, in consequence of settlements and unavoidable changes of temperature, thereby affording the ground-water access to the interior. Each of these explanations is satisfactory in some measure, but it is more likely that all the causes mentioned combine to accomplish the result.

In former years it was a frequent practice to build sewers with open joints at the bottom to admit the ground-water. An interesting measure of the quantity of such infiltration into an extensive sewer system built in this manner is given by Ernest Adam, Engineer of the Department of Streets of Newark, N. J., in the discussion of a paper on the subject before the American Society of Municipal Improvements, on Oct. 21, 1903. He stated that many of the old brick sewers of Newark were made without mortar joints in the bottom, the result being a sewage flow of 48,000,000 gals. per day, though the water supply of the city was only 25,000,000 gals. per day. It may be remarked that in 1903 the population of Newark was about 268,500, and that on Dec. 31, 1903, the total length of all public and private sewers in that city was 198.7 miles. The total area of Newark was then 14,976 acres, of which 10,679 acres were dry land surface, the remaining 4,297 acres being tidal meadows and water. From these figures it will be found that the stated daily infiltration of 23,000,000 gals. of ground-water into the sewer system of Newark corresponds to average rates of 85.7 gals. per capita, 115,752 gals. per mile of sewer and 2,154 gals. per acre, or 1,378,401 gals. per square mile of dry land surface, per day.

It is reasonable to consider that the soil under and adjacent to inhabited buildings will eventually be drained in some manner, either directly by special systems of tiles or indirectly by defective joints in the lateral sewer pipes; and it is also fair to assume that in most cases the ground-water thus intercepted will be discharged into the public sewers. The total area of the sewered territory, therefore, becomes a factor that must be taken into account, together with the adjacent uplands which may contribute to the flow of ground-water in the populous districts. In some cases much of the flow from the uplands is intercepted by the highest line of sewer, thereby greatly relieving the saturation of the lower ground; but in most instances the sewers are built in streets which cross the contours more or less at right angles, so that ample space is left between such streets for much of the upland ground-water to flow down to the lower districts and seek an entrance into the sewers there.

Some notion of the quantity of flowing ground-water per unit of tributary area may be gained from measurements of the yield of natural springs which have a well-defined water-shed. Numerous observations of this kind in central Switzerland have shown that the normal minimum yield of such springs is 154 gals. per acre of tributary water-shed per day, when derived from the fine-grained sandstone called "molasse;" from four to six times that quantity when derived from moraines, and from eight to ten times that quantity when derived from the gravelly soils of valleys. Similar observations in Germany indicate a minimum yield ranging from 154 to 924 gals. per acre of tributary water-shed per day; an average yield ranging from 462 to 1,232 gals., and a maximum yield ranging from 770 to 4,620 gals. and upward, depending on the nature of the subsoil and the distance traversed by the percolating water. These yields from flowing springs may also be compared with the observed dry-season flow of rivers. In the New England and middle states the least monthly flow of streams having a drainage area of more than 100 square miles usually ranges from 0.10 to 0.25 cu. ft. per square mile per second, which is equivalent to a yield of from 101 to 253 gals. per acre per day. This quantity is less than the aforesaid minimum yield of springs, but it must be remembered that in a considerable portion of a large water-shed the soil is generally unfavorable for absorption and percolation.

A better estimate of the quantity of ground-water that may reach a system of sewers is afforded by the results of numerous land-drainage experiments in England, France, Germany and the United States. It was found that the quantity of rainfall which would be absorbed by the soil and percolate to the under-drains varied greatly with the character of the soil, the nature of its surface with regard to plant growth, the season of the year and the magnitude of the rainfall during one or more days. A few references to such data may be of interest. J. Bailey Denton, a well-known English authority, states that the maximum discharge measured by him from the under-drains of a large tract of free-soil land at Hinxworth took place in January, and was at the average rate of 0.16 cu. ft. per acre per minute, which corresponds to 1,710 U. S. gals. per acre per day; and Charnock's observations, of the discharge of field under-drains at Holmfield during 1842-46, exhibit a maximum rate of 0.24 cu. ft. per acre per minute, or 2,585 gals. per acre per day. French authorities, like Hervé-Mangon and Delacroix, state that the system of under-drains should have a capacity to remove a depth of at least 0.24 in. of water per day on the entire area, which corresponds to 6,517 gals. per acre per day. In Germany, the Silesian Agricultural Commission recommended that the under-drains should remove not less than 2,845 gals. per acre per day from low-lying flat areas and 3,390 gals. from higher flat areas. Other German authorities on land drainage, like Vincent and Perels, advise the removal of 6,983 gals. per acre per day.

In the United States the subject of land drainage has recently been investigated by the Department of Agriculture, and in the report of such observations in Illinois and Iowa, published in 1908, it is stated that the tile under-drains of areas ranging from 400 to 1,040 acres of black open loam with a clay subsoil frequently gave a maximum discharge of 0.16 in. of depth in 24 hours, or 4,345 gals. per acre per day; also, that in some cases the under-drains were engorged, and that it would be better to remove a depth of 0.25 in. of water in 24 hours, or 6,788 gals. per acre per day. It may be noted that the lines of lateral drains were here from 100 to 250 ft. apart, and it was recommended that in heavier or more clayey soils they should be placed from 40 to 80 ft. apart.

The foregoing discharges from the under-drains of agricultural land were all carefully measured, and can be regarded as a good indication of the quantity of ground-water to be expected in the outskirts of a city. The figures range from 1,700 to 7,000 gals. per acre per day, or from 1,088,000 to 4,480,000 gals. per square mile per day, and relate to surface strata of ground from 3 to 4 ft. thick. It is very probable that much larger quantities would be found at times in strata 8 ft or more in thickness, corresponding to sewered territory. Larger figures would also be obtained by using the results of the numerous percolation experiments which have been made with lysimeters of small area. The data submitted, however, suffice to show that much water is present in the subsoil after a period of heavy rainfall, and that it will enter the sewers under considerable head if opportunity is offered, as in the aforesaid case of the Newark sewers.

Two very instructive measurements of the infiltration into a system of earthenware pipe sewers were made at Stamford, Conn., a number of years ago. An aggregate of 13.38 miles of such sewers, ranging from 6 to 18 ins. in diameter, had been laid in 1888 under the direction of the late Col. George E. Waring, Jr., in a wet gravelly soil under an area of 746 acres, or 1.16 sq. miles, of that city, and the infiltration was measured in May, 1889, when only 215 house connections had been made. The quantity was found to be 885 gals. per acre per day, or 566,400 gals. per sq. mile per day, or 49,340 gals. per mile of pipe per day, on the average. In September, 1892, when 530 house connections had been made, it was measured again by Col. Waring and John Bogart, M. Am. Soc. C. E., and was found to have increased to 1,689 gals. per acre, or 1,080,960 gals. per sq. mile, or 94,170 gals. per mile of pipe per day. The reason for this large increase is doubtless that numerous joints had become defective, in the course of three years, and thus facilitate the admission of the ground-water.

Numerous other data, not given in Table 1, of Mr. Brooks' paper, will be found in two papers on the subject by Mr. A. P. Folwell and E. D. Rich, M. Am. Soc. C. E. In Mr. Folwell's paper it is stated that in many sewer systems the infiltration is from 50 to 100 per cent of the volume of house wastes; also that in Boston Mass., Howard A. Carson, M. Am. Soc. C. E., estimated, from extensive measurements of the flow in the main sewerage system in 1889, that the infiltration was at the rate of 45 gals. per head of population per day, and in Malden, Mass., and Providence, R. I., it was, respectively, 65 and 47 gals. per head per day. It is also stated in the same paper that, in a length of about 4,000 ft. of brick sewer in East Orange, N. J., the rate of infiltration was 570,000 gals. per mile per day, while in 21 miles of 8-in. pipe sewer it was only about 9,000 gals. per mile per day; that in Malden, Mass., it was 50,000 gals. per mile per day on the average for 38 miles of sewer, and that, if only the length laid in wet ground were taken into account, it would be 83,000 gals. per mile per day; that in Westboro, Mass., in 1899, the infiltration into 1,950 ft. of 15-in. vitrified pipe sewer was 489,000 gals. per day, or at the rate of 1,320,300 gals. per mile per day, and in another section of the same sewer, 1,060 ft. long, it was at the rate of 610,000 gals. per mile per day; that in New York City the infiltration into a system of 5 miles of sewers, ranging from 8 to 24 ins. in diameter, was found to be about 1,300,000 gals. per mile per day; and that, according to a report made in 1900 by X. H. Goodnough, M. Am. Soc. C. E., to the State Board of Health of Massachusetts, about 137 miles of sewers, ranging from 8 to 36 ins. in diameter, had recently been constructed in and near Boston, in which the infiltration was at the average rate of 40,000 gals. per mile per day before any buildings had been connected thereto.

In Professor Rich's paper it is stated that in a 20-in. pipe sewer in Canton, Ohio, the infiltration was at the rate of 70,000 gals. per mile per day; and that in a 12-in. pipe sewer in New Bedford, Mass., it was 17,000 gals. per mile per day. These two papers also refer to some of the other data given in Table 1. In describing the sewage works of Fond du Lac, Wis., George S. Pierson, M. Am. Soc. C. E., stated that the soil in which the sewers were laid was a very retentive red clay, and that the infiltration into the new 24-in. vitrified-pipe outlet sewer was carefully measured before the old sewers were connected thereto. This new sewer had been laid below the level of low water in the river, and was a little more than 7,000 ft. long. The infiltration was found to be less than 3.0 cu. ft. per min., and was regarded as very slight. From these figures we obtain in said 24-in. pipe a rate of 24,370 gals. per mile per day.

In Table 2, Item No. 16, of Mr. Brooks' article, the author gives the average rate of infiltration into a reinforced concrete trunk sewer, 47,744 ft. long and ranging from 3.67 to 6 ft. in diameter, as being 0.8 gal. per day per sq. yd. of inside surface. This information is interesting, but it should be supplemented by naming the locality and describing the nature of the subsoil along the route. It would also have been useful if the author had stated explicitly that the aggregate interior surface of that sewer was 82,123 sq. yds., and that the measured infiltration was about 65,700 gals. per day, or at an average rate of 7,266 gals. per mile per day.

Reference was made in the foregoing to the probable increase in the quantity of infiltration in the course of time. This is to be expected, as small settlements of a sewer usually occur in soft ground, whereby cracks are produced. In the case of large pipes, such cracks are often due to the rapid settlement of the back-fill after a thorough saturation with water. The speaker has seen many miles of pipe sewer laid truly to line and grade originally, and has found them after ten or more years showing numerous irregularities of both line and grade, as well as many fractures. The same is also true of large brick and concrete sewers. In structures of this kind in wet ground, few have ever been built that did not exhibit considerable infiltration in the outset, and it is not likely that they became tighter subsequently if the external head of water remained unchanged. Cracks are likewise formed by the unavoidable contraction of the material when the temperature is lowered for a long period. It must be presumed, therefore, that the infiltration into old sewers will be greater than into new ones, other external conditions remaining the same.

The subject is important, notwithstanding that it has been treated very briefly in most textbooks on sewerage. It becomes specially prominent in a separate system when the sewage has to be pumped or treated in disposal works, and much of the initial capacity of the pipes is taken up by infiltering ground-water. It is hoped, therefore, that the author will succeed in eliciting and arranging in convenient form many additional trustworthy data. The proposition to estimate the infiltration by the square yard of interior surface is good, but it will probably be more convenient to express it in terms of per foot of diameter and a length of 100 ft., or even 1,000 ft. In any event, the nature of the subsoil and the height of the ground-water surface above the top of the sewer should be given, together with the date of the observation, and a brief description of the construction, and its age.

Anti-Typhoid Inoculation in Reclamation Service.—During the fall of 1912 a supply of anti-typhoid vacine sufficient to immunize approximately 450 persons was sent to employes in the U. S. Reclamation Service. This supply was divided among 16 projects and offices, the largest amount going to the Strawberry Valley project in Utah, where 110 men volunteered for treatment. Reports have been received from 131 cases regarding the reaction following inoculation. Of these 128 patients received three doses, and 8 received two doses. In four cases the patients suffered severe reaction but no bad after effects were experienced. Following the first inoculation, in 93.9 per cent of the cases, the reaction was mild or absent, and after the second, in 92.4 per cent. After the third in 91.1 per cent of the cases the reaction was absent. The harmlessness of the treatment is indicated by these reports, and its effectiveness has been sufficiently demonstrated.

A New Collapsible Steel Centering for Monolithic Concrete Sewers and Manholes.

(STAFF ARTICLE.)

The collapsible steel centering for concrete sewers and manholes here described and illustrated has been developed by L. Y. Stayton, a contractor of Tacoma, Washington, in connection with his work on sewer construction. This type of centering finds its greatest field of usefulness on monolithic sewer construction in which one of the sheet steel cores can be left in place until the concrete has thoroughly set, and may be reduced in size to pass through the cores adjacent to it which are still in service. The core so removed is set up again to form the centering for an additional length of the sewer.

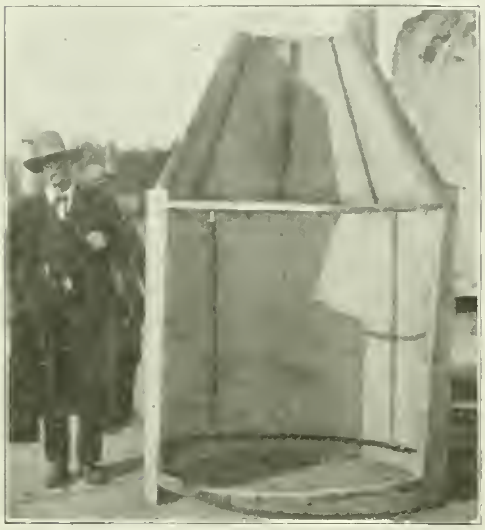


Fig. 1—Stayton Collapsible Steel Form for Concrete Sewer Manholes.

The core sheet is made of metal of such width as to form the circumference of the inside of the pipe and of a convenient length. When the core is in use it is held by means of folding ribs which are placed at suitable intervals, and held by clips fastened to the core sheet.

By the use of these forms a crew of nine men have shifted centering, mixed concrete by hand, and placed 85 lin. ft. of 40 in. sewer 6 ins. thick in a day of eight hours.

With this system of centering monolithic continuous concrete pipe can be constructed with reinforcement, and if the specifications require a brick invert it can be included and can be encircled by the reinforcement with but little extra trouble.

Mr. Stayton is at present laying a monolithic continuous pipe at Bremerton, Washington, in 36 in., 38 in., and 40 in. sizes where he has a flow of 5,000 gals. of spring water per hour to contend with.

The form for manholes is shown in Fig. 1. Fig. 2 shows the work at Bremerton on the 36 in. pipe, monolithic construction, where a series of springs were encountered. A collapsible section is seen drawn forward from 95 ft. down the pipe line through 19 5-ft. sections standing in place. This section will be expanded, as soon as the concrete base is placed in front, to the size of sections through which it came.

This same centering shown in Fig. 1 can be used in conjunction with outside mould held by outside rings to construct, outside the ditch, a reinforced jointed pipe in as many different sizes as can be made in the ditch, i. e., six sizes, 36 in., 38 in., 40 in., 42 in., 44 in., and 46 in.

Mr. Stayton has patented the centering here described, and markets it from his office at 510 California Bldg., Tacoma, Wash.

Construction Methods Employed on Pipe Sewers in Quick Sand at West Liberty, Iowa.

A contract was awarded by the city of West Liberty, Iowa, in October, 1910, for the construction of 5½ miles of pipe sewer ranging in size from 8 to 15 ins. The contract included manholes, flush tanks and a treatment plant consisting of a reinforced concrete septic tank, dosing chamber and sand filters. The first contractor put off the beginning of construction operations from time to time until at length, after being repeatedly urged to begin work, threw up his contract. The City Council notified the contractor's bondsmen to take up the work. The bondsmen promptly placed the contract in the hands of the Lytle Construction Company, of Sioux City, Iowa. This company immediately began construction operations. The first trenching machines were put in service on Aug. 20, 1911, and the outlook for completing the work that season was favorable. Much trouble was caused, however, by the quicksand which was encountered. The methods employed in laying the sewer in the quicksand were described by Mr. C. P. Chase in a paper before the Iowa Engineering Society, substantially as follows:

In the deepest cut of some 21 ft. the machine cut to grade with no trench bracing and the ditch was perfectly dry. A large number of laterals on the east side were built, with cuts from 7 to 20 ft., with an occasional brace, the machines making in some instances as high as 650 ft. in one day on a 6 to 8-ft. trench. The laterals were nearly in before cold weather, but in the meantime, on the other branch of the main sewer, something had happened. As will be remembered, 1910 and 1911 to the fall of the latter year were very dry; this was especially true around West Liberty. A rain of several days came about Oct. 1, 1911, and the dry ground in 48 hours was filled with water, there to remain. In a recent English lawsuit a lawyer described a certain quicksand that had resulted disastrously to his client as "an oily, slithery, nasty mess, where men would speedily sink to their death if not rescued." That adequately describes the West Liberty quicksand. By various sewer men the material traversed was designated as quicksand, floating clay, sea mud, boiling sand, and worse. I would designate it as a silt deposit of some ancient lake bed. It varied from a fine, silty sand to a molasses-like mud, in which men frequently sank to their hips and were pulled out with ropes. It would flow anywhere that water could run.

The first encounter with this was handled in the usual ways with hand-driven sheeting afterward removed. One block about 300 ft. long, put in in this way, was clear and in good shape when finished; later the sides settled and the whole line of pipe was heaved out of line and grade and nearly every pipe was crushed. The various ordinary expedients of sewer building were tried without much success. First a small section was taken out by hand, driving the sheeting down as the excavation proceeded. When to grade short ship lap was driven about 2 ft. below grade and left 2 ft. above. Straw, cinders, stone, brickbats and other material simply floated away, the great trouble being that after the pipe was laid the bottom of the trench would raise up from the pressure of the sides and break open the joints or even crush the pipe.

It was seen that although expensive, more strenuous methods would have to be adopted, and that perfectly tight sheeting must be used of sufficient strength to hold the side pressure and that it must be secured and left in. It was also found to be impossible to depend on hand driving. An Arnott hammer and a proper outfit were secured. To prepare for sheeting, the ditch was opened with a trenching machine as deep as the banks would stand, which was from 6 to 9 ft. Much better success attending machine digging than hand digging. Then 2x12-in. tight sheeting was driven about 3 ft. below the grade of the flow line of the pipe, thoroughly cross-braced and spiked. It was allowed to remain in the trench. Any attempt to remove the sheeting was attended with almost immediate disaster.

METHODS OF SHEETING EMPLOYED.

Two methods of placing and driving the sheeting were employed. In both cases the excavation was carried down 6 to 9 ft. with a trenching machine. Temporary braces were set to hold the clay banks until the stringers could be placed. In the first method a set of 4x6-in. stringers was placed at the bottom of the machine-dug trench, 2x6-in. stringers being placed next to the bank and separated from the 4x6-in. stringers by a 2-in. block, much care being taken to have them set plumb, otherwise the sheeting would drive crooked. A similar set was placed about 3 ft. below the surface of the ground and the sheeting was driven between the 2x6-in. and the 4x6-in. sets. A timber frame 16 ft. high was constructed on a platform wide enough to span the trench, and the hammer was suspended on a trolley running on a 7-in. I-beam set transversely of the trench at the top of the frame. The platform was built on skids parallel with the trench, so that it could be easily moved forward as the driving progressed. The hammer was operated between two pairs of guide rods made of galvanized iron pipe, a gasoline engine and hoist being used. With this method and equipment an average of about 60 pieces of 2x12-in. timber, 18 ft. long, could be driven per day at a cost for labor of 50 cts. per lin. ft. of trench, and a total cost for sheeting of about $3.20 per lin. ft. It was hard to keep the outfit upright and steady, and this reduced considerably the driving power. Only one plank could be set on each side of the trench at a time, making it necessary to move every foot, which was impracticable and too expensive.

In the second method blocks were set between the 4x6-in. stringers and the 2x6-in. stringers omitted. The steam hammer was handled by a derrick with a 20-ft. boom, the guide rods in this case being made fast to the hammer, and sliding through iron loops fastened to the end of the boom. The derrick was erected on a platform similar to the one described above, and in such a way that the foot of the derrick was over the center of the trench. In this way about 34 pieces of sheeting could be driven from one position. The derrick was then moved forward and the driving continued. Laborers set up the sheeting ready for the driver as soon as the stringers were in place, so that the hammer could be kept constantly at work. With this method the number of pieces driven per day was increased about 30 per cent, with a corresponding decrease in cost.

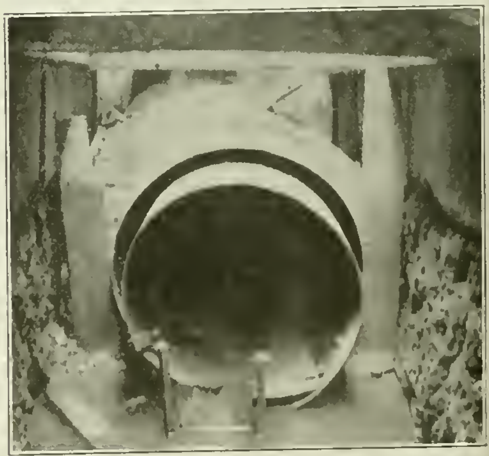


Fig. 2—Stayton Collapsible Centering for Monolithic Concrete Sewer at Bremerton, Washington.

METHOD OF REMOVING QUICKSAND.

The quicksand was taken out in buckets of ¼-cu. yd. capacity. To handle the buckets, two derricks made of 6x6-in. timbers, with 20-ft. booms, were erected on opposite ends of a platform made to span the trench. A four-post frame made of 6x6-in. timbers, properly braced, held the derricks in place. On the platform within the frame a 4 H. P. gasoline engine furnished power for the hoists, which were so arranged that one man could operate both derricks. This apparatus was employed to handle the steam hammer, and when hitched to a scraper was also used for backfilling. The blocks were so arranged that in raising a full bucket from the trench its weight pulled the boom around to the side of the trench where the bucket was to be emptied. Seven men were ordinarily sufficient to operate this device, doing more and better work than 14 formerly accomplished by hand. Without it or something similar it would have been almost impossible in the worst places to make any progress against the quicksand; for in spite of tight sheeting, carefully driven, the sand ran in through the smallest cracks and boiled up from the bottom. Occasionally after half a day's work there were no results apparent in the trench.

PREPARATION FOR PIPE LAYING.

With the sheeting in place, and the trench excavated, special methods had to be devised to prepare for pipe laying. Cinders, straw, brickbats, piling and concrete were experimented with, and at last concrete was chosen—first, to keep the sheeting from pressing in and crushing or disturbing the pipe, and, second, to obtain a pipe bed. The concrete placed one day was not used to lay pipe on until the next. Half of the diameter of the pipe was buried in concrete to distribute the weight and prevent crushing.

In some places where concrete was being placed for foundation the sand boiled up through the concrete before it had time to set and rendered it useless. To overcome this, 1-in. boards were laid lengthwise in the bottom of the trench for the full width and nailed together. They were then worked down through the sand and water as far as they would go, sufficient excavating having been done to permit the boards to be worked down to a point 6 or 8 ins. below grade. The sand and water were then cleaned off the boards and the concrete was placed. The time saved in this way more than paid for the boards, and a much better foundation was obtained.

Of all the equipment which the contractor had on the work the steam hammer and the derrick device for handling wet excavation gave him the best returns on the investment for plant.

Occasionally there would be an oasis in this sea of antediluvian mud where a good bottom could be secured by mixing cinders with it. This seemed to work where it was sticky, with clay predominating. It would fill up and bind, but if fine sand predominated, cinders were useless.

All pipe was eventually covered with dry earth and the fill was compacted by tamping to a depth of several feet.

RAILROAD CROSSING.

Where the 15-in. main crossed the Chicago, Rock Island and Pacific Railway right of way an attempt was made to tunnel the main tracks, but the sand was so bad that it was finally found necessary to drive a temporary bridge of 15-ft. span under each of the two main tracks and make the excavation in open cut. Under the stringers of the bridges for a space of several feet horizontal sheeting was set, and below this 2x8-in. sheeting was driven down below grade by hand. Outside the main tracks steel sheeting was driven and later pulled, using a 6-ton Triplex block. Cast-iron pipe was used across the right of way, and it was not thought necessary to leave sheeting in the trench. As the sand offered no foundation for the cast-iron pipe, brickbats and concrete were placed under the joints. The excavation was carried down below grade, a wagon load of brickbats dumped at the place where the joint would come, and about ½ or ¾ cu. yd. of concrete dumped from large buckets on the brick. So much sand was taken out at this place that the banks settled considerably, more than 1 ft. at one point. This line of sewer, however, showed up well on final inspection.

The contract, which ordinarily would have taken six months to complete, was completed in November, 1912. Much credit is due the contractor for the gameness with which he stuck and finished the work.

ROADS AND STREETS

The Accounting System of the Maryland State Roads Commission.

In March of last year the State Roads Commission of Maryland adopted a new system for recording its expenditures for highway purposes. The old accounting system had been found inadequate and in January, 1912, a committee was appointed to study the question. The committee employed Haskins & Sells, certified public accountants, New York and Baltimore, and this firm after auditing the books of the commission made an exhaustive study of the subject, visiting the highway departments of several states and closely examining the system of accounts used by each. After the most thorough examination, and after many consultations with the then Chief Engineer, W. W. Crosby, and the chairman of the commission, the present system was adopted. The following description of this system is taken from a paper by H. G. Shirley, Chief Engineer of the Commission, presented on Oct. 2 at the American Roads Congress:

The present organization consists of a commission, a secretary, a counsel and a chief engineer. The commission is composed of a chairman and five members, the governor being an ex-officio member. The chairman is in active charge, and all reports are made to him.

The state is divided in two divisions, over which is placed a division engineer who reports to the chief engineer. Each division is divided in four residencies, consisting of three counties, and over each residency is placed a resident engineer who reports to the division engineer, and is in charge of all work in his residency, consisting of both maintenance and construction.

The classification of expenditures is as follows:

CLASSIFICATION OF EXPENDITURES.

General Accounts.

- A—Administration and legal.
- B—Engineering.
- C—Preliminary surveys and plans.
- D—Construction.
- E—Reconstruction.
- F—Maintenance.
- G—Equipment.

Primary Accounts.

- A—Administration and legal.
  - 1—Commission salaries and expenses.
  - 2—Commission—Secretary's and office employes' salaries.
  - 3—Commission—Office expenses.
  - 4—Counsel's salary, fees and expenses.
- B—Engineering—General.
  - 101—Engineer's salary and expenses.
  - 102—Office employes—Salaries.
  - 103—Office expenses.
  - 104—Shop labor and material.
  - 105—Investigations.
- B—Engineering—Preliminary and Construction.
  - 110—Engineers' salaries and expenses.
  - 111—Resident engineers' salaries and expenses.
  - 112—Office employes' salaries.
  - 113—Office expenses.
- B—Engineering — Reconstruction and maintenance.
  - 120—Engineers' salaries and expenses.
  - 121—Resident engineers' salaries and expenses.
  - 122—Office employes' salaries.
  - 123—Office expenses.
- C—Preliminary surveys and plans.
  - 201—Survey parties.
  - 202—Draftsmen.
- D—Construction.
  - 301—Rights of way and damage.
  - 302—Grading.
  - 303—Surfacing.
  - 304—Bridges and culverts.
  - 305—Underdrains.
  - 306—Advertising.
  - 307—Inspection.
  - 308—Superintendence.
  - 309—Final surveys, plans and estimates.
  - 310—Miscellaneous.
- E—Reconstruction.
  - 401—Labor and material.
  - 402—Team hire and use of equipment.
  - 403—Superintendence.
  - 404—Inspection.
  - 405—Miscellaneous.
- F—Maintenance.
  - 501—Labor.
  - 502—Materials.
  - 503—Team hire and use of equipment.
  - 504—Superintendence.
  - 505—Inspection.
  - 506—Miscellaneous.

ENTERING RULES FOR EXPENDITURES IN PRIMARY ACCOUNTS.

A—Administration and Legal.

1—COMMISSION SALARIES AND EXPENSES.

To this account should be charged the salaries paid to the members of the commission. Also all expenses of the members of the commission when engaged on the work of the commission, such as railway fares, team and automobile hire, subsistence and incidental expenses.

2—COMMISSION—SECRETARY'S AND OFFICE EMPLOYES' SALARIES.

To this account should be charged all the salaries of the secretary of the commission and all bookkeepers, clerks, stenographers and office boys in the employ of the commission in its main office.

3—COMMISSION—OFFICE EXPENSES.

To this account should be charged all office expenses of the commission, such as rents, telegrams, telephones, postage, messengers, books, typewriters, adding machines, stationery and office supplies.

4—COUNSEL'S SALARY, FEES AND EXPENSES.

To this account should be charged the salary of the counsel, and such fees as are necessary to be paid other attorneys in the legal proceedings of the commission which, from their nature, cannot be charged direct to a particular road or county. Also the traveling, subsistence and other incidental expenses of counsel when engaged on business of the commission.

B—Engineering.

GENERAL.

101—ENGINEER'S SALARY AND EXPENSES.

To this account should be charged the salary of the chief engineer and his traveling, subsistence and incidental expenses when engaged on the business of the commission.

102—OFFICE EMPLOYES—EXPENSES.

To this account should be charged the salaries of the chief engineer's secretary, clerks, stenographers and office boys.

103—OFFICE EXPENSES.

To this account should be charged the office expenses of the chief engineer, such as rent, telegrams, telephones postage, messengers, books, typewriters, adding machines, stakes, instruments, stationery and office supplies.

104—SHOP LABOR AND MATERIAL.

To this account should be charged the labor and material used in the shop operated under the direction of the chief engineer.

105—INVESTIGATIONS.

To this account should be charged the cost of the time of chemists, physicists or others engaged under the direction of the chief engineer in conducting tests and investigations, together with the cost of materials used in connection therewith.

PRELIMINARY AND CONSTRUCTION.

110—ENGINEER'S SALARIES AND EXPENSES.

To this account should be charged the salaries and traveling expenses and incidental expenses of all engineers engaged exclusively on preliminary or construction work. At present they consist of the first, second and third division engineers.

111—RESIDENT ENGINEERS' SALARIES AND EXPENSES.

To this account should be charged the salaries, subsistence and incidental expenses of all resident engineers engaged exclusively on preliminary or construction work.

112—OFFICE EMPLOYES' SALARIES.

To this account should be charged the salaries of clerks stenographers, office boys, etc., employed in the office of the first, second or third division engineers.

113—OFFICE EXPENSES.

To this account should be charged the office expenses of the first, second and third division engineers, consisting of telegrams, telephones, books, typewriters, stationery and office supplies.

C—Construction—Preliminary.

201—SURVEY PARTIES.

To this account should be charged the salaries and expenses of engineers and their parties in the field engaged in surveying and locating new roads.

202—DRAFTSMEN.

To this account should be charged the salaries of draftsmen engaged in preparing the plans and drawings for the proposed new roads.

D—Construction.

All construction work should be done under regular contract or force work orders, which should bear distinctive numbers. An account should be opened for each such piece of work, such accounts to be grouped as to funds from which paid and counties in which work is located.

301—RIGHTS OF WAY AND DAMAGE.

To this account should be charged the cost of land acquired for right of way, expenses of appraisals, expenses of commissioners or arbiters in condemnation proceedings, commissions paid for additional rights of way, removal of fences, payments for damages or repairs to abutting property, counsel's fees and expenses when specificially applicable to the cost of acquiring certain right of way and damages paid for delays because of lack of right of way.

302—GRADING.

To this account should be charged the cost of grading, including ditch, masonry, culvert and bridge excavation, the excavation covered by the cross sections and from the borrow pits, the cost of operating steam shovels, scrapers and grading outfits, the hire of teams and equipment, rentals for the commission's equipment used and the cost of miscellaneous tools and supplies used on the work. The cost of grading done under contract should be charged to this account from the vouchers in favor of the contractors.

303—SURFACING.

To this account should be charged the cost of all labor employed and material used in surfacing, including the cost of operating stone crushers, spreaders, road rollers, sprinklers and oilers, the hire of teams and equipment, rentals for the commission's equipment used, the cost of miscellaneous tools and supplies used on the work, and in addition to the macadam or actual surfacing prescribed in the specifications under such head all paved gutters, curbing, concrete or other breakers across the shoulders, gravel, etc., used for the shoulders when so used particularly and independently of the grading expressly for the purpose of improving the shoulders, and any material, such as sand, cinders or stone dust, used as a layer between the sub-grade and the surfacing proper. The cost of surfacing done under contract should be charged to this account from the vouchers in favor of the contractors.

304—BRIDGES AND CULVERTS.

To this account should be charged the cost of labor employed and material used in construction of bridges and culverts, including the hire of teams and equipment, the cost of miscellaneous tools and supplies used on the work, all pipes, boxes, as well as culverts and bridges of all kinds used toward the end of disposing of the storm water coming to the road from above or from the surface of the adjacent lands. The cost of bridging and culverting done under contract should be charged to this account from the vouchers in favor of the contractors.

305—UNDERDRAINS.

To this account should be charged the cost of labor employed and material used in construction of underdrains, V-drains, blind drains, sumps, standard underdrains and such other devices as are installed for the purpose of taking care of the ground or sub-surface water, the hire of teams and equipment and the cost of tools and supplies used on the work. The cost of drain work done under contract should be charged to this account from the vouchers in favor of the contractors.

306—ADVERTISING.

To this account should be charged the cost of advertising the terms under which contracts for the work may be let.

307—INSPECTION.

To this account should be charged the salaries and expenses of inspectors on the work.

308—SUPERINTENDENCE.

To this account should be charged the salaries and expenses of superintendents in charge of work done by the commission's forces.

309—FINAL SURVEYS, PLANS AND ESTIMATES.

To this account should be charged the salaries and expenses of engineers and their parties engaged in making final surveys, plans and estimates on the completion of each contract.

310—MISCELLANEOUS.

To this account should be charged rip-rap, tests and such items as are not chargeable under accounts No. 301 to No. 309, inclusive; also the amount of preliminary surveys and plans applicable to each contract when transferred from accounts Nos. 2 1 to 202.

All items of $50 and over should have explanatory notes made opposite the item in the detail ledger.

E—Reconstruction.

401—LABOR AND MATERIALS.

To this account should be charged the cost of labor employed and materials used in reconstruction of roads and turnpikes acquired.

402—TEAM HIRE AND USE OF EQUIPMENT.

To this account should be charged the payments for hire of teams and equipment and a rental for the use of the commission's equipment on the work. It should include the labor employed and materials used in operating and maintaining the equipment in use.

403—SUPERINTENDENCE.

To this account should be charged the salaries and expenses of superintendents and foremen in charge of reconstruction work.

404—INSPECTION.

To this account should be charged the salaries and expenses of inspectors engaged on work of reconstruction.

405—MISCELLANEOUS.

To this account should be charged tests and such other items as are not chargeable under accounts No. 401 to No. 404, inclusive; all items of $50 and over should have explanatory notes made opposite the item in the detail ledger.

F—Maintenance.

501—LABOR.

To this account should be charged the cost of labor employed in maintaining existing roads.

502—MATERIALS.

To this account should be charged the cost of materials used in the maintenance of existing roads.

503—TEAM HIRE AND USE OF EQUIPMENT.

To this account should be charged payments for use of teams and equipment in the maintenance of existing roads, together with a rental for the use of the commission's equipment so used.

504—SUPERINTENDENCE.

To this account should be charged the salaries and expenses of superintendents and foreman engaged on the work.

505—INSPECTION.

To this account should be charged the salaries and expenses of inspectors engaged on the work.

506—MISCELLANEOUS

To this account should be charged tests and such other items as are not chargeable under accounts No. 401 to No. 404, inclusive; all items of $50 and over should have explanatory notes made opposite the item in the detail ledger.

G—Equipment.

To this account should be charged the purchase price of all equipment which may have a substantial value after it has been used on any particular piece of work, such as road rollers, crushers, scrapers, graders, sprinklers, horses and wagons, auto trucks, etc. Small tools and other equipment which quickly wear out or become valueless should be charged to the work for which purchased at the time of purchase and upon the completion of such work should be appraised and credited to it.

The commission's equipment should be inventoried and numbered, and a proper record kept thereof. Charges for the use of the equipment should be made against the work on which it is employed, the credits for which may be carried in a "depreciation reserve" or "rental" account.

It is possible at any time with this system of accounting and without any inconvenience to the bookkeeper to show exactly how much money has been expended on any contract or work in any county of the state. This system eliminates to a certain extent the journal which is only used when it is impossible to make a direct charge to a certain county or contract.

Force account work is kept in the detailed ledger, but a separate ledger is kept for payments to contratcors, which are posted from the cash disbursement book. Equipment is numbered and charged against the work on which it is used. Credits for equipment are carried in a depreciation reserve or rental account. Small tools are charged to the work on which they are used and upon the completion of the work are appraised and credited to it.

In comparing this system of accounts with those used in other states, it will be noticed that the appropriation bills passed in Maryland are very much more exacting than those in New Jersey and Massachusetts. The appropriations are made for definite work, leaving very little discretionary power with the commission, the State Road Fund being allotted by statue in proportion to the road mileage in each county. The State Road Fund is for the improvement of the Washington Road leading from Baltimore to Washington, and known as State Road No. 1.

The Roads and Bridges Fund is appropriated for constructing and rebuilding certain roads and bridges named in the appropriation bill, and the State Aid Fund is used where the county officials petition the State Roads Commission to have certain roads improved, of which the state pays one-half of the cost and the work is done under the commission's supervision. Having four separate and distinct funds to expend necessitates a more elaborate system of accounts than is necessary in New Jersey or Massachusetts.

In New Jersey, the money is spent under the direction of the State Highway Commissioner and is derived from an annual appropriation and from the motor vehicle tax. All construction work is done by contract and accordingly the commissioner has no equipment and in that respect differs from the Maryland commission. The entire fund is a State Aid Fund, and the counties are required to bear two-thirds of the expense of road building.

It is discretionary with the Board of Public Roads how the appropriations shall be allotted and they are not compelled to confine themselves to the road mileage of the different counties of the state. Payments are made to the counties when the contracts have been completed and accepted, by a request from the commissioner or the comptroller to issue the warrant. The commissioner handles no money but pays everything through the comptroller, making a very simple system of accounting.

The state makes a separate appropriation for the salaries of the commissioner, the general supervisor, the assistant supervisor and the office force.

The cost of roads as compiled by the engineers includes the salaries of the supervisors and engineers engaged exclusively on the work. No attempt is made to apportion the cost of general engineering, supervision and administration to the cost of roads.

In Massachusetts the money under the direction of the commission is derived from appropriations from the state and from motor vehicle tax. All construction work is done under contract either with a town or with a contractor, the towns being given the first chance to do the work at certain prices. The entire work is absolutely under its jurisdiction, the law giving the commission considerable latitude in expenditures, requiring only that it shall be equitably divided among the various towns. The commission makes the allotments and memorandum totals of these allotments are carried along in its records merely for the purpose of seeing that they are not exceeded.

The salaries of the commission, the chief engineer and his two assistants do not enter into the cost of construction. As the commission does no construction work itself, it has no construction equipment. It does, however, have repair and maintenance equipment of which it keeps a card record. No charge is made to maintenance of roads for the use of such equipment.

The commission keeps records of all expenditures under its construction appropriation by contract numbers which is brought together on a sheet and the expenditures segregated under the headings "Contract Bills," "Miscellaneous Items," "Weighing," "Resident Engineer" and "Engineers," the latter two items coming in by annual prorata. In a similar manner, the repairs and maintenance are brought together.

The system adopted in Maryland is more elaborate than the ones used in New Jersey or Massachusetts, owing to the greater number of funds with which it has to deal, but is so simple, accurate and flexible that it can be applied to any accounting system with beneficial results. The merits of this system are simplicity; accuracy, cheapness of operation and the large amount of cost data given. It is estimated that at least 50 per cent of the cost of keeping accounts under the old and generally used system has been eliminated and the amount of accurate and detailed information given increased 100 per cent.

After the system has been installed, almost any clerk of average ability can carry it on and at the end of each month make a detailed report, showing the receipts and disbursements in each county of the state.

Street Car Service and Vehicle Congestion.

(STAFF ARTICLE.)

Street congestion in the business districts of our larger cities is growing more and more acute. The congestion caused by vehicles has been enormously increased by the phenomenally rapid additions through the use of autos and motor-driven trucks. The congestion is not only a time consuming annoyance and menace, but has reached the stage of actually injuring some thoroughfares for business purposes. In the city of Los Angeles, Calif., the number of motor-driven vehicles is probably larger in proportion to population than any other city in the country, if not in the world.

In addition to the danger and confusion, the roadway space actually occupied by vehicles has produced very serious problems. From the standpoint of carrying passengers, the automobile is extremely inefficient, when considered from the amount of roadway taken up. A large proportion of them are carrying only the driver, while those carrying passengers are usually only occupied by from one to four. The indiscriminate occupancy of the roadway by vehicles standing at the curb is not only very wasteful of roadway space, but becomes a source of delay and danger to other traffic. This is more particularly true of vehicles standing at the curb opposite where street cars have to stop to take on and let off passengers.

Soon after taking up work with the Board of Public Utilities of Los Angeles, as Chief Engineer of the Railway Department, Mr. Charles K. Mohler recommended to the board that an ordinance be passed to prohibit vehicles standing at the curb opposite where cars stop for passengers. The question was taken up with the head of the Traffic Bureau of the Police Department, and the following ordinance prepared largely under the supervision of Lieut. J. L. Butler, relating to vehicles standing in the roadway of the business district:

HITCHING AND LEAVING ANIMALS AND VEHICLES STANDING.

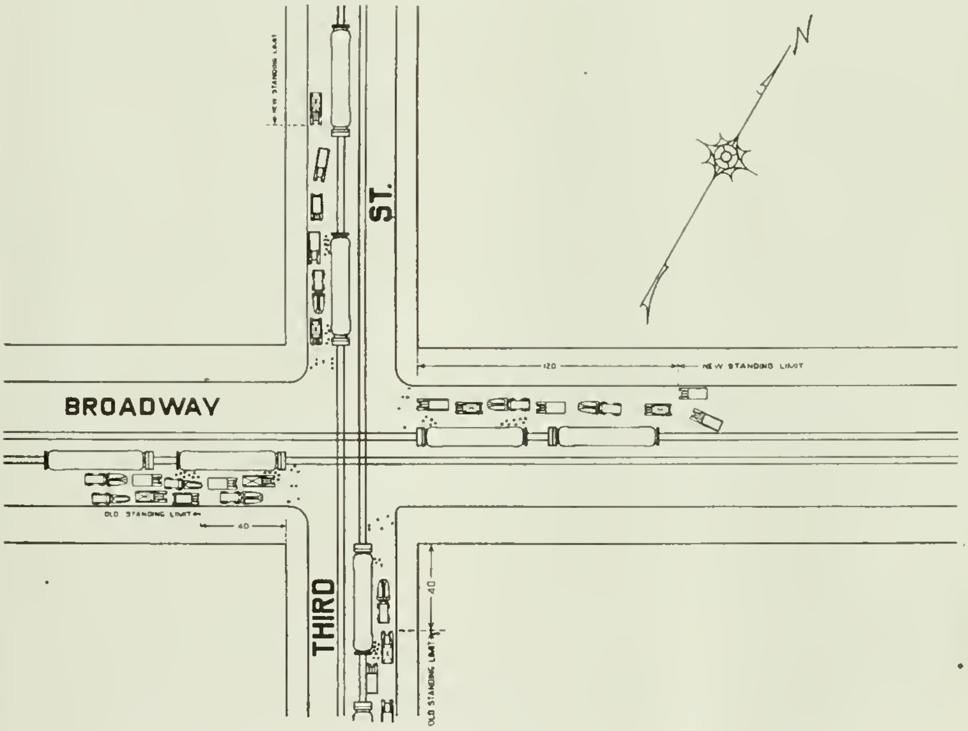
Sec. 55. The Board of Public Works is hereby authorized and directed to place signs within the business district at such points as may be designated by the Board of Police Commissioners as herein provided, said signs to be placed on streets in said district on which street railway cars are operated, and at or near the curb on the side of such streets where such street railway cars regularly stop to receive or discharge passengers. Such signs shall be placed at points on the westerly side of all such streets within said district which extend in a northerly and southerly direction distant not less than 80 ft. nor more than 150 ft. northerly from the curb return at the northwesterly corner of the nearest street intersection to the south and at points on the easterly side of all such streets within said district which extend in a northerly and southerly direction distant not less than 80 ft. nor more than 150 ft. southerly from the curb return at the southeasterly corner of the nearest street intersection to the north, and at points on the southerly side of all such streets within said district which extend in an easterly and westerly direction not less than 80 ft. nor more than 150 ft. westerly from the curb return at the southwesterly corner of the nearest street intersection to the east and distant at points on the northerly side of all such streets in said district which extend in a northerly and southerly direction not less than 80 ft. nor more than 150 ft. easterly from the curb return at the northeasterly corner of the nearest street intersection to the west.

Every such sign shall be placed not less than 8 ft. above the surface of the adjoining sidewalk and there shall be printed on every such sign a direction to drivers of animals or vehicles not to stand between such sign and the next street intersection.

It shall be unlawful for any person to hitch or to cause or permit to be hitched any animal, or to leave standing or to cause or permit to stand, or to be left standing any vehicle upon any portion of any street within the business district between any such sign and the line of the next street intersection nearest thereto for a longer period than is necessary to receive or discharge passengers or to load or unload goods, wares or merchandise, or to receive a signal from the crossing officer to proceed.

It shall be unlawful for any person to hitch, or to cause or permit to be hitched, any animal or to leave standing, or to cause or permit to stand or to be left standing any vehicle, upon any portion of any street along which street railway cars are run or operated and which is not required to be posted with sign as herein provided within 20 ft. of the nearest line of any street that intersects such street or terminates in such street or within 20 ft. of such side line extended across such street at right angles.

The accompanying sketch showing the old and new standing limits and the menace to passengers in trying to board or alight from cars, with vehicles standing at the curb and moving vehicles crowded in between those and the cars, was prepared by the engineering department of the Los Angeles Railway. In the lower left and lower right hand corners are shown the usual grouping under the old prohibited limits of 40 ft. from the near street line.



Grouping of Passengers and Vehicles Under Old and New Regulations.

In the upper right and upper left hand corners of the intersection shown in the cut are the grouping of passengers and vehicles under the new restrictions. The showing on Broadway is much more effective, as that is a double width roadway, or room for two vehicles alongside the car, while Third St. has room for only a single line.

As Mr. Mohler pointed out, there is still another good reason for keeping standing vehicles well back from the approach to a crossing which is that here is always the point of congestion for moving vehicles on account of the inevitable crossing delays. To provide additional roadway space for moving vehicles and remove the obstruction of standing vehicles at these points, would be reason enough of itself for the regulation.

The ordinance will go into effect the latter part of April.

The Value of Specifications and Tests for Bituminous Materials.

The importance of specifications and tests for bituminous materials is set forth in a paper presented at the Cleveland meeting of the American Association for the Advancement of Science by Charles S. Reeve, Chemist U. S. Office of Public Roads. An abstract of this paper follows:

A perfectly sound and legitimate specification should seek to secure the best available material for a particular purpose and permit as great competition as is consistent with this object.

The engineer who is called upon to prepare such a specification must be able to view his work honestly from two standpoints—his own and that of the producer who is to furnish the material. The work in prospect may be a surface treatment on one of the several types of roads, or it may be a piece of construction by some of the well-known methods, and he should know what particular requisites are most desirable in the type of bituminous material which he contemplates using. In this, however, he can not be governed entirely by theoretical considerations, but must be advised of the ability of the manufacturers to meet his requirements, and a lack of knowledge on this point has led to no end of righteous complaint on the part of the producers. Frequently the maximum and minimum limits of a particular clause are drawn unnecessarily close, and to control a product within such limits on a factory scale would prove next to impossible or an unjustifiable expense. Sometimes a clause is inserted which embodies the values of a newly devised test without any consideration or knowledge of the relation of these values to the other clauses of the specification, and thus a material is required which is wholly impossible to produce. The so-called "impossible" specification is frequently the result of best intentions on the part of the engineer, who, in his effort to broaden and yet strengthen his specification, selects clauses here and there from several others which he knows to have given satisfaction. The writer has seen several wonderful examples of this practice in which the author of the specification had practically nullified the purpose which he had set out to accomplish. It is therefore particularly advisable that the highway engineer who is responsible for the purchase of bituminous materials to be used in his work should file a record of the tests on all such materials used, thus preserving valuable data for his guidance in the future when preparing specifications. Moreover, he is placed in a position to intelligently assert what he has been receiving as a ground for later demanding similar material.

The value of being thus informed is frequently brought home to the writer, and a case in point is well illustrated by the following incident: A manufacturer of road tars had furnished on several occasions a tar for use in the cold surface treatment of macadam roads. Samples of this tar had all contained less than 5 per cent free carbon and were practically free from water, and since the material had given general satisfaction, specifications were drawn in which a maximum of 5 per cent free carbon was permitted. A representative of this same producer immediately raised the question that they had never produced a tar of that character, but he would gladly submit a sample of what they were prepared to furnish. His offer was accepted; the sample showed upon examination 7.5 per cent by volume of strongly ammoniacal water and 18 per cent free carbon. This was getting rather close to crude tar at refined prices, so a second sample was submitted which ran approximately 4.5 per cent by volume of ammoniacal water and 10 per cent free carbon. Needless to say, the specification was not changed to admit a tar of this character and a product, such as the record showed had previously been a commercial possibility, is still obtainable.

Having issued a specification, the engineer should, for his own protection, require that accurate tests be made on all shipments received. It may be from carelessness and haste, or it may be from the proverbial lack of harmony between the sales and manufacturing departments of the producers, that accepted orders are quite frequently not properly filled.

In a recent piece of macadam construction by the mixing method it was desired to use a particular bituminous binder that had given excellent satisfaction in the same locality for several years. Briefly, it was an oil-asphalt having a penetration of from 8.0 to 8.5 mm. at 25° C. An order was accepted for another shipment of this same binder, and it would undoubtedly have gone into the work had it not been for the forethought of the engineer in submitting a sample for test. A totally different material, having a penetration of but 3.8 mm. at 25° C. had been sent and was promptly rejected.

In some hot surface treatment of macadam during the past few months, it was necessary to obtain 15 or 20 bbls. of additional oil to finish out the work. The oil was a very viscous, semi-asphaltic residual, having but slight flow at normal temperatures. The second lot of the same oil was of about the consistency of thin sewing machine oil with a heavy sludge deposit in every barrel. In this case, a laboratory test was unnecessary, but it was only the timely arrival of the engineer that prevented the material from going into the kettle.

A recent specification for an oil-asphalt to be used in some experimental work called for a penetration of "not more than 20 mm. nor less than 14 mm. at 25° C." This permitted considerable latitude, but as the requirement was for only a few barrels, anything coming reasonably close to the above would have proven acceptable. The first shipment received proved to be a fluid residual petroleum which was promptly rejected, the shipper so notified and furnished with a second copy of the specification. With due apologies for an unaccountable error, he proceeded to make good in a second shipment. This proved to be a hard oil-asphalt, having a penetration of 3.2 mm. at 25° C., and in no sense whatever conforming to the specification. It was also rejected. The third shipment met the specification. Now the shipment of oil received could have been rejected on sight, but had the lot of hard oil-asphalt been turned over without testing to the construction force, it would probably have gone into work for which it was wholly unfitted.

The advisability of purchasing on a specification, even though it be a simple one, goes without question, but there are numerous consumers who look upon a trade name as a full and sufficient guarantee that the material is exactly what their requirements demand. The engineer orders in good faith some highly recommended brand of binder, and, when early failure develops, has small grounds for defense, since he received exactly what he ordered. And, in spite of the fact that a majority of the failures are unjustly ascribed to the binder, there do occur cases in which there can be no possible doubt that the binder was at fault. For instance, we have known manufacturers to recommend and even ship hard oil-asphalts having a penetration as low as 1 mm. at 25° C. for use in macadam construction, and we have known such materials to be used with, of course, immediate failure. Within the past few weeks a young highway engineer desired advice on the cause of a rapid failure of some recent construction. An examination of the binder, which he had accepted on faith, showed it to have a melting point of 99°C. and a penetration of 8.7 mm. at 25° C. It was supplied for penetration work in the northern United States and he had applied it in November. The cause of failure was readily apparent.

It is evident from the incidents above cited that the highway engineer who has under his supervision operations involving the use of bituminous materials should thoroughly familiarize himself with the characteristics of these materials; he should learn what requisites are most desirable to meet the conditions which will prevail upon his various projects. With this information in mind, he should prepare a specification briefly covering the essential requirements which he considers necessary and with due avoidance of complicating clauses whose interaction or other more important clauses he does not fully comprehend. Having thus accomplished the preliminaries to purchasing, he should assure himself thereafter that all materials delivered meet the requirements of his specification.

Some Tests of Oil Mixed Concrete with Particular Reference to Permeability.

Tests of oil mixed concrete published by Mr. Logan Walter Page indicated that by using an emulsion of water and oil a concrete of high impermeability was procured without material sacrifice of strength or other properties. Mr. Page's tests were made with Eastern oils, and the full conclusions were published in our issue of Nov. 15, 1911. To determine whether these conclusions would remain true if Western asphaltic oils were used tests were begun in February, 1912, by Messrs. Arthur Taylor and Thomas Sanborn, using western oils. These tests are described in a paper in the Proceedings, American Society of Civil Engineers, Vol. xxxix, p. 355 from which we reprint the conclusions as follows:

(1)—Oil-mixed concrete containing 5, 10 or 15 per cent of oil, by weight of cement, is more permeable under pressures from 20 to 60 lbs. per square inch than concrete without the incorporated oil, and oil-mixed mortar containing 10 per cent of oil is more permeable than plain mortar under pressures of 10 and 20-lb. per square inch.

(2)—Oil-mixed mortars containing percentages of oil up to 25 show slightly less absorption of water than plain mortar, except that with the most viscous oils the mortar becomes more absorptive, and absorption is not an index of the permeability. The absorption decreases with the increase in the quantity of oil.

(3)—The tensile strength of oil-mixed mortar is decreased considerably below that of plain mortar. The strength decreases with the increase in the quantity of oil.

(4)—The compressive strength of oil-mixed mortars follows lines similar to those of the tensile strength, but with a greater decrease in strength with the quantity of oil.

(5)—The strength decreases with the viscosity of the oils, and with the most viscous oils it requires considerably more water to keep a mixture at normal consistency than is required in the fluid oil mixtures.

(6)—The relative decrease in strength with the increase in the quantity of oil in mortars is less in 50 than in 28 days.

These conclusions are almost exactly contrary to those drawn by Mr. Page from his tests.

National Drainage Congress.—At the meeting in St. Louis, Mo., April 10, 11 and 12, the National Drainage Congress effected its permanent organization by the election of the following officers: President, Edmund T. Perkins of Chicago, Ill.; first vice-president, E. J. Watson of Columbia, S. C.; second vice-president, Col. William C. Gorgas, U. S. A., Panama; third vice-president, Edward Wisner of New Orleans, La.; fourth vice-president, D. E. King of St. Louis, Mo.; fifth vice-president, J. L. Craig of Stockton, Cal.; treasurer, A. M. McLachlen of Washington, D. C.; honorary vice-president at large, Sir William Willcocks. David R. Francis, former president, becomes, under the constitution, ex-officio a member of the National Executive Committee. Invitations for the Fourth National Drainage Congress were received from the cities of St. Louis, Memphis, Raleigh, and Savannah, and it was voted that the Fourth National Drainage Congress be held in the city of Savannah, Ga., in the early part of the year 1913.

NEWS SECTION

Editorial Comment—Personals—Society Meetings—Trade Notes—Catalog Reviews—Contract News, Embracing Bids Asked, Work Projected, Contracts Let and Contract Prices on All Classes of Civil Engineering Construction Work.

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The Doings of the Week.

There has been considerable improvement in the railroad construction situation in the last few days, and prospects are much brighter than they have been heretofore. A number of good-sized contracts have been let recently, and quite a bit of new work is in sight. Among the contracts awarded lately are the following: Walsh Construction Co., Davenport, Ia., for grading for additional second track between Elberon and Capron, Ia., 25 miles, for the Chicago, Milwaukee & St. Paul Ry.; J. T. McCarthy & Co., Gainesville, Fla., for grading for a 20-mile extension of the Gulf, Florida & Alabama Ry., from Local, Ala., into Monroe County, Ala.; Stuart Nichols, Beaumont, Tex., for grading, fencing and bridges for the new interurban line from Beaumont, Tex., to Port Arthur for the Jefferson County Traction Co.; Palmer, McBryde & Quayle, Monadnock Bldg., San Francisco, for building the Walnut Creek-Danville branch of the Oakland & Antioch electric line; W. Y. Williams & Co., Macon, Ga., for grading line of Hawkinsville & Western R. R. to Perry, Ga.; Lane Bros. Co., Altavista, Va., for grading and masonry on 12 miles of second track work and for grade revision between Rochester, N. Y., and Scottsville for the Buffalo, Rochester & Pittsburg R. R.; Miller Construction Co., Lock Haven, Pa., for grading and masonry work on a 5-mile branch near Lucerne, Pa., for the Buffalo, Rochester & Pittsburg R. R.

State highway work is commencing to make a showing. The California Highway Commissioner is calling for bids until April 21 on five contracts, the aggregate length being 15 miles. In Ohio the State Highway Commissioner is taking bids on 7 contracts; and in Connecticut Commissioner Bennett will open proposals on April 21 on 12 contracts. Among the road contracts let recently one of the larger is that secured by J. T. Bennett & Bro., Danville, Va. This contract amounts to about $109,000 and calls for the construction of 6½ miles of macadam and 37½ miles of "top soil" road. Of the street paving contracts let recently the following are among the largest: Union Paving Co., 112 N. Broad St., Philadelphia, Pa., at $170,000 for repairing and patching streets for the city of Philadelphia; L. W. Schroth, Milwaukee, Wis., at $95,000 for raising and paving Grand Ave. at Milwaukee; Montague-O'Reilly Co., Portland, Ore., at $108.580 for 64,000 sq. yds. of pavement at McMinnville, Ore.

No especially large drainage jobs appear to have come up for bids in last few days. The Commissioners of DeSoto County, Arcadia Fla., have postponed the opening of bids for the construction of 48 miles of open ditch involving 600,100 cu. yds. of excavation until May 6. A fair sized job is being advertised by Frank G. Bier, Secretary Marion County Drainage District, Palmyra, Mo. This calls for the construction of levees calling for the placing of 450,000 cu. yds. of earth, and the excavation of about 100,000 cu. yds. of earth. The Trustees of the Sanitary District of Chicago have awarded the contract for Sec. 6 of the Calumet-Sag channel to Green & Sons Co., 133 W. Washington St., Chicago, Ill., at $489,281. Bids on Sec. 10 of this channel were opened April 3, Shnable & Quinn, Chicago, Ill., at $495,412, being the low bidder.

The Passaic Valley Sewerage Commission, Newark, N. J., is readvertising the work of constructing the southerly and northerly portions of Sec. 6 of the main intercepting sewer. Bids on the work were opened on March 11, and the itemized proposals received appeared in our April 2 issue.

In the way of bridge contracts about the largest piece of work that has come up since our last issue is the building of a reinforced concrete viaduct at Baltimore, Md. This will be about 1,600 ft. long and 75 ft. wide and will cost about $250,000. Bids will be received until about May 21.

In the way of river and harbor work the following contracts are worthy of note: The Standard American Dredging Co., Central Bldg., Los Angeles, Cal., has been awarded the contract at $177,125 for dredging 1,300,000 cu. yds. from Slips 1 and 5 in Los Angeles inner harbor and filling adjoining lands. The T. J. Carlin Construction Co., New York City, has been awarded the contract at $345,939 for constructing 2,750 lin. ft. of reinforced concrete bulkhead backfilling and paving for the San Juan Harbor Board of San Juan, Porto Rico.

PERSONAL

Mr. J. F. Bowen has been appointed city engineer for Manchester, Conn.

Mr. James Lawson, civil engineer, has been engaged to plat an addition to Cuyuna, Minn.

Mr. N. R. Harmon has been appointed county road engineer for Marion county, Kentucky.

Mr. Ralph D. Earle, Jr., has been reappointed as county engineer for Bergen county, New Jersey

Mr. T. R. Atkinson has resigned as state engineer for North Dakota, to engage in private practice.

Mr. John Daniels has been appointed city engineer for Dubuque, Ia., succeeding the late C. H. Baumgartner.

Mr. W. H. Edwards, Jr., has been re-elected to the office of county road engineer for Woodford county, Kentucky.

Mr. Z. E. Sevison, county engineer for Albany county, Wyoming, has also been appointed city engineer for Laramie, Wyo.

Mr. Marc Johnson has been appointed as engineer of bridges and buildings for the Illinois Central Railway, with headquarters in Chicago.

Mr. J. B. Berry has been appointed assistant to the president of the Rock Island, and will be succeeded as chief engineer by Mr. C. A. Morse, formerly of the Santa Fe.

Mr. L. M. Rosseler has been appointed city engineer; Mr. L. D. Wright, water and light commissioner, and Mr. John Fletcher, street commissioner for the city of Fremont, Neb.

Mr. L. F. Lonnbladh has been appointed engineer of maintenance of way for the Missouri, Kansas & Texas R. R., with headquarters at arsons, Kas., vice Mr. F. Ringer, promoted.

Mr. B. Raymond Philbrick has been appointed head of the buildings branch of the Department of Public Works, Saskatchewan, succeeding Mr. W. P. Coltman, who has resigned.

Mr. R. C. Hardman has resigned as civil engineer and superintendent of construction for the U. S. War Department, to become associated with Mr. E. C. Van Diest, consulting engineer of Colorado Springs, Colo.

Mr. E. H. McHenry has resigned as vice-president in charge of operations for the New Haven Railroad. Mr. McHenry has been engaged in railroad work since 1883, and was formerly chief engineer of the Canadian Pacific.

Mr. A. G. McFarlane, district engineer of F Division, Transcontinental Railway, died at Ottawa, Ont., April 4, aged 53. Mr. McFarlane had been engaged in railway work since 1890, and was with the Transcontinental since 1905.

Mr. Albertus M. Jackson has resigned as assistant superintendent of sewers at Fitchburg, Mass., to become superintendent of streets and sewers for Leominster, Mass., a position which he held for 18 years previous to his removal to Fitchburg.

Mr. D. J. Brumley has been appointed engineer of maintenance of way for the Illinois Central, with headquarters at Chicago, vice Mr. L. W. Baldwin, promoted. Mr. F. L. Thompson has been appointed engineer of construction, succeeding Mr. Brumley.

Mr. J. C. Jacobson, of Grand Rapids, Wis., and Mr. G. E. Ackerman of Milwaukee, have formed a partnership under the name of Jacobson & Ackerman, hydraulic engineers. The firm will specialize in paper mill construction and general contracting, with offices in Minneapolis.

Mr. R. H. Thompson, formerly city engineer of Seattle, Wash., now engineer in charge of Strathcona Park, British Columbia, and Mr. C. H. Rust, city engineer of Victoria, B. C., have been requesttd by the provincial government to report on the proposed sewage scheme for Vancouver.

Mr. George E. Datesman, assistant chief engineer of the Philadelphia Bureau of Surveys, has sailed for Europe where he will spend the next three months in investigating modern sewage disposal systems in England, France and Germany, for the city of Philadelphia, which is planning a new system.

Civil Service Examinations.

The United States Civil Service Commission announces examinations as follows:

Architectural and Structural Steel Draftsman, $1,500 per annum; May 7-8.

Electro-Metallurgist, Bureau of Mines, $1,500 to $1,800 per annum; May 7.

Irrigation Managers and Assistants; Reclamation Service; $1,500 to $2,500 per annum; May 12.

INDUSTRIAL

The Yale & Towne Manufacturing Co. on April 18 will remove its general offices from 9 Murray St. to the new Yale & Towne Bldg. at 9 East 40th St., New York City.

H. J. Heinz Co., Pittsburgh, Pa., has been awarded a contract to the Raymond Concrete Pile Co., New York and Chicago, for the foundation, including standard Raymond concrete piles, for a new boiler house and tomato products building at the Pittsburgh plant. A contract has been awarded to the Raymond Concrete Pile Co., New York and Chicago, for placing standard Raymond concrete piles for the foundation of the Hutchinson high school, Buffalo, N. Y. H. Osgood Holland, Architect. The Durolithic Company, general contractors.

CATALOGUES

Industrial Cranes.—Paper, 6x9 ins., 8 pp. Industrial Works, Bay City, Mich.

Bulletin No. 209 contains illustrations and descriptions of cranes for wrecking, construction, and freight handling. Transfer tables and pile drivers are also illustrated.

Webster Method.—Paper, 6x9 ins., 48 pp. Webster Manufacturing Co., Tiffin, O.

This is the March number of this bulletin which contains descriptions of carriers and conveyors for coal and ash handling, for sand and gravel plants, package handling at railway terminals, etc. A diagram for giving accurate results of the capacities of screw conveyors is contained.

Universal Bulletin.—Paper, 6x9 ins., 16 pp. Universal Portland Cement Co., 72 W. Adams St., Chicago, Ill.

The April bulletin No. 107 contains a number of interesting articles describing the decoration of concrete buildings; bridge construction; road construction in South Dakota; buildings and foundations in which Universal Portland cement is used.

Expanded Metal.—Paper, 6x9 ins., 12 pp. Northwestern Expanded Metal Co., 926 Old Colony Bldg., Chicago, Ill.

This bulletin illustrates and describes a number of apartment buildings, theaters, schools, etc., in which has been used Expanded Metal Construction with "Kno-Burn" Expanded Metal Lath. An accompanying bulletin gives tables of stock, sizes and weights of "Econo," "Kno-Burn," "XX Century," "Kno-Fur" and "Diamond Mesh" metal laths for all classes of work.

Priestman Ejector System.—Paper, 9x12 ins., 16 pp. Merritt Hydraulics Co., 1211 Fidelity Bldg., Philadelphia, Pa.

This pamphlet illustrates and describes the Priestman Ejector System using compressed air expansively for lifting crude unscreened sewage without the employment of actuating mechanism and machined surfaces in contact with the solids, acids, grease, etc., of which the sewage is composed. The method of operation is described and arguments and advantages are given in detail. Tables giving standard types, sizes, capacities and dimensions are given, together with line drawings.

Steelcrete.—Paper, 5½x8 ins., 16 pp. Consolidated Expanded Metal Companies, 1180 Broadway, New York City.

This pamphlet gives useful drawings and tables for the design of highway bridges and culverts, using Steelcrete Expanded Metal Lath for reinforcement.

Rubber Goods.—Paper, 3½x5 ins. Albert J. Cox Co., 28 S. Jefferson St., Chicago, Ill.

This is a blank book arranged for keeping a brief directory of telephone numbers. A list of rubber goods sold by the company is given.

Dump Wagons.—Paper, 4½x9 ins., 12 pp. The Troy Wagon Works, Troy, O.

This bulletin illustrates and describes briefly Troy Dump Wagons for team hauling, Troy Reversible Wagons for traction hauling and Troy Dump Boxes for use on ordinary gear.

Deodorizing Appliances.—Paper, 6x9 ins., 4 pp. The West Disnifecting Co., 307 N. Michigan Ave., Chicago, Ill.

This bulletin describes a few of the products of this company, including disinfecting appliances and materials.

Engineering Instruments.—Paper, 6½x10 ins., 150 p. The Bausch & Lomb Optical Co., Rochester, N. Y.

This is a very complete and systematic catalog describing instruments of all kinds for field use. Complete illustrations with tables of prices, sizes and specifications for each instrument are given.

American Vanadium Facts.—Paper, 7¾x10¼ ins., 12 pp. The American Vanadium Co., 341 Vanadium Bldg., Pittsburgh, Pa.

This is the March number of this journal which is devoted to the application of vanadium through the use of Ferro Vanadium. An article is given on Service Records of Vanadium Locomotive Springs.

Contractors' Equipment. — Paper, 9x12 ins., 67 pp. Thos. Carlin's Sons Co., Pittsburgh, Pa.

This is a set of loose leaves for the catalog which contains illustrations, lists of prices, sizes, etc., of derricks, fittings, buckets, mixers, hoisting engines, clam shells, etc.

Travelers' Insurance.—Paper, 8¼x11 ins., 4 pp. Travelers' Insurance Co., Hartford, Conn.

This pamphlet describes a new policy covering accidents and is prepared especially for architects, engineers and contractors.

Leschens Hercules.—Paper, 8x10¼ ins., 8 pp. A Leschen & Sons Rope Co., St. Louis, Mo.

The April number of this paper describes a gold dredge and its method of handling 8,000 yds. of material per day. Other large dredges of various types are shown in this number.

Clay Products.—Paper, 7x10½ ins., 4 pp. Laclede-Christy Clay Products Co., Manchester & Sulphur Aves., St. Louis, Mo.

This circular describes the policy of the company in dealing with customers using fire clay products for all furnace purposes.

Yellow Strand.—Paper, 7x9¾ ins., 16 pp. Broderick & Bascom Rope Co., St. Louis, Mo.

This issue contains a number of interesting photographs of work upon which Yellow Strand Wire Rope is in use. Descriptions of various pieces of work are given.

Channon's Review.—Paper, 9½x6½ ins., 32 pp. H. Channon Co., Chicago, Ill.

This issue contains editorial articles on business conditions and a number of advertisements illustrate and describe contractors' equipment and supplies.

Track Material.—Paper, 6¾x9¼ ins., 62 pp. M. Mitshkum Co., Detroit, Mich.

This is Catalog F which contains lists of stock with prices, weights, etc. There is included a complete stock of steel rails, track material, cars for all purposes and other railway and contractors' equipment.

Rock Drills & Appurtenances.—Paper, 6x9 ins. Chicago Pneumatic Tool Co., 1010 Fisher Bldg., Chicago, Ill.

Three bulletins have been issued by this company, namely, Nos. 137, 138 and 139, which are entitled respectively, Chicago Giant Rock Drill (Tappet type), Chicago Giant Rock Drill (mountings) and Appurtenances for Chicago Giant Rock Drill Steels, including drill steels, blacksmith tools, sand pumps, rock drill hose and couplings, flexible joints, and blasting apparatus,. The catalogs are well illustrated and contain descriptions of the details of construction and the materials used. Tables of useful information are given.

Roberts' Track Laying Machine.—Paper, 6¾x9 ins., 24 pp. Roberts Brothers, 125 LaSalle St., Chicago, Ill.

This catalog gives a complete illustrated description of the construction and methods of operating the Roberts Patent Steam Track Laying Machine.

Sullivan Drills.—Paper, 6x9 ins., 32 pp. Sullivan Machinery Co., Peoples Gas Bldg., Chicago, Ill.

Catalogs 65A and 66B have recently been issued and are entitled respectively, Sullivan Diamond Core Drills and Sullivan Hammer Drills. Special attention is called to the "Rambler" Diamond Drill described on one of the pages of the Diamond Drill Catalog. This is a new type of drill which has recently been developed. It is designed to meet the requirements for a drill of moderate capacity where transportation of heavy machinery and fuel is costly. It is operated by a gasoline engine and has a capacity of about 500 ft., removing a 15/16 in. core. The catalogs are completely illustrated and the drills are carefully described as to their construction and limits of use.

Turbo-Blower.—Paper, 6x9 ins., 24 pp. The Turbo Blower Company, 32 Church St., New York City.

This catalog illustrates and describes the construction and operation of a combined turbine and blower which is designed to deliver the correct draft required for the combustion of any grade of fuel. The blower is made in various sizes for boilers ranging from 60 h.p. up.

Cement Facts.—Paper, 5¼x6¾ ins., 8 pp. Lehigh Portland Cement Co., Allentown, Pa.

This is the title of a publication, of which this booklet is the first issue. The book contains interesting information regarding the method of manufacture of Portland cement.

Paints and Damp Proofing Compounds.—Folder, 7¼x6¼ ins., 6 pp. Toch Brothers, 330 Fifth Ave., New York City.

This folder contains a number of interesting photographs showing the operations of painting structural steel on the Woolworth building.

Metaline.—Paper, 5½x8¼ ins., 24 pp. North American Metaline Co., Long Island City, N. Y.

This catalog illustrates and describes the application of Metaline for various types of bearings. Metaline is a mixture of graphite and anti-friction metals used in the form of plugs inserted into holes.

Wheelbarrows and Slip Scrapers.—Folder, 4½x8 ins., 20 pp. The Toledo Wheelbarrow Co., 337 River St., Chicago, Ill.

This folder contains illustrations with tables of sizes and brief descriptions of all types of wheelbarrows, concrete carts and slip scrapers which are furnished by this company.

Special Riveted Pipe.—3½x6¼ ins. American Spiral Pipe Works, P. O. Box 485, Chicago, Ill.

The company has recently issued a number of loose leaves which illustrate Taylor's Spiral Riveted Pipe as installed for industrial purposes and for irrigation, hydraulic mining and dredging.

Mushroom System if Concrete Construction.—Paper, 9x12 ins., 4 pp. C. A. P. Turner, Consulting & Contracting Engineer, Phoenix Bldg., Minneapolis, Minn.

This pamphlet contains a number of illustrations of concrete building construction showing office buildings, warehouses, hotels and bridges which have been constructed under the Mushroom System.

RAILWAYS

Alabama.

A survey is reported to have been started for a line from a point on the Illinois Central R. R. near River Bridge to Montgomery, Ala., a distance of 107 miles. The projected railroad will traverse Monroe, Wilcox, Lowndes and Montgomery Counties, passing through the towns of Camden and Hayneville.

⊙J. T. McCarthy & Co., Gainesville, Fla., have been awarded the contract for grading for a 20-mile extension of the Gulf, Florida & Alabama Ry. north from Local, Ala., into Monroe County.

Arkansas.

The Pine Bluff & Sulphur Springs Interurban Ry. Co. has been incorporated with a capital stock of $100,000, the incorporators being Harry Hanf, A. G. Russell and John H. Tucker Jr.

California.

⊙Palmer, McBryde & Quayle, Monadnock Bldg., San Francisco, have been awarded the contract for building the Walnut Creek-Danville branch of the Oakland and Antioch electric line for the San Ramon Valley R. R. Co.

The Railroad Commission of California has granted authority to the Stockton Terminal & Eastern R. R. Company to issue bonds in the sum of $345,000 or to sell a portion thereof and to pledge others for a loan. The money is to be used for the extension of the company's line of railway from its present terminus in Stockton to Stockton Channel, for the improvement of the company's line of railway from Stockton to Bellota, for the extension of the company's line of railway from Bellota to Jenny Lind, and for the purchase of a locomotive and other equipment. G. S. Cameron, Stockton, Calif., is General Manager.

The Southern Pacific R. R. is said to have completed arrangements for commencing construction work on the line from Dominguez Junction on the Long Beach-San Pedro line, to a connection with the distribution trackage at the new industrial city of Torrance. The work will be finished before fall.

The State Railroad Commission has rendered a decision suspending for the present time a determination upon the application of the Ocean Shore Railroad Co. to issue bonds in the amount of $700,000 and to pledge them as collateral security for a loan of $250,000. The commission held that as substantial litigation is now pending in the Superior Court, it should withhold action until a court of jurisdiction should act upon the legal matters now before it.

Petaluma & Santa Rosa Ry. Co., E. M. Van Frank, President, Petaluma, Cal., has applied to the State Railroad Commission for perimssion to issue $80,000 of bonds for extending the line from Liberty Station and Two Rocks, Sonoma County.

The Santa Fe System has location work under way for a spur to Portersville, and it is understood that actual construction work will be started shortly. The line as surveyed will skirt the foothills from Cutler to Woodlake, thence run south and west to Exeter, and thence south to Lindsay. From Lindsay it runs in an almost straight line through Porterville.

Colorado.

The directors of the Denver & Rio Grande R. R., J. G. Gwyn, Chief Engineer, Denver, Colo., have received the reports and plans of the engineers for the projected extensions involving the expenditure of about $17,000,000. These include the 131-mile extension of the Salt Lake Division from Helper, the 86-mile extension from Minturn to Salida and the electrification of the lines of Tennessee Pass and Soldier Summit.

A project is being promoted by W. A. Venter of New York involving the construction of a railroad from Albuquerque to Durango, Colo., a distance of 175 miles. The route of the proposed road is to be down the valley of the San Juan River to Aztec, thence to Sandoval, thence to Albuquerque. The new road will open up for settlement a region to be irrigated by pumping.

It has been announced at Meeker, Colo., that the Denver & Salt Lake Railroad has let a contract for the construction of its line from Springville, Utah, up Hobble Creek and thence to the summit of the Wasatch Range, to Mannie Deale. Work will be started immediately.

Connecticut.

The Board of Trade of Norwich, Conn., has revived the project to build a railroad connection between the Norwich and Worcester line of the New York, New Haven & Hartford R. R., just above Tafts and the Versailles station on its Providence and Willimantic line, and the matter is being considered by the railroad officials. The New Haven has had this five or six miles of proposed line surveyed several times, and very little preliminary work would stand in the way of its construction if this is decided upon. The object would be to join these two lines by a loop to give a feasible route for through service between Norwich and Hartford through Willimantic, and make it practicable to run through trains between the two cities and cut off about 16 miles of the distance now necessary to be traveled over the New Haven lines between Norwich and Hartford through Plainfield.

It is stated the General Electric Co., which last fall acquired the projected Norwich, Colchester & Hartford trolley line, intends to construct the road this summer.

Florida.

Parties interested in the Deep Lake section near Fort Myers, Fla., have organized a company with a capital stock of $350,000 and will construct a 13-mile railroad to cost about $100,000 from the Deep Lake orange groves to a point in Allens River, one mile above Everglade. A 30-lb. rail will be used, and a gasoline motor engine employed for traction purposes. The rails have already been ordered. W. G. Langford, Fort Myers, Fla., is interested.

Georgia.

⊙W. Y. Williams & Co., Macon, Ga., have been awarded a contract by the Hawkinsville & Western R. R. for grading the line to Perry, Ga. It is hoped to have the line completed by July 4.

A meeting was recently held at Thomson, Ga., by Lester Tucker, Savannah, Ga., representing the Brinson R. R., with the business men of Washington, Ga., and Thomson Board of Trade in regard to the extension of the railroad to those places.

Plans are understood to be under way for the immediate extension of the Brinson Ry., L. B. Ackerman, Chief Engineer, Springfield, Ga., through Thomson to Washington.

Idaho.

The Caldwell Traction Co., W. R. Sebree, President, Caldwell, Idaho, is reported to be planning to begin work shortly on an 11-mile extension of its traction line from the lower embankment to the south side of the Deer Flat Reservoir.

Illinois.

The Chicago, Milwaukee & St. Paul Ry., has sold $30,000,000 of its general mortgage bonds, due in 1998, to Kuhn, Loeb & Co. and the National City Bank.

⊙James Stewart & Co., 343 South Dearborn St., Chicago, Ill., has been awarded the contract for the construction of an 850,000-bu. grain elevator in the Calumet River District in South Chicago for the Baltimore & Ohio R. R. The elevator will have concrete foundations on piling cut off at the water line. The bins of the work house and storage rooms will be of reinforced concrete, as likewise the foundation of the car shed. The elevator will have a steel frame and be fireproof throughout. The work house will contain 55 bins, the capacity of these bins to be 250,000 bus., and in addition there will be 70 storage bins with a capacity of 625,000 bus. The dock will be of concrete and 300 ft. long.

Iowa.

⊙The Walsh Construction Co., Davenport, Ia., has been awarded a contract for grading for second track between Elberon and Capron, Ia., for the Chicago, Milwaukee & St. Paul Ry. About 750,000 cu. yds. of dirt will be moved. The work is to be completed this year.

A project is under consideration for the construction of an interurban line from Hopeville to Indianola. A. N. Oldahen, W. A. Adams and J. W. Taggard, Medora, Iowa, are interested.

The District Court has rejected the bids received by E. S. Harlan, Receiver, Atlantic, Ia., for the Atlantic, Northern & Southern R. R., and has ordered another resale of the property. The court held that none of the bidders offered sufficient to pay the creditors of the railroad and did not bid what the property is worth. New bids are to be submitted May 15, the successful bidder to have until June 2 in which to pay the balance of the agreed price.

Kansas.

The Santa Fe system is now understood to be planning to begin construction work in the late summer on its new branch line from Santanta west through Grant and Stanton counties.

Kentucky.

⊙W. W. Boxley & Co., Roanoke, Va., are reported to have been awarded a contract for constructing the first seven miles of the Elkhorn & Beaver Creek R. R., a new line projected to open up coal lands owned by the Elkhorn Fuel Co., of which J. A. Clark, Fairmont, W. Va., is president. The new road is to extend from the mouth of Beaver Creek on the Chesapeake & Ohio to the mouth of the Millstone.

Louisiana.

It is believed that the Southern Pacific is contemplating the construction within a short time of the proposed short line from Lafayette, La., to Abbeville. H. W. Sheridan, New Orleans, La., is General Superintendent of the Louisiana Western R. R.

The Southern Pacific Ry. contemplates the construction of a branch line from Lafayette to Abbeville, via Maurice. One report states that the branch is to be completed within the next six months.

A committee has been appointed at Lafayette, La., to acquire right of way for an extension of the Southern Pacific Ry. from Lafayette to Abbeville by way of Maurice and Le Roy.

Maryland.

Application has been made to the State Public Service Commission by Charles Williams, John C. Shaw, Vincent W. Hughes and W. E. Pairo for permission to issue bonds and sell stock for the construction of a 2½-mile railroad from North Beach to Anne Arundel County through Holland Point and Herring Bay.

The Hagerstown Electric R. R. Co., Hagerstown, Md., is reported to have plans under consideration for extending its line to Mont Alto and eventually to Gettysburg.

L. O. Davis, Harrisburg, Pa., and John R. Bear, Philadelphia, Pa., are considering the construction of an electric railway between Hagerstown and Clearsprings, a distance of 12 miles.

Michigan.

The officials of the Duluth, South Shore & Atlantic Ry. have decided to construct the

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

proposed new roundhouse in the upper yards west of the coal sheds on the south side of the track at Marquette, Mich. The new structure will have 15 stalls, each 80 ft. deep. Spur tracks will run into it. V. D. Simar, Marquette, Mich., is Chief Engineer.

The Muskegon-Casnovia Land & Development Co. has been organized for the purpose of promoting the construction of an interurban railway from Muskegon to Saginaw. It is hoped to build the first 20 miles to Casonvia and Kent City this year. Norman B. Lawson, Muskegon, is president and James L. Smith, Muskegon, is secretary.

St. Louis Items.

BY A. B. KEONIG.

⊙T. J. Walsh of the Walsh Construction Co. wires us from Davenport, Ia., that they have just been awarded 25 miles of team and shovel work on the Milwaukee road in Iowa and can use some team and shovel outfits on this work.

⊙Fruin & Colnon, St. Louis, secured the contract for rebuilding the 12th St. viaduct here across the railroad tracks; contract price $320,000. They expect to start work within the next two weeks.

⊙Frank C. Rand, the multimillionaire shoe manufacturer, was awarded the contract by the Board of Public Improvements for building the Rocky Branch sewer here on a bid of $450,663. Rand's bid was $11,538.50 less than the Fruin-Colnon Contracting Co., which twice had been the sole bidder and had its bids rejected. Rand's bid was $100,000 in excess of the estimate made by Sewer Commissioner Charles A. Moreno last January. The Rocky Branch Joint District sewer is designed to prevent floods like that of the summer of 1911. when scores of city blocks were inundated after heavy rainfall. It cannot be completed before next spring and will not affect the situation this spring and summer.

⊙Mulville Bros. secured a small piece of team work near Roodhouse, Ill., on the Chicago & Alton R. R.

List & Gifford have 3 locomotives, 24 standard gage cars and a 70-ton steam-shovel idle at Rockford, Ill. Their headquarters are New York Life Bldg., Kansas City, Mo.

Joyce Bros. & Bagwell have got started on their grading on the Northwestern R. R. in Iowa.

Chas. Adams can use a 25-team outfit on the Rock Island R. R. near Malvern, Ark.

T. J. Sullivan has been appointed manager of Koenig's Labor Agency in Memphis, Tenn. Sullivan can be found at No. 75 Poplar Ave. there.

Contracts will be let this week for a 10-story fireproof building for the Rice-Stix Dry Goods Co., to occupy the entire block bounded by Washington Ave., Eighteenth, Nineteenth and St. Charles Sts. Negotiations have been completed with the Metropolitan Life Insurance Co. for a building loan of $1,500,000, which will be secured by the fee to ground. The block is owned by Mrs. Grace A. Leathe. who will be the builder.

John Higgins left here to look over some of the Shelby County R. R. work near Shelbina, Mo. Up to the present writing he has not returned so cannot say whether he has taken any of this work or not.

Maloney & Donaldson, 31 E. Lyons St., Grand Rapids, Mich., have some nice machine work to let near Pittsburgh, Pa.

W. S. Meller will finish his work at Paducah, Tex., about the 25th of this month and is in the market for some work for 33 teams, 2 machines and a steam-shovel outfit.

The Missouri Pacific-Iron Mountain System is making rapid strides toward improving the efficiency of its telegraph and telephone service to facilitate the movement of trains. Train dispatching by telephone is now in effect over the entire Illinois division, and the important branch lines reaching to the Illinois coal fields; on the eastern division, St. Louis to Jefferson City; the Central Kansas Division, Kansas City to Hoisington; the Omaha Division, Kansas City to Falls City, and on the Arkansas Division, Little Rock to Texarkana, a total of 822 miles, with 148 stations equipped.

The St. Louis, Affton & Sunset Ry., which is constructing a railroad southwest from St. Louis to Fenton, filed a mortgage in the office of Recorder Henry Heineman at Clayton, securing an issue of bonds amounting to $300,000. The American Trust Co. of St. Louis is trustee for the bondholders. The bonds were authorized in February, and are for the purpose of constructing new trackage and for taking care of the floating debt. They become due in 1963 and bear 5 per cent interest. The right of way with the franchises and whatever property now is owned by the railway is included in the mortgage. John M. Storm is president and James Arbuckle, secretary of the railway company. James E. Rohan signed the mortgage as vice president of the trust company.

Ware & Riley, East Alton, Ill., have 24,000 yds. of grading on the Woodriver levee to sublet. They also have some clearing and grubbing on this line to let. Plenty of time to finish work.

Three thousand laborers have been shipped from St. Louis to various points along the river to build up the levees of the swollen Mississippi. The Koenig Labor Agency at 612 Walnut St. received orders from Maj. Markham, the Government's chief engineer in the Mississippi Valley, to send all the men it could get. The laborers have been guaranteed $1.50 a day and their board. In the last three days men have been sent to Charleston, Mo., Cairo, Ill., and Bird's Point and Bird's Mill, Mo. A special Iron Mountain train departed last week carrying 500 men to be distributed at Elaine, Melwood and Ferguson, Ark.

L. B. Hauck, General Manager of the Shelby County R. R. at Shelbina, Mo., was in the city the other day. He says he still has some grading to let on this line suitable for small outfits.

The recent cyclone in Omaha never touched Koenig's Labor Agency, which is located at 1320 Dodge St. After the blow Jack Gardner, the manager of this office, was one of the busiest men in town looking after the wants and assisting the residents all he possibly could, working day and night. Jack also is furnishing all the storm sufferers and those in need of employment work free of charge.

Mike Conroy left here for the north. When he returns we expect to see a nice grading contract with him.

Labor thinned out here very fast last week. Every railroad company in the south was after labor for shore protection and washout work. With the exception of a couple of bunches of Austrian laborers there are no foreigners left here.

Wm. Woods has moved his outfit onto part of the Shelby County R. R. work near Shelbina, Mo.

Jas. Austin was in from his farm at Benton, Ill. Jim says he has quit railroading and gone to raising white face cattle. It may be, however, if something good turns up that he will go back in the contracting business. We venture to say that it won't be long before Austin will be back in the game again.

New York.

⊙Lane Bros. Co., Altavista, Va., have been awarded the contract for grading and masonry on 12 miles of second track work and for grade revision between Rochester, N. Y., and Scottsville for the Buffalo, Rochester & Pittsburgh R. R.

The New York Central & Hudson River R. R. has purchased a strip of land about 6 miles long on the northwest side of its tracks from West Albany to Kinders, and will lay three additional tracks to be used as sidings for freight cars.

Plans for the connection of the existing subway with the new subway in Lexington Ave., New York City, have been changed by the Public Service Commission for the First District, so that the junction will be made south of 40th St. instead of near 42nd St. as originally contemplated. The first plan involved the passage of the new subway under private property on both sides of 42nd St., and it developed that the obtaining of easements would be very expensive. On this account the Board of Estimates and Apportionment refused to approve the first plan. The Public Service Commission then adopted a plan for a connection through 40th St. According to this plan the route just touches private property where it cuts the corners of blocks at Park Ave. and 40th St. and Lexington Ave. and 40th St. The Board of Estimate and Apportionment has not yet acted upon this plan.

A 50-day option on the plant of the Empire Electric Co. of Franklinville has been acquired by Joseph B. Mayer, 165 Broadway, New York City, vice president of the Western New York & Pennsylvania Traction Co. It is stated that if the deal is consummated an electric railway will be built eventually through Franklinville.

The New York Municipal Ry. Corp., 85 Clinton St., Brooklyn, N. Y., has filed maps and plats in the Queens County clerk's office for the proposed extensions of the Kings County R. R. on Liberty Ave. and of the Lexington Ave. line over Jamaica Ave. The Liberty Ave. extension begins at Grant Ave., Brooklyn, and extends to Lefferts Ave., Richmond Hill, at the westerly end of the Long Island R. R. yard at Jamaica, a 3-track structure 2½ miles in length. The Jamaica Ave. line from Crescent St., Brooklyn, to Grand St., Jamaica, will be a 3-track structure a little less than five miles in length. The work is to begin within six months after the obtaining of consents, and is to be completed within two years, except as to the third tracking. Plans for the third tracking of the Fulton St., Broadway and Myrtle Ave. lines were also filed.

North Dakota.

Citizens of Oakes, N. Dak., and Ellendale, N. Dak., are considering a project for constructing an electric railway between the two cities.

A report from Grand Forks states that practically all right of way for a proposed Milwaukee line has been secured from Fargo to Grand Forks, and that much of the right of way from the latter place to Winnipeg has also been secured.

Oklahoma.

The Oklahoma, New Mexico & Pacific R. R. has opened headquarters at Ardmore, Okla., preparatory to beginning construction work on the line from Ardmore west through Lone Grove, Hewitt, Cornish and Waurika to Byers, Tex., connecting with the short line from Byers to Wichita Falls. It is probable that construction contracts will be let next month. Jake L. Hamon, Lawton, Okla., is president.

The Norman Interurban Ry. Co., of Oklahoma City, has been chartered with a capital stock of $150,000 and proposes the construction of an interurban line between Oklahoma City and Norman. This is a subsidiary corporation to the Oklahoma Ry. Co., which operates the street railway system at Oklahoma City and several interurban lines out of Oklahoma City and now has a line from Oklahoma City to Moore, which will be used as a part of the Norman line. The incoporators include Geo. W. Knox, Oklahoma City, general manager of the Oklahoma Ry. Co., and Chas. Hoopes, secretary of the same company.

Oregon.

The Grants Pass-CrescentCity R. R., W. W. Harmon, Chief Engineer, Grants Pass, Ore., has made a location survey from Grants Pass to Crescent City, a distance of 91 miles, and is at present doing some revision work. It is expected to let contracts in the near future on this work.

Pennsylvania.

⊙Miller Construction Co., Lock Haven, Pa., has been awarded the contract for grading and masonry work for a 5-mile branch near Lucerne, Pa., for the Buffalo, Rochester & Pittsburgh R. R.

It is expected that A. Merritt Taylor, City Transit Commissioner of Philadelphia, Pa., will submit his report on the proposed extensions to the city transit system early in June. Some of the city officials are in hopes to be able to start work on the Broad St. subway late in the fall of this year.

The directors of the Pennsylvania R. R., at a meeting on April 9 passed a resolution authorizing a stock issue amounting to $45,000,000.

The Philadelphia & Garrettford Street Ry. Co., Upper Darby, Pa., is reported to be considering extending its line from Collingdale to Folcroft and the Darby Creek.

Arrangements have been completed whereby the Reading Transit & Light Co. of Reading, Pa., recently incorporated, takes over the Reading Transit Co. and its subsidiary interests in Lebanon, Norristown, Pottstown and Philadelphia. The new company is merely a reinforcement of the local transit company, made necessary because of lack of capital, the immediate acquisition of which was imperative to carry on improvements contemplated for the betterment of local transit facilities.

Tennessee.

The Nashville, Shiloh & Corinth Ry. Association has been organized at Nashville and has opened headquarters at offices of the Nashville Industrial Bureau, Nashville, Tenn. The company proposes the construction of a railroad from Nashville to Corinth, Miss., passing through seven counties in Tennessee. The cost of the line is estimated at about $3,000,000, and it is proposed to raise the necessary funds in the counties traversed by the road. A. P. Foster is secretary of the association.

Texas.

Surveys are under way for a route through Williamson County for the projected line of the Southwestern Traction Co. This company proposes a line from Waco via Temple, Belton, Georgetown, Austin and San Antonio. A. M. Coffin, Waco, Tex., is chief engineer.

The San Antonio & Austin Interurban Ry. survey has progressed as far as the town of New Braunfels, about one-third of the distance, the location and engineering work being done by the Southwestern Engineering Co., Gunter Bldg., San Antonio, Tex.

⊙Stuart Nichols, Beaumont, Tex., has been awarded the contract for the grading, fencing and bridges for the new interurban line from Beaumont to Port Arthur, Tex., to be built for the Stone & Webster Engineering Corp., of which Mark Lowd, Dallas, Tex., is general manager for the Southwestern System. The Lone Star Culvert Co., San Antonio, Tex., will build the culverts.

The Bryan & Central Texas Interurban Co. has been organized at Bryan with a capital stock of $85,000, fully paid in. The new company will take over the Bryan-College Interurban Co. Grading work for the extension of this line to the Brazos Bottoms was started last week by Smith Bros. O. E. Gammill, Bryan, Tex., is general manager.

The Wichita Falls & Southern Ry. (Missouri, Kansas & Texas line) has surveys under way for an extension from Newcastle south to Cisco.

Final survey of the route of the new line of the San Antonio, Uvalde & Gulf R. R., E. R. Breaker, Chief Engineer, Pleasanton, Tex., has been completed from Corpus Christi to the new townsite of McGregortown, 9 miles west. It is expected that a formal contract between the railroad and Corpus Christi will be signed in the next few days and that construction work out of Corpus Christ will begin 30 days later. The railroad is under contract to have trains running between San Antonio and the gulf terminus by Feb. 1, 1914.

It is believed that the Directors of the Rock Island System will take up at the next meeting the propositions to extend the main line to El Paso, Texas, and to build a branch line from Liberal, Kan., to Trinidad, Colo.

Surveys are now being made by engineers of the Enid, Ochiltree & Western R. R. for the extension of the line through the Texas Panhandle eastward via Ochiltree and Hansford to the Texas Border. W. T. Taylor, Dalhart, Texas, is Chief Engineer and George M. Perry, Ochiltree, Texas, is President.

It has been announced that the Pecos Valley Southern R. R., which recently changed ownership, will be extended from Toyahvale to Alpine as soon as necessary financial arrangements can be made. It is also proposed to construct an extension of this line north from Pecos to a connection with the Santa Fe, probably at Lamesa. At the recent meeting of the Directors of the company at Pecos, Tex., the following officers were elected: W. D. Cowan, President; F. W. Johnson, First Vice-President; L. W. Anderson, Second Vice-President and General Manager; G. C. Mountcastle, Treasurer; D. S. Floyd, Assistant Treasurer and Auditor; J. G. Love, Secretary; W. W. Hubbard, Assistant Secretary, and James F. Ross, General Counsel.

Engineers of the Gulf, Texas & Western R. R. have completed two surveys for the proposed extension of the line west from Seymour, Tex. One of these surveys runs northwest to Floydada, where connection will be made with the branch line of the Santa Fe that runs to Plainview. This proposed extension will be about 150 miles long. The other route for which a preliminary survey has been made runs from Seymour to Crosbytown, about 125 miles. There the line would connect with the Crosbytown & South Plains Railroad, which runs to Lubbock. The Gulf, Texas & Western recently finished its branch line running from Jacksboro to Salesville, 24 miles. B. B. Cain, Dallas, Tex., is Vice-President and General Manager.

Utah.

It has been announced by a representative of the Utah Railway Co., that it has been decided to locate the terminals at Provo, Utah, instead of Spanish Fork. William Ashton, Salt Lake City, Utah, is Chief Engineer of the company.

Washington.

The Spokane, Portland & Seattle Ry. is understood to be planning the expenditure of $750,000 in building new shops at Overlook adjoining Spokane.

A surveying crew of the Oregon-Washington Railroad & Navigation Co. has left Cosmopolis, Wash., and it is believed that the company proposes to extend its North River road to Doty and thence to an extension of the North Coast mountain road over the Cowlitz Pass. From Doty a branch line probably will run to Raymond, but Aberdeen will be the terminus of the road. This would bring Spokane six hours nearer tidewater and makes Aberdeen an important railroad terminal.

It has been announced that the Great Northern plans the expenditure of a considerable sum for the improvements contemplated at Leavenworth, Wash. A new concrete roundhouse will be erected and 11 miles of trackage will be installed.

The Willapa Bay Eastern Ry. Co., incorporated last week with a capital stock of $2,000,000, has been formed by officials of Oregon-Washington R. R. for the purpose of building a line from Rochester to Willapa Harbor, 51 miles, and a branch northeast from South Bend to connect with the Oregon-Washington North River branch.

West Virginia.

The city council of Fairmount, W. Va., will give an early hearing on the application of the Buckhannon & Northern R. R., S. D. Brady, Chief Engineer, for a franchise for extending the line into this city over the streets of the First ward.

The Charleston, Parkersburg & Northern R. R. Co., with principal offices at Parkersburg, W. Va., has been chartered with a capital stock of $100,000, and proposes the construction of a railroad from Charleston to Parkersburg. The incorporators are: K. B. Stephenson of Parkersburg, H. M. Fowler, E. R. Reidl, J. E. Fowler and A. H. Geiger of Washington, D. C.

Wisconsin.

The Pigeon Valley Ry. Co., the incorporation of which was mentioned in our April 2 issue, proposes the construction of a railway from the Village of Pigeon Falls, Trempealeau County, to Hay Creek, Eau Claire County, a distance of 20 miles. The incorporators include H. A. M. Steem, T. R. Kittleson, Niels Hagen, Ole A. Olson, B. M. Slettland and G. H. Neprud.

The Milwaukee Electric Ry. & Light Co., Public Service Bldg., Milwaukee, Wis., is to expend about $1,000,000 this season for improvements at Milwaukee. These will include about 5.2 miles of new tracks and the improvement of about 32 miles additional. About 28,000 cu. yds. of concrete will be used, and 97,500 cu. yds. of asphalt and 36,000 cu. yds. of stone block pavement constructed.

The Chicago, St. Paul, Minneapolis & Omaha Ry., C. W. Johnson, Chief Engineer, St. Paul, Minn., will, is is stated, have construction work started in the near future on an extension from Kaiser to Park Falls in Forest County.

Canada.

✣Bids will be received until noon, April 24, by the City Commission, Saskatoon, Sask., for double tracking certain streets in the City of Saskatoon municipal street railway. Specifications, instructions to bidders, and tender forms can be obtained on application to E. Hanson, Superintendent of Street Railway, Saskatoon.

⊙The Westinghouse, Church, Kerr Co., New York City, has been awarded the contract for making alterations to the terminals of the Canadian Pacific Ry. at Toronto, the work including an extension to the Royal Alexandra hotel and an addition to the station. About $1,000,000 is to be expended.

The Mackenzie-Mann syndicate, Toronto, Ont., is understood to have completed all financial arrangements for building its projected electric railway along the Canadian border from Port Colborne to Fort Erie, and it is probable that the work will be started in the near future. The authorized lines are from St. Catharines to Fort Erie and via Bridgeburg to the Falls, thence through Welland, St. Catharines and Hamilton to Toronto. D. B. Hanna, Toronto, Ont., is vice president of the electric railway.

Surveys have been started for the 36-mile extension of the Niagara Falls, Welland & Lake Erie Ry. (electric), 813 Traders' Bank Bldg., Toronto, Ont., from Niagara Falls to Welland and Port Colborne and east along the lake shore to Fort Erie. It is the intention to complete this extension this year. T. R. Cummings is the engineer in charge of construction. C. J. Laughlin, Jr., Welland, Ont., is general manager.

The St. John Suburban Ry. Co., of St. John, N. B., has started surveys for its projected electric railway. J. A. Jones is the engineer.

The Canadian Pacific Ry. will begin construction work shortly on its proposed tunnel through Kicking Horse Pass in the Rocky Mountains. This tunnel will be about 16 miles long and will cost about $14,000,000.

It is now reported that steel on the Canadian Northern main line through to the Pacific coast will reach Summit, 350 miles west of Edmonton, in July. The end of steel on the Canadian Northern Ry. is at Macleod River, where the big steel bridge is being erected. Steel laying has been suspended on this line for some weeks past during the construction of the bridge, which is now nearing completion and will be finished this month. Immediately the bridge is ready the big track layer will be taken over and dump already put upon the western side of the river will be proceeded with. The graders have had sufficient start to keep ahead of the steel laying gang, and it is expected that there will be no further interruption of the steel laying till the Athabasca River is reached. Steel on the Peace River line is laid nearly to Pembina River, and on the Brazen Coal branch to Rocky Mountain House, while the Goose Lake line is nearly completed.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

BRIDGES

Arkansas.

⊙The Joliet Bridge & Iron Co., Joliet, Ill., and Memphis, Tenn., has been awarded the contract for the construction of a steel bridge over the Codron near Mt. Vernon, Ark., 20 miles northeast of Conway. The structure will be 160 ft. long.

California.

⊙The contract for the construction of three reinforced concrete highway bridges has been let by Lieut. Col. W. W. Forsyth, Acting Supt. Yosemite National Park, Yosemite, Cal., to Oscar Parlier, Tulare, Cal. at $4,046. The work will include Bridges Nos. 2, 3 and 4. All bids for Bridge No. 1 were rejected.

Colorado.

⊙Patterson-Buzhardt Construction Co., Denver, Colo., has been awarded the contract by the County Commissioners for the construction of a steel bridge over Highland Ditch north of Longmont.

Connecticut.

C. R. Sibley, New Haven, Conn., and Sperry Engineering Co., New Haven, Conn., submitted the lowest bids respectively to the Board of Contract & Supply, Bridgeport, Conn., for the following bridges: Reinforced concrete bridge across the Pequonnock River, at North Ave., city, carrying 70 ft. street, 2 spans, 22 ft. clear; reinforced concrete bridge across the Rooster River, at North Ave., city, carrying 60 ft. street, one span, 22 ft. clear. Bids were opened March 28.

Illinois.

✣Bids will be received up to 1 p. m., April 30, 1913, at the County Clerk's office, in Ottawa, Ill., for the construction of one reinforced concrete bridge to be built in Deer Park Township, La Salle County. A. E. Bach, County Clerk, Ottawa, Ill. Hulinger Bridge: Span, 11 ft.; roadway, 20 ft.; height, 17½ ft. Estimated total concrete, 94.4 cu. yds.; reinforcing steel, 9,030 pounds; nearest railroad station, Utica, 4½ miles. No local concrete materials available. Average excavation, north side about 3½ ft.; south side about 16½ ft. Excavation in gravel and clay, to be carried to a depth of about 3½ ft. below stream bed. Engineer's estimate, $1,250. Work to be completed on or before Oct. 1, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office, or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received up to 10 a. m., April 25, 1913, at the bridge site for the construction of one reinforced concrete bridge to be built in Bunker Hill Township, Macoupin County. C. H. Folkerts, Town Clerk, Bunker Hill, Ill. Groves Bridge: Span, 22 ft.; roadway, 18 ft.; height, 12 ft. Estimated total concrete, 62.2 cu. yds.; reinforcing steel, 6,835 pounds. Nearest railroad station, Bunker Hill, about 2 miles. It is reported that gravel may be had from a creek bed about 3½ miles from bridge site at 25 cents per load at pit. This gravel contains a large excess of sand. Present bridge wood, 15-ft. span. Low water flow, dry; high water about 8 ft. deep. Average depth of excavation about 12 ft., to be carried through clay and loam to about 4 ft. below stream bed. Engineer's estimate, $850. Work to be completed on or before July 1, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office, or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received until 1 p. m., April 30, by Joint Committee of the Highway Commissioners of Deer Park and the Special Committee of Board of Supervisors addressed to A. E. Bach, County Clerk, Ottawa, Ill., for the construction of a concrete bridge over Hulinger Creek in the town of Deer Park. Plans and specifications are on file with the county clerk.

✣Bids will be received up to 3 p. m., May 1, 1913, at the Town Hall, Bethany, Ill., for the construction of one reinforced concrete bridge to be built in Marrowbone Township, Moultrie County. Wm. Stables, Town Clerk, Bethany, Ill. Old Circle Bridge: Span, 60 ft.; roadway, 16 ft.; height, 19 ft. Estimated total concrete, 215.7 cu. yds.; reinforcing steel, 33,816 pounds. Nearest railroad station, Bethany, about ¾ mile. No local concrete materials available. Present bridge, one 62-ft. steel leg span and three 16-ft. beam spans. Low water flow dry; high water, about 8 ft. deep. Average excavation, south abutment about 8 ft.; north abutment, 6 ft., to be carried through clay to about 3 ft. below stream bed. Engineer's estimate, $3,250. Work to be completed on or before Aug. 15, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office, or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received up to 12:30 m., April 28, 1913, at the Town Clerk's office, Mineral, Ill., for the construction of two reinforced concrete bridges to be built in Mineral Township, Bureau County. J. S. Hartley, Town Clerk, Mineral, Ill. Brainerd Bridge: Span, 40 ft.; roadway, 18 ft.; height, 17 ft. Estimated total concrete, 149.8 cu. yds.; reinforcing steel, 19,030 pounds. Nearest railroad station, Mineral, ½ mile. It is reported that gravel may be had F. O. B. cars at Mineral at about $1.50 per cu. yd., or from local pit (Rollins) about 5 miles from bridge, at 25 cents at pit. Present bridge, steel leg, 25-ft. span. Low water flow about 1 ft. deep and 5 ft. wide; high water, about 10½ ft. deep. Excavation, east abutment will average about 10 ft.; west abutment about 17 ft., through sandy clay and gravel, to about 4 ft. below stream bed. Humphrey Bridge: Span, 20 ft.; roadway, 18 ft.; height, 13 ft. Estimated total concrete, 67.1 cu. yds.; reinforcing steel, 6,682 pounds. Nearest railroad station, Mineral, about 2½ miles. Rollins gravel pit about 2 miles. Present bridge, wood, 30-ft. span. Low water flow about 6 ins. deep and 5 ft. wide; high water about 7 ft. deep. Excavation, east abutment about 6 ft.; west abutment about 13 ft. through sandy clay to about 4 ft. below stream bed. Engineer's estimate for both bridges, $3,075. Work to be completed on or before Aug. 15, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Ill.

⊙The contract for the construction of a 254-ft. 5-span reinforced concrete girder bridge over the Sangamon River 1½ miles south of Fisher, Ill., has been let by the Bridge Committee of Champaign County, Ill., to Goggin Construction Co., Arcola, Ill., at $11,083. The work will include grading, concrete piers, and repairing stone abutments. D. J. Holterman is Chairman of the Committee. Bids were opened April 5.

⊙The following were the bids submitted on the Baltz bridge, Freeburg township, St. Clair county, April 10, 1913: Joseph Klein, Freeburg, $1,700; W. C. Johnson, Salem, $1,600; Gass Bros., Belleville, $1,495. The contract for this bridge was awarded to Gass Bros., Belleville, Ill., for $1,495.

Following is the lowest bid submitted to the Department of Public Works, Chicagofi Ill., on March 9th, for furnishing, delivering and erecting in place on the viaduct span of the Washington St. bridge 16 bracket fixtures attached to the trusses of the viaduct, each containing 21 lights, 8 light standard, each containing 4 lights, 4 cluster light standards, each containing 7 lights, all fixtures to be of ornamental cast iron, and equipped with Alba glass globes, of sufficient thickness to withstand the vibrations of the bridge without breaking; contract price $10,120, Dearborn Foundry Co., 1525 S. Dearborn St. The contract has not been awarded. L. E. McGann, Commissioner of Public Works.

Indiana.

✣Bids will be received until 1 p. m.,. April 23, by Board of Benton County Commissioners, Fowler, Ind., for the construction of three bridges. Warren Mankey is County Auditor.

It is estimated by Paul Julian, County Surveyor, Indianapolis, Ind., that the cost to Marion County of reconstructing the bridges and retaining walls outside of Indianapolis, which were damaged by the flood, willl amount to more than $100,000.

⊙Haymond & Howard, Waldron, Ind., have been awarded the contract by the Board of Shelby County Commissioners for the construction of creosote block floor on Conn's Creek bridge. The contract price was $824. Bids were opened at Shelbyville, Ind., April 8.

⊙The Board of Jasper County Commissioners, Rensselaer, Ind., has awarded two small bridge repair contracts, one to Rochester Bridge Co., Rochester, Ind., at $247, and the other to F. M. Williams, Winamac, Ind., at $300.

Contracts for the construction of 11 concrete arches and culverts in Noble County will probably be awarded to the following contractors by the Board of County Commissioners, Albion, Ind.: J. E. Doty, Boyer, $412; Metz, $619; J. H. Ziglear, Hybarger, $198.75; Bowers, $190; Swank, $193; Paul Beizley, Kolb, $219; Baker, $263; J. J. Kime, Fuller No. 2, $267; John C. Veazey, Grumlich, $283; Lindsey, $264; Norman, $309. J. C. Kimmell is Auditor.

Contracts for the construction of six culverts in Marion County for which bids were received by the County Board of Commissioners, Indianapolis, Ind., March 31, will probably be let as follows: No. 546, Franklin Township, Hy. Tielking, Indianapolis, Ind.; No. 547, Franklin Township, Hy. Tielking, Indianapolis, Ind.; No. 549, Decatur Township, Charlie Hoover, Maywood, Ind.; No. 550, Decatur Township, Charlie Hoover, Maywood, Ind.; No. 551, Warren Township, Charlie Hoover, Maywood, Ind.; No. 552, Franklin Township, Hy. Tielking, Indianapolis, Ind.

The Marion, Bluffton & Eastern Traction Co. has decided to add a 30-ft. span to the bridge over Rock Creek near Liberty Center when rebuilding the structure. It will be necessary to construct new concrete piers. R. F. Cummins, Bluffton, Ind., is General Manager.

The County Council, Richmond, Ind., has appropriated $25,000 for repairing and improving bridges throughout Wayne County.

A meeting of the Howard County Commissioners was recently held at Kokomo, Ind., for the purpose of taking up the matter of restoring the bridges damaged by the recent floods. It is thought that steps will be taken as soon as possible to get the work of building a cement arch bridge across Wildcat on Washington street under way.

Kansas.

⊙The contract for building the east and west approaches to the Kellogg St. viaduct has been let by the City Commissioners, Wichita, Kan., to the Texas Building Co., Fort Worth, Texas, at $17,901. The contract for paving the structure was let to John Ritchie & Sons at $12,433.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

The Commissioners of Franklin County, Ottawa, Kan., recently inspected two bridges in Lincoln Township near the junction of Mud and Plum creeks. The Mud Creek bridge is too short and it will be moved to Plum Creek, where the present bridge is in bad condition and beyond repair. A new 32-ft. bridge will be constructed on Mud Creek. New abutments will be built by the township.

State Engineer W. S. Gearhart, Manhattan, Kan., has notified Charles F. Dodds, Chairman of the Streets and Alleys Committee of the City Council, Salina, Kan., that a reinforced concrete bridge across the Smoky Hill River on Iron Ave., with a 45-ft. roadway and two 9-ft. sidewalks will cost $31,500.

Louisiana.

An ordinance has been introduced at the meeting of the Commission Council, New Orleans, La., directing the City Engineer, W. J. Hardee, to prepare the plans for a lift bridge over the New Basin at Adams Ave. and to advertise for bids.

Maryland.

✣Bids will be received until about May 21 by the Board of Awards at the office of the City Register, Baltimore, Md., for the construction of a reinforced concrete viaduct about 1,600 ft. long and 75 ft. wide to carry the new roadway over the enclosed Jones Falls, at an approximate cost of something like $250,000. Calvin W. Hendrick is Consulting Engineer.

The Commissioners of Caroline County, Denton, Md., have advertised for bids for the construction of a bridge over the Choptank River on a road to be constructed from Denton to Willow Pond.

It is reported that the Norfolk & Western R. R. has appropriated $600,000 for the bridges to be erected on the Shenandoah Valley division between Hagerstown and Roanoke.

Masachusetts.

✣Bids will be received until 11 a. m., April 16, by the Board of Barnstable County Commissioners, Barnstable, Mass., for the construction of a reinforced concrete girder bridge over Bass River between the towns of Yarmouth and Dennis. Plans, specifications, forms of contract and bond may be had at the office of the engineer, F. C. Wales, 1150 Tremont Bldg., Boston, Mass. A deposit of $10 is required for the plans and specifications.

Michigan.

⊙The Delta County Board of Road Commissioners, Escanaba, Mich., has awarded the contract for the construction of the concrete work on three bridges spanning streams on the new Beaver Road to C. E. Nebel & Sons, Gladstone, Mich., at $1,735.

Minnesota.

Plans, specifications and profiles are being prepared for the construction of a bridge over Tischer's Creek at St. Marie St. and Princeton Ave., Duluth, Minn.

New Hampshire.

The McElwain Plant has submitted proposition to the Board of Aldermen, Manchester, N. H., offering to furnish the necessary land for a connection with the highways and the services of French & Hubbard, Boston, Mass., Engineers, providing the proposed new bridge over the Merrimack River 200 ft. south of the company's plant.

New Jersey.

Plans and specifications for the construction of the new Belleville bridge have been ordered amended by the Joint Bridge Committee of the Boards of Freeholders of Essex, Hudson and Bergen Counties at Newark, Essex County, N. J. R. F. Mattia is Chairman.

New York.

A resolution has been presented to the Board of County Supervisors, Rochester, N. Y., by Supervisor L. J. Dabelheiss, Irondequoit, N. Y., providing that plans be prepared for a bascule double deck bridge over the Genesee River connecting Ontario Beach and Summerville, to replace the present R. W. & O. structure. The cost of the improvement is estimated at about $250,000.

The Common Council of Glens Falls, N. Y., and the Town Board of Moreau recently held a meeting to discuss the matter of building a new bridge over the river at that point. The cost is estimated at about $8,000.

Ohio.

✣Bids will be received until noon, April 30, by Director of Public Service W. J. Springborn, Cleveland, Ohio, for construction of approaches to the subway under the L. S. & M. S. Ry. at East 79th St. Each bid must be made in accordance with the specifications, which may be seen at the office of the Chief Engineer, Room 305 City Hall.

✣Bids will be received until 11 a. m., May 7, by Board of Cuyahoga County Commissioners, Cleveland, O., for the construction of bridge work per report No. 3069, concrete bridge, Lee Road, E. Cleveland township, in accordance with plans and specifications furnished by F. R. Lander, County Surveyor. A certified check for 10 per cent the amount bid must accompany each bid. J. F. Goldenbogen is Clerk of the Board.

⊙The Board of Hamilton County Commissioners, Cincinnati, O., has awarded the contract for the construction of a bridge on Bogart Road, near Kuertz' place, Anderson township, to Peter Praechter, Girard St., Cincinnati, O., at $2,221. Albert Reinhardt is Clerk of the Board.

⊙The contract for the construction of a concrete bridge on Camargo Pike, west of the B. & O. S. W. R. R., in the Village of Madeira, Columbus township, has been awarded by the Board of Hamilton County Commissioners, Cincinnati, O., to Charles Staub, Reading, O., at $942.

⊙Charles Staub, Reading, O., has been awarded a contract by the Board of Hamilton County Commissioners, Cincinnati, O., for the construction of a concrete bridge on Whiskey Run. The contract price was $847. Bids were opened April 4.

⊙The contract for the construction of carpenter repairs to the present Brooklyn-Brighton Bridge has been let by the Board of Cuyahoga County Commissioners, Cleveland, O., to G. A. Cook, 3717 Archwood Ave., Cleveland, O. J. F. Goldenbogen is Clerk of the Board. Bids were opened March 26.

The Board of Hamilton County Commissioners, Cincinnati, O., has awarded the contract for the construction of a concrete culvert on Delhi Pike to M. Hanlon, Cleves, O., at $4,764. Bids were opened April 4. Albert Reinhardt is Clerk of the Board.

A petition has been filed with the Board of Hancock County, Findlay, O., asking that the river bridges be widened 50 ft. The matter has been taken under advisement.

The Commissioners of Huron County, Norwalk, O., estimate the damage to bridges and culverts at about $25,600. A list of the structures damaged is as follows: Peru bridge, Peru township, $2,000. Dickinson bridge, New Haven township, $4,000. Snapp bridge, Greenwich township, $3,500. Shedd bridge, Bronson township, $1,200. Truxell bridge, Bronson township, $500. Knoll bridge, Norwalk township, $500. Brown bridge, Ridgefield township, $200. Pleasant St. bridge, Norwalk city, $1,000. Mead bridge, Greenwich township, $1,200. Whisky Lane bridge, Peru township, $1,000. Ernsberger bridge, Hartland township, $1,000. Miner bridge, Hartland township, $1,000. Fitchville bridge, Fitchville township, $3,000. Damage to small culverts is estimated at $5,000.

Pennsylvania.

✣Bids will be received until 10 a. m., April 23, by D. K. Hoch, County Controller, Reading, Pa., for paving the east and west approach of the Lancaster Ave. bridge and the east approach of the Schuylkill Ave. bridge. Specifications and proposal blanks can be had at the County Commissioner's office, at Reading, Pa., for which a deposit of five dollars must be made, which will be refunded when the same are returned. All bids must be accompanied by a certified check equal to 10 per cent of the aggregate amount of the bid.

✣Bids will be received until noon, May 1, by R. J. Cunningham, Allegheny County Controller, Pittsburgh, Pa., for furnishing material and labor to paint the following county bridges, viz.: No. 3, Allegheny River at Sandusky (Seventh) St.; No. 6, Allegheny River at Thirtieth St., and No. 8, Allegheny River at Sixty-second St. No. 3, Youghiogheny River at Fifth Ave. (except the west span); No. 4, Youghiogheny River at Thirteenth Ave., and No. 6, Youghiogheny River at Boston. Bidders must bid for each bridge separately, but may, in addition, bid for Allegheny and Youghiogheny River bridges as separate groups. Specifications may be seen and blanks for bidding obtained at the office of the County Engineer, Room 308, Court House.

✣Bids will be received until April 23, it is reported, by Board of Berks County Commissioners, Reading, Pa., for paving both approaches to the Bingaman St. bridge and the city approach to the Schuylkill Ave. bridge with Belgian blocks.

⊙The Department of Public Works, Pittsburgh, Pa., has awarded the contract for the construction of the Murray Ave. reinforced concrete bridge to the Dravo Contracting Co., Pittsburgh, Pa. The list of bids received were given in our last issue.

⊙The Board of Carbon County Commissioners, Mauch Chunk, Pa., has awarded the contract for the construction of the new county bridge across Wild Creek in Penn Forest township to R. O. Sendel, Weatherly, Pa.

Preliminary surveys have been made and tentative plans completed for the construction of a $250,000 reinforced concrete arch bridge over the Schuylkill River and the Reading tracks at the site of Genreal Sullivan's bridge on the road to Valley Forge, Pa. A meeting of the interested parties was held recently at Jeffersonville, Montgomery County, Pa., and Ex-Congressman Wanger presided.

A meeting was held at Middleton, Pa., April 3, at which plans were made toward urging the passage of the Martin bill in the Legislature, providing for the bridging of the Susquehanna River at that place.

The Board of Butler County Commissioners, Butler, Pa., is preparing to make repairs on the bridge over little Breakneck Creek in Adams township, known as the Belfore bridge, which was injured by the recent floods. The work will include constructing one new abutment.

Bids were received March 28 by the Board of McKean County Commissioners, Smethport, Pa., for removing the present bridge over Marvin Creek and replacing it with a reinforced concrete ribbed arch bridge. Owing to an error the contract will not be let until after May 12. G. A. Flink, Commonwealth Trust Bldg., Harrisburg, Pa., is Consulting Engineer.

All bids received April 1, by Fuller R. Hendershot, Controller of Luzerne County, Wilkesbarre, Pa., for removing wood and iron superstructure of the present Pittston bridge over the Susquehanna River, altering substructure and constructing a new bridge, were too high and rejected. The work will be readvertised.

Advices from Easton, Pa., state that directors of the Minsi Trail Bridge Co. have placed the proposition before the stockholders to increase the issue of stock from $150,000 to $217,000 for the proposed new bridge across the Lehigh River, connecting Nisky Hill and crossing over the lower portion of the Lehigh plant of the Bethlehem Steel Co.

The County Commissioners and City Officials of Reading Pa., recently held a meeting to discuss the proposition of building a new bridge at Gardner Ave. A temporary structure will be erected immediately. E. B. Ulrich is City Engineer.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

South Dakota.

⊙The contracts for the construction of galvanized culverts in Kingsbury County have been let by W. M. Look, County Auditor, De Smet, S. Dak., to The Omaha Structural Steel Works, Omaha, Nebr., and Sioux Falls Metal Culvert Co., Sioux Falls, S. Dak., respectively.

Virginia.

⊙The Roanoke Bridge Co., Roanoke, Va., has been awarded the contract by the Water Department of the city of Baltimore, Md., for the construction of the two-span bridge at Lock Raven, mentioned in our last issue. The contract price for the superstructure is $50,915. The bridge is to have two 300-ft. through spans, weighing approximately 500 tons.

The Common Council, Norfolk, Va., has voted to adopt an ordinance authorizing a special election on the question of issuing $500,000 of bonds for the proposed bridge from Norfolk to Berkley. W. T. Brooke is City Engineer.

Tennessee.

⊙The Nashville Bridge Co., Nashville, Tenn., has been awarded the contract for the construction of the bridge over Sanders Fork in the 14th district, by the County Council, at a bid of $2,290. Bids were opened April 7.

The County Court, Nashville, Tenn., has made provision for the construction of a $10,000 viaduct 30 ft. wide between the Harding and Charlotte Pikes, near Bosley Spring.

Washington.

The bridge over Mill Creek at Walla Walla, Wash., has been declared unsafe by E. G. Miller, Traffic Manager of the Walla Walla Valley Railway Co., and a new structure will probably be erected this summer.

Wisconsin.

✣Bids will be received until 4 p. m., April 19, by Board of Public Works, Sheboygan, Wis., for furnishing all the material and doing all the work in and about the construction and completion of a bridge over the Sheboygan River at New Jersey Ave., consisting of two fixed spans and the necessary abutments and center pier, according to plans and specifications on file in the office of the board, work to be completed on or before July 15, 1913, or November 15, 1913. Bonds to accompany bids required in the penal sum of $6,000, or in lieu thereof the bidder may deposit with the Board of Public Works the sum of $6,000 in money, or certified check.

⊙The Town of Vienna, Wis., has let the contract for the construction of a new steel and concrete bridge, just south of Norway Grove Church, to W. E. Gifford, Madison, Wis., at $1,300.

The City of Janesville, Wis., will shortly take up the matter of constructing a new 300-ft. reinforced concrete bridge over the river at Milwaukee St., to replace the old wooden structure. It is estimated that the cost will be between $75,000 and $100,000. C. V. Kerch is City Engineer.

According to information received from Janesville, Wis., the town of La Prairie, Wis., has voted to construct a $4,000 bridge over Turtle Creek at Tiffany.

A special committee of the Common Council Bridge and Viaduct Committee, Milwaukee, Wis., recently held a meeting to discuss the Wright St. viaduct proposition. It is hoped to have the matter in shape to secure a provision for it in the 1914 budget.

It has been stated by City Engineer Howard M. West of Glens Falls, N. Y., that the cost of a concrete bridge over the Hudson River between that city and the town of Moreau would amount to about $150,000.

Canada.

✣Bids will be received until May 7 by J. E. Griffith, Engineer of Public Works, Victoria, B. C., for the substructure and erection of superstructure, for the superstructure metal and for alternative designs for concrete arch, on the proposed steel bridge spanning the Thompson River at Lytton, B. C. Drawings, specifications, etc., can be seen at the offices of the government agents at Ashcroft, New Westminster, Vancouver, and at the office of the Public Works Engineer, Parliament Bldgs., Victoria.

⊙McGregor & McIntyre have been awarded the contract for the construction of the steel superstructure and the hand railing of the St. Clair Ave. bridge, Toronto, Ont., at $36,323. The contract for the concrete piers and abutments was awarded to Scott & Lawat at $27,000.

Revised plans for the construction of the proposed viaduct for the Esplanade, Toronto, Ont., are under consideration by the Dominion Board of Railway Commissioners. H. L. Drayton is Chairman of the Board.

ROADS AND STREETS

Alabama.

The citizens of Blount County, Ala., on April 3, it is reported, voted the issuance of bonds in the sum of $150,000 for the construction of good roads. Oneonta is the County Seat.

The citizens of Marshall County, Ala., Guntersville, County Seat, have voted the issuance of bonds to the amount of $130,000 for the construction of modern highways.

The citizens of Cullman County, Ala., Cullman, County Seat, have voted bonds to the amount of $150,000 for the construction of good roads.

Arizona.

Governor Hunt of Arizona has made application to the Postmaster General for $10,000 from the fund for improvement of post roads to be applied to the mail route from Holbrook in Navajo County to Springersville in Apache County, a distance of 102 miles. For the purpose of improving this road, Apache County has appropriated the sum of $25,000 and Navajo County has apropriated $10,000.

California.

✣Bids will be received at the office of the California Highway Commission, 515 Forum Bldg., Sacramento, Cal., until 2 p. m., on April 21, 1913, at which time they will be publicly opened and read, for constructing a portion of a State Highway in San Mateo County between San Mateo and Beresford (IV, S. M., 2, B2) about 2 miles in length, to be built with macadam foundation and asphalt surface. Plans may be seen, and forms of proposal, bonds, contract and specifications may be obtained, at the said office; and they may be seen at the office of the Division Engineer at San Francisco, Cal. Austin B. Fletcher, Highway Engineer; Wilson R. Ellis, Secretary.

✣Bids will be received at the office of the California Highway Commission, 515 Forum Bldg., Sacramento, Cal., until 2 p. m. on April 21, 1913, at which time they will be publicly opened and read, for constructing a portion of a State Highway in San Mateo County between Oak Grove Drive and Bellevue Drive, Burlingame (IV, S. M., 2, A2) about 0.2 miles in length, to be built of Portland cement, concrete and asphalt surface. Plans may be seen, and forms of proposal, bonds, contract and specifications may be obtained at the said office; and they may be seen at the office of the Division Engineer at San Francisco, Cal. Austin B. Fletcher, Highway Engineer; Wilson R. Ellis, Secretary.

✣Bids will be received at the office of the California Highway Commission, 515 Forum Bldg., Sacramento, Cal., until 2 p. m. on April 21, 1913, at which time they will be publicly opened and read, for constructing a portion of a State Highway in Ventura County between the Southerly Boundary and Newbury Park (VII, Ven., 2, A) about 7½ miles in length, to be built of Portland cement, concrete with bituminized surface. Plans may be seen, and forms of proposal, bonds, contract and specifications may be obtained at the said office; and they may be seen at the office of the Division Engineer at Los Angeles, Cal. Austin B. Fletcher, Highway Engineer; Wilson R. Ellis, Secretary.

✣Bids will be received at the office of the California Highway Commission, 515 Forum Bldg., Sacramento, Cal., until 2 p. m., on April 21, 1913, at which time they will be publicly opened and read, for constructing a portion of a State Highway in Santa Clara County between San Jose and Edenvale (IV, S. Cl., 2, B2) about 4½ miles in length, to be built of Portland cement, concrete with bituminized surface. Plans may be seen, and forms of proposal, bonds, contract and specifications may be obtained at the said office; and they may be seen at the office of the Division Engineer at San Francisco, Cal. Austin B. Fletcher, Highway Engineer; Wilson R. Ellis, Secretary.

Bids will be received at the office of the California Highway Commission, 515 Forum Bldg., Sacramento, Cal., until 2 p. m., on April 21, 1913, at which time they will be publicly opened and read, for constructing a portion of a State Highway in San Mateo County between the northerly boundary and the south line of Daly City (IV, S. M., 2, A3) about 1.02 miles in length, to be built of Portland cement, concrete and asphalt surface. Plans may be seen, and forms of proposal, bonds, contract and specifications may be obtained at the said office; and they may be seen at the office of the Division Engineer at San Francisco, Cal. Austin B. Fletcher, Highway Engineer; Wilson R. Ellis, Secretary.

Colorado.

The State Highway Commission of Colorado, Thomas Ehrhart, Commissioner, has divided $318,000 among the counties of the state for the building of new good roads and repairing the old roads.

Connecticut.

✣Bids will be received at the office of Charles J. Bennett, State Highway Commissioner, Room 27, State Capitol, Hartford, Conn., until 2 p. m., of Monday, April 21, 1913, at which time they will be opened and read, for the following sections of road work: Town of Middletown, about 6,000 lin. ft. of macadam or gravel road. Plans and specifications may be seen at the First Selectmen's office, Middletown, Conn. Town of Trumbull, about 5,400 lin. ft. of native stone macadam or gravel road. Plans and specifications may be seen at the house of Lester H. Shelton, First Selectman, Nichols, Conn. Town of Morris, about 6,436 lin. ft. of graded or gravel road. Plans and specifications may be seen at the Town Clerk's office, Morris, Conn. Town of Coventry, about 8,027 lin. ft. gravel road. Plans and specifications may be seen at the Town Clerk's office, South Coventry, Conn. Town of Sharon, about 1,840 lin. ft. of gravel road. Plans and specifications may be seen in the Town Clerk's office, Sharon, Conn. Town of Preston, about 5,177 lin. ft. of native stone macadam road. Plans and specifications may be seen at the house of Walter McClimon, First Selectman of Preston, Preston Road, Preston, Conn. Town of Berlin, about 3,963 lin. ft. of macadam road. Plans and specifications may be seen at the Town Clerk's office, Berlin. Town of Old Lyme, about 5,586 lin. ft. of graded road. Plans and specifications may be seen at the Selectmen's office, Old

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Lyme. Town of Stafford, about 5,530 lin. ft. of bituminous macadam road. Plans and specifications may be seen in the Selectmen's office, Stafford Springs. Conn. Town of Prospect, about 3,771 lin. ft. of graded road. Plans and specifications may be seen at the house of Steven A. Talmadge, First Selectman, Prospect. Conn. Town of Hartford, about 7,567 lin. ft. of bituminous macadam or concrete road. Plans and specifications may be seen at the Selectmen's office, Town Hall, West Hartford, Conn. Town of North Branford, about 4,290 lin. ft. of macadam road. Plans and specifications may be seen at the house of A. J. Hill, First Selectman, North Branford, Conn. A limited number of blue prints of the various sections of road advertised herewith are placed as above noted, for contractor's use. These blue prints can be taken by any contractor upon a deposit of a suitable guarantee to secure their return in good condition on the same day. One set of blue prints will be held at the place of exhibition continually. No specifications can be taken from the place of exhibition. Sets of specifications and blue prints will be furnished to any contractor upon reasonable notice and the payment of the actual cost of preparation. No refund will be made in such cases. A surety company bond or a certified check in the sum of one-third of the amount of the bid must accompany each proposal, conditioned that the successful bidder will sign a contract at the price submitted and furnish a surety company bond or certified check.

Florida.

✣Bids will be received until May 9, by Board of Duval County Commissioners, Jacksonville, Fla., for the paving of the John Anderson Highway and the South Jacksonville Road. Bids for this work, which were received some time ago, were rejected.

⊙The Board of Public Works of Tampa, Fla., has awarded the contract for the laying of 200,000 sq. yds. of brick pavement to R. L. Davis. The prices are as follows: Ordinary brick pavement with sand filler, brick laid on edge, $0.10½, laid flat, 10-12 cts.; pavement laid with cement grout, edge, $0.14½, flat, $0.13; pavement laid with asphalt filler, edge, $0.21½, flat, $0.20½.

⊙The Board of Public Works of Key West, Fla., has awarded the contract for paving Whitehead St., and the streets adjacent to the Naval Station to the Southern Asphalt & Construction Co., for $2.14 a sq. yd., for vitrified brick, $1 a ft., for curbing, $0.21 for resetting, and $0.60 for headers.

City Attorney Odom of Jacksonville, Fla., has prepared the ordinances providing for the paving of a number of streets in the city, and they were presented to the Committee of Public Works of the Board of Bond Trustees. The work will include the following: Granitoid on concrete base—Ionia St., Jesse to Union, $7,945; Lee St., Bay to Adams St., $5,944. Vitrified brick on sand base—Cedar St., Union and State, $1,479; State St., Madison to Davis, $1,622; Eagle St., Hogan to Julia, $2,662; Union St., Cedar to Clay, $2,612; Lancaster Terrace, Riverside Ave. to Bulkhead, $1,174. Dolarway—Market St., Eighth to the City Limits, $15,023; Caroline St., Laura to Julia, $5,159; Charles St., Forest to Price, $2,278; Orange St., Main to Hogan, $4,974; North St., Hogan to Julia, $2,255; Duval from Davis to Stuart, $6,499; Julia St., Eagle to Hogan's Creek, $2,571; Price St., Magnolia to Myrtle Ave., $8,102; Lafayette St., Bay to Church St., $5,621; Schofield St., Hubbard to Market, $1,941. Asphaltic concrete on concrete base—Park St., Margaret to Forest, $33,042; Pearl St., Boulevard to the City Limits, $48,607; Broad St., Ashley to State, $7,397. Asphalt block on concrete base, vitrified brick on concrete base—Church St., Julia to Hogan, $1,367; Bay St., Market to Marsh, $29,451; Clay St., Ashley and State, $8,316; Washington St., Ashley to Union, $6,288.25; Bay St., Broad to Cleveland, $20,939.11.

Georgia.

✣Bids will be received until 3 p. m., April 18 by Chairman of the Street Committee at the office of R. M. Clayton, Chief of Construction, Atlanta, Ga., for the paving of certain streets with rock and chert, with rubble gutters, also for the paving of certain streets with creosoted wood blocks or vitrified brick. The approximate yardages are as follows: Rock and chert, 40,000 sq. yds., with 10,000 yds. of rubble gutters; vitrified brick or wood block, 19,000 sq. yds. Specifications can be obtained upon application to R. M. Clayton, Chief of Construction.

Illinois.

✣Bids will be received (readvertisement) until 8 p. m., April 21, by City of Waukegan, Ill., M. J. Douthitt, Engineer, for paving with brick on 6-in. concrete base, Grand Ave., including 14,750 sq. yds. Bids will be received at the same time for paving St. James St. with brick on 5-in. concrete base requiring about 3,100 sq. yds.

⊙The contract for constructing sewers and pavements by private contract in the third addition to Chester Highlands has been awarded to John A. McGarry Co., 189 W. Madison St., Chicago, Ill. The work includes 10,000 lin. ft. concrete combined curb and gutter, 16,000 cu. yds. excavation, average haul, 600 ft., 14,000 sq. yds. tar macadam pavement, 38 new catch basins 2,100 lin. ft. 12-in. tile pipe sewer, 12,100 lin. ft. 15-in. tile pipe sewer, 3,200 lin. ft. 6-in. tile pipe sewer 62,000 sq. ft. cement sidewalk, 5,000 sq. yds. alley pavement, total, $52,000; Aetna Engineering Bureau, 17 N. La Salle St. Chicago, Ill., Consulting Engineers, in charge.

⊙Charles Payne, of Waukegan, Ill., has been awarded the contract by the Board of Local Improvements of that city, for the paving of Grand Ave., with brick, for $38,286; also for the paving of Lake Court with brick, for $1,617.

⊙J. W. Bushell has been awarded a contract by the Board of Local Improvements of Peoria, Ill., for the resurfacing of Fayette St., with asphalt on top of the old brick paving, for $11,196.

⊙Stipes & Pilcher, 18 N. Walnut St., Champaign, Ill., have been awarded the contract by that city, L. N. Sizer, City Engineer, for the construction of 35,100 sq. yds. of brick pavement, for which bids were opened April 9. The pavement for Park Ave. will cost $19,145; pavement for W. University Ave., $22,954, and that for E. University Ave., $45,430.

Following are the lowest bids submitted to the Board of Local Improvements, Chicago, Ill., for constructing pavements: Berteau Ave., N. 52nd Ave. to N. 53rd Ave., 1,370 lin. ft. granite concrete combined curb and gutter, 60c; 2,270 sq. yds. asphalt pavement, $1.81, American Asphalt Paving Co., 133 W. Washington St. S. 40th Ave., Fillmore St. to W. 16th St. 2,100 lin. ft. sandstone curbing, 30c, 4,300 lin. ft. to be reset, 30c, 11,850 sq. yds. of brick pavement, $2.12, Jas. A. Sackley Co., 133 W. Washington St. 43rd Pl., Union Ave. to Canal St., 2,800 lin. ft. granite combined concrete curb and gutter, 60c; 4,450 sq. yds. asphalt pavement, $1.75, R. F. Conway Co., 133 W. Washington St. N. 51st Ct., Irving Park Blvd. to Berteau Ave., 2,650 lin. ft. granite concrete combined curb and gutter, 60c; 3,450 sq. yds. asphaltic concrete pavement, $1.58, American Asphalt Paving Co. Marshfield Ave., W. 67th St. to W. 72d St., 5,990 lin. ft. granite concrete combined curb and gutter, 60c; 9,790 sq. yds. asphalt pavement, $1.70, American Asphalt Paving Co. Ohio St., Western Ave. to Campbell Ave., 1,300 lin. ft. sandstone curbing, 83c; 2,280 sq. yds. brick pavement, $2.43, J. A. McGarry Co., 189 W. Madison St. Paulina St., W. 67th St. to W. 72d St., 6,700 lin. ft. sandstone curbing, 60c; 10,930 sq. yds. asphalt pavement, $1.70, American Asphalt Paving Co. Wood St., W. 67th St. to W. 72d St., 6,690 lin. ft. granite concrete combined curb and gutter, 60c; 10,920 sq. yds. asphalt pavement, $1.70, American Asphalt Paving Co. Troy St., Irving Park Blvd. to Montrose Ave., Albany Ave., Irving Park Blvd. to Montrose Ave., Belle Plaine Ave., Kedzie Ave. to Sacramento Ave., Cullom Ave., Kedzie Ave. to Sacramento Ave., 17,500 lin. ft. sandstone curbing, 82.5c; 29,730 sq. yds. asphalt macadam pavement, $1.13½, J. A. McGarry Co. 114th St., Stewart Ave. to Yale St., Yale St., 113th to 115th St., 9,100 lin. ft. sandstone curbing, 75c; 13,370 sq. yds. asphalt macadam pavement, $1.21, Farr Bros., 356 W. 111th St. Alley, Cortez St., Humboldt St., etc., 320 lin. ft. concrete curbing, 15c; 260 sq. yds. brick pavement, $2.60, P. J. O'Brien, 10 S. La Salle St. Alley, Belden Ave., Cleveland Ave., etc., 730 lin. ft. concrete curbing, 10c; 530 sq. yds. brick pavement, $2.39, J. A McGarry Co. Alley, Archer Ave., State St., etc., 400 lin. ft. concrete curbing, 15c; 400 sq. yds. granite block pavement, $4.34, J. Dillon, 179 W. Washington St. Alley, 29th St., Calumet Ave., etc., 750 lin. ft. concrete curbing, 10c; 600 sq. yds. brick pavement, $2.56, J. A. McGarry Co. Alley, 41st St., Michigan St., etc., 1,182 lin. ft. concrete curbing 16c; 1,182 sq. yds. brick pavement, $2.22, Jas. A. Sackley Co. Alley, Madison Ave., 61st Pl., etc., 630 lin. ft. concrete curbing, 10c; 500 sq. yds. brick pavement, $2.47, J. A. McGarry Co. Alley, Paulina St., Washington St., etc., 550 lin. ft. concrete curbing, 15c; 550 sq. yds. brick pavement, $2.29, Central Paving Co., 179 W. Washington St. Alley, Ohio St., Carpenter St., etc., 600 lin. ft. concrete curbing 10c; 580 sq. yds. brick pavement, $2.53, J. A. McGarry Co. Alley, Kedzie Ave., Schubert Ave., etc., 1,082 lin. ft. concrete curbing, 15c; 850 sq. yds. brick pavement, $2.29, Central Paving Co. Alley, Cottage Grove Ave., 42d St., etc., 500 lin. ft. concrete curbing, 10c; 370 sq. yds. brick pavement, $2.47, J. A. McGarry Co. Alley, Vernon Park Pl., May St., etc., 740 lin. ft. concrete curbing, 18c; 250 sq. yds. brick pavement, $2.45, P. J. O'Brien. Alley, 12th St., Lytle St., etc., 1,550 lin. ft. concrete curbing, 15c; 1,220 sq. yds. brick pavement, $2.19, Central Paving Co. The work includes preparation of the sub-grade, 6-in. Portland cement concrete foundation, sewer, manhole and catch basin, construction and adjustment, sidewalk construction and adjustment, etc. The contracts have not been awarded. E. J. Glackin, Secretary of the Board.

The citizens of Central Township, Bond County, Ill., at a recent election, voted in favor of the construction of hard roads. Greenville is the County Seat.

Following are the lowest bids submitted to the village board, Harvard, Ill., for constructing pavements and sewers, bids opened April 10: 6,700 sq. yds. concrete pavement, 72 cts.; 2,000 cu. yds. excavation, 35 cts.; 3,500 lin. ft. concrete curbing, 25 cts.; 10-in. sewer pipe 67 cts.; 6-in. sewer pipe, 37 cts.; manhole adjustment, $2.75 each; catch basin inlets, $2.75; 86 house drains, total, $8,186. Z. Graziano, Chicago, Ill. The contract has not been awarded. H. M. Price, Consulting Engineer 1207 Hartford Bldg., Chicago, Ill. The contract has not been awarded.

Indiana.

✣Bids will be received until May 5, by Board of blackford County Commissioners, Hartford City, Ind., for the construction of two roads. James Cronin, Jr., is County Auditor.

✣Bids will be received until 10 a. m., May 5, by Board of Clark County Commissioners, Jeffersonville, Ind., for the construction of two public highways. G. W. Stoner is Auditor.

✣Bids will be received until noon, May 1, by Board of Jay County Commissioners, Ind., and Board of Darke County Commissioners, O., at the office of L. Morgan, County Auditor, Greenville, O., for the construction of a gravel road.

✣Bids will be received until 10 a. m., May 7, by Board of Shelby County Commissioners, Shelbyville, Ind., for the construction of a gravel road in Union township. F. W. Fagel is County Auditor.

✣Bids will be received until 1 p. m., May 6, by Board of Wabash County Commissioners,

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Wabash, Ind., for the construction of four highways in Noble township. Daniel Showalter is County Auditor.

✣Bids will be received until 2 p. m., May 6, by Board of Knox County Commissioners, Vincennes, Ind., for the construction of gravel roads in Johnson, Vincennes and Vigo townships. J. T. Scott is County Auditor.

✣Bids will be received until 10 a. m., May 5, by Board of Vermillion County Commissioners, Newport, Ind., for the construction of gravel road in Vermillion township. Roy Slater is County Auditor.

✣Bids will be received until 10 a. m., April 29, by the Depot Quartermaster, Jeffersonville, Ind., for furnishing and delivering supplies, including wagons and appurtenances.

⊙Following contracts have been awarded by the Board of Public Works of Indianapolis, Ind.: 29th St., from Central to Fall Creek Blvd., asphalt roadway, to Republic Construction Co., at $3.43 per lin. ft.; Ashland Ave., from 13th to 14th, asphalt roadway, to Republic Construction Co., at $2.44 per lin. ft.; Ashland Ave., from 25th St. to Bellefontaine, asphalt roadway, to Republic Construction Co., at $3.34 per lin. ft.; Broadway, from 32nd to 34th St., asphalt roadway, to Republic Construction Co., at $3.05 per lin. ft.; 28th St., from Sutherland to Bellefontaine, asphalt roadway, to Republic Construction Co., at $3.88 per lin. ft.

⊙Evans & Van Natta have been awarded the contract by the Board of Newton County Commissioners, Kentland, Ind., for the construction of six gravel roads, for $5,100. Bids were opened April 7.

⊙Bennett & Scammahon, Rockport, Ind., have been awarded the contract by the Board of Spencer County Commissioners, Rockport, for the construction of 1½ miles of rock road, for $4,974. Bids were opened April 7.

⊙Jas. C. Brown, Salem, Ind., has been awarded the contract by the Board of Washington County Commissioners, Salem, for the construction of a gravel road in Polk Township, for $14,890. Geo. M. Albertson, Orleans, Ind., secured the contract to construct a stone road in Washington Township, for $16,394. Bids were opened April 7.

⊙The Mt. Vernon Construction Co., Mt. Vernon, Ind., has been awarded the contract by the Board of Posey County Commissioners, Mt. Vernon, for the construction of a gravel road in Black Township for $10,403. Bids were opened April 7.

⊙The following were the successful bidders for the construction of roads in Adams County, Ind., for which bids were opened April 8, by the County Commissioners at Decatur, Ind.: Merryman & Fugate, Decatur; David Gerber, Decatur; James O. Hoagland, Decatur; E. H. Faust, Decatur, and J. R. Tumbleson, Monroe.

⊙J. C. O'Connor & Son, Delphi, Ind., have been awarded the contract by the Board of Carroll County Commissioners, Delphi, for the construction of gravel roads in Monroe and Tippecanoe Townships, for $4,495. Bids were opened April 8.

⊙Dan Thomas, of Dana, Ind., has been awarded the contract by the Board of Vermillion County Commissioners, Newport, Ind., for the construction of the James Beard et al. gravel road in Hilt Township, for $2,945. Paul Thomas, Dana, secured the contract to construct the Harry E. Porter road in Eugene Township, for $12,190. Bids were opened April 7.

⊙James P. Wilson, of Paoli, Ind., has been awarded the contract by the Board of Orange County Commissioners, Paoli, for the construction of the Orleans & Livonia road, for $3,127. Chas. Trowbridge, of West Baden, Ind., secured the contract to construct the West Baden and Mitchell road, for $3,514. The work includes grading and macadamizing. Bids were opened April 8.

⊙Bert Wood, of Farmersburg, Ind., has been awarded the contract by the Board of Sullivan County Commissioners, Sullivan, Ind., for the construction of the Samuel Douglas gravel road in Curry Township, for $5,960. Bids were opened April 8.

⊙Wm. McCarthy, R. F. D., Lebanon, Ind., has been awarded the contract by the Boone County Commissioners, Lebanon, for the construction of the Calvin Dickenson gravel road, for $7,200.

⊙Howard M. Chapel, of Knox, Ind., has been awarded the contract by the Board of Starke County Commissioners, Knox, for the construction of a gravel road, for $5,945. Bids were opened April 7.

The Board of Harrison County Commissioners, Corydon, Ind., did not let contracts for the construction of a gravel road in Taylor Township, for which bids were opened April 8.

Iowa.

✣Bids will be received until 8 p. m., April 17, by J. J. Shea, City Recorder, Dubuque, Ia., for improving alley between Rhomberg Ave. and Garfield Ave., from Fengler Ave. to Ann Ave., in accordance with the plans and specifications prepared by the City Engineer and now on file in the office of the City Recorder. It is estimated by the City Engineer that said improvement will require: 867 sq. yds. of Telford macadam, 465 cu. yds. of cutting.

✣Bids will be received until 8 p. m., April 17, by J. J. Shea, City Recorder, Dubuque, Ia., for improving Nevada St., from the southerly lot line of Langworthy Ave. to the northerly curb line of Dodge St., in accordance with the plans and specifications prepared by the City Engineer and now on file in the office of the City Recorder. It is estimated by the City Engineer that said improvement will require: 1,800 lin. ft. of combination Portland cement curb and gutter, 2,700 sq. yds. of Telford macadam, 852 cu. yds. of earth filling, 5,267 cu. yds. of earth cutting and rock cutting.

✣Bids will be received until 7:30 p. m., April 23, by City Clerk, Clear Lake, Ia., for paving certain streets with cement, brick, dolarway and asphalt. The work will require about 19,000 sq. yds. H. D. Keerl. 204½ South Main St., Mason City, Ia., is Engineer.

⊙The Davenport Stone & Marble Co. has been awarded the contract by the City Council of Davenport, Ia., for the construction of permanent sidewalks for the city during the present year, for $0.10¾ for the first and third road districts and $0.10½ for the second district.

The City Clerk of Davenport, Ia., has advertised for bids for furnishing a street flusher for the asphalt paving in the city and for two additional wagons as equipment for the Health Department.

The City Council of Des Moines, Ia., will let contracts April 16 for 18 improvements to cost $110,000. The work will include 24,737 lin. ft. of curbing, at an estimated cost of $9,000, and 50,092 sq. yds. of paving, to cost about $101,000. Al. Frisk is Chief Clerk of the Department of Streets.

Citizens of Blackhawk County, Ia., are agitating a proposition to bond the county to the amount of $400,000 for the purpose of building good roads. Waterloo is the County Seat.

Kentucky.

⊙The Fiscal Court of Jefferson County, Louisville, Ky., has awarded the contract for making 18th St., road, from the end of the present macadam to Salt River bridge, to T. B. Miller & Co.; also a contract to construct Seventh St. road to F. G. Breslin.

The Board of Public Works of Louisville, Ky., plans street and alley improvements this year that will cost approximately $427,000. Wood block, asphalt and vitrified brick will be used in the paving of 73 blocks of streets. The sewers planned will cost about $210,750. John D. Wakefield is Chairman of the Board.

Louisiana.

✣Bids will be received until April 29 by Town of De Ridder, La., Z. T. Heard, City Attorney, for about 7 miles of sidewalks. Official advertisement will be found elsewhere in this issue.

Maryland.

✣Bids will be received until 11 a. m., April 23, by Board of Awards, at the office of the City Register, Baltimore, Md., for the construction of about 1.9 miles of macadam road known as Road No. 1, Improvement Gunpowder Supply Contract No. 7. Plans and specifications may be obtained at the office of the Water Engineer, City Hall, Baltimore, Md. A charge of $10 will be made for each set of plans and specifications. This amount will be refunded on their return on or before April 26, 1913, in good condition. Specifications used in making a bid will be considered as returned. A certified check of the bidder on a Clearing House bank, made payable to the Mayor and City Council of Baltimore, for the sum of $1,000 will be required with each bid. Approximate quantities are as follows: Clearing and grubbing, 9 acres; stripping, 1,000 sq. yds.; earth excavation, 13,210 cu. yds.; loose rock excavation, 12,060 cu. yds.; solid rock excavation, 22,950 cu. yds.; rubble masonry, 460 cu. yds.; concrete road drains, 18 cu. yds.; 24-in. reinforced concrete pipe, 204 lin. ft.; 48-in. reinforced concrete pipe, 58 lin. ft.; 72-in. reinforced concrete pipe, 132 lin. ft.; concrete for head walls, 106 cu. yds.; macadam (8-in. depth), 5,597 sq. yds.; macadam (16-in. depth), 5,597 sq. yds.; underdrain, 4-in. terra cotta pipe, laid in broken stone, 1,000 lin. ft. The successful bidder will be required to give bond and comply with the City Charter respecting contracts. Ezra B. Whitman is Water Engineer.

✣Bids will be received until noon, April 22, by State Roads Commission, 534 N. Howard St., Baltimore, Md., for building 7 sections of state highway, aggregating about 24.87 miles in length, as follows: Allegany County—One section along the National Pike, through the Town of Flintstone to foot of Polish Mountain, about 3.00 miles in length (local and limestone). Charles County—One section along the road from Indian Head to Mason's Springs, about 2.73 miles in length (gravel). One section along the road from Waldorf St., Mary's Co. Line road to Bryantown, about 0.81 mile in length (gravel). One section along the road from Rock Point to Wayside Road, about 8.20 miles in length (concrete and gravel). Carroll County—One section along the road from Manchester toward Cranberry, about 1.63 miles in length (concrete or macadam). Garrett County—One section along the National Pike from Grantsville, three miles east, about 3.00 miles in length (local and limestone). Harford County—One section along the road from Belair to Churchville Road, about 5.50 miles in length (local stone). Bids must be made upon the blank form contained in the book of specifications, which will be furnished by the Commission upon application and payment of $2 for each section. Blue prints of each section will be furnished at the rate of 25 cts. for each half mile. No bids will be received unless accompanied by a certified check for the sum of $500, payable to the State Roads Commission. W. L. Marcy is Secretary.

⊙The Hassam Paving Co., of Worcester, Mass., has been awarded the contract by the State Roads Commission, Baltimore, Md., for the building of 13.23 miles of concrete roads, at bids aggregating over $150,000. The contracts were as follows: 1.37 miles in Carroll county, on the Meadow Branch road, from Westminster toward Frizzleburg, macadam; to I. C. Moller, $17,634; .49 miles of the York road, running through Towson, bituminous concrete; to the Elder Paving Company, $18,348. The owners of abutting property agreed to pay $2,615 of this amount, for curbing and gutter; .91 mile in Harford county, from Belair to Conowingo, macadam; to Little & Spencer, $7,921; 1.46 miles on State road No. 1 (Washington Boulevard), from Sulphur Springs road to the Philadelphia, Washington & Baltimore railroad at Winans, macadam; to Rich & Justi, $17,702; 2.71 miles in Somerset county, from Crisfield to Hopewell, concrete, Hasson Paving Company, $30,425; 1.72 miles in Carroll county, from Taneytown toward

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Frizzleburg; concrete. Hasson Paving Company $16,853; 2 miles in Talbot County, from Easton to Wye Milles; concrete. Hasson Paving Company, $19,536; 4.80 miles in St. Mary's county, from Mechanicsville to Oaks; concrete. Hasson Paving Company, $53,136; 2 miles in Montgomery county, from the southern end of the improved road from Ridgeville toward Damascus; concrete. Hasson Paving Company, $26,852; 2.12 miles in Montobery county, from Cedar Grove north, towards Damascus; macadam. I. C. Moller, $25,732. A contract for motor and lights for the new draw bridge at Sharptown, in Wicomico county, was awarded to E. I. Rosenfeld & Co., the price being $1,250. The board agreed to build one mile of road in Baltimore county from Black Rock to Hampstead, under the State Aid Road law.

Massachusetts.

The City Council of Boston, Mass., has voted a loan of $300,000 for new streets and $100,000 for improvements to various playgrounds.

Michigan.

Berrien County, Mich., on April 7 voted bonds to the amount of $500,000 for the construction of good roads. It is planned to expend $125,000 each year for four years on the roads. A road will be built from Niles to St. Joseph, the county seat, and from Niles to Buchanan.

The City of Manistee, Mich., on April 7, it is reported, voted bonds in the sum of $35,000 for the paving of certain streets.

Minnesota.

✣The Town Board of Henrietta, Minn., will receive bids, it is reported, until April 19 for the breaking of the road from Nevis to Chas. Sargends place. Peter Avenson is Town Clerk.

✣B. J. Gunderson, Town Clerk, Moorhead, Minn., it is reported, will receive bids until May 3, for the construction of grade between certain sections of roads in the Township of Moland. A check to the amount of $300 must accompany each bid.

✣County Auditor Ernest Shepard, Marshall, Minn., it is reported, will receive bids until April 21, for building and grading the roads in certain sections of township. Certified check to the amount of 5 per cent of the amount of the bid is to accompany each bid.

⊙The McMullin Lumber Co., of Hastings, Minn., has been awarded the contract for furnishing lumber for replanking the High Wagon bridge, for $28 per M, as follows: 1,080 plank, 2x10 ins., 14 ft. long; 500 plank, 2x12 ins., 14 ft. long; 30 plank, 2¼x12 ins., 18 ft. long; 30 plank, 2¾x12 ins., 12 ft. long. All to be good, sound Washington fir plank of full dimensions as specified, not kiln-dried. Bids were opened April 8.

The City Council of Hibbing, Minn., has adopted a resolution providing for the paving of every street from Railroad to McKinley and from First to Fifth Aves., including practically all of Fourth Ave.

The City Council of Duluth, Minn., did not let the contracts for street paving to cost approximately $200,000, for which bids were received April 4. The matter will be held over until the new city officials take office.

The Board of Public Works of St. Paul, Minn., has approved the proposed paving of a portion of Summit Ave. The work will be done under the supervision of Oscar Claussen, City Engineer. The estimated cost is $95,200.

The City Council of Crookston, Minn., has practically decided to call for new bids for the paving to include concrete base and a bituminous surface.

Mississippi.

The citizens of Meridian, Miss., have voted bonds to the amount of $25,000 for street improvements.

Missouri.

✣Bids will be received until 7:30 p. m., April 21, by City Council of Poplar Bluff, Mo., for improving by grading, paving with vitrified brick and curbing and guttering the following streets: Main St.; Vine St. and Pine St., total amounts consisting of about 28,175 sq. yds. of vitrified brick on a 4-in. concrete base and a 1½-in. sand cushion; asphalt filler; 18,790 lin. ft. of combined 6-in. curb and 18-in. gutter; 1,963 ft. of protection concrete headers; 7,575 cu. yds. of grading; 400 ft. of 12-in. pipe; 80 ft. of 8-in. pipe; 8 catch basins and 4 curb boxes; bids may be on each street separately, all streets or less number. Proposals must be accompanied by cash or certified check for 5 per cent of the aggregate proposal, payable to H. H. Wilcox, City Clerk of the City of Poplar Bluff, Missouri. Plans and specifications may be seen at the office of the City Engineer, Edward C. Thomes, or copies may be obtained upon receipt of $5.

✣Bids will be received until 2 p. m., April 17, by Board of Park Commissioners, City Hall, Kansas City, Mo., for furnishing all the materials and doing all the work necessary to complete the grading of a portion of Union Station Park, according to contract plans and specifications on file in the office of the Board of Park Commissioners at the City Hall, in Kansas City, Mo. The work involves the excavation and removal of approximately 300,000 cu. yds. of material. A certified check for $1,000 must be filed with each bid. T. C. Harrington is Secretary of the Board.

✣Bids will be received until 5 p. m., April 21, by E. W. Robinson, City Engineer, Webb City, Mo., for constructing 22,825 sq. ft. of concrete sidewalk; 4,443 lin. ft. concrete combined curb and gutter; and 7,263 sq. yds. of asphalted macadam pavement, peneration method.

⊙The Board of Public Works of St. Joseph, Mo., has let a contract for paving with concrete Sacramento St., from 28th to 30th St., to the Land Construction Co. The Rackliffe-Gibson Construction Co., secured the contract for paving with Hassam Renick St., from 26th to 27 St. E. P. Olsen was successful bidder for the grading of Angelique from 29th to 30th, and the Kelley Construction Co. have contracted to grade the alley between 16th and 17th from Charles to Edmond. The Reinert Bros. Construction Co. will pave with concrete the alley between Sixth and Seventh from Messanie to Sylvanie. The Rackliffe-Gibson Construction Co. will pave Mulberry from 22nd to 24th with sheet asphalt.

⊙The Commissioners of Fulton Special Road District, Fulton, Mo., have let the contract for graveling several of the main roads in that district to the J. H. Sutherland Construction Co., of Kansas City, Mo., for approximately $30,000. The improvement will cover about 14 miles.

Montana.

⊙McGuire & Lord have been awarded the contract by the City of Hamilton, Mont., for the paving of a number of streets, for about $20,000.

New Jersey.

✣Bids will be received until 4 p. m., April 23, by Mayor and Council, Hoboken, N. J., for repairing and repaving the asphalt pavements on certain streets. James H. Londrigan is City Clerk.

⊙George & Conlon, 207 Market St., Newark, N. J., have been awarded the contract by the Board of Chosen Freeholders, Sussex County, Newton, N. J., for the completion of the Franklin Stockholm road. Bids were opened April 7. The contract for the Whitehall section of the Newton-Stanhope road was awarded April 10. The former road was let at $0.60 for earth, $2.50 for rock, and $1.20 for macadam.

⊙The contract for paving High St., Millville, N. J., with a vitrified brick to stand a 20 abrasion test under the new rattler, on a 6-in. concrete base, using an asphalt filler between the blocks was awarded, 21,000 sq. yds. by city and 7,000 sq. yds. by traction company to the Eastern Construction and Paving Co., at their bid of $2.44 per sq. yd. on a Mack block. Other bids were Kelly-McFeeley, Camden, N. J., Mack block, $2.49; Metropolitan, $2.49; Bessemer, $2.49; A. T. Osborne, Binghamton, N. Y., Mack, $2.57; Metropolitan, $2.50; Model, $2.50; Patterson, $2.40; Glengary, $2.39; Field, Barker & Underwood, Philadelphia, Mack, $3.05; Metropolitan, $2.97; Bessemer, $2.97; J. F. Shanley Co., Newark, Mack, $3.10; Metropolitan, $3.03; Bessemer, $3.03; Hassam Paving Co., Worcester, Mass., Mack, $2.66; Bessemer, $2.61; Model, $2.68; Sutton & Corson, Ocean City, N. J., Mack, $2.77; Metropolitan, $2.68; Keshequa, $2.75; Glengary, $2.64. Martinet Bros., Wildwood, N. J., Mack, $2.53½; Metropolitan, $2.53½; Clearfield, $2.48½; Mayer, $2.52½. Newton B. Wade is the City Engineer.

⊙The Borough Council of North Wildwood, N. J., has sold bonds for the erection and extension of the boardwalk from 18th to 26th Aves. Rufus P. Hays, of Wildwood, secured the contract to construct the walk, for $13,000.

The citizens of Haddon Heights, N. J., will vote on a proposition to issue bonds in the sum of $30,000 for street paving.

New York.

The City Council of Albany, N. Y., is reported to have issued an ordinance authorizing a bond issue of $450,000 for the repaving of a number of streets, with brick, asphalt, wood, granite, stone or concrete. Frank R. Lanagan is City Engineer.

The City Council of Fulton, N. Y., has decided to pave South First St., from Rochester St. to Broadway.

The citizens of Seneca Falls, N. Y., will shortly vote on the issuance of bonds in the sum of $30,000 for the paving of streets. Bids will be received at once for street sprinkling.

The Common Council of Albany, N. Y., has authorized a bond issue of $450,000 for a systematic repaving of a number of streets.

North Dakota.

✣C. W. Burnham, County Auditor, Carrington, N. D., it is reported, will receive bids until 2 p. m., April 18, for the grading to be done on the roads in Townships 145, 146 and 147.

The City Commission of Mandan, N. D., has passed a resolution creating a paving district and will probably engage State Engineer Atkinson to prepare the plans.

Ohio.

✣Bids will be received at the office of County Commissioners at Medina, Ohio, until 10 a. m., April 29, 1913, for grading and paving with a water-bound macadam pavement the Sec. 1 Medina-Wooster road, State Highway "C" Pet. No. 546 in Montville Twp., Medina County; length 3,485 ft., or 0.66 miles; width of paving, 10 ft.; estimated cost of construction, $5,526. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, August 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of County Commissioners at Medina, Ohio, until 10 a. m., April 29, 1913, for grading and paving with a concrete pavement the Wadsworth-Wooster road, State Highway "B" Pet. No. 548 in Wadsworth Twp., Medina County; length, 3,432 ft., or 0.65 mile; width of paving, 10 ft.; estimated cost of construction, $9,782. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, August 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of State Highway Commissioner at Columbus, Ohio, until 2 p. m., April 30, 1913, for grading and paving with a concrete pavement with a bituminous surface treatment, the Scotland Station Easterly road, State Highway "E" Pet No. 537, in Chester Twp., Geauga County: length, 5,800 ft., or 1.10 miles; width of paving, 14 ft.; estimated cost of construction, $12,319. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, August 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received until noon, April 24, by W. H. Kirby, Secretary, Director of Public Service, Cleveland, O., for the construction of concrete or asphaltic concrete pavement in Shaker Heights Park. Section 1—South Shaker Blvd., from Lee Road to South Woodland Road. Section 2—That portion of the park boulevard that lies between the triangle in South Shaker Blvd. west of Lee Road and North Woodland Road. Each bid must be made in accordance with the plans and specifications which may be obtained at the office of the Park Superintendent, Room 214, City Hall.

✣Bids will be received until noon, April 24, by W. H. Kirby, Secretary, Director of Public Works, Cleveland, O., for the construction of concrete or asphaltic concrete pavement in Shaker Heights Park. Section 1—South Shaker Blvd., from Lee Road to South Woodland Road. Section 2—That portion of the park boulevard that lies between the triangle in South Shaker Blvd. west of Lee Road and North Woodland Road. Each bid must be made in accordance with the plans and specifications which may be obtained at the office of the Park Superintendent, Room 214 City Hall.

✣Bids will be received until noon, April 24, by W. H. Kirby, Secretary, Director of Public Service, Cleveland, O., for one steam shovel with equipment. Each bid must be made in accordance with the specifications which may be obtained at the office of the Park Superintendent, Room 214 City Hall.

✣Bids will be received until noon, April 22, by H. H. Canfield, Clerk Village of Cleveland Heights, 309 Beckman Bldg., Cleveland, O., for the furnishing of one steam roller for said village, according to plans and specifications on file at the office of said Clerk at the Town Hall, and at the office of F. A. Pease, 931 Williamson Bldg., Cleveland, O.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., April 25, 1913, for grading and paving with bituminous surface treated concrete, the Columbus Road. State Highway "D," Petition No. 466, in Scioto Township, Ross County. Length, 5,280 feet, or 1.00 mile. Width of pavement, 16 ft. Estimated cost of construction, $10,391. Alternative bids will also be received, for grading and paving the above road with brick for heavy traffic. Estimated cost of construction, $18,903. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, August 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., April 25, for grading and paving with brick for heavy traffic, the Akron Canton Road. State Highway "F," Petition No. 495, in Springfield Township, Summit County. Length, 10,200 ft. or 1.93 miles. Width of pavement, 13-14 ft. Estimated cost of construction, $34,360. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, August 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., April 25, 1913, for grading and paving with a waterbound macadam having a bituminous surface treatment, the New Lexington and Logan Road. State Highway "B," Petition No. 596, in Pike Township, Perry County. Length, 5,280 ft. or 1.00 mile. Width of pavement, 14 ft. Estimated cost of construction, $11,841. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, August 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., April 25, 1913, for grading and paving with bituminous macadam, the Central Avenue Extension Road. State Highway "E," Petition No. 603, in Richfield Township, Lucas County. Length, 5,922 ft. or 1.12 miles. Width of pavement, 14 ft. Estimated cost of construction, $11,702. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the County Commissioners at Cleveland, Ohio, until 11 a. m., April 26, 1913, for grading and paving with a brick for heavy traffic, the No. 3 Richmond Road. State Highway "D," Petition No. 374, in Euclid Township, Cuyahoga County. Length, 7,000 ft. or 1.33 miles. Width of pavement, 14 ft. Estimated cost of construction, $38,012. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, August 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

⊙Morgan Bros., Ravenna, O., have been awarded the contract by the Department of Public Service of that city, W. H. Linton, Director, for grading, draining, curbing and paving Cleveland Ave. and North Chestnut St., for $21,193. Bids were opened March 31.

⊙O. E. Robinson, Hamilton Ave., Cincinnati, O., have been awarded the contract by the Board of Hamilton County Commissioners, Cincinnati, for the improvement of the North Bend road from Hamilton pike to Carthage in Springfield and Mill Creek Townships, for $15,511. Bids were opened April 4.

⊙Following contracts were awarded by the Department of Public Service of Elyria, O., G. H. Lewis, Director, for the construction of about 25,000 sq. yds. of pavement and 17,000 lin. ft. of curbing, for which bids were opened April 8: Eighth St., Elyria Construction Co., also Ninth St.; 10th St., Asphalt Block Paving Co.; also 12th, George, Columbus and Glenwood Sts. Bids were received for Wenckles St. and Dewey Ave. were rejected.

⊙George Garaux has been awarded the contract by the City of Canton, O., for the paving of Cassilly St., from Tuscarawas St. to Summit St., for $16,772. Metropolitan block with tar filler will be used. Bids are now being considered for the paving of West Eighth, Cook, Williams and Strubble Sts.

⊙Minnick & McLaren, of Newcastle, Ind., have been awarded the contract at Archbold, O., for the paving of South Defiance St., with Bessemer block, for $17,236. Other bidders were: Asphalt Block Pavement Co., Toledo, O., $19,453; E. A. Freshwater & Sons, Cleveland, $19,621; A. W. Fishbaugh, Celina, O., $19,119; Marsman & Green, Grand Rapids, Mich., $19,140; Jos. Karch & Son, Celina, $18,209, and Chas. F. Rice, Archbold, $18,469. George Champe, of Toledo, O., is Engineer.

The Stark County Commissioners, Canton, O., J. H. McConnell, Auditor, rejected all bids received April 7. for the construction of the Alliance-Harrisburg road, consisting of 9.69 miles of brick pavement. All bids were above the engineer's estimate.

Oregon.

✣Bids will be received until 11 a. m., April 24, by Lieut. R. F. Cox, Portland, Ore., Quartermaster, Fort Stevens, Ore., for the construction of roads and walks at that post.

⊙The Montague-O'Reilly Co., of Portland, Ore., has been awarded a contract at McMinnville, Ore., for the construction of Eloso paving on a 6-in. concrete base, for $108,581. The work includes 64,000 sq. yds.

Following bids were recently received at Portland, Ore., for street work: Rodney Ave., bitulithic redress, Warren Construction Co., Journal Bldg., Portland, $36,671; E. 26th St., Hassam class "B," Oregon-Hassam Paving Co., $10,163; 42nd St., southeast, Cochran-Nutting Co., $17,654; E. Lincoln St., gravel bitulithic, Pacific Bridge Co., $19,969; E. Lincoln St., Oregon Independent Paving Co., $22,689.

Pennsylvania.

✣Bids will be received until 8 p. m., April 17, by City Clerk, Easton, Pa., for the paving of Spring Garden St. from Front to Fourth St., Fourth St. from Church to Bushkill St., and Front St., from Spring Garden St. to County Bridge No. 2, with amiesite pavement; and Ferry St., from Fourth to West St., with vitrified paving block, in accordance with specifications and plans on file at the office of the City Engineer. C. A. Reese is City Engineer.

✣Bids will be received until 5 p. m., April 21, by Minott M. Baker, Acting Engineer, Municipal Bldg., Sewickley, Pa., for the paving of Nevin Ave., from Hill St. to the Borough line, with vitrified paving block, in the Borough of Sewickley, Pa., with the following approximate quantities: 1,700 cu. yds. excavation, 300 lin. ft. new curb, 1,650 lin. ft. curb redressed and reset, 3,035 sq. yds. vitrified paving block.

✣Bids will be received until 10 a. m.. April 18, by City Controller, Pittsburgh, Pa., for making certain public improvements as follows: Grading, curbing and paving with brick. Aspen St., from Cypress St. to Liberty Ave.; Canoe Alley, from Woolslayer Alley to Cabinet St.; Jordan Alley, from Winebiddle St. to Evaline St.; Princess Ave., from Westfield St. to Profile Ave.; Saline St., from William Pitt Blvd. to Monitor St. Grading, curbing and paving with asphalt—Ridgeville St., from Barnsdale St. to Dallas St.; Elwood St., from Summerlea St. to Maryland Ave.; Hamilton Ave., from Lambert St. to Fifth Ave.; Fingal St., from Greenleaf St. to Rockledge St.; McDonald St., from Meadow St. to east line of Kaiser's Plan of Lots. Grading, paving and curbing with asphalt and brick—Melvin St., from Wightman St. to Phillips Ave. Grading, curbing and paving with blockstone and brick—Kathleen St. from Beltzhoover Ave. to Pittsburgh & Castle Shannon

Incline tracks. Grading, curbing and paving with blockstone—Travella Blvd., from Lincoln Ave. to City Line. Sewers—Ellsworth Ave., north sidewalk, from the existing 8-in. sewer at St. James Place to the existing sewer crossing Ellsworth Ave., at a point about 120 ft. west of Colonial Place, with a branch sewer on St. James Place, 15-in. pipe with 9-in. laterals. Hamilton Ave., from a point about 25 ft. east of Julius St. to the present sewer on Fifth Ave., 9 and 15-in. pipe. Hamilton Ave., from a point about 20 ft. west of Enterprise St. to present sewer at Lambert St., 9 and 15-in. pipe. Phillips Ave., south sidewalk, from the crown east of Wightman St. to the sewer on the east sidewalk of Melvin St., 15-in. pipe. Ridgeville St., both sidewalks, from the crown on Ridgeville St. to the present sewers on Barnsdale St. and Dallas St. Third Ave., from a point about 30 ft. northwest of Grant St. to the present sewer on Cherry Way, 15-in. pipe. Light posts—Furnishing and erecting light posts for Hoeveler St. bridge over Everett St. All bids shall be made upon the regular printed form to be obtained at the office of the Department of Public Works, Room 432, Oliver Bldg., on and after April 9, 1913. All bids must be accompanied in the amount of 50 per cent of the estimated cost of the proposed contract.

⊙The Central Construction & Supply Co. of Harrisburg, Pa., has been awarded the contract for paving the streets of Chambersburg, Pa., at $2.19 a sq. yd. for Fairmont brick with concrete curbing at $0.62 a lin. ft.

⊙Samuel Gamble of Carnegie, Pa., has been awarded the contract for the construction of 3,000 sq. yds. of Dolarway pavement at Rochester, Pa. Contract awarded April 6.

⊙Following contracts were awarded by the Department of Public Works of Philadelphia, Pa., for street paving, recommended by the Bureau of Highways, William H. Connell, Chief, for which bids were opened March 27: Schedule "A"—grading—Geo. Ungerer, 4,921 N. Fairhill St., one contract, $411; John Devlin, Jr., Hancock and Thompson Sts., two contracts, $1,117. Schedule "B"—paving with asphalt—Philadelphia Paving Co., 1345 Arch St., 14 contracts, $73,857. Schedule "C"—paving with vitrified blocks—D. J. Lynch, 3906 Girard Ave., one contract, $5,217; Mack Paving & Con. Co., Fidelity Bldg., three contracts, $11,289; Cunningham Paving & Construction Co., 1345 Arch St., four contracts, $14,196; Franz Paving Co., 2nd St. and Fishers Ave., one contract, $4,311. Schedule "D"—paving with granite blocks—D. J. Lynch, 3906 Girard Ave., one contract, $11,420. Schedule "E"—repaving with asphalt—Philadelphia Paving Co., 1345 Arch St., 10 contracts, $29,632; Union Paving Co., 112 N. Broad St., five contracts, $5,093. Schedule "F"—repaving with vitrified blocks—D. J. Lynch, 3906 Girard Ave., six contracts, $12,836. Schedule "G"—resurfacing with asphalt—Philadelphia Paving Co., 1345 Arch St., 30 contracts, $92,258; Union Paving Co., 112 N. Broad St., one contract, $554. Schedule "H"—repairing and patching streets—Union Paving Co., 112 N. Broad St., one contract, $170,000. Schedule "I"—grading, paving, repaving and repairing sidewalks—Joseph McHugh, 60th and Angora Ave., one contract, $4,459.

The Public Works Committtee of the City Council, Pittsburgh, Pa., has recommended the construction of retaining walls to prevent landslides, as follows: Chislett St., near Bryant, $15,000; Waldorf St., $4.500; North and Irwin Aves., from Rope Alley to Beach Ave., $1,000; Buffington Ave., $10,000; Center Ave., and Neville St., $2,000; Collins Ave., north of Hoeveler St., $1,000; Itin St., $4.500, and Brownsville Ave., near Roanoke St., $12,000.

South Dakota.

Davison County Commissioners, R. A. Zangle, Auditor, Mitchell, S. Dak., will receive bids until April 25 for all the engineering work required for the construction of approximately 50 miles of highway in that county. A certified check to the amount of $50 must accompany each bid.

Tennessee.

⊙Goodrich & Crinkley, of Anniston, Ala., have been awarded the contract at Harriman, Tenn., for the grading and laying of asphalt on East Roane, Morgan and Clifty Sts.

The Bristol-to-Wise Highway Association was recently organized at Bristol, Tenn., for the purpose of promoting the construction of a macadamized highway from Bristol to Big Stone Gap, connected with the new $1,000,000 system of roads in Wise County. Hon. J. F. Sutton, of Mendota, Va., is President.

The Shelby County Court, Memphis, Tenn., has authorized the issuance of bonds in the sum of $600,000 for the construction of dirt roads, turnpikes and bridges.

The citizens of Union City, Tenn., on April 7 voted bonds to the amount of $30,000 for the construction of sidewalks and streets.

Texas.

⊙R. S. Womack of Abilene, Tex., has taken a sub-contract from E. M. Elby of Kansas City for the paving of the 16 streets of the city of Abilene out of the bonds recently issued and approved.

The City Council of Houston, Tex., has accepted plans and specifications as prepared by City Engineer F. L. Dormant for the improvement of portions of three streets, namely, Rusk Ave., between Milam and Bagby, with vitrified brick; Berry Ave., between San Jacinto and Louisiana, with bitulithic, and Louisiana St., between Capitol and Congress, with vitrified brick.

Utah.

The Salt Lake County Commissioners, Salt Lake City, Utah, have decided upon a thorough program of road improvements throughout the county calling for expenditures ranging from $30,000 to $40,000. William Snow is Road Supervisor.

The City Commissioners of Ogden, Utah, have instructed City Engineer H. J. Craven to advertise for bids for the paving of South Washington Ave., with concrete. It is proposed to pave the street from 34th St., south.

Virginia.

⊙J. T. Bennett & Bro., Danville, Va., have been awarded the contract by that city, J. O. Magman, City Engineer, for the construction of 6½ miles of macadam and 37½ miles of soil road in Dan River District of Pittsylvania County, Va., for $109,000. The work will be done under the supervision of the State Highway Commission, P. St. John Wilson, Commissioner. Bids were opened April 1.

The Richmond Architects' Association, Richmond, Va., has recommended to the City Council and Administrative Board the employment of a landscape architect and engineer to superintend the work of laying out streets and public squares in the territory now being urged for annexation.

Washington.

⊙The City Council of Spokane, Wash., has let the contract for the paving of 25th and 26th Aves., from Arthur St. to Grand Blvd., to the Spokane Bitus-Mass Paving Co., for $9,400, for Spokane bituminous No. 2 paving.

⊙The Spokane Asphalt Macadam Co., L. J. Gavin, Manager, Spokane, Wash., has been awarded the contract by the Lincoln County Commissioners, Davenport, Wash., for the macadamizing of the roadway of the Davenport-Harrington Highway No. 2, for $37,700. The road is over seven miles in length. The Inland Portland Cement Co., Spokane, secured the contract for furnishing the cement for the concrete construction necessary along the way, consisting of culverts and a few small bridges. About 300 barrels of cement will be required.

⊙J. H. Lich at $3,806 secured the contract for the paving of Broadway in Bellingham, Wash. C. G. Burnett at $11,442 secured the contract to macadamize Broadway from Holly to North Park St.

⊙The Keasal Construction Co. of Tacoma, Wash., has been awarded the contract for the paving of West Heron St., at Aberdeen, Wash., for $20,177.

⊙The Dolarway Paving Co., of Oregon and Washington, Seattle, Wash., has been awarded the contract by the city of The Dalles, Wash., for the construction of 9,000 sq. yds. of Dolarway pavement. Contract awarded April 4.

Following bids were received by the City Commissioners of Tacoma, Wash., for asphalt paving, etc., on N. 26th st., from Union to Proctor et al.: Geo. P. Wright, $26,500; Keasal Construction Co., $23,700; Washington Paving Co., $24,593; McHugh Construction Co., $27,862; Joseph Warter, $23,800; Joseph Warter, bitulithic. $22,800.

Rufus Buck submitted the lowest bid to the Board of Public Works of Seattle, Wash., for the grading of First Ave. northwest, et al. The bid was $45,219.

Wisconsin.

✣Bids will be received until 10:30 a. m., April 17, by Department of Public Works, Milwaukee, Wis., for laying cement concrete walks on top of the present hollow and solid walks.

✣Bids will be received until 2 p. m., April 21, by Board of Public Works, Oshkosh, Wis., for furnishing all of the material and doing all of the labor for the planking and paving of the Main St. bridge according to specifications on file in the office of the Board of Public Works and the office of the City Clerk of the City of Oshkosh. All proposals must be accompanied by a certified check payable to the City Treasurer of the City of Oshkosh for $500. R. A. Hollister is Chairman.

✣Bids will be received until 10:30 a. m., April 16, by Department of Public Works, Milwaukee, Wis., for the construction of permanent brick pavement with sand cushion on concrete foundation on a number of alleys.

✣Bids will be received until May 2, by City of Delaven, Wis., for the following work in accordance with plans and specifications prepared by P. J. Hurtgen, Engineer, Burlington, Wis.: 8,912 sq. yds. of brick paving, 1,940 lin. ft. of cement curb, 495 lin. ft. of cement retaining curb. 3,190 lin. ft. of combination cement curb and gutter. W. R. Topping is City Clerk.

✣Bids will be received until 10 a. m., April 21, by Village Board, Kilbourn, Wis., for reinforced concrete paving. The work will include about 15,211 sq. yds. of pavement and 4,983 lin. ft. of curb and gutter.

✣Bids will be received until 2 p. m., April 26, by Board of Public Works, Jefferson, Wis., for paving with creosoted wood block, vitrified block or reinforced concrete, Main St., including 8,520 sq. yds. of paving, 3,480 lin. ft. of curb and gutter and 4,672 cu. yds. of excavation.

⊙The Advance Construction Co. of Waukesha, Wis., has been awarded the contract by that city, Morgan R. Butler, City Engineer, for the construction of asphalt macadam pavement, for $54,982. The work includes 36,046 sq. yds. of asphalt macadam of the penetration method, 3,731 sq. yds. of waterbound macadam, 21,042 cu. yds. of excavation, 25,195 lin. ft. of concrete curb and gutter. Bids were opened April 8.

⊙F. Boortz of Waukesha, Wis., has been awarded the contract by that city, Morgan R. Butler, City Engineer, for the construction of 1,281 sq. yds. of asphalt macadam pavement and 970 ft. of concrete curb and gutter, for $1,820. Bids were opened April 8.

⊙The White Construction Co., of Milwaukee, Wis., has been awarded the contract at Appleton, Wis., for the laying of 30,989 sq. yds. of sheet asphalt pavement, for $1.97 a sq. yd. This company also secured the contract for laying combination curb and gutter, including tile, at $0.55 a lin. ft., 2½ ft. wide.

⊙L. W. Schroth has been awarded the contract by Commissioner of Public Works Simmons, of Milwaukee, Wis., for the raising and paving of Grand Ave., from the river to the alley, between Fourth and Fifth St., and West Water, Second, Third and Wells St., from Sycamore to Cedar Sts., for $95,281. Other bidders were: D. M. Sneddon, $116,494; Raulf

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Co., $113,002; White Construction Co., $109,338, and R. F. Conway Co., $104,860.

⊙The City Council of Antigo, Wis., has awarded the contract for the paving of the blocks north on Superior St., from First Ave. to Fifth Ave., and the one block east of Fifth Ave., from Superior St. to Field St., with as-P. J. Hurtgen is City Engineer.

The citizens of the Town of Windsor, Wis., at a recent election voted in favor of building a permanent highway in the town.

The city of Burlington, Wis., is considering the construction of three blocks of brick pavement and about 2,000 lin.ft. of cement curb. P. J. Hurtgen isc City Engineer.

The following townships in Green County, Wis., Monroe, County Seat, on April 1 voted highway funds at the town meetings: Adams, $800; Brooklyn, $1,500, $500 bridge fund; Cadiz, $1,000; Clarno, $1,000, $1,000 bridge fund; Exeter, $1,100; Jefferson, $3,000; Jordan, $1,000; Monroe, $1,000, to macadamize Monticello-Monroe Road, beginning at the Prairie House. One mile tax was levied for road work which will raise about $1,700; Mt. Pleasant, $1,200, $400 bridge fund; New Glarus, $1,000, $1,000 bridge fund; Spring Grove, $2,400, $1,000 bridge fund; Sylvester, $1,600, $800 contingent fund, $600 bridge fund, $200 extra fund; Washington, $1,000, $250 bridge fund.

The Town of Kimberly, Wis., will lay 7,000 sq. yds. of pavement this spring.

Canada.

✣Bids will be received until April 21, by Richard Kylie, Chairman, Board of Works, Lindsay, Ont., for the construction of approximately 25,000 sq. yds. of permanent roadways, of which about 17,000 sq. yds. will be laid on business streets and about 8,000 sq. yds. on residential streets. Parties tendering will specify the kind of permanent roadway they propose to construct, the cost per square yard, including curb, and the guarantee as to durability. A marked cheque equal to 10 per cent of the tender, and made payable to the order of the municipality, will accompany each tender.

⊙The Bitulithic & Contracting Ltd. of Winnipeg, Man., and Fielding & Shepley of St. Paul, Minn., were awarded the contracts at Saskatoon, Sask., for the construction of street paving. The former company will lay 29,000 sq. yds. of bitulithic at $2.90 per sq. yd., and the latter company 13,000 sq. yds. of 3½-in. wood block pavement at $3.55 per sq. yd. The contract for concrete sidewalks as noted in our last issue was awarded to the Western Pavers, Ltd., of Saskatoon, at the following prices: 265,390 sq. ft. of walk at $0.172; 5,700 sq. ft. of lane crossing at $0.21; 28,760 lin. ft. separate curb at $0.35; 22,050 lin. ft. combined curb at $0.32.

⊙Henri Beauregard, 70 St. James St., Montreal, Que., has been awarded the contract by the Department of Roads of the Province of Quebec, for the building of the Montreal-Quebec road.

The Board of Public Works of New Westminster, B. C., has authorized the construction of 24-ft. macadamized roads, aggregating 19,964 yds., to cost about $93,680.

The Board of Control of Montreal, Que., has approved of the report of the Chief Engineer for the paving of a number of streets by day labor, the city being the lowest bidder. The cost of the work is estimated at $53,000.

DRAINAGE AND IRRIGATION

Arkansas.

⊙Forrestal & Feyen, St. Paul, Minn., as noted in our last issue, have been awarded the contract at 7.87 cts. per cu. yd. for the construction of 30 miles of ditches for the Overcup Drainage District for which the Morgan Engineering Co., Memphis, Tenn., is the engineer. The following unit bids were received on the work, (1) bid per cu. yd on Contract No. 1 (590,000 cu. yds.), (2) bid on Contract 2 (350,000 cu. yds.), (3) unit bid on both contracts, work to be done with two machines. (4) unit bid on both contracts, work to be done with one machine: T. L. Gatke, (1) 8.47 cts., (2) 8.47 cts., (4) 8.20 cts.; C. H. Sternberg & Son, (1) 8.77 cts., (2) 8.99 cts.; Forrestal & Feyen, (1) 7.50 cts., (2) 8.50 cts., (3) 7.87 cts., (4) 7.71 cts.; Northern Construction Co., (1) 8.35 cts., (2) 8.35 cts.; Canal Construction Co., (1) 8.35 cts., (2) 8.35 cts., (4) 7.90 cts.; Horton & Mosley, (1) 8.70 cts., (2) 8.70 cts.; R. H. & G. A. McWilliams, (3) 7.94 cts.; Middle States Dredging Co., (4) 7.38 cts.; Moffett & Co., (3) 8.25 cts., (4) 7.75 cts.; Oscar Kochtitzky, (1) 8.00 cts.; (2) 9.00 cts., (3) 8.25 cts.; Crumpecker & Adams, (1) 7.74 cts.

California.

The Orchard Heights Land Co., composed of Michigan capitalists, headed by S. B. Piatt, of Los Angeles, Cal., has purchased 1,466 acres of the Porter ranch near Beaumont. A water supply is to be developed.

Advices from Willows, Cal., state that a plan for a drainage district to embrace about 30,000 acres west of Willows, Orland and Germantown has been revived by Attorney George R. Freeman, John H. Graves, who with H. A. Campbell have just filed on 102,000 acre-inches of water in Stoney Creek and Briscoe Creek. As outlined, the scheme is to form an irrigation district under the Bridgeford amendment and Wright act, then bond for $1,350,000, for which sum, estimates prepared by engineers show, the land could be placed under irrigation.

The Netherlands Farms Co., according to advices from Woodlands, has filed a deed of trust to the Federal Trust Co. for $3,000,000 to secure a bond issue with the county recorder. The property owned by the Netherlands Farms Co., on which the deed of trust was given, consist of nearly 30,000 acres of land in Yolo county lying between the by-pass and Elk slough, extending from the Lisbon district on the east into Solano county on west. The Farms Co. intends to reclaim and subdivide the land.

Colorado.

⊙The McDowell Construction Co., Pueblo, has been awarded the contract for enlarging the Cucharos Dam of the Pueblo-Rocky Ford Irrigation Co. The work includes 48,000 cu. yds. rock fill, 800 cu. yds. concrete and 500 cu. yds. rubble masonry.

It is reported that a committee of bondholders of the Greeley-Poudre Irrigation District will be appointed to complete the ditches of the system to bring water to 35,000 acres of land. J. R. Moore, Greeley, Colo., is a director of the district.

The Jackson County Land & Irrigation Co. proposes the reclamation and settlement of 25,000 acres of land in Jackson County, Colo. An expenditure of $200,000 is proposed. The plans call for two main ditches about 30 miles in length and the construction of a storage reservoir. James P. Miller, Lafayette, Colo., is president.

Florida.

✣In order to adjust legal matters Commissioner of Desoto County, Arcadia, Fla., has postponed the letting of contracts which was to take place on April 8 to May 6, at which time bids will be received. This work calls for the construction of 48 miles open canal ditches, requiring 600,000 cu. yds. of excavation Cravens & Kimmel, Arcadia, Fla., are the engineers.

Illinois.

⊙Green & Sons Co., 133 W. Washington St., Chicago, Ill., has been awarded the contract for constructing Sec. 6 of the Calumet-Sag channel, bids for which were opened March 27 by the Trustees of the Sanitary District of Chicago. The bids received on the work were as follows: (1) bid of Green & Sons, (2) bid of W. A. Kenefick, Chicago, Ill.:

	(1)	(2)
Glacial drift excavation, 675,000 cu. yds.	$0.44⅞	$0.49
Solid rock excavation, 135,000 cu. yds.	.82½	.90
Riprap slope, 75,000 sq. yds.	1.00	1.25
Totals	$489,281	$546,000

⊙Leo Cazalet & Son have been awarded the contract at $3,160 for furnishing, hauling and laying tile for Drainage District No. 1 Mosquito. The work includes 1,060 ft. 27-in. drain tile laid 5.2 ft. deep; 200 ft. 24-in. tile laid 5.3 ft. deep, and relaying 1,200 ft. 24-in. tile 5.6 ft. deep. Bids were opened March 6 at Mt. Auburn, Ill. J. W. Dappert, Taylorville, Ill., is the Engineer.

Bids as follows were received April 3 by the Trustees of the Sanitary District of Chicago, for constructing Sec. 10 of the Calumet-Sag channel, (1) bid of Shnable & Quinn, Chicago, Ill., total, $495,412; (2) Lorimer & Gallagher Co., Chicago, Ill., $514,000; (3) Yale & Reagan, Chicago, Ill., $564,350; (4) Carter Construction Co., New York, N. Y., $571,950; (5) D. A. Foley & Co., Aitkin, Minn., $696,400:

	(1)	(2)	(3)	(4)	(5)
Glacial drift excavation, 670,000 cu. yds.	$0.326	$0.31	$0.39	$0.38	$0.57
Solid rock excavation, 300,000 cu. yds.	.69	.675	.71	.70	.62
Riprap slopes, 72,000 sq. yds.	.77	1.10	1.00	1.25	1.15
Roadway construction, 2,500 lin. ft.	1.20	3.00	1.50	1.50	13.00
Concrete, 800 cu. yds.	8.44	10.00	12.00	7.00	6.00
Reinforcing metal, 20,000 lbs.	.04	.03	.035	.05	.07
Erection of 48th Av. bridge (lump)	4,000	8,500	4,000	7,000	7,000

Indiana.

✣Bids will be received until 10 a. m., May 3, by Harry C. Morrison, Drainage Commissioner, at the office of the County Surveyor, Princeton, Ind., for the construction of the Bozeman drain in Gibson County.

✣Bids will be received until 10 a. m., May 3, by B. F. Wieler, Drainage Commissioner, at the office of the County Surveyor, Princeton, Ind., for the construction of two drains in Gibson County.

Drainage Commissioners of Clay and Greene counties have filed their report on the proposed straightening of several miles of the Eel River, and it is probable that the work will be undertaken soon.

Iowa.

✣Bids will be received until 2 p. m., May 1, by Board of Kossuth County Supervisors, Algona, Ia., for the construction of a drainage district known as Drain No. 69, consisting of 27,300 ft. of open ditch, 8-ft. base and slope of 1 to 1, average depth 7.09 ft., estimated yardage 111,500 cu. yds. and 88,826 ft. of tile, ranging in size from 26 to 6 inches. Ten per cent check to accompany bid. B. E. Norton, County Auditor.

⊙Contracts for drainage work in District No. 42, Sac County, Ia., for which bids were opened April 8 by J. W. Neal, County Auditor, Sac City, Ia., have been as follows: Tile, cement products Co., Sac City, Ia., $3,240; labor, N. Jensen, Newell, Ia., $2,204.

⊙Donald Grant & Co., Faribault, Minn., has been awarded the contract at 12 cts. per cu. yd. for the construction of the Little Sioux drainage ditch, bids for which were opened April 8 at Sioux City, Ia. The ditch is designed to furnish a more direct channel for the Little Sioux river for a distance of

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

about 12 miles between Anthon and Smithland. It requires 482,695 cu. yds. of excavation.

⊙Kjar & Jensen, Humboldt, Ia., have been awarded the contract at $25,254 for constructing Drain No. 45 in Humboldt County, bids for which were opened April 9 at Dakota City, Ia. The work includes the following tile drain: 339 ft. of 6-in., av. depth 4.5 ft.; 2,799 ft. of 7-in., av. depth 5 ft.; 3,200 ft. of 8-in., av. depth 5.1 ft.; 3,660 ft. of 10-in., av. depth 4.9 ft.; 5,328 ft. of 12-in., av. depth 5.7 ft.; 4,550 ft. of 14-in., av. depth 6.8 ft.; 1,600 ft. of 15-in., av. depth 8.5 ft.; 1,500 ft. of 16-in., av. depth 8.3 ft.; 500 ft. of 18-in., av. depth 6.5 ft.; 3,600 ft. of 20-in., av. depth 6.3 ft.; 1,350 ft. of 22-in., av. depth 7.5 ft.; 2,100 ft. of 24-in., av. depth 7.8 ft.; 2,000 ft. of 26-in., av. depth 7.2 ft.; 2,300 ft. of 27-in., av. depth 8.1 ft.; 2,500 ft. of 36-in., av. depth 5.6 ft.; 1,000 ft. of open ditch, 308 cu. yds. Shortest haul is 4½ miles. J. L. Parsons, Humboldt, Ia., is Construction Engineer.

The Board of Woodbury County Supervisors, Sioux City, Ia., rejected all bids received April 8 for the construction of the Little Sioux Ditch and laterals in the Little Sioux Drainage District No. 2, including 482,696 cu. yds. of material.' E. E. Hosmer is County Auditor.

All bids received April 9 by Humboldt County Commissioners, Dakota City, Ia., for constructing County Drain No. 54 were rejected and the work will be readvertised. This work included the following tile drain: 3,260 ft. of 6-in., av. depth 5.3 ft.; 4,950 ft. of 8-in., av. depth 6.1 ft.; 1,800 ft. of 10-in., av. depth 6.5 ft.; 1,200 ft. of 14-in., av. depth 8.1 ft.; 1,500 ft. of 16-in., av. depth 9.3 ft.; 3,996 ft. of 18-in., av. depth 8 2 ft.; 4 ft. of 20-in. max. depth 9.3 ft. Average haul from Hardy, 5 miles. J. L. Parsons, Humboldt, Ia., is Engineer.

Louisiana.

⊙A. Baldwin & Co., Ltd., New Orleans, La., have been awarded the contract for pumping machinery for the Jefferson & Plaquemines Drainage District. This district covers about 37,000 acres of land in Jefferson, Plaquemines and Orleans Parishes, immediately across the river from New Orleans. Bond for $200,000 for financing the district have been sold, and it is expected that dredge and levee work will be let some time this month. J. F. Coleman, New Orleans, La., is Consulting Engineer.

Missouri.

✣Bids will be received until 10 a. m., April 26, by Frank G. Bier, Secy., Marion County Drainage District, Palmyra, Mo., for (a) the construction of levees involving the placing of about 450,000 cu. yds. of earth and excavating and filling of about 7,000 cu. yds. muck ditch; (b) the construction of canals and ditches involving the excavation of about 100,000 cu. yds. of earth, as a part of the reclamation of lands in the Marion County Drainage District. Particulars may be obtained from Edmund T. Perkins, Chief Engineer, Chicago, Ill.; Frank G. Bier, Secy., Palmyra, Mo., or W. E. Kendall, Quincy, Ill.

Texas.

State Drainage Commissioner Stiles, Austin, Tex., has organized a party to make a survey for levees and drainage on the Clemens State Farm in Brazoria County. The State Farm of 10,000 acres and the adjoining territory, together with country in the lower Brazos will be included. Complete drainage of the Clemens Farm together with the construction of levees to protect the farm against the overflow of the Brazos is contemplated.

State Drainage Commission Engineers have completed the field work in the Trinity Valley-Dallas District. The levees for the Dallas District will be designed by Drainage Commissioner Stiles, Austin, and his force. The river survey covers 25 miles and includes the City of Dallas, West Dallas and Harrys. It begins at Eagle Ford to the west of Dallas and terminates at Miller Switch, southeast of the city, on the Houston & Texas Central.

The County Commissioners at Houston will hold a hearing on May 5, on the question of submitting to the people of Drainage District No. 7, a proposition to issue $140,000 worth of bonds for work in that district. The district includes some 55,000 acres of land lying near Little York. It is traversed by Greens, Garners and Halls Bayous, which form the principal drainage channels under plans prepared by J. S. Burke, Houston, Special Engineer, appointed by the Board of Commissioners. It is proposed to dig about 70 miles of ditches, which are to be 16 ft. wide at the top, 4 ft. wide at the bottom and 4 ft. deep. The costs of the proposed work is made up of the following items: Cleaning and grubbing Greens Bayou, $16,100; clearing and grubbing Halls Bayou, $6,300; clearing and grubbing Garner's Bayou, $5,600; excavations, Hall's Bayou, $11,250; excavations, Garner's Bayou, $3,750; digging ditches, $57,000; Commissioners' salary, $800; bridges, $5,000; right of way, $3,000; engineers, $7,000; maintenance, $5,000; commissions to all county officers, $4,200.

Utah.

The City of Ogden and the Ogden River Reservoir Co., of which William Glasmann, Ogden, is President, have signed an agreement under which a $350,000 dam and reservoir will be constructed in South Fork Canyon.

Washington.

The Quincy Valley Water Users' Association, O. A. Kuck, President, Ephrata, Wash., is making plans for raising $100,000 for completing survey and preliminary work for an irrigation project designed to open up 500,000 acres of land in Grant County.

Canada.

⊙The Department of Natural Resources of the Canadian Pacific Ry. has awarded the contract for paving the Lake Newell Dams to Hayden & Skene, Calgary, Alberta. The work includes about 11,000 cu. yds. of paving and 8,700 cu. yds. of gravel base.

WATER WORKS

Arkansas.

The town of Malvern, Ark., is contemplating water supply. Hamilton Bros. have asked for a franchise contract by which the city will pay $60,000 for the supply.

California.

The citizens of Clovis, Calif., at a recent election, voted the issuance of bonds for the installation of a water works system.

The city of Tulare, Calif., has purchased the water plant of the Tulare Water Co. for a consideration of $31,400. The value of the plant was recently appraised by engineers at $50,000.

The present water plant at Hughson, Calif., has been purchased by R. W. Hobart of the Santa Fe, and others. A new and modern system is proposed by the new owners.

District of Columbia.

✣Bids will be received until 3 p. m., May 1, by Board of District Commissioners, Washington, D. C., for furnishing and delivering 10,000 ⅝-in. water meters for use in the water department.

Georgia.

⊙The citizens of Rochelle, Ga., on April 9 voted the issuance of bonds for the installation of a water works and an electric light plant. The contract has been awarded to the J. B. McCrary Co. of Atlanta, Ga.

Idaho.

The Village Council of Hope, Ida., has decided to extend the water works and put in a sewer from Second St. and First St. on down to the lake front.

Illinois.

⊙The Department of Public Works, Chicago, has awarded to the Kennedy Valve Manufacturing Co., Western Union Bldg., Chicago, Ill., the contract for furnishing and delivering to the meter mechanical shops, 1330 Indiana Ave., standard iron body, brass mounted gate valves as follows: 80 3-in., 100 4-in., 70 6-in., 20 8-in. all gate valves to be standard design with single stem inside screw valves, etc.; contract price, $1,400. L. E. McGann, Commissioner of Public Works.

⊙The City Commission of Moline, Ill., has awarded the contract for the remodeling of the local water plant to C. E. Heaps of that city, for $13,656.

⊙The Department of Public Works, Chicago, Ill., has awarded to Sleph, Sandrowitz & Goldblatt, 1108 Frank St., Chicago, Ill., the contract for furnishing and delivering to the various water pipe yards, 300 tons of pig lead, contract price, $25,000. L. E. McGann, Commissioner of Public Works.

⊙The Department of Public Works, Chicago, Ill., has awarded to the T. A. Cummings Foundry Co., 1358 Clybourn Pl., the contract for furnishing and delivering to the various pipe yards approximately 500 tons of valve basin covers, vault covers, etc.; contract price, $11,800. L. E. McGann, Commissioner of Public Works.

⊙The Department of Public Works, Chicago, Ill., has awarded to the Gardiner Metal Co., 1364 W. Lake St., the contract for furnishing and delivering to the city plumbing shops, such plumber's solder as is required during the year 1913. Contract price, $2,055. L. E. McGann, Commissioner of Public Works.

Following is the lowest bid submitted to the Department of Public Works, Chicago, Ill., on April 9, for furnishing and delivering to the Bureau of Engineering, 1 double cylinder, double friction drum hoisting engine with boiler and all fixtures, of 16 H.P. capacity mounted on skids and ready for use; also 1 set of derrick irons, 4 dump buckets, 600 lin. ft. wire cable, steam pump and fittings and 2 jacks, H. Channon Co., 150 N. Market St., Chicago. Contract price, $1,536, engine $870, the contract has not been awarded. L. E. McGann, Commissioner of Public Works.

Following is the lowest bid submitted to L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing, delivering and erecting at the 68th St. pumping station, 68th St. and Yates ave., 1 Hendy, Norton 12″x9 ft. engine lathe with 8 mechanical changes of speed, Manning, Maxwell & Moore, 111 N. Canal St., Chicago, Ill., $765. The contract has not been awarded.

The city of Oak Park, Ill., is contemplating the construction of lead water servicepipes, including brass taps, stop cocks and spiral cast iron shut-off boxes in the following streets, Taylor Ave., Harrison St. to Madison St.; Harvey Ave., Division St. to Augusta St.; Mapleton Ave., Division St. to Thomas St. H. L. Fearing, Commissioner.

Following are the lowest bids submitted on April 11, for constructing water service pipes in Chicago: Champlain Ave., E. 75th St. to E. 79th St., 1,241 lin. ft., 54 cts., D. Walsh, 6828 South Chicago Ave.; N. Franklin Ave., Augusta St. to W. Division St., 1,065 lin. ft., 61½ cts., D Walsh; Langley Ave., E. 75th St. to E. 79th St., 1,691 lin. ft., 56 cts., D. Walsh; Leland Ave., Milwaukee Ave. to 56th Ave., 1,179 lin. ft., 59½ cts., Milton Pl., N.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

48th Ave. to C. & N. W. R. R., 994 lin. ft., 59½ cts., D. Walsh; E. 93rd St., Anthony Ave. to Jeffrey Ave., 8,280 lin. ft., 78 cts., J. Renn, 367 W. Chicago Ave.; St. LawrenceAve., E. 75th St. to E. 79th St., 56½ cts.; Drexel Ave., E. 92nd St. to E. 93rd St.; Ellis Ave., E. 91st St. to E. 93rd St.; Dobson Ave., E. 91st St. to E. 93rd St.; Greenwood Ave., E. 91st St. to E. 93rd St.; Lexington St., E. 91st St. to E. 94th St.; Woodlawn Ave., E. 91st St., to E. 93rd St.; Washington Ave., E. 91st St. to E. 93rd St.; E. 91st St., Chauncey Ave. to I. C. R. R.; E. 92nd St., Drexel Ave. to I. C. R. R.; E. 93rd St., Drexel Ave. to I. C. R. R.; E. 93rd Pl., Drexel Ave. to Stony Island Ave., 8,519 lin. ft., 56 cts., D. Hardin, 3139 Indiana Ave.; Berenice Ave., N. 47th Ave. to N. 48th Ave., 309 lin. ft., 60 cts., Washington Plumbing and Heating Co.; Colfax Ave., E. 83rd St. to South Chicago Ave., 4,393 lin. ft., 57⅞ cts., Washington Plumbing and Heating Co.; Drake Ave., Franklin Blvd. to C. & N. W. R. R., 439 lin. ft., 64 cts., Washington Plumbing and Heating Co.; Exchange Ave., Baltimore Ave. to E. 87th St., 2,024 lin. ft., 60 cts., Washington Plumbing and Heating Co.; Escanaba Ave., E. 84th St. to E. 87th St., 1,260 lin. ft., 63 cts., D. Walsh; Grace St., N. 48th Ave. to C. & N. W. R. R., 542 lin. ft.; Houston Ave., Baltimore Ave. to E. 87th St., 888 lin. ft., 62 cts., Washington Plumbing & Heating Co.; W. Jackson St., S. 46th Ave. to S. 51st Ave., 1,822 lin. ft., 62 cts., J. Renn; Lawrence Ave., Central Park Ave. to N. 40th Ave., 2,055 lin. ft., Washington Plumbing & Heating Co., D. Hardin (tie) 64 cts.; Muskegon Ave., Baltimore Ave. to E. 91st St., 4,983 lin. ft., 57⅞ cts., Washington Plumbing & Heating Co., Manistee Ave., E. 86th St. to E. 87th St., 447 lin. ft., 58 cts., J. Renn; Park Ave., S. Boulevard to Madison St., 215 lin. ft., 57 cts., J. Renn; Waveland Ave., N. 48th Ave. to C. & N. W. R. R., 791 lin. ft., 62 cts., Washington Plumbing & Heating Co.; Warwick Ave., N. 48th Ave. to C. & N. W. R. R., 568 lin. ft., 63 cts., D. Walsh. The contracts have not been awarded. E. J. Glackin, Secretary of the Board of Local Improvements, Chicago.

Indiana.

The Lake Shore & Michigan Southern Railroad proposes to erect a pumping station in Elkhart, Ind., to supply water for all trains and the local depot and shop system.

Iowa.

✣Bids will be received until 1 p. m., April 22, by Town of Guthrie Center, Ia., for construction of water works extensions. Specifications are on file with the Town Clerk.

The citizens of New London, Ia., on April 2, it is reported, voted the issuance of bonds for the installation of a water works system.

The Town Council of Mt. Ayr, Ia., has retained E. T. Archer & Co., Consulting Engineers, of Kansas City, Mo., to make specifications for a water and sewer system.

⊙C. W. Roland Co., Des Moines, Ia., has been awarded the contract by the city of Epworth, Ia., for the construction of a waterworks plant, for $9,300. The work includes an air pressure system complete. Bids were opened April 1 by J. J. Hamilton, Clerk.

Kansas.

Commissioner E. B. Stotts of Topeka, Kans., has completed plans for the installation of a water works system, with drinking fountain attachments, for Westlawn Park.

Kentucky.

✣Bids will be received until 2 p. m., April 30, by Board of Public Works, W. J. Dulin, Secy., Madisonville, Ky., for the necessary labor and material for the construction of water works system and sanitary sewer system.

The Fayette County Fiscal Court, Lexington, Ky., has granted the right to raise the Richmond Pike at the Hickman Creek crossing to enable the Waterworks Co. of Lexington, Ky., to build a higher dam for one of its reservoirs.

Maryland.

The Board of Awards of Baltimore, Md., has approved plans and specifications of Water Engineer Ezra B. Whitman for the proposed filtration plant. The plant will cover between 15 and 20 acres of land, will cost approximately $1,750,000 and will have a capacity for filtering 132,000,000 gals. of water daily. The plans approved by the Board call for the following work, estimated to cost $1,000,000: Removing 106,000 cu. yds. of excavations. Building two coagulation basins, each having a capacity of 8,500,000 gals. Thirty-two filter units, each with a capacity of 4,000,000 gals. daily. Two filtered water basins, with a combined capacity of 2,500,000 gals. Two earthen dams, to be built from the excavated materials and to take care of the water used in washing the filters. A mixing chamber, with a capacity of 3,000,000 gals. The chemicals will be placed in this chamber before the water enters it. Water is to pass from the mixing chamber to the coagulating basins, from which it will be carried to the filters, passing through them into filtered water basins for distribution through the city. A contract for building the superstructures in connection with the plant will be awarded in June. Two reservoirs for the filtered water are already under construction.

Massachusetts.

The City Council of Boston, Mass., has voted a loan of $175,000 for the new high pressure water system for fire protection.

At a recent town meeting at West Stockbridge, Mass., the articles relative to a water system for fire purposes were laid over for future consideration.

Michigan.

Rial McArthur has asked the Village Council of East Grand Rapids, Mich., for a franchise for the installation of a water works system. Thomas B. O'Keefe is Village President.

Minnesota.

✣Bids will be received at once by the Village of Walters, Minn., at the State Bank in that city, for the construction of a system of water works. The work must be completed before next Winter.

⊙W. D. Lovell, 1415 Eighth St., Minneapolis, Minn., has been awarded the contract by the town of Miles, Ia., Chas. Allen, Town Clerk, for the construction of a water works system, for $9,368. The work will include 75 ft. 8-in. cast iron pipe, 3,600 ft. 4-in., 3,600 ft. 6-in., 30,000-gal. steel tank on steel tower, brick pump house, triplex pump, gasoline engine, etc. Bids were opened April 10. Chas. P. Chase, Clinton, Ia., is Engineer.

J. F. Druar, Consulting Engineer, The Oscar Claussen Engineering Co., St. Paul, Minn., has been retained to draw plans and specifications for the Municipal Water Works System of Maple Lake, Minn., the work to consist of water mains, valves, hydrants and 50,000-gal. tank on 115 ft. tower. Notice of date of letting later. Plans and specifications will be out Tuesday, April 15, check for $2.50 to cover cost of reproduction.

The citizens of Deerwood, Minn., at a recent election, voted the issuance of bonds to the amount of $15,000 for the installation of a water works system.

Mississippi.

The citizens of Meridian, Miss., have voted bonds to the amount of $100,000 for water works improvements; $25,000 for street improvements, and $25,000 for school purposes.

Missouri.

✣Bids will be received until noon, April 22, by Board of Public Improvements, St. Louis, Mo., for furnishing and delivering at the City Pipe Yard about 3,030 tons of 3-in., 4-in., 6-in., 12-in., 20-in., 30-in. and 36-in. cast iron coated water pipe. Drawings, specifications, form of contract and other information can be had at the offices of the Board of Public Improvements and the Water Commissioner.

The North Kansas City Development Co., Kansas City, Mo., plans the installation of a water works plant in North Kansas City at an estimated cost of $50,000 and extra mains to cost $10,000.

Nebraska.

The citizens of Staplehurst, Nebr. (population 228), at a recent special election voted against the installation of a waterworks system.

An election will be held in Columbus, Nebr., on May 20 for the purpose of voting on the proposition to issue $10,000 water works extension bonds.

New Jersey.

The special committee of the Common Council, Boonton, N. J., has recommended that the town buy the United Water Supply Co.'s water plant.

Following bids were received by the Common Council of Chatham, N. J., on April 7, for alterations to the water and light plant: William M. Sheehan Co., New York City, $34,810; Blackhall & Baldwin Co., New York City, $34,890, and Portland Engineering Co., $36,000. Following bids were received for installation of two 150-h. p. tube boilers: E. Keeler & Co., $5,200; J. D. Dranger Co., $5,420, and Heincke Co., $5,600. Other bids were as follows: Ridgeway Dynamo & Engineering Co., erecting tandem-compound Corliss engine and a three-phase 60-cycle generator, $8,955; Berman & Lehman bid on erection of chimney, $1,570; Westinghouse Machine Co., steam turbo-generating set, 100 k. w., $5,996, and 150 k. w., $6,792; Gould Manufacturing Co., 500,000-gal. pump, with motor, and 750,000-gal. pump, with motor, $7,220; Jersey City Iron Works, erecting water tube boilers, $5,653; erecting tandem-compound Corliss engine, $7,929; George D. Atwood Co., steam generating set, $4,973.

The citizens of Garfield, N. J., at a special election, voted in favor of a bond issue of $85,000 for improving the municipal water plant and the purchase of additional land, it being proposed to secure 16 acres of land, and install new wells, new pumps, machinery and pipes.

New York.

✣Bids will be received until 11 a. m., April 29, by Board of Water Supply, J. P. Morrissey, Secy., 165 Broadway, New York City, for furnishing and delivering and installing racks, stop shutters, screens, lifters and other apparatus in gate chambers along Catskill aqueduct.

✣Bids will be received until 8 p. m., April 24, by Board of Village Trustees, Honeoye Falls, N. Y., for the construction of a municipal water works system for that village. Approximate requirements: Five and one-half miles of pipe line; pumping station; elevated tank. Plans and specifications, etc., will be on file with A. B. Neal, Village Clerk. Proposals will be received for either the entire work or any part of the work, as shown in the proposals. All proposals are to be accompanied by a certified check for 10 per cent of the bid. White & Getman, C. E., Mutual Life Building Buffalo, N. Y.

⊙Murphy Bros., 25th Ave. and Cropsey Ave., Brooklyn, New York City, have been awarded the contract by the Park Board, Department of Parks, Arsenal Bldg., New York City, for furnishing and laying new cast iron water mains and appurtenances in Prospect Park, Borough of Brooklyn, for $25,146. Bids were opened April 7.

⊙John Siegrist of Utica, N. Y., has been awarded the contract by the village of West Winfield, N. Y., A. C. Hackley, Village Clerk, for the installation of a municipal water works system, for $6,447. The work will include the following approximate quantities: 10-in. pipe, 4,176 ft.; 8-in. pipe, 1,356 ft.; 6-in. pipe, 9,108 ft.; 4-in. pipe, 6,348 ft.; pump house, concrete; stand pipe foundation, concrete. W. G. Stone & Son, Mann Bldg., Utica, are Engineers. Bids were opened April 1.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

The Common Council of Oneida, N. Y., contemplates calling a special election for the purpose of voting on the proposition of raising $30,000 for a new school in the Second Ward; also on the proposition of buying additional apparatus for the Fire Department, costing $15,000.

The Common Council of Albany, N. Y., has authorized a bond issue of $16,000 for the purchase of a motor tractor for the fire department.

The one bid received by the Board of Managers, Craig Colony for Epileptics, Sonyea, N. Y., on April 8, for the improvement of the water supply was rejected because it exceeded the appropriation.

The citizens of Mt. Morris, N. Y., at a recent special election, voted against the issuance of bonds in the sum of $140,000 for the installation of a municipal water works system, and a sewerage system, at a cost of $15,000.

Ohio.

✣Bids will be received until noon, April 22, by W. J. Springborn, Director of Public Service, Cleveland, O., for furnishing vitrified sewer pipe, curves and stoppers for the Water Department. Each proposal must be made in accordance with the specifications which may be obtained at the office of the Superintendent of the Water Department.

✣Bids will be received until noon, May 10, by Board of Public Affairs, Willoughby, O., for furnishing two raw water pumps. Plans and specifications may be obtained of the Clerk of the Board, or of Burgess & Long, Engineers, Columbus, O.

The Water Department of Cleveland, O., C. F. Schulz, Superintendent, will make plans on extension of both water tunnels to a point about six miles from shore.

Oregon.

✣Bids will be received until 11 a. m., May 2, by Lieut. R. F. Cox, Fort Stevens, Ore., for the construction of one reinforced concrete cistern at Battery Russell.

The city of Linnton, Ore., recently voted to issue $100,000 in bonds for the installation of a 16-in. water pipe from the Portland city limits to Linnton, to supply that town with Bull Run water. The city will extend the mains to the Portland limits and Linnton will extend them from there to the users.

Pennsylvania.

A bill is now before the Pennsylvania Legislature providing for an appropriation of $1,000,000 for the city of McKeesport, Pa., for the construction of a storage reservoir to regulate the flow of the Youghiogheny River. The bill provides for the building of the reservoir at the head waters of the river at the Maryland state line, by the Water Supply Commission of Pennsylvania. The capacity of the reservoir would be 1,500,000,000 gals.

The City Councils of Lancaster, Pa., have passed an ordinance authorizing a loan of $80,000 for the installation of a new pump at the water works and the housing, etc., thereof.

South Carolina.

The citizens of McColl, S. C. (population 1,628), recently voted to issue bonds to the amount of $6,000 to install electric light, water and sewerage. Contracts will be let at once.

South Dakota.

✣Bids will be received until 2 p. m., April 23, by C. N. McIlvaine, Secretary of the South Dakota State Board of Agriculture, Huron, S. Dak., for the laying of 3,650 ft. of 4-in. water mains with connections and hydrants upon the state fair grounds at Huron, S. D.

The Oscar Claussen Engineering Co., Nat. Ger. Am. Bank Bldg., St. Paul, Minn., will have plans and specifications for a municipal electric light plant for Mayville, N. Dak., ready about April 28.

The City Council of Salem, S. Dak., has ordered the calling of a special election to vote on the issuance of bonds in the sum of $3,000 for the extension of the municipal water works.

The voters of Van Metre township, Lyman County, S. Dak., at a special election, authorized the issuance of bonds for the drilling of three artesian wells in the township. Oacoma is the county seat.

Texas.

The Aspermont Water Co. of Aspermont, Stonewall County, Tex., has been incorporated with a capital stock of $25,000. The incorporators are E. V. Sellers, A. V. McCarty, D. L. Couch.

J. D. Reagan, of Spur, Tex., is preparing plans for the installation of a waterworks system in that city, at an estimated cost of $25,000. The work will include tower, pipe, pumping machinery, etc. Water will be secured from wells.

Arrangements have been made to drill a deep well at Richardson, Tex., and put in a system of local water works.

Utah.

⊙The City Commission of Salt Lake City, Utah, has awarded a contract to Shirley M. Kunkle for the drilling of the first of a series of wells near Liberty Park. This is a part of the Water Department's scheme to add 6,000,000 gals. to the underground flow in that neighborhood. The contract price is $1.50 a ft. for the first 100 ft., $1.75 for the next 100 ft., $2 for the third and $2.25 for any depth beyond 300 ft.

Washington.

City Engineer Fred C. Powell of Wenatchee, Wash., is preparing specifications for the purchase of an auto fire truck.

The Washington State Public Service Commission has instructed the Pacific Power & Light Co. to install betterments in its system at North Yakima which will cost about $300,000. They include a concrete reservoir with two compartments, with a capacity of 15,000,000 gals., high enough above the city to give a continuous pressure of 85 lbs.; the mending of all leaks in the city distribution system by repairing wooden mains or displacing them with iron ones.

West Virginia.

At a recent mass meeting of citizens of South Warwood (P. O., Warwood), W. Va., a committee was appointed to confer with George Lutz, President of the Loveland Improvement Co., relative to a sufficient water supply for the southern end of Warwood.

Wisconsin.

✣Bids will be received until 8 p. m., April 23, by Board of Water Commissioners, Monroe, Wis., for the laying of approximately 2,500 ft. of 4-in. water mains and 800 ft. of 6-in. mains. Separate bids are asked for on the following: Necessary excavating and back filling; labor of laying pipe, fittings, etc.; furnishing all material. The right is reserved to reject any or all bids. Five per cent deposit required. Specifications on file with M. T. Gettings, Superintendent of Water Works, Monroe, Wis.

Canada.

✣Bids will be received until noon, April 30, by City Commissioners, Moose Jaw, Sask., for the supply and delivery of the following material, f. o. b. cars, Moose Jaw. Local tenderers must bid on the material delivered at the City Store Yards: 160 valve chamber frames and covers. 100 manhole frames and covers. Detailed plans and specifications may be obtained on application to J. Antonisen City Engineer, Moose Jaw. Time of delivery must be stated. Each tender must be accompanied by a marked check, payable to the City Commissioners, for five per cent of the amount of the tender.

✣Bids will be received until noon, May 1, by Board of Water Commissioners, London, Ont., for 1,450 tons of 4-in., 6-in., 8-in., 10-in. and 12-in. cast iron pipe; also for 94 valves and 20 tons of special castings for the above. 75,000 lbs. pig lead, 64,000 lbs. lead pipe, and 3,000 lbs. Russian jointing hemp. For specifications and form of tenders address H. J. Gaubitz, General Manager, Board of Water Commissioners, London, Ont.

✣Bids will be received until noon, April 30, by City Commissioners, Moose Jaw, Sask., for the supply and delivery of the following material, f. o. b. cars, Moose Jaw: 120 ft. 20-in. pipe, 6,000 ft. 12-in. pipe, 1,100 ft. 10-in. pipe, 8,620 ft. 8-in. pipe, 23,000 ft. 6-in. pipe, 3,000 ft. 4-in. pipe, 40 6-in. off 6-in. tees, 32 6-in. off 8-in. tees, 7 6-in. off 10-in. tees, 10 6-in. off 12-in. tees, 2 12-in. off 12-in. tees, 6 8-in. off 12-in. tees, 6 6-in. x 6 x 6 x 6 crosses, 6 6 x 6 x 8 x 8 crosses, 2 6-in. x 6-in. x 10-in. x 10-in. crosses, 5 6-in. x 6-in. x 12-in. x 12-in. crosses, 2 10-in. x 10-in. x 12-in. x 12-in. crosses, 1 10-in. to 12-in. increaser, 150 6-in. offsets, 60 8-in offsets, 10 10-in. offsets, 60 12-in. offsets, 50 6-in. plugs, 25 6-in. caps, 25 8-in. plugs, 15 8-in. caps, 10 10-in. plugs, 10 10-in. caps, 10 12-in. plugs, 10 12-in. caps, 6 6-in. ¼ bends, 6 6-in. ⅛ bends, 6 8-in. ¼ bends, 6 8-in. ⅛ bends, 5 10-in. ¼ bends, 5 10-in. ⅛ bends, 5 12-in. ¼ bends, 5 12-in. ⅛ bends. All pipes to be Class "C" and all specials to be Class "D." All pipes and specials must conform to the standard specifications of the Canadian Society of Civil Engineers. Tenderers must state time of delivery, and each tender must be accompanied by a marked check in favor of the Corporation of the City of Moose Jaw for 5 per cent of the amount of the tender.

✣Bids will be received until noon, April 30, by City Commissioners, Moose Jaw, Sask., for the supply and delivery of the following, f. o. b. cars, Moose Jaw: 1,500 ft. 20-in. pipe, 2,000 ft. 18-in. pipe, 2,800 ft. 15-in. pipe, 900 ft. 12-in. pipe, 8,000 ft. 10-in. pipe, 23,000 ft. 8-in. pipe, 40,000 ft. 6-in. pipe, 1,200 ft. 4-in. pipe, 26 6-in. off 20-in. tees, 90 6-in. off 18-in. tees, 50 6-in. off 15-in. tees, 15 6-in. off 15-in. Y's, 20 6-in. off 12-in. tees, 10 6-in. off 12-in. Y's, 350 6-in. off 10-in. tees, 200 6-in. off 10-in. Y's, 500 6-in. off 8-in. tees, 400 6-in. off 8-in. Y's, 6 4-in. off 18-in. tees, 5 4-in. off 15-in. tees, 15 4-in. off 10-in. tees, 45 4-in. off 8-in. tees, 125 4-in. elbows, 12 pieces 20-in. channel pipe, 6 pieces 18-in. channel pipe, 20 pieces 15-in. channel pipe, 8 pieces 12-in. channel pipe, 40 pieces 10-in. channel pipe, 85 pieces 8-in. channel pipe, 850 4-in. to 6-in. increasers, 800 6-in. ⅛ bends. All pipes and specials must be first-class glazed tile. All pipe and specials over 12-in. to be of double strength. Tenderers must state time of delivery. Each tender must be accompanied by a marked check in favor of the Corporation of Moose Jaw, for 5 per cent of the total amount of the tender.

✣Bids will be received until 11 a. m., April 28, by Board of Control, at the office of M. Peterson, Secy., Winnipeg, Man., for the supply of 2,500 half-inch water meters. Specifications and forms of tender, together with conditions covering tenders, as prescribed by by-law, may be obtained at the office of the City Engineer, 223 James Ave.

✣Bids will be received until 11 a. m., May 15, by Board of Control, at the office of M. Peterson, Secy., Winnipeg, Man., for the manufacture, delivery and erection in the Generating Station at Point due Bois of two 3-phase generators for direct connection to double-reaction turbines and for spare parts for same. Instructions to bidders, specifications and form of tender may be obtained at the office of the City Light and Power Department, 54 King St.

The City Council of Ottawa, Ont., will probably authorize an election in the near future for the purpose of voting on the issuance of bonds in the sum of $5,000,000 for the proposed water works system.

The Water Commission of Galt, Ont., has asked the Council to submit a by-law for $60,000 debentures, to provide funds for the construction of a new trunk main from the south to the north end of the town, and also several extensions in new sections.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

SEWERAGE AND SANITATION

Alabama.

A storm and sanitary sewer to cost $168,000 has been authorized by the city of Birmingham, Ala., to be constructed in the immediate neighborhood of Avenue H and 13th St.

California.

⊙Casley & Henwood have been awarded the contract by the City Council of San Jose, Calif., for the construction of four sewers in the Second Ward, for the aggregate sum of $7,897.

City Engineer W. M. Rumsey of San Diego, Calif., has submitted specifications to the City Council for 84,000 ft. of sewer pipe. The contract is expected to aggregate $18,000. The specifications will be advertised immediately and will call for either vitrified brick or Portland cement pipe.

The City Trustees of Gridley, Calif., have called for bids for the construction of the proposed sewer system, according to specifications prepared by Engineer Carstner.

The citizens of Clovis, Calif., have voted bonds for the installation of a sewer system and a water works system.

Florida.

✣Bids will be received until 8 p. m., May 21, by the Sewage Committee at the office of G. R. Ramsey, City Engineer, Orlando, Fla., for the construction of a system of sewers. The system will comprise 26½ miles of sanitary sewer and 3,000 ft. of storm sewer. Bids will be asked for as follows: Sewers and appurtenances, certified check $2,500; 3 Imhoff tanks and appurtenances, certified check $1,000; 3 12-in. wells, certified check $200. All bids must be accompanied by certified check. Plans and specifications will be on file at the office of the City Engineer. G. W. Fuller is Consulting Engineer.

The City Engineer of Pensacola, Fla., has been instructed to prepare plans for building an addiitonal sewer on East Romana St., near Bue, in order to prevent formation of pools of water nearby, after heavy rains.

Illinois.

✣Bids will be received until 7:30 p. m., April 24, by Trustees of the Village of Minooka, Ill., at the office of the Village Clerk, J. S. Gwynne, for the construction of a sewer system in accordance with plans on file with the Clerk. The work will include the following approximate quantities: Outlet sewer, 4,200 lin. ft. 15-in. sewer pipe, 4,200 lin. ft. excavation. Sewer system, 3,000 ft. 15-in tile, 960 ft. 12-in. tile, 3,890 ft. 10-in. tile, 2,275 ft. 8-in. tile, 2,522 ft. excavation under 6 ft., 5,144 ft. excavation 6 to 8 ft., 2,359 ft. excavation 8 to 10 ft., 100 ft. excavation 10 to 12 ft., 2 flush tanks, 21 manholes. 23 catch basins.

✣Bids will be received until 11 a. m., April 21, by the Board of Local Improvements, Chicago, Ill., for constructing brick and tile pipe sewer system in the following streets: Albany Ave, north bank of the west fork of the south branch of the Chicago River to W. 30th St. 610 lin. ft. 9-ft. 3-ring brick sewer, 18-ft. cut; 30th St., S. Albany Ave. to S. Troy St., 310 lin. ft. 9-ft. 3-ring brick sewer, 17-ft. cut; Troy St., W. 30th St. to W. 26th St., 1,990 lin. ft. 9-ft. brick sewer,, 3-ring, 18-ft. cut; W. 26th St., S. Troy St. to S. Turner Ave., 1,360 lin. ft. 9-ft. brick sewer. 3-ring, 16-ft. cut; S. Turner Ave., W. 26th St. to W. 27th St., 2,600 lin. ft. 9-ft. brick sewer, 3-ring 16-ft. cut; S. Turner Ave., W. 22d St. to W. 16th St., 2,710 lin. ft. 8-ft. brick sewer, 3-ring 16-ft. cut; W. 16th St., S. Turner Ave. to S. Spalding Ave., 310 lin. ft. 8-ft. brick sewer, 3-ring 16-ft. cut; S. Spalding Ave., W. 16th St. to W. 13th St., 1,960 lin. ft. 7½-ft brick sewer. 3-ring, 15-ft. cut; S. Spalding Ave., W. 13th St. to W. Polk St., 2,330 lin. ft. 7-ft. brick sewer, 3-ring, 15-ft. cut; W. Polk St., S. Spalding Ave. to S. Homan Ave., 670 lin. ft., 7-ft. brick sewer, 15-ft. cut, 3-ring; S. Homan Ave., W. Polk St. to first alley north, 160 lin. ft.; 7-ft. brick sewer, 3-ring, 15½-ft. cut; S. Homan Ave., first alley north of W. Polk St. to W. Van Buren St., 1,490 lin. ft. 6.5-ft. brick sewer, 3-ring, 16.*-ft. cut; S. Homan Ave., W. Van Buren St. to Colorado Ave., 580 lin. ft. 6-ft. brick sewer, 2-ring, 16-ft. cut; S. Homan Ave., Colorado Ave. to W. Monroe St., 950 lin. ft. 4-ft. brick sewer, 2-ring, 15.5-ft. cut; W. Monroe St., S. Homan Ave. to Central Park Ave., 1,320 lin. ft. 4-ft. brick sewer, 2-ring, 14-ft. cut; Colorado Ave., S. Homan Ave. to S. Kedzie Ave., 1,460 lin. ft. 5.5-ft. brick sewer, 2-ring, 16-ft. cut; W. Van Buren St., S. Homan Ave. to S. Central Park Ave., 1,370 lin. ft. 4-ft. brick sewer, 2-ring, 15-ft. cut; first alley north of W. Polk St., S. Homan Ave. to S. Central Park Ave., 1,360 lin. ft. 4-ft. brick sewer, 2-ring, 15-ft. cut; W. 13th St., S. Spalding Ave to S. Homan Ave., 670 lin. ft. 4.5-ft. brick sewer, 2-ring, 15-ft. cut; W. 16th St., Turner Ave. to S. Central Park Ave., 1,710 lin. ft. 4.5-ft. brick sewer, 2-ring, 15-ft. cut; W. 15th St., S. Spalding Ave. to S. Kedzie Ave., 710 lin. ft. 4-ft. brick sewer, 2-ring, lift cut; 65 lin. ft. 6-ft. brick sewer, 2-ring. 14.5-ft. cut; 35 lin. ft. 5-ft. brick sewer, 2-ring, 14.5 ft. cut; 25 lin. ft. 3-ft. brick sewer, 2-ring, 10-ft. cut; re-connection to old brick sewers, 30 lin. ft. 2.5-ft. double strength tile pipe, 14-ft. cut; 30 lin. ft. 2¼-ft. double strength tile pipe 14-ft. cut; 30 lin. ft 2-ft. double strength tile pipe, 14-ft. cut; 300 lin. ft. 20-in. double strength tile pipe, 13-ft. cut; 240 lin. ft. 18-in. double strength tile pipe, 12-ft. cut; 660 lin. ft. 15-in. tile pipe, 12-ft. cut; 940 lin. ft. 12-in. tile pipe, 12-ft. cut; 1 concrete bulk head, 225 manholes, 20 catch basins complete, including connection. Work requires the construction of a tunnel under the C. B. & Q. right of way. All asphalt pavements removed shall be replaced by the city and charged to contractor at the rate of $2.50 per sq. yd. Payment cash and bond ten years, reserve 15 per cent, provided same does not exceed $15,000; assessement available, $463,172. Plans and specifications may be had upon application to E. J. Glackin, Secretary of the Board of Local Improvements, upon receipt of $5. Cash or certified check for 10 per cent of bid must accompany proposal.

⊙Arthur Birt, 1649 E. Main St., Decatur, Ill., has been awarded the contract by the city of Champaign, Ill., L. N. Sizer, City Engineer, for the construction of the Fountain Head storm water sewer, for $11,249. The work includes 10,668 lin. ft. of pipe varying in size from 8-in. to 27-in. Bids were opened April 8.

Following are the lowest bidders for furnishing and delivering to the Bureau of Engineering, Department of Public Works, Chicago, Ill., one trench excavator, including the services of an engineer for 60 days: F. C. Austin, 80 E. Jackson Blvd.; G. W. Parsons Co., Newton, Ia. The contract has not been awarded. L. E. McGann, Commissioner of Public Works.

Following are lowest bids submitted to the Board of Local Improvements, Chicago, Ill., for constructing house drains, Exchange Ave., Baltimore Ave. to E. 87th St., 32 cts. per lin ft., M. Murphy, 5315 Wabash Ave.; W. 51st Ct., Irving Park Blvd. to Berteau Ave., 28 cts.; Lowe Ave., 103d St., Harvard Ave. to State St; Lowe Ave., 103d St. to 550 ft. south, 28 cts., D. Fosco, 814 Desplaines St.: South Park Ave., 71st St. to 75th St., 29¾ cts., D. Harkin, 3139 Indiana Ave. The contracts have not been awarded. E. J. Glackin, Secretary of the Board.

The Board of Trustees of Oak Park, Ill., has ordered that house drain be constructed in the following streets: Harvey Ave. and Mapleton Ave., between Thomas St. H. L. Fearing, Commissioner.

The Board of Local Improvements of East Moline, Ill., has ordered the construction of the new storm drain, to benefit the city from one end to the other. The estimated cost of the sewer is $200,000. H. G. Paddock is City Engineer.

The citizens of Farmington, Ill., are agitating the installation of a sewerage system.

Indiana.

⊙The Board of Public Works of Terre Haute, Ind., has awarded the contract for the construction of a sewer on 12½ St., from Barbour to Florida St., to J. Paul Welch, for $3,682.

⊙The following were awarded contracts by the Board of Public Works of South Bend, Ind., for the construction of sewers: G. Frank Stoeckinger, on E. Fifth St., from Laurel St. to Merrified Ave., and on Baker St., from Second St. to the Lake Shore tracks; Staples & Ackerman, South Bend, sewers on E. Third St., from Pine to Cedar St., and on Battell St., from Main to Division St.

The town of Boonville, Ind., will construct a new sewer in the north part of Boonville, to cost $84,000, according to the specifications now on file with the City Clerk.

Iowa.

✣Bids will be received until 8 p. m., April 17, by J. J. Shea, City Recorder, Dubuque, Ia., for the construction of an 8-in. tile pipe sanitary sewer in W. Locust St. and Arch St., from the present sewer in W. Locust St. to a point about opposite the dividing line of Lots 41 and 42 in Finley Addition, in accordance with the plans and specifications prepared by the City Engineer and now on file in the office of the City Recorder. It is estimated by the City Engineer that it will require 3,300 lin. ft. of 8-in. tile pipe, 15 manholes.

✣Bids will be received until 8 p. m., April 17, by J. J. Shea, City Recorder, Dubuque, Ia., for the reconstruction of a 10-in. tile pipe sanitary sewer in the alley between Main and Locust Sts., from First to Eighth St., in accordance with the plans and specifications prepared by the City Engineer and now on file in the office of the City Recorder. It is estimated by the City Engineer that it will require 2,200 lin. ft. of 10-in. tile pipe,. 13 manholes, 60 connections to be retapped into new sewer.

⊙The Hydraulic Concrete Construction Co. has been awarded the contract by the City Council of Davenport, Ia., for the construction of the 13th district main and lateral sewer system, for $61,300. Work must be begun on the system June 1 and the contract is to be completed by Jan. 1, 1914.

The town of Onawa, Ia. (population 2,026), plans the installation of a sewerage system. The Civic Improvement Association is behind the movement.

The city of Eldora, Ia. (population 1,995), plans the construction of two miles of sewers.

The Town Council of Mt. Ayr, Ia., has voted to have a preliminary survey of the town for sewers. The engineers will submit their report at the next meeting of the Council.

Kansas.

The City Clerk of Clayton Center, Kans., has asked for bids for the construction of sewers in District No. 51. The City Council also passed an ordinance providing for the extension of the sewer system on Lincoln Heights.

The Kansas State Board of Health has recommended to the city of Salina that it extend its sewer outlet a mile beyond the outlet at the end of Johnstown Ave.

Kentucky.

✣Bids will be received until 2 p. m., April 30, by Board of Public Works, W. J. Dulin, Secy., Madisonville, Ky., for the construction of a sanitary sewer system and water works system.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

The Board of Public Works of Louisville, Ky., John D. Wakefield, Chairman, plans the construction of sewers this year that will cost approximately $210,750.

Maryland.

⊙The Board of Awards of Baltimore, Md., has awarded a contract for the construction of storm water drains in different sections of the city, involving an expenditure of $241,247 from the sewerage loan, to McCarthy & O'Herron of Baltimore.

The Sewerage Commission of Baltimore, Md., Calvin W. Hendricks, Chief Engineer, has submitted specifications for the contract for sewers in the bed of the Reisterstown Road, to be paved by the State Roads Commission.

Maine

At a recent town meeting in Kennebunk, Me., the sum of $12,000 was voted for extending the lines of sewers.

Michigan.

✣Bids will be received until April 25, it is reported, by the city of Flint, Mich., for the construction of sewers.

⊙Phil O. Sheridan & Co., Houghton, Mich., have been awarded the contract by the city of Iron Mountain, Mich., for the construction of 1,650 ft. of 48-in. reinforced concrete sewer, for $10,725. The work also includes putting in 12-in. drain pipe alongside of said sewer. Bids were opened April 12.

City Clerk Newcombe of Flint, Mich., will sell bonds April 17 in the sum of $93,125 for the construction of sewers.

The citizens of Iron Mountain, Mich., on April 7, it is reported, voted the issuance of bonds to the amount of $40,000 for the construction of sewers in the northern part of the city.

Minnesota.

The city of Thief River Falls, Minn., plans the construction of sewers in Districts No. 3 and 4.

The City Council of Rochester, Minn., has instructed the City Engineer to prepare plans, specifications and estimates of cost of a storm sewer to be constructed from Glencoe to Main St., on College St.

Missouri.

✣Bids will be received until 7:30 p. m., April 21, by City Council, at the office of H. H. Wilcox, City Clerk, Poplar Bluff, Mo., for constructing sanitary sewers in Sewer District No. 3 in said city. Total amounts of sewers to be constructed consist of 20,187 ft. 6-in. pipe, av. cut 6.4 ft.; 1,796 ft. 8-in. pipe, av. cut 6.4 ft.; 923 ft. 10-in. pipe, av. cut 7½ ft.; 3,424 ft. 15-in. pipe, av. cut 7 ft.; 1,440 ft. 24-in. pipe, av. cut 8.3 ft., and 51 manholes.; said work to be done pursuant to ordinance passed, ordering same. Proposals must be accompanied by a certified check for 5 per cent of the aggregate amount of each proposal, payable to H. H. Wilcox, City Clerk of Poplar Bluff, Mo. Plans and specifications may be seen at the office of the City Clerk, or City Engineer, Edward C. Thomes, or copy may be obtained from said Engineer upon receipt of $5.

⊙The Board of Public Works of Kansas City, Mo., has awarded a contract for the construction of a storm and sanitary sewer to W. C. Mullins, for $73,956. The sewer will supply the district bounded by White and Bennington Aves. and Eighth and 16th Sts. W. W. Cook & Son bid $73,937 on the work, using vitrified clay pipe. Mullins' bid calls for the use of concrete pipe.

⊙The Board of Public Works of St. Joseph, Mo., has awarded contracts for sewers in Districts Nos. 88 and 26 to John Marnell.

New Jersey.

✣Bids will be received until 2 p. m., April 29, by Passaic Valley Sewerage Commissioners, J. S. Gibson, Clerk, Newark, N. J., for the construction of the northerly portion of Section 6 of the main intercepting sewer, in the City of Newark. Particulars that may enable contractors to judge of the character of the work are given below: Approximate quantities, northerly portion of Section 6, Station 40+00 to Station 56+00. Item 1—Earth excavation and refilling in trench, for 150-in. sewer, 1,600 lin. ft. Item 2—Concrete masonry, in trench, Portland cement mortar, 4,600 cu. yds. Item 3—Brick masonry, in manholes, laid with Portland cement mortar, and appurtenant work, 50 cu. yds. Item 4—Rock excavation, in trench, 300 cu. yds. Item 5—Furnishing, placing and maintaining steel and timber sheeting, etc., between Station 26+75 and 28+75, lump sum. Drawings, form of contract and specifications, and blank form for proposal may be obtained at the Commissioners' office from William M. Brown, Chief Engineer.

✣Bids will be received until 2 p. m., April 29, by Passaic Valley Sewerage Commissioners, J. S. Gibson, Clerk, Newark, N. J., for the construction of the southerly portion of Section 6 of the main intercepting sewer, in the city of Newark. Particulars that may enable contractors to judge of the character of the work are given below: Approximate quantities, southerly portion of Section 6, Station 9+00 to Station 26+00: Item 1—Earth excavation and refilling in trench for 150-in. sewer, 1,700 lin. ft. Item 2—Concrete masonry in trench, Portland cement mortar, 5,500 cu. yds. Item 3—Brick masonry, in manholes, laid with Portland cement mortar, and appurtenant work, 100 cu. yds. Item 4—Rock excavation, in trench, 7,000 cu. yds. Drawings, form of contract and specifications, and blank form for proposal, may be obtained at the Commissioners' office from William M. Brown, Chief Engineer.

✣Bids will be received until 2 p. m., April 29, by Passaic Valley Sewerage Commissioners, J. S. Gibson, Clerk, Newark, N. J., for the construction of the central portion of Section 6 of the main intercepting sewer in the city of Newark. Particulars that may enable contractors to judge of the character of the work are given below: Approximate quantities, central portion of Section 6, Station 26+00 to Station 40+00: Item 1—Earth excavation and refilling in trench for 150-in. sewer, 1,400 lin. ft. Item 2—Concrete masonry, in trench, Portland cement mortar, 4,500 cu. yds. Item 3—Brick masonry, in manholes, laid with Portland cement mortar, and appurtenant work, 50 cu. yds. Item 4—Rock excavation, in trench, 300 cu. yds. Drawings, form of contract and specifications, and blank form for proposal, may be obtained at the Commissioners' office from William M. Brown, Chief Engineer.

An election will be held in Hammonton, N. J., on April 29, for the purpose of voting on the issuance of bonds to the amount of $86,000 for the construction of a sewerage system and a disposal plant.

New York.

✣Bids will be received until 8 p. m., May 7, by City of Oneonta, N. Y., S. H. Close, City Clerk, for the construction of a main line intercepting sewer from Rose Ave. to Lyman Ave. in said city. The following is the Engineer's approximate estimate of quantities: Excavation, 4,800 cu. yds.; 10-in. vit. tile sewer, 1,920 lin. ft.; 12-in- vit. tile sewer, 4,020 lin. ft.; 18-in. vit. tile sewer, 1,500 lin. ft.; 21-in. vit. tile sewer, 1,710 lin. ft.; 30 concrete manholes; 150 lin. ft. wood stave pipe. Each proposal must be accompanied by a certified check, payable to the City Chamberlain of Oneonta, New York, equal to 5 per cent of the amount of proposal as evidence of good faith and to the effect that if the proposal of the bidder is accepted, said bidder will enter into contract and furnish a satisfactory bond. Plans and specifications may be seen at the office of the City Engineer, Oneonta, N. Y., or a complete set of plans and specifications may be had for the sum of $3 upon application to the City Engineer.

⊙The Board of Sewer Commissioners of Medina, N. Y., has awarded to S. V. R. Malcolm & Sons of that village the contract for building the Meade and Roseland Ave. sewers, for $1,780.

Ohio.

✣Bids will be received until noon, May 1, by George E. Frye, Village Clerk, Bexley, O., for constructing a system of sanitary sewers, comprising about 8 miles of 8, 10, 12, 15 and 18-in. sewer pipe in accordance with plans and specifications on file at the Captital Barber Shop, Bexley, Ohio, and also at the offices of the Engineer, A. Elliott Kimberly, No. 8 E. Long St., Columbus, Ohio. Plans and specifications may be obtained for personal use upon payment of $10. Proposals shall be sealed and shall be made upon the proposal blanks attached to the specifications and shall be addressed to George E. Frye, Village Clerk. Certified check, $4,000.

✣Bids will be received until noon, May 1, by George E. Frye, Village Clerk, Bexley, O., for constructing a system of sanitary sewers comprising about eight miles of 8, 10, 12, 15 and 18-in. sewer pipe, in accordance with plans and specifications on file at the Capital Barber Shop, Bexley, O., and also at the offices of the Engineer, A. Elliott Kimberly, No. 8 S. Long St., Columbus, O. Plans and specifications may be obtained for personal use upon payment of $10. Certified check, $4,000. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until noon, April 29, by W. J. Springborn, Director of Public Service, Cleveland, O., for furnishing and erecting a triple effect evaporator at the garbage disposal plant, Willow, O. Each proposal must be made in accordance with the specifications which may be obtained at the office of the Director of Public Service.

Oklahoma.

✣Bids will be received until 8 p. m., April 21, by City Council, Vinita, Okla., for the construction of a 15-in. vit. pipe out fall sewer and reinforced concrete sewage treatment tank for the city. The work to be done consists of the laying of approximately 7,700 lin. ft. of 15-in. vitrified sewer pipe and the building of a reinforced concrete disposal tank, 41x40x20 ft. The city reserves the right to reject any or all bids. Certified checks for $1,000, payable to the city without conditions must accompany all proposals. Plans, specifications and profiles can be had after April 12 upon payment of $10 to Nagel & Petersen, Engineers, Muskogee, Okla. A. J. Green, City Clerk.

Oregon.

⊙Dennis & Christensen have been awarded a contract at Glendale, Ore., for the construction of a sewerage system, for $6,420.

The city of Ontario, Ore., will construct a 24-in. trunk sewer at an estimated cost of $9,000.

Pennsylvania.

✣Bids will be received until 10 a. m., April 18, by City Controller, Pittsburgh, Pa., for the construction of sewers as mentioned under Roads and Streets in this issue.

⊙The City Council of Erie, Pa., has awarded to F. G. Diefendorf the contract for the construction of 1,200 ft. of sewer in 29th St., from Wood St. west, for $1.13 a ft.

Texas.

⊙The Board of Commissioners of Dallas, Tex., has awarded the contract for the construction of a three-unit addition to the city crematory to R. S. Winn Co., for $6,500.

Wisconsin.

✣Bids will be received until noon, May 6, by F. W. Gillman, City Clerk, Evansville, Wis., for the laying of 6,198 ft., more or less, of sanitary sewer in the city of Evansville, Rock County, Wis.; certified check amounting to $500 to accompany bid. Plans and specifications on file in the City Clerk's office. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until noon, May 6, by F. W. Gillman, City Clerk, Evansville, Wis., for the laying of 1,900 ft., more or less, of storm sewer in the city of Evansville, Rock County, Wis.; certified check amounting to

$150 to accompany bid. Plans and specifications on file in the City Clerk's office. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 2 p. m., April 22, by Board of Public Works, Oshkosh, Wis., for furnishing the city of Oshkosh with 137 lin. ft. of iron sewer pipe, 16 ins. in diameter by ¼ in., built of ingot iron, and 80 lin. ft. of iron sewer pipe, 20 ins. in diameter by ¼ in., built of ingot iron, according to specification on file in the office of the Board of Public Works and the office of the City Clerk of the city of Oshkosh.

The City Council of Antigo, Wis., contemplates constructing a trunk line sewer to relieve flood possibilities in the north end of the city.

Canada.

✣Bids will be received until 8 p. m., April 23, by W. C. McCall, Town Clerk, Simcoe, Ont., for the following works: Contract A, laying main sewer and sewage force main; Contract D, furnishing cast iron pipe; Contract G, sewage pumping machinery; Contract P, sewage pumping station; Contract S, tile sewer pipe; Contract X, sewage disposal works. Plans and specifications may be seen at the office of Chipman & Power, Engineers, Toronto, Ont., or at the Town Hall of Simcoe.

BUILDINGS

District of Columbia.

✣Bids will be received until April 24, by Maj. W. L. Clark, Signal Corps, U. S. A., Disbursing Officer, Washington, D. C., for furnishing the signal corp's with 528,000 ft. of outside distribution wire, 45 miles.

Georgia.

✣Bids will be received until May 1, by Maj. T. B. Hacker, Quartermaster, Fort Oglethorpe, Ga., for constructing isolation hospital at Fort Oglethorpe, Ga.

Illinois.

✣Bids will be received until April 18, 1913, by the Board of Education at Urbana, Ill., for constructing a two-story and basement high school building according to plans and specifications on file with J. H. Royer, Architect. Estimated cost, $150,000. C. W. Holmes, Secretary of the Board.

Indiana.

✣Bids will be received until 10 a. m., April 28, by Depot Quartermaster, Jeffersonville, Ind., for remodeling and repairing the present toilet building, constructing a bath room in the lodge and placing in safe condition the brick walls of the annex to the lodge, consisting of repairing, pointing and plastering, etc., at the Chattanooga National Cemetery, Chattanooga, Tenn.

✣Bids will be received until 2 p. m., April 21, by W. E. Oliphant, Trustee of Linton township, Vigo County, at the old School buildling in Pimento, Ind., for the construction of two-story, basement and brick school building.

✣Bids will be received until 10 a. m., April 25, by Ord W. Kuhn, Trustee, Brown Township, Hancock County, Wilkinson, Ind., for the construction of a brick and stone annex to school building.

Iowa.

The Iowa Legislature has passed a bill providing about $2,000,000 for the extension and improvement of the capitol grounds at Des Moines. The money is to be expended for the purchase and improvement of additional land and the erection of several additional buildings. E. L. Masqueray, 200 5th Ave., New York City, is the architect.

Massachusetts.

✣Bids will be received until noon, May 5, by Trustees of the Worcester State Asylum, Worcester, Mass., for the erection of a number of buildings at the Grafton Colony. The general construction, plumbing, heating and electric wiring will be considered as separate contracts. Plans and specifications may be seen at the office of Fuller & Delano Co., Architects, 44 Front St., Worcester, Mass.

⊙The Turner Construction Co., 11 Broadway, New York City, has been awarded the general contract for the construction of Building No. 43 of the General Electric Co., Pittsfield, Mass. This building is 500 ft. x 63 ft., five stories in height, reinforced concrete throughout. M. M. Thrane, Architect. Work will go ahead at once.

Minnesota.

✣Bids will be received until noon, April 21, by Board of Education, Duluth, Minn., for the erection and completion of the new E. R. Cobb School located in block 6, Woodland Park, Second Division. Kelly & Williams, 700 Lonsdale Bldg., are Architects. C. A. Bronson is Clerk of the Board.

Missouri.

✣Bids will be received until 3 p. m., May 24, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping,, heating .apparatus, electric conduits and wiring, interior lighting fixtures, and approaches, of the United States post office at Brookfield, Mo. The building is to be of one story, mezzanine and basement, and to have a ground area of approximately 4,400 square feet; fireproof, except roof; stone, brick and terra cotta facing and tin roof. Drawings and specifications may be obtained from the custodian of site at Brookfield, Mo., or at the discretion of the Supervising Architect.

New Jersey.

✣The City of Camden, N. J., will open bids in June for the construction of a municipal electric lighting plant. Plans and specifications were prepared by Runyon & Carey, Newark, N. J.

New York.

✣Bids will be received until 2 p. m., May 1, by Capt. A. J. Cooper, District Quartermaster, Fort Totten, N. Y., for the reconstruction of the quartermaster's stable at that post.

⊙The Turner Construction Co., 11 Broadway, New York City, has been awarded the general contract by the Robert Gair Co., paper goods manufacturers, for a 10-story factory building to be erected at Washington and Front Sts., Brooklyn, according to the plans of William Higginson, Architect. This building is 200 ft. by 125 ft. in plan, ten stories high, reinforced concrete throughout, fireproof in every detail. Work will be started at once.

Plans and specifications are being prepared by Lockwood, Greene & Co., architects and engineers for industrial plants, 60 Federal St., Boston, Mass., for a new reinforced concrete factory for the Hewett Rubber Co., Buffalo, N. Y. The building will be three stories high, 460 ft. by 90 ft. There will also be a new power plant.

North Carolina.

✣Bids will be received until 3 p. m., May 19, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for .the construction, complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures, and approaches, of the United States post office at Monroe, N. C. The building is to be of one story, basement and mezzanine, and has a ground area of approximately 3,450 square feet; fireproof first floor; stone and brick facing, and tin roof. Drawings and specifications may be obtained from the custodian of site at Monroe, N. C., or at the discretion of the Supervising Architect.

Ohio.

✣Bids will be received until noon, May 12, by Board of Education, Rockwell and E. 6th St., Cleveland, O., for furnishing all the materials and doing all the work necessary to complete the installation of ventilating apparatus in Fairmount, Giddings, East Madison, Miles Park and South Case Schools, in accordance with plans and specifications on file in the office of the Director of Schools, E. 6th St. Frank G. Hogen is Director of Public Schools.

Oregon.

✣Bids will be received until 2 p. m., May 7, by Commissioner of Indian Affairs, Washington, D. C., for furnishing materials and labor for the construction of a brick industrial building at the Salem Indian School, Oregon, instrict accordance with the plans, specifications and instructions to bidders, which may be examined at the office of the Supervisor of Construction, Denver, Colo.

Pennsylvania.

✣Bids will be received until 10:30 a. m., April 18, by City Controller, Pittsburgh, Pa., for the erection of an annex to the Golf Shelter House at Public Golf Links in Schenley Park. Plans and specifications can be obtained of J. G. Armstrong, Director of Department of Public Works.

⊙H. Miller & Sons, Union Bank Bldg., Pittsburgh, have been given the contract by Architect Charles Bickel, May Bldg., Pittsburgh, to build a three-story brick, stone and terra cotta club house at Bayard and Matilda Sts., Schenley Farms, for the Concordia Club. The building will cost about $100,000.

Carlisle & Sharrer, Jenkins Arcade Building, Pittsburgh, have plans in progress for the 2-story brick and terra cotta fireproof school building to be built in Third St. for the Board of Education of Duquesne, to cost $180,000.

Architects Arydaugh & Wolfe, 347 Fifth Ave., Pittsburgh, Pa., are preparing plans for a two-story fireproof brick elementary school building to be built at Stanton Ave. and Meadow St. for the Board of Education of Pittsburgh. The building will cost $250,000.

Architect Joseph Lee, 703 State St., Erie, Pa., is preparing plans for a 3-story brick, steel and reinforced concrete apartment building, 83x138 ft., to be built on 24th St. by M. J. Butler, 2401 Peach St., Erie, to cost $75,000.

Utah.

✣Bids will be received until 2 p. m., May 2, at the office of the Chief Clerk of the Department of Agriculture, Washington, D. C., for furnishing stationery and office supplies, instruments, field equipment, furniture and telephone supplies to the Forest Service Supply Depot at Ogden, Utah, during the fiscal year beginning July 1, 1913.

West Virginia.

Caldwell & Drake, Youngstown, Ohio, contractors, who have the work of erecting the four-story hotel building for the Windsor Hotel Co. at Wheeling, W. Va., will take sub-bids soon. The building will be 40x100 ft. and will cost $400,000.

Canada.

✣Bids will be received until 5 p. m., April 24, by Wininpeg Public School Board, R. H. Smith, Secretary, Winnipeg, Man., for the erection of a stone and brick addition to the Machray School, corner of Charles and College Sts. For plans, specifications, forms of tender, etc., apply direct to J. B. Mitchell, Commissioner of School Buildings, School Board office.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

RIVERS AND HARBORS

California.

⊙Pearson & Anderson, Los Angeles, have been awarded the contract at $31,834 by the City Trustees of Venice, Cal., for the construction of a bulkhead on the ocean front south of Center St.

⊙The Standard American Dredging Co., Central Bldg., Los Angeles, Cal., has been awarded the contract at $177,125 for dredging 1,300,000 cu. yds. from Slips 1 and 5 in Los Angeles inner harbor and filling adjoining lands. Bids were opened March 31 by the Board of Public Works of Los Angeles.

The Joint Councilmanic Committee and Advisory Board of Long Beach, Cal., have been considering plans for a pier and will probably recommend a bond issue of $400,000 for such work. E. P. Dewey is City Engineer.

District of Columbia.

✣Bids will be received until 10:30 a. m., May 2, by Maj. F. C. Boggs, General Purchasing Officer Isthmian Canal Commission, Washington, D. C., for furnishing steel, iron, wire cable, nails, nuts, wrenches, hack-saw blades, tool handles, solder, hose, packing, rubber belting, asbestos gaskets, manila rope, cotton canvas, soap, candles, white zinc, red lead, chrome green, orange gum shellac and linseed oil.

Indiana.

The Board of Public Works of Indianapolis, Ind., has adopted a resolution declaring its intention of improving White River from 38th St. to Southern Ave. by straightening and changing its boundaries, by widening the channel where necessary and building levees and roadways on both banks of the stream. In the resolution the city engineer is instructed to make the necessary survey, plans and specifications, and the city legal department is asked to prepare a formal preliminary resolution for the work. This is the first step toward the permanent improvement of the river levees to prevent the recurrence of the recent floods. Henry W. Klausmann is City Engineer.

Massachusetts.

✣Bids will be received until 11 a. m., April 23, by Board of Harbor and Land Commissioners, Boston, Mass., for dredging a channel from Woods Hole Great Harbor to Eel Pond, Falmouth. The work to be done is the dredging of about 6,000 cu. yds. of material to provide a channel 31½ to 36 ft. wide and about 565 ft. long. All dredging to be the depth of 8 ft. at mean low water. William F. Williams, Chief Engineer.

Bids as follows were received April 10 at the office of the U. S. Engineer, Boston, Mass., for building riprap seawall at Fort Heath, Winthrop, Mass., the bids being per ton of 2,000 lbs. for stone in place in riprap wall: W. H. Ellis, Boston, Mass, $3.39; Lawler Bros., Charlestown, Mass., $3.50; John Cashman & Sons Co., Boston, Mass., $2.24; Rendle & Stoddard, East Boston, Mass., $3.90.

Michigan.

✣Bids will be received until noon, May 1, by Lt. Col. Mason M. Patrick, U. S. Engineer, 337 Federal Bldg., Detroit, Mich., as noted in our last issue, for dredging Alpena Harbor, Mich. The area to be dredged extends from the 16-ft. curve in Thunder Bay to a point about 2,300 ft. above the Second St. bridge. In the bay there are four isolated shoals, of small extent, to be removed. They are located about 9,000 ft., 6,400 ft., 3,200 ft. and 2,000 ft. respectively from the lighthouse. The estimated amount of material to be removed is 72,000 cu. yds., scow measurement, of sand, soft clay and silt.

New Mexico.

County Commissioners, Albuquerque, N. M., have instructed County Surveyor Roos to make an estimate of the cost of filling in low places along the proposed line of a dike to be built on the east bank of the Rio Grande from the Barelas Bridge to a point west of Old Albuquerque.

New York.

✣Bids will be received until noon, April 28, by Col. W. M. Black, U. S. Engineer, Army Bldg., New York City, for furnishing and delivering Portland cement.

✣Bids will be received until 10 a. m., May 8, by M. Gray Zalinski, Depot Quartermaster, Army Bldg., New York City, for the construction and equipment of from 1 to 20 30-ft. self-righting, self-bailing tunnel stern motor life boats for the transport service of the War Department.

Pennsylvania.

Enabling bills are before the City Council of Philadelphia, Pa., providing for the improvement of the water front between Fitzwater and Christian Sts. by the construction of two piers to be erected by the city. These will be doubledeck, each 180 ft. wide and 560 ft. long, between Catharine and Christian Sts. Between the pier and on either side will be docks 200 ft. wide. The Pennsylvania R. R. Co., to the south, will increase the width of its present pier at the foot of Christian St. from 100 to 160 ft. and will extend the Washington Ave. pier, which is 100 ft. wide, to a distance of 930 ft. from the present line of Delaware Ave. This will be done as the result of a bargain with the railroad. The cost of the piers, as estimated by Director Norris of the Department of Wharves, Dock and Ferries, will be $1,000;000 or $1,200,000, and the entire exepnse can be paid out of the $1,600,000 appropriation contained in the $7,000,000 loan which was voted by the people last November, together with $108,000 remaining from the appropriation made by the last legislature.

Porto Rico.

⊙The P. J. Carlin Construction Co., New York City, has been awarded the contract at $345,939 for constructing 2,750 lin. ft. of reinforced concrete bulkhead, backfilling and paving for the San Juan Harbor Board. Bids were opened March 18.

South Carolina.

Bids as follows were received April 10 by Maj. G. P. Howell, U. S. Engineer, Charleston, S. C., for dredging about 100,000 cu. yds. from Archers Creek, S. C. Joseph F. O'Brien, Savannah, Ga., 16.9 cts., 16-in. hydraulic dredge Niagara, 2,000 cu. yd. capacity per day; Simons-Mayrant Co., Charleston, S. C., 19.4 cts., hydraulic dredge Sewee, 20,000 to 30,000 cu. yds. per month; P. Sanford Ross, Inc., Jersey City, N. J., 19.9 cts., clam shell dredge No. 10, two or more scows and tug Juno.

Virginia.

✣Bids will be received until noon, May 1, by Lt. Col. E. Eveleth Winslow, U. S. Engineer, Norfolk, Va., as noted in our April 9 issue, for dredging Thimble Shoal. The work consists in the deepening of that part of the entrance channel to Hampton Roads, known as the Thimble Shoal Channel. The dredging extends over a distance of about four miles. The western end of the work being about three miles southeast of Thimble Shoal Light in the lower part of Chesapeake Bay. The channel as dredged is to have a bottom width of 500 ft. and it is estimated that about 450,000 cu. yds. of material, chiefly sand, scow measurement, are to be removed.

✣Bids will be received until 2 p. m., April 21, by Board of Commissioners of the District of Columbia, Washington, D. C., for furnishing and delivering one tug boat and four barges (new or second hand) for use of the D. C. Workhouse, Occoquan, Va.

Bids as follows were received April 7 by Lt. Col. W. C. Langfitt, U. S. Engineer, Washington, D. C., for repairing and extending riprap jetties in Urbana Creek and Millford Haven, Va.: McClenahen Granite Co., Port Deposit, Md., Urbana Creek, $4.53 per cu. yd.: Millford Haven, $4.93. Columbia Granite and Dredging Co., Washington, D. C., $4.18 for Urbana Creek and $4.51 for Milford Haven.

Washington.

⊙The Erickson Construction Co., Downs Block, Seattle, Wash., has been awarded the contract at $166,332 for Pier No. 4 at Puget Sound navy yard, for the U. S. Bureau of Yards and Docks. The pier is to be of reinforced concrete construction and will require about 5,300 cu. yds. of concrete.

Commissioners of the Port of Grays Harbor are preparing to begin work on a fresh water basin and deepening the channels. About $50,000 is available, but the commissioners also favor bonding the county and city for not less than $300,000. Plans for the improvement have been prepared by Virgil Bogue, Seattle. W. J. Patterson, Aberdeen, is a member of the commission.

Wisconsin.

✣Bids will be received until 3 p. m., May 8, by Lieut. Col. George A. Zinn, U. S. Engineer, Milwaukee, Wis., for building crib and pile pier with concrete superstructure on old breakwater at Manistique, Mich.

The Wolf River Improvement Co., of Appleton, Wis., the incorporation of which was mentioned in our last issue, proposes to improve the upper Wolf River and its tributaries used for driving logs to improve the navigation of the river and to diminish the injuries done by floods. Another purpose of the corporation is to improve the water power of both the Wolf and Fox Rivers by establishing a system of water reservoirs to be situated north of Langlade County. The incorporators are F. J. Sensenbrenner, John M Baer and D. E. Reese.

Canada.

✣Bids will be received until 4 p. m., May 1, by L. K. Jones, Asst. Deputy Minister and Secy., Department of Railways and Canals, Ottawa, Ont., for the Fenelon Falls dam, Trent Canal. Plans, specifications and form of contract to be entered into can be seen at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Superintending Engineer, Trent Canal, Peterborough, Ont. A certified check for $1,000 must be filed with each proposal.

✣Bids will be received until 4 p. m., April 28, by R. C. Desrochers, Secy., Department of Public Works, Ottawa, Ont., for the supply of hardware, brushes, manila rope, packing, paint, paint oil, hose, wire rope, oils and greases, steam pipe and steam fittings, and chain for the departmental dredging plant in Ontario.

✣Bids will be received until 4 p. m., April 22, by R. C. Desrochers, Secy., Department of Public Works, Ottawa, Ont., for dredging Port Burwell, Ont. Combined specification and form of tender can be obtained on application to the Secretary, Department of Public Works, Ottawa. Tenders must include the towing of the plant to and from the work. Dredges and tugs not owned and registered in Canada shall not be employed in the performance of the work contracted for. Contractors must be ready to begin work immediately on the opening of navigation. Each tender must be accompanied by an accepted check on a chartered bank, payable to the order of the Minister of Public Works, for $1,500.

⊙Thos. P. Charleson, 179 Gilmour St., Ottawa, Ont., has been awarded the contract for construction of a wharf at Quaco, N. B., for the Department of Public Works of Canada.

The construction program of the Harbor Commissioners of Montreal, Que., for the present year calls for an expenditure of about $2,000,000 for harbor improvements.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

CALLS FOR BIDS

Rate, $2.40 an inch, single column. **Copy received until Monday noon.**

FILTERS, BASINS AND GRADING.

Baltimore, Md.

Sealed proposals, endorsed "Bids for Construction of Filters, Basins and Grading, Lake Montobello, Water Department, Contract No. 11," addressed to the Board of Awards of Baltimore City, will be received at the office of the City Register, City Hall, Baltimore, Md., until 11 a. m., Wednesday, April 30, 1913, for the construction of 32 mechanical filter units, 2 coagulating basins, 1 mixing basin, 2 earthen dam and appurtenances, as shown on plans on file in the office of the Water Engineer, City Hall, Baltimore, Md.

Plans and specifications can be obtained at the office of the Water Engineer, City Hall, Baltimore, Md., on and after April 7, 1913. A charge of fifty dollars ($50.00) will be made for each set of plans and specifications; this amount will be refunded upon the return of these plans and specifications before May 3, 1913, in good condition. Specifications used in making a bid will be considered as returned.

A certified check of the bidder on a clearing house bank, made payable to the Mayor and City Council of Baltimore for the sum of thirty thousand dollars ($30,000) will be required with each bid.

The extent of the work is as follows:

Excavation, 106,000 yards.

Two coagulating basins, capacity of each, 8,500,000 gallons.

One mixing chamber with capacity of 3,000,000 gallons.

Thirty-two mechanical filter units of 4,000,000 gallons daily capacity with complete equipment.

Filtered water basin with capacity of 2,500,000 gallons.

Two earthen dams built from the excavated materials.

The successful bidder will be required to give bond to comply with the city charter respecting contracts.

The Board of Awards reserves the right to reject any or all bids.

EZRA B. WHITMAN,
Water Engineer.

Approved April 2, 1913.
JAMES H. PRESTON,
President Board of Awards.

STREET PAVING.

Ridgway, Pa.

Sealed proposals for grading, paving and curb-setting will be received by G. F. Greiner, Secy. of Town Council, until 12 o'clock noon, April 28th, 1913.

Approximate quantities are as follows:

5,200 cu. yds. excavation.

11,400 sq. yds. brick paving.

10,500 lin. ft. curb-setting.

All in accordance with plans and specifications now on file in the office of F. W. Ward, Borough Engineer, Room No. 10, Masonic Temple, Ridgway, Pa.

Information and instruction to Bidders will be mailed upon request.

The right is reserved to reject any or all bids.

G. F. GREINER,
Secy. of Town Council of The Borough of Ridgway.

WATER TOWER REPAIRING.

The Board of Public Works, of the City of Maryville, Missouri, through F. L. Flint, Supt. of Construction, will receive sealed bids until noon April 28th, for repairs to Water Tower, also for two return tube boilers of one hundred horse power each. Each bid to be accompanied by a certified check for an amount equal to two per cent of the bid, payable to John D. Richey, City Treasurer.

Plans and specifications are on file at the office of Supt. of Construction, and also at the office of Hiram Phillips, Consulting Engineer, Liggett Bldg., St. Louis, Mo.

The Board of Public Works reserves the right to reject any or all bids.

F. L. FLYNT.
Supt. of Construction.

VITRIFIED BRICK PAVEMENT.

Poplar Bluff, Mo.

Sealed proposals will be received by the City Council of the City of Poplar Bluff, Missouri, until 7:30 o'clock p. m., Monday, April 21, 1913, at the Council Chambers in said City of Poplar Bluff, Missouri, for improving by grading, paving with vitrified brick and curbing and guttering the following streets: Main street; Vine street and Pine street, total amounts consisting of about 28,175 square yards of vitrified brick on a 4-inch concrete base and a 1½-inch sand cushion; asphalt filler; 18,790 lineal feet of combined 6-inch curb and 18-inch gutter; 1,963 feet of protection concrete headers; 7,575 cubic yards of grading; 400 feet of 12-inch pipe; 80 feet of 8-inch pipe; 8 catch basins and 4 curb boxes; bids may be on each street separately, all streets or less number.

Proposals must be accompanied by cash or certified check for 5 per cent of the aggregate proposal, payable to H. H. Wilcox, City Clerk of the City of Poplar Bluff, Missouri.

Plans and specifications may be seen at the office of the City Engineer, Edward C. Thomes, or copies may be obtained upon receipt of $5.00.

The right is reserved to reject any or all bids.

H. H. WILCOX, City Clerk.

DEPARTMENT OF THE INTERIOR, U. S. Reclamation Service, Washington, D. C., March, 25, 1913.—Sealed proposals will be received at the office of the United States Reclamation Service, Babb, Montana, until 2 o'clock, P. M., April 28, 1913, for the construction of twenty-two miles of the St. Mary Canal, Milk River Project, Montana. The work involves the excavation of about 1,201,000 cubic yards of material and extends along St. Mary River from Lower St. Mary Lake to the North Fork of Milk River, in the northwest portion of the Blackfeet Indian Reservation, Montana.

For particulars address the United States Reclamation Service, Washington, D. C., Helena, Montana, or Babb, Montana. MORRIS BIEN, Acting Director.

U. S. ENGINEER OFFICE, Portland, Ore., April 9, 1913. Sealed proposals for constructing and erecting eleven pairs of metal lock gates for Dalles-Celilo Canal will be received here until 11 a. m., May 24, 1913, and then publicly opened. Information on application. JAY J. MORROW, Maj. Engrs.

ADVERTISEMENT.

MARION COUNTY DRAINAGE DISTRICT.

Palmyra, Mo., April 5, 1913.

Sealed proposals will be received at the office of Frank G. Bier, secretary of Marion County Drainage District, Palmyra, Mo., until 10 o'clock a. m., April 26, 1913, for:

(a) The construction of levees, involving the placing of about 450,000 cubic yards of earth, and excavating and filling of about 7,000 cubic yards muck ditch.

(b) The construction of canals and ditches, involving the excavation of about 100,000 cubic yards of earth.

As a part of the reclamation of the lands in the Marion County Drainage District.

Particulars may be obtained from Edmund T. Perkins, Chief Engineer, Chicago, Illinois, Frank G. Bier, Secretary, Palmyra, Mo., or W. E. Kendall, Quincy, Illinois.

FRANK G. BIER,
Secretary.

SEWER SYSTEM.

Until 12 o'clock noon, Standard Time, on May 1, 1913, sealed bids will be received by the Clerk of the Village of Bexley, Franklin County, Ohio, for constructing a system of sanitary sewers comprising about 8 miles of 8, 10, 12, 15 and 18-in. sewer pipe in accordance with plans and specifications on file at the Capital Barber Shop, Bexley, Ohio, and also at the offices of the Engineer, A. Elliott Kimberly, No. 8 S. Long St., Columbus, Ohio. Plans and specifications may be obtained for personal use upon payment of $10.

Proposals shall be sealed and shall be made upon the proposal blanks attached to the specifications and shall be addressed to George E. Frye, Village Clerk. Certified check $4,000.

The village reserves the right to reject any or all bids.

By order of the Mayor and Council.
Attest: GEORGE E. FRYE, Village Clerk.

STREET PAVING.

Bids will be received by the City of Austin, Minn., until 8 o'clock, April 25, for paving and curbing of parts of streets. Approximately 15,000 sq. yds. of paving and 7,000 lin. ft. of cement curb.

FRANK CRONON,
City Recorder.

O. F. WEISSGERBER,
City Engineer.

DEPARTMENT OF THE INTERIOR, U. S. Reclamation Service. Washington, D. C., March 31, 1913. Sealed proposals will be received at the office of the United States Reclamation Service, Great Falls, Mont., until 2 o'clock p. m., April 30, 1913, for the construction of the Pishkun Reservoir Supply Canal, the Sun River Slope Canal and Tunnels No. 2 and No. 3 of the Pishkun Reservoir Supply Canal, involving the excavation of about 2,400,000 cubic yards of material and the construction of about 3,215 lineal feet of concrete lined tunnel. The work is situated on the north side of Sun River 25 to 70 miles west of Great Falls, Mont., and near the line of the Sun River Branch of the Great Northern Railway. For particulars address the United States Reclamation Service, Washington, D. C., Helena, Mont., or Fort Shaw, Mont. MORRIS BIEN, Acting Director.

ENGINEERING AND CONTRACTING

Devoted to the Economics of Civil Engineering Design
and to Methods and Cost of Construction

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Experimental Work in Sewage Treatment at State Universities.

The announcement that a prominent state university in the central west contemplates undertaking experimental work in sewage treatment suggests the possibilities of such experimental work under the direction of the civil or sanitary engineering departments of other state universities in all parts of the country. Engineers are familiar with the results of much of the experimental work of a varied nature which has been conducted in the engineering experiment stations of the Universities of Illinois, Iowa and Wisconsin. Much has been done at these institutions toward standardizing certain features of design, and in indicating good practice along some lines of engineering activity. Important industries in these states acknowledge their indebtedness to the investigators who have worked in these stations and who have reported the results of their labors in bulletins which have been issued from time to time. The general public, so far as it is informed, is also appreciative of the work done in the experimental engineering stations which are equipped and maintained by funds made available by taxation. In short, engineering experiment stations now fill an important place in the industrial affairs of the country. Much good work can be done by experimental work in sewage treatment at our state universities.

It has been stated frequently, perhaps over-frequently, that every problem in sewage treatment must be studied by itself and solved with due attention to the peculiarities of local conditions. Certainly this is true for the country as a whole, and even for the various states. Yet when the field is narrowed down to the area of a single state, the number of typical local conditions is correspondingly reduced. It will be found that many cities in each state have very similar local conditions, and may, therefore, be grouped together in classifying conditions. The type of treatment works best suited to handle the situation in any city of a certain group will also best serve the needs of the remaining cities in the group, although the details of the plants designed must in all cases be proportioned so as to be consistent with topographical conditions and capacity requirements. The actual design of individual plants should, of course, be handled by engineers in private practice.

The function of the state sewage treatment experiment station will be to indicate good practice in the choice of treatment methods for each group of frequently recurring local conditions within the state in which the experiments are conducted. Additional work will be done in testing the value of local sand and stone for use in sewage filters and beds. Characteristic local sewages will also be tested and classified. We believe that this service will be helpful to all, for far more mistakes, economic and otherwise, have been made in choosing methods of treatment than in working out engineering details after the choice of treatment has been made. This, of course, is particularly true of the plants in the smaller cities where the building of works has not been preceded by local experimental investigations.

The cost of equipping and operating these experimental treatment plants will be small and well within the means of any of our state universities. The studies made at these plants will form the best kind of educational work for students who intend to engage in sanitary engineering practice later on. Bulletins issued from these stations will certainly be of great service to practicing engineers, and the resulting improvement in this class of engineering work will amply repay the taxpayers of the state for the cost of the experimental studies.

The Creation of a National Bureau of Public Works for Flood Prevention.

The creation of a National Department of Public Works is called for by resolution of the National Drainage Congress which met in St. Louis April 10-12. The resolution and the reasons for it are quoted as follows:

> Whereas, In view of the appalling and ever recurring disasters caused by floods, which have destroyed life and property throughout the United States, and which is emphasized by the recent and widespread calamity brought upon our citizens by the floods which have devastated Ohio, Indiana, Illinois, and adjoining states, and which devastating floods are now moving southward throughout the Mississippi Valley, threatening destruction to life and property all the way to the Gulf of Mexico, and
>
> Whereas, We believe it to be an equally proper function of the Government and the United States, under the welfare clause of the Constitution, to take adequate measures to control the water resources of our country, so as to protect the life, health and property of our citizens from the controllable forces of nature, as it is to protect our citizens from the attack of a foreign foe; now, therefore, be it
>
> Resolved, By the National Drainage Congress in convention assembled, that we respectfully petition the immediate consideration of adequate provisions for flood control, for the regulation and control of stream flow, and for the reclamation of swamp and overflow lands and arid lands, and, in furtherance thereof, we pray that in your wisdom you create a body which will put in effect at the earliest possible moment such plans, in co-operation with the several states and such other agencies, as will meet with the needs of the several localities of

the United States, and we believe the most effectual and direct means will be the establishment of a Department of Public Works with a Secretary in charge thereof who shall be a member of the President's Cabinet.

This resolution was addressed to the President and the Congress of the United States.

The program of the National Drainage Congress also further recognized the proposal for a National Board of Public Works by including an address in its favor by Mr. Isham Randolph, of Chicago, and the draft by him of an act providing for such a board. We publish a portion of Mr. Randolph's address and the full text of his proposed act in another section of this issue.

The proposition to place national public works under the administration of a single government department independent of other departments now existing and ranking equally with them is not new. All logic supports such a plan, and there is little if any logic in the present plan of having arid land reclamation directed by the Department of the Interior, public building construction by the Treasury Department, and works affecting navigation by the War Department. These works are all of one class—all engineering works. We might easily carry the count further and include drainage and hydrographic investigations. But this would only multiply instances without adding force to our accusation of illogical administration of national public works. The grave fault of the present divided control and direction of national public works is not that any of the different departments is failing to handle its particular task reasonably well; it is that the public works work of every department is unrelated in character and purpose and directing talent required to the main service of that department. It is, too, and particularly in the case of the War Department, as pointed out by Mr. Randolph, a burden of work for whose direction the department organization plan does not provide enough directing officials. This last deficiency will be very greatly increased if a comprehensive plan for flood control and land reclamation be added to our present national public works.

While we believe that the logic of the action of the National Drainage Congress in recommending the direction and prosecution of flood control and land reclamation work by a separate governmental department is to be commended, we believe that it is more important to recognize the broad policy indicated by this action. This policy is that flood control and land reclamation in the United States should be handled as a unit for each river system. Attempt was made to secure the indorsement of the Congress by resolution of specific work, but it failed and only the broad general resolution which is quoted above was voted. We believe that this was wise action.

The problem of flood control is not alone the problem of controlling the floods of the Mississippi system. The flood control problem of the Mississippi is not alone a matter of reservoir construction or levee construction—it is a problem of many interrelated factors. The problem of river development, finally, is not alone a problem of flood control, it is a problem of flood prevention, land reclamation, and water power and navigation development. The first step in the attack of so great a problem is a comprehensive study of and a unit plan for each river system. A national board of direction of the kind that the National Drainage Congress suggests is necessary for such unit planning and investigation. We believe that engineers should uphold this broad conservation policy and should work to secure its adoption by the nation.

ROADS AND STREETS

Organization of Town Highway Departments.

It is quite apparent that any scheme of improvement to the highways of a state which contemplates the bettering of a skeleton system only, and does not also include some plan for the improvement of the vast system of tributary roads, which the farmer, the lumberman, the small manufacturer and the thousand and one people must use to avail themselves of the advantages of the more expensive construction, fails by just that measure in reaching its fullest possible value to the state as a whole. The majority of these tributary roads are under the care of the various towns in which they are located, and their improvement and maintenance are accomplished by some form of township organization. In New York, where the work of expensive highway improvement by the state has proceeded to a great, if not a greater, extent than in any other commonwealth, an excellent system has been developed for caring for these town roads. An interesting description of the New York form of town highway organization was given in a paper presented at the Cleveland meeting of Section D of the American Association for the Advancement of Science by Fred Bush, assistant deputy commissioner, New York State Highway Department, Albany, N. Y. An abstract of this paper follows:

The voters of New York some time ago authorized the issue of $50,000,000 in bonds for the work of highway improvement. Another $50,000,000 was authorized by the voters at the November election. When this money shall be expended it is extremely doubtful whether it will be considered sound business to incur any further indebtedness for this purpose until funds providing for the retirement of a considerable portion of the indebtedness already incurred, shall have been accumulated. Also it is practically certain that this vast sum will serve to improve not more than 15 per cent (about 12,000 miles) of the highways of the state. There are in the State of New York a total of 80,000 miles of highway. Deducting the 12,000 which may possibly be improved under the present bond issue, we have remaining 68,000 miles. We will assume that of this amount 18,000 miles are comparatively unimportant, consisting of little used roads in remote districts to which a comparatively small amount of expense and attention may be devoted. Deducting this amount, we find we have 50,000 miles of roads of considerable importance, and it must be borne in mind that a very large percentage of this 50,000 are fully as important commercially as some of the 12,000 miles which are to be improved by the state and county, and that all of these roads belong to the town highway systems. In the light of the foregoing statement the necessity for improvement of some kind to this class of highways as a matter of justice to a large percentage of the taxable property and population of the state, and as a rounding out of the general scheme of improvement, becomes at once apparent.

The enactment of the present highway law of this state created a system of highways connecting the principal centers of population of the state to be known as state routes, these to be improved at the sole expense of the state. Jointly with this improvement was to be carried forward a contemporary system known as county highways, these county highways being the principal tributary highways to the state system before mentioned and to be improved at the joint expense of the state and county under state direction. By the same law was also created the organization known as the Bureau of Town Highways, this bureau to have charge of all highways of the state not included in the state or county system.

In each town of the state is elected biennially an officer known as the town superintendent of highways, who has charge of all work connected therewith, hiring the necessary labor, procuring the necessary material and giving personal supervision to the execution of plans for the highway work in his town. In each county is an officer known as the county superintendent of highways, appointed by the Board of Supervisgors of the county. The county superintendent has general charge of all town highway affairs in his county, giving advice, assistance and directions to each town superintendent as the need therefor appears.

The revenues for the repair and maintenance of town highways are derived from taxes levied in each town for the maintenance of the highways within the town. These taxes are supplemented by moneys paid to the different towns by the state for the same purpose and forming in connection with the taxes before mentioned a common fund known as the Highway Fund. The amount to be paid by the state to the several towns is annually appropriated from the general funds of the state and is determined by the assessed valuation per mile, the state aid being graduated according to the valuation, varying from 100 per cent to the poorer towns to 50 per cent to the most wealthy ones. Giving this state aid by the state allows the State Highway Commission to have direction and control of the highway work as carried on in the various towns. For the purpose of this state supervision and control the state is divided into ten districts, each in charge of a representative of the State Highway Department known as a district supervisor, who has general charge of all town highway affairs within his district. The representative of the State Highway Commission in direct charge of the Bureau of Town Highways is a deputy commissioner, whose duties relate entirely to the town highway organization, and who is the officer directly superior to the district supervisors.

Previous to the organization of the Bureau of Town Highways the town highway work was carried on under the old "Commissioner" or "Path Master" system, each carrying on the work during his term of office according to his own ideas without any relation to that being done by his neighbor or that which had been done by his predecessor. The result was the hodge-podge with which everyone is familiar and which needs no description. With the installation of the present organization a general plan was adopted, the intention being to perform the work in each town along definite lines with a view to doing the work in such manner as would form a harmonious part of such work as might be done in succeeding years in the same town and also bear the proper relation to the work being done in adjoining towns. The actual results accomplished during the four years of the life of this organization have been little short of marvelous. Under this plan over 70,000 miles of highways of the state have been put in such condition that except for a very short period in the spring and fall they may be traveled in comfort and safety by vehicles of any character. By a careful husbanding of the resources, funds have been accumulated by means of which over 6,000 miles of town macadam roads have been built by the different town superintendents, these, while comparatively low in cost, being of a character sufficient for the traffic needs thereof. In like manner over 8,000 miles of good gravel roads have been constructed. When it is remembered that the foregoing improvements have been accomplished by the expenditure of a fund averaging about $40 per mile per year the effectiveness of the organization may be realized.

The accomplishments of the different town superintendents under the direction of this bureau in the construction of permanent culverts and short span bridges are such as would have been deemed absolutely impossible four years ago and are of an extent and nature which have surpassed the fondest hopes of the originators of this plan. Directly after the organization of the work a special bulletin on the construction of culverts and short span bridges was issued by the bureau and a copy placed in the hands of every town official in the state. In this bulletin plans were given covering practically all possible conditions of traffic requirements for bridges of reinforced concrete up to and including 30-ft. span. Working drawings of the plans outlined in this bulletin were prepared in quantities sufficient to meet the needs of all inquirers; and town superintendents everywhere were urged to take up the matter of constructing their own bridges, using their own local labor and local materials as far as possible in preference to contracting for steel structures, as had been the almost universal practice previously. This idea has gained growth to the extent that in 1911 in seven counties of the state every structure of this character which was erected during the year was built by the town superintendents in the manner before mentioned, not a contract being let in either of those seven counties for any short span bridge and in the state at large over 7 per cent of the bridges were constructed in a similar manner. The figures for 1912 have not at this date been compiled but enough are now at hand to show that the work of 1911 will be considerably surpassed by that of 1912. A careful comparison of the saving effected by this item alone, the same being made up from the most reliable figures of cost of former construction which are available, shows that in 1911 the total saving in the various towns amounts to not less than $350,000 cash. In addition to this there should be taken into consideration the great additional value these permanent structures have as against the flimsy affairs which were erected under the old contract system. Did time permit much additional information along the same lines might be produced showing the actual results of the working of this system. However, those cited will serve to illustrate the accomplishments in general.

While it is realized that many improvements may be made and that the organization as a whole has many weak points, still these defects appear to be matters of detail and not defects in the fundamental plan. Those who have been most closely associated with highway improvement in the state of New York from the very beginning and who have built the organization up and grown with its growth believe firmly that no scheme of improvement for the highways of any commonwealth is complete except that it contemplates the improvement of the entire system of highways in some manner, and from the experience of the organization of the Bureau of Town Highways in this state they also believe that the 88 or 90 per cent of its highways which any commonwealth will find it impossible to improve during the present generation cannot be dealt with in any manner so effectively and so satisfactorily as through a well equipped, thoroughly organized Bureau of Town Highways.

A Low Cost Concrete Pavement at Fort Smith, Ark.

Contributed by George Myers, Chief Engineer, Paving District No. 5.

During last year the Board of Improvement of Paving District No. 5, at Fort Smith, Ark., constructed by force account about 100,000 sq. yds. of concrete pavement at an average cost of 69.4 cts. per square yard. This cost includes the removal of about ¼ cu. yd. of earth per square yard of pavement in the grading and the rolling of the subgrade. It also includes a 10 per cent allowance for depreciation on equipment but no charge for superitnendence. The pavement was 6 ins. thick, of the 1-course type, unreinforced, and was made of 1-2-4 concrete.

The construction force was organized in August, 1912. The main equipment consisted of a No. 23 Chicago batch concrete mixer and ¾-cu. yd. Briggs 1-horse carts, besides the usual grading implements. Portland cement on an average cost $1.18 per barrel; gravel and sand averaged $1.25 per cubic yard; broken stone, crusher run, averaged $1.20 per cubic yard. The above prices are for materials delivered on the job. Common labor was paid for at the rate of 15 cts. to 20 cts. per hour; engineman at 25 cts.; foreman, $125 per month and teams 35 cts. per hour.

The cost of the concrete was as follows:

	Per cu. yd.
1½ bbls. cement at $1.18	$1.77
0.4 cu. yd. sand at $1.25	.50
0.9 cu. yd. broken stone at $1.20	1.08
Mixing, carting, laying and cleaning up	.49
Total	$3.84

This figures out at 64 cts. per square yard; adding 5 cts. per square yard for grading and .4 ct. per square yard for rolling makes the total cost 69.4 cts. per square yard.

The method of construction was as follows:

The subgrade was shaped to conform to and be 6 ins. below the finished pavement. The concrete mixer and material were placed about midway of each section of the work, but off to one side. The carts brought the concrete to one end of the work and it was deposited between ¼-in. x 6-in. steel templates 20 ft. apart, the entire width of the roadway. The concrete was quite wet and was tamped by means of a heavy steel-shod straight edge, and then "floated" with a 2-in. x 4-in. yellow pine float, 22 ft. long, in order to reach well beyond the templates. Segments of red building paper were placed next to each template before the concrete was placed and as soon as possible the template was withdrawn, leaving a contraction joint. The adjoining section was then laid in the same manner. An expansion joint was left every 60 ft. Remarkably few cracks have developed probably because the concrete was not floated by the usual one-hand float.

Bituminated Cemented Macadam.

(Contributed.)

A new method of pavement construction has recently been tried out with success at Kenilworth, Ill., a suburb of Chicago. It is what is known as a "bituminated cemented macadam" pavement. About 4,100 sq. yds. of this pavement were laid in Kenilworth last fall.

The roadway is 18 ft. wide and was constructed in cut, in water soaked clay subsoil. Tile drains were built under the margin of the pavement, under the gutter. On the subgrade a layer of limestone was placed and compacted to a finished thickness of 6 ins. This was rolled and filled after the manner of the usual waterbound macadam base. On this base was placed a wearing surface averaging 3 ins. thick. It consisted of a layer of limestone 1 in. to 2 ins. in size, thoroughly rolled to crown and well locked together. A cementitious binder was spread dry over the surface of the rolled stone and swept into the interstices and the stone given a light rolling. Water was then applied and all bare spots developing were swept over into the cement mortar until the surface was smooth, and all surface voids, at least, thoroughly filled. The road was barricaded for a week and wetted frequently. After the surface had dried about 1½ gal. per square yard of Tarvia was applied and while hot a layer of torpedo sand 1⅛ in. in thickness was evenly spread over the entire surface.

This is a very economical pavement and is doubtless noiseless, sanitary and non-slippery. A small piece was recently cut out of the surface and it showed an extremely dense wearing surface. The pavement is resilient and yet presents a tough, smooth, waterproof surface.

Application has been made for a patent for the method of preparing and applying the special binder used, which of course cannot now be made public. The pavement was built and the rights to it are controlled by John A. McGarry & Co., 1001 Security Bldg., Chicago. Windes & Marsh of Glencoe, Ill., were the engineers in charge.

River and Harbor Improvements in Ontario.—Appropriations have been made by the Dominion Government for various improvements in the vicinity of Kingston, Ont., as follows: Kingston harbor improvements, $150,000; Royal Military College, building breakwater, $2,500; improvement of Canadian channel in St. Lawrence river, between Kingston and Brockville, $40,000; harbor improvements at Trenton, Ont., $75,000; harbor improvements at Belleville, Ont., $50,000.

Notes on Road and Street Work.

Street Car Track Construction with Concrete.—During the past two years the city of Mason City, Ia., has constructed in the neighborhood of 2,000 ft. of street car track with concrete paving at an average cost of $1.75 per square yard. The method of handling this work was described by Mr. F. P. Wilson, City Engineer of Mason City, in a discussion before the Western Society of Engineers. A trench 14 in. deep and 7 ft. wide is excavated and thoroughly rolled and compacted with a 9-ton roller. The rails and ties are then placed in position, the latter being spaced 30 in. center. An extremely wet mixture of concrete is used, the same being 1 part cement, 2 parts sand and 4 parts of crushed rock. This mixture is run in just the same as a floor beam or column would be placed in a concrete structure or building. Immediately after the concrete is placed a wearing surface, 2½ in. in thickness, composed of 1 part cement and 2 parts screened sand, is put on. At the end of the ties there is a blind joint, so that the street pavement proper is separate from the street car track construction.

Cost of Hauling Gravel with a Gas Traction Engine.—Prinz & Carlson, Contractors, Winona, Minn., give the following data on hauling gravel with a Pioneer "30" gas traction engine: Engine left gravel pit at 7 p. m., and returned to gravel pit the third time at 7:20 a. m., having completed three round trips, hauling three 4-yd. Troy wagons loaded with gravel—a live weight of 18 tons. The distance of the haul was 7½ miles over dirt roads with grades ranging from 3 to 9 per cent. The cost operating engine for 12 hours, including depreciation, interest and overhead charges was:

	Per day
Engineer, 40 cts. per hour	$ 4.80
Helper, 25 cts. per hour	3.00
Gasoline, 60 gals. at 14 cts	8.40
Repairs, oils, etc	.75
Depreciation of outfit at 10 per cent per annum	.60
Interest on investment at 5 per cent	.31
Liability insurance, 2 per cent of payroll	.15
Overhead: Superintendence, etc., 20 per cent of above	3.60
Total	$21.61

On the above basis the gravel was moved at a cost of 5⅓ cts. per ton mile.

Percentage of Abrasion Loss on Paving Brick.—The following tabulation shows the maximum abrasion loss allowed on paving brick in the specifications of the cities mentioned. The maximum percentage of loss allowed is on tests to be made with the new standard paving brick rattler with spheres:

	Per cent
Baltimore	20 and 22
Chicago	21
Grand Rapids	22
Indianapolis	21
Trenton, N. J.	20
Canton, O.	21
Fremont, O.	22
Fostoria, O.	22
Akron, O.	22
Columbus, O.	21
Toledo, O.	22
Newark, N. J.	22
Philadelphia, Pa.	22
Sandusky, O.	21
Sydney, O.	22
Bryan, O.	22

Rock Asphalt Pavement at Salt Lake City, Utah.—The first natural rock asphalt pavement in Salt Lake City was laid in 1901 on Commercial St. Since that time portions of a number of other streets have been similarly improved. Most of the work has been done with a California product, the Utah rock asphalt being used on but three street improvements. One of these was the paving around the city and county building. This pavement was laid in 1904. The material was quarried near Thistle, Utah, and was delivered at the work directly from the cars. It was then heated in a crude vat with steam appliance and spread upon the natural earth, which had been rolled previously with a hand roller. The coarser nodules were raked out and thrown aside, while the balance was again rolled with a light hand roller. This was the only treatment applied to it. The pavement carries a light traffic. Mr. D. H. Blossom, City Engineer of Salt Lake City, in a paper presented last fall before the Utah Society of Engineers and reprinted in the Journal of the Association of Engineering Societies, stated that after eight years' service no repairs whatever, so far as could be determined, had been made to the pavement. As nearly as can be determined, the mixture used around the city and county building contained about 12 per cent of bitumen, about 65 per cent petroleum and 35 per cent asphaltum. Mr. Blossom stated that in some sidewalks constructed some 15 years ago with the Utah product and recently taken up, the material had the appearance of being as "lively" as when it was first laid. One same gave 14 per cent bitumen, another gave 8.6 per cent bitumen. According to Mr. Blossom the difficulty in the extensive use of the natural rock asphalt is the fact that it appears next to impossible to obtain a uniform product in its natural state. There is either an excess of bitumen or a scarcity of it, and even in the same shipment of material there are lumps or nodules of the base material carrying very little bitumen. He believes, however, that by proper grading and mixing of the crude material an ideal mixture can be obtained; but it is questionable whether such a process would not entail such an expense as to make the price of the mixture prohibitive as compared with the refined product. In the city's present specifications an effort has been made to provide for a uniform product, either by mixing different proportions of the crude material to obtain a correct mix or by adding an artificial flux to the lean material or sand to the rich material, as the case may be. The present specifications at Salt Lake City call for a 5-in. concrete base, as compared with a 6-in. base ordinarily used, and no binder. To offset the omission of the binder course, the specification calls for a roughened surface made by sprinkling the top of the concrete with crushed stone before the initial set takes place, leaving the stone only partly imbedded.

2-in. Oil Macadam at Pomona, Cal.—At the 15th annual convention of the League of California Municipalities Mr. Edward Baker, superintendent of streets of Pomona, Cal., stated that some of the residence streets were surfaced with 2-in. oil macadam. In the construction of this pavement the subgrade was rolled thoroughly and the crushed rock applied. This was then rolled and all of the dust swept out. Oil was next applied, ¾ gal. per square yard being put on in two applications. On some of the work ¾ gal. per square yard was put on in the first application, and ½ gal. in the next. It was found, however, that this was too much oil and that the smaller quantity gave the best results. The stone used was granite boulders, crushed and screened.

Street Car Track Construction With Asphalt Pavement.—In the construction of ½ mile of asphalt pavement last year at Lodi, Cal., it was necessary to provide for the tracks of a traction line down the center of the street. The interurban cars on the line are very heavy and the rails used were of the ordinary T type. In constructing the track portion of the pavement concrete 6 ins. deep was laid under the rails and through the center between the rails. In this concrete on the other side of the rail a row of basalt pavement blocks was imbedded—not toothed but running in a straight line parallel with the rail. On the inside of the rail the blocks were dressed off about 1½ in. for clearance. The cars were allowed to run over the track after it had been set in the concrete and after the binder and surface had been laid—within three or four days after the construction had been fixed. It is stated that this method of construction has proved satisfactory, as only five or six of the basalt blocks in the half mile of street have come up.

Limiting Grades for Various Classes of Pavement at Toronto, Ont.—In a paper presented at the recent annual meeting of the Ontario Good Roads Association Mr. G. C. Powell, Deputy City Engineer of Toronto, Ont., stated that for the guidance of the engineer of that city in selecting a pavement for a given street the following table of grades has been made:

Up to 3% grade—Any pavement.
From 3% to 5%—Brick, stone setts, asphalt macadam, asphaltic concrete, concrete macadam, rocmac, bitulithic, asphalt block.
From 5% to 7%—Brick, stone setts, macadam, rocmac.
Above 7%Macadam and rocmac.

DRAINAGE AND IRRIGATION

Cost of Constructing Concrete Culverts Under Canal in Sevier County, Utah.

Contributed by James Jensan, Engineer in Charge, Marysville, Utah.

The following tabulations give the costs of construction of reinforced concrete culverts to carry flood waters under the canal of the State Board of Land Commissioners, in Sevier county, Utah. The length of canal along which these culverts were distributed is ten miles. No two culverts were constructed from the same setting. On account of the comparatively small units in which this work had to be done, and the ruggedness of the country with reference to the moving of machinery and mixers, all concrete was mixed by hand. Sand and gravel for these structures was hauled by team an average distance of three miles, and constitutes the sole cost in column headed "Sand and Gravel." Water for mixing and camp purposes was also hauled by team a distance of two to three miles, and is included in the column headed "Haulage and Moving," which column also includes the cost of hauling cement, reinforcing steel, and form material from the railroad station, a distance averaging about eight miles. This column also includes the cost of moving apparatus and mixing boards from one setting to another; also moving the construction camp three different times.

The column headed "Hand Excavation" represents the cost of digging the trenches for the footing walls, and leveling the main trench for the culvert after it had been cut down practically to grade by team and scraper work.

The column headed "Form Material" is obtained from taking the total cost of all form material, including timber, wire, nails, etc., and dividing it up in proportion to the number of cubic yards of concrete in each structure. No deductions have been made from these averages on account of any salvage value of form material still on hand. The form of culverts specified as "tubular," "box" and "arch" forms in column two are shown on the accompanying drawings.

Two mixing gangs were used, each provided with its own accompaniment of apparatus and teams for hauling purposes. The work was done during the months of February, March and April, 1912, under extremely adverse weather conditions. During the major portion of this time all green concrete had to be covered up to keep it from freezing. No account of this was kept of this, but is included in the column headed "Mixing and Placing Concrete."

The chief item of interest as shown by these cost data, aside from the general value for comparison with other structures of a similar nature and built under like conditions, is the inverse proportion of the labor costs to the size of the unit constructed, which emphasizes the importance of knowing not only total yardage of concrete to be installed, but also its distribution in various units, and the variation of size in these units.

(1) *Tubular culvert*, 24 ins. diameter and 30 ft. long, requiring 90 sacks of cement and 272 lbs. of reinforcement; concrete 18 cu. yds.

Item.	Total.	Per cu. yd.
Cement	$ 57.60	$ 3.200
Reinforcement at 3cts. per lb....	8.16	0.453
Sand and gravel	25.20	1.400
Mixing and placing concrete	49.61	2.756
Total concrete	$140.57	$ 7.809
Form material	36.41	2.023
Building and moving forms	8.25	0.458
Total forms	$ 44.66	$ 2.481
Haulage and moving	24.00	1.333
Hand excavation	8.05	0.447
Grand total	$217.28	$12.080

(2) *Box culvert*, 2x2 ft., 53 ft. long, requiring 72 sacks of cement and 348 lbs. of reinforcement; concrete 14.4 cu. yds.

Item.	Total.	Per cu. yd.
Cement	$ 46.08	$ 3.200
Reinforcement at 3 cts. per lb....	10.44	0.725
Sand and gravel	30.80	2.132
Mixing and placing concrete	39.44	2.739
Total concrete	$126.76	$ 8.796
Form material	29.13	2.023
Building and moving forms	9.40	0.653
Total forms	$ 38.53	$ 2.676
Haulage and moving	19.20	1.333
Hand excavation	6.44	0.447
Grand total	$190.93	$13.259

(3) *Tubular culvert*, 18 ins. diameter and 52 ft. long, requiring 65 sacks of cement and 200 lbs. of reinforcement; concrete 13 cu. yds.

Item.	Total.	Per cu. yd.
Cement	$ 41.60	$ 3.200
Reinforcement at 3 cts. per lb....	6.00	0.461
Sand and gravel	22.40	1.723
Mixing and placing concrete	38.50	2.962
Total concrete	$108.50	$ 8.346
Form material	26.30	2.023
Building and moving forms	5.25	0.404
Total forms	$ 31.55	$ 2.427
Haulage and moving	17.33	1.333
Hand excavation	5.81	0.447
Grand total	$163.19	$12.553

(4) *Tubular culvert*, 16 ins. diameter and 52 ft. long, requiring 57 sacks of cement and 200 lbs. of reinforcement; concrete 11.4 cu. yds.

Item.	Total.	Per cu. yd.
Cement	$ 36.40	$ 3.193
Reinforcement at 3 cts. per lb....	6.00	0.522
Sand and gravel	22.40	1.969
Mixing and placing concrete	43.75	3.838
Total concrete	$108.55	$ 9.522
Form material	23.06	2.023
Building and moving forms	7.50	0.658
Total forms	$ 30.56	$ 2.681
Haulage and moving	15.20	1.333
Hand excavation	5.10	0.445
Grand total	$159.41	$13.981

(5) *Arch culvert*, 14x14 ins., 52 ft. long, requiring 65 sacks of cement and 200 lbs. of reinforcement; concrete 13 cu. yds.

Item.	Total.	Per cu. yd.
Cement	$ 41.60	$ 3.200
Reinforcement at 3 cts. per lb....	6.00	0.461
Sand and gravel	22.40	1.713
Mixing and placing concrete	41.94	3.236
Total concrete	$111.94	$ 8.610
Form material	26.30	2.023
Building and moving forms	8.25	0.635
Total forms	$ 34.55	2.658
Haulage and moving	17.33	1.333
Hand excavation	5.81	0.450
Grand total	$169.63	$13.051

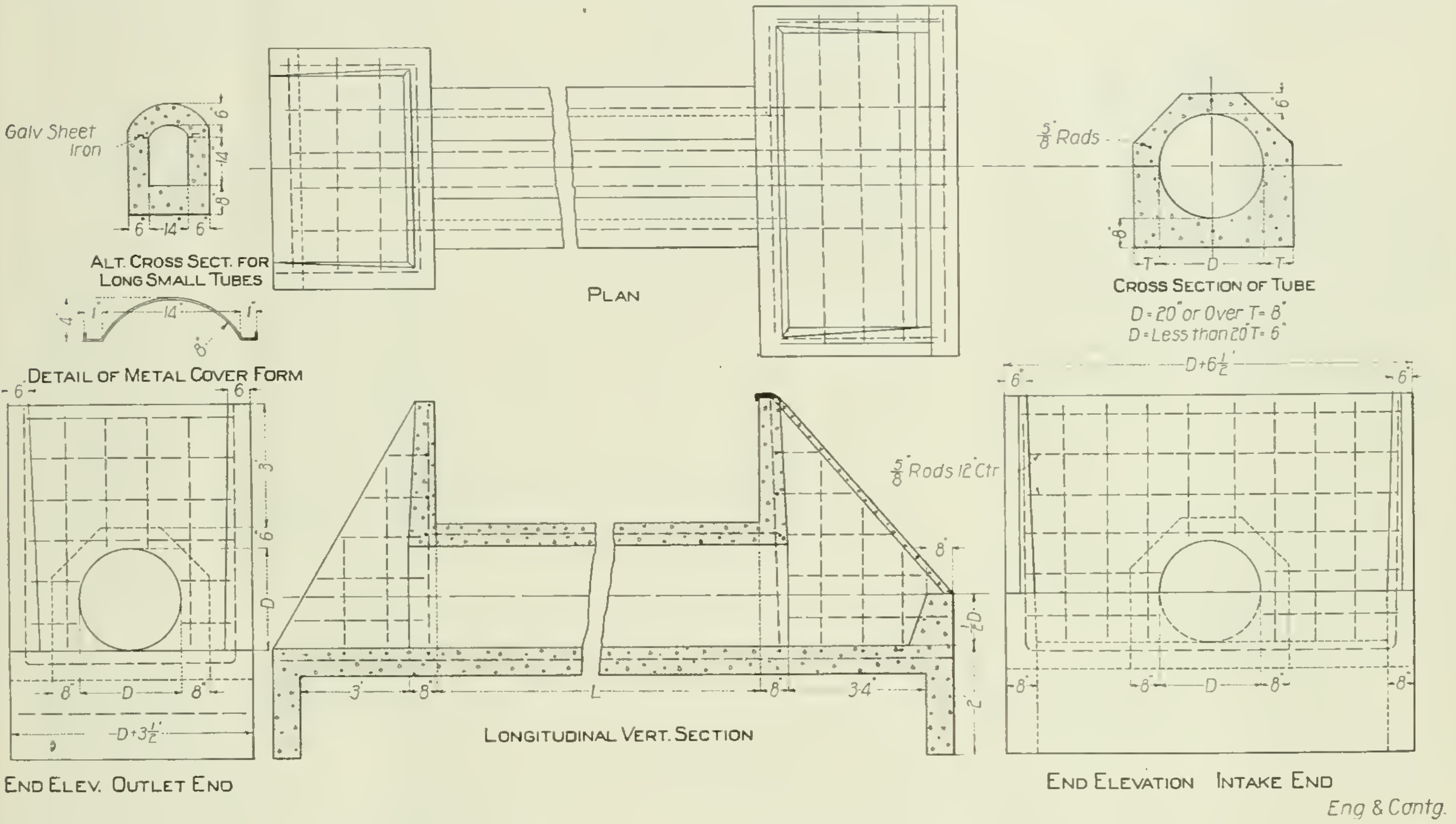
(6) *Box culvert*, 4x4 ft., 47 ft. long, requiring 146 sacks of cement and 1,617 lbs. of reinforcement; concrete 29.2 cu. yds.

Item.	Total.	Per cu. yd.
Cement	$ 93.44	$ 3.200
Reinforcement at 3 cts. per lb....	48.51	1.661
Sand and gravel	33.60	1.151
Mixing and placing concrete	65.15	2.231
Total concrete	$240.70	$ 8.243
Form material	59.06	2.022
Building and moving forms	18.00	0.613
Total forms	$ 77.06	$ 2.635
Haulage and moving	38.93	1.333
Hand excavation	13.06	0.447
Grand total	$369.75	$12.658

(7) *Tubular culvert*, 18 ins. in diameter,

68 ft. long, requiring 217 lbs. of reinforcement; concrete 13.6 cu. yds.

Item.	Total.	Per cu. yd.
Cement	$ 43.52	$ 3.210
Reniforcement at 3 cts. per lb.	6.51	0.479
Sand and gravel	11.20	0.815
Mixing and placing concrete	24.78	1.822
Total concrete	$ 86.01	$ 6.326
Form material	27.51	2.022
Building and moving forms	4.81	0.354
Total forms	$ 32.32	$ 2.376
Haulage and mixing	18.13	1.333
Hand excavation	6.09	0.445
Grand total	$142.55	$10.480



Eng & Contg.

Fig. 1—Details of Tubular and Arch Forms of Culverts.

(8) *Arch culvert,* 14x14 ins., 52 ft. long, requiring 52 sacks of cement and 182 lbs. of reinforcement; concrete 10.4 cu. yds.

Item.	Total.	Per cu. yd.
Cement	$ 33.28	$ 3.200
Reinforcement at 3 cts. per lb.	5.46	0.526
Sand and gravel	11.20	1.076
Mixing and placing concrete	51.85	4.985
Total concrete	$101.79	$ 9.787
Form material	21.04	2.023
Building and moving forms	8.25	0.793
Total forms	$ 29.29	$ 2.816
Haulage and moving	13.90	1.336
Hand excavation	4.65	0.447
Grand total	$149.63	$14.39

(9) *Box culvert,* 3x3 ft., 48 ft. long, requiring 130 sacks of cement and 1,369 lbs. of reinforcement; concrete 20.6 cu. yds.

Item.	Total.	Per cu. yd.
Cement	$ 83.20	$ 4.039
Reinforcement at 3 cts. per lb.	41.07	1.993
Sand and gravel	14.00	0.679
Mixing and placing concrete	61.00	2.961
Total concrete	$199.27	$ 9.672
Form material	41.67	2.022
Building and moving forms	12.00	0.582
Total forms	$ 53.67	$ 2.604
Haulage and moving	27.47	1.333
Hand excavation	9.21	0.447
Grand total	$289.62	$14.056

(10) *Box culvert,* 3x3 ft., 48 ft. long, requiring 138 sacks of cement and 1,369 lbs. of reinforcement; concrete 27.6 cu. yds.

Item.	Total.	Per cu. yd.
Cement	$ 88.32	$ 3.200
Reinforcement at 3 cts. per lb.	41.07	1.489
Sand and gravel	22.40	0.820
Mixing and placing concrete	57.29	2.075
Total concrete	$209.08	$ 7.584
Form material	55.83	2.023
Building and moving forms	11.25	0.407
Total forms	$ 67.08	$ 2.430
Haulage and moving	36.80	1.333
Hand excavation	12.34	0.447
Grand total	$325.30	$11.794

(11) *Arch culvert,* 14x14 ins., 66 ft. long, requiring 62 sacks of cement and 272 lbs. of reinforcement; concrete 12.4 cu. yds.

Item.	Total.	Per cu. yd.
Cement	$ 39.68	$ 3.200
Reinforcement at 3 cts. per lb.	8.16	0.658
Sand and gravel	16.80	1.353
Mixing and placing concrete	35.06	2.879
Total concrete	$ 99.70	$ 8.040
Form material	25.08	2.022
Building and moving forms	6.00	0.484
Total forms	$ 31.08	$ 2.506
Haulage and moving	16.53	1.333
Hand excavation	5.55	0.448
Grand total	$152.86	$12.327

(12) *Arch culvert,* 14x14 ins., 60 ft. long, requiring 56 sacks of cement and 248 lbs. of reinforcement; concrete 11.2 cu. yds.

Item.	Total.	Per cu. yd.
Cement	$ 35.84	$ 3.200
Reinforcement at 3 cts. per lb.	7.44	0.664
Sand and gravel	14.00	1.250
Mixing and placing concrete	34.31	3.062
Total concrete	$ 91.59	$ 8.176
Form material	22.65	2.022
Building and moving forms	6.75	0.602
Total forms	$ 29.40	$ 2.624

reinforcement; concrete 32.6 cu. yds.

Item.	Total.	Per cu. yd.
Haulage and moving	14.93	1.333
Hand excavation	5.01	0.447
Grand total	$140.93	$12.584

(13) *Box culvert,* 4x4 ft., 49 ft. long, requiring 163 sacks of cement and 1,617 lbs. of

Item.	Total.	Per cu. yd.
Cement	$104.32	$ 3.200
Reinforcement at 3 cts. per lb.	48.51	1.488
Sand and gravel	33.60	1.032
Mixing and placing concrete	81.37	2.496
Total concrete	$267.80	$ 8.216
Form material	65.94	2.022
Building and moving forms	18.00	0.552
Total forms	$ 83.94	$ 2.574
Haulage and moving	43.47	1.333
Hand excavation	14.58	0.447
Grand total	$409.79	$12.570

(14) *Box culvert,* 3x3 ft., 44½ ft. long, requiring 145 sacks of cement and 1,329 lbs. of reinforcement; concrete 29 cu. yds.

Item.	Total.	Per cu. yd.
Cement	$ 92.80	$ 3.200
Reinforcement at 3 cts. per lb.	39.87	1.375
Sand and gravel	22.40	0.770
Mixing and placing concrete	58.94	2.033
Total concrete	$214.01	$ 7.378
Form material	58.66	2.023
Building and moving forms	11.62	0.400
Total forms	$ 70.28	$ 2.423
Haulage and moving	38.67	1.333
Hand excavation	12.97	0.447
Grand total	$335.93	$11.581

(15) *Box culvert,* 3x3 ft., 48 ft. long, requiring 142 sacks of cement and 1,369 lbs. of reinforcement; concrete 28.4 cu. yds.

Item.	Total.	Per cu. yd.
Cement	$ 90.88	$ 3.200
Reinforcement at 3 cts. per lb.	41.07	1.446
Sand and gravel	14.00	0.493
Mixing and placing concrete	73.02	2.572
Total concrete	$218.97	$ 7.712
Form material	57.45	2.023
Building and moving forms	11.62	0.409
Total forms	$ 69.07	$ 2.432
Haulage and moving	37.87	1.333
Hand excavation	12.70	0.447
Grand total	$338.61	$11.924

(16) *Box culvert,* 3x4 ft., 46 ft. long, requiring 144 sacks of cement and 1,490 lbs. of reinforcement; concrete 28.8 cu. yds.

Item.	Total.	Per cu. yd.
Cement	$ 92.16	$ 3.200
Reinforcement at 3 cts. per lb.	44.70	1.552
Sand and gravel	24.00	0.833
Mixing and placing concrete	66.72	2.317
Total concrete	$227.58	$ 7.902
Form material	58.26	2.023
Building and moving forms	13.12	0.455
Total forms	$ 71.38	$ 2.478
Haulage and moving	38.40	1.333
Hand excavation	12.88	0.447
Grand total	$350.24	$12.160

(17) *Tubular culvert,* 18 ins. diameter, 46 ft. long, requiring 51 sacks of cement and

173 lbs. of reinforcement; concrete 10.2 cu. yds.

Item.	Total.	Per cu. yd.
Cement	$ 32.64	$ 3.200
Reinforcement at 3 cts. per lb.	5.19	0.508
Sand and gravel	16.80	1.647
Mixing and placing concrete	27.73	2.718
Total concrete	$ 82.36	$ 8.073
Form material	20.63	2.022
Building and moving forms	5.25	0.514
Total forms	$ 25.88	$ 2.536
Haulage and moving	13.60	1.333
Hand excavation	4.56	0.447
Grand total	$126.40	$12.389

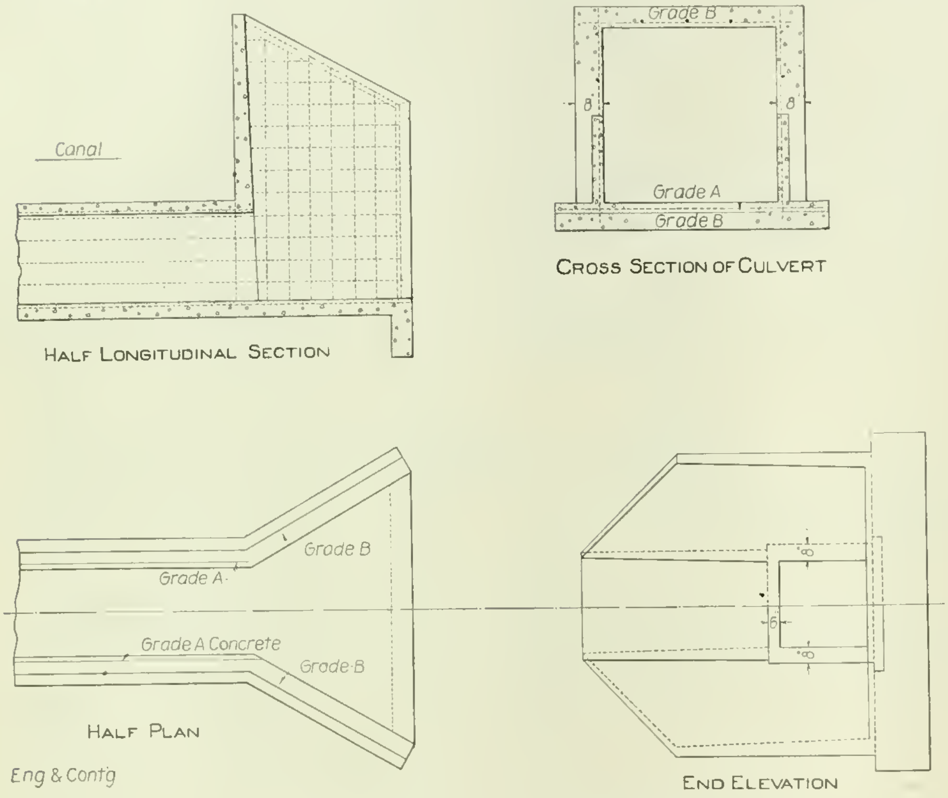


Fig. 2—Details of Box Form of Culverts.

(18) *Tubular culvert,* 18 ins. diameter, 49 ft. long, requiring 50 sacks of cement and 180 lbs. of reinforcement; concrete, 10 cu. yds.

Item.	Total.	Per cu. yd.
Cement	$ 32.00	$ 3.200
Reinforcement at 3 cts. per lb.	5.40	0.540
Sand and gravel	19.60	1.960
Mixing and placing concrete	25.07	2.507
Total concrete	$ 82.07	$ 8.207
Form material	20.23	2.023
Building and moving forms	5.12	0.512
Total forms	$ 25.35	$ 2.535
Haulage and moving	13.33	1.333
Hand excavation	4.47	0.447
Grand total	$125.22	$12.522

(19) *Arch culvert,* 14x14 ins., 46½ ft. long, requiring 48 sacks of cement and 183 lbs. of reinforcement; concrete, 9.5 cu. yds.

Item.	Total.	Per cu. yd.
Cement	$ 30.40	$ 3.200
Reinforcement at 3 cts. per lb.	5.49	0.577
Sand and gravel	19.60	2.063
Mixing and placing concrete	20.53	2.160
Total concrete	$ 76.02	$ 8.000
Form material	19.22	2.023
Building and moving forms	8.25	0.868
Total forms	$ 27.47	$ 2.891
Haulage and moving	12.66	1.333
Hand excavation	4.25	0.447
Grand total	$120.40	$ 2.671

(20) *Box culvert,* 4x4 ft., 50½ ft. long, requiring 167 sacks of cement and 1,626 lbs. of reinforcement; concrete, 33.4 cu. yds.

Item.	Total.	Per cu. yd.
Cement	$106.88	$ 3.200
Reinforcement at 3 cts. per lb.	48.78	1.460
Sand and gravel	36.40	1.089
Mixing and placing concrete	66.72	1.997
Total concrete	$258.78	$ 7.746
Form material	67.56	2.023
Building and moving forms	13.12	0.392
Total forms	$ 80.68	$ 2.415
Haulage and moving	44.53	1.333
Hand excavation	14.94	0.447
Grand total	$398.93	$11.943

(21) *Box culvert,* 3x3 ft., 47½ ft. long, requiring 141 sacks of cement, and 1,369 lbs. of reinforcement; concrete, 28.2 cu. yds.

Item.	Total.	Per cu. yd.
Cement	$ 90.24	$ 3.200
Reinforcement at 3 cts. per lb.	41.07	1.456
Sand and gravel	33.60	1.192
Mixing and placing concrete	67.82	2.406
Total concrete	$232.73	$ 8.254
Form material	57.04	2.023
Building and moving forms	11.62	0.412
Total forms	$ 68.66	$ 2.435
Haulage and moving	37.60	1.333
Hand excavation	12.61	0.447
Grand total	$351.60	$12.469

(22) *Arch culvert,* 14x14 ins., 48 ft. long, requiring 50 sacks of cement and 183 lbs. of reinforcement; concrete, 10 cu. yds.

Item.	Total.	Per cu. yd.
Cement	$ 32.00	$ 3.200
Reinforcement at 3 cts. per lb.	5.49	0.549
Sand and gravel	22.40	2.240
Mixing and placing concrete	20.80	2.080
Total concrete	$ 80.69	$ 8.069
Form material	20.23	2.023
Building and moving forms	8.25	0.825
Total forms	$ 28.48	$ 2.848
Haulage and moving	13.33	1.333
Hand excavation	4.47	0.447
Grand total	$126.97	$12.697

(23) *Box culvert,* 4x4 ft., 48 ft. long, requiring 179 sacks cement and 1,617 lbs. of reinforcement; concrete, 35.8 cu. yds.

Item.	Total.	Per cu. yd.
Cement	$114.56	$ 3.200
Reinforcement at 3 cts. per lb.	48.51	1.355
Sand and gravel	42.00	1.173
Mixing and placing concrete	77.39	2.162
Total concrete	$282.46	$ 7.890
Form material	72.42	2.023
Building and moving forms	18.00	0.503
Total forms	$ 90.42	$ 2.526
Haulage and moving	47.73	1.333
Hand excavation	16.01	0.447
Grand total	$436.62	$12.196

(24) *Box culvert,* 2x2 ft., 48 ft. long, requiring 69 sacks of cement and 335 lbs. of reinforcement; concrete, 13.8 cu. yds.

Item.	Total.	Per cu. yd.
Cement	$ 44.16	$ 3.200
Reinforcement at 3 cts. per lb.	10.05	0.728
Sand and gravel	33.60	2.434
Mixing and placing concrete	31.50	2.283
Total concrete	$119.31	$ 8.645
Form material	27.91	2.022
Building and moving forms	9.40	0.681
Total forms	$ 37.31	$ 2.703
Haulage and moving	18.40	1.333
Hand excavating	6.18	0.447
Grand total	$181.20	$13.128

(*A*) *Box culvert,* 3x3 ft., 48¼ ft. long, requiring 136 sacks of cement and 1,369 lbs. of reinforcement; concrete, 27.2 cu. yds.

Item.	Total.	Per cu. yd.
Cement	$ 87.04	$ 3.200
Reinforcement at 3 cts per lb.	41.07	1.509
Sand and gravel	33.60	1.235
Mixing and placing concrete	62.01	2.279
Total concrete	$223.72	$ 8.223
Form material	55.02	2.022
Building and moving forms	11.45	0.420
Total forms	$ 66.47	$ 2.442
Haulage and moving	36.26	1.333
Hand excavation	12.17	0.447
Grand total	$338.62	$12.465

(*B*) *Box culvert,* 2x2 ft., 47½ ft. long, requiring 66 sacks of cement and 335 lbs. of reinforcement; concrete, 13.2 cu. yds.

Item.	Total.	Per cu. yd.
Cement	$ 42.24	$ 3.200
Reinforcement at 3 cts. per lb.	10.05	0.761
Sand and gravel	28.00	2.121
Mixing and placing concrete	35.47	2.683
Total concrete	$115.76	$ 8.765
Form material	26.70	$ 2.022
Building and moving forms	9.50	0.719
Total forms	$ 36.20	$ 2.741
Haulage and moving	17.60	1.333
Hand excavation	5.90	0.447
Grand total	$175.46	$13.286

(*C*) *Tubular culvert,* 18 ins. diameter, 49 ft. long, requiring 49 sacks of cement and 200 lbs. of reinforcement; concrete, 9.8 cu. yds.

Item.	Total.	Per cu. yd.
Cement	$ 31.30	$ 3.102
Reinforcement at 3 cts. per lb.	6.00	0.612
Sand and gravel	28.00	2.857
Mixing and placing concrete	28.70	2.929
Total concrete	$ 94.00	$ 9.500
Form material	19.82	2.022
Building and moving forms	5.25	0.535
Total forms	$ 25.07	$ 2.557
Haulage and moving	14.06	1.523
Hand excavation	4.38	0.447
Grand total	$137.51	$14.027

(*D*) *Tubular culvert,* 18 ins. diameter, 50 ft. long, requiring 53 sacks of cement and 200 lbs. of reinforcement; concrete, 10.6 cu. yds.

Item.	Total.	Per cu. yd.
Cement	$ 33.92	$ 3.392
Reinforcement at 3 cts. per lb.	6.00	0.600
Sand and gravel	28.00	2.800
Mixing and placing concrete	32.29	3.229
Total concrete	$100.21	$10.021
Form material	21.44	2.144
Building and moving forms	5.25	0.525
Total forms	$ 26.69	$ 2.669
Hand excavation	4.74	0.474
Grand total	$131.64	$13.164

Automatic spill, 3x3 ft., requiring 182 sacks of cement and 1,860 lbs. of reinforcement; concrete, 36.4 cu. yds.

Item.	Total.	Per cu. yd.
Cement	$116.48	$ 3.200
Reinforcement at 3 cts. per lb.	55.80	1.533
Mixing and placing concrete	97.31	2.673
Sand and gravel	44.80	1.231
Total concrete	$314.39	$ 8.637
Form material	73.63	2.023
Haulage and moving	30.03	0.825
Hand excavation	16.28	0.447
Grand total	$434.33	$11.932

Waste Gate, requiring 85 sacks of cement and 272 lbs. of reinforcement; concrete, 17.0 cu. yds.

Item.	Total.	Per cu. yd.
Cement	$ 54.40	$ 3.200
Reinforcement at 3 cts. per lb.	8.16	0.480
Sand and gravel	27.71	1.630
Mixing and placing concrete	50.00	2.944
Total concrete	$140.27	$ 8.254
Form material	34.39	2.022
Haulage and moving	15.14	0.890
Hand excavation	7.61	0.447
Grand total	$197.41	$11.613

Waste Valve Box, 6x6 ft., 12 ft. long, requiring 172 sacks of cement and 439 lbs. of reinforcement; concrete, 34.4 cu. yds.

Item.	Total.	Per cu. yd.
Cement	$110.08	$ 3.200
Reinforcement at 3 cts. per lb.	13.17	0.382
Sand and gravel	56.00	1.628
Mixing and placing concrete	100.13	2.910
Totat concrete	$279.38	$ 8.120
Form material	69.58	2.022
Haulage and moving	16.00	0.465
Hand excavation	15.39	0.447
Grand total	$380.35	$11.054

SUMMARY.

A total of 3,093 sacks of cement and 22,640 lbs. of reinforcement was used in the 28 culverts, the automatic spill, waste gate and waste valve. Total concrete, 613.1 cu. yds.

Item.	Total.	Av. per cu. yd.
Cement	$1,979.06	$ 3.23
Reinforcement at 3 cts. per lb.	679.20	1.11
Sand and gravel	810.51	1.32
Mixing and placing concrete	1,566.20	2.55
Total concrete	$5,034.97	$ 8.21
Form material	1,240.17	2.02
Building and moving forms	270.53	0.51
Total forms	$1,510.70	$ 2.53
Haulage and moving	748.43	1.22
Hand excavation	274.21	0.44
Grand total	$7,568.31	$12.40

Note—Wages per day paid were as fololws: Teams with driver, $4; foreman, $4; laborers, $2.25.

GENERAL ARTICLES

Method of Lining a Small Tunnel with Concrete, Using a Pneumatic Concrete Machine.

(Staff Article.)

A pneumatic concrete conveying machine was recently used to place the lining for a small tunnel in Van Cortland Park, New York City. The tunnel is 500 ft. long and 4x5 ft. in section, and is known as a drain tunnel for the Catskill aqueduct. The work was done under adverse conditions. The tunnel was poorly lighted, and wet; the pump, which was intended to take care of the water, was unreliable, and at times the tunnel was half filled with water.

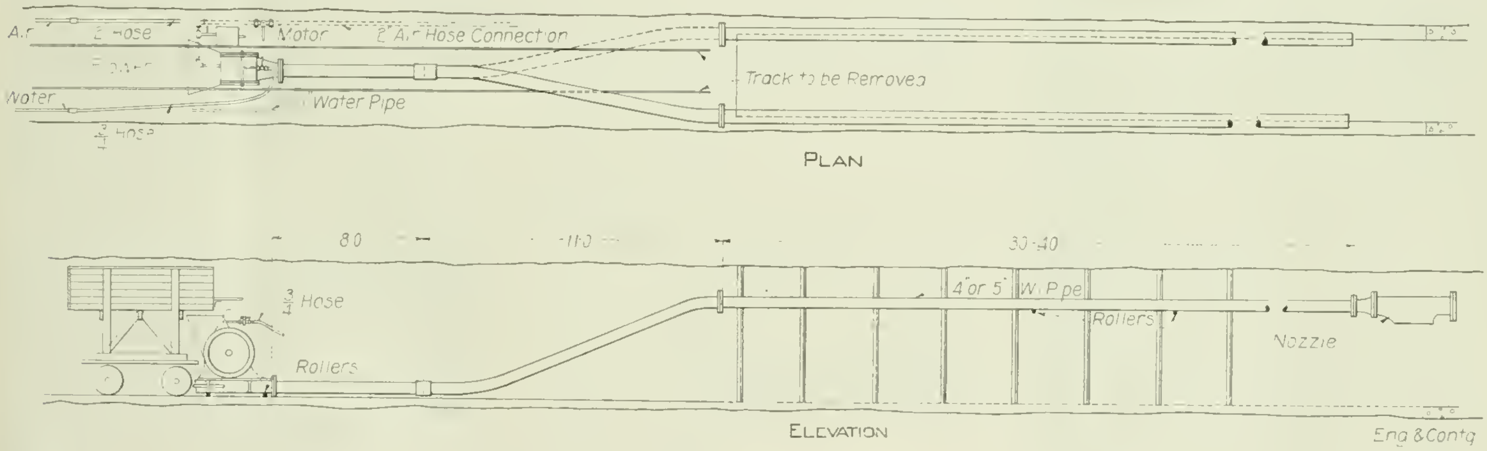


Fig. 1—Sketch Showing Arrangement of Concrete Blower System for Tunnel Lining.

Two systems of handling the work of lining the tunnel were employed by the subcontractors, the Concrete Blower Co., of New York City. The first system was used until 200 ft. of lining were completed, and the second system was used for the balance of the work, and was more satisfactory than the first.

By the first arrangement, the pneumatic machine was placed in the tunnel about 50 to 60 ft. from the point where the concrete was to be discharged into the forms, as shown by Fig. 1. The machine was placed on rollers and connected to a 4-in. discharge pipe line, which was carried along the wall to the forms. The discharge pipe rested on rollers carried on planks, which were supported in turn by cross-timbers hitched into the rock walls. As the forms were filled and moved forward, the mixer and discharge pipe were backed up toward the shaft.

The material for concrete was supplied to the machine by a car, Fig. 2, which traveled from a hopper at the bottom of the shaft to the machine. The car body consisted of a box about 1 ft. 6 ins. high, about 5 ft. long and with battered sides, making the box 1 ft. 3 in. wide at the bottom and 2 ft. wide at the top. In order that the materials could be dumped directly from the car into the machine, a sliding gate was built in the bottom of the box. The box was set on a frame built up on a small set of trucks so that it projected beyond the trucks sufficiently to place the sliding gate directly over the charging hopper of the machine. As the car body was within 6 ins. of the tunnel roof, it was necessary to rake the materials to the trap door. A rake, as shown in the sketch, Fig. 2, was used for this purpose.

The labor required for this arrangement of the work consisted of one man at the end of the discharge pipe to spade the concrete as placed; one man to rake concrete into the machine; two men to push material cars; one man at the surface, and one foreman. About 15 ft. of tunnel were lined per 8-hour shift.

The last 300 ft. of the tunnel were lined by placing the machine at the base of the shaft and discharging the material through a 5-in. pipe. This arrangement eliminated the transportation of the material by the car and saved the labor of two men involved in this operation. The machine was supplied by a chute about 40 ft. long and about 10x10 ins. in section reaching down to the machine hopper, from the surface. Baffles were placed in the chute so that the materials were fairly well mixed before they were loaded into the drum of the machine. Owing to the limited space in the tunnel, a small machine was used, having a capacity of 4 cu. ft.

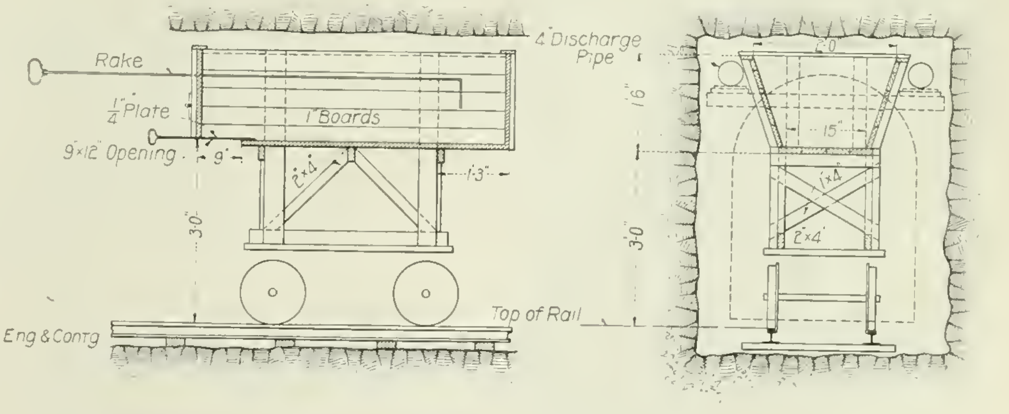


Fig. 2—Special Car for Charging Concrete Blower.

The forms used were made by the Blaw Steel Centering Co., of Pittsburgh. Usually two shifts of 8 hours were required for moving and resetting the steel forms. The labor required for this work consisted of three men and a foreman. In addition to this labor, a carpenter was employed, when the forms were set, to place the bulkheads.

The surface laborer was paid $1.75 per shift, the underground men were paid $2.00 per shift and the foreman was paid $3.50 per shift.

The machine used for the work is shown by Fig. 3. A receiving drum is bolted to the discharging air chamber. Passing through the drum is a central shaft, at the bottom end of which the feeding worm is secured. The shaft is driven by an air motor, and is under control of the operator on one side of the machine. On top of the drum is the air-locked hopper through which the materials are admitted to the drum. Flat steel bars with knife edges, secured to the central shaft and rotating with it, prevent the arching of the materials in the drum. Air is admitted to the air chamber through a nozzle, and directly opposite the nozzle is the discharge pipe, through which the materials are discharged and conveyed by means of the pressure supplied from the injector nozzle.

The air motor, operating the central shaft, causes the auger to empty the drum by a steady feed into the current of air passing through the air chamber. In front of the discharge pipe is the water connection, and water may be admitted to produce either wet or dry concrete, as desired.

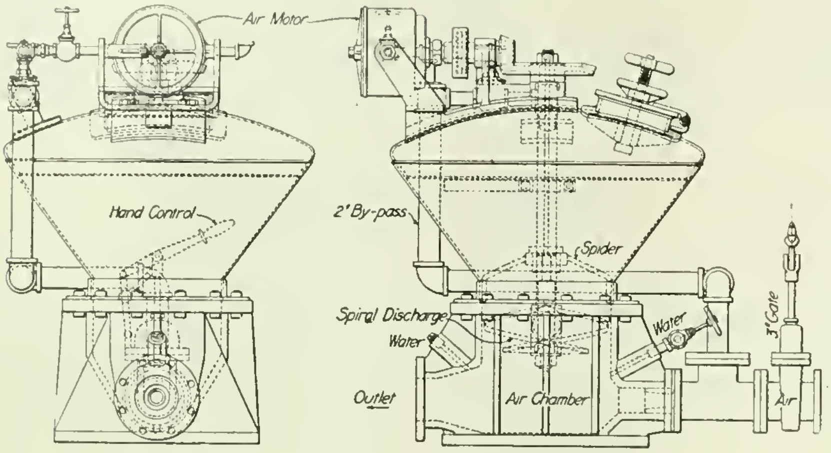


Fig 3—Detail of Concrete Blower.

In operating the machine the dry concrete ingredients are placed in the drum and the air-locked door closed. A blast of compressed air is supplied to the receiving chamber through the nozzle. The feeding worm is rotated by the power from the motor, and a stream of water under pressure is passed into the receiving chamber. As the screw revolves, it slowly feeds the concrete ingredients into the air blast, the air catches the concrete and carries it in a stream through the discharge pipe to place.

As recommended by the Concrete Blower Company, an outfit suitable for placing 100 cu. yds. of concrete in 8 hours should consist of a machine with a drum capacity of 10 cu. ft.; 500 lin. ft. of discharge pipe 6 ins. in diameter, with the necessary bends on a 5-ft. radius; an air compressor having a capacity of 500 cu. ft. per minute at 60 lbs. pressure, and an air receiver of 200 cu. ft. capacity.

Data Useful in Estimating the Cost of Power Plants.

A method of indicating how, in estimating the cost of steam power plants and pumping plants, the greatest percentage of error may be located so as to minimize the effect on the total estimate, is given in a brief paper in the March "Journal of the Worcester Polytechnic Institute," by Mr. F. W. Gay, chief mechanical engineer, J. B. White & Co. An abstract follows:

The first thing is to determine the relative importance of the various items to be covered by the estimate. Diagrams have been compiled from data at the writer's disposal, which data cover plants from 2,000 k. w. to 40,000 k. w. capacity. The diagrams show that: Engines and foundations constitute from 33.6 per cent to 61 per cent of the total equipment cost; an average of 50 per cent. Boilers, settings, and foundations, from 17.25 per cent to 31.5 per cent, average about 25 per cent. Piping, complete, from 7 per cent to 17 per cent, average about 11 per cent. Condensers, complete with foundations and auxiliaries, 10 per cent to 15 per cent, an average of 11 per cent. Circulating water system, 4.5 per cent to 8 per cent, average 6.5 per cent. Thus in these five groups we have a minimum of 72.35 per cent of all apparatus items, leaving the remainder, 27.65 per cent to be divided among at least eleven groups, including "miscellaneous." If, therefore, we spend the greater part of the time at our disposal on these five groups the result will justify the expenditure of time and money.

Boilers, foundations, and settings can be estimated closely, as can also the condensing apparatus. Engines, foundations, piping, and circulating water systems present greater difficulties, relatively, about in the order named. I think it possible to estimate as close as 3 per cent on boilers, installed; on engines, installed, as close as 5 per cent; on engine foundations, as close as 10 per cent; on circulating water systems, as close as 15 per cent; on piping systems as close as 20 per cent, on condensers, auxiliaries, and foundations, as close as 3 per cent.

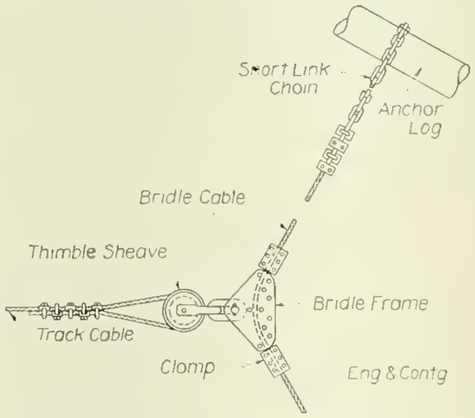


Fig. 1—Bridle Hitch for Tail of Track Cable, Cableway Scraper Excavator.

Applying these percentages of error to the minimum percentages of the whole, we have the total probable error on 72.35 per cent of the apparatus as follows:

		Pct.
Boilers	17.25 x 3 =	0.52*
Engines	33.60 x 6 =	2.01†
Piping	7.00 x 20 =	1.40
Condensers	10.00 x 3 =	0.30
Circ. water system	4.50x315 =	0.68
Total		4.91

*Plus or minus. †Including foundations.

Assume for the moment that we can estimate on the total cost as close as 15 per cent, which percentage ordinarily includes 5 per cent for contingencies and errors. If by concentrating our attention on the five principal groups we can come as close as 5 per cent on the larger items, and I think this is possible, we have then a leeway of about 43.5 per cent on the remaining items. Certainly we can, in almost every case, come within 20 per cent on these items, and if we do, our total estimate is within 8.5 per cent, as against the 15 per cent assumed.

I have used herein the minimum percentages for the principal items. In some cases this is as high as 85 per cent. If we analyze this in the same manner as for the 72.35 per cent, our total estimate may be within 6.5 per cent.

A New Cableway Scraper Excavator for Stripping and Pit Excavation.

(Staff Article.)

A new modification in cableway scraper excavators is illustrated by the accompanying sketches. This excavator will work under water as well as in dry pits and has been quite widely employed in stripping, in gravel pits and in other loose soil excavation. The records given later indicate its economy of operation.

In general the plant consists of a track-cable on which runs a carriage operated by a hauling rope and carrying suspended a scraper bucket. The track cable has an adjustable attachment at one end to a mast and is at the other end fastened by a bridle hitch to two anchors. By means of this adjustable mast connection the track cable can be slacked to lower the bucket into the pit to dig and then made taut to raise the loaded bucket out of the pit and provide a track cableway for hauling the load to the pit bank to be discharged. The line of the track cable being from the mast top on one side to the bridle hitch at ground level on the other side of the pit, is inclined so that the bucket returns by gravity when the hauling rope is slacked. In brief, then, the operation is as follows: The bucket being at the pit side farthest from the mast, the track cable is slacked to lower the bucket to the pit bottom. A pull on the hauling rope draws the bucket ahead and it scrapes up a load. The track cable is then hoisted taut and raises the bucket out of the pit. The loaded bucket is then hauled up the track cable to the dumping point where it is dumped automatically. The bucket then returns by gravity to its first position of readiness to excavate another load.

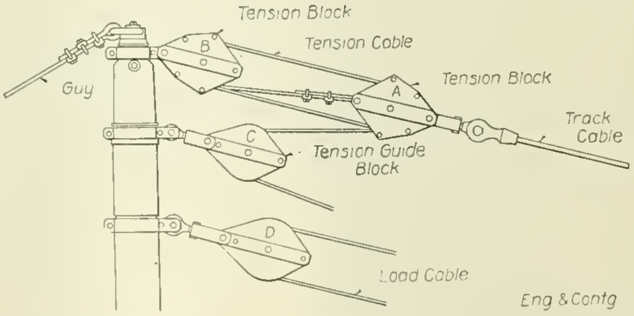


Fig. 2—Mast Top and Sheave Assembly, Cableway Scraper Excavator.

From this general statement it will be seen that the essential structural and operating parts of the excavator are the adjustable attachments at the mast head, the bridle hitch at the opposite end of the track cable and the bucket and carriage and their operating lines. The bridle hitch is simple and is completely explained by Fig. 1. Figure 2 shows the mast head attachment which is explained as follows: From the rear drum of a double-drum hoist at the mast bottom a tension line runs to the mast top and is fastened to the track cable block *A*, Fig. 2, after being rove as shown through blocks *B* and *C*. Block *C* is fastened in a fixed vertical position to a collar ring which is free to revolve around the mast, but the other blocks have ordinary swivel connections. The tension line as its name indicates is employed to make the track cable alternately slack and taut.

Turning now to the bucket hauling and dumping operations, it is noted first that from the front drum of the engine a line runs to block *D* on the mast, referring to Fig. 2, and thence to the dump block to which the bucket pull chain is attached as shown by Fig. 3. This line, called the load cable, hauls the bucket on its carriage along the track cable. Figure 3 shows the bucket and carriage and their various cable and chain attachments. The purpose of all these parts is clear from the drawing except possibly that of the dump chain. In traveling along the track cable the carriage and the traveler block keep in the relative positions shown until the dumping point is approached. Then the traveler block is arrested by a stop on the track cable, but the carriage and bucket continue on until a loop is taken up in the dump chain sufficient to elevate the rear end of the bucket and then dumps the load. The relative adjustment of the bridle and push chains determines the digging angle of the bucket.

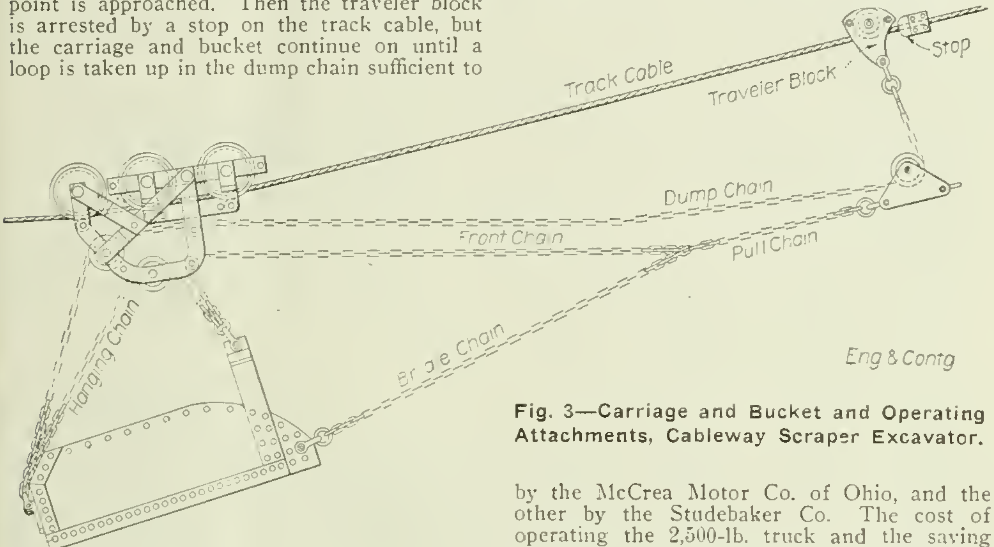


Fig. 3—Carriage and Bucket and Operating Attachments, Cableway Scraper Excavator.

As previously stated a number of this type of cableway scraper excavators are in use. The following figures are furnished of the cost of operation of one plant which is installed at a gravel pit:

Engineer	$3.00
Fireman	2.00
1½ tons coal	3.50
Oil, waste, etc	.50
Total	$9.00

This cost is for a 10-hour day. A 1-cu. yd. bucket is used and about 300 cu. yds. per day are handled. On this basis the cost is 3 cts. per cubic yard, not including overhead expenses. The machine is known as the Shearer & Mayer Patented Dragline Cableway Excavator. It is sold by Sauerman Bros., Consulting Engineers and Selling Agents, 1139 Monadnock Block, Chicago, to whom we are indebted for the information from which this description has been prepared.

Hydraulic Truck Hauls 45-Ton Load.—A load of 45 tons was recently hauled over New York streets by a La France hydraulic truck. This load consisted of a frame for the door of a bank vault. The frame, 7 ft. 6 in. wide, 9 ft. long and 3 ft. 6 in. thick, weighed 52,600 lbs. It was loaded on a four-wheel trailer which weighed, when empty, 16,400 lbs. The truck was loaded with five steel plates for the vault, which aggregated 12,100 lbs. The truck itself weighs 4½ tons, so that the total load to be moved was 90,100 lbs. Two horses were hitched to the pole of the truck so as to control this pole and steer the trailer. In order to test the tractive effort, the truck was stopped with its load on a 4½ per cent grade, and had no difficulty in starting again. The draw bar pull required to start the load was a little over 9,000 lbs.

A Study of Comparative Up-Keep Costs of Horse Drawn Vehicles and Electric Motor Trucks.

An investigation and report on the question of substituting at the Government Printing Office motor trucks for the teamdrawn trucks there in use was made in November, 1910. As the result of this study motor trucks were purchased and in a paper before the American Society of Mechanical Engineers Mr. W. R. Neatz describes the results obtained. We quote the paper as follows:

PRELIMINARY INVESTIGATION.

The naval gun factory at Washington operated five electric trucks, two of which had been in operation for four years; one of these had a capacity of 2,500 lbs. and the other a capacity of 5 tons. The first was furnished by the McCrea Motor Co. of Ohio, and the other by the Studebaker Co. The cost of operating the 2,500-lb. truck and the saving accomplished were as given in Table 1.

The cost of operating the 5-ton electric truck was about the same as the 2,500-lb. wagon, excepting that the 2,500-lb. wagon cost 75 cts. for charging per 40-mile radius while the 5-ton truck cost $1.10 for the same radius. The total cost of operation is given as $2,396.84, and if depreciation and interest on the investment of $3,725 are included the total cost will be $2,843.84.

This truck displaced two 2-horse wagons costing as follows:

3 laborers, each wagon, at $1.92 per day	$3,605.76
Stabling, shoeing, etc., 4 horses at $4 per day	1,252.00
Total	$4,857.76
Net saving of truck over horses	2,460.92

In this case depreciation and interest are not included as the original cost of the horses was not known.

One large company operates a number of horse-drawn wagons, also a number of motor trucks, both electric and gasoline driven. Their experience is given in Table II.

From Table II can be estimated the yearly expense of vehicles requiring more than one horse, by adding the items for horses and harness to the one-horse vehicle costs as follows:

1-horse vehicle expense	$ 464.81
Vehicle and 2 horses expense $464.81 plus $275.71	740.52
Vehicle and 3 horses expense $740.52 plus $275.71	1,016.23
Vehicle and 4 horses expense $1,016.23 plus $275.71	1,291.94

These costs do not include labor and stable expense.

TABLE III.—EXPENSE OF OPERATING ELECTRIC COMMERCIAL VEHICLES.

Capacity, Lbs.	850-1,000.	1,500-2,000	2,500-3,000	4,000.	7,000.
Interest and depreciation (machine less batteries and tires)	$244.50	$306.30	$391.40	$422.94	$470.84
Mechanical and electrical upkeep	67.54	84.15	101.70	110.96	121.42
Tire repairs and renewals	79.28	97.30	155.05	267.60	535.25
Battery repairs, cleaning and renewals	130.50	175.36	219.34	271.54	312.84
Current at 1 cent per kw-hr	20.00	30.20	40.00	60.00	51.50
Totals	$541.82	$693.31	$907.49	$1,133.04	$1,491.85

In Table III are given the costs of operation for the electric trucks used by this same company. Table IV compares the operation costs of the first two trucks recorded in Table III on the basis of 300 days' service per year. Table V makes a similar comparison of the commercial and individual gasoline machines assuming 300 days' service per year for the former and 365 days for the latter. The following makes of gasoline cars were in use: Cadillac, Brush, Buick, Ford, Franklin and Maxwell, ranging from 10 h.p. to 20 h.p.

TABLE I.—COST OF OPERATING 2,500-LB. ELECTRIC TRUCK.

Cost of truck	$2,230.00
Labor for charging batteries	46.44
Charging	16.50
Acid	18.00
Rubber jars	15.00
Batteries (partly renewed)	64.98
Carbon brushes	1.80
Repairs	99.96
1 operator at $2.48 per day	776.24
2 laborers at $1.92 per day each	1,201.92
Totals	$2,240.84
Depreciation, 10 per cent	223.00
Interest on investment at 2 per cent	44.60
Total cost	$2,508.44
Total mileage per year	3,366
Cost per mile	$0.745
This truck displaced 5 horses and carts, costing as follows:	
5 carts by contract at $1.92 per day	$3,004.80
5 laborers at $1.92 per day each	3,004.80
Total	$6,009.60
Net saving of truck over horses per year	3,501.16

In addition to the records obtained from this company, the attempt was made to secure data from a number of private firms, but unfortunately none of them had any exact figures and could only approximate the savings due to the use of both electric and gasoline-driven trucks over horse-drawn vehicles.

TABLE II.—HORSE-DRAWN VEHICLES.

Investment	
1 horse	$250.00
1 vehicle	125.00
Harness	30.00
Total	$405.00
Maintenance and Upkeep	
Depreciation	
Horse at 20 per cent	$ 50.00
Vehicle at 15 per cent	18.75
Harness at 15 per cent	4.50
Interest on $405 at 6 per cent	24.30
Total	$ 97.55
Horse Upkeep	
Feed at 47.4 cents × 365 days	$173.01
Shoeing at 7.5 cents × 365 days	27.38
Veterinary at 1.1 cents × 365 days	4.02
Total	$204.41
Vehicle expense at 43.4 cts. per day	158.35
Harness expense	4.50
Total	$162.85
Total expense exclusive of labor and stable	$464.81

VEHICLES IN USE BY GOVERNMENT PRINTING OFFICE.

During the fiscal year 1910 and 1911, which were the last two years that horse-drawn vehicles were used exclusively, the total expenses for the stable were $31,113.58 for 1910, and $31,231.93 for 1911; and for the same years the cost of the delivery section was $17,093.93 for 1910, and $17,256.19 for 1911, making a total cost for the delivery and stable sections of $48,207.51 for 1910, and $48,488.12 for 1911. It should be stated here that the stable and delivery sections were entirely separate at this time, each being in charge of a foreman, whereas after the automobiles were used these sections were combined, although the costs were separated.

The equipment, number of men employed, and the expenses of the stable and delivery sections during the fiscal year 1910 are given in Table VII.

Omitting the wages paid the drivers and messengers, the stable section alone cost $18,447.37, making the cost per horse per year $802.06, or $2.20 per day, of which 37¾ cts. was for feed.

From Table VII can readily be obtained the operating cost of one 2-horse 5,000-lb. capacity wagon, and these are given in Table VIII.

TABLE IV—TOTAL MILEAGE OF THE FIRST TWO CARS, AND THE COST PER MILE OF EACH, EXCLUSIVE OF INTEREST AND DEPRECIATION.

Capacity, lbs.—	Miles per day.	Miles per year.	Cost per year.	Cost per mile.
850 to 1,000	25	7,500	$297.32	$0.04
1,500 to 2,000	25	9,125	277.01	0.03

TABLE V.—COST AND MILEAGE OF COMMERCIAL AND INDIVIDUAL MACHINES.

Service.	Miles per day.	Miles per year.	Total Cost per year.	Cost per mile.
Commercial	22.2	6,660	$896.69	$0.135
Individual	19.7	7,190	809.53	0.1125

TABLE VI. — COMPARATIVE EXPENSE OF OPERATING MOTOR VEHICLES IN PLACE OF HORSE-DRAWN VEHICLES.

Vehicles for Emergency Work	
Two 2-horse vehicles at $740.52	$1,481.04
One 3-horse vehicle at $1,016.23	1,016.23
	$2,497.27
One 4,000-lb. automobile	1,133.54
One 2,500-lb. automobile	907.49
	$2,040.53
Annual saving by use of automobiles, not including labor	456.74
Supply Wagon	
One 4-mule wagon	$1,291.94
One 4,000-lb. automobile	1,133.04
Annual saving	$ 158.90
Paymaster's Money Wagon	
One 2-horse vehicle	$ 740.52
One 850 to 1,000-lb. vehicle	541.82
Annual saving	$ 198.70

During the month of November, 1911, there were purchased and put into service two 1,000-lb. trucks, two 2,000-lb. trucks, and two 5,000-lb. trucks, all of the electric type, and at the same time 17 horses and their equipment were sold, leaving six horses, one 5-ton capacity, two-horse truck, one single-horse truck, one carriage driven by two horses, and one carriage driven by one horse.

TABLE VII. — EQUIPMENT, NUMBER AND CLASS OF MEN EMPLOYED, AND COST OF OPERATION, MAINTENANCE AND REPAIR FOR HORSE-DRAWN VEHICLES FOR YEAR ENDING JUNE 30, 1910.

Equipment	Cost
23 horses (average per year)	$ 6,900.00
Harness, blankets, etc	1,350.00
1 five-ton truck (2-horse)	425.00
7 large delivery wagons (2-horse at $475.00 average)	3,325.00
6 single delivery wagons (1-horse at $275.00 average)	1,650.00
3 light mail wagons at $200	600.00
4 depot wagons (carriages) at $300	1,200.00
2 coupes, with pole and shafts, at $540	1,080.00
Total	$16,530.00
Number and Class of Men Employed	
Stable section:	
1 foreman at $2,000 per year.	
1 mail carrier at $3.20 per day.	
1 messenger at $2.40 per day.	
11 drivers at $2.40 per day.	
1 stableman in charge at $2.88 per day.	
8 stablemen at $2.40 per day.	
Delivery section:	
1 foreman at $2,000 per year.	
4 helpers at $3.04, $2.80, $2.72 and $2.40 per day.	
12 messengers at $2.40 per day.	
2 unskilled laborers at $2.00 per day.	
Total employees* in both sections = 42.	
Cost of Operation of Stable Section	
Wages of foreman and stablemen	$10,113.59
Wages of drivers	12,666.21
Rent	2,400.00
Feed	3,172.20
Supplies	959.62
Repairs to harness, wagons, etc	626.86
Shoeing	906.60
Gas and electricity	268.50
Total cost of operation, maintenance and repair	$31,113.58
Depreciation, horses 20%, harness 15%, wagons 10%	2,410.50
Interest on investment at 2%	330.60
Total cost, including depreciation and interest on investment	$33,854.68
Cost of Operation of Delivery Section	
Salaries and wages	$17,085.93
Material and supplies	8.00
Total cost	$17,093.93

*20 per cent additional is allowed for night service.

TABLE VIII.—COST PER YEAR OF ONE 2-HORSE, 5,000-LB. CAPACITY WAGON.

Wagon Expense	
Cost of truck, $425.00	
Cost of maintenance and repair	$ 31.75
Cleaning and washing	66.76
Lubricants	1.00
Depreciation, estimated at 10 per cent	42.50
Total	$ 142.01
Horse Expense	
Cost of two horses, $615.00	
Cost of feed	$ 264.33
Cost of care (hostler)	702.60
Cost of veterinary and office labor	250.10
Cost of medicine	2.17
Cost of shoeing	78.84
Cost of blankets, nets, etc	12.22
Rental value of space (2 horses) (based on $2,400 for 22 horses)	218.00
Depreciation, estimated at 20 per cent	125.44
Total	$1,641.48
Harness Expense	
Cost of harness, $123.00	
Cost of maintenance	$ 7.68
Depreciation, estimated at 15 per cent	18.45
Total	$ 26.13
Miscellaneous supplies	10.00
Drivers' wages	751.20
Helpers' wages	751.20
Gas and electricity	23.34
Interest on investment at 2 per cent	23.50
Total	$1,559.24
Total original cost, $1,175.22	
Total expense for one year	$3,368.86

In November, 1912, one additional 5,000-lb. truck and an electric-driven carriage were installed, and two carriage horses and one truck horse and their equipment were sold.

In January, 1913, one 8,000-lb. capacity truck was installed, and two more truck horses and their equipment were sold.

The truck equipment, and the number and class of men employed for caring for the electric vehicles and the remaining horses during the year 1912 is given in Table IX.

During the coming year, and after the remaining six horses are sold, the four stablemen will be dispensed with and in their place their will be employed probably two helpers and one laborer at a total cost of $6.80 per day, or $2,128.40, thus indicating a further reduction of $1,377.20.

All of the electric trucks were purchased from the Baker Motor Vehicle Co. of Cleveland, O., and the iron-clad exide storage batteries from the Electric Storage Battery Co. of Philadelphia, Pa.

It will be noted that there have been no tire costs during the year. This, of course, was due to the fact that none of the tires have worn out, but it should be stated that the tires on the 5,000-lb. trucks are practically worn out and, in fact, were being replaced during the month of January, 1913, so that the tires on these trucks wore out after running since December, 1911, or a period of 13 months. The tires on the 1,000 and 2,000-lb. trucks are still in fairly good condition. The tires on the 5,000-lb. trucks would undoubtedly have lasted longer than they did were it not for the fact that these trucks were often loaded up to 7,000 lbs., making a considerably harder service than could have been anticipated by the makers.

TABLE X.—SALARIES, WAGES, LEAVE OF ABSENCE, HOLIDAY AND LIABILITY PAYMENTS, MATERIAL AND SUPPLIES, REPAIRS, ETC., FOR DELIVERY, STABLE AND GARAGE, JANUARY 1, 1912, TO DECEMBER 31, 1912.

Month.	Salaries, Wages, Leave of Absence, Holiday and Liability Payments.			Material and Supplies, Repairs, Etc.		
	Delivery.	Stables.	Garage.	Delivery.	Stables.	Garage.
January	$1,429.23	$523.71	$818.23	$,14.75	$ 149.85	$ 223.87
February	1,330.59	465.88	822.56	2.74	127.06	224.89
March	1,345.76	487.61	828.97	2.28	189.36	240.67
April	1,245.10	484.17	891.61	13.51	76.21	197.08
May	1,378.52	543.23	1,019.64	25.55	114.27	183.87
June	1,141.73	453.61	821.78	66.96	213.18	495.99
July	1,454.96	512.77	887.06	9.40	124.35	173.57
August	1,372.38	447.99	889.27	6.00	127.84	251.64
September	1,487.09	429.50	678.68	4.34	122.55	198.60
October	1,391.65	443.33	710.59	9.94	129.54	307.26
November	1,565.02	337.95	809.68	1.35	57.76	222.40
December	1,460.70	252.00	910.13	13.95	48.81	203.41
Total	$16,602.73	$5,381.75	$10,088.20	$170.77	$1,480.78	$2,923.25
Equipment issued Jan. 1 to Dec. 31, 1912, $70.00.						$24,446.00

The total cost of operating the combined delivery, stable, and garage during the year 1912 was as given in Table X.

In Table X it is interesting to note that the six electric trucks, doing practically all of the work, cost only about twice as much as the six horses. As a matter of fact the six electric trucks alone did as much work as the total stable force did during the year previous, and the horse-drawn equipment simply took care of the increased work.

TABLE IX. — EQUIPMENT AND NUMBER AND CLASS OF MEN NOW EMPLOYED.

Equipment	
Two 1,000-lb. trucks	$ 4,639.00
Two 2,000-lb. trucks	5,498.78
Three 5,000-lb. trucks (two in use during full year)	10,625.22
One 8,000-lb. truck (installed in January, 1913)	5,509.00
One electric-driven carriage (installed in November)	3,671.00
Total cost	$29,943.00
Number and Class of Men Employed	
1 foreman at $2,000 per year	$ 2,000.00
12 chauffeurs at $2.40 per day each	9,024.40
3 helpers at $3.20, $2.80 and $2.72 per day	2,729.36
10 messengers at $2.80 (two) and $2.40 (eight) per day	7,762.40
1 mail carrier at $3.20 per day	1,001.60
2 messenger boys at $1.20 each per day	751.20
1 stableman in charge at $4.00 per day	1,252.00
3 stablemen at $2.40 each per day	2,253.60
2 drivers at $2.40 each per day	1,502.40
35	$28,276.96

Note—Labor charge is based on day service.

TABLE XII. — COST OF OPERATING ONE 5,000-LB. ELECTRIC TRUCK.[1]

Cost of truck and equipment (including spare battery and parts), $3,745.00	
Maintenance and repair (as per statement above)	$ 581.53
Depreciation at 10 per cent	374.50
Interest on investment at 2 per cent	74.90
Chauffeur's wages at $2.40 per day	751.20
Messenger's wages at $2.40 per day	751.20
Total original cost, $3,745.00	
Total expense for one year	$2,533.33

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[1] One of these electric trucks easily replaces two 2-horse trucks.

Table XI shows in detail the cost of taking care of the electric trucks, and as the cost of the trucks of any given size is about the same, only one of each size is given.

From the given figures we can readily ascertain the cost of operating one 5,000-lb. capacity electric truck as compared with one 5,000-lb. capacity 2-horse wagon.

The cost of two 2-horse wagons being $6,737.72 (Table XII), the saving due to the use of the electric truck is $4,204.39.

Unfortunately no mileage record of the horse-drawn vehicles was kept during the previous years, but the records show that the two-horse wagon made an average of four trips per day, and the present records show that the 5,000-lb. electric trucks make an average of eight trips per day. The mileage of the electric trucks being about 24 per day, it may be assumed that the mileage of the horse-drawn trucks was about 12 per day.

For the sake of comparison the costs of the three sizes of electric trucks and of the two-horse wagon are given in Table XIII.

The Use of Steel Wire in Townsite Surveying.

Contributed by Joseph M. Perkins, Madison, Wis.

While engaged in townsite surveying in the southwest, the writer found that for certain parts of the work steel wire was better than the customary steel tape. Of course, the tape and transit were necessary to lay out the block corners, but work accurate enough for setting the lot stakes could easily be done with the wire.

TABLE XI.—ELECTRIC VEHICLE RECORD.

	1,000-Lb.			2,000-Lb.			5,000-Lb.		
	Jan.-June.	July-Dec.	Total.	Jan.-June.	July-Dec.	Total.	Jan.-June.	July-Dec.	Total.
Total miles	3,013.60	3,511.00	6,524.00	2,978.00	2,864.00	5,842.00	3,586.00	2,918.00	6,504.00
Ampere hours	8,598.00	8,459.00	17,057.00	11,019.00	9,710.00	20,929.00	18,302.00	14,096.00	32,398.00
Ampere hours per mile	2.85	2.40	2.61	3.69	3.39	3.58	5.10	4.83	4.98
Kw-hr. supplied	1,249.8	1,303.80	2,553.6	1,573.6	1,389.4	2,963.00	2,678.4	2,047.8	4,726.2
Cost of current	$14.67	$16.64	$31.31	$18.58	$17.79	$36.37	$31.56	$26.28	$57.84
Battery upkeep	......	......	......	......	......	......	......	......	......
Tire upkeep	......	......	......	......	......	......	......	......	......
Electrical upkeep	1.20	2.93	4.13	0.75	14.38	15.13	5.06	8.67	13.73
Mechanical upkeep	26.80	27.68	54.48	41.34	28.41	69.75	129.62	80.10	209.72
Inspection	161.58	138.67	300.25	161.58	138.67	300.25	161.58	138.66	300.24
Totals	$204.25	$185.92	$390.17	$222.25	$199.25	$421.50	$327.82	$253.71	$581.53

The writer prefers the wire to the tape because it can be roughly handled without kinking or breaking, high winds will cause it to vibrate only slightly, and, best of all, being the full length of a block, the time which is usually wasted in reading and shifting a tape may be saved.

Number 11 galvanized steel wire, with handles fastened to each end, was used. The wire was graduated by giving it two slight kinks about ½ in. apart, winding the interval between them with copper wire. The graduations were placed 25 ft. apart on a 400-ft. wire, so that 15 lot stakes, 25 ft. apart, could be placed without moving the wire when it was once stretched on a line between the block corners. After a little use the copper graduations became bright and could be distinguished very easily, thus saving the time usually wasted in hunting for the tape graduations and also eliminating all errors in tape reading.

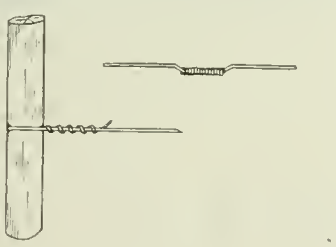

Fig. 1.

TABLE XIII.—COSTS OF ELECTRIC TRUCKS AND 2-HORSE WAGON.

	2-horse wagon, 5,000 lbs. capacity.	5,000-lb. electric truck.	2,000-lb. electric truck.	1,000-lb. electric truck.
Average trips per day	4	8	8	9
Mileage per day, average	12	24	20	20
Mileage per month (loaded halfway)	312	624	520	520
Average load per trip, lbs	4,000	5,500	2,500	900
Total load per day, lbs	16,000	44,000	20,000	8,100
Tons	8	22	10	4.05
Total load per month, tons of 2,000 lbs	208	572	260	105.3
Total cost per month	$280.74	$211.11	$187.81	$180.98
Cost per mile	0.899	0.338	0.361	0.347
Cost per mile (omitting driver's and helper's wages)	0.499	0.138	0.121	0.107

[1] One of these electric trucks easily replaces two 2-horse trucks.

Several time tests were taken, in which it was determined that it required only 2½ minutes to place the 15 stakes and move to the next block. After work at night, instead of having to be cleaned and wound, the wire was simply hung on a convenient fence or tree. No attempt was made to carry it from one survey to another, the cost of the wire and the time required to graduate it being a very small item

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The city of Milwaukee has purchased two 1,500-lb. motor wagons for use in the water department. This makes seven Kissel Kars in the municipal service of Milwaukee, four of which are in the water department.

Constructing a Foundation in Soft Muck by Means of Stone Filling and Grouting.

(Staff Article.)

A simple and unique method of securing a good foundation under difficult conditions was employed recently at a northern blast furnace plant. A sheet steel cofferdam, 30x30 ft., had been driven around the foundation site, and the excavation had been carried down until soft black muck was encountered. No headway could be made in this almost liquid muck, nor could braces be placed below its level to prevent the steel piling from bulging inward. These difficulties were attributed largely to the weight of a huge pile of ore stored on adjacent property and weighing several thousand tons per lineal foot of the space occupied.

The method followed was to throw into the excavation a large amount of broken rock and at the same time to stir up the muck by jets of air, causing the muck to come to the top and allowing the stones to settle to the bottom. This raised the level of the muck to a point where it could be removed without endangering the sheet pile walls. When it was removed a floor of concrete, about 1 ft. thick, was laid over the area. Through this floor a large number of holes were drilled at scattered points. These were drilled through to solid rock and with some difficulty. Grout pipes were then placed in several adjacent holes and grout was forced through the pipes until the grout began to appear at other holes, being forced up by the filling of the voids in the broken stone below. The pipes were then removed and placed in other holes on the side farthest removed from the previous grouting, thus giving the grout an opportunity to set up, and the operation was repeated. The foundation was completed when the grout was forced up in the last vacant hole. Several carloads of cement were required for the grouting and a satisfactory foundation was secured.

TABLE I.—COST OF BLACK SOIL FROM LEMONT.

	Cu. yds.	Total cost.	Unit cost.
Excavating and Loading—			
Year 1910	35,044	$ 5,948.81	$0.17
Year 1911	39,640	10,102.20	0.255
Year 1912	42,670	10,077.47	0.236
Total	117,358	$26,128.48	$0.223
Towing—			
Year 1910		$ 8,251.46	$0.235
Year 1911		7,040.87	0.178
Year 1912		15,278.97	0.358
Total		$30,571.30	$0.260
Unloading—			
Year 1910		$ 4,307.25	$0.123
Year 1911		3,844.89	0.098
Year 1912		5,246.77	0.123
Total		$13,398.91	$0.115
Hauling—			
Year 1910		$ 3,229.21	$0.093
Year 1911		4,054.47	0.103
Year 1912		7,036.08	0.165
Total		$14,319.76	$0.121
Spreading—			
Year 1910		....	......
Year 1911		$ 4,755.61	$0.12
Year 1912		5,894.70	0.138
Total		$10,650.31	$0.091
Totals for Black Soil—			
Year 1910		$21,736.73	$0.62
Year 1911		29,798.04	0.753
Year 1912		43,533.99	1.020
Grand total		$95,068.76	$0.81
Total acreage covered to date			57.68
Total yardage placed to date			126,233
Total cost to date			$129,300.84
Cost per cu. yd. to date			$1.02
Cost per acre to date			$2,241.70

Unit Costs of Covering a Park Area with Black Soil.

(Staff Article.)

In connection with the extension of Lincoln Park, Chicago, by filling in the shallow waters of Lake Michigan adjacent to the Park there has been a considerable amount of work done in covering the filled area with black soil, including grading, seeding, planting trees and laying water pipes and drains. The soil has been obtained by stripping a piece of land which was purchased by the Park Commissioners for this purpose, near Lemont, Ill., on the Chicago Drainage Canal. It is stripped by steam shovel and loaded on barges to be towed to the Park by the tugs belonging to the Park extension equipment.

We give below a summary of the work done during 1912, with complete costs of the work to date.

TABLE II.—COST OF SEEDING.

		Cost per acre.		
Year.	Total.	Labor.	Materials.	Total.
1910	$ 654.06	$23.31	$39.70	$63.01
1911	1,003.28	34.23	50.72	84.95
1912	2,170.72	34.40	58.50	92.90
Total	$3,828.06	$30.65	$49.64	$80.29

TABLE III.—COST OF WATER SYSTEM.

			Unit cost.		
Diam. of pipe, ins.	Ft. laid.	Total cost.	Labor.	Material.	Labor.
12	2,817	$6,402.23	$0.97	$1.30	$2.27
10	3,212	8,211.86	1.30	1.26	2.56
8	1,418	2,160.87	0.74	0.78	1.52
6	2,173	2,492.92	0.53	0.60	1.15
4	6,015	6,015.64	0.55	0.45	1.00
3	5,049	3,337.17	0.35	0.31	0.66
2	12,765	3,377.88	0.16	0.11	0.27
1	1,975	328.79	0.11	0.06	0.17

TABLE IV.—COST OF DRAINAGE SYSTEM.

			Unit cost.		
Diam. of pipe,	Ft. laid.	Total cost.	Labor.	Material.	Total.
8-in.	231	$ 232.79	$0.42	$0.58	$1.00
5-in.	361	349.30	0.53	0.44	0.97
2-in.	607	440.46	0.37	0.36	0.73
9-in.*	4,254	2,322.50	0.32	0.22	0.54
9-in.†	896	1,062.62	0.73	0.45	1.18
6-in.	601	449.90	0.53	.22	0.75
6 & 8-in.‡	7,916	2,272.64	0.24	0.05	0.29
4-in.	2,960	494.82	0.13	0.03	0.16

*Single. †Double. ‡Tile.

The work has been carried on by the Commissioners of Lincoln Park by day labor.

Grading.—The work for the year began early in April and proceeded without much lost time until Nov. 9. The number of acres graded was 23.35. The number of teams and scrapers used varied from 22 per day in May to 12 per day in August, when some of the teams were used in hauling black soil. The black soil used amounted to 42,670 cu. yds. This was towed from Lemont in 94 scow loads, averaging 454 cu. yds. per scow. This average per scow was less than the previous year on account of troublesome floods at Lemont, which hampered the excavation and loading work. The delays from floods totaled about ten weeks. The uncertain conditions made it necessary to keep the crew in constant readiness at all times, and the cost of this work was increased about 100 per cent over the cost for the previous year. During the present season the length of haul by wagons was about 3,500 ft., which is the maximum haul that will be required for all the work. This, also, has made the cost of the work exceptionally high for 1912.

Seeding.—The 23.35 acres graded were seeded with considerable care at a cost of $80.29 per acre, including labor at $30.45 per acre, and materials at $49.64 per acre. The soil was thoroughly raked and rolled to reduce it to its finest texture after plowing in about 2 ins. of sand. The sand counteracts to a large extent the spongy nature of the black soil. A mixture of 5 bushels of Kentucky blue grass, 5 bushels of Canadian blue grass, 5 bushels of Red Top and ½ bu. of white clover seed was used and proved very successful.

Planting.—A large number of trees and shrubs were planted at a cost of $11,587.05. This amount constitutes 28 per cent of the total contemplated for the 200 acres. The total amount of planting done in the three years of work has cost $24,034.07, or 58.8 per cent of the total contemplated.

Water System.—The total amount of pipe laid to date on the Park extension is shown, together with the costs of the work, in Table III.

Drainage System.—The amount and cost of the work done in constructing a drainage system is shown by Table IV. As the clay subsoil is practically impervious the pipes for drainage have been laid, as an experiment, between the surface soil and the clay, giving a cover of about 1 ft. So far this has proved satisfactory.

The accompanying tables show the amounts and costs for all the work.

Mr. A. S. Lewis is Superintendent and Engineer for the Commissioners, and Mr. H. A. Taft is Assistant Engineer in immediate charge of this branch of the work.

Method of Hauling a Steam Shovel Twenty-four Miles Over Country Roads and Fields.

Contributed by C. T. Montague, Plentywood, Mont.

The accompanying views show the method employed in moving a 70 C. Bucyrus shovel from Plentywood, Mont., the terminus of the Great Northern Railway in northeastern Montana, to the work of the Siems-Carey and E. A. Wickham & Co. on the Ambrose extension of the Soo Line. The shovel was moved 24.2 miles in eight days over country roads and fields during March at an average temperature of 10° F. The power consisted of one Minneapolis steam tractor 32 hp. and one 25 Case tractor, with a 5-ton Saurer truck to help out on the starts. The moving trucks were of the ordinary house moving type, consisting of three units of four wheels, each mounted on false bolsters. Although there were many deep ravines and sharp turns made, no difficulty was experienced except through the scarcity of water. Only four laborers were used. The cost per mile for moving the shovel was $48. It is believed that for tonnage of shovel and distance moved this established a record.

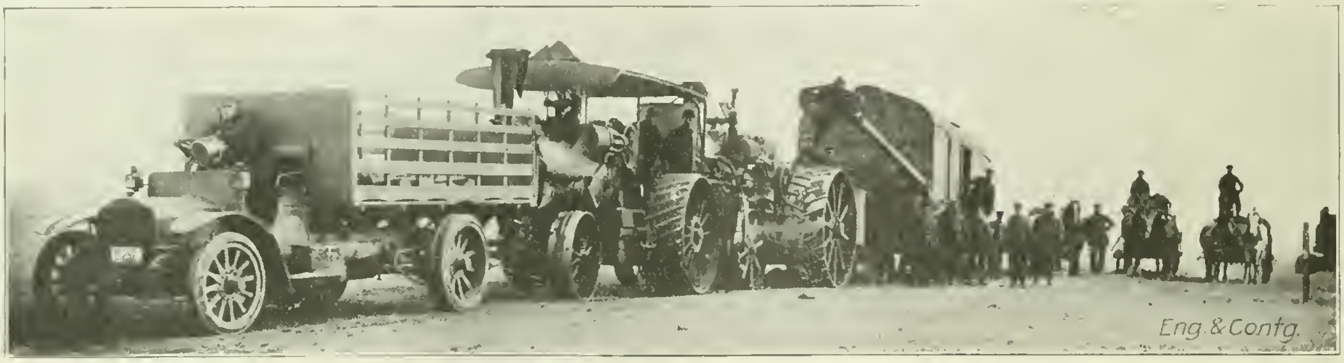


Fig. 1—Train of Tractors and Motor Truck Hauling a Steam Shovel.

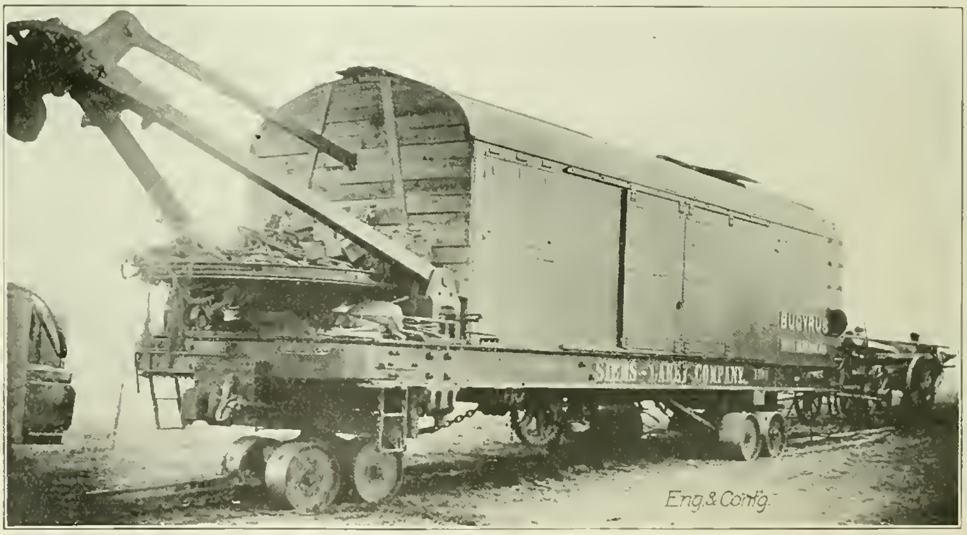


Fig. 2—View Showing Method of Mounting Steam Shovel for Hauling.

RIVERS AND HARBORS

A Suggested Method of Future Bank Protection and Channel Regulation for the Lower Colorado River.

When the break of the Colorado River into Salton Sink was closed as described in our issue of Dec. 11, 1912, it was known that another break was possible at the high water outlet known as the Abajas River situated about 25 miles south of the International Boundary line. This break actually occurred during the flood of 1909; the old Colorado River bed became dry and the waters took a new route to the California Gulf by way of the Abajas River, Volcano Lake and Hardy's Colorado. The United States appropriated $1,000,000 to be expended in restoring the original water route and during 1910-11 a dam was constructed across the Abajas break and continued north and south by 25 miles of levee parallel to the old Colorado. During the summer flood of 1911 this levee was broken and partially destroyed and the Colorado again flowed by way of the Abajas-Volcano Lake-Hardy's Colorado route. The task of flood control on the lower Colorado River still remains to be performed.

The matter which follows is a discussion of a method of channel control for the lower Colorado. Its author is Mr. Francis L. Sellew of the U. S. Reclamation Service, Yuma Project. The original discussion is published in proceedings American Society of Civil Engineers, Vol. xxxix, p. 518. We abstract as follows:

After more than six years of service, during which time about 45 miles of the lower river has been in his charge, the writer wishes to state that, in his judgment, the real problem of this river is not generally understood. This problem is bank protection. The work of bank protection should be directed:

(1) Toward holding existing levees and regaining lost ground, in order that work which has been destroyed may be rebuilt near its original position, thus maintaining as nearly as possible the irrigable area;

(2) To cause the river to occupy a position about midway between the levees in order to prevent, if possible, the erosion of one season from reaching the embankments; or the river slopes of the levee should be made impregnable to river attack.

It is also desirable, in order to prevent meandering—which may result in a rise in plane—to confine the stream to the shortest route consistent with a fall of about 1 ft. per mile.

The area protected by the Colorado levees will be occupied by farms of rather small area, and consequently a comparatively large population will be dependent on them. Intensive farming will be practiced, and the preparation of the land will be expensive, therefore it appears that overflow should be prevented by all possible safeguards. The integrity of the levee system will depend principally on bank protection. There are two general methods by which this may be accomplished: (1) To give the bank a revetment which will protect it against erosion; (2) to keep the main current away from the banks, so that erosion cannot occur.

Revetment may be continuous throughout the river, or salient points which are strongly attacked may be treated first, the work being extended as occasion demands. The most extensive revetment in the United States, if not in the world, is to be found along the Mississippi River and its tributaries, where the general and state governments and local levee boards have engaged in protective works for many years. The standard revetment consits of a woven brush mat or fascine mattress protecting the bed of the stream for a short distance from the shore and the side of the channel below low water. Above low water, where brush deteriorates rapidly, the bank is graded to a uniform slope and paved with rock. Such work is very expensive.

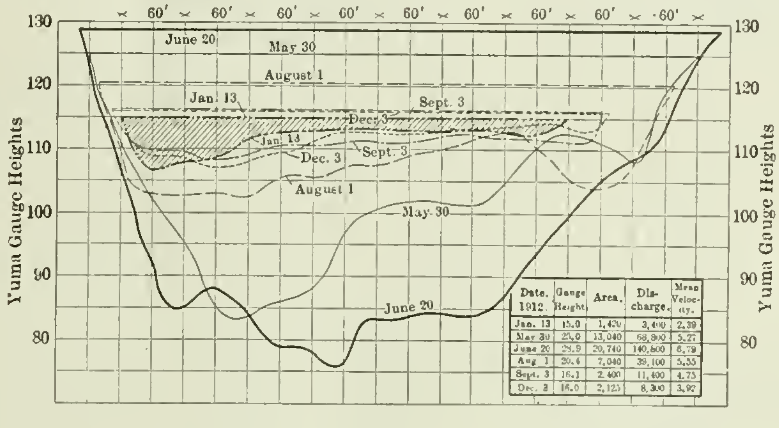


Fig. 1—Cross Sections Taken During 1912 of Colorado River at Yuma, Ariz.

Revetment should begin at Laguna Dam and proceed continuously down stream, leaving no unprotected caving banks above completed work.

The portion of the revetment lying above low water should be constructed by grading the bank to about a 3 to 1 slope and paving it with rock. This is necessary, as any brush work laid on this portion of the bank, being subject to alternate periods of submergence and exposure to the air, will deteriorate in about two seasons and be of little use in holding the bank. Below the low-water mark, the sides of the channel and the bottom for 50 ft. from shore should be protected by a fascine mattress. Assuming that the gage oscillation along the stream is about 12 ft., a slope of 3 to 1 for this height would give an exposed bank of about 38 ft., and, with a stone paving 2 ft. thick, would require 76 cu. ft., or say, 3 cu. yds. of rock per linear feet of bank. By using the quarries at Laguna Dam and Pilot Knob, delivering the stone in barges, and then towing the material into place for use, a fair estimate for the material in place on the bank will be about $2 per cubic yard, or $6 per lineal feet of bank. In addition, assume that brush mattress will cost about $4 per lineal feet, making a total for revetment of $10 per lineal feet of bank, or $50,000 per mile. The distance from Laguna to the Mexican boundary is about 45 miles, and probably at least two-thirds of this distance, or 30 miles, will require continuous revetment. At a cost of $50,000 per mile of bank or $100,000 per mile of river, 30 miles of revetment would cost about $3,000,000.

From the Mississippi reports the annual maintenance of bank revetment should not be taken at less than 10 per cent of the original cost, which means that expenditures for this purpose must be duplicated each 10 years.

S. Waters Fox, M. Am. Soc. C. E., an assistant engineer in charge of some of the Missouri River improvements, states that 45 miles of the alluvial portion of that stream had been improved at a cost of $2 500,000, or about $56,000 per mile. The division of this cost was stated by him as follows:

	Per cent.
Actual construction	67
Care of, repairs, and moving plant	22
Administration	9
Other items	2
	100

It is thus seen that, in this particular case, the cost of maintenance was more than double that assumed for the Colorado. Another thing to be considered in the matter of bank protection is the source of the material to be used. The supply of rock in the quarries at Laguna Dam and at Pilot Knob is abundant, but the same cannot be said regarding the brush, which for the best results, should be young, live willow.

The writer is not aware how the growth of willow along the Colorado compares with that along the Mississippi between Cairo and Vicksburg, but will assume for the present that the quantities are about equal. The assumption will also be made that the quantity required for the Colorado will not be more than one-third as much as that on the Mississippi; therefore, if 600 miles of river provide for 15 miles of revetment on the Mississippi, it would provide for 45 miles on the Colorado. If 600 miles of river will furnish material for 45 miles of revetment, then 45 miles of river between Laguna Dam and the International Boundary would provide for about 3½ miles of such work annually. In the 30 miles of stream to which it is suggested the revetment be applied there would be 60 miles of revetted bank, and at 3½ miles per year it would require 17 years to build this revetment with the ordinary growth. This makes no allowance for the annual repairs, which are estimated at 10 per cent. It would also be impracticable, even with the material available, to construct this revetment immediately, not only on account of the constructive difficulties of doing so much work in a short space of time, for the control of the stream by revetting its banks and contracting its channel must necessarily be slow because the changes which these works bring about cannot occur immediately.

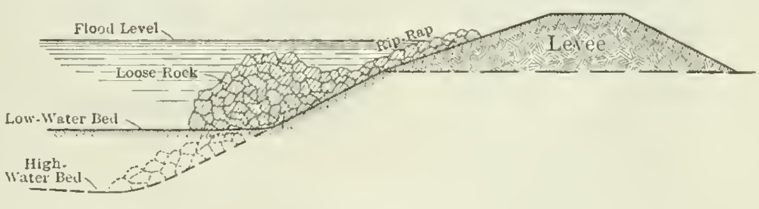


Fig. 2—Proposed Method of Rock Revetting Levee and Bank of Colorado River.

Seventeen years is entirely too long a period over which to stretch this work, as the protection of the Government's investment and the welfare of the settlers demand that the control of the river be almost immediate.

The radical difference between the high-water and the low-water channels of the Colorado furnish another obstacle to the foregoing form of bank protection. An examination of Fig. 1 shows that while protection of the upper bank by the rip-rap could be readily accomplished, it would be impossible to place the fascine mattress in the proper positon. At low water, when conditions are favorable for mattress work, the channel is so silted up that a mattress sunk in position would not even approximate the place it should occupy to protect the flood channel from erosion. At high water, when the channel is scoured out and the bank to be protected is exposed, the depth of water and the velocity of the current are too great to accomplish work of this class successfully.

From the foregoing it appears that mattress revetment below low water, combined with rock revetment above, should not be applied along the lower Colorado, tor the following reasons:

(1) The high first cost and excessive cost of maintenance (10 per cent).

(2) The time required (17 years) for the natural growth to produce the willows necessary for this form of protection.

(3) The impossibility of placing the mattress in its proper position, due to the silted condition of the stream at those seasons when depth and velocity are favorable for such work; and

(4) That in great floods a concentrated attack might destroy a portion of the mattress at a time when its repair or the protection of the bank thus exposed would be impossible.

Another method of protecting the bank would be to make the revetment entirely of rock. At low water the exposed slope would be graded, properly rip-rapped, and at the foot of this slope a large quantity of loose rock would be placed (Fig. 2). As the high-water channel was created by the scour of the current, this loose rock would be undermined and gradually slide into position, making a revetment along the bank thus exposed which would be practically a permanent protection. In approximating the cost of such work, let it be assumed that the average depth along the levee during high water will be about 20 ft. It is known that at exposed points where severe cutting has been in progress it has been as much as 32 ft., but, for a general average depth to which revetment should extend, 20 ft. appears to be safe. Suppose that the rock will stand at a slope of 2 to 1; then the length of the revetted slope in contact with the water will be 45 ft., and, if the revetment is 2 ft. thick, the area of the section will be 90 ft. Assuming that, owing to wasteful methods by which this is applied, one-half is lost, then the sectional area of rock per linear foot which has to be placed along the levee is 135 sq. ft., or 5 cu. yds. or 25,000 cu. yds. per mile of bank, equal to 50,000 cu. yds. per mile of river, For 30 miles this would mean the placing of about 1,500,000 cu. yds. of material.

Should such a course be adopted, quarries would be opened on each side of the river at Laguna Dam, which, by connecting railroads, would supply the levees within economic reach. Another quarry at Indian Hill, opposite Yuma, would serve for the portions above and below for proper distances, while quarries at Pilot Knob would control the remainder on the California side. From this latter point, a temporary trestle, which appears to be the best arrangement, would connect with the

Yuma alley levee, on the Arizona side of the Colorado. Later, if it was decided to extend similar treatment to the Gila levees, the Arizona quarry at Laguna Dam would control the levee on the north side of the stream, while the south levee could be reached from Penitentiary Hill. Considering now only the embankments along the Colorado, it appears that the suggested treatment will require a railroad over their entire length, which is about 60 miles. These levees are already in existence, and the cost of equipping them with track (52-lb. rails) is estimated as follows:

Steel, 52-lb. = 90 tons, at $30	$2,700
Fastenings	600
Ties, 8,600, at $1.25	3,250
Track laying	400
Train service	125
(Say, $7,000 per mile)	$7,075

There is a railroad on the Reservation levee between Yuma and Laguna Dam, and deducting this length of 13 miles from the 60 miles required leaves 47 miles to be built. At $7,000 per mile this cost would be $329,000, to which may be added about $10,000 for the Pilot Knob trestle, giving a total for railroad construction of, say, $340,000. The average length of haul from these quarries will approximate 15 miles, and it should be done for not more than 1½ cts. per ton-mile. The 1,500,000 cu. yds. will equal about 3,000,000 tons, and with average haul of 15 miles, gives 45,000,000 ton-miles, which at 1½ cts. equals $675,000. Using large steam shovels, quarries with long and high faces, mined with small tunnels in which heavy charges are used, it would appear that the material could be placed on the cars at an outside price of 30 cts. per cubic yard; to this should be added, say, 25 cts. per cubic yard for spreading and placing the rock on the slope, giving 55 cts. per cubic yard as the cost above that of hauling. At 55 cts., 1,500,000 cu. yds. would cost $825,000, which, added to the expense of hauling, makes a total charge of $1,500,000, which is increased to $1,840,000 when the cost of building the railroad is included. Adding 10 per cent for contingencies and repairs gives a round sum of $2,000,000 for protecting 30 miles of river, or about $66,000 per mile, equivalent to $33,000 per mile of bank.

Although these estimates must be considered as approximationss, it appears that permanent rock excavations can be had for not more than one in which mattresses are used, and probably for less. The permanence of the rock, its slight maintenance cost, the ample quantity available, and the fact that it can be placed as well during attack of high water as at low, makes it the best and most economic protection for the banks of the river between Laguna Dam and the Mexican boundary. Once the tracks were on the levee, exposed points could be quickly protected, and the remainder of the work could proceed as desired.

Bank protection by deflecting the currents away from the shore so that erosion cannot occur may be done by spur-dikes or by opening channels across sand-bars which are the cause of the impingement. The deflection of currents by brush dikes has been tried in many localities and with varying degrees of success. They are subject to destruction by the natural course of deterioration, by deep scour which occurs around their outer ends, and by the under-cutting of eddies below them which they have created. They have been tried sufficiently along the Lower Colorado under the writer's direction to demonstrate that at best they are only a temporary expedient. If built of cottonwood piling, which grows along the banks of the stream, their life would not exceed 2½ or 3 years as the maximum; probably the average is not more than 2 years. Constructed of fir piling, they could be depended on for 6 or 7 years. If, at the end of that time, the new banks which had been created by silting between them were not protected by revetment, it is probable that the dikes would need renewal, in order to hold the work. One other disadvantage of spur-dikes is that the proper location for them is demonstrated only by the varying attack of the river, and, when this attack comes on, the water is generally so deep and the currents so swift that the dikes cannot be built. It is then necessary to defend them as best one can until lower water, and perhaps, on the falling stage, the river changes its point of attack, so that dikes are needed in other places. In the writer's judgment, protection by spurs should be used only in an emergency; they have no place in any permanent form of bank protection on this river.

There remains the method of diverting the current by opening up channels across sandbars. Wherever the banks have been attacked, the impingement has been caused directly by the formation of deposits on the opposite side of the stream. As these deposits build out toward the opposite bank, the flowing prism of the river is narrowed, the concentration of the water increases the velocity, the channel is correspondingly deepened, and, as a result, there is deep water and high velocity against a caving bank. Under such conditions, if it were possible to open up a channel of sufficient dimensions across this bar, and if the current could be induced to follow this new channel, the attack on the bank would be immediately relieved. In some instances, where the encroaching bar is short and other conditions are favorable, channels have been opened up and relief secured by a liberal use of dynamite. Such a method is impracticable in most cases along the river. It is seldom that a condition occurs that can be relieved by explosives.

A suction dredge of large capacity and light draft which could be maneuvered in the Colorado during flood stages would be of value in opening channels across sandbars. During low water the dredge could be used in creating a channel about midway between the levees at those points where attack from caving banks was imminent. The excavated material could be deposited in the vicinity of the levee through pipes carried on pontoons, thereby building the banks and making their alignment more regular.

It might appear at first thought that the quantity of material to be moved would require a dredge of unheard of proportions, and that the expense would be prohibitive, but such work appears to be well within the range of the hydraulic dredges as developed for work on the Mississippi River, the largest of which have a capacity of 2,000 cu. yds. per hour. About one-third of their time is lost in tie-ups for repairs during high water, maneuvering for position on bars, and in change of position, so that throughout the year the dredge would operate not more than 240 days, or 5,760 hours. Such operation of the dredge would result in removing about 11,000,000 cu. yds. of material.

Assuming a low-water discharge of 4,500 sec.-ft., passing Yuma with a velocity of 3 ft. per second, the area of the flowing prism would be 1,500 sq. ft. If this was excavated, with a depth of 5 ft. and a width of 300 ft., the 45 miles of such channel between Laguna Dam and the Sonora line would contain about 12,400,000 cu. yds. It is clear that no such quantity of excavation will ever be required along the lower river in any one season, therefore the dredge under discussion has ample capacity. The subjects to be examined are: (1) Its cost; (2) whether it can be designed of dimensions which will allow it to navigate the shallow and tortuous channels of the Colorado; and (3) whether it can be operated during floods for opening channels across the bars.

Referring to Document 50, 61st Congress, page 55, where is shown a memorandum of a project for maintaining by hydraulic dredging alone a navigable channel, 14 ft. deep and 500 ft. wide, between St. Louis and the mouth of the Ohio River: The estimates provide for 20 dredges, each with a capacity of 2,000 cu. yds. per hour, to cost, with all attendant floating plant, tools, auxiliaries, etc., $6,000,000, or $300,000 per dredge. The annual maintenance is stated as $100,000 per dredge. In estimating the cost of a dredge, its life is here assumed as 20 years, and a sinking fund is provided for its removal at the end of that time. The estimated annual cost is:

Interest at 3 per cent on $300,000	$ 9,000
Annual maintenance	100,000
Sinking fund	11,166
	$120,166

The maintenance of the channel by dredging would require continuous work, year after year, no permanent results being obtained. In about 16 years the sum of the annual maintenance would equal the estimated cost of the rock revetment, and the maintenance, capitalized at 3 per cent, gives an amount double that for which it appears a safe and permanent bank protection may be obtained. Whether or not a dredge can be built to satisfy the local conditions cannot be stated from the data at hand, but as such operations will cost double those necessary for permanent bank protection, further examination in this direction appears to be needless.

The purpose of this discussion is to indicate in a general way the present conditions along the Lower Colorado, and to point out, from an analysis of the data here assembled, the future course which will probably be productive of the best results. It appears:

(1) That in their present state, the levees are at the mercy of the meanders of the stream, except throughout those portions where a railroad occupies the levee top;

(2) That checking the meanders of the stream by permeable dikes during low water and brush defenses during high water are simply emergency works which accomplish no permanent good;

(3) That owing to the large amount of scour during freshets and the fill-back on the falling stage, bank protection by means of willow mattresses as constructed in other places is impractical, if not impossible;

(4) That bank revetment, permanent in character and reasonable in cost, when compared with other methods, can be readily and quickly accomplished with rock placed from railroad trains operated on the levee tops and connecting with existing quarries which are within a reasonable distance.

(5) That further investigation is needed before it can be predicted, with any degree of accuracy, what effect the possible storage of flood water on the upper reaches will have on the flood discharge and the meandering tendency of the lower river;

(6) That it is doubtful if the amount of control obtained in this manner will eliminate the necessity of bank protection, and, even if such control could be obtained, a number of years must elapse before it can be made effective;

(7) In the meantime, existing works will continue to be menaced, therefore protective measures of greater or lesser magnitude must continue. In view of this fact, and the probability that some caving banks will always exist, the money spent for their protection should be for permanent revetment.

Nothing in the foregoing should be construed as opposing in any degree the creation of storage works at the head-waters of the Colorado. All feasible sites should be carefully examined, their probable influence estimated, and a well-determined construction plan matured. Such preliminary action is necessary before the advantages to come from the complete development of this river can be realized.

The destiny of this stream should be controlled by engineers rather than by statesmen, as the author suggests.

Miners Less Efficient.—According to a recent report of the Department of Mines of Philadelphia, there has been a decrease in efficiency of the anthracite miners of that state. The estimate was made by dividing the annual output of the mines by the product of the number of miners employed and the number of breaker days. The result shows that the average production per miner per day has gradually fallen from 8.74 tons in 1902 and 8.64 tons in 1903 to 8.07 tons in 1910 and 7.65 in 1911. As between 30,000 and 45,000 miners are employed, the difference amounts to more than 40,000 tons a day.

TABLE I.—COST OF OPERATING 38 HYDRAULIC PIPE LINE DREDGES DURING 1911-1912.

Name of dredge.	Year built.	Cost plus outfit.	Diameter of discharge pipe, ins.	Men in dredge crew.	Location of work.	Yardage during year.	Depth dredged, ft.	Actual working time, hours.	Lost time, hours.	Character of material.	Fuel consumed.	Cost of fuel.	Gross cost of work per cu. yd., cts.
Congaree	1907-08	$ 31,685	12	15	Congaree River, S. C	101,264	1.9-5.6	1,015.5	7,768.5	Sand and gravel	294½ cords wood 202.46 tons	$1,361.73	14.27
Indiana	1908	115,330	17	28	Lower Ohio River	166,452	3.5-8	832.5	7,951.5	Sand, gravel, boulders, rock	621.00 tons	$1.50 to $2.00 ton	14.10
Orange	1912	92,383	15	22	Sabine-Naches Canal, Texas	17,000	5.6-9	326.0	8,458.0	Stiff yellow clay	729.19 bbls.	0.94¼ bbl.	0.96
Port Arthur	1901	12,000	12	15	Port Arthur Canal	113,115	24-27	2,214.5	6,569.5	Silt and soft clay	2,887.64 bbls.	0.822 bbl.	10.90
Tortoise	1905-10	27,170	17	18	Superior Entry, Wis.	309,939	11-25	3,464.0	5,320.0	Sand, clay, peat, gravel	2,472.00 tons	3.20 per ton	10.55
Col. A. M. Miller	1906	112,952	20	47-54	Galveston, Texas	2,799,399	24-35	588.5	8,195.5	Mud, sand, hard red clay	30.75 tons	4.55 per ton	13.92
C'pt.C.W.Howell	1904	40,000	12	35	Galveston, Texas	208,097	2.6-5	1,016.5	784.2	Mud, sand, shell	1,816.49 bbls.	1.049 per ton	17.81
Jacksonville	1903-4	125,000	32	30	Cape Fear River, N. C.	31,344	25-29	258.7	1,037.1	Sand	621.00 tons	1.50-2.00 ton	2.31
San Pedro	1905	118,722	20	34	Los Angeles Harbor	692,087	23-31	5,678.0	3,106.0	Sandstone, yellow and blue clay, shell, quicksand, cobbles, silt	19,433.00 bbls.	0.68 per bbl.	11.20
Pascagoula	1909	196,832	20	40-66	Gulfport Harbor	3,501,076	17-29	4,426.7	4,357.2	Mud, sand and clay	4,352.77 tons	3.80 per ton	2.77
Wahalak	1910	161,040	20	41-45	Mobile Bay, Ala.	2,921,407	5.7-30	5,860.0	2,924.0	Mud and sand	5,644.52 tons	3.15 per ton	3.24
Humphreys	1907-08	46,561	12	33	Black Warrior River, Ala.	151,512	5-7.4	2,044.0	6,740.0	Sand and gravel	1,242.92 tons	1.20 per ton	0.90
Pettus	1908-09	65,352	15	26	Alabama River	125,665	3.5-6	1,239.5	7,544.5	Sand, gravel and marl	1,380.2 tons	3.62 per ton	19.26
Blackwater	1911	69,171	15	28-38	Florida	880,322	7-11	4,018.0	4,766.0	Sand, earth, stiff clay,	2,327.76 tons	$6,180	0.55
Florida	1904-5	90,000	12	20	St. John's River, Fla.	262,024	3-9	2,048.0	6,736.0	Sand, mud, clay, hardpan	875 tons 2,656 gals.	$6.16 per ton	10.56
Muscogee	1904	12,900	12	10	Alabama, Ga. and Fla.	174,366	3½-6	1,413.0	7,371.0	Mud, shell, sand, gravel	317 short tons	$1,096.20	20.70
Delatour	1908-9	39,812	7	15	New Orleans, La.	41,621	1½-8	2,052.1	6,731.7	Blue clay and stumps			
The Ram	1893	104,150	16	16-28	Red River	47,281	8-15.5	360.0	8,424.0	Sand and gravel	3,758.00 bbls.	0.42 per bbl.	18.07
Cataract	1905	94,811	30	35	Delaware River	1,731,023	Rehandling	4,925.7	3,858.0	Sand, stone, clay, gravel, mud	3,648.00 tons	2.90 per ton	3.18
Uncle Sam	1899	22,064	12	14	Delaware River	143,661	6-12	2,593.1	6,190.5	Mud, sand, gravel, cobble	1,010.00 tons	2.90 per ton	16.04
Oregon	1908	98,503	18	26	Coos Bay, Ore.	720,415	12.8-18.9	2,990.0	5,794.0	Sand, mud, shells	2,994.55 cords	$6,111.80	6.58
Geyser	1893	4,704	12	18	Wisconsin River	102,615	2-4.8	1,612.0	7,172.0	Sand, mud, gravel	746.00 tons	3.30 per ton	0.97
Hecla	1900-01	27,084	18	18	Mississippi River	191,714	2.4-5.7	1,933.0	6,851.0	Sand, mud, gravel	1,208.00 tons	2.09 per ton	0.65
Pelee	1908	36,172	17	18	St. Paul to Winona	242,112	4.6-8	2,093.0	6,691.0	Sand, gravel and loose rock	1,245.00 tons	2.83 per ton	7.30
Vesuvius	1909	33,032	15	22	Mississippi River	253,746	33-73	2,158.0	6,626.0	Sand and gravel	1,035.00 tons	2.53 per ton	0.49
Etna	1908-9	29,733	18	18	Rock Island, Ill.	388,695	3.9-6.3	1,878.0	6,906.0	Sand, gravel, mud	1,450.00 tons	2.40 per ton	5.70
Morgan	1907-8	151,176	20	44	Savannah, Ga.	1,204,041	19.4-27.15	4,219.5	4,564.5	Sand, clay, mud, shells, roots, logs	2,195.83 tons	4.135 per ton	7.31
Augusta	1911	20,448	10	9	Savannah, Ga.	93,825	0.2-7	1,279.9	7,504.1	Stiff clay, coarse sand gravel	358.00 tons	5.04 per ton	16.55
Macon	1911	20,448	10	8	Savannah River, Ga.	68,320	3-6	5,891.7	2,892.2	Coarse sand	29,502.00 bbls.	0.95 per bbl.	3.63
Selma	1897-98	219,551	28	55	Mississippi at St. Louis	374,500	7½-11	633.0	8,151.0	Sand and gravel	830.5 tons	2.49 per ton	0.60
Thebes	1897-98	114,575	28	55	Mississippi at St. Louis	657,300	6½-11	942.0	7,842.0	Sand and gravel	1,689.4 tons	2.49 per ton	0.40
Fort Gage	1907-08	117,979	32	55	Mississippi at St. Louis	455,800	6¾-12	717.0	8,067.0	Sand and gravel	2,548.7 tons	2.46 per ton	7.00
Fort Chartres	1907-08	176,796	32	55	Mississippi at St. Louis	608,900	7-11½	595.0	8,189.0	Sand, gravel	2,755.00 tons	2.42 per ton	5.00
Gamma	1897	88,531	24	35	Mississippi below Cairo	394,551	9.5-13	762.5	8,021.4	Sand, gravel, mud	1,719.00 tons	3.00 per ton	8.32
Kappa	1901	135,400	31⅞	45	Mississippi below Cairo	128,872	......	238.8	8,545.0	Sand, gravel, stiff mud	904.00 tons	3.00 per ton	15.27
Henry Flad	1901	135,400	32	45	Mississippi below Cairo	206,563	9-11	315.5	8,468.5	Sand and blue mud	1,216.00 tons	3.00 per ton	13.06
B. M. Harrod	1907	241,998	36	50	Lower Mississippi	430,347	......	322.2	8,461.7	Sand and gravel	1,923.00 tons	3.00 per ton	0.91
Warroad	1904	33,862	12	9	Lake of the Woods	75,541	3-9	872.0	7,912.0	Sand, gravel, clay, boulders	301 cords wood 421 gals. gasoline	$978.25	5.76
Total		$3,163,327				21,016,512							6.24 ave.

Cost of Dredging 21,016,512 Cu. Yds. of Material With 38 Hydraulic Pipe Line Dredges During 1912.

(Staff Article.)

The operation of 38 hydraulic pipe line dredges for river and harbor improvement work by the U. S. Engineer Department during the last fiscal year cost $1,212,301, including all expenses. The amount of dredging done was 21,016,512 cu. yds.; the average cost was thus $0.0576 per cubic yard. The work of this large dredging fleet is but a portion of the dredging operations carried on by the Government. Dredging is also done by contract, by a large fleet of sea-going hopper dredges, and by numerous dipper dredges. In our issues of Sept. 29, Oct. 9 and 16, 1911, the work of these fleets during the year 1910-11 was tabulated and described. In this article we give the costs and description of the work of the pipe line dredges which were operated during the year from July 1, 1911, to July 1, 1912, as tabulated from the reports of the Chief of Engineers U. S. Army.

The work of the fleet is divided into districts each of which employs plant suitable for the projects in hand. The most extensive work for the hydraulic pipe line dredges is, of course, on the Mississippi River.

The river is maintained by four fleets of dredges employed under direction of the Mississippi River Commission, the Rock Island District, the St. Louis District and the New Orleans District.

The Mississippi River Commission adopted a project in 1906 for obtaining and maintaining by means of dredges, a channel in the Mississippi River below Cairo, with a width of 250 ft. and a depth of at least 9 ft. throughout the year, except when the river is closed by ice. The commission in 1891 took under consideration the question of construction of dredging devices to be operated with a view to obtaining temporary relief for low-water navigation and experimented along these lines between 1891 and 1896. Up to the present time ten hydraulic dredging plants have been constructed, nine of which are still serviceable. But four of these were operated during the last fiscal year. The "Gamma," "Kappa," "Henry Flad," and "B. M. Harrod," were operated at various crossings from Medleys, 30 miles below Cairo, to Daisy Crossing, 252 miles below Cairo.

Four bar-survey parties were in the field during most of the season and surveys were made of crossings wherever it was considered necessary. Inspection trips were also made over the river to keep in touch with the prevailing conditions and decide where dredging was necessary. The following is a brief statement of the operations of each dredge while in the field during the low water season of 1911.

The dredge "Gamma," with pile sinker and pontoons, in tow of the steamer "Choctaw," left the dredge fleet May 24 for Point Pleasant, and on arrival at that place on May 28 was tied up to the bank to await a lower stage.

The "Gamma" was moved out on the middle crossing at Point Pleasant on June 1 and dredging was commenced at 12:10 p. m. on the same day. The work projected was completed at midnight on the 9th and the dredge was moved out of the channel. Delays in dredging were due to cleaning the suction head, alterations to jet nozzles and priming the pump.

The "Gamma" lay at the bank at Darnells Landing awaiting a lower stage, until June 23, when she was moved up to Toneys Crossing. On account of a slight rise in the stage, however, dredging was not needed until July 10, when the work in Toneys Crossing was commenced. On July 11, while raising the suction head to clear it of an overload of sand, a piece was broken out of the starboard radial elbow casting, and the port elbow casting was cracked. Temporary repairs were made by wrapping and bracing, and dredging was resumed. This work was completed on July 19.

On July 20, the plant departed for Medleys Crossing, where it arrived on the 21st. After waiting for the concrete jacket, which had been placed around the broken suction pipe elbow, to harden and location buoys to be placed, dredging was commenced on July 24 and continued until Aug. 5, when a satisfactory channel had been obtained.

There were some delays in the work on account of cleaning suction head, repairs to suction pipe, broken cable on the baffle plate, cleaning boilers, repairs to Snowden heaters and valve rods, priming pump, and deflecting pontoons.

The plant was then moved down to Hickman and tied up to await a lower stage. On Aug. 11, it was moved to Darnells Towhead.

On Aug. 17 it was moved to Linda Crossing where dredging operations were commenced the same day. This work was completed on the 23d and the dredge was moved down to the coal fleet, above Caruthersville, and on the 24th proceeded to the dredge fleet. On arrival the 25th, the dredge was temporarily withdrawn from service, pending repairs to the worms of the hauling engines and the installation of the drag suction head.

This dredge was returned to commission on Sept. 13 for the purpose of testing various designs of suction heads. It left the dredge depot on Sept. 13 for Daisy Crossing and arrived there the same day. Experiments with the drag suction head were completed and one of the upstream heads was installed and some experiments were made with it in sand and mud. On account of the high stage of the river, this dredge was moved up to the dredge depot on Oct. 10 and withdrawn from commission.

The dredge "Kappa" was placed in commission and left the dredge depot on Aug. 15 for Josie Harry Towhead. Dredging was commenced in the crossing at the foot of the Towhead on that day and continued until the following day when the port radial elbow was broken while raising the suction head to clear it of an overload of sand. Repairs to the elbow were completed, and dredging was resumed on the 18th. A satisfactory channel was completed on Aug. 21. Other delays in dredging were due to cleaning suction head, hot bearings, priming pump and the adjustment of the new casing liners. On Aug. 24 the Kappa went to the dredge depot for a barge of coal and returned to the vicinity of Josie Harry Crossing. On Aug. 30 the Kappa was moved to Daisy Crossing where work was commenced the same day. Dredging was continued until Sept. 5, when a satisfactory channel had been obtained.

No further dredging was required by the Kappa and it remained at the bank at Thelma Landing until Nov. 7, when it was moved to the dredge depot. The dredge was withdrawn from commission on Nov. 22.

The dredge "Henry Flad" left the dredge depot at West Memphis, Ark., on Aug. 7 for Daisy Crossing. Dredging was commenced on the same day and continued until the 22d, when a satisfactory channel had been obtained.

Work was stopped on Aug. 17, but after a careful examination of the channel, it was thought that some additional work at the upper end of the cut was desirable, so the dredge was placed back in the crossing and work resumed.

On completion of the work at Daisy Crossing, the "Flad" was moved up to the vicinity of Berkleys Crossing. On Aug. 29 work in this crossing was commenced. This work was completed on Sept. 3.

The material encountered was sand and mud. The dredge was moved to the dredge depot on Sept. 5, and while lying there economy tests of the generator set were made.

The "Flad" left the dredge depot on Sept. 11 for Drivers Landing and arrived at the latter place on the 14th. On the 23d it was moved up to Osceola Bar, where it remained until Oct. 10, awaiting a lower stage. On Oct. 10 the dredge was moved up to just below New Haven on account of caving bank at Osceola Bar. The "Flad" remained at the bank below New Haven, awaiting a lower stage until Dec. 15, when it was moved to the dredge depot to go into winter quarters, arriving there on the 16th.

The dredge "B. M. Harrod" left the dredge depot on June 3 for Island No. 35 Crossing, where it arrived on the 4th. The "Harrod" lay at the bank at this place, awaiting a lower stage, until the 9th, when it was moved to the foot of Bullerton Crossing, arriving on June 10. Dredging was commenced in foot of Bullerton Crossing on June 10, and continued until the 13th, when a channel of the project dimensions was obtained. On completion of the work the "Harrod" was moved up to Osceola Bar and tied up to await a lower stage.

TABLE II.—PERCENTAGE DISTRIBUTION OF COST OF DREDGING BY PIPE LINE DREDGE OF THE U. S. GOVERNMENT.

Dredge.	Total cost of work.	Pay roll.	Coal.	Water.	Subsistence.	Engine room supplies.	Miscellaneous supplies.	Renewals and additions.	Ordinary repairs.	Tow boats and launches.	Laundry, wharfage, etc.	Barges.
Congaree	$15,453	35.7	8.7	....	10.7	1.2	2.5	2.2	5.3	17.2	7.1	9.4
Indiana	23,545	44.8	7.0	....	6.4	1.4	....	11.2	1.3	27.8	0.2	....
Orange	2,799	47.8	24.5	....	11.0	1.1	....	....	....	9.4	0.3	5.9
Port Arthur	12,367	50.0	17.2	0.2	6.9	3.1	....	2.6	3.5	....	1.4	9.9
Tortoise	32,713	36.2	24.4	....	....	1.3	2.23	10.0	8.7	5.2	....	11.9
Col. A. M. Miller	9,512	33.1	6.5	....	12.4	5.3	4.7	25.5	1.1	5.3	....	6.1
Capt. C. W. Howell	12,533	38.2	17.1	0.4	9.2	2.0	1.2	8.5	0.3	10.5	1.6	6.1
San Pedro	77,548	44.0	17.0	....	0.3	....	1.7	....	15.8	1.6	0.1	19.5
Pascagoula	96,962	28.2	11.3	0.4	7.6	4.6	1.2	4.4	11.5	13.0	1.4	16.2
Wahalak	94,765	27.3	16.7	....	7.7	3.2	1.7	3.9	10.2	12.4	0.2	15.7
Humphreys	13,671	55.8	10.9	....	10.5	1.6	1.9	11.4	7.0	....	0.9	....
Pettus	24,202	32.7	12.7	....	9.5	0.9	2.2	4.7	1.5	10.6	0.6	24.6
Blackwater	48,790	37.4	17.3	....	11.0	4.5	2.5	0.9	1.9	7.4	2.8	14.3
Florida	27,672	38.6	21.0	....	13.4	2.9	1.5	0.7	7.9	2.3	2.4	8.3
Muscogee	23,010	46.7	7.7	....	7.8	1.1	3.6	6.3	0.3	13.0	1.1	12.4
Delatour	26,732	40.4	9.3	....	11.0	0.1	11.2	9.7	5.0	....	6.2	7.1
The Ram	8,544	28.7	18.5	....	5.0	0.8	2.8	2.5	....	....	1.2	40.5
Cataract	55,090	36.7	17.6	....	9.9	2.8	3.3	9.0	2.4	9.7	0.1	9.5
Uncle Sam	23,040	33.3	10.7	....	9.3	2.2	3.9	3.8	0.8	11.8	0.4	15.6
Oregon	47,449	44.3	13.3	0.1	9.5	1.3	0.2	10.7	2.5	8.5	0.4	9.2
Geyser	10,478	47.5	24.6	....	11.3	1.6	2.2	5.0	5.3	0.8	0.3	1.4
Hecla	12,471	50.5	20.3	....	10.7	1.0	3.3	0.7	9.1	1.0	1.2	2.2
Pelee	17,684	49.4	20.7	....	8.1	4.1	0.3	4.9	7.5	2.5	0.1	2.4
Vesuvius	12,554	47.3	20.3	....	11.2	1.3	10.0	2.2	4.1	1.5	....	1.6
Etna	22,392	46.1	15.0	....	10.1	2.2	2.1	3.2	12.3	1.5	2.2	5.3
Morgan	88,114	22.8	8.8	....	6.9	2.0	2.4	0.2	6.5	8.2	0.7	41.5
Augusta	15,527	34.0	11.5	....	11.4	4.3	5.1	14.8	2.4	3.5	....	13.0
Macon	119,037	23.6	21.8	0.3	7.6	1.9	1.3	7.3	11.4	6.6	3.6	14.6
Selma	21,231	58.7	9.5	....	16.6	4.8	....	....	9.5	....	0.9	....
Thebes	26,569	41.2	17.1	....	15.3	4.2	....	....	22.6	....	0.6	....
Fort Gage	30,152	35.8	21.0	....	11.7	4.7	....	....	27.2	....	0.6	....
Fort Chartres	34,256	45.2	19.5	....	11.6	2.3	....	....	20.8	....	0.6	....
Gamma	32,818	24.9	11.3	....	7.4	0.8	0.5	....	7.2	16.8	0.1	31.0
Kappa	19,684	30.4	13.8	....	9.0	1.0	0.9	....	6.8	....	0.1	38.0
Henry Flad	26,976	33.5	13.0	....	10.1	0.5	0.6	....	2.5	....	0.1	39.7
B. M. Harrod	39,238	38.6	14.5	0.2	9.7	0.6	0.9	....	2.1	....	0.5	33.4
Warroad	6,723	50.5	14.5	....	9.6	1.1	....	6.8	3.9	4.2	0.2	9.2
Total	$1,212,301											

On June 24 the dredge was moved to Round Lake Crossing, where dredging was commenced on the same day. This work was continued until June 25, when the jet engine was disabled by the breaking of a large number of buckets. The work of straightening the channel, for which the dredge was placed in the crossing, was, however, accomplished before the accident to the jet engine.

On June 17 the "Harrod" was moved down to Pecan Point to pull off the steamer Leota, which had grounded in that crossing. On completion of the work at Round Lake Crossing the "Harrod" was moved down to Luxora, tied up there to await a lower stage and remained until July 20, when it was again moved out on to Round Lake Crossing. Dredging was commenced in Cut No. 3 the same day and continued until the 22d, when the dredge was moved down to Luxora again and moored to the bank, there to await a lower stage.

The material encountered in this crossing was sand and gravel. Delays in dredging were due to cleaning the suction head, grounding of pontoons, and repairs to discharge pipe. On completion of the work there was a channel depth of 13 ft. through the crossing.

On July 28 the "Harrod" departed for Point Pleasant, arriving at Linda on the 30th. Dredging was commenced in Linda Crossing on the 30th and continued until Aug. 1, when the dredge was moved to Middle Point Pleasant. Work on this crossing was commenced on the same day. The channel through the crossing was completed Aug. 6 and the dredge was then moved to the park and tied up at Tiptonville to await a lower stage.

Since the work of the "Gamma" and "Harrod" at Medleys, Toneys, Point Pleasant and Linda had put the upper stretch of river in good condition, the "Harrod" was moved back down to the vicinity of Bullerton and Round Lake, leaving Tiptonville on Aug. 11 and arriving at Osceola Bar on Aug. 12.

On Aug. 15 the plant was moved down to Walts Crossing where dredging was commenced the following day. Operations in this crossing were completed on the 30th, and the plant was moved up to Golden Lake and tied up to await a lower stage. Exceptionally good progress was made by the "Harrod" in this crossing, the average advance for the 19th being 357 ft. per hour. On Aug. 31 the "Harrod" was moved from Golden Lake to Osceola Bar, where it was tied up to await a lower stage. On Sept. 10 the dredge was started for Caruthersville in order to be in the vicinity of the Point Pleasant and Linda country should dredging be required in these crossings. While enroute to Caruthersville, and in the vicinity of Cottonwood Point, the fly-wheel of the ammonia compressor broke and damaged the steam line to such an extent that it was necessary to stop at Cottonwood Point to make repairs. Towing was resumed Sept. 11 and the plant reached Caruthersville the same day. It remained there the remainder of the dredging season. The fly-wheel from the ammonia compressor on the steamer Wynoka was installed on the "Harrod" and the ice machine was started again on Sept. 17. The "Harrod" arrived at the dredge depot to go into winter quarters on Dec. 17. The amount of material moved by the dredges of the Mississippi River Commission during the season of 1911, was 1,160,333 cu. yds.

All employes were furnished subsistence in kind. During the year 82,767 rations were served at a cost of $0.5705 each, including the wages of cooks, waiters, and all necessary labor in caring for quarters.

The coal delivered at the coal harbor was cared for there and delivered to the dredges in that stretch of the river as required. At the close of the dredging operations, all barges remaining at the coal harbor were moved to the dredge fleet at West Memphis, Ark.

The dredges operated in the Rock Island district were the "Geyser," "Hecla," "Pelee," "Vesuvius" and "Etna." Their work was more or less continuous during the season of navigation. In some cases the dredged material was deposited for a foundation on the line of proposed wing dams of rock and brush, but as a rule the dredging was done to increase the depths on sand bar crossings and to maintain a navigable channel for floating craft. The grade of the excavation was, as a rule, 6 ft. below low water, but in the cases of dredging in connection with the construction of dams, the depths were greater in order to obtain the desired material. In all, these five dredges removed 1,286,511 cu. yds. at an operating or field cost of 67 cts. per cubic yard.

The dredges employed in the St. Louis District were the "Thebes," "Ft. Gage," "Fort Chartres" and "Beta." All four dredges were operated whenever and wherever required for a total of 2,887 dredge hours or slightly more than 1/6 of their total time in commission during the season. The St. Louis District includes the Mississippi River between the mouths of the Missouri and Ohio Rivers.

The dredges operated in the New Orleans District were the "Delatour" and "Ram." The "Delatour" was operated in Bayou Plaquemine Brule, Bayou Little Godell and in the Grand River, La., dredging blue clay and operating also as a snag boat. The "Ram" operated at the mouth of the Red River. The cutter head of this dredge is attached rigidly to the dredge and when operating, the dredge swings from a spud set near the stern. The swing is sufficient to enable the dredge to make a cut from 100 to 125 ft. wide and 7 to 10 ft. deep, discharging material on the bank of the cut through a discharge pipe 75 ft. long, suspended from the dredge. The dredge operates with and not against the current.

The dredge "Indiana" is a dredge belonging to the Cincinnati District and was in commission 217 days during the fiscal year for clearing the Ohio River Channel at five different points from 693 to 845 miles below Pittsburgh as follows:

	Cu. yds.
Tradewater Bar, sand	39,153
Walker's Bar, gravel	32,325
Sister Islands, sand	83,984
Shawneetown Bar, sand	7,970
Flint Island Bar, gravel	3,020
Total	166,452

The dredge "Indiana" is a combination hydraulic pipe line dredge with a steel hull. Her discharge pipe is 17 ins. outside diameter. She departed on July 1 from Dam No. 37, Ohio River, and on arrival at Caseyville, Ky., it was found necessary to dredge through a reef at Tradewater Bar. A single cut 1,991 ft. long, 100 ft. wide and 4 to 5 ft. below low water was made and the excavated material discharged through 480 ft. of pipe line. This was completed July 22.

At Walkers Bar repairs were made to the main engine and pump. While these were in progress soundings were made on the bar and less than 4 ft. depth was found at the crossing. Here one cut 1,385 ft. long and 90 ft. wide was made, discharging through 300 ft. of pipe and another, 990 ft. x 90 ft. discharging through the same length of pipe. The first cut was 4 ft. and the latter 5 ft. below low water. This work was completed Aug. 1 and the dredge moved down to Hurricane Island where a cut 900 by 90 by 5 ft. deep was made, using 300 ft. of pipe line. This work was completed on Aug. 5 and the dredge and fleet was made ready for travel to Sister Islands, 897 miles below Pittsburgh. The dredge and fleet arrived at Sister Islands Aug. 7 and landed at Ropers Landing on the Illinois shore.

The various channels were sounded and conditions found to be worse than the preceding season, a reef having formed from shore to shore below the Towhead, Bay City being the head of navigation.

In order to open navigation as soon as possible a cut 820 ft. long, 90 ft. wide and 5 ft. below low water was made through the narrowest part of the reef. The excavated material, 17,126 cu. yds. of sand, was discharged through 300 ft. of pipe line to the right of the cut.

As this cut was not with the axis of the river and more than likely to fill with the first rise, the dredge was moved back to the foot of the outside Sister Island on the 11th, and a cut 90 ft. wide, 4,349 ft. long, and 5 ft. below low water was made.

The excavated material, 66,858 cu. yds. of sand and gravel, was discharged through 360 ft. of pipe line to the left of the cut.

High water and passing coal tows stopped further operations on Sept. 8, and the dredge, with fleet, were moved to Shawneetown, Ill., where the packet boats had experienced considerable trouble during the low-water season.

The proposed improvement at Shawneetown Bar was a low-water channel

The dredge was placed on Sept. 13, and a cut 90 ft. wide, 5 ft. below water, was extended 530 ft. downstream from the point of beginning, when a second rise in the river suspended further operations at this place. The excavated material, 7,970 cu. yds. of light sand, mixed with light drift, was discharged through 666 ft. of pipe line to the right of the cut.

The dredge and fleet arrived at Flint Island on the evening of Sept. 27, but the stage of the river not permitting operations, the plant was held at the bank and the crew employed on overhauling the machinery, painting, cleaning, and general work.

The proposed improvement at this place was a low-water channel through the gravel bar. The dredge was located on the morning of October 2, when the river had receded to a working stage, and a cut 95 ft. wide and 4 ft. below low water, was extended 501 ft. downstream. The excavated material, 3,020 cu. yds. of coarse gravel and bowlders, was discharged through 420 ft. of pipe line to the left of the cut, against the island shore.

Owing to continued high water, dredging operations were suspended on Oct. 5 and the night crew discharged on the 7th.

TABLE III.—PERCENTAGE DISTRIBUTION OF TIME WORKED AND TIME LOST IN YEAR'S WORK OF 38 GOVERNMENT HYDRAULIC PIPE LINE DREDGES.

Dredge.		Time at Work.							Time Lost.					
	Hours at work.	Pumping.	Handling pipe line.	Handling swinging wires.	To and from wharf and anchorage.	Placing dredge.	Waiting for vessels to pass.	Total time lost.	Changing location of plant.	Bad weather.	Washing boilers and ordinary repairs.	Extraordinary repairs.	Miscellaneous.	Sundays and holidays.
Congaree	1,015.5	10.99	0.56	.....	.....	0.01	.....	1,015.5	.81	1.42	.12	1.91	79.97	4.21
Indiana	832.5	7.33	0.98	1.03	.....	0.01	.03	832.5	1.12	5.97	1.23	.....	76.50	5.80
Orange	326.0	3.41	0.14	0.12	.....	.....	.04	326.0	.....	.....	.60	.....	94.87	.82
Port Arthur	2,214.5	22.40	1.10	0.30	.....	.....	1.40	2,214.5	.....	1.20	2.60	.....	54.60	16.40
Tortoise	3,464.0	33.58	3.24	0.64	0.65	1.32	.....	3,464.0	.....	.....	1.03	2.13	46.48	10.93
Col. A. M. Miller	588.5	6.02	.44	0.22	.....	.....	.03	588.5	1.54	19.06	.24	.38	55.68	16.39
Capt. C. W. Howell	1,016.5	49.52	.89	6.02	.....	.....	.....	1,016.5	10.73	.....	2.20	.....	14.68	15.96
Jacksonville	258.7	15.40	2.90	1.40	.....	0.30	.....	258.7	0.70	.....	2.20	.....	14.90	62.20
San Pedro	5,678.0	50.00	.....	.....	11.00	.....	4.00	5,678.0	.....	.....	17.00	.....	.....	18.00
Pascagoula	4,426.7	44.70	4.10	1.07	.....	.41	.12	4,426.7	3.62	4.39	16.76	.....	8.44	16.31
Wahalak	5,860.0	57.85	6.88	1.70	.....	.27	.01	5,860.0	.61	.93	10.21	2.11	3.04	16.39
Humphreys	2,044.0	20.23	.79	1.51	.....	.47	.26	2,044.0	3.24	7.47	1.31	1.59	45.80	18.30
Pettus	1,239.5	10.32	2.49	.83	.....	.23	.24	1,239.5	4.59	1.16	.62	.34	70.98	6.19
Blackwater	4,018.0	38.14	2.52	1.88	.....	3.19	.....	4,766.0	15.47	4.11	11.91	.....	2.29	20.49
Florida	2,048.0	22.96	.31	.04	.....	.....	.01	6,736.0	1.57	.....	.14	.....	17.40	57.14
Muscogee	1,413.0	15.20	.30	.....	.....	.60	.....	7,371.0	.50	1.70	1.50	.....	94.87	.82
*Delatour	2,052.1	6.47	.....	.....	.....	.....	.....	6,731.7	2.95	.36	.79	.....	.....	6.58
The Ram	360.0	3.60	.....	.50	.....	.20	.10	8,424.0	.....	.60	.....	2.60	92.20	0.20
*Cataract	4,925.7	53.90	1.04	.17	.63	.34	.....	3,858.0	1.42	7.81	1.07	7.90	4.26	21.46
Uncle Sam	2,593.1	26.63	1.80	.90	.15	.....	.....	6,190.5	1.35	12.33	1.46	12.87	28.71	13.75
Oregon	2,990.0	21.10	3.70	.70	.....	.....	1.20	5,794.0	.70	.....	.80	1.40	62.70	7.70
Geyser	1,612.0	13.71	1.60	.69	.....	1.39	.91	7,172.0	1.41	.10	1.60	.....	72.20	6.31
Hecla	1,933.0	18.13	1.75	.17	.....	1.92	.02	6,851.0	3.42	.29	1.87	.....	65.03	7.40
Pelee	2,093.0	15.31	2.07	1.55	.....	3.43	1.44	6,691.0	.84	.09	5.32	.....	61.71	8.24
Vesuvius	2,158.0	17.06	2.88	1.02	.....	2.04	1.54	6,626.0	4.82	.23	1.07	.....	62.19	7.15
Etna	1,878.0	14.95	2.08	.31	.....	3.15	.86	6,906.0	8.10	.09	2.06	.....	59.43	8.97
Morgan	4,219.5	40.74	4.47	1.17	.....	1.64	.....	4,564.5	2.87	1.43	4.94	18.98	7.37	16.39
Augusta	1,279.0	13.04	1.08	0.37	.....	.....	.11	7,504.1	1.20	7.23	.09	.03	60.46	16.39
Macon	5,891.7	64.76	1.63	.69	.....	.....	.....	2,892.2	.09	.02	6.19	6.23	3.05	16.39
Selma	633.0	7.00	.....	.....	.....	.....	.....	8,151.0	.....	.....	83.0	.....	.....	10.00
Thebes	942.0	11.00	.....	.....	.....	.....	.....	7,842.0	.....	.....	79.0	.....	.....	10.00
Fort Gage	717.0	8.00	.....	.....	.....	.....	.....	8,067.0	.....	.....	84.0	.....	.....	8.00
Fort Chartres	595.0	7.00	.....	.....	.....	.....	.....	8,189.0	.....	.....	84.0	.....	.....	9.00
Gamma	762.5	7.35	.....	.....	.....	1.33	2.22	8,021.4	1.09	88.01	.....	.....	.....	.....
Kappa	238.8	2.26	.....	.....	.....	.....	0.46	8,545.0	0.37	.....	0.65	96.26	.....	.....
Henry Flad	315.5	3.13	.....	.....	.....	0.46	.....	8,468.5	1.38	.....	0.28	.....	94.75	.....
B. M. Harrod	322.2	3.18	.....	.....	.....	.49	.....	8,461.7	3.22	.05	.34	.....	.....	92.72
Warroad	872.0	8.94	0.68	0.26	.....	0.05	.....	7,912.0	0.06	0.11	2.19	0.31	83.71	3.70

*Dredge operated part time as snag boat.

The dredge was ordered to proceed to Carrollton, Ky., on the 16th, arriving on the 23d, when orders were received to go into winter quarters in the Kentucky River at Carrollton, Ky.

The dredge and fleet were placed in the landing and all property carefully laid by for the winter and the dredge tender discharged. Members of the crew not required for caretaking, were discharged or furloughed and returned to their homes on the 28th.

The dredge and plant were held in winter waters in the mouth of the Kentucky River at Carrollton, Ky., until April 14, 1912, and then towed to Dam No. 37, Ohio River, for annual repairs.

Due to the short working season of 1911, the machinery of the dredge was in fair condition, requiring only a general overhauling.

Repairs to the plant were practically completed June 5: the stage of the river not permitting of channel dredging, the dredge was moved into the lock chamber of Dam No. 37 to assist in cleaning the sand and silt deposit from the recess.

At the close of the fiscal year the dredge was in service at the dam.

The dredges "Cataract" and "Uncle Sam" belong to the Philadelphia District. They are employed mainly to rehandle material dumped in the dumping basins by the sea-going hopper dredges used in maintaining a channel in the Delaware River. The "Cataract" operated throughout the year on this work, except when laid up during the winter on account of ice conditions. The "Uncle Sam" operated on this work from July 1 to Oct. 5, and was then transferred to work above Philadelphia.

The dredge "Congaree" is a 12-in. dredge belonging to the Charleston, S. C., District. This dredge was employed fairly steadily from July 1 to Dec. 16 on the improvement of the Congaree River. It was then laid up with a part crew and resumed work at Congaree Creek Shoal June 20, where it was at work at the end of the fiscal year. It removed the following quantities of sand and gravel:

	Cu. yds.
Gill Creek	366
Congaree Creek (1911)	32,842
White House	12,059
Granby	47,383
Congaree Creek (1912)	8,614
Total	101,264

The cost of operating the dredge during the year was $11,714.71. The cost of caring for the dredge and other floating plant during the lay-up period, was $3,886.19, making a total cost of $14,453.10. The cost per cubic yard was therefore 14.37 cents.

The dredges "Morgan," "Augusta" and "Macon" belong to the Savannah, Ga., District. The "Morgan" was operated during the fiscal year for rehandling materials dumped in specially provided pockets by the two sea-going hopper dredges which maintain the channel through Savannah Harbor. The "Morgan" handled 1,204,041 cu. yds. of material, including 67,000 cu. yds., which was primary dredging on the project. The total unit cost of the "Morgan's" dredging was 7.3 cts. per cubic yard.

The "Augusta" was constructed during the previous year and began to operate Aug. 14, 1911, continuing throughout the fiscal year. The dredge was operated in the Savannah River below Augusta, maintaining the channel through several bars. She is equipped with 400 ft. of floating pipe line, a coal barge, quarter boat for the crew, and a launch for use as a tender. Work was retarded during the year by an unusual number of freshets. During one of these the plant was torn loose from its moorings, the gasoline launch and a number of anchors and lines were lost.

The 10-in. pump boat "Macon" was built in 1911 for work on the Altamaha, Oconee and Ocmulgee Rivers, and began to operate on Aug. 3. She operated during the year on the Altamaha River, but the work was retarded on account of the unusual number and the prolonged duration of freshets.

The hydraulic dredge "Jacksonville" was rented to the Wilmington, N. C., District by the Jacksonville, Fla., District at $41 per day. The dredge operated during the month of July, and was returned Aug. 16 to Jacksonville., Fla.

The dredge "Florida," belonging to the Jacksonville, Fla., District, was employed in improving the St. John's River from Jacksonville to Palatka and from Palatka to Lake Harney. The work in the latter section of the river amounted to 197,125 cu. yds. of sand, clay and hardpan which cost 14.15 cts. per cubic yard. Below Palatka, 64,899 cu. yds. were excavated at a cost of 3.25 cts. per cubic yard. This work was discontinued April 13, 1912, for lack of available funds.

The dredges "Pettus," "Blackwater" and "Muscogee" belong to and were operated during the year in the Montgomery, Ala., District.

The 15-in. dredge "Pettus" covered about 150 miles of the Alabama River and dredged a section totaling approximately 7½ miles in length to a depth of 4 ft. below low water. The average field cost for dredging was about 14.9 cts. per cubic yard. The materials were dredged from ten different points and amounted to 125,665 cu. yds.

The dredge "Blackwater" worked in the channel from Apalachicola River to St. Andrews Bay, Fla., from March 4, 1912, and removed a total of 194,816 cu. yds. up to the close of the fiscal year, from the western end of the improvement. The total cost of the work was 11.8 cts. per cubic yard.

The dredge "Muscogee" worked on the eastern end of this improvement and removed 111,157 cu. yds. between Jan. 27 and June 30, 1912, at a gross cost of 9.7 cts. per cubic yard.

The dredges "Barnard," "Pascagoula," "Wahalak," and "Humphreys," belong to and operate in the Mobile, Ala., District, with the exception of the "Barnard," which was used in connection with the raising of the battleship "Maine" in Havana Harbor. The other dredges were operated in the district for the improvement of the Mobile Harbor channel and for dredging in Black Warrior River. The "Humphreys," a 12-in. dredge was employed considerably in cleaning out locks on the Black Warrior River. The dredge removed 151,512 cu. yds. during the year at a cost of about 9 cts. per cubic yard.

The dredges "Orange" and "Port Arthur" belong to the Dallas, Tex., district. The Orange is a new 15 in. dredge just placed in service and the Port Arthur is a 12 in. dredge built in 1901. Both dredges are used in the operation and care of the Port Arthur Ship Canal. The Port Arthur dredged shoal places in the canal to a depth between 26 and 27 ft., removing 113,115 cu. yds. of soft silt between July 1 and Nov. 22, when the dredge was sent to winter quarters. The dredge is in poor condition, and it is proposed to again placed her in commission.

The dredges "Miller" and "Howell" are 20 and 12 in. dredges, respectively. They belong to the Galveston, Tex., district. The "Col. A. M. Miller" was used throughout the year in improving the Galveston channel and widening the channel by new work to the full project width of 1,200 ft. She removed during the year 2,799,399 cu. yds., at a total cost of 3.63 per cu. yd., including the cost of office expenses. The "Capt. C. W. Howell" was engaged in the channel from Aransas Pass to Pass Cavallo, a distance of 30 miles, and dredged through shoals for a distance of 8,000 ft., restoring the channel to the original depth of 5 ft. and width of 40 ft., removing 22,400 cu. yds. at a cost of 4,225 cents, including all expenses.

The dredge "Warroad," belonging to the St. Paul, Minn., district, operated until the early part of October in Zippel Bay, Lake of the Woods, Minn., and a channel was dug of sufficient size to permit the dredge fleet to pass into winter quarters in the bay. In May, 1912, dredging was resumed and material was deposited to form a dike. In all 75,541 cu. yds. were excavated.

The dredge "Tortoise" is a 15 in. dredge belonging to the Duluth, Minn., district. The dredge was employed on the improvement of the harbors of Duluth and Superior entry, Wisconsin. The dredge worked from July 1 to Nov. 11, 1911, and from April 18 to June 30, 1912, excavating during the fiscal year 309,939 cu. yds. Portions of the excavated material were discharged behind the breakwaters and concrete canal revetments. The depth of the channel entrance was made about 24.5 ft. The cost of all dredging, including charges for renewals and additions, tug and administration, was 10.55 cts. per cubic yard.

The dredge "Oregon" continued its previous year's work in the improvement of Coquille River in the Portland, Ore., district, and was operated until Sept. 8, 1911. She removed 130,000 cu. yds. from this work, of which 101,516 cu. yds. were removed during this fiscal year. On Sept. 14 the dredge returned to Coos Bay and commenced work Oct. 1., operating from that date till the end of the fiscal year on the 18 ft. project, which is 200 and 250 ft. wide. The material excavated consisted of mud, silt, sand and in some reaches oyster shells. It was all pumped behind bulkheads erected by private parties.

The 20 in. dredge San Pedro, belonging to the Los Angeles district, was employed during the year, dredging to a 31 ft. depth the channel for full width between wharves in the inner harbor of Los Angeles. The 692,087 cu. yds. dredged consisted of silt, quicksand, shell, yellow and blue clay, layers of sandstone, and cobbles. The material was pumped from 950 to 2,590 ft. and wasted on the lands of the Pacific Wharf & Storage Co., the Salt Lake R. R. Co., and outside of the seawall of the latter company. The work was done at a cost, including all items and overhead expenses, 11.29 cts. per cubic yard.

The solids pumped amounted to 4.4 per cent of the total amount discharged from the pipe.

A Bill to Create and Make Effective a National Department of Public Works.

Approval of the creation of a national Department of Public Works was embodied in the formal resolutions voted by the National Drainage Congress at St. Louis, Mo., April 10-12, 1913. At the same congress a paper by Mr. Isham Randolph, Chicago, Ill., supported this same proposal and concluded with the text of an act designed to create such a department. The argument in brief made by Mr. Randolph follows and to make the argument specific we also give the text of the act suggested by him:

We need a National Department of Public Works, and its executive head should be a member of the President's cabinet. This belief does not minimize my appreciation of the army engineer, and I cannot pass on without paying the men of that branch of our military service my tribute of esteem, an esteem born of my knowledge of the things which they have done and of association with many a man whose right it is to wear the insignia of the corps, the castle. Nowhere can you find men with a truer devotion to duty, a higher determination to guard the interests intrusted to them and to keep untarnished the honor of the corps which has built up a splendid reputation for integrity and manly virtue. All of which, indeed, we look for, in as much as the honor men of West Point are found in the United States Engineer Corps.

But that school does not graduate men enough to supply the engineering needs of a land like ours. There are not enough of them to go round. The natural consequence is that they seldom work together, one engineer in a place is the rule, and one West Point graduate cannot, single-handed, do the engineering work of the job to which he is assigned; hence he must secure the services and surround himself with men educated in the school of experience or in one or other of our great civil engineering schools. The result is apt to be, and too commonly is, that the West Pointer becomes the executive officer, the civilian does the engineering and the officer O. K.'s it.

The training, the discipline of the army engineer is not conducive to originality or initiative. He has to submit to a repression which cramps his genius and curtails his usefulness. I have had more than one of these men tell me that original suggestions about needed improvements were not only not welcomed in Washington, but, if made, were apt to be returned with something more than a hint that until information or advice upon the subject which prompted the communication was officially called for, it was not desired.

An examination of the roster of army engineers in active service astonished me. Their number and rank is as follows: One chief of engineers, with rank of Brigadier General; 12 Colonels, 19 Lieut. Colonels, 39 Majors, 51 Captains, 47 First Lieutenants and 19 Second Lieutenants; all told, 118 men. Numerically, not enough to conduct the engineering operations of the Pennsylvania Railroad. Of these, 11 are engaged in building the Panama Canal, 2 are in the Philippines, 1 in Hawaii and 14 are detailed as instructors at West Point and other training schools. This leaves 90 men to cope with all the requirements of these United States and its territorial possessions an aggregate area of 3,742,583 square miles, with a coast line of 48,881 miles and a navigable river system in the United States proper of 26,410 miles. With 75,000 square miles of swamp land to be drained and protected and 1,200,000 square miles of arid lands to be reclaimed by irrigation, my argument for a National Department of Public Works rests upon the facts recited. For lack of such a department some of the gravest problems which hinder our fullest material development and the welfare of our people have gone too long unsolved.

A BILL TO CREATE AND MAKE EFFECTIVE A NATIONAL DEPARTMENT OF PUBLIC WORKS.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled:

That the creation of a department to be designated and known as the Department of Public Works of the United States is hereby authorized. The head of this department shall be designated as the Secretary of the Department of Public Works and he shall be appointed by the President of the United States, with the consent of the Senate thereof, and he shall be a member of the President's Cabinet.

The first duty of the Secretary of the Department of Public Works shall be to perfect a working organization for the purpose of carrying on all of the public works of the United States other than those which pertain to national defense or work wholly relating to navigation and lighthouse construction and service.

He shall appoint a Commissioner of Public Works who shall be a man of recognized ability and successful accomplishment along lines of engineering science and construction.

This election and appointment shall be made with the full knowledge and approval of the President of the United States and the man so appointed shall hold office until disqualified by physical or mental infirmity, old age, moral delinquency or demonstrated unfitness. In consultation with the Secretary, the Commissioner of Public Works shall organize office and field forces sufficient in number and suitably qualified to carry out the intents and purposes of this act, which are as follows:

To carry to completion all constructive works, such as public buildings, levees, dams, roads, bridges and structures of every kind and description authorized and provided for by Congress.

To secure physical data pertaining to rivers, swamps, arid regions; to cure existing maps showing the natural and political divisions of the United States and its territorial and insular possessions.

To secure copies of all topographical maps of accepted reliability and to make topographical surveys of all areas under the control of the United States within which accurate knowledge of the earth's surface seems either necessary or desirable.

To study the meteorological data which has been accumulated by governmental or other agencies with a view to determining flood expectancy.

To study the characteristics and capacities of the streams of the country for the purpose of determining what had best be done, and how, to avert flood disaster.

To select suitable reservoir sites for storing flood waters with the purpose of lowering flood planes of streams, and later, releasing the waters so stored for the purpose of aiding navigation during dry periods and emptying the reservoirs in advance of recurring excessive precipitation.

To study those drainage problems which by reason of civil divisions are interstate in their scope.

To select available sites for the development of water power.

To gather and preserve data relating to arid lands and the sources from which water may be secured with which to irrigate these lands.

To prepare plans for such structures as it may be necessary or desirable to build in carrying out the purposes of this bill as hereinbefore set forth, together with estimates of cost and recommendations relating thereto.

Those works to be first considered and reported upon, the importance or necessity of which has been demonstrated by disasters creating national sorrow and sympathy.

The Secretary of the department shall, with the approval of the President, present to the Congress at each session such projects as he deems meritorious and for which there seems to be an urgent need, together with estimates of cost and his recommendations thereon.

The Secretary shall present each year a report of the operations and expenditures made in accordance with the intent and purposes of this bill and he shall prepare and present a budget setting forth the financial needs of his department, both for administration and constructive work, for the fiscal year next ensuing.

The salary of the Secretary of the Department of Public Works shall be the same as that of the Secretary of War and the salaries of the employes of the department shall be determined by the Secretary with the advice of the Commissioner of Public Works and the approval of the President.

To defray the expense of organizing the Department of Public Works of the United States and to maintain the same until the Secretary submits the first budget setting forth the needs of the department, the sum of five hundred thousand (500,000) dollars is hereby appropriated, which shall be paid out of the treasury of the United States upon warrants drawn by the Secretary of the Department of Public Works.

WATER WORKS

Design of the Reconstructed Water Works Plant at Miles City, Mont.

Contributed by G. C. Pruett, City Engineer.

Miles City is located in the eastern part of Montana at the junction of Tongue and Yellowstone Rivers, and has a population of 6,000. Its population previous to 1907 was less than 3,000, but during that year the C., M. & P. S. Ry. opened up their Pacific coast extension to traffic and located extensive repair shops at this point.

The water supply at that time was obtained from Tongue River by direct pumping and was sufficient in quantity, but very deficient in quality. Tongue River flows through an open range, semi-arid country for the majority of its course and both it and all tributary streams are bordered by what are known as "bad lands," i. e., steep broken hills, composed chiefly of gumbo soil, barren of vegetation. As a rule rains come in hard showers of short duration, and consequently the run off carries down a great deal of this gumbo in suspension, resulting in a water which is very muddy throughout the spring and summer. Besides being unsatisfactory in the matter of turbidity, it was also a source of typhoid breeding and consequently was very little used in the city for anything but irrigating purposes, and to run water lifts for pumping soft (or artesian) water.

There is a weak artesian stratum at 95 ft. and another at 380 ft., which is very fine water for all domestic purposes, but cannot be used for irrigating on account of the bad effects it produces on vegetation. There is also a surface or "hard water" supply, as it is locally called, obtainable at a depth of 12 to 14 ft., and on account of the expense necessary to obtain an artesian supply, a great many of the residents depended entirely on this surface water for their domestic supply, resulting in a very high typhoid rate.

Following the opening of the C., M. & P. S. Ry. and the sudden, abnormal growth of the city, it became evident to the city officials that a new and more suitable supply of water was desirable, and owing to the small capacity of the old plant became alarmingly necessary for fire protection before the new plant was finally constructed in 1911. In considering the different sources of supply due weight was given to each source, as mentioned above, but for different reasons they were abandoned. Tongue River was abandoned because of its very unsatisfactory nature and high alkalinity resulting in a water which would have been both very expensive and unsatisfactory to treat. The artesian water was worthless for irrigating on account of a high content of alkali carbonate and was also doubtful in quantity, as there seems to be a gradual failing in the supply as the number of private wells increases, since wells which once flowed must now be pumped. The ground water supply was abandoned on account of its being unsafe, unreliable and its high alkali content from which it obtained the local name of "hard water." The only other source left to consider was the Yellowstone River, which borders on the north side of the city.

The Yellowstone has its source in the mountains of the Yellowstone National Park and is fed principally by moutain streams, although there are a few streams entering it which supply a very unsatisfactory water; notably, the Big Horn River, a stream on the order of Tongue River. At certain seasons of the year this stream supplies a water of red color which affects the Yellowstone to such an extent as to make it difficult to treat, although it empties into the Yellowstone 150 miles west of Miles City. The Yellowstone is further contaminated by the towns and cities west of Miles City, dumping their sewage directly into the river without treatment. However, on account of the swiftness of the current and its being continually broken up with shoals and rapids, it has a considerable self-purifying power so that when it reaches Miles City it does not shown an abnormally high bacterial count. Its hardness is less than half that of Tongue River and for the greater part of the year its waters are clean and sparkling.

In considering the new source of supply it was considered advisable to go above the mouth of Tongue River, as analysis showed that it was affected both chemically and bacterially by the discharge from that river. Consequently the new purification plant was located just above the mouth of Tongue River on the Yellowstone.

GENERAL DESCRIPTION OF PLANT.

The new plant as finally constructed consists of an intake pipe reaching to the middle of the river and obtains its supply from near the bottom. This pipe feeds the water by gravity to an intake well located on the bank of the river, where it is taken by the low service motor driven centrifugal pumps and raised to a mixing tank. It is treated here with aluminum sulphate and returned to the settling basins by gravity, where it receives a settling period of six hours at maximum pumpage before going on to the filters. It passes by gravity through the mechanical filters established in four units of 500,000 gals. capacity each to the clear water well, which has a capacity of 250,000 gals. From here it is taken by high service, two stage turbine pumps installed in duplicate, each having a capacity of 2,000,000 gals. per 24 hours, and delivered to the city through 4,500 ft. of 14 in. cast iron force main. Here it is handled by the direct, indirect process, there being a 200,000 gal. elevated steel tank which acts as a balancer and up town storage.

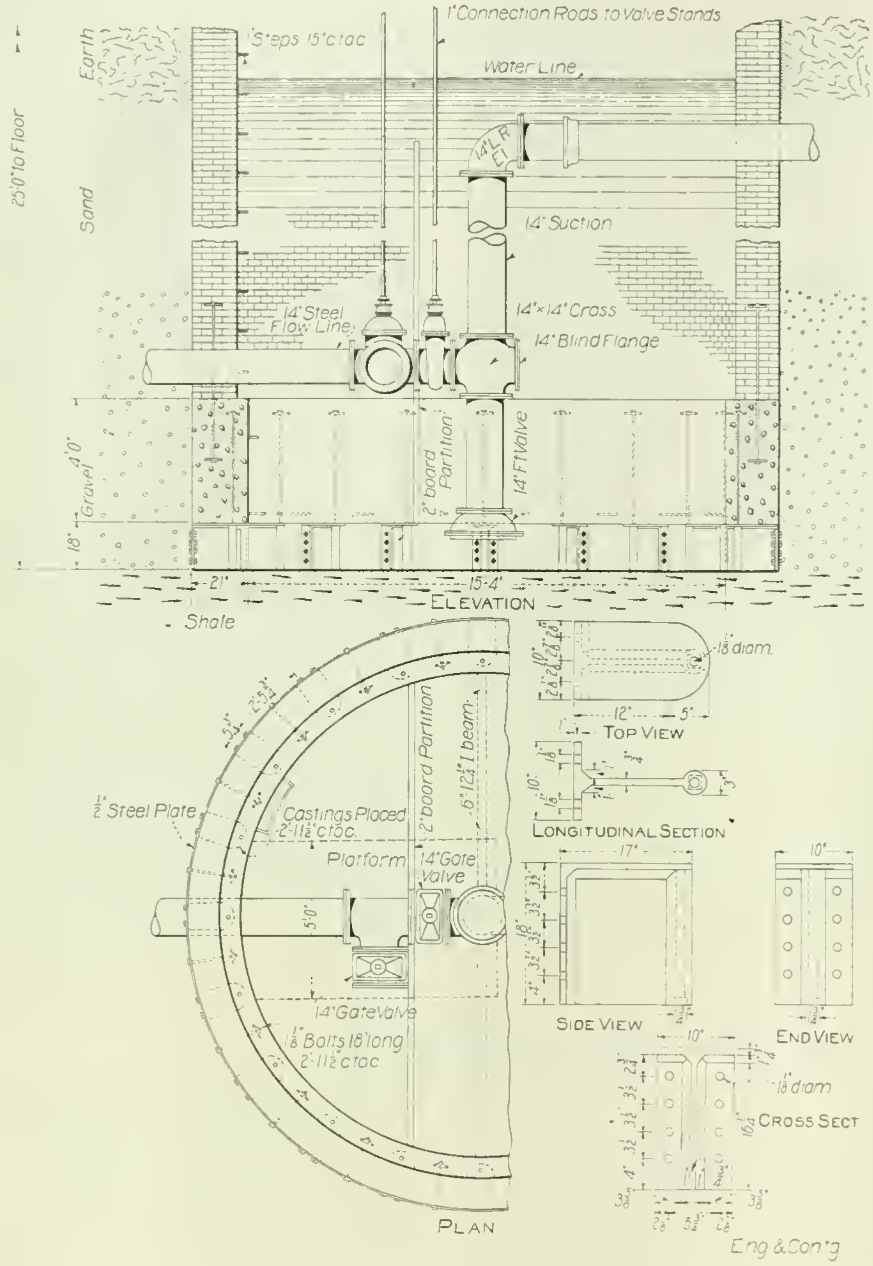


Fig. 1—Details of Intake Well and Cutting Shoe.

Intake.—The intake consists of a 14 in. wrought iron pipe ⅝ in. thick, anchored and strengthened at the joints with cast iron couplings, which are recessed to fit over the ordinary pipe coupling. These cast iron couplings are 3 ft. long and 2 ft. 6 ins. wide over the flanges, and are divided into two parts. The bottom part rests underneath the pipe and the top part fits closely over the top of the pipe; the two parts being connected with 6 1-in. bolts on each side, which pass through the flanges. The metal in these couplings is 2 ins. thick and the entire coupling weighs 400 lbs., making a very strong substantial joint. In addition it gives weight to the pipe, which is considered necessary on account of the ice which runs very heavy. The outer 200 ft. of this pipe is perforated on the top half with 4,550 ½ in. holes, which gives a cross sectional area of 893.4 sq. ins., or 5.8 times the cross sectional area of the pipe. In addition to this the outer end of the pipe is provided with a tide flap, which makes it possible to open up the full diameter of the pipe if necessary. This tide flap is connected back to the intake well by a ⅜ in. galvanized wire cable, which runs inside the pipe to a long threaded rod by which means the flap is held securely closed. The first 60 ft. of this pipe next to the bank was laid by the cofferdam method, but on account of the bottom of the river having a coarse gravel formation and the swiftness of the current it became impossible to continue by this method so that after some delay it was finally decided to dredge out a channel to receive the pipe, assemble the pipe on the ice (the river then being frozen over sufficiently to permit this) and lower it to its position by means of threaded rods. This was accomplished without any mishap or difficulty worth mentioning and the connection was made to the pipe already laid in the cofferdam by a diver, the flange bolts of the cast iron couplings being turned up by men standing on top of the ice and using an ordinary socket wrench. The actual lowering of this pipe consumed less than three hours and was accomplished quite satisfactorily, the bottom of the pipe resting on gravel at a depth of 6 ft. below the surface of the water.

Intake Well.—The intake well is 15 ft. in diameter of brick and concrete construction and the bottom of the shoe rests in blue shale at 25 ft. below the surface of the ground. Some details of the intake well design are shown in Fig. 1.

The first 10 ft. to water level was excavated with teams and drag scrapers, the walls being trimmed by hand. At this point the bottom was carefully leveled up and the cast iron and steel cutting shoe, which was of special design, was assembled. See Fig. 1. Forms were erected and the bottom section, which was constructed of reinforced concrete, was brought 2 ft. above ground level. After this had set three days the forms were removed and brick work was started on top, excavation being started at the same time inside the well. The dirt and gravel was handled by means of a specially constructed derrick made on the job using horse power for hoisting.

This work went on simultaneously and the well sank gradually to its final bearing. Very little water was encountered and no difficulty whatever was experienced in removing it. The walls of the well were brought 6 ft. above the surface of the ground and topped off with a conical shingle roof, a door being provided in the side facing the plant for entering the well.

Buildings.—The settling basins, filters, clear water well, pump pits, etc., are of reinforced concrete and the head house of brick, roofed with asbestos shingles. The whole structure except that portion occupied by the head house is roofed with reinforced concrete. A view of the purification plant and the general plan of the machinery setting and piping are shown in Figs. 2 and 3 respectively.

In plan the building is 100x155 ft. The roof is 11 ft. above the ground and the floor of the clear water well is 11 ft. below the surface of the ground. The settling basins are arranged on either side of the clear water well and filters, and each side is divided into four compartments 24x30 ft. in plan by 11 ft. deep.

The water enters these at the corner farthest away from the filters and passes consecutively through each compartment over a weir and into the next compartment until it is delivered to the filters. Each side can be operated sepa-

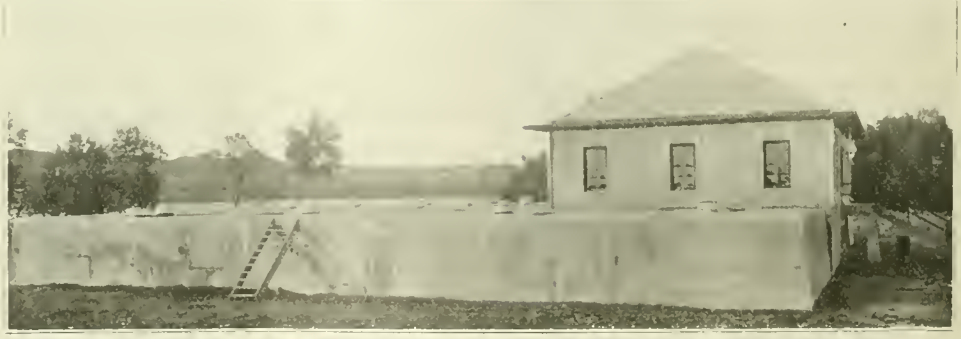


Fig. 2—View of Water Purification Plant at Miles City, Montana.

rately or in parallel but cannot be operated in series, this being unnecessary. The outside walls of the basins are of reinforced concrete, 6 ins. thick at the top and 16 ins. at the bottom, the batter being on the outside. Both the inside and outside of these walls are provided with fillets at the bottom, which are 9 ins. on each leg. These fillets were run simultaneously with the remainder of the wall and add considerable to its stability. The inside partition walls are also heavily reinforced to withstand full water pressure from either side and are 6 ins. thick on top and 16 ins. on the bottom with fillets, etc., the same as the outside walls. The floors are 6 ins. thick, increasing to 18 ins. at the outside walls and 16 ins. for partition walls, and are reinforced with woven wire fabric.

The roofs are 7½ ins. thick and are reinforced with woven wire fabric and bars. The roof slabs are 24x30 ft., being supported in the center with reinforced girders running longitudinally of the basins. The remainder of the walls are of similar construction to those of the settling basins, being designed for the particular pressures which they have to carry and reinforced in a manner to develop the required strength. The rear wall of the clear water well is buttressed to provide for outside earth and water pressures which sometimes come against it during high water.

Particular attention was given to reinforcing the corners of all compartments to provide against corner cracks and render the work water tight. The reinforcing was assembled and securely wired before erecting forms, the same being done so perfectly that it was possible to climb over the reinforcing without displacing the bars and was so rigid that it would sustain heavy loads. Owing to the duplication of the walls the forms were erected in panels and were used several times, this effecting a great saving in the cost of forms. The concrete was mixed in the proportions of one part cement, two parts sand and four parts washed gravel screened to 1 in. for the floors and roof, and one part cement, two and one-half parts sand and three and a half parts gravel for the walls. This difference in mixture was made necessary on account of it being difficult to spade the walls properly, and it was found that the latter produced the better concrete for this purpose. The mixture was rather wet and run in layers of approximately 8 ins.

All chambers for holding water were given a coat of asphaltic waterproofing furnished by the American Asphalt & Rubber Co. of Chicago and on top of this a plaster coat of 1:2 cement ½ in. thick was placed. This latter, however, did not adhere to the waterproofing as was anticipated, and the majority of it peeled off after going through the first winter.

The outside walls were plastered with a 1:2 cement mortar and given a sand finish, making a very satisfactory job. The low service pumps are placed in a pit in one corner of the clear water well, the floor being 5 ft. above low water in the river. One end of this pit is partitioned off for the heating plant. The high service pumps, wash water pumps, blower, toilet and switchboard are installed on a floor above the clear water well and joining the low service pump pit at one end. This floor is supported on 16 in. columns and 15 in. 45 lb. I-beams spaced 5 ft. c.c., and the panels are heavily reinforced with wire mesh and bars. The low service pump pit, filters, settling basins, clear well and toilet are each connected with the sewer separately so that any one can be washed or cleaned without interfering with the remainder of the service.

The main sewer is 12 ins. in diameter and discharges directly into the river below the intake well. A by-pass connection is also made from the settling basins on one side to the suction pipe of the low service pumps so that water can be turned back from the settling basins for priming the pumps and also for flushing and cleaning out the intake.

The construction of the plant was accomplished in the regular way, requiring no special mention, the gravel and sand being obtained from a gravel bar in the river adjacent and washed by means of a trough and screen arrangement.

Pumping Equipment.—The low service pumping equipment consists of two No. 12 Platt centrifugal pumps with 30 HP. motors, each capable of delivering 1,400 gals. per min. at normal rating and requiring about 20 HP. actual. The impellors in these pumps were changed later to deliver 1,800 gals. per min. with approximately 25 HP.

The motors are of the squirrel cage induction type, 2,200 volts, 60 cycle, 3 phase, with impregnated coils to withstand moisture. The pumps are connected with the intake well with a 14 in. cast iron suction pipe laid to give a

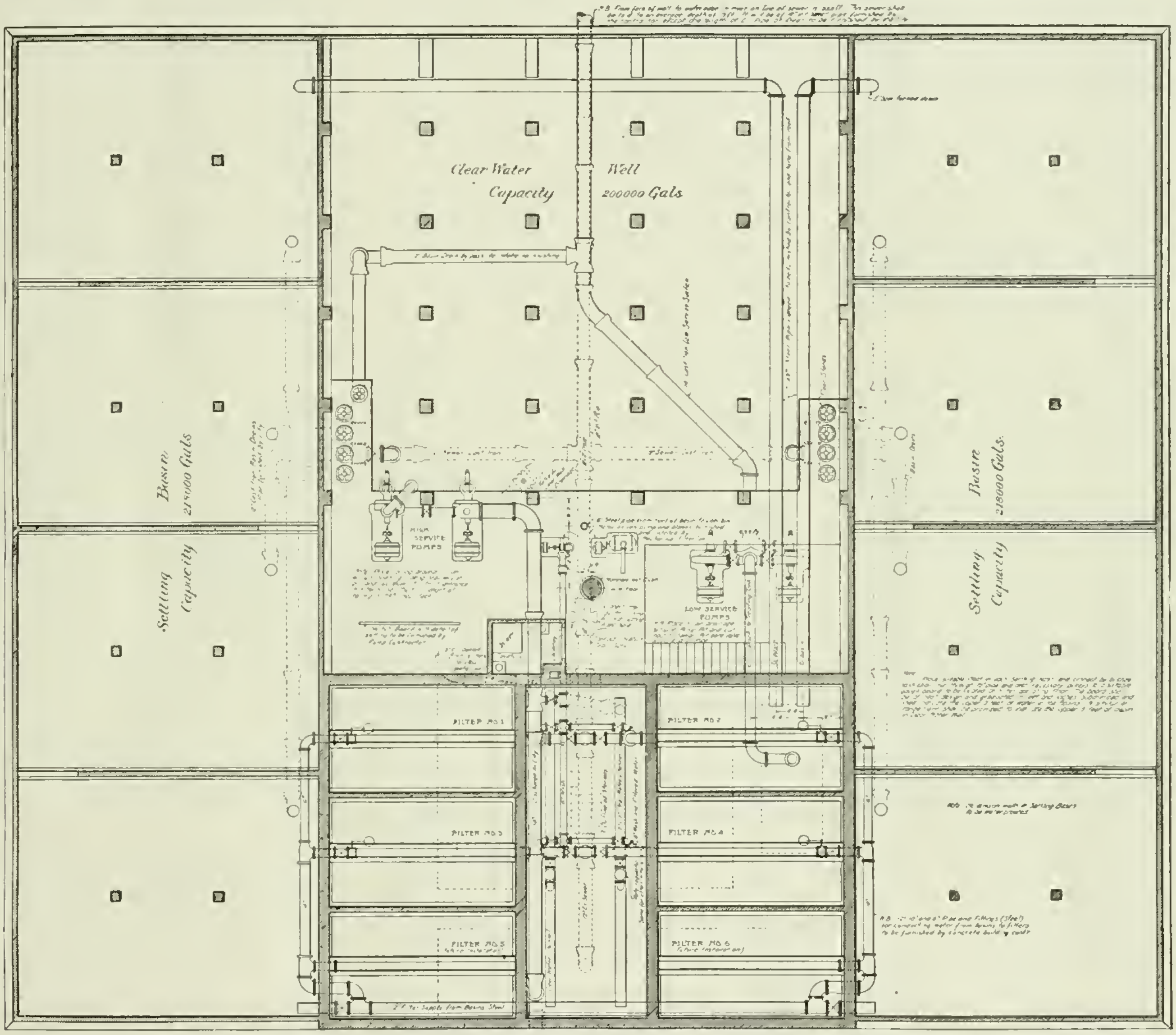


Fig. 3—General Plan of Machinery Setting and Piping, Water Purification Plant, Miles City, Montana.

fall of 6 ins. from the wall of the clear water well to the center of the intake well, a distance of 220 ft. At the intake well the suction is connected through a cross so that water can either be taken from the well or direct from the river as desired.

These pumps are connected so that they can be run either singly or in parallel, the lift including friction being from 32 to 36 ft. The high service pumps are No. 7 Platts, each capable of delivering 1,400 gals. per min. at 70 lbs. pressure with 100 HP. They are the two stage turbine type designed to withstand a working pressing of 150 lbs. and are so connected that they can be used singly, in parallel or in series. They are thrown in series for fire pressure, giving a pressure of 130 lbs. when delivering 1,400 gals. per min. In this arrangement they give the same results as would be had from a four stage pump with the advantage of having a duplicate domestic service installation.

The motors are each 100 HP. Westinghouse squirrel cage induction type, taking a 3 phase, 60 cycle, 2,200 volt current. They are directly connected to the pumps through a flexible pin coupling and have a speed of 1,120 r. p. m. The power factor at full load is 90 per cent, combined power factor and motor efficiency 81 per cent. The pump efficiency tested 69 per cent and combined pump and motor efficiency 56 per cent.

The low service pumps compared very favorably with the above, giving 70 per cent pump efficiency and 58 per cent combined efficiency.

The switchboard consists of a feeder panel —two high service and two low service pump panels. It is wired with both starting and running busses and equipped with ammeters, voltmeters, oil switches, pilot lights, etc. The auto transformers are tapped in on the 50 per cent connections, thus creating a very slight disturbance on the line at starting.

All wiring is of leaded cable run in conduct and the incoming power lines run in duplicate.

Filters.—The filter chambers are of reinforced concrete, having a floor area of 175 sq. ft. The manifold consists of a main 6 in. cast iron headed pipe laid lengthwise in the center of the chamber tapped on 6 in. centers for the reception of 1¼ in. galvanized collector pipes which lead out from the header with street ells. These latter pipes are tapped on 6 in. centers for the strainers. Rough concrete is placed under and around the collector pipes up to the bottom of the strainers. Ten inches of gravel is placed over the strainers graded from 1 in. to ¼ in. and on top of this gravel 2½ ft. of Red Wing filter sand having an effective size of 0.38 m.m. and uniformity coefficient of 1.65.

The overflow trough is 3½ ft. above the sand and is constructed of concrete steel. The raw water is admitted at the rear by a float controlled hydraulic valve, and after passing through the filter at the rate of 125,000,000 gals. per acre per day, regulated by a special rate controller, it passes to the clear water well through an open concrete channel and cast iron pipe. The outlet from each filter is provided with sewer, clear water, wash water rewash and air connections, all operated by hydraulic valves from operating tables above. These tables are also provided with loss of head gages, which shows the condition of the filters at all times. Wash water is furnished by means of a No. 8 Worthington centrifugal pump driven by a 40 HP. motor, the operating head being approximately 70 ft. This pump delivers 1,500-1,800 gals. per min. with a vertical rise of 14 to 18 ins. per minute. This high rate of washing is necessary on account of the height of trough above the sand bed and distance which the water has to travel to reach the overflow trough.

Air is furnished for washing by means of a No. ½ Garden City Fan Co.'s blower driven by a 20 HP. Western Electric Co.'s motor, and is regulated to give 3 cu. ft. of air per minute at 4 lbs. pressure per square foot of filter area. This effects a thorough breaking up of the sand bed and insures an even washing of the filters. The effluent from the filters is clear and sparkling at all times and shows a bacterial purification of from 98 to 99 per cent. The amount of alum used varies from ½ grain to 5 grains, depending on the character of the water. Generally, however, when the settling basins are clear and the river does not carry too much of the Big Horn sediment, 3 grains is sufficient for the muddiest seasons. The Big Horn mud seems to have a faculty of digesting or counteracting a large proportion of the alum applied, rendering it less effective even with the larger quantities used so that when troubled with sediment from this river it becomes necessary to depend more on the action of the filters for producing a clear effluent than during other periods. This necessitates washing at approximately twelve hour intervals.

The loss of head at washing averages 7 to 9 ft., and after washing 2½ ft. The periods of service average from twelve hours at the worst states of the raw water to 72 hours when the river is clear.

Heating Plant.—Steam heat is used for the plant, radiators being placed only in the head house. The boiler has a capacity of 500 sq. ft. radiation and is located in the room provided at one end of the low service pump pit. Coal is delivered into the bin through a pipe chute which leads from the roof.

The boiler room also contains an ash bin for storing the ashes. At intervals when this becomes full they are hoisted out by means of buckets through manholes in the high service pump floor and roof to the roof, where they are hauled to the rear of the building with wheel barrows.

Discharge Main.—The discharge main leading from the plant to the city is 14 in. cast iron and crosses under the tracks of the C., M. & P. S. Ry. and the channel of Tongue River. The track was tunneled for 50 ft. and the Tongue River crossing was made by the cofferdam method, this work being done at low water. The majority of this work was done while the river was frozen over, but before the job was completed the ice went out and the remainder was completed after the water had receded. This discharge main is connected both to the distribution system and to the tank, which produces a very satisfactory working condition for the pumps and gives a practically uniform pressure of 55 lbs. throughout the city.

Tank Control and Fire Alarm.—The main to the tank is provided with a hydraulic gate valve which is operated from the pumping station. This is accomplished by means of an Engberg electric control and works very satisfactorily. As originally installed, this control was operated by means of 24 dry cells connected in series, but later on account of the batteries being unreliable they were replaced with a ½ HP. motor generator set, which delivers direct current for this service.

This control is provided with a tell tale alarm so that by making a switch contact the position of the valve is determined. The city also has an electric fire alarm system, which, in addition to connecting with the fire department and power station, also connects to the water plant so that when an alarm is turned in all places concerned are notified. This enables the pumper on shift to immediately cut out the tank and put the second high service pumps to work.

The power plant as a rule does not keep sufficient power available to operate all pumps at once, but by means of this fire alarm system it is possible to cut in the second pump within five minutes from the time of the alarm.

Tower and Tank.—As mentioned above, the tank is of steel and has a capacity of 200,000 gals. above 100 ft. In addition, the 6 ft. mud drum which replaces the riser pipe, as generally found with tanks of this sort, has a capacity of 22,500 gals. The bottom of the tank has the shape of an elipsoid with a minor axis of 19 ft. and major axis of 28 ft. The mud drum sets directly on the center pier of the foundation and is connected to the tank with a 6 in. angle iron. It is provided with a blowoff valve at the bottom for draining and cleaning the tank, and the connection to the discharge main is made with a heavy lead joint.

An iron ladder runs up the tower on the outside and up the mud drum on the inside of the tank. A balcony is provided at the junction of the cylindrical part of the tank with the bottom on the outside. The tower was erected in panels with a gin pole set up on the completed panel below, and the tank by means of a small gin pole bolted to the side of the tank. Horsepower was used for hoisting.

All joints were cold caulked with a round nosed iron before painting, and in testing only one place in the mud drum showed any leakage. This was recaulked and the whole structure was then given two coats of Rabock paint, after which it was immediately put into service.

Distribution System.—The distribution system consists of 10 miles of new mains and 5 miles of old. The old system had very few shut off valves, and in addition to making connection with these old mains at all points of intersection, new valves were also cut in so that the water can now be closed off in small districts without interfering with the remainder of the service. The main supply pipes are 12, 10, 8 and 6 ins. in diameter and all laterals 4 ins. This was necessary on account of insufficient means to lay the larger sized pipes. All pipes laid are cast iron and tested for a working pressure of 150 lbs.

COSTS.

The pumping and purification plant was let complete in one contract and the distribution system in another exclusive of the tank, but the following figures approximate very closely the actual cost of the various items:

Intake	$ 3,500
Intake well	1,500
Buildings, including heat and plumbing	32,000
Low service pump (inst.)	1,500
High service pump	3,750
Station switchboard	1,350
Piping inside plant and suction pipe	3,000
Sewer	2,500
Filters, equipment only	9,200
Land and legal expense	500
Power line and transformers	4,000
Engineering and inspecting	3,100
Total	$65,900
Distribution System—	
10 miles 4, 6, 8, 10, 12 and 14-in. cast iron mains, including all valves, hydrants, specials, etc	$56,000
Tower and tank, including drain, shut-off, control, etc.	12,750
Engineering and inspection	3,400
Miscellaneous expenses	500
Total	$72,650

Plans and specifications for the above work were furnished by Burns & McDonnell, Consulting Engineers, Kansas City, Mo., the writer having complete supervision of construction. W. D. Lovell of Minneapolis, Minn., was contractor for the pumping and purification plant, including intake, etc., but exclusive of filter equipment, which was let to the Greer Filter Co., but on default of the contractor was completed under the supervision of the writer.

The pumps and electrical equipment were furnished by the Platt Iron Works and installed by Lovell. The Chicago Bridge & Iron Works furnished and erected the tower and tank and the American Cast Iron Pipe Co. furnished all pipe and specials, which were laid by W. D. Lovell. The Ludlow Valve Mfg. Co. furnished all hydrants and valves.

A Discussion of the Abuses of Water Filtration.

The chief uses and some of the abuses of water filtration were discussed recently by Mr. Gilbert H. Pratt, chemist of the Rhode Island State Board of Health, in a paper before the New England Water Works Association.

Among the uses of filtration which Mr. Pratt mentioned were the protection of a community from the attack of water-borne diseases, the removal of color and taste, the removal of iron from well waters, and the removal of turbidity, particularly from the waters of western rivers. These matters have all been fully discussed in Engineering and

Contracting, so that the portions of Mr. Pratt's paper relating to the uses of filtration will not be given here. However, the discussion of the abuses of filtration was very timely, and we are here giving that portion of the paper. Mr. Pratt called attention to certain abuses of filtration which in his judgment might lead to criticism of the whole idea of filtration.

In the case of slow sand filtration, one would consider it an abuse to attempt to purify a water high in algæ content which would result in clogging of the beds and a general upsetting of operating conditions at the plant. Of course, double slow sand filtration, especially if in connection with aeration, would qualify this previous statement, as aeration and pre-filtration would put the water in condition where it could be handled by the secondary filters; but where aeration followed by coagulation and sedimentation and filtration by mechanical filters would obviate all of the trouble due to clogging of the beds, it would seem as if it was abusing the at times satisfactory method of slow sand filtration to attempt to handle such a water by simple slow sand filtration.

It would also seem an abuse of this method to use it in connection with filtration of highly colored water, which would subject the method to criticism on account of the unsatisfactory appearance of the output.

Another abuse of this method in connection with operation of the filters is too quick changing of rates of operation, which tends to disturb the bacterial action going on at the surface, with attendant poor results from an analytical standpoint. Also attempting to overcrowd the filters by running at too high rates is a practice which is sometimes met with, which results in diminution of the efficiency of the plants.

A slow sand filtration plant which would handle a given water satisfactorily might, as was the case in Providence, be installed without covering the beds. Such an installation as this in this section of the country is certainly an abuse of the method, for the result invariably would be what was found in Providence, that as soon as a hard winter struck the plant the beds would become covered with ice and it would be impossible to get at the surface to clean without removal of the cakes of ice. This condition occurred in Providence for a short time during February, 1907, finally necessitating opening the river gate, and the use of raw water for about two weeks or so before the weather moderated and before the ice could be removed. This experience resulted in steps immediately being taken to cover the beds, and this experience should serve as a lesson against such open installations in this section of the country.

In connection with slow sand plants, it is necessary to have competent help administering the plant, and one of the easiest ways to abuse a plant is to put it into the hands of inexperienced operators.

The above remark about labor in connection with plants is especially true in the case of mechanical filters, where the supervision must be particularly close, and where tests for color and alkalinity must be made to regulate the doses of chemicals used.

One of these plants which has come under my observation had operated for a number of years satisfactorily, turning out a water which had given entire satisfaction in connection with work in a bleachery. When I was consulted with regard to difficulties which were occurring, I found that the only trouble was that the parties in charge did not have an understanding of the question of alkalinity control of the plant, and the residual alkalinity of the effluent had dropped to a point where the water was passing the plant at times in an acid condition, or at best with an extremely low alkalinity, resulting in after-coagulation in the vats and throughout the system. This condition was caused by the fact that a certain mill above them had been discharging a larger amount of acid wastes in the river than at the time their formula for operating was figured for them. Not knowing how to vary the dose from time to time, they had stuck to the old formula, with the resulting poor work until corrective measures were taken. The addition of alkalinity to the water put the plant back into its former good condition.

At another installation concerning which I had been consulted, I found another condition which was causing trouble. The responsible man in charge of the plant for some reason or other was assigned to night duty, and he was attempting to make his control tests for color and alkalinity at night by artificial light. This, of course, gave him far from accurate results. Another trouble of this plant was that the one man was expected to operate the flow of chemicals from the tanks, which were located in the pump house, and at the same time attend to washing the filters in a filter house which was located about one-eighth of a mile away. This spreading out of the plant made it impossible for the lone operator to properly attend to the dosing, and the result was that the flow of chemicals varied from time to time, with resulting poor output from the plant. Here, too, I found trouble in connection with the dosing, for the formula they were using to operate by had evidently been recommended without a knowledge of the water to be handled, and they, too, were operating with a too low residual alkalinity.

At another plant this same trouble as to a low residual alkalinity was found to exist, and the output contained undecomposed sulphate of alumina. Investigation showed that this operator was using an indicator solution many times too strong, and the alkalinity tests which he was obtaining were absolutely inaccurate. They also were not showing intelligence with regard to the necessity of increasing the doses of chemicals to meet varying conditions in the raw water. Corrective measures, recommended by the State Board of Health, and instruction of the operator, has resulted in this plant turning out one of the best outputs in our State at the present time.

At still another plant, the biggest difficulty discovered when troubles arose seemed to be with the application of the chemicals, which in this plant required an extremely close control, on account of an influence on the color of the filtered water as the residual alkalinity became too high. The engineer who was employed when this plant started was a man who had been for years pumping water out of the reservoir under the old system, and he could not be made to realize that careful supervision was necessary, and grossly neglected controlling the flow of the chemicals. These operating troubles immediately ceased when a new, competent engineer was put in charge of the plant.

The effect of an abnormal amount of organic matter or algae in comparison with the color of the water sometimes has resulted in an under-dosing with coagulant, as this additional amount of organic matter has seemed to prevent proper coagulation, with resulting incomplete removal of the constituents which it was intended to remove, and the effluent has contained alumina and abnormal amounts of color and algae. Proper dosing, in view of the above mentioned conditions, has resulted in excellent work from this plant.

Another abuse is oftentimes attempting to operate a plant with every possibility for good results by methods which some man of limited experience may have used at some other plant, meeting entirely different conditions. Such cases have occurred under my observation, but have been capable of adjustment when instructions have been given which had in mind the type of plant and the raw water to be handled.

In connection with the operation of plants of the mechanical type, it is essential that the night man should be one who can be depended upon to stay awake, as a nap for an hour or two may result in throwing the whole operation of the plant out of adjustment for several hours. I have had my experience with this trouble.

Having thus brought out the conditions which call for filtration of water supplies, and having shown the good results obtained with certain installations, I also attempted to point out a number of ways in which filtration plants are at times abused. One or more instances of abuse are sometimes the only cases of filter plants coming to the attention of some people, who immediately condemn the possibilities of the whole proposition of water purification on this meager knowledge.

I would take this opportunity to warn you waterworks men against such conclusions from knowledge of some plant or plants which may not be doing all that has been claimed for them. I would also particularly caution that you do not take the cases of abuse which I have mentioned as indicative of any lack of confidence on my part in the ability of plants to purify water satisfactorily when the following essential points have been observed: First, have the choice of the system and the general outline and construction of the plant in the hands of competent consulting engineers who are experts in these matters; next, having obtained the plant properly constructed and designed to handle the water to be filtered, obtain the best possible men to oversee and run the plant after instruction from competent specialists, and if trouble occurs, call in advice to straighten out the difficulty, instead of experimenting blindly; and last, throughout the whole operation of the plant, bear in mind that you are handling an efficient machine capable of results, and not an automatic affair which can be left to its own resources.

Average Cost and Consumption of Water in the Canadian Provinces.

On the average, each person in Canada served by waterworks uses 113 imperial gallons of water a day and pays $4.12 a year for it, according to a report on the waterworks of Canada in preparation by the Commission of Conservation.

New Brunswick has the highest per capita consumption in Canada, viz., 161 gals. per head per day, while Manitoba and Saskatchewan have the lowest—46 gals. per head per day. The more general use of meters in the western provinces reduces waste and keeps the per capita consumption down to about the same amount as in European countries. The people of Manitoba pay the highest per capita rate for their water—$6.27 per year; while those of New Brunswick come next, with a per capita cost per year of $4.82.

Table I shows the estimated cost per 1,000 gals., the estimated cost per capita, and the daily consumption per capita.

TABLE I.—CANADIAN WATER WORKS STATISTICS.

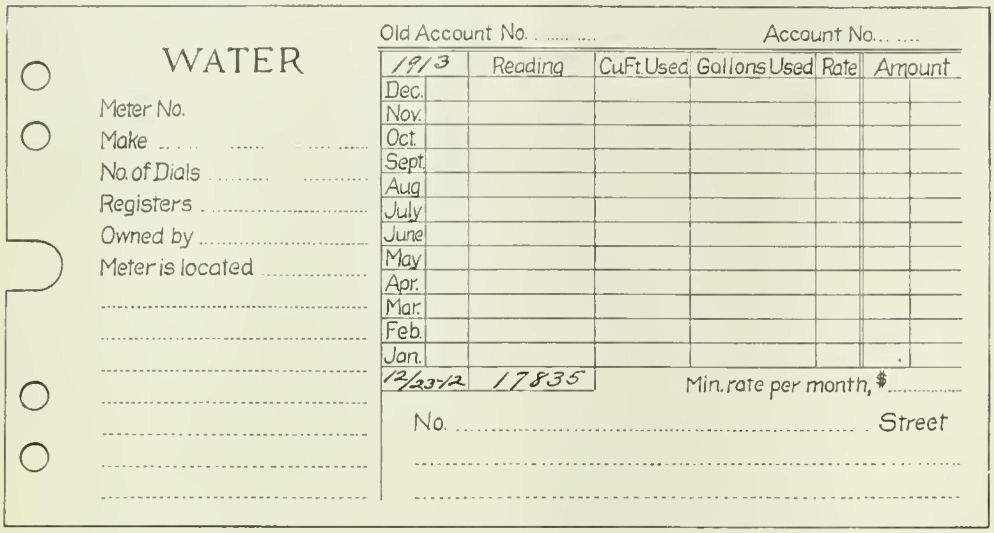
Province.	Estimated Cost per 1,000 gal. (cents).	Estimated cost per capita per year (dollars).	Daily consumption per capita (imp. gal.)
Nova Scotia	7	3.76	147
Prince Edw. Island	16.4	2.87	48
New Brunswick...	8.2	4.82	161
Quebec	9.5	3.92	113
Ontario	9.6	4.21	120
Manitoba	20.6	3.46	46
Saskatchewan	23.	3.86	46
Alberta	13.	6.27	132
British Columbia..	8.2	3.44	115
Canada	10	4.12	113

A New Water Power Development.—At Dundee Falls, Me., on the Presumpscot river, a new power station for the S. D. Warren Co., paper manufacturers, is being erected under the supervision of the Stone & Webster Engineering Corporation. The dam, about 1,400 ft. long, is of earth, with power house and spillway of reinforced concrete. A head of 50 ft. will be utilized, with a wheel capacity of 4,500 HP. The concrete spillway is of gravity suction type. Power will be supplied by three 33-in. horizontal turbines of the S. Morgan Smith type, each capable of developing 1,500 HP. at 277 r. p. m. They are of the wicket gate type, the gates of each wheel being controlled by a Lombard governor. Each wheel is direct-connected to an 800-kw. G. E. generator, with individual exciters mounted on its shaft.

Method of Handling Metered Water Accounts at Ottawa, Kansas.

Contributed by W. O. Myers, Superintendent of City Water and Light Department, Ottawa, Kans.

The style of meter sheet and the register for water service accounts illustrated and described in this article are in use in the small water and electric plant at Ottawa, Kansas. They have been found very satisfactory and may be of interest to engineers and superintendents who have charge of similar utilities.



Old Account No. .... Account No. ....

WATER

Meter No.

Make ....

No. of Dials ....

Registers ....

Owned by ....

Meter is located ....

1913	Reading	Cu.Ft.Used	Gallons Used	Rate	Amount
Dec.					
Nov.					
Oct.					
Sept.					
Aug.					
July					
June					
May					
Apr.					
Mar.					
Feb.					
Jan.					
12/23-12	17835				

Min. rate per month, $........

No. .... Street

Fig. 1—Style of Meter Sheet Used in Ottawa Kan., Water Department.

In designing the meter sheet, which is shown in Fig. 1, especial attention has been given to the need of having a book convenient for the meter reader and office employes to handle, and also to have the spaces for lead penciled figures in such position on the sheet that they will not be soiled by the necessary handling of the book. The lower right hand corner of the sheet will be used to rest the hand upon when putting readings in the book and for this reason the consumer's name and street location (written in ink) are placed on that corner of the sheet. The reference data—meter number, make, size, etc., are placed next to the binding edge and can be easily referred to even though the binder is clamped tightly on the sheets.

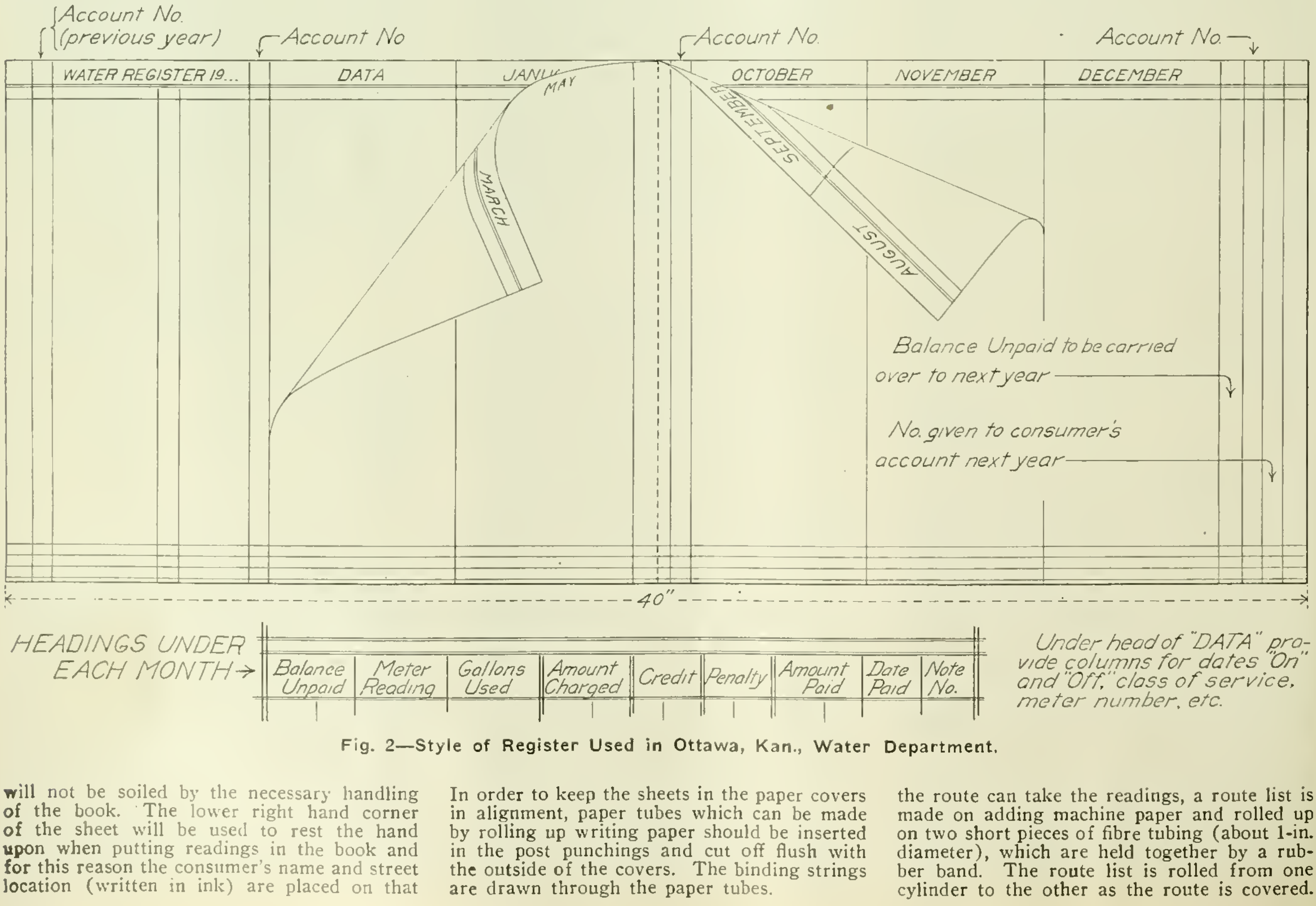

Account No. (previous year)
Account No
Account No.
Account No.
WATER REGISTER 19...
DATA
JANU
MAY
MARCH
OCTOBER
SEPTEMBER
AUGUST
NOVEMBER
DECEMBER
Balance Unpaid to be carried over to next year
No. given to consumer's account next year
40"
HEADINGS UNDER EACH MONTH
Balance Unpaid
Meter Reading
Gallons Used
Amount Charged
Credit
Penalty
Amount Paid
Date Paid
Note No.
Under head of "DATA" provide columns for dates "On" and "Off," class of service, meter number, etc.

Fig. 2—Style of Register Used in Ottawa, Kan., Water Department.

Flexible leather covered price book post binders of 1-in. capacity are used for holding the meter sheets and are found very convenient for the meter reader to handle, and also for the office employes when making out statements as the two parts of the binder can be separated and the sheets moved from one part to the other as the work progresses. These binders with alphabetical indices can be secured for about $3 each and will give several years' service. At the beginning of a new year, after the new sheets have been made out, the old sheets can be bound in paper covers. In order to keep the sheets in the paper covers in alignment, paper tubes which can be made by rolling up writing paper should be inserted in the post punchings and cut off flush with the outside of the covers. The binding strings are drawn through the paper tubes.

Some utility managers believe that a meter reader should have no record of the previous readings of the meters he is required to read, but a good meter reader can save a great deal of time and expense by detecting bad order meters, misreadings, leaks, etc., and thereby avert many complaints if he is provided with the previous readings and information that will enable him to detect any abnormal registrations.

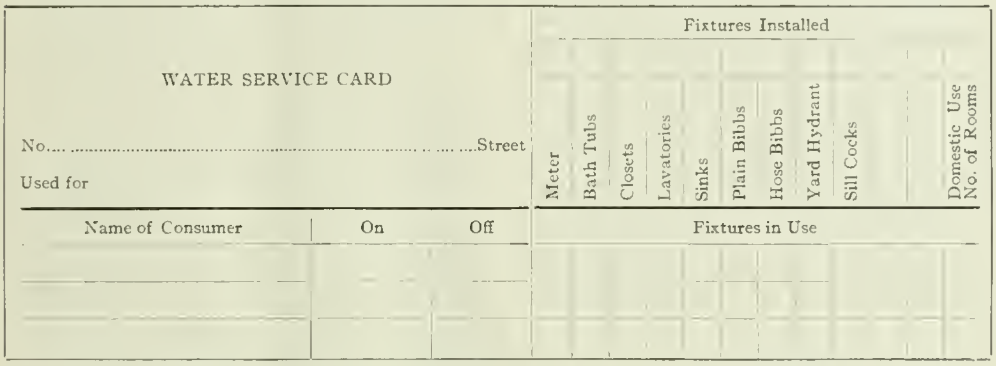
The following "Instructions for Meter Readers" (applying to both water and electric meters) are placed in the front of each meter book used by the writer:

Always record readings exactly as shown by the meter register. Make mental subtraction and note the amount consumed, and, if it is extraordinary, ascertain the cause, if possible. If the amount is small when no reason is known for an extra small consumption, see if the meter will operate. If the amount is unusually large, ask the consumer about leaks, etc. See if the meter runs when the service is not being used. Do not, under any circumstances, attempt to pass locked doors unless permission has been granted and key provided by the consumer. If the consumer appears to be away from home, try door and, if not locked, open and call out "meter reader" before entering and give the occupants opportunity to answer before proceeding to the meter. Do not attempt to tell a consumer what his bill will be, but always give the readings or amount consumed when requested. Be courteous in your dealings with consumers and others about the business of the water and light department and answer questions to the best of your ability. Explain things when requested, but do not argue with any one.

Plants in small towns can place the sheets in the meter books in alphabetical order and use the meter books as an alphabetical index, thereby saving the expense of keeping an alphabetical card index as any one meter book will rarely be out of the office more than one day. The writer has adopted this plan and in order that a meter reader unfamiliar with the route can take the readings, a route list is made on adding machine paper and rolled up on two short pieces of fibre tubing (about 1-in. diameter), which are held together by a rubber band. The route list is rolled from one cylinder to the other as the route is covered.

Statements are made on post card forms directly from the meter sheets and posting to the register is done from the statements after placing them in numerical order according to the account numbers. The form of register used in Ottawa is shown by Fig. 2.

The register possesses no especially new features unless it is the plan of providing columns for "Note numbers" which refer to remarks or explanations which may be necessary about entries made in the register. These explanations are recorded in a seaprate book (record ruling)and are given serial numbers. This plan affords an opportunity to make copious notes when necessary without disfiguring the register. The first few numbers in the "Remarks" book should be given over to explanations often required and then the insertion of the proper number in the "Note Number" column will refer one to the explanation previously written in the "Remarks" book.


WATER SERVICE CARD

No.... ....Street

Used for

Name of Consumer	On	Off

Fixtures Installed

Meter	Bath Tubs	Closets	Lavatories	Sinks	Plain Bibbs	Hose Bibbs	Yard Hydrant	Sill Cocks		Domestic Use No. of Rooms

Fixtures in Use

Fig. 3—Water Service Card Used by Ottawa, Kan., Water and Light Department.

As the meter book and register are the only books containing records of the consumers' accounts, the meter readings are recorded in the register in order that new meter sheets might be made if a meter book should be lost or destroyed. In using a large book of this kind it is necessary to have the account numbers in several places, as shown in Fig. 2, in order to minimize the danger of posting figures on the wrong line. Forty accounts can be carried on each folio in a book having sheet 16 ins. from top to bottom. Three lines should be provided at the bottom for the footings, the amount brought forward from the preceding folio and the total to be carried over to the next folio. The total collections at the close of the month or period allowed for the payment of bills must equal the amount charged, plus penalties and amounts unpaid at the beginning of the month, after deducting the credits or discounts given and balances unpaid and credits carried over to the succeeding month.

The cash book and a set of 4-in. by 6-in. service cards, a sample of which is shown in Fig. 3 and on which is recorded the street location of the service, fixtures connected and in use, measurements to locate stop box, class of service, etc., and names of different consumers with dates on and off, completes the office record except for the plumber's reports which are made on letter size paper and filed in vertical file folders. The service cards and plumber's reports are filed according to street locations.

Economical Operating Methods and the Study of Economies in Water Works Pumping Plants.

In Engineering & Contracting of March 19, 1913, an article was published entitled, "Practical Methods for Obtaining High Efficiency in Water Works Pumping Plants." The present article is along similar lines. The matter here given is from the paper of Prof. C. H. Benjamin, of Purdue University, before the recent annual convention of the Indiana Sanitary and Water Supply Association.

In studying possible economies of construction and operation for power stations, one must consider three factors: The rental due to the first cost of building and equipment, the cost of fuel, and the cost of labor. A power plant which is used ten or twelve hours a day for weekdays only will not always pay the interest on expensive equipment and must get along with moderately economical machinery. A plant which has a fluctuating load cannot afford compound or triple-expansion engines because of the extra expense of reserve units. A pumping station, on the other hand, with its 24-hour schedule and its reservoirs and storage tanks to steady the load, may well afford the best equipment which can be bought. The saving of fuel and labor in this case is continuous and will offset a much larger interest account than for the plants first mentioned.

To illustrate, I will quote a few figures from ordinary power station practice, since the principle involved is the same. The cost of buildings and equipment for a first-class power house having 1,000 H. P. capacity will be about $80,000, or $80 per H. P.. Possibly $60 of this sum represents the cost of engines and boilers, and the remaining $20 the cost of building and accessories. Assuming 10 per cent for interest, depreciation, etc., we have the following division of annual cost per horsepower in a plant of this size:

Rental	$ 8.00
Labor	10.00
Fuel	16.00
Incidentals	4.00
Total	$38.00

Various authorities give the annual cost of a horsepower in a plant of this size as from $35 to $45 for 24-hour service. It may be seen from these figures that a saving of 10 per cent in the fuel and labor bills will pay the interest on more than one-third the cost of equipment. We may, then, expect to see in a pumping station, compound or triple-expansion condensing engines, water tube boilers with chain grate or underfeed stokers, and mechanical methods of unloading, crushing and feeding the coal. The engine should be selected with a view to its economy and its durability. The test guarantee insures the former, and the weight per unit of capacity is a fair gage of the latter. In choosing between an engine which guarantees 18 lbs. of steam per horsepower and one which guarantees 16 lbs. under the same conditions, we must remember that this difference represents a saving of 11 per cent in fuel alone, or approximately $1.75 per horsepower per year. One thousand seven hundred and fifty dollars will pay the interest and depreciation on quite a respectable sum of money, probably much more than the difference in cost of the two engines. Condensation adds 20 or 25 per cent to the capacity and economy of the engine and in a water-pumping station costs but little.

After all, it is in the boiler room that the greater losses occur, and it is here rather than in the engine room that the up-to-date engineer will look for improvements. The boiler room is likely to be a rather dark, dirty sort of a place and its dull surfaces and dusty atmosphere are likely to be in marked contrast to the polished brass and steel of the room where the pumps are located. A little attention paid to the proper lighting and ventilating of this usually gloomy spot will be a profitable investment.

The efficiency of a boiler is the ratio of the heat units actually put into the steam to those available in the fuel and is usually about 60 per cent, when it might well be 70. Four hundred steaming tests of western coals reported by Professor Breckenridge in 1907 show boiler efficiencies ranging from 55 to 70, with an average of about 65 per cent. An efficiency of 60 per cent means that the coal is doing about one-thirteenth less work than can reasonably be expected at a loss of from 15 to 20 cts. for each ton of coal burned. The losses which go to make up the 30 or 40 per cent to be accounted for may be considered in the order of their importance as: 1. Escape of heat in chimney gases. 2. Loss of unburned gases. 3. Loss of unburned fuel in ash. 4. Radiation to ash pit and from outer brick work.

The first may be 15 or 20 per cent, the second 5 or 10 per cent, the third should not exceed 5 per cent, while the fourth is not to be measured directly, but represents whatever is otherwise unaccounted for. The first three losses above mentioned may be reduced to their lowest terms by simply insuring reasonably complete combustion of the fuel used. This involves the use of a mechanical stoker of a sufficient draft with good damper control and intelligent attention on the part of employes. In other words, efficient combustion requires a uniform supply of fuel and of air in the proper proportions and a thorough mixing of the two at a proper temperature. Doubtless, hand firing might be made to meet these conditions, but it rarely, if ever, does meet them. Irregular supplies of fuel cause the escape of unburned gases to the stack and unburned carbon to the ash pit. Irregular or poorly adjusted air supply causes variations in the stack temperature and, consequently, poor combustion. Too much air checks combustion and lowers stack temperatures; too little air causes incomplete combustion, smoke and dirty tubes. To properly regulate these two important factors, one must resort to mechanical aids, which are more or less automatic in their action.

To make this need clear, let us consider the aids to boiler-room economy in their order. The coal should be delivered in hopper cars, weighed on track scales at the plant and occasionally sampled by a competent chemist to determine its constituents. This procedure has an excellent moral effect on the coal company, even though it leads to no direct results. Properly, coal should be bought on a sliding scale in proportion to its heat value, but this is rarely done. The coal should be dumped from the cars into a bin underneath the track; and from that point, until it reaches the hoppers of the automatic stokers, it should be handled entirely by machinery. The labor expense will be reduced to one-fourth or one-fifth of that required when the fuel is unloaded and transported by hand. In like manner the ashes should be carried by machinery to the car or to the dump, and should be weighed in transit. The weight of ash is one indication of bad or good firing. If the chain grate stoker is used, experiments should be made with different thicknesses of fire and different rates of speed to determine which are best adapted to the kind of fuel burned and the particular load carried.

In like manner, tests should be made with various degrees of damper regulations to decide how much and how little draft can be advantageously used. Automatic damper control can then be adjusted to care for this permanently. Every boiler plant has its own personal equation, which must be worked out by the engineer in charge. A CO_2 recorder should be installed to show the composition of the stack gases and a good dial thermometer should be inserted to show the temperature. Some kind of automatic feed regulator should control the water supply of the boilers; a uniform boiler feed at a uniform temperature tends to make other factors more uniform and to improve the economy all around. Recording gages and a recording feed water meter are good investments if kept in order.

So far we have considered the installation of suitable machinery and apparatus for getting economical consumption of fuel. When all this is done, there remains the equally important problem of labor; unless that is efficient and well organized, all our pains have been for nothing. While the introduction of improved machinery cuts down the number of men employed, it necessitates a better quality of labor. Engineers and firemen who are to care for triple-expansion engines, water tube boilers and expensive coal handling machinery must be the best in their several classes—men who have the mechanical instinct, a good degree of common sense, and men who are absolutely dependable. No man who drinks should be allowed inside the building, and politics should be kept outside the gates. A daily log should be kept, which may include most, if not all, of the following items for the fire room: 1. Weight of coal burned. 2. Weight of ash rejected. 3. Weight of boiler feed. 4. Pressure at steam gage. 5. Temperature of stack gases. 6. Temperature of boiler feed. 7. Per cent of CO_2. For the engine room: 8. Volume of water pumped. 9. Pressure at head gage. 10. Level of suction well. 11. Pressure at condenser. 12. Temperature of superheat.

The gages and recorders should be of the recording dial type and the cards should be submitted with the log. A graphic log of the more important data should be kept by the chief engineer and hung on the wall, where it may be inspected at any time. It takes but little time each day to make these records, and they inspire everyone about the plant with an interest in its efficiency and the methods of improving it. After a time the firemen will, of their own pleasure, watch the readings of the CO_2 recorder and the various gages and appreciate their significance. The bonus system may be made effective by paying each employe a monthly bonus graded to his rate of pay and to the improvement in operating conditions. The pumping station I have described is an expensive one and might not be justified in all its details when the plant is a small one, but the principle is the same throughout. We must try to save fuel and labor, rather than to economize on overhead charges, if we are to have an efficient station and one that will justify itself for a term of years.

Methods Employed at Salamanca, New York, for Cleaning Out Old and Opening Up New Driven Wells—Economy of Natural Gas Pumping.

Contributed by H. E. Heller, Superintendent and Engineer, Water and Light Department, Salamanca, N. Y.

An article which appeared in ENGINEERING & CONTRACTING Jan. 15, 1913, relating to the sand pumping of driven wells at Ridgely, Md., while not being exactly a parallel case, suggested to the writer that methods used by him during the past year might prove of value to others in charge of water works properties. It is not claimed that this is a new departure and has not been used to some extent, but it has apparently received little attention by engineering publications and many are undoubtedly unaware of its possibilities in many cases where wells are not working at their best or have been abandoned as useless.

A short description of this plant, which embraces both the water and light equipment of the city, may not be out of place at this point as the results obtained by the reconstruction of an old obsolete property have been gratifying in the extreme and are worthy of consideration by those contemplating the building of new or the reconstruction of old plants. In 1905 the municipality acquired by purchase the water and light plant from a private corporation and reconstructed it along modern lines.

Briefly the lighting equipment at the present time consists of three 135 h. p. four-cylinder Bruce-Macbeth gas engines operating on natural gas of a thermal value of 1,000 B. t. u., which also supplies the pumping engines. The latter are a 100 h. p. two-cylinder and a 135 h. p. four-cylinder of the same make as the lighting engines, and are likewise equipped with a special gasolene attachment which guarantees continuous operation in event of failure temporarily of the natural gas. This attachment allowed the removal of the obsolete steam plant and gave room for additional gas engines which were afterward installed.

These two engines drive respectively a 1,500,000-gal. and a 2,500,000-gal. Worthington centrifugal pump. The pumps are now fed from eight 8-in. driven wells and discharge directly into the distribution system, the overflow going to a reservoir at an elevation of 170 ft. above the pumps.

The original wells, four in number, gave serious trouble during the winter of 1911, furnishing barely enough water to supply the demand, and it was determined to sink sufficient additional wells to guard against a recurrence of the difficulty.

The old wells mentioned were 8 ins. in diameter and were sunk to a depth of from 75 to 85 ft. and were in water nearly all the way down, the height of water in the pipe being dependent on the stage of water in the Allegany River, which flows about 250 ft. from them, indicating that the supply is unlimited and governed only by the number of wells. Being adequately protected from surface water the purity is unquestionable as the river bed acts as a perfect filter and repeated tests fail to show the slightest trace of contamination.

These wells were all tubed to a depth of 30 ft. with 5-in. pipe which was connected to an 8-in. suction line. Foot valves retained water in the line, and strainers made from 5-ft. lengths of 5-in. pipe each drilled with 650 ¼-in. holes were attached to end of each tube.

On examination after the difficulty mentioned it was found that small stones drawn from a depth of 50 ft. had partially filled these holes, and of course indicated that the wells were being forced. It was also found that one of the wells was fitted with a foot valve so small as to allow practically no water to enter the tube. This had always been considered the best well as the water in the 8-in. casing always remained at nearly the same level regardless of the pumping conditions, the reason for which was very apparent on examination of the foot valve. The history of this well was bad and efforts to clean it met with poor results. A set of tools had been lost in it, and as much trouble was experienced it was finally abandoned.

The three remaining wells were cleaned by the method described later in connection with the new ones. These wells, five in number, were located in a direct line, 45 ft. apart, between the pumps and the river and four of them offset merely enough to allow for connection into the suction line which varies in size from 6 to 12 ins.

The first well, located nearest the river, was driven to a bottom elevation the same as the deepest of the old wells but found clay which shut off the water and left it optional to drive through in an effort to open up another water-bearing stratum or pull it back. The latter course was decided on but the drive pipe pulled in two when subjected to a pressure of about 80 tons and this well was abandoned. The balance of the wells were all driven to within 7 ft. of this point, and no further trouble was experienced.

These wells were sunk with an ordinary portable drilling rig, and the cleaning started with a 4-in. Moran pump. The results obtained were not satisfactory, and a belt-driven 10x10-in. air compressor with a receiver was obtained, and for convenience in moving was bolted to a low heavy truck. The compressor was driven at 150 R. P. M. by a traction engine for want of a better prime mover and the outfit, piped to the bottom of the well to be cleaned with ¾-in. pipe, was complete. This pipe was arranged with swing joints so that the pipe could be moved vertically 3 or 4 ft.

When the air pressure reached about 100 lbs. the valve was opened admitting air to the bottom of the well and a solid 8-in. stream of water and gravel was thrown 20 ft. in the air. Stone nearly the diameter of the pipe were often ejected, and as the pressure reduced to 40 or 50 lbs. a slight agitation of the pipe would dislodge new masses of mud, sand and gravel which were in turn thrown out. By occasionally shutting the valve and using full pressure about 10 cu. yds. of gravel were taken from each well, and as this was used for concrete, and was ideal for the purpose, the cost of cleaning was nearly defrayed by that.

On measurement of flow when discharging with air pressure each well gave in excess of 400 gals. per minute without lowering the water level in the adjacent well perceptibly, and it is again evident that the supply is dependent only on the number of wells.

These wells as well as the old ones were tubed with 5-in. pipe fitted with a foot valve with inverted stem to guard against sand holding the valve up and the strainers instead of being drilled with round holes were slotted vertically every 1½ in. the full length, each slot being ¼ in. wide. This was to guard against round pebbles causing the trouble experienced before.

The vacuum shown at the pumps during the trouble of a year ago approached close to 28 ins., but now checks very nearly with the lift, an ideal condition.

It must not be assumed that all wells would respond to this method as the laws of hydraulics and pneumatics apply and such work should be undertaken only on the advice of a competent engineer. The writer recommended a trial in an adjacent village recently but was misinformed as to conditions, and was afterwards called in consultation. It was found that the depth of water was very close to the limit necessary and results would never have been obtained without a complete change in the arrangements. These changes were made and fine results were obtained.

It is interesting to note that in the year 1912, 201,500,000 gals. of water were pumped at a fuel cost of $700 or $3.16 per 1,000,000 gals. This is certainly exceptional and I think will compare favorably with any plant in the same class.

The Reduction in Typhoid Fever Rates in 16 Cities in New York Resulting from Improved Water Supplies.

The typhoid fever death rate in any city has proven to be the best index of the relation between the public health of the community and the purity of the public water supply.

Owing to the fact, however, that typhoid fever is traceable to other causes than impure water, and that contamination of supplies is generally of progressive occurrence, this relationship, as is well known to students of vital statistics, does not readily nor uniformly appear in the table or charts of typhoid fever rates of municipalities having public water supplies which are or have been subject to contamination. It is of considerable interest, therefore, to the water works engineer to find examples or illustrations in actual practice which show this relationship, especially where improvements have been made affecting the sanitary quality of the water.

The New York State Department of Health has for six years or more been actively engaged in a campaign for pure water supplies through the state. Although hindered greatly by inadequate laws and lack of direct control over public water supplies it has, by means of investigations, reports and educational measures brought strong and effective pressure to bear upon many municipalities in improving the quality of their supplies.

The results of these efforts are shown in the data here presented which show the typhoid fever rates in certain cities of the state where during recent years the Engineering Division has been especially active in this direction. The data here given are taken from the Bulletin of the Department for January, 1913.

Accompanying the typhoid statistics for each municipality is a brief statement of the essential facts having a bearing upon the sanitary quality of the supply. This comparison shows with marked clearness in nearly all cases, the lowering of the typhoid rates corresponding to the improvements in the water supplies responsible for them. If the data were plotted this relationship would be all the more apparent. The data follow:

Albany—Typhoid rate (per 100,000):

1900-5.	1906.	1907.	1908.	1909.	1910.	1911.	1912.
24.8	20.3	20.0	10.9	18.8	14.9	17.8	17.8

Water filtered since 1899 prior to which typhoid rate was over 80. Preliminary filters installed in 1910. Hypochlorite used at intervals during past three years. Note a great reduction, but not marked decline since filters were installed.

Amsterdam—Typhoid rate (per 100,000):

1900-5.	1906.	1907.	1908.	1909.	1910.	1911.	1912.
22.2	24.8	15.9	....	11.9	22.1	9.0	11.6

In 1908, department ordered city to inspect watershed, resulting in removal of violations. In 1910, as a result of department's recommendations, one polluted watershed abandoned. Note general but irregular decline in rate since 1906.

Auburn—Typhoid rate (per 100,000):

1900-5.	1906.	1907.	1908.	1909.	1910.	1911.	1912.
23.8	12.1	6.0	46.6	17.5	8.6	7.9	11.2

In 1906 rules and regulations protecting supply were enacted by department, since which time orders have been issued to local boards covering 170 violations. Water board maintains active sanitary patrol. In 1908 special orders were issued to the water board to remove all violations. With exception of 1908 note reduction and general low rate since 1905.

Binghamton—Typhoid rate (per 100,000):

1900-5.	1906.	1907.	1908.	1909.	1910.	1911.	1912.
25.6	9.1	18.2	15.2	13.1	12.4	4.0	17.8

Water supply filtered since 1902 prior to which rate exceeded 50. Note, as with the case of Albany, great reduction, but no marked decline since filters were installed.

Cohoes—Typhoid rate (per 100,000):

1900-5.	1906.	1907.	1908.	1909.	1910.	1911.	1912.
92.9	57.8	78.2	62.0	82.2	76.8	108.5	48.0

In February, 1908, the Mohawk River pollution investigation pointed out high typhoid fever rates and necessity for improved supply. In June, 1908, full investigation was made of water in connection with city investigation and water filtration was strongly urged. In 1911 filter plant was installed. Note reduction in rate in 1912.

Elmira—Typhoid rate (per 100,000):

1900-5.	1906.	1907.	1908.	1909.	1910.	1911.	1912.
45.5	44.7	28.0	30.7	33.5	26.9	13.3	15.9

In 1896, as result of serious epidemic, filtration plant installed. In 1909 investigation by department showed continued high rates and recommendations made to abandon local wells and increase efficiency of plant. Operation improved since 1909 and hypochlorite used during past two years. Note reduction in rate since 1909.

Lockport—Typhoid rate (per 100,000):

1900-5.	1906.	1907.	1908.	1909.	1910.	1911.	1912.
47.8	67.6	50.1	60.7	49.7	11.1	22.0	16.6

In 1906 as result of outbreak of typhoid fever the department recommended abandonment of polluted Erie Canal supply. Since 1909 the supply has been taken from Niagara River. In 1911 department recommended filtration. Note reduction in rate since 1909.

Middletown—Typhoid rate (per 100,000):

1900-5.	1906.	1907.	1908.	1909.	1910.	1911.	1912
24.1	18.8	18.8	42.1	18.1	26.1	59.1	26.5

Mechanical filter plant installed in 1900 and enlarged in 1909. Hypochlorite used recently. In 1908 department ordered city to inspect and remove violations on watershed. In 1912 outbreak of typhoid due to milk indicated high typhoid rate probably due in part to other causes than water.

New York—Typhoid rate (per 100,000):

1900-5.	1906.	1907.	1908.	1909.	1910.	1911.	1912.
18.6	15.5	17.4	12.8	12.7	11.6	11.0	9.7

Prior to 1907 practically no violations reported to the department for a number of years. Since 1907 some 267 violations of water rules examined into and necessary orders issued by department to local health boards. Since 1907 city very active in patrol of watershed and during past two years hypochlorite plant in use. Note marked decline since 1907.

Niagara Falls—Typhoid rate (per 100,000):

1900-5.	1906.	1907.	1908.	1909.	1910.	1911.	1912.
141.5	154.5	126.0	87.1	74.9	97.9	187.0	71.5

An investigation of the sanitary conditions of the city of Niagara Falls was carried on by the Engineering Division during the summer of 1907, following which the department strongly strongly urged a new or a filtered supply. In 1910, following another investigation, public warned of danger of supply. During 1912 filters installed, with hypochlorite treatment. Note marked reduction in rate in 1912 as result of filtration.

Ogdensburg—Typhoid rate (per 100,000):

1900-5.	1906.	1907.	1908.	1909.	1910.	1911.	1912.
52.8	67.3	47.1	26.8	26.8	37.5	30.8	36.7

In 1907 as result of investigation the department urged new filtered supply. Filtration plant installed during 1912. No typhoid deaths occurred during 1912 after filters were put in continuous use in the early fall.

Oswego—Typhoid rate (per 100,000):

1900-5.	1906.	1907.	1908.	1909.	1910.	1911.	1912.
47.5	58.0	66.0	62.2	26.6	51.2	12.7	21.0

In 1907, as result of investigation, department recommended new supply or purification. In 1910 new supply from Lake Ontario installed with hypochlorite used at intervals. Note decrease in rate since 1910.

Peekskill—Typhoid rate (per 100,000):

1903-5.	1906.	1907.	1908.	1909.	1910.	1911.	1912.
22.5	15.2	14.0	202.3	12.9	26.2	19.0	0.0

In 1906, as result of investigation, department urged removal of violations of water rules. In 1908, as result of typhoid epidemic, department renewed recommendations and urged water filtration. In 1910 new filters in permanent operation. Note reduction in typhoid rate since 1910, with no deaths in 1912.

Poughkeepsie—Typhoid rate (per 100,000):

1900-5.	1906.	1907.	1908.	1909.	1910.	1911.	1912.
42.4	39.4	112.0	34.5	23.0	17.8	14.0	13.7

In March and April, 1907, following a typhoid fever outbreak, department investigated water supply and recommended improvements in operation of filters. Following special report of Mr. George C. Whipple in April, 1907, improvements undertaken and completed in 1907. Hypochlorite used for past three years. Note marked and continuous reduction in typhoid rate since 1907.

Rensselaer—Typhoid rate (per 100,000):

1900-5.	1906.	1907.	1908.	1909.	1910.	1911.	1912.
67.5	18.6	58.3	30.0	29.9	28.0	18.7	9.4

Water supply filtered since 1901. Following recommendations of the department, since 1907 improvements in operation have been installed and hypochlorite used for past two years. Note continuous reduction since 1907 and especially in 1912.

Rome—Typhoid rate (per 100,000):

1900-5.	1906.	1907.	1908.	1909.	1910.	1911.	1912.
21.6	28.2	17.0	26.4	16.0	19.3	9.4	22.9

In 1908 department ordered city to inspect watershed and abate violation of rules and regulations. In 1910 and 1911 special inspections made by the department following which city urged to remove violations. Note general but irregular decline in rate since 1908.

Practical Results Following the Investigation of Methods of Operating the Pittsburgh Slow Sand Water Filtration Works.

In July, 1910, George A. Johnson, consulting engineer of New York, was engaged by Hon. W. A. Magee, Mayor of Pittsburgh, Pa., to make an investigation of certain features of construction and existing methods of operation of the slow sand water filtration works completed by that city in 1908 at a total cost of some $6,000,000. Mr. R. S. Weston of Boston was associated with Mr. Johnson on studies relating to the chemical phases of the problem.

The practical result of Mr. Johnson's investigation are set forth in the latest annual report of Mr. Chas. A. Finley, Superintendent of the Water Bureau. Abstracts from Mr. Finley's report follow:

It is noted with satisfaction that the total operating and maintenance charge for the year is almost $50,000 less than the cost of last year's operations. The total for the past year was $818,626.12; for the previous year, $868,141.07. Most of this saving is due to the improved methods of operating the filtration plant, the saving in operation at this plant during the last year being about $40,000.

The operation of the filtration plant for the past year has been attended with gratifying results from a financial and sanitary point of view, due to the fact that, with the improved methods of sand handling instituted last year, we were able to operate the plant about $40,000 cheaper than the cost of operating by the methods previously employed.

It appeared, from an examination of the records, that the operating cost of our plant was unnecessarily high. It also appeared that, at certain seasons, we got unusually small yields from filters between cleanings.

The question thus naturally divided itself along two lines: 1st. A study of the actual operating conditions within the filters, such as methods employed for sand handling, etc. 2nd. A study of the physical and chemical properties of the river water, for the purpose of devising methods of eliminating from the river water the causes of the excessive clogging prior to its application to the sand filters. The first question has been handled and investigated by Mr. Johnson. The second question has been handled and investigated by Mr. Johnson and Mr. Weston, acting in conjunction. These investigations began in July, 1910, and extended over about eighteen months' time, to January, 1912.

The principal changes in operating conditions within the filters were the introduction of the process of "raking" the filters between "scrapings," thereby securing additional yields from the filters at less expense than by continuous scraping, and a change in the process of restoring sand from restoring by machine to restoring from open hose lines under water.

The study of the physical and chemical properties of the river water was of necessity complicated and protracted, due to wide variation in the character of the water on account of seasonal and other changes. The investigations were continued until all the different types of water had been encountered, a large amount of data was compiled, careful study made thereof, and conclusions drawn therefrom.

In line with the conclusions, a system for the preliminary treatment of the river water was designed, and the necessary contract plans prepared for the construction of the same.

The result of these investigations indicates that the daily capacity of the plant can be increased from 125,000,000 gals. to 200,000,000 gals. without the construction of additional sand filters. The amount of water yielded by a filter between cleanings is an essential factor in the increased capacity of the plant. The prime object of preliminary treatment is the assurance of the necessary yield between cleanings. With this yield assured, the rate of filtration, or the amount of water filtered daily through each filter, can be increased so as to produce a total daily yield of 200,000,000 gals., and still maintain the economy of operations in sand handling.

To arrive at this total daily capacity by slow sand filters, without preliminary treatment, under the present conditions, would require the construction of about 30 additional slow sand filters of one acre each. The approximate cost of this installation would be over $2,000,000, not including the necessary land.

The annual saving in sand handling alone is $40,000 with the plant as it now stands, and if we consider the difference in cost between the extension of the present sand filters, without preliminary treatment, and the introduction of preliminary treatment, without extending the sand filters, as developed by the investigation, said difference being, in round numbers, about $1,600,000, exclusive of land, and allow 5 per cent annually on this saving, it amounts to $80,000, which, with the $40,000 saved in operations, makes a total of $120,000.

The Pittsburgh filtration works, under skilled supervision, and with the final filtered product sterilized with hypochlorite of lime, have cut the typhoid fever death rate to a practical minimum. The typhoid fever death rate per 100,000 population from 1906 to 1911, inclusive, was 141, 135, 53, 13, 12 and 10, respectively. It is thus seen that the results achieved at Pittsburgh in this line are by far the most gratifying and spectacular ever noted in connection with water purification in this country.

BOOK REVIEWS

Earthwork Haul and Overhaul.—By J. C. L. Fish. John Wiley & Sons, New York. Cloth, 6x9 ins.; 165 pp.; illustrated; $1.50.

This work relates to the computation of overhaul and to the use of the mass curve in planning the distribution of earthwork. The book is addressed to railroad engineers and contractors, and to computers, students, and teachers. It is divided into two parts having seven and three chapters respectively. Each chapter opens with a brief summary of the matter discussed in it. We are here giving the gist of those various summaries to show the scope of the book.

Chapter I shows the necessity of adopting an ideal distribution, instead of the actual, as a basis of computing haul or overhaul. The chapter also discusses swell and shows the uncertainty of any prediction of the amount of swell under some common conditions. A method for determining the most reasonable swell factors is given for those cases where field measurements for exact determination are not available. Chapter II gives the principles underlying the construction and interpretation of the mass curve, describes the horizontal and oblique balancing line, and discusses the effect of errors in drafting upon the results obtained from the mass curve. Chapter III tells how to determine the limits of a body of material in cut or fill from given conditions by eye, by arithmetic, and by mass curve; also how to determine the center of volume or mass of such a body. Chapter IV gives eight methods, of all degrees of accuracy, for finding the center of gravity of a body of material by eye, by arithmetic, or by mass curve. All the methods are applied to the same problem. Chapter V defines overhaul and gives a digest of American practice in computing it. The American Railway Engineering Association specification, upon which all the problems worked out in this book are based, is presented. Three methods of determining free-haul limits are given, namely, by eye, by arithmetic, and by mass curve. Crosshaul is discussed, and eight methods of computing overhaul are summarized. In Chapter VI a representative problem in overhaul is computed by the eight different methods just mentioned. The computations are presented in formal steps and in detail. This chapter is intended to serve the computer who has chosen one of the eight methods of computing overhaul as a guide to his computations. Chapter VII is similar to the preceeding chapter in scope and presentation, but the specimen problem solved is complex. This chapter concludes Part I.

Part II is devoted exclusively to problems of future haul. Chapter VIII discusses the effect of swell on planning distribution, and limit of profitable haul; this chapter also states the principle of economic distribution. Chapter IX discusses the application of the principle of economic distribution to each of several typical forms of mass curve, progressing from the simple to the complex. All the mass curves of this chapter are assumed to be plotted from "pay yards," that is, from yards in place. All of the mass curves of Chapter X are assumed to be platted from yards of swelled material. Otherwise the two chapters are similar.

This book will be of the very greatest service to all students of haul and overhaul. It should go far toward the total elimination of the disagreements which frequently arise between railroad engineers and contractors over the proper method of computing overhaul.

The Practical Railway Spiral.—By L. C. Jordan. D. Van Nostrand Co., New York. Leather; 4x7 ins.; 155 pp.; illustrated. $1.50.

The author of this work has, in the book before us, made a very commendable statement of the present inconsistencies in the use of spiral curves on American railways, and has followed up the statement of present faults in this connection with the recommendation of a carefully worked out and entirely practical spiral.

Chief among the inconsistencies in present practice, to which the author refers, are the following: Some railways vary the length of spiral with the degree of curvature, some with the amount of superelevation, others with the speed of the fastest train, and others vary the length of the spiral with the product of two of the factors just enumerated.

The author adopts the following rule for increasing the degree of curvature in his spiral as giving the closest possible approach to the ideal and practical curve easement:

> Divide the spiral length into six equal parts; attain 5 per cent of the desired degree of curvature in the first part; in each of the next four equal parts of the spiral length attain 20 per cent of the desired degree; and in the remaining portion of the length increase the degree of curvature the remaining 15 per cent.

The author chooses 2 ins. per second as a safe rate of change in superelevation to be employed in finding the minimum length of spiral for a given speed and superelevation. The general equation for length of spiral then becomes

$$L = 11/15\ V E$$

where L = length in feet, V = velocity of train in feet per second, and E = superelevation in inches.

There are, however, many practical objections to various lengths of spiral on the same stretch of track. One serious objection is the inability of section foremen to ascertain the exact position of the spirals unless the track is unusually well monumented. The author urges the advantages of employing a constant length of spiral for all curves of the same line. He considers that 150 ft. for the majority of lines and 300 ft. for the high-speed lines are best suited to the practical requirements of actual working conditions. In order to increase the elasticity of his curve he has also chosen lengths of 225 and 450 ft. Upon these lengths and the author's rule for rate of change of degree of curvature along the spiral as quoted above, he proceeds to work out all of the mathematical properties of his curve. The curve is easily applied to all problems of new and revised locations.

The book contains numerous tables which give all deflection and other angles and other functions of the curve for the four lengths above stated and for all the ordinarily used degrees of curve. Simple formulas are given from which the elements of any curve not tabulated can be easily computed. The book should go far towards bringing order out of the present chaos in railway spiral practice.

Alternating Currents Simplified.—By Elmer E. Burns. The Joseph G Branch Publishing Co., Chicago, Ill. Cloth, 5¼x7½ ins.; 138 pp.; illustrated; $1.50.

It is the aim of this book to give the electrical worker such a clear understanding of the action of an alternating current as to form a safe and sure foundation for his work. Alternating current machinery is not described, but rather the principles upon which the design of alternating current machinery is based. The book has fifteen chapters as follows: How Alternating Currents are produced; What is an Alternating Current? Magnetite Force of an Alternating Current; What is Self Induction; What is Capacity; Curve Tracing; Phase and Frequency; Volts and Amperes in an A. C. Circuit; Power Factor; Choking Coils; Magnetic Power Losses; Transformers; Converters and Rectifiers; Transmission of Power.

Practical Kinks, Recipes and Tables.—Collected by Joseph G. Branch. The Joseph G. Branch Publishing Co., Chicago, Ill. Cloth, 5¼x7½ ins.; 142 pp.; illustrated; $1.

This is a collection of descriptions of methods of handling details in mechanical and electrical work. The volume illustrates the valuable experiences of workers and shows the little schemes and "kinks" which have been found practical in everyday work. The book is indexed for easy reference so that the contents may meet the needs of engineers and mechanics.

Practical Mathematics for the Engineer and Electrician.—By Elmer E. Burns and Joseph G. Branch. The Joseph G. Branch Publishing Co., Chicago, Ill. Cloth, 5¼x7½ ins.; 138 pp.; illustrated; $1.

In this series of articles the authors have worked out problems useful for the practical engineer and electrician. The book is devoted to problems in computing the cost of supplies and the cost of power, computing estimates of cost of the proposed installations, including material and labor, and to work out the problems that arise in every power plant. It contains many valuable suggestions, even for those well initiated.

Questions with Answers on Pumps and Pumping Machinery.—By W. H. Wakeman. The Joseph G. Branch Publishing Co., Chicago, Ill. Cloth, 5¼x7½ ins.; 187 pp.; illustrated; $1.50.

This book presents a working knowledge of various kinds of pumping machinery required by widely different conditions. The operations of pumps for boiler feed service, for pumping chemicals, for dredging, unwatering cofferdams and for many other services, are described in questions and answers. Various types of pumps for each class of work are illustrated and described. The book is indexed.

Cement Specifications.—By Jerome Cochran. D. Van Nostrand Co., 25 Park Place, New York. Cloth, 5⅝x8⅝ ins.; 102 pp.; illustrated; $1.

This is the most complete treatise on specifications for cement yet published. The book is so arranged that the engineer can select clauses from the text and incorporate them into the specifications being prepared. A logical order has been observed and care has been taken in classifying and arranging the various requirements for convenient practical use and ready reference. The titles of the chapters indicate the scope of the contents of the book. They are as follows: General conditions governing the use of cement; furnishing cement to the contractor; purchase of cement from manufacturer; delivery and storage; inspection and tests; test requirements; methods of testing; significance of tests; methods of chemical analysis; and bibliography of specifications for cement.

Iron and Steel Constructional Work.—By K. Schindler. Translated by Charles Salter. D. Van Nostrand Co., New York. Cloth, 5x7 ins.; 140 pp.; illustrated; $1.25.

This work is a translation from the German and is adapted to British practice by the translator. It relates entirely to the use of iron and steel in buildings.

The book is divided into five sections as follows: Columns, girders and beams, roof construction, iron staircases and skylights, floor-lights, and glazed roofing. There are numerous illustrations of cast iron and steel details as used in building construction. The illustrations are sketches and do not, as a rule, show details of rivetting, dimensions, etc. Numerous examples are given to show the method of designing the various structural features illustrated and described. There are also the usual tables of properties of sections, safe loads, logarithms, antilogarithms, natural functions, squares, cubes, areas of circles, and metric conversion tables.

The book will serve admirably for a first text in a home study course of architectural engineering or for the technical graduate who wishes to brush up on the subject. The practical designer will find the book useful as a source of suggested structural details for which he can readily work out the mathematical details.

NEWS SECTION

Editorial Comment—Personals—Society Meetings—Trade Notes—Catalog Reviews—Contract News, Embracing Bids Asked, Work Projected, Contracts Let and Contract Prices on All Classes of Civil Engineering Construction Work.

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The Doings of the Week.

Although few railroad construction contracts of any size appear to have been awarded the last few days, the situation, nevertheless, may be said to be fairly encouraging. Figures have been taken on several large contracts, and it is expected that these will be let in the immediate future. The Chicago, Burlington & Quincy R. R. is now considering bids for constructing a third track from Galesburg to Wataga, but will not let the contract for several days. Bids are also in on the 5½ mile tunnel through the Selkirk Mountains for the Canadian Pacific Ry. This contract also has not been let at this writing. The West Virginia & Ohio Construction Co., owing to flood conditions in Ohio, postponed the opening of bids for the construction of 24 miles of railroad between Wellington, O., and Ashland, O., until April 21. Among the contracts let recently are the following: A. H. Smith, Pueblo, Colo., for grading for 12 miles of line for the San Luis Valley R. R. through the sugar beet fields at Bueno Vista, Colo.; C. D. Langhorne Construction Co., Beaver, Ky., for construction of a 21-mile line in Floyd County, Ky., for the Chesapeake & Ohio Ry.; T. Daly, Montreal, Que., for completing the Leois-New Brunswick section of the National Transcontinental Ry., 190 miles.

Nothing of any particular importance has developed in the way of state highway construction. Iowa and Arkansas have organized highway commissions under new state aid laws passed recently. About the largest highway contract that has come up for bids since our last issue is the work at Danville, Va. This calls for the construction of 6½ miles of macadam and 37½ miles of soil road in Dan River District of Pittsylvania County, Va. In Indiana the Commissioners of LaPorte County are calling for bids on a macadamized road 18.3 miles long in Pleasant, Lincoln and Washington Townships.

A good sized tunnel contract at San Francisco has been awarded lately. This calls for the construction of the Stockton St. tunnel, the first of several similar ones proposed by the city. Jacobson, Bade Co. secured the work at $337,000.

For the next few months Ohio will offer a promising field for the bridge contractor. Information collected by the State Highway Commissioner regarding the destruction of bridges in that state by the recent flood show that nearly 1,000 highway bridges were damaged. It is believed that it will cost nearly $7,000,000 or $8,000,000 to repair or replace these structures. In the way of bridge contracts let recently, the largest appears to be for work at Houston, Tex. This city has let a contract for the San Jacinto St. bridge to William P. Carmichael & Co., Houston, at $128,214; contract for the Capital Ave. bridge was let to H. C. Gass, Houston, at $88,500. The city of Pittsburgh, Pa., is preparing to call for bids on two large bridges. One of them, the Bloomfield bridge, will cost about $500,000. The other bridge will be built of reinforced concrete and will cost about $175,000.

The South Park Commissioners of Chicago, Ill., are preparing to go ahead with the Burnham plan of an outer parkway and lagoon from Grant Park to Jackson Park. This improvement will, when completed, cost about $10,000,000. The central feature of the plan is a filled in strip of outer driveway and paved beach, 1,800 ft. off the present shore line. Between the driveway strip and the shore will stretch an uninterrupted waterway 6 miles long, connecting with Grant Park on the north and Jackson Park on the south. The first work will be the construction of 1,800 ft. breakwaters at 35th and 53rd Sts.

One of the largest municipal contracts of the week is now being advertised by the City Commissioners of Montreal, Que. This calls for the enlargement of the city's aqueduct, forebay and tail race for a distance of about 31,000 ft. The work includes 2,350,000 cu. yds. of earth excavation; 436,000 cu. yds. rock excavation, and 203,000 cu. yds. of concrete.

Bids were opened last week by the Passaic Valley Sewerage Commission of Newark, N. J., for the construction of another section of the main intercepting sewer. Harrison & Craig, Newark, N. J., at $237,300, were the low bidders.

The House of Representatives of Iowa has passed a bill which, if it becomes a law, will make it much easier to finance proposed electric railways in that state. The bill provides that property owners within five miles on each side of a proposed line may vote a tax on themselves to aid the construction of an electric road or the electrification of a steam road. The Minneapolis & St. Louis R. R. is considering electrifying its line from Fort Dodge to Humboldt, and the Rock Island is contemplating a like change to its line from Livermore to Spirit Lake.

The State Senate of Iowa has passed a joint resolution providing for the expenditure of $856,000 for buildings and improvements at three state educations institutions. The expenditures are as follows: State University—New gymnasium, $125,000; roof for medical laboratory, $12,000; warehouse, $3,000; repairs for chemical laboratory, $8,000; tunnel to Currier hall, $13,000; kitchen for hospital, $15,000. State Agricultural College—New chemistry building, $250,000; agricultural laboratory, $95,000; transportation laboratory, $65,000; animal husbandry laboratory, $50,000. State Teachers' College—Women's dormitory, $100,000; manual training laboratory, $100,000.

Divining Rod Tests.

Tests of the powers of users of the divining rod, conducted recently in France, gave some surprising results, if the Paris correspondent of the London Daily Mail is to be believed. The experiments were made under the direction of M. Armand Vire, a professor at the Museum of Natural History, Paris, who is investigating, under the auspices of the Congress of Experimental Psychology, the subject of rhabdomancy. The tests were carried out in the Bois de Vincennes, a part of which is underlaid by a large deserted quarry. The four "subjects" were asked to point out the underground galleries and shafts, and their statements were compared by M. Vire with a specially constructed chart, showing the exact positions of the subterranean passages. The first "diviner" carried a supple forked hazel wand, and for sometime he walked steadily forward, the stick trembling slightly in his hand. Suddenly the wand twitched and the man, stopping, stated that a cavity began there. He then walked around the grass slope to measure the extent of the cavity and gave his observations to M. Vire, saying that pit was over 50 ft. deep and there was no water in it. The other diviners, using wands of whalebone, bamboo and copper, located three other underground pits, and marked them out with bits of paper and gave their approximate depths. One man indicated four galleries, which branched from the main shaft, the location of which he had marked out in the turf. When the results were compared with the official map it was found that all four of the men had succeeded with more or less accuracy in marking out caverns or pits which actually existed, and that the depths given were correct. The four galleries indicated by one of the men, were also traced on the map. This man, in a further test, was led blindfolded over the area, and the result he obtained corresponded almost exactly with the first indication he had given. It is stated that two of the diviners, as a proof of the magnetism with which they estimate, placed their hands on an ordinary compass and made the needles, jump and swing from pole to pole.

Tunnel Work in Canada.

It was a Scotchman, fresh from railroad construction in the old country, who when shown the surveys for a proposed railway in Iowa, the route of which ran across land as flat as a table top, expressed the opinion that it was impossible to build such a line. "How the de'il, mon," said he, "are ye going to make your tunnels." Were the man from the land of the heather to visit Canada at the present time he would whoop with delight, for the three larger Canadian railways have under construction, or in contemplation, a choice little collection of "holes through mountains." Some of these tunnels are no inconsiderable projects, as for instance, the bore now being driven by the Canadian Northern Ry. for an entrance to Montreal, or the 5½-mile tunnel through the Selkirk Mountains on which bids were opened last week by the Canadian Pacific Ry. But these are small prices of work as compared with the 15-mile tunnel through Kicking Horse Pass in the Rocky Mountains, which, according to press dispatches, will be placed under construction in the near future by the Canadian Pacific.

PERSONAL

Mr. Angus Smith has resigned as city engineer for North Vancouver, to take effect May 1.

Mr. John Holden and Mr. H. C. Beard have been appointed to the state highway commission of Iowa.

Mr. E. R. Morgan, formerly chief deputy state engineer for Utah, has been appointed state road engineer.

Mr. G. H. Kimball of Detroit has been appointed as engineer for the Terminal Commission of Buffalo, N. Y.

Mr. Julian Griggs, chief engineer of the Lancaster Traction & Power Co. of Columbus, Ohio, has been appointed city engineer for Lancaster, Ohio.

Mr. Thomas Berry has become associated with Mr. Wilhelm K. Winterhalter for consulting engineering practice, with offices in the Hearst building, San Francisco.

Mr. William B. Fuller, consulting engineer, 150 Nassau street, New York, is said to have been captured by Mexican bandits in the state of Chihuahua and held for ransom.

Mr. L. H. Neilson, formerly United States engineer in the Philippines, and Mr. K. J. Sawyer have been appointed as engineers on the Michigan State Highway Commission.

Mr. Irwin S. Osburn, engineer in charge of the municipal reduction plant at Columbus, Ohio, has been placed in charge of the work of cleaning up the flooded portion of the city.

Mr. W. J. Weller has been appointed superintendent of bridge construction for the Canadian Northern Railway. Mr. Weller was formerly provincial bridge builder for Manitoba.

Mr. Roy Buzzell has been appointed as chemist for the filtration plant at Flint, Mich. Mr. Buzzell is a graduate of the chemical engineering department of the University of Michigan.

Mr. J. A. Loughlin has formed a partnership with Mr. H. DeW. Rapalje, civil engineer, for general engineering practice at Wilmington, N. C., under the firm name of Rapalje & Loughlin.

Mr. Sylvester Q. Cannon, consulting, mining and hydraulic engineer of Salt Lake City, has been appointed city engineer for Salt Lake, succeeding Mr. D. H. Blossom, who recently resigned.

Mr. Charles B. Kingsley has become associated with Mr. W. H. Breithaupt, consulting engineer of Toronto, Ont. Mr. Breithaupt was associated with the late E. H. Keating, under the firm name of Keating & Breithaupt.

Mr. H. R. Parsons has been appointed city engineer for Peterborough, Ont. Mr. Parsons has been for the past six years assistant city engineer in charge of pavement, sewer and waterworks construction, for Ottawa, Ont.

Mr. William J. Thompson, president of the New York Concrete and Waterproofing Co., died in New York April 7. Mr. Thompson was formerly an engineer in the United States Army, and worked on the Panama Canal.

Arthur H. Blanchard, professor of highway engineering, Columbia University, on April 10 delivered an illustrated address entitled, "Modern Bituminous Pavements for Municipalities," before the Board of Trade, Elizabeth, N. J.

Mr. N. E. Brooks, formerly division engineer at Calgary, Alta., for the Canadian Pacific railroad, has been appointed engineer for the Maintenance of Way department, succeeding Mr. R. C. St. John. He will be succeeded at Calgary by Mr. F. W. Alexander.

Mr. James A. Armstrong has formed a partnership with Mr. Chester H. Prouty, for general engineering practice, specializing in soils and irrigation work. Offices will be in the Forsyth building, Fresno, Cal. Both Mr. Armstrong and Mr. Prouty were formerly in the engineering department of the Union Sugar Co., Santa Barbara, Cal.

Mr. Theodore Turner, mayor of Pocatello, Idaho, and president of the Idaho State Automobile Association and of the Bannock County Automobile Club, has been appointed by the governor of Idaho as chairman of the newly created state highway commission.

Mr. Philip H. Diehl, electrical engineer and inventor, and founder of the Diehl Manufacturing Co., died at his home in Elizabeth, N. J., April 7. Mr. Diehl was born in Germany, and came to New York in 1868. He placed the first electric fan on the market.

Eugene E. Haskell, director of the college of engineering, Cornell, William J. Stewart, chief hydrographer, Department of Marine and Fisheries, Canada, and Victor F. W. Forneret, engineer in charge, St. Lawrence ship channel, have been appointed as a commission to investigate water levels on the St. Lawrence river.

Mr. F. W. Adgate, western manager for the Foundation Co., with headquarters at Chicago, has taken charge of the work on Dam No. 12, Ohio river, at Wheeling, W. Va. He will be located at that point during the present season. Mr. R. J. Jackson, who has been superintendent on shaft construction for the Foundation Co. in the Northwest, is acting manager in Chicago during Mr. Adgate's absence.

Civil Service Examinations.

The United States Civil Service Commission announces examinations as follows:

Copyist Marine Engine and Boiler Draftsmen; $2.80 to $3.28 per diem; May 21.

Mineral Examiner; Surveyor in General Land Office, $7.00 per diem; also mineral examiner in the Forest Service at $1,800 per annum; May 21.

Assistant Engineer in 'Forest Products; $1,200 per annum; May 21.

Structural Steel Draftsmen; $4.72 per diem; May 21-22.

Drainage Engineer; $1,200 to $2,000 per annum; May 21.

INDUSTRIAL

Mr. Hugo Burgheim has opened an office in the Mercantile Library Bldg., Cincinnati, O., as dealer in railroad and contractors' equipment.

A contract has been awarded to the Raymond Concrete Pile Co., New York and Chicago, for placing 600 standard Raymond concrete piles for the foundation of the venturi meter and valve house at the Porter Ave. Pumping Station, Buffalo. Esenwein & Johnson, Architects, Buffalo, N. Y.

The Merchants' Association of New York has moved into its new headquarters in the Woolworth Building, 233 Broadway, its old quarters at 54-60 Lafayette St., having been outgrown. The new headquarters occupy the greater part of the ninth floor of the Woolworth Building, and they afford ample accommodations for the many acitivities of the Association. Organized in the heart of the wholesale dry goods district in 1898, concurrently with the creation of Greater New York by the annexation of Brooklyn, Queens, and Richmond, the Association has grown until it now has upward of 3,300 members. Among them are numbered not only leading merchants and manufacturers of the City, but also the representative firms, corporations, and individuals in practically every field of business and professional life in the five Boroughs. The headquarters of The Merchants' Association are so situated as to be easily reached by the various transit routes, and are therefore convenient of access for members of the Association and for visiting merchants from other cities. They contain a large assembly-room for meetings of the members, a reference library, and separate rooms for the officers and directors, and for the Industrial, Traffic, Publicity, Membership, and Convention Bureaus which have recently been organized by the Association.

CATALOGUES

Farquhar Engines.—Paper, 9x11 ins., 4 pp. A. B. Farquhar Co., Ltd., 716 North Duke St., York, Pa.

This folder contains illustrations of the Farquhar Double Cylinder Road Engine and its principal parts. Brief descriptions are given. An accompanying folder gives the dimensions of the various engines, boilers and traction parts.

First Aid Cabinets.—Paper, 5¾x8¼ ins., 12 pp. Johnson & Johnson, Lack St., New Brunswick, N. J.

This is a very complete catalog describing a number of emergency medical and surgical outfits put up in cabinets for use by contractors and manufacturers. Accompanying the various outfits is a book describing methods of rendering aid to the injured.

Wood Working Machinery.—Paper, 4x6¼ ins., 64 pp. A. H. Hitchcock, 1220 Caxton Bldg., Chicago, Ill.

This is the April number of this book which is called "The Wood Working Machinery List." It is a reference list for buyers of this class of machinery.

Turbine Sewer Cleaning Apparatus.—Paper, 5½x8½ ins., 4 pp. The Turbine Sewer Machine Renovating Co., 197 11th St., Milwaukee, Wis.

This circular contains reprinted articles and comments of the daily papers upon a competitive test of sewer cleaning apparatus made under the supervision of engineers and members of the Board of Public Works of Kansas City. Accompanying pamphlets illustrate and describe the methods of operating the turbine machine.

Cement Sacks.—Paper, 6x9 ins., 1 p. Universal Portland Cement Co., 72 W. Adams St., Chicago, Ill.

This circular contains a reprint from the April number of the Universal Dealer, which gives an autobigraphy of a cement sack, by way of impressing contractors with the importance of caring for sacks.

Francke Flexible Couplings.—Paper, 6x9 ins., 8 p. Smith-Serrell Co., Inc., 90 West St., New York City.

Bulletin No. 18 describes a new type of flexible coupling which is simply an ordinary flange coupling connected by flexible instead of rigid bolts. The details of the connection are illustrated and described very clearly and tables of dimensions, sizes, etc., are given.

Concrete Silos.—Paper, 6x9 ins., 44 pp. Polk-Genung-Polk Co., Fort Branch, Ind.

The Polk System of silo construction is described in this catalog in detail with illustrations of the work in progress, including drawings showing the method of handling silo forms, etc. The book also contains some interesting historical facts regarding the use of concrete.

The York Gas Engine.—Paper, 6x9 ins., 98 pp. Flinchbaugh Mfg. Co., Railroad Ave., York, Pa.

This is catalog 12-E. It contains illustrated descriptions of the York gas engines for use on contract work. Various types of portable and stationary engines are shown. Traction engines are also included.

Hydraulic Dredges.—Paper, 6¼x9½ ins., 48 pp. Ellicott Machine Co., 91 Bush St., Baltimore, Md.

This book contains full page illustrations with brief descriptions of a number of types of hydraulic dredges, including high power pipe line dredges for rehandling, dredge machinery, etc.

RAILWAYS

Alabama.

A project is under consideration for the construction of an interurban line from Melbourne, county seat of Izaid County, to Guion on the White River R. R. J. E. Baker, Melbourne, Ark., is interested.

Arkansas.

The Pine Bluff & Sulphur Springs Interurban Ry. Co., the incorporation of which was mentioned in our last issue, propose construction of an 8-mile line from Pine Bluff to Sulphur Springs. A. G. Russell, Pine Bluff, Ark., is President.

California.

It is stated $410,000 of stock for the projected Sacramento Valley Electric Ry. have been sold, and that it is now planned to let the first contract for grading in Solano County next month. Brainard Bros., Woodland, Cal., are fiscal agents for the road.

A report has been submitted to the Board of Supervisors of San Francisco by M. M. O'Shaughnessy, City Engineer, on proposed municipal railway extensions to provide adequate transportation and service for the 1915 exposition. The report suggests that work be expedited on the Van Ness Ave. and the projected lines. Three combinations of routes are recommended, the estimated cost of these being $2,742,000, $2,565,700 and $2,437,000.

The Santa Rosa & Petaluma Ry. Co., E. M. Van Frank, President, Petaluma, Cal., has been granted permission by the State Railroad Commission to issue $80,000 of bonds. The proceeds are to be used for a construction of 5½ miles of electric railway from the main line at Liberty Station to Two Rocks. It is expected that the extension will be completed by Aug. 1.

Colorado.

⦿A. H. Smith, Pueblo, Colo., has been awarded a contract amounting to about $20,000 for grading for 12 miles of railroad for the San Luis Valley R. R. from the sugar beet factory at Bueno Vista through the beet fields.

An expenditure of about $250,000 is proposed by the Denver & Rio Grande R. R. for the construction of new roundhouse, machine shops and tracks at Grand Junction, Colo.

A plan is reported under consideration for the reorganization of the Laramie, Hahns Peak & Pacific R. R., now in the hands of a receiver. The plans are understood to call for 10 per cent assessments on holders of $1,000,000 of unsecured notes and $450,000 of secured claims; and 4 per cent on holders of preferred and common stock. The total amount of such assessments is $507,000. A new company with $2,000,000 of 6 per cent, and $3,000,000 of preferred and common stock, may be organized.

Florida.

A project is under consideration for the construction of a suburban car line from Arcadia to a point on Lake Okeechokee. E. Prouty, Arcadia, Fla., is interested.

Surveys are now being made for the line of the Tampa & Gulf Coast R. R. from Tampa to St. Petersburg, Fla. The capital for construction purposes has been arranged for and contracts will be let at once. The company will build most of its road, letting only small contracts. O. N. Axtell, Tampa, Fla., is Chief Engineer, and Chas. H. Brown, Tampa, Fla., is President.

Georgia.

The Louisville Construction, Land & Development Co., Louisville, Ga., has been organized with a capital stock of $50,000, all of which has been subscribed, and proposes the construction of a 20-mile railroad from Louisville to St. Clair, Ga. W. W. Abbott, Louisville, Ga., is interested.

The Greene County R. R., W. D. Branan, General Manager, Bostwick, Ga., is contemplating the construction of an extension to Monroe, Ga., and from that place to Loganville, where a connection will be made with the Seabord Air Line Ry.

Illinois.

E. W. Clark & Co., 321 Chestnut St., Philadelphia, Pa., owner of the traction property at Alton, Ill., is planning to extend the line from Alton to the site of the new State Hospital for the Insane and thence to Bethalto and Fosterburg.

The Chicago, Burlington & Quincy R. R. has taken bids on constructing a third track from Galesburg to Wataga. The contract will not be awarded for several days.

The Lomax Terminal R. R. Co., of Lomax, Ill., has been incorporated with a capital stock of $25,000 and proposes to construct a line from Nauvoo, Hancock County, through the counties of Hancock and Henderson, to Stronghurst, Henderson County. The incorporators and first Board of Directors are: William T. Love, J. F. Smith, C. H. Kisner, H. W. Beardsley and L. O. Beardsley, all of Lomax.

The Wabash R. R. is contemplating improvement at Granite City this summer and fall which will call for an expenditure of about $500,000. These improvements are understood to include an office building, a new round house, station, freight house, 30 miles of track and the removal of the yards from Venice to Granite City.

The Santa Fe System plans the following minor improvements for the near future: Albuquerque Division—Extending bridge No. 265A, $6,533; constructing a reading room at Winslow, $19,130; erecting sand house and necessary equipments at Seligman, $3,045. Arizona Division—Providing a pumping plant at Pica, $7,372; extending passing track at Powell, $6,800; building and opening under the Ludlow Southern Ry., $10,994. Arkansas River Division—Placing bridges 545-546-548, $4.700; providing new machinery and other improvements at La Junta, $1,300. Beaumont Division—Renewing bridge No. 3A, $3,741; constructing a well and storage reservoir at Silsbee, $4,500. Colorado Division—Replacing 3 bridges, $4,000. Eastern Division—Purchase of a locomotive weighing scales and new machinery at Topeka, $52,500. Galveston Division—Building a new depot at Seeley, $24,493; supplying additional water facilities at Wallace, $6,952; constructing stock track at Alvin, $3,232; constructing a team track at Burroughs, $3,066; installing air compressor, reservoir and air line, at Galveston, $3.446. Illinois Division—Improving signals at Romeo, Edelstein, Willow Springs and Coal City, $8,000. Kansas City Division—Purchasing a 120-ton self propelling wrecking derrick, $16,000. Los Angeles Division—Replacing bridge, $2,618; installing side track at Ocean Side, $4,275; building passing track at Morena, $7,195; constructing side track and depot at Vista, $8,007; installing a spur track for the Factory Site Company at Los Angeles, purchasing an electric transfer crane for the team tracks at San Diego, $4,722. Middle Division—Replacing and renewing 4 bridges, $9,000; providing improved water facilities at Peabody, $6,821; installing automatic signals at Sand Creek, $4,662; installing automatic signals at Newton, $7,352. Missouri Division—Constructing a side track at South St. Joseph, $5,207; installing a spur track for the Martin & Hubbell Coal Co., at Camden; installing a telephone train dispatching circuit between Lexington Junction and St. Joseph, $9,974.

Indiana.

George R. Sheldon, New York City, representing the bondholders, has purchased at receiver's sale the Toledo & Chicago Interurban Ry. at the upset price of $550,000. The property will now go into the hands of a reorganized company to be known as the Fort Wayne & Northwestern Traction Co.

The Fort Wayne & Northwestern Ry. Co. of Kendallville, Ind., has been incorporated with a capital stock of $1,950,000, of which $10,000 has been subscribed. The company proposes to operate a line starting at Fort Wayne and extending to Huntertown, Garrett, Auburn, Waterloo, Avilla and Kendallville, thence west to Brimfield, Wawaka, Ligonier, Millersburg and Goshen, thence connecting with other nearby terminals. From Waterloo a branch of the line will go east to Butler, in Dekalb County, and on to the Ohio state line. The directors are: William L. Taylor, Elmer Leonard, James H. Rose, Fred E. Zollars and L. M. Pritchard.

Iowa.

⦿C. W. Gindelle Co., 3333 La Salle St., Chicago, Ill., has been awarded the contract for constructing shops at Clinton, Ia., for the Chicago & Northwestern Ry.

A meeting was recently held by the citizens of Hopeville, Ia., to consider the proposition of E. T. Dufur, to construct a railroad from Hopeville to a connection with the Great Western at either Shepard or Arispe, providing the citizens along the proposed route raise a bonus of $60,000 and donate right of way.

The Minneapolis & St. Louis R. R., according to reports, is contemplating the construction of a connecting line from Terrill to Ruthven, Ia. R. G. Kenly, Minneapolis, Minn., is Chief Engineer.

The House of Representatives has passed a bill providing that property owners within five miles on each side of a proposed line may vote a tax on themselves to aid the construction of an electric road or the electrification of a steam road. This bill, if it becomes a law, will probably result in a considerable amount of new electric railway construction and in the electrification of stretches of steam road. The Minneapolis & St. Louis R. R. is considering electrifying its line from Fort Dodge to Humboldt, and the Rock Island is contemplating a like change to its line from Livermore to Spirit Lake.

The Waterloo, Cedar Falls & Northern R. R., L. S. Cass, President, Waterloo, Ia., is to build new freight terminals, a new passenger terminal and make other improvements at Cedar Falls.

The Tri-City Ry. Co., J. G. Huntoon, General Manager, 127 W. 3rd St., Davenport, Ia., is to double-track its line on Warren St., Davenport, from 3rd to 5th St., and will also relay its track on 4th St. from Brady to Grand Ave.

Kansas.

The Midland Valley R. R. has revision work under way on its survey for the projected extensions from Wichita, Kan., to Denver, Colo., and it is reported on fairly good authority that construction work may be taken up soon. The company is now engaged in filling trestles on its line between Arkansas City, Kan., and Fort Smith, Ark., and as soon as the work is completed a considerable amount of betterment work may be undertaken on this line.

It is stated that construction work will be started in a few weeks on the extension of the Kansas City, Lawrence & Topeka R. R. (electric), F. P. Dickson, President, Gumbel Bldg., Kansas City, Mo., to Lawrence, Kan.

Kentucky.

⦿C. D. Langhorne Construction Co., Beaver, Ky., has been awarded a contract by the Chesapeake & Ohio Ry. for the construction of a 21-mile line from Beaver Creek Station on the Big Sandy District of the C. & O. Ry. up Beaver Creek to the mouth of Steele Creek. The line runs through Floyd County.

Louisiana.

An election is to be held April 26 at Port Barre, La., on the proposition to levy a tax

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

for securing the construction of a railroad to that city.

Maryland.

The Central R. R. of Maryland, chartered early this month with a capital stock of $125,000, proposes the construction of a 15-mile line from Union Bridge westward to a connection with the York, Hanover & Frederick R. R. near Keyman. The incorporators are Carl T. Hatch, New York City, Blair T. Scott, Wm. J. Gascoyne, Wm. J. O'Brien, Jr., Baltimore, Md., and Charles R. Foutz, Westminster, Md.

Massachusetts.

⊙The following are the itemized bids received March 25 by the Boston Transit Commisison, Boston, Mass., for the construction of Section B, Dorchester Tunnel: The contract was awarded to the Hugh Nawn Contracting Co., 82 Savin St., Boston, Mass., as noted in our April 2 issue, (1) bid of Rowe Contracting Co., Brighton, Mass., (2) Jas. J. Coughlin Co., 43 Tremont St., Boston, Mass., (3) P. McGovern & Co., 6 Beacon St., Boston, Mass., (4) The Conners Bros. Co., 157 Plain St., Lowell, Mass., (5) Coleman Bros., 1 Marginal St., Chelsea, Mass., (6) Hugh Nawn Contracting Co.

	(1)	(2)	(3)	(4)	(5)	(6)
Earth excavation, 47,000 cu. yds.	$4.75	$4.20	$4.25	$3.85	$4.00	$3.50
Masonry removed, 1,400 cu. yds.	10.00	8.00	5.00	15.00	6.00	6.00
Concrete base removed, 2,000 sq. yds.	1.00	.50	.50	1.00	.85	.60
Concrete masonry, 12,000 cu. yds.	12.50	11.15	10.50	10.50	10.00	10.50
Cinder concrete, 1,000 cu. yds.	9.00	6.00	9.00	6.00	5.00	5.50
Mortar under flanges of beams, 200 cu. yds.	9.00	13.00	15.00	14.00	16.00	14.00
Brick masonry, 100 cu. yds.	16.00	18.00	20.00	15.00	16.00	20.00
6-in. to 12-in. vitrified pipe, 500 lin. ft.	.50	1.00	.75	1.00	.50	.75
4-in. vitrified pipe, 700 lin. ft.	.40	.50	.25	.75	.25	.50
Setting reinforcing rods, 500 tons	12.00	10.00	12.00	10.00	8.00	7.00
Setting steel and iron, 700 tons	20.00	13.50	16.00	12.00	10.00	12.00
Portland cement mortar, 5,000 sq. yds.	.50	.40	.40	.60	.40	.40
Prepared textile and asphalt, 20,000 sq. yds.	.50	.50	.60	.45	.40	.50
Tarred felt and pitch, 10,000 sq. yds.	.30	.25	.30	.35	.25	.30
Other work and risks not covered by other items, lump	35,000	19,000	11,000	12,500	11,000	12,000
3¾ ft. x 2 ft. c. i. pipe, 356 lin. ft.	3.50	5.00	4.00	5.00	4.50	1.00
4¼ ft. x 3 ft. c. i. pipe, 513 lin. ft.	4.50	6.00	5.00	10.00	5.50	1.00
30-in. c. i. pipe, 77 lin. ft.	2.00	4.00	3.00	2.00	3.00	2.00
Totals	$476,388	$407,766	$397,720	$389,739	$367,479	$351,048

Michigan.

Citizens of Wells Township have voted to approve the petition of the Escanaba Traction Co., Escanaba, Mich., for a franchise for the extension of the Flat Rock branch of the interurban line to Groos. It is stated that work on the extension will be started soon, and the line completed during the summer.

Steps are to be taken shortly for floating the bonds of the Grand Rapids Belt Terminal Co., which proposes the construction of a belt road to connect all the railroads in Grand Rapids, Mich. The line will run in Burton Ave., the southern boundary of the city. Samuel Lazarus, New National Bank of Commerce Bldg., St. Louis, Mo., is President of the Grand Rapids Belt Terminal Co.

The Muskegon-Casnovia Land & Development Co., mentioned in our last issue, as an initial step in its plans for an interurban system for Muskegon proposes the immediate construction of a line from Muskegon to Kent City and Casnovia, a distance of 27 miles. The project also proposes the construction of a branch for a main line at a point eight miles east of Muskegon, this branch to extend to Walkerville and the north. James L. Smith, Muskegon, is Secretary of the company.

Minnesota.

M. W. Savage, International Bldg., Minneapolis, Minn., President of the Minneapolis, St. Paul, Rochester & Dubuque Electric Traction Co., is considering a proposition to construct 17 miles of new line south from Brookside to a junction with the old Dan Patch line.

Missouri.

⊙William Wood, Grading Contractor, Cape Girardeau, Mo., has started work on the extension of the Shelby County R. R. north from Shelbyville, Mo. Several other contractors will arrive ready for work just as soon as the weather will permit and the dirt is in a condition to handle properly.

The Missouri, Kansas & Texas R. R. has applied to the State Public Utilities Commission for permission to issue $25,750,000 in bonds for refunding purposes and for improvement of the line in Missouri.

Nevada.

The Fallon Belt Railroad, according to advices from Fallon, Nev., has perfected plans for the construction of the proposed line circling the valley for the accommodation of the sugar beet farmers. The line will be built to Stillwater some time this summer and it is expected to have it completed in time for the beet crop in the fall. The following officers have been elected by the Board of Directors: President, A. R. Merritt; Secretary, Scott Harmon, and Treasurer, E. E. Winters. Dr. C. A. Hascall was elected General Manager.

New Jersey.

The Public Service Newark Terminal Railway Co., Newark, N. J., has been incorporated with a capital stock of $5,000,000 to operate railroads. The incorporators are T. N. McCarter, Rumson; G. J. Roberts, East Orange, N. J.; J. J. Burleigh, Merchantville.

New York.

The Schenectady Ry. Co., J. F. Hamilton, General Manager, 420 State St., Schenectady, is reported to be contemplating about 12 miles of extensions to cost about $350,000.

City Council of Jamestown, N. Y., has granted a 50-year franchise to the Jamestown Street Ry. Co., G. E. Maltby, General Manager, Jamestown, to operate a line on the Willard St. extension. The line will extend from Winsor east on Willard to Willow Ave. The street railroad company will also double track Winsor St.

A proceeding to eliminate grade crossings on the Atlantic Ave. Division, Brooklyn, of the Long Island Railroad, will be instituted by the Public Service Commission of the First District, on May 14. The crossings in question are 21 in number and embrace all the streets crossing the tracks in Atlantic Ave., between the end of the elevated structure and the westerly end of the Jamaica improvement. An order for elimination work cannot be issued until the State appropriates the money to pay its quota of the elimination cost, of which the railroad company pays one-half, the City one-quarter and the State one-quarter. Until the State appropriates no work can be ordered done. The Commission has pending before the Legislature a request for an appropriation of $1,500,000 for grade crossing work for 1913, but about $1,000,000 of this will be needed for elimination work upon which the Commission has already held hearings and is ready to make final determinations. The remaining $500,000 and more will be required for the elimination of the 21 crossings upon Atlantic Ave., the cost of which is estimated at $3,500,000. If the money is provided by the Legislature, it is expected that the Commission will order the tracks elevated on concrete arches and the streets extended under the tracks.

North Carolina.

The Seaboard Air Line Ry. contemplates the expenditure of $2,500,000 for improvements. These include the double tracking of the North Carolina division from Raleigh to Hamlet, improvements at the Raleigh (N. C.) Richmond (Va.) and Monroe (N. C.) yards and the erection of additional phosphate elevators at Tampa and Fernandina, Fla.

Citizens of Rockingham, N. C., are advocating the construction of a railroad from that city to Cheraw, S. C., on the Atlantic Coast Line R. R. The sum of $75,000 has already been subscribed by the merchants and cotton mill people of the North Carolina town.

North Dakota.

A. Guthrie & Co., St. Paul, Minn., who have the contract for the construction of the Great Northern R. R. through McKenzie County, N. Dak., are preparing to start shipment of their outfits and material up the river from Williston to the mouth of Cow Creek on motor boats. Actual work will be started at an early date.

Condon Bros., 1406 Woodmen of the World Bldg., Omaha, Neb., have the following work to let: 1,200,000 yds. of machine and fresco work on the Northern Pacific in North Dakota and Montana. Free transportation on the N. P. system; also 700,000 yds. of team work, mostly side borrow, on the C., M. & St. P. Ry. in Iowa. Free transportation over the Milwaukee system.

Ohio.

The Ohio Southern R. R., from Lima to Wellston, has been purchased by Herman J. Schumacher and Daniel I. Murray, representing the Central Trust Co., first mortgage bondholders, at the upset price of $1,550,000.

The Lake Shore & Michigan Southern Ry., according to reports, is to expend $3,000,000 for improvements at Air Line Junction. New terminals will be constructed for through freight and the present terminals used for local traffic.

The Poland Street Ry. Co. recently organized at Youngstown, is reported to have secured the necessary capital for the construction of its line, and it is stated that the grading work will be started this month. The line will be about 4½ miles long and will pass through the holdings of the Realty Security Co.

The Middleport & Northwestern Ry. Co. of Columbus, has been incorporated with a capital stock of $1,000, and proposes a line to run from Middleport through the counties of Meigs, Athens and Washington, to the city of Marietta. The incorporators are D. N. Postlewaite, Charles P. Outhwaite, S. P. Outhwaite, E. Braguuier and J. C. Richard.

It is rumored that the Northwest system of the Pennsylvania Lines is contemplating the extension of the Cleveland & Pittsburgh branch from Powhatan, O., to a point down the Ohio River opposite New Martinsville, W. Va. The purpose of extending the line at this time is said to be for developing more than 25,000 acres of coal land lying on the Ohio side of the Ohio River between Powhatan and New Martinsville. The Powhatan branch of the Cleveland & Pittsburgh Railroad extends from Bellaire, O., to Powhatan. It is the only outlet for the six coal mines in that part of Belmont and Monroe counties.

Oklahoma.

The Norman Interurban R. R. Co. has completed surveys and has secured the capital for the construction of its projected 9-mile line. Contracts for the grading, which will be light, will be let at once. Guy Treat, Oklahoma City, Okla., is Chief Engineer; Geo. W. Knox, Oklahoma City, Okla., is President.

It is probable that construction work on the Colorado, Texas & Mexico Ry., a new line, will be continued during the summer. At the recent annual meeting of the stockholders James Gates, Mangum, Okla., was elected President.

Oregon.

The Portland, Eugene & Eastern R. R. Co. is ballasting its line for 15 miles south, and

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

10 miles north of Corvallis, Ore., with gravel taken from river at Corvallis.

The Mount Hood Railroad Co., W. H. Eccles, President, Mount Hood, Ore., has awarded the contract for the construction of a line from Dee into the Lost Lake country and work is to be started at once.

The Portland, Eugene & Eastern Ry. Co., which recently purchased the Sheridan & Willamina Ry., has announced that work will be commenced shortly on the reconstruction of the line. The Sheridan & Willamina Road is an extension of the branch of the Southern Pacific system which runs from Broadmead to Sheridan, Ore., and was constructed by the Pacific Face Brick Company, which has its large plant at Willamina. That portion of the branch between Broadmead and Sheridan will continue under the control of the Southern Pacific, the P. E. & E. to operate the stub end between Sheridan and Willamina, Ore.

Panama.

The firm of R. W. Hebard & Co., Inc., Engineers & Contractors, with offices at No. 16 Exchange Pl., New York City and Panama, have been awarded a contract by the Republic of Panama for a large amount of railroad studies, in the interior provinces of the Republic. The work is to include investigations of possible hydro-electric power development and the improving of existing ports or the construction of new ones. The firm named is now building the Panama Tramways project in the City of Panama.

Pennsylvania.

The Moshannon Central Railroad Co. has been incorporated with a capital stock of $50,000 to construct and operate a 5-mile railroad in Rush Township, Center County, Pa.

The Pittsburgh, Steubenville & Wheeling Ry. Co., is reported to be planning to have construction work started in June on its projected line. It is stated, that the construction contract has been awarded to an eastern firm. W. E. Hildebrand, Pittsburgh, Pa., is the promoter.

Construction work is to be started at once it is said on the projected electric railway from Cambridge Springs to Titusville. This line will follow the old Petroleum R. R. grade built in 1871. The line will be equipped with gasoline and electric cars. The construction contract is understood to have been let to the Cleveland Construction Co., Cleveland, O.. At last reports C. Tocco and L. Devitz, who will have charge of the construction work, were at the Hotel Turner, Cambridge Springs, Pa.

Rhode Island.

⊙William H. Hamlyn & Son, Providence, R. I., have been awarded a contract for erecting an addition to the Manchester St., Providence, power house of the Rhode Island Co. The cost of the building improvements is estimated at $750,000.

South Carolina.

The Lancaster & Chester Ry. Co. operating 29 miles of standard gage railroad line between Lancaster and Chester is to increase its capital stock from $50,000 to $500,000, for the purpose it is thought, of extending the road. Leroy Springs, Lancaster, S. C., is President.

Tennessee.

The Nashville, Shiloh & Corinth R. R. is projecting a 135 mile line from Nashville, Tenn., to Corinth, Miss. The capital for construction has not been secured as yet, nor have surveys been made. A. P. Foster Nashville, Tenn., is Secretary.

Texas.

The Brownsville Street & Interurban R. R. is constructing a 2½ mile extension from Brownsville to the Brownsville Country Club. The Hidalgo Construction Co., San Beinto, has the contract. E. E. McLellan, San Benito, is Chief Engineer of the Traction Co.

Survey is now being made for a railroad to extend from Matador through Motley, Dickens and Stonewall Counties to Hamlin, where a connection will be made with the Abilene & Southern Ry. Col. Morgan Jones, Abilene, Tex., President of the latter road, is the promoter of the new line.

The Atchison, Topeka & Santa Fe Ry. has about completed surveys for the extension of its line from Lamesa south to Sterling City, 100 miles, and it is possible that construction work may be started this spring or early summer.

It is reported that the Houston & Texas Central R. R., as soon as the Giddings-Stone City cut off is completed, will begin on an extension from Llano to Brady, a distance of 60 miles.

The Burr's Ferry, Broundel & Chester Ry., W. B. Scott, President, Houston, Texas, now in operation from Rochland to Turpentine and graded almost to Broundel, is reported to be contemplating an immediate extension east, probably to De Redder, Ia.

Surveys are under way for the Dallas Western Interurban Ry. Co. and the Dallas Eastern Interurban Ry. Co. The first mentioned company proposes a line from Dallas to Glenrose, via Cleburne. The second plans a line from Dallas to Gainesville via Denton. E. P. Turner, Dallas, is the promoter and John T. Witt, Praetorian Bldg., Dallas, is the Chief Engineer.

West Virginia.

H. M. Waugh, Orange, Va., has an 80,000 cu. yd. contract on the lower section of Pitts & Morris contract on Beaver Creek, Ky., C. & O. R. R., and is moving his outfit this week from Pond Creek, Ky., on the N. & W. R. R.

✣Bids will be received until noon, April 30, by the Coal & Coke Ry. Co. for lining, with brick and concrete, an aggregate of 1,400 lin. ft. in three tunnels. Plans and specifications may be obtained by application to R. H. Pembroke, Chief Engineer, Elkins, W. Va.

Wisconsin.

The Milwaukee Electric Ry. & Light Co., Public Service Bldg., Milwaukee, is considering extending its Watertown line down through Johnson's Creek, Jefferson and Fort Atkinson.

The Beloit, Clinton & Delavan R. R. Co. has been organized at Beloit, Wis., with a nominal capital stock of $50,000, and proposes the construction of an interurban railroad from Beloit to Delavan by way of Clinton. Joel B. Dow, Goodwin Block, Beloit, Wis., is interested.

Further information has been received in regard to the recently incorporated Pigeon Valley Railway Co., mentioned in our last issue. As proposed the line will extend from Pigeon Falls in Trempealeau County, Wisconsin, in a northwesterly direction to Northfield in Jackson County and continue on into Eau Claire to connect with the main line of the Omaha between Fairchild and Augusta. The village of Pigeon Falls is but about five miles from the Green Bay Road, but to the north and west is a large farming country without railroad facilities, and it is to bring these farmers nearer to the northwest markets that the road is projected. The directors of the company are H. A. M. Steen, Northfield; T. R. Kittleson, Northfield; Niles Heggen, Northfield; Ole A. Olson, Northfield; B. M. Slettland, Pigeon Falls; G. H. Neperud, Pigeon Falls; Ole Kolden, Hale; August Goplin, Hale.

Canada.

⊙The Canadian Stewart Co. has been awarded the contract for a 4,000,000-bu. extension to Grain Elevator D. at Fort Williams, Ont., for the Canadian Pacific Ry.

⊙T. Daly, Montreal, Que., has been awarded the contract for completing the Levis-New Brunswick section of the National Transcontinental Ry. This stretch of road is 190 miles long, and there is still considerable track laying to be done besides, some bridging and ballasting. The contract calls for a completion of the section before Sept. 30.

The Canadian Northern Ry. has started final surveys for the proposed tunnel by which it will carry its line from the North Arm of the Fraser to the terminals at False Creek, New Westminster, B. C. This will be a double track, concrete lined tunnel, 4½ miles long, and will cost about $3,400,000.

The Canadian Pacific Ry. has filed its plans at Ottawa for a proposed tunnel under Vancouver. It will connect the inlet and False Creek water fronts, will be nearly a mile long and will cost about $1,000,000. The company is understood to be ready to begin work as soon as the plans are approved at Ottawa.

Construction work will be started this year on the projected line of the Lake Huron & Northern Ontario Ry. The financing of this line is understood to have been completed, and it is reported that a contract for its construction will be let to M. J. O'Brien of Renfew, Ont. R. A. Lyon, Toronto, Ont., is interested.

Mexico.

The Mexican Government has renewed the concession which Eduardo Hartmann of Durango, Mexico, and associates obtained during the administration of President Diaz for the construction of a railroad across Northern Mexico, between Chihuahua and Monclova, about 450 miles. It is stated that the project will be carried to fulfillment as soon as possible.

BRIDGES

Alabama.

⊙The Board of Baldwin County Commissioners, Bay Minette, Ala., has awarded the contract for the construction of three steel bridges near Stockton to A. Farragut, Gulfport, Miss., at $8,000.

Arkansas.

✣Bids will be received until April 28, by J. R. Patterson, Van Buren County Judge, Clinton, Ark., for the building of three bridges, all across Little Red River, in Van Buren County, Arkansas, one 8 miles, one 13 miles, one 22 miles from the town of Shirley. The one 8 miles from Shirley is to be completed by October 1, 1913, and the one 13 miles from Shirley by July 1, 1913, and the one 22 miles from Shirley by October 1, 1913. The one 8 miles from Shirley is to have one span 150 ft. C-C, heights 19, 24 and 26½ ft., two approaches 16 ft., roadway 12 ft. clear, joists four 6-in. I-S and two 6-inch E-S, floor 2½-in. oak, two felloe guards 3x6-in. oak, two nailers 2½x6 ins., one pier of steel tube filled with concrete and one of concrete—concrete to be a 1 : 2½ : 5 mixture—and six end bents 6-in I-S, resting on concrete sill and having 8-in. concrete backing. The one 13 miles from Shirley is to have one span 110 ft. C-C, height 18 ft., one approach 90 ft. and one 60 ft., roadway 12 ft. clear, four joists 6-in. I-S and two 6-in. E-S on span, and four 9-in. I-S and two 9-inch E-S on approaches, floor 2½-in. oak, two felloe guards 3x6-in. oak; two nailers 2½x6-in. oak; piers, new 3-ft. concrete cap on stone masonry now in place, concrete to be 1 : 2 : 4 mixture, concrete pedestals 1 : 2½ : 5 mixture, six end bents 6-in. I-S, resting on concrete sill and having 8-in. concrete backing. The one 22 miles from Shirley is to have two spans 80-ft. ExX, height 8 ft., two approaches 16 ft.; roadway 12 ft. clear, four joists 6-in. I-S and two 6-in. E-S, floor 2½-in. oak, two felloe guards 3x6-in. oak, two nailers 2½x6-in. oak, end

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

bents 6-in. steel resting on concrete sill and 8-in. concrete backing, piers steel tubes filled with concrete. Further particulars of the plans and specifications are on file in the office of the County Clerk of Van Buren County, Ark.

⊙Judge Smith of Benton County, Bentonville, Ark., has awarded the contract for the construction of a steel bridge over White River to P. J. Barringer, Fort Smith, Ark., at $11,815.

California.

✣Bids will be received until 11 a. m., May 5, by Board of Supervisors Santa Clara County, San Jose, Calif., for the construction of a reinforced concrete culvert at Calabasas Creek on San Francisco and San Jose road. Henry A. Pfister, County Clerk. F. A. Schilling is Deputy Clerk.

The City Clerk of San Diego, Calif., has been authorized to advertise for the construction of one bridge at Old Town, over the San Diego river; one on Woolman avenue, over Chollas creek, and one on Main Street, over Chollas Creek.

The Board of Siskiyou County Supervisors, Yreka, Calif., has decided on the plans for a reinforced concrete bridge to span the Sacramento River at Dunsmuir in the surveyed line of the State highway. The bridge will have a span of 380 or 400 ft. and will cross the river at the upper end of town. It has to be high enough to clear the railroad as well as the river.

Town Engineer, F. A. Nikink, Mayfield, Calif., has completed plans and specifications for constructing a cement bridge at the First St. crossing over Barron's Creek and at Lambert Ave.

The Board of Orange County Supervisors, Santa Ana, Calif., has decided to replace the old wooden bridge over the Santa Ana River at Olive with a new concrete structure, estimated to cost about $60,000.

Colorado.

The Board of Supervisors, Denver, Colo., referred to a vote at the May election a proposition to issue $260,000 of bonds for the city's share of cost of West Colfax viaduct; also the ordinance authorizing construction of West Colfax Ave. viaduct and apportioning cost of same between the city, the railroads and the tramway company.

Delaware.

Governor Miller of Delaware has signed a bill, according to advices from Dover, Delaware, authorizing the issuance of $25,000 of bonds for the construction of a bridge over Christiana River at Third St., Wilmington, Delaware.

Idaho.

The Bannock County Commissioners, Pocatello, Idaho, have decided to move the Tilden bridge over the Snake River 900 ft. up the stream.

Illinois.

✣Bids will be reecived up to 2 p. m., May 1, 1913, at the Town Clerk's office, Carbondale, Ill., for the construction of three reinforced concrete bridges to be built in Carbondale Township, Jackson County. Alva Williams, Town Clerk, Carbondale, Illinois. Bridges No. 1, 2 and 3, spans 36, 16 and 8 ft.; roadways, 18, 18 and 20 ft.; height, 14, 9 and 6 ft. Total estimated concrete, 184.9 cu. yds.; reinforcing steel, 21,905 lbs. Nearest railroad station, Carbondale, ¾, 1½ and 2 miles. Acceptable broken stone will be furnished F. O. B. cars at Carbondale by the Commissioners. It is reported that sand may be had F. O. B. cars at Carbondale at about $1.00 per ton. Present bridges, steel, 24 ft. span, on stone abutments; steel, 14 ft. span, on stone abutments, and 7 ft. span, wood. Low water flow at each, trace; high water about 10, 5 and 4 ft. Excavation for each bridge, clay and full height of bridge; to go below stream bed about 4 ft., 3½ ft. and 8 inches. Engineer's estimate for the three bridges, $2,550.00. Work to be completed on or before August 15, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received up to 9 a. m., April 25, 1913, at the Town Clerk's office in Milledgeville, Ill., for finishing one reinforced concrete bridge and building three other reinforced concrete bridges complete in Wysox Township, Carroll County. J. E. Miller, Town Clerk, Milledgeville, Ill. G. F. Bellows, M. A. Hanna, Heimsbaugh and Jorner Bridges: Span of each, 40 ft.; roadway of each, 16 ft. Estimated total concrete, 378.8 cu. yds.; reinforcing steel, 57,575 lbs. Distance to gravel pit, about 2, 1¼, 4½ and 2½ miles. Present bridges steel, 29 ft. steel; 32 ft. wood and steel. Low water flow at each bridge dry. Excavation clay, clay, sand and clay. Piles will probably be required. Gravel at pit about 35 cents per cu. yd., must be screened. One abutment and the footing and about 2 ft. of the wall of the second abutment of the Jorner bridge have been completed. It is recommended that bidders make investigation on the ground before submitting proposals, as a considerable amount of gravel and reinforcing steel owned by the original contractor has been delivered at the sites, which possibly may be purchased from him. Engineer's estimate, $5,700.00. Work to be completed on or before August 15, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Illinois.

✣Bids will be received up to 2 p. m., May 1, 1913, at the Town Clerk's office, Savanna, Ill., for reflooring an old steel bridge in Savanna Township, Carroll County. Harry Craig, Town Clerk, Savanna, Illinois. Sarttwell Bridge: Span, 148 ft.; roadway 16 ft. Whipple truss, on stone abutments. Nearest railroad station, Savanna, about 3 miles. Work to be done consists of cleaning and painting all steel work, furnishing and placing new steel stringers and hand rail, pointing the abutments with cement mortar, placing concrete joist rests on abutments, and furnishing and placing new creosoted timber floor with bituminous wearing surface. Bids will be received on basis of completing the work by July 10, 1913, also on basis of completing by August 15, 1913. Engineer's estimate, $1,650. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Ill.

✣Notice is hereby given that the letting of contract for the Vandermoon bridge between Yorktown and Alba Townships, Henry County, has been postponed until 11 a. m., April 25, 1913. The letting will be held at Hooppole, Ill. More detailed information mav be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Ill.

All bids received April 16, by John F. Fisher, Civil Engineer, Danville, Ill., for the construction of two reinforced concrete bridges were rejected.

Advices from Fairfield, Ill., state that Big Mound township ratified the issuance of $10,500 of bonds for the construction of reinforced concrete bridges.

Indiana.

✣Bids will be reecived until 1 p. m., May 23, by Board of Hancock County Commissioners, Greenfield, Ind., for the construction and repair of 19 bridges. Lawrence Wood is County Auditor.

✣Bids will be received until May 9, by Board of Marion County Commissioners, Indianapolis, Ind., for the construction of culverts and retaining wall. W. T. Patten is County Auditor.

✣Bids will be received until 2 p. m., May 5, by Board of Blackford County Commissioners, Hartford City, Ind., for the material and labor for the construction of a concrete bridge at Moore Ditch. James Cronin, Jr., is County Auditor.

✣Bids will be received until noon, May 6, by Board of Pulaski County Commissioners, Winamac, Ind., for the construction of five bridges. William Munchenburg is County Auditor.

✣Bids will be received until 2 p. m., May 6, by Board of Knox County Commissioners, Vincennes, Ind., for the construction of a bridge in Oaktown and a culvert in Palmyra township. John T. Scott is County Auditor.

⊙The Board of Vermillion County Commissioners, Newport, Ind., has awarded the contract for the construction of the bridge over the little Vermillion River at Newport to Van Fosson & Noble, Rockville, R. F. D., Ind., at $8,475. The structure will be of concrete, having two 75-ft. spans.

The Indianapolis, Columbus & Southern Traction Co. has decided to abandon the present structure over the Bayou near Edinburg, Ind., and to replace it with a new bridge. Alexander Shane, Columbus, Ind., is General Manager of the company.

The Commissioners of Adams County, Decatur, Ind., have asked that the county council make an appropriation of money for the construction of a new bridge over the Wabash River at Ceylon to replace the one recently destroyed by the flood.

The Commissioners of Cass County, Logansport, Ind., have asked the county council for an appropriation of $150,000 for the construction and repairing of roads and bridges.

Iowa.

⊙Board of Marshall County Commissioners, Marshalltown, Ia., has awarded the contracts for the construction of five concrete bridges as follows: two structures to the Capital City Construction Co., Des Moines, Ia., at $11,584; three smaller bridges to N. M. Stark Co., Des Moines, Ia., at $10,113. Bids were opened March 26 and the contract let April 10.

⊙The Board of Winnebago Countv Commissioners, Forest City, Ia., has awarded the contract for the construction of concrete bridge over Lime Creek where the highway crosses between Sec. 32, Norway township, and Sec. 5, Center township, to the Iowa Bridge Co., Des Moines, Ia., at $3,488. The structure will be of concrete girder design, 109 ft. long with 20-ft. roadway and 12-ft. wingwalls.

Kansas.

⊙The Board of Riley County Commissioners, Manhattan, Kan., has awarded the contracts for the construction of a number of bridges to the following contractors: John P. Blair, Manhattan, Kan.; Canton Bridge Co., Kansas City, Mo.; Ben Clark, Keats, Kan.

⊙The Board of Sedgwick County Commissioners, Wichita, Kan., has awarded the contract for the construction of concrete abutments for bridge between Section 21 and 28, Gypsum township, to W. M. Blake & Sons, Wichita, Kan. Bids for the work were opened April 12.

Bids are to be asked shortly by the city of Hutchinson, Kan., for the construction of two new concrete bridges, one at First Ave. and the other at Avenue B. Plans for the structures are now being prepared by G. L. McLane, City Engineer.

Kentucky.

✣Bids will be received until 9 a. m., May 27, by S. A. Young, County Judge, Henderson, Ky., for furnishing f. o. b. cars Henderson, Ky., the following corrugated metal culverts: 4 pieces 72 ins. in diameter, 20 ft. long; 6 pieces 60 ins. in diameter, 20 ft. long; 6 pieces 48 ins. in diameter, 20 ft. long; 6 pieces 48 ins. in diameter, 18 ft. long; 8 pieces 36 ins. in diameter, 20 ft. long; 8 pieces 36 ins. in diameter, 18 ft. long; 10 pieces 24 ins. in diameter, 20 ft. long; 10 pieces 24 ins. in diameter, 18 ft. long; 10 pieces, 18 ins. in diameter, 20 ft. long; 10 pieces 18 ins. in diamter, 18 ft. long; 10 pieces 12 ins. in diameter, 20 ft. long; 10 pieces 12 ins. in diameter, 18 ft. long. Bidders are requested to state in their bids the gauge of iron and thickness of the different sizes of culvert pipe, also the chemical analysis showing the purity of the metal, etc., composing the pipe. The corrugated metal culverts must be delivered within thirty days after the contract is awarded. The County will pay for the metal culverts Dec. 5, 1913, and it is understood that the bill for the culvert pipe shall not be due or payable until Dec. 5, 1913. Bidders may submit their proposals specifications under which they are to furnish the pipe. S. H. Kimmel is County Road Engineer.

Michigan.

✣Bids will be received until 3 p. m., May 2, by Board of Public Works, Jackson, Mich., for the building of the bridge on Milwaukee St., over the Grand River (clear span, 60 ft.; width of roadway, 39 ft.; width of sidewalks, 6 ft.). Each bid must be accompanied by a certified check of five per cent of the amount bid as a guarantee that the successful bidder will enter into contract if awarded the work. Bids will be considered on designs and plans which shall be prepared by the bidder and submitted with his bid. Designs may include both steel and reinforced concrete bridges. All plans furnished must be in accordance with the specifications which may be obtained from the City Engineer. Upon application, the City Engineer will furnish blue prints showing width of roadway and sidewalks, length of span, elevations, etc. Bidders are requested, however, to examine the site before making their plans or submitting bids. A. W. D. Hall is City Engineer.

Minnesota.

⊙The Board of County Commissioners, Fergus Falls, Minn., has awarded the contract for the construction of 36 corrugated culverts to the North Dakota Metal Culvert Co., Fargo, N. Dak. The contract price was $488. Bids were opened April 11. William Lincoln is County Auditor.

Nebraska.

⊙Geer & Harrison Co., Grand Island, Nebr., has been awarded the contract for the construction of bridges in Hall County, Nebr., during the coming year.

New Jersey.

✣Bids will be received until 10:30 a. m., May 12, by Board of Freeholders, F. W. George, Clerk, Camden, N. J., for the construction of a Strauss bascule bridge over the Newton Creek on Broadway. Plans and specifications are on file with F. W. George, Clerk of Board of Chosen Freeholders at the Court House in Camden, or will be mailed to any address on receipt of $5. Also separate plans and specifications for a tumbling dam and bridge combined, also for two concrete bridges on same creek, will be mailed to any address on receipt of $1 for each of the subsequent propositions.

⊙The Board of Salem County Freeholders, Salem, N. J., has awarded to the Bridgeton Construction Co., Bridgeton, N. J., the contract for the construction of a new bridge at Nortonville at $29,850.

New York.

⊙The Board of Contract & Supply, Schenectady, N. Y., has awarded the contract for the reconstruction of the Cotton Factory Hollow Bridge to L. N. Cross, 781 Eastern Parkway, Brooklyn, N. Y., at $18,100. This structure at present is an exclusive trolley bridge. When finished it will accommodate all kinds of traffic. F. E. Johnson is Secy. of the Board. Bids were opened April 9.

⊙At a recent meeting of the town board, Herkimer, N. Y., the contract for the construction of a temporary bridge over West Canada Creek at East Albany St. was awarded to J. N. Fitzgerald, Sacket Harbor, N. Y., at $1,163.

The Senate Internal Affairs Committee, Albany, N. Y., has reported favorably the bill authorizing School District No. 5, of Carrollton, N. Y., to construct a bridge over the Allegheny River.

Plans are being prepared and estimates made of the cost of the proposed Lafayette St. and Black Lake bridges at Ogdensburg, N. Y. As proposed the present structure at Lafayette St. will be removed to Black Lake and a new bridge constructed at the former site.

The towns of Trenton Falls and Russia, according to advices from Utica, N. Y., plan the construction of a new bridge over West Canada Creek at a point above the site of the old structure, which was recently washed out by the flood.

North Carolina.

John E. Efird, according to information received from Charlotte, N. C., is organizing a stock company for the purpose of building a steel bridge over the Rocky River at Efirds Mill, Burnsville township, connecting Anson and Stanley counties.

✣Bids will be received until May 5, by Board of McDowell County Commissioners, Marion, N. C., for the construction of a steel bridge, with concrete piers, steel sleepers, 2-in. white oak flooring, clear of sap, across Catawba River at the Hall Town Ford. R. L. C. Gibson, Clerk of the Board.

North Dakota.

✣Bids will be received until 2 p. m., May 14, by Commissioners of Pembina County, Cavalier, N. Dak., for the construction of any and all steel and concrete bridges that may be built by the County of Pembina during the year 1913, according to plans and specifications now on file in the office of the County Auditor. A certified check in the sum of $500 must accompany each bid or proposal, said check made payable to John R. Gibson, County Treasurer, as per specifications. Wm. W. Felson is County Auditor, (P. O.) Cavalier, N. D.

Ohio.

✣Bids will be received until 11 a. m., May 21, by Board of Cuyahoga County Commissioners, Cleveland, O., for the construction, per Report No. 3078, of a concrete arch on Station Road, Brecksville township; also for a concrete culvert on Barrett Road in Middleburg township in accordance with plans and specifications furnished by F. R. Lander, County Surveyor. Plans, descriptions, bills and specifications for the above work can be seen and are open to public inspection of persons interested therein, at the office of the County Engineer at the New Haven House on Lakeside Ave., Cleveland, Ohio. John F. Goldenbogen is Clerk of the Board.

✣Bids will be received until 10 a. m., May 3, by Board of Shelby County Commissioners, Sidney, O., for furnishing all material and labor necessary for the construction and superstructure for one steel highway bridge over Mosquito Creek, in Green Township, near the farm owned by William Johnston, size 100 ft. span, 16 ft. roadway. Plans and specifications for same are on file at the office of the County Auditor. H. T. Ruese is County Auditor.

✣Bids will be received until noon (standard time), May 5, by S. A. Kinnear, Director of Public Service, Columbus, O., for the construction of a reinforced concrete floor, encasement and parapet wall for the South High St. viaduct in the city. Plans and specifications are on file with the Director and at the office of the Chief Engineer. P. B. Kemper is Clerk.

⊙The contract for the construction of a creosoted wood block floor on Erie Ave. has been awarded by the Board of Lorain County Commissioners, Elyria, O., to William Stewart, Wabash, Ind., at $14,366. F. L. Ellenberger is Clerk of the Board. Bids were opened March 17.

The Board of Trade, Uhrichsville, O., has decided to appoint a committee for the purpose of investigating the advisability of issuing $100,000 of bonds for the reconstruction of bridges damaged by the flood.

Walter Braun, Engineer of Franklin County, Columbus, O., has furnished State Highway Commissioner James Marker a list of bridges lost by the county during the recent flood and it is expected that the legislature will be asked for an appropriation amounting to about $1,000,000 for the repair and reconstruction of the structures. The bridges over the Olentangy destroyed by the flood and the approximate replacement costs are: Wilson bridge, $15,000; Worthington, $30,000; Weisheimer, $20,000; Dodridge, $2,000; Lane Avenue, $20,000; King Avenue, $20,000; Fifth Avenue, $2,000, and waterworks, $5,000. Those over the Scioto River and their building costs are: Williams, $50,000; Grand View Avenue, $25,000; Sandusky Street, $15,000; Broad Street, $200,000; Mound Street, $75,000; Greenlawn Avenue, $2,000; Frank Road, $30,000; Clickenger Road, $30,000, and Shadeville, $15,000. Over the Big Walnut Creek: Chillicothe Pike, $5,000; Lockbourne, $2,000; McCloud, $75,000; Platter, $5,000; Groveport Pike, $6,000; Refugee Pike, $6,000; Taylor, $5,000; Dehner, $2,000; and Moore, $20,000. Over Alum Creek: Eberly Road, $2,500; Matheny, $2,000; Park Mills, $5,000; Westerville Road, $5,000; and Westerville, $2,000. Over Big Darby Creek: Converse, $5,000; High, $3,000; National Road, $12,000; Georgesville, $5,000; Chenoweth Mills, $2,000; McKinley, $3,000; and Harrisburg, $25,000. Over Little Walnut: Winchester, $1,000; Brugstresser, $4,000; Harris, $2,000; Seymour, $2,000; Corbett, $4,000, and Hopewell, $10,000.

At a recent meeting of the City Council Toledo, O., Director of Public Service Cowell recommended the construction of a new bridge over the Cincinnati, Hamilton & Dayton Railroad at Miami St., and the matter was referred to the Public Improvements Committee.

Edward Moritz, Montgomery County Surveyor, Dayton, O., estimates that the damage to bridges will amount to $700,000. The greatest damage was in Miami township, where both the upper and lower bridges at Miamisburg were washed away. It will take more than $100,000 to replace these two structures alone.

Oklahoma.

It has finally been decided to locate the proposed new suspension bridge over Red River between Temple, Okla., and Byers, Texas, just above the mouth of the Wichita River. The cost of the structure is estimated at $75,000 and actual work will commence shortly.

Oregon.

⊙The Portland Bridge Co., Portland, Ore., has been awarded the contract for the construction of three bridges, according to advices from Roseburg, Ore. The contract price was $24,510.

⊙The contract for the construction of a new bridge at Eugene, Ore., has been awarded to the Coast Bridge Co., Portland, Ore.

The following bids were received April 14, by the Commissioner of Indian Affairs, Washington, D. C., for the construction of a steel highway bridge over Deschutes River, Ore.—(1) riveted bridge; (2) pin connected bridge: Midland Bridge Co., Kansas City, Mo., (1) $14,760 and $12,625; (2) $14,177 and $12,035. Illinois Steel Bridge Co., St. Paul, Minn., (1) $14,940 and $13,940; (2) $14,740 and $13,740; extra concrete, $10 and $14 per cu. yd. Clinton Bridge Works, Clinton, Ohio, (1) $20,940; (2) $21,600; extra concrete, $13 and $10 per cu. yd. Coast Bridge Co., Portland, Ore., (1) $14,248; (2) $13,580. Omaha Structural Steel Works, Omaha, Neb., (1) $14,985; (2) $14,225. Albert L. Smith, Spokane, Wash., (1) $17,800; (2) $17,400. Northwest Steel Co., Portland, Ore., (1) $14,985. E. G. Perham, Marshfield, Ore., (1) $14,900; (2) $14,400.

Pennsylvania.

✣Bids will be received until 4 p. m., April 30, by F. R. Hendershot, County Controller, Wilkesbarre, Pa., for painting the Ferry Bridge, at Pittston, Pa., as per specifications on file in the office of the County Commissioners, using Dixon's Silica Graphite Paint, manufactured by the Joseph Dixon Crucible Co., or No. 30 Superior Graphite Paint, manufactured by the Detroit Graphite Company, or their equal, in sufficient quantity to completely cover the entire structure with two coats.

✣Bids will be received until 10 a. m., May 3, by F. R. Hendershot, County Controller, Wilkesbarre, Pa., for building a steel girder bridge with concrete floor over the tracks of the Central Railroad Company of New Jersey where the same is crossed by the public high-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

way, known as the Bear Creek or Laurel Run Boulevard. Plans and specifications may be obtained at the office of the County Commissioners.

⊙The Reading Contracting Co., Reading, Pa., has been awarded a contract for the making of general repairs to Heinly's bridge over Saucony Creek in Richmond township. Bids were opened by D. H. Koch, County Controller, Reading, Pa.

Plans for the Bloomfield and Haights Run bridges have been completed and Director Joseph G. Armstrong, Pittsburgh, Pa., will advertise for bids from contractors for the construction of the structures. The Bloomfield bridge, extending from Cayuga St. across the Pennsylvania Railroad to the Grant Boulevard through Ridgeway St. will be of steel and cost $500,000. The other bridge, built of reinforced concrete, will cost about $175,000.

The Pennsylvania State Water Supply Commission, Harrisburg, Pa., has granted permission for a number of bridge projects including the plan of the Pennsylvania Railroad to bridge the Schuylkill River, at Auburn, and bridges for the Lehigh Valley Railroad at Glen Okene and the Buffalo, Rochester and Pittsburgh, in Center township, Indiana county. The Bucks County Commissioners have been given the right to erect a concrete highway bridge over Durham Creek, in Durham township, and the Northumberland Gas and Electric Company to lay gas mains under the Susquehanna River and Penn's Creek near Sunbury.

The Commissioners of Montgomery County, Norristown, Pa., have directed County Engineer James Cresson to prepare plans for the construction of the proposed new bridge over Schuylkill River between East and West Conshohocken to replace the present structure, which has been declared unsafe.

The Board of Cumberland County Freeholders, Carlisle, Pa., has authorized a committee to advertise for bids for the construction of a new drawbridge over Maurice River at Millville. The span is to be 131 ft. long and 46 ft. wide.

Tennessee.

The Hamilton County Court, according to advices from Chattanooga, Tenn., has adopted the proposition of the Birmingham & Chattanooga Railroad to join with that company in building a bridge over the Tennessee River near Moccasin bend. Under this proposition the railroad company will build the bridge and the county pay a rental of $15,000 a year for the right to use it as a passenger bridge.

Texas.

⊙The contract for the construction of a reinforced concrete bridge over the North Concho River has been awarded to the Midland Engineering & Construction Co., Fort Scott, Kan., at $46,888. Oscar Frink, San Angelo, Texas, is County Judge. Bids were opened April 15.

⊙The City Council of Houston, Texas, has awarded the contract for the construction ot the San Jacinto St. bridge to William P. Carmichael & Co., 11 Main St., Houston, Tex., at $128,214. The contract for the construction of the Capitol Ave. bridge to H. C. Gass, Houston, Tex., at $88,500. F. L. Dormant is City Engineer.

Wisconsin.

⊙The Wisconsin Bridge Co., Prairie du Sac, Wis., has awarded the contract for replacing the three spans of its bridge which were taken out by the ice to James O. Heyworth.

Preliminary surveys have been made by S. P. Wolff, Consulting Engineer, 1001 Germania Life Bldg., St. Paul, Minn., for the construction of the proposed concrete arch bridge at Water St. and Summit Ave., Eau Claire, Wis. As proposed the structure will be about 700 ft. long, having either four or six spans, and 24 ft. roadway. A. R. Garnock is City Engineer.

Washington.

An election will be held May 13 at Aberdeen, Wash., for the purpose of voting on the proposition to issue $95,000 of bonds for the construction of a bridge over the Wishkah River at that city.

ROADS AND STREETS

Alabama.

⊙The Commissioners' Court, Carrollton, Ala., has awarded the contract for the construction of four miles of the state aid highway between Carrollton and Pickensville, to D. S. Searcy, of Greenville.

The Franklin County Commissioners, Russellville, Ala., have called a special election for May 19 for the purpose of voting on the issuance of bonds in the sum of $125,000 for the building of pike roads.

The City Council of Gadsden, Ala., Charles L. Marsh, City Engineer, has decided not to let contracts at present for the construction of 1,334 sq. yds. of concrete sidewalks, 3,000 lin. ft. of 8-in. curb, 36-in. gutter, 200 lin. ft. 6-in. gutter, 200 cu. yds. of excavation, and taking up of 15 trees, for which bids were to have been opened on April 7.

Arkansas.

✣Bids will be received until 3 p. m., April 25, by E. J. Smith, Secy., Board of Commissioners, Paving District No. 1, Paragould, Ark., for grading, draining and paving the various streets within their district, approximately 41,000 sq. yds. Plans and specifications for the work may be seen at the office of the engineer for the district, E. A. Kingsley, 717 Southern Trust Building, Little Rock, Arkansas, or they may be obtained for the private use of the contractor by depositing with the engineer ten dollars to cover the cost of same.

California.

✣Bids will be received until about May 5, by Board of Trustees, National City, Calif., for 13 blocks asphalt pavement on National Ave., 300,000 sq. ft. pavement, 6,000 sq. ft. granite block guttters, as follows: 5-in. concrete base, 1-in. binder course, 2-in. asphalt wearing surface. Culverts and catch basins as per resolution of intention on file in office of City Clerk. H. I. Atwater is Street Superintendent. H. A. Kuehmsted is City Engineer.

⊙Following bids were received by the Board of Public Works of San Francisco, Calif., April 9, for the construction of the Stockton St. tunnel: Jacobson, Bade & Co., $337,000 (awarded contract); R. C. Storrie & Co., $394,000; E. Malley, $418,000; State Construction Co., $419,000; Grant, Smith & Co., $455,800, and F. Rolandi, $487,950.

⊙The City Trustees of Lordsburg, Calif., have awarded the contract for street improvements to H. L. Kuns of that city, for $34,049.

⊙The San Joaquin County Supervisors, Stockton, Calif., have awarded the contract to macadamize Hutchins St., from Pine St. to Lodi Ave., City of Lodi, to F. F. Irey.

The City Council of Santa Monica, Calif., has given the final order for the paving of Fremont Ave., from the sea to Sawtelle. The improvement will cost $10,000 and will be of concrete.

It is probable the citizens of Gilroy, Calif., will shortly be asked to vote on the issuance of city bonds for the paving of Monterey St., from its northern to its southern terminus a width of 24 ft. The cost of the improvement is estimated at $33,962.

The Orange County Highway Commission, Santa Ana, Calif., proposes to build 107 miles of good roads in the near future. The roads will be constructed of 5-in. concrete base with a covering of an inch or more of asphalt. The Board of Supervisors on April 10 was requested to call for bids for the erection of a rock crusher in the bed of the Santiago Creek. From that plant it is proposed to furnish crushed rock for the road work. The county will spend $1,270,000 in building the system of roads.

The citizens of Marin County, Calif., will shortly vote on the question of issuing bonds in the sum of $100,000 for the construction of good roads. San Rafael is the County Seat.

A bill carrying an appropriation of $50,000 will probably be introduced in the California Legislature providing for a wagon road from Chico to Susanviile, Lassen County.

The citizens of San Mateo County, Calif., at a recent election voted bonds to the amount of $1,250,000 for the construction of good roads. Redwood City is the County Seat.

Colorado.

The Board of Public Works of Denver, Colo., will order the paving of the streets and alleys, at a cost of $45,574, on June 4, for the district including 20th St., from the southeast line of Larimer to the northwest line of Welton, exclusive of its intersection with Champa; and Lawrence, Arapahoe, Curtis, Stout and California Sts., from the northeast line of 19th to the northeast line of 20th Sts.

Florida.

✣Bids will be received until noon, May 13, by Board of Bond Trustees, Pensacola, Fla., addressed to J. A. Merritt, Chairman, for grading, paving and curbing certain streets. The work for which proposals are invited consists of approximately 22,000 sq. yds. of concrete pavement and 14,400 lin. ft. of concrete or granite curb. Each proposal must be accompanied by a certified check in the sum of $2,000, drawn on some bank doing business in the City of Pensacola, and made payable to the Board of Bond Trustees of the City of Pensacola. Geo. Rommel, Jr., Chief Engineer.

✣Bids will be received until 10 a. m., May 9, by Board of Duval County Commissioners, Jacksonville, Fla., for the purpose of paving the road in the City of South Jacksonville, from the south end of the paving laid by the East Coast Railroad Company (with Miami rock) at its intersection with the St. Augustine Road to the intersection of the City Limits with the said St. Augustine Road and also from the intersection of the Pablo Beach Road with the St. Augustine Road to the intersection of the City Limits with the Pablo Beach Road with one or more of the following materials: No. 2 vitrified paving brick, laid flat, on a carefully prepared sand foundation. Concrete, when using broken granite, broken trap rock, washed gravel, or broken Florida flint rock on a carefully prepared sand foundation. Frank Brown is Clerk of the Board.

A resolution has been introduced in the Common Council of Tampa, Fla., providing for the repaving of Seventh Ave., in Ybor City, from 10th St. to 22nd St.

Georgia.

⊙Lewis & Stafford have been awarded the contract by the City Council of Augusta, Ga., for laying granite curbing during the year 1913 at the following prices: Straight curb, $0.41½; circular curb, $0.48½; drain holes, $0.65; catch basin holes, $1; resetting old curb, $0.08 per lin. ft. D. A. Bowe secured the contract for laying concrete sidewalks at $0.09⅞ per sq. ft., and driveways, at $0.13.

Idaho.

✣Bids will be received until 2 p. m., May 1, by H. W. Arnold & Co., Gem Bldg., Boise, Idaho, for the construction of certain buildings and clearing of streets and grounds at Payette Lakes for the Payette Lake Club. Plans and specifications may be seen in Boise or at the office of R. J. Wood, Weiser, Idaho.

Illinois.

✣Bids will be received until 10 a. m., May 10 (readvertisement), by S. Rose, Town Clerk, Crete, Ill., for the construction of ap-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

proximately 10 miles of hard roads, in Crete Township, Will County, Ill. Separate bids will be received for sufficient crushed stone for the whole work; separate bids will be received for sufficient gravel for the whole work: separate bids will be received for concrete road for any part or all of the roads; separate bids will be received for grading the whole roads and a lump sum may be bid for the entire construction, including material, labor, grading and tools necessary to complete the entire work. Plans and specifications for the crushed stone work may be seen at the office of S. Rose, Town Clerk, and may be had on request from the Illinois Highway Commission, Springfield, Ill., and the plans, profiles and specifications for the gravel or concrete road work can be seen at the office of S. Rose, Town Clerk, or can be obtained upon request.

⊙The following contracts have been awarded in Chicago for constructing pavements as shown; bids opened April 4: Belmont Ave., Rockwell St. to Milwaukee Ave., 15,600 lin. ft., sandstone curbing, 500 lin. ft. concrete curb wall, 1,050 sq. yds. of brick pavement, 23,800 sq. yds. creosote wood block pavement, total $91,997, The Ryan Co., 10 S. La Salle St., Chicago, Ill.; 5th Ave., S. Water St. to Van Buren St., creosoted wood block pavement, $50,781, The Ryan Co.; 42nd Ave., 22nd St. to Ogden Ave., 13,701 lin. ft. granite concrete combined curb and gutter, 2,200 sq. yds. asphalt pavement, $5,300.50, H. G. Goelitz, Oak Park, Ill.; 53rd St., S. Halsted St. to Union Ave., 1,270 lin. ft. granite concrete combined curb and gutter, 2,070 sq. yds. of asphalt pavement, $5,065, R. F. Conway Co., 133 W. Washington St.; Loretto Ct., Van Buren St. to Congress St., 600 lin. ft. sandstone curb stone, 1,280 sq. yds. of brick pavements, $4,218.20, R. F. Conway Co.; Lawndale Ave. to Hamlin Ave., 1,280 lin. ft. granite concrete combined curb and gutter, 1,870 sq. yds. of asphalt pavement, $4,541.70, F. P. McCormick, 133 W. Washington St.; Montrose Ave., Elston Ave. to Avondale Ave., 7,500 lin. ft. sandstone curb stone, 11,900 sq. yds. of brick pavement, $36,504, Citizen's Construction Co., 133 W. Washington St.; Prairie Ave., Lake St. to Chicago Ave., 4,450 lin. ft. granite concrete combined curb and gutter, 6,050 sq. yds. of asphalt pavement, $13,902, H. G. Goelitz; W. 26th St., 40th Ave. to 46th Ave., 7,730 lin. ft. sandstone curb stone, 15,130 sq. yds. of creosoted wood block pavement, $58,757, J. A. McGarry Co., 189 W. Madison St.; W. 28th St., 53rd Ave. to 44th Ave., 1,140 lin. ft. granite concrete combined curb and gutter, 1,840 sq. yds. of asphalt pavement, $4,063, H. G. Goelitz; W. 30th St., 43rd Ave. to 44th Ave., 1,140 lin. ft. granite concrete combined curb and gutter, 1,840 sq. yds. of asphalt pavement, $4,063, H. G. Goelitz; East 39th Street, State Street, to Cottage Grove Ave., 6,800 lin. ft. vertical concrete curbing, 15,530 sq. yds. creosoted wood block pavement, $59,213.80, The Ryan Co.; Wabash Ave., Washington St. to Congress St., creosoted wood block pavement, $43,094, The Ryan Co.; Washington St., La Salle St. to Franklin St., $8,872, J. A. McGarry Co.; Wilcox St., Oakley Ave. to Western Ave., 1,230 lin. ft. sandstone curb stone, 1,530 sq. yds. of brick pavement, $4,834.55. J. A. McGarry Co.; Haines St., Halsted St. to Hooker St., 1,500 lin. ft. sandstone curb stone, 3,260 sq. yds. granite block pavement, $14,533.10, Reidy & Callahan Coal Co., 133 W. Washington St.; the work includes preparation of the sub-grade, 6-in. Portland cement concrete foundation, sewer manhole and catch-basin construction and adjustment. E. J. Glackin, Secretary of the Board.

⊙John W. Bushell has been awarded the contract by the Board of Local Improvements of Peoria, Ill., for the resurfacing of Fayette St., from N. Adams St. to Knoxville Ave., with asphalt, for $11,196.

⊙The Board of Local Improvements of Ottawa, Ill., has awarded the contract for the paving of East Pearl St., to Joseph J. Leix, for $2,800.

The North Shore Park District, Chicago, Ill., at a meeting held April 16 voted to pave Sheridan Road, from Devon Ave. to the City Limits, with an asphaltic concrete pavement on present macadam foundation. W. A. Shaw, Chicago Opera House Block, is Engineer. Date of letting the contract has not been announced.

The City Commission of Moline, Ill., has approved the proposed paving of 13th St., from 16th to 23rd Ave., with brick, at an estimated cost of $20,141. The concreting of the alleys between Fifth and Sixth and Seventh Aves., the former from 11th to 15th Sts., the latter from 13th to 17th Sts., was decided upon. The first improvement will entail an outlay of $3,515, the second $3,733.

City Engineer Leonard D. Jeffries of Peoria, Ill., recently completed a survey of the proposed new paving project on Linn St, from the end of the present improvement at Nebraska Ave. to McClure Ave., near the northern City Limits. An estimate of cost is being made.

Blue Island, Ill. Following are the lowest unit bids submitted to the Board of Local Improvements on April 17, for constructing pavements in Western Ave., Burr Oak Ave. to 119th St., earth excavation, 17,900 cu. yds., 35 cts., grading parkways, 3,900 cu. yds., 30 cts., 22,425 sq. yds. brick pavement complete (Barr block), $1.67½, 10,450 lin. ft. concrete curb, 52 cts., 925 lin. ft. plankheaders, 25 cts., manhole adjustment, 35 at $3 each, catch basins adjustment, 54 at $5 each, 2 new catch basins, $50 each, 54 catch basin inlets $15 each, 6 water-valve boxes, $2 each, total $52,349. Pronger & Fletcher, Blue Island, Ill. W. V. Roberts, Reaper Bldg., Chicago, Ill., City Engineer.

Following bids were received by the Board of Local Improvements of Joliet, Ill., for the paving of Eastern Ave., with asphalt; R. F. Conway & Co., Chicago, $13,250; H. F. Streicher Co., Memphis, Tenn., $12,300, and Western Improvement Co., Racine, Wis., $12,210.

Indiana.

✣Bids will be received until 10 a. m., April 25, by Board of Public Works, Indianapolis, Ind., for the improvement of a number of streets and avenues as follows: Improvement of Thirty-third St., from the west property line of Central Ave., to the east property line of Meridian St., by grading and paving the roadway. The improvement of Congress Ave., from the west sidewalk line of Senate Ave., to the east property line of Shriver Ave., by grading, graveling and rolling the roadway. The improvement of Summitt St., from the north curb line of Ohio St., to the south curb line of New York St., by grading and paving the sidewalks. The improvement of Michigan St., from the west property line of Tibbs Ave., to east end of bridge over Little Eagle Creek, north, south and to east property line of Livingston Ave., by grading and paving the sidewalks. The improvement of Carrollton Ave., from the north property line of 38th St. (Maple Road), to the north property line of 40th St., by grading and paving the roadway. The improvement of Broadway, from the south property line of 38th St., to the southeast property line of Fairgrounds Ave., by grading and paving the roadway.

✣Bids will be received until 8 p. m., May 6, by Board of Town of Beech Grove, Ind., for grading and surfacing with crushed stone 13th, 14th, 15th, 16th and 5th Aves., in said town. M. H. Johnson is Town Clerk.

✣Bids will be received until noon, April 30, for furnishing and delivering the labor and materials necessary to macadamize the drive from Bryn Mawr Av. and 40th Av. northeasterly to Peterson Ave., by the Board of Directors of the Municipal Tuberculosis Sanitarium, Chicago, Ill. The work includes the construction of an 8-in. drain line, connecting with catch basins 150 ft. apart, grading and paving the roadways of 16 ft. and 10 ft. respectively, estimated quantities are as follows: 15,000 sq. yds. macadam pavement, 77 catch basins, 3,100 lin. ft. 8-in. tile pipe and 600-lin. ft. 6-in. drain pipe. Plans, specifications and profile may be had upon request, at the office, room 1512, 105 W. Monroe St. A deposit of $2.00 is required.

✣Bids will be received until 10 a. m., April 26, by Board of Local Improvements, Belleville, Ill., for the construction of the following improvements in the Church St. Paving District: 6,760 sq. yds. of vitrified brick paving on Portland cement concrete foundation four inches thick, complete in place; 5,700 lin. ft. of pitch expansion joints, complete in place; 4,680 lin. ft. of sandstone curbing, complete in place; 3,900 cu. yds. of excavating and grading; 280 lin. ft. of six inch vitrified clay sewer pipe, complete in place; 550 lin. ft. of 12 in. vitrified clay sewer pipe, complete in place; 400 cu. yds. of excavating and refilling sewer trenches; 2 brick manholes with cast iron covers, complete in place; 2 brick catch basins with cast iron covers, complete in place. Plans are on file in the office of the City Clerk of said City.

✣Bids will be received 2 p. m., May 10, by Board of Johnson County Commissioners, Franklin, Ind., for the construction of two gravel roads. H. L. Knox is County Auditor.

✣Bids will be received until noon, May 7, by Board of Lake County Commissioners, Crown Point, Ind., for the construction of gravel road in Calumet Township. Charles A. Johnson is County Auditor.

✣Bids will be received until 10 a. m., May 7, by Board of Bartholomew County Commissioners, Columbus, Ind., for the construction of macadamized roads in Haw Creek and Harrison Townships. Philip J. Sater is County Auditor.

✣Bids will be received until 10 a. m., May 6, by Board of Howard County Commissioners, Kokomo, Ind., for the construction of gravel and stone roads in Harrison, Clay and Center Townships. E. B. Swift is County Auditor.

✣Bids will be received until 10 a. m., May 8, by Board of Vanderburgh County Commissioners, Evansville, Ind., for the construction of three highways in Armstrong Township. C. P. Beard is County Auditor.

✣Bids will be received until 2 p. m., May 8, by Board of Harrison County Commissioners, Corydon, Ind., for the construction of gravel roads in Franklin and Spencer Townships. J. L. O'Bannon is County Auditor.

✣Bids will be received until 11 a. m., May 8, by Board of Floyd County Commissioners, New Albany, Ind., for the construction of a highway in New Albany Township. Julian T. Miller is County Auditor.

✣Bids will be received until 10 a. m., May 7, by Board of Delaware County Commissioners, Muncie, Ind., for the construction of a gravel road in Harrison Township; also crushed stone road on line between Harrison and Washington Townships, and on line between Union and Hamilton Townships. Francis M. Williams is County Auditor.

✣Bids will be received until 2 p. m., May 7, by Board of Monroe County Commissioners, Bloomington, Ind., for the construction of a pike road on line between Richland and Bean Blossom Townships. W. F. Kinser is County Auditor.

✣Bids will be received until 10 a. m., May 6, by Board of Adams County Commissioners, Decatur, Ind., for the construction of macadamized roads in Washington, Kirkland, Wabash, Marion and Hartford Townships. T. H. Baltzell is County Auditor.

✣Bids will be received until 10 a. m., May 6, by Board of Gibson County Commissioners, Princeton, Ind., for the construction of two gravel roads in Union Township and two in Montgomery Township. William T. Roberts is County Auditor.

✣Bids will be received until 2 p. m., May 6, by Board of Grant County Commissioners, Marion, Ind., for the construction of a stone road in Center Township; also stone roads in Van Buren Township. E. H. Kimball is County Auditor.

✣Bids will be received until 10 a. m., May 6, by Board of Cass County Commissioners, Logansport, Ind., for the construction of a highway in Washington Township. J. E. Wallace is County Auditor.

✣Bids will be received until 10 a. m., May 6, by Board of White County Commissioners, Monticello, Ind., for the construction of a highway in Prairie Township. A. G. Fisher is County Auditor.

✣Bids will be received until noon, May 6, by Board of Sullivan County Commissioners, Sullivan, Ind., for the construction of a stone and gravel road in Hamilton Township. William S. Bicknell is County Auditor.

✣Bids will be received until noon, May 6, by Board of Carroll County Commissioners, Delphi, Ind., for the construction of a highway on line between Adams and Jefferson Townships. M. G. Haun is County Auditor.

✣Bids will be received until noon, May 6, by Board of Pulaski County Commissioners, Winamac, Ind., for the construction of a gravel road in Harrison Township. William Munchenburg is County Auditor.

✣Bids will be received until 2 p. m., May 6, by Board of Davies County Commissioners, Washington, Ind., for the construction of three pike roads in Harrison Township. Lew S. Core is County Auditor.

✣Bids will be received until 10 a. m., May 6, by Board of Montgomery County Commissioners, Crawfordsville, Ind., for the construction of gravel roads in Scott and Franklin Townships. Bennet B. Engle is County Auditor.

✣Bids will be received until 2 p. m., May 5, by Board of Johnson County Commissioners, Franklin, Ind., for the construction of a gravel road in Hensley Township. H. L. Knox is County Auditor.

✣Bids will be received until noon, May 5, by Board of Starke County Commissioners, Knox, Ind., for the construction of a highway in California Township. Charles Weninger is County Auditor.

✣Bids will be received until 10 a. m., May 5, by Board of Laporte County Commissioners, Laporte, Ind., for the construction of a macadamized road in Pleasant, Lincoln and Washington Townships, 18.33 miles long. F. A. Hausheer is County Auditor.

✣Bids will be received until 10 a. m., May 5, by Board of Hendricks County Commissioners, Danville, Ind., for the construction of a crushed stone and gravel road in Lincoln Township. Lewis W. Borders is County Auditor.

✣Bids will be received until May 5, by Commissioners of Backford County, Hartford City, Ind., for the construction of two roads. James Cronin, Jr., is County Auditor.

✣Bids will be received until 2 p. m., May 5, by Board Spencer County Commissioners, Rockport, Ind., for the construction of a highway in Ohio Township. John T. Stevenson is County Auditor.

⊙Following contracts have been awarded by the Benton County Commissioners, Fowler, Ind., for the construction of crushed lime stone roads, for which bids were opened April 7: A. J. Freeland, Freeland Park, Ind., Metzinger Road; Wm. Mahoney, LaFayette, Ind., Moore Road, and Glynn & Vanatta, Otterbein, Ind., Glynn Road. The total cost of the roads is about $20,000.

⊙Pulse & Porter, Greensburg, Ind., have been awarded the contract by the Decatur County Commissioners, Greensburg, for the construction of bituminous macadam water bound and brick street in the city of Greensburg, for $18,855. Bids were opened April 7.

⊙Sisk, Sprinkle, Leavell & Co., Portland, Ind., have been awarded the contract for the construction of the Neclessent S. Cox Road in Wayne Township, Wayne County, Ind., for $47,020. Bids were opened April 12 by the County Commissioners, Richmond, Ind.

City Engineer Miles of Michigan City, Ind., has submitted plans and specifications for a pavement in Homer St., between Franklin and Wabash Sts., the estimated cost of which is given at $4,750.

The Board of Public Works of Muncie, Ind., has ordered the paving of the following streets with brick: Madison St., from Main to Kirby Ave.; Plum St., from Main to Jackson St.; Franklin St., from Washington to Howard; High St., from Charles to the first alley south of Howard.

The City Council of Goshen, Ind., has passed resolutions providing for the paving of parts of seven streets. The streets are as follows: Madison, Jefferson, Monroe, Douglas, Third, Washington and Clinton.

Iowa.

⊙Bryant Asphalt Paving Co., Waterloo, Ia., has been awarded the contract by that city, for paving, curbing and guttering certain streets in the city, for which bids were opened on April 14. The work includes 6-in. concrete base and 2-in. wearing surface. The contract price is $2.24.

⊙Following bids were received at Clarence, Ia.; on April 8, for paving work, (1) standing for bid of Garland & Shaffer, New Hampton; (2) M. Tschirgi & Son, Cedar Rapids (awarded contract), and (3) Frank K. Hahn, Cedar Rapids:

	(1).	(2).	(3).
Excavation, 1,000 cu. yds..	$0.46	$0.55	$0.50
Concrete curb, 2,425 lin. ft.	0.36	0.29½	0.39
Plain concrete, 7,300 sq. yds.	1.39½	1.39	1.38
Extra felt filler............	0.04½	....	0.05
Reinforced concrete, 7,300 sq. yds..................	1.59½	1.53	1.52
Totals	$12,977	$12,434	$12,542

Kansas.

✣Bids will be received until 3 p. m., May 13, by City of Manhattan, Kan., for the construction of about 35,000 sq. yds. of brick, asphaltic concrete and concrete pavement with bituminous skin top coat; also for curb and gutters, headers, etc. C. E. Noble is City Engineer.

Louisiana.

⊙It is reported the Louisiana Petrolithic Construction Co., of New Orleans, La., has been awarded the contract by the Caddo Police Jury, Shreveport, La., for the construction of five miles of road to the Caddo oil field.

The City Council of Lafayette, La., has adopted an ordinance calling an election of the property owners to vote on the question of levying a one-mill tax for 25 years and authorizing a bond issue of $75,000 for good roads.

The Iberville Parish Police Jury, Plaquemine, La., has adopted an ordinance creating Road District No. 1, in the First Ward, for the purpose of completing the gravel road along the river front, from White Castle to the Ascension line. An election will be held May 20 to vote on a bond tax, amounting to $10,000.

The City Council of New Iberia, La., has approved plans and specifications submitted by City Engineer Robb for the paving of 12 miles of additional sidewalks in the southern section of the city. Bids will be received at once by the Mayor.

Maryland.

⊙The County Commissioners, Denton, Md., awarded the contract for the construction of 1.62 miles of stone macadam road from Denton to Willow Pond, in Tuckahoe Neck, and for a draw bridge over the Choptank river to the Holt Construction Co., of Federalsburg, at $33,236. The concrete portion of the bridge is included in this contract. The bids for the bascule draw, being in excess of the State's estimate, were rejected, and other bids will be asked.

The Washington County Commissioners, Hagerstown, Md., have authorized the construction of the state road from Weverton to Harpers Ferry. The road will be a continuation of the highway running from Frederick to Weverton via Brunswick and Knoxville. Engineers are now at Weverton making surveys.

Massachusetts.

✣Bids will be received until 8 p. m., May 2, by Board of Selectmen, North Attleboro, Mass., for supplying brick pavers.

⊙Charles E. Horne of Millbury, Mass., has been awarded the contract for building the stone road to Douglas Center, Borough of East Douglas, Mass. The sum of $3,000 was appropriated for this work.

At a recent town meeting in Concord, Mass., the sum of $27,000 was voted for roads and bridges.

Mayor Burns of Somerville, Mass., has asked the Board of Aldermen to petition the Legislature for the right to borrow $150,000 outside the funded debt limit for the purpose of constructing permanent paving on several thoroughfares.

The Street Commissioners of Boston, Mass., in a report sent to the City Council approved proposed improvements affecting 105 streets in the city, the estimated cost of which is $1,630,600. L. K. Rourke is Commissioner of Public Works.

The Common Council of Malden, Mass., has appropriated $79,000 for permanent improvement to be made by the Street and Water Commission, including $35,000 for the paving of Main St., $30,000 for sewer extension and $5,500 for the purchase of the Gould lot by the city.

The Selectman of Lee, Mass., have appropriated $14,000 for highways and bridges for 1913.

The Selectmen of Webster, Mass., have appropriated $8,050 for highways and bridges for 1913. John E. Hickey is Town Clerk.

The Selectmen of Northbridge, Mass., have appropriated $6,500 for highways and bridges for the year 1913. Joseph A. Johnston is Town Clerk.

The Selectmen of Northbridge, Mass., have appropriated $4,000 for the improvement of Worcester Road in Rockdale. J. A. Johnston is Town Clerk.

The Selectmen of Dudley, Mass., have appropriated $6,700 for highways and bridges for 1913. James A. Thompson is Town Clerk.

Michigan.

✣Bids will be received until noon, May 2, by Board of Muskegon County Road Commissioners, Muskegon, Mich., for building the following county roads: First—One mile of road on the section line between sections 22 and 23, Holton township. Second—Two miles of road on the Holton county road, commencing at the northerly end of the present stone road in the Village of Twin Lake, then easterly along said Holton road two miles. Third—Bailey road, commencing at the quarter post on the section line between sections 5 and 8, in Casnovia township, thence east on section line one-half mile. Fourth—Grand Haven road, commencing at the west eighth post on the section line between sections 21 and 28, in Norton township, thence south on eighth line through said section 28 one mile, more or less. Fifth—Whitehall road, commence at the west one-eighth post on quarter line of section 30, township 11 north, range 16 west, thence west and northwesterly 6,542 feet to quarter line of section 19 in said township. John B. Barlow is Clerk.

⊙Lee Howland, Charlevoix, Mich., has been awarded the contract by the Common Council, Hastings, Mich., for the construction of one and one-tenth miles of cement pavement. Bids were opened March 28.

⊙The Department of Public Works of Detroit, Mich., has let the contract for furnishing 250,000 sq. yds. of creosoted wood block paving to The U. S. Wood Preserving Co., of New York City, for $1.99 a sq. yd. The Kettle River Co., and the Ayer & Lord Tie Co., of Chicago, Ill., bid $2.06.

The City Council of Manistee, Mich., has voted to pave Cypress St., from First to Third Sts., the estimated cost being $3,500.

Jackson County Commissioners, Jackson, Mich., propose the construction of about 25 miles of good roads during the coming summer at a cost of $75,000.

The citizens of Emmet County, Mich., on April 7, defeated the proposition to issue bonds in the sum of $225,000 for the improvement of roads throughout the county. Petoskey is the county seat. A. C. Modlem is County Clerk.

Minnesota.

✣Bids will be received until 1 p. m., April 25, by Board of Houston County Commissioners, Caledonia, Minn., for the grading to be done on roads in Willmington Township. Robert Burns is County Auditor.

✣The Board of Pinetop Township, Koochiching County, Minn., will receive bids until May 3, to grade three miles of road in that town. Bids must be filed with Town Clerk J. B. Clark, at International Falls, Minn., on or before 10 a. m.

✣The Cook County Commissioners, Grand Marais, Minn., Chris Murphy, Clerk, will receive bids until April 26, for the construction and completion of a road from the southwest corner of Sec. 5, West, according to plans and specifications on file. All bids must be accompanied by a certified check for 5 per cent of the amount of the bid.

⊙Edward Logan, of Marble, Minn., has been awarded the contract for the construction of the new Goodlands Judicial Road which is to be built jointly by Nashwauk, Itasca County and Stuntz, St. Louis County, Minn.

⊙The Hennepin County Commissioners, Minneapolis, Minn., A. P. Erickson, Auditor, have awarded the contract for grading 3,700 ft. of Road No. 8, being Contract No. 14, commencing at the westerly limit line of the city of Minneapolis and extending northwesterly to John Sibley, 3113 Second St., North, Minneapolis. Bids were opened April 14.

⊙Thos. Brogan, St. Peter, Minn., has been awarded the contract by the County Commissioners, C. L. Kennedy, Auditor, Mankato, Minn., for the construction of state rural highway No. 1, for $21,047. Bids were opened April 15.

The Pipestone County Commissioners, Pipestone, Minn., did not let the contract on April 15, for grading for State Roads numbered 3, 9 and 10, and graveling State Road number 2. T. Bailey is County Auditor.

The County Commissioners, Stillwater, Minn., will, at their meeting May 2, discuss the proposition of issuing bonds to the amount of $500,000 for road building. The sum of $2,000 is to be set aside for the Hastings Road.

Plans were recently submitted at a meeting of the City Council, Duluth, Minn., for the opening of Roosevelt St., at an estimated cost of $10,000.

The City of Minneapolis, Minn., plans the construction of 215,000 sq. yds. of pavement this year. Of this amount 177,000 sq. yds. will be of creosoted blocks. The remainder will be constructed of bituminous concrete with macadam base and plain concrete with a similar base. Ellis R. Dutton is City Paving Engineer.

Missouri.

⊙The Commissioners of the Kinbrough Special Road District, Springfield, Mo., have let the contract for improving highways in that district to V. E. Kosh, of Joplin, Mo., for $32,000.

Park Commissioner Dwight F. Davis in his annual report to the Board of Public Improvements of St. Louis, Mo., will urge a $5,000,000 bond issue for the purchase of new park property and extensive improvements in the parks and playgrounds now owned by the city.

Montana.

⊙Benson, Carpenter & Co., Helena, Mont., have been awarded the contract for furnishing the city of Helena, one 4-h. p. Austin reversible road grader. Bids were opened April 7.

Nebraska.

⊙E. R. Bing, Hastings, Nebr., has been awarded the contract by that city. A. T. Bratton, City Clerk, for repaving about 6,986 sq. yds. with Purington brick, for $1.16 a sq. yd. Bids were opened April 14.

⊙Parks & Lefler, of South Omaha, Neb., have been awarded the contract for the paving of Main, Sixth and Irving Sts., in Fremont, Neb., for $41,778. Brick will be used.

New Hampshire.

✣Bids will be received until May 7, by S. Percy Hooker, State Supt. of Highways, Concord, N. H., for the construction of a gravel road in Lee township. The work estimated to cost $1,750. Plans and specifications may be obtained of the State Engineer, Concord, N. H. or of Selectmen of Lee, N. H.

New Jersey.

✣Bids will be received until 2:30 p. m., April 30, by City Commission, Trenton, N. J., for the repaving of North Montgomery St., from Perry St. to Brunswick Ave. Also Bellevue Ave., from Willow St. to Calhoun St., with vitrified block. Frank Thompson is City Clerk.

⊙The Boulevard Commissioners, Jersey City, N. J., have awarded the following contracts: Standard Oil Co., road binder, at $0.08¼, $0.60¼, and $0.06 per gal.; delivering and spreading to cost $0.02 a gal. more; New Jersey Oil Works, road oil, at $0.05½ a gal.; August Thiel, crushed stone for Sections 3 and 4, at from $1.25 to $1.85 a cu. yd.; Jos. Murphy & Son, crushed stone for Sections 1 and 2, at from $1.85 to $2.15 a cu. yd. Jos. Murphy & Son secured the contract for paving sand, at $1.75 a cu. yd.

The City Commissioners of Trenton, N. J., have made provision for the construction of streets aggregating in cost about $90,000.

New York.

⊙M. Applegate & Son Co., Bradford, Pa., has been awarded the contract by the Commissioners of Public Works, Olean, N. Y., for the construction of a vitrified brick pavement on concrete foundation in Green St., from the west line of Third St., to the east line of South Fourth St., for about $27,000. The work also includes curbing and sewer connections. Bids were opened April 11.

⊙The Iroquois Iron Works, Buffalo, N. Y., has been awarded the contract by the Board of Control of Toledo, O., for furnishing one 8-ton asphalt road roller and tools for repairing asphalt pavements, for $2,398.

The Board of Contract & Supply of Albany, N. Y., has advertised for bids for the improvement of New Scotland Ave., from the Albany Hospital to the city line. The plans call for a grass plot running through the center on which the tracks of the United Traction Co. will eventually be laid. Frank R. Lanagan is City Engineer.

The citizens of Hornell, N. Y., will vote April 29 on plans for the continuation of the East Ave. pavement from the end of Main St. to the Erie Railroad. The city's share of the bonded indebtedness for this work will be $16,000.

North Carolina.

The citizens of Davidson County, N. C., it is reported, will shortly vote on the issuance of bonds to the amount of $300,000 for the construction of good roads. Lexington is the County Seat.

The citizens of Henderson, N. C., have voted bonds in the sum of $100,000 for street improvements.

North Dakota.

✣Bids will be received until 2 p. m., May 3, by W. L. Reager, County Clerk, Giese, N. D., for the following road work to be done in Sand Creek Road District. For grading the section line between 26-27, where road begins at foot of butte on north end of line running south to bridge grade. Said grade to be 16 ft. between cuts and raised to 1 ft. in center, tapering to a point 8 ft. from center. Ditch on each side to be 8 ft. wide and no more than 1½ ft. deep. Also grade starting from southwest corner of 14 running due north, between Sections 14-15-10-11-2-3, said grade to be 16 ft. wide between cuts, filled to the center, to 1 ft. height, tapering to a point 8 ft. from center. Ditch on each side to be 8 ft. wide and no more than 1½ ft. deep. Also to cut down hill in center between 22-23 on half mile line. Said hill to be cut 5 ft. in center 10 rods long north and south, and 20 ft. wide at bottom. Dirt to be hauled from the hill south over culvert.

Ohio.

✣Bids will be received until 11 a. m., May 14, by Board of Cuyahoga County Commissioners, Cleveland, O., for the improvement of Taylor Road No. 2, from a point 900 ft. south of Euclid Ave. to Mayfield Road in Cleveland and Cleveland Heights Townships, in accordance with the form of contract and specifications to be furnished by Frank R. Lander, county surveyor. Each proposal must be accompanied by a certified check for $1,000. Plans, descriptions, bills and specifications for the above work can be seen and are open to public inspection of persons interested therein, at the office of the County Engineer at the new Court House on Lakeside Ave., Cleveland, Ohio.

✣Bids will be received until noon, May 5, by James Stotler, Village Clerk, Girard, O., for furnishing the necessary labor and material for the improvement of Liberty St. from State St. east to the termination thereof, by draining, constructing the necessary connections for water and gas from the mains to within the inner lines of curbs, by grading, setting curb and paving, according to the plans, profiles and specifications on file in the office of said Village Clerk. Each bid must contain the full name of every person or company interested in the same, and be accompanied by a certified check on some solvent bank of Trumbull County, Ohio, payable to the Treasurer of the Village of Girard, for the sum of $500.

✣Bids will be received until noon, April 24, by W. H. Kirby, Secretary to the Director of Public Service, Cleveland, O., for the construction of concrete or asphaltic concrete pavement in Shaker Heights Park. Section 1, South Shaker Boulevard from Lee Road to South Woodland Road; Section 2, that portion of the Park Boulevard that lies between the triangle in South Shaker Boulevard west of Lee Road and North Woodland Road. Each bid must be made in accordance with the plans and specifications which may be obtained at the office of the Park Superintendent, Room 214 City Hall.

✣Bids will be received until 11 a. m., April 25, by John Lloyd, Director of Public Service, Middletown, O., for the necessary labor and material for the improvement of the following streets: Cleveland St., from Woodlawn Ave. to Grand Ave.; Jefferson St., from C. C. C. & St. L. Ry. to McKinley Ave.; Queen St., from Lincoln St. to Wycoff St.; Sixth St., from Broad St. to Garfield Ave.; Garden St., from Woodside Ave. to Lind St.; Clark St., from Vine St. to Third St.; Askew Ave., from Yankee Road to a point 139 ft. north of the center line of Prospect Ave., with sidewalks, curbs and gutters, in accordance with the plans of said improvements heretofore approved by Council and now on file in the office of the City Engineer. H. J. Duane is City Engineer.

✣Bids will be received until noon, April 26, by C. C. Sharp, Director of Public Service, Nelsonville, O., for the grading and paving of a portion of Madison St. Plans and specifications can be obtained of the Director.

✣Bids will be received until noon, April 26, by C. C. Sharp, Director of Public Service, Nelsonville, O., for paving, curbing and grading a portion of Poplar St. Plans and specifications are on file with the director.

✣Bids will be received until noon, April 26, by C. C. Sharp, Director of Public Service, Nelsonville, O., for paving a portion of Adams St., in accordance with plans and specifications now on file with the Director of Public Service.

✣Bids will be received until noon, May 5, by Village Council, Girard, O., at the office of James E. Stotler, Clerk, for furnishing the necessary labor and material for the construction and repair of all sidewalks which said village may be required to build upon the failure of the bounding and abutting property owners so to do; and for all cross-walks

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

and intersections that council may determine to construct or repair on behalf of the village. All for a period of six months from the first day of May, 1913, to the first day of November, 1913. Bids will be received for stone, concrete and ash sidewalks and for cement and brick paved cross-walks, which shall comply with all the requirements of the general sidewalk ordinance of said village and the statutes of the State of Ohio, also the specifications are on file with the director. the various streets on which construction or repair of sidewalks and cross-walks may be determined necessary, which are on file in the office of the Village Clerk.

✣Bids will be received until 11 a. m., May 14, by Board of Cuyahoga County Commissioners, Cleveland, O., for the improvement of Taylor Road No. 2, from 900 feet south of Euclid Ave., to Mayfield Road in E. Cleveland and Cleveland Heights Townships, in accordance with the form of contract and specifications to be furnished by Frank R. Lander, County Surveyor. Plans, descriptions, bills and specifications for the above work can be seen and are open to public inspection of persons interested therein, at the office of the County Engineer at the new Court House on Lakeside Ave., Cleveland, O. J. F. Goldenbogen is Clerk of the Board.

✣Bids will be received until noon, April 30, by Mayor and Clerk, Idlewood, O., for furnishing the necessary labor and materials for lighting streets, roads, avenues, alleys, ways, bridges and parks in the Village of Idlewood, Ohio, with 25 or more electric arc lights for a period of 10 years, according to plans and specifications on file in said office. Each bid must contain the full name of every person or company interested in the same, and be accompanied by a bond in the sum of $100. E. A. Burr is Clerk.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., April 30, 1913, for grading and paving with a waterbound macadam, the Section No. 2 Galion-Mansfield Road, State Highway "G," Petition No. 737, Sandusky Township, Richland County. Length, 11,485 ft. or 2.21 miles. Width of paving, 12 ft. Estimated cost of construction, $13,174. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, August 1. 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., April 30, 1913, for grading and paving with brick for heavy tracffic, the Ashland-New London Road, State Highway "F," Petition No. 339, in Ruggles Township, Ashland County. Length, 13,265 ft. or 2.51 miles. Width of paving, 10 ft. Estimated cost of construction, $34,538. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, August 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of County Commissioners at Medina, Ohio, until 10 a. m., April 29, for grading and paving with brick for heavy traffic, the Wadsworth Wooster road, State Highway "B," Pet. No. 548, in Wadsworth Township, Medina County. Length, 3,432 ft., or 0.65 miles; width of paving, 10 ft. Estimated cost of construction, $9,782. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion. August 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

⊙The Enterprise Paving & Construction Co., Cleveland, O., has been awarded the contract by the Board of Cuyahoga County Commissioners, Cleveland, for the grading of Stone Road. Bids were opened April 12.

⊙Fred L. Geiger, 7 School St., Warren, O., has been awarded the contract by Charles L. Craig, Director of Public Service, Warren, O., for the repaving of North Park Ave., from High St. to Belmont St., with Metropolitan brick, for $13,042. Bids were opened April 8.

⊙Greist, Markley & Keys, Shreve and Wooster, Ohio, have been awarded the contract by the village of Shreve for improving Market St., by grading, setting curbing and paving with vitrified paving block on concrete foundation, for $19,488. Bids were opened April 15.

⊙Thomas Burton & Son, Wellington, O., have been awarded the contract by the State Highway Commission, Columbus, for grading the Pittsfield-Wellington Center Road. The contract calls for the excavation of about 23,000 cu. yds. of earth.

⊙The Ohio State Highway Commission, Columbus, has let the contract for the building of the extension of the Leroy macadam road from Weeds Corners to Breakman church, to Baldwin, Little & Williams, for $25,010. The road will be built of macadam, but will be of concrete base with a bituminous top dressing.

The City Council of New Philadelphia, O., has adopted a resolution declaring it necessary to issue notes for the paving of West Fair and West High Sts., and Tuscarawas Ave. Plans and specifications have been accepted for the improvements, which will cost about $80,326.

Tuscarawas County Engineer Stingel, New Philadelphia, O., has submitted to Mill Township Trustees an estimate on the paving of Park Valley road. The cost of the proposed improvement is placed at $29,407.

The public improvement committee of the City Council, Toledo, O., has authorized Service Director Cowell to prepare plans and specifications for repaving Cherry St., from Bancroft St. to Collingwood.

Oklahoma.

The City Commission of McAlester, Okla., has passed a resolution authorizing the city engineer to prepare specifications for the paving on Miami Ave., between Sixth and Eighth Sts.

Oregon.

⊙Contracts for street improvements have been awarded by the street committee of the City Council, Portland, Ore., as follows: 42d St., S. E., from Holgate to Powell; macadam. Cochran-Nutting Co., $17,654. East Ninth St., from Cora to Holgate, grading and concrete curbs and walks, Stevens & White, $2,363. Crescent Drive, from East Morrison to East 33d St, grading and concrete curbs and walks. Stevens & White, $3,105. East Burnside St., from East 82d St. to East 90th, grading and concrete curbs and walks, Jeffery & Bufton, $7,107. Alley between Broadway and Hancock Sts., from East 27th to East 28th, gravel bitulithic, Pacific Bridge Co., $2,662. Rodney Ave., from Russell to Hancock, bitulithic redress, Warren Construction Co., $36,671. Alley between Clackamas and Halsey, from East 24th to East 28th, asphaltic concrete, E. J. Currigan, $4,132. East 41st St., from Mallory to East Harrison, gravel bitulithic, Pacific Bridge Co., $1,912. East 29th St., from Weidler to Tillamook, gravel bitulithic, Barber Asphalt Paving Co., $4,916. Schuyler St., from East 28th to Glenside Addition, gravel bitulithic, Pacific Bridge Co., $2,627. East 25th St., from Halsey to Wild Rose Addition, gravel bitulithic, Warren Construction Co., $4,563. East Lincoln St., from East 50th to East 60th, gravel bitulithic, Pacific Bridge Co., $19,968. Upper Drive, Portland Heights, grading and concrete curbs and walks, Giebisch & Joplin, $8,553.

⊙The Corvallis Concrete Co., of Corvallis, Ore., has been awarded the contract for the construction of street pavement in that city, to be of concrete. C. R. Beardsley is City Engineer.

Pennsylvania.

✣Bids will be received until 2 p. m., April 29, by Fuller R. Hendershot, County Controller, Wilkesbarre, Pa., for constructing a highway in the County of Luzerne, designated as Section 2 of the County Road, through the Townships of Fairview, Wright, Dennison and Foster, a distance of five and five-tenths miles, in accordance with the plans and specifications proposed by Charles S. Miles, Engineer, on file in the office of the County Controller of Luzerne County. A certified check for $1,000 must be filed with each bid.

✣Bids will be received until noon, May 1, by M. L. Cooke, Director of Public Works, Philadelphia, Pa., for surfacing macadam roads: Schedule "A," surfacing macadam roads: 5 contracts aggregating 16,495 sq. yds. of waterbound macadam. Schedule "B," resurfacing macadam roads: 12 contracts aggregating 71,647 sq. yds. of bituminous macadam, and 18,630 sq. yds. of waterbound macadam. Requests for copies of specifications to be sent by mail must be accompanied by certified check or money order to the amount of 50 cents for each specification desired, which charge will be refunded upon the return on or before May 1st, 1913, of the unused specification in good condition, or in case bid is submitted. Specifications and blank forms upon which bids must be made can be obtained upon application at the office of the Bureau of Highways, Room 232, City Hall.

✣Bids will be received until noon, May 14, by Board of Lackawanna County Commissioners at the office of the County Controller, Scranton, Pa., for the construction of the unfinished portions of an improved macadam road in three sections. Plans and specifications are on file at the office of the Commissioners, Scranton, Pa.

⊙The Allegheny County Commissioners, Pittsburgh, Pa., have awarded the following contracts for road material and for hauling: James Creese, William Glew, Charles Vere, Central Supply Co., A. G. Rothey, John Bardoner and L. Z. Hodil, for hauling, at prices ranging from $0.73 to $1.77 a ton. Donald McNeil Co., and The Pittsburgh Amiesite Co. secured contracts for asphalt concrete at from $8.46 to $9.62 a ton. The Clydesdale Stone Co. was awarded a number of contracts for ballast at from $1.23 to $1.33 a ton. C. P. Mayer will furnish brick block at prices ranging from $15.45 to $16.95 a ton. The Rogers Sand Co. will furnish sand and gravel.

⊙William Martin, of West Fairview, Pa., has been awarded the contract by the Northern Central Railroad Co., for the grading of Water St., in New Cumberland and Elkwood.

The Pennsylvania State Highway Department will begin the improvement of Southern Ave., borough of South Williamsport, within a few weeks. Contract will be let about May 1. The work will cost about $30,000.

The Mt. Carmel, Pa., Town Council has decided to pave 12 more squares of streets this summer.

The City Council of Steelton, Pa., has ordered an ordinance drawn up providing for the issuance of $40,000 bonds for street paving, a sanitary hospital and additions to water mains.

Highway Commissioner Fritchey, Harrisburg, Pa., received the following bids April 12 for grading Green, Woodbine to Emerald: J. L. Shearer, Jr., $2,943; Stucker Bros., $3,739. Bids on Swatara St., from 18th to 21st St., were: Central Construction & Supply Co., $1,690, and Stucker Bros., $2,042.

The Lawrence County Commissioners, New Castle, Pa., have had filed with them five petitions from North Beaver and Little

Beaver Townships, asking for state aid in the building of highways.

The Department of Public Works of Philadelphia, Pa., will spend $300,000 this year in resurfacing approximately 25 miles of country roads in the outskirts. Director Morris L. Cooke is now calling for bids on part of the work.

South Carolina.

✣Bids will be received until 10 a. m., April 29, by R. C. Keenan, Superintendent of Streets, Columbia, S. C., for furnishing a gasoline or oil tractor for the city of Columbia, suitable for work on the city streets. Tractor must have a capacity of either 15 horsepower at the drawbar, or from 20 to 23 horsepower at the drawbar, and a speed of from three to five miles per hour. Prices may be submitted for tractors of each class. Bidders are requested to submit complete plans and specifications, covering full details of tractors for which bids are submitted, and submit a price f. o. b. Columbia, S. C., together with guaranteed date of delivery. John McNeal is City Engineer.

Washington.

✣Bids will be received until 10 a. m., May 3, by Board of Clarke County Commissioners, Vancouver, Wash., for the improvement of Permanent Highway No. 2, Clarke County, which runs from Vancouver north 2½ miles. The work consists of either tarvia, dolorway, concrete or warrenite pavement estimated to cost $32,000. A certified check for 10 per cent of the amount bid must accompany each proposal. Specifications and plans are on file with W. A. Schwarz, County Engineer, Vancouver, Wash.

⊙The City Council of Wenatchee, Wash., has let the contract for the construction of wood block pavement on Wenatchee Ave., and brick blocks on side streets, to J. J. McNerney, of that city, for $102,455.

Bids were opened April 11 for paving Pine St., Seattle, Wash., a district heretofore planked and with most of the sewers, water mains, etc., installed. Some of the details of pavement and local prices are as follows: 6-in. concrete base, 1-4-4 mix; grout, 1-2 mix; sand cushion, 1½ in. to 2 in. Brick cost $20 per M f. o. b. cars; brick block, $30.50 per M f. o. b. cars; sandstone, $1.85 per sq. yd. f. o. b. cars; cement, $2 per bbl. wholesale; sand and gravel, 70 cts per cu. yd. at bunkers, $1.30 per cu. yd on job. Labor under the minimum wage law is $2.75 for an 8-hour day; teams, $6.50 for 8 hours. The bidders, all of Seattle, and their total bids were as follows: (1) T. Ryan, brick, $56,543; (2) B. L. Traphagen, bitulithic, $54,241, brick, $58,328; (3) McQuaid & Moore, brick, $57,950; (4) McGuire & Moon, brick, $58,944; (5) Ferguson-Coit Co., brick, $56,432; (6) F. S. Misho & Co., brick, $58,500; (7) Barber Asphalt Paving Co., bitulithic, $50,469, brick, $47,814; (8) Russell & Gallagher, brick, $58,798; (9) A. T. Baumgartner, bitulithic, $53,260, brick, $56,168. The itemized bids of the contractors were as follows:

Items.	Quantities.	(1).	(2).	(3).	(4).	(5).	(6).	(7).	(8).	(9).
Fixed estimate, $2,900.										
*Clearing and grubbing	Lump.	$1,500.00	$1,250.00	$750.00	$1,800.00	$1,250.00	$1,800.00	$1,000.00	$1,250.00	$1,200.00
Earthwork	4,600 cu. yds.	0.20	0.35	0.40	0.40	0.20	0.25	0.40	0.40	0.30
Curb, armored concrete, straight	5,146 ft.	0.50	0.55	0.50	0.50	0.50	0.55	0.48	0.55	0.47
Curb, granite, curved	460 ft.	2.00	1.65	1.65	1.80	1.70	1.85	1.60	1.35	1.95
Curb, concrete, replaced	5 ft.	0.50	1.50	0.50	0.60	0.60	0.55	0.30	0.60	0.50
Curb, granite, reset	42 ft.	0.70	1.00	0.75	0.70	0.60	0.50	0.80	0.70	0.60
Paving, asphalt	5 sq. yds.	1.75	1.50	2.00	1.70	1.80	2.00	1.60	1.70	1.79
Paving, brick	5,831 sq. yds.	2.48	2.47	2.50	2.45	2.40	2.55	2.40	2.50	2.35
Paving, bitulithic (alternate)	10,985 sq. yds.	....	2.10	....	....	....	....	1.75	....	2.15
Paving, brick block	5,674 sq. yds.	2.53	2.49	2.58	2.60	2.54	2.55	2.45	2.55	2.48
Paving, sandstone block	154 sq. yds.	3.30	3.35	3.50	3.60	3.40	3.60	3.50	3.70	3.45
Gutters, brick	7 sq. yds.	2.45	3.00	2.60	2.50	2.50	2.55	2.55	2.70	2.40
Gutters, brick (alternate)	527 sq. yds.	....	2.65	....	....	....	....	2.55	....	2.40
Alley crossings	351 sq. yds.	2.45	2.60	2.50	2.50	2.40	2.55	2.40	2.60	2.35
Gravel sub-base	60 cu. yds.	1.75	1.25	1.25	1.75	1.35	1.75	1.20	1.50	1.30
Concrete walks	6,820 sq. yds.	0.85	0.80	0.85	0.85	0.80	0.90	0.90	0.87	0.80
Concrete walks, repaired	20 sq. yds.	1.00	0.90	1.00	1.20	1.00	0.90	0.90	1.10	0.90
Wood stop	478 ft.	0.38	0.30	0.40	0.40	0.35	0.40	0.30	0.40	0.49
Catch basin, single inlet	10	60.00	65.00	65.00	65.00	60.00	56.00	60.00	70.00	55.00
Catch basin, double inlet	2	75.00	75.00	75.00	80.00	70.00	73.50	75.00	90.00	65.00
Catch basin, reconnected	7	10.00	15.00	15.00	20.00	25.00	20.00	20.00	10.00	15.00
Catch basin, moved	1	15.00	20.00	25.00	35.00	20.00	56.00	20.00	25.00	25.00
Single inlets	1	15.00	15.00	15.00	15.00	15.00	8.00	15.00	17.50	10.00
Curb inlets	1	10.00	15.00	8.00	8.00	8.00	15.00	7.00	10.00	7.00
Inlets moved	1	3.00	5.00	5.00	6.00	3.00	5.00	3.00	5.00	5.09
Inlets adjusted	11	2.00	3.00	3.00	3.00	2.00	2.00	2.00	1.50	3.00
C. B., M. H., etc., covers, adjusted	9	2.00	2.00	2.00	2.00	1.50	2.50	2.50	2.00	2.50
6-in. side sewers	22 ft.	1.00	1.00	1.15	1.20	1.50	0.40	1.40	1.00	0.90
8-in. side sewers	462 ft.	1.25	1.40	1.25	1.40	1.50	0.85	1.70	1.40	1.25
3-in. sewer pipe	50 ft.	0.20	0.15	0.20	0.15	0.15	0.25	0.12	0.30	0.15
Monument cases	6	9.00	10.00	9.00	8.00	8.00	8.00	7.00	7.50	8.00
Bulkhead lumber	7 M.	23.00	30.00	25.00	25.00	30.00	20.00	25.00	30.00	19.00
Bulkhead iron	1,400 lbs.	0.07	0.06	0.07	0.07	0.10	0.05½	0.15	0.08	0.09
Old lumber, relay	10 M.	5.00	5.00	6.00	5.00	6.00	5.00	5.00	7.00	5.00
Extra excavation	10 cu. yds.	0.75	1.00	2.00	1.00	0.80	0.50	0.75	1.00	0.30
Wood railing, rebuilt	100 ft.	0.10	0.10	0.10	0.10	0.08	0.15	0.20	0.20	0.15
Coal for steam roller	22 cwt.	0.60	0.40	0.40	0.40	0.50	0.50	0.40	0.50	0.40
Repairing wood sidewalk, old timber	5 M.	7.00	18.00	7.00	5.00	6.00	5.00	8.00	10.00	7.00
Repairing wood sidewalk, new timber	5 M.	18.00	18.00	22.00	20.00	22.00	20.00	18.00	25.00	20.00
Junction boxes, adjusted	16	3.00	3.00	2.50	1.00	2.50	2.00	5.00′	1.50	2.50
Manhole castings	2	10.00	10.00	12.50	11.00	10.00	10.50	10.00	12.00	10.00
Concrete for stand pipe, 1:3:6	5 cu. yds.	9.00	12.00	10.00	8.00	9.00	8.00	6.50	10.00	9.00
Steel	50 lbs.	0.10	0.06	0.10	0.10	0.04	0.06	0.20	0.08	0.09
Concrete drain, with inlet	3	15.00	25.00	20.00	22.00	15.00	8.00	20.00	25.00	10.00
Concrete drain, without inlet	3	5.00	15.00	10.00	12.00	8.00	0.50	7.00	17.50	3.00
Asphalt paving relay., new base	10 sq. yds.	1.75	1.50	2.00	1.70	2.00	1.60	1.60	2.00	1.70
Asphalt paving relay., ex. base	30 sq. yds.	1.00	1.25	1.25	1.20	1.00	1.25	0.90	1.50	1.10
Brick gutters relay., new base	2 sq. yds.	2.45	2.60	2.00	2.50	3.00	2.65	2.60	2.50	2.40
Brick gutters relay., ex. base	5 sq. yds.	2.00	2.00	1.50	2.00	2.00	1.25	1.00	2.00	1.00
Brick paving relay., new base	5 sq. yds.	2.45	2.60	2.00	2.50	3.00	2.65	2.50	5.00	2.35
Brick paving relay., ex. base	5 sq. yds.	2.00	2.00	1.50	2.00	2.00	1.25	1.00	2.00	1.10
Extra binder	1 cu. yd.	9.00	12.00	10.00	9.00	8.00	2.00	7.00	15.00	1.50
Wood curb and gutters	0.5 M.	18.00	18.00	25.00	22.00	22.00	20.00	20.00	30.00	22.00
Wood curb and gutters, adjusted	0.5 M.	7.00	4.00	15.00	6.00	10.00	5.00	10.00	10.00	6.00
Armored curb, replaced	5 ft.	0.50	1.00	0.50	0.75	0.60	0.55	0.30	0.60	0.65
6-in. side sewers, relaid	25 ft.	1.00	1.00	1.10	1.20	1.30	0.35	1.20	1.00	0.90
8-in. side sewers, relaid	25 ft.	1.25	1.00	1.20	1.40	1.30	0.35	1.40	1.50	1.25
3-in. tile drain	100 ft.	0.10	0.15	0.15	0.20	0.10	0.15	0.15	0.20	0.10
M. H., etc , tops, rebuilt, per lin. ft	10 ft.	4.00	1.50	4.00	4.50	5.00	2.00	3.00	5.00	3.00
Wood railing, light	240 ft.	0.12	0.10	0.15	0.10	0.15	0.18	0.20	0.15	0.15
8-in. vitrified pipe sewer	74 ft.	1.75	3.50	1.20	2.00	2.50	1.20	3.00	1.50	1.30
12-in. vitrified pipe sewer	592 ft.	2.00	2.40	2.15	1.95	2.10	1.85	2.65	2.00	2.00
15-in. vitrified pipe sewer	239 ft.	2.25	2.80	2.50	2.40	2.60	2.05	3.30	2.50	2.75
18-in. vitrified pipe sewer	393 ft.	2.65	3.90	3.50	2.80	3.20	2.40	3.70	3.00	3.50
4½-ft. brick manhole	4	70.00	75.00	70.00	65.00	75.00	75.00	100.00	75.00	75.00
4½-ft. brick manhole, rebuilt	1	60.00	25.00	60.00	90.00	60.00	75.00	50.00	50.00	65.00
Manhole, special	2	75.00	40.00	110.00	95.00	150.00	125.00	75.00	50.00	125.00
Extra Y's on 8-in. sewer	1	2.00	3.00	1.00	1.00	1.00	1.00	2.00	2.00	1.00
Extra Y's on 12-in. sewer	1	2.50	4.00	1.00	1.00	1.00	1.75	3.00	3.25	1.75
Extra Y's on 15-in. sewer	1	3.00	6.00	2.00	2.00	2.00	3.00	4.00	4.50	3.00
Extra Y's on 18-in. sewer	1	3.25	7.00	3.00	3.00	3.00	5.00	5.50	5.00	4.00
Inlet top for existing catch basin	1	10.00	15.00	12.50	12.00	4.00	3.00	7.00	5.00	2.00
8-in. cast iron water pipe	249 ft.	1.30	1.40	1.35	1.40	1.40	1.75	1.35	1.40	1.45
12-in. cast iron water pipe	1,498 ft.	2.15	2.45	2.25	2.40	2.20	2.50	2.10	2.30	2.50
8-in. gate valves	6	24.00	24.00	23.90	25.00	22.00	25.00	25.00	25.00	30.00
12-in. gate valves	6	44.00	54.00	45.00	45.00	45.00	50.00	50.00	50.00	45.00
6-in. hydrants	7	70.00	69.00	75.00	75.00	70.00	70.00	75.00	75.00	78.00
Hydrant, reset	1	10.00	10.00	15.00	20.00	15.00	15.00	20.00	20.00	15.00
Hydrant extensions, horizontal	1,300 lbs.	0.10	0.08	0.07	0.08	0.07	0.10	0.06	0.08	0.09
Hydrant extensions, vertical	100 lbs.	0.10	0 08	0.10	0.08	0.10	0.10	0.06	0.10	0.09
6-in. cast iron pipe, hydrant connection	132 ft.	1.10	1.50	1.20	1.40	1.25	1.10	1.20	1.20	0.60
Brick valve chambers, standard	21	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
Brick valve chambers, large	2	50.00	60.00	65.00	85.00	75.00	75.00	75.00	75.00	45.00
¾-in. galvanized iron pipe, hydrant drain	122 ft.	0.25	0 50	0.40	0.30	0.35	0.20	0.40	0.20	0.35
Special castings	200 lbs.	0.10	0.07	0.07	0.06	0.06	0.07	0.06	0.07	0.09
Shackle rods	50 lbs.	0.10	0.10	0.12	0.10	0.10	0.10	0.10	0.10	0.10
Hydrant drain base	1	5.00	6.00	5.00	1.50	5.00	3.00	3.00	3.50	10.00

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*Consisted of removing the old wood curb and gutters, the planking, and wood sidewalks, which practically covered the entire yardage.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Tennessee.

⊙W. B. Bruce, of Jefferson County, Tenn., has secured the contract for macadamizing the pike roads in McMinn County, of which Athens, Tenn., is the county seat.

A resolution has been introduced in the County Court, Memphis, Tenn., providing for authority to issue bonds in the sum of $600,000 for dirt roads, turnpikes and bridges.

Texas.

The City Council of Bonham, Tex., has ordered five blocks of East Ninth St. paved; also the construction of a number of blocks of sidewalks.

The Board of Harris County Commissioners, Houston, Tex., has ordered that a special election be held for the issuance of $15,000 of road bonds to be used in building new roads in the district about Mount Houston.

The citizens of Bell County, Tex., on April 14 voted on the issuance of bonds in the sum of $150,000 for the construction of good roads. Belton is the county seat.

A petition has been circulated in Tyler County, Tex., providing for the calling of an election for the purpose of voting on the issuance of bonds in the sum of $200,000 for the building of good roads. Woodville is the county seat.

Virginia.

✣Bids will be received until 10 a. m., April 29, for the construction of six and one-half miles of macadam and thirty-seven and one-half miles of soil road in Dan River District of Pittsylvania County, Va. Plans and specifications on file at the Clerk's office, Chatham, Va.; at the City Engineer's office, Danville, Va., and at the State Highway Commissioner's office, Richmond, Va. Engineer A. F. Brown will be in the City Engineer's office, Danville, Va., on April 21 and 28 to give information to contractors. A certified check for $250 to accompany each bid for one road, or $500 for two or more roads. Specifications can be obtained from the State Highway Commissioner, or the Engineer on the ground. Blueprints can be secured from Childrey-Sunday Co., Richmond, Va., at $3.55 per set.

Wisconsin.

✣Bids will be received until 2 p. m., April 29, by Purchasing Committee, James Steber, Chairman, Antigo, Wis., for one road grader machine.

✣Bids will be received until 7:30 p. m., April 24, by Board of Public Works, Two Rivers, Wis., for furnishing the necessary labor and material for grading, curbing and paving certain streets.

The White Construction Co., Milwaukee, Wis., is the probable contractor for paving parts of 73d, 65th and 63d Aves., and parts of Elm St., in West Allis, Wis., for which bids were opened April 14 by the Board of Public Works. The work includes 28,000 sq. yds. of pavement, 8,000 cu. yds. of grading and 16,000 lin. ft. of combined curb and gutter. The prices are as follows: $0.40 to $0.55 a cu. yd. for grading; $0.55 a lin. ft. for combined cement curb and gutter; $1.80 a sq. yd. for 2-in. asphalt on 6-in. concrete, no binder; $2 for 2-in. asphalt on 6-in. concrete, 1-in. binder, and $1.85 for 1½-in. asphalt on 6-in. concrete, 1-in. binder.

The Advance Construction Co., Wm. H. Stare, Pres. and Genl. Mgr., Waukesha, Wis., is in the market for 12 to 15 second-hand dump wagons of from 2 to 3 yds. capacity.

The Milwaukee County Board, Milwaukee, Wis., plans to expend about $400,000 in the improvement of highways of the county during 1913. It is proposed to pave 35 miles with concrete. H. J. Kueling is County Engineer.

The Douglas County Commissioners, Superior, Wis., will shortly be in the market for the purchase of a portable rock-crushing plant, to cost about $3,200.

Canada.

✣Bids will be received until 11 a. m., May 15, by Chairman Board of Control, at the office of M. Peterson, Secy., Winnipeg, Man., for the supply of from 1,200 to 1,600 tons of refined asphalt, and from 300 to 500 tons of fluxing oil. Specifications and form of tender, together with conditions governing tenders as prescribed by by-law, may be obtained at the office of the City Engineer, 223 James Ave., Winnipeg.

The citizens of Orillia, Ont., on April 14 voted a by-law to raise $30,000 to build cement sidewalks.

The following sums have been appropriated by the Provincial Government of British Columbia for public works and improvements during the fiscal year. Work will be in charge of the Department of Public Works, Victoria, B. C.: Roads, streets, bridges and wharves—

Alberni District	$127,000
Atlin District	50,000
Cariboo District	265,000
Chilliwack District	99,000
Columbia District	112,500
Comox District	150,000
Cowichan District	78,000
Cranbrook District	135,000
Delta District	94,000
Dewdney District	198,000
Esquimalt District	109,000
Fernie District	135,000
Grand Forks District	88,000
Greenwood District	63,000
The Islands District	55,000
Kamloops District	144,000
Kaslo District	95,000
Lillooet District	145,000
Nanaimo District	22,000
Newcastle District	58,000
Oknogan District	260,000
Revelstoke District	115,000
Richmond District	250,000
Saanich District	60,000
Similkameen District	210,000
Skeena District	403,000
Slocan District	105,000
Yale District	115,000
Ymir District	170,000
Road, Papff-Windermere	60,000
Road, Hope-Princeton	120,000
Roads, Point Grey	75,000
Development, Strathcona Park	150,000
Location of roads	75,000
Road machinery	130,000
Wharves generally	60,000
Bridges generally	918,000
Bridges, Prince Rupert (conditional)	35,000
Bridge across Second Narrows, re-vote	400,000
Bridge, Fraser River, New Westminster (maintenance and repairs, including salaries)	28,000
Roads, Point Grey (additional to $80,000 voted)	20,000
Location of roads (additional to $60,000 voted)	27,000
Wharves generally (additional to $50,000 voted)	13,000

DRAINAGE AND IRRIGATION

California.

The 808 Mutual Water Co., Arcadia, Cal., has been incorporated for the purpose of operating an irrigation system. The incorporators are: H. W. Meyer, B. L. Brown, C. B. Reas, J. W. Barnes and W. F. Palmer.

Colorado.

Bids as follows were received April 17 at the office of the U. S. Reclamation Service, Montrose, Colo., for excavation of the Selig Extension Canal and Peach Valley Lateral: Maney Bros. & Co., Boise, Idaho, all schedules 3 to 14, inclusive, $101,000, all schedules except 4, 6 and 11, $87,560; Sayler Construction Co., Lamar, Colo., all schedules 3 to 14, inclusive, $72,929, schedules 3, 6, 9, 10, 13, 14, $30,798; Midwest Engineering Co., Omaha, Neb., schedules 4, 5, 6, 7 and 11, $42,512; Chas. Palmgren, Montrose, Colo., schedules 4, 6 and 11, $11,423. The bid of $72,929 of the Sayler Construction Co. was recommended for acceptance.

Illinois.

✣Bids will be received until noon, May 2, at the office of W. D. Hall, Town Clerk, Joliet, Ill., for furnishing labor and material for the construction of tile drains in accordance with plans and specifications on file with the town clerk.

✣Bids will be received until 2 p. m., April 26, by Board of Commissioners, Wheeling Drainage District No. 1, C. J. McComb, Secy., Route 1, Arlington Heights, Ill., for excavating 80,000 yds. of open ditches and laying about 32,000 ft. of hard burned shale tile. Specifications may be obtained of the secretary or of Edgar A. Rossiter, Engineer, 526 Reaper Block, Chicago, Ill.

On account of legal matters no bids were opened on April 22 by the Illini Drainage District, Warrensburg, Ill., for the construction of a drainage system near Latham, Macon County, requiring 7,400 lin. ft. 24-in., 1,000 lin. ft. 22-in., 1,400 lin. ft. 16-in., 1,400 lin. ft. 15-in. and 1,300 lin. ft. 14-in. drain tile. The work will be readvertised and contract let probably in 30 to 60 days. P. T. Hicks is Engineer, Decatur, Ill. Chas. Faith is Supervisor, Warrensburg, Ill.

Iowa.

✣Bids will be received until noon, April 29, by Frank McSpaden, Hampton, Ia., Auditor, Franklin County, for the construction of Drainage District No. 26, consisting of tile drains. Plans and specifications may be obtained of A. C. Baker, Engineer, Hampton, Ia., or of F. M. Spaden, Auditor, Hampton, Ia.

✣Bids will be received until 1:30 p. m., May 2, by C. A. Batman, County Auditor, Nevada, Ia., for the labor and material necessary to build and complete the Warren Township Drainage District No. 49, Story County, Ia. Plans and specifications are on file with the county auditor.

✣Bids will be received until 2 p. m., May 5, by F. E. Osier, County Auditor, Clarion, Ia., for the improvement of County Open Ditch No. 10 in accordance with plans, profiles, etc., on file with the county auditor.

Petition has been presented to the commissioners of Buena Vista County, Storm Lake, Ia., for a drainage district in Township 91 and Township 92, Range 35. Petitions have also been presented for drainage district in Poland Township and in Fairfield Township.

Supervisors of Woodbury and Monona Counties have decided that present laws will not permit of a special tax levy to widen and clean the old Woodbury-Monona drainage ditch. It is the understanding that the men who petitioned for this improvement may now decide to move for an entirely new ditch project, using the old ditch as a section of the new one.

Kentucky.

✣Bids will be received until April 30 by Board of Public Works, W. J. Dulin, Secy., Madisonville, Ky., for the construction of an earth dam including 25,000 cu. yds.

Minnesota.

⊙Sedgley & Parrish have been awarded the contract for constructing Judicial Ditch No. 18 of Jackson County.

⊙Desomoux Construction Co., Mankato, Minn., has been awarded the contract for County Ditch No. 25 of Freeborn County.

Hearing will be held on April 28 on County Ditch No. 18 of Faribault County. Jesse L. Herring, Blue Earth, is County Auditor.

Nebraska.

✣Bids will be received until 2 p. m., May 12, by F. D. Ashton, Secy., Geneva-West Blue Drainage District, Geneva, Nebr., for the construction of about 4,000 ft. of 36-in. reinforced concrete pipe with excavation, backfilling, etc.

Washington.

⊙Grant Smith & Co., Henry Bldg., Seattle, Wash., have been awarded the contract for the construction of a flume for the Chelan High Line Canal near Wenatchee, Wash.

WATER WORKS

Arkansas.

E. C. Crove & Co., of St. Louis, Mo., have purchased the Van Buren Water Co., Van Buren, Ark., for $75,000. The new owners announce they will make improvements to the system.

California.

⊙F. Rolandi, 650 Montgomery St., San Francisco, Calif., has been awarded the contract by the Board of Public Works of that city for the construction of sewers in 48th Ave., from Lincoln Way to Cabrillo, for $185,767. The work includes sewers of reinforced concrete as follows: 4 ft. x 6 ft.: 9 ft. x 11 ft.; 8 ft. 6-in. x 5 ft. 3-in.; 8 ft. 6-in. x 3 ft. 6-in., across Golden Gate Park, about 4,000 ft. long. Bids were opened March 19.

The citizens of Perris, Calif., at a recent election voted the issuance of bonds to the amount of $20,000 for domestic water system.

A new bond election will be held in Riverside, Calif., on May 19 for $1,160,000 for purchase of the waterworks plants and improvements to the same. Bonds will bear 5% interest. Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., are Engineers.

T. J. Schmeiser, of Davis, Calif., has applied for a franchise to lay water mains and pipes in the streets of the town of Davis.

Delaware.

⊙Charles Owens, of Bridgeville, has been awarded the contract for the installation of the water mains at Rehoboth Beach, Del.

⊙The Board of Public Works of Rehoboth, Del., has awarded the contract to build the pumping station to Rufus A. Beach of that city.

Georgia.

Plans have been prepared for the installation of sewers in the town of Cornelia, Ga., to cost approximately $5,000. Contract will be let soon. O. Duckett is City Clerk.

Illinois.

⊙The following contracts for constructing water service pipes have been awarded by the Board of Local Improvements, Chicago: 84th St., Muskegon Ave. to Baltimore Ave., D. Walsh, 6828 South Chicago Ave.; Houston Ave., Baltimore Ave. to 87th St., Jackson St., 46th Ave. to 52nd Ave., Manistee Ave., 86th St. to 87th St., Muskegon Ave., Baltimore Ave. to 91st St., North Park Ave., South Blvd. to Madison St., Jas. J. Renn, 367 W. Chicago Ave.; Haveland Ave., 48th Ave. to C. & N. W. R. R., Champlain Ave., 75th St. to 79th St., Franklin Ave., Augusta St. to Division St., Langley Ave., 75th St. to 79th St., Leland Ave., Milwaukee Ave. to 56th Ave., Milton Pl., 48th Ave. to C. & N. W. R. R., D. Walsh; Anthony Ave. to Jeffry Ave., St. Lawrence Ave., 75th St. to 79th St., D. Walsh; Drexel Ave., 92nd to 93rd St., Ellis Ave., 91st St. to 93rd St., Dobson Ave., 91st St. to 93rd St., Greenwood Ave., 91st to 93rd St., Lexington Ave., 91st St. to 94th St., Woodlawn Ave., 91st St. to 93rd St., 91st St., Chauncey Ave. to I. C. R. R., 92nd St., Drexel Ave. to I. C. R. R., 93rd St., Drexel Ave. to Stony Island Ave., Washington Ave., 91st St. to 95th St., Daniel Hardin, 3139 Indiana Ave. E. J. Glackin, Secretary of the Board.

⊙The Laidlow-Dunn Gorden Co., 37 W. Van Buren St., Chicago, Ill., has been awarded the contract by the City Council of Joliet, Ill., for the furnishing of pumping machinery for the new artesian well on Van Buren St., city of Joliet, for $7,800.

Bids will be received until 11 a. m., April 28, by the Board of local Improvements, Chicago, Ill., for constructing water service pipes in the following streets: Aberdeen St., 77th St. to 79th St., Hutchinson St., 53rd Ave. to Milwaukee Ave., Lowe Ave., 103rd St. to W. 104th St., South Park Ave., E. 71st St. to E. 75th St. Cash or certified check for 10 per cent of bid must accompany proposal. E. J. Glackin, Secretary of the Board.

The Board of Local Improvments of Moline, Ill., Lyle Payton, City Engineer, has under consideration the construction of sewers at an estimated cost of $105,249; sewage tanks, estimated at $3,247; pump house and pit, estimated at $3,732; sludge bed, $762; total, $119,768.

Following are the lowest bids submitted on April 14, Chicago, Ill., for furnishing and delivering rubber gaskets and valves as specified to the Bureau of Engineering, for the use of the Water Department, 1,000 gaskets 1⅛x 8 15/16, weight, 3 ozs., 8.5 cts. each, 4,000 gaskets, 1⅛x9⅛, weight 5¾ ozs., 16.5 cts., 1,000 valves, 5½x1 2.49 cts., 2,000 valves, 6 9/16x 15/'6, weight 22 ozs., 60 cts., 4,000 valves, 4⅞x 9/16, weight 10.5 ozs., 28 cts., 200 valves, 3 15/16x13/16, weight 9.5 ozs., 25¼ cts. W. H. Salisbury, 105 N. Wabash Ave. The contract has not been awarded. L. E. McGann, Commissioner of Public Works.

The citizens of Elliott, Ill., will shortly vote on the question of installing a waterworks system.

The Western Construction & Engineering Co., of Fort Wayne, Ind., submitted the lowest bid to the water committee of the City Council, Princeton, Ill., for the construction of a new well at the waterworks. The company offered to drill a 20-in. hole 245 ft., cased in steel to a depth of 230 ft., and furnished with a Johnson well screen 17 ft. long and 16-ins. in diameter, for $16.05 a ft., making a total of $3,932. The well is to be equipped with a rotary pump at an estimated cost of $5,000.

Indiana.

✣Bids will be received until noon, May 6, by Common Council of Decatur, Ind., for the construction of a 230,000 gal. reservoir of reinforced concrete. H. M. DeVoss is City Clerk.

Engineer Byron T. Gifford, of the American District Steam Co., of Buffalo, has submitted plans to the Board of Public Works of Logansport, Ind., for the filtration plant.

Iowa.

✣Bids will be received until 8 p. m., May 6, by City Council, Cherokee, Ia., for furnishing labor and material for the construction of extensions to the water works system. W Shardlow is City Clerk.

✣Bids will be received until May 5 by City of Rock Rapids, Ia., for furnishing and installing water mains, etc. Plans and specifications are on file with Superintendent of Water Works. J. K. Medberry is City Clerk.

⊙Bids as follow were received April 10 by Miles, Ia., for a construction of waterworks for which Charles P. Chase, Clinton, Ia., is the Consulting Engineer: (1) bid of W. D. Lovell, Minneapolis, Minn. (awarded contract); (2) The Moffatt Co., Des Moines, Ia.; (3) Des Moines Bridge & Iron Co., Des Moines, Ia.; (4) Alamo Engineering & Supply Co., Omaha, Neb.; (5) C. W. Roland & Co., Des Moines, Ia. Star Boiler Works, Clinton, Ia., and Chicago Bridge & Iron Works, Chicago, Ill., bid on tank and tower only, bid of first mentioned being $2,685 and bid of the other company $3.100:

	(1).	(2).	(3).	(4).	(5).
8-in. cast iron pipe, 75 lin. ft.	$ 0.96	$ 1.00	$ 0.75	$ 0.95	$ 1.00
6-in. cast iron pipe, 3,600 lin. ft.	0.70	0.63	0.70	0.70	0.75
4-in. cast iron pipe, 3,600 lin. ft.	0.53	0.50	0.60	0.53	0.60
Hydrants, 20, each	28.00	26.00	27.50	....	27.50
8-in. gate valve, 1	24.00	25.00	18.00	....	22.00
6-in. gate valve, 6, each	16.00	15.00	13.00	....	15.00
4-in. gate valve, 4, each	12.00	12.00	11.50	....	11.00
Specials, 4,600 lbs.	0.03	0.03¼	0.03	....	0.04
30,000-gal. steel tank on 80-ft. steel tower	2,500.00	2,400.00	2,400.00	....	2,750.00
Brick pump house	480.00	....	500.00	....	650.00
150-gal. triplex pump, and piping, complete	500.00	....	600.00	....	850.00
15-h. p. gasoline engine	535.00	....	600.00	....	550.00
110-gal. deep-well pump, and piping (alternative)	300.00	....	....	....	250.00
10-h. p. gasoline engine (alternative)	525.00	....	....	....	750.00

The citizens of Fontanelle, Ia., at a recent special election decided to establish an electric light plant and a waterworks system. Bonds to the amount of $10,000 have been voted for the electric light plant and $12,000 for the water works.

Kansas.

⊙Everett & Burt, of Hutchinson, Kans., have been awarded the contract to build and install the new Turon, Kans., water and light plant, for approximately $19,100.

A bond election will be held in Herington, Kans., for $50,000 for waterworks improvements, consisting of pipe line and new supply from Kohl and Will Springs, west of Abilene. Plans have been approved. Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., are Engineers.

Maryland.

The Burgess and Commissioners of Williamsport, Md., on April 14 announced that Engineer Alfred M. Quick, of Baltimore, would shortly report on the cost of introducing a system of waterworks for Williamsport.

Massachusetts.

✣Bids will be received until 11 a. m., May 10, by Bureau of Yards and Docks, Navy Department, Washington, D. C., for fire protection system, consisting of 6 and 8 in. cast iron pipe, hydrants, valves, etc., at the naval hospital, Chelsea, Mass. The cost is estimated at $4,500.

⊙H. I. Peer, of Great Barrington, Mass., has been awarded the contract for the construction of the new dam for the South Edremont Water Co. The dam will be built across Goodale brook at an elevation of about 200 ft. on land belonging to the Spurr farm.

The Selectmen of Webster, Mass., have appropriated $6,000 for the fire department for the year 1913. John E. Hickey is Town Clerk.

The Common Council of Brockton, Mass., has passed an order authorizing a loan of $20,000 for the motorizing of four pieces of the fire apparatus.

The Selectmen of Dudley, Mass., have appropriated $3,500 for the water department for the fiscal year. James A. Thompson is Town Clerk.

Michigan.

⊙The Board of Public Works of Battle Creek, Mich., has let the contract for furnishing pumps and meters for the new Verona water plant to the Union Steam Pump Co., for $2,600. The Commonwealth Power Co. secured the contract to provide motors.

The city of Port Huron, Mich., will issue bonds in the sum of $46,500 for the purpose of safeguarding the city and bettering the water supply.

Minnesota.

The Village Council of Roseau, Minn., has purchased a portion of the Jonas Sjoberg property on Pearl St., with a river frontage of 150 ft. and 100 ft. in depth. The lots are to be used as the site of the waterworks and electric light plant which will be erected this summer.

Consulting Engineer J. F. Druar, of the Oscar Claussen Engineering Co., of St. Paul, Minn., has outlined a system of waterworks for the town of Wabasha, Minn., the estimated

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

cost of which is placed at about $30,000. The City Council has the matter under consideration.

Missouri.

An election will be held in Monroe City, Mo., on April 28 for the purpose of voting on the issuance of bonds in the sum of $78,000 for waterworks and sewers. Plans and specifications have been prepared by Consulting Engineers Burns & McDonnell, Scarritt Bldg., Kansas City, Mo.

Montana.

The citizens of Livingston, Mont., recently voted bonds to the amount of $225,000 for a new waterworks plant. Plans and specifications have been prepared and bids will be received some time in June. Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., are Engineers.

New Jersey.

⊙George Pfeiffer, of Camden, N. J., has secured the contract for the building of a 2,000,000-gal. water supply for the Carby Co., of Washington, D. C.

⊙The Borough Council of Cliffside Park. N. J., has awarded contracts for the construction of Sections 2, 3 and 4 of trunk sewers, for which bids were opened on April 14. The successful contractors are as follows: Section 2, F. Gillay & B. E. Brady, Palisade, N. J., $19,386; Section 3, the same, $12,501; Section 4, Lirigi di Sciascio, Cliffside, $10,089.

The Common Council of New Brunswick, N. J., has authorized the Water Board to spend $8,000 for extension of water mains.

New York.

✣Bids will be received until 2 p. m., May 7, by Board of Water Commissioners, G. W. Johnson, Clerk, Mexico, N. Y., for furnishing the materials and constructing a system of water works for said village. There will be required approximately the following: 860 tons cast iron pipe, 78 fire hydrants, 71 valves and boxes, 9 miles of water mains, pumping station, impounding well, etc., 2 power pumps and gasoline engines or electric motors 2 steel pressure filters, steel stand pipe, etc. Bids will be received for furnishing any of the materials mentioned above or for constructing the works complete. A certified check or its equivalent equal to 2 per cent of the amount of the bid must accompany each bid. Plans may be seen and specifications and blank forms of proposal procured at the office of the Engineers, Witmer & Brown, Room 2, Chapin Block, Buffalo, N. Y., or at the office of the Clerk of the Board, George W. Johnson, Mexico, N. Y.

The Board of Water Commissioners of Dunkirk, N. Y., has decided to improve the fire protection in the first ward by replacing the water mains in several of the streets with mains of larger diameter.

The Conservation Commission on April 24 considered the plans of the village of Marion, N. Y., for a waterworks system. The amount to be appropriated for the complete system 's $30,000.

Governor Sulzer of New York has signed the Cole bill which provides for the establishment of union water districts and conservation waterworks. The bill permits the state conservation commission with the consent of the board of trustees of a union water district to sell water by meter to waterworks companies and others.

North Dakota.

At a recent mass meeting of the business men of Belfield, N. Dak., the question of submitting a bond issue to the voters for a waterworks system was indorsed.

Ohio.

✣Bids will be received until noon, April 29, by W. J. Springborn, Director of Public Service, Cleveland, O., for furnishing branch sleeves and valves for the city water department. Plans and specifications are on file with the Superintendent of the Water Department.

✣Bids will be received until May 1, by J. R. Morris, Director of Public Service, Lima, O., for the proposed improvements to the water department. The work will include one 6,000,000-gal. pump; 2 150-H. P. boilers; steam piping; material for 3 miles of 20-in. pipe line. G. A. Crayton is Engineer.

The Water Department of Cleveland, O., is considering the construction of a 240,000,000-gal. reservoir on the heights overlooking the Fairmount reservoir, as a means of giving Cleveland a three-day supply of clear water to draw upon at times when freshets or lake storms produce bad conditions in the ordinary supply.

Oregon.

The Water Board of Portland, Ore., has approved plans of Engineer D. D. Clarke of the Water Department for lowering the 24-in. steel and the 28-in. cast iron submerged mains across the Willamette River. The work will cover the digging of a trench in the bed of the river in which to lower the mains, taking up and relaying both mains.

The City Council of Pendleton, Ore., has endorsed the Thorn Hollow spring plan for a gravity water supply and voted to offer the $200,000 bonds for sale in order that the Water Commission may have money with which to carry the work to a completion. Frank C. Kelsay, Portland, Ore., is Engineer.

Pennsylvania.

The Fayette County Home at Uniontown, Pa., has employed Chester & Fleming, Hydraulic & Sanitary Engineers of Pittsburgh, Pa., to prepare plans for a sewage treatment plant for the institution.

South Dakota.

✣Bids will be received until 10 a. m., May 2, by Board of Brule County Commissioners, Chamberlain, S. Dak., for the construction of one to four 8-in. artesian wells. John F. Maack is County Auditor.

Tennessee.

⊙John Broderick has been awarded the contract for laying water mains on 19th Ave., Edgehill, 15th, Third, Reid, Ridley, Elliott, Kayne, Hillside, Caruthers and Stephens Sts., in the city of Nashville, Tenn.

The Mountain Mineral Water Co., Hamilton County, Tenn., has been incorporated with a capital stock of $5,000. The incorporators are: F. A. Seagle, W. F. Langley, W. S. Heaton, G. N. Halliburton and S. J. McAllister.

Texas.

⊙Freund & Quay, First National Bank Bldg., Houston, Tex., have been awarded the contract by that city for the construction of the McKinsey Ave. sanitary sewer for $3,930. Bids were opened April 7.

⊙Fruend & Quay, First National Bank Bldg., Houston, Tex., have been awarded the contract by that city, F. L. Dormant, City Engineer, for Contract No. 2, Second Ward storm sewer, for $108,547. Bids were opened April 7.

Consulting Engineer Alexander H. Potter, of New York City, has submitted his report to the City Council of Corpus Christi, Tex., on the solution of the water problem. The report recommends the Tule Lake scheme and a bond issue of $316,000 for the building of the plant.

At a recent mass meeting in Willis, Tex., it was decided that a bond issue should be submitted to the voters for waterworks for the town.

Utah.

City Engineer Sylvester Q. Cannon, of Salt Lake City, Utah, has made application to the state engineer's office for filings upon waters of Hughes canyon, where it is proposed to develop about 1,000,000 gals. daily additional flow for the city water supply.

A resolution calling for the construction of a dam across City Creek canyon, several miles above the mouth and the impounding of about 40,000,000 gals. of water for emergency purposes, has been introduced in the City Commission of Salt Lake City, Utah. The cost of dam and reservoir is estimated at $90,000.

The Pelican Point Water Co. has filed articles of incorporation with the county clerk at Salt Lake City, Utah. The capital stock is $10,000. The incorporators are: W. S. Ramer, president; P. W. Ramer, vice president; A. L. Ramer, secretary and treasurer; J. M. Ramer, V. B. Cutler and P. S. Sowers, additional directors.

Washington.

The Chehalis Water Co., Chehalis, Wash., has announced plans for extensive improvements to the waterworks system. The capacity of the reservoir is to be enlarged and several mains laid where needed. The improvements planned will cost about $15,000.

The City Council of Winlock, Wash., has granted a franchise to C. E. Leonard to build a water system in the city. A reservoir is to be built on the hill just east of the city, the elevation of which will give a pressure of about 50 lbs. to the square inch in the business district. Ten fire hydrants are to be located on First St., between Griffith and Locust Sts.

Wisconsin.

✣Bids will be received until 9 a. m., April 23, by E. L. Williams, City Clerk, Appleton, Wis., for furnishing all labor and material, and constructing complete, a waterworks pumping station, building, according to plans and specifications heretofore adopted. Said plans and specifications are on file and may be seen at the office of the city clerk, in the City Hall, Appleton, Wis.

⊙The Jewell Water Improvement Co., of Chicago, Ill., has sublet the contract for the building of the new filtration plant and pumping station in connection with the municipal waterworks for Appleton, Wis., to the Hackworthy Construction Co., of Appleton. The plant will cost approximately $225,000. The plant will have a daily capacity of 4,000,000 gals. The contract calls for the water being 97½ per cent pure. The filtration plant and building will cost $50,000, pumping station and foundations $16,000, pumps and engines $53,000, distribution system $90,000, feed pipe $2,500, site $6,000.

Wisconsin.

⊙Coddington Engineering Co., 224 Sixth St., Milwaukee, Wis., has been awarded the contract by the Village Board of West Milwaukee, Wis., for the construction of a sewage disposal plant for $5,764. The work includes settling tanks, percolating filters, etc. Bids were opened April 15.

Wyoming.

✣Bids will be received until May 5, by A. R. Kimball, Town Clerk, Glenrock, Wyo., for the construction of a waterworks system. G. W. Thomas is Mayor. C. C. Carlisle, Cheyenne, Wyo., is Consulting Engineer.

Canada.

✣Bids will be received until 9 a. m., April 28, by J. D. Stewart, Town Clerk, Sarnia, Ont., for the supply of material and the construction of: Contract "A"—Labor laying approximately 11,700 feet of 24-inch force main. Contract "B"—Furnishing all material for and constructing pumping station. Contract "C"—Furnishing all material for and constructing infiltration basin and sluiceway. Copies of plans and profiles, specifications and instructions to bidders, may be seen at the office of H. A. McLean, Town Engineer, Sarnia, or at the office of Chipman & Power, Engineers, Toronto.

✣Bids will be received until noon, May 16, by Board of City Commissioners, Montreal, Que., for the enlargement of the city's aqueduct, forebay and tail race by widening and deepening same on a length of about 31,000 ft. The work will include about 2,350,000 cu. yds. of earth, 436,000 cu. yds. of rock excavation, 203,000 cu. yds. of concrete, syphon culverts, etc. Copies of specifications and plans may be obtained of the Superintendent of the Water Works on payment of $20.

The Board of Control of Montreal, Que., has recommended the acquisition of the property of the Montreal Water & Power Co., in St. Henri Ward.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

SEWERAGE AND SANITATION

Arkansas.

The City Council of Little Rock, Ark., is discussing a comprehensive plan for draining over 400 acres in the center of the city, by means of a 12-ft. storm sewer through Spring St., from Eighth to the Arkansas River. The proposed sewer would cost about $95,000.

California.

⊙Karl Ehrhart has been awarded the contract by the Board of Public Works of San Francisco, Calif., for the construction of sewers in 26th Ave., Cabrillo St. and 23d Ave. for $34,653.

The citizens of Sacramento, Calif., have voted on the issuance of bonds to the amount of $2,759,200 for municipal improvements. The amount includes $1,329,600 for water mains and $1,032,000 for sewerage and drainage of annexed district, $208,000 for hall of justice, $25,000 for site for hall, $113,600 for electricity distributing system and $151,000 for a municipal ice plant.

The City Council of San Bernardino, Calif., will ask for bids shortly on the construction of the northwest sewer system, which will cost about $30,000.

The Board of Trustees of East San Diego, Calif., has instructed City Engineer D. L. Bissell to prepare plans and specifications and estimate of cost for installation of a complete sewerage system.

Connecticut.

⊙Andreani & Gelormino Co. 54 Lewis St., Torrington, Conn., have been awarded the contract by that city, for sewer work, for $3,114. The work includes furnishing, excavating and laying 18-in. tile, at $1.16 a ft.; excavating and laying 15-in. tile, $0.52 a ft.; 12-in. tile, $0.88 a ft.; 8-in. tile, $0.74 a ft.; manholes at $42 each; catch basins at $36 each, and concrete in submerged weir, $8 per cu. yd. Bids were opened April 14.

Florida.

✣Bids will be received until 8 p. m., May 1, by Sewerage Committee, at the office of G. R. Ramsey, City Engineer, Orlando, Fla., for the construction of a system of sewers in the City of Orlando, Fla. The system will comprise 26½ miles of sanitary sewer and 3,000 ft. of storm sewer. Bids will be asked for as follows: Sewers and appurtenances, certified check $2,500; three Imhoff tanks and appurtenances, check $1,000; three 12-in. wells, check $200. All bids must be accompanied by certified checks. Plans and specifications on file at the office of the City Engineer.

Georgia.

Plans have been prepared for the construction of a water works system in the town of Cornelia, Ga., to cost approximately $15,000. Water will be secured from wells. Contracts will be let soon. O. Duckett is City Clerk.

Illinois.

✣Bids will be received until 11 a. m., April 28, by the Board of Local Improvements, Chicago, Ill., for constructing brick and tile pipe sewers as follows: Diversey Ave., 40th Ave. to 44th Ave., 2,700 lin. ft. 6 double ring bricks, 15 ft.; 44th Ave. to 48th Ave., 2,680 lin. ft., 5½ double ring, 15 ft. cut; 48th Ave. to 52d Ave., 2,680 lin. ft. 5-in. double ring brick, 18 ft. cut; 52d Ave. to 56th Ave., 2,720 lin. ft. 4¾-ft., 17-ft. cut; 48th Ave., Wrightwood Ave., to Wellington St., 2,660 lin. ft. 2½ double invert brick, 14-ft. cut, 50 manholes and 139 catch-basins, work to be completed October 1st; assessment available, $93,945. West End Ave., Prairie Ave. to Waller Ave., 440 lin. ft., 17-in. double strength tile pipe, 14-ft. cut; Waller Ave. to North Park Ave., 450 lin. ft., 22-in. double strength tile pipe, 12-ft. cut; North Park Ave., West End Ave. to 367 ft. north, 400 lin. ft. 1.8-in. double strength tile pipe, 10.3-ft. cut; 367 ft. north of West End Ave. to 227 ft. north of Frink St., 400 lin. ft. 18-in. double strength tile pipe, 10-ft. cut; 227 ft. north of Frink St. to South Blvd., 270 lin. ft. 12-in., 9.5-ft. cut; West End Ave. to Washington Blvd., 730 lin. ft. 12-in., 9.5 cut; Washington Blvd. to 5 ft. south of Madison St., 630 lin. ft. of 15-in. tile pipe, 10 ft. cut; wing sewers, 50 lin. ft., 15-in., 10-ft. cut; 48 6-in. house drains, 25 ft. long, 47 6-in. house drains to be relaid, 24 manholes, work to be completed June 15th; assessment available, $7,086.85. State St., 95th St. to 94th St., 670 lin. ft. 18-in. double strength tile pipe, 12-ft. cut; 94th St. to 93 St., 670 lin. ft. 15-in., 10.5 cut; 93d St. to 92d St., 670 lin. ft. 12-in., 10-ft. cut; wing sewers, 300 lin. ft., 12-in., 9-ft. cut; 21 manholes, 18 catch-basins; assessment available, $5,500; work to be completed July 1st. Center Ave., 99th St. to 100th St., 670 lin. ft. 18-in. double strength tile pipe, 11.5 cut; 100th St. to 1101st St., 670 lin. ft. 15-in., 10-ft. cut; 101st St. to 102d St., 670 lin. ft. 12-in., 9-ft. cut, 15 manholes, 15 catch-basins, work to be completed August 1st; assessment available, $3,470. 48th Ave., Belmont Ave. to School St., 670 lin. ft. 18-in. double strength tile pipe, 13.5-ft. cut; School St. to Roscoe St., 670 lin. ft. 15-in., 12-ft. cut, 11 manholes, 14 catchbasins, work to be completed August 1st; assessment available. Rockwell St., 59th St. to 58th St., 670 lin. ft. 15-in., 11-ft. cut; 58th St. to 57th St., 670 lin. ft. 12-in., 11-ft. cut, 10 manholes, 12 catchbasins, work to be completed July 1st; assessment available, $2,254. Cornelia Ave., 50th Ave. to 635 ft. east, 670 lin. ft. 15-in., 10.5-ft. cut; 635 ft. east of 50th Ave. to 150 ft. west of 48th Ave., 500 lin. ft. 12-in., 8-ft. cut, 9 manholes and 12 catchbasins, work to be completed July 1st; assessment available, $2,004. Eddy St., 50th Ave. to 635 ft. east, 670 lin. ft. 15-in., 10.5-ft. cut; 635 ft. east to 111 ft. west of 48th Ave., 520 lin. ft. 12-in., 8.5-ft. cut, 9 manholes and 12 catchbasins, work to be completed July 1st; assessment available, $2,074. 48th Ave., Belmont Ave. to 630 ft. south, 670 lin. ft. 20-in. double strength tile pipe, 14.5-ft. cut; 630 ft. south to 1300 ft. south, 670 lin. ft. 15-in., 12-ft. cut, 9 manholes, 14 catchbasins, work to be completed August 1st; assessment available, $3,000. Wentworth Ave., 73d St. to 72d St., 630 lin. ft. 22-in., 13-ft. cut; 72d St. to 71st St., 700 lin. ft. 20-in., 13.5-ft. cut; 71st St. to 70th St., 670 lin. ft. 18-in., 13-ft. cut; 70th St. to 69th St., 650 lin. ft. 15-in., 12-ft. cut; 69th St. to 67th St., 2,680 lin. ft. 9-in., 11-ft. cut, 39 manholes and 8 catchbasins, 6 house drains 25-ft. long, 6 house drains to be relaid, 400 sq. ft. cement sidewalk, work to be completed July 15th; assessment available, $12,790.35. 103d Pl., Wentworth Ave. to Princeton Ave., 665 lin. ft. 15-in., 11-ft. cut; 103d St., Princeton Ave. to Harvard St., 455 lin. ft. 12-in., 9-ft. cut, 9 manholes and 13 catchbasins, work to be completed July 1st; assessment available, $2,043. Gage Pl., 55th St. to 54th St., 470 lin. ft. 12-in., 9.5-ft. cut; 55th St. to 290 ft. south, 330 lin. ft. 12-in., 9.5-ft. cut, 7 manholes and 1 catchbasin, work to be completed July 6th; assessment available, $1,250. 45th Ave., Grace St. to 335 ft. north, 260 lin. ft. 12-in., 7-ft. cut, 7 manholes and 1 catchbasin; assessment available, $440, work to be completed July 1st. 53d Ave., North Ave. to Le Moyne St., 670 lin. ft. 15-in., 10-ft. cut; Le Moyne St. to Hirsch St., 670 lin. ft. 12-in., 9-ft. cut, 10 manholes and 15 catchbasins, work to be completed July 1st; assessment available, $2,307. E. J. Glackin, Secretary of the Board.

✣Bids will be received until 11 a. m., April 29, by the Department of Public Works, Chicago, Ill., for furnishing and delivering all labor and materials necessary in the construction of a municipal bathhouse at 1642 W. 35th St., separate bids are requested for the plumbing, sewerage and gas fitting, also for the heating plant. Cash or certified check for $1,250 must accompany bids for the general work, $300 for the plumbing, etc., and $200 for the heating. Plans and specifications may be had upon deposit of $10 from L. E. McGann, Commissioner of Public Works.

✣Bids will be received 11 a. m., April 28, by the Board of Local Improvements, Chicago, Ill, for constructing house drains in the following streets: Aberdeen St., 77th St. to 79th St.; Champlain Ave., 75th St. to E. 79th St.; Hutchinson St., N. 52d Ave. to N. 53d Ave.; St. Lawrence Ave., E. 75th St. to E. 79th St.; Yates Ave., E. 67th St. to E. 71st St. Cash or certified check for 10 per cent of bid must accompany proposal. E. J. Glackin, Secretary of the Board.

⊙The following contracts have been awarded by the Board of Local Improvements, Chicago, for constructing 6-inch house drains: Exchange Ave., Baltimore Ave. to 87th St., M. Murphy, 5315 Wabash Ave.; 51st Ct., Irving Park Blvd. to Berteau Ave., D. Fosco, 814 Desplaines St.; Lowe Ave., 103d St., 550 ft. south; 103d Pl., Harvard Ave. to State St.; S. Park Ave., 71st St. to 75th St., D. Hardin, 3139 Indiana Ave. E. J. Glackin, Secretary of the Board.

The Board of Local Improvements of Moline, Ill., Lyle Payton, City Engineer, has under consideration the construction of a water main, the principal items of which are as follows: 12,170 ft. 12-in. cast iron pipe laid, average depth 6 ft., at $1.91 per ft., $23,245; 5,600 ft. 10-in. cast iron pipe laid, average depth 6 ft., at $1.58 per ft., $8,848; 13,000 ft. 8-in. cast iron pipe laid, average depth 6 ft., at $1.23 per ft., $15,990; 33,800 ft. 6-in. cast iron pipe laid, average depth 6 ft., at 96 cts. per foot, $32,448; 4,300 ft. 4-in. cast iron pipe laid, average depth 6 ft., at 72 cts. per foot, $3,096. The total cost is estimated at $108,709.

Bids as follow were received April 21 by the Board of Local Improvement, Chicago, Ill., for constructing sewers; (1) bid of The Ryan Co., 10 S. La Salle St., Chicago, Ill.; (2) Jno. W. Farley, LaGrange, Ill.:

	Length, ft.	Diam., ft.	Depth, ft.	(1)	(2)
S. Albany Ave...	610	9*	18	$23.25	$22.50
W. 30th St........	310	9*	17	23.25	22.50
S. Troy St........	1,990	9*	18	23.25	22.50
W. 26th St.......	1,360	9*	16	23.25	22.50
S. Turner Ave...	2,600	9*	16	23.25	22.50
S. Turner Ave...	2,710	8*	16	20.60	17.00
W. 16th St.......	310	8*	16	20.60	17.00
S. Spaulding Ave.	1,960	7½*	15	17.50	16.00
S. Spaulding Ave.	2,330	7*	15	17.25	17.60
W. Polk St.......	670	7*	15	17.25	17.60
S. Homan Ave...	160	7*	15½	17.25	17.60
S. Homan Ave...	1,490	6½*	16½	16.50	16.85
S. Homan Ave...	580	6†	16	12.75	12.40
S. Homan Ave...	950	4†	15½	8.00	10.00
W. Monroe St....	1,320	4†	15	8.00	10.00
Colorado Ave. ...	1,460	5½†	16	11.00	9.00
W. VanBuren St.	1,370	4†	15	8.00	8.00
1st Alley N. of W. Polk St.	1,360	4†	15	8.00	9.00
W. 13th St......	670	4½†	15	8.25	8.50
S. Homan Ave...	55	4½†	15	8.25	10.75
1st Alley N. of W. 13th Pl.	1.320	4½†	15	8.25	9.40
W. 16th St.......	1,710	4½†	15	8.25	8.00
W. 16th St.......	710	4†	11	8.00	7.50
Brick Wing sewer	65	6†	14½	15.50	15.00
Brick Wing sewer	35	5†	14½	13.00	10.00
Brick Wing sewer	25	3†	10	8.00	6.00
Tile Pipe Wing sewers	30	2½‡	14	6.50	4.25
Tile Pipe Wing sewers	30	2¼‡	14	6.00	3.90
Tile Pipe Wing sewers	30	2‡	14	5.50	3.00
Tile Pipe Wing sewers	300	1⅔‡	13	5.50	2.50
Tile Pipe Wing sewers	240	1½‡	12	4.75	1.75
Tile Pipe Wing sewers	660	1¼	12	4.25	1.50
Tile Pipe Wing sewers	940	1	12	4.00	1.25
1 concrete bulkhead, bid price for bulkhead complete ....$				6,500.00	$ 4,000.00
225 manholes, bid price for each, complete				33.40	30.00
20 catch basins, complete, including connection, bid				50.00	40.00
Total				$461,870.75	$438,623.25

*3-ring. †2-ring. ‡Double strength.

The Board of Public Improvements of Springfield, Ill., has passed a resolution providing for the laying of an 18-in. sewer in

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

South 11th St., from South Grand Ave. to Ash St.

The City Council of Paris, Ill., has passed an ordinance providing for the construction of a storm sewer in the southwest part of Paris.

Petitions for two new sewers, draining all the western part of the City of Abingdon, Ill., and for the laying of one new water main have been filed in the Knox County Court at Galesburg.

City Engineer Myron Tarble of Aurora, Ill., is planning a new sewer district, to be known as District No. 11. The new district will include the district at the north end of Pennsylvania Ave. A trunk line is planned which will follow the route of Turkey Creek from Spruce St. to the river.

Indiana.

✣Bids will be received until 10 a. m., May 1, by Board of Public Works, South Bend, Ind., for the execution of the following work: Pipe sewer on Union St.; pipe sewer on Kenwood Ave., Anthony St. and Bertrand St.; pipe sewer on Iroquois St. and in the first alley north of North Shore Drive; pipe sewer on Eighteenth St.; pipe sewer on Lafayette St. and Parkovash Ave. Complete drawings and specifications of said work are now on file in the office of the Department of Public Works in the City Hall, of South Bend, Ind. Arthur P. Perley is Clerk of the Board.

⊙The City Council of South Bend, Ind., has let the contract for the construction of the proposed Bowman Creek sewer to the Interstate Construction Co., of Hammond, Ind., for $150,000.

The Town Council of Summitville, Ind., has voted to petition for a new sewer to be put through the southeast part of town near the Big Four tracks, which has been the flooded district.

Iowa.

✣Bids will be received until 9 a. m., May 1, by City Clerk, Burlington, Ia., for the construction of a sewer in Gnahn St., with branches in adjacent streets and alleys to drain the unsewered territory lying between Iowa and Pond Sts., to be known as the Gnahn St. Sewer and Branches. All improvements to be made in accordance with the plans and specifications now on file in the office of the City Engineer. H. G. Vollmer is City Engineer.

✣Bids will be received until 9 a. m., May 1, by City Clerk, Burlington, Ia., for the construction of a sewer in Garfield Ave., with branches in adjacent streets and alleys, to drain the unsewered portion of Starr and Foster's addition and adjacent territory, to be known as the Garfield Ave. Sewer and Branches. All improvements to be made in accordance with the plans and specifications now on file in the office of the City Engineer. H. G. Vollmer is City Engineer.

✣Bids will be received until 9 a. m., May 1, by H. G. Vollmer, City Engineer, Burlington, Ia., for constructing 35,000 lin. ft. of vitrified pipe sewer. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 2 p. m., May 3, by A. M. Compton, Commissioner of Public Works, Davenport, Ia., for the construction of a sanitary sewer system in the 13th Sewer District of Davenport, consisting approximately of the following quantities: 2,400 ft. of 96-in. drainage sewer, 3,000 ft. of 24-in. sewer, 2,400 ft. of 18-in. sewer, 3,500 ft. of 15-in. sewer, 2,400 ft. of 12-in. sewer, 2,000 ft. of 24-inch sanitary invert. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 9 a. m., May 1, by City Clerk, Burlington, Ia., for the construction of a sewer in Harrison Ave., between Madison Ave. and Summer St., with branches in adjacent streets and alleys, to be known as the Harrison Ave. Sewer and Branches. H. G. Vollmer is City Engineer.

The City Council of Burlington, Ia., has passed a resolution providing for the enlargement and extension of the Market St. sewer.

The city of Riceville, Ia., is contemplating the installation of a sanitary sewer system and septic tank. A. F. Kemman of New Hampton, is Engineer.

Consulting Engineer K. C. Gaynor, 408 United Bank Bldg., Sioux City, Ia., has prepared plans for the installation of a sewerage system in Schaller, Ia., to cost approximately $13,000. The work will include 8, 10 and 12-in. pipe, manholes, disposal tank, etc. Date for letting of contract has not been decided upon.

The City of Jefferson, Greene County, Ia. (population 3,000), intends to put in a sewerage system this season. Arrangements will be made so as to begin work this spring.

Councilman F. T. Van Liew of Des Moines, Ia., has received a blue print of plans for the garbage incinerator plant which will be erected if the lower house of the Iowa legislature passes the bill providing for a one-mill levy for garbage disposal. The plant will cost $50,000. Howard D. Hinkley is Engineer.

Kansas.

✣Bids will be received until April 28, by the Town of Great Bend, Kan., for the construction of a 21-in. outfall sewer. H. A. Rowland, McPherson, Kan., is Engineer.

An election was held in Kinsley, Kan., on April 18, to decide upon the question of a sewer outlet. Engineers have estimated the cost at $6,815.

Maryland.

✣Bids will be received until 11 a. m., April 30, by Board of Awards, at the office of the City Register, Baltimore, Md., for Sanitary Contract No. 115, for laying house connections across footways in District 20-B as shown on plans filed with Calvin W. Hendrick, Chief Engineer of the Sewerage Commission, American Bldg., Baltimore, Md The work will include the following approximate quantities: 10,570 lin. ft. 5-in. extra heavy cast iron soil pipe, 8,000 lin. ft. 5-in. T. C. pipe, 12,000 lin. ft. 6-in. T. C. pipe, 1,400 houses to be connected.

Massachusetts.

✣Bids will be received until 7:30 p. m., May 1, by Board of Sewer Commissioners, John Mullen, Chairman, Amherst, Mass., for the construction of a sewer system for that town. Approximate requirements as follows: Excavating, laying, etc., 14,380 ft. vit. sewer pipe in sizes from 8-in. to 18-in. inclusive; excavating, laying, etc., 2,600 ft. cast iron pipe in sizes of 12-in. and 16-in.; building 40 manholes—depths of excavation will be from 5 to 22 ft. Plans and specifications will be on file at the office of John Mullen, Chairman of Sewer Commissioners, on and after April 24th. All proposals to be accompanied by a certified check for $500 made payable to the Town of Amherst. W. C. Tannatt, Jr., is Civil Engineer, Easthampton, Mass.

⊙C. E. Trumbull & Co., of Boston, Mass., have been awarded the contract at Whitinsville, Mass., for putting in the Linwood extension of Whitinsville's sewer system, for $14,143. R. D. Wood, of Philadelphia, Pa., secured the contract for furnishing the cast iron pipe, for $25.95 a ton and $0.02½ a lb. for fittings.

The Sewer Commissioners of Attleboro, Mass., have voted to install the sewers in Merritt Place, and a carload of 5 and 6-in. Akron pipes was ordered for the sewer connections.

The Common Council of New Bedford, Mass., has approved the action taken by the Aldermen in adopting orders appropriating $1,000 for a sewer in North St., and $4,000 for a sewer in Brock Ave. and Aquidneck St.

The Board of Aldermen of New Bedford, Mass., has voted to appropriate $163,000 for the intercepting sewer work. The work is to be continued up Second St., from Rivet to School St. William F. Williams is City Engineer.

The Board of Aldermen of Fall River, Mass., has appropriated $60,000 for the construction of sewers.

The Sewer Commissioners of Fitchburg, Mass., will advertise about May 1 for bids for the construction of the proposed sewerage system for which plans have been drawn by Consulting Engineer Harrison P. Eddy of Boston, Mass., and David A. Hartwell, official in charge of sewers at Fitchburg.

The Aldermanic Committee, Fall River, Mass., has mapped out sewer construction work requiring an outlay of $60,000. Later in the year the committee will probably arrange for an expenditure of at least an equal amount, and the rest of the special loan will be taken up next year.

The Aldermen of Pittsfield, Mass., have adopted an order appropriating and issuing bonds for $35,000 for extension and improvement of sewerage system.

The City Council of Boston, Mass., has passed a loan of $600,000 for sewerage works, and $400,000 for a separate system of drainage, Charles River basin.

The City Council of Quincy, Mass., has appropriated $40,000 for sewer extensions.

The Selectmen of Westfield, Mass., have appropriated $18,000 for sewer construction for 1913.

The Selectmen of Northridge, Mass., have appropriated $30,000 for the extension of the sewer system on Fletcher St., and in Linwood. J. A. Johnston is Town Clerk.

Michigan.

✣Bids will be received until April 23, by C. C. B. Knutts, Village Clerk, Rockford, Mich., for the construction of a sewer in Fremont and Maple St. A certified check for $50, payable to R. B. Squires, must be filed with each bid.

The citizens of Iron Mountain, Mich., at a recent special election voted against the issuance of bonds in the sum of $40,000 for a new sewer district.

Petitions have been circulated in Menominee, Mich., for a trunk sewer on the south side of the city, running from 12th St. and 14th Ave. to the river. It is estimated that an adequate sewer could be constructed at a cost of from $14,000 to $16,000.

The village of Highland Park, Mich., has plan under way for the construction of a municipal sewer system. L. D. Beckley is Village Engineer. Donald Thomson is President.

The Board of Public Works of Grand Rapids, Mich., is having an estimate prepared of the cost of constructing a public sewer in Cora St., from the West Side Ditch trunk sewer east to Powers Ave.

An estimate is being made by the Board of Public Works of Grand Rapids, Mich., of the cost of constructing a public sewer in Ionia Ave., from Goodrich St. to Wealthy St.

Minnesota.

✣Bids will be received until 8 p. m., May 9, by City of Thief River Falls, Minn., for the construction of sewers in District Nos. 3 and 4. W. H. Quist is City Clerk.

✣Bids will be received until 8 p. m., April 25, by Common Council at the office of Frank Cronon, City Recorder, Austin, Minn., for the construction of storm and sanitary sewers in a number of streets, in accordance with plans and specifications on file with the City Recorder and with Oscar F. Weissgerber, City Engineer.

Consulting Engineer J. F. Drewer, of St. Paul, Minn., has submitted his report to the Village Council of Carlton, Minn., relative to the installation of the proposed sewerage system and waterworks.

The West Side Commercial Club of Minneapolis, Minn., has endorsed the project of tunneling 29th St., along the Milwaukee right of way, for accommodation of industries abutting on the street.

The village of Deerwood, Minn., will sell bonds April 29 to the amount of $15,000 for the construction of a water works system.

Missouri.

✣Bids will be received until noon, April 25, by Board of Public Improvements, Maxime Reber, President, St. Louis, Mo., for the construction of sewers in Gratiot Sewer District No. 4. The work will include vitrified clay pipe sewers: 167 ft. of 24-in. inside

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

diameter, 901 ft. of 21-in. inside diameter, 1,853 ft. of 18-in. inside diameter, 210 ft. of 15-in. inside diameter, 2,878 ft. of 12-in. inside diameter. With inlets, manholes and all other appurtenances. Deposit required, $490.

✣Bids will be received until 8 p. m., April 28, by City of Hermann, Mo., for the construction of about 4½ miles of sewer laterals. Plans and specifications for the work are now available. Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., are Engineers.

✣Bids will be received until May 7, by City of California, Mo., for the construction of about four miles of sewer laterals. Plans and specifications are now on file. Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., are Engineers.

Nebraska.

Engineer H. H. Tracy of Norfolk, Nebr., has prepared plans for extensions to the water mains in that city, to cost approximately $10,000. A bond election will be held May 5. Contract will be let about June 1.

New Hampshire.

The Morcello Construction Co., of Portsmouth, N. H., submitted the lowest bid on April 18 to the Board of Water Commissioners of Claremont, N. H., for water works improvements, the bid being $31,560. The work includes building 33,000,000-gal. reservoir, laying about 7,000 ft. of 20-in. pipe and about 3,000 ft. of 8-in. pipe; pipe valves, specials, etc., furnished by town.

New Jersey.

⦿Charles Ippolito, of Orange, N. J., has been awarded the contract by the Board of Contract & Supply of Schenectady, N. Y., for the construction of 30,000 lin. ft. of sewer, for $61,735. John Allen, Schenectady, bid $63,046 on the work.

A public meeting was recently held in Caldwell, N. J., under the auspices of the sewer committee, to discuss tentative plans for a sewerage system. William P. Barter is a member.

⦿A contract for the construction of a storm water sewer in the Borough of Pitman, N. J., has been awarded by the Council to Pugh & Hubbard, of Philadelphia, Pa., for $10,279.

Bids were received April 15 by the Passaic Valley Sewerage Commission, Newark, N. J., for the construction of Section 2 of the main intercepting sewer. In the table shown below (1) stands for bid of J. F. Shanley Co., Newark; (2) Robert W. Smith Corp., New York City; (3) Bruno & Petitti, Belleville, N. J.; (4) McCauley-Manton Co., Newark, N. J.; (5) Whiting-Turner Construction Co., Baltimore; (6) Dock Contractor Co., Hoboken, N. J.; (7) Pethick Bros. & Co., Inc., New York City; (8) Oscar Daniels Co., New York City; (9) Ryan & Reilly Co., Baltimore; (10) Patrick McMeel, Passaic; (11) Concrete & Foundation Co., New York City; (12) Union Building & Constr. Co., Passaic; (13) Culp Co., Inc., Brooklyn, and (14) Harrison & Craig, Newark.

	(1).	(2).	(3).	(4).	(5).	(6).	(7).	(8).	(9).	(10).	(11).	(12).	(13).	(14).
Earth excavation and refilling, in trench, for 120-in. sewer, 6,500 lin. ft.	$42.00	$43.75	$40.00	$34.00	$32.25	$33.70	$32.00	$31.50	$29.50	$27.00	$26.00	$28.00	$26.27	$21.20
Concrete masonry, in trench, 13,000 cu. yds.	12.50	7.60	9.00	7.75	8.25	7.34	8.00	8.10	8.40	9.00	8.50	7.50	6.60	7.50
Brick masonry, in manholes, and appurtenant work, 100 cu. yds.	15.00	16.00	20.00	20.00	17.00	15.00	20.00	15.00	16.00	15.00	16.00	15.00	20.00	15.00
Rock excavation, in trench, 100 cu. yds.	3.00	6.00	6.00	6.00	5.00	10.00	8.00	5.00	5.00	6.00	5.00	3.00	5.00	5.00
Totals	$437,300	$385,375	$379,600	$324,350	$319,075	$316,970	$314,800	$312,050	$303,050	$294,600	$281,600	$281,300	$259,055	$237,300

New York.

⦿R. D. Wood & Co., Philadelphia, Pa., have been awarded the contract by the Board of Water Commissioners, Olean, N. Y., for furnishing approximately 2,700 ft. of 4-in. cast iron pipe, 700 ft. of 6-in. cast iron pipe, and special castings, at $26.90 and $24.90 per ton respectively. Bids were opened April 11.

Commissioner Maxwell E. Briggs of the Department of Public Works, Lackawanna, N. Y., has submitted a list of all streets in the city requiring sewers. He has been instructed to have profiles ready at the next meeting of the Council so that plans for the laying of all sewers needed may be made at once.

Senator J. Henry Walters has introduced a bill in the Senate authorizing the city of Syracuse, N. Y., to issue $100,000 bonds for a system of storm water sewers in the First and Second Wards. The measure gives the Intercepting Sewer Board power to prepare plans and specifications and to award contracts for constructing the sewers.

The Metropolitan Sewerage Commission, New York City, has prepared a plan to divert that portion of the sewage from Manhattan Island which now flows into the lower East River, and dispose of it in a sanitary way by means of a 12-ft. tunnel under the river and Brooklyn to Coney Island and beyond. The plan calls for the carriage of the waste matter three miles beyond the Coney Island shore, the creation of an island in the shallows, and treatment of the sewage there before it flows into the ocean. The estimated cost of the project is about $23,000,000. Dr. Geo. A. Soper is President of the Commission.

City Engineer John M. Hackett of Dunkirk, N. Y., is preparing a sketch of the proposed intercepting sewer. It is planned to have this sewer extend down W. Front St., from Bass St. to Central Ave., thence north on Central Ave. to Water St., east on Water St. to Dear St., and follow the bank of the lake to a point near Battery Point, where the sewer will discharge into the lake.

Following low bids were received at the Borough Hall, of Queens, New York City, for sewer work aggregating $138,581: Sewer in Nott Ave., from Van Dam St. to Hulst St.; in Anable Ave., from Van Dam St. to Hulst St., and in Hulst St., from Anable Ave. to Nott Ave., First Ward; Sigretto & Co., $22,161. Sewer in Hamilton Ave., from Liberty Ave. to Jerome Ave.; Walnut St., from Liberty Ave. to Jerome Ave.; Briggs Ave., from Liberty Ave. to Jerome Ave.; Church St., from Liberty Ave. to Jerome Ave.; Kimball Ave., from Stoothoff Ave. to Lefferts Ave.; Fourth Ward· Peace Bros., $17,771. Sewer in Cypress Ave., from Cooper St. to Vermont Ave.; Second Ward; Tenth Ave. Construction Co., $22,759. Sewer in Lefferts Ave., from Liberty Ave. to Atlantic Ave. (Park Place); Fourth Ward; J. L. Sigretto Co., $23,468. Sewer in Liberty Ave., from Stoothoff Ave. to Chester St.; in Cedar Ave., from Liberty Ave. to Kimball Ave., and in Chestnut St., from Liberty Ave. to Kimball Ave.; Fourth Ward; Peace Bros., $9,122. Sewer in Decatur St., from Myrtle Ave. to Forest Ave.; Second Ward; M. J. Miranda, $4,639. Sewer in Jerome Ave., from Ocean Ave., East Side, to Greenwood Ave.; in McCormack Ave., from Beaufort Ave. to Jerome Ave.; in Oxford Ave., from Beaufort Ave. to Jerome Ave.; in Seattle St., from Beaufort Ave. to Jerome Ave.; in Portland Ave., from Beaufort Ave. to Jerome Ave., and in Herald Ave., from Jerome Ave. to crown 265 ft. north; Fourth Ward; Benidetto, $33,925. Sewer in Hulst St., from Greenpoint Ave. to Anable Ave.; First Ward; M. J. Miranda, $1,957. Sewer in Madison St., from Myrtle Ave. to Wyckoff Ave.; in Wyckoff Ave., from Madison St. to Halsey St., and in Halsey St., from Wyckoff Ave. to Irving Ave.; Second Ward; Benidetto, $2,234.

Ohio.

✣Bids will be received until noon, April 28, by V. T. Price, Director of Public Service, Cincinnati, O., for the construction of main and lateral sewers and drains, with their appurtenances, in Wool St., from Congress Ave. to Stanley Ave., and Stanley Ave., from Wool St. 200 ft. northeast. Plans, specifications and blank proposals can be obtained at the office of the Chief Engineer, Department of Public Service. Each proposal must be accompanied by a bond in the sum of $500, or a certified check on a solvent band. M. J. Keefe is Clerk.

✣Bids will be received until noon, April 25, by W. J. Springborn, Director of Public Service, Cleveland, O., for three digesters for the Cleveland Garbage Disposal Plant at Willow, O. Specifications are on file with the Director.

✣Bids will be received until noon, May 5, by Village Council, Girard, O., at the office of James E. Stotler, Clerk, for the furnishing the necessary labor and material for the improvement of Broadway from State St. east to the termination thereof, by draining, constructing the necessary connections for water and gas from the mains to within the inner lines of the curbs, by constructing the sewer connections to within the inner lines of curbs, by grading, setting curbs and paving the same according to the plans, profiles and specifications on file in the office of said village clerk.

⦿The Board of Control of Toledo, O., has awarded the contract for a two-mile sewer, taking in several streets and alleys in the vicinity of Lagrange St., and the Manhattan Road to Albert Grysdowski, for $14,946. The Toledo Contracting Co., secured the contract for sewer No. 1163, in the neighborhood of South St., and the boulevard, for $2,177.

⦿Service Director Price of Cincinnati, O., has awarded a contract for sewering Glenway Ave., Price Hill, to Welling & Franz, for $71,611.

Bids will be received until noon, April 23, by E. L. House, Director of Public Service, Painesville, O., for improving Mentor Ave., including 10,622 sq. yds. of brick pavement; 5,200 lin. ft. of stone curb; 1,500 lin. ft. of 12-in. storm sewer. Bids will also be received for building sanitary sewers in Mentor Ave., Grant St., Jackson St. and Jefferson St., being 968 ft. of 8-in. pipe and 1,062 ft. of 10-in. in Mentor Ave.; 730 ft. of 12-in. pipe in Grant St., 2,750 ft. of 15-in. pipe and 400 ft. of 20-in. pipe in Jackson St., 375 ft. of 20-in. pipe and 1,100 ft. of 10-in. pipe in Jefferson St. F. N. Downer is City Engineer, Painesville, Ohio.

The City Council of Mt. Vernon, O., has passed a resolution providing for a sewer to drain the low section between Hamtramck and Sugar Sts.

The City Commissioners of Springfield, O., have been petitioned by residents in Miller St., between Logan and Taylor Sts., for a sewer in that street.

Bids will be received until noon, May 13, by George E. Fry, Village Clerk, Bexley, O., for the construction of a municipal sewage treatment plant, in accordance with plans and specifications on file at Capital Barber Shop, Bexley, Ohio, and also at the offices of the Engineer, A. Elliott Kimberly, 8 E. Long St., Columbus, Ohio. Plans and specifications may be obtained upon payment of $3. Official advertisement will be received elsewhere in this issue.

Oklahoma.

The City Commission of McAlester, Okla., has created two new sewer districts, as follows: No. 36, in the Fourth Ward, with a total length of 845 ft.; No. 37, in the First Ward, with a total length of 1,652 ft. Specifications will be prepared for the laying of the same.

Oregon.

Following low bids were received recently

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

by the City Council of Portland, Ore., for the construction of sewers: E. 54th and Stanton Sts.—Consolidated Contract Co., $9,986; E. 52d St., from East Stark to a point 710 ft. north—C. Saloman, $719; E. 53d St., from Stark 710 ft. north—Chelich & Desko, $760; E. 40th St., from Brazee 110 ft. north—E. A. Bohren, $120; Westover Terrace—Giebisch & Joplin, $6,800; E. 15th St., from Powell to Frederick—E. A. Bohren, $405; E. 39th St., from Brazee 110 ft. north—Y. Rickards, $91; E. 48th St. and Alameda—Consolidated Contract Co., $7,025; E. 48th, from E. Harrison St. to the south line of Newport Addition—Azar & Hazeem, $313; E. 67th St. district—C. Saloman, $829; E. 38th St., from Brazee 110 ft. north—Abraham & Khoury, $112; E. 49th, from Wisteria Ave. to Sandy Road—Azar & Hazeem, $1,066; Union Ave. bridge—Pacific Fire Extinguisher Co., $1,095; E. 28th St. bridge—Pacific Coast Fire Extinguisher Co., $1,260.

Pennsylvania.

✣Bids will be received until May 19, by Town of Washington, Pa., for the construction of extensions to the sewer system estimated to cost $1,500. The work will include 1,500 lin. ft. 6-in. vit. pipe sewer; 500 ft. 8-in. vit. pipe sewer; 1,200 lin. ft. 4-in. house connections; 3 manholes; one flush tank. D. C. Morrow is engineer of the town.

⊙The Directors of the Scranton Poor District, Connell Bldg., Scranton, Pa., have awarded the contract for the erection of a sanitary sewage disposal plant at the Hillside Home to Lathrop, Shea & Henwood, of New York City, for $19,764. Other bidders were: New York Sewage Disposal Co., $22,767, and Hagen Lumber Co., $28,500.

Bids will be received by Borough Clerk J. C. Armstrong, Etna, Pa., until April 28 for the collection and disposal of garbage in the borough. Estimates are also being received for furnishing 500 ft. of fire hose and 500 ft. of street hose with snap Clay Jones couplings.

The Town Council of Pottstown, Pa., has decided to construct a sewerage system and disposal plant at a cost of over $300,000. Work will be started this summer.

Dr. Samuel Dixon of the State Health Department, Harrisburg, Pa., has given permission to Duryea Borough to build a trunk sewer. The plans call for a trunk sewer on Main, Walnut and Chittenden Sts., and the borough is permitted to empty sewerage from these streets into the Lackawanna River. Comprehensive sewer system plans must be submitted to the state before July 1, 1913.

Rhode Island.

An enabling act has been introduced in the Rhode Island General Assembly which, if passed, will give the First Ward taxpayers of Cranston, R. I., the right to vote on the question of having an Edgewood and Pawtuxet fire district for the primary purpose of installing a sewer system in that ward. The bill provides for the issuance of bonds to build a sewerage system not to exceed $160,000.

South Dakota.

The City Commissioner of Sioux Falls, S. Dak., have ordered the construction of sewers in several sections of the city. Bids for the work will soon be asked. The sewers will be laid in Minnesota Ave., Spring Ave., Second Ave., Third Ave., and Fifth Ave.

The City Commissioners of Sioux Falls, S. Dak., have passed resolutions providing for the construction of eight lateral sewers.

Tennessee.

The Tennessee Legislature has passed a bill permitting the Mayor and Board of Aldermen of Cleveland, Tenn., to issue bonds in the amount of $75,000 for the extension and completion of the present sewer system.

Texas.

The citizens of Jacksonville, Texas, on April 14, voted the issuance of bonds to the amount of $35,000 for the construction of a sanitary sewerage system and extension on water supply.

Plans have been submitted to the City Council of Sherman, Tex., for the construction of a storm sewer to carry off the refuse from the soap factory of the Interstate Cotton Oil Co., and the Diamond Mill.

The citizens of Temple, Tex., at the recent election voted the issuance of bonds in the sum of $75,000 for the sanitary sewer system.

P. G. Burns of Houston, Tex., has completed plans for the installation of a drainage system in Freeport, Tex. This system includes a drainage canal 3½ miles in length, 7 ft. deep and 26 ft. wide, surrounding the city on three sides, the fourth being bounded by the Brazos River.

Utah.

City Engineer H. C. Craven of Ogden, Utah, has recommended to the City Commissioners that concrete gutters and storm sewers be built from Washington Ave., in the district between 26th and 22d Sts., to the Ogden River. The estimated cost is $25,000.

The City Commissioners of Ogden, Utah, have given notice of intention to create a new sewer district on Brinker Ave., between 25th and 26th Sts., and 20th St. from Washington to Wall Ave., and south on Wall Ave. to the main sewer on 21st St.

Vermont.

A special meeting was held in the Village of Bellows Falls, Vt., on April 21, to decide whether money shall be appropriated to improve the sewer system and the sidewalks. The report of Engineer E. A. W. Hammatt of Newton Center, Mass., has been received. The estimated cost of making all of the improvements is $32,275. The engineer suggests the improvement of six sections at this time at an estimated cost of $20,535. Supt. of Streets Jay H. Lawrence has prepared estimates of improvements to the sidewalks in several parts of the village. It is thought that $2,000 will cover these improvements.

Virginia.

The Common Council of Petersburg, Va., has passed an ordinance appropriating the sum of $48,700 for the improvement of River and Second Sts., including the elevation of River St. to something like 4½ ft. above the present grade, the laying of a storm sewer from Pike to Third, along River St., and the raising of Second St. to meet the elevation of River St.

The City Council of Petersburg, Va., has passed an ordinance appropriating $6,420 for the construction of sewers and water mains in Blandford.

Washington.

⊙The Standard Engineering Co., Seattle, Wash., is the probable contractor for the installation of an ornamental lighting system in Helena, Mont., for $21,663. Bids were opened April 7.

The City Engineer of Olympia, Wash., has recommended the construction of a $10,000 10-in. trunk sewer on Park St.

The city of Tacoma, Wash., is considering the construction of nine garbage incinerators.

Wisconsin.

✣Bids will be received until 10 a. m., April 26, by Board of Public Works, at the office of the City Clerk, Racine, Wis., for furnishing all materials and performing all the labor for the following public work: Constructing a public sewer in Hartmann Court, from Prospect St. to Hamilton St., approximating the following quantities: 425 lin. ft. of 8-in. pipe and 1 manhole. Said work to be completed on or before the first day of June, 1913, all in accordance with the plans and specifications of the work on file in the office of said City Clerk.

✣Bids will be received until 9 a. m., May 8, by E. L. Williams, City Clerk, Appleton, Wis., for furnishing all labor and material and constructing a sewer in Franklin St. from Superior St. east about 228 ft. Plans are on file and may be seen at the office of the City Clerk. A certified check of $100 will be required deposited by all bidders.

Engineer George Bradish of La Crosse, Wis., has submitted plans for the proposed sewer system for Bangor, Wis., to the Village Trustees. The estimated cost of the system is $28,000. The village has $20,000 available for the work.

City Engineer B. C. Brennan of Kenosha, Wis., is working on plans for the proposed trunk sewer to take care of the north and northwest sides of the city.

⊙The Common Council of Fond Du Lac, Wis., has awarded a contract for a new west side sewer system and a modern purification and disposal for the entire sewer system of the city to the E. R. Harding Co., of Racine, Wis., at $63,358. The work is to be started at once.

Canada.

✣Bids will be received until 8 p. m., May 1, by George Elliott, Town Clerk, Sudbury, Ont., for the completion of Main Sewer, comprising about 7,000 lin. ft. of sewer, 20-in., 18-in., 15-in. and 12-in., with accessories. The Corporation will furnish the pipes. Plans, specifications, etc., may be seen at the office of the Engineers, Toronto, or at Sudbury.

⊙B. F. Sturtevant Co., Chicago, Ill., has been awarded the contract by the City Commissioners of Moose Jaw, Sask., for furnishing one fuel economizer with 7,000 sq. ft. of heating surface, with draft equipment, for $11,400. Bids were opened March 26.

BUILDINGS

California.

✣Bids will be received from 2 until 3 p. m., April 30, by Board of Public Works, San Francisco, Calif., for the general construction, plumbing and gas fitting, furnishing and installing boilers, boiler auxiliaries, etc., installation of heating and ventilating system in Polytechnic High School building. The work will be let in separate contracts.

District of Columbia.

✣Bids will be received until 3 p. m., May 28, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for two new high-pressure, water-tube boilers, etc., at the Bureau of Engraving and Printing, Washington, D. C., in accordance with the specification and drawings enumerated therein, copies of which may be obtained at the discretion of the Supervising Architect.

✣Bids will be received until 3 p. m., May 15, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for furnishing and delivering special lighting fixtures for the new United States Post Office at Washington, D. C., in accordance with the specifications and drawings enumerated therein, copies of which may be obtained at the discretion of the Supervising Architect.

⊙Bids as follow were received April 10 by the Supervising Architect, Treasury Department, Washington, D. C., for the construction of vaults for the new building for the Bureau of Engraving and Printing, Washington, D. C.: P. F. Gormley Co., Washington, D. C., $120,859 (awarded contract); Interurban General Contracting Co., 1790 Broadway, New York City, $124,900; National Fireproofing Co., Washington, D. C., $138,580; York Safe & Lock Co., York, Pa., $162,992.

Improvements to cost about $1,000,000 are to be made at the Catholic University, Washington, D. C. Two new laboratories, one to cost $300,000, and a main dining hall, are

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

to be erected. Monsignor Thomas J. Shahan is Rector.

Idaho.

✣Bids will be received until 3 p. m., May 28, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction, complete, including plumbing, gas piping, heating apparatus, electric conduit and wiring, and lighting fixtures, of the United States Post Office and Court House at Pocatello, Idaho. The building is three stories and basement, with a ground area of approximately 4,500 sq. ft, fireproof construction, stone and brick facing, tin roof. Drawings and specifications may be obtained from the Custodian of site at Pocatello, Idaho, or at the discretion of the Supervising Architect.

Illinois.

✣Bids will be received until 9 a. m., April 26, by William Henshaw, Clerk of School District No. 83, Glen Carbon, Ill., for all the material and labor required in the building of a new brick and stone school house for said School District, in accordance with the plans and specifications to be seen at the office of F. Oswald, Architect, at Alhambra, Ill., and at W. H. Wieduwilt Place, Glen Carbon, Ill. Specification, elevation and ground plan can be inspected at either place. Parties bidding upon this work will be required to furnish a certified check, accompanied by their bid, in the sum of $500.

✣Bids will be received until 2 p. m., May 7, by W. R. Strawn, Secretary of the Board of Education, Albion, Ill., for furnishing materials and labor necessary to construct a new school house in accordance with plans and specifications made for same by Spencer & Temple, Architects, Champaign, Ill.

Indiana.

✣Bids will be received until noon, May 6, by Board of School Trustees, Richmond, Ind., for the construction of a school building, also for plumbing, heating and ventilating.

✣Bids will be received until 10 a. m., May 9, by Henry C. Schroeder, Township Trustee, Marion County, Indianapolis, Ind., for the construction of a 2-story brick and stone school building. Henry C. Schroeder is township trustee.

Iowa.

✣Bids will be received until noon, May 1, by the Township Trustees of Crescent Township, for the construction of a township hall. Specifications can be seen at the office of J. A. Pratt, Township Clerk, Crescent, Ia.

Kansas.

Bids as follow were received April 11 by the Supervising Architect, Treasury Department, Washington, D. C., for the construction of U. S. Post Office at Ottawa, Kan., (1) bid on limestone, (2) on sandstone: Tom Lovell Sons, Enid, Okla., (1) $55,560, (2) $56,166; Rogers & Kaiser, People's Gas Bldg., Chicago, Ill., (1) $56,418, (2) $59,560; C. W. Benning, Massachusetts Bldg., Kansas City, Missouri, (1) $56,875, (2) $56,875; W. D. Lovell, Minneapolis, Minn., (1) $57,890; Frank H. Latimer & Son, Massachusetts Bldg., Kansas City, Mo., (1) $59,865; Alexander & Beeler, Ottawa, Kan., (1) $59,840, (2) $59,840; Interstate Construction Co., Saginaw, Wash., (1) $62,740, (2) $66,500.

Louisiana.

⊙Norman Ker Co., Washington, D. C., has been awarded the contract at $364,950 by the U. S. Treasury Department for the interior finish of the U. S. Post Office and Court House at New Orleans.

Michigan.

⊙The Turner Construction Co., 11 Broadway, New York City, has been awarded the general contract by the American Agricultural Chemical Co. for a new factory building at its Detroit works. This building will be 150 ft. by 40 ft. in plan, 3 stories in height, reinforced concrete throughout. A. H. Nickerson is Engineer and Architect. Work will go ahead at once.

Missouri.

George W. Stiles Construction Co., Rookery Bldg., Chicago, Ill., at $56,335 on limestone and $61,000 on sandstone, was the only bidder, April 11, for the construction of the U. S. Post Office at Boonville, Mo.

New Mexico.

✣Bids will be received until 6 p. m., May 8, by Capt. G. H. Scott, Quartermaster, Fort Bayard, N. Mex., for furnishing and installing one 10-h.p. engine in the sawmill at Fort Bayard.

New York.

⊙Wister & Arthur, Lowville, N. Y., have been awarded the general contract at $18,686 for constructing greenhouse and shop building at New York State School of Agriculture, St. Lawrence University, Canton, N. Y.

Plans and specifications are now being figured on and it is probable that a contract will be let this month for a new plant for the Crucible Steel Co. of America, Pittsburgh, Pa., to be erected near the works of the Halcomb Steel Co., at Syracuse. The plant will cost about $1,000,000.

North Dakota.

⊙Tom Powers Co., Fargo, N. D., has been awarded the contract at $68,750 for the erection of the main building for the Cass County jail. The Stewart Iron Works, Cincinnati, O., at $13,354, was awarded the contract for the jail fixtures; Fargo Heating & Plumbing Co., Fargo, secured the heating, wiring, plumbing and ventilating contract at $18,660.

The state will expend about $285,000 this season for the erection of buildings at the insane asylum at Jamestown. These will include the heating and power plant, the receiving ward and the tuberculosis building. Samuel F. Crabbe, Fargo, N. D., is the Architect.

Ohio.

✣Bids will be received until noon, April 29, by W. J. Springborn, Director of Public Service, Cleveland, O., for furnishing a motor operated freight elevator for the City Water Department. Plans and specifications may be obtained of the Superintendent of the Water Department. W. H. Kirby is Secretary of the Directors.

✣Architect Charles F. Owsley, Youngstown, O., will receive estimates until May 7 on constructing a brick and concrete school building at Grace and Hillman Sts. for the Board of Education. The building will contain 16 rooms and cost about $80,000.

✣Bids will be received until noon, April 28, by Charles W. Stage, Director of Public Safety, Cleveland, O., for furnishing rails, ties, wire and angle bars for the Infirmary Division of the Cooley Farms, Warrensville, Ohio. Each bid must be in accordance with the specifications which may be obtained at the office of the Director of Public Safety, Room 109, City Hall.

✣Bids will be received until noon, April 29, by Board of Education, J. S. Simpson, Clerk, Berea, O., for furnishing the necessary labor and materials for erecting a new high school building and altering an old building adjoining the same, according to the plans and specifications on file in the office of said clerk. Plans and specifications may be seen at the office of the clerk in Berea, O., or at the office of Badgley & Nicklas, 6110 Euclid Ave., Cleveland, O.

Construction work will be started next month on the new 6-story department store building to be erected at Euclid Ave., Ontario St. and Prospect Ave., Cleveland, O., for the May Co., of which Nathan L. Dauby, Cleveland, is General Manager.

Pennsylvania.

✣Bids will be received until noon, April 25, by Board of County Commissioners, Harrisburg, Pa., for the erection of an electric passenger elevator at the County Home, in accordance with specifications on file at the office of the Commissioners.

⊙Charles McCall Co., Philadelphia, Pa., has been awarded the contract for the new Mechanics' Bank Bldg., to be erected at 3rd and Market Sts., Harrisburg, Pa. York Safe Co., York, Pa., was awarded the contract for the safes and vaults. Structure is to be 8 stories high, with granite base, marble to second story and terra cotta brick with marble trimmings to the top.

South Dakota.

⊙General Construction Co., Milwaukee, Wis., has been awarded the contract at $68,973 for the construction of the U. S. Post Office at Brookings, S. D.

Utah.

⊙Lyman & Samuels, Salt Lake City, Utah, have been awarded the contract at $25,313 for the construction of an electric light plant for the City of Mt. Pleasant, Utah. The work includes a plant in Pleasant Creek Canyon, about four miles of transmission lines and remodeling present distributing system.

Washington.

✣Bids will be received until 1:30 p. m., May 14, by Port Commission of the Port of Seattle, Wash., C. E. Remsberg, Secy., for the construction of four superstructures in accordance with the plans and specifications on file at the office of the Commission. The work provides for the construction of two warehouses of frame construction and two stories high, 80x800 ft. in dimension.

RIVERS AND HARBORS

California.

The San Francisco Bridge Co., Nevada Bank Bldg., San Francisco, Cal., at 12.8 cts. was low bidder for dredging in Oakland Harbor, Cal., bids for which were opened April 14 by the U. S. Engineer at San Francisco.

Connecticut.

The Hartford & New York Transportation Co., Hartford, Conn., at 11 cts. per cu. yd. was the only bidder for maintenance dredging in the Connecticut River below Hartford, Conn., bids for which were opened April 12 by Maj. G. B. Pillsburg, U. S. Engineer, New London, Conn. The bid was recommended for acceptance. The estimated yardage is 68,000.

Delaware.

Bids as follows were received April 15 by Maj. R. R. Raymond, U. S. Engineer, Wilmington, Del., for about 85,000 cu. yds. of dredging, mud, sand and gravel, from Little River, Delaware: River & Harbor Improvement Co., Philadelphia, Pa., 8 cts.; Atlantic Dredging Co., Philadelphia, Pa., 8.72 cts.; The Ricards Dredging Co., Philadelphia, Pa., 8.9 cts.

District of Columbia.

✣Bids will be received until 11 a. m., May 3, by Bureau of Yards and Docks, Navy Department, Washington, D. C., for steel towers for high power radio station to be erected at Caimito, Canal Zone, including radio equipment under the cognizance of the Bureau of Steam Engineering.

✣Bids will be received until 2 p. m., May 5, by Commissioners of District of Columbia, Washington, D. C., for furnishing and delivering one 25-h.p. fuel oil engine with direct connected electric generator for use in the water department.

✣Bids will be received until 10:30 a. m., May 2, by Maj. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under canal circular 771, steel, iron, wire cable, nails, nuts, wrenches, hacksaw blades, tool handles, solder, hose, packing, rubber belting, asbestos gaskets, manila rope, cotton canvas, soap, candles, white zinc, red lead, chrome green, orange gum, shellac and linseed oil.

✣Bids will be received until 2:30 p. m., May 3, by Maj. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under Canal Circular 771-A, creosoted wood switch ties and window shades.

✣Bids will be received until 10:30 a. m., May 13, by Maj. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under Canal circular 772, lubricating oils and greases as follows: Valve oil, air compressor cylinder oil, marine engine oil, stationary engine oil, locomotive engine oil, turbine engine oil, gas engine oil, car oil, lard oil, nonfluid grease, yellow cup grease, black gear grease and cable grease.

✣Bids will be received until 10:30 a. m., May 16, by Maj. F. C. Boggs, General Purchasing Officer Isthmian Canal Commission, Washington, D. C., for manila rope, cotton waste, wool waste, white lead, red lead, turpentine, kerosene, gasoline.

✣Bids will be received until 10:30 a. m., May 19, by Maj. F. C. Boggs, General Purchasing Officer Isthmian Canal Commission, Washington, D. C., for furnishing under Canal Circular 771, steel dump barges.

Florida.

✣Bids will be received until 10 a. m., April 30, by Constructing Quartermaster, Fort Dade, Fla., for extensive repairs to the wood pile section of quartermaster wharf.

Illinois.

Plans and specifications are being prepared by the South Park Commissioners, 57th and Cottage Grove Ave., Chicago, Ill., for the completion of the adopted Burnham plan of an outer parkway and lagoon from Grant Park to Jackson Park. The central feature of the plan is a filled in strip of outer driveway and paved beach, 1,800 ft. off the present shore line. Between the driveway strip and the shore will stretch an uninterrupted waterway 6 miles long, connecting with Grant Park on the north and Jackson Park on the south. The first work will be the construction of 1,800 ft. breakwaters at 35th and 53rd Sts.

Louisiana.

Plans are being prepared by the State Board of Engineers, New Orleans, La., for the following improvements at that city: Concrete revetment to be constructed by the New Basin Canal and Sheelroad Board at West End, beautification of bulkhead extension by the Southern Yacht Club; concrete sea wall to extend from lighthouse to the main land, on the east bank of the canal.

Massachusetts.

✣Bids will be received until 11 a. m., May 10, by Bureau of Yards and Docks, Navy Department, Washington, D. C., for repairing concrete quay wall between piers 7 and 8 at the United States Navy Yard, Boston, Mass. The cost is estimated at $4,000.

✣Bids will be received until noon, April 29, by Col. F. V. Abbot, Boston, Mass., for dredging in Lynn Harbor, Mass.

⊙John T. Scully Foundation Co., 118 First Ct., Cambridge, Mass., has been awarded the contract at $1,891 for making water jet borings and soundings on the Commonwealth Flats, east of Jeffries' Point, East Boston, for the Port of Boston Commissioners. Bids were opened April 15.

New Hampshire.

✣Bids will be received until 11 a. m., May 3, by Bureau of Yards & Docks, U. S. Navy Department, Washington, D. C., for window and door screens at the naval hospital, at Chelsea, Mass.; Newport, R. I., and Portsmouth, N. H. The cost is estimated at $6,000.

✣Bids will be received until 11 a. m., April 26, by Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., for sterilizing equipments at the naval hospitals at Chelsea, Mass.; Portsmouth, N. H., and Newport, R. I. The cost is estimated at $3,000.

New York.

✣Bids will be received until noon, May 13, by Col. W. M. Black, U. S. Engineer, 39 Whitehall St., New York City, for dredging and rock removal in Port Chester Harbor and in East Chester Creek, N. Y. The work to be done at Port Chester Harbor is to secure a depth of 10 ft. at mean low water. This will require the removal of 3,070 cu. yds. (place measurement) of ledge rock, 20 cu. yds. broken rock and boulders ½ to 2 cu. yds. in size, and 5 cu. yds. over 2 cu. yds. in size, and 11,500 cu. yds. (scow measurement) of other material. The work at East Chester Creek requires a removal of 503 cu. yds. of ledge rock, 20 cu. yds. of broken rock and boulders and 46,950 cu. yds. of other material.

North Carolina.

No bids were received April 14 by Lt. J. R. Campbell, Constructing Quartermaster, Fort Caswell, N. C., for dredging creek at the fort.

Oregon.

✣Bids will be received until 11 a. m., May 24, by Maj. Jay J. Morrow, U. S. Engineer, Portland, Ore., for constructing and erecting 11 pairs of metal lock gates for Dallas-Colilo Canal.

All bids received March 10 by Maj. Jay J. Morrow, U. S. Engineer, 802 Couch Bldg., Portland, Ore., for furnishing 100,000 bbls. Portland cement were rejected. New bids will be asked later on.

Pennsylvania.

A bill is before the State Legislature, appropriating $1,000,000 for the construction of a reservoir at the headwaters of the Youghiogheny River for flood prevention. The bill was prepared by the Flood Commission of Pittsburgh.

Washington.

⊙J. A. McEachern Co., Baily Bldg., Seattle, Wash., has been awarded the contract at $196,000 for constructing docks and warehouse at the foot of Bell St., Seattle, for the Port of Seattle Commission. Bids were opened April 10.

Canada.

⊙Fraser, Brace & Co., 47 W. 34th St., New York City, have been awarded a contract amounting to about $3,000,000 for work in connection with the hydro-electric development of the Cedar Rapids Power Co., of Montreal, Que.

Bids will be received until noon, May 28, by E. L. Cousins, Chief Engineer, Toronto Harbor Commissioners, 76 Adelaide St., West, Toronto, Ont., for the removal of 35,000,000 cu. yds. of material by hydraulic dredging. Official advertisement will be found elsewhere in this issue.

CALLS FOR BIDS

Rate, $2.40 an inch, single column. **Copy received until Monday noon.**

TENDERS FOR DREDGING, TORONTO, CANADA.

The Toronto Harbor Commissioners have in prepartion plans and specifications for the removal of approximately 35,000,000 cubic yards of material by hydraulic dredging.

Borings indicate 70 per cent of material to be sand and gravel; 30 per cent, mixture of sand, silt and clay.

Each dredge must be capable of handling at least 600 cubic yards per hour at maximum length of discharge.

From source of supply to point of discharge, maximum distance is about 6,000 feet. Average length of delivery required, about 4,000 feet.

Direct line of discharge preferred, but consideration will be given to work being done in series or by relays.

Day and night operation required.

The plans and specifications will be ready on April 28, 1913. Tenders for all or part of the work will be received up to 12 o'clock noon, May 28. Work to commence August 1, 1913.

Borings, plans and specifications, tender forms, etc., and general information relating to the work, can be seen at the Engineering Department of the Commission, 76 Adelaide St., West.

Communications relative thereto to be addressed to E. L. Cousins, Chief Engineer.

All tenders to be sealed and addressed to A. C. Lewis, Secretary, Toronto Harbor Commissioners.

The Commissioners do not bind themselves to accept the lowest or any tender.

L. H. CLARKE,
Chairman.

NOTICE TO CONTRACTORS.

Bids will be received until 2 p. m., May 8, 1913, for building sewer system at Knox, Ind., costing approximately $24,000. The Town Clerk of Knox will furnish copies of plans and specifications upon a deposit of $5.00 to insure their return.

R. C. YEOMAN.

NOTICE TO CONTRACTORS.

Burlington, Iowa, April 17, 1913.

35,000 feet, vitrified pipe sewers.

Bids for the construction of 35,000 feet of vitrified pipe sewer will be opened at 9 a. m., May 1, 1913. For plans and specifications address H. G. VOLLMER,
City Engineer.

$3,000 in certified checks on Burlington banks.

Proposal Advertising
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ENGINEERING AND CONTRACTING

Devoted to the Economics of Civil Engineering Design
and to Methods and Cost of Construction

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Prospecting for Water Power.

Systematic search for coal "veins" has often yielded rich return on the money spent. Why may not an even greater profit come to those who prospect scientifically for water power?

Probably the average young engineer who might be sent out to search for water power would go first to places where waterfalls exist. Probably, also, he would overlook entirely the most feasible sites for water power development.

More and more is it apparent that water can be profitably diverted a long distance through conduits, if a high drop can be secured. The use of a long conduit makes it frequently possible to select a reservoir site of large capacity, and at a place where a relatively inexpensive dam can be built. Ample water storage at a low cost per acre-foot is usually the greatest desideratum.

Wellington lays down a rule in railway location to the effect that a survey should ordinarily be started at the summit of a divide and progress downward in opposite directions. This is wise, for a summit is a controlling factor in railway location. Similarly in locating a water power plant, it is well to start at the controlling point, namely the reservoir. Find an adequate, high reservoir site, where a dam of low cost per acre-foot can be constructed, and it will often develop that water can be diverted into the reservoir from somewhat distant sources at relatively small cost. Long diverting conduits to the reservoir and long flow conduits from the reservoir to the pressure pipe line are less expensive, measured in dollars per horsepower, than they often appear to be when not thus measured. Furthermore, conduits can usually be built in such a manner as to require almost no expense for maintenance.

It has been stated—with how much accuracy we do not know—that enough hydro-electric power can be generated with the water in the Los Angeles aqueduct to pay the entire interest and upkeep cost of the aqueduct, which is 230 miles long. If this is even approximately correct, it furnishes a striking illustration of what may be economically accomplished with very long conduits.

Long tunnels make feasible many a project that would otherwise be valueless. We fail to see why inclined shafts have not been frequently used instead of steel pressure pipes. Such an inclined shaft, located in rock lined with concrete and grouted exteriorly with cement mortar, can surely be built to withstand any pressure. Its first cost would frequently be far less than the cost of steel penstocks, and its life would be limitless.

Engineers should not assume that all the good water power sites have already been found and appropriated.

A power project that would have been valueless ten or fifteen years ago may now be extremely attractive. The weight of copper or aluminum wire required to transmit a given amount of current a given distance varies inversely as the square of the voltage. Within a comparatively few years 15,000 volts was regarded as a very high pressure. Today 140,000 volt lines are in use, and others of 150,000 volts are in process of construction. The 150,000 volt line will carry a given current 100 times as far as the 15,000 volt line with the same line loss, or it will carry it the same distance with the same loss and yet require only one 100th as much copper or aluminum conductor. Hence it is that the distance from the power station to the market has become an economic factor of much less significance than it was only a few years ago. Water power projects that were prospected and abandoned ten years ago may prove to be rich mines of wealth today.

A Call for Co-operative Action by River Improvement and Drainage Associations.

A census of the associations, congresses, levee boards and other organizations having for their objects the improvement of rivers and the reclamation of overflow lands would probably provide a list of half a hundred names. There are 31 states in the Mississippi basin alone and all but a few have drainage associations. There are associations along both the lower and the upper Missouri, along the Ohio and along the Tennessee and the Cumberland. All of the South Atlantic states have drainage associations and there are river improvement associations in Texas, California, Oregon and Washington. Louisiana and Illinois have flood protection associations.

The more than state wide organizations are hardly less numerous. The Rivers and Harbors Congress is working for a Federal appropriation of $50,000,000 for levee and revetment work in the lower Mississippi. The Association of Drainage and Levee Districts of Illinois is petitioning Congress to establish a Department of Public Works with power to build work for river control. In Pennsylvania the Flood Commission of Pittsburgh has reported on a reservoir system to cost $20,000,000 and is asking aid to carry out such a system. The Interstate Levee Association, representing several states along the lower Mississippi, is urging better levees. The Lakes to the Gulf Deep Waterway Association seeks river improvement for navigation. The Southern Commercial Congress asks for Federal swamp reclamation in the South. In Minnesota, Iowa and Missouri, the Upper Mississippi River Improvement Association is working for flood regulation and land reclamation. Finally there are the National Reclamation Association and its offspring, the National Drainage Congress, which is organized to secure a comprehensive national plan for drainage, reclamation, flood prevention, navigation and water power development and has by resolution, as noted in our last issue, urged Congress to create a Department of Public Works to plan and prosecute the work.

From their names and objects as given above it is plain that all these organizations, though each but one or two is working from a more or less sectional standpoint, have one great interest in common. This common interest is to secure Federal action of a comprehensive and systematic nature in the task of river control and land reclamation. To promote this common purpose these organizations should co-operate, and the point that we make here is the suggestion offered by the National Drainage Congress whereby this co-operation may be attained.

At its meeting in St. Louis, April 10, 11 and 12, the National Drainage Congress voted the following resolution:

> As the varied interests of the many states and reclamation organizations must be known and considered before a federal remedy can be applied, be it resolved, that an urgent invitation be sent by the National Drainage Congress to all the states, and to all reclamation organizations to become part of and participate in its Central Co-operative Committee. This committee shall consist of two members appointed by the existing organizations, either national, state, district or local, and in case such organizations do not exist in any state, that this congress requests the governor of that state to appoint committee men to represent that state. In issuing the above invitation it should be definitely stated that existing organizations by co-operating do not thereby surrender their identity, charter, organization or officers.

It would seem that this plan should appeal to any organization not wholly unwilling to work with its neighbors for the common good.

Estimating the Rate of "Reasonable Return" for a Public Utility.

In a recent argument submitted to the Wisconsin Railroad Commission, Mr. William H. Winslow, Vice President of the Superior Water, Light & Power Co., offers the following analysis of the rate of fair return to be allowed on capital invested in public utilities:

> The rate of reasonable return may be said to comprise six elements:
>
> A. Pure interest.
>
> B. Addition to cover narrow market and lack of established price of securities.
>
> C. Addition to cover absence of surplus.
>
> D. Addition to cover inherent risk of the business.
>
> E. Addition to cover risk of short-time and non-exclusive franchise.
>
> F. Additional return to cover community hazard.

In our opinion one of the most important elements of "reasonable return" is not mentioned at all by Mr. Winslow. We refer to the true profit, or return to the owners of the property for supervisory control. Mr. Winslow's "reasonable return" provides only for interest and risk, for items B to F are nothing else than hazard items.

Fair return is the sum of three elements:
(1) Pure interest.
(2) Insurance against hazards.
(3) Profit.

It is the last of these Mr. Winslow fails to consider. As we have previously had occasion to point out, profit is preferably calculated as a percentage of gross income and then converted into a percentage of the capital invested in the property.

For his own company Mr. Winslow derives the following rates of fair return. The symbols *A*, *B*, *C*, etc., are more completely explained below. The symbols *W*, *G* and *E* relate to the Water, Gas and Electric departments of the company:

	A Pure interest.			B Addition to pure interest to cover narrow market and lack of established sale price.			C Addition to pure interest to cover absence of large surplus earnings.			D Additional return to cover inherent risks of the business, state of the art, etc.			E Additional return to cover risk of short-time and non-exclusive franchises.		F Additional return to cover community hazard.			G Totals.		
	W.	G.	E.	W.	G.	E.	W.	G.	E.	W.	G.	E.	G.	E.	W.	G.	E.	W.	G.	E.
	Per cent.			Per cent.			Per cent.			Per cent.			Per cent.		Per cent.			Per cent.		
1896....	4	4	4	1.5	1.5	2	1.5	1.5	2	1	1.5	5	0.5	1	2	2	3	10	11	17
1899....	4	4	4	1.5	1.5	2	1.5	1.5	2	1	1.5	4	0.5	1	2	2	3	10	11	16
1904....	4	4	4	1.5	1.5	2	1.5	1.5	2	1	1.5	3	0.5	1	1.5	1.5	1.5	9.5	10.5	13.5
1905....	4	4	4	1.5	1.5	2	1.5	1.5	2	1	1.5	2.5	0.5	1	1	1	1	9	10	12.5
1908....	4	4	4	1.5	1.5	2	1	1	1.5	1	1.5	2	...	...	1	1	1	8.5	9	10.5
1909....	4	4	4	1.5	1.5	2	0.5	0.5	0.5	1	1.5	2	...	...	0.5	0.5	0.5	7.5	8	9
1911....	4	4	4	1	1	1	0.5	0.5	0.5	1	1.5	2	...	...	0.5	0.5	0.5	7	7.5	8

A.—Pure interest: This term is used to mean that almost entire absence of risk to principal and interest represented by a high-grade, first-mortgage railroad bond, where net income equals from two to six times first mortgage interest. In such cases the only risk taken is that the bond may have to be sold a few points under the purchase price.

B.—Addition to cover narrow market and lack of established sale price: In the case of non-listed bonds or small or comparatively small properties, even when the security is ample, a higher rate of interest must be paid, because, to effect a sale promptly, the price may have to be cut. Also, the bonds are not easily usable as collateral because of ignorance as to the price they would bring at forced sale.

C.—Addition to cover absence of surplus earnings: This term is used relatively, as, of course, entire absence of such earnings would render the bond entirely unsalable. What is meant is absence of sufficient surplus earnings to practically insure interest payments even should earnings shrink largely.

D.—Addition to cover inherent risks of the business and risks due to state of the art, etc.: In the water department this is placed at 1 per cent, the inherent risks being comparatively small, though contamination or inadequacy of supply might render this allowance inadequate.

In the gas department this is placed at 1½ per cent, to cover changes in manufacture or source of supply, danger of serious explosions, etc.

In the electric department this is placed at 5 per cent, during the first seven years, as the art of electric generation and distribution was then very new and subject to rapid changes—this rate being gradually reduced until it reaches 2 per cent, during the last six years, as considerable stability has lately been reached. There still remains, however, a very considerable probability of radical changes.

E.—Addition covering risks of short-time and non-exclusive franchises: In the water department no addition has been made under this head, the franchise being exclusive and for a long and renewable term.

In the gas department it has been placed at ½ per cent, the original franchise being for only 15 years and the renewal for 20, neither being exclusive. This addition is considered canceled on capital raised in 1907 and subsequent years, on account of exchange of franchise for indeterminate permit.

In the electric department this addition has been placed at 1 per cent, owing to the greater probability of competition than existed in the case of the gas plant, due in part to physical differences, in part to local conditions and in part to the statute law. As in the gas department—and for the same cause—this addition has been canceled, beginning with 1907. The full deduction may, however, be questionable, owing to doubt as to the exact status and permanency of the law in question.

F.—Additional returns to cover community hazards: Owing to the almost negligible scrap value of public investments, the status of the community at the dates on which capital is secured very largely influences the rate of return required to secure the same. In the case of cities of 75,000 population, or over, this hazard practically disappears, under ordinary conditions, as cities of this size almost never go backward, or even stand still. With young and small places, however, the risks under this head are large, and in the place referred to, from 1890 to 1900, they were probably as great as are often encountered. The great area of the city, with its six or seven widely separated communities—each of which, in itself, was much spread out—would alone make the community hazard great, to say nothing of the mushroom growth of the boom days, with the accompanying demands on the company to lay mains in advance of paving and for extensions to supply new industries and widely separated districts.

GENERAL ARTICLES

Tunnel Driving Using Tripod Drills and Supplementary Side Cut.

The interesting arrangement of drill holes and the firing procedure illustrated by the accompanying diagram was used in a 9x8 ft. mine tunnel at Mineville, N. Y. The material is hard granitic gneiss with hard magnetite. The tunnel driving is described as follows in "Engineering and Mining Journal" by Mr. T. V. K. Swift:

Two Ingersoll-Rand C-100, butterfly-valve, 2¾-in. machines, mounted on tripods of the Rand type, are used to drill the face and are operated by a drill runner and helper for each drill. The face is carried 7 ft. wide and 8 ft. high and a third machine is employed to follow up these two heading machines and bring the tunnel to the proper width of 9 ft. This machine is not run steadily. During one month it was capable of doing its work in an average of two shifts per week. This method is found to be quite advantageous over the method of carrying the face to the full width of 9 ft. as the tunnel advances, for this third or "trimming" machine can put in long side holes and break the ground more efficiently than if the holes are put alongside the other breast holes. This widening by the third machine is done on whichever side of the tunnel has the sharpest curvature, thus tending to ease the curves somewhat as the tunnel follows the ore.

Sixteen holes are needed to break the 7x8 ft. section. These holes average 4½ ft. in depth. Repeated efforts with deeper holes showed it to be impossible to break them to their full depth. The round is drilled approximately as indicated in the accompanying drawing, the dotted lines showing the work done by the trimming machine, whose 8 or 10 ft. holes it is easy to bring because of the free side-face to break to. Much difficulty is experienced in drilling this hard rock and it often requires two or three starters and generally more than one second drill on each hard "upper." This round is drilled and fired once every 10-hour shift, and although the footage per drill may seem low, it is, nevertheless, a good shift's work, considering the unusual nature of the ground. Tripods are used simply because the nature of the work in other parts of the mine is not suitable for a column or bar and neither of these rigs is included in the mine equipment. One setup is generally sufficient to allow each machineman to drill his half of the round. A hitch is cut in the floor with a piece of hand steel for the point of the forward leg to rest in, a wooden block is buried in the muck as a foundation for the hind leg and the third or outside leg is thrown up against the side wall and does not rest in any hitch, thus leaving the whole rig free to be moved out of line, if necessary, when changing steel. Eight cut holes for the vertical cut are drilled and are bottomed as nearly as possible in pairs, *A* with *A'*, *B* with *B'*, etc. Outside of these, eight side holes are drilled to break even with the bottoms of the cut holes. Each machine is started on the top holes and lowered as the holes are drilled, one setup being sufficient for each machine with the necessary swinging of the machines in the saddles and adjustments of tripod legs. An air pressure of 60 to 70 lbs. is maintained at the face.

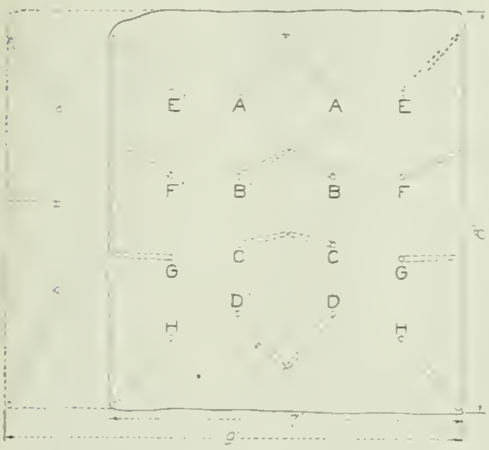

Fig. 1—Arrangement of Drill Holes in Driving 9x8-ft. Rock Tunnel.

TABLE I.—TUNNELING COSTS FOR MONTH OF OCTOBER, 1912.

Footage, 116.5 ft.

		Cost per ft.
Labor:		
Drill runners, $250	$ 280.50	......
Dril helpers at $1.95	218.78	......
Total drilling	$ 499.28	$ 4.29
Muckers at $1.95	149.77	1.29
Total	$ 649.05	$ 5.58
Supplies:		
Powder	$ 285.97	......
Caps	5.07	......
Fuse	14.41	......
Total	$ 305.45	$ 2.62
Miscellaneous:		
Air, 112 machine shifts at $1.50	$ 168.00	$ 1.44
Drill sharpening, 112 shifts at $0.20	22.40	0.19
⅓ foreman's time at $3.05	54.90	0.47
⅓ powder monkey's time at $2.50	45.00	0.39
Total	$1,244.80	$10.68

Note.—Air and drill-sharpening costs are figured from the average cost per machine shift for the seven preceding months.

Du Pont 60 per cent gelatin dynamite is used in all cut holes and du Pont 45 per cent gelatin dynamite is used in side holes, which are not too heavy, all sticks being split and thoroughly tamped as they are put in the hole. All holes are fired with du Pont No. 6 blasting caps and du Pont double tape white fuse. In all cases the primer is put in the hole next to the last, with one stick on top of it, and all holes are thoroughly tamped with fine wet ore in standard du Pont paper bags. Holes *A, A', B B' and C C'* are spit first and as nearly simultaneously as possible. *E E', F F'* and *G G* with fuses cut 4 ins. longer are spit next and the lifters *D D'* and *H H'* with fuses 4 ins. longer than the side holes are spit last in order to throw the muck back as far as possible from the face. It requires two men to light these holes properly. All powder is prepared and all holes are loaded and spit by the regular mine powder-monkey with the help of one of the machinemen.

All mucking, tramming and track laying is done by three muckers who work half a shift only and are then moved to some other part of the mine. At the beginning of each shift these men are sent directly to the face and muck back sufficiently for the machines to be set up while the machinemen are assembling their rigs, connecting hose, etc. Permanent 45-lb. rails in 30-ft. lengths are laid on 4-in. ties as the tunnel advances. Two sets of 15-ft. 45-lb. rails and one set of 5-ft. 45-lb. rails are used temporarily to keep the track as close to the face as possible. Koppel 2½ ton, 22 cu. ft. capacity cars are used and are trammed to a side track, where an electric locomotive hauls them to the portal of the tunnel. Shorthandled shovels and no muck plates are used.

Detailed costs for the month of October, 1912, are given in Table I. This is not phenomenally cheap or rapid driving, but under the unusually disadvantageous conditions, especially the hard formations, it was considered satisfactory.

Drilling and Blasting Methods in Sinking a Shaft Through Rock in the Lake Superior Copper District.

The accompanying sketch showing an arrangement of drill holes for shaft sinking is redrawn from an article by Claude T. Rice in "Engineering and Mining Journal" for April 19, 1913.

The shaft was started Dec. 12, 1906, and was 3,193 ft. deep Jan. 1, 1912. Frozen ground and other disadvantages attending the starting of a shaft in winter delayed the sinking. The shaft was 1,435 ft. deep Jan. 1, 1909, and one station had been cut at a depth of 1,200 ft. By Jan. 1, 1911, the shaft was 2,668 ft. deep, and stations had been cut on the 1,500, 1,800 and 2,570 ft. levels. The average monthly progress was 81 ft. when shaft sinking could be continued without interference from other work.

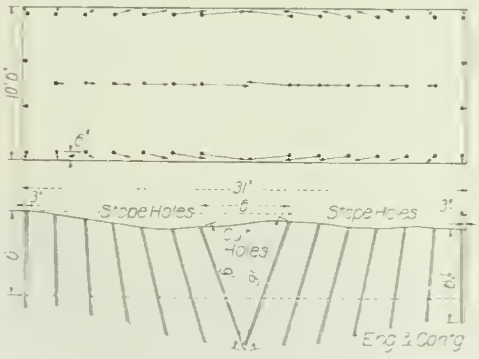

Fig. 1—Arrangement of Drill Holes in Sinking a Deep Vertical Mine Shaft.

The shaft work requires underground three shifts of six miners each, two shifts of seven muckers each, and two shifts of three landers each, at the 34th level station, while on surface there are two shifts of a hoisting engineer and helper each. A leading miner on each shift looks after the work in the shaft when the shift boss is in another part of the mine.

Three machines are used on a bar about 10 ft. long. The three machines are kept running most all the time that the bottom is being cleared, while a spare machine is kept set up on another bar so that it can be run as soon as the bottom is cleaned enough. In this way four machines are run part of the time, while the three regular machines run about 15 hours out of the 24. A regular shaft bar with a single crew at the end is used. The machines are all rigged on arms, and on each arm is a collar carrying a leg to steady the bar under the hammer of the three machines, which would otherwise make it difficult to keep the bar tight.

The shaft makes but little water, and all of it is hoisted in the bucket with the muck. A 6-in. air main is carried down the shaft, reduced to 4 ins. at the bottom. From this 4-in. pipe a ¾-in. nipple is tapped off for each machine as well as for a blowpipe that is kept handy all the time for blowing out the holes when they do not mud properly. The air pressure is 80 lbs. per square inch, and 3⅛-in. machines having a Rand valve with Ingersoll back-head and rotation are used. Cross bits are used on all except the 10-ft. drills, all of which and a few of the 8-ft. drills are made with a chisel bit.

The round is usually broken with from 40 to 44 holes, as shown in Fig. 1. The shaft is broken, 10½x31 ft., so as to leave plenty of room for the timbers without any pop shots being required at the sides. A V-cut is taken a little to one side of center, and wherever is the deepest part of the shaft. The cut is alternated from one side to the other.

Comparative Tests of Slag and Stone Concretes.

Blast furnace slag offers an aggregate for concrete which has several merits. The slag has in itself cementing properties of no mean proportions; it breaks up into unusually good forms; it has a porous texture which helps the bond of cement and aggregate, and in many

TABLE I.—TESTS SHOWING COMPARATIVE TENSILE STRENGTH OF SLAG AND STONE CONCRETE.

(Made by Prof. R. H. Fernald of Case School of Applied Science.)

No.	Mixture.	Dimensions, ins.	Lbs. per sq. ft.
	Stone Concrete.		
49	1 pt. Atlas cement	16x12x6.4	12,630
50	2 pt. sand	16x12x6.4	12,750
51	4 pt. broken stone	16x12x6.3	12,530
52	(1 in. screened)	16x12x6.35	12,000
	Average		12,477
	Slag Concrete.		
37	1 pt. Atlas cement	16x12x6.3	16,050
38	2 pt. slag dust	16x12x6.2	15,400
39	4 pt. crushed slag	16x12x6.3	15,850
40	(1 in. screened)	16x12x6.35	16,850
	Average		16,037
	Stone Concrete.		
53	1 pt. Vulcan cement	16x12x6.4	12,930
54	2 pt. sand	16x12x6.4	13,850
55	4 pt. broken stone	16x12x6.29	14,830
56	(1 in. screened)	16x12x6.26	14,330
	Average		13,985
	Slag Concrete.		
41	1 pt. Vulcan cement	16x12x6.23	18,450
42	2 pt. slag dust	16x12x6.23	15,520
43	4 pt. crushed slag	16x12x6.41	14,980
43	(1 in. screened)	16x12x6.34	17,330
	Average		16,570

These tests show slag concrete to be from 18.47% to 28.5% stronger than blue stone under like conditions.

TABLE II.—TEST PERFORMED BY ROBERT W. HUNT & CO., ENGINEERS, CHICAGO, ILL.

Thirty-day-old cubes composed of 1 part Universal cement (Portland), 2½ parts cleaned coarse sand and 5 parts ¼ to 1¼-in. crushed furnace slag.

No.	Dimensions.	Area. sq. ins.	Maximum load.	Crushing strength. Lbs. per sq. in.
9	6x6 ins.	36	95,450	2,653
10	6x6 ins.	36	95,200	2,644
11	6x6 ins.	36	88,300	2,453
12	6x6 ins.	36	95,920	2,664

Thirty-day-old cubes of 1 part Universal cement (Portland), 2½ parts clean, coarse sand, and 5 parts ¼ to 1¼-in. crushed limestone.

No.	Dimensions.	Area, sq. ins.	Maximum load.	Crushing strength. Lbs. per sq. in.
17	6x6 ins.	36	85,760	2,382
18	6x6 ins.	36	77,230	2,145
19	6x6 ins.	36	83,900	2,330
20	6x6 ins.	36	84,930	2,359

Average crushing strength slag cubes (¼ to 1¼-in.), 30 days old..........2,603.5
Average crushing strength limestone cubes (¼ to 1¼-in.), 30 days old...2,304

localities it is plentiful and cheap. In the following tables, taken from the "Cornell Civil Engineer" for April, 1913, there are given the results of several comparative strength tests of slag concrete and stone concrete.

Properly prepared slag should have a minimum of cell holes, should be hard and amorphous; sharp and angular. This angularity and surface cell structure lends itself favorably to concrete, the cement gets a firmer hold as there are no smooth surfaces on the slag. It has no cleavage directions and will not split, as most all stone will. In all classes and kinds of concrete reinforced or otherwise, slag has proven to be above the average aggregate, not only from the standpoint of its strength, but it is lighter per cubic foot, as the tests show, and is an absolutely fireproof material.

TABLE III.—AVERAGE RESULTS OF CRUSHING TESTS MADE ON 6-IN. CONCRETE CUBES BY CROWELL & PECK, ENGINEERING CONTRACTORS, OF CLEVELAND, O.

Age, 36 Days.

A Cubes—Parts by volume:
- 1 part Penn Allen cement.
- 2 parts bank sand (very good).
- 2 parts slag (1-in. screening).
    - Average lbs. per sq. in., 2,790.
    - Average weight, 15 lbs. 15 ozs.

D Cubes—Parts by volume:
- 1 part Penn Allen cement.
- 2 parts bank sand (very good).
- 4 parts limestone (crusher run).
    - Average lbs. per sq. in., 1,782.
    - Average weight, 17 lbs. 5 ozs.

Each result is the average of three cubes.
Showing slag concrete 36% stronger and 8% lighter.

Slag was used as the aggregate for the concrete in the subway structures of the Philadelphia Rapid Transit Co., the Rocky River bridge, Rocky River, Ohio, which is one of the largest concrete spans in the country, and in several of the largest buildings in Cleveland, Ohio, among which are the Tidewater Bldg., the Engineers' Bldg., and the New Kinney & Levan Bldg., which has just been completed and has a floor space of over eight acres.

An Air Dump Car for Steam Shovel Work.

(Staff Article.)

The train of dump cars shown by Fig. 1 can, from the locomotive or from any car, be dumped all cars right or all left, or half the cars right and half left or alternate cars right and left. One operator controls the dumping operation and also the righting and locking operation which makes the train ready for a new load. Both operations are performed by means of a compressed air dumping mechanism on each car and connected from car to car to the locomotive by air hose couplings. Figure 2 gives a general idea of the car dumping mechanism which we shall describe in detail in a succeeding article by means of lettered drawings. Here we shall note only the general operating features of the mechanism, prefacing this outline with the statement that each operation requires 10 seconds, that is, the car can be dumped in 10 seconds and righted and locked in another 10 seconds, making a total of 20 seconds.

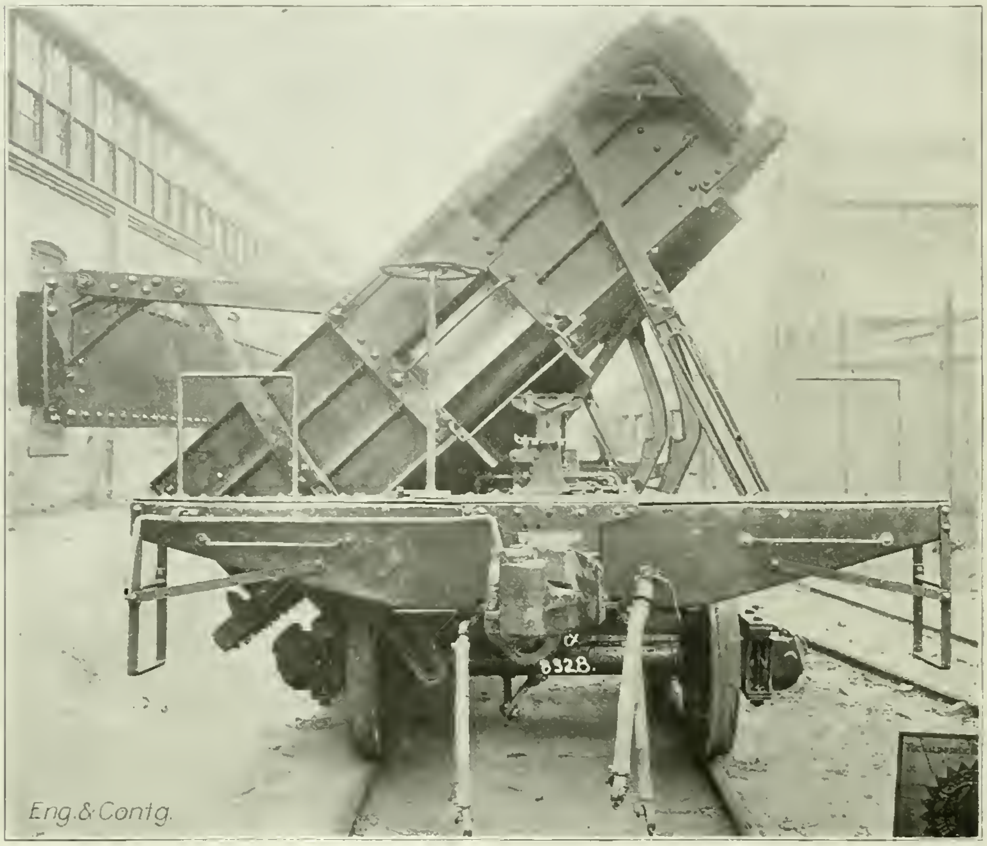

Fig. 2—End View of Automatic Air Dump 16-cu. yd. Car.

Both dumping and righting are positive operations; the car is dumped by a piston on one side and righted by a piston on the opposite side and since the cylinders, pistons and dumping mechanism are the same on each side and are separate, either set can be used for dumping or for righting. The cylinders receive air from a cylindrical storage reservoir underneath and between the car draft sills. This reservoir is charged from the air brake train line; a check valve prevents back pressure and when the car is uncoupled holds the reservoir full under pressure, so that the car can be dumped when disconnected from the air line.

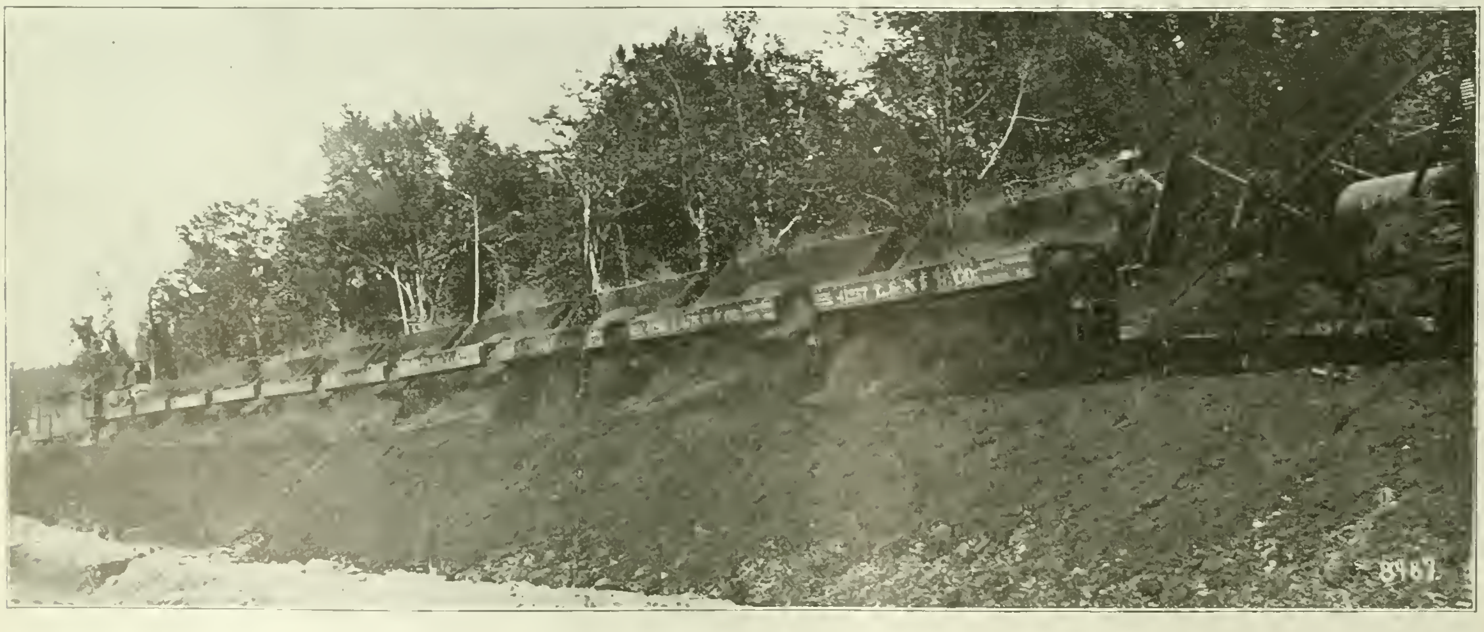

Fig. 1—Train of Automatic Air Dump 16-cu. yd. Cars Discharging Its Load.

Each cylinder is charged through a vertical valve situated on its side and controlling and regulating the passage of air from the reservoir to the cylinder. An independent operating pipe, fed from the reservoir, extends along underneath the car, having a port into this valve. To operate the cylinder it is only necessary to charge this pipe, this pressure opening the valve and allowing air to pass from the reservoir into the cylinder and operate the car. An automatic cut-off actuated by the piston, closes the valve and cuts off the air supply from the cylinder, when the exact amount of air required to do the work has been admitted.

The position of the car when dumping is clearly indicated by Fig. 2. The angle of dump is 44°. The movement of the side door begins as soon as the car body is appreciably tipped. The width of opening is indicated by the picture and since the door is hinged to its supporting arms it can swing out when struck by the sliding load to a position in line with the arms. The solid construction of the door enables it to withstand hard knocks and to keep its alinement and surface; it is a box girder formed by one flat and one U-shaped steel plate braced apart by channel separators and riveted together around the edges. Except its floor, which is of hard wood the entire car body is of steel; the sills, two center and two side sills, are steel angles.

The underframe is of steel and carries Westinghouse air brakes, M. C. B. couplers, hand brakes and the trucks and all other parts conform to the M. C. B. standards. This construction fits the car for main line hauling of any kind within its capacity of 60,000 lbs. The car weighs 40,000 lbs., has a clear height of 7 ft. 9½ ins., a clear width of 10½ ft., and a length between draw bar knuckles of 30 ft. 4¼ ins. The inside dimensions of the body are 24x9x2 ft., giving a capacity of 16 cu. yds. level full; this ordinary heaped load capacity is 23 cu. yds.

This air dump car is manufactured by the Kilbourne & Jacobs Mfg. Co., of Columbus, Ohio, to whom we are indebted for the data from which this description has been prepared.

Effect of Stone Dust on the Compressive Strength of Concrete.

There are obvious advantages in using run of crushed stone for concrete instead of screened stone and sand so long as the point is not passed where the stone dust begins to injure the strength of the concrete. This point was determined, at least for the specific stone tested, by tests made in 1911-12 at the Nova Scotia Technical College, Halifax, N. S., and described in the "Cornell Civil Engineer" for April, 1913, by Frances Dawson.

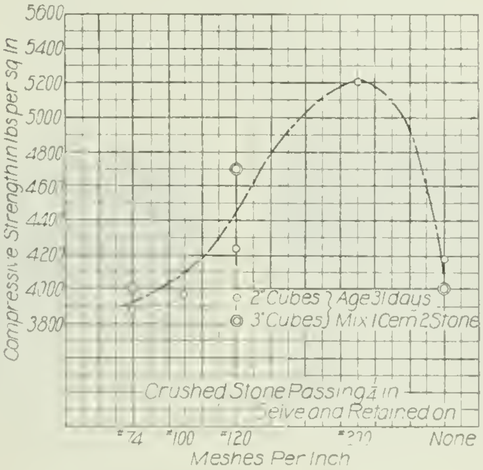

Diagram Showing Relation Between Compressive Strength of Concrete Cubes and Amount of Fine Dust in the Aggregate.

The rock was a variety of quartzite commonly known as "Whin," with a specific gravity of 2.72. The appearance of the finer dust which came from the crushing was by itself almost identical with white Portland cement, in fact strangers thought that which passed through the No. 200 sieve was cement. Some of this was mixed with water and molded like cement briquettes. When dry they were taken out and handled. Though quite soft, they looked like cement briquettes, but on being placed in still water they slowly crumbled away. The broken stone was separated at the crusher plant by a revolving screen into three sizes, less than ¼ in., ¼ in to ¾ in. and ¾ in. to 2½ inch. If the stone which passed the ¼ screen could be used as part of the finer portion of the aggregate a considerable saving would result.

The tests were made on 2 and 3 in. cubes, and in the series being considered had for their purpose to show the dividing line between where the fine material was beneficial, and where it became harmful. In this series fine material was screened out through the various sieves from the No. 74 up to and including the No. 200.

ROADS AND STREETS

The Rock Asphalt Pavements of Lawton, Okla.

Contributed by Frank B. King, City Engineer, Lawton.

Although rock asphalt has been extensively used for paving purposes in Europe, it seems to have been limited to a small area in this country, owing perhaps to the expense of shipping the material for any considerable distance, it having been cheaper to ship the refined asphalt and mix it with sand procured locally.

At the time paving was first agitated here in 1908, a committee of the council visited several cities to investigate the paving question, and as a result bids were asked for the laying of about 134,000 sq. yds. of pavement. Bids were requested on the following materials, all to carry a five year guarantee:

Sheet asphalt, Arkansas rock asphalt, Oklahoma rock asphalt with concrete base, Oklahoma rock asphalt with asphalt base, bitulithic with concrete base, bitulithic with bituminous base, brick and macadam.

The bid was accepted for sheet asphalt, but as there was a case pending in the Supreme Court to determine whether a city had the right to advertise for different kinds of pavement, it was agreed that in case the decision was adverse the contract should be without force or effect. Court proceedings held the matter up until the decision was handed down and, as it decided that the material should be selected before bids were asker for, a new start was made. The paving fever had subsided somewhat, however, and only about 26,000 sq. yds. were advertised to start with.

Owing to the belief that rock asphalt could be found in sufficient quantities in this country to pave the streets and the desire to use local material when possible the rock asphalt was adopted. This material for wearing surface was not altogether an experiment as the city of Ardmore, Okla., had been using a pavement of rock asphalt on a concrete base for some time and had found it satisfactory. As our streets, when dry, were as hard as a pavement it was believed that a further use could be made of the rock asphalt as a base and avoid the use of concrete, and accordingly the specifications were drawn as follows:

OKLAHOMA NATURAL ROCK ASPHALT BASE.

Over the sub-grade, which shall be first carefully rolled and compacted, shall be spread Oklahoma natural rock asphalt, which, after ultimate compression, shall be 2 ins. thick. The material shall be crushed so that the particles shall vary from that of sand grains to pieces that will pass through a 2-in. ring, sufficient of the finer material being present to fill all voids and make a perfect bond.

This course shall be evenly spread (cold) and shall be compacted with a steam roller having a weight of not less than 6 tons, and said rolling shall continue until in the opinion of the engineer no voids remain and the sheet is compact.

Over the first course shall be spread another similar course (cold or hot), which shall be spread, rolled and treated in a like manner.

On the foundation prepared as aforesaid (which shall be 4 ins. thick after ultimate compression) shall be laid the Oklahoma natural rock asphalt, pavement or wearing surface, proper, which shall be prepared of the material mixed and laid in the manner hereinafter specified.

OKLAHOMA NATURAL ROCK ASPHALT PAVEMENT, WEARING SURFACE.

The natural rock asphalt used in preparing this pavement shall be of the best grade of Oklahoma natural rock asphalt produced from the deposits of the State of Oklahoma and shall be prepared and laid in the following manner:

The lumps of rock, after being mixed in the proper proportions, shall be finely crushed and pulverized, and the powder passed through a 10-mesh screen. In case of the use of any asphaltic limestone or a mixture of an asphaltic limestone and an asphaltic sandstone, additional asphaltic powder, if required, may be added as herein provided. Should it be proposed to use an asphaltic sandstone only, which contains more than 10 per cent of natural bitumen, of such consistency that the resulting pavement would prove too soft to sustain traffic, the material, if satisfactory in other respects, shall be made to conform with the other provisions hereinafter contained, by the addition of Portland cement, but the resulting aggregate shall contain not less than 10 per cent of bitumen soluble in bisulphide of carbon.

If the powdered rock asphalt should contain less than 10 per cent of bitumen soluble in carbon bisulphide, sufficient other asphaltum may be added to give the mixture the desired percentage. Such asphaltum shall be a mineral bitumen, liquid or solid, which is adhesive, viscous and malleable, which is pliable at a temperature of 32° F. It shall have a melting point of from 170 to 220° F. and a penetration of from 35 to 50 M. (Dow).

The Oklahoma natural rock asphalt herein above specified shall be heated and mixed in a suitable batch mixing device that will thoroughly and evenly heat and distribute the bitumen throughout the entire mass and produce a uniform mixture without overheating the bitumen. The entire mixture shall be heated to from 250 to 300° F., when the heat shall be shut off and the mixture be mechanically stirred and cooked together for at least 5 minutes to produce a thoroughly homogeneous mass.

Fig. 1—Surface Material at Crushing Plant.

The Oklahoma natural rock asphalt mixture above specified shall be hauled to the street to be paved in wagons or carts, and be dumped onto the foundation specified hereinabove and be spread by means of hot steel rakes or shovels in a manner to produce, when thoroughly compressed, a thickness of 2 ins. The compression shall be produced by tamping and rolling with a steam roller weighing at least 12,000 to 16,000 lbs., and which will give a compression of at least 250 lbs. per inch run of roller, the rolling to be continued until the pavement shall be thoroughly compressed to the satisfaction of the engineer in charge.

The finished surface of the pavement shall be true and even, without waves or depression that will exceed ¼ of an inch when tested with a 4-ft. straight edge. After rolling the surface to a true grade there shall be swept over the surface enough hydraulic or natural cement to coat the entire surface. The rolling shall be continued until the pavement has received its ultimate compression to the satisfaction of the engineer in charge.

Work on this contract was started Jan. 1, 1909, and it was soon found that suitable asphalt in sufficient quantities could not be obtained from the known local deposits and thereafter the material was shipped from Ada, Okla.

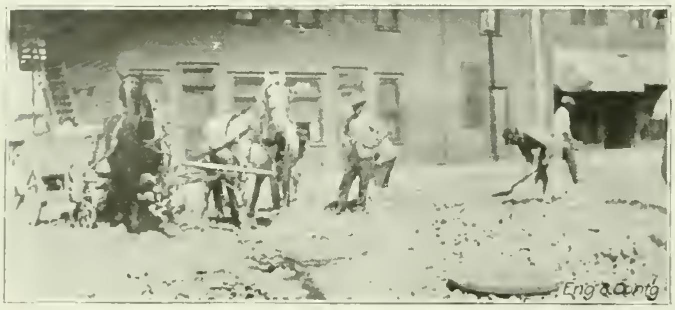

Fig. 2—Spreading Rock Asphalt for Pavement Base.

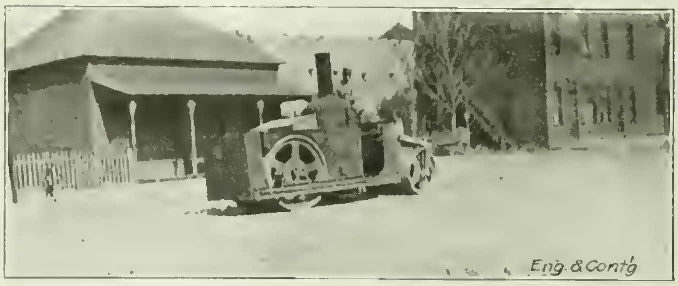

Fig. 3—Rolling Rock Asphalt Pavement Base.

The specifications as above set forth were followed except as noted. An attempt was made to lay the second course of base but as the heating drum was a continuous heater and not suitable for coarse material this practice was abandoned. The top was not screened as it was found that particles up to ½ in. in size were not detrimental to the work, also no means were at hand to measure the heat and this became a matter of judgment on the part of the man at the plant and the inspector on the street. Large numbers of samples were taken and analyzed by the contractor to determine the bitumen and lime content, but it was soon found that the analyses of small samples gave but little information as to the character of the whole. The material was shipped in chunks of about 1 cu. ft., broken and ground here. The mix was made at the crusher. In this way a very uniform product was obtained and very little patching was necessary.

Each block was opened to traffic in from 6 to 10 days after laying and although the shoes of horses cut it somewhat at first it became better with use and after four years of service this pavement looks and wears better than when first laid. It resists the heat of summer and the cold of winter better than sheet asphalt and shows no unsightly cracks. Practically all defects show us within two weeks after traffic is put on the street and the remainder seems to get better with time.

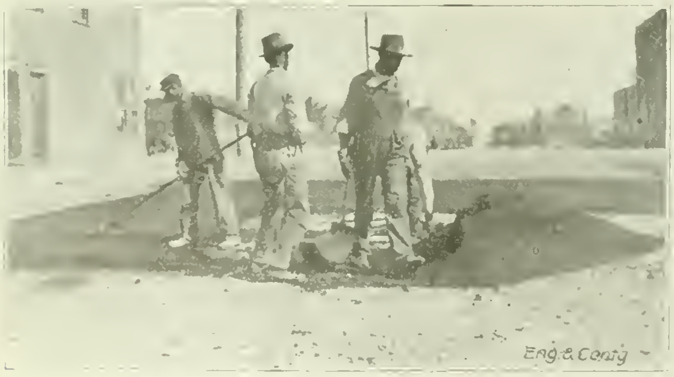

Fig. 4—Laying Wearing Surface of Rock Asphalt Pavement.

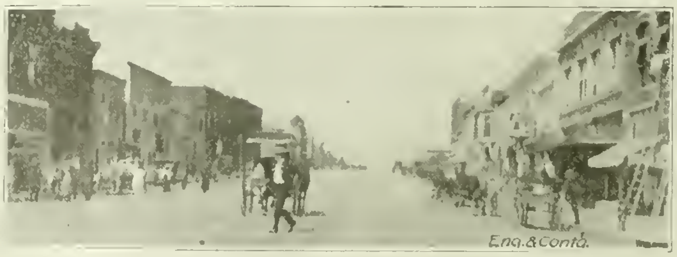

Fig. 5—View of Rock Asphalt Pavement at Lawton After Four Years' Service.

This paving was let at a cost of $1.85 per square yard exclusive of grading, curbing, guttering, etc. Before the completion of the contract in May, 1909, an additional 8,000 yds. were let, making a continuation of the same street (D Ave.), bringing the length of paved street up to one mile.

On May 26, 1909, a further contract was let for one mile of pavement on F Ave., 33,000 sq. yds. and one mile on C Ave., 33,300 sq. yds., at $1.85 per square yard, and these streets were completed in November, 1910, in the order named. The satisfaction given by this pavement was such that early in 1911 the paving of about four miles of cross streets, amounting to about 70,000 sq. yds., was petitioned for. This contract was let in April of the same year for $1.69 per square yard not including grading.

The specifications for this work were much the same as the other except that it was required that material for base should have not less than 3 per cent nor more than 7 per cent bitumen and that the top should have between 8 and 12 per cent bitumen, also that 8 and 2½-ton rollers should be used. The contract was held up by court proceedings so that work was not started until March, 1912.

Some time previous to the letting of this work another local mine was opened up and this material has been used for base for the most part and although some top material has been delivered at the plant, that used heretofore has come from Ada, Okla. The chief trouble with this base has been the length of time necessary for it to dry after being wet.

The original supposition was that this base material would unite into a solid mass but its condition where the top has been cut does not bear this out and there is no reason to believe but that broken stone would have done as well.

This last contract is about half completed at the present time. The material from the local mine costs $2.50 per ton for base crushed and delivered on the street, making a wagon haul of nearly three miles. The top is delivered at the plant in chunks at $3.25 per ton. Labor has been $2 per day of eight hours at all times while a team and driver were paid $4 per day of eight hours.

Two-story buildings 25x70 ft. in size have been moved over this pavement on truck wheels of not over 12-in. face without damage to the pavement, and about April 12 a wagon loaded with 100 bags of cement was hauled over this pavement and allowed to stand in front of a hardware store nearly all day. The tires of this wagon were only 1¾-in. wide, but it scarcely left a track. This test was made to show the strength of the wagon but it was also a severe test for an asphalt pavement. No attempt has been made to prevent anything passing over this pavement, therefore traction engines and ditching machines have used it freely.

There have been no repairs made on the original work up to this time although there is perhaps 100 sq. yds., or 1/10 of 1 per cent, in need of more or less repair that will be attended to soon.

The writer was not appointed engineer until just before work was started on the present contract and can therefore claim no credit for the good or bad quality of the specifications, but it must be admitted that the results obtained have been very satisfactory considering the fact that means of making proper tests have been entirely lacking.

Cost of Street Cleaning at Spokane, Wash., in 1912.

(Staff Article.)

In common with all other cities, Spokane, Wash., finds that the problem of thoroughly cleaning the paved area at a minimum cost presents more difficulties than any other phase of municipal activity. The experience in this city has indicated that flushing is the best method, but owing to freezing weather this method can be used only approximately 6½ months per year. For the remainder of the year it is necessary to resort to sweeping with horse drawn brooms. In following the latter method in frosty weather it is desirable to use as little water as necessary in order to avoid making the paving slippery. On the other hand, this procedure results in many complaints from pedestrians and shop keepers because of insufficient sprinkling. With the hope of meeting the objections of both team owners and shop keepers the Department of Public Works of Spokane early last year purchased a motor driven street cleaning machine which sprinkled, swept and picked up the sweepings in one operation.

The following tabulation gives general figures on the cost of street cleaning for the years 1910, 1911 and 1912:

		Years.	Ins.
	1910.	1911.	1912.
Total area of district kept clean, sq. yds.	653,945	1,113.675	1,489,720
Appropriations	$63,069	$75,295	$95,163
Expended	62,955	74,385	69,533
Cost per 1,000 yds. to keep clean	96.25	66.79	46.68
Percentage increase yardage from 1910	.....	70.29	127.80
Percentage increase yardage annually.	.....	70.29	33.77
Percentage decrease cost per yard since 1910	.....	30.61	51.50
Percentage decrease cost per yard annually	.....	30.61	30.11

In compiling cost data for 1912 it was found that the business district covers an area of 206,008 sq. yds. and that the cost per year for keeping this district clean was $97.21 per 1,000 sq. yds. The high cost of keeping this district clean is on account of it being necessary to cover the district a greater number of times during the year than is required to keep the residence district cleaned. The residence district, therefore, brings the total average cost of keeping the paved section of the city clean down to $46.68 per 1,000 sq. yds., as shown in the above table.

Owing to the great increase in paved area, the problem of cost has been a most important one. By references to the table shown above it will be seen that while in 1910 the cost of cleaning was $96.25 per 1,000 sq. yds., this cleaning was done in 1911 for $66.79 and in 1912 for $46.68 per 1,000 sq. yds. A large part of this saving is ascribed to systematizing the work and through the medium of daily reports keeping in close touch with the operations.

The area of streets cleaned and method of cleaning in 1912 were as follows:

	Sq. yds.
Cleaned by sweepers and flushers	1,283,713
Cleaned by white wings (hand cleaning)	206,008
Total area cleaned	1,489,721
Area cleaned by sweepers 6½ months	1,283,713
Area cleaned by sweepers 5½ months	477,584
Area cleaned by flushers 5½ months	806,129
Amount of debris removed (cu. yds.)	10,445

The area swept once by horsepower sweepers amounted to 100,785,638 sq. yds., the cost of this being as follows:

		Per 1,000 sq. yds. cleaned once.
Sweeping:		
Hired teams and teamsters	$ 9,226.90	
Use of city teams	806.80	
Total	$10,033.70	$0.09955
Pilers	9,954.60	.09885
Pick-up:		
Hired teams and teamsters	5,418.75	
Use of city teams	628.80	
Auto truck drivers and helpers	2,276.03	
Auto truck rental (city)	2,231.70	
Total	$10,555.38	.1047
Sprinklers:		
Hired teams and teamsters	2,090.00	
Use of city teams	3.75	
Total	$ 2,093.75	.020776
Maintenance sweepers:		
Labor	304.85	
Material	825.42	
Total	$ 1,130.27	.011215
Grand totals, horse sweeping	$33,767.70	$0.335

A gasoline power sweeper was used as an experiment, the total area covered once by this machine amounting to 6,090,518 sq. yds. The cost of sweeping was as follows:

		Per 1,000 sq. yds. cleaned once.
Sweeping:		
Operators and helpers	$ 420.00	$0.06896
Pilers	485.25	.079672
Pick-up:		
Hired teams and teamsters	18.00	
Use of city teams	10.50	
Auto truck driver and helpers	195.07	
Auto truck rental (city)	164.75	
Total	$ 388.32	.06375
Maintenance sweeper:		
Labor	311.83	
Gasoline	145.00	
Oil	19.36	
Repairs	247.85	
Total	$ 724.04	.10250
Grand total, auto sweeping	$2,017.61	$0.3149

Since cleaning 1,283,713 sq. yds. for 6½ months and 477,584 sq. yds. for 5½ months involved sweeping with horse and auto power sweepers a total area of 106,876,156 sq. yds., this district was covered 110 times during the year at an average cost of $36.89 per 1,000 sq. yds., or a total cost of $35,785.31.

The area cared for by flushers for 5½ months amounted to 806,129 sq. yds., equivalent to an area of 70,381,682 sq. yds. flushed once. The cost of this method of cleaning was:

		Per 1,000 sq. yds. cleaned once.
Flushing:		
Hired teams and teamsters	$ 8,459.51	
Use of city teams	950.50	
Total	$ 9,410.01	$0.1336
Pilers	9,052.23	.1286
Pick-up:		
Hired teams and teamsters	1,415.50	
Use of city teams	840.75	
Total	$ 2,256.25	.03206
Maintenance flushers:		
Labor	114.67	
Material	127.34	
Total	$ 242.01	.003438
Grand total, flushing	$20,960.50	$0.2977

On a square yard basis the cost of flushing figures out as follows:

		Per sq. yd.
Flushing	$ 9,410.01	$0.01167
Pilers	9,052,23	.01123
Pick-up	2,256.25	.002799
Maintenance	242.01	.0003002
Total	$20,960.50	$0.0259992

Since cleaning 806,129 sq. yds. involved flushing an area of 70,381,682 sq. yds., this district was covered 87.31 times during 5½ months at a cost of $26 per 1,000 sq. yds., or $20,960.50.

The business district of the city covers an area of 206,008 sq. yds., which was cared for by the white wings. The total area cleaned once amounts to 63,886,054 sq. yds., the cost of cleaning being as follows:

		Per 1,000 sq. yds. cleaned once.
Patrol	$17,528.49	$0.2744
Pick-up:		
Hired teams and teamsters	$ 1,486.50	
Use of city teams	596.50	
Auto truck driver and helpers	10.50	
Auto truck rental (city)	24.50	
Total	$ 2,118.00	.03316
Maintenance tools:		
Labor	200.33	
Material	178.85	
Total	$ 379.18	.005936
Grand total, hand cleaning	$20,025.67	$0.313496

On a square yard basis the costs were:

		Per sq. yd.
Patrol	$17,528.49	$0.08509
Pick-up	2,118.00	.01028
Maintenance	379.18	.00184
Totals	$20,025.67	$0.09721

Since caring for 206,008 sq. yds. by white wings involved cleaning an area of 63,886,054 sq. yds., this district was covered 310 times during the year at a cost of $97.21 per 1,000 sq. yds., or a total cost of $20,025.67.

The average unit cost per square yard of all street cleaning, according to the annual report of the Department of Public Works, from which these notes were taken, was as follows:

	Sq. yds.
Total area of paved street cleaned	1,489,721
Total area covered in cleaning	241,143,892

Cost of cleaning for 1912:

		Per sq. yd.
Cleaning	$68,037.33	$0.04567
Auto rental	2,420.95	.001625
Use of city teams	3,837.70	.002577
Maintenance of equipment and tools	2,475.50	.001662
Totals	$76,771.48	$0.051534

The total average cost of cleaning was $51.53 per 1,000 sq. yds.; total average cost to clean once was 31 cts. per 1,000 sq. yds.

The wage rates on which the above costs are based are as follows:

General foreman	$150.00 per mo.
Sub foreman	95.00 per mo.
Hired teams with teamsters	6.00 per day
Teamsters	3.00 per day
Use of city teams	1.50 per day
Laborers	3.00 per day
Rental city auto truck	7.00 per day
Truck driver and helpers	3.00 per day

National Association of Cement Users.—The tenth annual convention of the National Association of Cement Users will be held at Chicago, Ill., Feb. 16-20, 1914. Plans are under way for a suitable recognition of the tenth anniversary of the association. Mr. Edward E. Krauss is secretary.

Road Construction and Maintenance in the Philippines.

Since the American occupation of the Philippines steady progress has been made in opening up the country by the construction of roads and trails. On June 30 last there was in existence in all provinces 4,474 miles of roads. Of this total 1,140 miles were designated as first class roads, 1,338 miles as second class and 1,994 miles as third class.

It has long been recognized in the Islands that where there was much traffic the construction of gravel or broken stone surfaced roads was essential, as other types of road almost invariably became impassable after their first rainy season. The construction of macadam roads, however, is handicapped somewhat by the inferior rock available. Gravel taken from the river beds is generally abundant and cheap, and the greater part of the first class roads are gravel surfaced and up to a certain volume of traffic have proved satisfactory. It is anticipated that as traffic increases in the future it will become necessary to resurface many of these roads with 2 or 3 in. of broken stone. The expense of this will not be heavy, as the foundations of the road, structures, drainage, etc., are now complete, and all that will be necessary will be a top dressing of a more durable material than gravel. It is also anticipated that the use of bituminous and oil bound macadam roads will increase, particularly on those where there is heavy automobile traffic and on sections subjected to annual overflows.

Some excellent examples of bituminous macadam construction are already in service. The main trunk road running south from Manila was treated in 1912 at two separate points with heavy oil, the adjoining sections being left untreated, the object being to determine the value of oiling under Philippine conditions. The surfacing is two-course work with screenings on top rolled in place. The oiling cost $685.89 mile. Another excellent example of road construction on the Manila-South road is the section paralleling the shore of Manila Bay. On this section the surfacing is 6 ins. thick and 16.4 ft. wide. As is frequently necessary, the stone had to be brought a long distance; in this case 37 miles by railroad and 1.24 miles by team. The present traffic on the road is 1,600 vehicles per day and is rapidly increasing.

Two great trunk roads in Luzon running north and south from Manila are now under construction. The Manila-North road is to extend from the first mentioned city to Bangui at almost the extreme northern end of Luzon. A considerable portion of this road is now constructed as first-class road, and many new sections will be added during the coming dry season. Practically every section of this road leads through a country so productive that the local traffic alone would justify the construction. The completion of this road work as a great interprovincial project, with the construction of each local section as a link in a great chain, makes an appeal to public imagination which has materially aided in securing support for the same. The route through Neuva Ecija, in place of Pampanga and Tarlac, was adopted for the reason that the latter are served by a railroad, whereas the greater part of the eastern portion of the central plain of Luzon is not so served, and for that reason the construction of the Manila-North road through Nueva Ecija is more than justified from an economic and military point of view, particularly as there is little doubt that the construction of the Manila-North road will shortly be followed by the construction of another trunk road from Manila to Lingayen, through Pampanga and Tarlac. The Manila-North road will pass through the provinces of Rizal, Bulacan, Nueva Ecija, Pangasinan, Union, Ilocos Sur and Ilocos Norte, and eventually will form a continuous highway from the city of Manila to the plaza in Bangui. It will be constructed in sections by a combination of insular and provincial funds, and it is planned to make a first-class road from Manila to Laoag, and a second-class one from there on. The total distance will be about 369 miles.

The Manila-South road will eventually run from Manila to some point in the province of Sorsogon, at the extreme south end of the Island, a distance of about 300 miles. For some years to come, however, it will necessarily have to be considered as two sections—one from Manila to Gumaca, in Tayabas, and the other from Nueva Caceres, in Ambos Camarines, to Sorsogon. The construction of the road over the intervening mountains is a subject for the distant future, but one which will eventually be undertaken. There is now a road from Manila to Gumaca, a distance of 129 miles, open to wheeled traffic. There is already a through road from Nueva Caceres to Legaspi, in Albay, a distance of 64.5 miles. Investigations have been made in regard to the feasibility of an interprovincial road between the provinces of Sorsogon and Albay.

Two methods of road maintenance are employed: the road gang maintenance system and the isolated caminero system. By the latter method a roadman is permanently stationed every one or two kilometers and provided with a store of road mending material and tools, including a stone hammer, rake, hoe, shovel and barrow. At the end of June, 1912, 1,187 miles of road were under the isolated caminero system of maintenance. The average cost per mile for maintenance in this manner has been as follows: 1910, $459; 1911, $396; 1912, $374. About 1,450 miles of road were maintained by the gang system in 1912 at an average cost of about $115 per mile.

The violent storms and extraordinary rainfall of the islands, as well as the unstable formation of the hilly and mountainous country, make washouts and the other damages of frequent occurrence. In July of last year the Bued canyon, in which the Benguet road lies, was visited by an extraordinary storm, during which 46 ins. of rain fell in one day and 88 ins. in four days. This unprecedented rainfall falling on the bare, precipitous sides of the canyon, with its disintegrated and unstable geological formation, resulted in extensive damage to the road, although the upper half between Kilometer 17 and Banguio showed a stability not seen during previous floods. On the lower part of the road great destruction was caused by two slides at Kilometer 13, the contents of which were estimated at nearly 2,000,000 cu. yds. These two slides formed a natural dam 150 ft. high, impounding the water to that height. During the few hours of existence of this dam, gravel was deposited for a distance of several kilometers above the dam to a height of 40 and 50 ft. above the former roadbed. When the dam burst it let loose a flood, which swept down the canyon, tearing out the steel bridge at Kilometer 13 and the suspension bridge built at Camp One, by the railroad, and otherwise inflicting great damage all along the lower part of the road. As this was the only route to Baguio, this city was cut off from all communication for about eight days, at the end of which time engineers were first able to traverse the road and make an examination of it.

The reconstruction of the Benguet road at first seemed doubtful. The roadbed for several kilometers had disappeared under a vast deposit of gravel and boulders, and the location of a new road, higher up on the mountain side, was believed to be beyond the means of the government. Numerous schemes were taken under advisement by the authorities, and to the great satisfaction of all concerned eventually a contract was signed between the government and the railroad for the construction of a railroad into Baguio on the west side, leaving the coast at Aringay. It was evident, however, that adequate communication must be established with Baguio during the two to three years the railroad would be under construction. This was made possible by a tremendous rainfall in September, when 31 ins. of rain fell in 24 hours, which cut through the great gravel deposit and swept a large part of it away, making it possible to reconstruct a road more or less on the location of the old road in this section. The work of reopening the road was started in October and vigorously prosecuted to its completion. On Dec. 22, automobile trucks were able to travel the entire length of the road. The cost was about $50,000, and while the work in many places was cheap and unsubstantial, it served the purpose. The credit for the economy of the work and the remarkably short time in which it was accomplished is due to Mr. Will Arthur, who has been employed for many years on the road, and for his work in opening the road he was made superintendent of the same on the first of January, 1912. As soon as the road was opened, a tremendous traffic over it began, which was continued until July 1. In October traffic was maintained over the road with some minor interruptions in spite of the heavy rains. The total cost of all the work done on the road last year, including the repair of the damage from this unprecedented storm, was $122,500, which includes the payment of 8 per cent surcharge. The actual cost of the work itself was $117,124. During the past five years the cost of this road was least in 1908, when it cost $82,122. The highest year was 1910, when it cost $179,343. The average cost of the road for the past five years has been about $124,000, including contributions toward maintenance of the central organization of the Bureau of Public Works and including improvements as well as maintenance. With the opening of the railroad into Baguio the traffic on the road will drop off to such an extent that the cost of maintenance will be very much lessened, as a considerable portion of the maintenance is not due to floods, but to the wear and tear on the road surface and bridges from the exceedingly heavy traffic and to the necessity for rush work and expensive work to keep the road in condition for traffic during the rainy season. If it is deemed advisable to continue the maintenance of this road after the railroad reaches Baguio, it can be done at less expense than at the present time.

The Benguet road serves to connect Baguio with the nearest railroad. An automobile service for freight and passenger is maintained. During the year ending June 30, 1912, over 19,000 passengers were carried over this automobile line without accident or injury to any of them. In view of the conditions under which this automobile service is maintained, this result is considered remarkable, and may be attributed to the strict discipline maintained, and to following railroad practice in running automobiles in trains and regulating the traffic by a regular block system, with gates, gate keepers and telephones. The main reliance of the line is placed on 18 trucks, of which 17 were specially built by the De Dion Bouton firm for service on the Benquet road, and one by the same firm for use in Baguio as a bus. These have given splendid service, and leave nothing to be desired as passenger carriers. As freighters, however, they only carry 2 tons useful load, the design being limited to this load owing to the fact that at the time the cars were ordered, the weight limit of the bridges on the Benguet road was 6 tons, and the De Dion, with full load, driver, helpers, equipment, etc., weighed over 5 tons. The weight limit of the Benguet road bridges has since been increased to 8 tons. During the year 5,161 tons of 2,000 lbs. each were carried under the direction of the automobile line, for the greater part by the De Dion trucks, although a portion was conveyed by bull carts and mule teams. The total receipts of the line were $110,500, expenses $109,500. The expenses include the payment of an 8 per cent surcharge to the Bureau, but do not include depreciation or rolling stock, buildings or equipment.

The road work in the Philippines is under the direction of the Bureau of Public Works of the Department of Commerce and Labor. The material in this article has been taken from the recently issued report of the Bureau for the fiscal year ending June 30, 1912.

Sprinkle Streets with Salt Water.—The Board of Control of Norfolk, Va., has arranged to use salt water for sprinkling the streets. A salt water plant and hydrant have been installed at Bush and Main Sts.

Clay Clinker Road Construction.

Laboratory and other investigations into the qualities and possibilities of the clays of the Province of Saskatchewan as materials for road making purposes have been conducted by Prof. W. W. Andrews at the request of the Provincial Board of Highway Commissioners. The work was carried out on an experimental scale last summer, and of course it is not possible as yet to determine just what the practical value of the results will be. The following abstract of Dr. Andrew's report on his investigations and experiments is taken from the Canadian Engineer:

Very little experimental investigation was necessary to establish the fact that at a comparative low temperature the clays of the prairie almost without exception will burn to a porous, gritty material, the properties of which are a direct opposite of the corresponding ones in the clays. The clays are nearly impervious to water, especially when well puddled, the clay clinker is readily porous; the clays are weakest when wet, the clinker is stronger; the clays do not wear to a dust, the clinker will; the clays expand when moistened, the clinker powder shrinks; the clays are adhesive, the burnt clay is not, and the clinker varies in color from reddish yellow through a brown to a bright rouge, great contrast to the slaty colors of clays.

It became evident that if this clay clinker can be produced as a cost sufficient low, we would have a material which we could use to mix with the clay to counteract its troublesome qualities and which would prove of immense service in making roads in those parts of the province remote from sand and gravel beds. In some parts of the province natural mixtures have been made of sand and clay, and good roads in all seasons of the year are the result—witness many sections in the neighborhood of Estevan and Weyburn in the Duck Lake region. The mixture which has been chosen in this experimental work is one part of raw clay to four parts of clinkers, with the expectation that from untreated portions of the road clay will be carried on by the wheels of vehicles and dropped upon the clinkered section. There is danger that at first muddy wheels will tear up sections of clinker until the road has become properly mixed and compacted through traffic. In such a mixture the clay will keep it dustless and strong during dry weather, and during wet weather the sharp nature of the clinker will hold the wheels up, while at the same time the porosity will permit the excess of moisture to drain out of the road surface very readily. In these respects the clinker will be superior to sand and gravel because it will absorb a larger percentage of moisture before it appears to be wet. Experiments with clay taken from Albert St., Regina, show that clay containing 30 per cent of moisture will pack to a tough resistant mass, and observation of traffic showed that at this percentage the clay packed solidly under the wheels.

Experiment also showed that by using good coal the clinker could be produced at an economical rate, and that straw would give sufficient heat for this purpose. It remained to be demonstrated that the straw (the fuel universally abundant throughout the settled portions of the province) can be used for producing clinker at a rate sufficiently cheap. The great handicap to this form of fuel is found in the fact that a fireman needs to be in constant attendance upon a kiln during the burning.

A piece of experimental road was laid out on North Winnipeg St., Regina, where already an experimental stretch of clay and gravel road was being laid down. First, a trench was dug along the center of the road to an average depth of 2 ft. or 2½ ft. and a 3-in. tile laid down, covered to a depth of 1 in. The trench was divided in sections 6 ft. long and each section was used as a furnace. This plan had the great advantage that it burnt the sides of the trench, thus producing two porous sheets of burnt clay, extending from the surface down to the tile. It also clinkered the clay covering of the trench and a portion of the road to each side of the trench. Much time and expense was given to this side burning, but while with a steady fuel, left for a few days to burn itself out, the side burning was all that could be desired, we were defeated in our attempts to accomplish this in any adequate way with the straw fuel.

The central underdrain adds very considerably to the first expense of construction, and it has this defect that it weakens the roadbed for a year until the filling has settled down. On account of the permanent nature of a well-laid underdrain but one-tenth of its cost should be charged against the first cost of the road, and once laid down in proper manner it will last as long as the road is used. Moreover, if it be opened to the side ditches by drains to alternate sides of the road, every 200 ft. or so, the prairie winds all summer long will suck the air through the heart of the roadbed and reduce its moisture to at least 13 per cent. This is the percentage of moisture found in clay from a wheel track on Albert St., Regina, dug from under the snow.

Until a method be found for cheaply calcining the sides of the trench it will be better to dig the trench as narrow as possible and fill it with burnt clinker. One of the firms manufacturing mechanical ditchers is preparing estimates of a machine costing in the neighborhood of $1.500, which will cut a 6 or 8-in. trench to the required depth and mechanically deposit the tile in the bottom. This will reduce the cost of digging and it will require but little clinker when mixed with one-half its amount of raw clay to fill the trench. The after settling will be greatly reduced when the trench is so filled.

After the drain is completed the grading is done in the usual way and the surface rolled. If left to be puddled and packed by traffic the clay, even to the sods from the roadside, which is the most difficult material to treat, is compacted sufficiently to be broken up by the plough into hard lumps ready for the kilns.

The method of the burning the clay is as follows: Iron crates were made to provide a fire box and over these the lumps of clay made by breaking up the roads which had been graded and rolled are piled. In practice it will probably be well to grade the road and leave it for a month or so for the traffic to pack and then begin the burning. Prairie sods will form a good clinker only when it has been puddled and packed, as a rain and subsequent traffic will do it. The addition of salty water to the sods improves the clinker.

Eight hours' firing produces a fine mass of clinkers, from 2 to 2½ cu. yds. being produced in each kiln. A little straw is spread over the roadbed and then the clinker is spread mixed with a little straw and the proper amount of raw clay. The straw serves several purposes. It prevents the clay of the under bed working up and ingulfing the clinker on the surface, and its juice has a remarkable power to lessen the shrinkage of the clay and to increase its tensile strength. It supplements the binding power of the clay which is mixed with clinker, and by its cushioning tendency it reduces the crushing effect of the traffic on the clinker. The last operation is the rolling of the road, and that thoroughly done, the road is ready for use.

The cost of the first portion of the experimental road was $1.80 per lineal foot, the latter portion cost $0.82. The cost is estimated as follows:

Two men at $2.50 per day tending five kilns producing and spreading 10 cu. yds. of clinker per day	$5.00
Hauling straw	3.00
Oversight	1.00
Wear and tear of crates	.80
Cost of 10 cu. yds. of clinkers	9.80
Cost of one	.98
Therefore cost of metal per lin. ft	.33
Grading cost per lin. ft	.16
Total	.49
Which is equal to	$2,500 per mile
The underdrain costs	1,440 per mile

The total cost of clay clinker road underdrained and covered with 8 ins. deep of clinker and 12 ft. wide will be $3,940 per mile. A mechanical ditcher will reduce the cost of underdrain to two-thirds the above cost, namely, $1,000 per mile. The drain once in will provide drainage and ventilation of the roadbed. It may be found that the underdrain may with safety be omitted altogether. If so this will reduce the cost to $2,500 per mile.

If compact fuel such as coal be used, so that once charged and lighted a kiln may be left to burn itself out, two men could build, charge and open 15 kilns per day, and estimating the fuel at $9 per ton, a cubic yard will cost $0.47, and a lineal foot will cost $0.16, instead of $0.33 as above, while the cost of a graded road per mile will be $1,643, instead of $2,500.

RIVERS AND HARBORS

Cost of Dredging 29,708,465 Cu. Yds. of Material With 24 Seagoing Hopper Dredges During 1912.

(Staff Article.)

During the year ending June 30, 1912, the U. S. Engineer Department operated 24 seagoing hydraulic hopper dredges, which excavated 29,708,465 cu. yds. of material at a total cost of $1,595,916, or a cost of 5.37 cts. per cubic yard. The total value of the plant required for this work is $5,588,750. The operating records of these dredges for the year are given in Tables I, II and III, compiled from the Report of the Chief of Engineers U. S. Army. In our issue of Sept. 25, 1912, we gave similar records for 1911 of the work of the same fleet of dredges. Comparison of the two-years' work shows for 1912 a slight reduction in cost. The text below gives for each dredge such notes of its year's operations as will make the tabular matter clear.

The dredges "Benyaurd" and "New Orleans" belong to the New Orleans District and were operated for the improvement of the Southwest Pass of the Mississippi River. The "Atlantic," which belongs to the New York District, was also employed on this work. The dredge "Benyaurd" was operated day and night 10.43 months in the Southwest Pass channel, was under repair 1.4 months, and was operated in South Pass 5 days. Dredging was done mostly in the outer harbor, that is, between and beyond the sea ends of the jetties. From the Southwest Pass 2,014,913 cu. yds. of material were removed and from South Pass 24,103 cu. yds. at a total cost of 5.3 cts. per cubic yard, including extraordinary repairs. The dredge "Atlantic" operated 213 days and was under repair 25 days. It removed 1,275,754 cu. yds. of material at a total cost of 6.98 cts. per cubic yard. The dredge sailed for New York on May 20 and operated there 12 days before the close of the year.

The dredge "New Orleans" is new and was first placed in service April 11, 1912, in the Southwest Pass. The data given for her work covers the work done during her preliminary tests previous to acceptance by the Engineer Department. She operated 47 days, removing 186,515 cu. yds. at a cost of 11.2 cts. per cubic yard, but this figure does not represent, of course, the costs obtainable after the experimental work. Her propelling and pumping engine can be coupled, if desired.

The dredges "Navesink" and "Raritan," belonging to the New York District, were employed in completing the Ambrose Channel, which is one of the main entrances into New York Harbor from the sea. At periods of high water they worked in the Coney Island Channel. The total amount dredged in Ambrose Channel was 3,717,742 cu. yds. This was deposited in deep water from 7 to 14 miles distant. Excluding Sundays and holidays, the average actual working time made by each dredge was 19.52 hours per day.

The dredge "Burton," belonging to the Cleveland District, is operated for the improvement of harbors on Lake Erie, and worked during the year at the following points:

	Cu. yds.
Sandusky	52,362
Lorain	29,432
Cleveland	20,946
Fairport	7,121
Conneaut	22,140
Toledo	85,531
Total	217,532

The "Burton" was laid up at winter quarters from Dec. 1, 1911, to April 12, 1912. The total cost of her work, minus winter expenses, was 9.7 cts. per cubic yard.

The dredge "Cape Fear" was employed the entire year on the improvement of the Cape Fear River at and below Wilmington, N. C. She worked night and day for four months and during the day only for the remaining eight months.

The dredge "Gen. C. B. Comstock" was rented from the Galveston District at $45 per day, and operated on the Cape Fear River Improvement from July 1 to August 5, working day and night. She was then returned to the Galveston District where she began work in improving Aransas Pass and Bay. A total of 381,302 cu. yds. of material, mostly sand, was removed, at an operating cost of 8.35 cts. per cubic yard, and a total cost, including extraordinary repairs, and overhead expenses, of 13.97 cts. per cubic yard. The dredge was disabled Jan. 19, 1912, by striking the north jetty, her steering gear having fouled in rough weather. She was towed to New Orleans and thoroughly overhauled and repaired, and her bow, in which some rotten timbers were found, was thoroughly rebuilt. She returned to work at Aransas Pass March 25, 1912. The "Comstock" operated only in the day time, while engaged in this work because of the danger of handling the dredge at night in the narrow curved channel adjacent to the north jetty.

The dredge "Galveston," belonging to the Galveston District, was on duty in the Savannah District at the beginning of the fiscal year and continued to operate there until Oct. 17. She was engaged in removing shoals in Cumberland Sound, which is the ocean entrance to Fernandina Harbor, Fla. There was removed at this place 47,260 cu. yds. when operations were suspended on July 6 on account of a broken propeller. The cost of her work at Cumberland Sound was 9 cts., including dredge rental, operating cost, and a proportion of the repairs. The dredge was sent to Galveston where, on Oct. 17, she began work in the outer channel and removed 621,265 cu. yds. at an operating cost of 4.27 cts. and a total cost of 4.43 cts. per cubic yard. The dredge was out of commission after Feb. 23 to the end of the year.

The dredge "Caucus," belonging to the Montgomery, Alabama, District, was employed during the entire fiscal year, except for a period of about two weeks, on the improvement of St. Andrews Bay, Florida. The work accomplished was the removal from the outer bar of 453,493 cu. yds., and from Camel Back Shoal 285,266 cu. yds. at a unit field cost of 8.26 cts. per cubic yard, including all labor and material, ordinary and extraordinary repairs.

The dredges "Sumter," "Charleston" and "Winyah Bay," belonging to the Charleston District, were employed during the year for the improvement of the harbor at Charleston, S. C. The project requires a 28-ft. depth at mean low water.

The dredge "Sumter" worked continuously on the project until the hurricane of Aug. 27-28, during which it received damages so serious as to render it necessary for it to go into the dry dock for repairs until Oct. 15. Work was then resumed on the outer bar and continued until Dec. 5, when the shoe was broken by grounding on the shoal portion of

TABLE I.—PERFORMANCE AND COST OF WORK

Name of dredge	Year built.	Cost plus outfit.	Pumps.	Capacity of hoppers, yds.	Men in crew.	Location of work:	Total yardage.	Depth dredged.
Atlantic	1904-05	$341,577	2 20-in.	2,476	57	Southwest Pass, Mississippi River	1,275,755	24 -30
Atlantic	....	......	....	....	..	Ambrose Channel	79,083	35 -37
Benyaurd	1900-04	414,238	2 20-in.	2,214	63	Southwest Pass, Mississippi River	2,042,584	24 -30
Burton	1905	184,300	2 15-in.	935	28	Cleveland, Ohio, District	217,532	20 -22
Cape Fear	1895	60,809	2 10-in.	300	[3]17 [4]32	Cape Fear River and Bar	671,928	20 -24
Caucus	1905	176,000	2 18-in.	977	35	St. Andrews Bay, Fla	738,769	18.5-21.5
Charleston	1891	69,000	1 15-in.	318	26	Charleston Harbor, S. C.	323,171	13 -28
Charleston	....	......	......	....	..	Mobile Ship Channel	166,598	18 -22
Chinook	1892[1]	......	2 20-in.	3,600	47	Columbia River Bar	980,898	......
Clatsop	1908	234,500	2 18-in.	1,061	44	Lower Columbia River	1,631,088	22 -26
Comstock, Gen. C. B.	1895	96,000	2 15-in.	640.3	41	Aransas Pass and Bay, Texas	433,268	17 -20
Comstock, Gen. C. B.	....	......	......	....	..	Cape Fear River, N. C.	204,515	22 -24
Cumberland	1902	158,450	2 18-in.	970.29	35	Long Island Crossing	1,166,718	20 -22
Delaware	1905	392,134	2 20-in.	3,147	49	Delaware River	5,362,089	30 -35
Galveston	1908	380,435	2 20-in.	2,850	34	Galveston Harbor	621,265	32 -33¾
Galveston	....	......	......	....	..	Cumberland Sound, etc.	438,976	17 -23
Gedney	1887	72,500	2 15-in.	735	21	Harbor at Fall River, Miss.	240,668	17.5-25
Key West	1904	101,708	1 15-in.	369	24	Key West Harbor and St. Johns River, Fla	446,662	16 -17
Manhattan	1904	341,577	2 20-in.	2,476	57	Delaware River	4,439,107	27 -30
Meade, Gen. G. G.	1904	177,953	2 15-in.	935	31	Harbors on East Shore Lake Michigan	484,566	14 -16
Navesink	1908	384,129	2 20-in.	2,884	60	Ambrose Channel and Coney Island Channel	2,106,173	34 -38
New Orleans	1912	520,102	2 26-in.	3,102	73	Southwest Pass, Mississippi River	186,515	24 -30
Raritan	1908	384,129	2 20-in.	2,884	59	Ambrose Channel, Coney Island Channel	1,951,279	34 -38
Sabine	1901	90,290	2 10-in.	325	17	Sabine Pass Jetty Channel, Louisiana and Texas	137,475	24 -25.5
Savannah	1904	195,085	2 15-in.	935	34	Long Island Crossing	1,060,299	20 -21.5
St. Johns	1905	176,000	2 18-in.	1,000	41	St. Johns River, Florida	926,726	20 -24
Sumter	1904	151,834	2 18-in.	964	40	Charleston Harbor, S. C.	904,975	13 -28
Winyah Bay	1898	86,000	1 15-in.	306	24	Charleston Harbor, S. C.	469,783	13 -28

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[1] Dredge "Chinook" remodeled from transport "Grant" to 20-in. dredge at cost of $217.724.47—later remodeled at an additional cost of $137,075.

the proposed channel. This again necessitated docking. Repairs were completed and the dredge resumed work on Jan. 29. In April, May and June over 100,000 cu. yds. were removed each month from the channel across the bar by the "Sumter." These are the largest monthly outputs for any dredge ever working on Charleston Bar. The total amount removed by this dredge from the bar during the fiscal year was 813,878 cu. yds., at a total cost of 8 cts. per yard, including office expenses, surveys and all incidental expenses.

The dredge "Charleston" having been quite thoroughly repaired, resumed work July 5. On July 17 the "Charleston" grounded on the bar and sustained injuries which required docking. It was docked July 26 and repairs were completed Aug. 5. From Aug. 7 to Aug. 26 work was carried on by this dredge. It sustained practically no injury in the hurricane, but a delay of several days resulted from general disorganization due to the storm. Work was resumed Sept. 1. Between Dec. 2 and Dec. 21 no work was done on the bar by this dredge, as it was being used at the Charleston Navy Yard in removing mud from the area in front of the dock. The "Charleston" continued work on Charleston Bar through January and February and to March ily to the Mobile District where it remained during the balance of the year. The total amount removed from the outer bar by the "Charleston" was 204,724 cu. yds. at a cost of 9.1 cts. per cubic yard.

The "Winyah Bay" after being overhauled resumed work at Charleston July 7. This dredge escaped without injury from the hurricane. It was found necessary to use it for several days after the storm in recovering the launch "Dawho" and a stone lighter which had been driven on the marshes near Charleston during the storm. Work on the bar was resumed Sept. 11 and was continued until the 25th, after which date the "Winyah Bay" was sent to work in Winyah Bay, S. C. On March 18 this dredge again resumed work on Charleston Bar and continued until May 22, when it was laid up. The total quantity removed by the "Winyah Bay" from Charleston Bar was 213,636 cu. yds. at a cost of 6.9 cts. per cubic yard.

On days when it was too rough for the dredges to work on the bar they were employed in dredging on shoals opposite the southern portion of the city of Charleston, from which 128,966 cu. yds. have been removed. From Potts Shoal 91,097 cu. yds. were removed. From White Point Shoal, at the junction of the Ashley and Cooper Rivers, 37,869 cu. yds. were removed.

The total amount removed by all three dredges, including that taken from inner shoals, was 1,461,204 cu. yds., by bin measurement, at a cost of 7.4 cts. per cubic yard. The surveys indicate that bin measurements exceed place measurements by about 34 per cent of the latter. The results of these calculations are somewhat clouded by the facts that the locality under improvement is subject to scour, as well as wave action.

The "Charleston" worked also in the Mobile ship channel, commencing there on April 22, 1912. She removed from the channel and bar 63,852 cu. yds. of material at a cost of 7.23 cts. per cubic yard.

The dredges "Savannah" and "Cumberland" were employed during the year in the Savannah District, improving Savannah Harbor. Together they dredged a total of 2,227,017 cu. yds. of material, bin measurement, of which the Savannah removed 1,060,299 cu. yds., at a total cost of 5 cts., and the Cumberland removed 1,166,718 cu. yds. at the same cost. Of the amounts dredged by these dredges 1,004,798 cu. yds. were taken to sea and 1,222,129 cu. yds. were dumped in specially prepared pockets, from which it was pumped ashore or behind training walls by the U. S. dredge "Morgan."

The dredges "Delaware" and "Manhattan" operated in the Philadelphia District, on the Delaware River. The operations covered practically the entire section of the river under improvement. The Delaware removed 5,362,089 cu. yds. of material, of which 948,467 cu. yds. were dumped in depositing basins to be pumped ashore by the rehandling machines, and 4,413,622 cu. yds. was dumped directly overboard on ebb tide. The Manhattan removed 4,439,107 cu. yds. of material, of which 1,068,657 cu. yds. were dumped in depositing basins to be pumped ashore by the rehandling machines, and 3,370,450 cu. yds. were pumped directly overboard on ebb tide.

The cost of maintenance work during the year, including operation and repair of plant, rental of the dredge Manhattan from Aug. 10, 1910, to March 31, 1912 ($59,100), surveys, engineering, office expenses, minor contingencies, and miscellaneous expenses incident thereto, was $325,538.03.

The dredge "Gedney," belonging to the Newport, R. I., District, was operated during the year in the harbor of Fall River, Mass.,

TABLE II.—PERCENTAGE DISTRIBUTION OF TOTAL COSTS OF DREDGING BY SEAGOING HOPPER DREDGES OF U. S. GOVERNMENT FOR 1912.

Dredge:	Total cost of work.	Payroll.	Coal and oil.	Water.	Subsistance.	Engine room supplies.	Miscellaneous. supplies.	Renewals and additions to outfit.	Ordinary repairs.	Extraordinary repairs.	Alterations and additions to vessel.	Laundry, wharfage, etc.	Office expense.	Surveys.
Atlantic	$ 90,873	$30.97	$35.58	.....	$11.55	$ 2.50	$ 2.79	$ 0.43	$ 0.53	$ 8.40	.....	$ 1.41	$ 1.84	.....
Atlantic	8,223	57.90	18.30	.....	6.50	1.20	0.60	.....	.....	.....	.....	0.90	7.20	$ 7.40
Banyuard	109,763	31.38	35.81	.....	9.68	1.67	1.93	2.18	1.09	9.29	$ 4.79	0.30	1.88	.....
Burton	26,337	58.93	20.53	.....	13.44	0.81	1.15	1.74	1.05	1.30	.....	1.05	.....	.....
Cape Fear	37,717	36.00	24.20	$ 0.50	10.30	1.90	2.80	.....	14.20	.....	.....	3.00	5.60	1.50
Caucus	62,680	33.99	19.66	1.31	10.94	3.53	2.95	.....	0.77	18.74	.....	5.45	2.68	.....
Charleston	27,799	41.49	10.00	0.21	11.95	2.58	3.07	3.85	5.59	2.23	.....	5.76	8.95	3.62
Charleston	8,527	47.55	19.41	.....	15.22	4.53	2.40	1.18	1.27	3.65	.....	0.90	0.03	.....
Chinook	94.325	34.91	.....	.....	7.30	2.68	1.94	1.08	2.20	21.32	.....	0.26	0.99	.....
Clatsop	88,005	32.50	23.68	0.09	6.26	2.28	1.62	3.62	1.72	9.16	17.30	0.78	0.99	.....
Comstock, Gen. C. B.	50,424	30.20	18.99	0.77	9.48	2.97	2.98	1.61	0.97	23.62	.....	2.19	6.22	.....
Comstock, Gen. C. B.	12,649	27.60	15.70	1.00	9.80	2.30	1.90	.....	15.30	11.10	.....	8.40	5.70	1.20
Cumberland	58,708	33.81	26.05	0.40	9.90	3.08	3.24	.....	8.85	4.24	.....	1.05	2.13	7.23
Delaware	88,937	40.06	32.80	.....	10.20	2.50	2.20	1.00	0.90	2.90	0.70	0.30	5.90	.....
Galveston	38,386	28.12	29.88	0.59	6.31	3.21	4.63	9.24	1.82	0.29	9.24	3.59	3.08	.....
Galveston	36,845	17.20	36.30	0.40	7.00	2.80	1.70	.....	0.40	0.60	7.30	.....	24.20	2.10
Gedney	28,464	47.95	19.75	0.33	13.58	2.13	1.84	0.52	0.48	4.88	.....	2.51	6.03	.....
Key West	64,895	21.70	12.50	0.50	7.30	1.60	1.90	.....	3.80	43.00	3.90	1.20	1.80	0.80
Manhattan	93,964	37.50	30.70	.....	9.60	2.10	2.80	0.60	2.50	8.30	.....	0.30	5.60	.....
Meade, Gen. G. G.	59,291	31.90	29.22	.....	7.99	0.92	1.81	0.45	9.43	0.45	8.69	0.78	4.00	4.18
Navesink	114,802	32.50	30.90	0.60	8.40	1.60	2.20	4.50	3.30	.....	.....	1.50	7.10	7.40
New Orleans	23,199	40.29	26.89	.....	13.43	3.68	11.84	3.87	.....	.....	.....	.....	.....	.....
Raritan	121,238	30.20	27.80	0.50	8.00	1.20	2.20	6.00	8.20	.....	.....	1.40	7.10	7.40
Sabine	28,961	21.48	5.01	0.52	2.10	.....	2.01	1.94	0.92	56.05	1.20	1.77	8.00	.....
Savannah	53,732	34.03	29.94	0.57	10.82	3.91	4.41	1.10	8.36	0.56	.....	0.94	2.13	7.23
St. Johns	72,458	30.10	24.00	.....	10.90	2.50	3.50	.....	3.00	17.80	2.30	1.60	2.30	2.00
Sumter	65,243	35.08	13.44	0.43	10.64	2.92	2.39	0.04	3.33	16.52	.....	4.82	6.94	2.35
Winyah Bay	30,472	43.63	20.32	0.25	12.50	2.25	2.92	2.44	2.49	.....	.....	2.32	7.67	3.21

OF 25 U. S. SEAGOING DREDGES IN 1912.

Character of material:	Actual working time, hrs.	Lost time, hrs.	Kind of fuel.	Fuel per cu. yd., lbs.	Fuel cost.	Total cost of work.	Total cost per cu. yd., cts.
Sand, mud, silt	3,950.75	2,385.25	Coal	12.12	$4.37 per ton	$ 90,872.90	7.12
95 per cent sand, 5 per cent gravel and mud	219.00	......	Coal	13.80	3.08 per ton	8,222.67	10.40
Sand, mud, silt	5,419.80	1,924.16	Coal	8.89	4.32 per ton	109,763.03	5.37
Sand, mud, clay	1,352.68	6,015.31	Coal	18.30	2.70 per ton	26,336.97	12.10
Sand, clay, shell, mud	3,962.16	3,381.68	Coal	7.20	3.82 sh. ton	37,716.87	5.60
Sand	2,569.66	4,774.33	Coal	11.80	3.13 per ton	62,679.89	8.47
Sand, shells, mud	1,922.00	3,262.00	Coal	6.52	2.64 per ton	27,798.32	8.60
61.67 per cent mud, 38.33 per cent sand	661.00	1,654.00	Coal	6.63	3.35 per ton	8,527.47	5.12
Sand	2,045.51	5,154.20	Oil	0.035 bbl.	0.75 bbl.	94,324.64	9.61
Sand	2,636.01	4,587.91	Coal and oil	5.38 lbs. 0.0112 bbl.	6.36 ton 0.75 bbl.	88,004.63	5.40
Sand and shell	1,373.74	5,971.28	Oil	0.0195 bbl.	1.08 per bbl.	50,424.34	11.17
Sand, clay, mud, shells	520.01	414.88	Oil	0.41 gal.	1.00 per bbl.	12,649.22	6.20
Mud, clay, sand, shell	2,910.10	4,433.90	Coal	7.17	4.103 per ton	58,708.25	5.31
Sand, mud, clay, gravel	5,073.71	1,646.26	Coal	3.64	3.30 per ton	88,936.74	1.70
Sand and shell	935.66	[2]	Oil	0.0198 bbl.	0.902 per bbl.	38,386.24	6.19
Sand, mud, clay, shell	900.13	1,259.86	Oil	0.0241 bbl.	1.26 per bbl.	36,844.76	8.393
Mud, sand, cobble, shell	2,528.46	4,599.50	Coal, bituminous	....	2.97 per ton	28,463.68	11.83
Sand and shell	2,305.78	5,038.20	Coal	8.44 lbs.	4.81 per ton	64,895.08	14.53
Mud, sand, gravel	4,823.75	1,896.25	Coal	4.41 lbs.	3.30 per ton	93,964.13	2.12
Sand, clay, gravel, stone	1,731.50	6,377.25	Oil and coal	1.41 gals.	0.0268 per gal. 4.00 per ton	59,290.66	12.23
90 per cent sand, 10 per cent mud and stone	6,641.51	701.41	Coal	12.2	3.079 per ton	114,802.20	5.45
Sand and mud	711.95	194.40	Coal	0.084 bbl.	0.36	23,199.06	11.2
90 per cent sand, 10 per cent mud and stone	6,537.50	806.50	Coal	12.6	3.076 per ton	121,237.52	6.21
Soft blue mud and silt	525.83	6,818.16	Coal and oil	0.012 bbl.	0.90 per bbl.	28,961.38	21.00
Sand, clay, slush	3,000.00	4,343.96	Coal	7.07	4.103 per ton	52,732.22	4.97
Sand, shell, mud, clay	2,720.86	4,623.10	Coal	9.97	4.221 per ton	72,458.42	7.82
Sand, mud, clay, shell	2,548.80	4,819.10	Coal	5.14	3.77 per ton	65,242.80	7.2
Sand and mud	2,664.51	4,619.41	Coal	6.55	3.89 per ton	30,471.84	6.4

[2]Out of commission from Feb. 23 to June 30 at Galveston, Texas. [3]Single. [4]Double.

for extending the 25-ft. deep anchorage area. Between Jan. 21 and Feb. 21, the dredge was prevented from working by the heavy ice in the harbor. The amount of material dredged was 240,668 cu. yds. at a cost of 11.79 cts. per cubic yard.

The dredges "St. Johns" and "Key West," belonging to the Jacksonville, Fla., District, worked throughout the year deepening the straight channel across the bar from 22.8 ft. to 25.2 for a width of 500 ft.; also widening and deepening Jetty Cut to a width of 500 ft. and a depth of 30 ft., and deepening Wards Bank Cut to 30 ft. over a width of 100 ft., and restoring a 24-ft. channel through Mile Point Cut. The "St. Johns" removed, during the year, a total of 926,746 cu. yds. at a field cost of 5.64 cts. and a total cost of 7.22 cts. per cubic yard. This dredge was sunk on the bar mouth of St Johns River Aug. 7, 1912, and was a total loss. The "Key West" removed, during the year, 208,401 cu. yds. at a field cost of 7.27 cts. and a total cost of 7.76 cts. per cubic yard.

TABLE III.—PERCENTAGES OF TIME FOR OPERATION OF DREDGES.

Dredge:	Hours at work.	Pumping.	To and from dump.	Dumping.	Taking fuel and supplies.	To and from anchorage.	Turning in cut.	Bad weather.	Ordinary repairs.	Extraordinary repairs.	Alterations and additions.	Miscellaneous.	Total time lost.[1]
Atlantic	3.950	37.09	7.93	3.36	2.16	1.75	....	8.99	3.13	8.52	.....	10.88	2,385
Atlantic	219	.....	....	....	....	....	....	....	....	....	.....	.....	219
Benyuard	5.419	32.50	13.00	0.05	7.50	1.50	1.50	6.60	1.10	9.80	.....	4.30	1,924
Burton	1,352	8.20	5.55	0.55	0.60	1.00	....	2.00	0.30	1.10	.....	65.10	6,015
Cape Fear	3,962	30.10	6.40	2.40	4.00	1.90	....	0.90	1.10	2.30	.....	34.00	3,382
Caucus	2,569	10.72	6.53	1.19	5.17	4.05	1.58	1.22	4.27	1.88	.....	47.00	4,774
Charleston	1,922	9.53	5.13	1.51	0.26	4.70	0.67	2.82	1.83	6.95	.....	40.33	3,262
Charleston	661	9.53	5.24	3.41	2.87	5.69	....	....	1.12	6.27	.....	59.56	1,654
Chinook	2,045	14.49	1.95	1.49	0.98	4.38	....	1.22	2.61	9.00	.....	45.88	5,154
Clatsop	2,636	19.33	6.20	1.46	2.48	0.54	....	0.17	4.90	3.64	26.44	17.07	4,588
Comstock, Gen	1,374	11.50	2.20	0.50	0.13	1.20	....	8.90	3.13	10.58	0.52	45.00	5,971
Comstock, Gen	520	27.70	7.30	1.90	2.20	1.10	....	0.10	9.50	....	.....	22.40	415
Cumberland	2,910	15.69	8.54	1.36	3.35	4.20	....	1.61	4.25	1.05	.....	43.56	4,434
Delaware	5,074	34.70	10.20	0.90	4.90	4.40	2.80	9.10	0.10	6.50	.....	2.80	1,646
Galveston	936	10.03	2.98	0.66	1.39	1.37	....	2.02	2.16	....	.....	71.67	.....
Galveston	900	17.70	4.40	1.30	6.20	4.60	....	2.10	0.30	18.50	.....	27.30	1,260
Gedney	2.528	8.92	12.33	3.26	2.03	1.25	1.00	6.12	0.66	1.88	.....	43.70	4,599
Key West	3,306	13.92	6.96	1.29	0.05	3.82	....	2.68	0.01	7.93	.....	47.00	5,038
Manhattan	4,824	32.40	10.30	0.90	4.60	4.10	2.50	3.60	4.00	9.90	.....	4.10	1,896
Meade, Gen	1,732	14.00	3.43	1.08	0.03	1.19	....	4.30	7.23	0.07	.....	61.00	6,377
Navesink	6,642	37.51	23.66	1.70	7.23	1.95	3.57	1.65	2.73	....	.....	3.61	701
New Orleans	712	29.50	14.30	4.00	10.80	8.90	....	8.10	4.50	....	2.40	3.30	194
Raritan	6.538	37.41	23.61	1.58	7.09	1.87	2.87	1.33	4.46	....	.....	3.39	807
Sabine	526	2.90	1.20	0.40	0.10	0.90	0.40	0.50	0.30	13.40	.....	63.40	6,818
Savannah	3,000	16.58	7.62	1.99	3.87	4.09	....	0.49	4.77	0.19	.....	44.01	4,344
St. Johns	2,721	11.35	12.65	1.64	0.87	4.47	....	3.08	1.23	4.20	1.84	42.25	4,623
Sumter	2.548	16.16	5.02	1.04	0.16	4.48	2.16	1.97	1.94	24.04	.....	26.91	4,819
Winyah Bay	2,665	14.46	8.26	1.72	1.70	3.50	0.69	0.88	1.36	0.65	.....	49.70	4,619

[1]Item "Total time lost" does not include Sundays and holidays.

The dredge "General G. G. Meade," belonging to the Grand Rapids District, was in use in improving the harbors on the east side of Lake Michigan, from July 1, 1911, to Jan. 14, 1912, and April 10 to June 30, 1912. Upon completion of the dredging, Jan. 14, 1912, the "Meade" left Grand Haven for Milwaukee, and repairs were made in dry dock, including two new outboard propeller shafts with new sterm and strutt bushings, repairs to rudder, sand-bin gates, etc. The "Meade" arrived at Grand Haven from dry dock on Jan. 27 and was in winter quarters, making the usual general repairs to hull and machinery until April 9. The hull and machinery were inspected March 7, 1912. During March and April two additional storage tanks for fuel oil were placed, with a capacity of about 10,000 gallons, making the present total storage capacity about 23,000 gallons.

Oil fuel has been in use during the fiscal year, and while the combustion has not been as perfect as had been expected, due in part it may be to improper draft conditions, and while the quantity of oil used has been greater than expected, the general results have been without additional expense or loss of time, instead of consuming practically one working day out of six for coaling as had been the case with coal fuel, and the fireroom force was decreased by 6 men, at a saving of $300 per month. To offset these advantages of oil fuel, however, new delays were created by the failure of the railroads to deliver the oil promptly, due largely to congested freight traffic on all Michigan roads. Delays of this kind during the fiscal year amounted to 22½ days.

The changing state of the fuel-oil market is shown by the failure to receive more than one bid for the present season's supply and the increase of about 35 per cent per gallon over the prices of last year. Unless market conditions improve and the delays in delivery due to lack of equipment of tank cars and the non-delivery by the railroads can be decreased, it may become necessary to return to the use of coal. This can be done with the loss of a few days to make the changes in the furnaces.

Table IV gives a statement of results of operating the dredge during the fiscal year ending June 30, 1912.

The dredge "Sabine," belonging to the Dallas, Texas, District, operated in the jetty channel at Sabine Pass, Texas, during the fiscal year from July 1, 1911, to Sept. 11. On Sept. 15 the dredge proceeded to Beaumont for repairs to her boiler. On Sept. 22 the dredge left Beaumont for Sabine Pass. On the way down and while in the Sabine-Neches Canal, about three miles from Port Arthur, Tex., the starboard propeller shaft broke. The dredge was then towed to Sabine Pass. On Sept. 25, 1911, the dredge made a trial at dredging in the jetty channel, using one propeller. It developed, however, that the dredge could not be operated in this condition, and there being no spare propeller shaft on hand, the dredge was laid up at Sabine Pass to await repairs. The dredge remained laid up at Sabine Pass until March 20, 1912, when it was towed to Orange, Tex., to undergo extraordinary repairs, estimated at $35,000. The dredge was hauled out on marine ways at Orange on May 3, 1912, and at the end of the fiscal year was being repaired.

During the portion of the fiscal year the dredge was in operation it removed from the jetty channel 137,475 cu. yds. of soft blue mud and silt, which it carried out to sea and dumped.

The dredges "Chinook" and "Clatsop" belong to the Portland, Oregon, District, and are used on the Columbia River. Their operations during the fiscal year have consisted principally in dredging for maintenance of the 25-ft. channel between Portland and Astoria. The dredge "Clatsop" worked at various bars between Harrington Point and Astoria throughout the year, except for the period

Sept. 11, 1911, to Feb. 15, 1912, when she was undergoing alterations and repairs to fit her up as an oil burner, and from May 18 to June 8, 1912, when her pump liners were being repaired. The total amount of material dredged by the "Clatsop" and deposited in deep holes at a distance from the channel was 1,631,088 cu. yds. The field cost per yard while burning oil was reduced over ½ ct. compared with the cost while burning coal.

The dredge "Chinook," when not at work on the Columbia River bar, worked in the ship channel at Flavel Shoal, Smith Point Bar, and Upper Sands, removing a total of 438,150 cu. yds. from these localities.

The U. S. dredge "Chinook" worked on the bar during the fiscal year at such times as weather permitted. When not able to work on the bar, she worked on the channel between Portland and the sea. The number of days worked on the bar was 115, and the quantity of material dredged there was 542,748 cu. yds The total cubic yards dredged on bar and in river was 963,898. The cost of operating the dredge during the year was $94,324.64, including $20,122.77 for extraordinary repairs. Of this total $80,251.82 was charged to improving mouth of Columbia River and the balance to improving Columbia and lower Willamette Rivers below Portland.

The extraordinary repairs include drydocking, painting hull, and general repairs to machinery in April, 1912. All minor repairs were made by the ship's crew.

TABLE IV.

Appropriations for—	Dredge "Meade."	Surveys, examinations, etc.	Office and contingent expenses, etc.	Total.	Cubic yards dredged.
St. Joseph Harbor	$ 300 00	$ 224.78	$ 17.34	$ 542.12	....
South Haven Harbor	3,245.76	179.48	159.98	3,585.22	16,846
Saugatuck Harbor	5,806.93	249.44	282.00	6,338.37	57,386
Holland Harbor	4,334.16	169.88	205.68	4,709.72	18,594
Grand Haven Harbor	5,554.95	213.47	272.44	6,040.86	64,143
Muskegon Harbor	5,482.61	234.73	271.41	5,988.75	32,270
White Lake Harbor	5,198.33	266.25	227.29	5,691.87	37,926
Pentwater Harbor	2,609.24	112.26	17.77	2,739.27	58,541
Ludington Harbor	7,259.28	299.60	321.12	7,880.00	45,127
Manistee Harbor	7,948.21	285.33	397.35	8,630.89	46,278
Portage Lake Harbor	3,817.84	90.55	86.75	3,995.14	30,485
Arcadia Harbor	397.04	14.68	......	411.72	8,112
Frankfort Harbor	2,198.09	126.95	106.42	3,434.46	55,561
Charlevoix Harbor	200.00	101.27	4.00	305.27	13,297
Total	$54,352.44	$2,568.67	$2,369.55	$59,290.66	484,566
Cost per cu. yd. ...cts.	11.21	0.530	0.489	12.23	....

SEWERAGE AND SANITATION

The Design of the Sewage Treatment Plant at Albia, Iowa.

Contributed by M. G. Hall, of Hall & Adams, Civil and Sanitary Engineers, Centerville, Iowa.

The city of Albia, Iowa, has a population of 4,690, according to the 1910 census. The topography of the city is such that the surface drainage is divided naturally into at least four drainage districts.

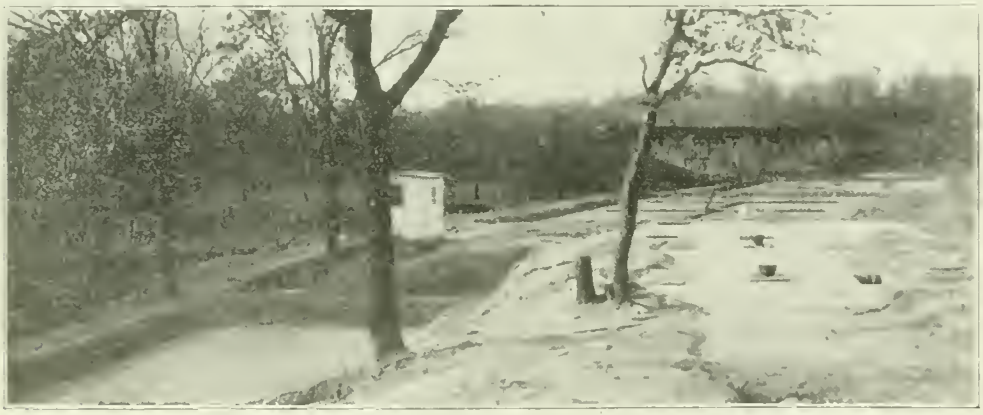

Fig. 1—View of Sewage Treatment Plant at Albia, Iowa.

There are several miles of sewers and, being inland from any flowing stream, the city had for years disposed of its sewage into the surface drainage ditches on the outskirts of the city Some such sewer outlets terminate within 100 ft. of residences, while others have been carried out to a remote section. At the present time there are still at least four such sewer outlets.

The city has never adopted a regularly planned and systematic sewer system except for a portion of one ward. This sewer was planned about three years ago, and a large part of it has been constructed. This district provides for sanitary sewers only.

The balance of the sewers of the city have been built without the whole district to be sewered having been mapped out and planned for Extensions have been made from time to time without any regular or systematic idea in mind except to serve a particular street or alley. In the meantime streets and alleys have been paved where sewers have not been built and this has worked, and will continue to work, to the disadvantage of property owners on these paved streets. These sewers were built as combined sewers and receive street and roof water through unscreened catch basins and consequently are poorly adapted for the installation of sewage disposal works at their outlets.

Of recent years the outlets of these sewers, beyond the pipe lines, have become more and more of a public nuisance and in the spring of 1912, upon the advice and demand of the city physician of said city that measures be taken at once to construct sewage disposal works on at least two of these sewer outlets, the city council retained the firm of which the writer is a member, to prepare plans, estimates and specifications for the building of two sewage disposal plants.

The question at the outset was to decide whether or not an effort should be made to treat all the sewage in time of storm. It was soon found that to treat storm water was out of the question at this time owing to the city's inability to finance the project. Hence our plans called for the treatment of the dry weather flow or its equivalent in volume in time of storm. One of these plants was constructed during the fall of 1912 and is now in operation, and further remarks will be confined to the plant that was built.

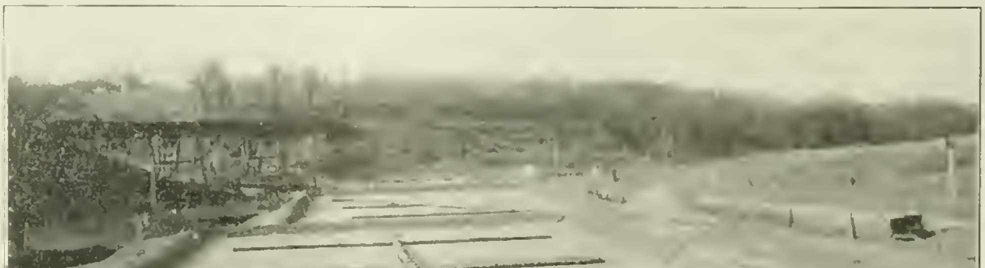

Fig. 2—View of Sand Filters at Albia, Iowa, Sewage Treatment Plant.

The plant consists of an intercepting sewer, grit chamber, Imhoff sewage tanks, dosing chamber, sand filters and a sludge drying bed. Fig. 1 is a general view of the plant showing the sludge bed to the left, the screeen chamber, tanks and dosing chamber in the foreground, and the two intermittent sand beds in the background. A closer view of the sand beds is shown in Fig. 2.

The population to be served is approximately 1,500 and has shown but little increase in numbers in the last ten years. The plant was designed for approximately 1,600 people with the idea of increasing the capacity of the plant as needed by building additional tanks or filters, or both. The amount of sewage to be treated has been shown by measurements to be approximately 48 gals. per minute or 69,120 gals. per 24 hours.

Owing to the fact that the sewers heretofore laid in this district have been laid across low ground in places, and that none of the sewers have been laid with cemented joints, and also to the fact that the condensation from a steam heating plant furnishing heat to the business section of the citcy has been turned into the laterals contributing to this sewer outlet, the normal flow of the sewage contains a considerable amount of water other than sewage For this reason the filter area provided for is not as great as otherwise would have been necessary. The city was also limited for available filter area and not wishing to purchase more ground at this time, this feature of the problem also affected the filter area for the time being at least. There is, however, available filter area adjacent to that already owned by the city and if it is found necessary to have more filter area it can be readily obtained.

The grit chamber, as shown by Fig. 3, is in two compartments for convenience in cleaning. One compartment is connected to a by-pass to the creek, thus enabling the cutting out of the flow through the tank at any time if it becomes necessary to do so.

The Imhoff tanks are as shown in Fig. 3 and consist of two wells 12 ft. in diameter and 10 ft. 1 in. in depth below the bottom of the upper chamber. This sludge digestion chamber has a capacity within the above named limits of approximately 1,800 cu. ft.

The upper chamber is 8 ft. in width and 28 ft. in length and has a capacity of approximately 1,020 cu. ft. which will allow a sedimentation period under present conditions of about 2 hours and 40 minutes. The total depth of the tanks over all is 19 ft. 6 ins.

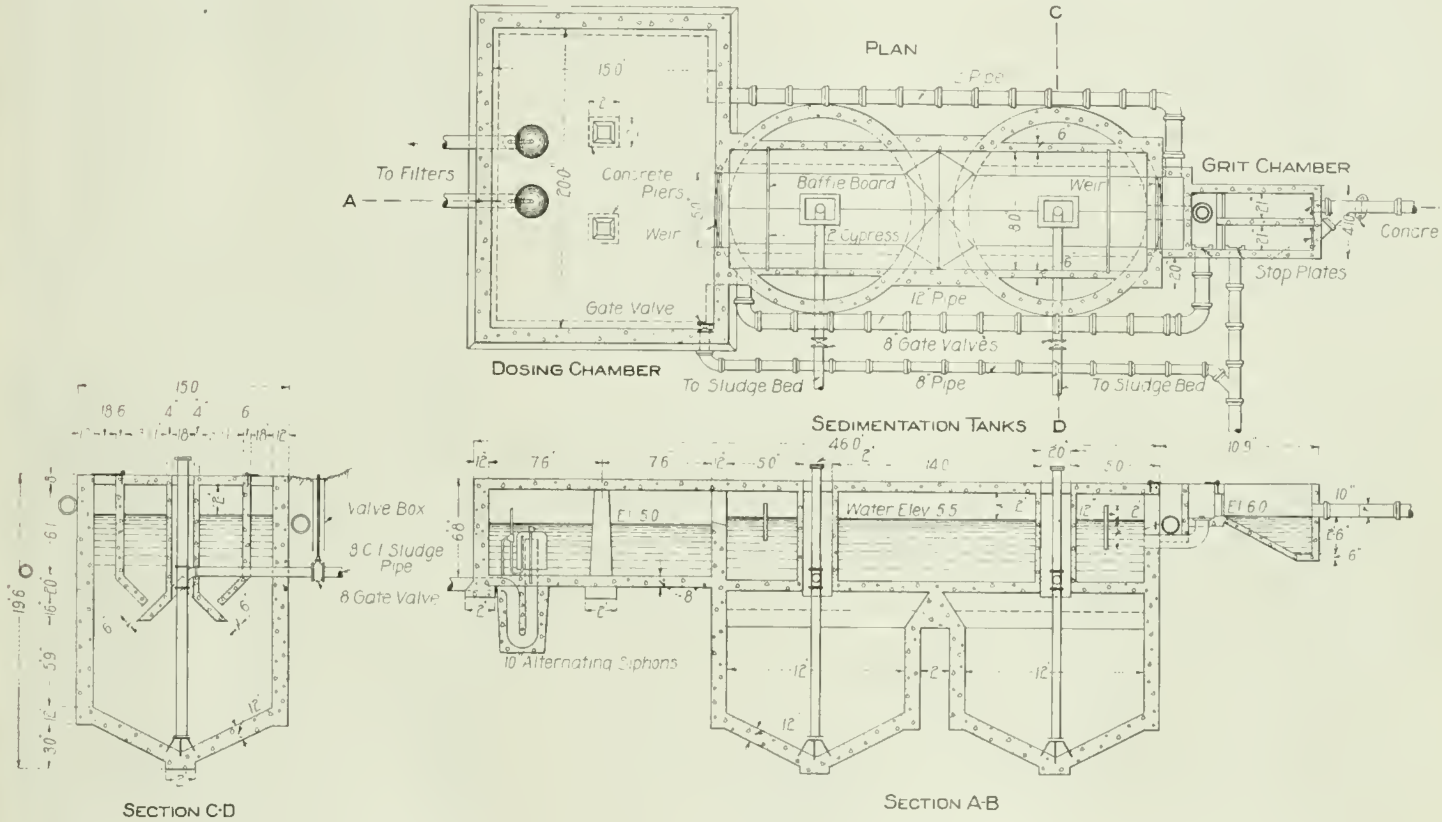

Fig. 3—Detailed Plan and Sections of Imhoff Tank, Screen and Dosing Chamber, Sewage Treatment Plant, Albia, Iowa.

The whole structure is built of concrete with the exception of the two baffle walls which are of cypress. The roof slab is of reinforced concrete. ⅝ in. bars being used, and the balance is plain concrete without reinforcement. The proportions were 1:3:5 where crushed stone was used in the aggregate and 1:5 where gravel was used. These proportions were used for side walls and bottom. For the roof slab the proportions were 1:2:3½ for the broken stone concrete and 1:3½ for gravel.

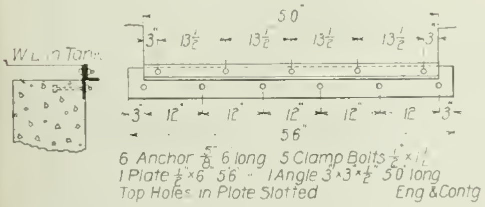
W L in Tank
5 0
3 13½ 13½ 13½ 13½ 3
3 12 12 12 12 12 3
5 6
6 Anchor ⅝ 6 long 5 Clamp Bolts ½ x 1½
1 Plate ½ x 6 5 6 1 Angle 3 x 3 x ½ 5 0 long
Top Holes in Plate Slotted
Eng & Contg

Fig. 4—Detail of Weirs in Tanks.

By means of two weirs and a by-pass the flow of sewage through the upper chamber may be reversed in direction. This arrangement was provided as it is expected that the well first receiving the sewage will become sludged up faster than the other and by being able to reverse the flow the digestion period in the tank may be somewhat increased. The weir at the inlet end is stopped off by means of a board clamped to the weir, when it is desired to reverse the flow, both weirs being at the same level. The type of weir employed is shown in detail in Fig. 4. A detail of the stop plates is shown in Fig. 5.

The dosing chamber is built at one end of the tank and at the same time as the tank so that the whole is one structure. Two 10 in. automatic alternating siphons, furnished by the Pacific Flush Tank Co., were installed in the dosing chamber. These siphons draw 3 ft. of sewage at each discharge.

The filters are two in number, up to the present time, and are each 60 ft. by 100 ft. in surface area. The bottom of the filter is ridged up and 4 in. underdrains are placed 5 ft. center to center between the ridges. The tops of these ridges are 18 ins. above the tops of the drains, and the surface of the sand bed is 18 ins. above the tops of the ridges or 3 ft. above the tops of the drains.

The main distributing pipe is stepped down in size as each pair of lateral distributors is passed. It is 15 in. pipe out to the first laterals and then decreases to 12 in. pipe, 10 in. pipe, and 8 in. pipe respectively, as pairs of laterals branch off of the main distributor. The main collecting underdrain is 8 ins. in diameter in each bed, and extends transversely across the bed at one end. These two 8 in. lines intersect in a manhole outside the beds. The effluent flows from the manhole to a nearby creek through a 10 in. pipe.

The sludge bed is 20x32 ft. in plan. The lateral drain pipes in this bed are 4 ins. in diameter, and are 7 ft. on centers. They drain into a collecting drain which is 6 ins. in diameter. The filling material of this bed is a coarse sand which is ridged up as in the filter beds above described.

Some of the contract costs were as follows: Imhoff tanks complete, including screen and dosing chambers, $2,435; filter bids complete, $2,354; sludge bed complete, $140; alternating siphons, $200; Imhoff tank royalties, $130. The total cost of the plant to the city, including the foregoing items, also 561 ft. of 10 in. sewer and 2 standard manholes, and various miscellaneous items herein illustrated or described, was $6,045. This figure does not include cost of engineering and supervision.

Some of the unit prices paid for materials delivered on the work were as follows:

Sand, per cu. yd.	$ 1.26
Stone, per cu. yd.	1.87
Cement, per bbl.	1.40
Brick, per M.	12.00
8-in. sewer pipe, per ft.	.18
10-in. sewer pipe, per ft.	.24
12-in. sewer pipe, per ft.	.36
4-in. drain tile, per ft.	.035
Labor cost for 10 hours	2.00
Foreman, per day	2.50

There are no sand beds in the vicinity and all sand used was shipped 20 miles or more to Albia. The sand used was Des Moines River sand. This was a clean sand well graded from fine to coarse.

The plant was built by the Albia Plumbing Co. It was put into operation early in January, 1913, and so far has shown excellent results, to all outward appearances. No analyses have been made as yet of the effluent of the plant but already the tank shows signs of vigorous septic action and, unlike the shallow tanks, no strong or offensive odors are given off.

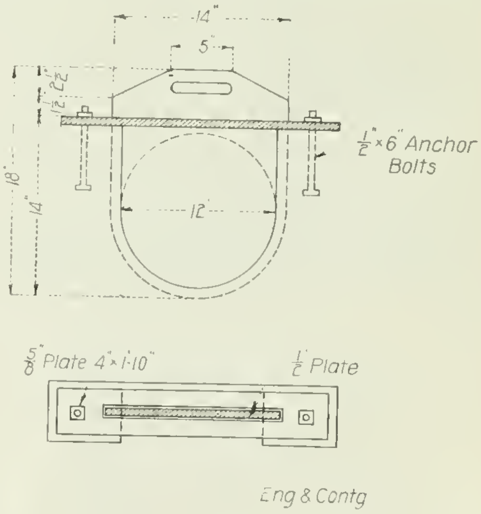

Fig. 5—Detail of Stop Plates at Head of Pipe Lines.

A Discussion of Rainfall and Run-Off Into Storm Water Sewers.

The relation existing between rainfall and run-off into sewers was discussed by Mr. Samuel A. Greeley in a recent paper before the Western Society of Engineers. A large amount of data were given which will aid sewerage engineers in making detailed studies in various localities. Brief compilations of most of the published records of the flow in storm sewers were given in such a manner as to throw as much light as possible on the proportional amounts of the rainfall reaching the sewer at the time of maximum discharge. The paper is here given practically in full.

The determination of the storm run-off for the computation of adequate sizes of sewers is a problem which involves, finally, three elements: (1) The tributary area, (2) the intensity of rainfall to be provided for and (3) the maximum run-off into the sewer.

An absolute determination of these elements is, in practice, impossible, and the calculation depends, ultimately, for its solution, upon the judgment of the designing engineer. The engineer's judgment is guided largely by experience, which means, presumably, that the engineer has measured, under known conditions, the rainfall and the run-off. Some engineers whose experience has been large have sought to express or record their judgment in formulæ by which their experience gained in one or more localities might be applied by themselves or others to different localities.

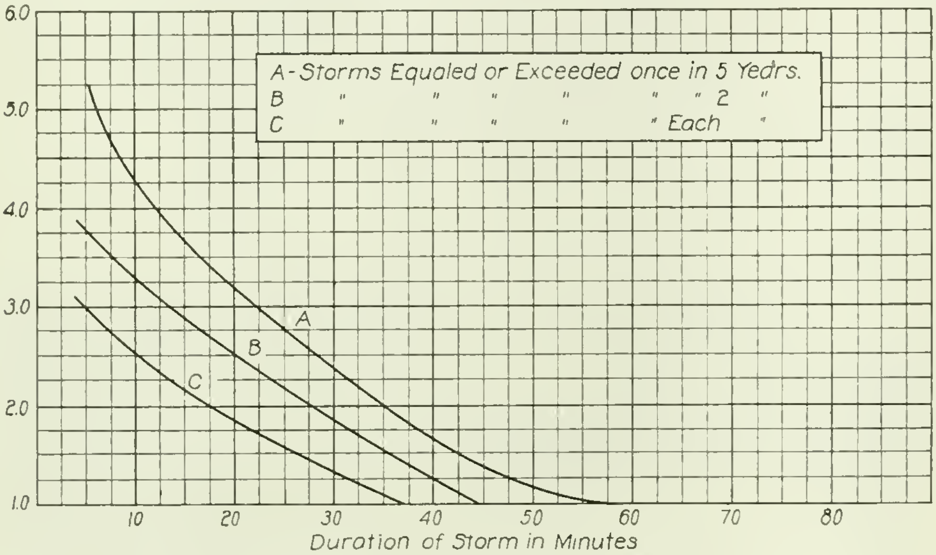

Fig. 1—Curves Showing Probable Rate of Rainfall to Be Equaled or Exceeded in One, Two and Five-Year Intervals in the Chicago "Loop" District.

TABLE I.—VALUES OF C AND r.

Formula.	C	r
1. Hawksley	3.95	1.0
2. Burkli-Ziegler	3.52	2.33
3. Adams	1.03	1.0
4. McMath	3.98	2.75
5. New York	3.26	2.75

These formulæ, or modifications of them, have been used very generally in this country and abroad. The most important of them, transposed to similar terms, are the following:

(1) Hawksley (1857) $Q=Cr^{\frac{3}{4}}\sqrt[4]{A^3S}$

(2) Burkli-Ziegler (1880) $Q=Cr\sqrt[4]{A^3S}$

(3) Adams (1880) $Q=Cr^{\frac{5}{6}}\sqrt[6]{A^5S^{\frac{1}{2}}}$

(4) McMath (1887) $Q=Cr\sqrt{A^4S}$

(5) New York (1889) $Q=Cr\ A^{.85}S^{.25}$

In these formulæ, Q equals the total discharge of the tributary area in cubic feet per second; C equals a coefficient; r equals a rate of rainfall in inches per hour; A equals the tributary area in acres, and S equals the average slope of the area. Modifications of these expressions have been formulated for use in the city of Chicago by Mr. C. D. Hill and are used by him with success for local sewer designs.

The value of these formulæ, and of their relative results, has been often discussed in the past, and the discussion will not be continued here. In accordance with the values of C and r, suggested by the authors of the formulæ and given in Table I for ordinary maximum conditions, and with a value of $S=0.002$, the run-offs for different sized areas have been tabulated in Table II. It would be interesting if some statements were made as to the adequacy of sewers designed and built in accordance with these formulæ.

TABLE II.—QUANTITIES OF RUN-OFF BY STANDARD FORMULAE VALUES OF C AND r AS IN TABLE 1.

Tributary area in acres.	Hawksley.	Burkli-Ziegler.	Adams.	McMath.	New York.
20.....	7.9	16.3	7.6	34.9	59.2
100.....	26.1	54.4	27.8	126.0	82.4
300.....	59.5	123.8	69.1	304.0	209.0
500.....	86.7	180.0	106.0	456.0	323.0
700.....	113.0	234.0	140.0	576.0	430.0
1,000.....	148.3	306.0	189.5	796.0	583.0

These formulæ themselves evidently do not give absolute or similar solutions for equivalent conditions, and the engineer's judgment, based on a familiarity with the practical workings of the formulæ must be applied. The element of judgment is required to select (1) the proper rate of rainfall, (2) the proportion of this rainfall reaching the sewer under maximum conditions and (3) the maximum conditions to provide for. A formula, or method for determining the quantity of storm run-off from these elements, is therefore more or less satisfactory in proportion to the ease and certainty with which it permits or requires the exercise of judgment. Judgment is chiefly based on the results of experience. Therefore what is needed for a truer estimate of the quantity of rainfall and run-off is a large number of actual gagings covering a sufficient number of cases to afford a reasonable basis for judgment.

The most recent of these standard formulæ was published in 1889. At that time the automatic rain gage had been used only for a few years and in a few places, and only one or two accurate gagings of storm flows in sewers were available. The co-ordination of formula to actual gagings was, therefore, not extensive.

There is now available, however, some information upon the intensities of rainfall for different durations and upon the actual storm run-off.

During the past year the Sewage Disposal Division of the Engineering Department of the Sanitary District of Chicago has maintained automatic rain gages and sewer gages on several of the sewers within the district. The rain gages are the standard tipping bucket gage made by Friez of Baltimore and used extensively in the government service. The sewer gages comprise a weir built at the sewer outfall, and a continuously recording Bristol water level gage, actuated by a diaphragm placed in the sewer. This gage records on a 12 in. disc chart moved by a seven-day clock, the actual head of the sewage passing over the weir at each instant. Similar gages were operated by Mr. C. C. Saner in the Davis St. Sewer District in Evanston, Ill.

The first series of such observations in which gagings of the rainfall and sewer flow were simultaneously recorded were made by Mr. Emil Kuichling in Rochester, N. Y. In the description of these observations the so-called "Rational Method" of computing the run-off was first described. This method of computation requires: (1) The determination of the area contributing rainfall to a point on the sewer; (2) the selection of the average maximum rate of rainfall of sufficient duration to make all parts of this area tributary, and (3) an estimate of the proportion of this rainfall reaching the sewer at the time of maximum discharge—the rainfall and run-off being expressed as rates of flow. The method is expressed by the equation:

$$Q = C\,r\,A.$$

In this equation, C is the ratio of the average rate of rainfall for a period of time equal to the time of concentration for each particular area, to the maximum rate of flow in the sewer following the period of concentration. The "time of concentration" means the duration of rainfall necessary to make all parts of the area tributary to the given point on the sewer.

The application of this method to any design requires, in the first place, a knowledge of the rate of rainfall to be locally expected for a given duration and for a given frequency or recurrence. With this knowledge, the permissible interval between surchargings of the sewer can be estimated, and the rate of rainfall for each particular time of concentration selected. In the second place there should be available sufficient records of actual gagings to afford a reasonable estimate of the value of C for the particular conditions of the design. Now that more data bearing on the selection of reasonable values of r and C have become available, the rational method of design is being used more frequently.

At the present time an inquiry into the recorded data available for the determination of r and C seems worth while, and into the factors influencing this determination.

FACTORS INFLUENCING R AND C.

1: *The Rainfall.*—The factors influencing the values of r and C are presented in tabular form, as follows:

r
1. Size of the tributary area.
2. Slope of the tributary area.
3. Character of the tributary surface.
4. Gutter and inlet facilities.
5. Slope of the sewers.
6. Storage in the sewers and on the ground surface.
7. Effective storm area.
8. Direction of storm travel.
9. Distribution of rainfall in the storm.
10. Value and development of the property served.

C
1. Imperviousness of the surface.
2. Density of the population.
3. Topography of the tributary area.
4. Character of subsoil.
5. Gutter and inlet facilities.
6. Duration and distribution of rainfall.
7. Distribution of the impervious area.

The first six of these factors really determine what may be called the effective duration of the storm. The maximum sewer discharge ordinarily occurs when all parts of the tributary area are actually contributing rain water to the sewer. The intensity of the rainfall should correspond in duration to this time of concentration. If the storm duration is longer, a lower intensity of rainfall will follow, and if the storm duration is shorter only a portion of the area will be tributary. That the first six factors do influence the time of concentration, and the intensity and duration of the rainfall, is clear. To what extent each factor enters the problem must be estimated for each design.

The effective storm area is an important factor about which very little data have been published. Rainfall records are commonly available for only one point on or near the drainage area. If this area is large, the maximum recorded rate of rainfall of given duration may not be uniform over the whole area. It may be proper to apply a distribution coefficient to the recorded rates of rainfall. Such coefficients have been proposed by Messrs. Wynne-Roberts and Brockmann and are given in Table III.

TABLE III.—COEFFICIENTS FOR RAINFALL DISTRIBUTION.
(Wynne-Roberts and Brockmann.)

Length of sewer in feet.	Coefficient.
500	0.937
1,250	0.900
2,000	0.875
3,000	0.847
5,000	0.802
7,500	0.758
10,000	0.720
15,000	0.660
20,000	0.605

The values given in Table III are computed from the formula $C = 1 - 0.002 \sqrt{L}$ in which L is the length of the longest sewer line in feet. There does not seem to be enough data back of these to warrant an unqualified acceptance. Mr. Kuichling's observation in Rochester was that storms lasting 15 minutes might cover an area of six square miles. This statement seems to have been based on careful field observation rather than gage readings.

In Philadelphia and New Orleans six rain gages are maintained by the city The United States Weather Bureau also maintains gages in each city. Therefore these two cities afford an opportunity for measuring the distribution of heavy storms over relatively small areas. Unfortunately the New Orleans records are not published in sufficient detail to bring out this point. Table IV shows records of two storms taken from Philadelphia gages.

TABLE IV.—DISTRIBUTION OF RAINFALL, PHILADELPHIA, PA., 1911.

City district number.	July 17 Max. rate per hour. Ins.	July 17 Max. rate per hour. Min.	July 17 Max. fall in 1 hr.	August 30 Max. rate per hour. Ins.	August 30 Max. rate per hour. Min.	August 30 Max. fall in 1 hr.
2d	3.18	10	1.00	0.53	60	0.53
7th	....	..	....	1.14	30	0.73
8th	2.76	15	1.27	1.57	30	0.98
9th	2.83	15	0.91	0.71	30	0.53
10th ...	4.25	10	1.23	0.98	30	0.71
11th ...	9.44	5	1.79	1.61	30	1.02

The gages in the second, seventh and eleventh districts of Table IV are within a triangular area of about five square miles. The variation in the intensity of rainfall within the area is marked.

Sewer areas may be as large as five square miles. It seems likely, therefore, that more data may warrant the introduction of a distribution coefficient.

TABLE V.—U. S. WEATHER BUREAU GAGE, RAINFALL RECORDS, 1899-1912, 14 YEARS, AT ALBANY, N. Y.
Courtesy of Theodore Horton.
Rate per hour of rainfall and total number of downpours.

Duration of downpour in minutes.	1.0-1.2	1.2-1.4	1.4-1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	4.0	4.5	5.0	5.5	6.0	6.5	7.0
5	5	2	2	3	1	..	1	4	1	3	2	2	3	7	5	2	1	2	..	1
10	..	2	4	3	3	3	4	7	4	2	2	3	3	1	1	2	1	..	..	..
15	..	2	3	5	3	4	4	..	1	2	..	..	1	2	..	1	..	..	..	..
20	..	2	1	5	2	1	2	1	..	..	..	..	..	..	..	..	..	..	..	..
25	..	..	2	1	3	..	1	1	..	..	..	..	..	..	..	..	..	..	..	..
30	4	1	2	..	1	1	..	1	..	..	..	..	..	..	..	..	..	..	..	..
35	1	1	..	1	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..
40	..	1	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..
45	1	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
50	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
60	4	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total	16	13	14	19	13	11	12	14	6	7	4	5	7	10	6	5	2	2	..	1

On several occasions records of the same storm have been received on several of the gages in the Sanitary District. Typical storms were platted and these data bear out the indications of other records, that storms of severe intensity do not cover the larger drainage areas.

TABLE VI.—U. S. WEATHER BUREAU GAGE, RAINFALL RECORDS, 1894-1907, 13 YEARS, AT BALTIMORE, MD.
Courtesy of H. C. McRae.
Rate per hour of rainfall and total number of downpours.

Duration of downpour in minutes.	1.0-1.5	1.5-2.0	2.0-2.5	2.5-3.0	3.0-3.5	3.5-4.0	4.0-4.5	4.5-5.0	5.0-5.5	5.5-6.0	6.0-6.5	6.5-7.0	7.0-7.5	7.5-8.0	8.0-8.5	8.5-9.0
5	..	2	8	6	7	4	8	2	2	4	1	1	..	..	..	1
10	3	6	6	9	9	5	3	3	..	..	..	..	..	..	1	..
15	1	4	3	2	2	2	1	2	..	..	..	..	1	..	..	..
20	4	3	5	3	3	..	..	1	..	..	..	1	..	..	..	..
25	3	3	1	..	..	..	..	..	..	1	..	..	..	..	..	..
30	..	2	4	1	..	..	..	..	1	..	..	..	..	..	..	..
35	1	..	3	..	..	..	..	1	..	..	..	..	..	..	..	..
40	..	1	2	..	..	..	..	..	..	..	..	..	..	..	..	..
45	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..
50	2	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..
60	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..
80	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
100	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
120	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total	16	25	32	21	21	11	12	9	3	5	1	2	1	..	1	1

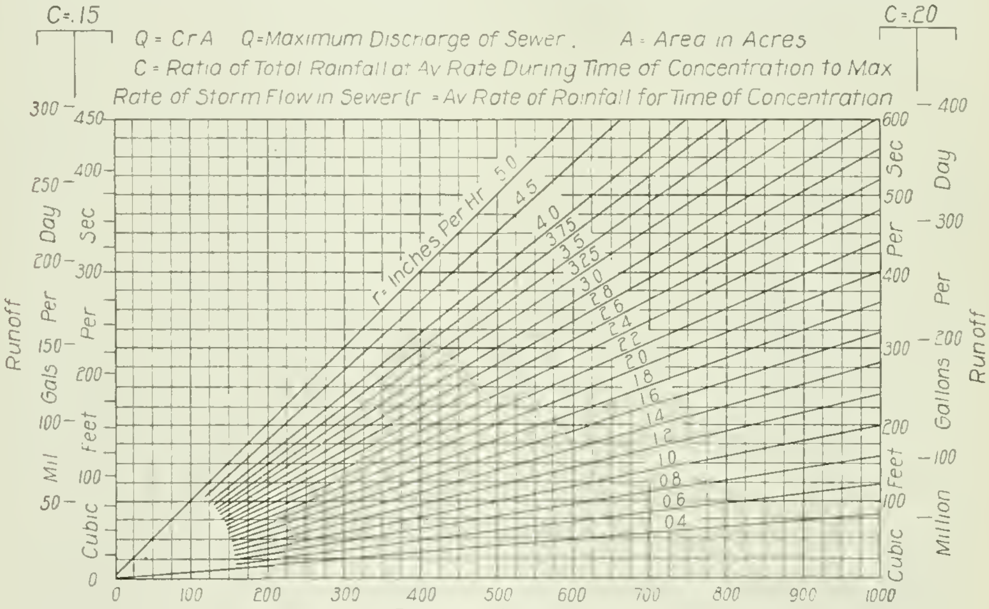

Fig. 2—Diagram Showing Run-Off from Sewered Areas for Value of C = 0.20 and 0.15.

The influence of the effective storm is controlled somewhat by the direction in which the storm travels. In long, narrow drainage areas, of which there are many in Chicago, this factor assumes importance. The factor is chiefly important, however, in the interpretation of actual rainfall and run-off gagings rather than in designing sewers for maximum conditions. This statement applies also to the variations of the intensity of rainfall in a storm, but in a different relation. If the heavy rate of rainfall comes after a long continued light rain, the ground will have become saturated and a greater run-off will result.

The tenth factor listed, the value and development of the property served, is one of great practical importance. Much property does not warrant, at least when first sewered, an expenditure for sewers of sufficient size to handle the severest storm. What value of r then shall be chosen? An approximate solution is to determine a reasonable interval in years between surchargings of sewers based on financial considerations. In some properties a flooding once a year for a short time may not be unreasonable, whereas other properties in which cellar storage of valuable goods is common should never be flooded. The intensity of rainfall of proper duration likely to occur once every year or every ten years, as the case may be, should be selected. Fortunately, rainfall records in a limited number of places are now available over a sufficient number of years to indicate the probable recurrence of rainfalls of different intensities and durations. Curves showing the probable rate of rainfall to be equaled or exceeded once in every year, every two years, and every five years in the loop district of Chicago, are shown in Fig. 1.

It should be noted that there are a number of records of storms of long duration and a great intensity which have surcharged apparently well-designed sewers. These surchargings are sometimes due to high water in the river or water course into which the sewer discharges.

Rainfall Considered Excessive.

Duration in minutes.	Depth in inches.
5	0.25
10	0.30
15	0.35
20	0.40
25	0.45
30	0.50
35	0.55
40	0.60
45	0.65
50	0.70
60	0.80

Rainfall Data.—The chief source of rainfall data in this country is the United States Weather Bureau. Automatic continuously recording rain gages have been installed by this bureau in all of the larger cities, and have been maintained in many for over 20 years.

It would seem advisable for the Weather Bureau to assemble and publish these records up to date, and to make revisions every five or possibly ten years. The saving effected through more accurate design of sewers would more than repay the public expenditure.

TABLE VII.—RAINFALL RECORD, EDGBASTON OBSERVATORY, 1900-1904, FOUR YEARS, AT BIRMINGHAM, ENGLAND.
Lloyd Davies, Proc. Inst. C. E., Vol. CLXIV.

Maximum duration of fall in minutes.	Rate of fall—inches per hour											
	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.5
	Total number of storms											
5	20	13	12	9	8	5	5	4	3	2	2	1
10	9	4	3	1	1	1	1	1	1	1	1	1
15	6	1	..	..	..	..	..	..	..	..	..	..
20	5	1	..	..	..	..	..	..	..	..	..	..
25	1	..	..	..	..	..	..	..	..	..	..	..
30	1	..	..	..	..	..	..	..	..	..	..	..
Total	42	19	15	10	9	6	6	5	4	3	3	2

The two most important factors desired from rainfall data are the intensity of rainfall for given durations and the probable recurrence or frequency of severe storms, so that the design of the sewers can be somewhat conditioned to the value and character of the property to be served. Data showing storm characteristics are useful more for particular detailed studies than for the average conditions of storm sewer design. Having this point of view in mind, Tables V to XIII have been prepared showing the number of storms of the tabulated intensity and duration which have occurred in each particular locality during the period of the observations. From these tables, the probable correct value of and for the particular conditions of each tributary area can be taken.

TABLE VIII.—CHESTNUT HILL RESERVOIR GAGE, RAINFALL RECORDS, 1879-1904, 25 YEARS, AT BOSTON, MASS.
(Courtesy of Harrison P. Eddy.)
Rate Per Hour of Rainfall and Total Number of Downpours.

Duration of downpour in minutes.	1.0 inch per hour or greater.	1.5 inch.	2.0 inch.	2.5 inch.	3.0 inch.	4.0 inch.	5.0 inch.	8.0 inch.
5	6	8	7	7	6	3	3	2
10	18	21	16	10	6	2	..	..
15	9	6	12	4	2	..	..	..
20	12	10	2	5	1	1	..	..
25	3	1	1	..	..	..	..	..
30	4	2	1	1	..	..	..	..
35	5	3	..	..	..	..	..	..
40	2	1	1	..	..	..	..	..
45	1	1	..	..	..	..	..	..
50	2	..	1	..	..	..	..	..
60	1	1	1	..	..	..	..	..
80	6	2	..	..	..	..	..	..
120	3	1	..	..	..	..	..	..
Total	72	57	42	27	15	6	3	2

TABLE IX.—RAINFALL RECORDS, 1899-1910, 22 YEARS, AT CHICAGO, ILL.
Compiled by W. W. Mathews.
Rate Per Hour of Rainfall and Total Number of Downpours.

Duration of downpours in minutes.	1.0 In.	1.1 In.	1.2 In.	1.3 In.	1.4 In.	1.5 In.	1.6 In.	1.7 In.	1.8 In.	1.9 In.	2.0 In.	2.1 In.	2.2 In.	2.3 In.	2.4 In.	2.5 In.	2.6 In.	2.7 In.	2.8 In.	2.9 In.	3.0 In.	3.1 In.	3.2 In.	3.3 In.	3.4 In.	3.5 In.	3.6 In.	3.7 In.	3.8 In.	3.9 In.	4.0 In.	4.1 In.	4.2 In.	4.5 In.	4.6 In.	4.7 In.	4.8 In.	5.3 In.	5.4 In.	5.8 In.	5.9 In.	6.1 In.	6.6 In.	7.2 In.
5....	5	6	8	8	9	..	10	5	11	5	7	..	4	4	8	2	2	..	3	..	6	2	1	..	3	4	3	..	1	..	..	1	1	..	..	..	1	..	1	1	..	1	1	1
10....	10	6	4	10	6	5	7	8	8	6	3	7	5	3	3	2	1	1	4	..	1	1	2	1	2	..	1	..	..	..	1	1	1	1	1	..	..	1	..	..	1	..	..	..
15....	7	5	10	5	12	6	4	5	3	4	6	1	1	1	2	3	2	1	1	..	2	3	..	..	..	..	..	..	..	1	1	1	1	..	..	1	..	..	..	..	..	..	..	..
20....	12	7	5	2	8	5	2	2	3	2	4	3	2	1	..	..	2	1	3	2	..	..	..	1	..	1	..	1	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
25....	5	3	5	11	4	2	..	2	1	3	2	..	1	2	..	2	2	1	..	3	..	1	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
30....	3	6	4	2	1	3	1	1	5	..	1	3	..	1	2	1	1	1	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
35....	2	5	1	..	1	..	3	5	2	2	..	1	2	1	..	2	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
40....	3	2	1	1	1	2	3	1	1	1	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
45....	2	..	1	1	3	1	2	..	1	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
50....	1	1	2	1	..	..	2	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
60....	2	..	..	..	2	2	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
80....	..	..	2	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
100....	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
120....	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

2: *The Run-off.*—The factors influencing the value of *C*, or the proportion of the rainfall reaching the sewer at the time of maximum discharge, have been given. The first five factors listed influence the selection of the proper value of *C* for maximum conditions and are also important in the interpretation of actual gagings. In such gagings the last two factors listed become important. For a short, quick storm, the value of *C* will be less than for a severe storm following a long moderate rain. A light rain falling on frozen ground will give a relative high run-off. In recording a measured value of *C*, the distribution of the impervious area should be noted. In a long narrow area a smaller run-off will result if the impervious area is mostly at the far end of the area. For maximum conditions these factors are not so important. However, as the determination of the values of *r* and *C* depends upon a correct interpretation of the existing and increasing number of actual gagings, these factors cannot be omitted.

Run-off Data.—The only practical way to determine the actual run-off of sewered areas is to measure it, and selections of the value of the coefficient *C* must be based on a sufficient number of actual gagings. Below are brief compilations of most of the published records of gagings of storm flows in sewers arranged in such a manner as to throw as much light as possible on the value of *C*. The data so far obtained in the Sanitary District are also given. The coefficient *C* is defined as the ratio

(1) of the average rate of rainfall for a period of time equal to the time of concentration for the particular area,

(2) to the maximum rate of flow in the sewer following the period of concentration. Gagings in which the duration of the rainfall was much less than the stated time of concentration have been excluded, and a few gagings in which the duration of the rainstorm was greater than the time of concentration have been included, to indicate the increase in the proportion of run-off as the area becomes saturated.

1. *Rochester Data.*—These data were secured in a scientific manner, all details being carefully worked out and all conditions being fully stated. Automatic rain gages were not used, but the gages were read during storms whenever the intensity appeared to vary.

The values of *C*, selected in Table XIV, appear to be typical. The percentage of impervious area on each district is not recorded, but a careful description of each district is given in the original paper. The population per acre for District 1 has been computed approximately from the data given.

2. *New York Data.*—The record of Mr. Hering's gagings of the Sixth Ave. Sewer, New York, have been tabulated and published by Mr. C. E. Gregory. Mr. Gregory states that the gagings "were made with a single clock gage which recorded the depth of flow in the sewers. The water surface slopes, therefore, had to be assumed. Mr. Hering states in his report that conditions were suitable for the safe application of a slope formula, and it may be only a matter of opinion whether or not this was true. The most serious objection is that the automatic gage from which the rainfall rates were obtained was two miles distant in Central Park, and these rates were checked with the rain gages on the area for total amounts only."

The tributary area is stated to have been 221 acres, of which 90 per cent was impervious. The time of flow through the longest line of sewer was 15 minutes, to which should be added 5 to 10 minutes to give the time of concentration. The rates of rainfall for durations corresponding to the time of concentration are not given, the longest short time storm recorded being for 16 minutes and the shortest long time storm being for one hour and 15 minutes duration. The average results are given in Table XV.

The values of *C* in Table XV are probably too small, because the duration of the storms was less than the time of concentration, and consequently the rainfall was computed as flowing from too large an area, giving a larger volume of rainfall than was actually tributary, and hence a smaller run-off than the true run-off. Mr. Gregory states that in seven of these storms "the percentage run-off in each storm varies only 5 per cent from the average of 39 per cent of the average rain for 15 minutes (the time required for the water to flow from the most remote part of the watershed), or from 50 per cent if this time be taken as 25 minutes." As a value of *C* to use in computations for maximum conditions, both these values seem low. A value equal to or greater than 69 per cent seems more practicable.

3. *Milwaukee Data.*—These gagings were made for a graduation thesis at the University of Wisconsin. They were made on an 8 ft. sewer in Milwaukee during a period of six weeks in the summer of 1898, an automatic float gage being used. The total tributary area was 1,138 acres and was residential in character, containing about 18.5 per cent of street area. The rainfall records were taken from the United States Weather Bureau automatic gage and were checked by comparison with a city rain gage which was read by means of a graduated stick at the beginning, and at the end of each rain and at times of noticeable change in the rate of rainfall. These two gages were about two miles from each other, and one to two miles from the drainage district. The two gages agreed fairly well and the writers felt safe in saying that "at least on those rainfalls used in the discussion, * * * the rainfall was uniform over the entire section, and fell with the registered intensity." The results of these gagings are summarized in Table XVI.

It is interesting to observe that the percentage of run-off increases with the intensity of the rainfall.

4. *Cambridge, Mass., Data.*—In 1900 a series of observations of storm flows in sewers

was made in Cambridge, Mass. The gagings were platted by Mr. Freeman and the following data have been taken from his diagrams. The Shepard St. and Sherman St. Sewers were gaged. The characteristics of the drainage areas of these two sewers is stated to be as follows:

	Shepard St.	Sherman St.
Tributary area in acres	56.5	61.8
Percentage in roof area	12%	10%
Percentage in streets	24%	18%
Percentage in lawns and gardens	64%	72%
Total number of houses	155	292
Houses from which roof water runs directly into sewer	80	87
General slope of drainage area	28 per 1,000	32 per 1,000
General characteristics of soil	Clay	Sandy

No statement of the time of concentration is given. For areas of this size it should not exceed 20 minutes, so that rates approximating this duration have been selected in computing the values of *C* given below. The rates of rainfall and the rates of discharge in the sewer are shown by Mr. Freeman diagrammatically.

1. Gagings made during a long, steady rain:

	Time after beginning of rain.	Av. rate of rainfall in ins. per hour.	Max. rate of discharge in sewer, cu. ft. per sec. per acre.	Value of C.
Shepard St.—				
Feb. 25...	2 hrs. 10 m.	0.30	0.07	23.3
	3 hrs. 55 m.	0.34	0.13	38.3
	5 hrs. 30 m.	0.275	0.15	54.7
	6 hrs. 20 m.	0.27	0.16	59.3
May 3....	5 hrs. 25 m.	0.43	0.05	13.6
	6 hrs. 25 m.	0.56	0.14	25.0
	8 hrs. 25 m.	0.30	0.095	31.6
Sherman St.—				
May 3.....	5 hrs. 35 m.	0.43	0.28	65.0%
	6 hrs. 55 m.	0.565	0.44	78.0%
	8 hrs. 35 m.	0.33	0.33	100.0%

2. Gagings of typical heavy summer showers:

	Av. rate of rainfall in ins. per hour.	Max. rate of discharge in sewer, cu. ft. per sec. per acre.	Value of C.
Shepard St.	1.00	0.32	32.0%
	0,70	0.35	50.0%
	1.80	0.51	28.3%
Sherman St.	1.00	0.45	45.0%
	0.70	0.20	28.8%
	1.80	0.70	38.9%

3. Gagings typical of steady, heavy rainfalls on ground saturated by a previous rainfall:

	Av. rate of rainfall in ins. per hour.	Max. rate of discharge in sewer, cu. ft. per sec. per acre.	Value of C.
Shepard St.	0.365	0.17	46.7%
	0.15	0.08	53.3%
Sherman St.	0.365	0.365	100.0%

These gagings show the effect of saturation in increasing the impervious area and the effect of the character of the soil.

5. *San Francisco Data.*—Mr. C. E. Grunsky, in an elaborate paper on the sewer system of San Francisco, gives the values of *C* in Table XVII as those used in estimating the required storm water capacity from the rate of rainfall. San Francisco is a hilly city, having relatively steep surface slopes.

These coefficients were used in the computations by the rational method in 1899. Mr. Grunsky states, after further investigation, that the quantities of run-off resulting from the use of these coefficients are reasonably close for areas with impervious surfaces, but will probably give too small values for small areas which are only partly pervious.

6. *St. Louis Data.*—Mr. W. W. Horner states that the coffiecient *C* should not be considered the proportion of total rainfall reaching the sewer, but represents the relation between the maximum rate of run-off and the average rate of rainfall during the critical time. For a district carrying a population of about 40 per acre, and having about 45 per cent of entirely impervious area, he suggests the average values of *C* given in Table XVIII.

Mr. Horner suggests that further data will establish slightly lower values for the short times and greater values for the longer periods. This increase in the percentage of run-off with longer downpours was apparent also in the Milwaukee gagings.

In designing for maximum conditions, it may probably be assumed that the short intense rainfall controlling the sewer size occurs after a lighter rain which has already saturated the ground, so that the larger values of *C* should be used.

TABLE XII.—U. S. WEATHER BUREAU GAGE, RAINFALL RECORDS, 1905-1912, 8 YEARS, AT NEW YORK CITY.

(Courtesy of Chas. Saville.)

Rate Per Hour and Total Number of Downpours.

Duration of downpours in minutes.	1.0-1.2 In.	1.2-1.4 In.	1.6 In.	1.8 In.	2.0 In.	2.2 In.	2.4 In.	2.6 In.	2.8 In.	3.0 In.	3.2 In.	3.4 In.	3.6 In.	4.0 In.	4.5 In.	5.0 In.	5.5 In.	6.0 In.	6.5 In.	7.0 In.	8.0 In.	9.0 In.
5	14	8	7	5	3	2	5	1	2	2	1	0	0	1	1	2	1	1	1	0	0	1
10	12	1	3	6	4	2	1	3	0	1	0	0	1	2	0	1	0	1	0	0	1	..
15	5	5	4	3	4	1	0	0	3	1	..	..	..	..	1	1	..	..	1	0	..	..
30	7	5	4	0	1	0	0	0	1	1	..	..	..	..	..	..	..	..	..	..	..	..
60	2	2	0	2	0	0	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total	40	21	18	16	12	5	7	4	6	5	1	0	1	3	2	4	1	2	2	0	1	1

7. *Birmingham, England, Data.*—The gagings made by Mr. Lloyd-Davier in Birmingham are very complete. The sewer discharges were determined by measuring the elevation of two points of the hydraulic grade line just back of the sewer outlet. The rainfall records were taken "by means of three self-registering recording rain-gages surrounding the selected area, and for several of the heaviest storms the record from a fourth gage, in the center of the area, was also used." Three sewers were gaged, a summary of the gagings being given below. It is stated that the run-off in excess of 100 per cent for the Bordesley St. Sewer results from the impossibility of determining exactly the intensity of the precipitation for very short periods. The author gives, as one result of the investigation, that "the storm water discharge from any defined district is directly proportional to the percentage of imperviable area comprised in it."

TABLE XIII. — U. S. WEATHER BUREAU GAGE, RAINFALL RECORDS, 17 YEARS, AT RICHMOND, VA.

(Courtesy of Allen J. Saville.)

Rate Per Hour of Rainfall and Total Number of Downpours.

Duration of downpours in minutes.	1.0-1.5 In.	1.5-2.0 In.	2.0-2.5 In.	2.5-3.0 In.	3.0-3.5 In.	3.5-4.0 In.	4.0-4.5 In.	4.5-5.0 In.	5.0-5.5 In.	5.5-6.0 In.	6.0-6.5 In.
5	4	1	2	3	2	1	1	1	..	0	1
10	3	3	3	3	..	1	..	1	1	..	..
15	1	3	3	1	1	..	1	1	..	..	..
20	1	7	2	1	1	..	..	1	..	..	..
25	2	6	3	2	..	..	..	..	1	..	..
30	3	6	2	..	1	..	..	..	1	..	..
35	2	6	3	..	1	..	..	1	..	..	..
40	1	4	2	1	..	..	1	..	..	..	..
45	3	4	..	1	..	1	..	..	..	..	..
50	3	3	..	..	1	..	..	..	..	..	..
60	4	3	1	1	..	..	..	..	..	..	..
80	2	1	..	..	..	..	..	..	..	..	..
100	2	..	..	..	..	..	..	..	..	..	..
120	1	..	..	..	..	..	..	..	..	..	..
Total	32	47	21	13	7	3	3	5	3	0	1

(1) Moseley St. Sewer:

Drainage area, 312.5 acres. Population per acre, 96.0. Percentage of drainage area impervious, 100 per cent. Number of buildings, 7,866. House area, 78 per cent. Street area, 22 per cent. Average slope of area, 1 in 60. Time of concentration, 18 minutes.

Minimum, maximum and average results of 28 gagings:

Date.	Rainfall, ins. per hr.	Sewer flow, C.F.P.S.P.A.	C.
Feb. 4, 1904....	0.198	0.246	124%
Sep. 13, 1904....	0.326	0.110	34%
Average			83%

(2) Charlotte Road Sewer:

Drainage area, 232 acres. Population per acre, 17.2. Number of buildings, 500. Street and road area, 10 per cent. Estimated amount of imperviable area, 18 per cent, increasing to 42 per cent as the perviable area becomes saturated. Time of concentration, 12 minutes.

Minimum, maximum and average results of 21 gages:

Date.	Rainfall, ins. per hr.	Sewer flow, C.F.P.S.P.A.	C.
Mar. 8, 1904.....	0.100	0.029	29%
Aug. 22, 1904.....	0.165	0.048	29%
May 21, 1904.....	0.198	0.030	15%
Aug. 17, 1904....	0.338	0.051	15%
Average			22.4%

(3) Bordesley Street Sewer:

Drainage area, 19.32 acres. Population per acre, 147.0. Percentage of drainage area impervious, 100 per cent. Number of buildings, 568. Street area, 25 per cent. House area, 75 per cent. Time of concentration, 6.5 minutes. Minimum, maximum and average results of 8 gagings:

Date.	Rainfall, ins. per hr.	Sewer flow, C.F.P.S.P.A.	C.
Mar. 29, 1904....	0.240	0.304	126%
Apr. 14, 1904....	0.414	0.386	93%
Average			105%

These gagings show that from small, totally impervious areas, the whole rainfall may run off as fast as it falls. From larger areas, also totally impervious, the run-off is smaller.

8. *Miscellaneous Data.*—Mr. Alva F. Grover describes some sewer gagings made in Kansas City. The percentage of the *total* rainfall discharged by the sewer was measured and recorded, as given in Table XIX.

TABLE XV.—PROPORTION OF RUN-OFF FROM NEW YORK GAGINGS.

Data.	Values of C.
1. Average run-off from 13 storms of duration less than 10 minutes	34.0%
2. Average run-off from 25 storms of duration equal to 10 minutes	44.5%
3. Run-off from one storm, lasting 13 minutes	37.7%
4. Run-off from one storm, lasting 15 minutes	69.0%
5. Run-off from one storm, lasting 16 minutes	45.8%

No explanation of the high run-off on Sept. 27 is given.

Mr. Gregory notes a single gaging made at Hartford, Conn., by Mr. F. L. Ford. He states that the greatest lack in the gaging is for accurate knowledge of the characteristics of the watershed. Three automatic rain gages were adjacent to the tributary area. The results of the gaging follow:

	Acres.
1. Tributary area	280
2. Percentage of impervious area	45.0
3. Time of flow through longest line of sewer (minutes)	17.0
4. Equivalent uniform rate of rainfall (ins. per hour)	3.4
5. Duration of this continuous rate of rainfall (minutes)	17.0
6. Observed value of C (per cent)	10.0

It is possible that the time of concentration should be increased to allow for the time of flow over the surface to the sewer. If the characteristics of the watershed are uncertain, the recorded proportion of impervious area may be excessive. Modification in both of these figures might explain the low value of *C*.

TABLE X.—U. S. WEATHER BUREAU RAINFALL RECORDS, JULY, 1897-JULY, 1912, 16 YEARS, AT CINCINNATI, OHIO.
(Courtesy of H. S. Morse.)
Rate Per Hour of Rainfall and Total Number of Storms.

Duration of storms in minutes.	1.0 In.	1.1 In.	1.2 In.	1.3 In.	1.4 In.	1.5 In.	1.6 In.	1.7 In.	1.8 In.	1.9 In.	2.0 In.	2.1 In.	2.2 In.	2.3 In.	2.4 In.	2.5 In.	2.6 In.	2.7 In.	2.8 In.	2.9 In.	3.0 In.	3.1 In.	3.2 In.	3.3 In.	3.4 In.	3.5 In.	3.6 In.	3.7 In.	3.8 In.	3.9 In.	4.0 In.	4.1 In.	4.2 In.	4.3 In.	4.4 In.	4.6 In.	4.9 In.	5.1 In.	5.5 In.	5.6 In.	5.8 In.	6.5 In.
5	..	..	1	..	..	..	2	2	3	4	9	..	5	4	7	4	7	..	6	7	5	6	1	..	2	5	2	..	2	..	1	1	..	1	1	1	1	..	1	1	..	1
10	..	1	..	..	5	1	3	5	4	13	11	4	9	7	4	4	4	2	..	3	1	2	1	..	..	2	..	1	..	1	..	1	1	..	..	..	..	..	..	..	1	..
15	1	1	2	3	5	9	9	3	13	3	5	2	4	4	3	2	2	1	1	..	..	2	..	1	..	1	..	..	..	2	..	..	..	..	..	..	..	..	1	..	..	..
20	4	..	5	10	4	7	4	2	4	3	1	4	2	2	2	2	1	..	..	..	..	1	..	..	..	1	1	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..
25	3	7	4	4	1	6	5	1	2	4	2	1	3	1	..	..	..	..	..	..	1	..	..	1	1	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..
30	4	1	3	6	6	2	..	2	3	1	2	1	..	..	..	..	..	..	..	2	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..
35	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
40	5	5	3	1	2	2	1	..	1	1	1	..	..	1	..	1	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
45	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
50	1	1	1	2	1	1	..	1	..	..	1	..	..	1	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
60	..	2	1	1	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
70	1	..	1	1	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
80	1	..	..	1	..	..	1	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
90	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
100	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
120	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

TABLE XI.—U. S. WEATHER BUREAU GAGE RAINFALL RECORDS, 1899-1912, 13 YEARS, AT MINNEAPOLIS, MINN.
(Courtesy of F. H. Bass.)
Rate Per Hour of Rainfall and Total Number of Downpours.

Duration of downpours in minutes.	1.0 In.	1.1 In.	1.2 In.	1.3 In.	1.4 In.	1.5 In.	1.6 In.	1.7 In.	1.8 In.	1.9 In.	2.0 In.	2.1 In.	2.2 In.	2.3 In.	2.4 In.	2.5 In.	2.6 In.	2.7 In.	2.8 In.	2.9 In.	3.0 In.	3.1 In.	3.2 In.	3.3 In.	3.4 In.	3.5 In.	3.6 In.	3.7 In.	3.8 In.	3.9 In.	4.0 In.	4.1 In.	4.2 In.	4.3 In.	4.4 In.	4.5 In.	4.6 In.	4.7 In.	4.8 In.	4.9 In.	5.0 In.	5.1 In.	5.2 In.	5.3 In.	5.4 In.	5.5 In.
5	..	3	8	2	1	2	..	1	3	1	6	2	..	3	..	2	1	3	..	1	4	2	..	1	1	..	4	..	1	..	..	..	..	..	..	..	..	1	1	..	1	..	..	..	..	1
10	1	..	5	1	10	3	2	3	8	3	2	6	4	2	2	5	3	2	1	..	2	..	..	1	..	..	1	1	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
15	..	4	1	3	8	5	4	5	4	4	4	1	3	2	3	1	1	..	4	..	2	..	1	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
20	3	1	4	3	6	3	3	6	5	1	1	4	1	3	..	1	2	1	1	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
25	1	4	5	4	3	2	1	3	3	1	1	2	1	1	1	1	1	..	..	1	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
30	1	3	2	4	4	1	2	2	1	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
35	3	4	5	3	2	2	..	..	2	..	..	4	..	..	..	2	..	..	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
40	3	1	3	1	..	2	2	1	..	..	..	1	..	..	..	..	..	2	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
45	1	2	1	2	1	..	..	..	1	1	..	..	..	..	..	1	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
50	..	3	2	1	..	..	2	..	..	1	..	..	..	..	1	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
60	3	1	1	1	1	..	..	..	..	..	1	1	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
80	..	2	..	2	..	1	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
100	..	..	..	..	1	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
120	..	1	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

The foregoing data comprise most all that has been published. It is understood that gagings are under way in St. Louis and Brooklyn, and it is hoped that the results of these gagings will be published from time to time, so that the selecton of the proper values of *C* may be done with greater certainty.

Gagings have also been made in Philadelphia, Pa. The results can be found in the annual report of the Bureau of Surveys for 1911. It is hoped that these and other data will be arranged for presentation and discussion.

TABLE XVII.—SAN FRANCISCO DATA.

Population per acre.	Value of C.
20	30.0
30	40.0
40	50.0
50	55.0
60	60.0
70	65.0
80	70.0
90	73.0
100 and higher.	75.0

Four sewers have been gaged in the Sanitary District. These are the Robey St. Sewer, discharging into Bubbly Creek; the Diversey Blvd. Sewer, discharging into the North Branch; also the Davis St. Sewer in Evanston and the Cherry St. Sewer in Winnetka, both discharging into Lake Michigan. Weirs were built at the outlets of all these sewers, and Bristol water level recording gages were installed. The records secured at Winnetka and Evanston are the most reliable.

The Robey St. area lacks uniformity, and a description of the controlling conditions is difficult. The street grades are above the general ground surface, so that a great deal of the area does not discharge rainwater to the sewer, except as it percolates through the ground. The paved and sewered streets are scattered quite irregularly over the area, which is very long and narrow. No rain gage is located on the area, but the gages at Center Ave. and Western Ave. are on either side and only two miles apart, so that a fairly close approximation of the rainfall is possible.

TABLE XVI.—PROPORTION OF RUN-OFF FROM MILWAUKEE GAGINGS.

1. Date of storms, 1898—	July 31.	Aug. 6.	Aug. 2.	Aug. 23.
2. Duration of rain, minutes	30	15	85	25
3. Average rate of fall during this period, inches per hour	0.1	0.173	0.28	0.72
4. Tributary area for this duration	490.0	170.7	1,138	421.0
5. Value of C	13.0	19.0	20.0	38.0

The Diversey Blvd. area is more regular. Unfortunately, however, the nearest rain gage is the government gage on the post office, 4.5 miles south, the next nearest being the gage at Evanston, 8.25 miles north. The records derived from these two sewers can only be considered approximations, and would not be included, were it not for the comparative scarcity of such gagings.

The conditions for securing accurate gagings at Evanston and Winnetka are satisfactory. The records of the gagings follow:

Winnetka Gagings.—In May, 1912, a rain gage was placed on the village hall in Winnetka, and in July, 1912, a sewer gage was placed at the outlet of the Cherry St. Sewer. This sewer receives the house and storm sewage of the northeastern section of the village. The total tributary area is 381 acres. The rain gage is located about 3,500 ft. from the sewer outlet, in the southwest corner of the tributary area. The area is practically all residential. A careful study of the area indicates that the impervious area amounts to 10 per cent. The population per acre is about 4.5. The area is rectangular, about one mile long and 0.6 mile wide, the Cherry St. outlet being at the extreme southeast corner. The time of concentration is, therefore, comparatively large. It is estimated that 60 minutes is required to make the whole area tributary. A short ridge about 30 ft. high cuts across the center of the area in a north and south direction; above and below the ridge the surface slope is about 4 per 1,000. The outlet sewer is a 26-in. by 39-in. egg shaped brick sewer. Computations, based on the gagings of seven storms, are given in Table XX.

Rabey St. Gagings.—The Robey St. Sewer drains approximately 2,513 acres of house and storm sewage. The population per acre (1911) is 15.5. The area is about 5.6 miles long and varies in width from 0.8 to 1.0 mile.

TABLE XVIII.—ST. LOUIS DATA.

Duration of rain, minutes.	Per cent run off from Impervious portion.	Per cent run off from Pervious portion.	Value of C.
10	60	20	40%
15	70	30	50%
20	80	35	55%
30	85	40	60%
60	95	50	70%
120	95	60	75%

About 7.6 per cent of the area is impervious. The area is practically flat throughout, and most of the lots lie below the street grade. The outlet sewer is a 9 ft. brick circular section. The time of concentration for the whole area is estimated to be seven hours. Practically all of the impervious surface, however, is in an area tributary to the sewer outlet within five hours. The area adjacent to the outlet contains very little impervious surface. The area which becomes tributary during ordinary storms lasting from two to four hours, therefore, contains most of the impervious surface, and this equals about 15 per cent of the smaller area. The time of concentration was taken off the sewer gage as being the time after the sewage surface first began to rise to the time of maximum discharge. The tributary area was then computed to correspond. No short storms have been included. The rainfall was taken from the records of the rain gage at 31st St. and Western Ave., about one mile away. The computations of the records are given in Table XXI.

TABLE XIV.—PROPORTION OF RUN-OFF FROM ROCHESTER GAGINGS.

Item.	District X.			District IX.			Dist. XVII.			District IV.			District I.		
1. Tributary area	25.12			132.96			92.27			128.67			356.94		
2. Population per acre	40			36			35			32			20		
3. Probable time of concentration (mins.)	16			23			24			26			44		
	T.	R.	C.	T.	R.	C.	T.	R.	C.	T.	R.	C.	T.	R.	C.
4. T=Actual duration of storm	20	.80*	35.2	30	.24*	38.2	30	.24*	20.8	35	....	26.2	60	.31*	13.8
R=Av. ratio rainfall, duration stated.	15	.76†	41.2	30	.30*	29.6	30	.30*	17.0	30	.24*	15.5	50	.47‡	19.8
C=Percentage of run-off.	15	1.62‡	24.7	20	.80*	35.2	20	.80*	37.4	30	.30*	15.8	35	....	16.4
5. Average value of C			33.7			34.3			25.1			19 2			16.7

*Preceded and followed by lighter rain.
†Heavy shower preceded by lighter rain.
‡Sudden shower followed by lighter rain.

TABLE XX.—RAINFALL AND RUN-OFF CHERRY ST. SEWER AT WINNETKA, VALUES OF C.

Date, 1912.	Time before maximum discharge. Minutes.	Area tributary in this time, acres.	Av. rainfall during this time. Inches per hour.	Av. rainfall during this time. Cu. ft. per second.	Maximum flow in sewer in excess of dry weather flow.	C.	Remarks.
July 20	75	381	0.163	62.1	13.5	21.7	Sudden moderate shower.
July 20	50	320	0.200	64.0	15.0	23.4	12 hours after previous storm.
July 23	25	160	0.450	73.9	15.5	20.9	Short, sharp shower.
July 28	60	365	0.154	56.2	12.3	21.8	Second of two showers.
Aug. 8	30	195	0.390	76.8	11.7	15.2	Short, quick storm.
Aug. 9	75	381	0.22	82.3	13.0	15.8	8 hours after previous storm.
Nov. 12	20	130	0.90	116.8	20.2	17.3	Sharp, short shower.

Diversey Blvd. Gagings.—This area contains about 725 acres. Of this it is estimated that 22 per cent is impervious during dry weather. The population per acre (1911) is 32.5. The district is about 2.4 miles long by 0.5 mile wide. The area is very flat and many of the lots lie below the street grade. The time of concentration for the whole area is estimated to be 75 minutes, and 580 acres are tributary in 60 minutes. The intensity of rainfall was proportioned by distance between the intensities recorded at Evanston and on the Chicago Weather Bureau gage. The outlet is a 7 ft. 6 in. brick circular sewer. The records of two storms are given as follows:

TABLE XIX. — TOTAL PROPORTION OF RAINFALL REACHING SEWER IN KANSAS CITY.

Date, 1892.	Duration of storm. Hr.	Duration of storm. Min.	Total rainfall, ins.	Per cent of total rainfall discharged.
Aug. 23	2	25	0.77	16.0%
Sept. 8	2	35	0.13	12.0%
Sept. 27	2	55	0.32	60.6%
Oct. 13	1	55	0.18	4.7%
Oct. 17	.	..	0.40	10.7%
Oct. 31	.	..	0.65	11.1%

(1) Oct. 11, 1912.—Short storm; no previous rain. Evanston gage recorded 0.34 in. in an hour and the U. S. gage 0.31 in. Assuming a rainfall of 0.32 in. over the Diversey Blvd. area, the value of C is estimated to be 22.7 per cent.

(2) Oct. 31, 1912—Long storm; ground previously soaked. Both gages showed 0.05 in. per hour rainfall. At this rate the whole area was contributing to the sewer. The estimated run-off is 67.7 per cent. These two rainfalls were not severe and were quite uniform over a large area.

SUMMARY.

A brief summary of the measured values of C is given below.

(a) For suburban residential districts, with average slopes and populations of about 5 to 10 per acre, C may have a value of 20 to 25 per cent.

(b) For urban residential districts with flat slopes and populations up to 35 per acre, the value of C will range from 25 to 40 per cent.

In hilly localities where the lot areas become saturated and the run-off can reach the sewer, this value of C may be as high as 70 per cent.

(c) For thickly built-up urban districts, the value of C will vary from 60 to 100 per cent.

These values are, of course, approximate only. It is believed that for each particular design a beter choice can be made by close reference to the original records of the gagings or the summaries presented herein. A diagram of run-off from sewer areas for $C = .20$ and $C = .15$ is given herewith as Fig. 2.

CONCLUSION.

Only general indications of values are intended in this paper. It is hoped that the paper will suggest lines along which further data will be presented in such shape as to bear, with some degree of uniformity, upon the rainfall and run-off problem. The Sanitary District data are not as yet complete.

With regard to the standard formulas it would seem that they are particularly useful in large sewerage districts in which the results in practice of the application of a formula are known, and the sewerage department has become used to expressing their judgment through the formula. They are dangerous in that they can be used without thought, and they do not adapt themselves so well to refinements in the design. The storm sewerage of a town or city is the most costly part of the system. Careful design may effect a considerable saving. A rule-of-thumb method, or the application of a formula without judgment, should be no longer necessary.

Sanitation in Jerusalem.—Since the work of sanitation was inaugurated in the city of Jerusalem by Nathan Straus, noticeable progress has been made in stamping out malaria. A health department on American models has been established, and is supported by the Ottoman Government. The work was begun last August by dividing the city into 30 districts and making a systematic study of health and sanitary conditions.

Method and Cost of Operating a Waste Paper Baling Press in Connection With Collection of Municipal Refuse in Evanston, Ill.

Contributed by H. H. Sherer, Superintendent of Streets, Evanston, Ill.

A short description of the location of the City of Evanston will make plain the reason for the installation of a system of paper collection other than the usual method of hauling it mixed with ashes or, as perhaps is more commonly done, with rubbish such as cans, bottles, rakings from lawns, etc.

Evanston has a frontage of four miles on Lake Michigan and has an average width of two miles.

The garbage of the city is taken care of at a central disposal station. It is hauled from this point by farmers and is used by them for hog feed or fertilizer for about six months of the year. The garbage is cremated the remaining six months.

Until eight months ago all the domestic refuse outside the garbage was hauled by 2-cu. yd. single box wagons or 3-cu. yd. double dump wagons. Many complaints were made by residents throughout the city because of loose paper blowing from the wagons as they went to the dump. More acute complaints were made by owners of property facing on, or in close proximity to, the lake front where the rubbish is used as filling. After an "off the lake" breeze the gutters, lawns and hedges close to this "fill" were covered with papers which had worked loose from the ashes or other rubbish.

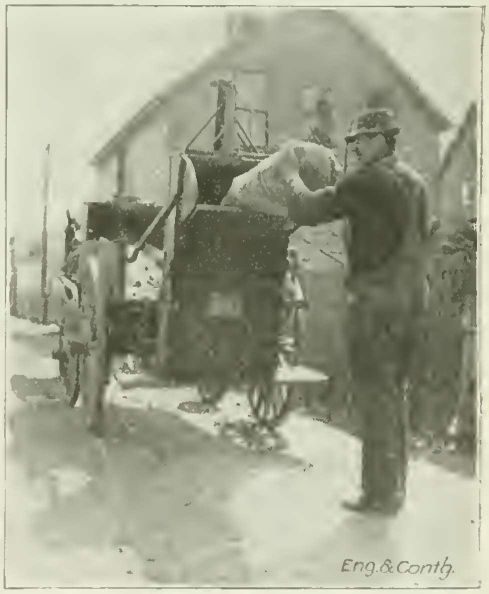

Fig. 1—View Showing Method of Handling Waste Paper and Loading Baling Press, Evanston, Ill.

A solution for this annoying problem was demanded and has been found in the baling press, owned and operated by the municipality as are the rest of the wagons used in rubbish collection in this city.

After a careful survey of the field we were to operate in, it was decided that it would be best to use a press which could be mounted and operated on a wagon.

Obviously the greatest part of the paper was to come from the business districts, which are three in number. The merchants were notified of our intention to confine all waste paper and cardboard boxes in 2½-bushel gunny sacks which they might then have on hand in their basements or which could be purchased for 10 cts. at one of the department stores. The response was almost unanimously in favor of the plan and it was put in force in each of the three districts on three successive days. Notice was given by the alley inspector that collection of the paper so bagged would be made on a certain day each week, naming the day.

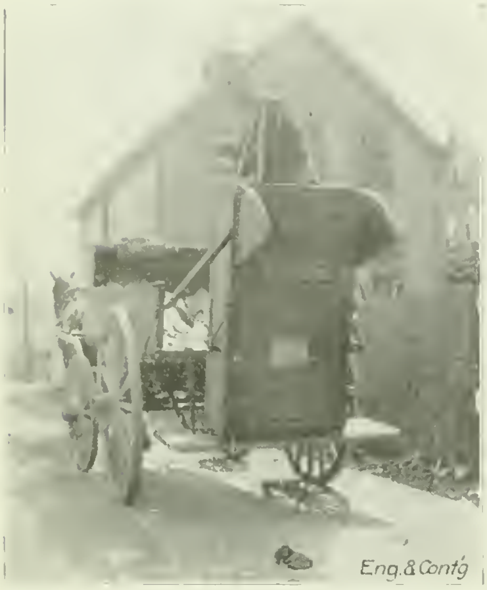

Fig. 2—Method of Compacting the Paper Into Bales.

The city is naturally divided into two parts by traction lines into the East and West sides. With this predetermined division, three districts were laid off on the East or Lake side of the city and separate from the business districts already mentioned. Each of these districts were comprised of some eight miles of alleys and were given each a separate day for collection. The request made by the inspector who canvassed these districts was that on the morning of the day that collection was to be made that the sack or sacks of paper should be hung just inside the alley gate. Nearly all those canvassed approved of the plan, though but 20 per cent have taken advantage of it in the resident portion of the city.

The success of the plan was immediate and even greater than we expected. The press is of steel, weighing some 300 lbs., and is mounted on the step of an old exercise wagon of the fire department. The handle is worked from the box of the wagon. Later developments have shown our choice of wagons a happy one, for there is ample room to store whatever rags are picked up en route under the wagon seat while the space next adjoining will accommodate at least 25 bales of paper. One man and a single horse are employed in this work.

The bales of paper are in size about 18 ins. x 24 ins. x 32 ins. and weigh from 85 to 100 lbs. apiece, though some are brought up to 125 lbs. when magazines or cuttings from printers' shops are included.

TABLE XXI.—RAINFALL AND RUN-OFF ROBEY ST. SEWER. VALUES OF C

Date, 1912.	Time before maximum discharge. Minutes.	Area tributary in this time, acres.	Av. rainfall during this time. Inches per hour.	Av. rainfall during this time. Cu. ft. per second.	Maximum flow in sewer in excess of dry weather flow.	C.	Remarks.
Sept. 21......	120	580	0.130	75.4	5.0	6.6	First part of storm.
Sept. 28......	120	580	0.070	40.6	6.0	14.7	Latter part of storm
Oct. 2......	180	900	0.033	29.7	5.0	16.8	Last part of long storm.
Oct. 8......	120	580	0.060	34.8	3.5	10.0	First part of light rain.
Oct. 22......	195	990	0.111	109.9	18.0	16.3	Last shower in 6-hour storm.
Oct. 30......	210	1080	0.034	36.7	4.7	12.8	Long, light rain.
Oct. 31......	240	1290	0.052	67.0	18.0	26.8	Last shower of a 10-hour storm.

To bale the paper the upper portion of the baler drops down as does a package shute on a mail box, as shown in Fig. 1. Into this opening the heads of the sacks of paper are inserted and shaken until the press is full. The handle, lever like, is then brought in play to compresse the mass, as shown in Fig. 2. After two or three more refillings and pressings the wire (comon hay wire is in use here) is drawn taut around the bale while still under compression. The wire is pulled through grooves in the frame of the press.

Now as to the cost of the equipment and the returns on the investment. We are using a horse which has outlived its usefulness as a rubbish carrier and the exercise wagon of the fire department, which is worth about $50. An ordinary laborer at $2.40 per day of eight hours handles the work, averaging 12 bales each on 6 days of the week.

Two of these bales by actual test made up a 2-cu. yd. wagon load of paper. Six loads of rubbish per day is the average for the 2-cu. yd. wagons from the district in which the press operates. Therefore this press takes a day's work each week from the routes of each of six men who cover the East side of the city for rubbish. This permits them to increase the service to all in their districts with the added advantage which cannot be too strongly emphasized of having far less loose papers blow down the alley to the street corners, to litter up the gutters, and startle horses.

The last point I wish to make relates to the actual dollars and cents return to the city. Assuming that the month is a short one of 20 working days, we will say that 12 bales averaging 80 lbs. are the product of each day's endeavor. At a price of 35 cts. per 100 lbs., which we find is the average for eight months' trial, $65 or more is turned over to the city collector every four weeks. This a little more than pays for the service and does much good.

We at present let bids every month or so for this product of our alleys, with the stipulation that all prices shall be for the paper as it stands in a shed at the city yards where it is brought each evening by the collector. This does away with further hauling, which we figure would reduce our profit even though we could get a slightly better rate in carload lots.

An ordinance compelling the use of bags for confining the paper will be put in effect as soon as provision can be made for collections on the West side of the city.

The appearance of the mounted press is not unsightly, though it at first occasioned considerable comment. The newspapers have been watching the results and are strongly urging co-operation with this department as a means towards securing the best of clean streets for Evanston.

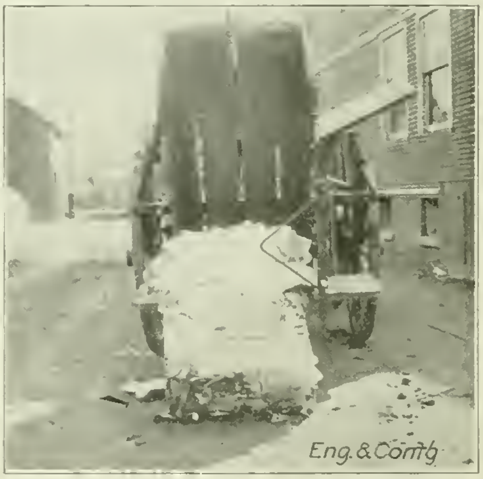

Fig. 3—View of Bale Wired and Thrown Out of Press.

BRIDGES

The Economic Theory of Drawbridge Design.

Contributed by Henry Grattan Tyrrell, Consulting Engineer, Evanston, Ill.

The forms of movable bridges are so numerous that it is difficult to invent or propose a type that has not been tried or used at some previous time, and many of those which have been patented during the last twenty years are merely revivals of earlier ones. The student or inventor may occasionally believe that he is evolving new ideas on the subject, while further research in the history of bridge building will show that his plans have all been worked out before.

Movable bridges belong to the few dynamic structures, the design of which falls to civil engineers. They are a combination of structure and machine, and must be treated as other machines, and their parts proportioned according to the lessons of experience rather than from simple calculations. Their perfection is, in fact, a development comparable with the evolution of the steamship and locomotive. The builders of the early steam engines when preparing their plans doubtless made the best possible use of their mathematical knowledge, and yet so great has been the change that the creation of James Watt's genius would hardly be recognized today as the prototype of the present railway locomotive. The condition with bridge building is somewhat different, for it was seldom that an engineer would design more than a very limited number of movable bridges, and too often instead of benefiting by the experience of others he has endeavored to try some new ideas, with perhaps no better results than had his predecessor. It is only in recent years since the subject has engrossed the whole attention of a special class of bridge engineers that the greatest progress has been made. Advancement has been greatly aided by recent competition, showing a variety of carefully studied plans for meeting or overcoming the same conditions.

Essentials.—Movable bridges are composed of (1) the structures, and (2) the machinery. The framing should be designed much like fixed bridges, excepting that as movable ones are subject to harder service, they should be proportionately stronger and more rigid. A few principles of design which are applicable to nearly all forms will be given:

(1) The mechanism should be the simplest possible for economy, both in construc-

tion and operation. As a general rule, the simplest design with the least frictional resistance and least cost of construction, operation and maintenance is the best. Those who are awed by the marvelous complexity of machinery are bestowing admiration where it is not deserved, for complexity is more often the mark of inferiority than of merit.

(2) Rapid action must be secured wherever necessary, to cause the least delay to road and river travel. This is frequently, though not always, essential, such a one as the direct lift at Nyasaland, Africa, opened only occasionally by eight men in 25 minutes, being well suited to its need.

(3) Durability of parts with minimum repairs is essential, as the bridge is useless when out of order.

(4) Minimum operating force is desirable, not only to reduce the cost of power, but also because the amount of wear is usually proportionate to the operating force.

(5) The center of gravity of moving parts should be as low as possible and should either be fixed or travel in a horizontal direction only, for then the machinery has no lifting duty.

(6) Parts should approach a state of equilibrium at all times, so the machine will have only friction to overcome.

(7) The weight of moving parts should be a minimum, and none should move, which could as well remain stationary.

(8) When the bridge is closed, the structural parts should act as nearly as possible like a well designed fixed span, the structural parts and machinery having separate duties, the latter being free from all stress when in place.

(9) Parts must have certain and positive action, such uncertain elements as ropes, chains, adjustable counterweights, flexible connections, etc., being used with caution.

(10) The bridge must be safe at all times for both road and water travel, with gates or other protection across the road when the bridge is open.

(11) The bridge should suit natural conditions, without obstructing or interfering with adjoining rights or property.

(12) The greatest clear waterway should be provided at the least cost, subject to other requirements.

(13) The structure should present a pleasing appearance and be equal to, or superior in dignity, with its surroundings.

Design.—No one type is the best for all conditions, for that which is suitable for one place may not be fitting for another. The choice of design will depend on many conditions, some of which are: (a) Height of road above water, (b) frequency of openings, (c) nature of counterweight, (d) possible use of counterweight pits and (e) number of principals and depth of floor, etc. The relative height of road and water has perhaps more influence on the form than any other imposed condition. This will determine whether the bridge shall be of deck or through construction, and may also fix the lower chord outline, permitting or precluding an arch form

On the frequency of openings depends the power equipment, and often the selection of type, some of which are not suitable for rapid operation.

It is often economy to increase the first cost by extra equipment, in order to save the wages of attendants, or the choice may lie between the use of shore towers with light counterweights or much larger counterweights without them. When a thin floor is required, more than two lines of trusses or principals may be needed to avoid raising the roadway.

Almost any kind of movable bridge can be made to work satisfactorily by giving proper attention to its design and construction, but for economy and efficiency, each one should receive individual attention and special study to meet its particular need.

Possible Future Improvement.—Bridges are now being installed according to the above principles, but it is quite possible that improvements may develop in several directions, some of which are noted below:

(1) The use of lighter or stronger structural material, such as aluminum or nickel steel, would reduce the weight of framing.

(2) A durable but lighter floor than is now known would also reduce the weight and cost of the supporting parts.

(3) A more general use of improved mechanical details free from patents is generally desirable.

Provision for Travel Under Bridges.—Large openings are desirable over most navigable channels, that boats may easily pass without danger of crowding.

Fenders of some approved form should guard the channel at each side, and the distance between them, rather than the length between abutment walls, is the clear span. The opening must be large enough for the largest boats and greatest travel, but on canals or other narrow waterways, it is usually permissible to make the clear openings less than the channel width, for the central channel only will be used for travel, a space of each side equal to the width of boats being occupied by vessels at the docks. The Miami and Erie canal in Ohio, with a normal width of 50 ft. for three lines of 15-ft. boats, has openings of only 32 ft. at the bridges, wide enough for two boats to pass.

TABLE I.—SWING BRIDGES WITH DOUBLE DECK.

Place.	Over	Date.	Type.	Span.	Truss.	Lower.	Upper.
Rock Island	Mississippi	....	Swing	366	.....	......	2-R. R.
Albany	Hudson	1877	Swing	397	.....	Hy.-2 wk.	R. R.
Chicago, Wells Street	Chicago	1888	Swing	...	.....	......	R. R.
Chicago, Lake Street	Chicago	....	Swing	...	.....	......	R. R.
Portland, Ore.	Willamette	1889	Swing	340	.....	R. R.	Hy.
Florence	Tennessee	1891	Swing	412	.....	Hy.	R. R.
Newport, Minn.	Mississippi	1895	Swing	442	.....	Hy.	R. R.
Charlestown	Charles	1897	Swing	240	.....	Hy.	R. R.
New Westminster	Fraser	1904	Swing	380	.....	R. R.	Hy.
Kansas City	Missouri	1904	Swing	424	.....	R. R.	Hy.
Newark, N. J.	Pasaic	1904	Swing	221	.....	R. R.	R. R.
Houghton, Mich.	Portage Canal	1905	Swing	160	.....	R. R.	Hy.
New York City	Harlem Canal	1906	Swing	...	.....	......	R. R.
Liverpool	Stanley Dock	....	Swing	...	.....	......	......
Bristol	Avon	1907	Swing	202	27′ 9″	R. R.	Hy.
Hamburg	———	1908	Swing	155	28′ 2″	Hy.-wk.	4-R. R.

When the river is wide enough, two channels are preferable to one, as the travel in two directions is then separated, but this is not possible on narrower courses, as the center pier is too great an obstruction. Double openings of 60 ft. each proved acceptable on the retractile bridge at Swansea in 1864. Over barge canals, the bridge must span both water and tow path, for if the path were outside the bridge, the towing line would have to be disconnected when the boat passed.

In comparatively narrow channels where width is needed for unrestricted waterflow, short spans over the water at the sides for the approaches are preferable to filled abutments. On swing bridges with unequal arms, the turntable may be placed on a framed platform above the water, as was done on the Anglesea swing over the Lee at Cork, rather than to extend masonry out into the water; or if unequal arm bridges revolve on a solid pier, the short arm may travel on a track supported on small cylinder piers, as is done on the Hawarden bridge over the Dee. Piers made of clusters of connected cylinders offer small obstruction to the flow of water, and are, therefore, preferable in some cases to those of solid masonry.

The determination of the right of way for travel on roadway and water will depend upon their relative amounts, the boat men preferring to have the bridge always open, while the highway traveler wants it always closed. The usual position of the bridge will depend upon the predominating course of travel. The old lift bridge of 1868, over the Oureq canal at Paris, was always open except occasionally when closed for trains, after the passage of which it was again opened; and in 1874 the water travel at Old Point street bridge at Providence was so great at certain times of the day that the swing was allowed to remain closed for only two minutes at one time. The best compromise between road and water interests is to place the bridge high enough above water for a large part of the smaller craft to pass under, and provide it with power for rapid operation, thus avoiding loss of time. The bridge should be closed during the crowded hours of street travel, and opened freely at other times, especially at night. Those in Chicago must remain closed between the hours of 6 to 8:30 a. m. and 5 to 6:30 p. m.

Provision for Road Travel.—It is evident that the road must be wide enough to accommodate the travel, and in other respects the bridge must be suitable to its location. Heavy pavements and buckle plates on bridges for ordinary country roads are plainly inappropriate. Cases in which these principles were ignored are the bridges over the Manchester Ship Canal at Moorlane and Warrington, which are better than bridges in some parts of London, though leading from nowhere to nowhere. In thinly settled districts, and especially on long bridges where only small funds are available for a bridge of any kind, it may be excusable to make the road wide enough for only a single line of vehicles, with increased width at occasional intervals, as was done on the Chemong Lake pontoon bridge in Ontario in 1901, which had a length of 3,638 ft. and five extensions in its width. Another permissible plan for light travel is to decrease the width from the center toward the end, as on the Mira River double swing, where trusses were 15 ft. apart over the pier, decreasing to 10 ft. apart at the outer ends. Such economy should not be practiced or considered where funds are available for a better structure. It is generally convenient and economical to divert sidewalk travel from the main road and place it on a bracket outside the truss, and sometimes vehible travel is divided by a curbing through the center, as in the double swivel bridge of 1876 at Havre, or by a center truss, as in some of the bridges in Chicago, though the latter method usually increases the cost.

For adjoining lines of railroad and highway on the same level, it is best for safety to separate the ways by a high fence, as on the Victoria bridge at Montreal, or the double swings at Omaha, Neb.

Duplex Bridges.—Road and waterways may both be kept open at all times by means of a Duplex bridge, which was first proposed by General Butler in 1801, similar ones having been proposed by Palmer and Barnett for the Thames. A more practical plan than these is the one used for the Weaver River at Northwich, where two separate bridges were placed only a short distance apart, one of which can always be in readiness for road traffic. In case one bridge should become disabled, the other would still be in service, while injury to a large one with the combined capacity of the two smaller ones would stop travel completely. For this reason double bridges of the bascule type are common, as at the crossing of the Metropolitan Elevated Railway over the Chicago River, where two double track rolling lifts stand side by side.

Number of Decks.—Bridges for combined railroad and highway travel are usually made with two decks, the railways being the upper one. When the upper deck has a solid waterproof floor, as on the Rock Island and Hambourgh bridges, it serves as a roof for the highway under it, where passengers are more exposed to the weather than in the cars. The bridge may be built at first with only a single deck, but strong enough for the addition of another one, such as those added to the Wells street and Lake street bridges in Chicago, eight years after the first construction. The type is useful in and about large cities where roads are elevated to avoid grade crossings.

In some respects the upper deck is more suitable for vehicles and pedestrians, for the view is less obstructed, and it forms a more agreeable driveway and promenade, many notable fixed ones, such as the Eads Bridge in St. Louis, being of this type. Double decks are not easily applied to bascules, and such bridges as those just mentioned can probably be most economically renewed by heavier swings, though several designs have appeared for two deck structures at La Salle Street, Chicago, and one or more built elsewhere. A portion only of the space available for double decks may be used, as on the Charlestown swing with four trusses, where the upper space between the center trusses is utilized by two lines of elevated railroad, the corresponding outer spaces being occupied by trussing. Railroad bridges needing many tracks may run passenger trains on the upper level and freight trains below, as on the Passaic River swing at Newark, N. J. An upper emergency deck for pedestrian travel may sometimes be utilized, as on the Tower bridge at London, which is served by elevators for use in case of accident to the opening span.

Provision for Widening.—Bascule bridges are easily widened by placing another span beside the original one. Provision may be made for widening swing bridges by placing the pivot on the original bridge a few feet out of center; then when another swing is placed beside the original one, with its pivot an equal distance out of center in the opposite direction, the two can be operated at the same time without interference. This method was used on the railway swing over the Ems at Weener in 1884, where pivots were 5 ft. out of center; and 14 years later on the Kinzie Street swing over the Chicago River, where the center of rotation was placed under one truss. Swing bridges which are to be widened in the future can have their trusses made strong enough at first, so other roadways can be placed outside the trusses on cantilever brackets, a plan which was used on the double swing at Omaha. This bridge, with trusses about 30 ft. apart, carried only one line of railway at first, but is strong enough for two tracks between the trusses and 16-ft. roadways outside.

Swing bridges with unequal arms can be duplicated by an adjoining one, the center of rotation of one span being further back from the water than the corresponding center of the other, both spans opening in the same direction and folding together over the abutment like a parallel ruler. This method was used in 1871 for the Peene River bridge at Anclam. The adjoining spans may open in opposite directions, from different sides of the water course, as at Cleve over the Spoy canal.

Number of Trusses.—Two lines of trusses are generally the most economical as far as construction itself is concerned, but when greater head room is required for boats, it may be cheaper to use a greater number of trusses with thin flooring rather than raise the whole bridge. Beside costing more, additional trusses are an obstruction to travel and, therefore, not desirable. Four track railroad bridges may have either two or three lines of trusses, the former being preferable, not only requiring less metal but a smaller center pier. In the first case, double tracks lie between the trusses with another track on cantilever brackets at each side, while bridges with three lines of trusses have double tracks between each line. With only two trusses, the center pier can be much smaller than with three, the diameter being about 43 and 60 ft., respectively. Comparative estimates made by Mr. Schaub for the superstructure of a bridge at 95th St., Chicago, showed that a three-truss design would cost $86,000, while one with only two lines would cost $59,000, or more than 30 per cent less. Four trusses are used on swings at Charlestown, Mass., and at Third Ave., New York, the width being 100 ft. and 87½ ft., respectively, the floor thickness on the Harlem River swing being limited to 20 ins.

General Outline.—The outline of a bridge should show its purpose and action. Swings and cantilevers should be deepest over the pier, tapering out to less depth at the ends. Curves are aesthetically preferable to straight lines and approximations to them can be used with panel points on the curve and straight lines between them. Curved bottom chords nearly always look well, and they are truthful construction for either arch or cantilever. Double leaf bascules with true arch action are stiffer than cantilevers, and are acceptable on solid foundations, but are unreliable on yielding soil such as that at Chicago. The eight track bridge at Campbell Ave., Chicago, with arch action when closed, has lately been replaced by trusses with vertical reaction only.

One or Two Leaves.—Both single and double leaf bridges have long been used. Double bridges have a better appearance than single ones, and are suitable for highway bridges and light loads, but the duplicate opening machinery makes them cost more, and the center lock is too uncertain for heavy trains and locomotives. Most of the cast iron swivel bridges in use from 1840 to 1870 had double leaves on turntables at either side of the channel, with true arch action when closed, which increased their stiffness. The Rhyl bridge, built previous to 1871 for heavy loads, had two leaves, and was found to be a mechanical failure; and many others since, as the one at Campbell Ave., Chicago, previously mentioned, have been replaced by single leaves, though a two leaf railroad bascule at Chicago is still in operation.

Tail Anchors.—Another objection to double leaf bascules is their expensive tail anchors. The double swing of 1861 over the Penfield at Brest is counterweighted on the tail end for dead load only, the live load on outer arms being resisted by tail anchors to the masonry. The Dunkerque swivel bridge of 1851 had interlocking ends, as had the double swing at Buccleuch Dock, all of which were below the floor. Some recent ones, like the Vernon Ave. Bridge, Brooklyn, and 22nd St., Chicago, have overhead anchors above the roadway clearance.

Skews.—Square crossings are nearly always preferable to oblique ones, and it is usually better to use a somewhat longer span with square framing than to adopt skew construction. Yet on very wide bridges the increased length of span for the square crossing might be so great as to be impracticable. In such cases there are several compromise methods which may be used.

(1) Two or more independent square spans may be placed side by side, each of which is long enough to permit square framing. The expedient is well suited for bascules, direct lifts, retractile draws and horizontal revoluing swings with eccentric centers of rotation. It was used for the six track bridge over the Fort Point channel at Boston, which has three separate rolling lift spans side by side. Similar unsymmetrical and framing may be seen in the railroad bascule bridge over the Chicago river at Kinzie street.

(2) Another method of treating skew spans is to place the trusses or principals at right angles to the channel, the skewed deck being supported thereon by means of floor beams, the ends of which extend out laterally beyond the principals, a method which was used at Hamilton Ave., Brooklyn, and over the Oswego Canal at Syracuse, N. Y. The latter bridge, which is a single leaf bascule, has a width of 110 ft. and a span of only 44 ft.

(3) Narrow bridges with only slight skew may sometimes have square framing and piers parallel with the current, the pier width being great enough so the bridge shoes on the piers can be placed at right angles to the center line of bridge, as on the Aignes-Mortes swing of 1874.

Aesthetic Treatment.—Ugliness in bridge design may usually be attributed either to the incompetence of the designer or to restrictions imposed upon him, which are beyond his control. The latter excuse is, however, too frequently offered where it is not sufficient. Some of these limitations are as follows: (1) Number of decks and their relative position, (2) elevation of deck above water, (3) under clearance required, (4) angle of crossing, whether square or skew, and (5) grade.

Movable bridges show a greater lack of aesthetic treatment than almost any other form, and many of them are about as ugly as could be imagined. Like other kinds, they must depend chiefly on their outline for their appearance, and their form should, as far as possible, show their purpose and action. If a wrong outline is chosen, no amount of after treatment can remedy the error, as was well proven by the balanced bridge over the Royal Canal at Dublin.

Each individual case requires different treatment, and a form which would be most suitable for one location might be quite unsuited to another. Bridges in cities like Chicago, London and Berlin, where the land adjoining the river is low, are perhaps the most difficult to treat satisfactory; and yet these cities, especially the last, have many examples of merit.

The number of decks and their height above the water greatly influences the design, and the required under clearance will usually fix the bottom outline. Deck bridges are nearly always preferable to through ones, and should be used wherever enough height is obtainable beneath the floor for framing. Parts above the deck obstruct the view, and may be a serious hindrance to travel, especially during crowded hours or in such emergencies as fire. When enough height is available, a curved form generally looks better than a straight one, though the latter leaves more space for the passage of boats and river craft. The height of floor above water, the length of span and number of leaves will also determine whether the floor must be above the principals or between them. The design is also influenced by the angle of crossing, whether square or skewed, and by the approach grades. In some cases, where the piers must stand parallel with the current, the angle of the skew may be small enough so that the ends above the piers may be arranged as though the bridge were square, enough space being available on the top of piers for arranging the shoes to the proper angle. In any case, skewed end panels, as on the bascule over Fort Point channel, Boston, and near Kinzie St., Chicago, should be avoided where possible.

Features which may usually be arbitrarily selected are: (1) Number of principals, (2) kind of principals, truss or girder; (3) number of leaves, (4) outline of principals (5) and bracing.

The surroundings of a structure greatly affect its appearance. They should always be neat, and when possible should have enough space adjoining so the bridge will stand out conspicuously. Landscape gardening at the ends, such as may be seen about the old Budapest suspension bridge, is most appropriate.

Some Features of Highway Bridge Practice Without Engineering Supervision.

The statements and illustrations of extravagant bridge work which follow happen to apply to the state of Iowa. They are given in the "Iowa Engineer" by F. R. White and J. H. Ames, assistant engineers, Iowa Highway Commission, and have therefore the stamp of accuracy. They are not published here to hold up Iowa practices for condemnation but to exhibit a condition which is true of many states in which highway bridge work is without engineering supervision. We quote as follows:

No accurate statistics are available regarding the number of the bridges in this state. Adair county in the southwest part of the state has 4,200 bridges, of which over 2,000 are 20-ft. span or above. The majority of these 4,200 bridges are of more or less temporary nature and will require attention soon. Polk county has 930 bridges with an average span of 34 ft. Seven hundred and fifty of these bridges are at the present time either wood or steel, and are in very bad condition. This county has spent over $300,000 in the construction of 265 concrete structures which have an average span of 10.5 ft.

From the statistics available it appears that the average county has approximately 1,600 bridges. The average cost of replacing these structures with permanent work as shown above will be about $1,000 per bridge, or the total cost for building all the bridges of permanent construction will amount to $1,600,000 per county, or for the ninety-nine counties in the state the cost of permanent bridges will be about $158,400,000.

The state has expended in the past year, approximately, $7,500,000 on roads and bridges; an average of $76,000 for each county. The proportionate expenditure for roads or for bridges cannot be accurately determined, but the bridge fund for the majority of the counties is close to $30,000 per year. In addition to that, the townships spend a large amount of their road fund on culvert work so that the funds as now spent are about equally divided betwen roads and bridges.

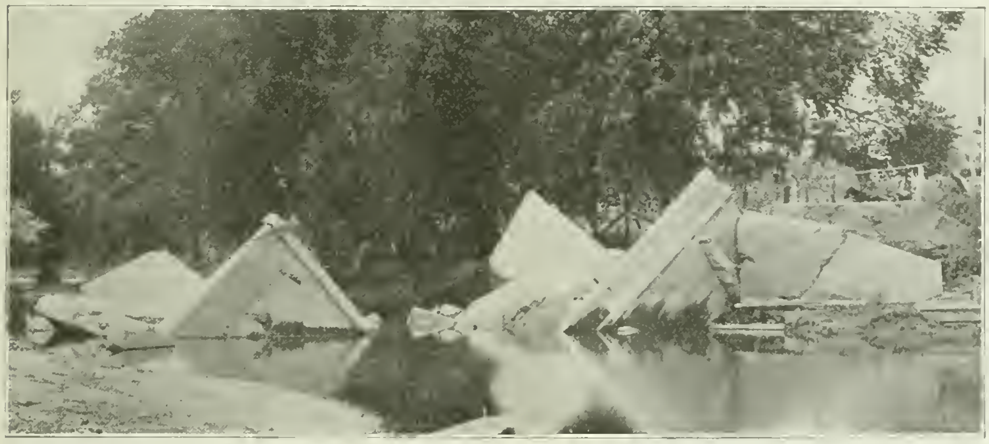

Fig. 1.—Failure of 50-ft. Arch by Flood Widening and Wash Out Behind Abutments.

The yearly contract system is in vogue in many of the counties of the state. Under this system bridge contracts are let in blanket form. They call for no specific number of bridges and no specific location for any bridges bid upon, and as a result the general design and the location of the structure in the field is left to the supervisor and bridge company's foreman. When such a contract is let, it is impossible to have detailed plans for the various bridges. Where any plans at all are submitted with the bids, such plans are incomplete, and will not fit the varying conditions of the different locations. Consequently when any bridge is built, there is item after item of extra charge for work not called for in the contract. Such charges for work not covered by the contract often run the price of the completed work up to a figure far in excess of what the work is worth, or what it might appear from the contract that the total price would be.

As an example of this, the following bill rendered by a bridge company for repairing an old 60-ft. steel span is a good illustration. To building two concrete abutments 12-ft. deep and encasing old piers:

Building one 10-ft. 6-in. wing, one 11-ft. 6-in., one 25-ft. 9-in., and one 11-ft. 6-in. wing	$2,935
Driving 11 steel piles at $7 each	77
Lowering old bridge 4 ft. and cutting off old cylinders	160
Filling north and south sides, including removal of old approaches	184
Laying floor and hauling lumber and freight on same to Follett's	36
Steel joists for 60-ft. span at $5.50 per ft.	330
Lattice railing on span	96
Angle to reinforce floor beams for holding joists and drilling floor beams	74
Total	$3,882

This bridge after being repaired was yet an old, flimsy, steel bridge with wooden floor, and will have to be replaced in a few years. Under the same contract the county could have built a new 60-ft. riveted steel bridge with concrete floor for $3,830, or an amount of $52 less than the price paid and this price ($3,830) could have been reduced several hundred dollars if a competent engineer had been employed by the county, before letting the contract, to plan and superintend the work.

Bridges must not be built too small to provide sufficient waterway for passing the run off from the watershed above them, and in the interest of economy neither should they be made too large. An example of the result of providing a waterway too small is shown by Fig. 1. This structure was a 50-ft. arch bridge built in 1910. The cost to the county was about $3,000. Two years later, or in 1912, the structure collapsed during a freshet, and after the water had gone down it was found that the current had widened the channel by cutting behind the west abutment. As this was a patented type bridge which used the earth pressure behind the abutments to help support the arch, and which has shallow foundations as one of its characteristic features, the result of washing out the fill was the collapse of the structure.

As an example of building bridges too large for the demands of the drainage area, the bridge shown in Fig. 2 is a good illustration. Here a 40-ft. riveted steel span with concrete floor and concrete abutments 18 ft. high was placed over a stream having a total drainage area of 69 acres. This bridge cost the county $5,187, when the run off from the watershed could have been carried by a 4x4-ft. box culvert costing about $500. The county in which the bridge is located has an approximate area of 440,000 acres, and at the rate shown above it would cost $32,700,000 to bridge the entire county. The bridge fund in this county is about $30,000 per year, or at the above rate it would require the entire bridge fund for 1,100 years to get once over the county with so-called permanent bridges.

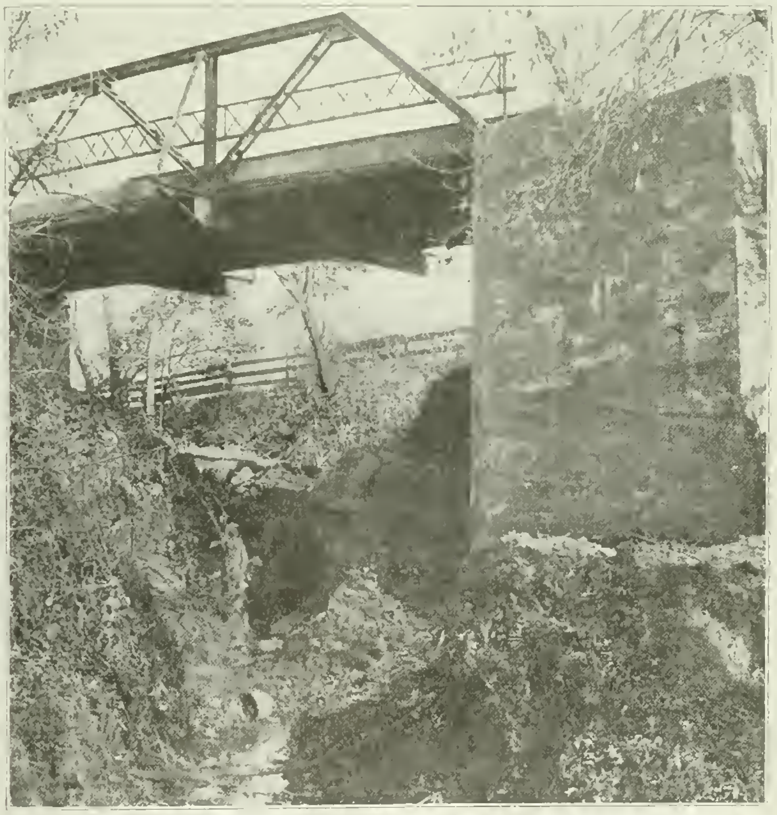

Fig. 2—View of Bridge 18 Ft. High With 40-ft. Span for Drainage Area of 69 Acres.

Under the systems usually used in the counties, the general design and the location of the structures are left to the supervisors and to the bridge company's foreman. The majority of supervisors are not trained bridge men, and the bridge company's foreman is not working for the county. As a result there are many examples of improper locations and designs. Bridges are often located several feet above the proper position. In a number of cases we have found concrete bridges located high upon the bank at one side of the stream, and with the pavement or floor 6 or 10 ft. above the stream bed. In other cases bridges are so located as to require excessive length of wing walls. In one case, a 40-ft. span steel bridge with concrete abutments and three wing walls cost $2,925. This bridge was so located that the other wing wall was made 60 ft. long, and the price paid for this wing was $2,262, or an amount nearly as great as the cost of the remainder of the bridge. Another bridge in the same county has one wing wall 80 ft. long. This wing extended out into the field, and does not hold up any fill or serve any other purpose which would justify the expenditure of so much money.

In most cases, no estimates are prepared showing the labor and material required to build a given piece of work and when the work is completed the bill presented is allowed by the board without question. This is well illustrated by the record in one county where bills amounting to $57,000 and covering a whole year's work were allowed by the board at one session which lasted not more than three hours. Apparently none of these bills were checked against the structures built as evidenced by the following:

One of the bills contained the item—

Building concrete abutments and two wings	$737.10

Investigation disclosed the fact that only one abutment had been built, and that it contained only 15.91 cu. yds. of concrete or the price paid was $46.33 per cubic yard. Another bill for construction on the bridge shown in Fig. 4 contained the item,

One-half contract price for building concrete bulkheads 16x20 ft. long on 48-in. steel culvert 36 ft. long	$390

This bridge is located on the line between two counties and hence the bill was presumably approved by two boards of supervisors. The bill apparently included only the building of the concrete bulkheads.

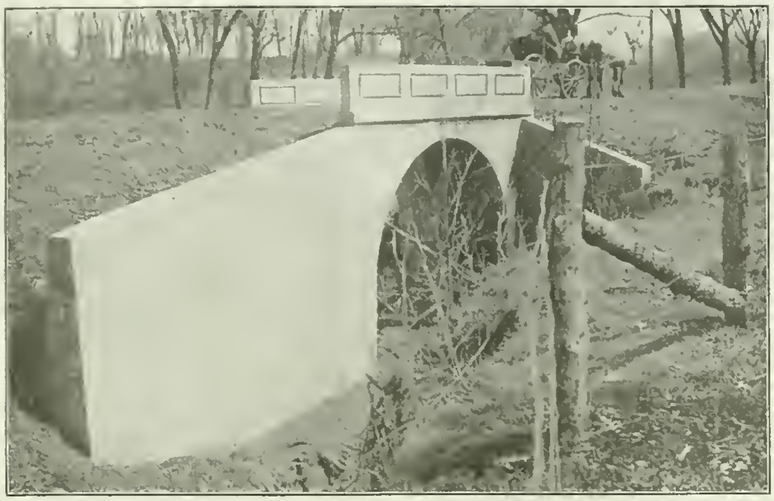

Fig. 3—View of Bridge With Excessively Long Wing Wall Due to Improper Location.

Investigation showed that the two bulkheads contained only 15.45 cu. yds. of concrete or the price paid was at the rate of $50.48 per cubic yard. According to the engineer who made these investigations, a fair cost for the concrete in each of these jobs would be $12.50 per cubic yard. Another example of the loose system under which the bridge business is handled in many counties is shown by the following invoice:

To one 14-ft. span with 12-ft. foundations	$ 720
Less acct. abutments 8 ft. deep, 8 ft. at $9	72
	$ 648
Lattice railing	28
One 16-ft. wing, one 10-ft., and two 8-ft. wings	382
Total	$1,058

When this bridge was examined it was found that the charge of $28 for lattice railing was a double charge as the railing had already been paid for in the charge of $720 for the first item.

Quite often bridges are built which provide roadways entirely out of proportion to the requirements of present or anticipated future traffic. This was well illustrated in one county where a bridge was found with a 40-ft. roadway. The location was such that an addition of filling over the culvert at some future date was impractical. The fact that the bridge was upon a road seldom frequented, made this width of roadway very excessive. Not a mile from this bridge, on an adjacent road, with a great deal more traffic, was another bridge with an available roadway of less than 12 ft. Had a study been made of present and future traffic conditions on these structures, they would never have been built as we found them.

Frequently, it is possible to relocate a road and thus avoid building one or more bridges. The following is given as a typical example. In one of the counties a new road about three-quarters of a mile long was established in such a location that two 40-ft. bridges costing over $2,000 each were required, when by a slight relocation of this road, such as any engineer would make, both of these bridges could have been avoided at a saving of nearly $4,000 and a better road secured.

Crematory Ash for Gardeners.—Arthur E. Peterson, superintendent of the Spokane, Wash., municipal crematory, has discovered that crematory ash is a valuable fertilizer and is conducting a brisk business in what was formerly a waste product. In 100-lb. sacks, large quantities are sold to gardeners in Spokane and vicinity, and to residents for lawns.

Method of Reconstructing an Old Cofferdam and Building a New Cofferdam for Two Bridge Piers.

(Staff Article.)

In constructing piers for a new bridge at Peoria, Ill., in 1911, the contractor's foreman began excavation in the interior of a cofferdam of steel sheet piling which was not sufficiently braced, and very soon the sides of the cofferdam began to give way. On one side the sheet piles bulged in as much as 7 ft. To save the dam, a subcontractor was called in who took over the work of constructing this pier and another similar pier, and successfully completed the work in two months.

The piers were 14x46 ft. in plan and about 50 ft. high. They were located in about 23 ft. of water and were carried down to rock through about 12 ft. of fill, quicksand, clay, shells and shale. When the work was taken over by the subcontractor the cofferdam—composed of a single line of 12-in. 35-lb. U. S. steel sheet piling 40 ft. long, around an area 56x24 ft.—was badly bulged, and the braces which had been placed were so badly distorted that they had to be removed and reset. The sheeting had been driven only a few feet into the bed of the river.

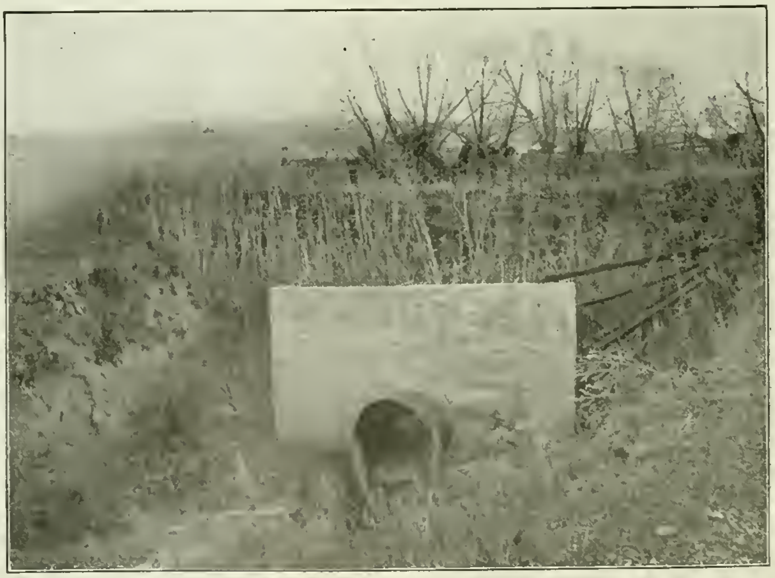

Fig. 4—Concrete Culvert Head Costing $50 Per Cubic Yard.

The first task was to determine by wash borings where bed rock would be encountered, and the next was to drive the steel sheeting down to this depth. The rock was found, about 12 ft. below the dredged bed of the river and 35 ft. below water level. The sheeting was driven by means of a hammer suspended from a derrick.

The old sets of bracing in the cofferdam had been placed too far apart, and were badly distorted. One set was out of level in one direction and another was out of level in the opposite direction. New sets were placed as fast as the water was pumped out. Some sets were placed between the old sets and vertical posts were placed between them. Rods were used to tie the sets together, and the top set was supported by hook rods, hung over the tops of the sheet piles and bolted to the timbers. The sets were wedged tight against the sheeting.

During the preliminary work a line of Wakefield piling was driven up stream from the cofferdam and in a position to protect the cofferdam from the river current. Clay puddle was placed between this piling and the cofferdam. The clay was dredged about three miles above the site of the bridge and was brought down on scows. In addition to the material required for the puddle dam, some 4,000 cu. yds. of clay were dumped around the other sides of the cofferdam.

A 10-in. centrifugal pump was started on Oct. 26, just ten days after the work was taken over by the subcontractor. The pump was operated 7½ hours, but the water was lowered only 2 ins. The pump was then stopped, and the dam filled up in two minutes. It was found that when the sheet piling had been set no wood strips had been placed in the interlocking joints. It was then decided to pour Portland cement grout into the joints. The grout was allowed to set over Sunday and the 10-in. pump was again started, but its capacity was insufficient to pump the water down. More pumps and an additional boiler were then put at work, and the dam was finally lowered and braced to 15 ft. A number of big leaks were stopped up when the water was held down to this level by the pumps. Some of the leaks through the interlocking joints were partially stopped by ⅜x2-in. wood strips which were forced down on the outside of the cofferdam along the joints. The suction of the water running through the joint drew the strip tight, and the pressure held it in place. The force of the water was so strong that these strips at times had to be driven down with a hammer to cover the entire leak.

Smaller leaks were stopped by means of manure. A box full of manure was fastened to the end of a pole and lowered on the outside of the cofferdam to the point shown by the leak on the inside of the sheeting. The box was open at the top and on one side so that the current formed by the leak would pass through the box and suck in the manure, thus gradually stopping the leak.

The outfit required to pump the water

down consisted of one 10-in., one 8-in. and one 6-in. centrifugal pump, and of one 6-in. Emerson pump. The Emerson pump was placed inside the cofferdam, and was the only pump necessary after the leaks were closed.

Excavation was begun on Nov. 6 with five men loading buckets, which were handled by a derrick and dumped alongside the cofferdam. The excavation was carried on in three shifts, and the timber braces were placed as fast as the excavation was carried down.

On Nov. 9 the excavation on the upstream side was completed, and concrete was placed in that section. The next day the whole of the bottom of the pier was concreted 8 ft. in depth. The concrete, from this time on, continued without serious interruption. As the concrete was brought up the braces were removed and short braces were substituted between the cofferdam wales and the concrete. New leaks were often started and were stopped with manure and with sacks. The cofferdam was allowed to fill up on Nov. 23, as the concrete work was then above the level of the river. The pier was completed to the coping on Nov. 25. The following day the coping forms were set, and on the 27th the pier was completed.

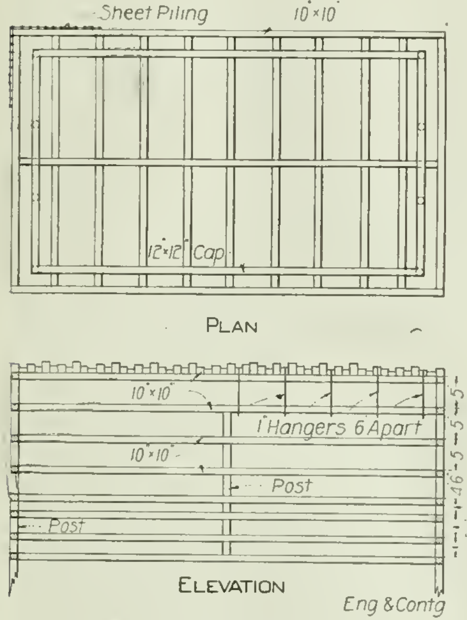

Fig. 1—General Plan of Cofferdam for a Bridge Pier.

In building the cofferdam for the second pier, a working platform was first built on the site by driving two rows of 4 piles each near the sides of the cofferdam. These were capped with 12x12 timbers, forming a rectangle inside the cofferdam which served as a working platform and as a guide for the crib bracing. The crib was built of 12x12-in. timber sets spaced as shown by Fig. 1, with vertical posts to hold the sets apart, and with tie rods to prevent them from spreading. The first set was framed to the size desired for the cofferdam area, and floated. Upon it posts were erected at the corners and at required intervals, and a second set of cribbing timbers was placed on top of the posts. The two sets were tied together with rods. The weight of the sets added caused the lower sets to sink, and when they did not sink sufficiently to make convenient the work on the next tier, they were pried down with bars and held in place.

After the cribbing had been built to the river bed the sheet piles were set around it, beginning at the middle of the upstream side and making the closure at the midde of the downstream side, so that junction could be made without interference from the current.

This crib construction was started Oct. 16; and the sheeting was started on Oct. 21. A derrick boat provided with a hammer suspended from the boom was placed for driving the sheeting on Nov. 1. The driving was completed Nov. 19, after some difficulties. The piles were driven to rock about 33 ft. below water level. It was found that a number of boulers at the bottom caused some of the piles to "hang up." After considerable driving, the piles were in some cases driven through these boulders into the shale rock below. The shape of the bottom could readily be seen by the line of the tops of the sheet piles, so that very abrupt irregularities were considered to be due to boulders, and the driving was continued at these points until the boulders were split, or the piles were forced down on one side.

When setting these piles, a 1½-in. half-round strip was placed in the groove. The half-round was held in place by several pieces of lath used as wedges and placed several feet apart along the wood strip. When the next sheet pile was set in place these wedges were knocked out by the pile as it slid down in the groove, and the 1½-in. half-round was left in place, thus forming a water-tight joint.

About 2,322 cu. yds. of material were dredged from the river, loaded on scows and dumped around the outside of this cofferdam. Excavation inside the cofferdam was begun on Dec. 1, working three shifts of men and handling the buckets of excavated materials with a derrick. The bottom was reached on Dec. 5, and concreting began the following day, working three shifts until the concrete was up to a safe point. It was up above water level on Dec. 15, which completed the work of the subcontractor.

The work was done by the John T. Walbridge Engineering Co. of Chicago, as subcontractor to the Milwaukee Bridge Co.

An Attractive Concrete Bridge at Methuen, Mass.

(Contributed.)

The recently completed "New Broadway Bridge" which spans the Spicket River on the road between Lawrence and Methuen, Mass., is an interesting example of what may be accomplished in bridge design with concrete when both utility and esthetic appearance are of importance. The bridge is a gift to the town of Methuen from Edward F. Searles, its most prominent citizen.

In designing the bridge the Aberthaw Construction Company of Boston, Mass., who also built it, followed the suggestions of the donor. It was desired to erect a structure that would serve the traffic needs of the town to the best advantage and at the same time add as much as possible to the appearance of that section. Mr. Searles did not desire anything elaborate or ornate so the bridge was designed with almost severe plainness. It is to its very severity of architectural treatment that much of the attractiveness of the bridge is due.

Concrete Bridge at Methuen, Mass.

The bridge is 80 feet long from the end of one abutment to the other, and 74 ft. 2 ins. overall width. It has three arches, each 18 ft. wide placed on 22-ft. centers. The forms for these arches were detailed at the contractor's office so that there was no confusion nor delay on the job. The details of these forms are shown in the accompanying cut. The concrete footings are 5 ft. wide and the piers themselves 4 ft. thick. A 1:2:4 mix was used.

Across the central portion of the bridge run the double tracks of the Bay State Street Railway Co. On either side of the car tracks is a roadway, and flanking the roadways are two sidewalks 8 ft. wide. The width of the roadway is just 50 ft. from one sidewalk curb to the other. The road is of macadam, and between it and the concrete bridge floor is a 3-ply waterproofing of felt and asphalt.

As will be seen from the photograph the parapet on either side of the bridge is without ornamentation being simply a wall with plain capping. The parapet was chosen in preference to an iron railing as it added enough to the artistic appearance of the bridge to pay for the extra expense. At either end of the piers is a small buttress of uniform cross sections which, despite its plainness, adds considerable to the appearance of the bridge. The surface of the spandrel and parapet walls are picked, while the edges of the arches, the floor, and the parapet capping were rubbed smooth.

Provision has been made for four electric light posts, one at each buttress. When these are installed, they will add to the general attractiveness of the bridge.

In putting in the piers a small cofferdam of 3-in. matched sheeting was sunk into the gravel bed of the river and the pier centering was hung from the horizontal sheeting braces.

A 16-in. water main that crossed the river at the bridge was provided for in the following manner: The pipe was carried on a 4-in. I-beam which rested on two trench braces at each pier. The braces placed side by side were expanded until the pipe was brought to the proper level. Then the concrete was poured around the braces and a permanent support at this level was assured.

The bridge is another to add to the long list of those built by The Aberthaw Construction Company and is in keeping with their reputation for high grade concrete work.

Drop Old Bridge Into River.—The huge Indiana span of the old Kentucky and Indiana bridge across the Ohio River at New Albany was dropped into the river recently by burning the bolts and fastenings with an oxy-acetylene burner. The contractors had concealed their plans, giving out that the bridge was to be taken down piece by piece, and as no explosives were used, only a few who happened to be passing witnessed the drop.

Railways of Argentina.—At the end of 1912 the total length of railroad lines in Argentina was estimated at 19,240 miles. The number of passengers carried during 1912 was 68,457,090. The freight traffic totaled 33,630,206 metric tons; the gross receipts for the year amounted to $114,961,218 compared with $112,649,748 for 1911. The total expenses for 1912 were $72,838,814, and for 1911 were $68,539,731.

WATER WORKS

Method of Estimating the Amount of Evaporation from Water and Soil Surfaces in the Livermore Valley of California.

I—FROM WATER SURFACES.

The water bearing gravels of the Livermore Valley form one of the chief water resources of the Spring Valley Water Company of San Francisco. In a report by the above named company on the future water supply of San Francisco, to the Secretary of the Interior and the Advisory Board of U. S. Army Engineers, the safe dependable yield of the Livermore Valley gravels was estimated at 55,000,000 gals. per day. The information given in this article is from the report to which we have referred.

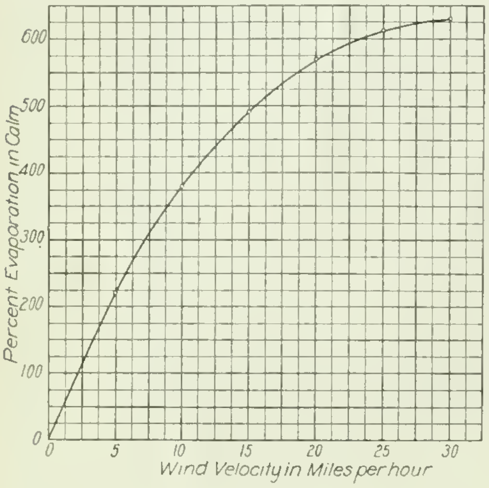

Fig. 1—Curve Showing Increase in Evaporation With Increase in Wind Velocity.

The Livermore Valley comprises an area of about 60 square miles. It is the final catchment of the water products of some 400 square miles of watershed. Besides several streams of less importance, three main streams enter it. The future plans contemplate the flood control of these streams by a combination of the reservoir and levee methods.

Up to within the last few years the western or lower end of this valley was one vast marsh and shallow lake, embracing between three and five square miles, with an abundance of such vegetation as is indigenous to soils in marshy conditions. During the entire year water from this marsh spilled over its boundaries into Laguna Creek, which carried it seaward through Alameda Creek and Niles Canyon.

During flood stages the surface streams of Livermore Valley flowed through this marsh and lake as they wasted into San Francisco Bay, and, because of the ease with which these waters could reach Laguna Creek, but little of them remained behind.

The loss from evaporation from this broad sheet of marsh lands and lake was constantly replaced, and the elevation of the water surface therein was maintained from subterranean sources under stress of artesian conditions.

It has long been known by interested and observing persons that the waters which entered this marsh from subterranean sources were the reappearance of waters from the surrounding watershed. These waters sank into the porous floor of the valley during the wet season, and, in point of fact, the lake and marsh were but the spillway of an underground lake of large proportions. The availability of a large water supply from this source has long been recognized by the management of the Spring Valley Water Company, and steps were taken to acquire property and rights which would enable this company to avail itself of the abundant water which was here annually going to waste in the form of surface run-off, evaporation and transpiration, and to utilize the great storage basin which was excavated and hemmed in by nature.

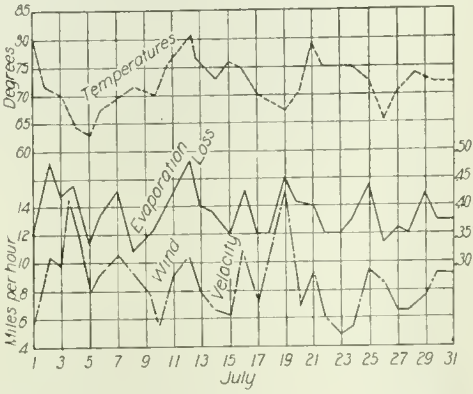

Fig. 2—Curves Showing Mean Temperatures, Average Wind Velocities and Evaporation Losses from a Free-Water Surface, Davis, Calif. July, 1909.

For the purpose of the report mentioned a study was made of the evaporation from large water surfaces and to that from surfaces of soils with varying degrees of saturation. Evaporation from water surfaces must be applied to the various surface storage reservoirs, as it is a loss that is operating constantly, and as this loss is not preventable nor recoverable, it affects the possible safe draft to a considerable extent. It was also necessary to consider evaporation from saturated soil surfaces because of the condition that exists in the westerly or lower end of Livermore Valley.

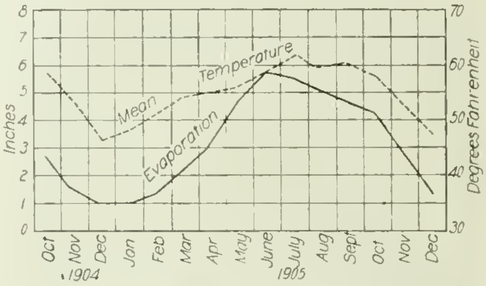

Fig. 3—Diagram Showing Relation Between Temperature and Evaporation at Berkeley, Calif.

This latter evaporation is pertinent to the underground reservoir in Livermore Valley, where by reason of the artesian pressure the water impounded in the gravel reservoir in seeking an outlet is forced upward through the denser materials in the western end of the valley commonly called the "clay cap." This causes the overlying soils to be in a state of saturation, from which a surprisingly large amount of water is lost by evaporation. That the source of this water is from the underlying gravels is made manifest from the fact that in small, swampy spots, where this upward pressure has been relieved by means of a number of large shallow wells, the soil near the wells dried out sufficiently to cultivate.

TABLE I—SYNOPSIS OF OBSERVED YEARLY EVAPORATIONS, SANTA CLARA COUNTY, CALIFORNIA, AND FLOATING-PAN EVAPORATION AS A PER CENT OF LAND-PAN EVAPORATION.

GROUP.	Nearby rain-gage. no.	1904 Inches evaporation.	1904 Floating pan as per cent of land pan. Pairs of pans.	1904 Floating pan as per cent of land pan. Means of groups.	1905 Inches evaporation.	1905 Floating pan as per cent of land pan. Pairs of pans.	1905 Floating pan as per cent of land pan. Means of groups.	Means of 2 years, in equal %
Coyote Valley Group—								
Pan No. 1, Weber, land	34	49.8	....	49.8 in.	46.7	....	46.2 in.	48.0
Pan. No. 2, Lower gorge, land	29	49.7	....		45.8	....		
Laguna Seca Group—								
Pan No. 3, Bailey avenue, land	33	53.8	....	56.6 in.=100%	55.4	....	56.9 in.=100%	56.7=100%
Pan No. 4, Laguna Seca north, land	31	62.3	.... =100%		60.4	.... =100%		
Pan. No. 5, Laguna Seca west, land	32	53.8	=100%		54.8	=100%		
Pan No. 6, Laguna Seca west, floating	31	39.4	= 73.3	41.2 in.= 72.8	43.1	= 78.6	48.3 in.= 85.0	44.8= 79.1
Pan No. 7, Laguna Seca east, floating	31	43.0	.... = 69.0		53.5	.... = 88.6		
Upper Gorge Group—								
Pan No. 8, San Felipe dam, land	35	41.7	....	45.1 in.	52.3	....	51.0 in.	48.1
Pan No. 9, San Felipe reservoir, land	7	47,2	....		45.2	....		
Pan No. 10, Upper Gorge, land	40	46.5	=100%	.... =100%	55.4	=100%	.... =100%	51.0=100%
Pan No. 11, Upper Gorge, floating	40	34.3	73.8	.... 73.8=	30.4	= 54.9	.... = 54.9	32.3= 63.4
Mean of Group Means—								
Land-pan evaporation				100%			100%	100%
Floating-pan evaporation				73.3			70%	71.3

TABLE II.—ADOPTED SAFE RESERVOIR EVAPORATIONS, INCHES PER YEAR.

Coyote Valley land pans.....=say 54 ins. per year
Coyote Valley reservoir evaporations.....=say 80 per cent of land pans=say 44 ins. per year
Laguna Seca land pans.....=say 64 ins. per year
Laguna Seca reservoir evaporations.....=say 80 per cent of land pans=say 52 ins. per year
Upper Gorge land pans.....=say 56 ins. per year
Upper Gorge reservoir evaporations.....=say 80 per cent of land pans=say 45 ins. per year

The adopted reservoir evaporations were fixed on only after a careful individual comparison with all the Pan-Records and Group Records above. One %-relation of Table I (88.6 per cent) is apparently somewhat disregarded, but it is believed that the adopted values are amply safe, especially that for the Upper Gorge Reservoir. It is believed that the adopted Upper Gorge evaporation, 45 ins. per year, will be amply safe for all the streams of the Bay Cities Water Company except Laguna Seca.

The subject of evaporation is considered in an appendix to the report. This appendix was prepared by Mr. T. W. Espy, Assistant Engineer, Spring Valley Water Company, who has had extensive experience in hydrographic work. Mr. Espy, as previously stated, considered the evaporation from both water and saturated soil surfaces. The information which follows is the portion of his study which relates to evaporation from water surfaces. A succeeding article will give Mr.

Espy's studies to determine the amount of evaporation from the saturated soil surfaces in the lower end of Livermore Valley.

EVAPORATION FROM WATER SURFACES.

The amount of evaporation from a free water surface depends upon the temperature of the water surface and upon the dryness of the air, and is caused by the difference in the vapor pressure at the water surface temperature and the vapor pressure in the air. Several factors affect these causes; those that are most easily measured are the temperature, relative humidity and wind velocity. The temperature has by far the greatest effect as it acts upon the dew point inversely to the vapor pressure. The air movement affects evaporation rate principally by its secondary effect upon humidity, as without air movement the air in contact with the evaporating surfaces soon approaches saturation and evaporation becomes a minimum.

Wind Velocity.—That wind velocity has a great effect upon the rapidity of evaporation is recognized by the most unscientific persons. The effect of wind velocity upon evaporation is well shown by experiments made by the U. S. Signal Service on evaporation and wind velocity. These experiments were made with the air at a temperature of 84° and a relative humidity of 50 per cent, by whirling Piche's Hygrometers at varying velocities on an arm 28 ft. in length. The evaporation was found to be 2.2 times as great with a velocity of 5 miles as in a calm, 3.8 times at 10 miles, 4.9 times at 15 miles, 5.7 times at 20 miles, 6.1 times at 25 miles and 6.3 times at 30 miles an hour. These results, plotted in Fig. 1, show that the evaporation due to the increase of wind velocity is very rapid at first, but gradually decreases until at after 30 or 35 miles an hour the evaporation is but little affected by increased wind velocity.

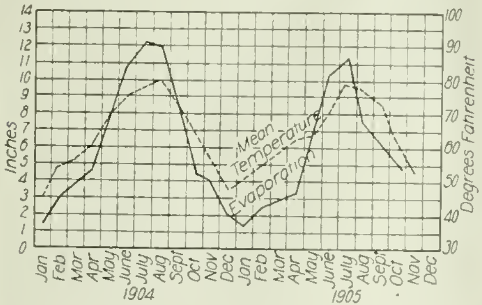

Fig. 4—Diagram Showing Relation Between Temperature and Evaporation at Chico, Calif.

Of experiments made at the Colorado State Agricultural College on evaporation, the Agricultural Experiment Station's Bulletin No. 45 says:

> The effect of the wind is to increase the amount of evaporation by bringing unsaturated air in contact with the water, and to give opportunity for the diffusion of the water vapor. From the working formula derived from the observations in 1889, each mile of wind increased the evaporation by about 2 per cent. Mr. Fitzgerald's experiments at Boston indicate an increase of 2 per cent for each mile of wind.

Evaporation is further shown to be closely governed by wind velocity by Fig. 2, taken from U. S. Department of Agriculture's Bulletin No. 248.

Water Temperature.—As a rise in the water temperature increases the vapor pressure and causes a larger evaporation, other conditions being the same, a record of the water temperature would be a gage upon the amount of evaporation. This was well demonstrated by experiments carried on in several widely distributed stations in California during 1904-05 by the U. S. Department of Agriculture and shown as follows:

Average Temperature of Water Surface °F.	Daily Evaporation Ins.
53.4	0.09
61.3	0.19
73.5	0.36
80.4	0.48
88.7	0.60

These records show a direct relation between water surface evaporation and temperature, as is easily seen by referring to Fig. 5.

In general, water temperature is not obtainable and some other method must be employed in estimating evaporation for a given locality. Air movement, humidity and water temperature are all governed to a large extent by air temperature, therefore the latter has been adopted by many who have had occasion to study evaporation loss as a gage of water surface evaporation.

In commenting on the results shown in the above table the Bulletin says:

> As the temperature of the water depends directly upon and follows closely the atmospheric temperature, the latter must be recognized as one of the controlling factors in evaporation loss.

Mr. C. E. Grunsky in his article on "Evaporation from the Salton Sea" states (page 163, Eng. News, Aug. 13, 1908):

> It may be allowable to compare the rate of evaporation during a moderately long time unit, as for a month, directly with the mean temperature of the air for the same time, and to apply the relation so established between temperature and evaporation to regions that are known to have climates similar to those at which evaporation measurements have been made.

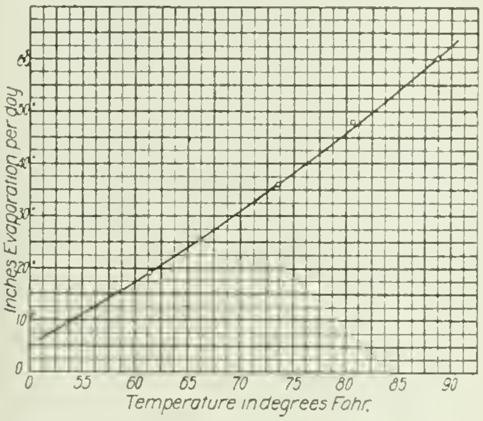

Fig. 5—Curve Showing Direct Relation Between Temperature and Evaporation.

The direct relation between evaporation and air temperature is well shown in Figs. 3, 4, 5 and 6, taken from U. S. Department of Agriculture's Bulletin No. 177.

Evaporation Records.—Considerable data have been obtained of the water surface evaporation in various places, but just how close these records apply to the evaporation that would take place from large water surfaces is in all cases questionable.

Two methods ordinarily used are either to record the evaporation from tanks floated by means of a raft in a large body of water—as a canal, reservoir or lake—or to measure the evaporation from a tank sunk into the ground until its top is level with the ground surface.

It has been considered by many that the latter method gives results much higher than should be applied to a large water surface.

Mr. Edwin Duryea, Jr., consulting engineer, made exhaustive observations during the years 1904 and 1905 (results published in Engineering News of Feb. 29, 1912) in the Santa Clara Valley, near San Jose, Cal., with eight land pans and three floating pans. While his results as given in Tables I and II show the floating pan to evaporate 73.3 per cent the first year and 70 per cent the second year of the land pan, he adopts 80 per cent as his safe reservoir evaporation for Laguna Seca and Upper Gorge reservoir.

This excess of land pan evaporation over water or floating pan evaporation was also found in observations at Kingsburgh, of which Mr. C. E. Grunsky writes (Eng. News, Aug. 13, 1908):

> The purpose of the Kingsburgh observations was not to establish any law of evaporation, but to ascertain the probable annual total from a water surface. The four-year record at that point showed 3.85 ft. as the depth of water evaporating annually from the pan floated in the river, and 4.96 ft. as the depth of water evaporating from the pan on the ground.

This water pan evaporation of 78 per cent of the land pan evaporation is believed by Mr. Grunsky to be lower than the actual evaporation from a large water surface, and he continues:

> It is believed that the evaporation measured from the pan floating in the river at Kingsburgh was somewhat less than would have occurred from a large body of open water, mainly for the reason that some protection was afforded to the pan by high river banks, a fringe of low trees and a nearby bridge, and for the further reason that the river temperature was probably a little below what would have been the temperature of an open body of water. But the pan on the ground probably showed evaporation in excess of what would have taken place from a large water surface, particularly for the reason that the water in this pan was warmer than the water surface of any large water body would have been.

Experiments Conducted by U. S. Department of Agriculture.—Experiments carried on by the U. S. Department of Agriculture in Wyoming and published in Bulletin No. 104 shows well the relation between land pan and water pan evaporation:

> To find roughly the difference in the rate of evaporation from the surface of water running in a canal and from the water of an evaporation tank, two records were kept during the season of 1900 at Wheatland. An evaporation tank was placed in the ground in the usual manner. Another tank of similar dimensions was placed in canal No. 2. The latter tank was supported on a raft which was anchored to the banks. All precautions were taken in both cases to prevent water being lost through any other source than evaporation, and it is believed that the results of the test are quite accurate. Table III gives the depths lost during each week from June 2 to October 16. The greatest loss occurred during July, the total evaporation during that month being 19.33 ins. from the tank on land and 16.72 ins. from the tank in the water. Table III shows the evaporation from each tank and the excess of evaporation from the land tank over the one in the water for each week and for the season.
>
> It is interesting to note that there is always an excess of evaporation from the land tank, and that it never exceeded 1.2 ins. for any week. Why the difference in the loss between the two tanks should vary as much as it does can not be explained. It is probably in a large measure due to the fact that the earth heats more quickly than the water. The evaporation from the tank on land would, under this assumption, be more quickly affected by every change in the temperature than from the tank in the water. It will be noticed that during the time the record was kept 66.4 ins., or 5 ft. 6.4 ins. of water in depth, was lost from the tank in the ground, and 54.45 ins., or 4 ft. 6.45 ins., was lost from the tank in the water. The difference between the losses in depth from the two tanks is, therefore, about 1 ft.
>
> When it is considered that the water in the canal is constantly moving and is subject to more or less disturbance, the loss from its sur-

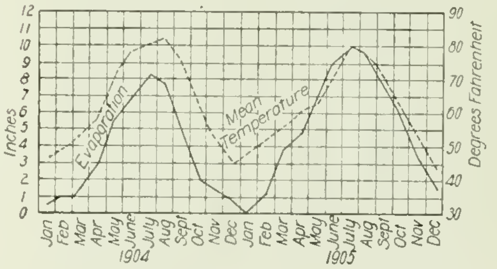

Fig. 6—Diagram Showing Relation Between Temperature and Evaporation at Tulare, Calif.

face will probably more nearly approximate the results from the land-tank measurements. The results obtained from the tank in the water will probably more nearly apply to the loss of water from the reservoir surface. However, it will likely be excessive for anything except quite shallow basins.

TABLE III—EVAPORATION AT WHEATLAND, WYO., 1900.

Date. Week ended—	Evaporation from tank on land, ins.	Evaporation from tank in water, ins.	Excess from tank on land. Depth, ins.	Excess from tank on land. Percentage.
June 9	3.50	3.00	0.50	17
June 16	3.95	3.35	0.60	18
June 23	4.00	3.60	0.40	11
June 30	4.28	3.78	0.50	18
July 7	4.75	4.25	0.50	12
July 14	4.18	3.98	0.20	5
July 21	5.59	4.39	1.20	27
July 28	3.98	3.58	0.40	11
Aug. 4	3.50	2.60	0.90	35
Aug. 11	3.63	2.63	1.00	38
Aug. 18	3.40	2.60	0.80	31
Aug. 25	3.40	2.40	1.00	42
Sept. 1	3.40	3.00	0.40	13
Sept. 8	3.40	2.20	1.20	55
Sept. 15	2.94	2.44	0.50	20
Sept. 22	2.25	1.75	0.50	29
Sept. 29	1.98	1.48	0.50	34
Oct. 6	2.02	1.67	0.35	21
Oct. 13	2.25	1.75	0.50	29
Total	66.40	54.45	11.95	22

It must be noted that the above water pan was placed in a flowing canal and that on account of the water movement in the canal the evaporation from the canal water was obviously greater than from the still water of the pan. Also that on account of the greater evaporation from the canal water it must have been constantly drawing upon the pan for heat, thus reducing the amount of evaporation that should have taken place in the pan, had the water in the canal not been in motion.

TABLE IV.

Lee Lake, 1896. Month.	Evaporation, ins.	No. days Record.	Lee Lake, 1897. Month.	Evaporation, ins.	No. days Record.
			May	4.31	24
June	6.36	15	June	9.55	21
July	9.11	32	July	8.53	21
Aug.	7.25	31	Aug.	8.61	32
Sept.	5.20	32	Sept.	8.40	31
Oct.	4.17	28	Oct.	4.60	32
Loomis Lake, 1897.			Claymore Lake, 1897.		
May	7.89	20			
June	7.91	26	May	5.22	14
July	11.87	20	June	....	..
Aug.	9.02	32	July	....	..
Sept.	....	..	Aug.	8.93	10
Oct.	4.89	32	Sept.	4.81	21
Warren's Lake, 1889.			Oct.	1.62	23
			Warren's Lake, 1890.		
May	....	..			
June	....	..	May	7.71	13
July	7.37	37	June	8.40	7
Aug.	....	..	July	5.41	29
Sept.	7.25	30	Aug.	8.06	38
Oct.	5.61	21	Sept.	....	..
			Oct.	....	..

This ability of flowing water to reduce the water pan evaporation is shown by experiments made at the Agrciultural Experiment Station at Fort Collins, Colo., and published in Bulletin No. 45 of the State Agricultural College. In these experiments observations of water pan evaporation were made upon a pan placed in a ditch passing through the state college grounds and upon several small lakes or reservoirs in the immediate neighborhood. The Bulletin says:

TABLE V—EVAPORATION FROM WATER SURFACE EXPOSED IN SHALLOW TANKS NEAR WATER OR GROUND SURFACE.

Rothamsted	England	9	17.80
London	"	14	20.66
Oxford	"	5	31.04
Munich	Germany	?	24.00
Endrup	Denmark	10	27.09
Cambridge	Massachusetts	1	56.00
Syracuse	New York	1	50.20
Logan	Utah	1	52.39
Tucson	Arizona	1	75.80
Fort Collins	Colorado	11	41.00
Fort Bliss	Texas	1	82.70
San Francisco	California	..	45 to 50
Sweet Water Res., San Diego	"	1	57.60
Peking	China	?	38.80
Demerara	South America	3	35.12
Bombay	East India	5	82.28
Petro-Alexandrowsk	West Turkestan	?	96.40
Kimberley	South Africa	?	98.80
Alice Springs	South Australia		103.50
Pomona	California	1904	66.92
Tulare	"	1904	74.68
Calexico	"	1904	108.23

A similar tank was placed in the Arthur ditch where it passes through the College grounds. Observations were taken daily. While not the same as reservoir conditions, it gives data for comparison:

	Ins.	
June, 1889	2.89	Record based on 16 days
July, 1889	4.13	" " " 31 "
Aug., 1889	3.94	" " " 21 "

From the above data we obtain the basis for estimating the evaporation at the same rate for the calendar months as given in Table IV.

TABLE VI.—AVERAGE MONTHLY AND ANNUAL EVAPORATION—CALIFORNIA STATIONS.

Month.	Chico, 1904-05.	Berkeley, 1905.	Tulare, 1904-05.	Pomona, 1904-05.	Salton Sea, 1904-08.	Calexico, 1904-05.	Laguna Seca (Adopted).	Upper Gorge (Adopted).	Lake Tahoe, 1902-1904.	Kingsburgh, 1881-1885.	Independence.	Bishop, 1904.	Sweetwater Res., 1889-97.	Arrowhead Res., 1895-97.
January	.30	1.00	1.46	2.35	2.16	3.56	1.00	.90	.97	.81	1.68	4.35	2.37	.33
February	1.14	1.36	2.74	2.11	2.64	4.03	1.00	.90	.73	1.18	2.45	2.21	1.99	.53
March	2.44	2.11	3.35	3.71	3.00	6.65	2.60	2.30	1.23	2.54	4.92	4.48	3.15	1.03
April	3.88	3.14	3.97	4.54	5.16	7.14	3.70	3.10	1.99	2.76	7.18	6.41	4.92	4.12
May	6.21	4.70	7.38	6.24	8.52	9.65	5.20	4.50	2.49	4.22	8.94	11.02	5.58	4.30
June	7.92	5.68	10.50	7.97	8.88	13.37	7.30	6.30	3.38	6.66	10.00	7.88	6.90	6.42
July	9.17	5.52	11.63	9.14	8.28	11.45	8.90	7.70	4.48	8.37	9.45	6.95	7.43	6.32
August	8.61	5.09	9.80	9.19	6.36	9.75	8.30	7.20	4.28	9.05	8.10	5.24	7.66	5.62
September	6.16	4.65	7.46	7.34	11.16	8.22	7.30	6.30	3.65	6.69	6.45	3.83	6.45	4.69
October	3.95	2.27	4.53	5.32	6.84	7.77	3.60	3.10	3.09	3.56	4.05	2.82	5.72	3.62
November	2.46	2.68	3.88	4.05	6.48	4.32	2.10	1.80	2.48	2.13	2.48	1.73	4.52	1.24
December	1.23	1.35	2.00	2.94	4.20	3.45	1.00	.90	1.29	1.18	1.54	3.21	2.38	.93
Annual	53.47	41.55	68.70	64.90	73.68	89.36	52.00	45.00	30.06	49.15	67.24	60.13	59.07	39.15

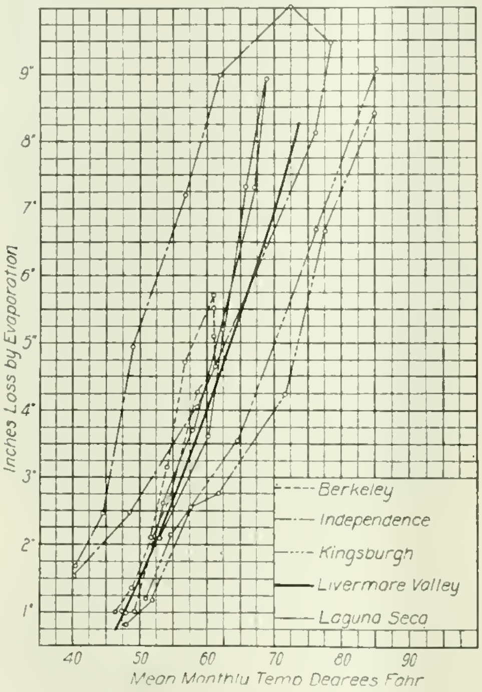

Fig. 7—Evaporation Curves Showing Probable Water Surface Evaporation in Livermore Valley.

It will be noticed that the evaporation from the tanks as given is much greater than the corresponding tank on the grounds of the Agricultural College. This difference is partially but not entirely due to temperature. The tanks in the lakes are more freely exposed to the wind than the standard tank, and this would, therefore, make a great difference.

The conclusions to be arrived at from the foregoing study is that evaporation from a large water surface is much less than is obtained by the usual land pan method, and that perhaps 80 per cent is a safe factor to apply to land pan observations.

A wide range in the total annual evaporation under different climatic conditions is shown by the Table V, taken from Prof. Hilgard's Work on Soils:

Considerable evaporation data have been collected through California which shows a wide range in evaporation. Some of these evaporation records are tabulated in Table VI.

In estimating the water surface evaporation applicable to our proposed Alameda System Reservoirs we have accepted results obtained by Edwin Duryea, Jr., in the Santa Clara Valley, California, and results obtained by Mr. C. E. Grunsky at Kingsburgh, Cal., as being on account of the close proximity and similarity of climatic conditions most applicable. These we have plotted in Fig. 7 as a function of mean monthly temperature along with results obtained in the Owens Valley and Berkeley, and from them constructed a curve applicable to Livermore Valley. From this curve we obtain a mean annual evaporation of 48.18 ins., shown in Table VII.

TABLE VII.—RATES OF EVAPORATION FROM WATER SURFACE.

Month.	Independence. Mean monthly temperature.	Independence. Evaporation in ins.	Independence. Pct. of annual evaporation in ins.	Kingsburg. Mean monthly temperature.	Kingsburg. Evaporation in ins.	Kingsburg. Pct. of annual evaporation.	Laguna Seca. Mean monthly temperature.	Laguna Seca. Evaporation in ins.	Laguna Seca. Pct. of annual evaporation.	Berkeley. Mean monthly temperature.	Berkeley. Evaporation in ins.	Berkeley. Pct. of annual evaporation.	Livermore. Mean monthly temperature.	Livermore. Evaporation in ins.	Livermore. Pct. of annual evaporation.
January	40.4	1.68	2	47.98	0.81	2	46.5	1.0	2	47.6	1.00	2.4	49.3	1.32	2.7
February	44.6	2.45	4	51.74	1.18	2	49.3	1.0	2	49.7	1.36	3.3	51.6	1.80	3.7
March	49.4	4.92	7	57.68	2.54	5	53.7	2.6	5	51.7	2.11	5.1	53.8	2.32	4.8
April	56.8	7.18	11	61.80	2.76	6	57.8	3.7	7	54.0	3.14	7.6	56.9	3.10	6.4
May	62.8	8.94	13	71.68	4.22	9	62.5	5.2	10	57.3	4.70	11.3	61.4	4.30	8.9
June	72.6	10.00	15	77.72	6.66	14	67.0	7.3	14	60.9	5.68	13.7	67.6	6.20	12.9
July	78.6	9.45	14	84.90	8.37	17	68.8	8.9	17	61.0	5.52	13.3	70.1	7.01	14.6
August	76.2	8.10	12	85.02	9.05	18	67.9	8.3	16	60.9	5.09	12.2	69.6	6.84	14.2
September	68.9	6.45	10	76.42	6.69	14	66.0	7.3	14	61.3	4.65	11.2	68.2	6.37	13.2
October	58.7	4.05	6	64.62	3.56	7	60.3	3.6	7	58.9	4.27	10.3	62.8	4.75	9.9
November	48.6	2.48	4	54.90	2.13	4	52.8	2.1	4	54.6	2.68	6.4	54.9	2.60	5.4
December	40.2	1.54	2	51.1	1.18	2	48.0	1.0	2	48.9	1.35	3.2	50.5	1.57	3.3
Annual	58.15	67.24	100	65.46	49.15	100	58.4	52.0	100	55.6	41.55	100.0	59.7	48.18	100.0

NOTE—Livermore evaporation taken from curve, Fig. 7. For Kingsburgh, temperature of Fresno adopted. For Laguna Seca, temperature of Gilroy adopted.

NEWS SECTION

Editorial Comment—Personals—Society Meetings—Trade Notes—Catalog Reviews—Contract News, Embracing Bids Asked, Work Projected, Contracts Let and Contract Prices on All Classes of Civil Engineering Construction Work.

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The Doings of the Week.

A number of good-sized railroad construction contracts have been awarded in the last few days, and a considerable amount of additional work is being figured on. One of the largest contracts of the year has been let by the Baltimore & Ohio R. R. This calls for the construction of 11 miles of additional double track railroad on the Cumberland Division. The Atlantic Coast Line R. R. is also reported to have awarded the contract for 75 miles of double tracking between Pleasant Hill, N. C., and Richmond, Va., but details as to this are not obtainable at this writing. The Canadian Pacific Ry. is calling for bids for clearing, grubbing and grading on three contracts near Kamloops, B. C., the aggregate length of which is 58 miles; the Lehigh Valley R. R. has taken figures on an extension of the Seneca Falls branch east to Cayuga Junction; and the Kentucky Southwestern Railway, Light & Power Co. of Paducah, Ky., has been taking contractors over the route of its projected 55-mile line from Paducah to Murray, Ky. Among the railroad construction contracts let recently are the following: Balimore & Ohio R. R., Sec. 1, Kefauver & McLaran, Baltimore, Md.; Sec. 2, H. S. Kerbaugh & Co., Philadelphia, Pa.; Sec. 3, Kefauver & McLaran and H. S. Kerbaugh & Co.; Sec. 4, H. S. Kerbaugh & Co.; Sec. 5, Bennett & Talbott, Greensburg, Pa.; Sec. 6, Smith & McCormack, Easton, Pa.; Sec. 7, Bennett & Talbott; Sec. 8, Smith & McCormack; Walsh Construction Co., Davenport, Ia., for a considerable amount of work in Ohio for the Big Four R. R.; Fred Baxter, Superior, Wis., for grading for an 8-mile spur for the Minneapolis, St. Paul & Sault Ste. Marie Ry., from Wahkon, Minn.; M. P. McGrath, 2 Woodland St., Worcester, Mass., for constructing the Carolina & Georgia Ry., a new line projected to extend from Augusta, Ga., to Columbus, 75 miles; Casciato & Ragione, Portland, Ore., for a 2-mile extension of the Mt. Hood R. R. from Dee, Ore.; M. P. McGrath, Worcester, Mass., for constructing 406 miles of line for the Central Canadian R. R., extending from Montreal to Ottawa and the Great Lakes; J. J. McCaughey, Chicago, Ill., for team work for the third track of the Burlington from Galesburg to Wataga.

Very little construction work is being advertised at the present time by the various states. Ohio is calling for bids on two small contracts and Pennsylvania has asked proposals on three contracts. In Virginia the State Highway Commissioner will open bids on May 7 on 38 miles of macadamized road in Augusta County. A bill was introduced in the New Hampshire legislature last week calling for an appropriation of $1,000,000 for constructing three cross-country highways. The Maine Legislature has passed the general highway bill providing for a State Highway Commission and the issuance of $2,000,000 of bonds for highway purposes. The Wisconsin Highway Commission, which will supervise the construction of public highways to cost $2,600,000 and highway bridges to cost $750,000 this year, last Saturday divided the state into seven districts, and appointed an engineer, draftsman, and corps of surveyors for each division. The division headquarters are to be at Madison, Milwaukee, Green Bay, Grand Rapids, La Crosse, Eau Claire and Ashland.

All obstacles to the construction by the city of New York of a pier 1,000 ft. long with a slip 1,200 ft. long at the foot of W. 46th St. are believed to have been removed by two new laws signed by the Governor last week. Plans for the new pier came up for the hearing of any further objections before the Board of Estimate and Apportionment, on April 30. A. C. Smith, Pier A, Battery Pl., New York City, is Dock Commissioner.

No bids were received April 19 by Maj. J. C. Oakes, U. S. Engineer, Louisville, Ky., for the construction of Lock and Dam No. 43 near New Amsterdam, Ind.

Human Nature on Construction Work.

A paper, unusual, both as regards selection of subject and method of treatment, was presented last month before the American Society of Engineering Contractors. This paper, in brief, was a discussion of the science of handling human nature on contract work. Its author, Mr. C. H. Hollingsworth of Buffalo, N. Y., has had an extended experience in the construction field, and he has drawn on this for his material. As a result he has produced a really valuable thesis on the practical management of men. In connection with his paper Mr. Hollingsworth gives many anecdotes of the more or less humorous side of construction work. Two of these are reprinted below:

JOE TO JOHN TO PAT METHOD.

Now as to time keeping methods the writer will run over some of the many he has come in contact with and will state the advantages and disadvantages of each. These systems run from the crude one of a firm of three men in the South, whose first names were Joe, John and Pat. Joe was small and slight and kept the books, and on pay day checked off the men as they came by; John was larger and he stood at the pay window and passed out the envelopes while Pat was in the heavy weight class, weighed 200 lbs., with no extra flesh, had a fist like a tea kettle, and he stood outside the pay window. The firm ran a commissary; the system was simple and consisted in giving each man on pay day an amount ranging from 50 cts. to $2.00, and taking the rest for what he had bought at the commissary, or what he should have bought or was going to buy. On pay day the system worked thusly: John called a name to Joe as a man appeared at the window; Joe selected an envelope, passed it to John and checked off the name; John gave the envelope to the man at the window. When the man passed on the system ended there; if he stopped to argue about the shortage John told him to move on; if he did not John said "hit him Pat," whereupon Pat smote him preferably with an upper cut on the jaw and thus moved him along. Very simple system! Did not necessitate a time keeper or anything like that, and was also exceedingly inexpensive. Funny part of this, is that it is true and the firm got away with it and are now all wealthy and I believe respected citizens.

THE COMMISSARY.

I cannot pass this subject without making a few remarks about one piece of work in Canada with which I am familiar and which is a beautiful sample of how a camp ought not to be run.

One cook and a cookee handled the headquarters camp of six to eight men. Another cook and several cookees attended to the main camp of about 60 men, including foreman, mechanics, etc. The board at both camps cost considerably above what the company could possibly charge the men for it, and on the average it was about 17th class or worse. One man was a combination timekeeper, bookkeeper and commissary man and usually the food proposition was so bad that it would have been alarming if it had not been so funny. For example, they bought beef on the hoof, and the master mechanic and the walking boss were sent out to buy it. That sounds like a joke and it was, unless you had to eat the beef. On one occasion they bought what they considered a fine, fat steer. It was, and the next day after they brought it in, it was much fatter than before and in fact, got to be the great granddaddy of all fat steers. Then they found it had dropsy, or whatever disease corresponds to that in cattle. They kept it around several days trying to cure it so they could kill it for beef. You better believe I was interested in that steer. I was so solicitous about him that I called on him every day to see if he was alive. Finally, his condition became serious and they disposed of the poor fellow and I was relieved, although to this day I do not know whether he appeared on the table or not. This same work was 9 miles from the railroad and about 30 miles from quite a large city. The people in charge kindly bought fresh fish in the city once a week, and it was sent by freight. It left the city Thursday or Friday and we had it for dinner Monday, if there were no breaks in the schedule or the train was not delayed. As a consequence of this mis-management, their men left in droves and they never seemed to catch on that there was anything wrong with the food question and resented the slightest hint in that direction. The manager of the construction company got to the work about once a month, and if he had time, would stay to dinner, whereupon the cook would do himself proud. He would get a chicken, owl, pelican, or other fowl, manhandle it, cook it, and serve it up on the table, looking as though its taking off had been by way of a boiler explosion or through an automobile accident on account of its mangled condition. The grand, high mucky muck would expand his chest, tell us we were living like lords, eat a quarter of a half portion of the deceased bird, get up from the table and "beat it" madly back to the city and eat enough dinner for four men that evening at the best hotel in that section of the country, after taking something in the nature of a restorative and invigorator to counteract the effects of his noon meal. As I was an outsider, I merely picked out the least damaged portions of the remains, ate my meal and restrained my desire to smite the gentleman when he sprung his remarks about our high living and prayed for deliverance from the camp.

PERSONAL

Mr. Elmer Folsom has been re-elected city engineer of Bloomington, Ill.

Mr. Frederic H. Betz has been appointed city architect for Cleveland, Ohio.

Mr. D. L. Bissell has been appointed city engineer of East San Diego, Cal.

Mr. E. B. Wingate, civil engineer and city engineer for Hamilton, Ont., died at his home in that city April 23, aged 57.

Mr. James E. Wright, civil engineer and clergyman, has been appointed road engineer for Trimble county, Kentucky.

Mr. J. E. Askwith, assistant city engineer for Prince Albert, Sask., has been appointed town engineer for Redcliffe, Alta.

Mr. Frederick A. Reimer, assistant county engineer for Essex county, New Jersey, has been promoted to county engineer.

Mr. Edward T. Maurer, civil engineer, who had been in the employ of New York City for 25 years, died April 6 in that city.

Mr. Dexter Bullard, 97 years of age, has been elected for a three-year term as water commissioner of Spencer, N. Y. He has held the office since 1884.

Mr. S. R. Hatch has been reappointed as manager of the Duluth Water and Light Department. Mr. George J. Bloedel has been appointed street commissioner.

Mr. John J. Martin, civil engineer and county surveyor of Jefferson county, Arkansas, for forty years, died April 6, at his home in Little Rock, Ark., aged 94.

Mr. William H. Frost, a pioneer railroad contractor, who aided in the construction of the Boston & Maine and Illinois Central railroads, died recently at Independence, Kas.

Mr. J. G. Mill has resigned from the city engineering department of Toronto, and has been awarded the contract for the installation of the new $50,000 water works system at Brighton, Ont.

Mr. G. M. Rice, assistant engineer of the Chicago, Milwaukee & St. Paul Railway, Puget Sound lines, has been appointed division engineer at Spokane, Wash., succeeding Mr. A. G. Holt, promoted to assistant chief.

Mr. B. Clifford Martin, resident engineer at Utica, N. Y., for the New York Central R. R., has been made assistant district engineer at Poughkeepsie on the Hudson division. He will be succeeded by Mr. G. F. Chisholm, resident engineer at Rome, N. Y.

Mr. Mervin D. Hallman has been appointed county road superintendent and Mr. H. J. Bowman county engineer for Waterloo county, Ontario. Mr. Bowman will attend the third International Highways Congress, to be held in London, England, in June.

Mr. Frank F. Rogers was elected state highway commissioner for Michigan, April 7. Mr. Rogers served several terms as engineer for Port Huron, Mich., and was made deputy state highway commissioner when that office was created, and has held it ever since.

Mr. J. P. Moore of New York City has been appointed superintendent of power and equipment for the Northwestern Railway Co., a city and suburban trolley line of Meadville, Pa. Mr. C. E. Douglas was appointed chief engineer of track and roadway department.

Mr. J. R. Taft, formerly with Coverdale & Co., Inc., consulting engineers, 66 Broadway, New York, has become a member of the firm of Emory & Eisenbrey, civil, chemical and industrial engineers, 2 South 15th St., Philadelphia, Pa. A New York office of the firm will be conducted at 50 Church St.

Mr. F. W. Thorold has incorporated the F. W. Thorold Co., Ltd., consulting engineers and contractors, of Toronto, Ont. Mr. Thorold was formerly chief assistant engineer for Toronto, and for four years was city engineer for Calgary, Alta. The company will specialize in municipal work and public utilities.

Civil Service Examinations.

The United States Civil Service Commission announces examinations as follows:

Hydro-Electrical Engineer; $1,800 to $2,400 per annum; May 19.

Logging Engineer; $2,400 to $3,000 per annum; May 19.

INDUSTRIAL

A. Eugene Michel and Staff, Advertising Engineers, New York, have removed from 21 Park Row into larger offices, Rooms 1001-7 Woolworth Bldg.

The cities of Chicago, Ill., and Calgary, Alberta, have recently purchased trench excavators from the F. C. Austin Drainage Excavator Co., Chicago, Ill.

The Hardaway Contracting Co., Columbus, Ga., which has the contract for constructing a hydro-electric development on the Yadkin River in North Carolina, requiring 600,000 cu. yds. of masonry, has placed an order with the Municipal Engineering and Contracting Co., Chicago, for three 2 cu. yd. Austin Mixers.

The Sefton Manufacturing Co., Chicago, has awarded a contract to the Raymond Concrete Pile Co., New York and Chicago, for constructing a 600-ft. reinforced concrete bulkhead dock at that plant on the south branch of the Chicago River, Chicago. The dock is to be built from plans submitted by the Raymond Company but the work will be done under the supervision of Postle & Fischer, Architects. George R. Morris, Architect, Baltimore, has awarded a contract to the Raymond Concrete Pile Co., New York and Chicago, for placing standard Raymond concrete piles and footings for the Avon Apartment House, 6 and 8 East Read St., Baltimore, Md.

The seventh Chicago Cement Show will be held in the Coliseum, Chicago, Feb. 12-21, 1914. The Coliseum has again been leased by the Cement Products Exhibition Co., 72 West Adams street, Chicago, for the next national Cement Show for a period of nine days. The show will open on the evening of Feb. 12, and close on Saturday evening, Feb. 21. This is a longer show than has been held heretofore, but as there will be only one show next season it is felt that larger benefits will be derived by extending the show two days longer than hitherto. While the exhibition will be conducted along the same general lines as in the past, a number of changes have been adopted. In addition to holding the show open for a longer period, the space units have been increased in size and the rates for space decreased. Some innovations in the way of booth equipment are also in prospect. With the announcement of the seventh Chicago Cement Show comes a bulletin from the office of the National Association of Cement Users, Harrison Bldg., Philadelphia, Pa., giving the place and time for the tenth Annual Convention as Chicago, Feb. 16-20, 1914. The holding of the Cement Show and the convention in Chicago at the same time means a tremendous gathering of concrete interests in February next. President Humphrey is already at work preparing the program of the sessions of the Association. The officers of the National Association of Cement Users are: President, Richard L. Humphrey; Vice Presidents, Arthur N. Talbot and Leonard C. Wason; Treasurer, Henry H. Quimby; Secretary, Edward B. Krauss; Directors, B. F. Affleck, Wm. P. Anderson, Edw. D. Boyer, W. L. Church, Chas. Derleth, Jr., and B. L. Ransome.

CATALOGUES

Engineering Service.—Paper, 5½x8 ins., 44 pp. C. G. Young, Bankers' Trust Bldg., New York City.

This book sets forth the fields of service in which the firm of C. G. Young is especially prepared to serve its clients. The book is very complete and gives a list of work, with brief descriptions, which has been carried on for numerous clients in the United States and other countries.

Chain Belt.—Paper, 6x9 ins. 8 pp. Chain Belt Company, Milwaukee, Wis.

This is the April number of "Chain Belt" which describes the new foundry for the manufacture of steel castings. Work now in progress in concrete construction, where Chain Belt Mixers are used, is also described.

Grab Buckets.—Paper, 6¼x9 ins., 16 pp. Pawling & Harnischfeger Co., Milwaukee, Wis.

This is Bulletin No. 101 under date of March, 1913. It illustrates by line drawings and views the construction of a "P. & H." Single Line Grab Bucket. A complete description of its operation is given, together with a description of the uses to which this grab bucket may be put.

Concrete Pavements, Sidewalks, Curb & Gutter.—Paper, 6x9 ins., 96 pp. Universal Portland Cement Co., 72 W. Adams St., Chicago, Ill.

This is an exceptionally complete book, prepared by the Information Bureau of the Universal Portland Cement Co., and should be in the hands of every constructor of this class of concrete work. The book includes under the various heads named above, the qualifications for good materials, the general construction details and methods of properly carrying out the work. A number of data on the costs of construction are given. There are also included a number of drawings showing standard types of construction.

South Boston Power Station.—Paper, 9½x12½ ins., 24 pp. Stone & Webster Engineering Corporation, 147 Milk St., Boston, Mass.

This book contains an interesting description with specially prepared illustrations of the South Boston Power Station, which is designed for 125,000 kilowatts ultimate development.

The Use of Appraisals.—Paper, 6x9 ins., 4 p. H. M. Byllesby & Co., Insurance Exchange Bldg., Chicago, Ill.

Vital reasons why utility corporations should have inventories and intelligently prepared appraisals at hand and in constant use are summarized in this pamphlet. The services and facilities of the Byllesby Company for this work are described.

Drilling and Boring Operations.—Paper, 4¼x6¼ ins., 12 pp. Pauling & Harnischfeger Co., Milwaukee, Wis.

This is a reprint of an article by P. G. Valentine describing drilling and boring operations in railway shops, and dealing particularly with the "P. & H." horizontal drilling and boring machine.

Grand Trunk Travelers' Literature.—Paper, 6x9 ins., 40 pp. Grand Trunk Railway System.

These pamphlets contain illustrated descriptions of the International Limited train which runs between Chicago and New York through Canada.

Bates All Steel Tractors.—Paper, 9x6 ins., 32 pp. Bates Tractor Co., Lansing, Mich.

This catalog contains illustrated descriptions of this gasoline tractor for plowing, hauling and general work.

Industrial and Locomotive Cranes.—Paper, 8¾x11 ins., 24 pp. Bay City, Mich.

This book contains a number of views of the construction of U. S. Steel Corporation Plants at Gary, Ind., and South Chicago, Ill., where 42 Industrial Works Locomotive Cranes were used for construction work.

Another catalog entitled "Locomotive Cranes," paper, 9¼x12½ ins., 36 pp., describes the general construction of industrial cranes of 5 to 30 tons' capacity and gives a number of illustrations showing the application for various classes of work. There are also illustrated a number of grab and orange peel buckets which are used on these cranes. This is catalog No. 105.

RAILWAYS

Alabama.

The Alabama, Tennessee & Northern R. R., formed to take over the Tombigbee Valley R. R. and the Mobile Terminal & Ry. Co., has effected its organization. John T. Cochrane, of Mobile, is President of the new company as he was of the other companies. William G. Cochrane, Mobile, is Vice President; Joseph A. Caviezel, Mobile, Secretary; William Goodman, New York, Assistant Secretary; R. K. Guthrie, Mobile, Treasurer, and E. J. Buck, Mobile, Assistant Treasurer. The Directors are the same with the addition of Frederick J. Lisman, 30 Broad St., New York City.

Alaska.

It is reported that the Alaska Copper Corporation of Valdez will construct a branch railroad from a connection with the Copper River and Northwestern R. R. at Strelna to Nugget Creek and the Rairus Mine. Alfred B. Iles is Manager of the Corporation.

Arkansas.

The Pine Bluff & Sulphur Springs Interurban Ry., incorporated recently, has made surveys for a projected 8-mile line between the places named. A. G. Russell, Pine Bluff, Ark., is President.

California.

⊙Palmer, McBryde & Quayle, Hooker & Lent Bldg., San Francisco, who have the contract for constructing a 9-mile electric line up the San Ramon Valley for the San Ramon Valley R. R., a branch of the Oakland, Antioch & Eastern Ry., have sublet all trestle and pile driving work to M. Anderson & Co., Oakland. The general contract includes all the work except the overhead construction.

The San Francisco, Oakland Terminal Rys., Oakland, Cal., is contemplating an extension of its San Pablo electric line west on Market St., Richmond, to reach several industrial plants.

The Pacific Electric Ry. Co. 6th and Main Sts., Los Angeles, will begin work in the immediate future on the construction of its proposed electric railway between San Mateo and San Jose.

Colorado.

The Santa Fe System has work under way enlarging and concreting the old Raton tunnel south of Trinidad, Colo. About $100,000 is to be expended.

Georgia.

⊙M. P. McGrath, 2 Woodland St., Worcester, Mass., is reported to have been awarded the contract for the construction of the Carolina & Georgia R. R., a new line projected to extend from Augusta to Columbus, a distance of 75 miles.

The Athens Railway & Electric Co., Athens, Ga., has been petitioned to extend its line across the Oconee River through East Athens and Barberville. A line to Oconee cemetery is also asked.

Idaho.

A plan for the construction of a Boise-Winnemucca-San Francisco R. R. is being worked out by Boise and San Francisco capitalists. A. R. Cruzen, Frank R. Coffin and Leo J. Folk, Boise, Idaho, are interested.

According to a reported announcement at Twin Falls, Idaho, by W. H. Bancroft, General Manager of the Oregon Short Line, that road will build south in Nevada this year to connect with the Southern Pacific, and the work will be started in a short time.

Illinois.

⊙The Chicago, Burlington & Quincy R. R. has awarded the contract for team work in connection with the construction of a third track from Galesburg to Wataga to J. J. McCaughey, Chicago, Ill. The steam shovel work will be done by the railroad itself. The work will cost about $250,000.

The Chicago Railroad Construction Co. has been incorporated with a capital stock of $100,000 and proposed to engage in general contracting and railroad construction. The incorporators are P. E. Pierson, R. Haas and A. E. Taylor.

Indiana.

⊙The Continental Building & Construction Co., St. Louis, Mo., according to reports has been awarded the contract for the construction of the new Wabash passenger station at Fort Wayne, Ind. Work will be started at once.

Iowa.

Citizens of Dubuque, Ia., have voted to grant the Union Electric Co., 240 Main St., Dubuque, a franchise for an extension traction line on W. Locust St.

The Des Moines City Ry. Co., C. F. Hewitt, General Manager, 710 Mulberry St., Des Moines, is to expend about $100,000 for the immediate construction of a new car barn and the installation of switching tracks on the west side of the Des Moines River, north of the Center St. dam. A considerable amount of filling will be required.

Kansas.

The Arkansas Valley Interurban Ry., O. A. Boyle, General Manager, Beacon Bldg., Wichita, Kan., will soon take up the matter of extending its line from Halstead to Hutchinson.

Kentucky.

The Queen & Crescent Route has purchased land south of the Lebanon Pike and immediately west of its tracks at Danville for additional trackage purposes.

The Rockcastle River Railway Co., which had surveys for its proposed route from Livingston to Jackson, completed some time ago, has decided to change the route, making the connection with the L. & N. at East Bernstadt instead of at Livingston. On account of the rough country it would be compelled to cut through along the Rockcastle River route. East Bernstadt is 10 miles south of Livingston, and from that point to Jackson is mostly level country, a distance of about 30 miles. The railroad will be the first to enter McKee, Jackson County, and will open up 75,000 acres of virgin forests and coal lands.

The Rock Castle R. R. Co. has filed amended articles of incorporation changing the name to the Rockcastle River H. R. Co. and the headquarters from Livingston to East Bernstadt, where one terminus of the line is to be. The line is to be 20 miles long, following the creeks to McKee. The incorporators are C. C. Williams, J. W. Brown, W. L. Richards, E. S. Albright and A. B. Furnish of Mt. Vernon, Ky.; H. W. Bowman of Livingstone, and N. U. Bond of Oakland, Md.

Promotion work is under way for the construction of a railroad from Hodgenville, Ky., to Rutherford, N. C. As proposed the line would utilize five short railroads already in operation, aggregating 125 miles. The line as projected would be built southeast from Hodgenville through Bradfordsville, Liberty to the Queen & Crescent at Waynesburg, then paralleling the Queen & Crescent to Somerset, where it would cross that line and run down Buck Creek, crossing Cumberland River and connecting with the Beaver Creek Coal Co.'s line, thence crossing the Queen & Crescent again at Greenwood and running to the Big South Fork River, then up it to connection with the Kentucky & Tennessee Ry., thence still up this river nine miles to connection with the Virginia Coal Co.'s line on Bear Creek, then 3½ miles to connect with the Tennessee R. R. at Onedia; this road is 54 miles long. Then running by Petros and Oliver Springs or via Coal Creek and Clinton into Knoxville, where connection would be effected with the Knoxville-Sevierville & Eastern, and then from this line to the Seaboard Air Line R. R. at Rutherfordton, N.C. J. M. Ross, Somerset, Ky., is interested.

Louisiana.

The citizens of Wards 1, 3 and 6, Vernon Parish, have voted a tax for the St. Louis Southwestern Ry., which proposes to build a line from White City, Tex., eastward, passing through Vernon Parish.

Maine.

The Sandy River & Rangeley Lake R. R., operating 102 miles of narrow gage railroad, proposes to extend its line to Stratton this season. This extension will run through Eustis and the old line of the Dead River R. R. will be reopened to Greene's Farm. From the latter place a new line will be built to Stratton. The State Railroad Commission has granted this company permission to expend $200,000. Of this sum $40,000 will go for new equipment, $65,000 for permanent repairs and the remainder for the extension. M. McDonald, Portland, Me., is President of the Sandy River & Rangeley Lakes R. R.

Maryland.

⊙The Baltimore & Ohio R. R. has awarded contracts for the construction of 11 miles of additional double-track railroad between Orleans Road and Little Cacapon. on the east end of the Cumberland division. The improvement will cost approximately $6,000,000, and owing to the heavy character of construction the work will be extended over a period of about two years. The contracts were awarded to the following: Slection 1, Magnolia work, Orleans Roads, W. Va., to Kefauver & McLaran, Baltimore, Md., the work including 240,000 cu. yds. unclassified excavation, mostly rock, 726 ft. small tunnels for cast iron pipe and 4,940 cu. yds. concrete masonry; Section 2, Magnolia cutoff, Doe Gully, W. Va., to H. S. Kerbaugh & Co., Philadelphia, Pa., the work including 1,333,000 cu. yds. of unclassified excavation; Section 3, Magnolia cutoff, Doe Gulley to Hansrote, W. Va., to Kefauver & McLaran, for 300,000 cu. yds. unclassified excavation and 1,919 cu. yds. concrete masonry, and to H. S. Kubaugh & Co. for 120,000 cu. yds. unclassified excavation and 950 lin. ft. of tunnel; Section 4, Magnolia cutoff, Hanrote to Magnolia, W. Va., to H. S. Kerbaugh & Co., the work including 277,500 cu. yds. of unclassified excavation, 3,500 lin. ft. of tunnel and 252 cu. yds. concrete masonry; Section 5, Magnolia cutoff, Magnolia, W. Va., to Bennett & Talbott, Greensburg, Pa. the work including 4,000,000 cu. yds, unclassified excavation, 1,650 lin. ft. of tunnel, and 16,007 cu. yds. concrete masonry and two bridges over the Potomac River; Section 6, Magnolia cutoff, Kesslers, W. Va., to Smith & McCormack, Easton, Pa., the work including 275,000 cu. yds. unclassified excavation and 25,115 cu. yds. concrete masonry in retaining walls; Section 6, Magnolia cutoff, east of Paw Paw, W. Va., to Bennett & Talbott, Greensburg, Pa., the work including 60,000 cu. yds. of unclassified excavation, 1,000 lin. ft. tunnel and 1,029 cu. yds. concrete masonry; Section 8, Magnolia cutoff, Paw Paw, W. Va., to Smith & McCormack, Easton, Pa., the work including 475,000 cu. yds. unclassified excavation and 26,603 cu. yds. concrete masonry in retaining walls. The new line will be known as the Magnolia cut-off and will be a low-grade line, which will greatly facilitate the movement of the large volume of tonnage handled over this section of the system and which is increasing steadily. The new tracks will parallel the present double-track line between Orleans Road and Little Cacapon and the tracks now in operation between these points will be used for west-bound traffic. While generally paralleling the present line, an entirely new location will be sought with lower grades. The construction will involve a tunnel about 3,000 ft. long, with three smaller tunnels. The new line will cross the Potomac River at two places and will pass from West Virginia across the river through a

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

small point of line in Maryland and back in West Virginia. The new line will diverge to the east-bound side of the present three-track line west of Orleans Road and rising on a .4 per cent compensated grade for 4,500 ft. to a point where it will cross the operated line at grade. From this point it will continue to rise on the same grade through the ridge at Doe Gully and will involve the elimination of Doe Gully tunnel and convert it into an open cut for four tracks. The new line will pass through the southerly edge of the town of Paw Paw and along the present line to Little Cacapon. The construction of the new line will involve several changes in the present double-track railroad and between Orleans Road and the present location of Doe Gully tunnel the old line will be raised to compose a four-track line. Between Doe Gully and Hansrote the present line will be relocated to eliminate curves. The old line will also be relocated to some extent at Paw Paw. The new work will be done under the supervision of F. L. Stuart, Baltimore, Md., Chief Engineer.

The Board of Estimates of Baltimore, Md., has approved an ordinance authorizing the United Railways & Electric Co., 1001 Continental Trust Bldg., Baltimore, Md., to extend its Monument St. line to Orangeville.

Michigan.

The Grand Rapids, Holland & Chicago Ry., Holland, Mich., proposes building a new 10-mile electric railway along the Lake Michigan front to Saugatuck.

The Copper Range R. R. is understood to have decided definitely to build a 5-mile branch, starting from a point 2½ miles north of Toivola and connecting at Painesville with the branch to that place. F. R. Bolles, Houghton, Mich., is General Manager.

Minnesota.

⊙Fred Baxter, Superior, Wis., has been awarded the contract for a grading for a spur for the Minneapolis, St. Paul & Sault Ste. Marie Ry., extending from Wahkon, Minn., for 8 miles through a timber country and farming section.

The Northern Pacific has made surveys for its proposed extension from East Grand Forks, Minn., to Drayton, N. Dak. The route in general runs directly north out of East Grand Forks to a point due east of Grafton, N. D. From there the line strikes off in a northwesterly direction, joining the present Grand Forks to Winnipeg line, 1½ miles south of Drayton.

The Minneapolis & St. Louis R. R. is understood to be planning to begin work about May 1 on a new station and yards at Albert Lea, Minn., which will call for an expenditure of about $300,000.

Missouri.

At a mass meeting of the citizens of Mokane, Mo., a committee was appointed with Dr. G. S. Collier, Chairman, and R. Earl Hodges, Secy., to make plans for securing the right of way for the St. Louis & Northern R. R., which it is proposed to build from Brookfield to Mokane. The Mokane people also hope to secure an extension of the Missouri, Kansas & Texas R. R. to the fire clay fields near that city and ultimately to Fulton. Katy surveyors already have made several inspections of the proposed extension.

It is expected that a definite decision will be announced shortly as to the building of the proposed extension of the St. Joseph-Savannah Interurban Ry. from Savannah to Fillmore. Most of the right of way has been secured and all details of the permanent survey have been completed. J. H. Van Brunt, 424 Edmond St., St. Joseph, Mo., is General Manager.

The Missouri Pacific R. R. and the Missouri Railroad and Warehouse Commission have reached an agreement whereby the entire line between Springfield and Kansas City, on the Frisco, will be improved within the next two years. Work on the improvement of the track will be begun immediately and before Dec. 31, 1915, the line will be relaid with 75-pound steel. The remainder of the line will be improved before Dec. 31, 1915. The rehabilitation of the Clinton line also provides for a double train service, to be inaugurated at once.

Surveys are being made for the projected 25-mile line of the Kingston & Excelsior Springs Electric R. R., the route running through Kingston, Lawson and Excelsior Springs in Caldwell, Ray and Clay Counties. The capital for construction purposes has not been secured. Beck Boner, Kingston, Mo., is President and S. C. Rogers, Kingston, is Chief Engineer.

St. Louis Items.

BY A. B. KOENIG.

⊙Grommet & Johnston report their track-laying work on the Wabash R. R. in Western Missouri as getting along nicely. They just secured another nice job of track-laying from this same company the other day.

⊙The Walsh Construction Co., Davenport, Ia., was awarded some big contracts by the Big Four R. R. Co. in Ohio after the high water a couple of weeks ago.

Labor easier here the past week. Quite a number of men returning from the Government emergency and shore protection work from the south. Don't look for these conditions to last long, as very near every railroad company in the country is in here after them.

The Condon Construction Co., 1406 W. O. W. Bldg., Omaha, Neb., have 300,000 yards of new and double track work suitable for machine and fresno outfits on the Milwaukee R. R. in Iowa to sublet. They also have 40 miles of new work on the Northern Pacific R. R. in North Dakota to let at good prices.

Yale & Reagan, 1816 Fischer Bldg., Chicago, Ill., have 500,000 yds. of machine and scraper work on the Wheeling & Lake Erie R. R. in Ohio to let. Can use 6 or 8 machines and about 150 teams on this work. They are going to open an office in Wheeling, O., where Mr. Yale will be pleased to show contractors profiles and take them over the work.

Keating Bros. are stripping a gravel pit near Pekin, Ill. Will be through there shortly. They have a good 20-team and machine outfit.

Mike Conroy returned from the North. Nothing new.

In a communication to the Municipal Assembly, City Comptroller James Y. Player stated $204,000 is available toward completion of the approaches of the Municipal Bridge. Maxime Reber, president of the Board of Public Improvements under Mayor Frederick H. Kreismann, estimated completion of the west wagon approach would cost $700,000. In regard to this approach work, Player sent the informal report into the City Council. He said the $204,000 is available, "unless the property at Eighteenth and Gratiot streets, under condemnation, is purchased." He added: "In such case, $90,000 or $95,000 should be deducted from the sum available.

Wm. Brothers moved his 25-team outfit from Birds Point, Mo., to Wickliffe, Ky., on account of high water. Brothers is in the market for same work for this outfit.

William R. Bush, president of the Bush Construction Co. and the Mack Motor Truck Co., was quietly married to Miss Bertha Parsons, daughter of Mrs. C. B. Parsons of 3405 Hawthorne Boulevard in Chicago last week. Frank J. Bush of 3830 Cleveland Ave., a brother of the bridegroom, said the marriage was not an elopement, but that owing to the recent death of the father of the bride, both wished the ceremony performed as quietly as possible. Mrs. Parson, mother of the bride, was present at the ceremony. The bride is a daughter of the late Charles B. Parsons, before his death president of the St. Joe Lead Co. After a honeymoon Mr. and Mrs. Bush will reside in a new home, recently purchased at Russell Ave. and Longfellow Blvd.

Montana.

Grading work has been started for the projected 20-mile line of the Billings & Central Montana R. R. The road is to run north from Billings to Crooked Creek. Frank H. Duffin and S. L. Whitaker, of Bozeman, are reported to have the contract. R. E. Shepherd, of the Billings Land & Irrigation Co., Billings, Mont., is President of the railroad.

Nebraska.

Officials of the Missouri Pacific Ry. have been discussing with the Commercial Club of Beatrice, Neb., the matter of extending the line from Virginia, Neb., to Beatrice, a distance of 15 miles. It is possible, however, that this company may make arrangements to use the Rock Island lines between the cities mentioned.

New York.

The Lehigh Valley R. R. has taken bids for constructing an extension of the Seneca Falls branch from Seneca Falls east to Cayuga Junction.

The receivers of the New York, Auburn & Lansing R. R., H. A. Clarke, General Manager, 109 N. Tioga St., Ithaca, N. Y., have applied to the Supreme Court for permission to issue certificates for $120,000, the proceeds to be used for finishing the Remington power plant and for minor improvements.

North Carolina.

The Newbern Ghent Street Ry. Co. of Newbern, N. C., is considering extending its car line from this city to Trenton and Pollacksville.

The Albemarle & Whiting Street Ry. Co. has been chartered with a capital stock of $100,000, of which $4,000 has been subscribed, and proposes the construction and operation of electric railways. The incorporators are: T. H. Vanderford, Salisbury, N. C., and J. H. Moss and L. L. Cotton.

Ohio.

The Lake Shore & Michigan Southern Ry. has begun the construction of enlarged yards at Air Line Junction and is also building new round houses and car repair shops. It is expected to spend about $1,500,000 this year, and a like amount next year, on these improvements.

The Mayor and City Solicitor of Cincinnati, O., recently conferred with the officials of the roads entering Cincinnati with a view of securing the construction of a new union station in that city.

Oregon.

Engineers of the recently incorporated Siletz Valley & Eastern R. R. are now at work near Buena Vista, Ore., locating the route from Independence to the Siletz Valley, where the company has timber interests. Stockholders of the Falls City Lumber Co., Falls City, Ore., are said to be financing the project.

⊙Casciato & Ragione, Portland, Ore., have been awarded a contract by the Mt. Hood R. R. for the extension of the line from Dee, two miles in the direction of Lost Lake.

It has been announced at Salem, Ore., by John H. McNary, attorney for the Oregon R. R. Co., that the organization has been perfected and that contracts for the construction of a portion of the roadbed would be let at once. The company proposes to construct a road from Salem to Bend by way of Stayton and through the Minto Pass, one of the few available railroad passes through the Cascade Mountains.

Pennsylvania.

✣Bids will be received until 8 p. m., May 12, at the office of the President, Chambersburg & Shippensburg Ry. Co., Chambersburg, Pa., for the graduation, track-laying and ballasting, masonry and culverts for extension from Red Bridge Park, Franklin Co., Pa., to Shippensburg, Cumberland Co., Pa., approximately 8.4 miles. Plans and specifications can be seen at the office of the Engineer, Bard Bldg., East Market St., Chambersburg, Pa. J. C. Schaff is Secretary.

⊙D. J. Carson, Du Bois, Pa., has been awarded the contract for the excavation work for the enlargement of the shops of the Buffalo, Rochester & Pittsburg Ry. at Du Bois. The contract calls for a considerable amount of excavation, and the contractor will use a steam shovel to handle part of this.

The construction program of the Pennsylvania R. R. provides for a large amount of improvements, a considerable part of which are now under way. Among the improvements for this year, contemplated or under construction, are the following: Electrification of the Philadelphia terminal and extension changes in the great Broad St. Station at that point, together with its facilities and approaches; elimination of grade crossings and elevation of tracks on the New York division from Colonia, eastward through Rahway to Bay Way, Elizabeth, and a slight change of line in Elizabeth, where the line has already been elevated; also the abolition of additional grade crossings in Philadelphia, Lancaster, Lilly, Johnstown, Freeport, Wilkinsburg, Pittsburgh and other points on its lines when the local authorities co-operate in making the eliminations. For the eastern section of the six-track system on the New York division between Colonia and Waverly, N. J., west of Newark, additional right of way has been acquired. This work comprehends station improvements, the elimination of 15 grade crossings by the elevation of the four existing main tracks and the construction of two additional elevated tracks between those points. The Bald Eagle line is also being double tracked. The freight facilities at York, Highlandtown, Md., and at Marysville yard are being enlarged and improved to accommodate the increased traffic. The Wilkesbarre Connecting R. R. was incorporated during the year jointly by the Pennsylvania R. R. and the Delaware & Hudson Co. to provide a 7-mile line from Buttonwood yard, on the Pennsylvania R. R. west of Wilkesbarre, to Hudson, on the Delaware & Hudson R. R., to facilitate the interchange of traffic between the two roads.

Tennessee.

The East Tennessee & Western North Carolina R. R., F. P. Howe, President, Johnson City, Tenn., operating a line from Johnson City to Cranberry, has taken over the Linville Ry., a 3-ft. gage line, 13 miles long, extending from Cranberry to Pineola, N. C. It is stated that the new property will be improved and standardized at once.

Surveys have been started at Bristol, Tenn., for the proposed steam belt line to encircle the city. The work is being carried forward by the Board of Trade of Bristol.

Right of way for the proposed electric railway from Chattanooga to Cleveland has been granted by Hamilton and James Counties; pledges of $30,000 have also been guaranteed. Bradley County has also granted free right of way and $15,000 in cash. J. W. Addams, Chattanooga, Tenn., is promoter.

Texas.

Representatives of the Business Men's Organization of Austin, Temple, Taylor, Bartlett and Granger have taken action to secure an extension of the Southern Traction Co., 124 N. 4th St., Dallas, from Waco to Austin via Temple.

Nothing definite has been decided regarding the proposed extensions of the Pecos Valley Southern Ry. The present intention is to build to a connection with the Orient at Fort Stockton and then northeast. L. W Anderson, Pecos, Tex., is Chief Engineer.

Advices from Littlefield, Tex., state that preparations are being made for the laying of steel for the new Santa Fe yards at that place. Tracks are laid within 18 miles of town, and the work is progressing rapidly. The yards in Littlefield will probably be the most extensive along the line between Lubbock and Texico.

The San Benito & Rio Grande Valley Ry., E. E. McLellan, Chief Engineer, San Benito, Tex., will about July 1 begin work on extensions from Alton to Point Isabel on the east and to San Antonio on the north.

Construction work has been started on 3-mile spur for the Houston & Brazos Valley R. R. from Freeport to the Freeport Sulphur Co.'s mines at Bryan Heights. P. J. Burns, Houston, is in charge of the work.

Engineers are at work in Baylor County, Tex., on the line of the Quanah, Dublin & Rockport R. R., which is planned to extend from Quanah to Rockport on the gulf, passing through Seymour, the county seat of Baylor County.

Washington.

Representatives of the Commercial Clubs of Richland and Kennewick, Wash., recently conferred with officials of the Oregon-Washington Railroad & Navigation Co., in regard to the construction of a line up the Columbia from Kennewick through Richland.

Tracklaying on the southern end of the Wenatchee North Line will be started, according to reports from Spokane, Wash., about May 15. The company expects to have this line completed by November. The company has laid about 40 miles on the northern end of the track and is now as far south as Omak.

Surveys have been about completed for a projected line for the Chicago, Milwaukee & St. Paul Ry. from Helsing Junction on the main line between Seattle and Aberdeen, southwest to Raymond, on Willapa Harbor. A considerable part of the right of way for this line has already been secured and it is probable that it will be placed under construction in the near future. The line will run through heavily timbered country and will cost something like $3,000,000. About 37 miles of road will be built to a junction with the Pacific & Eastern logging road. This road will be extended 10 miles into Raymond.

Citizens of Tacoma, Wash., will vote on May 10 on issuing $27,000 of bonds for constructing the proposed municipal electric railway into the tideflats. W. C. Raleigh is City Engineer.

Canada.

✢Bids will be received until May 10 by F. F. Busteed, Engineer Grade Revision, Canadian Pacific Ry., Kamloops, B. C., for clearing, grubbing and grading on three contracts, embracing 9 miles of line west from Kamloops, 25 miles of line east from Kamloops and 24 miles of line west from Revelstoke.

⊙The contract for the construction of 406 miles of railroad on the Central Canadian line extending from Montreal to Ottawa and the Great Lakes, has, according to reports, been awarded to M. P. McGrath, 2 Woodland St., Worcester, Mass.

⊙J. H. Simmons, Oakwood Ave., Winnipeg, Man., has been awarded the contracts to build 12 Canadian Pacific Ry. station buildings at the following places: Stranraer, Denzil, Herschel, Sovereign Bounty, Froude, Trossachs, Khedive, Hitchcock, Ernfold, Penzance and Dilke. The same contractor will build the freight car repair shops at Fort William.

A bill is before the Provincial Legislature empowering the city of Toronto, Ont., to issue $30,000,000 of bonds to purchase outright the physical assets of the Toronto Railway and Toronto Electric Light Cos. and authorizing the city to create a civic railway commission for operation of the combined municipal street railway system. The estimated cost of the two companies the city proposes to purchase is $28,600,000, of which $8,000,000 is for the electric light company.

The Niagara, Welland & Lake Erie Ry. is projecting a 45-mile electric railway from Welland to Niagara Falls and Welland to Port Colborne and Fort Erie. Surveys have been completed, the construction capital secured and four miles of the line in Welland will be built at once. The date for awarding construction contracts has not been decided. H. C. Scholfield, Toronto, Ont., is President, C. J. Laughlin, Jr., Welland, Ont., is Managing Director, and Thos. R. Cummins, Welland, Ont., is Chief Engineer.

BRIDGES

California.

✢Bids will be received until May 5 by the Board of Glenn County Supervisors, Willows, Calif., for the construction of a concrete arch bridge having 13 spans from 70 to 100 ft. in length. The piers, of which there will be 12, will be 7x24x24 ft. The roadway will be 23 ft. wide and paved with asphalt. The total cost is estimated at $146,000. Luther C. Stiles, Willows, Calif., is County Surveyor.

The Santa Fe Railroad System is to construct for the city of San Francisco, under supervision of M. M. O'Shaughnessy, City Engineer, a 150-ft. trunion bascule bridge with a 48-ft. roadway paved with bolted maple blocks. The substructure will consist of 36-ft. abutments and one 36-ft. concrete pier. It is estimated that the structure will cost $200,000.

The Supervisors of Siskiyou County, Yreka, Calif., have decided on the plans for the reinforced concrete bridges to span the Sacramento River at Dunsmuir, on the line of the state highway. The bridge will have a span of 380 or 400 ft., and will cross the river at the upper end of town. It has to be high enough to clear the railroad, as well as the river.

The Board of Nevada County Supervisors, according to advices from Nevada, Calif., has decided upon the construction of two new concrete bridges over an unnamed stream in the vicinity of Bear River, between Auburn and Nevada City.

Florida.

⊙The contract for the erection of a steel bridge over Rocky Creek, near Clara, Fla., has been awarded by R. L. Stripling, County Clerk, Perry, Fla., to the Converse Bridge Co., Chattanooga, Tenn., at $900. Bids were opened April 17.

Georgia.

✢Bids will be received until noon, May 5, by the Viaduct Committee, City Council, Newnan, Ga., for the construction of 210 ft. of timber approaches and 240 ft. of reinforced concrete and earth filled approaches to the proposed La Grange St. viaduct. E. D. Fouse is City Clerk.

Illinois.

✢Bids will be received up to 2:30 p. m., May 9, 1913, at the bridge site, for the construction of one reinforced concrete bridge, to be built in Prairie du Long Township, St. Clair County. Geo. Leilich, Town Clerk, New Athens, Illinois. Cortner Bridge—Span, 18 ft.; roadway, 20 ft.; height, 13 ft. Estimated concrete, 71.5 cu. yds.; reinforcing steel, 6,795 pounds. Nearest railroad station, New Athent, 9 miles. No local concrete materials available. Present bridge wood, 16-ft. span. Low water flow, dry; high water flow, about 10 ft. deep. Excavation to be carried about 3 ft. below stream bed in clay. Engineer's estimate, $1,200. Work to be completed on or before Sept. 1, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Ill.

✢Bids will be received up to 11 a. m., May 3, 1913, at the Court House, Quincy, Ill., for the construction of one reinforced concrete bridge on plain concrete abutments, to be built in Keene Township, Adams County. S. M. Ketchum, Town Clerk, Loraine, Ill. Ross Bridge—Span, 20 ft.; roadway, 18 ft.; height, 9½ ft. Estimated total concrete, 72.1 cu. yds.; reinforcing steel, 4,475 lbs. Nearest railroad

✢ indicates work now open for bids. ⊙ indicates a contract let recently.

station, Loraine, 2½ miles. It is reported that a good quality of gravel may be obtained from Bear Creek, 1 mile from bridge site, at 10 cents per cubic yard at pit. No present bridge. Green timber for falsework may be cut near the site. Low water flow, dry; high water, about 5 ft. deep. Excavation to be carried about 2 ft. below stream bed to rock. Average excavation, about 3 ft. Engineer's estimate, $800. Work to be completed on or before Sept. 1, 1913. Bids received at previous letting were rejected, as county aid could not be secured before June meeting of County Board of Supervisors. The low bid will be held until June meeting of Board of Supervisors, before contract is let. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Ill.

⊙The Joint Committee of Commissioners of Highways of the town of Freedom, Ill., and La Salle county, Ill., has awarded the contract for the construction of a bridge over Big Indian Creek in the town of Freedom to H. S. Wetherell, Morgan Park, Chicago, Ill., at $3,400. The superstructure will be of steel and the floor and abutments of concrete. Alex Heiberg, Ottawa, Ill., is County Auditor.

⊙The contract for the construction of the Couse bridge in the towns of Durand and Pecatonica, Ill., has been let to H. S. Wetherall, Morgan Park, Chicago, Ill. The structure will be of reinforced concrete, 30 ft. long, with an 18-ft. roadway. Bids were opened April 18.

⊙The contract for the construction of the Baltz bridge has been let by John Sintzel, Township Clerk, Freeburg, Ill., to Gass Bros., Belleville, Ill., at $1,475. Bids will be received until April 10.

The Joliet Township Highway Commissioners, Joliet, Ill., are making an effort to have the Sanitary District of Chicago, Chicago, Ill., construct a new bridge on Brandon Rd. over the Des Plaines River, south of the city.

The only bid submitted for the construction of the Conner bridge in Chambersburg Township, Pike County, Ill., April 15, was that of C. A. Wever & Son, Clayton, Ill., $2,550. The bid was rejected, however, on account of lack of funds.

Indiana.

✣Bids will be received until 10 a. m., May 13, by Board of Montgomery County Commissioners, Crawfordsville, Ind., for the construction of and repair of a number of bridges. B. B. Engle is County Auditor.

✣Bids will be received until 1 p. m., May 6, by Board of Boone County Commissioners, Lebanon, Ind., for the construction of several new bridges and repair of others. D. M. Clark is County Auditor.

✣Bids will be received until 11 a. m., May 5, by Board of Wayne County Commissioners, Richmond, Ind., for the construction of a reinforced concrete bridge at Sycamore Valley. L. S. Bowman is County Auditor.

✣Bids will be received until 10 a. m., May 5, by Board of Clark County Commissioners, Jeffersonville, Ind., for the construction of a bridge over Caney Fork, in Monroe Township. G. W. Stoner is County Auditor.

✣Bids will be received until 10 a. m., May 6, by Board of White County Commissioners, Monticello, Ind., for the construction of the following bridge work: For building a bridge over Pike Creek on center line north and south of section 22, township 27 north, range 3 west. Also one bridge over the W. F. Baker ditch on the center line north and south of section 21, township 27 north, range 2 west. Also the placing of a sewer in the Reiff ditch on the line between sections 23 and 26, township 27 north, range 2 west. Said improvements will be let as follows: Pike Creek bridge and Baker ditch bridge will be let as a finished bridge, and the sewer and bulkheads over Reiff ditch include the hauling of the sewer to the place of location, but the county to furnish said sewer. Specifications are now on file in the office of the Auditor of White County, together with plans, all of which have been approved by the Board. A. G. Fisher is County Auditor.

✣Bids will be received until 11 a. m., May 5, by Board of Wayne County Commissioners, Richmond, Ind., for the construction of a reinforced concrete bridge of 25 ft. span at Sycamore Valley, 2½ miles east of the city of Richmond, and a concrete retaining wall at the North Tenth St. bridge, in the city of Richmond. Plans and specifications are on file at the office of L. S. Bowman, County Auditor.

✣Bids will be received until 10 a. m., May 7, by Board of Allen County Commissioners, Fort Wayne, Ind., for the construction of the following bridge work, in accordance with plans and specifications on file with C. H. Brown, County Auditor: Steel bridge north of New Haven; two steel bridges on east line, section 2, Eel River Township; change steel bridge on Grabill Rd., west of Maysville, Springfield Township, and rebuild abutments for same; two new abutments and reinforce eight abutments on east line of section 2, Eel River Township; reinforce abutments north of New Haven; extend wing at Tennessee Ave. bridge.

⊙The contract for the construction of three bridges in Benton County, Fowler, Ind., has been awarded to the Lafayette Engineering Co., Lafayette, Ind., at $2,192. The work includes only the superstructure. Warren Mankey is County Auditor. Bids were opened April 23.

According to advices from Muncie, Ind., the Delaware County Commissioners have instructed County Surveyor Webber to prepare plans for the lengthening of the Elm, High and Washington St. bridges. The city has petitioned the officials of the railroads entering Muncie to lengthen all of their bridges across White River. Steps have also been taken by the citizens looking toward the widening and deepening of the river bed.

The Board of Fountain County Commissioners, Covington, Ind., recently conferred with the commissioners of Warren County in regard to ways and means of repairing the bridges and grades on both sides of the Wabash River.

At a recent session of the Rush County Council, Rushville, Ind., an appropriation of $59,382 was asked for bridges and roads damaged by the flood.

Following an inspection trip in the Whitewater River Valley flood district, the Commissioners of Dearborn and Franklin Counties, Ind., announced that the damage to bridges alone would probably amount to more than $500,000.

Commissioners of Wayne County, Ind., according to advices from Richmond, Ind., estimate the damage to bridges at about $25,000, and the County Council will appropriate that amount for the repair and reconstruction work.

A number of business men from Washington, Ind., recently interviewed the Board of County Commissioners in regard to the construction of the proposed bridge over White River, joining Daviess and Knox Counties at Camp Manning.

Iowa.

City Clerk Horace Susong, Des Moines, Ia., has been authorized to enter into a contract for the construction of a three-span bridge, consisting of two 80-ft truss of spans and one 30-ft. beam span, including steel work hand railing and floor, upon present piers and across Four Mile Creek, at Scott St.

The Iowa State Railroad Commission has notified the City Council of Des Moines, Ia., that the hearing on the matter of constructing viaducts as approaches to the new Seventh St. bridge over the Raccoon River will be held May 6.

The Chesterfield Improvement League, Des Moines, Ia., contemplates asking the Rock Island R. R. to construct viaducts over its tracks.

Kansas.

✣Bids will be received until 10 a. m., May 19, by Board of Wyandotte County Commissioners, Kansas City, Kan., for furnishing material and labor for re-construction and building the Argentine wagon bridge over the Kansas River according to plans and specifications now upon file in the office of E. M. Holcomb, County Clerk.

Kentucky.

Advices from Lexington, Ky., state that practically all objections to the erection of the two new viaducts proposed by the city and the Louisville & Nashville R. R. have been eliminated, and that active construction will probably be started shortly. It is expected that the viaducts will be completed by December, the railroad company having charge of the construction and drawing on the city for its share of the expense as the work progresses. The first plan for the viaduct, which was to extend from Main St., near Jefferson, to High St., near Merino, was objected to by the residents of Irishtown and other parts of the city west of the proposed viaduct, because it would close the streets now running east and west between Main and High. This difficulty has been met by a change in plans. By these plans, Water St. will be left open, and Merino St. will also remain open for travel, while the residents of the West End will be provided with an entrance to the viaduct from Manchester St.

The City Commissioners of Newport, Ky., have revived the scheme of constructing a viaduct to eliminate the grade crossing at the head of Monmouth St. The matter will be taken up with the representatives of the interested railroads on May 15. Bailie Morlidge is City Engineer.

Maryland.

⊙The Commissioners of Howard County, Ellicott City, Md., have awarded the contract for building the bridge over the Patuxent River, on the Columbia road, to the Luten Bridge Co., of York, Pa., for $2,688. The bridge will be 55 ft. long and 16 ft. wide.

Massachusetts.

✣Bids will be received until May 17 (readvertisement) by Board of Barnstable County Commissioners, Barnstable, Mass., for the construction of a reinforced concrete girder bridge over Bass River, between the towns of Yarmouth and Dennis. F. C. Wales, 1150 Tremont Bldg., Boston, Mass., is Engineer. All bids received for this work April 16 were rejected.

Michigan.

Residents of Osceola Township and Torch Lake Township, Houghton County, Mich., have petitioned the Boards for the construction of a joint bridge over Dollar Bay. The proposed structure would be about 200 ft. long.

Minnesota.

✣Bids will be received until 2 p. m., May 6, by Crow Wing County Board, Brainerd, Minn., for the following bridge work: New decking of creosote blocks on the Mississippi bridge on Laurel St., Brainerd. Length of bridge, 731 ft.; with of roadway, 16 ft. Sidewalk, 5 ft. Reinforced concrete bridge across Little Nokay Creek on State Highway No. 1, 12 miles south of Brainerd. Length of bridge, 20 ft. Width of roadway, 20 ft. Abutments, 7 ft. high. Specifications may be seen at the County Auditor's office or at the office of the State Highway Commission at St. Paul. Certified check of 10 per cent to accompany all bids. J. F. Smart is County Auditor.

✣Bids will be received until May 3 by C. A. Dettel, Town Clerk, Nebish, Minn., for the construction of approaches to the bridge over Mud River on the Island Lake Road in the town.

⊙The Duluth, South Shore & Atlantic Ry. has awarded to the American Bridge Co. contracts for the construction of four steel bridges. One of the structures, over the Bad River, south of Ashland, will be 1,000 ft. in

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

length. Another bridge, 700 ft. in length, will span Vaughn Creek, not far from the Bad River. There will also be smaller structures over the Montreal and Culvern Rivers. New steel turntables will also be installed by the American Bridge Co. at the South Shore division points at Marquette, St. Ignace and Thomaston.

⊙The contract for repairing the Anoka bridge, under contract No. 13, has been awarded by A. P. Erickson, Hennepin County Auditor, Minneapolis, Minn., to G. H. Smith. Bids were opened April 7.

Missouri.

✣Bids will be received until 1 p. m., May 5, by J. M. Black, Linn County Highway Engineer, Linneus, Mo., for the erection of the following steel bridges: No. 1, Hoyer bridge, Sec. 21, T. 57, R. 20, 44-ft. girder, 1 30 and 1 14-ft. span; No. 2, Lamme bridge, Sec. 20, T. 58, R. 20, 30-ft. girder; No. 3, Moore bridge, Sec. 12, T. 58, R. 20, pin truss, 60-ft. span; No. 4, Loomis bridge Sec. 33, T. 58, R. 21, 28-ft. girder; No. 5, Baker bridge, Sec. 8, T. 59, R. 18, 30-ft. girder; No. 6, Head bridge, Sec. 22, T. 60, R. 19, 44-ft. girder, 1 30-ft. and 1 14-ft.; No. 7, Miller bridge, Sec. 19, T. 58, R. 21, 308 girder; No. 8, Williams bridge, Sec. 22, T. 59, R. 19, 58-ft. girder, 1 30-ft. and 2 14-ft; No. 9, Arnold bridge, Sec. 13, T. 60, R. 19, 30-ft. girder; No. 10, Myres bridge, Sec. 22, T. 57, R. 19, 30-ft. girder; No. 11, Burch bridge, Sec. 23, T. 57, R. 19, 30-ft. girder; No. 12, Sturtevant bridge, Sec. 30, T. 58, R. 19, 308 girder; No. 13, Smith bridge, Sec. 23, T. 60, R. 22, 44-ft. girder, 1 30-ft. and 1 14-ft.; No. 14, Stone bridge, Sec. 24, T. 60, R. 20, 44-ft. girder, 1 30-ft. and 1 14-ft.

The Trafficway Commission has recommended to the Board of Public Works, Kansas City, Mo., that Missouri Ave. be opened to Wyandotte St. and that a viaduct be built from the alley east of Wyandotte to Walnut St. The structure as planned would be about 26 ft. wide with a grade of from 2½ to 3 per cent. It could be constructed for about $80,000.

The Farmers of Clark County, Mo., are advocating the construction of a bridge over the Des Moines River to connect Lee and Clark Counties. A meeting of the supervisors will probably be held at Kahoka, Mo., to consider the proposition.

Nebraska.

✣Bids will be received until noon, May 20, by Clay County Clerk, Clay Center, Nebr., for the erection of a 70-ft. bridge, with 24-ft. roadway, at Sutton, Nebr., in Clay County. Bids to be submitted on plans for steel bridge on concrete abutments and on reinforced concrete span. Plans on file with County Clerk at Clay Center, Nebr., Omaha and Des Moines, Ia., and at the State Engineer's office at Lincoln. Job within a quarter of mile of the Burlington station.

The Missouri Pacific Ry. Co. has submitted to the Board of Aldermen, Omaha, Nebr., plans for the construction of the Nicholas St. viaduct, and work will probably be started on the structure within a month.

New Jersey.

✣Bids will be received until 7:30 p. m., May 17, by Arthur C. King, Engineer in Charge, Toms River, N. J., for the construction of a road bridge across Barnegat Bay from Island Heights to Sea Side Park. The proposed bridge will consist of 7,212 ft. of timber trestle 24 ft. wide and 3,150 ft. of earth fill 24 ft. wide, bulkheaded. Plans and complete data are on file in the office of the engineer in charge. A complete set of plans and specifications will be furnished by the engineer in charge upon receipt of a deposit of $10 for each set, which amount will be returned, upon the return of the set in an undamaged condition. A certified check of $1,000 will be required with each bid as a guarantee of good faith.

✣Bids will be received until 2 p. m., May 9, by Committee of the Board of Freeholders of Bergen County, Hackensack, N. J., for the construction of a new bridge at River Edge. The cost of the structure is estimated at $12,000.

✣Bids will be received until 2 p. m., May 9, by Committee of the Board of Chosen Freeholders of Bergen County, Hackensack, N. J., for the construction of a bascule bridge over the Hackensack river at River Edge, Bergen County, N. J. Plans and specifications can be examined and all necessary information obtained at the office of the Clerk of the Board of Freeholders, Court House, Hackensack, N. J., or at the office of the County Engineer, Main St., Hackensack, N. J., any day except Saturday, between the hours of 10 a. m. and 4 p. m.

New York.

✣Bids will be received until 2 p. m., May 2, by Town Board, Norfolk, N. Y., for the construction of a bridge in the town of Norfolk, in accordance with plan and specification on file at the office of the Supervisor. H. L. Whipple is Town Clerk.

The Board of Estimate, New York City, has accepted the design of the two viaducts which the Long Island Railroad Company will build over Ramsey and Monroe Sts. and Roosevelt Ave., on the Woodside-Winfield cut-off. The viaduct will be of the plate girder type, and is designed to carry, besides the six running tracks, three station platforms of ample width and length. Concrete abutments will be built along the street lines and intermediate column supports will be provided just back of the curb lines. A clearance of 14 ft. will be provided over the roadway. The floor will be of solid concrete. The Engineer of the Board reports that Borough President Connolly has approved the design.

The lowest bid received by the Board of Contract & Supply, Troy, N. Y., for the construction of the proposed concrete overflow culvert from Glen and Cragin Aves. to the Hudson River, near First St., Lansingburgh, was that of E. L. Grimes, Troy, N. Y., at $38,367.

The unexpected high water of March 26, 27 and 28, carrying, as it did, thousands of logs, torn from retaining booms further up the river, wrecked and carried away the bridge between Glens Falls and South Glens Falls. The bridge was originally designed for ordinary highway traffic, but when the Hudson Valley Railway began operating interurban cars between Glens Falls and Saratoga, to accommodate the extra load, a single chord truss was added. This came down low enough to catch and retain logs, creating and increasing a jam, until at 9:55 p. m., March 27, the strain became too great, and the bridge collapsed. It is expected that a temporary bridge will soon be built, when the proposition of a permanent structure will be in line. Many citizens of both places favor a viaduct much higher than the original bridge, thus eliminating the grades at both ends, the cost of which has been estimated at $150,000. It is an ideal location for a concrete bridge, as all materials, with the exception of reinforcing metal, are procured here, and very little excavation is necessary to get to bed rock foundation. W. K. Reynolds is Village Engineer.

Plans have been submitted to the Common Council of Amsterdam, N. Y., by the Concrete Engineering Co., New York City, for the new bridge over the Mohawk River in that city. The proposed bridge would have three spans and would cost from $100,000 to $125,000. It would have a 30-ft. roadway with two footpaths of 8 ft. each in width.

A special town election is to be held May 9, at a request of the taxpayers, to vote upon the proposition of issuing bonds not to exceed $6,000 for the construction of a reinforced concrete arch bridge over Mill Creek on State St. L. C. Davenport is Village Clerk, Lowville, N. Y.

North Carolina.

✣Bids will be received until May 5, by R. L. C. Gibson, Clerk of the Board of McDowell County Commissioners, Marion, N. C., for the construction of a steel bridge, with concrete piers, steel sleepers, 2-in. white oak flooring, clear of sap, be built across Catawba River at the Hall Town Ford.

Ohio.

✣Bids will be received until 1 p. m., May 19, by Board of Tuscarawas County Commissioners, New Philadelphia, O., for substructure for lower river bridge at Newcomerstown, and substructure for Gnadenhutten River bridge, according to plans and estimates on file in the County Auditor's office. Each bid must be accompanied by a cash deposit of $100 each, or certified check payable to W. C. Shott, Auditor of said county.

✣Bids will be received until noon, May 14, by Board of Champaign County Commissioners, Urbana, O., for the construction of concrete abutments for the following bridges: Mitchell-Black Bridge No. 259, Plan No. 511, over Mad River, Salem Township; Nettleton Bridge No. 260, Plan No. 512, over Nettle Creek, Mad River Township; Snarr Bridge No. 261, Plan No. 513, over Muddy Creek, Concord Township; Johnson Bridge No. 262, Plan No. 514, Lippincott Rd., Concord Township, according to the plans and specifications on file at the office of the County Auditor. All bids must be sealed and made out in blank forms furnished by the County Engineer, R. F. Darnell.

✣Bids will be received until noon, May 23, by Board of Franklin County Commissioners, Columbus, O., for all of the labor and material necessary to construct and complete the following work: Estimate No. 489, completing the King Ave. bridge, according to revised plans; estimate No. 490, superstructure of the McGuffey bridge over Black Lick Creek, Madison Township; estimate No. 491, roadway construction on the superstructure of the McGuffey bridge over Black Lick Creek, Madison Township; estimate No. 492, substructure of the McGuffey bridge over Black Lick Creek, Madison Township; estimate No. 493,, approaches to the McGuffey bridge over Black Lick Creek, Madison Township. The plans, profiles, specifications and estimates of quantities for doing this work are on file in the offices of the County Auditor and County Surveyor. F. M. Sayre is County Auditor.

✣Bids will be received until 11 a. m., May 21, by Board of Cuyahoga County Commissioners, Cleveland, O., for the construction of bridge work per Report No. 3078, concrete arch, Station road, Brecksville Township; Report No. 3098, concrete culvert, Barrett road, Middleburg Township. In accordance with the form of contract and specifications to be furnished by Frank R. Lander, County Surveyor.

⊙The Board of Shelby County Commissioners, Sidney, O., has awarded the contract for the construction of the superstructures of two bridges, one a 92-ft. span at Siegel and the other an 84-ft. span at Hardin, to the Central States Bridge Co. and the Bellefontaine Bridge Co., at $2,900 and $2,675, respectively. W. A. Looker is County Surveyor.

⊙The Board of Mercer County Commissioners, Celina, O., has awarded the contracts for a number of bridges, as follows: Broerman to the Croghan Construction Co. for $1,787; Macke to the Brookville Bridge Co. for $1,797; Fox to New Bremen Bridge Co. for $777.50; Cain to New Bremen Bridge Co. for $777.50; Kindle to Ohio Concrete Supply Co., Fremont, O., for $646; Esser to Ohio Concrete Supply Co. for $440. The concrete substructures were awarded as follows: Broerman to Balmert & Flayler for $1,080. S. M. Burnett secured the contract for the construction of the Macke substructure at his bid of $1,058.75, the Fox at $480 and the Cain substructure for $420. The Kindle substructure to J. C. Preston for $322.40. The Clark concrete bridge to Wm. Canary for $512. Chivington concrete bridge to Henry Hughes for $293.20.

County Surveyor Anspach, Kenton, O., has estimated that the damage to bridges in Hardin County by the recent flood would amount to about $25,000. Immediate steps will be taken to rebuild and repair the structures.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Plans are being prepared by the Engineering Department of the county, Dayton, O., for the construction of a suspension bridge over the Miami River at Central Ave., in Miamisburg.

Plans are under consideration by the City Bridge Department, Cleveland, O., for the construction of a new double-lift bridge at the site of the lower W. 3d St. bridge. The cost of the new structure, it is estimated, would amount to about $250,000.

The city officials have decided to join with the County Commissioners in an effort to strengthen the 11th St. bridge over Raccoon Creek, Newark, O., to provide for heavy interurban traffic. C. H. Wells is City Engineer.

A resolution for the construction of a bridge over the Cincinnati, Hamilton & Dayton R. R. tracks at Miami St. by the railroad has been referred back to the Public Improvement Committee by the City Council of Toledo, O., to give the company an opportunity to explain plans for changing the location of the structure.

It is reported that the Pennsylvania Railroad is contemplating the construction of an 832-ft. steel trestle to replace the embankment recently washed out by the Tuscarawas River, west of Newcomerstown, O.

Oregon.

The City Commissioners, Baker, Ore., have ordered the construction of two new steel bridges over the Powder River, one at Center St. and the other at Bridge St. Plans and specifications will be prepared at once, and bids for the construction work will be advertised for shortly.

Pennsylvania.

✣Bids will be received until 10 a. m., May 6, at the office of the City Controller, Pittsburgh, Pa., for the removal of the present bridge and the construction of a new reinforced concrete arch bridge on the line of Butler St., over Haights Run. Printed pamphlets of contract and specifications and blue prints of contract plans can be obtained at the office of the Department of Public Works, Henry W. Oliver bldg., Pittsburgh, Pa., upon making the required deposit for same.

The State Water Supply Commission, Harrisburg, Pa., has announced that it has given permission to the Pennsylvania Railroad to rebuild the bridge over Conestoga Creek at Lancaster; the Baltimore & Ohio to rebuild bridge over Monongahela at Glenwood; Pittsburgh & Lake Erie to rebuild bridge over Beaver at West Ellwood Junction, and Wilkes-Barre Connecting Railroad over Susquehanna between Wilkes-Barre and Dorranceton.

The Board of Lawrence County Commissioners, Newcastle, Pa., has rejected all bids received for the construction of the temporary foot bridge over the Shanango at Gardner Ave. and the new pier for Mahoningtown bridge over Mahoning River. The bids received were as follows: Gardner Ave. footway, Kimbrough & Elder, $4,110; Farris Bridge Co., $4,100. Mahoningtown pier, Farris Bridge Co., $11,900. The Commissioners will at once readvertise the work.

A Board of Viewers has been appointed by Judge Kunkel, according to advices from Harrisburg, Pa., to determine whether or not two bridges destroyed in Mercer County last March should be replaced. One structure was located at Silver and Vine Sts., Sharon, while the other was in Hempfield and West Salem Townships, Mercer County.

South Dakota.

✣Bids will be received until 2 p. m., May 6, by W. R. Hall, County Auditor, Faulkton, S. Dak., for the construction and repair of bridges in Faulk County during the ensuing year.

Virginia.

✣Bids will be received until noon, May 13, by Board of Bath County Supervisors, Warm Springs, Va., for the construction of a steel bridge over Cowpasteure River, 4 miles west of Hillboro, Va. The structure will have a span of 175 ft. F. L. La Rue is Clerk.

Washington.

✣Bids will be received until May 5 by Board of Adams County Commissioners, Ritzville, Wash., for the construction of a concrete bridge over E St.

Wisconsin.

⊙The Chippewa County Bridge Committee, Chippewa Falls, Wis., has awarded the contract for the construction of the Henneman bridge, on the Henneman Creek at Tilden, to J. M. Vance, at $1,225.

It is reported that the city officials of La Crosse, Wis., will shortly take up the matter of eliminating the grade crossing of the Milwaukee R. R. at Rose St. George P. Bradish is City Engineer.

Plans and specifications are being prepared for the construction of the proposed new concrete bridge over Sauk Creek, Grand Ave., Washington, Wis. The Board of Public Works will probably advertise for bids for the work shortly.

The town of Menomonie, Wis., has voted to construct a new steel bridge over Wilson Creek in section 9 to replace the old wooden structure known as the "Heller" bridge. The new structure will be one span of about 60 ft., and it is estimated will cost about $1,400, half of which will be paid for by the county.

Eight petitions were recently filed with the County Commissioners, Eau Claire, Wis., for the construction of new bridges and repair of old ones. The towns of Lincoln and Ludington petitioned for repairs on the Eau Claire River in section 33, township 27, range 7 west. Each set the amount for each town's portion at $1,310, the county to pay half and the town the other half. Fairchild wants a bridge across Black Creek between sections 22 and 23, township 25, range 5 west, to take the place of the Lanterman bridge, to be of steel and concrete. The cost was set at $1,000. This town also wants a steel and concrete bridge across Travis Creek, the cost to be $800. Otter Creek wants three bridges, one over a branch of Otter Creek at $400, another in section 22, over a small creek, at $400, and still another in place of a culvert over a dry run, at $400. Drammen wants a bridge over Rock Creek at the price of $700.

West Virginia.

✣Bids will be received until 11 a. m., May 3, by the Greenbrier County Court, Lewisburg, W. Va., for the construction of two bridges. J. E. Dougher is Road Engineer.

Wyoming.

✣Bids will be received until 10 a. m., May 13, by W. H. Dobson, County Clerk, Newcastle, Wyo., for the construction of a wooden bridge over Main Beaver, about ¼ mile east of the present bridge near the Main Beaver Shearing Pens. The county will furnish all lumber and piles on the ground at the bridge site.

Wisconsin.

✣Bids will be received until 8 p. m., May 20, by Village of Turtle Lake, Wis., for the construction of a water works system. Plans and specifications are now on file with F. G. McKenzie, clerk of the Village of Turtle Lake, Wis., and A. T. Thompson, Engineer, Colfax, Wis.

ROADS AND STREETS

Alabama.

✣Bids will be received until 8 p. m., May 12, by City Council, New Decatur, Ala., for furnishing labor and material necessary for the construction of gutters, curbs and street pavement. Plans and specifications are on file with Henry Hartung, Clerk.

⊙The Montgomery Construction Co., Montgomery, Ala., has been awarded the contract at Opelika, Ala., for the construction of 10,000 sq. yds. of Dolarway pavement. Contract awarded April 23.

⊙The Southern Asphalt & Construction Co. of Birmingham, Ala., has been awarded the contract by that city, Walter G. Kirkpatrick, City Engineer, for paving N. 24th St., 7,000 sq. yds., including grading, 5-in. concrete base, paint coat and 2-in. asphalt top, for $1.74 a sq. yd.; also paving 14th Ave., Ash and Beech Sts., 16,000 sq. yds., including grading, 4-in. concrete base, 1½-in. asphaltic concrete top, at $1.47 a sq. yd. The Creosoted Wood Block Paving Co., New Orleans, La., secured the contract to pave Second Ave. and 19th St., 15,000 sq. yds., including grading, 5-in. concrete, and 3½-in. blocks, at $2.69 a sq. yd.

⊙The Southern Paving & Construction, of Birmingham, Ala., has been awarded the contract by the city of Charlotte, N. C., for the construction of pavement recently ordered by the Board of Aldermen, at $1.34 per sq. yd., for paving, and $0.38 per cu. yd. for grading.

California.

⊙Clark & Henery Construction Co., Sacramento, Cal., has been awarded the contract by the State Highway Commission, Sacramento, for the construction of the portion of the state highway between Oak Grove Drive and Bellevue Drive, Burlingame, Cal., for $3,688. Bids were opened April 21.

⊙Richard Keatinge & Sons, 303 Williams Bldg., San Francisco, Cal., have been awarded the contract by the State Highway Commission, Sacramento, for the construction of the portion of the state highway between San Jose and Edenvale, for $17,820. Bids were opened April 21.

⊙Raisch Improvement Co., 109 Montgomery St., San Francisco, Cal., has been awarded the contract by the California State Highway Commission, Sacramento, for the construction of a portion of the state highway between San Mateo and Beresford, for $19,234. Bids were opened April 21.

The California Highway Commission, Sacramento, did not let the contract on April 21, for constructing a portion of a state highway in Ventura County between the southerly boundary and Newbury Park, about 7½ miles in length, to be built of Portland cement concrete with bituminized surface.

The citizens of Roseville, Calif., at a recent election voted the issuance of bonds in the sum of $20,000 for street improvement. It is proposed to pave 15 ft. in the middle of the streets leading through the city from north to south.

Georgia.

⊙The street committee of the City Council, Atlanta, Ga., R. M. Clayton, Chief of Construction, awarded the following contracts for paving 40,000 sq. yds. with rock and chert, with 10,000 yds. of rubble gutters; 19,000 sq. yds. of vitrified block or wood block. R. M. Hudson, Atlanta, chert paving; Byron Sander, Atlanta, brick, $2.58 per sq. yd.; T. D. Meador, Jr., Atlanta, wood block, $2.68 per sq. yd. Bids were opened April 18.

Illinois.

✣Bids will be received until 10 a. m., May 10, for the construction of approximately 10 miles of hard roads in Crete township, Will County, Ill. Plans, profiles and specifications can be seen at the office of S. Rose, Town Clerk, Crete, Ill., and for the crushed stone may be had on request from the State Highway Commission, Springfield, Ill.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

⊙Harder Auto Truck Co., Chicago, Ill., has been awarded the contract by the City Council of Joliet, Ill., Matt Berschild. City Clerk, for furnishing the city with a combination ambulance and patrol wagon. for $3,450.

⊙H. P. Streicher Co., Inc., 811 133 Washington Blvd., Chicago, Ill., has been awarded the contract by the Board of Local Improvements of Joliet, Ill., Wm. S. Welch, Secy., for the paving of Eastern Ave., for $12,300. Bids were opened April 14; contract awarded April 25.

⊙McCugo, Bullock Co., Waukegan, Ill., has been awarded the contract by that city, for the paving of Grand Ave., with Marion brick, for $35,523. Chas. Payne, Waukegan, secured the contract to pave St. James St., with brick, for $8,557.

⊙The following contracts have been awarded by the Board of Local Improvements, Chicago, Ill., for constructing pavements in the following streets; Berteau Ave., 52d Ave. to 53d Ave., 1,370 lin. ft. granite concrete combined curb and gutter, 2,270 sq. yds. asphalt paving, The American Asphalt Paving Co., 133 W. Washington St.; 40th Ave., Fillmore St. to 16th St., 2,100 lin. ft. sand stone curbing, 2,270 sq. yds. asphalt pavement, American Asphalt Paving Co., 133 W. Washington St.; W. 43d Pl., Union Ave. to Canal St., 2,800 lin. ft., 4,450 sq. yds. asphalt pavement, R. F. Conway Co., 133 W. Washington St.; N. 51st St., Irving Park Blvd. to Berteau Ave., 2,650 lin. ft. granite concrete combined curb and gutter, 3,450 sq. yds. asphaltic concrete, American Asphalt Paving Co.; Marshfield Ave., 67th St. to 72d St., 990 lin. ft. granite concrete combined curb and gutter, 9,790 sq. yds. asphalt pavement, American Asphalt Paving Co.; Paulina St., 67th St. to 72d St., 6,700 lin. ft. granite concrete combined curb and gutter, 10,930 sq. yds. asphalt pavement, American Asphalt Paving Co.; Prairie Ave., Lake St. to Chicago Ave., granite concrete combined curb and gutter, asphaltic concrete combined curb and gutter, H. G. Goelitz, Oak Park, Ill.; Wood St., 67th St. to 72d St., 6,690 lin. ft. granite concrete combined curb and gutter, 10,920 sq. yds. asphalt, American Asphalt Paving Co.; Troy St., Montrose Ave. to Irving Park Blvd. to Montrose Ave., Albany Ave., Irving Park Blvd. to Montrose Ave., Belle Plaine Ave., Kedzie Ave. to Sacramento Ave., Berteau Ave., Kedzie Ave. to Sacramento Ave., Cullom Ave., Kedzie Ave. to Sacramento Ave., 17,500 lin. ft. sandstone curbing, 29,730 sq. yds. asphaltic concrete, J. A. McGarry 189 W. Madison St.; 114th St., Stewart Ave., to C. & W. I. R. R., Yale St., 113th St. to 115th St., Princeton Ave., 113th St. to 115th St., Harvard Ave., 113th St. to 115th St., 9,100 lin. ft. sandstone curbing, 1,370 sq. yds. asphaltic macadam, Farr Bros. Co. 356 W. 111th St.; alley Cortez St., Humboldt St., etc., 320 lin. ft. concrete curbing, 260 sq. yds. brick, P. J. O'Brien, 10 S. La Salle St.; alley, Belden Ave., Cleveland Ave., etc., 730 lin. ft. concrete curbing, 530 sq. yds. of brick pavement, J. A. McGarry Co.; alley, Archer Ave., Dearborn St., etc., 400 lin. ft. concrete curbing, 400 sq. yds. granite, John Dillon, 179 W. Washington St.; alley, Calumet Ave. 30th St., etc., 750 lin. ft. concrete curbing, 600 sq. yds. brick pavement, J. A. McGarry Co., alley, 41st St., Michigan Ave. etc., 1182 lin. ft. concrete curbing, 1,182 sq. yds. brick pavement, Jas. A. Sackley Co., 133 W. Washington St.; alley, Washington Ave., 61st Pl., etc., 630 lin. ft. concrete curbing, 500 sq. yds. brick pavement, J. A. McGarry Co.; alley, Paulina St., Warren Ave., etc., 550 lin. ft. concrete curbing, 550 sq. yds. brick pavement, Central Paving Co., 179 W. Washington St.; alley, Grand Ave., Curtis St., etc., 650 lin. ft. concrete curbing, 580 sq. yds. brick pavement, J. A. McGarry; alley, Kedzie Ave., Milwaukee Ave., etc., 1,082 lin. ft. concrete crubing. 850 sq. yds. brick pavement, Central Paving Co.; alley. Cottage Grove Ave., 42d St., etc., 500 lin. ft. concrete curbing, 370 sq. yds. brick pavement, J. A. McGarry; alley, Vernon Park Pl., May St., etc., 740 lin. ft. concrete curbing, 250 sq. yds. brick pavement, P. J. O'Brien; alley, Taylor St., Center Ave., etc., 1,550 lin. ft. concrete curbing, 1,220 sq. yds. brick pavement, Central Paving Co. The work includes a 6-in. Portland cement concrete foundation, preparation of the sub-grade, sewer, manhole and catch-basin construction and adjustment, sidewalk construction, etc. E. J. Glackin, Secretary of the Board.

⊙David Ryan has been awarded the contract by the Board of Local Improvements of Alton, Ill., for the paving of Bostwick St., from Seminary to Washington Ave., for $1.47½ a yd., and for the curb at $0.43 a ft.

⊙The Board of Local Improvements of Pontiac, Ill., has awarded the contract for paving Plum St., to R. Lobb & Son, for $9,275.

✣Bids will be received until 11 a. m., May 6th, by Board Local Improvements, Chicago, for constructing concrete sidewalks in the following streets: Ave. J. 99th St. to 110th St., 750 sq. ft., 2½ ft. fill, assessment price 21 cts.; Butler St., 123d St. to 124th St., 3,000 sq. ft., 1 ft. fill, assessment price, 15½ cts.; Blanche St., Fleetwood St. to Holt St., fill 1 ft., assessment price, 15 cts.; Cullom Ave., 52d Ave. to 800 ft. east, 4,800 sq. ft., 1¼ ft. fill, 800 lin. ft. cut, cut 1 ft., assessment price, 15½ cts.; Currier St., Chapin St. to Augusta St., 2,200 sq. ft., fill 6 ft., 250 lin. ft. cut, cut 1 ft., assessment price 39 cts.; 87th St., Commercial Ave. to alley west, 830 sq. ft., 8 ft. fill, assessment price 44 cts.; Evans Ave., 76th St. to 78th St., 2,800 sq. ft., 3 ft. fill, assessment price 23 cts.; 49th Ct., Sunnyside Ave. to Monross Ave., 2,000 sq. ft., 1¼ ft. fill, assessment price 16 cts.; Green Bay Ave., 89th St. to Harbor Ave., 3,000 sq. ft., 4 ft. fill, 467 lin. ft. retaining wall, 19 cts., assessment price, 27½ cts.; Halsted St., 89th St. to C. R. I. & P. Ry., 4,000 sq. ft., 1¼ ft. cut, assessment price 16 cts.; Jackson Blvd., 46th Ave. to 48th Ave., 1,200 sq. ft., 1 ft. fill, assessment price 17 cts.; Kedzie Ave., Chicago River to Sanitary District Canal, 4,000 sq. ft., 2 ft. fill, 200 lin. ft. cut 2½ ft., cut, assessment price 19 cts.; Marshfield Ave., 71st St. to 74th St., 5,000 sq. ft. fill 1 ft., 800 lin. ft. cut, 1 ft. cut, assessment price 15½ cts.; 19th St., Laflin St. to Western Ave., 18,000 ft., 6 ft. fill, 1,200 lin. ft. retaining wall $2.42, assessment price 28 cts.; 93d St., Stony Island Ave. to N. Y. C. & St. L. Ry., 900 sq. ft., 4 ft. fill, 100 lin. ft. cut, 4 ft. cut, assessment price 22 cts.; Sawyer Ave., Balmoral Ave. to 76th St. south, 600 sq. ft., 1 ft. fill, assessment price 15½ cts.; Washington Ave., 91st St. to 93d St., 1,000 sq. ft., average fill, 1 ft., assessment price 17 cts.; Western Ave., Barry Ave. to Nelson St., 150 sq. ft., 4 ft. fill, assessment price 20½ cts.; Montrose Ave., 880 ft. east of California St. to Humboldt St., Cullom Ave., California Ave. to Humboldt St., Berteau Ave., California Ave. to Humboldt St., Belle Plaine Ave., California Ave. to Humboldt St., California Ave., Montrose Ave. to Irving Park Blvd., Mozart St., Irving Park Blvd. to Montrose Ave., Francisco St., Montrose Ave. to Irving Park Blvd., Humboldt St. Montrose Ave. to Irving Park Blvd., 30,000 sq. ft., 1 ft. fill, assessment price 17 cts.; 77th St., Chauncey Ave to Woodlawn Ave., 78th St., Adams Ave. to Woodlawn Ave., 79th St., Monroe Ave. to I. C. R. R., Adams Ave., 125 ft. north of Anthony Ave. to 78th St., Kimbark Ave., Anthony Ave. to 79th St., Chauncey Ave., P. F. W. & C. R. R. to 79th St., Woodlawn Ave., 77th St. to 79th St., 12,000 sq. ft., 1½ ft. fill, 1,000 lin. ft. cut, 1½ ft. cut, assessment price 19½ cts.; 19th St., Center Ave. to Blue Isl-Ave., 20th St., Throop St. to Blue Island Ave., 21st St., Center Ave. to Blue Island Ave., 21st Pl., Throop St. to Laflin St., 22d St., Center Ave. to Blue Island Ave., Allport Ave., 19th St. to 22d St., Throop St., 19th St. to 22d St., Loomis St. to 19th St., to 22d St., Laflin St., Blue Island Ave. to 22d St., 25,000 sq. ft., 1 ft. fill, 2,000 lin. ft. cut, cut 1 ft., assessment price 15½ cts. Cash or certified check for 10 per cent of bid must accompany proposal. E. J. Glackin, Secretary of the Board of Local Improvements.

Roy L. Williams submitted the lowest bid to the Board of Local Improvements of Cairo, Ill., for the paving of Fourth, Sixth and 10th Sts., from Ohio St., to Washington Ave. and 12th St., from Ohio St., Poplar St. and Holbrook Ave., from 21st St. to Charles St. The bid was $53,241.

Indiana.

✣Bids will be received until 10 a. m., May 2, by Board of Public Works, Indianapolis, Ind., for the construction of the following improvements: Jefferson Ave., from the north property line of Washington St. to the south property line of Michigan St., by grading and paving the roadway; 19th St., from the west property line of Gent Ave., north side, and from west sidewalk of Gent Ave., south side, to east sidewalk of Schurman Ave., by grading and paving the sidewalks; Barth Ave., from the north sidewalk of Palmer St. to the south property line of Cottage Ave., by grading and paving the sidewalks; Rockwood Ave., from the south property line of 40th St. to the north property line of 43d St., by grading and paving the sidewalks; the first alley east of Park Ave., from the north property line of 21st St. to the south property line of 23d St., by grading and paving the roadway.

✣Bids will be received until 10 a. m., May 15, by Board of Allen County Commissioners, Fort Wayne, Ind., for the construction of a gravel road in Monroe Township. C. H. Brown is County Auditor.

✣Bids will be received until 1 p. m., May 12, by Board of Lawrence County Commissioners, Bedford, Ind., for the construction of gravel or macadamized roads. Ezra W. Edwards is County Auditor.

✣Bids will be received until 11 a. m., May 9, by Board of Tipton and Hamilton Counties Commissioners, Tipton, Ind., for the construction of a gravel road on the line between the said counties.

✣Bids will be received until 10 a. m., May 7, by Board of Wells County Commissioners, Bluffton, Ind., for the construction of a stone road on Wells-Huntington County line. L. A. Williamson is County Auditor.

✣Bids will be received until 1 p. m., May 6, by Board of Jackson County Commissioners, Brownstown, Ind., for the construction of two gravel or macadamized roads in Redding Township. Albert Leudtke is County Auditor.

✣Bids will be received until 1 p. m., May 5, by Board of Benton County Commissioners, Fowler, Ind., for the construction of five free macadamized roads in Grant Township, one crushed limestone road in Bolivar Township and four crushed limestone roads in Oak Grove Township. Warren Mankey is County Auditor.

✣Bids will be received until 1 p. m., May 5, by Board of Ripley County Commissioners, Versailles, Ind., for the construction of a macadam road in Center Township. J. Francis Lochard is County Auditor.

✣Bids will be received until 10 a. m., May 5, by Board of Laporte County Commissioners, Laporte, Ind., for the construction of a macadamized road in Pleasant, Lincoln and Washington Townships. Fred A. Hausheer is County Auditor.

✣Bids will be received until 10 a. m., May 2, by Board of Randolph County Commissioners, Winchester, Ind., for the construction of two highways in Nettle Creek Township, and one in Greenfork Township. H. F. Woods is County Auditor.

✣Bids will be received until 2 p. m., May 5, by Board of Spencer County Commissioners, Rockport, Ind., for the construction of the Atkinson Road in Ohio Township. J. T. Stevenson is County Auditor.

⊙Helm & Myres, of Marco, Ind., have been awarded the contract by the Greene County Commissioners, Bloomfield, Ind., to build the new macadamized road in Stockton and Stafford Townships.

⊙The Northern Construction Co., of Elkhart, Ind., has been awarded the contract by the Board of Public Works of that city, for the paving of S. Second St., a distance of three blocks, at the following bid: Metropolitan or medal block, cement filler, $7,112;

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

sand filler, $7,017; asphalt or pitch filler, $7,684.

⊙The Board of Warren County Commissioners, Williamsport, Ind., has let the contract for the construction of the Smith gravel road to Wm. Mahoney of Lafayette, Ind., and the contract to construct the Fisher gravel road to Perry McKinsey, Frankfort, Ind. Bids were opened April 7.

Engineer H. C. McCluer has prepared plans for the construction of seven squares of paving in Crawfordsville, Ind., at an estimated cost of $9,000. Brick will be laid on a 4-in. concrete base with sand filler, with concrete curb. The work will require 12 ins. of excavation. Contracts will be let May 19 or June 3. F. G. McIntyre is chairman of the Board of Public Works.

Iowa.

✣Bids will be received until 7:30 p. m., May 2, by City Recorder, Muscatine, Ia., for grading, paving and curbing of the streets and alleys in Improvement District No. 30, as laid out and ordered improved by the City Council of the city of Muscatine, Ia. The estimated quantities for the improvement of said district is as follows: 30,220 sq. yds. of either bitulithic, brick, asphaltic, concrete, concrete or Dolarway pavement, including sub-grading; 8,580 cu. yds. of extra grading; 21,661 lin. ft. of combined curb and gutter, including sub-grading; 6,167.50 lin. ft. of right of way of street railway, 7 ft. in width, to be paved with brick, including sub-grading; alley between Park Drive and Oakland Drive and between Park Drive and Parinkington Drive; in alleys block 81, 87, 97, 120, 148, 125, and 39 of the original town and blocks 1, 8 and 9 of Ogilvie's addition, 7,503.1 sq. yds. of concrete or Dolarway pavement, including sub-grade. Specifications for the work and blank proposals for the same can be had at the office of C. H. Young, City Engineer.

✣Bids will be received until about June 1, by L. J. Stout, City Clerk, Eldora, Ia., for the construction of 6,000 yds. of concrete paving. S. B. Gardner, Eldora, Ia., is Engineer.

✣Bids will be received until May 12, by J. O. Gregg, City Clerk, Iowa Falls, Ia., for the construction of 20,129 yds. of paving and 10,800 ft. of curb. B. S. Gardner, Eodora, Ia., is Engineer.

⊙The City Council of Waterloo, Ia., has let the contract for the paving of E. Fourth St., from Franklin to Dane Sts., to the Bryant Asphalt Co., at $2.24 a sq. yd. The company also secured the contract for paving at Prospect Hill.

⊙Wilmer Cook, 1699 Washington St., Dubuque, Ia., has been awarded the contract by that city, for improving the alley between Rhomberg and Garfield Aves. Bids were opened April 17.

⊙Tibey Bros., 11 Rush St., Dubuque, Ia., have been awarded the contract by that city, for improving Nevada St., from the southerly lot line of Langworthy Ave., to the northerly curb line of Dodge St. Bids were opened April 17.

Kentucky.

The Scott County Fiscal Court, Georgetown, Ky., has determined upon an extra expenditure of $10,000 over the present allotment of $6,000 toward the repairs on the roads of Scott County for the coming year.

Louisiana.

✣Bids will be received until noon, May 16, by the Mayor, Monroe, La., for paving Walnut St., from Jefferson to Pine. The principal paving material will be of wooden blocks. The amount of material in sq. yds. is 6,540 blocks, brick 384; 21,800 lin. ft. of concrete curbs are to be laid.

⊙The Healey Construction Co. and the Louisiana Petrolithic Construction Co., of Meridian, Miss., and New Orleans, La., respectively, have been awarded contracts by the Caddo Parish Police Jury, Shreveport, La., for the construction of about 15 miles of permanent highways to cost approximately $100,000.

Maine.

The Maine Legislature has passed the general highway bill providing for a State Highway Commission and the issuance of $2,000,000 of bonds for highway purposes. The County Commissioners are to be empowered to employ prisoners on the highways when 3 per cent of the voters of any county request them to do so.

Michigan.

Smith & Boulay Co., The Nasby, Toledo, O., are preparing plans for about 12,000 sq. yds. of street paving and some extensions to the present water system of St. Louis, Mich.

Smith & Boulay Co., The Nasby, Toledo, O., are preparing plans for 15,000 sq. yds. of street paving for Ithaca, Mich. The question will be submitted to a vote, and if carried the work will be done this year.

The citizens of Jackson, Mich., recently voted in favor of constructing pavements in W. Washington St. and Cooper St.

The Genesee County Highway Commission, Flint, Mich., has asked the Board of Supervisors to issue $100,000 in bonds for proposed improvements on roads this season. Ninety miles of highways are in the list which the commissioners wish to improve.

The Alpena County Board of Supervisors, Alpena, Mich., has appropriated $2,000 to help build the automobile road from Alpena to Bay City. Other counties have appropriated $18,000 as their share toward the work.

The citizens of Berrien County, Mich., St. Joseph, county seat, at a recent election voted the issuance of bonds in the sum of $500,000 for the construction of a trunk system of county roads. One of the first roads to be built will be five miles long between Niles and Buchanan.

A special election is to be held in Ithaca, Mich., for the purpose of voting on the issuance of bonds to the amount of $20,000, to be used in extending the street paving.

Minnesota.

✣Bids will be received until 11 a. m., May 5, by A. P. Erickson, County Auditor, Minneapolis, Minn., for grading about 3,625 lin. ft. of roadbed.

✣Bids will be received until 1 p. m., May 6, by H. C. Nolte, County Auditor, Fairmont, Minn., for the construction of state road work.

✣Bids will be received until 10 a. m., May 2, by Commissioner R. Murchison, of Public Works, Duluth, Minn., for 50,000 gals., more or less, of dark road oil containing not less than 40 per cent asphalt. Price should be quoted per gal. f. o. b., Duluth. C. S. Palmer is Clerk.

✣Bids will be received until 2 p. m., May 3, by C. A. Deitel, Town Clerk, Nebish, Minn., for the construction of road improvements, including grading.

⊙The city of Austin Minn., on April 25 awarded contracts to Field & Shepley, St. Paul, Minn., as follows: 14,820 sq. yds. of creosote block paving, $33,197; 6,974.95 lin. ft. of cement curbing, $2,626, and 377.25 sq. yds. of brick paving, $840. Oscar F. Weissgerber is City Engineer.

The County Commissioners at Marshall, Minn., Ernest S. Shepard, Auditor, rejected all bids received April 23 for constructing the Marshall-Ghent division state road No. 2. The Commissioners will have some large jobs to let in the near future.

The Itasca County Commissioners, Grand Rapids, Minn., have retained Engineer Geo. W. Cooley, of St. Paul, to take charge of the work of surveying and estimating the cost of a new trunk line road in that county for a distance of 57 miles. It is thought this road will cost approximately $116,000.

The Beltrami County Board of Commissioners, Bemidji, Minn., has acted favorably upon a petition for a state rural highway, 45 miles long, to be built under the Elwell law, in the northern part of the county. The estimated cost of the road is $68,900.

City Engineer C. H. West of St. Cloud, Minn., has estimated the cost of improving Fifth Ave., south, from Second to Eighth Sts., at $15,700. The improvements will include storm sewers, curbs and boulevards and paving.

The Town Board of Iron Range Township, according to advices from Coleraine, Minn., has decided to build a new cement walk between the villages of Bovey and Coleraine. This walk will be 1,300 ft. long and 6 ft. wide.

Mississippi.

✣Bids will be received until 6 p. m., May 6, by Board of Aldermen, Calhoun City, Miss., P. D. Williams, Clerk, for the construction of about 1 mile of concrete sidewalks in Calhoun City, Miss. Each bid must be accompanied by a certified check for $100.

The Board of Supervisors of Pike County, Magnolia, Miss., has authorized a $200,000 bond issue, the proceeds of which will be used in the construction of permanent highways in the Fourth Supervisors' District.

Missouri.

⊙Maret & Anthony, Webb City, Mo., have been awarded the contract by that city, E. W. Robinson, Engineer, for the construction of 22,000 sq. ft. of concrete walk, for $3,000. The asphalt macadam and curb gutter to have been let at same time has been delayed indefinitely by a temporary injunction. Bids were opened April 21.

C. J. Kahman submitted the lowest bid to the Board of Park Commissioners of Kansas City, Mo., on April 17, for grading a portion of Union Station Park.

Nebraska.

✣Bids will be received until 5 p. m., May 26, by City of Norfolk, Nebr., for 47,000 yds. of asphaltic concrete paving. The cost of the work is estimated at $97,000. H. H. Tracy is Engineer, Norfolk, Nebr.

⊙E. R. Bing has been awarded the contract by the City Council of Hastings, Nebr., for the repaving of Second St., between St. Joe and Burlington Aves., with Burlington brick block, with asphalt filler, at $2.16 a sq. yd.

New Hampshire.

✣Bids will be received until May 7, by S. Percy Hooker, Superintendent of Highways, Concord, N. H., for the construction of a gravel road in Madison, N. H., estimated to cost $950. Plans and specifications are on file with the State Engineer, Concord, N. H

New Jersey.

✣Bids will be received until 3 p. m., May 5, by Committee on Roads of the Board of Essex County Chosen Freeholders, Newark, N. J., for furnishing and sprinkling 75 miles more or less, of the county roads with road oil. Bids will be received on a gallon basis for furnishing and laying. Bidders may bid on one or all of the following sections: Sec. 1, east of First Mountain, north of and including Mt. Pleasant and Park Aves.; Sec. 2, east of the First Mountain, south of Mt. Pleasant and Park Aves.; Sec. 3, west of the First Mountain, north of and including Mt Pleasant Aves.; Sec. 4, west of the First Mountain, south of Mt. Pleasant Ave. The map of the different roads may be seen at the County Engineer's office, court house, Newark, N. J., and also specifications for oil to be furnished. Samples of the oil furnished by the respective bidders must be submitted at the time of making proposals, and analysis of the oil must accompany each bid. The miles of road to be treated in the different districts shall be at the option of the committee, but not less than 12 miles shall be treated in each district. Frederic A. Reimer is County Engineer.

✣Bids will be received until 8 p. m., May 13, by Common Council, Rahway, N. J., for the paving of Irving St., from Poplar St. to Grand St., with brick pavement. Approximate amount of work to be done: Excavate present surface of street to subgrade; lay 8,742 sq. yds. of vitrified brick pavement; re-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

set 3,591 lin. ft. of curb in concrete. A certified check, for the sum of $1,000 must accompany each bid, made payable to the Mayor and Common Council of the city of Rahway. Plans and specifications may be examined at the office of the City Engineer.

⊙Schneider & Steele have been awarded the contract at Westfield, N. J., for the construction of 7,500 sq. yds. of Dolarway pavement. Contract awarded April 21.

The town of Belleville, N. J., Edward E. Mathes, Town Clerk, did not let the contract for furnishing and sprinkling the streets with road oil, for which bids were opened on April 16.

New York.

✣Bids will be received until May 6, according to reports, by Commissioner of Public Works, Auburn, N. Y., for paving with brick Hoops Ave., between Walnut and Francis Sts., and Grant Ave., from Fulton St. to the Five Points, with brick or asphalt.

✣Bids will be received until 10:30 a. m., May 20, by Commissioner of Public Works, H. M. James, Secy., Hudson, N. Y., for furnishing material and labor necessary for relaying approximately 4,975 lin. ft. of old curbstone and paving about 13,600 sq. yds. of street with vit. brick. M. J. O'Hara is City Engineer.

The Board of Public Works of Fulton, N. Y., has voted to alter the grade of Oneida St., according to plans of the City Engineer.

The citizens of Catskill, N. Y., on April 15, voted the issuance of bonds in the sum of $11,000 for the paving of West Bridge St.

Bids were received by the Board of Aldermen, Batavia, N. Y., on April 15, for the paving of Summit St., from the following contractors: Warren Bros.' Co., of Boston; Louis H. Gipp, Buffalo; Arthur J. Shaw Co., Batavia; A. D. Osborn, Binghamton; W. W. Wilber, Rochester; R. W. Handson, Geneva; George E. Lear. The work will cost approximately $20,000.

A special election was held in Little Valley, N. Y., on April 22 to vote on a change in estimation of cost for paving the streets of the village. The first estimate made was $25,000, and later reduced to $22,000.

The Park Board of Buffalo, N. Y., has voted to pave Kenilworth Ave. with brick to a 40-ft. width, from Main St. to the city line connection with the new Niagara Falls Blvd.

North Dakota.

✣Bids will be received until May 6, by Adolph Schlenker, Sheridan County Auditor, McClusky, N. Dak., for the grading of a number of roads.

⊙Andrew Crean, Bowden N. Dak., has been awarded the contract by the Foster County Commissioners, Carrington, N. Dak., for grading all county roads in the nine unorganized townships for the year 1913 at prices ranging from $0.08 to $0.20 a cu. yd., according to kind of work. C. W. Burnham is County Auditor. Bids were opened April 8.

Ohio.

✣Bids will be received until noon, May 8, by Village Council, Middlefield, O., at the office of Joe A. White, Village Clerk, for furnishing the necessary labor and materials for the improvement of High and Elm Sts. and Main and State Sts. in said village by grading, draining and paving the same with tar concrete upon a cinder or slag foundation, in accordance with the plans, specifications, profiles and estimates now on file in the office of the Village Clerk. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 10 a. m., May 6, by Board of Lucas County Commissioners, Toledo, O., for the labor and the materials, tools, machinery and appliances required for the improvement by grading, draining and macadamizing of public highways in Wildwood addition, a subdivision of Adams township, Lucas County, Ohio.

✣Bids will be received until noon, May 5, by Fred Feuchter, Clerk of the village of West Park, O., for furnishing the labor and materials necessary for building delinquent sidewalks; also for building sidewalks at street intersections in accordance with the form of contract, details, plans and specifications on file at the office of the village clerk, and at the office of Wm. H. Evers Engineering Co., 382-384 The Arcade, Cleveland, O.

✣Bids will be received until noon, May 9, by John A. Fouts, Village Clerk, Dennison, O., for the improvement of First St., between the north side of Center St. to a point 200 ft. north of Wilson St., in the village of Dennison, O., by grading, paving and curbing, according to plans, specifications, profiles and estimates, heretofore prepared by the Engineer, and now on file in office of Village Clerk.

✣Bids will be received until noon, May 9, by John A. Fouts, Village Clerk, Dennison, O., for furnishing all labor and material necessary for the improvement of Miller Ave., from Woodland Ave. to Gardner Ave., in the village of Dennison, O., by grading, paving and curbing, according to plans, specifications, profiles and estimates, heretofore prepared by the Engineer, and now on file in office of Village Clerk.

✣Bids will be received until 11 a. m., May 14, by Board of Cuyahoga County Commissioners, Cleveland, O., for furnishing material for the repair of Miles Ave., Dunham Rd., Fenkell Rd., Canal Rd., Mayfield Rd., Brecksville Rd. Schaaf Rd., Denison-Harvard bridge, Euclid Rd., Berea Rd., Coe Ridge Rd., Wooster Rd., Lorain Rd. and Columbia Rd., pursuant to the reports of the County Engineer on file in the office of the board. J. F. Goldenbogen is Clerk of the board.

✣Bids will be received until May 6, by city of Delaware, O., for the construction of 7,000 sq. yds. of brick, asphalt block, or wood block pavement on 6-in. concrete base and pitch, asphalt or cement filler. The work will include 4,000 lin. ft. of 5x18-in. cement or stone curb and 1,000 cu. yds. of excavation. G. S. Irwin is City Engineer.

✣Bids will be received until 10 a. m., May 9, by Board of Lucas County Commissioners, Toledo, O., for the furnishing and delivering of all macadam and other materials required in the repair of all improved roads and parts of roads mentioned and described in the County Surveyor's report of March 18, 1913. All bids must be made in accordance with specifications on file in the office of Chas. J. Sanzenbacher, County Auditor.

✣Bids will be received until noon, May 9, by W. J. Springborn, Director of Public Service, Cleveland, O., for one 5-passenger automobile for the Park Department. Each proposal must be made in accordance with the specifications which may be obtained at the office of the Superintendent of Parks, room 214, City Hall. W. H. Kirby is Secretary to the Director.

✣Bids will be received until noon, May 9, by W. J. Springborn, Director of Public Service, Cleveland, O., for grading, draining, curbing, paving with paving brick and improving Adams Ave., N. E., from E. 92d St. to E. 99th St. and also E. 92d St., from Adams Ave., N. E., to Pierpont Ave., N. E. Each bid must be made in accordance with the plans and specifications which may be seen at the office of the City Engineer, room 305, City Hall. W. H. Kirby is Secretary of the Director.

✣Bids will be received until noon, May 26, by Fred H. Shoaff, Clerk of the village of Euclid, O., for furnishing the material and labor necessary for the improvement of Dille Rd., from the north line of Euclid Ave. to the south line of the N. Y., C. & St. L. R. R. right of way, by constructing a sidewalk on each side of said Dille Rd. where same is not already constructed, according to the plans and specifications now on file at the office of the said Clerk, and at the office of the F. A. Pease Engineering Co., 808 Marshall Bldg., Cleveland, O.

✣Bids will be received until 10 a. m., May 5, by Board of Stark County Commissioners, Canton, O., for the construction of the Alliance-Harrisburg-Louisville Rd. improvement, consisting of 9.69 miles of brick pavement, in accordance with the plans, specifications and estimate now on file in the office of the Auditor of Stark County. A certified check for $500 must be filed with each bid.

✣Bids will be received until noon, May 9, by W. J. Springborn, Director of Public Service, Cleveland, O., for grading, draining, curbing, paving with paving brick and improving Adams Ave., N. E., from E. 92d St. to E. 99th St., and also E. 92d, from Adams Ave., N. E. to Pierpont Ave., N. E. Each bid must be made in accordance with the plans and specifications, which may be seen at the office of the City Engineer, room 305, City Hall. W. H. Kirby is Secretary.

✣Bids will be received until noon, May 6, by W. H. Kirby, secretary to the Director of Public Service, Cleveland, O., for silica gravel road oil and tarvia or other coal tar road preparations. Specifications may be obtained of the Park Superintendent.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, O., until 2 p. m., May 15, 1913, for grading and paving with a waterbound macadam, the Sec. No. 2, Devalon Rd., State Highway "B," Pet. No. 441, in Union and Paint Twps., Fayette County. Length, 5,451 ft. or 1.03 miles; width of pavement, 14 ft.; estimated cost of construction, $6,914.40. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, Aug. 1, 1913 Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker, State Highway Commissioner

✣Bids will be received at the office of the State Highway Commissioner at Columbus, O., until 2 o'clock p. m., May 15, 1913, for grading and paving with a concrete pavement, with a bituminous surface treatment, the Columbus Lancaster Rd., State Highway "E," Pet. No. 662, in Madison Twp., Franklin County. Length, 3,750 ft. or 0.71 miles; width of pavement, 14 ft.; estimated cost of construction, $7,833. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker, State Highway Commissioner.

⊙The Department of Public Service of Columbus, O., S. A. Kinnear, Director, awarded the following contracts for street work, for which bids were opened on April 14: B. F. Patterson for Wrexham Ave.; Bentz Bros. for Wheatland Ave.; S. T. Knight for Tallmadge St.; S. T. Knight for 6th St.; Andrews Asphalt Paving Co. for Indianola Ave.; Bentz Brothers for Eureka Ave.; Geigele Garnes & Co. for Esper St.; Geigele Garnes & Co. for Davis Ave.; Geigele Garnes & Co. for Bruck St.; Geigele Garnes & Co. for Almond alley; S. T. Knight for alley west of 21st St.; S. T. Knight for alley west of Bryden Road.

⊙The Capitol Construction Co., Columbus, O., has been awarded the contract by the Board of Tuscarawas County Commissioners, New Philadelphia, O., for the construction of a creosote block floor for Third St. bridge, Uhrichsville, O.

⊙Wilson & Squires, Hamilton Ave., Cincinnati, O., have been awarded the contract by the Board of Hamilton County Commissioners, Cincinnati, for the improvement of Chester Ave., from Sharon Ave. to the Butler County line, in Sycamore Township, for $6,354. Bids were opened April 18.

⊙Following contracts were awarded by the Lyme Township Trustees, at Bellevue, O., for five road improvements in the Lyme Special Road District: Cemetery Rd., Lyme Construction Co., at $1.12 or $0.95, according to place of delivery; Aukland Rd., Tyson & North, $1.20 or $1.10; Plank Rd., W. C. Heyman, $0.85, at Yoeman Siding; Woodward Rd., Tyson & North, $0.75 or $0.45; Swaby Rd., Tyson & North, $0.85 or $0.70.

⊙James McCarron, of Youngstown, has been awarded the contract by the Good Roads Commissioners of District No. 1, Youngstown, O., for the construction of the Hubbard Rd., 5,221 ft. long, at $13,786; Belmont Ave. Rd., 2,517 ft. long, $6,602; McGuffey St., 4,450 ft. long, at $12,090.

⊙C. J. Mulligan of Lima, O., has been awarded the contract for the construction of approximately $100,000 worth of street paving in a northern Ohio city.

⊙Turnbull Bros., Canton, O., have been awarded the contract by the Department of Public Service of that city, for the paving of W. Eighth St., from High St., to the B. & O. R. R. tracks, for $15,601. The contract calls for Big Four brick with tar filler and Cleveland Stone Co.'s curbing. Hoffman & Nicheles, Canton, were given contracts for grading and curbing Cook and William Sts., from South St. to Cedar St., for $3,353, and Struble St., from Washington Ave. to Lawrence Ave., for $2,881.

⊙Peters & Palmer, of Marietta. O., have been awarded the contract for paving 2½ miles of county road at Brecksville, Cuyahoga County, a few miles from Cleveland, for $75,000.

Plans have been prepared by Engineer E. B. Pflueger, Circleville, O., for the construction of 27,200 sq. yds. of repressed brick pavement in that city to cost about $60,000. The work will include 6-in. concrete foundation, Berea stone or concrete curb, including 8,330 lin. ft. of straight and 660 lin. ft. of circle curb; asphalt or cement grout filler, and 11,670 cu. yds. of excavation. Contracts will be let the latter part of May. Louis Schneider is Director of Public Service.

City Engineer H. A. Glathart of Findlay, O., has estimated the cost of paving South St., from Blanchard St. to the Big Four R. R. at $9,533, and of paving W. Hardin St., from Main to Liberty, with westermite, at $9,758.

The City Council of Toledo, O., has passed resolutions providing for the paving of six streets. According to Service Director Cowell the city's share for new pavements and sewers provided for and contemplated amount to $130,000.

Oklahoma.

A resolution has been passed by the City Council Marietta, Okla., calling for the paving of Main St. from East 5th St., to West 8th St., making about 12 blocks in all, running through all the business district and a portion of the resident district. Plans and specifications are being prepared by the Benham Engineering Co., 435-37 American National Bank Bldg., Oklahoma City, Okla., who have been retained by the city as Consulting & Supervising Engineers for the work.

Oregon.

⊙The street committee of the City Council, Portland, Ore., has awarded a contract for paving the E. Stark St. improvement district with gravel bitulithic to the Oregon Independent Paving Co., of Portland, for $81,656. This improvement will cover E. Stark and contiguous streets in the Mt. Tabor district.

⊙The street committee of the City Council, Portland, Ore., has awarded the following contracts for street improvements: E. 22d St., from Killingsworth to Ainsworth, grading and concrete curbs and walks, Giebisch & Joplin, $4,205; Moore St., from Killingsworth Ave. to Portland Blvd., grading and concrete curbs and walks, G. M. Battersby, $6,800; E. 26th St., from Multnomah to Hancock, gravel bitulithic, Warren Construction Co., $10.213; Seventh St., from Burnside to Hoyt, bitulithic, Warren Construction Co., $21,841; E. 45th St., from Rossmere Addition to Wistaria Ave., gravel bitulithic, Warren Construction Co., $1,277; E. First St., from Oregon to Holladay, asphalt, Oregon Independent Paving Co., $4,195; E. 22d St., from Powell to Tibbetts, gravel bitulithic, Warren Construction Co., $3,644; E. 48th St., from Madison to Hawthorne terrace, gravel bitulithic, Warren Construction Co., $3,484; E. Ninth St., from Webster to Emerson, grading and concrete curbs and walks, G. M. Battersby, $1,962; E. 40th St. district, Hassam, Oregon Hassam Paving Co., $54.632; E. 39th St., from Fremont to the Alameda, grading and concrete curbs and walks, Elwood Wiles, $22,127; Emerald St., from Lombard to Willis, grading and concrete curbs and walks, G. M. Battersby, $6,279; Minnesota Ave. district, grading and concrete curbs and walks, G. M. Battersby, $16,698; 56th St. district, S. E., grading and concrete curbs and walks, G. M. Battersby. $3,308; 72d St., S. E., from Foster Rd. to 60th Ave., S. E., grading and concrete curbs and walks, G. M. Battersby, $7,011.

⊙The City Council of Sheridan. Ore., has awarded the contract for the construction of 17,204 sq. yds. of bitulithic pavement to the Warren Construction Co.

The city of Bayocean, Ore., plans the paving of two or more miles of streets this season.

Pennsylvania.

✣Bids will be received until 6 p. m., May 1, by E. A. Judge, Secy., Citizens' Committee, Jessup, Pa., for curbing the proposed new road from the Peckville borough line to the intersection of the new Moosic Lake Rd., aggregating two miles of curbing, more or less, curbstone to be 4x20 ins., and not less than 4 ft. long, same to be on crushed stone.

✣Bids will be received until 10 a. m., May 13, by the State Highway Department, Harrisburg, Pa., for the reconstruction of 24,105 lin. ft. of asphaltic bituminous macadam road (penetration method), 16 ft. wide, situated as follows: From crossroads on the land of Clayton Brubaker, north of the village of Warwick, and following the Newport Rd. through the village of Rothsville to the Cocalico Creek. Plans and specifications can be seen at the office of the State Highway Department, Harrisburg; 1001 Chestnut St., Philadelphia; 2117 Farmers' Bank Bldg., Pittsburgh, and 54 Hartman Bldg., York, Pa. Each bid must be made upon a blank furnished by the State Highway Department, accompanied by a certified check in the sum of $3,500. Edward M. Bigelow is State Highway Commissioner.

✣Bids will be received until 10 a. m., May 13, by State Highway Department, Harrisburg, Pa., for the reconstruction of 20,235 ln. ft. of asphaltic bituminous macadam road (penetration method), 16 ft. wide, situated as follows: From a point on the Litiz Pike, near the village of Neffsville, and extending to the Warwick Twp. line, passing through the village of Oregon, and known as the Oregon Rd. Plans and specifications can be seen at the office of the State Highway Department, Harrisburg; 1001 Chestnut St., Philadelphia; 2117 Farmers' Bank Bldg., Pittsburgh, and 54 Hartman Bldg., York, Pa. Each bid must be made upon a blank furnished by the State Highway Department, accompanied by a certified check in the sum of $3,000. Edward M. Bigelow is State Highway Commissioner.

✣Bids will be received until 10 a. m., May 13, by the State Highway Department, Harrisburg, Pa., for the reconstruction of 9,951 lin. ft. of asphaltic bituminous macadam road (penetration method), 16 ft. wide, situated as follows: From the Warwick Twp. line on the Reading Rd. to the crossroads at Brackbill's Hotel; thence to the left to the Warwick Twp. line. Plans and specifications can be seen at the office of the State Highway Department, Harrisburg; 1001 Chestnut St., Philadelphia; 2117 Farmers' Bank Bldg., Pittsburgh, and 54 Hartman Bldg., York, Pa. Each bid must be made upon a blank furnished by the State Highway Department, accompanied by a certified check in the sum of $1,500. Edward M. Bigelow is State Highway Commissioner.

⊙Ott Bros. Co., Mt. Oliver Sta., Pittsburgh, Pa., has been awarded the contract by the Board of Commissioners of Mt. Lebanon Township, Allegheny County, Pa., for the construction of 11 miles of 8-in. to 20-in. sewers, in Painters' Run, Big Sawmill Run and Little Sawmill Run districts of the township. Bids were opened April 17.

⊙Pierce & Hinde, Oil City, Pa., have been awarded the contract by that city, B. B. Weber, City Engineer, for the paving of W Second St. The North Western Construction Co., Franklin, Pa., secured the contract to pave Cooper Ave. and Crawford St. Bids were opened April 14.

⊙McPherson Bros., Edgeworth, Pa., have been awarded the contract by the borough of Sewickley, Pa., Minott M. Baker, Acting City Engineer, for the paving of Nevin Ave., from Hill St., to the borough line, for $6,583. Bids were opened April 25.

⊙Chas. T. Eastburn, Yardley, Pa., has been awarded the contract by the city of Easton. Pa., C. A. Reese, City Engineer, for the construction of 10,000 sq. yds. of amiesite paving on concrete base and 700 sq. yds. of brick paving on concrete base, at $2.05 per sq. yd. Bids were opened April 17.

⊙John E. Weidner, 234 N. 11th St., Reading, Pa., has been awarded the contract by the Berks County Commissioners, Reading, for paving the approaches of the Lancaster Ave., and Schuylkill Ave. bridge with Belgian blocks, for $1 per sq. yd. Bids were opened April 23.

Following bids were received on April 15 by the Bureau of Highways of the Department of Public Works, Philadelphia, Pa., for sprinkling macadamized roads. The bids include furnishing horses, carts and drivers as required in each of the eight districts in which the city has been divided: Donald S. Bader, $5.70 a day for a double team and driver; Richard P. Bennis, $6.80 a day; estate of Daniel McMahon, $5.95; Harry Magee, $5.39; James Irvin, $5.35; H. A. McCleeman & Co., $6, and J. Joseph McHugh, $5.95.

Tennessee.

The Shelby County Court, Memphis, Tenn., has passed a resolution authorizing the issuance of bonds in the sum of $600,000 for the dirt road, turnpike and bridge departments.

The Bradley County Court, Cleveland, Tenn., has authorized the issuance of $25,000 in road improvement bonds. It is planned to begin work at once. A. A. Martin is Road Commissioner.

Texas.

⊙F. W. Whitson has been awarded the contract by the city of Marshall, Tex., for the paving of E. Houston Ave., between Bolivar and Lafayette Sts., at $0.96 per sq. yd. The street will be constructed of 7 ins. of native rock as a base, with a 2-in. wearing surface of native rock and asphalt.

⊙The Texas Grading Co., Houston, Tex., has been awarded the contract by the Grimes County Commissioners Court, Anderson, Tex., for the construction of a system of macadamized and sand-clay roads, to be built in the Navasota Road district of the county, for $129,000. This work will comprise 30 miles of macadam work and 8 miles of sand-clay work and necessary culverts and bridges. Bids were opened April 14. J. Gibbons Browne, Houston, is Engineer.

Property owners of the Crawford Precinct, McLennan County, Tex., are preparing to petition the County Commissioners, at Waco, for a bond election for the improvement of about 50 miles of road in that section of the county.

The Dallas County Commissioners' Court, Dallas, Tex., has outlined plans for the paved highway between Dallas and Fort Worth.

Virginia.

✣Bids will be received until 9 a. m., May 7, by Board of South River Road of Augusta County at the office of the County Engineer, Waynesboro, Va., for the construction of about 38 miles of macadamized county highway.

The street committee of the City Council, Richmond, Va., has recommended to Council the adoption of the recommendation of City Engineer Charles E. Bolling concerning the proposed widening of 15th St., from Dock to Main Sts., and the widening of Dock St., from

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

14th to 15th Sts., to 80 ft., together with the widening of 14th St., from the dock to the new Mayo bridge, to 80 ft., the whole to cost approximately $244,000.

Washington.

✣Bids will be received until 2 p. m., May 13, by Board of King County Commissioners, Seattle, Wash., for the furnishing of all material and labor (Jap or Chinese labor not allowed) necessary for the construction of H. D. Longaker Rd. as per plans and specifications now on file in the County Engineer's office, Seattle, Wash.

⊙D. H. Traphagen, of Seattle, Wash., has been awarded the contract by the Board of Public Works of that city, for the construction of concrete walks on Brandon St. et al., for $17,964. Bids were opened April 11.

⊙The Board of Public Works of Seattle, Wash., has let the contract for the regrading, paving, etc., of Sixth Ave., et al., to the Independent Asphalt Paving Co., Northern Bank Bldg., Seattle, for $98,938.

⊙V. Ramoglia secured the contract from the Board of Public Works of Seattle, Wash., for the construction of a roadway in Olson Place, for $3,571.

⊙Foster & Hindle, 712 Fifth Ave., Spokane, Wash., have been awarded the contract by the city of Butte, Mont., for the construction of the proposed paving, grading and sidewalks, as follows: Regular walks, $1.38 a sq. yd.; reinforced walks, $4 a sq. yd.; cross walks, $2.25 a sq. yd.; curbing, $0.39½ a lin. ft.; combination curb and gutter, $0.80 a lin. ft.; plain concrete $8.50, and reinforced, $15 a sq. yd. Bids were opened April 2.

⊙The Barber Asphalt Paving Co., Seattle, Wash., has been awarded the contract by the Board of Public Works of that city, for the paving of Pine St., with bitulithic below Eighth St., and with brick above Eighth St., for $50,469. A list of the itemized bids was given in our last issue.

⊙The Barber Asphalt Paving Co., Seattle, Wash., submitted the lowest bid to the Board of Public Works of that city, for the paving of 15th Ave. west of Thorndyke, at $16,623.

⊙Swanson & Bjork Bros., Seattle, Wash., have been awarded the contract by the Board of Public Works of that city, for the planking of Connecticut St., at $2,379.

⊙The Keasal Construction Co., Tacoma, Wash., is reported to have been awarded the contract by the City Council of that city, for the paving of North 26th St., from Union Ave. to Proctor St. and North Proctor St., from 26th to 28th Sts., with asphalt, for $23,700. Joseph Warter bid $22,800 on bitulithic and $23,800 on asphalt. George P. Wright bid $26,500 on asphalt, the Washington Paving Co. $24,573, and McHugh Contracting Co., $27,860.

Wisconsin.

⊙The City Commission of Superior, Wis., has let the contract for the paving of Baxter Ave. to E. A. Dahl, at $34,983. The pavement will extend from N. Third to N. First Sts., and will be of concrete, 24 ft. wide.

The majority of the property owners on Ogden Ave., Superior, Wis., have decided in favor of paving the thoroughfare with concrete. It is estimated that the entire cost of the pavement will be $37,620.

The City Commission of Superior, Wis., has passed a resolution providing for laying out and grading a number of streets in the district east and south of the Normal school.

Canada.

⊙E. B. Miller, Watrous, Sask., has been awarded the contract by that city, F. C. Wright, Secy.-Treas., for the construction of concrete sidewalks. Bids were opened April 15. Chipman & Powers, Winnipeg and Toronto, are Engineers.

The Waterloo County Council, Berlin, Ont., proposes to expend about $30,000 in the construction of highways during the year. Mervin D. Hallman, of Berlin, is road superintendent.

The Board of Works of Vancouver, B. C., F. L. Fellowes, City Engineer, has approved the proposed paving estimated to cost $1,197,119. After the report is adopted the Council will ask for bids. The proposed work includes: Fourth Ave., from Vine St. to Alma Rd., wood block (asphaltic and vitrified brick in grades), at a total cost of $213,489; Bridge St., from Dufferin St. to Broadway (asphaltic), $44,642; Bridge St., from Broadway to 16th Ave. (asphaltic), $81,168; Hastings St., from Victoria Drive to Nanaimo St. (asphaltic), $64,358; Hastings St., Nanaimo St. to Renfrew (asphaltic), $139,737; Commercial Drive, Broadway to 12th Ave. (asphaltic), $31,759; Venables St. from Vernon Drive to Glen Drive (asphaltic), $13,466; Union St., from Campbell Ave. to Vernon Drive (wood block), $47,373; Helmcken St., from Granville St. to Homer St. (wood block), $18,398; Drake St., from Granville St. to Homer St. (wood block), $20,960; Vernon Drive, from Harris St. to Venables St. (asphaltic), $9,352; Glen Drive, from Union St. to Venables St. (asphaltic), $3,809; Victoria Drive, from Powell St. to 12th Ave. (asphaltic), Powell-Hastings (brick and asphalt), $217,095; Heather St., Broadway to 16th (asphaltic), (granitoid from Broadway to 12th), $37,270; Burrard St., Seaton to Pacific (asphalt, vitrified brick Pacific to Drake), $144,436; Water St., from Cordova to Carrall (asphaltic), $49,612; Alexander St., from Carrall St. to Main (asphaltic), $26,702.

DRAINAGE AND IRRIGATION

California.

The Lucerne Valley Development Co. has been organized and proposes to develop a rich valley on the desert side of San Bernardino Mountain, about 12 miles from Victorville. The company will sink artesian wells and install irrigation systems. The directors are: Samuel T. Montgomery, of Alhambra; F. H. Lee, of Lucerne Valley, and Fred H. Fewell, of Lucerne Valley.

The Mission Court Irrigation Co. of Los Angeles has been incorporated with a capital stock of $6,000. The incorporators are: M. M. Ritterband, C. E. Davenport, W. C. Osborne, W. M. Hilliker and E. Firth.

Idaho.

Residents of Paving District No. 19, Boise, Idaho, will vote June 3 on a bond issue of $30,000 for diverting waters of Hull Gulch into Crane Creek and reclaiming land. C. C. Stevenson is City Engineer.

Illinois.

✣Bids will be received until 1 p. m., May 17, by Drainage Commissioners of Union Drainage District No. 1, of towns of Will and Monee, at the office of William Cellarius, Monee, Ill., for the construction of a 3-mile open ditch with dragline excavator. The job will include about 20,000 cu. yds.

✣Bids will be received until 2 p. m., May 5, by U. S. Reclamation Service, 777 Federal Bldg., Chicago, Ill., for furnishing explosives and blasting supplies for a period of two years.

⊙Schnable & Quinn, 30 N. La Salle St., Chicago, Ill., have been awarded the contract at $495,412 for constructing Sec. 10 of the Calumet-Sag Channel for the Trustees of the Sanitary District of Chicago. Bids were opened April 3, and the unit prices were given in our April 16 isue.

Indiana.

✣Bids will be received until 2 p. m., May 3, by G. C. Winslow, Superintendent of Construction at the office of the Hancock County Surveyor, Greenfield, Ind., for the construction of a drain.

Iowa.

✣Bids will be received until May 10 by E. L. Marriage, County Auditor, Eldora, Ia., for the construction of D. D. No. 39, consisting of the following size tile: 6,000 42-in., 5,500 39-in., 2,500 30-in., 4,800 28-in., 2,300 26-in., 2,000 24-in., 8,400 22-in., 600 18-in., 700 16-in., 10,500 15-in., 9,400 14-in., 6,400 12-in., 14,900 10-in., 12,500 8-in., 16,300 7-in., 18,300 6-in., 700 5-in. S. B. Gardner, Engineer, Eldora, Ia.

✣Bids will be received until noon, May 12, by E. E. Hosmer, Woodbury, County Auditor, Sioux City, Ia., for the construction of main ditch and laterals in the Little Sioux Drainage District No. 2. Plans and specifications can be obtained of the County Auditor.

✣Bids will be received until 2 p. m., May 5, by F. F. Osier, Wright County Auditor, Clarion, Ia., for the construction of Drain No. 74, located in sections 5, 8, 9, 15, 16, 22 and 23, Woolstock Township. Plans and profiles may be found at the office of the County Auditor. The work must begin before June 1 and will include the following: Section 1, 645 ft. 16-in. tile, av. cut 4.60 ft.; Section 2, 2,300 ft. 18-in. tile, av. cut 5.80 ft.; Section 3, 2,300 ft. 20-in. tile, av. cut 7.00 ft.; Section 4, 2,100 ft. 22-in. tile, av. cut 8.60 ft.; Section 5, 4,600 ft. 24-in. tile, av. cut 9.30 ft.; Section 6, 2,700 ft. 26-in. tile, av. cut 7.70 ft.; Section 7, 3,500 ft. 28-in. tile, av. cut 7.40 ft.; Section 8, 5,200 ft. 30-in. tile, av. cut 7.30 ft. And bulkhead.

✣Bids will be received until 2 p. m., May 5, by F. E. Osier, Wright County Auditor, Clarion, Ia., for the construction of County Drain No. 80, located in Sections 27, 28, 29 and 30, in Lincoln Township. Plans and specifications are on file at the office of the County Auditor.

✣Bids will be received until May 12 by Board of Osceola County Supervisors, Sibley, Ia., for the construction of two drainage districts as follows: District No. 14—35,400 ft. drain tile, ranging in sizes from 6 in. to 18 in., to be laid in ditch and covered. District No. 15—8,300 feet drain tile, ranging in sizes from 6 in. to 15 in., to be laid in ditch and covered. Details may be had from V. A. Burley, County Auditor, or L. A. Wilson, Engineer, Sibley, Iowa.

✣Bids will be received at once by Board of Greene County Supervisors, Jefferson, Ia., for the labor and material necessary for the construction of drainage district No. 84. B. S. McCully is County Auditor. Official advertisement will be found elsewhere in this issue.

Kansas.

Surveys are being made for a ditch to straighten the Delaware River between Muscotah, in Atchison County, Missouri, and Arrington, and a petition for this improvement under the new law has been largely signed. Campbell & Griggs, Topeka, Kan., are the Engineers.

Minnesota.

Commissioners of Nobles County, Worthington, Minn., have appointed Wm. A. Saxon to make a survey for County Ditch No. 11 in Summit Lake Township.

Final hearing will be held on April 29 on County Ditch No. 14 of Faribault County. Jesse L. Herring, Blue Earth, Minn., is County Auditor.

Texas.

The Southern Irrigation & Sugar Co. has been granted a permit to operate in Texas with a capital stock of $2,000,000. It recently bought the Piper sugar plantation of 2,300

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

acres located near Brownsville, and will operate the plantation and the canal lines and construct power plants and ditches.

Wisconsin.

✣Bids will be received until 10 a. m., May 14, by the Commissioners of the Blaen Y. Cae Drainage District, at the office of R. F. Clark, Attorney, Randolph, Wis., for the following proposed ditch work: A main ditch, 10,100 ft. long, 6 ft. wide at the bottom, 34,943 yds.; a main ditch, 1,867 ft. long, 4 ft. wide at bottom, 5,232 yds.; a lateral 5,230 ft. long, 3 ft. wide at bottom, 12,246 yds.; a lateral 7,313 ft. long, 3 ft. wide at bottom, 18,199 yds.; a lateral 6,765 ft. long, 3 ft. wide at bottom, 14,132 yds.; a lateral 5,235 ft. long, 3 ft. wide at bottom, 10,272 yds.; a lateral 2,001 ft. long, 3 ft. wide at bottom, 4,026 yds. About 94,000 yds. are marsh soil underlaid with clay. About 5,050 yds. mixed granite and lime rock. Monthly payments of 75 per cent of the engineers' estimates of work done. Balance when completed. C. E. Corning, Portage, Wis., is Engineer in charge. Map and profile are on file at the office of Engineering & Contracting, Chicago, Ill.

WATER WORKS

Alabama.

The Anniston Water Supply Co., Anniston, Ala., will extend its mains to the Fifth ward. H. B. Rudisill is general manager.

California.

At a recent meeting of the members of the Municipal Water District, Richmond, Calif., Levi Boswell, President the firm of Haviland & Tibbits, Alaska Commercial Bldg., San Francisco, Calif., was employed to do the engineering work for the proposed water plant.

The City Trustees of Escondido, Calif., propose the installation of a municipal water plant which would be a unit in a plant suitable for a city of 20,000 people, at an expenditure of from $80,000 to $100,000. W. N. Bradbury is President of the Trustees.

Consulting Engineer Frank E. Lathrop, of Los Angeles, Calif., has prepared plans and specifications for a municipal water system for the city of Watts, Calif. Bonds to the amount of $100,000 will be voted upon shortly.

General plans have been prepared by Engineer P. H. Albright, of Los Angeles, Calif., for the construction of a water works system, sewer system, cattle pens, sheep and hog sheds, concrete paving, one hay barn, one yard stable, four scale houses, immediately and exchange building and horse and mule market. This work is planned for the Union Stock Yards at Los Angeles. All work will be done by day labor. J. A. Swank is President and F. E. Schlageter is Superintendent.

District of Columbia.

✣Bids will be received until 3 p. m., May 20, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for a new air-lift pumping plant, a new cooled drinking water supply system, etc., at the United States post office, Oklahoma City, Okla., in accordance with the specification and drawing, copies of which may be obtained from the Custodian at Oklahoma City, Okla., at the discretion of the Supervising Architect.

Florida.

⊙The J. B. McCrary Co., of Atlanta, Ga., has been awarded the contract for the installation of a waterworks system and an electric light plant at High Springs, Fla. The plants will cost $65,000.

⊙C. H. Turner Construction Co., 43 E. Garden St., Pensacola, Fla., has been awarded the contract by that city for the excavation and construction of a reinforced concrete water reservoir, 100 ft. x 150 ft., 8 ft. deep, covered with galvanized iron roof and supported by timber trusses for $6,823. Bids were opened April 22.

Georgia.

✣Bids will be received until noon, May 5, by J. H. Goldsmith, City Comptroller, Atlanta, Ga., for one triple combination pump, hose and chemical motor car, 700-gal. capacity, engine capacity to be rated on steam engine draft test. Lighting system, both gas and electric, and cars to be equipped with friction drive, siren horns and locomotive bell.

The City Council of Royston, Ga., has called an election to be held on May 19, for the purpose of voting on issuing $45,000 worth of bonds for a waterworks system.

The citizens of Zebulon, Ga., have voted $10,000 in bonds for the construction of a water works system. Water will be secured from wells.

A resolution has been introduced in the City Council of Atlanta, Ga., creating a special committee to investigate a new water supply for Atlanta.

Illinois.

✣Bids will be received until May 5 by Matt Berscheid, City Clerk, Joliet, Ill. (readvertisement), for furnishing the city one 40 hp. 4 cyl. motor car for Fire Chief.

✣Bids will be received until 11 a. m., May 7, by L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering to the various water pumping stations approximately 20,000 fire brick of the best quality, sized as follows: 9x4, 1½x2 9/32 and 8¾x4¼x2 7/32. Delivery as follows: Chicago Ave., Springfield Ave. 22nd St., 14th St., Lake View, 68th St., Harrison St., Roseland, Rogers Park and Washington Heights pumping stations.

✣Bids will be received until 11 a. m., May 7, by L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering to the Department of Public Works, brass corporation ferrules as follows: 10,000 ¾ in., 100 1-in., 200-2in., 400 1-in. ferrules without couplings, 400 1-in. galvanized iron cap nuts, 400 ¾ in. brass screw plugs, 100 brass screw plugs. All corporation ferrules to be constructed of bronze showing the following analysis: Copper, 81 to 83 per cent; tin, 5 to 7 per cent; zinc, 9 to 11 per cent; lead, not more than 2 per cent. Deliveries to be made as ordered.

✣Bids will be received until 11 a. m., May 7, by L. E. McGann, Commissioner of Public Works, Chicago, by the Department of Public Works for hauling cast iron water pipe and fittings from the city pipe yards to such points as are designated by the Commissioner, all bids to be submitted according to zones. Cash or certified check for $100 must accompany proposal.

⊙The contract for furnishing and delivering to the water pipe extension shop, 14th St. and Indiana Ave., Chicago, such heavy bronze angle valves for cold water has been awarded to the Kennedy Valve Manufacturing Co., 111 W. Jackson Blvd., Chicago. The work includes 1,000 1 in., 100 1¼ in., 300 1½ in., 400 2 in. valves. L. E. McGann, Commissioner of Public Works.

⊙The contract for furnishing and delivering special cast iron water pipe castings to various pipe yards, Chicago, has been awarded to the United States Cast Iron Pipe Co., 122 Michigan Ave., Chicago. Contract price, $19,900. The work includes 360 tons, varying in diameter, from 4 to 12 ins., 40 tons, 16 in. to 36 in. in diameter. L. E. McGann, Commissioner of Public Works.

⊙The Board of Local Improvements, Chicago, Ill., has awarded the contracts for constructing water service pipes in the following streets: Berenice Ave., 47th Ave. to 48th Ave., 309 lin. ft., Washington Plumbing & Heating Co.; Colfax Ave., 83rd St. to S. Chicago Ave., 4,393 lin. ft., Drake Ave., Franklin Blvd. to C. & N. W. R. R., 439 lin. ft., Escanaba Ave., 84th St. to 87th St., 1,260 lin. ft., Exchange Ave., Baltimore Ave. to 87th St., 2,024 lin. ft., Grace St., 48th Ave. to C. & N. W. R. R., 542 lin. ft., Lawrence Ave., Lawndale Ave. to 40th Ave., 2,055 lin. ft., Warwick Ave., 48th Ave. to C. & N. W. R. R., 568 lin. ft., Washington Plumbing & Heating Co. E. J. Glackin, Secretary of the Board.

Bids were opened April 14 by John H. Moore, Commissioner of Public Works, Evanston, Ill., for the construction of a 12,000,000-gal. mechanical filtration plant, for which Geo. W. Fuller, New York City, and Langdon Pearse, Chicago, Ill., are the engineers. The bids received were as follows, (1) standing for bid of Roberts Filter Mfg. Co., (2) Norwood Engineering Co., Florence, Mass., (3) L. K. Sherman Contracting Co., (4) Pittsburgh Filter Mfg. Co., (5) New York Continental Jewell Filtration Co., (6) Wm. A. Pope:

	(1)	(2)	(3)	(4)	(5)	(6)
Earth excavation, 22,200 cu. yds.	$ 0.68½	$ 0.90	$ 1.00	$ 0.80	$ 0.75	$ 0.75
Rock excavation, 1 cu. yd.	3.00	3.00	3.00	3.00	3.00	3.00
Mixing tank, coagulating basins, filtered water reservoir, filter tank, lump	76,000.00	60,000.00	101,500.00	83,400.00	84,390.00	79,290.00
Filter equipment, piping, chemical apparatus, head house equipment, lump	57,800.00	53,300.00	58,000.00	57,890.00	54,476.00	61,843.00
All outside piping and cast-iron lines and drains, lump	16,980.00	16,646.00	17,600.00	17,600.00	17,500.00	19,799.00
Head house, including plumbing, lighting, heating, lump	14,300.00	17,100.00	19,000.00	19,400.00	15,935.00	14,260.00
Low-lift pump house, lump	3,500.00	2,080.00	1,800.00	2,760.00	1,575.00	1,049.00
Low-lift pumps and appurtenances, non-condensing, lump	12,000.00	9,200.00	18,000.00	16,100.00	11,500.00	....
Low-lift pumps and appurtenances, condensing, lump	10,400.00	10,450.00	17,600.00	19,000.00	....	16,000.00
Low-lift pumps and appurtenances, turbine driven, lump	11,400.00	12,550.00	14,000.00	14,000.00	....	11,800.00
West water tower, lump	7,521.00	5,100.00	6,200.00	6,500.00	6,800.00	7,050.00
Reinforcing steel, 180,000 lbs.	.02¼	.03	.03½	6,300.00	.03¾	.03¼
Extra concrete, Class A, 120 cu. yds.	10.00	12.75	20.00	1,830.00	11.50	7.50
Extra concrete, Class B, 120 cu. yds.	9.75	12.25	16.00	1,680.00	8.50	6.50
Korkstone flooring, 1,200 sq. yds.	798.00	.50	.45	600.00	.50	.45
Floor tile, 1,200 sq. yds.	780.00	.70	1.00	780.00	.70	.65
White wall tile, 1,000 sq. yds.	750.00	.65	.80	750.00	.70	.80
Plastered partitions, 350 sq. yds.	40.00	.25	1.00	122.50	.27	.30
Hardware, stamped, bronze, lump	70.00	80.00	....	100.00	80.50	100.00
Hardware, solid, bronze, lump	100.00	100.00	....	125.00	105.05	100.00
Quartered oak finish, lump	500.00	390.00	....	500.00	400.00	700.00
Enameled brick, 1,800 sq. ft.	[illegible]	.60	1.00	.75	.65	.75
Totals	$209,734.00	$192,309.00	$254,923.00	$231,223.00	$217,979.00	$219,274.00

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Indiana.

The Roanoke Water Co., Roanoke, Ind., has been incorporated with a capital stock of $15,000 to supply Roanoke with water. The directors are: N. D. E. Richards, N. L. Highlands and D. A. Wasmuth.

At a recent meeting of the stockholders of the Richmond City Water Works Co., Richmond, Ind., the directors were authorized to issue $400,000 in preferred stock for the purpose of paying on the present bonded indebtedness of $250,000, providing $100,000 for the contemplated improvements and $50,000 treasury stock.

Consulting Engineers Worley & Black, Reliance Bldg., Kansas City, Mo., have been retained to appraise the electric light plant at Rochester, Ind

Iowa.

✣Bids will be received until about June 1 by L. J. Stout, City Clerk, Eldora, Ia., for the construction of water extensions estimated to cost $5,000. S. B. Gardner is Engineer, Eldora, Ia

⊙C. W. Roland Co., Des Moines, Ia., has been awarded the contract by the town of Guthrie Center, Ia., J. E. Batschelet, Clerk, for extending the water mains of the city for $7,721. The work includes 4-in. pipe and five 8 ft. hydrants. Bids were opened April 22.

Kansas.

⊙T. C. Brookes & Sons Co., Jackson, Mich., has been awarded the contract by the city of Jewell City, Kans., for the complete installation of a water works system with the exception of the filtration plant, which has not as yet been awarded. The contract price is about $24,468. The city is building the dam by day labor. Bids were opened April 21.

Consulting Engineers Worley & Black, Reliance Bldg., Kansas City, Mo., have been retained to appraise the waterworks plant of Lawrence, Kans.

Consulting Engineers Worley & Black, Reliance Bldg., Kansas City, Mo., have been retained to prepare plans and specifications for an electric light plant for Garden City, Kans., to cost $40,000.

Consulting Engineers Worley & Black, Reliance Bldg., Kansas City, Mo., have been retained to prepare plans and specifications for an $18,000 electric light plant for Augusta, Kans

Kentucky.

Bids were received on April 17 by the Commissioner of Fisheries, Department of Commerce, Washington, D. C., for the construction of a pump house at the Louisville, Ky., fisheries station, as follows: Alfred Struck Co., Louisville, $7,278; A. E. Deering, Louisville, $6,683.

Maryland.

Bids will be received until noon, May 13, by Board of Caroline County Commissioners, Denton, Md., for the construction of a lift bridge in Caroline County on or along the Denton-Willow Pond Road between Denton and Willow Pond over Choptank River. Plans and specifications can be obtained of the State Roads Commission, 534 N. Howard St., Baltimore, Md.

Michigan.

The citizens of Jackson, Mich., have voted to construct water mains in 25 streets and avenues.

Minnesota.

✣Bids will be received until 1:30 p. m., May 5, by Board of St. Louis County Poor Commissioners, Charles Shogren, Clerk, Duluth, Minn., for the drilling of a well on the St. Louis County Poor Farm, near the City of Duluth, according to the plans and specifications therefor on file at the office of said Poor Commission.

✣Bids will be received until 8 p. m., May 12, by E. P. Scanlan, Village Recorder, Maple Lake, Minn., for the construction of a complete water works system. Plans and specifications are on file and can be seen at the office of the Village Recorder, Maple Lake, Minn., or at the offices of the Consulting Engineers, The Claussen Engineering Co., 312-316 Commercial Bldg., St. Paul, Minn., or additional copies may be had of the Consulting Engineers at $2.50 per set.

The citizens of Lake City, Minn., have voted bonds to the amount of $15,000 to extend the water mains and build a concrete reservoir one mile from the city.

Missouri.

✣Bids will be received until noon, May 6, by Board of Public Improvements, St. Louis, Mo., for furnishing all tools, material and labor for the construction and completion of an intake tower, tunnel and screen chamber at the Chain of Rocks. Plans, specifications and other information can be had at the offices of the Board of Public Improvements and the Water Commissioner.

The citizens of Highland, Madison County, Mo., on April 15 voted on the issuance of bonds to the amount of $30,000 for the construction of a waterworks system.

The Springfield City Water Co., Springfield, Mo., will extend the water mains into Sagamore Hill, a new subdivision of the city.

The City Council of Memphis, Mo., will probably call a special election for the first Tuesday in June to vote upon water and sewerage.

Foxhall P. McCormick Co., at $474,732, submitted the lowest bid to the Board of Public Improvements of St. Louis, Mo., for the construction of the intake tower for the water department, near the present tower. The Pittsburgh Filter Mfg. Co., at $432,000, was low for filter equipment. The McCormick-Combs Construction Co. bid low on the new filters, at $225,024. Edward E. Wall is Water Commissioner.

Montana.

The citizens of Livingston, Mont., at a recent election voted the issuance of bonds to the amount of $225,000 for the installation of the proposed waterworks system.

Nebraska.

✣Bids will be received until 10 a. m., June 3, by Board of Village Trustees of Ralston, Nebr., at the office of the Towl Engineering Co., 1123 City National Bank Bldg., Omaha, Nebr., for the construction of a water works system. The approximate requirements are as follows: Cast iron mains, 50 ft. 8 in. pipe, 9,800 6 in. pipe, 21,500 ft. 4 in. pipe. Valves, 1 8-in. valve, 10 6-in. valves, 13 4-in. valves. Hydrants, 50 two nozzle 4-in. hydrants. C. M. Skinner is Chairman Village Board.

The citizens of Silver Creek, Nebr., at a recent election voted the issuance of bonds for the installation of a waterworks and an electric light plant.

New Jersey.

⊙The Florence Iron Foundry Co., Florence, N. J., has been awarded the contract by the town of Belleville, N. J., Edward E. Mathes, Town Clerk, for furnishing the town with pipe and castings for $7,839. Bids were opened April 16.

The citizens of Ashbury Park, N. J., on April 22 voted upon the issuance of bonds in the sum of $275,000 for the extension of the water system to the West Side.

The Lambertville Water Co., Lambertville, N. J., proposes to construct a water main from its reservoirs into the city for fire purposes.

New York.

President Fred Shepp of the Water Department, East Syracuse, N. Y., at a recent taxpayers' meeting, appointed a citizens' committee to discuss the situation in relation to building an addition to the water reservoir at an estimated cost of about $9,000 to $10,000.

The citizens of Jamestown, N. Y., on April 19 voted on the issuance of bonds in the sum of $150,000 to improve the waterworks system.

A special election was held in Mt. Morris, N. Y., on April 28 for the purpose of voting upon the proposition to purchase the Mills water works for $50,000 and to install a supplement system at a cost of $25,000.

Ohio.

✣Bids will be received until noon, May 9, by W. H. Kirby, Secy., Director of Public Service, Cleveland, O., for steam barge for the city water department. Plans and specifications are on file with the Superintendent of the Water Department.

⊙Herman Snyder, of New Philadelphia, O., has been awarded the contract by that city for the construction of the new municipal water works building, for $5,457.

Consulting Engineer R. Winthrop Pratt, 712 Hippodrome Bldg., Cleveland, O., has been retained by the city of Painesville, O., to prepare detail plans for a new water supply pump station, rapid sand filter plant, a new crib and intake extending about 1,500 ft. into Lake Erie.

Oklahoma.

The citizens of Cushing, Okla., at a recent election voted the issuance of bonds to the amount of $15,000 for the purpose of putting down a well at the Cimarron River and piping water to the city.

It is expected that some extensions will be made to the waterworks and electric light systems of Marietta, Okla., for which bonds will be voted. The Benham Engineering Co., 435-37 American Nat. Bank Bldg., Oklahoma City, Okla., have been retained to draw up the plans and specifications

Pennsylvania.

The waterworks committee of Lawrenceville, Pa., has announced a definite plan for the construction of waterworks for the village.

The State Water Supply Commission, Harrisburg, Pa., has received charter applications from the following companies: Colver Water Co., Cambria Township, Cambria County; Crainbrook Water Co., Shade Township, Somerset County, and Phoenix Water Power Co., Upper Province Township, Montgomery County.

The State Water Supply Commission, Harrisburg, Pa., has granted the Manufacturers' Water Co. at Holsopple, Somerset County, permission to construct a dam; also permission to Ridgway Borough to construct a dam across Elk Creek, and the Girard Water Co. a dam in Union Township, Schuylkill County.

The State Water Supply Commission, Harrisburg, Pa., has granted permission to the Mercersburg Water Co. at Mercersburg to construct dams.

South Dakota.

⊙The South Dakota Department of Agriculture, C. N. McElvaine, Secy., Huron, S. Dak., awarded contracts as follows for the water works extension at the South Dakota State Fair Grounds, Huron: Labor, Albert M. Anderson, Huron; pipe, U. S. Cast Iron Pipe & Foundry Co., Chicago, Ill.; hydrants, Wester Valve Co., Chicago; pig lead and hemp, Geo. R. McBride, Huron.

Texas.

The City Council of Corpus Christi, Tex., H. A. Stevens, City Engineer, will begin at once the building of a concrete reservoir of 155,000-gals. capacity, and also the installation of a relay pumping station five miles west of the city. The estimated cost is $20,000. Alexander H. Potter, New York City, is Consulting Engineer.

Commissioner Louis Blake of the Waterworks Department, Fort Worth, Texas, has requested City Engineer F. J. Von Zuben to prepare estimates on the cost of replacing the 36-in. water mains which connect the Holly plant with the city.

The city officials of Coleman, Tex., have employed an engineer to investigate conditions as they exist at Coleman and to devise favorable means wherewith to provide more adequate provision for a water supply.

Utah.

City Commissioner George W. Lindquist and City Engineer Humpherys of Logan,

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Utah, submitted to the City Commission a report which embodies a plan for providing the city with a pure water supply. It is recommended that 28,000 ft. of pipe line be constructed, at an estimated cost of $65,000.

The City Council of Cedar City, Utah, is arranging to have two more springs piped into the water main, as the present water supply is not sufficient for the city's needs.

The citizens of Payson, Utah, on April 21 voted the issuance of bonds to the amount of $43,000 for the construction of the proposed waterworks system. The contract for the work is held by A. A. Clarke & Co. of Salt Lake City and John Lyman. The new system contemplates the building of a main pipe line six miles from Honeycomb to a city supply tank, and about 1½ miles of distributing mains in the city. Richard R. Lyman is engineer in charge.

Virginia.

At a recent meeting of the Town Council of Galax, Va., a committee of three was named to take preliminary action looking to the establishment of a system of waterworks for the town.

The Town Council of Scottsville, Va., contemplates installing a complete waterworks system.

The Suburban Water Co., Norfolk County, Norfolk, Va., has been incorporated with a capital stock of from $100 to $5,000. J. W. Halstead is President, W. C. Defort, Secy. and Treas., both of Norfolk.

Washington.

Civil Engineer C. H. Green, Paulson Bldg., Spokane, Wash., has been commissioned to design a waterworks system for Endicott, Wash. The estimated cost is $10,000.

The Washington-Oregon Corporation, H. C. Coffman, Mgr., announces that $15,000 has been appropriated for the improvement of the water plant at Chehalis, Wash.

Wisconsin.

✣Bids will be received until 10:30 a. m., May 3, by Department of Public Works, Milwaukee, Wis., for furnishing all the material and doing all the work necessary and required to construct and erect the steel work, tile and concrete work for new floors in north addition of pumping station, located on the shore of Lake Michigan, at foot of North Ave., according to plans and specifications on file.

✣Bids will be received until 7:30 p. m., May 8, by J. C. Feldman, Village Clerk, Wauzeka, Wis., for the furnishing and laying of 6,128 ft. of 6 in. cast iron pipe, 4,800 lbs. special castings, setting 14 hydrants and 5 valves and boxes and the construction of a reinforced concrete tank 16 ft. diameter by 30 ft. deep. Bids for the laying of the water pipe will be taken separately from the bids on the materials. Certified check 5 per cent. W. G. Kirchoffer, Engineer, Madison, Wis.

✣Bids will be received until 8 p. m., May 9, by H. J. Johnson, City Clerk, Boscobel, Wis., for the laying of 10,523 ft. of 6 in., 7,011 ft. of 8 in. and 1,359 ft. of 4 in. cast iron water pipe, setting 15,000 special castings, 43 hydrants, 13 8-in., 6 in. and 4 in. valves and boxes, laying 1,865 ft. of 12 in., 3,325 ft. of 10 in. and 10,576 ft. of 8 in. vitrified pipe sewers, 38 manholes, 5 flush tanks and the construction of a sewage treatment tank 14 ft. x 42 ft. x 7 ft. of reinforced concrete. Certified check 5 per cent. W. G. Kirchoffer, Engineer, Madison, Wis.

The city of Milwaukee, Wis., has sold the $300,000 bond issue of the Water Department to Esterbrook & Co. of Boston, Mass. The proceeds are to be used in the construction of the new intake at the end of Linwood Ave.

Mayor Heim of Madison, Wis., advocates the building of a dual water system and using lake water for commercial and fire purposes, and the installation of a separate pump for the proposed system. The cost is estimated at $150,000

Canada.

✣Bids will be received until 8 p. m., May 20, by S. L. A. Smith, Secy.-Treas., Strassburg, Sask., for an electric light plant for the town. Plans and specifications are on file with the Secy.-Treas.

✣Bids will be received until 11 a. m., May 9, by Chairman Board of Control, at the office of M. Peterson, Secy., Winnipeg, Man., for the construction of conduit runs on Portage Ave., between Colony and Maryland Sts. Plans and specifications are on file at the office of the City Light and Power Dept., 54 King St.

✣Bids will be received until 11 a. m., May 8, by Chairman Board of Control, at the office of M. Peterson, Secy., Winnipeg, Man., for the manufacture and delivery, f. o. b. cars at Beasejour, of 3 100-k.w. transformers and for the same equipment for Stony Mountain, Man.; also for the manufacture and delivery at each of the said substations of 13,000-volt electrolytic lightning arrester and choke coils. Instructions to bidders, specification and form of tender may be obtained at the office of the City Light and Power Dept., 54 King St.

⊙The municipality of North Battleford, Sask., H. W. Dixon, Secy.-Treas., has awarded the following contracts for supplies for the Water Department, for which bids were opened on April 15: U. S. Cast Iron Pipe Co., Chicago, Ill., furnishing cast iron pipe; Canada Foundry Co., Toronto, Ont., furnishing steel pipe; John East Foundry Co., Saskatoon, Sask., furnishing special castings; Macomb Sewer Pipe Co., Macomb, Ill., furnishing sewer pipe; Canada Foundry Co., furnishing hydrants, and Kerr Engine Co., Walkerville, Ont., furnishing valves. Chipman & Powers, Winnipeg, Man., and Toronto, Ont., are Engineers.

⊙The Standard Construction Co., Box 503, Halifax, N. S., has been awarded the contract by that city for the construction of a reinforced concrete reservoir and gate house for $55,107. Bids were opened April 12.

SEWERAGE AND SANITATION

Arizona.

The City Council of Tucson, Ariz., has instructed City Engineer W. H. Thompson to prepare plans for a comprehensive sewer system.

California.

City Engineer Homer Hamlin of Los Angeles, Cal., has included in his budget an item of $50,000 to be expended at Hyperion for the construction of settling tanks at the outfall sewer.

Colorado.

⊙George H. Sethman has been awarded the contract for the construction of a new sewer system in Johnstown, Colo., for $2,200.

Connecticut.

⊙Andreani & Gelormino, of Torrington, Conn., have been awarded the contract for the construction of an outfall sewer for East Main, Baeder and East Center Sts., in the borough of Torrington, for $3,114; also for a sanitary sewer on Lafayette St., and a 15-in. tile pipe storm sewer on Franklin St.

⊙The Board of Contract & Supply of Hartford, Conn., has awarded the following contracts for the construction of three sections of sewers: Cheshire St. sewer—F. B. & W. H. O'Neil, $1,460; Capital Ave. extension—DiMarco & Berardino, $889; Jefferson & Madison Sts.—Petrossi Bros., $1,852.

District of Columbia.

✣Bids will be received until 2 p. m., May 7, by Board of District Commissioners, Washington, D. C., for the construction of substructure, Poplar Point substation, Anacostia main intercepting sewer in the District of Columbia.

✣Bids will be received until 2 p. m., May 7, by Board of Commissioners of the District of Columbia, Washington, D. C., for the construction of sewers in the District of Columbia.

Illinois.

⊙Bash & Gray, of Joplin, Mo., have been awarded the contract by the village of Wood River, Ill., for the making of extensions of water and sewer mains in the new Caldwell-Chessen addition to the village, for $6,000.

Indiana.

✣Bids will be received until 10 a. m., May 21, by Maj. Robert S. Smith, Quartermaster, Fort Benjamin Harrison, Ind., for alterations and additions to the sewage disposal plant.

✣Bids will be received until 2 p. m., May 8, by Town Clerk, Knox, Ind., for building a sewer system estimated to cost $24,000.

✣Bids will be received until May 19, by Board of Public Improvements, F. G. McIntyre, Chairman, Crawfordsville, Ind., for the construction of a 36-in. sewer in Lafayette Av., estimated to cost $4,000, and a 24-in. sewer in Mill St., estimated to cost $4,000. The work includes manholes, inlets, etc. H. C. McClust is Engineer.

Iowa.

✣Bids will be received until 6 p. m., May 2, by O. W. Sandberg, City Clerk, Keokuk, Ia., for the renewal of Sanitary Sewer No. 1, as follows: 8-in. pipe from the west line of Third St. through Block 28 and 10-in. pipe through Blocks 37 and 64, to a connection with the storm sewer in Sixth St., original city of Keokuk.

✣Bids will be received until 2 p. m., May 6, by Board of Public Works, Davenport, Ia., for the construction of sewers in accordance with plans on file at the offiec of the Board. A. M. Compton is City Engineer.

✣Bids will be received until about June 1 by L. J. Stout, City Clerk, Eldora, Ia., for the construction of sewer extensions estimated to cost $15,000. S. B. Gardner, Eldora, Ia., is Engineer.

✣Bids will be received until 8 p. m., May 5, by City Clerk, J. A. Dougherty, Carroll, Ia., for the construction of extensions to the sanitary sewer system of said city. The estimated quantities are as follows: 15,090 ft. of 8-in. sewers, 3,230 ft. of 6-in. sub-drains, 25 manholes, 12 combined manholes and flush tanks, 6 lampholes. Plans, specifications and blanks are on file at the office of the City Clerk, and may be obtained at that office. Henry M. Hanssen is City Engineer.

⊙The City Council of Sioux City, Ia., has awarded the contract for the construction of the Smith's Villa storm sewer to Cady & Savonell, for $24,727, on segmented block. The company bid $26,142 on concrete.

⊙Tibey Bros., 11 Rush St., Dubuque, Ia., have been awarded the contract by that city for the construction of a sewer in the alley between Main St. and Locust St. Bids were opened April 17.

⊙Wilmer Cook, 1699 Washington St., Dubuque, Ia., has been awarded the contract by that city for the construction of a sewer in Locust St. for which bids were opened on April 17.

Kansas.

The Kansas State Board of Health has approved the plans as drawn by City Engineer Fred Eckert of Dodge City, Kans., for the proposed new sewer system. The plans call for a system large enough to accommodate 15,000 inhabitants.

Kentucky.

✣Bids will be received until May 2, according to reports from Louisville, Ky., by the Board of Works, for the construction of sewers estimated to cost $40,000 and located as follows: Main St., from Wenzel to Preston; Main St., from First to Second; Main St., from Third to Fourth; Main St., from Fifth to Twelfth; Main St., from Fourteenth to Sixteenth; Main St., from Seventeenth to Eighteenth; Main St., from Twentieth to Twenty-first; Main St., from Twenty-second to Twenty-third; Main St., from Twenty-fifth to Twenty-sixth; Market St., from Shelby to Campbell; Market St., from Twelfth to Thirteenth; Market St., from Nineteenth to Twentieth; Jefferson, from Floyd to First; Jefferson, from Eighteenth to Twenty-first; Green St., from Twelfth to Fifteenth; Walnut St., from Fourteenth to Fifteenth; Beech St., from Woodland to Virginia; Bismarck Ave., from Thirty-second to Thirty-fourth; Virginia Ave., from Thirty-second to Thirty-fourth. Roy W. Burks is Sewer Engineer.

Maine.

The village of Brunswick, Me., has voted an appropriation of $15,000 for the construction of a sewer from Belmont St., southerly on Main St. John W. Riley is Village Clerk.

Maryland.

✣Bids will be received until 11 a. m., May 14, by Board of Awards at the office of the City Register, Baltimore, Md., for constructing lateral sewers and house connections in District 16-A, Sanitary Contract No. 111. Plans are on file at the office of Calvin W. Hendrick, Chief Engineer of Sewerage Commission, 904 American Bldg., Baltimore, Md. The work will include the following approximate quantities: 15,500 lin. ft. vitrified pipehouse connections, 19,000 lin. ft. vitrified pipe sewer, 8 in. to 22 ins. in diameter. Official advertisements will be found elsewhere in this issue.

⊙McCarthy & O'Herron were recently awarded the contract by the Board of Awards of Baltimore, Md., for the construction of storm water drains in different sections of the city, involving an expenditure of $241,247.

Massachusetts.

✣Bids will be received until 2 p. m., May 15, by Sewage Disposal Commissioner at the office, 352 Main st., Fitchburg, Mass., for building a sewage disposal works. The work includes the construction of five Imhoff settling tanks, two acres of sprinkling filters 10 ft. deep, four secondary settling tanks, sludge beds, a laboratory building, sludge pump building and appurtenant structures. Official advertisement will be found elsewhere in this issue.

⊙The Selectmen of Westfield, Mass., on April 23 awarded the contract for furnishing the pipe for the two miles of sewers to be laid this season to the Warner, Miller Co., of New Haven, Conn., at 71 3/5 per cent off the list price. The pipe will cost about $3,000. The sum of $18,000 was voted at the last town meeting for sewer work.

The Sewer Commission of Williamstown, Mass., has retained Civil Engineer William N. Tuller, of North Adams, Mass., to make the general map of the sewer system of the town.

Michigan.

✣Bids will be received until May 13 (postponed date) by City Council of Ironwood, Mich., for the construction of the sewer in Pine St. Oscar E. Olson is City Engineer.

⊙Phil O. Sheridan & Co., of Houghton, Mich., have been awarded the contract at Iron Mountain, Mich., for the construction of a sewer extension, for $10,725. Other bidders were: Pastoret Construction Co., Duluth, Minn., $12,198; R. J. Wilson & Sons, Appleton, Wis., $13,650, and J. R. Holfelz, Iron Mountain, $12,500.

Minnesota.

✣Bids will be received until 8 p. m., May 2, by Common Council, Austin, Minn., for the construction of a sanitary sewer in Baldwin St., in said city, from First St. to Fifth St., and from Seventh St. to Fifth St., the work calling for 2,016 ft. of 8 in. pipe. Frank Cronon is City Recorder and Oscar F. Weissgerber is City Engineer.

✣Bids will be received until 5 p. m., May 6, by Albert J. Meyer, City Clerk, New Ulm, Minn., for the furnishing of all material and labor for the construction of sewers on Broadway St. from Third, South, to Fourth, South. St., all according to plans and specifications on file in the said City Clerk's office.

⊙The city of Austin, Minn., on April 25 awarded contracts to H. J. Catheroe, of Omaha, Minn., for the construction of storm and sanitary sewers: 3,705 lin. ft. of storm sewers, 10, 12, 15, 18 and 20-in. pipe, $3,590; 7,106 lin. ft. of sanitary sewers, 8 and 18-in. pipe, $5,177. Oscar F. Weissgerber is City Engineer.

Mississippi.

Engineer J. C. Taylor, Louisville, Miss., is preparing surveys and estimates for a new sewer system for that city; also a water works system. W. J. Newsom is Mayor.

Missouri.

⊙The Skilbred Construction Co. has been awarded a contract by the Board of Public Works of St. Joseph, Mo., for a sewer in Shady Ave., from St. Joseph Ave. to Fifth St.

⊙Bell Hudson Construction Co., Poplar Bluff, Mo., has been awarded the contract by that city, Edw. C. Thomas, City Engineer, for the construction of sanitary sewers in District No. 3 for $16,692. Bids were opened April 21.

City Engineer C. E. Phillips of Springfield, Mo., is making surveys preparatory to the establishment of new sewerage districts. Bids have already been asked on two districts. A new district will embrace the National Blvd., on the west, Cherry St., on the south, Delaware Ave., on the east, and St. Louis St., on the north.

New Jersey.

⊙Harrison & Craig, 837 Broad St., New York City, have been awarded the contract by the Passaic Valley Sewerage Commission, Newark, N. J., for the construction of Section 2 of the Passaic Valley intercepting sewer, for $237,300. Section 2 extends from a point in River road on the boundary line between Belleville and Nutley, thence northerly through River road and private property to a point about 350 ft. south of the Third River, a total distance of about 6,500 ft.

A meeting of the taxpayers has been called for West Deptford Township, at Westville, N. J., on May 6, to determine whether a sewer system shall be installed and three sewer commissioners elected.

Engineer W. D. Willigerod, City Hall, East Orange, N. J., has prepared plans for the construction of the Halsted Valley sewer drain, estimated to cost $260,000. The work will include three-fourths mile of monolithic concrete (7 ft. x 8 ft. to 6 ft. x 6 ft.) and about three miles of pipe (reinforced concrete, etc.). Contracts will not be let before June.

New York.

✣Bids will be received until 8 p. m., May 6, by Common Council, Amsterdam, N. Y., for installing sanitary sewers and water mains on Genevieve St. from Guy Park Ave. to Stewart St. and on Stewart St. east of Genevieve St., according to plans and specifications on file in the office of the city engineer. James P. Wilson is City Clerk.

✣Bids will be received until 2 p. m., May 1, by Thomas W. Eddy, Secy. Commissioners of Sewer District No. 2, Greece, N. Y., for the construction of a sewer in accordance with plans and specifications prepared by R. E. Gaskin, Engineer, Room 20, Trust Bldg., Rochester, N. Y.

⊙The Frontier Contracting Co., of Buffalo, N. Y., has been awarded the contract by the Board of Public Works of North Tonawanda, N. Y., for the construction work on sewers in the Rumbold Ave. district, for $3,090.

At a conference of the Garbage Committee and the members of the Common Council, of Oswego, N. Y., the question of establishing a municipal garbage disposial system. D. D. Long is Mayor.

The citizens of Mt. Morris, N. Y., on April 28 voted upon the proposition of installing a sewerage system, at an estimated cost of $45,000.

City Engineer Charles H. Snyder, of Oswego, N. Y., is preparing plans for the sanitary and storm water sewers to be built in West Bridge St., from First Ave. west to the city line. The sewer will be about 2,600 ft. long and will provide for all property in the Boulevard Hill section.

Village Engineer John Y. Lavery, of White Plains, N. Y., has recommended to the Board of Village Trustees the dividing of the village into sewer districts.

North Dakota.

⊙The Haggart Construction Co., of Fargo, N. Dak., has been awarded the contract for the construction of a trunk sewer at Valley City, N. Dak., for $61,373.

Ohio.

✣Bids will be received until noon, May 8, by W. J. Springborn, Director of Public Service, Cleveland, O., for the construction of sewers in the following named streets, avenues, courts and thoroughfares, to-wit: Armor Ave., N. E., from East 105th St. to Parkwood Dr., N. E.; East 59th St., from Harvard Ave., S. E., to Newburgh & South Shore R. R.; East 128th St. from St. Clair Ave., N. E., to Penobscot Ave., N. E.; East 73rd Pl. from Aetna Rd., S. E., to 268 ft. southerly; Morgana Ave., S. E., from East 49th St. to 800 ft. west of Ackley Rd., S. E.; Morgana Ave., S. E., from 800 ft. west of Ackley Rd., S. E., to Broadway, S. E.; Sellars Ave., N. E., from East 112th St. to East 117th St.; East 108th St. from Union Ave., S. E., to Eliot Ave., S. E.; Buckeye Rd., S. E., from East 116th St. to East 140th St.; Train Ave., S. W., from West 41st St. to West 43d St. Each bid must be made in accordance with the plans and specifications, which may be seen at the office of the Chief Engineer, room 305 City Hall.

✣Bids will be received until May 6, by City of Delaware, O., for the construction of sewer extensions estimated to cost $5,000. George S. Irwin is Engineer.

✣Bids will be received until noon, May 16, by R. F. Brown, Director of Public Service, Lancaster, O., for the furnishing of all materials and labor required in the construction and completion of eleven sewers for laterals in Storm Water districts No. 1 and No. 4, in said city, as is shown by plats, profiles and specifications now on file in the office of the Director of Public Service. All bids must be accompanied by a certified check or bond in an amount of not less than $300.

✣Bids will be received until noon, May 6, by A. E. Burr, Clerk of the Village of Idlewood, care of the Pease Engineering Co., Marshall Bldg., Cleveland, O., for furnishing the necessary labor and materials for improving certain streets hereinafter named in the village of Idlewood by constructing therein sewer mains of vitrified sewer pipe, together with all necessary manholes, catchbasins and Y's, and doing any and all grading necessary and incidental thereto, according to plans and specifications on file in said office and also on file with the Pease Engineering Company, Marshall Bldg., Cleveland, O. A separate bid must be given for each separate street improvement. The streets to be improved are as follows: East Fairfax Rd. from Lee Rd. to Taylor Rd.; Clarendon Rd. from Lee Rd. to Taylor Rd.; Idlewood Rd. from North Woodland Ave. to East Monmouth Rd.; Bradford Rd. from Lee Rd. to Taylor Rd.; Taylor Rd. from North Woodland Ave. to Scarborough Rd.; Queenston Rd. from North Woodland Ave. to Scarborough Rd.; Shaker Rd. from North Woodland Ave. to East Monmouth Rd.; Princeton Rd. from North Wood-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

land Ave. to Scarborough Rd.; Kingston Rd. from North Woodland Ave. to Scarborough Rd.; East Monmouth Rd. from Taylor Rd. to the westerly limits of the village of Idlewood; Scarborough Rd. from Taylor Rd. to Canterbury Rd.

⊙The Board of Control of Mansfield, O., has awarded the contracts for the construction of eight new sanitary sewers to Perry & Nickles, .of Canton, O., for $9,800.

⊙The Bartlett & Snow Co. of Cleveland, O., has been awarded the contract by the Board of Contract & Supply of Schenectady, N. Y., for furnishing and erecting on foundations all of the machinery and equipment for a 30-ton garbage reduction works, for $52,000. Bids were opened April 16.

⊙Thomas Fitzgerald has been awarded the contract in Ashtabula, O., to construct the sewer in the Main St. subway, for $5,726.

Plans and specifications have been prepared for the installation of a sewerage system in the village of Toronto, O. James Connor is clerk of the Council.

The City Council of Salem, O., has passed ordinances providing for the building of sanitary sewers in different parts of the city.

Oregon.

⊙Dennis & Christenson, of Portland, Ore., have been awarded the contract by the city of Carlton, Ore., for the construction of sewers, at $14,879. Other bidders were: Jacobson-Bade Co., Portland, $15,259; George Gordon, Portland, $14,941; Consolidated Contract Co., Portland, $15,944, and James Kennedy Construction Co., Portland, $15,472.

The city of Glendale, Ore., has rejected all bids received for the installation of the proposed sewerage system and has decided to install the system by day labor, under the supervision of Capt. McGinnis, retired, U. S. A.

Pennsylvania.

✣Bids will be received until 3 p. m., May 2, by Borough of North Braddock, P. O. Braddock, Pa., for the construction of sewers on the following streets: Center St., Shaver Al., Grandview Ave., South St., Baldridge Ave., Beech Ave., Weiler Ave., Bell Ave., Bessemer St., Curry St., short unnamed street east of Curry St. and an unnamed alley between Bell and Bessemer Sts. Also for the grading, curbing and paving of Pallas Ave. from Grandview Ave. to Wolf Ave., Center St. from Hawkins Ave. to North End, East St. from P. R. R. to 325 ft. north of Pine Al., Margaret Al. from Earl to Coalmont, Shaver Al. from Pallas Ave. to South St., Grandview Ave. from Bowers St. to South St. and Poplar Al., from Willow St. to North End. Also the erection of wooden steps from Electric Ave. to Oak St. Plans, specifications and bidding blanks at borough engineers' office, Spring and Jones Av., North Braddock Borough, Pa. Geo. F. Siefers, Borough Engineer.

⊙E. M. Mullin & Co. of West Philadelphia, Pa., have signed a contract with the Borough Council of East Lansdowne, Pa., for the construction of the sewerage system, for $19,000.

⊙Vincent Vaccaro has been awarded the contract by the Department of Public Works, C. V. Terwilliger, Director, Scranton, Pa., for the construction of the North Main Ave. sewer, for about $14,000

⊙Pugh & Hubbard, of Philadelphia, Pa., have been awarded the contract for the construction of a storm water sewer in Pitman, N. J., for $10,279.

⊙Lesher & Roess, Chambers Bldg., Oil City, Pa., have been awarded the contract by that city for the construction of 3,200 ft. of 10-in. storm sewers and 3,600 ft. of 6-in. sewers. Bids were opened April 14.

Tennesse.

⊙W. B. Garrett has been awarded the contract by the Board of Public Works of Nashville, Tenn., for the construction of a sewer on East Lindsley and Woodland Sts., for $2,177.

Texas.

Following bids were received by the City Commission of Austin, Tex., on April 22 for the construction of nearly 11 miles of sanitary sewers, embracing three contracts: J. W. Moore & Sons of Fort Worth, contract 7. $6,850; contract 8, $14,302; contract 9, $10,877. F. D. Horton, contract 7, $7,766; contract 8, $16,584; contract 9, $9,606. Johnson & Carr, contract 7, $6,761; contract 8, $17,116; contract 9, $10,134.

The Attorney General at Austin, Tex., has approved the issuance of bonds in the sum of $35,000 by the city of Pecos, Tex., for sewers.

Utah.

✣Bids will be received until 11 a. m., May 10, by Maj. Willis Uline, Quartermaster, Fort Douglas, Utah, for the construction of a sewer system at that post.

Vermont.

The citizens of Bellows Falls, Vt., have voted to issue bonds in the sum of $20,000 for sewer improvements.

Washington.

⊙James Donofrio, Seattle, Wash., has been awarded the contract by the Board of Public Works of that city for the construction of sewers in E. 51st St. et al., for $34,085.

V. Ramoglia, Seattle, Wash., submitted the lowest bid to the Board of Public Works of that city for the construction of a sewer in 44th St., Southwest, at $10,103.

West Virginia.

The Common Council of Parkersburg, W. Va., has passed an ordinance providing for a sanitary sewer on Elm St., from Washington Ave. to 23d St.

Wisconsin.

✣Bids will be received until 3 p. m., May 5, by J. F. Hohensee, City Clerk, Fond du Lac, Wis., for the construction of a sanitary sewer in Forest Ave. from the city limits to Seymour St.; also the extension of the Rose St. sanitary sewer east to McKinley St., all according to plans and specifications on file in the City Clerk's office.

⊙Battis Bros., Oshkosh, Wis., have been awarded the contract by the Board of Public Works of that city for furnishing the city with 137 lin. ft. of iron sewer pipe 16 ins. in diameter by ¼ in. built of ingot iron, and 80 lin. ft. of iron sewer pipe, 20 ins. in diameter by ¼ in., built of ingot iron. Bids were opened April 22.

E. R. Harding & Co. of Racine, Wis., bid $31,995 on the construction of the Driving Park sewer in Pontiac, Ill. John Cherry & Co. of Jacksonville, Ill., bid $28,757 on the work. A. T. Maltby, 77 Jackson Blvd., Chicago, Ill., is Engineer.

The Common Council of Waupaca, Wis., has voted to bond the First Sewerage District for $3,500 for the purpose of constructing a sewer and septic tank on Fulton St.

Canada.

✣Bids will be received until 4 p. m., May 5, by Frank Ness, Secy.-Treas., Rural Municipality of Assiniboia, Kirkfield Park P. O., Man., for the construction of a sewer and a water system on Douglas Park, D. G. S., 28-29 St. James, Plan 906. Plans and specifications and details of work may be seen at the office of the Municipal Engineer, at the Municipal Hall, St. Charles. A marked check for 5 per cent of the amount of tender must accompany each tender.

✣Bids will be received until 10 a. m., May 6, by John Allan, Mayor, Chairman Board of Control, Hamilton, Ont., for the construction of reinforced concrete sewage tanks, conduits, sludge drying beds, pile foundations and all other structures required for the complete erection of the west end sewage disposal plant. Plans, specifications and form of tender may be obtained from the City Engineer, Hamilton, Ont., upon receipt of $10, which amount will be refunded on return of the plans in good condition.

The City Council of London, Ont., on April 21 received the report of Engineer Willis Chipman, of Toronto, Ont., on the storm sewer survey of London. The estimated cost of the system is $392,000.

BUILDINGS

Arizona.

Plans have been prepared for a 2-story and basement, 280x120 ft., retail building, to be erected in the city of Phoenix, Ariz., at a cost of about $120,000. Norman F. Marsh, Broadway Central Bldg., Los Angeles, Cal., is the Architect.

Arkansas.

✣Bids will be received until noon, May 12, by George R. Mann and Theodore M. Sanders, Architects, 38 Urquhart Bldg., Little Rock, Ark., for the erection of the city market and arcade building. Certified check for $1,500 must be filed with each bid.

California.

A $500,000 addition is to be built to the Mills Bldg. in San Francisco. The new section will be 10 stories high and will cost about $500,000. Willis D. Polk & Co., Merchants Exchange Bldg., San Francisco, is the Architect.

The Oxford Investment Co. is to erect a 10-story reinforced concrete apartment house at Ocean and Pike Aves., Long Beach, Cal., at a cost of about $700,000. John Schulz, Los Angeles, is the contracting engineer.

The West End Merchants Association of Sacramento is to erect a 10-story concrete and steel building at 4th and J Sts., Sacramento, at a cost of about $350,000. Charles Kaiser, 57 Post St., San Francisco, is the Architect.

Delaware.

The following commissioners have been appointed to have charge of the construction of the combined City Hall and County Court House to be erected in Wilmington: Harlan G. Scott, James Y. Ford, L. Scott Townsend, John J. Rackobsob and Daniel Corbit, Jr. It will cost, for land and building, $1,500,000, of which the city will pay three-fifths and the county two-fifths. The design will be selected by means of a competition. The location of the building is the block bounded by Tenth, Eleventh, King and French Sts.

District of Columbia.

✣Bids will be received until 2 p. m., May 12, by Secretary of the Interior, Washington, D. C., for furnishing all materials and performing all labor required to complete plumbing, cement, marble and tile work, roofing, waterproofing, etc., in Howard Hall and Dix Buildings Nos. 1, 2 and 3 at the Government Hospital for the Insane, Washington, D. C., in strict accordance with the plans and specifications for the work, copies of which can be obtained upon application to the department. A deposit of $5 will be required for the safe return of blueprint copies of drawings loaned to bidders.

Florida.

✣Bids will be received until noon, June 3, by Board of Hillsborough County Commissioners, Tampa, Fla., for the erection of a jail building as an annex to the present jail building, as per plans and specifications which are on file with the Clerk of the Circuit Court, Tampa, Fla. Plans and specifications may be inspected, and information had, by applying to the Clerk of the Circuit Court, Hillsborough County, at his office in court house, or to the Franz Safe & Lock Company, Engineers. 27-29-31 South Hogan St., Jacksonville, Fla., or Greeson Building. Tampa, Fla. Address all bids to the Board of County Commissioners of Hillsborough County, Florida, care J. L. Hackney, Chairman, Tampa, Fla.

Georgia.

✣Bids will be received until 10 a. m., May 19, by R. V. LaDown, Superintendent of Prisons, Department of Justice, Washington, D. C., for furnishing and delivering at the U. S. Penitentiary, Atlanta, Ga., marble for the administration building, U. S. Penitentiary, Atlanta, Ga.

⊙James Devault, Canton, O., has been awarded the contract at $46,500 for constructing U. S. public building at Tipton, Ga.

Illinois.

Bids as follows were received April 21 by the Supervising Architect, Treasury Department, Washington, D. C., for constructing U. S. Postoffice at Harrisburg, Ill. (1) bid on limestone, (2) bid on sandstone: N. H. Shields, Danville, Ill., (1) $52,657; James Devault, Canton, O., (1) $53,702, (2) $55,800; R. S. Moore, Lafayette, Ind., (1) $54,726, (2) $54,726; Rogers & Kaiser, Chicago, Ill., (1) $55,980, (2) $58,780; M. Yeager & Son, Danville, Ill., (1) $57,345, (2) $59,221; George W. Stiles Construction Co., Chicago, Ill., (1) $57,448, (2) $62,700; Central Concrete Construction Co., Louisville, Ky., (1) $58,750, (2) $61,000; Hiram Lloyd Building & Construction Co., St. Louis, Mo., (1) $58,929, (2) $62,929; D. T. McCarthy, Philadelphia, Pa., (1) $59,430, (2) $61,430.

Madison County Supervisors, Edwardsville, Ill., have authorized a special election on June 3 to vote on a proposition for the erection of a new court house at Edwardsville. The resolution provides for a bond issue of $250,000, to bear 4½ per cent and run 20 years.

Iowa.

Bids as follows were received April 22 by the Supervising Auditor, Treasury Department, Washington, D. C., for constructing U. S. postoffice at Le Mars, Ia.; J. W. Miller, St. Paul, Minn., limestone, $49,900; W. D. Lovell, Minneapolis, Minn., limestone, $51,000.

Missouri.

✣Bids will be received until 3 p. m., May 23, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the installation of air washers and humidity-control apparatus in the United States post office (new), St. Louis, Mo., in accordance with drawings and specification, copies of which may be obtained at the office of the superintendent of construction, St. Louis, Mo., at the discretion of the Supervising Architect.

⊙T. H. Johnson & Son, Sedalia, Mo., have been awarded the contract at $91,321 for constructing the concrete foundation for the new state capitol at Jefferson City, Mo. Bids on building proper will be asked by the State Capitol Commission, Jefferson City, about July 1. Missouri stone will be used in its construction.

New Hampshire.

⊙The H. P. Cummings Construction Co., Ware, Mass., secured the contract to erect a brick and steel mill building, 70x147 ft., at Lancaster, N. H., for the Thompson Mfg. Co. (manufacturers of iron castings and mill machinery). Kimball B. Fletcher, President.

New York.

⊙King Lumber Co., Charlottesville, Va., has been awarded the contract at $46,770 for constructing the U. S. postoffice and courthouse at Auburn, N. Y.

⊙Parsons Bros., Binghamton, N. Y., were awarded the general contract at $55,000 for the erection of high school building at Cobleskill, N. Y. Gaylord & Eitspence, Binghamton, secured the heating and ventilating, and I. D. Lets & Sons, Cobleskill, the plumbing. Bids were opened April 17.

New Jersey.

✣Bids will be received until 4:30 p. m., May 12, by Committee on Public Buildings, Board of Essex County Chosen Freeholders, Newark, N. J., for the following work: Furnishing and erecting the steel and iron work for the steam roller building at the Essex County Penitentiary, Caldwell, N. J. Bids must be for the entire work, as called for in the specifications and as shown on plans. Plans and specifications and full particulars may be had upon application at the office of Joseph B. Allen, Architect, 11 Sanford Ave., Irvington, N. J. August L. Lacombe is Chairman of the Committee.

⊙The Turner Construction Co., 11 Broadway, New York City, has been awarded the general contract for the construction of an 8-story and basement cold storage warehouse entirely of reinforced concrete for the Merchants' Refrigerating Co. in Newark, N. J., on River St., south of Cherry St. The building is to be 50x100 ft. in plan. J. B. Snook Sons, Architects. Work is to go ahead at once.

New York.

⊙The Turner Construction Co., 11 Broadway, New York City, has been awarded the general contract by the Hewitt Rubber Co., for the construction of an all-reinforced concrete factory building, 3 stories in height, 460x90 ft., with an "L" 61 x30 ft., to be erected in Buffalo, N. Y., according to the plans of Lockwood, Greene & Co. Work is to go ahead at once.

North Carolina.

✣Bids will be received until 3 p. m., June 2, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the extension, including plumbing, gas piping, heating apparatus, electric conduits and wiring, and approaches, of the United States post office at Winston-Salem, N. C. The extension is two stories and basement, and has a ground area of approximately 14,150 sq. ft.; fireproof construction; stone facing and metal roof. Certain buildings now on the site will be required to be removed and separate proposals for the purchase and removal of these buildings must be submitted with the proposals for the extension to the post office building. Drawings and specifications may be obtained from the custodian at Winston-Salem, N. C., or at the discretion of the Supervising Architect.

Ohio.

✣Bids will be received until noon, May 1, by Charles W. Stage, Director of Public Safety, Cleveland, O., for the electric wiring work in connection with Hospital Building No. 2, Tuberculosis Sanitorium Group, and the Women's Building, Correction Square Group, Warrensville, O. Each bid must be in accordance with the plans and specifications which may be seen at the office of J. Milton Dyer, Architect, 825 Cuyahoga Bldg.

✣Bids will be received until noon, May 12, by Board of Trustees, Ohio State University, Columbus, O., for furnishing the materials and constructing, first, an underground tunnel, approximately 653 ft. long, in accordance with plans and specifications prepared by Joseph N. Bradford, University Architect, on file in the office of the Auditor of State.; second, for two automatic underfeed stokers in the power plant of the Ohio State University, in accordance with specifications prepared by William C. McCracken, Chief Engineer, said specifications are on file in the office of the Auditor of State; third, for the heating, ventilating and plumbing of the new botany and zoology building, in accordance with plans and specifications prepared by Joseph N. Bradford, University Architect, on file in the office of the Auditor of State; fourth, for insectary and greenhouse (bids to be on completed units), in accordance with plans and specifications prepared by Joseph N. Bradford, University Architect, on file in the office of the Auditor of State. Plans and specifications for the above-named improvements may also be seen at the office of the Architect, the Chief Engineer and the Secretary of the Board of Trustees. Carl E. Steeb, Secretary.

⊙Rogers & Kaiser, Peoples Gas Bldg., Chicago, Ill., have been awarded the contract at $59,300 for constructing the U. S. postoffice at Defiance, O.

The W. Bingham Co., wholesale and retail hardware dealers, Superior and W. 9th St., Cleveland, O., is to erect a store and warehouse on W. 9th St., Cleveland, to cost, including the value of the land, $1,000,000. Building will be 8 stories high on W. 9th St. and 11 stories on W. 10th St., and will be of brick, steel and concrete construction.

Mudge & Beach, Brokers, Williamson Bldg., Cleveland, have announced plans for a 10-story mercantile warehouse to be erected on W. 9th St., at a cost of about $700,000.

Pennsylvania.

Architect Charles Bickel, May Bldg., Pittsburgh, Pa., is drawing plans for a 6-story addition to the store of Boggs & Bull, North Side, Pittsburgh, the site for which is now being cleared of the old buildings. The area is 90x120 ft. The work will cost about $250,000. The new building will be made to conform in architecture with the present main structure. The owners may award the contract without competition or may take separate bids for the work.

The American Metal Co., Ltd., 52 Broadway, New York City, has purchased 2,500 acres of coal land and 350 acres of other land, near Burgettstown in the Pittsburgh District, and will at once erect a zinc smelter and sulphuric acid plant. The plant at the start will have an annual capacity of 40,000 tons of sulphuric acid and 20,000 tons of zinc. A shaft will be sunk and coal mining operations will be commenced. An initial expenditure of $2,000,000 is proposed.

Henry Hornbostel, of New York and Pittsburgh, and R. M. Hood, Pittsburgh representative for Mr. Hornbostel, are preparing plans for a three-story brick and terra cotta building at Pittsburgh for the Carnegie Institute of Technology, to be used by the faculty members. Plans will be ready by July 1. The estimated cost is $100,000.

Carlisle & Sharrer, Jenkins Arcade building, Pittsburgh, will soon finish plans for the proposed school building for the Duquesne Board of Education, to cost $180,000. The building will be of brick and terra cotta, 120x126 ft., to contain 19 class rooms and several department rooms.

The Thompson-Starret Co., First National Bank Bldg., Pittsburgh, has all plans and specifications for the proposed department store of the Kaufman & Baer Company, to be erected at 6th Ave. and Smithfield St., Pittsburgh, for which the Lewis block is now being demolished. The building will have a flat tile roof, structural steel frame, ornamental iron and bronze, rubber tiling, interior marble, sprinkling system, steam heating system, 15 elevators, one sidewalk lift, etc.

Architect J. W. Yard & Son, Penn Bldg., Erie, is about ready for bids on a three-story fireproof school building to be erected at East Ave. and Sixth St. for the Board of Education, to cost $100,000.

Tennessee.

✣Bids will be received until 2 p. m., May 29, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures, and approaches, of the United States Post Office at Morristown, Tenn. The building is to be two stories in height with a basement, and will have a ground area of approximately 4,300 sq. ft.; fireproof construction, except roof, stone facing and tin roof. Drawings and specifications may be obtained from the custodian of site at Morristown, Tenn., or at the discretion of the Supervising Architect.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

✣Bids will be received until 3 p. m., May 16, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the interior painting in the U. S. Court House at Texarkana, Texas, in accordance with the specifications, copies of which may be had at the office of the Custodian at Texarkana, Texas, at the discretion of the Supervising Architect.

✣Bids will be received until noon, May 8, by Edgar Odell Lovett, President, William M. Rice Institute, Box 17, Houston, Texas, for the erection of a 2-story fireproof physical laboratory for the Institute. Plans, details and specifications may be obtained upon application at the office of the architects, Cram, Goodhue & Ferguson, Scanlan Building, Houston, Texas. Every application must be accompanied by a deposit of $50 in favor of the architects, which will be refunded upon the return of the drawings and specifications.

⊙Tom Lovell Sons, Enid, Okla., have been awarded the contract at $60,865 for construction of U. S. postoffice at Weatherford, Tex.

Vermont.

⊙The H. P. Cummings Construction Co., Ware, Mass., has been awarded the contract for the additions and alterations to the State National Bank Bldg. at Windsor, Vt.

West Virginia.

✣Bids will be received until noon, May 5, by State Board of Control, Charleston, W. Va., for furnishing all materials and labor necessary to do and fully complete all the work of remodeling and heating and power plant at the West Virginia University at Morgantown, according to plans and specifications filed at the following places: Mayor's office, Grafton, W. Va., office of the president of the university, Morgantown, W. Va.; office of the State Board of Control, Charleston, W. Va.

Canada.

✣Bids will be received until noon, May 5, by A. E. McKenzie, Brandon, Man., for the erection and total completion of new fireproof wholesale premises in Brandon, Man. Tenders will include all works complete, excavator, concrete, plain and reinforced, bricklayer, stone mason, carpenter, metal work, plaster, painting, heating, plumbing, electric light, etc. All tenders will be accompanied with a marked check for 2½ per cent of the contract amount. Plans may be seen at the Builders' Exchange, Winnipeg, or at the office of Thomas Sinclair, Licentiate, R. I. B. A., Architect, Brandon, Man.

RIVERS AND HARBORS

Delaware.

✣Bids will be received until 11 a. m., June 2, by Maj. R. R. Raymond, U. S. Engineer, Wilmington, Del., for the construction of the steel sea-going dredge Minquas.

District of Columbia.

✣Bids will be received until 10:30 a. m., May 17, by Maj. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for dynamite, copper wire, ingot copper, brass tubing, bronze, steel chain, track bolts, track spikes, boat spikes, washers, nails, tacks, plate zinc, rope clips, drills, taps, wrenches, files, vises, shovels, chain blocks, buckets, paint brushes, scrubbing brushes, machetes, padlocks, grease cups, oilers, water coolers, ladders, chairs, door mats, oars, signal flags, emery cloth, sash cord, chalk line, cheesecloth, vitrified sewer pipe, turpentine, paints, tie plugs, bolts, lumber and piles.

Hawaii.

✣Bids will be received until 11 a. m., May 3, by Bureau of Yards and Docks, Navy Department, Washington, D. C., for two coal hoisting towers for the naval station, Pearl Harbor, Hawaii.

Louisiana.

✣Bids will be received until 11 a. m., May 26, by Maj. Edward H. Schulz, U. S. Engineer, New Orleans, La., for dredging a canal between Calcasieu River and Sabine River, La., and Texas. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 11 a. m., May 8, by Maj. E. H. Schulz, U. S. Engineer, New Orleans, L. A., for furnishing and delivering about 8,000 cu. yds. of stone at South Pass and Southwest Pass, Mississippi River.

⊙J. M. Dyer, Morgan City, La., has been awarded the contract at about $8,000, for cleaning out Plaquemine Bruley for the U. S. Government.

Maryland.

✣Bids will be received until 1 p. m., May 27, by Col. Lansing H. Beach, U. S. Engineer, Baltimore, Md., for the removal of the wreck of the steel steamship Alum Chine, sunk in Patapsco River, Md.

Massachusetts.

⊙John Cashman Sons Co., Boston, Mass., has been awarded the contract at $2,982 for constructing concrete seawall at Fort Andrews, Mass. Bids were opened April 4 by the Constructing Quartermaster, Boston, Mass.

Michigan.

✣Bids will be received until noon, May 10, by Lieut. Col. Mason M. Patrick, U. S. Engineer, Detroit, Mich., for dredging Cheboygan Harbor, Mich.

New Hampshire.

⊙The H. P. Cummings Construction Co., Ware, Mass., has secured the contract for building a dam for the Lancaster & Jefferson Electric Co. at Lancaster, N. H.

New York.

✣Bids will be received until noon, May 21, by Col. W. M. Black, U. S. Engineer, 39 Whitehall St., New York City, for deepening Battery Reef, East River, New York City. The area to be deepened is approximately 1,200 ft. wide and varies in length from nothing at the point at its outer extremity to about 2,200 ft. The object of the work is to secure a clear depth of 18 ft. at mean low water over the reef for a width of 300 ft. outside of and parallel to the established pierhead line, and a clear depth of 26 ft. at mean low water over the remainder of the reef, with a slope of 1 on 1 joining these depths, the bottom limit of the slope being along the 300-ft. line above mentioned. The work consists in removing all material encountered in Battery Reef beginning at the southern end, the work of dredging and rock removal to be prosecuted simultaneously, so far as may be practicable. The amount of material to be removed to secure depths of 18 and 26 ft. at mean low water is estimated at 5,400 cu. yds., place measurement, of ledge rock; about 125 cu. yds. solid measurement, of broken rock and bowlders ½ cu. yd. to 3 cu. yds. in size; and about 209,000 cu. yds., scow measurement, of material other than ledge rock, broken rock and boulders.

⊙John Young, Syracuse, N. Y., has been awarded Barge Canal Contract No. 112 at $120,350. This contract calls for the driving of 145,000 lin. ft. of steel sheet piling for the protection of the embankments of the canal at various points in Niagara and Monroe Counties. The other bidders were: J. Elwood Baird Co., Buffalo, $124,700; Lathrop, Shea & Henwood Co., Buffalo, $126,150; Great Lakes Dredge & Dock Co., Buffalo, $130,750.

⊙William J. Dowdle, Oswego, N. Y., has been awarded Barge Canal Contract No. 113 at $21,964. The contract provides for furnishing and delivering lumber and wooden piles at Bushnell's Basin and Holley. The other bidders were Lupfer & Remick of Buffalo, $22,139, and John Murphy of Holley, $24,820.

⊙The H. P. Cummings Construction Co., Ware, Mass., has been awarded the contract to construct a concrete dam for the International Paper Co. at Corinth, N. Y. The contract also includes the repairing of part of the present crib dam which has been washed out by recent flood conditions.

⊙The H. P. Cummings Construction Co., Ware, Mass., has secured the contract for rebuilding the crib dam for the International Paper Co. at Fort Edward, N. Y. Approximately 500 ft. of the dam was washed out by the recent flood conditions.

Porto Rico.

✣Bids will be received until 11 a. m., June 14, by Bureau of Yards and Docks, Navy Department, Washington, D. C., for the construction of two steel towers at the naval radio station, San Juan, P. R.

Virginia.

⊙Bids as follows were received April 10 by the U. S. Engineer, Norfolk, Va., for removal of wreck of Barge Florida from Hampton Roads, Virginia: John B. Whealton, Jr., Norfolk, Va., $12,500; Hanbury & Blix, Brooklyn, N. Y., $10,850; Johnston & Virden, Lewes, Del., $10,800; Eugene Boehm, Atlantic City, N. J., $8,922 (awarded contract). The above bids are for removing the wreck by blowing up by use of explosives and removing the debris. For removing the wreck bodily the Merritt & Chapman Derrick & Wrecking Co., New York, N. Y., bid $22,450.

Washington.

✣Bids will be received until 1:30 p. m., May 15, by Port Commission, Port of Seattle, 843 Central Bldg., Seattle, Wash., for excavations and fill and the construction of substructure of what is known as the Smith's Cove Improvement. C. E. Remsberg is Secretary. Official advertisement will be found elsewhere in this issue.

Wisconsin.

✣Bids will be received until 3 p. m., May 8, by Lieut. George A. Zinn, U. S. Engineer, Milwaukee, Wis., for furnishing 5,000 bbls., more or less, of Portland cement at Manistique, Mich.

PROPOSALS

PROPOSAL FOR THE CONSTRUCTION OF A ROUGH-STONE-FACED BRIDGE ACROSS ROCK CREEK IN THE NATIONAL ZOOLOGICAL PARK.

NATIONAL ZOOLOGICAL PARK,
Under the direction of the
SMITHSONIAN INSTITUTION,
Washington, D. C.
Office of the Superintendent,
April 28, 1913.

Sealed proposals will be received at the office of the Superintendent of the National Zoological Park until 2 o'clock p. m., Tuesday, May 20, 1913, for the construction of a bridge of concrete reinforced with steel and faced with rough stone across Rock Creek to replace the present log bridge on the line of the roadway from Adams Mill Road entrance to the Zoological Park, and Cathedral Avenue.

Blank forms of proposals, specifications and all necessary information may be obtained at this office.

CHARLES D. WALCOTT,
Secretary, Smithsonian Institution.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ENGINEERING AND CONTRACTING

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and to Methods and Cost of Construction

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Interstate Commerce Commission Board for the Valuation of Railways.

The board of five members, who will plan and direct the work of valuation of the railways of the United States, under the Interstate Commerce Commission, has been formally named. It consists of Mr. R. A. Thompson, now in charge of valuation work for the California Railroad Commission; Mr. Howard M. Jones, consulting and bridge engineer; Prof. W. D. Pence, University of Wisconsin and chief engineer Wisconsin Railroad and Tax Commissions; Mr. J. S. Worley, consulting engineer, and Mr. Edwin F. Wendt, chief engineer Pittsburg & Lake Erie R. R., and president American Railway Engineering Association. The members of the board began service May 1.

Civic Fields for the Service of the Engineer.

An address to engineers which is of unusual significance is given in another section of this issue. It points out the broad fields of service which lie open to men of engineering training. Valuation of public utilities, regulation of public services, scientific management, public sanitation, public works direction, conservation of natural resources, land reclamation and development, are some of the fields named. None of these fields is new to the engineer. He has worked and is today working all of them, but he is not working them to their full opportunity nor to his full advantage. It is because of this negligence that the address of Professor Stout is of distinct usefulness.

One of the commonest complaints heard among engineers is that engineering schools are graduating too many engineers. The field of service, it is stated, is too small for all that are seeking to work it. Engineers' compensation as a result, it is urged, is too low and is likely to become lower. The facts, as we have said many times in these columns, are wholly different. There are perhaps too many engineers in one field, but there are not, nor can there be, too many men of engineering training once we as engineers have the conviction that the designing and building of physical structures is but a single field of service open to engineers. Engineers do not have this conviction. Engineering students in particular come from college, as a rule, convinced of the exact contrary, that there is no field but the one of designing and construction of works open, and further, that if they do not enter this field they will be, in a sense, false to their training.

Professor Stout's exhortation to the students of his school is one that the students of all engineering schools need to hear often. It is one that can be usefully repeated to engineers out of school. There is not one of the fields mentioned by him for which an engineering training does not fit a man better than any other training, yet to watch the neglect of engineers to demand their own as these fields open up one would imagine that they offered no service that the engineer could render.

The Possibilities of Consolidating Soils by Injecting Cement Grout.

Grouting behind tunnel linings and to fill and make solid for foundations fissured rock is a well known resort of engineering construction and has been widely successful. Masses of broken rock and gravel have been successfully consolidated by grouting, and another most successful use of the method has been in closing leaks in water bearing rock passed through in shaft-sinking and tunneling. From these practices it is natural to reason, and it has been reasoned that grouting offers a general method of consolidating soils for excavation or to give them greater bearing strength. Experience does not support this reasoning; grouting has in two important instances at least proved largely unsuccessful in consolidating fine soils.

In constructing the shafts for an inverted siphon under the Colorado River at Yuma, Ariz., it was planned to force grout into the earth about the shaft's bottom and so keep the water out until the tunnel heading had advanced from the shaft into tight ground. A row of pipes encircling the shaft was sunk to a good depth below the shaft bottom and grout was pumped in to refusal, then the pipes were raised and pumping was repeated. This process was continued until the bottoms of the pipes were above the level of the tunnel crown. Examination showed almost complete failure of the grout to consolidate the soil to any useful extent. This soil was a fine silty sand and while enough pressure could be got to ensure penetration the grout flowed through the material so slowly that it set up and blocked the pipes before any useful volume of the soil had been cemented.

The second instance of important failure of grouting to consolidate fine soil was at the Pennsylvania R. R. tunnel work under the East River at New York City. This experience in reality antedated that at the Yuma siphon, but the results were closely similar. The material penetrated by the East River tunnels was a fine silt and the attempt to employ grouting arose from the familiar difficulty in compressed air tunneling in soft soils of preventing blow-outs at the top of the working face and yet maintain enough pressure to hold back the water at the bottom of the working face. The plan was to consolidate the soil ahead of the upper half of the shield by injecting grout. Upon digging into the grouted soil it was found that the grout had collected into masses and was not generally distributed.

From these two experiences it will appear that unless the materials are fairly coarse, there is little chance of successfully consolidating them by the injection of grout.

Cost of Maintaining Ballast.

Reports of the Interstate Commerce Commission prior to 1908 contain no data on the cost of maintaining ballast. In recent reports, however, the total annual expenditure for ballast on the "large roads" is given. The mileage of the "large roads" is not given, but since the total maintenance of way expenses of the "small roads" is less than 3 per cent of the corresponding expenses of the "large roads," we shall not be far wrong in assuming that the mileage of the "large roads" is only 3 per cent less than the mileage of all roads.

Upon this assumption we deduce the following costs of maintenance of ballast (not including track labor):

Year.	Per mile of all track.	Per mile of roadbed.
1908	$18.00	$26.00
1909	18.20	26.50
1910	26.00	37.00

Ballast maintenance has apparently cost about half as much as rail maintenance, but it must be remembered that it is not always easy to separate the cost of ballast renewals from the cost of additional ballast. Hence too much confidence should not be placed in the above data as to ballast maintenance.

In a recent report of the Committee on Ballast, American Railway Engineering Association, the following data were given. In August, 1899, an experimental stretch of three miles of double track ballast was laid by the Pennsylvania R. R., using ¾-in. stone for one mile, 1½-in for the next mile and 2½-in. for the third mile. Records of maintenance cost were kept till October, 1903, a period of 51 months. The maintenance of ballast during this period averaged $9.70 to $11 per mile of single track. The ballast was 6.5 to 7.25 ins. thick under the ties, and there were 2,400 to 3,100 tons of stone per mile of single track, the average cost of which was about 65 cts. per ton in the quarry, and about $1.20 per ton in the track.

The annual maintenance cost was about 12 per cent higher for the ¾-in. stone than for the larger sizes.

GENERAL ARTICLES

A Device for Recording Automatically the Cross-Section of the Cut Made by Dredges.

In hydraulic dredge and continuous bucket dredge work, a "cut" is made by swinging the boat in combination with vertical movement of the excavator arm. Accuracy of the cut to planned cross-section depends upon the care and judgment of the dredge operator, and this accuracy can be verified only by making soundings and platting cross-sections at intervals along the channel after dredging. By the accompanying illustrations is shown a device for recording the exact cross-section of a dredge cut. This device is the invention of Mr. Uldric Thompson, and is described by him in the "Sibley Journal of Engineering" for March, 1913, from which we abstract as follows:

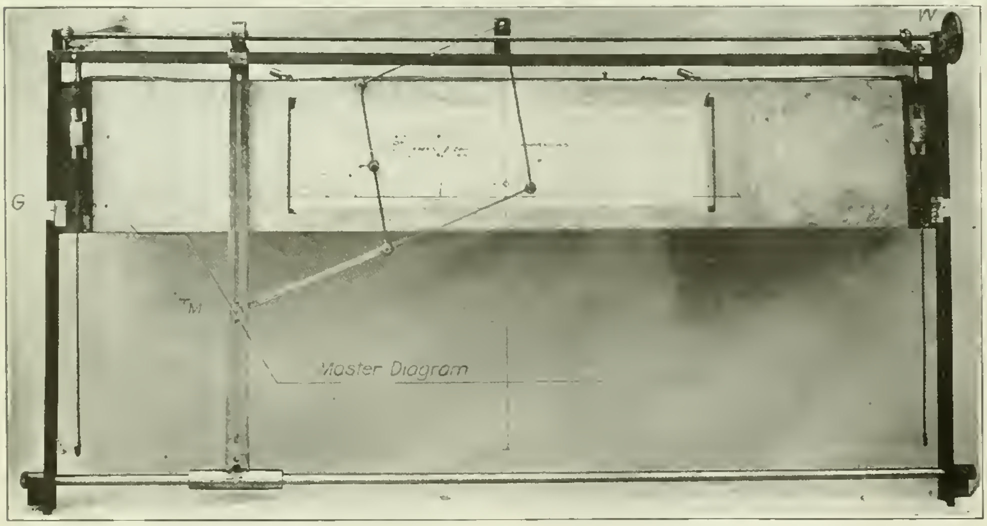


Fig. 1—Pantagraph Mechanism for Recording Cross Sections of Cuts Made by Dredges.

The purpose of the "Standard Dredge Director" is to show the location of the cutter and thus be a guide to the operator. It also makes a chart automatically, of the work done. The director is located in the forward part of the ship, in front of the operator. The apparatus is, mainly, a device for combining the horizontal and vertical motions of the cutter so as to show its resultant movement. This may easily be done by applying the horizontal component to the sliding guide, and the vertical component on the pointer *Tm* (see Fig. 1). The vertical movement of the arm is registered by running a wire from a point on the arm, around a differential pulley mounted on the projecting frame work, the other end being attached to a weight. Another wire, similarly weighted, is wound around the smaller circumference of the differential pulley and is then run back and connected to the director. In this way, all vertical movements of the arm are reduced and transferred to the apparatus.

The horizontal component of the cutter movement is taken care of as follows: A metal quadrant is pivoted at its center, in a vertical axis located midway between the spuds, on the rear deck, or on the ceiling of the boiler room. Wires are fastened from the ends of the arc and then run around the arc to pulleys on the opposite side and thence up forward to the director (see Fig. 2). The center line of the quadrant is then lined up with the center line of the river or canal. This may be done by sighting along the line to some distant point in the canal center line. During operation the quadrant may be kept centered either by hand or by a gyroscope mounted on the quadrant. In either case the quadrant will remain stationary as the boat swings beneath it. Hence, as the relative positions of the boat and quadrant change, the wires will be pulled through distances proportional to the swinging of the dredge. The purpose of running the wires around the arc in the manner shown is so that any movement of the boat will produce a movement in the same direction on the director. By selecting the proper radius for the quadrant, the horizontal component is reduced to the same scale as the vertical. A proposed improvement is to locate the quadrant and gyroscope in the wheel house and thus make the apparatus more compact. The gyroscope would keep the center line of the quadrant always parallel to itself. Hence the relative movements of the boat and quadrant would be the same as with the other location of the quadrant. This arrangement could not be used if the centering were done by hand. In case the canal is curved, the apparatus must be re-centered at short intervals.

A pantagraph mechanism is used to trace the path of the cutter; a pointer for the "master-diagram" and stylus for the recording diagram. *Tm*, Fig. 1, is the master tracer or pointer, and *Tp* the stylus on the recorder.

As may be seen from Fig. 1, the pointer moves behind a sheet of glass upon which has been drawn a "master-diagram" of the section to be cut out. It is the duty of the operator first to cut out the section roughly, as described above, and then to finish off the edges by manipulating the cutter so that the pointer follows the line of the "master-diagram." Change of water level may be allowed for by raising or lowering the glass plate by turning the wheel *W*. *G* shows a gage for this regulation. The director is equipped with a mechanism for automatically making charts of the work done by the dredge. A new section of a continuous chart is rolled into place every time the spuds are shifted. This is accomplished by means of simple electrical connections. In this way a chart of the section dredged is made each time the boat is "spudded" ahead. The blank charts may have a "master-diagram" drawn on them so that an easy comparison may be made between the actual cut and the cut called for. The chart mechanism is locked and sealed, and thus gives the government or canal company an absolute check on the work. Hitherto, the only way the government could get any data upon which to base its payment was to make cross-section soundings every fifty feet or so. This, at best, is expensive and inaccurate.

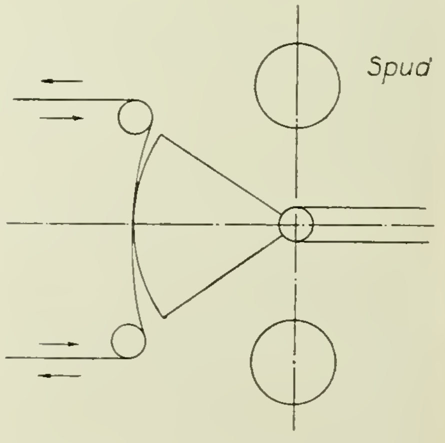


Fig. 2—Diagram of Quadrant Arrangement for Dredge Cut Director.

An Economical Concrete Fence.

(Staff Article.)

The accompanying view shows a concrete fence recently designed by R. V. Moss, city surveyor of New York city, for the Glen Ridge Tennis Courts.

A strong and durable fence was desired, of neat appearance, one that could be quickly erected and at low cost. At 12 ft. 1 in. centers 3-in I-beams 12-ft. 6-in. length were sunk in the ground to a depth of 2 ft. 6 ins., leaving 10 ft. of post above the surface. The flanges of these beams were wrapped with expanded metal lath to a height of 6 ft. above grade to carry cement plaster. A 2-in. x 3-in. spruce bottom rail was placed between the posts along the ground and a top rail of the same size at a height of 6 ft. with Rib-Trus Reinforcing Plates, manufactured by The Berger Mfg. Co., Canton, O., extended to cover the space between. The concrete was applied on the reinforcing plates to a thickness of three inches.

Above the reinforced concrete portion of the fence, wire netting is fastened to the height of 4 ft. making the entire height of the fence 10 ft., 6 ft. of which is concrete and the remainder wire. The cost of this fence was extremely low, especially for the concrete portion of it which, in this case, is increased by the fact that the I-beam posts extend 4 ft. above the concrete to carry the netting. The concrete portion alone cost about 25 or 30 cts. per square ft. including the contractor's profit which made the cost of the 6-ft. fence from $1.50 to $1.80 per lin. ft.

Concrete Tennis Court Fence at Glen Ridge, New York City.

Civic Fields for the Service of Men Trained as Engineers.

Some of the fields in which the engineer can render service and find employment outside the busily worked fields of design and construction are interestingly reviewed in an address by Dean O. V. P. Stout, University of Nebraska, delivered at the mid-winter commencement of that institution. We quote the following parts of this address:

"It depends upon the circumstances which he encounters and upon the man's own temperament and initiative whether, after graduation, he becomes a civic engineer. One of the most potent influences to this end is the fact that in this country society, which up to this time has concerned itself chiefly in the creation of values, is now moving toward an equitable distribution of the possession of those values. This distribution necessitates first an analysis and appraisal of the subject-matter. Since the primary basis is physical and is the result of designs which he has originated and of processes which he has directed, it follows that the engineer is the best equipped for the purely physical valuations. In the process of effecting this valuation he is brought into contact with other phases of the development, and discovers that the powers which he has been trained to exercise in the field of force and matter have a wider application. He discovers also that men of no other training are able to judge and to apportion more fairly than he, for the engineer as such is not an advocate or a partisan. The development of submission to fact, and of a temper to go to meet the fact, is an acknowledged tendency of all scientific work. It is not peculiar to engineering.

"Thus it appears that the valuations of public utility properties now so much in vogue as a basis for rate making, taxation, capitalization, sale and other purposes, have contributed conspicuously to bringing the engineer into notice as a man of important and continuing relations with intimate human affairs. The progress which has been made along these lines in the last few years has its foundation in the work of engineers. The first important contribution came from a study of problems connected with undertakings to supply water to municipalities, and the principles evolved have been extended to and further developed in other fields. Studies were made of the physical facts and principles involved, for the correct interpretation of which engineering training was plainly required. In dealing with these facts and principles the engineer was brought to a view and an understanding which led him to consider the financial, economic and social bearing of these items and of the enterprise as a whole. Consequently the principles which are to govern in such appraisals and the conclusions which are to be derived from them have, as a rule, been formulated first by engineers. Their formulas have become established when adopted by courts and commissions and embodied in their decisions and rulings.

"In his daily work the engineer has to deal with many elements besides those which admit of precise computation. The progress of engineering is not marked exclusively by the discovery of new principles or spectacularly new applications of old principles. This progress consists, to an extent much greater than is usually realized, in a narrowing of the range of uncertainty which attaches to the consideration of many of the problems which are encountered. Much of the most important work of engineering investigators has been directed to this end. For instance, many of the materials of construction, including both natural and artificial products, are of varying strength, and ordinary inspection will not enable even the expert to predict, within a wide range, what the actual strength of a piece will be. He must therefore, as a matter of ordinary prudence, assume that the strength does not exceed the minimum which can be expected. This means, of course, that in a majority of instances of the use of such a material it goes in excess quantity into the structure or machine, and the excess represents that much waste. Anything which will reduce the limit of uncertainty conduces to economy. The fact that the processes for the fabrication of steel in modern plants result in a product of great strength is of no more importance than is the fact that a high degree of uniformity in strength is also attained. Rational practice, on this account, justifies the use of a much lower factor of safety for steel than for cast iron, which is by no means so certain a product. Now the process of reducing the range of such uncertainties is in the nature of a reaching out for the intangible and reducing it to the tangible. Within recent years we have been able to design timber structures with less waste than formerly, due to patient and exhaustive studies which have been made of the effect of seasoning, moisture and other conditions. A complete theory takes account of all conditions. Almost all of our theories are incomplete and lead to only proximate results because they do not comprehend all attendant conditions. Many of these conditions are elusive, and seemingly defy incorporation in analysis. The old working theory of timber, as has been noted, disregarded many influences and conditions which are necessary to a complete consideration of the subject. The later modified theory is better than the old on account of the additional circumstances which have been evaluated. The range of uncertainty in the use of this material has thereby been narrowed, and economy has resulted, and a measure of conservation has been effected. What, then, is more natural than that the men who have had to consider these questions should have acquired the bent of mind which has enabled them to assume a distinct leadership in the process of reducing the intangible factors in our commercial and economic life to terms of the tangible. Recurring to the subject of public utilities, it may be noted that the light which has been shed on the so-called intangible values in properties has been the result, in no small degree, of the study of men trained as engineers, and accustomed to precisely analogous processes in the more material field. From the maze of going value, going concern, going concern value, connected business, good will, development expense, early deficits and the like, is coming a logical and practicable working understanding which will be fair to all concerned.

"Lately we have heard much of industrial efficiency, and a group of experts has come to the front under the name of efficiency engineers. It has been made manifest that the training which best fits a man to become expert in the elimination of unnecessary and unfit motions, machines, devices, ways and the like, and the assemblages of all of these, is along engineering lines. The forms of analysis which he has been taught to apply and the observations which he has been trained in making are those which are in order here. An essential feature of any plan for promoting efficiency in productive industrial operation is a wage system which rewards industry, expertness and general efficiency on the part of the individual worker. The formulation of a successful system of this sort brings about improved temper in the relations between employer and employe and contributes to the general stability of the social structure. Corresponding to the fact of the recent demonstration that there has been and is much room for improvement and saving in the methods employed in production, we note that the studies which have been inspired by the high cost of living indicate that there is undue expense attached to the distribution by commercial process of the products of industry. The engineer has been pre-eminent in bringing about our advanced methods and standards of material living, and he has rightly a place in the popular mind in this connection. Already it is evident as appears in what I have stated that through his study and development of scientific management of producing industry, the evolving of wage system, and the formulation of principles relating to public utility, he is to be an important factor in the adjustment of our political and social system to the material development in which he has played so basic a part. A recent writer has pointed out the field for the engineer in the introduction of scientific management into the distribution of the products of industry, analogous to that which he already occupies in the scientific management of the productive operations. We have early examples of the adaptability of a trained engineer to such services as this. Albert Fink, known in railway history as the great rate maker, had attained more than a national reputation as a bridge engineer before his attention was directed to rate making.

"Among the most important of the newly developed types is the sanitary engineer. Of him perhaps more than any other it is demanded that he be a teacher and a leader. He is a relatively new worker in the field which to many has been known as preventive medicine. For a period covering about thirty years chemists and biologists have been especially active in the phase of their respective sciences which pertains to human life and health. Some of the most important of their discoveries demand in their application the use of mechanical and structural devices. The design and construction of these, and the formulation of schemes of operation, call for one who is 'skilled in the art of directing the forces of nature to the use and benefit of man,' and that, according to one of our oldest definitions, constitutes an engineer. But if he is to be skilled in his art as he must now apply it, he must have prepared himself to take full account of the chemical and biological processes which attend, as well as those of a physical or a mechanical nature. The machine or structure to be employed, and the scheme of supervision and operation of the same must be so planned as to insure the action of processes favorable to the end sought and preclude the action of those which are unfavorable.

"The tremendous responsibility involved in conserving the health of communities is coming to be, in the popular mind as well as actually, in large measure directly insistent upon the engineer. Upon him rests the burden to see to it that the communities which he is called upon to serve are given the advantage of the very best knowledge and expedients which have been made available. I wish to join with those who contend that this duty rests upon him to the extent of requiring that he devote a large measure of his time and energy to the education or conversion of those whom he serves. Common experience proves that the people as a whole are slow to accept and employ, either in public works or on private premises, the best of available expedients when this best entails a first cost which is greater than that which attaches to some inferior system or device.

"A moment's reflection will bring to mind numerous other fields of engineering activity which afford training calculated to produce civic engineers, or else demand that the practitioner entering them be already qualified to consider his scope of operations as extending well beyond the domain of force and matter. It may be of interest if, without attempting an exhaustive enumeration, we give brief attention to a few examples which are more or less representative.

"An interesting experiment which has been tried in at least one instance, and has been launched in another, is the employment of an engineer as general manager of a moderate sized city. The completed experiment was a success to the extent that at the end of the first year the engineer-manager was able, after caring for all municipal needs more completely and efficiently than had ever before been found possible, to show a considerable balance in the funds which had been placed at his disposal. Such results in comparison with the usual showing are possible because it is rarely the case that the central authority had an appreciation of what can be done in the way of an efficient and economical use of the city plant and property. When the entire responsibility is placed upon one who has such an appreciation, and who has at the same time the necessary financial and business training and experience, improved general results must follow. In this country at the present time the combination of qualifications can rarely be found except in one who has worked as an engineer in some branch of that profession.

"We have thus far had little opportunity to observe the engineer as a teacher in the high schools. The few instances in which this opportunity has been presented, however, have on the whole moved us to bring the idea of such work each year to the attention of young engineers about to graduate. Many of the high school subjects, it would seem, can be put on a basis which will appeal to the youth more strongly than they do at present, if the instruction is given by one who has had a training directed to the practical application of the sciences. Unfortunately for the schools, as I believe, it is only rarely that the idea of such work appeals to the young engineer.

"There have been for many years a few to whom the term agricultural engineer would apply. Col. George E. Waring, known to fame in connection with the separate system of sewerage and the cleaning of the streets of New York, who died of yellow fever while engaged in the renovation of Havana, was in his earlier years engaged in the engineering of agricultural estates. The general use of the term agricultural engineers is, however, relatively new. It is applied to men whose training is designed to fit them especially for service in rural communities. This service will make them, in most instances, residents of such communities or towns in which the communities center. In either event, the young engineer of ability and initiative will be practically certain to develop within himself qualities of citizenship and leadership which bring him within the scope of this discussion.

"The data for a comparison of the results of the work of engineers with that of men of distinctly different training in dealing with a problem which rests on a physical basis are found in the early history of irrigation legislation and administration in Colorado and Wyoming. In Colorado it does not appear that engineering advice was sought in the framing of the early statutes. All controversy was referred to the courts, with no provision to insure that competent engineering advice should intrude. The consequence was that the statutes contained clauses so worded as to be incapable of consistent interpretation, and court decrees were rendered which abounded in manifest absurdities. Some of these decrees presented absurdity of the same nature as requiring that milk should be sold by the linear yard or rope by the liquid quart. In Wyoming, on the other hand, the statute was framed by an engineer, the same who as state engineer administered it for many years thereafter. That statute and the procedure for which it provides have been models for all the other western states. Litigation over water rights in Wyoming was at once reduced to a negligible quantity, due to the fact that there was assurance that the adjustment of differences would be effected in the light of a clear conception of the physical facts involved. We must not pass this instance, however, without noting that the man who accomplished this for a commonwealth had, in addition to a complete training in engineering, some experience in law and a strong natural bent toward constructive statesmanship. It is the peculiar combination of qualities and training which makes for such results. I do not wish to be understood as claiming that the engineering training is more than a primary and essential element of the combination.

"In my contention that experience in practical applied science may lead a man to an incisive view into the less material problems of life, and that by cultivation this view may become comprehensive, and result in eminently helpful service to the community in particular and the world at large, I shall call up the instance of Herbert Spencer, whose early adult years were passed as a civil engineer. That this early experience influenced his work ever afterward is plainly evident from his processes and conception and even his terminology. Witness 'Social Statics'—statics being the science upon which structural engineering is founded. Who more likely than an engineer to conceive the analogy with the social structure?"

Steamer for Thawing Hydrants.—The city of Bismarck, N. D., has purchased a steamer which will be used for thawing out frozen hydrants, culverts and pipes. It consists of an upright boiler about 6 ft. high and 2 ft. in diameter, with a heater attached. The steam is conducted wherever desired through a hose.

Plans for Relieving Earth Slides at Culebra Cut, Panama Canal, by Hydraulicking.

Work of relieving the pressure causing the earth slides at Culebra Cut has so far been confined to steam shovel excavation. According to the "Canal Record," plans are being carried out by which in June the steam shovel work will be supplemented by a hydraulicking plant working on the two slides to the north and south of Gold Hill.

Separating these slides, Gold Hill rises to elevation 652 ft. above sea level and presents a sheer face of dark, hard rock 482 ft. above the canal bottom; it is a mass of breccia which intrusions of basaltic lava pushed upward through several hundred feet of soft overlying formations. This mass stands as firm as Gibraltar, while the soft material flanking it at the crest of the continental divide is involved in slides which, of all those along Culebra Cut, are exceeded in volume only by the slide diagonally opposite, on the west bank at Culebra. No other breaks reach as high above the canal bottom.

The height of the tops and the outward slope of the adjacent ground will enable the use of hydraulic monitors in the adopted practice of excavating at the tops of slides to relieve the pressure. Equipment used in the hydraulic excavation south of Miraflores Locks is being installed for the purpose of sluicing material back into the valley toward which the earth slopes on the two sides and at the rear of Gold Hill. The surface over which it is proposed to waste the spoil is about 240 ft. above sea level. The construction of flumes on grades of 4.6 and 5 per cent will allow the sluicing of earth 330 ft. above sea level.

Sluicing will begin at the top of the slide to the north of Gold Hill. Under the original survey, it was estimated that 1,400,000 cu. yds. were to be removed from this area, but a later break of the earth, farther back, has rendered estimates of the extent of operations only approximate. It is estimated that between 1,000,000 and 1,500,000 cu. yds. can be removed economically in the Cucaracha territory, in addition to that which will be sluiced down the slide into the canal, to be removed by suction dredge. The material to be excavated is mostly soft earth, and includes a dump made from the French excavation.

Water will be supplied by damming the upper Obispo and several of its tributaries, draining a watershed with a total area of 4.1 square miles. This will be accomplished without difficulty, because the course of the stream is crossed by an American dump below which 20-in. pipes were laid for drainage. The water can be dammed by raising the pipe intakes with vertical elbows. Foundations and retaining walls for the pumping station have been built of concrete at a point near the relocated line of the Panama R. R., about four miles above Pedro Miguel and 3,000 ft. east of the canal, opposite Culebra. The station is to be equipped with half of the Agua Dulce pumping plant. The two 24-in. triple expansion horizontal pumping engines are stored on the ground, and the 500-h.p. boilers to supply them are being installed. Each unit was originally rated to deliver 7,500 gals. of water a minute at 150 lbs. pressure. In their worn condition, however, and in forcing water against a 100-ft. rise to the level of excavation, they will be counted on to furnish water at the monitors under pressure of from 80 to 85 lbs. to the square inch.

The pipe line from the station to the top of the slide on the north side of Gold Hill is approximately a mile in length. It reduces in diameter from 40 to 32 and 24 ins., and is laid with only one elbow. When the excavation is extended toward Cucaracha slide an electrically driven "booster" pump is to be installed on the northeast side of Gold Hill at elevation plus 425 ft., 200 ft. above the pumping station. The approach to Cucaracha slide will be made through a saddle between the main part of Gold Hill and an adjacent knob.

A force of about 200 men is engaged in the preparatory work of erecting the station, laying and riveting the pipeline, constructing flumes, clearing and drilling. The pumping plant and machine shop are close to a spur extending from the relocated Panama R. R. to the Obispo Diversion track, and additional tracks render the area accessible to trains and locomotive cranes for the handling of heavy parts. Water and compressed air for construction purposes are delivered from connections with the Culebra Cut service. The foundation for a fuel oil tank to hold 1,000 bbls. is laid near the station. It is proposed to have a section of the Government's permanent transisthmian oil line laid along the relocated railroad, from the pumping station to Paraiso in time for the sluicing operations and to make connections at Paraiso with the line of the Union Oil Co. It is expected that sluicing will begin about the middle of June, by the time the rainy season flow of the streams has accumulated a sufficient reserve supply of water at the pumping plant.

Cost of Pulling Small Trees with a Traction Engine.

Contributed by F. Hutchinson, Civil Engineer, Carthage, Mo.

A field of about 60 acres had been neglected for many years and was covered with a scattering growth of small trees, varying from saplings 1 in. in diameter to young trees having a diameter of 7 or 8 ins. It was desired to clean up this land as cheaply and also as quickly as possible.

The owners of the land had a gasoline-kerosene traction engine of 45 BHP., and with this I determined to attempt to pull the saplings out bodily, without the aid of falls or snatch blocks. A ⅝-in. Norway iron chain 30 ft. long was also available. One end of this chain was attached to the draw bar of the engine by means of a clevis, and the other end was given one and one-half turns around the tree to be pulled, and the end of the chain made fast with a grab hook. The first trees attempted were about 3 ins. in diameter, of persimmon, elm and black jack, all well rooted. Taken one at a time, they pulled out without great difficulty. I next tried the experiment of pulling two trees with one hitch by taking two turns of the chain about the first tree and leading the chain back to a second. This proved feasible, and the plan was extended as experience was gained to as many hitches as were permitted by the length of chain available, when the trees were not too large.

For the larger trees, 4 to 8 ins., a single pull to each tree was taken. We quickly learned to make the hitch as high above the ground as practicable, and a block of wood, 8 or 10 ins. in diameter by 4 ft. long, was thrown on the ground against the tree and directly under and at right angles to the chain. This bearing acted as a fulcrum when the tree was bent over by the pull, and served to bring a very powerful pull on the roots remote from the engine. In the case of a few 8-in. black locusts, a man stood by the tree with an axe and struck off the roots remote from the engine as the pull indicated their location. This process materially assisted. It was found that the most satisfactory results were secured with the larger trees when the hitch was made at a height of from 3 to 5 ft. above the ground.

The engine, as stated above, was a gasoline-kerosene engine having four vertical cylinders and rated at 45 BHP. The engine ran continuously, and the power was transmitted through an efficient friction clutch. The engine was reversible and could be reversed from forward to backward motion in 5 seconds. This feature was of value in providing slack in the chain immediately after a pull, and in backing down for the next hitch.

It was found necessary to use the full length of the 30-ft. chain in pulling the trees 4 ins. in diameter and over, as the tops often came down directly towards the engine with a vicious crash. The most efficient procedure was found to consist in running the engine at full speed and to bring the tractor against the load slowly until the pulling chain became taut, then suddenly to bring the full power of the engine against the pull by means of the friction clutch.

Owing to the intermittent character of the loading it was found impossible to obtain satisfactory results with any fuel but gasoline. The fuel consumption was quite low for the reason that very little was consumed except at such times as the tractor was actually making a pull.

The following is a statement of the expense attending the cleaning up of this field, careful count being kept of every tree pulled. Everything smaller than about 3 ins. was cut down with the axe, but there were not a great number of these and they are not included in this statement.

COST OF PULLING 1,246 SMALL TREES, 3 INS. TO 8 INS. IN DIAMETER.

108 gals. gasoline at 14 cts.	$15.11
Lubricants	2.32
One engine man 4 days at $3	12.00
Two laborers 4 days at $1.75	14.00
Charge for use of engine 4 days at $5	20.00
Total	$63.43
Average cost per tree for pulling	0.0509

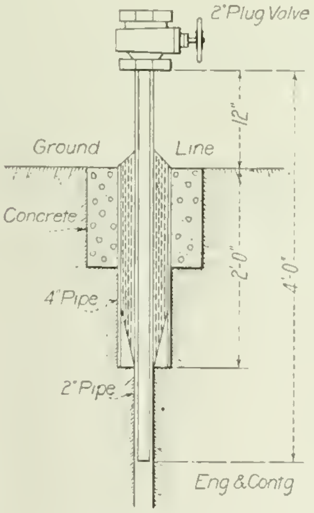
The trees were removed by teams, which chained them to a deep gully, into which they were rolled without further handling. The cost of removing trees was:

Two teams 3 days at $3	$18.00
Average per tree	0.014

The total cost of pulling and removing was $0.0649 per tree.

Method of Sealing Grout Pipes in Tops of Drill Holes in Grouting Fissured Rock Foundations.

In preparing foundations for the Freemantle Dry Dock in Australia grouting was employed to consolidate a subaqueous sandstone which was much fissured and contained many cavities. Figure 1 shows the construction adopted for sealing the grout pipes into the tops of the drill. A hole was started into which a 4-in. pipe 18 to 24 ins. long was sunk and keyed by a cube of concrete. The hole was drilled through this 4-in. pipe, and afterward it served as a socket into which to seal the 2-in. grout pipe 3 ft. long. The portion of the grout pipe filling into the 4-in. pipe was roughened and wound tightly with strips of soft bagging. The winding was done so that the bandage or wrapping of both had a tapered or top-like shape smallest at the bottom. When wound with twine and tallowed the grout pipe with its cloth wrapping was hammered into the 4-in. pipe. This seal showed no leakage under a pressure of 75 lbs. per square inch. This description is taken from the paper "Freemantle Greuing Dock," by J. F. Ramsbotham, Proceedings American Society of Civil Engineers, Vol. xxxix, p. 215.



Method of Sealing Grout Pipe Into Top of Drill Hole.

The New 1,000-Cu. Yd. Dump Barges for Panama Canal Maintenance.

An order has been forwarded to Washington for six dump barges with a capacity of 1,000 cu. yds. each, to be used in Panama Canal service in connection with the recently ordered 15-cu. yd. dipper dredges. They are to form part of the dredging equipment for use in emergency work in the Culebra Cut section.

The largest barges now in the Canal service have a capacity of 500 cu. yds. each. The new barges are to be of heavy construction, suitable for rough service, and will be rectangular in design, with a rake at each end. Each barge is to be 160 ft. long, with depth, molded, of not more than 13 ft. 6 ins., and is to have a 30-in. freeboard when fully loaded.

The hoppers are not to be more than four in number to each barge, with a minimum width of 12 ft. at the bottom and are to be provided with doors opening to their full size at bottom. The sides are to be framed with not less than 6 by 3½ by ⅜-in. angles, spaced 24 ins. from center to center, made of steel plates weighing 22.95 lbs. to the sq. ft., and lined throughout with 6 by 8-in. yellow pine timbers set on end to prevent injury to the hoppers when loading rock. The hopper doors are to be of wood 10 ins. thick, lined with steel plate. They are to be dropped by manual power and lifted by steam, or other approved method, the mechanism to be located on one side of the hopper.

The bulkheads forming the ends of the hoppers are to extend entirely across the barge frames to floor deck and side beams, and are to be made of steel plate weighing 12.7 lbs. to the sq. ft. There is also to be a watertight bulkhead at each end of each rake, and in the space forward and aft of the hoppers there is to be a central longitudinal bulkhead of steel plate weighing 10.2 lbs. to the sq. ft. In addition, there are to be two long lattice trusses, one on each side, midway from the center bulkhead to the side of the hull.

The deck beams are to be of 5 by 3⅛-in. Z-bars, spaced one on each frame. The hull plating will weigh 22.95 lbs. to the sq. ft. and the side plates not less than 18 lbs. to the sq. ft. The deck is to be of checkered steel about 7/16 in. thick.

Large Locomotive Crane.—The United States Government has recently placed an order with the Browning Engineering Co., Cleveland, O., for one 50-gross ton locomotive jib crane, to be delivered within nine months at the Brooklyn navy yard. The crane will have a maximum radius of 123 ft., at which point it will lift 15 gross tons to a height of 83 ft. At 85 ft. it will lift 40 gross tons, and at 70 ft., 50 gross tons. The main boom will have an auxiliary boom on the end, controlled with machinery and counterweights, on the body of the crane. The weight of the crane will be about 500 tons. It will be mounted on 16 wheels 30 in. in diameter, with rolled steel double flanged tires, keyed to the axles. The wheel gage is 18 ft., and the base 29 ft. 9 in. The crane will travel 120 ft. per minute, and will make a complete revolution in 2 minutes. The boom will be hoisted by 30 parts of 1-in. plow steel rope. The navy yard will use the crane for handling the "waste basket" cage masts of battleships in one piece, instead of dismantling, as heretofore, and handling in sections. The Government estimate for this crane was $50,000.

Summer School at University of Wisconsin.—Announcement is made of the annual six weeks' summer school of the College of Engineering, Wisconsin University, Madison, Wis., which opens June 23. Courses of instruction and laboratory practice are offered in electrical, hydraulic, steam and gas engineering, mechanical drawing, applied mechanics, testing of materials, machine design, shop work and surveying, in addition to which subjects may be taken in the College of Letters and Science.

ROADS AND STREETS

Highway Maintenance Costs in Foreign Countries.

(Staff Article.)

Congress at its last session in 1912 created a joint committee to investigate the question of Federal participation in road improvement in the various states. In connection with its study of the subject Jonathan Bourne, Jr., chairman of the committee, had tables prepared showing data regarding the highway systems of the leading foreign countries and statistics bearing upon Federal aid in highway improvement in the United States. The information was compiled and tabulated by Mr. A. W. Prescott and Mr. J. E. Pennyback, secretary and statistician, respectively, of the committee. A revised print of these tables has been issued recently, and to this we are indebted for the matter in this article.

Table I shows the population, area and mileage of roads in 19 countries.

TABLE I.—POPULATION AND ROAD MILEAGE.

Country.	Population.	Population per square mile.	Area, square miles.	Total mileage of all roads.	Miles road to square miles area.	Population per mile of road.
Australia (New South Wales).	1,700,000	5.47	310,400	69,191[1]	0.223	24.56
Austria	28,568,000[2]	246.50	115,903	74,264[3]	.641	385
Belgium	7,074,910	622.07	11,373	....	.....	...
Denmark	2,586,000	168.00	15,388	26,718	1.724	75.5
England and Wales	36,075,000	615.88	58,575	150,908[4]	2.571	239
France	39,252,000[3]	189.50	207,054	363,772	1.75	108
Hungary	20,851,000	166.00	125,430	31,800[2]	.253	655
Ireland	4,381,951	135.35	32,373	56,811	1.755	77.13
Italy	34,270,000[3]	310.00	110,550	92,199[2]	.834	371
Japan	53,875,390	364.88	147,655	257,378	1.743	210
Netherlands	5,898,429	466.25	12,648	....	.....	...
New Zealand	1,100,000	10.50	104,760	....	.....	...
Norway	2,303,000	18.50	124,129	19,955	.161	115.4
Russia	160,095,000	18.50	8,647,657	11,254[5]	.....	...
Scotland	4,759,521	156.74	30,443	22,691	.745	210
Spain	19,503,008	100.12	194,783	33,873[2]	.174	575.8
Sweden	5,477,000	31.68	172,876	35,450[6]	.205	154.5
Switzerland	3,742,000[2]	234.20	15,976	7,426[7]	.465	504
United States	91,972,266	30.90	2,974,099	2,199,646	.739	41.81

[1] 1912. [2] 1910. [3] 1909. [4] 1909-10. [5] Post roads only. [6] 1907. [7] 1911.

The highways of Australia (New South Wales) are divided into two administrative classes: roads of western division, controlled by the government, and roads of eastern and central divisions, controlled by shires, corresponding to counties in this country. There are 6,290 miles of roads of the first mentioned class, the average cost of construction of which ranged from $972 to $9,720. The average cost of maintenance of these roads ranges from $48 to $1,215 per mile. The roads controlled by the shires amount to 62,901 miles. Of the total road mileage of the country, 10,929 miles are metaled; 8,477 miles formed and cleared; 22,507 miles cleared; 27,278 miles in natural condition.

The road mileage of Austria is divided into the following administrative classes: government roads, 10,008 miles; provincial roads, connecting districts of large area, 2,288 miles; district roads, connecting towns or leading to larger roads or railways, 39,212 miles; town roads, which include all other roads, and such streets as do not form part of other roads. The average cost of maintenance of the government roads was $310.69 per mile. These roads are macadam and telford; tar is now used as a binder. The average width of traveled way is 12 to 16 ft. and there are 2-ft. walks on each side; most improved roads are 18 to 20 ft. wide. The national government has complete supervision of construction and maintenance on government roads. New construction is let to contractors under government engineers, but maintenance and reconstruction is done by each government unit as province, district, and town. The organization consists of district engineers, each in charge of 74.56 miles of road, road masters each having 24.86 miles of road and who supervise road crew, the latter working about 2.81 miles of road. About 4,000 men are employed. The engineers receive $400 to $600 per year and travel allowance; road masters, $150 to $200 and $3.27 per mile; road keepers $12 to $15 per month with rent allowance of $1.60 to $2 per quarter and increase of $2 per month salary after 6, 12 and 18 years' service.

The roads of Belgium are divided into three administrative classes: state roads, those running from capital to frontiers and connecting principal towns; provincial roads, and communal roads. The state roads amount to 5,090 miles, and the average cost of construction has been as follows: Paving, $1.65 to $1.85 per square yard; macadam surface, $0.85 to $1.03 per square yard. The highway administration system consists of the Department of Public Works, which has under it in each province a chief engineer, under whose orders are an engineer in each judicial ward and a superintendent in each district. The contract system is quite extensively followed, not only for construction but also for maintenance.

In Denmark the roads are divided into two administrative classes: Highways, those roads administered by county councils, and by-ways—roads administered by parish council. Of the first mentioned class there were in 1910 4,200 miles, the cost of construction of which ranged from $1,295 to $8,631 or more. These roads were macadam with a gravel surface, and the average width of traveled way was 12½ ft. The average cost of maintenance was $166.21 per mile. In 1910 there were 22,505 miles of by-ways, most of these being gravel roads. The average cost of maintenance of these in 1909-10 was $42.58 per mile. The main roads are maintained by patrolmen, each man covering 2½ miles. These men receive about $125 per year.

The roads of England and Wales are divided into two administrative classes: main roads and roads other than main roads. The first class comprise the arterial roads from one great center to another, but not all such roads have been declared main roads. In 1909-10 the mileage of main roads was 27,828; the mileage of other roads was 123,082. The main roads are of telford and macadam construction; lately a large mileage has been treated with bitumen. The average cost of maintenance of main roads in 1909-10 was $389 per mile; this does not include urban roads and streets. The average cost of maintenance of the other roads, excluding urban roads and streets, was $112 per mile. In general, contracts for new construction and maintenance are made annualy, and are approved by the county council and made part of the yearly budget.

The roads of France are divided into three administrative classes: National roads, those connecting Paris with frontiers, principal cities and ports; department roads, those connecting chief towns of the departments; and vicinal roads. The latter class is subdivided in (1) roads of through travel, (2) roads of common interest (both of them usually traverse several townships), and (3) ordinary vicinal roads—situated within a single commune. The mileage on Jan. 1, 1911 average cost of construction per mile, and average cost of maintenance in 1910 of these roads were as follows:

	Mileage.	Av. cost per mile.	Av. cost maintenance per mile.
National roads.....	23,756	$12,400	$284.69
Department roads..	8,161	7,750	165.65
Vicinal roads (1)...	107,049	6,200	120.58
Vicinal roads (2)...	47,256	3,750	102.56
Vicinal roads (3)...	177,550	2,470	49.10

Of the national roads of France 1,450 miles are paved, and 9,000 to 10,000 miles are telford. The balance are macadam. The roads were treated lately with bitumen. The other classes of roads are mostly macadam. The average width of traveled way for the various classes of road is: National roads, 16½ ft. to 23 ft.; department roads, 15 ft. to 19½ ft.; through travel vicinal roads, 13¼ ft. to 16½ ft.; "common interest" vicinal roads, 10 ft. to 15 ft.; ordinary vicinal roads, 10 ft.

The highway administrative organization of France includes 12 inspector generals, first class; 16 inspector generals, second class; 74 chief engineers, first class; 34 chief engineers, second class; 209 ordinary engineers; 403 sub-engineers; 1,715 conductors; 1,595 clerks; 34 student engineers; (1909) 8,560 patrolmen, average 2.8 miles. The engineers do all the engineering on public works and not merely that relating to roads. The salaries paid per annum are: Inspector generals, first class $3,377.50, second class $2,798.50; engineers in chief, first class $2,316; second class $2,123; ordinary engineers, first class $1,351; second class $1,158; third class $965; sub-engineers, first class $868.50; second class, $792; conductors, 5 grades, from $386 to $694.80; clerks, 6 grades, from $231.60 to $482.50; engineer students, $347.40; patrolmen, average $19 to $21 per month for 10 months.

The road system of France is practically complete and the particular roads on which the government funds are expended have for the most part been determined long since. The total annual expenditure on public roads in 1910, was $46,513,000; expenditure on national roads, 1910, $7,527,000; subsidy to department and communes, $1,930,000; expenditure by departments, 1910, for departmental roads, $1,351,000; expenditure by departments and communes for all other roads: construction, $5,790,000; maintenance, $29,915,000. Total expenditure on national roads, 1801 to 1900, for construction and extraordinary repairs was $102,904,000; maintenance same period, $337,750,000; total cost of constructing entire French system, estimated by M. de Puligny, $1,663,000,000.

The administrative classes and mileage of each of the roads of Hungary are as follows: Government roads 5,600 miles; county roads, 17,400 miles; district roads, 8,100 miles; parish roads, 700 miles. The government roads are surfaced with telford and macadam; the first mentioned type has largely superseded macadam (1909-10). The average cost of maintenance of the government roads was about $282 per mile exclusive of bridges.

The roads of Ireland are classified as main roads and district roads. The average cost of the main roads has been $0.36 to $0.96 per square yard, or $3,168 to $8,448 per mile for a 15-ft. road. The average cost of maintenance was $68.15 per mile.

The administrative classes and mileage in 1910 of the roads of Italy were as follows: National roads, 5,159 miles; provincial roads, 27,757 miles; communal roads, 59,283 miles. The average cost of maintenance of the national roads in 1909-10 was $274.70 per mile; on provincial roads the average maintenance cost (Jan. 1, 1909) was $183.32 per mile; the average maintenance of communal roads in 1904 was $55.55 per mile. In 1904 there were 2,049 patrolmen employed on national roads; one to every 2¼ miles.

In Japan the roads are classified as national, prefectural and township. Of the first class there are 5,233 miles of an average width of traveled way of 23.86 ft. There are 21,992 miles of prefectural roads, the total widths ranging from 23.86 to 29.82 ft. The township roads amount to about 230,143 miles. A permanent force of laborers is maintained by each prefecture for maintenance of national and prefectural roads.

The roads of the Netherlands are divided into two administrative classes: state roads and provincial and other roads. The state roads are surfaced with brick, cobble, crushed stone or gravel, the average costs of construction being about as follows: Brick paving, 85 cts per square yard; cobble, $1.85 to $2.35; stone mixture, 57 to 70 cts.; gravel, 47 to 50 cts. The following are selected examples of the cost of maintenance: North Holland (brick), $340 per mile; Zeeland (brick and cobble), $214 per mile; South Holland (gravel), $165 per mile; North Brabant (stone), $198 per mile; Friesland (brick), $81 per mile; Drenthe (brick), $147 per mile.

The highways of New Zealand are classified as main roads and by-roads. The former are 20 to 40 ft. wide in flat country and 16 ft. wide in side hills. The cost varies from $121.66 to $3,893.20 per mile. The average prices for earth excavation are 24 cts. per cu. yd.; rock, 60 cts.; crushed stone. $1.46 per cu. yd., and hauling one mile costs 48 cts. per cu. yd.

In 1910 there were 7,794 miles of main roads and 12,161 miles of district roads in Norway. The main roads are constructed of modified telford and gravel, have a 13 to 15-ft. width of traveled way, and cost $4,312 to $12,938 per mile. The district roads are constructed mostly of gravel; they have a 8 to 12-ft. width of traveled way and cost $1,294 to $4,313 per mile. The average cost of maintenance of these roads ranges from $12.95 to $129.50 per mile.

The 11,254 miles of main roads (post roads) in Russia are for the greater part surfaced with macadam, although some sections are paved. The roads cost from $8,544 to $10,874 per mile ($0.94½ to $1.39½ per sq. yd.). The average cost of maintenance has been from $70 to $210 per mile, or 1 ct. to 2cts. per sq. yd.

The average cost of maintenance based on entire mileage of roads in Scotland has been $121.62 per mile. In Spain the highways are classified as state roads. First class roads, second class, third class and provincial. The average cost of construction of state roads ranges from $3,456 to $10,080. The state roads are macadamized and have a total width of 26, 23 or 20 ft. The average cost of maintenance of these roads is at least $230.40 per mile. The average appropriation in 1912 for maintenance was $93 per mile.

The road mileage of Sweden is classified as follows: Main roads, 11,850 miles; district roads, 23,600 miles. These figures are for 1907. The main roads are generally surfaced with gravel except in the vicinity of large cities where broken stone is used. The width of traveled way is 8 ft. to 12 ft. The average cost of maintenance in 1907 was about $60 per mile for all roads.

Switzerland in 1911 had approximately 7,420 miles of road of which 4,302 miles were post roads. The administrative classes and mileage were as follows: Federal Aid—Canton roads, 350 miles; Canton roads, 862 miles; municipal roads 6,214 miles. The first mentioned class of roads is largely gravel with telford foundation, and a width of traveled way of 14 to 16 ft. The average cost of 11 roads of this class was $15,000 per mile. The average cost of maintenance computed for Zurich, Berne and Vaud was $144 per mile.

Municipal Asphalt Plant for Los Angeles.—A small municipal asphalt plant will be installed by the city of Los Angeles, for turning out the surface mixture necessary to repair the city's asphalt pavements. It is planned to purchase a portable plant and install it on a site adjacent to the municipal incinerator. The waste steam from the incinerator will be used to operate the plant, and sufficient sand can be obtained on the ground. There is a railway side-track which can be used for shipping supplies. A corrugated iron building and bins for asphalt, etc., will be constructed. The estimated cost is about $5,000.

Instructions for Building State Aid Roads in Wisconsin.

The Wisconsin Highway Commission, of which Mr. A. R. Hirst is the State Highway Engineer, has issued recently a bulletin of instructions for the guidance of county highway commissioners and foremen in the building of state aid roads. The following notes have been taken from these instructions:

PREPARING FOR SURFACING.

Width of Surface.—Practically all surfaced roads will be built with a stone or gravel surface, 9 ft. wide, which experience in Wisconsin has proven to be ample for 90 per cent of even the main traveled roads. This width usually arouses some antagonism in a community until they have traveled the road for a few months, but if properly built and not humped up in a "hog back," the prejudice soon wears away and the people think the road "wide enough but not long enough." The 9 ft. road has won its way until it is the standard width in practically every county in Wisconsin which has been building much modern stone or gravel road. It will win out in the new counties as well if it is given a fair trial.

Roads near cities or villages with very heavy traffic will be built 14 or even 16 ft. wide. If plans are sent out for a 9 ft. road and you or the town board think it must be wider to accommodate the travel, take the matter up with the commission. But remember always that even the dirt shoulder of a new road will probably be better at all times than the old road ever dared to be.

Laying Out Subgrade or Trench.—These remarks as to subgrade apply equally to all surfacings, whether stone, gravel or shale. Starting at the desired point, set two stakes opposite the reference stake, the distance between them being the width of the new road. To do this, refer to the grade sheet, which gives the distance from the side stake (placed when the survey was made) to the center of the new road. Subtract from this distance one-half the desired width of road and put in a stake with inside edge at this distance from the reference stake. Opposite this stake place another with its inside edge distant the width of the road from the inside edge of the first one. All stakes for subgrade should be made of ½ in. round iron about 24 ins. long, and about 25 should be kept on each surfacing job.

Stake out 700 or 800 ft. at a time. Be sure that the stakes are in line, except at bends or on curves. Usually curves will have to be staked out by eye to get good results.

Plow Work.—With a road plow cut as close to the inside edge of stakes as possible without disturbing them, turning the furrow toward the center of subgrade. Plow about 5 ins. deep. One furrow on each side is generally sufficient. Plow should be equipped with shoe or wheel and coulter. If a rooter is used, three furrows on each side will usually be necessary. Make first cut about 5 ins. deep as close to stakes as possible, the next 6 ins. nearer the center of the road. Drop the shoe down so rooter will run about 3 ins. deep for the third cut, working 6 ins. nearer center of subgrade than previous furrow.

Grader Work.—A light grader that can be handled with two horses is best. Use with the blade so set as to move the plowed ground from the center of trench or subgrade on to the bank outside of stake line. This work cannot be accomplished neatly with the grader alone, as some of the earth will roll back into the trench under the best of conditions. Make the trench deep enough. The depth at the sides should be at least the total loose depth of the two courses of material and more than this on sandy soils. It is much easier to throw out excess material with the road grader after the surface is laid than it is to bring extra material up from the ditches or to haul it in by wagons during the finishing when the trench has not been made deep enough to hold the stone. Nothing is more essential than a good solid shoulder, and the time to get it is before material is placed in the trench. In clay soils after making the trench, plow drains through the shoulders every 50 ft. on both sides and every 25 ft. at low points between hills.

The following procedure is not advised, as it is usually the most expensive way of getting shoulders. If the road has once been covered with crushed stone or gravel, and it is not desired to tear up the old surface, shoulders can be brought up to the stakes by bringing in dirt with the road machine from the side banks or from the ditches (if the latter material is fit to use), or it can be hauled in with wagons. If the old road has a crown of 1 in. to the foot, it will take approximately 1,100 cu. yds. of compacted material per mile to build up 6 in. shoulders and retain the minimum width of 20 ft. on top. The cost of hauling and placing this material is usually very much greater than the value of the stone or gravel saved. As a matter of fact, no material is wasted if the subgrade or trench is cut in the old surface, the stone or gravel thrown out, making an excellent shoulder. Failure is inevitable if an attempt is made to build a gravel or stone road with a heavy roller without first getting proper shoulders to support the material while it is being rolled.

Hand Work.—Straighten up stakes and drive them firmly. Tie a chalk or binder twine line to stakes on each side so line will draw on inside faces of stakes, drawing it tight. It is usually best to put in additional stakes at 50 ft. points so this line will not sag. These lines are to guide the laborer in trimming the shoulders so the edges will be straight and the grade uniform. On a 9 ft. road, if these lines are set 7 ins. above center of subgrade, they will be 1 ft. higher than the bottom of trench at the shoulder. On a 14 ft. road set lines 5 ins. above center of subgrade. They will be 1 ft. higher than the bottom of trench at the shoulder. The blade of an ordinary square point dirt shovel is 1 ft. long and can be used by the laborer to tell when trench is deep enough at sides by setting blade of shovel up to line.

Rolling Subgrade.—After the subgrade has been properly shaped to the same crown (or, better, a slightly greater crown) than the finished road is to have, it should be rolled until hard, especially if recently filled. Any hollows that develop during the rolling should be filled. Roll enough, but stop when the top layer of earth starts to slip. Wet spots in the subgrade should be shoveled out, filled with good earth or cinders and rolled. Don't leave sink holes with the expectation of filling them with crushed stone. They must be refilled with clean material if a good surface is to be gotten at that point.

Table I gives the number of linear feet of 9 ft. road a load of a given size should cover for various loose depths

TABLE I.

Weight of Load. Granite. Lbs.	Weight of Load. Limestone. Lbs.	Size of load. Cu. yds.	Loose depth in inches 3 ins. Ft.	Loose depth in inches 4 ins. Ft.	Loose depth in inches 5 ins. Ft.	Loose depth in inches 6 ins. Ft.
2,800	2,500	1	12	9	7.2	6
3,500	3,125	1¼	15	11.25	9	7.5
4,200	3,750	1½	18	13.5	10.8	9
4,900	4,375	1¾	21	15.75	12.6	10.5
5,600	5.000	2	24	18.	14.4	12
6,300	5,625	2¼	27	20.25	16.2	13.5
7.000	6,250	2½	30	22.5	18	15
7,700	6,875	2¾	33	24.75	19.8	16.5
8,400	7,500	3	36	27	21.6	18

Weights of Material.—When buying by weight, to find the amount required, estimate that limestone weighs 2,500 lbs. per cubic yard; granite and quartzite 2,800 lbs.; unscreened gravel or sand 3,000 lbs., and crushed gravel 2,650 lbs. Finer crushed sizes will weigh more than coarse sizes. The above averages the three sizes commonly used if they are dry. Screenings, sand and gravel are often shipped wet and will then weigh far in excess of the above.

Spreading.—The simplest and most satisfactory way to spread stone accurately to a definite depth is to know how many cubic yards are in a load, and figure from the foregoing table how many feet of road it should cover to the depth required, and to spread it over that many feet and no more or no less. It is much the most convenient to have all loads hauled the same size, in which case the spreader can measure accurately just how to dump-each load. To find the capacity in cubic yards of a wagon, multiply the inside length by the width and then by the height (all in feet) and divide by 27.

Daily Output.—For macadam roads, much of the stone will be locally crushed, usually with portable jaw crushers. The screen should be in two sections 4 ft. long, 30 ins. in diameter, the first section with perforations ½ in. in diameter, and the second with perforations 2 ins. in diameter. The bin should have three sections with a total capacity of not over 25 tons, and should be portable.

Arrangements for stone supply to the crusher should be such as to permit crushing not less than 75 cu. yds., and preferably 100 yds. per working day. A daily output of less than 75 yds. means an expensive job.

On roads of crushed stone or on any road where a roller is at work all the time, the crusher and roller must work to capacity if the road is to be built cheaply. On these roads at least 75 cu. yds. of surfacing material should be placed each day, and if possible even more should be placed, up to 100 cu. yds.

When a one course gravel road is built and the roller finishes it later, speed is not so essential, but on every road there is a certain fixed job cost and daily cost which is the same whether much or little material is placed daily. The most economical road is always the one built in the least working days. Work gangs of such size that they can produce a good output each day.

First Course.—(No. 1 stone usually 2 in. to 3½ in. in size, usually spread to a loose depth of 5 ins., never more than 6 ins. and seldom less than 4 ins.)

The first course of rock or gravel can now be dumped on the subgrade and spread to the required thickness with rakes and shovels, after which it is to be rolled until it is packed firm and hard and there is no movement under foot as you walk on it. On very sandy soils, to keep the sand from working up through the stone, place a fair covering of clay, marsh hay, hay, straw or weeds (good in the order named) before placing any stone. Shoulder trenches should be filled with the No. 1 stone so as to make blind drains. Cover this with sods, grass side down, or with hay or straw to keep dirt from clogging the water course. Care should be used in rolling the first course to keep the roller in the trench and not to overlap the stone and crush the shoulders. Roll from outer edge toward center. Clay or screenings are seldom necessary on the first course. Place about 200 ft. of first course stone before starting to lay No. 2. No. 1 bin does not usually hold this much, but No. 2 stone can be put in the bottom course until the first course is laid 200 ft. ahead, provided the two sizes are kept in separate strips, laying say the first 125 ft. of No. 1 and then starting with No. 2. Some prefer to pile the No. 2 until the No. 1 is far enough ahead and use it when the end of the work is reached.

It takes a good man to make a good spreader. Much of the looks of the road depends upon his work and much of the money available can be wasted by a careless workman who doesn't spread to the depth required. Check the loose depth of the stone often and see that he is spreading each load to the proper distance.

Harrowing.—Although not much used in Wisconsin, many highway engineers claim that a good stout spike-toothed harrow is a necessity in properly compacting stone and gravel, and that a large part of the rolling of the two first courses can be saved by thorough harrowing after spreading.

Second Course.—(No. 2 stone, usually ½ in. to 2 in. in size; usually spread to a loose depth of 4 ins., never more than 5 ins., seldom less than 3 ins.)

The second course of stone is now hauled on top of the first and spread evenly to the depth called for. This course is rolled commencing on each outer edge with the rear wheel half on the stone and half on the shoulders and rolling toward the center. The roller should be run over this course a number of times until the stone or gravel is brought to shape and fairly well compacted before screenings or dust is applied. All low places that have shown up should be filled with No. 2 stone and high spots raked down so that the surface presents a smooth, even appearance.

Third Course or Screenings.—(No. 3 stone, usually from dust to ½ in. in size. Not necessary in pit run gravel or shale roads.)

Screenings may be hauled at any time after subgrade has been finished. Dump in piles with inner edge about 2 ft. from edge of trench or subgrade. Never dump screenings on the second course. If a cubic yard is dumped in one place, the piles should be about 30 ft. apart for a 9-ft. road, or about 20 ft. apart for a 14 ft. road. A cubic yard of screening under ordinary conditions will cover about 275 sq. ft. of surface. Use a square point dirt shovel to apply screenings. Put them on very thinly with a quick sweeping motion, working from one end of the road toward the other. Keep roller running constantly while putting on the screenings. Repeat this process until all voids between stones are filled. Roll until stone stops moving and the surface is hard, and all second course stone slightly covered with screenings. It is necessary to bind quartsite or granite with limestone screenings or clay. If clay is used, apply it dry a little at a time, and after the voids are well filled and the road is rolled, cover the surface with screenings, preferably with the dust screened out. Don't use too many screenings—just enough to nicely cover the road at all stages is just right. Too many screenings simply allow the road to rut more easily.

Flushing.—With the stone covered with screenings the road is ready for water. On clay soils trim down shoulders with road machine before applying water to prevent too much mud at sides. Don't try to finish over 400 ft. of road at one time. It will dry out before you get it soaked. It is customary to finish up each night or every other night the road ready for finishing. If screenings stick to tires, scrape them or keep them well wet or both. Sprinkle road until screenings are thoroughly soaked and tires run clean. When road is wet enough, follow sprinkler with roller. If screenings pick up on roller wheels, stop rolling and apply more water. Keep roller as close to sprinkler as possible. If bare spots or holes appear, put on enough dust to cover them. Sprinkle and roll until water is continually carried along in front of the roller wheels, at every point of the road being flushed. Road is then finished. Pit run gravel roads are flushed in about the same way, but must be very wet when rolled or quite dry. A rainy day is the best time to finish a road. Never have more than 1,000 ft. of unfinished road on your hands. Keep the work compact and finish as you go.

Trimming Up.—After the road has dried sufficiently, use a road machine to smooth off the shoulders to proper slopes. Trim shoulders so water can get from center of road to ditches at every foot of the road's length. Remove all surplus material. Roll shoulders as far out as is safe to take roller. Road is then finished and can be thrown open to travel. Whenever the ground permits, it is a good plan to smooth off and widen one or both of the ditches so as to permit teams to use them as a dirt road in dry weather and as snow roads.

Slag in Highway Construction.

There is produced annually in the United States over 10,000,000 tons of blast furnace slag. Up to about 10 years ago this was considered a worthless or waste product. In the last few years, however, attempts have been made to use this slag in various ways; such as casting the molten material in moulds to form bricks or slabs for street pavement, in crushing and screening the slag after cooling to prepare ballast for railroads and in using the properly sized material for building roads. The last mentioned use of slag was the subject of a paper presented on April 25 before the National Good Roads Federation at Birmingham by Mr. Solon Jacobs, President ot the Birmingham Slag Co. An abstract of this paper follows:

Slags are the fused compounds of silica, lime, alumina, magnesia and other bases and result as a molten by-product in the reduction of metallic ores. Slags from the different processes of reduction vary widely in chemical composition.

In modern manufacture slags from similar plants are chemically uniform, being carefully analyzed and kept so from necessity. But slags, even though the same chemically in the molten state, are changed to vary widely in physical characteristics by the treatment received during the cooling process. This treatment is of the utmost importance, since on it depends the fitness and value of slag as a structural and building material.

Fortunately for this section of the country, there is no congestion and consequently no lack of dumping ground, and our slags are carried in molten state to high banks and dumped therefrom, causing the slag to run in thin layers and by such action the material is slowly air cooled. Such cooling gives a tougher product, and one less filled with air cells, as is often found in slags improperly treated. Nearly all, if not all, of the slag produced in the south, by reason of the disposal above mentioned, gives us hard, tough, compact and impervious slag product.

The reason that slag produced from iron furnaces must, from necessity, be more or less uniform in chemical composition, is due to the fact that the furnace operators strive to produce primarily high grade foundry iron, and the character of such iron can always be determined by the character of slag produced; hence a more or less uniform slag produce is always sought, and the furnace companies analyze all slag in order to keep the same uniformity, as much so as they do the iron. Consequently the variation in the chemical contents is small. An average taken from a large number of slag analyses shows the following:

Silica	35.90
Lime	43.40
Alumina	13.38
Magnesia	3.84
Sulphur	1.19

To correctly construct a highway, proper excavation should first be made and the subbase thoroughly well rolled with a roller of at least 10 tons in weight. This should be done no matter what kind of base material is used. However, in the construction of slag road, in order to obtain the very best results —and I would recommend no other method— it is necessary that the loose slag be spread on the sub-base to a proper depth, and then thoroughly rolled from time to time as the loose slag is being spread on the road.

During such procedure it is recommended that the road be kept well wet with water, if water is available, and in finishing it is only necessary to put on the top of the slag base, about 2 ins. of slag screenings, which contain dust and slag particles as large as ⅛ in.

This likewise should be thoroughly wet and well rolled. In fact, the top should never be put on except with plenty of water and thoroughly rolled. This is necessary because of the natural cementing qualities of slag and in order to get it properly bound, this material must be rolled to eliminate as many voids as possible.

A slag road built under these specifications will gradually improve until the entire roadbed becomes a solid mass.

The advantages of the use of slag in building highways may be analyzed as follows:

It is a natural cement rock.

It will cement together if properly compressed by wetting and rolling.

It is as a rule vastly cheaper than any other road material.

It is available in large quantities, and at all times regardless of weather conditions.

It is practically an impervious material.

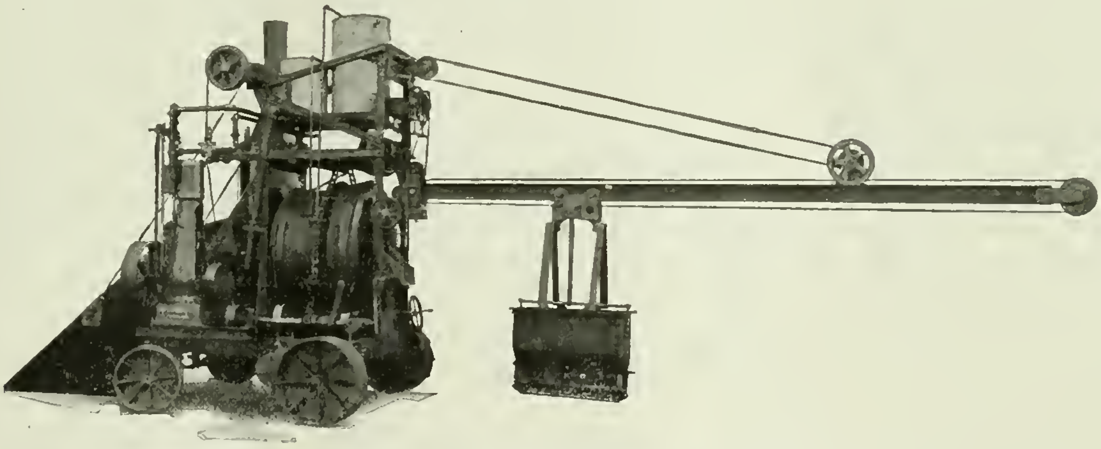
It is considerable lighter in weight than stone or gravel, consequently a great saving in freight is effected where distances are equal.

A Special Concrete Mixer for Concrete Road and Pavement Base.

(Staff Article.)

The essential features of a good mixer for concrete road and pavement base work is that it shall be easily moved along the work, capable of being readily charged from roadside stock piles, and provided with simple and fast mechanism for distributing the mixed concrete. In the special street mixer illustrated in the accompanying cut a reversible traction drive is provided so that the mixer can be moved forward or backward by its own power. The traction drive is fitted with a friction clutch, and to move the machine ahead it is only necessary to throw in this clutch, and to stop the machine, throw out the clutch. The traction drive is connected to both rear wheels and is sufficiently powerful to propel the machine up an incline of 15°. The front axle is of the automobile steering knuckle-joint type, and the rear axle is a compensating differential. The latter is advantageous in that it will equalize the speed of the rear wheels in turning corners; the wheels are heavy crucible steel castings 9 ins. wide.

No platforms or runways are required and if the material is placed sufficiently close to the machine it can be shoveled directly from the supply pile to the open end power loader bucket. All levers are so arranged that one man can operate the entire machine if necessary. The operator stands on a platform on one side of the machine, about 30 ins. above the ground, and can operate the power loader, water tank, discharge and boom. The mixer is capable of turning out a batch of concrete in 45 seconds.



Special Concrete Mixer for Concrete Road and Pavement Base Work.

To distribute the concrete it is equipped with a boom 20 ft. long and a delivery bucket. The concrete is discharged from the mixer into the delivery bucket, which travels on a single boom. The boom can be swung at an angle of 180°, and a street 50 ft. wide can be easily taken care of. The boom bucket will hold a full batch of mixed concrete and is provided with an automatic tripper, and the gate opens up automatically at any place where it is desired to deposit the concrete. When bucket returns to the mixer, the gate closes automatically. The same man who operates the mixer levers, also controls the movement of the boom and bucket.

In work where the road is less than 18 ft. in width a gravity swivel chute may be substituted for the distributing boom. This mixer is made in three sizes: 10, 15 and 23 ft. respectively. The No. 10 weighs 11,000 lbs., the No. 15 weighs 14,000 lbs. and the No. 23 weighs 17,000 lbs.

The mixer is manufactured by the Chain Belt Co., Milwaukee, Wis., and is in all features except those added especially for road work, the standard mixer made by that company for general concrete work.

The Specifications of the Illinois Highway Commission for Concrete Road Construction.

The Illinois Highway Commission, of which Mr. A. N. Johnson is State Highway Engineer, has issued lately specifications for the construction of concrete roads. One feature of these specifications is the provision for underdrains on each side of the pavement. The specifications as far as they relate to the concrete work are given below.

CONCRETE MATERIALS.

Cement. Some standard brand of Portland cement shall be used which has been in practical use on public works and shall have proved satisfactory therein. No brand of cement shall be used which the engineer deems unfit for the work, nor shall any cement be used which fails to give satisfactory results according to the standard methods of testing as provided by the American Society for Testing Materials. The contractor shall provide sufficient means to protect the cement against dampness, and no cement shall be used which has become caked.

The contractor shall notify the engineer in writing what brand or brands he intends to use, and before ordering the cement shall receive the written approval of the engineer as to the brand selected. It is understood that such approval merely covers the selection of the brand; that the cement itself may be rejected if it fails to meet the requirements herein specified.

Coarse Aggregate. The coarse aggregate shall consist of clean, hard, sound flint or other hard siliceous pebbles, having a reasonably uniform gradation from a size which will pass through a 1-in. screen to a size that is retained on a ⅛-in. screen, and no gravel composed in part of slate, shale, disintegrated limestone, or other equally soft stone, can be used. Crushed granite or trap rock, graded to the size provided above, may be used. Crushed limestone, graded to the size specified above, may be used only upon the approval of the engineer.

Fine Aggregate. The fine aggregate shall consist of clean, sharp quartz grains, and shall not contain over 2 per cent of clay or loam. The fine aggregate shall be reasonably uniformly graded from a size which will pass through a ⅛-in. screen down. Sand containing disintegrated shale, slate or limestone shall not be used.

GRADING OF AGGREGATE.

The specification that the coarse and fine aggregates must be reasonably well graded shall be interpreted to mean that the percentages of the aggregates passing screens of various sizes shall be within the limits given in the following tables:

TABLE OF GRADATION OF COARSE AGGREGATE.

Size of screen.	Allowable limits of percentage passing through.
1-in. square mesh....	100
¼-in. square mesh....	Not less than 45 nor more than 60

TABLE OF GRADATION OF FINE AGGREGTE.

Size of screen.	Allowable limits of percentage passing through.
⅛-in. square mesh....	100
1/16-in. square mesh....	Not less than 65 nor more than 85

If the contractor desires to use aggregate which is not graded in accordance with the table, he must submit a sample of 50 lbs. of such material to the Illinois Highway Commission, Springfield, Ill., one week prior to the date of the letting of this contract. His sample of aggregate will be analyzed and, if found suitable, its use will be approved in writing and the amount of cement that must be used with such aggregate will be stated. The aggregate used in the construction work must then be graded in accordance with the sample submitted, and must be of the same kind and quality as the sample, and the amount of cement used must be the quantity required by the engineer in accordance with this paragraph instead of the amount provided in paragraph 32. [Proportions for concrete.]

USE OF GRAVEL.

The use of gravel made up of a mixture of the coarse and fine aggregates described above will not be permitted. If the contractor wishes to use such material, he must screen it to the sizes specified above before proportioning the aggregate for mixing.

CONCRETE MIXER.

The concrete mixer used on the work provided for herein shall be a batch mixer of a type approved by the engineer. The concrete shall receive at least four complete turns of the drum before being discharged and if, in the opinion of the inspector, a greater amount of mixing is required, this number of turns shall be increased until a thoroughly mixed concrete is secured.

PROPORTIONS FOR CONCRETE.

The concrete for the work provided for herein shall consist of 1 part of cement, 2 parts of fine aggregate, and 3½ parts of coarse aggregate. The aggregate shall be placed in the mixer in such manner as to insure that a uniform amount of each class of aggregate is used in each batch of concrete; and the method of measuring the aggregate, whether in wheelbarrows or otherwise, shall be approved by the inspector, 1 sack of cement to be considered as 0.95 cu. ft., and all measurements to be by volume.

WATER.

The water used in mixing the concrete shall be clean.

SIZE AND KIND OF ROLLER.

Wherever it is provided herein that rolling shall be done on the road bed or macadam shoulders, a three-wheel self-propelling roller, weighing not less than ten nor more than twelve tons shall be used.

ROAD BED.

The road bed will be considered as that portion of the road upon which the concrete roadway and macadam shoulder are placed. The road bed shall consist of the natural earth which has been brought to the proper elevation and cross section and rolled until firm and hard. If sandy or other soil is encountered which will not compact readily under the roller, a small amount of clay or loam shall be added so as to secure a firm, hard surface after rolling. The road bed shall be thoroughly saturated with water immediately before concrete is placed.

SHOULDERS AND SIDE ROADS.

After the completion of the concrete roadway and macadam shoulders, the side roads are to be shaped in accordance with the cross section shown on the plans and shall be rolled, care being taken not to allow the roller on the edge of the concrete roadway. Upon completion, the cross slope of the concrete roadway, macadam shoulders, earth side roads and ditches shall be as shown on the plans.

THICKNESS OF CONCRETE ROADWAY.

The concrete roadway shall have, after completion, the thickness shown on the plans. If a greater thickness is laid than that shown on the plans, no extra compensation will be made therefor.

UNDER DRAINS.

An under drain 8 ins. wide and 6 ins. deep shall be constructed under each of the concrete roadway edges, the entire width of the drain being under the pavement. This under drain shall be filled with broken stone or coarse aggregate before the concrete is placed. At the end of each expansion joint or at intervals of not to exceed 50 ft., blind cross drains, not less than 8 ins. wide, shall be constructed from the longitudinal drains before mentioned, to the gutter. These cross drains shall be of such a depth as to drain readily from the longitudinal drains to the gutter, and shall be filled with at least 6 ins. of crushed stone or coarse aggregate, and then covered with earth, except that such part of the cross drain as lies under the macadam shoulder shall be filled with stone when the shoulder is constructed. The longitudinal and cross drains shall be completed before the concrete roadway is constructed.

SIDE FORMS.

The concrete roadway shall be placed between side forms of 2-in. plank. The side form plank shall be of a width equal to the thickness of the pavement at the edge. The side form planking shall be accurately set to the alignment and grade of the pavement, and shall be held securely in place by adequate stakes and bracing. Intermediate longitudinal form boards will not be permitted between the side forms to support the templet.

PLACING CONCRETE ROADWAY.

The concrete for the roadway shall be placed between the plank forms before described, the entire thickness of the concrete being placed at one time. After the concrete has been deposited between the forms, it shall be raked and tamped until the mortar flushes to the top, and the concrete shall be placed in such quantity that there will be a slight excess between the forms. The surface of the roadway shall then be shaped to conform to that which is shown on the plans by striking off with a templet cut to the proper shape. This templet shall be drawn along the forms, and shall be held securely against the top of the forms, and shall be moved with a combined longitudinal and crosswise motion which will prevent dragging the larger particles of the aggregate and marring the surface.

FINISHING SURFACE OF CONCRETE ROADWAY.

After the surface of the concrete roadway has been struck off to the proper cross section, it shall be finished with wood floats. The wood floats shall be used only to flush mortar to the porous places in the surface, and great care must be taken not to rub hollow places in the surface. The wood float finish shall be made as soon after the concrete has been deposited as possible, and in no case shall the finishing be delayed until the concrete has taken a set.

COVERING CONCRETE ROADWAY.

After the concrete roadway has been finished as above described, the roadway shall be covered with suitable canvas as soon as this can be done without marring the surface, which shall be kept wet, and as soon as the concrete sets sufficiently, the canvas shall be removed and the concrete covered with earth. The earth covering shall be put on at least 1 in. thick and shall be kept constantly wet for two weeks. The roadway shall be kept closed to traffic for two weeks, or, if in the opinion of the engineer, the weather conditions make it advisable, the roadway shall be kept closed to traffic a longer period of time.

EXPANSION JOINTS.

Expansion joints shall be provided and spaced as shown on the plans. The expansion joints shall be set at an angle of 60° with the center line of the roadway and shall be of the type shown on the plans. The expansion joints shall be constructed in such manner as to insure that the metal plates, creosoted blocks, or other device provided for the joints, shall conform to the cross section provided for the roadway; and great care must be exercised in placing these joints to insure that there will be neither a depression nor a raised place at the joint.

CLEANING FINISHED PAVEMENT.

When the concrete roadway has been completed for a sufficient length of time to permit a proper setting of the concrete, it shall be cleaned and then opened to traffic.

BEVELLING EDGES.

If the plans shall provide that the edge of the concrete shall be bevelled, then the plank forms shall be removed from the edge of the roadway before the concrete takes its final set, and the edge of the pavement shall be cut off by means of a shovel or other suitable tool so as to give the shape shown on the plans.

MACADAM SHOULDERS.

The macadam shoulders when completed shall be of the width and thickness shown on the plans. The stone for the macadam shoulders shall be deposited, spread and rolled at least twice over, and then covered with screenings or gravel, sprinkled and rolled. When completed the macadam shoulder shall be true to shape and shall be one-half inch above the concrete where it joins the concrete roadway.

TRIMMING SIDES OF ROAD.

The slopes on cuts and fills shall be neatly trimmed to the slopes shown on the plans, and all detritus and surplus materials left after completion of the work shall be removed from the road.

BRIDGES

A Comparative Study of Limiting Span, Maximum Span and Economic Span for Suspension Bridges and Cantilever Bridges.

At the annual Congress of Engineering and Scientific Societies held at Spokane, Wash., in February, a discussion by Prof. D. B. Steinman, University of Idaho, of span lengths of cantilever and suspension bridges merited particular attention. We print the discussion in full as follows:

Each type of bridge construction has some limiting span-length which it cannot exceed. This *"limiting span"* may be defined as the length at which the ratio of the intrinsic weight to the applied weight becomes infinite. In other words, it is the length at which the structure would be just capable of holding its own weight without carrying any live or moving load, any attempt to increase the load resulting in members of infinite cross-section. Under the stress of necessity, the span of any type of bridge may be pushed as close as may be desired to this theoretical limit: but this can be done only at a very great sacrifice of economy, as the cost of the structure increases very rapidly when the span approaches the limiting value.

The longest span at which the cross-sections of the principal members will not exceed an assigned maximum value, determined by the limitations of design, fabrication, transportation and erection, will be termed *maximum span*. The length of the maximum span for any form of bridge may be determined with sufficient definiteness from theoretical considerations applied to the data of actual designs; but it must be borne in mind that the results of such determination are subject to expansive revision when the methods of design or the materials of construction undergo improvement.

In addition to the above span-limits, each bridge type has an economic range of spans, within which it will be less costly than any other form of construction. If, for any two comparable types of structure, a *span of equal cost* be determined, that span will be the inferior economic limit for one of the bridge-types and the superior economic limit for the other.

The term *economic span* will be used to designate the limit above which the cost of a bridge would exceed the capitalized value of its usefulness to the builders. Although this is a problem of great practical significance, it does not readily lend itself to accurate treatment in any general manner on account of the large possible variations in local conditions, such as the magnitude and financial importance of the traffic expected, the cost of real estate for land spans and approaches, and the difficulty encountered in locating suitable foundations. By adopting the most favorable assumptions for these varying conditions, a maximum value for the economic span may be established.

The maximum and economic span-lengths for bridges of ordinary span have been fixed pretty definitely by the results of numerous designs and comparative estimates. We may take our values of these limiting lengths from the consensus of opinion among engineers as evidenced by their uniformity of practice. Thus the ordinary truss bridge finds its range of usefulness between the limiting spans of about 120 and 550 feet, there being but three truss spans exceeding the latter value. Below this range, the steel girder or concrete arch is more economical; above these limits the steel arch enters into competition. The latter construction, in turn, ceases to be economical at about 800 ft., although the proposed Hell Gate arch is to have a span of 1,000 ft.

For longer spans, the selection of a bridge structure narrows down to a choice between the suspension bridge and the cantilever. The relative economy of these two forms of construction has long been a mooted question. Although comparative designs have been prepared in individual instances for the particular local conditions obtaining, the author has been unable to find any general comparison of the two bridge-types for the purpose of establishing their relative economic or limiting spans. He has therefore undertaken the determination of these values for the suspension and cantilever bridges, namely:

(1) The limiting spans, or the greatest spans which can be designed.

(2) The maximum spans, or the greatest spans which can be built.

(3) The economic spans, or the greatest spans which it would pay to build.

(4) The span of equal cost for the two types; in other words, the span at which the cantilever ceases to be economically superior to the suspension bridge.

The method proposed for the solution of these problems is to prepare designs and estimates of a wide range of cantilevers and suspension bridges and to deduce therefrom the laws of variations of weight and cost with length of span. The relations between span and weight, thus established, fix the limiting span for each form of construction. The cost-curves of the two types indicate their comparative economy at different spans as well as the critical span of equal cost. Finally, an estimate of the maximum probable traffic returns, compared with the costs of different spans, determines the economic limiting length for each type.

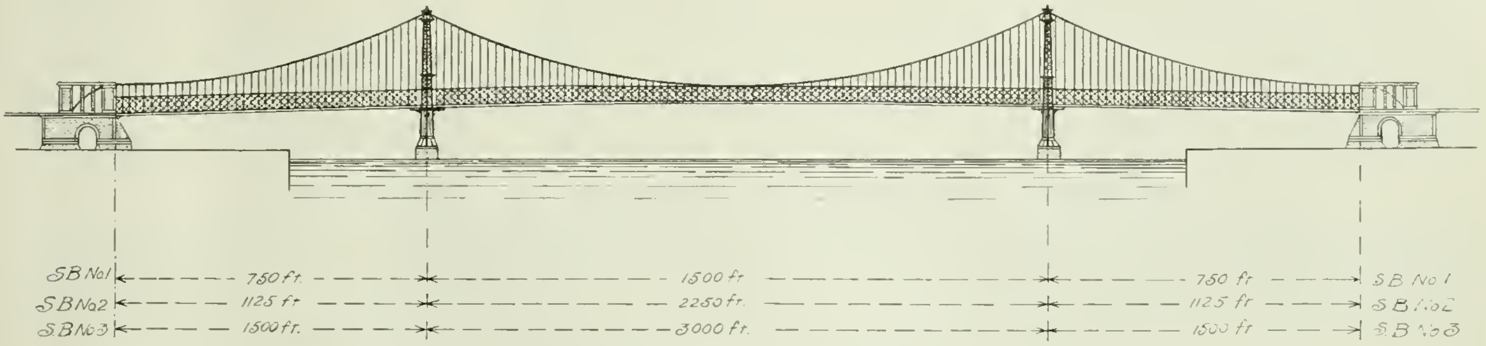


Fig. 1—General Elevation of Suspension Bridges Employed in Comparative Study of Span Lengths.

With the above objects in view, the author has prepared complete designs and estimates of three suspension bridges of 1,500, 2,250 and 3,000 ft. span, and of three cantilevers of 1,000, 1,500 and 2,000 ft. span respectively. To justify the large expenditure involved in structures of this magnitude, they will be assumed to be railroad bridges, with additional provision for electric cars, driveway and footwalks, making a total live-load capacity of 18,000 lbs. per linear foot.

The cost of a structure for a given span will, of course, be affected by local conditions such as prices of material, specified unit stresses, depth of foundations, etc. In order that the comparison between the cantilever and the suspension bridge may be an absolutely fair one, it is essential that all such arbitrary or varying factors be chosen with extreme care and be kept exactly the same for both types of construction. Furthermore, in order that the results for the limiting spans may be the true maximum values, it is necessary to carefully determine and use the most favorable proportions, material and form of construction for each design.

Suspension Bridges.

One of the first questions to be decided in the design of the suspension bridges was the choice between a steel-wire cable and a chain of eye-bars for the principal carrying member. The latter enables the bracing for the prevention of deformation under moving load to be incorporated in the cable system; the other requires a separate stiffening truss for the reduction of these deflections. Omitting from consideration the possibility of using the overhead bracing in conjunction with a wire cable—a construction which would combine the essential advantages of both systems but of which the feasibility has not yet been demonstrated, and without presuming to decide between the relative advantages of the two types of cable construction, the author adopted the "wire-cable type" in the present investigations for the following reasons:

(1) As both types are practically equal in cost, this choice would not affect the results for the economic lengths of span.

(2) As the wire cable affords a great saving in weight, it would yield a larger value for the maximum practicable span.

(3) As this choice conforms with the accepted past and present practice in suspension bridge design, and as no radical changes need be expected in the proximate future, the results obtained are better adapted for comparison with the data of existing structure and of greater value in estimating future designs.

The next question to be investigated was the economic ratio of cable-rise to length of span. By expressing the costs of the different parts of the structure in terms of this rise-ratio (n), the author found that the total cost of a suspension bridge of span l would be a minimum for $n = \frac{1}{8}$ (very closely) for all spans from $l = 1{,}000$ ft. to $l = 4{,}000$ ft.

The depth of stiffening truss was next investigated. The minimum depth of truss is determined by the requirement of limiting the deflections so that the resulting gradient in the roadway should never exceed a specified amount (r). With $r = 1$ per cent as a maximum limit, it may be shown that

$$\text{Minimum } \frac{d}{l} = \frac{1}{45}$$

By expressing the total weight of material in terms of the truss-depth, the *economic* depth of stiffening truss was found to be given by

$$\frac{d}{l} = \frac{1}{40}$$

This value is somewhat higher than the average of past practice, probably because most designs have been a compromise between the demands of economy and those of aesthetics. The Williamsburg Bridge is the only long-span structure conforming with the above economic ratio, but its appearance is undoubtedly marred by the excessive depth of the stiffening truss. For the purpose of this investigation, economy of weight and cost is of greater significance than any aesthetic considerations. The above depth-ratio is therefore adhered to, even at a sacrifice of appearance.

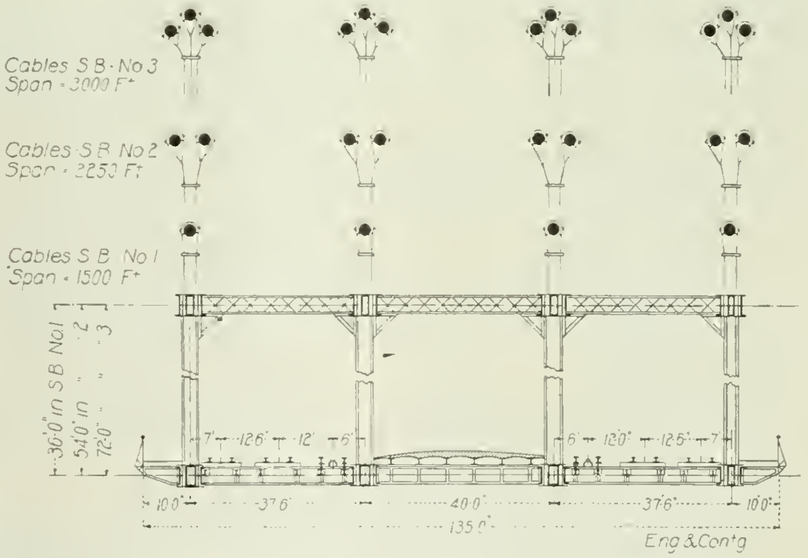


Fig. 2—Cross Section of Suspension Bridges.

ESTIMATE OF COST.

In order to establish an equitable schedule of unit prices for the two types of bridges, a critical study was made of the different bids received by New York city for the Williamsburg, Manhattan and Queensboro bridges. These structures were selected as combining the qualifications of recentness of date with similarity of construction and magnitude to the designs under investigation. The prices of the successful bidders were adopted except where they differed so widely from the following bids as to indicate their having been unbalanced for some special reason. The unit prices determined by this comparison are incorporated in the following estimates of cost:

The total substructure, including all work in preparing for and installing the tower foundations and anchorages, $3,757,640. The steel work, including cables, suspended structure, towers and anchorages, $7,887,300, or a grand total of $11,644,940 for the 1,500-foot span suspension bridge.

TABLE I.—PRINCIPAL DATA FOR DESIGN OF SUSPENSION BRIDGES.

	No. 1. Ft.	No. 2. Ft.	No. 3. Ft.
l = span	1,500	2,250	3,000
l_1 = side-span = ½ l	750	1,125	1,500
f = versed sine = 0.12 l	180	270	360
f_1 = versed sine in side-span = f/4	45	67½	90
d = depth of truss = 0.024 l	36	54	72

Type: Stiffening truss hinged at the towers. Suspension rods in side-spans.

Loading:	Lbs. p. l. f.
4 railroad tracks at 3,000 lbs	12,000
2 lines of cars at 1,000 lbs	2,000
40 ft. of roadway at 75 lbs	3,000
20 ft. of roadway at 50 lbs	1,000
Total congested load	18,000

For the 2,250-foot span these figures are respectively $6,008,940 and $17,750,590, giving a grand total of $23,759,530.

The substructure for the 3,000-ft. span would cost $10,011,820, while the steel work would amount to $36,772,710, making a grand total of $46,784,530.

EMPIRIC FORMULAS FOR WEIGHTS.

From the results of the preceding designs, we may construct semi-empirical formalas for the weights of the different parts of a suspension bridge. Such formulas will be useful in preparing estimates for other spans and loadings; also in drawing general conclusions as to maximum and limiting spans.

Let the weights (per linear foot) of live-load, cable, suspenders, truss (including bracing) and floor be represented by L, C, S, T and F respectively. The weight of the cable is evidently proportional to the total load it sustains and to the length of span, provided the rise-ratio remains unchanged. The weight of the suspenders is likewise proportional to the load they carry and to the span, as a longer span requires a proportionally greater average length of suspenders. The weight of the truss may be considered in two parts: the larger portion provides for the live-load and is proportional to that load and to the span length, if the depth ratio remains constant: the other part of the truss-weight represents the contribution of the wind-stresses and will vary with the square of the span if the width of bridge remains constant. The weight of the floor system is evidently proportional to the assumed live-load, and is practically independent of the length of span. Introducing the empirical constants from the preceding designs in those relations, we obtain the following formulas for suspension bridges:

$C = .068\ (C + L + S + T + F)\, l$

$S = .0075\, (L + S + T + F)\, l$

$T = 35\, L\, l + 105\, l^2$

$F = .84\, L$

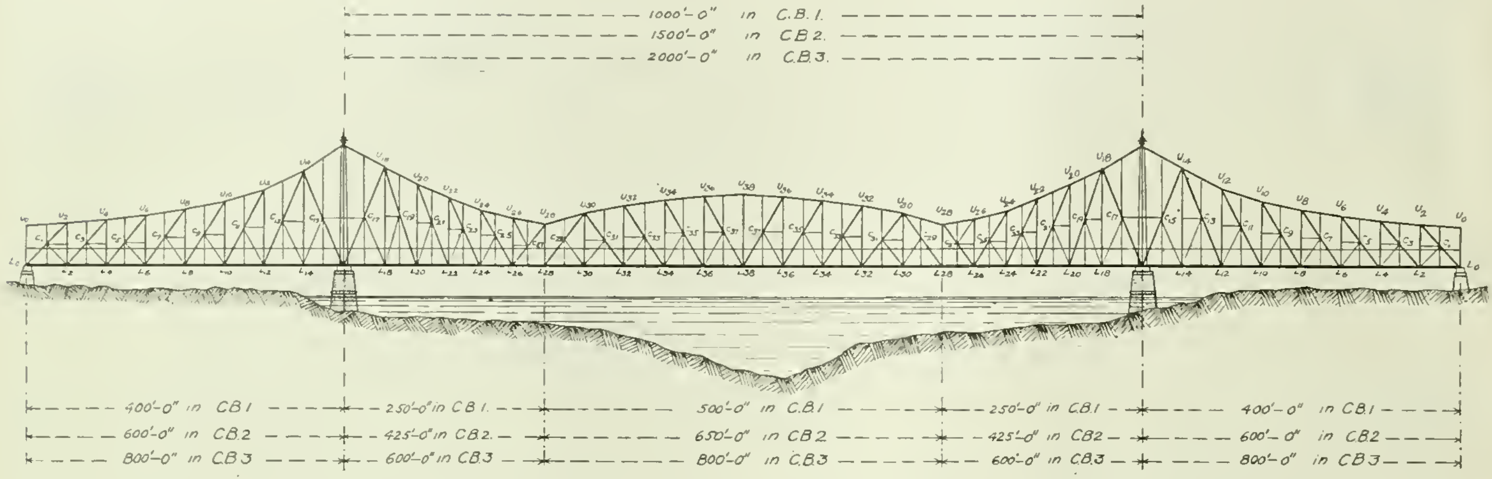
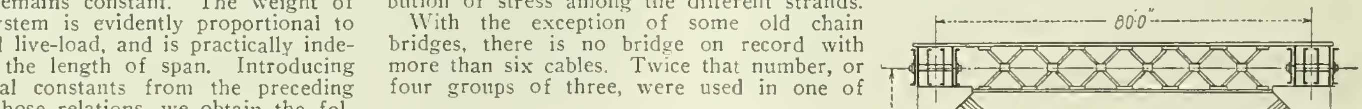


Fig. 3—General Elevation of Cantilever Bridges Employed in Comparative Study of Span Lengths.

From these equations we find that the cable-section becomes infinite or $C =$ infinity for a *"limiting span"* of

$$\text{Limiting } l = \frac{1}{.068} = 14{,}700 \text{ ft.}$$

This is the upper limit of feasible spans for suspension bridges and represents the span at which the suspension bridge would cease to be self-supporting.



Cantilever Bridge No.1 Span = 1000 Ft

Cantilever Bridge No.2. Span = 1500 Ft

Cantilever Bridge No 3 Span = 2000 Ft

Fig. 4—Midspan Cross Section of Three Cantilever Bridges Being Compared.

MAXIMUM SPAN FOR SUSPENSION BRIDGES.

Although the above is the limiting feasible span, defined by $C =$ infinity, it is evident that the sections will become too large for practical construction long before that length of span is reached. In order to determine the practical maximum span, a value for the maximum cable section must first be fixed.

The cables of the three largest suspension spans, viz., the Brooklyn, Williamsburg and Manhattan bridges, are 15⅝ ins., 18¾ ins. and 12½ ins. in diameter respectively. Cables with a diameter of 24 ins. were used in one of the designs in this investigation, but it is doubtful whether any larger diameter can be put together without excessive difficulty of manipulation and uncertainty of proper distribution of stress among the different strands.

With the exception of some old chain bridges, there is no bridge on record with more than six cables. Twice that number, or four groups of three, were used in one of the writer's designs, but it is extremely improbable that a greater number than 16 could be practically combined in one structure.

Assuming, then, a section of 16 cables of 24 ins. diameter for the bridge of maximum span, we have

Maximum $C = 20{,}000$ lbs.

Substituting in the preceding equations this maximum value of C, and assuming different values of the live-load (L), we obtain the following values for the maximum span:

For $L = 10{,}000$, max. $l = 4{,}900$ ft.
$L = 15{,}000$, max. $l = 4{,}000$ ft.
$L = 20{,}000$, max. $l = 3{,}500$ ft.

It is hardly probable that a structure of the magnitude under investigation would ever be planned for a lighter loading than about 10,000 lbs. per lineal foot, particularly when it is remembered that this would require about 10 lbs. of steel for every pound of useful load. It will therefore suffice to restrict the conditions of the problem to the practical limits of $L = 10{,}000$ to $L = 20{,}000$ lbs. of live-load per linear foot. We thus find that the maximum practicable span for suspension bridges ranges from 3,500 to 4 900 ft., depending upon the assumed live-load.

ECONOMIC SPAN FOR SUSPENSION BRIDGES.

The expression for the cost of any span (C) will be assumed of the general form.

$C = al + bl^2 + cl^3$ ....(1)

From the results of the preceding estimates we have

$C = \$11{,}645{,}000$ for $l = 1{,}500$ ft.
$C = \$23{,}760{,}000$ for $l = 1{,}250$ ft.
$C = \$46{,}785{,}000$ for $l = 3{,}000$ ft.

Substituting these values in (*1*), and solving the resulting three equations for the unknown coefficients, we obtain

$$C = 8{,}900\, l - 3.77\, l^2 + .0020\, l^3 \ldots\ldots\ldots\ldots (2)$$

as the general cost-formula for suspension bridges. This gives the combined cost of steelwork and substructures for any span for an assumed live-load of 18,000 lbs. per linear foot. For any other loading, the above coefficients should be changed in proportion.

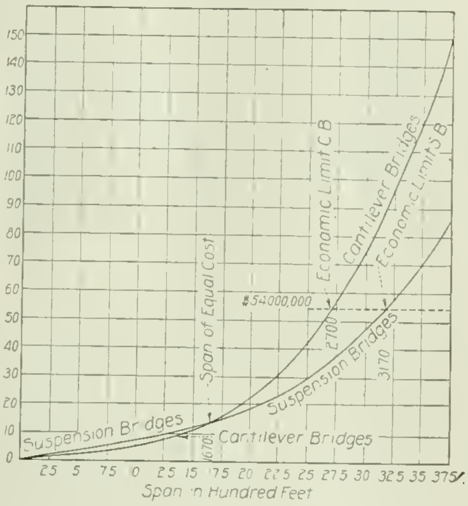


Fig. 5—Cost Curves of Suspension and Cantilever Bridges.

Of the above cost, about 65 per cent represents the steel work and all the remainder provides for the masonry and anchorages.

A study of the contracts for recent long-span bridges shows an additional cost of about 20 per cent for pavements, tracks, railings, ornamental work, electrical lighting, etc. To this must be added the cost of terminal structures and real estate for the approaches. In a city structure the last item, as in the case of the Manhattan Bridge, may amount to more than the cost of the bridge itself; a fair average value would be about 100 per cent. Adding the above items, we find

Total first cost of bridge = 220 per cent *C*.

The rate of interest will be assumed at 5 per cent. The annual cost of maintenance, including repairs, painting, lighting etc., averages about 4⅛ per cent of the cost of the superstructure. In addition, a certain annuity must be set aside for periodic renewal. The foundations may be permanent, but the steelwork has a limited life. The life-periods of numerous suspension bridges, or the periods before reconstruction or removal, whether terminated by failure or increased traffic demands, have been compiled by the author and found to average 31 years. This value, or 30 years in round numbers, will be adopted as the probable life of the steelwork of a suspension bridge. At 5 per cent compound interest a sinking fund to meet the cost of renewal in 30 years will require an annuity of 1.505 per cent. The annual charge against the bridge will therefore consist of the following items:

	% C.
Interest charge = 5% × 220% C.	11
Repairs and maintenance = 4.5% × 65% C.	3
Depreciation = annuity for renewal in 30 yrs. = 1.505% × 65% C.	1
Total annual charge	15

The limiting economic span is that at which the revenue from traffic (*T*) just balances the annual cost of the structure. We may therefore write

$$15\%\ C = T \ldots\ldots\ldots\ldots (3)$$

as the defining condition for the economic span.

In the absence of any better guide, let us take the amount of travel on the Brooklyn Bridge as the maximum traffic to be expected on any other long-span structure. This value may justly be augmented by 50 per cent for the greater capacity of a six-track bridge, but to compensate for the early years of undeveloped traffic this additional profit will be disregarded. We will therefore assume 118,000,000 passengers using the bridge in a year. For a span of the length under consideration, a toll of 5 cts. per passenger would be an equitable rate. The same charge is now made for ferry or tunnel-transportation across the Hudson River, and bridge travel would surely be preferred for its greater speed and comfort.

At night, when the passenger traffic is a minimum, the tracks can be used for the transportation of freight. We may safely count on at least 1,500 cars of freight daily crossing a six-track bridge over the Hudson River or any similar location.

The total annual traffic over a long-span bridge may therefore attain the following value:

118,000,000 passengers at 5 cts.	$5,900,000
547,500 cars of freight at $4	2,190,000
T = Total annual revenue	$8,090,000

Substituting this value in equ. (3) we obtain C = $54,000,000.

as the maximum justifiable expenditure for a long-span bridge. With this value of *C*, the solution of equ. (2) yields

$$\text{Economic } l = 3{,}170 \text{ ft.}$$

In the case of the proposed Hudson River bridge of somewhat shorter span, calculations indicated a profit of less than 1 per cent on the investment, thus confirming the above result.

CONCLUSION.

The limiting economic span for suspension bridges is about 3,170 ft., and will be less wherever the probable traffic returns are smaller than assumed in this investigation.

Cantilever Bridges.

In adaptability to long-spans and possibility of erection without falsework, the cantilever is the sole competitor of the suspension bridge. Both of these types have attained prominence by remarkable examples of design and construction. The suspension type, however, with but one exception has never been employed for fast railway traffic. Its use has been confined to highway bridges or wherever aesthetic requirements prevailed. The banner bridges of the suspension type, those over the East River, have been attributed to "an ingrained fad of the New York Department of Bridges." For long railway spans the cantilever has almost invariably been given the preference on account of its superior rigidity at a given cost. The longest span in the world (Forth Bridge = 1,710 ft.) is of the cantilever form, and the Quebec Bridge, now under construction, will raise the record for length of span to 1 800 ft.

Before proceeding with the designs, the author made a special study of the problems of economic span-ratios and width-ratios for cantilevers. The results are incorporated in Table II. In the estimates of cost, the same unit prices are used as in the case of the suspension bridges.

ESTIMATE OF COST.

The result of the author's designs of the above cantilevers are summarized in Table III of costs.

EMPIRIC FORMULAS FOR WEIGHTS OF CANTILEVER SPANS.

Let T_1, T_2, T_3 = truss-weights per lineal foot in suspended span, *l*, cantilever arm, *m*, and anchor arm, *n*, respectively.

F = Weight of floor, per lineal foot.
$L.\,L.$ = Live load per lineal foot.

We may then construct semi-empiric formulas for the truss-weights from the results of the preceding designs as follows:

Suspended Span.—The weight per lineal foot of a simple truss, if the relative dimensions are kept fairly constant, is proportional to the span and to the total load carried. Introducing a factor of proportionality, *a*, we have

$$T_1 = a\,(T_1 + F + L.\,L.)\, l \ldots\ldots\ldots\ldots (1)$$

Applying this equation to the preceding designs, we find

$a = .00056, \qquad .00053, \qquad .00053;$

or, as a mean value,

$a = .00054$

Cantilever Arm.—A simple formula, involving but one undetermined coefficient, may be constructed from the observed fact that the weight per lineal foot of the cantilever arm varies with the total loading and with the square root of the channel span, or

$$T_2 = b_1\,(T_2 + F + L.\,L.)\,\sqrt{L} \ldots\ldots (3)$$

TABLE II.—PRINCIPAL DATA FOR DESIGN OF CANTILEVER BRIDGES.

	No. 1. Ft.	No. 2. Ft.	No. 3. Ft.
L = total span = m + l + m	1,000	1,500	2,000
l = suspended span	500	650	800
m = cantilever arm	250	425	600
n = anchor arm	400	600	800
w = width c. to c. of trusses	50	60	80
d = depth of suspended truss	50-85	75-110	110-135
h = depth at towers	150	225	300

Load: L L = 18,000 lbs. per ft. Wind = 30 lbs. per sq. ft.

Working stresses:	Tension.	Compression.
Structural steel	20,000	$\dfrac{20{,}000}{1 + \dfrac{l^2}{8{,}000\, r^2}}$
Nickel steel	30,000	$\dfrac{30{,}000}{1 + \dfrac{l^2}{8{,}000\, r^2}}$

For erection of stresses, the above may be increased by 20%.

The constant of proportionality, *b*, is determined from the preceding designs, as

$b = .0133, \qquad .0134 \qquad .0134$

This close agreement between these values of *b* indicates the reliability of the above formula even under varying values of the suspended span ratio. Taking the mean value, we have

$$b = .0134$$

As the total amount of steel is not materially affected by limited changes in the form or proportions of the trusses, and as variations in the spans and in the loading are fully provided for in the above formulas, they may properly be applied to any other cantilever bridges designed for any live-load, provided the same working stresses are used. Whenever improved material or construction justifies higher unit stresses, the empirical constants in the above formulas should be reduced in the inverse proportion.

LIMITING SPANS FOR CANTILEVERS.

Limiting Channel Span.—A solution of the empiric formula for the weight T_2 of the cantilever arm, as established in the preceding article, yields

$$T_2 = \infty \text{ for Lim. } L = 5{,}600$$

Hence the limiting span for cantilever bridges is 5,600 ft. This value may be approached, but never exceeded, by increasing the ratio of dead-load to live-load indefinitely.

TABLE III.

Cantilever bridge.	L = 1,000 ft.	L = 1,500 ft.	L = 2,000 ft.
Suspended span	$ 573,919	$ 1,030,039	$ 1,929,267
Cantilever arms	874,266	2,261,308	5,308,402
Anchor arms	1,274,040	2,757,066	5,782,610
Towers	705,456	2,047,680	4,669,056
Anchorage steel	78,500	179,410	337,430
*Total	$3,506,181	$ 8,275,503	$18,026,765
Main piers	876,164	1,261,720	2,153,040
Anchorages	524,160	1,032,480	1,944,000
†Total	$1,400,324	$ 2,294,200	$ 4,097,040
‡Total	4,906,505	$10,569,703	$22,123,805

*Steelwork. †Substructure. ‡Cost of bridge.

Note that the corresponding limiting span for the suspension bridge is 14,700 ft., or about 2.6 times as great as the above.

MAXIMUM PRACTICABLE SPAN FOR CANTILEVERS.

In the three cantilever designs executed above, viz:

$L = 1{,}000, \qquad 1{,}500, \qquad 2{,}000$ ft.

the maximum required section is found in the lower chord of the anchor arm and amounts to

$$\text{Max } A = 574 \qquad 1{,}302 \qquad 2{,}338 \text{ sq. ins.}$$

It will be observed that these cross-sections are almost exactly proportional to the *squares* of the respective channel spans. Considering also that the section must vary with the live-load for which the structure is designed, we may write the proportion

$$\text{Max. } A = k\,(L.\,L.)\,L^2.$$

Substituting the values of Max. A, $L.\,L.$ and L from the above designs, and solving for the unknown coefficient, we find

$$k = .031 \qquad .032 \qquad .032$$

so that the above formula becomes

$$\text{Max. } A = .032\,(L.\,L.)\,L^2 \ldots\ldots\ldots\ldots (1)$$

where L is supposed given in 1,000 ft. units.

Hence the maximum practicable span for a cantilever is given by

$$\text{Max. } L = \sqrt{\frac{31.2\,\mathit{Max.}\,A}{L.\,L.}} \ldots\ldots\ldots\ldots (2)$$

Where *Max. A* is the greatest practicable cross-section in square inches, and $L.\,L.$ is the assumed live-load in pounds per lineal foot.

LARGEST CROSS-SECTIONS IN ACTUAL USE.

The values of the largest cross-sections ever fabricated are the following:

	Sq. ins.
Queensboro	1,120
Quebec	843
Beaver	639
Kansas City (truss)	485
St. Louis (truss)	441
Monongahela	348
Thebes	317
Memphis	228

All of the above chord-sections are of the multiple rib type. The number of ribs composing the section never exceeded four, that being the number used in the Quebec, Queensboro, Thebes, and Memphis bridges. Any larger number of ribs would make the action of the whole member as a unit extremely problematic; and, in the light of recent experience, no conservative engineer would propose such a section.

The greatest depth of rib is 5 ft. 6½ ins. occurring in the Beaver Bridge, followed by a depth of 4 ft. 6½ ins. in the Quebec and St. Louis bridges. In Lindenthal's design for the Hell Gate Arch (1,000-ft. span) a 10-ft. depth of rib is proposed. This is so far in advance of any previous design, and involves so difficult a problem of adequate stiffening and bracing, besides the difficulties of fabrication, that it may well be taken as the extreme limit for practicable depth of rib.

The greatest thickness of rib is 5¾ ins. in the Queensboro Bridge, followed by 4 7/16 ins. 4¼ ins., and 3½ ins. in the Monongahela, Hell Gate and Quebec bridges, respectively. On account of the extreme difficulty of riveting through so great a thickness, it is hardly probable that any greater thickness than the above, or say 6 ins. at the most, will ever be used.

Combining the above limitations, we find that the greatest practicable chord-section would consist of four ribs, 10 ft. deep and 6 ins. thick. Adding the largest angles obtainable for the flanges the total area will be, in round numbers,

$$\text{Max. } A = 3{,}000 \text{ sq. ins.}$$

With the necessary diaphragms and lacing, such a member would weigh over 7 tons per lineal foot.

This value of Max. A is nearly three times the cross-section of the largest member ever fabricated (1,120 sq. ins. in the Queensboro Bridge) and over twice the largest section to be used in the Hell Gate Arch (1,437 sq ins.). A member of 2,300 sq. ins. occurs in the plans for the Hudson River Bridge of 2 160 ft. span designed by the Union Bridge Co. in 1893, and a slightly larger cross-section (2,338 sq. ins.) is found necessary in the author's design of a 2,000-ft. cantilever bridge. But the above sectional area of 3,000 sq. ins. is far in excess of any chord section ever proposed.

VALUE OF L.

Substituting Max. $A = 3{,}000$ in. equ. (2) above, we find the following values of the maximum span for different assumed live-loads:

For L. L = 10,000 lbs. p. l. f. Max. L = 3,060 ft.
For L. L. = 15,000 lbs. p. l. f. Max. L = 2,500 ft.
For L. L. = 20,000 lbs. p. l. f. Max. L = 2,160 ft.

As it could hardly be considered practical to design a cantilever bridge of the magnitude under the consideration for a smaller live-load than about 10,000 lbs. per lineal foot, we conclude that *the maximum practicable span for the cantilever type ranges from about 2,000 to 3,000 ft., depending upon the assumed live-load.*

Comparing these with the corresponding values established above for the suspension bridge, viz:

$$\text{Max. } l = 3{,}500 \text{ to } 4{,}900 \text{ ft.}$$

the greater suitability of the suspension type to extreme long-span construction becomes apparent.

ECONOMIC SPAN FOR CANTILEVERS.

As in the case of suspension bridges, the expression for the cost of any span (L) will be assumed of the general form:

$$C = a.L + b.L^2 + c.L^3 \ldots\ldots\ldots\ldots (1)$$

From the results of the preceding estimates, we have

C = $ 4,905,000 for L = 1,000 ft.
C = 10,570,000 for L = 1,500 ft.
C = 22,125,000 for L = 2,000 ft.

Substituting these values in equ. (1), the unknown coefficients are determined, giving

$$C = 6{,}350\,L - 5.25\,L^2 + .0038\,L^3 \ldots\ldots (2)$$

as the general cost-formula for cantilever bridges. This gives the cost of steel work and substructure for an assumed live-load of 18,000 lbs. per lineal foot. For any other loading, the cost may be taken as varying in proportion.

Assuming the same cost of approaches, volume of traffic, life of steel work, expense of maintenance and rate of interest as for the suspension type, the limiting economic span for the cantilever will be defined by the same total cost as in the case of the suspension bridge, viz:

$$C = \$51{,}000{,}000.$$

As previously shown, this is the greatest expenditure for a long-span bridge, exclusive of approaches and accessories, that is warranted by the maximum traffic returns to be reasonably expected. Substituting this value in equ. (2) and solving, we find

$$\text{Econ. } L = 2{,}700 \text{ ft.}$$

as a maximum economic span for cantilevers.

Hence, *the greatest span for which the cantilever type may be profitably employed is 2,700 ft. or less*, depending upon the probable maximum traffic returns.

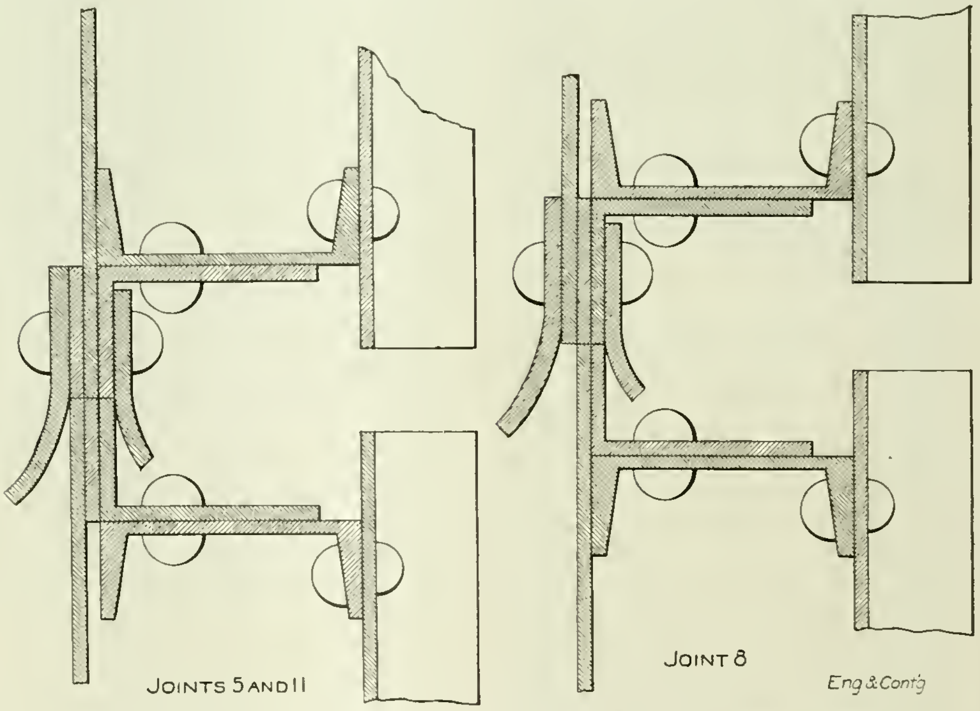


Fig. 1—Telescoping Joints for Connecting Sections of Pier Cylinder.

SPAN OF EQUAL COST.

Plotting the costs for the three suspension spans designed above, a smooth curve passing through the three points and the origin constitutes a cost-graph for suspension bridges. In the same manner, the graph representing the costs for different cantilever spans is constructed. The point where the two curves intersect marks the span of equal cost for the two types of construction, and is found at

$$l = 1{,}670 \text{ ft.}$$

Below this span, the cantilever bridge is cheaper; above this span, the suspension bridge exhibits the greater economy. As this value lies within the range of spans actually designed for each bridge, i. e., between the known points on each graph, the error of the above method, involved in extending the results of individual designs to other spans, is negligible.

The analytical equivalent of the above process consists in comparing the cost-formulæ for the two types of bridges. Equating the respective cost-expressions, and solving, we find, for the span of equal cost,

$$l = 1{,}670 \text{ ft.}$$

exactly as before.

The above comparison is somewhat unfair to the suspension type, as the side-spans in the above designs were 0.51 in the suspension bridges and only 0.41 in the cantilevers. Assuming therefore, that steel viaduct approaches are added to the cantilever bridges to make up the difference in total length, and estimating the cost of such viaducts at $1,000 per lineal foot, the span of equal cost is reduced to

$$l = 1{,}626 \text{ ft.}$$

somewhat less than the value established above. If the comparison of costs had been made between bridges of equal total length instead of between bridges of equal channel span, the result would have been still more favorable to the suspension bridge, reducing the critical span to about

$$l = 1{,}500 \text{ ft.}$$

Neglecting these differences in favor of the suspension type, we conclude that $l = 1{,}670$ ft. is the extreme upper limit of spans at which the cantilever can compete with the suspension bridge, when economy is the sole criterion.

	Suspension bridge,	Cantilever bridge,
Summary:	ft.	ft.
Theoretical limiting span	14,700	5,600
Practical maximum span	4,900	3,060
Maximum economic span	3,170	2,700
Span of equal cost	1,670	1,670

CONCLUSIONS.

In the foregoing designs, special care was taken to proportion the depths of truss in both types for equal and ample rigidity, so that the single inherent advantage claimed for cantilevers, viz: greater stiffness for railway traffic, is eliminated from consideration. Consequently no advantage remains to the cantilever type above the limiting span of 1,670 ft. The suspension bridge, on the other hand, is universally admitted to possess greater aesthetic qualifications; and, for a long-span city structure, this is a factor of decisive importance. For this reason alone, the above value for the span of equal cost should be considerably reduced, in favor of the suspension type, to obtain the "span of equal merit."

The preceding investigations have been restricted to designs for heavy railway traffic. For highway bridges, a relatively lighter stiffening truss may be used in the suspension type, thereby causing a considerable reduction in the span of equal cost.

Confining our attention to economic considerations, our final conclusions may be stated as follows:

(1) *The range of economic usefulness for cantilevers extends from the upper limit for the truss or arch to a span of 1,670 ft. Beyond this value, the cantilever would be more costly than the suspension type, although yielding a probable profit on the investment up to a span of 2,700 ft.*

(2) *The range of economic usefulness for suspension bridges begins at 1,670 ft. (or less in the case of highway bridges) and extends to the upper economic limit of 3,170 ft. Above this limit, the construction of suspension bridges would be practically feasible, but not as a profitable investment, up to an extreme limit of 4,900 ft.*

A Useful Telescope Joint for Connecting Up Sections of Cylinder Piers for a Railway Bridge.

In sinking steel cylinders in sections to form piers for the Southern Pacific Ry. bridge across San Francisco Bay at Dumbarton Point a rather unique joint, as shown by the accompanying drawing, was employed to facilitate the work. To understand clearly the usefulness of this joint an outline of the cylinder sinking operations is necessary, and we take the following from a paper by Mr. E. J. Schneider in Proceedings, American Society of Civil Engineers, Vol. xxxix, p. 117:

A description of the 40-ft. pivot pier will illustrate the type, which was also used for all smaller piers. Eight clusters of piles were driven to form a hollow square, 48 ft. on a side, with the center of the square at the center of the pier. About 10 ft. of mud and sand were then dredged, using an orangepeel bucket. The dredged material was placed in a bottom-dropping scow, transported, and dumped into the bay a short distance from the bridge site. Falsework, consisting of four wooden trusses, 44 ft. long and 14 ft. high, was constructed of 12x12-in. timbers and supported on the pile clusters, for the purpose of sustaining and erecting the guide-frame for the steel cylinders. The guide-frame consisted of twelve 20-in., 65-lb. I-beams, 80 ft. long, placed upright to form a regular, twelve-sided polygon about 39 ft. in diameter. These I-beam columns were braced horizontally at intervals of 12 ft. 6 ins. by two 12-in. channels placed back to back. Additional stiffening was obtained by reinforcing the top and bottom of these 12-in. channels at their midpoits with 8-in. channels. Thus was formed a series of trusses which added greatly to the lateral stiffness of the entire frame. In general appearance the guide-frame resembled the frame work for a gas holder. As the frame was built it was lowered by tackle until it rested on the soil. Then it was weighted to refusal by loading 300 tons of steel on its top. To assist in securing an even settlement, a ⅜-in. water jet was used, while the I-beam columns were tapped with a pile hammer. The guide-frame came to refusal when the first set of horizontal channel struts rested on the sand bottom. These struts were 17 ft. 4 in. above the lowest parts of the frame. The three lower courses of the steel cylinder were then assembled on the falsework, and with rope tackles were lowered as a unit into position. A clearance of ½ in. was allowed between the outer flange of the upright I-beams and the webs of the guide-channels which were attached to the shell. A rail was fastened to the top of the section of the shell with clips at each of the twelve points adjacent to the upright I-beam columns of the guide-frame. These rails were used as level rods, being appropriately marked. The shell was driven to refusal, with an even settlement, the bottom edge resting 6 ft. below the lowest horizontal struts of the guide frame.

The space within the cylinder shell was then further excavated, the center portion being dredged about 5 ft. deeper than at the outside, which just about offset the uplift of the ground, due to the driving of the outside row of piles first and working toward the center with succeeding piles. Two skid pile-drivers, with an overhang of 30 ft., were used working from the pier protection used to support them. Inside the steel cylinder 141 piles were driven, at about 32-in. centers. Care was taken to place each pile as nearly as possible to match its position on the pile plan. A diver cut off two-thirds of the piles at an average height of 3 ft. above the bottom of the cylinder; the remaining piles extended to within 15 ft. of the top of the pier, or about 13 ft. below the top of the guide-frame.

Before the second unit of the steel cylinder was placed, the lower section was filled with concrete to within 7 ft. of its top, this being the highest level to which the concrete could be placed without disturbance from the tidal currents passing over the top of the section. A bottom-dump bucket was used, having a capacity of 18 cu. ft. Care was taken to provide an even distribution of concrete. A diver was employed continuously. He found that the concrete materials had very little tendency to spread because the concrete was being deposited in still water. The second unit of the shell was then assembled and lowered to place.

To provide for a good connection between the units, the detail, Fig. 1, was evolved. The guide-frame was relied on to bring the joints to proper position and hold them there, but, to insure a more perfect bearing, continuous, flanged-steel plates, ½ in. thick, were riveted around the entire outside of the cylinder on the upper section at Joints 5, 8, and 11. Flanged clips, of ½-in. steel plates 8 ins. long, were placed around the interior of the cylinder, and were 2 ft. from center to center. Thus a butt joint was formed, with cylindrical flange plates on the outside and flange clips on the inside. This portion of the work was also watched by a diver as the unit was lowered into position, the result being that an even bearing was obtained and also a very satisfactory connection.

WATER WORKS

Method of Estimating the Amount of Evaporation from Water and Soil Surfaces in the Livermore Valley of California.

II—EVAPORATION FROM SOIL SURFACES.

In Engineering and Contracting of April 30, 1913, the methods employed in estimating the amount of evaporation from large water surfaces in the Livermore Valley were described. The present article discusses the evaporation from soil surfaces, of varying degrees of saturation, in the same valley. The information here given is from the report of T. W. Espy, which is included in the report of the Spring Valley Water Co. to the Secretary of the Interior and the advisory board of U. S. Army Engineers on the water resources of the company.

EVAPORATION FROM SOILS.

In addition to temperature, humidity and wind velocity, the rate of evaporation and transpiration from soils and vegetation is affected by varying soil conditions, such as relative moistness of the soil, the mechanical, mineralogical and chemical composition of the soil and the character of the vegetation covering the surface.

The amount of evaporation from soils has been extensively observed in California and the West by the U. S. Department of Agriculture and results are published in Bulletins Nos. 177 and 248. These observations were made for the primary purpose of determining the amount of evaporation from soils containing varying percentages of water and methods of preventing this loss. The results are more interesting to us as showing the relation between water surface evaporation and soil evaporation with water table at different depths.

The equipment used was water jacketed galvanized iron tanks about 24 ins. in diameter and 27 ins. deep. These were filled with soil and sunk into the ground until the tops were even with the surface. A 6-in. irrigation was applied to the surface of the soil, and when it had percolated until no free water remained upon the surface, the tanks and contents were

TABLE I.—AVERAGE EVAPORATION LOSSES FROM FREE-WATER SURFACE AND FROM CULTIVATED AND UNCULTIVATED SURFACES AT CALDWELL, IDAHO (JUNE 1-29 AND JULY 3-31, 1909.)

Period.	Days.	Loss from water surface.	Cultivated.				Uncultivated.			
			Tanks 1 and 2.		Tanks 3 and 4.		Tanks 5 and 6.		Tanks 7 and 8.	
Av. weight of tanks at beginning of experiment, lbs.	..	....	1,172.2		1,185		1,172		1,169	
Average loss:		Inches	Pounds.	Per cent.	Pounds.	Per cent.	Pounds.	Per cent.	Pounds.	Per cent.
First	3	1.15	20.40	21.7	20.25	21.6	22.00	23.4	22.50	23.9
Second	4	1.19	3.35	3.6	2.90	3.1	7.10	7.6	7.10	7.6
Third	3	.95	.65	.7	1.00	1.1	1.25	1.3	1.75	1.9
Fourth	4	1.42	.50	.5	.00	.0	1.00	1.1	.75	.8
Fifth	3	1.17	3.00	3.2	2.75	2.9	3.40	3.6	3.40	3.6
Sixth	4	1.50	1.75	1.9	1.35	1.4	1.75	1.9	1.35	1.4
Seventh	3	1.08	.25	.3	.25	.3	.25	.3	.25	.3
Eighth	4	1.35	.90	1.0	.90	1.0	1.00	1.1	.75	.8
Total	28	9.1	30.80	32.9	29.40	31.4	37.75	40.3	37.85	40.3
Equivalent loss in ins.	..	....	1.91				2.42			

weighed. The tank was again weighed at various intervals, the loss in weight representing the evaporation loss. These experiments show that the evaporation of the soil when saturated was greater than water surface evaporation. Some of the results are tabulated and shown with diagrams in Figs. 1, 2 and 3.

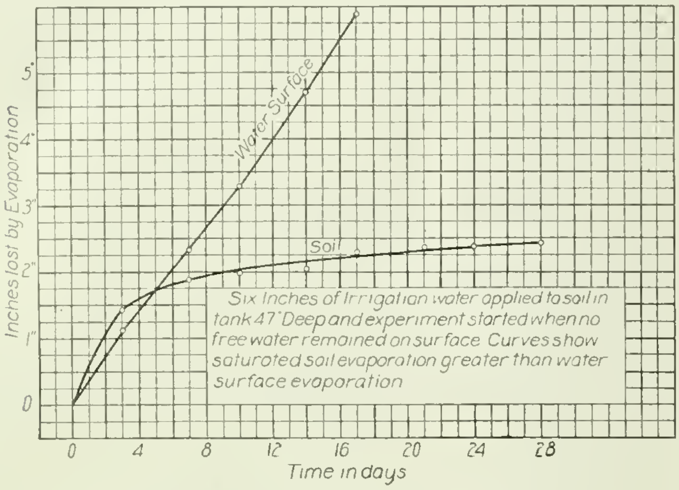


Fig. 1—Average Evaporation Losses from Free Water Surfaces and from Soil Surfaces at Caldwell, Idaho, 1909.

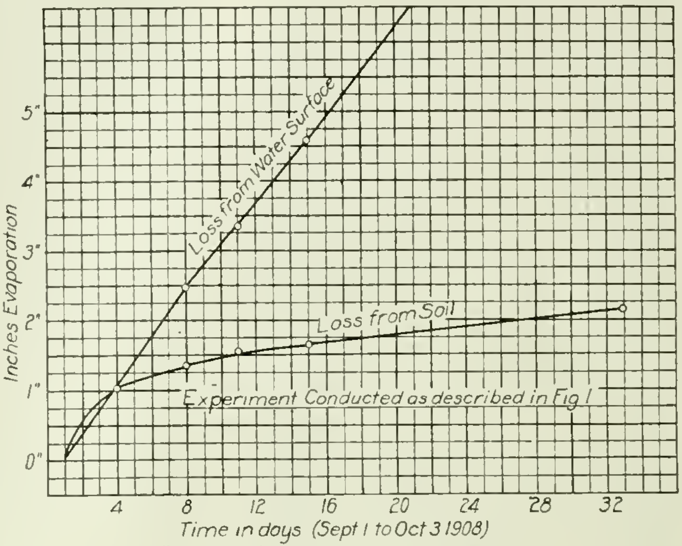


Fig. 2—Evaporation from Free Water and Soil Surfaces at Davis, Calif., 1908.

A comparison of evaporation from soil and water surface is given in U. S. Dept. of Agriculture's Bulletin No. 177 and is shown in Table IV. These experiments indicate that the evaporation from a saturated soil may be as much as 2½ times as great as from a free water surface.

Extensive experiments were carried on in Owens River Valley, where the artesian conditions are strikingly similar to those of the Livermore Valley, by Mr. Chas. H. Lee under the direction of the Los Angeles Aqueduct Commission. Mr. Lee in a special report states that two of the conclusions justified by the Owens River Valley experiments are:

1. There is a definite depth below which evaporation from ground water ceases, and
2. Soil evaporation decreases directly with the depth of the ground water.

This, together with the Department of Agriculture's results of saturated soil evaporation, would indicate that even though the water table was considerably below the surface of the ground, the evaporation would be as much or more than from a shallow water surface.

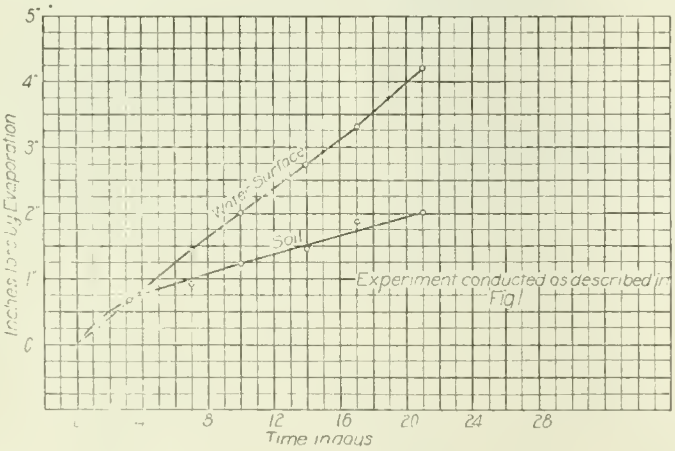


Fig. 3—Average Evaporation Losses from Williston, N. Dak., 1909.

Mr. Lee's conclusions are further borne out by Tables V and VI and Figs. 4 and 5, taken from U. S. Department of Agriculture's Bulletin No. 177.

Some explanation of the increase of moist soil evaporation over water surface evaporation is obtained from Fig. 6, taken from U. S. Department of Agriculture's Bulletin No. 177, showing the effect of air temperature and sun rays on water temperature, dry soil temperature and moist soil temperature. This diagram shows that soils absorb much more heat than does water in a tank, therefore causing the moisture in the soil to have a much higher vapor pressure than the tank water.

The capacity of the soil to absorb heat is further brought out in the report on "New York's Water Supply," by Messrs. Burr, Hering and Freeman, which says:

> In Fig. 7 the proportion of the total annual evaporation that occurs in each month has been plotted from the evaporation experiments and stream flow; in addition, Fitzgerald's curve of mean monthly evaporation from a water surface and the mean monthly air temperature has been added. Naturally the English experiments do not agree with the curves of evaporation computed from our American streams, because of the difference in the seasons, but the similarity of the curves of evaporation clearly indicates that the monthly evaporation from soil is roughly proportional, like that from a water surface, to the mean monthly temperature of the air.
>
> That a greater proportion of the evaporation should occur in the summer is very natural, for evaporation is due to molecular activity at a water surface, and this activity depends upon the amount of heat energy that exists, which is, of course, measured by the temperature of the air and of the surface soil. The soil temperature follows closely that of the air; this was brought out by a good series of soil temperature observations made at Albany from May, 1847, to December, 1848 (Natural History of New York, 1848), which are shown in Fig. 8, together with the mean monthly air temperature in New York City for 30 years.

TRANSPIRATION FROM VEGETATION.

Transpiration from plant life is varied, depending largely upon the habitat of the plant. Those species that are common to arid regions use a very small amount of water and have very small transpiration, while plants common to regions of abundant water are so constructed that they utilize and transpire a great deal. A wide range of data on plant transpiration has been obtained by various botanists, but most of it does not deal with the quantitative amount transpired. The Germans have done considerable work along this line. Of their work the Report of the Commission on Additional Water Supply for the City of New York, by Burr, Herring and Freeman, says:

> The amount of water required by vegetation has been estimated by many experimenters. The best known estimates are perhaps those of Resler, in Germany, which are as follows:
>
> | Crop. | Consumption of water in ins. per day. |
> |---|---|
> | Meadow grass | 0.134 to 0.267 |
> | Oats | 0.14[illegible] to 0.193 |
> | Indian corn | 0.110 to 0.157 |
> | Clover | 0.140 to ..... |
> | Vineyard | 0.035 to 0.031 |
> | Wheat | 0.106 to 0.110 |
> | Rye | 0.091 to ..... |
> | Potatoes | 0.038 to 0.055 |
> | Oak trees | 0.038 to 0.035 |
> | Fir trees | 0.020 to 0.043 |
>
> This indicates that anywhere from 10 to 30 ins. of rainfall each season will be absorbed by vegetation and even greater quantities when supplied.
>
> The experiments of Prof. King at Madison, Wis., on the amounts of water required to produce a pound of dry matter show that when an ample supply of water is furnished, some crops will absorb as much as 25 ins. of water during the growing season. An abundant supply of water is not, however, always present under field conditions and, on an average, cultivated areas probably dissipate 12 to 15 ins. of water between May and September.
>
> From the experiments of Dr. Ebermayer and those of Schubler, Harrington has deduced the values given in Table VII for the evaporation from different surfaces compared to the evaporation from a water surface and the precipitation during the warm season (May to September).

Experiments showing transpiration from wheat and barley were carried on at Tulare, California, from 1903 to 1905 and are published in U. S. Department of Agriculture's Bulletin No. 177. Twelve and 17-in. in diameter water jacketed tanks, 29 ins. deep, were filled with soil in which the grains were planted. These tanks received varying amounts of water and the amount of transpiration was recorded by frequent weighing. The first experiment on wheat was commenced December 11, 1903, and continued until July 14, 1904, when the crops were harvested.

The second experiment started January 12, 1905, and continued until June 22. The yields from the two sets of experiments together with the amount of water received and the net loss, both in weight and inches, during the season are given in the Tables VIII and IX.

These results show that the total loss by evaporation and transpiration was between two and three times the loss from bare soil.

Similar experiments with barley were carried on simultaneously with the wheat experiments, using 17-in. diameter water jacketed tanks instead of 12-in. ones. The first experiment began on December 11, 1903, and the losses as well as the total amounts of water received by each tank and the yields of grain are given in Table X.

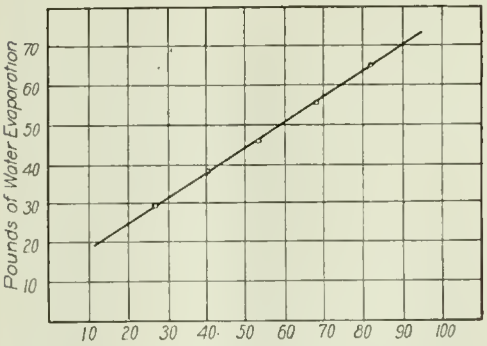


Fig. 4—Relation Between Amount of Water and Loss by Evaporation, Determined by Experiments with Tulare Soils, 1904.

Of this experiment the Bulletin says:

> When the experiment was terminated and the soils turned out of the tanks, that in Nos. 21 and 22, which received no irrigation water, was very dry. Roots had accumulated in the bottom of the tanks in their search for what moisture the soil contained. The bare tanks, 17 and 18, were fairly moist up to within 4 to 6 ins. of the surface. In Nos. 26 and 27, which received the most water—16 ins. in addition to rainfall—the surface was dry, but the bottom layers were quite moist.

TABLE II.—EVAPORATION FROM FREE WATER SURFACE AND FROM TANKS WITH MULCHES OF DIFFERENT DEPTHS AT DAVIS, CAL., SEPT. 1 TO OCT. 3, 1908 (6 INCHES OF IRRIGATION WATER APPLIED).

Periods.	Loss from water surface.	Loss from soil. No mulch tanks 1 and 2		3-inch mulch tanks 3 and 4		6-inch mulch tanks 5 and 6		9-inch mulch tanks 7 and 8	
Average weight of tanks Sept. 1, lbs	....	1,104.7		1,090		1,082		1,085.2	
Average loss:	Inches	Pounds.	Per cent.	Pounds	Per cent.	Pounds.	Per cent.	Pounds.	Per cent.
Sept. 1-4	1.07	16.75	17.8	1.75	1.9	0.00	0.0	0.00	0.0
Sepa. 4-8	1.40	4.50	4.8	.75	.8	.25	.3	*—.50	—.5
Sept. 8-11	.89	3.00	3.2	2.25	2.4	.75	.8	*—.25	—.3
Sept. 11-15	1.23	1.50	1.6	2.50	2.7	.00	.0	.00	.0
Sept. 15-Oct. 3	5.60	8.00	8.5	7.00	7.4	4.75	5.0	2.25	2.4
Total loss, 32 days	10.19	33.75	35.9	14.25	15.2	5.75	6.1	1.50	1.60
Equivalent loss, in inches	.....	2.15		.91		0.39		.10	

*Due to slight inaccuracies in weighing.

TABLE III.—AVERAGE EVAPORATION LOSSES FROM FREE WATER SURFACES AND FROM CULTIVATED AND UNCULTIVATED SURFACES AT WILLISTON, N. DAK. (AUG. 4 TO 24 AND AUG. 24 TO SEPT. 14, 1909).

Period.	Days.	Loss from water surface.	Cultivated. Tanks 1 and 2.		Cultivated. Tanks 3 and 4.		Uncultivated. Tanks 5 and 6.		Uncultivated. Tanks 7 and 8.	
Av. weight of tanks at beginning of experiment, lbs.	..	....	1,042		1,040		1,050		1,010	
Average loss:		Inches	Pounds.	Per cent.	Pounds.	Per cent.	Pounds.	Per cent.	Pounds.	Per cent.
First	3	0.62	11.15	11.9	12.45	13.2	11.55	12.3	9.45	10.0
Second	4	.83	3.85	4.1	2.65	2.8	4.35	4.6	3.75	4.0
Third	3	.56	3.00	3.2	4.10	4.4	4.95	5.3	3.40	3.6
Fourth	4	.74	3.50	3.7	2.25	2.4	4.10	4.4	4.60	4.9
Fifth	3	.57	2.30	2.4	3.80	4.1	6.35	6.8	5.70	6.1
Sixth	4	.89	4.45	4.7	3.70	3.9	2.30	2.4	2.00	2.1
Total	..	....	28.25	30.0	28.95	30.8	33.60	35.8	28.90	30.7
Equivalent of average total loss in ins.	21	4.21	1.82				1.99			

TABLE IV.—EVAPORATION FROM SOIL AND WATER.

Kind of soil and percentage of free water.	Mean temperature taken morning, noon and evening in degrees Fahrenheit. Air in shade. °F.	Soil in shade. °F.	Soil in sun. °F.	Moist soil. °F.	Surface of water. °F.	Weekly evaporation. Soil. Inches.	Water. Inches.
Sandy loam—saturated	71	76	95	83	77	4.75	1.88
Sandy loam—17.5	76	78	106	..	80	1.33	1.94
Sandy loam—11.9	76	78	106	..	80	1.13	1.94
Sandy loam—8.9	76	78	108	..	80	.88	1.94
Sandy loam—4.8	76	78	108	..	80	.25	1.94

This experiment shows that the transpiration from barley was as much as 2½ times the evaporation from bare soil.

Experiments carried on by the U. S. Experiment Station at Berkeley, California, on the common Portuguese or horse bean to determine the effect of varying amounts of water show interesting results.

Seventeen-inch diameter water jacketed tanks, 29 ins. deep, containing graded soils were used. In the first experiment the seed was planted September 1, 1904, one tank in seven being left bare and various amounts of water being supplied in addition to the natural rainfall.

The first experiment expired February 8, 1905, and the second one began March 8, 1905, and continued until August 8, 1905. In Table XI are given the amounts of water applied to and evaporated from the uncropped tanks and the yield from the cropped tanks are included.

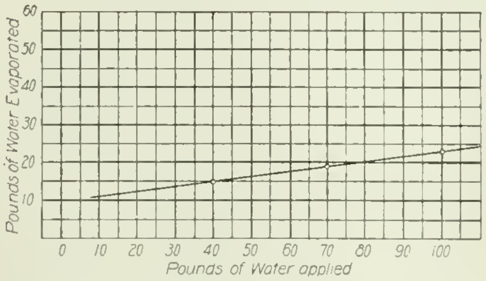


Fig. 5—Diagram Showing Relation Between Amount of Water and Loss by Evaporation as Determined by Experiments with Riverside Soils.

Speaking of the first experiment the Bulletin says:

> Although Tank No. 7, which was bare, received only 1 in. of irrigation water, the heavy rains kept it so saturated throughout the term of the experiment, and at various times sufficient standing water was removed from the surface to make a total depth so removed for the season of 9 ins. At one time, before the plants had made much growth, it was also necessary to remove about 2 ins. each from the four irrigated tanks.

The results as given in Table XI show that in the first experiment the tanks which did the best and the one which received the most water transpired five times as much as evaported from the bare soil, and that the total evaporation and transpiration from these tanks (5 and 6) in the first experiment was 29 ins., as against a water surface evaporation of 11.58 ins. The second experiment shows a loss by transpiration of 26.5 ins., from tanks 5 and 6, while the loss from bare soil was 11.5 ins. The total loss from tanks 5 and 6 was 38 ins., as against a water surface evaporation of 21 ins., or nearly twice water surface evaporation during the spring and summer months.

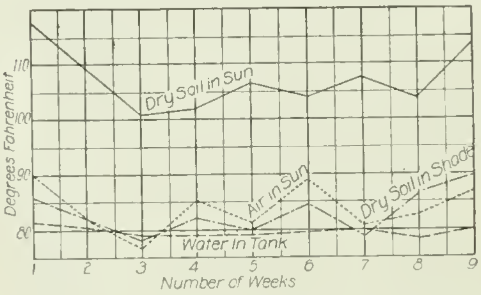


Fig. 6—Diagram Showing Relative Absorption of Heat by Soils and Water—Average Weekly Temperatures for Nine Consecutive Weeks.

In regard to Owens River Valley experiments Mr. C. H. Lee writes:

> Actual measurements on alfalfa in Owens Valley shows the depth of transpiration from blooming plants to be 0.49 ins. per 24 hours on a day when the depth of water evaporating from a pan floating in Owens River was 0.30 ins.

This experiment was made by cutting the alfalfa and weighing it at frequent intervals, and it does not include the loss from the soil.

Mr. Lee further writes:

> The evaporation from soil growing salt grasses when the water stands near the surface is 1.15 times that from a free water surface during the summer months and 45 per cent during the winter.

In his experiments Mr. Lee considered the winter as from October 1 to March 31. In Livermore Valley the wild grasses grow practically all winter and we take salt grass evaporation as 90 per cent during that period.

Many measurements have been made on transpiration per square inch of leaf surface and it has been found to vary from 26 to 45 per cent of water surface evaporation. The Burr, Hering and Freeman Report on "New York's Water Supply" says:

> The amount of water that is transpired by leaf surfaces has been estimated by Unger to be 33 per cent of the evaporation from an equivalent water surface (or perhaps 30 per cent of the rainfall); Sachs found 36 per cent of evaporation from equivalent water surface for white poplar and 42 per cent for sunflower.

As the leaf surface of plants is many times larger than ground surface which they cover, the above estimates indicate that plant transpiration over any given area is very much greater than water surface evaporation of an equivalent area.

TABLE V.—EVAPORATION FROM TULARE SOILS WHICH RECEIVED DIFFERENT AMOUNTS OF WATER, JUNE 15 TO SEPTEMBER 15, 1904.

Numbers of tanks.	Initial weight of soil. Pounds.	Amount of water applied. Pounds.	Inches.	Loss by evaporation. Pounds.	Inches.	Per cent.
1 and 2	319.5	0.0	0.0	3.8	...	.....
3 and 4	324.0	27.4	3.3	29.1	3.5	106.0
5 and 6	317.8	41.0	4.9	38.5	4.6	94.0
7 and 8	314.0	54.7	6.6	45.7	5.5	83.6
9 and 10	311.5	68.4	8.2	54.7	6.6	80.0
11 and 12	316.3	82.1	9.8	65.3	7.9	79.5

TABLE VI.—EVAPORATION FROM SOILS AT ARLINGTON HEIGHTS.

Numbers of tanks.	Initial weight of soil and tank, pounds.	Amount of water added, pounds.	Loss by evaporation in ten days. Pounds.	Inches.	Per cent.
1 and 3	962.4	0	6.3	0.4	....
2 and 4	940.8	40	15.4	1.0	38.5
5 and 7	941.5	70	19.1	1.2	27.3
6 and 8	950.0	100	23.9	1.5	28.9

Authorities state that crops in general use from 400 to 600 times their weight in water. The U. S. Department of Agriculture made experiments on sugar beets in Colorado and found that a very inferior crop of beets during their growth transpired more than 500 times their weight of water. This does not include the evaporation from the soil. A good crop of beets which is now extensively raised on the former saturated area of Livermore Valley will net more than 15 tons of beets per acre. Five hundred times these 15 tons is 7,500 tons of water per acre, equal to a depth of 66 ins. of water transpired in the growing season of six months between February and August.

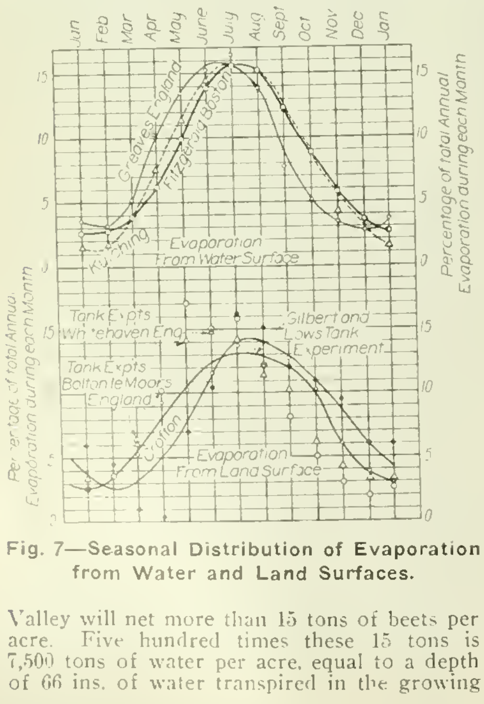


Fig. 7—Seasonal Distribution of Evaporation from Water and Land Surfaces.

CONCLUSIONS.

In view of the above given data and all data obtainable we are justified in assuming that:

(1.) The evaporation from the area of the Livermore Valley formerly saturated and supporting a dense growth of tules, willows and wild celery, etc., was at least 66 ins. per annum, and that under the present crop conditions the evaporation over this area is at least that much per annum.

TABLE VII.—EVAPORATION FROM VARIOUS KINDS OF VEGETATION.

	Proportion of evaporation from free water surface.	Proportion of precipitation.
Sod	1.92	.96
Cereals	1.73	.86
Forest	1.51	.75
Mixed, etc.	1.44	.72
Bare soil	.60	.30

TABLE VIII.—YIELDS OF WHEAT. TOTAL WATER RECEIVED, AND WATER LOST BY EVAPORATION AND TRANSPIRED AND USED BY CROP IN TULARE WHEAT EXPERIMENT, 1903-4.

Numbers of tanks.	Totat water received, lbs.	Total net loss during season, lbs.	Yield of grain, grams.	Inches water Received.	Used.
1 and 2	57.27	79.77	..	6.28	8.9
3	93.75	113.75	10	10.28	12.6
4	128.49	147.49	14	14.28	16.5
5	161.49	186.49	19	18.28	20.8
6 and 7	199.71	216.71	38	22.28	24.2
19 and 20	*75.51	69.76	..	8.40	7.8

*Bare soil.

TABLE IX.—YIELDS OF WHEAT IN TANKS 2 AND 7, AT TULARE, JANUARY 11 TO JUNE 22, 1905, WITH AMOUNTS OF WATER RECEIVED.

Numbers of tanks.	Total water received. Lbs.	Ins.	Loss, lbs.	Yield of grain, grams.	Loss, ins.
2 and 3	110.08	12.07	136.58	11.2	14.9
4 and 5	164.80	18.07	190.30	33.6	20.8
6 and 7	246.88	27.07	254.68	16.6	27.8
1 and 21	*97.53	10.69	92.60	....	10.1

*Bare soil.

TABLE X.—YIELDS OF BARLEY, TOTAL WATER RECEIVED, AND LOSS BY EVAPORATION AND AMOUNT OF WATER TRANSPIRED AND USED BY CROP IN TULARE BARLEY EXPERIMENT, 1903-4.

Numbers of tanks.	Total water received, lbs.	Total net loss during season, lbs.	Yield of grain, grams.	Inches water Received.	Used.
21 and 22	57.27	78.27	27	6.28	8.58
23	93.75	107.75	41	10.28	12.00
24	128.49	148.49	62	14.28	16.70
25	161.49	170.49	48	18.28	19.10
26 and 27	198.71	198.96	66	22.28	22.20
17 and 18	75.51	78.01	..	8.40	8.70

(2.) That over the area supporting salt grass and other wild grasses the evaporation is proportional to the depth of water table, being at least 52 ins. when the water table is near the surface.

(3.) That the water loss by evaporation applicable to large water bodies in Alameda County averages 48 ins per annum, which in its application to the gross draft should be reduced by that portion of the rainfall over the surface of the reservoir not included in the run-off.

Chlorination Practice, Sealing System to Reduce Water Waste and Motor Truck Service at Milwauke Water Works.

The notes here given with reference to waterworks operation in Milwaukee, in 1912, are abstracted from the latest annual report of Superintendent H. P. Bohmann. The features here discussed are the arrangement of the temporary chlorination plant, the preparation and application of hypo solution, the theft and contamination of city water through private fire protection systems, and the economy resulting from the use of light weight motor trucks in the meter department.

TEMPORARY CHLORINATION PLANT.

The plant is situated at the east end of the North Point pumping station and consists of three concrete tanks, two of which have a capacity of 2,000 gals. each, the other a capacity of 200 gals. The two large ones are under ground, the concrete tops of same serving as a floor for the plant, and incidentally furnishing support for the smallest or mixing tank. The latter is directly above and between the two former ones, and is equipped with a stirring device, a water inlet, two outlets and about 10 ins. above the bottom, which lead into the larger tanks, and an outlet which leads into the sewer. The large tanks have outlets leading into the well from which the water supply is pumped. The amount of solution passing through these outlets is controlled by a valve, and the rate at which the solution passes through them is indicated by a depth recorder. They also have sewer connections, thus facilitating thorough cleansing by flushing.

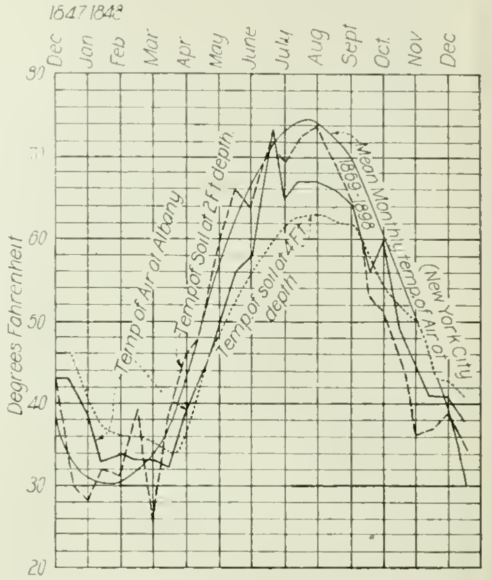


Fig. 8—Semi-monthly Observations on the Mean Temperature of the Soil at Albany, N. Y., in 1848.

PREPARATION AND APPLICATION OF "HYPO" SOLUTION.

The hypochlorite received at this station was of a fair degree of purity, containing about 35 per cent of available chlorine. A definite quantity of hypochlorite is dumped into the mixing tank, which is then gradually filled with water, an attendant meanwhile agitating the mixture by rotating the stirring device. After thorough agitation, the mixture is allowed to settle and the supernatant clear liquid is drawn off into one of the large 2,000-gal. tanks, which is then filled with water. The solution is next allowed to flow into the well at such a rate as to deliver any amount of hypochlorite per 1,000,000 gals. of water pumped, as may be desired.

From experience, we have come to the conclusion that 6 lbs. of hypochlorite of lime, equivalent to about 0.26 parts per 1,000,000 of available chlorine, is the logical quantity to use, as the destruction of bacteria is here about 95 per cent, keeping our average below 100 per cc. This destroying action does not seem to increase by the use of greater quantities of hypochlorite, whereas, in using quantities of less than 6 lbs. per 1,000,000, a marked increase in the bacterial count is observed. At the present time Jan. 1, 1913, only 3 lbs. of hypochlorite, or about 0.13 parts per 1,000,000, of available chlorine are being used. This reduction, although greatly decreasing the efficiency of the process, is necessary, as the water grows cold, the cold greatly retarding the chemical reaction of hypochlorite—the taste and odor finding its way into the water supply being objectionable to the consumer. In order to overcome this, steam pipes were connected with the various tanks and the water was warmed to 70° F. In this way, the conditions were rectified to some extent.

From laboratory experiments, we infer that the chemical action of hypochlorite is at its maximum at a temperature of 70° F., and the action decreases correspondingly with the decrease in temperature.

THEFT AND CONTAMINATION OF CITY WATER THROUGH PRIVATE FIRE PROTECTION SYSTEMS.

The 150 factories and mercantile establishments equipped with systems of automatic fire protection known as "automatic sprinkler systems" are uncontrolled by meters. The possibility of the use of water surreptitiously, or the leakage or misuse of these systems, led to an investigation of them. In many instances connections were found whereby water could be used for purposes other than fire protection, though evidence of actual use was not obtainable. In other cases the actual use of water was discovered, while in others wastage of water through defective drain valves, was found.

TABLE XI.—COMPARISON OF AMOUNTS OF WATER APPLIED TO HORSE BEANS, WITH THE AMOUNTS LOST BY EVAPORATION AND TRANSPIRED BY THE PLANTS.

	First experiment					Second experiment				
				Total water in inches.					Total water in inches.	
Numbers of tanks.	Total water received, lbs.	Total net loss during experiment, lbs.	Yield of green matter, grams.	Received.	Loss.	Total water received, lbs.	Total net loss during experiment, lbs.	Yield of green matter, grams.	Received.	Loss.
1 and 2.........	87.50	132.87	3,352	20.10	15.9	89.60	113.72	404	10.73	13.6
3 and 4.........	99.85	155.22	4,281	24.10	18.7	223.20	240.57	1,386	26.73	29.0
5 and 6.........	276.25	240.50	4,547	33.50	29.0	321.81	316.31	2,095	39.46	38.0
7	92.00	42.25	.....	11.00	5.0	131.35	95.83	.....	15.75	11.5

In order to control the systems of automatic sprinklers and to guard against the further pollution of the city water service, a plan of "sealing" and of periodical inspection of the systems was recommended. This consisted of the issuance of an order for the removal of all connections not properly part of the automatic service, the sealing with light copper wire (No. 19) and lead seals all drain valves and drip openings on the system, the closing of the gate valve on the discharge main of the fire pumps and the sealing of the same and the repair or replacing of defective check valves on the mains connecting with the city mains.

Notices were served the consumer that the destruction of these seals, without permission, except in case of leakage, due to the opening of the "heads" by fire, or accident, or for the use of service for insurance inspection test, would be sufficient cause for the issuance of an order to meter the system, or the withdrawal of the service. The report to this department at all times of the damage to seals was made obligatory on the part of the consumer.

In order to assure the consumer that this system of sealing would not affect their rates of insurance with the various companies, and at their request, conferences were held with representatives of the inspection departments of these companies, the plan explained and their co-operation invited. This was readily and cheerfully given, and the results of the first five months of this system of control show the necessity of a continuance of the work in lieu of a complete metering of each system, for and against which many good arguments can be advanced.

USE OF LIGHT MOTOR TRUCK IN METER DEPARTMENT.

A 1-ton automobile truck was purchased by the meter department and has proven very successful. It was used to take care of the far trips. This enabled us to shorten the drive of the teams. This resulted in the teams doing more work, as they did not have to spend several hours each day in merely driving to their jobs. The success of this one automobile truck is so marked that it would be policy to provide another to replace one of the horses that is of no further service and also take care of the increasing work.

By putting in service the automobile truck this year, it made possible another feature that has proven successful and very necessary. One of the teams was taken off its regular work, and with an organized crew of four men tests are being made on all large water meters. These tests are made on the premises, by means of connecting a proven or a test meter to the one to be tested. The meters in the large manufacturing plants, breweries, tanneries, railroad companies, etc., were thereby tested. The results of these tests show that it is necessary to continue these operations, as it was found that many meters showed a loss of from 2 to 40 per cent to the department, which means about $20,000 on the meters tested during the year.

Organization of the Department of Water, San Diego, California.

The city of San Diego, California, now owns its water supply properties from "mountain to meter." The city is situated in the extreme southwestern part of the state, the portion known as the semi-arid section. The annual rainfall is light and there are no natural sources of water supply near the city. For this reason it was necessary to dam up remote mountain gorges to impound the run-off of winter rainfalls, and to build conduits, flumes and pipe lines to convey these waters to the city. The population of the city was about 40,000 in 1910. All services are metered. The organization of the department is shown in the accompanying diagram, and the duties of the employes are described as follows by Assistant Superintendent and Hydraulic Engineer H. A. Whitney in the latest annual report of Superintendent Herbert R. Fay:

ORGANIZATION OF DEPARTMENT AND DUTIES OF EMPLOYES.

The Department of Water is governed by a member of the City Common Council known as the superintendent of the Department of Water, who is responsible for the different branches of the department, and as a member of the Common Council initiates all legislative acts in connection with the department, passes upon all ordinances, resolutions, petitions, etc.

The superintendent is assisted by a hydraulic engineer who acts as assistant superintendent. The assistant superintendent is responsible to the superintendent for each of the various bureaus and divisions into which the water department is divided. There are three divisions, namely: Clerical Division, Division of Lands, and Engineering Division.

Clerical Division.—The clerical division consists of the secretary, stenographer and office help in connection with the superintendent and assistant superintendent's office. The duty of the clerical division is to prepare all ordinances, resolutions, attend to all correspondence, and to gather together printed matter, such as catalogs and reports from different cities, for the aid and benefit of the superintendent and assistant superintendent, also to assist in compiling all reports.

Division of Land.—The division of land consists of the forester, gardener and his assistants. His duties are to oversee all lands pertaining to the department, to make reports on the different classes and varieties of trees, shrubs and flowers and report anything in connection with land soils, the different reservoirs and water sheds of which he may be in charge.

Engineering Division.—The engineering division is in direct charge of the hydraulic engineer to officially advise the superintendent as to the best methods of construction and operating the Department of Water of the City of San Diego, and of all the additions thereto, and to that end it is his duty when requested to prepare, and submit plans, details and specifications of any work proposed to be done by the department and he has in his charge, and under his control, subject to the superior authority of the superintendent, all construction work necessary for the perfection, preservation and maintenance of the water works system, and of all employes connected therewith. He has charge of all the maps, diagrams, service reports, papers, records and data of every description, pertaining to the water works system, and keeps and maintains them, as the records of his office, in the Department of Water. The engineer is, upon request of the superintendent of the water works, supposed to do all necessary surveying required in the prosecution of such work as may be done under the direction of the hydraulic engineer, and furnish him full reports of such services as may be necessary.

Aside from the three divisions mentioned above in connection with the Department of Water, there are three bureaus, known as the Bureau of Accountability, the Bureau of Distribution and the Bureau of Conservation.

Bureau of Accountability.—This bureau is divided into four parts, as follows: Part one pertains to all books, bills and time keeping. Part two pertains to the receiving of all cash and to the issuing of all orders for services and work to be done.

Part three pertains to the meters, investigation and monthly reading of same.

Part four has custody of all property which pertains to the receiving and compilation of all statistics and the keeping of stock in the yards of the Department of Water.

The Bureau of Accountability is in direct charge of a chief clerk whose duties are to have charge of the receiving of all moneys, make out receipts for same, issue orders for the installation of new services, give information to the different water consumers, keep check of the finances pertaining to the Water Department, have charge of the entire accounts and the bookkeeping pertaining to this department, give notice to those who are delinquent in paying their water bills, adjust such misunderstandings as may arise between water consumers and the Department of Water, make such investigations as may be necessary, in order to determine whether water is being illegally used or if the Water Department in certain cases is getting proper returns for the water consumed. He also has under his charge and direct control all the reading of meters and reporting of same to the Bureau of Distribution for repairs when same may be out of order. His duties are to keep correct account of all property under the control of the Department of Water, keep detailed statistics of all the pipe that is laid in the ground, location of all the valves, hydrants and service pipes, the size all mains, and to this end the department has compiled and prepared a complete printed list of every known gate-valve, and hydrant in the city, and bound them in the form of loose-leaf books, giving size and location of same, and every foreman and official who has any connection whatsoever, with the outside working of the system, has a copy of this book. The inspection of all faulty gates is under his supervision, and repair orders are issued from this office. All pipes, valves, fittings and other material connected with the Department of Water, and the inventory of same, is in the charge of the Bureau of Accountability until same is laid in the ground and a proper receipted record is returned to the chief of this bureau by the Chief of the Bureau of Distribution.

The connecting link between the Bureau of Accountability and the Bureau of Distribution and Bureau of Conservation is formed by three classes of orders, namely, Form No. 61, Work Orders; Form No. 62, Service Orders and Form No. 9, Extension Orders.

Channels for Form 61, Work Orders.—Upon receiving a written order from the superintendent, assistant superintendent or resolution of Council, the chief clerk issues a work order, known as Form 61, to any or all of the various foremen for execution.

Form 61 is made out in triplicate—Original (white), 2nd. sheet (blue), and 3rd. sheet (yellow). After being properly filled out by the chief clerk and retaining the 3rd. copy for his files he passes the Original and 2nd. copies to the statistician who places a drawing on the reverse side of the original in space set aside for this purpose, after which they are sent to the assistant superintendent for approval, who takes the 2nd. copy for his files and sends the original to the foreman to whom addressed, for execution.

The foreman sends the original back to the assistant superintendent as soon as the work is completed, the assistant superintendent then sends it to the office of the chief clerk, where the actual cost data is inserted by the bookkeeper and the new work is entered on the official maps by the statistician, and the meter registrar takes his portion through the Addressograph for collection of revenue, then the chief clerk takes his yellow copy and pastes it to the original, ready for the department files.

Channels for Form 62, Service Orders.—Form No. 62, known as Service or Tap Orders, is made out in triplicate, No. 1 is a pale green, No. 2 pink and No. 3 is a white color.

This order is issued by the service clerk at the window where applications for water are made, then sent to the chief clerk, who has them checked by the statistician and sent to the assistant superintendent for approval; he retains the white copy No. 3 for his office files.

The assistant superintendent then issues to the foreman of services who retains a copy, No. 1, and issues copy No. 2 to one of the service wagons for actual execution. The man in charge of this service wagon enters labor and material data on copy No. 2 and returns it to the foreman of services, who copies this data on sheet No. 1, returning same to the assistant superintendent and retaining copy No. 2 for his files. Copy No. 1 is then sent to the office of the chief clerk, where the cost data is entered by the bookkeeper and passed to the statistician who enters the service on the plat books, showing actual locations, date installed, etc. Then copy No. 1 is handed to the meter registrar, who makes a plate with typograph from which water bills are printed each ensuing month. Copy No. 1 is then filed for future reference.

Channels for Form No. 9, Petition to City Council, for Extension of Water Mains.—Form No. 9 is a single copy made out by the applicant for an extension of city water mains in order to secure privilege of city water.

After this form is properly filled in and signed by the applicant, it is given to the service clerk, who sends it to the chief clerk together with one or more service orders. The chief clerk has them all approved and verified by the statistician; then the chief clerk takes the service orders from the petition and inserts the required data on the back of them and sends them to the superintendent for signature, passing them then to the stenographer, who sees that the city clerk gets them in time for the following Council meeting. After Council action, the city clerk or his deputies return resolution covering said petition to the chief clerk, who then gathers the service orders that originally accompanied the form and issues a working order to cover the extension, attaching service orders thereto, all of which then go to the assistant superintendent, who in turn issues them to the foreman of services. The resolution covering the action of this petition will be found on file in the city clerk's office as well as the superintendent's office.

Bureau of Distribution.—The Bureau of Distribution is in charge of a general foreman, who is responsible for the work initiated in his bureau. His duties are to take all orders issued to the Bureau of Distribution and segregate and apportion them to the several sections into which his bureau is divided. It is his duty to keep an accurate report sheet showing where each of the several gangs is working; to make out, with the assistance of his section foreman, the charts showing the location of the various gangs for each subsequent day, to make out orders to the superintendent's office for all material needed to supply the depleting stock, to see that the necessary material, such as picks, shovels and work boxes are delivered in time to avoid the loss of work in the various departments, to keep account of all orders issued for stock and see that the same is delivered in ample time, to advise, from time to time, his various section foremen the most efficient methods of pursuing their work. This bureau is divided into three sections, namely, Section of Construction, Section of Services and Section of Operation. Each section is in charge of an assistant to the general foreman.

Duties of the Foreman of Construction.—As assistant to the general foreman the foreman of construction has direct charge of laying all the cast-iron water mains as laid under the Department of Water. He visits the various gang bosses and advises the general foreman from time to time regarding the amount of work being done. It is his duty to see that all the pipes, valves and fittings pertaining to his sections of work are delivered upon the work in plenty of time, and to this end it is his duty to inform the general foreman as to what material will be needed for each subsequent day in order that there be no delay due to the lack of delivery of same. A daily report is made showing the length of ditch, the amount of excavation, the sizes of the pipe, the number of gates and hydrants, and the locations of same as installed each day for each gang under his supervision.

This report is transmitted to the Bureau of Accountability and recorded by the statistician upon the official records.

Section of Services.—The Section of Services consists of laying and installing all pipes 3 in. and smaller; in fact, any work that is done by pipe-fitters is directly in charge of the foreman of services, who is required to install (when so ordered through the chief of the Bureau of Accountability), all service pipes tapping the water mains as installed by the Section of Construction. He also installs all meters, meter boxes and meter box covers. All service connections are connected to the water

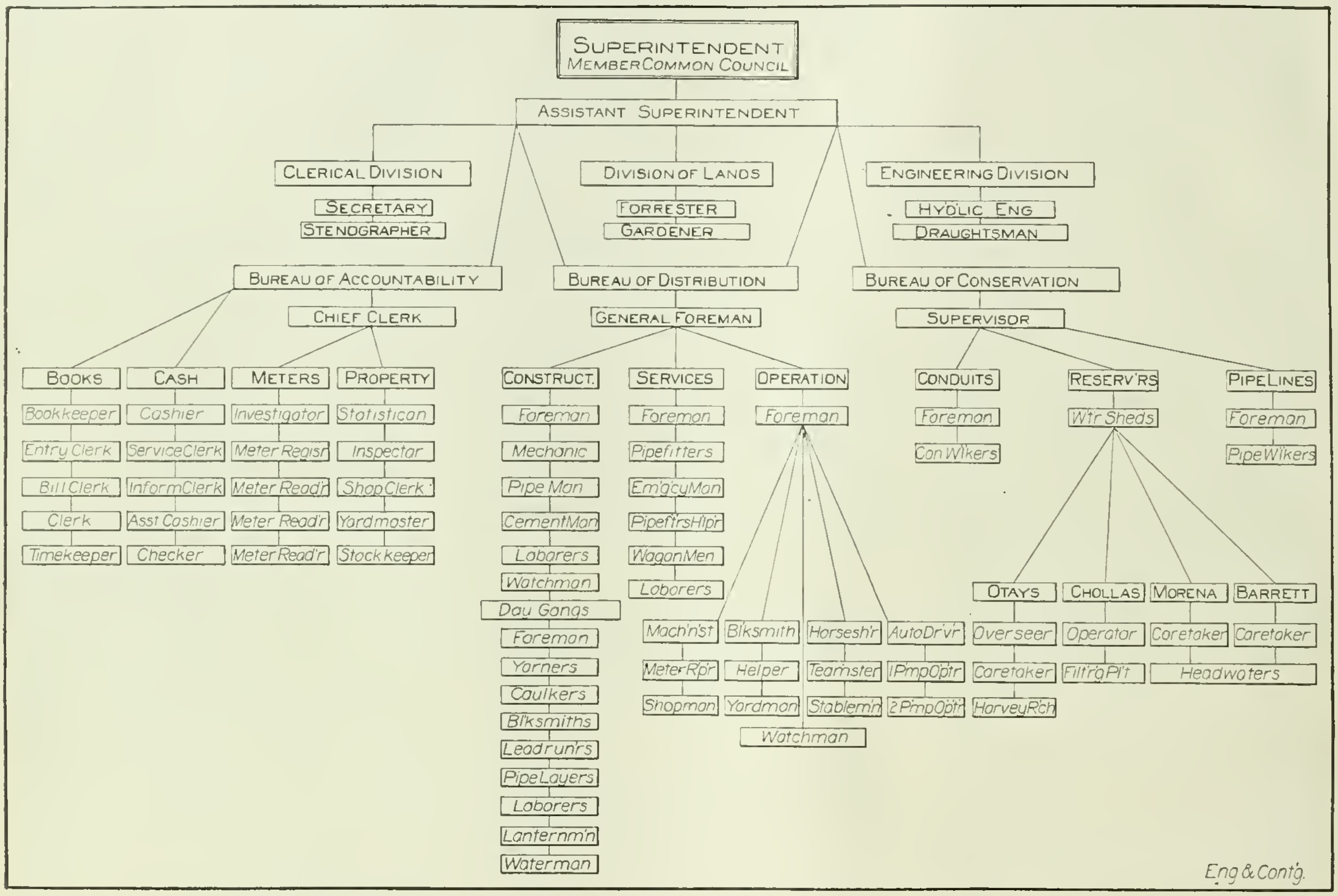


Diagram Showing the Organization of the Department of Water, San Diego, Calif.

mains by means of a corporation cock and a lead connection brought 1 ft. inside the curb line, and a service cock and the meter installed on same. Inasmuch as 100 per cent of all services in the Department of Water of the City of San Diego are metered, it requires a meter for each separate installation. All night troubles of any character whatsoever are under the direct charge (subject to the orders of the superintendent, the assistant superintendent or the general foreman) of the foreman of services. and to that end he is instructed to get out the proper crew should there be a break in any city water main, service connection, hydrant, or any trouble of a like character.

Section of Operation.—The Section of Operation is in charge of an employe known as the foreman of operation. His duties are to have charge of all machine work connected with the Department, the repairing and testing of all meters, and such blacksmithing work as needs to be done for the Department of Water, and working in conjunction with the representative of the Bureau of Accountability he takes all pipes, valves, fittings and material from the yards of the department and delivers them as needed (upon the order of the general foreman) to such jobs as may be designated. He is in charge of the teamsters, stablemen, automobiles, auto trucks and motorcycles, and it is his duty to report same when in need of repair, and on order from the assistant superintendent to place them in proper condition. It is necessary that he report from time to time the efficiency of the different pumps and make recommendations regarding the repair of same. He has the overseeing and charge of all pumping stations, reservoirs and stand-pipes and the repair of all faulty gates and the reinstallation of all hydrants and such other work as may be deemed necessary by the superintendent and his assistant.

BUREAU OF CONSERVATION.

The Bureau of Conservation is under the direct charge of the supervisor, and is divided into three sections, namely, Conduits, Reservoirs and Pipe Lines.

Section of Conduits.—The conduits include all the concrete flume lines and the wooden flume trestles between the proposed Barrett reservoir and the outlet of the Dulzura Conduit into the Dulzura Creek, a distance of about 13½ miles. There are thousands of feet of tunnel passing through the mountains which have to be continually looked after, especially during the rainy season. The wooden flumes passing across the high trestles are in constant danger of fire and it is necessary that they have the closest supervision for fear that they may be destroyed during the dry season by fire and during the rainy season by washouts. These are looked after by a foreman and a conduit walker.

Section of Reservoirs.—The reservoirs, together with the watersheds, are divided into four parts: the Upper and Lower Otay Reservoir and watersheds, the Chollas Heights reservoir and watershed, the Morena reservoir and watershed and the Barrett reservoir watershed. Each of these watersheds has a caretaker, and in addition to a caretaker at the Otay reservoir watersheds there is an overseer, whose duty is to look after the various pipe lines and inspect the outlet valves daily and to see that the watersheds are properly protected from contamination, and report any trespassing upon the city's reserves. At the Chollas Heights reservoir watershed the caretaker has charge of the filtration plant that takes the water as it eventually reaches this filtration plant from the various impounding reservoirs, whose duty is to operate the filtering plant and look after the repair and cleansing of same. The caretaker at Morena and Barrett reservoirs gives constant supervision to the watersheds and reports any trespassing and gives notice of any dangerous condition due to the dams or headworks of these reservoirs, as well as making a daily report of the amount of water impounded or let out of these reservoirs through the conduits. The pipe lines from the Lower Otay reservoir into the city of San Diego are in charge of a pipe line foreman, whose duty is not only to inspect the line, but also to repair and make the necessary improvements to keep the pipe lines in first-class condition. He has supervision over 20 miles of continuous wood stave pipe varying in size from 20 ins. to 42 ins. in diameter, and is assisted by two pipe walkers.

Some Data on the Relative Cost of Mechanical and Slow Sand Water Filtration Plants.

While both slow sand and mechanical water filtration plants may now be safely depended upon to furnish potable water, the slow sand process unquestionably is on the wane in this country. Where the two types are equally desirable, hygienically, the deciding factor is usually the relative cost. The following discussion of relative costs is from a paper by T. Aird Murray, Consulting Engineer, Toronto, before the Canadian Public Health Association.

The cost of installation for rapid filtration is much below that of slow sand. Covered slow sand filters cost on this continent from $50,000 to $60,000 an acre, apart from pumping, etc. Mechanical filters, with buildings, cost about $30 per sq. ft. of filtering area.

Assuming slow sand filters to treat 10,000,000 gals. per day at the rate of 2,500,000 gals. per acre, the cost would be $220,000. Assuming mechanical filters to treat the same quantity per day at the rate of 120,000,000 gals. per acre, at $30 per sq. ft. of filter area, the cost would be $108,900, or a saving in first cost in favor of mechanical filtration of $111,100. Approximately, slow sand filters in Canada may be said to cost at the rate of $20,000 per each 1,000 000 gals. of water per day, and mechanical filters half this amount.

In connection with the Grand Rapids scheme, the estimates show a cost of $779,210 to install a slow sand filtration plant of a capacity of 15,000,000 gals. per day, while the estimated cost of mechanical filtration for a 20,000,000 gal. plant was $350,000 complete. The latter contracts have been let within a few thousand dollars of the estimated cost. In the above case the cost rate of slow sand was $50,000 per 1,000,000 gals. per day, while the cost of mechanical treatment was at the rate of $17,500 per each 1,000 000 gals. treated, or about ⅓ of the cost of slow sand.

It is an undoubted fact that mechanical filtration costs somewhat less than half of the amount of slow sand filtration in the first instance. On the other hand, it is held by some, that this saving in first cost is more than set off by the extra cost in operation due to the use of coagulants. The cost with reference to pumping and laboratory administration may be said to be common to both systems, and need not be taken into account in comparative data. With slow sand filtration the frequency of scraping represents the chief cost, and this cost is in proportion to the turbidity of the raw water. With mechanical filtration the cost of operation also increases in ratio to the turbidity, as increased turbidity usually means an increased amount of coagulant.

A mechanical or rapid filter plant requires a less number of attendants, in fact, apart from the laboratory and pumping operatives, two men are usually sufficient to handle a fair sized plant. In order to compare the costs of slow sand and mechanical methods it is necessary that the amount of coagulant required by the latter be determined, as upon this factor the comparative operating expenses mainly depend.

It is usual to compare the operating costs of plants of both types, and thus create comparative cost data, but such data is not always conclusive. The only comparative data of exact value would be in the case of both slow and mechanical filtration treating an equal volume of the same character of water under similar conditions.

The operating costs of slow sand filtration plants vary considerable. In England the costs average about $1.24 per 1,000 000 gals. in connection with the London water companies. There the water is first well settled in sedimentation areas, and is only slightly turbid when applied to the filters. The cost of labor is very much lower than on this continent, and the data is of little value for comparative purposes. At Vernon, N. Y., with settled reservoir water, the cost per 1,000,000 gals. has averaged about $2. At Poughkeepsie, N. Y., with occasional turbidity the costs average $3. Four plants in connection with Philadelphia, viz., Roxbury, Upper Roxbury, Belmont, Queen Lane and Torresdale, respectively show operating costs of $4.24, $3.18, $3.23, $1.70 per 1,000,000 gals. Albany, N. Y., an average of three years, $3.67. Washington, an average of about $2.

The average cost of treating raw waters, without previous sedimentation by slow sand filtration appears to range somewhere between $3 and $4 per 1,000,000 gals.

The operating costs by mechanical filtration also appear to vary considerably. John Don gives the cost of operating Jewell Filters at from $2.60 to $3 per 1,000,000 gals. in England.

At Harrisburg, Pa., from 1906 to 1910, the average cost per 1,000,000 gals., apart from pumping, has been $3.69. The average operating expenses for 21 plants in the States, including the cost of coagulant and labor, amount to $2.02 per 1,000,000 gals. of water treated. See Table I. It may be concluded, however, that in order to obtain the high efficiencies as at Harrisburg and Cincinnati, a cost of $3 to $4 is nearer the actual average required, and that the extra cost incurred by the use of coagulants is about balanced by the extra cost of general operating expenses by slow sand filtration.

It has been said that the economic application of rapid filtration depends principally upon the amount of coagulant required. With river waters subject to high turbidity, much of the suspended matter can be retained by natural sedimentation. The coagulant frequently used is sulphate of alumina either by itself or with soda ash in cases where the water is low in alkalinity.

Sulphate of alumina, not being manufactured in Canada, is subject to duty and freight, and for this reason rapid filtration is more expensive here than in the States. The author in some recent investigations into the question of filtering a proposed surface water supply for the City of Port Arthur, Ont., had cause to go into the question of the cost of coagulation and mechanical filtration. It was determined that to treat each 1,000,000 gals. of water per day, at the rate of one grain of sulphate of alumina to the gallon, would cost $2.43 and for soda ash $3. As this particular water required about three grains to the gallon of alumina and one-fifth of a grain of soda ash in order to remove the vegetable dye from the water, the proposal was reported against on the score of excessive cost as against pumping water direct from Lake Superior. It appears reasonable to assume that in cases where the average amount of coagulant required does not exceed one grain to the gallon at a cost of, say, $2.50 per 1,000,000 gals., that mechanical filtration will compare favorably with slow sand filtration in cost.

Assuming that the installation of slow sand filters cost $20,000 and mechanical filtration $10 000 per 1,000,000 gals. per day, the capitalized cost of the systems with a daily capacity of 10,000,000 gals. may be stated as follows:

SLOW SAND FILTRATION.

Cost of installation	$200,000
Cost per annum at $3.50 per 1,000,000 gals. per day, capitalized at 5 per cent	255,500
Total capitalized cost	$455,500

MECHANICAL FILTRATION.

Cost of installation	$100,000
Cost per annum of coagulants and labor, $4 per 1,000,000 gals. per day, capitalized at 5 per cent	292,000
Total capitalized cost	$392,000

Balance in favor of mechanical filtration when one grain of coagulant per gallon is required is thus $63,500.

The above appears to be a reasonable statement, as it will be found that there are few instances where the coagulant will exceed one grain to the gallon, and in such cases it is probable that excessive turbidity can be reduced by preliminary unassisted sedimentation. At Saskatoon, Sask., a mechanical filtration plant of a capacity of 4,000,000 gals. per day, assisted by sedimentation is successfully treating the, at times, very turbid water of the South Saskatchewan River, with 0.5 of a grain of sulphate of alumina to the gallon. The filtered water is always sparkling and clear, while the bacteria count ranges from 0 to 8 per c. c. in the treated water.

TABLE I.—COST OF COAGULANT AND LABOR, PER 1,000,000 GALS. TREATED, IN 30 MECHANICAL FILTRATION PLANTS.

	Coagulant.	Labor.
Little Rock, Ark.	$3.50	$1.50
Birmingham, Ala.	1.00	.50
Chattanooga, Tenn.	1.00	1.00
Shreveport, La.	2.50	.50
Meridan, Miss.	.75	.75
Huntington, W. Va.	1.00	.75
East St. Louis	1.50	.50
Joplin, Mo.	.75	.50
St. Joseph, Mo	1.25	.40
Louisiana, Mo.	1.50	.70
Marinet, Wis.	.80	.30
Morril, Wis.	2.00	.50
Keokuk, Ia.	1.00	.60
Clinton, Ia.	1.00	.60
Muncie, Ind.	1.70	.50
S. Pittsburg, Pa	1.00	.60
New Castle, Pa	3.00	1.00
Butler, Pa.	.80	.50
Elizabeth, Pa.	1.00	.50
Connellsville, Pa.	.75	.40
Portsmouth, Vt.	1.00	.65
Davenport, Ia.	1.10	.50
Quincy, Ill.	2.00	...
Moline, Ill.	2.00	...
Danville, Ill.	1.00	...
Pontiac, Ill.	1.50	...
Lorain, Ohio	1.59	1.60
Elyria, Ohio	1.00	...
Vermillion, Ohio	1.50	...
Vicksburg, Miss.	2.00	...

Break in Water Main Caused by Blasting.—The use of dynamite in blasting a stump directly over a 20-in. water supply main at Richmond, Ind., caused a break which resulted in the loss of thousands of dollars to the business interests and much inconvenience to the residents of the city.

Drilling Methods Employed in Driving One Section of the Under City Tunnel, Catskill Aqueduct.

The under city tunnel of the Catskill aqueduct will be concrete lined and 15 ft. in interior diameter. The section is circular and the lining is 1½ ft. thick, so that the circular rock cut required to be driven is roughly 18 ft. in diameter. This gives a volume of excavation of 9.42 cu. yds. per lineal foot of cut. The diagram, Fig. 1, shows the drill hole arrangement employed on a section of the tunnel being built by the Pittsburg Contracting Co. This company's methods of driving are outlined as follows by Mr. S. W. Symons in "Compressed Air Magazine" for April, 1913:

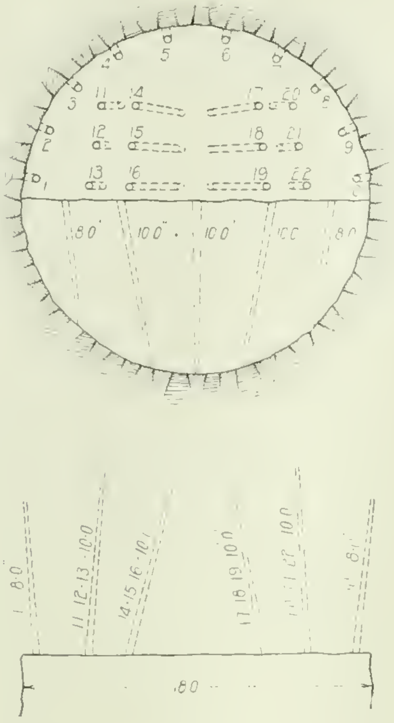


Fig. 1—Arrangement of Drill Holes, Under City Tunnel, Catskill Aqueduct.

Six drills are used, mounted on three columns, two arms and two drills to each column. Holes Nos. 1-2-3-4-11-12-13 (see diagram) are drilled from the left hand column; Nos. 5-14-15-16-6-17-18-19 from the center column; Nos. 20-21-22-7-8-9-10 from the right hand column. The lower arms are then swung around and the drills turned down for the bench holes, all holes being drilled without changing the set-up of the columns. All holes are started at 3 ins. and bottomed at 2¼ ins., Rose and Cross bits on 1¼ and 1½ hexagon steel being used.

Drilling is started about 4 p. m. and the round is completed in one shift. Blasting is carried on from 4 a. m. to about 7, holes being shot by electricity; 700 to 800 lbs. of powder are used per day for both headings, side and bench holes are loaded with 10 to 12 lbs. and cut holes with 9 to 10 lbs. The short cut holes and the bench are shot first, the long cut second and the back and side holes last. The heading has been advanced steadily at an average of 7½ ft. per day.

A saving is made in the high priced drill runners' time by having the mucking crew set up the drills, ready for the next round, as soon as they have cleared away the breast. This means that the drill runners can begin work without delay, everything being ready for them by 4 p. m. The drill crew, for each heading, consists of 6 drill runners, 6 helpers, and 1 water boy.

RAILWAYS

A Discussion of Effect on Maintenance of Way Accounts Produced by Physical Characteristics of Location and Nature of Traffic.

The chairman of the committee of the American Railway Engineering Association on the Economics of Railway Location, Mr. A. K. Shurtleff, made a study to determine the approximate general laws affecting such maintenance of way accounts as are influenced by changes in physical characteristics of locations and presented the results of his study to the association as the report of his committee. The information here given is abtracted from the report as published in the Bulletin of the Association for January, 1913.

The majority of the problems of economics of railway location deal only with main track questions, although an occasional problem introduces the consideration of side tracks. It is therefore necessary to analyze and separate certain of the primary operating accounts between costs for main track and costs for sidings, particularly those accounts covering maintenance of way and structures.

Only three or four railroads out of the many asked for information have attempted to give any data to aid in the digest of this particular question. However, the question has been studied on one large system of nearly 8,000 miles of main tracks and does not vary materially from the ratios of costs per mile of main and side tracks from the other three roads. The figures cover a period of four years and are used in the following analyses, believing them to represent a fair and reasonable average of the relative costs of maintaining main and side tracks for most of the railways of the United States. The figures will not apply to roads lying entirely within a dense manufacturing or mining district where the necessary mileage of side track nearly equals or sometimes exceeds the main track mileage, and the switching mileage is so heavy as to make the tonnage over the side tracks exceedingly large. The methods of this analysis can be followed in such a case, using the ratios of costs that have been found proper for the heavy switching traffic on the industrial sidings.

The following gives only the accounts which are particularly due to both main and side track usage:

Account 1.—Superintendence of Way and Structures.—One mile of side track requires practically one-third the cost of one mile of main track.

Account 2.—Ballast.—One mile of ballasted side track averages only about one-fourth the cost of one mile of ballasted main track. This factor is a difficult one to reach logically and is a matter of judgment. No detail figures have been obtainable, as usually only a minor portion of side tracks are ballasted and not all main tracks.

Account 3.—Ties.—The number of renewals per mile of side track for four years averaged about 70 per cent of the number per mile of main track. The side track renewals embraced No. 2 ties as well as No. 1, and the average cost per side track tie was about 70 per cent of the cost per tie for main track, making the total charge per mile of side track practically one-half of the cost per mile of main track.

Account 4.—Rails.—Main line rail was relaid by new rail, rerolled rail or good relayers of heavier section, in all cases the renewal portion of the charges being only the tonnage equal to the weight of the released rail at the charge per ton for the material replacing it. Side track renewals were from relayers only and charged out on the above principle according to the form prescribed by the Interstate Commerce Commission. The arbitrary credit for relayers released and charge for same used was practically 75 per cent of the cost of new rail. Scrap released was credited at approximately market value. The average charges per mile of side track for rail renewals was about 25 per cent of the cost per mile of main track.

Account 5.—Other Track Material.—Practically 37 per cent of this account was account of frogs and switches, the major portion being to *turnout* frogs, hence due entirely to side tracks, although many existed in the main track. A careful analysis shows that one mile of side track costs practically the same as one mile of main track for this account, due almost wholly to the costs of turnout frogs and switch points.

Account 6.—Roadway and Track.—The cost per mile of side track averages about one-third the cost per mile of main track. This is due not only to the lower grade of maintenance of side track, but to the fact that many items charged into this account are principally main track items, for example, ditching, bank widening, track walkers, cutting weeds on right of way, etc.

Account 9.—Bridges, Trestles and Culverts.

Account 10.—Over and Undergrade Crossings.—Occasionally a small portion of these two accounts is chargeable to side tracks, but for the majority of cases the amount is so small as to be negligible in economic calculations.

Account 18.—Roadway Tools and Supplies.—One mile of side track requires about one-third the cost of one mile of main track.

The train mile has been commonly used as a traffic unit in economic studies in the past, but it is illogical to use this unit as a measurement of wear and tear on the track owing to the wide limits in weights of trains that can be handled by the same locomotive on districts of different gradients. A train with gross weight of 2,000 tons will cause about double the wear and tear on the structure that would be caused by one of half the weight. The ton mile would be the best unit considering total weights on the rails if freight traffic only passed over the track, but passenger traffic also must be considered and owing to the higher velocity of trains the damage done per ton of passenger train is greater and the labor of maintaining track for the higher velocities is increased. With velocities equal, the damage done to track will vary about directly proportional to the load per axle and one ton of locomotive will create more disturbance to track than one ton of car and contents.

In studying average maintenance expenses by divisions for a period of years on the large system previously mentioned, it appeared that the best unit of traffic measurement of expense was what we will term the equivalent ton mile. The total equivalent ton miles would be the sum of the following:

Double the freight locomotive mileage times average weight per locomotive.

Four times the passenger locomotive mileage times average weight.

Total freight ton miles (cars and contents).

Double the passenger ton miles (cars and contents).

This unit considers that one ton of passenger car does double the injury of one ton of freight car, and that one ton of locomotive affects the track as much as two tons of the train back of the locomotive. This unit of measurement even best fits the increase of maintenance of buildings due to increase of traffic and consequent increase in number and size of buildings. Passenger traffic demands a higher type and better grade of maintenance than freight, and even a better type of shop buildings for repair.

With the exception of Account 4, Rails, there is a minimum expense for the accounts affected by volume of traffic due to depreciation and decay. This expense must be met to keep the road in shape for operation. The increase in expense above this minimum is practically directly proportional to the equivalent ton mileage passing over the tracks. There may be a slight loss of rails by corrosion, but its effect on the general account cannot be noticed and the cost can safely be considered directly proportional to the equivalent ton mileage.

TABLE I.—EFFECT OF TRAFFIC ON MAINTENANCE OF WAY ACCOUNTS.

Railroad.	Equivalent 1,000 ton miles per mile main track. Freight.	Passenger.	Total.	Costs per mile main track: Acct. 1. Supt.	Acct. 6. R. W. & T.	Acct. 18. R. W., tools. etc.	Acct. 4. Rails.	Acct. 5. Other track material.	Acct. 16. Buildings.	Renewals per mile of main track. Tons steel.	Ties No.	Ties Av. cost.
Pennsylvania R. R.	8,920	4,695	12,724	$142	$ 918	$28	$129	$131	$359	11.51	248	$1.00
D., L. & W.	7,338	4,532	11,870	111	619	33	301	152	294	20.22	209	.83
Pennsylvania Co.	7,629	4,106	11,735	109	774	12	107	101	265	3.86	228	1.13
P. & L. E.	8,269	2,771	11,040	136	1,282	40	171	161	348	24.86	384	1.17
N. Y. C. & St. L.	8,898	2,120	11,018	71	665	20	119	101	121	11.29	367	.78
P. & R.	7,888	3,627	11,515	109	681	26	130	117	279	12.22	287	.87
Vandalia	3,817	2,900	6,717	105	455	13	67	51	95	2.38	285	.65
L. S. & M. S.	6,060	4,412	10,472	77	824	48	90	105	260	5.78	289	1.12
N. Y. C. & H. R.	5,451	5,062	10,513	119	619	23	165	107	279	15.60	260	.85
C. R. R. of N. J.	6,263	3,996	10,259	71	714	14	128	120	457	16.24	242	.94
Northern Cen.	6,500	3,258	9,758	133	743	20	144	138	677	9.61	215	1.42
N. & W.	7,652	1,766	9,418	51	517	32	147	106	167	11.06	380	.57
P., C., C. & St. L.	5,979	3,368	9,347	109	704	9	97	85	161	3.39	205	1.20
Erie	5,766	3,269	9,045	82	569	19	105	80	167	18.02	233	.84
Lehigh Valley	6.405	2,280	8,685	76	469	17	109	70	196	7.54	153	.98
B. & O.	6,053	2,799	8,852	83	598	11	92	52	164	6.37	170	.93
P. B. & W.	3,478	5,558	9,036	141	678	26	56	93	293	5.73	310	.89
D. & H. Co.	6,151	2,311	8,462	46	377	15	77	77	134	5.00	176	.73
C., C., C. & St. L.	4,720	3,424	8,144	68	496	16	53	87	187	6.04	327	.87
C. & O.	5,688	1,770	7,458	50	504	18	69	73	123	6.11	317	.64
Wabash	4,155	2,642	6,797	34	445	8	71	56	100	3.44	397	.59
C. & A.	3,897	3,001	6,898	57	532	12	42	82	136	5.98	275	.67
Illinois Central	3,965	2,341	6.306	60	486	18	44	62	158	4.36	258	.64
Long Island	805	5,651	6,456	125	525	25	25	43	251	2.30	195	.92
D. M. & N.	4,749	790	5,539	46	1,149	28	69	66	176	5.89	204	.44
C. & E. I.	3,846	1,779	5,625	58	253	7	28	47	63	3.00	123	1.07
Mobile & Ohio	4,077	1,392	5,469	41	364	12	38	54	88	4.36	476	.40
L. & N.	3,487	1,888	5,375	64	427	18	113	67	200	7.02	324	.68
S. P.; G. H. & S. A.	2,170	3,146	5,316	82	602	31	76	96	147	6.60	283	.57
A., T. & S. F.	2,603	2,536	5,139	90	564	28	55	56	160	7.01	302	.74
U. P.; O. S. L.; O.-W. R. R. & N. Co.	2,322	2,455	4,777	77	514	28	30	57	128	5.25	243	.78
N. C. & St. L.	2,739	1,931	4,670	52	607	14	42	47	115	2.74	519	.43
C. G. W.	2,526	1,898	4,424	84	342	7	17	43	78	16.59	441	...
C., B. & Q.	2,351	1,943	4,294	62	454	8	69	26	126	15.01	337	.56
C. & N. W.	2,269	2,074	4,343	41	407	8	46	35	112	4.58	227	.52
C., R. I. & P.	2,176	2,184	4,360	62	371	11	34	35	132	2.85	245	.79
Canadian Pacific	2,298	1,879	4,177	45	580	16	68	40	164	9.11	240	.40
M., K. & T.	2,072	2,063	4,135	47	434	16	11	45	83	3.00	420	.48
Southern	2,176	2,033	4,209	55	299	9	73	47	83	5.89	374	.49
C., St. P., M. & O.	2,118	1,953	4,071	40	367	8	59	34	106	6.24	262	.50
C., M. & St. P.	2,400	1,618	4,018	28	311	15	53	34	89	7.24	197	.54
Northern Pacific	2,074	1,935	4,009	59	501	11	28	30	79	3.17	404	.45
Great Northern	1,968	1,933	3,901	64	561	11	28	41	66	3.14	320	.52
St. L. & S. F.	2,030	1,908	3,938	70	335	14	21	37	76	2.67	396	.52
Pere Marquette	2,295	1,300	3,595	33	267	6	18	33	65	4.63	192	.66
Texas & Pacific	2,051	1,439	3,490	30	364	13	32	41	135	2.64	329	.50
Missouri Pacific; St. L., I. M. & S.	2,050	1,492	3,542	76	384	15	61	53	77	6.64	409	.53
D. & R. G.	1,845	1,685	3,530	73	493	21	21	31	69	1.80	283	.70
Y. & M. V.	1,932	1,125	3,057	65	468	28	35	66	118	3.19	430	.58
Seaboard Air Line	1,674	1,538	3,212	38	319	13	23	46	91	4.69	381	.35
Atlantic Coast Line	1,586	1,536	3,122	39	269	11	66	41	89	9.92	324	.41
M., St. P. & S. Ste. M.	1,788	1,293	3,081	17	246	7	2	16	53	1.75	234	.27
Central of Georgia	1,453	1,360	2,813	63	270	11	62	42	94	6.42	362	.43
Average cost per mile of side track in per cent of main track cost				33⅓%	33⅓%	33⅓%	25%	100%				

Table I shows the items of costs of the maintenance accounts affected by traffic and is deduced from data given by the Interstate Commerce Commission, using the ratios of costs per mile of side track as outlined to reduce the cost per mile of main track only. As only average weights of locomotives, excluding tender, were given, two-thirds of the weight was added to cover weight of tender and the same weight of engine was assumed for both passenger and freight service. The ton mileage was worked from net ton mileage and the mileage of the two classes of cars and road engines.

There is no attempt to place the cost of ties in dollars per mile of track, as there is probably no account in which there is a wider variety of materials or unit costs than in ties. Climatic conditions affect the tie question, particularly noticed when comparing the roads of the south with those of the north. It is evident that the roads using either properly treated woods or timber of a high grade, and protecting the ties from mechanical wear by heavy tie plates with good bearing area, are receiving good returns because of the practice.

In all of the accounts it must be recognized that some of the roads were above the normal in the various accounts and other roads below.

The data given for ties is based on a study of renewals on different divisions of the same line with widely varying traffic. On track where ties were of a high grade timber or creosoted and with a large proportion of ties protected by heavy tie plates, the renewals in main track were 6.5 per cent of total in the track plus 0.3 per cent for each 1,000,000 equivalent ton miles traffic. This figure appears to fit very closely the northern half of the United States, where the roads have taken means to properly protect the ties. In the southern portion the per cent due to decay will be greater, but by multiplying the proper percentage by the value .046 per 1,000,000 equivalent ton miles, the average renewals can be approximated for cases where proper methods are used to retard mechanical wear. Each locality can determine within reasonable limits the value of the constant renewals required due to decay for the available timbers.

Account 4, Rail Renewals, apparently costs about $11 per mile of main track for each 1,000,000 ton miles and requires about 1.1 tons of new rail for this traffic. This figure will answer under present conditions of rail renewals and checks very closely with some data gathered on the equivalent ton mileage per mile of track during the life of 80-lb. tangent rail on a busy double track division. The maximum equivalent tons over any of the rail was 147,000,000. The tangent rail released was in condition for relayers or for re-rolling and considering 110,000,000 miles the average for this rail would make practically 1.1 tons per 1,000,000 equivalent ton miles.

According to custom, the maintenance charges are only for the weight released less the arbitrary credit for the usable released material, although heavier section may be used for replacements. The relayers when used to replace still lighter sections on districts of less traffic will further reduce the maintenance charges, as the rail finally released fixes the final distribution of total cost between maintenance and betterments. It is apparent that as the average weight of rail approaches the modern heavier section that betterments will absorb a less proportion of expense of rail renewals and maintenance charges will be increased. Sufficient data are not at hand to show whether the heavier rail will withstand an equivalent increase in tonnage directly proportional to its weight. It can hardly be expected to do so, as head wear determines the necessity of renewals where rail sections are sufficiently stiff for the axle loads. The cost of rail renewals will probably be found to bear a different relation to volume of traffic in a very few years.

The other maintenance of way and structures accounts affecting main track are for all practical purposes independent of the volume of traffic. Most of them are dependent on either mileage of main track or mileage of road. Tunnels, bridges and culverts and over and under grade crossings are dependent on topography of the country and materials of construction and in comparing the relative economy of different locations the amount and character of tunnels and bridges on each must be considered in estimating the difference in maintenance costs.

Tables II and III give the accounts under their respective headings. Other maintenance of way and structures accounts may be ignored, as they bear practically no relation to location.

The foregoing covers only the foundation of the work for analyzing the effect of changes in physical characteristics on maintenance of way and structures accounts. It can be seen that distance affects nearly all of the accounts mentioned and that volume of traffic affects only a portion of them. Curvature affects only the rail renewals and roadway and track accounts with a very slight addition to tie renewals, providing that good substantial tie plates having large bearing area are used. It must be assumed that proper details of construction are used in the initial work in estimating relative values of different lines.

The following are the conclusions with reference to the present study:

CONCLUSIONS.

Maintenance of Way and Structures.—1. The problems of economic location deal only with main track in the majority of cases, side tracks entering into the question only where differences in distance is so great as to necessitate additional side tracks.

2. The annual charge per mile of main track for any account embracing both main and side track can be approximated for any operated line by the following formula:

A = Total average main track mileage.
B = Total average side track mileage.
C = Average annual charge to the account.
P = Proportional charge per mile of side track as compared with charge per mile of main track.
E = Average annual charge per mile of main track only.

$$E = \frac{C}{A + BP}$$

The average value of P is shown in Table II, but for roads located almost wholly within dense mining or manufacturing districts requiring an exceedingly large proportion of busy side and spur tracks the values would be higher and should be determined.

3. The accounts covering maintenance of main track do not all vary by the same general law, but vary most directly according to the following groups: (a) Affected by both miles of track and volume of traffic. (b) Affected by miles of main track. (c) Affected by miles of road. (d) Affected by local topographical features.

Therefore no single unit of measurement of relative maintenance expense is applicable to all accounts in comparing the relative economies of two locations. Tables II and III show the groupings of the accounts under their proper heading.

4. One ton of passenger train does more damage to track than one ton of freight train and the locomotive creates more disturbance than an equal weight of cars and contents. Until data are available to correctly estimate the relative damage, it is recommended that the following ratio be used in estimating effect of traffic on the accounts in group (a): One ton of passenger car and contents produces approximately the effect of two tons of freight car and contents. One ton of locomotive produces approximately the effect of two tons of the balance of its train.

The total ton mileage reduced to terms of ton miles of freight car and contents is termed the *equivalent ton mileage.*

Most of the accounts in group (a) have a constant maintenance expense due to age and decay plus an additional expense depending on volume of traffic. This additional expense per mile of main track varies most directly with the *equivalent ton mile.* The equivalent ton mileage can be approximated by adding together the following: Net freight ton mileage. Double the freight locomotive mileage times average weight in tons. Freight train car mileage times the average weight of empty cars (at present about 18 tons). Double the passenger train car mileage times the average weight of car and contents (at present about 44 tons). Four times the passenger engine mileage times the average weight in tons.

TABLE II.—ACCOUNTS AFFECTED BY MILES OF TRACK AND VOLUME OF TRAFFIC.

		Av. values.		1911. Av. values.		
No.	Account.	P	R	X	RX	Remarks.
1.	Superintendence	0.33	0.44	$18	$ 8	
2.	Ties (based on number used)	0.7	0.046	Varies	..	Cost, quality and climatic conditions vary widely.
2.	Ties (based on cost)	0.5	0.046	Varies	..	Local conditions must determine value of X. Curvature affects charges but lightly where protected by proper plates and fastenings.
4.	Rails	0.25	....	..	..	Present average annual charge per mile of main track is $11 per 1,000,000 ton miles or 1.1 tons new rails for same traffic. Curvature affects this account.
5.	Other track material	1.0	....	..	..	Present average annual charge per mile of main track is $10 per 1,000,000 ton miles. Affected slightly by curvature.
6.	Roadway and track	0.33	0.245	$200	49	Affected by curvature.
16.	Buildings	....	2.4	10	24	Affected only where distance or increased volume of traffic makes additional buildings necessary.
18.	Tools and supplies	0.33	0.40	5	2	

5. The average annual expense per mile of main track due to age or decay for the accounts in which this item enters can be approximated for any road by the following formula:

E = Charge per annum per mile of main track only.
X = Annual charge per mile of main track due to age or decay.
R = Proportion of X covering the additional charge per annum per mile of main track for each 1,000,000 equivalent ton miles.
M = Million equivalent ton miles per annum per mile of main track.

Then from above and equation in conclusion 2.

$$E = X + MRX = X\,(1 + MR) = \frac{C}{A + BP}$$

$$X = \frac{C}{A + BP + MR\,(A + BP)}$$

Average values for P and R are shown in Table II.

TABLE III.—ACCOUNTS AFFECTED BY MAIN TRACK MILEAGE.

No.	Account.	Remarks.
2.	Ballast.	For full ballasted track this varies with the quality of ballast and cost laid down at side of track.
7.	Removal of snow and ice.	Varies widely, depending on climatic conditions.
13.	Signals (block signals only).	Present average cost $125 per mile with average of one signal to the mile. Curvature may necessitate additional signals.
20.	Stationery and printing.	
	Accounts affected by mileage of road:	
11.	Grade crossings, fences, cattle guards and signs.	Mileage of main track affects this account slightly, but variation is most directly in proportion to miles of road.
12.	Snow fences and snow sheds.	Varies widely, dependent on climatic conditions.
14.	Telegraph and telephone lines.	Varies slightly per mile of road, depending on number of wires.
	Accounts affected solely by topographical features:	
8.	Tunnels.	
9.	Bridges, trestles and culverts.	The expense of these items depends on the number, size and character of the structures on each location.
10.	Over and under grade crossings.	

In discussing the report, above abstracted, Mr. W. J. Wilgus, Consulting Engineer, questioned some of the assumptions made therein. The following excerpts are from the discussion of Mr. Wilgus as published in the Bulletin of the Association for March, 1913:

As regards the comparative effect of passenger and freight trains, it is the opinion of the writer that, generally speaking, there is no appreciable difference, if in considering the higher speeds in passenger service equal attention is paid to destructive agencies peculiar to the freight service, such as drippings from coal and refrigerator cars, imperfections of equipment, heavier wheel concentrations, twisting action of locomotives at slow speeds, littering of roadbed and the fouling and destructive action of the products of combustion of inferior grades of coal used in freight service.

Corrosive drippings are detrimental to floor beams and stringers, and solid floors of bridges; to track fastenings such as spikes, tie-plates, bolts and splices; and to rails, frogs and switches.

Side bearings on freight cars are so stiff as to provide much less freedom of adjustment to varying track conditions than on passenger cars. This has been strikingly shown on tracks used exclusively for freight traffic, where trucks in passing from curve to tangent retain their slewed position and grind the outer rail for considerable distances.

Springs under freight cars are less delicately adjusted than on passenger cars, with correspondingly greater shock to track and structures, especially in the cost of eight-wheel coal cars having 18,750 lbs. per wheel as contrasted with 12-wheel passenger coaches weighing but 12,500 lbs. per wheel.

Superworn tires, flat spots on wheels, dragging brake beams and draft rigging and similar imperfections peculiar to freight equipment cause additional wear and tear.

Slowly moving freight locomotives when exerting their maximum tractive force cause a twisting action from side to side that tends to work track out of line as much or more than higher speed passenger trains.

Droppings from freight trains such as lumps of coal, rubbish, loose doors and other broken parts increase danger and add to the cost of policing.

Freight locomotives consume more coal and use a poorer grade of fuel, and the resulting larger volume of cinders, gases and smoke fouls the ballast, corrodes metallic structures and injures paint on buildings, bridges and signals to a greater extent than with passenger power.

Freight locomotives under load stop and start more frequently, causing slipping of drivers that blisters and wears the rail.

Local freights do more or less switching on main tracks and at stations, with accompanying wear and tear on track and structures.

On many railroads both "drag" and preferential freight trains on certain divisions, in order not to interfere with the passenger service, are run at high speeds, and any fixed rule for calculating "equivalent ton mileage" would have to be varied to meet these frequent conditions.

It therefore seems clear that relative speeds of passenger and freight trains are so variable and the instances in which the latter are more destructive to track and structure so numerous that any attempt to arbitrarily fix the percentage that one exceeds the other would lead to questionable results. Judgment, which in any event must guide a decision, would seem to lead to the conclusion that, taking all these facts into consideration, the added cost of maintenance chargeable to passenger service by reason of higher speeds is practically offset by many features incident to the slower speed traffic.

As to the comparative effect of locomotives and of the load they haul, it is possibly true that the former cause somewhat more damage per ton than the latter, but not to the extent that might be imagined. For instance, taking two loaded coal cars weighing 150 tons, their smaller diameter wheels, less perfect construction and maintenance and drippings and droppings may be said to go far toward equaling the twisting and corrosive effects of a locomotive of the same weight; and in passenger service the smaller wheels and tail-end side swing may be considered as going far toward equaling the destructive action of the locomotive.

To guess that the locomotive, including its tender, creates twice as much destructive action per ton of gross weight as the load it hauls may yield a result more in excess of the truth than the making of no allowance may understate the truth.

Summarizing, in the absence of precise data, and taking into account the complexity of the problem, is it not fair to say that under *average conditions* a gross weight ton of passenger train creates the same destructive effect on track and structures as a gross weight ton of freight train; and that an attempt to assign constructive tonnage to portions of the rolling load as the measure of their assumed excess wear and tear on track and structures will result either in complications and contradictions, or in so many variations in the formula as to make the exceptions prove the rule.

Method Used in Taking Care of Street Car Traffic During High Water in Memphis, Tenn., in April 1913.

Contributed by C. L. R. Barclay, Assistant Engineer of Construction, The Memphis Street Railway Co., Memphis, Tenn.

The recent storms and high water in Ohio, Indiana and the upper Mississippi River basin, forced the Mississippi River over its banks at Memphis, Tenn., during the first part of April, 1913, and although an heroic effort was made to keep the river and Bayou Gayoso within its banks by means of levees hastily thrown up, the effort was without avail. As a record flood was expected by the Memphis Street Ry. Co., no dependence was placed on the levees and they set to work to maintain traffic over their Poplar Ave. Line and N. 2nd St. Line by trestling in the following manner:

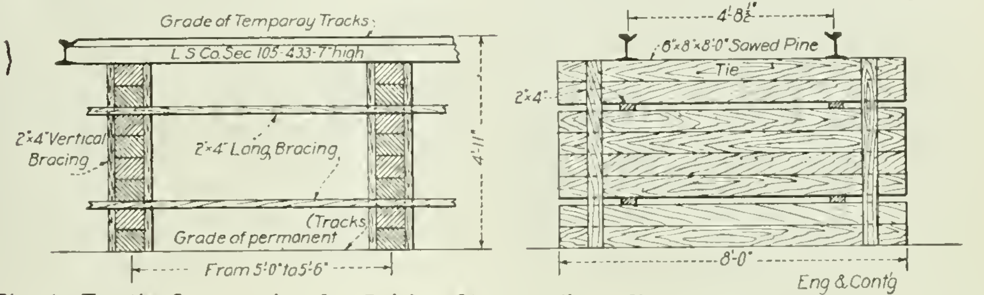


Fig. 1—Trestle Construction for Raising Street Railway Track Temporarily Above Flood Waters at Memphis, Tenn.

Two ties were placed across the track, one on top of the other, the full length of the street to be trestled; on top of these ties 2-in. x 4-in. lumber running longitudinally and directly under the rail was spiked to the tie below. Above the 2-in. x 4-in. longitudinal bracing, four additional ties were placed directly above the other two, and another 2-in. x 4-in. longitudinal brace fastened in the same manner as before stated. Two other ties were placed above the second set of longitudinal bracing and the entire bent braced with four 2-in. x 4-in. pieces placed vertically and each tie spiked securely. On top of this structure the rails were laid and spiked, the Lorain Steel Co. Sec. 105-433 being used. The details of construction described will be found more fully in the accompanying drawing.

As we had practically no current to contend with, this method of construction met all the requirements for which it was intended. The entire structure showed no tendency to float, or move out of line, except in a short distance of approximately 25 ft. on the N. 2nd St. line, but was perfectly safe from an operating standpoint.

These bents were spaced from 5 ft. to 5 ft. 6 ins. apart. The tie rods were placed every 5 ft. Four spikes were used on each tie to secure the rails. It was also found necessary to raise the trolley wire in some places as high as 4 ft.

On the N. 2nd St. line passengers were required to transfer at each end of the trestle. A single truck motor car attached to two open trailers of the double truck pattern transferred passengers across the high water.

On the Poplar Ave. line no transferring was required, the regular double truck cars used on this line running over the trestle. They were enabled to enter and leave by means of run offs constructed of the same section of rail as that used on the temporary trestle, a section of rail 10 ft. long being used, on which 8 ft. of the guard was sheared off and a like amount of the base was planed to a point at the head.

Later it was found necessary to raise the trestle on the N. 2nd. St. line in order to keep above the water. This was accomplished by spiking another 2x4-in. longitudinal brace on the outside of both rails and slipping two additional ties under the rail on top of the bents, shown in the plan. The track after being raised to this last elevation showed a slight tendency to float; however, it was perfectly safe for the operation of cars and no trouble was experienced.

A careful lookout was kept for any defects that might appear on both of these trestles and very little work was found necessary, except an occasional shim, and the structure throughout was found very satisfactory.

POWER PLANTS

Method of Constructing a Hydroelectric Power House and Dam on Sand Foundations.

(STAFF ARTICLE.)

The construction of a dam and power house on sand foundations is in progress on the Wisconsin River at a point about 1¼ miles upstream from the town of Prairie du Sac, Wis. The unusual sections of dam being built; the sand foundations and the several novel methods used by the contractor in constructing his work make this power plant of exceptional interest and from data furnished by the engineers and the contractor and gathered during a visit to this work, we have written the following account:

STRUCTURES.

The plant when completed will develop about 22,000 h.p., with eight horizontal twin turbines and direct connected generators. Only five of the generating units will be installed at first. Where the plant is located, high bluffs come down close to the west bank of the stream and on the eastern shore corresponding bluffs rise about half a mile inland. As shown by the plan, Fig. 1, the power house abuts into the western bluffs and from its east end a masonry dam 1,000 ft. long extends across-stream to the east bank and thence an earth dam or dike continues east until it merges into the eastern bluffs. The concrete dam, with its 1,000-ft. spillway length, is capable by computation to pass safely the largest flood of water. The earth dam, 1,700 ft. long, has a west level 7 ft. higher than expected floods. These and other general dimensions are indicated by the plan, Fig. 1.

Power House.—The power house is 329x146 ft. and is carried on a reinforced concrete footing on 25-ft. piles. The footing is inclosed by a continuous line of United States steel sheet piles 15 ft. long on the downstream side and 40 ft. long on the upstream side. Figure 3 is a cross-section and part plan showing these details.

The part plan shows only one of eight bays into which the power house substructure is divided. In each bay there are two twin turbines of the Allis-Chalmers horizontal type. The turbines are 57 ins. in diameter and operating at 107 r. p. m. under a head of 25 ft. the four of a set will develop 3,800 h.p. The generators are 2,100 kilowatt, 2,300 volt, 25 cycle, 3-phase machines.

Water is admitted to each set of turbines, as shown by Fig. 3, between concrete piers and under a concrete curtain wall which extends 11 ft. below the water surface of the fore-bay. There are also trash racks further to obstruct ice and drifts. The openings between the piers are closed by steel gates operated by an overhead traveling crane, and in front of the gates slats in the river provide for emergency closure by stop logs. Each pair of turbines discharges into a separate draft tube, and to permit this the tubes, as shown by Fig. 3, had to be warped in alignment.

Concrete Dam.—A cross-section of the concrete dam is shown by Fig. 4. It is a cellular structure of somewhat unusual form. A curved apron of reinforced concrete carried on transverse diaphragm piers or buttresses spaced 8 ft. apart center to center. The supporting buttresses are of two thicknesses, every third buttress is 4 ft. thick and the others are 18 ins. thick. The 4-ft. buttresses are supported on 30-ft. piles staggered in two rows, and the 18-in. buttresses are supported in one row of 30-ft. piles, the piles in each row being 2-ft. on centers. The downstream continuation of the aprons beyond the body of the dam is supported on 30-ft. piles spaced 4 ft. apart center to center in both directions.

The section, Fig. 4 shows details of the apron reinforcement; the foot walk inside the dam between and through the buttresses; the sheet piling which encloses the dam; and the rock fill in the sand bottom between buttresses.

The construction to prevent scour and to provide drainage deserves brief special mention. Chief reliance against scour is of course placed on the steel sheeting which goes down 50 ft. below river bottom on the upstream side and 30 ft. below bottom on the downstream side. The tops of both rows of sheeting are bedded in the concrete edges of the apron. A clay puddle is filled in against the upstream side of the corresponding line of sheeting to stop seepage. The downstream row of sheeting is also protected from scour on its down side by a mattress of brush and rip-rap. Besides the provision of the clay puddle provision against seepage water troubles is made by weepholes located just at the bottom of the downstream spillway portion of the apron.

The spillway of the dam is, as shown by Fig. 4, surmounted for its whole crest length with Tainter gates. To carry these gates every 4-ft. buttress previously described is carried above the apron stub to form a pier of the outline shown, and these piers are bridged across by a reinforced concrete steel gate operating platforms provided with track for a traveling electric gate raising winch. The Tainter gates are 20x14 ft. and of familiar construction. Stop log slats in the piers provide for closure independently of the gates.

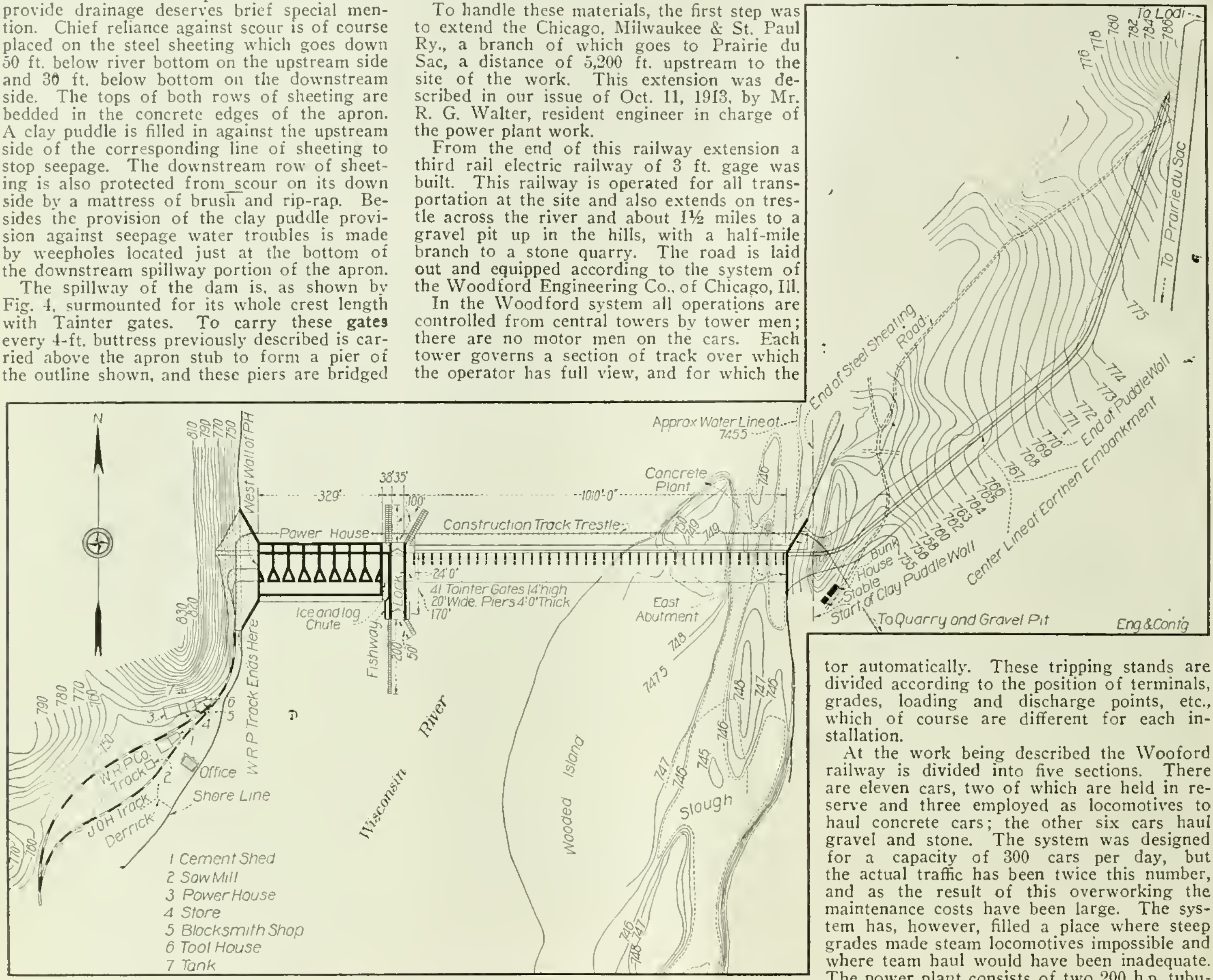


Fig. 1—General Plan of the Hydro-Electric Development of the Wisconsin River Power Co. at Prairie du Sac, Wis.

Earth Dam.—The earth dam or dike on shore on the west side of the river is of simple construction, as shown by the section, Fig. 2. It is an earth fill embankment with a puddle core wall 3 ft. thick.

Lock and Other Structures.—The lock required to meet navigation requirements is located between the power house and the dam end. The chamber is 170x35 ft. and it provides a depth of 5 ft. on its lower miter sill. Like the dam and power house, the lock is founded on timber piles and is enclosed with steel sheeting. Between the lock and power house are a log sluice and a fish way. All these subsidiary structures are completely enough indicated by the general plan, Fig. 1.

CONSTRUCTION METHODS.

The construction work is chiefly interesting for the methods adopted in handling materials to the sites and for the cofferdam construction. These two features will, therefore, be described more particularly.

Transportation of Materials.—The materials required to be transported for the construction of the power plant included all machinery and structural steel, cement and gravel for 80,000 cu. yds. of concrete, some 50,000 cu. yds. of one-man stone, 3,000 tons of steel sheeting, 8,000 piles and a variety of materials in smaller amounts.

To handle these materials, the first step was to extend the Chicago, Milwaukee & St. Paul Ry., a branch of which goes to Prairie du Sac, a distance of 5,200 ft. upstream to the site of the work. This extension was described in our issue of Oct. 11, 1913, by Mr. R. G. Walter, resident engineer in charge of the power plant work.

From the end of this railway extension a third rail electric railway of 3 ft. gage was built. This railway is operated for all transportation at the site and also extends on trestle across the river and about 1½ miles to a gravel pit up in the hills, with a half-mile branch to a stone quarry. The road is laid out and equipped according to the system of the Woodford Engineering Co., of Chicago, Ill.

In the Woodford system all operations are controlled from central towers by tower men; there are no motor men on the cars. Each tower governs a section of track over which the operator has full view, and for which the third rail is independent. A feeder runs from each tower to its section of third rail. The third rail can be energized with two different voltages, one for the car brakes and one for the motor which propels the car. This car has a capacity of 3 cu. yds. and is equipped with a 15 h.p. motor. A motor switch on the car automatically differentiates between the two voltages and when the low voltage is applied to the third rail directs the current through the solenoid brake; when the high voltage is applied it is directed through the motor. Only one car at a time is running on any one third rail section, and its movements are under the eye of the operator at all times. To reverse the travel of the car and to provide against runaways down grade tripping stands are placed in the track which cut off the current and reverse the motor automatically. These tripping stands are divided according to the position of terminals, grades, loading and discharge points, etc., which of course are different for each installation.

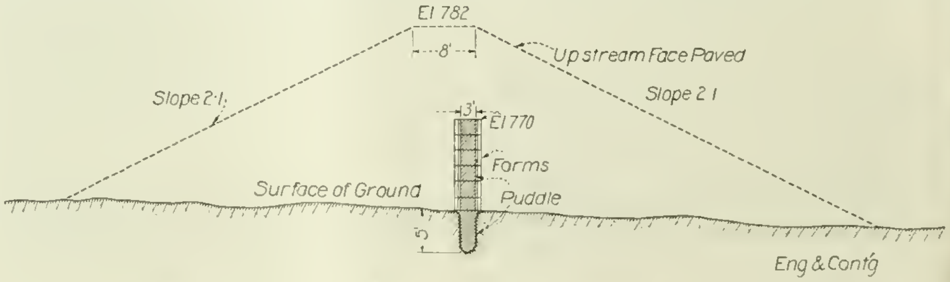


Fig. 2—Section of Levee Extending From East End of Spillway Dam.

At the work being described the Wooford railway is divided into five sections. There are eleven cars, two of which are held in reserve and three employed as locomotives to haul concrete cars; the other six cars haul gravel and stone. The system was designed for a capacity of 300 cars per day, but the actual traffic has been twice this number, and as the result of this overworking the maintenance costs have been large. The system has, however, filled a place where steep grades made steam locomotives impossible and where team haul would have been inadequate. The power plant consists of two 200 h.p. tubular boilers, a 14x14-in. single cylinder Erico engine and two 100 k.w. generators. It supplies current for drilling at the quarry, for pumping and for running a plant sawmill.

Cofferdams.—The first cofferdam built for the work in 1911 enclosed the site for the power house and lock, and extended approximately half way across the river. In October, 1911, with a flood stage of water equal to the highest known previous flood, the bottom of the river at the end of this cofferdam, began to scour. The cofferdam stood, however, until dams at the upper headwaters of the river gave way, turning loose a wave on top of the flood, and undermined the steel sheet piling. About half of the piling was recovered by the use of divers and heavy pulling

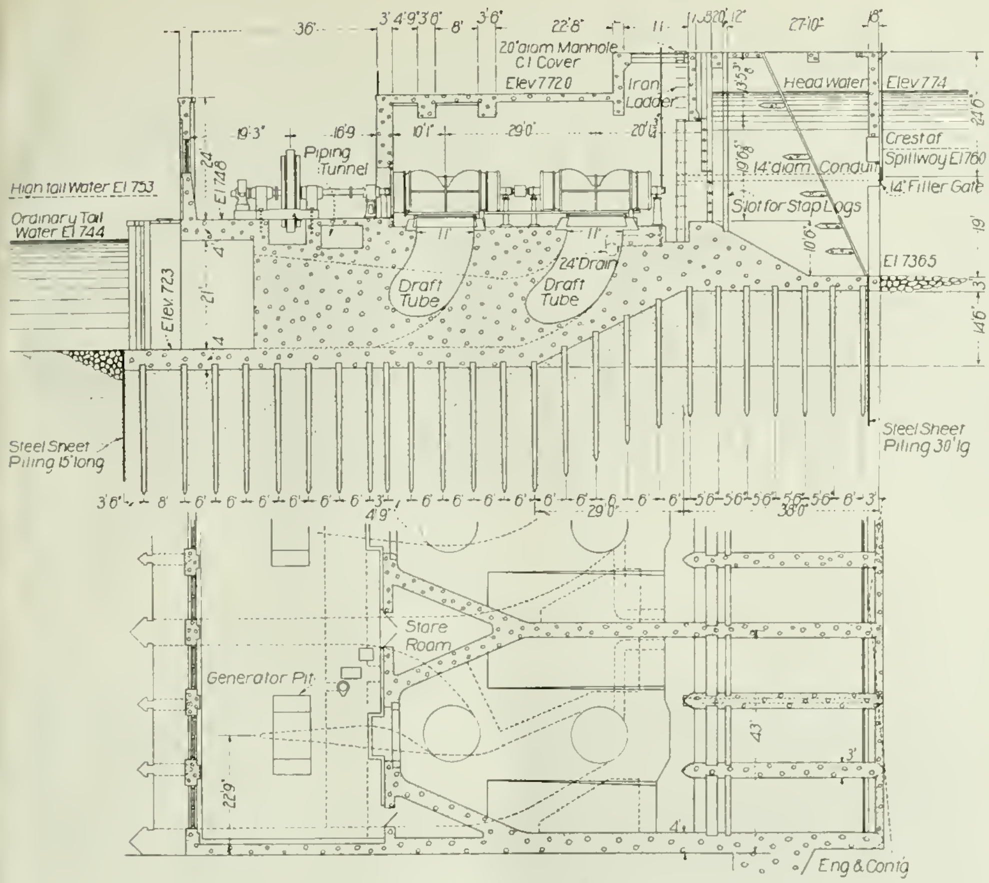


Fig. 3—Part Plan and Section Through Power House, Wisconsin River Power Co., at Prairie du Sac, Wis.

tackle and new lines were established. The cofferdam as rebuilt, Fig. 5, includes the site of the power house only. The cofferdam is 24 ft. wide and consists of steel piling on one side and Wakefield sheeting on the other, tied together and filled in with sand dredged from the river bottom by a 10-in. sand pump on a barge.

Although this cofferdam enclosing the power house site has safely withstood high water a number of times, steps are being taken to eliminate possible chance of scour against the end by the construction of a submerged dam entirely across the river. This will eliminate the concentration of the current at any point and the whole section of the river will be equally protected. The submerged dam consists of a line of steel sheet piling, which will form the wall at the base of the apron in the completed work. This line of piles is driven about 3 or 4 ft. below the water level, and a layer of brush matting about 30 ft. wide is laid on the river bottom just below the line of steel piles. The matting is weighted with one man stone and round wood piles are driven through it to hold the stone filling in place.

Concreting Work.—The concrete plant is located on the east side of the river, where storage room could be had for a stock of pit run gravel. The plant consists of a battery of two Austin improved cube mixers of 1⅓ cu. yds. capacity each. The materials are dumped into batch hoppers from a 15 cu. yd. bin. From the batch hoppers on the charging platform the materials are discharged into the mixers. The mixers discharge into a tower hoist bucket which is elevated to the level of the trestle where the concrete cars are placed to receive the concrete discharged from the tower bucket. The concrete cars are operated in trains of two cars propelled by one of the electrically operated Woodford cars. An operator located in a small house on the trestle controls the operation of the cars over the trestle crossing the river.

The steel concrete cars are a special feature of the construction plant and a drawing illustrating their construction details is shown by Fig. 6. Their capacity is 42 cu. ft. of concrete. The bottom of the body is sloped from three sides to the front gate and this is opened and closed from either end of the car by one of the two levers. The bottom of the outlet under the gate is shaped to a 10-in. radius. As the concrete is discharged from a high trestle into chutes of about 12-in. radius, the car really acts as a portable concrete hopper for a chuting system. The chutes are placed along the trestle at points convenient to the

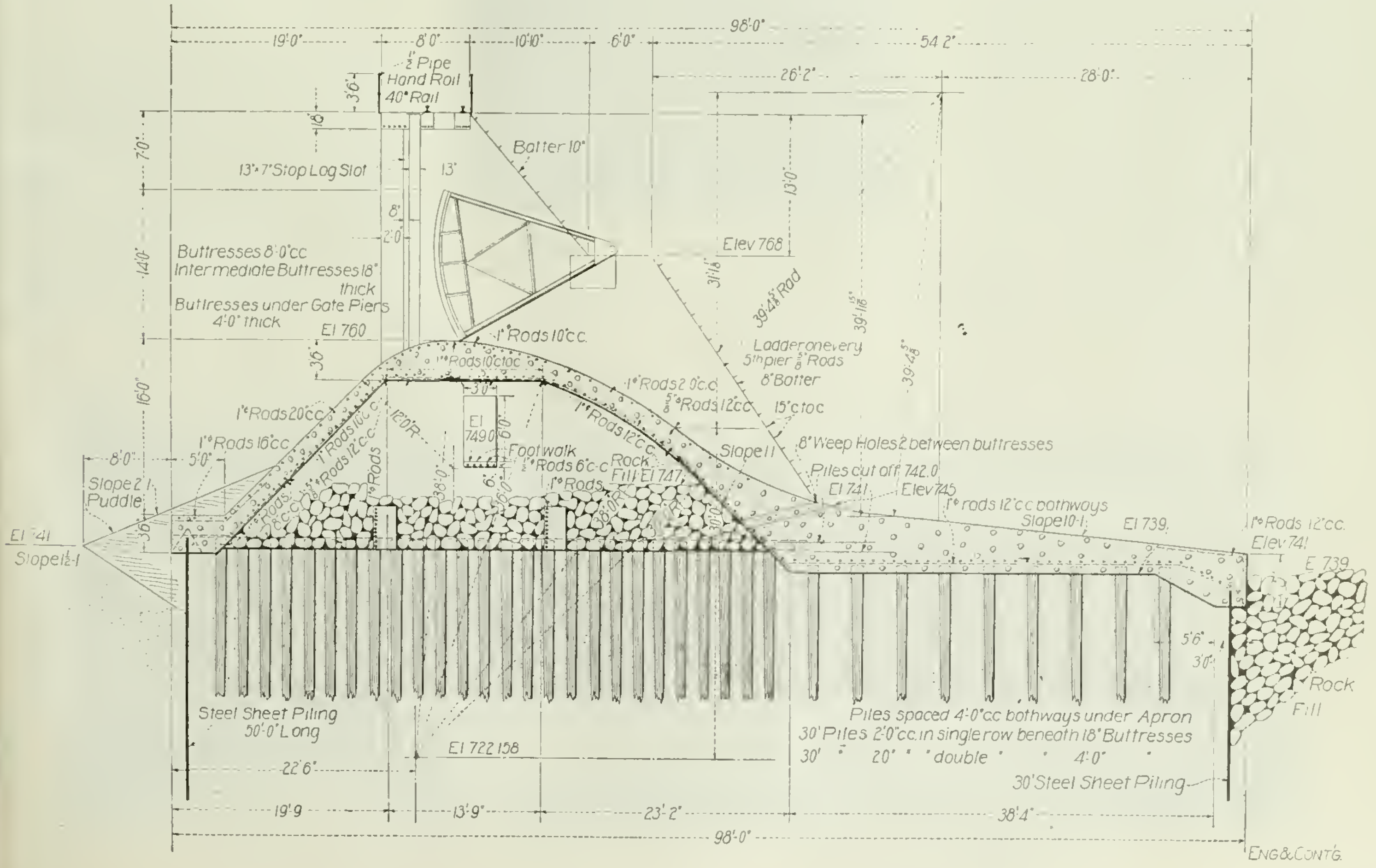


Fig. 4—Section of Concrete Spillway Dam With Tainter Gates.

forms and the car discharges into them without the necessity of an intermediate hopper. These cars were built especially for the work by the T. L. Smith Co.

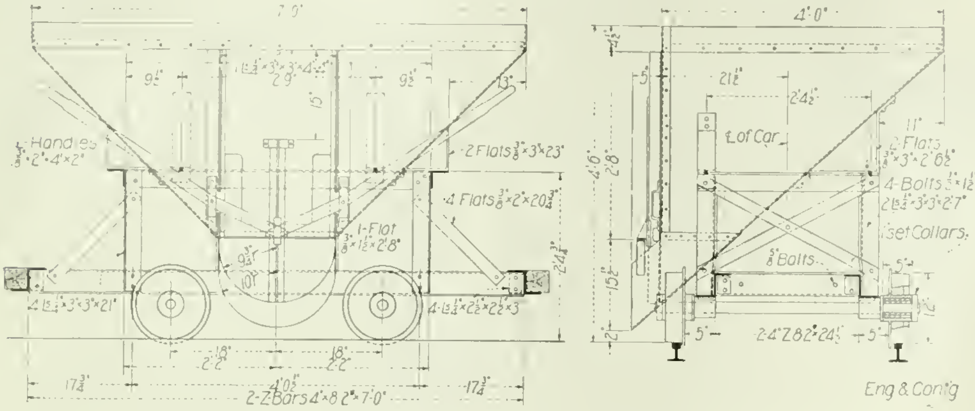


Fig. 6—Special Car for Transporting Concrete From Mixer to Chutes.

The forms for the concrete walls consist of 1x8 in. boards with 2x6 in. studs and 4x6 in. wales tied through the walls with wire, and in some cases with flat metal bands. Steel wall forms of the Blaw type were used on the west wall of the power house.

Blaw steel forms were used for the formation of the draft tubes through the concrete foundations. These steel forms are made of ¼-in. steel plates attached by bolts to angle ribs. For the 16 draft tubes four sets of steel forms were provided. The erection of the tube form for the first set of draft tubes required about 30 days, but afterward they were knocked down and re-erected by a gang of 20 men in five days and nights. It is the opinion of the contractor that, owing to the irregularity of the shape of these tubes, wooden forms would have been very slow to erect and would probably have cost more. The time element was an important factor, however, and from this viewpoint alone the steel forms were a success.

Another interesting feature in connection with the construction work is the method of loading the electrically operated cars with broken stone from the quarry. The Woodford cars reach a point about 150 ft. below the level of the quarry and the stone is lowered down an incline in cars operated, as shown in Fig. 7, by a cable to a double drum hoist. The hoist consists of two 30 in. drums on one 5⅝-in. shaft controlled by levers, each operating a friction band brake on one of the drums: The cable from one of the cars winds over the drum, and that for the other car winds under the other drum so that while one car is running down the incline loaded with stone, its weight pulls the other car up. The hoist was built for the contractor by the Monighan Machine Co. of Chicago.

The project has been planned and all the structures have been designed by D. W. Mead, Consulting Engineer, Madison, Wis. The work has been carried out by Jas. O. Heyworth, Engineer and Contractor, Chicago, Ill.

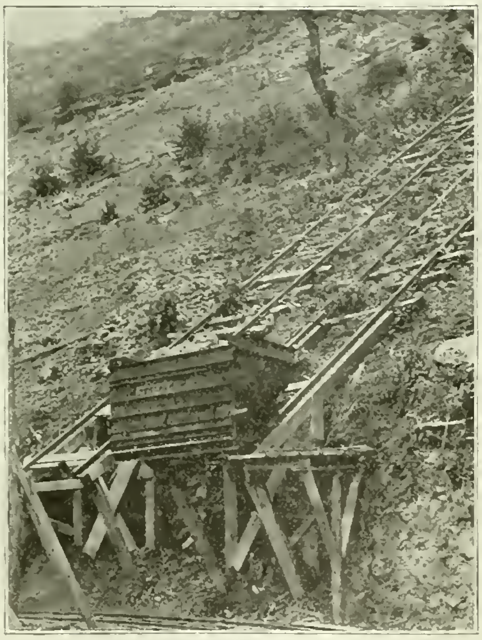


Fig. 7—Special Stone Car for Transferring Rock From Quarry to Cars at Foot of Incline.

The resident engineer in charge of the work is Mr. R. G. Walter, Prairie du Sac, Wis.

Work of Government Reclamation Service.—The area of all projects under way by the U. S. Reclamation Service at the end of 1912 was 3,020,689 acres. Irrigation work had been completed for 1,237,173 acres, and there was irrigated during 1912 an area of 643,155 acres in 17,058 farms. There had been completed reservoirs of 4,983,810 acre-feet aggregate capacity; 7,566 miles of irrigation and drainage canals; 21¾ miles of tunnels; 20 storage dams; 25 diversion dams; 81½ miles of levees; 13,173 concrete canal structures; 25,103 wooden canal structures; 3,111 bridges; 3,106 culverts; 140 miles of pipe lines; 1,292 flumes having a total length of 71 miles; 832 buildings; 344 wells; 674 miles of roads; 48 miles of railroads; 2,202 miles of telephone line; 345 miles of transmission line; and 12 power plants, having a total capacity of 25,116 h.p. The service has also mined 26,451 tons of coal, and manufactured 338,452 bbls. of Portland cement and 28,608 bbls. of sand cement.

Included in the foregoing work were excavation amounting to 94,503,000 cu. yds.; riprap, 408,383 cu. yds.; paving, 492,061 sq. yds.; concrete, 1,258,320 cu. yds.; cement used, 1,479,084 bbls.

Transportation Building and Laboratories, University of Illinois.—The dedication of the new Transportation Building and the Locomotive, Mining and Ceramics Laboratories of the University of Illinois, Urbana, Ill., will take place May 8-9, 1913. The Transportation Building is to be occupied by the Department of Railway Engineering and is a three-story fireproof building, 143 ft. long and 65 ft. wide. The Locomotive Laboratory is a brick and steel structure, 117 ft. long and 43 ft. wide, and is served by track connection with the Illinois Traction System. Facilities of every kind for testing locomotives are provided. The Mining Laboratory consists of four parts—a chemical laboratory, a "drills and explosives" laboratory, a mine rescue station and a coal washing and ore dressing laboratory.

Motor Truck in Flood Relief Work.—The motor truck has proved invaluable to the flooded cities of Ohio, particularly to Dayton. Several hundred horses were drowned in that city and railroad service was practically cut off. Supplies from other cities were conveyed by means of a group of motor trucks organized by the Kelly-Springfield Motor Truck Co., of Springfield, Ohio. The best road, that through Xenia, was 35 miles long, and in many places the mud was hub-deep. The heavily loaded trucks made the trip in a little more than three hours. After reaching the city the trucks were used in distributing supplies and in cleaning up debris.

ig. 5—General View of Construction Work With Power House Cofferdam in Foreground.

NEWS SECTION

Editorial Comment—Personals—Society Meetings—Trade Notes—Catalog Reviews—Contract News, Embracing Bids Asked, Work Projected, Contracts Let and Contract Prices on All Classes of Civil Engineering Construction Work.

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Doings of the Week.

Quite a number of railway construction jobs have been placed under contract in the last few days, and bids are in on several other pieces of work. Some of the larger contracts on which bids were taken some time ago are still hanging fire. Among the contracts let recently are the following: J. H. Flick Construction Co., 37 W. Van Buren St., Chicago, Ill., for constructing the Grand Rapids & Northwestern R. R., a new line projected to run from Ludington, Mich., to Grand Rapids; Jos. H. Sands Contracting Co., Roanoke, Va., for double tracking line of the Atlanta Coast Line R. R., between Pleasant, Hill, N. C., and Petersburg, Va., 60 miles; John F. Dolan Contracting Co., 50 Church St., New York City, for the extension of the Seneca Falls branch of the Lehigh Valley R. R.; H. F. Balch & Co., Minneapolis, Minn., for constructing 8 miles of electric railway to Long Lake, Minn., for the Electric Short Line of Minneapolis; Utah Construction Co., Ogden, Utah, for grading through Jordan Narrows, 7 miles, for the Salt Lake & Utah R. R.; Grant Smith & Co., Henry Bldg., Seattle, Wash., for a 1,200 ft. tunnel in the Cascade Mountains for the Great Northern Ry.; Velotta Construction Co., Leader Bldg., Cleveland, O., for 17 miles of electric railway between Titusville and Cambridge Springs, Pa., for the Erie & Central Pennsylvania Ry.

The chief development of the past week in the highway field has been the submission to the joint Congressional Committee on Federal Aid in the construction of post roads of a plan calling for the expenditure of $1,000,000,000 by the United States for the construction of improved roads. The plan contemplates the creation of a construction fund to be apportioned among the States upon the basis of area, population, assessment valuation and road mileage. To provide the money the States would deposit in the U. S. treasury 50-year 4 per cent bonds for the amount of their appropriation; upon these bonds the Federal Government would lend the par value for road construction. In its turn the Federal Government would issue 50-year non-taxable, 3 per cent bonds, to be sold to investors. The bill suggested with the plan provides for a United States Highway Commission with head offices at Washington; a highway division in each of the States, in charge of a United States highway engineer; and a national school of highway and bridge engineering in Washington, for the purpose of training specialists for the work of road building. One of the largest highway construction contracts ever let to a single contractor has just been awarded by the Commissioners of Tarrant County, Tex. This contract calls for the construction of eight roads from Fort Worth to the county line. The Texas Building Co., Fort Worth, Tex., secured the contract at $656,504.

Bids on a large irrigation job were opened last week by the U. S. Reclamation Bureau. This work called for the construction of the main canal of the Sun River Irrigation Project. MacArthur Bros. Co., Fisher Bldg., Chicago, Ill., at $858,615, was the low bidder.

Bids on one of the largest dredging jobs of the year are now being asked by the Harbor Commissioners of Toronto, Ont. The work calls for the removal of approximately 35,000,000 cu. yds. of material by hydraulic dredging. Borings indicate 70 per cent of material to be sand and gravel; 30 per cent, mixture of sand, silt and clay.

Specifications are being prepared for the new provincial government buildings to be erected at Winnipeg, Man., and tenders on the work will be asked in the near future. Frank W. Simon, 261 Fort St., Winnipeg, is the architect.

Some Experiences of a Superintendent.

In our issue of April 30 we printed two extracts from a paper presented before the American Society of Engineering Contractors by C. H. Hollingsworth. Two additional extracts from Mr. Hollingsworth's paper are given below:

TO FIGHT OR NOT TO FIGHT.

As a final word to both superintendents and assistant superintendents do not think because you are the boss that you have to be able to take off your coat and lick any man on the job or make a try at it. Many persons, Englishmen for instance, think that if you are boss, and some one of the men should stick an exceedingly dirty fist under your nose, by all laws and precedents you are called upon to carefully remove your coat and vest, roll up your sleeves and dramatically say, come on now. After which, according to the story books, the super, who is a little man, sails in and knocks what is generally termed the eternal stuffings out of the presumptuous laborer. The above, however, often does not work out in practice as some of the quantities may be wrong, thus throwing the entire formula out and besides that I personally have always held that a superintendent, walking boss or other man in charge of work is hired to work not to fight and for his brains, not his muscle. Also to put it badly, he is a fool to go into a fight with a man who is working for him as the latter has all to gain and nothing to lose, while the man in charge has all to lose, for if he once gets whipped he had better move off the work as he will be of no further use there. But I hear some one state that sometimes you are placed in position where you have to fight or back down and the latter is very bad policy. Ah, to true! too true! such is sometimes the case and in such event be sure there is a 2x4 handy or a starter or a monkey wrench and finish the fight with one fell swoop as it were. In the words of Terence Mulvaney, "Don't fight, but if you must fight with a man, knock the face off him first and frequent." Have peace if you have to knock a man out with a chuck wrench to get it. I recall visiting a contractor in a semi-southern city, part of whose name was Warren. While I was talking to him a colored gentleman approached in a very hostile manner and in a very aggressive tone demanded his money and wanted it right there, finishing up by putting his face close to Warren's and remarking "Mistah Warren, if I don't get that money there is going to be trouble." "There sure is," remarked Warren, as he sidestepped and picked up a club, "and it starts right now." It did, too. He only hit him twice and the second time he had to make a long reach as the colored brother was on his way. The next day was pay-day and the same colored gentleman approached Warren with his hat in his hand and said apologetically, "Mistah Warren, I was drunk yesterday or I never would have said that to you." "Correct," replied Warren, "and you better go back to work this afternoon," and he did so.

THE FOREMAN AND THE TWO-FISTED KERRY MAN.

On the other hand, back in the dim past, I once worked as foreman for a fine upstanding, two-fisted, old Kerry man, who at that time did business in the Eastern States and who wished to personally whale, whop or whip or otherwise chastise every foreman that came to work for him. He did not do it with malice aforethought, you understand, but when he was mad, which approximated 75 per cent of the time, he would carefully pull off his coat and hat, roll up his sleeves and wade in. As he was a man 65 years old, the sundry and divers foremen who were on the job at different times looked upon this benevolent looking old man with a red face and white galways as easy money, more especially as he was only about 5 ft. 6 ins. tall and did not look within 40 lbs. of his 200 lbs. of weight. However enthusiastically his opponent started in the finish was always the same. Foxy grandpa was the invariable winner. After which he would resume his coat and go on about his business and the foreman was good for a job with him whenever there was a chance. Now, I had observed this old party in several encounters and noticed that he enjoyed himself immensely during the same, and the hotter the battle was, the happier he seemed. Moreover, I had noticed that he possessed a fist about the size of a ham, had a pair of shoulders exceedingly wide, was very light on his feet and altogether was entirely too frisky for a person of his years. Observing these things, I made a bet with myself that if my popularity with him depended on being licked by him, I would prefer not to be loved. You see there was no use in spending your time trying to do something that you could not do, or that much better men could not do, and besides one of his fists might slip and land in some unseemly place and that would be the end of a bright youth. Hencely, when we conducted any arguments, I invariably chose the opposite side of the sewer trench. As those of you who have built brick sewers will recall, one side of the trench is reserved for niling the brick Well, that was my side. When the storm finally broke, it found me so situated. Also when the old gentleman started across on a brace to get where I was, I collected up a few bricks commonly called "Dublin confetti," and delivered an ultimatum. I had unwittingly hit upon his one weakness for while he would have been overjoyed to tackle the champion pugilist of the world, he owned a horror of bricks, clubs or anything that mussed a man up. So he went back and spent ten minutes begging me to put down the bricks and come over and fight like a man and ten more calling me names. He then went away and I had greatly fallen in his estimation. He told me so next day, said I was a fine boy but I had bad ideas.

PERSONAL

Mr. H. D. Forneri has been reappointed as city engineer for Eugene, Ore.

Mr. George Smith, engineer of Lindsay, Ont., has been appointed town engineer of Midland, Ont.

Mr. J. Antonisen has resigned as city engineer for Moose Jaw, Sask., to become superintendent for the Street Railway Company of Brandon, Alta.

Mr. Isham G. Randolph, Consulting Engineer, 38 S. Dearborn St., Chicago, has been made Chairman of the Everglades Drainage Commission in Florida.

Mr. Frank C. Heins has accepted a position as assistant to Chief Engineer J. E. Milliken, of the Port Arthur Rice & Irrigation Company, Nederland, Texas.

Mr. Henri Camp, civil engineer, has been appointed secretary of the International Association of Tramways and Light Railways, with offices at Brussels, Belgium.

Mr. Paul D. Cook announces that he has opened an office for general practice as a consulting engineer, with offices at 513 United Bank bldg., Sioux City, Iowa.

Mr. William H. Reichard has been reappointed as superintendent and Mr. John J. Kromer as chief engineer by the board of water commissioners, Allentown, Pa.

Mr. G. P. de Wolf, chief engineer of construction for the National Railways of Mexico, has assumed the duties of the director of construction, that position having been abolished.

Mr. H. M. Taylor, director of construction for the National Railways of Mexico, has resigned to accept the position of vice-president and general manager of a large railway system of Brazil.

Mr. John Ericson will read a paper on "The Chicago Water Works" before the extra meeting of the Hydraulic, Sanitary and Municipal Section, Western Society of Engineers, Monday, April 19.

Mr. George S. Rice will present a paper on "The Prevention of Earth and Rock Slides" before an extra meeting of the Bridge and Structural Section, Western Society of Engineers, Monday, May 12.

Mr. F. M. Bisbee has been appointed chief engineer for the Santa Fe western lines, with headquarters at Amarillo, Texas. He is also chief engineer of the Southern Kansas Railway of Texas, and of the Peco Northern lines.

Mr. John M. Hoffman has resigned as general manager of the Missouri, Oklahoma & Gulf Ry., and will be succeeded by Mr. Daniel Breck, formerly of St. Louis. Mr. Hoffman will engage in the contracting business in Arizona.

Mr. Hugh Wilson, a graduate of the civil engineering department of the University of Nebraska, and formerly assistant engineer of the Northern Pacific R. R., has been made inspector for the California State Railroad Commission.

Mr. George W. Tillson, consulting engineer to Brooklyn Borough; Mr. Alfred E. Steers and Mr. Nelson P. Lewis, chief engineer of the Board of Estimate, New York City, have been appointed by Mayor Gaynor to represent the city of New York at the International Road Congress to be held in London, June 23-28.

Mr. W. B. Willis has been appointed assistant division engineer of the Monongah division of the Baltimore & Ohio R. R. with headquarters at Grafton, W. Va., succeeding Mr. H. F. Klosso, transferred. Mr. D. W. Whisner is appointed supervisor of subdivision No. 11 of the Monongah division and will be located at Clarksburg, W. Va.

INDUSTRIAL

The Platt Iron Works Co., Dayton, O., manufacturers of pumps, feed water heaters, water wheels, etc., which suffered some damage from the recent flood at Dayton, is now prepared to accept and fill all orders promptly. The company's buildings were practically uninjured. The second day after the water subsided the company had steam up and the service and fire pumps were put in operation, and the work of removing the mud and debris was started. The entire organization responded most loyally towards getting the plant in operation, irrespective of the fact that many of them suffered personal loss due to the flood. A small portion of the plant was put in operation April 7, but due to the fact that a large number of the machine tools are equipped with individual motor drives it was necessary to bake and clean these motors and the company did not start up in all departments until April 21.

There is at present being built at Beldens, Vt., for the Vermont Marble Co., Proctor, a new power plant for furnishing electric power to the quarries in the neighborhood of Proctor, 4 miles away. There are to be two units of 1,200 h.p. each, direct-connected to 800 k.w. Westinghouse generators and running at 300 r.p.m. Each unit is a 1,200 h.p. double turbine, manufactured by the S. Morgan Smith Co., York, Pa., the turbines having runners 33-inches in diameter on a horizontal shaft, and the flow of water being controlled by the familiar wicket gate system. The discharge from the turbines runs through a draft tube 16 feet in depth. One of the interesting features of the new development is the fact that this plant is practically a duplicate of a similar plant built in 1910 at Huntingdon Falls, about 2 miles from Beldens. This previous development is operated also by S. Morgan Smith turbines, but the generators in this case are General Electric. Both plants will operate over the same set of transmission lines at high voltage, all of the power being used in the neighborhood of Proctor. One advantage of having the two plants so nearly alike is the fact that it is much easier to carry spare parts in sufficient quantity, resulting, of course, in better security against stoppage of operation.

CATALOGUES

Road Oiling Machinery.—Paper, 7x10½, ins., 40 pp. The Good Roads Machinery Co., Kennett Square, Pa.

This catalog deals with machinery for applying dust layers and bituminous binders. Special attention is called to the Climax Distributor, which is illustrated by several views. This is a recently developed machine and is claimed by the manufacturers to be the only kind that will successfully apply, under pressure, the heaviest bituminous binders, like Trinidad and Bermudez.

Reinforced Concrete Bridges.—Paper, 9x6 ins., 24 pp. Daniel B. Luten, Consulting Engineer, Indianapolis, Ind.

This is an interesting book showing the effects of the Indiana and Ohio flood of March 23 to 27, 1913, on bridges, and illustrating the stability of bridges of concrete construction.

New Towns and Business Opportunities.—Paper, 4¼x8¼ ins., 64 pp. Chicago, Milwaukee & St. Paul Ry., 1301 Railway Exchange Bldg., Chicago, Ill.

This booklet contains information compiled by a canvass made of different towns and cities located on the Chicago, Milwaukee & St. Paul line and shows their business and professional needs. The various lines of business are segregated in alphabetical order and the body of the book contains a description of the town and local conditions.

Graphite Products.—Paper, 7¼x10½ ins., 48 pp. U. S. Graphite Co., Saginaw, Mich.

General catalog and price list No. 19 is briefly descriptive and is devoted to serve the trade as a convenient reference. In addition to the graphite products listed, the company is equipped to prepare graphite for special purposes.

Water Proofings.—Paper, 7x10¼ ins., 80 pp. Imperial Water Proofing Co., Ltd., 712-9 S. La Salle St., Chicago, Ill.

This catalog describes I. W. P. Hydraliquid and its properties and cost, and illustrates a number of buildings and other structures in which the material is used.

Ransome Concrete Machinery.—Paper, 6x9 ins., 80 pp. Ransome Concrete Machinery Co., Dunellen, N. J.

Catalog No. 13 contains illustrations, descriptions and brief specifications of concrete mixers and auxiliary plant for concrete work, including engines, towers, buckets, hoppers, cars, testing machines, benders for reinforcing steel, portable pumps, Ransome-Canniff Grout Mixer, spouting apparatus, etc. Line drawings with tables of dimensions to show the sizes of various machines are given.

Crude Oil Engines.—Paper, 6x9 ins., 8 pp. The Snow Steam Pump Works, Buffalo, N. Y.

Bulletin S-110 illustrates and describes the Snow Crude Oil Engine of from 50 to 600 H. P.

Flexible Hose.—Paper, 5x8 ins., 12 pp. Pennsylvania Flexible Metallic Tubing Co., Abbott Bldg., Philadelphia, Pa.

This catalog illustrates and describes an interlocking metal hose for use in railway shops. Price list is given.

Barrett Adding Machines.—Paper, 4¾x8¼ ins., 24 pp. Barrett Adding Machine Co., Bulletin Bldg., Philadelphia, Pa.

This catalog illustrates and describes the Barrett Adding Machine and gives useful information as to the increased efficiency through the use of the machine, arguments for the superiority of the machine, the utility, etc.

Pumps.—Paper, 6x9 ins., 48 pp. John H. McGowan Co., Cincinnati, O.

This catalog deals with centrifugal pumps and gives illustrations, descriptions and specifications with tables of dimensions, capacities, etc. A similar catalog is devoted to Triplex Pumps. Pamphlets Nos. 36 and 31 are devoted to Duplex Pumps. Catalog No. 30 to single cylinder pumps.

G-K Compound.—Paper, 3½x5¾ ins., 20 pp. Union Clay Products Co., 20 Water St., New Brunswick, N. J.

This compound is described as a positive, permanent, pliable pipe joint for connecting vitrified pipe. Tables of quantities necessary for various sizes of pipe are given, together with directions, descriptions, etc.

Centrifugal Pumps.—Paper, 6¾x10¼ ins., 48 pp. D'Olier Centrifugal Pump and Machine Co., Morrison Bldg., Philadelphia, Pa.

This is Catalog T, which is devoted to horizontal centrifugal pumps. It contains illustrations and descriptions of a number of sizes, with various types of drive. Useful technical information is given.

Shoveling Machines.—Paper, 10½x8¼ ins., 24 pp. Myers-Whaley Co., Knoxville, Tenn.

This is Catalog No. 2, which illustrates and describes shoveling machines for underground and surface work. Descriptions of the machine and its economy are given, together with complete illustrations showing the machine in operation.

RAILWAYS

Alabama.

⊙O. J. Pruitt, Montgomery, Ala., has, according to reports from that city, been awarded the contract for grading and building a railroad from Alexander City in Tallapoosa County to Kowaliga in Elmore County, a distance of 15 miles. Work will probably be commenced at once. Benjamin Russell, Alexander City, Ala., is promoting the project.

⊙Tom Worthington, Birmingham, Ala., has started work on his contract for constructing several miles of trackage at Russellville, Ala., to connect the mines of the Sloss-Sheffield Steel Co. with a new iron ore washer, which is to be erected shortly.

Ernest Lamar and L. M. Hooper of Selma, Ala., are reported to be in New York for the purpose of financing the construction of the proposed railroad from Selma up the Cahaba Valley to Birmingham.

Arkansas.

Engineers of the Fort Smith, Subiaco & Eastern R. R. Co. expect to have surveys completed shortly in order that the construction work can be started. Efforts will be made to have the line open for operation by the middle of August.

The Memphis, Dallas & Gulf R. R., W. P. Hart, Chief Engineer, Nashville, Ark., has accepted the bonus raised by Hot Springs, Ark., and it is understood that work will be started at once in compliance with the provisions of the contract for the new line from that city.

California.

Residents of Montecito are to petition the Santa Barbara & Suburban Ry. Co., Santa Barbara, Cal., to extend its Haley St. line to Miramar.

The Harbor Advisory Board has requested the Board of Public Works of Los Angeles to call for bids for necessary rails, ties, frogs and other supplies for six miles of railroad for the use of the wharves and warehouses at the harbor. The estimated cost is $50,000. Homer Hamlin is City Engineer of Los Angeles.

The budget of the Santa Fe System for 1913 includes an item of $100,000 for the construction of a 2-story concrete freight depot and warehouse on Taylor St., between California and San Joaquin, Stockton, Calif. The work will probably be started in a short time.

The Board of Supervisors of San Francisco has prepared an ordinance providing for a bond issue of $3,500,000 with which to construct municipal railways on Van Ness Ave., Stockton, Church and California Sts., Potrero Ave. and the rebuilding of the Union St. line at San Francisco. The cost and length of the contemplated additions to the municipal railroads are estimated as follows:

Roads—	Miles.	Cost.
Van Ness Ave	2.07	$ 479,200
Church St	2.15	500,000
Potrero Ave	2.2	350,000
California St	2.	400,000
Stockton St	1.	230,000
Union St	3.78	800,000
Total	13.5	$3,059,200

The State Railroad Commission has granted permission to the Pacific Electric Ry Co., 6th and Main Sts., Los Angeles, to issue bonds for the completion of its improvements in the vicinity of the San Bernardino Valley. About $1,424,000 is to be used for the construction of the line from Upland to San Bernardino; $408,000 for completing the line between San Bernardino and Riverside; $43,000 on the line between San Bernardino and Redlands, and $105,000 on the line between San Bernardino and Highland. The total amount of the bond issue is to be $6,839,000.

The Modesto & Empire Traction Co. has secured practically all right of way for an extension from Empire to Waterford, 8 miles, and will probably begin construction work in the near future. The extension will cost about $60,000, and the line will be operated either by the storage battery system or gasoline motors. T. K. Beard, Modesto, Cal., head of the Beard Construction Co., is President of the traction company.

The Healy-Tibbitts Construction Co., San Francisco, at $34,450, was low bidder for the extension of the Geary St. Municipal Railway to the ocean front for the city of San Francisco.

The Mill Valley & Mt. Tamalpais Scenic Ry., Charles F. Runyon, President, Mill Valley, Cal., has about completed plans for its proposed improvements to roadbed and equipment. About $200,000 is available. It is probable, however, that the West Point Station-Bolmas extension will not be built at this time.

F. S. Edinger, 137 Market St., San Francisco, has about finished his contract for constructing a 4-mile extension of the Nevada County Narrow Gage R. R. from Colfax.

Colorado.

The Denver, Northwestern & Pacific R. R. has been purchased by Benjamin Strong, Jr., and George H. Burr, representing the bondholders of the road, for $3,000,000. The Denver & Salt Lake R. R. Co. has been organized with Newman Erb as president, to take over the property from the bondholder purchasers. The sale was part of the legal formality necessary to the reorganization of the road, which has been in the hands of receivers for the past two years. It is stated that further steps will be taken to extend the road to Salt Lake City immediately following the city election at Denver of May 20, upon condition that the people of Denver at that time vote in favor of amending the city charter so as to permit of the city's voting the bonds necessary to defray two-thirds of the cost of the tunnel of the road to be built under James' Peak.

Georgia.

A conference was recently held by citizens of Rome and Gadsden, Ga., in regard to the construction of the proposed railroad between the two cities.

Illinois.

The Springfield, Taylorville & Pana Interurban R. R. Co. incorporated last week with a capital stock of $325,000, proposes the construction of a road from Springfield through the counties of Sangamon and Christian, through the city of Taylorville, to Pana in Christian County. The incorporators and first board of directors are: W. B. Adams of Taylorville and P. E. Ballet, George H. Backer and H. V. Gehm of St. Louis. Mr. Gehm is President and Mr. Backer Treasurer of the St. Louis Railroad & Equipment Co., St. Louis, Mo., which has the contract for building the new road. It is expected that the line will be built from Taylorville to Pana by Oct. 1, 1913, the other end being built next spring.

A project is under consideration for the organization of a company to build and operate an interurban line from Ridgefarm to Clinton, via Dana, Ind. John A. Johnson, Indianapolis, Ind., is interested.

The Santa Fe System contemplates making the following minor improvements, in the near future: New Mexico Division—Ballasting the main track between Trinidad and Ralston, estimated cost $91,773, replacing bridge 664, $1,690; northern division, deepening the well at Crowley, $4,922; building new wheel shops at Crowley, $6,311; constructing transfer pits at Clebourne, $5,164; constructing team track at Oak Cliff, $3,920; building two spur tracks at Clebourne, rearrangement of the shop yards at Clebourne, $58,598; constructing a team track and driveway at East Dallas, $1,261; installing an automatic signal plant at Midlothian, $6,142; installing tracks for the New Century Milling Co. at Dallas, extending passing track and crossovers at Saginaw. Oklahoma Division—Replacing bridges 36 C, 32B and 108A; constructing a team track at Cushing; extending elevator track at Sitka on the Panhandle Division. Pecos Division—Extending passing track at Boaz; extending passing track at Krider; extending passing track at Portales, Greenfield, Orchard Park and Buchanan, estimated cost $10,000. Plains Division—Extending the passing track at Gage, Folsom, Glazier, St. Francis and Whitedeer, estimated cost $9,000. Rio Grande Division—Changing and adding to track facilities at Whitewater, Santa Fe, Prescott and Phoenix lines; reduction of grades. Southern Division—Extending track at Cameron; replacing bridge 215, extending passing track at Blum; extending passing track at Moody; estimated cost, $12,000; grade reduction at milepost 224, $29,068; replacing the bridge approaches of bridge No. 192Q; constructing storage track at Rosenburg; extending passing track at Chreisman, Phillipsburg and Cameron, estimated cost, $18,000; constructing a steel tank and water crane at Coleman, $5,257; extending house track at Bangs, $5,346. Southern Kansas Division—Changing track at Caney, $3,989; changing track at Thayer, $3,013; building a team track at Earlton; constructing a coal chute at Meline, $7,071; building connecting track at Tulsa, $3,349. Valley Division—Replacing bridge 68A, renewing bridge 890D, estimated cost $90,000; constructing scale track and passing track at Hanford, $11,322; installing a water pumping plant and pipe line at Antioch, $1,872; installing a spur track for Standard Oil Co. at Corcoran, installing a spur track at Taft for the Kern Trading & Oil Co., building a concrete freight house with appurtenances at Stockton, $80,772; widening banks and cut along the line as specified, $52,052. Western Division—Widening embankments and cuts and raising bridges between Kinsley and Dodge City, $107,024; replacing and renewing bridges as specified.

Indiana.

Application will be made to the County Commissioners at Logansport, by Fausler & Foskett, Attorneys, Logansport, representing the Laporte, Logansport & Southwestern Traction Co., for a franchise to be granted that company for a right of way for a traction line to be extended through the northeastern end of the county to Logansport.

Plans are understood to be under consideration for the formation of a new company to take over the bonds of the Fort Wayne & Springfield Ry. Co. (electric), Decatur, Ind., and provide about $600,000 for extending the line to Portland, Ind.

Kansas.

O. P. Byers, Hutchinson, Kan., promoter of the Anthony & Northern R. R., is now securing right of way for the Anthony-Bratt line through Pratt County.

The Manhattan City & Interurban Ry. Co., W. R. West, President, Manhattan, Kan., is making good progress with its plans for an extension from Manhattan to Topeka.

Maine.

City Council of Bangor, Me., has granted the Bangor Railway & Electric Co., John R. Graham, President, 86 Harlow St., Bangor, Me., a renewal of all trackage rights, and as a result the company will expend about $300,000 for extensions and improvements.

Maryland.

Agents of the Western Maryland Railroad are negotiating for the necessary right of way through Berkeley County, W. Va., across the Potomac River from Williamsport, Md., for the construction of a spur track to the limestone quarries along the river in the vicinity of Indian Church. The plans include a bridge over the river.

Massachusetts.

The Board of Trade of Holyoke, Mass., will call a meeting this month to take action toward securing an extension of the electric railway from Holyoke to Belchertown and Enfield. M. A. Morse, Belchertown, is interested.

Michigan.

⊙The Grand Rapids & Northwestern R. R. has awarded the contract for the construction of the new railroad from Ludington, Mich., to Grand Rapids to J. H. Flick Construction Co., 37 W. Van Buren St., Chicago, Ill. Actual construction work will be commenced at once and it is expected to have steel laid before winter. Walter S. Syrett, Post Office Bldg., Ludington, Mich., is promoting the project.

The Copper Range R. R. will let a contract on May 15 for a 5-mile extension of the main line from Painesville to Toivala. F. L. Batchelder, Houghton, Mich., is Chief Engineer and F. R. Bolles, Houghton, Mich., is General Manager.

Town of Linden voted on May 1 on granting a franchise to Oliver H. Lau, Detroit, Mich., for an electric railway from Linden to Fenton and Holly.

Minnesota.

⊙H. F. Balch & Co., Minneapolis, Minn., has been awarded the contract for constructing 8 miles of electric railway to Long Lake for the Electric Short Line of Minneapolis.

It is reported that work has been started by the Minneapolis & St. Louis R. R. on a new station and yards at Albert Lea, Minn. The cost of the improvement will amount, it is said to $300,000. The improvements are to include a two story freight depot. The passenger station will provide for all the offices of the Minneapolis & St. Louis at Albert Lea. The company has purchased all the necessary land with rights to alleys and streets with the exception of two properties, against which condemnation proceedings are to be started.

Citizens of Fulda and other towns along the Pipestone branch of the Chicago, Minneapolis, St. Paul & Omaha Ry. are making efforts to secure a conference with the officials with a view of persuading them to abandon a stretch of seven miles of track between Lime Creek and Avoca and run the line from Lime Creek over to Fulda and then back to the present line at Avoca. The distance from Lime Creek to Fulda is three miles and from Fulda to Avoca six miles. By the change the mileage of the branch would be increased but two miles. Fulda has the Southern Minnesota line of the Milwaukee.

Advices from Carlton, Minn., state that the Northern Pacific has let contracts for a number of improvements at that place. The work will include stripping, the construction of buildings, laying tracks, etc.

Missouri.

✣All bids received May 1 for grading the Moberly, Huntsville & Randolph Springs Ry. have been rejected, and the work is readvertised to be let May 29. L. H. Dameron, Huntsville, Mo., is President.

Bids are reported to have been received by C. H. Damern, Huntsville, Mo., President of the Moberly, Huntsville & Randolph Springs Electric Ry., for grading the proposed line.

The Missouri Public Utilities Commission has approved the bond issue of $25,750,000 proposed by the Missouri, Kansas & Texas R. R. The proceeds are to be used for equipment, improvements, etc.

Nevada.

Survey work is underway for the proposed Winnemucca R. R. H. H. Sheldon, Winnemucca, Nev., is Chief Engineer.

It has been announced that the Copper Belt R. R. will shortly commence construction on the proposed line to Aurora, Nev., through the camps of Willington and Sweet Water.

The Southern Pacific is contemplating the extension of its road from Thorne to Hawthorne Nev.

New Jersey.

The Morris R. R. Co., a subsidiary of the Morris County Traction Co., J. L. Desch, Chief Engineer, Morristown, N. J., is to take steps to at once increase its capital stock to cover the cost of constructing 2.6 miles of line between Morristown and Madison. The estimated cost is $175,000.

Residents of Linden, N. J., are organizing a company to build and operate a 6-mile electric railway through that township to connect with the new Short Line of the Public Service Co. of Newark. The road will probably cost about $15,000 per mile. Jacob L. Bauer, 130 Broad St., Elizabeth, N. J., is the Engineer. Frank R. Anderson, Linden, N. J., is interested.

New York.

⊙The John F. Dolan Contracting Co., 50 Church St., New York City, has been awarded the contract for the extension of the Seneca Falls branch of the Lehigh Valley R. R., from Seneca Falls east to Cayuga Lake.

The Syracuse Grade Crossing Commission and the Delaware, Lackawanna & Western R. R. Co., according to advices from Syracuse, N. Y., have reached a general agreement for the elimination of the company's grade crossings within the city.

The Delaware, Lackawanna & Western R. R. has plans underway for double tracking its line from Solvay to Jamestown, and it is probable the work will be undertaken this summer.

The Hudson River Connecting R. R., the incorporation of which was mentioned in our March 26 issue, has applied to the Public Service Commission for permission to begin construction work and to issue $250,000 of capital stock. This company is a subsidiary of the New York Central & Hudson River R. R., and proposes the construction of three short lines in Albany, Rensselaer and Columbia Counties by which connections will be made between the New York Central, the West Shore and the Boston & Albany railroads.

North Carolina.

⊙Jos. H. Sands Contracting Co., Roanoke, Va., has been awarded the contract for double tracking the line of the Atlantic Coast Line R. R. between Pleasant Hill, N. C., and Petersburg, Va., a distance of 60 miles.

North Dakota.

Surveyors of the Northern Pacific at work on the proposed line from East Grand Forks have already reached Drayton, N. D., the line crossing the Red River to a point in St. Andrews township, Walsh County. Running directly north out of East Grand Forks the line is practically straight until it reaches a point due east of Grafton. There it takes a northwesterly course into North Dakota, joining the present line between Grand Forks and Winnipeg about 1½ miles south of Drayton. This line, according to the general understanding of the situation, is proposed by the Northern Pacific with a view to shortening the run between St. Paul and Winnipeg.

Ohio.

⊙MacArthur Bros. Co., Fisher Bldg., Chicago, Ill., has recently secured a contract for 24 miles of railroad work on the Lorain, Ashland & Southern, between Wellington, O., and Ashland, O. The work comprises 500,000 cu. yds. of good team, wheeler and machine work; also the bridging and concrete. Offices will be opened at once at Wilmington, O.

Oklahoma.

The Pryor, Salina & Eastern Ry. Co. proposes the construction of a 10-mile interurban line from Pryor, on the Missouri, Kansas & Texas Ry., to Salina, Okla., on the Missouri, Oklahoma & Gulf. The line will cross Grand River and will traverse a practically level country. The project is being backed by Pryor and Salina citizens, but will have outside financial aid. Surveys have not been made, nor has the contract capital been named. J. A. Qinn, Pryor, Okla., is the promoter.

The Vinita Interurban Ry. Co. of Vinita, Okla., has been incorporated with a capital stock of $10,000, the incorporators being J. T. Ratcliff, M. T. Knight, Seymour Riddle, John A. Wise and Paul F. Mackey of Vinita. The company proposes the construction of a line from Vinita to the Eastern Hospital for the Insane, located about three miles outside the city, and ultimately the building of a city street car system.

Oregon.

The State Railroad Commission of Oregon has instructed the Corvallis & Eastern R. R. to improve the entire 140 mile line by the end of next year. The old rails, which are considered too light, will be taken up and replaced with heavier steel. J. K. Weatherford, Albany, Ore., is President of the company.

The Kerry Timber Co., according to advices from Astoria, Ore., has filed a mortgage to secure an $800,000 bond issue to obtain funds for the purpose of building a logging railroad from Woods Landing on the Columbia River to the Nesalem Valley, a distance of 31 miles, as well as to erect mills and establish and operate logging camps. Clearing and grading work on the railroad is now under way.

Pennsylvania.

⊙Irwin & Leighton, Philadelphia, Pa., has been awarded the contract for constructing two car repair shops at St. Clair, Pa., for the Reading Ry. The plans call for a heavy and medium shop, and an intermediate shop, which are designed to be steel skeleton structures, 83 ft. wide by 604 ft. long, and 53 ft. wide by 464 ft. long, respectively. The buildings will be of brick.

⊙The Velotta Construction Co., Leader Bldg., Cleveland, O., has been awarded the contract for constructing 17 miles of electric railway between Titusville and Cambridge Springs, Pa., for the Erie & Central Pennsylvania Ry.

⊙Steir, Marsh & Co., Philadelphia, Pa., have been awarded the contract for the grading and masonry work for the extension of the Pottstown & Reading Street Ry. from the township line below Sanatoga to the site of the new bridge over the Schuylkill River at Linfield.

Tennessee.

Wm. McCarthy, West Point, Tenn., will finish his work at West Point on the Tennessee Western Ry. early in May, and will then be in the market for some good team work for his 35-team outfit.

Texas.

The Rio Grande & Eagle Pass Ry., R. W. Davis, Chief Engineer, Laredo, Tex., has plans underway for an extension down the valley of the Rio Grande from Laredo to Sam Fordyce, about 150 miles, and up the valley from Minerva to Eagle Pass, about 125 miles.

F. E. Ebersole, Houston, Tex., is reported to have purchased the right of way and other holdings for the proposed interurban line from Houston to La Porte by way of South Houston. It is stated that he will have construction work started this summer.

It is expected that the Southern Traction Co., 1316 Commerce St., Dallas, Tex., will commence work in the near future on the construction of 4 miles of street railway at Waxahachie.

The Commercial Club of Big Springs, Tex., has signed a contract with J. Fry, representing the Empire Construction Co., of Omaha, Neb., whereby a proposed railroad from Tucumcari, N. Mex., to San Antonio, Tex., will have passenger and freight terminals in Big Springs.

Utah.

⊙The Utah Construction Co., Ogden, has a contract for grading and building a roadbed for six miles of line through the Jordan Narrows for the Salt Lake & Utah R. R., a new interurban company of which W. C. Orem, Salt Lake City, is President.

The Ogden, Lewiston & Northern Ry. Co. has been incorporated with a capital stock of $100,000 and proposes the construction of the interurban line from Ogden, Utah, to Preston, Idaho. The company is reported to have expended about $20,000 for preliminary work, including surveys and the securing of franchises and right of way. Fred W. Crockett, Logan, Utah, is President and Morris W. Swingard, Lewiston, Idaho, is Secretary.

The Logan Construction Co. of Logan, Utah, has been incorporated with a capital stock of $100,000, the officers being: President, P. A. Wells of Omaha; vice president, Mrs. Fred W. Crockett of Logan; secretary and treasurer, George H. Blood of Preston, Idaho. This company was probably organized to construct the Ogden, Lewiston & Northern Ry., the incorporation of which is noted elsewhere in these columns.

Virginia.

The Virginia-Carolina Ry. Co. on May 5 opened bids for a further extension of 40 miles. This line is in Washington County, Virginia, and Ashe County, North Carolina, the line running via Jefferson to Todd, N. C., on the south fork of New River. The contract for the first 8 miles of the extension was awarded last December to the Callahan Construction Co. of Knoxville, Tenn. P. W. Early, Abingdon, Va., is Chief Engineer.

The New River, Holston & Western R. R. Co., P. W. Early, Chief Engineer, Abingdon, Va., was to let contracts last week for a 15-mile extension from Rocky Gap, on Wolf Creek, to Suiters, on Hunting Camp Creek. The line is all in Bland County, Virginia, and passes 6 miles north of Bland Court House. The work is light.

Washington.

⊙Grant Smith & Co., Henry Bldg., Seattle, Wash., have been awarded a contract for a 1,200 ft. tunnel in the Cascade Mountains for the Great Northern Ry. The tunnel will enable the railway to cut out track around Windy Point, near the summit.

⊙G. O. Foss & Co., Spokane, Wash., have secured a subcontract from Guthrie, McDougall & Co., on the Northern Pacific double tracking through the Cascade Mountains. The subcontract covers about 3 miles of line out of Lester and involves some heavy work.

The Tacoma Railway & Power Co., L. H. Bean, Manager, 1319 A St., Tacoma, Wash., has appropriated $315,000 for improvements, work on which is to be started in June. The work includes the reconstruction of tracks on Pacific Ave. and C St. and the replacing of the present 70 lb. rails with 90 lb. steel.

It is rumored that officials of the Great Northern Ry. are contemplating the double tracking of its Cascade Mountain division in Washington.

The articles of incorporation recently filed by the North Bank Logging Co. provide for the construction and operation of a logging, freight and passenger railroad between Ilwaco and Kalama, Wash. The incorporators were John K. Kolloch, M. A. Zollinger and F. Winn.

The Chehalis & Cowlitz Ry., according to information received from Centralia, Wash., has been granted permission by the Lewis County Commissioners to extend its line southeast from Chehalis across the Newaukum Prairie. Actual work will be commenced at once.

West Virginia.

Bids have been opened by the Fayette Traction Co., C. W. Dillon, President, Fayetteville, W. Va., for completing grade of the line from Fayetteville to Fayette Station, 4½ miles.

Wisconsin.

Plans for the improved Chicago & Northwestern Ry. terminal at Milwaukee, Wis., will be ready in a few days.

The Milwaukee Traction Co. has been incorporated with a capital stock of $10,000 and proposes the construction of a car line on the north side of Milwaukee. The incorporators are Lorenze F. Wagner, 1051½ Sixth St., Milwaukee; N. C. Schulz, 1465 Tenth Sst., Milwaukee, and H. A. Schmidt, 1013 Fourth St., Milwaukee.

Wyoming.

Among the reports circulating in regard to the new work proposed by the Chicago, Burlington & Quincy R. R., is one to the effect that the company contemplates building a line connecting its Powder River extension and its Sheridan Main line, using a route through the Salt Creek oil fields.

Canada.

✣Bids will be received until 4 p. m., May 10, by Robt. A. Grant, 1003 McArthur Bldg., Winnipeg, Man., for the construction of a street railway through Baxter Pl., Moose Jaw, Sask. Plans and specifications may be seen at 1003 McArthur Bldg., Winnipeg.

⊙The Saskatoon & Sutherland Contracting Co., Saskatoon, Sask., has been awarded the contract for constructing a municipal electric car line on 8th St., Saskatoon.

Town Council of Dunnville has granted a 1-year extension of the time for the Dunnville, Welland & Beamsville Electric Ry. Co. to earn the bonus voted by the rate payers some years ago. The company expects to complete its line to St. Anns before fall and will connect with the Toronto, Hamilton & Buffalo Ry. at that place.

It is reported that the contract for the construction of 57 miles of line from Otter summit to Hope, B. C., which will be used jointly by the Kettle Valley and Great Northern Rys., will be let in the next few days. It is likely that Grant, Smith & Co., Henry Bldg., Seattle, who built 40 miles of the Canadian Northern through the Fraser canyon, will be the successful tenderers. The contract will amount to about $3,500,000.

ROADS AND STREETS

Alabama.

✣Bids will be received until noon, June 2, by Board of Henry County Commissioners, Abbeville, Ala., for grading, drainage and surfacing with sand-clay about 4 miles of Headland road and 5 miles of Eufaula road, the work starting at Abbeville and estimated to cost $8,000. W. S. Keller, Montgomery, Ala., is State Highway Engineer.

✣Bids will be received until May 31, by Board of Franklin County Commissioners, Red Bay, Ala., for grading, draining and surfacing with gravel portion of Old Fulton and Russellville road. W. S. Keller is State Highway Engineer, Montgomery, Ala.

✣Bids will be received until May 19, by Board of Coosa County Commissioners, Rockford, Ala., for grading, drainage and surfacing with topsoil portion of Kellyton and Rockford Road. W. S. Keller, Montgomery, Ala., is State Highway Engineer.

⊙The Alabama Construction Co., Montgomery, Ala., has been awarded the contract by Marshall County Court, Guntersville, Ala., for the construction of two miles of chert and four miles of sand-clay road, at approximately $8,000. The work includes grading, drainage and surfacing. Bids were opened April 22.

California.

✣Bids will be received at the office of the California Highway Commission, 515 Forum Bldg., Sacramento, Cal., until 2 p. m., on May 19, 1913, at which time they will be publicly opened and read, for constructing a portion of a State Highway in Santa Clara County between Lawrence Station Road and Santa Clara; about 1 mile in length, to be built of Portland cement concrete with bituminized surface. Plans may be seen, and forms of proposal, bonds, contract and specifications may be seen at the office of the Division Engineer at San Francisco, Cal. Austin B. Fletcher, Highway Engineer.

✣Bids will be received at the office of the California Highway Commission, 515 Forum Bldg., Sacramento, Cal., until 2 p. m., on May 19, 1913, for constructing a portion of a State highway in Los Angeles County between Calabasas and the westerly boundary; about 11¼ miles in length, to be built of Portland cement concrete with bituminized surface. Plans may be seen, and forms of proposal, bonds, contract, and specifications may be obtained at the said office; and they may be seen at the office of the Division Engineer at Los Angeles, Cal. Austin B. Fletcher, Highway Engineer.

✣Bids will be received at the office of the California Highway Commission, 515 Forum Bldg., Sacramento, Cal., until 2 p. m. on May 19, 1913, at which time they will be publicly opened and read, for constructing a portion of a State highway in Ventura County between the southerly boundary and Newbury Park; about 7½ miles in length, to be built of Portland cement concrete with bituminized surface. Plans may be seen, and forms of proposal, bonds, contract, and specifications may be obtained at the said office; and they may be seen at the office of the Division Engineer at Los Angeles, Cal. Austin B. Fletcher is Highway Engineer.

⊙Bids were received on April 23 by the State Highway Commission, Sacramento, for the construction of Section B of the state highway in San Mateo County, Division 4, Route 2. In the table shown below (1) stands for bid of Raisch Improvement Co., San Francisco, (awarded contract); (2) City Street Improvement Co., San Francisco; (3) The Barber Asphalt Paving Co., San Francisco; (4) Clark & Henery Construction Co., Sacramento; (5) Western Paving Co., Burlingame, and (6) engineer's estimate:

		(1)	(2)	(3)	(4)	(5)	(6)
Excavation (without classification)..	2,400 cu. yds.	$0.45	$0.80	$0.80	$0.50	$0.90	$0.80
Corrugated iron pipe, 12-in..........	152 lin. ft.	1.30	1.80	1.50	1.40	1.65	1.20
Corrugated iron pipe, 18-in..........	38 lin. ft.	2.00	2.20	1.80	1.80	2.10	1.80
Cement concrete, Class "A".........	60 cu. yds.	2.60	10.00	9.00	9.50	14.50	12.00
Cement concrete, Class "B".........	25 cu. yds.	6.00	9.00	8.00	9.50	12.75	10.00
Asphalt wearing surface.............	20,645 sq. yds.	.55	.589	.648	.54	.89	.54
Broken stone	2,750 tons	2.25	1.70	1.49	2.20	4.35	2.25
Monuments (hauling and setting)...	16 each	2.00	2.00	3.00	2.00	3.80	1.00
Totals		$19,234	$19,969	$20,048	$19,519	$34,077	$23,566

⊙The Brashear-Burns Co., of Los Angeles, Calif., has been awarded the contract for grading and paving work in Angeles Mesa, at about $40,000. Mesa Drive is to be paved on each side with rock-macadam and oiled. Approximately four miles of streets will be paved.

All bids received on April 23 by the State Highway Department, Sacramento, for the construction of Section A of the state highway in Ventura County, Division 4, Route 2, were rejected. The lone bidder on the work, Geo. A. Rogers Bros., Co., Los Angeles, bid as follows, (1) standing for engineer's estimate and (2) Roger's bid:

			(1)	(2)
1.	Excavation (without classification)	22,020 cu. yds.	$0.50	$0.80
2.	Corrugated iron pipe, 12-in.......	234 lin. ft.	1.20	2.00
3.	Corrugated iron pipe, 18-in.......	88 lin. ft.	1.65	2.35
4.	Corrugated iron pipe, 24-in.......	112 lin. ft.	2.10	2.70
5.	Cement concrete (culv.), Class "A"	45 cu. yds.	11.00	10.00
6.	Cement concrete (culv. and monuments), Class "B"	36 cu. yds.	10.50	10.00
7.	Cement concrete (pav.), Class "B"	7,180 cu. yds.	4.50	6.00
8.	Asphaltic oil (hauled & placed)	770 bbls	1.50	3.00
9.	Broken stone screenings	555 tons	2.20	2.50
10.	Sand	370 cu. yds.	2.50	2.50
11.	Guard rail.......	2,744 lin. ft.	0.40	.50
12.	Monuments (hauling and setting).	136 each	.60	5.00
	Totals		$56,735	$67,923

⊙Bids were received April 23 by the State Highway Commission, Sacramento, for the construction of Section A of the state highway in San Mateo County, Division 4, Route

2. In the table shown below (1) stands for engineer's estimate; (2) Raisch Improvement Co.; (3) City Street Improvement Co.; (4) Flinn & Treacy, San Francisco, (awarded contract); (5) F. E. Hilmer, San Francisco; Ransome-Crummey Co., Oakland, bid cost plus 15 per cent on the work:

		(1)	(2)	(3)	(4)	(5)
1. Excavation (without classification)	3,500 cu. yds.	$0.70	$0.45	$0.80	$0.90	$0.75
2. Cement concrete, Class "A"	1 cu. yd.	12.00	1.00	2.20	20.00	20.00
3. Cement concrete (paving), Class "C"	2,140 cu. yds.	2.50	2.60	2.20	1.75	2.17
4. Asphalt wearing surface	15,350 sq. yds.	.57	.52	.675	.45	.54
5. Monuments (hauling and setting)	29 each	2.00	1.00	2.00	7.50	1.50
Totals		$19,112	$15,151	$17,929	$14,040	$15,621

⊙Bids were received on April 23 by the State Highway Commission, Sacramento, for the construction of Section A of the state highway in San Mateo County, Division 4, Route 2. In the table shown below (1) stands for engineer's estimate; (2) Raisch Improvement Co.; (3) Western Paving Co.; (4) Clark & Henery Construction Co.; Ransome-Crummey Co., bid cost plus 15 per cent on the work:

		(1)	(2)	(3)	(4)
1. Excavation (without classification)	1,780 cu. yds.	$0.65	$0.60	$0.85	$0.50
2. Cement concrete (monuments), Class "B"	0.3 cu. yds.	10.00	2.80	12.75	10.00
3. Cement concrete (pavement), Class "C"	421 cu. yds.	2.50	2.80	2.48	3.00
4. Asphaltic wearing surface	3,032 sq. yds.	.54	.60	.83	.50
5. Monuments (hauling and setting)	8 each	1.00	2.00	3.50	2.00
Totals		$4,436	$4,083	$5,105	$3,688

⊙Bids were received on April 23 by the State Highway Department, Sacramento, for the construction of Section B of the state highway in Santa Clara County, Division 4, Route 2. In the table shown below (1) stands for engineer's estimate; (2) bid of Richard Keating & Sons, (awarded contract); (3) A. Teichert & Son, Sacramento; (4) McGillivray Construction Co., Sacramento; (5) Fred W. Wehner, San Jose; Ransome-Crummey Co., bid cost plus 15 per cent on the work:

		(1)	(2)	(3)	(4)	(5)
Excavation (without classification)	4,435 cu. yds.	$0.70	$0.60	$1.00	$0.80	$1.00
Corrugated iron pipe, 18-in	32 lin. ft.	1.80	2.25	2.00	3.50	3.00
Cement concrete (culverts), Class "A"	10 cu. yds.	10.00	6.50	8.00	10.00	6.00
Cement concrete (culverts and monuments) Class "B"	21 cu. yds.	8.00	6.50	8.00	10.00	6.00
Cement concrete (paving), Class "B"	4,855 cu. yds.	2.75	2.75	2.78	3.19	2.50
Broken stone screenings	375 tons.	1.00	1.00	.85	1.50	1.00
Sand	250 cu. yds.	1.50	1.00	1.00	2.00	1.00
Asphaltic oil (hauled and placed)	520 bbls.	1.00	1.50	1.50	1.50	1.00
Monuments (hauling and setting)	43 each	1.00	3.00	2.00	1.00	1.00
Totals		$20,809	$17,820	$19,679	$21,343	$18,043

Citizens of various sections of the city of Ontario, Calif., recently held a meeting at the Chamber of Commerce to select an advisory committee to act with the City Council on the road building campaign. It is proposed to improve every street of the city.

Final arrangements have been made for the disposing of the $1,270,000 worth of bonds for the construction of the Orange County good roads system, of which the Coast Blvd. is a part. The County Highway Commission, Santa Ana., Calif., is pushing the surveying work and all of the various routes are being established.

The Orange County Highway Commission, Santa Ana, Calif., will probably adopt a concrete base of 5 ins. in depth, with a surface dressing of about an inch, the latter consisting of heavy asphalt oil with sand or gravel screenings, for the proposed good roads system. D. C. Pixley is Highway Commissioner.

Colorado.

The Board of Public Works of Denver, Colo., has ordered the paving of all alleys between High and York Sts., from Sixth Ave. to Eighth Ave., between Williams St., parkway and High St., from Sixth to Seventh, and between Gilpin and High, from Fifth to Sixth. The work will cost $18,123.

According to advices from Canon City, Colo., surveys have been started on the connecting link of the Santa Fe trail-Rainbow route between Parkdale and Texas Creek. The $12,000 offered by the state highway commission has been accepted by Fremont County and a like sum will be appropriated by the county commissioners, Canon City, to carry on this work.

Florida.

The City Council of Jacksonville, Fla., has decided upon more street paving for the city. The pavements will be laid on sections of the following streets: Enterprise, Laura, Duval, Florida Ave., Bay, Parker, Jefferson, and Myrtle Ave.

Georgia.

⊙The County Board, Atlanta, Ga., has awarded contract as follows for asphalt to be used during the year on paving work: Texas Oil Co., "Texaco," $21.75 a ton, f. o. b. Atlanta; Sam E. Finley, "California," $25 a ton, f. o. b. Atlanta; Barber Asphalt Co., "Trinidad," $25 a ton, f. o. b. New Orleans or Mobile; Barber Asphalt Co., "Bermudas," $32 a ton, f. o. b. Maura, N. J.

Idaho.

The City Council of Lewiston, Ida., has decided to call for tentative bids for hard surface pavement in District No. 4. The estimated cost, as compiled by City Engineer D. C. Wrighter, is about $86,000.

The City Council of Boise, Ida., has passed an ordinance organizing the new paving district. It is to be known as paving district No. 19. and will include the streets named by the city in the estimates submitted by City Engineer C. C. Stevenson some time ago. An election will be held June 3 for the purpose of voting on the question of issuing bonds in the sum of $125,000 for the work.

Illinois.

⊙The Board of Local Improvements of Decatur, Ill., has awarded the contract for the paving of Waggoner St., from Water to Warren Sts., to Lisle Hunt, at $0.40 a yd. for excavating, $0.50 for curbing and $1.72 a yd. for paving.

⊙The Board of Local Improvements of Clinton, Ill., has awarded the contract for paving in the west part of the city to S. A. Tuttle, of Decatur, Ill.

⊙Roy Williams was recently awarded a contract by the Board of Local Improvements of Cairo, Ill., for the paving with vitrified brick of Fourth, Sixth and 10th Sts., from Ohio St. to Washington Ave., and 12th St., from Ohio St., Popular St., and Holbrook Ave., from 21st St. to Charles St., for $53,241.

⊙The Board of Local Improvements of Dixon, Ill., has let the contract for paving Third St., from Galena Ave., west to Douglas Ave., to Gund, Graham Co., of Freeport, Ill., for $32,633.

Following are the lowest bids submitted to the Board of Local Improvements, Chicago, Ill., on April 28 for the construction of pavement in the following streets, Chicago Av., Kedzie Av. to 40th Av., 10,600 lin. ft. sandstone curbing, 82 cts. per lin. ft., 20,300 sq. yds. creosoted wood block pavement, $3.08, Jas. A. Sackley, 133 W. Washington St.; 40th Av., Division St. to Fullerton Av., 15,150 lin. ft. sandstone curbing, 63 cts., 23,000 sq. yds. brick pavement, $1,97, Ready & Callahan Coal Co., 133 W. Washington St.; 40th Av., Indiana St. to Division St., 9,350 lin. ft. sandstone curbing, 78 cts., 14,200 sq. yds. brick pavement, $1.97, Ready & Callahan Coal Co.; 51st Pl., Halsted St. to Morgan St., 2,610 lin. ft. granite concrete combined curb and gutter, 4,380 sq. yds. asphaltic concrete pavement, on concrete, $1.45, R. F. Conway, 133 W. Washington St.; Grand Ave., Western Av. to Sacramento Av., 9,000 lin. ft. sandstone curbing, 80 cts., 4,200 sq. yds. brick pavement, $2.03, Citizens' Construction Co., 133 W. Washington St.; Herndon St., Belmont Ave. to Roscoe St., 2,500 lin. ft. granite concrete combined curb and gutter, 4,200 sq. yds. asphalt pavement, $1.74, R. F. Conway Co.; Lake St., 40th Av. to Hamlin Av., 2,520 lin. ft. sandstone curbing, 80 cts., 4,550 sq. yds. brick pavement, $2.19, Central Paving Co., 179 W. Washington St.; Monroe St., La Salle St. to Market St., 4,100 sq. yds. creosoted wood block pavement, $3.37; Park Av., Madison St. to South Blvd., 4,620 lin. ft. granite concrete combined curb and gutter, 60 cts., 7,320 sq. yds. asphaltic concrete pavement, $1.50, Standard Paving Co., 9 S. La Salle St.; Park Av., 71st St. to 75th St., 5,750 lin. ft. granite concrete combined curb and gutter, 8,890 sq. yds. asphalt pavement, $1.78, American Asphalt Paving Co., $1.78; alley, 40th, State St., etc., 1,820 lin. ft. concrete curbing, 13.2 cts., 1,220 sq. yds. brick pavement $2.27, Jas. A. Sackley Co.; alleys, 42d St., Grand Blvd., etc., 1,740 lin. ft. concrete curbing, 1,380 sq. yds. brick pavement, $2.45, J. A. McGarry Co., 189 W. Madison St.; Ashland Pl., Ashland Av., to alley east, 370 lin. ft. concrete curbing, 320 sq. yds. brick pavement, $2.75. The work includes the preparation of the subgrade, 6 in. Portland cement concrete foundation, sewer manhole and catchbasin construction and adjustment, the contracts have not been awarded. E. J. Glackin, Secretary of the Board.

Following are the lowest unit bids submitted on April 29, to the Board of Directors of the Municipal Tuberculosis Sanitarium, for the construction of a macadam roadway, at the site of the institute, 40th Av. and Bryn Mawr Av., macadam pavement per sq. yd., $1.05, catchbasins each, $4.00, 8-in. tile pipe, 13 cts., 6-in. tile pipe, 25 cts., date of completion, 60 days, J. A. McGarry & Co., 189 W. Madison St. The contract has not been awarded. F. Wing, 1514 Fort Dearborn Bldg., Chicago, Superintendent.

⊙A. D. Thompson Contracting Co., of Peoria, Ill., has been awarded the contract by the Board of Local Improvements of that city for the paving of Thrush Ave., from Knoxville to Wisconsin Ave., for $21,694. The contract provides for a 30-ft. brick paving between curbs.

City Engineer A. M. Daneley of Urbana, Ill., is making estimates for the East Illinois and Cottage Grove Ave. pavements. The proposed pavement is over a mile in length.

The village of Rantoul, Ill., will pave two more streets this year with brick. About one mile of pavement will be laid on Grove and Kentucky Aves.

City Engineer C. G. Paddock of East Moline, Ill., has completed his estimates for the construction of more than three miles of cement sidewalks this summer.

Indiana.

✢Bids will be received until 10 a. m., May 9, by Board of Public Works, Indianapolis, Ind., for the construction of the following improvements: Improvement of Oakland Av., from the north property line of North St. to the north property line of Michigan St., by grading and paving the sidewalks. Improvement of Parke Av., from the north property line of 34th st. to the southeast property line of Fairgrounds Av., by grading, graveling and rolling the roadway. The improvement of Alton St., from the north property line of Vermont St. to the south property line of North St., by grading and paving the sidewalks. The improvement of English Av., from C., C. C. & St. L. R. R. tracks to the east property line of Keystone Av., by curbing the outer edges of the roadway. The improvement of Ohio St., from the east property line of State Av. to the west property line of Randolph St., by curbing the outer edges of the roadway. The improvement of Parker Av., west side, from the north curb line of New York st. to the south property line of Michigan St., by grading and paving the sidewalks. The improvement of 21st St., from the west property line of Montcalm St. to the east property line of Schurman Av., by grading, graveling and rolling the roadway. The improvement of College Ave., east side, from the south property line of 44th St. to the south property line of 46th, by grading and paving the sidewalks. The improvement of 21st st., from the west property line of Montcalm St. to the east sidewalk of Schurman Av., by grading and paving the sidewalks.

✣Bids will be received until 10 a. m., May 21, by Board of Madison County Commissioners, Anderson, Ind., for the construction of 13 gravel roads. Joel B. Benefiel is County Auditor.

✣Bids will be received until 1 p. m., May 13, by Board of Benton County Commissioners, Fowler, Ind., for the construction of a limestone road in Benton, Tippecanoe County line. Warren Mankey is County Auditor.

✣Bids will be received until 10 a. m., May 15, by Board of Allen County Commissioners, Fort Wayne, Ind., for the construction of a macadamized road in Maumee township. Calvin H. Brown is County Auditor.

✣Bids will be received until May 9, by Board of Public Works, New Albany, Ind., for the paving of East Fifth St. from High to Elm St. with vitrified brick.

⊙The Board of Public Works, Elkhart, Ind., has designated Medal brick with an asphaltum filler as the material to be used in the paving of South Second St. The work will be done by the Northern Construction Co., at a cost of $7,112.

⊙Dillard Artis has been awarded the contract by the Board of Public Works of Marion, Ind., for the improvements of East 15th and South Meridian Sts., with tarvia binder, for $7,058.

⊙Wm. Stewart, of Wabash, Ind., has been awarded the contract at Lorain, O., for the repaving of the East Erie Ave. viaduct with creosoted wood block, for $14,366. Other bidders were: W. C. Traxler, Lorain, $16,790; The Wynkoop-McGormley Co., $16,894; The Croghan Construction Co., of Fremont, $14,978; The Modern Construction Co., Fremont, $16,000; The Capital Construction Co., $15,740; C. B. Ramsey, $15,700; C. L. Ramsey, $16,100; H. R. Klipenger, $15,765.

⊙The Board of Public Works of Muncie, Ind., has substituted the use of 3-in. wood blocks for the paving of East Washington St., from Mulberry to the Pennsylvania tracks in place of brick. The contract has been awarded to the Western Construction Co., of Lafayette, Ind., for $45 894.

⊙The New Albany, Ind., Board of Public Works awarded to W. C. Dorsey, of Terre Haute, Ind., the contract for the improvement of East Eighth St., from Spring to Beeler. The specifications provide for a sarco macadam roadway with granitoid pavement and grass plat on each side of the street. The contract price is $3.24 a ft. for that part of the street from Culbertson Ave. to Beeler St. and $3.45 from Culbertson Ave. to Spring St.

Olive Township, St. Joseph County, Ind., will macadamize roads at an expense of $50,000. South Bend is the county seat.

The city of Bloomfield, Ind., plans the expenditure of about $56,000 in the construction of brick pavements this year. Engineer Parker has submitted a report on the proposed work.

Iowa.

✣Bids will be received until May 7, by F. M. Hughes, City Clerk, Decorah, Ia., for the construction of cement sidewalks according to plans and specifications.

⊙Garland & Shaffer, New Hampton, Ia., have been awarded the contract by the city of Clear Lake, Ia., for the paving of about 10 blocks, 19,000 sq. yds., with a two course Portland cement concrete pavement, at $1.26 per sq. yd. Bids were opened April 23.

Kansas.

⊙J. R. Ramsey, Topeka, Kans., has been awarded the contract for paving East Euclid St., with asphaltic concrete, at McPherson, Kans. The yardage amounts to about 17,000. About 11,000 ft. of combined curb and gutter is included. H. A. Rowland is City Engineer.

Louisiana.

✣Bids will be received until noon, May 26, by Highway Department of the Board of State Engineers, of Louisiana, Room 104, New Orleans Court Building, New Orleans, La., for the re-crowning and gravelling of a Public Highway from the City of Baton Rouge to Hope Villa, East Baton Rouge Parish, Louisiana, a distance of about 14 miles. Information as to location, character of work, amount, extent and class of material, terms of payment, regulations governing manner of submitting proposals and executing contract, may, on application, be obtained at the office of the Highway Department. Frank M. Kerr, Chief State Engineer and President, Board of State Engineers. W. E. Atkinson, State Highway Engineer.

Maryland.

✣Bids will be received noon, May 20, by Board of Caroline County Commissioners, Denton, Md., for building a section of state aid highway along Preston-Grove Road a distance of 2.92 miles. Plans and specifications can be obtained of the State Roads Commission, Baltimore, Md. W. H. Anderson, Denton, Md., is Clerk of the Board of County Commissioners.

⊙The F. E. Schneider Paving Co., of Baltimore, Md., has been awarded the contract by the Board of Awards of that city, for Paving Constracts Nos. 106, 109 and 111, all of which call for bituminous concrete. The contract prices are: $20,709, $6,543 and $13,368, respectively.

⊙Bids were opened April 23 by Baltimore Water Department, E. B. Whitman, Water Engineer, Baltimore, Md., for the construction of Road No. 1, in connection with the Gunpowder Supply Improvements. The bids received on this work were as follows, (1) standing for bid of Thos. Mullon, 4001 York Rd., Baltimore, Md. (awarded contract), (2) D. V. Ault & Co., Baltimore, Md., (3) The Piedmont Construction Co., Baltimore, Md., (4) Mason, Hilton & Co., New York, N. Y., (5) King-Ganey Contracting Co., New York, N. Y., (6) The Whiting-Turner Construction Co., Baltimore, Md., (7) Hassam Paving Co., Worcester, Mass.:

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
1. Clearing and grubbing...	9 acres	$72.00	$350.00	$100.00	$200.00	$100.00	$200.00	$125.00
2. Stripping	1,000 sq. yds.	.15	.25	.16	.20	.15	.10	.40
3. Earth excavation	13,210 cu. yds.	.39	.85	.45	.55	.50	.63	.69
4. Loose rock excavation...	12,060 cu. yds.	.58	.85	.85	.70	.75	.80	1.10
5. Solid rock excavation....	22,950 cu. yds.	.69	.85	1.10	1.30	2.00	1.61	2.00
6. Rubble masonry	460 cu. yds.	5.25	7.00	6.00	5.00	5.00	7.85	4.00
7. Concrete road drains.....	18	70.00	16.00	125.00	80.00	25.00	50.00	75.00
8. 24-in. reinforced concrete pipe	204 lin. ft.	3.75	6.00	10.00	2.75	2.00	3.88	4.00
9. 48-in. reinforced concrete pipe	58 lin. ft.	6.50	10.00	18.00	8.50	3.00	6.65	12.00
10. 72-in. reinforced concrete pipe	132 lin. ft.	11.00	18.00	20.00	17.50	4.00	10.35	20.00
11. Concrete in end walls....	106 cu. yds.	11.00	14.00	12.00	13.50	8.00	10.68	10.00
12. Macadam (8-in. depth)..	5,597 sq. yds.	1.00	1.10	1.38	1.40	.70	1.52	1.25
13. Macadam (6-in. depth)..	5,597 sq. yds.	.90	.90	1.20	1.10	.55	1.19	1.00
14. Underdrain, 4-in. terra cotta pipe laid in broken stone	1,000 lin. ft.	.60	.40	.80	.70	.40	.50	.70
15. Paving	200 sq. yds.	1.00	.90	1.50	.60	1.00	1.00	1.00

The Montgomery County Commissioners, Rockville, Md., have fixed May 20 as the date to hear protests against calling special elections in the county for the purpose of voting on bonds for good roads. The proposed bond issues are for the following amounts and districts: Laytonville district—$10 000, $9,000 of which is to be used in connection with $8,000 in hand to resurface the Laytonville pike, and $1,000 for use in grading the road leading from Unity to Laytonville. Poolesville and Barnesville districts—$30,000 to construct pike from Dawsonville to Boyds. Rockville district—$12,000 to build pike from junction of the Redland and Norfolk roads to Derwood.

Massachusetts.

✣Bids will be received until noon May 13, by Massachusetts Highway Commission, 15 Ashburton Pl., Boston, Mass., for the construction of a section of State highway 7,800 ft. long in the town of Grafton. A certified check for $250 must be filed with each bid. Bidding blanks and other information may be obtained of the Commission on a deposit of $2.

✣Bids will be received until noon, May 13, by the Massachusetts Highway Commission, 15 Ashburton Pl., Boston, Mass., for building a section of State highway about 10,000 ft. in length in the town of North Andover. A certified check for $250 must be filed with each bids.

✣Bids will be received until noon, May 13, by D. P. Avercrombie, Jr., Treasurer Northern Massachusetts Street Railway Co., Boston, Mass., for paving sections of Street Railway track on Main and School Sts. in the town of Athol. A certified check for $250 must be filed with each bid.

✣Bids will be received until noon, May 12, by Board of Road Commissioners, Danvers, Mass., for the construction of Bituminous Macadam Road on Water and Liberty Sts., Danvers. Approximate area 4,100 sq. yds., also about 600 ft. of drains and three catch basins. Copies of the plans and specifications may be obtained at the office of T. A. Appleton, Civil Engineer, 237 Essex St., Salem, Mass.

The Board of Aldermen of Melrose, Mass., has voted to appropriate $25,000 to rebuild Main St., from the Malden line to Porter St., near Ell Pond.

Michigan.

✣Bids will be received until 2 p. m., May 16, by Board of the Village of Caro, Mich., for the furnishing of all labor and material for improving by grading, draining, curbing and paving the following streets: State St., from the north street line of Grant St. to a point 75 ft. south of the south street line of Almer St.; Almer St., from the north street line of Frank St. to the south street line of Joy St.; Frank St., from the west street line of Almer St. to the east street line of Montague St. R. W. Roberts, Engineer, of Saginaw, Mich.

✣Bids will be received until 3 p. m., May 12, by Dean Thompson, City Clerk, Ludington, Mich., for paving approximately 11,000 yds. of street. Bids will be received for a 2-in. asphaltic concrete top of Topeka specifications, but bidders may also submit proposals on any other kind of surfacing they desire, the surface to be laid on a concrete base with combined curb and gutter, etc., as called for in the plans and specifications now on file in the City Clerk's office. G. W. Clark is City Engineer. Official advertisement will be found elsewhere in this issue.

The Water Board of Detroit, Mich., has decided to establish a municipal athletic field on the river front in Gladwin Park. A baseball diamond, football gridiron and tennis courts will be constructed.

The City Council of Eaton Rapids, Mich., has granted a petition asking for the extension of the pavement on South Main St. to the Michigan Central railroad, and a block west to the depot.

The voters of Ingham County, Mich., have

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

adopted the county road system. The Supervisors, Mason, Mich., will soon call a special meeting to appoint the special commissioners and prepare for work.

Minnesota.

⊙Ulrich Munkel, Caledonia, Minn., has been awarded the contract by the Houston County Commissioners, Robert Burns, County Auditor, Caledonia, for grading roads and constructing two concrete culverts, for $1,800.

⊙The city of Duluth, Minn., C. S. Palmer, City Clerk, has awarded the contracts for paving the following streets to P. McDonald, of Duluth, all the streets to be paved with asphalt except Victoria St., on which bituminous concrete will be used and First St., on which creosoted blocks are to be used: Victoria St., from Woodland Av. to Hartley Road, $14,349; 22d Av., east from 4th St. to 6th St. $4,055; 17th Av., east from 4th St. to 6th St., $10,002; 6th St., from 18th Av. east to Woodland Av., $12,322; 4th St., from 6th Av. east to 14th Av. east, $46,282; First St., from 1st Av. east to 6th Av. east, $34,442.

⊙The County Commissioners, Mankato, Minn., have let a contract to C. S. Erickson for cutting down the Eberhart hill on the Mankato-Good Thunder road, two miles south of Rapidan station. Approximately 4,689 cu. yds. of dirt will have to be removed.

City Engineer Hawley of Hibbing, Minn., is preparing specifications for the paving projected by the City Council. The specifications cover all the street intersections not now paved, south of Railroad St. to McKinley St., betwen First and Fifth Aves., and several small sections on the north side of the city. The specifications cover creosoted wood block, bitulithic, vitrified brick, Donnellite, asphalt and granitoid.

Missouri.

⊙Z. B. Myers of Chillicothe Mo., has been awarded the contract for the paving of Edgewood Ave., from Bryan St. to the entrance of Edgewood cemetery, city of Chillicothe. Hassam pavement will be laid.

Montana.

⊙Following low bids were recently received by the City Council of Butte, Mont., Paul A. Gow, City Engineer, for street paving; contracts reported to have been awarded to the lowest bidder in each instance: District No. 134, including 27,949 sq. yds. of sidewalks, 52,767 ft. of curbing, 71,252 cu. yds. of excavating, 13,804 cu. yds. of embankment, and 125 sq. yds. of cross walks—Robert Metcalf, $0.39 a cu. yd. for grading; R. M. Bardsen & Co., $1.36 a sq. yd. for sidewalks. District No. 135, including 2,185 sq. yds. of paving and 289 ft. of curbing—Miracle, Tripp Concrete Co., $3.95 a sq. yd. for vitrified brick. District No. 137, including 8,805 sq. yds. of sidewalks, 15,996 ft. of curbing, 35,058 cu. yds, of excavation, and 30,458 cu. yds. of embankment—R. M. Bardsen & Co., $0.78; Foster & Hindle, $1.40 a sq. yd. for sidewalks.

New Jersey.

✣Bids will be received until 11 a. m., May 19, by Commissioner of Public Roads, E. A. Stevens, Trenton, N. J., for the following list of machinery and materials needed: 3 motor trucks, 3 three-wheeled steam rollers, 3 three-wheeled gasoline rollers, 6 road machines, 3 scarifiers, 6 sprinkling wagons, 18 dump wagons, 4 underslung stone wagons, 2 tank wagons, 2 trailing pressure distributors, claw hammers and hatchets, plows and rooters, drill presses and pipe-cutters, shovels, grindstones, pick and handles, mattocks, barrows, saws, scythes, brush-hooks, blocks and falls and snatch-hooks, log chains, forges and anvils, blacksmith tools, wrenches and striking hammers, tents and tarpaulins, axes and handles, bunk, cooking and office wagons, beds and bedding, camp chairs, stools and tables, cooking and mess outfits, camp ranges, lanterns and lamps, road signs, Manila rope, stone crushers, screens and bins, asphalt heater and distributing kettle, mason line, assorted lumber, roofing, gasoline pumps, crowbars. Road binders—Standard Lignin binders, grades F, G, H, I, in carload lots of not less than 4,000 gallons; also in carload lots contained in barrels. Standard inorganic binders, grade A, in carload lots, or in barrels of carload lots. Standard bituminous binders, grades B, N, and S, by the carload, containing not less than 4,000 gallons, and also in barrels of carload lots. The prices quoted on these different binders must be on a gallon basis, f. o. b. any railroad station in New Jersey and in carload lots. These various materials must meet the requirements specificed in the specifications now on file in the office of the State Road Commissioner at Trenton, for the various purposes for which they shall be used. If a graded bid is made on tonnage, bidders will state the unit tonnage upon which their different bids are based.

⊙The Standard Bitulithic Co., 50 Church St., New York City, has been awarded the contract at Long Branch, N. J., for paving Rockwell Av., with concrete and a bitulithic surface, at $2.07 per sq. yd. Bids were opened April 16. The work includes about 4,000 sq. yds.

⊙M. C. Burns, Long Branch, N. J., has been awarded the contract by that city, for the paving of Second Av., with concrete and Mack brick surface, at $2.59 per sq. yd. Bids were opened April 16. The work includes 33,000 sq. yds. of paving.

⊙The Standard Bitulithic Co., 50 Church St., New York City, has been awarded the contract at Long Branch, N. J., for paving Third Av., with concrete and a bitulithic surface, at $2.09 per sq. yd. Bids were opened April 16. The work includes about 4,000 sq. yds.

New York.

✣Bids will be received until 8 p. m., May 13, by Common Council, Rahway. N. J., for the paving of Irving St. from Poplar St. to Grand St. with brick pavement. Aprpoximate amount of work to be done: Excavate present surface of street to subgrade; lay 8,742 sq. yds. of vitrified brick pavement; reset 3,591 lin. ft. of curb in concrete. A certified check, for the sum of $1,000, must accompany each bid, made payable to the Mayor and Common Council of the City of Rahway. Plans and specifications may be examined at the office of the City Engineer after April 29, 1913.

✣Bids will be received until 4:30 p. m., May 12, by Board of Public Works, Poughkeepsie, N. Y., for paving work including the following approximate items: 20,000 sq. yds. vitrified brick pavement; 25,000 sq. yds. sheet asphalt pavement; 20,000 lin. ft. new four cut bluestone curb set in place.; 5,000 lin. ft. new quarry dressed bluestone curb set in place; 3,000 lin. ft. resetting bluestone curb. A certified check for 5 per cent of the amount of the bid must accompany each proposal. Plans and specifications may be examined at the office of the Board of Public Works. R. J. Shields is Clerk of said Board.

⊙The Standard Bitulithic Co., of Newark, N. J., has been awarded the contract by the Village Trustees of Cedarhurst, L. I., for the paving of Washington and Cedarhurst Aves., and Spruce and Chestnut Sts., at $1.82 a sq. yd. The work includes about 15,000 sq. yds.

The Board of Freeholders of Sussex County, Newton, N. J., has instructed County Engineer Harvey Snook to survey and map out 23 miles of road in the county, with a view to improvement.

The citizens of Salem, N. Y., on April 28, voted the issuance of bonds in the sum of $6,000 for the purpose of macadamizing its main street.

The taxpayers of Binghamton, N. Y., will vote May 9 on the proposition to issue bonds to the amount of $20,000 for the purpose of laying new pavements this year.

Following low bids were submitted to the Common Council of Dunkirk, N. Y., on April 22 for street paving: Lake Shore Construction & Supply Co., Marsden St., with brick, $2,340, concrete, $2,002; Fox St., brick, $6,000, concrete, $4,933; Robin St., brick, $13,670, concrete, $11,044; E. Seventh St., brick, $15,930, concrete, $12,845. The Dunkirk Construction Co. bid low on asphalt for Robin St., at $15,927, and Seventh St., at $18,528.

Ohio.

✣Bids will be received until 11 a. m., June 4, by Board of Cuyahoga County Commissioners, Cleveland, O., for the improvement of Linndale Road from the west limits of the City of Cleveland to Ridge Road (Shun Pike) in Brooklyn Township, in accordance with the form of contract and specifications to be furnished by Frank R. Lander, County Surveyor. Plans, descriptions, bills and specifications for the above work can be seen and are open to public inspection of persons interested therein, at the office of the County Engineer at the New Court House on Lakeside Ave., Cleveland, Ohio. J. P. Goldenbogen is Clerk of the Board.

✣Bids will be received until noon, May 29, by Township Trustees, Mill Township, City Bldg., Uhrichsville, O., for the furnishing of all materials, tools and labor for the improvement of the Park Valley road in said Township a distance of 10,000 feet, more or less, beginning at a point 1,000 feet, more or less, north of the residence of T. B. Page in Mill Township, Tuscarawas County, Ohio, and running southward to the culvert in said road, near the residence of E. Dutton in said Township, by paving to a width of 14 feet, between curbs. Plans and specifications are on file with H. O. Snyder, Township Clerk, City Bldg., Uhrichsville, O.

✣Bids will be received until noon, May 26, by Board of Delaware County Commissioners, Delaware, O., for the reconstruction of the following bridges: Bellepoint Bridge in Concord Township; the Liberty Bridge, in Liberty Township; the Cole Bridge, in Troy Township; the Milcreek Bridge No. 3, in Scioto Township, and the Fulton Creek Bridge No. 4 in Thompson Township. These bridges are all to be of iron construction.

✣Bids will be received until noon, May 12, by John L. Lloyd, Director of Public Service, Middletown, O., for furnishing of the necessary labor and materials for the improving of Jefferson St. from Clark St. to Charles St. with Macadam Pavement, in accordance with the plans and specifications of said improvements heretofore passed by the Council of the City of Middletown, Ohio, and now on file in the office of the City Engineer.

✣Bids will be received until noon, May 10, by Milton Utley, Village Clerk, Sunbury, O., for the improvements of the following streets, in accordance with plans, profiles specifications and estimates of cost, on file with the Village Clerk and also with H. O. Core, C. E., New York Cash Store Building, Delaware, Ohio: Granville St. from the east line of Columbus St. to the west line of Vernon St. by draining, grading, curbing, and paving the roadway thereof with brick 40 ft. wide. Vernon St. from the south line of Granville St. to the south line of Cherry St. by draining, grading, curbing and paving the roadway thereof with brick 40 ft. wide. Vernon St. from the north line of Cherry St. to the south line of North St., by draining, grading, curbing and paving the roadway thereof with brick 24 ft. wide. North St. from the west line of Vernon St. to the west line of Morning St., by draining, grading, curbing and paving the roadway thereof with brick 20 ft. wide. North St. from the east line of Morning St. to the west line of Otis St. by draining, grading, curbing and paving the roadway thereof with brick 26 ft. wide. Cherry St. from the east line of Columbus St. to the east line of Vernon St. by draining, grading, curbing and paving the roadway thereof with brick 38 ft. wide. Cherry St. from the east line of Vernon St. to the east line of Morning St. by draining, grading, curbing and paving the roadway thereof with brick 30 ft. wide. Morning St. from the north line of Cherry St. to the south line of North St. by draining, grading, curbing and paving the roadway thereof with brick 26 ft. wide.

⊙Nugent & Hines, Harrison, O., have been awarded the contract by the Board of Hamilton County Commissioners, Cincinnati, O., for the improvement of Sand Run road, at $1,485. Bids were opened April 25.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

⊙Petrie & Long, Logan, O., have been awarded the contract by the State Highway Commission, Columbus, O., for the construction of the New Lexington-Logan road, Perry County, for $11,300. The road is 5,280 ft. long and 14 ft. wide. Bids were opened April 25.

⊙H. E. Hunt, Jackson, O., has been awarded the contract by the State Highway Commission, Columbus, O., for the construction of the Akron-Canton Road, Summit County, for $34,300. The road is 10,200 ft. long and 13-14 ft. wide. Bids were opened April 25.

⊙W. H. Ringwald & Sons, Chillicothe, O., have been awarded the contract by the State Highway Commission, Columbus, O., for the construction of the Columbus road in Ross County, for $9,671. Bids were opened April 25.

⊙C. J. Chinnock, Warren, O., has been awarded the contract by the State Highway Commission, Columbus, for the construction of the Wadsworth-Wooster road, Medina County, for $9,537. Bids were opened April 29.

⊙Geo. S. Mellert, Medina, O., has been awarded the contract by the State Highway Commission, Columbus, O., for the construction of section 1 of the Medina-Wooster road, Medina County, for $5,200. Bids were opened April 29.

⊙Abner Juniper, Chestnut St., Nelsonville, O., has been awarded the contract by that city, for grading, curbing and paving Adams St., with brick, at $3,800. Bids were opened April 26.

⊙Abner Juniper, Chestnut St., Nelsonville, O., has been awarded the contract by Director of Public Service C. C. Sharp, Nelsonville, for the grading, curbing and paving Poplar St., with brick, at $2,600. Bids were opened April 26.

⊙Abner Juniper, Chestnut St., Nelsonville, O., has been awarded the contract by C. C. Sharp, Director of Public Service, Nelsonville, for grading, curbing and paving Madison St., with brick, at $5,600. Bids were opened April 26.

⊙C. J. Chinnock, Warren, O., has been awarded the contract by the State Highway Department, Columbus, O., for the construction of the Wadsworth-Wooster road, Medina County. The road will be paved with brick for a distance of 3,432 ft., at a width of 10 ft. The contract price is $9,537. Bids were opened April 29.

⊙Kessner & Martt, Delaware, O., have been awarded the contract by the State Highway Department, Columbus, for the construction of the Galion-Mansfield road, Section 2, Richland County, for $13,100. The road is 11,485 ft. long and 12 ft. wide. Bids were opened April 30.

⊙J. C. Devine has been awarded the contract by the Department of Public Service of Alliance, O., for the paving of the roadways of the public square, at about $2 700.

⊙O. R. Rhinehart, of Galion, O., has been awarded the contract by the County Commissioners, Bucyrus, for building sections A and B of the Cox pike road running east and west within the townships of Washington, Congress and North Bloomfield, at $11,906 and $9,319, respectively. Raymond & Caldwell of Galion secured section C, for $6,268. Geo. R. Christian, of Marion, O., will furnish the stone for $5,805.

⊙William H. Vogt & Son, of Massillon, O., have been awarded the contract by the Stark County Commissioners, Canton, for paving two miles of the Canton-Louisville highway from the east corporate limits of Canton for $36,423. The road is to be of brick with flag base concrete filler and stone curbing.

⊙Garrigan Bros. are reported to have been awarded the contract by the Department of Public Service of Toledo, O., for the repaving of Washington St., from Ontario to 22nd St., with either wood block, sheet asphalt or bitulithic. Other bidders were: Russell & Jennison, C. O. Warner, H. P. Streicher, Andrews Asphalt Paving Co., and Harris & Tansey.

No bids were received on April 30 by the State Highway Department, Columbus, O., for grading and paving with brick for heavy traffic, the Ashland-New London Road, Ashland County, Ruggles Township. The road is 13,265 ft. long and 10 ft. wide.

Consulting Engineer Geo. Champe, 610 Nasby Bldg., Toledo, O., has prepared plans for the construction of 4,000 sq. yds. of bituminous macadam pavement in Holgate, O., at an estimated cost of $9,000. The work will include concrete foundation and concrete or stone curb. Contracts will be let in about three months.

The Cuyahoga County Commissioners, Cleveland, O., have decided to complete about 30 miles of county road paving and build a number of bridges and culverts. Seven miles of paving will be completed on Center Ridge Road, Dover Township, two miles on S. Woodland road, Shaker Township, one mile on N. Woodland road, Orange Township, three miles on Canal road, South Newburg Township, four miles on Green road, Euclid Township, and four miles on Warren road, Lakewood.

Bids will be received until noon, May 20, by N. H. Turner, Director of Public Service, Ashtabula, O., for labor and materials for the improvement of Lake St., from the south line of Aunger Av. to the south line of Erie St., by grading, draining, curbing and paving with shale block upon a concrete foundation. The work includes approximately 9,626 cu. yds. of excavation, 23,653 sq. yds. of pavement, 15,460 lin. ft. of curbing, 5,000 lin. ft. of storm sewers, 72 catchbasins, 28 manholes.

No bids were received on April 25 by the State Highway Commission, Columbus, O., for the construction of the Central Av. extension road in Lucas County. The road is 5,922 ft. long and 14 ft. wide, and is to be improved with bituminous macadam.

No bids were received on April 30 by the State Highway Commission, Columbus, O., for the construction of the Scotland Station Easterly road, Geauga County. The road is 5,800 ft. long and 14 ft. wide and is to be paved with concrete with a bituminous surface treatment.

Oregon.

⊙The street cleaning committee of the City Council, Portland, Ore., has awarded a contract for furnishing the city with three flushing machines to Studebaker Bros., for $2,775. Beall & Co. offered to furnish the three flushers for $3,000.

Following low bids have been received by the City Council of Portland, Ore., for street improvements, as follows: East 37th St., from Hancock St. to Rossmere addition, Oregon Independent Paving Co., $8,417; 19th St. district, Jeffery & Bufton, $7,102; Cactus Drive, from Green Av. to east line of Washington Park, Giebisch & Joplin, $9,000; Wistaria Av., district, Warren Construction Co., $44,157; Millers Av., from East Seventh to East 16th, Barber Asphalt Co., $12,000; East Lincoln St. district, Pacific Bridge Co., $61,903; East 57th St., from Sandy to Fremont, Oregon Independent Paving Co., $12,426; East Clay St. district, Montague-O'Reilley, $68,829.

City Engineer Tom Hurlburt of Portland, Ore., plans the paving of Albina Ave., between Killingsworth Ave. and Lombard St., to a width of 24 ft.

Pennsylvania.

✣Bids will be received until noon, May 14, by Charles P. Savage, Lackawanna County Controller, Scranton, Pa., for the construction of the unfinished portion of an improved macadam road in three sections. Plans and profiles are on file with the Commissioners at Scranton, Pa.

✣Bids will be received until 11 a. m., May 26, by Col. Thomas Cruse, Depot Quartermaster, 26th St. and Grays Ferry, Philadelphia, Pa., for waterproofing 520,000 yds. sheeting.

✣Bids will be received until noon, May 10, by the Borough of Edgewood, Pa., for the grading, curbing and paving of Duquesne Ave. Plans and specifications are on exhibition at the office of the borough Engineer, Swissvale Ave., Edgewood, Pa. A certified check for $1,500 to accompany each bid. Approximate quantities: Grading, 1,030 cu. yds.; curbing, 4,290 lin. ft.; paving, 6,290 sq. yds. D. C. Neal is Borough Engineer.

⊙Pierce & Hindoeliter, Oil City, Pa., have been awarded the contracts by that city, R. Mackenzie, Controller, for the paving of West Second St. and Oak alley.

The city of Pittsburgh, Pa., Jos. G. Armstrong, Director of the Department of Public Works, rejected all bids received April 18, for grading, curbing and paving with brick a number of streets.

South Dakota.

The City Comimssioners of Sioux Falls, S. Dak., have adopted the specifications for paving the alley east of Phillips Ave., between Ninth and Tenth Sts., with concrete.

Texas.

⊙The Texas Building Co., Fort Worth, Tex., has been awarded the contract by the Tarrant County Commissioners, Fort Worth, Jas. C. Travilla, Consulting Road Engineer, for the construction of cardinal and sub-cardinal roads, at $656,504. The work includes the construction of eight roads from Forth Worth to Tarrant County line—eight points of the compass. Bids were opened April 22.

⊙The City Council of San Antonio, Tex., has awarded a contract to grade and gravel Denver Blvd. and Iowa St. to W. A. Kelley for $12,800.

The Commissioners' Court, Bastrop, Tex., has ordered County Judge Price to advertise for bids for the construction of $100,000 worth of good roads in Smithville precinct. It is proposed to build about 50 miles of roads, all of which have been surveyed.

The Commissioners' Court, Bastrop, Tex., and the committee in charge of the fund of $80,000, with which to build roads in Justice Precinct No. 1, Bastrop, Hills' Prairie and Goodman, has given the contract for the supervision of the road building to Albert Clopton, of Elgin, Tex. Work will begin at once.

Three elections were held in Victoria County, Texas, on April 26, for the purpose of voting on improvement bonds as follows: Nursery precinct road bonds amounting to $45,000; Bloomington precinct drainage bonds, $54,000, and Lake Placedo precinct road bonds, $45,000. It is reported all propositions carried.

The voters of Justice Precinct No. 1 of Milam County, Tex., at a recent election voted in favor of a $150,000 bond issue for the purpose of building good roads in the precinct. The district around the town of Gause, Tex., on April 11 voted $50,000 for good roads. Cameron is the county seat.

The Commissioners Court of Liberty County, I. B. Simmons, County Judge, Liberty, Tex., on May 6 sold bonds in the sum of $300,000 for the construction of good roads.

Virginia.

✣Bids will be received until noon, May 22, by W. L. Craft, City Clerk, Roanoke, Va., for the construction of improvements on the following streets and alleys and for constructing granolithic sidewalks. Plans and specifications can be obtained of F. L. Gibboney, City Engineer.

Plans have partially been prepared for the construction of 50 blocks of concrete pavement in Highland Park, Va., at an estimated cost of $18,000. The work will include cinder or gravel foundation. Contracts will be let within 90 days. Jno. M. Lewis is official in charge.

The Town Council of Bedford City, Va., has ordered West Main St. macadamized from the brick paving to a point on College St., from Peaks St. to the Elks' Home, and Longwood Ave., from Belmont to the city limits.

Washington.

✣Bids will be received until 11 a. m., May 12, by G. F. Downey, Depot Quartermaster, Washington, D. C., for furnishing material and labor required to resurface roadway through Fort Myer, Va.

✣Bids will be received until 2 p. m., May 20, by the Board of King County Commission-Seattle, Wash., for furnishing material and labor (Jap or Chinese labor excepted) for the

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

construction of Permanent Highway No. 3 B. Byron Phelps is Clerk of the Board.

✣Bids will be received until 2 p. m., May 20, by the Board of King County Commissioners, Seattle, Wash., for furnishing all labor and material (Jap or Chinese labor not allowed) for the construction of Permanent Hightway No. 2 B as per plans and specifications on file at the office of the County Engineer. Byron Phelps is Clerk of the Board.

⊙The Board of Park Commissioners, Tacoma, Wash., has let the contract for the completion of a link of pavement in Point Defiance Park to Joseph Warter, Sr., for $23 753.

⊙W. F. Manney, of Seattle, Wash., submitted the lowest bid on April 25 to the Board of Public Works of that city, for grading Division Ave. et al., at $25,032.

⊙Mitchell Bros. have been awarded the contract by the City Council of Spokane, Wash., for the paving of North Monroe St., Cora to Fairview Ave., with Spokane bituminous, for $13,126.

Plans for the improvement of Trent Ave., Division St., to the east bridge, have been filed with Commissioner of Public Works D. C. Coates of Spokane, Wash., by City Engineer Morton Macartney. The street will be paved with some permanent paving between Division and Grant St., at a cost of $22,000 for asphalt, with other materials in proportion.

The Board of Public Works of Seattle, Wash., has rescinded the contract recently awarded for the paving of Pine St., between Westlake Ave. and Melrose Ave.; Fifth Ave., between Pine St. and Westlake Ave., and Sixth and Seventh Aves., between Pine and Pike Sts., with brick. The work will be readvertised. A list of the itemized bids on the work was given in our April 23 issue.

The City Council of Spokane, Wash., has accepted plans and specifications for the paving of Mission Ave., from Division St. to the Mission Ave. bridge. The work is estimated to cost $50 000.

Wisconsin.

⊙Birdsall-Griffith Construction Co., Racine, Wis., has been awarded the contract by the city of Delavan, Wis., for paving and curbing, at $19,198. The work includes 8,912 sq. yds. of brick pavement, 1,940 lin. ft. of cement curb, 495 lin. ft. of cement retaining curb, 3,190 lin. ft. of cement combination curb and gutter. Bids were opened May 2. P. J. Hurtgen, Burlington, Wis., is Engineer.

The Wisconsin State Highway Commission has furnished an engineer to assist in the construction of good roads in Douglas County. F. M. Sargent of Ashland has been appointed to have charge of the work in that county as well as overseeing similar work in Ashland, Bayfield, Barnett, Washburn, Sawyer, Iron, Vilas, Oneida, Forest, Price and Rusk Counties. It is planned to spend about $50,000 for road work in Douglas County this year.

Canada.

✣Bids will be received until May 20 by W. D. Beaman, Town Clerk, Essex, Ont., for the construction of approximately 3,000 sq. yds. of permanent pavement. Plans are on file at the office of J. S. Laird, Essex, Ont.

⊙Henry Nelch & Son, of Springfield, Ill., have been awarded the contract by the Board of Public Improvements of that city for paving First St., from Edwards to Cook St., at $1.69 per sq. yd. for paving and $0.55 a lin. ft. for sandstone curbing.

City Engineer F. L. Fellowes of Vancouver, B. C., has completed a plan of roadway for Point Grey municipality to form a basis of development in commercial highways, semi-business highways and residential streets.

The ratepayers of Beaverton, Ont., on April 21 voted a by-law for $8,000 to be expended in constructing sidewalks and improving the streets.

The City Council of Streator, Ill., has adopted an ordinance for the paving of North Bloomington St., from the north line of Boys St. to the C. I. & S. tracks. The estimated cost is $8,089.

BRIDGES

California.

Citizens of East San Jose have passed a resolution urging the city of San Jose, Calif., to build a new bridge over the Coyote creek on East Santa Clara St. A committee of three, consisting of George Wakefield, Dr. L. J. Belknap and Mr. Green, was appointed to draft a petition to be circulated for signatures urging the City Council to take early action. This matter will be taken up before the Chamber of Commerce and the Merchants' Association for their co-operation.

Edgar Annear, Stanislaus County Surveyor, Modesto, Calif., has submitted a report to the Board of Supervisors on the proposed new bridge replacing the present structure over the the Tuolumne River near the city of Modesto.

The following are the low bids received by the City Council of San Diego, Calif., for bridge work and Rock ford: R. O. Coggleshall, at $900 for Rock ford · Harry D. Trounce, $4,004, for the Main St. bridge over Chollas Creek; S. M. Kerns, at $6,230, for bridge over Chollas Creek at Wooman Ave.; Wurster Construction Co., $21,600, for bridge over San Diego River on the LaJolla road. The bids received for the three structures and the ford were as follows: Charles Steffgen, $35,900; Engineering Construction Co., $37,400: Hyde Construction Co., $39,000, and John Campbell, $50,142.

⊙The Board of Orange County Supervisors, Santa Ana, Calif., has awarded the contract for the construction of a bridge across the Santa Ana River on the Talbert road to S. E. Talbert of Talbert. The contract price of the bridge was $2,889. The bridge will provide a crossing for the lower route of the county highway system between Huntington Beach and Santa Ana, the road passing through albert and Old Newport.

Colorado.

The Board of Rio Blanco County Commissioners, Meeker, Colo., has appropriated $5,000 for the construction of a new steel bridge to replace the one at White River City which was washed out about a month ago.

Delaware.

The Newcastle County Levy Court, Wilmington, Del., is considering the construction of a new bridge over the Narrow Dyke and the rebuilding of the approaches.

District of Columbia.

✣Bids will be received until 2 p. m., June 24, by Commissioners of the District of Columbia, Washington, D. C., for the construction of a masonry bridge consisting of 7 spans over Rock Creek, in the city of Washington, connecting Q St. on the east and west sides of Rock Creek. Plans and specifications can be obtained of the Chief Clerk of the Engineering Department, Room 427, District Bldg., Washington, D. C.

Illinois.

✣Notice is hereby given that contracts for the Vandermoon bridge, Yorktown Township, Henry County, for which letting was held April 25, 1913, was not let because of the fact that but one bid was received and that was irregular. A re-letting will be held on May 6, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Illinois.

✣Bids will be received up to 2 p. m., May 31, 1913, at Mile's hardware store, Streator, Illinois, for the construction of one reinforced concrete bridge to be built in Otter Creek Township, LaSalle County. Frank Birtwell, Town Clerk, Streator, Ill. Munts Bridge—Span, 16 ft.; roadway 24 ft.; height, 8½ ft. Total estimated concrete, 56.6 cu. yds.; reinforcing steel, 3,972 lbs. Nearest railroad station, Streator, about 1 mile. It is reported that crushed stone may be had f. o. h. Streator at $1.20 per cu. yd. and sand at $1 per cu. yd. Present bridge wood, 14-ft. span. Low water flow about 6 ins. deep and 14 ft. wide; high water the same. Excavation about 7 ft. through clay and loam to about 3 ft. below stream bed. Engineer's estimate, $700. Work to be completed on or before Sept. 1, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Illinois.

✣Bids will be received up to 10:30 o'clock a. m., May 16, 1913, at the Town Hall, New Douglas, Ill., for the construction of two reinforced concrete bridges to be built in New Douglas Township, Madison County. T. A. McNeilly, Town Clerk, New Douglas, Ill. Happy Hollow and Long Bridges; Spans, 15 and 18 ft.; roadways, 18 and 18 ft.; height, 12.5 and 15 ft. Estimated total concrete, 60.8 and 74.9 cu. yds; reinforcing steel, 4,681 and 6,760 pounds. Nearest railroad station, each about 3 miles from New Douglas. No local concrete materials available. Old bridges wood, 15 ft., and steel 18-ft. span. Low water flow for both bridges, dry; high water, 5 and 6 ft. deep. Excavation, sand about 12.5 ft.; clay about 6 ft., to be carried below stream bed 4 and 3½ ft. Engineer's estimate for both bridges, $1,800. Work to be completed on or before Sept. 15, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received up to 1 p. m., May 20, 1913, at the Court House, Mt. Carroll, Ill., for the construction of three reinforced concrete bridges to be built in Cherry Grove Township, Carroll County. Albert Lindsay, Town Clerk, R. F. D. No. 3, Lanark, Ill. Zier, Leonard and Myers Bridges: Spans, 30, 30 and 22 ft.; roadways, 16 ft.; height, 15, 15 and 16 ft. Estimated total concrete, 92.8, 93.2 and 87.8 cu. yds.; reinforcing steel, 11,180, 11,220 and 8,150 pounds. Nearest railroad stations, Lanark, about 6½ miles; Shannon, about 5 miles, and Lanark, about 3 miles, Gravel available in creek bed at 25 cts. at pit, about 3 miles from Zier bridge, must be washed and sand added. It is reported that gravel may be had F. O. B. cars at Lanark or Shannon for $1.40 per cu. yd. Present bridges wood, 18-ft. span, wood trestle, 40 ft. long and wood, 14-ft. span. Excavation gravel, average depth about 14 ft., 5 ft. and 12 ft., to be carried about 3½, 4 and 4 ft. below stream bed. Engineer's estimate for the 3 bridges, $4,250. Bids will be received on basis of completing Aug. 1st, and also on basis of completing Sept. 30, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Ill.

⊙The Joliet Bridge & Iron Co., Joliet, Ill., has been awarded the contract for the construction of the Brainard and Humphrey bridges in Mineral township, Bureau County, at the bid of $3,100. Other bids received, April 28 for the work were as follows: Ill. Gravel Co., Buda, Ill., $3,250; S. M. Magnuson, Buda, Ill., $3,090; Capperrune & Deyo, Bradford, Ill., $3,400.

⊙The contract for the construction of the Triplett bridge in Barry Township, Pike County, Ill., has been let to C. A. Wever & Son, Clayton, Ill., at $1,395. Other bids received April 21 were: Rock River Bridge Co. Oregon, Ill., at $1,500.

⊙The following were the bids submitted on the Sarttwell bridge in Savanna Township, Carroll County, Illinois, May 1, 1913: J. F. Meffley & Son, Galena, Ill., $2,085; Elkhart Br. & Iron Co., Elkhart, Ind., $2,110. Contract awarded to J. F. Meffley & Son of Galena, Ill., for $2,085.

⊙Bids were not opened on April 30th for the Hulinger bridge, Deer Park Township, La Salle County, as advertised in notice sent out under date of April 10, 1913, as legal requirements for advertising in the township had not been complied with. Contract for this work will be let at the County Clerk's office, Ottawa, Ill., at 1:30 o'clock p. m., May 20, 1913. More detailed infirmation may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office, or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Ill.

Bids were received by the Board of Aldermen, Rockford, Ill., for the construction of two bridges, as follows: Race St. bridge—Illinois Hydraulic Stone & Construction Co., Elgin, $3,215; Peterson Brothers, Rockford, $3,965; R. P. Beckstrom & Co., Rockford, $3,500; J. H. Sabin, Rockford, $2,895.

Seventh Street Bridge—Illinois Hydraulic Stone and Construction Co., $5,537; Peterson Brothers, $5,590; R. P. Beckstrom & Co., $3,989; J. H. Sabin, $4,100; Gust Holm, $4,909.

The following bids received April 25 for the construction of the Groves bridge in Bunker Hill Township, Macoupin County, Ill., have been rejected: W. C. Johnson, Salem, Ill., $925; W. J. McCully, St. Louis, Mo., $840.

L. E. McGann, Commissioner of Public Works, Chicago, Ill., has awarded the Dearborn St. Foundry Co. the contract for furnishing, delivering and erecting on the viaduct span of the west approach of the Washington St. bridge, the following fixtures, complete with wiring, lamps, globes, etc., 16 bracket fixtures, attached to the trusses of the viaduct, each containing 2 lights, 8 light standards, each containing 4 lights, 4 cluster light standards, each containing 7 lights, contract price $1,760.

Indiana.

✣Bids will be received until May 12 by Board of Adams County Commissioners, Decatur, Ind., for the construction of the county line bridge in Hartford Township known as the Heller bridge. P. A. Macklin is County Surveyor.

The Commissioners of Hamilton County, Noblesville, Ind., are contemplating the construction of a new concrete bridge over White River at Perkinsville to replace the old covered structure. The new bridge is estimated to cost $10,000.

It is rumored that the County Commissioners, Logansport, Ind., have under consideration tentative plans for constructing a new bridge over the Wabash River at 7th St., to replace the structure washed out at 3d St.

The Delaware County Council, according to recent reports from Muncie, Ind., has authorized the issuance of $81,500 of bonds for building new bridges throughout the county and for repairing and lengthening the present structures.

Indiana.

✣Bids will be received until 10 a. m., May 12, by Board of Adams and Wells Counties' Commissioners, Decatur, Ind., for the construction of the Heller bridge on French-Nottingham township line. T. H. Baltzell is County Auditor.

✣Bids will be received until 2 p. m., May 13, by Board of Johnson County Commissioners, Franklin, Ind., for the construction of five small bridges. H. L. Knox is County Auditor.

Iowa.

⊙The Board of Carroll County Commissioners, Carroll, Ia., has awarded the contract for the construction of 10 small concrete bridges to the Waterloo Construction Co., Waterloo, Ia., at $12,000.

The State Railroad Commission of Iowa held a hearing May 6 on the Des Moines viaduct case. The cost of the structure, which will span the Racoon River, will amount, it is estimated, to about $250,000.

Advices from Waterloo, Ia., state that there is a movement on foot to erect the two iron bridges recently spanning the Black Hawk at Falls Ave. at points further up that stream, the city and county to equally share the expense.

Kansas.

⊙The contract for the construction of a 110-ft. steel bridge over Sand Creek between sections 4 and 9, Newton Township, Harvey County, Kan., has been let to J. D. Marshall, Walton, Kan. The substructure will be of concrete.

Kentucky.

✣Bids will be received until 11 a. m., May 10, by Committee, Paris, Ky., for a steel bridge over Townsend Creek, between Bourbon and Harrison counties, to be built on plans furnished to the Road Supervisors by the State Commissioner of Public Roads. Plans and specifications may be seen in Road Supervisor C. F. Redmon's office or in the office of 'Squire L. J. Fretwell.

Louisiana.

⊙The Parish of Arcadia, Crowley, La., has awarded the contract for covering Jaenke bridge, over Bayou Nezpique, between Jennings and Oil Field, to D. Lermand.

Maryland.

✣Bids will be received until 11 a. m., May 21, by Board of Awards, at the office of the City Register, Baltimore, Md., for the construction of the Fallsway viaduct above the foundation level, in accordance with plans on file at the office of Calvin W. Hendrick, Consulting Engineer, 904 American Bldg., Baltimore, Md. A certified check of the bidder, on a clearing house bank, made payable to the order of the Mayor and City Council of Baltimore, in the sum of $6,000, will be required to be deposited with each bid. Approximate quantities: 14,000 cu. yds. concrete masonry, 48,000 sq. ft. hammer dressing, 1,591,000 pounds reinforcing steel, 3,200 sq. yds. granolithic surfacing, 2,500 lin. ft. concrete curbing. Official advertisement will be found elsewhere in this issue.

A petition has been presented to the Board of Howard County Commissioners, Ellicott, Md., asking that the Montgomery County Commissioners be interviewed in regard to bearing half the expense of building a bridge over the Patuxent River, known as Murphy's bridge.

Massachusetts.

Plans are now completed and on file at the office of City Engineer Stephen Kearney, Lowell, Mass., for the new bridge over the Wamesit Canal at Lawrence St. The expense of the bridge will be borne by the B. & M. R. R., the Wamesit River Co., the Bay State Street Ry. and the city, and will be maintained by the city. It is expected that work on the bridge will be begun in a short time, and the job will also include the widening of Lawrence street at that point.

Michigan.

✣Bids will be received until 6 p. m., May 15, by the Marquette County Road Commission. V. S. Hillyer, Superintendent, Ishpeming, Mich., for constructing a 250-ft. reinforced concrete bridge over Peshekee River, 2½ miles west of Champion. Official advertisement will be found elsewhere in this issue.

Minnesota.

✣Bids will be received until 1 p. m., May 8, by Board of County Commissioners, Welcome, Minn. The contract for building a reinforced concrete bridge fifty feet long across Elm Creek on the north and south half section line in section 2, Fraser Township. D. C. Montgomery is Clerk.

⊙The Security Bridge Co., Minneapolis, Minn., has been awarded the contract for the construction of three steel bridges near Lewiston. Idaho, at $2,900 for the superstructures and $11.50 per yd. for concrete.

Missouri.

✣Bids will be received until 3:30 p. m., May 7, by Sullivan County Clerk, Milan, Mo., for one 75-ft. steel span on tubes across East Locust Creek on the Milan-Browning road, about 3 miles north of Browning. E. L. Calfee is Highway Engineer.

✣Bids will be received until 1 p. m., May 7, by Clark E. Jacoby, Engineer, Drainage District No. 3, Carroll County, Mo., for the construction of one 75-ft. by 12-ft. riveted pony truss bridge, with a 15-ft. wooden approach at each end, at Sta. 970x20 of the main canal of said district, 2¼ miles east and 1¼ miles north of the village of Wakenda.

H. Hewitt, Shelby County Engineer, Shelbyville, Mo., recently located eight sites for eight steel bridges in the vicinity of Clarence, Mo.

A conference between the city officials and the Municipal Assembly was recently held at St. Louis, Mo., to determine upon a course of action to complete the municipal bridge over the Mississippi River.

Montana.

Plans are on file in the office of County Surveyor of Cascade County, Montana, at Great Falls, and bids are being asked for construction of a steel highway bridge at Ulm, Mont.: consists of 3 185-ft. spans across the Missouri River; of riveted through truss, arched top chord, concrete floor, on concrete abutments and steel tubements and steel tube foundations.

Nebraska.

✣Bids will be received until noon, May 13, by J. C. Penrod, County Clerk, Beatrice, Nebr., for the furnishing of materials and the performing of labor for the construction and repairing of bridges built or repaired in Gage County, Neb., for the term of one year, in accordance with plans and specifications now on file in the office of the County Clerk. All bids to be made on bidding blanks furnished by the County Clerk of said county. All bids must be accompanied by a certified check for $500.

✣Bids will be received until noon, May 20, by County Clerk, Clay Center, Neb., for the erection of one 70-ft. bridge with 20-ft. roadway. A certified check for $500 must be filed with each bid. W. K. Newcomb is County Clerk.

The Commercial Club of Fremont, Neb., has appointed a committee to confer with the Commissioners of Dodge County in regard to securing the construction of the Magenau bridge over the Elkhorn.

New York.

The New York Central R. R. is planning the construction of a new bridge over the highway in Washington St., Adams Basin, N. Y.

The Utica Steam Engineer & Boiler Co., Utica, N. Y., has been awarded the contract by the County Commissioners for the reconstruction of the bridge over West Canada Creek at Trenton Falls. The contract price was $4,100.

A bill has passed the New York Assembly authorizing the construction of a bridge over the Hudson River a few miles below Albany, by the New York Central Railroad. The measure provides that the bridge shall have a clearance of not less than 135 ft. above mean low water. By the provisions of the bill, work on the structure is to be begun not later than May 1, 1914, and the bridge is to be completed in five years. The main span is to be a full 300 ft. wide. The bridge is to be built under the name of the Hudson River Connecting Railroad Corporation, and its purpose is to permit the connection of the New York Central, West Shore and Boston and Albany Railroad Companies' lines. It is expected that much of the through western freight of the New York Central to and from New York City will go by way of the connecting line, as well as two or three of the limited passenger trains.

North Dakota.

The Commissioners of Grand Forks, N. Dak., have received 24 petitions for the construction of bridges throughout the county, and an inspection will be made of the proposed sites.

Ohio.

✣Bids will be received until 11 a. m., June 4, by Board of Cuyahoga County Commissioners, Cleveland, O., for the construction of bridge work per Report No. 3116, concrete culvert and fill, Berkshire road, Mayfield Township; Report No. 3117, concrete culvert and fill, Berkshire road, Mayfield Township, in accordance with the form of contract and specifications to be furnished by Frank R. Lander, County Surveyor. Plans, descriptions, bills and specifications for the above work can be seen and are open to public inspection of persons interested therein, at the office of the County Engineer at the New Court House on Lakeside Ave., Cleveland, Ohio. J. F. Goldenbogen is Clerk of the Board.

✣Bids will be received until about May 12, by the Board of Coshocton County Commissioners, Coshocton, O., for the construction of the following bridges: Orange bridge, Warsaw bridge, Walhonding bridge, Randles bridge, Mohican bridge, Roscoe bridge (reflooring), Coshocton bridge (repairing of lattice work), Layland bridge (reflooring).

✣Bids will be received until 1 p. m., May 12, by Board of Morgan County Commissioners, McConnelsville, O., for the labor and the material necessary for the repair of the Muskingum River bridge at Stockport, Ohio, according to the plans and specifications on file in the Auditor's office at McConnelsville, Ohio. Said plans and specifications call for the furnishing of the material and the performance of the labor necessary to erect the superstructure of said bridge, consisting of two main span and one draw span and being of a total length of 585 ft., width of 16 ft. in the clear. Said plans and specifications may be seen at the Auditor's office at any time during the regular office hours. J. E. Patterson is County Auditor.

✣Bids will be received until 11 a. m., May 28, by Board of Cuyahoga County Commissioners, Cleveland, O., for the construction of bridge work per Report No. 3108, concrete culvert, Yellowstone Rd., E. Cleveland Township; Report No. 3109, fill, Independence Rd., Newburgh Township; No. 3110, fill, Stranahan bridge, Rockport Township. In accordance with the form of contract and specifications to be furnished by Frank R. Lander, County Surveyor. J. F. Goldenborgen is Clerk.

✣Bids will be received until 10 a m., May 10, by Board of Shelby County Commissioners, Sidney, O., for furnishing labor and material necessary for the construction of the following bridges: One steel highway bridge over Loramie Creek, ½ mile north of Ft. Loramie, O. Two spans of 75 ft. each, roadway 16 ft. One steel highway bridge over Brush Creek in Orange Township, known as Calhoun bridge. One span, 64 ft., roadway 16 ft. Plans for same are on file and open for inspection at the County Auditor's Office, Sidney, Ohio. H. T. Ruese is County Auditor.

✣Bids will be received until noon, May 26, by Board of Ross County Commissioners at the office of Robert D. Alexander, County Auditor, Chillicothe, Ohio, for furnishing the necessary labor and material for the construction of bridge over North Fork of Palm Creek near Scioto township, Ross County.

⊙The Commissioners of Coffee County, Burlington, Kan., have awarded the contracts for the construction of a number of bridges to the Canton Bridge Co., Canton, O.

⊙The contract for the construction of a temporary bridge over the Scioto at Prospect has been let by the Commissioners of Marion County to John Baldauf, Prospect, O., at $1,000.

The Board of Summit County Commissioners, Akron, O., received no bids for the construction of the proposed reinforced concrete arch bridge over the Cuyahoga River on North Howard St. extension.

The contract for the construction of a concrete culvert for Shawnee Run, near Wooster Pike, in Columbia Township, Hamilton County, O., has been let to Peter Praechter, Cincinnati, O., at $17,886. Albert Reinhardt is Clerk.

Plans are being completed by Henry Maetzel, City Engineer, Columbus, O., for the reconstruction of the Fourth St. viaduct. The work will include widening the structure. Plans for the new concrete viaduct at Parsons Ave. will soon be completed.

The Canton Bridge Co., Canton, O., has been awarded the contract by the Butte County Commissioners, Belle Fourche, S. Dak., for the construction of steel bridges in the county. The contract for wooden and pile bridges has been awarded to Robinson, Southmayd & Nelson.

The Commissioners of Butler County, Hamilton, O., have passed a resolution accepting the offer of the Baltimore & Ohio Southwestern R. R. in regard to the construction of the proposed temporary bridge over the Great Miami River near the Old High St. and Main St. bridge.

The City Council of Youngstown, O., and the County Commissioners have under consideration the elimination of the West Ave. grade crossing by the construction of a bridge. F. M. Lillie is City Engineer.

According to information received from Cincinnati, O., the East Cumminsville Improvement Association has launched a movement for a new bridge to replace the wooden structure over Mill Creek at Knowlton St.

The Commissioners of Muskingum County, Zanesville, O., have instructed W. V. Hollingsworth, County Surveyor, to prepare plans and estimates for the construction of a temporary wagon bridge over the Muskingum River at Putnam and Sixth Sts. The cost of the work is estimated at between $10,000 and $15,000.

Oklahoma.

All bids received up to April 19 by W. S. Neal, Clerk of Pittsburgh County, McAllister, Okla., for the erection of a number of bridges, have been rejected, and the work will be readvertised later.

Oregon.

Plans, specifications and estimates prepared by City Engineer T. M. Hurlburt for the construction of a reinforced concrete bridge on E. Sixteenth St. across Sullivan's Gulch have been adopted by the City Council, Portland, Ore., at a recent meeting. This is the last of the bridges to span this ravine, and will cost approximately $98,000. The City Executive Board was directed to advertise for proposals for the viaduct.

Pennsylvania.

✣The Commissioners of Fayette and Washington Counties, Pa., according to advices from Washington, Pa., the county seat of the latter county, will be ready about June 1, to receive estimbates on the construction of the proposed steel bridge over the Monongahela River. The strutcure will cost, it is believed, $150,000.

The Commissioners of Delaware County, Media, Pa., have under consideration the reconstruction of the bridge over Crum Creek on the Baltimore Pike near Swarthmore. P. A. F. Damon is County Engineer.

Texas.

⊙The Board of Tarrant County Commissioners, Fort Worth, Texas, has awarded the contract for the construction of the proposed new East Fourth St. bridge to the Tarrant County Construction Co., Fort Worth, Texas, at $51,928. The contract for the Samuels Ave. bridge was let at the same time to McKenzie-Williams Construction Co., Webb City, Mo., at $54,400. Following are the bids received on the bridge work: East Fourth St. bridge—Kuhlman & Blue, $49,021.96; McKenzie-Williams Construction Co., $50,899.16; Roy McDonald & Co., $61,303.26; Drake Brannum Construction Co., $67,853.61; Yorty & Thomas, $69,589.10; Trinity Bridge Co., $63,686.92; Texas Building Co., $53,114.88; W. R. Hughes, $56,023.28; General Construction Co., $60,971.23. Samuels Ave. bridge—McKenzie-Williams Construction Co., $54,399.63; Roy McDonald & Co., $64,877.09; Yorty & Thomas, $70,510.82; Trinity Bridge Co., $68,190.91; Texas Building Co., $59,810.80; W. R. Hughes, $58,938.53; General Construction Co., $63,284.58.

The County Commissioners, with a delegation of citizens of Nacogdoches, Texas, recently visited Lufkin, Texas, to discuss the construction of a steel bridge over the Angelina River.

The County Highway Commissioners, Beaumont, Texas, have been petitioned to take immediate action in urging the County Commissioners Court to order a $30,000 bond election for the construction of a bridge over the Neches River, connecting Beaumont, Jefferson County, with Orange County.

Virginia.

✣Bids will be received until noon, June 3, by Courts of Greenbrier and Monroe Counties at Lewisburg, Va., for a bridge across Second Creek at the Clarence Dickson ford on two propositions. No. 1—Two 60-ft. clear spans of reinforced concrete 20 wing walls, 16-ft. roadway 14 ft. from bed of stream to finished roadway or 4 ft. above nail in corner of Bruce's icehouse, marked high-water mark, to finished roadway. Proposition No. 2—One span 120 ft. substructure concrete abutments, superstructure steel with a reinforced concrete floor 16 ft. wide, or 3-in. wood floor of No. 1 oak lumber. Other measurements same as proposition No 1. Carrying capacity of both propositions No. 1 and No. 2, 50 lbs. to a sq. ft. or a concentrated load of a 20-ton road roller.

Wisconsin.

Bids were recently received for the construction of the proposed bridge at New Jersey Ave., Sheboygan, Wis. The specifications call for two truss spans, each 109 ft. long, one center pier and two abutments. The general dimensions of the superstructure will be 220 ft. long, width over all 41 ft., roadway between curbs 24 ft. and clear width of sidewalk, 7 ft. The center pier and abutments will be made of concrete resting on rock and piles. The contract also calls for the removal of the old bridge, all the material therefrom going to the contractor. The roadway will be planking and the sidewalks concrete. Bids: (1) standing for bridge complete; (2) for superstructure; (3) for substructure.

Name of bidder.	Date of completion.	(1)	(2)	(3)
Worden & Allen Co., Milwaukee and Chicago	July 15	$19,845	$10,945	......
	Nov. 2	18,845	10,345	......
Newton Engineering Co., Milwaukee	....	......	......	$12,245
Lakeside Bridge Co	July 15	22,798	12,817	10,981
	Nov. 13	21,934	11,953	10,981
King Bridge Co., Cleveland	Nov. 15	......	14,800	......
Milwaukee Bridge Co	Nov. 15	26,910	13,957	12,953
Wisconsin Dredge & Dock Co	July 15	20,000	......	7,300
	Nov. 15	19,800	......	7,300
Wausau Iron Works	July 15	18,900	11,650	......
	Nov. 15	18,600	11,350	......
Optenberg Iron Works	....	22,150	......	......
Pellet & McMullen, Manitowoc	July 15	19,500	10,900	9,331
	Nov. 15	19,350	10,700	8,900
Model Steel Construction Co., Waukesha; substructure contract conditional	July 15	......	13,187	7,500
	Nov. 15	......	12,275	7,500

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

⊙Commissioner F. G. Simmons, Department of Public Works, Milwaukee, Wis., has awarded the contract for the reconstruction of the abutment at the west approach of Grand Ave. bridge to the C. H. Starke Dredge & Dock Co. at $9,693.

The U. S. War Department, according to advices from Milwaukee, Wis., has approved plans for the bascule bridge at Buffalo St., to replace the present uncertain swing bridge. A bond issue of $175,000 is available for the structure.

Washington.

Commissioner M. Kunz of Lincoln County, Davenport, Wash., has recommended the construction of a 32-ft. steel bridge over Wilson Creek at Shrewsbury.

The Lewis County Commissioners, Chehalis, Wash., have decided that it wil be impossible to provide for the construction of a bridge over the Cowlitz River, in eastern Lewis County, before 1914.

An election has been called for May 13, for the purpose of deciding on an issuance of bonds for the construction of a bridge over the Wishkah River at Aberdeen, Wash. The structure proposed is of the bascule type and will cost $95,000. C. W. Ewart is City Engineer.

DRAINAGE AND IRRIGATION

California.

The Burton Water Co., Porterville, Cal., has been incorporated with a capital stock of $6,000 and proposes to supply water for an irrigation system. The incorporators are J. R. Marshall, W. M. Pratt, E. C. Elder, F. J. Wright and C. A. Ridgeway.

The Imperial Irrigation District, Masonic Temple, El Centro, Cal., is considering the construction of an all-American tunnel through the sand hills to the east of the valley.

A Los Angeles syndicate, composed of William Holliday, Marco Hellman, W. L. Valentine, E. T. Stimson, W. E. Keller, Victor Kleinberger and F. H. Edwards, has purchased the Big James Ranch, about 20 miles west of Fresno. About $75,000 will be spent in water development, sinking artesian wells and completing the extensive system of canals.

Indiana.

⊙Fred C. Morgan, Vincennes, Ind., has been awarded the contract at $28,034 for constructing the Homer E. Totter drainage ditch. The other bidders were T. Foohey Dredging Co., Fort Wayne, Ind., $31,700; Hilbert Bennet, Richland City, Ind., $37,990; J. G. Berger, South Bend, Ind., $29,500; H. G. Roetzel & Co., Rockport, Ind., $24,282. The ditch to be constructed is about five miles long and is along the Warrick and Spencer county line. It will follow the course of the Pigeon creek.

Iowa.

⊙Contracts for constructing Drain No. 49, Story County, Ia., bids for which were opened May 2 by C. A. Batman, County Auditor, Nevada, Ia., were let as follows: Labor, to Thos. Blakemore, Nevada, Ia., at $8,273; tile to Monmouth Mining & Mfg. Co., Monmouth, Ill., at $19,599. The work includes: 3,500 ft. 33-in. tile; 3,000 ft. 30-in. tile; 3,500 ft. 28-in. tile; 2,400 ft. 26-in. tile; 1,000 ft. 24-in. tile; 1,500 ft. 22-in. tile; 800 ft. 20-in. tile; 3,050 ft. 16-in. tile; 850 ft. 12-in. tile; 800 ft. 10-in. tile; 550 ft. 10-in. tile; 300 ft. 8-in. tile; 200 ft. 8-in. tile; 625 ft. 8-in. tile; 800 ft. 12-in. tile; 175 ft. 8-in. tile; 400 ft. 8-in. tile; 4 cu. yds. concrete; 6 inlets.

⊙J. C. Anderson, Marshalltown, Ia., has been awarded the contract for constructing tile ditch for Drainage District No. 14 of Lincoln and Crocker Townships, Polk County, bids for which were opened April 28 at Des Moines, Ia. The ditch will be 8¾ miles long.

Illinois.

✣Bids will be received until 2 p. m., May 24, by William Funk, Clerk, Union Drainage District No. 4, Tinley Park, Ill., for laying a pipe line 5,888 ft. in length. Size of pipes to be used in construction pipe line is 1,888 ft. of 30-in. pipe and 1,900 ft. of 24-in. pipe, and 2,100 ft. of 20-in. pipe. Plans may be seen at office of William Funk, Drainage Clerk, Tinley Park, and also at office of Francis A. Harper, Attorney, Roanoke Bldg., Chicago.

✣Bids will be received until 1 p. m., May 17, by Commissioners of District No. 5, Monee, Ill., at the office of Williams Cellarius, Clerk, Monee, Ill., for the construction of an open ditch, about 3 miles long with a drag line excavator machine; ditch 6 ft. wide at bottom, sides slope 1 to 1—and excavation to be 30,000 cu. yds. Also bids will be received for laying 700 ft. 22 in. in diameter tile. Plans and specifications may be seen at the office of Wm. Celarius, Town Clerk, Monee, Ill. All bids must be accompanied by a certified check in amount equal to 10 per cent of the bid. The Commissioners reserve the right to reject any and all bids.

Michigan.

✣Bids will be received until 9 a. m., May 9, by W. T. Shafer, Kent County Drain Commissioner, Grand Rapids, Mich., for the construction of the Werden Drain.

Minnesota.

✣Bids will be received until May 24, by J. C. Jensen, Watonwan County Auditor, St. James, Minn., for the construction and completion of Judicial Ditch No. 7. The approximate amount of work is as follows: Stations 163-200, dredge, earth, 16,805.5 yds., $1,680.54; Stations 200-250, dredge, 25,328.6 yds. earth, $2,532.86; Stations 250-288, dredge, 8,372 yds. earth, $837.20; Stations 257-30, bridge, $700; Stations 0-68, 3,100 ft. 10-in. tile, 1,200 ft. 14-in. tile, 1,200 ft. 15-in. tile, 1,300 ft. 16-in. tile, $2,230.05; Stations 22-40, manhole, $28; Stations 68-125, 3,500 ft. 22-in. tile, 2,200 ft. 24-in. tile, $6,913; Stations 125-163, 3,800 ft. 28-in. tile, $7,307.35; concrete wall, $113.60; Branch 1, 1,300 ft. 10-in. tile, $237.56; Branch 2, 300 ft. 6-in. tile, $24.21; Branch 3, 1,400 ft. 14-in. tile; 1,465 ft. 12-in. tile; 1,735 ft. 10-in. tile, 1,400 ft. 8-in. tile, $1,723.16; laterals A and B, 200 ft. 6-in. tile, 900 ft. 8-in. tile, $127.92; Branch 4, 0-43, 2,500 ft. 15-in. tile, 1,800 ft. 14-in. tile, $2,263.45; Branch 4, 43-90, 1,700 ft. 12-in. tile, 1,800 ft. 10-in. tile, 1,200 ft. 8-in. tile, $1,023.77; laterals C and D, 1,655 ft. 9-in. tile, 700 ft. 8-in. tile, 585 ft. 6-in. tile, $465.39; Branch 5, 1,500 ft. 14-in. tile, 1,600 ft. 12-in. tile, $1,132.91; Branch 6, 3,600 ft. 9-in. tile, $492.03; concrete wall, $36; Branch 0-40, 4,000 ft. 24-in. tile, $5,137.94; concrete wall, $36.80; Branch 7, 40-65-50, 1,300 ft. 22-in. tile, 1,350 ft. 20-in. tile, $2,431.42; Branch 7, 65-50-113, 4,750 ft. 14-in. tile, $2,129.74; manhole, $28; lateral E, 1,100 ft. 10-in. tile, 1,700 ft. 9-in. tile, 1,100 ft. 8-in. tile, $680.53; Branch 8, 2,300 ft. 10-in. tile, $488.31; concrete wall, $29.60; total, $40,721.63.

North Carolina.

Final report on Stewart's Creek Drainage District, in Hornett County, N. C., has been approved by the Clerk of the Court of the county. The plans for the proposed improvements are on file in the clerk's office at Lillington, N. C., also with the attorney for the district, C. J. Smith, Down, N. C., who will forward all information as to date of letting contract for the construction, or J. M. Hodges, Chairman Board of Commissioners, Linden, N. C. Plans call for excavating with dipper dredge 102,872 cu. yds., excavating lateral or hand ditches, 30,500 cu. yds. Total length of main canal is 5 miles and total length of laterals is 9 miles. Plans and report were made by W. K. Allen, Drainage Engineer, Wilmington, N. C.

Texas.

✣Bids will be received until May 24, by J. O. Ralston, Chairman Board of Drainage Commissioners, District No. 6, 304 Commercial Bank Bldg., Houston, Tex., for the construction of drainage ditches. Specifications are on file with the County Clerk. J. S. Burk, 304 Commercial Bank Bldg., Houston, is Engineer.

Montana.

Bids as follows were received April 30 by the U. S. Reclamation Service for the construction of the main canal of the Sun River project. Schedule 1—The Pishkun reservoir supply canal from Mile No. 1 to Mile No. 12, MacArthur Bros. Co., Fisher Bldg., Chicago, Ill., $247,800; Kilpatrick Bros. & Collins Construction Co., Beatrice, Neb., $282,380. Schedule 2—Sun River slope canal, Spring Valley Division, Mile 1 to Mile 10, MacArthur Bros. Co., $236,910; Kilpatrick Bros. & Collins, $242,025. Schedule 3—Sun River slope canal, Spring Valley Division, Mile 10 to Mile 25, MacArthur Bros. Co., Winston Bros. Co., $108,610; Kilpatrick Bros. & Collins, $97,075. Schedule 4—Sun River slope canal, Greenfield's Division, Mile 25 to Mile 24, MacArthur Bros Co., $117,250; Winston Bros., $145,250; Kilpatrick Bros. & Collins, $130,587.50; Charles Wilhite, $127,460. Schedule 5—Tunnel No. 2, length 1,200 ft, MacArthur Bros. Co., $62,500; Winston Bros., $79,675; Kilpatrick Bros. & Collins, $75,455. Schedule 6—Tunnel No. 3, length 1,400 ft., MacArthur Bros. Co., $116,255; Winston Bros., $152,670; Kilpatrick Bros. & Collins, $133,475. Totals—MacArthur Bros. Co., Schedules 1-6, $858,615; Winston Bros. Co., Schedules 3-6, $486,205; Kilpatrick Bros. & Collins Construction Co., Schedules 1-6, $960,997.50; Charles Wilhite & Co., Schedules 3 and 4, $212,520.

Washington.

Plans have been completed under the direction of M. R. Thompson, County Engineer, Tacoma, Wash., for reclamation about 2,000 acres of tidelands in the Wapato District, by dredging about 8 miles of ditches, at a cost of $8,000 to $10,000.

WATER WORKS

California.

Engineer Frank A. Lathrop, of Los Angeles, Cal., has filed plans with the City Trustees of Watts, Cal., for the proposed municipal water system. A bond election will be held shortly to vote on issuing $100,000 for the improvement.

The La Habra Domestic Water Co., La Habra, Calif., has been incorporated with a capital stock of $20,000. The incorporators are: W. L. York, C. J. Henshaw, J. G. Launer, C. M. Glazier, J. C. Knight, J. G. Sargent and others.

The Richgrove Citrus Water Co., Los Angeles, Calif., has been incorporated with a capital stock of $100,000. The incorporators are: J. Stein, W. Villinger, A. Gross, A. Holt and F. W. Curtin.

The Railroad Commission of California has granted authority to W. W. Wilcox, Dan Johnston and O. L. Emery to sell their water sys-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

tem near Colton to the Clara Vista Water Co. The new owners contemplate improvements to the system.

The Davis Water Co., Woodland, Calif., has been incorporated with a capital stock of $50,000. The incorporators are: T. G. Schmeiser, D. R. Throop, B. R. Brewster, Dr. W. E. Bates and C. W. Bowers.

The Water District Commissioners of Richmond, Calif., have named Levi Baswell, president, and John Chandler, secretary. Committees are to be named at once and an engineer selected for the proposed waterworks system.

The citizens of Sacramento, Calif., at a recent election voted in favor of issuing bonds in the sum of $1,329,600 for water main extension and better fire protection; $1,032,000 for sewer extension in the suburbs, and $113,600 for an electrical distribution system.

The Railroad Commission of California has granted the application of Terra Bella Development Co. to sell its water system of Tulare County to the Terra Bella City Water Co. for $15,000. Permission has also been granted the latter company to issue $15,000 in stock.

The citizens of Riverside, Calif., will vote May 19 on the qeustion of issuing bonds in the sum of $1,160,000 for a municipal water system.

The Board of Supervisors of Davis, Calif., has passed a resolution granting the Schmeiser Mfg. Co. the authority to lay water mains along and across all the streets, lanes and alleyways at Davis.

Georgia.

The City Council of Royston, Ga., has called an election to be held on May 19 for the purpose of voting on issuing $45.000 worth of bonds for a waterworks system.

Illinois.

✣Bids will be received until 2 p. m., May 26, by City of Moline, Ill., for furnishing and erecting at the water works pumping station a reinforced concrete raw water well and pump pit, complete with piping and appurtenances. The work will involve about 1,200 cu. yds. of excavation, 230 cu. yds. of concrete, 19,500 lbs. of reinforcing steel, 411 lin. ft. of hub and spigot pipe, ranging from 6 in. to 30 in.; 168 lin. ft. of flanged cast iron pipe, ranging from 10 in. to 20 in., and sundry gate valves, check valves, specials, fittings and appurtenances. Plans and specifications may be examined at the office of the Engineer, D. H. Maury, 1137 Monadnock Blk., Chicago, Ill. Official advertisement will be found elsewhere in this issue.

The village of Melrose Park, Ill., plans the erection of a new waterworks to replace the present one. The new works will cost $30,000 and will be operated by electricity.

Following bids were received at Riverside, Ill., on April 14 for the furnishing of pumps and motors for the waterworks, for which Dabney H. Maury, Monadnock Blk., Chicago, Ill., is Engineer, (1) standing for time of delivery, (2) amount, and (3) combined efficiency:

	(1) Days.	(2)	(3) %
Alberger Pump & Cond. Co...	70	$1,800	57.85
Lea-Courtney Co...............	60	1,570	52.6
		1,555	55.2
Western Pump & Eng. Co.....	70	1,600	67.0
Buffalo Steam Pump Co.......	75	1,368	55.0
American Well Works.........	70	1,950	61.06
	60	1,920	59.68
	75	1,890	58.65
Gould Mfg. Co..................	49	1,775	56.6
Manistee Iron Works..........	50	1,389	63.36
Epping-Carpenter Co..........	60	1,700	51.0
R. D. Wood & Co..............	84	1,932	54.8
Henry R. Worthington........	56	1,800	55.0
		1,700	51.0
Dravo-Doyle Co................	80	2,250	57.5
		2,305	58.0

✣Bids will be received until 11 a. m., May 12, by L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering all the labor, tools and materials necessary in the construction of alterations to the Harrison St. pumping station, 735 W. Harrison St., the work includes steel beams, columns, etc., delivered and fabricated ready for erection by the city; estimated quantities are as follows: steel, 31,000 lbs.; cast iron, 2,200 lbs. Cash or certified check for $100 must accompany proposal.

✣Bids will be received until 11 a. m., May 12, by L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering all labor, materials, etc., necessary in the construction of a steam power piping system in the Harrison St. pumping station, 734 W. Harrison St. The work includes various sizes of piping, connections, etc. Plans and specifications may be had at the office. Cash or certified check for $200 must accompany proposal.

Kansas.

✣Bids will be received until 10 a. m., May 14, by Constructing Quartermaster, Fort Leavenworth, Kan., for furnishing and delivering f. o. b. cars, terminal railway station, Fort Leavenworth, Kan., 45 sets extra heavy cast-iron soil pipe and fittings and 704 sets same; 11 sets same; also for furnishing a miscellaneous quantity of cast-iron soil pipe, bends, branches, increasers, fittings, reducers, tees, elbows, traps, and a quantity of galvanized extra heavy cast-iron crosses, elbows, caps, branches, bushings, couplings, plugs, standard steel pipe, reducers, tees, cocks, unions, valves, pig lead, sheet copper, etc. For further information, address Thomas H. Slavins, Lieutenant-Colonel Q. M. Corps, Constructing Quartermaster.

The city officials of Scott City, Kans., on April 25 sold the $40,000 issue of bonds recently voted for a municipal light and waterworks plant. Bids are being asked for the construction work.

The citizens of Herington, Kans., will vote on the water propositions May 15. The estimate of the cost of putting in reservoirs, laying pipe and installing necessary machinery at the Kohl and Will springs was $39,000. The laterals will cost about $7,000. Bonds to the amount of $50,000 will be voted upon.

Kentucky.

✣Bids will be received until 3 p. m., May 28, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for deep-well pumping plant at the United States Post Office and Court House at London, Ky., in accordance with the specification and drawing, copies of which may be obtained from the custodian at London, Ky., or at the discretion of the Supervising Architect.

Louisiana.

A mass meeting of citizens of Ville Platte, La., was held on April 24 for the purpose of discussing ways and means for the immediate construction of a complete system of waterworks and to take the necessary steps to induce three railroads that are contemplating extensions in that territory to come through the city.

Maryland.

✣Bids will be received until May 10, by J. S. Schriver, Water Commissioner, Cumberland, Md., for the trench excavation, laying of 30-in. water main, making necessary shut-off valve connections, and recovering pipes to street and alley grades. Approximate length of pipe line, about 2,400 ft. Average depth about 6 ft. Branch connections to include 3 4-in. pipes, 1 6-in. pipe and 1 12-in. main. Also for the furnishing, delivered on the ground, about 480 tons of Class "C" cast iron pipe, 30 ins. inside diameter; about 5 tons of standard castings for water branches. Plans and specifications may be seen at the office of City Engineer James P. Gaffney.

Minnesota.

The City Council of Mankato, Minn., has approved the specifications made by City Engineer H. F. Blomquist for the laying of water mains in Hinckley's and Bronson's additions in East Mankato. The cost is estimated at $3,660.

Missouri.

✣Bids will be received until noon, May 16, by Board of Public Improvements, St. Louis, Mo., for furnishing labor and material for the construction and completion of the Chain of Rocks Filter Equipment. Further information may be obtained of the Board or of the Water Commissioners.

⊙Merkes-Hines Machinery Co., Scarritt Bldg., Kansas City, Mo., has been awarded the contract by the Board of Public Works, Maryville, Mo., for furnishing two 100 h. p. horizontal return tubular boilers, and for tearing out two old boilers, at $3,450. Bids for repairing the water tower have not yet been accepted. Bids were opened April 28.

The Improvement Association of King City, Mo., is agitating the installation of a waterworks system.

The new owners of the Jefferson City, Mo., waterworks plant contemplate a number of extensions to the system this year. The company is capitalized at $400,000.

Business men of Fenton, Mo., have started a movement to furnish the village with a water supply from the Meramec River, for fire protection.

Montana.

⊙Robinson Auto Mfg. Co., St. Louis, Mo., has been awarded the contract by the city of Helena, Mont., for furnishing one auto fire wagon, at $5,500. Bids were opened April 7.

New Hampshire.

⊙The town of Claremont, N. H., on April 29 awarded the contract for the new work and repairs on the water system to the Osgood Construction Co., of Nashua, N. H., for $39,970.

New Jersey.

✣Bids will be received until 2 p. m., July 1, by Passaic Valley Sewerage Commissioners, Newark, N. J., for furnishing and erecting a pumping plant for the Newark Bay Pumping Station in the City of Newark. Drawings, etc., may be seen at the office of the Chief Engineer, W. M. Brown. J. S. Gibson is Clerk. Official advertisement will be found elsewhere in this issue.

New York.

⊙The Vulcan Rail & Construction Co., Brooklyn, N. Y., has been awarded the contract by the Board of Water Supply, New York City, for furnishing, delivering and installing racks, stop shutters, screens, lifters and other apparatus in gate chambers along Catskill aqueduct, at $34,675. Bids were opened April 30.

Engineers Nicholas G. Hill, Jr., John Gregory, N. P. Goodrich and Ames L. Schaeffer have submitted their report to the Board of Estimate of New York City, recommending the establishment of a filtration plant in Jerome Park. The improvement will cost about $7,500,000.

The Board of Aldermen of Lockport, N. Y., has voted to have the Water Board carry out its plan for the building of a system of water lines throughout the south, east and north sides of the city.

North Carolina.

✣Bids will be received until 2 p. m., May 26, by James R. Campbell, Constructing Quartermaster, Fort Caswell, N. C., for following projects: 1. Constructing an 8-in. water main, pump house, necessary machinery and power transmission line. 2. Constructing an 8-in. water main to Southport side of river, and furnishing water to Southport end of main. 3. For all the material, labor, machinery and accessories necessary to install a complete distilling and preliminary water softening plant, including brick or reinforced concrete building, with slate roof, and the necessary boiler, tanks, piping and accessories needed to furnish not less than 3,000 gals. per hour, or 70,000 gals. daily, of good potable distilled water; bidders must submit complete plans and specifications, and must state in bids the guaranty with proper security that they will furnish covering the durability and operation of the apparatus; water will be taken by the plant from a salt water suction pipe to be installed by the government. Plans and specifications for projects 1 and 2 furnished on deposit of $10 to guarantee return. For information and all necessary papers, apply to Jas. R. Campbell, Constructing Quartermaster.

✣Bids will be received until 2 p. m., May 26, by James R. Campbell, Constructing Quartermaster, Fort Caswell, N. C., for the construction of a 400,000-gal. concrete reservoir. Plans and specifications furnished on a guarantee of $5.

Ohio.

✣Bids will be received until noon, May 13, by L. G. Bradley, Clerk of the Board of Public Affairs, Chagrin Falls, O., for constructing a 6-in. water main for the additional water supply system. Said bids will be received in accordance with the plans and specifications on file at the office of said Clerk, and at the office of the Wm. H. Evers Engineering Co., 332 The Arcade, Cleveland, Ohio.

The Ashtabula County Commissioners, Jefferson, O., plan the construction of a concrete dam across Grand River for the Geneva waterworks plant. The estimated cost is $17,000.

According to advices from Cuyahoga Falls, O., the Walsh Milling Co. is having plans prepared for the construction of a new dam above the Portage St. bridge to replace the old one. It will be of concrete. It is expected that contracts can be awarded and work started by July 1.

Oklahoma.

✣Bids will be received until 10 a. m., May 26, by A. U. Faulkner, Construction Quartermaster, Fort Sill, Okla., for the construction of a wooden storage tank and installing motor driven triplex pump with necessary piping.

The City Council of Howe, Okla., is considering a proposition to establish a waterworks system.

Some extensions to water works and electric lighting systems will be made by the city of Watonga, Okla. The Benham Engineering Co., American Nat. Bank Bldg., Oklahoma City, will draw plans and specifications for same.

Oregon.

Pendleton, Ore., is to install a water system at a cost of approximately $200,000. The plans have been prepared by Engineer Frank C. Kelsey, Selling Bldg., Portland, Ore. The system will include about 16 miles of pipe line and two concrete reservoirs with a capacity of 1,000,000 gals. each. Bonds will be sold on May 14.

Engineer Louis C. Kelsey, 404-5 Selling Bldg., Portland, Ore., has been engaged by the City of Amity, Ore., to design and supervise the construction of a deep-well pumping plant and waterworks system, for which it is proposed to issue bonds.

Bonds have been voted for the installation of a water works system at Arlington, Ore., to cost about $5,000. Engineer Louis C. Kelsey, Selling Bldg., Portland, Ore., is preparing the plans and specifications.

Pennsylvania.

⊙The contract for the equipment of a 3,000,000-gal. filter plant for the Borough of Phoenixville, Pa., has been awarded to the Roberts Filter Mfg. Co., of Philadelphia. The concrete work and buildings will be done on force account and work will be begun June 1. Chester & Fleming, Pittsburgh, are Engineers.

Rhode Island.

✣Bids will be received until 2:15 p m., May 21, by Board of Contract & Supply, Providence, R. I., for 30,000,000-gal. pumping plant at Pettaconset Pumping Station, Cranston, R. I. Plans and specifications are on file at the office of the City Engineer.

South Carolina.

The Town Council of Walterboro, S. C., plans to enlarge the waterworks system by constructing larger mains, boring another well and installing auxiliary pumping station.

The citizens of Orangeburg, S. C., on April 29 voted the issuance of bonds in the sum of $60,000 for the purpose of removing the present water, light and power plant from its present location to the city lot on the Edisto River. Dr. J. G. Wannamaker is Commissioner of Public Works.

South Dakota.

Steps are being taken in the town of Volin, S. Dak., toward the installation of the proposed waterworks system, for which bonds in the sum of $8,450 were voted.

Tennessee.

The citizens of Henderson, Tenn., have voted in favor of issuing bonds for the installation of a water works system.

Texas.

✣Bids will be received until noon, May 8, by State Normal Board of Regents, San Marcos, Texas, for the erection of a steel water tower, capacity 50,000 gals., 100 ft. high, cement foundation, 6-in. supply pipe to connect with well. A certified check of $100 payable to F. M. Bralley, President of Board, should accompany each bid. The right to reject any and all bids is reserved. For detailed information, write C. E. Evans, President Southwest Texas State Normal School, San Marcos, Texas.

The City Council of Corpus Christi, Tex., H. A. Stevens, City Engineer, plans the building of a concrete reservoir of 155,000 gals. capacity, and also the installation of a relay pumping station five miles west of the city. The estimated cost is $20,000.

Utah.

The citizens of Payson, Utah, at a recent special election, voted the issuance of bonds in the sum of $43,000 for the purpose of constructing a waterworks system.

Supt. Charles F. Barrett, of the waterworks, Salt Lake City, Utah, has recommended the rebuilding of the redwood tank at the head of the old high line. The estimated cost is $5,000.

Virginia.

⊙The Alexandria Water Co., Alexandria, Va., has awarded to the Piedmont Construction Co., of University, Va., a contract for the construction of a dam across Holmes Run, a tributary of Cameron Run, from which Alexandria and suburbs now receive their water supply, and will be located near Barcroft, Fairfax County, about five miles west of the city. The structure will be of concrete, 600 ft. in length, 50 ft. thick at the base, and 70 ft. in height. The reservoir thus formed will cover 75 acres, will be 6½ miles in circumference, and will hold 600,000,000 gals. of water. The contract price is about $125,000.

Washington.

Following low bids were received by the Board of Public Works of Seattle, Wash., on April 25 for water main construction: West 63d St., Washington Construction Co., $1,523; 6th Ave., S. T. Ryan, $11,064; Boyer Ave., Nels Erickson, $22,230.

Carsten & Earles, of Seattle, Wash., have purchased the $300,000 bonds recently voted in Centralia, Wash., for the purchase of the local water plant of the Washington-Oregon Corporation and the construction of a municipal gravity water system. Of the amount, $165,000 will be used to install the gravity system.

Nels Erickson of Seattle, Wash., submitted the lowest bid to the Board of Public Works of that city on April 25 for the construction of water mains in Mercer St., at $3,169.

Wisconsin.

⊙F. Hoppmom & Sons, of Appleton, Wis., have been awarded the contract by that city for the construction of a waterworks pumping station, for $11,031.

⊙George Zimmerman, of Milwaukee, Wis., has been awarded the contract for laying water pipe in several streets of West Allis, Wis., at $1.09 for 6-in. pipe and $1.30 for 8-in. pipe.

A special election was held in Palmyra, Wis., on May 6 for the purpose of voting on the question of bonding the village for $18,000 to construct a waterworks plant. J. Rollin Gray, 803 Great Northern Bldg., Chicago, Ill., is Engineer.

Joseph Hanreddy, 127 N. Dearborn St., Chicago, submitted the lowest bid to the Department of Public Works of Milwaukee, Wis., for the construction of the new intake tunnel, at $420,300, with an additional $24,000 for concrete work. The tunnel proper will have a length of $4,000 ft. A shore shaft of 85 ft. must be constructed and a lake shaft of 90 ft. Nash Bros. of Chicago bid $613,275, and $40,000 additional if the 4,000 ft. of tunnel shall consist of concrete instead of brick.

The City of Prescott, Wis., has the sum of $17,350 available for the construction of a waterworks plant and connecting sewers. J. W. Howes is Mayor.

Bids were received on March 21 by the Board of Water Commissioners of Madison, Wis., for the construction of water mains in the Highland Park District, and for a 12-in. feeder main in West Johnson and Park Sts. In the table below (1) stands for engineer's estimate; (2) bid of J. F. Icke; (3) J. T. Blake, and (4) Webber & Gray:

Size of pipe. Ins.	Depth of cover.	Length.	(1) Unit.	(2) Unit.	(3) Unit.	(4) Unit.
4	5 ft.	400 ft.	$0.35	$0.43	$0.285	$0.55
4	6 ft.	700 ft.	.40	.45	.305	.625
4	Additional feet		.05	.03	.04	.10
4	8 ft.	350 ft.	.50	.51	.385	.825
6	5 ft.	700 ft.	.42	.47	.325	.70
6	6 ft.	3,500 ft.	.47	.51	.345	.75
6	Additional feet		.05	.03	.05	.10
6	7 ft.	500 ft.	.52	.54	.395	.85
8	5 ft.	....	.55	.54	.385	.75
8	6 ft.	3,000 ft.	.60	.58	.385	.82
8	Additional feet		.05	.04	.05	.10
8	7 ft.	1,000 ft.	.65	.62	.435	.92
4	Setting valves	12	.50	2.75	1.25	5.00
6	Setting valves	27	.60	3.15	2.00	7.00
8	Setting valves	11	.75	4.00	2.25	8.00
5	Setting hydrants	18	2.00	10.00	5.00	10.00
	Total		$5,310	$5,752	$3,869	$8,383
	12-in. feeder main.					
4	6 ft.	.....	.40	1.00	.40	.60
6	6 ft.	.....	.47	1.10	.40	.80
12	6 ft.	3,650 ft.	1.10	1.57	.90	1.60
12	Additional feet		.10	.20	.15	.20
4	Setting valves	13	.50	2.75	1.75	5.00
6	Setting valves	1	.60	3.15	2.00	7.00
12	Setting valves	8	1.25	6.00	4.00	10.00
5	Setting hydrants	10	2.00	10.00	5.00	10.00
	Total		$4,052	$5,917	$3,392	$6,092
	Grand total		$9,363	$11,669	$7,260	$14,475

Wyoming.

Engineer C. C. Carlisle has been commissioned by the town of Manville, Wyo., to prepare plans and specifications for a municipal waterworks system and an electric lighting system.

Canada.

✣Bids will be received until noon, May 29, by A. McNaughton, City Clerk, Fort William, Ont., for the construction of three tunnels in Hudson Shale, etc., with reinforced concrete lined shafts, viz.:

	L. Ft.	W. Ft.	H. Ft.	D. Ft.
Tunnel under Kaminlstikwia River	1,275	7	8	119
Tunnel under Mission River	677	5	6	95
Tunnel under McKellar River	629	5	6	91

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Plans and specifications may be seen and forms of tender may be obtained at the office of this journal or at the office of T. Aird Murray, 303 Lumsden Bldg., Toronto, Ont. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 6 p. m., May 20, by H. H. Elliott, M. D., Secy-Treas., The Pas, Sask., for the supply and delivery of the following machinery and materials: Tender "A," for the supply delivery and erection of two crude oil engines; tender "B," for the supply, delivery and erection of two generators, exciters, switch and other apparatus; tender "C," for the supply and delivery of, approximately 4,400 ft. of 12-in. steel pipe or cast iron pipe; 3,500 ft. of 10-in. steel pipe or cast iron pipe; 4,400 ft. of 8-in. steel pipe or cast iron pipe; 2,000 ft. of 6-in. steel or cast iron pipe; 50 specials; tender "D," for the supply and delivery of 30 hydrants, 52 gate valves and boxes; tender "E," for the supply and delivery of two pneumatic storage tanks. Plans and specifications may be seen at the office of Murphy & Underwood, Consulting Engineers, Saskatoon.

The citizens of Melita, Man., will vote May 17 on by-laws for the construction of a lighting, heating and power system, a waterworks system, and a street railway system. R. E. Denny, of Brandon, Man., has the franchise.

SEWERAGE AND SANITATION

Arkansas.

The Sewer Commissioners of Districts Nos. 1 and 2, Van Buren, Ark., recently held a meeting to plan work on the sewerage system in Cane Hill addition. Contracts will be let at once.

Plans and specifications are being prepared for the construction of a sewerage system in Brinkley, Ark. Benjamin Emmons is interested.

California.

⊙The City Trustees of Gridley, Calif., have awarded a contract for the completion of the sewer system to F. F. Moore, at $4,400.

The Engineering & Contracting Co. submitted the lowest bid to the City Council of San Diego, Calif., for the construction of a system of sewers east of 15th St. to extend through Balboa Park, at $37,933. Other bidders were: C. L. Hyde Construction Co., $38,955, and C. J. Julian, $39,568.

At a recent mass meeting of citizens of Quincy, Calif., a committee of five was appointed to investigate the cost of the proposed sewer system and to report at a meeting to be held May 2.

The Board of Public Works of Long Beach, Calif., has retained Consulting Engineer Olmstead & Gillelen, Wright & Callender Bldg., Los Angeles, to prepare preliminary and detailed plans for a new sewerage system. It is proposed to issue bonds to the abount of $340,000 for the improvement.

The City Trustees of Woodland, Calif, have decided to call a bond election for the extension of the water system, extension of sewer system, a new chemical engine and a septic tank with the pumping required.

City Engineer Chapman of Richmond, Calif., is preparing plans for the cons ruction of an adequate sewerage system for the annexed districts of Pullman and Stege.

The citizens of Sacramento, Calif., at a recent election voted to issue bonds for the extension of the city sewers and the water service to suburban districts.

The citizens of Berkeley, Calif., at a recent election voted the issuance of bonds for the construction of intercepting and outfall sewers along various routes in different sections of the city. The plans for these sewers were prepared by City Engineer J. J. Jessup. The cost of the improvement as fixed was $475,000.

The City Council of San Bernardino, Calif., will shortly advertise for bids for the construction of the northwest sewer system, which will cost about $30 000.

The citizens of Visalia, Cal., on April 29 voted on the issuance of bonds to the amount of $25,000 for the extension of the sewer system. L. E. McCabe is City Engineer.

Asst. Supt. of Sewers F. M. Lockwood, of San Diego, Cal., has asked for an appropriation of about $500,000 to complete the present sewer system of the city.

At a recent mass meeting of citizens of Woodland, Cal. (population 3,187), a resolution was adopted in favor of calling an election for the purpose of voting upon the issuance of bonds to the amount of $70,000 for improving water and sewer systems.

Connecticut.

⊙The Warner Miller Co of New Haven, Conn., has been awarded the contract at Westfield, Mass., for furnishing the town 12,000 lin. ft. of sewer pipe, at 71⅓ per cent off the list price.

Delaware.

Consulting Engineer T. Chalkley Hatton, of Wilmington, Del., has completed preliminary work for the plans for the proposed sewer system in Newark, Del. A special election will be held shortly to vote on the proposition.

District of Columbia.

✣Bids will be received until 2:30 p. m., May 20, by Maj. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington D. C., for furnishing hoisting cable, galvanized wrought steel pipe, sewer pipe, files, hinges, pipe dies, blocks differential and tackle; carpenters' braces, garden hose, door frames, doors, window frames, windows and screen windows, waste baskets, library paste, memorandum books, cardboard, bond paper and writing paper.

The District Commissioners Washington, D. C., will open bids May 7 for the construction of a relief sewer along Maryland Ave., between Seventh and Fifth Sts., for the interception of drainage that now pours into the valley north of Mayland Ave. Supt. of Sewers Asa E. Phillips has estimated the cost at $40,000.

Georgia.

⊙The sewer committee of the City Council, Atlanta, Ga., has awarded the contract for the construction of three groups of sewers to the Dysard Construction Co., of Atlanta, and to F. D. Harvey & Co., of Memphis, Tenn., for two groups.

Illinois.

✣Bids will be received until May 16 by Commissioners, Hillsboro, Ill., for the construction of a new sewer system. The estimate on materials to be furnished made by the Engineer in charge are as follows: 2,828 ft. of 8 in. sewer pipe; 11,134 ft. of 10 in. pipe; 1 895 ft. of 12 in. pipe; 1,770 ft. of 14 in. pipe; 1,890 ft. of 20 in. pipe; 2,050 ft. of 24 in. pipe; 1,450 ft. of 30 in. pipe and 4,275 ft. of 36 in. pipe. The av. depth of this pipe will be 6.90 ft. and there will be 21 manholes, 27 lamp holes, concrete header walls, etc.

✣Bids will be received until 11 a. m., May 13th, by L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering to the Bureau of Streets, F. O. B. any public switch track, in the 1st ward, approximately 5,000 sq. yds. of sandstone blocks according to specifications on file in his office; cash or certified check for $600 must accompany proposal.

⊙The Embankment Co., Joliet, Ill., has been awarded the contract by the village of Minooka, Ill., J. S. Gwynne, Village Clerk, for the construction of a sewerage system, for $11,109. Bids were opened April 24.

Special assessment rolls have been made by City Engineer Lee S. Trainor of Centralia, Ill., for the proposed $30,000 sanitary sewerage system extension which is to be begun this summer.

The citizens of White Hall, Ill., at a recent election voted in favor of the installation of a sewerage system. H. W. Roodhouse is Mayor.

Following are the lowest bids submitted to the Board of Local Improvements, Chicago, Ill., on April 8th, for constructing sewers in streets as shown, alley north of Garfield Blvd., Marshfield Ave. to Paulina St., 335 lin. ft. 9-in. tile pipe, 3 manholes, 88 cts. per. lin. ft., C. Roberts, 1227 Gilpin Pl., 45th Ave., Grace St. to 235 ft. north, 260 catch basins, $1.25 per lin. ft., G. Pontorelli, lin. ft. 12-in. tile pipe, 2 manholes and 3 904 Forquer St., Gage Pl., 55th St. to 54th St., 470 lin. ft. 12-in. tile pipe, $1.38, Campbell Ave., 55th St., 290 ft. south, 330 lin. ft. 12-in. tile pipe, $1.38, 7 manholes and 6 catch basins; G. Pontorelli, 103d Pl., Wentworth Ave. to Princeton Ave., 665 lin. ft. 15-in. tile pipe, $1.50 per lin. ft., Princeton Ave. to Harvard Ave., 455 lin. ft. 12-in. tile pipe, $1.40, 53d Ave., North Ave. to Lemoyne St., 670 lin. ft. 15-in. tile pipe, $1.50, Lemoyne St. to Hirsch St., 670 lin. ft. 12-in. tile pipe, $1.30, 10 manholes and 15 catch basins; G. Pontorelli, Cornelia Ave., 50th Ave. to 635 ft. east, $1.44, 635 ft. east of 50th Ave., to 150 ft. west of 48th Ave., 500 lin. ft. 12-in. tile pipe, $1.24, 9 manholes and 12 catch basins, S Ryan, 2927 W. Congress St., Rockwell St., 59th St. to 58th St., 670 lin. ft. 12-in. tile pipe, $1.49, 58th St. to 57th St., 670 lin. ft. 12-in. tile pipe, $1.39, 10 manholes and 12 catch basins, P. J. McNulty Co., 4345 Prairie Ave., Center Ave., 99th St. to 100th St., 670 lin. ft. 18-in. double strength tile pipe, $1.38, 101st St. to 102d st., 670 lin. ft. 12-in., $1.30, 15 manholes and 15 catch basins. S. Ryan, Eddy St., 50th Ave. to 635 ft. east, 670 lin. ft. 15-in. tile pipe, $1.44, 635 ft. east of 50th Ave. to 110 ft. west of 48th Ave., 500 lin. ft. 12-in. tile pipe, $1.24, 9 manholes and 12 catch basins, 48th Ave., Belmont Ave. to 630 ft. south, 670 lin. ft. 20-in. double strength tile pipe, $2.00, 630 ft. south to 1,300 ft. south, 670 lin. ft. 15-in. $1.50, 9 manholes and 14 catch basins, The Ryan Co., 10 S. La Salle St., 48th Ave., Belmont Ave. to School St., 670 lin. ft. 18-in. double strength tile pipe, 18-in., $1.91, School St. to Roscoe St., 670 lin. ft. 15-in. tile pipe, $1.55, 11 manholes and 14 catch basins, The Ryan Co., State St., 95th St. to 94th St., 670 lin. ft. 18-in. double strength tile pipe, $2.75, 94th St. to 93d St., 670 lin. ft. 15-in. tile pipe, $2.00, 93d St. to 92d St., 670 lin. ft. 12-in. tile pipe, $1.75, 300 lin. ft. tile pipe wing sewers, $1.50, 21 manholes, 18 catch basins, G. Pontorelli, Wentworth Ave., 73d St. to 72d St., 630 lin. ft. 22-in. double strength tile pipe, $2.76, 72d St. to 71st St., 700 lin. ft. 20-in. double strength tile pipe, $2.62, 71st St. to 70th St., 670 lin. ft. 18-in. tile pipe, $2.20, 70th St. to 69th St., 650 lin. ft. 15-in. tile pipe, $1.80, 69th St. to 67th St., 2,680 lin. ft. 9-in. tile pipe, $1.55, 48 6-in. house drains, 30 ft. long, $15 each, 78 6-in. house drains, 30 ft. long to be relaid, $15 each, one 9-in. house drain to be relaid, $20, 39 manholes and 8 catch basins; A. Scully, 4892 Our St., West End Ave., Prairie Ave. to Waller Ave., 440 lin. ft. 27-in. double strength tile pipe, $2.50, Waller Ave. to Park Ave., 450 lin. ft. 22-in. double strength tile pipe, $2.30, Park Ave., West End Ave. to 367 ft. north, 400 lin. ft. 18-in. double strength tile pipe, $1.80, 367 ft. north of West End Ave. to 227 ft. north of Frink St., 400 lin. ft. 15-in. tile pipe, $1.60, 227 ft. north of Frink St. to South Blvd., 270 lin. ft. 12-in. tile pipe, $1.50, West End Ave. to Washington Blvd., 730 lin. ft. 12-in. tile pipe, $1.50, Washington Blvd. to Madison

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

St., 670 lin. ft. 15-in. tile pipe, $1.60, Waller Ave., 50 lin. ft. tile pipe wing sewers, $1.60, 48 6-in. house drains, 25 ft. long, $10 each, 47 6-in. house drains, 25 ft. long to be relaid, $10 each, one 9-in. house drain, 25 ft. long, to be relaid, $15 each, 21 new manholes, A. Scully, Diversey Ave., 40th Ave. to 44th Ave., 2,700 lin. ft. double ring brick sewers, Wentworth Ave. to 48th Ave., 2,680 lin. ft. 5-ft. double ring brick sewer, $6.15, 52d Ave. to 56th Ave., 2,720 lin. ft. 4¾-ft. double ring brick sewer, $5.25, 48th Ave., Wrightwood Ave. to Wellington St., 2,660 lin. ft. 2½-ft. brick sewer, double invert, $2.75, 50 manholes and 139 catch basins, the Ryan Co. The contracts have not been awarded, E. J. Glackin, Secretary of the Board.

Following are the lowest bids submitted on April 28th, to the Board of Local Improvements for the construction of house drains (6-in.) in the following streets: Aberdeen St., 77th St. to 79th St., 3,000 lin. ft., 48 cts. per lin. ft., De Vito & Tirtilli, 600 De Koven St.; Champlain Ave., 75th St. to 79th St., 1,500 lin. ft., 34 cts., N. Mancini, 900 W. Taylor St.; Hutchinson St., 52d Ave. to 53d Ave., 700 lin. ft, 30 cts. per lin. ft., A. Mancini, 902 W. Taylor St.; Lawrence Ave., 75th St. to 79th St., 3,800 lin. ft., 34 cts. per lin. ft., N. Mancini; Yates Ave., 67th St. to 71st St., 500 lin. ft., 60 cts. per lin. ft., L. Scully, 1017 W. Polk st. The contracts have not been awarded. E. J. Glackin, Secretary of the Board.

Following are the lowest bids submitted to the Board of Local Improvements, Glen Ellyn, Ill., for the construction of a sewer system and pavement in Crescent Blvd. to the city limits, the work includes 2,800 cu. yds. earth excavation, 40 cts. per cu. yd., 2,000 lin. ft. 9-in. tile pipe, 47½ cts. per lin. ft., 5 manholes complete, including cast iron cover, $25 each, 9 catch basins complete, including iron covers, $23 each, 9,400 sq. yds. tar macadam pavement, complete 80 cts. per sq. yd., J. B. Price, Elgin, Ill. The contract has not been awarded. Aetna Engineering Bureau, 17 N. La Salle St., Chicago, Engineers in charge.

Judge Bernreuter of the Circuit Court has confirmed the assessment roll for the Silver St. sewer improvement, in the city of Belleville, Ill. The estimated cost made by City Engineer William Ziehnert is $2,800. Bids for the work will be advertised shortly.

Indiana.

City Engineer H. H. Thompson of Logansport, Ind., has estimated the cost of constructing a sewer along Front St., from the Wabash river to Sycamore St., at $18 500.

Iowa.

✣Bids will be received until 7:30 p. m., May 20, by G. J. Byers, Town Clerk, Belmond, Ia., for the construction of about 12,618 ft. of 8-in. and 1,442 ft. of 6-in. vitrified sewer; also 33 manholes, 12 flush tanks, including all labor and material. All bids must be in strict accordance with the plans and specifications, prepared by M. Tschirgi & Sons, of Cedar Rapids, Ia., which may be seen at the office of Town Clerk, and may also be seen on application to M. Tschirgi & Sons, Cedar Rapids, Ia. A certified check for $500, payable to the order of Town Treasurer, must accompany each bid.

⊙Brogan & Pitz have been awarded the contract by the city of Burlington, Ia., H. G. Vollmer, City Engineer, for the construction of a vitrified pipe sewer in Harrison Ave., at $1.37 per lin. ft. Bids were opened May 1.

⊙The Lytle Construction Co., Sioux City, Ia., has been awarded the contract by the city of Burlington, Ia., for the construction of a sewer in Garfield Ave., with branches, for $1.35 per lin. ft. Bids were opened May 1.

⊙The Lytle Construction Co., Sioux City, Ia., has been awarded the contract by the city of Burlington, Ia., H. G. Vollmer, City Engineer, for the construction of the Guahn St. sewer and its branches, for $1.30 per lin. ft. Bids were opened May 1.

The Town Council of Alden, Ia., has decided to have a map of the town made for the purpose of aiding in the adoption and maintenance of a sewer system.

Consulting Engineer Geo. W. Sturtevant, 38 S. Dearborn St., Chicago, Ill., has submitted a rough estimate of the probable cost of the installation of a sewerage system in Osage, Ia., to the City Council. The system will require about 12 or 14 miles of sewers and cost in the neighborhood of $60,000.

The sewer committee of the City Council, Odebolt, Ia., has retained Engineer Ernest Carlson, of Battle Creek, Ia., to make the survey and draw the plans for the proposed sewerage system. The system will cost about $4,000.

Maine.

⊙Lovello & Porfew, Portland, Me., have been awarded the contract by the Board of Selectmen, Kennebunk, Me., for the construction of a system of sewers in that city. Bids were opened April 26.

The city of Biddeford, Me., has retained an engineer to select a route and prepare plans for the proposed sewerage system. G. C. Smith is Mayor.

Maryland.

✣Bids will be received until 11 a. m., May 21, by Board of Awards, Baltimore, Md. at the office of the City Register, for building section 8 of the High Level Interceptor, and constructing lateral sewers and house connections in District 22 B, as shown on plans on file in the office of Mr. Calvin W. Hendrick, Chief Engineer of the Sewerage Commission. Specifications and plans can be obtained upon application at the office of H. W. Rodgers, Secretary of the Commission, Room 904, American Building, Baltimore, Md. Official advertisement will be found elsewhere in this issue.

⊙The Board of Awards of Baltimore, Md., has awarded the contract for the construction of sanitary sewers in the heart of the business district to McCarthy & Co., of that city, for about $145 000. The same company secured the contract to construct sanitary sewers in widely scattered sections of the city.

The Board of Awards of Baltimore, Md., has approved specifications submitted by the Sewerage Commission for sewers in the bed of the Reisterstown road, to be paved by the State Roads Commission.

Massachusetts.

The Brook Commission of Swampscott, Mass., has recommended the abandonment of the present system of disposal of sewage by a pumping plant and the substitution of a gravity system.

Michigan.

⊙Hunting Co., Rockford, Mich., has been awarded the contract in that city, for the laying of 870 lin. ft. of sewer. Bids were opened April 24.

No bids were received on April 18 by the Board of Public Works of Mt. Clemens, Mich., for the construction of main sewer extensions at an estimated cost of $50,000.

The city of Jackson, Mich. has voted to construct sewers in 20 streets and avenues.

A survey of the streets of the village of Chesaning, Mich., has been made to establish the necessary depths and grades for a trunk sewerage system. The survey included six blocks of the main streets for a contemplated pavement.

The City Council of Marshall, Mich., on April 25 sold bonds in the sum of $50,000 for the laying of paving and surface sewers this summer. L. A. Doulay, of Toledo, O., has been retained to superintend the work.

Minnesota.

⊙H. J. Cathroe & Co., 503 Ware Blk., Omaha, Nebr., have been awarded the contract by the city of Austin, Minn., for the construction of storm and sanitary sewers, at $5,177 and $3,590, respectively The work includes 3,700 lin. ft. of storm sewer from 10 to 20 ins. in diameter, 6,400 lin. ft. of sanitary sewer from 8 to 18 ins., with all necessary manholes and appurtenances. Bids were opened April 25.

Missouri.

⊙Coonty Bros., 4047 Wyoming St., St. Louis, Mo., have been awarded the contract by the Board of Public Improvements of that city, for the construction of sewers in Gratiot Sewer District No. 4, for $8,272. Bids were opened April 25.

⊙The Tonkawa Construction Co., Tonkawa, Okla., has been awarded the contract at Hermann, Mo., for the construction of 4½ miles of sewer laterals, for $11,218. Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., are Engineers. Bids were opened April 28.

The Plummer-Adams Co., of Springfield, Mo., has been awarded the contract by the City Council for the construction of sewers in Section No. 10, as follows: District No. 1 of section No. 8, $12,899; District No. 2 of section No. 8, $10,538.

Nebraska.

Farnam, along the boulevard.

⊙Arthur A. Dobson Co., of Lincoln, Neb., has been awarded the contract for the installation of the proposed sewerage system at Sibley, Ia., for $19,250.

The City Council of Omaha, Neb., has set aside from the general sewer bond fund $18,000 for the laying of a storm water sewer from 28th Ave. and Chicago St. to 31st and

New Hampshire.

✣Bids will be received until 1 p. m., May 15, by Board of Selectmen, Charlestown, N. H., for furnishing and laying about 30,000 ft. of sewer and drain pipe, from 6 to 12 ins. in diameter, and the construction of about 80 flush tanks, manholes and catch basins. Plans and specifications will not be mailed, but may be seen at the office of E. E. Davis, Engineer, 78 Main St., Northampton, Mass., or at the office of the Selectmen in Charleston, N. H., on and after May 12th.

New Jersey.

⊙The Standard Bitulithic Co., of Newark, N. J., has been awarded the contract by the Village Trustees of Cedarhurst, L. I., for the installation of a drainage system with catch basins and pipes. Each basin will cost $55 and the pipes $0.50 a lin. ft. The improvement will cost about $3,700.

Bids were received on April 29 by the Passaic Valley Sewerage Commission, Newark, N. J., for the construction of the northerly portion of Section 6, Intercepting Sewer; (1) standing for bid of Nash Bros., Chicago, Ill.; (2) Donlon Construction Co., Brooklyn, N. Y.; (3) Booth & Flinn, Ltd., Pittsburgh, Pa.; (4) Union Building & Construction Co., Passaic, N. J., and (5) Pethwick Bros. & Co., Inc., New York City.

		(1)	(2)	(3)	(4)	(5)
Earth excavation, in trench, for 150-in. concrete sewer	1,600 lin. ft.	$152.00	$134.00	$108.00	$75.00	**$60.00**
Concrete masonry, in trench	4,600 cu. yds.	9.00	6.00	9.00	8.50	**8.00**
Brick masonry, in manholes, and appurtenant work	50 cu. yds.	20.00	20.00	15.00	16.00	**20.00**
Rock excavation, in trench	300 cu. yds.	4.00	1.00	3.00	3.00	**5.00**
Special steel and timber sheeting, etc., sta. 26 + 75 to 28 + 75	Lump sum	26,000	1.00	13,200	12,000	**14,000**
Totals		$312,800	$243,301	$229,050	$172,800	**$149,300**

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Bids were received on April 29 by the Passaic Valley Sewerage Commission, Newark, N. J., for the construction of the central portion of section 6, Intercepting Sewer, (1) standing for bid of Nash Bros.; (2) Donlon Contracting Co.; (3) Concrete & Foundation Co., New York City, and (4) Pethick Bros. & Co., Inc.:

		(1)	(2)	(3)	(4)
Earth excavation, in trench, for 150-in. concrete sewer	1,400 lin. ft.	$99.00	$95.00	$75.55	$65.00
Concrete masonry, in trench	4,500 cu. yds.	9.00	8.00	8.25	8.00
Brick masonry, in manholes, and appurtenant work	50 cu. yds.	20.00	20.00	16.00	20.00
Rock excavation, in trench	300 cu. yds.	4.00	5.00	6.00	4.00
Totals		$181,300	$171,500	$145,495	$129,200

Bids were received on April 29 by the Passaic Valley Sewerage Commission, Newark, N. J., for the construction of southerly portion of Section 6, Intercepting Sewer, (1) standing for bid of Nash Bros.; (2) Concrete & Foundation Co.; (3) Donlon Contracting Co.; (4) Whiting-Turner Construction Co., Baltimore; (5) Union Building & Construction Co.; (6) William Horne Co., New York City; (7) O'Gara & Maguire, Inc., Newark; (8) Culp Co., Inc., Brooklyn; (9) Pethick Bros. & Co., Inc.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Earth excavation, in trench, for 150-in. concrete sewer	1,700 lin. ft.	$83.00	$69.95	$80.00	$65.00	$64.00	$66.90	$73.00	$78.25	$49.00
Concrete masonry, in trench	5,500 cu. yds.	9.00	8.25	8.00	8.70	8.50	7.50	8.00	6.95	8.00
Brick masonry, in manholes, and appurtenant work	100 cu. yds.	20.00	16.00	20.00	16.00	16.00	19.00	20.00	15.00	20.00
Rock excavation, in trench	7,000 cu. yds.	4.00	3.00	.01	2.90	3.00	2.50	.50	.01	3.00

New York.

⊙Joseph L. Sigretto has been awarded the contract by President Maurice Connolly of the Borough of Queens, New York City, for the construction of the proposed trunk sewer in Liberty Ave. to Nebraska Ave., and in South Curtis Ave. from Liberty Ave. to the Atlantic, for $116,395. The Green Construction Co. secured the Richmond Hill sewer contracts at $11,987. Harry Britton will construct sewer in Jerome Ave., Chestnut, Walnut and Church Sts., and Hamilton and Briggs Aves., for $20,379. William Cravello was awarded the sewers at Far Rockaway, for $23,550, and John Hart secured the contract to construct test pits in 51st St., in Corona, at $2,649.

Following bids were received at Albion, N. Y., R. R. Fernaw, Engineer, for the construction of a sewer system and disposal plant; (1) standing for bid of Hager & George, Newark, N. Y.; (2) Ripton & Murphy, Rochester; (3) Vang Construction Co., Cumberland, Md.; (4) Barrally & Ingersoll, Rochester; (5) W. S. Cooper Co., Albion; (6) Jos. S. Stabell & Co., Buffalo, N. Y.; (7) Flower City Construction Co., Rochester; (8) Sam Bonn, Syracuse, N. Y.; (9) S. M. Neff, New York City; (10) F. J. Munn Co., Buffalo, N. Y.:

Items.	Quantities.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
8-in. vitrified pipe	67,830 lin. ft.	$0.67	$0.676	$0.77	$0.72	$0.65	$0.60	$0.80	$0.75	$1.05	$0.97
10-in. vitrified pipe	3,370 lin. ft.	.81	.826	1.00	.76	1.09	.90	.90	1.00	1.30	1.12
12-in. vitrified pipe	1,220 lin. ft.	1.00	1.06	1.10	.86	1.25	1.00	1.10	1.35	1.45	1.20
15-in. vitrified pipe	5,560 lin. ft.	1.75	1.99	1.80	2.25	2.20	1.70	1.45	2.00	3.15	3.05
20-in. vitrified pipe	6,460 lin. ft.	2.85	1.30	1.50	2.00	1.89	1.40	1.75	1.90	2.05	2.94
Y branches	1,000	.53	.40	.25	.80	1.25	1.50	1.50	1.00	.65	2.50
Manholes	200	54.00	55.00	58.00	45.00	80.00	55.00	50.00	50.00	67.00	50.00
Flush tanks	60	75.00	75.00	80.00	60.00	95.09	75.00	75.00	75.00	90.00	90.00
Rock in trenches	6,000	1.50	3.00	2.50	3.00	3.00	3.50	3.00	3.00	2.75	4.80
Pumping station, Main St	Lump sum	1,500	1,250	1,300	1,900	1,855	2,000	2,855	3,190	2,550	3,777
Pumping station, Brown St	Lump sum	1,500	1,250	1,300	1,900	1,855	2,200	2,855	3,190	2,550	3,777
Earth excavation	14,000 cu. yds.	.40	.40	.35	.40	.60	.58	.50	1.50	.40	.70
Rock excavation	500 cu. yds.	2.50	2.50	2.00	2.00	2.50	2.20	2.00	3.00	2.75	2.75
Earth embankment	3,500 cu. yds.	.35	.50	1.00	.20	.30	.55	.55	.50	.45	.55
Seeding	½ acre	100.00	100.00	100.00	20.00	200.00	125.00	50.00	20.00	60.00	45.00
Sodding	200 sq. yds.	.25	.50	.50	.10	.40	.35	.25	.90	.30	.45
20-in. cast-iron pipe	48 lin. ft.	3.50	5.00	3.60	2.80	4.80	5.40	3.00	3.50	5.80	4.80
16-in. cast-iron pipe	250 lin. ft.	2.95	3.15	3.00	2.40	3.00	10.00	3.00	5.70	4.70	10.00
10-in. cast-iron pipe	260 lin. ft.	1.40	1.50	1.35	1.40	1.60	1.50	3.00	1.80	1.30	1.25
8-in. cast-iron pipe	40 lin. ft.	1.00	1.05	1.00	.80	1.26	1.50	2.25	2.60	2.30	2.00
6-in. cast-iron pipe	180 lin. ft.	1.25	1.20	1.15	.60	1.50	2.04	2.25	2.50	2.10	1.65
18-in. vitrified pipe	500 lin. ft.	.90	1.00	1.00	1.50	1.00	1.56	1.00	1.55	1.10	1.35
Grit chamber	Lump sum	350.00	406.00	300.00	400.00	510.00	329.00	348.00	575.00	350.00	380.00
Settling tank	Lump sum	7,800	7,500	8,000	13,000	8,062	10,587	9,602	7,250	10,000	10,000
Dosing chamber	Lump sum	1,950	2,185	2,100	2,500	1,535	1,330	1,200	1,480	1,290	1,440
Contact beds	Lump sum	21,000	21,900	22,500	19,000	25,219	34,050	27,349	26,190	25,600	25,000
Sludge bed	Lump sum	500.00	600.00	500.00	700.00	780.00	970.00	1,200	500.00	560.00	595.00
Extra concrete	50 cu. yds.	7.00	10.00	10.00	10.00	12.00	10.00	8.00	12.00	10.00	10.00
Extra steel	1 ton	45.00	60.00	60.00	70.00	70.00	100.00	40.00	140.00	75.00	70.00
5-in. vitrified pipe	1,000 lin. ft.	.62	.65	.80	.60	1.00	......	1.00	.50	.80	.60
20-in. gate valves	2	90.00	125.00	100.00	50.00	100.00	84.00	125.00	80.00	80.00	95.00
Totals		$148,321	*$150,769	$157,420	$159,266	$166,575	$169,325	$171,774	$184,206	$199,965	$216,127

*Probable contractor.

⊙William Crovello, Mott Ave., Far Rockaway, L. I., has been awarded the contract in that city, for the sewering of Remsen Ave., for $23,550.

City Engineer J. M. Hackett of Dunkirk, N. Y., has submitted drawings for a $100,000 intercepting sewer along the lake front to the Board of Health for approval.

Ohio.

⊙Press Campbell of Canton, O., has been awarded the contract by that city for the construction of the last section of the Liberty St. storm water sewer from North St. to a point 250 ft. north of Lawrence Ave., for $26,847. Logan D. Burd, of Canton, secured the contract to construct the Chance Ave. and Oxford St. storm sewer, at $1,602; also for a storm water sewer in McDonald, Oaklawn and Harrisburg Aves., for $7,600. Jones & Addesi secured the storm sewer in Schroyer Ave., West Eighth and West 10th Sts., for $5,662.

⊙J. P. O'Neil, of Akron, O., has been awarded the contract at Barberton, O., for the construction of the West Barberton storm sewers, for $41,000.

⊙Haskell & Battles, of Painesville, O., have been awarded the contract at Wooster, O., for the construction of sewers at $17,556.

⊙The Department of Public Service of Painesville, O., has awarded the contract for building the new sewers on Mentor Ave., Grant, Jackson and Jefferson St. to Hukari, Brandt & Koski, of Ashtabula, O.

The city of Nelsonville, O., C. C. Sharp, Director of Public Service, contemplates the construction of a brick or concrete sewer about 10,800 ft. long, starting at a 6-ft. diameter and increasing to 11½-ft. diameter. The bottom of the sewer will be 10 to 12 ft. below top of ground.

The City Council of Toledo, O., has retained Consulting Engineer R. W. Pratt, Hippodrome Bldg., Clevelond, O., to investigate and report upon the disposal of city sewage into Ten Mile Creek and Swan Creek.

The City Council of Canton, O., Phil Weber, City Enginer, has passed ordinances providing for the construction of a number of sewers.

Oklahoma.

✣Bids will be received until 8 p., May 15, by Board of Trustees, W. W. Boone, Chairman, Caddo, Okla., for the construction of a system of sewers in the town of Caddo, Okla. The system will comprise 25,500 ft. of 6-in., 3,600 ft. of 8-in., 3,500 ft. of 10-in., 1,200 ft. of 12-in. and 2,100 ft. of 15-in. vitrified sewer pipe; 58 manholes, 27 lampholes and 6 automatic flush tanks; one septic tank. All bids must be accompanied by a certified check for 5 per cent of amount of bids. Plans and specifications will be on file at the office of the City Engineer.

⊙J. S. Weathers, of Muskogee, Okla., has been awarded the contract at Vinita, Okla., for the construction of $15,000 worth of sewers. Nagle & Peterson, of Muskogee, are Engineers.

The city of Watonga, Okla., will install a system of sanitary sewers, including sewage disposal plant, and bonds in the amount of $35,000 will be voted on May 16. The Benham Engineering Co., American Nat. Bank Bldg., Oklahoma City, has been retained to draw plans and specifications and supervise construction work.

Oregon.

⊙The sewer committee of the City Council, Portland, Ore., has awarded the contract for the construction of a sewer in East 28th and Wasco Sts. to George Gordon, for $6,980.

Pennsylvania.

✣Bids will be received until noon, May 20, by the Borough of Danville, Pa., for the construction of a reinforced concrete settling Basin, Coagulant Apparatus, connections and appurtenances. Plans and specifications may be obtained of Chester & Fleming, Union Bank Bldg., Pittsburgh, Pa., by depositing $25.

⊙The city of Oil City, Pa., R. Mackenzie, Controller, has awarded the contract for the construction of the Imperial tract sewers to Lesher, Roess & Lesher, Oil City.

⊙Fehr & O'Rourke have been awarded the contract by the Board of Public Works of Reading, Pa., for the construction of pipe sewers in a number of streets, for $67,638. John E. Weidner bid $71,226 on the work.

⊙Director of Public Works C. V. Terwilliger of Scranton Pa., has awarded contracts for eleven paving jobs and four sewer jobs. The MacDonald Construction Co. secured four of the paving contracts and R. C. Ruthven the remainder of the paving. The sewer work was awarded as follows: Summa & Co., Diamond Ave. and Ward St., at $1.49 a lin.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ft.; Vincenzo Vaccaro, Mylert Ave., Green Ridge St. to Marion St., $2 a lin. ft.; C. L. S. D'Andrea, Albright Ave., Lackawanna river to Green Ridge St., $1.45 a lin. ft.; also North Main Ave. and Euclid Ave., $1.49 a lin. ft. The total cost of the work will reach about $200,000.

⊙The Borough Council of Collingdale, Pa., has awarded the contract for a sewer system to Patrick Mahoney of Oakview, Pa., for $33,238. Other bidders were: Contrell Construction Co., $33,341; William P. Mahoney, $37,880; Suburban Construction Co., $33,400; Field, Blake & Underwood, $40,000.

The city of Pittsburgh, Pa., rejected all bids received April 18 for the construction of a number of sewers. Jos. G. Armstrong is Director of Public Works.

Consulting Engineer George W. Fuller, of New York City, has submitted his report to the City Councils of York, Pa., relative to the proposed installation of a system of sewerage and sewage disposal. The estimates of cost are as follows: 1,500 ft. of 42-in. sewer with appurtenances, $7,500; Poor House run siphon, $6,000; 150 ft. of 39-in. sewer connecting siphons to main outfall, $750; 6,000 ft. of 48-in. outfall sewer, $37,500; repair work and connections in the city for existing sewers, $10,000; lands and rights of way, $2,500; rock excavation, $5,000; treatment works and pumping equipment to be designed in point of size to conform to the balance of available funds, $30,000; total, $99,250.

The Board of Public Works of Reading, Pa., rejected all bids received recently for the construction of storm water sewers on West Elm St. and North Sixth St. and directed City Engineer E. B. Ulrich to re-advertise the work.

The Borough Council of Clifton Heights, Pa., has passed an ordinance for the purpose of making a loan of $40,000 for the construction of a sewerage system. Albert F. Damon, Darby, Pa., is Engineer.

Consulting Engineer Charles E. Collins, Drexel Bldg., Philadelphia, Pa., has prepared plans for the construction of new sewers in Lansdale, Pa., and has submitted the same to the State Department of Health for approval. The work will include 19 miles of pipe sewers, 6 in. to 24 in. in diameter; settling tank and sprinkling filter. A. S. Wismer is President of the Council.

South Carolina.

The Town Council of Walterboro, S. C., has appointed a committee to arrange for a survey of the town for the proposed sewerage system.

Tennessee.

Commissioner A. N. Sloan, of the department of streets and sewers, Chattanooga, Tenn., has two surveying parties in the Orange Grove and Ridgedale sections taking levels, with a view to mapping out routs for the proposed sewers.

Virginia.

Plans have been prepared for the making of extensions to the sewer system of Highland Park, Va., at an estimated cost of $5,000. Contracts will be let within 90 days. Jno. M. Lewis is official in charge.

Washington.

The City Council of Tacoma, Wash., has passed ordinances preparing for the $222,000 bond issue election to be held May 10. The largest item is for the construction of storm and sanitary sewers, at $102,000. Other items are a municipal farm, $15,000; a tideflats railway, $87,000, and road extensions, $18,000. W. C. Raleigh is City Engineer.

Chief Engineer H. Day Hanford of the Stone-Webster Corporation has recommended to the City Commission of North Yakima, Wash., the abandonment of plans for the construction of a drainage system until more definite data can be obtained. The plans of City Engineer N. A. Gilman for the disposal plant have been approved. Those for the sewer system are altered to save $20,000 by reducing the size of two main pipes. Bonds to the amount of about $240,000 will be voted upon by the citizens shortly.

The City Commission of North Yakima, Wash., has set June 1 as the date of the election on the bond issue for the proposed sewer system. The estimated cost is $246,000. H. D. Hanford of Seattle is Consulting Engineer. N. A. Gilman is City Engineer.

The City Council of Garfield, Wash., has called a special election for May 3, for the purpose of voting on the installation of a trunk sewer system, purchase of a site for and installing a sewage disposal plant at a cost of $14,350, to make improvements in the present water system and install a standpipe at a cost of $7,947.

West Virginia.

The City Council of Martinsburg, W. Va., has appointed a sewerage commission of five persons, who are to take charge of the proposition to install a sewerage system in the city.

⊙The Board of Control of Wheeling, W. Va., has let a contract for a 10-in. sewer to be laid on Market St., between 10th and 11th Sts., to G. A. Jocavetti, of that city. F. P. Jones Co., of Wheeling, will furnish the sewer pipe.

Wisconsin.

⊙Peter Rasmussen, 911 Racine St., Racine, Wis., has been awarded the contract by that city, Chas. A. Ryba, City Clerk, for the construction of a sewer in Hartman St., at $.75 per sq. ft., and $35 for manholes. Bids were opened April 26.

✣Bids will be received until 9 a. m., May 8, by E. L. Williams, City Clerk, Appleton, Wis., for furnishing all labor and material and constructing a sewer in Franklin St. from Superior St. east about 228 ft. Plans are on file and may be seen at the office of the City Clerk.

The sewage committee of the Common Council, Milwaukee, Wis., has recommended sewerage construction to the amount of $165,000, as follows: Main sewage lines in Cleveland Ave., First Ave. and Dakota St. from Kinnickinnic river to American Ave., $95,000; sewers in Seventh Ave., Park St., and Eighth Ave., from Greenfield Ave. to Burnham Canal, $45,000; in 25th St., from Greves St. to St. Paul Ave., $13 500; in Galena St., from 27th to 30th Sts., $11,500.

⊙Mulholland, Kuehn & Co., of Kaukauna, Wis., has been awarded the contract at Clintonville, Wis., for the installation of a stretch of sewers from the southern limits of the city along Main St., to the river, for about $8,000.

City Engineer P. H. Connolly of Racine, Wis., is preparing plans and specifications for a system of sewers in West Racine.

Canada.

Consulting Engineer Willis Chipman of Winnipeg and Toronto has submitted his report to the City Council of London, Ont., on the storm sewer survey. The estimated cost of the system is $392,000.

⊙H. C. Ulen, 38 S. Dearborn St., Chicago, Ill., has been awarded the contract at Edmonton, Alta., for sewer construction amounting to $372,000.

The city of Watrous, Sask., did not let the contract for laying water and sewer mains for which bids were opened on April 15. Chipman & Powers, Winnipeg & Toronto, are Engineers.

BUILDINGS

Arizona.

✣Bids will be received until 10 a. m., May 23, by John A. Wagner, Constructing Quartermaster, Fort Huachuca, Ariz., for the construction complete, including plumbing, heat-electric wiring, where required, of three double captains' quarters, one trop barrack, one double lavatory, additions to buildings Nos. 19, 20 and 30 and installation of sewer extension at this post.

California.

✣Bids will be received until 11 a. m., May 12, by Lieut. R. W. Pinger, Quartermaster, Fort Baker, Calif., for furnishing labor and material necessary for construction of 5-strand woven wire fence on Fort Baker Reservation, including about 8,000 ft.

Illinois.

✣Bids will be received until 3 p. m., June 16, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures, and approaches, of the United States post office at Rochelle, Ill. The building is one story, basement, and mezzanine, and has a ground area of approximately 4,000 sq. ft.; fireproof construction except the roof, brick and stone facing, and tin roof. Drawings and specifications may be obtained from the custodian at Rochelle, Ill., or at this office, at the discretion of the Supervising Architect.

✣Bids will be received until 12 m., May 16, by the Board of Directors of the Municipal Tuberculosis Sanitarium, 40th Ave. and Bryn Mawr Ave., for furnishing and delivering all materials, labor, equipment, etc., necessary in the construction and erection, complete, of an infirmary group, consisting of an ad inistration building, and men and women's infirmary. Plans and specifications may be had upon application to Frank Wing, Superintendent, 1514 Fort Dearborn Bldg., Chicago, Ill., upon deposit of $15 for the safe return of plans.

✣Bids will be received until 10 a. m., May 17, at the office of Charles Pauley & Son, Architects, Granite City, Ill., for all material and labor required in the erection and completion of a labor temple, to be erected at Staunton, Ill. Plans and specifications can be had at the office of the secretary of the local lodge of Staunton, Ill. Plans may be seen at the office of Chas. Pauley & Son, Granite City, Ill.

✣Bids will be received until 11 a. m., May 12, by L. E. McGann, Commissioner of Public Works, Chicago, Ill., for the construction of a new 2-story and basement brick bath-house (except heating, sewerage and plumbing) at 1444 Holt St. for the Health Department and to be known as the Kosciusko Public Bath. Plans and specifications may be had upon application, same to be accompanied with deposit of $15 cash, or certified check for $100 must accompany proposal.

✣Bids will be received until 11 a. m., May 12, by L. E. McGann, Commissioner of Public Works, Chicago, Ill., for making the necessary alterations and additions to the sewerage, plumbing and heating work in the new Kosciusko public bath house (2-story and basement brick building), 1444 Holt St. Plans and specifications may be had upon deposit of $15.

Iowa.

✣Bids will be received until 10 a. m., May 10, by G. B. Healy, Supt. Parks and Public Property, Sioux City, Ia., for 6,000 ft. 0, 2-ply weatherproof covering copper wire.

⊙Dunphy-Fridstein Co., 812 Majestic Bldg., Milwaukee, Wis., and 536 First National Bank Bldg., Chicago, Ill., has been awarded the general contract for the Russell-Lamson Hotel, which is to be built at Waterloo, Ia. Marshall & Fox, of Chicago, are the architects. This is a 7-story reinforced concrete building. The contractors are in the market for bids on all branches of the work, as well as reinforcing steel, cement, sand, gravel and tile.

Kentucky.

✣Bids will be received until 3 p. m., June 17, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete (including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures and approaches) of the United States post office at Cynthiana, Ky. The building is one story, basement and mezzanine, and has a ground area of approximately 3,750 sq. ft.; fireproof construction, stone facing, and tin roof. Drawings and specifications may be obtained from the custodian of site at Cynthiana, Ky., or at the discretion of the Supervising Architect.

Massachusetts.

⊙The Florence Manufacturing Co., Florence, Mass., manufacturers of prophylactic tooth brushes, etc., have awarded the contract to the Aberthaw Construction Co., of Boston, Mass., for building a new structure to replace an old structure which is being torn down.

⊙The Aberthaw Construction Co., Boston, has received the contract for a reinforced concrete 4-story building, 120x60 ft., for the Russia Cement Co., Gloucester, Mass., manufacturers of Le Page's glue, inks, oil, etc.

Massachusetts.

✣Bids will be received until 4 p. m., May 15, by School Committee, at the office of the Town Selectmen, Brookline, Mass., for the construction and completion of a school house on the Edward Devotion school lot. Plans and specifications may be seen at the office of Kilham & Hopkins, 9 Park St., Boston, to whom all inquiries must be addressed. A certified check for $1,000, made payable to the Town of Brookline, must accompany each bid for the general contract.

✣Bids will be received until 1 p. m., May 26, by Commanding Officer, Watertown Arsenal, Watertown, Mass., for furnishing during the year commencing June 30, 1914, rope, rod brass and bronze, bar steel, nails, fuel, cement, lime, lumber, oils, blue and brown print paper, foundry supplies, dry cells and rubber. Information furnished on application to the Commanding Officer, Watertown Arsenal.

Michigan.

The State Legislature has passed a bill appropriating $375,000 for a new science building for the University of Michigan, Ann Arbor.

Minnesota.

✣Bids will be received until 2 p. m., May 26, by Commissioner of Indian Affairs, Washington, D. C., for furnishing materials and labor for the erection of a brick dormitory and brick mess hall and installation of acetylene lighting extension at the White Earth School and the erection of a laundry building at the White Earth Agency, Minn., in strict accordance with the plans, specifications and instructions on file with supervisor of construction, Denver, Colo.

Missouri.

✣Bids will be received until noon, May 23, by Board of Public Improvements, St. Louis, Mo., for the erection of the first and second sections of a jail building.

New York.

✣Bids will be received until 11 a. m., May 24, by Bureau of Yards and Docks, Navy Department, Washington, D. C., for steel trusses, purlins, bracing, columns, corrugated siding, millwork, etc., for the naval magazine at Iona Island, N. Y. The cost is estimated at $7,000.

✣Bids will be received at 11 a. m., May 19, by Capt. G. Robinson, Constructing Quartermaster, Fort H. G. Wright, N. Y., for constructing, including plumbing, heating, electric wiring and fixtures, addition to and alterations of hospital at that place.

North Dakota.

✣Bids will be received until 2 p. m., June 2, by Commissioner of Indian Affairs, Washington, D. C., for furnishing materials and labor for the erection of a brick hospital at the Wahpeton Indian School, North Dakota, in strict accordance with the plans, specifications and instructions to bidders, which may be examined at the offices of the supervisor of construction, Denver, Colo.

North Carolina.

✣Bids will be received until 3 p. m., June 11, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for and then opened for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures, and approaches, of the United States post office at Hickory, N. C. The building is to be two stories high with a basement, and will have a ground area of approximately 4,800 sq. ft.; fireproof construction to top of second floor; stone and brick facing and tin roof. Drawings and specifications may be obtained from the custodian of site at Hickory, N. C., or at the discretion of the Supervising Architect.

Ohio.

⊙The Crowell & Sherman Co., 1951 E. 57th St., Cleveland, O., is reported to have been awarded the contract for constructing an art museum in Wade Park, Cleveland, to cost about $1,000,000. Herman A. Kelley is Secretary of the Cleveland Art Museum Trustees.

Pennsylvania.

✣Bids will be received until 8 p. m., May 9, by Borough Council, Dermont, Pa., for the grading, curbing and paving of Wainbell Ave., from Peermont Ave. to Biltmore Ave. Approximate quantities are: 1,250 cu. yds. of grading, 1,700 lin.' ft. of concrete curb and gutter and 1,950 sq. yds. of brick paving. Also for the grading, curbing and paving of Dormont Ave. from West Liberty Ave. to Pinehurst Ave. Approximate quantities are: 1,300 cu. yds. of grading, 1,950 lin. ft. of concrete curb and gutter and 2,300 sq. yds. of brick paving. Plans and specifications may be seen, and bidding blanks and all necessary information may be had at the office of Douglass & McKnight, Borough Engineers, 1709 Union Bank Bldg., Pittsburgh, Pa. Hugh M. Stilley is Chairman Street Committee.

⊙The contract for the building of the new plant of the Model Gas Engine Co. of Peru, Ind., which will locate in Pittsburgh, has been awarded to the Nicola Building Co. of Pittsburgh. The main building will be 187x208 ft., two stories, and of brick and steel construction. The office building will be 40x46 ft. and the testing building 46x120 ft.

⊙The contract for building the brick and steel manufacturing plant of the Model Gas Range Company, in the Homewood district of Pittsburgh, has been awarded to the Nicola Building Co., Pittsburgh, by the W. G. Wilkins Company, architects.

Architect C. C. Compton, Post Office Bldg., Donora, Pa., is revising plans for the new building to be erected by the Board of Education of that city. Plans will be ready for bids about May 15. The school building will be 130x165 feet, two stories and basement high, and of brick and steel with terra cotta or stone trimmings. It will cost about $80,000.

Architect A. P. Cooper, First National Bank Bldg., Uniontown, Pa., has plans in progress for a church building for the Methodist Episcopal congregation at Uniontown. A parsonage will also be built. The work is to cost $125,000.

Architect Carlton Strong, Union Bank Bldg., Pittsburgh, is preparing sketches for the proposed science hall, chemistry and engineering buildings for the Duquesne University, to cost $250,000. The structure will be 40x150 ft., five stories high.

Preliminary plans for the new penitentiary to be constructed for the state at Bellefonte have been completed by Architect John T. Windrin, Commonwealth Bldg., Philadelphia. The work will cost $1,250,000.

Bids as follows were received by the Bureau Yards and Docks, Navy Department, Washington, D. C., for the construction complete of a marine barracks at the Navy Yard, Philadelphia, Pa.: Thomas Riley, 1616 Thompson St., Philadelphia, $158,799; Edward Fay & Son, 2 Sole St., Philadelphia, $159,985; E. W. Van Loon, Denckle Bldg., Philadelphia, $173,723; Edward F. Fondar, Land Title Bldg., Philadelphia, $164,400; Guernsey-O'Meara Co., 1408 North American Bldg., Philadelphia, $174,677; C. M. Leach, P. O. Box 2285, Boston, Mass., $173,773; B. Ketcham Sons, 129 Brown St., Philadelphia, $171,707; W. E. Dotts & Co., 510 Bulletin Bldg., Philadelphia, $173,993; Wells Construction Co., 619 Witherspoon Bldg., Philadelphia, $187,000; Interstate Construction Co., Ltd., 1407 N. Niagara St., Saginaw, Mich., $172,130; Turner Concrete Steel Co., 1713 Sansom St., Philadelphia, $174,900; Mitchell Bros., 2125 Race St., Philadelphia, $194,109.

Plans are now being made by Architects Kiehnel & Elliott, Publication Bldg., Pittsburgh, for a 1 and 2-story brick, terra cotta and tile fireproof tuberculosis hospital to be built on the Leach farm, near Highland Park, for the city of Pittsburgh. The group of buildings will cost $150,000.

South Carolina.

✣Bids will be received until noon, May 15, by Board of Trustees, at the office of August Kohn, Chairman, 407 Loan and Exchange Bank Bldg., Columbia, S. C., for the installation of Section No. 1 of the central heating plant at the University of South Carolina. The plans and specifications are now ready, and may be had on application to Wilson & Sompayrac, architects, 1302 Main St., Columbia, S. C.

Texas.

✣Bids will be received until 2:30 p. m., May 19, by E. V. Swift, County Judge, Palestine, Tex., for the erection of a three-story and basement fireproof court house, to be built in Palestine, Anderson County, Texas., with heating, plumbing and wiring systems complete. Each bid on the general contract must be accompanied by a certified check for $5,000, and bids on the heating, plumbing and wiring plans with a certified check for 5 per cent of the amount of bid, all checks to be made payable to Judge E. V. Swift, Palestine, Tex. Plans and specifications can be secured by applying to the office of C. H. Page & Bro., Austin and Houston, Tex., and the further consideration of a $50 deposit check to guarantee the safe return of all plans to the architect.

Washington.

✣Bids will be received until 3 p. m., May 27, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures and approaches, of the United States Post Office at Marlin, Texas. The building is to be of one story, basement and mezzanine, and has a ground area of approximately 3,450 sq. ft.; nonfireproof construction; stone and brick facing and tin roof. Drawings and specifications may be obtained from the custodian of site at Marlin, Tex., or at the discretion of the Supervising Architect.

✣Bids will be received until May 14 by the Board of King County Commissioners, Seattle, Wash., for the erection of a 3-story court house estimated to cost about $950,000. The structure, which will be of concrete and steel, will be erected according to plans prepared by A. Warren Gould, Seattle, Wash., Architect.

Wisconsin.

Otto Schomberg, Lumber Dealer, Milwaukee, Wis., proposes the erection of a 12-story building at West Water, Second and Wells St., Milwaukee. The building will have a frontage of 230 ft. on West Water St., 200 ft. on Second St., and 118 ft. on Wells St.

Wyoming.

Bids as follow were received April 12 by the Supervising Architect, Treasury Department, Washington, D. C., for the construction of the U. S. Post Office at Douglas, Wyo.: W. D. Lovell, Minneapolis, Minn., limestone, $84,000; J. F. Jenkins & Co., Ocala, Fla., limestone, $89,500, sandstone, $94,000.

Canada.

The Hammond Stooker Co., R. Hammond, Manager, Sylvester-Willson Bldg., Winnipeg, Man., is to expend about $250,000 for construction of buildings and for equipment for a plant to be erected at Red Cliff, Man.

RIVERS AND HARBORS

Arkansas.

The Commercial Club of Pocahontas, Ark., is advocating the construction of a levee along Black River, east of the city, for the prevention of overflows from the river.

California.

✣The San Francisco-Oakland Terminal Rys. Co., W. R. Alberger, General Manager, Oakland, Cal., is reported to be calling for bids until May 15 for filling in the Key Route pier at Oakland. About 1,000,000 cu. yds. of sand will be taken from the harbor and placed behind a concrete wall.

Connecticut.

✣Bids will be received until 2 p. m., May 31, by Major G. B. Pillsbury, U. S. Engineer, New London, Conn., for dredging in Mystic River, Conn.

Connecticut.

The following bid was received April 18 by Maj. G. B. Pillsbury, U. S. Engineer, New London, Conn., for constructing riprap dikes and revetment on the Connecticut River: E. S. Belden & Sons, Hartford, Conn., training dike, Clay Banks Bar, 13,300 tons, $2.13; four spur dikes, Press Barn Bar, 1,200 tons, $2.13; two training dikes, Glastonbury Bar, 10,200 tons, $2.13; 1,000 ft. revetment, Glastonbury Bar, 8,600 tons, $2.13; total, $70,929.

Bids were opened April 19 by Maj. G. B. Pillsbury, U. S. Engineer, New London, Cann., for constructing timber and brush spur dikes at Press Barn Bar, Connecticut River. S. A. Bailey, 175 E. 85th St., New York City, at the following bid was the only bidder:

Furnishing and driving 8,200 lin. ft. piling	$ 0.30
Furnishing and placing 21,750 ft., B. M., lumber	1.00
Furnishing and placing 7,700 lbs. iron rods and bolts	.10
Furnishing and placing 780 lbs. cast-iron washers	.05
Furnishing and placing 280 cords brush	12.00
Furnishing and placing 100 long tons stone	2.50
Total	$9,204

Florida.

Election is to be held at Fernandina, Fla., to vote on a $50,000 bond issue for the construction and operation of a municipal plant, and the purchase of a portion of the water front to be used for a public dock and recreation pier. A. J. Kiernan is City Engineer.

Hawaii.

✣Bids will be received until 11 a. m., May 24, by Bureau of Yards & Docks, U. S. Navy Department, Washington, D. C., for one steel oil storage tank at the naval station, Pearl Harbor, Hawaii. The cost of the work is estimated at $20,500. W. M. Smith is Chief of the Bureau.

Illinois.

✣Bids will he received until 10 a. m., May 27, by Lieut. Col. G. A. Zinn, U. S. Engineer, Chicago, Ill., for dredging in Chicago River, Illinois.

Indiana.

Bids as follow were received April 11 by Board of Park Commissioners, Indianapolis, Ind., for dredging Fall Creek: Mansfield Engineering Co., cost plus 15 per cent profit, with a guarantee daily operation expense will not exceed $100, the company to pay the city 10 cts. a cu. yd. for all gravel removed that will not be required in boulevard construction work; North Side Sand & Gravel Co., cost plus 12 per cent profit, with a guarantee daily maximum operating expense will not exceed $185, company to pay 6 cts. a cu. yd. for excess gravel; Indiana Excavating Co., cost plus 5 per cent profit, with a guarantee maximum daily operating expense will not exceed $60, company to pay the city 10 cts. a cu. yd. for excess gravel. Specifications call for the dredging of the stream for a depth of from 8 to 16 ft. Most of the gravel that will be removed will be used in boulevard construction work.

Iowa.

⊙Capital City Construction Co., Des Moines, Ia., has been awarded the contract at $5,362 for building an extension to the river wall at Des Moines.

Maine.

✣Bids will be received until noon, May 29, by Lieut. Col. W. E. Craighill, U. S. Engineer, Congress St., Portland, Me., for dredging in Portland Harbor, Me.

Bids as follows were received May 1 by the U. S. Engineer, Portland, Me., for ledge excavation at Portland Harbor, Me.: G. H. Breymann & Bros., Toledo, O., $18 per cu. yd.; Eastern Dredging Co., Boston, Mass., $16.92; Johnston & Virden, Lewes, Del., $18.90; Geo. W. Beeman, Hyde Park, Mass., $17.45.

The following bids were received May 1 by the U. S. Engineer, Portland, Me., for ledge excavation on three contracts (1) in Saco River, Me., (2) in South Bristol Harbor, Me., and (3) at Sullivan Falls, Me.: Eastern Dredging Co., Boston, Mass., (1) $19.70 per cu. yd., (2) $15.70, (3) $39.70; Geo. W. Beeman, Hyde Park, Mass., (1) $24.50, (2) $22.75; Frank W. Carlton, Bath, Me., (2) $11.30, (3) $40; Gilbert H. Harries, Boston, Mass., (3) $36.90.

Massachusetts.

✣Bids will be received until 11 a. m., May 31, by Bureau of Yards & Docks, U. S. Navy Department, Washington, D. C., for coaling tower and alterations and improvements to coaling plant, Navy Yard, Boston, Mass. The amount available for the work is estimated at $65,000. W. M. Smith is Acting Chief of the Bureau.

The following bids were received April 23 by the Harbor and Land Commissioners, Boston, Mass., for dredging channel to Eel Pond, Falmouth, (1) bid per cu. yd. for dredging, (2) bid per cu. yd. for removing boulders over 1 cu. yd.: J. H. Letteney, Boston, Mass., (1) $1.39, (2) $11.80; J. S. Packard Dredging Co., Providence, R. I., (1) $1.49, (2) $24.

Bids were opened April 30 by the Directors of the Port of Boston for constructing a bulkhead at East Boston, Lawler Bros., Boston, Mass., at $163,587 being the low bidders.

Bids as follows were received April 29 by Col. F. V. Abbott, U. S. Engineer, Boston, Mass., for dredging in Lynn Harbor, Mass. (1): Price per cu. yd., scow measurement, $10 for dredging, (2) price per cu. yd. for removing bowlders exceeding 2 cu. yds. each: G. H. Broymann & Bros., Boston, Mass., (1) 17 cts., (2) 17 cts.; Bay State Dredging Co., Ltd., Boston, Mass., (1) 10¾ cts., (2) 10 cts.; Eastern Dredging Co., Boston, Mass., (7) 19 6/10 cts., (2) $5; Jeremiah P. O'Riorden, Charlestown, Mass., (1) 19⅜ cts., (2) $15.

Michigan.

Bids as follows per cu. yd. scow measurement were received May 1 by Lt. Col. Mason M. Patrick, U. S. Engineer, Detroit, Mich., for dredging channels at Alpena Harbor, Mich.: Greiling Bros. Co., Green Bay, Wis., 17 cts.; John B. Breymann, Toledo, O., 19½ cts.; Muir-O'Sullivan Dredge & Dock Co., Port Huron, Mich., 21½ cts.; Great Lakes Dredge & Dock Co., Cleveland, O., 29 cts.

A company is being organized with the intention of building dams across the Rifle River to develop electric power to be supplied to cities of the Saginaw Valley and other points. H. W. Carr, Saginaw, Mich., and Angus McDonnell, Omer, Mich., are interested.

Property owners at Muskegon have organized a company for dredging entrance to Lake Harbor to permit all boats of ordinary draught to enter the inner lake. Edward R. Swett, Muskegon, is President.

The Graham & Morton Transportation Co. and the Grand Rapids, Holland & Chicago Ry. (electric), Holland, are to construct a new pier at Jenison Park, Holland, to cost $25,000.

Mississippi.

No bids were received April 14 by Maj. J. A. Wood, U. S. Engineer, Vicksburg, Miss., for furnishing sand and gravel and broken stone near Little Calloo Landing, Big Sunflower River, Miss.

Missouri.

A committee has been appointed at New Madrid, Mo., to formulate and circulate a petition to the county court to organize a new levee district, embracing the territory outlined by commencing at High Bank, below New Madrid, Mo., and surrounding the city, extending to Highland, near Farrenburg, a distance of 12 miles. The estimated cost is $150,000. A. B. Hunter, Davis Riley and A. L. Phillips are members of the committee.

Citizens of New Madrid, Mo., are considering a project for building levees. Three plans are proposed: One to unite with the St. John Levee District, which adjoins this city; another to join the Little River Drainage District, and the third to organize a New Madrid District. The first two districts are already organized. The St. John District will contain 110,000 acres, with benefits amounting to $3,000,000, and the levee will cost $1,020,000, of which it is believed the government will pay $750,000. The New Madrid District would protect 2,000 acres and cost about $200,000. It is proposed to build a levee from the high bank below this city along the river to the St. John's Bayou bank, thence along or near the bank to the high ground near Farrenburg, a distance of 12 miles. H. C. Riley is chairman of the committee.

New Jersey.

Bids as follows were received April 18 by Col. Wm. T. Rossell, U. S. Engineer, New York City, for (1) dredging in Woodbridge Creek, N. J., (2) dredging in Matawan Creek, N. J., (3) in Shoal Harbor and Compton Creek, N. J., (4) in Shrewsbury River, N. J.: John & Joseph McSpirit, 118 Wayne St., Jersey City, N. J., (1) 39 cts., (2) 43 cts.; John H. Gerrish, 81 New St., New York, N. Y., (2) 52 cts., (3) 68 cts.; Miller & Field Co., 68 Grand St., Newburgh, N. Y., (4) 40 cts.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

New York.

The Sinking Fund Commission of New York City has approved the plan submitted by Dock Commissioner R. A. C. Smith, Pier A, Battery Pl., New York, for the improvement of the North River front between West 44th and 48th Sts. Under the plan the city will build at once a pier 1,000 ft. long at the foot of West 46th St., at an estimated cost of $2,735,000. The Mayor set May 21 as the date for a public hearing on condemnation proceedings.

North Carolina.

Bids as follows were received April 25 by Maj. H. W. Stickle, U. S. Engineer, Wilmington, N. C., for furnishing crushed stone or gravel, (1) being bid of Harris Granite Quarries, Salisbury, N. C., for material on cars at Wilmington; (2) bid of North Carolina Granite Corp., Mt. Airy, N. C., for material on cars at Wilmington.

	(1) Per ton.	(2) Per ton.
8,700 tons, ¼x2½ ins.	$1.80	$1.80
6,200 tons, ¼x1½ ins.	2.00	1.90
1,100 tons, ⅛x ¾ ins.	2.30	2.30
Total	$30,590	$29,970

Ohio.

All bids received April 15 by Williams & Patterson, 118 East Mill St., Athens, O., for the construction of a 9-ft. dam across the Hocking River, at mill site known as Barth's Mill, with fore bay wheel house and all necessary connections and appliances suitable for milling purposes, have been rejected. The plans are to be changed, after which the work will be readvertised.

No satisfactory bid was received on April 17 by R. M. Pillmore, Director of Public Service, Akron, O., for Contract 24, for the Cuyahoga River Dam.

The following bids were received April 15, by Maj. L. H. Rand, U. S. Engineer, Cincinnati, O., for reconstructing, in concrete, the top of Dam No. 4, Muskingum River, and strengthening its foundation: (1) standing for J. A. Swingle Contracting Co., Zanesville, O.; (2) G. T. Fogle & Co., St. Albans, W. Va.; (3) Newton Engineering Co., Milwaukee, Wis.:

	(1).	(2).	(3).
Excavation, 4,700 cu. yds.	$ 0.95	$ 0.90	$ 2.50
Concrete, 1,900 cu. yds.	5.95	4.70	7.00
Piling, 6,480 lin. ft.	0.45	0.40	0.75
Timber (driving sheet piling), 77,000 ft., B. M.	40.00	18.00	40.00
Grand totals	$39,616	$31,238	$53,990

Oregon.

✣Bids will be received until 11 a. m., May 15, by Major J. F. McIndoe, U. S. Engineer, Portland, Ore., for the furnishing and delivering of stone for jetty construction, mouth of Columbia River, Ore., and Washington.

Pennsylvania.

The American Dredging Co., Philadelphia, Pa., was the only bidder April 26 for dredging at U. S. Navy Yard, Philadelphia, for the Bureau of Yards and Docks. Its bid was 24½ cts. per cu. yd., totaling $18,750.

Pennsylvania.

✣Bids will be received until noon (Eastern time), May 21, by Francis R. Shunk, U. S. Engineer, Pittsburgh, Pa., for building a fireproof power house, furnishing and installing one 115-HP. boiler, one 15-HP. boiler, one steam-driven air compressor and two air receivers, piping, and accessories, and furnishing one feed-water heater, one feed-water pump, and one service-water pump at each of dams Nos. 7 and 9, Ohio River.

Texas.

Plans are being drawn for a dry dock to be constructed at Texas City for the Steele Dry Dock Co. An expenditure of about $200,000 is proposed. J. H. W. Steele, Galveston, Tex., is interested.

Virginia.

✣Bids will be received until noon, June 2, by Lieut. Col. Evaleth Winslow, U. S. Engineer, Norfolk, Va., for constructing and delivering three motor survey cruisers.

⊙King Lumber Co., Charlotteville, Va., has been awarded the contract at $45,930 for construction of U. S. Post Office at Beloit, Kan.

⊙Tom Lovell's Sons, Enid, Okla., has been awarded the contract at $58,000 for constructing U. S. Post Office at Ottawa, Kan.

The only bidder for furnishing and delivering two wooden quarterboats, proposals for which were opened at U. S. Engineer's office, Room 2, Custom House, Norfolk, Va., April 26, 1913, was that of Smith & McCoy, of Norfolk, Va., for $5,865.98 each, or a total of $11,731,96.

Bids as follows were received May 1, by Lt. Col. Evelett Winslow, U. S. Engineer, Norfolk, Va., for dredging Thimble Shoal; approximate quantity, 450,000 cu. yds.: Coastwise Dredging Co., Norfolk, Va., 17.85 cts.; Maryland Dredging & Contracting Co., Baltimore, Md., 17.3 cts.

Bids as follows were received by Lt. Col. L. Eveleth Winslow, U. S. Engineer, Norfolk, Va., for removal of wreck of the whaleback barge Bangor, sunk in Hampton Roads, Va., (1) being bid for removal of wreck bodily, (2) bid for removal of wreck by use of explosives and raising pieces, (3) for removal of wreck by sinking it into the bottom so that the depth after it is sunk will be 40 ft: W. H. French, Norfolk, Va., (2) $8,235; Coastwise Dredging Co., Norfolk, Va., (3) $6,950; King & Wotherspoon, Inc., 149 Broadway, New York, N. Y., (1) $15,000, (2) $12,000; Johnston & Virden, Lewes, Del., (2) $11,900.

Washington.

Bids will be taken in the near future for reconstructing the Elwah dam of the Olympia Power Co. of Port Angeles, Wash., recently carried away by flood. The new dam will be 200 ft. high and 400 ft. long, of concrete construction. The work includes a 16 by 20 by 400 tunnel through solid rock. An expenditure of about $500,000 is proposed. Daniel W. Mead, Madison, Wis., is Consulting Engineer.

Canada.

⊙William English, Kaslo, B. C., has been awarded a contract at $7,250 for constructing a wharf at Willow Point, B. C., for the Canadian Government.

⊙The Canadian Government has awarded contracts as follows for the Prince Edward Island car ferry piers: Halifax Dredging Co., Halifax, N. S., at $799,495 for piers at Craleton Point; Albert Mackie, Toronto, Ont., at $571,591 for piers at Cape Tormentine.

✣Bids will be received until noon, May 28, by Toronto Harbor Commissioners, A. C. Lewis, Secy., Toronto, Ont., for the removal of approximately 35,000,000 cu. yds. of material by hydraulic dredging. Borings indicate 70 per cent of material to be sand and gravel, thirty per cent mixture of sand, silt and clay. Each dredge must be capable of handling at least 600 cu. yds per hour at maximum length of discharge.

From source of supply to point of discharge maximum distance is about 6,000 ft. Average length of delivery required about 4,000 ft. Direct line of discharge referred, but consideration will be given to work being done in series or by relays. Day and night operation required. Borings, plans and specifications, tender forms, etc., and general information relating to the work can be seen at the Engineering Department of the Commission, 76 Adelaide St. West. Communications relative thereto to be addressed to E. L. Cousins, Chief Engineer. Official advertisement will be found elsewhere in this issue.

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✣ indicates work now open for bids. ⊙ indicates a contract let recently.

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The Limitations of Mud or Silt as a Material for Fills.

In California a very high earth dam with a concrete core has been under construction for several years, and is yet far from completion. The earth is a silt that has been "sluiced" into place. It is of such a character that once wet it drains dry with exceeding slowness. The down stream side of the fill has drained out more rapidly than the upstream side, resulting in unequal pressure on the core-wall, which has been cracked and badly displaced.

The unfitness of certain silts for embankment purposes is again pointed out in a recent report by Mr. Charles W. Staniford, Chief Engineer, Department of Docks and Ferries of New York City. Mr. Staniford says that the mud dredged from the Hudson River is utterly worthless for "making land." Several bulkheads have been destroyed by the pressure of dredged mud filling behind them. In one instance a million yards of such fill had to be re-excavated and taken out to sea, for it failed to afford sufficient support for a railway yard.

Is it not possible that such mud could be successfully used for fills if drain pipes were placed in the body of the fill?

Pernicious "Full Crew Bills."

Two years ago the legislature of the state of Washington made itself ridiculous by passing a bill that compels the railways to man every train with a "full crew." The states of New York and New Jersey have just enacted similar laws. Yet in each of these states there is a public service commission whose function it is to "regulate" the common carriers. If legislators aim to bring regulation of public utilities into popular contempt, there is no surer method than to pass regulating laws that have not received the endorsement of public service commissions. We have yet to hear of a "full crew bill" that has received the approval of such a commission.

The plain facts are that the railway labor unions are responsible for these bills, and that the elective law making bodies of the states rarely have courage enough to reject a measure that is strongly supported by labor unions.

The Supreme Court has declared a railway rate-making law void because its effect would be confiscatory. It would seem that a law that will cause a useless expenditure of $2,500,000 annually in New York and New Jersey, merely to provide "full crews," serves to confiscate $50,000,000 quite as effectually as if that amount of railway capital were siezed outright and wrested from its owners.

Pure Water as a Revenue Producer.

That water should be pure for hygienic reasons is common knowledge. For that reason the statement in technical literature that a water supply should be pure and wholesome usually impresses one as superfluous. However, the fact that pure water is an asset of a water department, and can be made the basis of an advertising campaign for the purpose of increasing the business and earnings of the department, is very generally overlooked by water works officials. Two illustrations will be given to show the value of pure water as a revenue producer.

Engineers in estimating the probable changes in the annual receipts and expenditures of water works systems following the adoption of filtration often fail to assign proper weight to the fact that filtration adds many new consumers per mile of main. This fact is well shown by a reference to two Ohio cities of about the same population, having the same general class of population. The two towns draw their supplies from the same river. The supply of one town has been filtered for some years past. In that town there are 74 consumers per mile of mains. In the other city filtration works were only very recently installed. At the time of adoption of filtration by the second city there were only 43 consumers per mile of mains. Moreover, the length of mains in the first town exceeded that in the second by 10 miles.

An interesting example of how a community can be educated up to a proper appreciation of a pure water supply occurred in a town in southern Kansas a few years ago. The original water system was owned by a private company. The supply was pumped from a river which was seriously contaminated by the town's sewage. Analyses showed a large bacteria count and the presence of coli. In addition to the poor quality of the supply the pressure maintained was inadequate for fire protection purposes. The officials of the company refused to improve the service in either particular. At length the plant was appraised by experts and the city offered to purchase the water works properties at the figure fixed by the expert's valuation report. The company held out for a much larger figure based on a big earning capacity and intangible assets. The city then voted bonds for independent works, including a filtration plant, and after the usual legal delays the works were ready for operation.

The company made its last stand when the time came for changing over the service connections from the private to the public mains, and, as a war measure, offered its water free. The consumers were slow to make a change under those circumstances and for several months the city water was not purchased by the consumers. Then a pure water campaign was launched. In parallel columns, in the daily papers, comparative analyses of the two waters were published. Also at the new filtration plant a filter operator gave daily demonstrations of the manner in which the city water was purified. This educational scheme accomplished the result desired by the city officials Within five months the city plant had the consumers and the revenue. The impure water was no longer wanted, even when furnished gratis.

The foregoing illustration must not be regarded as an editorial jibe at private water plants, or as an argument for municipal ownership of such utilities. The editors fully realize that there are good and bad plants under either form of ownership. The illustration is intended to show the value of pure water as a business getter, and the possibilities of turning individuals away from a polluted supply by a legitimate advertising of the purity of the public supply and of the impurity of other supplies in cases where such impure supplies are utilized by a portion of a city's population.

Cases like that which existed in the Kansas town, where there were two complete competing water systems, are exceedingly rare. However, the same choice between pure and impure water is still only too freely offered to the citizens of many towns. The common occurrence of this selective process lies in the choice between surface wells, which receive the run-off of back yards, and the wholesome public water supply. In a great many cities surface well waters are used by a very large part of the city's population.

The point which we wish to urge upon owners and officials of water systems is their opportunity to secure much new business by getting people to abandon shallow wells in favor of the public supply. To accomplish this end expeditiously, advertising is necessary. The advertising need not be of an expensive kind. One of the best advertisers in the water works business at the present time, the president of a private company, has secured many new consumers by displaying a few freehand cross sectional sketches of a typical shallow well in his city, the soil conditions surrounding the well, and the manner in which grossly polluted surface water can readily enter it. These sketches are posted in places where they will attract attention. This method is easily and effectually supplemented by published analyses of the city supply, properly interpreted, and of the water drawn from the surface well. In addition there are many statistics readily available which show that about half the well waters examined by state experts are pronounced dangerous.

Educational work of this character is being done, of course, through many agencies. Still, much better results will follow some such intensive local campaign as that which we have here suggested. It is a legitimate business proposition for the water works man as well as a public health problem in which he has much moral responsibility.

Engineers as Members of Public Service Commissions.

This journal was one of the first to urge the appointment of engineers as members of public service commissions. Colorado, Indiana and Missouri are about to join the ranks of the progressive states that have commissions of this sort, and it seems probable that Pennsylvania will also be one of the group. Engineers in those states should act concertedly in an effort to secure the appointment of at least one engineer in each utility commission.

All of the three members of the new Maine public service commission are attorneys. Yet, for every ounce of law involved in regulating the rates and service of public service companies there is a pound of engineering. Neither the public nor governors of states know this to be a fact. It rests with members of the engineering profession to produce evidence and argument in support of the selection of engineers as members of these supremely important commissions.

A Cost-Saving Kink In Tunneling.

The progress of a tunnel heading depends largely upon the rapidity with which the "muck" is cleared away from the face after a blast. Mr. J. H. Graham recently described in "Engineering Record" the following method of expediting such work:

After the "cut shots" and "side shots" had been fired, and before shooting the "roof shot," a "muck shot" was prepared. This consisted of eight sticks of 60 per cent giant gelatine, placed against the face immediately under the "roof shot," and covered with sand. In one of these eight sticks was placed a "delayed electric exploder," which was connected with the roof holes, and exploded a second after the "roof shot" went off. The rock from the roof holes would drop vertically upon the "muck shot," which would then go off and hurl the muck away from the face. In this way the immediate face of the heading was cleared of muck, and one hour was saved in making room to set up the columns for the next round of holes.

GENERAL ARTICLES

Cost and Service Comparisons of Motor Trucks and Horse Drawn Vehicles.

A notably well considered comparison of the speed, convenience, reliability and cost of operation of motor trucks with horse drawn vehicles is given by Mr. Clinton Brettell, Truck Sales Department, Locomobile Company of America, in the April issue of "The School of Mines Quarterly," Columbia University. We abstract this article as follows:

There are several ways of making a cost comparison. One is to reduce all costs to a "per day" basis. This method is of little value, for while the motor truck costs more per day, it also does more work per day. Then there is the "cost per mile" basis. This is a little better, but also shows but one phase of the question, as no account is taken of the tonnage moved. The third method, and the best one, considered from all sides, is the "cost per ton-mile." This is the method which will be employed in practically all cases throughout this paper. Data on the subject of transportation costs are abundant, but so many methods of bookkeeping and computation are used that it is not safe to accept any of them off-hand. Before adopting them for comparisons they should be carefully analyzed.

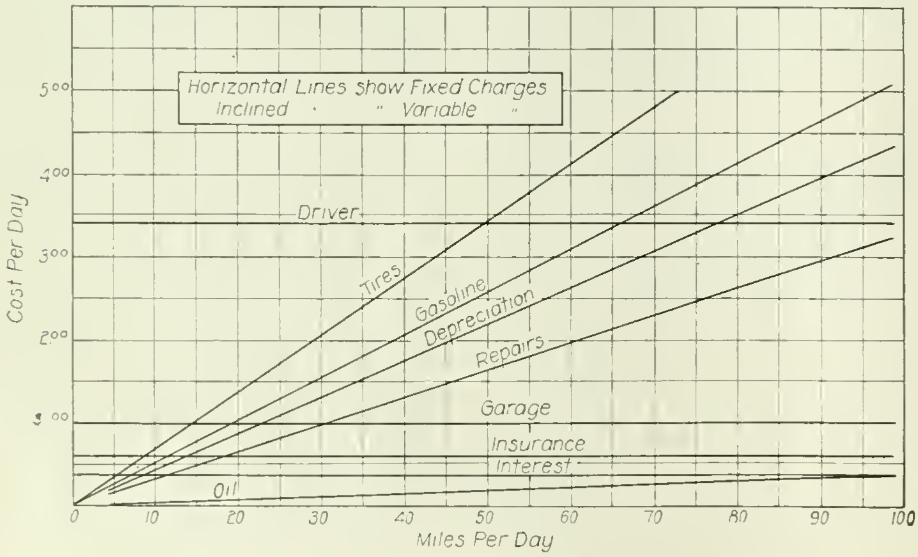

Fig. 1—Estimated Daily Cost of Operation of Five-Ton Gasoline Truck Subdivided Into Its Various Items.

Motor Trucking.

To be accurate, the cost of operation for motor trucks should include the following items:

I. FIXED CHARGES.

Based on an average number of working days. A figure of 300 working days per year is often used, and approximates quite closely the actual working days for the average case.

A. Driver's Wages.—About $20 per week is a fair charge for this item

B. Garage.—If the truck is stored in a public garage, about $25 per month is charged. This includes washing, polishing, inspection, heat, light, power, etc. If the owner maintains his own garage, this figure may be somewhat lower. In that case the charge for storage, to compare with the above, would be made up as follows: (*a*) Interest on investment, including building, property and equipment. (*b*) Insurance and taxes on same. (If the building is rented, the above, i. e., interest on investment, insurance and taxes on building, and an additional charge for depreciation on building would all be included in one item, rent. (*c*) Depreciation on building and equipment, if owned by truck owner; on equipment only, if building is rented. (*d*) Wages of attendants, elevator men, washers and polishers, inspectors, superintendent or foreman. (*e*) Charges for heat, light and power. (*f*) Charges for maintenance of building and equipment.

C. Insurance.—Fire, liability, theft, property damage. These rates vary all over the country. As a rule they are unreasonably high. In most cases the same rates as for pleasure cars are applied to commercial vehicles, without taking account of the lessened liability with slow moving motor trucks. Insurance against fire and theft is generally at some percentage on a partial valuation, say, 2¼ per cent on 80 per cent valuation. Insurance against property damage depends on the horsepower of the truck and is arranged on a sliding scale basis, which is arbitrarily adopted without scientific basis. Liability is usually a flat sum, being greater the more hazardous the occupation. This item should also include taxes for licenses, etc.

D. Interest.—Opinion differs as to what rate of interest to use. One common method is to assume as a basis the rate offered by banks. Whatever the rate finally adopted, it is well to recognize that there is a regular depreciation in the amount of capital invested; so that while interest for the first year is

TABLE I.—ESTIMATED YEARLY COST OF OPERATING 5-TON GASOLINE TRUCK.

Investment: Chassis..... $4,800. Chassis, with stake body......$5,000.

Miles per day................		20	25	30	35	40	45	50	60	70
Miles per annum.............		6,000	7,500	9,000	10,500	12,000	13,500	15,000	18,000	21,000
Fixed charges:	Cost per day.									
Driver	**$3.466**	$1,040.	$1,040.	$1,040.	$1,040.	$1,040.	$1,040.	$1,040.	$1,040.	$1,040.
Garage	**1.000**	300.	300.	300.	300.	300.	300.	300.	300.	300.
Insurance	**.633**	190.	190.	190.	190.	190.	190.	190.	190.	190.
Interest	**.416**	125.	125.	125.	125.	125.	125.	125.	125.	125.
Total fixed charges.......	**$5.515**	$1,655.	$1,655.	$1,655.	$1,655.	$1,655.	$1,655.	$1,655.	$1,655.	$1,655.
Variable expenses:	Cost per mile.									
Depreciation	**.044**	267.	333.	400.	467.	534.	601.	668.	802.	934.
Tires	**.068**	405.	506.	607.	709.	810.	911.	1,012.	1,215.	1,418.
Repairs	**.033**	200.	250.	300.	350.	400.	450.	500.	600.	700.
Gasoline	**.051**	308.	386.	463.	540.	617.	694.	771.	925.	1,079.
Oil	**.004**	24.	30.	36.	42.	48.	54.	60.	72.	84.
Total variable expense....	.200	$1,205.	$1,505.	$1,806.	$2,108.	$2,409.	$2,710.	$3,011.	$3,614.	$4,215.
Total cost per annum....		2,860.	3,160.	3,461.	3,763.	4,064.	4,365.	4,666.	5,269.	5,870.
Total cost per day........		9.53	10.53	11.53	12.54	13.55	14.55	15.55	17.56	19.60
Total cost per mile.......		.476	.422	.384	.358	.339	.324	.311	.293	.280
Total cost per ton mile...		.190	.168	.154	.143	.136	.129	.124	.117	.112

Number of working days, 300.
Full load carried half way.
Driver, $20 per week.
Garage, $25 per month.
Insurance: Fire, 2¼ per cent of $4,000; liability, $100.
Interest: The interest charge represents the average yearly interest at 5 per cent on principal.
NOTE.—Mileage costs shown in boldface should not be used in figuring yearly costs under "Variable Expenses," as they are only carried out to three decimal places and are therefore only approximate. The variable expenses shown under the various mileages were worked on yearly totals.

Depreciation (less cost of tires): Life of truck figured at 100,000 miles.
Tires, $540 per set for 8,000 miles guaranteed by tire manufacturer.
Repairs, $500 per annum for daily mileage of 50 miles (or 15,000 miles per annum), exclusive of tires.
Gasoline, 18c per gallon (3.5 miles per gallon).
Oil, 40c per gallon (100 miles per gallon).
NOTE.—The above yearly cost of tires does not take into account the tires on the truck when delivered. Accordingly $540 should be deducted in estimating tire cost for first year.

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chargeable on practically full value, for the second year it should be on less than full value, for the third year on still less, and so on. The easiest way of taking account of this is to use an average rate of interest, assuming full capital first year and entire dissipation of capital at the end of, say, the tenth year. The average rate will then be ½ the flat rate decided on, say ½ of 5 per cent. This method charges too little interest for the first five years and too much for the last five, the one balancing the other in the final result.

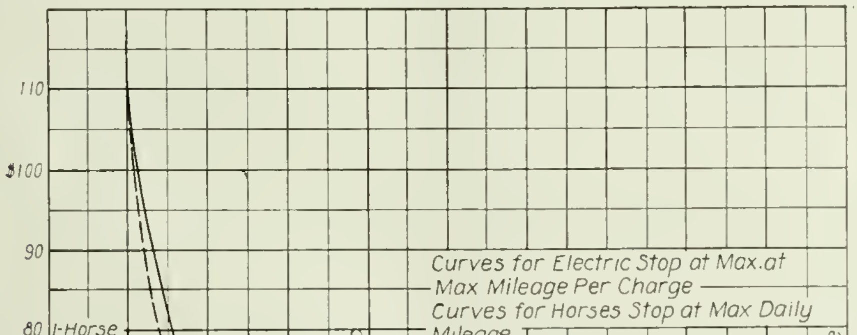


Fig. 2—Comparative Operating Costs of Gasoline, Electric and Horse Trucks.

II. VARIABLE OR MILEAGE CHARGES.

A. Depreciation.—To account for the gradual wearing out of the truck, even with the best possible care and maintenance, a certain amount must be charged off each year, so that at the end of the truck's life there will be a fund sufficient to purchase a new truck, identical with the old one. If a truck receives ordinary care and attention in the matter of upkeep, etc., and is not abused in operation, it will last as much as ten years before it is really worn out, and many will last longer.

(*a*) One method of charging depreciation, then, is to write off one-tenth the original value of the truck each year. Opinion differs as to the life, but under present conditions it is not wise to figure over ten years. Naturally a truck which is run 25 miles a day should last longer than one operated 100 miles a day, with equal care and attention in both cases. (*b*) This suggests a second method of charging depreciation, i. e., on a mileage basis, figuring the life of a truck at 100,000 miles under average conditions. The latter method seems the more logical one to follow, since in fixing the rate for the former method it was necessary to consider, among other things, the daily mileage of the truck. Cost per mile is thus equal to total cost divided by total mileage.

B. Tires.—The life of tires is subject to practically the same discussion as given in connection with depreciation. The method generally employed is as follows: The tire maker guarantees his tires for a certain mileage (provided that rated capacities of tires are not exceeded, and in some cases, that speeds are limited to certain specified values) usually around 8,000 miles. In addition, the time element is involved, because tires, being made of rubber, deteriorate even when standing idle. The tire maker covers this phase of the situation by stipulating (in most cases) that the guaranteed mileage must be covered within a given time usually 12 months, to validate the guarantee. Hence cost per mile equals cost per set of tires divided by guaranteed (or actual) mileage, as the case may be.

C. Repairs (exclusive of tires).—This includes labor and material (and profit if work is done in a public garage). It is generally figured on a yearly basis and then converted to a mileage rate, by determining the yearly mileage. For electric trucks, this item includes renewals of plates, electrolyte, etc.

D. Gasoline or Current.—Cost of current, motors, etc., and cost per kw.-hour. This cost is figured for a year and then reduced to a mileage basis. Cost of gasoline depends on the fuel consumption of the motor and the prevailing price of gasoline. It is best to figure this on a yearly basis and then reduce to a mileage basis. The same discussion applies to oil.

Summary.—The total of items under I gives total cost per day for fixed charges. Assuming a certain daily mileage, and multiplying the rates for the various items under II by this mileage, we get the daily cost for each item. Total of these gives total variable costs per day. Adding daily fixed charges and daily variable charges, we obtain total daily operating cost. Ton-miles per day is the product of the tonnage, by the distance this tonnage was carried. Dividing average cost per day by ton-miles per day, we obtain "Cost per Ton-mile" which is the final result sought. As an example of the foregoing, see Table I, which shows costs for a 5-ton gasoline truck, figured for various daily mileages, and Fig. 1 plotted from these figures.

TABLE II.—COSTS INCIDENT TO HORSE TRANSPORTATION, CHICAGO.

Commodity.	1871.	1881.	1891.	1901.	1906.	1911.	1912.
Corn, per bu	$0.39	$0.635	$0.59	$0.675	$0.46	$0.70	$0.90
Oats, per bu	.33	.468	.334	.483	.358	.474	.40
	1903.	1907.	1908.	1909.	1910.	1911.	1912.
Hay, per ton	$15.00	$21.50	$14.00	$17.00	$21.00	$25.00	$20.00

CHICAGO TRUCK DRIVERS' WAGES PER WEEK.

Type of wagon.	1902.	1904.	1906.	1909.	1910.	1912.
Single wagon—one horse	$11.00	$11.25	$11.25	$11.50	$12.00	$13.50
Single wagon—two horses	12.75	13.00	13.00	13.50	14.00	15.50
Double wagon—two horses	13.75	14.00	14.00	14.50	15.00	16.50
Double wagon—three horses	15.50	15.75	15.75	16.00	17.00	18.50
Double wagon—four horses	16.50	17.00	17.00	18.00	18.00	19.50
Double wagon—six horses	18.50	19.00	19.00	20.00	20.50	21.50

Overtime (year 1912), 30 cents per hour up to 8 p. m.

Horse Trucking.

Following out the same computation for horse drawn trucks, the costs would be determined as follows:

I. FIXED CHARGES.

A. Driver.—In case the driver's wages are paid by the week, it is best to figure this item on the basis of a year and then reduce it to a daily basis. For average figures at Chicago, see Table II.

B. Stable.—If a truck owner keeps a stable for his equipment the following items should be included in the cost account: (*a*) Feed, hay and straw, water and stable supplies. (*b*) Taxes, insurance, depreciation, interest; if the building is rented, rent includes all of these. (*c*) Light, heat and power. (*d*) Wages of stablemen, helpers, etc.; salary of manager.

If he boards his horses, a flat figure covers all of the above items. Record of costs should be kept for a year and then reduced to a daily basis by using the average days in service per year.

D. Interest.—The same methods are applied as in connection with motor trucking. Interest on horses and equipment (harness, wagons, blankets, etc.)

E. Insurance.—No insurance is carried, as a rule.

F. Veterinary and Medicine.—Charges for a year are reduced to daily basis.

II. VARIABLE CHARGES.

A. Depreciation. — Distinctly a mileage charge, as horses are worn out much quicker by working long hours, and constantly, than by giving them plenty of rest. Under average conditions, horses are unfit for heavy trucking after more than a few years' service. Life of wagons, while somewhat longer, depends on the amount of service; also on nature of service and care as to upkeep. Yearly mileage under average conditions is based on average number of working days, and an average daily mileage (not over 18 miles for light work, considerably less for heavy work). The original cost must thus be divided over the total mileage for the working life of the horse. Cost of wagon is distributed in same way. This gives cost per mile.

B. Repairs.—Repairs on harness and wagons, painting, etc., are figured for a year and then reduced to a mileage basis by applying the total yearly mileage. For any given daily mileage, find total mileage cost per day. Then sum of fixed and variable charges gives total cost per day. Dividing by ton-miles per day gives the final result, cost per ton-mile. The curves shown in Fig. 2 give quite accurately the ton-mile costs for various capacities of trucks, gasoline, electric and horse drawn, figured for various mileages. Table III shows another method of keeping the cost records for two-horse and three-horse wagons. The final result is cost per ton-mile.

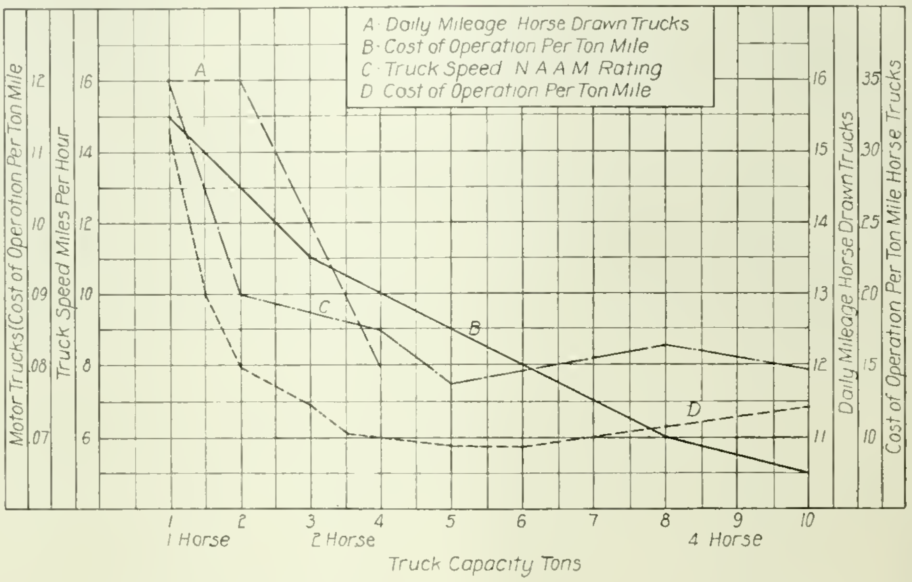


Fig. 3—Comparative Operating Costs of Motor and Horse Trucks.

Comparative Economies.

The costs of horse transportation were calculated as follows: A one-horse truck with driver can be hired for $4 per day. Its maximum daily mileage would be 22 miles and its maximum capacity 1 ton. Hence, ton-miles per day (full load half way) = ½ × 22 × 1 = 11; and cost per ton-mile = $4.00 ÷ 11 = $0.364. Similarly:

Two-horse truck with driver, per day	$6.00
Maximum daily mileage, miles	20
Maximum capacity, tons	3
Maximum ton-miles per day = ½ × 20 × 3 =	30
Cost per ton-mile = $6.00 ÷ 30 =	$0.20
Three-horse truck with driver, per day	$8.00
Maximum daily mileage, miles	18
Maximum capacity, tons	5
Maximum ton-miles per day = ½ × 18 × 5 =	45
Cost per ton-mile = $8.00 ÷ 45 =	$0.178

These are the extreme points for the three curves. For lower mileages, the costs will be higher. The daily mileages given are much higher than would be obtained under average operating conditions. Hence, in most cases, the costs would be found further up on the curves.

The figures from which curves in Fig. 2 were plotted, for gasoline trucks, are from figures given in a table (see Table IV) published in "Commercial Car Journal," Feb. 15,

TABLE III.—COST OF OPERATING HORSE WAGONS.
(On basis of five years' operation; loaded both ways.)

Two-horse wagon—

Price of open express-body wagon	$300.00
Price of two horses	400.00
Price of double set harness	75.00
Total cost of equipment	$775.00
Working days	300
Average miles per day	20
Load in pounds	8,000

Three-horse wagon—

Price of open wagon	$ 375.00
Price of three horses	750.00
Price of harness	100.00
Total cost of equipment	$1,225.00
Working days	300
Average miles per day	18
Load in pounds	12,000

Items.	Per year.	Per working day.	Per mile.	Per ton mile.	Per cent.	Per year.	Per working day.	Per mile.	Per ton mile.	Per cent.
Wagon expense—										
Maintenance, grease, repairs, etc	$ 125.00	$0.417	$0.0208	$0.0052	6.94	$ 125.00	$0.417	$0.0232	$0.0039	5.20
Depreciation, 10 per cent	30.00	.100	.0050	.0012	1.66	37.50	.125	.0007	.0011	1.56
Rental value of space	25.00	.084	.0042	.0010	1.38	30.00	.100	.0056	.0009	1.25
Horse expense—										
Depreciation, 15 per cent	60.00	.200	.0100	.0025	3.33	112.00	.374	.0208	.0035	4.66
Ratio that die, 1 in 20	10.00	.433	.0016	.0004	.56	10.00	.033	.0018	.0003	.42
Feed and bedding	360.00	1.200	.0600	.0150	20.00	550.00	1.834	.1019	.0169	22.91
Care (hostler)	100.00	.333	.0168	.0042	5.57	150.00	.500	.0278	.0046	6.25
Veterinary	15.00	.050	.0026	.0007	.84	20.00	.066	.0036	.0006	.83
Medicine	10.00	.033	..0016	.0004	.56	15.00	.050	.0028	.0004	.63
Rental value, space for horses	125.00	.417	.0208	.0052	6.94	150.00	.500	.0278	.0046	6.25
Shoeing	50.00	.167	.0083	.0021	2.78	75.00	.250	.0139	.0023	3.13
Water	10.00	.033	.0016	.0004	.56	15.00	.050	.0028	.0004	.63
Blankets	8.00	.026	.0014	.0004	.45	12.00	.040	.0022	.0004	.50
Deterioration to building caused by horses	16.00	.053	.0027	.0007	.89	25.00	.084	.0046	.0007	1.05
Rental value of space for storing feed	12.00	.040	.0020	.0005	.66	15.00	.050	.0028	.0005	.63
Harness expense—										
Depreciation	7.50	.025	.0012	.0003	.41	12.00	.040	.0022	.0004	.50
Maintenance and repairs	10.00	.033	.0016	.0004	.56	20.00	.066	.0036	.0006	.83
Rental value of space	5.00	.017	.0008	.0002	.28	8.00	.027	.0015	.0003	.33
General—										
Interest on investment	46.50	.155	.0077	.0019	2.58	73.50	.245	.0136	.0024	3.06
Driver's wages	750.00	2.500	.1250	.0313	41.66	900.00	3.000	.1666	.0278	37.50
Stable supplies	15.00	.050	.0025	.0006	.83	25.00	.084	.0046	.0007	1.05
Removing manure	10.00	.033	.0016	.0004	.56	20.00	.066	.0036	.0006	.83
	$1,800.00	$5.999	$0.2998	$0.0750	100.	$2,400.00	$8.001	$0.4380	$0.0739	100.

1912, and are averages taken over a number of years, from records of trucks in actual service. They are based on the assumption that full load is carried half way.

TABLE IV.—COST OF OPERATING 1, 3 AND 5-TON GASOLINE TRUCK.*

Average Expense of Operating Commercial Cars, Compiled from Records of Trucks in Service.

Fixed Expenses.		Operating Expenses.	15 miles per day; 4,500 miles per yr.	20 miles per day; 6,000 miles per yr.	30 miles per day; 9,000 miles per yr.	40 miles per day; 12,000 miles per yr.	50 miles per day; 15,000 miles per yr.	60 miles per day; 18,000 miles per yr.	70 miles per day; 21,000 miles per yr.
One-ton Truck.									
Dep. on $2,000 at 20% for 5 years.	$1.3030	Gasoline at 15 cts.; 12 miles to gal.; .0125 per mile	.1875	.2500	.3750	.5000	.6250	.7500	.8750
Interest at 6%	.4000	Oil at 30 cts.; 125 miles to gal.; .0024 per mile	.0360	.0480	.0720	.0960	.1200	.1440	.1680
Insurance	.1600	Grease and supplies, .002 per mile	.0300	.0400	.0600	.0800	.1000	.1200	.1400
Garage	.8000	Parts, renewals and painting, .0125 per mile	.1875	.2500	.3750	.5000	.6250	.7500	.8750
		Tires, .0111 per mile	.1665	.2220	.3330	.4440	.5550	.6660	.7770
Total per day	$2.6630	Driver, $2.50 per day	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000
		Fixed expenses	2.6630	2.6630	2.6630	2.6630	2.6630	2.6630	2.6630
		Total per day	5.7205	5.9730	6.3780	6.7830	7.1880	7.5930	7.9980
		Total per mile	.3813	.2986	.2126	.1695	.1437	.1265	.1142
		Total per ton-mile	.3813	.2986	.2126	.1695	.1437	.1265	.1112
Three-ton Truck.									
Dep. on $3,500 at 20% for 5 years.	$2.3333	Gasoline at 15 cts.; 6½ miles to gal.; .0232 per mile.	.3480	.4640	.6960	.9280	1.1600	1.3920	1.6240
Interest at 6%	.7000	Oil at 30 cts.; 75 miles to gal.; .0040 per mile	.0600	.0800	.1200	.1600	.2000	.2400	.2800
Insurance	.2800	Grease and supplies, .002 per mile	.0300	.0400	.0600	.0800	.1000	.1200	.1400
Garage	.8000	Parts, renewals and painting, .0022 per mile	.3330	.4440	.6660	.8880	1.1100	1.3320	1.5540
		Tires, .0370 per mile	.5550	.7400	1.1100	1.4800	1.8500	2.2200	2.5900
Total per day	$4.1133	Driver, $2.50 per day	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000
		Fixed expenses	4.1133	4.1133	4.1133	4.1133	4.1133	4.1133	4.1133
		Total per day	7.9393	8.3813	9.2653	10.1493	11.0333	11.6103	12.8213
		Total per mile	.5292	.4140	.3088	.2572	.2206	.1935	.1831
		Total per ton-mile	.1764	.1380	.1029	.0857	.0735	.0645	.0610
Five-ton Truck.									
Dep. on $4,500 at 20% for 5 years.	$3.0000	Gasoline at 15 cts.; 4 miles to gal.; .0375 per mile	.5625	.7500	1.1250	1.5000	1.8750	2.2500	2.6250
Interest at 6%	.9000	Oil at 30 cts.; 40 miles to gal.; .0075 per mile	.1125	.1500	.2250	.3000	.3750	.4500	.5250
Insurance	.3600	Grease and supplies, .002 per mile	.0300	.0400	.0600	.0800	.1000	.1200	.1400
Garage	.8000	Parts, renewals and painting, .0292 per mile	.4380	.5840	.8760	1.1680	1.4600	1.7520	2.0440
		Tires, .0583 per mile	.8745	1.1660	1.7490	2.3320	2.9150	3.4980	4.0810
Total per day	$5.0600	Driver, $2.50 per day	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000
		Fixed expenses	5.0600	5.0600	5.0600	5.0600	5.0600	5.0600	5.0600
		Total per day	9.5775	10.2500	11.5950	12.9400	14.2850	15.6300	16.9750
		Total per mile	.6385	.5125	.3865	.3235	.2857	.2605	.2425
		Total per ton-mile	.1277	.1025	.0773	.0647	.0571	.0521	.0485

Note.—Load carried full distance. For figures relating to intermediate, and longer distances, refer to the original paper. Costs per ton-mile plotted on Charts II and IV are for load carried half-distance; hence they are double those shown in this table.

*The Commercial Car Journal, Feb. 15, 1912.

The figures for electric trucks of from 1 to 5 tons' capacity (see Table V) were taken from a table published in February, 1912, by the Commonwealth Edison Co. of Chicago, a company operating a large force of electrics and supplying current to many others. Both these tables are thus from reliable sources.

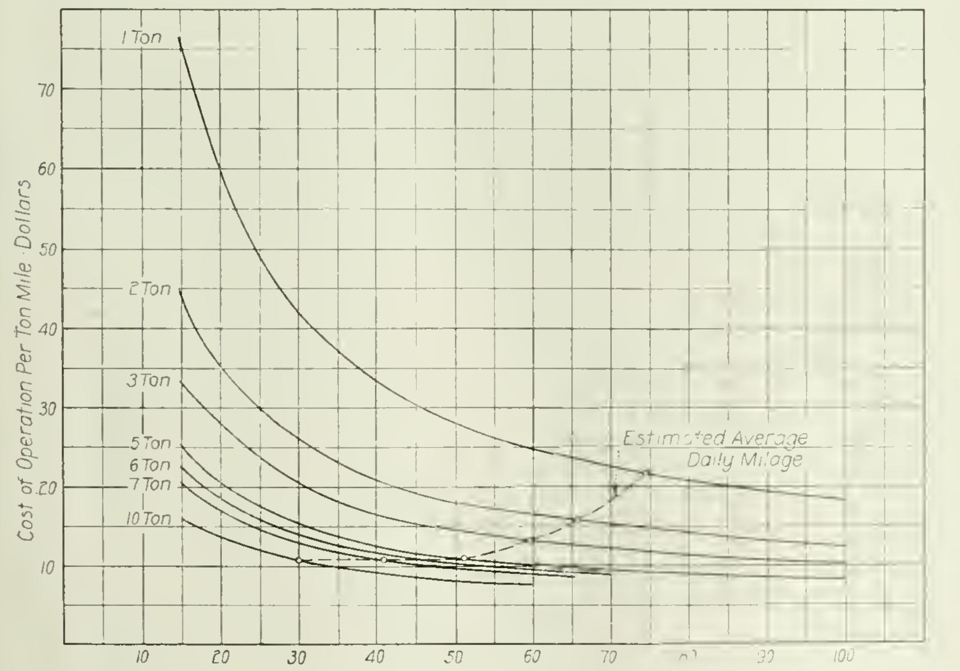


Fig. 4—Cost of Operation per Ton-Mile for Average Conditions, Various Truck Capacities and Daily Milages.

In Fig. 3 is given another set of curves showing: (1) Horse-haulage costs collected by the National Association of Automobile Manufacturers, from professional truckmen. (2) Probable daily mileages for horse-trucks of various capacities. These are the results of actual practice. (3) Motor-truck speeds recommended by N. A. A. M. for trucks of various capacities. These speeds have been determined after considering all sides of the question, so that depreciation will not be too rapid, due to excessive speeds. (4) The costs shown in this curve for the operation of gasoline trucks of various capacities were plotted from figures published by the Knox and the Hewitt automobile companies. Part of the figures are averages of the two, the remainder being either Knox or Hewitt costs alone.

In Fig. 2 truck capacities up to 5 tons were shown. In Fig. 4 additional curves are shown for capacities from 6 to 10 tons. The same rates of increase were maintained in figuring the unit costs in these trucks of larger capacity, the results being checked by estimating the various capacities. In addition, calculations were made, assuming average conditions as to running speeds and working hours, to determine what daily mileages trucks of these various capacities would accomplish under ordinary conditions. Results were compared with figures submitted by the N. A. A. M., and were found to check quite well. A curve was plotted from these values, between daily mileages and truck capacity, on the same sheet with the other curves. This curve cuts the cost curves, thereby marking out the working part of these curves for average conditions. The cost curves approach one another as capacity is increased; increase of daily costs begins to catch up to increase in daily ton-miles, so that it becomes less and less of an advantage to increase from one capacity to the next. This is true even when the mileages per day are kept constant. But in actual changing from seven to ten ton capacity there is practically no decrease in cost of hauling per ton mile.

Referring again to Fig. 2, we find that for low mileages, up to about 18 miles per day, the three-horse truck is the most economical means of transporting goods. This then is the field of usefulness of the horse-drawn vehicle, i. e., where traffic loading, unloading or other conditions are such that the conveyance is forced to remain idle a considerable portion of the day and would therefore be un-economical. Realizing the truth of this argument, the truck manufacturer is designing loading and unloading devices, by the use of which standing time is reduced to a minimum, and the motor truck is thus able to cope successfully with the horse, even in this short haul work. To reduce loading time, several means are resorted to, depending on the nature of the product to be transported. For building materials, coal, etc., cranes, scoops and other mechanical loading devices are employed with great success. For general merchandise, bodies made up of several units are used. For unloading, the bodies are made to dump either by power or by hand. Where removable units are employed, these are removed by cranes or trolleys.

One company has brought out an arrangement which combines both the dumping and removable-body features. By means of several such bodies, the truck is enabled to keep in motion a large portion of the day, stopping only long enough to slide off an empty body and pick up a full one, the time required for the entire operation not exceeding five minutes. Loading and unloading can then be carried on as leisurely as the nature of the product or the rate at which it is delivered to shipping room may demand, without in any way delaying the truck. If the material can be unloaded by dumping, this can be easily accomplished and in considerably less than five minutes. The operating time of the truck can thus be increased from less than half the working day to over three-quarters, with corresponding gain in economy. It is also possible to have several different types of bodies for one chassis, thus economizing in first cost.

TABLE V.—COST OF OPERATING ELECTRIC VEHICLES.

(As published in February, 1912, by the Commonwealth Edison Company of Chicago.)

Item.	1,000-Pound Wagon. Mileage per annum—10,500.			2,000-Pound Wagon. Mileage per annum—10,140.			2-Ton Truck. Mileage per annum—9,390.			5-Ton Truck. Mileage per annum—7,200.		
	Per annum.	Per day.	Per mile.	Per annum.	Per day.	Per mile.	Per annum.	Per day.	Per mile.	Per annum.	Per day.	Per mile.
Fixed Charges—												
Amortization	$ 220.00	$0.7333	$0.0210	$ 265.00	$0.8833	$0.0262	$ 340.00	$1.1333	$0.0362	$ 450.00	$1.5000	$0.0625
Interest	66.00	.2200	.0063	79.00	.2633	.0078	102.00	.3400	.0109	135.00	.4500	.0188
Fire insurance	22.00	.0733	.0021	26.50	.0883	.0026	34.00	.1133	.0036	45.00	.1500	.0062
Liability insurance	100.00	.3333	.2095	100.00	.3333	.0008	100.00	.3333	.0106	100.00	.3330	.0139
Total	$ 408.00	$1.360	$0.0389	$ 470.50	$1.568	$0.0464	$ 576.00	$1.920	$0.0613	$ 730.00	$2.433	$0.1014
Renewal Charges—												
Batteries	$ 187.00	$0.6233	$0.0178	$ 221.00	$0.7367	$0.0218	$ 289.00	$0.9633	$0.0308	$ 425.00	$1.4167	$0.0590
Tires	145.60	.4853	.0138	216.30	.7210	.0214	286.60	.9553	.0305	618.80	2.0627	.0859
Chains	25.20	.0840	.0024	32.30	.1077	.0032	37.90	.1263	.0040	58.10	.1936	.0081
Gears and sprockets	46.00	.1534	.0044	54.00	.1800	.0053	59.05	.1964	.0063	79.40	.2646	.0110
Bearings	22.65	.0755	.0022	25.55	.0851	.0025	30.35	.1011	.0032	43.15	.1439	.0060
All other parts	30.00	.1000	.0029	35.00	.1167	.0034	40.00	.1333	.0043	50.00	.1667	.0069
Total	$ 456.45	$1.522	$0.0435	$ 584.15	$1.947	$0.0576	$ 742.90	$2.476	$0.0791	$1,274.45	$4.248	$0.1769
Garage Charges—												
Electric power	$ 122.35	$0.4078	$0.0116	$ 152.10	$0.5070	$0.0150	$ 218.80	$0.7293	$0.0232	$ 330.50	$1.1016	$0.0459
Rent, light and heat	88.00	.2934	.0084	109.05	.3635	.0107	136.15	.4537	.0145	164.05	.5469	.0228
Garage labor	232.00	.7733	.0221	232.00	.7733	.0229	232.00	.7733	.0247	232.00	.7733	.0322
Total	$ 442.35	$1.475	$0.0421	$ 493.15	$1.644	$0.0486	$ 586.95	$1.956	$0.0624	$ 726.55	$2.422	$0.1009
Driver	750.00	2.500	.0715	750.00	2.500	.0738	750.00	2.500	.0798	750.00	2.500	.1042
Grand total	$2,056.80	$6.857	$0.1960	$2,297.80	$7.659	$0.2264	$2,655.85	$8.852	$0.2826	$3,481.00	$11.603	$0.4834

Note.—300 working days per year. For intermediate capacities, see original article in Power Wagon, February, 1912.

As an example of the economy introduced by motor trucks in transportation connected with engineering enterprises may be mentioned the case of the Bridgeport Hydraulic Co., engaged in the construction of a large dam 7 miles outside of Bridgeport, Conn. Horse drawn trucks were first considered as a means of transporting the materials to the dam, but on investigation it was found that in order to employ horses, the roads would have to be made over and, in one place, a hill cut down, with corresponding expense. In addition, the estimates on the cost of hauling showed about $0.35 per ton-mile, (1 team and driver, 2-ton load, 1 trip of 7 miles each way per day) as compared with $0.14 per ton-mile by motor trucks (4 trips per day at $0.89 per ton; 5 tons per trip of 7 miles). Naturally motor trucks were selected and the wisdom of the selection is manifest when the actual figures after over six months' operation show the cost to average about $0.10 per ton-mile, or $0.04 cheaper than the estimate. These trucks have never faltered in spite of the severe road conditions encountered. They have since been equipped with power mechanism for rolling onto the body a pipe 48 in. diameter by 13 ft. long, weighing 5 tons. Four trips per day are made to the dam, one pipe being carried each time, or four pipes per day moved. To do this same work, four teams of six horses each, with additional horses to assist on the hills would be required. A trailer has been designed to carry an additional pipe on each trip and will be used as soon as road conditions permit. In addition to the economy gained, it might be added that the condition of the roads traveled by only one motor truck with broad tires, making four trips per day, is far better than with four teams with narrow-tired wagons which cut into the road bed, especially in bad weather. This should stand as an example for contractors engaged in this kind of work.

Considerations Other Than Economy.

As a rule, the matter of economy is the only one considered in deciding on the relative merits of horse and motor transportation. As a matter of fact, this is only one of a number of factors that help to determine which system is, on the whole, the more desirable. To make a fair decision, we must consider and weigh each of the following: (1) Area in which business can be done; (2) Regularity of service; (3) Rush of business; (4) Quick delivery; (5) Advertisement.

1. *Increase of Business.*—The limit of 18 miles a day for a three-horse team is much greater than would be reached even under the most favorable conditions. Ordinarily 12 miles per day would be more nearly correct. This would raise the cost per ton-mile a corresponding amount. On the other hand, the motor truck is almost unlimited in its radius of action; 75 to 100 miles per day is as easy for the motor truck as it is impossible for the horse drawn truck. Thus it is plain to how great an extent business is cramped by adhering to the old fashioned horse and wagon. As an illustration, I would mention the case of a soda water manufacturer, of Hartford, Conn., who realized the advantages to be gained by pushing out his business into widely separated territories. He replaced his horse equipment by a 5-ton gasoline truck and then introduced his product into towns previously considered as belonging to other manufacturers, simply because Hartford seemed so far removed. The company in Hartford found that it could load a truck, send it to some city 20 or 30 miles distant, make deliveries there during the day, meanwhile picking up empty cases, and be back at the factory before nightfall. Naturally, this would have been utterly impossible with horse equipment. This is only one of many instances, records of which find their way into the trade journals from time to time.

2. *Regularity of Service.*—Weather conditions have little or no effect upon the motor truck. In former years, whenever extremes of weather were experienced, either as blizzards in winter, or excessive hot spells in summer, the horse was an object of pity, and transportation and delivery systems were correspondingly crippled. With the advent of the motor truck, the only limit placed upon its performance is the endurance of the driver. This feature appeals to the contractor who has an important job which must be finished at a certain time. He cannot afford to take chances on such delays in obtaining his materials as are common with horse trucks. Likewise the merchant, whose business depends to a great extent on the regularity with which he is able to make deliveries, finds in the motor truck a friend of no mean ability.

3. *Rush of Business.*—It is evident that by working the motor truck overtime, rush of business can be handled without interfering with regular deliveries. By employing two shifts of men, the truck can be kept going almost continuously, with only an occasional intermission for inspection and minor adjustments.

4. *Quick Delivery.*—Where quick delivery is of prime importance it will often be possible to secure business from the customers of a more conservative competitor who continues to use horse delivery. Quick delivery is imperative with the florist and the merchant who handles perishables; also to department stores, which often secure trade simply because people appreciate prompt and reliable delivery.

The large express companies were quick to realize the importance of the three factors: Reliability of service, ability to care for rush of business, and quick delivery. Today the transition from horse to motor in this work is almost completed. The Adams Express Company now operates 485 motor trucks, gasoline and electric, representing an investment of $1,000,000 and an additional $300,000 for garage, shops, etc. The American Express Company now operates 352 power wagons, including 28 electric baggage trucks at the terminals in Boston. A total investment of $1,000,000 is represented, including garage, etc., the trucks alone being valued at over $800,000. The Wells-Fargo Company has 42 trucks at present, and expects in the near future to increase this to 200. The United States Express has 53 in service. The Long Island operates 36. This makes a total of 968 among five companies. It might be added that all the big express companies have motors on order.

5. *Advertisement.*—This may be a very important factor in some cases and will eventually force many an unwilling merchant into line with his more progressive competitor in the installation of motor equipment. The public is very keen to appreciate and reward up-to-date methods.

A Machine for Loading Broken Stone and Similar Materials from Stock Piles Into Wagons.

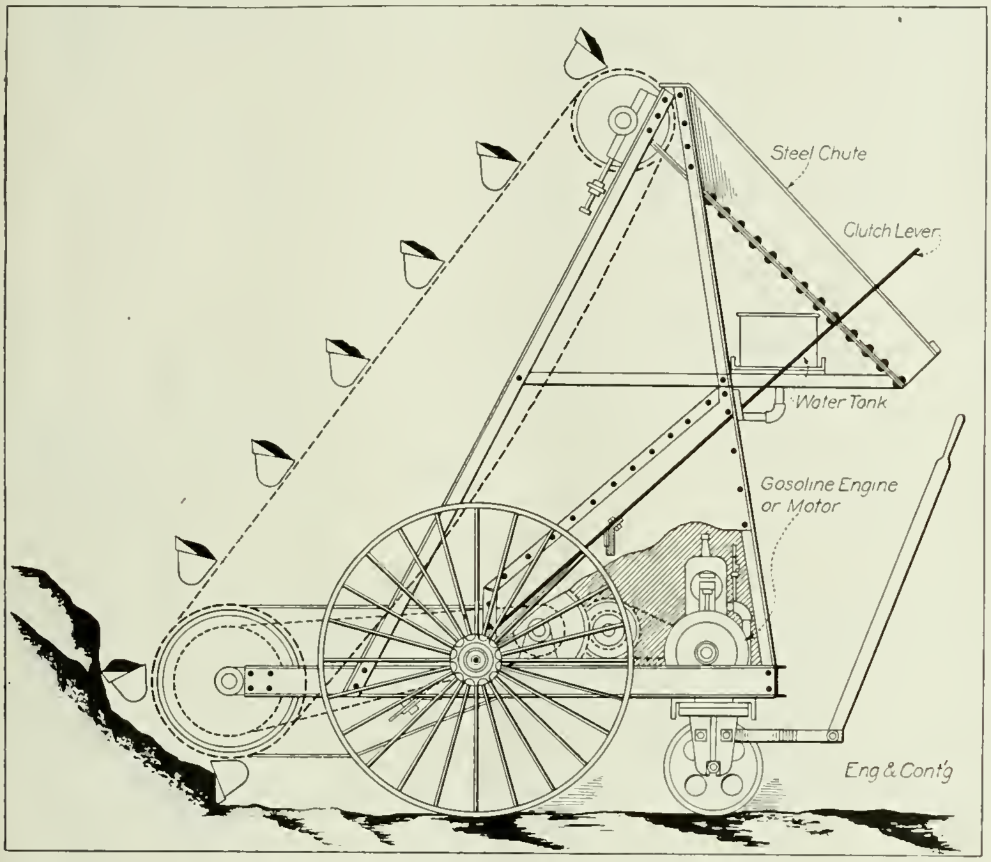
(STAFF ARTICLE.)

A wagon loader which is very simple in construction and operation is illustrated by the accompanying drawing. The loader first attained success in handling coal and has recently been strengthened and adapted for contractors' use in handling sand, gravel and stone for concrete.

The machine consists of a chain belt to which buckets, with or without teeth, are attached, and is operated by a 5 h. p. motor or gasoline engine. It is mounted on a truck with light steel wheels of large diameter so that it may easily be moved about by hand.

In operation it is placed against the foot of a pile of material, as indicated by the sketch, and one man is required to pull the material down within reach of the buckets, which carry it to the chute which discharges into the wagon or car. The bucket chain may be adjusted by a worm gear so that the foot of the chain is raised or lowered to accommodate the work. A friction clutch allows the power to be thrown on after the engine or motor has been started.

The stone and gravel machine is calculated to handle 40 to 50 tons of material per hour and the coal handling machines in operation handle a ton each minute. At the yard of the Scranton & Lehigh Coal Co., in Brooklyn, a machine is used to load wagons and motor trucks. One man is required to operate the machine and loads a five-ton truck in five minutes, whereas it had previously required four men to do the same work in 30 minutes. This company has effected a saving of 10 cts. on every ton of coal handled. The cost of power, according to the records of the S. D. Hall Co., of Philadelphia, who are using a motor for operating the machine, is about ⅓ ct. per ton handled. The cost of the machine is about $700, so that a saving of 10 cts. per ton handled should pay for the machine in handling 7,000 tons, or in about 18 days at the rate of handling 400 tons per day.



Machine for Loading from Stock Piles Into Wagons.

The machine is manufactured by the Link Belt Machinery Co., Chicago, Ill.

Proposed Method of Underground Retaining Wall Construction to Prevent Earth Slides.

Earth slides have always been matters of serious concern to engineers. At the present time they are the one cause of serious uncertainty in the Panama Canal work. No apology is called for, therefore, in presenting a plan for preventing earth-slides, even though it has not been tested out in practical work. Such a plan, and one of decidedly unique character, is proposed by Mr. Geo. S. Rice in a paper read May 12 before the Western Society of Engineers. We take the following description from this paper with an illustration showing the application of the plan at Culebra Cut, Panama Canal.

(1) Drill a series of holes placed along lines parallel with the axis of the canal, these holes to be both vertical and inclined, and to go deep enough to reach firm strata below the level of the bottom of the canal. The depth of the holes might need to be 100 ft. or perhaps over 150 ft. deep.

(2) Force cement grout into these holes under high pressure, 750 to 1,000 lbs. per square inch, so that the cement will penetrate all the joints and fissures, making the mass impervious to water, and also binding the rock together.

(3) Place steel rods in the holes; these rods may be of considerable diameter, say 3 ins. or more, and are to be grouted into the holes.

(4) Before the steel bars have been placed in the holes, dynamite is to be fired in the bottom of each hole to make an enlarged or pear-shaped space in the firm stratum which the holes should reach. These will provide anchorage at the bottom. The rods will thus act as reinforcement to the cemented zone; and the rods in the inclined holes will serve as tension members of the wall. The latter rods will therefore be made much heavier than the others—the size being proportioned to the probable stress, so far as can be estimated. The rods are to have nuts and washers or to be "upset" at each end. The upper ends are to be fastened in a concrete capping over the top of the "dam."

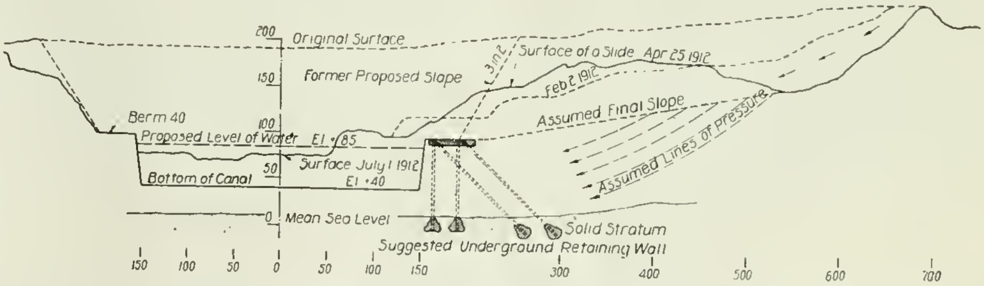


Fig. 1—Proposed Underground Retaining Wall Construction for Preventing Earth Slides.

This underground dam or buttress will be of approximately triangular shape, the base being at the bottom and deep enough to be in firm strata. The vertical holes would be drilled by ordinary churn or auger drills; the diagonal holes drilled with either a diamond or chilled shot drill, or auger if the strata are not too hard.

In applying this method for the support of side walls of the Panama Canal or elsewhere, it must be done before the ground begins to move. It is evident that it cannot be applied to ground that is actually moving. Moreover, the wall must go sufficiently deep to get into solid strata; but there is nothing but cost to prevent such an underground dam from going as deep as seems desirable, or to make the holes as large or the tie rods as heavy as desired. It must be admitted that the expense of application is considerable, but on the other hand the saving that might be effected may be vastly greater, besides insuring that the finished engineering work is reasonably certain to be stable. It would of course be a desirable thing to try out the method beyond the present slide areas in order to determine the obstacles and necessities of the case. The work could be pushed from either edge into the slide area. Intermediate ground walls could be constructed further up the slopes, so as to lessen the weight and also to prevent water which might enter above from working down into the larger mass below. Accompanying these dams, underground horizontal drifts might in some cases be put into the slopes to drain the ground.

In order to obtain information about the stresses, a trial dam might be bulit ahead of a slow moving slide. In the same bore hole in which a tie rod was placed, a small rod (say ¼ in.) inclosed in a pipe, could be inserted parallel to it, the rod to be greased so as to allow free play in the pipe. Before inserting the rods into the bore hole, the small rod could be attached to the tie rod at the lower end or intermediate point, as desired, and extended to the surface parallel with the main rod. The extension of the main rod could then be measured by comparison with the ¼ in. rod, which would not be put under stress, although the small inclosing pipe might pull apart at the joints.

In conclusion, while it is evident that the scheme of the underground retaining wall cannot be applied to all natural conditions, apart from the limitation of cost, it is hoped by the writer that in some cases it will be advantageous. So far as known to the writer the plan of combining steel or iron reinforcement with underground cementation is new and, in particular, provides tension members of calculable strength and anchorage for the tie bars by enlarging the bottom of the holes and filling them with cement around the ties.

Big Bridge Being Built for India.—A large bridge is being made at West Bromwich, England, for the Eastern Bengal Railway, to span the lower Ganges, 120 miles above Calcutta, India. There will be 17 spans. The two approach spans will be 75 ft. long, and the others 345 ft. long, 49 ft. high and weighing 1,400 tons each. Tube lacing, new in British practice is being used and forms a rigid system, giving a maximum of strength when used in the form of a strut. The bridge will be the largest ever shipped from England, and, with the exception of the Forth Bridge, it is the largest yet built by British engineers. The total cost of the bridge, including piers, will be $5,500,000.

ROADS AND STREETS

Comparative Statistics on Cost of Road Construction.

(STAFF ARTICLE.)

In connection with its investigation of the question of Government participation in road improvements in the various states, the Congressional Committee on Federal Aid in the construction of Post Roads has collected a large amount of data on the cost of road construction in different sections of the country. This and other information was compiled and tabulated by Mr. A. W. Prescott, secretary, and Mr. J. E. Pennypacker, statistician, of the committee. A revised print of the information has been issued recently, and from this the matter in this article has been taken. In the accompanying tabulations Tables I to IV show the segregated costs of typical or average examples of various types of road construction in various states. Table V shows the unit costs for excavation and broken stone, and the average costs for labor and teams applying to the roads in the other tables.

TABLE I.—TYPICAL OR AVERAGE EXAMPLES OF MACADAM CONSTRUCTION IN SEVERAL STATES.

	Calhoun Co., Ala.	Connecticut.	District of Columbia.	Bingham Co., Idaho.	Vigo Co., Ind.	Shelby Co., Ind.	Huntington Co., Ind.	Wyandotte Co., Kans.	Shawnee Co., Kans.	Jefferson Co., Ky.	Howard Co., Md.	Charles Co., Md.	Massachusetts.
Width surfaced, feet	10	16	16	12	9	12	12	16	18	12	14	14[6]	15
Comparative thickness, inches	6	7	6	6	9	7	8	8-12	10-12	5½	8	8	5
Preliminary surveys and plans	$ 30	$ 60	$ 34	$ 641[4]	$ 30	$ 12	$ 51	$ 120	......	$ 40	$ 72	$ 51	$ 200
Grading	1,034	......	1,781	1,549	500	600	1,600	200	1,282	600	3,128	1,264	3,270
Surfacing	2,406	6,500[1]	4,333	5,304	2,640	3,000	4,500	5,600	6,938	1,700	6,678	3,702	4,886
Culverts	261	......	36	......	100	......	250	800	......	348	1,361	1,221	[7]950
Underdrains	.....	......	71	......	......	......	......	100	......	30	229	211	......
Inspection and superintendence	100	......	242	......	75	35	120	120	78	100	416	138	455
Miscellaneous	82	......	54	505	75	......	75	60	62	......	46	17	100
Total per mile	$3,913	......	$6,551	$8,030	$3,420	$3,647	$6,596	$7,000	$8,360	$2,818	$11,931	$6,605	$9,861
Administration and general engineering	.....	......[2]	196	......	200	......	......	200	88	12	528	327	235
Total, including overhead	.....	......	6.747	......	3,620	......	......	7,200	8,448	2,830	12,459	6,932	10,096
Total per sq. yd	$0.684	$0.724	$0.48[3]	......	......	......	......	$0.77	$0.80	......	$1.52[5]	$0.84[5]	$0.75

	Michigan.	Minnesota.	Oktibbeha Co., Miss.	Missouri.[9]	Missouri.[10]	New Hampshire	New Jersey.	New York.	Huron Co., Ohio.	Ohio—state.	Washington Co., R. I.	Wisconsin.[1]	Wisconsin.
Width surfaced, feet	9	16	24[8]	15	15	15	14[12]	16	10	14	14	9	[18]9
Comparative thickness, inches	6	6	7	7½	10[11]	5	6-10	6	6-8	6-8[7]	6	8	10
Preliminary surveys and plans	$ 40	$ 30	......	$ 25	$ 25	$ 125	$ 375[13]	$ 200	$ 25[14]	......	$ 200	$ 30	$ 30
Grading	600	700	2,645	100	......	1,431	3,683	3,000	800[15]	......	1,927	550	360
Surfacing	3,150	3,200	6,610	4,500	2,500	3,960	6,700	5,000	......	......	3,490	2,640	1,056
Culverts	200	300	78	500	500	200	......	500	......	200	467	200	150
Underdrains	50	......	3	100	100	160	524	100	......	......	......	......	......
Inspection and superintendence	200	100	......	150	60	50	188	300	......	......[17]	210	......	......
Miscellaneous	75	50	150	......	......	......	390	2,000	......	......	322	......	......
Total per mile	$4,325	$4,380	$9,486	$5,300	$3,200	$5,926	$11.858	$11,100	$4,000[16]	$9,000	$6,616	$3,420	$1,596
Administration and general engineering	.....	150	......	100	......	......	......	1,000	......	......	......	150	150
Total, including overhead	.....	4,530	......	5,406	......	......	......	12,100	......	......	......	3,570	1,746
Total per sq. yd	.....	$0.50	$0.674	$0.55	$0.30	......	......	$1.29	......	......	$0.805	$0.68	$0.33

[1] Includes culverts, grading, underdrainage, etc. [2] 5 per cent, includes inspection and superintendence. [3] Average 48 cts. to 70 cts. [4] Includes inspection and superintendence. [5] Average width 23 ft. [6] Gravel macadam. [7] Includes underdrains. [8] Chert macadam. [9] Class A, general average. [10] Class B, general average. [11] Loose. [12] 14 ft. to 18 ft. [13] Includes general engineering. [14] $25-$40. [15] $800-$1,500. [16] $4,000-$5,000. [17] 5½ per cent for preliminary surveys and plans and inspection and superintendence. [18] Gravel-macadam.

The Planning of City Streets.

The planning of a city's street system is one of the most important problems that municipal engineers are called upon to solve. For this reason a paper by B. Antrim Haldeman, Assistant Engineer, Bureau of Surveys of Philadelphia, presented before the Engineers' Club of Philadelphia and reprinted in the Proceedings of the club, is of particular interest. An abstract of Mr. Haldeman's paper follows:

The planning of streets is the first, if not the most important problem in the origin and growth of cities. The very first step in the creation of a town or city is the preparation of a plan of its streets, for without streets, or public passageways serving as such, there could be no city; therefore, the streets may fairly be considered the foundation upon which the city, with all its countless activities, rests, and unless the foundation shall be properly proportioned and constructed the structure reared upon it will be subject to the constant menace of failure, decay and ruin. Every engineer will admit that the stability and the durability of the structure he erects depends upon the integrity of the foundations beneath it; therefore, the modern city, being the greatest and most comprehensive of the works of man, representing in its purposes and its accomplishments the ambitions and the triumphs of human energy along every avenue of science, industry and art, should have a foundation broad enough, and sound enough, and substantial enough to bear the ever increasing burdens the passing years lay upon it.

The large importance of the street lies in the fact that the entire system of transportation throughout the city depends upon it, that it is a controlling element in the development of property and the making of the homes of the people, and that it is the principal factor in encouraging and promoting the physical expression of civic art.

The chief mission of the street is to provide adequate facilities for the untrammeled movement of the people and the circulation of every form of service necessary to their in-

TABLE II.—TYPICAL OR AVERAGE EXAMPLES OF GRAVEL ROAD CONSTRUCTION IN SEVERAL STATES.

	Dallas Co., Ala.	Colorado.	Connecticut.	Vigo Co., Ind.	Shelby Co., Ind.	Huntington Co., Ind.	Massachusetts.	Michigan.	Minnesota.	Missouri.[4]	Missouri.[5]	New Hampshire	New Jersey.	Loudon Co., Tenn.	Vermont.[10]	Vermont.
Width surfaced, ft	16[1]	16	16	9	12	12	15	9	16	15	15	15	16[7]	18[9]	10[11]	12[12]
Compacted thickness, ins	6-8	6	8	6-10	8	10-12	5	8	6	7½	10[6]	8	6-8	9	6-12	8-15
Preliminary surveys and plans	$ 25	......	$ 60	$ 30	$12.50	$ 40	$ 200	$ 40	$ 30	$ 25	$ 25	$ 125	$ 141[8]	......	$ 22	$ 22
Grading	497	......	......	450	600	2,200	3.270	600	700	100	......	788	1,059	$760	......	......
Surfacing	1,903	......	4,000[2]	1,845	2,200	1,300	1,320	1,150	1,500	3,000	1,500	1,369	2,060	1,379	......	......
Culverts	84	......	......	100	......	485	950[3]	200	300	500	500	200	......	147	......	......
Underdrains	......	......	......	......	......	......	......	50	......	100	......	160	......	......	......	......
Inspection and superintendence	100	......	......	50	35	200	280	150	100	60	50	50	45	130	74	74
Miscellaneous	......	......	70	70	......	80	100	50	50	......	......	......	47	......	......	......
Total cost per mile	$2,607	$1,600	......	$2,515	$2,847	$4,305	$6,120	$2,240	$2,680	$3,800	$2,075	$2,692	$3,352	$2,416	$3,596	$1,596[13]
Admin. and general engineering	......	48	......	200	......	......	145	......	135	100	......	......	......	......	32	32
Total, includ. overhead charges	......	1,648	......	2,715	......	......	6.265	......	2.815	3,900	......	......	......	......	3,628	1,628
Total per sq. yd	$0.277	$0.18	$0.445	$0.515	......	......	$0.46	......	$0.30	$0.40	$0.25	$0.306	......	$0.23	......	......

[1] Clay gravel. [2] Includes all grading, culverts, underdrainage, etc. [3] Includes underdrains. [4] Class A, general average. [5] Class B, general average. [6] Loose. [7] 16 ft. to 22 ft. [8] Includes general engineering. [9] Chert-gravel. [10] Gravel on Telford base. [11] 10 ft. to 18 ft. [12] 12 to 21 ft. [13] $1,596 to $1,746.

TABLE III.—TYPICAL OR AVERAGE EXAMPLES OF BITUMINOUS MACADAM AND BITUMINOUS CONCRETE CONSTRUCTION IN SEVERAL STATES.

	Los Angeles Co., Calif.	Los Angeles Co., Calif.	Los Angeles Co., Calif.	Connecticut.	District of Columbia.	District of Columbia.	Vigo Co., Ind.	Jefferson Co., Ky.	Baltimore Co., Md.	Montgomery Co., Md.
Width surfaced, feet	22[1]	25[1]	21[1]	16*	16*	23†	20*	25*	18*	12½*
Compacted thickness, inches	6[2]	6[2]	6[3]	6½	6	4[5]	10	7½	8	6-6½
Preliminary surveys and plans	$ 143	$ 408	$ 267	$ 60	....	$ 163	$ 50	$ 50	$ 84	....
Grading	1,102	1,164	869	....	....	2,208	500	800	1,814	2,970
Surfacing	5,014	8,326	6,783	7,500[4]	$ 9.396	14,937	11,650	7,200	11,063	4,305
Culverts	183	860	222	....	....	....	....	800	263	....
Underdrains	....	....	....	....	....	....	....	50	9	161
Inspection and superintendence	76	247	81	....	326	713	250	200	220	90
Miscellaneous	....	5	51	50	193	....	100	....	1,391	91
Total per mile	$6,518	$11,510	$8,273	....	$9,915	$18,021	$12,550	$9,100	$14,645	$7,617
Administration and general engineering	486	693	623	....	297	540	400	20	684	....
Total per mile, including overhead charges	7,003	12,203	8,895	....	10.212	18,561	12,950	9.120	15,529	....
Total per square yard	$0.5426	$0.832	$0.722	$1.085	$1.09	$1.39	....	....	$1.47[6]	$1.64

	Massachusetts.	Massachusetts.	New Jersey.	New Jersey.	New York.	Kent Co., R. I.	Providence Co., R. I.	Yakima Co., Wash.	King Co., Wash.	Walla Walla Co., Wash.
Width surfaced, feet	15†	15*	14*	16†[8]	16*[9]	16*	14*	16*[10]	16[10]	16*
Compacted thickness, inches	5	5	6-8	5½-8	6	6	6	10	6[11]	8
Preliminary surveys and plans	$ 200	$ 200	$ 417[7]	$ 676[7]	$ 200	$ 150	$ 150	$ 25	$ 78	$ 112
Grading	3,270	3,270	1,986	2,396	3,000	1,225	966	700	4,660	2,356
Surfacing	8,800	7,116	7,506	12,005	5,000	8,369	6,225	6,305	15,395	8,439
Culverts	950	950	....	....	500	38	16	450	57	2,535[12]
Underdrains	....	....	328	203	100	....	....	....	....	....
Inspection and superintendence	650	667	264	258	300	210	100	275	715	1,008[13]
Miscellaneous	100	100	452	531	3,600	1,236	161	40	....	....
Total per mile	$13,970	$12,203	$10,955	$16,969	$12,700	$11,228	$8,018	$8,155	$20,905	$14,450
Administration and general engineering	338	295	....	....	1,000	....	....	....	86	....
Total per mile, including overhead charges	14,308	12,498	....	....	13,700	....	....	....	20,991	....
Total per sq. yd.	$1.06	$0.93[6]	....	....	$1.46	$1.196	$0.976	$0.87	$2.24	$1.54

*Bituminous macadam. †Bituminous concrete. [1]County road system; prices furnished in 1911; oiled macadam. [2]6-in. center, 2-in. sides. [3]6-in. center, 4-in. sides. [4]$7,500 to $12,000; includes grading, culverts, underdrains, etc. [5]2-in. on old macadam base with 2-in. bituminous concrete. [6]Average width 23 ft.; the above figures are for tarred macadam, penetration method. [7]Includes administration and general engineering. [8]16 ft. to 20 ft. [9]Macadam (asphalt grout). [10]Warrenite. [11]Includes 4-in. base. [12]Culverts and bridges. [13]Includes general engineering.

dustrial activities, their comfort, and their convenience, and the real test of the efficiency of a street system is the facility with which transportation, "the act of conveying," may be conducted throughout all parts of a city; for direct, rapid and unobstructed means of communication are as necessary to the progressive development of a city and its industrial and commercial enterprises as direct, rapid and unobstructed means of transportation are to the trade and commerce of the world; therefore, the requirements of every form of urban and interurban transportation, present and prospective, must receive first consideration in any plan of streets.

Once established and built upon, the street becomes more nearly permanent than any other feature of the city. Assuming that the present era of peace and industrial enterprises will continue indefinitely, the passing of time may witness the demolition and reconstruction, one by one, of all existing business, methods of trade and transportation may be revolutionized, buildings and social customs may be transformed, the forms and methods of every class of public service necessary to the health, comfort and convenience of the people may

TABLE IV.—TYPICAL OR AVERAGE EXAMPLES OF EARTH, SAND-CLAY AND CONCRETE ROAD CONSTRUCTION IN SEVERAL STATES.

	Russell Co., Ala.	Russell Co., Ala.	Bullock Co., Ala.	Limestone Co., Ala.	Los Angeles Co., Calif.	Colorado.	District of Columbia.	Shawnee Co., Kans.	Shawnee Co., Kans.	Massachusetts.
Width surfaced, feet	20[1]	12[3]	14[4]	22[1]	20[5]	24[1]	30[5]	20[6]	16[8]	16[13]
Compacted thickness, inches	12	12	10-12	....	5	....	6	8-10	12	3
Preliminary surveys and plans	$ 20	$ 20	$ 25	$ 26	$ 118	$ 25	$ 245	$ 49	$ 162	$ 200
Grading	675	675	536	1,093	1,143	300	2,658	3,522	6,358	3,270
Surfacing	350	350	540	....	9,743	....	16,449	5,870	11,280	4,400
Culverts	150	150	190	517	215	250	....	345	117	950
Underdrains	....	....	....	....	....	....	....	....	....	12
Inspection and superintendence	.......[2]	.......[2]	100	96	411	29	984	135	194	430
Miscellaneous	10	10	66	99	32	17	322	1,191[7]	1,612[9]	100
Total per mile	$1,205	$1,205	$1,458	$1,831	$11,663	$ 621	$20,658	$11,111	$19,723	$9,350
Administration and general engineering	10	15	....	....	527	19	620	281	390	228
Total per mile, including overhead charges	1,215	1,220	....	....	12,190	640	21,278	11,392	20,114	9,578
Total per sq. yd.	....	....	....	....	$1.039	....	$1.21	$0.97	$2.14	$0.71[13]

	Michigan.	Minnesota.	New Jersey.	New York.	Iredell Co., N. C.	Lenoir Co., N. C.	Cuyahoga Co., Ohio.	Brookings Co., S. Dak.	Pierce Co., Wash.	King Co., Wash.	Milwaukee Co., Wis.
Width surfaced, feet	9[14]	16[14]	16[15]	16[5]	16[4]	16[4]	16[19]	40[1]	16	16[21]	18[14]
Compacted thickness, inches	7	7	6-12	6	8	6	8	....	6	9	7
Preliminary surveys and plans	$ 40	$ 60	$ 148[16]	$ 200	....	....	$ 150	....	$ 124	$ 107	$ 200
Grading	600	700	2,396	3,000	$ 914[17]	$ 223	4,000	$ 355	535	2,425	2,500
Surfacing	6,749	10,450	12,005	8,000	450	663	15,200	35	13,146	20,100	9,000
Culverts	50	300	....	500	63	49	900	351	195	2,875	600
Underdrains	50	....	203	100	....	....	600	....	15	....	....
Inspection and superintendence	200	150	258	300	27	....	800	....	436	1,112[22]	500
Miscellaneous	75	50	531	1,000	....	114	4,000	....	342	50	100
Total per mile	$7,764	$11,710	$16,069	$11,100	$1,314[18]	$1,049	$25,650	$ 741	$14,793	$26,669	$13,900
Administration and gen'l engineering	150	200	....	1,000	61	....	285	....	....	150	300
Total per mile, incldg. overhead chrgs.	7,914	11,910	....	12,100	....	....	25,935	....	....	26,819	14,200
Total per sq. yd.	....	$1.24	....	$1.29	....	$0.1118	$3.15	$0.0315	$1.58	$2.86	$1.36

[1]Earth road. [2]Included in grading and administration. [3]Sand-clay and gravel top. [4]Sand-clay. [5]Concret with bituminous top. [6]Clay, graveled, oiled. [7]Oiling and rolling. [8]Brick on sand foundation. [9]Overhaul in grading. [11]Sand and oil mixed. [12]Included in culverts. [13]Average width 23 ft. [14]Concrete. [15]Oyster shell; 16 ft. to 24 ft. wide. [16]Includes general engineering. [17]$914-$1,750. [18]$1,314-$2,253. [19]Brick — 4-in. concrete. 4-in. brick. [20]Granitoid. [21]Vitrified brick on 5-in. concrete base; concrete curb. [22]Item high on account of slowness of contractor.

TABLE V.—UNIT COSTS OF EXCAVATION, CRUSHED STONE AND LABOR.

	Excavation, per cu. yd.	Crushed stone, per cu. yd. at road.	Average cost of labor per day.	Average cost of teams per day.
Montgomery Co., Ala..	$0.20	.....	$1.25	$4.00
Russell Co., Ala.......	.14	.....	.50[1]	1.25[1]
Calhoun Co., Ala......	.24	$1.75	1.50	4.00
Dallas Co., Ala........	.21	.673[2]	1.50	4.00
Lauderdale Co., Ala...	.151	.785[3]	1.00	3.00
Bullock Co., Ala.......	.111	.241[4]	.55[5]	1.65[5]
Limestone Co., Ala....	.225	.....	1.50	4.00
Los Angeles Co., Cal..	....	.....	2.00	5.00
Colorado	.15[6]	.80[7]	2.25[8]	5.00
Connecticut	.35	.90[9]	1.75	5.00
District of Columbia...	....	.....	1.60	4.00
Vigo Co., Ind..........	.15	1.00	2.25	5.00
Shelby Co., Ind........	.40	1.75	2.00	3.50
Huntington Co., Ind....	.26	.....	2.00	4.00
Wyandotte Co., Kan...	.25	1.40	1.75	4.50
Shawnee Co., Kan.....	.40	1.65[10]	1.75	3.75
Jefferson Co., Ky......	.21	1.18	1.75	5.00
Howard Co., Md.......	.60	1.30	.13[11]	.35[11]
Charles Co., Md........	.36	.40[2]	.15[11]	.35[11]
Baltimore Co., Md.....	.75	1.30	.16[11]	.50[11]
Montgomery Co., Md..	.78	1.25	1.50	5.00
Massachusetts	.50	4.12	2.00	4.00[13]
Michigan	....	1.35	2.00	4.50
Minnesota	.25	1.75[15]	2.25	4.50
Oktibbeha Co., Miss...	.219	1.40[16]	1.12	3.25
Missouri	.25	1.00[17]	1.50	1.50
New Hampshire........	.55	2.25[18]	1.75	4.50
New York..............	.50	3.50[12]	2.25	6.00
Iredell Co., N. C.......	.18	.....	1.25	3.00
Lenoir Co., N. C.......	.15	.224[4]	....	2.00
Cuyahoga Co., Ohio...	.40	2.50	2.25	6.50
Huron Co., Ohio.......	.30	1.30	2.00	4.50
Ohio	.30	.....	2.00	4.50
Washington Co., R. I..	.805	2.55[12]	2.00	4.50
Kent Co., R. I.........	1.50	3.75[12]	2.00	5.00
Providence Co., R. I...	1.00	3.25[12]	2.00	5.00
Brookings Co., S. D...	.089	.....	2.00	4.00
Madison Co., Tenn.....	.25	1.80	1.00	3.00
Loudon Co., Tenn......	.172	.365[16]	1.25	3.00
Vermont	....	.....	1.75	3.50
Henrico Co., Va........	.41	.87[19]	1.25	3.50
Tazewell Co., Va.......	.532	.....	1.25	3.00
Pierce Co., Wash......	.20	1.10	2.50	5.50
Yakima Co., Wash.....	....	1.17	2.25	4.50
King Co., Wash........	.30	1.35[20]	2.25	6.00
Walla Walla Co., Wash.	.30	2.00[12]	2.25	5.50
Wisconsin	.60	1.75	2.00	5.00
Milwaukee Co., Wis...	.80	1.50[2]	2.25	6.50

[1]Convict labor; free labor, $1.25; teams, $3. [2]Gravel. [3]Chert. [4]Sand-clay. [5]For maintenance of convicts. [6]15 cts. to 80 cts. for ordinary earth roads. [7]80 cts. to $1.50 per ton. [8]$2.25 to $3. [9]90 cts. to $1.25. [10]Clay-gravel; oil cost 5½ cts. per gal. on road. [11]Per hour. [12]In place. [13]$4-$5.50. [14]Gravel cost 75 cts. per cu. yd.; stone and gravel for the concrete road cost $1.70 per cu. yd. [15]Gravel, 75 cts. per cu. yd.; stone for concrete road, $2 per cu. yd. [16]Chert gravel. [17]$1 to $1.50; gravel, 50 cts. to $1. [18]Gravel, 70 cts. per cu. yd. [19]Gravel in place. [20]Brick per sq. yd.

change, the people themselves may have new ambitions, new ideals and new activities; the tendency of all these changes will be to increase the usefulness and importance of the public highways, but no matter what changes come, or what new demands upon it may be made, so long as the city endures the street system will offer the strongest resistance to the processes of transformation; its evils will be most difficult to reform and opportunities for its improvement will become fewer as the years pass away; therefore, the best judgment and skill and the keenest foresight of the probable future usefulness of the street should be called to its original planning.

In addition to the importance of the street as the channel through which the industrial and social activities of the city flow, there are other large considerations which must not be neglected. Intelligent thought and care must be exercised in providing opportunities for the advantageous and economical development of abutting property for either public or private use, and the probable character of such development should have a large influence, but should not be permitted to subordinate the larger purpose of public usefulness. Aesthetic effect, or the opportunity for attractive and ornate development, must also receive attention, for the tendency of the education and training of the present is toward higher ideals and a larger appreciation of art and beauty in all our surroundings.

Almost invariably the street system of a new town has been prepared by or for a proprietor or proprietary corporation and the site has been selected for the promotion of some commercial, industrial or social enterprise. The plan adopted has usually provided only for the development of a limited area with little regard for future expansion; if the enterprise proved successful the town gradually grew beyond the original limits of the plan and the owners of adjacent property began to lay out streets and subdivide their land, sometimes in conformity with the original plan, but more often in the manner most advantageous to their own immediate purposes and profits without regard for any existing system or future exigency. It is just here that the evils of careless, irresponsible and ill-considered street planning begin to take root unless there shall be some public body with sufficient authority, foresight and skill to control and direct the planning of extensions with due regard for public service as well as private rights.

In view of the progress that has already been made in scientific street planning and the general recognition of its merits, it is entirely probable that the best skill available will hereafter be employed in planning new towns, especially those established under such circumstances as give a reasonable guarantee of considerable future growth and importance, but our immediate attention should be directed toward the better planning of the extensions of the street systems of our rapidly growing cities and of the detached suburban town sites which are being developed near them.

There is a very positive movement in the great cities of both America and Europe to discourage the increase of apartment and tenement houses, to reduce the tendency toward congestion of population by spreading it over the suburban areas, and to get people, particularly the working people and those of only modest means who now live in tenements, out into the open and closer to nature. The success of this movement depends primarily upon two conditions—the economical development of property to insure reasonable values for home sites, and direct and cheap transportation to enable the people to be carried quickly between their homes and their places of employment or business. In Philadelphia, the conditions are reversed to the extent that we need fair land values and better transportation facilities to perpetuate the present system of one-family houses and prevent the growth of the tenement system of living; in both instances, however, the object aimed at can only be accomplished by a more complete public control of the development of property and a more intelligent exercise of the street planning power. The abandonment of the apartment and tenement house in favor of the one-family house built with a larger regard for light, air and hygienic conditions means larger building lots and more open space in our cities, and this, in turn, will necessitate the exercise of greater economy in street planning, and especially in the distribution of paved areas upon minor and residential streets.

The first problem which should be considered in plotting a street system is the establishment of main traffic routes. A town or city is usually the commercial and distributing center of a large area tributary to it. Philadelphia is the local center of an area having a radius of at least 50 miles; that is, more or less of the traffic within that area centers in the city, its intensity increasing as the center is approached, and all this traffic wants to reach its destination by the most direct routes; other towns within that radius are secondary centers having, or needing, direct routes connecting them with each other and with the chief center; these routes began to be established as soon as the first settlements were made and increased in number and importance as the settlements prospered; they were natural routes; at first forest trails, then wagon roads, then post roads and turn pikes, and now carrying fast motor traffic and high speed electric lines, yet many of them are no wider and very little better than when they were first laid out.

These old roads which grew up in the early days to meet the needs of travel formed fairly direct lines from one village to another and connected all with an important trade center. There are at least ten such roads radiating from Philadelphia, not counting those upon the New Jersey side of the Delaware river, which occupy strategic locations and have from their beginning been traffic highways of the first class; this fact should long ago have suggested the desirability of increasing their width in order that they might better fulfill their functions in the future.

There is no indication of any falling off in the percentage of increase of population in the more progressive industrial and commercial communities, and the doubling of the population in such cities as New York, Chicago, Philadelphia and Boston within the next 30 or 40 years means that wiser provision must be made for caring for the general increase of traffic such an increase of population will bring, for this new population will spread over large areas which are now suburban or rural and will no doubt greatly influence the growth of nearby towns.

To provide properly for the transportation, both public and private, necessary for the service of the great urban populations of the future, existing main traffic routes should be protected and measures for increasing their capacity as the need arises should be adopted; direct routes between important centers of population and industry should be established where none now exist and all of these should be planned with generous widths and easy grades.

Classification and standardization have been suggested by some progressive planners as an aid in simplifying the work of street planning and has met with some approval; the number of classes and standards proposed vary greatly, according to individual opinion or the seeming need of the city to which they are to be applied; those of Washington, a residential city, are quite simple and appear to be well adapted to a city of that particular class; they are:

	Ft.
Main thoroughfares	160
Secondary thoroughfares..............	120
Local streets............................	60 to 90

These are widths between building lines. This is the simplest form that has been suggested, but it is scarcely adaptable to an industrial city; the widths are greater than would be economical where a city builds up closely with small houses, as in Philadelphia.

Many German cities have adopted standards which are so elastic that the term seems a misnomer; they are:

	Ft.
In first class cities:	
Main thoroughfares....................	Over 95
Secondary thoroughfares...............	65 to 95
Local streets............................	40 to 65
In second class cities:	
Main thoroughfares....................	Over 85
Secondary thoroughfares...............	50 to 85
Local streets............................	33 to 50

There are many streets of from 100 to 200 ft. in width in the big cities of Germany, the people of which live almost entirely in apartments or tenements, and this method of living makes wide streets almost necessary from the viewpoint of both economy and hygiene. Efforts are now being made in many of these German cities to establish the system of one family house, and this is having an influence on street widths.

The London Traffic Commission recommended five classes of streets for that city:

	Ft.
Main avenues	140
First class arterial streets..............	100
Second class streets.....................	80
Third class streets.......................	60
Fourth class streets.....................	40 or 50

If a classification is to be of any great benefit the number of classes and the number of clear widths in each class should be reduced to the least possible, and for the purpose of this paper the following are suggested:

	Ft.
Main traffic streets....................	110 or 150
Secondary traffic streets..............	88
Residential streets.....................	52 or 64

These seemingly irregular widths are based on suggested standard units of widths for lines of vehicles, pedestrians, and planting spaces, the scheme of which will be explained further on; they are between building lines and should be subdivided in such manner as to give the least width of paving required for traffic, the remainder being made grass plot. Parkways, or streets intended to combine the uses of a traffic route and a parkway, should form another class and their widths should be subject to special study.

It is recommended that new or existing streets should not be opened or widened to these widths until they are reasonably necessary for safe or convenient travel, but the widths should be legally established and protected from the encroachments of buildings or other permanent improvements which might prevent their future development to meet increasing needs. This can be done, and has been done, in Philadelphia for many years, under an Act of Assembly protecting the general system of streets, and similar authority should be given to rural districts. Such a restriction may seem at first glance to be a hardship and an encumbrance on the property, but it is doubtful whether there has been an instance of real pecuniary loss due to it during the many years it had been in force.

No great hardship or depreciation of values could result along existing important highways if new buildings were required to recede 55 to 75 ft. on either side of the center line, and it would seem a wise policy for real estate operators and town site promoters to voluntarily place such a restriction upon their properties; as a matter of fact, property owners can, and frequently do, place such restrictions in rural and suburban sections more effectively than can be done by the public authorities. The general provision and recognition by property owners and the public authorities that certain roads are to permanently remain the great traffic routes and will not be abandoned in favor of some new route that may be opened more cheaply and made more popular should have the effect of establishing more stable values upon them, and the extra area thrown into them could be compensated for by making the purely residential streets somewhat narrower, for in many land development schemes roads which can never have any large usefulness for public travel are made wider than is necessary in view of the more open form of improvement which is increasing in popularity with both builders and home buyers.

With the increasing demand for rapid transit, underground railroads for both passengers and freight could be placed under these wide avenues or elevated lines could be erected along them and concealed by trees as is done in Paris and Berlin; they would also be most available for the main trunks of underground systems for many kinds of service, the numbers and character of which are constantly increasing. It is quite probable that the future will witness a great development of underground transportation and that much of the material now carried on the surface will be delivered by underground railways or through pneumatic tubes or similar devices. If the tendency toward the more open development of property continues it is doubtful whether the general system of underground galleries favored by some engineers will be financially practicable, and, if not, wide avenues will be necessary to accommodate their trunk lines. It is not beyond the realm of possibility that more space will be required in the future for sub-surface than for surface transportation along main arteries and with wide spaces between the building lines many of the underground structures could be placed beneath sidewalks and grass plots and the necessity for the frequent tearing up of roadway paving avoided.

If restrictions can be enforced requiring buildings to recede to established widths, the full width of the street need not be opened and improved until required for traffic; this, in the case of streets of any width or class, might not be required for many years after the original opening; take the street 110 ft. wide for instance; its initial opening might be only 60 ft. with a 24 ft. driveway, a row of trees and a sidewalk on each side; this is equivalent to the width of almost any of our best-improved and most-traveled country roads; if restrictions cannot be imposed and the initial opening must be to the full width the first roadway might be placed in any one of several locations, in the center or on either side, or it might even be allowed to meander somewhat in very wide avenues and the walks might do the same, but this should only be permitted in rural or suburban sections where there is not likely to be any early necessity for full width development; if trees are planted they should be placed in locations where they will not be disturbed in the final improvement of the road; as the demands of traffic increase the roadway could be widened or new ones opened in accordance with a pre-determined cross-section. The principle of the elastic subdivision could be applied with advantage to all the various classes and widths of streets and if no further widening of driveways or walks was ever required after the initial opening, as would probably be the case in many instances, the streets would always remain very attractive, or afford opportunities for being made so.

The establishment of cross-section subdivisions might be simplified by adopting units of traffic width for determining each section. There is some difference of opinion among advocates of this method as to the proper width of units; some suggest 8 ft. and some 9 ft. as the unit width for a line of vehicles; motor trucks are coming into very general use and there is a tendency toward increased widths of both gear and body among some makers of them; the standard maximum at present seems to be 7 ft. or 7 ft. 3 ins. and the extreme 9 ft. 6 ins., over all; widths of over 7 ft. are reported as being difficult to handle, bothersome in general traffic and subject to overloading. Two feet should be a normal unit for a line of pedestrians and the width for a grass plot with a row of trees should be a multiple of the unit for a line of pedestrians. Street railway and general traffic should be kept separate and prevented from obstructing each other as much as possible, and the former should be given an independent right-of-way on wide streets; the unit of width for a double track surface line should be 20 ft.

These standard units used in combination with an intelligent forecast of the probable future needs of the street would afford a more rational and systematic means for determining proper and economic widths than the unreasoning and arbitrary methods usually employed. Minimum widths based upon them and upon the probable immediate use of the street could be used in the initial improvement of the driveways and footwalks and these widths could be increased by units as the travel increased.

Main traffic routes should be planned in as direct lines as possible between important points, but they need not necessarily be straight; sharp curves and sudden jogs should, however, be avoided and changes in direction should be accomplished by means of curves rather than angles; an easy curve or a well planned fork will tend to break the monotony of long, straight lines; topographical conditions should not be allowed to exert as large an influence as in streets of less importance; detours which would materially lengthen the route should only be made to avoid excessive grades; some heavy cutting and filling is to be preferred over many windings in a great traffic route which in the ordinary course of events may be called upon to carry the trade of a great city for centuries; the first plan of a street must usually be considered its permanent one, for its location, width and grade cannot be changed at will to accommodate increasing traffic, as is the case with a railroad line.

Secondary traffic streets should be established connecting the main traffic ones with each other and with secondary centers of population and industry, and these two classes of traffic streets should form the skeleton plan, designed with a view of creating direct routes at reasonable intervals throughout the entire city and surrounding districts without regard for the development of any particular property, but with an intelligent purpose of encouraging an equal distribution of opportunity for improvement.

As there are local business needs to be served in every community, or at various points in large and widespread ones, and as the social intermingling of the people in every legitimate manner should be encouraged, the planning of the traffic streets should take into consideration the points at which local business centers may be established, and also those which seem most available for the purposes of civic or social centers. The municipal authorities cannot directly control the drift of business, but they can control the location of libraries, schools, public halls, gymnasiums, playgrounds and baths, branch offices of the central government, fire houses, police stations and other buildings necessary to the proper administration of the public business; these public buildings, properly grouped, form the civic or social center and by reason of being the center of the social, educational and official life of the community will attract hotels, theaters and general business. These centers should be planned in such a manner that traffic may have an option of passing either through or around them so that congestion in them may be avoided. The village "green," characteristic of all New England towns, is the embryonic type of what such a center should be. It is a somewhat sad commentary upon the wisdom and skill of some of the more modern town planners to say that the men who laid out the American towns of a century or two ago were wiser than they in their appreciation of the value of civic centers and open spaces for the use of the people, that those town planners of the long ago established a custom which, after having been abandoned for more than a century, has become one of the vital issues of the new town planning, and that the restoration of the park and the open public place is due to the active interest of private citizens and associations in civic affairs.

Parks, playgrounds and other open spaces for the use and enjoyment of the people have come to be recognized as essential features of modern urban improvements and should be provided for on every plan of street extension. The selection and distribution of such places can be more intelligently made in connection with the establishment of traffic streets than if left until residential or other development has commenced and the value of land has advanced.

With an efficient system of traffic streets firmly established, other parts of the plan, covering residential streets and those which can never be of much importance to through travel, should be left as elastic as possible in order that any legitimate form of development may be accommodated. Industrial sections, high class residential sections, and sections given to the modest type of dwellings, each require a different treatment of the street plan. In factory districts the streets surrounding industrial plants should be wide and straight, while those in the same vicinity upon which the homes of the workmen front may be of a quite different type; some of the garden cities and industrial colonies of England and Germany suggest admirable arrangements for this form of development, the driveways and walks being narrow and the building set back with foreyards or arranged around open spaces or squares.

High class residential sections lend themselves to most attractive forms of planning; houses built singly or in pairs on large plots permit greater freedom in establishing beautiful streets and narrower paved areas are allowable; the local travel through a residential section may even be accommodated by lanes wide enough for two vehicles to pass and a single footwalk.

In sections given to more modest dwellings built in pairs or long, solid rows on small plots, a minimum width between building lines should be established, and this width should be sufficient to allow a part of it to be planted; in such a section the streets will naturally be closer together and economy will be effected if the paved spaces be only such as are necessary to the local use.

The question of grades is one of great importance and should receive the most careful study; grades that are steep or irregular or that break at frequent intervals are neither desirable for traffic or attractive in appearance; long, even slopes should be obtained wherever possible, especially on straight streets; upon traffic streets the maximum should not exceed 1 in 20 unless physical conditions render it absolutely impossible to keep within it, and places where it is adopted should be short, few and far between. Maximum grades in Europe, even in hilly cities, are generally lighter than in America, and in some instances are kept within the limit by ramping or zigzagging the lines. In some parts of Germany, the law limits the grade to 1 in 50, in France the maximum on national highways is 1 in 33 and on departmental highways 1 in 20.

Heavy grades are as difficult and dangerous in their descent as in their ascent; this is well illustrated in the 1 in 10 grade on Market and Chestnut Sts., Philadelphia, approaching Delaware Ave., where heavy laden vehicles zigzag across the street in ascending and do the same or drag the wheels along the curb as a brake in descending.

Under the methods which have heretofore prevailed in municipal street planning, considerations of attractiveness have been almost entirely neglected and whatever beauty our streets possess is due to private initiative; the street has been regarded as just so much space to be paved between houses, the idea apparently being that the municipality could not afford to construct and maintain anything there except paving and such unlovely objects as telegraph, telephone and trolley poles; we shall probably find in the future that considerable of this area can be used for grass plots and trees, that the cost of maintaining them properly need not be prohibitive, and that the attractiveness of the streets will be immeasurably enhanced; it will be interesting to note whether this change, which is certain to come, will result from intelligent and well-directed efforts on the part of the public authorities or be allowed to go by default until it is forced by political or private agitation.

Scientific City Planning.

City planning from a scientific standpoint is the subject of a paper presented last week at the Fifth National Conference on City Planning, by Geo. B. Ford, of New York City. In his paper, which is reprinted below in full, Mr. Ford gives an outline for the standardized procedure by means of which a proper plan can be determined upon in a comparatively short time.

Except on the aesthetic side, city planning is rapidly becoming as definite a science as pure engineering. The best plans for the development of a city can be determined upon in advance as clearly as can the plans for a bridge or for a reservoir. It is solely a matter of proceeding logically from the knowns to the unknowns. In city planning there is above all the necessity for a careful analysis of the conditions. The requirements must be first definitely determined upon. Then these should be separated into several classes according to their urgency, ranging from the immediate and the imperative through the desirable to the more remotely advantageous. Working in this way one soon discovers that in almost every case there is one and only one logical and convincing solution of the problems involved.

From recent experience in city planning, I am fully convinced that the sort of facts we want to hunt for and the method of bringing down our game can actually be standardized and it is one of my minor ambitions to change this hitherto rather capricious procedure into that highly respectable thing known as an exact science.

Before elaborating my point let me sound a note of warning since in certain cities science in city planning has been decidedly overdone. The reaction from the "City Beautiful" has swung the pendulum too far the other way and the work has been put entirely in the charge of engineers who, while they have achieved excellent results from a scientific standpoint have failed to appreciate the vital importance of the social and aesthetic sides of the problem. In doing so they have attained results fully as unfortunate in their way as have those city planners who have approached the subject only from the standpoint of the city beautiful.

It is becoming more and more obvious that the best way to secure a city plan which will be lastingly satisfactory from all points of view and really comprehensive, is to put the work in charge of several experts, one an engineer, one an architect, and one, perhaps, a social expert. It is practically a physical impossibility for one man, in one lifetime, to acquire an adequate and impartial appreciation of all these points of view. Realizing their limitations they should be sufficiently broad-minded to seek first aid from specialists in landscape architecture, housing, recreation, transit, etc. This group of experts must work together from the start and consult continually with regard to each feature and phase of the city plan.

By such co-operation and by the standardized procedure of which I am about to give you a rough outline, it is possible to determine within a comparatively short time a plan which is not only the best for today, but which is so elastic that any changes during the next 50 or 100 years can be fitted into it with virtually no loss or alteration.

In emphasizing the scientific side of city planning I do not wish to administer a snub to the aesthetic side. Both phases are necessary to the complete city. The problems of convenience, of health, and of efficiency are matters of science, while the things which foster our own delight in the city and which impress the stranger within our gates, come within the range of the aesthetic. The development of both should go on side by side, the practical a little in advance because it most nearly affects our life and well-being. The aesthetic to stand the test of time must follow the lines laid down by the practical interests of the community. Psychologically it is quite justifiable that American city planning began with the "City Beautiful." The "City Scientific" would never have aroused such enthusiasm. However, after floundering around for a number of years we have now got our perspective and a sense of the proportion of things, and we know that considerations of health, convenience and efficiency, are of fundamental importance.

In the science of city planning the whole city is our laboratory. All its facts and symptoms are more or less under observation but the expert city planner soon sifts the significant from the less important.

Experience has shown to the expert that the significant facts must be collected under the following heads:

Streets.
Transportation of people.
Transportation of goods.
Factories and warehouses.
Food supply; markets.
Water supply and sanitation.
Housing.
Recreation.
Parks, boulevards, street planting.
Architecture.
Laws.
Financing—Methods of paying for improvements.

All of these, of course, are capable of infinite subdivision.

Within the space allotted to this paper it is manifestly impossible to go into detail but we will take a few typical subjects to illustrate the scientific method which applies to all.

Street Widening and Extension.—In any given city, before we begin to gather our data it is imperative to have clearly in mind the various types of street use. Streets are used by pedestrians, either moving along the sidewalks or crossing the roadways. The roadways are used by light horse-drawn vehicles, heavy horse-drawn trucks, light, swift-moving automobiles, heavy, slower moving automobile trucks, by bicycles and push carts—which are in most cases, hardly important enough to count—by street cars, and, in some instances, by motor buses.

We must further determine what is the ideal street arrangement on street cross-section for each of these types under various conditions. Highway engineers are pretty well agreed upon such types. We have our units of sidewalk width of 2 ft. per person, we have our units of roadway width of 8 ft. per vehicle, and we know that for so many slow moving vehicles, passing a given point in a street per hour we need so many units of width in order to prevent congestion and that so many swift moving vehicles demand so many units, that so many heavy trucks demand so many units, and that the varying combinations of these, demand a certain definite number of units of width in the street. We know that wherever possible it is desirable to segregate the different types of traffic, and put the swift moving automobiles on a street by themselves, and the slow heavy trucking on another street by itself and the street cars and ordinary vehicles on still a third street, but where we cannot realize this ideal the more nearly we can approximate it the better.

We are now in a position to gather our data for the particular case with some knowledge of what we are doing and why.

The first tool we need is a set of complete up-to-date surveys and maps of all existing and proposed streets together with their cross-sections and surfacing. We must have, also, contour maps if possible, models so we can visualize grades.

The next tool we need is a set of historical maps of the city made at periods from 10 to 25 years apart. These will give us a basis for determining the tendencies of growth of the city.

We should have made further maps showing the distribution of people both as to where they live and as to where they work. Also charts showing how people leave and enter the city by street cars or by trains. Also how goods and freight are handled and where.

Next, after this general data it is necessary for us to know the existing use of the streets at all of the critical points in the city, both at street juncture and in the centers of important blocks. Traffic counts should be taken simultaneously by one tabulator to each item of all the different kinds of traffic passing the given point. The pedestrian traffic in each direction on each sidewalk, the light horse-drawn traffic in either direction, the heavy trucking in either direction, the swift-moving automobile traffic in either direction and the street car traffic in either direction. On corners this becomes multiplied several times so that on important corners it has been found necessary to have as many as 32 men at once in order to tabulate simultaneously a correct count of the traffic passing these points. Furthermore, this tabulating should be done on various typical days under different weather and temperature conditions and also on some day of exceptional stress when the movement of large crowds taxes the street to the utmost. The data secured at all these strategic points should be tabulated under appropriate headings and arranged for immediate comparative reference.

By comparing these figures, at any given critical point with the standards and ideals as to street use, we can see, at a glance, whether or not, this street at this point is doing its work efficiently, whether it is over- or under-burdened. If a given street is working under capacity and a neighboring street is over-taxed, we can study means of diverting some of the traffic from the second street on to the first, either by traffic regulations or by cutting through a diverting channel. As to whether cutting through this diverting channel is good economy or not is a question which we will discuss later.

In case a given street is over-taxed and there is no parallel street through which traffic can be readily diverted then we can study the comparative advantage of widening the existing street or of cutting through a new street to take part of the traffic. In the first place, we should bear in mind that in widening a street there is always a point beyond which a street becomes too wide to be efficient because the two sides are so widely separated that people hesitate to cross the roadway. Then we must consider carefully the cost of widening the street, including all details and see if the gain through avoiding congestion of traffic and the gain to business on either side of the street will warrant such widening. To be more explicit counts should be taken with a view to determining the loss of time to pedestrians and to the various forms of traffic due to congestion and blocks caused by the narrowness of the street. This loss of time multiplied by the money value of the time of the people involved and by the time interest on the capital tied up in vehicles and their loads, will give us a definite figure. The aggregate of these figures for the year will sometimes reach amazing totals. If we then consider what capital on a 5 per cent basis this yearly waste represents, anyone can judge for himself whether the saving to the citizens warrants the cost of the improvement. It the cost of widening the street proves to be unwarranted the next problem is to see whether the traffic can be diverted through parallel side streets and if these are not wide enough whether they can be widened to good advantage. If these do not work out, then we should consider the desirability of cutting through new streets or extending existing streets in the neighborhood parallel to the congested street. The same method of testing the desirability of these solutions can be applied in each of these cases.

Every critical street corner must be analyzed to see where traffic goes, what proportion crosses and what proportion turns the corners. If a large percentage turns a given corner it is obvious that a cross connection between these streets would relieve that corner. The desirability and value of such a cross relief can be determined in the same scientific manner as street widening.

The same principles apply to streets in all parts of the city, and by considering each over-taxed and each under-used street in relation to others in its neighborhood it is possible to determine the one best solution for the case in hand, whether it be the widening or the extension of existing streets, or the cutting through of new streets.

Of course, we must bear in mind, in any given instance, that our best laid plans may be interfered with by some political or local prejudice and probably a certain amount of compromise will be necessary in order to get results.

Now all of this development of our plans is purely scientific and the best way of doing it can be as well determined now as through a process of sifting over a long period of years. The aesthetic enters in only to a slight degree. In a case where slight shift in the axis of a new street or the widening of an old street on one side instead of the other, would give us a vista of some impressive building due cognizance should be taken of this provided it does not call for an unwarranted increase in the cost of the improvement and does not otherwise invalidate the practical reasons for the original solution.

The same general principles apply in the case of transit, transportation and sanitation, as in the case of street widening. The same scientific investigation, analysis and deduction and the same definiteness in determining the best solution of the problems is now possible and feasible. If cities have failed to solve these problems it is because they have not gone at it in this scientific manner.

Housing.—Housing can be roughly divided into two main divisions, i. e., improvement of housing in already built up sections and the providing for housing in new sections. In either case, experience has developed working standards as to sanitation, lighting, air and convenience, and given us the minimum to go below which is criminal.

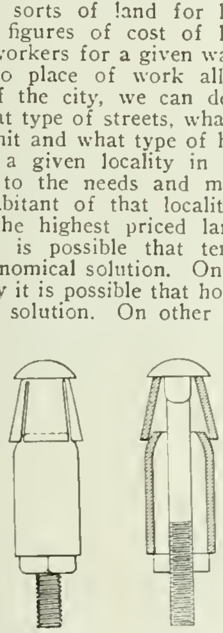
The obvious first step in any given city is to make a survey of existing conditions. It is important to have maps showing the distribution of the population locating at a glance the congested districts. Other maps showing the location of each kind of habitation with the increase of that type during each of a number of previous years, will determine the tendency of growth both as to direction and as to kind of dwelling. Then a number of typical blocks including in particular some of the worst, should be investigated with an intensive survey to discover the amount, character and location of housing conditions which fall below our minimum standards.

If, with regard to already built up areas, a proposed street improvement can be carried through a slum area without otherwise invalidating its usefulness, it will be of great advantage in the cleaning up of that area.

In the case of congested transit and traffic conditions in the center of the city, the determination of the best way of housing people in suburban areas and the relative distribution of such people with a veiw to their number per acre in any given district will have a marked influence on the relief of such congestion. Furthermore, the creation of desirable housing areas on the outskirts will tend to pull people away from the congested districts and these would be accordingly converted into commercial districts with a corresponding effect on the desirable width of streets and sidewalks in these parts of the town.

When it comes to the planning of new areas the whole problem can be worked out as scientifically as in the case of street widening and extension. Investigation will show just how many people can afford to spend a maximum of $10 a month for rent, how many $15 per month, how many $20, etc. It will show where they work and how far they ought to live from their work for the maximum efficiency.

Investigation will also show the cost of land throughout the city and the relative desirability of different sorts of land for housing use. With these figures of cost of land, of the number of workers for a given wage and with figures as to place of work all plotted on the maps of the city, we can determine accurately what type of streets, what type of lot and block unit and what type of house should be built in a given locality in order to be best suited to the needs and means of the normal inhabitant of that locality. For example, on the highest priced land near the factories, it is possible that tenements are the only economical solution. On land a little further away it is possible that houses in rows are the best solution. On other property the single house or the two family house will be the best solution, according to the habits and demands of the community. For each of these types of house experience has standardized the types of streets, blocks and lot units, which from all points of view give the best results. In the case of the tenement it consists of many not too wide streets, running north and south with the tenements in rows only two rooms deep, with north and south open spaces between them. In the case of the house in rows it consists of a corresponding north and south arrangement with lots more or less on the Philadelphia type. In the case of the two-family or one-family houses, it consists of an arrangement of plots from 50 to 75 ft. deep and from 30 to 40 ft. wide with such variety in direction and line of streets as aesthetic consideration may dictate. In each of these cases, however, the problem as to the width of roadways, sidewalks, grass plots, etc., must be worked out with a view both to present lot cost and to future convertibility when the character of the neighborhood may change.



A Simple Expansion Fastening.

The best type of plan of street block and lot units for any part of the city, can, by this program, be scientifically determined, all with a view to giving the maximum advantage from a housing standpoint. The whole could be done with scientific accuracy except for the variations due to the possibilities of different treatments from an aesthetic standpoint. In suburban areas, particularly in the cases of the one and two family houses there is an infinite variety of artistic schemes possible, all with very little loss of efficiency.

When we come to recreation we find the problems are similar to those of housing and that they can be solved in the same definite way according to scientific methods.

Laws and Financing.—Even the laws, financing and administration have all been standardized. The Bureau of Municipal Research in New York has, from the experience of cities all over the country worked out definite methods of handling these to secure the greatest efficiency with the minimum cost.

Architecture.—Architecture is a most important side of city planning. It has to do with the designing, grouping and setting of public buildings, the designing of bridges and quais and other water front improvements, the designing and location of public monuments, such as arches, columns, obelisks, fountains, exedras, statuary, etc., and with all street and park features such as subway and elevated stations, public comfort stations, waiting stations, advertising and other kiosks, lighting, telegraph and telephone poles, lighting fixtures, fire alarm and mail boxes, hydrants, water troughs, street names, water towers and gas tanks, and all temporary street architecture for parade or pageantry use. In the same connection we should consider landscape architecture.

In each of these cases, expreience has become standardized to the extent of having a best arrangement for use and a most economical construction. Otherwise, in contradistinction to all the previously discussed phases of city planning, architecture and landscape architecture are much more matters of aesthetics than of science. As in the artistic field so much depends on inspiration that the happiest solution of any given problem can never be counted on from any one designer at any given time. For that reason a competition among a limited number of the best designers is often warranted. However, before throwing these matters open to competition all the facts should be very carefully collected, arranged and presented in a clear and definite form to the competitors. In short, in our city planning work we have not made enough distinction between these two main phases of city planning: the aesthetic and the scientific.

In conclusion I would say that a great deal of our disagreement as to the method of attack and the relative importance of the various problems in connection with city development has resulted from a failure to recognize that we were often arguing about entirely different matters or from an entire different point of view. One man has been discussing the problem from the practical side and another from the aesthetic side. Now, it is quite feasible for us to get together and to understand each other, provided we recognize that there are these two points of view, and that each is justified in its place, and provided we can agree upon a dividing line between these two phases.

An Expansion Shell and Bolt for Bolting to Concrete or Other Masonry.

(Staff Article.)

An expansion bolt fastening for which high efficiency has been demonstrated by actual tests is shown by the accompanying sketch. To use the fastening it is dropped into a drilled hole of the proper size and by means of a hammer blow or by screwing down the nut, the cartridge-shaped part of the shell in forced into the slotted cone-shaped portion whose wings are expanded and take a grip on the sides of the holes. Several forms of this expansion shell are made. In one a screw-headed bolt is provided for by threading the inside of the cone-shaped portion of the shell. In another two cone-shaped sections are used, one fitting partly into the other. This fastening is manufactured by the Paine Co., Corn Exchange Bank Building, Chicago, Ill.

Street Cleaning in San Francisco.—A motor vacuum street sweeper has been tried out on San Francisco, similar to those used in Milan, Italy, and other European cities.

WATER WORKS

Cost of Constructing by Contract Water Pipe Extensions Aggregating 17.7 Miles in Chicago in 1912.

(Staff Article.)

Extensions of water mains in Chicago are built by contract and also by city workmen under the direction of the Water Pipe Extension Division of the Bureau of Water. The bulk of the extension work is done by city forces; for example, in 1912 the total miles of water pipe extensions was 92 and of this mileage only 17.7 miles, and this all 6, 8, and 10-in. main, were constructed by contract. The tabulations which follow cover the contract work alone. Figures on the work done by city forces are now being compiled and will be given in a succeeding article.

Of the 17.7 miles of pipe extension by contract in 1912, 14.2 miles were in streets not having sufficient residents to yield the required revenue for water service of 10 cts. per lineal foot of main. The work scheduled, therefore, has been nearly entirely in unpaved streets and as will be seen in earth trench.

EXTENSIONS OF 6-IN. MAINS.

There were 19 contracts for laying 6-in. mains; the average contract price per lineal foot was 98 cts., the minimum was 84 cts., and the maximum was $1.19. Valve basins were extra. The actual costs, based on the tabulations which follow were: minimum, 72.2 cts.; maximum, $1.194; average, 94.6 cts.

Avers Ave. to 304 ft. North.—The work was commenced Jan. 2, 1913, and completed Jan. 4, 1913, and included 386 ft. of 6-in. pipe laid 5 ft. underground. One 2½-in. hydrant was set. The contract price per lin. ft. was $0.97. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	3	$5.00	$ 15.00
Calkers	3	4.00	12.00
Laborers	26	3.00	78.00
Teams	1	5.00	5.00
Total			$110.00
Average per ft. for labor			0.28

	Price.	Cost.
Material:		
Pipe, 6.42 tons	$26.00	$166.92
Special castings, 215 lbs	.03	6.45
Hydrants, 1-2½-in. D. C.	51.00	51.00
Lead, 350 lbs	.05	17.50
Mason material, 1 basin	30.00	30.00
Coal and gaskets	....	1.00
Total		$272.87
Average per ft. for material		0.769
Average per ft., material and labor		1.049

Dobson Ave., 91st St. to 92d St.—The work was begun Nov. 28 and finished Dec. 5, 1912, and included 600 ft. of 6-in. pipe laid 5 ft. underground. Two 2½-in. D. C. hydrants were set and two hydrants drained. The contract price was $1.05 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	4½	$5.00	$ 22.50
Calkers	4½	4.25	19.13
Laborers	32	3.50	112.00
Teams	1	3.25	3.25
Total			$156.88
Average per lin. ft. for labor			0.261

	Price.	Cost.
Material:		
Pipe, 9.99 tons	$26.00	$259.74
Special castings, 440 lbs	0.03	13.20
Hydrants, 2-2½-in. D. C.	51.00	102.00
Lead, 436 lbs	0.05	21.80
Coal and gasket	....	.90
Total		$397.64
Average per lin. ft. for material		0.662
Av. per lin. ft. for material and labor		0.923

Euclid Ave., 74th St. to 228 Ft. North of 75th St.—The work was commenced July 3 and completed July 6, 1912, including 370 ft. of 6-in. pipe laid 5½ ft. underground. Two hydrants were set. The contract price was $1.19 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	2½	$4.00	$10.00
Calkers	2½	3.75	9.38
Laborers	12	3.50	42.00
Teams	1	4.25	4.25
Total			$65.63
Average per ft. for labor			0.177

Material:

	Price.	Cost.
Material:		
Pipe, 6.16 tons	$26.00	$160.16
Special castings, 415 lbs	0.03	12.45
Hydrants, 2-2½-in. D. C.	51.00	102.00
Lead, 312 lbs	0.05	15.60
Coal and gasket	0.80	0.80
Total		$291.01
Average per ft. for material		0.786
Average per ft. for material and labor.		0.963

Ellis Ave., 91st St. to 92d St.—The work was commenced Aug. 21 and completed Oct. 3, 1912, including 595 ft. of 6 in. pipe laid 5 ft. underground. Two hydrants were set and two drained. The contract price was $0.93 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	7	$4.00	$ 28.00
Calkers	6	4.00	24.00
Laborers	36	3.25	117.00
Teams	1	5.50	5.50
Backfilling, 595 ft		0.02½	14.77
Total			$189.27
Average per lin. ft. for labor			0.318

	Price.	Cost.
Material:		
Pipe, 9.91 tons	$ 3.33	$257.66
Special castings, 400 lbs	0.03	12.00
Hydrants, 2-2½ D. C	51.00	102.00
Lead, 472 lbs	0.05	23.60
Coal and gasket	....	3.25
Total		$398.51
Average per lin. ft. for material		0.636
Av. per lin. ft. for material and labor		0.954

41st Place, Kedzie to Albany Ave.—The work was commenced Aug. 1 and completed Aug. 10, 1912, including 635 ft. of 6-in. pipe laid 5 ft. under ground. Two hydrants were set and two drained. The contract price was $0.92 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	3	$ 5.00	$ 15.00
Calkers	4	4.00	16.00
Laborers	15	3.00	45.00
Teams	2	2.00	4.00
Backfilling, 635 ft		0.03¼	20.64
Machine	2	15.00	30.00
Total			$130.64
Average per. lin. ft. for labor			0.206

	Price.	Cost.
Material:		
Pipe, 10.55 tons	$26.00	$274.30
Hydrants, 2-2½ D. C	51.00	102.00
Lead, 500 lbs	0.05	250.00
Coal and gasket	1.30	1.30
Total		$627.60
Average per ft. for material		0.988
Average per ft. for material and labor.		1.194

58th St., Central Pk. Ave. to St. Louis Ave.—The work was commenced Aug. 2, and finished Aug. 7, 1912, and included 946 ft. of 6-in. pipe, laid 5 ft. underground. Three hydrants and one 6-in. Miller valve were set. One valve basin was built. The contract price was $0.91 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	5	$ 5.00	$ 25.00
Calkers	14	4.00	56.00
Laborers	52	3.25	169.00
Teams	1	5.50	5.50
Machine	2	15.00	30.00
Total			$285.50
Average per lin. ft. for labor			0.302

	Price.	Cost.
Material:		
Pipe, 15.75 tons	$26.00	$409.50
Special castings, 497 lbs	0.03	14.91
Valves 1-6 in	13.75	13.75
Hydrants, 3-2½ D. C	51.00	153.00
Lead, 756 lbs	0.05	37.80
Mason material, 1 basin	25.00	25.00
Coal and gasket	2.30	2.30
Total		$656.26
Average per lin. ft. for material		0.693
Av. per lin. ft. for material and labor		0.995

Iowa St., from Western Ave. to Oakley Ave.—The work was commenced June 18 and completed June 22, 1912, and included 496 ft. of 6-in. pipe laid 5½ ft. deep. One 2½-in. hydrant was set and one hydrant drained. The contract cost was $1.02 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	4½	$3.75	$ 16.87
Calkers	5	3.50	17.50
Laborers	24½	2.75 }	
Laborers	5	2.50 }	82.30
Teams	2	5.50 }	
Teams	1	3.50 }	14.50
Total			$131.17
Average per lin. ft. for labor			0.262

	Price.	Cost.
Material:		
Pipe, 8.26 tons	$26.00	$214.76
Special castings, 200 lbs	0.03	6.00
Hydrants, 1-2½ D. C	51.00	51.00
Lead, 368 lbs	0.05	18.40
Coal and gasket	....	.95
Total		$291.11
Average per lin. ft. for material		0.587
Av. per lin. ft. for material and labor		0.843

Kedzie Ave., 37th Pl. to 232 ft. n. of 36th St.—The work was commenced June 25 and completed Aug. 10, 1912, and included 68 ft. of 6-in. pipe and 1,277 ft. of 8-in. pipe laid 5 ft. underground. Two hydrants and one 8-in. Miller valve were set, one valve basin built and one drained. The contract price was $1.04 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	13	$3.75	$ 48.75
Calkers	15	3.50	52.50
Laborers	82	3.00	246.00
Teams	2	5.50	11.00
Total			$358.25
Average per lin. ft. for labor			0.266

	Price.	Cost.
Material:		
Pipe, 31.46 tons	$26.00	$817.96
Special castings, 1,014 lbs	0.03	30.42
Valves, 1 8-in	20.75	20.75
Hydrants, 2 2½ D. C	51.00	102.00
Lead, 1,400 lbs	0.05	70.00
Mason material, 1 basin	25.00	25.00
Coal and gasket	5.45	5.45
Total		$1,071.58
Average per lin. ft. for material		0.796
Av. per lin. ft. for material and labor		1.062

Lincoln St., from 71st St. to 72nd St.—The work was started July 1 and completed July 3, 1912, and included 734 ft. of 6-in. pipe laid 5½ ft. underground. One 2½-in. hydrant and one 6-in. Miller valve were set. One valve basin was built. The contract price was $0.85 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	3	$5.00	$ 15.00
Calkers	2	4.00	8.00
Laborers	42	2.75	115.50
Teams	1	5.00	5.00
Total			$143.50
Average per lin. ft. for labor			0.195

Material:	Price.	Cost.
Pipe, 12.22 tons	$26.00	$317.72
Special castings, 200 lbs	0.03	6.00
Valves, 1 6-in	13.75	13.75
Hydrants, 1 2½ D. C	51.00	51.00
Lead, 552 lbs	0.05	27.60
Mason material, 1 6-in. basin	25.00	25.00
Coal and gasket	....	210.00
Total		$651.07
Average per ft. for material		0.887
Average per ft. for material and labor.		1.082

May St., 85th St. to 86th St.—The work was commenced Dec. 26 and completed Dec. 30, 1912, and included 671 ft. of 6-in. pipe laid 5½ ft. underground. Two 2½-in. hydrants were set and two drained. The contract price was $0.92 per ft. The cost was as follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	4	$5.00	$ 20.00
Calkers	3	4.00	12.00
Laborers	50	3.00	150.00
Teams	1	5.00	5.00
Total			$187.00
Average per ft. for labor			0.282

	Price.	Cost.
Material:		
Pipe, 11.17 tons	$26.00	$289.42
Special castings, 555 lbs	0.03	16.65
Hydrants, 2 2½ D. C	51.00	102.00
Lead, 520 lbs	0.05	26.00
Coal and gasket	1.55	1.55
Total		$435.62
Average per ft. for material		0.649
Average per ft. for material and labor.		0.931

Marianna St., Elston Ave. to Western Ave., etc.—The work commenced July 19 and was completed July 25, 1912, and included 741 ft. of 6-in. pipe laid 5 ft. deep. One 2½-in. hydrant was set, and one drained. One 6-in. Miller valve was set, one valve basin built and one drained. The contract price was $0.84 per lin. ft. The cost follows.

	Days.	Rate.	Cost.
Labor:			
Foreman	6	$5.00	$ 30.00
Calkers	5	4.00	20.00
Laborers	43	3.25	139.75
Teams	1	6.50	6.50
Total			$196.25
Average per ft. for labor			0.265

	Price.	Cost.
Material:		
Pipe, 12.33 tons	$26.00	$320.58
Special castings, 745 lbs	0.03	22.35
Valves, 1 6-in	13.75	13.75
Hydrants, 1 2½ D. C	51.00	51.00
Lead, 576 lbs	0.05	28.80
Mason material, 1 basin	25.00	25.00
Coal and gasket	2.40	2.40
Total		$463.88
Average per ft. for material		0.626
Average per ft. for material and labor.		0.891

E. 98th St., Houston to P., Ft. W. & C. R. R.—The work was commenced Oct. 10 and completed Oct. 15, 1912, including 314 ft. of 6-in. pipe laid 5 ft. underground. One hydrant was set and one drained. The contract price was $1.18 per lin. ft. The cost was as follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	5	$4.00	$ 20.00
Calkers	5	4.00	20.00
Laborers	10	3.50	35.00
Teams	1	6.00	6.00
Total			$162.00
Average per lin. ft. for labor			0.516

Material:	Price.	Cost.
Pipe, 5.23 tons	$26.00	$135.98
Special castings, 215 lbs	0.03	6.45
Hydrants, 1 2½- D. C	51.00	51.00
Lead, 244 lbs	0.05	12.20
Coal and gasket	0.80	0.80
Total		$206.43
Average per ft. for material		0.657
Average per ft. for material and labor.		1.173

Spaulding Ave., Foster to 400 ft. South.—The work was started July 15 and completed July 17, 1912, and included 420 ft. of 6-in. pipe laid 5 ft. underground. One 2½-in. Dbl. hydrant was set, one hydrant drained, one 6-in. Miller valve set, one valve basin built, and one valve basin drained. The contract cost was $1.15 per lin. ft.

	Days.	Rate.	Cost.
Labor:			
Foreman	3	$5.00	$ 15.00
Calkers	3	4.00	12.00
Laborers	27	3.50	94.50
Teams	1	6.50	6.50
Total			$128.00
Average per lin. ft. for labor			0.305

	Price.	Cost.
Material:		
Pipe, 6.99 tons	$26.00	$181.74
Special castings, 240 lbs	0.03	7.20
Valves, 1 6-in	13.75	13.75
Hydrants, 1 2½ D. C	51.00	51.00
Lead, 384 lbs	0.05	19.20
Mason material, 1 basin	25.00	25.00
Coal and gasket	1.60	1.60
Total		$299.49
Average per lin. ft. for material		0.713
Av. per lin. ft. for material and labor		1.018

38th Pl., St. Louis Ave. to Central Park Ave.—The work was begun Aug. 2 and finished Aug. 3, 1912, and included 671 ft. of 6-in. pipe laid 5 ft. underground. Two 2½-in. D. C. hydrants were set, and one hydrant drained. The contract price was $0.92 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	2	$ 5.00	$ 10.00
Calkers	3	4.00	12.00
Laborers	11	3.00	33.00
Teams	1	4.00	4.00
Machine	2	15.00	30.00
Backfilling, 671 ft		0.03¼	21.80
Total			$110.80
Average per lin. ft. for labor			0.165

	Price.	Cost.
Material:		
Pipe, 11.17 tons	$26.00	$290.42
Special castings, 415 lbs	0.03	12.45
Hydrants, 2 2½ D. C	51.00	102.00
Lead, 500 lbs	0.05	25.00
Coal and gasket	1.15	1.15
Total		$431.02
Average per lin. ft. for material		0.642
Av. per lin. ft. for material and labor		0.807

Tremont Ave., 101st Pl. to 102nd St.—The work was begun May 28 and finished June 1, 1912, and included 410 ft. of 6-in. pipe laid 5 ft. underground. The contract price was $1.10 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	4	$5.00	$ 20.00
Laborers	27	3.25	87.75
Teams	1	5.00	5.00
Total			$112.75
Average per lin. ft. for labor			0.275

	Price.	Cost.
Material:		
Pipe, 6.83 tons	$26.00	$177.58
Special castings, 240 lbs	0.03	7.20
Lead, 296 lbs	0.05	14.80
Coal and gasket	1.25	1.25
Total		$200.83
Average per lin. ft. for material		0.490
Av. per lin. ft. for material and labor		0.765

39th Pl., Albany Ave. to Sacramento Ave.—The work was begun June 22, and finished June 26, 1912, and included 713 ft. of 6-in. pipe laid 5½ ft. deep. One 2½-in. hydrant was set, one hydrant drained, one 6-in. Miller valve set, one valve basin built and one valve basin drained. The contract price was $0.88 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	3	$5.00	$ 15.00
Calkers	3	4.00	12.00
Laborers	52	2.75	143.00
Teams	2	5.00	10.00
Total			$180.00
Average per lin. ft. per day			0.252

	Price.	Cost.
Material:		
Pipe, 11.87 tons	$26.00	$308.62
Special castings, 268 lbs	0.03	8.04
Valves, 1 6-in	13.75	13.75
Hydrants, 1 2½ D. C	51.00	51.00
Lead, 536 lbs	0.05	26.80
Mason material, 1 basin	25.00	25.00
Coal and gasket	2.30	2.30
Total		$435.51
Average per lin. ft. for material		0.610
Av. per lin. ft. for material and labor		0.862

Winchester Ave., 71st St. to 72nd Ave.—The work was started July 25 and completed July 27, 1912, and included 735 ft. of 6-in. pipe laid 5½ ft. underground. One hydrant was set. The contract price was $0.88 per lin. ft. The cost follows;

	Days.	Rate.	Cost.
Labor:			
Foreman	3	$ 5.00	$ 15.00
Calkers	4	4.00	16.00
Laborers	16	3.00	48.00
Teams	2	2.00	4.00
Machine	2	15.00	30.00
Backfilling, 735 ft		0.03¼	23.89
Total			$136.89
Average per ft. for labor			0.187

	Price.	Cost.
Material:		
Pipe, 12.24 tons	$26.00	$318.24
Special castings, 200 lbs	0.03	6.00
Hydrants, 1 2½ D. C	51.00	51.00
Lead, 700 lbs	0.05	35.00
Coal and gasket	1.75	1.75
Total		$411.99
Average per ft. for material		0.560
Average per ft. for material and labor.		0.747

West End Ave., 47th Ave. to 46th Ave.—The work was started July 13, and completed July 18, 1912, and included 1,486 ft. of 6-in. pipe laid 5 ft. underground. Three 2½-in. Dbls. hydrants were set, and three drained. One 6-in. Miller valve was set, one valve basin was built and one drained. The contract price was $0.88 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	6	$5.00	$ 30.00
Calkers	6	4.00	24.00
Laborers	96	3.00	288.00
Mason labor	1	5.00	5.00
Teams	1	5.00	5.00
Total			$352.00
Average per lin. ft. for labor			$0.237

	Price.	Cost.
Material:		
Pipe, 24.74 tons	$26.00	$643.24
Special castings, 600 lbs	0.03	18.00
Valves, 1 6-in	13.75	13.75
Hydrants, 3 2½ D. C	51.00	153.00
Lead, 1,187 lbs	0.05	59.35
Mason material, 1 basin	25.00	25.00
Coal and gasket	5.00	5.00
Total		$917.34
Average per lin. ft. for material		0.617
Av. per lin. ft. for material and labor		0.854

Yale St., 210 ft. N. of 114th St. to 235 ft. S. of 114th St.—The work was begun Nov. 25 and completed Nov. 26, 1912, and included 518 ft. of 6-in. pipe laid 5 ft. deep. The contract price was $0.98 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	2	$5.00	$ 10.00
Calkers	2	4.00	8.00
Laborers	33	3.00	99.00
Teams	1	5.00	5.00
Total			$122.00
Average per lin. ft. for labor			0.235

	Price.	Cost.
Material:		
Pipe, 8.641 tons	$26.00	$224.66
Special castings, 200 lbs	0.03	6.00
Lead, 396 lbs	0.05	19.80
Coal and gasket	1.90	1.90
Total		$252.36
Average per lin. ft. for material		0.487
Av. per lin. ft. for material and labor		0.722

EXTENSIONS OF 8-IN. MAINS.

The average contract price for the 8-in. pipe was $1.179 per lineal foot, the maximium price being $1.39 and the minimum $1.05. The average total cost to the contractor was $1.15, showing an average profit of 2.9 cts. per. lineal foot. The maximum total cost to the contractor was $1.63 and the minimum $0.891. The average labor cost was $0.237, the maximum $0.467 and the minimum $0.095. The average cost of materials was $0.896 per lineal foot, the maximum was $1.354 and the minimum $0.772. The costs follow:

Albany Ave., Lawrence Ave. to Argyle Ct.—Work was commenced July 6 and completed July 13, 1912, and included 1,285 ft. of 8-in. pipe laid 5½ ft. underground, four 2½-in. hydrants, set; four hydrants drained, one 8-in. Miller valve set, one valve basin built at a cost of $30 and one valve basin drained. Contract price per lin. ft. was $1.17. Costs as follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	7	$5.00	$ 35.00
Calkers	7	4.00	28.00
Laborers	73	3.25	237.25
Teams	1	5.00	5.00
Total			$305.25
Average per ft. for labor			0.24

	Price.	Cost.
Material:		
Pipe, 30.37 tons	$27.00	$819.99
Special castings, 5,685 lbs	0.03	170.55
Valves, 1 8-in	20.75	20.75
Hydrants, 4 2½ D. C	52.00	208.00
Lead, 1,425 lbs	0.05	71.25
Mason material, 1 basin	30.00	30.00
Coal and gasket	5.45	5.45
Total		$1,325.99
Average per ft. for material		1.03
Average per ft. for material and labor		1.27

Addison St., Western Ave. to Drainage Canal.—Work was started July 8 and completed Aug. 1, 1912, and included 2,047 ft. of 8-in. pipe laid 5½ ft. underground, three hydrants set and three drained, one 8-in. Miller valve, one valve basin built, and one drained. Contract price per lin. ft. was $1.14. Costs as follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	12	$4.00	$ 48.00
Calkers	19	4.25	80.75
Laborers	100	3.50	350.00
Teams	2	5.50	11.00
Total			$489.75
Average per ft. for labor			0.24

	Price.	Cost.
Material:		
Pipe, 48.62 tons	$26.00	$1,264.12
Special castings, 835 lbs	0.03	25.05
Valves, 1 8-in	20.75	20.75
Hydrants, 3 2½ D. C	51.00	153.00
Lead, 1,676 lbs	0.05	83.80
Mason material, 1 basin	30.00	30.00
Coal and gasket	....	4.25
Total		$1,580.97
Average per ft. for material		0.772
Average per ft. for material and labor		1.012

Bennett Ave., 72nd St. to 75th St.—The work was commenced May 3 and completed Sept. 7, 1912, and included 1,953 ft. of 8-in. pipe laid 5 ft. underground. Six hydrants and two 8-in. valves were set. Two valve basins were built. The contract price per lin. ft. was $1.14. The costs were as follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	11½	$5.00	$ 57.50
Calkers	12	3.50	42.00
Laborers	82	3.25	266.50
Teams	4	5.50 3.50	25.50
Total			$391.50
Average cost per lin. ft. for labor			0.20

	Price.	Cost.
Material:		
Pipe, 46.37 tons	$26.00	$1,205.62
Special castings, 2,392 lbs.	0.03	71.76
Valves, 2 8-in.	20.75	41.50
Hydrants, 6	51.00	306.00
Lead, 1,579 lbs.	0.05	78.95
Mason material, 2 basins	25.00	50.00
Coal and gasket 121 G 600 coal	0.25 0.20	7.20
Total		$1,761.03
Average cost per lin. ft. for material		0.902
Average cost per lin. ft. for material and labor		1.102

Carpenter St., 79th St. to 80th St.—The work was started Dec. 21 and finished Dec. 24, 1912, and included 598 ft. of 8-in. pipe laid 5 ft. underground. Two 2½-in. D. C. hydrants were set and two hydrants drained. One 8-in. Miller valve was set, one valve basin built and one valve basin drained. The contract price was $1.16 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	3	$5.00	$ 15.00
Calkers	3	4.00	12.00
Laborers	46	3.00	138.00
Total			$165.00
Average per ft. for labor			0.276

	Price.	Cost.
Material:		
Pipe, 14.20 tons	$ 26.00	$369.20
Special castings, 270 lbs.	0.03	8.10
Valves 1 8-in.	20.75	20.75
Hydrants, 2 2½ D. C.	51.00	102.00
Lead, 695 lbs.	0.05	34.65
Mason material, 1 basin	25.00	25.00
Coal and gasket	250.00	250.00
Total		$809.70
Average per ft. for material		1.354
Average per ft. for material and labor		1.63

Cornelia Ave., 50th Ave. to 190 ft. W. of 53d Ave.—The work was commenced Oct. 7 and finished Oct. 15, 1913, and included 2,227 ft. of 8-in. pipe laid 5 ft. underground. Six hydrants were set and two valves. The contract price was $1.11 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	4½	$ 5.00	$ 22.50
Calkers	6½	3.75	24.37
Laborers	37	3.50	129.50
Teams	3	5.00	15.00
Machine	4½	15.00	67.50
Total			$258.87
Average per lin. ft. for labor			0.116

	Price.	Cost.
Material:		
Pipe, 57.89 tons	$26.00	$1,505.14
Special castings, 2,136 lbs.	0.03	64.08
Valves, 2 8-in.	20.75	41.50
Hydrants, 6 2½ D. C.	51.00	306.00
Lead, 2,277 lbs.	0.05	113.75
Mason material, 2 basins	25.00	50.00
Coal and gasket	5.85	5.85
Total		$2,086.32
Average per lin. ft. for material		0.939
Av. per lin. ft. for material and labor		1.055

Cregier Ave., 75th St. to 77th St.—The work was commenced Nov. 4 and completed Nov. 11, 1912, and included 1,320 ft. of 8-in. pipe laid 5 ft. underground. Four hydrants and one valve were set, and one valve basin built. The contract price was $1.14 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	6	$5.00	$ 30.00
Calkers	5	4.00	20.00
Laborers	72	3.00	216.00
Teams	1	3.50	3.50
Total			$269.50
Average per lin. ft. for labor			0.204

	Price.	Cost.
Material:		
Pipe, 31.35 tons	$26.00	$ 815.10
Special castings, 16.06 lbs.	0.03	48.18
Valves, 1 8-in.	20.75	20.75
Hydrants, 4 2½-in.	51.00	204.00
Lead, 1,343 lbs.	0.05	67.15
Mason material, 1 8-in. V. B.	25.00	25.00
Coal and gasket	....	4.05
Total		$1,184.23
Average per ft. for material		0.897
Average per ft. for material and labor		1,101

Claremont Ave., 62nd St. to 63d St.—The work was commenced Aug. 6 and finished Aug. 7, 1912. It included 619 ft. of 8-in. pipe laid 5 ft. underground, two hydrants set, one valve set and one valve basin built. The contract price was $1.39 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	3	$ 5.00	$15.00
Calkers	5	4.00	20.00
Laborers	32	3.25	104.00
Teams	1	5.50	5.50
Digging machine	1	15.00	15.00
Patent connection	1	100.00	100.00
Total			$259.50
Average per lin. ft. for labor			0.419

	Price.	Cost.
Material:		
Pipe, 14.70 tons	$26.00	$382.20
Special castings, 540 lbs.	0.03	16.20
Valves, 1 8-in.	20.75	20.75
Hydrants, 2 2½ D. C.	51.00	102.00
Lead, 1,234 lbs.	0.05	61.70
Mason material, 1 basin	25.00	25.00
Coal and gasket	....	4.25
Total		$612.10
Average per ft. for material		0.989
Average per ft. for material and labor.		1.408

Euclid Ave., 79th St. to So. Chicago Ave.—The work was commenced Aug. 26 and completed Sept. 14, 1912, including 2,236 ft. of 8-in. pipe laid 5 ft. deep. Eight hydrants were set and seven drained, two valves were set, two valve basins built and one drained. The contract price was $1.18 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	16	$4.00	$ 64.00
Calkers	26	4.00	104.00
Laborers	78	3.25	253.50
Teams	1	5.50	5.50
Patent connection			100.00
Total			$527.00
Average per ft. for labor			0.236

	Price.	Cost.
Material:		
Pipe, 53.11 tons	$26.00	$1,380.86
Special castings, 2,557 lbs.	0.03	76.71
Valves, 2 8-in.	20.75	41.50
Hydrants, 8 2½ D. C.	51.00	408.00
Lead, 2,462 lbs.	0.05	123.10
Mason material, 2 valve basins	29.99	59.98
Coal and gasket	....	8.18
Total		$2,098.33
Average per ft. for material		0.938
Average per ft. for material and labor		1.174

Bennett Ave., 79th St. to So. Chicago Ave.—The work was commenced June 6 and completed June 20, 1912, and included 1,900 ft. of 8-in. pipe laid 5½ ft. underground. Seven 2½-in. hydrants, one 24 by 8 Pat. and one 8-in. Miller valve were set, and two valve basins built. The contract price was $1.25 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	9	$ 5.00	$ 45.00
Calkers	8	4.00	32.00
Laborers	134	2.75	368.00
Teams	1	5.50	5.50
Pat. cut	..	100.00	100.00
Total			$551.00
Average per ft. for labor			0.29

	Price.	Cost.
Material:		
Pipe, 45.62 tons	$26.00	$1,186.12
Special castings, 1,950 lbs.	0.03	58.50
Valves, 2 8-in.	20.75	41.50
Hydrants, 7 2½ D. C.	51.00	357.00
Lead, 2,040 lbs.	0.05	102.00
Mason material, 2 basins	25.00	50.00
Coal and gasket	....	7.80
Total		$1,800.92
Average per ft. for material		0.95
Average per ft. for labor and material		1.24

East End Ave., 75th St. to 77th St.—The work was commenced Oct. 29 and completed Nov. 11, 1912, including 1,317 ft. of 8-in. pipe laid 5 ft. underground. Four hydrants were set and four drained. One valve was set, one valve basin built and one valve basin drained. The contract price was $1.16 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	7	$5.00	$ 35.00
Calkers	5	4.00	20.00
Laborers	69	3.00	207.00
Teams	1	5.00	5.00
Total			$267.00
Average per ft. for labor			0.203

	Price.	Cost.
Material:		
Pipe, 32.50 tons	$26.00	$ 845.00
Special castings, 1,080 lbs.	0.03	32.40
Valves, 1 8-in.	20.75	20.75
Hydrants, 4 2½ D. C.	51.00	204.00
Lead, 1,335 lbs.	0.05	66.95
Mason material, 1 valve basin	25.00	25.00
Coal and gasket	....	3.85
Total		$1,197.95
Average per ft. for material		0.909
Average per ft. for material and labor		1.112

58th St., Hamlin Ave. to Central Park Ave.—The work was commenced July 29 and completed Aug. 2, 1912, and included 1,294 ft. of 8-in. pipe laid 5½ ft. underground. Nine 2½-in. D. C. hydrants and three 8-in. Miller valves were set. Three valve basins were built. The contract price was $1.09 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	7	$ 5.00	$ 35.00
Calkers	12	4.00	48.00
Laborers	65	3.00	185.00
Teams	1	5.50	5.50
Machine	5	15.00	75.00
Total			$348.50
Average per lin. ft. for labor			0.269

	Price.	Cost.
Material:		
Pipe, 30.75 tons	$26.00	$ 798.98
Special castings, 5,299 lbs.	0.03	98.97
Valves, 3 8-in.	20.75	62.25
Hydrants, 9 2½ D. C.	51.00	459.00
Lead, 2,973 lbs.	0.05	148.65
Mason material, 3 basins	25.00	75.00
Coal and gasket	7.60	7.60
Total		$1,650.45
Average per ft. for material		1.276
Average per ft. for material and labor		1.545

40th Ct., Argyle to Ainslee.—The work was commenced Dec. 9 and completed Dec. 14, 1912, and included 685 ft. of 8-in. pipe laid 5 ft. underground. Two 2½-in. D. C. hydrants were set. The contract price was $1.27 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	5	$5.00	$ 25.00
Calkers	5	5.00	25.00
Laborers	35	3.25	113.75
Teams	1	3.00	3.00
Total			$166.75
Average per lin. ft. for labor			0.243

	Price.	Cost.
Material:		
Pipe, 16 tons	$27.00	$432.00
Special castings, 540 lbs.	0.03	16.20
Hydrants, 2	50.00	100.00
Lead, 480 lbs.	0.05	24.00
Coal and gasket	4.50	4.50
Total		$576.70
Average per lin. ft. for material		0.842
Av. per lin. ft. for material and labor.		1.085

Hermitage Ave., 87th St. to 85th St.—The work was commenced July 5 and completed July 6, 1912, and included 1,298 ft. of 8-in. pipe laid 5½ ft. underground. Four 2½-in. hydrants and one 8-in. Miller valve were set. One valve basin was built. The contract price was $1.12 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	4	$ 4.00	$ 16.00
Calkers	7	4.00	28.00
Laborers	22	3.00	66.00
Teams	2	4.00	8.00
Digging machine	2½	15.00	37.50
Total			$155.50
Average per lin. ft. for labor			0.119

	Price.	Cost.
Material:		
Pipe, 30.32 tons	$26.00	$ 788.32
Special castings, 1,375 lbs.	0.03	41.25
Valves, 1 8-in.	20.75	20.75
Hydrants, 4 2½ D. C.	51.00	204.00
Lead, 1,400 lbs.	0.05	70.00
Mason material, 1 8-in. basin	25.00	25.00
Coal and gasket	....	3.30
Total		$1,152.62
Average per lin. ft. for material		0.904
Av. per lin. ft. for material and labor		1.023

Harding Ave., Division St. to Augusta St.—The work was commenced Aug. 5 and completed Aug. 14, 1912, and included 1,392 ft. of 8-in. pipe laid 5 ft. underground. Three hydrants were set and three drained. Two 8-in. Miller valves were set, two valve basins built and two drained. The contract price was $1.11 per lin. ft. The cost was as follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	6	$ 4.00	$ 24.00
Calkers	11	4.00	44.00
Laborers	28	3.00	84.00
Teams	1	4.00	4.00
Digging machine	2	15.00	30.00
Total			$186.00
Average per lin. ft. for labor			0.134

	Price.	Cost.
Material:		
Pipe, 33.06 tons	$26.00	$ 859.56
Special castings, 1,096 lbs.	0.03	32.88
Valves, 2 8-in.	20.75	41.50
Hydrants, 3 2½ D. C.	51.00	153.00
Lead, 1,502 lbs.	0.05	75.10
Mason material, 2 8-in basins	25.00	50.00
Coal and gasket	....	3.85
Total		$1,220.89
Average per lin. ft. for material		0.877
Av. per lin. ft. for material and labor		1.011

Hayes Ave., Southport Ave. to C. E. & L. S. R. R.—The work was commenced Aug. 1 and completed Aug. 23, 1912, and included 1,018 ft. of 8-in. pipe laid 4½ to 5 ft. underground. Three 2½-in. hydrants and one 8-in. Miller valve were set. One valve basin was built and one drained. The contract price was $1.12 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	8	$4.00	$ 32.00
Calkers	14	4.00	56.00
Laborers	42	3.25	136.50
Teams	2	5.50	11.00
Total			$235.50
Average per lin. ft. for labor			0.231
		Price.	Cost.
Material:			
Pipe, 24.17 tons		$26.00	$628.42
Special castings, 978 lbs		0.03	29.34
Valves, 1		20.75	20.75
Hydrants, 3		51.00	153.00
Lead, 1,064 lbs		0.05	53.20
Mason material, 1 8-in. basin		25.00	25.00
Coal and gasket		....	3.45
Total			$913.16
Average per lin. ft. for material			0.897
Av. per lin. ft. for material and labor			1.128

Honore St., 71st St. to 74th St.—The work was commenced July 13 and completed July 17, 1912, and included 1,997 ft. of 8-in. pipe laid 5 ft: underground. Six 2½-in. Dbls. hydrants and two 8-in. Miller valves were set. Two valve basins were built. The contract price was $1.14 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	5	$ 4.00	$ 20.00
Calkers	8½	4.00	34.00
Laborers	27	3.00	81.00
Teams	2	5.00	10.00
3 digging machines	..	15.00	45.00
Total			$190.00
Average per lin. ft. for labor			0.095
Material:		Price.	Cost.
Pipe, 48.42 tons		$26.00	$1,258.92
Special castings, 1,645 lbs		0.03	49.35
Valves, 2 8-in		20.75	41.50
Hydrants, 6 2½-d. c		51.00	306.00
Lead, 2,100 lbs		0.05	105.00
Mason material, 2 8-in. basins		25.00	50.00
Coal and gasket		....	4.45
Total			$1,815.22
Average per lin. ft. for material			0.909
Av. per lin. ft. for material and labor			1.004

Irvington Ave., 105th St. to 107th St.—The work was commenced July 1 and completed July 3, 1912, and included 1,304 ft. of 8-in. pipe laid 5½ ft. deep. Four 2½-in. hydrants were set, four hydrants drained, one 8-in. Miller valve set, one valve basin built and one valve basin drained. The contract price was $1.09 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	4	$ 5.00	$ 20.00
Calkers	6	4.00	24.00
Laborers	19	3.00	57.00
Teams	1	5.50	5.50
Backfilling, 1,300 ft	..	0.03¼	42.25
Machine	3	15.00	45.00
Total			$193.75
Average per lin. ft. for labor			0.149
Material:		Price.	Cost.
Pipe, 30.97 tons		$26.00	$ 805.22
Special castings, 1,209 lbs		0.03	36.27
Valves, 1 8-in		20.75	20.75
Hydrants, 4 2½-d. c		51.00	304.00
Lead, 1,440 lbs		0.05	72.00
Coal and gasket		3.00	3.00
Total			$1,141.24
Average per lin. ft. for material			0.874
Av. per lin. ft. for material and labor			1.023

Indiana Ave., 73d St. to 75th St.—The work was commenced June 3 and completed June 7, 1912, and included 1,331 ft. of 8-in. pipe laid 5½ ft. underground. Four hydrants and one 8-in. Miller valve were set. One valve basin was built. The contract price was $1.12 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	4	$ 5.00	$ 20.00
Calkers	4	4.00	16.00
Laborers	53	2.75	145.75
Teams	1	5.00	5.00
Total			$186.75
Average per lin. ft. for labor			0.140
Material:		Price.	Cost.
Pipe, 31.61 tons		$26.00	$ 821.86
Special castings, 1,105 lbs		0.03	33.15
Valves, 1 8-in		20.75	20.75
Hydrants, 4 2½-d. c		51.00	204.00
Lead, 1,376 lbs		0.05	68.80
Mason material, 1 basin		25.00	25.00
Coal and gasket		5.20	5.20
Total			$1,178.76
Average per lin. ft. for material			0.886
Av. per lin. ft. for material and labor			1.026

Indiana Ave., 300 ft. S. of 100th St. to 102nd St.—The work was started Nov. 20 and completed Nov. 25, 1912, and included 989 ft. of 8-in. pipe laid 5 ft. underground. Two 2½-in. D. C. hydrants were set, two hydrants drained, one 8-in. Miller valve set. one valve basin built, and one drained. The contract price was $1.06 per lin. ft. The cost follows.

	Days.	Rate.	Cost.
Labor:			
Foreman	4	$ 5.00	$ 20.00
Calkers	4	4.00	16.00
Laborers	57	3.00	171.00
Teams	1	4.00	4.00
Backfilling, 989 ft	..	0.03	29.67
Total			$240.67
Average per lin. ft. for labor			0.243
Material:		Price.	Cost.
Pipe, 23.48 tons		$26.00	$ 610.48
Special castings, 683 lbs		0.03	20.49
Valves, 1 8-in		20.75	20.75
Hydrants, 2 2½-d. c		51.00	102.00
Lead, 962 lbs		0.05	48.10
Mason material, 1 8-in		25.00	25.00
Coal and gasket		....	5.65
Total			$ 832.47
Average per lin. ft. for material			0.842
Av. per lin. ft. for material and labor			1.085

Lincoln St., 73d St. to 74th St.—The work was commenced June 26 and completed June 28, 1912, and included 630 ft. of 8-in. pipe laid 5½ ft. underground. Two 2½-in. hydrants and one 8-in. Miller valve were set. One valve basin was built. The contract price was $1.18 per lin. ft. The cost was as follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	3	$ 5.00	$ 15.00
Calkers	3	4.00	12.00
Laborers	55	2.75	151.25
Teams	1	3.50	3.50
Total			$181.75
Average per lin. ft. for labor			0.288
Material:		Price.	Cost.
Pipe, 14.96 tons		$26.00	$ 388.96
Special castings, 708 lbs		0.03	21.24
Valves, 1 8-in		20.75	20.75
Hydrants, 2 2½-d. c		51.00	102.00
Lead, 660 lbs		0.05	33.00
Mason material, 1 8-in. basin		25.00	25.00
Coal and gasket		....	3.60
Total			$ 594.55
Average per lin. ft. for material			0.943
Av. per lin. ft. for material and labor			1.231

La Fayette Ave., 108th St. to 300 ft. S. of 107th St.—The work was commenced Nov. 25 and finished Nov. 29, 1912, and included 302 ft. of 8-in. pipe laid 5 ft. deep. The contract price was $1.22 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	4½	$ 5.00	$ 22.50
Calkers	3	4.25	14.87
Laborers	22	3.25	71.50
Teams	1½	4.00	6.00
Total			$114.87
Average per ft. for labor			0.380
Material:		Price.	Cost.
Pipe, 7.17 tons		$26.00	$ 186.42
Special castings, 104 lbs		0.03	3.12
Lead, 219 lbs		0.05	15.95
Coal and gasket		....	1.05
Total			$ 196.54
Average per ft. for material			0.651
Average per ft. for material and labor			1.031

May St., 99th St. to 100th St.—The work was started Nov. 16 and completed Nov. 19, 1912; 664 ft. of 8-in. pipe was laid 5 ft. underground. Two hydrants were set and two drained. The contract price was $1.14 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	3	$ 5.00	$ 15.00
Calkers	3	4.00	12.00
Laborers	46	3.00	138.00
Teams	1	4.00	4.00
Total			$169.00
Average per lin. ft. for labor			0.255
Material:		Price.	Cost.
Pipe, 15.77 tons		$26.00	$ 410.02
Special castings, 565 lbs		0.03	16.95
Hydrants, 2 2½-d. c		51.00	102.00
Lead, 659 lbs		0.05	32.95
Coal and gasket		....	3.50
Total			$ 565.42
Average per lin. ft. for material			0.851
Av. per lin. ft. for material and labor			1.106

Muskegon Ave., 87th St. to 88th St.—The work was commenced Dec. 5 and completed Dec. 7, 1912, and included 641 ft. of 8-in. pipe laid 5 ft. deep. One 2½-in. D. C. hydrant was set and one hydrant drained. One 8-in. Miller valve was set and one valve basin drained. The contract cost was $1.19 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	3	$ 5.00	$ 15.00
Calkers	3	5.00	15.00
Laborers	28	3.50	98.00
Teams	2	4.00	8.00
Total			$136.00
Average per lin. ft. for labor			0.212
Material:		Price.	Cost.
Pipe, 15.22 tons		$26.00	$ 395.72
Special castings, 481 lbs		0.03	14.43
Valves, 1 8-in		20.75	20.75
Hydrants, 1 2½-d. c		51.00	51.00
Lead, 587 lbs		0.05	29.35
Coal and gasket		1.70	1.70
Total			$ 512.95
Average per lin. ft. for material			0.800
Av. per lin. ft. for material and labor			1.012

MacFarlane Ave., 79th St. to So. Chicago Ave.—The work was commenced June 8 and completed June 12, 1912, and included 1,023 ft. of 8-in. pipe laid 5 ft. underground. Four 2½-in. hydrants and on 24x8 Pa. valve were set. One valve basin was built. The contract price was $1.28 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	5	$ 5.00	$ 25.00
Calkers	5	4.00	20.00
Laborers	25	2.75	178.75
Teams	1	5.50	5.50
24x8 patent connection	..	100.00	100.00
Total			$328.25
Average per ft. for labor			0.320
Material:		Price.	Cost.
Pipe, 23.80 tons		$26.00	$ 618.80
Special castings, 1,105 lbs		0.03	33.15
Valves, 1 8-in		20.75	20.75
Hydrants, 4 2½-d. c		51.00	204.00
Lead, 5,410 lbs		0.05	270.50
Mason material, 1 basin		25.00	25.00
Coal and gasket		4.35	4.35
Total			$1,176.55
Average per ft. for material			1.15
Average per ft. for material and labor			1.47

Morgan St., 79th St. to 80th St.—The work was commenced June 24 and completed June 27, 1912, and included 600 ft. of 8-in. pipe laid 5½ ft. deep. Two 2½-in. hydrants were set and two drained, one 8-in. Miller valve was set, one valve basin built and one drained. The contract price was $1.21 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	4	$ 5.00	$ 20.00
Calkers	4	4.00	16.00
Laborers	35	3.00	105.00
Teams	1	5.00	5.00
Total			$146.00
Average per lin. ft. for labor			0.243
Material:		Price.	Cost.
Pipe, 14.25 tons		$26.00	$ 370.50
Special castings, 616 lbs		0.03	18.48
Valves, 1 8-in		20.75	20.75
Hydrants, 2 2½-d. c		51.00	102.00
Lead, 656 lbs		0.05	32.80
Mason material, 1 basin		25.00	25.00
Coal and gasket		2.25	2.25
Total			$ 571.78
Average per lin. ft. for material			0.953
Av. per lin. ft. for material and labor			1.196

91st Pl., St. Lawrence Ave. to South Park.—Work was commenced June 28 and completed July 5, 1912, and included 1,334 ft. of 8-in. pipe laid 7½ ft. underground. Four 2½-in. hydrants were set and one 8-in. Miller valve. One valve basin was built. The contract price was $1.17 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	6	$ 5.00	$ 30.00
Calkers	6	4.00	24.00
Laborers	58	3.25	188.50
Teams	1	5.00	5.00
Total			$247.50
Average per ft. for labor			0.185
Material:		Price.	Cost.
Pipe, 31.68 tons		$26.00	$ 823.68
Special castings, 1,173 lbs		0.03	35.19
Valves, 1 8-in		20.75	20.75
Hydrants, 4 2½-d. c		51.00	204.00
Lead, 1,371 lbs		0.05	68.55
Mason material, 1 basin		25.00	25.00
Coal and gasket		4.10	4.10
Total			$1,181.27
Average per ft. for material			0.885
Average per ft. for material and labor			1.070

97th St., Logan Ave. to Carpenter St.—The work was begun April 25 and finished May 2, 1912, including 432 ft. of 8-in. pipe laid 5 ft. underground. One 2½-in. hydrant was set and one drained, one 8-in. Miller valve was set, one valve basin built and one drained. The contract price was $1.25 per lin. ft. The cost follows:

	Days.	Rate.	Cost.
Labor:			
Foreman	5	$ 5.00	$ 25.00
Calkers	5	4.25	21.25
Laborers	43	3.50	150.50
Teams	1	5.00	5.00
Total			$201.75

Average per ft. for labor		0.467
Material:	Price.	Cost.
Pipe, 10.26 lbs.	$26.00	$ 266.76
Special castings, 330 lbs.	0.03	9.90
Valves, 1 8-in.	20.75	20.75
Hydrants, 1 2½-d. c.	51.00	51.00
Lead, 518 lbs.	0.05	25.90
Mason material, 1 basin	25.00	25.00
Coal and gasket	3.25	3.25
Total		$ 402.56
Average per ft. for material		0.929
Average per ft. for material and labor		1.396

Oakley Ave., 105th St to 107th St.—The work was begun Jan. 11 and completed Feb. 18, 1913, and included 1,577 ft. of 8-in. pipe laid 5 to 8 ft. deep. Five 2½-in. D. C. hydrants were set and three drained. One 8-in. Miller valve was set and one valve basin built. The contract price was $1.35 per lin. ft. The cost follows:

Labor:	Days.	Rate.	Cost.
Foreman	6	$ 5.00	$ 30.00
Calkers	13	3.00	39.00
Laborers	125	2.50	312.50
Teams	2	5.50	11.00
Total			$392.50
Average per lin. ft. for labor			0.25

Material:	Price.	Cost.
Pipe, 41.71* tons	$26.00	$1,084.46
Special castings, 1,669 lbs.	0.03	48.07
Valves, 1 8-in.	20.75	20.75
Hydrants, 5 2½-d. c.	51.00	255.00
Lead, 1,686 lbs.	0.05	84.30
Mason material, 1 basin	25.00	25.00
Total		$1,517.58
Average per lin. ft. for material		0.962
Av. per lin. ft. for material and labor		1.212

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*Estimated.

114th St., Princeton Ave. to Yale St.—The work was begun June 15 and completed June 17, 1912, and included 295 ft. of 8-in. pipe, laid 5 ft. underground. One 2½-in. hydrant was set and one drained. The contract price was $1.32 per lin. ft. The cost follows:

Labor:	Days.	Rate.	Cost.
Foreman	2	$ 5.00	$ 10.00
Calkers	2	4.00	8.00
Laborers	14	3.25	45.50
Teams	1	5.00	5.00
Total			$ 68.50
Average per lin. ft. for labor			0.232

Material:	Price.	Cost.
Pipe, 7.006 tons	$26.00	$ 182.16
Special castings, 330 lbs.	0.03	9.90
Hydrants, 1 2½-d. c.	51.00	51.00
Lead, 322 lbs.	0.05	16.10
Coal and gasket	1.50	1.50
Total		$ 260.66
Average per ft. for material		0.883
Average per ft. for material and labor		1.115

101st St., from Ave. "M" to Ave. "N."—The work was begun Oct. 16, completed Oct. 25, 1912, and included 333 ft. of 8-in. pipe laid 5 ft. underground. One 8-in. valve was set and one valve basin built. The contract price was $1.25 per lin. ft. The cost follows:

Labor:	Days.	Rate.	Cost.
Foreman	9	$ 4.00	$ 36.00
Calkers	6	4.00	24.00
Laborers	25	3.50	87.50
Teams	1	4.00	4.00
Total			$151.50
Average per lin. ft. for labor			0.455

Material:	Price.	Cost.
Pipe, 7.91 tons	$26.00	$ 205.66
Special castings, 286 lbs.	0.03	8.58
Valves, 1 8-in.	20.75	20.75
Lead, 333 lbs.	0.05	16.65
Mason material, 1 basin	25.00	25.00
Coal and gasket	1.65	1.65
Total		$ 278.29
Average per ft. for material		0.836
Average per ft. for material and labor		1.291

114th St., Harvard Ave. to Stewart Ave.—The work was begun Oct. 2 and completed Oct. 10, 1912. It included 331 ft. of 8-in. pipe laid 5 ft. underground. One 8-in. Miller valve was set and one valve basin built. The contract price was $1.10 per lin. ft. The cost was as follows:

Labor:	Days.	Rate.	Cost.
Foreman	6	$ 4.00	$ 24.00
Calkers	6	4.00	24.00
Laborers	15	3.25	48.75
Teams	1	5.00	5.00
Total			$101.75
Average per ft. for labor			0.307

Material:	Price.	Cost.
Pipe, 7.86 tons	$26.00	$ 204.36
Valves, 1 8-in.	20.75	20.75
Lead, 426 lbs.	0.05	21.30
Mason material, 1 basin	25.00	25.00
Coal and gasket	1.50	1.50
Total		$ 272.91
Average per ft. for material		0.824
Average per ft. for material and labor		1.131

Princeton Ave., 113th St. to 114th St.—The work was started June 17 and finished June 22, 1912, and included 672 ft. of 8-in. pipe laid 5½ ft. underground. One 2½-in. hydrant was set, one hydrant drained, one 8-in. Miller valve set, one valve basin built and one drained. The contract price was $1.18 per lin. ft. The cost follows:

Labor:	Days.	Rate.	Cost.
Foreman	6	$ 5.00	$ 30.00
Calkers	6	4.00	24.00
Laborers	40	3.25	130.00
Teams	1	5.00	5.00
Total			$189.00
Average per lin. ft. for labor			0.281

Material:	Price.	Cost.
Pipe, 15.96 tons	$26.00	$ 414.96
Special castings, 984 lbs.	0.03	29.52
Valves, 1 8-in.	20.75	20.75
Hydrants, 1 2½-d. c.	51.00	51.00
Lead, 747 lbs.	0.05	35.35
Mason material, 1 basin	25.00	25.00
Coal and gasket	3.50	3.50
Total		$ 580.08
Average per ft. for material		0.863
Average per ft. for material and labor		1.144

Pease Ave., Fullerton Ave. to Diversey Ave.—The work was started Sept. 11 and finished Sept. 26, 1912. It included 2,626 ft. of 8-in. pipe laid 5 ft. underground. Eight 2½-in. D. C. hydrants were set and four drained. Two 8-in. Miller valves were set, two valve basins built and two valve basins drained. The contract price was $1.14 per lin. ft. The cost follows:

Labor:	Days.	Rate.	Cost.
Foreman	6	$ 5.00	$ 30.00
Calkers	7	3.75	26.25
Laborers	53	3.25	172.25
Mason labor	½	10.00	5.00
Teams	2	4.25	8.50
Backfilling, 2,626 ft.		0.03	78.78
Machine, 5 ft.		15.00	75.00
Total			$395.78
Average per ft. for labor			0.157

Material:	Price.	Cost.
Pipe, 62.37 tons	$26.00	$1,621.62
Special castings, 23.28 lbs.	0.03	69.84
Valves, 2 8-in.	20.75	41.50
Hydrants, 8 2½-d. c.	51.00	408.00
Lead, 2,701 lbs.	0.05	135.05
Mason material, 2 basins	25.00	50.00
Coal and gasket	6.85	6.85
Total		$2,332.86
Average per ft. for material		0.89
Average per ft. for material and labor		1.047

Rhodes Ave., 77th St. to 79th St.—The work was started Aug. 14 and finished Aug. 20, 1912, including 1,229 ft. of 8-in. pipe laid 5 ft. underground. Four hydrants were set and four drained. One valve was set, one basin built and oned rained. The contract price was $1.19. The cost follows:

Labor:	Days.	Rate.	Cost.
Foreman	6	$ 4.00	$ 24.00
Calkers	6	4.00	24.00
Laborers	26	3.25	84.50
Teams	1	2.50	2.50
Patent connection		....	100.00
Backfilling, 1,229 ft.		0.02½	30.72
Total			$266.72
Average per ft. for labor			0.217

Material:	Price.	Cost.
Pipe, 29.19 tons	$26.00	$ 758.94
Special castings, 10.80 lbs.	0.03	32.40
Valves, 1 8-in.	20.75	20.75
Hydrants, 4 2½-d. c.	51.00	204.00
Lead, 1,309 lbs.	0.05	65.45
Mason material, 1 basin	25.00	25.00
Coal and gasket	3.70	3.70
Total		$1,110.24
Average per ft. for material		0.903
Average per ft. for material and labor		1.120

Ridgeland Ave., 75th St. to 77th St.—The work was started Nov. 1 and finished Nov. 11, 1912, and included 1,307 ft. of 8-in. pipe laid 5 ft. underground. Four hydrants were set, four hydrants drained, one valve set, one valve basin built and one valve basin drained. The contract price was $1.14 per lin. ft. The cost follows:

Labor:	Days.	Rate.	Cost.
Foreman	5	$ 5.00	$ 25.00
Calkers	4	4.00	16.00
Laborers	59	3.00	177.00
Mason labor	1	5.00	5.00
Total			$223.00
Average per ft. for labor			0.170

Material:	Price.	Cost.
Pipe, 31.04 tons	$26.00	$ 807.04
Special castings, 1,503 lbs.	0.03	45.09
Valves, 1 8-in.	20.75	20.75
Hydrants, 4 2½-d. c.	51.00	204.00
Lead, 1,234 lbs.	0.05	61.70
Mason material, 1 basin	25.00	25.00
Coal and gasket	3.85	3.85
Total		$1,167.43
Average per ft. for material		0.893
Average per ft. for material and labor		1.063

Rockwell St., 71st St. to 74th St.—The work was begun July 18 and finished July 25, 1912, and included 2,576 ft. of 8-in. pipe laid 5 ft. and 4½ ft. underground. Nine hydrants and two 8-in. Miller valves were set. Two valve basins were built. The contract price was $1.19 per lin. ft. The cost follows:

Labor:	Days.	Rate.	Cost.
Foreman	7	$ 5.00	$ 35.00
Calkers	9	4.00	36.00
Laborers	44	3.00	132.00
Mason labor	1	10.00	10.00
Teams	3	2.66	8.00
Machine	5	15.00	75.00
Backfilling, 2,576 ft.		0.03½	83.72
Total			$379.72
Average per ft. for labor			0.149

Material:	Price.	Cost.
Pipe, 61.18 tons	$26.00	$1,590.68
Special castings, 3,378 lbs.	0.03	101.34
Valves, 2 8-in.	20.75	41.50
Hydrants, 9 2½-d. c.	51.00	459.00
Lead, 2,850 lbs.	0.05	142.50
Mason material, 2 basins	25.00	50.00
Coal and gasket	5.80	5.80
Total		$2,390.82
Average per ft. for material		0.929
Average per ft. for material and labor		1.078

71st Ave., Greenwood Ter. to Schubert Ave.—The work was started Aug. 19 and finished Aug. 27, 1912, and included 1,332 ft. of 8-in. pipe laid 5 ft. underground. Three hydrants were set and three drained. One valve was set, one valve basin built and one drained. The contract price was $1.07 per lin. ft. The cost follows:

Labor:	Days.	Rate.	Cost.
Foreman	4	$ 5.00	$ 20.00
Calkers	4½	3.75	16.88
Laborers	28	3.50	98.00
Mason labor	1	5.50	5.50
Teams	2	5.50	11.00
Machine	3	15.00	45.00
Backfilling, 1,332 ft.		0.03	39.96
Total			$236.34
Average per lin. ft. for labor			0.177

Material:	Price.	Cost.
Pipe, 31.63 tons	$26.00	$ 822.38
Special castings, 1,454 lbs.	0.03	43.62
Valves, 1 8-in.	20.75	20.75
Hydrants, 3 2½-d. c.	51.00	153.00
Lead, 1,472 lbs.	0.05	73.60
Mason material, 1 basin	25.00	25.00
Coal and gasket	3.85	3.85
Total		$1,142.20
Average per lin. ft. for material		0.857
Av. per lin. ft. for material and labor		1.034

71st Pl., Ada to Ashland Ave.—The work was begun Aug. 15 and finished Aug. 22, 1912, and included 1,788 ft. of 8-in. pipe laid 5 ft. underground. Three hydrants were set and three drained. Two valves were set, two valve basins built and two drained. The contract price was $1.06. The cost follows:

Labor:	Days.	Rate.	Cost.
Foreman	5	$ 5.00	$ 25.00
Calkers	8	. 4.00	32.00
Laborers	52	3.25	169.00
Mason labor	2	6.00	12.00
Machine	3	15.00	45.00
Backfilling, 1,788 ft.		0.03	53.64
Total			$336.64
Average per lin. ft. for labor			0.188

Material:	Price.	Cost.
Pipe, 43.47 tons	$26.00	$1,130.22
Special castings, 1,923 lbs.	0.03	57.69
Valves, 2 8-in.	20.75	41.50
Hydrants, 3 2½-d. c.	51.00	153.00
Lead, 1,797 lbs.	0.05	89.85
Mason material, 2 basins	25.00	50.00
Coal and gasket	....	7.50
Total		$1,529.76
Average per lin. ft. for material		0.855
Av. per lin. ft. for material and labor		1.043

72nd St., Ashland Ave. to Ada St.—The work was begun Aug. 12 and completed Aug. 21, 1912, and included 1,791 ft. of 8-in. pipe laid 5 ft. deep. Three hydrants were set, two drained, two valves set, two valve basins built, two valve basins drained. The contract price was $1.06 per lin. ft. The cost follows:

Labor:	Days.	Rate.	Cost.
Foreman	5	$ 5.00	$ 25.00
Calkers	8	4.00	32.00
Laborers	52	3.50	182.00
Mason labor	1	6.00	6.00
Backfilling, 1,191 ft.		0.25	44.77
Total			$289.77
Average per lin. ft. for labor			0.162

Material:	Price.	Cost.
Pipe, 42.54 tons	$26.00	$1,106.04
Special castings, 2,170 lbs	0.03	65.10
Valves, 2 8-in	20.75	41.50
Hydrants, 3 2½-d. c	51.00	153.00
Lead, 1,805 lbs	0.05	90.25
Mason material, 2 basins	25.00	50.00
Coal and gasket	7.80	7.80
Total		$1,513.69
Average per lin. ft. for material		0.845
Av. per lin. ft. for material and labor		1.007

73d St., Ada St. to Ashland Ave.—The work was started Aug. 7 and completed Aug. 12, 1912, and included 1,794 ft. of 8-in. pipe laid 5 ft. deep. Four hydrants were set, one valve set, one valve basin built and one drained. The contract price was $1.05 per lin. ft. The cost follows:

Labor:	Days.	Rate.	Cost.
Foreman	4	$ 5.00	$ 20.00
Calkers	7	4.00	28.00
Laborers	41	3.25	133.25
Teams	1	5.00	5.00
Machine	3	15.00	45.00
Backfilling, 1,794 ft		0.025	44.85
Total			$276.10
Average per lin. ft. for labor			0.154

Material:	Price.	Cost.
Pipe, 42.60 tons	$26.00	$1,107.60
Special castings, 1,105 lbs	0.03	33.15
Valves, 1 8-in	20.75	20.75
Hydrants, 4 2½-d. c	51.00	204.00
Lead, 1,725 lbs	0.05	86.25
Mason material, 1 basin	25.00	25.00
Coal and gasket	5.35	5.35
Total		$1,482.10
Average per lin. ft. for material		0.826
Av. per lin. ft. for material and labor		0.980

Saginaw Ave., 83d St. to 82nd St.—The work was begun Dec. 3, 1912, and completed Jan. 3, 1913, and included 645 ft. of 8-in. pipe laid 5 ft. deep. Two 2½-in. hydrants and one 24x8-in. valve were set. One valve basin was built. The contract price was $1.31 per lin. ft. The cost follows:

Labor:	Days.	Rate.	Cost.
Foreman	3	$ 5.00	$ 15.00
Calkers	2	4.00	8.00
Laborers	37	3.00	111.00
Mason labor	1	5.00	5.00
Teams	1	5.00	5.00
Total			$144.00
Average per lin. ft. for labor			0.223

Material:	Price.	Cost.
Pipe, 15.33 tons	$26.00	$ 398.32
Special castings, 565 lbs	0.03	16.95
Valves, 1 8-in	20.75	20.75
Hydrants, 2 2½-d. c	51.00	102.00
Lead, 648 lbs	0.05	32.40
Mason material, 1 basin	25.00	25.00
Coal and gasket	2.65	2.65
Total		$ 598.07
Average per lin. ft. for material		0.927
Av. per lin. ft. for labor and material		1.150

Springfield Ave., Courtland St. to Armitage Ave.—The work was begun July 20 and completed July 23, 1912, and included 596 ft. of 8-in. pipe laid 5½ ft. deep. One 2½-in. hydrant was set and one drained. The contract price was $1.30 per lin. ft. The cost follows:

Labor:	Days.	Rate.	Cost.
Foreman	3	$ 5.00	$ 15.00
Calkers	3	4.00	12.00
Laborers	39	3.00	117.00
Teams	1	5.00	5.00
Total			$149.00
Average per lin. ft. for labor			0.248

Material:	Price.	Cost.
Pipe, 14.15 tons	$26.00	$ 367.90
Special castings, 295 lbs	0.03	8.85
Hydrants, 1 2½-d. c	51.00	51.00
Lead, 561 lbs	0.05	28.05
Coal and gasket	3.10	3.10
Total		$ 458.90
Average per lin. ft. for material		0.769
Av. per lin. ft. for labor and material		1.017

Throop St., W. 79th St. to 77th St.—The work was begun May 17 and completed May 24, 1912, and included 1,310 ft. of 8-in. pipe laid 5½ ft. deep. Four hydrants were set, four hydrants drained, one 8-in. Miller valve set, one valve basin built and one drained. The contract price was $1.18 per lin. ft. The cost follows:

Labor:	Days.	Rate.	Cost.
Foreman	5	$ 5.00	$ 25.00
Calkers	5	4.00	20.00
Laborers	65	2.75	178.75
Mason labor	1	5.00	5.00
Teams	1	5.00	5.00
Backfilling, 1,310 ft		0.025	32.75
Total			$266.50
Average per lin. ft. for labor			0.203

Material:	Price.	Cost.
Pipe, 21.11 tons	$26.00	$ 548.86
Special castings, 1,105 lbs	0.03	33.15
Valves, 1 8-in	20.75	20.75
Hydrants, 4 2½-d. c	51.00	204.00
Lead, 1,306 lbs	0.05	65.30
Mason material, 1 basin	25.00	25.00
Coal and gasket	4.40	4.40
Total		$ 901.46
Average per lin. ft. for material		0.688
Av. per lin. ft. for material and labor		0.891

Vincennes Ave., 77th St. to 79th St.—Work was started May 5 and completed May 12, 1912, and included 1,358 ft. of 8-in. pipe laid 5 ft. underground. Four hydrants and two 8-in. Miller valves were set. Two valve basins were built. The contract price was $1.19 per lin. ft. The cost follows.

Labor:	Days.	Rate.	Cost.
Foreman	4	$ 5.00	$ 20.00
Calkers	4	4.00	16.00
Laborers	67	2.75	184.25
Mason labor	1	10.00	10.00
Teams	1	5.00	5.00
Patent connection		100.00	100.00
Total			$335.25
Average per lin. ft. for labor			0.247

Material:	Price.	Cost.
Pipe, 32.25 tons	$26.00	$ 838.50
Special castings, 1,452 lbs	0.03	43.56
Valves, 2 8-in	20.75	41.50
Hydrants, 4 2½-d. c	51.00	204.00
Lead, 1,312 lbs	0.05	65.60
Mason material, 2 basins	25.00	50.00
Coal and gasket	4.95	4.95
Total		$1,248.11
Average per lin. ft. for material		0.919
Av. per lin. ft. for material and labor		1.166

Vernon Ave., 77th St. to 79th St.—The work started July 9 and was finished July 12, 1912, and included 1,359 ft. of 8-in. pipe laid 5½ ft. underground. Four hydrants and two 8-in. Miller valves were set. Two valve basins were built. The contract price was $1.19 per lin. ft. The cost follows:

Labor:	Days.	Rate.	Cost.
Foreman	4	$ 5.00	$ 20.00
Calkers	4	4.00	16.00
Laborers	64	2.75	176.00
Mason labor	1	10.00	10.00
Teams	1	6.00	6.00
Total			$228.00
Average per lin. ft. for labor			0.168

Material:	Price.	Cost.
Pipe, 32.28 tons	$26.00	$ 839.28
Special castings, 1,572 lbs	0.03	47.16
Valves, 2 8-in	20.75	41.50
Hydrants, 4 2½-d. c	51.00	204.00
Lead, 1,153 lbs	0.05	57.65
Mason material, 2 basins	25.00	50.00
Coal and gasket	7.15	7.15
Total		$1,246.74
Average per lin. ft. for material		0.918
Av. per lin. ft. for material and labor		1.086

Winchester Ave., 73d St. to 74th St.—The work was started June 28 and completed June 29, 1912, and included 631 ft. of 8-in. pipe laid 5½ ft. deep. Two 2½-in. hydrants and one 8-in. Miller valve were set. One valve basin was built. The contract price was $1.18 per lin. ft. The cost follows:

Labor:	Days.	Rate.	Cost.
Foreman	2	$ 5.00	$ 10.00
Calkers	2	4.00	8.00
Laborers	37	2.75	101.75
Teams	1	5.00	5.00
Total			$124.75
Average per lin. ft. for labor			0.197

Material:	Price.	Cost.
Pipe, 14.99 tons	$26.00	$ 389.74
Special castings, 708 lbs	0.03	21.24
Valves, 1 8-in	20.75	20.75
Hydrants, 2 2½-d. c	51.00	202.00
Lead, 676 lbs	0.05	33.80
Mason material, 1 basin	25.00	25.00
Coal and gasket	2.70	2.70
Total		$ 695.23
Average per lin. ft. for material		1.101
Av. per lin. ft. for material and labor		1.298

Wabash Ave., 75th St. to 79th St.—The work started Nov. 12 and was finished Dec. 7, 1912, and included 2,625 ft. of 8-in. pipe laid 5 ft. underground. Nine 2½-in. D. C. hydrants were set and nine cleaned. One 24x8 valve and one 8-in. Miller valve were set. Two valve basins were built and two drained. The contract price was $1.17 per lin. ft. The cost follows:

Labor:	Days.	Rate.	Cost.
Foreman	19	$ 5.00	$ 95.00
Calkers	16	4.50	72.00
Laborers	134	3.25	435.50
Teams	1	9.50	9.50
Patent connection		....	100.00
Total			$712.00
Average per lin. ft. for labor			0.271

Material:	Price.	Cost.
Pipe, 62.34 tons	$26.00	$1,620.84
Special castings, 2,430 lbs	0.03	72.90
Valves, 2 8-in	20.75	41.50
Hydrants, 9 2½-d. c	51.00	459.00
Lead, 2,798 lbs	0.05	139.90
Mason material, 2 basins	25.00	50.00
Coal and gasket	8.30	8.30
Average per lin. ft. for material		0.912
Av. per lin. ft. for material and labor		1.183

Winchester Ave., 97th St. to 98th St.—The work was started Nov. 12 and completed Nov. 16, 1912, and included 674 ft. of 8-in. pipe. One hydrant was set and one drained. One 8-in. Miller valve was set, one valve basin built and one valve basin drained. The contract price was $1.17. The cost follows.

Labor:	Days.	Rate.	Cost.
Foreman	5	$ 5.00	$ 25.00
Calkers	4	4.00	16.00
Laborers	72	3.00	216.00
Mason labor	2	5.00	10.00
Teams	1	5.00	5.00
Total			$272.00
Average per lin. ft. for labor			0.403

Material:	Price.	Cost.
Pipe, 16 tons	$26.00	$ 416.00
Special castings, 698 lbs	0.03	20.94
Valves, 1 8-in	20.75	20.75
Hydrants, 1 2½-d. c	51.00	51.00
Lead, 659 lbs	0.05	32.95
Mason material, 1 basin	25.00	25.00
Coal and gasket	2.50	2.50
Total		$ 569.14
Average per lin. ft. for material		0.844
Av. per lin. ft. for material and labor		1.247

Yates Ave., 83d St. to So. Chicago Ave.—The work was started Nov. 27, 1912, and completed Dec. 4, 1912, and included 2,548 ft. of 8-in. pipe laid 5 ft. underground. Eight 2½-in. D. C. hydrants were set. One 24x8-in. Miller and two 8-in. Miller valves were set. Two valve basins were built. The contract price was $1.18 per lin. ft. The cost follows:

Labor:	Days.	Rate.	Cost.
Foreman	7	$ 5.00	$ 35.00
Calkers	7	4.00	28.00
Laborers	94	3.00	282.00
Mason labor	2	5.00	10.00
Teams	1	5 00	5.00
Patent connection		100.00	100.00
Total			$400.00
Average per lin. ft. for labor			0.156

Material:	Price.	Cost.
Pipe, 60.52 tons	$26.00	$1,573.52
Special castings, 3,158 lbs	0.03	94.74
Valves, 2 8-in	20.75	41.50
Hydrants, 8 2½-d. c	51.00	408.00
Lead, 2,765 lbs	0.05	138.25
Mason material, 2 basins	25.00	50.00
Coal and gasket	....	11.75
Total		$2,317.76
Average per ft. for material		0.909
Average per ft. for material and labor		1.065

EXTENSIONS OF 12-IN. MAINS.

The average contract price for 12-in. main was $1.60 per lineal foot. The maximum was $1.70 and the minimum was $1.16. The average total cost of the contractor was $1.51, showing an average profit of 9 cts. per lineal foot. The maximum total cost to the contractor was $1.67 and the minimum $1.188. The average labor cost was $0.224, the maximum was $0.29 and the minimum was $0.154. The average cost of material was $1.28, the maximum was $1.406 and the minimum was $0.963. The costs of the work follows:

Belmont Ave., 40th Ave. to 43d Ave.—The work was commenced Nov. 30 and completed Dec. 7, 1912, and included 2,012 ft. of 12-in. pipe and 24 ft. of 6-in. pipe laid 5 ft. underground. Four 2½-in. D. C. hydrants were set and four hydrants drained. One 12-in. Miller valve set, one valve basin built and one drained. The contract prise was $1.66 per lin. ft. The cost follows:

Labor:	Days.	Rate.	Cost.
Foreman	6	$ 5.00	$ 30.00
Calkers	12	4.00	48.00
Laborers	51	3.00	153.00
Teams	2	4.00	8.00
Machine	5	15.00	75.00
Total			$314.00
Average per ft. for labor			0.154

Material:	Price.	Cost.
Pipe, 82.98 tons	$26.00	$2,157.48
Special casting, 2,695 lbs	0.03	80.85
Valves, 1 12-in. Miller	34.25	34.25
Hydrants, 4 2½-in. d. c	51.00	204.00
Lead, 3,300 lbs	0.05	165.00
Mason material, 1 basin	30.00	30.00
Coal and gasket	....	7.50
Total		$2,679.08
Average per ft. for material		1.315
Average per ft. for labor and material		1.469

Central Ave., North Ave. to Hirsch St.—The work was begun Oct. 23 and completed Nov. 9, 1912, including 1,275 ft. of 12-in. pipe laid 5 ft. deep. Four hydrants were set and four drained, one valve set, one valve basin built and one drained. The contract price was $1.77 per lin. ft. The cost follows:

Labor:	Days.	Rate.	Cost.
Foreman	5	$ 5.00	$ 25.00
Calkers	9	4.00	36.00
Laborers	29	3.00	87.00
Patent connection	..	100.00	100.00
Teams	2	4.00	8.00
Backfilling, 1,275 ft.	..	0.04	51.00
Machine	4	15.00	60.00
Total			$367.00
Average per ft. for labor			0.29
Material:		Price.	Cost.
Pipe, 52.33 tons		$26.00	$1,360.58
Special castings, 2,100 lbs.		0.03	63.00
Valves, 1 12-in.		34.25	34.25
Hydrants, 4 2½-d. c.		51.00	204.00
Lead, 2,000 lbs.		0.05	100.00
Mason material, 1 basin		25.00	25.00
Coal and gasket		5.20	5.20
Total			$1,792.03
Average per ft. for material			1.406
Average per ft. for material and labor			1.696

Division St., 48th Ave. to 52nd Ave.—The work started Oct. 28 and finished Nov. 11, 1912, and included 2,636 ft. of 12-in. pipe laid 5 ft. underground. Five hydrants were set and five drained. Two valves were set, two valve basins built and two valve basins drained. The contract cost was $1.64 per lin. ft. The cost follows:

Labor:	Days.	Rate.	Cost.
Foreman	7	$ 5.00	$ 35.00
Calkers	13	4.00	52.00
Laborers	59	3.00	177.00
Teams	2	4.50	9.00
Backfilling, 2,636 ft.	..	0.04	104.44
Machine	5	15.00	75.00
Total			$452.44
Average per lin. ft. for labor			0.172
Material:		Price.	Cost.
Pipe, 108.21 tons		$26.00	$2,813.46
Special castings, 2,612 lbs.		0.03	130.60
Valves, 2 12-in.		34.25	68.50
Hydrants, 2 2½-in. d. c.		51.00	255.00
Lead, 4,200 lbs.		0.05	210.00
Mason material, 2 basins		25.00	50.00
Coal and gasket		....	9.15
Total			$3,536.71
Average per foot for material			1.341
Average per ft. for material and labor			1.513

Irving Park Blvd., 66th Ave. to 72nd Ave.—The work was commenced Dec. 9, 1912, and completed Jan. 2, 1913, and included 4,400 ft. of 12-in. pipe and 260 ft. of 8-in. pipe laid 5 ft. underground. Thirteen 5½-in. D. C. hydrants and four 12-in. Miller valves were set and four valve basins built. The contract price was $1.79 per lin. ft. The cost follows:

Labor:	Days.	Rate.	Cost.
Foreman	21	$ 5.00	$105.00
Calkers	23	4.00	92.00
Laborers	356	3.00	1,068.00
Teams	5	4.00	20.00
Total			$1,285.00
Average per lin. ft. for labor			0.276
Material:		Price.	Cost.
Pipe, 186.80 tons		$26.00	$4,856.80
Special castings, 14,268 lbs.		0.03	328.04
Valves, 4 12-in.		34.25	137.00
Hydrants, 13 2½-d. c.		51.00	663.00
Lead, 7,875 lbs.		0.05	393.75
Mason material 4 basins		25.00	100.00
Coal and gasket		19.05	19.05
Total			$6,497.64
Average per lin. ft. for material			1.394
Av. per lin. ft. for material and labor			1.670

83d St., Cottage Grove Ave. to Drexel Blvd.—Work was commenced Dec. 6 and completed Dec. 20, 1912, including 689 ft. of 12-in. pipe and 4,473 ft. of 8-in. pipe laid 5 ft. underground. Twelve 2½-in. D. C. hydrants were set and twelve drained. One 16x12-in. connection, one 12-in. Miller and six 8-in. Miller valves were set. Eight valve basins were built and eight drained. The contract price was $1.16 per lin. ft. The cost follows:

Labor:	Days.	Rate.	Cost.
Foreman	21	$ 5.00	$105.00
Calkers	19	4.00	76.00
Laborers	272	4.00	816.00
Mason labor	6	3.00	18.00
Teams	5	4.00	20.00
Backfilling, 5,162 ft.	..	0.02½	128.05
Total			$1,163.05
Average per ft. for labor			0.225
Material:		Price.	Cost.
Pipe, 133.02 tons		$26.00	$3,458.52
Special castings, 6,431 lbs		0.03	192.93
Valves, 2 12-in.		34.25	68.50
Valves, 6 8-in.		20.75	612.00
Hydrants, 12 2½-d. c.		51.00	612.00
Lead, 5,876 lbs.		0.05	293.80
Mason material, 8 basins		25.00	200.00
Coal and gasket		21.45	21.45
Total			$4,971.70
Average per ft. for material			0.963
Average per ft. for material and labor			1.188

Notes on Water Supply Problems in the Canadian Prairie Provinces.

The rapid growth of the cities in Western Canada, with the resulting pollution of surface water supplies, has drawn attention to the ground water supplies. Some of the physical conditions connected with these water supply problems are unique, and we here give some notes on these problems as described by Mr. R. O. Wynne-Roberts in his recent paper before the Illinois Water Supply Association. The paper relates particularly to conditions at Regina, Sask.

The major part of these prairie provinces are geologically included in the glacial formation. Two immense ice sheets passed over this country and disturbed its physical features by leveling down the hills and filling in the valleys, forming moraines and depositing material of a heterogeneous character in a chaotic manner. In the course of time, after the recession of the ice sheets, the streams formed new beds, eroded new valleys and conveyed the detrital material to other and lower parts and formed out-wash plains.

The prairies, although probably thought to be flat, are really undulating plains, which change so slowly in their altitudes that the variations in level are not ordinarily observed by travelers.

From the engineer's point of view, however, this formation is interesting, because it is only by careful study and investigation that the locations of water-bearing strata are to be found. It would appear that the last invasion of the ice sheets caused parts of the former surface to be compressed and hardened, so that what is colloquially known as "hardpan" was formed, and under this layer, which is usually only a few inches thick, water is generally found.

When the writer was asked to investigate and report on the Regina water supply he made a careful study of the country for a distance of about 25 miles north, east and south of the city, and as a result of his observations and conclusions, he urged that wells should be sunk in places he considered favorable for water. Sixteen such wells have up to the present been sunk and out of these 10 have proved to be gushers. These wells range from 60 to 160 ft. in depth, the distance between the two extreme wells is only about ½ mile. Water was found, as was anticipated, in almost every instance under the "hardpan." The wells are 5 ins. and 7 ins. in diameter, steel lined. The underground flow and pressure of water was, in some cases, so great that the inlets to the wells were choked with sand and gravel. In one instance, while the well sinkers were endeavoring to clear a 7-in. casing, after such a choke, they found the drilling bit, weighing 700 lbs., being floated up on a plug of sand and clay, almost to the top of the well, thus indicating a great subterranean pressure.

As the water is very hard and there is a tendency for it to form scale in steam boilers, etc., the writer was instructed to report on the question of softening it. With this object in view a sample of town water was sent for analysis, with the following results:

Results of analysis of Regina water in parts per 100,000:

Calcium carbonate	25.4
Calcium sulphate	none
Calcium chloride	none
Calcium nitrate	none
Magnesium carbonate	2.30
Magnesium sulphate	21.00
Magnesium chloride	none
Magnesium nitrate	none
Iron and alumina	0.103
Silica	1.70
Suspended matter	2.06
Sodium sulphate	4.64
Sodium chloride	1.51
Sodium carbonate	none
Sodium nitrate	none
Free carbon dioxide	0.99
Half bound carbon dioxide	12.40
Hydrogen sulphide	none
Free sulphuric acid	none

Lime reputed to contain 96.86 per cent of CaO and another to contain 82.40 per cent of CaO will cost 0.96 and 0.97ct. per lb., respectively. Fifty-eight per cent soda-ash will cost 3 cts. per lb.

While the initial expenditure for a softening plant is not excessive, the annual expenditure necessary to operate the same to soften to a considerable degree is very high. Permutit has been considered, and in this case as salt costs 7 cts. per lb. and the initial expense will be high, the writer has not yet seen his way to recommend it for adoption by the City Council.

Although the water is undoubtedly pure, under certain conditions it is liable to pollution, owing to the presence of farms, dwellings, etc., in the catchment. Sterilization by hypochlorite of lime is now recognized to be efficient. There is, however, the question of the best arrangement for a permanent plant for mixing and injecting into the main. At the pumping station, there are two 80-H.P. gasoline engines and two 2,000,000-gal. per day turbine pumps. A Simplex water metor will shortly be installed on the rising main and it may be possible to utilize it for proportioning the sterilizing re-agent, as well as to record the quantity pumped at all hours. Other proposals for proportioning the hypo are under consideration, but so far no definite plans have been decided upon.

There is also the residue from the hypochlorite of lime which has to be disposed of, and the diminishing percentage of available chlorine in the lime, once the drums are opened, and further there is the human factor in measuring the quantity of hypo.

There are other methods of sterilizing water, of course, such as by electrolytic hypochlorite of soda, for which purpose common salt costs 7 cts. per lb., while rock salt can be had for $12 per ton. The latter probably contains impurities that will militate against its use. Sterilization by compressed chlorine gas and by ultra-violet-rays will also be considered. In the last two cases, the experience gained in actual practice is somewhat limited from which to judge of their merits, although so far as special tests are concerned they appear to be all that may be desired.

The last item to be dealt with is that of climate as it affects water works in this region. The temperature in these parts at times falls as low as minus 50° F.; that is, we occasionally have 82° of frost. This, however is exceptional. From November to March, inclusive, the temperature seldom rises above freezing point. The results of this is the freezing of the ground to a depth of about 5 ft., so the mains and connections have to be laid below the frost level. They are generally laid with a cover of about 7 ft. 6 ins. The houses, as a rule, have basements or cellars, in which the heating plants are installed. So, provided the mains and connections are properly covered, they are seldom frozen. Occasionally, a main or service connection is frozen and then the officials of the electric department are called upon to thaw the ice by means of electricity. This is done by attaching a wire to the pipe in the building and another wire to the nearest street hydrant. They use a transformer and apply current at 55 or 110 volts. Both the electric current and water pressure are left on and the ice is thawed by the heat generated in the pipe by the electric current. This process usually takes from three to ten minutes, according to the length and size of the pipe and the voltage applied. They use a 25-K.W. transformer without any regulating resistance whatever, it being the practice to use 55 volts, and if this does not thaw the pipes in a reasonable time, then 110 volts are applied, and this has never failed to dissolve the ice inside of 15 minutes. This simple apparatus has been in use in Regina for five or six years and has given every satisfaction.

RIVERS AND HARBORS

A Study of the Possibilities of Colorado River Flood Control by Reservoirs.

The possibilities of bank protection and levee construction on the lower Colorado River as thought out by Mr. Francis L. Sellow, Project Engineer, U. S. Reclamation Service, were presented in our issue of April 23, 1913. In the abstract which follows from a discussion in Proceedings, American Society of Civil Engineers, Vol. XXXIX, p. 517, Mr. Sellow considers the possibilities of flood control of the same stream by reservoirs.

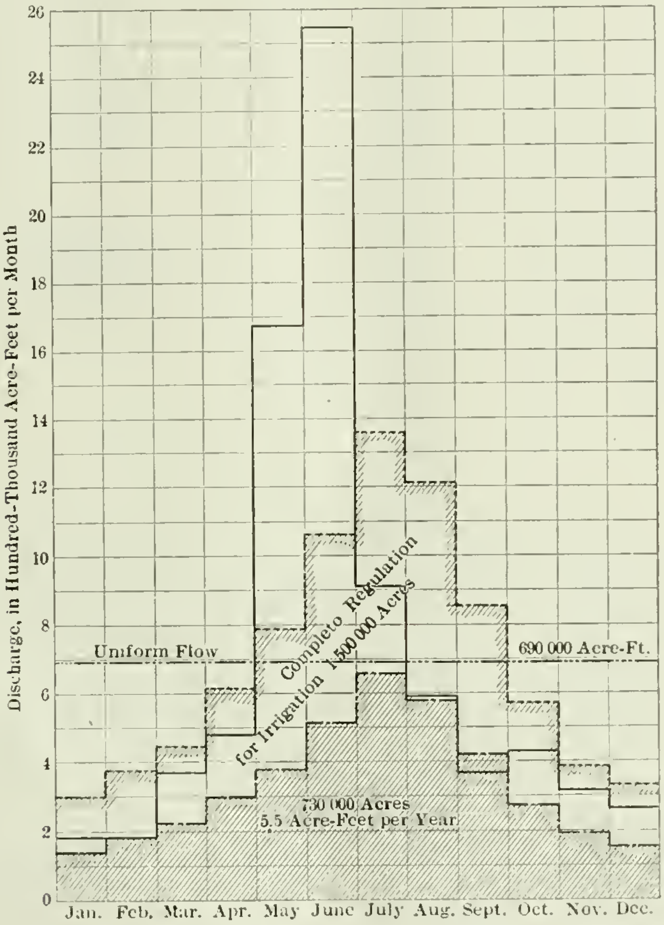

Fig. 1.

It is apparent that if the flood discharge of the Colorado could be reduced materially, thereby bringing the fluctuations between low and high water within reasonable limits, the erosion of the bed and banks would be much reduced. There might still be a limited amount of bank protection required, but, if the control was such as to keep the river within banks, the cost of protective works would be greatly lessened. We have recently heard much about the control of streams by storage works; and, with reference to the Colorado, one advocate claims that storage near the head-waters will reduce flood levels so much that levees will be a thing of the past; that the flow of the stream may be entirely devoted to irrigation, thereby putting water on 5,000,000 acres of land; and also that immense quantities of electrical energy may be developed as the water is released from the places in which it is impounded.

EXISTING STORAGE WORKS.

Before discussing the feasibility of reservoir control on the Colorado, attention is called to Tables I to V, which show what has been accomplished by storage systems in various countries, with their extent and approximate cost.

Table I contains data on ten projects of the Reclamation Service having a total capacity of about 3,800,000 acre-ft., which have been constructed at an average cost of $2.65 per acre-ft.

Table II shows other existing reservoirs in America with an aggregate storage of 2,383,500 acre-ft., built at a total cost of $2,629,800, or an average of $1.10 per acre-ft. In this list the storage at the head-waters of the Mississippi was by utilizing natural lakes, the outlets of which were controlled by low, inexpensive dams, the average cost being only 36 cts. per acre-ft. If this system be excluded, it appears that the remainder amounts to only 283,500 acre-ft., which cost about $6.65 per acre-ft. In this table there are also five sites in Wyoming and Colorado, suggested by Gen. Chittenden, aggregating 939,200 acre-ft., estimated to cost $2,709,500, or an average of about $2.90 per acre-ft. This table also shows 70,415 acre-ft. of storage in Europe and Australia, which have cost $74 per acre-ft.

Table III contains data on ten works in France, having a total capacity of 38,593 acre-ft. and costing $3,518,900, or about $91 per acre-ft. This table also shows that 38,400 acre-ft. of storage in Austria has cost $232 per acre-ft., while in Canada reservoirs containing 3,800,000 acre-ft. are being created on numerous lakes on the Ottawa River at an estimated cost of 20 cts. per acre-ft.; and further, that about 700,000 acre-ft. in South Africa have been built at an average cost of $14 per acre-ft.

Table IV gives a list of eleven projects in Germany, volume 488,111 acre-ft., cost $22,449,874, or $46 per acre-ft.; shows that Russia has 800,000 acre-ft. on the Volga (no records of cost); and that five systems in India, aggregating 775,250 acre-ft., cost $6.77 per acre-ft. The storage of about 1,900,000 acre-ft. at the Assuan Dam in Egypt has cost about $10 per acre-ft.

The completed storage (Canada being excluded as under construction) is summed up in Table V.

Although there are many storage dams for water supply and power in various parts of the world, they are of such relatively low capacity and high unit cost that they have no place in a discussion of this kind. The foregoing data are not submitted as complete, but include all the larger systems for river control, of which records are available to the writer; and it is believed that they cover the field quite thoroughly.

It appears that the storage in the United States (which is about 50 per cent greater than that of the rest of the world) as listed in these tables, has cost on the average only one-ninth as much per unit of volume, while the maximum cost, that of Austria, is about 116 times the average in America. The low cost of the storage created by the Reclamation Service, when compared with that of the rest of the world, is shown in a most remarkable manner.

TABLE I.—RESERVOIRS IN THE UNITED STATES, BUILT BY THE RECLAMATION SERVICE.

Location.	Type of controlling works.		Storage, in acre-feet.	Cost. Total.	Cost. Per acre-foot.	Source of information.
Arizona:						
Roosevelt Dam	Masonry	280 ft.	1,284,000	$3,697,000	$2.90	10th Annual Rept., U. S. R. S.
California:						
East Park	Concrete	139 ft.	45,600	239,000	5.25	10th Annual Rept., U. S. R. S.
Idaho:						
Deerflat	Earth	40 to 70 ft.	186,000	868,800	4.65	10th Annual Rept., U. S. R. S.
New Mexico:						
Carlsbad	Earth and rock	50 ft.	47,000	220,700	4.70	10th Annual Rept., U. S. R. S.
Oregon:						
Cold Springs	Earth	98 ft.	50,000	442,600	8.85	10th Annual Rept., U. S. R. S.
Klamath	Rock fill	33 ft.	462,000*	130,000	0.28	10th Annual Rept., U. S. R. S.
South Dakota:						
Belle Fourche	Earth	115 ft.	209,700	1,123,900	5.40	10th Annual Rept., U. S. R. S.
Washington:						
Bumping Lake	Earth	45 ft.	34,000	410,700	12.10	10th Annual Rept., U. S. R. S.
Wyoming:						
Pathfinder	Masonry	218 ft.	1,025,000†	1,693,000	1.65	10th Annual Rept., U. S. R. S.
Shoshone	Concrete	328 ft.	456,000	1,179,300	2.60	10th Annual Rept., U. S. R. S.
Totals			3,799,300	$10,005,000	$2.63	

*Lake storage. †Drainage area, 12,000 sq. miles.

DETERMINING FACTORS OF FEASIBILITY OF STREAM CONTROL BY STORAGE.

The feasibility of controlling a stream by storage will depend largely on:

(1) The cost, including the value of the area flooded, when compared with the benefits to be derived;

(2) The quantity of storage required and whether sufficient volume is available.

TABLE II.—VARIOUS RESERVOIRS.

Location.	Type of controlling works.	Storage, in acre-feet.	Cost.		Source of information.
			Total.	Per acre-foot.	
In the United States.					
Mississippi Reservoir System	Earth and timber dams	2,100,000	$ 750,000	$0.36	Pittsburgh Flood Commission.
Texas:					
Pecos River					
Upper Reservoir	Earth	82,640	170,000	2.06	Chief of Engineers, 1898.
Lower Reservoir	Earth	7,000	86,000	12.29	Chittenden Report.
Colorado:					
Larimer and Weld	Earth	7,460	90,000	12.00	Chittenden Report, p. 2842.
Cache la Poudre	Earth	5,650	125,000	22.20	Chittenden Report, p. 2842.
California:					
Escondido	Rock fill	3,500	110,000	31.44	Chittenden Report, p. 2842.
Cuyamaca	Earth	114,755	959,800	8.37	Chittenden Report, p. 2842.
Sweetwater	Masonry	22,500	264,000	11.70	Chittenden Report, p. 2842.
Bear Valley	Masonry	40,000	75,000	1.88	Chittenden Report, p. 2842.
Totals		2,383,505	$2,629,800	$1.10	
Suggested Reservoirs—Gen. Chittenden.					
Wyoming:					
Laramie	Masonry 80 ft.	414,000	$1,416,000	$3.42	Chittenden Report.
Sweetwater	Masonry 100 ft.	326,900	276,800	0.85	Chittenden Report.
Piney Creek	Masonry 3 low dams	85,400	214,600	2.52	Chittenden Report.
Colorado:					
South Platte	Masonry 200 ft.	67,200	540,000	8.04	Chittenden Report.
Loveland	Masonry	45,700	262,100	5.78	Chittenden Report.
Totals		939,200	$2,709,500	$2.90	
Miscellaneous Reservoirs:					
Spain:					
Villar	Masonry	13,050	$ 390,000	$29.90	Buckley.
Belgium:					
Gilleppe	Masonry	9,730	874,000	90.00	Buckley.
Wales:					
Vyrnwy	Masonry	44,690	3,334,000	75.00	Buckley.
Australia:					
Beetaloo	Concrete	2,945	573,300	195.00	Buckley.
Totals		70,415	$5,171,300	$74.00	

(3) The situation of such storage, whether it is placed so as to control properly the water-producing zone of the drainage area;

(4) The character of the water to be impounded, whether it is clear or so charged with sediment that the silting will unduly shorten the life of the works.

These factors, as applied to the Colorado, will be considered in the foregoing order.

The Cost.—From what has already been written, it appears that, where storage exists in the arid regions, its cost is reasonable. Assume that the cheapest sites have been taken up and that future storage will cost twice as much as that already created by the Reclamation Service ($2.65 per acre-ft.), and we have $5.30 per acre-ft. This is in close agreement with Gen. Chittenden, who as previously stated, estimated $5.35 for all storage needed in the Arid West. Of course, each site must be carefully examined, and detailed estimates must be prepared, which will no doubt vary considerably from the foregoing, but, from what has been stated, the figure given appears to be a fair and reasonable one to use in this discussion.

Volume of Storage Required—An intelligent discussion of this phase of the matter would be greatly aided by continuous discharge measurements on the Colorado River at various points, and extending over a long period. Unfortunately, however, such measurements do not exist. The most complete records are those made at Yuma since November, 1902, by the Reclamation Service. These observations include current meter measurements three times each week. Previous records of the flow at Yuma are based on such insufficient data—being a few scattered meter measurements from which a rating-curve was constructed—that they are of no value in this discussion. The wide variation in the quantity flowing for the same gage height, due to the change in cross-section caused by scour, renders observations without a meter measurement practically worthless.

Table VI shows the total discharge of the Colorado (excluding the Gila) in acre-feet per year from 1903 to 1912, inclusive. This table shows that the yearly discharge has varied from a minimum of 9,800,000 acre-ft. in 1904, to a maximum of 25,300,000 acre-ft. in 1909. The total monthly discharge has varied from a minimum of 182,500 acre-ft. in February, 1903, to a maximum of 6,397,000 acre-ft. in June, 1912.

In considering the uses of the stream for irrigation, it is proper to forecast as nearly as possible the lowest flow that is to be anticipated. In doing this, the writer has compiled Table VII showing what may be called an "ideal minimum year," and also the monthly us of water for irrigation at Yuma. This table has been constructed by selecting the minimum January discharge, the minimum February discharge, etc., for all months included in Table VI. This gives a minimum year containing a total discharge of 8,315,500 acre-ft., and these discharges are shown in monthly totals on the diagram, Fig. I.

For the present, the duty of water in this vicinity is assumed as 5½ acre-ft., its use being distributed throughout the year as shown in Table VII. It is hoped, and indeed expected, that this use of water will be reduced considerably as larger areas are put under cultivation and the settlers become more skilled in the application of water, but for the present this appears to be the best distribution for calculations, in view of the fact that the use now is considerably in excess of 5½ acre-ft. On Fig. I is also platted the use which can be made of the stream for irrigation without any regulation whatever. This was ascertained in the following manner: The use of water in February being about 0.25 acre-ft. and the lowest run-off in that month being 182,500 acre-ft., it was found that this quantity was sufficient for the watering of 730,000 acres. This was assumed as the limiting month. If greater areas were placed under cultivation, there would be a shortage in that month at a time when the new crops are usually going in. Taking this 730,000 acres as a basis, and platting the monthly duty in the ratio shown in Table VII, it appears that the volume of water used will be that shown by the shaded area in Fig. I. This arrangement may create a slight shortage in September, but the use in that month is so near the minimum run-off that the danger is considered of slight importance and is neglected.

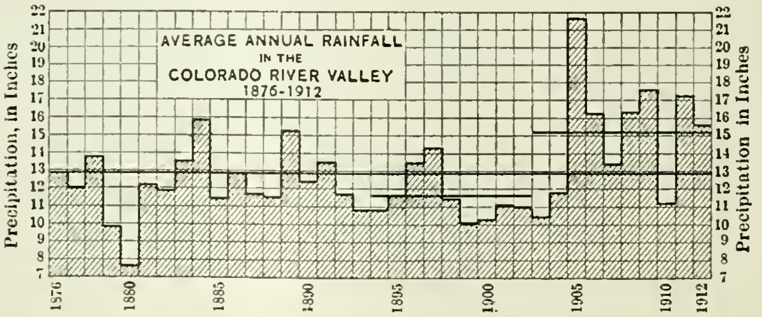

Fig. 2.

It is well to remark that the continuous irrigation of 730,000 acres depends on the diversion of the entire river, and is substantially all that can be accomplished, unless the stream is regulated, even should the duty of water be increased, for it is seen that the use of water at the extremes of the year is as low as can be anticipated, and although a saving may be made in the summer months, it will allow an increase in the cultivated area only during those months, because the crops which can be grown continuously for twelve months in the year are limited by the small quantity of water available during low flow.

There is drawn on Fig. I a line showing the uniform flow throughout the year, which would be at the rate of 690,000 acre-ft. per month. The establishment of such uniformity in discharge would be of value in controlling the floods and also for power purposes, but it is extremely wasteful toward the irrigation interests, because this line is practically coincident with the maximum use of water in July for 730,000 acres. The reinforcement of the low flow by this method would not allow an increase in the area under crop in the summer. It would cover more ground, however, during the winter.

Table VII also shows the percentages of irrigating water required per month, and on this basis the discharge of the low-water year of 8,315,500 acre ft. has been distributed. This assumes complete regulation of the river, entirely in the interests of irrigation, and the distribution throughout the year is shown by the shaded line. Under such regulation 1,500,000 acres (which agrees with the author's estimate) could be irrigated. This is the area that could be served with the flow of the Colorado past Yuma as observed during the years under discussion. The lower Gila is so erratic in its discharge that it is not a very dependable supply, for which reason it is omitted. To the foregoing should be added any area existing in the upper reaches already under cultivation and which it is assumed has received its supply. To regulate the river as indicated would require a storage capacity of about 2,400,000 acre-ft., which, at $5.30 per acre-ft. would cost $12,720,000. Such regulation in low-water years would also have a very beneficial effect on the flood discharge. The maximum monthly volume would be about 1,400,000 acre-ft., equivalent to approximately 50,000 acre-ft. per day, or 25,000 sec.-ft. The effect of this discharge on the bed and banks would be but slight, as compared with what goes on at the present time, and would keep the lower river well within its banks.

TABLE III.—RESERVOIRS IN FRANCE, AUSTRIA, CANADA AND SOUTH AFRICA.

Location.	Type of controlling works.	Storage, in acre-feet.	Cost. Total.	Cost. Per acre-foot.	Source of information.
Reservoirs in France.					
Rhone River	Recommended as too expensive for reservoir control				Pittsburgh Flood Commission.
Garonne River					Pittsburgh Flood Commission.
Loire River	Recommended for construction, but not built because of expense				Pittsburgh Flood Commission.
Seine River	Reservoir control not applicable. Scarcity of sites				Pittsburgh Flood Commission.
Furens Dam	Masonry 184 ft.	1,300	$ 318,000	$ 244	Pittsburgh Flood Commission.
Ternay Dam	Masonry 119 ft.	2,100	204,372	97	Pittsburgh Flood Commission.
Curzon	Masonry	1,297	247,600	190	Buckley.
Ban	Masonry	1,499	190,000	127	Buckley.
Pas du Riot	Masonry	1,054	256,000	243	Buckley.
Chartrain	Masonry	3,647	420,000	115	Buckley.
Lake Oredon	Earth	5,894	142,000	24	Buckley.
Mouche	Masonry	7,011	1,003,657	143	Buckley.
Liez	Earth	13,051	598,418	46	Buckley.
Wassy	Earth	1,740	138,942	80	Buckley.
Totals		38,593	$3,518,989	$ 91±	
Reservoirs in Austria.					
Oder River	Six Reservoirs	5,100*	$1,488,000	$ 292	Pittsburgh Flood Commission.
Elbe and Tributaries	Four Projects proposed	13,000	2,067,000	159	Pittsburgh Flood Commission.
Wien River	Six Projects	19,000	3,661,000	193	Pittsburgh Flood Commission.
	One Project	1,300	1,680,000	1,292	Pittsburgh Flood Commission.
Totals					
*Drainage area, 29 sq. miles.		38,400	$8,896,000	$ 232±	
Reservoirs in Canada.					
Ottawa River	Three Projects. Low concrete dams on numerous lakes	3,800,000	$ 728,000	$ 0.20	Pittsburgh Flood Commission.
Reservoirs in South Africa.					
Cape Colony	Earth, six dams	55,422	$1,700,000	$30.80	Buckley.
	Concrete, five dams	44,274	2,800,000	63.20	Buckley.
Transvaal	Earth, one dam	95,000	684,000	7.20	Buckley.
	Concrete and weirs, four dams.	505,000	4,646,000	9.20	Buckley.
Totals		699,696	$9,830,000	$14.00	

Although this amount of storage would make the river an ideal one for irrigation during periods of ordinary low flow, it would have little beneficial effect on floods in the maximum years.

TABLE IV.—RESERVOIRS IN GERMANY, RUSSIA AND INDIA.

Location.	Type of controlling works.	Storage, in acre-feet.	Drainage area, in square miles.	Cost. Total.	Cost. Per acre-foot.	Source of information.
Reservoirs in Germany:						
Wupper River:						
Bever Valley	Masonry 52.5 ft.	2,700	9	$343,200	$127	Pitts. Flood Com.
Lingese Valley	Masonry 61 ft.	2,100	4	256,800	121	Pitts. Flood Com.
Ruhr River:						
12 Reservoirs	Masonry 64 to 114 ft.	33,000	71	3,480,000	105	Pitts. Flood Com.
Rur River:						
Urft Reservoir	Masonry 190 ft.	37,000	145	1,000,000	27	Pitts. Flood Com.
Weiseritz River:						
Malter Reservoir	Masonry 115 ft.	7,000	40	883,000	126	Pitts. Flood Com.
Kleingenburg Reservoir	Masonry 128 ft.	12,000	35	858,000	72	Pitts. Flood Com.
Weser River	Masonry 136 ft.	164,000	552	4,500,000	27	Pitts. Flood Com.
Oder River:						
Glatzer Neisse, proposed	Earth 37 ft.	82,500	906	3,840,000	47	Pitts. Flood Com.
Malapane Reservoir	Earth 33 ft.	72,000	403	2,880,000	40	Pitts. Flood Com.
Tributaries in Silesia	13 Reservoirs completed or under construction.	75,000	.....	4,317,000	58	Pitts. Flood Com.
Remscheid	Masonry	811	.....	91,154	112	Buckley.
Totals		488,111	.....	$22,449,874	$46	
Reservoirs in Russia:						
Volga Reservoirs	Low dams on numerous lakes	800,000	.....	....	......	Pitts. Flood Com.
Reservoirs in India:						
Tansa	Masonry	52,670	.....	$988,000	$18.76	Buckley.
Betwa	Masonry	36,800	.....	160,000	4.35	Buckley.
Chumbrumbaukum	Earth	63,780	.....	312,000	4.89	Buckley.
Bombay:						
20 tanks	Earth	372,000	2,500±	2,090,100	5.62	Buckley.
4 tanks	Masonry	250,000	450	1,700,000	6.80	Buckley.
Totals		775,250	.....	$5,250,100	$6.77	

When the river at Yuma rises above 125 on the local gage, overflow occurs at various points within the limits of the Yuma Project, and levees become a necessity. If the control of the stream by storage is to regulate the discharge in such a way that levees will not be required, the volume passing when the gage is above 125 must be stored. The volumes of discharge above this gage height in various years are:

	Acre-ft.
1903	933,000
1904	80,000
1905	2,829,000
1906	2,843,000
1907	7,055,000
1908	38,000
1909	5,391,000
1910 (gauge did not rise above 125)	....
1911	94,000
Season just passed	2,417,000
Total	21,680,000
Average for 10-year period	2,168,000

If storage is to be created for the maximum of these quantities, 7,055,000 acre-ft.—and this is necessary if all overflow is to be prohibited along the lower river—the cost of storage, if sufficient sites existed, would be $37,391,500, estimated at $5.30 per acre ft. Should this be considered an excessive provision to make, and it were thought better to take what damage would come from a flood of this kind (which might be of infrequent occurrence), and storage were provided for the next largest year, which is 1909, 5,391,000 acre-ft. would be required, which would cost, on the same basis, $28,572,300. This would give a protection that would have been ample during the last 10 years, with one exception. If we take the average of the excess discharge of Yuma above the 125 gage for the last 10 years, we get 2,168,000 acre-ft., which is about that required to regulate the low flow in the interests of irrigation. The cost of creating this amount of storage at $5.30 would be $11,490,400. With such control of the river, however, overflow would have occurred in 5 years during the last 10.

Attention is directed to the annual discharge of the river from 1894 to 1911, inclusive, a period of 18 years. The first nine years have an average discharge of 7,220,000 acre-ft., and the last nine years show an average of 17,556,000 acre-ft., indicating a most remarkable, sudden, and continued increase in run-off. Such an increase might be possible with a small drainage, but, with a tributary area of more than 250,000 square miles, the variation appears to be altogether too much. To aid in the examination of this question, various publications of the Weather Bureau have been used in the preparation of Fig. 2. For the northern part of the water-shed, no continuous observations within the drainage area appeared to be available, therefore Denver, Salt Lake City, and Cheyenne were used. These stations are probably indicative of conditions within the area under consideration. For the central and southern portions, the records of Prescott, Tucson, Yuma, Phoenix and Flagstaff were taken. The average precipitation for the entire period is 12.92 in. shown by the heavy line. That for the period 1894 to 1902 is 11.73 in., and for 1903 to 1912 is 15.20 in. These latter amounts are indicated by the shorter and lighter line. Thus it appears that although the run-off in the latter half of the

18-year period is about 2.4 times that of the first half, the increase in precipitation was only 1.3 times. Furthermore, it appears that the sudden increase in precipitation did not occur until two years after the change indicated. There is no doubt that there is considerable difference in the run-off of the two periods, but it is not nearly as great as indicated. The explanation is clear: In November, 1902, careful and systematic gagings of the stream were inaugurated at Yuma by the Reclamation Service, and the data since collected are dependable. The data prior to that time are based on a rating-curve constructed from so few observations that the results are worthless.

TABLE V.—SUMMARY OF COMPLETED RESERVOIRS.

Foreign—	Acre-ft.	Cost.
Egypt	1,900,000	$19,750,000
France	38,593	3,518,000
Germany	488,111	22,498,000
Austria	38,400	8,896,000
India	775,250	5,250,000
South Africa	699,696	9,830,000
Miscellaneous foreign	70,415	5,171,000
	4,010,465	$74,913,000

$$\frac{74{,}913{,}000}{4{,}010{,}465} = \$18.70 \text{ per acre-ft.}$$

United States—		
Reclamation service	3,799,300	$10,005,000
Other systems	2,383,500	2,629,800
	6,182,800	$12,634,800

$$\frac{12{,}634{,}800}{6{,}182{,}800} = \text{say, } \$2 \text{ per acre-ft.}$$

Available Storage Sites.—Having indicated in a general way the volumes of storage required to attain various degrees of control of the Colorado at Yuma, the next inquiry relates to the existence of such storage. The writer has not the advantage of having made a personal examination of the upper river and its tributaries, hence this portion of the discussion must be limited to the data found in published reports to which he has access. The only authentic data found are contained in the various annual reports of the Reclamation Service, to which reference is made for more complete information. The first reference is to the Second Annual Report, page 123, "Investigations on Colorado River," where mention is made of the various schemes examined. On page 132 data are given of a dam site at Williams River, where 1,300,000 acre-ft. of storage may be created. The statement is made that investigations of a site at Bulls Head were abandoned because of poor foundation. A 100-ft. dam at this point would provide storage for 845,000 acre-ft. The lower end of Pyramid Canyon was examined. Surface conditions appeared to be favorable for a high dam, but no suitable foundation was found. If it were possible to build dams at these points, the scheme would be impractical because the reservoirs would soon be filled by the deposition of sediment, which will appear from data given later. Reference is made to this difficulty in the Second Annual Report, page 155, where we may read:

TABLE VI. — DISCHARGE OF COLORADO RIVER AT LAGUNA DAM IN TOTAL ACRE-FEET AND MEAN SECOND-FEET.

Year.	The Year. Total acre-ft.	The Year. Mean sec.-ft.
1903	10,907,419	15,060
1904	9,882,461	13,590
1905	16,043,327	22,180
1906	17,422,481	24,020
1907	24,818,400	38,230
1908	12,590,920	17,340
1909	25,306,334	34,880
1910	14,108,656	19,440
1911	17,757,030	24,460
1912	18,357,686	25,360

> In connection with this question of the study of reservoirs which silt up, it seems most necessary that a thorough investigation be made of the reservoir possibilities upon the head-waters of the Colorado, above the points where the streams carrying large quantities of silt enter, so that permanent reservoirs may be established in anticipation of the time when all the irrigable lands along the Colorado will be under ditch.

Thus the Second Annual Report shows no available storage sites for the permanent control of the river.

The Third Annual Report, page 70, has the following:

> Colorado River Storage Projects.—As it has been thought necessary to store water in the Rocky Mountain region for the regulation of the flow of the Colorado River, with a view to the reclamation of about 600,000 acres of land along the lower Colorado in Arizona and California, certain reservoir sites have been withdrawn in western Colorado, two of these being on Grand River, in Grand County, and two on Yampa River, in Routt County. Preliminary examinations have been made of all these sites, and some of them have been surveyed.

On page 217, the Kremmling site is credited with a capacity of 1,500,000 acre-ft. At Grand Lake about 23,000 acres are reported as withdrawn, but no capacity is given. Two sites on the Yampa were located and 100,000 acres withdrawn, but no capacity is given, as the data were not complete.

In the Fourth Annual Report, page 121, it is stated that at the Kremmling site more than 1,000,000 acre-ft. may be stored by a dam 180 ft. high, and that a 230-ft. dam would impound 2,200,000 acre-ft.

On page 124 reference is made to further examinations on Grand River above the Kremmling site, where it is stated that: "Few reservoir and dam sites worthy of investigation were encountered during the reconnoissance."

Reference is made to:

	Capacity, acre-ft.
Windy Gap site	100,000
Lehman site	24,000
Grand Lake	140,000
Total	264,000

The first site is crossed by a railroad; would require a large dam; and 75 per cent of the area flooded would be ranches already under cultivation. The second site would cover valuable land under cultivation, and is of slight consequence in size. Regarding Grand Lake, the report says, on page 127:

> Considered as a site for storing irrigation water for use along the lower Grand and Colorado Rivers, Grand Lake, as will be readily seen from the foregoing, would be of little value.

It appears, then, that this report shows no storage sites of value except the Kremmling, with a possible capacity of 2,200,000 acre-ft.

The Fifth Annual Report states, on page 114, that the field work in connection with reservoir sites on the Colorado was brought to a close late in 1905, and no additional examinations have been made since those described in the Fourth Annual Report. The Sixth Annual Report gives no additional information regarding this matter. On page 57 of the Seventh Annual Report reference is made to investigations for storage reservoirs along the Green River and its tributaries, from which the following is obtained:

	Capacity, acre-ft.
Flaming Gorge site	350,000
Island Park site	150,000
Browns Park site	2,500,000
Total	3,000,000

No additional information is contained in the Eighth, Ninth, or Tenth Annual Reports.

Taking from the foregoing those sites which appear to be available for storage on the tributaries of the Colorado, we have:

	Capacity, acre-ft.
Grand River—	
Kremmling site	2,200,000
Green River—	
Flaming Gorge site	350,000
Island Park site	150,000
Browns Park site	2,500,000
Total	5,200,000

Railroad interests have secured control of the Kremmling site, therefore its future development may prevent the creation of reservoirs of any magnitude. Such a result would remove the only known reservoir capable of controlling the Grand River, and would reduce the known available storage for uses on the Lower Colorado to 3,000,000 acre-ft., all confined to the Green. This is but little in excess of that required for minimum-year control in the interests of irrigation, and furnishes little relief in the years of maximum flow, when, as previously shown, 7,000,000 acre-ft. must be stored in order to prevent overflow, unless dependence is placed on levees. The foregoing data are not sufficient to determine with accuracy the feasibility of reservoir control on the Colorado River. Before conclusions can be properly drawn, investigation should show the total available storage, its geographical distribution, and whether it is placed so that it will control the run-off from the various parts of catchment area. Should sufficient storage exist to save the surplus of the maximum years for use in years of low flow, the irrigable area along the Colorado could be increased correspondingly.

TABLE VII.—MINIMUM MONTHLY DISCHARGE OF COLORADO RIVER AND DISCHARGE IN RATIO OF MONTHLY DUTY.

Month—	Minimum discharge in acre-ft.	Monthly duty.	Percentage of total yearly duty.	Monthly discharge for year in ratio of duty.
January	185,407	0.20	3.6	302,801
February	182,531	.25	4.5	378,000
March	367,702	.30	5.4	453,500
April	479,663	.41	7.4	619,801
May	1,670,000	.52	9.4	786,100
June	2,550,000	.70	12.8	1,058,100
July	904,476	.90	16.4	1,360,700
August	591,480	.80	14.6	1,209,500
September	366,948	.56	10.3	846,701
October	429,428	.38	6.9	574,500
November	321,271	.26	4.7	393,150
December	266,598	.22	4.0	332,651
Totals	8,315,504	5.50	100.0	8,315,504

The Quantity of Silt.—As previously stated, reservoirs created on the lower portion of the stream would very soon fill with deposits, as the Lower Colorado is a notorious silt carrier. Professor R. H. Forbes* says, regarding Colorado silt:

> Beginning with January, the regular low winter water averages about 62 parts of sediment in 100,000 parts of water during January, February, and March. These sediments are probably chiefly the result of erosion upon the upper river channel, rather than surface sweepings into the drainage. During April, as the river rises with the melting snows of its highest water-shed, and its erosive power increases, the sediment rises to an average of 112 parts; during the highest waters of May and June, to an average of 374 parts; decreasing with the lowering waters of July and August to an average of 122 parts. The summer rain storms of September, October, and November, partly within Arizona, bring the silt to its maximum (2,072 parts, Oct. 8-13), after which the quantity sinks to the normal amount for winter waters, averaging 151 parts in 100,000 during the two months ending Jan. 24, 1901.
>
> . . . The average acre-foot of Colorado River water for the year of observation carried 7,291 pounds of silt, varying from 1,182 to 56,410 pounds, as shown by six-day composite samples.
>
> On the basis of the profile constructed from available data for the volume of flow of the Colorado, and of the year's silt determinations made in this laboratory, it is estimated, conservatively, that the river during 1900 brought

TABLE VIII.—QUANTITY OF SEDIMENT IN COLORADO RIVER.

Year.	Total discharge, in acre-ft.	Number of silt observations.	Average percentage of silt, by weight.	Acre-ft. of submerged mud annually.
1909	25,967,577	8	0.65	321,010
1910	14,332,692	22	.50	136,660
1911	17,839,245	52	1.15	391,115
1912	18,357,686	64	0.756	265,734
Total				1,114,519

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*Bulletin No. 44, Arizona Experiment Station, pp. 198 and 200.

down about 61,000,000 tons of sedimentary material, which, condensed to the form of solid rock, is enough to cover 26.4 square miles one foot deep, or to make 53 square miles of dry alluvial soil one foot deep, or to make about 164 square miles of recently settled, submerged mud one foot deep, reckoning the whole amount of mud for the year to average 6.2 times the bulk of the solid sediment.

From these extracts it appears that in 1900 the volume of sediment varied from 0.062 per cent in January, February and March, to 0.374 per cent in May and June, and that following desert rains it was as high as 2.07 per cent. An area of 164 sq. miles of mud 1 ft. deep equals 105,000 acre-ft. Since May, 1909, the Reclamation Service has observed the quantity of sediment passing Yuma, the results being as shown in Table VIII.

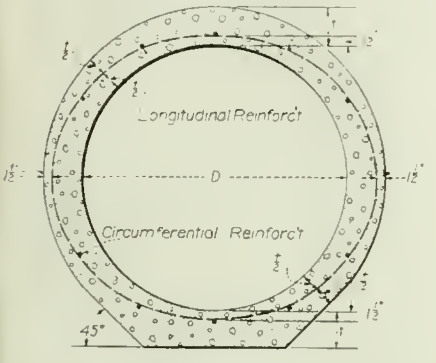
The observations of 1909, although few in number, covered the period from May 26 to Oct. 7, and should give a fair average. Those of 1910 extended from April 19 to Dec. 31. In 1911 they extended from Jan. 11 to Dec. 28, and in 1912 from Jan. 4 to Nov. 30, the discharge being estimated to Dec. 31. As shown in Table VIII the total quantity of sediment passing Yuma during the last four years, when measured as submerged mud, has exceeded 1,000,000 acre-ft. This proves conclusively that reservoirs for the permanent control of this stream must be placed on the head-waters where clear water exists.

SEWERAGE AND SANITATION

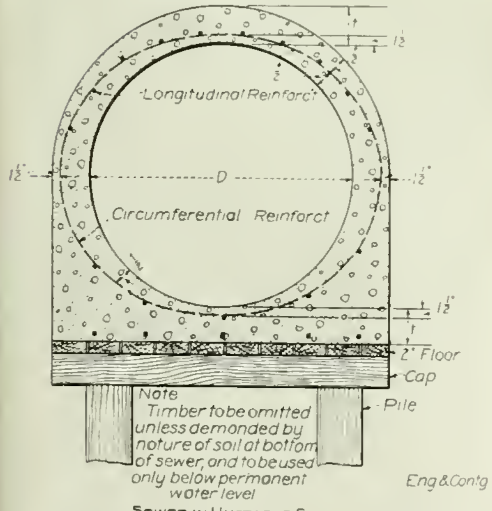
Some Structural Features of the Flint, Michigan, Sewerage and Drainage System.

(STAFF ARTICLE.)

The city of Flint, Mich., has adopted a plan for a comprehensive sewerage and drainage system as drawn up by H. E. Terry, City Engineer, and Messrs. H. E. Riggs and W. C. Hoad of the Civil Engineering Department of the University of Michigan, Consulting Engineers. The report supplementing and explaining the plans was prepared by Mr. Hoad. The information here given with reference to some of the structural features of the proposed system is taken from the plans and report. About 33 miles of storm and sanitary sewers will be installed at an approximate cost of $325,000.



SEWER IN FIRM SOIL


Longitudinal Reinforc't
D
Circumferential Reinforc't
1½"
2" Floor
Cap
Pile
Note
Timber to be omitted unless demanded by nature of soil at bottom of sewer, and to be used only below permanent water level
Eng&Con'g

SEWER IN UNSTABLE SOIL

Fig. 1—Standard Reinforced Concrete Sewer Sections for Use in Firm and Unstable Soils, Flint, Mich.

CLAY AND CONCRETE SEWERS.

Sewer Sections.—It was recommended that vitrified clay pipe be used for all sewers, both sanitary and storm sewers, not larger than 24 ins. in diameter, and that reinforced concrete sections be used for sewers larger than this size; and that all concrete sections be made circular in shape.

TABLE I.—DIMENSIONS AND REINFORCEMENT OF STANDARD CONCRETE SEWERS, FLINT, MICH.

D.	t.	*Circumferential bars.		*Longitudinal bars.	
		Size.	Spacing.	Size.	
Ins.	Ins.	Ins.	Ins.	Ins.	No.
27	5¼	⅜	9	⅜	4
30	5½	⅜	8	⅜	4
33	5¾	⅜	7	⅜	6
36	6	½	12	⅜	6
39	6¼	½	10	⅜	8
42	6½	½	10	⅜	8
45	6¾	½	9	½	6
48	7	½	8	½	6
51	7¼	½	7½	½	8
54	7½	½	7	½	8
57	7¾	½	7	⅝	6
60	8	⅝	10	⅝	6
63	8¼	⅝	9½	⅝	8
66	8½	⅝	9	⅝	8
69	8¾	⅝	8½	⅝	10
72	9	⅝	8	⅝	10

*Shape and character—square, twisted.

Pipe Sewers.—The pipe sewers will be made of standard weight vitrified clay pipe of first class quality, with wide and deep sockets, except that double strength pipe may be used in deep trenches if deemed necessary. All straight pipe 12 ins. in diameter. and larger, should be in 3-ft. sections, and 8-in. and 10-in. pipe in 2½-ft. sections. This is for the purpose of decreasing the number of sewer joints, which are the weakest part of the sewer. Obviously, there are 50 per cent more joints in a sewer laid with 2-ft. lengths than in one laid with 3-ft. lengths of pipe.

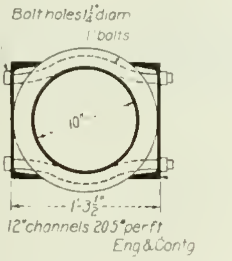


Fig. 2—Cross Section of Iron Pipe Stream Crossing Conduit Showing Suspending Channels.

TABLE II.—DIMENSIONS OF SPECIAL INLETS FOR NATURAL WATERCOURSES INTO STORM DRAINS, FLINT, MICH.

D	A		B		C		H		I	
Ins.	Ft.	Ins.	Ft.	Ins.	Ft.	Ins.	Ft.	Ins.	Ft.	Ins.
15	2	6	2	1	4	2	3	6	5	6
18	3	0	2	6	5	0	4	0	6	4
21	3	6	2	11	5	10	4	6	7	2
24	4	0	3	4	6	8	5	0	8	0
27	4	6	3	9	7	6	5	8	9	0
30	5	0	4	2	8	4	6	2	9	10
33	5	6	4	7	9	2	6	8	10	8
36	6	0	5	0	10	0	7	2	11	6
39	6	6	5	5	10	10	7	10	12	6
42	7	0	5	10	11	8	8	4	13	4
45	7	6	6	3	12	6	8	10	14	2
48	8	0	6	8	13	4	9	4	15	0
51	8	6	7	1	14	2	10	0	16	0
54	9	0	7	6	15	0	10	6	16	10
57	9	6	7	11	15	10	11	0	17	8
60	10	0	8	4	16	8	11	6	18	6
63	10	6	8	9	17	6	12	2	19	6
66	11	0	9	2	18	4	12	8	20	4
69	11	6	9	7	19	2	13	2	21	2
72	12	0	10	0	20	0	13	8	22	0

Joints in pipe sewers should be made with a jute gasket sufficiently large to fill the joint space to a depth of not less than 1 in. when tamped into place and thoroughly compacted with a calking tool, the remainder of the joint space being filled with dense cement mortar. If pipes are carefully bedded and back-filled, so that joints will not be broken by settlement in the trench, the joint just described will be sufficiently tight and strong to prevent the entrance of tree roots, and to prevent serious infiltration of ground water, in the case of sanitary sewers.

Concrete Sewers.—Standard designs for reinforced concrete sewers from 27 ins. to 72

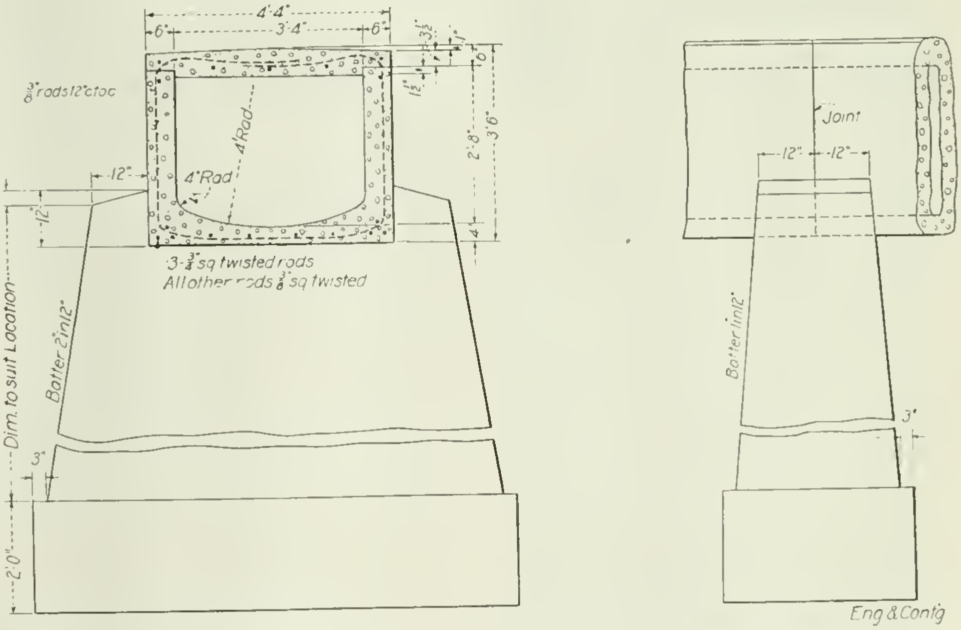


Fig. 3—Side and End Elevations of Pier and Cross Section of Concrete Sewer in Concrete Stream Crossing, Flint, Mich.

ins. in diameter, for both ordinary soils and unstable soils, are given in Fig. 1 and Table I. Sewers built on this plan will be abundantly strong to resist both crushing stresses and stresses induced by unequal settlement of the trenches. In addition, with the use of collapsible metal forms, concrete sewers can be made smoother than any other kind. From a structural standpoint, the designs shown are stronger than brick sewers of two or three times the thickness. Table I gives dimensions and other data relative to the standard concrete sewers.

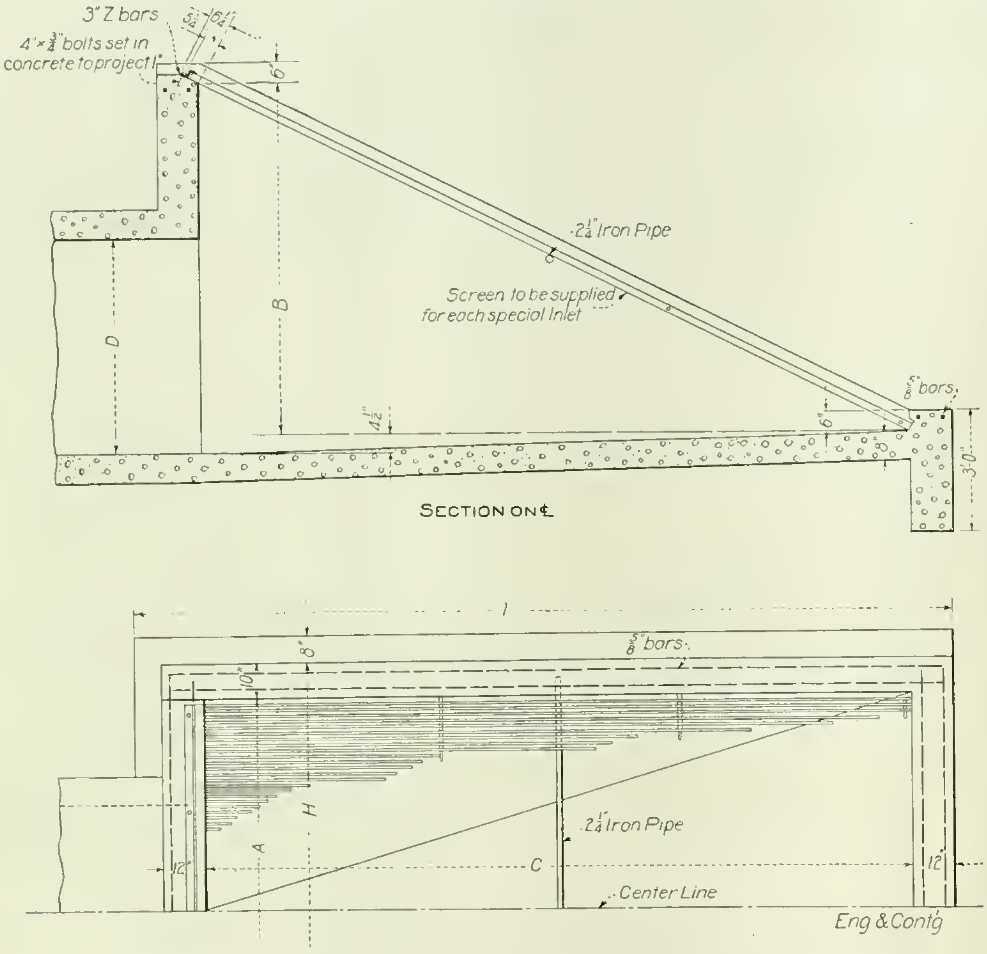


Fig. 4—Plan and Section of Special Inlets for Intercepting Flow of Small Natural Watercourse, Flint, Mich.

Sewers larger than 24 ins. in diameter cannot be given a satisfactory curve within the limits of a manhole. The plans provide that on all concrete sewers any considerable change in direction shall be made by curving the sewer, with a manhole at each end of the curve.

STREAM CROSSINGS.

Iron Pipe Crossings—Inverted siphons are avoided by carrying the sewers, both pipe and concrete, across streams at grade. Fig. 2 shows a detail of the iron pipe crossing of Thread Creek by the Cedar St. sewer. For the stream crossing the vitrified pipe is supplanted by cast iron pipe. The pipe at this crossing is supported on concrete piers, and is suspended between piers by means of the 12-in. channels shown in section in Fig. 2. There are three of these piers at this crossing, the spans between piers being 24 ft., or two lengths of cast iron pipe. The bolts which clamp the channels to the pipe are spaced 4 ft. apart along the axis of the pipe.

Concrete Stream Crossing.—The concrete sewers are carried across streams as shown in sectional views in Fig. 3. The details shown in this figure are for the Thread Creek crossing of an intercepting sewer. The piers which support the sewer are spaced 25 ft. apart. At each shore end there is a combination abutment and manhole. In this case the distance from center to center of end manholes is 79 ft.

SPECIAL STORM WATER INLETS.

The main storm water sewers lie along the valley lines. There are numerous small natural water courses which pass through the city before discharging into the creeks and the Flint River. These small stream beds, some of which carry water only in rainstorms, are to be led into the new stormwater drains through special inlets of large size. The largest size of these special inlets is shown here in plan and section in Fig. 4. These inlets have been standardized for discharge openings ranging in size from 15 to 72 ins. These openings are, in many cases, the upper ends of main drains. The drains are of vitrified clay pipe for sizes from 15 to 24 ins., inclusive, and of reinforced concrete circular sections above 24 ins. up to and including the largest size of 72 ins. Table II shows the dimensions of these special inlets according to the size of the main drain entered.

The pipe which supports the grating at its center varies from 1½ ins. to 2¼ ins. in diameter. The thickness of the concrete bottom of the inlet chamber ranges from 4 to 8 ins. The inlet bottom slopes toward the center of the chamber and toward the drains.

Data on and Order of Steps in the Analysis of Municipal Refuse Collection and Disposal Problems.

The miscellaneous refuse collection and disposal data and the statement of the order of the various steps in the analysis of a specific problem of this character here given are abstracted from the paper on Collection and Disposal of Municipal Waste by G. H Herrold before the Civil Engineers Society of St. Paul, as published in the Journal of the Association of Engineering Societies. Many of these data have been published in Engineering and Contracting from time to time, but the summary here presented will serve the reader's convenience.

The average weight of garbage is 1,150 to 1,475 lbs. per cu. yd. The average weight of mixed rubbish and ashes is from 800 to 1,100 lbs. per cu. yd. In summer the mixture is 35 per cent. ashes and 65 per cent rubbish, and in winter 75 per cent ashes and 25 per cent rubbish.

An analysis of ashes in numerous cities gives 19½ to 24½ per cent unburned coal.

A garbage collector can collect from 40 to 90 places in an eight-hour day. The time spent in getting in and out from the houses is about one half of the total time consumed by the collector.

The average time required to remove garbage from a house is about three minutes. The average rate of travel for a garbage collecting wagon is 2¾ to 3 miles per hour.

It is cheaper to make the collection with teams; but, after the wagon is loaded, it is cheaper to haul the load to the plant with a motor truck, putting the team on to another loading wagon.

Men should precede the collecting team and bring the can out to the curb, and a man should follow and return the can to the back door, to reduce the idle time of the team.

A portable paper baling machine hauled by one horse is an aid to the city cleanly and a paying institution.

In cities the garbage produced per capita is from 175 lbs. to 225 lbs.

The rubbish and ashes produced per capita are from 325 to 530 lbs.

The separate system of collection, separating garbage from other refuse, makes a filthy garbage can, which can be a greater nuisance than the garbage.

The mixed collection of garbage, house sweepings, ashes and rubbish makes a much cleaner material to handle and prevents fly-breeding and lessens the dust nuisance from the ashes. The mixed collection can be made at less cost than the separate collection.

With these data one can proceed to make a study of any particular city. The first step is to get out a density of population map. This has been done for St. Paul by taking the number of voters registered in the 1912 election and the city directory population for the same time and determine the ratio, which for St. Paul is 5.73. Using this factor and the registration records for each precinct in the city, the approximate population of each precinct has been determined.

The next step will be to work out the cost data for various systems of collection and disposal. Assuming that incinerators will be used, the capacity of each incinerator would be decided upon, say 75 tons per day. As we should figure on this plant being capable of handling a certain district for a certain number of years, we figure on running it to a capacity of 60 tons, with the present population. On the basis of the amount of garbage and refuse per capita already given, this size plant would serve 50,000 people.

The next step is to divide the city into districts, taking into consideration railroad tracks, bridges, grades, etc., with 50,000 population each and with the proposed incinerator plant centrally located in this district.

The question of type and size of wagons must be decided upon. Too large wagons cannot be used where there is much snow. On the other hand, wagons should be as large as possible. In Seattle, wagons of a capacity of 1.6 tons, or about 3 cu. yds., are used; 15 wagons for each 50,000 of population.

My investigations show an extreme variation of cost of collecting refuse in various cities. It is a problem that should be worked out very carefully. In fact, I believe there is more chance for working out economies in the collection and transportation of the wastes of a city than in any other field of municipal maintenance.

A reduction plant should also be figured on in order to make a comparison of the cost of two methods. It is probable that in St. Paul such a plant would have to be erected down the river, near the packing houses, and loading stations for garbage established on the levee. The garbage would be taken to the reduction works by means of barges, equipped with tanks which could be hoisted from the barges at the plant and unloaded. The cost of collection would then have to be refigured for handling all garbage to two loading stations, one on each side of the river. It is probable that for a few years we could then continue to use the dumps for ashes, rubbish and street sweepings. Manure is now hauled away by farmers. But it would be necessary to figure on eventually establishing incinerating plants for the destruction of these refuses, as the city becomes more densely populated.

To decide upon the types of furnaces for destructor plants and the system of grease recovery to be adopted, with the necessary machinery, is a problem which will require the inspection of plants actually in operation, showing fully their advantages and disadvantages.

To determine the relative economy of the reduction process or incineration of all refuse the cost must be reduced to annual expenditures, taking into consideration that the reduction process disposes of garbage only. Such costs would include the cost of collection and delivery at plant, operation of plant, interest on the investment, depreciation of equipment and plant, and all repairs, land rental, insurance, etc., and also the credits from stone dust, which can be used in our municipal asphalt plant and take the place of material for which we now pay $1 per cu. yd.; and the clinker, which can be crushed and used as crushed stone is now used; also steam for the generation of electricity or heat; also grease, fertilizer, base, etc., the last two being by-products of a reduction plant.

Proceeding along the above lines, comparison can be made by which we can decide which process would be the most economical. Any estimate of cost of the reduction process must, however, include the cost of disposal of other refuse in a modern way in order to compare it with the cost of the destructor process. St. Paul has as area of 55.50 miles square and over 800 miles of streets. It was evidently laid out for a city of homes, but the large majority of the people prefer to live in apartments, with the result that certain residence districts are thickly populated, while others are very sparsely settled. Any system of refuse collection makes necessary the traversing of all these streets over the entire area of the city. This will increase the cost of collection per capita as compared with some other cities of the same population but smaller area and with the population more evenly distributed over their areas; furthermore, the apartment house districts are a fruitful field for the licensed garbage collector, as a large amount of garbage can be collected from a small area and in a very fresh condition. It is also garbage very rich in food for animals. A reduction plant would not pay unless 75 tons per day of garbage could be taken to it, and this is very close to St. Paul's present garbage output. Of this, approximately 40 tons are taken by private collectors and the city would have to eliminate these private collectors, if it should adopt the reduction process, in order to make a paying proposition.

The problem is one, however, which can be estimated very closely, and definite figures can be determined indicating the probable per capita cost of whichever process it should be decided to adopt.

The Design of a Sanitary Privy for Unsewered Portions of Towns and for Contractor's Camps.

Contributed by Charles W. Sherman, Principal Assistant Engineer, Metcalf & Eddy, Boston, Massachusetts.

The sanitary privy here described is suitable for use at country houses, in the unsewered portions of towns, and in contractors' camps.

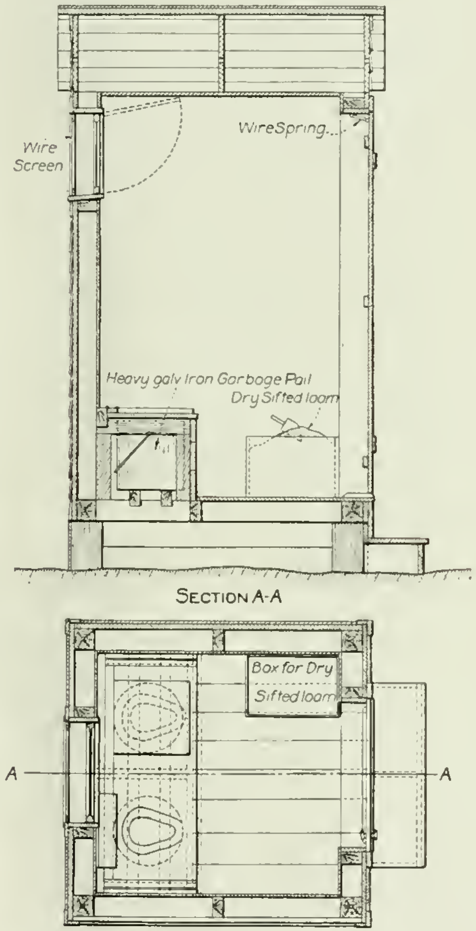
Two or three years ago, the writer, confronted with the necessity of constructing a sanitary privy for his summer home in the country, made a careful search for descriptions of such a structure, but without satisfactory results. None of the privies described in print seemed to fulfill the requirements—

1. That it shall be absolutely sanitary; that is, the receptacle must be tight, non-absorbent, easily cleaned, and inaccessible to flies.
2. That it shall be inoffensive to use.
3. That it shall be, as nearly as possible, inoffensive to clean.

Even the one described in "Farmers' Bulletin 463" of the U. S. Department of Agriculture seemed seriously defective in these particulars.

After some study, the writer constructed the privy shown in the accompanying illustration, which seems to him to fully satisfy all three requirements. It has now stood the test of two season's use, and has proved entirely satisfactory.

The receptacle consists of a heavily galvanized garbage pail, which is tight, and not too large to be easily handled by one man when full. It is so supported as to come in contact with the under side of the hinged seat, forming a fly-tight joint.



Plan and Section of Sanitary Privy.

Earth is used freely as an absorbent and to minimize odors.

When it becomes necessary to empty the pail the hinged seat is raised, and the pail immediately covered with the fairly tight-fitting cover with which garbage pails are always supplied. The pail is never soiled on the outside, and when covered it can readily be removed and handled by one man, without being offensive. In the writer's practice it is carried to a remote part of the garden and its contents there buried, after which the pail is rinsed, when it is again ready for service.

Owing to the small size of the pail, it is necessary to empty it at frequent intervals, but in the writer's opinion this is rather an advantage than otherwise, especially as the offensiveness usually accompanying this operation has been substantially eliminated.

Recommended Procedure in Sanitation of Construction Camps.

The regulations here given relative to camp sanitation are recommended by the Northwestern Sanitation Association. The voluntary adoption of such regulations as those here suggested is coming to be regarded as good business procedure by contractors who have large encampments on construction works. The regulations follow:

Hereafter contractors and all other persons who may establish an industrial camp or camps, for the purpose of logging or any like industry, or for the purpose of construction of any road, railroad or irrigation canal, or other work requiring the maintenance of camps for men engaged in such work, or any other temporary or permanent industrial camp of whatsoever nature, shall report to the state health official concerning the location of such camp or camps, and shall arrange such camp or camps in a manner approved by the state health official, so as to maintain good sanitary conditions, and shall at all times keep such camp or camps in a sanitary condition satisfactory to the state health official.

Camps should be established upon dry, well-drained ground.

Any natural sink holes or collections or pools of water should be artificially drained and filled when the camp is first established.

The general scheme of the relation of the structure of the camps should be as follows: Stable and kitchen should be at the opposite ends of the camp and separated by a distance as great as consistent with the natural topography of the land and with the necessity for convenient access to the stables.

Eating houses should be next to the kitchen and beyond the eating house should come the bunk houses, and between the bunk houses and the stables the toilets for the men in the camp.

The use of the toilets provided for the men should be made obligatory and instant discharge of any employes polluting the soil must be rigidly enforced to make such rules effective.

A small temporary incinerator should be constructed near the stables. Incinerators capable of doing effective work can be constructed for not over $25, sufficient to care for all the refuse of a camp of 150 men and stables of 10 to 12 horses.

There must be in camps of 100 men or over one employe whose particular duty should be acting as scavenger and garbage collector.

All manure should be gathered and burned each day, and for the convenience of the collector should be thrown into a tightly covered box.

All fecal matter should be treated in the same way or else treated in some other approved manner. Collection and incineration is the safest in the long run and the easiest method by making use of the removable pan, which can be freshly lined.

The kitchen and eating house in particular should be effectively screened. It is also desirable to have this done for the bunk houses.

All garbage should be collected in tight cans and incinerated daily along with the manure and other rubbish.

Non-inflammable refuse, such as tin cans, should be collected daily and placed in a deep earth pit and covered with a light covering of earth each day or covered with oil and burned over.

All urinals should consist of open trenches lined with quick lime, and fresh quick lime should be added in the proportion of ½ barrel per day per 100 men.

All food supplies should be carefully screened.

Thorough and systematic scrubbing of kitchens and eating houses, and to a less extent bunk houses, should be regularly insisted upon.

The supply of water for the camp should be carefully decided upon, and wherever possible, if the camp is to remain several weeks, it is well to run it in pipes from an absolutely uncontaminated source.

All sick from whatever cause should be isolated from the remainder of the crew immediately.

All persons engaged in the care of the premises and handling of the food, particularly cooks and helpers, should be carefully examined and particular attention paid to the point as to whether or not they have suffered from typhoid fever within recent years.

BOOK REVIEWS

Civil Engineers' Pocket Book.—By Albert L. Frye. New York, D. Van Nostrand Co. Chicago, The Myrus C. Clark Publishing Co. Leather, 4½x7 ins.; pp. 1,611; illustrated; $5.

This new pocket book for civil engineers follows closely in character and form the precedent set by the older writers of pocket books. It is the work of one author and it is purely a classified collection of tables, formulas and notes necessary or useful to the civil engineer in computing and designing. The tabular matter is of unusually great volume and variety and includes all the standard trigonometrical tables, tables of cubes and squares and roots of numbers, mensuration tables, etc., besides special tables of great number and variety. The most pronounced feature of the book, perhaps, is its tables.

To summarize more in detail, there are some 300 pages of mathematics and mechanics under the following main headings: Elementary Arithmetic; Powers, Roots and Reciprocals; Practical Arithmetic; Measures, Weights and Money; Algebra; Logarithms of Numbers; Plane Geometry; Solid Geometry; Plane Trigonometry; Spherical Trigonometry; Mensuration; Analytic Geometry; Calculus; Mechanics. Mechanics, 26 pages, is followed by 10 pages on Theory of Stresses in Structures.

Engineering materials are considered in the next general group of headings which are entitled: Natural History of Materials; Explosives; Preservatives; Lumber and Lumbering; Metallurgy; Building Stones and Cements; Quarrying; Stone Cutting; Masonry; Stereotomy; Weights and Specific Gravity of Materials, Strength and Resistance of Materials; Properties and Tables of Plane Surfaces; Properties and Tables of Steel Shapes; Properties and Tables of Beams and Girders; Properties and Tables of Columns; Structural Details; Metal Gauges; Cordage, Wire and Cables; and Pipes and Tubes. This group of subjects occupies 370 pages.

The remainder of the book, except for a glossary and some miscellaneous data, is devoted to specific engineering structures or branches of engineering. The subjects are: Bridges; Railroad Bridges; Electric Railway Bridges; Highway Bridges; Cantilever Bridges; Movable Bridges; Suspension Bridges; Arches; Trestles; Roofs; Buildings; Retaining Walls; Dams; Foundations; Wharves, Piers and Docks; Breakwaters; Jetties; Earthwork; Rock Excavations; Dredging; Trenching; Surveying; Mapping and Leveling; Railroads; Highways; Hydrostatics; Hydraulics; Water Supply; Water Works; Sanitation; Irrigation; Waterways; Water Power; Steam and Gas Power; Electric Power and Lighting. The glossary which concludes the book is one of the best known to us.

To point out specifically the points deserving of praise or criticism in a book of such volume and covering so great a multitude of quantities, factors and statements is impossible except after its actual use for some time. A few facts stand out clearly, however, and the most important of these, as already indicated, is the unusual number and originality of the tables. This feature alone gives the book full value. The second noticeable fact is a fault. The author has failed in places to bring his presentation closely up to date. This is shown most prominently in his bibliography which is confined to articles in one publication and refers to no article in that publication which is of later date than 1910. This is a fault that should be corrected in new printings.

Trade Waste Waters: Their Nature and Disposal.—By H. Maclean Wilson and H. T. Calvert. J. B. Lippincott Co., Philadelphia. Cloth, 6x9 ins.; 340 pp.; illustrated; $5.

This book describes the trade processes which produce objectionable liquid water in large quantities, describes the origin and nature of such wastes, and describes the means which have been successfully employed in Great Britain in the purification of trade waste waters.

The text is divided into 13 chapters under the following headings: Historical and Legal; The Coal Trade; Coal Gas Manufacture; Grain Washing, Malting, Brewing, and Distilling; The Leather Trades; The Paper Trades; The Textile Trades (3 chapters); Miscellaneous Trades; Pumps, Screens, Tanks, Filter, and Other Apparatus; Discharge of Trade Waste Waters to Public Sewers; and Methods of Analysis and Limits of Impurity. The chapter headings quoted give an adequate idea of the scope of the book.

The chapter on The Coal Trade is typical in its method of treating the general subject and will be analyzed somewhat. The operations in the coal trade in which water is fouled are enumerated. The sources of pollution are stated and are taken up in turn and discussed. The chemical composition of each class of fouled water is given and the methods of treating the water are described. The engineering works which are commonly used in England for purifying the various forms of trade waste waters are illustrated and described. Typical installations are described in detail. Each chapter concludes with a bibliography of the subject matter of the chapter.

This is an excellent book American engineers who are working to restore our streams to something approximating their original purity will find much of value in this book on trade waste waters. Much more has been done in England than in this country in the treatment of trade wastes. This book summarized British experience to date and will form an excellent guide to the American engineer who is now confronted with the necessity of treating trade wastes as well as sewage in his efforts to alleviate stream pollution.

Asphalt Construction for Pavements and Highways.—By Clifford Richardson. New York. McGraw-Hill Book Co. Cloth; 4¼x6¾ ins.; 155 pp.; illustrated; $2.

Careful attention to details is necessary to secure the best results in any form of pavement construction. Mr. Richardson's book has been prepared with a view to supplying the necessary information in regard to these details as relating to the construction of sheet asphalt pavement, asphaltic concrete and asphaltic broken stone surfaces. The instructions in the book have been derived from observations and from the experience of the author extending over 35 years, beginning in 1878 with the original Trinidad sheet asphalt surface laid in Pennsylvania Ave., in Washington, D. C., in 1876, and the extraordinary surface laid in 1879 on Vermont Ave. in that city, which is still in existence. Mr. Richardson gives in detail a statement of the procedure which should be followed in order to duplicate these and other successful examples of asphalt pavement. The first ten chapters are devoted to a consideration of the components which make up the various forms of asphalt surface mixture, and to their combinations in a rational way. The titles of the remaining chapter are: Maintenance and Repairs; The Plant; Work Upon the Street; Advice to Engineers, Contractors and Inspectors; Laboratory; Methods for Examination of Bituminous Materials and Mineral Aggregates; Instructions for Taking Samples and Specimens of Materials for Examination.

Air Compression and Transmission.—By H. J. Thorkelson, New York, McGraw-Hill Book Co. Cloth, 6x9 ins.; pp. 207; illustrated; $2.00.

This is a well presented text book on its subject, and an unusually pleasing example of book making. All the illustrations are line cuts and free hand pen drawings, and this with the particularly good rendering gives a harmony to the whole make up which is rarely seen in engineering books.

The purpose of the book, as stated by its author, is to present in logical order the fundamental principles of air compression and transmission through pipes with such examples as will serve to illustrate their application. The chapter titles are: Characteristics of Air; Fundamental Definitions; Graphical Diagrams; Air at Pressure Below the Atmosphere; Air at Low Pressure; Piston Compressors; Efficiency and Energy Compensation; Multi-Stage Compression; Details of Piston Air Compressors; Turbo Compressors; Hydraulic Compression of Air; Effect of Altitude and Compressor Tests; Receivers; Measurement and Transmission of Compressed Air; Selection and Care of Air Compressors. Two appendices give tables of common and Naperian logarithms and a third is entitled Hygrometry, and contains charts for hygrometric determinations.

Selected Standard Specifications.—American Society for Testing Materials, Edgar Marburg, Secretary, Philadelphia, Pa. Cloth, 6x9 ins.; pp. 420; illustrated; $3.

The work accomplished by the American Society for Testing Materials in the formulation of standard specifications is well known to engineers and requires no introduction or explanation. In this volume the society has gathered 20 of its specifications, all relating to steel products, and has printed them in duplicate in English, German, French and Spanish. The lengths of these sections are, respectively, 95 pages, 112 pages, 104 pages and 109 pages. Each section bound separately may be purchased for $1. The specifications included are those for: Bessemer Steel Rails; Open-Hearth Steel Rails; Open-Hearth Girder and High Tee-Rails; Steel Splice Bars; Structural Steel for Bridges; Structural Nickel Steel; Structural Steel for Buildings; Structural Steel for Ships; Boiler and Fire Box Steel; Boiler Rivet Steel; Steel Axles; Heat Treated Carbon Steel Axles, Shafts and Similar Objects; Carbon Steel Wheels for Engine Truck, Tender and Passenger Cars; Carbon Steel Wheels for Freight Cars; Steel Tires; Steel Forgings; Steel Castings and three specifications for locomotive materials.

Specifications for Street Roadway Pavements.—By S. Whinery. Second edition. New York, McGraw-Hill Book Co. Cloth; 6x9½ ins.; 116 pp.; $1.

The first edition of this book was published in the form of a pamphlet in 1907. Since that time no little advance has been made in the design and construction of street pavements and the framing of specifications for that work. As a result a number of changes from the original text have been made in the present specifications. In addition specifications have been added for bituminous concrete pavement, concrete pavement, concrete curb and gutter and concrete sidewalks. Not the least valuable feature of the present edition is a code of instructions for inspectors on street paving work. While these instructions would probably need some revision and modification to meet the conditions and special specification provisions in any particular city, they should prove useful in at least suggesting the points to be covered.

Manual of Cement Testing.—By William A. Richards and Henry B. North. New York, D. Van Nostrand Co. Cloth, 5¼x8 ins.; pp. 137; illustrated; $1.50.

This book is substantially a paraphrase of the directions for the physical and chemical testing of cement as standardized by the American Society of Civil Engineers, The Society of Chemical Industry and allied organizations. The text condenses the standard directions, simplifies them in certain particulars and occasionally amplifies them. It is a safe guide for the student in making tests and will aid him in securing uniformity of results. It needs to be supplemented by some of the larger treatises on cement testing to enable the student to gain much certainty in the interpretation of test results.

NEWS SECTION

Editorial Comment—Personals—Society Meetings—Trade Notes—Catalog Reviews—Contract News, Embracing Bids Asked, Work Projected, Contracts Let and Contract Prices on All Classes of Civil Engineering Construction Work.

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The Doings of the Week.

Railroad construction as regards the letting of new contracts has been rather quiet the past week. Few contracts of any size appear to have been awarded, and very little new work of importance has made its appearance. Among the contracts let recently are the following: Dale & Baumgartner, St. Paul, Minn., and R. A. McMememy for about 500,000 cu. yds. of grading for the new Northern Pacific yards at Carlton, Minn., Nels Bolander and H. A. Whittier, Minneapolis, Minn., for grading the Fairmont & Veblen R. R., a 46-mile line from Veblen, S. Dak., to Fairmont, N. Dak., this work calling for about 500,000 cu. yds. of grading; Keasal Construction Co., Tacoma, Wash., for 2 miles of track for the Northern Pacific Ry., on Tacoma water front; Littig Bros., Davenport, Ia., for track construction at Oxford, Victor and South Amana, Ia., for the Chicago, Rock Island & Pacific Ry.

State Highway work is opening up in good shape, although some of the states, notably New York and Pennsylvania, have not yet begun this year's work. Of the new work open for bids in this issue, Ohio is advertising eight contracts and Massachusetts three. One of the largest single road contracts advertised in the last few days is for the construction of 10 miles of gravel roads in Bastrop County, Texas. The Maryland Good Roads Commission has awarded contracts for 7 sections of highway at prices ranging from $17,000 to $39,000, and is calling for bids on 9 sections.

It looks now as though the Department of Railways and Canals of Canada would call for tenders this month for the first work in connection with the construction of the new Welland ship canal. Final inspection of the proposed work was made last week.

Most of the drainage contracts that have been let since our last issue are for tile drains in Iowa. Quite a number of fair sized contracts for this work have been let. Few large open ditch contracts are up for bids at the present time. One of the largest contracts that has been let recently was secured by R. H. & G. A. McWilliams, Chicago. The contract called for 450,000 cu. yds. of levee and 100,000 cu. yds. of ditch work for the Marion County (Mo.) drainage district. There will be a large amount of earth work undertaken this season throughout the Mississippi Delta in repairing and constructing new levees.

Bids on a fair-sized U. S. Reclamation contract have been opened at Babb, Mont. This called for the construction of the St. Mary Canal of the Milk River project. The work was divided into three schedules, Kilpatrick Bros. & Collins Contracting Co., Beatrice, Neb., offered the following bid: Schedule 1, $140 730; Schedule 2, $212,675; Schedule 4, $159,170. On the latter schedule the Cardston Construction Co., Cardston, Alberta, bid $101,030.

In the way of private irrigation projects about the most interesting development of the past few days is the starting of preliminary work by the Pacific Gas & Electric Co., San Francisco, for a project covering the southwestern portion of Nevada county, Cal., from Chicago Park to Indian Springs and Spenceville and extending to Bear River. Preliminary plans and estimates will be made for an irrigation system providing for practically 100,000 acres of foothill land as the first step toward developing Nevada county's horticultural and agricultural resources.

A good sized government dredging job is now open for bids. This calls for dredging in Portland Harbor, Me., the approximate quantity totaling 1,413,200 cu. yds.

At a special election on May 7 the voters of Calgary, Alberta, approved the following by-laws: For trunk sewers, $527,660; for grading of Nose Creek hill, $5,500; for street railway equipment and extensions, $250,000; for concrete sidewalks, $3,500; for asphalt paving, $25,000; for extending conduit system, $70,000

"Just Wops."

A few months ago a touching little sob story appeared in a New York publication. Sentimental people shed tears over it; immigration societies investigated it, and ministers used it as a text for sermons. The following version of how the story came to be written was given by Mr. C. H. Hollingsworth in a paper presented before the American Society of Engineering Contractors:

There are many less accidents on public works than many people think. Part of the general public does not think about it at all and the other part thinks that every construction job is a veritable shamble. This latter idea is helped along by some budding or blossoming author who is looking for throbs, said throbs to be incorporated in an article for a popular magazine or Sunday supplement at so much per. One article in that line appeared some time ago entitled "Just Wops." It was extremely thrilling and very harrowing. The author went over to the "Jersey side" and discovered the Erie Cut. He also discovered some young engineer who, upon finding the literary gent was easily led, proceeded to fill him up. Kill men! sure they had killed several score, were killing them every day. Unfortunately, they were not killing any that day, but they might have a few new killings on hand soon, so he had better stick around. Upon the author's asking this truthful young man if his conscience did not smite him at all about this needless slaughter and if his soul did not shrivel up appalled, he replied nary a shrivel, they are "just wops." Hence the immortal title. The innocent author being unfamiliar with the fact that the word "wop" is the technical name for the subjects of King Humbert, proceeds to tell us what the word means and gets his cables crossed badly. He elucidates that laborers, sand-hogs, structural iron workers, and, in fact, any man employed on construction work, is a Wop. He is, eh? I should love to be around when he called some sand-hog from East Boston, some ironworker from Buffalo, or some Negro drill runner a Wop. There would be something doing, I trow. Anyway, he proceeds with the agony and hints darkly that the young man did not tell him all about the dead ones and that there were doubtless many more. They used them for back-filling, no doubt. He furthermore states that it is a historical fact that there is a fixed rule of structural iron workers that one man must be killed for each floor of a skyscraper building. He does not say whether they scrag them one at a time or wait until the building is completed and then push them all off the top. Fool articles like this would make very little difference except that a lot of otherwise intelligent people believe them and, unfortunately, some engineers foster that belief and like to strut around and tell how many "we killed" on the last job. The bright gentleman that wrote the article did not get the case of the man whose leg was pinned down by a bowlder too big to lift and how the other men propped up the boulder and the company doctor crawled under it and amputated the man's leg in an effort to save his life. Also, I have on several occasions seen a foreman or superintendent, when there was a blow-out in front of a shield, go down in front and pull out Italians, or other laborers, who were caught in the first rush of mud or sand.

Letters to a Drainage Engineer.

Two examples of the gentle art of letter writing are given below. While they do not exactly follow the rules laid down by the author of "Polite Correspondence—or a Letter for Every Occasion," due consideration should be given to the conditions under which they were written:

crag 17 march

mr bil hazen
drane engineer
sant jo mo
dere sir,

i do just lak you sais i make my teems down on the deetch alrite an i wate 3, 4 dazes for profeel so i can dig deetch you no i do nottins wit out a profeel why doan you send me a profeel i fin al them stobs alrite but wat gut is stobs wen i got no profeel. you run for offic i nock you lik hell and so my boys and my skinners we al fite you hard my teems ete hay by the tun an i maks nottins becoz i got no profeel then it ranes an i maks nottings again soon mr bil you doan tend to binnes enuf you ride roun in otomobeel to —— —— moch ples send me a profeel quick so i can mak sum mony ure frend

—— ——.

crag 19 march

mr bil hazen
drane enganeer
sant jo mo
dere frend,

excuse me i haf that dam profeel you sen him 5, 6 dazes an my boy pete gats him out of bocks he wans to go sant jo an have hell of tims and keeps that profeel you runs for offic we all work hard for you and gets you votes i am ure frend an so is my boys an my skinners we all lik you moch cum up in ure otomobeels som dazes an we haf big diner you let me no i go to Rulo an gat cas an we haf gut tims we work now by stashun 6 an move lots of dirt pete is seek an not work for 2, 3 dazes i make moch mony now i haf 12 teems ure frend

—— ——

PERSONAL

Mr. B. F. Cresson, Jr., has resigned as first deputy dock commissioner of New York.

Mr. Charles E. McRae and Mr. H. A. Stringfellow have opened a consulting engineering office in the Reliance building, Kansas City, Mo.

Mr. F. W. Bruce has been appointed resident engineer in charge of the new municipal terminal development for the city of Jacksonville, Fla.

Mr. G. W. Heinmiller, civil engineer and county surveyor for Foster county, North Dakota, has been appointed city engineer for Cerrington, N. D., for a term of two years.

President Charles R. Van Hise of the University of Wisconsin will address the University of Wisconsin Club of Chicago at the luncheon held Friday, May 16, Grand Pacific Hotel, Chicago.

Professor F. P. McKibben of Lehigh University has sailed for France and Switzerland, where he will spend five months studying highway and concrete construction and waterpower development.

Mr. C. R. Fickes, locating engineer for the Burlington Railroad, has returned from a Western trip and will superintend the construction of the $5,000,000 bridge to be built over the Ohio river at Metropolis, Ill.

Mr. William Hoskins, chemical engineer for the Committee on Smoke Abatement and Electrification, Chicago Association of Commerce, addressed the University of Wisconsin Club of Chicago, Friday, May 9, on the smoke nuisance.

Jacob Friday, a bridge builder, died at his home in Pittsburgh, April 6. Mr. Friday built some of the largest bridges across the Allegheny and Monongahela rivers at Pittsburgh, and part of the harbor protection at Charleston, S. C.

Mr. Daniel W. Mead, instructor in engineering at the University of Wisconsin, has been selected by the Indiana Railroad Commission to act for the city of Peru, Ind., in the construction of a railroad bridge over the Wabash river at that point.

Mr. H. E. Chubbuck, vice president of the Illinois Traction System, will address the joint meeting of the Electrical Section, Western Society of Engineers, and the Chicago Section, American Institute of Electrical Engineers, to be held in Chicago, May 26.

Mr. M. C. Blanchard, Santa Fe division engineer at Topeka, Kan., for the past two years, has been promoted to the position of office engineer in the office of R. A. Rutledge, chief engineer of eastern lines. He succeeds Mr. K. B. Duncan, recently appointed engineer of Santa Fe gulf lines.

Mr. H. B. Pullar and Mr. C. H. Enzenroth, consulting engineers, have opened a laboratory at 378 Woodward avenue, Detroit. The firm makes a specialty of road and pavement work, and of testing bituminous material. Mr. Pullar was formerly chief chemist and assistant manager for the American Asphaltum & Rubber Co. of Chicago.

Adolphus Bonzano, civil engineer and formerly vice president and chief engineer of the Phoenix Bridge Co., died at his home in Philadelphia, May 6, aged 83. Mr. Bonzano was born in Germany, coming to this country in his youth and settling in Texas. He began his engineering career in 1852 with the Reynolds Machine Works of Springfield, Mass., rapidly rising to the superintendency of the plant. In 1865 he had charge of construction of the Detroit Bridge and Iron Works. In 1868 he and the late Thomas C. Clarke organized the Phoenix Bridge Co. In 1893 he retired from active interest in that firm, and engaged in private consulting practice.

Civil Service Examinations.

The United States Civil Service Commission announces an examination as follows:

Testing Machine Operators: $1,800 per annum; June 4.

Examinations will be held at Philadelphia as follows:

Superintendent of Water Bureau of Department of Public Works, Philadelphia: $2,200 per annum; May 26. Applicants must reside in Philadelphia.

District Surveyor and Regulator of Public Works, Philadelphia; $4,000 per annum; May 27. Applicants must be residents of Philadelphia.

INDUSTRIAL

The Westinghouse Church Kerr & Co. has moved to its new offices at 37 Wall St., New York City.

The Montreal, Canada, office of the Sullivan Machinery Co., hitherto located at 403 Lagauchetiere St. West, is now situated at Room 806 Shaughnessy Bldg., corner St. Paul and McGill Sts.

Among recent orders received by the Heine Safety Boiler Co., of St. Louis, Mo., is one from the H. J. Heinz Co., of "57 Variety" fame, for five 607 HP. boilers, totaling 3,035 boiler horse power for installation in the new plant at Pittsburg. The H. J. Heinz Co. is already users of 2,700 HP. of Heine boilers. The new boilers will be of larger capacity than the old, and will be of the two drum type with two horizontal passes for the gases.

Scottdale Foundry & Machine Co., with works and general offices at Scottdale, Pa., has opened a Chicago branch office in charge of Mr. Carl Heim at 327 S. La Salle St., Chicago, Ill. This company specializes in coal, coke, ash handling machinery and equipment, and has constructed a large number of coal mining tipples and machinery in West Virginia and Pennsylvania during the last 15 years. It has recently completed a coal tipple for the Chicago, Wilmington & Vermilion Coal Co. and is at the present time taking contracts for machinery and equipment from many other Illinois coal companies.

On April 16, 1913, Allis-Chalmers Manufacturing Co. took over the properties and entire operation of the business of Allis-Chalmers Co., which latter company during the past year has been in the hands of a receiver. This change marks the end of the Allis-Chalmers receivership and the commencement of the administration of the new company. Beginning with April 16 all business has been and will be conducted by Allis-Chalmers Manufacturing Co., which starts out under conditions promising success. The new company will operate all departments of the business as conducted by its predecessor and will carry out all contracts on hand for the sale of its products. It has no bonded indebtedness nor liabilities of any character. In addition to all assets of the former Allis-Chalmers Co. the new company has over $4,000,000 additional cash for new working capital which has been raised through the recent reorganization. The new company will continue to operate the large West Allis works and Reliance works at Milwaukee, the Chicago works, and in addition will control the operations of Bullock Electric Manufacturing Co. at Cincinnati. Otto H. Falk, of Milwaukee, who for the past year has been receiver of the Allis-Chalmers Co. and under whose management as receiver the operations of the business have shown marked improvement, has been elected president of the new company. The general offices will be at Milwaukee. All properties of the new company are in good condition and its inventories and working capital on a sound basis. Its engineering departments are well equipped and the various lines of product now turned out are of the highest quality. Under these conditions it is believed that with the present careful and intelligent management the operations will show substantial profits.

CATALOGUES

Fire Proof House Construction.—Paper, 9x12 ins., 4 pp. Duall Fireproofing Co., 6 N. Clark St., Chicago, Ill.

This folder describes a method for erecting concrete floors without centering.

Case Road Machinery.—Paper, 6¾x10½ ins., 16 pp. J. I. Case Threshing Machine Co., Inc., Racine, Wis.

This catalog illustrates and describes the Case Steam Road Rollers, including a type which is convertible into a traction engine; There are also included road graders, rock crushers, portable bins and auxiliary machinery. A complete price list is given.

Economical Burning of Coal.—Paper, 8¼x10¾ ins., 32 pp. Valley Iron Works, Williamsport, Pa.

This is a treatise on the burning of coal to secure greatest economy, smoke prevention and ease with hand firing. It includes a discussion of the methods of accomplishing these results with Ajax Grates, a description of the Ajax Shaking and Dumping Grates, Standard Tupper Grates, Competition Grates, Standard Circular Grates, etc. The catalog is well illustrated, showing the construction details.

Peerless Motor Trucks.—Paper, 11x8¾ ins., 56 pp. Peerless, Cleveland, O.

This catalog contains a large number of illustrations of motor trucks in operation. It gives the names of the owners of the trucks and a brief outline of the work done by each truck. The catalog also gives descriptions of the parts of the truck outlining the construction and operation.

Reo Motor Trucks.—Paper, 11x8¾ ins., 16 pp. Reo Motor Truck Co., Lansing, Mich.

This catalog gives a number of illustrations with description of the various models of Reo trucks of 1½ and 2 tons capacity.

Graflex.—Paper, 6½x9¾ ins., 60 pp. Folmer & Schwing Division, Eastman Kodak Co., 120 Caledonia Ave., Rochester, N. Y.

This catalog contains a number of very interesting photographs showing the results of operations with Graflex Cameras. Complete illustrations, descriptions and prices are given.

Pavement and Roadways.—Paper, 6x9¼ ins., 100 pp. American Steel & Wire Co., 72 W. Adams St., Chicago, Ill.

This book is devoted to triangle mesh wire reinforced concrete pavements and roadways. It contains a large amount of valuable information and data regarding the construction of concrete pavements. Descriptions of the construction of pavements and the methods used are shown with complete illustrations and drawings.

Electrical Machinery.—Paper, 8x10 ins., 20 pp. General Electric Co., Schenectady, N. Y.

Bulletin A4061 is devoted to electric arc headlights and supersedes the company's previous bulletins on this subject.

Bulletin A4084 is devoted to centrifugal compressors and supersedes the company's previous bulletin on this subject.

Advantages of Using Water Meters.—Paper, 8½x11 ins., 8 pp. Buffalo Meter Co., 280 Terrace, Buffalo, N. Y.

This is a summary of the experiences of water works official and engineers which have been published in reports and recommendations and is published in this form by the Buffalo Meter Co. to save investigators the necessity of research.

Toncan Metal.—Paper, 5¼x8¼ ins., 72 pp. The Stark Rolling Mill Co., Canton, O.

This is a text book on corrosion. It has been revised and enlarged and contains photographs of prominent installations. It is divided into three parts. Part 1 contains technical information, Part 2 is illustrative of some of the meritorious qualities and properties of Toncan Metal, and Part 3 on sheets and products contains valuable tables and information on roofing, siding, standard weights, gages, number of corrugated sheets in one square, rules of measurement, index, etc.

Waterproofing Compound.—Paper, 3½x6 ins., 8 pp. The Goldstein Waterproofing Products Co., 1135 Broadway, New York City.

This booklet describes the Marvel Waterproofing Compound and gives specifications.

Derricks & Excavators.—Paper, 6x9 ins., 32 pp. National Equipment Co., Chicago, Ill.

This catalog contains illustrations, descriptions and tables of sizes and specifications for hoisting machinery, derricks, excavators and material handling equipment for contractors, gravel plants, railroads, manufacturing plants, etc.

Steelcrete.—Paper, 3¼x6¼ ins., 16 pp. Expanded Metal Engineering Co., Architects' Bldg., Park Ave. & 40th St., New York City.

This booklet gives a detailed description of the Steelcrete Expanded Metal Lath and shows a number of uses for its application. Other products such as Steelcrete Reinforced Corner Bead, Metal Base Ground, Metal Picture Molds, Hollow Studs, Sockets, etc., are shown.

Railroad Hydraulic Tools.—Paper, 6x9 ins., 160 pp. Watson-Stillman Co., 62 Church St., New York City.

Catalog No. 92 contains illustrations, descriptions and tables of sizes and prices of hydraulic tools and auxiliary parts. This catalog supersedes Catalog No. 73.

Application of Stucco.—Paper 3½x6 ins., 8 pp. The Standard Paint Co., 101 William St., New York City.

The suggestions for the application of stucco which are given in this booklet are being followed by contractors, it is stated, who guarantee their stucco to remain free from hair cracks and checking for a period of five years.

Automatic Mixers.—Paper, 3½x6 ins., 6 pp. Automatic Concrete Mixer Co. of New York, 286 5th Ave., New York City.

This folder illustrates and describes briefly the operation of the automatic mixer known previously as the Haines Mixer.

Calculating Machine.—Paper, 3½x6½ ins., 20 pp. The Arithstyle Co., 120 E. 28th St., New York City.

This booklet describes a calculating machine which adds, subtracts, divides, multiplies, etc., is 5x2½x1 in., and weighs two lbs. Letters from a number of users describe its merits.

Portable Dump Wagon Boxes.—Paper, 8x5 ins., 12 pp. The Everett Manufacturing Co., 45 Lake St., Newark, N. Y.

This catalog contains a complete description with illustrations of the portable dump box, its operation and details of construction.

RAILWAYS

Alabama.

A company has been organized for the purpose of having surveys made and data compiled for a proposed interurban line from Gadsden to Rome. W. H. Lumpkin, Gadsden, Ala., is interested.

Arkansas.

The Kentark Land & Lumber Co., R. Carnahan, President, Kenyon Bldg., Louisville, Ky., is to build 10 miles of railroad from Humnoke on the St. Louis Southwestern Ry. into timber lands.

California.

The State Railroad Commission has granted a certificate of public convenience and necessity to the San Francisco-Oakland Terminal Rys., Oakland, to construct a spur track on Poplar St., 26th St. and Chestnut St., Oakland.

The State Assembly has passed the bill empowering the Harbor Commissioners of San Francisco to extend the Belt Line R. R. to the Exposition site in San Francisco and to dig a tunnel under Fort Mason for the road. It is proposed that the railroad be utilized to not only handle freight along the water front, but to operate passenger trains to convey people to the Exposition in 1915.

The California, Shasta & Eastern R. R. Co. has filed articles of incorporation at Redding. The company has a capital stock of $600,000, of which $32,000 is subscribed. This company recently bought the Anderson & Bella Vista R. R. It is proposed to build a railroad from Anderson through Bella Vista to Ingot, a distance of 28 miles. The first Board of Directors is composed of S. E. Bretherton, Felix T. Smith, W. T. Barnett, Paul McCarthy, F. D. Madison, Plat Kent and V. W. Vincent.

Colorado.

It is now stated that the first improvements in the Union Station at Denver will be commenced in August. This first work will consist of remodeling and enlarging and the extension of the tracks in the yards.

Connecticut.

It is expected that work will be resumed in the near future in the construction of proposed electric railway from Waterbury to Marion. John H. Cassidy, Attorney, Waterbury, Conn., has the franchise for this line.

Florida.

Advices from Pensacola, Fla., state that W. P. Dickinson, President of the Memphis & Pensacola R. R., has returned from a conference with his Chicago associates and has announced that work will be pushed forward as rapidly as possible.

Georgia.

The Ocilla Southern R. R., J. A. J. Henderson, President, Ocilla, Ga., is reported to have completed surveys for extension of line from Macon to Jacksonville, a distance of 230 miles.

Idaho.

Grading work is underway for the Nez Perce & Idaho R. R., to be built out of Lewiston. Z. A. Johnson, Lewiston, Idaho, is the promoter.

Press reports state that preliminary surveys have practically been completed for the proposed extension of the Rogerson branch of the Oregon Short Line R. R. from Twin Falls, Idaho, to a connection with the Southern Pacific. Construction work, it is expected, will be commenced some time this summer. W. H. Bancroft, Salt Lake City, Utah, is Vice President and General Manager.

The Phoenix Construction Co. has grading work under way between Alexander and Grove, 6 miles, for the first section of a branch railroad to be built from Alexander on the Oregon Short Line R. R. to Preston. The construction is being financed by the Utah Power & Light Co., but the road will be taken over by the Oregon Short Line R. R. It is being built at this time to facilitate transportation of supplies for the power plant to be under Grace.

Illinois.

The Chicago & Milwaukee Electric R. R. Co., Highwood, Ill., is contemplating extending its North Ave. line at Waukegan to the golf grounds.

The Chicago & Alton R. R. has authorized an appropriation of $987,000 for the erection of new shops at Bloomington, work on which is to be commenced at once.

The Oil Belt Construction Co., Bridgeport, Ill., will let 12 miles of earth work on the Oil Belt Ry., Bridgeport, Ill.

The People's Traction Co., an electric interurban, operating between Galesburg and Abingdon, has been purchased by the McKinley syndicate, which now controls in addition to the city street car system, all of the interurbans running out of Galesburg except the line to Rock Island.

The Peoria, Canton & Galesburg Ry. Co. has been incorporated with a capital stock of $2,000,000, and proposes the construction of an electric railway from Peoria to Farmington and thence to Galesburg. Engineering work for this road is now under way, right of way is being secured, and it is the intention to begin construction work in the near future. Horace Clark and George T. Page, Peoria, Ill., are interested.

The Commercial Club of Camp Point, Ill., has appointed a committee to consider plans for securing the construction of a steam or electric railroad from Camp Point to Hannibal, a distance of 35 miles. Isaac Cutter is a member of the commitee.

The Tri-State Traction Co. has completed the survey for a line from Hamilton to Quincy, and the necessary right of way is now being taken up. Proposed extensions to the northeast and south are now being taken up, and the terminal facilities and interchange of freight are under negotiation. Construction work is expected to start before the end of June. The company is undecided yet whether to let the work out by competitive bids, or negotiate with a single firm on a cost plus the percentage profit basis. R. O. Marsh, Warsaw, Ill., is President and Chief Engineer.

Indiana.

Articles of incorporation have been filed at the office of the Secretary of State, Indianapolis, Ind., by the Elgin Terminal Ry. Co., capitalized at $60,000. The company proposes the operation of a railroad. The incorporators are E. Oliver, E. J. Binford and S. P. Shope.

The Indianapolis & Delphi Traction Co., incorporated about a year ago for the purpose of building a traction line from Indianapolis to Delphi, has increased its capital stock from $100,000 to $2,000,000. The Delphi Construction Co. of Indianapolis has been incorporated with a capital stock of $10,000 and will probably construct the new line. H. L. Smith, Indianapolis, M. E. Cox and R. E. Johnson are the incorporators of the construction company.

Iowa.

⊙Littig Bros., Davenport, Ia., have been awarded a contract by the Chicago, Rock Island & Pacific for track construction work at Oxford, Victor and South Amana. The work, which will be in charge of Louis Littig, will include considerable grading.

The Interurban Ry. Co., C. F. Hewitt, General Manager, 710 Mulberry St., Des Moines, Ia., is contemplating purchasing the 14 miles of track of the Newton & Northwestern R. R. from Colfax to Newton.

A proposition is under consideration by the Iowa & Southwestern R. R. to construct a line running between Clarinda and Blanchard, Ia., a distance of 17½ miles. The cost is estimated roughly at about $350,000. C. B. Judd, Clarinda, Ia., is interested.

Engineers of the Rock Island System have been running a line for the company between Washington, Ia., and Brighton. The new road will eleminate some heavy grades which made

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

heavy freight traffic on the old line difficult. The route between Brighton and Perlee has also been resurveyed, shortening the distance. No definite information as to when the actual construction work will be started is as yet available.

Kansas.

Surveys are under way for the Interstate Interurban between Arkansas City, Kansas and Enid, Okla. The engineering party is working between Ponca City, Okla., and Tonkawa, Okla., at present. O. L. Brown of Arkansas City, Kan., is President, and S. K. Titus of Arkansas City, Kan., is Chief Engineer. It is expected to push the work as rapidly as possible and to get construction work started soon.

Maryland.

Officials of the Pennsylvania R. R. have been inspecting the route of the proposed Fox Creek R. R. from Cambridge to Lower Dorchester.

Massachusetts.

Plans for financing the Grand Trunk Ry. extension in New England (the Southern New England R. R.) have taken definite shape, and it is understood that the money will be forthcoming shortly for the completion of the line from Palmer, Mass., to Providence, R. I., work on which was suspended some months ago. It is stated that about $6,000,000 will be furnished by New England capitalists for this purpose.

Michigan.

Citizens of Brownstown have voted to grant a franchise to Arthur J. Greenway Co., Detroit, Mich., for right of way through the town for a proposed electric car line from Rockwood to Flat Rock, Dundee and Adrian

The Pere Marquette Ry. Co. is contemplating the reconstruction of the Pentwater branch during the coming summer. The old rails will be taken up and the line laid with heavier steel. Samuel M. Felton, Chicago, Ill., is one of the receivers.

The citizens of Fenton, Mich. and Linden, have voted to grant franchises for a street railway through the village to the Independent Power Co., of which Dr. O. H. Lau, Detroit, is President. The company now has all franchises for a line from Linden to Holly. Surveys have been made and it is hoped to have the road in operation by Dec. 1.

The Detroit, Bay City & Western R. R., Wm. N. Boyd, Chief Engineer, Bay City, Mich., is reported to be planning to begin work at once on the extension of its lines from Wilmot, the present eastern terminal, to Sandusky, the county seat of Sanilac County.

Minnesota.

Bids were opened last week at St. Paul for the construction of terminal buildings at Carlton, Minn., for the Northern Pacific Ry., estimated to cost $175,000.

The Minneapolis & Northern Ry. Co., of Minneapolis, operating a line from Anoka to Duluth, has given a $450,000 mortgage to secure funds for beginning work on an extension of its line.

The Backus-Brooks Co., which recently purchased the Shelvin-Mathieu mill at Spooner, is reported to be planning to start work in the near future on the extension of its Minnesota, Dakota & Western Ry. from Loman to Spooner. C. E. Giles, Internataional Falls, Minn., is Chief Engineer.

The Minneapolis, St. Paul & Sault Ste. Marie Ry. has engineering work under way for its new line from the western end of Duluth to connect with its present line just east of the Northern Pacific R. R.'s Grassy Point line. The route will cross the Northern Pacific track just east of the blast furnace, run through the Zenith Furnace Co.'s property south of the casthouse, and through the entire residence district in the vicinity of Waseca St. The company has already purchased nearly all the property it requires to enter the city in this manner. It is the intention to use this route as a short cut to get its trains out of the city toward the west. A new line is planned which will give the company almost a "bee line" road to Lawler and the Cayuga range country and Western Minnesota.

Duluth and the Iron Country.

By Peter E. Meagher.

⊙E. C. Coons, of the Butler, Coons Construction Co., was a caller and stated that they had just been awarded a paving contract amounting to $150,000 by the city of Hibbing, Minn., and they would start on the same immediately. Mr. Coons is to be congratulated on securing this contract.

⊙Charles Johnson, of the firm of Grant & Johnson, railroad contractors, was a caller, and stated that they were awarded some work on the Northern Pacific Ry., and will start the same immediately.

⊙Dale & Baumgartner, St. Paul, Minn., together with R. A. McMememey, were awarded a contract by the Northern Pacific Ry. Co., amounting to 500,000 yds., for the grading of the Northern Pacific Ry.'s new yards at Carlton, Minn.

John Hannahan, representing the Anchor Packing Co., was a caller. This is Mr. Hannahan's first visit up here in the interest of his firm, and so far he is well pleased with the progress he is making.

H. C. Cameron, Assistant General Manager of the Canadian Northern Railway Company, with offices at Winnipeg, was a caller a short while ago.

E. C. Hingeston, of the Bucyrus Steam Shovel Co., came in to see us and reports business very fine.

Patrick McDonnell, General Contractor, was a caller a few days ago. He has $350,000 worth of sewer and paving work already, and is very busily engaged on the same.

E. C. Tomlinson, of Tomlinson Brothers, Contractors, who are at present working on the Grand Trunk Pacific Ry. in Canada, was a caller.

James Harden, better known as "Jimmy," traveling representative for the Broderick & Bascom Rope Co., spent about a week with us here recently, calling on the trade.

W. A. Kingston and A. J. Brown of the Roberts, Kingston Contracting Co., were callers, and stated that they had already started on their stripping and ore loading contract at the Union Mine, Virginia, Minn.

F. G. Cutter, representing the Warren Brothers' Co., paving contractors, has been in this vicinity for some time, and has been quite successful.

C. R. McLean, the contractor, was a caller, and stated that he had some new work and purchased some new dump cars and track for the same.

Charles Magnasun, the railroad contractor, was a caller, and stated that he was figuring on some steam shovel work at the present time, and hoped to be the successful bidder.

Harry Roberts, president of the Roberts, Kingston Contracting Co., who has been away for most of the winter, has returned, and is living in the city at the present time, and looks better than ever.

Arthur Mitchell was a caller recently and advised us that he and his associates had just incorporated a railway company, called the Grand Mere & Northwestern Railway Company, and of which he is the President. They have a line surveyed out as far as 70 miles. They have sold their bonds and expect to start construction this season. We hope Mr. Mitchell is successful in his new venture, and if ability counts for anything he will be.

John Myers, manager for the Barnett & Record Co., came in to see us the other day, and they are very busily engaged at the present time.

Sam Anderson, who has a rock quarry near Superior, Wis., was a caller, and stated that the outlook for their operations this season was very bright.

Charles Jones, Superintendent for Stewart & Hewitson, contractors, Fort William, Ont., was a caller.

E. J. Seymour, the labor agent from Minneapolis, came in to see us, and states labor is getting scarce in his city.

The outlook for construction work in this vicinity is fairly bright. There are several contracts in view, and labor, of course, is getting scarce.

At the present time there are quite a number of men here, but they are very independent and hard to please. Contractors are paying $2.50 per day for laborers, and company work $2.25 per day. As stated in our other issues we expect to see a severe shortage of laborers in this vicinity this year.

Peter E. Meagher, 409 West Michigan St., Duluth, Minn., will be pleased to have contractors or any one interested in the construction line make his employment and equipment offices their headquarters while in this vicinity.

Missouri.

✣Bids will be received until 2 p. m. May 29, by John Mundinger, Chief Engineer, Huntsville, Mo., for grading the Moberly, Huntsville & Randolph Springs Ry., from Randolph Springs to Moberly, Mo., requiring about 80,000 cu. yds. of grading. Official advertisement will be found elsewhere in this issue.

It is reported that the Chicago, Rock Island & Pacific is planning extensive improvements on the Missouri division during the present summer. The work will include relaying sections of the track with 100-lb. steel and reballasting the line.

Montana.

Surveyors of the Northern Pacific, according to advices from Helena, Mont., are now at work on the eastern end of the Glendive-Helena cutoff and it is expected that actual construction work will be commenced before the summer is over. In addition, it is said the Northern Pacific has just finished surveys of a long loop running north from the main line a few miles west of Laurel, into the Lake Basin country, and thence westerly via Melville to a connection with the terminus of the Shields River branch.

The Northern Pacific Ry. is reported to be purchasing right of way for an extension of its line from Bridges to Washoe, 2½ miles from Red Lodge, and it is believed that the spur will be built this season. It will cost $500,000.

Nevada.

A corps of Southern Pacific surveyors is in the vicinity of Ledlie, Nev., surveying a line from Argenta, east of Battle Mountain, southerly to connect with Owens Lake Road through Los Angeles.

It is planned by the officials of the Winnemucca & Northern R. R. Co. to have surveys completed and everything in readiness to start actual construction on the proposed line from Boise Idaho, to Winnemucca, Nev., by Sept. 1, 1913. H. H. Sheldon, Winnemucca, Nev., is Chief Engineer.

The Nevada Copper Belt R. R., W. C. Orem, President, Salt Lake City, Utah is reported to be planning to begin construction in the near future on an extension to the Aurora mining district, the line to run through the camps of Wellington and Sweetwater and to have its terminus at Aurora.

New Jersey.

⊙The Philadelphia & Reading Ry. has awarded a contract to Frederick A. Havens & Co., 845 N. 19th St., Philadelphia, Pa., for coal pockets and a bin at 40th and New York Ave., Atlantic City.

New Mexico.

The City Council of Albuquerque, N. M., has been asked by E. W. Dobson, resident attorney of the Santa Fe System, for permission to close streets through the site where the company plans to erect shops.

North Dakota.

⊙Nels Bolander, Lidgerwood, N. Dak., and H. A. Whittier, Minneapolis, Minn., have been awarded the contract for constructing the grade for the Fairmount & Verblen R. R. The line will be about 45 miles long, 35 miles of which will be through a level country

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

where the grading will be comparatively light. The remaining 15 miles is through a more hilly country where the cuts and fills will be heavier. Mr. Bolander will have his headquarters at Hankinson.

The Dakota R. R. Co., incorporated early this month, proposes to secure the right of way for a line from Dickinson to Mott, 50 miles. Alphonzo Hilliard, Dickinson, N. Dak., and Richard H. Johnson, Mayor of Dickinson, are interested.

Ohio.

⊙MacArthur Bros. Co., Fisher Bldg., Chicago, Ill., will at once open offices at Wellington, O., for its contract for 24 miles of work on the Lorain, Ashland & Southern, between Wellington and Ashland, O., This contract, as noted in our last issue, includes 500,000 cu. yds. of good team, wheeler and machine work; also the bridging and concrete.

The Pittsburgh & Lake Erie R. R. has obtained 25 additional acres from the Youngstown Steel & Tube Co. and will greatly increase its yard capacity.

The Cleveland & Akron Short Line Ry. Co. has been incorporated with a capital stock of $25,000 and proposes to run an interurban line between those two cities. Most of the private right of way is stated to have been obtained. The route of the new line will pass through Brooklyn, Independence, Brecksville, Everett, Botsum and Portage, a branch taking in Barberton. John C. Chapman, Attorney, Cleveland, O., is one of the incorporators.

T. W. Jackson, Belpre, Ohio, President of the Kanauga Traction Co., has been granted a franchise to build and operate a street railway from the present terminus of the line at Kanauga to the Meigs county line.

Oklahoma.

Arrangements are reported to have been made by H. A. Noah, attorney, Alva, Okla., for securing the necessary funds from Paris financiers to construct the proposed line of the St. Louis, Bartlesville & Pacific R. R. The company, which was chartered several years ago, proposes to build a line west from Joplin, touching the Oklahoma towns of Bartlesville, Pawhuska, Ponca City, Pond Creek, Cherokee, Alva, Beaver and Guymon, thence west to Des Moines, N. M. The first link built will be that west from Alva to Des Moines, where there are rich coal fields. It will cross Beaver, Texas and Cimarron Counties in Oklahoma. The entire length of the new line, if completed according to charter, will be 864 miles. F. Cometah, representing the French bankers who are to finance the construction, has visited Oklahoma, and with Mr. Noah, gone over the proposed route.

Oregon.

A meeting was recently held at Fossil Ore., to discuss the proposition to develop the coal fields about 10 miles south of the city in order to secure the construction of the proposed extension of the Condon branch of the Oregon-Washington Railroad & Navigation Co. to the county seat of Wheeler County.

Pennsylvania.

⊙The Phoenixville, Valley Forge & Strafford Street Ry. Co. has awarded the contract for the concrete piers and abutments and for the erection of the iron work for a bridge over Valley Creek for the proposed extension from Valley Forge to Bridgeport. The Phoenix Bridge Co. has the contract for the bridge. A contract for 15,000 ties has been let to Bush & Co., Wilmington, Del.

The Eastern Transit Co., H. R. Fehr, President, Easton, Pa., is to rebuild about 3,000 ft. of track in Freehousburg, and will also lay about 2,000 ft. of new track in Easton.

The Scranton & Birmingham Traction Co., R. W. Day, General Manager, 227 Wyoming Ave., Scranton, Pa., will, it is stated, let contracts in the near future for 17 miles of new track between Nicholson and Montrose.

The South York Portage Ry. Co., Chas. H. Morgan, President, Johnstown, Pa., has secured an extension of its charter rights, and will, it is understood, extend its line via Cassandra, Lilly and Cresson to Gallitzin as soon as the line between South Fork is completed.

The Lehigh Valley Transit Co., Allentown, Pa., has taken bids for double tracking 14 miles of electric line from Lansdale to Souderton.

Steps are being taken at Punxsutawney to organize a company to build a street railway from that place to Rossiter, North Rossiter and Frances Mines, by way of Cloe.

The Chestnut Ridge Ry., C. R. Funk, chief engineer, Palmerton, Pa., operating 13 miles of line from Palmerton to Saylorsburg, is to construct an extension into Stroudsburg.

Tennessee.

⊙Roper Bros. & Larkin, Memphis, Tenn., have been awarded a $25,000 contract for grading for the new terminal to be built at Memphis for the Memphis Bridge & Terminal Co. In connection with these terminals two subways, to cost about $100,000 each, will be built, as well as a warehouse to cost about $1,000,000. Work on the bridge will be started early in the fall. K. G. Williams, 397 E. Calhoun Ave., Memphis, Tenn., is engineer in charge.

Texas.

The Atchison, Topeka & Santa Fe Ry. has appropriated $797,670 for improvements to its Texas lines this year. These improvements are exclusive of the construction of extensions and new lines now under way.

Engineers of the Quanah, Seymour, Dublin & Rockport R. R. have completed the survey from Graham to Seymour, Texas. G. S. Plants, Seymour, Texas, is a director of the company.

Vermont.

The Boston & Maine R. R. will probably in the near future have work started on double-tracking its line from Brattleboro to Putney, 10 miles. The new link between South Vernon and Brattleboro will be completed next month by the contractors, Holbrook, Cabot & Rollins Corp., Boston, Mass.

Washington.

⊙The Keasal Construction Co., Tacoma, Wash., has been awarded the contract by the Northern Pacific Ry. for laying about two miles of rail on the waterfront between the Tacoma Smelter and Old Town

The Puget Sound-Willapa Harbor Ry. Co. (Milwaukee System), has established offices at the Nixon Bldg., Raymond, Wash., and preparations are being made for an immediate start on the construction of the road. C. H. Byers is Chief Engineer, M. B. McBride is Auditor and F. J. Long is Right-of-way Agent.

Advices from Clarkston, Wash., state that Engineer P. P. Oehlers, began surveys on May 1 for the line of the Lewiston-Clarkston Valley R. R., between Clarkston and Asotin. The survey has already been completed between Lewiston and Clarkston, and it is expected this part of the line will be in operation by Aug. 1.

West Virginia.

The Wheeling Traction Co., Wheeling, W. Va., is reported to be contemplating extending its double track at McMechen to the lower end of the city. The work may be done this summer.

Wisconsin.

The Minneapolis, St. Paul & Sault Ste. Marie R. R. has filed with the Secretary of State, Madison, Wis., amendment to its articles of incorporation, providing for the reconstruction of its line between Owen and Withel in Clark County. The new line will run north of the present line.

Canada.

⊙The contract for double track work on the municipal railway at Saskatoon has been awarded to the Bitulithic & Contracting Co., Ltd., Saskatoon, for that portion of the street railway lying within the area of their paving contract, a matter of about 1,519 ft. Fielding & Shepley will do that portion of the tracks lying within their paving area, about one city block, and the El Oso Co. will be asked to do that portion which lies within the remaining portion of their paving contract, about two city blocks.

It is believed that the officials of the Great Northern Ry. Co., contemplate the extension of the Kootenai Valley line to Kuskanook, opposite Nelson, B. C., on the Kootenai Lake. The company now operates to Wolf Junction, but the new route will shorten the distance.

The Canadian Pacific officials have authorized the construction of the line from Bassano to Lacombe, via Alix. A line is now under construction from Bassano to Acme.

Ratepayers of Calgary, Alberta, have approved a by-law to expend $250,000 for street railway equipment and extensions.

BRIDGES

Alabama.

✣Bids will be received until noon, May 19, by Board of Revenue, Mobile County, Mobile, Ala., for the construction of reinforced concrete bridges and culverts on Hall's Mill Road from Station 290 to Theodore.

Arkansas.

⊙The Van Buren County Bridge Commissioners, Clinton, Ark., have awarded the contract for the construction of a bridge over South Fork of Little Red River, about one-fourth of a mile from the city, to the Vincennes Bridge Co., Vincennes, Ind., at $5,000.

J. W. Johnson, Conway County Judge, Conway, Ark., and Judge J. W. Holt of Faulkner County, Ark., recently held a meeting to decide on the plans for the proposed bridge over Cadron Creek at Gleason.

California.

⊙The Mercereau Bridge & Construction Co., Los Angeles, Cal., has been awarded the contracts for the erection of two steel bridges for the Pacific Electric line, one to be located at Lytle Creek, south of the city of San Bernardino, and the other across the Santa Fe line at Highgrove.

The Board of Public Works, on the recommendation of City Engineer M. M. O'Shaughnessy, San Francisco, Cal., has ordered the temporary closing of the bridge which carries the 20th St. roadway over the Santa Fe tracks between Iowa and Tennessee Sts. until the floor can be replaced.

Colorado.

Seth B. Bradley, President of the Board of Public Works, Denver, Colo., has expressed his belief that work will be started on the Colfax viaduct by June 1. Bids for the work are being advertised for and an election will be held May 20 to submit to the voters the proposition of issuing bonds.

Georgia.

As the result of recommendations made by a session of the Floyd County Grand Jury, it is expected that new concrete bridges will be constructed over the three rivers in the City of Rome, Ga.

Illinois.

✣Bids will be received up to 1 p. m., May 26, at the Town Hall, Okawville, Ill., for the construction of three reinforced concrete bridges to be built in Okawville Township, Washington County. A. R. Ochs, Town Clerk, Okawville, Ill. Franks, Rennegarbe and Nus-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

baumer bridges: Spans, 6, 6 and 18 ft.; roadways, 20 ft.; height, 9, 10 and 13 ft. Estimated total concrete in three bridges, 109.6 cu. yds.; reinforcing steel, 10,080 lbs. Nearest railroad stations (approximate), Okawville, ¼ miles, 2 miles and 1½ miles. No local concrete materials available. Present bridges wood, 4, 4 and 15-ft. spans. Low water flow dry; high water about 4, 4 and 7 ft. Excavation clay, about 7 ft.; clay about 8 ft.; clay and loam about 12 ft. for east abutment and 6 ft. for west abutment. Engineer's estimate for the three bridges, $1,675. Work to be completed on or before September 1, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office, or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received until 2 p. m., May 17, by Town Commissioners of Highways, Ursa, Ill., for the construction of a riveted steel truss bridge over Jenkins Creek. M. M. M'Nay is Town Clerk. Lillbern H. Richardson, Quincy, Ill., is County Surveyor.

✣Bids will be received up to noon, May 14, 1913, at Smull's Hall, McConnell, Ill., for the construction of one reinforced concrete bridge to be built in Waddams Township, Stephenson County. J. C. Fisher, Town Clerk, McConnell, Ill. Herman Schrader bridge: Span, 50 ft.; roadway, 16 ft.; height, about 17 ft. Estimated total concrete, 88 cu. yds.; reinforcing steel, 5,980 lbs. Nearest railroad station, McConnell, about 2 miles. It is reported that gravel may be obtained from a bank about 1½ miles from bridge site at 25 cts. per cu. yd. at pit. This gravel, if used, must be washed. High water about 16 ft. deep. Average excavation about 16 ft. deep. Engineer's estimate, $2,600. Work to be completed on or before October 1, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office, or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received up to 2 p. m., May 16, 1913, at Carl Lager's store, Geneso, Ill., for the construction of one reinforced concrete bridge to be built in Munson Township, Henry County. Carl J. Lager, Chairman, Geneseo, Ill. Wiedenhoeft bridge: Span, 25 ft.; roadway, 20 ft.; height, 11.5 ft. Estimated total concrete, 75.6 cu. yds.; reinforcing steel, 9,205 lbs. Nearest railroad station, Cambridge, about 2½ miles. It is reported that gravel may be had from Moline f. o. b. Cambridge at about $1.60 per cu. yd. Present bridge wood, 24-ft. span. Low water flow about 6 ins. deep and 10 ft. wide; high water about 5½ ft. deep. Excavation will average about 7 ft. deep through black gumbo and mud to about 3 ft. below stream bed. Engineer's estimate, $1,200. Work to be completed on or before October 1, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office, or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received up to 2 p. m., May 16, 1913, at the Town Clerk's office, Collinsville, Ill., for the construction of two reinforced concrete bridges to be built in Collinsville Township, Madison County. Wm. Grenard, Town Clerk, Collinsville, Ill. Junghans and Trautwine bridges: Spans, 20 and 25 ft.; roadways, 20 and 20 ft.; height, 21 and 15 ft. Estimated total concrete, 137.9 and 108.4 cu. yds.; reinforcing steel, 11,720 and 11,130 lbs. Nearest railroad stations, Sand Bank switch, 1 mile; coal mine No. 2 siding, ½ mile. No local concrete materials available. Present bridges steel, 20-ft. span on stone abutments; steel leg bridge, 24-ft. span. Green timber for false work can be cut near each bridge. Low water flow for both sites, trace; high water for both, about 10 ft. Excavation, clay and sand, to go about 6 ft. below stream bed, in each case. Engineer's estimate for both bridges, $5,700. Work to be completed on or before October 16, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office, or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received up to 2 p. m., June 2, 1913, at the Town Clerk's office, LaSalle, Ill., for the construction of a viaduct across the C., B. & Q. tracks and the Big Vermilion River, about 3 miles south of LaSalle, Ill. John Dillon, Town Clerk, LaSalle, Ill. Big Vermilion bridge: Alternative bids will be received as follows: For an entirely reinforced concrete structure, consisting of three 45-ft., reinforced concrete, through girder spans; west of the channel, a reinforced concrete truss channel span, 224 ft. in length, and one 45 ft., through, reinforced concrete girder approach, east of the channel. Bids will also be received on a structure as outlined above, with the exception of the channel span, which in this case is to be a 224-ft., steel truss with concrete floor. The roadway is to be 18 ft. wide in the clear. The viaduct is to be located about 200 ft. from a side track of the C., B. & Q. railroad, near Oglesby, Ill. Periodical payments will be made on this work, not oftener than once a month, to the amount of 50% of the engineer's estimate of the work completed during the period. Bidders will be required to sign a contract with the C., B. & Q. Railroad Company, a copy of which will be furnished with each copy of the plans and specifications. Bidders are requested to view the site of the structure before submitting proposals. Estimated cost, $23,000. Work to be completed on or before July 1, 1914. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office, or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received until 11 a. m., May 23, by L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing all labor, tools, materials, etc., necessary for the construction of a highway bridge over the north branch of the Chicago River at Irving Park Blvd. Specifications require that unit bids be submitted upon the following items: A—for the complete removal of all timber approaches, pile bents, etc., found at bridge site, for transferring and adjusting the present river span to a temporary location, the removal of temporary bridge upon completion of permanent structure; B—for the superstructure of new bridge complete, including structural steel, cast iron, materials for center and end spans, subplanking, paving, etc.; C—for building, maintaining, protecting and removing cofferdam; D—excavation for piers, abutments, etc., approximate quantity 3,500 cu. yds.; E—piles for temporary and permanent bridges, delivered at site, approximate quantity 16,500 lin. ft.; F—for driving piles, approximate quantity 14,000 lin. ft.; G—for yellow pine used for approaches for the temporary bridge, including all labor, tools and fastenings, approximate quantity 70,000 ft. B. M.; H—for Portland cement concrete in abutments and piers in new bridge, including labor, materials and forms (exclusive of reinforcing bars), approximate quantity 1,480 cu. yds.; I—furnishing and driving 4 test piles; K—Portland cement concrete in retaining walls, including excavation, approximate quantity 870 cu: yds.; L—for filling in approaches, approximate quantity 4,000 cu. yds.; M—asphaltic macadam pavement, approximate quantity 3,000 sq. yds.; N—for reinforcing steel bars and rods, furnished and erected in place, approximate quantity 12,500 lbs.; O—for concrete combined curb and gutter built in place, quantity assumed 1,030 lin. ft.; P—for concrete sidewalks built in place, approximate quantity 6,840 sq. f.; Q—for gas pipe railing built in place, approximate quantity 820 lin. ft.; cash or certified check for $1,500 must accompany proposal. Deposit of $10 required for safe return of plans and specifications.

⊙The contract for reflooring a steel bridge known as the Sarttwell bridge, Savanna Township, Carroll County, Ill., has been let to J. F. Meffley & Son, Galena, Ill., at $2,085. Bids for the work were opened May 1 by Harry Craig, Town Clerk, Savanna, Ill.

⊙The contract for the construction of a reinforced concrete bridge in Keene Township, Adams County, Ill., has been let to C. A. Wever & Son, Clayton, Ill. S. A. Ketchum, Town Clerk, Loraine, Ill., opened bids May 3.

The Peoria & Pekin Union and the Chicago, Rock Island & Pacific Rys., according to advices from Peoria, Ill., are about to let contract for the construction of the Bridge St. viaduct. It is estimated that the cost will amount to about $97,000. R. H. Johnson, Peoria, Ill., is General Manager of the P. & P. U.

Indiana.

✣Bids will be received until 10 a. m., June 6, by Board of Shelby County Commissioners, Shelbyville, Ind., for the construction of four steel truss bridges and some concrete and grade work. F. W. Fagel is County Auditor.

✣Bids will be received until 10 a. m., June 2, by Board of Blackford County Commissioners, Hartford, Ind., for the construction of 6 new culverts and bridges. James Cronin, Jr., is County Auditor.

✣Bids will be received until 10 a. m., May 19, by Board of Rush County Commissioners, Rushville, Ind., for the construction of 13 bridges and repair for two. A. R. Holden is County Auditor.

✣Bids will be received until 10 a. m., May 20, by Board of Fayette County Commissioners, Connersville, Ind., for the construction and repair of 13 bridges. J. L. Kennedy is County Auditor.

✣Bids will be received until May 24 by Board of Shelby County Comnfissioners, Shelbyville, Ind., for the construction of a number of reinforced concrete culverts. F. W. Fagel is County Auditor.

✣Bids will be received until May 26 by Board of Henry County Commissioners, Newcastle, Ind., for the construction of repairs to the Blue River bridge near Knightstown. P. H. Wolfard is County Auditor.

✣Bids will be received until 2 p. m., June 2, by Board of Spencer County Commissioners, Rockport, Ind., for the construction of 11 bridges. J. T. Stevenson is County Auditor.

✣Bids will be received until 10 a. m., June 5, by Board of Marion County Commissioners, Indianapolis, Ind., for the construction of culverts and bridge repairs. W T. Patten is County Auditor.

⊙The contracts for the construction of five new bridges in Boone County, Ind., have been let to the following contracts by the Board of Commissioners, which opened bids May 6: Central States Bridge Co., Indianapolis, Ind., three bridges at $475, $859, $4,775. J. W. Fielwider, Lebanon, Ind., one 24-ft. bridge, $1,116; Earl E. McDonald, Lebanon, Ind., one 21-ft. bridge at $1,300.

All bids received May 6 by the Board of White County Commissioners, Monticello, Ind., for the construction of bridges have been rejected. A. G. Fisher is County Auditor.

The Indiana Railroad Commission has selected Daniel W. Mead of the University of Wisconsin, Madison, Wis., to act for the City of Peru, Miami County, Ind., and the railroad officials in the construction of a new bridge over the Wabash River at Peru.

The Common Council, Kendallville, Ind., contemplates the construction of three new bridges to replace the present structures. One of these will be at South State, another at South Oak and the third at Garden Sts., all over Deibele Creek. The present bridges are worn out to such an extent that some of them

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

are really dangerous. F. L. Kirebler is City Engineer.

A committee of engineers has recommended to the Commissioners of Tippecanoe County, Lafayette, Ind., that no attempt should be made to restore the present flood-damaged Main St. bridge connecting Lafayette with West Lafayette. A new structure costing about $300,000 will probably be built.

The Commissioners of Elkhart County, Elkhart, Ind., have granted the petition of the Board of Works for a creodone floor for Main St. The cost is estimated at $6,000.

The Clay County Council, Brazil, Ind., has appropriated $4,000 for the construction of a new bridge over Croy Creek and smaller amounts for five other bridges.

The Commissioners of Vigo County, Terre Haute, Ind., will shortly advertise for bids for the construction of six new bridges. As soon as County Surveyor Herbert A. Anderson completes the plans and specifications for the five new Harrison Township roads, in line with the report of the viewers, bids will likewise be asked for the paving of the roads.

The Commercial Club of Connersville, Ind., is advocating the construction of a new bridge between the city and East Connersville. W. F. Ridpath is City Engineer.

Iowa.

⊙The City Council of Des Moines, Ia., has awarded the contract for the construction of the proposed bridge over Four Mile Creek on Scott St. to the Federal Bridge Co., Des Moines, Ia., at $2,650.

⊙The contract for the construction of the Sycamore Valley bridge and the retaining walls of the North 10th St. bridge has been let to William R. Payne, Liberty, Ind., at $1,460.

The City Council of Clinton, Ia., has received and placed on file the preliminary report of City Engineer J. G. Thorne on the concrete arch bridge proposed for Seventh St.

The Board of Clinton County Supervisors, Clinton, Ia., has received a petition asking for the construction of a 60x90-ft. concrete bridge over Deep Creek on Broadway.

Plans are now being prepared by Charles Young, City Engineer of Muscatine, Ia., for the construction of a new concrete bridge to span the river at Monroe St.

The Commissioners of Grundy County, Grundy Center, Ia., are taking steps toward replacing the 100-ft. bridge, 3 miles west of Wellsburg, which was burned recently. The cost of the new structure will probably amount to about $3,000.

Maryland.

The Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., on May 3, received the following bids for the construction of a highway bridge over Dorsey Creek at the Naval Academy, Annapolis, Md.: (1) Standing for work complete; (2) amount to be added to (1) for removal of old bridge on completion of the new bridge; (3) same as (1) with a rolling lift bridge, single leaf, one draw opening not less than 40 to 42 ft. clear, opening at right angles to channel and between faces of timber guards. Sanford & Brooke Co., 24 Commerce St., Baltimore, Md., item 1, $39,600; 2, 1,000; 30 days additional time. Edward L. Micheau, 231 Cortlandt St., Baltimore, Md., item 1, $43,500; 2, $1,000. W. W. Lindsey & Co., 902 Harrison Bldg., Philadelphia, Pa., item 1, $44,800; 2, $900. Penn Bridge Co., Washington, D. C., item 1, $47,900; 2, $700; 3, $45,900; one month additional time; 3, $45,000. Nelson-Merydith Co., Chambersburg, Pa., item 1, $49,900; 2, $1,500, one month additional time; 3, $45,000.

Massachusetts.

A resolution has been introduced into the City Council, Brockton, Mass., providing for a loan on $5,000 for the construction of a new bridge on Warren Ave., near West Bartlett St., to replace the old structure at that place.

Michigan.

⊙The Bay County Bridge Commission, Bay City, Mich., has awarded the contract for remodeling the Lafayette Ave. bridge over the east channel to the Standard Engineering Co., Toledo, O., at $8,126. The work will include paving the roadway with concrete blocks. It is reported that the Commission expects to let a contract shortly for paving with creosote wood blocks the west approach to the Third St. bridge.

Minnesota.

✣Bids will be received until 3:30 p. m., May 19, by Commissioners of Brown County, New Ulm, Minn., for the construction of a new steel and concrete bridge in the Village of Comfrey. Bridge to be 20 ft. long, with concrete abutments, and four 6-ft. concrete wings. Bridge to have 20-ft. roadway, reinforced concrete floor, top of floor to be 6 ft. above bottom of run. Bidders to submit their own plans and specifications. Same to be approved by the State Engineer.

⊙The Board of Hennepin County Commissioners, Minneapolis, Minn., has awarded the contract for the grading of the approaches to the Crystal Bay bridge to Turnham & Turnham at $3,950.

Missouri.

A resolution has passed the City Council and the House of Delegates, St. Louis, Mo., providing that City Counselor Baird draw up a bill calling a special election on the proposition to issue $3,500,000 of bonds for the completion of the municipal free bridge.

⊙The contract for the construction of 14 steel bridges in Linn County has been awarded to J. W. Ward, Tecumseh, Neb., at $4,295. J. M. Black, Linneus, Mo., is Highway Engineer.

Montana.

✣Bids will be received until June 2 by Board of Cascade County Commissioners, Great Falls, Mont., for the construction of a bridge over the Missouri River at Ulm.

Nebraska.

Advices from Lincoln, Neb., state that applications have been filed with D. D. Price, State Engineer, for four state aid bridges. The applications cover one over the Elkhorn in Dodge County, 250 ft. long to cost $14,000; one over the Republican in Furnas County, 300 ft. long to cost $20,000, and two over the Platte in Merrick County, one 825 ft. long to cost $30,000, and the other 465 ft. long to cost $19,000.

New Jersey.

The Board of County Commissioners, Elizabeth, N. J., has made an appropriation for the construction of a new bridge at Hampton St., Cranford. A committee was also appointed to secure a concrete bridge at Walnut Ave. to replace the present structure at Walnut Ave.

New York.

✣Bids will be received until 2 p. m., May 22, by Commissioner of Bridges O'Keefe, New York City, for work in connection with the improvement of the Manhattan bridge, Brooklyn plaza.

✣Bids will be received until 1 p. m., May 28, by Lighthouse Inspector, Tompkinsville, N. Y., for furnishing the following supplies during the fiscal year ending June 30, 1914: Brushes, chimneys, dry goods, engineers' stores, packing, hardware, fire hose, rubber, fire and steam hose, tool steel, cold-rolled steel, lumber, lamps, mixed paints, paints and oils, varnishes, ship chandlery, khaki duck, tin cans, brooms, blocks, chinaware, brass rod, brass castings, sheet metal, iron castings, ammonia, alcohol, glycerin, sal soda, asbestos cement, Bon Ami, Sapolio, soap, polishing powder, polishing paste, clocks, boat compasses, time markers, buff skins, machine wipers, candles, engine oils, lubricating compound and graphite greases, charcoal, cement coal bags, waste, cocoa mats, rubber mats, excelsior, iron, steel, billets, tees and angles, sheet steel, linseed oil, turpentine, mattresses, matches, packing, Russia crash, toiler paper, red lead, white lead, white zinc, zinc slab and shellac.

✣Bids will be received until 11 a. m., May 23, by Francis G. Ward, Commissioner of Public Works, Buffalo, N. Y., for the following work, bids for each job being made separately: For the repair of the timber and planking of the roadways and walks of all bridges and approaches, and of the walks and stairs of all viaducts maintained by the City of Buffalo, from date of contract to June 30, 1914. For cleaning various grade crossing viaducts over railroads, by sand blast, from date of contract to June 30, 1914. For the dredging, above upper limits of the U. S. Government maintenance, of Buffalo River to Lot Line 65 of the City Ship Canal to the south channel, of Peck Slip, to the completed contract depth for maintenance of channel, from date of contract to June 30, 1914.

⊙Aldrich & Hamond Co., Inc., Auburn, N. Y., has been awarded the contract for the construction of the temporary bridge over the Hudson River at Glen Falls, N. Y., by the Hudson Valley Ry. Co.

At a recent meeting of the Common Council, Amsterdam, N. Y., May 22 was the date set for holding a special election to vote upon the proposition of bonding the city for the construction of a new river bridge. F. E. Crane is City Engineer.

Plans have been completed by the Concrete Steel Construction Co. of New York for the proposed new bridge over the Oswego River at Minetto, N. Y. The plans call for a concrete arch structure estimated to cost $150,000.

Commissioner Francis Ward, Department of Public Works, Buffalo, N. Y., has submitted to the Board of Aldermen the report of R. J. Reidpath & Son, Engineers, on the grade crossing viaducts. The structures covered by the report are the Michigan, Chicago and Louisiana and Hamburg Sts. viaducts; the Seneca St. viaduct over the Central, Pennsylvania and Lake Shore; the Smith St. viaduct over the Erie, and the Seneca St. viaduct over the Erie, Pennsylvania, Buffalo Creek and Nickel Plate. The report from the engineers states that much of the iron work in these viaducts has rusted out and needs replacement or reinforcing; that there is excessive vibration of the structures, and it is unsafe for horse vehicles to travel over them faster than a walk, or for automobiles to travel over them faster than 6 miles an hour. None needs be taken down, but repairs are urgently recommended.

The Town Board of Danville, N. Y., has authorized a special election to be held May 20 for the purpose of submitting to the voters the question of raising money by tax for the purpose of building a new iron bridge at Cumminsville, one-half of which Danville is responsible for, and also for building dikes and repairing some other bridges which were damaged by the late floods. The sum called for is $7,000.

North Carolina.

⊙The contract for the construction of a steel bridge on concrete piers over Catawba River at Town Hall Ford, McDowell County, N. C., has been let to the Roanoke Bridge Co., Roanoke, Va., at $4,442. Bids were opened at Marion, N. C., May 5.

North Dakota.

Tentative plans have been filed with the City Auditor, Grand Forks, N. Dak., for the proposed overhead viaduct over the tracks of the Great Northern near the depot. The viaduct, according to the plans, will be about 6 ft. wide and about 250 ft. long. It will be just high enough to clear the engines and cars. The viaduct will start at a point just west of the express building of the Great Northern, at the end of DeMers Ave. It will cross the tracks slightly diagonally and end on 1st Ave., 140 ft. west of Cottonwood St.

Ohio.

✣Bids will be received until 11 a. m., May 28, by Board of Mahoning County Commissioners, Youngstown, O., for furnishing necessary labor and material to construct a steel bridge, 180 ft. in length on the south Center Road, Youngstown Township, Mahoning County, O. Plans and specifications may be seen at the office of the County Surveyor.

✣Bids will be received until noon, May 27, by Peter Frank, Jr., Wyandot County Auditor, Upper Sandusky, O., for furnishing the material and labor for the construction of a new sandstone abutment at the Parker bridge in Crane Township; also the Greasy Run abutment, Mohawk Road, in Sycamore Township.

✣Bids will be received until noon, May 23, by Board of Franklin County Commissioners, Columbus, O., for all of the labor and material necessary to construct and complete the following work, to-wit: Estimate No. 489: Completing the King Ave. bridge, according to the revised plans. Estimate No. 490: Superstructure of the McGuffey bridge over Black Lick Creek, Madison Township. Estimate No. 491: Roadway construction on the superstructure of the McGuffey bridge over Black Lick Creek, Madison Township. Estimate No. 492: Substructure of the McGuffey bridge over Black Lick Creek, Madison Township. Estimate No. 493: Approaches to the McGuffey bridge over Black Lick Creek, Madison Township. The plans, profiles, specifications and estimates of quantities for doing this work are on file in the offices of the County Auditor and County Surveyor. F. M. Sayre is County Auditor.

✣Bids will be received until noon (standard time), May 26, by Board of Madison County Commissioners, London, O., for the following work: Reinforced concrete box culvert on Lafayette and Mechanicsburg road, near Arbuckle school house. Substructure for Junk road bridge over Bradford Creek. Consisting of one pier and abutment to be of concrete and containing about 400 cu. yds.; also the furnishing and driving of about 828 lin. ft. of piling. A 60-ft. low Warren truss, 14-ft. roadway, with steel joist and oak floor, the same being an extension of the Junk bridge over Bradford Creek. Reinforced concrete wings at the Gauley bridge over Little Darby Creek on the Blair pike. Repairs on levee on the Post road at bridge over Big Darby, east of Plain City. Cutting hill and building levee at Spring Fork bridge on the Wilson and Winget pike. Said work to consist of grading and graveling. Plans and specifications are on file with H. L. McCafferty, County Surveyor.

✣Bids will be received until noon, May 14, by Village Council, East Youngstown, O., for the labor and material for the construction of a retaining wall on the north side of Wilson Ave., near the Coitsville road. P. J. Carney is Clerk.

The Commissioners of Butler County, Hamilton, O., have issued bonds in the sum of $37,500 for the purpose of temporary work in constructing bridges and roads damaged by the recent flood. The temporary bridges at Hamilton and Middletown will require an expenditure of at least $24,000. The Middleton bridge will be located over the new channel cut by the river, according to an agreement reached today, and when it is built the old channel will be filled up and abandoned. George Mehl offered to remove the iron bridges from the river and pay the county $2.50 a ton for the iron. The offer was accepted.

The Commissioners of Franklin County, Columbus, O., have filed suit in the county courts to secure the permission of the courts to expend $23,135 for repairing bridges and approaches throughout the county. The work will affect 29 structures and the expenditures will range from $500 to $2,500.

The Commissioners of Mahoning County, Youngstown, O., have received from Ett Smith, County Surveyor, plans for the proposed bridge to span the ravine in South Center St., from Poland Ave. to the township line. The structure, as proposed, will be 180 ft. long and will be 20 ft. in width.

The City Council of Cincinnati, O., recently took up for consideration the matter of building a viaduct from the foot of Price Hill to Eighth and Baymiller Sts. The cost of such a structure would amount to several millions of dollars. Henry Waite is City Engineer.

Oregon.

⊙The Coast Bridge Co., Portland, Ore., has been awarded the contract for the construction of a bridge at Dillard in Douglas County, Ore., at $19,736.

Pennsylvania.

⊙The contract for furnishing labor and material for painting a number of bridges in Allegheny County, Pa., has been awarded to Theodore Charlin, 1006 Locust St., Pittsburgh, Pa., at $6,957. Bids were opened at Pittsburgh, Pa., May 1.

⊙Peter Barr, Spruce St., Shamokin, Pa., has been awarded the contract by the County Commissioners for the paving of the Eighth St. bridge.

⊙The Commissioners of Lawrence County, Newcastle, Pa., have awarded the contract for building a temporary bridge at Gardner Ave. to Eugene Sheridan of Newcastle for $2,880, his bid being the lowest. The other bids were as follows: Farris Bridge Co., Pittsburgh, $3,683; Anderson & Filey, Newcastle, $2,945; Kimbrough & Elder, Newcastle, $3,700; Anderson & Kramer, Newcastle, $3,490; Woods & Golder Construction Co., Newcastle, $3,450. The contract for the repairs to the Mahoningtown covered bridge was let to Anderson & Filey for $4,825, contract to be completed by July 10. Other bids were: Farris Bridge Co., $6,100; Kimbrough & Elder, $6,750; Anderson & Kramer, $7,460.

The Enabling Act introduced in the State Senate of Pennsylvania to empower the State to change the location of the Gardner Ave. bridge, Newcastle, Pa., in replacing the structure destroyed by flood and to merge the new structure into the viaduct proposition for the elimination of grade crossings, passed the upper house.

The Commissioners of Montgomery County, Norristown, Pa., contemplate the construction of a new bridge to replace the old Mattsonford bridge connecting East and West Conshohocken. The improvement will necessitate an expenditure of $200,000.

The Commissioners of Luzerne County, Wilkesbarre, Pa., are about to advertise for bids for the construction of the proposed new Nanticoke bridge.

Surveys have been started by George Chaney of Armstrong & Chaney, Washington, Pa., representing Washington County, and George Porter, employed by Fayette County, have started preliminary surveys of the site of the proposed site for the bridge to be erected over the Monongahela River at West Brownsville. It is believed that work on the structure will be under way some time in June.

The Commissioners of Chester County, West Chester, Pa., have decided to erect three bridges during the present season. These are as follows: One in London Britain Township, over the west branch of White Clay Creek; one in West Pikeland Township, over a branch of Pickering Creek, and one in East Brandywine Township, over tributary of the Brandywine Creek. Plans and specifications have been prepared by County Surveyors and Engineer N. R. Rambo, and bids will be advertised for in a few days, so that operations may begin early and completed before fall.

South Dakota.

✣Bids will be received until May 24 by Town Supervisors, Portland, P. O. Altamont, S. Dak., for the construction of the following: Constructing bridge and approaches and making 20 rods of 2-ft. cut, on north line N. E. ¼ Sec. 33. Digging 200 rods of 3-ft. ditch on north line N. E. ¼ Sec. 10 and placing one 4x24-ft. culvert, grading approaches and making about 15 rods of 6-ft. cut, latter work to be done on north line Sec. 3. Specifications of above projects on file in Clerk's office. B. F. Roe is Town Clerk.

Tennessee.

⊙Modjeska & Angier, Consulting Engineers, Chicago, Ill., have completed surveys preliminary to drawing plans for the Memphis Bridge & Terminal Co. bridge over the Mississippi River. A contract for grading has been let by the company to Roper Bros. & Larkin at $25,000.

Texas.

⊙The Milam County Commissioners' Court, Cameron, Texas, has let the contract for the construction of a steel bridge on Little River, northeast of Cameron, to C. Q. Horton at $5,449.

Utah.

The Commissioners of Salt Lake County, Salt Lake City, Utah, have decided to advertise for bids on the construction of three new bridges. One bridge is to be built across Little Cottonwood Creek in Union, another across Big Cottonwood Creek at Sixteenth South, just east of Murray, and the third across Mill Creek on West Temple, between Thirteenth South and Fourteenth South.

Virginia.

✣Bids will be received until noon, May 22, by Circuit Court of Caroline County, Bowling Green, Va., for the construction of a 66-ft. 1-in. reinforced concrete bridge on plain concrete and pile substructure over the Mattaponi River, ¾ of a mile from Woodslane on the R. F. & P. Ry. Gravel and sand may be secured within 1 mile of the site. Gravel will be allowed in the concrete, screened, washed if necessary and subject to inspection by the State. The work of the substructure will include tearing down the old bridge. Plans and specifications are on file with the Clerk of the Circuit Court. A certified check payable to P. St. J. Wilson, State Highway Commissioner, Richmond, Va., for $250 must be filed with each bid. Blue prints of plans can be secured from Childrey-Sunday Co., Richmond, Va., at a cost of 20 cts. and postage.

✣Bids will be received until noon, May 22, by Circuit Court, Caroline County, Bowling Green, Va., for the construction of a 20-ft. culvert and a 66-ft. 1-in. reinforced concrete bridge over the Mattaponi River, ½ mile from Guinea. The substructure will be of plain concrete and piles. Gravel and sand can be secured within 1 mile of the site, and gravel screened and washed if necessary will be allowed in the concrete, subject to State inspection. The substructure work will include tearing down old structure. Plans and specifications are on file at the office of the Clerk of the Court. Blue prints of plans can be secured of Childrey-Sunday Co., Richmond, Va., for 20 cts. and postage.

The Board of Chesterfield County Supervisors, Chesterfield, Va., has under consideration the construction of a concrete bridge over the creek which crosses Semmes Ave., between Dundee and Forest Hill Park. The board has authorized County Engineer W. W. LaPrade to draw up the plans and ascertain the cost of the project. If the cost is not too steep, bids will be advertised for. It is probable that the Virginia Railway and Power Co. will be asked to consider the advisability of uniting with the county in the construction of a bridge, which would then be used by the cars, instead of the wooden trestle over the creek.

Washington.

The Board of Yakima County Commissioners, North Yakima, Wash., has awarded the contract for the construction of 30 bridges to Frank Moody and W. C. Baker, Grandview, Wash.

All bids for the construction of a bridge roadway on West Wheeler St., for which J. M. Bruce & Co., Seattle, Wash., bid low at $206,422, have been rejected as being too high.

The City Engineer of Edmonds, Wash., has been instructed to call for bids for the construction of a bridge over Still Creek on Pole Line road. The structure is estimated to cost $11,350.

Wisconsin.

✣Bids will be received until 10:30 a. m., May 19, by the Department of Public Works, Milwaukee, Wis., for furnishing all the material, and doing all the work necessary for the new abutment for the Chestnut street bridge of the city of Milwaukee, as per plans and specifications on file in the office. A certified check for $1,000 must be filed with each bid.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ROADS AND STREETS

Arkansas.

⊙The Commissioners of Street Paving District No. 1, of Paragould, Ark., have awarded the contract for paving 42,000 sq. yds. of streets to the Pouncey Paving Co., of Memphis, Tenn., for about $90,000. The principal streets will be paved with brick, while some of the residence streets on which the traffic is light will be paved with concrete.

⊙The Pauncey Paving Co., Memphis, Tenn., has been awarded the contract by the city of Paragould, Ark., for street paving at $1.80 per sq. yd. The work includes 25,000 sq. yds. of brick and 16,000 sq. yds. of concrete. Bids were opened April 25.

The City Council of Argenta, Ark., has created two new districts for street improvement, to be known as Districts Nos. 15 and 16. About six miles of concrete pavement will be laid, running north and south between the river and Eighth Sts., and east and west from Willow St. to as far as Beach St.

California.

⊙The City Council of Richmond, Calif., has awarded contracts for paving to C. W. Cushing, of that city, amounting to about $55,000, as follows: A, B and C Sts., $27,895; Pennsylvania Ave., $15,770; 18th St., $11,991.

⊙The Barber Asphalt Co. has been awarded the contract by the City Council of Richmond, Calif., for the improvement of Ripley Ave., for $8,460.

⊙C. E. Pike of La Porte, Calif., has been awarded the contract by the Supervisors of Sierra County, Downieville, Calif., for the construction of a wagon road from Gold Lake to the Sardine Lake bridge, for $7,446. The road is a little over seven miles long.

Preparations are being made by the City Council of Pomona, Calif., for the expenditure of $50,000 in street improvements.

Colorado.

The Colorado State Highway Commission will apportion the sum of $200,000 at once for road building.

District of Columbia.

✣Bids will be received until 2 p. m., May 29, by Commissioners of the District of Columbia, Washington, D. C., for the furnishing and delivering of one 5-passenger motor car, and two combined chemical and hose motor wagons for the fire department.

✣Bids will be received until 2 p. m., May 29, by Commissioners of the District of Columbia, Washington, D. C., for the furnishing of granite and sandstone curbing during the fiscal year beginning July 1. Further information may be obtained of the Purchasing Officer, Room 320, District Bldg.

Florida.

The Hillsboro County Commissioners, Tampa, Fla., contemplates calling an election shortly for the purpose of voting on the issuance of bonds in the sum of $1,000,000 for the laying of brick pavements on county roads.

Illinois.

✣Bids will be received until 2 p. m., May 17, by Board Local Improvements, Du Quoin, Ill., for paving as follows: Improvement No. 2, 22,626 sq. yds. brick on 5-in. concrete base and 17,312 lin. ft. sandstone curb; Improvement No. 3, 17,834 sq. yds. brick on 5-in. concrete base, and 13,263 lin. ft. sandstone curb. John C. Gibson, City Engineer. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 8 p. m., May 19, by Board of Local Improvements, Waukegan, Ill., for 1,535 sq. yds. of brick paving on County St. and 1,370 sq. yds. of brick paving on Hickory St. M. J. Douthitt is City Engineer.

✣Bids will be received until 7:.30 p. m., May 16, by Board of Local Improvements, Kewanee, Ill., for furnishing all labor and material necessary for paving a portion of McKinley Ave. with asphaltic concrete in accordance with plans and specifications on file with Arthur E. Holt, City Engineer.

✣Bids will be received until 7:30 p. m., May 16, by Board of Local Improvements, Kewanee, Ill., for furnishing all labor and material for paving and improving a portion of E. Prospect St. with asphaltic concrete. Plans and specifications are on file with Arthur E. Holt, City Engineer.

✣Bids will be received until 8 p. m., May 20, at the village hall by the Board of Local Improvements, Wilmette, Ill., for the construction of a pavement in Chestnut Ave., Sheridan Rd. to West Village Limits, 12th St., Chestnut Ave. to Elwood Ave., estimated quantities are as follows: 13,680 sq. yds. of brick pavement, Galesburg, Crawfordsville or Streator brick specified on 6-in. crushed stone foundation bonded with lime stone screenings and 2-in. sand cushion, 4,500 cu. yds. excavation, 120 lin. ft. of plank headers, 20 manholes to be adjusted, 190 cu. yds. of sand covering, payment 10-year bonds, plans and specifications may be had upon application at the village hall or at the office of C. H. Jackson, 8 S. Dearborn St., Chicago, Ill. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 11 a. m., May 19, by the Board of Local Improvements, Chicago, Ill., for the construction of cement sidewalks in the following streets: Blue Island Ave., Ashland Ave. to Robey St., 3,900 sq. ft., 1 ft. fill assessment price 23 cts.; Blue Island Ave., Robey St. to Western Ave., 3,600 sq. ft., 1 ft. fill assessment price 24½ cts.; Diversey Ave., 40th Av. to C., M. & St. P. R. R., Milwaukee Division, 6,000 sq. ft., 1 ft. fill, assessment price 15½ cts.; Ewing Ave., 101st St. to 102d St., 1,000 sq. ft., 8 ft. fill, assessment price 53 cts., 135 ft. of retaining wall at $3.26; Greenwood Ter., 45th Ave. to 46th Ave., 2,200 sq. ft., 1 ft. fill, assessment price 15½ cts.; Grace St., 53d Ave. to 54th Ave., 2,550 sq. ft., 1½ ft. fill, 1½ ft. cut, assessment price 17½ cts.; Houston Ave., 95th St. to 96th St., 600 sq. ft., 2 ft. fill, assessment price 19 cts.; Indiana Ave., 103d St. to 444 ft. south of 105th St., 8,000 sq. ft., 1½ ft. fill, assessment price 17½ cts.; 96th St., Ewing Ave. to Avenue N, 2,000 sq. ft., 4 ft. fill, assessment price 46 cts.; 98th St., Avenue G to Avenue N, 2,000 sq. ft., 1½ ft. fill, assessment price 17 cts.; 101st St., Indianapolis Ave. to Calumet River R. R., 8,000 sq. ft., 4 ft. fill, assessment price 26 cts., 1,270 lin. ft. of retaining wall, $1.19; 105th St., Vincennes Rd. to Prospect Ave., 6,000 sq. ft., 1½ ft. fill, 600 lin. ft., 1½ ft. cut, assessment price 17 cts.; Ohio St., Lake Shore Dr. to St. Clair St., 6,000 sq. ft., 2 ft. fill, assessment price, 20½ cts.; Ontario Ave., 90th St. to 91st St., 1,800 sq. ft., 8 ft. fill, assessment price 33 cts.; Ontario Ave., 91st St. to 92d St., 4,000 sq. ft., 8 ft. fill, assessment price 33 cts.; Oakley Ave., Cullom Ave. to Berteau Ave., 2,300 sq. ft., 1 ft. fill, assessment price 15½ cts.; Pensacola Ave., Spaulding Ave. to Kimball Ave., 3,900 sq. fr., 1 ft. fill, 500 lin. ft. 1 ft. cut, assessment price 15½ cts.; Paulina St., 71st St. to 74th St., 5,000 sq. ft., 1½ ft. fill, 500 lin. ft., 1½ ft. cut, assessment price 17 cts.; Paxton Ave., 74th St. to 198 ft. south, 150 lin. ft., 1 ft. fill, 25 lin. ft., 1 ft. cut, assessment price 15½ cts.; Peoria St., 118th St. to I. C. R. R., 10,000 sq. ft., 1 ft. fill, assessment price 15½ cts.; Robey St., 95th St. to 96th St., 3,200 sq. ft., 1¼ ft. fill, 400 lin. ft. 1¼ ft. cut, assessment price 17 cts.; Addison St., Avondale Ave. to Hamlin Ave., Avondale Ave., Central Pk. Ave. to Addison St., Eddy St., Avondale Ave. to Lawndale Ave., Cornelia Ave., Central Pk. Ave. to Hamlin Ave.; Roscoe St., Lawndale Ave. to Hamlin Ave.; Central Pk. Ave., Avondale Ave. to Rockwell St.; Lawndale Ave., Addison St. to Roscoe St.; Hamlin Ave., Addison St. to Roscoe St., 18,000 sq. ft. 1½ ft. fill, assessment price 17 cts.; Leland Ave., 45th Ave. to 48th Ave.; 46th Ave., Lawrence Ave. to Leland Ave.; 47th Ave., Lawrence Ave. to Leland Ave.; 47th Ct., Lawrence Ave. to Leland Ave.; 48th Ave., Lawrence Ave. to Leland Ave., 5,400 sq. ft., 1 ft. fill, 900 lin. ft., 4-in. cut, assessment price 15½ cts.; 76th St., St. Lawrence Ave. to 124 ft. west of Rhodes Ave., 77th St., St. Lawrence Ave. to 125 ft. west of Rhodes Ave.; St. Lawrence Ave., 75th St. to 77th St.; Rhodes Ave., 75th St. to 77th St., 1,800 sq. ft., 1½ ft. fill, assessment price 17 cts.; 82d St., Muskegon Ave. to 124 ft. west; Muskegon Ave., 82d St. to 48 ft. south, 1,150 sq. ft., 1 ft. fill, assessment price 15½ cts., E. J. Glackin, Secretary of the Board.

✣Bids will be received until 7:30 p. m., May 16, by Board of Local Improvements, Kewanee, Ill., for the necessary labor and material for the improvement of a portion of Elliott St., with asphaltic concrete. Plans and specifications are on file with Arthur E. Holt, City Engineer.

✣Bids will be received until 11 a. m., May 19 by the Board of Local Improvements, Chicago, Ill., at their office for the construction of the following paving contracts: Alleys, Adams St., Peoria St., Jackson Bd., Green St., 790 lin. ft. concrete curbing, 720 sq. yds. brick pavement, assessment available $2,177.50; Alleys, Colorado Ave., Jackson Bd., Sacramento Bd. and Whipple St., 1,980 lin. ft., concrete curbing, 1,550 sq. yds. brick pavement, assessment available $4,665.40; alleys, Ewing Pl., LeMoyne St., Hoyne Ave. to Leavitt St., assessment available $5,410.70, 1,800 lin. ft. wood curbing, 650 cu. yds. earth cutting, 1,800 sq. yds. brick pavement; Addison St., Robey St. to Leavitt St., assessment available $15,837.79, 2,400 lin. ft. granite concrete combined curb and gutter, 1,900 cu. yds. earth cutting, 5,210 sq. yds. asphalt pavement; Ashland Ave., Fulton St. to Carroll Ave., 350 lin. ft. sandstone curbing, 250 cu. yds. earth cutting, 620 sq. yds. granite block pavement, assessment available, $3,004; Campbell Ave., Archer Ave. to 39th St., assessment available $5,500, 30 lin. ft. granite combined curb and gutter, 900 lin. ft. concrete gutter, 450 cu. yds. of cutting, 2,020 sq. yds. asphalt pavement; East Ct., Belmont Ave. to 304 ft. south, assessment available $2,940, 720 lin. ft. granite combined curb and gutter, 360 cu. yds. cutting, 950 sq. yds. asphalt pavement; Eastwood Ave., Leavitt St. to Lincoln Ave., assessment available $6,370, 1,430 lin. ft. granite combined curb and gutter, 140 cu. yds. cutting, 2,260 sq. yds. asphalt pavement; Ewing Ave., 94th St. to 102d St., assessment available $53,879.57, 9,550 lin. ft. granite concrete combined curb and gutter, 100 lin. ft. concrete gutter, 19,310 sq. yds. brick pavement; 44th Pl., State St. to Dearborn St., assessment available $1,380, 440 lin. ft. granite combined curb and gutter, 200 cu. yds. cutting, 480 sq. yds. asphalt pavement, 75 sq. ft. sidewalk; 52d Ave., Irving Park Bd. to Montrose Ave., assessment available $24,332.84, 5,300 lin. ft. granite concrete combined curb and gutter, 2,900 cu. yds. cutting, 8,640 sq. yds. asphalt pavement; Foster Ave., Evanston Ave. to Sheridan Rd., assessment available $10,412.70, 2,000 lin. ft. granite concrete combined curb and gutter, 320 lin. ft. concrete gutter, 3,630 sq. yds. asphalt pavement; Green Bay Ave., 106th St. to 108th St., assessment available $11,927.20, 2,630 lin. ft. sandstone curbing on concrete filling, 4,460 sq. yds. asphaltic macadam pavement; Hutchinson St., Milwaukee Ave. to 53d Ave., assessment available $14,000, 4,100 lin. ft. granite concrete combined curb and gutter, 900 cu. yds. cutting, 5,310 sq. yds. asphaltic concrete pavement; Jackson Ave., 63d St. to 64th St., assessment available $6,462.80, 1,240 lin. ft. granite concrete combined curb and gutter, 2,310 sq. yds. asphalt pavement; Leland Ave., Robey St. to Leavitt St., assessment available $11,960, 2,500 lin. ft. granite concrete combined curb and gutter, 4,250 sq. yds. asphalt pavement; Lincoln St., Garfield Bd. to 59th St., assess-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ment available $24,432.31, 4,940 lin. ft. granite concrete combined curb and gutter, 2,400 cu. yds. cutting, 8,130 sq. yds. asphalt pavement; Ohio St., Western Ave. to Campbell Ave., assessment available $6,914.85, 1,300 lin. ft. sandstone curbing, 1,150 cu. yds. earth cutting, 2,280 sq. yds. brick pavement; 100th Pl., Wood St. to Prospect Ave., assessment available $9,500, 2,420 lin. ft. granite concrete combined curb and gutter, 1,400 cu. yds. cutting, 3,700 sq. yds. asphaltic concrete pavement; Rawson St., Elston Ave. to McHenry St., assessment available, $14,425, 1,400 lin. ft. sandstone curbing, 1,350 cu. yds. cutting, 3,040 sq. yds. granite block pavements; 69th St., Vincennes Rd. to South Park Ave., 5,760 lin. ft. sandstone curbing, 2,500 cu. yds. cutting, 8,040 sq. yds. brick pavement; Washtenaw Ave., Grand Ave. to Chicago Ave., 1,680 lin. ft. granite combined curb and gutter, 400 cu. yds. earth cutting, 2,760 sq. yds. asphalt pavement. Payment cash and bond, 5 years; work includes 6 in. Portland cement concrete foundation, cash or certified check for 10 per cent of bid must accompany proposal, E. J. Glackin, Secretary of the Board.

⊙The following contracts for constructing pavement have been awarded by the Board of Local Improvements, Chicago Ill.: Alleys, 40th St., Root St., State St. and Dearborn St., 1,820 lin. ft. concrete curbing, 1,220 sq. yds. brick pavement, James A. Sackley Co., 132 W. Washington St.; Alleys 42d St., Grand Bd., 42d Pl., Vincennes Ave., 1,740 lin. ft. concrete curbing, 1,380 sq. yds. brick pavement, J. A. McGarry & Co., 189 W. Madison St.; Chicago Ave., Kedzie Ave. to 40th Ave., 10,600 lin. ft. sandstone curbing, 20,300 sq. yds. creosoted wood block, James A. Sackley Co.; 40th Ave., Division St. to Fullerton Ave., 15,150 lin. ft. sandstone curbing, 23,000 sq. yds. brick pavement, Ready & Callaghan Coal Co., 133 W. Washington St.; 40th Ave., Indiana St. to Division St., 9,350 lin. ft. sandstone curbing, 14,200 sq. yds. brick pavement; 51st Pl., Halsted St. to Morgan St., 2,610 lin. ft. granite combined curb and gutter, 4,380 sq. yds. asphaltic concrete pavement, R. F. Conway Co., 133 W. Washington St., Grand Ave., Western Ave. to Sacramento Ave., 9,000 lin. ft. sandstone curbing, 14,200 sq. yds. brick pavement, Citizens' Construction Co., 133 W. Washington St.; Herndon St., Belmont Ave. to Roscoe St., 2,500 lin. ft. granite combined curb and gutter, 4,200 sq. yds. asphalt pavement, R. F. Conway Co., 133 W. Washington St.; Lake St., 40th Ave. to Hamlin Ave., 2,520 lin. ft. sandstone curbing, 4,550 sq. yds. brick pavement, Central Paving Co., 179 W. Washington St.; Park Ave., Madison St. to South Blvd., 4,620 lin. ft. granite combined curb and gutter, 7,320 sq. yds. asphaltic concrete pavement, Standard Paving Co., 9 S. La Salle St.; S. Park Ave., 71st St. to 75th St., 5,750 lin. ft. granite combined curb and gutter, 8,890 sq. yds. asphalt pavement, American Asphalt Paving Co., 133 W. Washington St.; the work includes 6-in. Portland cement concrete foundations, sewer, manhole and catch basin, construction and adjusting, cement sidewalk construction, preparation of the sub-grade, etc. E. J. Glackin, Secy. of the Board.

⊙Reeb Bros., of Belleville, Ill., have been awarded the contract by that city for the paving and sewering of the Church St. Paving District, for $16,002. The contract calls for 6,760 sq. yds. of brick pavement on eight blocks of streets.

⊙The Burlington Construction Co. has been awarded the contract at Monmouth, Ill., for the laying of the new pavement on S. Main St., from Seventh Ave. to 11th Ave., for $11,540. Ralph Ferguson is City Engineer.

⊙The Board of Local Improvements of Rock Island, Ill., has awarded the contract for the paving of 44th St., from 10th to 13th Aves., to the Tri-City Construction Co., at $2.20 per sq. yd. The McCarthy Improvement Co., Davenport, Ia., secured the 11th Ave. paving job, between 11th St. and 23d St., at $2 per sq. yd. for asphalt, $0.63 for curb and gutter, $0.45 for concrete flag, $50 for catch basins and $70 for storm drains.

⊙Nelsh & Sons of Springfield, Ill., have been awarded the contract by the Board of Local Improvements of that city, for the paving of First St., from Canedy to Allen St., at $1.64 per sq. yd. for brick paving and $0.55 per ft. for curbing.

Following are the lowest bids submitted on May 6 to the Board of Local Improvements, Chicago, Ill., E. J. Glackin, Secretary for the construction of Portland cement concrete sidewalks in the following streets: Butler St., 123d St. to 124th St., 3,000 sq. ft., 11.9 cts., A. P. Larsen, 11320 Indiana Ave.; Blanch St., Fleetwood St. to Holt St., 3,000 sq. ft., 12.87 cts., G. Kehl & Son, 1225 N. Maplewood Ave.; Cullom Ave., 52d Ave. to 800 ft. east, 4,800 sq. ft., 12.5 cts., Siewert, Caulsen Co., 3865 Milwaukee Ave.; Courier St., Chapin St. to Augusta St., 2,200 sq. ft., 13.23 cts., G. Kehl & Son; Evans Ave., 76th St. to 78th St., F. K. Shobe Paving Co., 524 W. 63d St.; 49th Ct. Sunnyside Ave. to Montrose Ave., 2,000 sq. ft., 12.5 cts., Siewert, Caulsen Co.; Green Bay Ave., 89th St. to Harbor Ave., 3,000 sq. ft., 21 cts., 467 ft. concrete wall $1.12, G. Kehl & Son Co.; Halsted St., 89th St. to C., R. I. & P. R. R., 4,000 sq. ft., 13 cts.; Jackson St., 46th Ave. to 48th Ave., 1,200 sq. ft., 15.23 cts., G. Kehl & Son Co.; Kedzie Ave., south branch of the Chicago river to the Sanitary District Canal, 4,000 sq. ft., 13.44 cts., A. Graff, 138 N. La Salle St.; Marshfield Ave., 71st St. to 74th St., 5,000 sq. ft., 13 cts.; 19th St., Laflin St. to Western Ave., 18,000 sq. ft., 10.97 cts., 1,200 sq. ft., wall 25 cts., A. Graff; 93d St., Stony Island Ave. to N. Y. C. & St. L. R. R., 900 sq. ft., 15 cts., P. F. Biesen, 9 S. La Salle St.; Sawyer Ave., Balmoral Ave. to 76.71 ft. south, 600 sq. ft., 15.5 cts., H. P. Larsen, 1542 N. Rockwell St.; Washington Ave., 91st St. to 93d St., 1,000 sq. ft., 13.5 cts., P. F. Biesen; Western Ave., Barry Ave. to Nelson St., 150 sq. ft., 20.5 cts., H. P. Larsen; Montrose Ave., 881 ft. east of California Ave. to Humboldt St., 30,000 sq. ft., Siewert, Caulsen Co., 77th St., Chauncy Ave. to Woodlawn Ave., 12,000 sq. ft.: 12.69 cts., D. Ryan; 19th St., Center Ave. to Blue Island Ave., 25,000 sq. ft., 10.47 cts., A. Graff; the contracts have not been awarded.

The Board of Local Improvements of Rock Island, Ill., Wallace Treichler, City Engineer, has recommended the paving of 16th Ave., fsom 12th to 15th Sts., with asphalt, at an estimated cost of $4,420. It has also been decided to pave 20 St. with brick from Seventh Ave. to 17th Ave.

The City Council of Elgin, Ill., M. H. Brightman, City Engineer, has passed an ordinance for the paving of District No. 1. An ordinance is to be prepared for the paving of District No. 2. The Board of Local Improvements will shortly ask for bids on this work.

The City Council of Havana, Ill., is completing plans for the paving of about a mile of streets this summer.

The Board of Local Improvements of Peoria, Ill., has adopted a resolution to proceed with the paving of Wayne St., from Madison to Glendale, at an estimated cost of $9,274. L. D. Jeffries is City Engineer.

The Board of Local Improvements of Champaign, Ill., has adopted a resolution in favor of paving Cottage Grove Ave. and E. Illinois St., at an estimated cost of $35,837.

City Engineer Lyle Payton of Moline, Ill., has completed the estimating work upon the schedule prepared by Commissioner Anderson for street paving during the year. It is proposed to construct 102,000 sq. yds., at an estimated cost of $260,468. Brick and asphalt will be the material.

The Board of Local Improvements of Rock Island, Ill., held hearings on May 12 for the paving of the following streets: 12th Ave., from 12th to 22d Sts., with asphalt; Second Ave. from 14th to Ninth Sts., with asphalt; 43d St., from 10th to 13th Aves., with asphalt; 10th Ave., from 30th to 34th Sts., and 34th St., from Ninth and half to 10th Aves., with brick.

The citizens of Ottawa, Ill., have voted in favor of paving West Ottawa, according to the plans outlined by the Board of Local Improvements. Geo. Farnsworth is City Engineer.

Indiana.

✣Bids will be received until 2 p. m., May 22 by Town Board, Paoli, Orange County, Paoli, Ind., for grading and improving the public square in Paoli. Arthur McCart is Clerk of the Board.

✣Bids will be received until June 3, by Board of Pulaski County Commissioners, Winamac, Ind., for the construction of a road in Harrison township. W. E. Munchenburg is County Auditor.

✣Bids will be received until 10 a. m., June 3, by Board of Cass County Commissioners, Logansport, Ind., for the construction of highways in Eeel and Deer Creek townships. J. E. Wallace is County Auditor.

✣Bids will be received until 10 a. m., June 3 by Board of Montgomery County Commissioners, Crawfordsville, Ind., for the construction of one gravel road in Scott township and three in Franklin township. Bennet B. Engle is County Auditor.

✣Bids will be received until 2 p. m., June 3, by Board of Knox County Commissioners, Vincennes, Ind., for the construction of gravel roads in Vigo, Harrison and Washington townships 8 miles in all. J. T. Scott is County Auditor.

✣Bids will be received until 10 a. m., June 3, by Board of White County Commissioners, Monticello, Ind., for the construction of roads in Princeton and Jackson townships. A. G. Fisher is County Auditor.

✣Bids will be received until 1 p. m., June 2, by Board of Decatur County Commissioners, Greensburg, Ind., for the construction of a free macadam road in Marion township. L. W. Sands is County Auditor.

✣Bids will be received until 1 p. m., June 2, by Board of Decatur County Commissioners, Greensburg, Ind., for the construction of a free bituminous macadam binding road in Washington township. L. W. Sands is County Auditor.

✣Bids will be received until 11 a. m., June 2, by Board of St. Joseph County Commissioners, South Bend, Ind., for the construction of a gravel or macadamized road in Lincoln township. Clarence Sedgwick is County Auditor.

✣Bids will be received until 2 p. m., June 2, by Board of Newton County Commissioners, Kentland, Ind., for the construction of a highway in Washington township. S. R. Sizelove is County Auditor.

✣Bids will be received until 10 a. m., June 2, by Board of Clark County Commissioners, Jeffersonville, Ind., for the construction of a gravel road. G. W. Stoner is County Auditor.

✣Bids will be received until 1 p. m., June 2, by Board of Warren County Commissioners, Williamsport, Ind., for the construction of a gravel road in Washington township. D. H. Moffitt is County Auditor.

✣Bids will be received until May 29 (readvertisement), by Board of Laporte County Commissioners, Laporte, Ind., for the construction of a macadamized road in Pleasant, Lincoln and Washington Townships, 18.33 miles long. F. A. Hausheer is County Auditor.

✣Bids will be received until noon, May 26, by James Howarth, Township Trustee, Wayne Township, at the court house, Richmond, Ind., for improving Cart Road in accordance with plans and specifications on file at the office of the Wayne County Surveyor.

✣Bids will be received until noon, May 26, by James Howarth, Trustee of Wayne Township, Wayne County, Richmond, Ind., for the improvement of cart road in Wayne township.

✣Bids will be received until 1 p. m., May 24, by Ed. Oliver, Supt. of Construction, Rensselaer, Ind., for the construction of the Oliver Road in Barkley township, Jasper County.

✣Bids will be received until 1 p. m., May 21, by A. M. Yeoman, Supt. of Construction, Rensselaer, Ind., for the construction of the

Halstead gravel road in Newton township, Jasper County.

✣Bids will be received until 1 p. m., May 24, by Robert J. Yeoman, Supt. of Construction, Rensselaer, Ind., for the construction of the Yeoman road in Newton township, Jasper County.

⊙Luttman & Finney, of Portland, Ind., have been awarded the contract for the construction of a gravel road on line between Jay County, Ind., and Darke County, O., for $18,299.

⊙William Birch has been awarded contracts by the Board of Public Works of Muncie, Ind., as follows: For the paving of the roadway of Ohio Ave., from Main St. to Washington St., $1.75 per sq. yd., for Terre Haute brick, with cement curb and gutter at $0.44¾ per lin. ft.: for the construction of a cement sidewalk on Monroe St., from Charles St. south in various portions, at $0.53½ per lin. ft.; for a cement sidewalk on the east side of Plum St., from Jackson St. south to the first alley, at $0.54½ per lin. ft.; for the construction of a cement sidewalk on each side of North St., from Walnut St. to Madison St., at $0.54¾ per lin. ft.

⊙William Torrence & Co. have been awarded the contract by the Board of Public Works of Muncie, Ind., for the construction of a paved alley between Jackson St. and Adams St., and Elm St. to Madison St., for $1.60 per lin. ft.

⊙The Board of Cass County Commissioners, Logansport, Ind., has awarded the contract for the construction of the Tousley free gravel road in Washington Township to George H. Palmer, of Logansport, for $3,545.

⊙Taber & Hullihan, Wabash, Ind., have been awarded the contract by the Wabash County Commissioners, Wabash, for the construction of four stone roads in Noble Township, at $49,920. Bids were opened May 6.

⊙James H. Spiker, Knox, Ind., has been awarded the contract by the Starke County Commissioners, Knox, for the construction of a gravel road in California Township. Bids were opened May 5.

⊙Albert Claimne, Hartford City, Ind., has been awarded the contract by the County Commissioners, Hartford City, for the construction of the Chas. Mannix road, at $8,139. Jas. Mannix road was let to the same contractor at $14,400. Bids were opened May 5.

⊙The Adams County Commissioners, Decatur, Ind., have awarded the following contracts for the construction of six macadam roads, for which bids were opened on May 6: Meschberger & Co., Linn Grove, Ind.; Merryman & Fugate, Monroe, Ind.; N. Beberstein, Geneva, Ind., and Clay Engle, Decatur.

⊙G. M. Briney, Delphi, Ind., has been awarded the contract by the County Commissioners, Delphi, for the construction of a gravel road in Jefferson and Adams Township, for $6,900. Bids were opened May 6.

⊙D. J. Bush, Beech Grove, Ind., has been awarded the contract by that city for macadamizing eight squares of Fifth Ave., for $9,036.

⊙L. T. Kent, Brookston, Ind., has been awarded the contract by the White County Commissioners, Monticello, Ind., for the construction of the Chas. E. Clay et al. road, at $18,849. The work includes three miles of macadam road, bridges, etc. Bids were opened May 6.

⊙Following road jobs were awarded by the Benton County Commissioners, Fowler, Ind., for which bids were opened on May 5; Kelley road, Hall & Bernard, Delphi, Ind.; Smith road, Packer-Lewis, Oxford, Ind.; Sewall road, Glynn & Vanatta, Otterbein, Ind.

⊙The County Commissioners, Winchester, Ind., awarded the following road jobs for which bids were opened on May 2: F. H. Thompson road, J. G. Johnson, Lynn, Ind.; D. L. Fonts Road, Chas. E. Tansel, Winchester; W. H. Shockney road, Greenville Gravel Co.

⊙H. G. Roetzel & Co., Rockport, Ind., have been awarded the contract by the County Commissioners, Rockport, for the construction of the Lakey road, at $8,894. J. V. Atkinson rock road was let to the same firm for $7,495.

⊙Baker & Montgomery, Seymour, Ind., have been awarded the contract by the County Commissioners, Brownstown, Ind., for the construction of the L. M. Graber road, at $861. Balwin & Marsh, Seymour, secured the contract to construct the James Baldwin road, for $1,176.

⊙Jackson & Gordon, Liberty Center, Ind., have been awarded the contract by the Wells County Commissioners, Bluffton, Ind., for the construction of the John E. Priffle county line road, at $4,499.

No bids were received on May 5 by the LaPorte County Commissioners, LaPorte, Ind., for the construction of a macadam road in Pleasant, Lincoln and Washington Townships.

Iowa.

✣Bids will be received until 7:30 p. m., May 14, by Rufus Brewer, City Clerk, Independence, Ia., for grading, draining and paving, guttering and curbing a number of streets,

⊙The Capital City Construction Co., of Springfield, has been awarded the contract by the City Council of Burlington, Ia., for the paving of N. Seventh St. with asphaltic concrete.

⊙Ford Paving Co., Cedar Rapids, Ia., has been awarded the contract for the construction of bitulithic street paving in Muscatine, Ia. A. Korneman & Co., Muscatine, will lay concrete street and alley paving. Bids were opened May 2.

⊙Garland & Shaffer of New Hampton, Ia., have been awarded the contract by the City Council of Clear Lake, Ia., for the paving of a number of city streets, at $1.26 per sq. yd.

The Webster County Board of Supervisors. Fort Dodge, Ia., has mapped out a county road system which includes 123 miles of highways. The system connects all of the towns of the county.

The City Council of Oskaloosa, Ia., has ordered the paving of a considerable amount of the down-town section.

The City Council of West Union, Ia., has ordered the laying of almost three-quarters of a mile of paving on the principal business streets.

Kansas.

The City Commission of Leavenworth, Kans., has decided to pave Spruce St., from Main to Fifth Sts., with brick during the summer. John Franks is City Engineer.

Louisiana.

⊙DeLatte & LaGrange of Lake Charles, La., have been awarded the contract for the construction of the nine miles of sidewalks that are to be built at De Ridder, La.

Maryland.

✣Bids will be received until noon, May 14, by the State Roads Commission, 534 N. Howard St., Baltimore, Md., for constructing 9 sections of state highway, aggregating about 31.2 miles. Official advertisement will be found elsewhere in this issue.

⊙Fogel & Co., Hollidaysburg, Pa., at $26,106, W. C. Evans, at $21,661 and $22,880, C. H. Hoyt, Evans Bldg., Washington, D. C., at $23,434, W. F. Swann, LaPlata, Md., at $39,377, and Thomas Pool & Hunter, Westminster, Md., at $17,477, have been awarded the contracts by the State Roads Commission, Baltimore, Md., for the building of seven sections of state highway, aggregating about 24.87 miles in length, for which bids were opened on April 22.

Massachusetts.

✣Bids will be received until noon, May 20, by Massachusetts Highway Commission, 15 Ashburton Place, Boston, Mass., for the construction of a section of state highway in the town of Wilbraham. A certified check for $250, must be filed with each bid.

✣Bids will be received until noon, May 20, addressed to the Massachusetts Highway Commission, 15 Ashburton Place, Boston, Mass., for the construction of state highway 5,300 ft. long in the town of Wrentham. A certified check for $250 must be filed with each bid.

✣Bids will be received until noon, May 20, by Selectmen, Wenham, Mass., at the office of the Massachusetts Highway Commission 15 Ashburton Place, Boston, Mass., for the construction of a section of state highway in the town of Wenham. A certified check for $250 must be filed with each bid.

Michigan.

⊙The Schoolcraft County Commissioners, Manistique, Mich., have awarded the contract to macadamize 3¼ miles of state reward road in Hiawatha Township, to the Delta Construction Co., for $2,900 per mile. Work is to be completed by Nov. 1.

⊙F. P. Ryan has been awarded the contract by the Board of Public Works of Bay City, Mich., for the construction of brick pavement on Farragut St., for $26,047. Theodore M. Gaffney secured the contract to construct a brick pavement on Henry St., from N. Union to Hart Sts., for $7,285.

The village of Constantine, Mich., contemplates the paving of two of its main thoroughfares this summer. Plans and specifications are on file with the Village Clerk. Concrete will be used.

Minnesota.

✣Bids are being asked by the City of Austin, Minn., for about 13,214 sq. yds. of paving and 6,000 lin. ft. of cement curbing. Oscar F. Weissgerber, City Engineer. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 8 p. m., May 19, by City Council at the office of George Stein, City Clerk, Bemidji, Minn., for the paving of street with concrete including approximately 10,000 sq. yds.

⊙W. H. Whealen, Nebish, Minn., has been awarded the contract by the town of Nebish, C. A. Deitel, Clerk, for the construction of road improvements. Bids were opened May 3.

⊙Standard Oil Co., has been awarded the contract by the city of Duluth, Minn., for furnishing 50,000 gals., more or less of road oil, at $0.0514 per gal. Bids were opened May 2.

Mississippi.

✣Bids will be received until noon, June 3, by Road Commission, District Scott County, Mississsissippi, at Forest, Miss., for the construction of the 5 miles of gravel road, complete, on Forest and Homewood Road; also a separate bid will be received for the construction of 4 miles of sand clay roads on Forest and Hillsboro Road. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until noon, June 3 by the Road Commission, Sup. Dist. No. 1, Scott County, Mississippi, at Forest, Miss., for approximately 8,000 cu. yds. of road material. Official advertisement will be found elsewhere in this issue.

⊙Bowlin & Son, Columbus, Miss., have been awarded the contract to Calhoun City, Miss., for grading, culverts, street crossings and constructing about one mile of concrete sidewalks. Bids were opened May 6.

It is reported the citizens of Yazoo County, Miss., on May 2 voted the issuance of bonds to the amount of $300,000 for the construction of good roads. Yazoo City is the county seat.

The Lafayette County Board of Supervisors, Oxford, Miss., has authorized the issuance of another $50,000 issue of road bonds for Beat No. 1, Oxford.

Missouri.

✣Bids will be received until May 15, by Gus Thiel, Town Clerk, Cottonwood, Minn., for grading and widening a road about 40 rods long.

✣Bids will be received until May 20, by H. C. Allen, Engineer, Clinton, Mo., for the construction of 6,000 sq. yds. of concrete pavement on earth foundation. The work will require about 200 cu. yds. of excavation.

✣Bids will be received until 1 p. m., May 19, by City Clerk, Jefferson, Mo., for all labor

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

and material necessary for the construction of Chestnut St., from High St. to Atchison. Plans and specifications are on file with City Clerk. Phil C. Harding is City Engineer.

⊙The Plummer-Adams Co., Springfield, Mo., has been awarded the contract by the City Council of that city for the construction of concrete pavement on Campbell St., from Chase to Kearney Sts., for $1.36¼ per sq. yd. Dan C. Crane secured the contract to construct concrete pavement on Main St., from Nichols to Lyon Sts., at $1.23 per sq. yd. The Oxark Engineering & Construction Co. will lay concrete pavement on Evans St., from College St. to Grand Ave., at $1.27 per sq. yd. Vanderslice & Sturdevant will pave State St., from New to Fort Sts., with concrete, for $1.35 per sq. yd.

⊙The Ramsay County Commissioners, St. Paul, Minn., have awarded the contract for grading, claying and graveling the Lake Johanna County road to James Corr, for $6,759.

⊙The contract for the laying of sidewalks on Hammond, Lincoln and Cumming Aves., in the vicinity of 21st St., has been let by the Board of Public Works of Duluth, Minn., to Magnus Peterson of Superior, Wis., for $0.645 per lin. ft.

The Winona County Commissioners, Winona, Minn., have approved the plan for launching the construction of permanent roads in Winona County, to cost $600,000.

The city of Virginia, Minn., will spend over $50,000 on street paving during the coming summer. Plans are being prepared by City Engineer E. F. Johnson. The improvement is to be made on Virginia Ave. and Hemlock St., as well as other streets and avenues.

The Jasper County Court, Carthage, Mo., has been ordered by Judge J. D. Blair of division No. 2 of that county Circuit Court, to issue a call for a special election in Neck City and Duval Township for the purpose of determining whether or not that territory should be formed into a special road district.

The city of Warrensburg, Mo., will construct 18,000 sq. yds. of vitrified brick block pavement on a 4-in. concrete foundation, with 1½-in. sand cushion, artificial stone curb, about 12,000 ft., and asphalt filler. The estimated cost is $2 per sq. yd. Contract will probably be let this summer. R. P. Fitch is City Engineer.

Nebraska.

✣Bids will be received until 8 p. m., May 26, by H. B. Willard, City Clerk, Falls City, Nebr., for the furnishing of material and labor and for the construction of paving in districts No. 4, No. 5, No. 6 and No. 7 in said city according to specifications now on file. The City Engineer's estimate of the cost thereof is as follows: District No. 4, $11,900; District No. 5, $18,000; District No. 6, $12,500; District No. 7, $12,500; total, $54,900. All bids for said contract shall be accompanied by a certified check for $500 for each district, payable to the order of said city, to insure the execution of a contract for said work, and a bond for the proper construction thereof.

City Engineer H. H. Tracy of Norfolk, Nebr., has completed the plans for the Fourth St. paving, as well as those for the paving of W. Norfolk Ave. and N. Ninth St. The estimated cost is over $97,000.

New Jersey.

✣Bids will be received until 8 p. m., May 20, by Town Council, West New York, N. J., for the improvement of Hudson Ave. from southerly side of 23d St. to the southerly limits of the town. Plans and specifications are on file with James L. Wolfe, Town Clerk.

⊙Standard Oil Co., Newark, N. J., has been awarded the contract for furnishing and applying road oil on 75 miles of road in Essex County, N. J., for $0.08 per gal. Bids were opened May 5.

⊙Following contracts have been awarded at Trenton, N. J., for street work: Newton Paving Co., for paving E. State St., between the canal and N. Clinton Ave., with Bermudez asphalt, $2,633; Charles A. Reid & Co., for paving W. State St., with Jamestown vitrified block on the existing concrete base, $7,440; also for paving Pennington Ave. with Pennsylvania fire clay vitrified brick, $1,980; also for paving S. Broad St. with vitrified fire clay block, $1,490; McGovern Contracting Co. for paving E. Front St. with Metropolitan block, $3,262.

⊙The Allen Construction Co., of New Jersey, has been awarded the contract to build 4.6 miles of macadam road between Elkton and Chesapeake City for $47,561.

At a recent conference at Jersey City, N. J., between State Road Commissioner E. A. Stevens, Supervisor O'Mealia, County Engineer Tom Wasser and the road committee of the Freeholders, plans were discussed for the improvement of the Newark Turnpike. The estimated cost of the work is $300,000.

New York.

✣Bids will be received until 11 a. m., May 31, by Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., for wood block paving at the Navy Yard, New York, N. Y. The estimated cost is $15,000.

✣Bids will be received until 10 a. m., July 7, by M. Gray Zalinski, Depot Quartermaster, Army Bldg., Whitehall St., New York City, for supply of from 1 to 10 motor trucks.

✣Bids will be opened May 17 by the President and Board of Trustees, Canastota, N. Y., for constructing 1 mile of vitrified brick pavement with concrete curb and gutter. H. F. Hamil is Village Engineer. Official advertisement will be found elsewhere in this issue.

⊙The Board of Public Works of Poughkeepsie, N. Y., has awarded the contract for the laying of about 40,000 ft. of concrete sidewalks and curb and gutter to A. Bump.

⊙A. D. Osborn, of Binghampton, N. Y., has been awarded the contract by the Board of Public Works of Elmira, N. Y., to build several brick pavements, at $1.96 and $2.06 per sq. yds. for paving, $0.75 for straight curbs, $0.98 for curved curbs, $0.75 for headers at the extreme end of the pavements, and $0.15 for resetting curbs. Bids were opened May 5.

⊙Jerome Maloney and John Pardee have been awarded the contract by the Board of Public Works of Oneida, N. Y., for street sprinkling. Contracts awarded May 6.

⊙Brayer Bros., on May 6, secured the contract from the Common Council of Auburn, N. Y., for the paving of James St. with asphalt.

The citizens of Hornell, N. Y., have voted in favor of paving East Ave., from E. Main St. to the city limits. The work will cost about $16,000.

North Dakota.

✣Bids will be received until May 19, by City Commissioners, Minot, N. Dak., for paving Main St., from the north end to Third St., and First St., from Ward to Wellcome St.

⊙J. P. O'Leary has been awarded the contract for the building of sidewalks and street crossings for the city of Carrington, N. Dak., for the ensuing year, at $1.10 per sq. yd. and $1.95 per sq. yd., respectively. G. W. Heinmiller is City Engineer.

Ohio.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., May 23, for grading and paving with a waterbound macadam with a bituminous surface treatment the Newark-New Lexington road, State Highway "C," Pet. No. 696, in Thorn Twp., Perry County. Length, 9,775 ft. or 1.86 miles; width of pav., 16 ft.; estimated cost of construction, $18,726. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received until 11 a. m., June 11 by Board of Cuyahoga County, Commissioners, Cleveland, O., for the improvement of Aurora Road from Bainbridge Road to county line in Solon township. Plans and specifications furnished by F. R. Lander, County Surveyor. A certified check for $1,000 must be filed with each bid. Plans, descriptions, bills and specifications for the above work can be seen and are open to public inspection of persons interested therein, at the office of the County Engineer at the New Court House on Lakeside Ave., Cleveland, Ohio.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., May 29, 1913, for grading and paving with brick for heavy traffic the Guernsey County State Highway G, Pet. No. 661, Steubenville-Cambridge road, Inter-County No. 26 in Cambridge Township. Length, 5,280 ft., or 1.00 mile; width of paving, 14 ft. Estimated cost of construction, $16,858.35. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., May 29, 1913, for grading and paving with concrete the Sandusky County State Highway "D," Pet. No. 255, Sec. No. 3, Port Clinton road, Inter-County No. 277 in Sandusky Township. Length, 6,380 ft., or 1.21 miles; width of paving, 16 ft. Estimated cost of construction, $16,540. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., May 29, 1913, for grading and paving with a waterbound macadam the Bryan-Napoleon road, State Highway "A," Pet. No. 744, in Napoleon Township, Henry County. Length, 13,200 ft., or 2.50 miles; width of paving, 16 ft. Estimated cost of construction, $16,722. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the County Commissioners at Kenton, Ohio, until 1 p. m., May 28, 1913, for grading and paving with a waterbound macadam the Hardin County State Highway "D," Pet. No. 745, Sec. No. 2, Kenton-Findlay road, Inter-County No. 221 in Blanchard Township. Length, 7,860 ft., or 1.49 miles; width of paving, 12 ft. Estimated cost of construction, $5,064. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the County Commissioners at Kenton, Ohio, until 1 p. m., May 28, 1913, for grading and paving with a waterbound macadam the Hardin County State Highway "B," Pet. No. 599,

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Kenton-Forest road, Inter-County No. 227, in Pleasant Township. Length, 10,550 ft., or 2.00 miles; width of paving, 12 ft. Estimated cost of construction, $6,252. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the County Commissioners at Kenton, Ohio, until 1 p. m., May 28, 1913, for grading and paving with a waterbound macadam the Hardin County State Highway "C," Pet. No. 745, Sec. No. 1, Kenton-Findlay road, Inter-County No. 221, in Blanchard Township. Length, 2,700 ft., or 0.51 miles; width of paving, 12 ft. Estimated cost of construction, $1,787.64. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the County Commissioners at Kenton, Ohio, until 1 p. m., May 28, 1913, for grading and paving with a waterbound macadam the Hardin County State Highway "A," Pet. No. 598, Kenton-Mt. Victory road, Inter-County No. 228, in Hale Township. Length, 10,560 ft., or 2.00 miles; width of paving, 12 ft. Estimated cost of construction, $8,638. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of ths contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received until noon, May 13, by V. T. Price, Director of Public Service, Cincinnati, O., for the improvement of Highpoint Ave., from Wardall Ave. to its northern terminus, by constructing brick pavement, drains, inlets, curb, etc.

✣Bids will be received until noon, May 16, by W. H. Kirby, secretary of the Director of Public Service, Cleveland, O., for the construction of asphaltic concrete pavement in Brookside Park. Plans and specifications are on file with Park Superintendent, Room 214, City Hall.

✣Bids will be received until noon, May 15, by J. R. Morris, Director of Public Service, Lima, O., for the paving of Jameson Ave., from Elm St. to Lakewood Ave., with first-class quality of vitrified brick or bituminous macadam. Plans and profiles of this work are now on file at the office of the Director of Public Service, where specifications and blank proposals may be obtained.

✣Bids will be received until noon, June 9, by Fred H. Shoaff, Clerk of the village of Euclid, O., for furnishing the material and labor necessary for the improvement of Dunham Ave., from the north line of Euclid Ave. to the south line of the N. Y., C. & St. L. R. R. right of way, by establishing a grade, draining and paving same with brick, according to plans and specifications on file at the office of said Clerk at the Town Hall, and at the office of the F. A. Pease Engineering Co., at 931 Williamson Bldg., Cleveland, O.

✣Bids will be received until noon (central standard time), June 10, by H. Canfield, Clerk of the village of Cleveland Heights, 309 Beckman Bldg., Cleveland, O., for furnishing the material and labor necessary for the improvement of Ardoon St., from Mayfield Road to the south line of Glenwood St., by establishing a grade, grading and constructing sidewalks, according to the plans and specifications on file at the office of said Clerk at the Town Hall and at the office of the F. A. Pease Engineering Co., Marshall Bldg., Cleveland, O. Bids will also be received by said Clerk at said places and time for furnishing the material and labor necessary for the improvement of Lee Road, from the north line of Fairmount Blvd. to the north line of Monmouth Road, by establishing a grade, grading, draining, curbing and paving the same with brick, asphalt or macadam; for furnishing the material and labor necessary for the improvement of Yellowstone Road, from the north line of Mayfield Road to the center line of Noble Road, by establishing a grade and grading; also for furnishing the material and labor necessary for the improvement of Yellowstone Road from the north line of Mayfield Road to a point 1,800 ft. northerly therefrom, by grading, draining, curbing and paving the same with brick, asphalt or macadam; also for furnishing the material and labor necessary for the improvement of Woodward Ave., from the north line of the Cleveland Heights Realty Co.'s subdivision to the north line of Berkshire Road, by establishing a grade, grading, draining and paving with macadam. Each bid must contain the full name of every person or corporation interested in the same, and be accompanied by a certified check for 10 per cent of the amount of the bid.

✣Bids will be received until 5 p. m., May 20, by City Council of Durant, Okla., for the construction of approximately 18,000 sq. yds. of asphaltic concrete pavement with combined curb and gutter, etc. J. L. Foote, Mayor. W. P. Danford, City Engineer.

✣Bids will be received until 1 p. m., June 2, by Board of Lorain County Commissioners, Elyria, O., for furnishing labor and material necessary for the grading, draining and macadamizing of the cemetery road from east side of S. Main St., in Wellington, to the east side of main entrance to the cemetery. F. D. Ellenberger is Clerk.

✣Bids will be received until noon, May 26, by Board of Ross County Commissioners, at the office of R. D. Alexander, County Auditor, Chillicothe, O., for the furnishing of all necessary labor and materials to make the improvement known as the grading, rolling and graveling of Richmondale pike, a distance of one and one-half miles, located in Jefferson Township, Ross County. The plans and estimates and specifications for the above work are now on file in the office of the County Auditor and County Surveyor.

✣Bids will be received until 11 a. m., June 11, by Board of Cuyahoga County Commissioners, Cleveland, O., for the improvement of Brookpark No. 1 road, from Wooster Pike to Settlement Road in Brooklyn, Parma & West Park Townships, in accordance with plans and specifications on file at the office of the County Engineer. J. F. Goldenbogen is Clerk. A certified check for $1,000 must be filed with each bid.

⊙The Department of Public Service of Middletown, O., has awarded contracts for the construction of sidewalks, curbs and gutters to John Arpp Co., Middletown, at about $4,500, and to Fred Kesting, Middletown, at about $3,500. Bids were opened April 25.

⊙The Cleveland Stone Co., Cleveland, O., has been awarded the contract by the Village of West Park, O., for furnishing labor and material for building sidewalks, at $20,000 Bids were opened May 5.

⊙W. C. Heyman of Bellevue, O., has been awarded the contract by the Sherman Township Trustees, Norwalk, O., for the improvement of the Dog Town Road, at $0.30 for grading and $3,846 for macadam; also for the improvement of the Old Plank Road, at $0.30 for grading and $2,280 for macadam. The Lyme Construction Co., of Bellevue, secured the contract to improve the Sheid Road, at $0.35 for grading and $2,550 for macadam.

⊙The Stark County Commissioners, Canton, O., have awarded the contract for the paving of the Alliance, Harrisburg and Louisville road to W. H. Vogt & Son, of Massillon, O., for $190,000. The road will connect Louisville and Alliance. The distance is a fraction more than 9 miles.

The Stark County Commissioners, Canton, O., have adopted plans for the paving of the Canton-Canal Dover highway, from Howenstine to below Sparta, a distance of four miles. The contract will be let in about four weeks.

The Stark County Commissioners, Canton, O., rejected the one bid received for the paving of the Canton-Cairo road for a distance of five miles as being too high.

Oklahoma.

✣Bids will be received until 10 a. m., May 27, by Constructing Quartermaster, Fort Sill, Oklahoma, for constructing roads and walks.

Pennsylvania.

✣Bids will be received until 8:30 p. m., May 15, by Borough Secretary, Hastings, Pa., for paving five squares on Beaver St. and two squares on Fourth Ave., in said borough with vitrified brick. Plans and specifications can be seen at the office of Charles E. Schlicher, Spangler, Pa., or at the office of Clerk of Council C. S. Hoyt, Hastings, Pa.

✣Bids will be received until 10 a. m., May 23, by City Controller, Pittsburgh, Pa., for the following improvements: Regrading, repaving with asphalt and blockstone, reconstruction of sewers, and otherwise improving certain public highways affected by the abolition of grade crossings over P. R. R. tracks at Homewood Ave. and Braddock Ave., to wit: Homewood Ave., McPherson St., Finance St., Annan Alley, Susquehanna St. and Tioga St. Grading, regrading, paving, repaving with asphalt, and otherwise improving Braddock Ave., from Penn Ave. to Hamilton Ave. Grading, paving and curbing with asphalt Hamilton Ave., from Lambert St. to Fifth Ave., Jonathan St., from Homewood Ave. to Lexington St.

✣Bids will be received until 7 p. m., May 19, by H. A. Johnston, President of the Town Council, Masontown, Pa., for grading, curbing and paving Main St. from Church St. northward to the Borough line and Church St. from Main St. eastward to the Borough line, and Main St. from the south end of present pavement southward 1,350 ft. more or less with brick or asphaltic concrete. All bids to be accompanied by a certified check for $1,000. W. E. Ward, Borough Engineer.

⊙M. J. Barrett & Co., Jessup, Pa., have been awarded the contract by the borough of Jessup, E. A. Judge, Secy., for the construction of $2\frac{1}{2}$ miles of curbing, at $0.65 per ft. Bids were opened May 6.

⊙McCrady Bros., Sixth St., Braddock, Pa., have been awarded the contract by Borough of North Braddock, Geo. F. Siefers, Borough Engineer, for grading and curbing Pallas Ave., Center St., East St., Margaret Al., Shaver Al., Grandview Ave. and Poplar Al., at $49,609. The work includes concrete foundation and brick pavement. Bids were opened May 2.

⊙The Raymond Contracting Co. has been awarded the contract by Director of Public Works C. V. Terwilliger, Scranton, Pa., to pave Taylor Ave. and Mahon Ct., with stone block on a concrete base.

The citizens of Meadville, Pa., at a recent election voted the issuance of bonds in the sum of $60,000 for the paving of 12 additional streets.

The City Councils of Steelton, Pa., on May 5 is reported to have passed an ordinance authorizing a bond issue of $40,000, of which $20,000 will be used for street paving and improvements.

The Pennsylvania State Highway Commission has had plans prepared for the construction of $1\frac{1}{4}$ miles of brick road in Watsontown, Pa., to be laid on cement foundation with cement curb.

Tennessee.

⊙Koehler Bros., of Memphis, Tenn., have been awarded the contract by the officials of Union City, Tenn., for the construction of sidewalks, at about $30,000.

The Shelby County Commissioners, Memphis, Tenn., are considering a propositon for a road from the Parkway to the Country Club at Buntyn, to be built jointly by the county and the club.

Texas.

✣Bids will be received until noon, May 26, by J. B. Price, Bastrop County Judge, Bastrop, Texas, for the construction and completion of about 40 miles of graveled roads and bridges and culverts and appurtenances thereto in Road District No. 1 of Bastrop County, Texas, Smithville being the principal town in and near the center of said district. Plans and specifications covering said work can be had on personal application to the County Judge at Bastrop, Texas, or to E. H. Eagleston, chairman of the citizens' committee, at Smithville, or to Abney & Mitchell, engineers for the district, at Eagle Lake, Texas. A certified check for $5,000 must be filed with each bid.

⊙The Texas Building Co., Fort Worth, Tex., will sub-let two-thirds of the road work in Tarrant County, Tex., which was recently secured by that company on a bid of $656.504. The sub-letting will close May 18. The company wishes to get in touch with contractors with outfits of 20 teams or more. The work includes the building of eight cardinals and sub-cardinal macadam roads radiating from Fort Worth to the Tarrant County line, averaging in length 15 miles per road.

The Jefferson County Commissioners, Beaumont, Tex., have called an election for May 22, for the purpose of voting on the issuance of bonds in the sum of $500,000 for road improvements. The routes to be taken for the repairing and extending of the county roads system have been agreed upon.

The citizens of Midland County, Tex., at a recent election voted the issuance of bonds to the amount of $50,000 for the building of good roads. Midland is the county seat.

J. C. Field, of Denison, Tex., has been appointed supervising engineer in charge of the constructieon of $200,000 worth of good roads which will be built in Robertson County, Tex., of which Franklin is the county seat.

The contract for the supervision of the construction of road work in Precinct No. 1, Bastrop, Hills Prairie and Goodman, has been let by the Commissioners' Court, Bastrop Tex., to Albert Clopton of Elgin, Tex. A total of $80,000 is available for the work.

Utah.

✣Bids will be received until 10 a. m., May 20, by City Commissioners, Salt Lake City, Utah, for constructing cement sidewalks in sidewalk extension No. 159, from Third East St. to 13th East St., between 11th South and 12th South Sts. Instructions to bidders, together with plans and specifications and forms for contract and bond are on file in the City Engineer's office, and copies will be furnished on receipt of $5. Noble Warrum is City Recorder.

Washington.

✣Bids will be received until 2 p. m., May 27, by Board of King County Commissioners Seattle, Wash., for the necessary material and labor (excepting Jap and Chisene labor), for the construction of the Henry Richard's Road. Byron Phelps is Clerk of the Board.

*Magnus Peterson, of Superior, Wis., has been awarded the contract by the Board of Public Works of that city for the construction of cement sidewalks in the Fifth Ward, at $0.645 per lin. ft.

⊙The Pierce County Commissioners, Tacoma, Wash., have awarded the contract for the construction of Permanent Highway No. 3, from Tacoma to Spanaway, for $43.843, to the Washington Paving Co. Concrete pavement will be laid.

⊙Elwood Wiles Co., Portland, Ore., has been awarded the contract by the Board of Clarke County Commissioners, Vancouver, Wash., for the construction of Permanent Highway No. 2 and part of Pacific highway, for $32,155. The work includes two miles of Warrenite pavement and one-half mile of concrete pavement. Bids were opened May 3.

⊙K. O. Sausett of Bellingham, Wash., has been awarded the contract, at $21,900 for the construction of the Northeast Diagonal Road.

T. Ryan & Co., Seattle, Wash., at $60,913, submitted the lowest bid to the Board of Public Works of that city, for the paving of Grand Ave., and F. A. Hadley, at $3,603, was low bidder for paving the roadway of Olson Place.

The City Commission of Superior, Wis., E. B. Banks, City Engineer, has approved plans and specifications for the paving of N. Sixth St., from Tower Ave. to Banks Ave., and Ogden Ave., from First St. to Third St. Bids will be received on the work immediately.

Wisconsin.

✣Bids will be received until 10 a. m., May 16, by Board of Public Works, Delavan, Wis., for the construction of cement curbs and gutters on both sides of Racine St., from Eighth St. to a point 150 ft. east of Fremont St. and on the east side of Eighth St., from Racine St. to the south side of Walworth Ave., and also on both sides of N. Fourth St., from Walworth Ave. to McDowell St. Specifications may be seen at the office of the City Clerk.

✣Bids will be received until June 10, by City of Madison Wis., for the construction of 31,000 sq. yds. of asphalt mixed macadam on plain macadam and telford base. The work will include 20,000 ft. of concrete combined curb and gutter. The cost is estimated at about $60,000. E. E. Parker, Madison, Wis., is City Engineer.

⊙E. J. Thiede & Co., Two Rivers, Wis., have been awarded the contract by that city, for furnishing necessary labor and material for grading, curbing and paving streets, at $23,081. Bids were opened April 24.

DRAINAGE AND IRRIGATION

California.

The Modesto Irrigation District has decided to construct the Upper Dominici and Morton fills by day labor The work will be directed by R. A. Edwards, Engineer, Modesto, and will cost about $80,000.

The Pacific Gas & Electric Co., 925 Franklin St., San Francisco, has engineers in the field for an irrigation project covering the southwestern portion of Nevada county from Chicago Park to Indian Springs and Spenceville and extending to Bear River. Preliminary plans and estimates will be made for an irrigation system providing for practically 100,000 acres of foothill land, as the preliminary step toward developing Nevada county's horticultural and agricultural resources.

Illinois.

✣Bids will be received until 1 p. m. May 24, by Drainage Commissioners of District No. 5, Assumption, Ill., at the City Hall for furnishing the following materials, viz.: 2,970 ft. 18-in. salt-glazed, vitrified drain tile; 1,820 ft. 14-in. salt-glazed, vitrified drain tile; 1,800 ft. 12-in. salt-glazed, vitrified drain tile; 825 ft. 10-in. first-class drain tile; 1,820 ft 8-in. first-class drain tile. To be delivered f. o. b. at Assumption, Ill. Also for unloading from cars, hauling and distributing said tiles along the lines of the drains. Also for trenching laying and refilling trenches necessary to properly construct the following tile drains, viz.: (1) Main Drain, 18 ins., 180 rods, average depth 4.5 ft.; (2) Main Drain, 14 ins., 110 rods, average depth, 5.5 ft.; (3) Main Drain, 12 ins., 109 rods, average depth 5.0 ft.; (4) Main Drain, 10 ins., 50 rods, average depth 4.0 ft.; (5) Main Drain, 8 ins., 110 rods average depth 4.0 ft. Taking up 110 rods of 6-in. old tiles, before laying 8-in. tiles. Detailed plans and specifications for material and work are on file in the office of Roy Johnson, Town Clerk, at Assumption, Ill., or may be seen at the office of J. W. Dappert, Engineer, at Taylorville, Ill. Taylor & Taylor, Attorneys for District, Taylorville, Ill.

✣Bids are asked by the Commissioners of Coon Creek Drainage District, De Kalb and Kansas Counties, Illinois, for constructing the west branch ditch and the Jap branch ditch of said drainage district. West branch ditch estimate, 398,074 cu. yds. of excavation. Jap branch ditch estimate 46,985 cu. yds. of excavation. Plans, profiles and specifications may be seen at the office of the Clerk of DeKalb County, Sycamore, Ill., and at the office of W. M. Hay, Engineer Sycamore, Ill. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until May 31, it is reported, by Commissioner of Drainage District No. 1, Oreana, Macon County, Ill., at the office of Charles Shastid, Oreana, Ill., for furnishing the necesary labor and material for the construction of a tile drainage system. Preston Hicks, Decatur, Ill., is Engineer.

✣Bids will be received until 1 p. m., May 21, by the Commissioners at the Court House, Urbana, Ill., for the construction of the main open ditch of Sangamon and Drummer Drainage District in Champaign and Ford Counties. The work will include about 381,373 cu. yds. of excavation. Further information may be obtained of Dobbins & Dobbins, Attorneys, Champaign, Ill. E. F. Helman, Paxton, Ill., is Engineer.

⊙Hutchinson & Oakford, Peoria, Ill., have been awarded the contract for constructing open ditch requiring 80,000 cu. yds. excavation and for laying 32,000 ft. of shale tile, for the Wheeling Drainage District No 1 of Wheeling, Ill. The contract for 32,000 ft. of tile was let to the National Drain Tile Co., Terre Haute, Ind. Bids were opened April 26.

Indiana.

✣Bids will be received until 10 a. m., May 24, by G. F. Stichfield, Porter County Surveyor, Valparaiso, Ind., for the construction of the Ludington Ditch. The work includes about 128,982 cu. yds. floating dredge work and 12.2 miles of drain tile from 5 to 18-in. diameter. A certified check for $500 must be filed with each bid.

✣Bids will be received until 4 p. m., May 24, by Elmer C. Williams, Construction Commissioner, Winamac, Ind., for the construction of the Robert's ditch.

⊙J. G. Berger, Fort Branch, Ind., has been awarded the contract at $2,020 for consructing the two Watson ditches, and at $3,525 for constructing the Deputy ditch. The Watson ditches will be each about 1 mile long, requiring 11,600 cu. yds. of excavation. The Deputy ditch includes 2 miles of open work and ½ mile of tile. Bids were opened May 3 by Harry C. Morrison, Drainage Commissioner, Princeton, Ind.

⊙Bids were opened May 3 by Harry C. Morrison, Drainage Commissioner, Princeton, Ind., for the construction of the Bozeman drain, the contract being awarded to J. G. Berger at $2,650. The work calls for 7,800 ft. of open ditch requiring 16,390 cu. yds. of excavation.

Iowa.

✣The bids received May 6 by B. S. McCully, County Auditor, for furnishing tile for Drain No. 84 were rejected and new bids will be opened May 19. The contract for digging trenches and laying the tile was let to Condon & Robinson, Jefferson, Ia., at $11,595.

✣Bids will be received until noon, May 15, by H. G. McGee, Secretary, Board of Park

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Commissioners, 105 Pearl St., Council Bluffs, Ia., for the embankment of about 40,000 cu. yds. of earth in the Nathan P. Dodge Park in government lots 2 and 3, section 33, township 75, range 44. Plans and specifications can be seen at the office of the City Engineer. All work to be completed by December 1, 1913. All bids must be accompanied by a certified check in the sum of $100.

✣Bids will be received until May 19 by B. S. McCully, County Auditor, Jefferson, Ia., for furnishing tile for construction of drainage District No. 84, Greene County. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 2 p. m., May 26, by Board of Drainage Commissioners, Henderson County, Henderson, Ky., for the construction of Double dam and Swan Pond ditch. The work will include 132,776 cu. yds. of material. Peter Manion, Henderson, Ky., is President.

⊙Contracts for Drain 69, bids for which opened May 1, by B. E. Norton, County Auditor, Algona, Ia., have been let as follows: Open work, Hunt & Anderson, Bancroft, Ia., 10.49 cts.; tile work, Welp Cement Products Co., Bancroft, Ia., $34,060.

Kentucky.

⊙J. H. Salisbury, State Center, Ia., has been awarded the contract at $25,222 for constructing tile drain for Drainage District No. 26 of Franklin county. The work calls for 40,250 ft. of 5-in. to 30-in. tile. Bids were opened April 29 by Frank McSpaden, County Auditor, Hampton, Ia. A. C. Baker, Hampton, Ia., is the engineer.

⊙Henry Swift, Webster City, Ia., has been awarded the contract at $15,184 for constructing County Drain No. 80, bids for which were opened May 5 by F. F. Osier, County Auditor, Clarion, Ia. The work includes: Section 1, 645 ft. 16-in. tile, av. cut 4.60 ft.; Section 2, 2,300 ft. 18-in. tile, av. cut 5.80 ft.; Section 3, 2,300 ft. 20-in. tile, av. cut. 7.60 ft.; Section 4, 2,100 ft. 22-in. tile, av. cut 8.60 ft.; Section 5, 4,600 ft. 24-in. tile, av. cut 9.30 ft.; Section 6, 2,700 ft. 26-in. tile, av. cut 7.70 ft.; Section 7, 3,500 ft. 28-in. tile, av. cut 7.40 ft.; Section 8, 5,200 ft. 30-in. tile, av. cut 7.30 ft.

⊙O. L. Olson, Lanesboro, Ia., has been awarded the contract at $31,379 for constructing County Drain No. 74, bids for which were opened May 5 by F. F. Osier, County Auditor, Clarion, Ia.

George R. Parks and others have petitioned the Board of Supervisors at Alden, Ia., for the establishment of a drainage district and drain. The land affected is located in sections 9, 10, 15 and 16 of Alden Township, North Range 22. The board appointed S. B. Gardner Engineer to make a survey.

Engineer G. P. Smith has filed a report recommending the establishment of a drainage district and drain in Deer Creek township to be known as No. 166. County Auditor, Fort Dodge, Ia., will fix a date for hearing.

Minnesota.

✣Bids will be received until May 28, by A. G. Lundgren, County Auditor, Warren, Minn., for the construction of a 14-mile judicial ditch in Marshall County. The work will necessitate 230,000 cu. yds. of excavation. J. H. Baugh is Engineer.

Petition has been filed with J. P. Pau, County Auditor, St. Cloud, Minn., for the construction of a public ditch to be known as County Ditch No. 32 of Stearns County.

Viewers on Ditch No. 25 have reported to the County Commissioners at Fairmount, Minn., that the system will cost $22,445. It is located in the town of Fox Lake.

Hearing was held on May 17 by the County Commissioners on the petition of D. J. Doyle and others for the establishment of a ditch in Meeker County. A. O. Palmquist, Litchfield, Minn., is County Auditor.

Hearing was held on May 6 in office of S. O. Tjosvold, County Auditor, Granite Falls, on the petition for a new public ditch in Medicine County.

Viewers have been appointed for the proposed ditch No. 33 petitioned for by Frank Lippsmeyer and others in the county of Melrose. Samuel S. Chute will make the survey of the ditch. J. P. Rau, St. Cloud, Minn., is County Auditor.

Missouri.

✣Bids will be received until 10 a. m., May 17, by Frank C. Bier, Marion County Drainage District, Palmyra, Mo., for the construction of tile drains. The work will include about 83,900 lin. ft. of 4 to 18-in. tile, 17 concrete outlet abutments, 23 catch basins. Plans and specifications may be seen at the office of Edmund T. Perkins, Chief Engineer, Chicago, Ill., Frank G. Bier, Secy., Palmyra, Mo., or W. E. Kendall, Quincy, Ill.

⊙R. H. & G. A. McWilliams, Steger Bldg., Chicago, Ill., has been awarded the contract for levees and ditches for the Marion County Drainage District, bids for which were opened April 26 by Frank G. Bier, Secretary, Palmyra, Mo. The work includes about 450,000 cu. yds. of levees, filling 7,000 cu. yds., muck ditch and canals and ditches calling for 100,000 cu. yds. of excavation.

Montana.

Bids were received April 28 at Babb, Mont., by the U. S. Reclamation Service for the construction of St. Mary Canal, St. Mary Storage Unit, Milk River Project, Montana. Winston Bros. Co., Minneapolis, Minn., and the Cardston Construction Co., Cardston, Alberta, bid on Schedule 4 only, the total of the former company being $120,150 and of the latter $104,030. Kilpatrick Bros. & Collins Contracting Co., Beatrice, Neb., bid on all three schedules, its unit prices being as follows:

Schedule 1:	
Excavation, class 1, 267,000 cu. yds....	$ 0.50
Excavation, class 2, 10,000 cu. yds.....	0.64
Excavation, class 3, 500 cu. yds.......	1.00
Overhaul, 16,500 sta. cu. yds..........	0.02
Total	$140,730
Schedule 3:	
Excavation, class 1, 496,500 cu. yds....	0.35
Excavation, class 2, 10,000 cu. yds.....	0.55
Excavation, class 3, 10,000 cu. yds.....	1.00
Overhaul, 1,170,000 sta. cu. yds........	0.02
Total	$212,675
Schedule 4:	
Excavation, class 1, 428,000 cu. yds....	0.35
Excavation, class 2, 5,000 cu. yds......	0.55
Excavation, class 3, 1,000 cu. yds......	1.00
Overhaul, 281,000 sta. cu. yds..........	0.02
Total	$159,170

Bids were opened April 30 by H. N. Savage, Supervising Engineer, U. S. Reclamation Service, Great Falls, Mont., for the construction of the Pishkun reservoir supply canal and tunnels and the Sun River slope canal in Sun River Project, Montana. The totals of the bids on this work were given in our last issue. The unit prices of the various bidders are given below. In addition to the bids shown in the table Charles Wilhite & Co., Malta, Mont., bid on Schedule 3 and 4, the totals being $85,060 and $127,400, respectively. In the table (1) stands for bids of Kilpatrick Bros. & Collins Contracting Co., Beatrice, Neb., (2) bids of Winston Bros. Co., Minneapolis, Minn., and (3) bids of MacArthur Bros. Co., Chicago and New York City:

	(1)	(2)	(3)
Schedule 1:			
Excavation, class 1, 610,000 cu. yds.........	$ 0.25	$	$ 0.23
Excavation, class 2, 27,000 cu. yds.........	0.40	....	0.40
Excavation, class 3, 112,000 cu. yds.........	0.99	....	0.75
Overhaul, 95,000 cu. yds.........	0.02	....	0.02
Rolled embankment, 90,000 cu. yds.........	0.07	....	0.12
Schedule 2:			
Excavation, class 1, 687,000 cu. yds.........	0.26½	....	0.27
Excavation, class 2, 56,000 cu. yds.........	0.42½	....	0.40
Excavation, class 3, 34,000 cu. yds.........	1.00	....	0.75
Overhaul, 14,000 cu. yds.........	0.02	....	0.02
Rolled embankment, 27,000 cu. yds.........	0.07	....	0.12
Schedule 3:			
Excavation, class 1, 408,000 cu. yds.........	0.21½	0.24	0.17
Excavation, class 2, 9,000 cu. yds.........	0.37½	0.45	0.40
Excavation, class 3, 6,000 cu. yds.........	0.95	1.00	0.75
Overhaul, 7,000 cu. yds.........	0.02	0.02	0.02
Rolled embankment, 2,000 cu. yds.........	0.07	0.25	0.15
Schedule 4:			
Excavation, class 1, 360,000 cu. yds.........	0.21¾	0.24	0.19
Excavation, class 2, 75,000 cu. yds.........	0.37½	0.45	0.40
Excavation, class 3, 25,000 cu. yds.........	0.96¼	1.00	0.75
Overhaul, 5,000 cu. yds.........	0.02	0.02	0.02
Schedule 5:			
Excavation in open cut, class 1, 5,800 cu. yds.........	0.25	0.45	0.25
Excavation in open cut, class 2, 700 cu. yds.........	0.40	0.45	0.50
Excavation in open cut, class 3, 8,500 cu. yds.........	0.99	1.00	0.80
Tunnel, including lining, 980 lin. ft.........	60.00	63.00	47.00
Concrete in portals, 350 cu. yds.........	15.00	15.00	20.00
Placing reinforcing steel, 42,000 lbs.........	0.03	0.03	0.02
Schedule 6:			
Excavation in open cut, class 1, 6,400 cu. yds.........	0.25	0.45	0.25
Excavation in open cut, class 2, 100 cu. yds.........	0.40	0.45	0.50
Excavation in open cut, class 3, 3,000 cu. yds.........	0.99	1.00	0.80
Tunnel, including lining, 2,235 lin. ft.........	55.00	63.00	47.00
Concrete in portals, 320 cu. yds.........	15.00	15.00	20.00
Placing reinforcing steel, 38,000 lbs.........	0.03	0.03	0.02
Totals, individual proposals.........	$960,997	$486,205	$858,615

Ohio.

✣Bids will be received until May 19, it is reported, by J. S. Cartwright, Putnam, County Surveyor, Ottawa, O., for the construction of the T. P. Kelley ditch, consisting of 1½ miles of open ditch with 3-ft. bottom, containing 8,805 cu. yds. and 7,824 ft. of 20, 22 and 24-in. tile.

City of Lorain, O., is to issue $18,000 of bonds for dredging flood sediment from the Black River. C. M. Osborn is City Engineer.

Tennessee.

F. Ray Moomaw, County Surveyor, Huntingdon, Tenn., has preliminary surveys under way for a drainage district to drain Beaver Creek and also to extend to Weakley County line, necessitating the drainage of several miles of Obion River.

Texas.

✣Bids will be received until noon, June 16, by the Navigation and Canal Commissioners of Beaumont Navigation District of Jefferson County, Texas, at the office of J. F. Weed, Engineer, Alamo Block, Beaumont, Texas, for the construction of a lock, dam and canal in Taylor's Bayou in Jefferson County, about half a mile above West Port Arthur. The contract will include furnishing all material and labor for the construction of a canal approximately 1,000 ft. long, 10 ft. deep, 30 ft. bottom width, 60 ft. top width, one lock with chamber 250 ft. long, minimum depth of water over sills ten feet, gates 30 ft. wide, gate walls and foundation to be of reinforced concrete construction; also the construction of a dam across Taylor's Bayou approximately 160 ft. wide with 7 sections of drop gates of 20 ft. each. Detailed plans and specifications may be seen at the office of James F. Weed, Engineer, Beaumont, Tex.

Election will be held June 14 to vote on issuing $140,000 of bonds for the construction of a drainage system for Drainage District No. 7 of Harris County. J. S. Burk, 303 Commercial Bank Bldg., Houston, Tex., is the Engineer.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

WATER WORKS

Alabama.

The citizens of Roanoke, Ala., at a recent election voted the issuance of bonds in the sum of $20,000 for the purpose of rebuilding and enlarging the electric light and water works plant.

The citizens of Attalla, Ala., at a recent election decided to sell the waterworks plant of the city to the Alabama Power Co. About $20,000 will be spent in improving the system.

Arizona.

✣Bids will be received until 2 p. m., June 5, by Salt River Valley Water Users' Association, Phoenix, Ariz., for the construction of the Crosscut power plant building. A certified check for $3,000 must be filed with each bid.

California.

The City Council of San Diego, Calif., has authorized the department of finance to purchase without bids a pumping plant outfit to be installed at Chollas reservoir. The sum of $8,000 has been appropriated for the outfit. H. R. Fay is superintendent of water.

The Mutual Water Co., of Escondido, Calif., will probably bond the system in order to raise the dam to 100 ft. contour; $150,000 will be required. Other improvements are contemplated at an estimated cost of $25,000.

District of Columbia.

Bids as follows were received May 1 by the District Commission for furnishing 10,000 5/8-in. water meters: Neptune Meter Co., 90 West St., New York City, $8, Trident disc; National Meter Co., 84 Chambers St., New York City, $10; Pittsburgh Meter Co., East Pittsburgh, Pa., $4.90, type W.; H. R. Worthington, 115 Broadway, New York City, $5.25, model G, $5.85 model D, Worthington make, without couplings; Thompson Meter Co., Brooklyn, N. Y., $5.95 Lambert special, $6.95 Lambert regular; Thomas Somerville, Washington, D. C., $5, American meter; Hersey Mfg. Co., South Boston, Mass., $5, Hersey ,disc, model F, or $5.75 Hersey disc, model FF.

Georgia.

⊙The American-LaFrance Fire Engine Co., Elmira, N. Y., has been awarded the contract by the city of Atlanta, Ga., for furnishing one triple combination pump and hose and chemical car, at $9,000. Bids were opened May 6.

Illinois.

✣Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., until 11 a. m., May 15, for furnishing and delivering the labor, tools, etc., necessary in the removal and replacing of the boiler tubes in the boilers in the Springfield Ave. pumping station; the work includes the removal of back tube sheet, 112-3" boiler tubes and 28-3" stay tubes, and replacing same with one new back tube sheet, 112-3" seamless steel boiler tubes properly fitted and expanded in the tube sheets, also to furnish and place 28 seamless steel stay tubes. Cash or certified check for $100 must accompany proposal.

⊙The Board of Local Improvements, Oak Park, Ill., B. C. Bradstreet, Secretary, has awarded the contracts for furnishing and laying water service pipes, including brass taps, stop cocks and cast iron shut-off boxes, in Highland Av., Harrison St. to Jackson Blvd., to H. Breyer, Jr., 2125 Milwaukee Ave., Chicago, Ill.

⊙The following contracts for constructing water service pipes have been awarded by the Board of Local Improvements, Chicago, Ill.: Aberdeen St., 77th St. to 79th St., James J. Renn, 367 W. Chicago Ave.; Hutchinson St., 53rd Ave. to Milwaukee Ave., David Walsh, 6828 S. Chicago Ave.; Lowe Ave., 103rd St. to 104th St., David Walsh; South Park Ave., 71st St. to 75th St., Daniel Hardin, 3139 Indiana Ave. E. J. Glackin, Secy. of the Board.

⊙The Village Board of Riverside, Ill., on May 5 awarded a contract for the construction of a water works system, as follows: Steel tower, balcony and ornamental iron works for the water tower, to the Chicago Bridge & Iron Works, 105th & Throop Sts., Chicago, contract price $10,140; centrifugal pumping machinery, American Well Works, Aurora, Ill., contract price $1,950; piping work, etc., J. W. Castle, Riverside, Ill., contract price $2,735; electric works switchboard, wiring, etc., Riverside Electric Co., Riverside, Ill., contract price $1,941; building an extension to the masonry of the water tower, G. Hinchliff Co., 189 W. Madison St., Chicago, Ill., contract price $12,585. D. H. Henry, 1137 Monadnock Bldg., Chicago, Consulting Engineer.

A resolution has been introduced in the meeting of the City Council, East St. Louis, Ill., recommending a municipality-owned waterworks.

Indiana.

✣Bids will be received until 7:30 p. m., May 26, by Board of Trustees, Jasper, Ind., at the office of the Light & Water Department, for furnishing power plant apparatus for the municipal light and water plant of said town, according to plans and specifications on file in the office of the Clerk of said town, and at the office of the Consulting Engineer, Paul H. White, Union Trust Bldg., Indianapolis, Ind. The successful bidder will be required to give bond with surety to be approved by said Trustees, insuring the faithful completion of the said work according to the contract. Each bidder at the time of making his proposal shall deposit a certified check in the sum of 5 per cent of his bid price, drawn to the order of the clerk of the town of Jasper. J. A. Wuchner is clerk of the Board of Trustees.

The citizens of Yorktown, Ind., at a recent election decided to incorporate in order that it might provide more adequate fire protection, water and sewerage system and electric light.

⊙W. O. Newton has been awarded the contract by the city of Decatur, Ind., for the construction of a concrete reservoir, at $3,100. Bids were opened May 6.

Iowa.

✣Bids will be received until May 22 (readvertisement), by City Council, Cherokee, Ia., for the necessary labor and material for the construction of extensions to the waterworks system. W. Shardlow is City Clerk.

The City Council of Council Bluffs, Ia., has ordered the old lining of the Glen Ave. reservoir taken out and replaced with new lining of concrete 6 ins. deep, with reinforced network of special wire. The improvement will cost about $2 000.

The citizens of Hedrick, Ia., on May 12, it is reported, voted the issuance of bonds in the sum of $16,000 for the purpose of putting in a system of waterworks.

The Des Moines Water Co., C. S. Denman, General Manager, plans improvements and extensions to the system this year at an estimated cost of $75,000.

The Board of Waterworks Trustees of Waterloo, Ia., has been requested to supply Prospect Hills with city water. This would require 6,000 ft. of mains. J. P. Berry is superintendent. The Board has ordered approximately 3,000 ft. of new mains in various streets on the west side of Waterloo.

Kentucky.

✣Bids will be received until 2 p. m., June 4, by Commissioner of Fisheries, Department of Commerce, Washington, D. C., for the construction of two pump houses at the Louisville, Ky., fisheries station.

Louisiana.

An election will be held in Shreveport, La., during the summer for the purpose of deciding whether or not the city is to take over the plant of the Shreveport Water Works Co. A board of engineers is at work appraising the plant.

Maryland.

✣Bids will be received until 11 a. m., June 4, by the Board of Awards, Baltimore, Md., for the construction of 32 mechanical filter tanks, two coagulating basins and appurtenances, as shown on plans on file in the office of E. B. Whitman, Water Engineer, City Hall, Baltimore, Md. The extent of the work is as follows: Excavation approximated, 110,000 cu. yds. Two coagulating basins, capacity each, 3,500,000 gals. One mixing chamber, capacity of 3,000,000 gals. Thirty-two mechanical filter tanks, four million gals. daily capacity, with complete equipment. Filtered water basins with capacity of 2,300,000. Two earthen dams built from excavated materials. Official advertisement will be found elsewhere in this issue.

The Board of Awards of Baltimore, Md., on May 7 rejected all bids for the contract for building the filtration plant at Lake Montebello. The bids were as follows: Keystone State Construction Co., Philadelphia, $971,187; New York Continental Jewel Filtration Co., $982,263; Oscar Daniels Co., New York City, $1,016,526. New specifications are to be prepared by the Water Department, Ezra B. Whitman, Engineer, and the work will be divided into two or more contracts.

Consulting Engineer Alfred M. Quick, Baltimore, Md., has recommended to the City Commission of Wililamsport, Md., the Haw spring, located on the Robert Farmer lands, one-half mile from Williamsport, as the best source of supply. It is also recommended that the water from the spring be piped to the Old Van Lear mill and a 100,000-gal. reservoir built at the site.

Minnesota.

✣Bids will be received until June 3, by city of Eveleth, Minn., for furnishing and installing a 1,000,000-gal. pump, either electric or steam driven, data for which may be obtained of D. P. McIntyre, City Clerk. Bids will also be taken for furnishing and installing one 10-in. meter.

Missouri.

✣Bids will be received until May 27 (readvertisement), by Board of Public Improvements, St. Louis, Mo., for furnishing all tools, material and labor for the construction and completion of an intake tower, tunnel and screen chamber at the Chain of Rocks. Plans, specifications and other information can be had at the offices of the Board of Public Improvements and the Water Commissioner. C. A. Cheney is Secretary of the Water Department.

⊙G. Gaeger, of Rich Hill, Mo., has been awarded the contract by the Town Council of Broad Oaks, W. Va., for the installation of a waterworks and a sewerage system for $18,000. The contract calls for 3½ miles of water line.

Nebraska.

The City Council of Bennington, Nebr., has decided to install a waterworks system.

New Mexico.

⊙The Deming Electric Supply Co., Deming, N. Mex., has been awarded the contract for furnishing one motor at Fort Bayard, N. Mex., for $487. The Moloney Electric Co., St. Louis, Mo., will furnish three transformers, at $270. Bids were opened April 4.

New Jersey.

✣Bids will be received until 3 p. m., May 23, by Board of Finance, Jersey City, N. J., for furnishing one triple combination pump-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ing engine and hose motor car, capacity of pump not less than 900 gals. per minute; and one 75-ft. gasoline four-wheel drive and steer motor aerial truck. Engine to be delivered in Jersey City within 90 days and truck within 120 days from the date of award of contract. Each bidder will furnish his own specifications. Richard J. Vreeland is Clerk.

The borough of Hawthorne, N. J., has secured an option on a piece of property for the proposed site of the pumping station and the resrevoir. Arthur Rhodes is Commissioner.

New York.

✣Bids will be received until May 14 by City of Lockport, N. Y., for the construction of 3½ miles of 12-in. cast iron water mains. Julius F. Frehser, Lockport, N. Y., is Engineer.

The New York State Conservation Commission, Albany, has granted permission to the Albion Waterworks Co. to install its proposed additional water supply by erecting an 18-ft. high dam in Otter Creek, in Eagle harbor gully; to install a filtration plant in accordance with maps, surveys and plans submitted Sept. 11, 1912.

The citizens of Mount Morris, N. Y., at a recent special election voted to purchase the Mills waterworks for $50,000 and improve it at a cost of $25,000.

The city of Ithaca, N. Y., will lay 8,350 ft. of 6-in. water mains by day labor; also 8,100 ft. of 6-in., 250 ft. of 4-in., and 36 specials. Martin Conlon is superintendent.

Ohio.

✣Bids will be received until noon, May 27, by W. H. Kirby, Secretary to the Director of Public Service, Cleveland, O., for boilers for the water department. Specifications are on file with the Superintendent of the Water Department.

✣Bids will be received until noon, May 23, by R. M. Pillmore, Director of Public Service, Akron, O., for furnishing and erecting pumping machinery. Alternate bids will be received as follows: For one vertical triple expansion pumping engine of a capacity of 15,000,000 gals. per 23 hours. For two turbine-driven centrifugal pumping units each of capacity of 15,000,000 gals. per 24 hours. Contract will be awarded for one of the above types of apparatus. Bids must be accompanied by satisfactory bond or certified check in the sum of $5,000 as security for the execution of the contract.

✣Bids will be received until noon, May 20, by W. H. Kirby, secretary to the Director of Public Service, Cleveland, O., for hoisting engine for the Water Department. Specifications are on file with the Superintendent of the Water Department.

✣Bids will be received until noon (central standard time), June 10, by H. Canfield, Clerk of the village of Cleveland Heights, 309 Beckman Bldg., Cleveland, O., for furnishing the labor and material for the construction of an 8-in. water pipe in Yellowstone road, from Mayfield road to Noble road. Plans and specifications are on file with the Clerk and with F. A. Pease Engineering Co., Marshall Bldg., Cleveland, O.

✣Bids will be received until noon, May 20, by W. H. Kirby, secretary of the Director of Public Service, Cleveland, O., for shaper, radial drill and pipe threading machine for the Water Department. Specification may be obtained of the Superintendent of the Water Department.

⊙The Platt Iron Works, Dayton, O., has been awarded the contract by the City Council of Valdosta, Ga., for furnishing a cross compound Corliss condensing pumping engine with a capacity of 3,000,000 gals. every 24 hours, for $8,241.

Engineer W. H. Dittoe of the State Board of Health recently consulted with the officials of Pleasant City, O., relative to the proposed installation of a waterworks plant.

An election will be held in Norwood, O., on June 17 for the purpose of voting on a bond issue of $105,000 for the making of extensions to the waterworks, and $35,000 for the installation of a water-softening system.

Oklahoma.

✣Bids will be received until 8 p. m., May 19, by the town of Hinton, Okla., for furnishing all tools, labor and materials for the construction of waterworks and electric lighting systems. Plans and specifications can be obtained upon payment of $5 at the office of the Benham Engineering Co., Consulting and Supervising Engineers, 435-37 American National Bank Bldg., Oklahoma City, Okla.

The Atchison, Topeka & Santa Fe R. R. has purchased a 70-acre tract of land east of Guthrie, Okla., which is to be converted into a reservoir. A dam will be built.

The town of Coleman, Johnston County, Okla., is considering a proposition for a waterworks system, with deep wells as the source of supply.

Pennsylvania.

✣Plans for the new reinforced concrete settling basin for the city water supply of Danville, Pa., which were prepared by Chester & Fleming, Hydraulic Engineers, Pittsburgh, Pa., have been approved by the State Board of Health and bids for same will be received May 20. This basin will be used in connection with the filter plant.

✣Bids will be received until May 20, by Board of Managers, Pennsylvania Training School, Morganza, Pa., for the construction of a waterworks dam according to plans prepared by R. Winthrop, Pratt, Consulting Engineer, Cleveland, O. W. F. Penn, Morganza, Pa., is Superintendent.

The Delaware, Lackawanna & Western R. R. has acquired land on Tunkhannock Creek for the purpose of setting up a water plant to supply its collieries and shops and locomotives with water, at Scranton, Pa. E. M. Rine, Scranton, is General Superintendent.

The Pennsylvania State Water Supply Commission, Harrisburg, has approved applications for charters for five water and power companies in Lancaster County under the following names: Lancaster County Water & Power, for the county; Buchanan, for Lancaster Township; Lafayette, for Pequea Township; Hamilton, for Manor Township, and Stevens, for Conestoga Township. The commissioners also approved these applications: Hershey Water Company, for the supply of water to the public in the towns of Hershey, Hockersville and Swatara, Derry Township, Dauphin County; Castanea Water Company, Castanea Township, Clinton County; Woodward Township Water Co., Woodward Township, Clinton County; Flemington Water Co., Flemington Borough, Clinton County; Bald Eagle Township Water Co., Bald Eagle Township, Clinton County.

The Sunbury Water Co., Sunbury, Pa., has made arrangements to make a number of extensive improvements at the No. 2 pumping station on Front St., south of the Reading railroad station.

Rhode Island.

✣Bids will be received until 2:15 p. m., May 21, by Board of Contract & Supply, Providence, R. I., for a 30,000,000-gal. pumping plant at Pettaconset Pumping Station, Cranston, R. I. Bids will be received for: (a) For a high duty steam engine and plunger pumps, with boilers; (b) For electric motor-driven centrifugal pumps; (c) For steam turbine-driven centrifugal pumps, with boilers. Terms and requirements for bidding and plans and specifications may be procured at the office of the City Engineer, City Hall. Wm. C. Pelkey is Clerk.

A resolution was introduced in a recent meeting of the Common Council of Central Falls, R. I., to make an appropriation for the improvement of the filtration plant. The estimated cost is placed at $10,000.

The present owners of the waterworks plant at Bristol, R. I., have offered to sell their holdings to the town for a consideration of $713,125. James J. Walsh is chairman of the water rates committee.

South Dakota.

✣The Town Board of Carter, S. Dak., has had plans prepared for the installation of a new waterworks system at an estimated cost of $9,500. The water supply will be secured from well and dam. The work will include a steel tank. Contracts will be let May 27. J. R. Martin is Town Clerk.

Tennessee.

The Nashville Machine Co., at $35,389, submitted the lowest bid to the Board of Public Works of that city, for the delivery and installation of the 1,500-kilowatt turbine for the city power plant. The company also submitted the lowest bid for the 900-kilowatt turbine, at $9,889.

The citizens of Henderson, Tenn., have voted to issue bonds in the sum of $50,000 for the construction of a waterworks system.

Texas.

The Edna Electric Light, Ice and Water Co., of Edna, Jackson County, Tex., has been incorporated with a capital stock of $20,000. The incorporators are: L. E. Ward, Rudolph Linmartz and W. W. McCreary.

A number of citizens of Cooper, Tex., plan to form a stock company for the purpose of installing a waterworks system. The estimated cost is $50,000. R. J. Thomas is interested.

Utah.

City Engineer Sylvester Q. Cannon, of Salt Lake City, Utah, has begun an extensive investigation into the ways and means of securing for the city an increased yater supply system.

City Engineer Sylvest Q. Cannon, of Salt Lake City, Utah, has completed plans for dams at Lake Phoebe, at Big Cottonwood canyon, for imponnding the waters of that lake and twin lakes and of storing 318,000,000 gals. of water.

Vermont.

At the annual village meeting in Essex Junction, Vt., it was voted to extend the water system along South and West Sts., and to increase and enlarge the water system and water supply of the village. Bonds to the amount of $10,000 will be issued for the improvements.

Washington.

⊙Nels Erickson, Seattle, Wash., has been awarded the contract by the Board of Public Works of that city, for the construction of water mains on Boyer Ave., for $22,230, and for water mains on Mercer St., for $3,169. T. Ryan secured the contract to lay water mains at $11,064, and the Washington Construction Co. will install mains in W. 63d St., for $15,032.

An ordinance has been passed by the City Council of Puyallup, Wash., to submit to a vote a proposed bond issue of $100,000 to be used to install a new water main from Salmon Springs to the city. It is proposed to lay an 18-in. iron main in place of the present wooden main.

Wisconsin.

✣Bids will be received until 10:30 a. m., May 19, by Department of Public Works, Milwaukee, Wis., for furnishing and delivering to the city of Milwaukee, for the use of its water department, at the city pipe yard, corner of Florida and Clinton streets, 125 6-in., 30 8-in., 20 12-in. and 4 16-in. Standard valves, and 50 2-in., 30 3-in., 50 4-in. and 6 6-in. Special valves according to plans and specifications on file in the office of the department.

Canada.

⊙The National Meter Co., Chicago, Ill., has been awarded the contract by the Board of Control of Winnipeg, Man., M. Peterson, Secy., for furnishing 2,500 ½-in. meters, at $11.75 each, and 100 1-in. meters at $29.25. Bids were opened April 28.

SEWERAGE AND SANITATION

Alabama.

✣Bids will be received until June 3, by City of Birmingham, Ala., for the construction complete of an extension of South Side trunk sewers. Plans and specifications are on file with Walter G. Kirkpatrick, City Engineer, and can be had for $2.50. A certified check for $1,000 must be filed with each bid.

The town of Capitol Heights, Ala., F. S. Laseter, Mayor, plans the expenditure of about $50,000 on the improvement of municipal property. Sidewalks, curbing, storm sewerage and gravel streets will be put in.

The citizens of Roanoke, Ala., at a recent election voted the issuance of bonds to the amount of $20,000 for the purpose of installing a sewerage system.

California.

⊙The City Council of San Diego, Cal., has awarded the contract to construct the proposed Pound canyon sewer through Balboa Park to the Engineering & Contracting Co. for $37,093.

The City Trustees of Huntington Beach, Cal., have submitted the plans for the proposed sewerage system to Consulting Engineer Thomas James. The plans call for an extension of 1,000 ft. into the ocean, at a depth of 10 ft. The estimated cost is $46,000.

The City Council of San Bernardino, Cal., will ask for bids immediately for the construction of the northwest sewer system, which will cost about $30,000.

A sewer system is planned to be installed for the benefit of the business section of Quincy, Cal. It is a private project, the expense to be borne by the properties that will be benefited by it. J. W. Larison is interested.

Florida.

⊙The City Council of Orlando, Fla., has awarded the contract for the construction of a system of sewers in that city to F. D. Harvey & Co. of Atlanta, Ga., for $77,904. Hamilton Johnson, Jackson, Miss., secured the contract for the septic tanks at $22,691. The Ohio Well Drilling Co. of Jacksonville, Fla., will sink the three wells for the disposal plant at $3,530.

Illinois.

⊙The following contracts for constructing sewers have been awarded by the Board of Local Improvements, Chicago, Ill.: Alley north of Garfield Blvd., Marshfield Ave. to Paulina St., 335 lin. ft. 9-in. tile pipe, Carmine Roberts, 1227 Gilpin Pl.; 45th Ave., Grace St. to 235 ft. north, 260 lin. ft. 12-in. tile pipe, $325, G. Pontorelli, 903 Forquer St.; Gage Pl., 55th St. to 54th St., 470 lin. ft. 12-in. tile pipe, Campbell Ave to 55th St., 290 ft. south, 330 lin. ft. 12-in. tile pipe, $1,104, G. Pontorelli; 103d Pl., Wentworth Ave. to Princeton Ave., 665 lin. ft. 15-in. tile pipe, 103d Pl., Princeton Ave. to Harvard Ave., 455 lin. ft., 12-in tile pipe, $1,634.50, S. Ryan, 9227 Congress St.; 43d Ave. North Ave. to Le Moyne St., 670 lin. ft. 15-in tile pipe, 53d Ave., Le Moyne St. to Hirsch St., 670 lin. ft. 12-in. tile pipe, $1,876, G. Pontorelli; Cornelia Ave. 50th Ave. to 635 ft. east, 670 lin. ft. 15-in. tile pipe, Cornelia Ave., 635 ft. east of 50th Ave. to 150 ft. west of 48th Ave.,) 500 lin. ft. 12-in. tile pipe, $1,585, S. Ryan; Rockwell St., 59th St. to 58th St., 670 lin. ft. 15-in. tile pipe, Rockwell St., 58th St. to 57th St., 670 lin. ft. 12-in. tile pipe, $1,929.60, P. J. McNulty Co., 4345 Prairie Ave.; Centre Ave., 99th St. to 100th St., 670 lin. ft. 18-in. double strength tile pipe Centre Ave., 100th St. to 101st St., 670 lin. ft. 15-in. tile pipe, Centre Ave., 101st St. to 102d St., 670 lin. ft. 12-in. tile pipe, $3,002, S. Ryan; Eddy St., 50th Ave: to 635 ft. east of 50th Ave., 670 lin. ft. 15-in. tile pipe 635 ft. east of 50th Ave. to 110 ft. west of 48th Ave., 500 lin. ft. 12-in. tile pipe, $1,584; S. Ryan; 48th Ave., Belmont Ave. to 638 ft. south of Belmont Ave. 670 lin. ft. 20-in. double strength tile pipe, 48th Ave., 630 ft. south of Belmont Ave. to 1,300 ft. south of Belmont Ave., 670 lin. ft. 15-in. tile pipe, $2345, The Ryan Co. 10 S. La Salle St.; 48th Ave., Belmont Ave. to School St., 670 lin. ft. 18-in. double strength tile pipe; 48th Ave., School St. to Roscoe St., 670 lin. ft., 15-in. tile pipe, $2,318; Ryan Co.; State St., 95th St. to 94th St., 670 lin. ft. 18-in. double strength tile pipe, State St., 94th St. to 93d St., 670 lin. ft. 15-in. tile pipe, State St., 93d St. to 92d St., 670 lin. ft. 12-in. tile pipe, 300 lin. ft. wing sewers, 12-in. tile pipe, $4,805, G. Pontorelli; Diversey Ave., 40th Ave. to 44th Ave., 2,700 lin. ft. 6-ft. brick sewer, double ring; Diversey Ave., 44th Ave. to 48th Ave., 2,680 lin. ft. 5½ ft. brick sewer, double ring; Diversey Ave., 48th Ave. to 52d Ave., 2,680 lin. ft. 5-ft. brick sewer, double ring; Diversey Ave., 52d Ave. to 56th Ave., 2,720 lin. ft. 4¾ ft. brick sewer, double ring; 48th Ave., Wrightwood Ave. to Wellington St., 2,660 lin. ft. 2½-ft. brick sewer, double invert, $81,779, Ryan Co. The work includes construction of manholes and catch basins. E. J. Glackin, Secretary of the Board.

⊙The following contracts for constructing house drains have been awarded by the Board of Local Improvements, Chicago, Ill.: Aberdeen St., 77th St. to 79th St., 3,000 lin. ft., 48 cts. per lin ft., De Vito & Tiritilli, 600 De Koven St.; Hutchinson St., 52d Ave. to 53d Ave., 700 lin. ft., 30 cts., Angelo Mancini, 902 W. Taylor St.; Yates Ave., 67th St. to 71st St., 500 lin. ft., 60 cts. per lin. ft., Louis Scully, E. J. Glackin, Secretary of the Board.

⊙The City Council of Springfield, Ill., has awarded the contract for the erection of two incinerator units to C. E. Hunter & Co. of Springfield at $2,500 per unit.

⊙The Board of Local Improvements of Belleville, Ill., has awarded the contract for the Silver St. sewer to Hoeffken Bros. of that city for $2,326.

⊙The Board of Local Improvements, Chicago, Ill., has awarded the following contracts for the construction of sewers to J. W. Farley, La Grange, Ill.: S. Albany Ave., Chicago River to W. 30th St., 610 lin. ft. 9-ft. brick sewer, 3-ring; W. 30th St., S. Albany Ave. to S. Troy St., 310 lin. ft. 9-ft. brick sewer, 3-ring; Troy St., 30th St. to 26th St., 1,990 lin. ft. 9-ft. brick sewer, 3-ring; 26th St., Troy St. to Turner Ave., 1,360 lin. ft. 9-ft. brick sewer, 3-ring; Turner Ave., 26th St. to 22d St., 2,600 lin. ft. 9-ft. brick sewer, 3-ring; Turner Ave., 22d St. to 16th St., 2,710 lin. ft. 8-ft. brick sewer, 3-ring; 16th St., Turner Ave. to Spaulding Ave., 310 lin. ft. 8-ft brick sewer, 3-ring; Spaulding Ave., 16th St. to 13th St., 1,960 lin. ft. 7½-ft. brick sewer, 3-ring; Spaulding Ave., 13th St. to Polk St., 2,330 lin. ft. 7-ft. brick sewer, 3-ring; Polk St., Spaulding Ave. to Homan Ave., 670 lin. ft. 7-ft. brick sewer, 3-ring; Homan Ave., Polk St. to first alley north, 160 lin. ft. 7-ft. brick sewer, 3-ring; Homan Ave., Van Buren St. to Colorado Ave., 580 lin. ft. 6-ft. brick sewer, 2-ring; Homan Ave., Colorado Ave. to Monroe St., 950 lin. ft. 4-ft. brick sewer, 2-ring; Monroe St., Homan Ave. to Central Park Ave., 1,320 lin. ft. 4-ft. brick sewer, 2-ring; Colorado Ave., Homan Ave. to Kedzie Ave., 1,460 lin. ft. 5½-ft. brick sewer, 2-ring; Van Buren St., Homan Ave. to Central Park Ave., 1,370 lin. ft. 4-ft. brick sewer, 2-ring; alley north of Polk St., Homan Ave. to Central Park Ave., 1,360 lin. ft. 4-ft. brick sewer, 2-ring; 13th St., Spaulding Ave. to Homan Ave., 670 lin. ft. 4½-ft. brick sewer, 2-ring; Homan Ave., 13th St. to first alley north of 13th Pl., 55 lin. ft. 4½ft. brick sewer, 2-ring; alley north of W. 13th Pl., Homan Ave. to Central Park Ave., 1,320 lin. ft., 4½-ft. brick sewer, 2-ring; 16th St., Turner Ave. to Central Park Ave, 1,710 lin. ft. 4½-ft. brick sewer, 2-ring; 16th St., Spaulding Ave. to Kedzie Ave., 710 lin. ft. 4-ft. brick sewer, 2-ring; brick wing sewers, 65 lin. ft., 6-ft., 2-ring; 25 lin. ft. 3-ft., 2-ring; tile pipe wing sewers, 30 lin. ft. 2½-ft. double strength tile pipe, 30 lin. ft. 2-ft. double strength, 30 lin. ft. 2¼-ft. double strength, 300 lin. ft. 20-in. double strength 240 lin. ft. 18-in. double strength, 660 lin. ft. 15-in., 940 lin. ft. 12-in., 1 concrete bulkhead, 225 manholes, 20 catch basins; total, $438,623.25. E. J. Glackin, Secretary of the Board.

⊙The Board of Control of Fulton, Ill., has awarded the contract for furnishing the labor and material for the construction of the proposed sewerage system to Kelly Bros., Morrison, Ill., at the following bid: For 30-in. sewer pipe, 1,183 ft., at $2.83 a ft., $3,349; for 20-in. pipe, 1,367.12 ft., at $1.40 a ft., $1,913; for 18-in. pipe, 1,520.7 ft., at 95 cts. a ft., $1,444; for 15-in. pipe, 4,434 ft., at 87 cts. a ft., $3,857; for 12-in. pipe, 9,239.9 ft., at 79 cts. a ft., $7,299; for 10-in. pipe, 2,583.3 ft., at 65 cts. a ft., $1,679; for 8-in. pipe, 2,834.4 ft., at 51 cts. a ft., $1,445; for 8-in. pipe, catch-basin connections, 1,886 ft., at 30 cts. a ft., $565; for 71 man-holes at $40 each, $2,840; for 46 catch-basins at $40 each, $1,840; for 39 lampholes at $5 each, $195; excavating 446 cu. yds. of rock excavation at $3 a yard, $1,338; concrete bulk head, 32 cu. yds., at $7 a yard, $224; four flush tanks, $280; rip-rapping, 25.4 cu. yds., $25.40. The aggregate cost of the completed sewer system will be $28,297.

Indiana.

⊙August Schneider has been awarded the contracts by the Board of Public Works of Michigan City, Ind., for the construction of a sewer in Sixth St., from Willard Ave. to the west line of Orr and DeWolfe's addition, and for a sewer in Sixth St., from the east line of Willard Ave. to a point 60 ft. east of the west line of lot 4, Blair's addition.

Plans have been prepared by Engineer John E. Anderson of Mt. Vernon, Ind., for the construction of new sewers in that city at an estimated cost of $12,000. The work includes brick, segmentel block and concrete in specifications. Contracts will be let about June 1.

The Board of Public Works of Marion, Ind., has adopted a resolution calling for the construction of the combined storm and sanitary sewer for West Marion.

It is reported that the City Council of Seymour, Ind., has retained the W. J. Sherman Co., the Nasby, Toledo, O., to prepare plans and specifications for a complete sewerage system for Seymour.

Iowa.

✣Bids will be received until 8 p. m., May 15, by J. J. Shea, City Recorder, Dubuque, Ia., for the construction of an 8-in. tile pipe sanitary sewer in 22d St., from the alley between Washington and Jackson Sts. to the westerly line of Elm St., in accordance with plans and specifications on file with the Recorder. The work will include about 327 lin. ft. of tile and 2 man-holes.

⊙R. J. Hamilton, Carroll, Ia., has been awarded the contract by that city for the construction of sanitary sewers for 18,523. The work includes 15,090 ft. of 8-in. sewers, 3,230 ft. of 6-in. sewers, 25 man-holes, 12 combined man-holes and flush tanks and 6 lamp holes. Bids were opened May 5.

⊙The City Council of Fort Dodge, Ia., has let the contract for the sanitary sewers in Districts Nos. 1 and 2 to C. O. Peterson and Claus Kling, respectively. The former's bid was 90 cts. per lin. ft. for 8-in. main pipes, 40 cts. for 6-in. house connections, 50 cts. for 6-in. standpipes and $40 for man-holes. The latter's bid was $2,411.

⊙Ette & Prasse, Keokuk, Ia., have been awarded the contract by that city for the reconstruction of sanitary sewer No. 1, at the following prices: Earth excavation, $2.50 per cu. yd.; rock excavation, $5 per cu. yd.; 4-in. inlets on 10-in. pipe, 24-in. length, $55 each; 4-in. inlets on 8-in. pipe, 24-in. lengths, $0.42 each; 10-in. sewer pipe in place, $0.40 per lin.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ft.; 8-in. sewer pipe in place. $0.35 per lin. ft.; inspection pipe, $27 each.

⊙C. O. Peluson & Claus A. Kling, Fort Dodge, Ia., have been awarded the contract by that city for the construction of sanitary sewers. Bids were opened April 28.

⊙D. E. Keeler Co., Surety Bldg., Davenport, Ia., has been awarded the contract by the Board of Public Works of that city for constructing the 13th district sewer, at $67,757. Bids were opened May 3.

⊙The Ideal Heating & Construction Co., 320 West Third St., Davenport, Ia., has been awarded the contract by that city, A. M. Compton, Commissioner, for the construction of a sewer in Davenport Ave., at $1.03 per ft., including manholes. Bids were opened May 6.

The Commercial Club of Council Bluffs, Ia., advocates the installation of an incinerator or garbage disposal plant. T. D. Metcalf is President.

Kansas.

✣The City Commissioners of Dodge City, Kans., have approved plans of Fred Eckert, Larned, Kans., for the construction of sanitary sewer and outlet system in Dodge City, at an estimated cost of $13,000, aside from laterals. The work will include 3,000 ft. of 4-in. pipe, 9,000 ft. of 8-in., 4,610 ft. of 10-in., 1,690 ft. of 12-in., 3,275 ft. of 18-in., 48 manholes, 5 flush tanks and about 8,500 cu. yds. of excavation. Bids on the work will be received until May 29. H. B. Bell is Mayor.

⊙The City Council of McPherson, Kan., has awarded the contract to construct the Imhoff sewerage tank to Everett & Burt of Hutchinson, Kan., for $1,785.

Louisiana.

The citizens of Baton Rouge, La., will vote this month on the issuance of bonds in the sum of $40,000 for sewerage extension, $20,000 for drainage and $90,000 for street paving.

Massachusetts.

The committee on roads, bridges and sewers has recommended to the City Council, New Bedford, Mass., that a $20,000 sewer system be placed in the extreme northwest section of the city.

Minnesota.

✣Bids will be received until 8 p. m., May 23, by City of Austin, Minn., for constructing 3,240 lin. ft. of 10, 12 and 15-in. pipe sewers. Oscar F. Weissgerber, City Engineer. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 3 p. m., May 15, by H. E. Weiss, Village Recorder, Zumbrota, Minn., for the construction of sewers and water mains.

✣Bids will be received until 8:30 p. m., May 27, by Village Council, Blackduck, Minn., for the construction of an Imhoff tank in accordance with plans and specifications on file with D. D. Rolfe, Village Recorder.

Missouri.

✣Bids will be received until noon, May 23, by Board of Public Improvements, St. Louis, Mo., for the construction of sewers in Rock Creek Sewer District No. 2. Plans and specifications are on file at the office of the Board and with the Sewer Commissioner.

⊙G. Gaeger of Rich Hill, Mo., has been awarded the contract by the Town Council of Broad Oaks, W. Va., for the construction of a water and sewerage system for approximately $18,000. The contract calls for the laying of 3½ miles of water line and 2½ miles of sewerage.

Montana.

✣Bids will be received until 8 p. m., May 15, by City Clerk J. A. Mattson, Helena, Mont., for the construction of a sanitary sewer in Sanders St.

New York.

✣Bids will be received until 7:30 p. m., May 19, by Thomas Troy, Superintendent of Streets, Olean, N. Y., for the construction of an 8-in. sewer in Davis Ave., from Orchard Ave. to Eastman Ave. Plans and specifications may be examined, bid blanks procured and further information may be obtained at the office of the City Engineer, City Building, Olean, N. Y.

⊙The Board of Public Works of Oneida, N. Y., has awarded the contracts for the construction of sewers on two streets to Nixdorf & Besenza, as follows: Cedar St., $1,554; Mott St., $1,163.

⊙E. J. & R. J. Dandignac have been awarded the contracts at West New Brighton, N. Y., for the construction of three sewers at $6,905. Joseph Johnson & Sons secured one contract at $2,339.

⊙Cecce & Green have been awarded the contract by the Board of Public Works of Corning, N. Y., for the construction of 3,759 ft. of new sanitary sewers during the coming summer for $2,405.

⊙The Board of Estimate and Apportionment of Middletown, N. Y., has awarded a contract to F. L. Hammond of Newburgh to furnish 11,400 ft. of 20-in. sewer pipe for the East Side trunk sewer at 58½ cts. per foot, f. o. b. Middletown.

⊙The City Council of Johnstown, N. Y., has let the contracts for the construction of the laterals to the Thyneville sewer, with the exception of that in South Perry St., to A. M. Banker.

⊙The Board of Contract and Supply of Binghamton, N. Y., has awarded the contract for the construction of a sewer in West End Ave. to George Pignatello at $3,000, and to George Serifina for a sewer in Broad Ave. for $5,896.

⊙William Crovello, Mott Ave., Far Rockaway, L. I., has been awarded the contract by that city for the sewering of Remsen Ave. for $23,550. The sewer will extend from Leland Pl. to McNeil Ave.

North Dakota.

✣Bids will be received until May 19 by City Commissioners, Minot, N. Dak., for the construction of a storm sewer system covering the business district.

Ohio.

✣Bids will be received until noon, May 16, by V. T. Price, Director of Public Service, Cincinnati, O., for the construction of main and lateral sewers and drains with their appurtenances in Sturgis Ave. Plans and specifications are on file with the Chief Engineer of the Department of Public Service. M. J. Keefe is Secretary.

✣Bids will be received until noon, May 22, by C. C. Lowe, Clerk of the Village of Bedford, O., for furnishing the necessary labor and materials for constructing a sewage disposal plant. Specifications may be procured at the office of said Clerk, or at the office of C. W. Courtney and Wilbur J. Watson, Engineers, 1150 Leader-News Bldg., Cleveland.

⊙Dan B. Smith, Delaware, O., has been awarded the contract by that city for the construction of sanitary sewers for $3,300. The work includes 2,600 lin. ft. of 8-in. pipe, 1,100 ft. of 5-in. pipe, 60 ft. of 8-in. iron pipe, 63 Y's, six manholes, one flush tank, 1,100 lin. ft. of 2-in. gal. iron pipe. Bids were opened May 6.

⊙Sieverling & Fairbairn, Springfield, O., have been awarded the contract by the village of Idlewood, O., care of the Pease Engineering Co., Marshall Bldg., Cleveland, O., for the construction of storm sewers on 11 streets, at $39,423. Bids were opened May 6.

⊙Taylor & Chambers, Genoa, O., have been awarded the contract at Delaware, Ohio for the construction of sanitary sewers at $6,900. The work includes 3,500 lin. ft. of 8-in. sewer, 6,000 ft. of 5-in. sewer, 100 Y's, 10 manholes, and one flush tank. Bids were opened May 6.

Pennsylvania.

✣Bids will be received until 5 p. m., May 19, by J. C. Armstrong, Borough Clerk, 23 Locust St., Etna, Pa., for the construction of a sanitary sewer in Prospect St., Etna, Pa. A certified check for $100 must be filed with each bid. Plans and specifications are on file with the Borough Clerk.

✣Bids will be received until 2 p. m., May 28, by Samuel G. Dixon, M. D., Commissioner of Health, Harrisburg, Pa., for the construction of a sewer system and sewage disposal plant and for water works system for the Pennsylvania State Sanatorium for Tuberculosis, near Hamburg, Berks County, Pa. Plans and specifications may be obtained at either the Harrisburg office or the Philadelphia office (1900 Race St.) of the Pennsylvania Department of Health, by depositing $25, which will be returned upon receipt of same in good condition.

✣Bids will be received until 10 a. m., May 23, by City Controller, Pittsburg, Pa., for the construction of sewers in Hamilton Ave., from point about 20 ft. west of Enterprise St., to present sewer on Lambert St., 9 and 15-in. pipe; Hamilton Ave., from point about 25 ft. east of Julius St., to present sewer on Fifth Ave., 9 and 15-in. pipe.

✣Bids will be received until 1:30 p. m., May 27, by Frank Seasholtz, Chairman, Sewer Committee, Pottstown, Pa., for the construction of Section A of a complete system of sanitary sewers comprising 13.5 miles of 6 to 30-in. pipe. Charles E. Collins, Drexel Bldg., Philadelphia, Pa., is Engineer.

⊙D. J. Madigan, J. P. Gilson and Phillips & George have been awarded contracts by the borough of North Braddock, Pa., Geo. F. Siefers, Engineer, for the construction of sewers on Center St., Shaver Al., Grandview Ave., South St., Baldridge Ave., Beech Ave., Weiler Ave., Bell Ave., Bessemer St., Curry St., etc., for $8,102. Bids were opened May 2.

⊙John Pape & Co. have been awarded the contract at New Castle, Pa., for the construction of the Martin St. sanitary sewer for $1,044, and for the Finch St. storm sewer at $308.

South Dakota.

⊙The Stover Construction Co., Watertown, S. Dak., has been awarded the contract by the City Commission of that city for the construction of No. 1 sewer, consisting of two blocks on First Ave. S. for $1,021. Hess & Rau, Watertown, secured the contract for sewer No. 2, consisting of one block on First Ave. N., and also for the installation of the catch-basins and inlets, at $845.

Washington.

⊙V. Ramaglia has been awarded the contract by the Board of Public Works of Seattle, Wash., for the construction of sewers on 44th Ave. S. W., et al., for $10,103.

Wisconsin.

✣Bids will be received until 2 p. m., May 22 (readvertisement), by F. W. Gillman, City Clerk, Evansvile, Wis., for the laying of 6,198 ft., more or less, of sanitary sewer in the City of Evansville, Rock County, Wis.; certified check amounting to $500 to accompany bid. Plans and specifications on file in the City Clerk's office.

⊙Peter Rasmussen has been awarded the contract by the Board of Public Works of Racine, Wis., for the laying of a sewer on Hartmann's court at 75 cts. per lin. ft.

Canada.

✣Bids will be received until May 20 (extension of date) by John Allan Chairmen Board of Control, Hamilton, Ont., for the construction of reinforced concrete sewage tanks, conduits, sludge drying beds, pile foundations and all other structures required for the complete erection of the west end sewage disposal plant. Plans, specifications and form of tender may be obtained from the City Engineer, Hamilton, Ont., upon receipt of $10, which amount will be refunded on return of the plans in good condition.

⊙Dominion Construction Co., Winnipeg, Man., has been awarded the contract by the municipality of Assiniboia, Kirkfield Park P. O., Man., for the construction of a sewer in Douglas Park, St. James, at $5,999. The work includes sewer and work in connection with water system, the contract for which was let to Donagh & Ingraham of Winnipeg, for $3,775. Bods were opened May 6.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

BUILDINGS

California.

⊙M. M. Finlayson, 2429 Vallejo St., San Francisco, Cal., has been awarded the contract at $196,892 for constructing the Academic building, Polytechnic high school, for the city of San Francisco. The work covers steel frame, plumbing, electric work, heating and ventilating and miscellaneous extras. Bids were opened April 30.

District of Columbia.

✣Bids will be received until 2 p. m., May 19, by Maj. W. J. Barden, U. S. Engineer, Washington Barracks, D. C., for furnishing two motor-driven ventilating sets.

⊙George E. Wyne, Washington, D. C., has been awarded the contract at $88,900 for constructing an engineer school building at Washington Barracks, D. C.

Florida.

✣Bids will be received until 11 a. m., June 7, by Bureau of Yards and Docks, Navy Department, Washington, D. C., for a marine officers' quarters at the Key West, Fla., naval station. The amount available for the work is $8,000.

Hawaii.

✣Bids will be received until 11 a. m., June 28, by Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., for the construction of two officers' quarters at the naval station, Pearl Harbor, Hawaii. The amount available for the work is $23,000.

Illinois.

Bids as follows were received May 2 by the Supervising Architect, Treasury Department, Washington, D. C., for construction of U. S. post office at South Chicago, (1) being bid on limestone and (2) being bid on sandstone: M. Yeager & Son, Danville, Ill., (1) $132,417, (2) $136,300; The J. P. Cullen Co., Janesville, Wis., (1) $134,587; The Conners Bros. Co., Lowell, Mass., (1) $135,822, (2) $141,822; Hiram Lloyd Building & Construction Co., St. Louis, Mo., (1) $137,207, (2) $141,207; George W. Stiles Construction Co., Rookery Bldg., Chicago, Ill., (1) $139,664, (2) $149,664; Inter-State Construction Co., Saginaw, Mich., (1) $142,246, (2) $145,900; Moore & Danner, Kokomo, Ind., (1) $147,860; Wm. H. Maxwell, Auburn, Ind., (1) $156,522; Dieter & Wenzel Construction Co., Wichita, Kan., (1) $159,920, (2) $162,420.

Massachusetts.

✣Bids will be received until 11 a. m., June 14, by the Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., for the reconstruction of Building No. 24 at the Boston Navy Yard. The cost is estimated at about $62,500.

New York.

⊙Turner Construction Co., 11 Broadway, New York City, has been awarded the general contract for the construction of four reinforced concrete buildings for the Cyphers Incubator Co., in accordance with the plans of Colson & Hudson. The sizes of these buildings will be 146 ft. by 401 ft., 80 ft. by 97 ft., 301 ft. by 122 ft. and 50 ft. by 146 ft. These buildings are to be all 1-story, sawtooth roof, excepting the power house, which is 2 stories. Work will be undertaken at once.

Oklahoma.

⊙W. D. Lovell, Minneapolis, Minn., has been awarded the contract at $123,000 for construction of U. S. postoffice at courthouse at McAlester, Okla.

Washington.

✣Bids will be received until 11 a. m., June 4, by King County Commissioners, Seattle, Wash., for the construction of a courthouse at 3d and James, estimated to cost $950,000. Plans and specifications for the work are now on file at the office of A. Warren Gould, American Bank Bldg., Seattle, Wash., Architect.

✣Bids will be received until 1:30 p. m., June 4, by Port Commission, Port of Seattle, Wash., 843 Central Bldg., Seattle, Wash., for furnishing and installing three elevator gangways. C. E. Remsberg is Secretary.

West Virginia.

⊙W. H. Fissell & Co., 1133 Broadway, New York City, have been awarded the contract at $111,500 for constructing U. S. post office at Grafton, W. Va.

RIVERS AND HARBORS

California.

⊙The Mercereau Bridge & Construction Co., Los Angeles, Cal., has been awarded the contract, at $8,940, for constructing a wharf at Fort Pio Pico, Cal., for the Quartermaster Department, U. S. Army.

Connecticut.

✣Bids will be received until 2 p. m., May 31, by Maj. G. B. Pillsbury, U. S. Engineer, New London, Conn., for dredging about 34,000 cu. yds. of mud and sand in the Mystic River, Conn.

⊙Bids as follows were received April 29 by Maj. G. B. Pillsbury, U. S. Engineer, New London, Conn., for dredging and rock removal in Southport Harbor, Conn., (1) unit price for dredging (45,200 cu. yds.), (2) unit price for rock removal (136 cu. yds.), (3) total: Maritime Dredging Co., 80 Broad St., New York, N. Y., (1) 24½ cts., (2) $12, (3) $12,706 (accepted); John A. Seely, 30 Church St., New York, N. Y., (1) 35¾ cts., (2) $14, (3) $13,543; Atlantic Dredging Co., 81 New St., New York, N. Y., (1) 26¾ cts., (2) $13.50, (3) $13,927; George W. Beeman, Dyer Blk., Hyde Park, Mass., (1) 25¾ cts., (2) $24.50, (3) $14,971.

Cuba.

✣Bids will be received until 11 a. m., June 14, by Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., for the construction of one frame house and concrete storehouse at the naval station, Guantanamo, Cuba. The cost is estimated at $5,500.

District of Columbia.

✣Bids will be received until 11 a. m., May 31, by Bureau of Yards and Docks, Navy Department, Washington, D. C., for 150-ton railroad track scale at the Washington, D. C., Navy Yard.

✣Bids will be received until noon, June 4, by Bureau of Ordnance, Navy Department, Washington, D. C., for furnishing two, four or six sets of 12-in., 50 calibre steel gun forgings. N. C. Twining is Chief of the Bureau.

Hawaii.

✣Bids will be received until 11 a. m., June 28, by Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., for two gunners' quarters at the U. S. Naval Magazine, Island of Kuahua, Pearl Harbor, Hawaii. The amount available for this work is $14,000.

Illinois.

✣Bids will be received until 10 a. m., May 27, by Lt. Col. Geo. A. Zinn, U. S. Engineer, 508 Federal Bldg., Chicago, as noted in our last issue, for dredging in Chicago River, Illinois. The dredging is to be done in the North Branch Canal, length about one mile, average width from 70 to 110 ft., yardage about 56,000 cu. yds.; and in the North Branch between North Ave. and Clybourn Pl., a distance of about 0.68 mile, average width 110 to 150 ft.; yardage about 62,000 cu. yds. The material is believed to be sand and silt with a small quantity of clay.

Massachusetts.

✣Bids will be received until noon, June 7, by Col. Frederic V. Abbot, U. S. Engineer, Boston, Mass., for rock excavation in Mystic River, Mass.

Mississippi.

There will be a large amount of earth moving work in connection with repairing and constructing levees throughout the Mississippi Delta this season, and probably for several years to come. Luther Y. Kerr, Custom House, Memphis, Tenn., is Assistant Engineer Mississippi River Commission.

New York.

✣Bids will be received until 11 a. m., June 7, by Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., for the furnishing of one switching locomotive for the Navy Yard at New York. Further information may be obtained of the Commandant of the Navy Yard.

✣Bids will be received until 11 a. m., May 31, by Bureau of Yards and Docks, U. S. Navy Yard, Washington, D. C., for two 50-ton steel coal cars for the New York Navy Yard.

Ohio.

⊙M. Rabbitt & Sons, The Nasby, Toledo, O., have been awarded a contract for eliminating a bend in Swan Creek at Toledo by diverting the stream through the abandoned side cut of the Miami and Erie canal. The cost of the work, including the removal of the bridge to a point on St. Clair St., where the side cut will be opened, and filling in the old bed of the stream, will amount to about $98,068.

⊙The Hamilton, Kennedy Co. has been awarded a contract at about $100,000 for changing the river channel at the East Youngstown Mills of the Sheet & Tube Co.

Plans have been prepared for docks, passenger stations and freight houses to be erected at E. 9th St., Cleveland, by the Cleveland & Buffalo and the Detroit & Cleveland Navigation Lines. An expenditure of $350,000 is proposed by the two companies

Rhode Island.

✣Bids will be received until 11 a. m., June 7, by Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., for one concrete float for the government landing, Newport, R. I. The cost is estimated at $2,000.

Texas.

✣Bids will be received until 11 a. m., May 26, by Maj. E. H. Schulz, U. S. Engineer, 325 Custom House, New Orleans, La., for dredging a canal between Calcasieu River and Sabine River, Louisiana and Texas.

✣Bids will be received until noon, May 20, by Lieut. Col. C. S. Riche, U. S. Engineer, Galveston, Texas, for building a creosoted pile bulkhead near Port O'Connor, Texas. Official advertisement will be found elsewhere in this issue.

Wisconsin.

✣Bids will be received until 10:30 a. m., May 19, by the Department of Public Works, Milwaukee, Wis., for constructing a 200-ft. extension, timber breakwater, adjacent to the present breakwater, in front of the Kinnickinnic river flushing tunnel lake inlet.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ENGINEERING AND CONTRACTING

Devoted to the Economics of Civil Engineering Design
and to Methods and Cost of Construction

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(See News Section Index for Prices, Bids Asked, Work Proposed and Contracts Awarded.)

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The Growth of the City Manager Plan of Municipal Government.

Between five and six years ago the city of Staunton, Va., employed a general manager and furnished a peg on which were hung many sage editorials remarking a new idea in municipal government. The Virginia city still has its general manager, which is presumptive evidence that the innovation has been measurably successful. There is no direct evidence. Meanwhile a new plan of city government, the commission plan, has gained considerable popularity. Also the idea of employing a general manager of city business has gained advocates. The state of Wisconsin, for example, with its cherished reputation for progressiveness, is, we are informed, considering an act providing for city managers for all cities of the second to the fourth classes. We shall try to obtain further information about this law and to publish it in a future issue. Meantime we make note of it as being by far the most pretentious effort that has been inaugurated to establish the new plan.

The example of Staunton, Va., in putting its city works in charge of a general manager was not quickly imitated. Last June, however, the city of Sumter, S. C., adopted the commission plan of government with a city manager, and in the following October advertisement was made for applicants for the position of city manager. The commission's announcement specified the qualifications sought as follows:

> The applicant should be competent to oversee public work, such as paving, lighting, water supply, etc. An engineer of standing and ability would be preferred. The City Manager will hold office as long as he gives satisfaction to the commission. He will have complete administrative control of the city, subject to the approval of the board of three elected commissioners. There will be no politics in the job, but the work will be purely that of an expert. Local citizenship is not necessary.

There were about 150 applicants for the position and it was given to Mr. M. M. Worthington, a civil engineer.

It will be noted that Sumter has a commission form of government, while Staunton is governed by a mayor and councilors. We note this fact because the latest city, Hickory, N. C., to adopt the plan of having a city manager is, like Staunton, of the more familiar form of government. Referring to Hickory, the clauses of the new city charter which refer to the duties of the city manager are as follows:

> Sec. 9.—He shall have power to revoke licenses pending the action of the City Council.
>
> Sec. 10. He shall have authority and charge over all public works, the erection of buildings for the city, the making and construction of all improvements, paving, curbing, sidewalks, streets, bridges, viaducts, and the repair thereof; he shall approve all estimates of the cost of public works, and recommend to the City Council the acceptance and rejection of the work done or improvements made; he shall have control, management and direction of all public grounds, bridges, viaducts and public buildings; he shall have control of the location of street-car tracks, telephone and telegraph poles and wires; he shall have charge of the watersheds from which the city takes its supply of water, pumping stations, pipe lines, filtering apparatus, and all other things connected with or incident to the proper supply of water for the city; and shall secure all rights of way and easements connected with the water works or sewerage systems or the extension of the streets, etc.
>
> All the powers enumerated, however, shall be exercised subject to the supervision and control of the City Council.

Besides the three cities named, which have actually adopted the city manager plan, there have been named from time to time a number of others where city managers have been considered. Also, we should not neglect to note in view of what Wisconsin is doing that bills were recently introduced in New Jersey providing for the adoption by popular vote of city managers in any commission plan city of that state.

From what has been said, necessarily very briefly, it will be seen that the city manager plan for handling the executive functions of city government shows an appreciable gain in popular favor. In noting this fact another point should not be overlooked. Whether the city government consists of a mayor and councilors or of a commission, there must be a readjustment of authority and functions in adopting the city manager plan if that plan is to be reasonably assured of success. Mayors and councils, the latter particularly, and commissioners, when commission government exists, must be relieved of most of their executive powers. This does not mean, more than the general managership of a private business means, that the city manager must, as the "Engineering News" states in a recent editorial, "be absolutely free of all control by the city council or commission, except that inhering in the power of removal for cause."

The city manager plan for executive direction of city works is a leaf taken from the management system of private business corporations. The notion of it is the outgrowth of an increasing realization that a city government is merely a business organization for supplying to the people needed or desirable public service, sanitation, police protection, schooling and recreation. No private business corporation makes its manager, however fit or wise he may be, "absolutely free of all control"; there is always a veto power above the manager and there is always an advising and controlling board, or council or commission of directors. There must be the same veto and directing power, besides the power of removal, superior to any power of the city manager.

Protecting Concrete From the Attack of Alkali.

Will painting with linseed oil protect concrete from destruction by alkali? A contributer states in another column that it will. He bases his assertion on experiments conducted by himself in the alkali regions of the western United States and on practice with the same remedy for 50 years in India. Coincident with oil painting, the author recommends the use of highly silicious cements and, where work is constantly under water, of slag cement, and the employment of all precautions to ensure a dense mixture. The oil coating, however, is the primary reliance for protection.

If so simple and inexpensive procedure as painting with linseed oil will protect concrete from destruction by alkali the irrigation and drainage engineers of the alkali plains of the west have a boon. There is no blinking the fact that alkali attacks are bringing disaster to irrigation engineers. While the fact l not been shouted from the housetops, m than a few irrigation works engineers h within a twelvemonth been called upon to j tify their concrete work. Some of them h failed in their defense and have lost th positions. This condition is one that has be met squarely. It is not so calamitous a has been assumed to be by some, but neithe it one that warrants inattention and, least all, the derision with which it is often aside. Whether painting with oil is a pana for alkali attacks may be doubted, but conditions do not justify its possibilities be scouted.

ROADS AND STREETS

Method and Cost of Asphaltic Macadam Construction on the Boulevard System of Kansas City, Mo.

Contributed by C. W. Redpath, Kansas City, Mo.

The boulevard system of Kansas City comprises about 55 miles of improved roadways, practically all of which are of macadam construction. These boulevards and parkways have undergone various changes of construction and maintenance, made necessary by the constantly increasing traffic during the past few years. All of the older boulevards were of well constructed water bound macadam and were formerly maintained by sprinkling with water during the summer months. As traffic increased, it was realized that a more substantial, dustless and permanent road surface would be necessary and with this in view experiments were started using various road oils and methods of application. The result was the use of a road oil furnished by the Standard Oil Co., which tests 19/21 B. by high grade hydrometer. This oil has been applied hot from a tank by gravity or by spraying at a pressure of about 20 lbs. This was essentially an improvement in maintenance and while satisfactory to a degree has had several drawbacks, viz.:

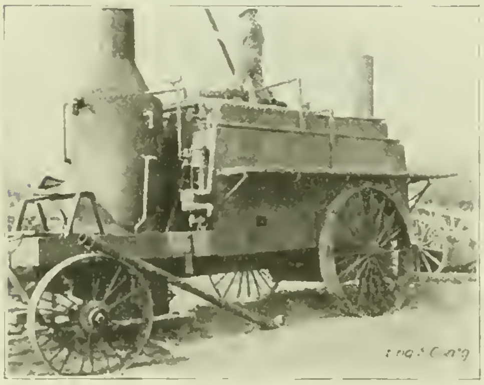

Fig. 1—Agitation Tank for Mixing the Asphalt and Road Oil.

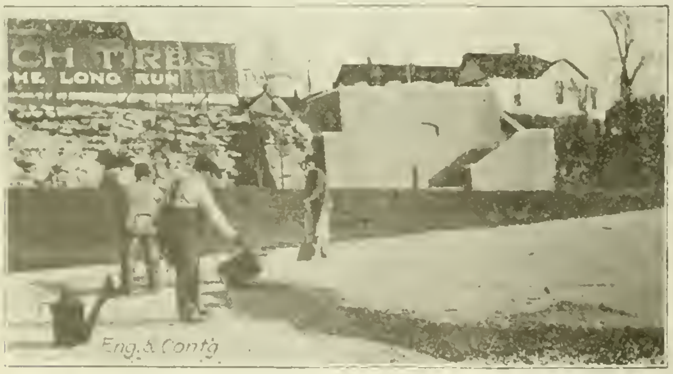

Fig. 2—Pouring Asphalt, Showing Type of Hand Kettle Used.

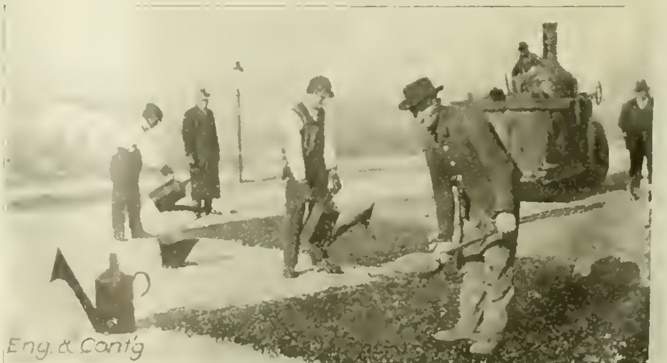

Fig. 3—Spreading Joplin Flint on First Coat of Asphal

(a) Oiling must be done from two to four times a year at an average cost of 1 ct. per square yard per application.

(b) Constant oiling has built up a thick oil cushion.

(c) Satisfactory repairs are impossible on this cushion.

(d) The thick cushion has become wavy and uneven under traffic.

Recently several methods of improved macadam construction have been tried, the principal change being the use of some kind of a bituminous binder for the wearing surface. Various mixtures of asphalt and road oil have been tried with more or less unsatisfactory results. Several kinds of commercial road binders, paving cements and asphalts have been used, some of which have given excellent results. So far a 2-in. top or wearing course of asphalt bound macadam of 1 to 2½-in. limestone has given the best results, the asphalt being applied by the penetration method.

All macadem roads have been constructed of 12 ins. of native limestone with a 12-in. crown on the standard 40-ft. roadway, with a 7-in. bottom course of 2 to 7 ins. limestone and a 5-in. top course of 1¼ to 2½-in. limestone. Ample drainage has been provided all cases.

Some of these roadways have been rec structed by removing 2 ins. of the top cou and replacing with a 2-in. asphalt bound we ing surface applied by the penetration meth This has proved a satisfactory solution for improvement of the old oiled macadam pa ments.

TABLE 1.—COST OF LABOR AND MATERIALS—APPLYING ASPHALT ON MACADAM BY PENETRATION METHOD.

8,300 Square Yards.	First Coat. Hours.	Cost.	Cost per sq. yd.	Squeegee Coat. Hours.	Cost.	Cost sq.
Foreman, 31.2 cts. per hour	56	$17.47	$0.00210	46	$14.35	$0.00
Stripping barrels and loading into big kettle	162	40.50	.00488	103	25.75	.00
Firing large kettle and loading small kettle	97	36.37	.00438	65	24.37	.00
Transporting small kettles	8	4.00	.00048	4	2.00	.00
Lost time of gang	47	11.75	.00142	24	6.00	.00
Loading and carrying hand kettles	98	24.50	.00295	49	12.25	.00
Pouring asphalt	87	21.75	.00262	49	12.25	.00
Spreading and wheeling Joplin flint	51	12.75	.00154	65	16.25	.00
Roller, 50 cts. per hour	54	27.00	.00325	38	19.00	.00
Joplin flint from car to work	..	13.10	.00158	..	20.47	.00
Asphalt from car to work	..	15.08	.00182	..	5.02	.00
Brooming Joplin flint from first coat	164	41.00	.00494			
Total labor	..	$265.27	$0.03196	..	$157.71	$0.01
Asphalt ... Gals.	12,732[1]	$1,118.67	$0.13478	4,283[2]	$376.30	$0.04
Joplin flint ... Cu. yds.	57[3]	73.87	.00890	89.3[4]	115.93	.01
Total materials		$1,192.54	$0.14368		$492.23	$0.5
Total labor and materials		1,457.81	.17564		649.94	.07

[1] 1.534 gal. per sq. yd. [2] .516 gals. per sq. yd. [3] 18.6 lbs. per sq. yd. [4] 29.1 lbs. per sq. yd.

The construction of asphalt bound macad herein described was under the following sp ifications:

MACADAM.

Bottom Course.—On the sub-grade, prepa in the manner above described, shall be spr a layer of crusher-broken limestone, or ha broken limestone, which, when thoroughly c pacted by rolling to the satisfaction of the Bo of Park Commissioners, shall be 6 ins. in de The Board of Park Commissioners shall de whether crusher-broken limestone or h. broken limestone shall be used in this cours

Hand-Broken Limestone.—The stone in layer shall be good, sound limestone, practi uniform in quality and as near an approach cube as possible, and broken so that the gre dimension shall not exceed 7 ins. and sha not less than 2 ins., free from dust, dirt and screenings, and all stones that are wedge-shaped and do not approach uniformity of measurement on their side shall be taken from the road-bed and no stones allowed to remain which are not sound, strong and equable in size and quality of material. After this layer has been thoroughly compacted by rolling, should any unevenness or depressions appear, they shall be filled with smaller size broken stone and re-rolled, and this process repeated until a firm, thoroughly compact, even surface is obtained that is 6 ins. below and parallel to the established finished surface cross-section of the pavement.

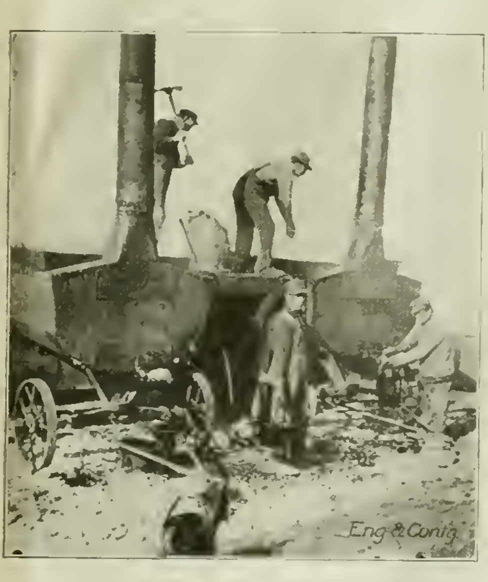

Fig. 4—View of the 500-gallon Kettles.

Second Course.—Upon the above described foundation will be placed a layer of broken limestone of the same quality as that above described and of sufficient depth to bring this layer to a uniform finish, free from irregularities and depressions, 2 ins. below and parallel to the established cross-section as shown upon the plan for said improvement heretofore approved by the Board of Park Commissioners. The stone in this layer shall be broken so that the greatest dimension shall not exceed 2½ ins., and shall not be less than 1¼ ins., and of this material from 60 to 75 per cent shall be not more than 2½ ins. in its greatest dimension and its least dimension shall be not less than 2 ins. This layer shall be thoroughly compacted by rolling and all defects corrected before spreading any limestone screenings upon the same.

There shall then be cast upon this layer from the side of the roadway a sufficient quantity of clean limestone screenings to completely fill all interstices. This layer shall then be flooded and rolled to the satisfaction of the Board of Park Commissioners and until it is compact and solid and ceases to creep under the action of the roller, and until the screenings and water flush to the surface upon all parts of the roadway. The limestone screenings shall be clean and free from all clay, dirt or other foreign matter, and of such size and quality as shall be acceptable to the Board of Park Commissioners.

No sprinkling wagon having tires of less than 6 ins. in width shall be used to flush or water this layer.

TABLE III. — AVERAGE TRAFFIC DURING RUSH HOURS—7 DAYS—GILLHAM ROAD AND McGEE STREET.

Hour.	Automobiles.	Horse-drawn vehicles.	Motorcycles.	Trucks.	Total vehicles.
8 a. m. to 9 a. m.	354	121	10	30	515
9 a. m. to 10 a. m.	288	132	16	23	459
3 p. m. to 4 p. m.	394	197	27	29	647
4 p. m. to 5 p. m.	534	189	32	38	793
5 p. m. to 6 p. m.	683	144	35	27	889
Maximum 1 hour	812	234	58	54	1,158

In all the above layers or courses the depressions must be filled and all defects in grade or cross-section shall be corrected as the rolling progresses.

Rolling.—All the rolling above specified shall be done with a steam road roller weighing not less than 10 tons.

TABLE II.—COST OF LABOR AND MATERIALS—APPLYING ASPHALT ON MACADAM BY PENETRATION METHOD.

6,184 Square Yards.	First Coat.			Squeegee Coat.		
	Hours.	Cost.	Cost per sq. yd.	Hours.	Cost.	Cost per sq. yd.
Foreman, 43.8 cts. per hour	27	$11.82	$0.00191	16	$7.01	$0.00113
Stripping barrels	27	6.75	.00109	18	4.50	.00073
Loading and firing kettles	80	20.00	.00324	45	11.25	.00182
Loading hand kettles	27	6.75	.00109	17	4.25	.00069
Carrying hand kettles	65	16.25	.00263	38	9.50	.00154
Pouring asphalt	53	13.25	.00214	30	7.50	.00122
Wheeling Joplin flint from piles to work	28	7.00	.00113	42	10.50	.00170
Spreading Joplin flint	15	3.75	.00061	27	6.75	.00109
Roller, 50 cts. per hour	27	13.50	.00219	17	8.50	.00138
Joplin flint from car to work	..	10.25	.00166	..	16.00	.00259
Asphalt from car to work	..	8.28	.00134	..	3.04	.00048
Brooming Joplin flint from first coat	115	28.75	.00465			
Total labor	..	$146.35	$0.02368	..	$88.80	$0.01437
Asphalt Gals.	8,720[1]	$766.16	$0.12390	3,210.5[2]	$282.01	$0.04560
Joplin flint Cu. yds.	41[3]	53.14	.00859	64[4]	82.94	.01341
Total materials		$819.30	$0.13249		$364.95	$0.05901
Total labor and materials		965.65	.15617		453.75	.07338

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[1] 1.410 gals. per sq. yd. [2] .519 gals. per sq. yd. [3] 17.9 lbs., or .00663 cu. yds. per sq. yd. [4] 27.94 lbs., or .01035 cu. yds. per sq. yd.

Wearing Surface.—Upon the second course, prepared in the manner above described, there shall be spread a layer of broken limestone, which when thoroughly compacted by rolling, shall be 2 ins. in depth. The stone in this layer shall be clean, sound durable limestone, free from dust and screenings or other fine bonding material. It shall be broken as near cubical as possible and so that the greatest dimension shall not exceed 2¼ ins. and its least dimension be not less than 1 in. This layer shall be dry rolled until the particles are thoroughly keyed together and firm and even and true to grade and cross-section of the finished pavement; the surface being left open and porous to permit the penetration of the bituminous binder. After rolling, should any unevenness or depressions appear, they shall be filled with smaller size broken stone and re-rolled until a firm, even surface is obtained that is true to grade.

Asphalt Binder.—Upon the above wearing surface an application of asphaltic cement of the quality below specified shall be uniformly and evenly spread with suitable appliances, so as to completely coat all the stone and penetrate to the bottom of the wearing surface. Not less than 1½ gals. of asphaltic cement to the square yard shall be used. The temperature of the asphaltic cement at the time of application must be between 325 and 350° F., and shall be applied only when the stone is thoroughly dry.

Immediately after the application of the asphaltic cement, this layer shall be covered with a sufficient quantity of clean stone screenings or chips to completely fill all interstices and shall then be thoroughly rolled until it is compact and solid and ceases to creep under the action of the roller, and the surface is even and true to grade. The stone screenings or chips shall be thoroughly dry, clean, sound durable stone and free from all clay, dirt or other foreign matter; and shall range in size from ¼ in. in its least dimension to ¾ in. in its greatest dimension.

Asphaltic Cement.—The asphaltic cement, considered apart from any mineral matter which it may contain, shall conform to the following analysis:

(1) It shall be free from water or decomposition products.

(2) The various hydrocarbons composing it shall be present in homogeneous solution, no oily or granular constituent being present.

(3) It must be of such consistency that at a temperature of 77°, a No. 2 needle, weighted with 100 grams will not in 5 seconds penetrate more than 12, nor less than 8½ mm. The No. 2 needle referred to is a common sewing needle about 1 mm. in diameter and tapering uniformly to a sharp point for 1 cm. of its length.

(4) Twenty grams of it shall not lose more than 4 per cent in weight upon being maintained at a uniform temperature of 325° F., for 7 hours in a cylindrical vessel 3 ins. in diameter and 1 in. high.

(5) Twenty grams of it shall not lose more than 7½ per cent in weight upon being maintained at a uniform temperature of 400° F., for 7 hours in a cylindrical vessel 3 ins. in diameter and 1 in. high.

(6) It shall be soluble in chemically pure carbon disulphide (CS_2) at air temperature to the extent of at least 95 per cent.

(7) It shall not contain more than 4½ per cent of carbonaceous matter insoluble in chemically pure carbon disulphide, air temperature.

(8) It shall be soluble in 85° B. petroleum naphtha, air temperature, to the extent of not less than 65 per cent and not more than 80 per cent.

(9) Its solubility in carbon tetrachloride shall not be more than 1½ per cent less than its solubility in carbon disulphide—both tests being made at air temperature.

(10) It shall show of fixed carbon not more than 15 per cent.

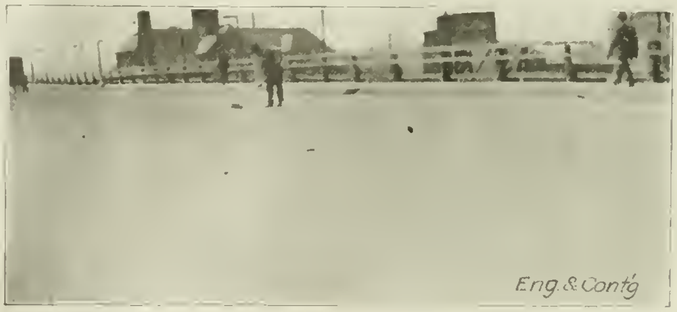

Fig. 5—Asphaltic Macadam Surface After 9 Months' Service.

(11) It shall show a flashing point (New York State Closed Oil Tester) of more than 350° F.

(12) Its viscosity at a temperature of 77° F., shall be not less than 1 gram, or more than 10 grams. Viscosity of asphaltic cement, by the terms of this contract, shall mean the number of grams of asphaltic cement that will, in 2 hours, be forced through a circular orifice 0.5 centimeters in diameter, by a pressure equal to

that exerted by a column 150 cm. high. The thickness of the plate through which orifice is made shall not be more than 0.5 mm.

(13) Its ductility, at a temperature of 77° F., shall be not less than 25 cm. or more than 75 cm. Ductility, by the terms of this contract, shall be understood to mean the distance in centimeters that a cylinder of asphaltic cement, 1 cm. in diameter, can be drawn out at the rate of 1 cm. per minute. The drawing out shall be accomplished by means of two similar clips cylindrical in form, of inside diameter of about 3 cm., open at one end, and having a concentric orifice 1 cm. in diameter through a circular plate, not more than 0.5 mm. thick and covering the other end. To make a determination, one of the clips is placed on a smooth surface with the open end down. The other clip is then placed on top of the first with the open end up so that the 1 cm. orifices coincide. The hot asphaltic cement is poured into the top one slowly so as to fill both clips completely. The temperature of the asphaltic cement is then adjusted to the temperature of 77 F., and the clips pulled apart at the rate of 1 cm. per minute.

Squeegee Coat.—As soon as possible after rolling the above layer, and while the surface is still fresh and clean, a second application of the asphaltic cement above specified shall be uniformly spread over the surface, at the rate of not less than ⅓ or more than ½ gals. per square yard. This coating shall completely coat all the stone and flush the surface voids, but care should be taken that no excess is used. Immediately after this, a top thin dressing of clean stone screenings or chips, such as previously described, shall be spread and thoroughly rolled in the surface. The rolling shall be continued until the surface gives indication of no further compressibility and is even and true to grade.

All rolling shall be done with an approved road roller weighing not less than [illegible] tons.

The cost of constructing the macadam road ready for the application of the first and squeegee coats of asphalt is practically the same as the cost of constructing a standard 12-in. 2-course water bound macadam—the extra cost of spreading two layers of fine rock being closely balanced by the fact that the water binding on the second course is not so thoroughly done as when it is for the final wearing surface. So that to the cost of water bound macadam, which has been about $1.00 per square yard in Kansas City, only the cost of the materials (asphalt and stone screenings) and labor for applying them must be added to get the cost of the asphaltic macadam.

First Method.—Under the above specifications 8,300 sq. yds. of macadam were put down on Gillham Road and bound with asphalt, the asphalt being applied by the penetration method. Most of the asphalt was received in car lots on a railroad siding near by and was hauled by wagon to a large asphalt agitator tank (Fig. 1) that had been used to mix asphalt and oil on other work. It was loaded into this tank with a hand derrick, after as many of the hoops and staves as possible had been removed, the remaining pieces of the barrel being taken from the tank when the asphalt was melted.

The liquid asphalt at about 350° F. was then pumped into a small portable kettle of about 300 gals. capacity, which was supplied with a fire box to keep the asphalt at the proper temperature for pouring, and in this kettle was hauled by team to a convenient location for distribution. Here it was loaded into small hand kettles and carried to the man who poured it upon the prepared rock surface.

It was necessary to have an engineer at $3.00 per day on the agitator tank to fire and operate the pump. Only one portable kettle was used and some time was lost by the pouring gang each time it was taken away to be filled. This has been made note of in Table I, which is the complete cost report on labor and materials for applying two coats of asphalt on 8,300 sq. yds. of pavement.

Several types of small hand kettles were tried, but that one which gave the best results is shown in Fig. 2. It holds 5 gals. and was made specially for this work. The liquid asphalt is spread from this kettle with a long swinging motion of the arm from right to left. The asphalt used was Texaco 96 Paving Cement, which weighs 8.25 lbs. per gallon and costs $21.30 per ton, f. o. b. Kansas City. It was delivered in ordinary wooden barrels and was very hard to strip when the weather was warm.

The first coat of asphalt was covered with a layer of ¼ or ¾ in. Joplin flint (Fig. 3), a very hard stone which is found in the lead and zinc mines at Joplin, Mo. It costs $.048 per 100 lbs., f. o. b. Kansas City, or $1.30 per cubic yard. A cubic yard of the flint weighed about 2,700 lbs. This also was received in cars on a railroad siding near by. After rolling this first coat thoroughly, all the loose Joplin flint was swept off by hand with street brooms and the road surface was ready for the second or squeegee coat of asphalt, which was applied in the same way as the first coat and covered with Joplin flint. After rolling, the surface was ready for traffic and while some loose screenings were removed afterward, most of them worked into the asphalt under traffic. All finish rolling was done with a 7-ton Springfield-Kelly tandem roller. The engineer was paid $3.00 per day and the roller is charged in the cost report at 50 cts. per hour.

As this was the first work of this kind done, some difficulty was experienced in training the laborers to handle and pour the asphalt. The foreman was paid $2.50 per day, two engineers at $3.00 per day and all labor at 25 cts. per hour. Teams were paid for at the rate of 50 cts. per hour. When asphalt was poured only part of the day, the gang was put at other work.

To secure the best results, the roadway should be perfectly dry before any attempt is made to pour the asphalt. The asphalt should be kept at 350° F. until the time of pouring to secure penetration into the top course of rock. Any spots of fine material should be removed from the top course of rock as they will prevent the asphalt from penetrating into this course, and bad spots will show in the pavement under traffic. A firm foundation is essential.

Second Method.—In continuing this work, 6,184 sq. yds. of pavement were laid just as the above with the exception that a different method of heating and distributing the asphalt was used. The advantages of these changes is shown in Table II in the reduced cost of labor per square yard. Part of this difference, however, is due to the better organization and greater skill in pouring and handling the asphalt.

Two large kettles (Fig. 4) of 500 gal. capacity and supplied with fire boxes were manufactured to order by the Ell-Kay Manufacturing Co. of Kansas City, Mo., at a cost of $300 apiece. They proved very satisfactory. The kettles were placed side by side with space enough between for a platform, the top of which was about level with the top of the kettles. A long incline plane was attached to the platform so that it could be readily removed. The barrels were stripped from the asphalt, which was rolled up the plane to the platform where it was cut up and dropped into the kettles. One kettle was loaded while the liquid asphalt was taken from the other.

The melting plant, as above described, could be quickly moved as the work progressed, so that when the distance between the kettles and the point of pouring became more than 150 ft., it was moved.

The average hourly traffic over a section of this roadway during the rush hours for seven days is shown in Table III.

The advantages of this asphaltic macadam pavement are:

1. It does not disintegrate under impact or suction.
2. It is not slippery.
3. It is entirely waterproof.
4. Its wearing properties are excellent.
5. Its surface can be readily renewed by another squeegee coat.
6. It is easily cleaned.
7. Cuts can be quickly and neatly repaired.
8. The disagreeable feature of oiling two or more times a year is eliminated.
9. The maintenance cost is low.

The results obtained on this roadway hav been very satisfactory and after six to nin months under heavy traffic it affords a smooth resiliant, waterproof and dustless pavement which shows very little wear. Fig. 5 show the condition of the road surface after months' service. It is now proposed to gradually change the entire boulevard system o Kansas City from a water bound macadan maintained with road oil to an asphaltic macadam by surfacing with a 2-in. asphalt wearing surface.

Notes on Road and Street Work.

(Staff Article.)

Wheeled Scoops for Gathering Stree Refuse.—In the downtown district of Johannesburg, South Africa, natives are employed to sweep up manure and other stree refuse. According to a recent consular repor each of these men is supplied with an iro scoop, mounted on an axle carrying sma wheels. A handle is attached to the scoo which is pushed by the native, who sweeps th manure into the scoop with a small broon The contents are deposited into street orderl bins, which are fitted into the sidewalks flus with the surface. The refuse is dumped int a semicircular container, which operates o hinges in the bin. In emptying the bin th cover is tilted back and the semicircular container tipped over, the contents being deposited in the gutter, and removed in carts.

Handling Street Openings at Hambur Germany.—In Hamburg the public sewer are almost invariably under the middle of th street and the various other pipes and wire under the sidewalks. According to local la no work of any character can be performe on public territory except by special permissio from the building department. When it becomes necessary to repair underground wor or to make additions thereto or to ere fences or scaffolding, the building departme issues the necessary permit but reserves to i self the right to restore the street and sidewalk pavement to its original condition, an the owner of the property involved is taxe with the total cost of effecting these repair Gas and electric connections are always ma by the companies themselves, the cost there being charged to the owners of the proper involved. Private electricians and plumbe are never authorized to tear up the street f the purpose of making gas or light conne tions. According to a consular report, in o der that the derangement of traffic and anno ance involved in building operations upon t streets may be reduced as much as possibl an annual meeting is held in Hamburg whi is called by the director of underground work who is the chief of the central bureau of t engineering department. These meetings a attended by eight members and one secreta of the public building department, four mer bers of the street railway companies, and o representative each of the electric lighting a power company, the gas company, the wate works, the traffic police department, the fi department, and the telephone and telegra department. The program is prepared in a vance for these meetings, the one for 19 containing 584 different items nearly all which related to the repair of street pav ments. The program is sent out in advan to various persons who attend the meeti and during the discussion thereof arrang ments are made to have all necessary work a given locality performed at the same tin as far as possible. These annual meetin have proved to be extremely useful not o in reducing the cost of effecting changes, b in minimizing inconvenience to the public.

Treatment and Resurfacing of Aquedu Roads, Washington, D. C.—In connecti with the Washington Aqueduct 14 miles roads are maintained. The amount and c of the work done on these roads during t fiscal year ending June 30, 1912, according the last annual report of the Chief of En neers, U. S. Army, is shown in Table I.

The section from the Conduit Road to Da carlia siding was given two different tre ments; that on the hill was treated with Tarvia A and X as in sections 3 and 5a, while the remainder, being nearly level and used only by the Government to haul material, was built as water-bound macadam. The areas of road treated with Tarvia A on sections 7, 7a, and 8 were first swept clean of all loose dirt and covered with about 0.7 gal. of Tarvia per square yard applied hot from a tank wagon; a thin layer of screenings was then spread over the Tarvia and rolled. The parts of sections 3 and 5a which were resurfaced were first plowed, shaped, covered with a layer of broken stone in sizes between ¾ in. and 1½ in., and rolled. About 1.4 gals. of Tarvia X per square yard of surface was applied hot from tank wagons, and upon this was spread and rolled a layer of stone screenings ¾ in. and smaller, in quantities slightly more than sufficient to fill the voids. After rolling, the excess screenings were swept off and about 0.7 gal. of Tarvia A per square yard was applied hot, followed by more screenings to take up excess Tarvia.

TABLE I.—AMOUNT AND COST OF WORK ON ROADS.

Sections.	Linear feet.	Square yards.	Materials used.	Cost per square yard. Tarvia.	Stone.	Labor.	Total.
Nos. 1 and 2	5,740	10,850	Tarvia A	$0.0610	$0.0560	$0.0314	$0.1484
Nos. 3 and 5a	5,062	9,091	Tarvia A, X	.1794	.2810	.1264	.5868
Nos. 7, 7a and 8	13,702	24,359	Tarvia A	.0536	.0556	.0314	.1406
To Dalecarlia siding	821	1,094	Tarvia A, X	.2230	.2814	.2684	.6928
To Dalecarlia siding	1,411	1,881	Water bound	.....	.2814	.2700	.5511

Average Cost of Road Construction in New York State.—The following data on road construction in the state of New York were given by Mr. J. H. Sturdevant, Acting Superintendent of Highways, in response to a report of the chairman of the Congressional Joint Committee on Federal Aid in the Construction of Post Roads: In 1912 contracts were let for the following class types of roads: 27 miles of Peekskill gravel with a hot oil or asphalt binder; plain puddled macadam, 59 miles; puddled macadam with surface application of hot oil, 284 miles; asphalt macadam, penetration method, 1,000 miles; concrete with a ½-in. bituminous wearing surface, 325 miles; California asphaltic concrete, 11 miles; brick, 1,283,329 sq. yds.; bitulithic, 134,472 sq. yds.; hassam, 25 miles; asphalt block, 6 miles; warrenite pavement, 25 miles. The following are the average costs per square yard of the various classes of construction:

3-in. macadam bottom course, sand filler	$0.25
6-in. field stone sub-base, gravel or crushed stone	.33
5-in. second-class concrete	.73
5-in. gravel concrete	.60
¼-in. bituminous surfacing on concrete pavement	.10
3-in. macadam top course, puddled	.30
3-in. macadam top course, puddled and oiled	.38
3-in. macadam top course, penetration bituminous	.60
1½-in. California asphaltic concrete	1.20
2-in. Topeka asphalt	1.20
2-in. warrenite	1.30
2-in. bitulithic	1.60
4-in. brick	1.40
4-in. creosoted wood block	3.50
7-in. granite block	2.75
7-in. medina block	2.75

Mr. Sturdevant stated that none of these types of construction has been in use long enough to give accurate data regarding their life, but in general this can be estimated as follows:

Macadam top course, puddled—about 7 years (estimated).
Macadam top course, puddled and oiled—about 10 years (estimated).
Macadam top course, penetration bituminous—about 10 years (estimated).

Mr. Sturdevant stated that as regards macadam roads they found that the average cost for maintenance for hot oil and cold oil was about 4 cts. per square yard per year.

Cost of Treating Parkway Roads with Oil and Tar at Washington, D. C.—During the fiscal year ending June 30, 1912, 126,450 sq. yds. of macadam roadway in the parks and public reservations in the District of Columbia were oiled; 39,010 sq. yds. of similar roadway were surface treated with coal tar and 5,700 sq. yds. with sulphite liquor. The cost of this work is shown in Table I, the figures being taken from the last annual report of the Chief of Engineers, U. S. Army.

The unit cost of some of the items entering into the work were shown in Table I as follows:

	Cts.
Labor, per sq. yd	0.8
Cost of oil, per gal	4
Cost of tar, per gal. (on road)	8
Cost of tar, per gal. (in car)	5.7
Cost of sulphite liquid, per gal	14

The average cost of watering roads in the fiscal year was 32 cts. per square yard.

Road Maintenance Costs.—Col. Wm. D. Sohier, Chairman Massachusetts Highway Commission, in a bulletin issued last month for the use of the Congressional Joint Committee on Federal Aid in the Construction of Post Roads, gave the following information on the cost of maintenance of state highways in Massachusetts: The average cost of maintenance of the 930 miles of state highway (average width 15 ft.), perhaps 10 per cent being gravel and 25 miles of sand and gravel, is about $650 a mile a year. It costs about $100 a mile a year to clean the gutters and catch basins, sand the road, etc. To coat with light oil, it costs from $125 to $225 for ⅕ gal. coat. The heavy cold-oil ½-gal. coat costs from $450 to $700 a mile. The hot-oil coat costs from $700 to $1,100 per mile. Many of the old roads will need resurfacing and widening from 15 to 18 ft. If bituminous macadam is used on the main roads, this will cost from $8,000 to $10,000 a mile. The cost of maintenance on a gravel road is usually about $100 a mile, possibly a little less, until it needs 3 ins. or so of new gravel. This added gravel wears for a period from three to eight years, depending upon travel. Three inches of gravel cost from $1,000 to $2,000 a mile, depending upon haul, etc. In the old times the macadam roads required resurfacing in anywhere from 5 to 14 years. Average cost of resurfacing waterbound macadam was from $2 500 to $3,500 a mile, resurfacing being required when a 6-in. road had worn to 3 ins. Sufficient data is not available to show what the cost of maintenance will be on bituminous macadam roads. Some of the best ones have gone now without any substantial repair. The roads built of tar macadam apparently require a surface coat of tar every two or three years, this costing from 5 to 8 cts. a square yard. The cost of repairs on the little-traveled country roads is very much less than the above. The average number of vehicles using the main roads is between 300 and 400 a day, and on a large number of roads there are over 1,000 vehicles a day. The following data on road maintenance in New Hampshire were also given in the above mentioned bulletin by Mr. S. Percy Hooker, State Superintendent of Highways: The total cost of maintaining 343 miles of gravel and macadam roads of the trunk line system was $78,454, or an average of $228.45 per mile. It is not so easy to separate the costs as between the different types of roadway inasmuch as in many towns there were both gravel and macadam roads. In a somewhat general way, however, the costs can be subdivided as follows:

	Per mile.
Macadam:	
Application, ½ gal. hot asphalt per sq. yd. (approximately)	$615
Application, ⅓ gal. cold 60% oil	400
Sanded and patrolled	200
Gravel:	
Application, ⅓ gal. 60% oil	400
Patrol	150
Reconstructing	700

On State Aid roads where traffic was made lighter than on trunk line roads the average cost of macadam maintenance was approximately $100 per mile and on gravel roads $70, the actual cost of maintaining 306½ miles of the highway being $24,364, an average cost of $79.50 per mile. Mr. Hooker states that an additional expenditure of $25 per mile would have maintained those State-Aid roads in a perfectly satisfactory condition, while in some of the towns the maintenance was not entirely satisfactory during 1912.

TABLE I.—COST OF TREATING MACADAM ROADS IN WASHINGTON PARKS DURING FISCAL YEAR 1911-12.

Location of road.	Material used.	Quantity. Gals.	Area of road. Sq. yds.	Length of road. Ft.	Sq. yds. treated, per gal.	Cost of material and applying, per sq. yd. Cts.	Remarks.
Around base of monument	Tar	800	3,400	650	4.25	2.1	Third application.
Monument grounds	Tar	630	1,860	480	2.96	3.5	First application.
Monument grounds	Tar	1,600	6,600	2,370	4.13	2.2	Second application.
B St., 15th St. to Potomac Drive	Tar	3,600	19,130	5,700	5.32	1.9	Second application.
Henry Park	Tar	2,520	5,920	1,600	2.35	4.2	First application.
Smithsonian grounds	Tar	850	2,100	750	2.47	4.0	First application.
White lot	Oil	3,570	20,000	3,700	5.10	1.6	Fourth application.
Monument grounds	Oil	2,300	11,350	4,300	4.94	1.6	Third application.
Monument grounds annex	Oil	3,150	22,200	4,100	7.05	1.4	Third application.
Potomac Park	Oil	10,000	50,000	12,200	5.00	1.6	Third application.
Potomac Park	Oil	740	3,450	850	4.67	1.7	First application.
Potomac Park	Oil	5,240	19,450	3,800	3.71	1.9	Third application.
White House grounds	Sulphite liquid	2,030	5,700	700	2.80	5.0	First application.
Total		37,030	171,160	41,200	[1]4.21	[1]2.5	

[1] Average.

Unit Costs of Cotton Store Houses.—The unit costs of five cotton store houses designed by Lockwood, Greene & Co. are given as follows:

No.	Construction.	Cost per sq. ft. Cts.	Per cu. ft. Cts.	Per bale.
1.	Mill construction with corridors of concrete	63.5	6.8	$ 5.68
2.	Mill construction	62.2	6.56	6.64
3.	Mill construction	67.4	8.6	6.65
4.	Mill construction	80.8	8.8	6.84
5.	Reinforced concrete	$1.034	18.5	$10.58

In all of these store houses about 8⅓ sq. ft. is allowed per bale of cotton.

Long Tunnel Through the Caucasus.—A project is now before the Russian Railway Department for the construction of a tunnel through the Caucasus mountains. This tunnel would be the largest in the world, having a length of nearly 16½ miles, and it has been already the object of a conference between Russia and foreign engineers, who have found: (1) That the geological structure of the mountain does not present any great obstacles. (2) That during the borings of the galleries no such difficulties will be encountered as during the borings of the Simplon tunnel. (3) That the temperature can be maintained at about 77° F. (4) That the elevation of the tunnel being between 4,300 and 4,650 ft. there is no danger of encountering subterranean water courses. (5) The work will take about eight years.

DRAINAGE AND IRRIGATION

The Protection of Concrete Structures From Alkali and Other Destructive Agents.

Contributed by W. D'Rohan, Irrigation Engineer, Denver, Colo.

It is now several years since the destructive effects of alkali on concrete structures was pointed out by Mr. Tannatt, Rural Engineer, Montana, and although his predictions and experiments were received with derision at the time by both engineers and cement manufacturers this destruction has been forcibly brought to the attention of the engineering profession on many projects throughout the West. Concrete culverts and substructures have either failed or been dangerously weakened where the concrete has been in contact with either alkali waters or soil containing alkali; and there is a strong possibility that his prediction of the destruction of several dams in the West from this cause will soon be an acknowledged fact.

It is not the writer's intention to go into the physical or mechanical action of alkali on concrete; indeed the subject has been fully discussed in the various engineering journals for the past four years, and beyond the conclusion that dense concrete as well as concrete well water-proofed, offered the greatest resistance, there have been no results attained. These recommendations only afforded the manufacturers of various water-proofing compounds an additional opening to exploit their wares, with the result that the destruction still goes merrily along.

In all probability alkali has been made the scapegoat for many failures to which it contributed very little, for as we shall shortly see there are many other causes tending to this destruction. All soft waters, such as rain water and snow water, owing to the presence of considerable carbonic acid, are ruinous to any cement containing lime in any shape or form, the destruction being of course proportional to the lime content of the cement. The carbonic acid leaches out the lime forming calcic bicarbonate, with the result that as soon as the lime content is sufficiently poor the structure fails. This action can be easily seen in sidewalks where the rainwater is allowed to fall from the eaves on the concrete. In less than a year the upper skin is abraded and the concrete soon becomes a mass of gravel. It may be mentioned however that where a top coat of sand and cement is used this destruction is considerably delayed.

In connection with the above, the following quotation taken from a paper by Professor A. Stutzer and R. Hartleb, M. D., published in the "Zeitschrift fur Angewandte Chemie" will be of interest:

> We have had occasion to examine a cement taken from reservoirs where it had remained in connection with water for eight or nine years. The cement had grown poorer and poorer in lime, and was converted into a soft, brownish mass, while its proportion of ferric oxide and alumina had increased. We concluded that the carbonic acid in the water had gradually dissolved the lime with formation of calcic bicarbonate, and are still of that opinion. On closer analysis a co-operating cause appears in the action of bacteria in the lime.

Now it is a well known fact that all of the western reservoirs and canals are holding and conveying waters impregnated with decaying vegetation and bodies of dead animals, which increase the carbonic acid and bacteria content of the waters and undoubtedly contribute to the destruction of all concrete structures in these waters.

Distilled water or in other words pure water is another "bete noir." Professor H. McCloud has furnished the following notes of an investigation of some cements. A Portland cement containing:

	Per cent.
Soluble silica	19.15
Lime	62.8
Alumina	7.86
Magnesia	1.04
Ferric oxide	2.76
Sulphuric acid	2.06
Insoluble silica	3.6

was finely ground and shaken with distilled water for six days; 40.5 per cent of lime was dissolved, 38 per cent being dissolved in three days only. Some of the same cement was mixed with water, allowed to set, and kept in water for three days. It was then powdered and shaken with water for three days, when about 32 per cent of the lime was dissolved.

A block of hardened cement, of unknown composition, 3x3x2 ins., which had been kept in water for 3¼ years, was broken, some of the exterior and of the interior was finely powdered and shaken with distilled water for 11 days. From the exterior 26.5 per cent of lime was dissolved, and from the interior 27.6 per cent. The exterior contained 4.5 per cent of carbonic acid, and the interior 3.1 per cent.

A briquette which had been tested at seven days after making, and probably had not been kept in water, was examined 3⅓ years afterwards. Portions were powdered and shaken with distilled water for 11 days. From the interior portion 36.3 per cent of lime was dissolved and from the exterior 23.4 per cent. The interior contained 1.1 per cent of carbonic acid, and the exterior 8.7 per cent.

Experts are all agreed however that all of the destructive causes of cement, whether arising from sea water, sewage, gases, alkali, and others, are entirely due to their action on the lime, ferric oxide, and alumina in the cement. Slag cement being high in silica, and low in lime and ferric oxide would apparently offer a panacea, and the manufacturers taking advantage of this tide of public opinion in their direction, immediately boosted their prices and advertised their cements as resisting alkali. A great many engineers of western projects, ignorant of the fact that any kind of slag cement is only suited for subaqueous work and rapidly deteriorates when subject to periods of wetness and dryness, paid the extra charge without demur, only to find no appreciable difference between their high priced purchase and ordinary Portland cement.

One of the oldest structures with which the writer is acquainted, in which slag cement was used, is the breakwater and pier about 850 ft. long on an exposed portion of the Yorkshire coast, England, at Skinningrove Iron Works. The monolithic mass has so far withstood all attacks of the sea, and though built in 1886 the portion under the water has acquired a hard durable surface, which resists attrition, and also any decomposing action. Above water the skin has become white and is less satisfactory than ordinary Portland cement in a similar situation.

The superiority of cements highly silicious over aluminous cements is unquestionable. M. Beid of le Teil Department of Ardeche, France, is confident that the addition of dehydrated clay is the only known means at present of resisting decomposition. Mr. C. G. Potter has shown that the addition of six parts of calcined red brick clay added to the clinker while grinding greatly increased the resistant powers of cement to all influences. He also further experimented with over-burnt, well-burnt and under-burnt clays, and found the best results came from the under-burnt clay.

In fact it may be claimed that all cements resist alkali in degrees varying with their composition, but there is no cement at present manufactured that does so effectually. Iron ore cement may be the exception, but whether from diffidence or want of funds it is not well advertised nor well known in this country.

Pozzulana cements are credited with very high resisting powers, and justly so. In this connection the writer gave several formulas for their manufacture in a paper published in Engineering and Contracting for Aug. 24, 1910. The article was the subject for some caust editorial comment, but the increasing use c pozzulans in this country has produced an en tire change of front. All of the exampl cited are of old and tried cements, and any on of them makes a better alkali-proof cemen than the commercial Portland; and they po sess this advantage that they can be easily an cheaply manufactured right on the job, and b common labor.

The decomposition of concrete mortars b rain water and other causes was fully recog nized in Europe and England many hundrec of years ago, and various additions were mad to the concrete, all designed to counteract th destruction; bullock's blood, rye-dough, barle water, beer, eggs, buttermilk and earth bein added with various results. The accounts c the repairs to the steeple of Newark Churc in 1571 has this entry: "6 strike of malt t make mortar to blend with the lyme, and tem per the same, and 350 eggs to mix with it. On the continent, in 1840, Mr. Fred Kuhlman exploited silica of soda and cement, and sil cate of potash.

In Engineering and Contracting for July 2 1910, the writer gave a symposium of practice along the same lines all over the world, an quoted the Indian practice of painting concret with a mixture of two parts boiled linseed oi with one of raw linseed oil. From experi ments made during the last three years th writer is now convinced that this method i the only one to save existing concrete fror alkali, and indeed from all other destructiv agencies. Mineral oils being subject to soften ing from the effects of gases are not as suc cessful as vegetable oils. The linseed oil wi also, by preventing the oxidation of the sul phides in slag cement, save the latter fror decomposition from any source whatever.

This remedy is not new. It has been use in India for over 50 years, and it also form the base of nearly all of the waterproofin compounds made in this country. It is applie when the concrete is about six months ol in the form of a point, and should be renewe every five years. Formerly concrete was sup posed to need no attention after the form were removed, but that is a mistake. Concret while not needing the same attention a wooden structures, nevertheless should b carefully watched, and examined every yea It is also advisable that where the structur is to be backfilled, the filling should be post poned as long as possible, and the concret sprinkled every day; and painted with th linseed oil mix when the backfilling become compulsory.

It is absolutely necessary to use highly sil cious cements with no free lime, and with th use of oil as above recommended slag cemen is the most suitable, especially for the sub queous portion of the structure, but the pa exposed to the air should be always of goo sound Portland cement.

If possible, water entirely free from alka should be used in the mixing. This can l acquired by boiling the water, but it is foun that water containing from 1 to 2 per cent c alkali has a beneficial effect by hastening th hardening of the concrete. In fact the Ge mans add a certain quantity of alkali, eith soda or potash, depending on the amount a ready contained in the cement-clay, but enoug to bring the amount to 3 or 4 per cent of th whole for the purpose of forming a solub silicate to act upon the lime in setting an sometimes a small amount of finely pulveriz sand or quartz rock is added.

The washing of the sand is another d pensable luxury, as it has been conclusive shown that 15 per cent of clay or loam i creases the density of the mix without a appreciable depreciation of strength.

Slag cement, while usually made from bla furnace slag, can also be made from smelt and other slags, and the large number smelters in the West offer wide fields for e ploitation, more especially by the harassed rigation engineer who is trying to put up substantial structures with meager capital. For his benefit it is necessary to point out that furnace or any slag slowly cooled in the air possesses no hydraulic properties. In this shape it is known as "ortho-calcium silicate." To impart hydraulic properties to such slag it must be converted to decalcium silicate by suddenly chilling the slag in cold water, the colder the water the higher the hydraulic properties imparted. The water granulates the molten slag, and about 40 per cent of each individual grain becomes strongly hydraulic. When molten slag is chilled in lime or other alkali water the slag will absorb the alkaline properties of the water and become strongly hydraulic. Molten slag, however, chilled in cold milk of lime will become hydraulic in the highest degree, and when ground will in tensile and compressive strength equal Portland cement. This milk of lime is made by using two parts of lime by weight to 100 parts of slag, and is commercially known as the Canaris process.

In the Grau process a jet of super-heated steam is projected on fused slag in such a manner that the slag falls into a state of powder and forms a pile which is allowed to cool slowly in order to prolong the effect of heat and steam.

In the process of Dr. Heinrich Colloseus of Berlin, the molten slag is allowed to fall slowly on a rotating drum which serves to split it up into small particles. Magnesium sulphate (common Epsom salts) is sprayed on it through the drum.

Other processes use salts of barium, or strontium, salts of calcium magnesium and aluminum.

All of these cements have to be finely ground before using.

Data on the Manufacture and Use of a Blended Cement (Sand-Cement) at the Arrowrock Dam, U. S. Reclamation Service.

The following tests and cost data for sand-cement, which is being employed in constructing the Arrowrock Dam, are taken from a discussion in Proceedings American Society of Civil Engineers, vol. xxxix, p. 271, by Mr. Charles H. Paul:

In the construction of the Arrowrock Dam—which is being built by the U. S. Reclamation Service to store the flood waters of the Boise River—about 550,000 cu. yds. of concrete will be laid, and the cost of cement is, of necessity, a most important item. The dam is about 22 miles above the city of Boise and 17 miles above Barberton, the nearest point on the Oregon Short Line R. R. A railroad from Barberton to Arrowrock has been built by the United States Government, over which the freight rate on cement charged against the work is 23 cts. per barrel. The commercial freight rate on cement from Utah mills to Barberton is $1.14 per barrel, from California points $2 per barrel, and from Kansas points $2.09 per barrel, so that the total freight charges on cement to the Arrowrock work are from $1.37 to $2.32 per barrel.

Laboratory tests on sand-cement have been carried on by the Reclamation Service for six years or more, and, during the winter of 1910-11, when the investigations in connection with the storage works on the Boise River were nearly finished, a series of these tests was started, using for blending material the native rocks in the vicinity of Arrowrock, particularly granite from the spillway site, a large quantity of which would have to be wasted during the construction period. Table I gives an average of three long-time tensile tests on sand-cement mortars (1 to 3, by weight, standard sand), each test being an average of 5 briquettes; and comparison with mortars made from Portland cement used in the manufacture of the sand-cements and tested under the same conditions.

The first column of Table III (percentage of blending material) in each case represents the Portland cement from which the sand-cement is made, tested under the same conditions.

Investigations of the actual use of sand-cement in structures which had been in service for 10 or 15 years, further tests in the local laboratory, and estimates of cost of installation and operation of the necessary equipment, finally led to the decision to use sand-cement, in so far as practicable, in the construction of the Arrowrock Dam, and to use for blending material granite from the spillway excavation.

TABLE I.

Kind of cement.	7 days.	28 days.	3 months.	6 months.	1 year.	2 years.	3 years.	5 years.
Sand-cement	219	333	397	423	457	423	449	444
Portland cement..	266	400	425	482	460	496	428	404

Blending material for sand-cement was river sand, bank sand, or granite, blended in each case with equal parts by weight of Portland cement.

Table II gives average long-time tensile tests on 13 brands of Portland cements used by the U. S. Reclamation Service during the last five years.

TABLE II.

Mortar briquettes, 1 to 3 by weight, standard sand:

7 days.	28 days.	3 mos.	6 mos.	1 yr.	2 yrs.	3 yrs.	5 yrs.
260	373	448	447	432	411	379	398

It is noticeable that there is not the marked decrease in strength in the case of the sand-cement briquettes as is shown here, and is so common with Portland cements.

TABLE III.—SAND-CEMENT TESTS ON MATERIAL FROM ARROWROCK DAM SITE, ARROWROCK, IDAHO.

(Blending material, spillway granite. Mixture. 1 to 3 by weight, with standard sand. Strength, in pounds per square inch.)

% blending material.	7 days.	28 days.	3 mos.	6 mos.	1 year.
Tensile tests on standard briquettes:					
..	343	428	461	467	408
30	374	417	467	499	494
40	368	467	504	...	...
50	330	419	460	452	410
60	294	369	400	...	...
70	156	237	266	320	335
Compression tests on 2-in. cubes:					
..	1,077	1,969	3,720	3,744	.....
30	1,631	2,454	3,171	4,392	4,656
50	1,471	1,763	2,729	3,121	3,712
70	458	938	1,215	1,256	1,560

A sand-cement plant, with a capacity of 1,000 bbls. per 24 hours, consisting of a crusher and sand rolls, rotary dryer, ball mill, mixing machine, and three tube mills, all electrically operated, with the necessary bins, hoppers, and conveying machinery, has been erected and has been in operation for about 2 months. The cost of this mill, complete, was about $46,000, itemized as follows:

Excavation	$ 1,500
Foundations	3,750
Erection of building, chutes, etc	8,150
Equipment, including freight	23,000
Installation of equipment	7,850
Electrical work	1,750
Total	$46,000

The total output of the mill to date (February, 1913) has been about 25,000 bbls. and about 20,000 cu. yds. of sand-cement concrete have been placed in the dam up to the present time.

All incoming Portland cement is tested and accepted before shipment. All sand-cement is tested for fineness, blend, setting time, and tensile strength in 1:3 sand briquettes, and is subjected to the boiling test before being used in the work. Tests for fineness and blend are made every hour that the mill runs, or oftener if either needs correction, and the other tests are made on an average sample from each day's run. The blend now being used is 45 per cent granite by weight, and the requirement for fineness is at least 90 per cent passing a 200-mesh sieve. Standard Portland cement requirements are satisfied by the other tests, and no sand-cement is used until it has passed the 7-day tensile tests of 200 lbs. per square inch. No sample tested has ever failed to pass the boiling test.

TABLE IV.—MILL-RUN TENSILE TESTS ON SAND-CEMENT MANUFACTURED AT ARROWROCK.

(All tests on 1:3 standard sand briquettes. Strength, in pounds per square inch.)

Average of all (52) 7-day tests	258
Average of 10 lowest 7-day breaks	221
Average of 10 highest 7-day breaks	297
Average of all (29) 28-day tests	332
Average of 10 lowest 28-day breaks	304
Average of 10 highest 28-day breaks	366

None of the sand-cement tested has failed to pass either the 7-day or the 28-day requirements. Occasionally, briquettes have been broken at the age of 4, 5, or 6 days, and in every case yet tested these briquettes have shown a strength exceeding 200 lbs. per square inch.

A representative cost of manufacturing 1 bbl. of 45 per cent by weight blend of sand-cement at Arrowrock is given in Table V, which includes depreciation on the plant and installation, at a rate which will wipe out the total cost at the time that a total output of 500,000 bbls. is reached. It does not include sacking, as most of the sand-cement will be used in bulk.

The use of sand-cement under actual working conditions bring out several characteristics that are different from those of Portland cement.

Comparing sand-cement concrete with Portland concrete, batch by batch, an experienced concrete man will note no difference, either in its appearance or in its behavior while being spread, but, after a run of an hour or two, in mass work, it will be noticed that an ordinary plastic or quaking mixture gives off water more readily than does Portland cement concrete, and that this water is clearer and apparently carries less cement than is the case with ordinary concrete.

A mushy or really wet mixture which is worked up continually shows, at the surface, an accumulation of sloppy material which is more marked than in Portland concrete and sets and hardens very slowly. In fact, it is the writer's opinion that, for this reason, extremely wet mixtures should be avoided, especially with sand-cement concrete.

TABLE V.—COST OF MANUFACTURING SAND-CEMENT.

Items.	Unit cost of sand-cement, per barrel.
Granite delivered to crushers	$0.02
*Portland cement, including freight and storing	1.35
Handling and storing Portland cement.	0.08
Labor, operating	0.10
Power and lights, including maintenance, etc.	0.16
Installation, depreciation, supplies, repairs, etc.	0.14
Total cost	$1.85

*Portland cement at $2.36 per bbl., f: o. b. Arrowrock.

Sand-cement concrete sets more slowly than ordinary Portland concrete, and its slowness in hardening is very marked. It is natural to assume that internal shrinkage stresses, due to setting and hardening, will be less on this account, but, at the present time, we have no other evidence on this point.

The writer has not noticed that sand-cement concrete adheres to the forms any more than Portland concrete, and as he has had no occasion to use sand-cement plaster, he has not had an opportunity to compare it with ordinary cement plaster.

It is natural for the ordinary construction man to look on a new product with prejudice, especially when it shows characteristics to which he is not accustomed; but, supposing, for the sake of making a comparison from another viewpoint, that sand-cement had been in general use for years and that Portland cement were the new product being introduced; would we look with favor on a cement which almost invariably showed a decrease in strength after a few months? Or one which not infrequently failed to pass the boiling test? Would we consider it a favorable sign that the excess water coming to the surface of concrete apparently brought with it an unusual quantity of cement? Quick-setting cements are usually considered undesirable for use in mass work, and were we accustomed to the slow-setting and slow-hardening sand-cement, might we not look with suspicion on a quick-setting cement, especially if one of the quicker-setting Portlands happened to be the first of the new product to fall into our hands?

The use of sand-cement in mass work, where the requirements are enough to justify the installation of the necessary grinding machinery, where suitable blending material is available, and where the transportation charges on Portland cement amount to a considerable portion of its cost laid down, will result in a marked saving in construction costs, and will give a product which is at least the equal of the Portland cement from which it was made, in fact, one which, for ordinary requirements, is not open to the least suspicion.

Methods and Devices for Measuring Water for Irrigation.

Contributed by Albert Eugene Wright, Irrigation Engineer, Provo, Utah.

The problems involved in the measurement of water for irrigation differ in almost every respect from the metering of city supplies. In the first place, the quantities of water delivered to single users are enormously greater, being on the general scale of 1 or 2 sec. ft. for each irrigator, while the city house is supplied through a ⅝-in. corporation cock.

The unit prices for water are almost as far apart as the quantities delivered. Where the price of city water runs from 15 cts. in eastern cities to 75 cts. per thousand gallons in some Pacific coast towns, the price of water delivered for irrigation may be said to run from 50 cts. per acre foot to holders of water rights in Imperial Valley, to $5 per acre foot of stored water, the going price in Colorado to all applicants, regardless of water rights. These prices are equivalent to 1/7 ct. per thousand gallons in Imperial, and 1½ cts. for water from the Colorado reservoirs.

In city water service, it is essential that the user be allowed to take water at any time of day or night, and meters are installed to check waste as much as to provide an equitable basis of sale. There is no parallel condition in irrigation practice. The amount to be delivered is first fixed by agreement, and the time and rate of delivery is arranged as conveniently as possible by an officer of the ditch or canal. This officer, whose title may be Water Master, Ditch Rider or Zinjero, covers his canal or section every day, and locks the gate of each user in position according to the reading of some device for measurement, and of course detects waste instantly, because the ditches are open.

And considering the measuring devices themselves, a city meter is a small patented article which is purchased complete, ready to insert in a pipe line. But a measuring device for an open ditch is a structure commensurate with the size of the ditch, with details as varied as the ideas of the builder. Even the patented "irrigation meters" are not complete units, but devices to be set in a structure.

THE GROWTH OF IRRIGATION MEASUREMENTS.

The steep topography and great number of small mountain streams in the Rocky Mountain region favored the early construction of innumerable small individual or partnership ditches, built without engineering advice, and claiming water rights equal to their capacities. The builders put in money or labor according to their acreages, and took "shares" in proportion. These shares, while they soon came to represent a definite number of acres, did not call for a definite amount of water, but always for a proportionate part of what the ditch carried.

Under such a system, all that is necessary to effect a just division of water is to give each owner the entire stream for a number of hours corresponding with his shares. Or if the ditch carries more than one man can handle, it is not hard to divide it in two merely by the eye. As between the irrigators on a given ditch this method of measurement will always find favor, because it rests on a time measurement for its accuracy, and is fully understood by the dullest. If only the quantity carried by the ditch is the correct quantity for the irrigation of the entire area under it, this pro rata division is about as satisfactory in point of economy as most of the distribution under the large canal systems. The water rights of most of the Rocky Mountain ditches have been settled in court, and the quantities which they divert from the rivers are measured by a public officer. In many cases the quantities allowed have been much greater than required for the best irrigation practice, and in Colorado, ditch owners have been allowed to sell the excess (adjudicated as "*required* for the irrigation of said lands"), a permission which makes the original decree a farce, but has justified itself by putting a money value on the saving of water.

But in the other mountain states, the principle of the attachment of water rights to specified lands has held more rigidly, and great waste of water has resulted. The writer's place, for instance, is located in one of the oldest irrigating communities, and yet the water for irrigation is not measured after it leaves the river. The lateral which supplies the place is simply filled to its capacity once a week, and the two acres are entitled to "half the water in Ditch No. 4 from noon to 6 p. m., on Tuesdays." The amount delivered is fully twice what is required, and during most of the season we irrigate only on alternate Tuesdays. The balance runs to waste. And nobody seems to care at all about it, because there is no way to make anything out of economy.

The crude conditions described above are presented not so much to show how water may be distributed without measurement, as to emphasize the principle that economy in the use of water will only result from some system which rewards the economical user.

MEASUREMENTS UNDER THE LARGER CANAL SYSTEMS.

Under the larger canals water can no longer be divided by the eye, and measurements of some kind have to be made. Many of these canals maintain a permanent engineering corps, and methods and devices have been carefully worked out. In states that have been irrigation code, each river system is divided among the canals according to their water rights, by an elaborate set of daily measurements taken by public officers.

On the Arkansas in Colorado, for instance, three water commissioners report twice a day to a division engineer the stage of the river in their several sections, the amount coming in from every tributary, and the diversion by every canal under their charge. From these data, the division engineer, making due allowance for the time required for water to move down a long channel, decides how much water each commissioner is entitled to, and issues his orders by long distance telephone. Each commissioner then distributes his allowance for the day among his canals, issuing his orders to head gatekeepers, as it would be physically impossible for him to cover his stretch of the river every day.

The actual measurements, both in the river and the canals, are of course gage readings at rated stations; and on streams that carry a great deal of silt new current meter ratings must be made after every flood to get any sort of accuracy. Canal ratings are made by the commissioner or his deputy, and are usually fairly permanent where the gaging station can be located on a hard bottom, or better still a long flume. Occasional check measurements are made, however, to catch any unseen error due to change in the condition of the canal, or, on the other hand, the dishonest altering of a gage, etc.

Disregard of the commissioner's orders is rare, because if a gatekeeper is caught ru ning more water than has been apportioned his ditch, it is a serious misdemeanor. Tl commissioner can not check up every gat keeper very often, but they check each oth to such a degree that it is hard to get aw with a bald theft of water in these days. I deed, some of the big canals keep a river rid armed with a small current meter, whose sc duty is to read ditch gages up and down t river, and to make occasional gagings by w of a check on the work of the commissione

Having passed the headgate of a canal, t water is no longer under public control, thou according to law, the commissioners are su posed to detect waste of every kind, and deny water to wasteful users. But they ha never found it good policy to interfere bel the headgate, and more careful methods irrigation are coming into use without int ference by the state, because it is to the int est of canal managers and irrigators to sa water.

Each main lateral from a large canal has own water master, and the amount of wa that he has to distribute each day is a p portionate part of the water in the canal, cording to the acreage under the particu lateral. Measurement into the laterals is o more by current meter, except in rare ca where the fall will admit the use of a weir.

It is the final measurement from the late to the irrigator that is of the greatest int est, showing a variety of methods, none which can be said to be wholly satisfactory, will be seen from a review of the meth most in use at the present time.

DEVICES FOR MEASUREMENT.

The universal instrument for the measu ment of water in open streams is the curre meter, and its importance to irrigation beg in the hydrographic records of the sources supply, and does not end until the small rating flume on some remote lateral has b tabulated. As an instrument it needs no scription for engineering readers, to whom is almost as familiar as a transit. Its accur is more than sufficient for most irrigation quirements, and exceeds that of any me that is set permanently in place, because the uniform condition of its bearings. Wl its main use in irrigation is in obtaining ings for gaging stations, it is also of value determining seepage losses. On the Impe Canal, in California, it has been used to termine discharge coefficients for gates various construction, and the main canal measured every day at the head, where g readings are subject to considerable fluct tions from the influence of silt and wind.

The rating flume is entirely satisfactory far as the accuracy of its original rating concerned, and if it can be located where conditions of flow are unchangeable, no vice is better. Each gage height mean definite quantity of water, and the same charge table may lie used year after year. it has three chances of inaccuracy, which anyone familiar with irrigation canals will once be seen to increase as we go down canal, and are most certain to arise on smaller laterals. The first is silt, which dom deposits in the upper reaches of a w designed canal, but which can not be kept suspension under the more fluctuating cor tions of flow in laterals. The indications a gage may often be vitiated 20 or 30 per c in a season, so that an accuracy of 10 cent would require at least three ratings w current meter at short intervals. If the di is cleaned, a new rating is required, as original conditions appear to be restored.

The second great enemy of the rating flu is the growth of aquatics in the ditch, here again the trouble is most marked in smaller channels where the flow is at ti sluggish. There is no limit to the error ratings which may be due to backwater fr a weedy ditch—except, of course, that the ror is always one way. When the weeds cut, the original condition is seldom resto and a new rating should be made.

The third difficulty with the rating flum the interference caused by opening outlets raising flashboards in canal bulkheads, if t structures are near enough to the rating station to affect its gage readings. Whether they interfere or not is often hard to decide, as it may not be visible to the eye, and backwater computations are both difficult and inconclusive. A rerating under that condition of operation which would cause the maximum interference is the only practical test in many cases. Such errors may, of course, run in either direction.

The one great advantage of the rating flume as a measuring device is that it requires no additional grade or fall, and can hence be placed in situations where none of the methods requiring pressure or an overflow are available. As a structure, it usually consists of a section of flume about twice as long as the width of the ditch, and having a running-board from which to operate a current meter. The flume provides a constant cross-section at the point of measurement, and a smooth channel in which to take meter readings. For flows under 2 or 3 sec. ft. the rating flume is unsatisfactory, as the current meter gives readings higher than the average velocity in very shallow and narrow channels. For that reason it fails to meet the requirements for measurements to individual irrigators.

Measurement through an orifice under pressure is the method most used for the final distribution of water. It is the old "miners' inch" method, and has been unduly despised by the advocates of more precise measurements, or at least of methods having a standard construction. As usually defined, a miner's inch is the discharge per square inch through an orifice 2 ins. high and of any horizontal length, a head of 4 or 6 ins. of water above the center of the orifice being maintained, with a free discharge into the open air on the lower side. The orifice is to be in "thin plate"; that is, it should have sharp edges on the inside, and there must be a margin all around to insure complete contraction. This is the miners' inch that has been calibrated, and is the basis of the tables in use. Such an orifice has a discharge coefficient of about 0.62, which makes the value of a miner's inch under 4 or 6-in. pressure about one-fiftieth and one-fortieth (really one forty-first part) of a second foot, and the inch is so defined by statute in several states. The old Colorado inch had a 6-in. pressure above the top of the orifice, giving it a value of about one thirty-eighth of a second foot.

But alas for the way this simple and accurate device is installed in the field. As used on one of the largest irrigation systems in the country, the device for measurement consists of an outlet box 3 by 7 ft. set in the side of a lateral, and having a gate to admit and control the flow. Near the lower end of the box a second gate is set, with its bottom raised 2 ins. from the floor by a cleat. The water is measured by raising this gate to any convenient height, and admitting enough water to maintain the desired pressure. On this particular canal the irrigator often requires a much larger flow than could be run through the standard 2-in. orifice, 3 ft. long, and the water masters are provided with tables giving the discharge per square inch for any pressure, and these tables are applied to openings of any necessary width. The head of the center of the orifice is taken as the mean effective head, which introduces a slight error if the orifice is wide and the head small.

Much more serious errors, however, result from the failure to provide sharp edges for the orifice, and from the lack of end contraction, which is merely that afforded by the guide-cleats in which the gate slides. In case a free discharge into the air is not available, on account of the very flat topography, the water master uses a table for submerged openings, and records the difference in the head above and below the orifice. If it happens that the orifice is only half subemrged, he puts a flashboard across the lower end of the box to back the water over the orifice and so produces a state of flow that comes within the scope of his tables.

The discharge tables used for these measurements are computed for orifices with sharp edges and complete contraction, and after the sharp corner of the gate has worn smooth neither of these conditions is adhered to. The cleats at the side do not give complete end contraction, and the proper coefficient for an orifice with rounded edges is considerably over 0.62. Both of these errors favor the buyer of water, as do the additional errors that may be due to velocity of approach and the accumulation of silt in the bottom of the measuring box. The manager of the canal in question informed the writer that after allowing for seepage, the amount of which had been measured, the measurements in the main canal were constantly short of the sum of individual measurements, the shortage being something like 10 per cent.

The above conditions are not cited as an argument against the method, which is perhaps adaptable to more field conditions than any other. How easily the defects noted could be remedied! Strips of sheet metal nailed to the top and bottom edges of the orifices would eliminate the greatest error. The use of a wide guide-cleat for the gate on the upstream side would suppress all end contraction, and make a standard type of orifice such as has frequently been calibrated. And finally, a baffleboard across the box would destroy any undue velocity of approach.

The logical development of the miners' inch box into a universal measuring device leads us into unfortunate complications, however. If we are going to use an adjustable opening, say of 2 to 4 ins., its vertical width must be measured within 1/16 in. to get an accuracy of 3 per cent, and that means that the water masters will have to carry caliper rules. Moreover, there will have to be some way of locking the gate which forms the upper part of the orifice so there shall be no play, and that will require a steel gate-stem and hand-wheel construction, instead of the wooden upright bored with uncertain holes for a pin and lock. And finally, unless the openings used are in even inches, the water master's discharge tables will fill a book, unless, indeed, ditch-riders can be found who are handy with the slide rule in formulas involving square roots. Even then the farmer would not be convinced.

Miner's inch boxes with a fixed 2-in. opening and a standard head over it are much more commonly used than boxes with variable conditions, such as have been described. Of course they have a fixed discharge, and if the irrigator is to get more water, it is simply run for a longer time. This simple but inelastic method appeals to the farmer, who can see the square inches of his water right before his eyes, and measure the head with his two-foot rule.

The method is well adapted to the measurement of the small individual streams used by orange growers in Southern California, and a very accurate and satisfactory type of measuring box has been developed there, for distribution from the cement pipe lines. The device consists of a standpipe 2 or 3 ft. high set in the pipe line. In the side of the standpipe, which is often merely a section of pipe the same size as the main line, is set a metal plate with an orifice cut to deliver the number of miner's inches owned by the irrigator. A bulkhead with its top 6 ins. above the center of the orifice is placed across the standpipe, and a metal sluicegate through the bottom of the bulkhead completes the device.

When no water is to be taken the gate is locked open, and as the pipe is not under pressure, no water rises in the standpipe. When water is to be delivered, the gate is partially closed, until the water rises just to the top of the bulkhead. If for some reason the flow in the main increases, the water rises but little in the standpipe, as the excess flows over the top of the bulkhead, and so back into the main pipe. This overflow tends to keep the discharge of the orifice constant, and it is the more effective in that a change of head effects a large change of discharge over a weir where the area varies, and a small change of flow through an orifice of fixed area. In some cases orifices with horizontal slides are used to vary the measurement, but usually the only movable part of the device is the sluice gate.

WEIRS.

The sharp crested weir is undoubtedly the favorite measuring device among engineers, being the most accurate of field methods, of well known and standard construction, without movable parts, and in various sizes adapted to flows from a few "inches" up to 100 sec-ft. The specifications are very simple: sharp crest and sides, full contraction at sides and bottom, and no considerable velocity of approach. The common construction is an extension of an outlet gate with a short section of flume, across which is set a notched bulkhead. The depth of water over the notch is read from an ordinary gage.

The trapezoidal or Cippoletti weir is coming to be the accepted type, as its discharge varies as the crest length, and hence an extended table based on a 1-ft. weir-crest is all that is needed for all other sizes. If more accurate tables are wanted, those of Steward and Longwell, based on their Boise experiments,* meet all possible requirements for weirs from 6 ins. to 3 ft. in size, the gage heights being extended far beyond the rather meager limits covered by the common formula. This type of weir has long been standard with the U. S. Department of Agriculture, is used on many of the United States reclamation projects and perhaps it is safe to say on most of the newer and more enlightened private irrigation systems in the west.

There are places where the fall of the ditches is too small to allow the use of a weir, which must have a free fall of water over its crest. And there are many water supplies like the Feather and Colorado in California, and in general the southern rivers, which carry great quantities of silt. In some cases the forebay above any sort of weir will fill level with the crest in a few hours, suppressing the contraction, which, of course, is much to the advantage of the buyer of water. The best remedy is probably to use narrower forebays, and compute discharge tables that take the velocity of approach into account.

AUTOMATIC REGISTERS.

None of the measuring devices that have been described are anything but indicators of the flow at the moment of observation, and the greatest single inaccuracy in the distribution of water is due to unrecorded changes in the gage height. Snow-fed rivers have a very marked daily rise and fall, and these waves combined with the fluctuations due to the continual changing of the outlet gates along a canal, make it impossible to hold the water at any fixed gage height. Many styles of automatic registers have been designed to make a complete record which would give the correct total flow for any of the standard devices. But these machines have never come into extended use except for experimental purposes, mainly because the clock is not a satisfactory field instrument. Any one who has "changed sheets" on an automatic register during a Umatilla sandstorm will agree that the present types of registers require not only to be housed, but to be in a house, if they are to give fair service for a single season.

Other drawbacks, such as the floats and cords, ink that gets full of dust, and sheets that have to be pasted, to say nothing of a record that is tedious to interpret, have kept the register out of the commercial class. It is, however, capable of improvement, and a good dust-proof instrument for about $25 would command a large market.

IRRIGATION METERS.

This subject is approached with a strong fellow-feeling for any reader who has built and scrapped an open ditch meter. In the present state of the art, the irrigation meter may be dismissed with a statement of the problem which is to be solved. The meter must handle large quantities, a capacity of 1 sec. ft. being about the smallest size wanted. It must require the least possible fall, in some cases less than half a foot being available. It is not feasible to protect an open ditch meter with a fine grating, which would dam the water back and break the ditch bank, so grass and weeds and sticks, such as are always present, must go through the meter without any possibility of winding up in its bearings. Indeed, the presence of siliceous silt in western waters almost precludes the use of submerged bearings at all.

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*Proc. Am. Soc. C. E., Feb., 1913.

Such a meter must be of a type that is convincing to a jury; that is, it must give a plain reading in figures proportional to the flow. For instance, a weir register with an integrating cam that solves the formula as it goes will never go with the farmer, and, after all, he is the man who must come to believe in irrigation measurements and effect at last those economies on which the extension of irrigation now depends.

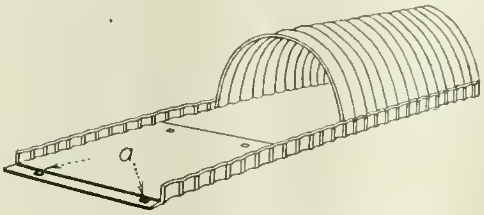
MEASUREMENTS AND ECONOMY.

It is unfortunate that so few of the contracts between the canal and the irrigator have been drawn with any regard for the different water requirements of different soils and crops. Alfalfa needs heavy irrigation through the season. Potatoes want little water early in the season, but plenty later on. Orchards need about half the water used by some other crops, and so on. As alfalfa covers 40 per cent of the whole area under irrigation (excluding wild grasses) it is virtually the basis for estimating water requirements. No irrigator wants to sign a contract for less water than will raise alfalfa on his land. Hence contracts call for the same quantity for each acre under the canal, and the annual charge is the same.

Under such contracts it is seen that measurements are not made as the basis for sale, and that they do not contribute directly to economy of use. Their purpose is mainly to provide an equitable division of the water among the holders of water rights. The farmer does not care, nor can he tell you, what quantities he applies to his crops. If he thinks he is a getting a fair proportion, and if the crops are not suffering, he is satisfied.

The first very large system to make a quantitative charge for water was Imperial Canal, where it has proved most successful, both from a revenue and economical standpoint. At 50 cts. per acre foot single irrigations cost but 15 to 25 cts. per acre, yet that small direct charge has developed as high a "duty of water" in that hot valley with its 10-month irrigation season as anywhere in the country. Indeed, the quantity of water used to raise a ton of alfalfa is probably less there than anywhere.

Incidentally, the quantitative charge enforces a degree of diligence in the delivery of water unknown under the pro rata contracts. If one of the larger laterals of the Imperial Canal must be repaired during the summer, the company loses a dollar a day for each second foot carried, or in many cases $500 per day as long as water is shut down. New structures are often built beside the flowing ditch, which is then relocated so as to pass through.



Metal Culvert With Corrugated Arch and Cast Iron Base.

The measurement of water is the necessary basis for intelligent irrigation. It provides a basis for the sale and exchange of stored water and for the equitable division of water among the canals, and under them to the owners of water rights. Measurements of considerable accuracy make possible the quantitative charge for water, providing motives o economy and diligence for both the irrigato and the canal company. And finally, at som not too distant time, the water requirement of different crops will be so generally know and accepted that the farmer will apply measured quantities to his various fields with greater certainty of results and greater econom of time and water than is possible under present irrigation practice.

A Metal Culvert Combining a Corrugated Arch and a Cast Iron Bottom.

(Staff Article.)

The metal culvert shown by the accompan ing sketch consists of a corrugated iron arc fitted between the flanges of a cast iron ba or bottom. As indicated the base is made of sections which are connected by dapp joints held fast by cast lugs *a*. The sectio are 26 ins. long and the joint laps 2 in making the net length of a section 2 ft. T side flanges are corrugated for strength a to fit the corrugations of the arch sectio which are also 26 ins. long with a lap of o corrugation or 2 ins. In setting the arch plat a special 14-in. section is used at each e These permit the standard arch plates to set so as to break joints with the base plat In constructing this culvert no concrete used; the base plates are set directly on t leveled soil. A cast iron end wall is provid when desired or a concrete end wall can built. These culverts are built in eight reg lar sizes from 12x8 ins. to 60x34 ins., by t American Culvert Manufacturing Co., Ba of Buechel, Buechel, Ky

GENERAL ARTICLES

Method of Trenching for a Grain Elevator Foundation in Soft Ground.

The site of the Manchester Ship-Canal grain elevator at Manchester was an old basin forming a pond in wet weather, which had been filled with a soft sludge dredged from the canal work. This sludge bed was from 14 to 18 ft. deep and of the consistency of soft butter; it had 2 ft. or so of sand covering and underneath it were layers of fine silt, wet sand and gravel in sequence. The building was 454x45 ft. and it was decided to carry it on a gridiron foundation of concrete; this type of foundation, more common abroad than in America, consists of a footing wall sunk to hard ground and boxing in the foundation and of parallel walls built in trenches and crossing the foundation transversely, all walls being covered with a slab of concrete. Figure 1 is section at right angles to the transverse walls and shows the nature of the construction.

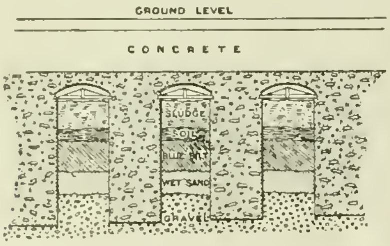


Fig. 1—Section Across Concrete "Gridiron" Foundation for Grain Elevator.

The footing and grid walls of the Manchester elevator were built in trenches and this article from a paper by Mr. G. G. Lynde, before the Institution of Civil Engineers, Great Britain, describes briefly the methods of trench construction which are also shown by Fig. 2. Referring to *a*, Fig. 2, it will be seen that the first step was the excavation of a trench about 6 ft. deep through the sand and the harder top crust of the sludge and the sheeting of this trench in the ordinary manner. Inside this sheeting 14 ft. sheet piles were driven down to hard material and the sludge was excavated from between them and braces were placed, the several steps being as shown at *b*, *c* and *d*, Fig. 2.

The concrete in the trenches, etc., was composed of 6 parts of gravel or broken stone or bricks, 2 parts of sand, and 1 part of cement, all by measure, and was mixed by turning over on plank stages twice in its dry state and three times after water had been added, after which it was filled in the trenches by means of wooden shoots. Each layer of concrete, after being levelled, was hand packed with rough lumps of hard sandstone, a minimum thickness of 6 ins. of concrete being left between the stones. The concrete in the arches and cellar floors was composed of 4 parts of gravel and 1 part of cement. As the concrete in the outside walls was completed the excavation of the enclosed area was commenced. The springing level of the arches was 10 ft. below the finished ground-level, and it was found that the average level of the bottom of the sludge was 14 ft. below ground-level, so that there was about 4 ft. of sludge below springing level, Fig. 1. It was intended, if the material excavated proved suitable, that the dumplings between the trenches should have been left untouched; but in consequence of the character of the lower 4 ft., it was thought best to remove the whole and afterwards to refill the spaces between the concrete walls above the trenches with other material. While this was proceeding it was deemed desirable to shore up the outside walls on account of the pressure behind them, the concrete not having had sufficient time to set. 10x4-in. "soldiers" were placed against the walls, 14 ft. apart, and 9-in. square rakers, 20 ft. long, were placed against them; these were not removed until the concrete of cross trenches was completed up to the le of the springing of the arches. The woo ribs were then fixed with their ends rest on the concrete, and were lagged with 1 boards. Concrete was filled in over the wh area, which formed the floor on which elevator was to be built, the upper 6 inc being of 4 to 1 concrete. This floor was ab 7 ft. below finished ground-level, and a c crete retaining wall was built upon the out wall up to ground-level.

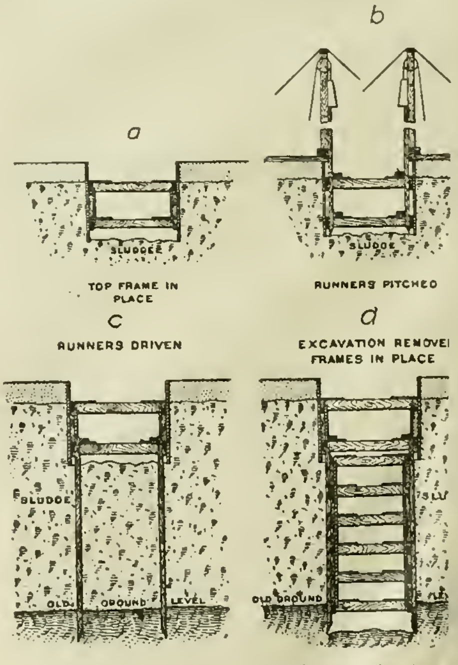
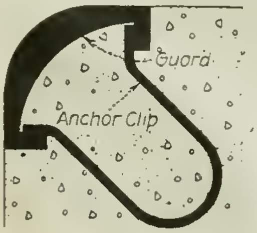


Fig. 2—Method of Trenching Soft Gro for Concrete "Gridiron" Foundation.

A Simple Metal Protection for Concrete Column Corners and Curb Edges.

(STAFF ARTICLE.)

Sharp exposed edges of concrete work, such as column corners and curb and platform edges, require special construction to prevent chipping. The common special construction is to round or bevel off the sharp corners. Another method is to armor the edge or corner with a strip of metal cemented into the concrete. The accompanying sketch shows a form of such metal guard. It consists of a guard bar of galvanized steel and of the U-shaped steel anchors. The anchors are separate from the bar and are applied to it by clipping the open ends between the flanges of the bar; a pressure of the finger performs the operation. The dimensions of this metal guard are as follows: Thickness of guard bar at center of arc, ¼ in.; length of arc of guard bar, 2 ins.; distance from crown of guard bar arc to loop of the anchor, 2 ins.; width of the anchor strap, ½ in. This guard is manufactured by the Clip Bar Manufacturing Co., 2542 Ohio St., Philadelphia, Pa.



Metal Guard for Curb Edges on Column Corners.

Electric Current by Submarine Cable.—A project is now before the Swedish government for the transmission of electric power from the Trollhatten Fall in Sweden to Denmark by submarine cable. A high voltage transmission line will be constructed from the Trollhatten, along the coast for 160 miles and then by submarine cable to Elsinore, on the Island of Zeeland. A central distributing station will be erected at Elsinore and a current transmitted to Copenhagen, 50 miles south and to other industrial centers on the island. The power will be used to operate the street railways of Copenhagen.

Diagram for Flow of Air in Pipes.

The accompanying diagram is an air transmission diagram for determining graphically the size of pipe required to transmit a given quantity of air through a given distance with any assumed loss of pressure. It is one of three diagrams worked out by Mr. C. R. Richards in a bulletin just published by the Engineering Experiment Station, University of Illinois. We quote the text relating to this diagram as follows:

The application of the principles of thermodynamics to the flow of air in pipes leads to the following formula connecting the several variables entering into the problem:

$$u_1 = \sqrt{\frac{gRTm}{KL} \cdot \frac{p_1^2 - p_2^2}{p_1^2}} \; \ldots\ldots (1)$$

where u_1 = the initial velocity of flow in feet per second.

g = the acceleration due to gravity.

T = the absolute temperature, considered constant.

m = the "hydraulic mean depth," or the ratio of the area to the perimeter of the pipe.

K = the coefficient of resistance.

L = the length of the pipe in feet.

p_1 and p_2 = the initial and final pressures in the pipe in pounds per square inch, absolute.

If V = the number of cubic feet of free air at 70° Fahr. and 14.7 pounds pressure flowing per minute.

d = the *actual* diameter of pipe in inches.

$r = \frac{p_2}{p_1}$ the ratio of the final to the initial pressures.

$m = \frac{d}{4}$ for circular pipes.

then equation (1) reduces to

$$V = 3.061 \sqrt{\frac{d^5 p^2_1 (1 - r^2)}{KL}}.$$

In plotting the chart the value of K has been assumed to be

$$K = 0.003 \left(1 + \frac{3.6}{d}\right)$$

and, instead of plotting r direct

$100 \left(\frac{p_1 - p_2}{p_1}\right)$ has been used as more convenient, since it shows the percentage of pressure drop in the pipe in terms of the initial pressure.

While the formula for V is theoretically correct, its ultimate accuracy depends upon the assumption of a correct value of K, which is not easy considering the paucity of reliable data available.

University of Illinois Engineering Experiment Station, Bulletin No 63
Entropy Temperature and Transmission Diagrams for Air by C. R. Richards.

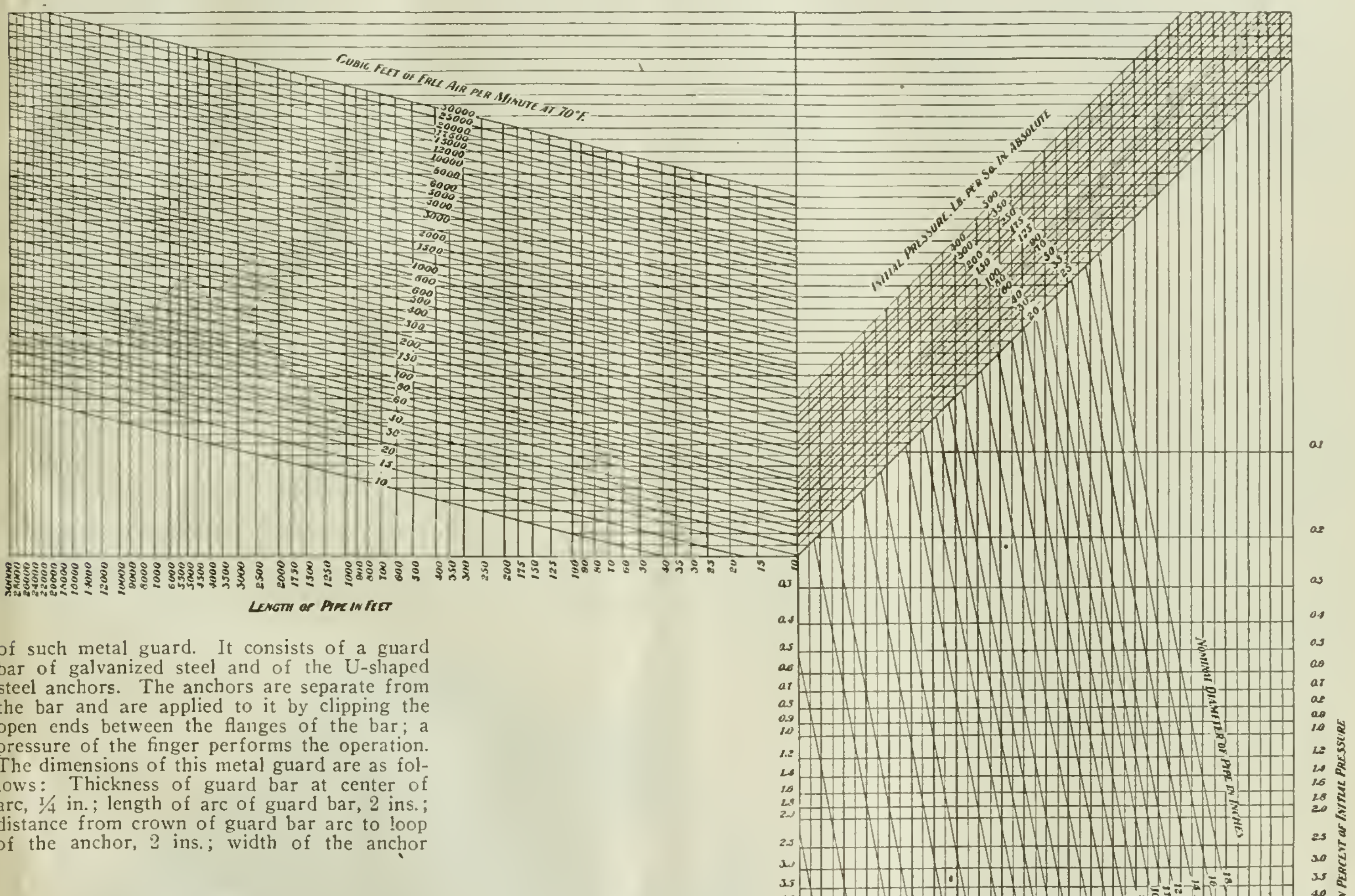


Diagram for Flow of Air in Pipes.

Should it be desired to use K', another value for K than the one given, the values of V from the chart are to be multiplied by $\sqrt{\frac{K}{K'}}$

Should the discharge from a pipe be required for another temperature than 70° F. (530° absolute) the values of V from the chart are to be multiplied by $\sqrt{\frac{T'}{530}}$, where T' is the absolute temperature desired.

The use of the air flow diagram is simple. If the volume of free air per minute, the length of pipe, the initial pressure, and the permissible drop in pressure are given, proceed as follows:

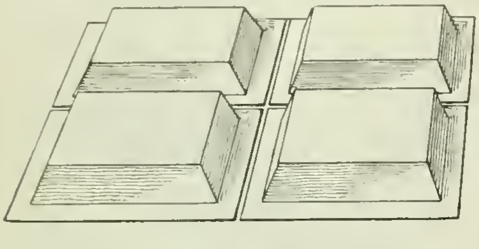


Fig. 1—Panel Mold Units for Floor Slab Centering.

From the length of pipe in ft. follow a vertical line to its intersection with the volume line; from this point follow a horizontal line to its intersection with the initial pressure line, and from there follow a vertical line until it intersects the horizontal line through the given pressure drop. The position of this last point determines the proper pipe diameter. Any other combination of given data is handled similarly.

This diagram may be adapted to other gases than air (assuming the coefficients of resistance to be the same) by multiplying the volume of air by $\sqrt{\frac{v'}{v}}$ where v^1 and v are respectively the specific volumes of the given gas and of air; or by $\sqrt{\frac{1}{D}}$ where D is the density of the given gas in terms of air.

To illustrate, let $L = 2{,}000$ feet, $V = 1{,}000$ cu. ft., $p_1 = 100$ lbs., drop $= 5$ per cent. Following a vertical line from $L = 2{,}000$ to $V = 1{,}000$, a horizontal line to $p = 100$, a vertical line to drop $= 5$ per cent, it is found that a 4-in. pipe is the nearest commercial size available, although the drop for this size is about 6 per cent.

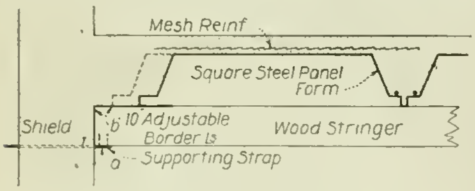


Fig. 2—Sketch Showing Manner of Supporting Panel Mold Floor Centers.

Without the aid of the chart, the solution of the problem just given would require considerable time since the pipe diameter can only be obtained from the formula by a series of approximations, and at least three trial solutions would ordinarily be necessary.

Quick Removal of Wreckage.—After a recent fire in Baltimore which destroyed a large street building a quick job of cutting up and removing the wreckage was done by means of a No. 3-T oxyacetylene welding and cutting plant. The frame was a mass of twisted members, mostly 10-in. steel channels. The plant was mounted on a truck and 50-ft. lengths of hose used. Thus one operator and helper with a single torch were able to cut up the wreckage into movable lengths faster than five men could load it on rail trucks and take it away.

Steel Forms for Paneled Ceiling Floor Slab Construction.

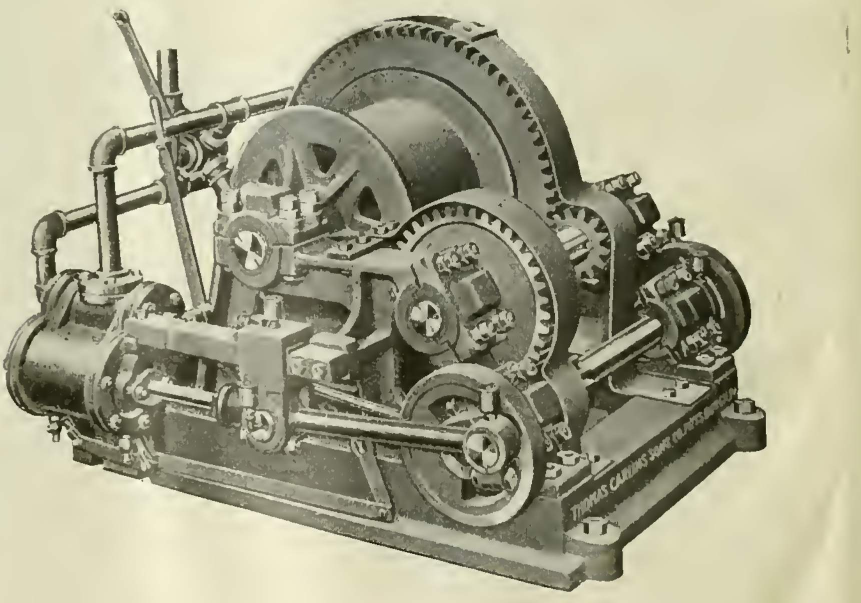
(STAFF ARTICLE.)

A system of concrete floor slab centering composed of solid panel forms is illustrated by the accompanying sketches. Figure 1 shows an assembled group of four panel forms, but the units, which are usually made 3x3 ft., may be assembled in any desired arrangement or number. To use these panels, the building walls and interior columns are carried up to the height of the floor. The floor girder forms are then built and over them and also over the wall tops or the tops of the wall girder forms, are placed perforated straps, as indicated at *a*, Fig 2. These straps are inclosed in an envelope to permit easy removal after being concreted around and are spaced about 3 ft. apart. These straps, projecting as shown at *a*, Fig. 2, support the ends of 2x6-in. joists. Spanning from joist to joist and binding their ends are placed angle plates, *b*, Fig. 2, of ⅛-in. steel in lengths convenient for the work, the lengths being lapped and as many used as are necessary to surround the panel spanned. On these angle plates and on the joists are set the panel molds as indicated by Fig. 2. This completes the center for the slab and the concrete is then reinforced and poured as indicated. The completed slab has a 3-in. top or slab proper stiffened by underside ribs 8 ins. deep. Where a paneled ceiling is not desired a metal lath and plaster ceiling can be applied to cover the exposed ribs. The forms described are the invention of Milton Dana Morrill, 1 Joralmon St., Brooklyn, N. Y.

A Derrick Swinging Engine Which Abolishes Shock in Stopping.

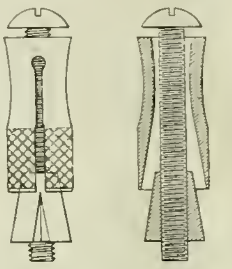
(STAFF ARTICLE.)

Engines with high-gear ratio used for swinging have a great tendency to stop suddenly and throw a heavy strain on the derrick and bull wheel and on the engine itself. The engine shown by the accompanying cut aims to remedy this trouble by a special design of four-way reversing valve. This valve has its parts arranged to give free exhaust when swinging and also so that when in the off position they connect the exhaust outlet with the steam outlet of the cylinders. This allows the engine to come to rest gradually.



A New Derrick Swinging Engine.

The engine, as will be seen from the illustration, is of the single drum, double-geared type. All bolts which attach the engine to the bed plates are reamed so that the engine is perfectly stiff when assembled. The shafts are large, and are turned all over. The crank shaft pinion is made from a forging, and the intermediate gear has machine-cut teeth. The cylinders are of the piston valve type; tl valves are fitted with rings and work in cag in which the ports are accurately laid out. Th type of valve is perfectly balanced when ru ning in either direction. The cross heads ha tapered gibs, both top and bottom, and are a justed by stud in nuts. The connecting ro are of crucible steel, and have bronze bus ings at each end, which are renewable.



Expansion Bolt for Fastening to Concrete Masonry.

This engine is made in 4x5-in., 6x7-in., 6-in. and 7x8-in. sizes, by the Thomas Carlir Sons Co., Pittsburgh, Pa.

An Expansion Bolt Unit for Bolting Concrete or Other Masonry.

(Staff Article.)

The expansion bolt shown by the accor panying sketch was tested to a holding pow of 500 lbs. for a 3/16-in. bolt embedded concrete and of 1,720 lbs. for a 5/16-in. bo The operation of the bolt is quite clearly inc cated by the drawing. The shell and bolt, a sembled as indicated, are inserted into a drill hole; by screwing down the bolt the cone drawn into the open end of the slotted she whose wings are thus forced apart and agair the sides of the holes. These fastenings a made in various sizes by the Van Expans Bolt Mfg. Co., Fort Dearborn Building, C cago, Ill.

Roads Improved by Automobilists.—Meeker, Colo., automobile owners have de mined to secure good roads for their vici and have added shovels and drags to tl garage equipment. On one day recently, i said, every automobile in the town was with road-leveling apparatus.

A large underground river was rece pierced in driving a tunnel through the C d'Or Mountains in France, and the work narrowly escaped with their lives.

RIVERS AND HARBORS

Construction Features of Bear Creek Hydraulic-Fill Dam, Jordan River Development, Vancouver Island, British Columbia.

Contributed by C. E. Blee, Assistant Engineer in Charge, Victoria, B. C.

The Bear Creek Dam, completed in May, 1912, forms the first of the storage reservoirs in connection with the hydro-electric development of the Jordon River, Vancouver Island, B. C. This development was carried out for the British Columbia Electric Railways Co., Ltd., by the firm of Sanderson & Porter, the design and construction of the entire project being under the personal direction of Mr. Wynn Meredith of the above firm, and the construction under the immediate charge of Mr. E. E. Carpenter. An article on the general features of the whole development has been written by Mr. Carpenter, appearing in the "Canadian Engineer" of November 28, 1912.

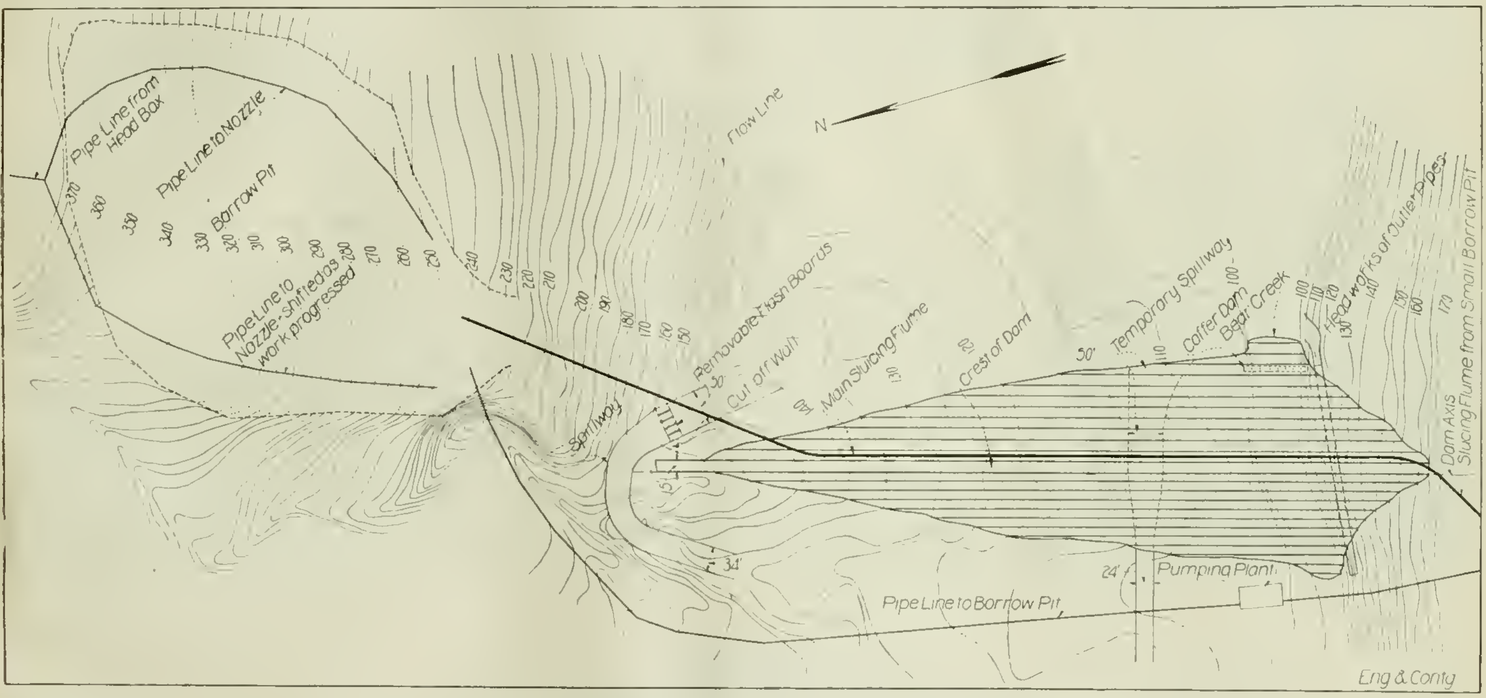


Fig. 1—Bear Creek Dam; Plan of Dam Site, Borrow Pit and Pipe Lines for Sluicing.

The scope of the present article is confined to the construction details of the hydraulic fill dam at Bear Creek, the writer having been the assistant engineer directly on this work.

LOCATION AND TRANSPORTATION.

The mouth of the Jordon River, at which place the lower camp was situated, is on the Straits of Juan de Fuca, about forty miles west of the city of Victoria. All transportation was carried on between this place and Victoria by means of a tug-boat and scows. From here there is an inclined tramway, two miles in length, operated by hoisting engines and cable; then a narrow gage railway, operated with horses and cars, parallels the flumes for about five miles. From this point the site of the dam is reached by a wagon road 4½ miles in length.

From the above it will be seen that the transportation charge on freight into Bear Creek was an important item.

PRINCIPAL DIMENSIONS.

The dam was a true hydraulic-fill structure, the material being transported and placed by the hydraulic process. The following table gives the principal dimensions of the dam and reservoir:

Total volume of dam (embankment measurement), cu. yds.	148,390
Length of crest of dam, ft.	1,017
Greatest height above original ground surface, ft.	57
Greatest height above bottom of sheet piling curtain, ft.	127
Top width of dam, ft.	15
Upstream slope of dam	3 to 1
Downstream slope of dam	2½ to 1
Capacity of spillway, cu. ft. per sec.	5,000
Distance of spillway entrance below crest of dam, ft.	15
Distance of high water level below crest of dam, ft.	5
Capacity of reservoir above outlet gates, cu. ft.	320,000,000
Drainage area of reservoir (approx.), sq. miles	8
Average annual precipitation, ins.	85

CLEARING AND STRIPPING.

The site of the dam was covered with a very heavy timber growth of fir, cedar, hemlock and spruce. The dam site proper was cleared and all stumps removed, while all timber which could reach the dam or spillway in falling was cut, but not stumped. The borrow-pit area was likewise cleared, and the stumps here were removed as they were reached by the excavation. The flowage area was not cleared, excepting the area immediately adjacent to the dam. Stumps were removed with powder and with donkey engines, and donkey engines were used to some extent in piling logs, etc., for burning. However, as a general rule, it was found more economical to bucksaw the logs into shorter lengths and roll and pile them by hand.

The area within the lines of the dam was stripped to a depth of about 2 ft. to expose the soil proper. In part of the stripping work, and in removing snow, V-shaped flumes were used to good advantage in carrying off the material. Water was diverted from a small tributary creek and carried across the dam site in light flumes, whose position could be readily shifted. The snow and stripped material was then shoveled directly into the flumes and carried off by the water, being discharged below the dam. The clearing and stripping work is summarized in Table I.

CUT-OFF TRENCH.

As soon as stripping had advanced far enough to permit it, work was started on a cut-off trench, extending throughout the length of the dam and parallel with the axis, the center line of the trench being directly under the downstream edge of the crest of the dam. This trench was 6 ft. wide at the bottom, and averaged about 20 ft. deep, with side slopes of ¼ to 1. At both ends of the dam it was carried down to bedrock as far as the practicable depth of the trench would permit, the bedrock dipping rather rapidly toward the center of the valley. The material excavated consisted of a semi-cemented gravel, and heavy boulders with thin layers of sand at deeper levels. The first lift of 5 or 6 ft. was shoveled directly into wheelbarrows. The greater part of the remainder was removed by a steam derrick with skips, a hand derrick also being used to some extent. The smaller material in the section under the old stream bed, where considerable water was encountered, was removed with a hydraulic elevator.

All material excavated from the trench was placed in the embankment, excepting near the ends where, due to the narrowness of the base of the dam, but little of this material could be used, and it was more economical to waste it than to haul to the wider portions. In placing material of any description by means other than sluicing, care was observed to keep it well without the limits of the middle third of the section, in order to reserve this central portion for the puddle material depos-

TABLE I.—SUMMARY OF CLEARING AND STRIPPING.

	Acres.
Cleared and stumped for dam site	5.3
Cleared, but not stumped, adjacent to dam	11.4
Cleared, but not stumped, for borrow pits.	9.0
Cleared, but not stumped, for camp site.	3.0
Stripped for dam site	4.1

ITEMIZED LABOR COST CLEARING DAM SITE.

Item.	Per acre.
Falling	$ 38.50
Swamping and burning brush	127.50
Bucking	140.50
Log rolling and burning	260.00
Powder work	38.50
Donkey work (pulling stumps and piling)	198.50
Second burning	60.00
	$863.50

Timber on above was estimated at 100,000 bd. ft. per acre, including unmerchantable timber. The following prices were paid for labor: Fallers, 40 cts. an hour; buckers, 32½ cts. an hour; swampers and common labor, 27½ cts. an hour. Weather conditions were unfavorable throughout the work, due to rain and snow.

Cost of stripping dam site to average depth of 2 ft., shoveling into V-flumes, $737 per acre.

ited under water. The material from the trench excavation placed in the embankment was largely used to start the toe of the slopes of the dam, thus forming dikes some 5 ft. or more in height, which would serve to retain the sluicing pond and be otherwise useful at the time of starting the fill by sluicing methods.

The total volume of material removed from the trench was 8,675 cu. yds. The direct labor cost of excavation when the steam derrick was used was approximately $1.00 per cu. yd.

TEST HOLES.

The trench described above also served to show the geological formation as far as the limits of the trench, and in order to determine the nature of the underlying material, test holes were sunk from the bottom of the trench to bedrock. This was accomplished by driving down 3-in. pipe casing, a churn drill being operated inside the casing, and the material removed with a water jet. Lengths of 1-in. pipe coupled together were used to carry the drill-bit; a 1-in. garden hose was used for the jet, this being found better than pipe, as the material forced up by the jet tended to wedge between the pipe and casing when it was attempted to withdraw the pipe.

All work in connection with sinking these holes was done by hand, and on the whole, proved very satisfactory, as the progress was fairly rapid, and the nature of the underlying strata could be determined quite accurately by the material brought up with the water jet. Holes were sunk by this method to a maximum depth of nearly 70 ft., and at an average labor cost of $0.50 per ft.

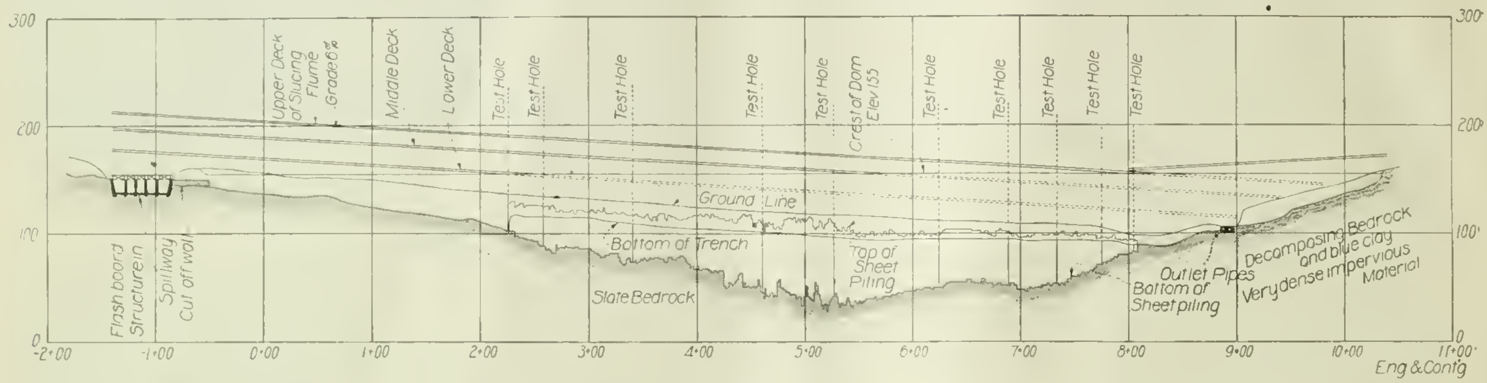


Fig. 2—Bear Creek Dam; Section Along Center Line of Cut-Off Tunnel, then Through Cut-Off Wall and Flush-Bound Piers.

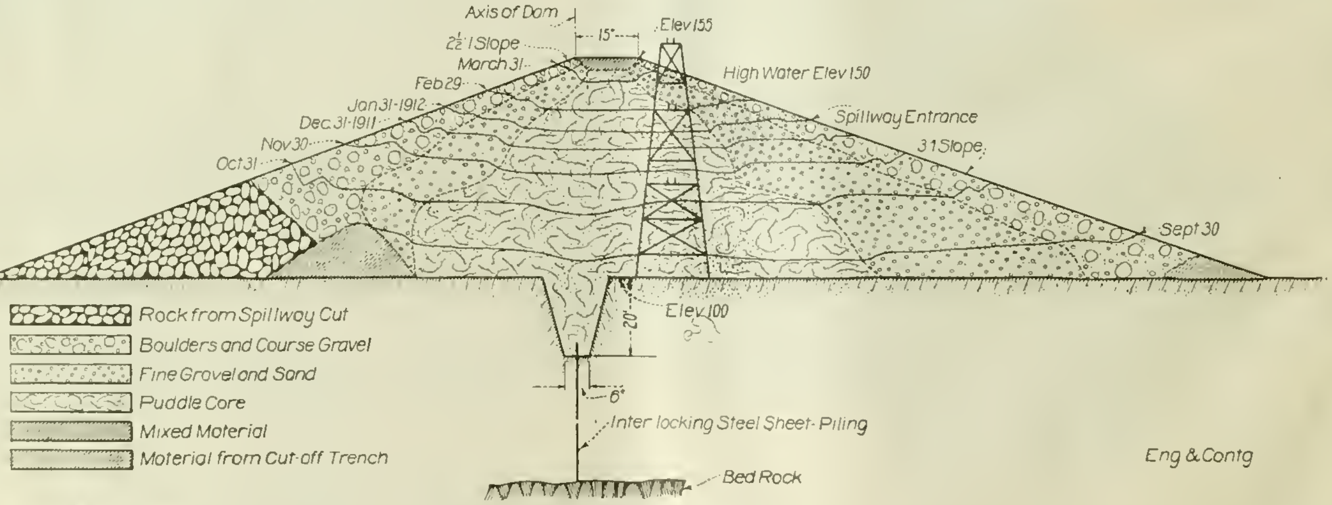


Fig. 3—Section of Bear Creek Dam Showing Distribution of Material and Monthly Progress.

STEEL SHEET-PILING.

The trench, together with the test holes, showed the formation to consist generally of a stratum of top soil 3 ft. in thickness, then heavy boulders and gravel which, at a depth of from 12 to 16 ft. changed to a stratum of semi-cemented gravel, 5 to 10 ft. in thickness. Below this were alternating layers of sand and water-bearing gravel which extended to bedrock. The bedrock, which is of slate formation, was found to dip gradually toward the center of the valley, reaching a maximum depth of 87 ft. below the ground surface.

With this data at hand, in order to provide a secure, water-tight foundation, it was decided to drive to bedrock a curtain of steel sheet-piling. This was further justified by the fact that it is planned ultimately to increase the height of the present dam so as to raise the water level an additional 20 ft., and thus double the capacity of the reservoir.

Interlocking steel sheet-piling—Carnegie 12-in. 40-lb. section—was used. Two pile drivers with 2,000-lb. gravity, hammers were operated continuously day and night in driving the piling. Driving was started in August, 1911, and it required two and a half months to complete the work. A driving cap with a wooden block was furnished with the piles; but this proved unsatisfactory, and the hammers were used directly on the piles. In hand driving, this would occasionally batter and bend the head of a pile so that a foot or so had to be cut off to straighten it up, but this was not often necessary.

The piles were furnished in lenghts of 50 ft. and less. In driving, the piling had at all times a tendency to lean forward at the top from the piles already driven, due to the greater compression encountered near the bottom crowding the lower ends closer together. It was attempted to overcome this by taking a strain on the pile with a cable and the donkey engine while driving, but this was not very effectual. When the lean became too pronounced, it was necessary to start a new row, in order to straighten up the piles; care being taken to fully overlap the end of the previous row. It was necessary to resort to this procedure about four times in the course of the work. Near the north end of the trench very hard driving was encountered, owing to the presence of large boulders, but no pile was left until it reached bedrock as indicated both by the test-holes and by the "feel" of the hammer blow.

The piling was driven along the center line of the cut-off trench, and sufficient length was left projecting from the bottom to serve as a bond with the puddle core which was to fill the trench. Also in the section of the trench which was carried directly to bedrock, a small concrete wall, 2 ft. in height, was constructed on the bedrock to serve as a key with the puddle. The trench was cleared of all loose material before sluicing was started. The following is a tabulation of the steel piling work:

Total number of piles driven	616
Total length of cut-off accomplished, ft.	580.5
Average net length cut-off per pile, ft.	0.94
Maximum penetration of pile below bottom of trench	68.5
Total piling driven, lin. ft.	28,509
Total piling driven, tons	570

OUTLET STRUCTURE.

The headworks of the outlet pipes are situated at the upstream toe of the dam, and just south of the original creek channel. They consist of a simple concrete intake provided with screens, and containing two 24-in. gate valves. The gates are operated from the platform of a light structural steel tower, 50 ft. in height, the valve stems being extended up through the platform and turned by simple hand wheels without gearing. At present a boat is used to reach the tower from the dam. Two 30-in. riveted steel pipes, ¼ in. thick, each 300 ft. long, lead from the intake through the base of the dam. There are taper inlets to the 24-in. valves, and they are connected with the 30-in. pipes by taper pieces, in order to reduce the losses of head. The trench for the pipes was excavated through bedrock, and was backfilled with concrete so as to form a casing about the pipes with a minimum thickness of 1 ft. Projecting cut-off walls of concrete were placed at intervals of about 40 ft. along the top of this casing to oppose any tendency of the water to follow along it.

The excavation for the whole outlet structure amounted to 3,730 cu. yds., and 343 cu. yds. of concrete were placed in the headworks and pipe casing.

During the early construction period a cofferdam consisting of a timber-crib, rockfill structure with earth backfilling was constructed to divert the stream through the outlet pipes, the discharge during the summer months amounting to only a few cubic feet per second. This cofferdam was so placed as to be included within the upstream toe of the main dam as the work progressed.

BORROW PITS.

The main borrow-pit was located on the north side of the valley, directly opposite the dam, and about 400 ft. from the north end of the dam axis. Test pits showed this to be the only available deposit sufficiently large to furnish the material for the embankment. The material was a hard-pan made up of sand, gravel, and boulders, mixed with clay, and overlying the bedrock in depths of from 8 to 18 ft. It was not an economical material to handle, as it was necessary to break it with powder, it required a heavy grade on the flumes, and a large amount of boulders had to be handled and wasted in the pit; but it was so proportioned that when segregated and deposited by the hydraulic process it formed an embankment which, for stability and imperviousness, could not be surpassed.

Small borrow-pits were opened on the south side of the valley to be used in finishing the south end of the dam. The main pit was at an elevation of from 150 to 250 ft. above the valley floor, which is equivalent to 95 and 195 ft. above the crest of the dam.

EQUIPMENT FOR SLUICING.

Gravity Water Supply.—A gravity supply of water was obtained from a small tributary creek rising on the north slope of the valley, and entering Bear Creek just below the dam. A crib dam, 13 ft. in height, was built near the head waters of this creek, forming a storage reservoir with a capacity of approximately 1,500,000 cu. ft., which was sufficient to operate the sluicing five to seven days, aided by the natural flow of the creek. This storage proved very useful, as the stream fluctuated rapidly with weather conditions, running very low in dry periods or in freezing weather. The water was diverted at a point about half a mile from the dam site, and carried by means of a 10-in., spiral-wound wood-stave pipe to a head-box above the borrow pit. This pipe had a capacity of approximately 7 cu. ft. per second. From the head-box to the borrow-pit, a distance of about 400 ft., an 8-in. slip-joint riveted steel hydraulic pipe—No. 12 gage—was laid. A gate was provided at the head-box and two 2-in. standpipes installed as air valves. Care was taken to securely anchor this pipe, especially at all angle joints. A Y piece was installed just above the borrow-pit with one pipe leading down the west side, and the other down the east side of the pit. Both were provided with gate valves near the Y. The monitors were connected directly to these pipes, which were shifted about as the progress of the work required. The static head at the nozzles ranged from 125 to 225 ft., giving discharge of from 3 to 6 cu. ft. per sec. Nozzle tips of 3 and 4-in. diameter were used.

Pumping Plant.—A pumping plant was installed just below the dam near the creek, to be used whenever the gravity supply ran low, and so avoid, as far as possible, delays in sluicing operations. This was considered necessary as it was imperative that the dam be completed in time to store water for use during the summer of 1912. The plant contained two three-stage centrifugal pumps, 6-in. discharge, 1,000 gals. per minute capacity, the pumps being driven by steam engines, equipped with four 50-H. P. boilers. Wood cut near the site was used for fuel. When running at full capacity, about 25 cords were burnt per 24 hours. This was delivered at the plant at an average total cost of $3.50 per cord.

The small borrow pits south of the dam were operated entirely by water from the pumps.

For lighting the works, 16 c. p. incandescent lamps were strung on each deck of the main flume and laterals, the power being generated by a D. C. 100-amp. 125-volt dynamo, operated in connection with the pumping plant.

Sluicing Flume.—A main flume of three decks was erected to carry the sluiced material from the borrow-pits into the dam. This flume extended the full length of the dam, parallel to the axis, and with its center-line 8 ft. upstream from the upstream edge of the crest. It was so located in order to be clear of the cut-off trench, but ordinarily it is better practice to keep the flume within the lines of the crest so that as the fill approaches the crest, any overflow from the flume will not tend to wash out the newly formed slopes.

A flume box was carried on each of the three decks, the dimensions of box and trestles being indicated by the accompanying sketch, Fig. 4. The blocks used in the bottom of the boxes were cut on the site, and it was found economical to select the best fir timber for

TABLE III.—RECORD OF SLUICING OPERATION.

Date.	Number of days.	Gravity or pumped water.	Sluicing time, hrs.	Time effy., %.	Aver. water used. Sec. ft.	Water used. Cu. yds.	Material placed in dam. Cu. yds.	Ratio material to water, %.	Cu. yds. placed per 24 hrs. sluicing time.	Cu. yds. placed per 24 hrs. straight time.	Cu. yds. placed per 24 hrs. sluicing time per sec. ft. of water.	Remarks.
							9,900					Preliminary work, opening up pit, etc.
1911— Sept. 14-24	10	Pump	120.0	50.0	3.4	54,000	4,030	7.5	806	403	237	Delays due to filling pond and pump. plant repairs.
Sept. 24-Oct. 10	16	Pump	330.0	86.0	3.3	144,200	9,460	6.6	688	591	208	Delays due to drawing down pond and pump. plant repairs.
Oct. 10-20	10	Pump	70.0	29.2	2.9	27,200	2,950	10.8	1,010	295	350	Delay 24 hrs. due tem. spillway; closed down Oct. 14-21 waiting for grav. water.
Oct. 20-31	11	Grav.	27.5	10.4	4.4	16,000	1,050	6.6	917	96	208	Closed down Oct. 22-31 waiting for grav. water.
Oct. 31-Nov. 10	10	Grav.	84.0	35.0	6.1	68,400	3,325	4.9	950	333	156	Closed down Oct. 31-Nov. 6 waiting for grav. water. Extremely cold weather interfered with sluicing.
Nov. 10-20	10	Grav.	83.5	34.8	6.3	70,000	2,825	4.0	811	282	129	Delay 5 days due tem. spillway; 1 day by accident to wood pipe line; 3 hrs. for flume repairs.
Nov. 20-30	10	Grav.	205.5	85.6	6.3	173,000	8,780	5.1	1,025	878	163	Delay 38 hrs. due tem. spiltway; 2 hrs. flume repairs.
Nov. 30-Dec. 10	10	Grav.	221.5	92.3	6.4	188,200	7,810	4.2	846	781	132	Delay 17 hrs. due tem. spillway; 3½ hrs. flume repairs.
Dec. 10-31	21	Grav.	272.0	54.0	6.1	221,100	10,320	4.7	911	492	149	Delay 300 hrs. removing temp. spillway; 13½ hrs. changing pipe line; 19 hrs. filling pond.
1912— Dec. 31-Jan. 10	10	Pump	89.0	70.0	1.4	16,840	725	4.3	196	335	140	Delay 24 hrs. removing temp. spillway; 10 hrs. pipe line frozen; 25 hrs. thawing ice on pond.
		Grav.	79.0		5.5	57,500	2,620	4.6	796		145	
Jan. 10-20	10	Grav.	203.0	84.6	5.9	160,000	6,730	4.2	796	673	135	Delay 22.5 hrs. thawing ice on sluicing pond; 35 hrs. resetting valves on pipe.
Jan. 20-31	11	Grav.	259.0	98.2	6.8	233,600	9,530	4.1	883	866	130	Delay 3 hrs. repairing flume bottom.
Jan. 31-Feb. 10	10	Grav.	241.0	100.0	5.3	169,000	10,320	6.1	1,030	1,032	194	No delays.
Feb. 10-20	10	Grav.	240.0	100.0	4.3	137,000	9,500	6.9	950	950	220	No delays.
Feb. 20-29	9	Grav.	167.0	98.9	4.4	97,900	8,320	8.5	1,195	1,096	272	Delay 2½ hrs. engine repairs.
		Pump	46.5		3.0	18,200	1,540	8.5	813		271	
Feb. 29-Mar. 10	10	Pump	223.3	93.0	3.0	88,200	6,665	7.6	716	667	239	Delay 13 hrs. for oiling engines; 4 hrs. delay shifting pipe line.
Mar. 10-20	10	Pump	122.5	51.0	3.0	48,810	3,775	7.7	740	378	243	Delay 63½ hrs. relaying pipe line; 27½ hrs. engine repairs, etc.; 26½ hrs. shut down, proper material not in reach of pumps.
Mar. 20-31	11	Pump	41.5	65.4	3.5	19,160	1,300	6.8	751	624	215	Closed down 79 hrs. waiting for grav. water; 9½ hrs. delay moving monitor, etc.; 4 hrs. building up slopes on dam.
		Grav.	131.0		4.3	75,100	5,560	7.4	1,020		237	
Mar. 31-Apr. 15	15	Grav.	133.0	48.5	4.5	79,900	5,800	7.3	1,047	492	233	Break in slope on dam—delay 23 hrs.; 14.3 hrs. building up slope on dam. Night shift discontinued April 4 = 148 hrs. closed down.
		Pump	41.4		3.8	21,000	1,570	7.5	910		239	
Totals and averages.	—	Grav.	2,347.0	...	5.6	1,746,700	92,490	5.3	946	....	169	
		Pump	1,084.2	...	3.0	437,610	32,015	7.3	709	....	236	
	214	Combined	3,431.2	67.0	4.8	2,184,310	124,505	5.7	871	582	181	
							9,900					
							134,405					

these. It was necessary to replace these blocks after the passage of about 25,000 cu. yds. of borrow-pit material, and even before this they would become so badly hollowed out and worn as to interfere considerably with the flow of the sluiced material. There was but slight wear on the sides of the flumes, the original boards lasting throughout the work. A grade of 6 per cent was used on the main flume, and this proved to be as light a grade as could be used with the dense heavy material which was found in the borrow-pits here.

Lateral flumes, branching off from the main flume, and then curving and extending along near the face of the slope and parallel to the axis, were erected to distribute the material along the edges of the rising embankment. Two types of laterals were used, according to the construction of the flume-box. The longer and more permanent laterals had a box with flush or butt joints and of practically the same construction as the main flume box, also the same grade—6 per cent—was used on these. The material was dumped by means of gates or openings in the sides of the box, and where necessary for the placing of the material, spouts were attached to these openings. The box on the other type of lateral had telescopic or lap joints, and was of lighter construction throughout. Grades of 7 and 8 per cent were necessary with these, because of the loss of grade due to the lapping. The material was dumped from the telescopic boxes by simply displacing them at the joints where desired.

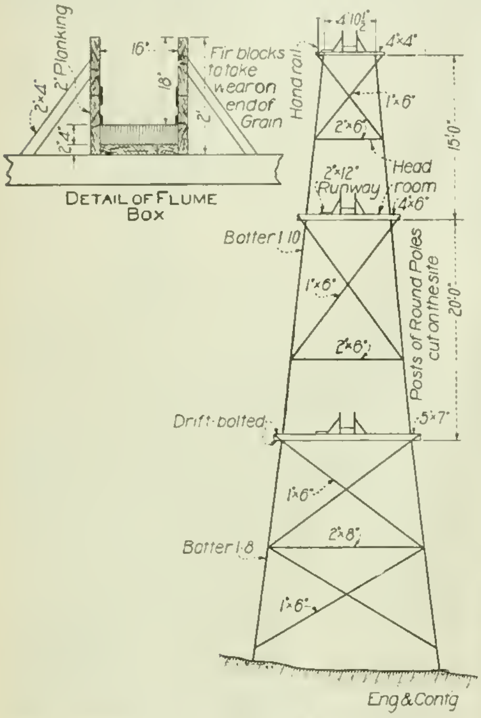


Fig. 4—Sketches of Main Sluicing Flume, Bear Creek Dam.

As the slopes approached the crest, the material was distributed directly from the main flume by means of spouts.

SLUICING OPERATION.

Sluicing was started Sept. 1, 1911, and carried on as nearly continuously as possible in day and night shifts of 12 hours each. Delays were encountered due to weather and flood conditions, so that sluicing operations were maintained 67 per cent of the total elapsed time after starting. However, the fill was completed April 15, which was somewhat earlier than had been anticipated.

Weather as cold as 5° F. above zero was experienced, and the snow on the ground reached a depth of about 3 ft. The extreme cold interfered with the flow of the sluiced material by the freezing along the edges of the sluiceways and the formation of ice on the sides of the flumes. Also the ice on the sluicing pond attained considerable thickness, but this was overcome by laying steam pipes around the edge of the pond, and introducing live steam from the boiler plant. With the outside temperature ranging from 10° to 25° F., it was necessary to operate the thawing system about 12 hours out of 48 to keep the pond comparatively free of ice.

During the months of November and December some severe delays were occasioned by maintaining the temporary spillway through the dam. Further delays were due to a failure of the gravity supply of water, when suitable borrow-pit material was not available at an elevation to be economically reached with pumped water.

In the borrow-pit, a nozzle was maintained on each side of the pit, the two being operated alternately in periods of about six hours. While the nozzle was in operation on one side, the crew would remove the boulders from the sluiceways, and put in the holes for breaking the ground on the other side. It was necessary to break all the ground with powder. "Gopher" holes were put into the base of the banks to a depth of from 10 to 16 ft.; also in places where the ground was shallow downholes were put in by driving 1-in. drill steel.

The larger masses resulting from the heavy shots were "bulldozed" and the whole further broken down with picks. Throughout the work the amount of powder used in the complete breaking of the ground ran remarkably close to ¼ lb. of powder per cubic yard of ground. In the "gopher holes" 25 per cent dynamite was used, and 40 per cent was used for bulldozing."

A fairly large proportion of the boulders were too large to be transported in the flumes with the amount of water available, and these had to be handled and wasted in the pit. They were removed from the sluiceway when the nozzle was not in operation, and were generally thrown out on the side toward the center of the pit, so as to form a wall or dike which would confine the water in the sluiceway and tend to throw it in toward the bank. This had the effect of cutting out the sloping toe of the bank and keeping the face vertical, which was of considerable help in putting in the "Gopher holes." It is estimated that 10 per cent of the total material removed was handled and wasted in the pit. Also when the sluicing was in operation, men were kept in the sluiceway with long-pronged rakes removing the larger boulders and keeping the material moving. It was found necessary to keep the sluiceways cleaned right down to bedrock, or the material would start to deposit and block up, even where the grade was as steep as 15 or 20 per cent. The stream from the nozzle was frequently turned into the sluiceways to push the material. Later on in the work, flume boxes were carried up closer to the working face, and this did away with much of the work of maintaining the open sluiceways on the bedrock.

A donkey engine was used for pulling and removing stumps as they were undercut by the excavation. It was also used in removing large boulders, and a stone-boat was used to some extent in removing rock.

Flume tenders were stationed on the flume to keep the material moving when blockades started to form. These blockades were fairly frequent, and when they occurred it was necessary to stop sluicing and run in clear water from the nozzle. Two men were kept on the lateral flumes to attend to the depositing of the material along the edge of the embankment.

As the material was deposited from the flumes, the boulders and coarse gravel would form conical piles, while the lighter material was carried off by the water toward the sluicing pond, the material being graded and deposited as the velocity of the water decreased until when it reached the edge of the pond and the velocity was entirely checked, all sand, etc., was immediately dropped, and nothing but the fine clay silt was carried in to the puddle core. From the edge of the embankment when deposited, the material formed a slope of about 5 per cent until the edge of the pond was reached, when it dropped off abruptly at a slope of 1 to 1. The surface of the puddle forming the bottom of the pond was practically level.

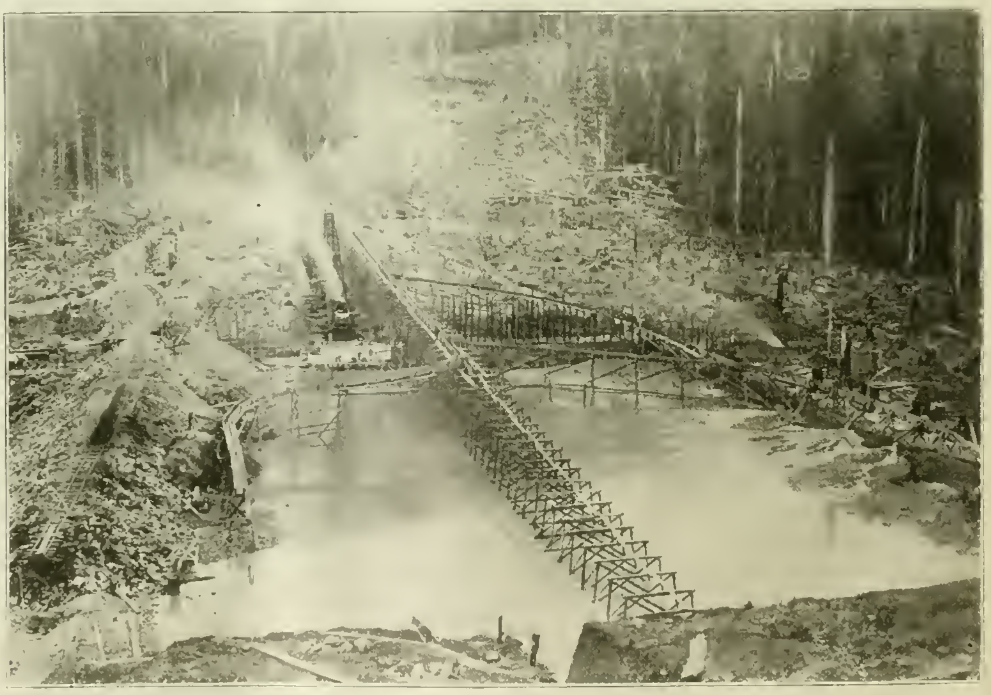


Fig. 5—General View of Bear Creek Dam from South End During Early Construction Period.

(Main sluicing flume is shown extending down the center from the borrow-pit in the background, and with the lateral flumes leading off from it. In the middle ground is the temporary spillway, under construction, and just beyond this are the two pile drivers, driving steel sheet-piling. On the downstream toe is the rock-fill from the spillway cut.)

An average crew of eight men was employed in shoveling to slope the piles deposited from the flumes.

No difficutly was experienced in maintaining the slopes, as the outer portion of the embankment was built up entirely of boulders and coarse material which gave stable, well-drained slopes. Boulders as large as 8 ins. in diameter were delivered through the flumes.

By sluicing from different sections of the borrow-pit, it was possible to select material with differing proportions of clay and coarse ingredients. This proved quite helpful, especially as the dam neared completion, for if the sides were building up too fast in proportion to the puddle, material could be selected that carried a greater proportion of clay.

The puddle core was examined on several occasions when the pond was drawn off, and showed no tendency toward stratification. The first few inches on the surface of the puddle was very light and fluffy, but at a depth of 2 ft. or so it became stiff and fairly solid, showing that it drained and solidified rapidly.

An outlet for the sluicing pond was, in the earlier stages of the work, provided by a timber culvert extending in from the downstream toe of the dam to a vertical shaft, also of timber. This shaft was carried up as the work progressed, the level of the pond being regulated by openings or gates in the shaft. The depth of the pond was usually kept at from 3 to 6 ft., according to the width desired for the puddle core. As soon as the embankment had reached an elevation such that the pond backed up into the north end of the cut-off trench, a deep narrow ditch was cut from this into the spillway, so that the pond would now discharge through this ditch, by way of the cut-off trench. This was desired in order that any current set up in the sluicing pond would tend to carry puddle material up into the north end of the trench, for it was feared that there might be a shortage of puddle for this portion, due to the narrowness of the dam section here. The level of the pond was now regulated by placing sandbags in the entrance to the ditch, and the waste water was discharged into the reservoir by means of a small flume. This was done simply as an extra precaution in order that the fine material carried by the waste water might tend to silt up the reservoir floor.

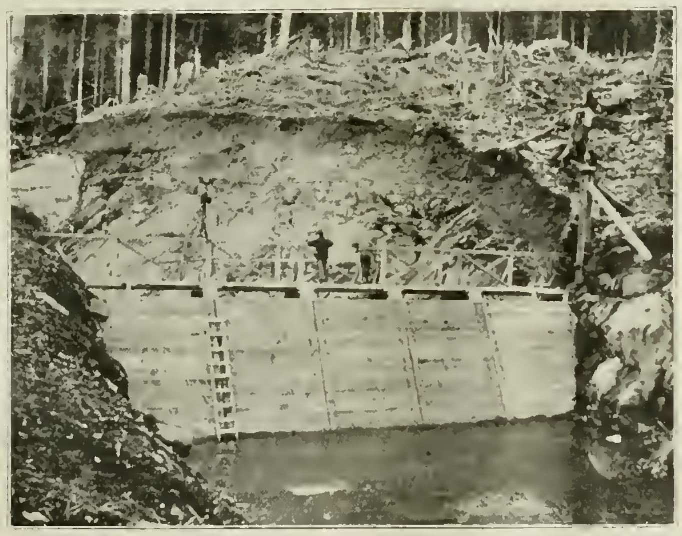


Fig. 6—Flush Bound Structure in Spillway of Bear Creek Dam.

TABLE II.—COST, BY MONTHS, OF SLUICING OPERATION.

	Cu. yds.	Cost.	Cost per cu. yd.
September, 1911, placed..	17,470	$10,480	$0.60
October, 1911, placed....	9,920	7,216	.73
November, 1911, placed..	14,930	6,575	.44
December, 1911, placed..	18,130	7,135	.39
January, 1912, placed....	19,605	8,198	.42
February, 1912, placed...	29,680	8,167	.27
March, 1912, placed......	17,300	6,506	.38
Totals for 7 months....	127,035	$54,277	$0.42½

As the fill neared completion, the puddle core was carried up to high water elevation, and then in topping off the embankment, mixed material was dumped in directly from the flumes without maintaining any pond. The work of topping off was started at the south end, the water draining off at the north end.

Following is a list of the average force employed in the borrow-pit, and on the dam:

BORROW-PIT CREW.

Day Shift—	
1 Foreman	$ 5.75
6 Drillers (breaking ground), 11½ hours at 30 cts.	20.70
5 Laborers (rocking out sluiceways), 11½ hours at 30c	17.25
1 Nozzleman	4.00
Donkey engine crew	16.75
Night Shift—	
1 Nozzleman	$ 4.50
4 Men (breaking ground and rocking out), 11½ hours at 30 cts.	13.80
CREW ON DAM.	
Day Shift—	
3 Flume tenders on main flume, 11½ hours at 30 cts.	$10.35
2 Tenders on lateral flumes, 11½ hours at 30 cts.	6.90
8 Laborers building up slope, 10 hours at 27½ cts.	22.00
Night Shift—	
3 Flume tenders, 11½ hours at 30 cts.	10.35
2 Tenders on laterals, 11½ hours at 30 cts.	6.90
1 Foreman	5.75
Total labor cost	$145.00
Powder for breaking, 1,000 cu. yds. = 250 lbs.	30.00
	$175.00

From this force account it is seen that when sluicing with gravity water, and placing 1,000 cu. yds. per 24 hours, the normal capacity when no delays were encountered—the powder and direct labor cost of taking the material from the borrow-pit and placing it to slope in the dam was practically 17½ cts. per cubic yard.

The following costs, Table II, by months includes in addition to the powder and labor cost given above, all labor and fuel and supplies for pumping plant operation and maintenance, superintendence, and all labor and material for maintenance and extension to pipe lines and flumes.

Due to the other items included and to the delays, these costs run much higher than the amount given above. February was the only month in which gravity water was used practically throughout, and when serious delays were not encountered.

Table III gives a complete record of the sluicing operation, and indicates the cause of delays. The ratio of the material to the water would be expected to increase with the second feet of water used; but in this case other conditions influenced this ratio so that no direct relation is evident. When there was a small flow of water used, a proportionately greater amount of help was given the water, and so increased the carrying ratio. This explains why the ratio is greater with pumped than with gravity water.

A summary of the material placed in the dam is as follows:

	Cu. yds.
Rock from spillway cut	8,285
Material from cut-off trench	5,700
Sluiced from borrow-pit (measured in excavation)	129,364
	143,349
Completed structure (measured in embankment)	148,390
Excess of embankment over excavation measurement, 3.6 per cent	5,041

The figure given above for excess or swell would be modified by two conditions.

(1) The amount of fine material lost with the waste water from the sluicing pond would, if accounted for, increase this figure.

(2) In measuring the excavation in the borrow-pit, the piles of waste rock left in the pit were considered as solids. If the voids in these were corrected for, it would tend to decrease the above figures. It is evident, however, that with no losses there should be a considerable excess of embankment over excavation in taking a material such as was found in the borrow-pit here—which as far as voids are concerned was practically a natural concrete—and grading it into coarse and fine material.

PERMANENT SPILLWAY.

A spillway was cut through slate bedrock around the north end of the dam, and entirely outside of the embankment. The entrance to the spillway was 10 ft. below high water elevation, and was 50 ft. wide. About 50 ft. from the entrance, a taper was started gradually reducing the width to 34 ft., the grade being increased to maintain the same capacity, 5,000 cu. ft. per second. The cut was taken out by contract, and the most of the rock was placed on the down-stream toe of the dam. The quantities and contract price are given below:

	Per cu. yd.
Solid rock, 9,762 cu. yds.	$1.43
Loose rock, 669 cu. yds.	.50
Hard pan	.50
Earth, 836 cu. yds.	.25

The contractor was paid 25 cts. a yard extra for all rock placed on the toe of the dam.

A flashboard structure, to hold the reservoir at any desired level, was provided by placing six concrete piers in the spillway, timber stop-logs to be set horizontally against the piers. The stop-logs are handled by means of a chain-block traveling on an overhead cableway. It is intended that the timbers shall not be placed until after all danger of freshets is past, and they will probably have to be set and removed but once a year. However, provision is made for removing them with the reservoir at high water level. A platform extends from pier to pier, this serving as a runway from which to operate the flashboards, and also as a piling rack for the stop-logs when not in use.

A concrete cut-off wall, extending to impervious bedrock was placed along the upstream toe of the piers as the blasting in the spillway had opened seams in the rock forming the immediate floor. The floor between the piers and downstream for a short distance was paved with rock set in concrete to prevent erosion of the slate bedrock. A concrete cut-off wall, extending to bedrock, also connects the south abutment of the flashboards with the puddle core of the dam.

The masonry placed in connection with the flashboard structure amounted to 110 cu. yds.

TEMPORARY SPILLWAY.

A temporary spillway consisting of a large timber flume was maintained through the dam during the flood period, 1911 to 1912. Through the body of the dam the flume was 50 ft. wide, and then tapered to 24 ft., provision being made for carrying water to a depth of 6 ft. The flume box was carried across the cut-off trench on log stringers, but throughout the rest of its length the sills rested directly on the ground. All sills, posts, and yokes were of round poles cut on the site. The bottom and sides were planked and battened on the inside throughout, and the sides were planked on the outside through the dam where they would have to retain the fill. It was planned to go ahead with the sluicing, and when the fill reached the temporary spillway to let the embankment build up on each side, the sides of the flume acting as bulkheads. Then when the spillway was removed, the opening left could be filled in, but considerable difficulty was encountered.

When the level of the sluicing pond reached the flume box it tended to float the box like a barge. This was overcome by putting flashboards in the flume, and keeping the level of the water within the flume equal to that of the pond. Then the water from the pond tended to follow along the bottom of the flume on the downstream side, and so cut its way out. This was stopped by putting down a cut-off underneath the spillway floor, and at right angles to its direction.

This temporary spillway was removed about Jan. 1. It was necessary to discontinue the sluicing for a short time previous, in order to allow the puddle to stiffen, so that it would not slough in when the sides of the flume were removed. The section through the central portion of the dam was entirely removed, the sills and stringers being pulled out with a donkey engine. After the removal of this spillway a timber apron was maintained on the downstream slope as an emergency overflow until the embankment reached the level of the permanent spillway, but it was not necessary to make use of it.

In order to save as much of the run-off as possible, the level of the reservoir was allowed to follow up the embankment as the work progressed, it being kept some 10 or 15 ft. in elevation below the top of the fill. No water wasted after March 1; but exceptionally dry weather conditions prevailed during the spring season, and the reservoir failed to reach the high water level by 7 ft.

SEEPAGE.

Weirs were set below the dam to measure all leakage through or drainage from the dam. Daily readings were taken, and showed the amount of this to be steadily decreasing, although at this time the level of the reservoir was rising. This would indicate that it was largely, if not entirely, made up of drainage from the fill. On April 4, 1912, the measurements showed a total of 0.191 cu. ft. per second, and on April 27, 0.100 cu. ft. per second. Unfortunately, I have no later readings available.

SETTLEMENT OF EMBANKMENT.

During the construction, the slopes settled on an average of 0.2 ft. per 15 ft. (measured horizontally in towards the axis) up to a point within 45 ft. (measured horizontally) of the crest, where, as the slopes overlaid the puddle more, the settlement increased to 0.4 ft. per 15 ft. The settlement seemed to take place near the edge of the rising embankment, there being practically no further settlement on the completed slopes. This was noticed in setting the slope-boards. The lower end of the board was set at the edge of the completed slope, and the other end extended in 15 ft. Then when the slope had been built up to the top of this board, the board was checked up for elevation, and the next course of boards put on. It would then be found that the slope board had settled the amount noted above at its upper end, while there was practically no settlement at the lower end.

The crest of the dam was finished above grade to allow for all settlement. It settled 0.5 ft. soon after being completed, and then showed no further settlement. The slopes remained true and straight. Cross sections of the embankment taken seven months after completion showed that there had been practically no further settlement.

The surface of the slopes was so largely made up of boulders that the heavy rains of this winter have had no tendency to wash or erode them, and such wave action as there is in the reservoir has not affected them.

The Bear Creek Dam presents no features of particular engineering interest, other than that hydraulic fill dams of this height are not so common as yet, but that any data concerning them is of more or less value; also the weather conditions under which the work was performed, and the remote and heavily timbered country in which it was located make the project somewhat unique.

Method of Taking Soundings and Current Readings in the Hell Gate Channel, New York.

A special method of taking soundings and current meter readings in channels having great depth and swift currents is described in "Professional Memoirs," May-June, 1913, by Col. Wm. Black, Corps of Engineers, U. S. A. The method was developed in the course of an investigation of tidal movements in the East River at New York city, and was employed specifically for current meter readings in Hell Gate Channel, which is 120 ft. deep. We abstract as follows:

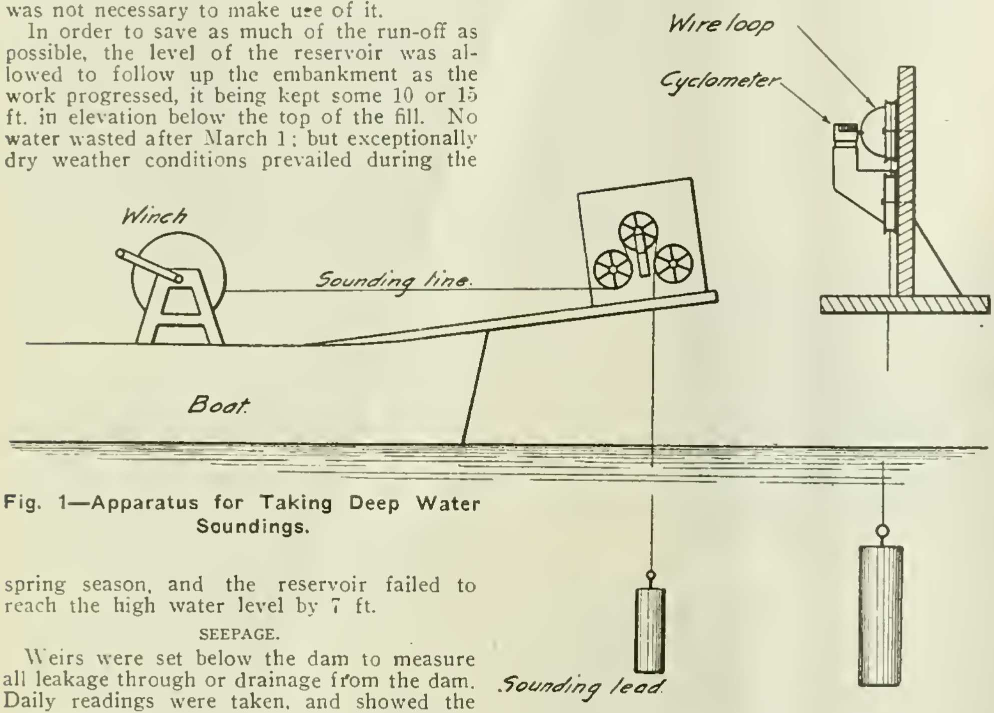


Fig. 1—Apparatus for Taking Deep Water Soundings.

The first necessity was a carefully determined cross-section at the gorge between Negro Point Bluff and Woods Island and Scaly Rock on the Long Island shore. The sounding obviously had to be done at slack water, the duration of which in Hell Gate is extremely short, requiring a heavy lead for sounding and considerable speed in its manipulation.

The apparatus shown (Fig. 1) was devised to meet these conditions. The sounding line, of 1/16-in. steel "aviator cord," supported the 20-lb. lead, and was carried over three wheels, as shown. The center wheel was exactly 1 ft. in circumference and was direct-connected to a cyclometer, which registered tenths of a revolution. As one revolution of the wheel let out 1 ft. of line, soundings could be taken to 1/10 ft. The cord led to a crab-winch in the boat, geared so as to take in or pay out the line very rapidly.

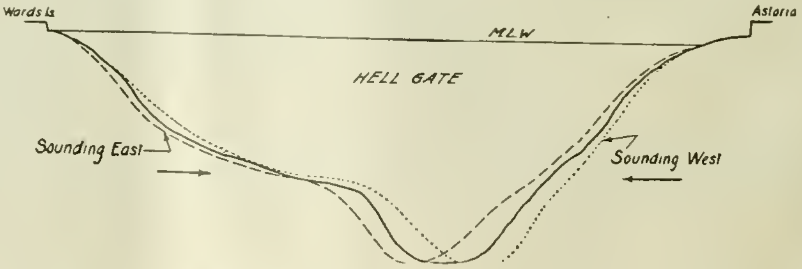


Fig. 2—Cross-Section of Hell Gate Channel, Showing Manner of Arranging Soundings.

In operation the boat was rowed across on range, at slack water, and the lead lowered by the winch until bottom was touched, when the cyclometer was read and a flag signal given to a transitman on shore to cut in on the range and locate the sounding. One range across, with soundings at intervals of about 30 ft., occupied ten or twelve minutes and was all that could be accomplished at one slack period. The proposed meter section was sounded several times, and when plotted the soundings taken in one direction gave the section shown by dotted line (Fig. 2), while those taken in the opposite direction gave a section as shown by the broken line. This was due to the "drag" of the long lead-line while being drawn across behind the boat; and the mean of the two, shown in heavy line in the figure, was adopted as the true section. Sections were sounded 250 ft. above and below the meter section, and found to differ very little from the latter or from each other, so that a reasonably straight run was assured on either side.

The first attempt at measuring current velocities, June 23 1911, resulted disastrously. A power launch, fitted with tackle for handling meters and the necessary electric recording apparatus, was taken into Hell Gate and an effort made to anchor in the current. The moorings would not hold, and in a struggle to refasten the line one man was dragged overboard and drowned, while some of the apparatus was smashed, necessitating another period of preparation. The second attempt also failed, owing to the parting of some of the electric conductors leading to the meters, but the *modus operandi* was the same as later succeeded, and which will be described.

It was recognized, as a result of the accident, that any stationary point of observation was impracticable, both on account of the difficulty of holding any craft in the current and of the time that must elapse between observations, in casting loose, moving, and making fast. Interference by traffic much of which when caught in the grip of the current is virtually beyond control, must also be considered.

The plan finally adopted contemplated the use of a steam tug, running free, which could be brought slowly up to the range and her engines throttled until she hung poised in the current during the period of the observation, about one minute for each of four depths at one position. No difficulty was experienced in thus holding the tug upon the range and the distance out was determined by a sextant angle read by an observer in the pilot house.

The three meters, heavily weighted, were suspended from an outrigger over the bow by an especially manufactured cable, made up of a center tension member (steel) and six surrounding single-strand electric conductors, insulated from the central core and from one another. Each meter had, therefore, a complete circuit of its own, and the distance between meters (about 1½ ft.) was so small that the mean of the three readings could be taken for a position, and if one, or even two, meters stopped recording, a record was still obtainable. The cable led inboard to a winch the drum of which had been built up by rolling upon it a piece of thick canvas until its circumference was just 1 ft., tested by winding up a 100-ft. tape in 100 revolutions. The length of cable was read from a cyclometer, placed on the winch, and reading feet and tenths. The actual depth, however, on account of the swift current, differed greatly from the length of line paid out. When any correction at all is made for this it is usual simply to measure the angle of departure of the suspending line from the vertical, and to multiply the length of line by the cosine of this angle to determine the true depth.

In Hell Gate, however, this departure was so large, amounting in some cases to 60°, the depth so great (120 ft. in the center) and the previous assumption, that the line is straight from the point of suspension, is so manifestly incorrect that a more accurate method of determining the depth was sought.

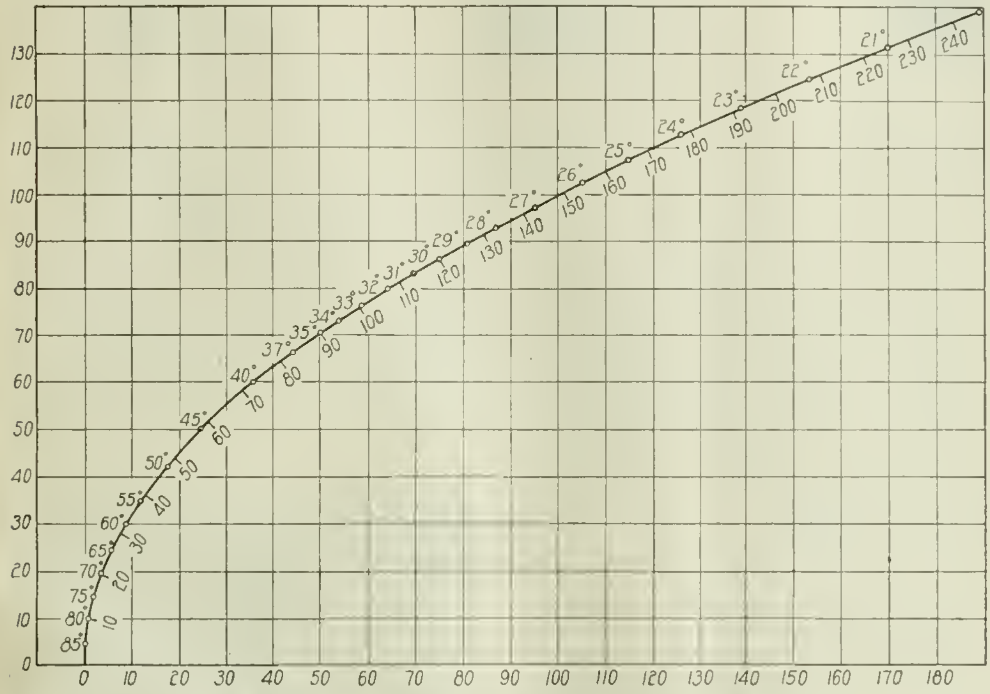


Fig. 3—Diagram for Determining True Depth of Current Meters When Length and Slope of Suspending Cables Are Known.

The line will evidently assume the shape of a curve, due to the tension of the weight acting downward, of the opposite reaction at the point of support, and of the horizontal force of current. Were this latter force uniform, the curve would evidently be a parabola, and it may be assumed to be such for all practical purposes. To find the depth of the meters, therefore, for a given angle and a given length of cable paid out, the diagram, Fig. 3, was constructed upon cross section paper. The curve is a parabola, plotted with its vertex up the X-axis, and the points of tangency marked for tangents making 24°, 30°, 35°, etc., with the horizontal.

The lengths of the curve from the vertex are placed in convenient positions upon diagram. The assumption upon which this computation is based is that for a given slope of the parabola the ratio between the curve length and the semi-chord through the point of tangency is constant. To use the diagram, suppose that the cyclometer on the winch reads 73.5 ft. of cable out, and its angle with horizontal is 60°. Locating the point of tangency for an angle of 60°, we find the length of curve to that point is 30.5, and the vertical ordinate is 28.8. Setting a slide rule to the ratio 28.8:30.5 and solving the proportion with 73.5, the recorded length of line as the third term, we obtain 69.4 as the depth of the meters.

No great refinement is claimed for this method, and it would probably not stand the test of a rigid mathematical analysis, but it is at least more accurate than the ordinary method of considering only the slope of the line, and in testing its accuracy by lowering the meters to bottom in localities previously sounded at slack water, the results agreed uniformly within 1 per cent or less, whereas, for the location of the meters, an accuracy of even 2 per cent would have been sufficient.

The horizontal scale on the diagram may be used in the same manner, by a proportion, to determine the horizontal displacement of the meters. This is not excessive, and, considering the straight run, no correction was deemed necessary, but if desired, the observer may, when this amount has been determined, place himself an equal distance aft of the point of suspension when he will be above the meters and may bring his new position upon range.

The procedure of taking observations was as follows: The chief of party, equipped with a sextant, stationed himself just outside the pilot house of the tug, a table tacked up near at hand gave the sextant angles computed for 50-ft. intervals across the river. The sextant was set at the required angle for a given distance out, and the tug gradually approached the range, steering so as to arrive on line at the proper distance from shore, the meter being paid out as the line was approached. A computer was stationed in the pilot house with a slide rule, the parabolic curve depth diagram mentioned above, and a cross section chart of the meter section, from which, knowing the distance out, the depth could be picked off. As the measurement was always made at a predetermined station, and observations were made as nearly as possible at the 0.2, 0.4, 0.6, and 0.8 depths, it was a simple matter to find the depth at which the meters should be placed. Tidal height was read and signaled from shore at the commencement of each set of observations.

One man, equipped with a clinometer, read the slope of the suspending cable as the tug approached the line. From the required depth and this angle, the computer, with the diagram and slide rule, obtained the required reading of the winch cyclometer to place the meter at the desired depth. If the slope changed as the meters were raised or lowered, a second computation was made, taking but a second or two. An exact location at the 0.2, 0.4, etc., points was not imperative.

The speed was gradually reduced until finally the tug hung balanced in the current on range, with the meters at approximately the required depth. Then the three observers, each with a stop-watch and a telephone head receiver connected with one of the meters, observed the time for a stated number of revolutions, usually ten. These were called out in sequence to the recorder, who placed them in his note-book. The depth recorded was that computed from the cyclometer reading and the slope of the cable after the meters were in position, and not that at which the meters should theoreticaly be placed. The distance, however, between the actual depth and the theoretical points was in most cases negligible.

If the tug could be held stationary for a long enough period, the four depths at one station would be observed in succession, taking about five minutes, but if not, the approach was made as before at the same distance out, the meters at the new depth.

In this manner the stream was crossed, using, say, the 100-ft. stations, then returning to the starting point and crossing again in the same direction, observing at the 50-ft. points. The two trips across consumed about one hour, giving a complete observation at each interval of 50 ft. within that period.

Economic Analysis of Excavation Methods On a Typical Section of New York State Barge Canal Work.

Contributed by Emile Low, Buffalo, N. Y.

In the improvement of the present Erie Canal between Lockport and Rochester, N. Y. —the so-called long level—only small changes are being made in the alinement for the enlargement. The larger cross-section is obtained by widening and deepening the present prism and by raising the embankments.

In the present canal there is a fall of 3.16 ft. between the points mentioned above, and which slope causes a slight easterly current. In the Barge Canal this fall has been modified, the ordinary water surface elevation at Rochester having been established at 512.6 ft. A. T., and at Lockport, below the locks, at 514.9 ft. A. T., a difference of 2.3 ft. In the Barge Canal the new water surface will be about 2.6 ft. higher than the present one, and the bottom elevation of the new grade will be 2.4 ft. lower, so the increased water depth will be about equally divided between deepening the prism and raising the embankments.

Between Lockport and Rochester the present canal follows generally the 500 ft. contour (above tide), closely paralleling the south shore of Lake Ontario, about 10 miles off. The sloping country bordering this lake is rolling land and broken by small streams. The towpath of the canal is on the north side, generally in embankment, and the heel path or berme bank in cutting, except at stream crossings.

At South Greece, west of Rochester, the Barge Canal leaves the line of the present Erie Canal, the distance between South Greece and Lockport being 54.3 miles, divided into 7 contracts, ranging in length from 2.31 to 14.15 miles. Table I gives the details of these contracts. It will be noted that the cost of the Barge Canal work ranges from $115,000 to $400,000 per mile, with an average of $161,000, the high average being due to the expensive work at Medina, the crossing of Oak Orchard Creek.

Three contracts have been completed, Nos. 9, 60 and 66, Nos. 61, 62 and 64 are well advanced and No. 65 has just been let. These completed contracts are links in the Barge Canal chain and in order to give an idea what the completed waterway looks like, we present some views recently taken and some data relative to Contract No. 66, extending from Lockport to Gasport, a distance of 6.35 miles, and which is a fair example of this stretch of 54 miles of the enlarged canal.

The contract was executed by the Empire Engineering Corporation of 6 Church St., New York. Bids for the contract were opened Sept. 9, 1908, Table II showing the State Engineer's quantities, and the contractor's unit prices and extended amounts, the total aggregating $750,685. This amount was considerably augmented by various alterations, which increased the estimated cost to $852,805. By the elimination of certain pieces of work the final cost was $773,890. The contract under the supervision of Mr. F. W. Allan, General Manager, was fully completed Dec. 31, 1912, a little over four years being occupied in its execution.

It will be noted that the four main items of construction are (1) excavation, including grubbing, (2) wash walls, (3) concrete and (4) forming embankment. All necessary excavation is paid for under one classification, which includes its disposition in spoil banks. When suitable excavation is used in embankments, an additional price is paid under the head of "Forming embankments."

Various plants for excavation were employed; at first, picks and shovels, horse scrapers and ordinary derricks with scale boxes, later a Marion steam shovel and Koppel cars, also Wellman-Seaver-Morgan and Browning cranes, clam shells and orange peel buckets installed on scows and boats, and last a ladder dredge, the "Mineola," built by the Bucyrus Co. of South Milwaukee, Wis. Three other dredges of this type have been employed on the Barge Canal, the "Mohawk," on Contract 60, and the "Cyclone" and "Tornado" on Contract 12.

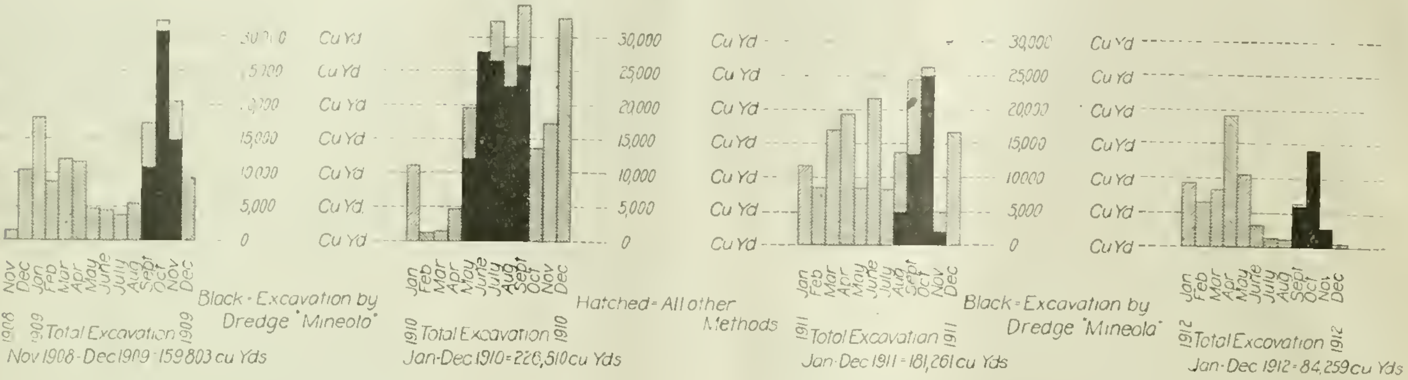


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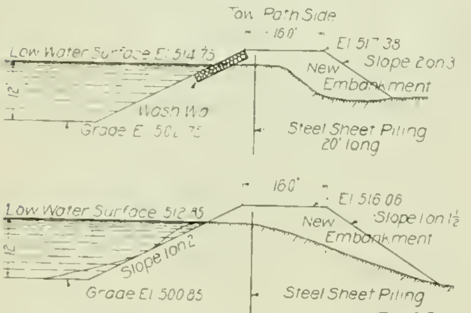
Fig. 1—Diagrams Showing Monthly Progress of Excavation and Proportion of Work Done by Dredge.



Eng & Contg

Fig. 2—Sections of Canal Embankment With Steel Sheet Pile Core.

It is attempted to give a statement of operations of the various excavation methods employed, and is believed to be reasonably accurate. It has not been possible to separate the item of "Grubbing" from the total excavation. The former item is about 30,000 cu. yds. and the price 36 cts., while the excavation price is 49.7 cts., the resulting difference being thus small and a separation ignored. Grubbing means the removal of organic matter over areas occupied by embankments and why not included in excavation can only be explained by the desire of mankind to follow precedents regardless of rhyme or reason.

TABLE II.—ESTIMATED QUANTITIES AND CONTRACT COST, CONTRACT NO. 66.

Item.	Measure.	Quantity.	Unit price.	Amount.
Cofferdam, pumping	Miles	6.35	$2,000.00	$ 12,700
Grubbing	Cu. yds.	31,500	.36	11,340
Excavation	Cu. yds.	617,700	.497	306,997
Forming embankment	Cu. yds.	283,800	.18	51,084
Forming embankment	Cu. yds.	61,600	.14	8,624
Lining	Cu. yds.	17,400	1.25	21,750
Puddle	Cu. yds.	8,800	2.00	17,600
Second class concrete	Cu. yds.	11,130	9.00	100,170
Third class concrete	Cu. yds.	1,420	7.80	11,076
Wash wall	Cu. yds.	53,500	2.50	133,750
Structural steel	Lbs.	683,300	.05	34,165
Twenty lesser items	....	....	...	41,429
Total estimated cost				$750,685

I have prepared four diagrams covering the four years of excavation, 1909, 1910, 1911 and 1912, which show the monthly progress of excavation; that done by the dredge "Mineola" is shown in black, all others by hatched lines. The dredge "Mineola" began operations in September, 1909, worked during October and November of this year, excavating a total of 56,137 cu. yds. of material. The greatest output was during October, 1909, working triple shift and removing 30,634 cu. yds., which output was never exceeded.

Referring to Table III, it will be noted that this dredge excavated altogether 240,000 cu. yds. of material or about 37 per cent of all, which at the contract price, 49.7 cts. per cubic yard, amounts to $119,280, which amount is probably not far from the original cost of the dredge. During the four years of service the dredge worked but 15 months, equivalent to a monthly output of 16,000 cu. yds., about one day's work for any of the hydraulic dredges working elsewhere on various sections of the Barge Canal.

The quantity of excavation on Contract 66 is 100,000 cu. yds. per mile, comprising roughly the removal of the bottom of the present canal, an area 50 ft. wide and 3 ft. deep and the side slopes on the berme side 25 ft. wide and 12 ft. or more in depth. Had the canal been entirely in side hill cut a large percentage of the excavation could have been removed by the ladder dredge, but as a considerable length of the berme side is also in embankment, this portion could only be widened in the winter time, when the water was out of the canal, and for this reason other methods of earth removal had to be resorted to.

A Marion steam shovel excavated 25 per cent, teams, scrapers and by hand, 16 per cent, clam shells and orange peel buckets installed on boats and scows 13 per cent and various cranes in the dry, 9 per cent. Tabulating the earnings of the various methods of excavation we have the following result:

Dry—Teams, scrapers, hand, 104,000 cu. yds.	$ 51,688
Dry—Steam shovel, Koppel cars, 165,000 cu. yds.	82,005
Dry—Wellman-Seaver-Browning cranes, 56,000 cu. yds.	27,832
Wet—Clam shells, orange peels on boats, 87,000 cu. yds.	43,239
Wet—Ladder dredge "Mineola," 240,000 cu. yds.	119,280
Total, 652,000 cu. yds.	$324,044

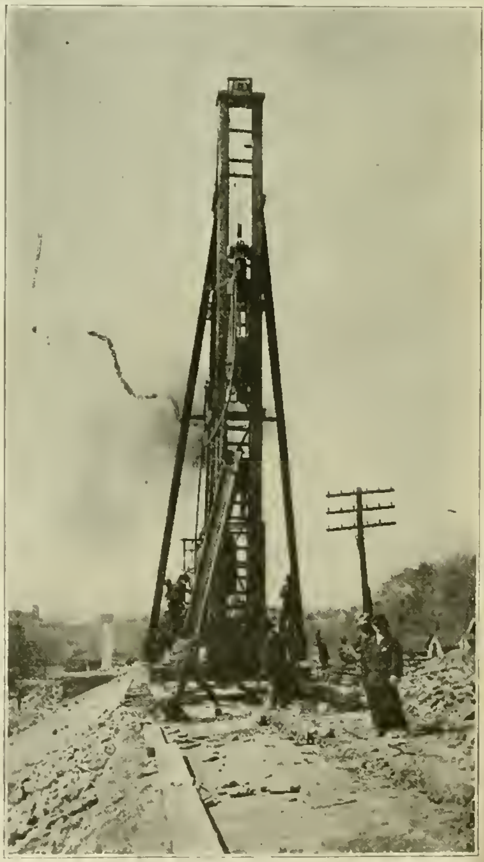


Fig. 3—Driving Steel Sheet Piling in Canal Embankment.

TABLE 1.—CONTRACTS, BARGE CANAL, BETWEEN ROCHESTER AND LOCKPORT.

Contract No.	Work begun. Date.	Contract finished. Date.	Location, Western Division, Erie Canal.	Contractor.	Length, miles.	Total cost.	Cost per mile.
60	Aug., 1908	Dec., 1912	South Greece. - .ams Basin	Empire Engineering Corporat'n	8.53	$1,308,740	$154,000
61	Nov., 1908	In progress	Monroe-Orleans Co. Line*	Cleveland & Sons Co.	7.39	1,090,853	148,000
62	Oct., 1910	In progress	Monroe-Orleans Co. Line†	I. M. Ludington's Sons, Inc.	14.15	2,577,144	182,000
9	May, 1908	May, 1911	Eagle Harbor, Medina	Thomas Crimmins Cont'g Co.	5.68	655,461	115,000
65			Medina	Maryland Dredging & Ctg. Co.	2.31	1,000,098	400,000
64	Oct., 1908	In progress	Medina-Gasport	Empire Engineering Corporat'n	9.91	1,335,434	135,000
66	Nov., 1908	Dec., 1912	Gasport-Lockport	Empire Engineering Corporat'n	6.35	773,890	120,000
Totals					54.32	$8,741,620	$161,000

*Adams Basin. †Eagle Harbor.

The excavation represents about 42 per cent of the cost of the contract. The steam shovel only operated in the winter time, when the water was out of the canal, Koppel car outfits being used to transport the excavated material. The cranes handled scale buckets set on portable transverse tracks in the bed of the canal, which were loaded by hand and pushed to the crane, which dumped the buckets upon the spoil banks. Scraper gangs also removed material in the usual way. Derrick boats resting on the bottom of the canal were used to load Koppel car outfits.

For wet excavation, after water was let into the canal, derrick boats equipped with orange peel and clam shell buckets were used. Also scows equipped with Browning cranes. Material was also handled in scows loaded by dredges and unloaded by Wellman-Seaver shore cranes.

The major portion of the wet excavation was of course handled by the ladder dredge "Mineola," although a small quantity was excavated by dipper dredges. Owing to the high cost of the ladder dredge plant this method of excavation proved the most expensive, while of the other methods the steam shovel was the cheapest, owing to the low initial cost of the plant.

In the spring of 1912 some apprehension was felt for the safety of the towpath embankment, east of Chapel St., Lockport, and as a precaution against a washout at the point mentioned, some Lackawanna steel sheet piling was driven.

Since the completion of Contracts 66 and 60 further apprehension as to the stability of certain canal embankments has arisen and it has been decided to drive steel sheet piling in the embankment of the canal at five localities within the limits of Contract 60, with a total length of 5,100 lin. ft., and at one locality within the limits of Contract 66, with a total length of 2,000 lin. ft. With the exception of 500 lin. ft. on the berme side, all is to be driven in the towpath side of the canal.

The contract for this special work, No. 112, calls for 145 000 lin. ft. 12-in. steel sheet piling, at an estimated cost driven of 90 cts. per lin. ft., amounting to $130,500. The specifications for this work are as follows:

Twelve-inch steel sheet piling shall be composed of medium steel of a quality acceptable to the engineer and shall be subjected to surface inspection. It shall be of some standard type which has been satisfactorily used in other works and the least thickness of metal shall be $^3/_8$ in., except on tapering edges. The heads of the piles when driven shall not project above or more than 6 ins. below the elevations shown for them on the plans.

Piling shall be furnished in lengths to fit the locations and shall be of such dimensions as will give a distance of not less than 12¾ ins. from center to center of piles, measured along the line of piling.

It shall be driven so that the top will be as nearly as possible at the elevations shown on the plans. All piles which project above this elevation shall be sawed off.

The contract price per linear foot of pile for 12-in. steel sheet piling shall include the cost of all labor and materials necessary to furnish, drive and cut off the piling as shown on the plans. The cost of all excavation and the backfilling necessary to place the piling shall be included in the contract price for 12-in. steel sheet piling.

Fig. 2, copied from the contract plans, show two typical cross-sections of the proposed piling. It varies in length from 20 to 24 ft. and is driven 2 ft. back from the inner top angle of the embankment, and with tops 12 ins. below the same.

Bids for furnishing and driving this steel sheet piling were received April 15, 1913, at Albany, N. Y., by Duncan W. Peck, Superintendent of Public Works, State of New York. Four bids were received. they being 83, 86, 87 and 95 cts. per linear ft., respectively. The State Engineer's estimate was 90 cts. per linear foot.

TABLE III.—YEARLY QUANTITIES OF EXCAVATION.

Method of Excavation.	Years. 1909.	1910.	1911.	1912.	Total, 4 years.	Percentage.
Teams, scrapers, hand	33,923	49,507	15,799	5,000	104,229	16
Steam shovel	69,743	34,945	43,850	16,330	164,868	25
Cranes	....	....	36,072	20,000	56,072	9
Clam shells, orange peels or scows	....	27,014	40,071	19,879	86,964	13
Ladder dredge "Mineola"	56,137	115,344	45,469	23,050	240,000	37
Totals	159,803	226,810	181,261	84,259	652,133	100

WATER WORKS

The Design and Construction of a 2,000,000-Gal. Circular, Covered, Reinforced Concrete Reservoir at Fort Dodge, Iowa.

Contributed by C. T. Harding, Water Works Engineer, with Burns & McDonnell, Consulting Engineers, Kansas City, Mo.

The City of Fort Dodge, Ia., gets its water supply from three flowing artesian wells, which have a combined flow of 1,300 gals. per minute. The water flows from these wells to a small basin at the pumping station, which is not large enough to afford any storage, but is used merely as a suction well for the pumps. This arrangement proved satisfactory as long as the rate of pumping did not exceed the flow of the wells, although a large amount of water was wasted every night when not much water was pumped. However, during the summer of 1912 the water consumption increased to more than 1,300 gals. per minute during the daytime and there was a shortage of water, although the wells easily flowed enough water during the 24 hours to supply the total daily consumption. It then became evident to the city commissioners that they must either drill more wells or provide some means for storing the water that was wasted at night, and they decided upon the latter course. As a result, a 2,000,000-gal. reinforced concrete reservoir has just been completed, which has ample capacity for storing the surplus water at night and furnishing the excess of water that is needed in the daytime over and above the flow of the wells.

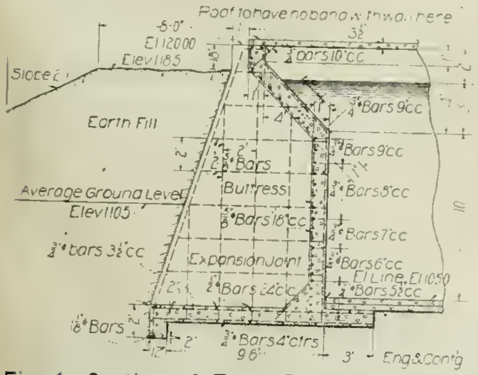


Fig. 1—Section of Fort Dodge Reservoir Wall Through Buttress.

The reservoir is located on an island in the Des Moines River immediately opposite the pumping station, and is so designed that the high water line of the reservoir is at the same elevation as that of the suction well into which the water from the wells flows. The reservoir and suction well are connected by an 18-in. pipe, which remains open at all times, and the overflow pipe is at the reservoir. With this design no low service pumping machinery is necessary and no attention is needed to this part of the plant, as no water overflows or wastes until the reservoir is full.

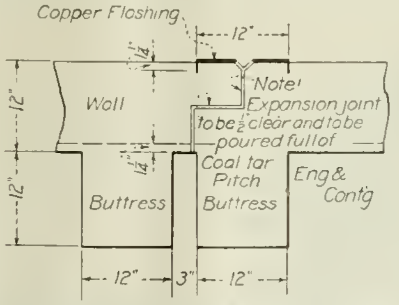

Copper Flashing
12"
12"
Wall
Note!
Expansion joint to be ½" clear and to be poured full of Coal tar Pitch
Eng & Cont'g
12"
Buttress
Buttress
12"
3"
12"

Fig. 2—View of Double Buttress Just Below Roof.

DESIGN.

The reservoir is circular and is constructed of reinforced concrete throughout, with concrete columns, beams, girder and roof slab. It is shown in plan and elevation in Fig. 4. It is 162 ft. in diameter at the bottom, 13 ft. deep to the high water line, and 15 ft. deep to the top of the walls. The walls are vertical for 10 ft. and then slope outward at an angle of 45° as a precaution against damage from expansion, should the water freeze. A section of the wall through a buttress is shown in Fig. 1. The side walls are 12 ins. thick through the entire height, reinforced both horizontally and vertically and supported every 12 ft. with buttresses, which carry the stresses to the footing under the walls. A view of the double buttress just below the roof is shown in Fig. 2. This footing is heavily reinforced, 12 ins. thick and 13½ ft. wide and extends all around the reservoir. This footing was designed heavy on acount of poor foundation. Both the wall and footing are designed in sections 36 ft. long, with expansion joints between, which system not only allows for the expansion in the walls and footings but divides the work into sections of convenient size for one day's work and thereby does away with construction joints in the concrete and aids in obtaining a waterproof job. A sheet of lead, bent in the form of a channel, covers the expansion joint on the inside of the reservoir. The bent edges of the sheet are imbedded in the concrete on either side of the joint and a groove is made in the sheet at the joint to provide for expansion in the lead. A section through the base of the column is shown in Fig. 3, and a section of the floor is shown in Fig. 5.

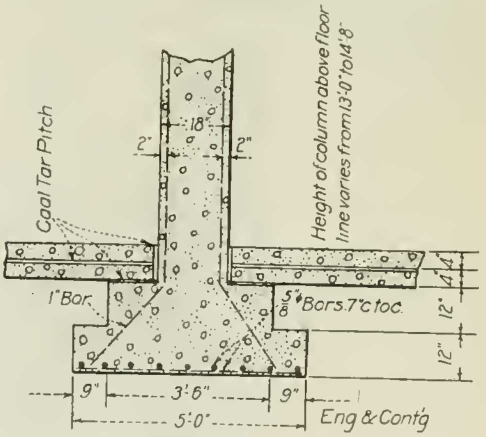


Fig. 3 — Section Through Base of Column.

METHOD OF CONSTRUCTION.

All excavations were completed to the outside of the footings before any concrete was placed and the excavated material was placed in a circular dump around the excavation to a height slightly higher than the finished wall, with the exception of a short space at one end where the concrete mixer stands, as shown in Fig. 6.

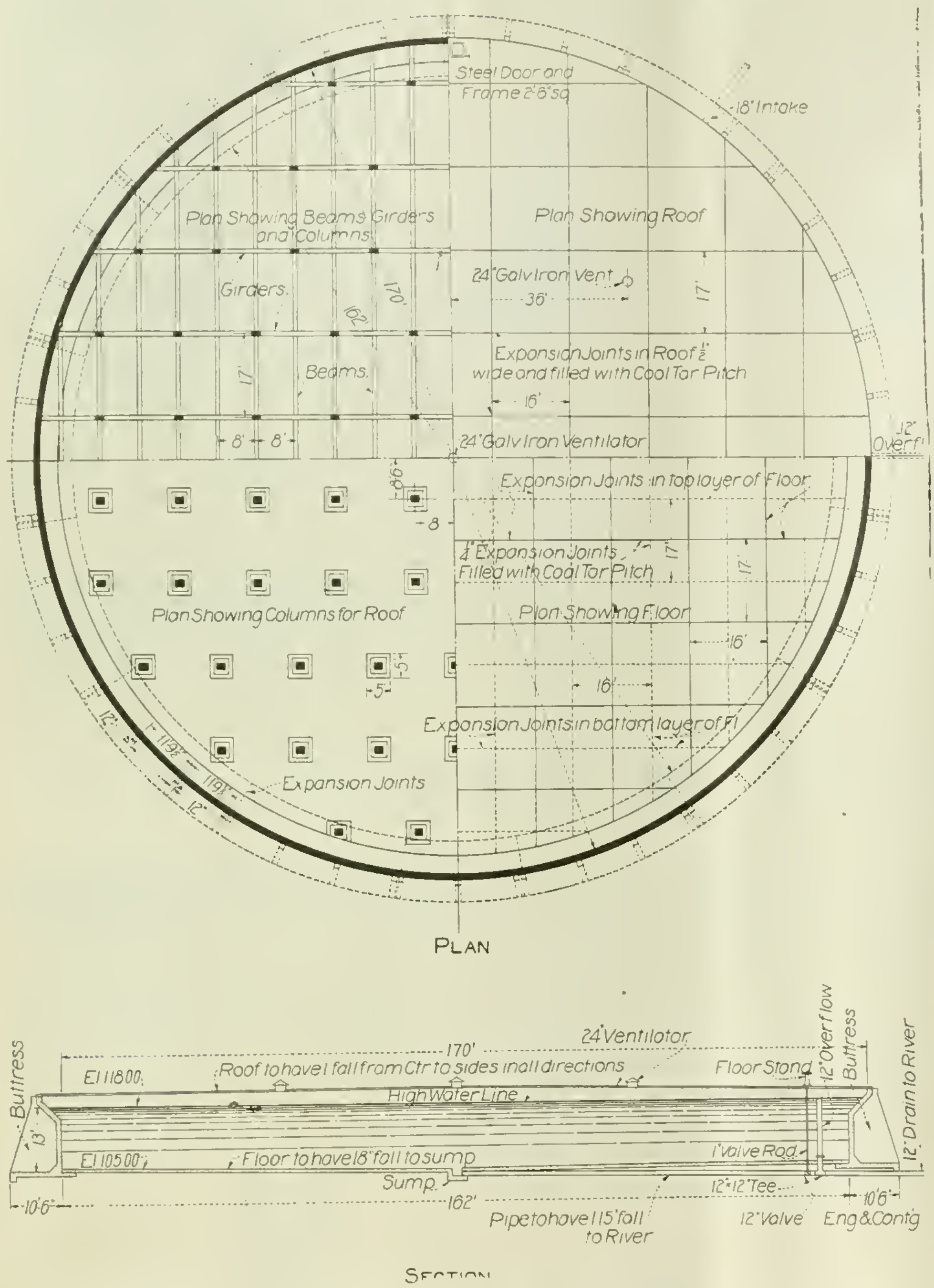

Steel Door and Frame 2'6" sq
18" Intake
Plan Showing Beams Girders and Columns
Plan Showing Roof
24" Galv Iron Vent
36'
Girders
170'
162'
17'
Beams
Expansion Joints in Roof ½" wide and filled with Coal Tar Pitch
16'
8'
8'
24" Galv Iron Ventilator
12" Overfl
Expansion Joints in top layer of Floor
8
¼" Expansion Joints Filled with Coal Tar Pitch
Plan Showing Columns for Roof
Plan Showing Floor
16'
5'
5'
Expansion Joints in bottom layer of Fl
Expansion Joints
119'
PLAN
Buttress
170'
24" Ventilator
12" Overflow
Buttress
12" Drain to River
El 118.00
Roof to have 1' fall from Ctr to sides in all directions
Floor Stand
High Water Line
13'
El 105.00
Floor to have 18" fall to sump
1" Valve Rod
Sump
12"x12" Tee
162'
10'6"
10'6"
Pipe to have 1.5' fall to River
12" Valve
Eng & Contg
SECTION

Fig. 4—Plan and Sectional Elevation of 2,000,000-gal. Reinforced Concrete Reservoir at Fort Dodge, Iowa.

The concrete mixer was left at the ground elevation for mixing the concrete for the footings for the wall and columns. A circular track was constructed around the inner edge of the footings and the concrete was pushed, in ½-cu. yd. dump cars, from the mixer to place. As shown in Fig. 6, this footing was constructed in alternate sections about 36 ft long and short steel rods were placed in the footings for the vertical wall and buttress reinforcement. These rods were all of a length to lap 30 diameters and for a short 90° bend on the lower end. When the alternate sections were constructed, the middle sections were poured and expansion joints, filled with coal tar pitch, were left between the sections.

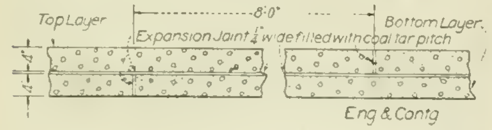


Fig. 5—Section of Floor Showing Expansion Joints.

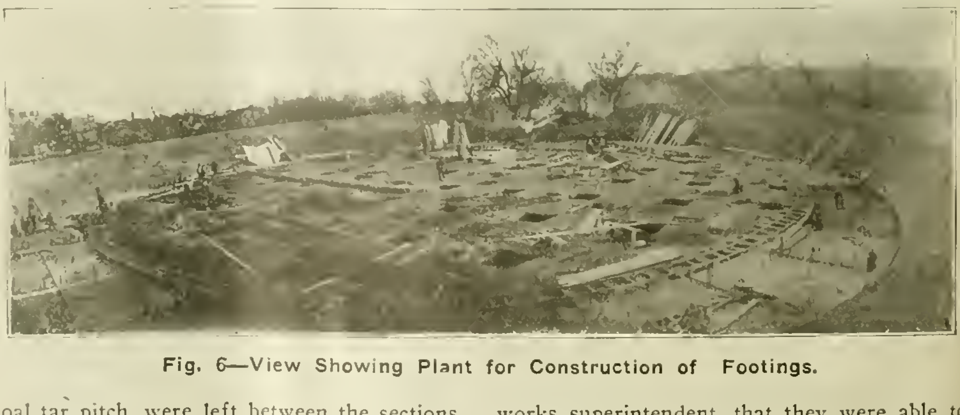


Fig. 6—View Showing Plant for Construction of Footings.

When the concrete for the footing was all poured the railroad track was taken up and relaid on top of the earth fill and the concrete mixer was elevated on large timbers to an elevation above the top of the fill. The concrete for the walls and buttresses was mixed at this elevation, carried to place in dump cars and run into the forms by means of chutes. This proved to be a very economical manner of handling the concrete as the mixer was equipped with a slip for elevating the raw material from the ground level and all loading was done there. Figure 7 shows the method of construction followed on the walls, and shows that this was constructed in alternate sections in the same manner as the footing. Coal tar pitch was used in the expansion joints between the wall sections.

The concrete for the roof and columns was mixed at the same elevation as for the walls and carried to place over the roof forms in wheelbarrows. The roof slab was built in sections 16 ft. x 17 ft. with ½-in. expansion joints on all sides and was constructed in alternate sections.

On account of cold weather the floor was not constructed until after the roof was put on. A section of the roof was left out and the concrete was carried by chutes from the elevated mixer to the floor elevation and then to place in wheelbarrows. The completed floor is 8¼ ins. thick and is designed in two layers 4 ins. thick, with a layer of very plastic coal tar pitch between. Each of these layers was built in sections 16 ft. x 17 ft., with expansion joints on all sides and with the center line of the top layer over the expansion joint in the lower layer.

The greatest difficulty encountered during the construction was that of preventing the concrete from freezing before it set. The reservoir was constructed between the months of November and May, and work was never shut down on account of cold weather. An upright boiler was installed near the material piles and a sufficient number of steam coils were run through them to heat what material was used in one day. A steam pipe was also used to heat the water required for mixing. In this way the concrete was always warm when put in place and was then covered with canvas and protected with salamanders for a few days. Fig. 7 shows a section of the wall under canvas. In this way the concrete was poured successfully with the thermometer as low as Zero Fahrenheit. In the roof slab, calcium chloride was used in the concrete and it was not protected after being placed, 2 lbs. being used to every sack of cement. This produced good results except in one case where a few sections of the roof, when the concrete was very "green," were exposed for several hours to a temperature of —15° F. and the concrete was ruined.

The total cost of the reservoir proper was $25,000. It was designed in the office of Burns & McDonnell, Consulting Engineers of Kansas City, and the construction was supervised by C. T. Harding, their resident engineer. It was constructed by Zitterell & Sullivan, Contractors, of Webster City, Ia.

The City of Fort Dodge has the commission form of government and it speaks well for the city commissioners and Mr. Pray, the water works superintendent, that they were able to construct this reservoir with the earnings of the plant and without the aid of a bond issue.

A New Portable Steel Derrick.

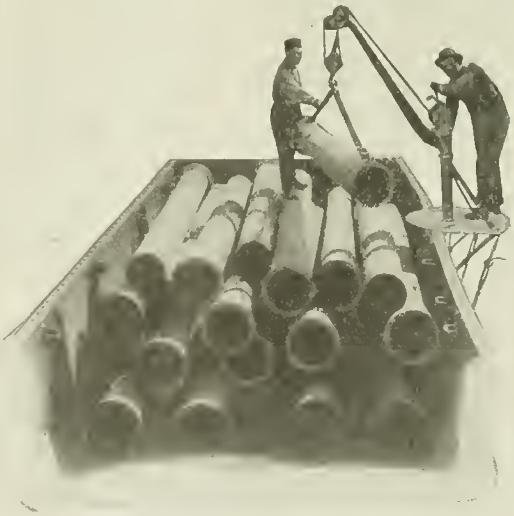
(Staff Article.)

The accompanying view illustrates the use of the Taylor portable steel derrick, with gondola car attachment, for unloading cast iron water pipe. A crew of three men is required for the most efficient use of the derrick for unloading pipe. One man attaches the hooks of the chains to the ends of the pipe and by pushing on the pipe or the beam of the derrick swings the pipe clear of the car. The man who turns the cranks which operate the derrick gives his entire attention to the raising, and lowering of the pipe and does not swing the derrick beam. The third man is required on the wagon to which the pipe is being transferred for the purpose of guiding the pipe as it is lowered to the desired position on the wagon and to unhook the lifting chains. Working in this manner a crew of three laborers, unaccustomed to the use of the derrick, unloaded 22 12-ft. lengths of 8-in. cast iron water pipe in 15 minutes. The pipe was transferred to two wagons, 11 lengths to each wagon. The time stated includes the time required to draw one wagon away from the car and to drive the other into the proper position for loading. One minute is sufficient in which to pick up any pipe of a weight less than 2,000 lbs. and to complete the transfer of it to a wagon or to skids on the ground. One man can readily operate the cranks when the derrick is working at its full lifting capacity.

Two men are required to mount the derrick on a car. The beam is removable and weighs 105 lbs. The mast is attached to the platform, the two parts together weighing 230 lbs. Lugs attached to the platform go inside the side of the car, and braces which are also attached to the platform bear for their full length along the outer surface of the side of the car. These braces are caused to press tightly against the car by three chains which are attached to the platform and to the truss rods under the car. The slack in the chains is taken up by means of turnbuckles. The derrick is held firmly in position by the action of these chains and braces. An important advantage of the platform at the edge of the car is that the operator, from his station, can see in and outside of the car, thereby making it possible to dispense with signals. This greatly facilitates the work. The derrick is attached to either wood or metal cars.

There are many uses for the Taylor derrick other than that here described. The platform of the gondola attachment is replaced by two channel irons, set at right angles to each other in a horizontal plane, when the derrick is used for anything else besides unloading cars. These channels are bolted down to whatever is serving as an operating foundation for the derrick. The derrick is used successfully for hoisting building materials, roofing materials, for hoisting in connection with well digging, and for other similar purposes. All details of the derrick have been carefully tested and perfected.

The derrick with gondola car attachment sells for $70, and the type used for other purpose, as described above, sells for $50 f. o. b. Chicago. The steel cable sells for 4½ cts. per ft. in addition to the prices given. The derrick is manufactured and marketed by John L. Taylor, 1034 W. Lake St., Chicago, Ill.



View Showing Use of Taylor Portable Steel Derrick for Unloading Cast Iron Water Pipe From a Gondola Car.

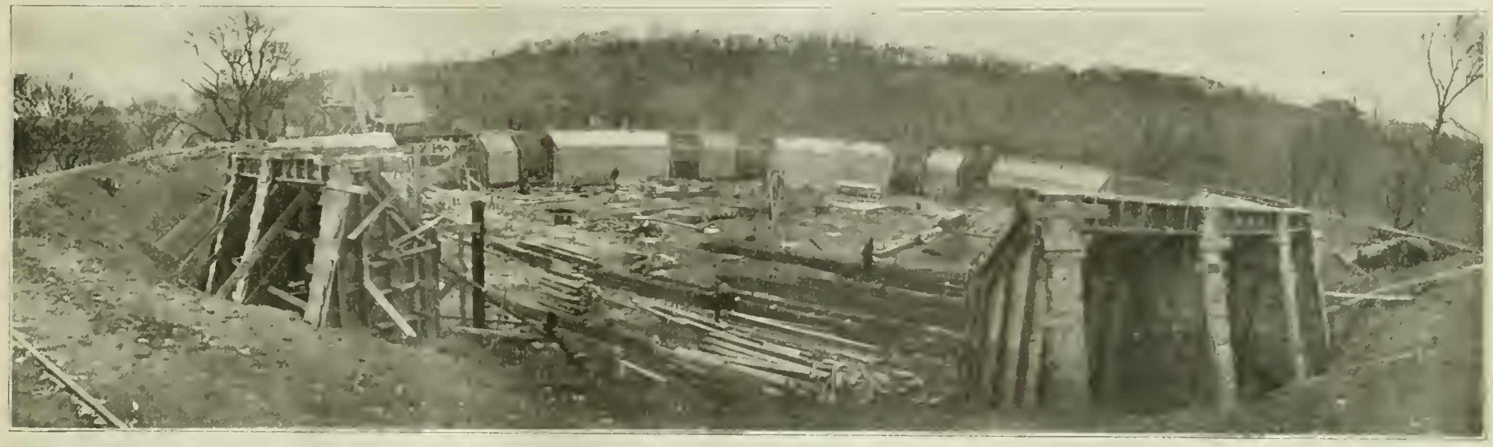


Fig. 7—View Showing Wall Construction, Fort Dodge Reservoir.

Diagrams of Discharge Over Sharp-Crested Rectangular Weirs, Without End Contractions, for Heads on Crest from 0.20 ft. to 10 ft.

Diagrams for quick computation of weir discharges and a non-technical discussion of the measurement of flowing streams by weirs are given by Prof. R. R. Lyman, in Bulletin No. 5, Utah Engineering Experiment Station. The utility of the diagrams makes them of general interest and we have redrawn them for reproduction here. The following text is abstracted from the Bulletin:

TYPE OF WEIR RECOMMENDED.

The type of weir recommended for measuring the flow of small streams may be briefly described as follows: The channel of approach should be built, and maintained of a truly rectangular cross section, and therefore must be built of timber, masonry, concrete or some other permanent material. When the channel of approach is simply a cut in the earth its size varies more or less continuously with the amount of sediment carried by the stream. Not infrequently, in mountainous districts, gravel and sand are deposited until the bottom of the channel is practically on a level with the crest of the weir. If such a condition prevails, even a few times in a season, the measurements taken are almost valueless. The crest of the weir should be as long as the channel of approach is wide.

The channel of approach, having a definite shape can be restored to its original size and form at any time by cleaning it out. When this channel is of definite shape an important factor in accurate weir measurement is gained. Flush gates are provided at the bulkhead, on which the weir is attached, in order to facilitate the cleaning out of the sediment which is deposited in the channel of approach. Since it is important to have the up-stream side of the bulkhead plane and vertical, the sluice gates should be built flush with the up-stream face of the bulkhead.

Crest of Weir.—The crest of the weir should be "sharp," as shown in Fig. 3, and it should be accurately set in a horizontal position, with the sharp edge or rectangular corner up-stream, the sloping edge down-stream. Sometimes the angle-iron, or other metal used for making the sharp crest, is so designed that it can be slightly adjusted if it gets out of level; but when a substantial structure, such as concrete, is built, it is best to set the metal crest with care, having its two ends firmly buried in the concrete.

While the crest is to have a so-called "sharp" edge, this edge should not be so thin that rust or exposure will easily render it more or less imperfect. In Fig. 3 a good design for a crest is shown.

The Size of the Channel Above the Measuring Structure.—The size, or the cross-section of the stream, above the channel of approach for a distance of from 6 to 30 ft., should be greater than the size of the channel of approach. If this condition is fulfilled, the velocity of the water above will be less than it is in the channel of approach. In addition to having this slightly smaller velocity, the water should flow toward the channel of approach with a uniform motion. Where there are eddies, cross-currents, or irregular velocities, these must be eliminated by the use of a properly designed baffle. The two velocities mentioned can be measured by noting the time required for a small chip, or other float dropped in the water, to travel over a measured distance.

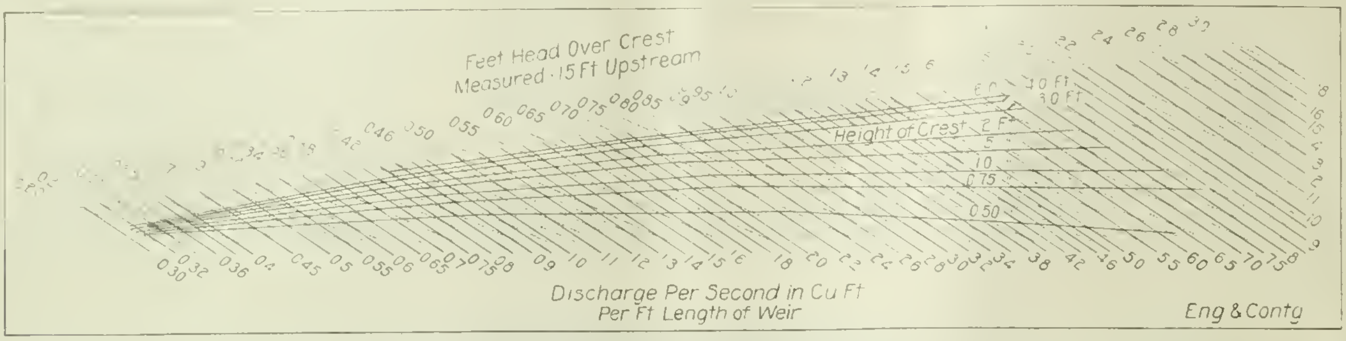


Fig. 1—General Diagram of Heads and Corresponding Discharges Over Sharp-Crested Rectangular Weirs, of Various Heights, Without End Contractions.

These curves are derived from the results of experiments made by Bazin, Fteley and Stearns, and Francis, and in the hydraulic laboratories of Cornell University and the University of Utah. They represent mean curves for practical use.

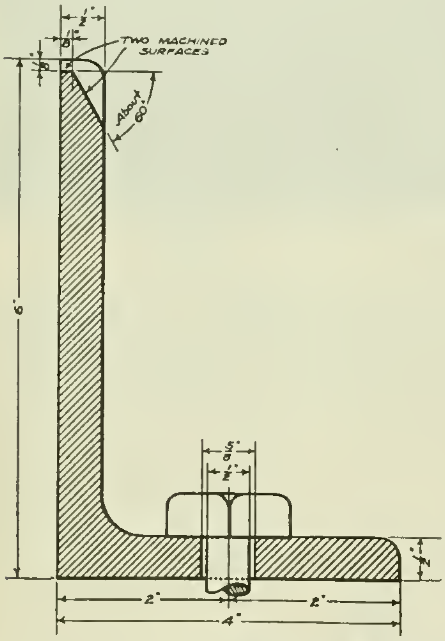


Fig. 3—Angle Iron with "Sharp" Edge Suggested for Crest of Weir for Measuring Floor of Small Streams.

THE DIAGRAMS.

The diagrams here shown as Figs. 1 and 2, it is believed, give the most accurate results that can be obtained by the use of weirs.

Fig. 1 is based upon all the experiments of Bazin, Francis, Fteley and Stearns, and also upon those made in the hydraulic laboratories of Cornell University and the University of Utah. The author presents this plate with the belief that it gives more accurate results than can be obtained by going through the troublesome calculation required by any weir formula that has thus far been devised.

Fig. 2 gives the results graphically that can be obtained analytically by using the formulas of Bazin, Francis, and Fteley and Stearns. While the results given on this plate are beyond the limits of experimental data, and there is, therefore uncertainty as to their accuracy, the use of this plate will probably give the most accurate results to be obtained at present for weirs of the dimensions it covers.

All points on these diagrams represent heads, discharges, and heights of weirs.

All points on the heavy full lines represent weirs of the heights marked on these lines. If discharges are desired over weirs with heights between those given, the heights must be approximated.

All points on the light full lines represent the discharges in cubic feet per second per foot of length of weir, that are marked on these lines. If discharges for points between these lines are desired, they can be closely approximated.

All points on the broken lines represent the heads in feet that are marked on these lines. If readings are desired for heads between the values marked, they are approximated.

While these statements, that if close values are desired they are to be approximated, may make it appear that the results obtained are lacking in accuracy, the scale on which these plates are drawn is such that these values can be easily read with as great accuracy as is warranted by the excellent data upon which they are based.

TO FIND THE DISCHARGE BY USING THE DIAGRAMS.

Example.—If a weir is 3 ft. long and 1½ ft. high and the depth of water on the crest is 0.276 ft., what quantity of water is flowing over it?

On the heavy full line marked "1½ ft. height of crest," find a point between the broken line marked "0.27 ft." and that marked "0.28 ft." that is 0.6 of the distance from the former to the latter line. This point represents the head 0.276 ft. The discharge it indicates is between "0.50 cu. ft." and "0.55 cu. ft.," for it falls between the light full lines marked with these quantities. Since this point is about 0.1 of the distance from "0.5 cu. ft." to "0.55 cu. ft." the quantity it indicates is 0.5005 cu. ft. per sec. per foot of length of weir. Since the weir is 3 ft. long, the total discharge is 3 times 0.5005 cu. ft., or 1.5015 cu. ft. per second.

As to the accuracy of this result: There is hardly a chance that the reading taken from

TABLE I. — SUGGESTED DIMENSIONS OF WEIRS TO BE USED FOR MEASURING VARIOUS QUANTITIES OF FLOWING WATER.

Smallest quantity to be measured. Cu. ft. sec.	Largest quantity to be measured. Cu. ft. sec.	Distance from crest to top of wall.* Ft.	Length of crest and width of channel. Ft.	Height of weir.† Ft.	Length of channel.‡ Ft.
0.05	0.25	0.5	0.2	0.50	2
0.15	0.60	0.5	0.5	0.50	4
0.30	1.30	0.5	1.0	0.50	6
0.45	1.90	0.5	1.5	0.75	8
0.60	2.5	0.5	2.0	0.75	10
0.75	3.2	0.5	2.5	0.75	10
1.0	3.7	0.5	3.0	1.0	10
1.5	11.0	1.0	3.5	1.0	12
2.0	15.0	1.0	4.0	1.0	12
2.5	18.0	1.0	5.0	1.5	12
3.0	21.0	1.0	6.0	1.5	14
3.5	25.0	1.0	7.0	1.5	14
4.0	28.0	1.0	8.0	2.0	14
4.5	*32.0	1.0	9.0	2.0	16
5.0	65	1.5	10.0	2.0	16
6.0	71	1.5	11.0	2.0	16
7.0	78	1.5	12.0	2.0	16
8.0	81	1.5	13.0	2.0	16
9.0	91	1.5	14.0	3.0	18
10.0	97	1.5	15.0	3.0	18
11.0	104	1.5	16.0	3.0	18
12.0	170	2.0	17.0	3.0	18
13.0	180	2.0	18.0	3.0	18
14.0	200	2.0	20.0	3.0	20
15.0	215	2.0	22.0	4.0	20
16.0	230	2.0	24.0	4.0	20
17.0	250	2.0	26.0	4.0	20
18.0	270	2.0	28.0	4.0	20
19.0	290	2.0	30.0	4.0	20
20.0	310	2.0	32.0	4.0	20

*From crest of weir to top of wall of channel of approach.

†This is height of crest of weir above floor of channel of approach.

‡Length of channel of approach.

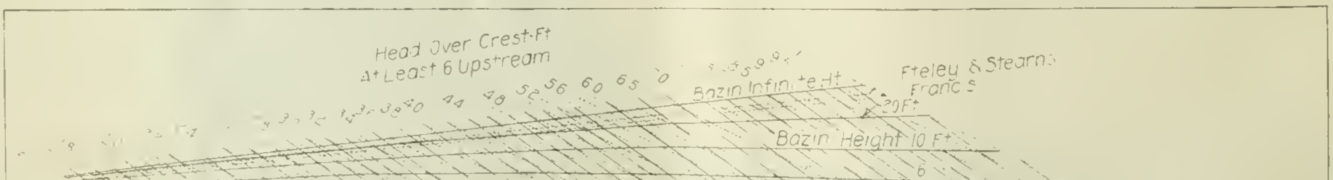


Fig. 2—Diagram of Heads and Corresponding Discharges Over Sharp-Crested Rectangular Weirs, of Various Heights, Without End Contractions.

These curves are based on the formulas of Bazin, Fteley and Stearns, and Francis.

the diagram would vary more than from 0.5003 cu. ft. to 0.5007 cu. ft., that is, 0.0002 in 0.5005—an error of but 0.4 of 1 per cent. No weir formula, no weir data in existence, will warrant giving a discharge closer than this.

Since all problems solved by using Figs. 1 and 2 are similar to the example given, no further explanation is necessary to make clear the method of using both plates.

SIZE OF WEIR TO USE FOR MEASURING WATER.

In Table 1 are given carefully prepared dimensions of weirs recommended for measuring the quantities of flowing water given in the first and second columns of the table.

Method of Computing the Yield of a Watershed With Special Reference to the Hickman Creek Watershed in Kentucky.

West of the Allegheny Mountains, municipal supplies from impounded rainfall are rare, and information is lacking from which the yield estimates can be made with accuracy. In the East, the cities of New York and Boston are thus supplied, and records are available covering periods of 25 to 30 years. These records have been the only available guide for estimates by those living in the West, and have been used with corrections for difference in climatic conditions, rainfall, and run-off. This method of securing a water supply from impounded rainfall is, however, used extensively by railroads in many localities on account of its softness, even where water is plentiful. Moreover, with the great increase in the acreage of well drained agricultural lands the run-off is increasing rapidly in many districts and the level of the ground water is being lowered. With the exhaustion or full development of ground water supplies many cities will be obliged to turn to the impounding of rainfall for water supply purposes. In a very timely paper before the Western Society of Engineers George L. Thon and L. R. Howson analyzed the various steps in the computing of yield on the Hickman Creek watershed, run-off records of which are available for a period of 26 years. The analysis is very useful as a general study and the particular results obtained will be directly useful in the solution of similar problems in the same locality. The results will also supplement the Sudbury and Croton data of similar nature which have done good service for years in prompting engineers to be conservative in estimating the probable yield of watersheds. The paper is here given practically in full:

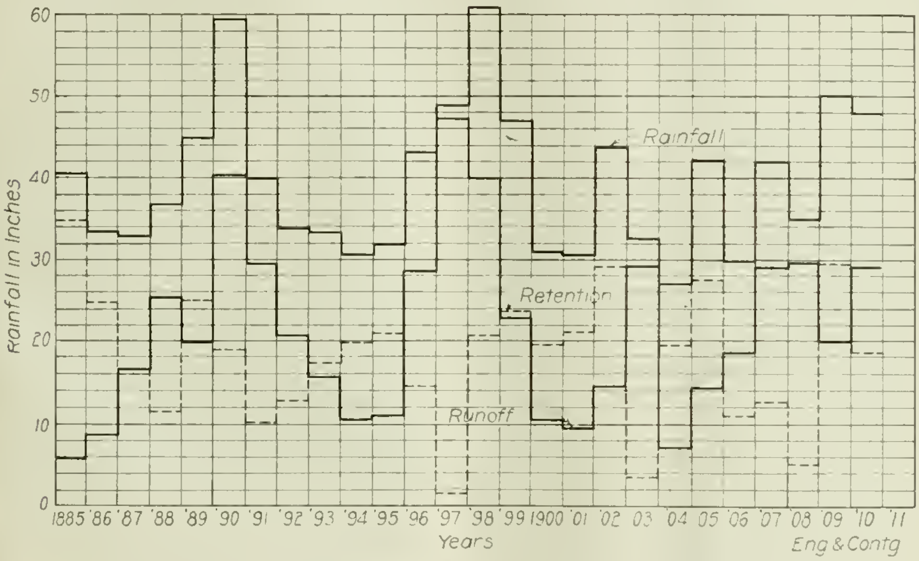


Fig. 1—Annual Rainfall, Run-off and Retention, Hickman Creek, Lexington, Ky.

The city of Lexington, Ky., derives its water supply from impounding reservoirs located on Little Hickman Creek about three miles southeast of the city. The growing demands of the city have recently demonstrated to the water company that an additional supply must be provided. To secure this additional supply the development of the adjoining watershed, East Hickman Creek, was contemplated.

In the consideration of this problem the comprehensive records kept by the water company on the Little Hickman watershed since the installation of its plant in 1885, furnish data upon which can be based an accurate estimate of the yielding capacity of the watershed which it is now proposed to develop.

The original reservoir, known as Reservoir No. 1, was built in 1885 and was capable of impounding, when full, 103,000,000 gals., the equivalent of 2.3 ins. of depth upon the 2.55 square miles of watershed draining therein. In 1896 Reservoir No. 2 was added by building a second dam across the Little Hickman about 1,500 ft. down-stream. The combined capacity of the two reservoirs as governed by Dam No. 2 was 391,000,000 gals., the equivalent of 6.6 ins. of depth on the 3.4 square miles of watershed. In 1903 a third dam was built about 1,500 ft. down stream from Dam No. 2, making the combined capacity of the three reservoirs 814,000,000 gals., or 10.9 ins. of depth on the watershed of 4.3 square miles.

The drainage area of Little Hickman Creek lies in the heart of the famous Blue Grass region, draining southerly into the Kentucky River. The country has a gently undulating surface which becomes quite abrupt at the creek basins. The top soil is, in general, a clay loam of the residual type formed of the decomposition of the underlying rock and averages about 3 ft. in thickness. The underlying rock belongs to the Lexington and Winchester limestone formation of the Ordovician system.

The water company which operates the Lexington Waterworks, early realizing the importance of complete and accurate records, instituted a system of complete daily records covering the observations which were necessary in this study. Among these records, covering 26 years, are observations of rainfall, pumpage, spillway discharge, gage height of reservoir water level, and some observations on evaporation.

Rainfall—The run-off on a given watershed being primarily dependent upon the amount of rainfall, it is essential, in a study of this character, to first of all thoroughly investigate the amount and distribution of the rainfall. Rainfall records are much more easily obtained in practically every locality than continuous daily gagings of run-off. Rainfall records were collected by the water company at the gaging station on the watershed

For purposes of comparison with the water company's rainfall records, we have tabulated the summaries of rainfall as reported by the U. S. Weather Bureau at the observation stations nearest the watershed. These observations from 1858 to October, 1872, inclusive, were taken at Chilesburgh about nine miles east of the watershed. In 1872 this station was discontinued and the remaining readings to date were taken at the Government station located in Lexington, no records being available from 1876 to 1886. Comparing these records with those kept on the watershed we find considerable variation in the amounts recorded, the maximum difference being in 1888 when the Government record exceeded the record kept on the watershed by 10 ins. In 1899 the readings on the watershed exceeded the Government records by 6.5 ins. The average readings at the Government station for the period 1885 to 1911, inclusive, is 42.2 ins., which is 3 ins. greater than the mean annual rainfall for the same period as recorded on the watershed. Some differences in the amount of rainfall recorded at two observing stations located in such close proximity are to be expected, due to inaccuracies of observation, to the relative location, surroundings, and elevation of the gages. The fact that this locality is subject to severe and frequent local thunderstorms of high intensity further accounts for variations in the records. The Government station at Lexington reports an average of 21 thundershowers for the ten years from 1895 to 1904 during July, August and September. Such storms also occur during the rest of the year, but less frequently.

Retention—"Retention" may be defined as the difference between rainfall and run-off; it includes the evaporation from the surface of the drainage area, the seepage into the ground, the water used by vegetation and that temporarily held in swamps and lakes. The retention varies greatly from month to month, as the run-off for short periods frequently exceeds the rainfall for that period. During the summer months the losses from evaporation and the uses of plant life are usually large, and the rainfall being comparatively heavy, the retention is usually quite heavy during that season.

Run-Off—The run-off at a given point on a watershed is that part of the rainfall upon the watershed which reaches the natural water course of the area at the selected point. The run-off of Hickman Creek is based on the following records kept by the Lexington Water Company for the past 26 years: 1st. Wastage over the spillway. 2nd. Water stored in reservoirs. 3rd. Pumpage. 4th. Evaporation from exposed water surface of the reservoir.

The wastage over the spillway was computed from daily readings of head on the spillway channels. These channels are excavated in rock and have an irregular section. The weirs at the entrance to the channel are broad crested and of irregular section. Topographic surveys were made of the three spillway channels and the discharge computed both on the theory of flow in channels and over broad crested weirs; it was deemed advisable to check the wastage in this way on account of the irregularity in the shape of both the channels and weirs. The wastage thus figured is, in our opinion, substantially correct. Inasmuch as these records cover a long period of years, with little available knowledge as to the changes in spillway due to erosion of the channels, washing out of weir planks, and clogging and removal of fish screens, any refinements in the theoretical calculations involved are obviously unwarranted for the purpose of this discussion. As the

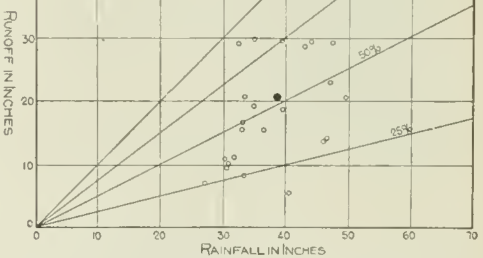


Fig. 2—Annual Relation of Rainfall and Run-off, Hickman Creek.

primary purpose of this paper is the determination of yield and storage capacity required, and as the safe yield is based upon the records of the driest period during which periods there was no wastage, moderate inaccuracies in the measurement of wastage do not materially affect the yield.

The storage draft is computed from daily elevations of the water level in the reservoirs, the volume of which was computed from hydrographic surveys of the reservoir made at the time of this investigation. Storage draft as here considered is the volume of water added or substracted as determined by the difference in the daily gage heights.

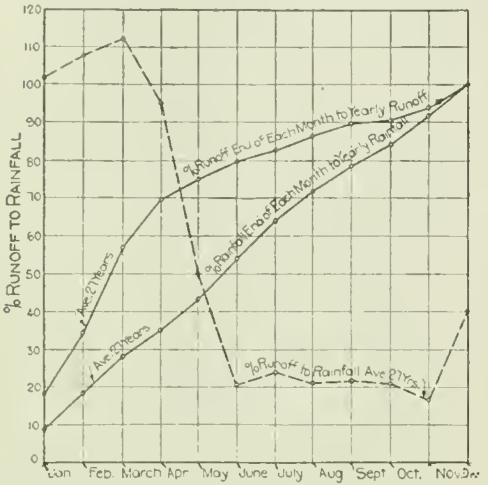


Fig. 3—Diagram Showing Cumulative Average Percentages of Rainfall and Run-off, and Average Monthly Percentage of Run-off to Rainfall.

A portion of the run-off also is withdrawn as pumpage. This amount is computed from average daily records of water pumped by the Lexington Water Company.

To secure the total run-off from the watershed, it is necessary to add to the above component parts an additional amount for the losses due to the evaporation from the surface of the artificial reservoirs. This evaporation should not be confused with the ordinary evaporation on the watershed which is included in the discussion of "retention."

The evaporation was computed monthly based on the calculated monthly evaporation at Cincinnati in 1888, using the area of water surface corresponding to the average gage height during that month. The evaporation record at Cincinnati, Ohio, was used because only fragmentary records of evaporation were kept by the company. The amount of evaporation obviously depends on the area of exposed water surface in the reservoir.

TABLE 1.—RUN-OFFS ON VARIOUS WATERSHEDS.

		Number of years' record.	Area, sq. miles.	Average annual rainfall in ins.	Average annual run-off in ins.	Per cent run-off.	Annual retention in ins.
1.	Hickman Creek, Ky...........	26	4.3	39.2	20.3	52	18.9
2.	Muskegon	8	5,826	39.7	13.1	33	26.6
3.	Geneseo, N. Y.................	9	1,070	40.3	14.2	35	26.1
4.	Croton, N. Y...................	25	338	48.4	22.8	47	25.6
5.	Lake Cochituate	38	18.9	47.1	20.3	43	26.8
6.	Sudbury	25	75	45.8	22.5	49	23.3
7.	Mystic Lake....................	18	26.9	44.1	20.0	45	24.1
8.	Neshaminy Cr., Pa............	16	139.3	47.6	23.1	49	24.5
9.	Perkiomen Cr., Pa............	16	152	48	23.6	49	24.4
10.	Tohickion Cr..................	15	102.2	50.1	28.4	56	21.7
11.	Hudson River..................	14	4,500	44.2	23.3	53	20.9
12.	Pequannock	9	63.7	46.8	26.8	57	20.0
13.	Wigwam Cr., Conn............	9	18	47.4	24.3	51	23.1
14.	Chippewa, Wis................	6	6,740	32.5	16.2	50	16.3
15.	Wisconsin-Merrill, Wis........	15	2,630	29.67	17.87	60	11.80

The run-off having been computed as outlined above, we have shown in Figs. 1 and 2, the annual relation between rainfall, run-off and retention. It will be noticed from Fig. 1 that the run-off averages 52 per cent of the rainfall, but varies considerably from year to year. The mean annual rainfall is 39.2 ins., and the mean annual run-off is 20.6 ins. In finding the mean run-off we have omitted the abnormally high run-off of 1897, amounting to 47 ins., as the records of waste over the spillway for this year appear inaccurate. The percentages of the annual run-off, and the annual rainfall occurring each month, are shown cumulatively in Fig. 3. Seventy per cent of the total run-off occurs during the first four months of the year, and during the same period but 35 per cent of the total annual rainfall occurs. During these four months the run-off averages 103 per cent of the rainfall. The percentage of run-off to rainfall occurring each month is shown by the broken line on the same diagram. The monthly relation of rainfall and run-off during the driest year, 1904, as compared with the average monthly rainfall from 1885 to 1911, is shown diagrammatically in Fig. 4.

Comparison With Run-off in Other Localities—In order to compare the run-off of Hickman Creek with that of other watersheds, we are including Table I, which shows the run-off on a number of American watersheds where records are available for a long period of years.

Yield and Storage—The yield of any watershed depends primarily upon the following factors: (1) The area of the watershed. (2) The run-off, especially during a cycle of dry years. (3) The possible storage capacity which can be developed to store flood waters to be used during dry periods. (4) The evaporation losses in the storage reservoir.

With the above data it is possible to compute how great a uniform daily draft can be sustained by the natural flow from the drainage area supplemented by the use of such storage as is available.

Area of Watershed as Influencing Yield—The yield of two watersheds is proportional to their drainage area, providing other influencing factors such as run-off per unit of area, storage development and evaporation are equal. This being true, it is convenient for comparative purposes to express yield in inches on the watershed per year, or million gallons daily per square mile.

Run-Off as Influencing Yield—To determine the safe yield of a watershed, it is necessary to base all computations upon the run-off data for the driest cycle of years covered by the available records. For a correct determination of the driest periods upon which a safe future estimate may be based, records covering the run-off upon the watershed for a number of years are of the utmost value. The records on Little Hickman Creek watershed cover a period of 26 years, including two dry cycles, of about three years each.

Storage—The storage capacity is of as much importance in the safe yield of a watershed as the area or run-off, and its value consists in augmenting the flow during the dry season from flood waters held in storage, thus providing a more uniform run-off throughout the year. The importance of storage is shown by the following facts. The watershed of Little Hickman Creek with 4.3 square miles does not furnish any flow during dry periods, while with a storage capacity of 814,000,000 gals. it can be relied upon to furnish 1,800,000 gals. per day continuously throughout the driest period occurring in the 26 years.

Computation of Yield—The yield of a watershed as here discussed is the maximum quantity of water which can be obtained daily throughout the driest cycle of years covered by the records. A complete study of this problem is quite involved and requires careful analysis. The most convenient method of procedure in the study of yield is by means of the mass diagram. This diagram is a graphical, cumulative summary of all the basic run-off data derived from the period of observation. This method of determining yield was first used by Rippl, and later applied by Desmond Fitzgerald in his studies on the Sudbury River, and by John R. Freeman in his report on the New York Water Supply.

We have prepared a mass diagram showing the run-off data on the Little Hickman watershed, Fig. 5. The construction of this diagram required a large number of laborious calculations, but once platted shows by inspection the dry cycles during the period under investigation.

This diagram, Fig. 5, was prepared by platting the aggregate run-off of the Little Hickman cumulatively from the beginning to the end of the record. The data platted are the calculated run-offs month by month composed of the following quantities: Evaporation, pumpage, change in reservoir water levels (plus or minus), and the wastage over spillways. This run-off represents the total flow of the Little Hickman at the site of the reservoir. The total run-off for each month is the summation of the above factors, and is platted cumulatively to form the mass curve with "inches on the watershed," as ordinates.

Referring to the diagram, it will be seen that during the year 1885 the total water furnished by the Little Hickman aggregated about 5 ins., the greater portion of this run-off occurring during the early part of the year; the run-off line being practically horizontal during the summer, with the slope again increasing during the balance of the year. In 1886 the run-off was about 7 ins., making a total run-off of 12 ins. for the two years. In 1887 the run-off amounted to 15 ins., occurring as usual during the spring, making the total to date of 27 ins. In the following year, 1888, the run-off aggregated 25 ins., making a total cumulative run-off of 52 ins. during the four years.

The measurements of the spillway wastage were not susceptible to so precise determination as the other qualities comprising total run-off, but as no wastage occurred during the driest cycles, the uncertainty of spillway wastage does not affect the conclusions of this discussion.

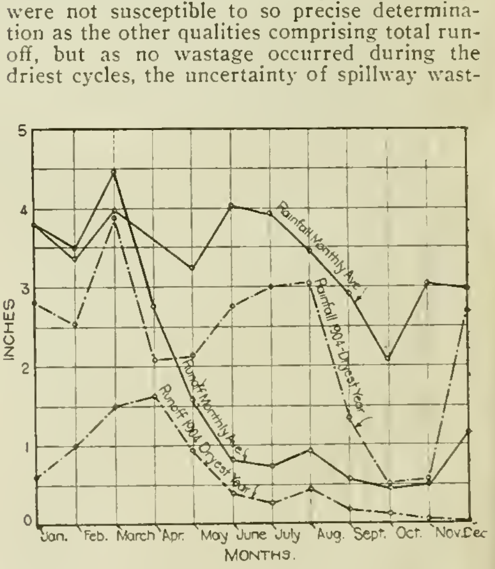


Fig. 4—Relation of Monthly Run-off to Rainfall for Monthly Averages 1885-1911 and for Driest Year 1904.

Mean annual rainfall 1885 to 1911 = 39.2 ins.
Average annual run-off 1885 to 1911 = 20.3 ins.
Driest year 1904 total rainfall = 26.95 ins.
Driest year 1904 total run-off = 7.14 ins.

Application of the Mass Diagram—In any project for the collection of water in storage reservoirs we are principally interested in the dry years, particularly a series of consecutive dry years, for such periods govern the limiting yield of the watershed. It is evident that the factor of greatest importance in the consideration of a watershed for water supply purposes is the maximum daily yield which is capable of being sustained with a given storage capacity during the driest cycle of years to be expected. An examination of the mass curve shows the most unfavorable water-supplying conditions to have occurred in the years 1903, 1904 and 1905, during which time the summer run-off was practically nothing, and the spring run-off from 5 ins. to 8 ins. only. A more critical examination of this period is made possible by replatting this dry period to a larger scale in Fig. 6.

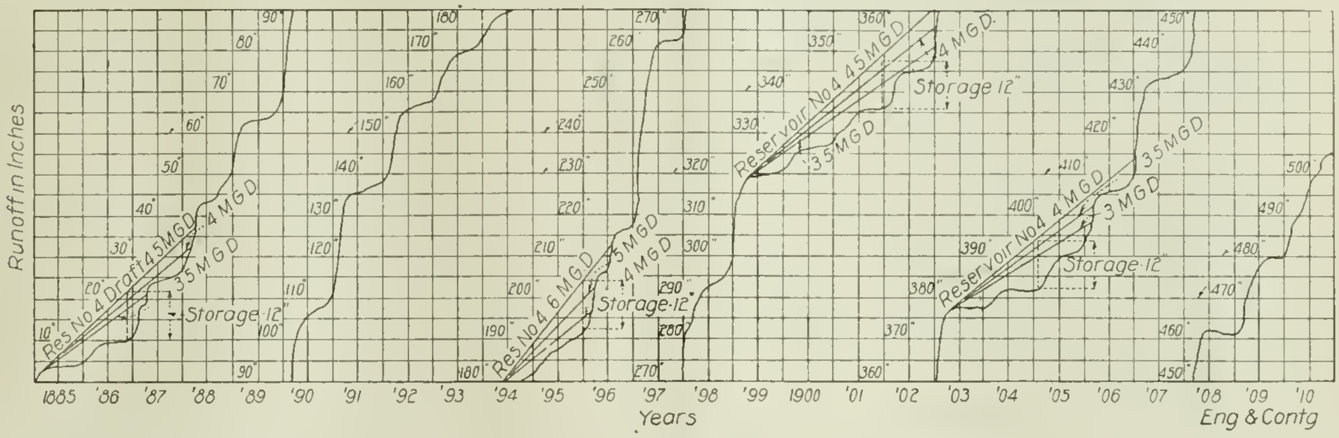


Fig. 5—Mass Diagram Showing the Accumulated Run-off of Watershed No. 1 in Inches of Depth on Watershed. Based on Records of Pumpage and Reservoir Water Levels With Estimated Waste Over Spillways Added, 1885 to 1910.

Drainage area 4.3 sq. miles. Average water surface 5% of drainage area.

There are three irregular lines drawn on this diagram, the middle one of which represents the line drawn in Fig. 5 which shows the run-off cumulatively based on an area of water exposed to evaporation of 5 per cent of the area of the watershed. This condition corresponds approximately with the average reservoir conditions on the Little Hickman. The lines above and below in this figure represent the condition as they would be with less or greater water surface, respectively. These lines are of value in applying this mass diagram to watersheds having a different percentage of reservoir surface. The enlarged mass curve for the dry period, Fig. 6, begins in February, 1903, and it will be noticed that preceding the last of April of that year the run-off was plentiful, materially exceeding the amount necessary to fill the reservoirs so that it may be assumed that the reservoirs would be full on the last of April. This condition is verified by the actual record of gage heights. For the remainder of the year the run-off was very slight, the line being nearly horizontal. Between January and May, 1904, about 5 ins. of run-off occurred with no further accretions until February, 1905. During this year, it will be observed that there was a gradual accumulation, showing a small and fairly uniform flow from month to month until the beginning of 1906. Beginning with January, 1906, the run-off increased at a rapid rate, amounting to 11 ins. in the first three months of the year. The total run-off from May 1, 1903, to May 1, 1906, is about 27 ins., or an average of 9 ins. per year, or 675,000,000 gals. The inclined lines in Fig. 6 indicate varied rates of draft.

It is now practicable to measure from this diagram the amount of storage in inches on the watershed which would be required to permit various rates of uniform draft throughout this dry period, by measuring the vertical distance between the inclined draft lines and the run-off curve. Thus it will be seen that the maximum depletion occurs about the middle of February, 1905, and the storage required on the watershed of the Little Hickman to sustain a flow of 1,500,000 gals. per day would have been 8 ins. on the watershed, or with a daily draft of 1,000,000 gals. per day would have been approximately 4 ins. on the watershed. Applying this diagram to the East Hickman, having a drainage area of 5,403 acres, or approximately twice as large as the Little Hickman, we find that with a uniform daily draft of 3,000,000 gals. per day the depletion would have amounted to 8 ins. on the watershed. Thus, by giving the sloping lines in Fig. 6 the proper inclination corresponding to the area of the watershed, we can ascertain the amount of storage that would be necessary to supply various uniform rates of draft from that watershed.

Further, it will be noted that for a pumpage of 3,500,000 gals. per day on the watershed of the East Hickman, the water surface would be drawn below the crest for a period beginning May, 1903, and ending in March, 1906, practically three years. For the Little Hickman this same period would furnish a yield of 1,750,000 gals. per day and the reservoir would not have filled for the same length of time. It is an interesting fact that the mass diagram checks the actual observed conditions on this watershed. A depletion diagram, not here given, shows the reservoir to have been full in April, 1903, and was gradually drawn down until in February, 1905, it was 65 per cent depleted, then it gradually filled until it overflowed again early in 1906. During this period the pumpage was approximately 1,600,000 gals. per day. This is a check on the accuracy of the mass diagram as a means of estimating storage capacity required.

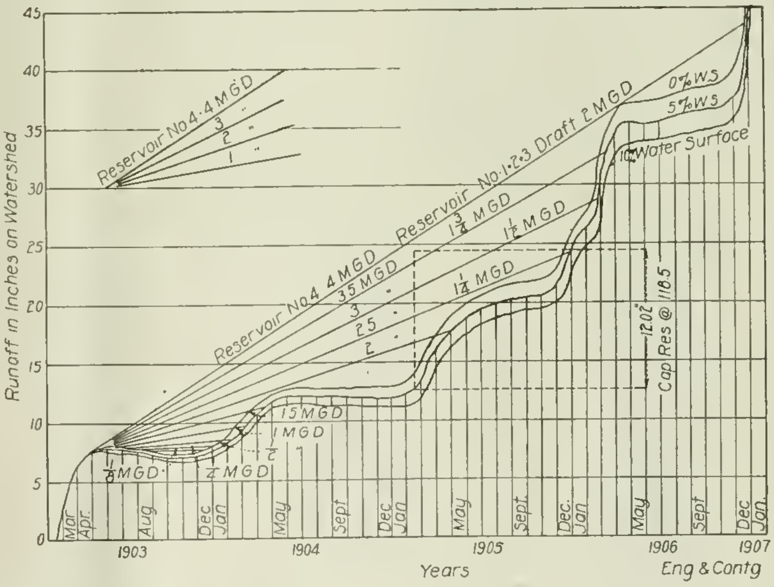


Fig. 6—Mass Diagram for Computation of Amount of Storage Required to Sustain Various Rates of Consumption During Dry Period, 1903-1907, Reservoir No. 4, Lexington, Ky.

Area Watershed Res. No. 4 = 8.45 sq. miles.
Area Watershed Res. No. 1 + 2 + 3 = 4.3 sq. miles.

Yield as Affected by Storage Capacity—During the period 1885 to 1895, at the time Reservoir No. 1 was in use with a storage capacity of 2.3 ins. on the watershed, the annual pumpage varied from 2¾ ins. to 9½ ins. This is interesting, in that it shows that during this period there were years when the total amount of water pumped within a year was equal to four times the capacity of the reservoir. From 1896 to 1902 with Reservoirs Nos. 1 and 2 in operation, having a combined capacity of 6.6 ins. on the watershed, there was pumped from the reservoirs an amount varying from 6¼ ins. to 8¼ ins. per year, and from 1902 to 1910 with 10.9 ins. on the watershed storage capacity the annual pumpage varied from 6½ to 9½ ins. on the watershed. A comparison of these yields with the development of storage on the watershed shows plainly the relative importance of the size of the reservoir to the area of the watershed. During the last 17 years there were three periods of from two to three years when the reservoirs did not overflow, the lowest reservoir level occurring in 1905 when the storage was about 65 per cent depleted.

Effect of Evaporation From Reservoir Surface on Yield—The storage capacity required to sustain various rates of draft from a watershed cannot be conveniently taken from the mass diagram on account of variations in evaporation and pumpage rates.

To facilitate this computation, we have constructed Fig. 7, which shows the storage capacity required to sustain various rates of draft with varying percentages of exposed water surface. This diagram is prepared from the information shown on the enlarged mass diagram. The draft lines as indicated in million gallons daily apply to Reservoir No. 4 on the East Hickman; in order to make this diagram applicable to similar watersheds, we have converted million gallons daily into million gallons daily per square mile of watershed. From this diagram it is now possible on a similar watershed in this locality, knowing its area and the topography of the reservoir location, to estimate the probable safe yield for any degree of storage development. We have prepared Table II, which shows the storage capacity required per square mile for 0, 5 and 10 per cent water surface to sustain the constant rates of draft per square mile as shown in the first column. For the purpose of comparison we have included in this table similar information for the Croton watershed as computed from data in Freeman's report on the New York Water Supply in 1900, and for the Sudbury watershed from Turneaure & Russell's *Public Water Supplies*. This information is shown graphically in Fig. 8. It will be noticed that the yield per square mile is greater on the Croton and Sudbury than on the Little Hickman. This difference is due primarily to the following difference of conditions: (1) The rainfall at the Little Hickman watershed averages but 39.2 ins., while the Croton and Sudbury have an annual rainfall of 48.4 ins. and 45.8 ins., respectively. (2) The evaporation on the Hickman watershed averages 52 ins., while the Croton and Sudbury watersheds have an annual evaporation of 39 ins. (3) The effect of the size of the watershed upon the yield is also an influencing factor, inasmuch as the run-off from the large watersheds is now uniform in its distribution throughout the year. This is shown by the fact that the minimum flow on the Hickman is *nil*, while on the Croton this flow is at the rate of 2.15 ins. on the watershed per year.

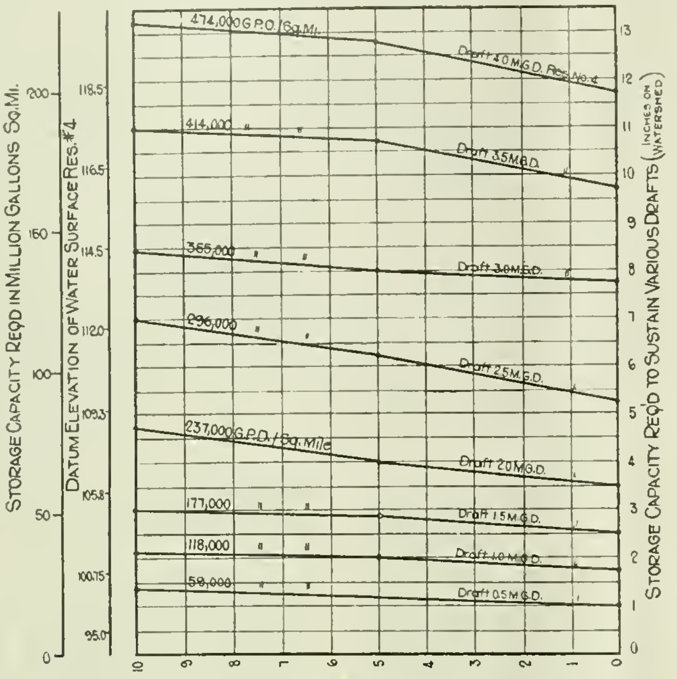


Fig. 7—Diagram Showing Storage Capacity Required to Sustain Various Rates of Draft From Watersheds Containing Various Percentages of Water Surface.

TABLE II.—COMPARISON OF STORAGE CAPACITY REQUIRED FOR VARIOUS DAILY DRAFTS FROM ONE SQUARE MILE OF WATERSHED BASED ON RECORDS OF HICKMAN, CROTON AND SUDBURY WATERSHEDS.

	0 per cent		5 per cent		10 per cent	
Constant daily draft, gals.	Storage volume per sq. mile, gals.	Length of time reservoir is below high water, mos.	Storage volume per sq. mile, gals.	Length of time reservoir is below high water, mos.	Storage volume per sq. mile, gals.	Length of time reservoir is below high water, mos.
Hickman Watershed—						
50,000	17,000,000	6	20,000,000	9	22,000,000	9½
100,000	25,000,000	10	30,000,000	10	34,000,000	10
150,000	35,000,000	11	39,000,000	11	42,500,000	11
200,000	49,000,000	12	55,300,000	13	59,500,000	22½
250,000	67,000,000	24	78,400,000	25	83,500,000	31½
300,000	94,000,000	31½	106,000,000	32	114,500,000	32
350,000	124,000,000	34	138,000,000	34	147,000,000	34
400,000	158,000,000	34½	171,000,000	35	181,000,000	35
450,000	185,000,000	35	206,000,000	36	215,000,000	43
500,000	222,000,000	43	237,000,000	43	247,000,000	43½
Croton Watershed—						
100,000	5,000,000	....	8,500,000	....	12,000,000	....
200,000	14,000,000	....	19,000,000	....	29,000,000	....
300,000	30,000,000	....	36,000.000	....	43,000,000	....
400,000	50,000,000	....	58,000,000	....	67,000,000	....
500,000	76,000,000	....	82,000,000	....	90,000,000	....
600,000	100,000,000	....	110,000,000	....	118,000,000	....
700,000	129,000,000	....	137,000,000	....	145,000,000	....
800,000	157,000,000	....	175,000,000	....	239,000,000	....
900,000	285,000,000	....	340,000,000	....	396,000,000	....
Sudbury Watershed—						
100,000	314,000	1.5	....	....	15,012,000	6.5
150,000	3,006,000	3.5	....	....	19,642,000	7.5
200,000	8,797,000	7.5	....	....	25,742,000	7.5
250,000	17,997,000	7.5	....	....	33,338,000	8.5
300,000	28,473,000	8.5	....	....	43,437,000	8.5
350,000	39,173,000	9.5	....	....	54,137,000	9.5
400,000	51,303,000	9.5	....	....	66,050,000	10.5
450,000	63,553,000	9.5	....	....	78,300,000	10.5
500,000	75,803,000	9.5	....	....	90,550,000	10.5
550,000	88,053,000	9.5	....	....	105,987,000	21.5
600,000	100,651,000	10.5	....	....	134,937,000	21.5
650,000	114,451,000	10.5	....	....	163,887,000	21.5
700,000	139,950,000	21.5	....	....	192,837,000	22.5
750,000	168,900,000	21.25	....	....	221,787,000	23.5
800,000	199,106,000	58.5	....	....	297,460,000	92.5
850,000	250,328,000	80.5	....	....	380,557,000	107.5
900,000	334,078,000	93.5	....	....	465,857,000	116.5

Effect of Length of Record on Reliability of Yield Computations—It is evident that in any estimates made of the probable yield of a watershed, the length of the run-off record is of vital importance. This is best shown by referring to the mass diagram, Fig. 5. From this diagram it will be seen from inspection that the driest period occurred from 1903 to 1906. With an available storage equal to 12 ins. on the watershed of Reservoir No. 4, it will be seen that a daily yield of 3,600,000 gals. per day could be obtained.

To show the importance of the length of the record, let us suppose that the record ended with 1902 covering a period of 18 years from 1885 to 1902, inclusive. During this period the driest cycle of years occurs from 1899 to 1902. Assuming the same amount of reservoir storage available as in the previous case, we find a daily yield of 4,300,000 gals. per day could then be obtained.

If we take the record between 1885 and 1899, the driest period then occurs from 1885 to 1887, and our daily yield with the same storage as before would have been 4,500,000 gals. per day.

Selecting the period from 1888 to 1898 from the record, we have eleven years during which time, even in the driest years, 1894-95, a daily yield of at least 5,800,000 gals. per day could be obtained, based on 12 ins. of storage available.

The above facts show very conclusively that by using a record of short duration, some very erroneous conclusions as to the least yield might result. The following tabulation shows clearly the value of the length of a run-off record in the computation of yield:

Length of record.	Least yield during driest cycle.	Pct. based on 26-year record.
26 years.........	3.6 M. G. D.	100%
18 years.........	4.3 M. G. D.	120%
15 years.........	4.5 M. G. D.	125%
11 years.........	5.8 M. G. D.	160%

Even with a record with 26 years of run-off data available, it cannot be safely assumed that a drier period has not existed previous to these records, or may not again occur at some future time.

Road Work in Burma.—The city council of Rangoon has decided to spend approximately $3,000,000 in the next ten years in placing the roads of Rangoon in good condition. Contracts have been let for compressed asphalt surfaces on a foundation of 9 in. cement-stone concrete for the roads through the business center. About 17,600 sq. ft. of pavement is planned for the present year.

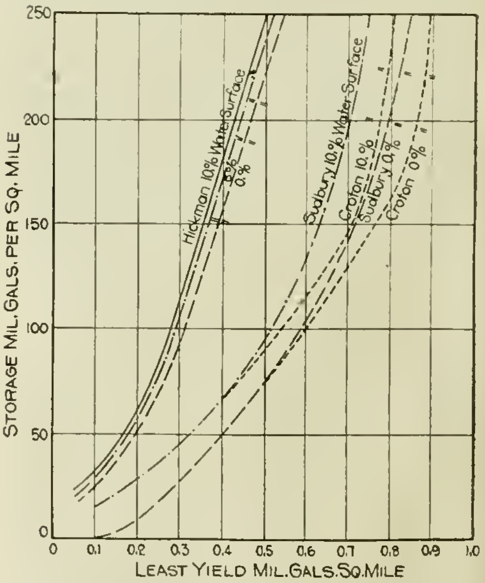


Fig. 8—Comparison of Yield Capacity Hickman Creek, Sudbury and Croton Watersheds.

	Hickman.	Sudbury.	Croton.
Average yearly rainfall (ins.)	39.2	45.8	48.44
Average yearly evaporation (ins.)..........	52	39	49
Minimum flow (rate per year) (ins.)..........	0	0	2.15
Length of record (yrs.)	26	25	25
Drainage area (sq. mi.)	4.3	75	338.8

NEWS SECTION

Editorial Comment—Personals—Society Meetings—Trade Notes—Catalog Reviews—Contract News, Embracing Bids Asked, Work Projected, Contracts Let and Contract Prices on All Classes of Civil Engineering Construction Work.

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The Doings of the Week.

Aside from railroad work construction prospects are excellent. Many good sized municipal improvements are being advertised and quite a few large contracts have been let in the last few days. Railroad construction is comparatively quiet at this time, and there is not very much new work in sight. A few fair sized contracts have been let recently, among them being the following: Alex McGavock, Black River Falls, Wis., for 3 miles of work on the extension of the Fairchild & Northwestern Ry., from Emmit, Wis.; Lorimer-Gallagher Construction Co., Chicago, Ill., for completing the Southern Traction Co.'s lines between East St. Louis and Belleville, Ill.; Curtis & Shumway, Inc., Lynchburg, Va., for the Catasauqua extension of the Lehigh & New England Ry., 6 miles; A. F. Hadigan, 1133 E. 63rd St., Chicago, Ill., for 3 miles of tracks for the new plant of the Baldwin Locomotive Co., at East Chicago; Brocklehurst & Potter Co., 517 Howard Bldg., Providence, R. I., for constructing the Chartiers Southern Ry., a 20-mile line in Pennsylvania; John Dahlgren, St. Paul, Minn., for widening roadbed and straightening track in Tumwater canyon for the Great Northern Ry.; Kilpatrick Bros., Beatrice, Neb., for filling in trestle bridges for the Denver & Rio Grande Ry.

A considerable amount of state highway work is now open for bids. Proposals on three good sized contracts were opened last week by the Pennsylvania State Highway Department. John B. Shreiner, Manheim, Pa., at $63,599 was low bidder on 20,235 ft. of road in Manheim Township; Geo. C. Souder, Lancaster, Pa., at $71,706 was low bidder on 24,105 ft. of road in Warwick Township, and Matthew J. Bert, Philadelphia, Pa., at $26,401, was low bidder on 9,951 ft. of road in West Earl Township.

In the way of municipal contracts among the larger let last week are the following: Pittsburgh Filter Mfg. Co., at $398,200, for filter equipment for the city of St. Louis, Mo.; R. H. Newell Co., Uxbridge, Miss., and N. S. Brock, Boston, Mass., at $209,027, for sewage disposal plant for the city of Fitchburg, Mass.; the Cook Co., Sudbury, Ont., at about $3,000,000, for enlarging the reservoir main for the city of Montreal, Que. Bids are now being asked by the city of Seattle, Wash., on the construction of the Cedar River gravity dam. About $1,000,000 will be expended, the work requiring about 150,000 cu. yds. of concrete.

The Mucker In Action.

A situation that would have furnished an excellent subject for a "human nature" fiction writer is described as follows by C. H. Hollingsworth in a paper presented recently before the American Society of Engineering Contractors:

One of the very last operations on the building of the Buffalo (N. Y.) water works tunnels was the sealing up of the bottom of shaft No. 3. To do this a concrete bulkhead was built in the shaft with an air lock in it for the man and 42 lbs. of air was put on. This pressure was not only on the shaft but also on a 250 ft. of the lake tunnel and the whole 4,700 ft. of land tunnel. This latter was stopped off from the shaft by two gates which had been lowered and under them ran two 12 in. pipes for drains. While working in the shaft bottom the pumps, which were located just off each side of the shaft in chambers in the rocks, were run by steam. This made it unbearably hot, more especially up under the bulkhead near the air locks. Even down in the pump chamber the temperature was 135° F. The instructions were to always have at least two men inside the lock. One evening at 8 p. m., when the 4 o'clock shift came out for lunch, there was a new pump man on duty and he followed the gang out to get oil for his pumps, leaving only the lock tender inside. This man evidently, after taking the lock back in, started down the ladder leading to the bottom of the shaft and fell, striking his head and killing himself. After an hour of trying to attract the lock tender's attention, it being throught he was asleep, efforts were started to get inside. If matters were let go it was only a question of time when the one pump, which was running, would either break down or stop for lack of oil and the tunnel would be flooded. First of all, we tried to get through the air locks at the next shaft on the land tunnel, stop the drains under the gates and then blow the air off the shaft to get in as that could probably have been done before the water drowned out the pumps which were located 6 ft. above the tunnel grade. It was found, however, that the last man through that lock which was not expected to be used again had tied the outer door very nearly shut and the inner door leaked enough to catch the outer one and the lock had gone in by itself. At the same time the lower door was prevented from falling completely open by a rope. The next thing was to wedge open the outer door far enough for the air rushing out to catch the inner door. The upper door was wedged open about 4 ins. and we then had to desist, for if the lower door had been forced shut with that amount of air rushing out under 40 lbs. pressure, the chances were that the shock would have driven it clear through. The upper door was allowed to close and the gang went back to the other shaft, where it was finally decided to wedge open the upper lock door, have a man go into the lock and close the lower door, thus bringing the lock out. Then there commenced an exceedingly interesting period and I had a chance to see the festive mucker in action when things were going against him and when he had to step lively to keep living at all. All the blow pipes were open, but this reduced the air very slowly, owing to the large amount in the tunnel, and the door was wedged open when there was still 31 lbs. of air on the shaft and tunnel. There was no need to call the roll and ask for volunteers. I was standing on the stage at the top of the lock with two foremen and five muckers when the door came open and two of the latter jumped for the lock. One reached it and the air coming through the door struck him with such force that he was literally blown back across a brace like a wet rag. The second man dropped on his face, pushed his feet and legs down through the door and gradually worked toward it. When he felt the ladder with his feet he straightened up, but his body blocked the door, which was only 15 in. x 18 in. in size, and the air going up his trousers ripped his clothes to ribbons and forced him out again. A third man tried it with the others holding him against the air pressure and he got down with his shoulders level with the door when the air blew up his nostrils with such force that it nearly strangled him and distended his cheeks like a chipmunk with a mouth full of nuts, so he had to back out. By means of signs and a few kicks I conveyed to them the idea that they were to wait until the pressure went down some, which they did and a few minutes after we tried it again with one man going down head first, after the fashion of a man diving, so as to keep the air from going up his nostrils, and at the same time we fastened a rope to his leg so as to keep him right end up, or wrong end up with care. We lowered him down to the bottom of the lock, shut the door and the trick was done with the gage at the power house which was piped directly back from the tunnel, showing that the air had not gone below 19 lbs. The minute the bottom door of the lock was closed the pump man tumbled into the lock, followed by a foreman and two muckers, and they were in through while I was telephoning the power house to run the air up again. When I went inside they had all the pumps going, and while I do not want to get in the "just-arrived-in-time-class," I wish to state that if we had fooled around with our air lock 5 min. longer we would not have had a tunnel to go into, unless we used a submarine. The worst was yet to come, however, for after the water was pumped down and we had found the dead lock tender, the problem was to take the body up 60 ft. of perpendicular ladder across a stage and through a 15 in. x 18 in. lock door into a 30 in. diameter lock stood on end with nothing to stand on but the rungs of a ladder up one side, accomplish this in 42 lbs. of air in a temperature of over 135° and finally get the body up through the lock and the upper door and up another ladder for about 20 ft. to the surface. Taking it all together, I do not ever recall of putting in such a strenuous hour since I was born, for it took us that long to get him up into the lock. Then I sent the lock out with the body and five men and it was necessary to use the derrick and pick up the five live ones and the dead one out of the lock and land them on top. Now this may not prove anything to some people, but it did to me, because I was most emphatically among those present. First of all, in the two gangs that night, for the 12 o'clock shift got around before the lock was opened, there were two foremen, one English and one Polish-American; a master mechanic, American; two pump men, one Canadian and one Yankee, and about 20 muckers who were mostly Polish, but partly Irish-American, native Americans, English and negroes, besides outside men and hoisting engineers, and they all stuck to me just as a matter of course. Secondly, they did not wait for anyone to go along ahead to see if it was all right, but when they knew what there was to do they went at it like as if it was all in the day's work, which it was; and, finally, when they were hard pressed, they showed that they could think pretty well also, as they tried some schemes that required a pretty level head to think out in the excitement, and when we got the air blowing the noise was so great that it was deafening. Also and furthermore and moreover, these men did not go home and tell the neighbors about it—they simply went back to work and finished their shift.

PERSONAL

Mr. G. C. Cummins has resigned as city engineer of Dayton, Ohio.

Mr. Julian C. Field has been appointed highway engineer at Hearne, Texas.

Mr. Dudley D. Britt has been appointed city engineer for Clarksburg, W. Va.

Mr. A. M. Lund of Little Rock, Ark., has been appointed city engineer for New Decatur, Ala.

Mr. M. H. Rourke has been appointed street commissioner for Owosso, N. Y., succeeding Mr. Thurston Stebbins.

Mr. David W. Immel has resigned as superintendent of the Jamestown, N. Y., water works, which position he has held for twenty-one years.

Mr. Philip Partenheimer has been appointed chief engineer of the water department, and Mr. Clifford E. Martin first assistant engineer, at Greenfield, Mass.

Mr. K. A. Dunphy has been appointed resident engineer of the Canadian Pacific, District No. 2, Alberta Division, with headquarters at Calgary, succeeding Mr. J. Robertson.

Mr. Arthur R. Carver, chief engineer of the Mission Division, San Benito & Rio Grande Valley Railway, has resigned to go with a new road now building out of Orange, Texas.

Mr. Charles A. Ferry, formerly associated with Mr. A. B. Hill, consulting engineer of New Haven, Conn., has opened an office in the Benedict building in that city for private practice.

Mr. E. A. Kingsley has been appointed state highway engineer of Arkansas. Mr. Kingsley was formerly city engineer of Little Rock and later highway engineer of Pulaski county, Arkansas.

Mr. Timothy Harrington, a pioneer contractor of Vermillion, S. D., died recently at the age of 80. He was superintendent for the Milwaukee Railroad of track construction through Clay county, South Dakota.

Mr. H. Curtis has been appointed bridge engineer for Polk county, Iowa. Mr. Curtis was formerly surveyor for Polk county. He will have supervision of the construction of twenty-nine new bridges planned by the county.

D. H. Gilman, a railroad builder of Seattle, died at Pasadena, Cal., aged 68. Mr. Gilman was one of the incorporators of the Seattle & Montana Railroad, and in 1883 organized the Seattle, Lake Shore & Eastern Railroad, now part of the Northern Pacific System.

Mr. E. H. McHenry has resigned as vice-president and head of the engineering, construction and maintenance of way departments for the New York, New Haven & Hartford Railway, and Mr. A. R. Whaley, another vice-president of the road, has been appointed to succeed him.

Mr. Ben M. Hall, Jr., of Atlanta, Ga., has been employed as assistant hydrographer by the State Engineering Commission, recently appointed to investigate and report upon the reclamation of the Florida Everglades by drainage. Mr. Hall is junior member of the firm of Hall Bros., consulting engineers.

INDUSTRIAL

Frank O. Briggs, first assistant treasurer of John A. Roebling's Sons Co., Trenton, N. J., died May 8.

The Blanchard Machine Co., Cambridge, Mass., has sold to Mueller Rhodes, Tampeco, Mex., an 8 h.p. stationary Blanchard oil engine.

Stone & Webster, Engineering Corp. announces that Mr. Edward N. Lake, formerly in charge of the electrical division at Boston will hereafter represent them in Chicago.

Mr. Charles H. Pindell, assistant to the president of Warren Brothers Company, died suddenly May 13th, at the age of 32 from heart trouble following an illness of only two days. During the past several years Mr. Pindell has attended many good roads conventions in connection with exhibits of this company and his genial presence will be missed by a host of friends.

Mr. A. T. Enlow has resigned as manager of sales of The Stark Rolling Mill Co., to become associated as partner with the Pedlar People, Oshawa, Ont., Canada. Mr. Enlow has had an active time in the sheet trade of the United States, starting 20 years ago and having been closely connected with the various companies ever since. While sales manager of The Stark Rolling Mill Co., Mr. Enlow devoted considerable time to the exploiting of Toncan Metal, in the Canadian field. The Pedlar People, with whom Mr. Enlow will be associated, are large sheet metal factors, having branches at all Canadian points and at many points abroad, purchasing flat sheets in the United States.

On a total volume of business during 1912 of $14,995,323, the annual report of the General Asphalt Company made recently shows net earnings of $1,343,698. After deductions to cover maintenance costs above the reserve for this purpose, there was left a net gain to surplus of $1,120,924, as compared with $818,785 for 1911. The net gain to surplus amounts to 8.5 per cent on the preferred stock. After paying the full 5 per cent dividend on the $657,000 of preferred, there was earned a balance of 4.7 per cent on the common stock. Reduced to a basis of crude asphalt the tonnage sold and consumed amounted to 300,403 tons in 1912 as compared with 265,677 tons in 1911. The continued development of the company's business along the lines of a manufacturing and supply company, rather than a contracting company, is shown by the fact that the sales of asphalt reached a total of $9,009,309, or more than twice the amount of the paving account and substantially larger than all the other accounts put together. During 1912 the company constructed 1,106,287 sq. yds. of sheet asphalt pavement, exclusive of the yardage constructed with its materials by other contractors. The latter, on the basis of asphalt tonnage delivered, constructed not less than 6,500,000 sq. yds., or 410 miles of streets of an average width of 27 ft. The tonnage of road asphalt increased from 20,479 tons in 1911 to 31,289 tons in 1912. Trinidad liquid asphalt for road purposes, as distinguished from street paving, increased from 4,653 tons in 1911 to 18,902 tons in 1912. Reporting the progress of its oil development in Trinidad, the report shows that the production for the year ending Jan. 31st, 1913, was 247,208 bbls. as against a production of 141,233 bbls. in the corresponding year previous. From Feb. 1st the production has averaged 875 bbls. a day as against an average of 675 bbls. in the year ending Jan. 31st. The company reports the conclusion of arrangements for the development of oil in Venezuela, where exploration wells have already begun to produce.

CATALOGUES

Headgates and Headgate Lifts.—Paper, 6x9 ins., 12 pp. C. D. Butchart Co., Denver, Col.

Bulletin No. 11 illustrates and describes the details of the Northwestern and Standard Headgates and rack lifts.

Pumps—Paper, 6x9 ins., 48 pp. Kingsford Foundry and Machine Works, Burley St., Oswego, N. Y.

Centrifugal Pumping Machinery is the title of catalog No. 11 which gives the complete illustrations and descriptions of the details of various types of pumps. Tables of useful information are given.

Chase Motor Trucks.—Paper 7x5½ ins., 80 pp. Chase Motor Truck Co., 532 E. West St., Syracuse, N. Y.

Blue Book No. 2 gives illustrations of Chase Motor Trucks of from 500 to 4,000 lbs. capacity, showing the diversity of usage, prices of trucks, etc.

A separate catalog, 6x9 ins., 32 pp., gives illustrations and specifications of various models.

Stationary Oil Engines.—Paper, 6x9 ins., 34 pp. Remington Oil Engine Co., 120 Broad St., New York City.

Catalog C-12 contains complete general descriptions of the various types of oil engines for pumping, compressing air and general service. Special bulletins are also issued describing engines for railway pumping stations.

Ransome Concrete Forms.—Paper, 6x9 ins., 32 pp. Ransome International Conduit Co., 92 West St., New York City.

This bulletin describes and illustrates centering and machines for molding concrete for aqueducts, tunnels and large water or sewer pipes. A complete description is given of a special machine for molding concrete curbs and sidewalks, which does away with skilled handwork and prevents scaling of the top layer.

Bessemer Paint.—Paper, 3½x5½ ins., 16 pp. Rinald Brothers, 1139 E. Hancock St., Philadelphia, Pa.

This booklet sets forth the claims of the manufacturers for a rust proof paint and gives desirable information. Several other books are issued covering various paints and enamels, including a book of questions and answers regarding the uses of paint on iron and steel.

Concrete Mixers.—Paper 6x9 ins., 20 pp. Waterloo Cement Machinery Corporation, Waterloo, Ia.

This catalog illustrates and describes mixers from 4 to 50 cu. ft. capacity. Information on the cost of concrete mixing is given.

Aztec Asphalt.—Paper, 6x8½ ins., 15 pp. United States Asphalt Refining Co., 90 West St., New York City.

This book contains illustrations of pavements laid with Aztec Asphalt. Several tests made by consulting testing engineers are given. Another catalog contains information regarding liquid asphalt for oiling roads.

Gas Engine.—Paper, 8x10½ ins., 6 pp. The Producers' Supply Co., Franklin, Pa.

This folder gives illustrations of the construction of this gas engine with a complete description.

Wood Working Machinery.—Paper, 4x6¼ ins., 64 pp. A. H. Hitchcock, 1220 Caxton Bldg., Chicago, Ill.

This is a reference list for buyers of saw mill and woodworking machinery.

Concrete Bridges, Roads and Curbs.—Paper, 5½x7½ ins., 48 pp. Trussed Concrete Steel Co., Detroit, Mich.

This catalog contains useful data for the design of reinforced concrete structures. Illustrations of bridges and culverts now built are shown.

Sash Operators.—Paper, 6x9 ins., 78 pp. Drouve Co., Bridgeport, Conn.

This is a catalog of the "Antipluvius" Puttyless Skylight and the "Straight-Push" and other sash operators. It gives a detailed explanation of the system of skylighting. Attention is called to the methods of supporting skylights, fastening of the frame work to curbs, and the spacing of channels.

RAILWAYS

Alabama.

The recently organized Rome & Gadsden Ry. Co. is projecting a 65-mile line via Center Forney, Key and Cave Springs, through Cherokee County, Etowah County, Ala., and Floyd County, Ga. The company will open bids in a few days for making the preliminary survey. J. B. Wadsworth, Gadsden, Ala., is President.

Work will be started at Athens, Ala., shortly, laying steel on the second track of the Lewisburg & Northern, and it is hoped to have the line in operation as far north as the Elk River in Tennessee, by August.

Papers have been filed in the probate office of Jefferson County, Birmingham, Ala., by the Southern Bond & Securities Co., of Birmingham, Ala., changing its name to Tidewater Securities Corporation and increasing the capital stock from $2,000 to $100,000. The present definite purpose, as stated, is to promote and to own the control of what are known in Birmingham as the Tidewater propositions, to wit: To build a railroad from Birmingham to Gadsden and to the Warrior river; to establish a steamboat and barge line on the river to the gulf; to develop Dauphin Island as a deep water terminal and as a summer and winter resort; also to put in lighting and power systems in Birmingham, Jefferson county and elsewhere. The officers and directors are: J. M. Dewbery, president; R. D. Johnston, Jr., secretary, and Forney Johnston, attorney.

Arkansas.

S. M. Bush, according to advices from Fort Smith, Ark., will begin operations at once on building ten miles of the Memphis, Dallas & Gulf railway from Hot Springs. He will have charge of building the line from Hot Springs to Murfreesboro, 10 miles.

Stockholders of the Midland Valley R. R. have voted a bond issue of $15,000,000. It is stated that this special issue has been provided for extending the line from Fort Smith, Ark., to Shreveport, La., and from Wichita, Kans., to Denver, Colo.

California.

The Modoc Northern Ry., which is now completed to Susanville, is reported to have let a contract for the continuation of its line from that place to Outlook. The new contract carries the line through the Pitt River canyon.

The Exposition Terminal Ry. Co. has been incorporated for the purpose of operating a railroad on the grounds of the Panama-Pacific Exposition for the transportation of exhibits and materials from the freight slips of the exposition to the various exhibit places and buildings. The road is to be about ten miles long. The directors are I. W. Hellman Jr., James McNab, William H. Crocker, Henry F. Fortmann and Leon Sloss, all exposition directors and members of the transportation and buildings committee of the Panama-Pacific International Exposition Co. of San Francisco.

The Board of Supervisors of San Francisco has decided on a $3,500,000 bond issue for the construction and equipment of municipal railway lines, and the proposition will probably be submitted to the people at a special election on or about July 1.

With the recording of 17 rights of way for property between the West San Jose Railway station and the Franklin school, May 3, the Southern Pacific completes a cut-off link between these points which will shorten the distance from San Francisco to Los Angeles a mile and a half, stop municipal regulation, give San Jose a big union depot on the Alameda, and possibly make possible the electrification of the old line from San Francisco to San Jose. The cost of improvements which are to be installed, including new trackage, property cost, union station, freight buildings and wrecking will be in the neighborhood of $2,000,000, and when completed will give a union point for all the Southern Pacific lines coming into the city, including those from San Francisco, Oakland and Niles on one side and Los Gatos, Santa Cruz and the south on the other. By the cut off plans the Southern Pacific will cross the Guadalupe Creek near Willow St., and will connect the main line just south of the Oak Hill cemeteries. It will avoid nearly every city street except Santa Clara, and will cross but two or three county roads south and west of the city.

Colorado.

⊙The Denver & Rio Grande Railroad Co. has awarded a contract to Kilpatrick Bros., Beatrice, Nebr., to fill in all the trestle bridges on La Veta Pass with rock and earth. It will take till the fall to finish the job, and then the company will lay a heavier grade of steel between La Veta and Alamosa, a distance of 62 miles.

The Union Pacific Ry. is reported to be planning to begin work early in the fall on the construction of its Denver-Fort Morgan cutoff. This line will be about 73 miles long.

The Denver & Rio Grande R. R. is to expend $1,000,000 this fiscal year in addition to apportionments already announced for improvement to the system.

The Colorado & Southern Ry. is contemplating changes in its Western Denver yards to cost about $50,000.

Connecticut.

The Waterbury & Milldale Tramway Co., projecting an 8½-mile electric railway from Waterbury to Milldale, has made surveys and has secured the construction capital in part. Contracts for 4 miles of line will be let very soon. Chas. H. Clark, Milldale, Conn., is President; W. G. Smith, Waterbury, Conn., is Chief Engineer, and Jno. H. Cassidy, Waterbury, Conn., is Secretary.

Delaware.

The Pennsylvania R. R. is reported to have arranged for the purchase of the Latimer estate, a large tract between Wellington and Newport, Del., for the establishment of new freight yards.

Illinois.

The stockholders of the Kankakee & Urbana Traction Co., George M. Bennett, President, Urbana, Ill., have voted to increase the capital stock to $1,000,000. It is stated that as soon as the new issue is sold in sufficient amount to pay for the work the construction of the line between Rantoul and Paxton will be started.

The Chicago, Milwaukee & St. Paul Ry. has started track elevation work on Bloomingdale Road, Chicago, beginning at the end of the present elevation and extending 2½ miles west. The work is being done by force account. R. J. Middleton, 1803 N. Mozart St., Chicago, is Engineer of Track Elevation.

The Illinois Traction System, L. B. Martin, Engineer Maintenance of Way, Decatur, Ill., is to construct a fill at Bennett to replace a bridge. About $25,000 will be expended.

The Macoupin County Extension Ry. Co. has been incorporated with a capital stock of $10,000 and proposes to operate a connecting railroad in Macoupin county, Illinois, with branches and spurs to coal mines and industries in Macoupin and Madison counties. The incorporators include W. A. Gardner, Chicago, Ill., President of the Macoupin County R. R., a subsidiary of the Chicago & Northwestern Ry.

The Union Depot Co., which is planning new terminals at Chicago for the Pennsylvania and other railroads, has acquired the last parcel of land needed for the improvement, and arrangements may be perfected in the next few months for beginning work. The improvement will cost about $25,000,000.

Indiana.

⊙The Baldwin Locomotive Works, Philadelphia, Pa., has awarded a contract for 3 miles of tracks to be used in connection with its new plant to be built at East Chicago, to A. F. Hardigan, 1133 E. 63d St., Chicago, Ill. The contract for the concrete work for the foundations for the erection and machinery building has been let to H. A. Strauss, 30 N. La Salle St., Chicago, Ill. The plant will probably call for an expenditure of about $5,000,000.

H. E. Bucklen, Elkhart, Ind., President of the St. Joseph Valley Traction Co., is reported to have ordered work started on a new line from Elkhart to Eagle Lake, and possibly to Cassopolis.

Iowa.

⊙The Chicago, Rock Island & Pacific Ry. Co. has awarded the contract for the construction of freight house and track improvements at Davenport, Ia., to George B. Swift & Co., Chicago, Ill. The total cost of the improvement is estimated at $100,000.

The Chicago, Rock Island & Pacific Ry. has surveys under way for a cutoff between Washington, Ia., and Brighton, with a view to eliminating heavy grades.

The Waterloo, Cedar Falls & Northern Ry., C. F. Rairey, Assistant Engineer, Waterloo, Ia., is now asking preliminary bids for filling Virden Creek slough near Waterloo. The area is about 32 acres and the estimated amount of filling is 500,000 cu. yds. The company now has one track across this slough but in its proposed changes for the future is planning on double tracking this area, but changing the alignment somewhat. Within the last two years the company has acquired all of the acreage and intends to fill the entire area, using this for its freight terminals. The material for filling will have to be dredged from Cedar River and hauled about ¼ mile to the proposed fill.

The Davenport & Muscatine Ry., 125 W. 3d St., Davenport, Ia., has made surveys for its street railway extension to North Muscatine.

Kansas.

Surveys are under way for a probable route for an interurban line between Atchison and St. Joseph on the Missouri side of the river. The Doherty Operating Co., Frank W. Frueauff, 60 Wall St., New York City, is interested.

The Kansas City, Kaw Valley & Western Ry. has secured the capital for the construction of its projected 40 mile electric railway from Kansas City, Mo., to Lawrence, Kans. The company will let sub-contracts for the various parts of the construction work. J. D. Waters, Bonner Springs, Kans., is President; O. K. Williamson, Bonner Springs, Kans., is Chief Engineer.

Kentucky.

It has been announced that the Louisville & Nashville, R. R. contemplates certain changes in its line through Bowling Green and also the double tracking of the road from a point south of that city to Nashville, Tenn.

The Wise Terminal R. R. (Interstate R. R., A. H. Reeder, General Manager, Big Stone Gap, Va.) is reported to be planning to start construction work next month, into the coal and timber fields of Dickinson County. Right of way for a 25 mile line is now being secured.

The Kentark Land & Timber Co. has secured the capital for building 10 miles of logging railroad and will begin construction work in about 90 days. The company will build the line with its own forces. R. Carnahan, Kenyon Bldg., Louisville, Ky., is President.

Louisiana.

The preliminary survey of the Orange & Northastern R. R., from Orange, Texas, via Leesville, La., to Natchitoches, La., has been

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

completed and engineers are at work on the permanent line. Clearing and grading is already under way and it is expected the project will be rushed through to completion. The officers of the company are as follows: Alphonse Pruhdomme as President and John G. Gray of Vinton, La. Vice-President. J. W. Sullivan is in charge of construction and Ed. Kennedy is general manager.

Massachusetts.

The committee on street railways of the State Legislature has favorably reported the Western Massachusetts trolley bill, permitting the New York, New Haven & Hartford R. R. Co. to acquire street railway properties in and west of Worcester, under certain restrictions. The measure requires that the New Haven road spend $5,000,000 in street railway extensions.

Minnesota.

⊙Fred Smith, Laurel, Minn., has been awarded a contract by the Minnesota, Dakota & Western R. R., for extending the Loman branch, west from Black River 2 miles.

The Minnesota & International Ry., W. H. Gemmell, General Manager, Brainerd, Minn., is reported to be planning the construction of a 5.8 mile cutoff for improving its entrance to Brainerd, Minn.

Mississippi.

Citizens of Gulfport, Miss., have subscribed $150,000 for the construction of the new railroad to be known as the Gulfport & Western. Most of the right of way between Covington, La., and Gulfport has already been secured.

Missouri.

Surveys are being made by a crew under H. O. Garst, City Engineer, Trenton, Mo., for the extension of the Cainesville-Trenton-Chillicothe R. R., from Carrollton to Chillicothe, through Plymouth and Dawn. The survey from Carrollton to Chillicothe will follow the route chosen for an electric line several years ago, which was never completed. The city of Chillicothe will arrange for the right of way from that city to the Carroll County line. One of the conditions exacted for building the road is that the right of way be donated. Six townships in the northwest part of Carroll County are without a railroad, and, as the new road would pass through all of them, it is believed no trouble will be experienced in getting the right of way.

Work on surveying and securing the right of way for the proposed line of the Hannibal & North Missouri R. R., between Hannibal and Palmyra, Mo., is progressing rapidly. Col. Henry Funk is trustee of the properties of the company

St. Louis Items.

By A. B. Koenig.

✣The Board of Public Improvements here are calling for bids for the erection of the first and second sections of a jail building to be located on City Blocks 208 East and 208 West. Bids will be received in Room 300, New City Hall Building, until 12 o'clock noon, May 23.

⊙J. J. McCaughey, 5402 Magnolia Ave., Chicago, Ill., was awarded 30,000 cu. yds. of drag scraper and wheeler work on the Burlington R. R. at Galesburg, Ill. He will sublet this to some team outfit that can handle it. Free transportation on the Burlington R. R. About half of this work is drag scraper and the other wheeler work.

⊙The Lorimer-Gallagher Construction Co. of Chicago has been given a new contract to complete the Southern Traction Co. lines between East St. Louis and Bellville, Ill. This road will be completed not later than October 1. The company's East St. Louis terminal will be at 4th and Broadway.

⊙The List & Gifford Construction Co. and the Winters Construction Co. secured a nice job of track laying and surfacing on the Wabash R. R. near Bement, Ill. This work has been started and will be finished in record time.

J. H. Hayes, 7019 Hencock Ave., St. Louis, Mo., has 10 teams that he wants to place on some grading work.

P. J. McNerney of Carthage, Mo., spent a day with us last week.

T. J. Walsh of the Walsh Construction Co. was in and out of town the other day. As usual, too busy to give out much information.

Mike Conroy returned from the North. He is about through with his extensive grading job at Granite City, Ill.

Municipal ownership of railroad tracks along the river front, from the Chain of Rocks to the River Des Peres, was the keynote of a report submitted by the City Plan Commission to the Municipal Assembly. The report points out several railroad franchises along the river front will expire in a short time, and suggests it would be feasible for the city to take them over. The report suggests these lines be made to connect with the Municipal Railway which now operates from Bissell's Point to the Chain of Rocks, which would give a continuaus line to Arsenal St., and that an extension be built from that point south to the River Des Peres. The report shows such a road, with connections with the free bridge, would give an opportunity to open vast industrial enterprises on the North and South sides. The report suggests the widening of the river front to the east. The report was accompanied by maps and plans showing the work as suggested in the report. The report carried no recommendation, simply pointing out the feasibility of the plans suggested.

The Davis Commissary & Supply Co. was incorporated here on May 10 to do a general contractors' supply business, boarding and lodging railroad laborers, buying and selling contractors' tools and outfits. They have opened an office at 612 Walnut St. Mr. L. B. Davis is Vice President and General Manager in charge of this company.

C. R. Fickes, locating engineer for the Burlington R. R., who will superintend the construction of the $5,000,000 bridge to be built over the Ohio River at Metropolis, Ill., 12 miles below Paducah, has returned to Metropolis from the west. He expects to begin work sometime this month. The high stage of the river prevented work from starting earlier.

The Memphis, Dallas & Gulf R. R. Co. has accepted a $60,000 bonus from Hot Springs and will extend the road to that city as soon as possible. About ten miles of the right of way has been laid out and grading and laying of track will begin at once.

Preparations are being made by the Illinois Central R. R. for the construction of a new passenger station in Memphis, Tenn., in addition to the construction of the temporary depot which will be completed and ready for occupancy the latter part of next week.

J. M. Vernon resumed work about three miles south of Monticello, Ark., to finish the uncompleted grading on the A. D. & N. R. R. This work was discontinued last fall. Fifteen cars of steel have been received at Ladell, Ark., the present northern terminus, and track laying north to Monticello will begin at an early date. This railroad, when completed, will give Monticello a direct connection with the Rock Island System at Crossett. It will open up much fine country and be of the greatest benefit to this section. The Townside Co. has just contracted with the Clifford Wells Co. for the boring of a deep well at the new town of Ladelle. It is thought the road will be completed to Monticello by July.

The Wm. P. Carmichael Co. started work on an overhead crossing for the Wabash R. R. at Edwardsville, Ill. Besides the bridge the Wabash R. R. Co. is making extensive improvements and adding a lot of new track to its yards in Edwardsville.

The Rock Island R. R. Co. is going to build a modern freight depot and warehouse at Keokuk, Ia. The building will be built on the bluffs, high above the present depot. The estimated cost is between $40,000 to $50,000.

The Springfield & Central Illinois Traction Co. has filed a mortgage for $20,000,000 at Belleville, Ill., covering all its properties to the Chicago Title & Trust Co. of Chicago, Ill., and City Safe Deposit and Agency Co. of London, England.

C. G. Young, Consulting Engineer for the Southern Traction Co. of Illinois, who is in St. Louis, says St. Louis is in no way obligated to complete the free bridge at a specified time in order that the company may realize on its bond issue. Young stated that the company has arranged to sell its bonds. He said the issue would be approximately $7,500,000. Young said the company must complete a line from East St. Louis to Belleville by Oct. 1, and must have the St. Louis loop completed by the time the upper deck of the bridge is finished in order to realize on the bond issue. The length of the road will be 75 miles.

The Building Industries Association and the American Institute of Architects have appointed committees to meet jointly to devise plans for fair bidding on contracts and subcontracts and to correct other evils in the building trade. O. G. Selden, S. M. Lederer and William Simpson will represent the builders and G. F. A. Brueggemann, M. P. McArdie and E. Helfensteller the architects. The Masters Painters' and Decorators' Protective League has sent out notices that it will not submit bids to such contractors as refuse to publish bids received by them for decorative work, nor who shall refuse to award contracts to the lowest bidder who is acceptable to the architect or owner, at this time of awarding the general contract.

Montana.

E. A. Wickham & Co., Council Bluffs, Ia., have opened offices at Lewiston, Mont., preparatory to constructing the line from the tunnel site to Grass Range, a distance of 20 miles.

New York.

Surveys have been started from South Dayton to Hamburg for the projected electric railway from Jamestown to Hamburg. Nearly all options for right of way for the line have been secured. C. G. Mead, Jamestown, N. Y., is a member of the executive committee of the towns through which the line will pass.

Hornell Traction Co., Hornell, N. Y., is to construct a 1-mile extension from Seneca St. to the new site of the Hornell Country Club, the line passing through North Hornell.

The State Public Service Commission has granted permission to the New York State Rys., Rochester, N. Y., to construct extensions of its lines in West Dominick, East Dominick and Mill Sts. at Rome. The city recently granted franchises for these extensions.

North Carolina.

A project is under consideration for the construction of a railroad from Taylorsville to Wilkesboro, 20 miles. Officials of the Watauga & Yadkin River R. R., H. C. Landon, General Manager, North Wilkesboro, N. C., were recently over the route.

The Hiawassee Valley Ry. Co., has secured the capital for the construction of its projected 35-mile line from Andrews to Hayesville, N. C., and Hiawassee, Ga. Surveys have not been made as yet, nor has the chief engineer been selected. It is proposed to let construction contracts about Aug. 1. The company will effect its organization about June 3. J. Q. Barker, Andrews, N. C., is interested.

North Dakota.

The Commercial Club of Devils Lake, N. Dak., is reported to have subscribed $20,000 to the capital stock of a company proposing to build an electric railway for Devils Lake connecting with the Devils Lake Chautauqua.

Ohio.

The Columbus, Marion & Bucyrus R. R., Marion, O., operating 18 miles of electric railway, has been purchased by James H. Caldwell, Troy, N. Y., chairman of the committee of bondholders. It is stated that a new company will be incorporated with $350,000 capital stock and that a considerable amount

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

of improvement work will be undertaken.

The Fostoria & Fremont Ry. Co., J. W. S. Reigle, Chief Engineer, Findlay, O., is to make preliminary surveys for an extension of its electric railway from Fremont to Port Clinton. Two routes probably will be surveyed, one by way of Oak Harbor and the other direct to Port Clinton.

Oklahoma.

The Muskogee & Missouri Pacific R. R. Co. has filed its charter and proposes the construction of a 12-mile line from Muskogee to a point 2 miles north of Fort Gibson to a connection with the Missouri Pacific Ry. C. N. Haskell, Muskogee, Okla., is interested.

Oregon.

⊙Advices from Astoria, Ore., state that a new logging railroad is to be built in Clatsop County, from a point near Gearhart Park to a point as far east as the Lewis & Clark River. Olson Bros., Seaside, Ore., have the contract for the work.

Pennsylvania.

⊙Curtis & Shumway, Inc., Lynchburg, Va., have been awarded contract for the Catasauqua extension of the Lehigh & New England Ry. The line will run from near Bath, Pa., to Catasauqua, Pa., about 6 miles. The contractors will sub-let some steam shovel work and 2,000 cu. yds. of concrete.

⊙Brocklehurst & Potter Co., 517 Howard Bldg., Providence, R. I., has been awarded the contract for constructing the Chartiers Southern R. R., a subsidiary of the Pennsylvania R. R. This road is to be about 20 miles long and will extend from Emman to Marianna, Pa.

A project is being promoted by E. C. Hall, Orbisonia, Pa., W. M. Comerer, Burnt Cabins, and George C. Fraker, Fort Littleton, to construct a railroad through the lumber country of Fulton County.

The Board of Directors of the Commercial Exchange, Philadelphia, Pa., has adopted resolutions favoring the immediate abolition of the grade crossings of South Philadelphia, a question which has been a cause of agitation among the city authorities and the railroads for several months, by the substitution of an extension of the Belt Line R. R. along the entire river fronts of the Delaware and Schuylkill Rivers. In connection with the Board of Trade the Commercial Exchange is co-trustee of 51 per cent of the capital stock of the Philadelphia Belt Line R. R. Co. The resolution states that the Exchange considers it proper and its duty under the trust it holds in perpetuity for the city, that the officials of the Belt Line and municipal authorities be notified that it believes the projected improvements in South Philadelphia, which have been the subject of recent conferences of city, railroad and Belt Line officials, should be finished as an extension of the Belt Line Co.

Utah.

The Salt Lake & Utah Interurban Ry. has grading and track laying under way in Provo. Grading work has also been started in the Jordan Narrows, and the contract for grading from that place to Lehi was to be let at once. W. C. Orem, Salt Lake City, is President.

South Carolina.

The South Carolina Western Ry., W. R. Bonsal, President, Hamlet, N. C., is reported to be ready to extend its line from Florence to Poston as soon as the right of way is donated.

Construction work on the Orangeburg Railway, a short line between Orangeburg and the city of North, a distance of 18 miles, is practically completed and the line will be in operation within a short time. William C. Wolfe of Orangeburg, S. C., promoted the project.

South Dakota.

The South Dakota Central Ry., G. W. McArthur, General Manager, Sioux Falls, S. Dak., is reported to be contemplating the construction of an extension from Watertown to Hankinson, N. Dak., a distance of 125 miles.

Tennessee.

The Memphis & Lake View Ry. Co. has been incorporated with a capital stock of $50,000. The incorporators being T. H. Tutwiller, Memphis; L. E. Wright and L. P. Niles. This is probably a reorganization of the Lake View Traction Co.

The West Tennessee Traction Co., B. G. Sargent, General Manager, Southern Express Bldg., Memphis, Tenn., projecting an electric railway from Memphis, via Brownsville, to Jackson, Tenn., is reported to have completed preliminary work between Memphis and Arlington, and will, it is stated, let contracts on the first section some time next month. Engineering work on the section east of Arlington is now under way.

Texas.

The Wichita Falls Traction Co., Wichita Falls, Tex., is to construct a 2-mile extension at Wichita Falls.

A project is under consideration for an interurban line to connect Johnson City and Stonewall. John Kinney, Johnson City, Tex., is interested.

Grading work has been started at Tule Lake for the construction of the San Antonio, Uvalde & Gulf R. R. from Mathis to Corpus Christi. E. R. Breaker, Pleasanton, Tex., is Chief Engineer of the railway.

The National Railways of Mexico, Jas. M. Reid, Chief Engineer, City of Mexico, is contemplating a number of improvements for the division between Laredo and Corpus Christi. It is probable that the line will be extended from Corpus Christi to Port Aransas, 30 miles, to secure a deepwater outlet on the Texas Coast.

It has been announced by A. Courchesne, who promoted the construction of a line from El Paso to Artesia, N. Mex., that the Frisco will probably build a short line over the route surveyed by his engineers.

L. E. Walker, President of the Middle Buster R. R., which projects a line from Quanah to Rockport, has announced that it is expected to have the grading work well advanced within the next month. The survey of that portion of the line between Graham and Seymour was recently finished and the route between Graham and Strawn is now being located. Liberal bonuses have been raised in aid of the project at many points along the route.

Officials of the Southern Pacific are inspecting the property of the state railroad between Rusk and Palestine, Texas, a distance of 30 miles, with a view of submitting a proposition to purchase it. The Governor has requested the Railroad Commission to prepare a profile of the railroad and Engineer Parker of the commission is at work on the same.

Vermont.

Plans for the new union station at Burlington, Vt., to be erected by the Central Vermont Ry., G. C. Jones, Vice President, St. Albans, Vt., and the Rutland R. R., have been agreed upon. The estimated cost is about $180,000, this including the building and track improvement work.

Virginia.

The Lyndhurst Lumber Corporation is constructing a 9-mile lumber road from the Norfolk & Western R. R. at Lipscomb to the lumber tracks in the Blue Ridge Mountains. Harrison Ball, Mahoney City, Pa., is interested.

Bids were opened on May 20 by the Virginia-Carolina R. R., P. W. Early, Chief Engineer, Abingdon, Va., for a 40-mile extension from Green Cove Creek to Jefferson and Todd, N. C. This is the work mentioned in our May 7 issue on which bids were to have been opened May 5.

The New River, Holston & Western Ry. opened bids on May 20 for a 15-mile extension from Rocky Gap to Sutton. P. W. Early, Abingdon, Va., is Chief Engineer.

Washington.

⊙John Dahlgren, St. Paul, Minn., has been awarded a contract by the Great Northern Ry. for widening of the roadbed and straightening of the track in Tumwater canyon from Leavenworth to Chiwaukum.

Final surveys are under way for the 37-mile line to be built between Helsing Junction and Raymond for the Puget Sound & Willapa Ry. Co., a subsidiary of the Chicago, Milwaukee & St. Paul Ry. From Raymond to tidewater the new line will use the tracks of the Pacific & Eastern, a logging road. The 37 miles of line, however, run through a heavily timbered country and will require some expensive construction. Offices have been opened at Raymond, Wash., with C. H. Byers as Chief Engineer.

The General Electric Co. and the Westinghouse Co. are now working on estimates for the electrification work on 450 miles of line on the Puget Sound Division of the Chicago, Milwaukee & St. Paul Ry. It will probably be sometime before bids are asked on the work. It is probable that the electrification work will cost about $8,000 per mile.

West Virginia.

⊙Charles E. Price is reported to have been awarded a contract for constructing a 14-mile line for the Virginia Ry. to a connection with the Norfolk & Western Ry. in the New River Valley. H. Fernstrom, Norfolk, Va., is Chief Engineer of the Virginia Ry.

The Baltimore & Ohio R. R. is reported to have taken over the survey rights of the Long Fork R. R. and it is stated that a new extension running 28 miles from Huntington, W. Va., up to the left fork of Beaver Creek, will be built.

The Grafton, Fairmont & Clarksburg Traction Co., George R. Kirk, President, Grafton, W. Va., is reported to be planning to let contracts at once for the construction of the section of the line from Grafton to Pruntytown. The company projects a line to connect Fairmont, Grafton and Clarksburg.

Wisconsin.

⊙Alex McGavock, Black River Falls, Wis., has been awarded 3 miles of work on the construction of the Fairchild & Northeastern Ry. from its present terminus at Emmit, Wis. Mr. McGavock intends doing the work with a steam shovel; there is also some nice team work on the line.

Delays in the courts in street valuation proceedings are holding up the commencement of work on the south side track elevation and separation of grades at Milwaukee. It is hoped, however, that the proceedings will be cleaned up soon so that work can be started. The Chicago, Milwaukee & St. Paul R. R. and the Chicago & North Western Ry. will elevate their tracks from Greenfield Ave. north to the Milwaukee River. The total cost will be nearly $2,000,000.

Canada.

The Atlin Ry. Co. is to apply to parliament at the next session for an act to incorporate a company with power to construct a railway, commencing at a point on the southern end of Atlin, at or near the town of Atlin, and following a generally southerly direction to a point on the Taku River, where it intersects the international boundary, and also from a point on the line easterly to the southern end of Teslin Lake in British Columbia.

Application is to be made to parliament at the next session for an act to incorporate a company under the name of the Naas Valley & Northern Ry. Co., with power to construct a railway commencing at a point at or near the mouth of the Naas river and following in a general direction along the valley of the Naas river to the Stickeen river, and onward northerly, following the shore of Teslin Lake to the junction of the Yukon territory.

The Portage Development Co., William Richardson, President, Portage la Prairie, Man., is reported to have received an application from a Liverpool, England, concern to purchase the franchise for building the Portage Radial Ry.

The Taber Transit Co., V. O. Eastland, Chief Engineer, Calgary, Alberta, will let contracts in the near future for the construction of a railroad from Taber, Alberta, north to coal mines at Retlaw and Bow City.

BRIDGES

Alabama.

✣Bids will be received until June 3 by Walter G. Kirkpatrick, City Engineer, Birmingham, Ala., for constructing two reinforced concrete bridges, 25th St. (Village Creek), 72 ft. long by 24 ft. wide, Avenue "E" (Valley Creek), 86 ft. long by 34 ft. wide. Both are slab floor type on concrete columns, approximating 410 cu. yds. concrete.

Lumbermen of Elmore County, Ala., have submitted a proposition to the Board of Revenue, Montgomery, Ala., offering to furnish $12,500 for the construction of a bridge over the Tallapoosa River at Ware's Ferry providing the board would furnish a like amount.

California.

⊙The Board of Glenn County Supervisors Willows, Calif., opened bids May 5 and awarded the contract for the construction of a bridge over Howard Slough in Road District No. 5 to Jenkins & Wells, $3,488. W. H. Sale is County Clerk.

The Board of Tehama County Supervisors. Red Bluff, Calif., has adopted plans and specifications for the construction of a bridge over Antelope Creek near Dairyville.

A petition asking the Supervisors of Shasta County, Redding, Calif., to build a bridge across the Sacramento River at Kennett at a cost of $30,000 is being circulated in that city and in other parts of the county.

The Board of Orange County Supervisors of Santa Ana, Calif., has applied to the Federal Government through Col. C. H. McKinstry, U. S. Engineer. Los Angeles, Calif., for permission to construct a highway bridge across the entrance to Anaheim Bay, parallel with the bridge of the Pacific Electric Company.

R. H. Jamison, Agnew, Calif., at $1,102 submitted the lowest bid May 5 for the construction of a concrete bridge over Calabasas Creek on San Francisco Road, Santa Clara County.

Colorado.

The City of Denver, Colo., and four corporations have reached an agreement for the construction of the Colfax-Larimer Street viaduct, ratified recently when the interested corporations signed a contract for apportioning the cost of the project. By the terms of the agreement the city's share of the cost of the viaduct is about one-third of the total cost. The viaduct will be constructed at a cost of $715,000, the city's share being $260,000. Mayor Arnold, Auditor Markey City Clerk Thum signed the contract for the city. The contract bears the names of the following corporation officers: President E. L. Brown and Secretary J. B. Andrews for the Denver & Rio Grande Railroad; President A. D. Parker and Secretary B. N. James for the Colorado & Southern; President Darius Miller and Secretary H. W. Weiss for the Chicago, Burlington & Quincy; General Manager John A. Beeler and Secretary F. E. Cobb for the Denver City Tramway Company, and President William G. Smith and Secretary A. C. Montgomery for the Denver & Intermountain.

Georgia.

Bids will be received shortly by the City of Macon, Ga., J. J. Gailliard, Engineer, for strengthening the Spring St. bridge. The work will cost about $13,000 and will include new pillars and paving.

Illinois.

✣Bids will be received up to 2 p. m., June 7, 1913, at the Town Hall, Magnolia, Ill., for the construction of a reinforced concrete retaining wall in Magnolia Township, Putnam County. Frank N. Glover, Town Clerk, Magnolia, Ill. Pletch Retaining Wall: Total length, 129 ft.; height, 10 ft. Estimated total concrete, 76.5 cu. yds.; reinforcing steel, 3,255 lbs. Nearest railroad station, McNabb, about 2¾ miles. Acceptable gravel and cement will be furnished by the commossioners free to the contractor at the site of the work. Excavation, clay, to be carried about 3 ft. below stream bed. Engineer's estimate, $650. Work to be completed on or before October 1, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission which may be seen at the Town Clerk's office or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received until 11 a. m. May 24 by the Department of Public Works, Chicago, Ill., for furnishing and delivering and erecting sidewalk railings for 3 fixed bridges over the north branch of the Chicago River at N. Kedzie Av., Forest Glen Av. and N. 56th Av., the railings to be of structural steel wrought iron or cast iron as shown on plans, separate bids must be submitted for work on each bridge, cash or certified check for $200.00 must accompany proposal, plans and specifications may be had upon application to L. E. McGann, Commissioner of Public Works.

✣Bids will be received up to 2 p. m., May 31 1913, at the Town Hall, Troy, Ill., for the construction of one steel bridge on creosoted timber foundations in Jarvis Township, Madison County. H. C. Dettmar, Town Clerk ,Troy, Ill. Kingston Bridge: Span, 75 ft.; roadway. 16 ft. Nearest railroad station, Troy, about 5 miles. The bridge is to be a 75-ft. riveted steel truss with creosoted pile foundations, and a 12-ft. creosoted timber approach at each end. Bridge is to be designed with a view to moving to a new site, in case a drainage ditch in a new location is substituted for the present channel. Engineer's estimate, $3,000. Work to be completed on or before November 1, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Ill.

⊙Ball & Son, Bement, Ill., have been awarded the contract for the construction of a steel and concrete bridge over Punkin Run about 3 miles southeast of White Head. The structure must be completed by August 1.

⊙Harry L. Wells, Geneva, Ill., County Surveyor, has been awarded a contract for improvements in the east river hghiway south of Batavia. This job includes a 24-ft. single arch re-inforced concrete bridge and two culverts, besides grading and cutting down two hills on the road.

At a special election held at Kent, Ill., it was voted to bond the township for $1,800 for the construction of cement bridges.

The citizens of Wilmington Township have petitioned for a special election on the proposition of building a new bridge over the Kankakee River at Wilmington, Ill.

A special meeting will be held shortly at Freeport, Ill., on the bridge question. C. F. Franz is Mayor.

The following were the bids submitted on the Old Circle Bridge, Marrowbone Township, Moultrie County, Ill., May 1, 1913: Melloy Const. Co., Chicago, Ill., $3,098; G. J. Berger, Fort Branch, Ind., $3 060; Driscoll-McCalman Co., Decatur, $3,198; Geo. A. Quinlan, Chicago, Ill., $3,040. All bids were rejected.

Indiana.

✣Bids will be received until 2 p. m., June 1, by Board of Blackford County Commissioners, Hartford City, Ind., for the construction of a number of culverts. James Cronin, Jr., is County Auditor.

✣Bids will be received until 10 a. m., June 4, by Board of Wabash County Commissioners, Wabash, Ind., for the construction of a bridge over Mississinewa River. Dan Showalter is County Auditor.

⊙The Pan American Bridge Co., Newcastle, Ind., has been awarded the contract for the construction of a bridge over the Wabash River near Geneva, Ind. The work will include abutments and a 110-ft. steel truss, and will cost $8,600.

⊙Amos Fisher has been awarded a contract at $1,238 for the construction of a bridge near Decatur, Ind.

⊙The Board of Johnson County Commissioners, Franklin, Ind., awarded the contract for the construction of five small bridges to Albert Haman, Columbus, Ind., at $1,405. Bids were received until May 13.

⊙The Commissioners of Adams and Wells County, Decatur, Ind., awarded the contract for the construction of the Heller bridge on the French-Nottingham Township line to Berne Supply Co., Berne, Ind., at $495.

The Morgan County Council, Martinsville, Ind., has appropriated $13,550 for the repairs to bridges damaged by the recent flood. The work will include repairs to the Henderson Ford bridge over the White River in Green Township which will cost $7,400, and the Cope bridge in Green Township, costing $3,400.

Citizens of Elkhart, Ind., contemplate the construction of a new bridge at North Main St. instead of reflooring the old structure. The cost of such an improvement would amount to about $40,000. A. M. Smith is City Engineer.

Iowa.

The Grant Park Improvement League, Des Moines, Ia., has adopted a resolution that the request of the Rock Island Railway Company to the City Council to vacate certain streets be granted, provided that a viaduct be erected at East 26th St. and one at East 13th St., and that they open up and widen Market St. from East 30th to East 18th Sts.

Kansas.

✣Bids will be received up to noon, June 4, 1913, at the office of the County Clerk in the Court House at Garnett, Kan., for the construction of a bridge in Anderson County. A deposit of Fifty Dollars ($50) must accompany each bid. Patton Bridge: A reinforced concrete arch of 75-ft. span and 16-ft. roadway. Excavations will be in clay and gravel and carried 4 ft. below stream bed. Estimated quantities approximately 14,800 lbs. of steel and 325 cu. yds. of concrete. Piling will probably be required in the foundation, but the piling will be furnished at the bridge site by the county. Stone suitable for crushing can be bought from Mr. Patton, living near the bridge. Other stone can be quarried within 1½ miles of site. Sand will have to be shipped in. Freight rate on sand from Topeka to Garnett is 3½c per 100 lbs. Location is in Monroe Township, 4 miles from Garnett on the Mo. P. and A., T. & S. F. Railroads. The county owns a rock crusher and will rent same to contractor at a nominal price. Plans and specifications are on file in the County Clerk's office and copies of the same may be had by mailing $1 to the State Engineer, Manhattan, Kan.

✣Bids will be received up to noon, May 23, 1913, at the office of the County Clerk in the Court House at Alma, Kan., for the construction of seven (7) bridges, in Wabaunsee County. A deposit of Fifty Dollars ($50) must accompany each bid. Fink Bridge: A 16-ft. span stone arch bridge. Estimated quantity, about 133.5 cu. yds. of stone masonry. Location is in Farmer Township, about 4 miles southeast of Volland. Ringle Bridge: A 20-ft. span, 18-ft. roadway, reinforced concrete superstructure on a plain concrete substructure. Estimated quantities, about 28.9 cubic yards of reinforced concrete, 3,613 lbs. of steel and 46.6 cu. yds. of plain concrete. Location is in Alma Township, about 1½ miles

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

west of Alma. Sengle Bridge: A 10-ft. span, 20-ft. roadway, reinforced concrete superstructure on a plain concrete substructure. Estimated quantities, about 10.7 cu. yds. of reinforced concrete, 1,217 lbs. of steel, and — cu. yds. of plain concrete. Location is in Alma Township, about 1 mile from Alma. Herren Bridge: A 10-ft. span, 20-ft. roadway, reinforced concrete superstructure on a plain concrete substructure. Estimated quantities, about 10.7 cu. yds. of reinforced concrete, 1,217 lbs. of steel, and — cu. yds. of plain concrete. Location is in Alma Township, about 1 mile from Alma. Schwanke Bridge: A 25-ft. span, 18-ft. roadway, reinforced concrete superstructure on a plain concrete substructure. Estimated quantities, about 30.3 cu. yds. of reinforced concrete, 3,765 lbs. of steel, and 38.4 cu. yds. of plain concrete. Location is in Farmer Township, about 10 miles south of Alma. Fields Bridge: A 24-ft. span, 16-ft. roadway, reinforced concrete superstructure on a plain concrete substructure. Estimated quantities, about 27.8 cu. yds. of reinforced concrete, 4,416 lbs. of steel, and 86.4 cu. yds. of plain concrete. Location is in Plum Township, about 1 mile from Harveyville. Schreiber Bridge: A 10-ft. span, 25-ft. roadway, reinforced concrete superstructure on a plain concrete substructure. Location is in Alma Township, about ½ mile from Alma. Plans and specifications are on file in the County Clerk's office and copies of the same may be had by mailing $2 to the State Engineer, Manhattan, Kan.

✣Bids will be received until noon, May 28, by Board of Washington County Commissioners, at the office of F. V. McKelvy, County Clerk, Washington, Kan., for the construction of the following bridges and bridge repair: One 45-ft. steel bridge, superstructure only, on south side Section 13, Strawberry Township. One 30-ft. steel bridge, superstructure only, on south side Section 35, Mill Creek Township. One 30-ft. steel bridge, superstructure only, on west side Section 5, Little Blue Township. One 30-ft. steel bridge, superstructure only, on east side Section 33, Coleman Township. One 30-ft. steel bridge, superstructure only, on west side Section 20, Haddam Township. Repair of bridges between Sections 33 and 34, Washington Township. Plans for the foregoing structures are on file in the office of County Clerk.

✣Bids will be received until June 3, by George H. Hungerford County Clerk, Manhattan, Kan., for the replacement of the bridge across Seven Mile Creek, Ogden Township.

Farmers in the vicinity of Eden are petitioning the Commissioners of Atchison County, Atchison, Kan., for the construction of a bridge over Independence Creek near the county line.

The Commissioners of Morton County, Richfield, Kan., contemplate the construction of a $100,000 bridge over the Cimarron River where the Colmar cutoff of the Santa Fe crosses and where the new town of Elkhart will be founded.

Kentucky.

✣Bids will be received until 9 a. m., May 28, by County Judge S. A. Young, Henderson, Ky., for the construction of 23 bridges estimated to cost $19,847. S. H. Kimmel is County Road Engineer.

Advices from Frankfort, Ky., state that Fayette, Bath, Lawrence, Hopkins, Marion, Knox, Whitley, Madison, Mercer and Henderson Counties have applied to Commissioner of Roads R. C. Terrell for plans and estimates on bridges to be built this year, and the plans have been prepared. They include steel bridges with concrete abutments and piers and wooden or concrete floors as specified and thirteen concrete beamed bridges for Henderson County, ranging in span from 22 to 30 ft. Henderson County also has secured plans for seven steel bridges with concrete floors, two with 50-ft. spans, three with 40-ft. spans and one with 60 and one with 55-ft. spans. Fayette County has plans for an 80-ft. span of steel; Bath has plans for a span of 150 ft. over Slate Creek with 16-ft. abutments; Lawrence County has plans for an 85-ft. span over Cat Creek, 100-ft. span over Blain Creek and another of three spans 276 ft. long over the same stream; Hopkins County has plans for three bridges, a 50-ft. span over Drake's Creek and two over Clear Fork, 100 and 56 ft. long, respectively; Marion County has plans for a span 125 ft. long over Rolling Fork; Knox has plans for a 50-ft. span over Richland Creek; Whitley for a span 147 ft. long over Jellico Creek; Madison has plans for a 54-ft. span over Brushy Fork and a three-span bridge 112 ft. long over Silver Creek; Mercer County has plans for a two-span bridge 80 ft. long over Buchanan Creek.

Massachusetts.

The Committee on Counties of the Massachusetts Legislature voted unanimously to report a bill carrying with it an appropriation of $150 000 for the construction of a bridge at Lake Quinsigamond.

Minnesota.

⊙The County Court has awarded the contract for the construction of the new Main St. bridge at Pine Island, Minn., to the Security Bridge Co., Minneapolis, Minn., at $9,000.

Mississippi.

✣Bids are being taken by the Commissioners of the Third District of Harrison County, according to advices from Pass Christian, Miss., for the construction of a bridge and draw across Bayou Portage and the construction of a graded road from Pass Christian to Wolf River. At Wolf River another drawbride is proposed, also a blind bridge across Bayou DeLisle. This district issued $15,000 worth of bonds to build the Portage bridge.

Missouri.

✣Bids will be received until noon, May 23, by Board of Public Improvements, E. R. Kinsey, Pres., St. Louis, Mo., for constructing two reinforced concrete bridges over the tracks of the Missouri Pacific Ry., one at Arsenal St. and one at Columbia Av. A deposit of $728 is required. Plans and specifications are on file at the office of the Board and at the office of the Street Commissioner.

⊙The Kansas City Bridge Co., Kansas City, Mo., has been awarded the contract for the construction of a 75-ft. riveted pony truss with two 15-ft. wooden approaches at $2,010. The work, which will include all material and labor, will be done for Drainage District No. 3, Carroll County, Mo.

⊙The Dildine Bridge Co., Hannibal, Mo., has been awarded a contract by the County Court for the erection of a new bridge at Greenwell Ford. The contract price was $2,441.

⊙The Grundy County Court, Trenton, Mo., has awarded the contract for the construction of four bridges to the Illinois Steel Co., Jacksonville, Ill., as follows: Fulkerson bridge, located 2 miles east of Brimson, will be put up for $2,246. Graham Ford bridge, located 2 miles south of Parkerton, will be erected for $2,688; the Kemp bridge, 2 miles east of Hickory, at a cost of $3,108, while the bridge across Honey Creek at what is known as the McLain crossing, will be built for $950. Six other companies submitted bids. The companies and the amount of bids for the building of the four bridges follows: Illinois Steel Co., Jacksonville, Ill., $8,992; Bill Dine Bridge Co., Hamilton, $9,975; Mid-West Bridge Co., Omaha, Neb., $10,140; Massillon Bridge & Structure Co., Akron, O., $9,557; Proposal Illinois Steel & Bridge Co., Illinois, $10,116; Frank E. Gott, St. Louis, Mo., $12,900, and the Midland Bridge Co., $10,452.

Andrew and Holt Counties Courts at a recent conference at Fillmore, Mo., ordered the construction of a joint steel concrete bridge near the site of the Hollister mill west of Fillmore. The new bridge will be a large one, costing between $4,000 and $5,000. It will be of steel, on concrete abutments, and the approaches and span together will be about 200 ft. in length. The driveway will be 16 ft. wide, enabling vehicles to pass on the bridge. Advertising and letting of contract will be done at Savannah, Mo.

Nebraska.

✣Bids will be received until June 8, by J. H. Jensen, Kearney County Clerk, Minden, Neb., for the construction of all wood, steel and concrete bridges. Plans and specifications are on file at the office of the clerk. A certified check for $200 must be filed with each bid.

✣Bids will be received until 2 p. m., June 9, by H. E. Wells, Clerk of Lancaster County, Lincoln, Neb., for the furnishing of all labor and material for building concrete bridges and culverts for one year from date of contract, said concrete bridges and culverts to be built in accordance with the plans and specifications now on file in the office of the County Clerk of Lancaster County, Neb., and to be for a lump sum for each size of bridge or culvert shown on plans and per foot to be added or deducted for each foot increase or decrease in the length of barrel; also for each foot increase or decrease in height of walls of box culverts or rise of arch or arch culverts. Also bids on extra reinforced concrete in wings per cu. ft. All proposals should be addressed to H. E. Wells, County Clerk, and must contain a certified check for $200, made payable to the County Clerk, as evidence of good faith.

⊙The Supervisor and Road Commissioners of Chester Township at a recent meeting at the office of the County Clerk, Lincoln, Neb., let the contract for the construction of a new bridge over Salt Creek on the Lincoln-Mt. Pulaski road to T. L. Blackburn. The bid was $8,250. The old bridge over the creek was washed out during the high waters early this spring. The new span will be steel with a concrete floor. A pier will be built at the north end 30 ft. high and the old 40-ft. span will be moved 20 ft. to the north. Work will begin at once on the old bridge and the new parts ordered. The contractors expect to have the bridge completed by September 1.

New Hampshire.

The Finance Committee of the City Council Manchester, N. H., has recommended the appropriation of $100,000 for the construction of a bridge over the Piscataquog River at Kelley St.

New Jersey.

A hearing will be held by Col. William T. Russell, U. S. Engineer, Army Bldg., New York City, 11:30 a. m., May 28, on the application of the Erie Railroad to construct a bridge over the Passaic River at Fourth Av., Newark.

New York.

✣Bids will be received until noon, May 26, by Isaac Budlong, Chairman, Good Roads Committee, at the office of the County Superintendent of Highways, J. Y. McClonoock, Rochester, N. Y., for the construction of a steel truss bridge, with concrete floor, and cube pavement, 216-ft. span. Concrete abutments on pile foundations, approaches about 7,000 cu. yds. of earth filling with macadam and cube pavement. Plans and specifications for the above work will be exhibited at the office of the County Superintendent of Highways at the Court House in Rochester, N. Y. A certified check for $1,000 must be filed with each bid.

The citizens of the village of LeRoy, N. Y., voted at a recent election in favor of borrowing $5,000 for the construction and repair of roads and bridges.

Ohio.

✣Bids will be received until noon, May 24, by S. A. Haskell Director of Public Service, Painesville, O., for furnishing the necessary labor and material for the improving of portions of Mentor Av., South State St., Erie St. and Richmond St., by draining, curbing and paving.

✣Bids will be received until 11 a. m., June 9, by Board of Warren County Commissioners, Lebanon, O., for furnishing labor and material necessary to erect one 150-ft. and one 190-ft. span high truss steel bridge with creosote plank and block floor and one 5-ft. sidewalk thereon over the Little Miami River at Kings Mills, O. Also for one new concrete abutment; for facing and raising one old abutment with concrete and rebuilding one pier with concrete for above superstructure over said river and also for piling under above masonry. Plans, descriptions, bills and specifications thereof, heretofore approved by the Board, can be seen at the office of the County Auditor at Lebanon, O. T. C. Pattersoe is County Auditor.

✣Bids will be received until June 6, by the Board of Morrow County Commissioners, Mount Gilead, O., for the construction of four bridges to replace structures destroyed by the floods.

✣Bids will be received until June 9 (re-advertisement), by the Board of Morgan County Commissioners, McConnelsville, O., for repairing the Muskingum River bridge at Stockport. J. E. Patterson is County Auditor.

✣The Commissioners of Lucas County, Toledo, O., according to reports, will receive bids until June 6, for the construction of a new bridge over Ten Mile Creek on the Bancroft road in Washington Township. The cost is estimated at $12,450.

✣Bids will be received until noon, May 27, by S. A. Kinnear Director of Public Service, Columbus, O., for furnishing the labor and material for building and erecting the steel superstructure of a viaduct over the tracks of the Baltimore & Ohio, the P., C., C. & St. L. and C., C., C. & St. L. Railways, on North 4th St., in the City of Columbus, O. According to the Engineer's estimate the superstructure will require about 2,770,000 lbs.

✣Bids will be received until 11 a. m., June 9, by Board of Muskingum County Commissioners, Zanesville, O. for furnishing the material and labor for the building and placing the superstructure of a bridge across the Muskingum River at the Stilwell farm in Cass Township, said Muskingum County. Said bridge to consist of two spans each 155 ft. in length, with a 16-ft. roadway, and to have a carrying capacity of 125 lbs. per sq. ft., all in accordance with plans and specifications therefor to be submitted by the bidder. H. H. Kennedy is Clerk of the Board.

✣Bids will be received until 10 a. m., June 7, by the Board of Muskingum County Commissioners, Zanesville, O., for furnishing the material and labor for the construction of a new bridge across Jonathan Creek at Fultonham, Newton Township, on the Maysville Pike, to replace a bridge recently destroyed by flood; said bridge to be 121 ft. long over all, with a roadway 16 ft. wide in the clear, and to have a carrying capacity of not less than sufficient to carry an 18-ton steam roller. Said bridge to be erected to correspond to the elevations in the plans and profiles for the substructure of the said Fultonham bridge, which plans and profiles are now on file in the County Commissioners' office at Zanesville, O. All of said work to be in accordance with the plans and specifications therefor to be submitted by the bidder; said bidders shall carefully examine the site and location of the structure, and shall assume all responsibility arising from failure to do so. H. H. Kennedy is Clerk of the Board.

⊙The Board of Morgan County Commissioners, McConnelsville, O., has awarded the contract for the construction of the superstructure of the Malta-McConnelsville bridge to the Oregonia Bridge Co., Lebanon, O., at $46,400. Bids were opened May 12.

⊙G. W. Lane, Norwich, O., has been awarded a contract for the construction of repairs to the Monroe St. bridge at Zanesville, O., on his bid of $9,800. E. M. Scully, Columbus O., bid $10,000 for the work.

⊙The Board of Champaign County Commissioners, Urbana, O., has awarded the contract for the construction of a new bridge to replace the old Arrowsmith bridge over Bad River northwest of Urbana to Fred Nagel, at $2,124.

Resolutions have been adopted by the Commissioners of Montgomery County, Dayton, O., providing for the construction of a new bridge over Stillwater River at Little York in Randolph Township, to replace the structure destroyed by the flood. Acting upon the suggestion that the bridges of the county should be elevated, the Commissioners ordered the substructure built at least 2 ft. higher than the old. County Surveyor Moritz is busily engaged in drawing up plans and specifications for the bridge. In connection with the work of replacing and rebuilding county bridges, the Commissioners will next authorize the construction of a new structure at Union, north of the city.

Oklahoma.

✣Bids will be received until June 9, by Board of Pittsburg County Commissioners, McAlester, Okla., for the construction of three steel bridges, one 50-ft. steel span over North Boggy near Kiowa, one 124-ft. steel span over Coal Creek near McAlester and one 75-ft. steel span over Longtown Creek near Brewer.

Petitions addressed to the Commissioners of Tulsa County, Tulsa, Okla., are circulating in Sand Springs and in the districts lying south of the Arkansas River for a bridge over stream at Sand Springs.

Oregon.

The City Executive Board, Portland, Ore., has adopted a resolution authorizing the City Auditor to advertise for bids for the construction of a concrete viaduct over Sullivan's Gulch at East 16th St.

Pennsylvania.

✣Bids will be received until noon, June 5, by Samuel B. Rambo, Superintendent of Public Grounds and Buildings, Harrisburg, for the construction of a bridge over the Mahoning Creek, at Mack's Fording, Armstrong County, Pa.

⊙The Department of Public Works, Pittsburgh, Pa., has awarded the contract for the construction of the Heights Run Bridge to the Cummings Structural Concrete Company at a price of $109,480. The estimate of the Bureau of Construction for the work was $110,000. The new bridge is to be an ornamental structure and will carry Butler St. into Highland Park. The roadway of the bridge will be 60 ft. wide. The length of the span is 195 ft. The total length of the bridge and its approaches is 327 ft. The bridge was designed in the Bureau of Construction and approved by the Art Commission. The only other bidder for the contract was the Dravo Contracting Company, which bid $136,000.

⊙The Board of Northumberland County Commissioners, Sunbury, Pa., has received the following bids for the construction of the proposed new bridge at Mt. Carmel: N. R. Porterfield, Philadelphia, $7,650; George Dale, Wilmington, Del., $5,900; The Ferro-Concrete Co., Harrisburg, $4,695; Nelson-Merydth Co., Chambersburg, $5,474 (awarded contract).

⊙W. H. Johnson, Jr., Philadelphia, Pa., has been awarded the contract for the construction of the 5-arch singe track concrete bridge over the Schuylkill River north of Auburn on the Schuylkill division of the Pennsylvania R. R.

A delegation of citizens from Middletown recently visited the Appropriation Committee at the Court House, Harrisburg, Pa., and urged the passage of a bill appropriating $200,000 to build a bridge across the Susquehanna River at Middletown. Construction of the bridge would connect state roads at Dauphin and York Counties and shorten the distance by 23 miles.

It is probable that the State of Pennsylvania will take steps shortly toward reconstructing the V bridge over the Shanango River at Sharon.

The State Viewers have recommended the construction of a 3-arch structure to replace the old Wasser bridge at Shanango, Pa. The structure will be 175 ft. long with 18-ft. roadway and will cost approximately $25,000.

The Commissioners of Carbon County, Mauch Chunk, Pa., plan the construction of three bridges during the present season. One will be at Weatherly, another at Rockport and the third at Hudsondale.

City Solicitor A. A. Cochran, Chester, Pa., has filed a petition for a jury of view for the erection of the proposed new bridge over Ridley River to permit the widening of Morton Av.

Washington.

✣Bids will be received by the Lewis County Commissioners, Chehalis, Wash., for the construction of a new steel bridge across the Chehalis River at Riverside in the southwest part of Chehalis.

⊙The Board of County Commissioners has awarded the contract for the contract for the construction of the proposed concrete bridge at E St., Ritzville, Wash., to S. S. Schuler, at $3,240.

⊙S. S. Schuler, Ritzville, Wash., has been awarded a contract at $3,262 for the construction of a concrete bridge on E St. in that city. Bids for the work were opened May 5.

⊙The Board of Public Works, Seattle, Wash., has awarded the contract for the construction of the West Wheeler St. bridge roadway to J. M. Bruce & Co., at $206,422.

Plans have been approved for the construction of a bridge over the ravine at Ravenna Park, 30th Av., N. E., Seattle, Wash.

Plans have been approved by the Park Board, Seattle, Wash., for the improvement of divisions 4, 5 and 6 of Queen Anne Blvd., consisting of a series of retaining walls and a viaduct on the crest of Queen Anne Hill from Highland Drive and 70th Av., West, to McGraw St. and 8th Av., West. . The improvement is to cost $100,982.

City Engineer Morton Macartney, Spokane, Wash., favors the construction of a fill at the south end of Monroe St. bridge instead of the additional arch which would cost about $30,000.

Wisconsin.

⊙Sherman & Alder, Edgerton, Wis., have been awarded the contracts for building two bridges in the town of Porter at a total cost of $1,120 and one in the town of Milton at a cost of $525. The contract for a $1,080 structure in the town of Harmony was awarded to W. C. Kernan by the County Board. All of the bridges will be built of concrete.

ROADS AND STREETS

Alabama.

President Culpepper Exum of the City Commission, Birmingham, Ala., plans to take up the question of constructing the proposed boulevard, from East Lake to Ensley.

State Highway Engineer W. S. Keller, Montgomery, Ala., is planning a trip through the state during June to determine the routes of two proposed trunk highways extending north and south, and east and west.

California.

⊙John Engebretsen has been awarded the contract by the city of San Diego, Calif., for the paving of Boston Ave., from 28th to 29th St., for $6,686.

CALIFORNIA STATE HIGHWAY WORK.

The State highway system of California which is being constructed under the $18,000,000 bond issue, is divided into 12 routes having an aggregate length of 2,312 miles. The status of work on the system on April 1, according to the California Highway Bulletin was as follows:

ROUTE 1.

Marin. Secs. A and B. Surveys complete. Plans in progress.

Sonoma. Sec. B. Laid out as a state highway Sept. 25, 1912. Contract awarded Oct. 22, 1912, to Richard Keatinge & Sons. Length, 13.7 miles. Pavement, oiled concrete 15 ft. wide. Probable total cost, $109,050. Probable cost per mile, $7,960. Per cent of contract complete March 15, 1913, 4.2 per cent. Secs. A and C. surveys complete and plans in progress.

Mendocino. Sec. A. Laid out as a state highway May 21, 1912. Contract awarded July 23, 1912, to the General Contracting Corp. Length, 12.8 miles. Road to be graded 18 ft. wide but not paved. Probable total cost, $69,900. Probable cost per mile, $5,460. Per cent of contract complete March 15, 1913, 90 per cent. Sec. C. Laid out as a state highway Feb. 4, 1913. Contract awarded March 26, 1913, to D. L. Sawyers and C. Whited. Length, 7.6 miles. Road to be water bound macadam and gravel 15 ft. wide. Probable total cost, $55,665. Probable cost per mile, $7,325. Sec. E. Laid out as a state highway Oct. 22, 1912. Contract awarded Feb. 4, 1913, to Fairbanks & Baechtel. Length, 6.9 miles. Road to be graded 18 ft. wide. Probable total cost, $32,845. Probable cost per mile, $4,760. Secs. B, D, and F. Surveys and plans complete. Secs. I and J. Surveys complete and plans in progress. Secs. G, H, and K. Surveys nearly complete.

Humboldt. Sec. A. Survey complete and plans in progress. Secs. B, C, D, E, F, and G. Surveys begun.

Route 2.

San Mateo. Sec. A. Survey complete. A1. Laid out as a state highway May 21, 1912. Contract awarded July 23, 1912, to F. R. Ritchie & Co. Length, 5.4 miles. Sheet asphalt 24 ft. wide on concrete base. Probable cost, $92,180. Probable cost per mile, $17,070. Per cent of contract completed to March 15, 1913, 66 per cent. A2. Laid out as a state highway Oct. 22, 1912. Now advertised for contract. Length, 0.2 miles. Road to be asphaltic concrete on Portland cement concrete base 24 ft. wide. A3. Laid out as a state highway March 26, 1913. Now advertised for contract. Length, 1.0 miles. Road to be asphaltic concrete on Portland cement concrete base 24 ft. wide. Sec. B. Surveys and plans complete. B1. Laid out as a state highway Oct. 22, 1912. Contract awarded March 26, 1913, to S. P. Doyle. Length, 3.3 miles. Road to be asphaltic concrete on macadam base 20 ft. wide. Total probable cost, $42,980. Total cost per mile, $13,025. B2. Laid out as a state highway March 26, 1913. Now advertised for contract. Length, 1.8 miles. Road to be asphaltic concrete on macadam base 20 ft. wide.

Santa Clara. Secs. A and B. Survey and plans complete. A1. Laid out as a state highway July 23, 1912. Contract awarded Oct. 22, 1912, to City Street Improvement Co. Length, 6.4 miles. Road to be asphaltic concrete on macadam 20 ft. wide. Probable total cost, $43,275. Probable cost per mile, $6,760. A2. Laid out as a state highway July 23, 1912. Contract awarded Oct. 22, 1912, to A. Teichert & Son. Length, 5.5 miles. Pavement, oiled concrete 20 ft. wide. Probable total cost, $47,315. Probable cost per mile, $8,600. Per cent of contract completed to March 15, 1913, 57.7 per cent. B1. Laid out as a state highway Oct. 22, 1912. Contract awarded March 26, 1913, to Richard Keatinge & Sons. Length, 13.0 miles. Pavement, oiled concrete 15 ft. wide. Probable total cost $87,865. Probable cost per mile, $6,760. B2. Laid out as a state highway March 26, 1912. Now advertised for contract. Length, 4.3 miles. Pavement, oiled concrete 15 and 20 ft. wide. Sec. C. Survey complete and plans in progress.

San Benito. Survey complete.

Monterey. Secs. B and H. Surveys and plans complete. Sec. E. Laid out as a state highway Oct. 22, 1912. Length, 7.3 miles. Pavement, oiled concrete 15 ft. wide. Secs. C, D, F, G, and I. Surveys complete. Sec. A. Survey nearly complete.

San Luis Obispo. Secs. A, C, and D. Surveys and plans complete. D1. Laid out as a state highway Oct. 22, 1912. Bid received and rejected Nov. 18, 1912. Length, 6.4 miles. Pavement, oiled concrete 15 ft. wide. Secs. B and E. Survey complete and plans in progress. Sec. F. Survey complete.

Santa Barbara. Secs. B and G. Surveys and plans complete. Secs. A and F. Surveys complete and plans in progress. Secs. C, D, and E. Surveys complete. Sec. H. Survey started.

Ventura. Sec. A. Laid out as a state highway March 26, 1913. Now advertised for contract. Length, 7.3 miles. Pavement, oiled concrete 15 ft. wide. Sec. F. Laid out as a state highway Aug. 27, 1912. Length, 4.4 miles. This section includes a long timber trestle which was taken over by the State. Secs. B, C, D, E, and G. Surveys complete and plans in progress. Secs. H and I (alternate route). Surveys complete.

Los Angeles. Sec. A. Laid out as a state highway Sept. 25, 1912. Contract awarded Oct. 22, 1912, to Rogers Bros. Co. Length, 6.6 miles. Pavement, oiled concrete 15 ft wide. Probable total cost, $50,090. Probable cost per mile, $7,590. Per cent of contract completed to March 15, 1913, 45.8 per cent. Sec. B. Laid out as a state highway Feb. 4, 1913. Contract awarded March 4, 1913, to John D. Marsh. Length, 10.1 miles. Pavement, oiled concrete 15 ft. wide. Probable total cost, $81,755. Probable cost per mile, $8,095. Sec. C. Survey and plans complete.

Orange. Secs. A, B, C, E, and F. Surveys complete and plans in progress. Sec. D. Survey complete.

San Diego. Sec. A. Laid out as a state highway July 23, 1912. Contract awarded Aug. 27, 1912, to M. L. Curtis & Co. Length, 8.4 miles. Oiled concrete 15 ft. wide. Probable total cost, $68,090. Probable cost per mile, $8,105. Per cent of contract completed to March 15, 1913, 54 per cent. Sec. B. Laid out as a state highway Oct. 22, 1912. Bids received. No award. Length, 10.3 miles. Pavement, oiled concrete 15 ft. wide. Secs. C and D. Surveys and plans complete.

Route 3.

Sacramento. Sec. A. Laid out as a state highway Aug. 27, 1912. Contract awarded Sept. 25, 1912, to Burns, Clark & Da Roza. Length, 1.8 miles. Oiled concrete 15 ft. wide. Probable total cost, $13,320. Probable cost per mile, $7,400. Per cent of contract completed March 15, 1913, 93.8 per cent.

Placer. Sec. A. Laid out as a state highway Aug. 27, 1912. Contract awarded Sept. 25, 1912, to Burns, Clark & Da Roza. Length, 9.9 miles. Pavement oiled concrete 15 ft. wide. Probable total cost, $83,820. Probable cost per mile, $8,465. Per cent of contract completed March 15, 1913, 25.0 per cent. Sec. B. Surveys complete and plans in progress.

Yuba. Sec. B. Laid out as a state highway May 21, 1912. Contract awarded July 23, 1912, to F. E. Frey. Length, 9.2 miles. Oiled macadam 15 ft. wide. Probable total cost, $75,230. Probable cost per mile, $8,175. Per cent of contract completed March 15, 1913, 66.4 per cent. Sec. A. Survey complete and plans in progress.

Sutter. Surveys and plans complete.

Butte. Sec. D. Laid out as a state highway Oct. 22, 1912. Bids received Nov. 18, 1912, and rejected. Length, 11.2 miles. Pavement oiled concrete 15 ft. wide. Secs. A, B, C. Surveys complete.

Tehama. Secs. A and C. Surveys and plans complete. Sec. B. Survey nearly complete.

Shasta. Secs. B and D. Survey complete and plans in progress. Sec. A. Survey complete. Sec. C. Survey begun.

Siskiyou. Sec. A. Survey complete and plans in progress. Secs. B and C. Surveys begun.

Route 4.

Sacramento. Built by the county.

San Joaquin. Built by the county.

Stanislaus. Sec. A. Laid out as a state highway July 23, 1912. Contract awarded Aug. 27, 1912, to E. O. Burge. Length, 12.1 miles. Oiled concrete 15 ft. wide. Probable total cost, $84,850. Probable cost per mile, $7,010. Per cent of contract completed March 15, 1913, 55.9 per cent. Sec. B. Laid out as a state highway March 4, 1913. Contract awarded March 26, 1913, to Considine & Bates. Length, 9.6 miles. Pavement oiled concrete 15 ft. wide. Probable total cost, $68,155. Probable cost per mile, $7,100.

Merced. Sec. A. Laid out as a state highway. Oct. 22, 1912. Bids received. No award. Length, 14.2 miles. Pavement oiled concrete 15 ft. wide. Sec. C. Laid out as a state highway Aug. 27, 1912. Contract awarded Sept. 29, 1912, to the Worswick Street Paving Co. Length, 10.9 miles. Oiled concrete 15 ft. wide. Probable total cost, $84,805. Probable cost per mile, $7,780. Per cent of contract completed to March 15, 1913, 15.9 per cent. Sec. D. Laid out as a state highway July 23, 1912. Contract awarded Aug. 27, 1912, to the Worswick Street Paving Co. Length, 9.6 miles. Oiled concrete, 15 ft. wide. Probable total cost, $74,775. Probable cost per mile, $7,790.

Madera. Entire county under contract. Sec. A. Laid out as a state highway July 23, 1912. Contract awarded Aug. 27, 1912, to the Worswick Street Paving Co. Length, 9.9 miles. Oiled concrete 15 ft. wide. Probable total cost, $66,510. Probable cost per mile, $6,720. Sec. B. Laid out as a state highway May 21, 1912. Contract awarded July 23, 1912, to Ransome Crummey Co. Length, 9.9 miles. Oiled macadam 15 ft. wide. Probable total cost, $74,255. Probable cost per mile, $7,500. Per cent of contract complete April 1, 1913, 53.3 per cent. Sec. C. Laid out as a state highway July 23, 1912. Contract awarded Aug. 27, 1912, to Worswick Street Paving Co. Length, 6.8 miles. Oiled concrete 15 ft. wide. Probable total cost, $46,100. Probable cost per mile, $6,780.

Fresno. Sec. C. Laid out as a state highway July 23, 1912. Contract awarded Aug. 27, 1912, to the Worswick Street Paving Co. Length, 9.6 miles. Oiled concrete 15 ft. wide. Probable total cost, $62,615. Probable cost per mile, $6,520. Per cent of contract completed to March 15, 1913, 73.4 per cent. Secs. A and B. Surveys and plans complete.

Tulare. Secs. A, B, C, and E. Surveys complete and plans in progress.

Kern. Secs. C, D, E. and F. Surveys and plans complete. Secs. A and B. Surveys complete and plans in progress.

Los Angeles. Secs. A, B, C, and D. Surveys complete and plans in progress.

Route 5.

San Joaquin. Built by the county.

Alameda. Secs. A, B, C, and D. Surveys complete.

Santa Clara. Sec. A. Survey complete. Sec. B. Survey complete.

Santa Cruz. Sec. A. Survey complete and plans in progress.

Route 6.

Yolo. Sec. A. Survey nearly complete and plans in progress.

Route 7.

Solano. Secs. C and D. Surveys complete. Sec. E. Survey in progress. Secs. A and B. Surveys not begun.

Yolo. Sec. B. Surveys complete and plans in progress. Secs. A and C. Surveys complete.

Colusa. Secs. A, B, and C. Surveys complete.

Glenn. Secs. A, B, and C. Surveys complete.

Tehama. Sec. A. Survey complete.

Route 8.

Surveys not begun.

Route 9.

Los Angeles Sec. A. Survey complete. Sec. B. Survey in progress.

San Bernardino. Secs. A, B, C, and D. Surveys complete.

Route 9a.

San Bernardino. Secs. A and B. Surveys complete and plans in progress.

Riverside. Sec. A. Survey complete and plans in progress.

Route 10.

Tulare. Sec. A. Survey and plans complete.

Kings. Sec. A. Survey and plans complete.

Route 11.

Sacramento. Sec. A. Survey complete and plans in progress.

El Dorado. Secs. A and B. Surveys nearly complete.

Route 12.

San Diego. Secs. A and B. Surveys complete. Secs. C, D, E, F, and G. Surveys in progress.

District of Columbia.

✣Bids will be received until 2 p. m., May 26, by Commissioners of the District of Columbia, Washington, D. C., for paving various streets and avenues in the District of Columbia, with sheet asphalt and bituminous concrete. Further information can be obtained of the Clerk, Engineer Department, 427 District Bldg., Washington, D. C.

Florida.

⊙W. P. Kennedy, Pensacola, Fla., has been awarded the contract by that city, for the construction of 22,000 sq. yds. of concrete pavement, at $1.24 per sq. yd The work also includes straight curbs, at $0.27 per lin. ft., and reinforced concrete corner curb, at $0.55 per lin. ft. Bids were opened May 13.

Georgia.

The County Commissioners, Macon, Ga., are considering a proposition to pave Houston road, from the city limits of Macon to the end of the car line.

Illinois.

✣Bids will be received until May 28, at 10 a. m., by the Board of Local Improvements, Elgin, Ill., for the paving of a portion of Division St. in accordance with plans and profiles and specifications on file in the office of the Engineer. The work will include about 11,300 sq. yds. of asphaltic concrete pavement. M. H. Brightman is Secretary of the Board.

✣Bids will be received up to 2 p. m., June 2, at the Town Clerk's office, Edwardsville, Ill., for the construction of the roads described below. Peter Dresch, Town Clerk, Edwardsville, Ill. Bids will be received on three types of construction as follows: (1) Concrete roadway with macadam shoulders; (2) brick roadway with macadam shoulders; (3) concrete roadway without macadam shoulders. Any bidder may submit a price on any or all of the above types. Location: (1) On the highway known as the Old Fair Grounds Road, beginning at the west end of the brick pavement on St. Louis St., in the city of Edwardsville, and extending in a southwesterly direction for 6,000 ft. (2) On the highway known as the Edwardsville-Troy road, beginning at the south end of the existing macadam and extending in a southerly direction for a distance of 7,985 ft. The approximate quantities are as follows: Brick road—Old Fair Grounds Road, 6,857 sq. yds. of brick roadway on concrete base, 3,176 sq. yds. of macadam shoulders 6 ins. thick, 8,170 lin. ft. of concrete curb 6 ins. thick and 9 ins. high, 3,620 lin. ft. of concrete curb 6 ins. thick and 15 ins. high, 4,500 cu. yds. excavation. Section 2 of Edwardsville-Troy Road, 7,097 sq yds. brick roadway on concrete base, 6,211 sq. yds. macadam shoulders 6 ins. thick, 15,970 lin. ft. concrete curb 6 ins. thick and 9 ins. high, 4,121 cu. yds. earth excavation. Concrete Road—Old Fair Grounds Road, 7,311 sq. yds. concrete roadway 6 ins. thick, 3,176 sq. yds. macadam shoulders 6 ins. thick, 3,620 lin. ft. of concrete curb 6 ins. thick and 12 ins. high, 4,500 cu. yds. earth excavation. Alternative plan: 10,487 sq. yds. concrete roadway 6 ins. thick, 3,620 lin. ft. of concrete curb 6 ins. thick and 12 ins. high, 4,500 cu. yds. earth excavation. Section 2, Edwardsville-Troy Road, 7,985 sq. yds. concrete roadway 6 ins. thick, 6,211 sq. yds. macadam shoulders 6 ins. thick, 4,121 cu. yds. earth excavation. Alternative plan: 14,196 sq. yds. concrete roadway 6 ins. thick, 4,121 cu. yds. earth excavation. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received until 11 a. m., May 28, by the Board of Local Improvements, Chicago, Ill., for the construction of pavements in the following streets and alleys: Alley, State St. Dearborn St., etc., concrete curbing brick pavement; alleys, St. Lawrence Ave., 46th St., etc., concrete curbing, brick pavement; alleys, Harrison St., Center Ave., etc., concrete curbing, brick pavement; alleys, Vernon Park Pl., Aberdeen St., etc., concrete curbing brick pavement; alleys, Vernon Park Pl., Morgan St., etc., concrete curbing brick pavement; alleys, Harrison St., May St., etc., concrete curbing brick pavement; alleys, Harrison St., Peoria St., etc., concrete curbing, brick pavement; alleys, Vernon Park Pl., May St., etc., concrete curbing, brick pavement; alleys, Blue Island Ave., Morgan St., etc., concrete curbing, brick pavement; alleys, Aberdeen St., 77th St. to 79th St., granite concrete combined curb and gutter, asphalt pavement; Albany Ave., Logan Blvd. to Belmont Ave., granite concrete combined curb and gutter, asphalt pavement; Aubert Ave., Robey St. to Lincoln Ave., granite concrete combined curb and gutter asphalt pavement; Central Ave., Thomas St. to Division St., granite concrete combined curb and gutter, asphalt pavement; Champlain Ave., 60th St. to 61st granite concrete, combined curb and gutter, asphalt pavement; W. 41st St., Lowe Ave. to Emerald Ave., granite concrete combined curb and gutter, asphalt pavement; 49th Ave. Madison St. to Park Ave., granite concrete, combined curb and gutter asphalt pavement; Hermitage Ave. 61st St. to 62d St., granite concrete combined curb and gutter, asphalt pavement; Huron St., Western Ave. to Cambell Ave., granite concrete combined curb and gutter asphalt pavement; Lawrence Ave., Central Park Ave. to Ridgeway Ave., granite concrete curb, creosote wood block; Mildred Ave., Oakdale Ave. to Wellington St., granite concrete, combined curb and gutter asphalt pavement; Ogden Ave., 40th Ave. to C. & W. I. R. R. sandstone curbing, brick pavement; W. Superior St., 46th Ave. to 48th Ave, granite concrete combined curb and gutter asphalt pavement; Windsor Ave., Milwaukee Ave. to 56th Ave., granite concrete combined curb and gutter asphalt pavement; W. Superior St., 48th Ave. to 51st Ave., granite concrete combined curb and gutter asphalt pavement; the work includes a 6-in. Portland cement concrete foundation sewer, catch basin and manhole construction and adjustment, preparation of the sub-grade, etc. Cash or certified check for 10 per cent of bid must accompany proposal. E. J. Glackin, Secretary of the Board.

✣Bids will be received until 11 a. m., May 24, by the Department of Public Works, Chicago, Ill., for furnishing and delivering 17,000 ft. B. M. 4-in. x 6-in. creosoted yellow pine timber, 12,900 ft. B. M. 2-in. x 8-in., 2-in. x 10-in, 2-in. x 12-in. creosoted yellow pine timber, 630 sq. yds. creosoted wood block pavement for use on three fixed bridges over the North Branch of the Chicago River at N. Kedzie Av., Forest Glen Av. and N. 56th Av. Cash or certified check for $100 must accompany proposal. L. E. McGann, Commissioner of Public Works.

⊙The Board of Local Improvements, Chicago, Ill., has awarded to Jas. A. Sackley Co., 133 W. Washington St., the contract for constructing a granite concrete combined curb and gutter and a brick pavement in Ashland Place, Ashland Aye. to alley east. E. J. Glackin, Secretary of the Board.

⊙The West Side Quarries Co., Kankakee, Ill., has been awarded the contract by the town of Crete, Ill., for the construction of about 7½ miles of crushed stone macadam road, including furnishing all material, for $37,500. Bids were opened May 10.

⊙Gund-Graham Co., of Freeport, Ill., has been awarded the contract by that city for the improvement of Cottonwood, Foley and Powell Sts., and Washington and Williams Sts., for $26,193. Brick and macadam pavements will be laid.

⊙The Burlington Construction Co. has been awarded the contract in Monmouth, Ill., for the paving of Main St., from Seventh Ave. to the city limits, for $11,540.

Plans have been prepared by City Engineer Fred H. Renz, Streator, Ill., for the construction of 5,200 sq. yds. of vitrified brick block pavement on a gravel or crushed stone foundation for North Bloomington St. The estimated cost is $8,089. The work will also include 2,700 lin. ft. of sandstone curb and sand filler and 1,420 cu. yds. of excavation.

The Village Board of Ludlow, Ill., contemplates constructing a mile of pavement east and west through the center of the town at an estimated cost of $11,000.

The Village Board of Wood River, Ill., S. A. Beach, Mayor, has decided to pave Ferguson Ave. with bituminous asphalt, from Ford St. to the old St. Louis Road, a distance of a half mile. The estimated cost is $1.40 a sq. yd. Hearing will be held May 17.

The Board of Local Improvements of Urbana, Ill., has authorized the paving of E. Illinois St., from Race to Cottage Grove Ave., and the latter thoroughfare from Illinois to Main St., at an estimated cost of $37,000.

The Board of Local Improvements of Moline, Ill., has ordered the paving of 16th Ave., from First St. to 13th St., with brick on a 5-in. concrete base, with a sand cushion of 1½ ins. between the brick and the cement foundation. The width of the pavement is to be from 30 to 38 ft. The estimated cost of the improvement is $75,505. Lyle Payton is City Engineer.

The city of Chicago is contemplating the construction of a 2-level thoroughfare comprising filling, excavation, retaining walls, abutment walls, bridge houses, curbing, pavements, sidewalks, stairways, electric lamps, construction of new sewer manholes and catchbasins, etc. Estimated cost, $2,298,247. Details of structure are as follows: Sec. A, superstructure of bascule bridge, 6,150,000 lbs. of structural steel, 92,000 forged steel, 150,000 lbs. steel castings, 120,000 lbs. cast iron bolsters, 11,000 cu. yds. concrete, 700 tons pig iron and punchings, 500 tons cast iron block, 113,000 ft. creosoted timber, 1,680 sq. yds. creosoted paving block, 1,940 sq. yds. asphalt pavement, 540 lin. ft. hand railing on upper deck, 440 lin. ft. hand railing on lower deck, 17,500 sq. ft. wire fabric for asphalt pavement. Sec. B, machinery for bascule bridge, 84,000 lbs. cast steel racks, 280,000 lbs. cast steel gearing, 150,000 lbs. rolled steel, 25,000 lbs. cast iron machinery, couplings and clutches, 9,000 lbs. bronze bushings, 2,300 lbs. babitt metal, 4 100-H. P. operating motors, 4 10-H. P. electric motors, 2 7½-H. P. electric motors, 4 5-H. P. electric motors, 4 centrifugal pumps complete, 2 air compressers complete, 4 hand brakes complete, 4 air brakes complete, switchboards, controllers, interlocking devices, signals and wire connections between motors and controllers, safety gates. Sec. 3, substructure of bascule bridge including foundation of abutments, walls and bridge houses, machinery room, basement and dock wall, construction and removal of necessary cofferdam, 10,000 cu. yds. dredging excavation, 15,100 cu. yds. dry excavation, 1,950 wooden piles, 13,400 cu. yds. class A concrete, 750 cu. yds. Portland cement mortar for waterproofing pits, 1,240,000 lbs. steel for reinforcing concrete, 115,000 lbs. anchor rod, 25,200 sq. ft. concrete floors including docks, 650 cu. ft. granite. Sec. D, bridge houses, 3,108 cu. ft. Bedford stone, 62 cu. yds. reinforced concrete, 220 cu. yds. plain concrete, 8,000 lbs. steel reinforcing, 620 sq. ft. book tile, 440 sq. ft. 4-in. hollow tile, 66 sq. yds. plain plastering, 60

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

sq. yds. hard plastering, 90 sq. ft. metal lathing, 2 circular metal frames and sashes, 12 metal frames and sash, 7 metal door frames, etc. Sec. E, abutment, walls, masonry, stairways and balustrades at plazas, 14,250 cu. ft. granite masonry, 20,440 cu. ft. Bedford stone masonry, 1,750 cu. yds. concrete, 12 iron grills, etc. Sec. F, elevator structure exclusive of bascule bridge including steel, concrete, glass, sidewalk, lights, concrete stairways, terra cotta and balustrades, 9,000,000 lbs., 1,125,000 lbs. of steel for reinforcing concrete, 460,000 lbs. cast iron wheel guards, 20 iron posts, 550 lin. ft. iron railing, 600 lin. ft. iron pipe railing, 4,500 cu. yds. concrete foundation for columns, 12,350 cu. yds. concrete enclosing steel structure, 90 cu. yds. concrete stairways, 156,980 ft. concrete walks, supported on steel structure, 38,000 sq. ft. glass sidewalk lights, 20 tons asphalt for expansion joints, 525 tons terra cotta, 1,550 lin. ft. terra cotta moulding, 2,310 cu. ft. Bedford stone, 750 balusters. Sec. G, retaining walls, except at river, curbing, sidewalks and supporting walls and columns, concrete foundation for pavement, including concrete pavement, excavation and filling except at river, 9,600 cu. yds. Class A concrete in walls and columns, 53,660 sq. yds. Class A concrete foundation for pavement, 7,600 lin. ft. concrete curbing, 3,125 sq. yds. concrete pavement, 80,500 sq. ft. concrete sidewalk, 32,310 sq. ft. concrete slab sidewalk, 500,000 lbs. of reinforcing steel, 66,000 cu. yds. excavation, 23,000 cu. yds. filling, 1,650 cu. yds. soil for parkway, removal of 43,000 cu. yds. surplus excavation. Sec. H, pavements, exclusive of concrete foundation. adjustment of sewer manholes and catchbasins, 44,000 sq. yds. asphaltic pavement, 27,000 sq. yds. granite block pavement, 88 new catchbasins complete, 27 cast iron inlets and downspouts, 170 lin. ft. 4 ft. sewer, 130 lin. ft. 12-in. tile pipe sewer. Sec. 1, electric lighting system, 36 electric lighting fixtures, Michigan Ave. type, 2 Safety Island electric light fixtures, 57 Lincoln Parkway electric light fixtures, type 1 electric light fixtures, 32 type 2 electric light fixtures, 4 of type 3, 6 of type 4, 728 incandescent light fixtures, iron conduit pipe, 22,000 lin. ft. iron conduit, 1,800 lin. ft. fibre conduit. E. J. Glackin, Secretary of the Board. Date of letting contract has not been announced.

Following are the lowest bids submitted on May 10 to the Board of Local Improvements, Chicago, Ill., for constructing cement sidewalks by special tax: Clark St., Lake St. to Randolph St., 560 sq. ft. 5-in. cast iron columns in place, $7.54; sub-structure, except cast iron columns, 27½ cts. per sq. ft.; concrete walk complete, except sub-structure, 17½ cts.; Clark St., Madison St. to Monroe St., 5-in. cast iron columns, $7.54 each; sub-structure complete, 25½ cts.; concrete walk complete, except sub-structure, 17½ cts.; 5th Ave., Lake St. to Randolph St., sub-structure, 20½ cts.; concrete walk, 17½ cts.; La Salle St., S. Water St. to Lake St., cast iron columns, $7.54; sub-structure, 25½ cts.; concrete walk, 17½ cts.; La Salle St., Lake St. to Randolph St., 54-in. columns, $7.54 each; sub-structure, 27½ cts.; concrete sidewalks, 15½ cts.; Madison St., La Salle St. to 5th Ave., cast iron columns, $7.54; sub-structure, 23½ cts.; concrete sidewalks, 17½ cts.; Madison St., 5th Ave. to Franklin St., cast iron columns, $7.54; sub-structure, 25½ cts.; sidewalks, 17½ cts.; Monroe St., La Salle St. to 5th Ave., cast iron columns, $7.54; sub-structure, 23½ cts.; concrete sidewalks, 17½ cts.; Randolph St., State St. to Dearborn St., cast iron columns, $7.54; sub-structure, 25½ cts.; sidewalks, 17½ cts.; State St., Van Buren St. to Harrison St., cast iron columns, $7.54; sub-structure, 28½ cts.; concrete sidewalks, 19½ cts. G. Kehl & Son Co., 1225 N. Maplewood Ave., Chicago. The contract has not been awarded. E. J. Glackin, Secretary of the Board.

Indiana.

✣The Common Council of Goshen, Ind., will receive bids until June 2 for the paving of the following streets: Madison, from Third to 11th; Clinton, from Fifth to Sixth; Third, from Pike to Lincoln Ave., and from Lincoln to Washington; Washington, from Fifth to Seventh; Jefferson, from Third to Main, and from Fifth to Seventh; Monroe, from Third to Seventh, and Douglas, from Main to Seventh.

✣Bids will be received until 10 a. m., May 28, by Board of Public Works, Indianapolis, Ind., for the following improvements: For the improvement of Olney St., west side, from south property line 28th St. to south property line 30th St., by curbing outer edges of roadway; for the improvement of Olney St., west side, from south property line 28th St. to south property line 30th St., by grading and paving sidewalks; for the improvement of Carrollton Ave., from north property line 38th St. to north property line 40th St., by grading and paving roadway; for the improvement of English Ave., from C., C., C. & St. L. R. R. tracks to east property line Keystone Ave., by curbing outer edges of roadway; for the improvement of Berwick Ave., from north property line Vermont St. to south property line North St., by curbing outer edges of roadway; for the improvement of Berwick Ave., from north property line Vermont St. to south property line North St., by grading and paving sidewalks.

✣Bids will be received until 1 p. m., May 29, by Commissioners of Wells County, Bluffton, Ind., for the construction of 18 gravel and stone roads. L. A. Williamson is County Auditor.

✣Bids will be received until 2 p. m., May 31, by Board of Putnam County Commissioners, Greencastle, Ind., for the construction of gravel roads in Russell, Marion and Jefferson townships. C. L. Airhaut is County Auditor.

✣Bids will be received until 10 a. m., May 29, by Board of Laporte County Commissioners, Laporte, Ind., for the construction of highways in New Durham, Center, Pleasant. Lincoln and Washington townships. F. A. Hausheer is County Auditor.

✣Bids will be received until 1 p. m., June 2, by Board of Ripley County Commissioners, Versailles, Ind., for the construction of a macadam road in Center township. J. Francis Lockhard is County Auditor.

✣Bids will be received until 10 a. m., June 2, by Board of Jay County Commissioners. Portland, Ind., for the construction of a road in Green township. John Bonifas is County Auditor.

✣Bids will be received until 1 p. m., June 2, by Board of Franklin County Commissioners, Brookville, Ind., for the construction of a highway in Springfield township. C. G. Reifel is County Auditor.

✣Bids will be received until 2 p. m., June 2, by Board of Spencer County commissioners, Rockport, Ind., for the construction of a highway in Ohio township. John T. Stevenson is County Auditor.

✣Bids will be received until 2 p. m., June 2, by the Board of Johnson County Commissioners, Franklin, Ind., for the construction of gravel roads in Pleasant and Clark townships. H. L. Knox is County Auditor.

✣Bids will be received until 10 a. m., June 3, by Board of Adams County Commissioners, Decatur, Ind., for the construction of gravel roads in French and Root townships. T. H. Baltzell is County Auditor.

✣Bids will be received until noon, June 3, by Board of Starke County Commissioners, Knox, Ind., for the construction of a highway in Railroad township. Charles Weninger is County Auditor.

✣Bids will be received until noon, June 3, by Board of Carroll County Commissioners, Delphi, Ind., for the construction of a road in Tippecanoe township. M. G. Haun is County Auditor.

✣Bids will be received until 10 a. m., June 3, by Board of Cass County Commissioners, Logansport, Ind., for the construction of the Unger road in Eel township. J. E. Wallace is County Auditor.

✣Bids will be received until 1:30 p. m., June 3, by Board of Wabash County Commissioners, Wabash, Ind., for the construction of gravel roads in Noble and Liberty townships. Dan Showalter is County Auditor.

✣Bids will be received until 1 p. m., June 3, by Board of Lawrence County Commissioners, Bedford, Ind., for the construction of nine gravel roads. Ezra W. Edwards is County Auditor.

✣Bids will be received until 2 p. m., June 3, by Board of Orange County Commissioners, Paoli, Ind., for the construction of a gravel road in Orangeville township. E. A. Palmer is County Auditor.

✣Bids will be received until 2 p. m., June 3, by Board of Knox County Commissioners, Vincennes, Ind., for the construction of gravel roads in Vincennes township. J. T. Scott is County Auditor.

✣Bids will be received until 2 p. m., June 4, by Board of Monroe County Commissioners, Bloomington, Ind., for the construction of gravel roads in Richland and Van Buren townships. W. F. Kinser is County Auditor.

✣Bids will be received until noon, June 4, by Board of Whitley County Commissioners, Columbia, Ind., for the construction of highway in Smith township. C. E. Kiser is County Auditor.

✣Bids will be received until 2 p. m., June 3, by Board of Grant County Commissioners, Marion, Ind., for the construction of three highways in Center township and one in Van Buren township. E. H. Kimball is County Auditor.

✣Bids will be received until 10 a. m., June 3, by Board of Howard County Commissioners, Kokomo, Ind., for the construction of gravel and stone roads in Center and Ervin townships. E. B. Swift is County Auditor.

✣Bids will be received until 1 p. m., June 6, by Board of Wabash County Commissioners, Wabash, Ind., for the construction of two highways in Noble township. Dan Showalter is County Auditor.

✣Bids will be received until 10 a. m., June 5, by Board of Wabash and Kosciusko Counties' Commissioners, Wabash, Ind., for the construction of a county line highway. Dan Showalter is County Auditor.

✣Bids will be received until 2 p. m., June 6, by Board of Harrison County Commissioners, Corydon, Ind., for the construction of roads in Spencer, Washington and Franklin townships. J. L. O'Bannon, is County Auditor.

✣Bids will be received until 2 p. m., June 6, by Board of Posey County Commissioners, Mt. Vernon Ind., for the construction of a highway in Black township. J. R. Haines is County Auditor.

✣Bids will be received until 10 a. m., May 22, by Board of Public Works, Richmond, Ind., for the construction of cement sidewalks on east side of Northwest First St., from Richmond Ave. to Laurel St.

✣Bids will be received until 10 a. m., May 23, by Board of Park Commissioners, Indianapolis, Ind., for the construction of cement sidewalks.

⊙The City Council of New Castle, Ind., has awarded the contracts for the paving of Church St., Race St. and Livery alley to Garvey and Payne.

⊙The County Commissioners, Newport, Ind., have awarded the contract for the paving with brick of Extension St., from the depot to Main St., in Newport, to George R. Chapman for $23,800, who will sub-let the work to George C. Foulkes, of Terre Haute.

⊙The Board of Public Works of Indianapolis, Ind., has awarded contracts for paving streets with asphalt as follows: Linwood Ave., from New York to Michigan St., Union Asphalt Construction Co., $4,996; 19th St., from Illinois St. to Capitol Ave., American

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Construction Co., $1,199; 21st St., from Talbott to Central Aves., American Construciton Co., $6,054.

⊙John W. Lambert has been awarded the contracts by the Board of Delaware County Commissioners, Muncie, Ind., for the improvement of the Snider, Clark and Lee roads, at $10,409, $2,415 and $3,076, respectively.

⊙Milady C. Lloyd has been awarded the contract by the County Commissioners, Sullivan, Ind., for the construction of the Campbell Road in Hamilton Township, for $10,370. Keegan Bros., of Brazil, Ind., secured the contract to construct Sec. 1 of the Hughes road, Hamilton Township, for $9,080, and O. T. Piety will construct Sec. 2 of the road for $5,800.

⊙The Board of Clark County Commissioners, Jeffersonville, Ind., has awarded the contract for the construction of the Philip Fisher road, in Charlestown Township, to E. M. Lutz, for $5,200, and for the Holcan road, in Jeffersonville Township, to Lemuel O. Graves, for $3,250.

⊙Geo. R. Chapman, R. F. D., Clinton, Ind., has been awarded the contract by the Board of Vermillion County Commissioners, Newport, Ind., for the construction of 3,900 ft. of brick paving, 21 ft. wide with curbing in Vermillion Township, for $23,800. Bids were opened May 5.

⊙James M. Goodrich, 402 W. Taylor St., Shelbyville, Ind., has been awarded the contract by the County Commissioners, Shelbyville, for the construction of a road in Union Township, for $8,000. Bids were opened May 7.

⊙The Board of Johnson County Commissioners, Franklin, Ind., has awarded the contract for the construction of the M. M. Pitcher road to J. W. Brown, of Bargersville, Ind., and the contract for the Applegate and Suryser road to Green & Banett, of Columbus, Ind. Bids were opened May 5.

⊙John Fridy has been awarded the contract by the Board of Vanderburgh County Commissioners, Evansville, Ind., for the construction of two rock roads, at $25,200. Bids were opened May 8.

⊙Oliver P. Turley, Orleans, Ind., has been awarded the contract by the Board of Lawrence County Commissioners, Bedford, Ind., for the construction of 5,650 ft. of macadam road in Main Township, for $3,365. Bids were opened May 12.

⊙The Erie Stone Co., has been awarded the contract by the Board of Allen County Commissioners, Fort Wayne, Ind., for the construction of the Gustin stone road in Maumee Township, for $7,499, and the Clem stone road in Monroe Township, for $4,890. Thos. Linger, of Dixon, O., secured the Morgan stone road in Monroe Township, for $8,395. Bids were opened May 15.

⊙Evans & Vanatta, Fowler, Ind., have been awarded the contract by the Board of Benton County Commissioners, Fowler, for the construction of a limestone road in Benton, Tippecanoe County line, for $18,600. Bids were opened May 13.

City Engineer Geo. A. Lanphear of Anderson, Ind., has recommended to the Board of Works that the board order the paving of Central Ave., from the Big Four R. R. to 23d St., at an estimated cost of $10,000. It is also recommended that Prospect St. be improved.

Bids will be received until 1 p. m., June 2, by Board of Decatur County Commissioners, Greensburg, Ind., for the construction of a macadam road in Marion township. Linton W. Sands is County Auditor.

Iowa.

✣Bids will be received until 3 p. m., May 26, by Scott Martin, City Clerk, Sheldon, Ia., for approximately 16,000 sq. yds. of paving. Bids will be received on the following kinds of paving: brick block on concrete base, asphaltic concrete on concrete base, Portland concrete, and Dolarway bitumen on concrete base. K. C. Gaynor, United Bank Bldg., Sioux City, Ia., Engineer.

⊙The Ward Cement Construction Co., Decorah, Ia., has been awarded the contract by the city, F. M. Hughes, Clerk, for the construction of crosswalks and abutments, at $0.14 and $0.19, respectively. F. Carlson, Decorah, secured the contract for sidewalks and culverts, at $0.09 and $0.25, respectively Bids were opened May 7.

⊙George Peterson has been awarded the contract at Clear Lake, Ia., for constructing curbing in the district to be paved, at $0.32 a ruuning ft.

The Town Council of Hamburg, Ia., has passed resolutions of necessity for 40 additional blocks of paving, asphalt to be used. Contracts will be let soon.

The City Council of Leon, Ia., has passed a resolution ordering the paving of Main, Commercial and Church Sts., and around the public square.

The M. Ford Paving Co. of Cedar Rapids, Ia., has been awarded the contract by the City Council of Muscatine, Ia., for the laying of brick and bitulithic pavement. Korneman & Co., of Muscatine, secured the contract to lay concrete pavement. The work will amount to approximately $90,000.

Kansas.

✣Bids will be received until 5 p. m., May 26, by George Amyx, City Clerk, Chanute, Kans., for the construction of 5,550 sq. yds. brick or concrete pavement and 3,216 lin. ft. of 7-in. curb and 18-in. gutter. Charles Pratt is City Engineer.

⊙Stingley & Co., Manhattan, Kans., have been awarded the contract by that city, C. E. Noble, City Engineer, for the construction of 17,000 sq. yds. of asphaltic concrete pavement, at $1.43 per sq. yd., and 12,000 sq. yds. of brick, at $1.99 per sq. yd. Bids were opened May 13.

⊙The Kaw Paving Co, Topeka, Kans., has been awarded the contract by the city of Iowa Falls, Ia., for the construction of 21,000 sq. yds. of concrete paving and 10,800 ft. of curbing. The pavement will cost $1.25 per sq. yd. Bids were opened May 12.

⊙J. E. Ramsey has been awarded the contract by the City Commissioners of Emporia, Kans., for the paving of State St., from Fourth Ave. to Kansas Ave.; Constitution, from Third Ave. to Kansas Ave.; Merchant, from Fourth Ave. to Sixth Ave., for $38,881, for a concrete base and asphalt covering.

Kentucky.

✣Bids will be received until 4 p. m., May 29, by committee of the Mayor, City Clerk and City Engineer, Hopkinsville, Ky., for the construction of approximately 12,500 sq. yds. of bitulithic, asphaltic concrete, vitrified brick or sheet asphalt paving. M. G. Moore is City Engineer. Official advertisement will be found elsewhere in this issue.

Louisiana.

✣Bids will be received until noon, June 2, by Board of State Engineers, Louisiana, 104, New Orleans Court Bldg., New Orleans, La., for the construction with gravel of a Public Highway, beginning at a point about 5.1 miles from the city limits of Shreveport, and extending to Keithville, Caddo Parish, Louisiana, a distance of about 5.8 miles. Information as to location, character of work, amount, extent and class of material, terms of payment, regulations governing manner of submitting proposals and executing contract, may, on application be obtained at the office of the Highway Department. Frank M. Kerr is Chief State Engineer and President Board of State Engineers. W. E. Atkinson, State Highway Engineer.

Maryland.

✣Bids will be received until noon, June 9, by Frederick County Commissioners, Frederick, Md., for building a section of State Aid Highway in Frederick County, upon or along the Burkittsville-Knoxville road, between Burkittsville and Knoxville, for a distance of about one mile. A certified check for $200 must be filed with each bid. M. D. Harp is Clerk.

✣Bids will be received until noon, May 27, by the Joint Commission on State Aid Roads of Prince George's County, Upper Marlboro, Md., for building a section of State aid highway in Prince George's County upon or along the Queen's Chapel Road between the district of Columbia line and Hyattsville, Md. for a distance of about 1 mile. All bids must be made upon blank forms to be obtained of the State Roads Commission at its office, 534 North Howard St., Baltimore, Md.

Massachuetts.

✣Bids will be received until noon, May 28, by Directors of the Port of Boston, 40 Central St., Boston, Mass., for paving a portion of Northern Ave. and Commonwealth Pier No. 6, on the South Boston Flats and building in the same sewers, surface water drains and water pipes. The work to be done is the paving with granite blocks of Northern Ave. 100 ft. wide for a length of about 1,000 ft.; also a section of D St. 50 ft. wide and 250 ft. long and a street on the pier 100 ft. wide and about 1,100 ft. long; the building of sewers, surface water drains and water pipes in said streets and the paving with vitrified brick on a concrete base the outer edge of the pier 45 ft. wide and about 2,600 ft. long. All proposals must be made upon blank forms which may be obtained at the office of the Directors, where plans and specifications and other information relating to the work may be obtained. F. W. Hodgdon is Chief Engineer of the Directors.

⊙The Massachusetts State Highway Commission, Boston, has awarded the contract for the construction of a section of state highway in the town of Grafton to Horne-Lowe Contracting Co., of Worcester, Mass., for $8,277. Bids were opened May 13.

⊙The Massachusetts Highway Commission, 15 Ashburton Pl., Boston, has awarded the contract for the construction of a section of state highway in the town of North Andover to D. J. Sheehan Co., of Lynn, Mass., for $15,538. Bids were opened May 13.

Michigan.

✣Bids will be received until 2 p. m., May 27, by David W. Hunter, County Clerk, Bomanville, Mich., for grading and stumping County Road No. 8. David W. Hunter, Gladwin, Mich., is County Clerk.

✣Bids will be received until 10 a. m., May 28, by County Road Commissioners, at corner of Sections 15, 16, 21 and 22, Clement Township, Gladwin County, for jobs on County Road No. 3. D. W. Hunter, Gladwin, Mich., is County Clerk.

✣Bids will be received until 2 p. m., May 28, by County Road Commissioners at the corner of sections of 9 and 16, in Clement Township, on Meridian line, for jobs on Bliss road. D. W. Hunter, Gladwin, Mich., is County Clerk.

✣Bids will be received until 2 p. m., June 2, by County Road Commission at the cement bride over Howland Creek, on the town line between Sage and Grout Townships, for jobs on County Road No. 10. D. W. Hunter, Gladwin, Mich., is County Clerk.

✣Bids will be received until 2:30, June 3, by County Road Commission, at Rheims Corner, on County Road No. 7, Beaverton Township, for jobs on the said road. D. W. Hunter, Gladwin, Mich., is County Clerk.

✣Bids will be received until 10 a. m., June 4, by County Road Commissioners, at Garrish dam bridge, on County Road No. 5, for jobs on that road. D. W. Hunter is County Clerk, Gladwin, Mich.

✣Bids will be received until 10 a. m., June 5, by County Road Commissioners, at a point half a mile east of Meridian line, on County Road No. 9, in Billings Township, for jobs on said road. D. W. Hunter, Gladwin, Mich., is County Clerk.

⊙Lee Howland, Charlevoix, Mich., has been awarded the contract by the city of Caro, Mich., R. W. Roberts, Saginaw, Mich., Engineer, for the construction of reinforced con-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

crete pavement, for $16,063. Bids were opened May 16.

⊙The City Council of Bay City, Mich., has awarded contracts as follows for building concrete sidewalks: First district, consisting of that part of the east side north of 11th St., to Fred Rhemus & Son, at $0.09¾ per sq. ft.; second district, east of the river and south of 11th St., to John Dardas, at $0.09½; third district, all of the west side, to Frank Hoyt, at $0.09.

The city of Ludington, Mich., Dean Thompson, City Clerk, rejected all bids received May 12, for the construction of 11,000 sq. yds. of street pavement, and has ordered the work done by day labor under the supervision of City Engineer Geo. W. Clark.

County Surveyor Vern Royce of Corunna is at Perry, Mich., assisting A. E. Burke, Township Road Commissioner, in laying out a mile and a half of new state road. The road begins at Green's Corners and extends to the John Fulton Corners. At the Austin school house it will be carried north through Bennington Township, a distance of two miles, to Pittsburg.

The citizens of Ithaca, Mich., have voted to issue bonds in the sum of $20,000 for paving purposes.

Minnesota.

✣Bids will be received until 10 a. m., May 27, by Board of County Commissioners, Grand Rapids, Minn., for the construction of County Road 114 in the town of Arbo.

✣Bids will be received until June 2, by Board of County Commissioners, Minneapolis, Minn., for the grading of Road 105 in Hennepin County, and graveling and repairing of the same.

✣Bids will be received until 1 p. m., May 31, by J. B. Lemire, County Auditor, Aitkin, Minn., for the construction of the State Road No. 24. The work will include, clearing, grading, turnpiking and ditching.

⊙Coons & Butler, of Hibbing, Minn., have been awarded the contract by the City Council of that city, for the construction of approximately 20 blocks of streets with bitulithic and creosoted wood blocks, at the following prices: $0.55 for excavation, $2.33 per yd. for creosoted wood blocks 3 ins. thick, and $2.43 per yd. for bitulithic. The work includes about 37,000 sq. yds., of which 15,000 will be bitulithic.

The Village Council of Aurora, Minn., is considering the question of paving Jackson St.

County Commissioner Charles Kauppi, Duluth, Minn., will construct county roads leading out of the western end of the city of Duluth this year, at an estimated cost of $40,000.

According to advices from St. Paul, Minn., the promoters of the Capital National highway are now ready to advertise for bids for the construction of the piece of road between that city and Northfield. The engineers have completed their survey of this section of the route and have submitted an estimate of the cost, totaling $27,944 for the portion between Northfield and Westcott and an additional $4,800 for the distance between the latter place and St. Paul. The sum of $27,000 has already been appropriated for the work by Ramsey and Dakota Counties.

The City Council of Austin, Minn., has voted to have Kenwood Ave. paved, from Lansing Ave. south to Water St., and Water St., from Kenwood east to connect with the paving at St. Paul St.

City Engineer Oscar Claussen of St. Paul, Minn., has submitted estimates as follows to the Board of Public Works for the paving of Marshall Ave.: Creosoted blocks, $7.58 a front ft.; brick, $6.32; asphalt, $6.06, and asphaltic concrete, $5.53. The total cost of blocks is estimated, at $229,179.

Mississippi.

✣Bids will be received until 10 a. m., June 3, by J. E. Sandlin, Secretary Highway Commissioners of Road District No. 1, of Itawamba County, Mississippi, Fulton, Miss., for the permanent improvement of approximately 15 miles of roads in said district. Novaculite, chert or gravel will be used for finishing surface, and is to be compacted with roller. Parts of the road may be left unsurfaced.

Montana.

⊙R. Metcalf, of Butte, Mont., has been awarded the contract by the City Council of that city, Paul A. Gow, City Engineer, for grading about 60,000 cu. yds. of city streets in District No. 134, at $0.39 per cu. yd. Bardson & Co., Butte, secured the contract to construct 25,700 sq. yds. of concrete sidewalks and 49,900 lin. ft. of curbing, at $1.36 per sq. yd., and $0.40 per lin. ft., respectively. Bids were opened April 2.

⊙Miracle, Tripp Co., Helena, Mont., has been awarded the contract by the City Council of Butte, Mont., for the construction of vitrified brick pavement, curbing and necessary catch basins, for $3.95 per sq. yd. Bids were opened April 2.

⊙The City Council of Butte, Mont., W. A. Willis, City Clerk, has awarded the contract for excavating about 35,0000 cu. yds., in the city streets to Bardson & Co. of that city, for $0.78 per cu. yd., and the contract for the construction of 8,600 sq. yds. of concrete sidewalk and 15,600 lin. ft. of concrete curbing to Foster & Hindle, of Spokane, Wash., for $1.40 and $0.43, respectively. Bids were opened April 2.

An election will be held in Sanders County, Mont., on June 17, for the purpose of voting on the issuance of bonds in the sum of $75,000 for roads and bridges. Thompson is the county seat.

Nebraska.

The city of Lincoln, Nebr., will shortly let contracts for the construction of 10,000 yds. of additional paving. Districts including 57,000 sq. yds. are also under consideration.

New Hampshire.

⊙Maurice N. Layn, Dover, N. H., has been awarded the contract by S. Percy Hooker, Superintendent of Highways, Concord, N. H., for the grading and surfacing with gravel about 2,000 lin. ft. of road in Lee Township, for $1,968. Bids were opened May 7.

⊙James W. Tyler, Silver Lake, N. H., has been awarded the contract by S. Percy Hooker, Superintendent of Highways, Concord, N. H., for the construction of a gravel road in Madison, for $771. Bids were opened May 7.

New Jersey.

✣Bids will be received until 4 p. m., May 28, by Mayor and Common Council, Hoboken, N. J., for repaving and reimproving Ferry St., between Hudson and Jefferson Sts. A certified check for $5,000, payable to J. H. Londrigan, City Clerk, must be filed with each bid.

✣Bids will be received until 8 p. m., June 13, by Frank A. Stedman, Borough Clerk, Rutherford, N. J., for the paving of Station Square and Park Avenue with first quality vitrified paving blocks, the work consisting of approximately 25,800 sq. yds. for the borough of Rutherford and 12,400 sq. yds. for the street railway company.

⊙The Dover Boiler Works, 50 Church St., New York City, has been awarded the contract by the Committee on Public Buildings, Board of Essex County Commissioners, Newark, N. J., for erecting steel and iron work for the steam roller building at the Penitentiary, Caldwell, N. J., at $2,895. Bids were opened May 12.

New York.

✣Bids will be received until noon, May 27, by Park Commissioner, 13 City Hall, Buffalo, N. Y., for paving Kenilworth Ave., 40 ft. wide, with brick pavement, from the westerly curb line of Main St. to the center line of Kenmore Ave., or the city line, with all necessary connections, according to plans and specifications on file in the office of the Park Commissioners. G. H. Selkirk is Secretary.

✣Bids will be received until 10 a. m., July 7, by Depot Quartermaster, Army Bldg., Whitehall St., New York City, for furnishing from one to 10 motor trucks.

⊙The Board of Contract & Supply of Rochester, N. Y., has awarded the contract for re-surfacing Portland Ave. with asphalt to Whitmore, Rauber & Vicinus, of that city, for $32,721.

⊙The Board of Trustees of Waverly, N. Y., has awarded the contract for the Park Ave. pavement to the Lane Construction Co., at the following prices: $0.55 per cu. yd. for excavation, $0.98 per yd. for road work, and $0.49 per lin. ft. for concrete curb and gutter.

⊙The Board of Public Works of Elmira, N. Y., has awarded the contract for paving sections of several streets to A. D. Osborne, of Binghamton, N. Y., at prices ranging from $1.96 to $2.06 per sq. yd. for paving, $0.75 for straight curbing, set in concrete; $0.90 for curved curbing, $0.75 for headers, and $0.15 for resetting curb.

Ohio.

✣Bids will be received until noon, June 6, by Board of Hamilton County Commissioners, Cincinnati, O., for the following county work under Specifications No. 425, for improvement of the Mill Road, from Hamilton Pike to the Butler County line, in Springfield Township. Specifications are on file at the office of the Board. Albert Reinhardt is Clerk.

✣Bids will be received until noon, May 27, by S. A. Kinnear, Director of Public Service, Columbus, O., for the following improvements, in accordance with the plans, profiles, specifications and estimates of cost therefor, on file in said department, and shall be made on blanks to be procured from the chief engineer, to-wit: Cherry St., from Washington Ave. to Parsons Ave., by grading, draining, curbing, paving the roadway with asphalt or brick and laying water service pipe; Fifth St., from Town St. to Mound St., by grading, draining, curbing and repaving the roadway with asphalt or brick; High St., from Livingston Ave. to Beck St., by grading, draining, curbing, paving the roadway with asphalt, brick or stone block and laying water service pipe; Jenkins Ave., from Parsons Ave. to the east corporation line, by grading, draining, curbing, paving the roadway with brick, and laying water service pipe; Mt. Vernon Ave., from 20th St. to Taylor Ave., by grading, draining, curbing, paving the roadway with brick or asphalt and laying water service pipe; Ninth St., from Broad St. to Gay St., by grading, draining, curbing, paving the roadway with asphalt and laying water service pipe; State St., from Third St. to Grant Ave., by grading, draining, curbing, and repaving the roadway with asphalt or brick; Wall St., from Frankfort St. to Kossuth St., by grading, draining, curbing and paving the roadway with asphalt or brick.

✣Bids will be received until 11 a. m., June 14, by Board of Cuyahoga County Commissioners, Cleveland, O., for testing of materials for one year from June 15, 1913, to June 15, 1914, in accordance with the form of contract and specifications to be furnished by Frank R. Lander, County Engineer. J. F. Goldenbogen is Clerk of the Board.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, O., until 2 p. m., May 29, 1913, for grading and paving with waterbound macadam the Van Wert County State Highway A, Pet. 715, Willshire-Fort Recovery road, Inter-County No. 263, in Willshire Twp. Length, 5,284 ft. or 1 mile; width of pavement, 14 ft.; estimated cost of construction, $4,828. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners, Township Trustees, and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., May 29, for grading and paving with concrete the Belmont County State Highway H, Pet. No. 191, Sec. No. 2, Belmont National road, Inter-County No. 1, in Union Township. Length, 4,424 ft. or 0.84 mile; width of pavement, 13 ft.; estimated cost of construction, $11,011. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner, at Columbus, O., until 2 p. m., May 29, for grading and paving with waterbound macadam the Champaign County State Highway D, Pet. 557, Westville section of the Piqua-Urbana road, Inter-County No. 190, in Mad River Township. Length, 5,280 ft. or 1 mile; width of pavement, 14 ft.; estimated cost of construction, $7,739. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, O., until 2 p. m., May 29, for grading and paving with brick for heavy traffic the Belmont County State Highway H, Pet. No. 191, Sec. No. 2, Belmont National road, Inter-County No. 1, in Union Township. Length, 4,424 ft. or 0.84 mile; width of pavement, 13 ft.; estimated cost of construction, $12,900. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received until noon, May 26, by Robert D. Alexander, Ross County Auditor, Chillicothe, O., for the furnishing of all necessary labor and materials to make the improvement known as the grading, rolling and graveling of Richmond Dale Pike, a distance of 1½ miles, located in Jefferson Township, Ross County. The plans and estimates and specifications for the above work are now on file in the office of the County Auditor and County Surveyor.

✣Bids will be received until June 3, by A. B. Holland, Director of Public Service, Fostoria, O., for grading, paving and curbing Fremont St. Bids will be taken on asphalt block and brick and the job will require about 3,300 sq. yds. Charles Latshaw, Fostoria, is Engineer.

✣Bids will be received until noon, May 26, by Director of Public Service, Galion, O., for the following street improvements: The paving of Payne Ave., from the east line of North Market St., to the west line of North Liberty St., by paving same with brick, asphalt, asphalt block, wood block or treated macadam, together with the necessary gutter curbing and drainage. Said improvement approximating 2,805.2 sq. yds. The paving of Cherry St., from the west line of South Boston St. to the east line of the State road, by paving same with brick, asphalt, asphalt block, wood block or treated macadam, together with the necessary gutter curbing and drainage. Said improvement approximating 9,555.3 sq. yds. The paving of Jefferson St. from the south line of West Church St. to the north line of Grove Ave. by paving same with brick, asphalt, asphalt block, wood block or treated macadam, together with the necessary gutter curbing and drainage. Said improvement approximating 5,849.2 sq. yds.

⊙Oather M. Junk, of Chillicothe, O., has been awarded the contract by the State Highway Commission, Columbus, O., for the construction of the Columbus-Lancaster road, Madison Township, Franklin County, at $7,333. The work will include 5,451 ft. of waterbound ment with a bituminous treatment surface 14 ft. wide. Bids were opened May 15.

⊙K. E. Kunkle, of Dayton, O., has been awarded the contract by the State Highway Commission, Columbus, for the construction of Section 2 of the Devalon Road, Union and Paint Townships, Fayette County, for $6,347. The work will include 5.451 ft. of waterbound macadam road, 14 ft. wide. Bids were opened May 15.

⊙Strodtbeck Bros., Middletown, O., have been awarded the contract by that city, J. Lloyd, Director, for the laying of macadam pavement, 7½-in. stone base and 2½-in. wearing surface, with Tarvia binder. Bids were opened May 12.

⊙The Board of Control of Youngstown, O., has awarded contracts for sidewalks, crosswalks, renewing and repairing sidewalks and for the paving of Fulton St. The paving job went to Charles Harris. Artificial stone sidewalks will be laid by W. J. Ramm. The remaining contracts were secured by M. J. Joyce.

⊙The City Council of Dennison, O., J. A. Fouts, Clerk, has awarded the contract for paving, etc., Miller Ave., to Geo. J. Bock & Son, of Coshocton, O., for $10,600. Bids were opened May 9.

⊙Geo. J. Bock & Son, of Coshocton, O., have been awarded the contract by the City Council of Dennison, O., for the paving, grading and curbing of First St., for $21,098. Bids were opened May 9 by Jno. A. Fouts, Clerk.

⊙Russell & Jennison have been awarded the contract by the Board of Control of Toledo, O., for the paving of St. Clair St., for $47,600. That part of the street between Monroe and Knapp St., will be paved with wood block, for $40,500, and between Knapp and Emerald with asphalt over the present Medina stone pavement, at a cost of $7,100.

⊙Turner & Olson, of Youngstown, O., have been awarded the contract by the Village Council of Girard, O., for the paving of Liberty and Broadway Sts., with Bessemer paving brick, for about $40,000. R. W. Williams will construct the sidewalks in the town during the year for $0.12 a sq. ft.

The City Council of Findlay, O., has passed a resolution for the paving of South St., from Blanchard St. to the C., C., C. & St. L. R. R. The pavement probably will be of brick and will cost about $9,533.

The City Council of Zanesville, O., has adopted estimates for $35,000 worth of city work, including paving, water mains and sewers.

The City Council of Upper Sandusky, O., has passed an ordinance providing for the paving of Eighth St., at an estimated cost of $16,000. Plans will be prepared by Smith & Boulay, The Nasby, Toledo, O.

The City Council of Lorain, O., has passed an ordinance providing for the paving of E. Erie Ave., from the end of the present pavement to the Root road. The pavement will be 38 ft. wide.

McHugh Bros., of Springfield, O., submitted the lowest bid to the Department of Public Service of Delaware, O., for the paving of Griswold St., with brick, at $0.93 per sq. yd.; also for wood block, at $1.68 per sq. yd.

Plans have been made by Engineer Pfleuger, of Circleville, O., for the construction of 8,570 sq. yds. of brick pavement on a concrete foundation in Ashville, O. The work will include stone and concrete curb and asphalt filler. Contract will be let in about two weeks.

Oklahoma.

⊙The County Commissioners, Bartlesville, Okla., have awarded the contract for paving the streets around the new court house to P. S. Kaull, for $6,742, using bitulithic.

Oregon.

⊙The City Council of Springfield, Ore., has let the contract to the Clark & Henry Construction Co. to pave Fourth and Fifth Sts. this summer. A 4-in. concrete base with 1½-in. asphalt top dressing will be laid, for $1.30 per sq. yd.

⊙Elwood Wiles, of Portland, Ore., has been awarded the contract for the construction of about two and three-quarter miles of hard surface paving on the Main St. road extension, running north out of the city of Vancouver, Wash., for about $26,000.

Pennsylvania.

✣Bids will be received until 2 p. m., May 24, by Borough Council, St. Marys, Pa., for the grading, paving and curbing of certain streets in the said borough, at which time and place they will be publicly opened. There will be approximately 11,000 yds. of brick paving, together with the necessary curb, surface water sewers and inlets. Plans and specifications may be seen at the office of the Borough Secretary, Chas. P. Harvey.

⊙The Town Council of Mauch Chunk, Pa., has decided to pave the remaining unpaved streets throughout the town with Auburn brick, and awarded the contract to John A. Leffler, of Hazelton, Pa.

⊙Minns Bros., DuBois, Pa., have been awarded the contract at Ridgway, Pa., for the paving of approximately one mile of streets with brick block on a concrete foundation, for $23,330. Bids were opened April 28.

Director Morris L. Cooke, of Philadelphia, Pa., plans to have Chestnut St., from Front to 23d St., repaved with wood blocks. The cost is estimated at $100,000.

The Central Construction & Supply Co., of Harrisburg, Pa., submitted the lowest bid on May 9 to Highway Commissioner Fritchey of that city, for the paving and the resetting of the curbing in Strawberry St., from Market Square to Third St. The bid was $1.90 per sq. yd., and $0.40 per lin. ft. for curbing.

Bids were received on May 13 by the State Highway Department, Edward M. Bigelow, Commissioner, Harrisburg, Pa., for the construction of three state highways, as follows:

Lancaster County, Manheim Township, 20,235 ft.—John B. Shreiner, Manheim, Pa., $63,598 Cor. pipe; $64,032 C. I. pipe. Duquesne Contracting Co., Pittsburgh, Pa., $72,017 Cor. pipe; $72,261 C. I. pipe. Ambler-Davis Co., Philadelphia, Pa., $70,211 Cor. pipe; $70,564 C. I. pipe.

Lancaster County, Warwick Township, 24,105 ft.—Duquesne Contracting Co., Pittsburgh, Pa., $89,435 Cor. pipe; $90,263 C. I. pipe. Ambler-Davis Co., Philadelphia, Pa., $72,993 Cor. pipe; $74,311 C. I. pipe. Daniel S. Bader, Philadelphia, Pa., $84,896 Cor. pipe; $87,417 C. I. pipe. Stucker Bros. Construction Co., Harrisburg, Pa., $113,454 Cor. pipe; $114,508 C. I. pipe; George C. Souder, Lancaster, Pa., $71,706 Cor. pipe; $72,825 C. I. pipe.

Lancaster County, West Earl Township, 9,951 ft.—Duquesne Contracting Co., Pittsburgh, Pa., $36,770 Cor. pipe; $36,984, C. I. pipe. Ambler-Davis Co., Philadelphia, Pa., $30,728 Cor. pipe; $31,043, C. I. pipe; Matthew J. Best, Philadelphia, Pa., $26,401 Cor. pipe; $26,697, C. I. pipe. George C. Souder, Lancaster, Pa., $32,381 Cor. pipe; $32,633, C. I. pipe. John B. Shreiner, Manheim, Pa., $32,801 Cor. pipe; $33,147, C. I. pipe.

South Dakota.

✣Bid will be received until 1 p. m., May 28 by the County Auditor, Mitchell, S. Dak., for the construction of certain highways in Davison County.

South Carolina.

✣Bids will be received until 11 a. m., May 23, by Board of Richland County Commissioners, Columbia, S. C., for paving Divine St., Shandon, from Harden St. east. Bids will be received for standard bituminous bound macadam on crushed stone or concrete foundation. Complete roadway shall be 5 ins. thick. Contractors must give unit prices per square yard for roadway; per lin. ft. for 5-in.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

x 15-in. concrete curb; per foot for 18-in. and 24-in. storm drains; for each 24-in. x 36-in. catch basin with grates. The contractor is to bid on furnishing all materials, skilled labor and equipment. The county will furnish all teams and common labor. W. C. Thomas is Clerk of the Board.

Tennessee.

The citizens of Polk County, Benton, Tenn., on May 13 voted to bond the county to the amount of $250 000 to build pike roads.

Texas.

⊙The City Council of Nacogdoches, Tex., has let the contract for the paving of Main St., to the Municipal Paving Co., of Dallas, Tex., at about $50,000. The work calls for brick and wood block pavement, curbs, gutters, sewers, etc.

The taxpayers of the Barry community, 10 miles west of Corsicana, Tex., county seat of Navarro County, have petitoned the Commissioners' Court to allow them to vote an issuance of $80,000 in bonds for good roads purposes.

The Attorney General at Austin, Tex., has approved the $1,000,000 bond issue of Harris County, Tex., for good roads. These bonds will be sold on June 2. W. H. Ward, Houston, is County Judge.

Virginia.

✣Bids will be received until noon, May 23, by Clerk of the Cumberland Court, Cartersville, Va., for the construction of about 3 miles of soil road between Cartersville and Muddy Creek Mills and Hamilton School House, in Cumberland County, Va. Plans and specifications on file at the Clerk's office, Cartersville, Va. A certified check for $250 must accompany each bid. Specifications furnished on application to P. St. J. Wilson, State Highway Commissioner.

Washington.

✣Bids will be received until 2 p. m., May 23, by Board of Spokane County Commissioners, Spokane, Wash., for the completion of the sub-grade of the roadway of gravel macadam on the North Road, Permanent Highway No. 6. R. W. Butler is Clerk.

✣Bids will be received until 11 a. m., June 11, by Capt. R. F. Woods, Constructing Quartermaster Fort Worden, Wash., for the construction of concrete walks, steps, curbs, gutters, drains, catch basins, roads, etc., at Fort Casey, Wash.

⊙The Lewis County Commissioners, Chehalis, Wash., have let the contract for the grading of the county road between Dryad and Ceres, to Ray Bros., of Ceres, for $3,495.

⊙The Elliott Construction Co. has been awarded the contract by the Board of Public Works of Seattle, Wash., for the paving of 11th Ave., west, and connecting streets with bitulithic and asphalt, for $31,403, or an average bid of $1.80 per sq. yd.

⊙The Washington Paving Co. has been awarded the contract by the County Commissioners, Tacoma, Wash., for concreting five miles of Highway No. 3, between Tacoma and Spanaway, for $43,843, or approximately $0.75 a sq. yd. Savage-Scofield, F. T. Crow & Co., and Balfour-Guthrie bid $1.77½ a bbl. for furnishing the county with 25,000 bbls. of cement.

West Virginia.

The citizens of Parkersburg, W. Va., at a recent election voted bonds to the amount of $200,000 for street improvements.

Wisconsin.

⊙The Birdsall-Griffith Co. of Racine, Wis., has been awarded the contract at Delavan, Wis., for the construction of 10,000 sq. yds. of brick pavement, at about $25,000.

⊙T. W. Quinn, of Madison, Wis., has been awarded the contract by the City Council of Monroe, Wis., for paving E. Russell St., from the northeast corner of the square to the fair grounds, at $1.30 per sq. yd.

S. A. Riches, at $38,884, submitted the lowest bid to the Board of Public Works of Superior, Wis., for the paving of Grand Ave., from North Third St. to Belknap St., with concrete. McDonnell & Johnson were low bidders on asphaltic concrete and sheet asphalt, at $46,862 and $49,249, respectively.

DRAINAGE AND IRRIGATION

Illinois.

✣Bids will be received until noon, June 19, by John McGillen, Clerk of the Sanitary District of Chicago, 900 S. Michigan Ave., Chicago, Ill., for the excavation and collateral work on Contract Sections 7 and 8 of the Calumet-Sag Channel of the District, in the townships of Palos and Worth, Cook County, Ill. The approximate quantities of the work included are as follows: Contract Section 7—1,150,000 cu. yds. of excavation of glacial drift, 10,000 cu. yds. of excavation of solid rock, 120,000 sq. yds. of rip-rap slopes, 1,800 lin. ft. of roadway construction, 650 cu. yds. of concrete, 10,000 lbs. of reinforcing metal, erection of Worth Road bridge (lump sum). Contract Section 8—1,200,000 cu. yds. of excavation of glacial drift, 5,000 cu. yds. of excavation of solid rock, 130,000 sq. yds. of rip-rap slopes, 1,275 lin. ft. of roadway construction, 550 cu. yds. of concrete, 9,000 lbs. of reinforcing metal, erection of Piper Road bridge (lump sum). Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 2 p. m., June 2, by Commissioners, Cairo Drainage District, 1808 Washington Ave., Cairo, Ill., for constructing about 562,000 cu. yds. of earthwork enlargement on the Cairo Drainage District levees. Profiles, plans and specifications may be seen and blank forms obtained at office of the Cairo Drainage District, 1808 Washington Ave., Cairo, Ill. In addition to the above, and being a part of the same system, the United States Engineer Office, at Cincinnati, O., will later receive proposals for about 522,000 cu. yds. of earthwork enlargement. Information upon application to H. Jervey, Lieut.-Col., Engineer. Miller Engineering Co., Little Rock, Ark., Engineers; Gilbert & Gilbert, Attys., Cairo, Ill. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 1:30 p. m., June 9, by Commissioners of the Martinton Drainage District No. 3, at the court house, Watseka, Ill., care of the clerk of the county court, for the furnishing of all materials and the construction of the entire work in Sub-District No. Two of said drainage district. Plans, profiles, specifications and estimates of said work are now on file in the office of the clerk of the county court of said county. The work includes the construction of tile drains as follows: 1,900 ft. of 20 in. tile; 500 ft. of 18 in. tile; 3,600 ft. of 16 in. tile; 400 ft. of 14 in. tile; 1,000 ft. of 12 in. tile; 1,725 ft. of 10 in. tile; 1,600 ft. of 8 in. tile; 150 ft. of 6 in. tile. Blake & Jordan, Engineers.

Indiana.

⊙Yoder & Swartz, Nappanee, Ind., have been awarded the contract at $13,600, for constructing the Wisler ditch in Elkhart County.

Iowa.

✣Bids will be received until May 22, by Board of Mahaska County Supervisors, Oskaloosa, Ia., for the proposed work in Drainage District No. 2. L. R. Briggs is County Auditor.

Bids were opened May 10 by E. L. Marriage, County Auditor, Eldora, Ia., for constructing Drainage Ditch No. 39. The work was not let owing to the fact that no bids were received on the 39-in. and 42-in. clay tile. The plans may be changed to cement tile on the larger sizes and the work readvertised. The bids were asked on the following: 6,000 42-in., 5,500 39-in., 2,500 30-in., 4,800 28-in., 2,300 26-in., 2,000 24-in., 8,400 22-in., 600 18-in., 700 16-in., 10,500 15-in., 9,400 14-in., 6,400 12-in., 14,900 10-in., 12,500 8-in., 16,300 7-in., 18,300 6-in., 700 5-in. S. B. Gardner, Engineer, Eldora, Ia.

⊙The Canal Construction Co., Chicago, Ill., has been awarded the contract for the construction of main ditch and laterals for the Little Sioux Drainage District No. 2, bids for which were opened May 12 by E. E. Hosmer, County Auditor, Sioux City, Ia. The bid on the main ditch was 10½ cts. per cu. yd., on the laterals it was 15 cts. per cu. yd.

⊙Sibley Cement Co., Sibley, Ia., has been awarded contract at $10,175 for constructing Drainage District No. 14, bids for which were opened May 12 at Sibley, Ia. The work includes 35,400 ft. of 6-in. to 18-in. tile laid in ditch and covered. L. A. Wilson, Sibley, Ia., is the Engineer.

Florida.

✣Bids will be received until 10 a. m., June 21, by the County Commissioners, Orange County, Orlando, Fla., for the construction of a drainage system for Black Hammock Drainage District. The system comprises 19.49 miles of canals and ditches, with approximately 240,000 cu. yds. of excavation. Payment will be made in cash as the work progresses. All bids must be accompanied by a certified check for $1,000, payable to B. M. Robinson, Clerk, as a guarantee that the bidder will within 15 days execute a proper contract and bond acceptable to the Board of County Commissioners, provided he be the successful bidder. The Board reserves the right to reject any or all bids. General information, plans and specifications may be obtained upon application to B. M. Robinson, Clerk, Board of County Commissioners, Orlando, Fla. Official advertisement will be found elsewhere in this issue.

⊙J. M. Murdock, First National Bank Bldg., Chicago, Ill., has been awarded the contract for 48 miles of drainage ditches at Arcadia, Fla., and is in the market for excavating equipment.

⊙A. B. Sanders, Miami, Fla., has been awarded a contract by the Miami Land & Development Co. for deepening the Detroit Canal to 6 ft. for a length of 9 miles. The cost of the dredging, together with the construction of 18 miles of roadway along the canal, will be about $75,000.

Louisiana.

✣Bids will be received until noon, May 28, by Caddo Levee Board, 815 Spring St., Shreveport, La., for the following named work for improving drainage in Caddo Parish, La., to be done in accordance with plans and specifications prescribed by the Board of State Engineers of Louisiana, viz: Through Alligator Slough and Dooley Bayou. Deposit required, $300; bond required $3,000. Cash or certified check to the amount named as deposit must accompany each proposal. The right to reject any or all proposals is reserved. Other information as to location, character of work, manner of submitting proposals, execution of contract and bond, and time of beginning and completing of work, as well as blank forms for submitting proposals, may be had on application to the Board of State Engineers, Rooms 213-215 New Orleans Court Bldg., New Orleans, La., or to J. S. Douglas, Secretary. John Glassell is President.

Minnesota.

✣Bids will be received until May 24 by J. C. Jensen, County Auditor, St. James, Minn., for the construction of Judicial ditch No. 7, in Watonwan and Blue Earth Counties.

✣Bids will be received until 1 p. m., June 6, by J. L. Herring, County Auditor, Blue Earth, Minn., for construction of County Ditch No. 14, Faribault County. The work will include the following approximate quantities: Open work requiring the removal of 43,539 cu. yds of earth and tile portion as follows, to-wit: 18,901 ft of 6-in. tile, av. cut 4.26 ft., maximum cut 8.25 ft.; 21,526 ft. of 7-in. tile, av. cut 4.46 ft., maximum cut 7.32 ft.; 36,861 ft. of 8-in. tile, av. cut 5.19 ft. maximum cut 9.30 ft.; 28,258 ft. of 10-in. tile, av. cut 5.22 ft., maximum cut 9.06 ft.; 11,770 ft. of 12-in. tile, av. cut 5.18 ft., maximum cut 10.48 ft.; 12,700 ft. of 14-in. tile, av. cut 5.20 ft., maximum cut 7.93 ft.; 2,758 ft. of 15-in. tile, av. cut 5.91 ft., maximum cut 7.32 ft.; 400 ft of 16-in tile, av. cut 4.12 ft., maximum cut 4.58 ft.; 1,300 ft. of 18-in. tile, av. cut 5.63 ft., maximum cut 6.97 ft.; 6,900 ft. of 20-in. tile, av. cut 6.11 ft., maximum cut 8.19 ft., 7,400 ft. of 22-in. tile, av. cut 8.37 ft., maximum cut 10.38 ft.; 9,000 ft. of 24-in. tile, av. cut 9.86 ft., maximum cut 21.71 ft.; 800 ft. of 26-in. tile, av. cut 6.50 ft., maximum cut 7.30 ft.; 20 ft. of 34-in. sewer pipe, av. cut 7.80 ft., maximum cut 8.00 ft. Tile or closed work requiring 61 open catch basins, each composed of 10 ft. 6-in. tile and one 18-in. vitrified sewer pipe 30 in. long, except one shall have 30 ft. of 6-in. tile, and 5 bulkheads in place, as per engineer's plans and specifications. The soil is black loam with clay subsoil; no timber Average haul about 5 miles from Blue Earth, on the C. & N. W. and Omaha railroads. Number one hard burned clay tile specified. The contract will provide that openings be left in the spoil banks wherever tile is encountered and wherever required by the engineer during the construction of the ditch. All bids must be accompanied by a certified check for not less than ten per cent of each bid. Robert B. Miller, Engineer, Blue Earth, Minn.

Commissioners of Ashland and Richland Counties are considering a petition for dredging the Blackfork for a distance of eight miles. Mansfield is the County seat of Richland County.

Missouri.

✣Bids are being taken by T. O. Stanley, Engineer, Sedalia, Mo., for the construction of the Gilham Lake drainage ditch in Saline County, Mo. The work will include a 5½-mile open ditch 16 ft. wide at the bottom, 6 ft. deep with slope of 1 to 1, and will require about 90,000 cu. yds. of excavation. There will also be two laterals totaling one mile in length, 3 ft. wide at the bottom, 3 to 4 ft. deep, with slope of 2 to 1, and including approximately 1,500 cu. yds. The cost of the work, which is suitable for a floating dredge, is estimated at $9,000. Two bridges of I-beam type will be constructed on concrete abutments. About two acres of timber clearing will be necessary. The work will be through black loam soil. Whites Siding, which is about 450 ft. from the starting point of work, is the nearest railroad station. A certified check for $100 is required with each bid. Payments made in cash on 30-day estimates.

Utah.

The Alta Ditch Co., according to advices from Provo, Utah, will hold a special stockholders' meeting on June 7 to consider building a 1⅛-mile pipe line to cost about $8,000 to convey waters of Guard Quarters Spring in Provo Canyon.

Washington.

A plan is under consideration for the organization of a drainage project for reclaiming some 30,000 acres of land in the Kootenai Valley. Charles G. Reeder and W. L. Beckwith, Spokane, Wash., are interested.

The Great Northern Ry. is to make surveys in the Okanogan Valley for the directors of the East and West Okanogan Irrigation District.

The Cascade Irrigation District, Ellensburg, Wash., is issuing $700,000 of bonds, the greater part of the proceeds of which will be used for improvements. The improvements planned contemplate the extension of present intake about 150 ft. upstream; straightening of canal alignment wherever practicable; the use of unlined earth canal in place of flume when possible; the use of steel and concrete flume in place of the present wooden flume; and a two mile tunnel through the ridge to eliminate a long stretch of treacherous ground along the Easterly bank of the Yakima river. The capacity of the canal will also be increased to 150 second ft. in order that the full water right may be made use of. The following indicates the approximate length of the various kinds of construction planned: Unlined earth canal (including 8,950 ft. present canal), 14,235 ft.; concrete and steel flume, 14,750 ft.; tunnel through ridge (concrete lining), 10,060 ft.; total length of short tunnels (concrete lining), 1,800 ft.

WATER WORKS

Arkansas.

The Board of Commissioners for the Walnut Ridge, Ark., water works system has let the engineering contract. The construction contract will be let immediately upon the completion of plans and specifications. B. F. Graff is President of the Board.

California.

⊙The Board of Trustees of Tulare, Calif., has awarded the contract for the construction of the water tower and tank to the Des Moines Bridge & Iron Co., Des Moines, Ia., at $49,840. C. D. Vincent secured the contract to install the water works system, using galvanized converse pipe dipped, for $37,648.

Commissioner E. M. Wilder, Sacramento, Calif. plans improvements to the water works plant. It is proposed to install electricically-driven centrifugal pumps and extend the water mains.

Connecticut.

⊙The Board of Public Works of Meriden, Conn., has awarded the contract for the construction of the Broad Brook dam to the Pierson Engineering & Construction Co., of Bristol, Conn. R. D. Wood & Co., of Philadelphia, Pa., have been awarded the contract for furnishing the pipe for the new reservoir system at $82,137.

The Thompsonville Water Co., Henry R. Cooper, Supt., Thompsonville, Conn., plans the construction of a dam 20 ft. high the entire width of the Crombie property, fronting a basin, with a storage capacity of 76,000,000 gals.

District of Columbia.

✣Bids will be received until 11 a. m., June 7, by Depot Quartermaster, Washington, D. C., for the construction of a concrete settling basin, etc., of the Walter Reed General Hospital, D. C.

✣Bids will be received until 2 p. m., May 27, by Secretary of Interior, Washington, D. C., for the furnishing of all labor and materials required in the reconstruction of the boiler and pump room in the old postoffice building, 8th and E Sts., northwest, Washington, D. C., and on the same date at 3 o'clock p. m., for the installation of a sewer system in the same building and for the installation of a sewer system in the Patent Office Building, 7th St., between F and G Sts, northwest, Washington.

Florida.

⊙The J. B. McCrary Co., of Atlanta, Ga., has been awarded a contract by the town of Newberry, Fla., for the construction of an electric light plant and a water works system, for about $26,500.

Georgia.

The Board of Water Commissioners of Macon Ga., has authorized the superintendent to lay a water main on Woolfolk St., between Main and Peachtree, and on a portion of Fairview St., a distance of 1,750 ft.

Illinois.

✣Bids will be received until 2 p. m., June 5, by City of Galesburg, Ill., for about 30,000 lbs. of riveted steel plates and shapes for a pump pit and well strainer. Plans and specifications may be examined at the office of Dabney H. Maury, 1137 Monadnock Block, Chicago, Ill., or at the office of J. P. Evans, Chairman of the Water Committee, Galesburg, Ill. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 2 p. m., June 5, by City of Galesburg, Ill., for sinking a well. Plans and specifications may be examined at the office of Dabney H. Maury, Consulting Engineer, 1137 Monadnock Block, Chicago, Ill., or at the office of J. P. Evans, Chairman of the Water Committee, Galesburg, Ill. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 11 a. m., May 22, by the Department of Public Works, Chicago, Ill., for furnishing and delivering steel boiler tubes and furnace tubes, as follows: 14th St. Station, 300 3½ in. in diameter, 12½ ft. in length, B. W. G. 10; 22nd St., 275 3½ in., 12½ ft., B. W. G. 10; Chicago Av., 100 3½ in., 13 ft., B. W. G. 10; Chicago Av., 25 3½ in., 13 ft., B. W. G. 8; Central Park Av., 150 3 in., 12 ft., B. W. G. 10, and 35 3 in., 12 ft., 8; Springfield Av. 100 3 in., 12 ft., 10, and 35 3 in., 12 ft., 8; 68th St., 15 4 in. 18 ft., 10; Roseland, 24 4 in., 18 ft., 10; Rogers Park, 25 4 in., 16 ft., 10; 14th St., 50, 2⅜, 5 ft., 1¾ in., 6; 22nd St., 125, 2⅜, 5 ft., 1¾ in., 6; Chicago Av., 50 2⅜, 5 ft., 1¾ in., 6; Central Park Av., 150, 2⅜ in., 5 ft., 1¾ in., 6; Springfield Av., 150 2⅜ in., 5 ft., 3½ in., 6; tubes to be seamless, cold drawn, Shelby steel tubes, of good quality soft steel, rolled from solid ingots; cash or certified check for $100 must accompany bid. Specifications may be had upon application to L. E. McGann, Commissioner of Public Works.

✣The Board of Local Improvements, Chicago, Ill., will receive bids until 11 a. m., May 28, for the construction of water service pipes, including stop cock, spiral shut off boxes, etc., in the following streets; Avenue G, 106th St. to Indianapolis Ave., Avenue H, 106th to 108th St., Cuyler Ave., Kimball Ave., to Spalding Ave., Elston Ave., Lawrence Ave., to Maple Ave., 43rd Ave., Elston Ave., to 175 ft. south of Wilson Ave., 44th Ct., Elston Ave., to Montrose Ave., 54th Ave., Lawrence Ave. to Roberts Ave., Hamlin Ave., Elston Ave. to Montrose Ave., Lawrence Ave., Milwaukee Ave. to 56th Ave., Leland Ave., Elston Ave. to 45th Ave., Montrose Ave., Western Ave. to Avondale Ave., Sawyer Ave., Berteau Ave. to Montrose Ave. E. J. Glackin, Secretary of the Board. Cash or certified check for 10 per cent of bid must accompany proposal.

⊙The Board of Local Improvements, Chicago, Ill., has awarded to A. Scully, 4892 Our St., the contract for the construction of water supply pipe in 84th St., Muskegon Ave. to Escanaba Ave., Hutchinson St., 53rd Ave. to 115 ft. west of 52d Ave., to E. Connor, 2432 Courtland St.; 50th Ave., W. Chicago Ave. to Augusta St., Kedzie Ave., W. 53rd St. to W. 63rd St., M. Murphy, 5315 Wabash Ave.; Roseland Ave., 99th St. to 100th St. E. J. Glackin, Secretary of the Board.

⊙The contract for the erection of a filtration plant at the foot of Lincoln St., Evanston, Ill., has been awarded to the Norwood Engineering Co., of Florence, Mass., by the City Council, for $186 494. A list of the itemized bids on this work was given in our April 30 issue.

⊙The City Council of Decatur, Ill., has awarded the contract for the construction of a new reservoir at the water works plant to W. O. Newlin, for about $3,000.

The Village Council of Plainfield, Ill., has decided to extend the water main on Joliet St., from Commercial St. to the end of the sewer. Col. McNaughton, Joliet, Ill., is Village Attorney.

Citizens of Roanoke, Ill., are again agitating the installation of a waterworks system. L. L. Risser is a member of the council.

The Village Board of Stockton, Ill., contemplates the construction of a water reservoir during the coming summer having a capacity of 500,000 gals.

The City Council of Galesburg, Ill., is considering a proposition to build a reservoir between Galesburg and Knoxville. Plans are now being prepared. The cost will be about $400,000.

Indiana.

The Board of Public Works of Indianapolis, Ind., has instructed the Water Co. to lay approximately 21,000 ft. of mains.

Iowa.

Citizens of Walnut, Ia., have voted against the sinking of a deep well and the extension of the water works at Walnut, at a cost of $15,000.

The Town Council of Stanwood, Ia., contemplates the establishment of a system of water works.

Consulting Engineer Wynkoop Kiersted of Kansas City, Mo., has submitted his report to the City Council of Fort Madison, Ia., relative to the proposed municipal water works system. The estimates are as follows: To construct a distributing system complete—mains, fire hydrants, valves, distributing reservoir, but not including the pumping station—$127,899. For a gang well, single lift, water supply works, with steam equipment, $45,384. For an individual well, double lift (reservoir at pumping station to receive water from well, then to be again pumped into hill top reservoir), water supply works, electrically operated, $22,747.

Following is the lowest bid submitted on May 15, to L. E. McCann, Commissioner of Public Works, Chicago, Ill., by the Conroy Boiler & Tank Works, 112 W. Adams St., Chicago, for the repair of boiler at Springfield Ave. pumping station, contract price, $1,710. The work requires the removal of old boiler tubes, stay tubes and back sheet tube from No. 5 boiler, and replacing same complete. The contract has not been awarded.

Kentucky.

✣Bids will be received until noon, June 2. by the Lexington Hydraulic & Manufacturing Co., Lexington, Ky., for constructing an earthen reservoir dam and miscellaneous appurtenances thereto, the total work involving about 48,500 cu. yds. of earth work. Alvord & Burdick, Hartford Bldg., Chicago, Ill., are Engineers. Official advertisement will be found elsewhere in this issue.

The town of Flemingsburg, Ky. (population, 1,219) is considering a proposition to install water works at a cost not exceeding $25,000.

Maryland.

⊙Thos. S. Kean, Smallwood St., Cumberland, Md., has been awarded the contract by that city, for the laying of 2,400 ft. of 30-in. cast iron water pipe at $16,550. Bids were opened May 10 by J. S. Schriver, Water Commissioner.

Massachusetts.

⊙The Board of Water Commissioners, North Attleboro, Mass., has awarded the contract for the furnishing and delivering of 70 tons of 6-in. cast iron water pipe to R. D. Wood & Co., of Philadelphia, Pa., for $24.50 per ton. Water mains are to be extended on the following streets: High St., 1,200 ft.; Ralph St., 390 ft.; Ivy St., 393 ft.; Peck St., 1,100 ft., and Lake Av., 540 ft.

The water department of the City of Springfield, Mass., has completed plans for the construction of a standpipe in the town of Ludlow, Mass., to hold 318,000 gals. It is proposed to install a small pump of 1,500,000 gals. capacity a day. The standpipe will be 60 ft. in diameter and 15 ft. high.

Michigan.

✣Bids will be received until June 10, by the Public Lighting Commission, F. T. Bowles, Secy., Detroit, Mich., for erecting one 5,000 kilowatt steam turbine, alternating current generator and condensing apparatus for the turbine, in accordance with the specifications on file in the office of the Commission.

⊙The Advance Pump & Compressor Co., Battle Creek, Mich., has been awarded the contract for furnishing the Rock Island Arsenal, Rock Island, Ill., with one centrifugal pump, one 30-h. p. motor and one oil circuit breaker, at $670. Bids were opened April 14.

The Village Council of Trenton, Mich., has named a committee to investigate the proposition to secure a water supply for that village. It is proposed to sink wells.

James Wilkie, President of the Water Commissioners, Detroit, Mich., has recommended that the board appropriate $10,000 for preliminary plans for the installation of a mechanical filtration plant in Gladwin Park. It is estimated that a filtration plant capable of taking care of a city of 1,000,000 inhabitants will cost between $2,000,000 and $2,500,000.

Minnesota.

✣Bids will be received until 8 p. m., May 29, by the Village of Morgan, Minn., for the furnishing of all material, labor and tools required in the construction of a water works system in and for the Village of Morgan, Minn., completed in accordance with the plans and specifications, and must be made on blanks furnished by the village and there must be plainly written a price in each blank of said form for additions or deductions. Each proposal must be accompanied by certified check for $500. J. B. Jackson is President of the Village Council.

⊙McLaurin & Northrup have been awarded the contract by the city of Mankato, Minn., for the laying of water mains on East Main St., for $4,024.

⊙The Village Council of Morgan, Minn., has let the contract for drilling the well for the city water works system to J. F. McCarthy, of Minneapolis, Minn.

The town of Woodstock, Minn., contemplates the installation of a water works system and an electric light plant.

Missouri.

✣Bids will be received until noon, June 2 by Board of Public Works, Maryville, Mo., at the office of F. L. Flynt, Supt. of Construction, for the following equipment: 1 high service, compound condensing, duplex, direct acting pump of 1,000,000 gals. capacity; 2 low service, horizontal split case, centrifugal pumps direct connected to steam engine, 1,000 gals. per minute capacity each; 1 boiler feed pump; 2 pressure filters, 250,000 gals. capacity each; 1 4-K.W. 120 volt D.C. generator direct connected to steam engine; 1 150-H.P. open feed water heater; low concrete dam, gravity section. Each bid to be accompanied by a certified check for an amount equal to 2 per cent of the bid, payable to James Colby, City Treasurer. Plans and specifications are on file at the office of F. L. Flynt at Maryville, Mo., and also at the office of Hiram Phillips, Consulting Engineer, St. Louis, Mo. Official advertisement will be found elsewhere in this issue.

⊙The Pittsburgh Filter Co., Pittsburgh, Pa., has been awarded the contract by the Water Department, St. Louis, Mo., for furnishing labor and material for the construction and completion of the Chain of Rocks filter equipment at $398,200. Bids were opened by the Board of Public Improvements on May 16. Chas. A. Cheney is Secretary of the Water Department.

The citizens of Monroe City, Mo., at a recent election voted the issuance of bonds to the amount of $68,000 for the installation of water works and $10,000 for sewers.

Montana.

The Libby Water Works, Electric Light & Power Co., Libby, Mont., proposes the installation of about 15,000 ft. of new pipe on the main pipe line leading from the dam in Flower Creek to the power house in town, changing the line to a more secure position and thus avoiding small land slides. The work will cost about $7,000.

Following bids were received by the City Council of Helena, Mont., on May 5, for furnishing 2,500 ft. of 6-in. cast iron pipe: American C. I. Pipe Co., Kansas City, $37.20 a ton; Massillon Iron & Steel Co., Chicago, $37.55 a ton; U. S. C. I. Pipe & Foundry Co., Chicago, $37.50 a ton; James Clow & Son, Chicago, $38.20 a ton; R. D. Wood & Co., Philadelphia, $46.55 a ton; A. M. Holter Co., Helena, $38.55 a ton.

City Engineer F. E. Marsh of Kalispell, Mont., has completed a survey of the proposed installation of a municipal water plant and is preparing plans for submission to the City Council.

Nebraska.

The city officials of Dixon, Neb., are considering a proposition to install a municipal water works and electric lighting system.

The citizens of Norfolk, Neb., at a recent election voted the issuance of bonds to the amount of $10,000 for water works extension for Edgewater Park addition and East Norfolk.

The citizens of Columbus, Neb., on May 20, voted on the proposition to issue bonds in the sum of $10,000 for water works extensions.

The city of Omaha, Neb., will shortly advertise for bids for the construction of three reservoirs for the water plant, having a total capacity of 25,000,000 gals. Plans were prepared by Architect George T. Prince. The estimated cost is $350,000. Immediately upon the completion of these reservoirs six additional ones will be built of equal capacity.

New York.

⊙The Board of Water Commissioners of Canastota, N. Y., on May 13 awarded the contract for the laying of water mains in Main St., before the new pavement is laid, for $3,356.

⊙The Mexico Water Commission has let the contract for the construction of the proposed new water supply system in the village of Mexico, N. Y., to The Public Engineering & Constructing Co., of Buffalo, N. Y. Other contracts were awarded as follows: Rumsey Pump Co., Seneca Falls, pumping machinery and motor; American Water Softener Co., Philadelphia, Pa., filters; Des Moines Bridge & Iron Works, Des Moines, Ia., standpipe; Millar Sons & Co., Utica, supply pipe; R. D. Wood & Co., Philadelphia, hydrants and valves. The system will cost about $50,000.

⊙The Consolidated Water Co., of Utica, N. Y., has announced the awarding of its new 6-mile pipe line contract from Marcy Summit to the intersection of Champlin Av. and Whitesboro St., to Horace K. Corbin, of Elizabeth, N. J. The contract also includes construction of the equalizing reservoir on the William Watson farm in Marcy.

⊙The Board of Contract and Supply of Schenectady, N. Y., has let a contract to the Chapman Valve Co., of Indian Orchard, Mass., for furnishing the water bureau with supplies, for $1,044.

A tax payers meeting was recently held in the village of East Syracuse, N. Y., for the purpose of receiving plans and specifications and estimates of cost of constructing the proposed reservoir, having a capacity of from 8,000,000 to 10,000,000 gals. The improvement will cost about $10,000.

North Carolina.

The engineers employed by the City of Raleigh, N. C., to appraise the value of the Wake Water Co., of that city, have agreed upon a price of $250,000. The city proposes to take over the plant.

Gilbert C. White, Consulting Engineer of Charlotte, N. C., Benjamin M. Hall, Consulting Engineer of Atlanta, Ga., and Judge Thomas J. Shaw of Greensboro, N. C., were appointed as a Board of Arbitration to appraise the value of the Wake Water Com-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

pany's plant at Raleigh, N. C., for the purchase of same by the City of Raleigh. Their decision fixing the value at $250,000 was rendered on May 3, and the city will take over the plant within thirty days from that date.

North Dakota.

A water works system is to be installed in Belfield, N. Dak., at an estimated cost of $10,000.

Ohio.

✣Bids will be received until noon, May 30, by V. T. Price, Director of public service, Cincinnati, O., for the relining of the West Basin of Eden Park Reservoir. The engineer's estimate of the work is $120,000. A certified check or bond for $5,000 must accompany each bid. M. J. Keefe is Secretary. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until noon, May 27, by W. H. Kirby, Secretary to the Director of Public Service, Cleveland, O., for one 40-ton motor electric traveling crane, with one 5-ton auxiliary, for the Municipal Electric Light Plant of the City of Cleveland, O. Each bid must be made in accordance with the plans and specifications, which may be obtained in the office of the Engineer of Construction, Room 319 City Hall.

✣Bids will be received until noon, May 27, by W. H. Kirby, Secretary to the Director of Public Service, Cleveland, O., for steam driven and motor driven electric generators and rotary converters for the Municipal Electric Light Plant of the City of Cleveland, O. Each bid must be made in accordance with the plans and specifications, which may be obtained in the office of the Engineer of Construction, Room 319 City Hall.

⊙The contract for the storage reservoir for impounding water for the city water works at Alliance, O., has been let to J. C. Divine, of that city. The work is under the supervision of Chester & Fleming, Hydraulic Engineers, Pittsburgh, Pa., who prepared plans.

⊙Following contracts have been awarded by the Public Service Department of Lima, O., J. R. Morris, Director, for water works improvements, for which bids were opened on May 1: Engine and crane—Snow Steam Pump Co., Buffalo, N. Y., $17,200; boilers (sterling)—Toledo Power Equipment Co., $5,770; material for three miles of 20-in. pipe line—Massillon Iron Works, Massillon, O., $36,153; steam piping—American Foundry & Construction Co., Pittsburgh, $2,256; valves, hydrants and fittings—James B. Clow, Chicago, Ill., $6,200.

⊙The J. C. Devine Co. has been awarded the contract by the Department of Public Service of Alliance, O., for the construction of the Westville storage reservoir. The reservoir is to have a capacity of 300,000,000 gals. Bids were opened Oct. 24, 1912. Contract let April 25, 1913.

According to advices from Piqua, O., an appropriation of $15,000 has been made for improvement work at Lewistown reservoir at Indian Lake Park. It is proposed to expend about $41,000 on this reservoir within the next two years.

Service Director Lewis of Elyria, O., will request the City Council to appropriate $15,000 for the construction of a standpipe in connection with the water works system. The proposed reservoir would be erected on the west side and would be capable of storing 500,000 gals. of water.

Oklahoma.

✣Bids will be received until June 2, by Constructing Quartermaster, Fort Sill, Okla., for the construction of a pump house and 10-in. cast iron water pipe line and installation of a motor-driven pump. Official advertisement will be found elsewhere in this issue.

Oregon.

⊙Payne & Reed, of Portland, Ore., have been awarded the contract by the City of Newport, Ore., for the construction of a 1,000,000-gal. reservoir.

Pennsylvania.

✣Bids will be received until 10 a. m., May 26, by Howard B. Oursler, Director of Supplies, Pittsburgh, Pa., for furnishing one heater for the Bureau of Fire. Specifications and blanks for bidding may be secured at the office of the Department of Supplies, 507 Oliver Building.

South Dakota.

Preliminary arrangements are being made to extend the mains of the water works system in Leola, S. Dak., so that all parts of the town will be supplied with water.

Texas.

The Luling Water Co., of Luling, Tex., contemplates the installation of a filter.

Virginia.

The new town of North Richmond, Va., has petitioned the City of Richmond, Va., to furnish it with water from the city mains.

The Town Council of Harrisonburg, Va., has purchased a two-acre lot on top of the Newman Hill, east of Campbell St., to be used as a site for the new 5,000,000-gal. reservoir.

Washington.

✣Bids will be received until 10 a. m., June 13, by the Board of Public Works, Seattle, Wash., for the work on the Cedar River granite dam. The dam is to be 200 ft. high, 800 ft. long, 200 ft. wide at bottom and 15 ft. wide at top, requiring about 150,000 cu. yds. of concrete. About $1,000,000 is to be expended. A. H. Dimock is City Engineer.

West Virginia.

Plans have been prepared by City Engineer R. D. Hennear of Morgantown, W. Va., for the installation of a new water works system in that city, to cost about $200,000. The work will include 6 or 8 in. wells, reservoir, mains, etc.

Wisconsin.

✣Bids will be received until 7:30 p. m., June 18, by J. F. Blanchard, City Clerk, Park Falls, Wis., for the laying of 255 ft. 6-in. vit. pipe sewers 4 ft. deep; 2,283 ft. 10-in. vit. pipe sewers 8 ft. deep; 3,840 ft. 8 in. vit. pipe sewers 7.3 ft. deep; 34 manholes, 3 lampholes. Certified check, 5 per cent; bond, 25 per cent of contract price. Plans will be placed on file with W. G. Kerchoffer, Engineer, at 31 Vroman Bldg., Madison, Wis. J. F. Blanchard, City Clerk.

⊙C. S. Philipps, of Madison, Wis., has been awarded the contract by the city of Boscobel, Wis., H. J. Johnson, Clerk, for the laying of water works and sewer mains, disposal tanks, etc., for $23,790. Bids were opened May 9. W. G. Kirchoffer, Madison, is Engineer.

⊙J. N. Roherty, Madison, Wis., has been awarded the contract by the Village of Wauzeka, Wis., J. C. Feldman, Clerk, for the laying of 6,128 ft. of 6-in. cast iron water pipe, for $0.33 per ft., and for building a concrete tank at $1,550. Bids were opened May 8.

⊙Jos. Hanreddy, 127 N. Dearborn St., Chicago, Ill., has been awarded the contract by the city of Milwaukee, Wis., for the construction of the water works tunnel, 12 ft. in diameter, for approximately $430,000. The tunnel will be 4,000 ft. long, lake and shore shafts. Bids were opened April 24.

Wyoming.

⊙Petry & Moulton, of Cheyenne, Wyo., have been awarded the contract for the installation of a water works system in the town of Glenrock, Wyo., conditional on the sale of bonds for the improvement. Other contracts were awarded as follows: U. S. C. I. Pipe & Foundry Co., furnishing pipe; Fairbanks, Morse & Co., pumping machinery; Colorado Portland Cement Co., cement, and the Rensselaer Valve Co., valves and hydrants. C. C. Carlisle, First Nat. Bank Bldg., Cheyenne, is Engineer. Bids were opened May 5.

Canada.

⊙The Cook Co., of Sudbury, Ont., has been awarded the contract by the city of Montreal, Que., to enlarge the city's reservoir main, for approximately $3,000,000. Contract awarded May 16.

⊙The City Council of South Vancouver, B. C., has awarded a contract for the erection of a water supply tank at Central Park, capacity 750,000 gals., to the British Columbia Equipment Co., of Vancouver, for $30,411. A. C. Langley & Co., Vancouver, secured the contract for the 100,000-gal. tank at the municipal hall.

Property owners of Woodstock, Ont., have voted a by-law to provide $12,000 for the making of extensions to the water mains.

SEWERAGE AND SANITATION

Arkansas.

✣Bids will be received until 8 p. m., June 12, by Board of Commissioners, Sewer Improvement District No. 1, Brinkley, Ark., for the construction of sewers and sewage treatment works. Plans and specifications may be seen at the office of B. Emmons, Chairman of the Board. F. L. Wilcox, Chemical Bldg., St. Louis, Mo., is Engineer. Official advertisement will be found elsewhere in this issue.

City Engineer G. H. Burr, of Conway, Ark., has completed plans and specifications for the installation of the proposed sewerage system. The contract will be awarded within the next 20 days.

A meeting was recently held in Little Rock, Ark., to discuss the proposed storm sewer, which will extend from Eighth and Spring Sts., north to the river, and also the proposed system of deep drainage sanitary sewers, to cover practically the entire business district of the city. The Spring St. sewer, as proposed, will be 12 ft. in diameter and will cost about $95,000. Lund & Hill, Little Rock, are Engineers.

California.

⊙The City Council of San Bernardino, Calif., has awarded four sewer contracts to John Kerr and Louis Meyer of Upland, Calif., two to the Highway Construction Co., and one to M. M. Pkich of Los Angeles. The total cost of the sewers, which are to be laid in the northwest section, is $19,533.

Colorado.

The Board of Public Works of Denver, Colo., has ordered the construction of storm sewers that will cost $425,000. The sewers will be laid in North Denver, bounded by Lowell Blvd., Inca St. and West 32d and West 45th Aves. A. L. Fellows is City Engineer.

Delaware.

The Town Council of Newark, Del., has approved plans and specifications of Consulting Engineer T. Chalkley Hatton, Wilmington, Del., for the proposed sewerage system and disposal plant. An election will be held May 24 for the purpose of deciding on the proposition.

District of Columbia.

Bids as follows were received May 7 by the District Commissioners, Washington, D. C., for constructing the Maryland Ave. trunk sewer: Warren F. Brenizer Co., Washington, D. C., Sec. 1, excavation, 67 cts.; concrete masonry B, $6.75; vitrified brick masonry, $21; sewer brick masonry, $14. Sec. 2, excavation, 67 cts.; concrete masonry B, $6.75; vitrified brick masonry, $21; sewer brick masonry, $14. E. G. Gummell, Washington, D. C., Sec. 1, excavation, 82 cts.; concrete masonry B, $5.66;

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

vitrified brick masonry, $22; sewer brick masonry, $14. Sec. 2, excavation, 82 cts.; concrete masonry B, $5.66; vitrified brick masonry, $22; sewer brick masonry, $14. Whiting-Turner Co., Baltimore, Md., Sec. 1, excavation, $1.70; concrete masonry B, $7.90; vitrified brick masonry, $22; sewer brick masonry, $15. Sec. 2, excavation, $1.70; concrete masonry B, $7.90; vitrified brick masonry, $22; sewer brick masonry, $15. George Hyman, Washington, D. C., Sec. 1, excavation, 64 cts.; concrete masonry B, $7; vitrified brick masonry, $19; sewer brick masonry, $12. Sec. 2, excavation, 64 cts.; concrete masonry B, $7; vitrified brick masonry, $19; sewer brick masonry, $12. R. J. Malone, Washington, D. C., Sec. 1, excavation, $1; concrete masonry B, $8.30; vitrified brick masonry, $21; sewer brick masonry, $15. Sec. 2, excavation, $1; concrete masonry B, $8.30; vitrified brick masonry, 21; sewer brick masonry, $15.

Bids as follows were received May 7 by the District Commissioners, Washington, D. C., for constructing Sections 5 and 6 of Pine Branch trunk sewer: Whiting-Turner Construction Co., Baltimore, Md., excavation, 61.5 cts.; concrete masonry B, $9; vitrified brick masonry, $22; sewer brick masonry, $15. E. G. Gummell, Washington, D. C., excavation, 30 cts.; concrete masonry B, $8; vitrified brick masonry, $22; sewer brick masonry, $14. Warren F. Brenizer Co., Washington, D. C., excavation, 40 cts.; concrete masonry B, $7; vitrified brick masonry, $21; sewer brick masonry, $14. R. J. Malone, Washington, D. C., excavation, 90 cts.; concrete masonry B, $9; vitrified brick masonry $22; sewer brick masonry, $16. George Hyman, Washington, D. C., excavation, 30 cts.; concrete masonry B, $6.65; vitrified brick masonry, $20; sewer brick masonry, $14.

Idaho.

⊙A. M. Van Dyke, of Lewiston, Ida., has been awarded the contract for the sewer tops for the drainage system and city sewers in connection with the Moscow, Ida., paving contract, for about $3,000.

Illinois.

✣Bids will be received until 11 a. m., June 5, at Room 406 City Hall, Chicago, Ill., for furnishing all tools, appliances, materials, labor and facilities to properly design, deliver material and equipment, prepare site, construct dock, retaining wall, roadways, foundations, buildings, switch tracks, machinery, appurtenances, and auxiliaries, and completely erect a garbage reduction plant and operate same for a period of five years upon a site located at 48th Ave. and Sanitary District Canal. The work includes preparation of site, construction of a dock, approximate length 1,405 ft., a concrete roadway running parallel with the dock; retaining wall of the gravity type or reinforced concrete construction; power plant is to consist of a building of modern fireproof brick and steel construction; a stack of radial brick construction, 8 ft. in diameter and 180 ft. high, shall be erected; machinery of plant to consist of 3 turbo generators, 500 K.W., 60 cycles, 3 phase, 220 volts; steam turbine to be of the horizontal condensing, reaction or parsons type; air pump shall be 1 horizontal independent air pump of crank and fly wheel type having a normal displacement capacity not less than 220 cu. ft. per minute at a speed not exceeding 70 R.P.M.; crane motors in engine room and on dock cranes shall operate at 220 volts, 3 phase, 60 cycles; flaming arc lamps shall be used for yard illumination; 4 water tube boilers of 400 H.P. normal rating, each provided with a super heater; mechanical stokers shall be furnished and erected; the reduction plant shall have a capacity of 1,200 tons of garbage per day of 24 hours; the building shall be of modern factory design of steel and concrete or brick and steel construction; floors shall be of concrete covered with waterproofing; 4 derricks for unloading garbage tanks or boxes from scows, cars or wagons shall be provided, each shall be of high grade design and type and provided with complete electric power equipment; receiver and picker building shall be provided with receiving bins so that the conveying devices will be invisible and its fumes subject to control by ventilating system; provisions for sterilizing garbage boxes after unloading must be arranged; main dryer building, the primary drying to be done by direct heat revolving type dryer; furnaces to be equipped with mechanical stokers such as to permit a convenient feeding and combustion of coal used as fuel or oil; there shall be 12 direct heat dryers of high grade make and construction, each not less than 5 ft. in diameter and 40 ft. in length; 4 secondary dryers, not less than 70 ins. in diameter and 35 ft. in length; there shall be furnished and installed a completely equipped grease extractor plant of modern design; grease storage tanks each not less than 30 ft. in diameter and 30 ft. in height shall be erected on concrete foundation; 3 gasoline storage tanks not less than 16 ft. in diameter and 16 ft. high shall be provided; 2 bone crushers of the Steadman type shall be furnished; 6 rendering tanks 6 ft. by 16 ft. of heavy steel construction, each provided with a Mathews valve, shall be erected upon concrete foundation; necessary filters or purifying devices shall be installed to serve the water supply and properly treat the effluents discharged into the Sanitary District Canal; all conveyors not inclosed in buildings shall be provided with metal or concrete ducks; a complete ventilating system connecting all chambers of buildings where obnoxious vapors are emitted from the garbage in course of reduction, shall be installed; the yard pavement shall be of concrete with necessary slopes, gutters, drains, etc.; other items are heating system, safety appliances, fire systems. Official advertisement will be found elsewhere in this issue.

⊙The Board of Local Improvements, Chicago, Ill., has awarded the contract for the construction of a tile pipe sewer in Wentworth Av., 67th St. to 69th St., and from 69th St. to 73rd St. to A. Scully, 4892 Our St. The work includes construction of catch basins, manholes, house drains and the removal of existing sewers and house drains. E. J. Glackin, Secretary of the Board.

⊙The Rock Island Bridge & Iron Co., Rock Island, Ill., has been awarded the contract by the City Council of East Moline, Ill., for the construction of the pumping station for the sanitary sewer, at $5,910. H. G. Paddock is City Engineer.

At a recent meeting of the East Batavia Improvement Association, Batavia, Ill., a campaign for a complete sanitary sewer system for East Batavia was launched. A committee was named to secure plans and estimates of the cost of the improvement. John Geiss is interested.

The Village Board of Stockton, Ill., plans the construction of a sewer system and the paving of four blockes of the principal business streets with brick during the coming summer.

The City Council of Upper Alton, Ill., John Schwaab, City Engineer, has passed an ordinance providing for the installation of the proposed sewer system.

Indiana.

✣Bids will be received until 7:30 p. m., May 26, by Board of Danville, Ind., for the construction of a sewer system estimated to cost $19,680. Cly R. Humston is Clerk of the Town Board.

✣Bids will be received until 10 a. m., May 22, by Board of Public Works, Richmond, Ind., for the construction of a sanitary sewer in the alley between South 11th and South 12th Sts., from South T. to South G. Sts.

✣Bids will be received until May 26 by Board of Public Works, Kokomo, Ind., for the construction of a local sewer in Lordeman St. to a connection with the Union St. sewer. Ben Havens is City Clerk.

✣Bids will be received until May 26 by Board of Public Works, Kokomo, Ind., for the building of a local sewer beginning in the Long branch at a point where the middle line of the first alley running east and west north of Broadway St. in Kokomo intersects it, running thence west in said alley to the middle of the first alley running north and south, thence north in said alley running north and south to the south gutter of North St. in Kokomo. Also a branch line beginning in the main line where said main line begins to run north and running thence west to a point 30 ft. east of Washington St. in Kokomo. Ben Havens is City Clerk.

⊙Bids were received at Knox, Ind., on May 8 for the construction of the East District sewer. The character of the excavation is sand, coarse variety. Ground water will average 6 ft. below the surface. In the table shown below (1) stands for bid of J. C. Poll, (2) T. J. Campbell, (3) Wm. J. Eiler & Co., (4) Tony Bros., (5) Lewis E. Barnes, (6) A. M. Lanyon, (7) Tom Joyce and (8) Vito Graziano, 515 W. Oak St., Chicago (awarded contract):

Item.	Size.	Amount.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Pipe	20-in.	750 ft.	$ 1.90	$ 1.72	$ 1.72	$ 1.60	$ 1.40	$ 1.50	$ 2.98	$ 2.00
"	20-in.	660 ft.	1.90	1.75	1.72	1.85	1.55	2.00	3.33	2.00
"	18-in.	660 ft.	1.70	1.62	2.32	1.70	1.50	1.75	1.44	1.75
"	15-in.	1,010 ft.	1.25	1.53	2.17	1.50	1.20	1.25	.97	1.50
"	12-in.	350 ft.	1.00	.85	.82	.75	.65	.70	.84	1.00
"	12-in.	1,700 ft.	1.00	1.00	1.27	.97	.75	.80	.925	1.00
"	12-in.	350 ft.	1.00	1.25	1.56	1.20	.80	1.00	1.00	1.00
"	8-in.	6,650 ft.	.85	.72	.69	.60	.65	.60	.44	.50
"	8-in.	8,970 ft.	.85	.78	.79	.65	.75	.70	.51	.50
"	8-in.	350 ft.	.85	.85	.89	.70	.90	.65	.625	.50
"	8-in.	200 ft.	.85	.70	.59	.50	.60	.40	.44	.35
"	6-in.	190 ft.	.65	.45	.46	.45	.40	.30	.37	.35
Railroad crossing—										
Pipe	16-in.	60 ft.	3.00	3.45	6.75	2.916	2.25	1.50	3.00	3.50
"	20-in.	30 ft.	4.00	5.00	7.90	3.33	2.70	2.00	4.00	4.00
"	8-in.	30 ft.	2.00	2.50	4.30	3.33	1.80	1.00	2.00	3.00
Outlet		10 cu. yds.	7.50	37.50	25.00	30.00	20.00	20.00	45.00	20.00
Manholes		57	25.00	38.00	35.00	35.00	30.00	31.00	25.00	25.00
Manholes and catch basins		2	25.00	90.00	70.00	35.00	35.00	40.00	42.60	75.00
Lampholes		9	5.00	6.00	7.50	12.00	5.00	7.00	15.00	6.00
Catch basins		4	20.00	60.00	40.00	45.50	27.80	40.00	40.00	35.00
Sewer inlets		4	15.00	16.00	17.50	5.00	5.00	10.00	20.00	5.00
Totals			$23,426	$23,313	$23,205	$20,691	$20,015	$19,986	$19,174*	$18,221

*Accepted.

The Board of Public Works of Logansport, Ind., has instructed City Engineer H. H. Thompson to prepare plans and specifications for the construction of the extension of the Westside sewer. The city's share of the improvement will cost $15,000.

Iowa.

✣Bids will be received until 10 a. m., May 23, by City Council, Cedar Rapids, Ia., for the construction of sanitary sewer and water connections. L. J. Storey is City Clerk.

✣Bids will be received until 1 p. m., June 6, by G. J. Gittinger, City Clerk, Chariton, Ia., for the construction of storm and sanitary sewers. The work will include the following approximate quantities: Sewer No. 1, 250 ft. of 12-in. and one manhole; Sewer No. 2, 935 ft. of 12-in. and two manholes; Sewer No. 3, 1,600 ft. of 15-in., 1,840 ft. of 12-in. and five manholes; Sewer No. 4, 860 ft. of 18-in., 445 ft. of 15-in., 3,500 ft. 12-in. and 8 manholes; Sewer No. 5, 310 ft. of 15-in., 410 ft. of 12-in., 800 ft. of 8-in.; Sewer No. 6, 660 ft. of 24-in., 530 ft. of 18-in., 865 ft. of 15-in., 3,230 ft. of 12-in. and 9 manholes. F. W. Trost is City Engineer.

The proposed sewer work for Odebolt, Ia. will cost about $17,000 instead of $4,000 as stated in our May 7 issue. The engineer's estimate on this work is: Septic tank and filter beds, $3,710; 3.1 miles of sewer, $13,400 Ernest E. Carlson, Battle Creek, Ia., is the Engineer.

Kentucky.

✣Bids will be received until May 27, according to reports, by the Board of Public Works, Louisville, Ky., for a block of new sewers, estimated to cost $85,000.

Massachusetts.

✣Bids will be received until 5 p. m., May 23, by Board of Sewer Commissioners, Milton, Mass., for the construction of 4,600 ft. of pipe sewers. A certified check for $500 must be filed with each bid. Plans and specifications may be seen at the office of the Engineer, Town Hall, Milton.

⊙R. H. Newell Co. & N. S. Brock of Uxbridge and Boston, Mass., respectively, have been awarded the contracts by the Sewage Disposal Commission, Fitchburg, Mass., D. A. Hartwell, Chief Engineer, for the construction of a sewage disposal plant, for $209,027. The work includes Imhoff tanks, sprinkling filters, settling tanks, roadway sludge bed, laboratory, etc. Bids were opened May 15.

Michigan.

✣Bids will be received at the office of D. E. Newcomb, City Clerk, Flint, Mich., until 2 p. m., of Tuesday, June 3, for the construction of about 33 miles of sewers ranging in size from 8-in. to 66-in., the total lengths of each size being approximately as follows: 8-in. sewer, 43,387 ft.; 10-in. sewer, 12,101 ft.; 12-in. sewer, 22,403 ft.; 15-in. sewer, 16,214 ft.; 18-in. sewer, 11,690 ft.; 20-in. sewer, 7,419 ft.; 22-in. sewer, 11,145 ft.; 24-in. sewer, 11,266 ft.; 27-in. sewer, 8,004 ft.; 30-in. sewer, 5,968 ft.; 33-in. sewer, 6,893 ft.; 36-in. sewer, 5,994 ft.; 39-in. sewer, 2,526 ft.; 42-in. sewer, 420 ft.; 45-in. sewer, 1,270 ft.; 48-in. sewer, 2,096 ft.; 51-in. sewer, 540 ft.; 54-in. sewer, 160 ft.; 60-in. sewer, 825 ft.; 66-in. sewer, 882 ft. Sewers 24-in. in size or smaller will be of vitrified clay sewer pipe. In the case of sewers larger than 24-in. bids are asked for on the basis of the city's standard plans for monolithic reinforced concrete sewers; but proposals will be received for brick, reinforced concrete pipe, reinforced concrete block or vitrified clay block sewers meeting the specifications of the City Engineer. Complete maps and profiles may be examined and specifications and plans of sewer sections and appurtenances may be obtained at the office of the City Engineer, H. E. Terry. Each bid must be accompanied by a certified check for 5 per cent of the amount of the bid. Official advertisement will be found elsewhere in this issue. W. C. Hoad Ann Arbor, Mich., is Consulting Engineer.

Mississippi.

✣Bids will be received until 2:30 p. m., June 1, by City Commissioners, Laurel, Miss., for the construction of 4½ miles of 8 to 15-in. pipe sewers, 61 manholes and 17 flush-tanks. Monthly payments in cash, 75 per cent on completed work. A certified check for $1,000 must be filed with each bid. D. A. Scarborough is City Clerk. Frank Reynolds, Iowa Engineering Co., Clinton, Ia., is Engineer.

Missouri.

⊙Ben Inman, of California, Mo., has been awarded the contract by that city, for the construction of about four miles of lateral sewers, at $16,495. Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., are Engineers. Bids were opened May 7.

⊙The Indiana Reduction Co. has been awarded the contract by the Board of Public Improvements of St. Louis, Mo., for the disposal of the city's garbage for the next six years. The city garbage amounts to about 50,000 tons a year. The company proposes the construction of a $200,000 reduction plant.

New York.

✣Commissioner of Public Works John Smith, Oswego, N. Y., will receive bids until June 4 (readvertisement) for the construction of the East 10th, East 11th and East Oneida Sts. sanitary sewers.

✣Bids will be received until 11 a. m., May 27, by Francis Ward, Commissioner of Public Works, Buffalo, N. Y., for the following improvements: Constructing a 12 and 10-in. tile sewer in Wende St., between 200 and 606 ft. north of Perry St.; constructing a 12 and 10-in. tile sewer in Leslie St., between Ferry St. and 606 ft. north.

⊙The Ingalls Stone Co., Oneonta, N. Y., has been awarded the contract by that city for the construction of the main line intercepting sewer, for $10,163. Bids were opened May 7.

⊙R. M. Barnett has been awarded two of the sewer contracts by the Department of Public Works of Oswego, N. Y.

⊙P. Goggin, of Fredonia, N. Y., has been awarded the contracts by the Common Council of Dunkirk, N. Y., for the building of a system of sewers in Howard and Lucas Aves., for about $10,000. J. M. Hackett is City Engineer.

⊙Kellam & Shaffer Co., of Schenectady, N. Y., has been awarded the contract by the Common Council of Newburgh, N. Y., for the laying of the Fullerton Ave. trunk sewer, for $15,466. Other bidders were: John Stino, Poughkeepsie, $16,527; Java & Kehoe, $17,085.

Ohio.

✣Bids will be received until noon, May 27, by village of Bexley, O. (readvertisement), for the sewage treatment plant. G. E. Fry is Village Clerk.

✣Bids will be received until noon, May 27, by Samuel A. Kinnear, Director of Public Service, Columbus, O., for the following improvements, in accordance with the plans, profiles, specifications and estimates of cost therefor, on file in said department, and shall be made on blanks to be procured from the Chief Engineer, to-wit: Sewer in Broad St., from Fifth St. to Grubb St. Sewer in Orchard Lane from the intercepting sewer to High St., Kenworth Ave. from the intercepting sewer to High St., the alley north of Brighton Ave., from the intercepting sewer to the alley east, thence north to North Broadway and east to High St.; the alley north of Como Ave., from the intercepting sewer to High St., the second alley west of High St., from the alley north of Como Ave. to the alley north of Clinton Pl., thence east to the alley west of High St.; the alleys north of Lakeview Ave. and Jason Ave. and the alley south of Jason Ave., from west terminus to alley west of High St.; the second alley west of High St., from the alley south of Jason Ave. to the alley north of Lakeview Ave., and the alley west of High St., from the alley south of Jason Ave. to Orchard Lane. Sewer in Howard St., from Reynolds Ave. to the alley north of First Ave., and in the alley north of First Ave., from Ninth St. to the alley east of Howard St. Sewer in the second alley north of Innis Ave. (alley south of Wood Ave.), from Fourth St. to the alley east. Sewer in Liberty St., from Front St. to west terminus, thence north via right of way to the Peters Run sewer. Sewer in State St., from Center St. to the alley west of Levee St., thence north to Capital St. and east to Levee St.

✣Bids will be received until May 26 by H. Hocker, Director of Public Service, Galion, O., for the construction of 24,868 lin. ft. of 8 to 120-in. pipe sewer, and 20,661 of subdrains. The work will include 85 manholes, 22,054 cu. yds. of excavation and 18,209 sq. yds. of street paving. A. O. Theobald is Engineer.

✣Bids will be received until noon, May 26, by Director of Public Service, Galion, O., for the following sewer work: The construction of the Union, Boston, Grand St. storm water sewers. Said improvement requiring approximately the following material: 856 ft. of 20-in. vit. sewer pipe; 1,308 ft. of 18-in. vit. sewer pipe; 461 ft. of 15-in. vit. sewer pipe; 191 ft. of 12-in. vit. sewer pipe; 300 ft. of 10-in. vit. sewer pipe; 3.47 tons of cast iron pipe and 10 manholes. The construction of the 10th District sanitary sewer, said improvement requiring approximately the following labor and materials: 17,080 ft. of 8 and 10-in. vit. sewer pipe; 2,632 ft. of 12-in. vit. sewer pipe; 1,040 ft. of 15-in. vit. sewer pipe; 20,661 ft. of subdrain pipe; 13.5 tons of cast iron pipe; 75 manholes; 22,054.2 yards of excavation. Plans and specifications, estimates and profiles are on file in the office of the Director of Public Service in said city.

✣Bids will be received until noon, May 22, by C. C. Lowe, Village Clerk, Bedford, O., for furnishing the necessary labor and materials for construction of a sewage disposal plant. Specifications may be procured at the office of said Clerk, or at the office of C. W. Courtney and Wilbur J. Watson, Engineers, 1150 Leader-News Bldg., Cleveland.

⊙The village of Bexley, O., has awarded the contract for the construction of sewers to Kohbarger & Hoyles, of Marion, O.

⊙Adam Schwab of New Philadelphia, O., has been awarded the contract by Service Director Charles H. Krantz, for the new storm sewer line to be installed in Tuscarawas Ave. and Washington St., in Canal Dover, O. The contract price is $6,600.

Pennsylvania.

⊙John Hanna & Sons have been awarded the contract by the City Council of Chester, Pa., for the construction of the Penn St. sewer from Second to Third St. E. A. Oliver secured the contract for the Thurlow St. sewer from Second to Third Sts.

Virginia.

✣Bids will be received until 3 p. m., June 17, by the Mayor and Councilmen of the Town of Pulaski, Va., for furnishing material and constructing a system of sewers for said town. The work to be let consists of furnishing material and laying, complete, about 10 miles of 6-in. to 18-in. vitrified sewer pipe and constructing, complete, the necessary manholes and flush tanks. M. S. Hudgins, City Engineer.

Wisconsin.

✣Bids will be received until 10 a. m., May 24, by Board of Public Works at the office of the City Clerk, Racine, Wis., for furnishing of all materials and performing all the labor for the following public work: Constructing a public sewer in Graham St., from Hansen Ave. to Carmel Ave., approximating the following quantities: 308 lin. ft. of 15-in. pipe; 305 lin. ft. of 12-in. pipe; 2 manholes; 2 catch basins.

✣Bids will be received until 4 p. m., June 2, by City Clerk, Kaukauna, Wis., for the construction of a sewer in Second St., in accordance with plans and specifications on file with the city clerk.

⊙Following sewer contracts have been awarded by the Board of Public Works, Racine, Wis.: Birdsall-Griffith Construction Co., Summit Ave. sewer, 10-in. pipe, $0.98, manholes $35 and catch basins $30; Patrick Gavahan, Gould St. sewer, 8-in. pipe $0.80, lampholes $5; Patrick Gavahan, Barker St. sewer, 8-in. pipe $0.80, lampholes $5; Patrick Gavahan, Main St. sewer, 10-in. pipe $1.30, 8-in. pipe $0.70, manholes $40, lampholes $5; Hans C. Hanson, Yout St. sewer, 8-in. pipe $0.79, lampholes $8; Andrew P. Thomsen, Rapids Road sewer.

All bids received on May 8 by the city of Appleton, Wis., E. L. Williams, Clerk, for the construction of a sewer in Franklin St., from Superior St., east about 288 ft., were rejected. Work will be done by day labor.

Canada.

⊙Blanchard & Shanahan, Sault St. Marie, Ont., have been awarded the contract by the town of Sudbury, Ont., George Elliott, Clerk, for the completion of Main Sewer, comprising about 7,000 lin. ft. of sewer, 20-in., 18-in., 15-in. and 12-in. with accessories. Bids were opened May 1.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

BUILDINGS

California.

Plans have been completed by Architect Walter S. Keller for the seven-story fireproof office building to be erected for the Rice-Landswick Co. at the corner of First and D Sts., San Diego, Cal. The construction will be of reinforced concrete. The cost will be $125,000.

Colorado.

✣Bids will be received until 3 p. m., June 24, by Oscar Wenderoth, Supervising Archtect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures, and approaches, of the United States postoffice at Grand Junction, Colo. The building is to be two stories high with a basement, and will have a ground area of approximately 5,600 sq. ft.; fireproof construction, except ceiling and roof; stone or marble and stucco facing; and slate and tin roof. Drawing and specifications may be obtained from the custodian of site at Grand Junction, Colo., or at the discretion of the Supervising Architect.

District of Columbia.

✣Bids will be received until 2 p. m., May 28, by Maj. W. J. Barden, U. S. Engineer, Washington Barracks, D. C., for furnishing cable hangers and screws.

✣Bids will be received until 2 p. m., May 24, by Maj. W. J. Barden, U. S. Engineer, Washington Barracks, D. C., for furnishing water, light, electric fixtures and accessories.

✣Bids will be received until 2 p. m., May 27, by Maj. W. J. Barden, U. S. Engineer, Washington Barracks, D. C., for furnishing cambric insulated cable.

Georgia.

The Empire Life Insurance Company will meet at Augusta, Ga., on May 22, at which time an architect will be selected to prepare plans for a 15-story office building to be erected on Broad St., Augusta. H. C. Lorick, Augusta, Ga., is a director.

Hawaii.

✣Bids will be received until 3 p. m., June 20, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete of latrine buildings, sewage purification tanks, and connected piping at quarantine station, Honolulu, Hawaii, in accordance with the specification and drawing. Drawing and specification may be obtained from the custodian of the station at Honolulu, Hawaii, or at the discretion of the Supervising Architect.

✣Bids will be received until July 5 by Maj. W. P. Wooten, U. S. Engineer, Honolulu, Hawaii, for furnishing and erecting or for furnishing only a 70-ft. steel searchlight tower of Scherzer type. Further information may be obtained of Lt. Col. T. H. Rees, Custom House, San Francisco, Cal.

Bids as follows were received May 10 by Bureau Yards and Docks, Navy Department, Washington, D. C., for naval hospital buildings at Naval Station, Pearl Harbor, H. T.: W. N. Concannon Co., Monadnock Bldg., San Francisco, Cal., $241,973; Spalding Construction Co., Chamber of Commerce Bldg., Portland, Ore., $237,939; Pearson Construction Co., 754 New York Blk., Seattle, Wash., $297,828; Lord, Young Engineering Co., Campbell Blk., Honolulu, H. T., $278,298.

Illinois.

✣Bids will be received until 3 p. m., June 19, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures, and approaches, of the United States postoffice at Duquoin, Ill. The building is to be two stories in height, with a partially excavated basement, and will have a ground area of approximately 4,500 sq. ft.; fireproof first floor; stone facing, and tin roof. Drawings and specifications may be obtained from the custodian of site at Duquoin, Ill., or at the discretion of the Supervising Architect.

Indiana.

✣Bids will be received until 8 p. m., May 27, by Common Council, Garrett, Ind., for the conctruction of a city building. The building is to be 125 ft. on the foundation with basement, built of cement, two stories above basement to be built of brick. Plans and specifications prepared by Ellwood & Ellwood, Architects, 211 South Main St., Elkhart, Ind. W. W. Mountz is City Clerk.

Minnesota.

✣Bids will be received until 3 p. m., June 23, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring, and interior lighting fixtures, of the United States post office at Moorhead, Minn. The building is to be two stories and basement, approximately 4,100 sq. ft. ground area, brick faced, with wood, terra cotta, stucco, and stone trimmings, tin roof, and nonfireproof construction, except the first floor. Copies of drawings and specifications may be obtained from the office of the custodian of the site at Moorhead, Minn., or at the discretion of the Supervising Architect.

Preliminary plans are being prepared for a 20-story office building to be erected at 4th and Jackson Sts., St. Paul, for James J. Hill. Granger & Frost, Chicago, Ill., are the Architects.

Missouri.

The erection of a public market in the vicinity of Grand Ave. and Olive St., St. Louis, to cost $400,000, is contemplated by B. M. Nevins, President of the Nevins Realty & Investment Co., St. Louis, Mo

New York.

✣Bids will be received until 2 p. m., May 27, by Board of Managers, P. L. Lang, President, Craig Colony, Sonyea, N. Y., for addition to storehouse for cold storage plant—construction (not including heating, plumbing lighting or refrigerating apparatus); also construction work for new barn at Craig Colony for Epileptics, Sonyea, N. Y. Drawings and specifications may be consulted and blank forms of proposal obtained at Craig Colony for Epileptics, Sonyea, N. Y., and at the office of the State Architect. Complete sets of plans and specifications will be furnished to prospective bidders upon reasonable notice to and in the discretion of the State Architect. Lewis F. Pilcher, Capitol, Albany, N. Y.

North Dakota.

✣Bids will be received until 3 p. m., June 9, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the installation complete of an electric passenger elevator in the U. S. post office and court house at Bismarck, N. Dak. Official advertisement will be found elsewhere in this issue.

Ohio.

✣Bids will be received until noon, June 10, by Clerk of the Board of Education, Rockwell and East 6th St., Cleveland, O., for furnishing all the materials and doing all the work necessary to complete the installation of ventilating apparatus in Bolton, Hough, North Doan, Union, Woodland, Woodland Hills, Huck and Central High Schools, in accordance with plans and specifications on file in the office of the Director of Schools, E. 6th street, and as determined by the Board of Education. Frank G. Hogen is director of the board.

✣Bids will be received until noon, June 9, by Trustees of the Public Library, City School District, Cleveland, O., for 2,000 or more yards of cork carpet, Wilde's best grade or equal thereto, to be laid in cement as may be directed by the library board, on the fifth and sixth floors of the Kinney and Levan building on Euclid Ave.

⊙Contracts for improvements at the Ohio State University, Columbus, O., bids for which were opened May 12, have been let as follows: Underground tunnel, M. P. Streett, Columbus, O., $6,888; two automatic underfeed stokers, American Engineering Co., Philadelphia, Pa., $4,385; heating, ventilating, plumbing, gas fitting and sewers for Botany & Zoology Bldg., Wm. H. Conklin Co., Columbus, O., $17,241. Bids for the greenhouse and insectary were rejected.

Oklahoma.

✣Bids will be received until noon, May 27, by John Foster, Secretary of the Board, First National bank, Cushing, Okla., for the construction of a 12-room three-story school building in accordance with plans and specifications prepared by F. E. Fagerquist, Architect, Cushing, Okla.

Pennsylvania.

⊙Isaac A. Hall, Paterson, N. J., has been awarded a contract to erect an addition, 300 by 56 ft., and 5 stories high, to the plant of the Allentown Reed, Harness & Mill Supply Co.

Pittsburgh Lodge, No. 46, Loyal Order of Moose, will erect a home at Penn Ave. and Barkers Way, Pittsburgh, Pa., in the heart of the down town section of the city, to cost about $400,000. The report of the building committee was approved at a meeting held on May 15. The site has a frontage of 80 ft. in Penn Ave., and is 120 ft. deep. The building will be a 5-story fireproof structure, containing a swimming pool, bowling alleys, pool and billiard hall, lodge rooms, auditorium, ball room and roof garden. The $400,000 is for the building alone, the price for the site not having been made public.

Architect Henry D. Whitfield, 160 Fifth Ave., New York, will draw plans for the addition to be constructed to the Carnegie Library, North Side, Pittsburgh, Pa., which will cost $150,000.

Texas.

Plans are under consideration for a 12-story office building at Tremont and Church Sts., Galveston, Tex., to cost $750,000. John Christensen & Co., Galveston, are interested.

Washington.

✣Bids will be received until 11 a. m., June 3, by Board of King County Commissioners, Seattle, Wash., for the necessary material and labor (Chinese and Jap. labor prohibited) for the construction of the court house. The work consists of the construction of a reinforced concrete-steel, fireproof building, approximately 240 ft. square, on Block 33, C. D. Boren's Addition to the city of Seattle, Wash., major portion three stories high, balance five stories.

Plans are being prepared for a 16-story hotel building to be erected at 12th Ave. and Pacific St., Tacoma, Wash., for the National Realty Co., at a cost of about $600,000. Heath & Grove, National Realty Bldg., Tacoma, are the Architects.

Plans have been started by Saunders & Lawton, Architects, Alaska Bldg., Seattle, Wash., for the construction of shops, etc., at the Northern Hospital for the Insane at Sedro Woolley, to cost about $250,000; and for work shops at the State Reformatory, Monroe, to cost $150,000. The buildings will be of reinforced concrete and brick construction and will be erected for the State Board of Control.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

RIVERS AND HARBORS

District of Columbia.

✣Bids will be received until 11 a. m., June 14, by Bureau of Yards and Docks, Navy Department, Washington, D. C., for a section of the quay wall, navy yard, Washington, D. C. The cost is estimated at $11,000.

✣Bids will be received until 10:30 a. m., June 5, by Maj. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under Circular 776. Two retort Crematory, switches, frogs, galvanized steel, steel pipe, pipe fittings, lead pipe, sheet lead, pig lead, chisels, hammers, cable clips, screws, twist bits, twist drills, stocks and dies, reamers, wrenches, hack-saw blades, files, vises, bronze-wire cloth, tool handles, buckets, garbage cans, brooms, water coolers, grease cups, bibbs, valves, vitrified sewer pipe, metallic tapes, sand paper, emery cloth, scrubbing brushes, paint brushes, hose, cotton canvas, lump chalk, fire clay, metal polish calcium carbide, soap, gasoline, coal tar, white zinc, shellac, varnish, paints, paper and tag board.

Iowa.

✣Bids will be received until May 26 by City Council of Waverly, Ia., for the construction of a bulkhead and flood gates at the west end of the present dam. R. B. Slippy, Waterloo, Ia., is Engineer. F. A. Lee is City Clerk.

Louisiana.

✣Bids will be received until 7:30 p. m., June 20, by W. G. Davis, Mayor and Towns Council, Mandeville, La., for the furnishing of all materials and constructing a timber sea wall and for the filling with earth the area between the said sea wall and the edge of the beach. Plans and specifications will be furnished by the Mayor at Mandeville, La., on receipt of a deposit of $10, said deposit to be refunded upon the return of said plans and specifications in good order.

Maine.

✣Bids will be received until noon, May 29, by Lt. Col. W. E. Craighill, U. S. Engineer, 537 Congress St., Portland, Me., as noted in our last issue, for dredging in Portland Harbor. The areas to be dredged are located in the inner harbor, between Portland and South Portland; in the anchorage ground northwest of Diamond Island Ledge; and in the entrance channel to Back Cove. The portion of the inner harbor in which dredging is to be done extends from Brown's wharf northeastwardly toward Diamond Island Ledge for a distance of about 6,000 ft.; and from the established harbor line on the Portland side southeastwardly for an average width of about 1,400 ft. The estimated quantity of material to be removed from this area is 216,000 cu. yds., scow measurement. The portion of the anchorage ground in which dredging is to be done extends from the northwesterly end, toward Diamond Island Ledge for a distance of about 2,500 ft. and has an average width of about 1,040 ft. The estimated quantity of material to be removed from this area is 1,142,600 cu. yds., scow measurement. The entrance channel to Back Cove extends from the anchorage ground northwestwardly and westwardly to the Grand Trunk Ry. bridge, a distance of about 4,300 ft. The estimated quantity of material to be removed from this channel is 55,200 cu. yds., scow measurement. The material to be removed from the inner harbor and entrance channel to Back Cove is believed to be soft mud or clay, except in the old 29-ft. channel, where there is a comparatively small area of hard clay. The material to be removed from the anchorage ground is believed to be soft mud overlying blue clay with a sub-stratum of yellow clay in some parts of the area.

✣Bids will be received until noon, June 7, by Lt.-Col. W. E. Craighill, U. S. Engineer, 537 Congress St., Portland, Me., for dredging in Kennebic River, Me. The areas to be dredged are in the channel of Kennebec River which lies west of Swan Island. The shoals to be excavated are not continuous, but lie within a channel length of about 5 miles, the upper end being somewhat less than a mile above the Richmond Town landing. The material is believed to be mostly sand, ground soft, mixed, in some places, with a little clay or gravel. The approximate amount is 147,000 cu. yds.

✣Bids will be received until noon, June 7, by Lt. Col. W. E. Craighill, U. S. Engineer, 537 Congress St., Portland, Me., for dredging in Medomak River, Maine. The area to be dredged is located in the tidal portion of Medomak River, Maine, and extends down stream from the village of Waldoboro for a distance of about 1.23 miles. The material to be removed is believed to be mostly mud, and covered in some places with a crust of shells from 6 ins. to 2 ft. in thickness, and in some places with a crust of gravel 6 to 8 ins. thick. There is also believed to be a comparatively small quantity of gravel and small stones, and possibly some boulders. The estimated quantity is 58,000 cu. yds.

✣Bids will be received until noon, June 7, by Lt. Col. W. E. Craighill, U. S. Engineer, 537 Congress St., Portland, Me., for dredging in Carver's Harbor, Me. The material to be removed is believed to be mostly soft mud, mixed in some places with a little sand or gravel. There is also believed to be a comparatively small quantity of gravel and small stones, and possibly some boulders. The area to be dredged is partly underlaid with ledge which, in some places, may lie above the required grade. The estimated quantity is 80,455 cu. yds. scow measurement.

Massachusetts.

✣Bids will be received until 11 a. m., May 28, by the Harbor and Land Commissioners, William F. Williams, Chief Engineer, State House, Boston, Mass., for dredging a channel in Saugus River, an anchorage basin in Lynn Harbor, widening a channel and dredging an anchorage basin in Manchester Harbor, and dredging a channel in South River, Salem. The work to be done is the dredging of about 69,000 cu. yds. of material in Saugus River, 74,000 cu. yds. in Lynn Harbor, 66,000 cu. yds. in Manchester Harbor, and 12,000 cu. yds. in Southt River, Salem. The dredging in Saugus River, Lynn Harbor and Manchester Harbor is to be a depth of 6 ft. at mean low water and the dredging in South River, Salem, is to be a depth of 10 ft. at mean low water.

C. M. Leach, Box 2285, Boston, Mass., at $3,333 was low bidder for making repairs to quay wall between piers 7 and 8, Navy Yard, Boston, Mass. Bids were opened May 10 by the Bureau of Yards and Docks, Washington, D. C.

Michigan.

✣Bids will be received until noon, June 16, by Lieut. Col. Mason M. Patrick, U. S. Engineer, Federal Bldg., Detroit, Mich., for excavating at Fighting Island.

Minnesota.

✣Bids will be received until noon, June 13, by Capt. E. D. Peek, U. S. Engineer, Duluth, Minn., for dredging Duluth-Superior Harbor.

New Jersey.

✣Bids will be opened June 9 by Lt. Col. Joseph E. Kuhn, U. S. Engineer, 815 Witherspoon Bldg., Philadelphia, Pa., for dredging in Delaware River, from Lalor St. to the upper railroad bridge, at Trenton, N. J. The work will consist in the construction of a channel 12 ft. deep at mean low water, with a bottom width of 200 ft., and with a turning basin at its upper end, of the same depth, 300 ft. wide and 100 ft. long. The work will require the removal of approximately 450,000 cu. yds. of material, place measurement, figured to the plane 12 ft. below mean low water. The depth of cutting will vary from 2 to 14 ft., and will average about 11 ft. over the entire area. The character of material to be removed varies greatly in different sections of the proposed channel, and is believed to run from sand to very coarse gravel, cobbles, clay and some boulders.

Ohio.

✣Bids will be received until 10 a. m., June 12, by Maj. C. S. Bronwell, U. S. Engineer, Cleveland, O., for dredging Toledo Harbor, Ohio.

✣Bids will be received until noon, May 28, by R. M. Pillmore, Director of Public Service, Akron, O., for the construction of the Cuyahoga River Dikes. The principal items included in this contract are as follows: Earth excavation (surface), 142,500 cu. yds; earth excavation, below 3 ft., 7,000 cu. yds.; rolled embankment, 118,500 cu. yds.; wooden sheet piling, 164,000 ft. B. M.; rip rap, 6,700 cu. yds.; selected gravel, 3,500 cu. yds. Minor items include seeding, laying of pipe drains and 80 cu. yds. concrete. A bond or certified check for $10,000 must accompany each bid. A bond for $50,000 will be required of the successful bidder. Plans and specifications may be seen at the office of the Director or at the office of F. A. Barbour, 1120 Tremont Bldg., Boston, Mass. Blank forms for bidding can be secured at the same place and all bids must be made on such blank forms.

Pennsylvania.

✣Bids will be received until 11 a. m., June 14, by Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., for furnishing and installing three electrically-driven capstans at the navy yard, Philadelphia, Pa. The cost is estimated at $9,000.

South Carolina.

✣Bids will be received until 11 a. m., June 28, by Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., for locomotive and crane shed at the Charleston, S. C. Navy Yard.

Texas.

✣Bids will be received until noon, June 6, by Maj. T. H. Jackson, U. S. Engineer, Dallas, Texas, for furnishing about 3,000 bbls. of American Portland Cement, delivered at Crockett, Texas.

Virginia.

✣Bids will be received until 11 a. m., June 14, by Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., for furnishing and installing three electric hoists at the U. S. Naval Radio Station, Radio, Va.

Washington.

✣Bids will be received until 11 a. m., June 21, by Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., for electric traveling cranes for the general foundry, navy yard, Puget Sound, Wash. The amount available for the cranes is $19,000.

✣Bids will be received until 2 p. m., June 3, by Board of King County Commissioners, Seattle, Wash., for furnishing all material and labor (Jap or Chinese labor not allowed) for the construction of Dumas Bay Dock. Plans and specifications are on file at the office of the County Engineer, Seattle, Wash.

✣In the call for Bids Section of this issue will be found an advertisement from the Port of Seattle Commission, 843 Central Bldg., Seattle, asking for proposals for furnishing 650,000 lin. ft. of creosoted piling. The Port Commission is of the opinion that the magnitude of this order is sufficient to justify the erection of an additional creosoting plant in this vicinity, and it will entertain under this advertisement, and give most careful consideration to a proposal for the erection of such a plant—upon its own properties, if desirable—and the furnishing therewith of the above bill of material.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ENGINEERING AND CONTRACTING

Devoted to the Economics of Civil Engineering Design
and to Methods and Cost of Construction

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Bonus Payments for Business Solicitors Based on a System of "Points."

It cannot be too frequently stated that the most important law of management is to make all payments for service in proportion to performance.

Recently the *Electrical World* gave an example of the application of this law in rewarding the business solicitors of an electric company at Lawrence, Kansas. The method consists in paying each salesman a minimum of $12.50 per half-month, plus 5 cts. for each "point" in excess of 250 "points." A schedule of "points" has been established, based probably on the time and difficulty of securing different orders, as well as upon the size of the orders. The following is typical of the scheduled "points":

	Points.
Each meter gained..........................	5
Wiring residence on lines, min. 0.2 K. W. load	12
Wiring residence on line, min. 0.5 K. W. load	25
Electric iron sold..........................	10
Chafing dish sold..........................	15
Motors, per H.P..........................	15
Collecting bad accounts, per dollar........	2
First 20 calls on one street..............	5

It is stated that the salaries earned under this bonus system have ranged from $80 to $160 per month.

It will be seen that this scheme of rating the value of work done in terms of "points" can be applied in a great many ways other than in business soliciting. Thus, the work done by section men on a railway could be similarly rated. In fact, whenever the class of work done by a man varies from hour to hour or from day to day, it would be well to study the units of work with a view to assigning bonus "points" to each unit.

The Automobile as a Stimulator of Good Road Sentiment.

Automobile associations and manufacturers are coming in for considerable criticism because of attempts to influence legislation in favor of road improvement. Those who advocate good roads merely as a means of economic hauling of farm products are quite certain that little money should be spent to provide luxurious highways for owners of luxurious conveyances. Seemingly these critics have forgotten that nearly every present-day necessity was itself a luxury at one stage of its evolution. The very clothes we wear are said to be the evolved result of prehistoric ornamentation.

Purely as a luxury the bicycle came into general use, although it now survives only as a thing of utility. In similar manner the automobile was first marketed solely to gratify a desire for exhilerating locomotion. Yet it has quickly become an economic necessity for many purposes and is destined to effect as many revolutionary industrial changes as were caused by the steam locomotive.

We may accept this as an axiom: Any luxury that involves the use of machinery may well be fostered, because of its assured evolution into an economic necessity.

The smooth roads between cities, and even the fine driveways in parks and to remote pleasure spots, are perhaps even more to be desired at present than roads built solely for utilitarian purposes. They will serve to excite the envy of the farmer who sees the procession of cars gliding by. He will himself soon become the owner of a glider, then of a motor truck, and finally will be an ardent advocate of better roads.

A well known writer on applied psychology has said that men are not ordinarily influenced by argument, but that the great persuasive agent is suggestion. Suggest to a man that he can be one of the select few who enjoy a certain thing and he is likely to respond by attempting to secure that thing. Attempt to convince him that he should have the thing, and he is apt to resist the argument. Because of this fact, reasoning as to the desirability of having better roads has influenced farmers much less than has the subtle suggestion of pleasure to be obtained from an automobile.

The President of Cuba a Civil Engineer.

The newly inaugurated President of Cuba, General Mario G. Menocal, is a graduate in civil engineering from Cornell University. Upon leaving Ithaca he became a member of the engineering staff that surveyed the Nicaragua Canal route. Later he joined the revolutionary forces in Cuba and there rose to the rank of general. At the time of the Spanish evacuation, he was appointed chief of police of Havana. During recent years he has been the manager of a very large sugar plantation in Cuba, where he has displayed excellent business judgment and executive ability of a high order.

The new Secretary of Public Works, Jose Ramon Villalon, is also a civil engineer, a graduate of Lehigh University, in the class of 1889. He is a professor of mathematics in the University of Havana and a member of the American Society of Civil Engineers.

Motor Street Sprinklers in Manila.—The city of Manila is to have either electric or gasoline motor-driven street sprinklers, or perhaps both. The gasoline sprinkler proposed is a 6-ton Berliet truck, while the electric sprinkler is a 4-ton truck of American manufacture. Each will be given a 15-day test.

ROADS AND STREETS

Bituminous Macadam Construction by the Illinois Highway Commission.

In 1908 the Illinois Highway Commission began the construction of experimental roads upon which bituminous compounds of various kinds were used. This work was continued in 1909, the roads of the type built in these two years being for the most part tar treated macadam. The experiments with bituminous compounds were continued during 1910, 1911 and 1912, asphaltic compounds being used very largely in the latter work. The conclusions of the commission drawn from its experience in bituminous macadam construction are given elsewhere in this issue. The following description of the apparatus used and the methods employed in constructing this type of surfacing is taken from the last annual report of the commission.

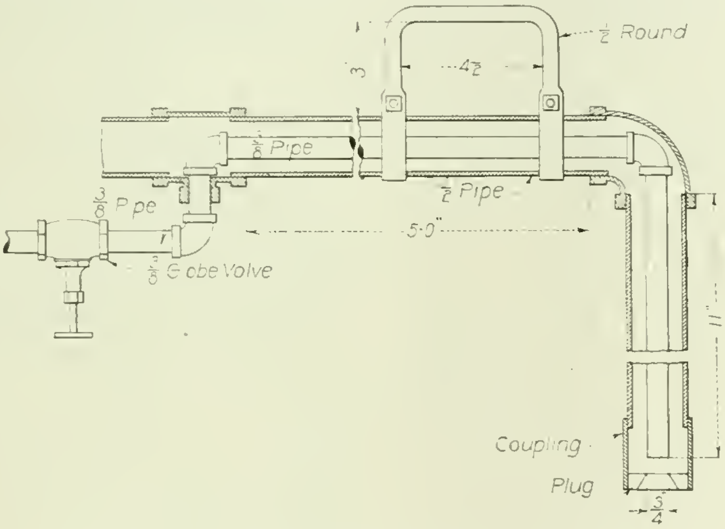


Fig. 2—Details of Nozzle for Applying Bituminous Compound.

APPARATUS.

An attempt was made in 1910 to apply heavy asphaltic compounds with the apparatus and in the manner followed in applying heavy tars. The heavy asphaltic binders were purchased in tank car lots, heated by means of steam coils in the cars, delivered on the road in tank wagons, and distributed by hand from spreading cans. This method was entirely unsatisfactory for a number of reasons. It was difficult to get the compounds hot enough in the cars to transfer to tank wagons, and the expense of heating was large on account of the length of time steam was required to be on the cars before the compounds would be hot enough to flow readily. A temperature of 225 to 250° F. was the most that could be reached and this was entirely too low for spreading compounds of the consistency used. When spread on the road they were not sufficiently fluid to flow into the interstices between the stone, and where the spreaders would overlap in distributing the binder, a hump was formed. These places "bleed" excessively in hot weather and it was necessary to cover repeatedly with stone chips. This resulted in a very uneven surface and one very difficult to smooth afterwards. Later the method was modified by introducing a superheater in the steam line leading to the coils in the car and by this means the binders were heated to a temperature from 300 to 325° F. in the tank car. The material was then forced into a heater wagon and the temperature raised to 400° F. which was sufficient for application.

When material is bought in tank car lots there are certain practical considerations which govern the method of carrying on the work. A tank car can not be retained on a siding for any considerable length of time. There must, therefore, be enough macadam ready for the binder to make it possible to carry on the application continuously until the tank car is empty, and at a rate which will empty a car of 8,000 or 10,000 gal. in three or four days. On resurfacing work this would be practical, but on the construction of new roads it is undesirable to have so large an amount of the road surface ready and waiting for the binder. On country road work, there are times when the traffic can not be kept off such a road, and a large amount of the work which has been done in shaping and rolling the surface of the macadam has to be done over. Inclement weather may interfere materially with the application of the binder when it is received, making it necessary to hold tank cars longer than it is desirable, or heavy rains may wet the foundation under the unfinished road so thoroughly as to delay the rolling very seriously.

It is desirable on new construction work to have as little unfinished road as possible open at a time. This means that every few days the road which is ready will be covered with binder and that a supply of the material must be on hand for that purpose. For these reasons the method finally adopted by the commission is to purchase binders in tin drums or in barrels, and to distribute the same alongside the road ready for use and to apply it as fast as the macadam can be prepared.

The methods used for applying the bituminous compound must be such as to permit the use of varying quantities of the compound to the surface. These variations may be but slight, but will be very important. The method of application should also permit variation in the amount of binder used as the necessities of the construction require.

The apparatus which is in use by the State Highway Commission was designed to meet such requirements. The asphalt is put on the road in a fine spray from a nozzle which can be carried by one man, and which will permit the operator to put either large or small quantities on any particular section of the road as desired. The nozzle is L-shaped, made from pipe. Fig. 1 shows very clearly its construction. The binder is forced out of the tank wagon by air pressure through a 1¼-in. flexible metal hose to which the nozzle is connected. Steam is conducted from the steam roller through a steam hose and pipe to the nozzle. The arrangement of the apparatus is such that as the binder is forced through the orifice in the nozzle, a jet of steam blows into the binder, breaking it into a fine spray as it leaves the nozzle.

The tank itself is a steel shell designed to withstand an internal pressure of 100 lbs. per square inch, and is equipped with a furnace which will burn either wood, coal or coke for heating the material in the tank. The tank has a trap door of sufficient size to permit the introduction of large pieces of solid bitumen, but so arranged that the cover can be closed air tight. A thermometer is provided at the rear. Near the front of the tank is a small dome which has an air connection and a pressure gauge. The air pipe is attached by means of a flexible hose to a Westinghouse air compressor on the rear of the roller. Steam for operating the spray is piped from the steam roller through connections permanently attached to the tank wagon to the spraying apparatus and the piping is so arranged as to permit the use of the steam for warming or cleaning the discharge hose and nozzle preparatory to starting the spray.

On much work done by the commission, solid bitumens are being used which require considerable time to heat, and in order to increase the capacity of the outfit, there is provided with each pressure tank an auxiliary kettle having a capacity of about 500 gal. The auxiliary kettle is filled and heated while the pressure tank is being emptied on the road. The pressure tank is then drawn alongside the auxiliary kettle and partially exhausted of air by means of the air pump. Thus, the connections being reversed so as to pump air from the tank, the contents of the kettle are transferred to the pressure wagon.

Each outfit on this work consists of a steam roller and a sprinkling wagon, an asphalt heater wagon, with complete spray apparatus, including a Westinghouse air pump which is connected to the rear of the steam roller, an auxiliary heating kettle, and an asphalt cutter, together with such small tools as are necessary.

METHODS OF CONSTRUCTION.

In addition to the modifications made in the method of applying the bituminous compounds, it has been necessary to modify previous methods of construction by discontinuing the use of limestone chips in the bituminous surface on account of the dust. Two sizes of gravel are used instead, one ranging in size from ⅜ in. to ⅛ in., the other from ¾ in. to ⅜ in. Besides eliminating the trouble with dust, the gravel adds greatly to the wear resisting qualities of the bituminous surface.

As with any ordinary macadam construction, it is of prime importance that the road bed be properly prepared both as to drainage and compactness, yet, fundamental as are those requirements and as supposedly well understood, no small number of the failures seen today can be attributed to lack of attention to these important features of the construction. If the road bed has been properly drained and compacted, there will not be required a greater thickness of completed pavement than 7 to 8 in. The material should be put on in two layers, the first layer forming the base on which the wearing layer is to be placed.

The method of placing the base usually does not vary, whatever may be the type of construction used for the top layer. It is essential that this base layer be compact and true to shape, and this can not be accomplished unless the stone is well spread, thoroughly harrowed and rolled, and then well bonded with stone dust or gravel in the same manner and with as much thoroughness as though the road were to be left with an ordinary waterbound surface.

The size of the pieces of stone in the different layers is a matter for some consideration. It has been the practice of the Illinois Highway Commission to use stone varying from 1 in. to 2½ ins. in size. As practically all of the stone available for road work in Illinois is limestone, there is required a somewhat larger sized material for surface work than is demanded with a harder variety of stone. Also, it has been found convenient to use but one size of stone in both layers of the road, so that the screens at the State crushers are provided with 1-in. holes and 2½-in. holes, and no intermediate size. A dust screen with

⅜-in. holes is used to prepare stone chips from the 1-in. material.

The depth to which the stone is to be spread for the base depends upon the thickness the base is to be after it has been rolled. If the total thickness of the pavement is to be 8 ins., the wearing surface is not usually made less than 2½ ins. in thickness, leaving 5½ ins. for the thickness of the lower course. If the material for the top course is composed of 2½-in. sized pieces, it is recommended that this layer be made 3 ins. thick, leaving 5 ins. for the thickness of the base. A layer of stone about 6 ins. thick, measured loose, will roll to 5 ins., possibly a little less, depending somewhat upon the nature of the material.

After the stone has been spread to the required thickness, which should be done with great care, so that there will not be more in one spot than in another, it should also be thoroughly harrowed with a coarse tooth harrow. The effect of this is to shake the various sized pieces of stone into place, and, as is well known, a box of loose stone can be compacted no better than by shaking them, so, too, we find that the loose stone in the road is compacted by shaking or harrowing which allows the smaller pieces to take their natural position at the bottom of the layer and the larger near the top. It will be found, moreover, that harrowing the material in this way will permit the roller to compact the material without the creeping that is often observed, and with one-half as much rolling.

The lower course should not be covered with screenings until it has been thoroughly compacted and each piece of rock keyed tightly in place so that when a wagon load of screenings is driven upon it the wheels will disturb the rolled stone scarcely any, if at all, and leave no decided rut or track. The screenings should be spread evenly over the whole surface and slightly watered. If the foundation is clay and wet weather has prevailed, the greatest care must be taken in watering the screenings of the first course before the road is tightened, otherwise the surplus water will soften the foundation, which must be dry before further progress can be made. After the screenings have been slightly washed or worked into the stone, more should be spread and again watered and then rolled to tighten the surface, more water and screenings being added until the surface of the base, or lower layer, is water tight. Screenings should not be applied so as to separate the pieces of rock which have already been keyed, but merely to fill the voids in the compacted stone with as little disturbance as possible.

The amount of crown that the finished road is to have will decide the amount of crown that the earth road bed and the base should have. In general, ½-in. per foot is not enough for the average country road with a bituminous macadam top, nor is it practical to exceed ¾-in. per foot. On roads to 16 ft. in width, not less than ¾-in. per foot is advisable. On roads 20 ft. in width or wider, indicating that there is a large amount of traffic spread more or less evenly over the whole road, the crown can be somewhat less than on the narrower roads, but it should never be less than ½ in. On the wider roads, a good practice is to increase the crown somewhat towards the gutter, perhaps starting on ¾ in. and gradually flattening towards the center, which would be effected by a curved cross-section.

On narrow roads, 12 to 15 ft. in width, it is necessary to give special attention to consolidating at least 3 or 4 ft. of the earth shoulder on either side of the road to hold the stone in place. As can readily be appreciated, when the roller is near the center of the road, there is a tendency to push the stone sidewise, and if there is nothing to resist this movement the stone becomes more and more open as the roller proceeds and the pieces of rock do not tighten. On wider roads, there is not so much difficulty from this cause, as a small amount of rolling towards the edge of the stone at first will place it sufficiently solid to resist any further movement of the stone at the center, for which reason it is very much easier to get a well-shaped, well-compacted road that is 18 ft. or wider, than one but 12 ft. wide.

The next step, after the base course has been prepared, as has already been described, is to spread the stone for the wearing layer. The stone for this layer, if limestone, should be composed of pieces 2½ ins. in size and graded from this downward. If a 3-in. layer is to be made when consolidated, which is as thick as this layer need be, the stone should be spread to a thickness of 3½ ins. and thoroughly raked or harrowed so as to bring the larger pieces to the surface in order that the surface may be composed in the first instance of as nearly uniform sized material and to give as great compactness as possible after it is rolled. As soon as spread uniformly and harrowed, the surface is to be rolled until it is thoroughly tightened. It may be found that there will be places where the stones do not lock together firmly; on such places a small amount of stone should be spread, just sufficient to fill the interstices, and then rolled. The effect of this rolling is to force the pieces of stone into the interstices, thus keying the whole surface until tight. It is important that great care be taken in rolling this upper layer that it be thoroughly tightened. When this has been accomplished, there will still remain interstices of appreciable size which should be filled with stone chips. These chips should be preferably of some harder material than limestone, and it is often possible to secure screened gravel that will prove excellent for this purpose. The size of the chips should vary from ¾ in. to ⅜ in. and they should be spread over the surface of the upper course just sufficient to fill the interstices.

A good method to insure this being done is first to shovel the chips on by hand, throwing each shovelful so as to cover as much area as possible; then follow with hand brooms, sweeping ahead the surplus pieces and allowing all the interstices to become thoroughly filled. When this is done, the road is ready for the bituminous binder, as no rolling should be attempted after the chips have been spread and before the binder is applied. If the chips are rolled before the binder is applied, the effect would be merely to allow them to set in between the stones which have already been and tend to loosen the surface rather than tighten it, so it is important that after the surface has been thoroughly keyed and the chips spread, no rolling be done until after the bituminous binder has been applied.

The amount of the binder to be applied should be as little as is necessary to secure a thorough coating for all the exposed surfaces of the stone. This usually requires from ¾ gal. to 1 gal. per square yard. When this treatment has been applied, the surface should again be treated with the stone chips or screened gravel so as to make practically one layer of the chips evenly distributed over the entire surface of the road. This gravel had better be applied as soon as possible after the binder has been spread, if practicable following immediately behind the spreader. It may be spread somewhat in excess and swept ahead with a broom. It is important that the gravel be clean and have as little dust adhering to it as possible.

After the gravel has been spread the second time more binder is applied, which should be sufficient thoroughly to cover all of the gravel This usually requires ½ to ¾ gal. per square yard. Coarse sand, if available, should then be spread upon the road, or finely screened gravel may be used. After the surface has been covered with the fine gravel grading from ⅜ in. to ⅛ in., a seal coat of binder, using ½ gal. per square yard, is applied. The surface is then covered with the fine gravel and rolled. The roller should be provided with pipes with small orifices an inch or two apart so as to keep the wheels of the roller wet while rolling. If this is done, there will be no difficulty whatever with the binder sticking to the roller wheels. The rolling should continue until the surface is seen to be well set and compacted. It will then perhaps be found that there are some spots needing further treatment to bring them to a uniform appearance with the remainder of the road, in which case, if there be any dust, it should be swept away, fine gravel and binder applied and the whole rolled to give a uniform surface. It is probable that quite as good or better results can be obtained, after the road has been sanded and rolled, to throw it open and let the traffic develop any places in the road that need further attention.

This form of construction, it will be seen, gives a road which has the strength and rigidity of the ordinary macadam, with a water-tight covering of bituminous compound holding the surface of the road intact against the action of the motor traffic or dislodgment by the mud that adheres to the wagon wheels. So long as the waterproof covering can be maintained the road should be in perfect condition. The gravel in the surface furnishes the resistance to abrasion. This is greatly helped by the binder, if of proper quality, which will tend to keep the particles covered or imbedded as fast as they may become loosened or broken by the traffic. When in the course of time the surface has become sufficiently worn to expose the stone making up the wearing course, it can be renewed by thoroughly cleaning the road, putting on a light application of the binder and renewing the fine gravel.

Highway Construction With Paint Binder and Its Sheet Asphalt Surface.

A type of construction not generally used in the building of interurban roads is being employed on Route 2 of the state highway system of California on the section lying between South San Francisco and Burlingame. The most unusual features of the construction are the thin asphalted binder coat and the 1-in. sheet asphalt surface. The following description of the work on this section is abstracted from an article by Mr. A. E. Loder, Division Engineer, in the California Highway Bulletin, the official publication of the State Highway Commission:

The roadway is graded to a width of 40 ft., with a maximum gradient of 4 per cent, conforming with the rolling contour of the country. Long, easy, vertical curves connect all changes of grade, producing a pleasing profile. Flat curves are used at every deflection in the line.

The pavement is 24 ft. in width and has a crown of 4 ins. Earth shoulders containing gravel and old macadam extend to a width of 8 ft. along each side of the pavement with a cross slope of 1¼ ins. per foot. The pavement rests upon a thoroughly compacted subgrade composed of old macadam and a sand-clay mixture resembling hardpan, which after rolling is in such condition that it is not damaged when the gravel and sand are hauled and dumped directly upon it without the use of planking, and it remains so compact that no dirt is picked up with the sand when loading it into the mixer.

Timber headers 2 ins. by 6 ins., nailed to stakes, line the pavement trench and are laid to a line flush with the finished surface. These protect the edges of the pavement while the shoulders are being settled by traffic, and provide a means by which the pavement may be readily brought to a true and uniform surface.

The pavement consists of a 5-in. concrete base composed of a 1:3:6 mixture, to which is bounded a standard sheet asphalt surface 1 in. in thickness.

The concrete is prepared in a portable mixer to a rather wet consistency and is delivered directly to its place in the pavement by means of a swinging spout. The surface is given a rough finish, suitable for binding bituminous material, by sweeping across the line of pavement with a stiff house broom or warehouse broom before the concrete reaches its final set. The new concrete is watered daily, except in rainy or damp, cloudy weather, until about five days old.

The asphalt wearing surface being laid on this job is shown on the daily test sheets to be as near the standard grading and composition as is possible to obtain. Nothing unusual is noted in connection with its use, except that a greater density is obtained after rolling the one-inch sheet than is possible with a thicker city surface, and consequently better wearing qualities and more stability should be expected.

When the concrete is dry and at least one week old, it is thoroughly swept, removing the dust of traffic passing at the side of road. The binder coat is then applied. This coat consists of 1 part by volume of melted asphaltic cement, of the consistency used in the pavement, to 2 parts by volume of engine distillate. The asphaltic cement is heated in a small portable kettle to a temperature between 200° and 325°. A measured quantity is removed to the spreading pail a safe distance from the fire and allowed to cool to about 250°. The distillate is then added and stirred for about one minute, when it is found to be thoroughly uniform and the temperature is reduced by at least 100°. The distillate can be added when the asphalt is at a temperature of 325°, but at this temperature it is accompanied by considerable boiling and is somewhat dangerous.

The binder liquor, while hot, is poured over the concrete from buckets, and uniformly swept over the surface with stiff house brooms until every particle of surface is coated with a thin film and all excess is swept from holes or depressions in the concrete. The paint binder penetrates deeper into the concrete when permitted to flow in a thin wave ahead of the first sweeping. A second sweeping after a few minutes removes excess from depressions and spreads it uniformly over the concrete. The thinnest possible application of paint should be used so that after evaporation, which is completed in from one and one-half to two hours, the surface should have a glossy black appearance. If too small a quantity is used, or if the percentage of asphaltic cement to distillate is considerable less than above, a brown surface will result, which will not make a successful bond with the asphalt surface.

Two men can easily mix and apply this asphaltic coat on 12,000 sq. ft. per day. On 69,000 sq. ft., where the proportions were being varied somewhat, it was found that 100 sq. ft. required 0.856 gal. of engine distillate and 3.5 lb. of asphaltic cement. The total cost on above area, including 15 per cent on labor, was $0.0018 per square foot of surface.

It is found that no inconvenience is caused to the work of laying asphalt by the placing of the asphaltic coat. After one hour's time it does not stick to the wheels of motor trucks or wagons. It is not desirable to so cover the concrete farther ahead of the asphalt work than is required for the distillate to evaporate and leave the binder hard.

In one case, several days' rain which fell on paint freshly applied caused the asphaltic coat to appear loosened from the concrete in many places. After two days' dry weather, however, it seemed to bond again to the concrete so that it could not be removed. It is believed that the paint binder will tend to waterproof the asphalt surface, preventing damage to its under side from moisture which may rise through the concrete.

If the asphaltic coat is allowed to accumulate in any quantity in a depression such as a heel mark, its location is soon apparent after the placing of asphalt since excess asphaltic cement appears on the surface during rolling. With reasonable sweeping, however, no trouble of this kind has been experienced.

There is a marked difference in the behavior of hot asphaltic mixture under the roller where the paint binder has been used and where it has been omitted. Where concrete has been painted, the asphalt does not move or welt up in front of the roller to any appreciable extent, as is noted when rolling asphalt on plain concrete.

It is found that the asphaltic cement, while dissolved in the distillate, penetrates into the surface of the concrete to a distance of from 1-10 in. to ⅛ in. and in some cases even further. Samples of the surface removed show the concrete adhering uniformly to the asphaltic surface. When removing the sample the concrete is fractured and a layer of solid concrete is removed, carrying the first layer of finer gravel. When trimming a joint to begin a new day's work, the surface of the concrete base is always broken off in removing the thin edge of asphalt which has been cut from the finished work.

For experimental purposes, a few hundred feet of the surface has been placed without the use of the paint binder. As expected, no bond is secured except that of a mechanical nature, due to the roughness of the concrete. Notwithstanding this, the surface remains in first class condition after one month of heavy traffis, and it it is believed that good results will be obtained under wear without the use of a binder of any kind. However, the use of this binder at so emall an additional cost will improve the pavement and prolong its life to such an extent it will more than justify its expense.

Cost of Concrete Road Construction By an Illinois Highway Commission.

During the season of 1912 five sections of concrete roads were constructed by the Illinois Highway Commission. In general these roads were built along the lines outlined by Mr. A. N. Johnson, State Engineer, in a paper presented before last year's American Road Congress [Engineering & Contracting, Nov. 13, 1912]. Present specifications for concrete roads of the Illinois Highway Commission were given in our May 7, 1913 issue. The following data on the cost of these roads are taken from the recently issued report of the Commission.

Table I, which gives an estimate of the cost of concrete roads, is based on the information obtained in the construction of the five sections of road mentioned above, so far as the cost of mixing and placing the concrete and the cost of expansion joints are concerned. But for the remainder of the items which enter into the cost of the concrete roads, such as earth costs and hauling materials, the table is based on data obtained in the construction of macadam roads.

In making this estimate, it is assumed that gravel concrete will be used and that the gravel will cost $1.50 per cubic yard f. o. b., cars at destination. The cost of hauling material is taken from data on hauling crushed limestone in macadam work. But in making these estimates proper corrections have been made for the difference in weight per cubic yard of the two materials. It is also assumed that cement costs $1.20 per barrel f. o. b., cars at destination and no profits or overhead charges are considered in making up the table.

The following explanation of the manner in which the cost of a square yard of 6-in. concrete roadway is determined will show in general how the table is compiled:

The item "superintendence, watchman and miscellaneous labor" is taken from the actual cost for these items on concrete work done by the State Highway Commission.

The items "shaping road bed" and "trimming shoulders" are taken from data obtained in the construction of the macadam roads. These data also show the cost of loading material on wagons to be 10.7 cts. per cubic yard, and likewise give the cost per cubic yard for hauling ½ mile. These two items added together and compensated for the difference in weight between gravel and crushed stone gives the item of loading and hauling materials. The other labor items are determined by the assumptions made as regards the cost of gravel and the cost of cement. The items "expansion joints," "coal, oil and miscellaneous supplies for mixer," "forms and other lumber," and "mixing and placing," are determined from Table II, which gives the cost of this work on the concrete roads constructed during 1912.

In this manner the cost per square yard for concrete road 6 ins. thick is computed when the length of haul for materials is ½ mile. If the average haul is greater than ½ mile, the only item which changes is that of loading and hauling materials, which of course varies with the length of the haul.

Having determined the cost per square yard for 6 ins. and 7 ins., and for the four lengths of haul given, the cost per mile for the concrete roadway of varying widths is determined by multiplying the number of square yards in a mile of road of the given width by the cost per square yard. The table also gives the cost of a mile of concrete road 6 ins. thick and 10 ft. wide, with 3 ft. of macadam on each side of the concrete roadway. In computing this cost, the cost of the concrete roadway is determined as before explained, and to that is added one-third of the cost of a mile of 12-ft. macadam road. This cost of the macadam, alongside the concrete, is determined on the assumption that it is made two-thirds the thickness of a standard macadam road, and being one-half as wide will therefore require one-third of the material and labor of a 12-ft. macadam road.

In the same manner the cost of a concrete road 12 ft. wide, with 2 ft. of macadam along each side, is determined with the assumption that the cost of the macadam will be one-sixth the cost of a standard 12-ft. macadam road.

It should be noted that there is no cost given for a 7-in. pavement of the widths 10 and 12 ft., as it is thought there will be no occasion to make a concrete road 7 ins. thick when it is less than 16 ft. wide.

TABLE I.—ESTIMATED COST OF ONE MILE OF CONCRETE ROAD. BASED ON ACTUAL COST OF WORK DONE BY THE ILLINOIS HIGHWAY COMMISSION, 1906-1912.

Width.		Cu. yds. gravel per mile.	Sq. yds. per mile.	Av. haul ½ mile.		Av. haul 1 mile.		Av. haul 2 miles.		Av. haul 3 miles.	
				6 ins. thick.	7 ins. thick.	6 ins. thick.	7 ins. thick.	6 ins. thick.	7 ins. thick.	6 ins. thick.	7 ins. thick.
10 ft. concrete with 6 ft. macadam	Gravel..	1,535	Con. 5,867	$ 7,391	....	$ 7,652	....	$ 8,166	....	$ 8,720	....
	Stone...	734	Mac. 3,520								
12 ft. concrete with 4 ft. macadam	Gravel..	1,830	Con. 7,040	7,802	....	8,902	....	8,563	....	9,140	....
	Stone...	367	Mac. 2,347								
16 feet	6 ins.	2,200	9,387	9,414	....	9,720	....	10,230	....	10,880	....
	7 ins.	2,550	......	....	$10,730	....	$11,080	....	$11,680	....	$12,400
18 feet	6 ins.	2,331	10,560	10,591	....	10,930	....	11,520	....	12,200	....
	7 ins.	2,725	......	....	12,050	....	12,450	....	13,150	....	13,950
20 feet	6 ins.	2,592	11,733	11,768	....	12,150	....	12,780	....	13,550	....
	7 ins.	3,025	......	....	13,410	....	13,840	....	14,600	....	15,480
24 feet	6 ins.	3,110	14,080	14,122	....	14,580	....	15,350	....	16,320	....
	7 ins.	3,630	......	....	16,060	....	16,600	....	17,530	....	18,570

Conclusions and Cost Data on Macadam Construction in Illinois.

At the end of 1912 the Illinois Highway Commission of which Mr. A. N. Johnson is State Engineer, had constructed 150 pieces of experimental road, aggregating a total of 1,001,823 sq. yds. On the basis of a width of 12 ft. this is equivalent to 140 miles of new road. Of the total yardage 651,123 sq. yds. were waterbound macadam and 288,971 sq. yds. were bituminous macadam. One of the purposes of constructing these roads was to determine what modifications, if any, were necessary in the usual methods of macadam construction to adapt it to the soil and climatic conditions encountered in Illinois. With this end in view, frequent inspections have been made of all experimental roads built by the Commission and information has been obtained as to their condition from year to year. As a result of this experience the following conclusions as to waterbound macadam and bituminous macadam under Illinois conditions are given in the last annual report of the Commission:

TABLE II.—COSTS OF CONCRETE ROADS CONSTRUCTED IN 1912.

Road.	McLean.	DeKalb.	Springfield.	Carlinville.
Amount of pavement laid	5,000 sq. yds.	7,334 sq. yds.	5,594 sq. yds.	7,111 sq. yds.
Thickness of pavement	6 ins.	6½ ins.	7 ins.	6½ ins.
Width of pavement	45 ft.	12 ft.	18 ft.	16 ft.
Length of haul for materials	⅛ mile.	½ mile.	⅛ mile.	Sand, 1½ mile; stone, ½ mile.
Cost of cement per bbl	$1 --$1.06	55 cts.	$1.02½	98 cts.
Cement used per sq. yd. pavement	.29 bbl.	.31 bbl.	.29 bbl.	.33 bbl.
	Per sq. yd.	Per sq. yd.	Per sq. yd.	Per sq. yd.
Superintendence	$0.028	$0.0273	$0.0361	$0.0220
Excavation	......	0.1227	....	0.0840
Shaping roadbed	0.061	0.0095	0.0415	0.0153
Trimming shoulders and side roads	......	0.0099	0.0378	....
Loading and hauling stone and sand, including rehandling	0.053	0.0812	0.1078	0.1120
Mixing and placing concrete	0.083	0.1020	0.1150	0.0986
Watchman and miscellaneous labor	0.022	0.0255	0.0682	0.0184
Cost of sand and stone f. o. b.	0.204	0.2280	0.2897	0.1050
Cost of cement f. o. b.	0.309	0.1700	0.2772	0.3246
Expansion joints	0.010	0.0218	0.0369	0.0156
Reinforcing steel	......	....	....	0.0140
Coal and oil for mixer and miscellaneous supplies	0.006	0.0044	0.0213	0.0034
Forms and other lumber	0.007	0.0163	0.0033	0.0047
Filling expansion joints next curb	0.010	....	....	....
Total	$0.793	$0.8186	$1.0352	$0.8176

CONCLUSIONS AS TO THICKNESS AND WIDTH.

Roads have been constructed of varying thicknesses, sometimes because the local officials felt that on account of the cheapness of the stone, it would be as well to use plenty of it, and sometimes it was desired to demonstrate the possibility of economical construction by reducing the thickness of the stone where local conditions would warrant. The thickness has varied from 5 ins. to 12 ins., after being thoroughly compacted. Inspections made on these various roads from time to time show conclusively that there is no soil encountered in Illinois upon which it is necessary to use a thickness of crushed stone greater than 8 ins. after being rolled and have also shown there are many types of sandy soil in the State upon which a layer of stone 6 ins. thick will serve all purposes of traffic.

The width of roadway has also been varied considerably on the various sections of the road, the widths built being from 10 ft. to 30 ft. Observation of these roads under traffic indicates that there are very few places in the State where a roadway 10 ft. wide is sufficient. A road which does not have any large amount of traffic before improvement will after improvement attract a great deal of traffic, and consequently require a wider road than seems to be necessary from the traffic observed before improvement.

It is also apparent that roads constructed in the vicinity of cities of from 10,000 population upwards, should be wider than 12 ft. This is particularly true if the road will be subjected to any considerable amount of motor traffic, as is often the case in the vicinity of a city. These roads should be at least 16 or 18 ft. wide in order to accommodate both the motor and horse drawn traffic. While it may not seem desirable to build roads merely for motor traffic, yet it is evident that the motor traffic is here and must be taken into account in any comprehensive system of road improvement.

In general, it can be said that in most communities where it is worth while to construct and improve roadways at all, a width of 12 ft. is desirable. And in many communities the roadways must necessarily be 16 to 18 ft. wide in order properly to accommodate the traffic which will use them. Moreover, the traffic census which has been taken by the Illinois Highway Commission during the past six years shows that there is a large increase in motor traffic on these improved roads from year to year, and consequently a road which might be wide enough upon completion will be too narrow to accommodate the traffic in a few years.

CONCLUSIONS ON WATERBOUND MACADAM.

In regard to waterbound macadam construction, it may be remarked in general that there has been no difficulty, if reasonable precautions are taken for proper drainage, to support this form of construction on any of the soil conditions usually encountered in the State. Wherever isolated sections of macadam roads are exposed to mud marks tracked on at the ends and from adjoining roads, a disproportionate amount of damage is done to that done on a larger mileage of road. The most serious damage to any of the macadam roads has resulted from tracking on of sticky mud, particularly the first year, before the road has become thoroughly seasoned and consolidated. The mud will pick out the binder and loosen the stone which will be carried with the mud on the wheels and deposited upon the road, which, when dry, leaves the surface very uneven. Such action will be in evidence for 100 to 300 ft. from either end of the road.

It has been found, however, that if sand or gravel is placed on the earth roads adjacent to the macadam for 100 or 200 ft., that it will render the mud non-sticky and no damage is done to the macadam surface. If precautions of this nature are taken for the first and second winters, there does not seem to be much further difficulty experienced from this source, as the road in the meantime will have become thoroughly compacted and does not pick up.

Some roads have been much more affected by traffic than others, although it is a fact that the roads that have worn the best in some instances have carried the largest amount of traffic. On the roads with the lesser amount of traffic, it is usually the case that one vehicle follows the other, the majority of which have narrow tires, and all the wheels use a narrow space practically within 10 ins. in width. Where traffic uses a road in this manner, a rut or depression will form within a very short time after the road is thrown open to travel, and unless this depression is removed, practically every vehicle will follow in the track thus made.

If the incipient track is filled with a bonding gravel, the team traffic will avoid it, turning first to one side and then the other, according to the direction it may be going, and eventually consolidate the surface of the road. Wherever it is possible once to distribute the traffic over the whole road, there seems but little difficulty from the formation of ruts or concentration of wear in one track. Roads, however, that carry automobile traffic even in very limited amounts are difficult to repair in this manner, as the loose gravel will be soon thrown out by the motor traffic.

It has been found that a limestone road bonded with gravel to make a gravel surface is a very much better wearing road and will carry with less damage to the surface a very considerable amount more of motor traffic than a limestone road bonded with limestone screenings alone. It is to be noted that the damage done to a macadam road the first year is much more than during subsequent years. In general, if a small amount of gravel is distributed over the surface early in the first spring, the amount required being about one carload to the mile, and a drag is used on the road occasionally as wet weather permits, it is found that the road will pass through the next two or three seasons with little or no attention, save the occasional use of the drag during late fall and early spring.

With the majority of the roads built by the Commission, however, the general impression has been that such construction is permanent in a strict sense of the word, and once a road is built that nothing further needs to be done. Thus very few of the roads have had any proper attention, so that their condition in many instances is much poorer than would have been the case under proper and systematic maintenance. As a result, when maintenance repairs have been made, the condition of the road is such that a very considerable amount of work is necessary to restore the surface, so that when this cost is distributed over the years which the road has been in use, the cost per year is often greater than would have been the case had a small amount of work been done more frequently, and the road surface in the meantime maintained in a much higher state of preservation.

In general, it may be said that waterbound macadam construction, particularly where gravel is used for the surface dressing, is a practical form of road construction for many miles of moderately traveled roads in the State; roads that carry a sufficient amount of traffic to make their improvement in this manner worth while at the same time have not developed an amount of motor traffic to prevent the maintenance of this form of construction at a reasonable cost. This applies particularly on those roads which eventually would become feeders to main roads where it is believed that this form of construction will prove serviceable for many years to come. But waterbound macadam is not advised on roads carrying a considerable amount of motor traffic or roads which will eventually become the main roads of a county or State system.

TABLE I.

Item.	Cost per sq. yd.	Cost per cu. yd.
Shaping roadbed, trimming shoulders and side roads	$0.03	......
Applying bituminous binder	0.023	......
Superintendence, watchman, etc.	0.037	$0.12
Loading stone on wagons	......	0.107
Spreading stone	0.028	0.093
Rolling and sprinkling	0.027	0.071

CONCLUSIONS ON BITUMINOUS MACADAM.

The comparatively short experience that has been had with this form of construction with the work under the supervision of the Illinois Highway Commission and elsewhere, makes it impossible to draw any final conclusions. The results, however, of the experience so far gained, seem to show:

First, the necessity in this form of construction for as stable a foundation course as possible, and that probably the best method would be to lay the first course of the road as waterbound macadam, applying the bituminous top about 3 ins. thick the following season when the foundation course had become thoroughly well compacted.

Second. The necessity for using durable material in the bituminous top, and where under the conditions that exist in Illinois, limestone alone is available, the material used for filling the voids and dressing the surface of the bituminous layers as they are applied, should be of washed gravel and torpedo sand. The particles of the gravel are made up for the most part of silicious material, which is the hardest material available, but where the rock of which the road is made is tough and hard, then rock chips could be substituted.

Third. It is necessary that the bituminous binder be spread so as to present as uniform a surface as possible. This may not necessarily mean the uniform distribution of the binder as the texture of the surface of the macadam before the application of the binder may itself not be quite uniform. Therefore, the more finely divided form in which the asphalt can be applied, the better the control of its distribution. The form of the application whereby the material is spread by a jet of steam has given excellent results.

TABLE II.—ESTIMATED COST OF ONE MILE OF MACADAM ROAD

Width—ft.	Cu. yds. stone per mile.	Sq. yds. per mile.	Average haul ½ mile. Water-bound.	Average haul ½ mile. Bituminous.	Average haul 1 mile. Water-bound.	Average haul 1 mile. Bituminous.	Average haul 2 miles. Water-bound.	Average haul 2 miles. Bituminous.	Average haul 3 miles. Water-bound.	Average haul 3 miles. Bituminous.
12	2,200	7,040	$4,572	$ 5,859	$4,836	$ 6,123	$5,298	$ 6,585	$ 5,870	$ 7,157
16	2,637	9,387	5,659	7,375	5,875	7,591	6,429	8,145	7,115	8,831
18	2,805	10,560	5,960	7,892	6,297	8,229	6,886	8,818	7,615	9,547
20	3,116	11,733	6,624	8,770	6,995	9,141	7,649	9,795	8,459	10,605
24	3,740	14,080	7,948	10,524	8,397	10,973	9,182	11,758	10,154	12,730

Fourth. Too much binder should not be used as it will result in a less stable layer of bituminous concrete than if sufficient binder is used only to fill the voids in the stone.

Fifth. It is essential that the surface of the road have very close texture and that usually this cannot be secured in less than three applications except by an excessive amount of binder. The most economical and best results can be secured when the binder is put on in three applications.

Sixth. The bitumens which do not possess some ductility at freezing temperature have not been satisfactory.

Seventh. There is some evidence to show that certain bitumens of low ductility at ordinary temperature are seriously injured by mud that may be tracked upon the road, particularily if the soil is of highly alkaline character. There does not appear to be an equal amount of injury done by mud from soils of slightly acid character, though in either case the results are not as satisfactory as with bitumens possessing higher ductility. It is important that bitumens be applied at high temperatures, and if possible, during hot weather, as some unsatisfactory results obtained can be attributed to the cold weather prevailing at the time of construction. The roads constructed with tar binder under ordinary traffic conditions seem to require a paint coat at the end of the second, or at the latest, during the third season, by which time the tar near the surface of the road seems to have lost most of its adhesive qualities.

Eighth. A tar with approximately the following analysis has proved most satisfactory:

Specific Gravity. The specific gravity at 25° C shall not be more than 1.26.

Free Carbon. The free carbon shall not exceed 20 per cent by weight.

Consistency. The consistency as determined by the Howard & Morse float apparatus at a temperature of 50° C shall be not less than 1½ mins. nor more than 2½ mins.

Distillation. Fractional distillation shall give results within the following limits, all measurements being by volume.

Up to 110° C the distillate shall not exceed 2 per cent and shall be free from ammoniacal water.

Up to 170° C there shall be not to exceed 5 per cent distillate, of which not more than one-fourth shall be naphthalene.

The total distillate up to 315° C shall be at least 18 per cent.

Brittleness. A cylindrical prism of the tar binder 1 cm. in diameter, after being maintained at a temperature of 0° C for 20 mins., shall bend into a semi-circle of 3 cm. diameter without checking or breaking.

Ninth. A surface constructed with an asphalt binder apparently requires a paint coat during the third or fourth season. While the asphaltic binders do not seem to lose their adhesiveness, the mat forming the close texture of the surface under ordinary traffic conditions will have become worn so as to make the application of a paint coat desirable as a protection against further wear of the road. The most satisfactory results with asphalt binders were obtained with those having closely the following analysis:

Class A bituminous binders shall conform to the following specifications, the various properties described being determined by the methods proposed by the American Society for Testing Materials:

1. The material shall be free from water.

2. **Specific Gravity.** The specific gravity at 25 C 25° C (77° F) shall not be less than unity.

3. **Total Bitumen.** The bituminous material shall be soluble in chemically pure carbon bisulphide at air temperature to the extent of at least 99.5 per cent for residuums and gilsonite products, 95 per cent for Bermudez products, 80 per cent for Cuban products, and 65 per cent for Trinidad products.

4. **Naphtha Insoluble Bitumen.** Of the total bitumen not less than 15 nor more than 28 per cent by weight shall be insoluble in 86° B paraffine naphtha at air temperature. On evaporation of the naphtha solution the residue obtained shall be sticky and not merely oily.

5. **Fixed Carbon.** The fixed carbon shall be not less than 8 nor more than 14 per cent.

6. **Penetration.** The penetration as determined with the Dow penetration machine, using a No. 2 needle, 100 grams weight, 5 sec. time, and a temperature of 25° C (77° F) shall not be less than 12 mm., nor more than 16 mm.

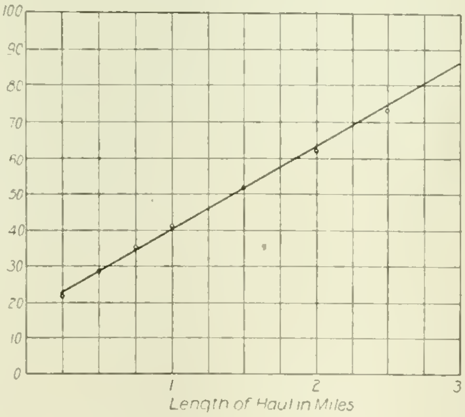


Fig. 1—Curve for Cost of Hauling.

7. **Loss on Evaporation.** When 20 grams (in a tin dish 2⅜ ins. in diameter and ¾ in. deep with vertical sides) are maintained at a temperature of 170° C (338° F) for 5 hours in a New York testing laboratory oven, the loss shall not exceed 6 per cent by weight. The surface of the residue at air temperature shall be smooth and show no sign of blistering or cracking, and when tested with the Dow penetration machine for 5 secs. at 25° C (77° F) with a No. 2 needle, and 100 grams weight, it should have a penetration of at least 5 mm.

8. **Ductility Test.** The ductility at 25° C (77° F) shall not exceed 85 cm., according to the District of Columbia standard.

9. **Flash Test.** The flash point in an open cup shall not be less than 163° C (325° F).

10. **Paraffine Scale.** The asphaltic binder shall not contain more than 2 per cent by weight of paraffine scale.

Class B bituminous binders shall conform to the following specifications, the various properties described being determined by the methods proposed by the American Society for Testing Materials:

1. The bituminous material shall be free from water.

2. **Specific Gravity.** The specific gravity at 25° C 25° C (77° F) shall not be less than 0.965 nor more than unity.

3. **Total Bitumen.** The bituminous material shall be soluble in chemically pure carbon-bisulphide to the extent of at least 99.5 per cent by weight at air temperature.

4. **Naphtha Insoluble Bitumen.** Of the total bitumen not less than 20 nor more than 26 per cent by weight shall be insoluble in 86° B paraffine naphtha at air temperature. On evaporation of the naphtha solution, the residue obtained should be sticky and not merely oily.

5. **Loss on Evaporation.** When 20 grams (in a tin dish 2⅜ ins. in diameter and ¾ in. deep, with vertical sides) are maintained at a temperature of 163° C (325° F) for 5 hours in a New York testing laboratory oven, the loss shall not exceed 2 per cent by weight. The surface of the residue at air temperature shall be smooth and shall present no greasy spots nor any sign of blistering or cracking. The peneration in the residue shall not be decreased more than 40 per cent from the original consistency.

6. **Fixed Carbon.** The fixed carbon shall not be less than 7 nor more than 13 per cent.

7. **Penetration.** The penetration as determined with the Dow penetration machine, using a No. 2 needle, 100 grams weight, 5 secs. time, and a temperature of 25° C (77° F) shall not be less than 7 nor more than 12 mm.

8. **Paraffine Scale.** The bituminous binder shall not contain more than 6 per cent by weight of paraffine scale.

9. **Carbon-Tetrachloride Insoluble Bitumen.** Of the total bitumen not more than 0.5 per cent by weight shall be insoluble in chemically pure carbon-tetrachloride at air temperature.

10. **Brittleness Test.** A cylndrical prism of the bituminous binder 1 cm. in diameter, after being maintained at a temperature of 5° C for 20 mins., shall bend in a semi-circle of 3 cm. diameter without checking or breaking.

11. **Flash Test.** The flash test in open cup shall be not less than 200° C (392° F).

12. **Melting Point.** The melting point shall not be less than 60° C (140° F).

13. **Ductility.** The ductility at 25° C shall not be less than 25 mm., according to the District of Columbia standard.

These binders are of two general classes, and it was found in practice that excellent results were obtained by using a mixture of three parts of low price blown oil or residual asphalt of class B combined with one part of a natural asphalt of class A.

Tenth. The size of stone in the bituminous layer should range from 2½ ins. to ¾ ins. where limestone is used. When trap rock or other equally hard material is available, stone should not exceed 2 ins. in size; the chips for filling the stone not to exceed ¾ in. and the grit for the top dressing not to exceed ¼ in., and all of the materials to be free from dust.

Eleventh. The use of laboratory is absolutely necessary for making tests on materials and mixtures as construction proceeds.

Twelfth. Experience indicates that this form of construction is adapted to moderate traffic roads, that is, where there is no large amount of extra heavy hauling. Where the traffic is composed of automobiles and farm loads not to exceed two tons, this form of construction will prove satisfactory, although possibly not as durable as either concrete or brick. Where traffic consists of heavier loads, wholesale trucks, heavy coal hauling and loads reaching to five and six tons, it is believed this form of construction is not at all suitable.

It presents a pleasing appearance and is well adapted to horse drawn traffic as well as automobile traffic, but requires close attention for maintenance, and there is some evidence that during warm weather when the bitumen is least stable there is a tendency for the surface to creep and undulations develop.

The cost of this form of construction over that of first class waterbound macadam is approximately 20 cts. per square yard, but there has not been had sufficient experience to determine definitely the maintenance cost and its final economy. The construction requires the utmost care in every detail, and owing to the small experience contractors have had with it, appreciation of this fact has not been realized, with the result that nearly everywhere work done under contract has not been as satisfactory as that done by day labor under the immediate supervision of skilled men. Where attention is given to the construction and where the services of a laboratory are available, to insure the character of the materials, there is no difficulty in duplicating results. Bituminous macadam is of doubtful value on those sections of roads so situated that considerable quantities of mud will be tracked on them from adjoining roads.

COST OF MACADAM CONSTRUCTION.

At the close of the season of 1912 there were available cost data obtained from the construction of about 150 separate pieces of road, involving the handling of 286,491 cu. yds. of stone. A study of these data shows that the various unit costs are constant, regardless of the distance to the road from the tracks from which stone is hauled, except the cost per cubic yard for hauling stone. The costs of the various parts of the work shown in Table I are the averages of these items for all of the roads constructed.

A study of the data on the cost of hauling stone shows that this cost increases constantly and almost uniformly from a distance of ¼ mile upwards. This variation is most readily shown by means of a curve which is given as Fig. I. It is possible, with these data available, to make an estimate of the cost of the construction of a mile of macadam road for any length of haul for stone not exceeding three miles. When the width of a road and the thickness of the material have been decided, the fixed items of cost in the road can be immediately determined by use of the unit costs from Table I. Then, by referring to Fig. 1, the cost per cubic yard for hauling stone is determined.

In this manner the estimates of cost of one mile of road, as given in Table II have been made up. In the table, the cost of crushed stone is assumed to be $1.25 per cubic yard f. o. b., cars at the siding from which it is to be hauled. In bituminous macadam roads the cost of the bituminous binder is assumed to be 8 cts. per gallon f. o. b., the siding from which it will be hauled, and it is also assumed that 2 gals. of binder per square yard of surface will be used. This table is based on the actual cost of the work which has been done by the Illinois Highway Commission, and makes no provisions for contractors' profits. It does, however, include cost of maintenance of equipment under the item of rolling and sprinkling.

It should be noted that the allowance for shaping the road bed, and trimming shoulders and side roads, while covering the ordinary earth work necessary on the average road encountered in Illinois, would not be a large enough allowance if the road to be improved included heavy earth work to reduce grades, or construct embankments.

The cost of labor on the various pieces of work varied from 30 cts. to 50 cts. per hour for teams and from 15 cts. to 25 cts. per hour for men, and the number of pieces of work where the lower price was paid was about as large as where the higher price was paid. It would probably be fair to assume that these costs are substantially correct where teams received 40 cts. per hour, and men 20 cts. per hour.

In Table II the quantity of stone per mile is given and it will be noted that the quantity does not increase in proportion to the width. This is due to the fact that a road 12 ft. wide is made of uniform thickness, while the wider roads are made somewhat thinner at the edge than at the middle. The 12-ft. road is estimated on a basis of a thickness of 10 ins. of loose stone, while the 16-ft. road is assumed to be 10 ins. thick at the middle and 8 ins. thick at the edge, making the average thickness 9 ins. For roads wider than 16 ft., the average thickness has been taken as 8½ ins.

The cost of bituminous macadam roads exceeds the cost of waterbound macadam roads by the cost of the binder, plus the cost of application, and the experience of the Commission in the construction of bituminous macadam roads by the penetration method indicates that 2 gals. of binder per square yard of macadam is required.

WATER WORKS

Operation of the Rapid Water Filtration Plant at Saskatoon, Saskatchewan.

The construction of the water filtration plant of the city of Saskatoon was completed early in 1912, and the plant has been in continuous operation since that time. The design of the works is based on the Harrisburg, Pa., plant. The treated water is colorless and free from turbidity, and the bacterial count ranges from 0 to 8 per c. c. The capacity of the plant is 4,000,000 Imperial gallons per day. It was built by the Roberts Filter Co. of Philadelphia at a contract cost of $55,980. The operation of the plant was described by T. Aird Murray in a paper on water filtration before the Canadian Public Health Association, from which the information here given is taken.

The water to be filtered is taken from the Saskatchewan River at a point opposite the existing pumping station. It flows by gravity to two deep wells from which it is pumped to the existing storage basins, which are converted into a sedimentation basin.

This basin is divided into two compartments by a wall extending across its center. The water is admitted to that section of the sedimentation basin farthest from the filtration plant through three bell shaped delivery pipes; flows toward the central division wall, is there collected into three bell shaped pipes, which extend to within 12 ins. of the high water level in the basin affording a weir effect to the naturally subsided water. It is then conveyed through a cast iron pipe around the central division wall to the second half of the sedimentation basin which acts also as a coagulating basin. Provision is made for feeding sulphate of alumina into the pipe line conveying this naturally subsided water to the second half of the sedimentation basin or coagulating basin. It is then delivered through similar bell shaped pipes, flowing toward the end of the coagulating basin, collected into bell shaped pipes as described in the preceding basin, which convey the water to the pipe leading to the filters; provision is made also for feeding sulphate of alumina to the water in this pipe just after leaving the coagulating basin.

The treated and subsided water then flows through the 20-in. influent main down the filter gallery and is distributed through 10-in. pipes to each of the six filters.

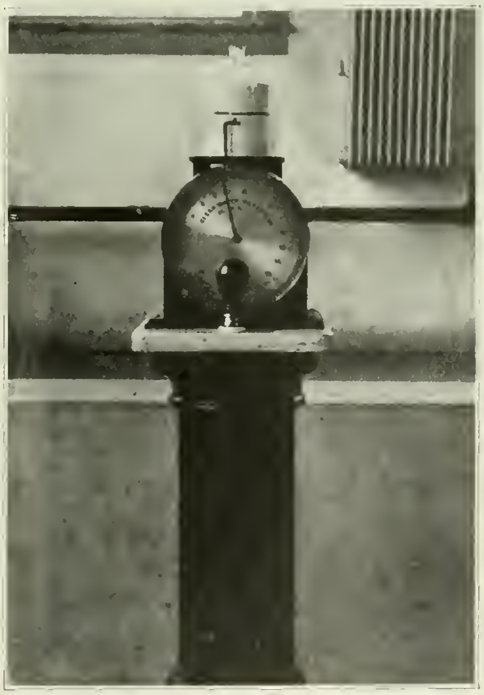


Fig. 1—Roberts Recording Depth Gage for Clear Water Reservoir, Saskatoon Filtration Plant.

During the process of filtration the water flows into and fills the concrete pocket in front of each of the six filter units, rises to a level with the tops of the steel supply and wash trough, spills over onto the sand bed, filters through the sand and gravel and is collected by the bronze strainers into the wrought iron strainer system. It is then conveyed through the central cast iron manifold collecting pipe and across the front of the filter to the effluent rate controller.

The effluent rate controllers are set to deliver a given quantity of water under a head of 10 ft. 6 ins., and are capable of adjustment to within 30 per cent above or below the normal rate for which they are designed; they in turn deliver the filtered water to the filtered water storage reservoir, located beneath the six filter units. The Robert's gage for showing the depth of water in the clear water reservoir is shown in Fig. 1.

The filtered water then flows by gravity from the storage reservoir to the high duty pump suction well, from whence it is pumped to the stand-pipe, from which it flows through the distribution system to the consumers.

Each of the six filter units is equipped with hydraulically operated valves, which permit the filter being controlled from a Robert's operating table located on the operating floor immediately in front of each unit, as shown in Fig. 2.

The equipment includes a centrifugal pump for supplying water for washing the filters, also a blower for supplying air under pressure during the washing process. Each of these units is independently driven by an electric motor mounted on the same bed plate.

The plant is so arranged that the filters can be washed either by using the centrifugal wash pump for filtered water or by filtered water taken from the force main leading from the high duty pumps to the stand-pipe, affording an auxiliary wash in case of accident to the wash-pump.

During the washing process the inlet valve to the filter is closed. The water on the sand bed is allowed to filter through the rate controller into the filtered water storage well. The operator then signals by the use of an electric bell controlled from the operating table for the engineer to start the blower. The air supply valve being opened on the filter, the air is admitted to the sand bed, and the latter is scoured for a period of two minutes, after which the air supply is shut off and the wash pump is placed in operation and filtered water is admitted to the filter through the manifold and strainer system, causing a reverse current for a period of two minutes, which washes the sand, carrying the heavy deposits which have been filtered out of the water during the process of filtration to the supply and wash trough, from whence it is carried to the waste and thence to the drain. This alternate air and water washing is continued for a period of from six to ten minutes, the time depending upon the cleanliness of the sand bed. The duration of the air scouring and washing periods being diminished after the first period of two minutes each.

After the washing process the sand settles back into its normal position in the bed, the heavier particles settling on the bottom with the finer grades toward the surface, or the sand settles in relation to its specific gravity.

The air, the wash water supply and waste valves are then closed, and the influent and filtered water to waste valves are opened, allowing the treated water to filter through the sand bed as during the process of filtration, the water passing to the drain until the clay particles which were not raised during the washing process to the waste trough are carried off to the drain and until the water is about the color of the treated water being supplied to the filter.

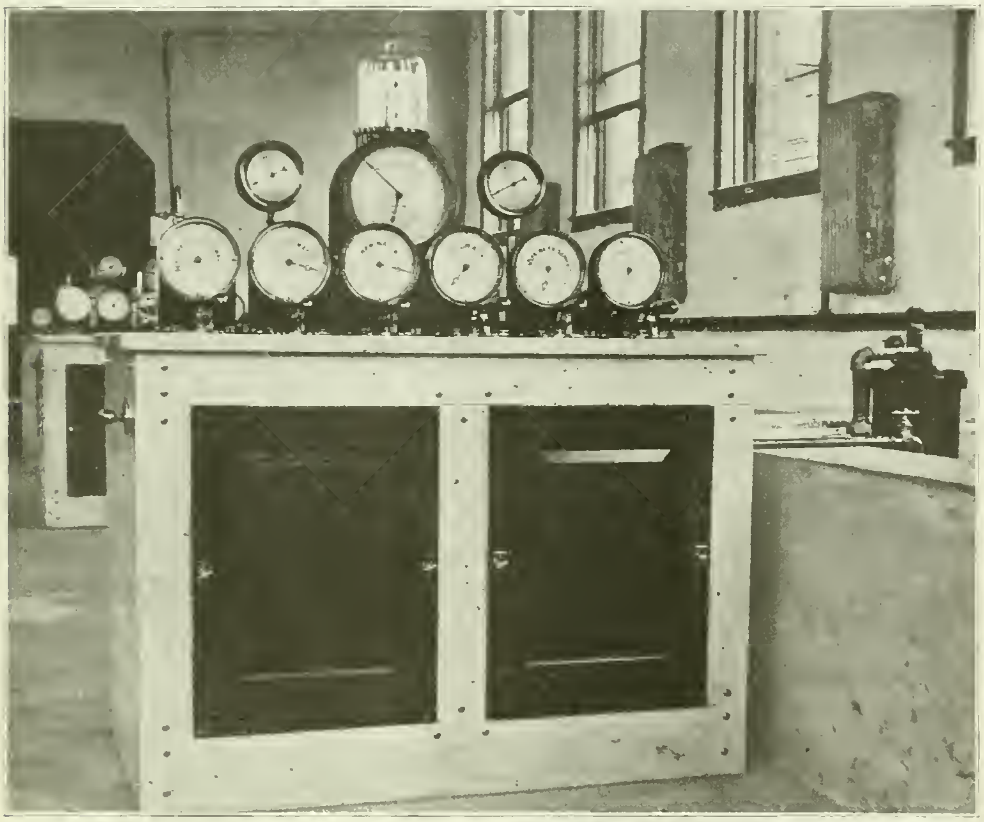


Fig. 2—Roberts Operating Table for Filters, Saskatoon Filtration Plant.

The filtered water to waste valve is then closed and the effluent valve is opened, placing the filter in operation and allowing the water to pass through the effluent rate controller to the filtered water storage well beneath the filters.

On each of the operating tables is located a test bibb for drawing samples of the wash water during the washing process, also for taking samples of the filtered water at any time while the filter is in operation.

In the laboratory equipment is included a test basin having properly marked bibbs for taking samples of filtered water from each of the six filters, also provision for taking samples of the raw and treated water before and after coagulation. The samples of the water are pumped by the use of hydraulic lift from the sources of their supply to the bibbs. The hydraulic lifts are actuated by the high pressure of the water in the force main from the high duty pumps. By opening the bibbs on the operating tables and test basin, the pressure is released to the hydraulic lifts, which places them in operation.

The chemical feeding plant consists of four concrete solution tanks located in the second story of the machinery end of the filtration plant; two for the preparation and mixing of sulphate of alumina and two for hypochlorite of lime.

In the sulphate of alumina solution tank the chemical is placed in lump form in wooden dissolving trays and filtered water is allowed to spray over the material until it is dissolved and the solution tanks are then filled with this liquid. Wooden paddles are driven through the solution by a pair of bevel gears at a slow speed to insure a more finely graded solution.

The Effect of Artesian Water Upon Galvanized Steel Pipe at Moline, Ill.

An artesian well 1,467 ft. deep, and flowing 70 gals. per minute, was put down to the St. Peter sandstone at the works of Deere & Co. of Moline, Ill., in 1911. The water so secured was used for drinking purposes by the employes of the company. The water was examined by the State Water Survey and pronounced excellent for drinking purposes. The mineral analysis was as given in Table I. However, when the water was turned into the piping system of the industrial works serious and altogether unexpected results followed. The action of the water on the pipe coating formed a chemical compound which caused sickness among the users of the water. The details of the experience and the methods employed in removing the cause of the trouble were described by D. H. Stacks, Chief Chemist for Deere & Co., in a paper before the Illinois Water Supply Association from which the information here given is taken.

TABLE I.—MINERAL ANALYSIS OF ARTESIAN WATER FROM WELL OF DEERE & CO., AT MOLINE, ILL.

	Parts per M.		Parts per M.	Grains per gal.
Potassium K	33.0	Potassium Chloride KCL	62.9	3.66
Sodium Na	304.3	Sodium Chloride Na Cl	420.8	24.53
Ammonium NH_4	1.6	Sodium Sulphate Na_2So_4	427.4	24.92
Magnesium Mg	26.1	Ammonium Sulphate $(Nh_4)_2So_4$	5.9	.34
Calcium Ca	54.0	Magnesium Sulphate Mg So_4	27.1	1.58
Iron Fe	2.0	Magnesium Carbonate Mg Co_3	71.3	4.15
Alumina Al_2O_3	5.2	Calcium Carbonate Ca Co_3	134.8	7.85
Chlorine Cl	286	Iron Carbonate Fe Co_3	4.1	.23
Sulphate So_4	314.7	Alumina Al_2 O_3	3.2	.30
Silica Si C_2	6.8	Silica Si O_2	6.8	.39
Bases	5.2	Bases	5.2	.30
Total			1,171.5	68.25

The analysis given in Table I shows the water to be not out of the ordinary for deep well water, although the water as it issues from the pump has a very strong odor of hydrogen sulphide.

Shortly after the completion of the well a new drinking water system was installed for carrying the water to all parts of the plant. This comprised about 20,000 ft. of galvanized steel piping and 300 fountains. The fountains were mostly of the valve type, which could be opened or closed at will. Owing to the large number of fountains, the majority of which were situated 80 ft. above the water head, it was found necessary to keep most of the valves closed on fountains when not in use; especially was this the rule when the day's work was completed.

About 30 days after the water system had been completed and put in operation complaints were heard regarding the quality of the water as it came from the fountains, and many of the employes were taken ill with cramps, fainting spells and nausea, soon after drinking the water. An inspection of the system was made and each fountain was thoroughly flushed. When this was done it was noticed that the water appeared very cloudy, and apparently contained a white sediment. Samples of water were collected from several points about the works and this sediment was allowed to settle, the water was decanted off and the precipitate was put upon a filter paper and thoroughly washed with warm water. After this the precipitate was used for qualitative examination which showed the presence of silica, alumina, ferric oxide, lime, magnesia, sulphuric anhydride in small amounts, while sodium, potassium, chlorides, zinc and hydrogen sulphide were present in large quantities. This qualitative examination showed nothing out of the ordinary for this class of water, excepting the zinc, which would have been noticed in such quantities as here found by the State Water Survey when making their report had it existed in the well water.

Further research was conducted on samples of water collected directly from the pump, and also from different points in the system, with the result that a trace of zinc could not be found in the water as it came from the pump, while very appreciable amounts were found in all samples collected from different parts of the system. Several sections of pipe ranging in diameter from ½ in. to 3 ins. were thoroughly cleaned and filled with water fresh from the pump, sealed tightly, allowed to stand 45 days, when the seal was broken, the pipe again washed thoroughly with warm water and all water was collected and evaporated to dryness, including the water which was sealed up in the pipe. The residue from this evaporation was taken for analysis which, when completed, showed a slight increase, principally of the iron, alumina and silica, over the amounts reported by the State Water Survey. In addition zinc sulphide was present to the extent of 15 grains per gallon. Sections of the pipes in which the water was sealed were cut out and given a thorough microscopical examination which disclosed large patches where the zinc coating had been entirely removed, and everywhere there were innumerable pits some of which penetrated to an appreciable depth into the metal.

During the time this investigation was under way, which was about 60 days, conditions grew rapidly worse throughout the works, making it imperative that some action be taken immediately towards remedying the trouble. Accordingly a section of the pipe that had been exposed to the action of the water in the system was taken out and along with a new section with the coating intact, were used for experimental work in order to determine if it would be practical to remove the zinc coating and not injure the pipe to the extent of making its removal necessary at once. As a result of this experimental work it was found that a 5 per cent solution of sulphuric acid would remove the greater part of the zinc in the course of three hours, when its action about ceased. Accordingly plans were made to remove the zinc coating from the entire system.

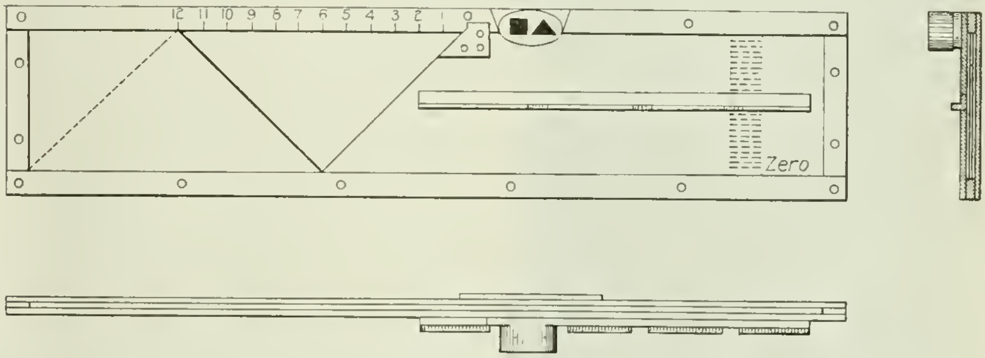
The architectural and engineering departments furnished the data showing the quantity of liquid necessary to completely fill the system. This was about 700 gals. A pump was installed in the power house through which the acid solution could be forced through the pipes. It was thought best to start operations on a Saturday night, so plenty of time would be available for doing thorough work. The system was completely drained and was afterwards blown out with air to remove water from pipes that could not be drained completely. This work was completed by Sunday morning. Then all fountains were shut tight and the pump was started, filling the system in about 35 minutes. To fill the system with the 700 gals. of the acid solution required a pressure of 70 lbs. per sq. in., which increased with the action of the acid upon the zinc and impurities to 125 lbs. per sq. in. At the end of three hours the acid solution was drained off and the system was connected to the feed water pipe of the boilers and hot water containing boiler compound was pumped through the system for several hours. The main pump was then cut into the system and artesian well water was forced continually through the pipes until they were thoroughly washed and the water was fit to drink. This was accomplished by the time manufacturing operations were resumed on Monday morning.

During the investigation the water had been thoroughly sampled and analyzed after completely flushing the fountains of the precipitate of zinc sulphide which collected in large quantities over night, or during the week end shut-down, and was found to contain as high as 1.80 grains of zinc per gallon, with an average of .50 grains per gallon. After the treatment, which was resorted to twice at 30-day intervals, the water was found to contain nothing but a slight trace of zinc, showing that the zinc coating had been almost entirely removed, excepting perhaps in some locations where the sediment had collected in sufficient quantities to quickly weaken the action of the acid solution.

Undoubtedly as it is now known from other experiences of a similar nature, the system will have to be replaced in altogether too short a period, with a new installation of pipe at a cost of several thousand dollars and much inconvenience on the part of the company. When the trouble at the Deere plants was at its height on an average of 40 to 50 men were ailing each day, and many were confined to their homes several days seriously ill. The writer has endeavored to find references to similar cases, or to find authority for stating that the zinc sulphide as found in the water issuing from fountains would cause the nature of sickness that was experienced by the employes but no similar case could be found and the information relating to the compound of zinc in this connection is very meager in any authorities on medical subjects. The only reference of importance which tends to throw any light on the subject at all is as follows: "Zinc chloride is never used internally, the smallest dose recorded as fatal to adults is 3.5 grams, the smallest fatal dose of zinc sulphate to adults is 15.5 grams, the dose as an ametic is 1 gram, the regular dose .016 to .032 grams equals 16 to 32 parts per million, or .25 to .50 grains per gallon."

Taking into consideration the amount of zinc contained per gallon as given by the references, and the amount contained in the average water in the Deere works, it would be necessary to drink from 1 to 2 gals. of water in order to take into the system a regular medicinal dose, but since the majority of fountains in the Deere works are controlled by valves, to be opened at the time of drinking, or if flowing slightly and an increased flow is desired, this operation generally raised a very large amount of zinc sulphide collected in the pipe below the fountain and was no doubt taken into the system while drinking. This precipitate was so heavy that ⅛ in. has been seen to collect upon the bottom of an ordinary drinking glass full of water. In this case very much less than 1 gal. of water would be needed to cause serious results if taken into the system.

In certain methods of galvanizing a mercury solution is used apparently for the purpose of forming a closer bond between the pipe and the zinc coating. It is also a well known fact that in large quantities of zinc on the market, which may be used for galvanizing purposes, there are contained as impurities appreciable amounts of lead and arsenic, both of which are capable of forming poisonous compounds, that together with the mercury used would result in serious consequences should the galvanizing be attacked in the manner which has just been described. In view of these facts and for the reason that artesian well water seems to be growing in favor, particularly for domestic purposes, architects and engineers having supervision of installations of drinking water systems, whether for industrial establishments or private homes, would do well to consider carefully the source and quality of water to be used as well as its effect upon certain classes of pipe.



Plan and Elevations of Harrison's Patent Adjustable Triangular Notch for Regulating and Measuring Flow of Water.

Adjustable Notches for Measuring the Flow of Water.

(Staff Article.)

The Harrison Patent Adjustable Notches were designed to furnish a simple method of regulating and measuring the flow of water discharged into channels such as, for example, the service laterals of irrigation canals. The accompanying illustration shows the front and end elevations and the plan view of the Triangular V Notch. This device consists of a fixed weir with an adjustable plate one edge of which can be moved horizontally. The adjustable plate is moved across the notch in the fixed plate, thereby reducing the area of the orifice without altering its form.

In the illustration the movable panel is shown with its advancing edge coincident with one edge of the fixed notch. In this position the notch delivers its maximum quantity. The panel may be moved to the left until its advancing edge occupies the position shown by the dotted line, when the notch opening is entirely closed. The movable panel is secured in position by means of locking screws at the position necessary to give the requisite discharge. The notches are graduated and calibrated, and are readily set for any intermediate discharge desired between the maximum and minimum limits of flow. The apparatus can be arranged with one or more notch openings in the fixed plate. These notches may all be controlled by means of a single sliding panel, or they may each be controlled by means of a separate movable panel if so desired.

In addition to the triangular notch described there are also two forms of adjustable rectangular notches. In one type the bottom edge or sill of the rectangular notch is raised or lowered by moving the adjustable plate back and forth along an inclined plane. This reduces the area of the orifice without altering its form. This type is used for narrow channels. In the other type of adjustable rectangular notch one end of the notch is made movable. This type is used when the channel is wide. The agent for these devices in the United States is Mr. E. K. H. D'Aeth, Produce Exchange, New York.

Spuds of Native Timber for Panama Dredges.—It has been found necessary to resort to native wood for the manufacture of new forward spuds for the dipper dredges "Mindi" and "Chagres," at work in the Atlantic Division, Panama Canal, because of the lack of other timber of suitable size in the stock piles of the Canal Commission. The native timber is obtained in the vicinity of Gatun Dam. The wood is fairly close grained, slightly resembling oak. It has not the resisting power of Douglas fir or yellow pine, and serves only as a temporary substitute. In order to strengthen them the timbers are encased in iron plates made into a continuous piece by welding the short lengths together. Each plate is ¾ in. thick 36 ins. wide and 48 ft. long, and is fastened to the spud timbers by 1⅛-in. rivets. The plates, four to each timber, add a weight to each spud of about 9 tons, making the total weight about 20 tons. The spuds on the dredge "Mindi" are 40 x 40 ins. square and 57 ft. long; on the "Chagres," 36 x 36 ins. square by 68 ft. long. The "Mindi" has broken 9 spuds in the past two years and the "Chagres" 19. The "Chagres" spuds are longer and therefore subjected to greater strain, and also, the sectional area is much smaller.

Motor Vacuum Street Cleaner.—In many cities of Europe various types of vacuum cleaners are being tried on the streets. Most of them are motor vehicles in which the motor operates the suction pump and drives the car. In Milan a street sweeper similar to the ordinary carpet sweeper is being used. A revolving broom, 5 ft. wide and 4 ft. thick, revolves in an iron shell, which fits it closely except for the slot where the broom sweeps the pavement. The motor drives the broom round so fast that it creates a suction in the shell, sucking in dirt that is stirred up by the bristles. The dirt is then carried two-thirds of the way round the shell and thrown into a bin.

Road Testing Laboratory.—The University of Colorado operates a laboratory for testing road materials in connection with the highway engineering department. This laboratory is the only one of its kind in the Rocky Mountain region and contains all the machinery and chemical apparatus necessary for such work.

Method of Moving a 100,000 Gallon Elevated Water Tank.

(STAFF ARTICLE.)

An elevated water tank 140 ft. high and weighing 48 tons was recently moved bodily a distance of about one-fourth mile at the West Pullman works of the International Harvester Co. This is the first record known to us of such a task being performed and since it was done without accident and at a contract price less than the estimated cost of dismantling and re-erecting the tank, a description of the methods employed is of interest.

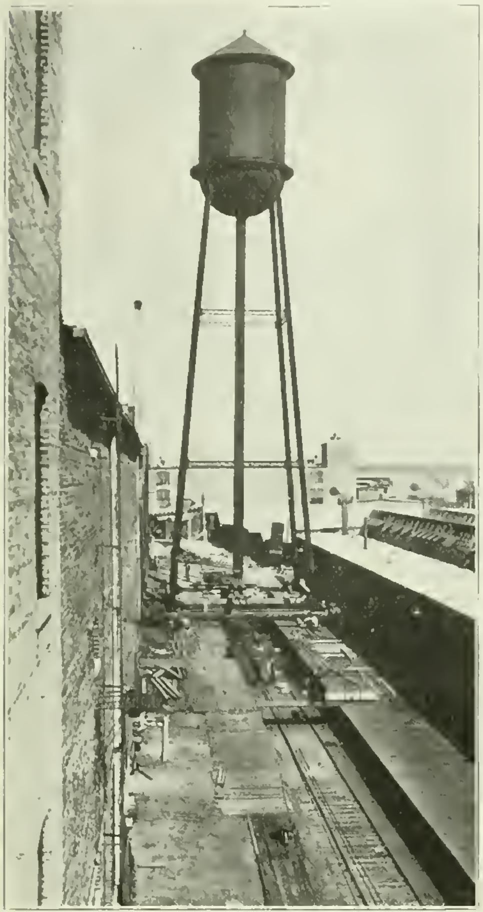


Fig. 1—View Showing 100,000-Gallon Elevated Tank Being Moved One-fourth Mile to New Location.

The character of the tank and tower is indicated by Fig. 1. The whole structure is of steel. The route followed in moving the truck was for 150 ft. on a curve of about 100 ft. radius, thence on tangent for 600 ft. between two rows of buildings (Fig. 1), thence on a long curve through a freight yard to the new location, where the tower was turned, as on a pivot, through an angle of 45°. The total distance was nearly one-fourth mile and the total time required was 25 days. There was no interruption due to accident, and on one day of the work there was a gale of 40 miles per hour. The methods in detail were as follows:

To prepare the tower for moving its legs just above the base plates were encased with steel plate collars as shown at *A*, Fig 2. Then collars were attached to the legs by removing the original rivets and replacing them with bolts. These collars were connected first by 1½-in. tie rods *B* diagonally across the tower bottom and then around the four sides by 20-in., 100-lb. I-beams, *C*. The collars were of ⅜-in. plates and the view, Fig. 2, shows the arrangement and bolted connections quite clearly. The diagonal tie rods were provided with iron buckles which served both to give a strain on the ties and for making slight adjustments in fitting the foot plates to the anchor bolts in the new foundations.

After being connected up as described, the tower was jacked up about 4 ft. and onto a platform. This platform consisted of two 20x20-in. x 50-ft. "runners" placed just inside the tower legs, one on each side, and under the collars to which they were clamped as shown at *A*, Fig. 2. Across the runners 12x12-in. x 36-ft. timbers were spread and clamped as shown by Fig. 2. Then cross-timbers connected the runners rigidly together, supported the blocking for the delivery pipe to the tank and carried counterweights of pig iron *D* at each corner inside the tower legs and at the outer corners *E* of this platform. From each outer corner of the platform a guy was carried up to the adjacent leg and attached at a point about 30 ft. above its foot plate. The pig iron counterweights consisted of 25 pigs inside each tower leg and 50 pigs at each outer corner of the platform, the total weights brought the center of gravity of the the weights of the collars and I-beam braces and of the timber platform. These aggregate weights brought the center of gravity of the tower to about half way between the base and top, so that a tilt of 30 ft. at the top would be necessary to topple the tower over.

The track on which the platform traveled on rollers was a cribwork of timbers except for the distance between the two rows of buildings, Fig. 1, where the regular loading platforms served as tracks. These platforms were about 3 ft. high, so that the cribwork track approaching and leaving them was made the same height. This cribwork track was composed of 6x6-in. crossties laid up to the proper height and carrying a roller track of 2-in. planks. Two rows of cribwork, one under each "runner" of the carriage platform, were employed. The "runners" themselves had planks spiked on their under sides at each end and under these were a group of rollers, in all, therefore, four groups of about eight rollers each, 6 ins. in diameter. The cribbing was taken up from behind and built ahead as the tower advanced; about 50 ft. were built and the tower pulled this distance, then another 50 ft. of crib built.

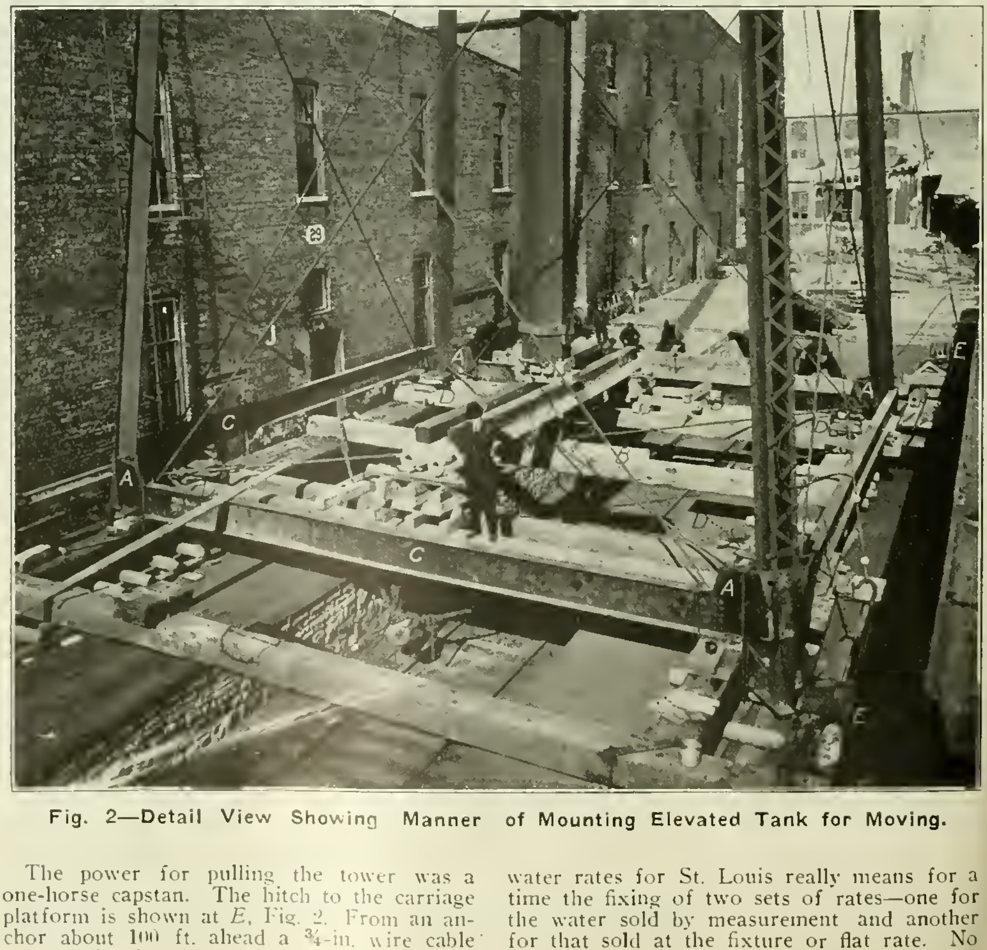


Fig. 2—Detail View Showing Manner of Mounting Elevated Tank for Moving.

The power for pulling the tower was a one-horse capstan. The hitch to the carriage platform is shown at *E*, Fig. 2. From an anchor about 100 ft. ahead a ¾-in. wire cable was carried back to one of the blocks at *E*, then ahead to a similar single block anchored ahead, then back through the secured block at *E* and then ahead to the capstan, from which the rope was run onto a reel. In twisting around corners the rollers were "skewed" under the runners to positions radial with the arc being traveled. To make the final revolution of 45° the rollers were properly skewed and a pull exerted in opposite directions from hitchers on opposite sides of the carriage platform.

The average force consisted of two men to manage the capstan and hauling ropes and six men to handle the rollers and build track. The straight 600 ft. run shown by Fig. 1, without much track construction was made in two days, but the whole distance, as already stated, required 25 days. The contractor for the work was the L. P. Friestedt Co. of Chicago, Ill., to whom we are indebted for the information from which this discription has been prepared.

A Study Made to Determine Equitable Water Rates for the City of St. Louis, Mo.

The establishing of equitable water rates in any city is a difficult problem, worthy of the most careful expert study. Truly equitable rates can be reached only after a thorough study of local conditions affecting the cost of furnishing water at the consumer's tap. The practice of copying the rates in vogue in other cities, without any effort to evaluate the difference in cost of supplying the water, leads to unequitable charges for service. Such a procedure is illogical and unscientific. Rates in other cities are useful in the study of a local rate case only as a rough check on the consistency of the local rates rather than as to the details of the charges. The study of equitable rate determination for the city of St. Louis here given was prepared by Edward E. Wall, Water Commissioner, and published as a part of his report to the Board of Public Improvements on the future requirements and needs of the city's water works system.

The establishment of a new schedule of water rates for St. Louis really means for a time the fixing of two sets of rates—one for the water sold by measurement and another for that sold at the fixture or flat rate. No flat rate schedule can be devised which will do even approximate justice to all, for the reason that the rate which averages right for a large number of families will be a rank injustice to the careful consumer, and equally unjust to the city in the case of the wastful consumer. No gas or electric company would attempt to give flat rates to consumers, except at exorbitant charges, yet 1,000 cu. ft. of gas is worth but little more than 1,000 cu. ft. of water.

In St. Louis about 7 per cent of the service connections are metered. These include all service connections larger than ¾ in. Nearly one-third of the water pumped into the mains is measured and paid for at meter rates. Almost two-fifths of the entire revenue of the water department comes from the meter rates. At first sight this would seem to indicate that the meter rates are too high, but as will be shown later, this inference would not be correct.

Ninety-three per cent of the services provide the remainder of the revenue, but less than one-half of the water pumped passes through these services.

Fully one-fourth of the water pumped is used for public and free service and unpreventable losses.

The net revenue for the year ending April 1, 1912, was $2,145,526.25. The total expenditure during the same time was $1,154 853.68, not including $300,000 set aside for the sinking fund and $133,799 for interest on bonds. The charter provides that the water rates for St. Louis shall be so fixed as to provide, at least, sufficient revenue to pay the cost of operation and maintenance, and for payment of interest on water works bonds. All extensions and improvements have, in the past, been paid out of the revenue. In order to arrive at the amount of revenue required it will first be necessary to estimate as nearly as possible the amount of money necessary for these purposes for each year for some time in the future, say a period of not less than ten years.

In order to do this intelligently, a review of the total expenditures for the past 30 years, and a careful analysis of these figures should lead to some definite conclusions, both as to the present and future cost of delivering water to the consumer.

Beginning with the year 1883, and ending with 1912, the total expenditures of the water department were as follows:

Water pipe and laying	$ 7,098,700.40
Water works extension and reconstruction	10,177,607.75
Assessment and collection of water rates	1,753,121.11
Operating and maintaining works	14,998,770.42
Interest on bonds and sinking fund	4,804,794.75
Total	$38,832,994.43

This is an average of $1 296,769.84 per year for 30 years with a net expenditure of $700,252.37 in 1883, $1,540,327.46 in 1910-11, and $1,588,652.68 in 1911-12. During the 30 years there was pumped 580,241 million gallons of water into the mains. The average cost per 1,000,000 gals. would, therefore, be $67.05.

The revenues collected during the 30 years amount to a net total of $41,686,783.21, or an average of $1,389,559.44 per year.

Attention is called to the fact that of the total amount of $4,874 795.65 paid for interest and sinking fund $4,384,429.10 was paid during the last eight years. After 1886 and until 1904 the interest on water works bonds was paid out of municipal revenue.

So that the expenditure for the first 22 years of the 30 years taken will average somewhat lower than the last 8 years. The average cost per 1,000,000 gals. for the 22 years from 1883 to 1904 inclusive was $61.77.

Since 1904 the additional cost of purifying the water has been added, so that the figures of the last eight years should be a better index as to present costs than the longer period. The expenditures for this period have been as follows:

Water pipe and laying	$ 2,244,778.90
Water works extension and reconstruction	2,356,654.52
Assessment and collection of water rates	564,601.73
Operating and maintaining works	6,843,839.00
Interest on bonds and sinking fund	4,384,429.10
Total	$16,394,303.25

This gives an average of $2,049,287.90 per year for the eight years during which time there was pumped 216,504 million gals. of water. The average cost per 1,000,000 gals. for this period would, therefore, be $75.72.

The revenues collected during the eight years amount to a total of $15,371,684.70, which is $1,022,618.25 less than the amount expended.

It is probable that the average cost for the immediate future will be greater than that of the last eight years for the reason that the expenditures for the new intake, and for increasing the capacities of the purification plant, of the pumping stations and of the distribution system, all of which must be done during the next few years, will be much greater than the average cost of extensions during the past eight years. The cost of extensions for the eight years just past, as given above, has been $2,356,654.52. The cost of new extensions which must be completed within ten years if meters are installed, is approximately $6,000,000, itemized as follows:

New settling basins or filters	$1,250,000.00
Intake tower and tunnel	550,000.00
Revetment of two miles of river bank	150,000.00
One 40,000,000-gal. pump at Chain of Rocks	40,000.00
Six boilers at Chain of Rocks	45,000.00
Two triple expansion pumps at Bissell's Point	220,000.00
New conduit from Baden to Bissell's Point	300,000.00
Pump main from Bissell's Point to Magnolia Ave	455,000.00
Meters	2,873,004.25
Total	$5,883,004 25

Assuming that the average daily pumping for the period of ten years would be 81.5 million gallons and applying this to the increase of $3,526,349.73 in the expenditures for extensions, we will have an increase of $11.85 per 1,000,000 gals., which, added to the former figures of $75.72, gives $87.57 as the probable average cost per 1,000,000 gals. of water pumped during the next ten years. No account has been taken of interest on the money invested during the ten years, nor on the capital invested in the entire plant. No depreciation, except on meters has been figured in the expenditures.

As the St. Louis Water Works is a municipal plant and is not operated for profit and, going on the theory that the people prefer to have this public utility operated for their use, comfort and convenience at a charge to them which covers only the necessary expenditures, taking their profit on the investment in reduced charges for water and efficient service, no effort will be made to estimate interest or depreciation.

The necessary expenditures over and above operating expenses for the coming ten years, if meters are not installed, will approximate the same amount of $6,000,000 as follows:

New settling basins or filters	$1,250,000
Intake tower and tunnel	550,000
Revetment of two miles of river bank	150,000
Pumps, boilers, etc	1,120,000
Interest on bonds for new works to be begun in 1915, and partially completed by 1923	1,440,000
Sinking fund for redemption of $12,000,000 bonds to run 30 years—$400,000 per yr. for 5 years	2,000,000
Total	$6,510,000

So that it would seem a conservative estimate to say that $87.57 will represent the average cost per 1,000,000 gals. of water pumped for the next ten years.

As already stated, not more than three-fourths of the water pumped is delivered to paying consumers, so that it must be sold at an average price of $116.76 per 1,000,000 gals. to cover the total cost.

If all the water sold were measured to the consumers it would be possible to prepare a schedule of rates so that the average amount of $116.76 per 1,000,000 gals. would be collected. But with only one-third of the total pumpage measured, the fixing of flat rates for the rest becomes a vexatious problem.

First, in considering the question of establishing an equitable meter rate, it will be well to analyze the present consumption through meters, and the rates paid for same.

For the year ending April 1, 1912, the quantities of water sold through meters and the rates were as given in Table I.

The average rate at which this portion of the water pumped was sold was $93.60 per 1,000,000 gals., which is $23.16 less than the estimated average cost per 1,000,000 gals. for the next ten years. Taking the average cost of the water pumped during the last eight years, viz: $75.72, and calculating the price at which three-fourths of the pumpage must be sold to meet the expenditures, it will be found that an average amount of $100.96 per 1,000,000 gals. must be charged for the water sold, which is $7.36 more than was actually collected for the water sold at meter rates.

If three-fourths of the 30,506 million gallons of water pumped into the mains during the year ending April 1, 1912, had been paid for at the average meter rate of $93.60 per 1,000,000 gals., the revenue collected would have amounted to $2,140 819.20, or $4,707.15 less than was actually collected. This means that the water sold at flat rates was sold for approximately the same rate per 1,000,000 gals. as that sold at the meter rate, or $7.36 below the average cost of the past eight years.

TABLE I—QUANTITY OF WATER SOLD AND RATES PER 1,000 GALS. FOR YEAR ENDING APRIL 1, 1912.

Quantity in million gals.	Rate per 1,000 gals. in cts.	Amount collected.
303.6	25	$ 75,904
254.5	20	50,910
283.4	15	42,518
362.0	13	47,069
648.8	11	71,371
6,698.0	8	535,833*
99.6	7⅓	7,308†
353.2	3⅓	11,704‡
9,003.1		$812,687

*Manufacturers' rate.
†Special rate for Jefferson Barracks.
‡Special rate for public schools.

The first thought that would occur to any one reading the above statement would be that if the water department is selling water below cost, how is it that there is now and has been for twelve years a substantial balance ranging from $800,000 to $2,000,000 to its credit? Has the department been approaching bankruptcy all these years? The answer to such a question will be, first, that the cost per 1,000,000 gals. figured on the pumpage and expenditures of any one year may show a deficit, while other years will show a surplus, and only the averages for an extended period can mean anything; and second, that the unappropriated balance of over $2,000,000 to the credit of the department in 1904 has been reduced to less than $1,250 000 in 1912, showing an absolute loss of $4.72 per 1,000,000 gals. pumped during that period. Further, the present surplus will be almost, if not entirely, expended during the next two years.

TABLE II.—PRESENT METER RATES IN ST. LOUIS.

	Cts. per 1,000 gals.
For an average consumption of 1,000 gals. or less per day	25
For an average consumption between 1,000 and 2,500 gals. per day	20
For an average consumption between 2,500 and 5,000 gals. per day	15
For an average consumption between 5,000 and 10,000 gals. per day	13
For an average consumption between 10,000 and 25,000 gals. per day	11
For an average consumption of more than 25,000 gals. per day	8
For manufacturing purposes only, any quantity, per day	8

The fact that the department has been furnishing water to consumers for the past eight years at less than actual cost cannot be too strongly emphasized.

If the department is to be self-sustaining in the future a general reduction of rates is not to be considered but a revision to a more equitable schedule is most desirable.

Returning to the present meter rates, a glance at the quantities sold at each rate will show that they are based on no logical foundation. There may be some justification found for giving the manufacturer a rate as low as $80 per 1,000,000 gals., but there can be none for the ridiculously low figure of $33.33 for the public schools, which should be treated as other consumers.

The present meter rates are as given in Table II.

The above schedule permits the user of water to take advantage of a lower rate by wasting water, and makes it economical for him to waste water, whenever his legitimate use of water approaches the maximum under the rate.

For example, the consumer whose average use of water is over 18,400 gals. per day can reduce his bill for water by wasting water until his daily average reaches 25,000 gals. or more, thus:

Taking the period of six months (150 days) for which bills are rendered, at the average use per day of 18 400 gals., and at 25,000 gals. his bills would be:

18,400 gals. for 150 days at 11 cts. per 1,000	$303.60
25,000 gals. for 150 days at 8 cts. per 1,000	300.00

The nearer his legitimate use approaches the maximum, the greater his saving would be, for example:

22,000 gals. for 150 days at 11 cts. per 1,000	$363
24,000 gals. for 150 days at 11 cts. per 1,000	396

These rates put a premium on wasting water, and work gross injustice on the careful consumer, who uses only the quantity of water he needs. Also the 25-ct. rate for consumers using less than 1,000 gals. per day virtually prohibits the use of meters to small consumers, and enforces an exorbitant charge against the unfortunate small user, who is compelled by law to have a meter placed on his service pipe.

In establishing a schedule of meter rates for water many cities have proceeded on what may be called the minimum rate method.

This method, properly worked out, insures an equitable rate to all consumers. The minimum rate for each size of meter allows the consumer to use a certain quantity of water per year, giving him a lower rate for all water used in excess of the allotted amount.

The schedule of meter rates given in Table III is calculated on the minimum rate plan.

TABLE III.—SCHEDULE OF RATES CALCULATED ON MINIMUM RATE PLAN.

Size of meter. Ins.	Minimum annual charge.	Gals. of water allowed annually.	Rate per 1,000 gals. for water used in excess of allowance. Cts.
½	$ 3	12,000	16
⅝	5	25,000	16
⅝	9	50,000	16
¾	17	100,000	15
1	31	200,000	13
1½	56	400,000	10
2	75	600,000	9
3	110	1,000,000	8
4	190	2,000,000	7
6	330	4,000,000	6
8	570	8,000,000	6

The charge for water would be calculated on each individual meter, and not on the total quantity used by the individual, firm or corporation using water and having more than one meter. As all water licenses must be paid in advance, the deposit required under the above schedule would not be the minimum charge, but would be in each case an amount sufficient to pay for the average amount of water used in the class of premises under which it would come.

Fixing the amount of deposit required would present no more difficulty than under the present schedule, the only difference being in those cases where more than one meter is used to measure the supply into the same premises.

In case of vacation of premises, rebates would be paid only on the amount deposited above the minimum annual charge, and only such part of that as remained, in case the consumer had exceeded his anual allowance.

For example, if a license were issued for a ⅝-in. meter, minimum annual charge of $9 and a deposit of $10 made for the first six months, and the consumer should vacate the premises inside of 60 days, the meter showing a consumption of 20,000 gals., the rebate given him would be $5.50, although he would not have used up the allowance of 25,000 gals. provided for by the minimum charge. If, on the other hand, his meter showed a consumption of 40,000 gals. during the 60 days of his occupancy, his rebate would be only $3, since he would be charged with 15,000 gals. of water in excess of his allowance, at the schedule rate of 16 cts. per 1,000 gals. In the first case he would be paying 22½ cts. per 1,000 gals. for the water used during the 60 days, and in the second case, 17½ cts.

TABLE IV.—REVENUE UNDER PROPOSED SCHEDULE FOR CONSUMPTION DURING YEAR ENDING APRIL 1, 1912.

Size of meter. Ins.	Number of meters.	Total quantity in million gals.	Approximate average per meter in gals.	Minimum annual charge.	Rate per 1,000 gals. used above allowance. Cts.	Total collections.
⅝	1,246	62.3	50,000	$ 3	16	$ 11,214
⅝	1,246	186.9	150,000	5	16	31,150
⅝	1,245	311.2	250,000	9	16	51,054
¾	1,102	441.0	400,000	17	15	68,324
1	795	795.0	1,000,000	31	13	107,325
1½	402	603.0	1,500,000	56	10	66,732
2	558	1,395.0	2,500,000	75	9	137,268
3	273	1,638.0	6,000,000	110	8	139,230
4	207	1,763.0	8,500,000	190	7	133,515
6	56	2,912.0	52,000,000	330	6	179,760
8	2	118.0	59,000,000	570	6	7,260
	7,132	10,225.4				$932,832

The above schedule affords no opportunity for a consumer to reduce his water bill by wasting water until his consumption becomes great enough to give him a lower rate, but it does give lower rates to the majority of consumers, and does not establish any list of preferred customers.

To apply the above schedule of rates to the 9,003 million gallons of water measured through 7,132 meters during the year ending April 1, 1912, and paid for at the existing meter rates, necessitates a division of the total quantity measured, among the different sizes of meters in use. An inspection of the records shows that for the 3,737 ⅝-in. meters in service, the quantity of water passed through each meter during the year ending April 1, 1912, varied from 10,000 to 350,000 gals. with an approximate average of 150,000 gals. Approximate averages for the other sizes are given in Table IV.

The proposed schedule provides for three rates for ⅝-in. meters, in order to allow a low minimum rate for the small user of water. Therefore, the total quantity of water passed through ⅝-in. meters will be divided into three parts, so that the average for each meter will be 150,000 gals.

The revenue which would have been collected last year under the proposed schedule is given in Table IV.

The above schedule gives an average charge of about 9⅛ cts. per 1,000 gals.

These figures must be considered only as approximations based on averages, and the actual effect on the revenue may vary considerably in either direction. The effect on the individual consumer will be to lower the bills for all small consumers who are not at present enjoying the manufacturers' rate of 8 cts. per 1,000 gals., and will include all residences, tenements, stores, shops, stables, garages, office buildings, etc.

The manufacturer who uses less than 4,000,000 gals. of water per year will have to pay more than the present rate, but if he uses 5,000,000 gals. or more, his rate will be less than 8 cts.

The adoption of a sliding scale of charges such as one proposed, as well as that now in effect, is in accordance with the rules under which private business is conducted, namely: to give the buyer of large quantities the advantages of lower prices.

Although there is in St. Louis a special rate for manufacturers, established no doubt for the ostensible purpose of inducing them to locate here, yet there is no logical reason why such a concession should be made to them. The manufacturer of today, whose presence in any community is desirable, is influenced in his choice of a location more by the general facilities for clean and wholesome living for his employes, and by the average prosperity of the locality, than by the proportionately small expense of a high water rate.

To show what an inconsiderable fraction the cost of water is of the value of manufactured articles, the following example is cited:

At one of the large breweries in St. Louis, the total water license paid per year amounts to a tax of 4 cts. on each barrel of beer containing 31 gals. and sold at $8. The following are also examples of a similar nature:

Cost per automobile manufactured and sold for $2,500	.53 cts.
Cost per thousand brick manufactured and sold from $7 to $20	2 cts.
Cost per pair of shoes manufactured and sold from $1 to $2.50	$.00209

The water license paid by one large shoe manufacturing corporation amounted to slightly more than 3/100 of 1 per cent of its total annual sales, estimated at 7/10 of 1 mill per pair of shoes. Besides there is no earthly reason why the water works should supply anybody with water below cost. If the City of St. Louis decides that, in order to induce manufacturers to locate here, it is necessary to hold forth special inducements of some kind, then these should take the form of cash bonuses paid from municipal funds, reduction or exemption from general taxation for a number of years, a remittance or abolishment of manufacturers' licenses, or some method in the expense of which the whole tax-paying body of citizens should participate. There is no reason why the expense of such concessions should be confined to the water department, where a certain percentage of license paying citizens would be overcharged in order to make up the deficit caused by a preferred rate to one particular class of consumers. The injustice of such a procedure is too apparent to require further comment.

All over this country the subject of the charges made by public service corporations is being discussed and efforts made to reduce rate making to a more rational basis where a "square deal" shall be given both to the consumer and the investor. These efforts are especially directed towards the prevention of unfair charges against different classes of consumers. Rates should not be based upon favoritism, or the amount of good which the consumer gets from the service, nor upon the quantity of the product for which he pays, except in so far as this last item affects the cost of the service. Following out this idea that a municipal plant should base its rates on absolute justice to all the citizens, then water should be sold to all at a uniform price per 1,000 gals., the only difference made between the small and large consumer being in a graduated service charge to cover the interest and depreciation charges on the cost of meters in place, including, of course, the cost of maintenance, reading meters and making out and delivering bills. It is evident that the above costs applied to one 6-in. meter through which 60,000,000 gals. of water passes each year, will be many times less than the same costs on 400 ⅝-in. meters, each of which passes 150,000 gals. per year.

The objection to a graduated service charge will come from the small consumers, who are by far the greater in number, and to whom the meter charge may in some cases approach or even exceed the charge for the water used.

The service charge calculated on a 4 per cent interest charge on the cost of the meter, depreciation estimated on a life of 15 years, 4 per cent of the cost taken to cover testing and repairs. and a flat charge of 66 cts. per meter for clerical work and delivering bills, will amount to the following schedule in even figures:

Per meter.	Annual service charge.
Each ½-in. meter	$ 2.00
Each ⅝-in. meter	2.50
Each ¾-in. meter	3.00
Each 1 -in. meter	5.00
Each 1½-in. meter	10.00
Each 2 -in. meter	14.00
Each 3 -in. meter	20.00
Each 4 -in. meter	30.00
Each 6 -in. meter	50.00
Each 8 -in. meter	100.00

For all water recorded by meter, the consumer would pay a flat price of 10 cts. per 1,000 gals., regardless of the quantity used.

The annual service charge would be collected only for the time the premises were occupied, but no service charge for any period should be less than $1. Rebates would be made to the owner or occupant for the unexpired time of his license, and for the balance of his deposit remaining after the value of the water used had been deducted.

The annual service charges adopted by the Sewerage and Water Board of New Orleans are as follows:

On each ⅝-in. meter	$ 4.00
On each ¾-in. meter	5.00
On each 1 -in. meter	6.60
On each 1½-in. meter	10.60
On each 2 -in. meter	14.60
On each 3 -in. meter	22.00
On each 4 -in. meter	36.00
On each 6 -in. meter	64.00
On each 8 -in. meter	97.00

The charges proposed at Louisville are as follows:

For each ½-in. meter	$ 4.50
For each ⅝-in. meter	6.00
For each ¾-in. meter	9.00
For each 1 -in. meter	12.00
For each 2 -in. meter	24.00
For each 3 -in. meter	36.00
For each 4 -in. meter	48.00
For each 6 -in. meter	72.00

Water rates based on a graduated service charge as previously outlined will be without discrimination, equitable and just to all consumers. The price of 10 cts. per 1,000 gals. is as low as water can be furnished, so long as all extensions and additions are paid for out of the revenue, and also so long as water is furnished free for public use and fire protection. It is questionable whether the total cost of extensions and additions should be made a direct item in rate making. New water pipe laid, meters, new pumps built and, in fact, all new work which increases the capacity or adds to the efficiency of the service might well be separated from the items making up the yearly expenditure for the water works. These expenses could be readily taken care of in the following manner: Authorize the issuance of 30-year bonds to the amount of $6,000 000 to cover the cost of necessary extensions during the next ten years, sell these bonds from time to time, appropriate the money by ordinance for each piece of work as it became necessary, and charge only the interest and annual sinking fund to the operating costs in making up rates.

The figures for operating and maintaining the works during the past eight years give an average cost of $926,055.09 per year.

Placing this item at $1,000,000 per year for the average of the next ten years, the total expenditure per year upon which rates would be based is as follows:

Operating and maintaining	$1,000,000
Interest on bonds now outstanding	133,000
Sinking fund bonds now outstanding	300,000
Interest on new bonds	120,000
Sinking fund new bonds	200,000
Total	$1,753,000

Estimating the average annual quantity pumped at 30,000 million gallons (with general installation of meters), would give $58.43 as the average cost per 1,000,000 gals. of all the water pumped. Paying consumers who use not more than three-fourths of the total must pay an average of $77.91 per 1,000,000 gals. to cover the above expenditure. Should the method of paying for all new work by bond issues be adopted, the rate per 1 000 gals. could be made 8 cts. for all consumers.

To go a step farther and abolish the free use of water entirely, making all city departments pay for water used, and establishing an annual charge for fire protection, at so much per fire hydrant, would enable the department to supply water to all consumers at a still lower rate than 8 cts. per 1,000 gals., probably about 6½ cts.

TABLE V.

No. houses.	Av. No. rooms in each.	Baths in each.	Toilets in each.	Total number occupants.	Av. per house per year in gals.	Licenses: Present flat rate.	Licenses: Service charge method.	Licenses: Minimum rate method.
1	20	8	8	13	764,952	$62.00	$79.50	$90.00
1	21	2	5	10	632,808	50.50	66.50	78.00
3	14	3	3	16	303,504	29.00	33.50	44.50
3	12	2	2	13	237,108	23.00	26.00	36.00
2	11	2	3	12	149,596	26.00	17.50	24.50
3	10	1	2	18	112,020	16.00	13.50	19.00
3	9	1	1	13	88,392	12.00	11.50	15.00
6	8	1	1	24	58,248	12.00	8.50	10.50
3	7	1	1	15	67,788	10.00	9.50	12.00
4	6	1	1	17	58,920	9.00	8.00	10.50
2	4	1	1	12	37,176	8.00	6.00	7.00

The principal arguments for the adoption of the above policies are that the payment of the first cost of all new work should be distributed over a long period of time, and not made a direct charge on water users at the time the work is done; also that the free use of water and for fire protection should be made a charge against the public funds since all of the people in the city benefit by such service. If the various departments of the city government to whom water is now furnished free in unlimited quantities, knew that the cost would be taken from their funds, there would soon be a most remarkable decrease in the quantities found necessary for their use. At least 25 per cent of the water now supplied for free and public use is wantonly and carelessly wasted.

A great many users of water under the present flat rates are really paying less than half the rate per 1,000 gals. that the small user under meter is obliged to pay, where the law requires him to have a meter. Many of our larger residences on flat rates are paying less than the manufacturers' rate of 8 cts. per 1,000 gals.

TABLE VI.

No. houses.	No. rooms in each.	Total No. occupants.	Av. per house per year in gals.	Licenses: Present flat rate.	Licenses: Service charge method.	Licenses: Minimum rate method.
Residences Without Toilets or Baths.						
3	3	9	26,109	$ 2	$4.50	$ 6.00
4	4	19	28,332	3	5.00	5.50
7	5	31	34,730	3	5.50	6.50
7	6	38	40,036	4	6.50	7.50
6	7	34	28,750	5	5.50	5.50
6	8	63	38,649	6	6.50	7.00
5	9	58	48,323	7	8.00	9.00
4	10	33	51,428	8	8.00	9.00
1	11	8	59,844	9	9.00	10.50
5	12	41	50,867	9	8.00	9.00
1	15	13	59,844	11	9.00	10.50
1	18	16	33,662	11	8.50	6.50
Saloons With Rooms Above.						
1	5	3	67,324	23	9.50	12.00
1	7	8	44,883	25	7.50	8.00
1	8	12	78,545	26	11.00	13.50
1	9	6	56,103	27	8.50	10.00

Table V gives the average consumption, number of rooms, occupants present flat rate, and the amount each would pay under the service charge and minimum rate methods.

Table VI gives the average consumption measured in a number of residences, stores, etc., during the past yeai

The residences in the lists given in Tables V and VI were selected each as representing the average house of its size and class, so that the consumption recorded could be reasonably taken as a basis for rate comparison.

It is evident that the flat rates bear but slight relation to the quantity of water used, the charge per 1,000 gals. varying from 7¾ to 55 cts. Either the service charge or minimum rate method make a schedule of charges more equitable and upon a logical basis. Every citizen should be willing to pay for what he receives, especially if he knows that water is being furnished him at cost. Because, in years gone by, he has been getting his water supply at the expense of his fellow citizens is no reason why such a happy condition for him should be perpetuated.

It is only by beginning the installation of meters and carefully watching the effect upon the consumption and revenue that the price per 1,000 gals. can be finally established. The facts and figures given in this report and the deductions therefrom can serve only as a basis for a start toward the final establishment of just and equitable water rates fitted to suit our local conditions.

Convention American Water Works Association.—The 33d annual convention of the American Water Works Association will be held at Minneapolis, Minn., June 23-27, 1913. The following papers have been announced: The Deisel Engine for Water Works, by Edward S. Cole; Water Works Special Franchises, by Henry De Forest Baldwin; Reforestation and General Care of Water Sheds, by Ermon M. Peck; The Bacterial Count on Gelatin and Agar Media and Its Value in Controlling the Operation of Water Purification Plants, by James M. Caird; The Tuscaloosa, Alabama, Water Works, by Prof. Edgar B. Kay; a paper on Filtration, by George W. Fuller; Charges for Public Water Service to Private Fire Protection Systems, by W. E. Miller; A. Reasonable Basis for the Determination of Charges for Private Fire Protection, by Leonard Metcalf; Metering Private Fire Services at Kenosha, Wisconsin, by August Baltzer; How a Private Fire Service Polluted a Public Water Supply and Some of the Consequences, by Robert J. Thomas; Modern Filter Practice, by Nicholas S. Hill, Jr.; Gravity Water Supply at the City of Manila, Philippine Islands, by H. E. Keeler; Power for Pumping Derived from Refuse, by E. H. Foster; Pumping Engines, by L. E. Strothman; Ground Water Supplies, by Charles B. Burdick; Rates and Rate Making, by Halford Ericson. There will also be illustrated lectures by Edward Wegmann and Dr. William P. Mason. A few other papers will be added to the list here given and there will be an experience meeting and a question box. The convention headquarters, exhibits, and office of the Secretary will be at West Hotel, where the business sessions will also be held. John M. Diven, 47 State St., Troy, N. Y., is Secretary of the Association.

Work on Gatun Dam.—The hydraulic fill of Gatun Dam was begun in March, 1909, and completed in September, 1912. The fill was made by suction dredges pumping from nearby borrow pits, and amounts to 10,124,082 cu. yds. The dry fill of the dam was begun in 1907, and has continued to the present time, 11,385,362 cu. yds. being in place on May 1. On that date the dry fill, exclusive of paving, was approximately 98 per cent completed. The work of paving the lake side of the dam for a distance of 10 ft. above and below the normal level of the water, 85 ft. above sea level, is in progress. About 175,000 cu. yds. will be required for this purpose.

BRIDGES

Method of Replacing a Five-Span Through Truss Bridge with Deck Plate Girder Spans, Chicago & Alton Railway.

(Staff Article.)

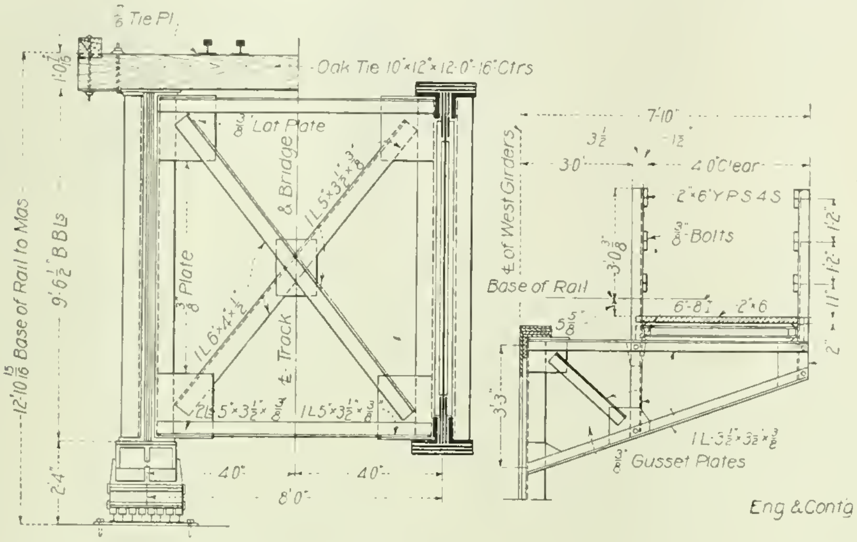


Fig. 1—Cross Section and Sidewalk Details of New Plate Girder Spans for Chicago & Alton R. R. Bridge at Wilmington, Ill.

The bridge replaced had five pin-connected through truss spans and a suspended floor system. It crossed the Kankakee River at Wilmington on the single track line of the Chicago & Alton R. R. between South Joliet and Mazonia, Ill. The crossing is skewed 31 degrees. The trusses weighed 52 tons each.

The new bridge is a single track deck plate girder bridge with a cantilever sidewalk on one side as indicated by Fig. 1. The plate girders have a span of 107 ft. 6 ins., and weight 45 tons each. Figure 1 and the views Fig. 2 and Fig. 3, indicate the general character of the old and new structures. The task was to replace the truss spans with the plate girder spans with as little interruption as possible of traffic over the bridge. Fortunately this task was simplified by the fact that the railway company was able to route certain trains over the double track line operated by it between South Joliet and Mazonia. This was done for about six hours on each of the five days on which the floor system for one of the truss spans was being cut out and the girders set. The bridge was closed for traffic, therefore, for six hours a day for five days.

The replacement work required two operations. The first operation was the elevation of the grade over the bridge to provide for the difference in clearance between a through and a deck bridge. The second operation was the actual dismantling of the old spans and the erection of the new spans. The grade elevation was carried out by the railway company and the bridge replacement proper was performed by contract.

Grade Elevation.—It will be seen from Fig. 1 that the height of the new plate girders from bottoms of end pedestals to base of rail was 12 ft. 10 ins. It was decided to provide for the excess between this dimension and the depth of the truss span floor system by raising the grade 4½ ft. and by cutting down the old bridge seats. The old masonry also had to be repaired and added to in places. Briefly, the noses of the old stone piers were rebuilt of concrete and a 21-in. facing of concrete was placed on the abutments. The abutment wing walls were also extended to provide for the higher embankment. Then the embankment approaches were widened, and all was ready to raise the old spans and the approach embankments to the new grade. By widening the embankments before raising was begun, it will be seen that only a moderate amount of embankment material had to be hauled in to raise the grade rapidly and keep pace with the jacking up of the bridge.

The arrangement for jacking up the truss is shown by Fig. 4; four of these devices were provided so that the adjacent ends of four trusses or two spans could be raised simultaneously. As shown by the drawings each device consisted of a yoke *A* of two parallel I-beams bolted together through timber separators. This yoke carried two short channel yokes *B* from each of which hung a U bolt the loops of which engaged the projecting ends *C* of the end pin of the truss. Under each end of the yoke *A* was placed a block *D* and under this a locomotive jack *E*. At the beginning of operations the jacks *E* rested on the pier masonry, but as the truss was raised blocking was built under the jack as indicated by the drawing.

The jacking operations proceeded as follows: The four jacking devices were placed and connected up to the four adjacent truss ends. The four trusses were raised simultaneously 6 ins. and a layer of 6-in. blocking as at *F*, Fig. 4, was inserted. The jacking devices were then released and taken to a succeeding pier and the four truss ends resting there were jacked up and blocked. The jacking devices were again carried ahead and the succeeding truss ends were jacked up and blocked and these operations were repeated until all five trusses had been raised 6 ins. At the abutments only two jacking devices had to be used. Also, since the end stringers of the trusses rested directly on the piers, a separate jacking operation was necessary. A box girder of 15-in. I-beams was placed along the bridge seat under the stringer ends and under the ends of this girder jacks were placed. This arrangement enabled the stringer ends to be raised and blocked up simultaneously with the trusses. Successive raises of 6 ins. carried out as described elevated the old truss spans to the new grade level. A gang of six to eight men handled all jacking operations.

Replacing Bridge Spans.—After the old bridge had been completely jacked up by the railway company, the work of replacing the old spans was turned over to the Strobel Steel Construction Co., Chicago, Ill. The contractors task consisted in removing the old spans and of erecting the new plate girder spans. The equipment used consisted of an Industrial Works locomotive crane of 30 tons capacity and a derrick car. Two flat cars were employed to bring in the new girders and take out the old trusses. A locomotive was also furnished to aid the crane and derrick in hauling the spans to and from the yard.

The sequence of operations was approximately as follows: The first day a gang of about 13 iron workers cut the rivets out of the floor system of one span and replaced them temporarily with bolts. The next morning at 5 o'clock the last train passed through and service was routed for the next six hours or so on the other line. The two girders for the span were brought in on flat cars and set at opposite sides of the track next to the trusses and blocked up on the piers to 10 ins. above the rail. The floor system for the old span was then taken out. The rails were

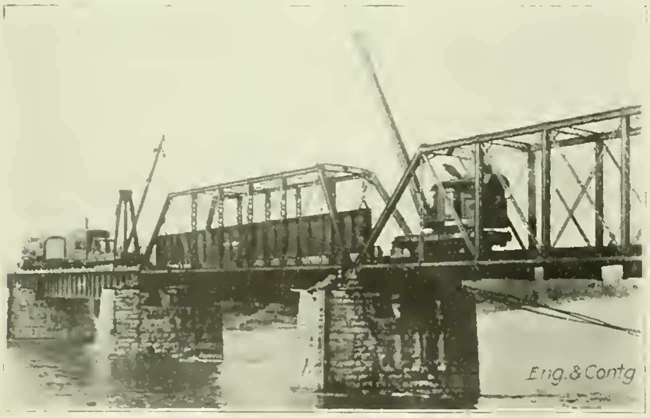


Fig. 2—View Showing Method of Placing Plate Girders, Chicago & Alton Bridge.

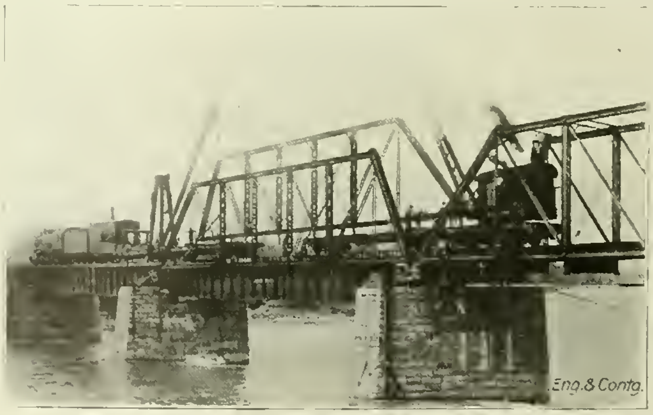


Fig. 3—View Showing Manner of Taking Down Old Trusses, Chicago & Alton Bridge.

carried back to the adjacent spans and the ties slipped out through the 10-in. space under the girders. The stringers were then unbolted and lifted by tackle suspended from the trusses and placed on the flat cars, as were also the beams. On the shore spans the floor members were dropped onto land below the bridge and these members were lifted out after the bridge was completed. After the floor beams and stringers were removed the girders were lowered onto the pier and bolted up, and the track relaid upon them. The bridge was then open for traffic.

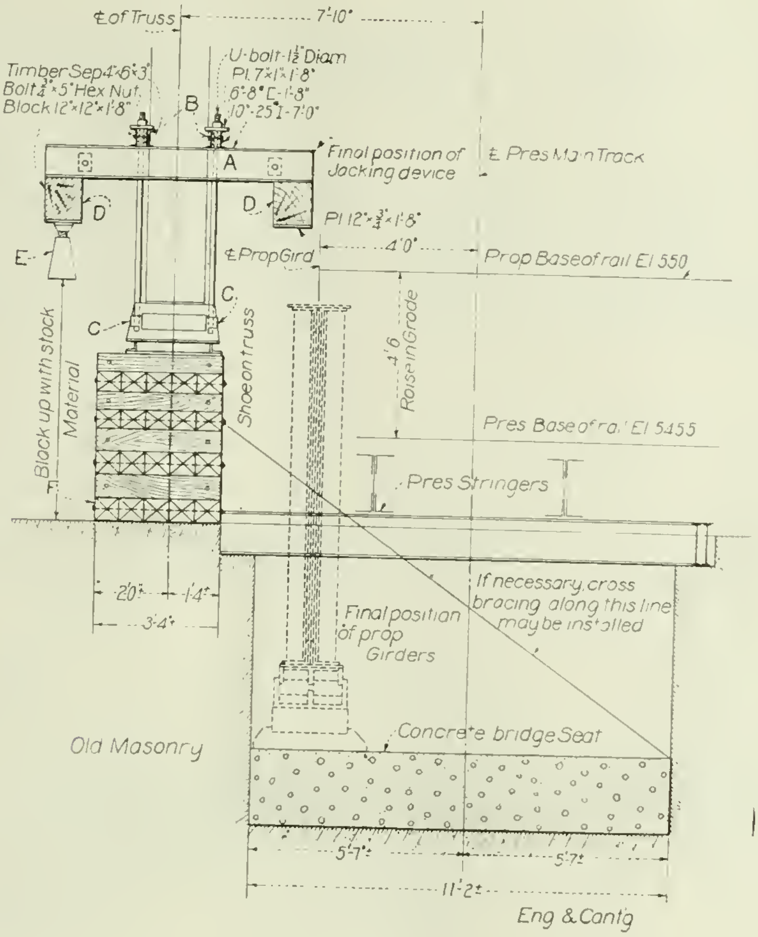
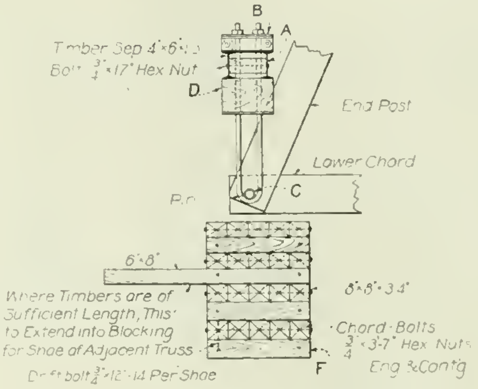


Fig. 4—Sketches of Jacking Devices for Raising Old Truss Spans, Chicago & Alton Bridge.

The following day the trusses for this span were made ready for removal. The top laterals were removed, except two at the U-1 points which were left bolted in place. Provision was also made for bracing a single truss from falling over after the other was taken out. An 8x16-in. timber about 30 ft. long was placed under the rails so that it projected about 20 ft. to one side of the bridge through the single truss. The rails were spiked to this timber and it was also lashed to the bottom chord of the truss over which it passed. One of the old bottom lateral pieces was bolted to the timber near its outer end and to the lattice column of the truss forming a diagonal brace. Two of these braces were placed for one truss. This work was done by 12 o'clock, at which time the last train until 4:30 passed through. This allowed plenty of time to remove the two trusses without interfering with traffic. The trusses were usually removed by 2:30 p. m. On one occasion the work was not done until 3:30 while on another the work was completed at 1:52 p. m. This was on the day of the removal of the last pair of trusses, April 30.

On this day the last train passed through at 12:05 p. m. The Industrial crane moved into the north end of the span at 12:10 with a crew of 1 engineer, 1 foreman and 4 men. Two men mounted the truss and made a hitch at the hip of the truss, using a 1¼-in. chain. Two other men blocked up the near corner of the crane car and placed the dogs tieing the car to the rails at the rear. They mounted the trusses and made ready to loosen and lower the lateral joining the trusses. At 12:32 p. m. the engine and derrick car with the two flat cars moved into the south end of the span with a similar crew and including a niggerhead man. The two crews were directed by the Superintendent. When both hip connections were made and a strain was taken on them the laterals were unbolted and lowered onto the flat cars. The cars were set far enough apart so that the load was carried on the two far trucks. A tie was placed at these points to receive the truss. The truss, which weighed 52 tons, was then lifted and set on the cars. The blocking under the front end of the derrick and crane car and the dogs at the rear then removed and the train was pulled slowly away with the truss being balanced by support from the booms of the derrick and crane. The truss was hauled away at 12:48. At 1:07 the truss was lifted from the car and set on blocks on the ground and before laying it down the men cut out the rivets at the base of the posts on one side so that they would not have to be cut from underneath after the truss was laid down. In laying the truss down care was taken to block it up approximately level so that the pins would not bind and be difficult to remove. The train moved back for the second truss at 1:25 p. m., which was hitched as was the previous one. The two diagonal braces were moved and the 8x16-in. timber was loosened and shoved back to clear the bottom chord. The truss was landed on the car and moved away at 1:52 p. m. It was landed on top of the first truss 15 minutes later, leaving the track clear for traffic. The following day after removing the trusses the men were employed in breaking them up and loading the parts on cars to be shipped to a junk yard in Chicago.


B
A
Timber Sep 4"×6"
Bolt 3/4"×17" Hex Nut
D
End Post
Lower Chord
Pin
C
6"×8"
Where Timbers are of Sufficient Length, This to Extend into Blocking for Shoe of Adjacent Truss
8"×8"×3'4"
Chord Bolts 3/4"×3'-7" Hex Nuts
F
Drift bolt 3/4"×12"-14 Per Shoe
Eng & Cont'g

On the contractor's force there were 19 men including the two gangs of steel men, the superintendent, timekeeper and laborers. The work was completed in 22 working days between April 2 and April 30. Two days were lost on account of rain and four days were

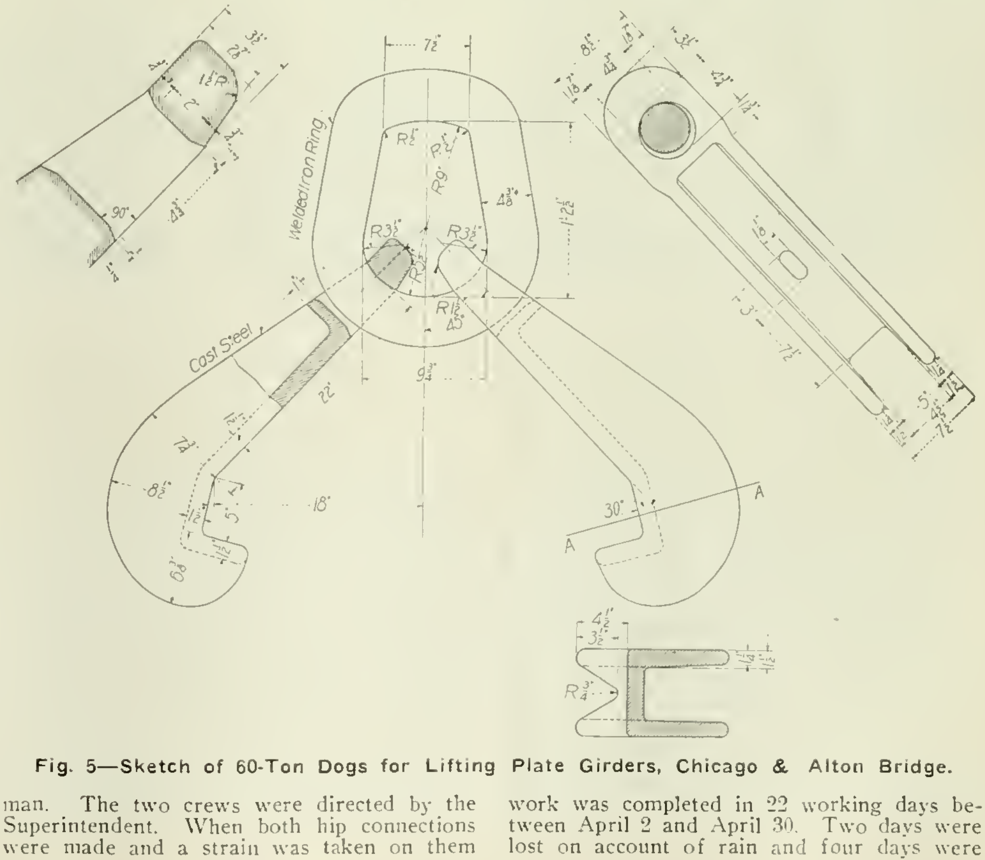


Fig. 5—Sketch of 60-Ton Dogs for Lifting Plate Girders, Chicago & Alton Bridge.

Sundays. The work was carried out under the supervision of Mr. H. T. Douglas, Chief Engineer of the C. & A. R. R., and Mr. J. W. Reid, Bridge Engineer. Mr. R. A. Cook, Assistant Engineer, had charge of the track elevation and concrete construction. The Gary plant of the American Bridge Co. fabricated the steel which was erected by the Strobel Steel Construction Co., with Mr. William McAley as Superintendent. We are indebted to these gentlement for the information from which this article has been prepared.

SEWERAGE AND SANITATION

The Design of Siphon and Grit Chambers for the Main Intercepting Sewer, Fitchburg, Mass.

The method of estimating the volume of the sewage flow to be handled by the new intercepting sewer at Fitchburg, Mass., was described in Engineering & Contracting of Sept. 4, 1912. The present article describes two interesting structural features of the main intercepter, namely, a siphon chamber and a grit chamber. Some data on sewer maintenance are also given. An article describing some of the chief features of the sewage disposal plant will be published in this journal two weeks hence. The information given in the present article is abstracted from the fifth semi-annual report of the Fitchburg Sewage Disposal Commission. David A. Hartwell is Chief Engineer, and Harrison P. Eddy is Consulting Engineer.

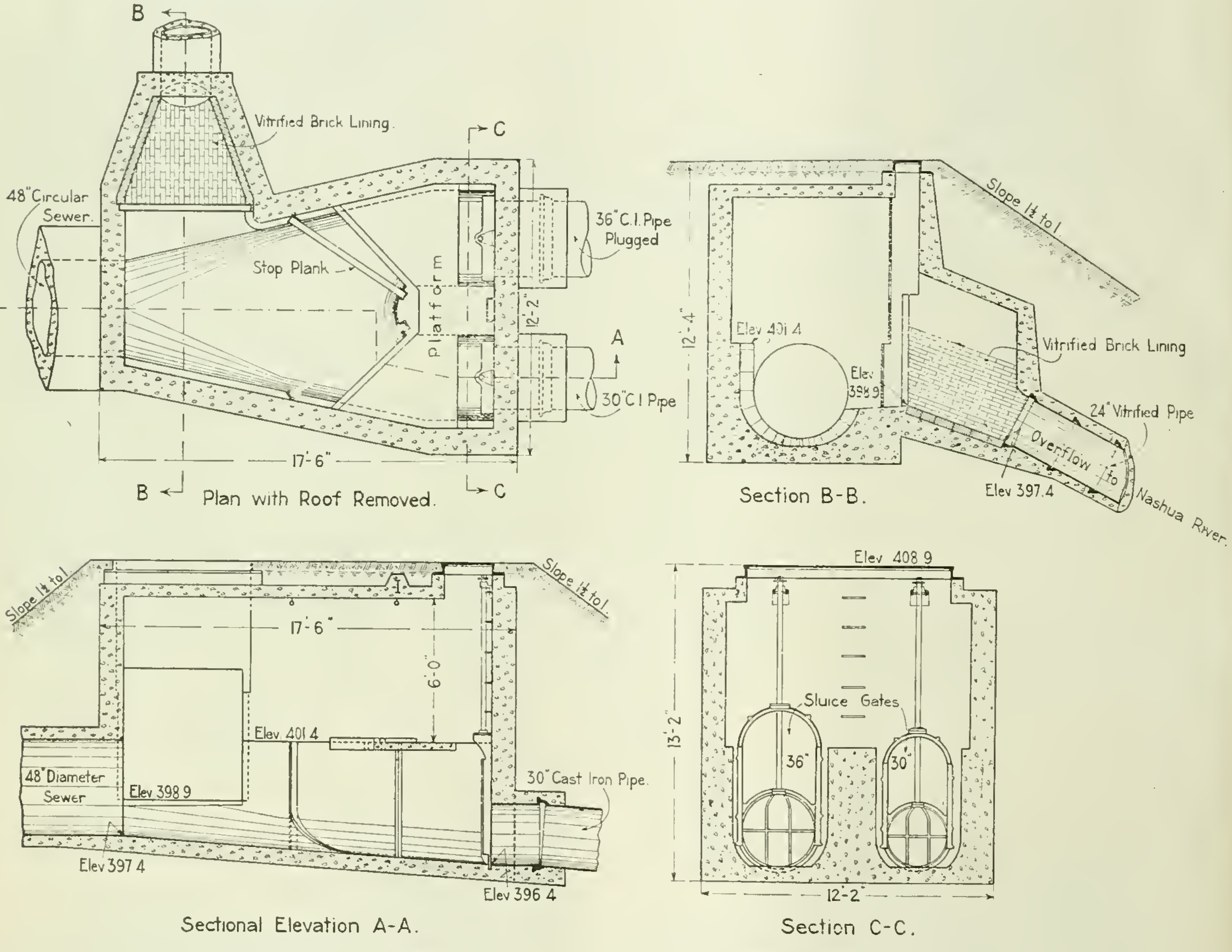


Fig. 1—Details of Siphon Chamber, Main Intercepting Sewer, Fitchburg, Mass.

SIPHON CHAMBER.

The first section of the main interceptor is 5,989 ft. long. Of this distance 5,070 ft. is 30-in. cast iron pipe and 919 ft. is 48-in. concrete sewer. At the junction of the 48-in. sewer with the 30-in. cast iron pipe there has been constructed a siphon chamber, so arranged that when the flow in the sewer exceeds the capacity of the 30-in. siphon the excess will spill to the river through a 24-in. pipe line. The capacity of the 30-in. siphon is about 11,000,000 gals. per day, and as the present flow of sewage is only about one-half this amount it is only at times of considerable rain that anything from the sewer will flow through this overflow pipe to the river. The siphon chamber is also constructed with a 36-in. connection for an additional siphon pipe to be laid when the normal flow of sewage about equals the capacity of the 30-in. pipe. This overflow can be regulated by stop planks so that when the 36-in. pipe line is also laid no flow will be diverted to the river unless the amount flowing in the 48-in. sewer should exceed the capacity of both pipe lines. This siphon has a hydraulic grade of 1 ft. in 350 ft. When this 30-in. pipe is carrying the present amount of sewage the velocity of flow will be about 1½ ft. per sec., which would probably prevent the pipe from clogging if there were no gravel or sand carried with the sewage. To avoid possible clogging at time of storm a grit chamber has been constructed about 1,400 ft. above the siphon chamber, and between which and the siphon chamber there are no lateral connections. This grit chamber will be described in detail later. In case this siphon should become partially clogged, provision has been made for blowing out the line by placing a 30-in. gate and blow-off pipe at the crossing of the river on land taken for the disposal area. This gate is so located and the siphon so laid that it will be completely and rapidly emptied when the blow-off gate is opened. The siphon chamber complete, as shown in Fig. 1, was built at a contract cost of $500.

GRIT CHAMBER.

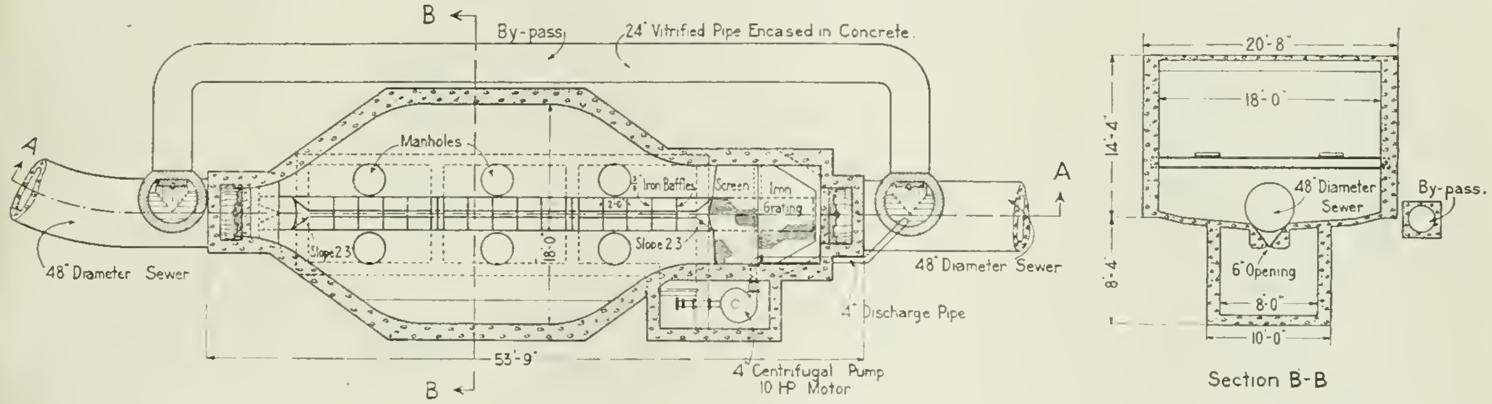
In all combined sewer systems there is at times of heavy rain considerable sand and gravel washed from the streets into the sewers. The catch-basins retain large quantities of this material but the rapidity of the flow through the catch-basins at time of heavy rains is such as to carry large quantities of mineral matter into the sewers. Before the sewage is treated in tanks at any disposal plant it is advisable to remove as much as possible of this mineral matter. This is done by grit chambers which are usually located near the disposal plant. Owing to the location of the long inverted siphon in the Fitchburg intercepting sewer with the lower end at the disposal plant it seemed desirable to construct the grit chamber above this siphon. Theoretically, the best location would be directly above the siphon chamber, but it seemed undesirable to build such a structure on private land if any other satisfactory location could be found. The location determined upon for this structure was in the sewer department yard about 1,400 ft. from the siphon chamber. While this grit chamber is located some distance from the siphon chamber still there will be no lateral connections with the sewer between the two. The general details of this grit chamber are shown in Fig. 2. The total length is 53 ft. 9 ins. and the maximum inside width is 18 ft. The sump or grit catcher situated below the sewer invert is 31 ft. 6 ins. long, 8 ft. wide and about 7 ft. deep. At the lower end of the sump is a pump well with a 4-in. centrifugal pump vertically connected with an electric motor with which to remove the water from the sump when it is desired to remove the sand and gravel settled from the sewage. The material collected in the sump will be removed in buckets through manholes provided in the floor and roof of the chamber. There is a 6-in. opening in the line of the sewer invert through the grit chamber floor the full length of the sump. Spaced 2 ft. apart there are placed in this opening iron baffle plates, the tops of which are of the same shape and at the grade of the sewer invert. These baffles are designed to arrest the flow of any mineral matter beginning to settle and divert it into the sump. The floor of the grit chamber was designed both in plan and section so that the velocity of the flow would be about 1 ft. per sec., no matter what volume was flowing in the 48-in. sewer. Table I gives data relative to velocities in the main sewer and grit chamber for the probable flow under conditions immediately following the completion of the present construction and also for the average flow of domestic sewage in 1940.

At the lower end of the grit chamber there is placed a screen so that any large matters in the sewage will be removed. This screen is made of 2-in. by ⅜-in. flat bars spaced 2 ins. apart on centers, making an opening between bars of 1⅝ ins. A 48-in. sluice gate is placed at each end of the grit chamber and a 24-in. by-pass constructed so that at times of removing grit from the sump the sewage will be carried around the chamber. This diverting of the sewage around the chamber will be only at such times as there is no storm water with the sewage. The grit chamber is roofed over at the surface of the ground with a concrete slab reinforced with I-beams and wire mesh. A small brick building for housing the electric motor and other equipment will be erected the coming season. This grit chamber was constructed by the International Construction Co. of Boston, at a total cost to the city of about $8,000.

TABLE I.—FLOW AND VELOCITIES IN INTERCEPTER AND GRIT CHAMBER

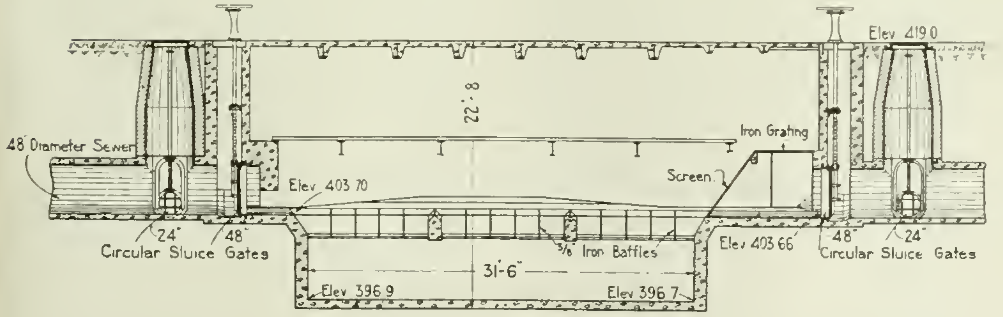
Flow.	Gals. per day.	Cu. Ft. Sec.	Depth in 4-ft. sewer.	Velocity in 4-ft. sewer.	Area of maximum water section in Grit Chamber.	Velocity in Grit Chamber.
1910 Minimum,	3,000,000	4.65	.92	2.06	3.99	1.17
1910 Average,	4,000,000	6.20	1.08	2.24	6.27	.99
1910 Maximum,	6,000,000	9.30	1.32	2.53	9.97	.93
1910 Storm,	10,000,000	15.50	1.70	2.91	16.68	.93
1940 Average,	6,875,000	10.65	1.40	2.64	11.32	.94

Capacity of 4-ft. sewer with grade of .001 = 39.38 c. f. s.
Velocity of 4-ft. sewer with grade of .001 = 3.13 ft. per sec.
All above computations with n = .015 in Kutter's formula.



Plan with Roof Removed.

Section B-B



Sectional Elevation A-A.

Fig. 2—Details of Grit Chamber, Main Intercepting Sewer, Fitchburg, Mass.

USE OF MOTOR TRUCKS IN SEWER DEPARTMENT.

Early in the season of 1912 an automobile was purchased with a removable body attached to enable the assistant superintendent of sewers to carry a limited quantity of tools and supplies to the work under his direction. In a city covering such a large area, where the assistant superintendent may have work in different sections of the city under his direction at the same time, so located as to be at least five or six miles apart, it is almost a necessity that he have some more rapid means of getting about than a horse. By combining the means of travel for the assistant superintendent with light trucking a very satisfactory method of carrying forward the work has been found.

During 1912 a total of 1,500 catch-basin cleanings were made at an average cost of $2.67. The average amount of material removed at each cleaning was 1.88 cu. yds. The cost per cubic yard was $1.42. This cost includes the expense of hauling away the material, which, owing to the long haul necessary in order to dispose of this material in nearly all sections of the city, is a considerable percentage of the cost per yard. On account of this long haul in order to dispose of waste material it seems that in the near future it may be desirable to own some form of motor truck of large carrying capacity for the purpose of transporting the material taken from the catch-basins. If such a truck had a special body for this class of work and a different body for ordinary trucking, Mr. Hartwell believes such equipment could be used economically and to advantage. The total number of catch-basins to be cared for at present is about 872. Owing to the location of some of these on steep grades and the rapidity with which the road surface washes into the basins at time of rains some of these catch-basins have to be cleaned six or eight times each season. These catch-basins must be kept cleaned or the material which they might retain would be carried by storm water into the sewers from which it is much more difficult and expensive to remove it.

The Nature of and the Art of Disposing of Paper Mill Wastes.

The art of disposal of trade wastes has been studied more in Europe than in this country. There, all paper mills at least paritally purify their wastes. For this reason most of the available information is of European origin. A large amount of experimenting is being done in America, but it is, as yet, mostly unpublished. At the present time very little is known about the purification of trade wastes, and this is especially true of paper mill wastes. Mr. Edward Hutchins, in a recent paper before the Boston Society of Civil Engineers, presented a brief summary of the wastes to be handled from paper mills, gave the characteristics of such wastes and the principal methods of treatment, and a brief description of a typical installation. The information here given is abstracted from Mr. Hutchins' paper as published in the Journal of the Association of Engineering Societies for May, 1913.

The subject of trade wastes is made more difficult by the fact that there are no set standards of purification which can be used as guides by engineers engaged in disposal work. It would simplify the whole problem if it were known, in advance, what amount of purification would be required. No matter how much the manufacturer may be in accord with the idea of a clean river, he does not feel justified in spending any more for disposal works than is necessary to satisfy the public, and he is entirely justified in this attitude. In fact, he is obliged to take this stand because his competitors, being better situated for the time being, do not have to purify their wastes and thus have him at a disadvantage.

With the present uncertainty as to what will be required, the manufacturer usually directs the engineer to spend as little money as possible in getting him out of his difficulty. Thus the most important question the engineer has to solve is the personal equation of those charged with the enforcement of the law. In nine cases out of ten, this results in a plant that may be acceptable for a year or so, but which will not permanently or satisfactorily dispose of the wastes. In this way money is wasted that would have been expended to better advantage had it been known what was required.

It should be the duty of authorities, charged with the purification of rivers, to formulate definite requirements and to inform the manufacturer the degree of purification required. With this information, the manufacturer can ascertain what disposal works will cost and determine whether he can afford to stay on the stream or not.

The standard should be a practical one, commercially attainable, which would allow manufacturers to utilize the rivers in the disposal of their wastes so long as the wastes do not pollute the rivers beyond the point where fish can live in the water and the rivers be pleasant for recreative purposes. Two standards might be required, one for the streams used as public water supplies and another for streams used for manufacturing purposes. We are only concerned with the latter.

Standards of this kind would change the attitude of the manufacturer from one of procrastination and half measures to one of action. He would desire to get what must be done, done and out of the way. He would not ask the engineer how little he could do and escape prosecution, but would instruct him to build a plant to treat his wastes so as to meet the standards, and to keep the expense as low as possible.

WASTES TO BE HANDLED.

The manufacture of paper is not carried on in the same manner for any two grades, but the processes are similar and the variations usually consist in omitting one or more of the stages to be mentioned.

The raw material, wood, paper, rags or other stock, is first cut into small pieces and dusted. These operations produce the "solid wastes." The stock is then boiled in an alkaline or acid solution to break down the fiber and to remove grease, dirt, resins, etc. The spent liquors from this boiling produce the "boiler wastes."

The stock is next washed to remove the chemicals and loosened dirt. It is then bleached and again washed to remove the spent bleaching fluid.

The water used in these two operations is called "wash water" and the wastes "washer wastes." They are usually similar to the boiler wastes in composition, except that they are diluted. Washing is usually done in large tubs, in which the stock is circulated. The dirty water is removed continually by means of a revolving wire-covered cylinder, fitted with buckets on the inside. Fresh water is added as fast as the dirty water is removed. The washing is often done in the beating engine. After the washing, and in many cases during the washing, the stock is beaten,—that is, reduced by mechanical means,—to the proper length and condition for the formation of paper. Beating is a cutting, drawing or bruising process, or a combination of all three, depending on the quality of product desired. When the beating is complete the stock has been reduced to pulp and is ready for the manufacture of paper. This stock is then further diluted with water and pumped to the paper machine, where it is formed into sheets by one of two processes. The first is by means of wire-covered cylinders revolving in vats of dilute stock. The water passes through the fine wire cover and the stock is retained on its surface, from which it is removed in a continuous sheet. The second is by means of a horizontal wire cloth belt conveyor, made of fine mesh wire, one end of which receives the dilute stock and carries it forward. The water runs through the wire while the stock is retained on its surface.

In either case the stock is removed from the wire cloth to a woolen carrier belt, called a "felt," which takes it through a series of presses and delivers it in the form of a partially dried sheet to the driers. From the driers it is carried to the calenders, slitter and winder, where it becomes the finished product. The paper is called cylinder machine paper or Fourdrinier machine paper, depending on the type of machine on which it is made.

In the process of forming paper, large quantities of water are used, but fortunately most of this is used over and over again. A certain amount of fresh water has to be added to clean the felts and wires and to prevent an accumulation of slime and dirt. This added water requires the withdrawal of an equal amount of waste water to keep the vats from overflowing, and this water is known as "machine wastes."

Hence the wastes to be disposed of are of four classes—solid, boiler, washer and machine wastes. These will be discussed separately and an idea given of the amount and character of the wastes.

Solid Wastes.—The disposal of the solid wastes does not ordinarily cause trouble, as they can be burned as fuel. These wastes vary in amount from nothing in some mills to as high as 20 per cent of the original stock. The dustings from fibrous material, which may amount to three or four per cent of the stock and consist of short fibers, dirt, etc., have in some mills been used in connection with liquid wastes as fertilizer. Slivers and like matter from wood mills have been allowed to go to waste, but they are readily saved and either made into pulp or burned with bark and other refuse.

Boiler Wastes.—Many mills do not boil their stock, but those that do are considered under three classes, depending on the treatment given the stock. These are—rag mills, sulphite mills, soda and sulphate mills. Under the term "rag mill" will be included all mills that use old material such as rags, rope, burlap, old papers and the like, not requiring too drastic treatment of the stock to render it fit for paper making. Stocks of this kind are usually boiled in long horizontal boilers, revolving slowly under a pressure of twenty to thirty pounds of live steam. They are boiled in a solution of lime or caustic soda, or a mixture of both, for several hours, after which the spent liquor is blown off and the boiler emptied.

The amount of waste liquor to the ton of stock varies greatly and depends on two things—first, on the amount of liquor used in boiling; and, second, on the care with which the liquor is drained away from the boiled stock. It varies from 100 gals. to perhaps 300 gals. per ton of stock and may be said to average about 150 gals.

The quality of the waste liquor varies with the chemicals used and with the stock. As a rule, it is very strongly alkaline and is very badly polluted with dirt, alkaline soaps, etc. Much of the foreign matter is in solution and much of the matter in suspension is in such a fine state that it will not settle even when using a reasonable amount of coagulant. Filtration will remove only the matter in suspension. There can be no bacterial action due to the strong alkali. Filtration is also difficult from the tendency of fine material to clog the filters. The only way that they have been treated, as far as the writer knows, is by evaporation. Where large amounts of caustic soda are used, the recovery of this by evaporation might make a satisfactory method of treatment, but there are several conditions which make it much less profitable than in the soda process mills to be described later:—in the first place the amount of organic matter in the waste is comparatively small, due to the less severe boiling of the stock, and hence more fuel is required to evaporate the liquor; second, the amount of caustic used is less per ton of product and more wash water is required to remove the dirt; lastly, with the usual small amount of liquor to be treated the apparatus and labor costs are so great that recovery is out of the question. A method of evaporation which has been suggested is to place the wastes out of doors in shallow pools, where they can be evaporated by natural heat. This should make a satisfactory method of disposal for small quantities. Another method is to use them for sprinkling the streets. Where the public will allow this method, it is very satisfactory. The soaps and gums in the waste seem to have the property of cementing the fine dust particles and, in this respect, to act similarly to road oil. The effect, however, does not last as long. Another method of treatment is to combine evaporation and filtration by applying the waste to land so situated that the liquid will partially evaporate and partially filter back to the water course, being diluted on its way by the ground waters. Large areas are required for this purpose, and in time they become clogged so as to be useless for filtration.

It has been suggested that these boiler wastes be used as a fertilizer and this will be well worth looking into, where other means of disposal do not look promising.

By adding phosphates and the dustings from the rags, this might be made into a fertilizer which would allow the waste to be disposed of without too great expense.

Sulphite Mill Wastes.—The sulphite process is used in the reduction of wood exclusively, and is carried out as follows: The wood is barked and cut into small chips. The chips are fed into large stationary or rotary boilers called digesters. The bisulphite liquor, made by absorbing sulphur dioxide gas in a solution of milk of lime, is then added to the digester and steam turned on. The mass is cooked for about eight hours, under eighty to ninety pounds of steam. The whole charge is then blown into a pit with a perforated bottom called a blow pit. The waste liquor drains away and runs to waste. There is a loss of 250 to 350 lbs. of sulphur and about 50 per cent of the weight of the wood per ton of pulp made. There have been many attempts to recover the sulphur or other by-products, but no system has yet been introduced, for the recovery of the wastes, on a commercial scale, which is likely to be remunerative.

Soda Mill Wastes.—The soda process is used in the reduction of wood, straw and other fibers, and is similar to the sulphite process, except in details and in that the reducing agent is caustic soda. Caustic soda is so valuable, and such large quantities are necessary to reduce the fiber, that it is always recovered. Hence these wastes do not pollute the rivers. This is fortunate, as a worse liquor would be hard to find.

In making soda pulp, the wood is prepared as for sulphite, and then put in boilers with 16 to 20 per cent of caustic soda, based on the weight of the wood. The boiler is a rotary or stationary boiler and the pulp is cooked under 70 to 80 lbs. of steam for eight or nine hours. It is then emptied into drainers and the waste liquor drained and washed out. The wash water is kept as low as possible in this process and is treated in connection with the boiler wastes. The limit of wash water and boiler wastes for economical operation is about 1,000 gals. per ton. The combined liquors are evaporated to a thick syrup and finally burned to "black ash," which is an impure carbonate soda. This is made into caustic soda in the usual way by boiling up with quick lime. The clear liquor thus formed is used for the reduction of more wood. The loss of soda in the cycle is about 20 per cent.

This waste can be economically treated because it contains at least 50 per cent of the original wood in solution and this organic matter supplies most of the fuel needed to effect the evaporation. The evaporation of the weak liquors in this country is done in a multiple effect evaporator and in England by a multiple effect or a Porian evaporator. The thick liquors are burned in a furnace, the heat from the furnace being used to help evaporate the weak liquors.

The successful operation of the plant depends, to a great extent, on the care with which the evaporation, as a heat-consuming operation, is conducted, and the care with which the wash water is regulated.

Sulphate Mill Wastes.—This process is used in the reduction of wood and is similar to the soda process, except that the caustic soda is made from the sulphate of soda, instead of from carbonate. There are also other slight differences. Vile odors are produced in the course of the process, and hence it can be used only in sparsely settled communities. The waste liquors are always recovered and there should be no stream pollution. The recovery process is similar to that used in soda mills.

Washer Wastes.—Washer wastes vary greatly in composition and amount. Wastes from rag mills will be considered first.

Rag mills that do not boil their stock may wash it, and in this case the washer wastes will have only the dirt in the stock, together with some fiber. Most washer wastes, however, contain the chemicals and other matters from boiling, which cannot all be drained from the stock, as well as more or less fiber resulting from the method of washing. It is not unusual to start the reduction of the stock to pulp during the washing period, to save time and to help dislodge the dirt. The determining of the point at which to stop washing and the handling of the wash water depend entirely on the judgment of the workman. He is apt to use too much water, rather than too little. Where the chemicals are recovered it is customary to treat the wash water with the boiler waste and to limit it to the minimum amount. Where any method of treatment is proposed it would be wise to do this, except where it is desirable to further dilute the boiler wastes.

The amount of wash water may be estimated from 10,000 to 30,000 gals. per ton of paper, and may run higher, depending on the class of stock used and the products required. Washer wastes are usually badly polluted with organic matter in solution as well as in suspension. They require treatment to remove this soluble matter, except where the stream is large enough to effect their purification by dilution at all stages of the river.

In some cases it may be possible to remove the suspended matter and allow the stream to care for the soluble organic matter. It is very difficult to remove all of the suspended matter, even when large amounts of coagulant are used. The usual treatments are by sedimentizing, screening and filtration. The analysis of washer wastes will vary with the mill and the product.

The washer wastes of the sulphite and soda mills are dilute boiler wastes, and should be treated with these wastes where any treatment is attempted. They do not need a separate description.

Machine Wastes.—The machine wastes are the bulkiest of all the wastes, but fortunately they are the least difficult to treat. They contain large amounts of fiber, clay, coloring matter, etc., but do not contain much organic matter in solution or much readily putrescible material.

The machine wastes vary from 15,000 to 50,000 gals. per ton of product, with an average of about 40,000 gals. for cylinder machines and 20,000 gals. for Fourdrinier machines. In many mills this waste can be reduced 50 per cent by the use of shower pipes designed especially for this purpose.

The machine wastes often contain large amounts of fiber which is unnecessarily wasted. This is due to leaks on the paper machine which could and should be stopped by the operator. These careless losses are apt to be at times larger than the inevitable natural losses.

The usual method of treatment for machine wastes is by settling or straining, and as the organic matter in solution is very small, these methods should be all that is necessary. It is possible by installing the proper system to still further reduce the volume of wastes from a paper mill by utilizing the purified machine wastes in place of fresh water for boiling and washing stock.

METHODS OF TREATMENT.

Paper makers have long known that in the manufacture of paper there is a considerable shrinkage of stock. It is only recently that any of them have realized that a large amount of this shrinkage is preventable. It is now estimated that the preventable loss is from 8 to 15 per cent of the paper made.

In the last ten years there have been introduced many devices, known technically as "save-alls," for the recovery of fiber, clay, etc., from paper mill wastes.

These save-alls are of various kinds and may be divided into the following classes:

A. Screening save-all. 1. Rotary. 2. Stationary.

B. Settling save-alls. 1. Continuous. 2. Intermittent.

The trouble with all save-alls of the straining type is to keep the wire clean. A dirty wire will not allow the water to pass through and hence renders the save-all useless. Turning to settling save-alls, we find that there are many types, in fact, nearly everyone who has attempted to settle stock has developed some differences in the type of tank or pond used. Settling save-alls are usually made conical in shape and can be built of reinforced concrete or lumber, which is an advantage where it is absolutely necessary to prevent iron rust entering the stock.

The settling save-all which has been used more than any other is the settling pond. This is built either above or below ground and is either worked continuously or intermittently. The trouble with this type of save-all, from the paper makers' point of view, is the difficulty of removing the fiber and clay from such settling ponds. The ponds have to be drained and the material shoveled out by manual labor. This is expensive, and the material is not in a satisfactory condition to use on a paper machine, but has to be worked over in the beaters.

Paper mill wastes are treated by filtration and evaporation. Filter beds for paper mill wastes are built similar to those for sewage. There has been little done in the line of filtration and no rules can be given for the construction of beds. The surface of the bed, and probably the whole bed, can be made of coarser sand than for sewage. The beds have to be cleaned often and will need frequent renewals of the top sand. Sewage, where available, can be mixed with the wastes and in this way some bacterial action can be obtained. Paper mill wastes, as a rule, are sterile and would not by themselves plant the beds. Trickling filters might be used, but as far as the writer knows there have been no satisfactory experiments with them. It is feared that they would be too expensive to maintain, due to clogging with fiber.

The evaporation of paper mill wastes is usually done in a multiple effect evaporator to save fuel. The recovery process for caustic soda and sulphate mills is quite simple but requires a large expenditure for apparatus and maintenance. The multiple effect evaporators are very hard to keep clean. The furnace for burning the thick liquors has to be very hot and is hard to maintain.

GENERAL SUMMARY OF TREATMENTS AND CONCLUSION.

There are four principal wastes from a paper mill: 1. Solid. 2. Boiler. 3. Washer. 4. Machine.

There are five principal methods of treatment: 1. Screening. 2. Settling. 3. Filtering. 4. Evaporating. 5. Diluting.

These may be applied to the combined wastes or to the individual waste. The solid wastes can all be burned for fuel and some can be used for fertilizer as stated. This subject of fertilizer is one that should be carefully studied, where boiler wastes high in nitrogen must be disposed of. In some cases it would undoubtedly be the best method available. This is only true where there is a distinct saving in this method over all others, as the cost of marketing the fertilizer and overhead charge is considerable for the amount of product.

The boiler wastes contain so much chemical, so much dirt in suspension and solution, that they are best treated by evaporation with or without recovery. Where recovery is too expensive the only treatments remaining are natural or artificial evaporation and dilution.

Natural evaporation in especially prepared beds or on the roads is practical and in non-thickly settled regions should be satisfactory. If the stream is large enough to care for these wastes by dilution, it is probably most satisfactory to treat all other wastes and let the stream care for this one. Natural evaporation will require about 1,500 sq. ft. of area per ton of product. These beds must be located where the odor will not be offensive to residents. If artificial evaporation becomes necessary, about 26 lbs. of waste can be evaporated per pound fuel. This is too expensive, however, for most mills to stand and they had better move to larger streams.

The treatment of sulphite wastes at a reasonable expense is impossible on a large scale with our present knowledge of disposal.

WASHER WASTES IN RAG MILLS.

The screening of this waste is not of any particular value because the fine material will pass any mesh wire and because it is practically impossible to keep wires clean to handle the waste. These wastes can be settled and this should be done before any further treatment is attempted. The settling does not remove the matter in solution, nor does it remove all suspended matter. The use of coagulants to bring down this fine suspended matter is usually too expensive.

If the stream is not large enough to take care of the washer wastes by dilution, then filtration is the most practical method of further treatment. Filtration preceded by sedimentation will remove all of the matter in suspension and some of the matter in solution. It can be filtered on slow sand filters with good results, at rates from 200,000 to 400,000 gals. per acre, depending on the condition of the waste.

If bacterial action is needed to remove the matter in solution the wastes must be mixed with sewage to give the bacteria needed to plant the beds. It must also be carefully watched to see that the alkalinity is not great enough to kill bacteria. Mechanical filters are too rapid in their action and will not produce as satisfactory an effluent as slow sand filters. The cost of the necessary coagulant will be excessive and there can be no bacterial action. Washer wastes from sulphite, soda and sulphate mills contain too much organic matter in solution to be satisfactorily filtered without the addition of large volumes of sewage. This sewage is often hard to obtain.

MACHINE WASTE.

These wastes contain very little organic matter in solution and contain much material perfectly suitable for the manufacture of paper, in suspension. For this reason they should be treated by themselves so that the recovered stock can be immediately used again in the manufacture of paper. As a general rule, the paper manufacturers have found that the recovery of this material is a profitable operation and are putting in machines and tanks of their own accord. In some cases it has been customary to mix the washer wastes and the machine wastes. This is not advocated because the dirt which is in the washer wastes detracts greatly from the value of the stock recovered from the machine wastes.

It is desirable to keep all stock possible on the machines and keep the machine wastes as small as possible. For this reason it may be very desirable to install a rotating screening save-all as leak detector on all paper machines, and to use shower pipes of the improved type, which use comparatively little water.

The machine wastes should be settled and the stock recovered. More stock can be saved by the intermittent save-all than by the continuous-flow type. On the other hand, the labor cost of the latter is much less. The type to adopt depends largely on the size of the stream and the value of the raw stock used.

The Effect of the Introduction of Sewers Upon Water Consumption.

The effect of the introduction of sewers upon water consumption in any community is indicated by the experience in Marlborough, Newton and Waltham, Mass., as here expressed in Table I. Similar figures for the increased water consumption in residences following the installation of sewerage facilities, as observed in Madison, Wis., are given in Table II. These tables are taken from the report of the commitee on water consumption statistics and records of the New England Water Works Association.

TABLE I.—AVERAGE CONSUMPTION OF WATER IN THREE MASSACHUSETTS CITIES BEFORE AND AFTER THE INTRODUCTION OF A FAIRLY COMPLETE SYSTEM OF SEWERS.

	Gallons per person per day																	
	Years previous to introduction of sewers							Year when system of sewers was practically	Years subsequent to introduction of sewers									
City.	7	6	5	4	3	2	1	completed (1891).	1	2	3	4	5	6	7	8	9	19
Marlborough	13	17	20	21	24	24	25	26	30	30	35	34	37	37	38	38	36	37
Newton	28	31	33	33	31	36	40	43	50	52	60	65	63	60	57	63	62	63
Waltham	37	36	39	33	31	32	33	40	47	53	61	59	71	70	76	88	90	88

These data will be of interest to water department officials who desire to estimate the additional draft on water systems due to the installation of sewer systems. They will be of special interest to sewerage engineers who wish to estimate the probable flow in a system of sanitary sewers from present water pumping statistics. The present tendency in the design of such sewers is toward small pipe with its low cost and self-cleansing velocities. More attention is now being paid to the water-tightness of sewer joints than formerly, so that the uncertain infiltration of ground water, in a well designed and built sewer, need no longer render inconsistent the effort to estimate accurately the volume of flow in a proposed sewer.

TABLE II.—EFFECT OF SEWERAGE FACILITIES ON WATER CONSUMPTION IN RESIDENCES AT MADISON, WIS.

No. of services.	Total consumption cu. ft. per year.	Av. consumption gallons per day per service.
Residences without sewer connections:		
23	8,444	7.5
33	21,960	13.7
5	5,544	22.8
2	3,346	34.4
1	2,300	47.3
1	2,977	61.2
65	44,571	
Av. per service...	685.8	14.1
Residences with sewer connections:		
2,634	3,788	68.0

RAILWAYS

The Design and Operation of the New Timber Treating Plant of the Baltimore and Ohio Railroad.

Contributed by F. J. Angier, Superintendent of Timber Preservation, Baltimore & Ohio System.

One of the most complete timber treating plants in America has recently been put in operation by the Baltimore and Ohio Railroad at Green Spring, W. Va. The plant covers an area of about 60 acres adjacent to large tracts of timberland along the South Branch Valley of the Potomac River. The requirements of this railroad approximate 2,500,000 ties annually for renewals. A large proportion of these ties will be treated at the new plant, as will laso other timber for railway use. The plant is shown in diagrammatic plan and elevation in Fig. 1.

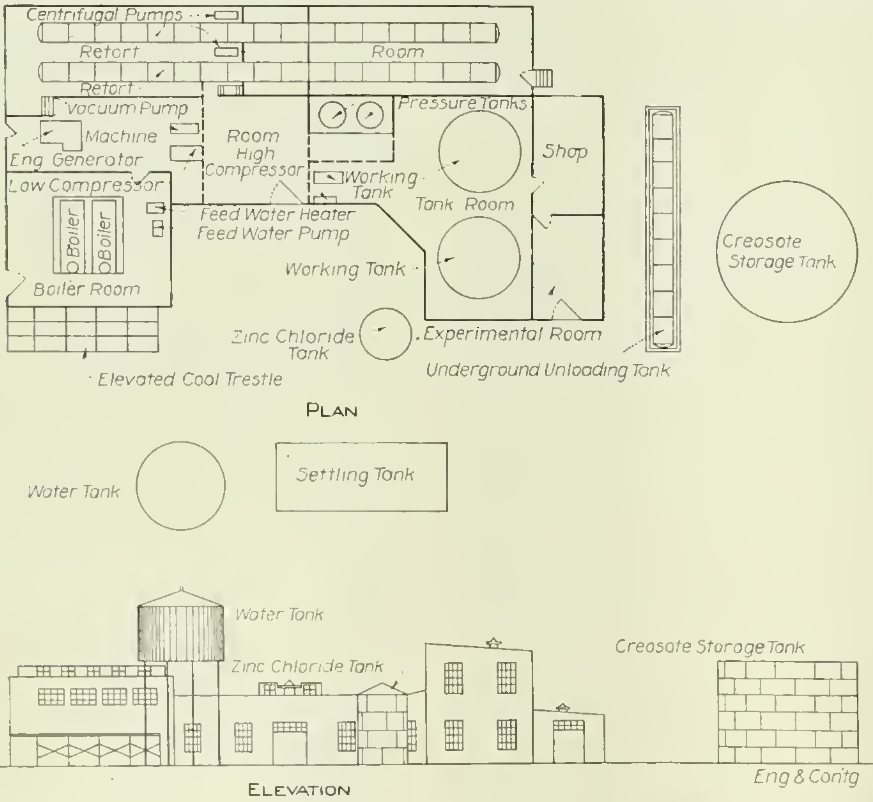


Fig. 1—Diagrammatic Plan and Elevation of the New Timber Treating Plant of the B. & O. R. R. at Green Spring, W. Va.

The plant is equipped with two treating cylinders, or retorts, as they are commonly called. These retorts are 7 ft. in diameter and 132 ft. long, made of ¾-in. steel and built for a working pressure of 175 lbs. per sq. in. Each of the retorts rests on nine concrete piers and is securely anchored to a center pier with six 1¼-in. bolts. On the remaining eight piers the retort rests on cast-steel saddles, and placed between the saddles and an iron plate imbedded in the concrete are nests of steel rollers, each nest being made of three rollers 2 ins. in diameter and 10 ins. long.

At each end of the retort is a door which swings on steel rollers and can be opened and closed easily by one man, notwithstanding the weight of 6,400 lbs. each. The door consists of a steel frame with flanged steel dished head 1 in. thick. The retorts are equipped with heating coils and also with perforated pipes. The pipes are used to obtain a more perfect distribution of steam when green timber is being artificially seasoned as well as for the circulating device used in the Card process.

The main building of the plant is of steel frame construction with corrugated iron sides and concrete roof. The floors of the building are of cement, and there is a concrete basement so constructed that should any of the preservative be spilled it can be recovered. In the basement is a concrete sump equipped with an electric device which indicates to the engineer in charge that the sump is filled. The sump is emptied by means of an ejector, the liquid passing into a settling tank about 50 ft. from the building. The settling tank is also of concrete construction, with dimensions of 20 ft. in width, 50 ft. in length and approximately 10 ft. in depth. The tank has four compartments and after the drainings from the plant enter the first compartment the liquid is forced to travel through each of the other compartments in a circuitous path to the last compartment. By this time any creosote carried from the plant falls to the bottom, because of its greater specific gravity, and enters a well in the bottom of the last compartment of the settling tank. Here a bilge pump, operated by electricity, picks it up and carries it to an underground tank, and then by compressed air it is carried into the working tanks.

The boiler room is situated adjacent to the main building, the dimensions of the room being 30 ft. by 40 ft. The boiler room contains two horizontal return tubular boilers of 150 H. P. each, built of 125 lbs. working pressure per square inch. Space is provided in the room for a third boiler to be installed when the requirements of the railroad justify the enlargement of the plant. A boiler feed heater, injector and feed water pump complete the equipment in the boiler room.

The oil storage tank is 40 ft. in diameter by 30 ft. high, having a total capacity of 280,000 gals. There is also a storage tank for a concentrated solution of zinc-chloride, the dimensions of which are 15 ft. in diameter by 20 ft. high, with a capacity of 25,000 gals. The oil storage tank is equipped with a system of heating coils made in four sections, the combined heating surface of which is 500 sq. ft. An angle stem thermometer is placed in the side of this tank to enable the oil being kept at a constant temperature of about 120°. F.

Near the storage tank is an underground

unloading tank, 6 ft. in diameter by 60 ft. long. The tank is enclosed in a concrete pit, which will prevent waste of the creosote in the event that leakage occurs. The tank will withstand an air pressure of 50 lbs. per square inch and creosote is forced from this tank into the storage, or working, tanks by air also. The working tanks and pressure tanks are all located inside the building, so that they can be kept warm and the temperature of the working solution retained at 190°. The locating of these tanks inside the building also accomplished a further economy in the consumption of fuel, particularly in cold weather.

The working tanks are 24 ft. in diameter by 20 ft. high, each having a capacity of about 68,000 gals. They rest on concrete foundations 6 ft. above the floor line, being equipped with cast-iron radiators for heating the solution. Each tank has three sets of radiators working indepenedently of one another. The combined heating surface of the radiators is 441 sq. ft. Each tank is also equipped with air coils for agitating a mixed solution of creosote and zinc chloride. Air is admitted at 100 lbs. pressure and distributed in such manner as to completely mix the solution in from two to five minutes. The tanks are also equipped with mercury gages which show the true reading in tub feet and gallons, regardless of the temperature. This avoids the necessity of making correction for temperature readings with these gages. Besides the mercury gages each tank has a syphon regulator which regulates the steam supply to the radiators and automatically opens and closes the steam supply valve in maintaining the required temperature.

The pressure tanks are 8 ft. in diameter and 14 ft. high, made of ⅞-in. steel for a working pressure of 175 lbs. They are in reality a combination of pressure, measuring and drain tanks, and are located in such a way that they are readily filled while the treating cylinders are being filled preparatory to treating a charge of timber. Compressed air is then applied through the top of these pressure tanks and the preservative is forced through a pipe in the bottom connected with the cylinders. Pressure is maintained until the required absorption is obtained in the timber, after which the valve is closed and any preservative remaining in the tank can be returned to the working tank by means of the compressed air already in the pressure tank. There is also a sufficient amount of compressed air in this tank to force all of the solution in the treating cylinder back to the working tank. The tanks are also used for measuring purposes, being equipped with mercury indicators which show the amount of solution and thus inform the engineer as to the amount of solution going into the timber he is treating. They are also used as drain tanks to catch and measure the solution taken from the timber during the vacuum and draining process. The bottoms of the pressure tanks are only slightly lower than the treating cylinders; and though all of the drainings from the charge would not flow into the pressure tank by gravity, this is easily and quickly accomplished by admitting atmospheric pressure to the treating cylinder while the pressure tank still maintains a vacuum. This combination of pressure-measuring-drain tank is entirely unique with the plant at Green Spring. It was worked out by the writer, assisted by Card and McArdle, who were the draftsmen in getting out the pipe plans. It eliminated entirely the dirty and expensive pressure pumps commonly in use in timber treating plants.

Recording gages and recording thermometers are connected to the treating cylinders. This places the superintendent in complete touch with the treatment in all of its details, the charts indicating the temperature, pressure and vacuum recorded for every moment the plant is in operation.

The plant is heated throughout by steam, the vacuum system being used, all condensation being returned to the boiler feed heater and thence to the boilers. A 50-K. W. generator furnishes the light for the plant and the yard, there being three arc lamps and about 50 incandescent lamps in the system. The electric plant also furnishes current to operate two 10-H. P. centrifugal pumps and a 1 H. P. bilge pump. The 8-in. centrifugal pumps are used to circulate the mixture of creosote and zinc chloride in the retorts while using the Card process. The latter is in the settling tank and is used to pump creosote, that may have settled out from the drainings, into the underground unloading tank.

An experimental plant is situated adjacent to the main building. This plant consists of a complete physical and chemical laboratory. The experimental cylinder is 30 ins. in diameter and 9½ ft. long, or large enough to hold three or four ties. There are two working or pressure tanks, underground drain tank, pressure pumps and electric centrifugal pump. The tanks are equipped with the latest gages and thermometers and the entire plant is so designed that any process can be used and pressure can be supplied as high as 300 lbs. The chemical laboratory adjoins the physical laboratory, and creosote distillations, zinc chloride analyses, etc., will be made.

The office building is of concrete and is fireproof in its entire construction. The same is true of the other buildings in the plant. The hose and engine houses are of wood, but these are small and located some distance from the other buildings. A fire system has been installed as a protection against destruction in this way and a fire department will be organized from among the employes, the organization of which will be similar to that at the large terminals, shops and other centers on the Baltimore and Ohio System. A 6-in. water main has been laid the entire length of the tie yard and every 300 ft. there is a hydrant. The hose house is near the office and is equipped with a reel of 300 ft. of hose. Water pressure for fire emergency is maintained by a high 50,000-gal. water tank kept filled at all times.

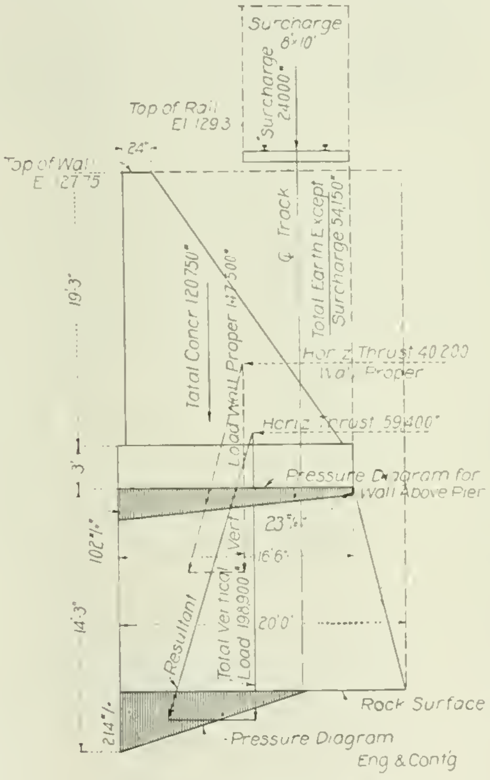


Fig. 1—Cross Section and Force Diagrams of Solid Gravity Retaining Wall.

At the present time the water used in the timber-treating plant is being pumped from the Potomac River, but this arrangement is but temporary until a permanent water system can be built for the joint use of the timber-treating plant and for supplying water to locomotives in train service. The permanent water plant plan calls for two pumps located at the plant in a concrete well about 100 ft. below the surface of the ground. The depression was deemed necessary on account of the lift from the river. Water will be pumped into the high storage tanks and fed by gravity throughout the plant and yard.

Practically all of the ties treated at the plant to date are oak, the number being approximately 200,000. The standard tie in use on the Baltimore and Ohio is 7 ins. x 8 ins. and 8½ ft. long, containing 3⅓ cu. ft. These ties are unloaded and cribbed in piles of seven and one, and are handled by piece work. It is the intention to air-season all ties. However, if they are not received in quantities sufficient to properly air-season, the plant is designed to take care of this by giving a preliminary steaming and vacuum before the injection of preservatives.

All storage yard tracks have three rails, the outside pair being of standard gage and the inside rail fixing a 30-in. gage for the tram cars. In loading for treatment the ties are classified as hard and soft woods and as No. 1 and No. 2. For this work the men are paid at a rate per tram instead of per tie as is the case of unloading and cribbing for seasoning. Thus it makes no difference whether there are 30 or 40 ties on a tram, the cubical contents are practically the same and the amount paid is the same. There are 130 tie cars used to deliver the ties to and from the treating cylinders.

Alternate Designs of Gravity and Reinforced Concrete Counterfort Retaining Walls for Track Elevation Construction in Cleveland.

A reinforced concrete counterfort retaining wall of somewhat unusual design was constructed on the New York, Chicago and St. Louis Railroad in East Cleveland, Ohio, in 1910. The purpose of the wall was to permit the elevation of the tracks without encroaching upon the adjacent property. The design of this wall and of the alternate solid gravity wall and the estimated costs of the two types was given by Albert J. Himes, Engineer of Grade Elimination of this railroad, in an article in the Cornell Civil Engineer for March, 1913, from which the information here given is taken.

TABLE I.—COMPUTATION FOR REINFORCED COUNTERFORT WALL.

	Loads per Foot Section, lbs	C. of G. Refer. to C Tracks, ft.	Moment ft.-lbs.
Counterfort and Main Wall	30,320	5.4	183,700
Footing	9,000	2.5	22,500
Surcharge	9,600	0.0	00000
Earth	20,790	—1.9	—39,500
Pier	30,000	5.5	165,000
Loads per ft. of pier brought from intervening wall—			
Main Wall × 8/5	6,400	11.0	70,400
Earth × 8/5	65,100	1.3	84,600
Footing × 8/5	14,400	5.5	79,200
Surcharge × 8/5	15.400	0.0	00000
	201,010		565,900

X = 2.81.

E = Thrust at Pier;

E′ = Thrust brought to Pier by intervening wall;

E = .285 × 36.5 (36.5 + 20) 120 ÷ 2 = 35,280 lbs.

E′ = .285 × 22.25 (22.25 + 20) 120 × 8/5 ÷ 2 = 25,730 lbs. per ft. of Pier;

E acts at a height of $[(36.5)^2 + 3 \times 36.5 \times 10] \div [3 \times (36.5 + 20)] = 14.26$ ft.

E′ acts at a height of $[(22.25)^2 + 3 \times 22.25 \times 10] \div [3 \times (22.25 + 20)] = 8.84$ ft.

Taking bottom of footing at Reference Line.

Total Horizontal Thrust acts at a height of (35,280 × .01 + 25,730 × 8.84) ÷ 61,010 = 3.75 ft.

Resultant cuts the case 4.26 ft. from front of footing.

Toe Pressure = 2 × 201,000 ÷ (3 × 4.2) = 31,900 lbs. sq. ft. = 222 lbs. sq. in.

Resultant of Forces acting on wall proper cuts the top of the Pier 8 ft. from the face.

Toe Pressure = $(4 \times 14 - 6 \times 8)\ 171{,}010 \div (14)^2$ = 6,980 lbs. sq. ft. = 49 lbs. sq. in.

Heel Pressure = $(6 \times 8 - 2 \times 14)\ 171{,}010 \div (14)^2$ = 17,450 lbs. sq. ft. = 121 lbs. sq. in.

E′ = 16,080 lbs. per foot of Wall at bottom of Footing.

The owners of the adjacent property exhibited a very unfriendly spirit towards the railroad company, and it was deemed necessary to effect the elevation of the tracks without in any way encroaching upon that property. This made it necessary to carry the wall down to the rock surface, some 18 ft. below the top of the ground. The center line of the nearest railroad track was about 11 ft. 6 ins. from the face of the wall. A careful study of the problem was made and estimates were prepared to show the comparative cost of a reinforced and a gravity wall.

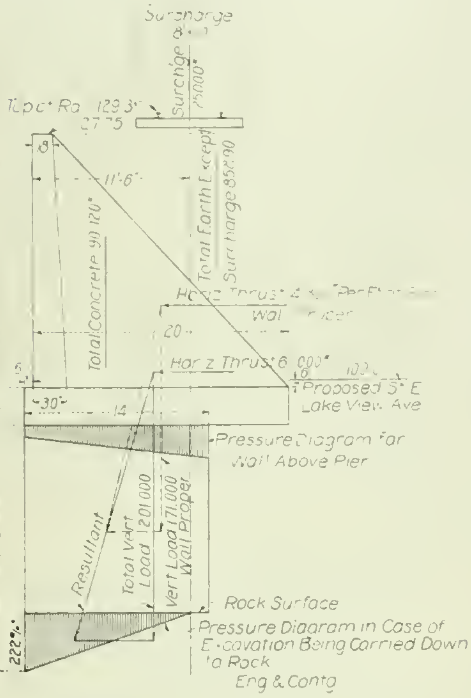

Surcharge
8'-0
Surchge 25000*
E Top c* Ra 129.3'
27.75
8
11'-6"
Total Concrete 90 120*
Total Earth Except Surcharge 85290
19'3
Horz Thrust Per Ft of Wall Proper
20
Horz Thrust 6 000*
6
103
5
3'
30"
14
Proposed S* E Lake View Ave
Pressure Diagram for Wall Above Pier
14'3"
Resultant
Total Vert Load 201 000
Vert Load 171,000 Wall Proper
Rock Surface
Pressure Diagram in Case of Excavation Being Carried Down to Rock
222%
Eng & Contg

Fig. 2—Cross Section and Force Diagrams for Reinforced Concrete Retaining Wall.

The accompanying figures and tables show a full theoretical discussion of the subject and the final design, the formulas of the American Railway Maintenance of Way Association being used.

TABLE II.—ESTIMATE OF COST OF REINFORCED WALL.

Item.	Quantity.	Unit Price.	Cost.
Concrete (Wall)	1,250 cu. yds.	$6.50	$8,125
Concrete (Piers)	700 cu. yds.	6.50	4,550
Excavation (Wall) ...	40 cu. yds.	0.35	14
Excavation (Piers) ...	1,125 cu. yds.	1.00	1,125
Steel	121,900 lbs.	0.025	3,050
Engineering & Contingencies, 15%			2,530
			$19,394

The solid gravity wall design which was considered was 247 ft. 6 ins. long. The piers were 8 ft. long and 12 ft. apart. It was a condition of the design of this wall that it should be so constructed as to be perfectly stable in the event of the removal of all material above the rock surface immediately in front of the wall.

The assumed weight of earth was taken at 120 lbs. per cu. ft., and that of concrete at 150 lbs. per cu. ft. The working stress in the reinforcing steel was taken at 16,000 lbs. per sq. in. It was assumed that the concrete was incapable of taking tension.

TABLE IV.—ESTIMATE OF COST OF SOLID GRAVITY WALL.

Item.	Quantity.	Unit Price.	Cost.
Concrete (Wall)	2,000 cu. yds.	$6.50	$13,000
Concrete (Piers)	1,000 cu. yds.	6.50	6,500
Excavation (Walls) ..	40 cu. yds.	0.35	14
Excavation (Piers) ...	2,020 cu. yds.	1.00	2,020
Engineering & Contingencies, 15%			3,230
			$24,764

The reinforced wall, as built, is about 246 ft. long. The counterforts are placed directly upon and are symmetrical about the center lines of the piers. The piers are 5 ft. and the counterforts 3 ft. wide. The piers are spaced 13 ft. from center to center. Cross sections of the plain and reinforced walls are shown in Figs. 1 and 2, respectively, and the details of the wall and counterfort reinforcement are shown in Fig. 3.

The estimated cost of the wall as finally designed was $23,570, and the actual cost after writing up the accounts was found to be $21,342.20. The estimated saving over the cost of a gravity wall was about 20 per cent. The wall was constructed with the forces of the Grade Elimination Department, not by contract.

A feature of special interest in the wall is the manner in which the load was distributed, so as to prevent the maximum pressure from occurring at the toe of the wall on the top of the pier. Theoretically the maximum toe pressure occurs in the face of the wall at the rock surface, but since the ground surface is near the top of the piers, it is probable that the maximum toe pressure at the rock surface is somewhat less than calculated. The face of the piers was built exactly on the property line. The face of the wall was set back 6 ins. in order to insure that no part of it would by mischance encroach on private property. The wall has now been two years in service and no change of any kind has yet occurred.

At the street, abutments were constructed for the bridge over the highway. These abutments have no physical connection with the wall, being separated with carefully constructed joints. The several sections of the wall, each about 60 ft. long, were likewise separated by expansion joints. All of these joints have opened a trifle during the winters. A joint at the juncture of the main wall and the wing wall was located so as to bisect the angle between the walls. This location is always a plane of weakness and subject to cracks. In this case the crack was forestalled and the joint so arranged that should either wall be inclined to tilt forward it would receive support from the other. Two-inch stone was used in the construction of the wall. It was found that because of the closeness of the reinforcing bars it was difficult to get the coarse concrete material in place. The use of smaller stone or gravel would have secured somewhat better results and cost less money. Quicksand was encountered in the foundations, but occasioned no serious difficulty beyond the settlement of the temporary trestle, from which the material was handled.

TABLE III.—COMPUTATIONS FOR SOLID WALL.

Loads per Foot Section, lbs.		C. of G. Refer. to C Tracks, ft.	Moment ft.-lbs.
Main Wall × 20/8...	63,250	6.7	423,800
Footing × 20/8...	18,500	4.25	78,600
Earth × 20/8...	41,750	0.7	29,200
Surcharge × 20/8...	24,000	0.0	00000
Additional Load on Pier—			
Pier	39,000	3.3	128,700
Earth	12,400	—5.9	—73,100
	198,900		587,200

E = Same as for Counterfort Wall = 35,280 lbs.

E′ = 285 (22.25 × 42.25) × ½ × 120 × 12/8 = 24,120 lbs.

Total Horizontal Thrust acts at a height of [(35,280 × .01) + 24,120 × 8.84)] ÷ 59,400 = 3.59 ft.

Resultant cuts the base 4.3 ft. from front of footing.

Toe Pressure = 2 × 198,900 ÷ (3 × 4.3) = 30,837 lbs. sq. ft. = 214 lbs. sq. in.

Resultant of Forces acting on wall proper cuts the top of the Pier 6.5 ft. from the face.

Toe Pressure (4 × 16.5 — 6 × 6.5) 147,500 ÷ $(16.5)^2$ = 14,628 lbs. sq. ft. = 102 lbs. sq. in.

Heel Pressure (6 × 6.5 — 2 × 16.5) 147,500 ÷ $(16.5)^2$ = 3,250 lbs. sq. ft. = 23 lbs. sq. in.

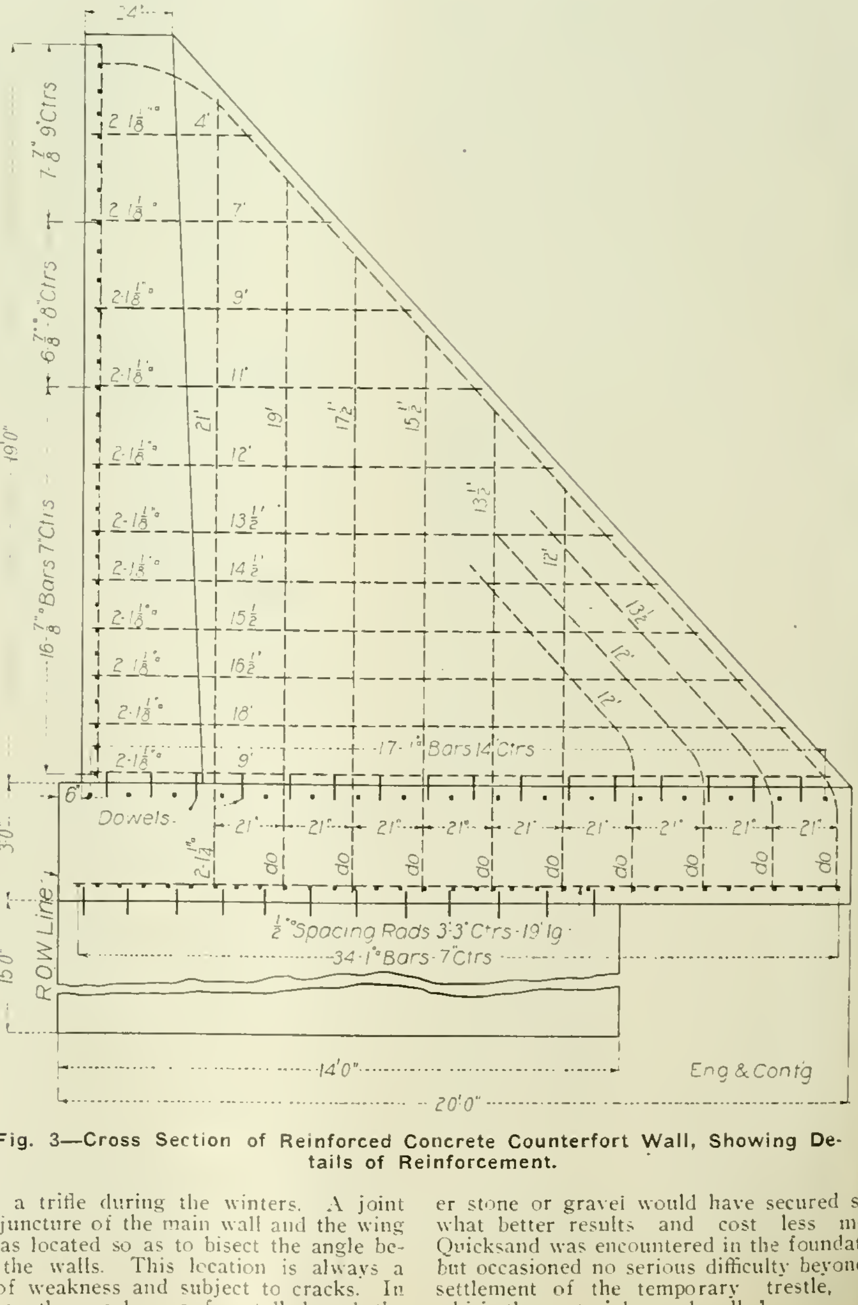


Fig. 3—Cross Section of Reinforced Concrete Counterfort Wall, Showing Details of Reinforcement.

A New Rail Joint for Bascule and Lift Bridges.

(Staff Article.)

The type of rail joint for use between the stationary track and track on bascule and vertical lift bridges here described and illustrated has been in successful service for over a year on the Calumet River bridge of the Chicago & Western Indiana R. R. This joint was designed and patented by W. A. Casler, Assistant Engineer, of the Western Indiana.

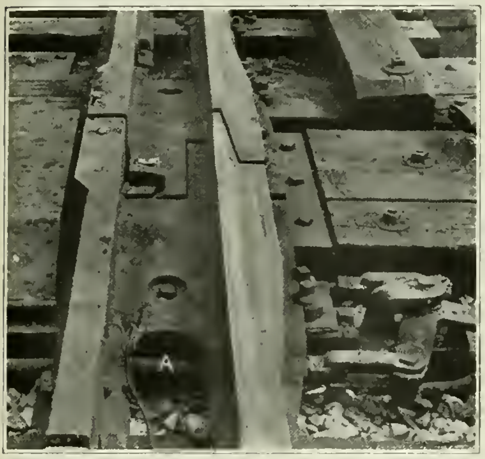


Fig. 1—View of Rail Joint at Strauss Bascule Bridge on C. & W. I. R. R. Across Calumet River Near South Chicago.

The joint is made of cast manganese steel. Fig. 1 shows a close view of one of the running rails and a guard rail at the special joint as installed at the Calumet bridge. This is a double track bridge and as clearly shown in Fig. 1 the points of the miter joint trail in the direction of traffic at the gage side of the running rail.

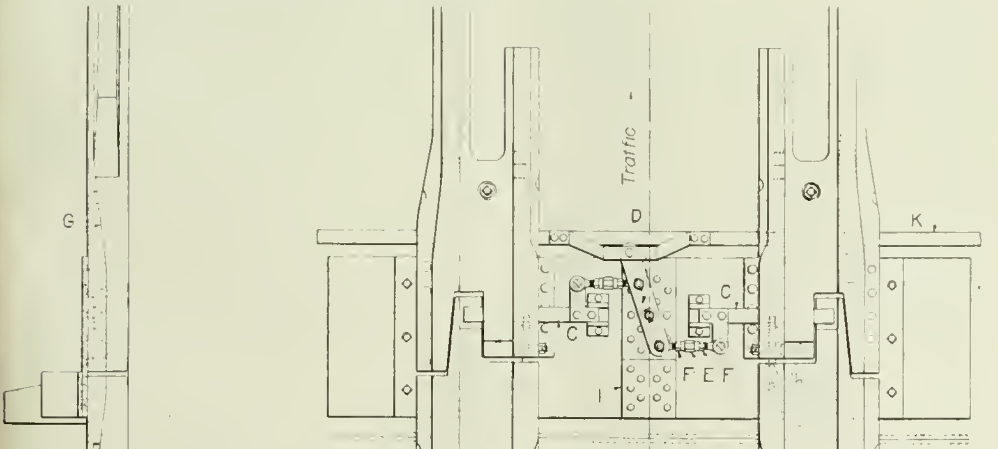


Fig. 3—Plan and Elevation of Miter Joint and Locking Mechanism on Bridge.

A special feature of this joint is its ability in closing to bring the track to proper alignment. This end is accomplished by means of the guiding member, marked A in Fig. 2, and by the pocket marked B in the same view. As will be noted from this view the guiding member is on the movable portion and the pocket is on the stationary portion of the joint castings. The guiding member is tapered as shown in Fig. 2 and also as shown at A in Fig. 3. As the guides enter the pockets during the closing of the bridge the movable rail section is brought to a close alignment independently of the alignment of the bridge and before the mitered surfaces of the joint come in contact with each other. This self-aligning feature of the joint was devised to overcome the difficulties which arise at the outer end of the moving leaf in bascule bridges due to the unequal expansion caused by the direct rays of the sun striking one side of the bridge while the other side is shaded. This variation sometimes amounts to as much as ½ in. in hot weather.

The castings at the stationary end of the joint are riveted to a bed plate which contains the pockets previously mentioned. The sides of the pockets are formed by means of angles which are riveted to the under surface of the bed plate as shown at B in Fig. 3.

When the bridge is in position for service the joints are locked in place by means of sliding bolts C of Fig. 3. These bolts are actuated by the pivoted lever D which is placed in the center of the track. Connection between the bolts and lever is made by links whose lengths are adjusted with the turnbuckles E and the jam nuts F. The locking mechanism is covered by a hinged metal cover to protect it from the weather and from dragging brake beams, etc.

As shown in Fig. 1 the running surfaces of the rail are widened in the regions adjacent to the miter joints. This enlargement of the section is designed to aid in the elimination of wear at the joint and to add strength to the joint. It will be noted that the rail section castings provide for the prolongation of guard as well as running rails. The guard rail spacing is the same opposite the joint as on the bridge.

The surface of the portion of the casting which lies between the guard and running rails at the joint is raised and the approaches to it are inclined as shown by the line marked G in Fig. 3. The outer flanges of the running rails are also raised and have similar inclined approaches so as to correspond to the inclined surface of the casting previously mentioned. This construction was adopted as a means of maintaining the general equilibrium of derailed cars at this point. Bolt and rivet heads are depressed and countersunk wherever there is a likelihood of their being struck and damaged by the wheels of derailed cars or engines.

A bevel is given to the under surfaces of the sliding bolts in the locking device at their outer ends. These beveled areas on the bolts move along similarly beveled surfaces in the movable section of the casting. A wedging action is thus set up which clamps the movable portion of the joint tightly against the bed plate to which the stationary casting is firmly riveted.

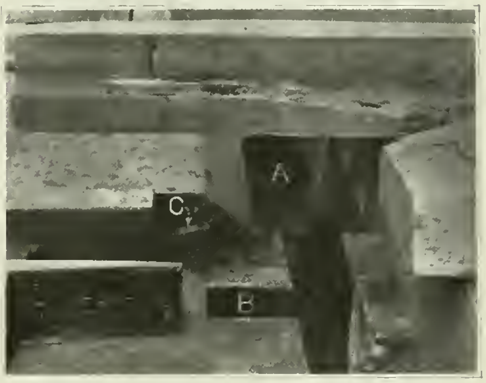


Fig. 2—View of Joint in Opened Position.

The detail shown at C in Fig. 2 and more fully in Fig. 4 is a safety latch which prevents the operation of the sliding bolts of the locking mechanism while the joint is even partially opened during the raising or lowering of the bridge. As will be noted in Fig. 4, these safety latches are pivoted and bear against a spring which tends constantly to turn the latch into a position which will prevent the motion of the bolts. These latches are placed in recesses which are cast for that purpose in the outer ends of the guard rail sections of the stationary portion of the joint casting. The position of the latches is also shown at H in Fig. 3. When the lift of the movable leaf of the bridge begins the springs force the latches down at their inner ends. The shoulders of the sliding bolts are then engaged in such manner that the bolts cannot be moved until the bridge is again completely closed. Recesses similar to those in the outer ends of the guard rail sections of the stationary casting are also cast into the corresponding section of the movable casting. The upper surfaces of these recesses bear against the adjusting screws shown on the safety latches and the pressure so exerted or relieved actuates the latches.

In order to maintain track signal electric circuits the bed plate of the stationary casting is spliced and the two sections of the plate are insulated from each other as shown at I and J in Fig. 3. The locking bolts are also insulated from the links which connect them to the pivoted lever D, Fig. 3, of the operating mechanism. These pivoted levers are moved by means of the bar shown at K in Fig. 3 and at A in Fig. 1, which, in turn, is actuated by an electric motor controlled by the bridge tender from his tower.

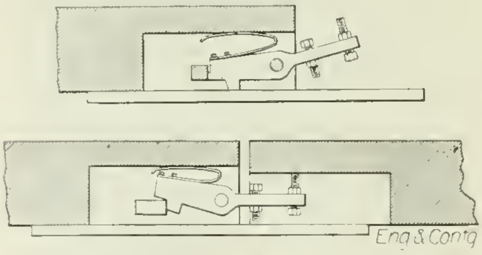


Fig. 4—Details of Safety Latches.

Method and Cost of Cleaning Stone Ballast With Screens.

Stone ballast is now generally cleaned on American railroads by shaking it out with ballast forks. During the summer of 1912 experiments were made on the Baltimore & Ohio Railroad with screens for cleaning this type of ballast. The experiments indicate that the use of screens is preferable to the use of ballast forks, both on account of better work and lower cost. The type of screen and the method and cost of using it for cleaning stone ballast, were described by Mr. W. I. Trench, Division Engineer of the Baltimore & Ohio Railroad, in an appendix to the report of the Committee on Ballast of the American Railway Engineering Association. The information here given is taken from Mr. Trench's description as published in the Bulletin of the Association for February, 1913.

In approaching the problem of cleaning ballast by means of screens, it was recognized that the present methods involved one of the most expensive and tedious operations occurring in railway maintenance and that for this reason the periodical cleanings are often deferred much longer than good practice would seem to demand. It was felt that if a screen could be designed which would make a proper separation of stone and dirt and at the same time dispose of these two materials in a way to avoid further handling, with a single cast of the shovel instead of the repeated sifting motion and the further shoveling of the dirt in its disposal as required by the fork, an enormous saving could be made.

It was believed that to be practicable this screen must be as cheap as was commensurate with durability, easily portable, and so related in position to the track when in use as to make its removal unnecessary on the passage of trains. Its operation must be progressive along the track and complete, working toward the dirty ballast and leaving the clean ballast behind it in such shape as to require no further handling. Its capacity must be limited only by the speed with which the laborers can handle the shovel and it must be susceptible to use by a gang, so arranged that the work of every man is continuous and unchanging and so proportioned that no man's work is dependent on the progress made by another; that is, there should be no halts. It is believed that these results have been secured in the screen to be described and that its use, by a properly organized gang, will result in such a saving as to make the further general use of the fork method improbable.

Experiments on the Baltimore & Ohio Railroad were made on a portion of its double track line, and it was found that the most efficient gang for this condition was one of twelve men equipped with three screens. There is a screen for each berm and one for the center ditch. The construction of all three is identical there being interchangeable legs for use on the berm, and in the center ditch. The legs for use on the berm are so designed that the screen rides on the ends of the ties outside the rail at such a distance from the track as not to interfere with traffic, and at the same time deposits the cleaned stone on the berm in final position. It stands at such an elevation that the dirt is deposited directly into a wheelbarrow standing on subgrade. The legs for use in the center ditch are designed to ride on the cleaned subgrade as the screen is slid along and are of such a height that the dirt is deposited in a handbarrow, which is placed beneath the screen, and the clean stone is left in the center ditch in final position. The upper end of the screen is carried on supports which are readily adjustable in height to accommodate it for use in the center ditch or on the berm in either cut or fill. When in use in the center ditch, the screen is laid flat upon the ground on the passage of trains and lies wholly below the top of rail.

A short description of the structural details will be made so that a better understanding will be had of the method of operation to follow. The screen frame is constructed of standard 2-in. x 3-in. x 1¾-in. angle iron set up so that the short leg turns out, the long leg forming the vertical sides of the screen. The screen proper is formed of ¼-in. rods, crimped together, giving a mesh ¾ in. x 8 ins. It was found with this mesh and with the screen inclined at 45° that the separation of stone and dirt was perfect even in damp weather, and this cannot always be said of the results secured from forks. These crimped rods are set in a rectangular steel frame made of 1-in. x ½-in. x ⅛-in. channel iron, and this frame is bolted inside the main frame so that the screen proper can be readily detached, as a whole, and sent to the shop for repairs. The entire screen is backed with a galvanized iron slide which is so formed that it gathers the dirt which has come through any part of the screen and deposits it in a receptacle set beneath by means of a spout. The spout is really a hinged door suspended at its outer end by a chain and convenient fastening so that its height can be regulated, and when the receptacle is removed for emptying, can be closed. With this door closed the screen will hold about one wheelbarrow load of dirt, so that the operation of the screen is not stopped while dirt is being dumped. At the top of the screen is a hood which forms a deflector for the ballast thrown over the top, the method of operation in this case being to slide the screen backwards from the cleaned ballast towards the uncleaned ballast, the latter being thrown over the top and being left in clean condition at the bottom. This hood when screen is in use on the berm is thrown back and forms the top against which ballast is thrown when in this position. The screen constructed as indicated is practically indestructible and will support the weight of a man without impression.

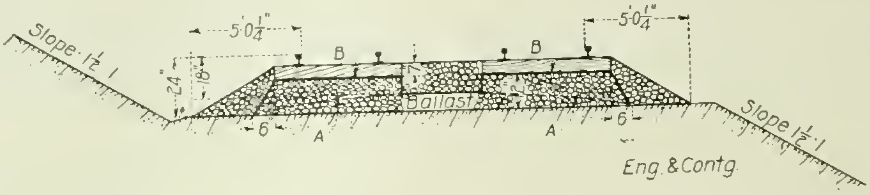


Fig. 1—Roadbed Section for Cut and Fill, Baltimore & Ohio Railroad.

Note.—Line A is line to which one crib is taken out every 50 ft. to facilitate drainage from center ditch. Line B is line to which all stone ballast is cleaned.

For use with each screen is provided a galvanized iron handbarrow which is so formed that it fits exactly upon the horizontal legs when in use on the berm, being so placed after a sufficient quantity of cleaned ballast has been allowed to fall outside the rail, the remainder being caught in the handbarrow and drawn across the rail to be deposited in the cribs. When in use in the center ditch, the handbarrow is placed beneath to catch the dirt.

The cross-section of the finished work is shown in Fig. 1. It will be noted that the cribs are cleaned to the bottom of the ties, the center ditch 18 ins. below the top of rail and the berm 24 ins. below the top of rail at the end of tie and sloping to 3 ft. below top of rail at back of side ditch. Every 50 ft. one crib is cleaned to the bottom of the center ditch on one end and to the top of subgrade on the other, forming an outlet for water collected in the center ditch. This arrangement gives an absolutely dry and stable roadbed. The dirt from the ballast, or so much of it as is required, is dressed upon the subgrade outside the ballast line, and in addition to giving a neat black appearance and a pleasing contrast to the white stone ballast, serves to keep down weeds very effectually. What is not required for this purpose is used to widen embankment along the line.

As stated above for double track work, three screens are used. When tracks are on fill on both sides, dirt from each side screen is disposed of on its own side of the embankment, and dirt from the center ditch is dumped directly from handbarrow over bank on side most desirable. When one side is on fill and other side in cut, wheelbarrow loads of dirt are wheeled or carried bodily from cut side to fill side. When it is necessary to carry dirt across tracks, care is used to keep the screen on the side from which it is carried in an advanced position, with reference to the other screens, so that dirt will be carried over uncleaned roadbed and not over that which has been cleaned. It will be seen that dirt carried to the fill on other side of tracks from the center screen passes over dirty ballast before the arrival of the screen to the right, and likewise, dirt from the screen to the left passes over the tracks before the arrival of either of the other two screens, the screens in this case traveling from right to left. When tracks are in cut, on both sides, wheelbarrow loads are wheeled out to end of cut at nearest end, the handbarrow from the screen in the center ditch being dumped into a wheelbarrow or shoveled directly from pan to barrow standing across one rail, dirt from side screens being poured from screens directly into wheelbarrow. It is found that dirt can be wheeled out of a cut for a distance of 800 ft. to 1 000 ft. at less expense than would be the case if thrown upon the ground and loaded again upon a work train on a busy railroad.

The following gang organization is adhered to: For the operation of three screens as indicated under ordinary circumstances, twelve men are sufficient; with long hauls of dirt, more men to be added for wheelbarrow work, so screen gang will be kept going. Of the twelve men, two shovel from each side of berm onto their respective screens, two from the center ditch onto the center screen, and one man in center of each track shoveling from the cribs onto the screen most available. One man with pick advances ahead of shovelers to loosen hardened ballast before their arrival. These are dispensed with if ballast is loosened by means of a plow attached to work engine. Long stretches of ballast can be loosened in this way in a short time by work engine; enough to keep gang going several days. The remaining three men are sufficient usually to handle wheelbarrows in disposal of dirt, dress dirt down on berm and fork a uniform ballast line, although if hand laid ballast line is required, more men would be necessary. By careful handling of this gang, ballast and dirt are disposed of at one operation in their final position and no further attention is necessary. In most cases it is found that the cleaning of ballast so reduces its volume that additional stone is necessary. In this case the disposition of the stone from the screens is so handled that the berms and center ditch are filled out completely, and any deficiency occurs between the rails where additional stone can be most conveniently distributed from Rodger ballast cars without further handling. The gang of twelve men cost per day: Foreman, $2.40; 11 laborers at $1.60, $17.60; total, $20.

We find that a gang equipped and organized as above will cover 165 ft. of double track per day of 10 hours, making the cost per mile of double track, $640. This, of course, includes cleaning ballast, dressing ballast and disposal of dirt complete. Single track work would cost considerably less than half this amount, as there would be no center ditch to contend with. The ballast really handled in this test was considerably more than the cross-section, shown in Fig. 1, would indicate, as before cleaning the ballast was piled above rail in center ditch and rounded high on berm. An average of 227 wheelbarrow loads of dirt were removed per 100 ft. of double track cleaned.

For comparison with the fork method, the identical gang used above was tried with forks and advanced but 72 ft. per day. This also included the dressing complete and disposal of dirt, it being necessary to shovel the latter in wheel and handbarrows. This shows a cost per mile of double track, $1,466.

We see various figures given from time to time on the cost of cleaning ballast per mile. Some of them are very much less than the above, and we can only believe that this is occasioned by omitting to include the disposal of dirt and dressing road complete, or on account of cleaning to a less depth in track than indicated in Fig. 1 or perhaps a less thorough separation of stone and dirt. In many cases, a raise is given track and ballast put under without cleaning. In the above test, no raise was made. For the quality of work done, we do not believe the figures can be much lessened. This shows a saving of 56 per cent by use of screen over forks.

This screen weighs about 325 lbs., and can be easily propelled along track by the two shovelers at work at the respective screens, and with the material used in them with careful handling and pointing, they should last for years. The trial lot of three made for us with handbarrows complete by a Baltimore firm cost $45 each. We believe, if made in quantity and bid on by competitive firms, the cost would be greatly reduced.

Analysis of the Premises Adopted and Methods Used in Determining the Cost to Reproduce New, Together With the Depreciation Thereon of the Physical Property of the Metropolitan System and the Kansas City and Westport Belt Railway of Kansas City, Mo.

In a recent report on the value of the properties of the Kansas City, Mo., street and elevated railways, Mr. Bion J. Arnold, Chicago, explains the methods followed in taking inventory of the various physical features and many of the data given are generally instructive. We abstract the parts of most general interest as follows:

DEFINITION OF TERMS.

Cost to Reproduce New.—The "cost to reproduce new," represents the cost that would be incurred in replacing the physical property as found as of May 31, 1912, with new property of similar character, such reconstruction to be carried out under the physical conditions that obtained at the time of the original construction of the property.

Present Value.—The present value of the physical property means the cost to reproduce new less the accrued depreciation on a straight line basis as determined in detail in the premises hereinafter given for the various classes of property.

Whenever in the report there appear the words, "present value of the physical property," it is intended only to refer to the actual cost of reproduction less depreciation, and there is not included therein any of the many other elements which enter into the value of the entire property as an operating entity.

In arriving at the cost to reproduce new, a complete inventory of the existing physical property was prepared as of May 31, 1912. To the quantities found in this inventory there were applied unit cost prices, thus arriving at the total cost of material and labor for the items of property covered in the appraisal. The unit cost prices cover all expense for material, tools and labor required to furnish each item in place. These unit costs contain such profit as exists in the manufacturer's price for equipment furnished, or in a contractor's price for such parts of the work as naturally would be let to a contractor. In case equipment has been purchased directly from the manufacturer, whose price included the cost of erection, the only profit included in the unit cost is manufacturer's profit. In case of other parts of the property, the unit cost is intended to represent the amount for which the company is able to contract for the work in place. In no case is a general contractor's profit included in this appraisal, in addition to the profit of the direct contractor, or the manufacturer being considered a contractor as the term contractor is used in this paragraph. In the case of certain divisions of the property specifically mentioned in the detail following, the contractor's profit has been added as a part of the overhead percentage, instead of having been included in the unit price.

There has been included in the cost to reproduce new certain expenditures of the company for property or other construction charges which are not based on the inventory, but which were determined from the history of the company, and which form a direct part of the construction of the system. These expenditures are Damages to Property on Account of Track, Viaduct or Building Construction, and Expenditures of the Company for Real Estate or Right of Way, which since its acquirement has been dedicated to the various municipalities generally because of franchise requirements.

To the base cost of the various items of property there have been added varying percentages to cover the expense of organization, engineering and incidentals.

The percentage added for organization covers the cost of general office expense, securing bids, preparing contracts, purchase of material, salaries of officials chargeable to construction, general superintendence and legal expenses chargeable to construction.

The percentage added for engineering covers cost of preparing working plans, specifications and contracts, supervision, progress reports, estimates for payment, together with expense of shop inspection tests and field engineering.

The percentage added for incidentals covers all the incidental construction expense to the company that lies outside of the contract cost such as extras on the contract price. These extra expenditures may be due to small changes in design, interference with construction for various causes, the cost of trial operation, cost of insurance, and operation expense during construction.

Such percentages have been added to the exhibits containing the values of track; Grading; Bridges; Paving; Electrical Distribution System; Rolling Stock; Power Plant Equipment; Shop Equipment and Buildings. In case of the exhibits containing Stores, Roadway Tools and Miscellaneous Equipment and Furniture and Fixtures, the percentage added has been 5 per cent which is intended to cover in lieu of organization, engineering and incidentals the cost of purchasing, handling and drayage. In the case of Real Estate, Right of Way Property Damages on account of construction and real estate dedicated to the municipalities, 5 per cent has been added to the appraised value, which percentage is intended to cover the cost of organization as above defined, and what might be termed the equivalent of engineering, namely, selection of site, search of title, purchase commissions, and various other expense arising in connection with the securing of the property.

The aggregate of all of the above percentages included under organization, engineering, incidentals, or its equivalent, varies from a minimum of 5 per cent in certain exhibits to a maximum of 15 per cent in other exhibits, and for the whole property the average amounts to 11 per cent.

The total obtained after adding the percentage covering organization, engineering and incidentals represents the actual cash that would be required in reproducing the property new, but does not include the cost of obtaining the money necessary to finance the property, such as brokerage and bond discount, nor the carrying charges during construction, including taxes and interest, nor such legal expenses not properly chargeable to construction, such as those incurred in organizing the company, obtaining frontage consents and advertising proposed extensions, nor any preliminary engineering, legal or other expense incurred in initiating the enterprise.

To cover the above charges, with the exception of bond discount, 5 per cent has been added to the general summary, of which 3 per cent represents carrying charges and 2 per cent represents the general legal and organization expense. It should be noted that the aggregate of this percentage used in this appraisal is lower than that generally used in appraisals of this character for the reason that since the construction records of the company were found to be so unusually complete, it was possible to prepare more accurate inventories and to include in specific exhibits certain expenditures which in the case of most appraisals it is only possible to approximate by means of general overhead percentages.

The amount added for bond discount is 5 per cent based on the total money which the company is to provide, including the overhead percentage for carrying charge and general legal and organization expense. This percentage represents the minimum discount which it is estimated that such securities bearing a 5 per cent interest rate could be marketed, provided the investment were protected and safeguarded by a franchise or ordinance which equitably defined the relations between the street railway company and the municipalities in which it operated. The bond discount in case of a similar unprotected investment would ordinarily vary from 8 per cent to 12 per cent and, as a matter of fact, the discount on all securities, bonds and notes of the Metropolitan Company has averaged in excess of 10 per cent.

The bond discount on the securities of Chicago traction properties, where the investment is protected and where the ordinance allowance has been 5 per cent has on some issues considerably exceeded and on other issues been slightly less than this amount, and the average for all the securities issued since the ordinances went into effect has been materially more than 5 per cent. Other things being equal, the rate of discount will be smaller as the ratio between the total bond issue and the value of the physical property is decreased. When reproduction cost includes as one item, discount of bonds sufficient to cover the entire cost of the property, it necessarily follows that a higher rate will prevail, and a 5 per cent rate of bond discount will be sufficient only on the assumption that the investment will be protected by fair franchise stipulations in municipal ordinances.

To determine the value of the property on the basis of an unprotected investment, tables have been prepared in which the percentages representing the cost of financing have been increased, the carrying charges, general legal and organization expenses having been included as 7 per cent and bond discount as 8 per cent, a total of 15 per cent. This percentage represents the probable cost of financing should the investment be unprotected by fair ordinance provisions.

The total resulting from the application of the above percentages to the base cost, represents the total cost incurred in reproducing new the physical property and therefore includes not only the cost of all material and labor together with the suitable percentages for contractor's profit, organization, engineering and incidentals, but as well the expense that would be incurred in organizing and financing the property. The cost thus determined includes no development expense or promoter's profit.

Present Value.—The present value of the physical property has been determined by depreciating the cost to reproduce new the various items of property as contained in the various exhibits. Varying rates of depreciation have been applied to the different classes of physical property and the present value has been determined by consideration of the life of the property and its salvage value, such consideration having been given to all items of the property that are normally considered as depreciable. Certain exhibits such as Real Estate, Right of Way, Property Dedicated to the Municipalities and Damages to Property, have been treated as non-depreciable property, in case of which exhibits the present value has been taken the same as the Cost to Reproduce New.

In case of the item "Bond Discount" the present value has been obtained by depreciating the original bond discount in the same proportion as the average depreciation for the entire physical property; Legal Expenses, Carrying Charges and Incidentals have not been depreciated for the reason that when the rehabilitation of the property takes place this will be done without incurring further carrying charges or legal expenses in that such expense will be charged to operation.

Inventory.—For the purpose of making inventory, the property was divided into the following general divisions, termed Exhibits:

I. Track.
II. Grading.
III. Bridges, trestles, culverts and viaducts.
IV. Paving.
V. Electrical distribution system.
VI. Rolling stock.
VII. Power plant equipment.
VIII. Shop equipment.
IX. Stores, roadway tools and miscellaneous equipment.
X. Buildings.
XI. Furniture and fixtures.
XII. Real estate.
XIII. Right of way.
XIV. Property damage paid on account of construction.
XV. Cost of real estate dedicated on account of ordinance requirements.

Each exhibit was in turn subdivided into various parts, that is Track was divided into Tangent Track, Track Special Work; Tangent Track in Car Houses and Yards; Track Special Work in Car Houses and Yards, and in a similar way subdivisions were also made for all the other exhibits.

In the following paragraphs, the premises upon which the value of the physical property listed in the various exhibits was determined, are set forth in detail:

TRACK.

Tangent Track.—The lengths of all sections of Tangent Track were determined by field measurements, the entire system having been chained twice, once to determine the track distance, the second to determine paving quantities. During this survey the various types of rails and joints, together with their location, the size and spacing of the ties, the depth and kind of ballast and other features of track construction, were determined together with the limits of each type. The various types were grouped into classes and unit price estimates of the cost per mile of single track were prepared for each class. The location and type together with the dates of installation of each section of track on the system, was determined from various sources; by the records of the engineering department of the company, from contracts on file showing the dates of reconstruction of existing track; from store room requisitions, covering issuance of material used; from vouchers on file showing the expenditures and type of track constructed under same, and from interviews with track foremen whose term of employment by the company was prior to the electrification period. Also owing to the fact that a large amount of reconstruction work was under way when the inventory was being taken, the type of track was verified at approximately 200 locations along the paved sections.

In estimating the cost to reproduce new a mile of single track under the original specifications, because of the numerous different types of construction, it was deemed advisable to segregate the substructure and superstructure of the track and it was found that the five types of substructure and the fifteen types of superstructure hereinafter given could be so combined as to cover all the various classes of construction found existing at this date. To the unit cost estimates there has been added 15 per cent to cover the cost of contractor's profit and of organization, engineering and incidentals, as previously defined, in order to arrive at the total cost. The item of contractor's profit has been included in the percentages since the unit costs used in estimating the cost of track are the net prices for like material laid down at the site of the work. In determining the cost of track, it should be emphasized that the concrete subbase for the pavement is excluded from the track estimates and appears only in Paving. In arriving at the net tangent distance, the lengths of all special work layouts have been excluded. Included in the lengths of the special work layout is the tangent track distance from the switch point join to the heel of the frog, no average having been taken between the distance to the heel of the frog and that to the mate joint.

In determining the present value of the substructure, as a result of field investigations, it was decided that the life of the concrete beam construction should be taken at fifteen years; the life of ties in paved track twenty years; the life of ties in open track and on bridges, ten years; but in no case has the depreciation of the substructure of open track been more than 50 per cent, since both the field investigations and the records of the engineering department show that where the ties are easily maintained—that is in open track—the company has regularly renewed them and as a result the general or average condition is never allowed to go below 50 per cent, a condition always brought about by good maintenance.

The life of the joints excepting where welded was taken at twenty years and the rail measurements show that this life is equal to approximately 80 per cent of the life of the rail. The life of the welded joints has been taken the same as that of the rail. All joints, excepting welded joints, were depreciated on the assumption that it would be necessary to renew them at some time, in order to realize the full wearing value of the head of the rail. It was assured that at the time of such renewal the ends of the rail would be cut off and the life of the balance of the rail lengthened thereby. The amount so cut off has been taken at 6 per cent of the amount of the 30-ft. rail and 3 per cent of the amount of the 60-ft. rail. This is equivalent to cutting off approximately 11 ins. from the end of each rail, when the joint is trimmed.

The present value of the girder or center bearing rail, excepting the joints, was determined in terms of the wearing height remaining at the present time in the head of the rail. The life of the rail is considered to be the period of time required for the head of the rail to wear away to a height of ⅞ in. above the tram or base of groove in trilby rail. The difference between this height and the height of the head above the tram or base of groove at any time constitutes the wearing height of the rail at that time.

The distance between the head and tram of all girder or center bearing rail was determined and expressed in sixty-fourths of an inch. To determine the height of the head of the rail at the present time measurements were taken along the track with a specially constructed Vernier device, by means of which the actual distance between the head of the rail and the tram was obtained in sixty-fourths of an inch. These measurements were obtained at frequent intervals on each section sufficient number being taken to determine the average height of the head of the rail. From this determined height was deducted the scrap height of 56/64 in., the remainder representing the present wearing height of the rail. In this method the depreciation of the rail is entirely independent of the life of the track substructure or joints.

The depreciation of the tee rail was determined in the following manner: The area of the head or ball of the rail was found and expressed in hundredths of an inch. From examination of discarded rails and by interviews with maintenance of way engineers, it was determined that the rail would be scraped when an area of one-quarter of the head had been worn away and the value of the rail was therefore expressed in hundredths of an inch, the total wearing value being ¼ or 25 per cent of this amount. By means of a rail tracing machine, the present area of the head of the tee rail installed on the various tracks and sections was determined, these measurements being taken at frequent intervals on each section and the present value of the tee rail is that determined by this method.

Track Special Work.—Each Special Work layout was measured, listed and sketched, sketches being reproduced herein and a unit cost estimate was prepared for each layout. Included with the price of the steel work shown in these estimates is that of the interior and exterior compromise joint plates, and of all necessary fastenings. To the price of the steel layout there has been added the cost of ties, ballast, excavation, labor and necessary miscellaneous items included in the installation of same, in order to determine the total cost of the work in place and further included in this estimate is 15 per cent to cover cost of contractor's profit, engineering, organization and incidentals. The depreciation of the Special Work has been determined by field inspection, during which inspection the present condition of work was noted and the rates of depreciation which have been applied to the summaries are the weighted average percentages shown by this investigation.

Tangent Track in Car Houses and Yards.—The length of the Tangent Track in Car Houses and Yards was found in the same manner as the Tangent Track. An inventory was made of the various kinds of rail, joints, number of ties in each location and unit cost estimates were prepared. The item of excavation does not appear as part of the cost of the work listed in this division since it has been considered a part of the building cost and is so listed.

Special Work in Car Houses and Yards.—Special Work in Car Houses and Yards was inventoried in the same manner as was the Track Special Work and the cost has been determined on the same premises.

Removal of Gas and Water Mains.—The items included in this exhibit cover the expenditure of the company at various times during its construction period for the removal of gas and water mains as shown by either detailed vouchers or by contracts on file. Prior to construction of the cable lines, the practice of the Water and Gas Companies of Kansas City was to lay their mains in the center of the street and the expenditures enumerated under this exhibit cover the cost of removing the mains from this position to a place outside the right of way of the Traction Company, the position in which the mains have been laid initially since the building of permanent track construction. While the expenditures above listed were all made during cable construction, it also follows that, had these mains not been removed at that time, they would have been removed when the existing track was constructed, owing to the inconvenience to operation and the damage to track construction, brought about by the constant repair and removal of such mains, together with the installation of additional service connections, and for that reason these expenditures have been included with the cost of reproducing new the existing construction.

GRADING.

The normal quantity of excavation required in the construction of track—that is, track trench—is included in the unit cost estimates prepared for the various classes of Tangent Track. Owing to the uneven topography of Kansas City, however, a much larger quantity of both cut and fill has been required in the construction of certain sections of the track than has been included in the above unit cost estimates. This excess amount is listed under this exhibit and has been determined both from cross section run along the various outlying lines and from vouchers covering the cost of grading on the original construction of track located in paved streets, since it is impractical to measure or estimate the extra amount of grading at this time, although it is self-evident that a considerable amount of regrade work has been performed.

BRIDGES, TRESTLES, CULVERTS AND VIADUCTS.

Each structure inventoried under this exhibit was inspected and the plans of all structures whenever obtained were checked against the existing structures. Where plans were not obtainable, sufficient field sketches and measurements were made as would permit the working up of a detailed inventory. Detailed bills of material were prepared from which estimates have been made, covering the cost of material and labor required to reproduce new the structure as of this date. To the total, resulting from the above, there has been added

10 per cent to cover the expense of organization, engineering and incidentals.

In many of the structures erected within the past ten years it was possible to obtain the final voucher covering the contractor's last payment and attached to this voucher was the engineer's final estimate of quantities installed and labor performed. Wherever these estimates were obtainable the detailed quantities shown in this exhibit for that particular structure are shown by this final estimate, but the prices applied to these quantities, however, are not the prices as shown by the voucher, but rather are the present day prices for like material.

Wherever construction of a bridge jointly owned with foreign interests has been handled by the other parties, no detailed estimate has been prepared, but rather there has been included the cost to the Metropolitan of the structure.

In determining the present value of bridges and viaducts no depreciation has been applied on the masonry or concrete sub-structures, it being held that since they are well constructed, they should support any present or future superstructure. The superstructures of the various items enumerated in this exhibit have been depreciated on the following basis:

	Years.
Timber structures	25
Steel structures over railroad tracks	33⅓
Steel trusses	50
Plate girders	66⅔

PAVING.

Paving quantities as listed were determined from a track survey covering the entire system, during which survey the limits of each particular type of paving was noted. No deduction has been made in working out the quantities of paving for the width of head of the rail, it being assumed that since no extra labor has been included in the estimate for laying the pavement adjacent to the rail and since neither is there included any amount for rail filler, the excess cost of these two items would offset the amount of paving taken up by the width of the rail heads. In determining the quantities therefore it has been assumed that there are two yards of pavement per foot of double track, the company being required to pave a strip 18 ins. outside the outer rails.

The cost of paving does not include the item of excavation, that being included with the Cost of Track, but it does include 5 or 6 ins. of concrete base. Unit price estimates were made for the various types of pavement, which when applied to the quantities as above determined gave the total cost new. There is included in the unit price estimates 10 per cent to cover the cost of engineering, organization and incidentals. The depreciated or present value of the Paving has in all cases been determined by field inspection.

ELECTRICAL DISTRIBUTION SYSTEM.

The Electrical Distribution System has been inventoried under the following heads: Overhead Straight Line Construction, Overhead Special Work, Overhead Feeders, Overhead High Tension Lines, Lead Covered Cables, Underground Conduits and Manholes, Rail Bonds, and Telephone Signal System.

A complete field inventory as of May 31, 1912, was made of all straight line material, included with which are the poles, trolley wire and feeder equipment contained in the overhead special work. The length of the trolley wire was determined from the company's maps and to which net distances shown therein, 1 per cent has been added for sag and waste.

Detailed field sketches were made of all overhead special layouts, including those in the car houses and yards, all the various kinds of material being listed in detail.

The overhead feeders, the overhead high tension and all underground cables, were measured both for length and size, except in a few cases where the size was estimated or taken from the purchase records. To the chained length 2 per cent has been added for sag and splices.

The quantity and type of rail bonds were determined from field data sheets on tangent track. All track not cast welded was considered copper bonded, as was the track special work.

The length of all the telephone lines and the signal system, were determined from the company's maps. The various material prices used are based upon quotations obtained from various supply companies from whom the company purchased its supplies, which quotations were in turn checked by the purchasing agent's records. Whenever such quotations were not obtainable the average price for the class of equipment as shown by the purchase records covering a period of several years was used.

The price used for copper wire, both weatherproof and bare, is based upon the monthly average price per pound of bar copper for the past ten years f. o. b. New York, this being the period during which 90 per cent of the existing copper has been purchased. To this has been added the cost of drayage, of freight and of installation, in order to obtain the cost new in place. The prices used herein for lead covered cables are the weighted average costs per foot of all cables of the respective sizes as shown by the purchase records of the company, plus the cost of installation. The scrap values were based on quotations from local dealers in these commodities.

The cost of poles in place includes the cost of the various kinds of digging as obtained from the city records and as shown by observation. This was classed as dirt, gravel, dirt and rock, rock with blasting and rock without blasting, and the cost of installing the underground conduits and manholes had also been determined upon this basis.

The depreciation in general has been based on the estimated life of the various materials used in the construction, and by inspection where the original dates of installation were not obtainable.

The depreciation of the trolley wire was determined by actual measurement of the cross sectional area of all sections, one-half of the original area being taken as the scrap value.

The depreciation rates which have been applied to the equipment included in this exhibit are as follows:

Item.	Years of life.	Depreciation per year.
Pole base, cast iron	40	2½
Iron poles	35	3
Box	35	3
Plate	35	3
Tubular	40	2½
Latticed	30	3⅓
Cedar poles	20	5
Pole brackets	25	4
Cross arms:		
Wood	20	5
Iron	30	3⅓
Weatherproof cables	30	3⅓
Lead cables	35	3
Transmission line material	20	5
Miscellaneous	20	5
Bare copper	100	1

Trolley fitting and span equipment on the various parts of the system were found to be well maintained and have therefore been depreciated by inspection. No depreciation has been applied on underground conduits. In the estimate, 15 per cent has been added to cover the cost of contractor's profit, organization, engineering, and incidentals.

ROLLING STOCK.

This exhibit has been divided into three divisions, viz.: Passenger Equipment, Utility Equipment, and Miscellaneous Equipment. Under Passenger Equipment is listed all of the passenger cars; Utility Equipment includes all of the remaining cars; while under Miscellaneous Equipment is given the extra rolling stock equipment and parts that are not included under the Stores Exhibit.

The cars have been classed into groups, according to type, style, and make of the bodies; and the cars of each group have also been separated into their component parts, such as bodies, trucks, electrical equipment, air brake equipment, etc., to facilitate the determining of the cost new and present value. The bodies include all that portion of the car ordinarily purchased from a car builder, including hand brake equipment, together with such fixtures as headlights, fenders, and registers. Trucks include the complete truck equipment with the exception of the motors. Electrical equipment includes the motors, controlling apparatus, and wiring. Air brake equipment includes the compressor, the compressor motor, and auxiliary apparatus.

A complete specification was prepared for a typical car in each group, from which the cost of the component parts of the car, f. o. b. builder's factory, was determined. To this was added freight charges to Kansas City, together with the labor cost of assembling body and truck and installing equipment in order to obtain the cost new for the complete car. To the cost new, thus determined, 5 per cent was added for organization, engineering, and incidentals.

After a thorough inspection of the equipment and of the records of operation, the life of the car bodies with wood under-frames was fixed at 25 years, and with steel under-frames at 33 years. The life of the trucks was fixed at 25 years. The electrical equipment, air brake equipment, and miscellaneous equipment were depreciated by inspection, special attention being paid to type and suitability for service.

In the case of the car bodies rebuilt in the companies' shops, the age was taken at the date of rebuilding and from three to eight years were added to that age, depending both upon the type and age of the old body and the amount of old material remaining in the rebuilt body.

In order to determine what proportion of the value of the Rolling Stock should be included with the various political divisions, the lengths of each operating route were determined and the mileage of this route operated in Missouri and in Kansas was found and the divisions therefore are based upon the car miles operated in the separate states.

POWER PLANT EQUIPMENT.

A detailed field inventory was made of all equipment of every description in each of the various power plants and sub-stations as of May 31, 1912. To the quantities found in this inventory there were applied the present-day prices for like equipment, in order to arrive at the cost new in place. There were included in the cost new and present values of the equipment in this exhibit 10 per cent, which per cent has been added to cover the cost of organization, engineering and incidentals.

The depreciation of the apparatus has been based both upon the number of years the particular equipment has been installed and upon the manner in which it has been maintained. The rates of depreciation generally applied are enumerated below and in arriving at the dates of installation, to which these rates were applied, information was obtained from office copies of purchase orders and contracts, log books in possession of plant employes and from the records of the engineering department of the company. Where the dates are not shown, as in the case of switchboards and wiring, it has been assumed that portions of such equipment were installed with and at the time the machine for which the switchboards and wiring required were installed.

In the case of Plant Tools and Furniture, the dates of installation have not been given, and as the purchase of these items extends over a considerable period of years, they were depreciated by inspection.

RATES OF DEPRECIATION.

Machinery foundations depreciated at same rate as machinery which they support.

	Per cent.
Coal and ash bandling machinery combined	7
Coal handling machinery	6
Ash handling machinery	8
Grates and stokers, maximum	25
That is, depreciated 10 per cent per year for 2½ years, no further depreciation being applied if they are in use.	
Boilers:	
Horizontal tubular boilers and settings	8
Water tube boilers and settings	3½
Smoke breeching:	
Steel smoke breeching	10
Brick smoke breeching	5
Stacks:	
Self-supporting steel stacks	6
Brick or concrete stacks	3
Guyed steel stacks	8
Heaters:	
Open heaters	3
Closed steel heaters	6
Closed cast iron heaters	4

Water softening apparatus:	
All-steel apparatus	5
Pumps	5
Air compressors:	
Steam driven air compressors	5
Motor driven air compressors	5
Engines:	
Corliss slow-speed engines	3
Automatic high-speed engines	5 to 8
Steam turbines with generators	4
Condensers:	
Cast iron surface condensers	5
Steam driven condensing apparatus	5
Barometric condensers	3½
Piping and covering	3½
Generators and transformers:	
Slow-speed generators	4
High-speed generators	5
Transformers	5
Belt driven generators	5
Rotary converters	5
Switchboards and generator leads:	
Switchboards	3
Generator leads	3
Wiring and cable	3
Traveling cranes	3
Miscellaneous plant tools, 25 per cent of total.	
Cable winding machinery	3 to 5

SHOP EQUIPMENT.

There is included in this exhibit all fixed and hand tools in the general shops and in car houses, a detailed inventory of which was made as of May 31, 1912.

All the equipment in the general shops and the large hand tools in the car houses were listed in detail and included with the price of each machine is the cost, not only of the machine proper, but also of the pulleys, countershafts and belting used in connection with it, together with foundation where same exists.

The smaller tools, while they have been inventoried and valued in detail, are grouped under the heading "Miscellaneous Small Tools," opposite which item there has been placed the aggregate cost to reproduce new the numerous items included.

To the cost to reproduce the shop equipment new there has been added 5 per cent to cover the cost of purchase, drayage and incidentals. The Shop Equipment has been depreciated at an annual rate based upon the life of the tool together with its present condition as shown by inspection at the time of the inventory. Dates of installation have been determined from various sources, among which are contracts on file covering the installation of particular tools, purchase records and the company's general record of construction and equipment expenditures. All small fixed tools have been depreciated by inspection, the average of which was found to be approximately 30 per cent.

Methods and Progress of Driving Freight Tunnel Extension in Chicago.

(Staff Article.)

The Chicago Tunnel Company has in progress several extensions to its system of freight tunnels under the business section of the city. These extensions include several branches from the main lines under streets to the subbasements of large buildings being constructed, one extension in Canal St., from Taylor St. south to the new freight station of the Minneapolis, St. Paul & Sault Ste. Marie Ry. Line and another on 13th St., from Indiana Ave. to Lake Michigan, where a new disposal station will be placed. At this disposal station cars of excavated material from various parts of the business district will be lifted by two elevators and the spoil will be used to fill in along the lake shore. The disposal station is provided by the Chicago Tunnel Co. as a convenient means of disposing of waste material. The land which will be filled in is a part of a project of the South Park Commission to extend Grant Park along the lake front.

The length of the tunnel extending from Indiana avenue to the Lake on 13th St. is approximately 1,000 ft. It is 6½ ft. wide and 7 ft. high with an arch built to a 3 ft. 3 in. radius. The tunnel extension is carried for almost all of its length, under the right of way of the Illinois Central R. R., and the material excavated is a soft blue clay which is easily cut with a draw knife. Air pressure is used on this extension because of the soft nature of the clay and because of the location of the tunnel under the right of way of the railway. A pressure of 10 lbs. is carried. The railway company has a compressed air plant at this location and carries an air pressure of 100 lbs. for use in the coach yard. Air from this plant is furnished for the tunnel work. The air pressure is supplied through a reducing valve which automatically maintains the pressure in the tunnel at 10 lbs. For emergencies a motor driven compressor is installed in the tunnel.

Three shifts are worked in driving the tunnel and each shift excavates and lines 6 ft. of tunnel. The first 4½ hours of the shift are occupied by mining. Two miners cut away the heading and two muckers load the chunks of clay—which come out in pieces of the consistency of putty—onto small cars which hold about 6 cu. ft. These cars are passed through the air lock and hauled away in trains through the main tunnel to a disposal station. There are about 13 cu. yds. of excavation in the 6 ft. section of tunnel. Two men excavate this and throw the material back to be loaded in cars by the two helpers, in about 4½ hours, or at the rate of 0.7 cu. yds. per man per hour.

After the excavation is completed about four batches of concrete are thrown in the bottom and leveled off approximately to the elevation of the bottom of the ties in the permanent track work. Two or three planks are laid on this to support the steel ribs for the forms of wood lagging and these ribs are bolted together in place. The ribs consist of 6-in. channels made to conform to the shape of the tunnel. They are in two pieces with flanges at the top and bottom so that they may be bolted together. A 1-in. wood block is placed between the flanges so that the bolts pass through the block. When the ribs are removed this block is first knocked out so that the steel ribs may not bind. The flanges for the bolts which tie the two sections of the rib together are not made square with the rib but are skewed about 10°. This provision aids materially in loosening the ribs when they are unbolted.

When the ribs are set up and bolted in position 3 ft. apart, a piece of 1¾x6 in. lagging is placed behind them on each side of the tunnel and held there by driving a nail through the steel rib. Holes in the ribs are provided for this purpose. Concreting then is commenced and the lagging is placed on each side as fast as the concrete is carried up.

The concrete is brought into the tunnel through the lock in the same cars used for carrying out muck. From 31 to 35 one-bag batches of 1 to 5 bank run gravel concrete are used for each 6-ft. section of tunnel. The gravel is brought to the work in canvas bags holding about one bushel each. The concrete is hand mixed outside the lock. The mixture is made sufficiently wet to cause the cement to set but is not wet enough to form a sloppy concrete. In the arch or key, 3-ft. lagging instead of 6 ft. is used and the concrete is put in over the end of the 3-ft. lagging and rammed back to fill the space. The last concrete placed in the key is sloped back to the roof so that it will form a sloping joint with the next section.

Concrete is allowed to set at least four days before removing the forms and lagging in sufficient amount to permit the continuous prosecution of the work is provided. This requires 72 lin. ft. of forms.

The work of extending the Canal St. tunnel is being prosecuted without air pressure. This tunnel is approximately the same size as the 13th St. extension, but is oval in shape, corresponding to the standard section of tunnels under the city streets. The Canal St. excavation is more difficult, and grub hoes and mattocks are used to cut down the heading. Six men form a gang and three shifts of eight hours each are worked. In each shift 4 lin. ft. of tunnel are excavated and lined.

Following the work of extending the tunnel as described, the narrow gage track is laid and concreted in, and the tunnel is plastered with a mixture of 2 parts stone dust and 1 part cement. The stone dust is ground limestone and the mixture adheres well to the rough surface of the concrete. It produces a smooth surface and waterproofs the wall satisfactorily.

Excavation Work at Culebra Cut.—The greater part of the material remaining to be excavated from the canal in the dry is confined to a section of the Culebra Cut about 9,000 ft. long. On May 1, about 6,633,400 cu. yds. remained to be excavated from the Culebra Cut section. Of this, only about 1,500,000 cu. yds. come under the head of original excavation, the remainder having been brought in by slides. A new movement developed on Feb. 5 on the east bank opposite Culebra village. Blasting operations in the Cut will probably be concluded in about 3 months, and this may diminish the danger from slides to some extent. The increased activity on the part of slides made necessary a revised estimate of excavation, and in February, 1913, 5,634,161 cu. yds. were added to the total, making the estimate for Culebra Cut 99,516,817 cu. yds., and for the entire Canal 218,138,299 cu. yds. The excavation in the Culebra Cut section, by years, follows:

May 1 to May 1.	Cu. yds.
1904-05	648,911
1905-06	1.250.570
1906-07	4,861,895
1907-08	11,285,217
1908-09	13,955,753
1909-10	14,886,427
1910-11	15,925,976
1911-12	16,448,513
1912-13	13,762,255
Total	90,005,517

Steamshovel Excavation on the Panama Canal.—During the month of March, the total amount of material excavated in the Central Division, Panama Canal, was 1.183,900 cu. yds., of which 259,571 cu. yds. were classified as earth and 924,329 cu. yds. as rock. The high record for the month was made by shovel No. 208, working 25 days in the Culebra district, which excavated 51,128 cu. yds. of rock. The second best record for the month was made by shovel No. 207, working 25 days in the Culebra district, which excavated 50,152 cu. yds.; 10,802 cu. yds. of rock and 39,350 cu. yds. of earth. The best record for a shovel of the 70-ton class was made by shovel No. 109, working 25 days in the Culebra district, which excavated 42,300 cu. yds. of earth. Shovel No. 208, working in the Culebra district, made a high record for one day by excavating 2,940 cu. yds. of rock on March 24. Shovel No. 224, working on a 12-hour shift in the Culebra district, made a high record of 3,743 cu. yds. of earth on Mar. 29.

Work of Seagoing Suction Dredges at the Panama Canal.—The two seagoing suction dredges, "Caribbean" and "Culebra," have been in continual service on the Panama Canal since they were first placed in commission in 1907. During the calendar year of 1912 the "Caribbean" removed 2,754,755 cu. yds. from the Atlantic at an average cost of $0.03807 per cubic yard. The average unit cost of repairs made to the dredge during that year was $0.0364 per cubic yard. On the Pacific side, the "Culebra" excavated 2,436,505 cu. yds. in 1912 at an average unit cost of $0.04897 per cubic yard, and the average unit cost of repairs during the same period was $0.02855 per cubic yard. While the upkeep in the case of the "Caribbean" runs as high as $49,569.46 during the fiscal year ending June 30, 1912, this dredge, like the "Culebra," has been kept in a high state of working efficiency.

International Engineering Congress, 1915.—In connection with the Panama-Pacific International Exposition, which will be held in San Francisco in 1915, there will be an International Engineering Congress in which engineers throughout the world will be invited to participate. This congress will be conducted under the auspices of the following engineering societies: American Society of Civil Engineers, American Institute of Mining Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers, and the Society of Naval Architects and Marine Engineers.

NEWS SECTION

Editorial Comment—Personals—Society Meetings—Trade Notes—Catalog Reviews—Contract News, Embracing Bids Asked, Work Projected, Contracts Let and Contract Prices on All Classes of Civil Engineering Construction Work.

Editorial Comment: The Doings of the Week—Levee Work—Road Dragging Jubilee—Construction Work in New York—Gauge Rhyme 39
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The Doings of the Week. Very little has been doing the past week in the railroad construction field, as far as concerns the awarding of contracts No new work of any importance has made its appearance, and few railroad jobs of any size appear to be open for bids. There are some prospects that the New York Central Lines will have work started this spring on the $10,000,000 Hudson River Connecting R. R. in New York state. Among the contracts let recently are the following: Grant-Smith-McDonald Co., for 55 miles of double track work near Kamloops, B. C., for the Canadian Pacific Ry.; C. P. Bower, Reading, Pa., for grading and masonry for low grade freight line at Wayne Junction, Pa., for the Philadelphia & Reading Ry.; Rinehart & Dennis Co., Charlottesville, Va., for two tunnels at Whitney, N. C.; 2,000 ft. by 40 ft. by 30 ft. for the power development of the Southern Aluminum Co.; Piedmont Construction Co., Charlottesville, Va., for lining with brick and concrete an aggregate of 1,400 lin. ft. in three tunnels for the Coal & Coke Ry.; Henry J. Cox & Co., New Iberia, La., for grading, bridging and tracklaying for the Alexandra & Western R. R.; James A. Alexander Construction Co., Memphis, Tenn, for the new terminal at Memphis for the Illinois Central Ry.

The Public Service Commission of the First District, New York City is asking bids for the construction of Sec. 4 of the Broadway-4th Ave. rapid transit railroad. This is to be a 4-track subway. The contract extends from a point in Broadway between Houston and Bleeker Sts., to a point near 14th St. The bids are to be opened June 24.

Bids are now being asked on a large government dredging job in the Delaware River. The work is located on Schooner Ledge lighthouse range and involves an estimated quantity of 6,845,000 cu. yds. Another good-sized river and harbor contract, on which bids will be asked in a few days, is for work at Toronto Harbor, Canada. This will be done for the Canadian Government and will involve an expenditure of about $6,000,000.

The Port Commission of Seattle, Wash., has opened bids on a considerable amount of construction work at Seattle, the low bidders being as follows: For the superstructure of the East Waterway improvement, Harrington-Peters Co., Seattle, at $97,200; for work at Smith's Cove, the Puget Sound Bridge & Dredging Co., Seattle, at $252,308; substructures at Smith's Cove, Harrington-Peters Co., at $230,316.

It begins to look now as though the long projected extension of the Moffat R. R. from Denver to Salt Lake City would soon be a reality. At an election at Denver last week the citizens voted in favor of an amendment to the city charter to authorize a commission to formulate plans for a bond issue to aid in building Moffat tunnel, the question of issuing the bonds to be submitted at a future election. The tunnel will be constructed through James Peak, starting just east of Tolland, 35 miles from Denver. It will be 6.04 miles long and will cost about $4,500,000. It will be built for the extension of the Denver & Salt Lake R. R. (Moffat Road) from Craig to Salt Lake City, and will be owned by the city and county until the railroad pays the entire amount of bonds. Before the voting of the bonds the Denver & Salt Lake R. R. will put up $1,500,000 as a first payment on the construction work of the tunnel. The railroad company also agrees to turn over to the tunnel commission all surveys, charts, rights of way to the approaches of the tunnel, and agrees to pay all expenses entailed in the building of the east and west approaches.

A bill is before the State Senate of Pennsylvania for an amendment to the constitution to permit Philadelphia to borrow $25,000,000 for wharf and dock improvements, exclusive of any other debt. Under the proposed amendment Philadelphia could borrow this amount of money, even though the limit of the present borrowing capacity, 7 per cent of the real estate assessment, had been reached.

The State Water Supply Commission, Harrisburg, Pa., has granted a number of cities, corporations and county commissions permission to construct bridges as follows: Commissioners of McKean County, permission to construct a concrete arch bridge across Marvin Creek at Smethport; Pennsylvania Railroad Company permission to replace an existing bridge over the Schuylkill River at Auburn; Chambersburg & Shippensburg Railway Company, permission to construct a bridge over Conococheague Creek at Red Bridge, Franklin County; Commissioners of Northumberland County, permission to erect a single arch concrete bridge over Shamokin Creek at Mount Carmel; City of Philadelphia and County of Delaware, for permission to construct a bridge over Darby Creek at 84th St., Philadelphia.

Levee Work. In the next 30 to 50 days bids will be received for Government levee construction along the Mississippi River between Cairo and White River, to the extent of about $800,000 worth of work, to be performed in several contracts requiring from 6 to 18 months for completion. It is possible that work of similar character, during the season of 1914 and thereafter for a number of years, will be let to the extent of several million dollars per year. The work consists of levee construction along the customary lines, but owing to the largely increased quantities likely to be involved, and the fact that the construction will probably be let in continuous stretches of many miles, it would seem to afford excellent opportunities for machine work as well as for team work. Heretofore animal labor has necessarily been used almost exclusively, by reason of the non-continuity of the work involving excessive expenses in moving machine equipment from place to place. The Ransdell bill, now before Congress, contemplates levee construction throughout the Mississippi Valley, beginning in 1914, to the extent of about $12,000,000 per year for five years. The great amount of construction covered by such an expenditure practically demands that some of it be done by machine work. Levee construction seems to offer an unusually attractive field for the application and development of machinery suitable for work of this kind.

Road Dragging Jubilee. The commonplace road drag is becoming a social factor in Iowa. Recently a road-digging jubilee was held at Stuart, Iowa. Business men of that place offered prizes of $5 worth of merchandise to every farmer who would drive into town on a certain day on a road drag. As a result some 20 farmers took a day off and helped smooth out the road into Stuart. Prizes were given also for the longest distance covered, the best drag, and the heaviest 4-horse team hitched to a drag. The long distance prize was won by a man who dragged in from a farm located 10½ miles from town. The second prize for distance went to a farmer who drove in from 10 miles distant. "A feature of the occasion," states a press dispatch, "was the appearance of two young girls on a drag. They came in from two miles north of Stuart on a King drag, which they had fitted with a comfortable seat covered with rugs."

Construction Work in New York. It is so seldom that New York gets honorable mention in the papers that it may not be out of place to call attention to a few little bits of construction work that are to be undertaken in that thriving village. For example, the Public Service Commission is going to ask contractors to undertake the building of a few more subways. Perhaps $300,000,000 or so will be expended for this work. Then, too, the New York Central & Hudson River R. R. has in view a number of improvements on the west side of the city, that will cost a few dollars—$80,000,0000 or $90,000,000 maybe. In addition, the city will expend something like $15,000,000 for the construction of docks, and there will also be a few minor improvements, such as the regular street, sewer and building work.

Gauge Rhyme. There are some persons so peculiarly constituted mentally that they find it an easy matter to turn out a rhyme for any occasion. Such a one is the young man, reader of a gauge on a stream in Illinois, who reported an accident to the gauge in the following original manner:

On a dark night (sometime back), unseen,
January nineteenth, nineteen thirteen,
An ice gorge swooped down with hate,
And tore from its moorings the gauge at the gate.

As the water continues to be very high,
To reset the gauge I dare not try;
Trusting an answer you'll endeavor,
I assure you, I am yours as ever.

Chief Gauge Reader.

PERSONAL

Mr. A. F. Kenman has been appointed county engineer for Chickasaw county, Iowa.

Albert F. Holden, mining engineer, of Cleveland, Ohio, died at his home in that city May 17, aged 47.

Mr. Emmett C. McAnelly has been appointed chief deputy to State Engineer John E. Field of Colorado.

Mr. John Duder, assistant city engineer for Salt Lake City, has resigned, to take a position with the A. A. Clark Construction Co. of Salt Lake.

Mr. Ralph Martin, formerly assistant city engineer, has been made city engineer for Tampa, Fla., succeeding Mr. F. T. Warner, resigned.

Mr. Archibald Currie, at present city engineer for Westmont, Ont., has been chosen by the Board of Control of Ottawa as city engineer for that city.

Mr. Frank Beckwith, civil engineer, of Quincy, Ill., has been chosen chief engineer for the American division of the new railroad to be built in China.

Henry Schlacks, a well known railroad man of the middle west, and for many years superintendent of motive power of the Illinois Central railroad, died at his home in Chicago recently, aged 77.

Mr. Earl D. Wood, assistant engineer of the Syracuse, N. Y., Intercepting Sewer Board, has accepted appointment as hydraulic engineer for the Underwriters' Association of New York State.

Colonel H. N. Ruttan, city engineer of Winnipeg, has been appointed a member of the council of 26, of the Institution of Civil Engineers of London, England, the oldest association of engineers in the world Colonel Ruttan is the only Canadian named on the council.

Mr. Edward C. Carter, chief engineer of the Chicago & Northwestern Ry., announces the appointment of Mr. L. J. Putnam as principal assistant engineer, with headquarters at Chicago. Mr. M. E. Thomas has been chosen engineer of the east and west Iowa, and the Iowa and Minnesota divisions of the road.

Metcalf & Eddy, consulting engineers, 14 Beacon street, Boston, Mass., announce that they have taken into partnership Charles W. Sherman, principal assistant engineer; William T. Barnes, engineer in charge of their Chicago office, and Almon L. Fales, until recently superintendent of the Worcester, Mass., sewage treatment works.

Mr. Emile Berliner, inventor of the gramophone; Mr. Isham Randolph, civil engineer of Chicago, and Dr. Charles P. Steinmetz of Schenectady, N. Y., an electrical engineer and educator, were the recipients of the Elliott Cresson Gold Medal, presented by the Franklin Institute of Philadelphia, May 21, for their distinguished achievements in science.

Mr. Leo Dalkart, Moline, Ill., presented a paper on "Cost Systems in Electrical Contracting," before the joint meeting of the Chicago section, American Institute of Electrical Engineers, and the Electrical section of the Western Society of Engineers, Monday, May 26. This was a change of program,—an address by Mr. H. E. Chubbuck having been announced for that evening.

Horace Greeley Burt, formerly president of the Union Pacific railroad system, and chief engineer of the Chicago Association of Commerce committee on smoke abatement and electrification of railway terminals, died in Oak Park, Ill., May 19, aged 64. Mr. Burt had been in railroad work since he was 19. In 1887 he was made chief engineer of the Northwestern. Later he was general manager of the Fremont, Elkhorn and Missouri Valley, and the Sioux City and Pacific railways. In 1898 he became president of the Union Pacific, and six years later was succeeded by E. H. Harriman. In 1905 he engaged in private consulting engineering practice in Chicago, and two years ago received the appointment by the Association of Commerce.

Stephen Dudley Field, sometimes called the "father of the trolley car," and an inventor of note, died at his home in Stockbridge, Mass., May 18, aged 68. Among the inventions patented by Mr. Field are the quadruplex telegraph, electric elevator, amplifier for doubling the speed of ocean cables, stock ticker, hotel annunciator, and the police patrol telegraph. Altogether Mr. Field held more than 200 patents. Mr. Field's first trolley car was built at his experimental station in Stockbridge. Its success encouraged him to build a second car, which is now in the Smithsonian institution. In 1883 his first car for commercial purposes was used at the business exposition of railroad men in Chicago. Later Mr. Field went to London, where he became chief engineer for a group of London capitalists engaged in building electric railroads in Europe.

Henry M. Flagler, the man who developed Florida, and built the famous "seagoing" railroad over the Florida keys, died at his home in West Palm Beach, Fla., May 20, aged 83. Mr. Flagler began business as a grocer's clerk in a small Michigan town, in his teens. He later engaged in the salt making industry at Saginaw. Next he entered the petroleum field, and with J. D. Rockefeller, founded the gigantic Standard Oil Co. In 1885 he became interested in the possibilities of Florida, and has devoted himself to the development of that state ever since. He built the Florida and East Coast railroad, and the famous Ponce de Leon and Alcazar hotels. At the age of 75 he began the construction of the railroad across the gulf from Miami to Key West. The plan was laughed at and termed "Flagler's Folly," but the railroad was built, and is regarded as one of the engineering triumphs of the age.

Civil Service Examinations.

The State Civil Service Commission of New York announces examinations as follows:

Instructor in Masonry; State Institutions; salary, $65 per month and maintenance; June 14.

Junior Bridge Draftsman; $901 to $1,200 per annum; June 14.

Bridge Designer; $1,501 to $2,100 per annum; June 14.

Junior Railway Engineer; $901 to $1,200 per annum; June 14.

Highway Inspector; $3.50 to $4.50 per day; June 14.

INDUSTRIAL

The Acme Equipment & Engineering Co. of Cleveland, O., has opened a branch opposite 30 Church St., New York. The office will be in charge of Mr. C. E. Babcock, formerly with the Griscom-Russell Co. of New York.

The Raymond Concrete Pile Co. of New York and Chicago have been awarded a contract for placing standard Raymond concrete piles for the foundation of the new boiler house and laundry building on Randall's Island, New York, Frank J. Helmle, Architect. The Raymond Concrete Pile Co. also has been awarded contracts for placing standard Raymond concrete piles for the foundation of a new warehouse for S. J. Van Lill Company, Baltimore, Md., and for the foundation of a crane runway at the La Belle works of the Crucible Steel Company of America, Pittsburgh. James Brennan, Chief Engineer.

Mr. W. W Ramsey has been appointed General Sales Manager of the J. I. Case T. M. Company, Inc., of Racine, Wis., succeeding Mr. C. J. Farney, who becomes assistant treasurer. Mr. Ramsey's period of service with the company dates back to 1893. On Jan. 15 of this year he was given a position at the Nashville, Tenn., branch house. The next year he was appointed manager of this branch, which position he held until 1900, when he was transferred to Dallas, Texas, as branch house manager. Here he remained until 1903, when the company called him to the home office at Racine to fill the position of Assistant Sales Manager. In 1905, by another upward step, he became Division Sales Manager. It is from this position that he now assumes the duties of General Sales Manager. Further announcements are those of the appointments of F. R. Washburn, former branch house manager at Spokane, Wash., as Division Sales Manager, to succeed Mr. Ramsey, and of Stephen Bull II, grandson of Stephen Bull, one of the founders of the company, as assistant secretary.

CATALOGUES

The Sterling Destructor.—Paper, 6x9 ins., 8 pp. The Griscom-Russell Co., 2150 West St. Bldg., New York City.

This gives a complete description of the Sterling Destructor for destroying combustible refuse.

Sand Blasting Rolling Barrel.—Paper, 8x10½ ins., 16 pp. The New Haven Sand Blasting Co., 147 Orange St., New Haven, Conn.

This catalog shows complete details with descriptions of the New Haven Self-Contained Sand Blast Rolling Barrel.

American Wire Wheel News.—Paper, 8¼ x11½ ins., 20 pp. American Steel & Wire Co., 72 W. Adams St.

This paper is a very complete description of the various makes of wire wheels for automobiles and of the details of construction.

Blickensderfer Typewriters.—Paper, 5x 6½ ins., 12 pp. Blickensderfer Mfg. Co., 640 Atlantic Ave., Stamford, Conn.

This catalog illustrates and describes an aluminum typewriter which is suitable for carrying in a traveling case.

Boyer Railway Speed Recorder.—Paper, 6x9 ins., 20 pp. Chicago Pneumatic Tool Co., Fisher Bldg., Chicago, Ill.

This catalog illustrates and describes the Boyer Speed Recorder for locomotives. A complete description is given with instructions for applying and operating the apparatus.

Channon's Review.—Paper, 6¾x9½ ins., 32 pp. H. Channon Co., Market & Randolph Sts., Chicago, Ill.

The May number of Channon's Review contains information as to business conditions and a number of advertisements showing contractors' equipment and supplies.

Automatic Concrete Mixers.—Paper, 4x 8¾ ins., 16 pp. Automatic Concrete Mixer Co., 288 Fifth Ave., New York City.

This catalog illustrates and describes the methods of mixing concrete by gravity through a Hains Mixer. Several drawings are shown giving the layout for plants for various classes of work

Universal Crane and Excavator.—Paper, 6x9 ins., 16 pp. C. O. Bartlett & Snow Co., Cleveland, O.

This catalog illustrates and describes a traveling derrick which may be equipped with a drag scraper bucket, a steam shovel dipper, clam shell bucket, drop or steam pile driver hammer and leads, or with a lifting magnet.

Copper in Steel.—Paper, 7¼x10 ins., 70 pp. American Sheet & Tin Plate Co., Frick Bldg., Pittsburgh, Pa.

This is a reprint of a paper by Mr. D. M. Buck, Chief Chemist of the American Sheet & Tin Plate Co., and gives full details of some instructive experiments made with metal roofing sheets made from ordinary steel and also sheets to which copper has been added.

RAILWAYS

Alabama.

The Pensacola, New Orleans & Mobile R. R. Co. has filed a mortgage to secure a loan of $350,000 to be used for extensions and improvements. Henry McLaughlin, Pensacola, Fla., is President.

The Tidewater Securities Co. of Birmingham, Ala., organized recently, proposes to build a railroad from Birmingham to Gadsden, a distance of 60 miles; to the Warrior River, a distance of 30 miles; to equip a steamboat and barge line on the Warrior River to the gulf; to develop Dauphin Island as a deep water port and as the gulf terminal for the rail and water line from Birmingham. J. M. Dewberry is President.

Arkansas.

Steps are being taken at Batesville, Ark., to organize a local company to build a railroad to connect with the Frisco line on the north and to go to Baton Rouge on the south.

Citizens of Ash Flat, Ark., are considering a plan for building an electric car line from that place to a connection with the Frisco Ry.

The Midland Valley R. R. has filed a mortgage with the Girard Trust Co. for $15,000,000, the money to be used in part for extension purposes, previously noted in these columns. It is probable that the first work undertaken will be the extension from Hartford, Ark., where the road now has its eastern terminus in the Arkansas coal fields, to Shreveport, La., a distance of about 120 miles. The extension from Wichita, Kans., west to Denver will follow the construction of the Hartford-Shreveport line.

California.

It is rumored that the Rock Island System has under consideration the construction of a line to San Diego, Calif., within a short time. No definite information on this report is as yet available.

The Pacific Electric Ry. Co., Geo. E. Pillsbury, Chief Engineer, 6th and Main Sts., Los Angeles, Cal., has received bids for grading for its Upland-San Bernardino extension. This extension will be about 21 miles long and will call for an expenditure of about $1,500,000. A considerable amount of bridge work will be required, and orders for the material for this are understood to have been placed.

Colorado.

The Grand Valley & Grand River Ry., E. A. Sunderlin, President, Colorado Springs, Colo., is reported to be planning to build an extension from Frulta to Mack, where a connection will be made with the Uintah Ry. The plan is said to contemplate broad gaging the latter road and the tunneling of Baxter Pass.

Arrangements are understood to have been about completed for refinancing the Colorado Midland Ry., G. W. Valley, Receiver, Denver, Colo., and it is probable that about $1,000,000 will be expended for improvements. These contemplate the laying of 80-lb. steel over that part of the system where it is not now in use, construction of steel bridges and the purchase of new motive power and rolling stock

A meeting was held on May 22 at the office of H. W. Cowan, Cooper Bldg., Denver, Chief Engineer of the Colorado & Southern Ry., to consider changes in plans for the new Denver Union Depot, that are expected to prove final. Officials of the Union Pacific, Colorado & Southern, Denver & Rio Grande, Burlington, Santa Fe and Rock Island participated in the meeting. Improvements on the depot and new trackage and terminal facilities costing in the neighborhood of $2,000,000 will be made by the six roads, although it is probable, as previously noted, that they will decide not to begin work until after the Knights Templar conclave in August.

The Montezuma-San Juan Southern Ry., incorporated recently with a capital stock of $4,000,000, is to have surveys started at once for its projected 200-mile line, from Cortez, Colo., south to Fruitland, N. Mex., and thence to Grants, where a connection will be made with the Santa Fe System. Emil Stein, Cortez, Colo., is General Manager.

The citizens of Denver, Colo., have voted in favor of an amendment to the city charter to authorize a commission to formulate plans for a bond issue to aid in building Moffat tunnel, the question of issuing the bonds to be submitted at a future election. The commission consists of Jesse E. Fleming, Charles M. Wilcox and J. C. Helm. The tunnel will be constructed through James Peak starting just east of Tolland, 35 miles from Denver. It will be 6.04 miles long and will cost about $4,500,000. It will be built for the extension of the Denver & Salt Lake R. R. (Moffat Road) from Craig to Salt Lake City, and will be owned by the city and county until the railroad pays the entire amount of bonds. Before the voting of the bonds the Denver & Salt Lake R. R. will put up $1,500,000 as a first payment on the construction work of the tunnel. The railroad company also agrees to turn over to the tunnel commission all surveys, charts, rights of way to the approaches of the tunnel and agrees to pay all expenses entailed in the building of the east and west approaches.

Connecticut.

The Connecticut Legislature has passed a bill authorizing the Westchester & Northern R. R. Co. to construct and operate its line from White Plains, N. Y., to Danbury, Conn. The company has a New York charter and did not apply for a Connecticut charter, but merely the right to build and operate in this state. Originally the bill carried powers which would have permitted it to acquire water power rights anywhere in the state, but this provision was cut out by the Committee on Railroads. The Westchester & Northern is a subsidiary of the New York Central Lines.

Georgia.

The Covington & Oxford Street Ry. Co., R. C. Guinn, General Manager, Covington, Ga., has petitioned for permission to increase its capital stock from $10,000 to $50,000. The increase in capital stock is to be used in changing the motive power to electricity on the present 3-mile horse car line to Emory College. It is also proposed to extend the line three miles to Porterdale.

Illinois.

⊙The Westinghouse-Church-Kerr Co., New York City, has been awarded the contract for constructing the machine shop and other buildings at Bloomington, Ill., for the Chicago & Alton R. R. An expenditure of about $987,000 is contemplated.

The Kankakee & Urbana Traction Co. has completed surveys for a 10.6 mile extension between Rantoul and Paxton, and has obtained 75 per cent of the construction capital. Date for awarding construction contracts, however, has not been decided upon. C. J. Hays, Urbana, Ill., is Chief Engineer; Geo. M. Bennett, Urbana, Ill., is President.

Surveys have been completed and the capital has been secured for the construction of the projected 53 mile line of the Peoria, Canton & Galesburg Ry., from Peoria to Galesburg. Construction contracts will be let this summer. Horace Clark, Peoria, Ill., is the President; L. L. Summers & Co., Chicago, Ill., are the Engineers.

The Santa Fe System in contemplating the construction of the following minor improvements along the line: Albuquerque Division—extending siding at Bibo, estimated cost, $2,563; at Sanders, $2,925; at Carrizo, $2,848; at Allentown, $2,225; building ditches to protect the roadbed at bridge No. 202; Arizona Division—renewing bridges, $2,263; constructing set out spur at Java, extending passing track at Argos, $3,784; at Pisgah, $3,500; at Jimgrey, $2,593; at Hawes, $2,920; at Tungsten, $4,982; installing boiler washing plant at Barstow, $3,000; installing a new pumping plant at Goffs, $4,774; building a concrete protection wall at Essex, $19,163; Mojave Gap, relocating and extending sand spur at Bissell, $2,961. Beaumont division—extending passing track at Dobbin, $3,931; at Koutze, $2,003; constructing storage track at Silsbee, constructing storage track at Wood, $5,259; constructing passing track at Call Junction, $5,051; constructing drainage ditches between mile posts 56 and 75, $8,655; extending passing track and constructing storage track at San Augustine, $3,604; rehabilitating telegraph facilities between Beaumont and Post Bolivar. Galveston Division—constructing a new team track at Alvin, $3,795; a new storage track at same place, $10,171; constructing yard tracks at Port Bolivar, $1,161; extending and connecting lumber spur at Wallis, $1,027; installing an air compressor reservoir and pipe line at Galveston, $3,546;. improving and erection of telegraph line between Virginia Point and Alvin, $7,192; extending south bound passing track and constructing trestle at bridge at Rosenberg, $6,228. Illinois Division—changing yard tracks at Corwith, $5,718; building a spur track to accommodate the Chicago Starch Co. at Chicago. Los Angeles Division—replacing the following bridges with concrete pipe: bridge No. 261A, $1,165; bridge No. 180B, $1,183; bridge No. —— ;installing spur track for the General Pipe Line Co. at Los Angeles. Middle Division—extending 2 cinder pits at Newton, $3,259; extending east bound passing track at Newton, $7,478; installing telephone train dispatching circuits between various cities, $30,828. Missouri Division—protecting banks at bridge No 426A. New Mexico Division—building a concrete slope wall at bridge No. 624A. Northern Division—making changes in tracks at East Dallas, $11,586; extending and realigning passing and oil mill tracks at Midlothian, $2,055; improving present water facilities and constructing additions thereto, $6,983; raising grade and constructing bridges between Merit and Celeste, $5,382; installing a train dispatcher's telephone circuit between Clebourne and Paris. Oklahoma Division—extending trackage at Cushing, $8,771, providing an additional boiler at Guthrie, $2,000; protecting earthen reservoir spillway with concrete at Meramec, $2,654; renewing bridge 67A, $1,073. Panhandle Division—extending passing track at Loder, $1,959; at Crystal, $1,637; at Eagle, $2,252. Pecos Division—extending passing track at Elida, $1,789, at Kenna, $1,906; constructing passing track at Dexter, $6,905. Plains Division—providing drainage facilities at Snyder. Southern Division—building a connecting track at Coleman, $22,339. Southern Kansas Division—installing train dispatcher's telephone system between Ottawa and Tulsa; constructing a track scale, etc., at Bartlesville, $5,245; building a stock track at Augusta, $2,486; installing a new water treating plant at Augusta, $4,118; changing tracks at plant of Kansas City Hydraulic Pressed Brick and Chaunte Vitrified Brick Co.'s plants at Chaunte. Valley Division—building a spur track to accommodate the Oro Electric Co., at Stockton; constructing spur track to accommodate the Corcoran Department Store at Corcoran; building a sand blanket on each side of track between mile posts 1129 and 1138, estimated cost $63,819. Western Division—changing yard trackage at Kinsley, $15,961; changing tracks at Scott City, $3,658.

Indiana.

The Evansville Ry. Co., Evansville, has purchased the Evansville & Mt. Vernon Electric Ry. Co. and the Evansville Terminal Ry. Co.

and has become lessee of the Evansville, Henderson & Owensboro Ry. Co. The transfer places three traction lines under one management.

Iowa.

The City Council of Des Moines, Ia., has voted to vacate the streets between East 18th and 30th, Dean Ave., and Market St., donating the land to the Rock Island System for the construction of its proposed $750,000 shops upon which work will be commenced at once.

It is probable that if the street railway controversy at Des Moines is settled satisfactorily the Harris Trust Co. of Chicago will start immediately to develop the interurban field around Des Moines. At least two extensions of the service of the Interurban Ry. Co., controlled by the Harris Trust Co., are now being planned. A survey has been made of a new line to Indianola. This will follow a route through South Des Moines past the army post. A preliminary survey already has been made of a new route from Newton to Colfax. This new line, 11 miles in length, will be shorter than the Newton & Northwestern line by three miles. C. F. Hewitt, Des Moines, Ia., is General Manager.

Kansas.

The Topeka Ry. Co., A. M. Patton, General Superintendent, Topeka, Kan., is contemplating extending its West 10th Ave. line to Gage Park, Topeka, at a cost of $45,000.

The Anthony & Northern Ry. has grading work under way for a 6-mile section from Iuka to Pratt, where a connection will be made with the Missouri Pacific. The steel and ties have been purchased and it is hoped to have the track laid by July 15. O. P. Byers, Hutchinson, Kan., is President.

It is reported that the Santa Fe System contemplates the construction of a second track between Kinsley and Dodge City, Kan., and also between Hutchinson and Newton. It is believed, however, that the company has no immediate intention of undertaking this work.

The Interstate Traction Co. is projecting a 50-mile line from Arkansas City through Blackwell, Okla., Tonkawana, Okla., and Billings to Enid, Okla., with a branch line to Ponca City and White Eagle. Surveys have been made for 40 miles of line, and it is expected to let construction contracts soon. O. L. Brown, Arkansas City, Kan., is President; S. K. Titus, Arkansas City, is Chief Engineer.

Kentucky.

It is reported that officials of the Chicago, Memphis & Gulf R. R., which was recently acquired by the Illinois Central, hope for the early extension of the line to Clinton, Ky.

The Louisville & Nashville R. R. is contemplating the expenditure of about $1,000,000 for improving its Lexington & Eastern Division.

Louisiana.

⊙Advices from Alexandria, La., state that a contract has been let to Henry J. Cox & Co., of New Iberia, for grading, bridging and track laying on the Alexandria & Western R. R. It is hoped to have the road completed and ready to operate by or before August 1. This road extends from Alexandria, through the Bayou Rapides country, to a rich tract of timber owned by the Bayou Rapides Lumber Co., which is building a large saw mill here. There is also a large tract of timber owned by the Garden City Lumber Co. and other concerns. The road will be fully equipped with passenger cars and freight cars to do business through that section.

Advices from Eunice, Ia., state that the 11-mile railroad now being constructed by the Newell Lumber Co., under supervision of J. L. Adams and Anthony Lambert, Civil Engineer, will, in the near future, be extended to the Town of Jennings, La., about 6 miles.

The Gulfport & Western R. R. recently organized to construct a railroad from Gulfport to Covington, La., according to advices from Mobile, Ala., has secured valuable options on property between 22d and 23d Aves., Mobile, Ala. An election will be held in the city May 31 to vote on the proposition to issue $150,000 of bonds when the road is built.

Maryland.

The Cumberland Valley R. R. has taken bids on a small amount of grade revision work between the Potomac River and Bedington, W. Va., south of Hagerstown, Md. About 87,000 cu. yds. of excavation is required.

Mississippi.

A number of business men of Corinth, Miss., have filed an application for a charter for the Corinth & Northwestern Ry. Co. and propose to build a railroad from Corinth, Miss., to the Tennessee River, there to connect with a proposed road to be built from Nashville, Tenn. Stock subscription books have been opened and quite a large amount of stock has already been subscribed.

Missouri.

The Kansas City, Ozark & Southern Ry., J. B. Quigley, Chief Engineer, Ava, Mo., is reported to be planning to begin construction work in the near future on an extension from Ava south to Rockbridge, 15 miles. Later on it is proposed to continue this extension for a distance of 40 miles to Mountain Home, Ark.

The St. Louis & San Francisco Ry. Co. has applied to the State Utilities Commission for permission to issue $761,000 gold bonds bearing 5 per cent interest to run until 1940. These are to be first mortgage bonds on the New Orleans, Texas & Mexico division of the Frisco and are issued for general betterment purposes.

Montana.

The Northern Pacific Ry. is reported to be securing right of way for a line from Bridges to the Bear Creek coal field.

According to reports received at Helena, Mont., the surveyors of the Northern Pacific R. R., at work on the Glendive-Helena cut-off, have almost completed their work. The survey, it is said, runs due east of Helena through White Sulphur Springs, continuing eastward to Willow Creek in the eastern part of Musselshell County. It then takes a northerly course toward Glendive. It is said that the proposed new line reduces the distance between the capital city and Glendive by about 100 miles, and taps the richest agricultural sections in Musselshell and other counties along the route.

New Jersey.

A plan is under consideration to utilize the New Jersey & Pennsylvania R. R. and the Morristown & Erie to form a connection between the Erie and the Central Railroad of New Jersey. The proposition is to unite the New Jersey & Pennsylvania with the Morristown & Erie. The former road extends from Whitehouse on the Central, to Watnong, at Morristown. The other road extends from Essex Falls terminus of the Erie to Morristown. The plans are understood to call for the ultimate expenditure of about $2,500,000.

New York.

✣Bids will be opened June 24 by the Public Service Commission, First District, Travis H. Whitney, Secretary, 154 Nassau St., New York City, for the construction of Sec. 4 of the Broadway-4th Ave. rapid transit railroad. This railroad will be operated by the New York Municipal Railway Corporation (Brooklyn Rapid Transit) under the Dual System contracts. The Broadway subway is now under construction from Trinity Place and Morris St. to a point in Broadway midway between Houston and Bleecker Sts. Section No. 4 extends from this point north under Broadway to a point 390 ft. north of the southerly line of 14th St. It will be a 4-track subway, and the section includes a local station at 8th St. and half of the express station at Union Square. Working shafts will be located in Union Square, one in Broadway at Waverly Place and one in Bond St. just off Broadway. These locations are chosen to minimize the interference with traffic and general business during the construction of the subway. The contractors will bid for construction only, which will not include the laying of tracks, or the finish work in stations. Each bid must be accompanied by a certified check for $15,000. The successful bidder will be required to give a bond for $75,000, and as further security the City will retain 15 per cent of the money paid to the contractor until the amounts so retained shall equal 10 per cent of the total bid, after which 10 per cent will be retained until the completion of the work.

It is expected that the Geneva & Auburn Ry. Co. (electric), Seneca Falls, N. Y., now in process of reorganization, will make an announcement shortly regarding its proposed extension to Auburn and other improvements. Plans for the improvement include the construction of an $80,000 trestle over Cayuga Lake.

The Public Service Commission, Albany, is to hold a hearing on May 28 on the application of the Hudson River Connecting R. R. for permission to begin work on the construction of its road to connect the West Shore and Boston & Albany R. R. tracks by means of a bridge across the Hudson about 10 miles south of Albany. At a hearing last week the cost of this line was estimated as follows: Construction from Feura Bush to the river, $1,500,000; bridge across the Hudson, $3,000,000; railroad connections in Rensselaer County, $2,500,000; yard at Feura Bush from $1,500,000 to $3,000,000. The Hudson River Connecting R. R. is to be financed and built by the New York Central Lines.

The first plans for elevated railroad improvement in New York under the Dual System contracts have been submitted by the New York Municipal Railway Corporation (Brooklyn Rapid Transit), for the proposed connection of the existing Myrtle Ave. and Broadway elevated lines in Brooklyn. The Public Service Commission for the First District approved the plans, on the condition that the company will invite competitive bids for the construction work. The plans call for the alteration of the existing structures and their connection so that trains may operate freely from one line to the other.

North Carolina.

⊙Rinehart & Dennis Co., Railway Contractors, Jeffersonville National Bank Bldg., Charlottesville, Va., has been awarded the contract for constructing two tunnels at Whitney, N. C., for the Southern Aluminum Co. The tunnels will be 2,000 ft. long, 40 ft. wide and 30 ft. high. These contractors now have 32 tunnels under construction.

North Dakota.

⊙P. S. Brosinare has the contract for the bridge work for the Fairmount & Verblen R. R., a new 45-mile line to be constructed between the places named. H. A. Whittier and J. A. Brolander, Hankinson, N. Dak., have the grading contract. J. H. Thomas, Fairmount, N. Dak., is the Engineer.

Ohio.

The Middleport & Northeastern Ry. Co. has been organized as a subsidiary company of the Kanawha & Michigan Ry., F. B. Sheldon, President, Columbus, O., for the purpose of constructing a 50-mile line between Marietta and Middleport along the Ohio River.

Surveys have been started for the proposed Portsmouth-Jackson interurban line, which is to be constructed by the Portsmouth Street R. R. & Light Co. as an extension of its Portsmouth-Sciotoville line. L. D. York, Portsmouth, O., is President.

The Parkersburg, Marietta & Interurban Ry. Co., Parkersburg, W. Va., has surveys under way for an extension from Beverley to McConnellsville, 15 miles. It is stated that construction work will be started this summer.

The Columbus Depot Co. has concluded negotiations for one-half of the block bounded by High, Town, Front and Rich Sts., and is contemplating the expenditure of about $1,000,000 for the erection of an 8-story building to furnish station facilities for interurban traffic. It is reported that financing of the new project has been arranged. The proposition is backed by the Scioto Valley Traction Co. Negotiations are under way with the city for franchises necessary to run tracks into and through the proposed stations. Frank L. Packard, Architect, Columbus, O., is the Architect.

Oklahoma.

Surveys have been started for the projected line of the Muskogee & Missouri Pacific Connecting R. R., the incorporation of which was mentioned in our last issue. The line will run north out of Muskogee, then turn directly east, connecting with the Missouri Pacific about 2½ miles south of Fort Gibson. It is stated that grading will be started in the near future and that the road will be completed as soon as possible. C. N. Haskell, Muskogee, Okla., is President.

Pennsylvania.

⊙Frank A. Haven & Co., Philadelphia, Pa., has been awarded the contract for the erection of a power and pump house in connection with the Philadelphia & Reading Ry.'s improvements at Yardley.

⊙George H. Hardner, Allentown, Pa., has been awarded the contract to erect a new roundhouse and locomotive repair shop at the Bethlehem Steel Works for $50,000. The roundhouse will have a diameter of 160 ft. and will store 20 locomotives.

⊙The Philadelphia & Reading Ry. has awarded the contract for grading and masonry account the low-grade freight line at Wayne Junction to C. P. Bower, Reading, Pa.

The Mt. Bethel Street Ry. Co. and the Bangor & Portland Traction Co., of East Bangor, have been merged. The new company has a capital of $130,000.

The Chestnut Ridge Ry., C. R. Funk, Chief Engineer, Palmerton, Pa., operating 13 miles of line from Palmerton to Kunkleton, is reported to be contemplating an extension to Stroudsburg during this summer with the intention of forming a more direct route to the New Jersey zinc mines.

The Lehigh & New England R. R., F. W. Gilchrist, Chief Engineer, Mauch Chunk, Pa., has started work on large classification yards at Mountain Junction, 1 mile east of Tamaqua.

The Philadelphia & Reading Ry. is reported to have approved plans for improvement work which will involve the expenditure of several million dollars. These improvements include the construction of the elevated extension from 16th St., Philadelphia, to Manayunk and a new line to Royersford for a third track. The survey for this line runs parallel to the Schuylkill River from the southern entrance to the Black Rock tunnel to the base of the Black Rock, and crosses the river close to the old toll bridge near the Montgomery County almshouse. This route will entail a deep cut at Mingo, two miles below Royersford.

Papers have been filed for the merger of the Trenton, New Hope & Lambertville; Yardley, Morristown & Trenton; Newton & Yardley, and the Bucks County Electric Rys. Cos. into the Bucks County Interurban Ry. Co., Philadelphia, to operate in Bucks County. The capital is $1,000,000, and the directors are W. Frederick Snyder, President; W. H. Snyder, Sydney L. Wright and W. Redwood Wright, all of Philadelphia; John Barhey, Reading; Frederick Battles, Newtown Square, and Gaylord Thompson, Trenton.

Tennessee.

⊙The James Alexander Construction Co., Memphis, Tenn., has been awarded the contract at about $500,000 for constructing the new terminal at Memphis for the Illinois Central Ry.

The West Tennessee Traction Co., projecting an 86-mile line from Memphis, Tenn., to Jackson, Tenn., via Brownsville, has made its surveys and has practically secured its construction capital. It is proposed to let construction contracts soon. Geo. C. Bennett, Memphis, Tenn., is President; A. N. Bullett, S. E. Bldg., Memphis, is Chief Engineer, and B. G. Sargent, Memphis, is Vice President and General Manager.

Texas.

Practically all right of way for the projected interurban line from Dallas to Terrill has been secured, and the Stone & Webster Engineering Corp., Boston, Mass., is reported to be about ready to start construction work. This line will be about 30 miles long and will cost about $1,000,000. Edward T. Moore, Dallas, is manager of the Stone & Webster interests in that city.

The Palacios, San Antonio & Pecos Valley R. R. Co. has opened offices in the Shropshire Drug Co.'s building at Yoakum, Tex. This company is understood to be planning the construction of a line from Yoakum to two ports on the Gulf of Mexico.

The St. Louis Southwestern Ry. is reported to be planning to have work started in the near future on extensions from Comanche to Sweetwater and from Stephenville to the Thurber coal fields.

Preliminary surveys have been completed by A. B. Axtell, Chief Engineer, for the projected 92-mile line from Austin to San Antonio for the Guadalupe Traction Co. The route as outlined follows the course of the river down to Onion Creek, thence by Evelyn in Lockhart, from Lockhart to Seguin, and from Seguin to San Antonio. Dr. E. W. Brown, Orange, Tex., is President.

Advices from Austin, Texas, state that the International & Great Northern has made application to the State Railroad Commission for authority to issue bonds to the amount of $780,000 for additions and betterments to that property. Preliminary to acting on this application an examination of the books and records of the road is being made by W. F. Fitzgerald, Auditor of the Commission. It is stated that if the bonds are issued the proceeds will be used to improve the physical condition of the property, particularly that part between San Antonio and Laredo, 150 miles. Although this latter division is one of the links of the main line of Mexico-United States traffic, the rails are only 56-lb., and have been in use ever since the road was constructed many years ago. New and heavier steel for this portion of the system was ordered some time ago. O. H. Crittenden, Houston, Texas, is Chief Engineer.

Mason Williams, Attorney for the San Antonio, Uvalde & Gulf R. R., recently conferred with the State Railroad Commission, Austin, Texas, regarding issuance of bonds for that road. At present there is 230 miles of the road in operation upon which bonds have not yet been issued. A. R. Ponder, San Antonio, Texas, is Vice President and General Manager.

President Lawrence Eastland, Jr., of the Estacado & Gulf Ry., Plainview, Texas, contemplates selling the road. It is reported that the prospective buyers intend to extend the mileage and make numerous improvements in the near future.

Utah.

The locating crew of the Denver & Salt Lake (Moffat) Railroad has, according to reports, crossed the Colorado border into Utah. The surveyors are under contract to get the levels through to Salt Lake City in six months. The grading gangs are following with 25 separate outfits between Steamboat Springs and Craig. When this stretch is completed the remainder of the line to Salt Lake will be rushed, and, according to announcement, will be finished within 18 months. General Manager W. E. Morse has announced that the construction work will continue the year round.

Virginia.

⊙Virginia Railway & Power Co. has awarded a contract to Louis Lawson at $4.24 per foot for laying the roadbed for new tracks to be laid on Bute and York Sts., from Boush St. to Botetourt on both streets, at Norfolk, Va. The contract will amount to about $18,000.

Washington.

The Veness Logging Railroad extending eastward from Winlock, according to advices from Toledo, Wash., is to be extended to become a part of the Harris System up Salmon Creek and into southern Lewis County. John L. Harris, Kelso, Wash., is promoting the project.

Advices from Stevenson, Wash., state that Sweeney Bros. have the contract for constructing a logging road at Cascade, 6 miles west, and also have the contract for constructing a 14-mile logging road for the Jones-Krebs Timber Co. The latter line is to run up Rock Creek to the basin, where a large mill is to be erected.

West Virginia.

⊙Boxley, Goodwin & Bray, Lester, W. Va., have been awarded a contract for four miles of double track work and a 900 ft. double track tunnel for the Virginia Ry.

⊙The Piedmont Construction Co., Charlottesville, Va., has been awarded the contract by the Coal & Coke Ry. Co. for lining, with brick and concrete, an aggregate of 1,400 lin. ft. in three tunnels. R. H. Pembroke, Elkins, W. Va., is Chief Engineer. Bids were opened May 3.

The Buckhannon & Northern R. R. has accepted the franchise granted by the Council of Fairmount, W. Va., giving it an entrance to that city.

The Western Maryland Ry. is securing the necessary right of way through Berkeley County, W. Va., across the Potomac River from Williamsport, Md., for the construction of a spur track to the limestone quarries along the river in the vicinity of Indian Church.

Wisconsin.

The Minneapolis, Merrill & Marinette Ry. Co., of Merrill, Wis., has filed with the Secretary of State, Madison, Wis., articles of incorporation. The company proposes to build a standard railroad from Antigo to Prentice Junction, a distance of 75 miles. The capital stock of the company is $100,000, of which $300,000 is preferred. The incorporators are: J. N. Cotter, Assemblyman John O'Day, L. N. Anson, A. B. Nelson, A. H. Wright, George T. Harding, Herman Meyer, E. S. King, F. W. Kubasta, William F. Peterman, and Christ Solum, all of Merrill.

Wyoming.

Chester F. Perry, of Albin, Wyo., and Di Marshall, of Pine Bluff, Wyo., are promoting the construction of a railroad from Cheyenne to Bridgeport. It is planned to run the road north of the present line of the Union Pacific through the Albin District, which is considered to be one of the greatest grain producing sections in the West, with the eastern terminal of the road at Bridgeport, Neb. The road will be practically 120 miles in length and would cost, it is estimated, in the neighborhood of half a million dollars.

Canada.

⊙Grant-Smith-McDonald Co. have been awarded the contract by the Canadian Pacific Ry. for the following double track work in the west: Revelstoke to Taft, Westmore to Kamloops and Kamloops to Tranguille. The work covers about 55 miles of line, and bids for it were opened May 10 by F. F. Busteed, Engineer Grade Revision, Kamloops, B. C.

The Winnipeg Electric Ry. Co., Wilfred Phelps, Chief Engineer, 218 Portage Ave., Winnipeg, Man., is to build 12 or 14 miles of new line this season.

The Toronto, Hamilton & Buffalo Ry., R. L. Latham, Chief Engineer, Hamilton, Ont., has received bids for building railroad track from Welland, Ont., to Smithville, 16½ miles.

Rate payers of Berlin, Ont., have voted a by-law to raise $30,000 for a double track to be laid by the Berlin & Waterloo Street Ry. from Wellington St. to the Waterloo boundary line which is to be permanently paved

BRIDGES

Arkansas.

Advices from Clinton, Ark., state that Judge J. F. Patterson of Bee Branch has awarded the contract for the construction of a steel bridge over Little Red River near that place to the Vincennes Bridge Co., Vincennes, Ind., at $5,000.

California.

The Board of Shasta County Supervisors, Redding, Calif., has instructed the County Surveyor to prepare estimates for a bridge across the river at Kennett. These will be considered at the July meeting.

Advices from Sacramento, Calif., state that the bill introduced by C. H. Johnson appropriating $25,000 for the construction of a bridge across the Colorado River at Needles, contingent upon similar appropriations by Arizona and the government, was passed unanimously.

The City Trustees of Redding, Calif., have asked that plans and specifications for a bridge to span the Sacramento at or near Reid's Ferry be submitted to them by May 30. This is preparatory to calling a bond election. The bridge must be either all steel or reinforced concrete. Under a recent opinion given by District Attorney Chenoweth, the county must pay half the cost and Redding half the cost, which will be $50,000 or $60,000. H. C. Woodrum is City Clerk.

Plans are being prepared by City Engineer H. S. Gierlich, Monrovia, Calif., for the construction of a concrete bridge over the Santa Anita wash at Fallingleaf Ave. The cost of the structure will amount to about $6,000, it is estimated.

Colorado.

At a recent election held at Denver, Colo., it was voted to issue bonds amounting to $260,000 for the construction of the Colfax-Larimer viaduct.

Connecticut.

The Public Utilities Commission has approved the plans of the railroad company for the reconstruction of bridges at De Witt, Lamberton and Cedar Sts. and Howard Ave., New Haven, Conn.

Georgia.

✣Bids will be received at once by G. C. Bell, Chairman, Hancock County, Sparta, Ga., and G. R. Maner, Chairman, Warren County, Warrenton, Ga., for the erection of a steel bridge over Ogeechee River at Jewel, Ga., between the two counties.

Idaho.

✣Bids will be received until 10 a. m., June 2, by Board of Boise County Commissioners, Idaho City, Idaho, for the construction of two steel highway bridges, and a reinforced concrete retaining wall, at the following locations: One bridge across the north fork of the Payette River near Crawford, Ida. One bridge across the middle fork of the Payette River in Garden Valley, the retaining wall to be built in conjunction with the bridge in Garden Valley, all in accordance with the plans and specifications on file in the office of the County Auditor at Idaho City, Ida., and with E. R. La Pointe, Consulting Engineer, Room 502 Overland Bldg., Boise, Ida., Bids must be accompanied by a certified check in the sum of 5 per cent of the amount of the bid, acceptable to the Board of County Commissioners. J. C. Mills, Jr., chairman of the Board of County Commissioners, Boise County, Ida.

Illinois.

✣Bids will be received up to 2 p. m., June 5, at the People's Bank, Camp Point, Illinois, for the construction of one reinforced concrete bridge, to be built in Camp Point Township, Adams County. J. Q. Ward, Town Clerk, Camp Point, Ill. Reservoir Bridge—Span, 25 ft.; roadway, 18 ft.; height, 14 ft. Estimated total concrete, 86.2 cu. yds.; reinforcing steel, 9,240 lbs. Nearest railroad station, Camp Point, about ¾ mile. No local concrete materials available. Present bridge wood, about 37 ft. span. Green timber for false work can be cut near the site. Low water flow dry; high water, about 6 ft. deep. Excavation, clay, averages about 8 ft. deep and to be carried about 3½ ft. below stream bed. Award of contract subject to full aid being granted by Board of Supervisors of Adams County at June meeting. Engineer's estimate, $1,325. Work to be completed on or before Oct. 1, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Illinois.

✣Bids will be received up to 2 p. m., June 4, at the Town Clerk's office, Ohio, Ill., for the construction of two reinforced concrete bridges to be built in Ohio Township, Bureau County. Guy Morton, Town Clerk, Ohio, Ill. Crannels and Hussy Bridges—Spans, 12 and 14 ft.; roadways, 20 and 18 ft.; heights, 12 ft. 9 ins. and 14 ft. Estimated total concrete, 64.1 and 69.9 cu. yds.; reinforcing steel, 5,220 and 5,310 lbs. Nearest railroad stations, Ohio, about 2 miles, and Kasbeer, about 1½ miles. It is reported that Yorkville screened and washed gravel may be had F. O. B. cars at Ohio or Kasbeer at about 90 cts. per ton. Present bridges wood, 6 ft. span, and wood, 16 ft. span. Low water flow for both bridges, dry; high water flow for both bridges, 8 ft. Excavation will average about 11 and 8 ft., in clay, to 1 ft. and 3½ ft. below stream bed. Engineer's estimate, $1,825. Work to be completed on or before Sept. 1, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received up to 10 a. m., June 10, 1913, at the Court House, Cairo, Ill., for the construction of one reinforced concrete bridge to be built in Road District No. 4, Alexander County. Jesse E. Miller, County Clerk, Cairo, Ill.—Rock Spring Bridge: Span 20 ft.; roadway, 18 ft.; height, 24 ft. Estimated total concrete, 161 cu. yds.; reinforcing steel, 15,550 lbs. Nearest railroad station, Thebes, about 2 miles. It is reported that gravel may be had from a creek bed about ½ mile from bridge site at 10c per cubic yard at pit. This gravel if used, will require washing. Present bridge, stone arch, 8-ft. span, 12 ft. high to intradose. Low water flow, about 2 ft. deep, 12 ft. wide; high water about 22 ft. deep. It is recommended that bidders visit the bridge site to ascertain to their own satisfaction the amount of excavation and other local conditions, before submitting a proposal. Engineer's estimate, $2,000. Work to be completed on or before October 15, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received up to 1 p. m., June 5, at the Town Clerk's office, Lanark, Ill., for the construction of one reinforced concrete bridge to be built in Rock Creek Township, Carroll County. S. C. Wiley, Town Clerk, Lanark, Ill. Paul Bridge—Span, 30 ft.; roadway, 16 ft.; height, 16 ft. Estimated total concrete, 111 cu. yds.; reinforcing steel, 12,650 lbs. Nearest railroad station, Lanark, about 3½ miles. It is reported that gravel containing about 70 per cent of sand may be obtained from a pit about 3½ miles from bridge site at 50 cts. per cu. yd. at pit. Present bridge, 12 foot, steel. Low water flow, dry; high water, about 8 ft. deep. Excavation will average about 15 ft. deep through clay to about 4 ft. below stream bed. Piles may be found necessary. Engineer's estimate, $2,700. Work to be completed on or before Oct. 5, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received until 11 a. m., May 29, for furnishing and providing labor, materials, etc., necessary to fabricate and deliver structural steel castings, bolts, field rivets, etc., for 3 fixed bridges over the North Branch of the Chicago River at Kedzie Ave., Forest Glen Ave. and 56th Ave., according to plans and specifications, cash or certified check for $500.00 must accompany proposal. L. E. McGann, Commissioner of Public Works, Chicago, Ill.

✣Bids will be received until 1 p. m., June 4, at the Court House, Mt. Carroll, Ill., for the construction of one reinforced concrete bridge to be built in Woodland Township, Carroll County. Henry Toepfer, Town Clerk, R. F. D. No. 3, Mt. Carroll, Ill. Tipton Bridge—Span, 12 ft.; roadway, 16 ft.; height, 12 ft. Estimated total concrete, 48.1 cu. yds.; reinforcing steel, 3,580 lbs. Nearest railroad station, Mt. Carroll, about 9 miles. It is reported that stone may be had from creek bed, about 400 ft. from bridge site at 25 cts. at pit; same will require screening and contains some sandstone and soapstone which will have to be thrown out. Sand must be added. Sand F. O. B. cars Mt. Carroll, about 60 cts. per cu. yd. Present bridge, wood, about 13 ft. span. Low water flow, dry; high water, about 5½ ft. Excavation gravel, east side about 10 ft.; west side about 4 ft.; to be carried about 3 ft. below stream bed. Engineer's estimate, $800. Work to be completed on or before Sept. 5, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received until 1 p. m., May 31, by Frank Birtwell, Town Clerk, Otter Creek, Streator, Ill., for the construction of reinforced concrete bridgework to be built in the town of Otter Creek.

⊙Advices from McConnell, Ill., state that the contract for the construction of the Herman Schrader bridge, for which bids were opened May 14, has been let to W. H. Shons, Freeport, Ill., at $2,245.

⊙Contracts for the construction of the proposed Bridge St. viaduct at Peoria, Ill., have been let by the Rock Island and the P. & P. U. Railroads as follows: J. J. Jobst Contracting Co., Peoria, Ill., for the substructure and viaduct proper: Milwaukee Bridge Co., Milwaukee, Wis., for the superstructure of steel. It is hoped to have the work completed by Sept. 1.

The City Council of Joliet, Ill., has ordered plans prepared for the repair of the Second Ave. bridge over the Hickory Creek. C. D. O'Callahan is City Engineer.

The Highway Commissioners of the town of Wilmington, Ill., decided at a recent meeting that when a highway bridge was built over the Kankakee River at that place it would be of reinforced concrete and would have a 30-ft. roadway. An election will probably be held early in June on the proposition.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Indiana.

✣Bids will be received until 10 a. m., June 2, by Board of Dubois County Commissioners, Jasper, Ind., for the erection of the following bridges: 1. George Fuhrman Bridge in Boone Township, 12 ft. span. 2. Bither Graveyard Bridge in Boone, 12 ft. span. 3. Andrew Krodel Bridge in Boone Township, 12 ft. span. 4. Christ Weisman Bridge in Boone Township, 12 ft. span. 5. Sarah Crandal Bridge in Boone Township, 17 ft. span. 6. Bridge over Hunley Creek, near Joseph Gehlhausen's, 2¾ miles northwest of Ferdinand, 40 ft. span. 7. Bridge near Henry Remke's on Eddyville Road, 2 miles southeast of Ferdinand in Ferdinand Township, 22 ft. span. 8. Bridge over Greens Creek, northeast of Ferdinand, near Jos. Schlachter's on the St. Anthony road in Ferdinand Township, 30 ft. span . All of said bridges to be built in accordance with plans and specifications now on file at the auditor's office in Jasper, Ind., Jacob H. Seng is Auditor.

✣Bids will be received until 2 p. m., June 2, by Board of Knox County Commissioners, Vincennes, Ind., for the following bridge work in accordance with plans and specifications on file with the County Auditor: Each bid must be bid on separately and no composite bid will be considered. Bridge on state road at southwest corner of Oaktown. Culvert near Henry Decker's residence in Palmyra Township. No. 1—Bridge near White River, 2 miles east of the residence of Martin Rogers. No. 2—Brown road bridge over Brocksmith lateral. No. 3—Grizzle road bridge, 1 mile from Grizzle station. No. 4—Grizzle road bridge, 1 mile east of 60-ft. span. No. 5—Shelt Johnson bridge, 5 miles east of Oaktown. No. 6—Bridge near Charles Myers residence near Purcell, Ind., in Johnson Township. No. 7—Removing bridge material from Wesley ice bridge in Decker Township to Rodenhouse Bridge, and the last named bridge to Mariah Creek and the erection thereof. Bidders will be required to furnish bond double the amount of bid conditioned for the faithful performance of their work.

✣Bids will be received until 1 p. m., June 10, by Board of Decatur County Commissioners, Greensburg, Ind., for the construction and repair of 15 bridges. L. W. Sands is County Auditor.

✣Bids will be received until June 9, by Charles W. Hodgkin, Union Township Trustee, 120 W. Main St., Crawfordsville, Ind., for the construction of two bridges known as the Tapp Oliver and Voris bridges and also some repair work in the above township.

✣Bids will be received until 2 p. m., June 4, by Board of Fulton County Commissioners, Rochester, Ind., for the construction of six bridges. W. C. Miller is County Auditor.

✣Bids will be received until 3:30 p. m., June 4, by Board of Fulton and Miami County Commissioners, at Rochester, Ind., for the construction of two county line bridges. W. C. Miller is County Auditor.

✣Bids will be received until 2 p. m., June 4, by Board of Howard County Commissioners at Kokomo, Ind., for the construction of a bridge across Kokomo Creek. E. B. Swift is County Auditor.

✣Bids will be received until 1:30 p. m., June 3, by Board of Jefferson County Commissioners, Madison, Ind., for the construction of three bridges. A. M. Taff is County Auditor.

✣Bids will be received until 10 a. m., June 2, by Board of Clark County Commissioners, Jeffersonville, Ind., for the construction of sub and superstructure of a bridge over Silver Creek at Samples Road in Monroe township. G W. Stoner is County Auditor.

✣Bids will be received until 2 p. m., June 2, by George W. Wray, Union County Auditor, Liberty, Ind., for the construction of one concrete bridge over Silver Creek in Harmony Township. The structure will have a 30-ft. span; also for concrete repairs to the bridge over Little Four Mile between Center and Union Townships.

✣Bids will be received until 1 p. m., June 2, by Board of Jackson County Commissioners, Brownstown, Ind., for the construction of three bridges and the repair of three other bridges. Albert Luedtke is County Auditor.

✣Bids will be received until June 2 by Jasper County Commissioners, Rensselaer, Ind., for the construction of one steel bridge and the repair of two others. J. P. Hammond is County Auditor.

✣Bids will be received until 2 p. m., June 2, by Board of Union County Commissioners, Liberty, Ind., for the construction of bridges and repairs. G. W. Wray is County Auditor.

✣Bids will be received until 1 p. m., June 2, by Board of Benton County Commissioners, Fowler, Ind., for the construction of six bridges. Warren Mankey is County Auditor.

⊙The Board of Rush County Commissioners, Rushville, Ind., awarded on May 19 the following contracts for the construction of concrete bridges to replace the old structures washed out by the flood: J. D. White Bridge, Burk Construction Co., New Castle, Ind., at $5,900; U. S. Maffett Bridge, Burk Construction Co., New Castle, Ind., at $3,000: Lem Hill Bridge, Burk Construction Co., New Castle, Ind., at $2,460; J. W. Anderson Bridge, Burk Construction Co., New Castle, Ind., at $5,360; A. L. Winship Bridge, Francis Long, Lebanon, Ind., at $1,522; Frank Capp Bridge, Francis Long, Lebanon, Ind., at $1,005; L. L. Ferree Bridge, Milroy Construction Co., Milroy, Ind., $772; E. Myers Bridge, Milroy Construction Co., Milroy, Ind., $763; Wm. Booth Bridge, William Avery, Waldron, Ind., at $1,690; Noah Matlock Bridge, Ohio Construction Co., Rushville, Ind., at $1,390; John Bowles Bridge, Franklin D. Miles, Mayo, R. R., Ind., at $1,107; F. G. Eubank Bridge, Everett McMahin, Fortville, Ind., at $1,378; John Julian Bridge, Lawrence & Enos, Arlington, Ind., at $589. Allen R. Holden is Auditor.

⊙William F. Slattery, Crawfordsville, Ind., has been awarded the contract for the construction of seven bridges at $4,500. Bids for the work were opened by the Board of County Commissioners, Crawfordsville, Ind., May 13.

⊙The Commissioners of Allen County, Fort Wayne, Ind., have awarded the contracts for the construction of and repairs to culverts and bridges as follows: Culvert No. 1, Aboite Twp., $350; Ed. Gallagher; No. 2, St. Joe Twp., $460, George Jaap; No. 3, Wayne Twp., $360, George Jaap; No. 4, Adams Twp., $412, Ed. Gallegher; No. 5, Jefferson Twp., $410, Ed. Gallegher; No. 6, Jefferson Twp., $365, George Jaap; No. 7, Jackson Twp., $340, George Jaap; No. 8, Lafayette Twp., $320, Isaac Jones; No. 9, Lafayette Twp., $320, Isaac Jones; No. 10, Marion Twp., $300, Ed. Gallegher; No. 11, Eel River Twp., $304, Ed. Gallegher; No. 12, St. Joseph Twp., $240, Ed. Gallegher; No. 13, Perry Twp., $250, Griffin; No. 14, Jerry Twp., $240, Griffin; No. 15, Springfield Twp., $302, Harry Zeiner; No. 16, Springfield Twp., $318, Harry Zeiner; No. 17, Springfield Twp., $295, Harry Zeiner; No. 18, Milan Twp., $314, Isaac Jones; No. 19, Washington Twp., $290, Geo. Jaap; No. 20, Maumee Twp., $318, Harry Zeiner; No. 21, Washington Twp., $250, Ed. Gallegher. Bridge No. 22, Milan Twp., $168.50, Chas. Eling; No. 23, St. Joe Twp., $220, George Jaap; No. 24, Milan Twp., $372.75, Charles Eling; No. 25, Milan Twp., $397.50, Charles Eling; No. 26, Milan Twp., $337, Charles Eling; No. 27, Milan Twp., $172, Charles Eling; No. 28, Adams Twp., $191, Charles Eling; No. 29, Pleasant Twp., $329, Charles Eling; No. 30, Jefferson Twp., $297, Charles Eling; No. 31, Aboite Twp., $578, Henry Penn; No. 32, Aboite Twp., $674, George Jaap; No. 33, Marion Twp., $1,267, Attica Bridge Co.; No. 34, St. Joe Twp., $1,759, Attica Bridge Co.

C. A. Johnson, Secretary of the North Side Civic League, Indianapolis, Ind., has appeared before the Board of County Commissioners in an effort to have a bridge erected over Fall Creek between Capitol and Northwestern Aves.

Iowa.

✣Bids will be received until 2 p. m., June 5, by J. D. Hannan, Pottawattamie County, Council Bluffs, Ia., for the construction of a 70-ft. pony truss steel bridge with concrete floor and abutments.

The County Board of Supervisors has ordered the construction of a new bridge for the city park, Iowa City, Ia.

✣The Board of Polk County Supervisors, Des Moines, Ia., has awarded to N. M. Stark, Des Moines, the contract for the construction of 28 concrete bridges at $39,219.

The City Council of Des Moines, Ia., has voted to vacate East 18th St. and 36th St., Dean Ave. and Market St. and to donate the land to the Rock Island for the construction of the new shops. In return for the concession the company agrees to construct a viaduct at 30th St. and a foot bridge at 26th St. The work is to be completed by July 1, 1914.

A meeting was recently held by the West Council Bluffs Improvement Club to discuss the prospects of a free bridge being erected to connect Omaha, Nebr., and Council Bluffs, Ia.

Kansas.

✣Bids will be received until noon, June 2, by L. P. Sheldon, Jefferson County Clerk, Oskaloosa, Kan., for the construction of a county bridge over the Colley ditch southeast of Grantville. The cost is estimated at $4,000. E. E. Clark is County Engineer.

The Commissioners of Douglass County, Lawrence, Kan., are preparing to call a special election in June for the purpose of raising funds for the erection of a new county bridge across the Kaw River, to replace the structure which has done duty at Lawrence for so many years. The proposition will be submitted to the voters of the county under an act passed at the last session of the Kansas Legislature. The county is authorized to create a sinking fund to raise $200,000 for the building of the bridge, and when the fund is accumulated to advertise for bids for the construction of it. It is proposed to build a concrete bridge across the river.

Citizens of Leoti, Kan., have for some time been advocating the construction of five concrete bridges on the most important county roads at a cost of about $2,500 per bridge.

Massachusetts.

The selectmen of Springfield, Mass., are planning to construct a concrete bridge over Dresser Brook north of Interlaken at once, to replace the old wooden structure which recently collapsed.

Michigan.

A resolution has been introduced into the City Council of Detroit, Mich., directing the Park Commissioner to prepare a supplemental estimate of the cost of obtaining an approach to a proposed Belle Isle bridge somewhere east of Gladwin Park and instructing the City Engineer to present tentative figures on the cost of the proposed bridge. To obtain the amount necessary for the bridge a special session of the board of estimates will have to be called.

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Minnesota.

✣Bids will be received until 8 p. m., June 2, by City Council, Montevideo, Minn., for the construction of a concrete spillway and bridge over Little Chippewa River. Plans and specifications are on file with A. M. Parks, City Clerk.

No contract was awarded on May 19 by the Commissioners of Brown County, New

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Ulm, Minn. for the construction of a new steel and concrete bridge in the village of Comfrey owing to the bidders failing to furnish plans and specifications. The board has decided to have plans and specifications prepared and advertised for new bids.

The State Highway Engineer, St. Paul, Minn., has completed plans for the construction of a reinforced concrete and steel bridge spanning the White Earth River on the line of the new Judicial road between Becker, Mahnomen and Clearwater counties.

Mississippi.

✣Bids will be received until noon, June 3, by Chancery Clerk, Clarke County, Quitman, Miss., for the construction of a steel bridge over the Chickashay River near Desota.

Missouri.

✣Bids will be received until 1 p. m., June 12, by J. M. Black, Highway Engineer of Linn County, Linneus, Mo., for the erection of the following steel bridges: No. 1—Wm. Brown Bridge, 30 ft. girder, sec. 7, T. 36, R. 21; No. 2—R. F. Maxwell Bridge, 30 ft. girder, sec. 34, T. 39, R. 20; No. 3—Guyer Bridge, 30 ft. girder, sec. 8, T. 39, R. 19; No. 4—Hale Bridge, 30 ft. girder, sec. 10, T. 39, R. 20; No. 5—Walsh Bridge, 30 ft. girder, sec. 14, T. 57, R. 19; No. 6—Simmons Bridge, 44 ft. girder, 1 30- and 1 14-ft. span, sec. 27, T. 57, R. 19; No. 7—Parson Creek Bridge, 60-ft. pin con-truss, sec. 38, T. 38, R. 20.

✣Bids will be received until 1 p. m., June 4, by Worth County Court, Grant City, Mo., for the construction of a 60-ft. span and one 50-ft. span and the following 1-beam bridges: one 36 ft., one 34 ft., one 32 ft., one 30 ft. and one 24 ft. Also for one car of red cedar piling from to 24 ft. long and one car of oak lumber. For further information write John Bunker, County Engineer, Grant City. Mo.

⊙The Gentry Court, Albany, Mo., has awarded the contract for the erection of the Greenwell Ford Bridge to the Dildine Bridge Co., of Cameron, for $2,491, which was the lowest bid. Six companies presented bids, as follows: A. M. Blodgett Con. Co., $2,650; Illinois Steel Bridge Co., $2,448; Kansas City Bridge & Iron Co., $2,497; Misssouri Valley Iron & Bridge Iron Co., $2,744; Midland Bridge Co., $2,743. The contract calls for the bridge to be completed within four months.

A petition has been filed with the County Court at Kingston, Mo., by the citizens of Kidder, asking that 20 ft. of the county line street be sold to the Kidder Institute and that the proceeds be used for the construction of a bridge.

A resolution has been introduced into the City Council of St. Louis, Mo., asking that E. R. Kinsey, President of the Board of Public Improvements, replace the Reber approach to the new Free bridge.

Montana.

✣Bids will be received until 11 a. m., June 2, by Board of Cascade County Commissioners at the office of Lee Dennis, County Clerk, Great Falls, Mont., for the construction of a 3-span steel bridge, including foundations, over the Missouri River, at Ulm, Cascade County, Mont. Plans and specifications for the above structure may be seen at the office of the County Surveyor, in the court house, Great Falls, Mont.

✣Bids will be received until June 3, by Board of Choteau County Commissioners, Fort Benton, Mont., for one car load of galvanized corrugated culvert pipe.

New Hampshire.

The Committee on Streets and Sewers of the Common Council, Manchester, N. H., has instructed City Engineer Samuel J. Lord to prepare estimates for two kinds of bridges to span the Merrimac River south of Granite bridge. The types proposed are concrete and steel. The committee has decided that a 50-ft. bridge as to width is the one best adapted, and in this case a double trolley track could be laid with little or no inconvenience. A bridge at either Schiller or Byron Sts. will be more than 1,000 ft. long, and the east approach will pass over the tracks of the Boston & Maine Railroad, doing away with drop gates and a grade crossing. It is estimated that a steel bridge will cost about $110,000 and a concrete bridge about $135,000.

New Jersey.

⊙The Reynolds Iron Co., of Paterson, N. J., has been awarded the contract by the Board of Freeholders, Hackensack, N. J., for the construction of the bascule bridge at River Edge, for $15,994.

⊙The Cumberland County Board of Freeholders has awarded the contract for the construction of the new draw bridge over the Maurice bridge at Main St., Millville, N. J., to the Owego Bridge Co., Owego, N. Y., at $27,096.

New York.

The Town Board of Thurman, N. Y., at a recent meeting adopted a resolution appropriating $2,000 for repairs to the Warrensburg-Thurman bridge which was damaged by the recent high water.

An election was held May 20, at the village hall, Dansville, N. Y., on two propositions. The first proposition, whether or not the sum of $3,500 be appropriated by tax to pay one-half of the expense of the construction of a joint town bridge between the towns of North Dansville and West Sparta, on the Dansville-Mount Morris highway at Cumminsville. The old bridge was carried away by the recent flood. The other proposition for $3,500 to be used to repair the abutments of several bridges along the Canaseraga Creek damaged by flood, and also to erect levees to prevent the flooding of considerable land in this part of the valley.

At the special town election held at Fort Edward, N. Y., it was voted to appropriate $20,000 for the construction of a bridge over the Hudson River. The proposed structure will consist of three steel spans on concrete abutments and piers, and will have a concrete floor.

Commissioner of Bridges Arthur J. O'Keefe, New York City, has prepared plans for an alternate treatment for the Williamsburgh Plaza of the Williamsburgh bridge to allow Roebling St. to transverse the Plaza without the danger attending the crossing of heavily loaded trolley tracks by vehicular traffic. It is proposed to elevate the lines of the Third Ave. and Metropolitan St. Railway Company over the plaza and to have them pass through a four-loop station on Havemeyer St. near the corner of Broadway. The new tracks will begin far enough back from New St. on the bridge approach to be taken out on a level over that street, and over Roebling St. at a height sufficient to allow vehicular traffic to pass underneath. The elevated structure is to be made of steel, covered with concrete.

North Dakota.

✣Bids will be received until 2 p. m., June 9, by Board of Traill County Commissioners, Hillsboro, N. Dak., for the building, furnishing material and construction of two 45-ft. low truss steel bridges with concrete floor, as per plans and specifications on file in the County Auditor's office. Said bridges to be located between Sections 7 and 18, 146-51 and 26 and 35, 144-51. Bids must be accompanied by a certified check in the sum of $100, payable to Nels O. Lindaas, County Auditor.

Ohio.

✣Bids will be received until noon, June 20, by Board of Summit County Commissioners, Akron, O., for the construction of a reinforced concrete arch bridge over the Cuyahoga River on North Howard St. Extension. Plans and specifications are on file at the office of the County Surveyor and at the office of Wilbur J. Watson & Co., Consulting Engineers, Cleveland, O. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until noon, June 6, by Board of Public Affairs, Geneva, O., O. C. Kenyon, Clerk, for the construction of a reinforced concrete dam 325 ft. long and 8 ft. high, with end walls. Plans and specifications, etc., may be obtained of the board on a deposit of $5. Burgess & Long, Columbus, O., are Engineers.

✣Bids will be received until noon, June 16, by Board of Warren County Commissioners, Lebanon, O., at the office of the Board of County Commissioners of Clermont County, at Batavia, O., and at the office of the Board of County Commissioners of Hamilton County, O., at Cincinnati, for the following work, under specification No. 459, for new superstructure and repair of substructure and approaches to bridge over Little Miami River at Loveland, O., in Hamilton, Clermont and Warren Counties. The work to be done according to plans and specifications now on file in the offices of the Board of County Commissioners of Hamilton, Clermont and Warren Counties. All bids must be made on blank forms to be had at the offices of the Board of County Commissioners of Hamilton, Clermont and Warren Counties, and be accompanied by a bond in the sum of $3,000. Albert Reinhardt is Clerk of the Hamilton Board, Cincinnati.

✣Bids will be received until 11 a. m., June 7, by Board of Muskingum County Commissioners, Zanesville, O., for furnishing the material and labor for the construction and replacement of the Gaysport bridge across the Muskingum River at Gaysport, O.; said bridge to consist of one approach span on the west end thereof 58 ft. in length and three channel spans of 109 ft. 3½ in., 139 ft. 10 in. and 140 ft., respectively, and one approach span on the east end thereof 59 ft. 4½ in., in length; also, the draw span to be repaired and put in good and proper condition, all as shown in accordance with the lay-out of structure of said bridge now on file in the office of said County Commissioners.

✣Bids will be received until 10 a. m., June 7, by Board of Muskingum County Commissioners, Zanesville, O., for furnishing material and performing the labor or part thereof (at the option of the bidder) necessary for the reconstruction of part of the substructure and for the whole of the superstructure of a highway bridge crossing Jonathan Creek in White Cottage, O., known as the White Cottage bridge, said proposals to be in accordance with plans and specifications now on file in the office of said County Commissioners in Zanesville. H. H. Kennedy is Clerk.

✣Bids will be received until noon, June 16, by Ira Eisenbraun, Clerk, Struthers, O., for the construction of brick pavement on Bridge St. from the end of the present brick pavement on said street, southerly to its intersections with Poland Ave., according to plans and specifications on file in said office.

✣Bids will be received until 11 a. m., June 12, by Board of Muskingum County Commissioners, Zanesville, O., for furnishing the material and labor for the construction, building and placing the superstructure of a bridge across the Muskingum River at Dresden, Muskingum County, O., to replace the suspension bridge at said place, recently destroyed by flood; said bridge to be 600 ft. long, with a roadway of 20 ft. in the clear, and to have a carrying capacity of 150 lbs. per sq. ft.; all in accordance with plans and specifications therefor to be submitted by the bidder; the said submitted plans and specifications to show fully the detail and method of construction and material and to be subject to the approval of the United States Engineer. H. H. Kennedy is Clerk of the Board.

✣Bids will be received until 11 a. m., June 13, by Board of Hamilton County Commissioners, Cincinnati, O., for the old iron and other materials of bridges destroyed by the recent flood as follows: Bridge over Big Miami River at Elizabethtown; length, 587 ft.; approximate number of tons, 900. Bridge over Big Miami River at Cleves; length, 400 ft.; approximate number of tons, 140. Bridge over Big Miami River at New Baltimore; length, 465 ft.; approximate number of tons, 360. Bridge over Little Miami River at Loveland; length, 532 ft.; approximate number of tons, 170. Bridge over Little

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Miami River at Remington; length, 290 ft.; approximate number of tons, 100. Bridge over Little Miami River at Union Levee; length, 350 ft.; approximate number of tons, 70, and wire. Bridge over Whitewater River at Harrison; length, 450 ft.; approximate number of tons, 80, and wire. Each bridge to be sold separately and to the highest bidder in each case, upon the conditions that all of said old iron and wire be removed from the streams above mentioned not later than 150 days from date of sale. Terms—cash on day of sale. By order of the Board of County Commissioners of Hamilton County, Ohio. Albert Reinhardt is Clerk.

✣Bids will be received by Board of Wyandot and Crawford County Commissioners at the office of Peter Frank, Jr., Auditor of Wyandot County, Upper Sandusky, O., for furnishing the labor and material for the construction of a new county line bridge in Sycamore Township.

✣Bids will be received until 1 p. m., June 2, by Board of Knox County Commissioners, Mt. Vernon, O., for all labor and materials necessary to construct the west abutment of the Banning bridge, and the west abutment of the Young bridge, both of Morris Township, Knox County, O. The plans, estimates, quantities and specifications for doing this work are on file in the office of Irvin Young, County Auditor.

✣Bids will be received until noon (eastern standard time), May 29, by Board of Jefferson County Commissioners, Steubenville, O., for the construction of a steel superstructure for the Rayland bridge in accordance with plans and specifications on file at the office of the County Surveyor. A certified check for $300 must be filed with each bid. J. L. Means is County Auditor.

✣Bids will be received until noon, June 4, by W. J. Springborn, Director of Public Service, Cleveland, O., for the erection of structural work for repairing Praha and Columbus bridges. Specifications are on file with Chief Engineer, 305 City Hall.

✣Bids will be received until noon, June 13, by Board of Hamilton County Commissioners, Cincinnati, O., for the following county work: Under Specification No. 460, for alterations for Lift Bridge over the Miami and Erie Canal at Section Ave., Hartwell, in Springfield Township. The work to be done according to the plans and specifications now on file in the office of the Board of County Commissioners. All bids must be made on blank forms, to be had at the office of the Board of County Commissioners, and be accompanied by a bond in the sum of $500. Albert Reinhardt is Clerk of the Board.

⊙The contract for the construction of the concrete floor of the South High St. viaduct at Columbus, O., was awarded by Director of Public Service S. A. Kinnear to Fritz-Rumer-Grant-Coke Co., Columbus, O.

⊙The Board of County Commissioners, Zanesville, O., has awarded the contract for the construction of a temporary wagon bridge over the river at Sixth St. to Clifton Bros. The contract price is 60 cts. per lineal foot for piling in place and 50 cts a thousand for lumber framed and in place.

The successful bidder shall reclaim and replace all such steel of the old bridge as shall be or may be put in fit condition to be used in said re-construction, the fitness of the same to be subject to the approval of said County Commissioners and the County Engineer, all new steel to be shop painted and in addition thereto the entire bridge to receive one coat of No. 1 graphite bridge paint; said bridge to be floored with creosote blocks; all parts of said bridge to be thoroughly adjusted and to be complete ready for use. Said bridge to have a roadway of 16 ft. in the clear. Said proposal shall state the time when said bridge will be completed as aforesaid in event this contract is awarded. H. H. Kennedy is Clerk of the Board.

At a joint meeting of the Commissioners of Hamilton, Clermont and Warren Counties at the court house, Cincinnati, O., an agreement in regard to the plans for the construction of the proposed foot and wagon bridge at Loveland, O., was reached, also the matter of dividing the expense was settled. Bids for the structure will be advertised for shortly.

The Commissioners of Hamilton County, Cincinnati, O., find that it will cost $13,000 to build a temporary bridge over the Great Miami River at New Baltimore, while the 465-ft. permanent structure will cost $90,169.

The Board of Hamilton County Commissioners, Cincinnati, O., has adopted a resolution providing for an expenditure of $39,000 from the emergency fund for the rebuilding and repairing of bridges. A petition was received from the residents in the vicinity of where Lost Bridge formerly stood, asking the Commissioners to erect a foot bridge so that they will have direct access from their homes across the river.

The city officials of Columbus, O., and representatives of the Scioto Valley Traction Co., and the T. & O. C. R. R. have reached an agreement in regard to the location of a temporary crossing during the construction of the Parsons Ave. viaduct.

Engineers have submitted a report to the Viaduct Improvement Association of North Side, Cincinnati, O., on the feasibility of constructing a branch viaduct. They proposed the spur shall leave the Ludlow viaduct about 425 ft. east of Knowlton's Corner, then about parallel with Hamilton pike and east of it, northwesterly to Knowlton St., at a cost of less than $300,000. This will eliminate the C., H. & D. and dangers from high water. It is claimed this viaduct will favorably affect from 30,000 to 40,000 people.

The City Council of Elyria, O., has instructed City Engineer C. M. Theobald to prepare plans for the construction of a single arch concrete bridge to replace the structure washed out by the recent flood. The bridge will have a 30-ft. roadway and a 6-ft. walk on each side. The cost will probably amount to about $60,000.

Oregon.

Estimates made and submitted to the City Council by City Engineer Tom Hurlburt, Portland, Ore., show that the projected public market to be built along the west approach of the street bridge will entail a cost of $20,000. The plan of the City Engineer calls for steel piers on which will rest a building level with the bridge sidewalk. As drawn the market will have a length of 120 ft. and each stall will be 36 ft. deep.

Pennsylvania.

✣Bids will be received until June 5 by West Chester, Pa., by Board of County Commissioners, for the furnishing and erecting the following bridges: Steel girder bridge with reinforced concrete floor and stone substructure, London Britain Township, near Jones' bridge. Proposals to be submitted by 12 o'clock noon. Steel girder bridge with reinforced concrete floor and stone substructure, East Brandywine Township, near Bondsville. Proposals to be submitted by 1:30 o'clock p. m. Stone bridge with reinforced concrete floor of standard I beams, West Pikeland Township, near Upperman's store. Proposals to be submitted by 2:30 p. m. Plans and specifications for all of the above bridges are on file in the County Commissioners' office, also in the County Surveyor's office, West Chester, Pa. N. R. Rambo is County Surveyor.

✣Bids will be received until noon, June 5, by Board of Commissioners of Public Grounds and Buildings, Harrisburg, Pa., for the construction of a bridge over the Mahoning Creek at Mack's Fording, Armstrong County, Pa. Plans can be secured of S. B. Rambo, Supt., The Capitol, Harrisburg, Pa.

The Commissioners of Luzerne County, Wilkesbarre, Pa., recently conferred with the Carbon County officials in regard to the construction of the proposed joint bridge. The structure is in need of repairs, including a new floor.

The County Commissioners and Engineers G. B. Zahnizer and T. A. Gilkey recently held a conference at New Castle, Pa., in regard to the proposed bridges to replace the structures swept away by the flood.

A hearing was held May 27 by the Judges of Lehigh and Northampton Counties, Pa., on the proposition to construct a $525,000 bridge over the Lehigh River at Bethlehem.

Tennessee.

The Road Commission of Hamilton County, Chattanooga, Tenn., has instructed the engineer to inspect all steel bridges in the county and report on the same.

Texas.

The Commissioners Courts of Angelina and Nacogdoches Counties, Texas, have employed Col. P. A. McCarthy, C. E., of the engineering firm of P. A. McCarthy & Sons, Consulting Engineers, Lufkin, Texas, to make surveys and soundings for bridge site over the Angelina River, in the vicinity of Spradley's ferry, and prepare plans and estimates. This is in line with the plans for a public highway between Lufkin and Nacogdoches. Preliminary surveys already made indicate that a span of 125 ft. will be required over the river channel, and about 2,300 ft. of approaches on the Angelina County side. The engineers expect to have the plans completed in about a month.

Vermont.

At a special town election, at White River Junction, Vt., May 14, it was voted to build a new bridge across the White River to replace the one carried away by the March flood. The State Engineer has recommended a 3-span steel bridge on concrete substructure.

Virginia.

City Engineer C. E. Bolling, Richmond, Va., has recommended the appropriation of $4,000 for constructing repairs to the Ninth St. bridge to South Richmond.

Utah.

Advices from Brigham City, Utah, state that the County Commissioners have authorized the immediate construction of five concrete bridges to span creeks in the following places: One over Mill creek, just west of Honeyville; one over Beaver Dam creek at Beaver Dam; one over the slough northwest of Brigham; one over Salt creek, just north of the cement works, and one to span Box Elder creek in Mantua. The bridges will have a 20-ft. driveway.

Washington.

⊙The Board of Grant County Commissioners, Ephrata, Wash., has awarded the contract for the construction of the Moses Lake bridge over the Narrows, one and one-half miles west of Neppel, to the Everett Construction Co., Everett, Wash., at $9,494. Other bids received for the structure were as follows: Nettleton, Bruce & Eschbach, $9,575; American Pile Driving Company, $11,000; Security Bridge Company, $11,850; Central States Bridge Company, $12,237; O. H. Stratton, $12,148; C. C. Bulle, $13,150.

The Pearson Construction Co., New York Block, Seattle, Wash., at $92,405, submitted the lowest bid May 19 to the City Executive Board, Portland, Ore., for the construction of the proposed reinforced concrete bridge over Sullivan's Gulch at East 16th St. Other bids were: The Graff Construction Co., $101,513; Giebisch & Joplin, $96,754; International Contract Co., $96,990; Consolidated Contract Co., $94,261; Hans Pederson Construction Co., $99,704; Portland Bridge Building Co., $95,650. The bids were referred to the bridge committee.

Wisconsin.

⊙J. E. Hathaway, Canal W., of 1st Ave., Milwaukee, Wis., has been awarded the contract for the construction of the new abutment for the Chestnut St. bridge at $5,900. Bids for the work were opened May 19.

The Highway Committee of the Milwaukee County Board, Milwaukee, Wis., has recommended that a $60,000 concrete bridge for the Port Washington road is needed this year. The proposed structure will be 285 ft. long and 60 ft. wide. Ten-foot sidewalks are provided for each side, with a 10-ft. roadway, according to the plans.

The City Council of Kenosha, Wis., recently held a meeting to consider the plan for changing the level of the Middle St. bridge. The members of the council also made an examination of the bridge on Middle St. connecting with the island, and it is probable that immediate repairs will be ordered on this bridge. The bridge is badly in need of planking and it is possible that the council will be able to work out some way to replace worn out timbers of the bridge and pave the floor of it with some permanent paving material.

The Manitowoc County Board, Manitowoc, Wis., has appropriated $27,000 for the construction of new bridges to span the various streams and creeks. Petitions for 20 structures have already been received.

Wyoming.

✣Bids will be received until June 12 by Capt. C. H. Knight, U. S. Engineer, Yellowstone Park, Wyo., for furnishing the necessary labor and material for the construction of steel and concrete highway bridges in that park.

Canada.

✣Bids will be received until noon, June 6, by Board of Control, M. Peterson, Secy., Winnipeg, Man., for one second-hand single track, through truss, steel railway bridge, with a span of approximately 80 ft. The bridge must be in good condition and be able to safely carry a ten-wheel locomotive with 34 tons on a rigid wheel base of 14 ft. 10 ins., followed by a rolling load of 3,000 pounds per lineal foot of track. Tenders shall give full description of bridge, stating age, condition, name of manufacturer, location, type, whether pin connected or riveted, clearance, width, height and weight, and if possible shall be accompanied by stress diagrams, blue prints, drawings and photographs. Earliest delivery shall be stated. Prices to be f. o. b. Lac du Bonnet station, C. P. R., Manitoba, including Canadian customs, if any.

⊙Graff Construction Co., Crary Bldg., Seattle, Wash., has been awarded the contract by the Provincial Government of British Columbia for the construction of an $80,000 bridge over the Thompson River, New Lytton, B. C. The bridge will have one span of 250 ft. concrete piers and steel superstructure.

ROADS AND STREETS

Alabama.

✣Bids will be received until noon, June 2, by Board of Revenue of Montgomery County, Montgomery, Ala., for the graveling of the following roads: (1) Snoudown-Chambers Road, a distance of five and one-half (5½) miles. (2) Lime Creek Road from Mt. Meigs to county line, a distance of about five (5) miles. (3) Naftel Road from end of gravel to Ebenezer Church, a distance of about one and one-half (1½) miles. Specifications may be had at County Engineer's office. Thos. H. Edwards is County Engineer.

⊙F. G. Proudfoot has been awarded the contract by the City Commissioners of Mobile, Ala., for the paving of the municipal steel sheds on the river front with concrete, calling for 6,000 sq. yds. An appropriation of $5,000 has been made for the work.

Consulting Engineers Lund & Hill, Little Rock, Ark., have been retained by the City of New Decatur, Ala., for the design and supervision of extensive improvement work in that city. The city will build about four miles of paved streets and a storm water drainage system at an estimated cost of $300,000.

Arkansas.

⊙The Lonoke County Commissioners, Lonoke, Ark., have awarded to the Big Rock Stone & Construction Co. a contract for 200,000 cu. yds. of rock, to be used in the construction of macadam roads in four districts of the county.

City Engineer Vogt of Jonesboro, Ark., has begun the survey for the new paving district which includes all of Church St. and connecting thoroughfares.

Lund & Hill, of Little Rock, Ark., have been selected as engineers for two of the four new road districts of Lonoke County, Ark., by the County Commissioners at Lonoke. The districts, No. 2 and No. 4, embrace 47 miles of road. About 27 miles are in or near Lonoke, while the remainder is in the southern part of the county, near England. It is planned to spend about $200,000 in macadamizing the roads in these districts. The commissioners of the four districts are: District No. 1, E. B. Adams and D. T. Alexander; District No. 2, W. K. Oldham, R. S. Boyd and W. S. Chaney; District No. 3, Dr. N. B. Beakley, J. E. Hicks and G. W. Morris; District No. 4, W. W. McCreary, S. S. Glover.

California.

✣Bids will be received until 11 a. m., June 4, by Capt. James Longstreet, Constructing Quartermaster, Fort McDowell, Calif., for installing rock crushing plant.

⊙The Fairchild-Gilmore Wilton Co., of Los Angeles, Calif., has been awarded the contract by the Board of Public Works of Wilmington, Calif., for the paving and other improvement of East Seventh St., from Broadway to Canal and other streets, for $104,070.

Colorado.

⊙The Beach & Decker Contracting Co. has been awarded the contract by the Board of Public Works of Denver, Colo., for the improvement of Williams St. parkway, at about $33,000. The parkway will be surfaced with macadam and bordered with trees, extending from Cheesman Park south to Third Ave., west to Downing St., and south again to the Downing St. Bridge.

Connecticut.

⊙Edward Balf Co. has been awarded the contract by the Board of Contract & Supply of Hartford, Conn., for the construction of sheet asphalt pavement on Front, Morgan, Pleasant and Marsh court, for $23,111, and on Farmington Ave., from Asylum Ave. to Woodland St., for $21,815. F. W. & W. H. O'Neil secured the contract to construct block pavement on Church and Spruce Sts., for $7,562.

⊙The Ahern Construction Co. of Willimantic, Conn., has been awarded the contract by the Connecticut State Highway Commission, for the macadamizing of 8,027 lin. ft. of road in the town of Coventry on the Manchester-Willimantic turnpike, for $2.05 per lin. ft.

Delaware.

The City Council of Wilmington, Del., on May 22 acted upon the ordinance to borrow $150,000 for street improvements, and also the $60,000 park loan ordinance.

District of Columbia.

✣Bids will be received until 11 a. m., May 29, by G. F. Downey, Depot Quartermaster, Washington, D. C., for construction of a bituminous macadam road from south end of Highway Bridge to Arlington National Cemetery, Va., and resurfacing a portion of the Georgetown-Alexandria turnpike.

✣Bids will be received until 2 p. m., June 3, by Secretary U. S. Department of Agriculture, Washington, D. C., for resurfacing with water bound macadam that section of the Rockville pike extending from station 210 of the survey to station 477/89 at the Rockville City Limits, and for doing such other work as specified.

✣Bids will be received until 2 p. m., May 29, by Commissioners of the District of Columbia, Washington, D. C., for grading and improving suburban streets and avenues in the District.

Illinois.

✣Bids will be received until 7 p. m., May 31, by Board of Local Improvements, Kewanee, Ill. (readvertisement), for improving portions of Elliott St., E Prospect St. and McKinley Ave., with asphaltic concrete. A E. Holt is City Engineer.

✣Bids will be received until June 2 by Peter Dresch, Town Clerk, Edwardsville, Ill., for highway improvement on the Old Fair Grounds Road and the Troy Road in that township.

⊙The Board of Local Improvements of Rock Island, Ill., has awarded the contract for the paving of 11th St., between First and 11th Aves., to the McCarthy Improvement Co., of Davenport, Ia. Asphalt will be used.

⊙Reeb Bros., of Belleville, Ill., have been awarded the contract by the Board of Local Improvements of Du Quoin, Ill., John C. Gibson, City Engineer, for the construction of 40,460 sq. yds. of brick paving, for $77,495. Bids were opened May 17.

⊙The Board of Public Improvements of Duquoin, Ill., has awarded the contract for the paving to be done in Districts Nos. 2 and 3, which embrace practically all of the residence part of the city east of the I. C. Railroad, to Reeb Bros., of Belleville, Ill. Their bid in District No. 2 was $49,265, and in District No. 3, $38,230. Work on the paving will begin June 1.

The Board of Local Improvements of Rock Island, Ill., Wallace Treichler, City Engineer, has approved the ordinances covering the paving of 10th Ave., from 30th to 34th St., and 16th Ave., from 12th to 15th St. Asphalt will be the material for both.

The Board of Local Improvements of Springfield, Ill., has passed a resolution favoring the paving of South 18th St., from Washington St. to South Grand Ave. The estimated cost is $42,000.

The Village of Watseka, Ill., will shortly call for bids for the paving of Fourth St., from the T. P. & W. tracks to the north village limits. The plans call for a macadam pavement with curb and gutter. The estimated cost is $11,286.

Property owners on North Main St., Canton, Ill., have petitioned the Board of Local Improvements, E. F. Motsinger, City Engineer, to pave that street from the Depler Corner to the City Limits.

The Board of Local Improvements of Quincy, Ill., has asked for bids for the paving of North Fifth St., between Hampshire and Vermont Sts., with creosoted wood blocks.

City Engineer George L. Farnsworth of Ottawa, Ill., has prepared plans for the construction of 66,000 sq. yds. of brick pavement, estimated to cost $142,000. The work will include 4-in. concrete foundation, 41,406 lin. ft. of curb, grout filler, 30,215 cu. yds. of excavation. Contracts will be let between June 10 and 15.

Following are the lowest bids submitted to the Board of Local Improvements, Chicago, Ill., on May 19 for the construction of pavements in the following streets: Addison St., Robey St. to Leavitt St., 2,400 lin. ft. granite concrete combined curb and gutter, 60 cts. per lin. ft., 5,210 sq. yds. asphalt pavement, $1.68, R. F. Conway Co., 133 W. Washington St.; Ashland Ave., Fulton St. to Carroll Ave., 350 lin. ft. sandstone curbing, 80 cts., 920 sq. yds. granite block pavement, $3.79, F. P. McCormick, 133 W. Washington St.; Campbell Ave., Archer Ave. to 39th St., 30 lin. ft. con-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

crete curbing, 60 cts., 900 lin. ft. concrete gutter, 30 cts., 2,020 sq. yds. asphalt pavement, $1.69, American Asphalt Paving Co.; East Court, Belmont Ave. to 304 ft. south, 720 lin. ft. granite concrete combined curb and gutter, 65 cts., 950 sq. yds. asphalt pavement, $1.82. American Asphalt Paving Co.; Eastwood Ave., Leavitt St. to Lincoln Ave., 1,430 lin. ft. granite concrete combined curb and gutter, 60 cts., 2,260 sq. yds. asphalt pavement, $1.76, R. F. Conway Co.; Ewing Ave., 94th St. to 102d St., 9,550 lin. ft. granite concrete combined curb and gutter, 69 cts., 19,310 sq. yds. brick pavement on slag, $1.57, John A. McGarry & Co., 189 W. Madison St.; 44th Pl., State St. to Dearborn St., 440 lin. ft. granite concrete combined curb and gutter, 69 cts., 480 sq. yds. asphalt pavement, $1.71, American Asphalt Paving Co.; 52d Ave., Irving Park Blvd. to Montrose Ave., 5,300 lin. ft. granite concrete combined curb and gutter, 60 cts., 8,640 sq. yds. asphalt pavement, $1.39, Standard Paving Co 9 S. La Salle St.; Foster Ave., Evanston Ave. to Sheridan Rd., 2,000 lin. ft. granite concrete combined curb and gutter, 65 cts., 3,630 sq. yds. asphalt pavement, $1.88, American Asphalt Paving Co.; Green Bay Ave., 106th St. to 108th St., 2,630 lin. ft. granite concrete combined curb and gutter, 75 cts., 4,460 sq. yds. asphaltic macadam on slag, $1.23, Calumet Coal & Teaming Co., 9022 Commercial Ave.: Hutchinson St., Milwaukee Ave. to 53rd Ave., 4,100 lin. ft. granite concrete combined curb and gutter, 60 cts., 5,310 sq. yds. asphaltic concrete pavement on concrete base, $1.37, Standard Paving Co.; Jackson Ave., 63rd St. to 64th St., 1,240 lin. ft. granite concrete combined curb and gutter, 65 cts., 2,310 sq. yds. asphalt pavement, $1.87, American Asphalt Paving Co.; Leland Ave., Robey St. to Leavitt St., 2,500 lin. ft. granite concrete combined curb and gutter, 59 cts., 4,250 sq. yds. asphalt pavement, $1.79, American Asphalt Paving Co.; Lincoln St., Garfield Blvd. to 59th St., 4,940 lin. ft. granite concrete curb and gutter, 60 cts., 8,130 sq. yds. asphalt pavement, $1.68, R. F. Conway Co.; Ohio St., Western Ave. to Campbell St., 1,300 lin. ft. sandstone curbing, 75 cts., 2,280 sq. yds. brick pavement, $2.07, Ready & Callaghan Coal Co., 133 W. Washington st.; 100th Pl., Wood St. to Prospect Ave., 2,420 lin. ft. granite concrete combined curb and gutter, 60 cts., 3,700 sq. yds. asphaltic concrete pavement on concrete base, $.64, American Asphalt Paving Co.; Rawson St., Elston Ave. to McHenry St., 1,400 lin. ft. sandstone curbing, 80 cts., 3,040 sq. yds. granite block pavement, $3.20, James A. Sackley Co., 133 W. Washington St.; 69th St., Vincennes Ave. to South Park Ave., 5,760 lin. ft. sandstone curbing, 63 cts., 8,040 sq. yds. brick pavement, $2.04, Central Paving Co., 179 W. Washington St.: Washtenaw Ave., Grand Ave. to Chicago Ave., 1,680 lin. ft. granite concrete combined curb and gutter, 55 cts., 2,760 sq. yds. asphalt pavement, $1.72, American Asphalt Paving Co.; West End Ave., 48th Ave. to 52d Ave., 5,500 lin. ft. granite concrete combined curb and gutter, 60 cts., 11,600 sq. yds. asphalt pavement, $1.67, Standard Paving Co.; alley, Adams St., Jackson Blvd., Peoria St., Green St., 790 lin. ft. granite concrete combined curb and gutter, 10 cts., 720 sq. yds. brick pavement, $2.48, John A. McGarry & Co.; alley, Colorado Ave., Jackson Blvd., Sacramento Ave., Whipple St., 1,980 lin. ft. granite concrete combined curb and gutter, 15 cts., 1,550 sq. yds. brick pavement, $2.37, Central Paving Co.; alley, Ewing Pl., Le Moyne St., Leavitt St., Hoyne Ave., 1,800 lin. ft. granite concrete combined curb and gutter, 15 cts., 1,800 sq. yds. brick pavement, $2.17, Central Paving Co. The work includes 6-in. Portland cement concrete foundation, preparation of the sub-grade, sewer manholes and catch basin construction and adjustment. The contracts have not been awarded. E. J. Glackin, Secretary of the Board.

Following are the lowest bids submitted to the Board of Local Improvements, Chicago, Ill., Chicago, Ill., May 19, for the construction of cement sidewalks in the following streets: Blue Island Ave., Ashland Ave. to Robey St., 3,900 sq. ft., 12.4 cts., General Cement Construction Co., 167 Washington St.; Blue Island Ave., Robey St. to Western Ave., 3,600 sq. ft., 12.4 cts., General Cement Construction Co.; Ewing Ave., 101st St. to 102d St., 1,000 sq. ft., 49 cts., 136 lin, ft. retaining wall 50 cts. General Cement Construction Co; Greenwood Ter. 45th Ave. to 46th Ave. 2200 sq. ft. 11.7 cts. A. C. Skafgard 1656 N. 40th Ct.; Grace St., 53rd Ave. to 54th Ave., 2,550 sq. ft. 11.8 cts. Siewert-Callsen Co. 3865 Milwaukee Ave.; Houston Ave., 95th St. to 96th St., 600 sq. ft. 12.74 cts., A. Graff, 138 N. La Salle St.; Indiana Ave. 103rd St. to 440 ft. south of 105th St., 8,000 sq. ft., 13.89 cts., A. P. Larsen, 11320 Indiana Ave.; 96th St., Ewing Ave. to Avenue N, 2,000 sq. ft., 43 cts., tie, G. Kehl & Son Co., 1225 N. Maplewood Ave., Wollick & McAllister; 98th St., Avenue G to Avenue N, 2,000 sq. ft., 16 cts., Wolleck & McAllister; 101st St., Indianapolis Ave. to C. R. R. R., 8,000 sq. ft., 25 cts., 1,270 lin. ft. retaining wall, 50 cts., General Cement Construction Co.; 105th St., Vincennes Rd. to Prospect Ave., 6,000 sq. ft., 14 cts., Wolleck & McAllister; Ohio St., Lake Shore Drive to St. Clair St., 6,000 sq. ft., 13.23 cts., G. Kehl & Son Co.; Ontario Ave., 90th St. to 91st St., 4,000 sq. ft., 19 cts., A. Graff; Ontario Ave., 91st to 92d St., 1,800 sq. ft., 19 cts., A. Graff; Oakley Ave., Cullom Ave. to Berteau Ave., 2,300 sq. ft., 12.74 cts., A. Graff; Pensacola Ave., Spaulding Ave. to Kimball Ave., 3,900 sq. ft., 13.64 cts., H. P. Larsen, 1542 N. Rockwell St.; Paulina St., 71st St. to 74th St., 5,000 sq. ft., 12.99 cts., Daniel Ryan; Paxton Ave., 74th St. to 198 ft. south, 150 sq. ft., 15½ cts., Hansen-Undine Co., 2858 E. 83rd St.; Ptoria St., 118th St. to Illinois Central R. R., 10,000 sq. ft., 11.99 cts., Daniel Ryan; Robey St., 95th St. to 96th St., 3,200 sq. ft., 13.99 cts., Daniel Ryan; Addison St., Avondale Ave. to Hamlin Ave., Avondale Ave., Central Park Ave. to Addison St., Eddy St., Avondale Ave. to Lawndale, Ave., Cornelia Ave., Central Park Ave. to Hamlin Ave., Roscoe St., Lawndale Ave. to Hamlin Ave., Central Park Ave., Avondale Ave. to Roscoe St., Lawndale Ave., Addison St. to Roscoe St., Hamlin Ave., Addison St. to Roscoe St., 18,000 sq. ft., 11.2 cts., Siewert-Callsen Co.; Leland Ave., 45th Ave. to 48th Ave., 46th Ave., Lawrence Ave. to Leland Ave., 47th Ave., Lawrence Ave. to Leland Ave., 47th Ct., Lawrence Ave. to Leland Ave., 48th Ave., Lawrence Ave. to Leland Ave., 5,400 sq. ft., 11.3 cts., Siewert-Callsen Co.; 76th St., St. Lawrence Ave. to 124 ft. west of Rhodes Ave., 77th St., St. Lawrence Ave., to 125 ft. west of Rhodes Ave., St. Lawrence Ave., 75th St., to 77th St., Rhodes Ave., 75th St. to 77th St., 1,800 sq. ft., 12½ cts., P. F. Biesen, 9 S. La Salle St.; 82d St., Muskegon Ave. to 124 ft. west, Muskegon Ave., 82nd St. to 48th ft. south, 1,150 sq. ft., 13½ cts., P. F. Biesen, 9 S. La Salle St. The contracts have not been awarded. E. J. Glackin, Secretary of the Board.

Indiana.

✣Bids will be received until 10 a. m., May 31, by Board of Marion County Commissioners, Indianapolis, Ind., for the furnishing of 150,000 gals. of road oil. W. T. Patton is County Auditor.

✣Bids will be received until 10 a. m., May 29, by Board of Laporte County Commissioners, Laporte, Ind., for the construction of highways in Michigan, Springfield and Clinton townships. F. A. Hausheer is County Auditor.

✣Bids will be received until 1 p. m., June 3, by Board of Wabash County Commissioners, Wabash, Ind., for the construction of two highways in Noble township. Dan Showalter is County Auditor.

✣Bids will be received until 1 p. m., June 31, by Board of Boone County Commissioners, Lebanon, Ind., for the construction of a public highway. D. M. Clark is County Auditor.

✣Bids will be received until 10 a. m., June 4, by Board of Bartholomew County Commissioners, Columbus, Ind., for the construction of a gravel road on line between Clifty and Hawcreek townships. P. J. Sater is County Auditor.

✣Bids will be received until 10 a. m., June 4, by Board of Tippecanoe County Commissioners, Lafayette, Ind., for the construction of a gravel road in Wabash, Sheffield, Fairfield, Washington and one on township line between Washington and Perry townships. G. W. Baxter is County Auditor.

✣Bids will be received until 1 p. m., June 5, by Board of Orange, Crawford and Washington Counties, at Paoli, Ind., for the construction of a gravel road on line between Orange, Crawford and Washington counties. E. A. Palmer is Orange County Auditor.

✣Bids will be received until 1 p. m., June 5, by Board of Orange, Crawford and Washington counties at Paoli, Ind., for the construction of a gravel road known as the Hardinsburg and Marengo road, running along the county lines between said counties. E. A. Palmer is Orange County Auditor.

✣Bids will be received until 2 p. m., June 5, by Board of Clinton County Commissioners, Frankfort, Ind., for the construction of 11 gravel roads. C. F. Cromwell is County Auditor.

✣Bids will be received until 2 p. m., June 13, by Board of Harrison County Commissioners, Corydon, Ind., for the construction of a road in Harrison township. J. L. O'Bannon is County Auditor.

✣Bids will be received until 11:30 a. m., June 16, by Board of Clay County Commissioners, Brazil, Ind., for the construction of two highways in Van Buren township, one in Posey township and one in Brazil township. E. A. Staggs is County Auditor.

✣Bids will be received until 10 a. m., June 5, by Board of Public Works, Richmond, Ind., for grading and constructing cement sidewalks, curbs, gutters and driveways through said curbs as indicated on plat of this addition.

✣Bids will be received until 10 a. m., June 4, by Board of Public Works, Indianapolis, Ind., for the improvement of Nowland Ave., from the east sidewalk of Rural St. to the west curb line of Olney St., by grading and paving the sidewalks; also for curbing the outer edges of the roadway.

✣Bids will be received until 2 p. m., June 2, by Board of Town Trustees, Kirklin, Ind., for a street paving including about 17,000 sq. yds. A certified check for $900 is required. C. W. Wright is Clerk.

✣Bids will be received until 7:30 p. m., June 2, by Common Council, Union City, Ind., for grading and paving Pearl St. from Mason to North Charles St. R. C. Sutton is City Clerk.

✣Bids will be received until 7:30 p. m., June 7, by Board of Town Trustees, Spring Grove, Ind., for the construction of a brick or other form of pavement for North Tenth St. L. J. Wood is Town Clerk.

✣Bids will be received until 2 p. m. May 29, by Samuel Carr, Superintendent of Construction of Rider Ditch, Brownstown, Ind., for the construction of Rider ditch in Washington, Vernon and Grassy Fork townships.

⊙George J. Miller, Lebanon, and C. B. Nowling, Rockville, Ind., have been awarded the contracts by the Board of Montgomery County Commissioners, Crawfordsville, for the construction of gravel roads in Scott and Franklin townships, for $26,800 and $10,980, respectively. Bids were opened May 6.

⊙The Board of County Commissioners. New Albany, Ind., has awarded to W. F. Woodruff, of Louisville, Ky., the contract for construction of that part of the Charlestown Road which extends from the Floyd and Clark County line near Blackiston's Mill, a distance of 15,446 ft., at $25,600. The contract for the remainder of the road will be awarded later.

⊙The contract for the building of the Warfield Road, in Harrison Township, Pulaski County, Ind., has been awarded by the County Commissioners, Winamac, to Harry A. Burns, for $2,490. The Corbett Road, in the same township, was let to O. L. Markle for $2,764

⊙John Gordon has been awarded the contract by the Huntington County Commissioners, Huntington, Ind., for the construction of the John E. Pribble Road, on the Huntington and Wells County line.

The Board of Public Works of Indianapolis, Ind., has confirmed a resolution for the improvement of English Ave., between the Big Four Railroad tracks and Keystone Ave.

Iowa.

✣Bids will be received until 2 p. m., June 2, by H. C. Schoemaker, County Auditor, Muscatine, Ia., for the grading of the public highway in Road District No. 8, from Station 80 to Station 123, as shown by the plat and profile for said District No. 8. The said work is located commencing at a point 1½ miles east of West Liberty and extending thence east to the Iowa City Road. The estimated quantity of the earth to be moved is 3,500 cu. yds. Said work shall be commenced on or before June 16, and completed on or before July 16, 1913. Profiles and specifications can be seen and proposals had at the office of the County Auditor or from James J. Ryan, Engineer in charge of the work, Hershey Bldg., Muscatine, Ia.

⊙The Dolarway Paving Co., Marshalltown, Ia., has been awarded the contract at Anamosa, Ia., for the construction of 7,500 sq. yds. of pavement.

⊙The contract for paving Lakeport Road from the end of the Morning Side Ave. paving to Graceland Park Cemetery, Sioux City, Ia., has been awarded to Krage & Jensen of that city.

⊙Bids as follow were received May 19 by the City of Belle Plaine, Ia., for paving Division Ave., for which Charles P. Chase, Clinton, Ia., is the Consulting Engineer: (1) Bid of Des Moines Asphalt Paving Co., Des Moines, Ia.; (2) M. Tschirgi & Sons, Cedar Rapids, Ia.; (3) J. W. Turner Improvement Co., Des Moines, Ia. (awarded contract), at $18,680, with cement filler.

	(1)	(2)	(3)
Excavation, 2,650 cu. yds.	$0.50	$0.60	$0.48
Curb and gutter, 1,050 lin. ft.	.58	.75	.60
Cast iron, 546 lbs.	.045	.04	.045
Concrete base, 8,400 sq. yds.	...	.95	...
Brick with sand filler, 8,400 sq. yds.	1.935	1.10	1.925
Extra for cement filler	.08	.10	.07

The Board of Local Improvements of Davenport, Ia., has recommended the paving of 16th Ave., from 12th to 15th Sts.; 10th Ave., from 30th to 34th Sts., and 34th St., from Ninth and a half to 10th Ave. Asphalt will be used.

A petition is being circulated in Clear Lake, Ia., asking that Fourth St. be paved from Main St. north to the C. M. & St. P. Depot, a distance of about 10 blocks, with concrete. Garland & Shaffer, of New Hampton, Ia., are completing concrete pavement at the present time which will cost $1.26 per sq. yd.

Kansas.

⊙J. R. Ramsey, of Topeka, Kan., has been awarded the contract by the City Council of McPherson, Kan., for the paving of North Main St., from the Santa Fe Depot and the section line, four blocks, at $1.24 per sq. yd., for 4-in. concrete base and a 2-in. concrete top.

Kentucky.

✣Bids will be received until 7:45 p. m., June 3, by H. M. Ringo, City Clerk, Mt. Sterling, Ky., for the construction of approximately 9,410 sq. yds. of paving and 4,575 lin. ft. of curb and gutter. W. A. Samuels, Mt. Sterling, Ky., is Mayor.

Louisiana.

City Engineer W. J. Hardee of New Orleans, La., is preparing plans and specifications for the paving of both sides of St. Claude Ave., from Delery St. to the parish line.

An election was held in Baton Rouge, La., on May 27 for the purpose of voting on a bond issue of $225,000, of which $90,000 is set aside for paved and graveled streets that would link the city streets up with the graveled roads of the county.

Massachusetts.

✣Bids will be received until noon, June 3, by Boston Transit Commission, B. Leighton Beal, Secretary, 15 Beacon St., Boston, Mass., for laying about 6,000 sq. yds. of either asphalt or bithulithic pavement on Boylston St., between Exeter and Hereford Sts.

✣Bids will be received until 10 a. m., May 31, by Middlesex County Commissioners, E. Cambridge, Mass., for the construction of a portion of the Acton Road leading from Chelmsford Center through South Chelmsford to the Westford town line.

⊙The Massachusetts State Highway Commission, Boston, has awarded the contract for the construction of a section of state highway in the town of Wrentham to Snow & Farrington, of Wrentham, Mass., for $4,985.

The Board of Aldermen of Holyoke, Mass., has voted bonds to the amount of $20,000 for permanent sidewalk work, and $100,000 for permanent highway work.

Michigan.

⊙The City Council of Grand Rapids, Mich., has awarded a contract for the paving of the street from Lafayette Ave. to Eastern Ave., with asphalt macadam, to Carpenter & Anderson of that city, for $32,865.

⊙Andrew Geeck has been awarded the contract by the City Council of Owosso, Mich., for the paving with creosote blocks of the Washington St. Bridge, for $3,200.

⊙The Board of Dickinson County Commissioners, Iron Mountain, Mich., has awarded the contract for the construction of the first six-mile link of the new Randville-Felch highway to John E. Bloomgren, for $11,050

The Marquette County Commissioners, Marquette, Mich., have asked for bids on the construction of three highways. One job is about one mile of earth road grading, between Stations 206 and 263, on the Duke's Siding Road, requiring about 3,300 cu. yds. of dirt and clearing and grubbing. Another calls for the building of about one and one-half miles of earth road between Stations 316 and 399, on the Humboldt-Republic Road, requiring the moving of approximately 5,700 cu. yds. of dirt, clearing and grubbing. And for a road between champion and Michigamme, which calls for a steel and concrete bridge over the Pescheke River.

Minnesota.

✣Bids will be received until 2 p. m., June 5, by O. Halden, County Auditor, Duluth, Minn., for considerable work. The work upon which bids are asked is as follows: (a) Clearing and grubbing 1 mile of the Vermilion Road, along E line of Sec. 15, Twp. 51-14. (b) Constructing Lost Lake Road from the point where it leaves the Vermilion Road in Sec. 11, Twp. 57-16, to the N¼ corner of Sec. 15, Twp. 57-16, a distance of approximately 1½ miles. (c) Constructing 2/3 mile of the Oakman Road, north from the SW corner of Sec. 31, Twp. 64-20. (d) Constructing approximately 2 miles of the Connors Road, west from the Sturgeon Lake Road to SW corner of Sec. 20, Twp. 59-21. (e) Constructing ½ mile of the Yoki Road, south from the NW corner of Sec. 26, Twp. 55-19. (f) Grading 3¼ miles of the Lavell Road, north from St. Louis River. (g) Deepening the channel of East Two Rivers to a depth of eight (8) feet, from the foot of the rapids about opposite the D. & I. R. Depot at Tower, to a point in Lake Vermilion where the present depth is 8 ft.

✣Bids will be received until 4 p. m., June 3, by Charles Purnell, Town Clerk, Palisade, Minn., for the construction of the Palisade-Waukenabo Road from the river to Olson Crossing of the railroad.

✣Bids will be received until 11 a. m., June 17, by Board of Kakota County Commissioners, Hastings, Minn., for grading, graveling, turnpiking and constructing culverts and bridges on a number of county roads. The work estimated to cost $35,000. P. A. Hoffman is County Auditor.

⊙Fielding & Shepley, 216 University Ave., St. Paul, Minn., have been awarded the contract by the city of Austin, Minn., Oscar Weissgerber, City Engineer, for the construction of 13,214 sq. yds. of paving and 6,000 lin. ft. of cement curbing, for $31,897. Bids were opened May 23.

⊙Goodman & Lorlved have been awarded the contract by the City Council of Bemidji, Minn., George Stein, City Clerk, for the construction of 10,000 sq. yds. of concrete pavement, at $1.05 per sq. yd. Bids were opened May 21.

⊙The Polk County Commissioners, Crookston, Minn., have awarded the contract for the construction of a gravel road to Peter Baudkin Co., of Crookston.

⊙The City Commission of Duluth, Minn., has awarded the contract for the improvement of Seventh St., from Fourth Ave. west to 14th Ave. east, to J. A. Johnson, at $63,340. Crushed rock macadam will be used.

The City Commission of Duluth, Minn., has ordered 29th Ave. west paved from Superior St. to Third St. The estimated cost of sandstone block is $18,291; creosoted blocks, $17,071, and of brick, $16,303.

The City Council of Two Harbors, Minn., has ordered Seventh and Eighth Aves. graded. L. S. Burnham is City Engineer.

The Hennepin County Commissioners, Minneapolis, Minn., plan the expenditure of $337,500 this year in road work. The arterial roads to be improved are as follows: Cedar Ave., 2½ miles, $6,500; Excelsior Blvd., 8 miles, $8,000; Superior Blvd., 3½ miles, $35,000; Rockford Road, 22 miles, $110,000; Territorial Road, 11 miles, $33,000; Eden Prairie Road, 13 miles, $39,000; Watertown Road, 22 miles, $66,000.

Missouri.

✣Bids will be received until June 3, by Jefferson City, Mo., for the construction of several streets and bridges. J. Frank Morris is Clerk.

⊙Joseph Pope, 222 W. Dunklin St., Jefferson City, Mo., has been awarded the contract by that city for the improvement of Chestnut St., from High to Atchison, and Adams from Dunklin to Elm Sts., for $24,500. Bids were opened May 19.

Members of the Sherwood Special Road District, Springfield, Mo., have agreed to construct tarvia road at a cost of $10,000 a mile from the City Limits on Fort St. south past Ingleside Park Addition and Elfindale Academy. The road will be 2½ miles in length.

Included in the annual budget for St. Louis, Mo., James Y. Player, Comptroller, is a bill authorizing the purchase of 19 automobiles for city officials.

Montana.

✣Bids will be received until June 4 by City of Missoula, Mont., for 13,000 sq. yds. of paving on Pattee St., and 6,000 sq. yds. of paving on Stevens St. Bids are asked on vitrified brick, creosoted wood block, bithulithic and asphaltic concrete. F. E. Buck is City Engineer.

Nebraska.

The City Council of Omaha, Neb., has passed an ordinance providing for the repaving of Farnam St., from 18th to 24th Sts.

New Hampshire.

✣Bids will be received until noon, June 4, by Highway Department of New Hampshire, Concord, N. H., for the construction of a trap rock road in Bow estimated to cost $3,100, and also a similar road in Greenville, estimated to cost $3,000.

New Jersey.

✣Bids will be received until 8:30 p. m., June 10, by City Council, South Amboy, N. J., for the construction of vitrified brick pavement on Stevens Ave., from Bordentown Ave. to Main St. A certified check for $1,000 must be filed with each bid. Plans and specifications are on file with R. M. Mack, City Clerk.

✣Bids will be received until 12:30 p. m., June 2, by Board of Bergen County Chosen Freeholders, Hackensack, N. J., for resurfacing the Franklin Turnpike between Ramsey and Mahway. Plans and specifications can be examined and all necessary information

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

obtained at the office of the Clerk of the Board of Freeholders, Court House, Hackensack, N. J., or at the office of the County Engineer, Court House, Hackensack, N. J., any day except Saturday between the hours of 10 a. m. and 4 p. m.

⊙E. C. Humphrey of Hackensack, N. J., has been awarded the contract by the Board of Freeholders, Hackensack, for the improvement of the first section of the Fort Lee turnpike, from Court St. bridge to Teaneck road, a distance of a little over a mile, for $80,830.

⊙The De Vogel Contracting Co., Passaic, N. J., will be awarded the contract on June 6, by the Board of Commissioners of Passaic, for grading, laying asphalt-bound macadam, concrete curb and flag in Temple Place, for $8,302. Other bidders were: John T. Harrop Co., Garfield, N. J., $10,354, and Union Bldg. & Construction Co., Passaic, $8,780.

New York.

✣The Common Council of Auburn, N. Y., will receive bids until June 3 for the paving of South Division St., from Clark to Genesee St., with brick, bitulithic or asphalt. Also for the paving of Chapel St., from the New York Central tracks to Central Ave., with brick.

✣Bids will be received until 5 p. m., June 10, by D. J. Coutant, City Clerk, Newburgh, N. Y., for all materials and labor necessary to permanently improve by paving in accordance with plans and specifications prepared by William J. Blake, Jr., City Engineer, of that portion of Liberty St. lying between Broadway and South St., and between the north line of South St. and the south line of North St. Separate proposals will be received for the two sections of the street mentioned. The approximate quantities are as follows: Between Broadway and South St., about 10,800 sq. yds. pavement, about 4,750 lin. ft. curbing, catch basins, manholes, etc. Each bid must be and North Sts., about 11,300 sq. yds. of pavement, excluding street railway portion, about 14,650 sq. yds. of pavement, including street railway portion, about 7,130 lin. ft. of curbing, catch basins, manholes, etc. ach bid must be accompanied by a certified check or cash to the amount of $1,000. Plans and specifications may be seen and form of proposal obtained at office of City Engineer on and after June 1, 1913.

⊙R. W. Henson of Geneva, N. Y., has been awarded the contract by the village of Canastota, N. Y., H. F. Hamil, Engineer, for the construction of one mile of vitrified brick pavement with concrete curb and gutter for $47,480. The work includes 18,530 sq. yds. of pavement, 13,150 lin. ft. of concrete curb and gutter, 575 lin. ft. of protection headers, 15 catch basins, 10 drop inlets, 4 manholes with covers and 800 lin. ft. of 10-in. sewer pipe. Bids were opened May 17.

⊙John W. Davitt, of Troy, N. Y., has been awarded the contract by the Board of Contract & Supply of Utica, N. Y., for the improvement of Elm and Albany Sts., and Seymour and Capitol Aves., with bitulithic pavement. Harry W. Roberts & Co. secured the Catharine St. work.

⊙The Board of Contract & Supply of Rochester, N. Y., has awarded the contract for resurfacing Portland Ave. with asphalt to Whitmore, Rauber & Vicinus, of that city, for $32,721.

⊙The Dunkirk Construction Co., Dunkirk, N. Y., has been awarded the contracts by the Common Council of that city for paving Robin and E. Seventh Sts. with sheet asphalt.

⊙The contract for the paving of Grant Ave., between Fulton St. and Five Points, with vitrified brick, has been awarded by the Common Council of Auburn, N. Y., to David Tumpusky, of Binghamton, N. Y., for $7,464.

The citizens of Cuba, N. Y., have decided to borrow $10,000 to pave South St., from Main to the overhead crossing of the Erie Railroad.

Mayor John A. Rafter, of North Tonawanda, N. Y., intends to call a joint meeting of the Board of Public Works and the Common Council to make arrangements for the repaving of several streets and the paving of several others that are under consideration.

Following bids were received by the Board of Contract & Supply of Syracuse, N. Y., on May 20, for paving Stolp Ave., from Dudley St. to Reed Ave.: Uniform pavement with stone curbing—F. J. Baker, $71,398 for sandstone block, $51,431 for vitrified brick and $46,698 for asphalt; Warner-Quinlan Asphalt Co., $72,767 for sandstone block, $52,736 for vitrified brick and $47,895 for asphalt. Asphalt on the sides of the street and sandstone block at the sides on grades and on the railway strip—F. J. Baker, $59,432; Warner-Quinlan Asphalt Co., $60,677. Asphalt on the sides of the street and sandstone block on the railway strip—F. J. Baker, $49,413; Warner-Quinlan Asphalt Co., $50,856.

Ohio.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., June 6, for furnishing the labor for grading and paving with waterbound macadam the Fairfield County State Highway A, Petition 449, Lancaster-Newark Road, Inter-County No. 359, in Walnut Township. Length, 22,616.5 ft. or 4.28 miles. Width of pavement, 12 ft. Estimated cost of furnishing labor, $3,630. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., June 16, 1913, for grading and paving with waterbound macadam and concrete the Champaign County State Highway F, Petition 738, Piqua-Urbana Extension No. 1 Road, Inter-County No. 188 in Urbana Township. Length, 3,125 ft. or .60 miles. Width of pavement, 14 and 16 ft. Estimated cost of construction, $7,779. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, August 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., June 6, 1913, for grading and paving with brick for medium traffic the Athens County State Highway F, Petition 655, Athens-Logan Road, Inter-County No. 155 in Athens Township. Length, 9,978 ft. or 1.89 miles. Width of pavement, 16 ft. Estimated cost of construction, $26,268. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, August 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., June 6, 1913, for grading and paving with waterbound macadam the Champaign County State Highway E, Petition 721, Urbana-West Jefferson Road, Inter-County No. 188 in Union Township. Length, 5,280 ft. or 1.00 mile. Width of pavement, 12 ft. Estimated cost of construction, $8,960. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, August 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., June 6, 1913, for grading and paving with waterbound macadam the Jefferson County State Highway D, Petition 660, Section No. 1, Canton-Steubenville Road, Inter-County No. 75, in Springfield Township. Length, 12,700 ft. or 2.40 miles. Width of pavement, 14 ft. Estimated cost of construction, $31,096. A draft or certified check for $300 shall be deposited with each bid. The successful bidder with be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, August 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., June 6, 1913, for grading and paving with concrete the Geauga County State Highway H, Petition 537, Scotland Station Easterly Road, Inter-County No. 15, in Chester Township. Length, 5,800 ft. or 1.10 miles. Width of pavement, 14 ft. Estimated cost of construction, $14,124. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, August 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received until noon, June 14, by George H. Eversman, Clerk, Village of Wyoming, O., for the construction of combined curb and gutter on portions of a number of streets.

✣Bids will be received until noon, June 5, by Director of Public Service, Lorain, O., for furnishing the necessary labor and material for the improvement of the following streets according to plans and specifications on file in said Director's office as follows: Globe Ave., from the south line of East 28th St. southerly to the south line of East 31st St., by grading, draining, curbing and paving the same with vitrified brick or asphalt, and constructing the necessary gutters, culverts and retaining walls. East 30th St., from the east line of Vine Ave. to the west line of Pearl Ave., by grading, draining, curbing and repaving the same with vitrified brick, block or sheet asphalt, and constructing the necessary gutters, culverts and retaining walls.

✣Bids will be received until noon, June 23, by Village Council, Lockland, O., for the furnishing of the necessary labor and material for the improvement of William St., from the south line of Wyoming Ave. to the south line of Lock St., by grading, paving the roadway with vitrified brick on concrete foundation and constructing concrete curbs and gutters and the necessary drains, culverts and retaining walls, all in accordance with the plans, profiles and specifications now on file in the office of the Village Clerk of Lockland, O. Frank Reed is Village Clerk.

✣Bids will be received until 1 p. m., June 2, by Board of Lorain County Commissioners, Elyria, O., for furnishing material and performing the necessary labor for grading, draining and macadamizing of the Cemetery Road from the east side of South Main St., in Wellington Village, easterly to the east side of the main entrance to the cemetery, in all a distance of about 1,100 ft., in accordance with the forms of contract and specifications to be furnished by T. L. Gibson, County Surveyor.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

⊙Z. Blodgett, of Gomer, O., has been awarded the contract by the Public Service Department of Lima, O., for the paving of Jameson Ave., from Elm St. to Lakewood Ave., at $8,320. Bids were opened May 15.

⊙The Board of Control of Springfield, O., has awarded the contract for the paving of Limestone St., from Rice to Leffel's Lane, a distance of about 1 mile, to Edward Ryan, at $13,431. Trinidad Lake asphalt will be used with gravel grout, cement curb and gutter and Hocking block between the car tracks.

⊙Rhoads & Fraser have been awarded the contract to pave East River St., in Elyria, O., with brick, for $5,400. The Elyria Construction Co. secured the contract to pave Winckles Court with brick at a cost of $5,087.

⊙The contract for paving 8 squares at Sunbury, O., for which H. O. Core, Delaware, O., is the Engineer, was let on May 19 to Lambert Bros. & Wirt, Delaware, O., on Hocking Valley block. The itemized bid of the successful contractors was as follows:

	Cu. yds.	
Excavation	5,373	$0.35
	Sq. yds.	
Base, 5-in. concrete, 1-3-6	10,685	.53
Brick with sand cushion	10,685	.92
Filler, No. 6 paving pitch	10,685	.16
Filler, asphalt	10,685	.25
Filler, cement grout	10,685	.09
Catch basins, complete	8	32.00
	Lin. ft.	
Curb, 5x20 in., machine dressed	5,226	.50
Curb, circle	559	.90
Curb, concrete	5,785	.59
Stone headers, 4x15 in.	198	.39
Relaying 12-in. sewer pipe	74	.35
New-laid 12-in. sewer pipe	258	.65
New-laid 10-in. sewer pipe	56	.65
New-laid 8-in. sewer pipe	353	.65
4-in. drain tile, laid	626	.10
12/8-in. "T" or "Y"	2	1.80
8 5-in. "T" or "Y"	10	1.10

⊙Shelling Construction Co. of Youngstown, O., has been awarded the contract at Middlefield, O., for the construction of 19,194 sq. yds. of Dolarway pavement. Contract awarded May 19.

⊙The Board of Lucas County Commissioners, Toledo, O., has awarded the contract for the grading, draining and macadamizing of public highways in Wildwood addition, a subdivision of Adams Township, to Wm. Roy Wiltsie of Toledo for $7,950. Bids were opened May 6.

No bids were received on May 23 by the State Highway Commission, Columbus, O., for grading and paving with a waterbound macadam with a bituminous surface treatment the Newark-New Lexington road, Perry County, Thorn Township. The road is 9,775 ft. long and 16 ft. wide. The estimated cost was $18,726.

Oklahoma.

⊙Levy & Levy of Muskogee, Okla., have been awarded the contract by the City Council of Durant, Okla., W. P. Danford, City Engineer, for the construction of 18,000 sq. yds. of asphaltic concrete pavement and 8,500 lin. ft. of combined curb and gutter with excavation, etc., at $1.79 per sq. yd. Bids were opened May 20. Contract awarded May 22.

Oregon.

⊙The City Council of Portland, Ore., has awarded the contracts for street improvements as follows: Vistaria and other streets, to the Warren Construction Co., for gravel bitulithic paving, $44,157; East 57th St., from Sandy Blvd. to Tremont, Warren Construction Co., for gravel bitulithic, $12,649; Millers Ave., from East Seventh to East 16th Sts., to the Linden, Kibbe Construction Co., for concrete, $15,619; East 37th St., from Hancock to Rossmere, to the Oregon Independent Paving Co., for concrete, $8,418; East Lincoln and other streets, to the Pacific Bridge Co., for bitulithic redress, $61,903.

⊙The Warren Construction Co. has been awarded the contract by the City Council of Portland, Ore., for the construction of gravel bitulithic pavement on Wistaria Ave., from East 45th St. to Alameda, for $44,157. The Pacific Bridge Co. secured the contract to lay bitulithic redress on East Lincoln St. District for $61,903. Linden-Kibbe Construction Co. will pave Miller's Ave., from East Seventh to East 16th, with concrete, for $15,619.

The City Council of Portland, Ore., rejected all bids received May 10 for the improvement of the East Clay St. District, estimated to cost approximately $90,000. The lowest bid was for bitulithic redress, but the property owners have asked for a more substantial pavement. City Engineer Tom Hurlburt will divide the district into several improvements under the new proceedings.

Pennsylvania.

✣Bids will be received until 1 p. m., June 9, by Board of Delaware County Commissioners, Media, Pa., for the construction of the Infirmary Road. W. F. Whittier is County Surveyor.

⊙Stucker Bros. Construction Co., of Harrisburg, Pa., has been awarded the contract for paving the streets designated by the Town Council of Mechanicsburg, Pa. Vitrified brick will be used.

Bids were received recently by the Highway Bureau of Philadelphia, Pa., for the construction of about $400,000 worth of street paving work. The bidders and their bids on asphalt are as follows:

	Per square yard.		
Bidder	Resurfacing.	Paving.	Repaving.
Eastern Paving Co.	$1.08	$1.07	$1.17
Union paving Co.	1.28	1.60	1.52
Phila. Paving Co.	1.32	2.06	1.88
Barber Asphalt Co.	1.23	1.58	1.47

These prices do not include the renewal or new foundations. The other work for which bidders submitted estimates included grading of streets, paving with vitrified brick and granite blocks, surfacing macadam roads with bituminous binders.

The Borough Council of Middletown, Pa., is considering the question of paving some of the principal streets of the town.

Rhode Island.

⊙The State Board of Public Roads, John H. Edwards, Chairman, Providence, R. I., has awarded the following road contracts for which bids were opened on May 16: A. D. Bridge's Sons, Inc., Hazardville, Conn., surface treatment with asphaltic oils sections in the Town of Warwick, 30,000 ft. in length, $2,236; Walter Cressy, Gloucester, Mass., a section in the Town of South Kingstown, 25,000 ft. in length, $1,723; a section in the Town of East Providence, 5,000 ft. in length, $402; a section in the Towns of Middletown and Portsmouth, 11,000 ft. in length, $814; a section in the Town of Tiverton, 6,461 ft. in length, $542. A. D. Bridge's Sons, Inc., a section in the Town of Bristol, 2,300 ft. in length, $4,193; Oscar Rackle, Providence, a section in the Town of Tiverton, $6,380, and a section in the Town of Warren, $3,606.

South Dakota.

⊙The City Commission of Watertown, S. D., has awarded the contract for the entire paving work during the year to the Watertown Cement Product Co., for $73,403. Asphaltic concrete will be laid on all streets except First Ave. N., where 8-in. concrete is to be used in part. The same company also secured the contract to construct curbs and gutters.

The City Commissioners of Sioux Falls, S. D., have been petitioned to pave Prairie Ave., from Sixth to 12th Sts., inclusive.

Texas.

Surveyors are in the field surveying the public roads to be made in Conroe Precinct, No. 1 Road District, Montgomery County, Texas. Bonds to the amount of $250,000 were voted for road work in this county. Four main roads are to be built from the Court House in Conroe, east, west, north and south, to connect with the Harris County line at Spring Creek.

The citizens of Precinct No. 1, Bell County, Texas, on May 16 voted the issuance of bonds to the amount of $150,000 for the construction of good roads. Pink Denman, Belton, Texas, is Commissioner of Precinct No. 1.

The City of Denison, Texas, will let contracts within six weeks for the construction of about 50,000 sq. yds. of pavement. J. C. Feild is City Engineer. E. E. Davis is Commissioner.

Coke County, Texas, has voted a 15-cent tax for the construction of good roads. Robert Lee is the County Seat.

The Commissioners' Court, Groveton, Texas, will sell bonds June 16 in the sum of $60,000 for the construction of good roads in Road District No. 1.

Utah.

⊙The City Council of Provo, Utah, has awarded the contract for constructing gutters and curbing on Center St., between Fifth East and Fifth West Sts., to the Wheelwright Construction Co., of Ogden, Utah, for $7,771.

⊙P. J. Moran, Salt Lake City, Utah, has been awarded the contract by the city of Salt Lake for the construction of 106,753 ft. of cement sidewalks in District No. 159 for $80,005. Part of the walks will be five ft. wide and part six ft. Bids were opened May 22.

Washington.

⊙The Adams County Commissioners, Ritzville, Wash., have awarded the contract for the construction of about two miles of state road leading from Washtucha toward Ritzville to Roy E. Nelson of Prosser, for $19,920.

⊙Joseph Warter, Sr., 631 N. Fife St., Tacoma, Wash., has been awarded the contract by that city for the paving of N. Oakes St., with asphaltic concrete, for $35,312.

The City of Bellingham, Wash., will grade Monroe St., from Broadway to Cherry Sts., curbs, gutters, etc., at a cost of $16,000, and Cherry St., from Monroe to Eldredge will be paved with asphalt at a cost of $20,000.

Following low bids were received by the City of Vancouver, Wash., for the paving of 13th St.: Lumdon-Kibbe Co., of Portland, Ore., $24,124 for concrete; Elwood Wiles, Portland, Ore., $23,747 for Dolarway; L. Olter & Force at $23,820 for monolithic; Lumdon-Kibbe at $25,471 for bitucrete; Star Sand Co., Portland, $27,812 for gravel bitulithic.

Pierce County Engineer Thompson, Tacoma, Wash., will complete plans this month for the road through the forest reserve to Mt. Tacoma, to cost about $10,000.

Bids will be asked in the near future by the King County Commissioners, Byron Phelps, Clerk, Seattle, Wash., for the following road contracts, representing a total of over $1,250,000: Vashon Island Trunk Road, $50,000; Manhattan-Des Moines Road, $10,150; Richmond Beach, north trunk, $30,000; Auburn-Black Diamond-Enumclaw, $278,000; Seattle-Des Moines-Pierce County, $146,000; Redmond-Renton, $298,000; Stevens Pass Road, $165,000; Mercer Island, $50,000; Seattle-Woodinville-Dupval, $128,000; Kirkland-Renton, $30,000; Seattle-Renton, $45,000; connecting roads at Issaquah, Bothell and Pacific City, Seattle-Pierce County, $330,850; Bothell-Snohomish County, $8,000; Issaquah-Fall City, $86,000; Renton-Renton Junction, $17,000; Renton-Black Diamond, $76,000.

Wisconsin.

⊙Garlin Bros., of Marinette, Wis., have been awarded the contract for the construction of 6½ blocks of macadam paving in that city, for $10,949.

⊙Chris. Johnson, Oshkosh, Wis., has been awarded the contract by the Board of Public Works, Wausau, Wis., B. C. Gowen, City Engineer, for the construction of approximately 11,200 sq. yds. of vitrified block pavement for $2.12 per sq. yd. Grout filler will be used. Bids were opened May 15.

⊙Jas. Cape & Sons Co., Racine, Wis., has been awarded the contract by the Board of Local Improvements of Waukegan, Ill., M. J. Douthitt, City Engineer, for the construction of 1,535 sq. yds. of brick pavement on County St., at $3,854, and for 1,370 sq. yds. of brick pavement on Hickory St., for $3,375. Bids were opened May 19.

⊙Birdsall & Griffiths, Racine, Wis., have been awarded the contract by the Board of Public Works of Delavan, Wis., Daniel E. LaBar, Mayor, for the construction of cement curb, gutter and brick pavement on Wal-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

worth St., Racine and Fourth Sts. The pavement will cost $1.79 per sq. yd., and the curb and gutter, $0.60 per lin. ft. Bids were opened May 2.

⊙The Board of Public Works of West Allis, Wis., has let the contract for paving Greenfield Ave., from 66th to 75th Aves., 71st and 72nd Aves., from National to Greenfield Ave., and Burnham St., from 51st to 45th Aves., to the White Construction Co., of Milwaukee, Wis. The contract calls for 45,000 sq. yds. of asphalt on a concrete foundation.

⊙Flanagan & Son, of Lannon, Wis., have been awarded the contract to furnish 5,000 tons of stone to be used on the highways of Columbia County, Wis. That county will expend $80,000 on the roads this season. Portage is the County Seat.

The Wood County Board, Grand Rapids, Wis., has voted to construct 31 miles of macadam roads this season. An appropriation of $6,000 will be made for grading this year on inter-city road, and a levy tax of $10,000 for next year's work. A highway will be built from Grand Rapids to Marshfield by way of Vesper, Arpin and Auburndale. Also a trunk line from Grand Rapids to Marshfield by way of Pittsville.

The White Construction Co., of Milwaukee, Wis., submitted the lowest bid to the City Council of Green Bay, Wis., for the construction of asphalt, or asphaltic macadam, on a number of streets. The Schuette Co., of Manitowoc, bid low on tar macadam.

Canada.

The property owners of Wingham, Ont., on May 19 voted a by-law to raise $6,500 for the purchase of a stone-crusher and road-roller.

DRAINAGE AND IRRIGATION

Arizona.

Preliminary work is to be started shortly on an irrigation project in the Agua Caliente Country, which includes the construction of an 80 ft. high, 1,800 ft. long dam across the Gila River and the watering of about 100,000 acres of land. The New Johnson Irrigation Co. has been incorporated to handle the project. J. L. Gant, Phoenix, Ariz., is interested.

California.

A committee of the Chamber of Commerce of Oroville, Cal., will make a preliminary report in a short time on a proposition to organize an irrigation district of 50,000 acres south and east of this city. It is believed that the report will be ready in time for the circulation of a petition in June asking the Board of Supervisors to call an election on the organization of the irrigation district.

The Wechicka Water Co., of Shellville, has been incorporated for irrigation purposes. The incorporators are W. S. Dottarar, J. W. Berness, E. Burke, H. W. Lauder and E. R. Seward, all of Shellville.

Idaho.

✣Bids will be received until 2 p. m., June 14, by U. S. Reclamation Service, Boise, Idaho, for furnishing sluice gates for the New Jackson Lake Dam, Snake River Storage Project, Idaho-Wyoming. For particulars address U. S. Reclamation Service, Boise, Idaho, or Washington, D. C. Official advertisement will be found elsewhere in this issue.

Illinois.

✣Bids will be received until June 3, by the Commissioners of the Kankakee Drainage District at the office of Webber & Roth, Attorneys, First National Bang Bldg., Urbana, Ill., for the improvement of tributary 13 of the Main Ditch. The work will include bulkhead and tiling estimated to cost $1,600.

⊙Bids were opened May 22 at Sycamore, Ill., for about 15 miles of ditches in the Coon Creek Drainage District requiring 480,000 cu. yds. of excavation, the contract being awarded to G. A. McWilliams, Chicago, Ill., at 7.25 cts. per cu. yd. The other bids received were as follows: Carter Bros., Danville, Ill., 7.5 cts.; Wolcott Dredging Co., Wolcott, Ind., 7.4 cts.; Thomas & Sweet, Royal Center, Ind., 9.25 cts.; Henry P. Johnson, Sterling, Ill., 7.5 cts.; Foohey Dredging Co., Ft. Wayne, Ind., 7.0 cts.; Northern Construction Co., Elkhart, Ind., 7.95 cts.; Horton & Moseley, Chicago, Ill., 7.75 cts.; Dilley & Berdine Co., Hebron, Ind., 7.62 cts.; Indiana Dredging Co., Royal Center, Ind., all at 6.0 cts. per cu. yd. on 200,000 yds., 12.0 cts. per cu. yd. on 60,000 yds. W. M. Hay, Sycamore, Ill., is Engineer.

Iowa.

✣Bids will be received until 2 p. m., June 5, by F. E. Osier, Wright County Auditor, Clarion, Ia., for the construction of Drain No. 82, located in Sections 24, 25, 35, 36, Belmond Township, and Section 2, Grant Township, at which time and place the contract will be awarded to the lowest responsible bidder or bidders for material and labor necessary for the construction of said drain according to the plat, profile, plans and specifications, all of which may be found at the County Auditor's office. Work to begin on or before July 1, 1913, and be completed on or before November 1, 1913. Section 1—900 ft. of 12-in. tile, av. cut about 4.90 ft; Section 2—1,000 ft. of 14-in. tile, av. cut about 5.50 ft.; Section 3—1,000 ft. of 16-in. tile, av. cut about 5.64 ft.; Section 4—1,000 ft. 18-in. tile, av. cut about 6.50 ft.; Section 5—1,000 ft. of 20-in. tile, av. cut about 6.53 ft.; Section 6—3,000 ft. of 24-in. tile, av. cut about 7.08 ft.; Section 7—100 ft. of 24-in. D. S. sewer pipe, av. cut about 7.08 ft.; Section 8—900 ft. of 24-in. tile, av. cut about 7.08 ft.; Section 9—1,100 ft. of 20-in. tile, av. cut about 5.92 ft. One concrete bulkhead of five cu. yds. to encase the end tile at Station A. Five 8-in. sewer pipe catch basins with C. I. tops. Bids will be considered on both cement or clay tile under the following specifications: The clay tile must be No. 1 salt glazed vitrified farm drain tile and specifications for cement tile must be those adopted at the state drainage convention in 1913 to govern their manufacture.

✣Bids will be received until 2 p. m., May 29, by Board of Wright and Hamilton Counties, Ia., at the office of Hamilton County Auditor, Webster City, Ia., for the construction of Joint Drain No. 79 in Wright County and Hunter Drain No. 144 in Hamilton County.

✣Bids will be received until 2 p. m., June 5, by F. E. Osier, Wright County Auditor, Clarion, Ia., for the improvement of County Drain No. 8, in Clarion Township, in accordance with plans and specifications on file at the office of the County Auditor. Work to begin on or before July 1, 1913, and be completed on or before October 1, 1913, to be laid with No. 1 salt glazed vitrified farm drain tile. The work will consist of laying 1,200 ft. of 24-in. tile and relaying 300 ft. of 24-in. sewer tile. Section 1—1,200 ft. of 24-in. tile, av. cut about 5.63 ft.; Section 2—Relaying 300 ft. of 24-in. sewer tile, av. cut about 5.36 ft. A concrete bulkhead containing about 8 cu. yds. is to encase the end tile at Station O. All bids must be by sections and bids may also be filed for improvement complete and must be accompanied by cash or certified check equal to ten per cent of amount of bid.

✣Bids will be received until 2 p. m., June 5, by F. E. Osier, Wright County Auditor, Clarion, Ia., for the construction of Drain No. 85, located in Sections 4, 9, 10, Grant Township, at which time and place the contract will be awarded to the lowest responsible bidder or bidders for material and labor necessary for the construction of said drain according to plat, profile, plans and specifications, all of which may be found at the office of the County Auditor. Work to begin on or before July 1, 1913, and be completed on or before November 1, 1913. Main Drain. Section 1—2,800 ft. of 18-in. tile, av. cut about 5.9 ft.; Section 2—1,200 ft. of 16-in. tile, av. cut about 6.6 ft.; Section 3—4,000 ft. of 14-in. tile, av. cut about 7.4 ft. Lateral No. 1. Section 1—600 ft. of 8-in. tile, av. cut about 5.2 ft. Lateral No. 2. Section 1—1,000 ft. of 12-in. tile, av. cut about 5.8 ft.; Section 2—1,000 ft. of 8-in. tile, av. cut about 4.7 ft. One concrete bulkhead of 5 cu. yds. to encase the end tile at Station O. Bids will be considered on both cement or clay tile under the following specifications. The clay tile must be No. 1 salt glazed vitrified farm drain tile and specifications for cement tile must be those adopted at the State Drainage Convention in 1913 to govern their manufacture. Ten per cent of amount of bids in cash or certified check must accompany same. Bids must be by sections and be submitted, received and acted upon separately as to main drain and laterals, the board exercising their own discretion as to letting the work as to main drain as a whole, or as to the laterals as a whole, or by sections as to both main drain and laterals, and reserving the right to reject any and all bids.

✣Bids will be received until 2 p. m., June 5, by F. E. Osier, County Auditor, Wright County, Clarion, Ia., for the construction of Drain No. 84, located in Sections 28, 32, 33, 34, Belmond Township, and Sections 3, 4, 5, Grant Township, at which time and place the contract will be awarded to the lowest responsible bidder or bidders for material and labor necessary for the construction of said drain according to plat, profile, plans and specifications, all of which may be found at the County Auditor's office. Work to begin on or before July 1, 1913, and be completed on or before November 1, 1913. Main Drain. Section 1—3,500 ft. of 24-in. tile, av. cut about 1.6 ft.; Section 2—2,000 ft. of 22-in. tile, av. cut about 7.8 ft.; Section 3—1,000 ft. of 15-in. tile, av. cut about 5.1 ft.; Section 4—2,000 ft. of 14-in. tile, av. cut about 5.6 ft.; Section 5—1,500 ft. of 12-in. tile, av. cut about 5.2 ft.; Section 6—1,000 ft. of 10-in. tile, av. cut about 5.9 ft. Lateral No. 1. Section 1—1,400 ft. of 14-in. tile, av. cut about 5.5 ft. Lateral No. 2. Section 1—2,000 ft. of 14-in. tile, av. cut about 6.1 ft.; Section 2—2,100 ft. of 10-in. tile, av. cut about 6.0 ft.; Section 3—700 ft. of 8-in. tile, av. cut about 5.4 ft. One concrete bulkhead of 5 cu. yds. to encase the end tile at Station O. Bids will be considered on both cement or clay tile under the following specifications: The clay tile must be No. 1 salt glazed vitrified farm drain tile, and specifications for cement tile must be those adopted at the State Drainage Convention in 1913, to govern their manufacture.

⊙Contracts for Tile Drain No. 84 of Greene County, Ia., bids for which were opened May 19 by B. S. McCully, County Auditor, Jefferson, Ind., have been let as follows: Tile, Arthur McHose, Boone, Ia., at $14,430, and Redfield Brick & Tile Works, Redfield, Ia., at $2,385. The contract for the labor was let previously to Condon & Robinson, Jefferson, Ia., at $11,594.

The bids received May 15 by H. G. McGee, Secretary Park Commissioners, 105 Pearl St., Council Bluffs, Ia., for about 40,000 cu. yds. grading in embankment for drive and levee, were considered too high and were rejected.

County Supervisors, Council Bluffs, Ia., are considering building a ¼ mile levee in Rockford Township, connecting the old levee with the re-located levee, as an addition to the Honey Creek drainage system.

Michigan.

✣Bids will be received until May 29, by Louis F. Green, Clinton County Drain Com-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

missioner, St. John, Mich., for cleaning out the Mead Drain in Bath Township.

⊙Ananias Ipe, Nappanee, Ind., has been awarded the contract at about $11,000 for cleaning, deepening and extending the Hickory Creek drain in Berrien County, Mich.

Nebraska.

✣Bids will be received until 2 p. m., June 9, by John O'Connor, Dodge County Clerk, Fremont, Nebr., for the construction of a ditch and drain. Plans and specifications are on file with the County Clerk.

Ohio.

⊙Pharon Dull, Redkey, Ind., has been awarded the contract at $1,321 for constructing the T. P. Kelley ditch, bids for which were opened May 17 at Ottawa, O.

Texas.

J. Gerardus Johnston, Engineer, Victoria, Tex., has completed and filed final reports for two drainage districts for Victoria County. The County Commissioners have issued bond orders to be approved by the attorney general in accordance with the reports. It is proposed to issue $13,792 of bonds for District No. 1 and $56,680 of bonds for District No. 2. The headquarters for Drainage District No. 1 is Salem, Tex., and the Commissioners are Frank L. Coleman, D. G. Musselman and Abner Stoltzfus. For District No. 2 the Commissioners are Grant Page, W. K. Lane and F. Lenart and the post office address is Bloomington, Tex.

Utah.

The Bear & Sanford Irrigation Co. of Salt Lake City, Utah, has increased its capital stock to $19,500.

WATER WORKS

Alabama.

✣Bids will be received until 8 a. m., June 2, by J. M. Phillips, Mayor, Jasper, Ala., for the construction of sewer laterals as follows: 780 ft. of 8-in. pipe, and 9,075 ft. of 6-in. pipe with suitable appurtenances, all in accordance with plans and profiles now on file in the city engineer's office. All bids must be accompanied with a certified check for $500 payable to the city of Jasper.

Arkansas.

The water works committee of the City Council, Walnut Ridge, Ark., has retained Consulting Engineers R. C. Huston & Co., of Memphis, Tenn., to estimate the cost of a water works plant for Walnut Ridge.

California.

City Engineer M. M. O'Shaunghnessy of San Francisco, Calif., has prepared specifications for a proposed contract for supplying the city with 2,750 tons of cast iron pipe, to be used in carrying water to residence districts not reached by the Spring Valley system. The cost of the pipe is estimated at $100,000.

The citizens of Escondido, Calif., will shortly vote on the issuance of bonds to the amount of $100,000 for the installation of a municipal water system.

The city of Richmond, Calif., contemplates purchasing the Pinole water plant owned by the Peoples Water Co., and other lands owned by that corporation in Contra Costa County.

The city of Berkeley, Calif., will probably ask the citizens to vote within a short time for establishing a high-pressure water system to supply adequate fire protection. The cost of such a system is estimated by City Engineer J. J. Jessup to be $700,000.

The Sherman Water Co. has been incorporated at Los Angeles, Calif., with a capital stock of $15,000. The incorporators are: P. T. Durfy, E. O. Lenov and P. F. Backus.

The Walnut Water Co. of East Whittier, Calif., has been incorporated with a capital stock of $10,000. The directors are: J. F. Hubbard and W. T. Brokaw.

Property owners of Roseville, Calif., have started a movement for a municipal water system.

Supervisor A. J. Gallagher, chairman of the water committee, San Francisco, Calif., has been requested to present a proposition for supplying water to the Richmond and Sunset districts by connecteing the city's proposed pipe extensions with a private system owned by Blum & Co., with works near Hillcrest, south of the San Mateo County line.

Connecticut.

✣Bids will be received until June 16, by Board of Water Commissioners, Hartford, Conn., for the construction of the Nepaug Pipe line 7½ miles long in the towns of Farmington, Avon and Burlington, Conn. Specifications may be obtained of Caleb Mills Saville, Chief Engineer, Pilgard Bldg., Hartford, Conn., upon a deposit of $10. Official advertisement will be found elsewhere in this issue.

District of Columbia.

✣Bids will be received until 2 p. m., June 2, by Commissioners of the District of Columbia, Washington, D. C., for furnishing and delivering one motor driven lathe for use in the fire department at Washington.

Approximately $60,000 will be expended from the general funds of the District of Columbia water department during the year in construction of a water main east of Capitol Hill for the reinforcement of the water supply of the northeast section of the city. Plans for the improvement practically have been decided upon. W. A. McFarland, Washington, is superintendent of the water department.

Illinois.

✣Bids will be received until 3 p. m., June 9, by Board of Administration, Capitol Bldg., Springfield, Ill., for a 50,000 gal. capacity steel tank and tower to be erected at the farm colony of the Peoria State Hospital, South Bartonville, Ill. F. D. Whipp is Fiscal Supervisor, Springfield, Ill. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 8 p. m., June 2, by City of Farmington, Ill., for the necessary labor and material for the construction of a pump house. J. G. Findley is Clerk.

✣Bids will be received until 11 a. m., June 4, for furnishing and delivering at the Water Pipe Yard, 2352 S. Ashland Ave., drills and taps as follows: 24-2 in. drills and taps, 24-1½ in. drills and taps, 12-1 in. drills and taps, 120-¾ in. drills and taps. Cash or certified check for $100 must accompany proposal. Plans and specifications may be had upon application to L. E. McGann, Commissioner of Public Works, Chicago, Ill.

✣Bids will be received until 11 a. m., June 6, by the Department of Public Works, Chicago, Ill., for furnishing and erecting at the Jefferson Park pumping station, 4440 N. 47th Ave., 1 motor driven centrifugal pump with a capacity of 3,000,000 gals. per 24 hours, against 120 ft. head; details as follows: Contractor to construct foundation, etc.; pump to be single stage horizontal shaft, centrifugal type with double suction and single discharge; the motor to be of slip ring induction type designed to operate on 3-phase, 60 cycles, 220 volts, alternating current, with a capacity of 100 h.p. at full load; high tension apparatus to consist of 3 single pole single throw, 50 ampere 10,000 volts, disconnecting switches, 1-3 pole 7,500 volt 300 ampere, remote control, single throw, automatic oil switch, to be operated manually. Proposal must be accompanied by cash or certified check for $200, and a list showing the following information pertaining to proposed machinery to be installed: Type of pump, number of runners, diameter of runners, diameter of suction openings, diameter of discharge openings, type and dimensions of pump shaft bearings, synchronous speed, full load speed, type and dimensions of motor bearings. Plans and specifications may be had upon application to L. E. McGann, Commissioner of Public Works.

✣Bids will be received until 11 a. m., June 6, for furnishing and delivering to the following points steel reinforcing rods, as specified: Lake View pumping station, Montrose Blvd. and Clarendon Ave., 1,255 lbs. 1-in. in diameter, 1,245 lbs. ⅞-in. in diameter, 22,075 lbs. ¾-in. in diameter, 29,300 lbs. ⅝-in. in diameter, 9,400 lbs. ½-in. in diameter, 20 lbs. ¼-in. in diameter; pipe yard B, 2352 S. Ashland Ave., 14,565 lbs. ⅜-in. in diameter, 440 lbs. 7/16-in. in diameter, 510 lbs. ½-in. in diameter, 3,616 lbs. ¾-in. in diameter; Harrison St. pumping station, 735 W. Harrison St., 4,455 lbs. ½-in. in diameter, 3,530 lbs. ⅝-in. in diameter, 14,305 lbs. ¾-in. in diameter; 14th St. pumping station, 1354 Indiana Ave., 125 lbs. ⅜-in. in diameter, 1,510 lbs. ⅝-in. in diameter; Central Park Ave. pumping station, 1015 S. Central Park Ave., 105 lbs. ½-in. in diameter; at the bridges crossing the north branch of the Chicago river at N. Kedzie Ave., N. Central Park Ave., Forest Glen Ave. and 56th Ave., 21,500 lbs. of square rods, varying in size from ¼-in. to ¾-in.; at pipe yard B, 22,000 lbs. of square rods in stock lengths, ¾-in. to ⅜-in. in size. All rods to be round unless otherwise specified and of various lengths. Cash or certified check for $100 must accompany proposal. Specifications may be had upon application to L. E. McGann, Commissioner of Public Works, Chicago, Ill.

⊙P. F. Trenkenschuh has been awarded contracts by the Board of Local Improvements of Rock Island, Ill., for the laying of water mains on 31st St., between 12th and 14th Aves.; 12th, between 30th and 31st Sts., and 14th Ave., between Seventh and Eighth Sts.

Mayor H. G. Henry of Camp Point, Ill., has named a committee to investigate the feasibility of installing a water works system.

Indiana.

✣Bids will be received until 7:30 p. m., June 2, by Common Council, Union City, Ind., for the construction of a new water works building. R. C. Sutton is City Clerk.

Iowa.

⊙Thomas Melvold of Cresco has been awarded the contract for drilling a well at Lime Springs, Ia., for the proposed new city water works. Supplies for the system have been purchased.

The City Council of Mt. Ayr, Ia., has adopted the report of the engineer employed to make a preliminary survey for a water works and sewer system. The plans submitted contemplate the building of a reservoir three-fourths mile east of town and piping the water to a water tower to be located south and east of E. E. Hayes & Sons elevator. The estimated cost of the systems is $60,000.

The Trustees of the city water works, Cedar Rapids, Ia., are contemplating the electrifying of the main pumping station and the erection of three booster electric pumping stations. E. D. McCartney is a member of the trustees.

Kentucky.

✣Bids will be received until June 2, as noted in our last issue, by the Lexington Hydraulic & Mfg. Co., Lexington, Ky., for the construction of a water works impounding reservoir, estimated quantities as shown on specifications as follows: 38,500 cu. yds. of embankment, including stripping and preparation of foundation; core wall, including earth and rock excavation; concrete spillway and abutment, 90 cu. yds., 159 sq. yds. of concrete pavement, 4,900 sq. yds. of stone riprap at dam in place, including rock excavation in spillway channel, spillway abutment and excavation for toe of concrete pavement; gate chambers and pipes 8,000 cu. yds. of enbankment on Richmond pike, concrete culvert on Richmond pike, 2,940 sq. yds. stone riprap on Richmond pike, 2,940 sq. yds. stone paving on Richmond pike. Plans and specifications may be seen at the office of Alvord & Burdick, Engineers, 1417 Hartford Bldg., Chicago, or may be had upon application to the Lexington Hydraulic & Mfg. Co.

The City Council of Madisonville, Ky., has employed Engineer C. H. Jenks of Union City, Tenn., to supervise the construction of the proposed water works system.

Massachusetts.

⊙The Water Commissioners of West Brookfield, Mass., have let the contract for laying the piping in town for the new water system to John E. Palmer, 1020 Old South Bldg., Boston, Mass.

The Board of Aldermen of Holyoke, Mass., have voted bonds to the amount of $17,000 for auto equipment for the fire department.

Michigan.

✣Bids will be received until 4 p. m., June 3, by F. T. Bowler, Secy., Public Lighting Commission, 56 Atwater St., E., Detroit, Mich., for furnishing cedar poles.

The city of Midland, Mich., David M. Bye, City Clerk, is putting down water wells. Will shortly be in the market for pump and elevated reservoir.

Minnesota.

✣Bids will be received until 3 p. m., June 2, by Village Council, Taylor Falls, Minn., for the construction of a water works distribution pipe system of a 100,000 gal. reinforced concrete reservoir. Plans and specifications are on file with W. H. Robertson, Village Clerk, and with L. P. Wolff, 1000 Germania Life Bldg., St. Paul, Minn., is Consulting Engineer.

⊙Fraser & Danforth, Hackney Bldg., St. Paul, Minn., have been awarded the contract for the making of water and sewer extensions in Zumbrota, Minn., for $3,845. Bids were opened May 15.

The Town Council of Ironton, Minn., is having preliminary plans prepared for water works and sewers. James G. Lawson of Duluth, Minn., is Engineer.

Mississippi.

According to Councilman J. M. Slaughter, Meridian, Miss., several improvements in the water works plant of the city are contemplated. The improvements include the installation of a new 250-h.p. Heinie boiler and a new roof for the pumping station.

Missouri.

⊙The contract for a new vertical triple expansion pumping engine for the water works of Jefferson City, Mo., has been awarded to the Epping-Carpenter Co. The work is in charge of Chester & Fleming, Hydraulic Engineers, Pittsburgh, Pa.

A special election will be held in Hannibal, Mo., on July 1, to decide whether or not the city shall purchase the water works plant for $285,000.

Water Commissioner Edward E. Wall, St. Louis, Mo., has introduced in the City Council a bill appropriating $175,000 for revetment of the Illinois shore of the Mississippi River opposite the St. Louis water works at Chain of Rocks. The proposed work will be for the protection of the new intake tower being constructed near the old tower.

Montana.

The city of Kalispell, Mont., is contemplating purchasing the water works now owned by the Northern Idaho & Montana Power Co. Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., have been retained to estimate the cost of the new water works system and also appraise the value of the existing water works.

As soon as estimates are completed a bond election will be called by the citizens of Roundup, Mont., for the purpose of purchasing the privately owned water works at that place and for constructing a sanitary sewer system and treating plant. The Gearharz-Jaqueth Engineering Co., of Great Falls, Mont., have the engineering work. An evaluation survey of the water works is now being made by Engineer Carl C. Adams of that company.

Tentative plans have been prepared by the City Engineer's office, Great Falls, Mont., for the construction of a chemical treating plant for the municipal water supply of that city. The plans include an addition to the pumping equipment and the installation of concrete purification tanks. M. L. Morris is City Engineer.

Bids will soon be asked for the installation of a water works system at Cut Bank, Mont., consisting of an electric driven centrifugal pump, reinforced concrete storage tank and distributing system. C. J. Donaldson of the Gearharz-Jaqueth Engineering Co. of Great Falls, Mont., is Engineer.

Nebraska.

The citizens of Columbus, Nebr., have voted the issuance of $10,000 in bonds for the installation of a water works system.

New York.

✣Bids will be received until 8 p. m., June 3, by Board of Water Commissioners, Olean, N. Y., for trenching, laying and back filling for water line construction in North 14th St. from State to Sullivan St., North 15th St. from State to Sullivan St., Queen St. from Crown to Prince St., South Eighth St. from Irving to Henley St., East Ave. from State to Tompkin St. Specifications on file at the office of said board.

✣Bids will be received until 10 a. m., June 14, by Quartermaster, Fort Porter, N. Y., for filtration plant and remodeling water distributing system at Fort Porter, N. Y.

The Village Board of Waterloo, N. Y., has granted the Waterloo Water Co. an exclusive franchise for 20 years. Provisions of the franchise call for the erection and maintenance of a mechanical pressure filter capable of furnishing 1,000,000 gals. of water each day.

The Common Council of Schenectady, N. Y., has authorized an expenditure of $280,000 from the water bureau surplus, for the improvement of the water system.

The Brightwaters Water Co., Inc., Islip-Boring, has been incorporated with a capital stock of $100,000. The incorporators are: T. B. Ackerson, C. F. Ackerson and H. W. Ackerson, Brightwaters, N. Y.

The taxpayers of Brockport, N. Y., have voted to purchase the plant of the Brockport-Holley Water Co., in Brockport for the sum of $60,750. Additions and improvements to the plant are contemplated.

Ohio.

✣Bids will be received until noon, June 5, by W. J. Springborn, Director of Public Service, Cleveland, O., for iron conduit for the water department. Each bid must be made in accordance with the specifications which may be obtained of the Superintendent of the Water Department. W. H. Kirby is Secretary.

✣Bids will be received until noon, June 3, by W. J. Springborn, Director of Public Service, Cleveland, O., for steam engine and generator for the Collinwood station of the municipal electric light plant of Cleveland, O. Each bid must be made in accordance with the specifications, which may be obtained at the office of the engineer of construction, at the office of the Engineer of Construction, Room 319, City Hall.

✣Bids will be received until noon, June 4, by Charles W. Stage, Director of Public Safety, Cleveland, O., for furnishing and installing a stoker for one 250-h.p. water tube boiler for the Infirmary Group, Cooley Farms, Warrensville, O. Each bid must be in accordance with the specifications, which may be obtained at the office of the Director of Public Safety, Room 109, City Hall. H. F. Stillman is Secretary.

✣Bids will be received until noon, June 4, by Director of Public Safety, C. W. Stage, Cleveland, O., for furnishing and constructing an ice machine for the Tuberculosis Sanatorium, Cooley Farms, Warrensville, O. Each bid must be in accordance with the specifications, which may be obtained at the office of the Director of Public Safety, Room 109, City Hall. H. F. Stillman is Secretary.

✣Bids will be received until noon, June 10, by S. A. Kinnear, Director of Public Service, Columbus, O., for furnishing 400 Idaho cedar winter cut poles, 138,000 ft. of tripe braided weatherproof solid wire, 4,400 K. V. A. single phase oil insulated water-cooled transformers, 6,600 primary and 2,200 secondary voltage; one steam-driven wet vacuum pump, and one steam-driven duplex condensate pump; one motor-driven centrifugal boiler-feed pump, and one auto truck for the municipal electric light plant in the city of Columbus.

The city of Piqua, O., has been granted authority to issue $60,000 in bonds to repair the present water works system.

The citizens of Bucyrus, O., have voted the issuance of bonds to the amount of $180,000 for the installation of a municipal water works plant.

Chief Engineer M. J. Bahin, Supt. George Cotter, of the water works department, and Harry Ernest, Springfield, O., have been making surveys for the proposed extensions to the water works system.

Plans have been prepared by Engineer H. L. Maddock, Newark, O., for the installation of a water works system in Pleasant City, O., at an estimated cost of $15,000. The work will include two deep wells, two deep well pumps, two 15-h.p. gas, oil or gasoline engines, 3,700 ft. of iron or wood pipe, 8,040 ft. of 6-in. mains, 3,500 2-in. mains, 19 hydrants, 88-in. valves, 16 6-in. valves, two brick pump houses, 800 4-in. cast iron or wood mains. Contracts will probably be let between June 10 and 20th.

Oklahoma.

⊙The contract for the construction of a water works and electric lighting system in Hinton, Okla., has been awarded to Don A. Tolbert of Ada, Okla., for $25,917. Bids were opened May 19. The Benham Engineering Co., American Nat. Bank Blg., Oklahoma City, Okla., is Engineer.

Oregon.

The Santiam Water Co., according to advices from Salem, Ore., has been incorporated with a capital stock of $300,000. The incorporators are: W. E. Pierce, Boise, Ida.; Charles Theis, Spokane, Wash., and John D. Turner, Salem, Ore. The principal offices will be at Salem. Salem and other valley towns will be supplied with water from the little north fork of the Santiam River.

Texas.

⊙J. H. Garrison & Sons, Garrison, Tex., have let a contract to J. W. Leterjette for the drilling of a deep water well which is preliminary to the establishment of a system of water works for fire protection and domestic use in the town.

⊙The Chicago Bridge & Iron Works, Praetorian Bldg., Dallas, Tex., has been awarded the contract by the State Normal Board of Regents, San Marcos, Tex., for the erection of a steel water tower, capacity 50,000 gals., 100 ft. high, cement foundation, 6-in. supply pipe to connect with well, for $4,600. Bids were opened May 8.

The City Council of Hallettsville, Tex., is considering the question of adopting a meter system for the water works.

The Edna Electric Light, Ice & Water Co., of Edna, Jackson County, Tex., has been incorporated with a capital stock of $20,000. The incorporators are: L. E. Ward, W. W. McCrory and Rudolph Linnartz.

The town of Kerens, Tex., is drilling for artesian water and will put in a sewer and water system.

Utah.

According to advices from Richfield, Utah, George C. Morrison plans the installation of a water works system to furnish water to the

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

farms lying under Cedar Ridge and Willow Creek canyons and to the people of Sigurd and Vermisson. Water will be secured from the Eversall spring at the forks of Willow Creek canyon and conveyed to the mouth of the canyon, a distance of three and one-half miles, in a 6-in. pipe, and there empty into a 50,000-gal. tank.

W. H. Korns, Commissioner of Water Supply and Water Works, Salt Lake City, Utah, has presented to the City Commission a recommendation that a special appropriation of $25,000 be made to continue work on the dams in Big Cottonwood canyon. Sylvester Q. Cannon is City Engineer.

Virginia.

✣Bids will be received until June 13, by Capt. W. W. Whiteside, Depot Quartermaster, Front Royal, Va., for constructing water and sewer system at that place.

The city of Harrisonburg, Va., contemplates the construction of an additional reservoir of 5,000,000 gals. The land has been purchased, but so far no other steps have been taken. The matter will probably be brought before the Council on June 3. J. H. Downing is Mayor.

Washington.

⊙N. A. Jones Construction Co., California Bldg., Tacoma, Wash., has been awarded the contract for the laying of water mains, for $8,000.

Wisconsin.

⊙W. D. Lovell of Minneapolis, Minn., has been awarded the contract by the village of Turtle Lake, Wis., for the construction of a water works system for $7,570. The work includes 80-ft. steel tank and tower, 4,822 ft. of 6-in. pipe laid in 8 ft. trench, 430 ft. of 4-in. pipe laid in 8 ft. trench, 10 4-in. fire hydrants, 7 valves with boxes and 4,410 lbs. of pipe specials. A. T. Thompson, Colfax, Wis., is Engineer. Bids were opened May 20.

⊙B. Hoffmann Mfg. Co., 257 Sixth St., Milwaukee, Wis., has been awarded the contract by that city for furnishing 125 6-in., 30 8-in., 20 12-in., 4 16-in. standard valves, 50 2-in., 30 3-in., 50 4-in. and 6 6-in. specials, for $5,849. Bids were opened May 19.

The citizens of Palmyra, Wis., at a recent election voted in favor of the construction of the proposed water works system. Plans and specifications have been prepared by Civil Engineer J. Rollin Gray, 803 Great Northern Bldg., Chicago, Ill.

Canada.

✣Bids will be received until noon June 12, by J. J. Carment, City Clerk, Kamloops, B. C., on water wheels, generators, exciters, transformers and switching equipment for the proposed hydro-electric power plant. Plans and specifications may be seen at the office of Du Cane, Dutcher & Co., Consulting Engineers, 915 Rogers Bldg., Vancouver, B. C.

✣Bids will be received until 4 p. m., June 23, by R. C. Desrochers, Secy., Department of Public Works, Ottawa, Ont., for the following works on the New Barracks property, Long Branch, near Toronto, Ont., viz.: (1) Water works pipe laying, (2) sewer pipe laying, (3) pump house, filter house and reservoir, (4) foundations for water tower, (5) steel water tower and supports, (6) water works intake pipe and well, (7) sewage pumping station, (8) sewage disposal works, (9) bridges or viaducts. Plans, specifications and forms of contract can be seen and forms of tender obtained at the office of Messrs. Chipman and Power, Engineers, Mail Bldg., Toronto, Ont., and at this department.

⊙Willoughby & Kelso, Main St., Winnipeg, Man., have been awarded the contract by the Board of Control of Winnipeg for the construction of conduit runs on Portage Ave., from Colony to Maryland Sts., for $13,881. Bids were opened May 12.

The rate payers of Medicine Hat, Alta., on May 15 passed by-laws authorizing the extension of the water works plant at a cost of $85,000, the purchase of fire apparatus, $17,000; fire halls, $67,000; water works system and extensions, $225,000.

The property owners of Wingham, Ont., on May 19 voted to raise $5,000 for the improvement and extension of the present water works system.

A bill is now before the House of Commons, Ottawa, Ont., authorizing the city of Ottawa to secure a supply of water from the Gatineau hills in Quebec province.

The rate payers of Coquitlam, B. C., have passed a by-law appropriating $100,000 for water works purposes. The first unit of the permanent water system to be established will connect with the New Westminster main from Coquitlam Lake on Pipe Line road. The mains will mostly be of 6-in. pipes with larger ones where needed. Forty hydrants will be established with the first unit of the system.

SEWERAGE AND SANITATION

Alabama.

⊙The Board of Revenue, Montgomery, Ala., has awarded a contract to Sullivan & Long for improvements on the main sanitary sewer at a point below Bessemer, Ala. The contract calls for work to cost about $4,279.

Arkansas.

✣Bids will be received until June 5 by Board of Commissioners of the Conway Sewer Improvement District, Conway, Ark., for the construction of the system. C. H. Burr is Engineer.

California.

City Engineer Homer Hamlin, of Los Angeles, Calif., has completed the plans for the proposed main sanitary sewer to be installed in the Maple Ave. Sewer District. In connection with this work it is proposed to establish a supplementary sewer in Los Angeles St., between Seventh St. and Winston St.

Governor Johnson of California has approved the bill drawn by City Attorney William J. Carr, of Pasadena, at the request of the San Gabriel Valley Inter-City Commission, authorizing the formation of public utilities districts. This is the second definite step taken towards providing the trunk line outfall sewer for that valley.

The City Council of Reedley, Calif., is perfecting a plan for installing a modern sewer system for the city. It is proposed to hold an election shortly to vote bonds in the sum of about $50,000 for the improvement.

Connecticut.

⊙C. H. Slocomb & Co. have been awarded the contract by the Board of Contract & Supply of Hartford, Conn., for the construction of a sewer in Terry road, for $19,827, and for a sewer in Broadview Terrace, for $2,875.

District of Columbia.

✣Bids will be received until May 31, by Chief Signal Officer, War Department, Washington, D. C., for furnishing under proposal No. 653, 200 manhole covers.

✣Bids will be received until May 31, by Commissioners of the District of Columbia, Washington, D. C., for furnishing one D. C. semi-enclosed 5 h. p. electric motor for the sewer division.

Florida.

The City Council of South Jacksonville, Fla., has asked the Legislature for permission to issue municipal bonds to the amount of $65,000. This money is to be used for improving the sewers, electric lighting plant and water works, as well as the building of a combination fire station and city hall.

The citizens of Miami, Fla., on May 13 voted the issuance of bonds to the amount of $170,000, to be divided among six departments, as follows: Street improvement, $60,000; sewers,, $40,000; fire department, $30,000; incinerators, $25,000; hospital, $10,000; parks and docks, $5,000.

Consulting Engineers Twombley & Alexander of New York City, have submitted plans and specifications to the City Council of Tampa, Fla., for the proposed new sewerage system. Ralph Martin is City Engineer.

Idaho.

An election will be held in Kellogg, Idaho, on June 16 for the purpose of voting on the issuance of bonds to the amount of $30,000 for the construction of sewers. The length and cost of the different sections of proposed sewers are: McKinley Ave. and laterals, 10,000 ft., $13,438; railroad trunk and laterals, 10,000 ft., $13,997; Sunnyside, 5,000 ft., $5,960; or a total of $46,734. It is proposed to construct all of these sewers this summer except the Sunnyside, Cowels, Papesh and Pressly laterals of the railroad trunk system. The estimated cost of the work to be done this summer is $30,000.

Illinois.

✣Bids will be received until 2 p. m., June 2, as noted in our last issue, by the Pawnee Construction Co., at the office of Alvord & Burdick, 1417 Hartford Bldg., Chicago, Ill., for the construction at Kincaid, Ill., of approximately 4½ miles of sanitary sewers, and 60,000 cu. yds. of street grading; estimated quantities as follows: 8-in. sewers, Commonwealth St., Ridge St. to Springfield St., 1,780 lin. ft.; cut 6.5 ft. Edison St., Springfield to Glenn St.; cut 7.8 ft. Prairie St., Richardson to Edison St., 510 lin. ft.; cut 6.3 ft., 2 manholes. Ash St., Beach to Edison St.; cut 4.3 ft., 350 lin. ft., 2 manholes. Richardson St., Ridge St. to alley north of Main St.; cut 7.7 ft., 1,711 lin. ft., 8 manholes. North St., Glenn St. to Ridge St.; cut 6.4 ft., 967 lin. ft. 4 manholes. Tower St., North, St. to Central St.; cut 6.9 ft., 700 lin. ft., 3 manholes. City Place, Glenn St. to Tower St.; cut 6.8 ft., 400 lin. ft., 2 manholes. Central St., Glenn to Main St.; cut 8.3 ft., 954 lin. ft., 5 manholes. Main St., Edison to Richardson St.; cut 6.9 ft., 510 lin. ft., 2 manholes. Springfield St., Edison to Market St.; cut 7.9 ft., 615 lin. ft., 2 manholes. Springfield St., Central St. to Park St.; 8.4 ft., 722 lin. ft., 3 manholes. Park St., Springfield St. to Edinborough St.; 7.3 ft., 760 lin. ft., 5 manholes. Market St., City Hall Court to Springfield St.; cut 12.7 ft., 348 lin. ft., 1 manhole. North St., Glenn St. to Main St.; cut 11 ft., 756 lin. ft., 5 manholes. State St., Main St. to Springfield St.; cut 14.3 ft., 560 lin. ft., 3 manholes. Main St., Richardson St. to North St.; cut 11.8 ft., 300 lin. ft., 1 manhole. Main St., Central to State St.; cut 15 ft., 409 lin. ft., 2 manholes. City Hall Court, State St. to Market St.; cut 15 ft., 380 lin. ft., 2 manholes. Sumit St., Main to Springfield St.; cut 10.1 ft., 869 lin. ft., 4 manholes. 12 sewers. Beach St., Commonwealth St. to Edison St.; cut 5.2 ft., 525 lin. ft., 4 manholes. Edinburg St., Sumit St. to Glenn St.; cut 7 ft., 877 lin. ft., 5 manholes. Edison St., Glenn to Beach St.; cut 14.7 ft., 491 lin. ft.,.3 manholes. Central St., Main St. to Springfield St.; cut 14.5 ft., 750 lin. ft., 5 manholes. Glenn St., Edinburg to Edison Sts.; cut 11.6 ft., 2,070 lin. ft.; 5 manholes. Glenn St., Edinburg to Edison St.; cut 11.6 ft., 2,070 lin. ft., 12 manholes. Main St., Summit to Central St.; cut 13.7 ft., 395 lin. ft., 2 manholes, 15-in. sewer. Summit St., Edinburg to Main St.; cut 11.4 ft., 434 lin. ft., 3 manholes. Edinhurg St., Park to Summit St.; cut 9.7 ft., 541 lin. ft., 4 manholes. Overflow sewer in Edinburg and Park Ave.; cut 6.7 ft., 1,530 lin. ft. All pipe to be vitrified tile pipe, concrete manholes. Plans and specifications may be seen at office of Alvord & Burdick, or the resident engineer.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Indiana.

✣Bids will be received until 4 p. m., June 2, by Board of Public Works, Terre Haute, Ind., for the construction of the following improvements: Sewer in South Sixth and One-half St., from Lincoln St. to Voorhees St.; sewer in South 17th St., from Orchard St. to Poplar St.; sewer in South 17th St., from Oak St. to College St.; sewer in South 17th St., from Putnam St. to Hulman St.; sewer in Sixth Ave., from Fourth St. to Second; alley east. Detail plans and specifications are now on file in the office of the Board of Public Works of said city and may be seen by all persons interested. W. A. Thornton is Secretary of the Board.

✣Bids will be received until 2 p. m., June 2, by Town Board of Trustees, Kirklin, Ind., for the construction of concrete sewer, including 1,800 ft. of 30-in., 400 ft. of 24-in., together with manholes. A certified check for $100 must be filed with each bid. C. W. Wright is Clerk.

✣Bids will be received until 10 a. m., June 5, by Board of Public Works, Richmond, Ind., for the construction of a sanitary sewer, a drop manhole and another sewer.

✣The Board of Public Improvements of Crawfordsville, Ind., F. G. McIntyre, Chairman, will receive bids until June 2, for the construction of a 36-in. sewer in Lafayette Ave., estimated to cost $4,000. The work will include manholes, inlets, etc. H. C. McClust is engineer.

⊙The Board of Public Improvements of Crawfordsville, Ind., has awarded the contract for the construction of a 24-in. sewer in Mill St., to Clements & Clements. The estimated cost is $4,000. Bids were opened May 19.

Iowa.

✣The City Council of Fort Dodge, Ia., has passed a resolution for sanitary sewers in the northeastern part of the city to be known as the "Northeast System." Bids on these sewers will be opened June 9. Work started June 20 and completed Aug. 10. Chas. H. Reynolds is City Engineer.

✣Bids will be received until noon, May 30, by A. R. Corey, Secretary, Des Moines, Ia., for 16,000 sq. ft. of 4-in. cement sidewalks and 960 ft. of 4-ft. concrete storm sewer.

⊙Wilmer Cook, 1699 Washington St., Dubuque, Ia., has been awarded the contract by that city, for the construction of an 8-in. tile pipe sewer in 22d St., from the alley between Washington and Jackson St., to the westerly line of Elm St., for $297. Bids were opened May 15.

Kansas.

⊙Morrison Bros., of Great Bend, Kan., have been awarded the contract for the installation of new outflow pipes from the sewer septic tank to the creek in Great Bend for $18,494.

Maine.

⊙The Selectmen of Sanford, Me., have awarded the contract for labor on the Roberts St. sewer extension to W. M. Ames of Berwick, at $0.55 per ft., all material to be furnished by the town. The improvement will cost about $8,000.

Engineer Roland W. Libby of Saco, Me., is preparing plans for the installation of a sewerage system in Biddeford, Me.

Massachusetts.

✣Bids will be received until 2:30 p. m., June 6, by the Metropolitan Water and Sewerage Board, 1 Ashburton Place, Boston, Mass., for constructing in earth trench and tunnel a 54-in. and 48-in. concrete sewer, Section 68 of the New Mystic Sewer, North Metropolitan System, in Winchester, from a point in Grove Place northerly through Grove Place, private lands and land of Commonwealth of Massachusetts, Mystic Valley Parkway and land of Town of Winchester to Pleasant St., in accordance with the forms of contract and specifications to be furnished by the Board. Some particulars are estimated to be as follows: Length of 54-in. sewer in trench, 600 ft.; length of 48-in. sewer in trench, 3,850 ft.; length of 48-in. sewer in tunnel, 180 ft.; length of vitrified pipe drains, 560 ft.; 60 cu. yds. of Portland brick masonry; 3,900 cu. yds. of concrete masonry in trench; 180 cu. yds. of concrete masonry in tunnel; 10,000 lin. ft. of spruce piles in place. Plans can be seen and specifications and forms of contract can be obtained at the above office. Each bid must be accompanied by a certified check for $3,000, payable to the Commonwealth of Massachusetts, and a bond in the sum of $25,000 will be required from the successful bidder. Frederick D. Smith, Engineer of Sewerage Works. William N. Davenport, Secretary of the Board.

The Town Board of Longmeadow, Mass., contemplates the installation of sewers. Walter Bliss is Town Clerk.

Michigan.

⊙John A. Mercier, of Detroit, Mich., has been awarded the contract by the Board of Public Works of Mt. Clemens, Mich., for the construction of the trunk sewer system, to include North Ave., Clemens and Church Sts.

The Board of Public Works of Mt. Clemens, Mich., has decided to install a branch trunk sewer system on Clemens St., for which $50,000 has been appropriated.

Minnesota.

✣Bids will be received until 8 p. m., June 16, by C. J. Stark, City Clerk, Ortonville, Minn., for the construction of a sanitary sewer system and sewage disposal plant in accordance with plans and specifications on file with C. J. Stark, City Clerk.

⊙H. J. Catheroe & Co., Omaha, Nebr., have been awarded the contract by the city of Austin, Minn., Oscar F. Weissgerber, City Engineer, for the construction of 3,240 lin. ft. of 10, 12 and 15-in. pipe sewers, at $2,168. Bids were opened May 23.

⊙The Pastoret Construction Co., of Duluth, Minn., has been awarded the contracts by the Board of Public Works of Chippewa Falls, Wis., for sewer work as follows: Jefferson Ave., $3,465; Main and Superior Sts., $2,085; Columbia St., $1,105.

Nebraska.

⊙The Offerman Construction Co., has been awarded the contract by the City Council of Omaha, Nebr., for the storm water sewer to be constructed between 28th Ave. and Chicago St. and 31st and Farnam Sts., for $15,481.

New Jersey.

✣Bids will be received until 3:30, May 28, by City Commission, Trenton, N. J., for the construction of sewers in a number of streets and avenues. Frank Thompson is City Clerk.

✣Bids will be received until 2 p. m., July 15, by Passaic Valley Sewerage Commissioners, Essex Bldg., Clinton St., Newark, N. J., for the construction of Section 1 of the Passaic Valley Sewer in New York Bay off Robbins Reef. Drawings, specifications, etc., may be obtained of W. M. Brown, Chief Engineer. Official advertisement will be found elsewhere in this issue.

⊙The Borough Council of Audubon, N. J., has awarded the contract for the installation of a complete sewerage system to the Cantrall Construction Co., of Philadelphia.

The Sewer Commission of Hammonton, N. J., has requested the City Council to appropriate $10,000 for carrying out the plans of the engineer for the proposed sewer system.

New York.

✣Bids will be received until noon, June 5, by J. A. Striker, Village Clerk, Mount Morris, N. Y., for the installation of a sewer system. Plans, specifications, etc., are on file with the Board. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 11 a. m., May 29, by O. H. Gardner, City Clerk, Elmira, N. Y., for the construction of the Roe Creek trunk sewer in accordance with plans and specifications on file at the office of T. A. Brown, City Engineer. The work will include 1,652 lin. ft. of 24-in. double strength vitrified tile and 84 lin. ft. of 24-in. c. i. pipe ¾ in. thick. A certified check for $500 must be filed with each bid.

✣Bids will be received until 2 p. m., June 10, by Watervliet Storm Sewer Commission, J. D. Brown, President, Watervliet, N. Y., for the completion of one earth filled dam and one concrete dam across Dry River, together with overflow and outlet works, concrete and brick conduits and storm drains, and other appurtenances. The work will consist of approximately 58,000 cu. yds. of earth fill, concrete overflow and outlet works, concrete dam about 26 ft. high at spillway elevation, together with 6,000 lin. ft. of concrete conduit, from 6 ft. to 8 ft. 6 in. diameter, and 1,000 ft. of terra cotta sewer pipe. Each proposal must be accompanied by a certified check payable to the Watervliet Storm Sewer Commission, to an amount equal to 5 per cent of the bid as a guarantee that the contract will be entered into if awarded. A bond of 50 per cent of the contract price will be required. Payments will be made in cash on monthly estimates. Plans and specifications are on file at the office of the Watervliet Storm Sewer Commission, and also at the office of Solomon, Norcross & Keis, Engineers, 1622 Candler Bldg., Atlanta, Ga.

⊙Frank Custurer, 204 Davis St., Rochester, N. Y., has been awarded the contract by the Commissioners of Sewer District No. 2, Greece, N. Y., for the laying of 4,700 lin. ft. of 8-in. sewer, 3,300 lin. ft. of lateral sewer and 11 manholes, for $7,774. R. E. Gaskin, 20 Trust Bldg., Rochester, N. Y., is engineer. Bids were opened May 16.

⊙The Board of Public Works of Fulton, N. Y., has awarded the contract for the construction of the city sewer to E. J. Schem.

⊙Nash, Robinson & Griffin, of Norwich, N. Y., have been awarded the contracts by the Board of Sewer Commissioners of that city, for the construction of sanitary sewers on Pleasant, Plymouth, Beach, Canasawacta, Wait, State and Berry Sts., and for repairing of the South Bend St. sewer, for $7,838.

⊙The Board of Contract & Supply of Schenectady, N. Y., has awarded improvement contracts for the sluice gates for the sewage disposal system to the Chapman Valve Co., of Indian Orchards, Mass., for $2,052. The contract for valves was awarded the Ludlow Mfg. Co., of Troy, N. Y., for $455.

⊙A. L. Burton & Sons have been awarded the contract by the Board of Public Works of Watertown, N. Y., for the construction of the Moulton St. sewer, for $1,377.

North Dakota.

⊙George W. Kemper of Minot, N. Dak., has been awarded the contract by that city, E. J. Thomas, City Engineer, for the construction of one mile of storm sewer, for $16,800. Bids were opened May 19.

Ohio.

✣Bids will be received until noon (standard time), June 10, by S. A. Kinnear, Director of Public Service, Columbus, O., for furnishing the labor and material for the construction of the southern relief sewer, in accordance with plans and specifications on file with the Chief Engineer and with the Director. All bids will be compared on the basis of the Engineer's estimate of the quantities of work to be done, as follows: Main Line, Scioto River to Oakwood Ave.—Item 1. Sta. 0 to Sta. 13+08 96-in. sewer, 1,308 lin. ft. Item 2. Sta. 13+08 to Sta. 20+34 72-in. sewer, 726 lin. ft. Item 3. Sta. 20+34 to Sta. 46+15 90-in. sewer, 2,581 lin. ft. Item 4. Sta. 46+15 to Sta. 75+96 72-in. sewer, 2,981 lin. ft. Item 5. Sta. 75+96 to Sta. 104+00 60-in. sewer, 2,804 lin. ft. Item. 6. Sta. 104+00 to Sta. 111+08 48-in. sewer, 708 lin. ft. Item 7. Sta. 111+08 to Sta. 122+65 36-in. sewer, 1,157 lin. ft. Peters Run Branch—Item 8. Sta. 0 to Sta. 28+00 72-in. sewer, 2,800 lin. ft. Sixth St. Branch—Item 9. Sta. 0 to Sta. 4+50 48-in. sewer, 450 lin. ft. Wager St. Branch—Item 10. Sta. 0 to Sta. 10+87 36-in. sewer, 1,087 lin. ft. Gilbert St. Branch—Item 11. Sta. 0 to Sta. 7+15 48-in. sewer, 715 lin. ft. Item 12. Standard manholes, 53. Item 13. Special manholes, 6. Item 14. Brick repaving, 5,100 lin. ft. Item 15. Asphalt repaving, 485 lin. ft. Item 16. Cobble stone repaving, 1,520 lin. ft. Item. 17. Concrete outlet at river, lump sum. Item 18. Intercepting chamber at "B," lump sum. Item 19. Intercepting chamber and connection at "F," lump sum.

✣Bids will be received until noon, May 28. by V. T. Price, Director of Public Service, Cincinnati, O., for the construction of main and lateral sewers and drains, with their appurtenances, in Carr St., from Budd St. to West Sixth Ave. Plans, specifications and blank proposals can be obtained at the office of the Chief Engineer, Department of Public Service.

✣Bids will be received until noon, May 28, by V. T. Price, Director of the Public Service, Cincinnati, O., for the construction of main and lateral sewers and drains, with their appurtenances, in Wilkinson St., from Symmes St. to alley west of Fowler St., and Fowler St., between Wilkinson St. and Burbank St. Plans, specifications and blank proposals can be obtained at the office of the Chief Engineer, Department of Public Service.

⊙Kenneth Allen, Civil Engineer for the Village of Oakwood, O., has awarded the contract for the construction of 3,500 ft. of sanitary sewer mains in the Park Hillis plat to Charles F. Smith, Youngstown, for $3,800.

⊙William Strachan, North Maple St., Lancaster, O., has been awarded the contract by the Department of Public Service of that city, for the construction of 11 sewers in Storm Water Districts Nos. 1 and 4. Bids were opened May 6.

⊙H. W. Ralston, Mt. Vernon, O., is the probable contractor for grading, piping and concrete work for sewage treatment plant at Bedford, O. The bid was $6,200. Bids were opened May 22.

Oklahoma.

⊙J. S. Terry Construction Co., Poteau, Okla., has been awarded the contract by the Board of Trustees, Caddo, Okla., for the installation of a sewerage system, for $28,017. The work includes 22,000 ft. of 6-in., 5,800 ft. of 8-in., 3,100 ft. of 10-in., 1,250 ft. of 12-in., 2,200 ft. of 15-in., 500 ft. of 24-in., and 800 ft. of 30-in.; one septic tank and contact beds. Bids were opened May 15. J. Davis is city engineer.

The citizens of Watonga, Okla., on May 16 voted the issuance of bonds to the amount of $35,000 for a sanitary sewer system and disposal plant. Plans and specifications are being prepared by the Benham Engineering Co., American Nat. Bank Bldg., Oklahoma City, Okla.

Pennsylvania.

✣Bids will be received until 6 p. m., June 2, by Leo McDermott, Secretary, Borough Council, Winton, Pa., for the erection and construction of a sewer system in the Borough of Winton, to be known as "Sections 2, 3, and 4 of the sanitary sewer system," according to plans, profiles and specifications prepared by Joseph R. Murphy, Civil Engineer.

✣Bids will be received until 2 p. m., June 4, by Board of Public Works at the office of L. S. Ramsey, City Clerk, Reading, Pa., for the construction of two concrete storm sewers, known as the West Elm St. Relief Sewer; and the North Sixth and Third St. Sewer and branches. The former consists of about 2,400 lin. ft. of concrete sewer and 400 lin. ft. of vitrified pipe branch sewer; the latter consists of about 4,200 lin. ft. of concrete sewer and 3,500 lin. ft. of vitrified pipe branch sewers. The above work is divided into 2 contracts, namely: (1) West Elm St. Relief Sewer; (2) North Sixth St. and Third St. Sewer. Each bid must be accompanied by a proposal bond or certified check for the sum of $2,000. D. B. Ulrich is City Engineer.

✣Bids will be received until June 4 (postponement of date from May 21), by Board of Public Works, Reading, Pa., for the construction of the storm water sewer in North Sixth St., and in West Elm St.

✣Bids will be received until 6 p. m., June 3, by J. M. Simeral, Secretary of the Council, 26 S. Harrison Ave., Bellevue, Pa., for constructing a system of drains on the west side of Rodgers Ave., from Maryland Ave. to a point about 600 ft. south therefrom. Approximate quantities: 850 ft. 8-in. sewer, 5 manholes, 1,000 yds. excavation, 340 cu. yds. gravel. Also for sub-grading and paving S. Harrison Ave., from Jefferson St. to Division St. Approximate quantities: 320 cu. yds. grading, 800 sq. yds. paving. Certified check for $100 to accompany proposal on each contract. Plans and specifications can be seen and bidding blanks obtained at the office of the Borough Engineer, John McBride, room 313 Fitzsimons Bldg., Pittsburgh, Pa.

The City Council of Wyomissing, Pa., has passed an ordinance for the laying of sewers on Penn Ave., and may vote for spending $20,000 to repair some of the streets.

Bids were received as follows by the Borough Council of West Chester, Pa., for the construction of the proposed intake sewer system to connect with the sanitary sewer line to the disposal plant near Eachus' Mill, West Goshen Township: M. & T. E. Farrell, $13,350; E. H. Oliver, $14,975.

Plans are being prepared by Consulting Engineer Geo. W. Fuller, 170 Broadway, New York City, for the construction of a sewage disposal plant and outfall sewer in Altoona, Pa. Franz Engstrom is City Engineer.

Tennessee.

✣Bids will be received until noon, June 3, by Ennis M. Douglass, City Clerk, Memphis, Tenn., for the construction of a garbage crematory of 50 tons daily capacity. Each bid must be accompanied by a certified check in the sum of $250 on some good and solvent bank in the city of Memphis as a guarantee of good faith on the part of the bidder. General specifications for this crematory can be seen or procured at the office of Dan C. Newton, Building Commissioner.

Texas.

The Town of Kerens, Texas, plans the installation of sewer and waterworks systems.

The citizens of Hamilton, Tex., have voted bonds in the sum of $6,000 for the construction of sewers.

Utah.

⊙The City Commission of Salt Lake City, Utah, has let the contract for the construction of the sewer extension on Canyon Road to the Gilkerson Construction Co., for $5,114.

Heuser & Sim, Salt Lake City, Utah, submitted the lowest bid on May 10 to Maj. Willis Uline, Quartermaster, Fort Douglas, Utah, for the construction of a sewer system at that post. The bid was $5,600.

Vermont.

The Village of Bellows Falls, Vt., has adopted the report of Engineer E. A. W. Hammatt of Hyde Park, Mass., regarding improvements to the sewer system by building the additional or relief sewer on the west side of Atkinson St., from South St. to Earle St.; enlarging the brick sewer on Earle St.; build an outfall sewer at the river to care for Granger and Barker Sts. and the main sewers; to enlarge the sewer on Atkinson St., between School and Oak to 20 ins., and put a new one on Oak St. extension, between Church Pl. and Atkinson St. The sum of $20,000 has been appropriated for the work.

Virginia.

✣Bids will be received until 3 p. m., June 17, by Mayor and Councilmen, Pulaski, Va., for furnishing material and constructing a system of sewers in said town The work to be let consists of furnishing material and laying complete about ten miles of 6-in. to 18-in. vitrified sewer pipe and constructing complete the necessary manholes and flush tanks. Plans and specifications will be on file in the City Engineer's and Mayor's office and may be obtained for proposal purposes upon a deposit of $7.50. Certified check, $1,000. M. S. Hudgins is City Engineer.

Plans have been prepared for the construction of a new sewer system in Appalachia, Va., to cost approximately $20,000. Contract will be let as soon as bonds are disposed of.

The City Council of Pulaski, Va., has adopted plans for a sewerage system. Bonds to the amount of $50,000 were voted for this improvement some time ago. Bids for construction work will shortly be asked.

The citizens of Appalachia, Va., at a recent election voted an appropriation of $21,000 for the building of a sewer system in connection with the waterworks, on which work is now under way.

Washington.

⊙The Washington Paving Co., of Tacoma, Wash., has been awarded the contract by the City Council of Sumner, Wash., for sewers in District No. 8, at $11,055. The contract includes the first unit of a combination sanitary and storm sewer system which, when completed, will drain an area of approximately 70 acres.

⊙The Northwest Municipal Construction Co., Realty Bldg., Spokane, Wash., has been awarded the contract at New Westminster, B. C., for the installation of 12,000 ft. of sewers, for approximately $70,000.

Wisconsin.

⊙C. H. Hughes, Rockford, Ill., has been awarded the contract by the City Council of Evansville, Wis., for the laying of 6,198 ft. of storm and sanitary sewers, for $8,000. Bids were opened May 22.

⊙Robert Bernett, of Fond du Lac, Wis., has been awarded the contract by the Village Board of North Fond du Lac, for the construction of the Harrison St. sewer, at $0.49 a ft., and $25 for manhole.

⊙S. A. Riches has been awarded the contract by the Board of Public Works of Superior, Wis., for the building of lateral sewers at Billings Park, for $22,706. Other bidders were: Russell Construction Co., $27,500; Peterson & Holm, $24,892; Pastoret Construction Co., all vitrified pipe, $23,990; part vitrified pipe and part clay blocks, $22,991; Peter Johnson, $27,892.

BUILDINGS

California.

✣The Board of Public Works of San Francisco, Cal., will open bids on June 11 on structural steel for the new city hall. About 7,000 tons will be required, estimated to cost $500,000.

✣Bids will be received until 3 p. m., June 30, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction, complete (including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures, and approaches, of the United States postoffice at Grass Valley, Calif. The building is to be one story high with a mezzanine and basement and will have a ground area of approximately 4,900 sq. ft., fireproof construction except roof; stone and stucco facing; tile and tin roof. Drawing and specifications may be obtained from the custodian of site at Grass Valley, Cal., or at the discretion of the Supervising Architect.

District of Columbia.

✣Bids will be received until noon, June 20, by Maj. W. J. Barden, U. S. Engineer, Washington Barracks, D. C., for the construction of ponton shed No. 3 at Washington Barracks, D. C.

✣Bids will be received until 2 p. m., June 5, by Secretary of Interior, Washington, D. C., for the necessary labor and material required for furnishing one 350 K. W. engine and generator, installation of water tube boiler and mechanical stoker and for relocating, extending and connecting switchboard in engine room of Old Post Office Bldg., Washington.

Bids will be received until June 7 by Chief Signal Officer, War Department, Washington, D. C., for furnishing the following 20,000 ft. rubber-covered wire, 30,000 ft. pothead wire, 10,000 ft. twisted pair bridle wire, 5,000 ft. single bridle wire, 50 miles G.-I. wire, 85,000 ft. house wire, 10,000 ft. type 413 cable, 3,000 ft. type 418 cable, 10,000 ft. type 411 cable, 5,000 ft. type 417 cable, 50 miles G.-I. wire, 10,000 ft. type 213 cable, 35,000 ft. type 321 cable, 6,000 ft. type 324 cable, 18,000 ft. type 327 cable, 10,000 ft. type 401 cable, 6,000 ft. type 403 cable, 10,000 ft. type 407 cable, 3,000 ft. type 408 cable, 10,000 ft. type 409 cable, 1,000 ft. type 624 cable, 1,000 ft. type 644 cable and 5,000 ft. type 325 cable. For further information address W. L. Clark, maj., signal corps, U. S. A., disbursing officer.

Illinois.

✣Bids will be received until 11 a. m., June 4, for the construction complete, except plumbing and sewerage work, of a one-story field house, Northwestern Playground, Larrabee and Alaska Sts., for the special Park Commission. Cash or certified check for $150 must accompany proposal. L. E. McGann, Commissioner of Public Works, Chicago, Ill.

✣Bids will be received until 11 a. m., June 4, by the Department of Public Works, for doing all plumbing and sewer work required for new field house at Northwestern Playground, Larrabee and Alaska Sts. Cash or certified check for $100 must accompany proposal. Plans and specifications may be had upon application to L. E. McGann, Commissioner of Public Works, Chicago, Ill.

✣Bids will be received until 11 a. m., June 4, by the Department of Public Works for the construction of shelter and sand court houses at the Dante Playground, Desplaines and Ewing Sts. Cash or certified check for $150 must accompany proposal. Plans and specifications may be had upon application to L. E. McGann, Commissioner of Public Works, Chicago, Ill.

Indiana.

✣Bids will be received until 11 a. m., June 23, by Board of St. Joseph County Commissioners, South Bend, Ind., for the construction of a public comfort station in accordance with plans and specifications on file with Clarence Sedgwick, County Auditor.

✣Bids will be received until 10 a. m., June 11, by H. R. Perry, Depot Quartermaster, Jeffersonville, Ind., for furnishing and installing two 75 h.p. tubular high pressure boilers with Dutch ovens.

Iowa.

✣Bids will be received until noon, June 17, by A. R. Corey, Secretary, Des Moines, Ia., for the erection and completion of a brick Women and Children's Building, 144x248 ft. on the Iowa State Fair Grounds, in accordance with plans and specifications prepared by O. O. Smith, Architect, No. 606 Youngerman Bldg., Des Moines, Ia. Plans and specifications may be seen after June 7th at the Architect's office.

Maine.

✣Bids will be received until 3 p. m., July 1, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures, hydraulic mail lift, and approaches, of the United States postoffice at Camden, Me. The building is to be of one story and basement, and has a ground area of approximately 4,100 sq. ft.; fireproof construction, except roof; granite and brick facing; and tin roof. Drawings and specifications may be obtained from the custodian of site at Camden, Me., or at the discretion of the Supervising Architect.

New Jersey.

✣Bids will be received until 3 p. m., June 16, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for one electric elevator and one hydraulic lift in the United States postoffice, Jersey City, N. J., in accordance with the drawings and specifications, copies of which may be had at the discretion of the Supervising Architect.

Ohio.

✣Bids will be received until noon, June 16, by Board of Commissioners for the erection of the Lima State Hospital, G. E. Whitney, Secy., at the office of F. L. Packard, Columbus, O., for the furnishing of the materials and performing the labor necessary for the Machine Shop Building and Equipment, at the Lima State Hospital, Lima, O., according to the plans, descriptions, bills, estimates and specifications, prepared by Frank L. Packard, Architect, Columbus, O., and which are on file at the office of the Architect, New Hayden Bldg., Columbus, O., and at the Lima State Hospital Grounds, near Lima, O., and open to public inspection during all business hours until the date fixed for opening the bids.

South Carolina.

✣Bids will be received until 4 p. m., June 4, by Board of Trustees of Walhalla School District, E. L. Herndon, Chairman, Walhalla, S. C., for the erection of addition of four class rooms and auditorium to the Graded School Building. Plans may be seen at the office of the chairman of the board, E. L. Herndon, Walhalla, S. C., and at the offices of Sayre & Baldwin, Architects, Anderson, S. C. Individual copies of plans and specifications may be procured by any contractor desiring to bid by depositing $5 with the architects to guarantee the safe return of the same.

South Dakota.

✣Bids will be received until 2 p. m., June 24, by Commissioner of Indian Affairs, Washington, D. C., for furnishing the labor and materials necessary for the erection of a brick hospital at Canton Indian Insane Asylum, S. Dak.

✣Bids will be received until 2 p. m., June 18, by Commissioner of Indian Affairs, Washington, D. C., for furnishing the labor and material for the erection of a brick hospital, addition to brick laundry, addition to brick mess hall and additions to two brick dormitories at the Pine Ridge Indian School, South Dakota.

Tennessee.

✣Bids will be received until 3 p. m., July 2, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction, complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures, and approaches, of the United States postoffice at Springfield, Tenn. The building is to be two stories high, with a basement, and will have a ground area of approximately 4,130 sq. ft.; nonfireproof construction; stone and brick facing; terra-cotta cornice; tin roof. Drawings and specifications may be obtained from the custodian of site at Springfield, Tenn., or at the discretion of the Supervising Architect.

Texas.

✣Bids will be received until 3 p. m., June 27, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction, complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, and interior lighting fixtures, of the United States postoffice at Hillsboro, Tex. The building is to be approximately 4,350 sq. ft. in ground area; one story and mezzanine, faced with stone and granite to first floor with brick above, terra-cotta trimming and tile roof; the first floor only is of fireproof construction. Drawings and specifications may be obtained from the custodian of site at Hillsboro, Tex., or at the discretion of the Supervising Architect.

Virginia.

✣Bids will be received until 3 p. m., June 28, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction, complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures, and approaches, of the United States postoffice at Bedford City, Va. The building is two stories and basement and has a ground area of approximately 4,240 sq. ft. Nonfireproof construction, stone and brick facing, and composition roof. Drawings and specifications may be obtained from the custodian of site at Bedford City, Va., or at the discretion of the Supervising Architect.

Canada.

✣Bids will be received until 11 a. m., June 5, by Chairman Board of Control, Winnipeg, Man., at the office of M. Peterson, Secy., for furnishing labor and material for the construction of an extension to the Power Terminal Station. Instructions to bidders, plans, specifications and form of tender may be obtained at the office of the City Light and Power Department, 54 King St.

RIVERS AND HARBORS

Alabama.

✣Bids will be received until noon, June 20, by Maj. Earl I. Brown, U. S. Engineer, Montgomery, Ala., for lock gates, filling and emptying valves, gate maneuvering gear, etc.

District of Columbia.

✣Bids will be received until Noon, Aug. 4, by Josephus Daniels, Secy., Navy Department, Washington, D. C., for constructing six torpedo boat destroyers Nos. 57-62.

✣Bids will be received until 10:30 a. m., July 21, by Maj. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for two lock-entrance floating caissons and their equipment.

✣Bids will be received until 10:30 a. m., June 10, by Maj. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for electric hoists, wire rope, nails, tacks, nuts, cable clips, hammers, hasps, taps, shovels, buckets, cocks, hand oilers paint brushes, packing hose, candle wicking, twine, sash cord, railway flags, bedroom mats, rules, seacoal facing and switch ties.

Kentucky.

⊙Henry Bickel Co., Louisville, Ky., has been awarded the contract at $656,095 for widening the Louisville and Portland canal. Bids on this work were opened March 26 by the U. S. Engineer at Louisville, Ky.; the unit bids were given in our April 9 issue.

Louisiana.

✣Bids will be received until 7:30 p. m., June 20, by Mayor and Town Council, Mandeville, St. Tammany Parish, La., for the furnishing of all materials and constructing a timber sea wall and for the filling with earth the area between the said sea wall and the edge of the beach. Plans and specifications will be furnished by the Mayor at Mandeville, La., on receipt of a deposit of $10. W. G. Davis is Mayor.

Maryland.

✣Bids will be received until 11 a. m., June 21, by Bureau of Yards and Docks, Navy Department, Washington, D. C., for a sea wall at the engineering experiment station, Annapolis,

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Md. The amount available for the work is $50,000.

✣Bids will be received until 11 a. m., June 14, by Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., for timber bulkhead and wharf at the U. S. Naval Academy rifle range, Annapolis, Md.

Michigan.

⊙Park Board of Detroit, Mich., has awarded a contract to W. M. Murphy, 1737 Selby Ave., Detroit, at about $6,000, for constructing a 50-ft. dock at Phalen Park.

Bids as follows, price per cu. yd., scow measurement, were received May 10 by Lt. Col. Mason M. Patrick, U. S. Engineer, Detroit, Mich., for dredging harbor at Cheboygan, Mich.: Greiling Bros., Co., Green Bay, Wis., 14¾ cts.; Arthur H. Vogel, Milwaukee, Wis., 197 cts.; Great Lakes Dredge & Dock Co., Chicago, Ill., 22 cts.

Minnesota.

✣Bids will be received until noon, June 13, by Capt. E. D. Peek, U. S. Engineer, Duluth, Minn., as noted in our May 21 issue, for dredging in Duluth-Superior Harbor. The work proposed consists in dredging a triangular-shaped area of about 34 acres at the southerly end of the projected extension of Duluth Harbor Basin, to a minimum depth of about 22 ft. low water datum. The present depth of the area to be dredged averages about 7.2 ft. The northerly side of this area is about 600 ft. southerly from the Peavey Elevator wharf and lies at about right rangles to Rice's Point Channel. The westerly side lies along the easterly side of Rice's Point Channel. The work may be done either by the hydraulic process or by dipper dredges, or by both methods. The conditions are believed to be especially favorable for hydraulic work, to the extent of room available for discharging the material within the harbor lines, but a considerable portion of the material may have to be taken out into the lake in dump scows. The material is believed to be clear sand, rather fine in grade, with a thin layer of mud over it in places. The estimated quantity is 925,000 cu. yds., scow measurement.

✣Bids will be received until noon, June 3, by Capt. E. D. Peek, U. S. Engineer, Duluth, Minn., for dredging in Portage River harbor. The area to be dredged has a width of 250 to 300 ft. and a length of 1,100 ft. Some of this area will be shallow digging, near the channel, and some of it will be in marshy land. It will include the dredging away of the remains of the Edgerton Dock, after the warehouse and timber of value are removed, and possibly the base of the Rear Range Light consisting of a rock filled timber crib and a small amount of cellar cement work, and some pile revetment just to the south of the range light. The total estimated quantity of material to be removed under the project for constructing the harbor is 986,000 cu. yds., scow measurement.

✣Bids will be received until noon, June 3, by Capt. E. D. Peek, U. S. Engineer, Duluth, Minn., for dredging at Superior Entry, Duluth-Superior Harbor. The material to be removed is believed to be soft fine sand for the most part. The estimated quantity is 268,500 cu. yds., scow measurement.

New Jersey.

⊙Bay Dredging & Constructing Co., Brooklyn, N. Y., has been awarded the contract at $57,654 for erection of jetties at Shark River for the State Geological Survey. The work calls for a 1,950 ft. jetty and a 750 ft. jetty, both of reinforced concrete. The other bids on the work were as follows: Herbert O. Gardner, Asbury Park, $59,907; P. J. Monahan, South Amboy, $60,474; F. W. Schiers Jr., New York, $64,531; MacArthur Concrete Pile & Foundation Co., New York, $64,649; Young & Hyde, Inc., New York, $67,199.

New York.

✣Bids will be received until Noon, June 23, by Col. S. W. Roessler, U. S. Engineer, Army Bldg., New York City for (a) enlarging extending and repairing two stone jetties and (b) for dredging in the harbor, each at Mattituck, Long Island, N. Y.

✣Bids will be received until 11 a. m., June 21, by Col. J. G. Warren, U. S. Engineer, 540 Federal Bldg., Buffalo, N. Y., for dredging outer harbor and dredging and rock excavation in lake approach to north entrance, Buffalo Harbor, N. Y.

⊙The Great Lakes Dredge & Dock Co., Buffalo, N. Y., has been awarded the contract for constructing a pile and timber dock at Hamburgh St., on the Buffalo River at Buffalo, for the Pennsylvania R. R. It will cost about $50,000.

North Carolina.

✣Bids will be received until noon, June 18, by Maj. H. W. Stickle, U. S. Engineer, Wilmington, N. C., for furnishing and delivering about 688,690 ft. B. M. long leaf yellow pine lumber for construction of a dam in the Cape Fear River, at Kings Bluff, N. C. Kings Bluff is 39 miles by river above Wilmington, N. C. Vessels drawing not more than 7 ft. of water can navigate the river from Wilmington to the dam site.

Ohio.

✣Bids will be received until 10 a. m., June 12, by Maj. Chas. S. Bromwell, U. S. Engineer, Cleveland, O., as noted in our last issue, for dredging Toledo Harbor, O. The locality to be dredged is the channel from a point 7,600 ft. west of west light, Maumee Bay, Straight Channel Range through Maumee Bay to red gas buoy No. 34 at the mouth of the river near the city of Toledo, or such portion of this channel as it may be practicable to dredge with funds available. This channel is 400 ft. in width and approximately 3 miles in length; it is divided into sections each 800 ft. long, and containing about 77,000 cu. yds scow measurement. As estimated the total quantity of material to be removed is about 1,344,000 cu. yds., scow measurement. The work to be done is the dredging of the channel, heretofore dredged 400 ft. wide throughout, as required to remove any fill and to lower the bottom of the original channel about 2 ft. to the depth of 23 ft. at mean lake level of 1860-1875. The material to be removed is believed to be clay overlaid with sand and silt.

Pennsylvania.

✣Bids will be received until noon, June 25, by Lt. Col. Joseph H. Kuhn, U. S. Engineer, 815 Witherspoon Bldg., Philadelphia, Pa., for dredging in Delaware River, on Schooner Ledge lighthouse range. The area proposed to be dredged is located on the new Schooner Ledge lighthouse range in Delaware River, about 20 miles below Philadelphia The area will be divided into three sections: Section A—Dredging will extend from station 111, opposite the Sharpless wharf at Chester, Pa., to station 116+172 at the lower end of upper Schooner Ledge lighthouse range, a length of 5,172 ft. The estimated quantity of material to be removed from this section is 1,575,000 cu. yds. Section B—Dredging will extend from the lower limits of Section A, at station 116+172, to station 129+456, at the boundary line between the States of Pennsylvania and Delaware, a length of 13,284 ft. The estimated quantity of material to be removed from this section is 2,540,000 cu. yds. Section C—Dredging will extend from the lower limits of Section B, at station 129+456, to station 144+021, at a point opposite the lower end of the present Schooner Ledge lighthouse range, a length of 14,585 ft., and will include the widening of the bend at the junction of Schooner Ledge and Bellevue lighthouse ranges to 1,000 ft. The estimated quantity of material to be removed from this section is 2,730,000 cu. yds. The work will consist in the excavation of a channel having a bottom width of 800 ft. in the straight reaches, a bottom width of 1,000 ft. at the junction of Schooner Ledge and Bellevue lighthouse ranges; a depth of 35 ft. at mean low water; and a total length of 33,041 ft. The depth of cutting will vary from nothing to about 15 ft. in section A; from about 1 ft. to about 13 ft. in section B, and from nothing to about 12 ft. in section C, except in a few small isolated areas. A channel 600 ft. wide and 30 ft. deep at mean low water was dredged previously over that part of the present Schooner Ledge lighthouse range included in the area covered by these specifications. Award of contract will be made separately for each of the sections. The material to be excavated is believed to be mainly mud, or mud with an admixture of fine sand, except over small areas at the lower end of section A, the upper end of section B, and the lower end of section C, where sand, clay, gravel, cobbles, and some boulders may be encountered.

Tennessee.

✣Bids will be received until noon, June 23, by Maj. E. M. Markham, U. S. Engineer, Custom House, Memphis, Tenn., for furnishing and delivering three ice and refrigerating plants, complete.

Texas.

✣Bids will be received until noon, June 20, by Maj. T. H. Jackson, U. S. Engineer, Dallas, Texas, for jetty work at Sabine Pass.

The Blodgett Construction Co., Galveston, Tex., was the only bidder for building a creosoted pile bulkhead near Port O'Connor, Tex., bids for which were opened May 20, by S. M. Wilcox, U. S. Assistant Engineer, Galveston, Tex. The bid was as follows: Constructing creosoted timber bulkhead, 1,800 lin. ft., $7.39 per lin. ft.; furnishing and placing 30 tons riprap, $4.60 per ton; total, $13,440.

Washington.

✣Bids will be received until 2 p. m., June 3, by Board of King County Commissioners, Seattle, Wash., for furnishing material and labor (Chinese and Jap labor not allowed) for the construction of the Dumas Day dock in accordance with plans and specifications on file with the County Engineer.

⊙Puget Sound Bridge & Dredge Co., Central Bldg., Seattle, Wash., has been awarded the contract at 12 cts. per cu. yd. for dredging in Coos Bay. The contract amounts to about $200,000.

Wisconsin.

✣Bids will be received until 3 p. m., June 16, by Lieut. Col. George A. Zinn, U. S. Engineer, Milwaukee, Wis., for building reinforced concrete caisson breakwater and pile pier, removing old pier and dredging at Sheboygan, Wis.

⊙C. H. Starke Dredge & Dock Co., Milwaukee, Wis., has been awarded the contract at $17,874 for constructing a 200 ft. extension timber breakwater at Kinick River inlet for the city of Milwaukee. Bids were opened May 19.

Canada.

✣Bids will be received until noon, June 16, by Adam Beck, Chairman, Hydro-Electric Commission, Continental Life Bldg., Toronto, Ont., for the construction of a concrete dam and reinforced concrete power-house at Wasdell's Falls, on the Severn River. Plans and specifications may be seen at the office of the Commission, and copies of same obtained upon receipt of certified check for $5, to be held by Commission until said plans and specifications are returned, either with or without a tender. W. W. Pope is Secretary.

✣Bids will be received until 4 p. m., June 23, by R. C. Desrochers, Secy. Department of Public Works, Ottawa, Ont., for the construction of a dry dock at Lauzon, in the county of Levis, Que. Plans, specification and form of contract can be seen and forms of tender obtained at this Department and at the offices of C. E. W. Dodwell, Esq., District Engineer, St. John, N. B.; Chas. Chapais, Esq., District Engineer, Post Office, Quebec; J. L. Michaud, Esq., District Engineer, Post Office, Montreal District Engineer's Office, Confederation Life Bldg., Toronto; H. J. Lamb, Esq., District Engineer, Windsor Ont.; W. Z. Earle, Esq., District Engineer, Ashdown Bldg., Winnipeg, and on application to the Postmaster at Lauzon, Que.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ENGINEERING AND CONTRACTING

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and to Methods and Cost of Construction

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Veto of the Oklahoma Full Crew Bill.

Public service commissions are a comparatively new thing and the habit of corporation regulation directly by statute is old. It is not surprising, therefore, that legislators continue this year to make laws against specific abuses to remedy which they last year legislated into being a public service commission. Three weeks ago we noted as examples that the states of New York and New Jersey had enacted "full crew" laws despite the fact that both states have public service commissions clothed with full authority to handle just such matters of railway operation. Still another example of similar disregard comes from the Legislature of Oklahoma. A full crew bill was recently enacted and escaped becoming a law only because of the veto of the Governor. In his veto message the Governor made the point that such regulation as the act contemplated was a matter for the state's public service commission to decide and execute. We quote this portion of the message:

> Another thing I have learned to believe is that those who have made a lifetime study of railroad operations are better judges of the proper method of operating them than I am, and I believe that this is equally true when applied to a majority of the members of any legislative body. The trouble in Oklahoma is, and has ever been, that in dealing with public service corporations we have assumed to know more about how properly to operate them than those who have given the matter careful study. Public service corporations need to be regulated and need to be controlled. Oklahoma has undertaken to do this by the creation of a corporation commission, and has clothed that commission with unusual authority in dealing with such matters. That commission, after having studied the question, is better able to place suitable regulations upon the railroads than is the governor or the legislature.

The Governor of Oklahoma has done a service to right principles of public service regulation by his message and by the exercise of his veto power to kill legislation counter to the policy established by his state when it created and empowered a public service commission.

Should We "Pay As We Go" for Roads and Other Public Works?

Certain daily papers in Pennsylvania seem to have taken their cue from recent editorials in civil engineering periodicals and are protesting against the proposed bond issue of $50,000,000 for state road work. The arguments against such a bond issue are twofold: (1) That the public of today should not make the public of the future pay for road improvement; and (2) that bonds should never be issued against structures that will have to be renewed before the bonds mature. Bad ethics and bad economics are attributed to those who propose long time bonds for road work. Let us consider each objection briefly.

The "pay as we go" advocates seem entirely to have overlooked the fact that strict ethics would require the present generation to pay in part for the roads built by preceding generations. Certainly we are enjoying the fruits of the labors of the first road builders, and are paying next to nothing for roads built in the past. This might be urged as a reason why we should be equally generous with our descendants, and "pay as we go" for all road improvement, but with better reason may it be contended that the pioneers should never have been obliged to bear the entire cost burden of their road building. Without question each generation should pay for its own road maintenance costs, but that is a matter quite apart from the contention that future generations should be relieved entirely of payments for the original road construction. In fact, a truly equitable procedure would be to make all future generations pay the interest on the original cost of road construction. In essence this is precisely what is now the policy of railway companies, for their bonds are refunded as fast as they mature.

When the matter is thus presented to the opponents of long time road bonds, the reply is that railways differ from roads in two radical ways. First, in that railways are more durable than roads; second, in that railways are revenue producing, while roads are not. Yet neither of these reasons is sound. The most durable railway is not a whit more durable than the most durable type of road. The grading and bridging of a railway have not greater life than of a road. The rails of the average American railway last about 20 years, which is no longer than the life of a good asphalt or brick road surface. The ties of a railway last only 10 years.

But in order to secure even this length of track life one track laborer per mile of railway is kept constantly at work. Before the ordinary 50 year bond of an American railway matures, its rails have been renewed twice, its rolling stock has been renewed twice, its ties have been renewed ten times, and most of its bridges have been renewed more than once, to say nothing of entire abandonment of its original roadbed in order to secure easier gradients and curvature. Yet, no real student of economics has contended that it is wrong to issue 50-year railway bonds. Why? Because it is recognized that the existence of the original structure at the date of bond maturity is immaterial, provided a new unmortgaged structure stands in its place. In brief, so long as repairs and renewals are paid for out of earnings, and not by bonding, the life of the bond may properly be many times as long as the composite life of the bonded plant.

Now, as to the argument that railways differ from roads in that the latter produce no income with which to pay for renewals, we find a difference that exists only in the seeming. A plant unit may be a true net revenue producer in either one of two ways: (1) By causing the payment of cash for its product, or (2) by effecting a saving in the cost of production. The efficient turbo-generator that supplants the less efficient reciprocating engine plant in an electric central station is as truly a producer of net revenue as was the original plant that led people to buy incandescent light. For the same reason an improved road that reduces the cost of hauling is a revenue producer for the public that it serves, even though not a dollar of the revenue passes into the hands of toll collectors. But a part of this revenue—the saving effected in hauling—should be collected in the form of taxes and used to keep the road in repair; just as a part of the revenue of a railway, collected in the form of freight charges, is used for maintenance. There is nothing but sophistry in the various arguments whereby it is sought to find a fundamental economic difference between roads and railways.

Again we repeat that we fail to understand why the editors of prominent civil engineering journals persist in their cries of "Beware" whenever large bond issues for state road work are mentioned. Is it because the states that have done the most road building are in danger of bankruptcy in conseuuence? Is it because farmers are becoming progressively poorer? Or is it simply because the editors have drifted into an eddy of argumentation where they enjoy whirling without progression?

There has been a merry-go-round of talk about road improvement for many years. And now that a strong forward movement has begun it seems a pity that those who should know something both about roads and about economics, should show symptoms of knowing little about either.

The Suitability of Drag Line Machines for Railroad Grading from Side Borrow.

A very interesting and highly efficient application of drag line excavators in railroad building was made during the past construction season in South Dakota. The work done by drag line machines is described in an article in the present issue of this journal.

In double track construction, on the Chicago, Milwaukee and St. Paul Railway, between Andover and Groton, S. D., a fill 5 miles in length and averaging 20 ft. in height was made from natural surface to subgrade by means of drag line machines which took the material for making the fill from side borrow pits. By this method slightly over 900,000 cu. yds. of material were placed in the fill in three months' time. At times as many as five machines were in operation. The booms of these machines ranged from 50 to 100 ft. in length. When in service the buckets of the machines were dumped, on the average, once a minute. The buckets used ranged from 2 to 3½ cu. yds. capacity. The largest machine made 3½ cu. yds. of fill per minute when in service.

Prominence is here given to a notice of this construction method, which was successfully applied on the double tracking of the St. Paul, for the reason that the method seems to have a wide range of usefulness. It is thought that the era of extensive railroad construction is past so far as new lines are concerned, and that hereafter construction work will become more and more confined to double tracking and to changes in grade and alinements of existing lines. On construction work of this character the use of drag line machines seems to be economically applicable.

GENERAL ARTICLES

A Study of the Cost Per Ton of Rock of Mining at Eight Mines in the Joplin, Mo., District.

The cost of mining in the Joplin, Mo., District, is comparatively low, due to the favorable conditions. In a paper in the "Colorado School of Mines Magazine" Mr. Charles W. Burgess, manager S. V. D. Mining Co., Webb City, Mo., analyzes these costs in some detail. We reprint this paper as follows:

The Joplin District, comprising about 490 square miles, is located in southwestern Missouri, southeastern Kansas, and includes the new camp of Miami, in northeastern Oklahoma.

From the production of ore in this district about 50 per cent of the annual production of spelter of the United States is made. In 1912 there were 351,847 tons of concentrates of sphalerite, galena and calamine produced, with a valuation of $18,241,200. A very significant consideration is the large tonnage mined to make the annual production of concentrates, owing to the low grade of the ores, averaging about 4.6 per cent sphalerite, and 0.3 per cent galena in soft ground mines, and 0.5 per cent galena and 2.4 per cent sphalerite in hard ground mines. There was approximately 10,924,000 tons of crude ore mined and milled in 1912.

MINING COSTS.

Costs in the district are figured by the different mines upon two different units, namely: cost per ton of crude ore mined and milled, and cost to put a ton of concentrates in the bin ready for market. In this article the former only will be considered, because the latter is dependent upon the grade of ore, and although it is a cost by means of which an operator can directly figure his profit from operations at his particular mine, it does not give a means of comparison between the operating costs of the different mines of the district, or a cost which can be compared with the cost of other mining districts.

The cost of mining in the Joplin District is comparatively very low, due to the favorable external and internal conditions existing in the district, relative to mine operations. The cost of mining and milling per ton of crude ore varies from $0.82 to $1.25, and a fair average is about $1.

It is the intention in this article to analyze the factors making up this mining cost, describing briefly, equipment of mining plat, geology, exploitation of ore bodies, methods of mining and milling as they affect the cost of mining.

EXPLOITATION.

There are three different classes of operating companies: (1) Those that own the land, operate the mines and send the concentrates to their own smelter; (2) those that own the land, operate the mine and sell their concentrates to ore buyers; (3) those that do not own the land, but operate the mines as leases, or sub-leases, paying the land owner or first lessee a definite per cent of money received from the sale of ore, as royalty. There is only one company of the first class mentioned, namely, the American Zinc, Lead & Smelting Co., and very few companies in the second class. About 95 per cent of the operating companies are leasing companies, having leases upon 20 to 160 acres of land, operating one to four mills, and paying a royalty from 10 to 30 per cent. Royalty is not an operating charge, but should be charged as a part of investment, because it is a payment by the operating companies for the privilege of mining upon the land, a privilege which if not paid for by royalty would have to be obtained by an investment in the purchase of the land.

Prospecting on the land for ore bodies is done by use of churn drills. Drill holes are fairly satisfactory means of prospecting in sheet ground, where the ore bodies are quite uniform in grade and fairly persistent over large acreage. In soft ground deposits drilling is not as reliable in results obtained, and it is necessary that holes be carefully cased to prevent following down of the ore into the hole. However, if drill results are taken conservatively and holes put down at close distance, drilling affords an effective and economical means of prospecting. Drilling is contracted for at 90 cts. per foot, and holes are generally drilled from 200 to 250 ft. The cost of a company prospecting its lease, will vary from $200 to $3,000, depending upon the number and depth of the holes. Fifteen holes, at depth of 200 ft., would be considered very thorough prospecting of a 40-acre lease.

GEOLOGY OF ORE BODIES.

The important commercial ores mined are sphalerite, galena and calamine. Sphalerite leads in amount of production, and galena is about one-sixth of the sphalerite, while calamine is about one-fifteenth of the production of sphalerite.

The ore bodies occur in two general divisions: (1) Sheet ground deposits, from which about 75 per cent of the production of the district is obtained: (2) Runs locally known as disseminated deposits, which include pockets and irregular bodies of ore, in which the sphalerite occurs cementing together chert particles, or what is known as soft ground deposits, in which the ore is found in a mass of lime, chert and shale. The ore occurs in the Mississippian Series of the carboniferous system, and in the soft ground and disseminated deposits is found as irregular placements resulting from complicated underground drainage. The sheet ground deposits are found as fairly consistent blankets in the hard Grand Falls Chert.

The ore in some areas has been found at very shallow depth. However, at present, in the mines making the largest productions, mining is being done at depths varying in the different mines from 140 to 200 ft.

SHAFTS.

Shafts are sunk 4 to 10 ft. below the bottom of the ore bodies to allow for sumps. Shaft equipment used in sinking through soft ground to shallow deposits often consists of a windlass or a horse whim and is very inexpensive. In sinking to lower deposits at which the ore bodies have been proven up by drill holes, the regular hoisting installation is generally used, and put in position to allow for the addition of milling department. This shaft equipment consists of boilers, hoist, cables and housing, and will cost from $800 to $2,000.

The cost of sinking shafts is so variable, because of the great number of different conditions, that wide limits are necessary to include fair estimates of cost per foot. The principal conditions affecting costs are amount of water, depth to which shaft is sunk, size of shaft, character of ground through which the shafts are sunk, whether soft ground requiring cribbing, or limestone, in which no cribbing is necessary, but in which the expense is augmented by the need of more labor and powder. Shafts are either sunk by companies or let out on contract to shaft sinkers. Average shafts, 5x7 ft., sunk to sheet ground levels, including handling of water, powder, labor, power, cribbing and supplies, will cost from $6 to $13 per foot to sink.

MILLS.

Mills in which the ore is treated range from those consisting of crude hand jigs up to the more complex 500-ton mills, with up-to-date table departments. The milling and power equipment used in most of the mines is quite uniform, and the same milling practice, with few modifications, very general.

The mill equipment consists of crushers, rolls, elevators, screens, jigs, clasifiers, tanks and tables with the necessary shafting, belting, piping and boxing. In the engine room there is a great variation in the character of equipment used, inasmuch as different power is used. In a typical power department, in which electricity is used, the principal pieces of equipment are mill motor, pump motor, motor-driven compressors and switchboard, with control. A typical power department, in which natural gas or coal is used, consists of boilers with heater and pumps, mill engine, either gas or steam, compressor driven by gas or steam engine, and underground steam pump.

Additional to the mill and shaft equipment for the completion of a typical mining plant there are blacksmith shops, oil house, dynamite magazine, change house for miners, and office.

AMORTIZATION.

The initial investment necessary to provide for drilling, shaft sinking, shaft and mill, and all other necessary equipment will vary greatly in different plants. In typical 250 to 300-ton sheet ground mines, which constitute the majority of operating plants, the investment will be from $20,000 to $40,000. A very prevalent practice is the buying at low cost of second-hand mills; because of the short life of mines there are always a number of these for sale.

TABLE I.—COSTS OF MINING AT TYPICAL JOPLIN DISTRICT MINES.

Name of Company☞	Alba Federated.	Neck City Federated.	Webb City Federated.	Diplomat.	S. V. & D. Mine.	Mattes Mine.	Kramer.	Calhoun.
Character of ore body	Soft	Disseminated	Sheet	Sheet	Soft	Sheet	Disseminated	Sheet
Tonnage of mill in 10 hours	95	200	200	250	200	250	450	300
Pumping required	Light	Heavy	Heavy	Heavy	Heavy	Medium	Light	Medium
Heights of drifts	12 to 14 ft.	25 to 35 ft.	16 ft.	12 to 14 ft.	10 to 12 ft.	7 to 10 ft.	12 to 40 ft.	14 to 16 ft.
			Costs Per Ton of Rock.					
Superintendence	$0.021	$0.009	$0.010	$0.012	$0.011	$0.033	$0.029	$0.014
Surface labor	0.157	0.147	0.176	0.127	0.138	0.160	0.171	0.158
Underground labor	0.340	0.242	0.337	0.261	0.308	0.360	0.392	0.342
Explosives	0.049	0.120	0.137	0.173	0.057	0.195	0.111	0.141
Timber	0.067	.....	.....	.....	0.091	.....	0.008	.....
Hard iron and supplies	0.098	0.089	0.162	0.130	0.112	0.091	0.197	0.118
Power	0.085	0.124	0.083	0.094	0.129	0.100	0.027	0.081
Oil	0.012	0.015	0.014	0.011	0.009	0.014	0.014	0.015
Fire insurance	0.005	0.005	0.004	0.004	0.005	.....	0.016	0.006
Liability insurance	0.015	0.014	0.016	0.016	0.015	0.020	0.023	0.020
Interest and depreciation	0.026	0.019	0.019	0.012	0.011	0.050	0.015	0.013
Total	$0.875	$0.784	$0.958	$0.840	$0.886	$1.023	$1.003	$0.908
Amortization	0.159	0.112	0.101	0.056	0.102	0.110	0.125	0.104
Grand total	$1.034	$0.896	$1.059	$0.896	$0.988	$1.133	$1.128	$1.012

The paying back of the original investment is an important item in the consideration of cost of mining in this district. This might not seem so important because the original investment is very small compared to that of other mining districts; but it is also true that the life of the mine is so much shorter. The average life of a soft ground mine is about four years, and of a sheet ground mine from 10 to 15 years. In many mines amortization is charged to the cost per ton, by approximating the tonnage of ore mined in the life of the mine; while in other mines no account is taken of the amortization, and this should be considered in the fair comparison of the costs of mining at different plants.

LABOR.

Labor is generally quite plentiful, especially in the winter months, as many of the men engaged in farming in the surrounding country come in and work in the mines. No foreigners are employed, the workmen being native Americans, mostly from the hill district of Tennessee, Arkansas and Missouri. The climate is mild and healthful, and the miners enjoy the advantages of populated centers. Many of them live in Joplin, a town of 33,000, and others living in smaller towns can easily reach Joplin, as the district is interlaced with the lines of an excellent electric car system. Mining is carried on at comparatively shallow depths, and the underground conditions under which the miners work are good, and none of the disagreeable features of high temperatures are present, as is the case in many of the deeper mines of the world.

The miners are not as efficient, intelligent or as hard working as the higher classes of foreign laborers, such as the Swedes and Cornishmen, found in the western mines, but surpass the lower foreign laborers of the coal mines, and many of the metal mining districts of the West. There is a great tendency of the miners to group together, exchanging experiences and stories, and this, if not carefully watched, is done on company time, at great expense to the labor efficiency. One very marked characteristic is the ingenuity of the men of this district, and many original ingenious devices to increase milling efficiency are seen in the mills.

There are no labor unions, although several attempts to organize a union have been made, but have proven unsuccessful. Labor is plentiful enough, so wages are not bid up higher than warranted because of competition. Wages compare favorably with those of other districts, considering the lower cost of board and room, good living conditions and climatic advantages.

Following is the scale of wages general in the district:

	8 hr. shift.	10 hr. shift.
Blacksmith	$2.50	
Hoisterman	2.50	
Machine men	2.50	
Machine man helper	2.25	
Pumpmen	2.50	
Drillmen	2.00	
Crusher feeder		$2.25
Jig helpers		2.50
Engineers		2.50

During the latter part of 1912 the wages were increased 25 cts. per shift, because of the high price paid for concentrates, but wages are now back to the original scale tabulated above. Shovelers are paid from 5 to 9 cts. per can, varying with the size of the can, as 800, 1,000 and 1,200-lb. cans are used, and also in the length of tramming required of the shovelers. In some cases the shovelers are required to tram the cans to the shaft, and in other cases to a main track where it is then taken by a mule to the shaft. Ground bosses are paid $25 to $35 per week, straight time. Head jig-men are paid $25 to $30 per week, straight time.

The labor cost, including all surface and underground labor is from 53 to 58 per cent of the entire operating cost.

MINING AND MILLING SUPPLIES.

There are a number of supply houses located in the larger cities of the district, and these send solicitors around for orders, much as orders are taken for groceries. Transportation of supplies is easily accomplished, because of the good roads and nearness to supply houses, and these supply wagons make daily trips to the mines. In case of an urgent need of a certain supply, all the mine operator has to do is to call the supply house up on the telephone, and the article is put on one of the numerous electric cars that make frequent trips over lines that run close to most of the mines. Because of supply houses and the ease of transportation, mining companies are not required to carry an expensive stock of duplicate parts of machinery, which is necessary in many of the mining plants of the mountainous regions of the West.

Three different powder companies are represented in the district, two of which have factories located here. Powder is one of the largest items of the operating cost, especially in the sheet ground mines. In sheet ground mines the ore occurs as a blanket in a very hard chert, and requires a great deal of powder in breaking the ground. The deposit is worked by driving a heading in the upper part of the deposit, followed by taking up the lower bench, or stope, as it is locally known. The face in sheet ground mines is seldom higher than 40 ft., and averages about 14 ft. Pillars of the ore are left alternately as the spots of a five in playing cards. With a good roof, pillars need not be left closer to each other than 40 ft. After the ore is worked out to the limits of the deposit, these pillars are pulled, retreating toward the shaft.

In soft ground mines, while powder expense is not so high, this advantage is offset by the necessity of timbering. The timber used is native white oak. Mining is carried on at one level, with faces very seldom higher than 14 ft., and the timbering consists of posts, caps and spiling. In case of working the same deposit at lower depths, the timber is shot out and the ground thrown, as the character of the ground is not amenable to the use of square sets, or modifications of square sets, in working out the deposit.

Milling consists in concentration of the ore by jigging. The ore is crushed and sent through rolls, and after being screened is concentrated in two stages; first, to the roughing jig, and finally cleaned on a cleaning jig. Tables are used to concentrate the finer ore and sludge. Hard iron, belting, elevator cups, bolts, pipes and fittings are the leading items of expense in mill supplies. Hard iron costs are higher in sheet ground mines because of the wearing out of the shells on the rolls in grinding the hard chert ore. Hard iron is supplied by four local foundries, and is made up and delivered as grates, shells, crusher jaws and side plates at 2½ cts. per 100 lbs.

Oil is supplied at reasonable charges and delivered to the mines by a number of competing companies having agencies established in the district. Sunshine and carbide are furnished by the mining company to the miners for their lamps.

POWER.

Steam, natural gas and electricity, or combinations of these, are used for power in the operation of mining plants. Power is quite cheap, due to the nearness of the Joplin District to the coal fields of Pittsburg, Kans., and to the natural gas fields of Oklahoma and Eastern Kansas. Mine run coal costs from $2.25 to $2.65 per ton, delivered to the nearest railroad switch. Gas burned under boilers costs from 12½ cts. to 15 cts. per 1,000 cu. ft. During the winter, when the demand upon the gas supply is very heavy, the gas pressure often becomes so reduced as to necessitate mining plants, depending upon this power, to shut down days at a time. In a few plants a fuel oil system is installed to take care of this emergency, and in others a supply of coal is kept on hand and boilers equipped to burn either coal or gas. The Empire District Electric Co. have lines covering most of the district, and furnish electricity, charging $1.25 per horsepower, connected per month, as an installation charge, and 1⅛ ct. per horsepower hour for electricity used, with discounts, depending upon the size of installation, amount of electricity used and promptness in paying bills.

ADMINISTRATION.

Some of the largest companies carry their own risks, and in case of accident pay the liability; but the majority of the companies carry liability insurance, paying as premium 4 per cent of the total amount of the pay roll.

Concentrates are sold through competitive bidding of ore buyers representing the different smelters, and as the ore is sold in the bin, there is no charge to the operator in marketing the ore, except the cost of the assay of the samples. The price bid is on the basis of 60 per cent metallic content of the concentrates. A premium of $1 is paid for each per cent above 60 per cent. Ore buyers allow 1 per cent of iron in the concentrates without penalty, but for every per cent of iron above 1 per cent the operator is penalized $1. Concentrates having no lime or galena in them are termed high grade concentrates, and receive a better base price than other grades of ore.

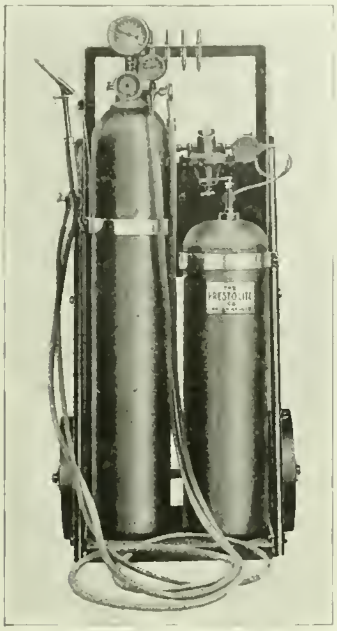


Fig. 2—Prest-O-Lite Oxy-Acetylene Welding Outfit.

The first impression of engineers coming from other districts to the Joplin District is that the methods of mining and milling seem crude and inefficient, but upon investigation they are surprised with the results obtained, and the low cost of mining. While it is true that both external and internal features are very favorable to low costs in this district, yet some credit must be given to the practice which is general in the district of mining and milling large tonnages with a small outlay of capital.

Ontario Government to Make Investigation of Water Pollution.—The government of Ontario is planning extensive investigations of sewage disposal methods and the protection of the fresh water supplies of the province. Dr. J. W. S. McCullough, chief of the provincial health department, is to visit various places in Great Britain and Europe to determine the best and most practical methods in use there. The boundary waters will be examined and reports on the water supply situation will be presented in November. Recent legislation places within the jurisdiction of the provincial board power to force installment of whatever water systems they consider best, and if a purification plant or a sewage treating plant is thought necessary the municipality concerned will be obliged to install it without appeal to the people. This obviates much of the trouble which has occurred in unwilling towns in the past.

Cutting Steel Beams with Oxy-Acetylene Torch to Clear Away Bridge Wreckage.

(Staff Article.)

The possibilities of the oxy-acetylene torch in wrecking operations is illustrated by the accompanying view showing the beams of a wrecked Melan reinforced concrete arch being cut to clear the channel of wreckage. The bridge crossed Fall River, Indianapolis, Ind., at Meridian St., and was wrecked by the recent spring floods. The view, Fig. 1, indicates clearly the character of the wreck and shows that an almost absolutely necessary preliminary task to effective clearing operations was the cutting of the steel I-beams. To perform this task, Mr. H. W. Klausmann, City Engineer, contracted with the Prest-O-Lite Co., Indianapolis, Ind., to cut away the beams by means of one of their portable oxy-acetylene outfits. A description of the outfit and of the cutting operations furnished by Mr. Ralph G. Elvin, of the Prest-O-Lite Co., follows:

An oxy-acetylene welding outfit consists of a cylinder containing 100 cu. ft. of dissolved acetylene mounted, with an oxygen drum of equal capacity, on a light two-wheeled truck, Fig. 2. The weight of the entire outfit, with complete welding equipment, is only slightly over 300 lbs. and it can easily be handled by two men. The flow of acetylene is governed by an automatic regulating valve, which admits the gas into the mixing chamber of the torch under constant pressure. The oxygen is also automatically controlled, and can be regulated to enter this mixing chamber in any quantity desired. The temperature produced by the welder is 6,300° F. This temperature, while much greater than that required for melting any of the commercial metals, is useful and necessary because of the rapid dissipation of heat through the metals being worked upon.

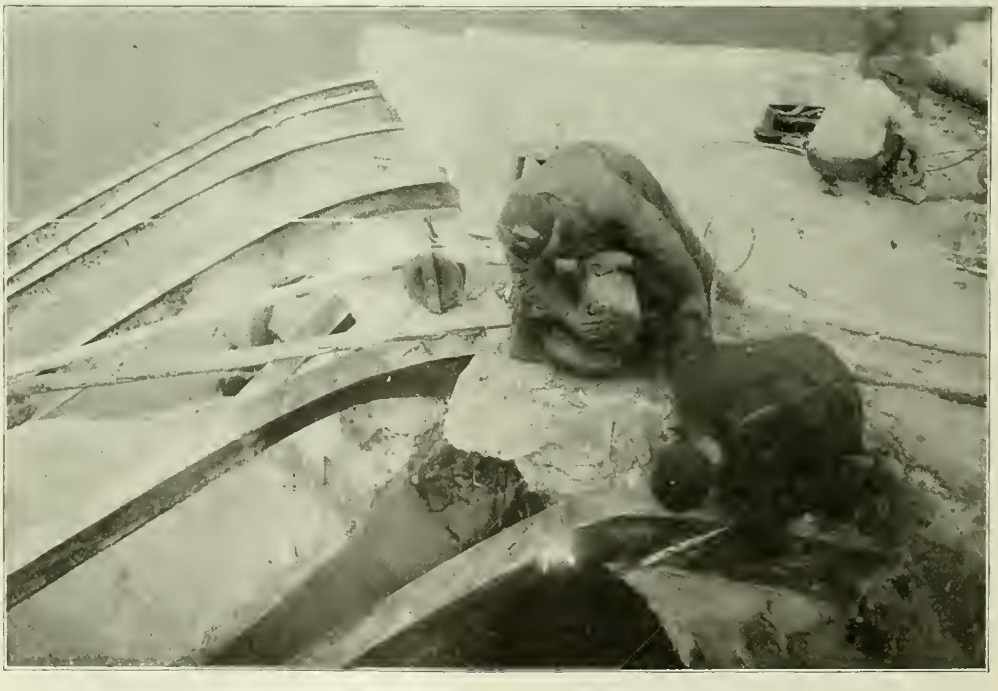


Fig. 1—Cutting 10-in. Steel T-Beams with Oxy-Acetylene Welding Outfit, Meridian St. Bridge, Indianapolis.

When the welder is being used in cutting, as in the case of the ruined Meridian St. bridge, a special cutting torch is used. The metal to be cut is first pre-heated by the welding flame, and a stream of pure oxygen is then directed against it. This allows the metal to burn quickly with a smooth, narrow kerf, leaving the metal unharmed on either side of the cut.

This welder was especially useful in clearing away the steel wreckage of the bridge because of its portability. It was easily wheeled from place to place over the ruined abutments and was even lowered onto chunks of fallen concrete in order to allow the operator to cut close up to the stone. The work was such that the wreckage could not be sawed or removed by any ordinary means, for the operator of the welder was literally "hanging on by his toes" much of the time he was cutting.

The material cut by means of the welder consisted of 10-in. I-beams of heavy steel. In all, 35 cuts were made. The total time required in making the 35 cuts was 4½ hours while the total elapsed time on the job was 12½ hours.

Cost of a 1,400-K. W. Hydroelectric Plant.

A small hydroelectric plant has recently been built by the city of Eugene, Oregon. We are indebted to the *Electrical World* of May 17 for the data from which we have prepared the following summary of the cost of the plant, as of Dec.10, 1912:

	Total.	Per kw.
1. Intake	$ 3,971	$ 2.84
2. Canal	90,171	64.40
3. Headgates	4,514	3.22
4. Flume, forebay and wasteway	10,604	7.57
5. Water wheels and pressure pipe lines	25,656	18.35
6. Electric apparatus	22,097	15.78
7. Station buildings and grounds	9,299	6.64
Total of items 1 to 7	$166,312	$118.80
8. Transmission line	12,164	8.69
9. Substation apparatus	5,631	4.02
10. Substation building and grounds	813	.58
11. Real estate and right of way	12,164	8.69
12. Miscellaneous	112	.08
Total of items 1 to 12	$197,196	$140.86
13. Distribution lines and transformers	22,419	16.01
14. Meters	9,724	6.94
15. Series street lighting	17,676	12.63
16. Ornamental posts	7,324	5.23
Total of items 1 to 16	$254,339	$181.67
17. Supervision	4,755	3.40
18. General office	4,417	3.16
19. Interest during construction, and bond expense	20,755	14.82
Grand total	$284,266	$203.05

Note: Item 2 includes excessive charges of $26.257, due to failure of contractor and court costs.

Water from the McKenzie River is diverted through a canal 19,400 ft. long and wooden flume 650 ft. long, designed to carry 560 second-feet. The canal headgates are of concrete, located in the canal 350 ft. below the intake.

There are two wood stave pressure pipes, 8 ft. diam., each 100 ft. long, bedded on timber cradles 12 ft. apart. Just before entering the power station the stave pipe connects to a 96-in. riveted steel Y which carries the water to the turbine of each unit.

There are two turbines, each 1,200 H. P., Pelton Francis type, direct connected to Fort Wayne generators. Each generator is rated at 705 K. W. or 945 H. P. This difference between turbine and generator rating indicates that the generators are designed to carry a 25 per cent overload for a short time (probably two hours) without excessive heating. The generators are 2,300-volt, 60-cycle, 3-phase, 300 r. p. m.

The hydraulic head on the shaft centers of the wheels is 28 ft. and the draft head is 15 ft., giving a total head of 43 ft.

The power plant building has a concrete foundation and floor, and corrugated iron walls on a wooden frame.

The current is stepped up to 23,000 volts, by means of one bank of three 200 K. W. Westinghouse oil-insulated, water-cooled units, delta connected, which have a 50 per cent overload capacity for an hour without undue heating. A fourth spare unit is provided.

The transmission line to Eugene is 15.5 miles long, and its cost was not quite $800 per mile, including a telephone line. Cedar poles are spaced 40 to the mile. Three wires of No. 4 copper are mounted on Pittsburgh single-petticoat porcelain insulators, 8 in., 40,000 volt. There is one river crossing of 670 ft. span.

The substation transformers are installed in a part of the city water-filtration plant building, which accounts for the low cost of "substation buildings." The current is stepped down to 2,300 volts, and carried in three-phase circuits. Line transformers deliver the current at 230 and 115 volts.

Thirty miles of streets are lighted with incandescents. On Dec. 1, 1911, only two customers were being served; but 1,001 customers were served Dec. 1, 1912.

An Ingenious Method of Excavating a Core-Wall Trench.

In the building of the Katchess Dam, Wash., by the U. S. Reclamation Service, it was necessary to excavate a deep, narrow trench for a concrete core-wall, 2 ft. thick. First a wide cutoff trench was dug to a depth of 20 ft. with a Lidgerwood-Crawford drag-line bucket. Then in the bottom of this trench a narrow trench (about 4 ft. wide) was dug to a depth of 35 to 75 ft. below the original ground level. It was in the digging of this narrow trench that the following method was adopted: At intervals along the trench shafts were sunk. A ¾-cu. yd. bucket, operated from a head frame, traveled up and down each shaft. A vertical chute delivered earth into the bucket, from wheelbarrows. The trench was excavated in benches about 7 ft. high. One or two men worked on each bench, loading the barrows and wheeling them to the shaft.

A double drum hoisting engine served two shafts. The bucket of earth were automatically dumped into a 1½-cu. yd. car which was hauled by a horse to a waste dump.

The scheme of excavating a shaft down which earth is chuted into a bucket and then elevated to the surface is one that has long been used in mining. But we do not recall seeing mention of this method for trench work prior to the description of it by Mr. E. H. Baldwin in *Engineering News*, May 15, from which we have abstracted the above given facts.

ROADS AND STREETS

Bituminous Gravel Concrete Road Surfaces.

Sirs: Gravel, because sometimes easily obtained or cheaper, has been tried in various ways, for some years, as a substitute for crushed stone, as the principal mineral aggregate of bituminous bound road surfaces. The following may be interesting in connection with the paper of similar title by S. J. Stewart in Engineering & Contracting, Feb. 5, 1913.

The writer has lately been called to investigate the causes of failure of certain new pavements containing gravel and bituminous cement, and to advise a municipality what, if anything, can be done to repair the disintegration and to prevent it occurring in the rest of the pavements to be constructed in 1913. He consulted his field notes and data on bituminous stone mixture pavements, filed during past years, and then inspected various other similar roads and pavements, including the four roads of light traffic, described in your publication. Mr. Stewart's paper, while describing the construction during 1911 and 1912, seems to have been written too soon after these roads were finished to then draw definite conclusions.

The practical objection to the use of gravel, as found in a bank or pit, is the lack of uniformity as stored by nature, and the necessity for the successful construction of bituminous pavement, of actual knowledge by the constructor of the quantities of sizes and properties of the particles of gravel used, together with the qualities of the surfaces of the gravel, such as will insure adhesion of the bituminous cements to it. Without this definite information, in advance, the successful construction of any bituminous pavement is necessarily a matter of conjecture or chance. A few instances of success or failure, with bank gravel in its natural state, prove nothing as to the best methods of constructing a uniform and successful pavement or road surface.

If gravel is used for water-bound road, it will not bind itself together, if the hardness of the gravel is such as is good to resist wear. Much more than 10 per cent of clay or other water soluble or equivalent hydro-colloidal material must be added to, or be found in, the natural gravel, to bind such gravel together in ordinary water-bound roads. This clay is found in some so-called conglomerate or cementitious gravel.

But if such water-soluble cementitious clay is present in the gravel, as in the White Plains, Amityville, Easthampton or similar roads, then it remains as a film or layer, coating each particle of gravel, thus preventing the bituminous cement from coming in contact with and adhering to the gravel. The road, constructed with such clay-gravel and bituminous cement, occludes or absorbs water from rains. The water penetrates the clay covering of the stones and steadily disintegrates such a pavement or road; aided by frost and the shocks of hoofs and wheels. Auto tires also steadily suck out the finer particles of gravel and finally some of the larger ones also. This is shown by inspection and tests of parts of the four roads referred to. A piece of such road or pavement, placed in water, in due time disintegrates and falls apart.

There are, however, parts of these four roads which are not of the same composition and construction as other parts referred to above. This is evidently due to irregularity of the gravel sizes. Where gravel has not enough small sizes to fill the voids, or where, as published, "gravel screenings containing not less than 10 per cent of clay saturated with water" were spread over the bituminous-gravel layer of the roads, and subsequently was washed away by rain; at such places the upper surface of the road soon becomes pitted, rough and friable.

Bituminous Gravel Road, White Plains, N. Y., Showing Results of Lack of Uniformity of Natural Gravel Used.

In Babylon, N. Y., where the clay-gravel bituminous road was constructed about 9 months ago, its surface was covered with a thick carpet of asphalt-cement, which, for a while, will keep water out of the pavement below. This carpet is so soft in hot weather, as to stick to clothes and shoes of pedestrians, wheels, tires, etc., and is objectionable and disagreeable. At some places this bituminous carpet has been forced into the mineral aggregate below, thus providing an excess of bitumen, causing the entire road surface-layer to be displaced by traffic and form into humps and hollows. Other parts of these roads are composed of gravel so graded as to be similar to the gradation of some gravel-bituminous roads in other states, made of special, selected, graded mixtures of gravel, sand, etc. The result in these parts is that the voids in the mineral aggregate (excluding the bitumen, as shown by analyses), are reduced to the low minimum of 11 per cent. The bituminous cement coats the gravel, etc., and fills these small amounts of voids. The result is a dense, water-excluding mass (except for the clay on the gravel) compressed firmly together by the heavy roller used.

Other reasons why bituminous gravel roads fail and some succeed, in various parts of the United States are worthy of note. Where poorly graded sizes have been used, voids or pockets are formed; even though some sand, etc., is mixed with the gravel. Rain and the elements of weather, the worst enemies of roads, cause water to enter these voids and disintegrate the roads, aided by freezing and expanding. The weather, and especially contraction in cold weather, causes many minute cracks; and traffic disengages the gravel and ravels the road surface. Other failures occur when too large sizes of gravel are used, where stones are of greater or almost as great diameter as the thickness of the wearing surface. The same difficulties in general are experienced with gravel for Portland-cement-concrete as with bituminous-cement-concrete. Clayey, earthy matter, etc., interferes with adhesion of either Portland cement or bituminous cement. If the surface of a gravel is too smooth and polished, although clean, Portland and bituminous cements sometimes fail to adhere.

The bituminous-gravel-concrete roads or pavements which have succeeded in a few parts of the United States are those containing very hard and durable gravel, having surfaces to which bitumen can adhere, and of such expressly graded sizes that such gravel can be combined with some sand and suitable finer filler to make a dense mineral mass with a low per cent of voids. Then the whole mass is well coated and mixed with good waterproof asphalt road cements.

Sometimes it is possible to use hard crushed stone and some carefully selected hard, fine gravel, sand, etc., mixed to form the mineral aggregate for a good bitminuous-stone-gravel concrete road construction; made by the mixing method and firmly compressed on a durable foundation.

Yours truly,
J. W. HOWARD, C. E.,
Consulting Engineer on Pavements and Roads.
New York City, May 26, 1913.

Bituminous Resurfacing by the Illinois Highway Commission in 1912.

During the six years that the Illinois Highway Commission has been in existence it has constructed 50 pieces of experimental road, aggregating 1,001,823 sq. yds., and has also done 166,554 sq. yds. of resurfacing and maintenance work. The following data abstracted from the recently issued report of the commission show the cost of resurfacing work done in 1912:

The Mt. Sterling experimental road was constructed as a tar macadam in the summer of 1909. Frequent service inspections were made on this road, and in 1912 it was decided that the road should be resurfaced in order to insure that its condition would be maintained. The road was still in a very serviceable condition, but the tar originally used in dressing the surface seemed to have lost its life to a certain extent, and as a result the stone had loosened in a few places. In order to prevent this condition becoming any more serious, the resurfacing was undertaken.

The depressions in the surface were repaired by the addition of stone and rolling, and the entire surface painted with a light tar followed by a dressing of coarse sand. On many parts of the road it was necessary to make a second application of tar followed by a second dressing with coarse sand.

The following table is an itemized statement of the cost of the work:

Length of road, ft.	1,900
Width of road, ft.	30
Amount of road resurfaced, sq. yds.	6,400
Amount of bituminous binder used, gals.	4,700
Rate of pay: Men, 15 cts.; teams, 35 cts. per hour.	
Amount of bituminous binder used per sq. yd. of surface, gals.	0.73
Cost of Labor and Supplies—	
Superintendence	$ 75.00
Loading, hauling and spreading sand and stone	54.25
Cleaning and reshaping macadam	102.25
Rolling and sprinkling	46.25
Watchman and miscellaneous labor	13.00
Cost of stone and sand	183.16
Coal, oil and miscellaneous supplies	18.55
Cost of bituminous binder, f. o. b. Mt. Sterling	365.80
Heating, hauling and spreading binder	112.00
Total	$ 970.26
Cost of resurfacing per sq. yd. of surface	$0.152
Cost per sq. yd. per year	.051

In the season of 1909, tar macadam experimental roads were constructed on Hurst and Davis Sts. in the city of Bushnell. Frequent service inspections were made on these roads, and these reports showed that the following year the surface began to get somewhat rough and uneven in places, due to the picking out or disintegration of the tar surface. Some sections of the road remained in excellent condition, but in general the road began to deteriorate the second season. In 1911 it was decided to resurface this road, but the work was not reached until 1912. By that time the surface had disintegrated to such an extent that a practically new surface had to be built on Hurst St. Davis St. was in somewhat better condition and only a part was entirely resurfaced. The remainder was surface painted with an asphaltic binder to renew the life of the old tar surface.

The portion of Davis St. from the pavement south for three blocks and all of Hurst St. were cleaned by sweeping and flushing with a fire hose until all detritus and mud between the stone was removed so far as possible. The uneven places in the road were loosened by means of a scarifier, new stone added and the surface rerolled. The entire road surface was then painted with tar, about ¼ to ⅓ gal. per square yard of surface being used. This application of tar was then covered with gravel about the size used for roofing, after which the surface was rolled and a second spreading of tar was applied. The second spreading of tar was covered with a torpedo sand and the road opened for traffic.

The section of Davis St. from the end of the third block to the end of the road was painted with a binder and covered with torpedo sand.

The following table is an itemized statement of the cost of this work:

Length of road, ft.	4,443
Width of road: 3,193 ft. 12 ft. wide; 1,250 ft. 15 ft. wide.	
Amount of road resurfaced, sq. yds.	8,512
Amount of stone used, cu. yds.	80
Amount of bituminous binder used, gals.	11,600
Amount of gravel used, tons	220
Amount of bituminous binder used per sq. yd. of surface, gals.	1.36
Cost of Labor and Supplies—	
Superintendence	$ 150.00
Reshaping road	68.00
Loading and hauling stone and gravel	195.42
Rolling and sprinkling	118.50
Watchman and miscellaneous labor	138.47
Heating bituminous binder	33.53
Hauling and spreading bituminous binder	139.98
Cost of gravel and stone, f. o. b. Bushnell	401.95
Cost of bituminous binder, f. o. b. Bushnell	856.28
Coal, oil and miscellaneous supplies	45.26
Total	$2,147.39
Cost per sq. yd. of surface for resufacing	$0.253
Cost per sq. yd. per year	.084

The Troy and St. Louis roads were constructed in 1910, and the Marine road in 1911, and all were waterbound macadam, constructed with Menard prison stone.

The Troy road is used by a large amount of country traffic. The St. Louis road carries a considerable amount of country traffic, and a section of about 1,500 ft. just outside the city limits of Edwardsville carries traffic from a coal mine and brick yard. This section of the St. Louis road has traffic which is too heavy for a waterbound macadam.

The Marine road leads from the pavement down a steep hill and then across low land, which is occasionally overflowed and the road covered with water.

All of these roads, when inspected in 1912, were in need of some maintenance work, and the commissioners therefore decided to put all of them in good condition during this year. All uneven places and ruts in the roads were scarified and reshaped with the addition of crushed stone, then rolled and bonded with screenings. Some work was done throughout the length of all of these roads, but it was not necessary to scarify all of the surface on the roads. The stone for the maintenance work was furnished from the penitentiary at Menard, and the cost of the work was paid by the township commissioners from township funds.

The following table is an itemized statement of the cost of this maintenance work:

Width of road, ft.	12 and 16
Amount of road resurfaced, sq. yds.	14,271
Amount of stone used, cu. yds.	250
Length of haul of material, mile	¾
Cost of labor: Men, 22¼ cts.; teams, 50 cts. per hour.	
Cost of Labor and Supplies—	
Superintendence	$ 105.00
Loading, hauling and spreading stone	312.50
Rolling and sprinkling	124.00
Freight on stone	177.50
Coal, oil and supplies	17.85
Scarifying and reshaping old surface	134.75
Total	$ 871.60
Cost per sq. yd. of surface repaired	$0.06108
Cost per sq. yd. per year	$0.03 and $0.02

The Tri-City road was constructed in 1909 on a roadway leading from the Black bridge in East St. Louis north towards Granite City. The nature of the traffic on this road is such that at the time of its construction brick was recommended, but for financial reasons it was impossible to secure the brick construction and a bituminous macadam was built. The action of traffic soon demonstrated that this road was not of a type which would withstand the class and amount of traffic which was using it.

In the season of 1912 this road was repaired and the section from the Black bridge to the Troy & Eastern R. R. was entirely reconstructed. From the Troy & Eastern to the north end only the worst depressions and uneven places were repaired. In the reconstruction of the section from the Black bridge to the Troy & Eastern, some methods were followed which were an improvement over those used when the road was first built, and while the road may not prove, on account of the nature of the traffic to be of long life, still it is believed that it will last longer than the road as first constructed.

The section of road from the Black bridge to the Troy & Eastern was rebuilt as follows: The depressions in the old tar macadam were filled with stone which was rolled and bonded with screenings, and was then covered with a 4-in. layer of 3-in. stone, which was thoroughly rolled. The voids were then partially filled with ¾-in. washed gravel, and the surface covered with about 1 gal. per square yard of bituminous binder. This spreading of binder was covered lightly with the ¾-in. gravel, which was carefully brushed into the voids, and a second spreading of binder applied at the rate of about 1 gal. per square yard of surface; ¾-in. gravel was then brushed into the remaining voids in the surface and a third spreading of bituminous binder, amounting to about ½ gal. per square yard, was applied and the whole thoroughly rolled. The surface was finally covered with torpedo gravel and again rolled. The bituminous binders used were as follows: Station 8 to 15, 1 gal. per square yard, followed by 1½ gals. per square yard of binder.

The following table is an itemized statement of the cost of this work:

Amount of macadam resurfaced, sq. yds.	6,300
Amount of stone used, tons	1,090
Amount of gravel used, tons	192
Amount of asphalt used, gals	8,360
Amount of tar used, gals	3,000
Rate of pay: Men, 20 cts.; teams, 60 cts. per hour.	
Cost of Labor and Supplies—	
Superintendence	$ 260.00
Cost of gravel delivered National City	171.61
Loading and hauling stone, including rehandling	529.10
Spreading stone and gravel	220.40
Hauling, heating and spreading bituminous binder	295.30
Rolling and sprinkling	169.00
Watchman and miscellaneous labor	321.43
Cost of bituminous binder delivered, National City or Venice	745.27
Coal, oil and miscellaneous tools and supplies	73.49
Freight on stone	388.21
Total	$3,173.81
Cost Per Square Yard for Labor and Supplies—	
Superintendence	$0.0412
Loading and hauling stone and gravel, including rehandling	.0840
Spreading stone and gravel	.0349
Hauling, heating and spreading bituminous binder	.0470
Rolling and sprinkling	.0268
Watchman and miscellaneous labor	.0510
Cost of bituminous binder delivered	.1180
Freight on stone	.0616
Coal, oil and miscellaneous supplies	.0115
Cost of gravel delivered	.0272
Total	$0.5032

The West Bluff road in Hollis Township, Peoria County, was constructed in 1910 as a tar macadam. The foundation upon which the macadam was constructed was very unsatisfactory, being in part an unsettled fill, and it was realized when the road was completed that it was not as thoroughly compacted in places as was desirable, but the work was done as well as possible with the conditions of the foundations on the road.

It was inevitable that under these conditions some uneven places would develop in the surface of the road, and in 1912 it was deemed advisable to repair and resurface the entire road. On some sections of the road the tar surface was in perfect condition, and on other sections of the road the tar had worn off and left the stone bare. The chips between the stone loosened in places, leaving the road rough. In repairing the road all the uneven places were loosened and filled to the desired shape by means of the addition of stone and rolled. The repair of these uneven places was made by cleaning the depressions, loosening the stone, then painting with an asphaltic binder, after which stone was placed in the depressions, rolled and filled with the asphaltic compound. After all the uneven places in the road had been repaired in this way the entire surface was painted with about ½ gal. per square yard of surface of a light tar and covered with coarse sand.

The following table is an itemized statement of the cost of this work:

Amount of road repaired, ft.	7,468
Width of road repaired, ft.	16
Sq. yds. treated with bituminous binder	9,400
Amount of binder used, gals.	5,000
Length of haul for sand and stone, miles	2
Rate of pay: Men, 20 cts.; teams, 50-60 cts. per hour.	
Amount of binder used per sq. yd. of surface, gals.	0.53
Cost of Labor and Supplies—	
Superintendence	$ 70.00
Sweeping and cleaning surface	41.05
Loading, hauling and spreading stone to repair holes	21.80
Loading, hauling and spreading sand	156.10
Rolling	60.00
Heating, hauling and spreading binder	134.35
Watchman and miscellaneous labor	109.55
Cost of tar binder, f. o. b. Pekin	495.51
Cost of sand and stone	38.40
Coal, oil and miscellaneous supplies	17.67
Total	$1,144.43
Cost Per Square Yard for Resurfacing—	
Bituminous binder	$0.052
Applying bituminous binder	.026
Other labor and materials	.044
Total	$0.122

The Prospect Heights road in Richwood Township, Peoria County, was put under construction in the fall of 1909, but was incomplete at the close of the season and the work was completed during the summer of 1910. Throughout the construction of the road considerable difficulty was encountered because of the nature of the soil which made a poor foundation. In addition to that, the binder which was used being of fairly heavy grade of petroleum residuum was handled in tank cars and consequently was applied to the road at too low a temperature. The chief source of trouble, however, was due to lack of underdrainage, which, although advised by the state highway commission, was not put in by the local commissioners until the road had suffered serious damage. As a result, the surface of the road was unsatisfactory on account of its unevenness, and in 1912 other commissioners having been elected, it was decided to restore the road.

The entire road, with the exception of about 1,000 ft. at the north end, was scarified and a little stone added so as to bring the surface to the desired cross section and then resurfaced with a bituminous compound. After the road had been prepared and reshaped, about ½ gal. per square yard of the bituminous compound was spread. The surface was then covered with gravel about the size of roofing gravel, which was brushed into the voids and a light coating of bituminous compound amounting to about ¼ gal. per square yard applied. Torpedo gravel was then spread, which was carefully brushed into all the remaining voids in the surface and the road was again covered with about ¼ gal. per square yard of bituminous compound. It was then covered with torpedo sand and opened for traffic. The 1,000 ft. on the north end of the road was cleaned, painted with ¼ gal. per square yard of surface of binder and covered with torpedo gravel. A fluxed binder was used.

The following table is an itemized statement of the cost of this work:

Length of road surfaced, ft.	10,560
Width of road, ft.	12
Amount of surface, including intersection, sq. yds.	14,280
Length of haul for gravel and stone, miles	1
Amount of bituminous binder used, gals.	14,638
Rate of pay: Men, 25 cts.; teams, 50 cts. per hour.	
Amount of binder used per sq. yd. of surface, gals.	1.025
Cost of Labor and Supplies—	
Superintendence	$ 182.00
Spiking and reshaping surface	71.94
Loading and hauling gravel and stone	578.77
Spreading stone, sand and gravel	461.03
Rolling	327.75
Trimming shoulders and side roads	227.04
Watchman and miscellaneous labor	417.76
Coal, oil and supplies, including tools	191.11
Gravel and stone, including freight	714.82
Hauling bituminous binder	72.95
Heating and spreading bituminous binder	376.23
Cost of bituminous binder	1,171.04
Total	$4,792.44
Cost Per Square Yard for Resurfacing—	
Bituminous binder	$0.0824
Applying bituminous binder	.0315
Other labor and materials	.2217
Total	$0.3356

The Cemetery road in Olney Township, Richland County, was constructed as a waterbound macadam in the fall of 1908 and in the spring of 1909. After its completion very little work in the way of maintenance had been done upon it. In the summer of 1912 it was decided to resurface this road throughout. The mud which had accumulated on the surface of the road was removed when the surface was found to be in fairly good condition. This mud had accumulated partly on account of the vehicles pulling it onto the macadam from adjoining unpaved roads and partly due to the fact that in cleanning the gutters alongside the roads a considerable amount of mud was thrown back onto the roadway itself.

All uneven places in the macadam were loosened up and filled with stone so as to bring the surface to the desired shape. Some sections of the road were loosened up for the entire width, while other sections were loosened where the traffic had worn a rut into the surface. The entire roadway was then covered and bonded with screenings. After the screenings had been placed and bonded it was covered to a depth of ¾ in. with a good grade of bonding gravel, which was watered and rolled.

The following table is an itemized statement of the cost of this work:

Length of road resurfaced, ft.	5,000
Width of road: 2,500 ft. 16 ft. wide; 2,500 ft. 12 ft. wide.	
Amount of road resurfaced, sq. yds.	7,700
Amount of stone used, cu. yds.	220
Amount of gravel used, cu. yds.	150
Length of haul for materials, miles	½
Rate of pay: Men, 17½ cts.; teams, 35 cts. per hour.	
Cost of Labor and Supplies—	
Superintendence	$ 150.00
Cleaning and reshaping old surface	75.00
Loading, hauling and spreading stone and gravel	156.65
Rolling and sprinkling	90.00
Freight on stone	188.89
Cost of gravel delivered, Olney	110.74
Coal, oil and supplies	16.10
Total	$ 787.38
Cost of resurfacing per sq. yd. of macadam	$0.102
Cost per sq. yd. per year	.034

The sixth annual meeting of the American Society for Testing Materials will be held at Atlantic City, N. J., June 24-28. A provisional program has been arranged, according to which the following subjects will be discussed: "Preservative Coatings"; "Steel"; "Wrought Iron"; "Cement, Concrete and Waterproofing"; "Ceramics and Road Materials"; "Non-Ferrous Metals"; "Testing Apparatus and Methods."

Notes on Road and Street Work.

(Staff Article.)

Cost of Maintenance of Road Building Outfits.—During the years 1908-1912 the Illinois Highway Commission built 1,022,159 sq. yds. of experimental roads. Of this total 397,244 sq. yds. were bituminous macadam. The recently issued report of the commission gives the following data on the cost of maintenance of the road outfits, owned and operated by the commission for the construction of the experimental roads:

Cost of 11 macadam outfits	$37,579
Cost of 6 bituminous outfits	6,628
Cost of 2 concrete outfits	5,381
Total	$49,588
Cost of maintenance of macadam outfits	$3,272
Cost of maintenance of bituminous outfits	1,273
Number of outfit seasons covered by maintenance charges on macadam outfits	52
Number of outfit seasons covered by maintenance charges on bituminous outfits	12
Cost per season for outfit for maintenance of macadm outfits	$61.80
Cost per season per outfit for maintenance of bituminous outfits	106.00
Cost per sq. yd. for maintenance of macadam outfits	0.003
Cost per sq. yd. for maintenance of bituminous outfits	0.003

Estimates on California State Highway System.—At a hearing on March 21 Mr. A. B. Fletcher, Highway Engineer of the California Highway Commission, gave the following estimates as to the mileage of roads to be built under the bond issue of $18,000,000.

Trunk Lines:	
1,305 miles, requiring paving, at $8,620	$11,249,246
489 miles, reinforced with local materials, at $5,944	2,852,905
Laterals:	
785 miles at $2,881	2,261,485
Improved county roads, 190 miles, at 0	0
Add 10% for administration, surveys, and engineering	1,636,364
Total bond issue	$18,000,000
Total mileage (miles)	2,760

It was stated that the figures of mileage were tolerably accurate, but that the average prices per mile were rough only. It was also stated that the roads with a thin asphaltic wearing surface on a concrete base, on the basis of the 100 miles under contract, were costing about $7,600 per mile, this cost being made up approximately as follows:

	Total Per Mile.	Per Cent.
Grading, culverts, etc.	$1,300	17.1
4-in. concrete base	5,860	77.1
⅜-in. bituminous wearing surface	440	5.8
Total	$7,600	

These roads have a concrete base of a minimum thickness of 4 in. and 15 ft. wide. Shoulders at least 3 ft. wide are built on each side of the concrete. The concrete base is covered with a thin coating of asphaltic oil of special quality and stone screenings, forming a bituminous carpet for ⅜ in. to ½ in. in thickness to serve as a wearing surface and to protect the concrete.

Cost of Feeding Horses at Newport, R. I.—During the municipal year of 1912 the department of highways and bridges of Newport, R. I., maintained 11 horses at the city stable. The amount of forage consumed and its costs are shown in the accompanying tabulation, the figures being taken from the last annual report by J. K. Sullivan, Street Commissioner of Newport:

	Total.	Per Horse.
Hay, 49.6 tons	$1,448.92	$131.72
Oats, 1,754 bu.	1,062.20	96.56
Straw, 2.2 tons	51.64	4.69
Bran, 500 lbs.	7.95	.72
Salt, 20 lbs.	.40	.03
Corn, 64 lbs.	1.88	.17
Totals	$2,572.99	$233.89

Cost of Road Rolling.—The recently issued report of the Illinois Highway Commission for the years 1910, 1911 and 1912 contains the following data on road rolling. The data are for the rolling of 1,022,159 sq. yds. of experimental roads, mostly macadam, constructed in 1908-1912, the machinery being owned and operated by the Illinois Highway Commission.

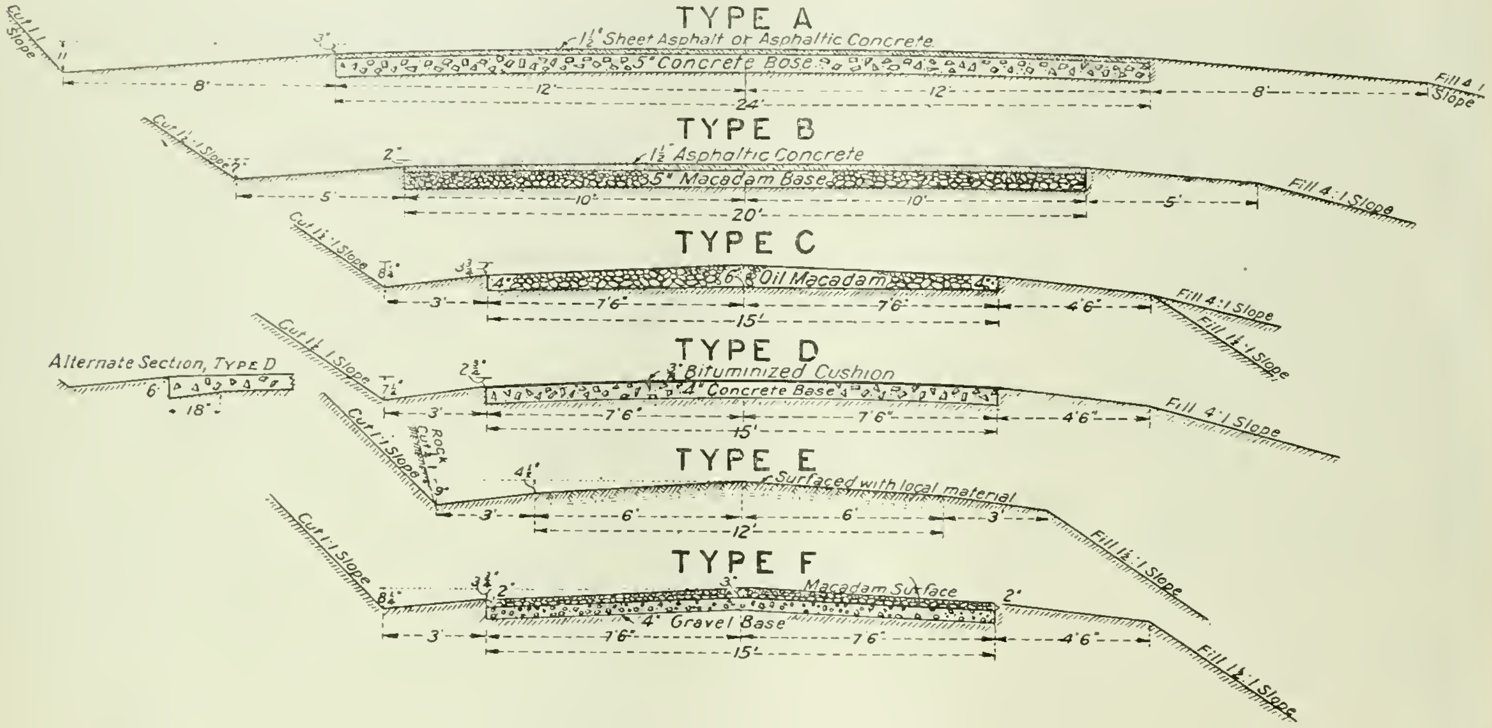
The total cost and the cost per square yard were as follows:

	Total.	Per Sq. Yd.
Salary and expenses of roller operation	$27,593	$0.0270
Maintenance of outfits	4,545	.0044
Freight on outfits	4,749	.0047
Totals	$36,887	$0.0361

Cost of Hauling with Team and Tractor Outfit.—In connection with the construction of an experimental road in 1912 in Sargent Township, Douglas County, Illinois, by the Illinois Highway Commission, a traction engine outfit was used for hauling and placing part of the stone. The road was surfaced with waterbound macadam for a length of 16,800 ft., a width of 10 ft. wide and a depth of 8 in., the haul for the stone being an average of 3 miles. The rates of pay were: Men, 20 cts. per hour; teams, 40 cts. per hour. The following data on the cost of hauling on this work are abstracted from the recently issued report of the commission:

Cubic yards stone hauled by engine	2,590
Cubic yards stone hauled by team	3,989
Days outfit was on job	120
Days outfit hauled (fraction counted as full)	40
Cost to Illinois Highway Commission of engine operator (salary and expenses, straight time)	$340.00
Cost of fireman (actual time worked)	66.20
Coal, oil and supplies for outfit	181.81
Cost of maintenance of hauling outfit (one-half season)	53.00
Total cost of traction outfit work	$641.01
Total cost per cu yd. for hauling	$ 0.247
Actual cost per cu. yd. for team hauling (on same work and same length haul)	.560
Cost of hauling by engine, per cu. yd. mile	.082
Cost of hauling by team per cu. yd. mile	.186

Detailed cost of engine hauling:	Per Cu. Yd.
Operator	$ 0.043
Fireman	.008
Coal, oil, etc	.024
Maintenance	.007
Total	$ 0.082



Typical Road Sections of California State Highway System.

Oiled Earth Road Construction in Illinois.—In 1911 the Illinois Highway Commission constructed an experimental oiled earth road in Virginia, Cass County, Illinois. The following data on the work are taken from the last report of the Commission. The road began at the corner of the public square in Virginia and extended on Main St. for a distance of about 1 mile. The country is slightly rolling and only a small amount of grading was necessary. Practically all common types of Illinois soil were found on this road. About 16 ft. of the middle portion of the road was treated with oil. This portion of the road was plowed up and pulverized with a roller and disc harrow, and the pulverized earth moved out to the side of the road. The foundation was then thoroughly compacted with a 10-ton steam roller, and the oil and earth applied in alternate layers. The earth was then thoroughly water soaked and mixed with a disc harrow and compacted with a rolling tamper. The work was completed rather late in the fall and did not thoroughly dry out before freezing weather. The oil used was an asphaltic residuum, having a specific gravity of 12°-14° B. The length of road constructed was 5,600 ft. the width 16 ft. and the surface treated 9,956 sq. yds. A total of 19,457 gals. of bituminous binder was used, the average haul of tank wagon being ⅜ mile. The rates of pay were: Men, 20 cts. per hour; teams, 35 cts. per hour. The cost of the work was as follows:

	Total.	Per Sq. Yd.
Superintendence	$ 90.00	$0.00903
Excavation	233.91	.02349
Shaping road bed	60.60	.00608
Trimming shoulders and side roads	46.20	.00460
Mixing and tamping	237.65	.02386
Rolling	22.50	.00226
Watchman and miscellaneous labor	18.20	.00183
Coal, oil and supplies	40.50	.00406
Applying oil	109.20	.01096
Cost of oil delivered	729.64	.07228
Totals	$1,588.40	$0.15845

The cost of applying the oil can be further itemized as follows:

		Per Gal.
Heating oil	$70.90	$0.00364
Hauling and spreading	38.30	.00196
Total		$0.00560

Cost of Engineering, Supervision and Inspection on Experimental Roads.—The following data on the cost of engineering, supervision and inspection relate to experimental roads constructed in 1908-1912 by the Illinois Highway Commission. The figures are taken from the fourth report of the Commission, which was issued last month:

Cost of work constructed	$650,183.00
Square yards of road constructed	1,055,501
Cost of 1,055,501 sq. yds. of road	$624,319.00
Total cost of engineering, superintendence and inspection, including office expenses for all road work	87,466.00
Less cost of engineering furnished on roads not built by the commission (25 miles at $50.00)	$1,250.00
Less cost of supervision of non-experimental roads using penitentiary stone	1,335.00
Total expense not chargeable to experimental roads	$2,585.00
Cost of engineering and supervision on experimental roads	$84,881.00
Percentage of total cost of experimental roads expended for engineering, superintendence and inspection, per cent	13
Cost per square yard finished road for engineering, supervision and inspection	$0 059

Increase of Motor Traffic.—Some interesting figures on the rapidly changing traffic conditions in Illinois roads are given in the recently issued report of the Illinois Highway Commission. As an illustration of the change taking place on some of the roads in Illinois, mention could be made of the traffic census taken on the road leading from Chicago to Clinton. At Dixon and DeKalb observations of the traffic were taken in 1907. In 1912 observations were also taken on this road at DeKalb, Dixon, Wheaton, Ashton, Sterling, Geneva, Lombard and Maple Park. All of these stations are outside of the villages and towns named, and include therefore what may be called strictly country road traffic as distinguished from local village traffic. At the DeKalb station in 1907 the automobiles were 4 per cent of the total traffic, while in 1912 at the same point they were 50 per cent. At Dixon in 1907 the motor traffic constituted 2 per cent of the total traffic; in 1912, 33 per cent. Also in 1912 at Wheaton the motor traffic was 63 per cent; at Ashton, 34 per cent; at Sterling, 34 per cent; at Geneva, 58 per cent; at Lombard, 55 per cent, and at Maple Park, 66 per cent, these percentages being averages of observations taken four days each in May, June, August and September in 1912.

Typical Sections of California State Highway System.—The accompanying illustration shows typical sections of the state highway system of California, which is to be built under the $18,000,000 bond issue. The thickness of pavement shown is the minimum; if so ordered by the Highway Engineer it is increased. The illustration is taken from the California Highway Bulletin, the official publication of the California Highway Commission.

Experimental Road Work of the Public Roads Department of New Jersey.

In 1911 several experimental roads were constructed under the direction of the Commissioner of Public Roads of New Jersey. A description of this work was given in Engineering and Contracting, Sept. 25, 1912. During last year several additional experimental roads were constructed and some of the roads built previously were repaired. The following description of the work along these lines is taken from a report of Mr. Robert B. Gage, Chemist of the Geological Surevy, as embodied in the report of Mr. E. A. Stevens, Commissioner of Public Roads, for the fiscal year ending, Oct. 31, 1912.

GRAVEL BASE WITH BITUMINOUS SURFACE.

This experiment was made in 1911 near Hartford, Burlington County. The object was to see if a gravel base did not possess sufficient strength to hold a bituminous pavement on roads which were not subject to too heavy travel. The results secured so far on this particular road would lead one to believe that such is the case, for as yet the defects that have developed in this pavement have all been confined to the bituminous surface, and can hardly be traced to any defects in the base.

The bituminous top that was laid upon this road was composed of sand and tar built up by a penetration method to a thickness in many places of about 2 ins. Since a soft tar was used in the construction of this pavement, it became quite soft during the warm weather last summer and rutted more or less. This would no doubt not have happened had the thickness of the tar coating been limited to about ½ to ¾ in. instead of 2 ins. Apparently the main fault to be found with this surface was its lack of stability. In order to give it the necessary resisting power, a layer of 1½-in. stone was scattered over its surface and rolled into the soft pavement. Another layer of tar was then applied and some stone chips and the road again rolled. This appeared to be just what was needed, for no evidence of rutting or creeping has developed since the application of these stones. The road today is in very good condition, and its life no doubt now depends on the ability of the tar to resist oxidation with subsequent disintegration.

Mr. Gage states that this experiment would lead one to believe that if a good solid gravel base were protected by some kind of a waterproof coating that would prevent its becoming over saturated with water during the wet season, or too dry during the summer, it would then possess sufficient strength and stability to maintain an ordinary bituminous pavement. He adds that no doubt the pavement best adapted to lay upon such a surface would be like that specified under the New Jersey Public Roads specification for Type H. [A cold mixed bituminous concrete.] Pavements of this class have an open base with a tight top; consequently, the moisture contained in the gravel could not come in contact with and decompose the upper part of the pavement. Pavements of this type are prepared by a mixing method, and cost considerably more than a pavement constructed by a penetration method in the manner described hereinabove. The former type, however, possesses greater uniformity and no doubt durability, yet in certain cases where the travel is not excessive the latter type will fulfill all the requirements to which it will be subjected.

Since several different types of pavement will conform to the Type H requirements, we are not limited to any one particular pavement in this case. If these gravel bases can be made to maintain a bituminous pavement in this manner it will be a considerable saving in the construction of new roads and maintaining the old gravel roads in localities where gravel is abundant.

GLUTRIN, WESTRUMITE.

The section of the White Horse-Maple Shade road treated with glutrin in 1911 showed little effect of such treatment this spring. At a few points in this road a clay gravel was exposed in the cuts. At such places the glutrin appeared to have had some little effect, but on the sandy base no effect whatever could be seen this spring of the glutrin applied during the fall of 1911. Two other experiments were completed upon this road during the past summer. One of these was a slag base with a slag top. This road has been treated with glutrin, the manufacturers of which claim will harden the surface of this road into a concrete. The object of this experiment is to ascertain the correctness of this statement, and also to see if a slag base will in time cement itself into a slag concrete.

Upon another section of this road was laid some 1,500 ft. of bituminous pavement known as Westrumite. This pavement was laid upon a regular macadam base of about 5 ins. in thickness after compression. The pavement itself was laid in two courses, the bottom course consisting of a uniform size of 1½-in. stone laid 2 ins. thick. These stones were coated with the Westrumite, using just enough of this material to coat them. They were then scattered over the base of the road in a uniform layer and allowed to harden somewhat before the surface was applied. The top course consisted of limestone screenings impregnated with the Westrumite.

It was prepared by mixing these screenings with sufficient of the Westrumite to make a mortar that would flow and could be raked quite easily, but not sufficiently thin to run off the road after being spread. This mortar was dumped on the road surface and immediately raked over the larger stones in a uniform layer of about 1 in. in thickness. After several hours the mortar had cured sufficiently so that it could be rolled without adhering to the wheels of the roller. It was then rolled until the mortar had been forced into the voids of the 1½-in. stone. The surface thus produced was then painted with the Westrumite, after which an application of screenings was spread over its surface, the road again rolled and opened to travel.

CONCRETE ON COBBLESTONES AND BITUMINOUS SURFACE.

The road leading from Moorestown to Camden was originally paved with cobblestones. These stones have become displaced by the frost and travel to such an extent that the present surface is very irregular. About the only way in which such a surface can be repaired is to relay these stones to the proper grade and curvature, or cover them over with a thin layer of concrete before the bituminous surface is laid. Such a road can be repaired by the latter method at a much lower figure than by the former; consequently, a small stretch was selected and repaired by the latter method.

After the concrete was spread and brought to the proper grade and curvature, a layer of 1½-in. stone was scattered over the fresh concrete and tamped until the stones were about one-half imbedded in the concrete. Upon the surface thus prepared a layer of bituminous mortar was spread about 1 in. thick after compression. This mortar was composed of about 48 per cent grit, 44 per cent sand and 8 per cent asphalt. The mortar was squeezed by rolling into the openings between the stones which projected above the concrete and was thus firmly anchored in place. It is the function of these stones to hold this mortar firmly in place and prevent it from creeping or rutting, and also to diminish the quantity of mortar which would be otherwise required. In time these stones will show on the surface and should then take the burden of the travel.

The chief benefits secured from this experiment to date have been the determination of the errors which most generally accompany any new type of construction, and which we desired to know. Once these points have been determined we can easily prevent their repetition in constructions of this type in the future. If the merits of this type of construction can be judged from the present appearance of the pavement, it should be very satisfactory. A bituminous mixture of this type is waterproof and exceedingly tough. It possesses the durability of a sheet asphalt pavement, has much more inherent stability, can be prepared from a softer bitumen and is not nearly so brittle or slippery.

There is little doubt but that we will have more or less trouble in constructing roads using this base or any other concrete base, until the contractors realize the importance of making concrete of a uniform character and high quality. The quality of concrete which the ordinary contractor has been accustomed to lay will not answer our purpose in a base of this type. If we adopt a concrete base or use this type of base to any extent it will have to be constructed of a uniform character and of a high quality, otherwise failures will surely develop at points where the concrete is of an inferior grade.

The inequalities of the base upon which this concrete was placed compelled us to use a much larger quantity of concrete than was originally figured upon. In depressions, 4 to 5 in. of concrete often had to be laid in order to bring the surface up to the required grade.

REPAIRING GRAVEL ROADS.

During the season we have made several efforts to try to find a satisfactory method of repairing and maintaining our gravel roads. Glutrin was applied with fairly satisfactory results. It may be possible with this material, when it is properly applied, to prevent these roads from rutting and cutting up during the wet season in the spring, and also from raveling during the dry period of the summer. As yet we have no assurance that we have applied this material in a manner that will give us the maximum results. Several applications have been made on roads of different characters to determine the ability of this material to resist solution and subsequent disintegration during the spring and wet season.

There is little doubt but that this material is almost a total failure when applied to a sand aggregate or an aggregate composed of silicates which are not easily decomposed by mineral or organic acid. However, when it is applied to an aggregate that is easily attacked by these acids, such silicates are more or less gelatinized, and will cement the aggregate thus treated into a comparatively solid concrete. This being the case, we will no doubt find that this material may hold certain gravel roads and fail on others, depending on the character of the silicates, which are the real binding materials that hold a gravel road together. It has been demonstrated, apparently quite conclusively, that this material will cement some blast furnace slags into an apparently firm concrete.

Another method of repairing gravel roads that was tried and promises to give fairly good results at a comparatively low cost of treatment, is the coating of the surfaces of these roads with a liquid asphalt containing about 30 per cent of a volatile liquefier. An asphalt cement containing this quantity of a liquefier will be sufficiently thinned that it can be handled and applied cold. After the gravel surface has been coated with about ¼ to ¾ gal. of such a bitumen the surface is ignited and the volatile liquefier burnt out of the bitumen. The heat thus generated heats the top surface of the road sufficiently so that the hot bitumen will penetrate into the surface to a depth of from ¼ to ½ in. As soon as the surface has become cooled, the bitumen will no longer adhere to the wheels of passing vehicles and the road can be opened to travel at once. It is, however, always safer to scatter a light layer of sand over the surface, for it is not always possible to keep the travel off such a road until it has become thoroughly cooled.

The heat generated during ignition of the light liquefiers is not sufficient to injure the asphalt. This point was carefully determined by testing a bituminous residue from such an ignition. It possessed all the qualities the original material had before fluxing, and was not "cracked" in any way. This is not true of crude petroleum containing medium and heavy distillates, for such a material is ruined by this treatment. Cut back tars are also ruined if all the light liquefiers are burnt out. In order to secure the best results by this method of treatment, the gravel surface should be perfectly dry, of a dense uniform character and free from breaks in the surface containing loose material. Since most of our gravel roads when in a dry condition contain more or less of these loose openings, it will be necessary to fill these openings with a gravel which has been treated with some material that will harden fairly quickly and give a surface equally as hard as the remaining part of the road.

The cost of a cut back asphalt of this character is about 12 cts. per gallon. By using ⅓ gal. per square yard the cost of the bitumen required and its application should not be over 6 to 7 cts. per square yard of surface treated. If such a treatment will hold the surface in shape for a year or more, the cost of applying this bitumen is so low that the roads could be treated annually by this method, for the quantity of bitumen required for the second application will be much less than the amount used for the first. In order to secure the maximum results by this method it may, however, be necessary to first treat the gravel surface with some other material that will harden it temporarily until the bitumen has been applied in the manner above described. As yet we have no roads thus treated which have passed through a winter; consequently, it is not possible at this time to say just how efficient this method of repairing a gravel road will be.

Third American Road Congress.—The American Road Congress will hold its Third annual meeting at Detroit during the week of September 29. The Congress is held under the auspices of the American Highway Association, the American Automobile Association and the National Association of Road Machinery and Material Manufacturers, the latter organization being concerned primarily with the exposition of machinery and materials held in conjunction with the Congress. The sessions will be arranged as heretofore, so as to specialize on construction, maintenance, legislation, administration, economics, etc. It has been decided to have a special session for the benefit of contractors, and in order to make this session of practical value to the contractor, a committee composed of some of the best informed men on contract work in this country will have full charge of preparing the program and conducting the session. The exposition will be held on the ground floor of the Wayne Gardens, immediately under the large hall in which the sessions of the Congress will be held and, in order to meet the requirements of the companies which manufacture heavy road building machinery, a large vacant lot and an adjoining street will be transformed into exhibit space by the erection of a large tent, in which heavy machinery may be exhibited and demonstrated. As heretofore, the remarkable government exhibit of road models will be a feature of the exposition, together with the various state exhibits which will be shown in much larger number than at the congress held in Atlantic City in 1912. The officers of the Congress are Logan Waller Page, director of the United States Office of Public Roads, President; Lee McClung, Former Treasurer of the United States, Treasurer; J. E. Pennybacker, Secretary of the American Highway Association, Secretary; and Charles P. Light, Former State Highway Commissioner of West Virginia, Assistant to the President. The headquarters of the Congress are in the Colorado Building, Washington, D. C.

DRAINAGE AND IRRIGATION

Recent Irrigation Works in Porto Rico With Descriptions of Structures and Some Construction Costs.

The development of a comprehensive irrigation system for Porto Rico is perhaps the most notable public work undertaken by Americans since their occupation of the island. A very good account of this development is given by Mr. W. L. Squire and F. H. Knapp, Assistant Engineers, Porto Rico Irrigation Service, Guayama, Porto Rico, in the "Cornell Civil Engineer" for May, 1913, and from it we take the following extracts:

Porto Rico, the smallest of our island possessions, is 95 miles long by 35 miles wide. The chief product of Porto Rico is cane sugar, of which it is one of the chief producers of the world. The available cane land of the island is of a very small percentage of the entire area and consists of only a narrow coastal plain, for the most part in the south, east and west borders. The area to be irrigated by the project now under construction is located in the central southern part and extends in a general way from the Patillas River valley on the east to the Jacaguas River on the west; it is a strip of land about 40 miles long by two miles wide. (Fig. 1.)

Because of the topography irrigation is absolutely necessary in this district. The interior of the island is mountainous. It is traversed by a main divide of about 2,500 ft. elevation, running east and west a short distance from the southern coast throughout its entire length. There are secondary divides further north which are parallel to it, but which generally radiate toward the sea. Porto Rico is in the zone of the Trade Winds which furnish its moisture; because of their prevailing northeast and easterly direction most of their moisture is precipitated on the northern slope. Thus the mean annual rainfall in the northern part of the island is in places from 100 to 125 ins. and more, while in the southern part it averages about 45 ins. and in many places below 40 ins. and with a minimum yearly rainfall recorded at Aguirre in 1907 of 21 ins.

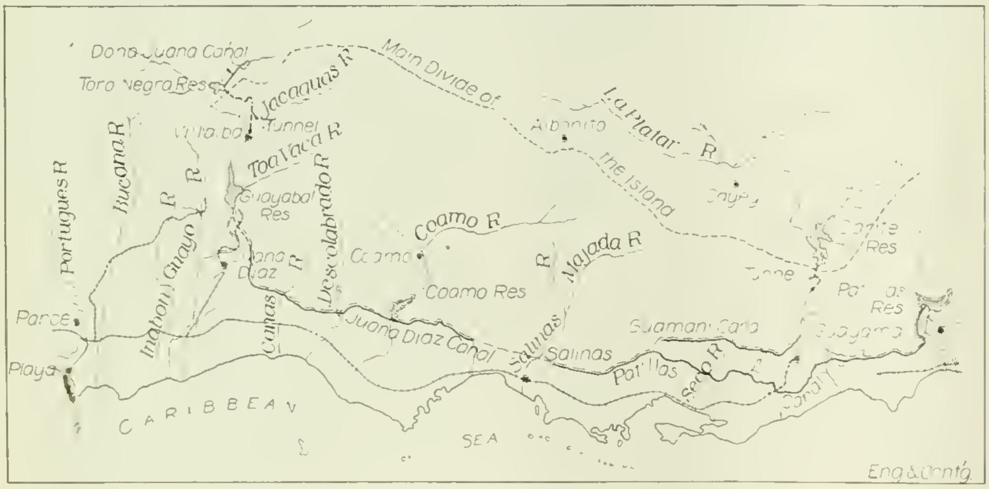


Fig. 1—Map of Irrigation System of Porto Rico.

Long periods of drought are common—as many as six months have passed without rain. The dry season extends from June to September. In general, most of the rain falls in the months of October, November and May. During the season of prevailing rains, the rainfall is often heavy and of short duration. The heaviest recorded on the entire island since 1899 occurred during the passage of the hurricane August 8, 1899, when at one of the mountain stations 23 ins. were recorded in 23 hours. During the last year, by the irrigation service rain gages, 10.72 ins. were recorded in about 12 hours; at another time 4.39 ins. fell in 2 hours.

In order to cultivate sugar cane successfully a large quantity of water is needed throughout the year. So in order to make up for the ordinary deficient rainfall as well as to insure the crops against unexpected droughts, irrigation has been resorted to for many years. By concessions dated from 1844, all of the ordinary flow of the rivers and some flood waters have been granted to the planters. There were in all about 75 concessions granted from which about 40 independent systems of canals have been developed, each one of which watered one or two estates. These many systems carried from 1 to 14 sec. ft. To supplement this supply, about 90 pumping plants, aggregating 900 useful horsepower were installed; these varied from 1 h. p. to 40 h. p., costing from $1,800 to $37,000 each and furnished water at an average cost of about $7.50 per acre foot, a mean for all the pumps.

However, withal, the supply of water was very insufficient. The need of a large centralized system to conserve the flood waters that now go to waste has generally been recognized for many years. During Spanish possession several attempts were made to develop such a system but failed. Finally in 1907 under American administration the legislature passed appropriations and a study of the possibilities was made. In all, $4,004,000 have been appropriated to date and about $2,000,000 more will be needed. This will be paid back by the owners of the land benefited.

GENERAL PLAN.

The scheme of the project consists in impounding the water of four of the rivers in the district, the Patillas, the Jacaguas, the Coamo and Guamani, and catching most of their flood water; and diverting the flow of the three rivers, the Plata, Toro Negro and Dona Juana just north of the divide and conducting their water by tunnels to the southern slope. These latter rivers rise in mountain districts of abundant rainfall and have a relatively large ordinary flow and many floods.

The Patillas reservoir will have a capacity of 11,830 acre feet and will be supplied by a drainage area of 20 square miles. This will feed the Patillas canal of 150 sec. ft. capacity at intake, which extends westward 24 miles to the Salinas River, and commands 16,200 acres of irrigable land.

The Plata River reservoir, which is supplied by a drainage area of 8 square miles, has a capacity of 10,160 acre feet. Its water is conducted by a canal cut 1,000 ft. long, to the Carite tunnel, which is 3,036 ft. portal to portal. The maximum capacity of the tunnel is about 400 sec. ft. On the south slope all the water passes into the Guamani River basin. Thirty-four sec. ft. is used first, however, by the Carite water power project. The static head is 760 ft. Two thousand h. p. in two units of 1,000th h. p. each are developed to run irrigation pumping plants and to light neighboring towns.

The combined discharge, from the Plata reservoir and the Guamani River is intercepted by diversion dams and conducted into the two canals, Guamani east and Guamani west. From the former 925 acres will be irrigated. The latter canal commands 3,200 acres and will also supply the Conuco storage reservoir of 230 acre feet capacity and add to the flow of the Patillas canal at 14 miles from the Patillas headgates. These comprise the eastern district.

In the western district, the Jacguas River is dammed, forming the Guayabal reservoir. It has a capacity of 10,480 acre feet and is fed by the Jacaguas drainage district of 30 square miles and by the flow of the Tora Negro and Dona Juana rivers north of the divide. All of the ordinary flow and part of the flood flow will be furnished by the rivers. It is carried through the mountains by the Toro Negro tunnel, which is 2,770 ft. long and has a capacity of 400 sec. ft.

The Guayabal reservoir supplies water to the Juana Diaz canal—capacity 125 sec. ft. The canal is 24 miles long. It extends to the Jueyes River and commands 19,700 acres of irrigable land.

At the Coamo River, about 21 miles from the Guayabel dam, its flow is augmented by the Coamo reservoir of 2,600 acre feet capacity stored from the Coamo River.

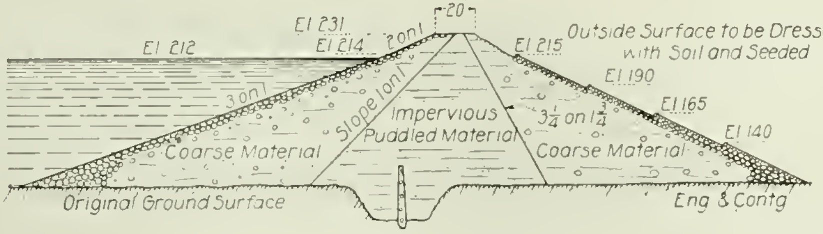


Fig. 2—Cross-Section of Patillas Dam.

As preliminary to the design and construction of the works a hydrographic service was started in 1907 and has kept a record of these river flows. It has been necessary to keep records of the flow in the old canal systems also in view of the relinquishment of their water rights for equivalent value in the new system, since the old systems in most cases will have to be abandoned. The unusual character of the flow of some of the rivers is shown by Table 1 of maximum, minimum and mean discharges.

A topographic survey was made of the entire district, followed up by special surveys and investigations determining, with accuracy, the division of the property into land lots of separate ownerships and into classifications of cultivated lands and soils. The work shows a result of 60,000 acres total area in the district, of which 43,000 acres are irrigable; of the latter figure 20,000 are already in cane and 21,000 of it irrigated, though usually very insufficiently.

It is possible with the available water supply of the new system to irrigate 35,000 acres, giving an application of one acre inch per week during the entire year and somewhat more during the wet season. This application with the prevalent rainfall is considered by some of the planters as sufficient for a good yield of cane.

TOPOGRAPHIC SURVEY.

The area covered consisted of about 140 square miles. The country, being open and gently sloping, lent itself readily to the plane table method, which was adopted. The horizontal control was connected with several stations occupied by the United States Coast and Geodetic Survey in 1889; 32 primary stations were occupied and 23 more located by theodolite intersections. The vertical control was based on a precise line of levels run from Ponce to Patillas along the main road and shorter check level lines run from the main road north and south along private or country roads to the mountains and to the sea. Bench marks were placed at intervals of 1,000 to 2,000 ft. along these roads. A scale of 1,000 ft. to the inch was decided upon with 5 ft. contours. Boundary lines were all carefully put in to obtain areas for taxation purposes. This survey cost $192 per square mile.

TABLE 1.—RIVER FLOWS IN P. R. I. S. PROJECT.

Name.	Mean daily per year.	Extreme Max. Mom.	Minimum daily.	Maximum daily.	Maximum daily per month.	Minimum daily per month.
Patillas R.	105.3	19,630	11.6	3,990	358.9	16.6
La Plata	41.6	13,030	7.2	3,550	218.4	8.8
Guamani	13.6	2,850	1.5	1,160.1	90.0	1.9
Coamo	45.6	22,500	1.0	4,700	425.5	4.2
Jacaguas	105.5	57,800	6.4	7,570	447.3	14.21
Toro Negro	27.0	10,760	2.0	1,150	130.0	5.9

"Mean daily records per year," as based upon all whole year records from commencement of same to January 1, 1913.

PATILLAS DAM.

Patillas dam is located across the Patillas River, about 1,000 ft. below its junction with Maton creek. It is being built of earth and rock with a concrete cut-off wall. The dam will have a maximum height of 135 ft., a crest length of 1,020 ft. and will contain 733,000 cubic meters of material. The width at the top will be 20 ft. and the maximum thickness at the base 695 ft.

For the temporary diversion of the river during construction and for the ultimate outlet and control of the water, a tunnel 20 ft. wide, 20 ft. high and 600 ft. long was excavated through the hill adjacent to the north side of the dam. Most of this work was done by contract at a cost of $9 per cubic meter to the irrigation service. This price included placing the material in the dam. The rock is described as a highly altered diorite and is badly fractured. The tunnel is lined throughout with a minimum of 9 ins. of concrete.

The excavation of the core wall was carried well down into impervious rock. Fairly good foundations, consisting of hard tosca, were easily reached, except in the river bed. Here the excavation was carried down a distance varying from 18 to 30 ft. first through a layer of gravel and boulders, then into tosca. The core wall is built of plain concrete and is 40 ft. high across the river bed. The top width is 12 ins. and each side has a batter of 1 in. per foot.

A spillway is being cut through the ridge easterly of the dam to care for a maximum flood of 60,000 cu. ft. per second. A Marion steam shovel, model 35, with 1 cu. yd. bucket is now excavating from this site, dumping the material, which consists of tosca and clay, into 4 cu. yd. dump cars, which are hauled over a meter gage track by a 9 ton locomotive. The cars discharge into a wooden flume, which is located on a 5 per cent grade and is 700 ft. long. The material is then hydraulicked to the dam by water obtained from the Maton creek pipe line.

The bulk of the material for the dam is being excavated by two other Marion steam shovels; one, model 50, carries a 1½ cu. yd. bucket, and the other, model 70, operates a 2½ cu. yd. bucket. A training channel, leading direct from the junction of the Patillas and Maton rivers to the entrance of the tunnel was first excavated. This shovel then continued excavating around the edge of field, coming back again to the junction of the two rivers. Similar circuits around the field will be made, drawing in towards the center each time until the whole area is covered. Figure 2 is a typical cross section of the Patillas dam.

The material is loaded into 8 cu. yd. Western automatic dump cars which are hauled by 20-ton American locomotives in trains of 4 or 5 cars each. To reach the first lift trestles, they are hauled up a grade not exceeding 2 per cent for a distance varying from ¾ to 1 mile. The trestles are located, one along each face of the dam at elevation 160. Clay and sand are washed down into the impervious section by means of hydraulic monitors. The water is brought from Maton creek through 8,000 ft. of 12 and 14 in. pipe and delivered at the work under a head of 200 ft. Two sets of pontoons, each carrying a pressure pipe line and three monitors throwing 3 in. streams were first used, one on each side of the pool, but at present, as some of the water is being used for sluicing material from the spillway into the dam, there is only sufficient pressure for one set of monitors. To take the place of the other set, a barge has been built on which will be mounted a 60 h. p. gasoline engine, directly connected to a centrifugal pump. One monitor throwing a 6 in. stream will be used on the barge. Water will be obtained from the pool itself and will be used over and over again.

When the fill is up to elevation 160, the track on the dam will be raised to meet the higher level approach by switching back from the east end of the dam up a grade built on the fill. Three approaches will be used, each one 25 ft. higher than the preceding. Where the grades are increased, extra engines will be connected to the trains.

CARITE DAM.

Carite dam is located on the north side of the main divide of the island. It intercepts the flow of the LaPlata River, where it has a drainage area of about 8 square miles. It is an earth dam, faced with rock, and has three main cut off trenches of puddled clay placed as shown on the plan. The trenches are about 10 ft. wide at the base, decreasing in size as they approach the top, and are carried well up above the line of saturation of the dam. Several other cut-off trenches were put in across soft pockets encountered in the foundations and in the excavation for the outlet culvert. The maximum height of the dam is 110 ft. thickness at the bottom, 570 ft. width at top, 20 ft. length of crest 500 ft. and volume of material 155,000 cubic meters.

Most of the material for the dam is obtained from the spillway cut. By referring to drawing Fig. 3, showing track and trestle No. 1, the method of construction of dam up to elevation 1,730 can be obtained from the following description: Beginning at the point marked *A*, elevation 1,783, the rock is loosened in a circular section around a movable hopper, 15 ft. square with sides 3 ft. high, which is built of heavy timbers, and has a trap door in the bottom; 4 cu. yd. dump cars are then run in under the hopper and filled. A hoisting engine has been placed at *B* to start the cars from the spillway and to hold them back in descending the 10 per cent grade to the first trestle. The cars are dumped either on the first or second trestle, then pushed by hand down the ½ per cent grade to point *C* at elevation 1,725. The hoist *D* draws the cars up the 18 per cent grade to elevation 1,785, from where they descend again by gravity to the cut. Two more lifts will be necessary to complete the dam. The second layout is similar to the one shown, except that the trestles have been drawn in, on account of the decreased width of the dam at the higher elevation, making a smaller loop. The third lift will consist of two parallel trestles not connected on the farther side, the cars being hauled from the spillway to the dam by the hoists and dropped back by gravity. The last lift will be a single track across the center at elevation 1,800. As the spillway cut increased in width and the material became heavier the hopper was discarded and the material loaded into the cars by hand. Seven tracks are at present laid in the cut, which varies in width from 100 ft. at the entrance to 80 ft. at the center. The greater part of the material in the spillway is a formation, peculiar to the island, called tosca. It is a kind of rotten rock which disintegrates rapidly upon exposure to the atmosphere. It comes out in pieces of all sizes, which must be broken up before it can be compacted in the dam.

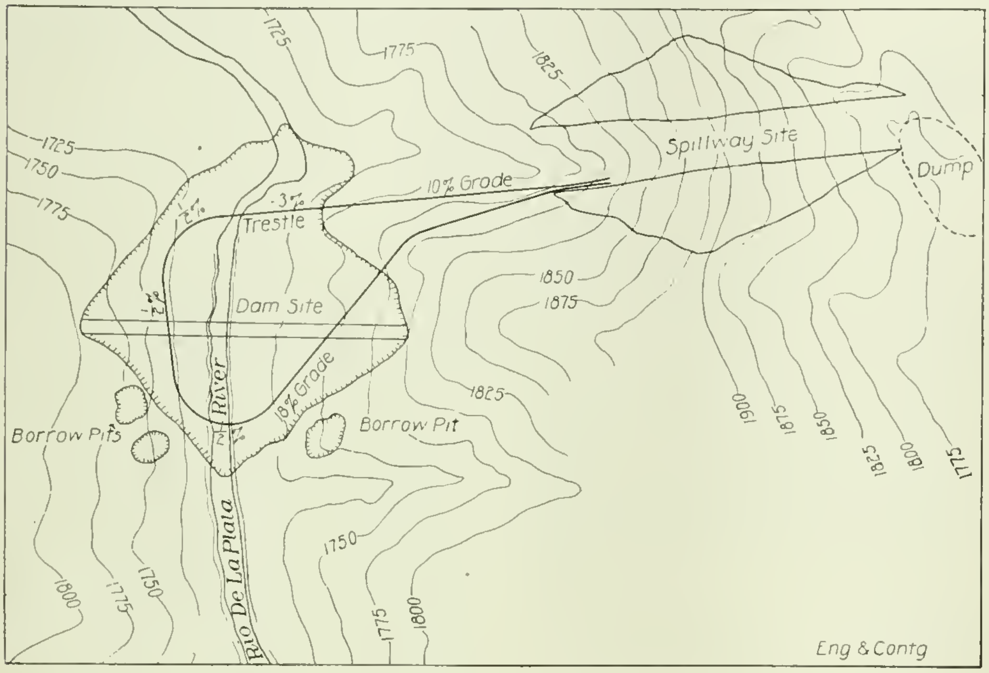


Fig. 3—Construction Plan of Carite Dam.

Different methods of spreading and rolling have been tried. The fill is built in carefully compacted layers covering the entire area of not more than 12 ins. in thickness. To meet this requirement, the clay and tosca must be carried from the dumps underneath the trestles, spread out and rolled until no motion appears in front of the roller. Drag scrapers drawn by mules were first tried out, but on account of the usual highly saturated state of the clay and the large lumps of tosca, the mules were unable to spread the material economically.

Wheelbarrows were resorted to and practically all the material will be handled in this way. For compacting the fill, a 12-ton traction engine was obtained. Except in very wet weather the engine does very satisfactory work. A concrete roller weighing 2 tons was constructed to take the place of the traction engine when the dump was too heavy to manipulate the latter.

The dam is at present 60 per cent completed. Nine miles of wagon road had to be built over the mountains to haul supplies to the dam site. Transportation from Arroyo, the nearest port to the site, cost $16 per ton, exclusive of the cost of the road. In reading the following cost data it should be remembered that labor is high, that the average monthly rainfall at Carite for 22 months is 7.62 ins. with a maximum of 26.8 ins. and a minimum of 2.7 ins. and that hardly a day passes without rain. The average cost to date, including all overhead charges at Carite, of excavating from the spillway and placing and compacting in the dam is $0.70, $1 and $1.60 per cubic meter for first, second and third class material, respectively. Cost of washing from the outlet end of the spillway is $0.50 per cubic meter and of borrowing and placing clay in the impervious sections of the dam from the adjacent hillsides averages $0.75 per cubic meter.

A reinforced concrete culvert 10 ft. wide, 10 ft. high and 500 ft. long provides for the flow of the stream during construction. This was constructed first, of course, and at a cost of $13.72 per cubic meter.

The water passes from the Carite reservoir through the Carite tunnel to the south side of the divide. This tunnel, 4 ft. x 6 ft. in section and 3,046 ft. long, was excavated by contract. The inlet portal cut is 1,000 ft. long, and a concrete conduit with gate tower at the end is being built to eliminate the danger of filling up the tunnel by slides. Headings were worked from both sides, first by hand, then with machine drills. Air was furnished by gasoline engines. The material encountered varied from soft tosca to a very hard diorite requiring no lining. Many difficulties were experienced; partly due to the inaccessibility of the site and to trouble with the laborers. Drill runners from the states were imported, but practically all of them were discharged or became dissatisfied with the conditions under which they were forced to live and left within a few weeks. The tunnel was finished finally by Spanish hand drillers who were taught how to run the machines by the American drill runners. Ventilators run by small gasoline engines were installed at each end to clear the tunnel of smoke. The contract price was $14 per cubic meter, and the actual cost about double this amount.

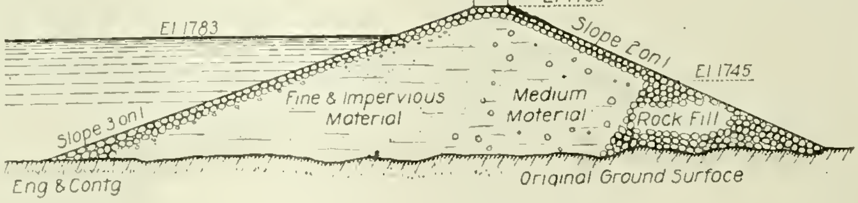


Fig. 4—Cross-Section of Carite Dam.

CARITE WATER POWER PLANT.

The work under this division consists of the construction necessary to take water at the portal of the Carite tunnel, lead it by a canal and steel penstock to the power house and to install all machinery and construct all transmission lines.

The power is generated to 2,300 volts, transformed to 22,000 volts and carried by the transmission lines to sub-stations at Guayama and Salinas, where it will be stepped down for service.

The construction camp is located at the power house site, well up on the mountain side. It is distant 5 miles from Guayama and 9 miles from Arroyo, the nearest port. Its elevation is 960 ft. above sea level. To get materials and supplies on the job · it was necessary to construct an access road 3,500 ft. long to connect with the nearest highway. The total rise in the road is 325 ft. Its construction was completed in November, 1911, at a cost of $1,575.

All hauling from Arroyo has been done by service mule teams. To date 424 tons of material and machinery, consisting of pieces weighing up to 6 tons, have been hauled at an average cost of $6 per ton. The best contract bid offered for the transportation was $13 per ton.

The canal conducting the water from the tunnel is built along a steep mountain side. Its length is 1,441 ft., including one flume, 70 ft. long, of the Maginnis type. It is a covered canal of reinforced concrete, inside dimensions 2 ft. 6 ins. wide, 3 ft. deep. There were 5,250 cu. yds. excavation, costing $0.31 per cubic yard, native labor costing 70 to 80 cts. a day is used here, as in all other parts of this division. The concrete, consisting of 320 cubic yards, cost $12.22 per cubic yard. The cement cost $4.42 per barrel on the job. All cement was brought up mountain trails from the camp to the site of the work by laborers, who took the work by contract. The rock used for the concrete was tunnel waste.

The lower end of the canal is 760 ft. higher than the power house site. Here the water passes from a forebay, having overflow wier, gate and screens into the penstock, which takes it to the power house.

The penstock is a 30-in. riveted steel pipe 2,337 ft. long. The lengths of the sections as shipped were 7 ft. and 10 ft., weighing from 414 lbs. to 1,595 lbs. There were 290 sections of pipe and two expansion joints, each of which weighed 2,718 lbs. Grades varied from 0.8 per cent to 95 per cent.

The pipes were hauled from the power house to place on a 30-in. gage track by winches and mules for power. The installation consisted of 2,300 lin. ft. of portable track and 3,500 ft. of ⅝ in. cable. Most of the pipes were riveted together, at the bottom of the hill, in lengths up to 30 ft. and weighing up to 5,568 lbs. All riveting was done by hand; 12,164 rivets were placed, varying in sizes from ⅜ in. by ¾ in. by 3¼ · ins. long. The average cost of installation was $2.67 per foot.

The excavation amounted to 1,900 cu. yds., and the backfill to 1,800 cu. yds., costing per cubic yard 29 and 75 cts., respectively.

Reinforced concrete anchors were placed at frequent intervals. They contained 3 to 8½ cu. yds. of concrete each, at a cost of $11.85 per cubic yard.

The reinforced concrete power house building now under construction, 84.5 ft. long by 32 ft. wide, will be equipped with a 6-ton hand operated crane.

The installation is in two units. There will be two 700 k. w., 2,300 volt, 3 phase, alternating current, Westinghouse generators of

400 R. P. M. These will be driven by a 62 in. Pelton impulse type water wheel. Two 30 k. w., d. c. Westinghouse exciters are used; one is driven by a 27½ in. Pelton water wheel and the other is driven by the main unit.

PATILLAS AND GUAMANI CANALS.

Upon the completion of the Pitillas dam, bulkheads and gates will be placed in the outlet tunnel to control the flow from the reservoir into the canal. The top of the dam is at elevation 232, the spillway at 212 and the grade of the canal at the intake 138.3.

In locating the Patillas canal several governing factors had to be considered; first, the higher the location the greater the area of cane land commanded, but on the other hand, the higher the location, the smaller the amount of water available from the reservoir; second, the higher the location, the shorter the tunnels; third, the elevation of certain saddles by the cutting through of which considerable length of canal lines and some elevation could be saved; fourth, favorable points for crossing river valleys with short siphons or flumes. The location finally decided upon follows along the foot of the mountains almost entirely above the cane land to the Arroyo River. From this point on the line passes usually through the cane, running out at elevation 45 at Salinas.

The strip of cane land, extending from the Arroyo River to Salinas, above the Patillas canal, will be irrigated by the Guamani canal and by pumping, power being furnished by the electric plant at Carite.

The Patillas canal is 24.3 miles long. The velocity, when running full, will be 2.64 ft. per second and the grade, except in the tunnels, siphons and flumes, is .06 per cent. The size of the canal decreases as water is taken out by the different laterals.

Three tunnels have been excavated. The materials encountered in all was practically the same as that in the Patillas tunnel, described above. A layer of tosca, varying from 50 ft. to 100 ft. in thickness and increasing in hardness, was generally encountered at the portals before the diorite was reached. These tunnels are excavated 7 ft. 6 ins. wide and 6 ft. high in the center. The concrete lining consists of 9 in. walls, 4 in. floor and a 6 in. arch.

The longest of these tunnels, Ancones, is 2,171 ft. Work was begun by contract, but after advancing the north heading about 50 ft. through soft material, the roof caved in, and the contractor abandoned the work, which was then taken up by force account. The cut and cover method was adopted in this heading, a concrete conduit 6 ft. wide and 5 ft. high being built and backfilled immediately. About 188 ft. were constructed in this manner. The material then became soft tosca, which could be tunneled, but required timbering and lining. This heading was advanced in all 886 ft. All the drilling was done by hand. A 30 in. gage track was laid to within 12 ft. of the heading, and the muck was transported in 1 cu. yd. dump cars to a point about 600 ft. from the mouth of the tunnel, where rock suitable for concrete was taken out and the remainder wasted. The total cost for excavation, including all division overhead charges, was $12.55 per cubic meter and for concrete lining $17.27 per cubic meter.

The outlet heading was advanced 1,285 ft., the first 400 ft. by hand drilling and the remainder by machine drilling. The plant consisted of a 25 h. p. locomotive type boiler, an air compressor with a capacity of 125 cu. ft. free air per minute and a small ventilator, run by a 1 h. p. gasoline engine. Small McKiernan pneumatic hammer drills and Chicago pneumatic hammer drills were tried out, both proving unsatisfactory. Two Sergeant E-24 piston drills were then installed, with which the tunnel was completed. The rock encountered was extremely hard and badly fractured, the seams being very close together and running in all directions. The mucking was carried on in the same manner as from the north portal. The cost of excavation was $16.29 per cubic meter and the cost of concrete lining $13.59.

The other two tunnels on the Patillas canal, Carlota and Felicita, 450 ft. and 516 ft. long, respectively, were constructed by contract. The excavation of both was done by hand drilling. The former is lined throughout; the latter, all excepting 115 ft. in the center, which is in very hard rock.

The other structures on the canal are three concrete siphons, the aggregate length of which is 532 ft., four steel flumes aggregating 2,453 ft. in length; one reinforced concrete flume, 174 ft. long, 79 culverts, 107 bridges, 103 outlets, 3 spillways and 3 combination culverts and spillways.

TABLE II.—TOTAL ESTIMATE.

	Quantities Cu. m.	Unit cost.	Total cost.
Excavation for dam foundation	24,000	$ 1.25	$ 30,000.00
Excavation for core-wall	900	0.75	675.00
Excavation for spillway	10,000	0.40	4,000.00
Excavation for embankment and backfill	22,000	0.90	19,800.00
Leveling, rolling and sprinkling	10,000	0.40	4,000.00
Concrete in bulkhead dam	29,000	15.00	435,000.00
Concrete in spillway	4,000	18.00	72,000.00
Concrete in core-wall	1,100	11.00	12,100.00
Iron and steel, gates, etc	100,000 lbs.	.07	7,000.00
Road excavation	29,925	.46	13,741.76
Road structures, concrete	265	20.55	5,445.02
Miscellaneous	....	.....	21,000.00
Totals			$624,761.78

Concrete siphons are circular in section, concrete 8 ins. thick on the sides and top, 12 ins. on the bottom and reinforced longitudinally with ⅝ in. square rods, spaced 24 ins. apart; laterally, with ½ in. square rods, spaced 18 ins. center to center. Concrete inlets and outlets have flaring sections, changing from trapeziodal to semicircular shapes, thereby increasing the hydraulic efficiency of the channel. The concrete in these siphons cost $25 per cubic meter.

The flumes will be of the Hess type, consisting of steel plates bent into a semicircular form, connected by lap joints. The flumes will be supported on creosoted wooden trestles, which rest upon concrete pedestals.

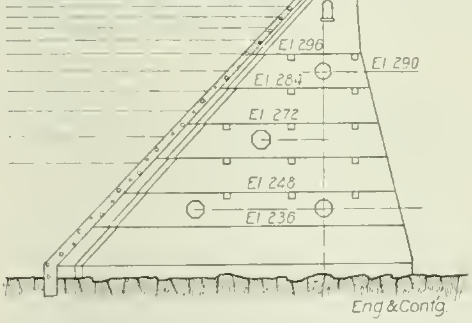


Fig. 5—Cross-Section of Guayabal Dam.

The culverts vary in size, from 30 in. pipe culverts to double 5 ft. x 5 ft. box culverts. All have been constructed of reinforced concrete, costing $12.50 per cubic meter, the amount of concrete in each varying from 11 cubic meter to 50 cubic meter.

The bridges, also of reinforced concrete, cost $16.50 per cubic meter.

The Guamani canal has one tunnel, 600 ft. long, and a section inside the concrete lining 5 ft. wide and 5 ft. 9 ins. high in the center of the arch. It was excavated by the administration at a cost of $8.74 per cubic meter. The rock was mostly hard tosca, and was drilled by hand. All but 50 ft. of the tunnel was lined at a cost of $10.92 per cubic meter. The floor was 4 ins. thick, walls 9 ins. and arch 6 ins.

GUAYABAL DAM.

The Guayabal dam crosses the Jacaguas River at a point where the valley narrows down to a rocky gap favorable for dam location. The structure is of the Ambursen reinforced concrete type, having a length of 918 ft. and a maximum height above the river bed of 115 ft. This type of dam consists of a deck inclined at an angle of 45°, supported by a series of buttresses decreasing in size from the bottom up, braced laterally by concrete beams and extending under the whole length of the dam. At the west end of the bulkhead dam is located the spillway section, 756 ft. long. At the east end is an earth and rock fill, containing a concrete core wall. This section is 303 ft. long, making a total length of 1,977 ft. A reinforced highway bridge crosses the entire structure. The reservoir created by the dam will have an area of 300 acres.

The construction plant is located adjacent to the east end of the dam (as shown on the accompanying plan) and is close to the quarry which furnishes rock for the concrete.

The quarry plant, besides small tools, consists of two Sergeant E-24, 3¼ in. rock drills, one Sergeant A-86, 2¼ in. drill and two Imperial hammer drills for use in breaking small rock.

The power plant, consisting of four 4 h. p. locomotive type boilers with feed pumps, water heater and an air compressor of the steam driven Imperial type No. 10, furnishes air for the above mentioned drills and for several hoisting engines. The capacity of the compressor is 1,000 cu. ft. of free air per minute.

Two crushers, a No. 6 and a No. 3 McCully gyratory type, are in use. Rock from the crushers and sand from the storage bins are elevated to bins in the top of the mixing plant building by a belt and cup conveyor. Another cup elevator raises the loose cement to a similar bin. From these bins the different materials descend by gravity through measuring hoppers to the two Smith No. 14 concrete mixers of 1 cu. yd. capacity each. The mixers dump into a combination bucket and car of the Dowd pattern. This is pushed by men a distance of less than 100 ft. till under one of the two cableways which span the dam site. The cableway then transports the car from the mixer track to a movable track located on top of the form which is being filled at the time. The plant is run by a single cylinder, Chandler and Taylor engine.

The cableways, which are also used for moving the sectional forms of the dam are of the well known Lidgerwood pattern of eight tons capacity. The main cables of these systems have a diameter of 2¼ ins. and have spans of 1,100 and 1,162 ft, respectively, and are suspended between four timber towers having heights varying from 80 to 125 ft. These two cableways are each operated by a 12 in. x 12 in. Locke type engine.

Six hoisting engines, 7 ins. x 10 ins., are on the work. Two were used to operate derricks employed in the excavations for dam foundations. Two more operated derricks used in the excavation for the spillway. The latter will be used also for placing the concrete in the spillway.

At present writing the dam is 75 per cent completed. Total costs to date, including all overhead charges, of the more important items follow. In comparing these costs with other costs for the same work in different localities it should be borne in mind that labor in Porto Rico runs from 60 cts. per day for pick and shovel work to $1.25 per day for more exacting or arduous work, the average wage being about 75 cts. This appears to be very cheap labor. As a matter of fact, it is comparatively high, because it takes two or three of these peons, as they are called, to do the work of an average laborer in the state. Besides they have had no previous experience in this kind of work and must be patiently trained and very carefully watched. The cost of transportation from Ponce, the nearest seaport and supply station to the dam site, averages $5.50 per ton exclusive of the cost of a railroad 2½ miles long and having four bridges across the same river, which was built at an initial cost of $10,500. Last fall the floods took out all four of these bridges and the last mile of the haul is now being made with bull teams and two wheeled carts. The following is the cost of excavation for dam foundation:

	Per cubic meter.
Buttresses	$1.09
Corewall	.75
Spillway	.39

The buttress trenches were carried down an average of 12 ft., the core well trench about 16 ft. Practically all the material was tosca in different stages of decay, varying from a soft crumbly formation at the surface which could be excavated by hand to a hard compact structure at the bottom, which required blasting. Boulders of all sizes were encountered.

	Per cubic meter.
Excavation of backfill and embankment	$0.58
Leveling, rolling and sprinkling	.37

The material was obtained from stripping the quarry and from nearby borrow pits and was moved to the embankment by means of small cars running on a 30 in. gage track. Practically all the leveling and tamping had to be done by hand on account of the small size of the fill.

	Per cubic meter.
Concrete in bulkhead dam (reinforced)	$13.57
Concrete in corewall (plain)	10.56

Forms for the former cost $1.80 per cubic meter of concrete placed and for the latter, $0.95 per cubic meter. The concrete plant delivers concrete to the cars at the rate of $6.30 per cubic meter, subdivided as follows:

	Per cubic meter.
Cement	$3.85
Rock	.90
Sand	.64
Labor	.38
Power	.52
Supplies	.01
Total	$6.30

The difference between the above form and concrete plant costs and the total unit cost of concrete is made up of the following items: Proportion of general expenses, depreciation of equipment, placing of concrete and steel, proportion of power and shop charges, preliminary expense and maintenance of camp.

Table II shows the estimated quantities and costs. This data includes all material and labor, all plants and repairs, preliminary expenses, construction and operation of camp. It does not include financing expenses, such as interest, insurance, patents and overhead charges of the main office.

JUANA DIAZ CANAL.

The problems met on this division consist of excavation of the waterway 24 miles long, the piercing of two tunnels, 510 ft and 526 ft. long, respectively, the erection of eight concrete flumes and building of 51 concrete bridges, 45 concrete culverts, two syphons, 19 spillways, 14 steel flumes, the longest of which is 3,000 ft., and constructing the necessary drops and turnouts.

Water passes from the Guayabal dam with a maximum head when full to the top of the flash boards at elevation 328 ft. above sea level, through three sluice gates into fore bays or stilling chambers where it passes over weirs, elevation 238, into the canal. Arrangements are also made to take the water into the canal when lower than the top of the weir by means of 2 ft. 18 in. rectangular gates, thus lowering it to the elevation of 232 ft.

About the first thousand feet of the Juana Diaz canal below the head gates is a concrete conduit with rectangular sides and bottom and slightly arched cover, inside width 8 ft., height 4 ft. As the canal is only a few feet elevation above the bed of the river, it was necessary to put in this form of construction in order to protect it from any floods that go over the spillway.

The earth canal has grades from .0004 to .0008, averaging about .0007.

For the steel flumes a creosote wood frame placed upon concrete piers is used.

ORGANIZATION.

The main office is centrally located at Guayama. The Chief Engineer, the Supervising Engineer, who is also the Division Engineer of the Patillas and Guamani canals, the Designing Engineer and his assistants, the chief hydrographer and part of his corps of engineers, stream gages, etc., the right-of-way attorney and his clerks, all have their offices here. Also there are the accounting, purchasing and property departments.

The several divisions are in charge of division engineers, who with their assistants have their offices on the location of their work.

Each division chief reports monthly to the chief engineer, stating conditions on his work, progress made and future plans. Cost analysis sheets for each item of work done, summaries, progress diagrams and photographs accompany each report.

The chief engineer submits a quarterly report to the commissioner of the interior, who in turn reports to the governor yearly.

The work is being done under the direction of Mr. James W. Beardsley, Chief Engineer.

Cost of Irrigation Works Per Acre of Land Supplied with Water.

The cost of irrigation works per acre of land irrigated has been tabulated by the U. S. Reclamation Service for some 140 projects of which 87 are Carey act projects, 39 are private projects and 14 are projects of the Service. The data are given in Tables I, II and III, and from the text accompanying them we take the following:

Under the present conditions of construc-

TABLE I.—COST OF PRIVATE IRRIGATION PROJECTS.

Name of Project or Company.	Acreage in project.	Cost or water right charge per acre.
Colorado:		
Amity Canal	80,000	$100[2]
Beaver Land and Irrigation Co.	20,000	175[2]
Catlin Canal	25,000	100
Colorado Co-operative Co.	5,200	60
Denver Reservoir and Irrigation Co.	200,000	45
East Palisade Irrigation District.	645	63
Montana:		
Fort Lyon Canal	70,000	100[3]
Grand Valley Canal	40,000	60[4]
Greeley Poudre Irrigation Co.	125,000	45
Mesa County Irrigation Project	2,568	73
Orchard Mesa Irrigation District	9,122	119
Otero Irrigation District	20,000	40
Palisade Irrigation District	6,000	41
Paradox Valley Irrigation Co.	30,000	45
Pueblo-Rocky Ford Irrigation Co.	100,000	150[5]
Redlands Irrigation and Power Co.	5,000	100[6]
Routt County Development Co.	39,000	45
South Palisade Heights Irrigation District	700	127
Conrad Land and Water Co.	......	40
Great Falls Land and Irrigation Co.	36,000	50
Nebraska:		
Belmont Canal and Irrigation District	20,000	25[7]
Tri-state Canal	60,000	42
New Mexico:		
French Land and I Co.	40,000	50
Oregon:		
Bonanza Project	20,000	39
Eagle Valley	21,700	80
Turnish	6,000	60[8]
Paradise	100,000	60
Willamette Valley	20,000	50
South Dakota:		
Red Water Irrigation Association	4,000	40
Utah:		
Provo Reservoir	12,000	80
Utah Lake Pumping	8,000	40[9]
Washington:		
Cascade Canal Co.	10,000	50
Congdon Canal Co.	4,200	121
Kennewick Canal	14,000	163
Lower Yakima I. Co.	12,500	129
Selah Moxie	7,000	86
Selah Valley Development Co.	10,000	150
Union Gap Irrigation Co.	5,000	135
Washington Irrigation Co.	50,000	46

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[1] Engineers' estimates where project is proposed or incomplete.

[2] Estimated at from $75 to $150 per acre. Includes land.

TABLE II.—COST OF CAREY ACT PROJECTS.

	Acreage.	Cost.
Colorado Land and Water Supply Co.	16,278	$45
Two-Butte Irrigation and Reservoir Co.	22,000	35
Valley Investment Co.	24,000	60
Colorado:		
Great Northern Irrigation & Power Co.	2,121	55
Colorado Realty and Security Co.	45,875	45
Toltec Canal Co.	14,853	40
Idaho:		
American Falls Canal & Power Co.	57,242	40
Big Lost River Irrigation Co.	78,242	40
Birch Creek Irrigation Co.	20,000	50
Blackfoot North Side Irrigation Co.	22,280	..
Black Canyon Irrigation District.	98,492	72
Blaine County Irrigation Co.	14,720	40
Boise City Carey Act Project	151,000	..
Bruenau Irrigation Co.	40,000	60
Emmett Irrigation District	5,800	50
Grandview Extension Irrigation Co.	1,000	65
Grassmere Irrigation Co.	47,500	65
Hansen, C. V., Mackay Project.	3,456	40
Hegsted, Victor, Project	3,410	40
High Line Pumping Co., Ltd.	3,860	45
Houston Ditch Co., Ltd.	1,884	35
Idagon Irrigation Co., Ltd.	9,000	60
Idaho Irrigation Co., Ltd.	130,000	50
Keating Carey Land Co.	15,597	30
Kings Hill Extension Irrigation Co.	9,655	65
Kings Hill Irrigation and Power Co.	13,359	65
Lemhi Irrigation Co.	3,500	50
Little Lost River Land & Irrigation Co.	20,000	30
Marysville Canal & Improvement Co., Ltd.	6,134	20
Owsley Carey Land and Irrigation Co.	8,600	35
Owyhee Land and Irrigation Co.	29,535	55
Owyhee Irrigation Co., Ltd.	3,296	45
Pahsimeral Project	6,000	30
Portneuf-Marsh Valley Irrigation Co.	11,914	35
Pratt Irrigation Co., Ltd.	4,674	40
Snake River Irrigation Co., Ltd.	6,500	50
Thousands Springs Land and Irrigation Co.	6,300	30
Twin Falls Land and Water Co.	244,000	25
Twin Falls North Side Land and Water Co.	207,144	45
Twin Falls Oakley Land and Water Co.	45,000	65
Twin Falls Raft River Irrigation Co.	99,668	50
Twin Falls Salmon River Land & Water Co.	127,707	40
West End Twin Falls Irrigation Co.	46,000	50
Montana:		
Billings Land & Irrigation Co.	27,000	40[10]
Big Timber Project	17,194	60
Valier Project	115,100	40
Oregon:		
Central Oregon Irrigation Co.	139,204	40
Central Oregon Irrigation Co.	74,198	60
Columbia Southern Co.	27,000	50[11]
Deschutes Land Co.	31,082	36
Deschutes Reclamation & Irrigation Co.	1,280	40
Desert Land Board	27,000	..
Portland Irrigation Co.	12,000	46
Powder Land & Irrigation Co.	65,000	100[12]
Utah:		
Mosida Pumping Plant	8,000	150[13]
Wyoming:		
Big Horn County Irrigation Co.	20,411	50
Boulder Canal	6,120	30
Burch Canal	35,887	50
Carbon County Land & Irrigation Co.	7,793	30
Cody and Salsbury Canal	77,199	..
Cody Canal	26,429	50
East Fork Irrigation Co.	4,901	30
Eden Land & Irrigation Co.	95,658	30
Elk Canal	2,724	30
Fisher Ditch	320	10
Green River Land and Irrigation Co.	75,257	35
Hammitt Canal	6,295	60
Hanover Canal	10,682	50
Hawk Springs Project	12,238	50
Hubbard Canal	38,604	40
James Lake Irrigation Co.	14,554	35
La Prele Ditch and Reservoir Co.	18,558	50
Lovell Irigation Co	11,320	25
McDonald Canal	15,159	50
Medicine Wheel Canal Co.	22,385	30
North Laramie Canal Co.	4,133	50
North Platte Canal & Colonization Co.	14,424	30
Big Horn Basin Development Co.	204,650	50
Paint Rock Canal	53,162	50
Platte Valley Canal	18,171	30
Rock Creek Irrigation Co.	11,696	45
Sahara Ditch Co.	7,920	50
Sidon Canal & extensions	20,559	30
Tinsleep-Bonanza Canal	16,486	40
Uinta County Irrigation Co.	26,000	35

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[3] Estimated at $75 to $150 per acre.

[4] Per miner's inch.

[5] Includes land.

[6] Estimated at from $65 to $150 per acre.

[7] For river rights only. Purchase of Pathfinder Reservoir water will increase this to $35.

[8] Estimated at from $50 to $70 per acre.

[9] Estimated at from $40 to $50 per acre.

[10] Estimated at from $20 to $60 per acre.

[11] Estimated at from $50 to $60 per acre.

Wheatland Industrial Co.	33,115	45
Wyoming Land & Irrigation Co.	4,526	50

tion, the cost per acre of water rights, or of water for irrigation in the arid region, is far higher than is usually appreciated. During earlier decades, before any considerable number of large irrigation canals had been built, it was a relatively simple and inexpensive matter for farmers to join together and build small canals that could be enlarged as the demand for water increased. All such easily available opportunities, however, have been utilized, and development has proceeded to a point where on most of the recent irrigation systems it has been necessary to provide storage, thus adding materially to the cost.

There has also been a notable increase in the cost of labor and of materials used in construction. This condition has been pointed out in various hearings before Congress, notably in the series before the Ways and Means Committee of the House of Representatives at the time of the granting of the $20,000,000 loan. It is there shown, notably in a statement submitted by Representative Mondell, that one of the arguments for increase of the reclamation fund was in the fact that common labor had advanced from the time of the preparation of the plans for works in 1903 and 1904 from 20 to 50 per cent, and that the efficiency of such labor had fallen off in greater proportion. Costs were also affected by the increased price of materials and equipment.

The figures in Tables I, II and III obtained from printed reports of state engineers and public data, show that on over 90 modern irrigation systems being built by private or corporate capital, the cost per acre averages nearly $53. This cost does not include the annual cost for operation and maintenance.

The cost to the settler is increased by the fact that payment is made on most of these projects in instalments bearing interest at 6 per cent or even more. The total payments made for such a water right with simple interest at 6 per cent would be about $70.50 per acre on the basis of ten equal annual instalments of the principal as compared to $53 without interest.

For comparison with the cost of the foregoing private and Carey Act projects, there is given in Table III a partial list of the projects being built under the terms of the reclamation act showing the total acreages in them and the charges for water rights for completed portions of such projects as far as these have been fixed by public announcement of the Secretary of the Interior. These figures are seen to average a little over $41 per acre.

TABLE III.—RECLAMATION SERVICE PROJECTS.

State.	Project.	Approx. acreage.	Cost per acre. from	to
Arizona-California	Yuma	131,000	$55	$66
Idaho	Minidoka	118,700	22	30
Montana	Sun River	216,346	30	36
Montana-North Dakota	Lower Yellowstone	60,116	45	..
Nebraska	North Platte	129,270	45	55
Nevada	Truckee-Carson	206,000	22	30
New Mexico	Carlsbad	20,277	32	45
Oregon	Umatilla	25,000	60	70
Oregon	Klamath	72,000	30	..
South Dakota	Belle Fourche	100,000	30	35
Washington	Okanogan	9,900	65	..
Washington	Sunnyside	102,824	52	..
Washington	Tieton	34,613	93	..
Wyoming	Shoshone	164,122	45	50

It is interesting to note that the average cost of water from the Government works is about $12 per acre less than from the recent private works of comparable size. The real difference is still greater because of the fact that deferred payments on Government works do not draw interest.

This difference is further accentuated by the greater probability of the water users under the Government projects receiving an adequate water supply, as this matter has been given more careful consideration and deficiency guarded against with greater care than in the private investments. In fact, it is known that in a few cases at least there is not water enough for the entire area of land included in these projects. Also, on the Government works, provision in many cases has been made for drainage such as has not been provided by the private works, and the water is, as a rule, brought nearer to the land to be irrigated, still further reducing the cost to the water user.

Summing up all of these advantages—lower first cost, absence of interest, more dependable water supply, and more complete works, it would appear to be fair to state that water from the Governmenet projects is obtained at one-half to two-thirds the cost of that from private works here listed, including those built under the terms of the Carey Act.

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[12] Estimated at from $75 to $200 per acre.

[13] Estimated at from $100 to $250 per acre, in-

RAILWAYS

Some Features of Double-Track Railroad Construction on the Chicago, Milwaukee and St. Paul Railway in South Dakota.

Contributed by F. W. Van Buskirk, Assistant Engineer, C., M. & St. P. Ry., Aberdeen, S. Dak.

The Chicago, Milwaukee & St. Paul Railway Company experienced such heavy passenger and freight traffic on its Hastings and Dakota Division, Minneapolis, Minn., to Aberdeen, S. Dak., in the years 1910 and 1911, that it was decided that the Division would warrant building a second track for the entire distance of 287 miles.

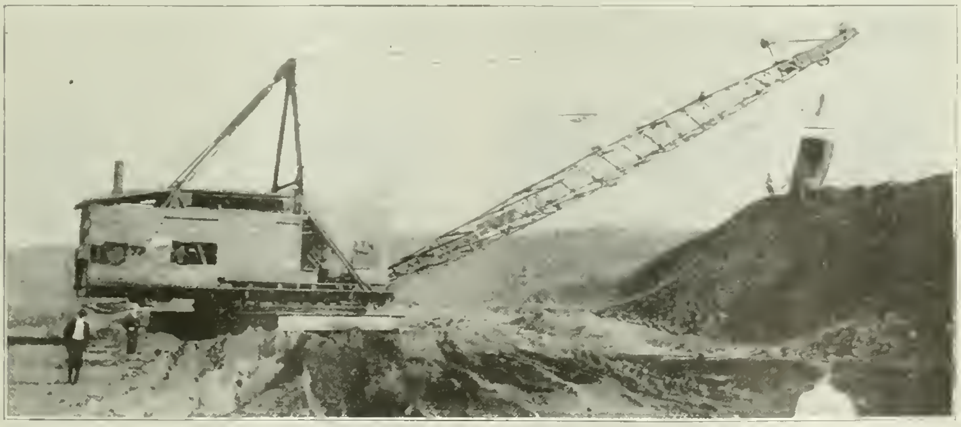

Fig. 1—Drag Line Excavator on Railroad Construction Handling 3½ Cu. Yds. of Fill Per Minute, from Side Borrow, with 100-ft. Boom.

Early in the year 1912 the company placed several locating engineers in the field to determine the best and most economical location that could be had for the new line. As the original alinement was very unsatisfactory having a large number of sharp curves and steep grades containing a maximum curvature of 4° and a maximum grade of 1 per cent, it was found advisable, in order to handle future traffic more perfectly, to rectify the original grade and alignment in connection with the construction of second track. This meant that many miles would have to be constructed entirely new and some distance from the old alignment.

Investigations resulted in finding a 0.4 per cent line practicable and it was adopted on the east division.

Montevideo, Minn., is a terminal point, being 133 miles west of Minneapolis and 154 miles east of Aberdeen, and it was desired to handle through business in both directions between Minneapolis and Montevideo, also between Montevideo and Aberdeen. For so few as four trains per day in one direction it was found an economy would result from the construction of a 0.4 per cent line.

There are a few places, however, where our ruling grade is a 0.5 per cent, which we could not hope to get away from, and by starting a train at its origin loaded to its limit for a 0.4 per cent grade would result in using a pusher engine in a few cases, but it was deemed unquestionable that it would be desirable to handle the through business independently of the local business in so far as possible.

Morris, Shepard & Dougherty, contractors of St. Paul, Minn., during the months of April, May, June, July and August, 1912, were granted contracts covering the construction of second track and rectification of present grade and alignment between Aberdeen and Summit, 75 miles, Twin Brooks to 4 miles east of Milan, 53 miles, Montevideo to Great Northern Crossing, 9 miles, Sacred Heart to Cologne, 79 miles, a total of 216 miles, involving about 7,440,000 cu. yds. of material to be moved, consisting of earth, loose rock and solid rock.

Probably the most interesting thing that could be said to the general contracting world in regard to the work performed by Morris, Shepard & Dougherty and to which attention is called as a remarkable piece of railroad construction, is a long fill about 5 miles in length averaging about 20 ft. in height, between Andover and Groton, S. D. This fill was all made to sub-grade for new double track from side borrow with drag line machines, inside of three months' time, moving a little more than 900,000 cu. yds. of material. There were five machines in service part of the time. The booms of these machines averaged a length of from 50 ft. to 100 ft. The highest yardage moved by one machine was 85,000 cu. yds., in one month, working two ten-hour shifts, or an average of 2.3 cu. yds. per minute of working time. A view of a drag line machine in operation is shown in Fig. 1.

John Marsch of Chicago was awarded in June, 1912, the contract covering the work between Summit and Twin Brooks, a distance of 15 miles, involving a yardage of nearly 890,000 cu. yds.

In June, 1912, the grading work from Hopkins, Minn., to Cologne, Minn., a distance of 22 miles, was let to the Cook Construction Company of St. Paul. Of the 22 miles, 18 miles was entirely new work for new double track, averaging around 90,910 cu. yds. of material per mile, or a total of 2,000,000 cu. yds. This construction was quite difficult where the new change of line crossed Shady Oak Lake, about two miles west of Hopkins, Minn., the lake being about 1,200 ft. across where the new line was located, requiring a fill of 50 ft., 40 ft. of which was under water. As the contractor wanted to do the filling by first driving piles and then building trestle work up to the proposed grade so that he could have material hauled out over the trestle from an adjacent cut and side dump into the water, such action was undertaken. As the piles were being driven it was found that the water overlaid a very soft mucky material, there appearing to be scarcely any bottom to be found. Piles were spliced until the contractor finally succeeded in getting the false-work constructed so that the grading could be started. However, the operation did not continue long until the weight of the filling began to shove the piling out of place and the timber work settled so that grading operations had to be discontinued until more piling and trestle could be placed. It was finally decided to abandon further trestling and the work will be completed with the aid of scows or barges to carry the construction trains, the material being dumped on the head of the bank continuously, the dump being carried ahead instead of upwards. A view of trestle erected to fill from is shown in Fig. 2.

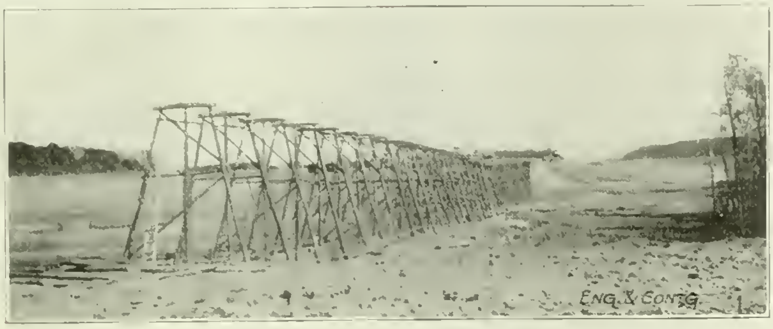

Fig. 2—Temporary Trestle for Railroad Grading in South Dakota.

The following figures show the amount of work done and material used during the year 1912: 6,034,560 cu. yds. of grading placed; 74,297 sq. ft. of concrete sidewalk and platforms: 41,215 sq. ft. of brick sidewalk and platforms, 35,532 bbls. Portland cement, 16,221 cu. yds. of crushed rock, 8,700 cu. yds. of sand and gravel, 188,700 paving brick, 1,149,000 lbs. of reinforcing material of concrete construction. Over $900,000 has been authorized to cover the cost of installing a complete signal system between Minneapolis and Aberdeen.

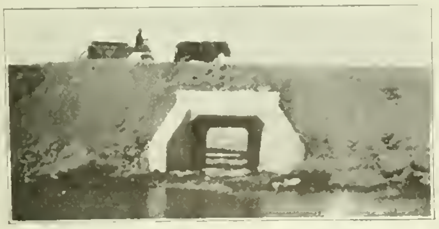

Fig. 3—Reinforced Concrete Box Culvert on C. M. & St. P. Ry., Near Summit, S. Dak.

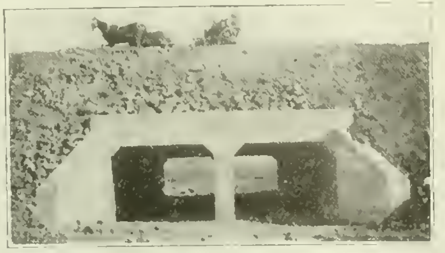

Fig. 4—Double Reinforced Concrete Box Culvert on Loop Line.

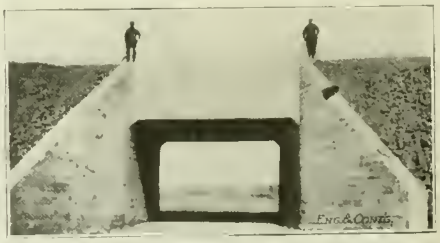

Fig. 5—Standard Reinforced Concrete Highway Under-Crossing on C. M. & St. P. Ry., in South Dakota.

ORGANIZATION.

The work now in progress is divided into residences of from seven to twelve miles each, depending on the character of the work, a resident engineer having charge of the residency with a party of from four to eight men, all the resident engineers reporting direct to Mr. T. H. Strate, Construction Engineer, Aberdeen, S. D., who reports to Mr. A. G. Holt, Assistant Chief Engineer, Chicago, with Mr. C. F. Loweth of Chicago, Chief Engineer of the Milwaukee System. All construction work in general, under the construction engineer's supervision, is carried on with the co-operation of the operating department, which is represented by Mr. F. M. Melin, Superintendent of the H. & D. Division, headquarters, Aberdeen, S. D.

The construction engineer's office at Aberdeen is comprised of a force of from 16 to 20 men, with Mr. H. G. Crowe, Assistant Engineer, in charge of the drafting room; the writer, with assistants, having charge of all fiscal valuation and estimate work in connection with which all final estimates, actual cost data, and valuation of the various railroad properties when finally completed will be made to conform with the rules as prescribed by the Interstate Commerce Commission in their first revised issue, "Classification of Expenditures for Additions and Betterments for Steam Roads."

All concrete bridge construction is done by company forces divided into districts. Great Northern Tower is the dividing point, the work between Great Northern Tower and Hopkins being handled by one general concrete foreman, Mr. E. E. Chadwick, and from Great Northern Tower to Aberdeen by a general concrete foreman, Mr. F. M. Sloane. These two men are responsible for all bridge construction on their respective territories. All foremen in charge of the labor report to the general foreman, who reports to the construction engineer. Both general foremen are engineers and are furnished one engineer and an inspector each to keep tab on all material, work up reports and report to the general foreman any deficiency at any time during progress of the work.

Practically all construction work with the exception of grading is done by the company forces; the larger portion of right of way fencing, usually five-wire barbed for plain fence and eight-board snow fence, will be done by contract, having been awarded to Mr. H. S. Haggard of Chicago.

DRAINAGE.

Cast iron pipe, concrete pipe, and reinforced concrete bridges constitute the waterways used, and are very important and interesting parts of the work. Considerable time and money are required to get the proper surveys made so that decisions can be reached as to the proper kind and size of masonry structure required to properly care for all future needs and at the same time do it in the most economical way at time of construction. Views of standard reinforced concrete structures are shown in Figs. 3-7.

Drainage surveys of all waterways, from the smallest to the largest, are made by the resident engineers on their respective territories. The sizes of the drainage areas in acres are usually determined by a compass survey. Contours are taken at every 2-ft. interval from 200 to 800 ft. on each side of the proposed opening to properly determine the slope and course of the waterway. Soundings are taken at the proposed site to determine the kind of foundation to be used. Levels are run to locate high and low water levels and often various other detail field work is performed that will help to furnish the designing department sufficient information to design properly the most economical and practical structure.

All resident engineers are furnished drainage area sheets which when properly filled out by them gives the location, present structure, if any, height base of rail to bottom of opening under the track, unobstructed waterway in square feet, drainage area, per cent of slope, acres cultivated, acres in pasture, acres wooded, whether tillable or untillable, general character of soil, average fall of creek bed, high water in square feet due to head water, date of high water, head water above or below opening, back water above or below opening, number of feet water can be backed up without encroaching or damaging adjacent or private property, sketch of the situation and size of opening recommended, the size of the opening being arrived at by formula

$$A = C\sqrt[4]{a^3}$$

where A = size of opening; C average slope or constant slope a = area of water shed, the general conditions at each opening having considerable weight on the decision of size. The formula for waterway openings generally but not always determines the size of opening.

In the total distance of 287 miles between Minneapolis and Aberdeen there will be in the neighborhood of 175 bridges and concrete structures, including waterways, cattle passes, overhead highway, undergrade highway crossings, and something like 625 pipe culverts.

ESTIMATING ACTUAL COST.

Weekly progress reports are kept of all concrete work under construction. The actual amount of material and labor used in each bridge is reported on the final report sheets which are forwarded to the engineer of construction, in whose office the exact costs of material and labor are determined. A record of all freight on company material as well as all freight on contractors' supplies and equipment is being kept.

As soon as any piece of construction is authorized it is divided into "AFE" numbers, meaning "Authority for Expenditure," each number covering from 5 miles to 20 miles, depending upon the character of the work in order that the expense involved can be more readily and properly classified.

Estimates of costs of all contemplated improvements and often times comparative estimates for different propositions are made previous to securing authority from the management to proceed with construction. After formal authority is received and the work under way, then preliminary estimates are prepared covering each "AFE." This statement is supposed to be a very close estimate of the cost of the work, including every item of expense that is likely to be encountered, such as rail material, which is all 90-lb. steel on main tracks, freight on contractors' supplies and equipment, freight on all company material, rental of and repairs to equipment, etc. All of these expenditures are itemized and the probable cost is distributed to conform as closely as possible to the Interstate Commerce Commission's prescribed method: that is, the costs are distributed between additional main track, grade reduction and change of line, sidings and spurs, temporary tracks, terminal yards, etc.

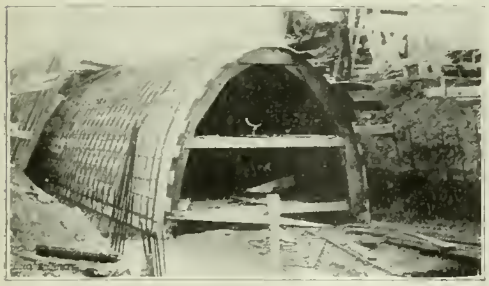

Fig. 6—Standard 12-ft. Reinforced Concrete Arch Culvert Under Construction, C. M. & St. P. Ry.

The object in making such preliminary statements is to furnish sufficient detail to enable the accounting department to classify intelligently the expenditures.

After the work on the various "AFEs" are entirely complete the actual cost of the various items, as near as can be obtained, will be collected for a final statement showing the correct distributions to the various accounts, accompanied with an estimate of cost covering all operating charges, renewal in kind charges, and everything that is pertinent and necessary for the accounting department to distribute properly the charges as they are sent in for final record.

As soon as a piece of masonry is fully completed the general concrete foreman in charge fills in the information called for in the "Masonry Cost Report blanks" which are furnished them, most of which can be taken from their time books and records. This gives the labor and material used from which the final costs of any piece of masonry is derived. Then a small sketch of each culvert and bridge structure is made, giving the conditions under which it was constructed, the "AFE" number, and the profile station, and quantities chargeable to each primary account are shown in the sheet. In this way close percentages of the distributive costs are arrived at and shown thereon.

The double track work between Minneapolis and Aberdeen will in all probability be completed in the fall of 1913 when the company will have a first-class double track roadbed from Chicago to Aberdeen, a distance of 708 miles, and a single track from Aberdeen to Seattle, Wash., and will be in condition with first class rolling stock now in service, to handle the developing traffic from the lines west of the Missouri River and the new countries which are constantly being opened and settled in the west.

Fig. 7—Standard Reinforced Concrete Arch Culvert, C. M. & St. P. Ry.

RIVERS AND HARBORS

A Discussion of Levee Location, Height and Grade.

Two useful tables and an instructive discussion of the proper location, height and grade of levees are contained in the report of Mr. Arthur A. Stiles, State Levee and Drainage Commissioner of Texas, which has just been issued. We abstract portions of the discussion and republish the tables here.

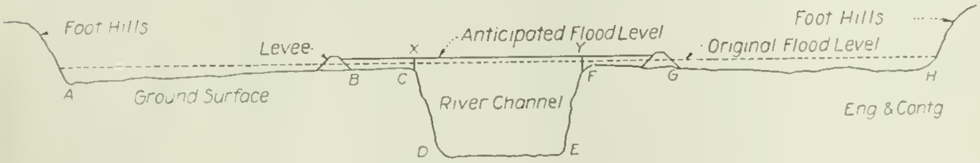

Fig. 1—Ideal Cross-Section of Overflowed River Valley.

(Illustrates characteristic ground surface slope, determination of hydraulic capacity of flood way, resulting flood level and position of levees.)

It is a well-known characteristic of overflowed river valleys that the ground surface, rising gradually from the base of the foothills at either side of the flood-plain, reaches its greatest elevation at the banks of the channel overlooking the principle stream. Hence, a levee to be of minimum height and maximum protection should be built along this crest, but a stable position cannot be obtained so near the channel, and the distance which should separate the proposed levee from the adjacent stream bank may be regarded as the result of a compromise between practical interests, and other more technical requirements, now to be discussed.

The case is selected for illustration where a protection levee is required upon each of the opposite sides of the stream channel. As a first requirement, obviously a flood-way or clear space large enough to convey the entire flood volume, must be provided between the opposite levees. The fixed factor of this flood-way is the maximum discharge of the stream, during the highest flood against which the proposed levees are designed as a protection. The adjustable factors are the heights and positions of the proposed levees, or the two dimensions sought. It follows conversely that the maximum discharge of the stream divided by the mean velocity of the flood, gives the cross-sectional area of the required flood-way. The area of the cross-section of the channel being established by Nature, it remains to increase or diminish the heights of the opposite levees, and the distance between them, until the proper supplemental area in the flood-way cross-section is found.

The simplest manner of finding this area is by a series of computations, using trial positions and heights for the levees. For this purpose a cross-section of the proposed floodway may be considered at any point desired. As represented in Fig. 1, the anticipated flood level is the surface of the maximum flood, raised somewhat by reason of the levees. A trial elevation of this flood level with a trial distance separating the opposite levees, is assumed. Not being uniform throughout, the cross-section must be treated in three sections. The middle section represents the stream channel; the two end sections, *BC* and *FG*, represent the spaces between the channel banks and the levees. Usually, there is no reason to know with safe accuracy the actual mean velocity of each of the three sections. The separate mean velocities must, therefore, be theoretically calculated by applying Kutter's Formula, as previous explained. The wetted perimeter of the channel cross-section is the line *CDEF;* that of the end sections is the ground surface, *BC* and *FG*, and the submerged sides of the levees. The vertical distances, *CX* and *FY*, from the channel banks to the flood surface are not counted as part of the wetted perimeter. The hydraulic slope *s* and the coefficient of roughness *n* are the same for all parts of the cross-section.

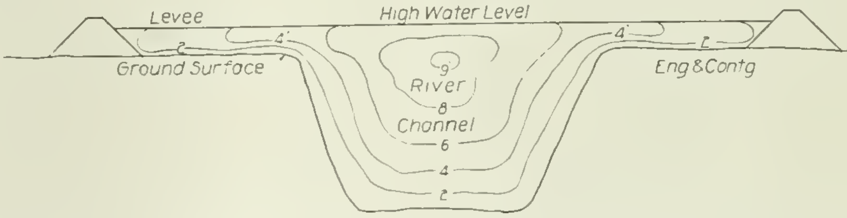

Fig. 2—Typical Cross-Section of River Channel, Showing Probable Distribution of Current Velocities in Feet Per Second and Their Influence Upon Levee Positions.

Having computed the mean velocity and maximum discharge of each section of the cross-section, the total maximum discharge through the entire cross-section is obtained by adding these three results. Comparing this maximum discharge with the known maximum discharge of the stream, the area of the cross-section with the assumed positions and heights of the levees is shown to be correct, or too great or too small. If not correct, another trial computation is made with the assumed values changed in the direction last indicated, and the correct dimensions are soon found.

It will be noticed that an increase of a few inches in the elevation of the high-water level in the flood-way is equivalent to an increase of a hundred feet or more in the distance between the levees and the channel banks. But great care must be exercised in raising this level. The "regimen," or usual system of the stream, changes as the flood level rises. Sudden and disastrous alterations may take place in the channel; or existing levees further upstream may be overtopped by the resulting backwater.

The space required for a properly formed and located borrow pit is dependent upon the size of the levee that is to be built. As the earth must be taken only from the side of the levee adjacent to the stream channel, the

TABLE 1.—CUBIC CONTENTS, COSTS AND EQUIVALENT BORROW PITS, OF LEVEES WITH VARYING HEIGHTS AND CROWNS, HAVING SIDE SLOPES 2 TO 1.

Vertical Ht., Ft.	Crown Wd., Ft.	Base Wd., Ft.	Area of Cross-section, Sq. Ft.	Cubic Yards of Embankment. Per 100 ft., Cu.yds.	Cubic Yards of Embankment. Per mile. Cu.yds.	Cost of Levee Per Mile: At 1c per Cu. yd.	At 2c per Cu. yd.	At 3c per Cu yd.	At 4c per cu. yd.	At 5c per cu. yd.	At 6c per cu. yd.	At 7c per cu. yd.	At 8c per cu. yd.	At 9c per cu. yd.	Dimensions of the Equivalent Borrow Pit: Area of cross-section. Sq. ft.	Greatest depth. Ft.	Top width. Ft.
1	4	8	6	22	1,173	$ 11.73	$ 23.46	$ 35.19	$ 46.92	$ 58.65	$ 70.38	$ 82.11	$ 93.84	$ 105.57	6.4	2.0	6
1½	4	10	10.5	39	2,053	20.53	41.06	61.59	82.12	102.65	123.18	143.71	164.24	184.77	11.2	2.7	8
2	4	12	16.0	59	3.129	31.29	62.58	93.87	125.16	156.45	187.74	219.03	250.32	281.61	17.1	3.01	10
2½	4	14	22.5	83	4.400	44.00	88.00	132.00	176.00	220.00	264.00	308.00	352.00	396.00	24.0	3.3	12
3	4	16	30.0	111	5,867	58.67	117.34	176.01	234.68	293.35	352.02	410.69	469.36	528.03	32.0	3.6	15
3½	4	18	38.5	143	7,529	75.29	150.58	225.87	301.16	376.45	451.74	527.03	602.32	677.61	41.1	3.8	17
4	4	20	48.0	178	9,387	93.87	187.74	281.61	375.48	469.35	563.22	657.09	750.96	844.83	51.2	4.1	20
4	6	22	56.0	207	10,951	109.51	219.02	328.53	438.04	547.55	657.06	766.57	876.08	985.59	59.8	4.3	22
4½	6	24	67.5	250	13,200	132.00	264.00	396.00	528.00	660.00	792.00	924.00	1,056.00	1,188.00	72.0	4.5	24
5	6	26	80.0	296	15,644	156.44	312.88	469.32	625.76	782.20	938.64	1,095.08	1,251.52	1,407.96	85.4	4.8	27
5½	6	28	93.5	346	18,284	182.84	365.68	548.52	731.36	914.20	1,097.04	1,279.88	1,462.72	1,645.56	99.8	5.1	30
6	6	30	108.0	400	21,120	211.20	422.40	633.60	844.80	1,056.20	1,267.20	1,478.40	1,689.60	1,900.80	115.2	5.4	33
6	8	32	120.0	444	23,467	234.67	469.34	704.01	938.68	1,173.35	1,408.02	1,642.69	1,877.36	2,112.03	128.0	5.6	35
6½	6	32	123.5	457	24,151	241.51	483.02	724.53	966.04	1,207.55	1,449.06	1,690.57	1,932.08	2,173.59	131.8	5.7	36
6½	8	34	136.5	506	26,693	266.93	533.86	800.79	1,067.72	1,334.65	1,601.58	1,868.51	2,135.44	2,402.37	145.6	5.9	38
7	6	34	140.0	518	27,378	273.78	547.56	821.34	1,095.12	1,368.90	1.642.68	1,916.46	2,190.24	2,464.02	149.4	6.0	39
7	8	36	154.0	570	30,116	301.16	602.32	903.48	1,204.64	1,505.80	1,806.96	2,108.12	2,409.28	2,710.44	164.3	6.3	42
7½	6	36	157.5	583	30,800	308.00	616.00	924.00	1,232.00	1,540.00	1,848.00	2,156.00	2,464.00	2,772.00	168.1	6.3	42
7½	8	38	172.5	639	33,733	337.33	674.66	1,011.99	1,349.32	1,686.65	2,023.98	2,361.31	2,698.64	3,035.97	184.1	6.6	45
8	6	38	176.0	652	34,418	344.18	688.36	1,032.54	1,376.72	1,720.90	2,065.08	2,409.26	2,753.44	3,097.62	187.8	6.6	45
8	8	40	192.0	711	37,547	375.47	750.94	1,126.41	1,501.88	1,877.35	2,252.82	2,628.29	3,003.76	3,379.23	204.9	6.9	48
8½	6	40	195.5	724	38,231	382.31	764.62	1,146.93	1,529.24	1,911.55	2,293.86	2,676.17	3,058.48	3,440.79	208.6	6.9	48
8½	8	42	212.5	787	41,556	415.56	831.12	1,246.68	1,662.24	2,077.80	2,493.36	2,908.82	3,324.48	3,740.04	226.7	7.2	51
9	6	42	216.0	800	42,240	422.40	844.80	1,267.20	1,689.60	2,112.00	2,534.40	2,956.80	3,379.20	3,801.60	230.5	7.2	51
9	8	44	234.0	867	45,760	457.60	915.20	1,372.80	1,830.40	2,288.00	2,745.60	3,203.20	3,660.80	4.118.40	249.7	7.5	54
9½	8	46	256.5	950	50,160	501.60	1,003.20	1,504.80	2,006.40	2,508.00	3,009.60	3,511.20	4,012.80	4,514.40	273.7	7.8	57
10	8	48	280.0	1,037	54,756	547.56	1,095.12	1,642.68	2,190.24	2,737.80	3,285.36	3,832.92	4,380.48	4,928.04	298.8	8.1	60
10½	8	50	304.5	1,128	59,547	595.47	1,190.94	1,786.41	2,381.88	2,977.35	3,572.82	4,168.29	4.763.76	5,359.23	324.9	8.4	63
11	8	52	330.0	1,222	64,533	645.33	1,290.66	1,935.99	2,581.32	3,226.65	3,871.98	4,517.31	5,162.64	5,807.97	352.1	8.8	67
11½	8	54	365.5	1,320	69,716	697.16	1,394.32	2,091.48	2,788.64	3,485.80	4,182.96	4,880.12	5,577.28	6,274.44	380.4	9.1	70
12	8	56	384.0	1,422	75,093	750.93	1,501.86	2.252.79	3,003.72	3,754.65	4,505.58	5,256.51	6,007.44	6,758.37	409.7	9.4	73
12	10	58	408.0	1,511	79,787	797.87	1,595.74	2.393.61	3,191.48	3,989.35	4,787.22	5,585.09	6,382.96	7,180.83	435.3	9.7	76
12½	8	58	412.5	1,528	80,667	806.67	1,613.34	2,420.01	3,226.68	4,033.35	4,840.02	5,646.69	6,453.36	7,260.03	440.1	9.7	76
12½	10	60	437.5	1,620	85,556	855.56	1,711.12	2,566.68	3,422.24	4,277.80	5,133.36	5,988.92	6,844.48	7,700.04	468.8	10.0	79
13	8	60	442.0	1,637	86,436	864.36	1,728.72	2,593.08	3,457.44	4,321.80	5,186.16	6,050.52	6,914.88	7,779.24	471.6	10.0	79
13	10	62	468.0	1,733	91,520	915.20	1,830.40	2,745.60	3,660.80	4,576.00	5,491.20	6,406.40	7,321.60	8,236.80	499.4	10.3	82
13½	8	62	472.5	1,750	92,400	924.00	1,848.00	2,772.00	3,696.00	4,620.00	5,544.00	6,468.00	7,392.00	8,316.00	504.2	10.3	82
13½	10	64	499.5	1,850	97,680	976.80	1,953.60	2,930.40	3,907.20	4.884.00	5,860.80	6,837.60	7,814.40	8.791.20	533.0	10.6	85
14	8	64	504.0	1,867	98,560	985.60	1,971.20	2,956.80	3,942.40	4,928.00	5,913.60	6,899.20	7,884.80	8,870.40	537.8	10.6	85
14	10	66	532.0	1,970	104,036	1,040.36	2,080.72	3,121.08	4,161.44	5,201.80	6,242.16	7,282.52	8,322.88	9,363.24	567.6	10.9	88
14½	8	66	536.5	1,987	104,916	1,049.16	2,098.32	3,147.48	4,196.64	5,245.80	6,294.96	7,344.12	8,393.28	9,442.44	572.4	10.9	88
14½	10	68	565.5	2,094	110,587	1,105.87	2,211.74	3,317.61	4,423.48	5,529.35	6,635.22	7,741.09	8,846.96	9,952.83	603.4	11.3	92
15	8	68	570.0	1,111	111,467	1,114.67	2,229.34	3,344.01	4,458.68	5,573.35	6,688.02	7,802.69	8,917.36	10,032.03	608.2	11.3	92
15	10	70	600.0	2,222	117,334	1,173.34	2,346.68	3,520.02	4,693.36	5,866.70	7,040.04	8,213.38	9,386.72	10,560.06	640.2	11.6	95
15½	8	70	604.5	2,239	118,214	1,182.14	2,364.28	3,546.42	4,728.56	5.910.70	7,092.84	8,274.98	9,457.12	10,639.26	645.0	11.6	95
15½	10	72	635.5	2,354	124,276	1,242.76	2,485.52	3,728.28	4,971.04	6,213.80	7,456.56	8,699.32	9,942.08	11,184.84	678.1	11.9	98
16	8	72	640.0	2,370	125,156	1,251.56	2,503.12	3,754.68	5,006.24	6,257.80	7,509.36	8,760.92	10,012.48	11,264.04	682.9	12.0	99
16	10	74	672.0	2,489	131,414	1,314.14	2,628.28	3,942.42	5,256.56	6,570.70	7.884.84	9,198.98	10,513.12	11,827.26	717.0	12.2	101
16½	10	76	709.5	2,628	138,747	1,387.47	2,774.94	4,162.41	5.549.88	6,937.35	8,324.82	9,712.29	11,099.76	12,487.23	757.0	12.6	105
17	10	78	748.0	2,770	146.276	1,462.76	2,925.52	4,388.28	5,851.04	7,313.80	8,776.56	10,239.32	11,702.08	13,164.84	798.1	12.0	108
17½	10	80	787.5	2,917	154,000	1,540.00	3,080.00	4,620.00	6,160.00	7,700.00	9,240.00	10,780.00	12,320.00	13,860.00	840.3	13.2	111
18	10	82	828.0	3,067	161,920	1,619.20	3,238.40	4.857.60	6,476.80	8,096.00	9.715.20	11,334.40	12,953.00	14,572.80	883.5	13.5	114
18½	10	84	869.5	3,220	170,036	1,700.36	3,400.72	5,101.08	6,801.44	8,501.80	10,202.16	11,902.52	13,602.88	15,303.24	927.8	13.9	118
19	10	86	912.0	3,378	178,347	1,783.47	3,566.94	5,350.41	7,133.88	8,917.35	10,700.82	12,484.29	14,267.76	16,051.23	973.1	14.2	121
19½	10	88	955.5	3,539	186,854	1,868.54	3,737.08	5,605.62	7,474.16	9,342.70	11,211.24	13,079.78	14,948.32	16,816.86	1,019.5	14.5	124
20	10	90	1,000.0	3,704	195,556	1,955.56	3,911.12	5,866.68	7,822.24	9,777.80	11,733.36	13,688.92	15,644.48	17,600.04	1,067.0	14.8	127
20½	10	92	1,045.5	3,872	204,454	2,044.54	4,089.08	6,133.62	8,178.16	10,222.70	12,267.24	14,311.78	16,356.32	18,400.86	1,115.5	15.1	130
21	10	94	1,092.0	4,044	213,547	2.135.47	4,270.94	6,406.41	8,541.88	10,677.35	12,812.82	14,948.29	17.083.76	19,219.23	1,165:2	15.4	133
21½	10	96	1,139.5	4,220	222,836	2,228.36	4,456.72	6,685.08	8,913.44	11.141.80	13,370.16	15,598.52	17.826.88	20,055.24	1,215.8	15.8	137
22	10	98	1,188.0	4,400	232,321	2,323.21	4,646.42	6,969.63	9,292.84	11,616.05	13,939.26	16,262.47	18,585.68	20,908.89	1,267.6	16.1	140
22½	10	100	1,237.5	4,583	242,001	2,420.01	4,840.02	7,260.03	9,680.04	12.100.05	14,520.06	16,940.07	19.360.08	21,780.09	1,320.4	16.4	143
23	10	102	1,288.0	4,770	251,876	2,518.76	5,037.52	7,556.28	10,075.04	12,593.80	15,112.56	17,631.32	20,150.08	22,668.84	1,374.3	16.7	146
23½	10	104	1,369.5	4,961	261,947	2,619.47	5,238.94	7,858.41	10,477.88	13,097.35	15,716.82	18,336.29	20,955.76	23,575.23	1,429.2	17.1	150
24	10	106	1,392.0	5,156	272,214	2,722.14	5,444.28	8,166.42	10,888.56	13,610.70	16,332.84	19,054.98	21,777.12	24,499.26	1,485.3	17.4	153
24½	10	108	1,445.5	5,354	282,676	2.826.76	5,653.52	8,480.28	11.307.04	14,133.80	16,960.56	19,787.32	22,614.08	25,440 84	1,542.3	17.7	156
25	10	110	1,500.0	5,556	293,334	2,933.34	5,866.68	8,800.02	11,733.36	14,666.70	17,600.04	20,533.38	23,466.72	26,400.06	1,600.5	18.1	160

Explanation of Table 1.—This table applies only to levees having side slopes of 2 to 1. The figures representing the equivalent borrow pit provide for a 20-foot "traverse" located at intervals of 300 ft. The figures representing cost are manipulated by moving the decimal point.

Example: Required the cost per mile of a levee 6 ft. high, with 6 ft. crown, at 13½ cts. per cubic yard.

From the table:
Cost at 1 ct. per cubic yard = $212.2; cost at 10 cts. = $2,112 .... $2,112.00
Cost at 3 cts. per cubic yard = $633.6 .... 633.60
Cost at 5 cts. per cubic yard = $1,056.0; cost at ½ ct. = $105.6 .... 105.60
Adding, gives total cost per mile at 13½ cts. per yard $2,851.20

dimensions of the borrow pit may be had from table I, using the height and crown of the proposed levee as arguments. This space must also be sufficient to provide for a berm at the toe of the levee, and another undisturbed strip of land between the outer edge of the borrow pit and the channel. The berm is usually 20 ft. wide, and the distance from the borrow pit to the channel should, in general, not be less than 100 ft.

The dangers to the levee position which result from current wash may be seen from Fig. 2. In the illustrative case presented, the greatest velocity exists near the center and upper portion of the cross-section. From this point the dangerous velocities decrease in the direction of the channel banks, and disappear between the banks and the levee positions. Experiments are now in progress by this department which, it is hoped, will result in a more accurate determination, in the Texas streams, of the nature of these side currents, and the risk to the levees which may result therefrom.

The grade along the top of the levee must obviously be parallel to the surface of the highest flood that is expected to be held back by the levee. The proper difference of water level existing at any two points on the levee, divided by the distance between the two points, clearly established this grade. If no difference in water level is found between the two points, the levee is supporting back water, the grade is zero, and the top of the levee is level. If the levee is retreating from the main stream, and following the up-grade course of a tributary stream, to join the high land, the grade of the levee adopts the grade of the side stream, plus an increasing height due to the back water curve. The surface slopes of all floods are by no means parallel. In the Texas streams, the great flood of 1899 gives a generally uniform longitudinal surface profile; whereas, the smaller ones present rather unaccountable wave effect. As a basis for levee grades, the surface slope of the water at lowest stage is scarcely more reliable than the slope indicated by the high-water marks. The safest hydraulic datum to which the top of the levees may be built parallel, is the water surface in the channel of the stream adjacent to the levees, as determined during the highest available stage of the stream, but after all evidence of disturbance has disappeared and the condition of the stream is stationary. As a precaution against the possible erratic behavior of the flood volume, the levees, having been established upon this grade, are then built 2 ft. higher than the level of the anticipated high-water.

Under primeval conditions a flood, spread out over an unprotected valley, moves along its course in the form of a lower volume, and an upper volume; and the two are frequently in conflict. The lower volume fills the meandering main channel of the stream, and extends directly upward to the high-water surface, except in places where the upper volume is sufficiently powerful to sweep across it, causing a sub-surface deflection. In which case there is a stratum where the water is not moving. The upper flood volume covers the flood-plain. When the levees are built parallel to the channel, the original condition of the upper volume of the flood is eliminated; all of the waters are required to follow the main channel; and the hydraulic slope indicated by the original high-water marks no longer exists. The movement of the flood in its original condition, no doubt, is greatly retarded by the presence of this upper flood volume, and the resulting cross-currents.

In a flood-plain where the main stream channel meanders extensively, the original high-water slopes, and those that are expected to exist after the levees are built, sometimes lead to singular combinations that require considerable investigation and study. Certain characteristics of the original flood surface slope as a whole, may therefore, be observed. This slope is not necessarily the same throughout, as the slope of the average ground surface beneath it. A line of equal elevation passing through a high-water mark is generally normal to the longitudinal axis of the valley. The surface of the flood does not always fall in the direction that all

TABLE II.—CUBIC YARDS OF MATERIAL PER LINEAR MILE IN DITCHES OF VARYING DEPTHS AND WIDTHS.

Vertical depth of ditch. Feet.	Average Width of Ditch								
	1 foot. Cubic yards.	2 feet. Cubic yards.	3 feet. Cubic yards.	4 feet. Cubic yards.	5 feet. Cubic yards.	6 feet. Cubic yards.	7 feet. Cubic yards.	8 feet. Cubic yards.	9 feet. Cublic yards.
0½	97.78	195.56	293.34	391.12	488.90	586.68	684.46	782.24	880.02
1	195.56	391.12	586.68	782.24	977.80	1,173.36	1,368.92	1,564.48	1,760.04
1½	293.33	586.66	879.99	1,173.32	1,466.65	1,759.98	2,053.31	2,346.64	2.639.97
2	391.11	782.22	1,173.33	1,564.44	1,955.55	2,346.66	2,737.77	3,128.88	3,519.99
2½	488.89	977.78	1,466.67	1,955.56	2,444.45	2,933.34	3,422.23	3,911.12	4,400.01
3	586.67	1,173.34	1,760.01	2,346.68	2,933.35	3,520.02	4,106.69	4,693.36	5,280.03
3½	684.44	1,368.88	2,053.32	2,737.76	3,422.20	4,106.64	4,791.08	5,475.52	6,159.96
4	782.22	1.564.44	2,346.66	3,128.88	3,911.10	4,693.32	5,475.54	6,257.76	7,039.98
4½	880.00	1,760.00	2,640.00	3.520.00	4,400.00	5,280.00	6,160.00	7,040.00	7,920.00
5	977.78	1,955.56	2,933.34	3,911.12	4.888.90	5,866.68	6,844.46	7,822.24	8,800.02
5½	1,075.55	2.151.10	3,226.65	4,302.20	5,377.75	6,453.30	7,258.85	8,604.40	9,679.95
6	1,173.33	2,346.66	3,519.99	4.693.32	5,866.65	7,039.98	8,213.31	9,386.64	10,559.97
6½	1,271.11	2,542.22	3,813.33	5,084.44	6,355.55	7,626.66	8,897.77	10,168.88	14,439.99
7	1,368.89	2,737.78	4,106.67	5.475.56	6,844.45	8,213.34	9,582.23	10,951.12	12,320.01
7½	1,466.67	2,933.34	4,400.01	5.866.68	7,333.35	8,800.02	10,266.69	11,733.36	13,200.03
8	1,564.44	3,128.88	4.693.32	6,257.76	7,822.20	9,386.64	10,951.08	12,515.52	14,079.96
8½	1,662.22	3,324.44	4,936.66	6,648.88	8.311.10	9,973.32	11,635.54	13,297.76	14,959.98
9	1,760.00	3,520.00	5,280.00	7,040.00	8,800.00	10,560.00	12,320.00	14,080.00	15,840.00
9½	1,857.78	3,715.56	5,573.34	7.431.12	9,288.90	11,146.68	13,004.46	14,862.24	16,720.02
10	1,955.56	3,911.12	5,866.68	7,822.24	9,777.80	11,733.36	13,688.92	15,644.48	17,600.04
10½	2,053.33	4,106.66	6,159.99	8,213.32	10,266.65	12,319.98	14,373.31	16,426.64	18,479.97
11	2,151.11	4,302.22	6,453.33	8,604.44	10.755.55	12.906.66	15,057.77	17,208.88	19,359.99
11½	2,248.89	4,497.78	6,746.67	8,995.56	11,244.45	13,493.34	15.742.23	17,991.12	20,240.01
12	2,346.67	4,693.34	7,040.01	9,386.68	11.733.35	14,080.02	16,426.69	18,773.36	21,120.03
12½	2,444.44	4,888.88	7,333.32	9,777.76	12.222.20	14,666.64	17.111.08	19,555.52	21,999.96
13	2,542.22	5,084.44	7,626.66	10,168.88	12,711.10	15,253.32	17,795.54	20,337.76	22,879.98
13½	2,640.00	5,280.00	7,920.00	10,560.00	13,200.00	15,840.00	18,480.00	21,120.00	23,760.00
14	2.737.78	5,475.56	8,213.34	10,951.12	13,688.90	16,426.68	19,164.46	21,902.24	24,640.02
14½	2,835 56	5,671.12	8,506.68	11.342.24	14,177.80	17,013.36	19.848.92	22,684.48	25,520.04
15	2,933.33	5,866.66	8,799.99	11.733.32	14,666.65	17,599.98	20,533.31	23,466.64	26,399.97
15½	3,031.11	6,062.22	9.093.33	12,124.44	15,155.55	18,186.66	21,217.77	24,248.88	27,279.99
16	3,128.89	6,257.78	9,386.67	12,515.56	15.644.45	18,773.34	21,902.23	25,031.12	28,160.01
16½	3,226.67	6,453 34	9,680.01	12,906.68	16.133.35	19.360.02	22,586.69	25,813.36	29,040.03
17	3,324.44	6,648.88	9,973.32	13,297.76	16,622.20	19,946.64	23.271.08	26,595.52	29,919.96
17½	3,422.22	6,844.44	10,266.66	13,688.88	17,111.10	20,533.32	23,955.54	27,377.76	30,799.98
18	3,520.00	7.040.00	10,560.00	14,080.00	17,600.00	21,120.00	24.640.00	28.160.00	31,680.00
18½	3,617.78	7,235.56	10,853.34	14.471.12	18,088.90	21,706.68	25,324.46	28,942.24	32.560.02
19	3,715.56	7,431.12	11,146.68	14,862.24	18,577.80	22,293.36	26,008.92	29,724.48	33,440.04
19½	3,813.33	7,626.66	11,439.99	15.253.32	19,066.65	22,879.98	26,693.31	30,506.64	34,319.97
20	3,911.11	7,822.22	11,733.33	15,644.44	19,555.55	23,466.66	27,377.77	31,288.88	35,199.99
20½	4,008.89	8,017.78	12,026.67	16,035.56	20,044.45	24,053.34	28,062.23	32,071.12	36,080.01
21	4,106.67	8,213.34	12,320.01	16,426.68	20.533.35	24,640.02	28,746.69	32,853.36	39,960.03
21½	4,204.44	8,408.88	12,613.32	16.817.76	21,022.20	25,226.64	29,431.08	33,635.52	37,839.96
22	4,302.22	8,604.44	12,906.66	17,208.88	21,511.10	25,813.32	30,115.54	34,417.76	38,719.98
22½	4,400.00	8,800.00	13,200.00	17,600.00	22,000.00	26,400.00	30,800.00	35,200.00	39,600.00
23	4,497.78	8.995.56	13,493.34	17,991.12	22,488.90	26,986.68	31,484.46	35,982.24	40,480.02
23½	4,595.55	9,191.10	13,786.65	18,382.20	22,977.75	27,573.30	32,168.85	36.764.40	41,359.95
24	4,693.33	9,386.66	14.079.99	18,773.32	23,466.65	28,159.98	32,853.31	37,546.64	42,239.97
24½	4,791.11	9.582.22	14,373.33	19,164.44	23,955.55	28,746.66	33,537.77	38,328.88	43,119.99
25	4,888.89	9,777.78	14,666.67	19,555.56	24,444.45	29,333.34	34,222.23	39,111.12	44,000.01

Explanation of Table II.—The figures in the body of the table represent cubic yards. The partial duplication facilities the use of the table. The figures are manipulated by the movement of the decimal point. Obviously, the average widths and vertical depths are interchangeable; and the table applies equally to ditches and levees, with any side slopes.

Example: Required the number of cubic yards of material per mile in a ditch 3½ ft. deep, and 17 ft. wide.

		Cubic-yards.
From the Table	Cubic yards in ditch 3½ ft. deep, 1 ft. wide = 684.44; for 10 ft. wide = 6,844.4.....	6,844.4
	Cublic yards in ditch 3½ ft. deep, 7 ft. wide = 4,791.08..............................	4,791.t
	Adding, gives total cubic yards per mile for ditch required..............................	11,635.5

of the flood travels; consequently a paradoxical situation takes place among the original high-water marks, when they are considered solely in relation to the meandering stream channel. Following down the natural flow of the channel, along the bank of a bend that has meandered half-way around, a high-water mark located not far from the channel upstream, is lower than a similar mark further downstream; and the contradictory condition continues until the channel resumes the direction of the moving flood surface.

It will be seen that the foregoing process for finding a suitable position for the levee has the effect of determining a series of points along the proposed route through which the levee must be built. With these points thus established, the levee alignment must not under any circumstances consist of tangents and angles. There must be no angles. The stream does not employ angles in any part of its length; and as already shown, the levees, to avoid cross-currents must follow with moderate precision, the meanderings of the stream. The straight portions of the levee must be connected by curves. From a hydraulic standpoint, a circular curve is the least desirable, but a curved connection which reaches its greatest abruptness at the lower end, furnishes the maximum protection against washing along the outer levee. In bends of the channel so sharp that it is not feasible to levee around them, and where there may be severe cross-currents, a single dyke, or spur levee should be built from the main levee at the upper end of the bend to a position well within the point of the bend In this manner the great flood volume is safely turned by the aid of its natural channel; and does not encounter disturbances when leaving the levee system at the upper point, or returning to it at the next lower point, but moves serenely along a natural and consistent grade.

Method of Concreting in Freezing Weather at the Timiskaming Dam, Ottawa River Storage, Ontario.

Contributed by Emile Low, 606 Ashland Ave., Buffalo, N. Y.

The specifications of 10 or more years ago prohibited the laying of masonry during freezing weather, oftentimes designating the prohibited period as between Nov. 15 and April 15. With the increased use of concrete and with the necessity of doing concrete work during the winter, the above clause has been modified more or less. The specifications of the New York State Barge Canal contain the following clauses:

> Whenever directed by the engineer, newly-laid masonry shall be protected to prevent freezing, and the protection shall be in all respects satisfactory to him.
>
> Whenever necessary the engineer may withhold permission to lay concrete during freezing weather until the work is protected by housing or until the ingredients entering into the composition of the concrete shall be heated so that when the concrete is mixed and ready to be deposited it shall have a temperature of not less than 75° Fahrenheit.
>
> The contractor shall be responsible for all damage to concrete by freezing, and any concrete so damaged shall be cut out and replaced at the contractor's expense, as directed by and to the satisfaction of the engineer.

In this connection the following history of the concrete building in the Timiskaming dam of the Ottawa River Storage during the unusual cold winter of 1909-10, is interesting. Owing to various delays, work was not started until Feb. 12, 1910. A gravel pit was found near the site of the dam, and a large bin with steam pipe was constructed to heat the gravel, which was of fair quality, but sandy. The natural mixture was screened at the pit to ensure 5 parts of stone to 3 parts of sand, and to this 1 bbl. of cement (4 bags) was added and mixed by machine, the water used also being warmed.

Large boulders were used as displacers in the concrete, each being thoroughly steamed to clean off ice before laying. The gravel, sand and water were heated to about 70° F. After laying, a steam radiator was laid on top, and covered with the tarpaulin, so that all night the temperature, as recorded by self-registering thermometers, was kept above freezing. The trench, into which the heated mixture was placed, had, unfortunately, hard frozen sides and there must have been a loss of heat to the frozen ground.

TABLE I.

1910.	Day. Maximum degs. F.	Day. Minimum degs. F.	Night. Maximum degs. F.	Night. Minimum degs. F.
Feb. 5.......	0	—16	—10	—23
Feb. 6.......	—13	—16	—10	—20
Feb. 7.......	19	—10	—12	—26
Feb. 8.......	32	28	28	3
Feb. 9.......	5	— 5	2	—18
Feb. 10.......	— 3	—18	— 8	—30
Feb. 11.......	17	—24	6	2
Feb. 12.......	18	4	12	—14
Feb. 13.......	21	—10	20	—13
Feb. 14.......	31	17	18	—18
Feb. 15.......	1	—14	2	— 7
Feb. 16.......	9	0	2	—22

Table 1 gives an idea of the cold weather during February, 1910. The temperature recorded are degrees Fahrenheit.

It was therefore imperative to demand strict attention to the precautionary rules prescribed. A sub-inspector watched the concrete mixer, allowing the chief inspector to devote his undivided attention to the placing of concrete and covering it from frost. By the end of February 75 ft. in length of the up-stream cut-off had been laid and 60 ft. of trench were ready. By the end of March, the platform was well started and nearly 2,000 cu. yds. of concrete had been laid, altogether.

The difficulties created by the intense cold of this northern section had only been overcome when the spring rise in Timiskaming Lake flooded the foundations. Table II of temperatures is interesting.

All thermometers were Fahrenheit and were hung in vertical iron pipes, plugged at top and bottom. The top of the concrete was kept covered. Fall in temperature is probably due to there being from 2 to 2½ ft. of frost in the ground.

After being flooded with water at 32° F. for 70 days until June 25, 1910, when the water was 55° F., the concrete was still soft enough to penetrate easily with a steel bar or pick. In 30 days, however, the mass was hard enough to resist repeated blows of a pick and only a few inches of the surface required to be removed.

No doubt the concrete rose in temperature at some stage in setting.

TABLE II.—TEMPERATURES OF CONCRETE AT TIMISKAMING DAM.

Date, 1910—	Time.	In Concrete at— A. Degs.	B. Degs.	C. Degs.	D. Degs.	Atmospheric. Day. Max. Degs.	Day. Min. Degs.	Night. Max. Degs.	Night. Min. Degs.
Feb. 18	......	..	..	..	..	18	— 5	4	—10
Feb 19	A. M.	52	..	..	..	22	— 7	13	0
Feb. 20	......	..	..	..	..	37	13	32	17
Feb. 21	A. M.	44	92	..	..	23	10	10	—17
Feb. 22	A. M.	..	74	..	..	19	—15	7	— 6
Feb. 22	P. M.	33	65	55	..	..	..	..	..
Feb. 23	A. M.	33	53	48	..	12	— 4	1	—19
Feb. 23	P. M.	..	50	40	74	..	..	..	..
Feb. 24	A. M.	..	..	42	64	12	—14	9	—19
Feb. 24	P. M.	33	42	40	61	..	..	..	..
Feb. 25	P. M.	33	38	37	47	24	—14	18	8
Feb. 26	P. M.	34	33	..	41	31	16	36	30
Feb. 27	P. M.	33	32	..	36	48	36	33	24
Feb. 28	P. M.	34	32	33	36	39	28	32	8
Mar. 1	P. M.	33	31	..	..	42	14	36	24
Mar. 2	A. M.	33	30	31	..	40	28	32	19
Mar. 3	A. M.	33	30	31	33	36	22	24	7
Mar. 4	A. M.	30	30	31	32	48	16	..	..

Note.—Thermometers A and C were set at half depth in platform 3 ft. thick, and B and D were 5 ft. down in the cut-off wall below the platform.

BRIDGES

Traversing Bridges.

Contributed by Henry Grattan Tyrrell, Consulting Engineer, Evanston, Ill.

Traversing bridges are those which move back parallel to the center line of the roadway, and the modification known as "Retractile Bridges," which retreat at an angle, either to one or both sides, are not considered here, but are discussed later under that sub-heading. Traversing or rolling bridges were used to some extent for crossing castle moats during the fifteenth century, though not so generally as bascules, the platform being projected out or withdrawn by ropes attached to the bridge and wound over drums by means of hand wheels. That their use was confined to very narrow widths is shown by illustrations in early architectural works, and it is probable that their breadth did not exceed 4 to 5 ft.

Traversing bridges are capable of development in a great variety of forms, and in this discussion, they are classified under the following headings: (1) Underbridges, or those which recede beneath the adjoining road; (2) overbridges, or those which are drawn back above the rear deck: (3) telescoping bridges, or those which move back through approaches; (4) traveling elevated ferries; (5) duplex bridges. Type 2 in this classification includes the largest number of examples and is subdivided into several varieties.

Traversing bridges of all kinds usually require large operating power and are, therefore, not well suited for heavy structures, but are appropriate for small highway and foot bridges, and in this capacity have been extensively used. They are suitable also in special cases for locations where no other kind of bridge would fit the position.

Because of their suitability for short spans, plate girders have generally been preferred, but trusses are appropriate for longer spans. Double leaves can be used only for highway service and not for railway loads, and the rear end of the leaves when closed must be securely anchored to the masonry to resist uplift. In common with other double leaf bridges the two halves when closed must be locked together.

Advantages of Traversing Bridges. Little or no trouble is experienced on these structures from wind, as in bascules and swings, and long obstructing fender piers are not needed. When opening, they occupy no extra dock space like some other types, and are well suited for small light structures like those at Middleborough dock or the more recent temporary bridge at Oneida St., Milwaukee, Wis.

Disadvantages of Traversing Bridges.—The chief objections to these bridges are: (1) The moving resistance and large operating power required; (2) rapid deterioration and frequent repairs; (3) slow and unsteady movement; (4) great length of bridge, usually twice that of the opening; (5) valuable space occupied, and obstruction of the approach when open; (6) complication of approaches and interference with adjoining floor; (7) high first cost.

It appears, therefore, that the list of objections is quite formidable compared with the few advantages named. The greatest drawback to the type is the difficulty of moving; the large amount of power required, and the rapid deterioration from friction and uneven motion. It is much harder to move a whole mass bodily than to rotate it on a hinge or pivot, and this explains in a large degree the greater difficulty of moving traversing bridges.

It is now well known that bridges of this class require more power to operate them than almost any other kind of moving bridge, and the cost of operation is correspondingly increased. Experiments by Mr. James Price showed, that while swing bridges on rollers required an average force of 4.4 lbs. per ton to move them, traversing bridges on wheels needed 10 lbs. per ton. Observations were also made on two bridges over the same river at Hull, England, one a swing and the other a rolling bridge. The first had a span of 58 ft. and could easily be operated by hand, while the second, with a span of only 37 ft., needed a 10 h. p. engine to move it. Enough power should, therefore, be provided to exert a tractive force not less than 20 lbs. per ton, though in some cases with bridges out of repair and conditions generally unfavorable, three to four times that amount of power has been required. Experiments made on another bridge weighing 250 tons, over Millwall Dock, England, showed that 300 gals. of water were consumed in raising the bridge from its bearings when it was to be opened or closed, while a swing bridge of the same span near by, weighing 500 tons, or twice as much as the other, used only 66 gals. of water to raise it. Therefore, in proportion to their weights, it required nine times as much power to move the rolling bridge as the swinging one. The force to move a bridge is usually an index of the amount of repairs which will be needed to maintain it in working order. Maladjustment results from unequal bearing, deflection, worn surfaces and uneven track, and all of these items may require frequent renewals. Unsteady movement is caused sometimes by double systems of track with rails both on girders and abutments, the adjustment of which may be difficult to maintain.

Floors of Traversing Bridges.—Direct, retractile, or telescoping bridges need some special arrangement of floors at the shore end or approach to permit the span to move back from the channel. The usual method for highway bridges is to have a section of the roadway at the rear mounted on trucks, the length of this section being equal to the retreating distance. Then, before opening the draw, the movable roadway section is rolled laterally into a chamber reserved for it, leaving a clear space into which the bridge can be drawn. This method was used on one of the early bridges at Coblentz. In some cases, it may be easier, instead of moving a section of roadway, to pull the bridge itself to one side and then draw it back into an open recess on shore. The movement of a roadway section may be avoided by using a diagonal retractile draw which rolls back at an angle of about 45° from the channel into an open chamber. A bridge of this character was recently built at Summer St., Boston, over Fort Point Channel. Another method is to revolve a hinged and counterweighted section of floor behind the span far enough to clear the approach, before the span itself is moved back from the water, as on the Tiverton Bridge of 1894. For small or unimportant structures, the floor of the moving span may be enough higher than the approach so the bridge can be drawn back over land with only a movable apron 4 to 5 ft. long, hinged to the bridge and sloping down to the road, an example being that of the bridge of 1902 at Princess Bay, New York, over Lemon creek.

Another method of arranging the floor is first to lower that on the moving span far enough to allow it to pass under the deck of the approach, as on the Queensferry Bridge over the Dee, the depression in this case being 23 ins. It was lifted again on 8-in. hydraulic rams. For a telescoping railroad bridge with open floor, a section of the rails and stringers adjoining the structure on shore may be revolved down, leaving a clear space for the retreating span. A plan which might be practicable in some cases is that patented by Mr. W. L. Sampson in 1898, where the rear upper chords of the moving parts in the form of wedges are thrust under a hinged section of the roadway behind it, which not only rises to make way for the retreating leaf, but forms, when the bridge is open, a substantial barrier against street travel.

Wheels for Traversing Bridges.—Wheels must be used for traversing bridges instead of rollers, as the movement on rollers of small diameter would be too slow, and large rollers would be impracticable. One type of bridge has leading wheels running on one pair of tracks, and trailing wheels on other tracks outside the first ones; the outside tracks have a grade of about 2 per cent to bring the floor up to level. Another type has two wheels fastened to the rear end which roll on tracks, and two other wheels fastened to the abutments at or near the water. Other designs like one at Swansea of 1864, have piers on the top of which wheels are fixed over which the bridge travels as it moves back and forth. The best practice in England where these bridges have been developed, is to use wheels about 4 ft. in diameter with ten arms, and to mount them on roller bearings as at Barmouth, or later at Summer St., Boston. Wheels on the bridge at Millwall Dock were originally cast iron, but when worn out were replaced in cast steel.

Weight of Traversing Bridges—Weights and other data from three designs for traversing bridges made by the writer at different times during the last 20 years are as follows:

(1) Highway bridge, length 123 ft.; width

between truss centers, 19 ft.; roadway, 18 ft.; one walk, 5 ft. wide, outside; live loads, on road, 100 lbs. per square foot, or 15-ton road roller; live load on walk, 80 lbs. per square foot; tension unit, 15,000 lbs. per square inch.

	Lbs.
Weight of bridge steel	49,600
Weight of machinery	7,500
Weight of track	5,000
Weight of counterweight	2,500

(2) Single track railway bridge; length, 50 ft.; clear opening, 27½ ft.; plate girders, 34 to 38 in. deep· live load, Cooper's Extra A. Weight of whole span, including beams and gears for raising track at the rear, 32,800 lbs.

(3) Single track railway bridge; length, 65 ft.; clear opening, 35 ft.; plate girders; live load, Cooper's Extra A. Weight of whole span, including mechanism for raising truck at the rear, 46,800 lbs.

Under-bridges.—This classification includes those which retreat when open, beneath the approaching road or platform. For bridges with only a single span, such as those over canals, the leaves may move into an abutment chamber, and floor continuity may be established either by means of short hinged aprons leading down from the abutment to the bridge, or the leaves may when closed be on a level with the approach and drop on eccentrics before disappearing into the abutments. The rear end must be held down either by counterweighting or by rollers bearing upward against inverted tracks. Under-bridges are generally suitable only for small highway bridges 10 to 12 ft. wide.

A small "sliding draw" was erected at Howland's Ferry, R. I., in 1799, but the use of this type in America has been very limited, though designs have frequently appeared. The type has been developed chiefly by British engineers, quite a number being the work of the Royal Engineers of the British army. One of this kind, 8 ft. wide, at Port Regent, in Jersey, was placed over a 17½ ft. channel, the whole leaf including rear end being 33 ft. long. The floor was covered with 3-in. plank and the total weight was 13,500 lbs. A single rack was fastened in the center below the deck, and the leaf was drawn in beneath the shore platform by means of a winch and hand power. It was the design of Mr. John Le Sueur, and cost only $1,800. Another similar bridge was placed over a 50-ft. dock entrance at Southampton in 1854. The two leaves, one from each shore, were 9½ ft. wide, and were drawn back below the adjoining floor when open. Each leaf was 65 ft. long, but on account of the difficulty of moving them, the type was not considered suitable for greater widths than 10 to 12 ft. Plans were made by Mr. A. Giles, and his bridge continued in use for more than 25 years.

A patent which was previously mentioned, was granted in February, 1898, to Mr. W. L. Sampson of Ocean Grove, for a bridge with double leaves, moving when opening, under adjoining spans hinged at their rear ends, and rising in bascule fashion to make room for the retreating ones.

Over-bridges.—This classification includes all those which are drawn back above the adjoining roadway. They are made in several distinct types, one type being represented by the bridges at Swansea and at Millwall Dock, and another by that at Barmouth, while still other forms have been developed which will be referred to in the following pages. One of the most interesting in England was that of 1845 over the Arun at Arundel, on the South Coast Ry. The channel crossed was 60 ft. wide, and the platform was supported by timber trusses braced by truss rods from the ends, sloping up to a central tower, the design being carried out with good architectural effect. The framing was 144 ft. long with equal arms, and when opening it a section of approach track was first pulled to one side and the bridge rolled back on wheels. When closed, the overhanging part rested on the opposite abutment. Tracks were fastened below the lower truss chords. It was the work of John V. Rastrick, engineer. Others crossed the canal at Wolverton, and the Ouse River, near Lewes.

A bridge differing from other types in England was erected at Swansea in 1864 over the River Towey for a double line of railway. As the channel was 205 ft. wide and the center pier of a swing bridge would occupy too much of the water way, the width was divided by two piers into three spans of 60 ft., two of which were covered by a moving part which passed back and forth on rollers fixed to the tops of the piers and west abutment. In opening the bridge, the end resting on the second pier was released, which caused it to tilt on its center roller, raising the end at the abutment sufficiently high to pass over the fixed rollers when it was drawn back. It weighed 205 tons, was opened by hydraulic power, and worked successfully for many years.

Traversing bridges are well suited for light foot service, and a large proportion of those erected are for that purpose. Examples are those at Grand Surrey and Middlesbrough Docks, Montevideo, and the Port of Dieppe. One of 1868 over a 50-ft. entrance to Grand Surrey Docks is unique, for the platform is a leaf hinged at the shore end to a moving truck with a central tower from which the outer end of the leaf is supported by tension rods. The two girders are 3 ft. 8 ins. deep and 61½ ft. long, supporting a wood floor, and the whole is moved back and forth by hand. A somewhat similar bridge built in 1874 over a 65-ft. channel at Middlesbrough Dock is only 3 ft. 9 ins. wide.

The foot bridge over a graving dock at Montevideo has a 55-ft. opening and platform 9½ ft. wide, rolling on ten wheels, the load on each being 1,000 lbs. Another one of 1881 at the Port of Dieppe over the Duquesne, crosses an opening 16½ meters wide and its total length is 31.24 meters. It is only 2 meters wide and the wooden lattice trusses are 1.5 meters deep. It is permanently mounted on wheels and rolls back over the shore. A patent for a light bridge of this kind was granted in December, 1885, to Marcelin Daigle of Houma, La.

The bridge crossing a canal at Newry on a skew of 38° has a rolling platform 60 ft. long and 40 ft. wide, and is more than twice as long as the channel width. It travels on ten wheels and is drawn back at right angles to the canal, but was difficult to work by hand and often required repairs. It carried a line of railroad and could be opened in 3½ minutes.

Traversing bridges offer so great an opportunity for diversity in design that almost every conceivable contrivance has been tried at one time or another. A species of hinged rolling bridge with a clear opening of 10 meters was placed over the canal harbor at Drontheim in 1887, to carry a highway only. The two leaves, after being slightly elevated at their rear ends, are swung back over the adjoining floor, while the outer end was being supported by hinged struts beneath. It was a temporary structure made of piles and timber, the piles below water standing in glazed earthenware pipes for protection and preservation.

Patents were granted in January, 1888, to Mr. Oscar F. Balston of Brooklyn for a traversing bridge mounted on two trucks running on abutment rails. Racks are attached beneath the chords and the moving platform is connected with the permanent roadway at each end by hinged aprons which are raised before movement begins. Another American patent was obtained in July, 1890, by G. H. Crafts of Atlanta, for a rolling bridge which could be pulled back inside of the adjoining spans.

One of the most important recent bridges of the kind in England was completed in 1890 to carry a line of railway over the 83-ft. entrance to Barry Docks, on the north shore of Bristol channel, between Barry Island and the main land. The steel plate girders, 9½ feet deep and 154 ft. long, counterweighed on their tail ends, are supported at the front end on two pairs of 30-in. steel wheels, placed tandem under each girder, while the tail end which is slightly the heavier is carried on two 6-ft. wheels. These run on separate tracks, those for the large rear wheels being outside of the tracks for the front ones. The track wheels ascend a grade of 1 in 60 and bring the floor to a level.

Considerable interest in this type of bridge was aroused in America in 1892, when a competition for a traversing bridge was invited by the city of Duluth, for crossing a 260-ft. channel. Quite a variety of designs were submitted, including those by Messrs Arentz and Sangdahl, Cooper, Sanne and Finley, Sooysmith, McNicol and Waddell. The preference and first prize was awarded to Arentz and Sangdahl for a double deck structure with railway at the upper level. Beneath each of its twelve legs were trucks with six double wheels 36 ins. in diameter and 10-in. face, on 70-lb. rails, and under every shore panel point were other wheels 24 ins. in diameter and 5-in. face. It was moved by six 1½-in. steel ropes attached to an engine of 116 h. p. The estimated cost was $236,000. The design of Mr. A. S. Cooper had an estimated cost of only $81,300. That by Mr. J. A. McNicol had two trusses with equal arms divided into ten panels of 26 ft., and a central tower 30 ft. long and 86 ft. high. The arms were disconnected at the top, excepting by the toggles above the center tower, and the estimated cost was $125,000. The design by Messrs. Sanne and Finley was conventional, having trusses with rear arms 145 ft. long for counterweights, and a movable trestle approach, which could be drawn to one side before the bridge was pulled back. The estimated cost in this case was $140,000. A design by Mr. J. A. L. Waddell had double leaves meeting over the center of the channel, each one having short rear arms for concrete counterweight. These spans were to be drawn back into openings made by removing sections of roadway. The cost including approaches was estimated at $154,000. Mr. William Sooysmith presented a design with double leaves rising at each side on ascending tracks, and pinned together at the center when closed, the cost being estimated at $140,000 to $190,000. But none of these designs were accepted, and for openings of so great a width, traversing bridges are no longer considered, for they occupy more space on shore and require much greater moving power and more frequent repairs than other types.

In April, 1894, a patent was granted to Mr. N. C. Jessup for a light rolling bridge mounted on wheels, moved back and forth by men turning hand wheels similar to those in the pilot house of steamboats, and in June, 1895, another patent was allowed to Morse and Sylvester for a pull-back bridge mounted on wheels fastened to the masonry, with long front arms and short rear arms for counterpoise.

Traversing bridges are well suited for temporary purposes and they have frequently been so used. One of the kind for a highway was invented by Mr. C. E. Burrough of Norfolk, Va., in 1895, for crossing a 23-ft. opening, and he reported the type suitable for greater lengths up to 50 ft. The leaf stood on wheels running in a track descending towards the water, and it was balanced by a counterweight car on a track sloping in the opposite direction and attached to the rear end of the bridge by rope. When being drawn back, the leaf would slope up above the approach floor without the need of aprons. Another method of avoiding floor interference is illustrated by the highway bridge of 1894 at Tiverton, crossing a small 36-ft. channel. The span was mounted on wheels and a section of floor 17 ft. long and 12 ft. wide was counterbalanced by levers, and was swung up before the bridge was rolled back. A similar design over a 48-ft. channel with trusses 74 ft. long and 10 ft. deep in seven panels, had an estimated cost of $28,900.

In February, 1898, a patent was issued in favour of Mr. C. L. Strobel for a traversing bridge essentially different from former ones. Over one of the approach spans were trusses with cantilever arms extending out to the center of the channel, the whole being mounted on wheels. To the end of these cantilever arms, the channel span was suspended and to remove it the cantilever trusses were tilted up till the span was lifted from its bearings and free of the adjoining deck. The whole structure was then rolled back until the channel was free. Another patent for a tilting traversing bridge was granted in August, 1898, to Mr. C. F. Franson of St. Louis, and Mr. Edward Wilmann of Chicago.

A small traversing bridge over the 36-ft. channel of Lemon Creek was completed in 1902 at Princess Bay, Borough of Richmond, Staten Island. It is a small wooden affair, rolling back over the adjoining roadway at right angles to the stream, a hinged apron at the rear end, joining the bridge with the roadway when closed. It has since been replaced by a double arm swing. The same type is used on the Erie Canal to carry a tow path over a connecting slip, but in this case an apron is not used because a mule can easily step across from the path to the bridge floor.

A temporary foot bridge which was examined and photographed by the author shortly after its completion, was opened in 1911 at Oneida St., Milwaukee, during the construction of the new bascule over the Milwaukee River. The final bridge is 67 ft. wide over an 80-ft. channel, but the temporary one just beside it was only 10 ft. wide with a 60-ft. opening over the water. It consists of a through truss bridge 92 ft. long mounted on pile trestle and heavily counterweighted at the rear end. The entrance to the bridge at the rear was from the side through one of the panels where the diagonal was omitted, and a stiff overhead portal girder substituted, leaving headroom of 10 ft. This arrangement left the space in line with the bridge behind it, free for its operation. It travels on six cast steel flanged wheels on 2¾-in. shafts worked by a 25 h. p. electric motor, and was opened or closed in 45 to 60 seconds. The span weighed 24,000 lbs., and 30,000 lbs. of counterweight were needed, though a lot of other heavy material was added for security. Its original cost was $3,165, and the extra cost of removing and storing it for further use was $188, making the final cost $3,353.

Over-bridges on Hydraulic Pistons.—One of the first bridges of this type was the Rhine Bridge of 1850 at Cologne. Wheels were fixed to the top of piers, and rails were attached beneath the moving girders. The channel was 96 ft. wide, and before opening, it was tilted up about 1 ft. and then rolled back, similar to those afterwards installed at Sunderland, Swansea, Dublin, Hull, London, Birkenhead, St. Nazaire and Antwerp. The rolling bridge of 1857 at Sunderland Dock, carrying both railway and highway travel, crosses a passage 60 ft. wide, the total length of bridge being 100 ft. It is 16 ft. wide and including counterweight weighs 200 tons. Before opening it, the rear end was first raised about 18 ins. by hydraulic power, and the whole was then rolled back on shore. Two others at Swansea crossed single channels, one over the North Dock Lock having an opening of 60 ft. for a 44-ft. highway, the main plate girders being 30 ft. apart on centers and 113 ft. long. The other had a 75-ft. clear opening and carried one line of railway, the total weight of moving parts being 200 tons. These bridges each rest on hydraulic rams, the head of which carry wheels which support the bridge girders. As the piston ascends, the light end of the bridge is prevented from rising by horns attached beneath the end of the light arms, the horns entering slots in the abutment. This permits the heavy end to be lifted first, and brought to a bearing on the abutment rollers, after which the bridge is drawn open. The bridge at Spencer Dock, Dublin, over a 26-ft. passage, has a 30-ft. highway on one leaf which is worked by hand. Before opening, the tail end is lifted onto fixed shore wheels near the water edge, and the bridge is then drawn back over the adjoining platform. The one at Hull over the river of the same name, has a 37-ft. passage and a single leaf 32 ft. wide, the weight of moving parts being 120 tons. It is worked by hand, and is on the same principle as those at Swansea, excepting that the rear wheels are fastened beneath the girders instead of to the piston head.

A hydraulic piston bridge at Millwall Dock, London, carried a 32-ft. highway over an 80-ft. channel, and at the time was the largest of its kind. To open it, the girders, were first raised 32 ins. by hydraulic pistons, the light end being held down by metal horns, as previously described, until the rear end was mounted on rollers and ready to retreat. It weighed 250 tons, and 300 gals. of water were consumed in lifting it from its bearings prior to opening or closing. In proportion to its weight, nine times as much water power was needed to move it as an adjoining swing bridge of the same span which weighed 500 tons and used only 66 gals. of water. The cast iron wheels wore out in a few years and were renewed in steel, and the whole bridge was afterwards replaced by a swing bridge. At Morpeth Dock, Birkenhead, were three traversing bridges, side by side, over a 25-ft. channel, similar to those previously described.

The rolling bridge over Kattendyk Basin at Antwerp, carries a highway with one car track and two walks over a small 27½-ft. channel. The principals are half through plate girders 48.4 meters long and the bridge is worked by hydraulic power. Another one of 1885 over Penhouet at St. Nazaire, is 43 meters long with a 25 meter clear span, and a 7.6 meter roadway. But the new rolling railway bridge at the Port of St. Nazaire has an opening of 30 meters and a total length of 53½ meters. The long outer arms are lattice trusses, but the rear ends are plate girders, the distance on centers being 5½ meters. To open the bridge, the rear end is first tilted up in the usual way on hydraulic jacks, and then rolled back. One other over the South Lock at Newport, England, has a single span lattice truss with curved top chord 157½ ft. long and 17 ft. deep. The lock is 78 ft. wide, and the travel of the bridge is 107 ft. It has brick piers and cast iron cylinders 8 ft. in diameter and 54 ft. deep. The whole weight of 450 tons is lifted about 51 ins. before rolling back.

Over Rolling Bridges with Projecting Counterpoise.—The first hydraulic traversing bridge was completed in 1853 over the River Towey on the South Wales Ry., near Carmarthen, the moving part being lifted and rolled back above the floor of the adjoining viaduct. On this bridge, and on another over the Medina at Newport on the Isle of Wight, the bridges for each of the two railway tracks were worked separately. It was designed by I. K. Brunel and was one of the first of its kind. The whole viaduct contained 13 fixed spans of 20 ft. and one opening span of 50 ft. The tidal rise was 14 ft. and the depth at high water was 19 ft. It continued in use for 56 years and was replaced in 1908 by a modern bascule.

In 1871, a viaduct 2,600 ft. long was built at Barmouth on the Cambrian Ry., over the estuary of Mawddach, at the mouth of the Dovey River, containing a moving span 47 ft. long, with a clear opening of 36 ft. between the piles. It traveled back over the adjoining deck on four 4-ft. wheels. Mr. Henry Conybeare was the engineer, and the principle of his design was similar to that in Mr. Burnless' viaduct over Morecambe Bay. The total width was 21½ ft., and it was moved by hand power. On the rear end of the girders were long levers supporting counterweights, and to open the bridge the leaf was first tilted up and then rolled back over the adjoining spans. The water beneath the bridge is 54 ft. deep and often has a tidal current of nine knots per hour. It supported a single track only, but had a 9-ft. walk at one side. The Rhyl traversing bridge had double leaves meeting over the center of the channel, and each of the girders was mounted on two wheels 4 ft. in diameter with roller bearings. It carried a railroad and because of its double leaves, proved a failure and was removed.

Bridges with Movable Rear Roadway Sections.—The rolling bridge over the Shannon at Drumsna, Ireland, consisted of a platform with inverted track rails fastened beneath the girders and running in two pairs of grooved wheels fixed to the abutment. A section of track back of the bridge is carried on girders resting on counterweighted revolving brackets which can be folded down toward each other, leaving space for the retreating span which moves back on fixed rollers without change of level. The whole structure was three times as long as the 30-ft. water opening, and as it was unsteady and otherwise unsatisfactory, it was afterwards converted by Mr. James Price into a bascule. The original structure was 16¼ ft. wide, weighed 45 tons, and was worked by hand power. It was the work of Mr. Hemans. Another one, known as "Palmers Bridge," crossed one of the Metropolitan Docks.

A double track bridge over the Severn on the Tewkesbury & Malvern Ry. had six metal spans in lengths of 43 to 60 ft., with two stone arches at one end and one at the other. The two girder spans pulled back over the approach arches, where the rails were first revolved down out of the way. It was designed by Mr. G. W. Hemans and built by Thomas Kennard of Crumlin. Later experience showed that this type was more suitable for single than for double track.

The rolling bridge at Coblenz carried two railway tracks over a channel 3.2 meters wide. The plate girders 8.8 meters long were mounted on wheels traveling on longitudinal tracks, and before the bridge could be opened, a section of track at the rear was rolled out to one side, leaving room for the retreating span.

Telescoping Bridges.—Telescoping bridges are those in which the leaves, either single or double, travel back inside of approach spans. They are better than other traversing bridges in some respects, because they are not only free from serious wind exposure, but leave the adjoining roadway unobstructed. Two single track railroad viaducts containing traversing bridges worked by hand power, were erected at Morecombe Bay over the Leven and Kent estuaries in 1857 by Mr. James Brunless. That over the Leven is 26 ft. above water, has a clear opening of 36 ft. and platform 78 ft. long, sliding in beneath the fixed structure. In addition to the moving span, it contains 48 fixed spans of 30 ft. The length over all is 1,563 ft. and the cost £18,600. For a double track the cost would have been £24,000. It contains 395 tons of wrought iron and 438 tons of cast iron. Before opening the bridge, the deck is first lowered by withdrawing eccentrics on which it rests at the rear end. This allows the end to drop far enough to pass under the floor of the adjoining structure and between the framing members. Wheels fixed beneath the moving leaf come to a bearing on girders which have a grade of about 2½ per cent.

The Kent viaduct contains 50 fixed spans in addition to the opening span, and its deck is 23 ft. above water. Its construction required 406 tons of wrought iron and 368 tons of cast iron and the cost was £15,000, which, for double track, would have been increased to £20,800. Wheels fastened to the piers supported the moving leaf as it rolled back.

Several methods for crossing the Thames at the Tower were presented in 1884, one of them prepared by William Parsey, having two towers in the river, 300 ft. apart, and one on each shore, supporting girders 150 ft. above the water from which hung a traversing carriage. A design prepared the same year by Knipple and Morris was a most elaborate one with telescoping leaves and a passenger subway under the water. The clear opening between the central towers was 200 ft., and beneath the side approach spans was a clearance of 25 ft. The total estimated cost of the whole work in three spans was £1,274,800. Floor interference has always been one of the chief difficulties with bridges of this kind, and the problem has been treated in quite a variety of ways. An arrangement for lifting and counterbalancing a section of floor on the approach, to leave room for the retreating span, was developed

TABLE I.

Type.	Length. Ft.	Width. Ft.	Weight in tons.	Length of travel. Ft.	Work done in opening or closing. Ft. tons.	Cost in dollars: Fixed.	Cost in dollars: Moving.	Cost in dollars: Mach'y.	Cost in dollars: Total.
1.	112	27	140	..	.....	$1,500	$10,000	$4,000	$15,500
2.	112	27	110	52	5,720				
3.	92	2x13	77	42½	3,273	1,500	6,250	7,500	15,250
4.	61½	60	54½	28	1,526	2,000	4,250	3,800	10,050

and pàtented in 1891, the balance arms in pairs lying outside the structure to the right and left of the sidewalks.

The telescoping bridge over the River Dee at Queensferry, completed in 1897 under the direction of Mr. T. W. Barber, cost $70,000, and replaced an old ferry of 1743. Competitive designs were invited, and no less than eighteen were received, the accepted one having three spans over the river, the clear distance between the central piers being 120 ft. The approach spans have an 18-ft. roadway and 3½-ft. walks at each side, but the center span in double leaves is only 15 ft. wide so that it may roll back inside the others. Before moving, the floor and railing of the center span are lowered 23 in. so that the leaves may pass beneath the adjoining decks, but when restored to its closed position, the floor is raised again on 8-in. hydraulic rams. Each moving leaf weighs 90 tons and is 100 ft. long, the outer 60-ft. cantilever ends being balanced by a 40-ft. arm loaded with pig iron counterweight. The trusses are 13 ft. apart in the center and 20 ft. apart on the end spans, and each leaf moves on twelve wheels, 52 in. in diameter. The approaches are paved with asphalt and concrete on steel troughs.

Elevated Ferries on Piers.—Patents have been granted for many kinds of movable bridges, one of the most interesting and unique being that of April, 1854, known as "Field's Traveling Bridge," which greatly resembled a steam ferry moving over the top of towers and free from frost and ice obstruction in winter. The example shown was 600 ft. long on piers 150 ft. apart. The same principle was also used in a proposed design for an opening bridge over the Thames at London, prepared by Sir George Barclay Bruce in 1876, which showed a 700-ft. water way with piers 15 ft. thick placed 100 ft. apart. Over the tops of these piers, moved a rolling platform 300 ft. long and 100 ft. wide, capable of carrying 100 vehicles and 1,400 people, and weighing when loaded, 5,000 tons. The ferry was long enough to be always supported on two piers, on the tops of which rollers were fixed, which could be set revolving to impart motion to the traveling platform. The estimated cost was £144,000, and the yearly operating expense £10,000.

Duplex Bridges.—Duplex bridges are those which have one or more extensions in their width, divided into two separate roadways with a water channel between them, and each of these ways has a separate moving leaf, so that one will always be closed for street travel, while the other is open for boats. They have been proposed at different times, one of the first being that by General Bentham in 1801. The type was patented in America in 1868 by Mr. Thomas S. Speakman of Camden, N. J., his plan showing only a single extension. One of this type with two separate duplex bridges, one near each shore, was presented by Mr. F. P. Palmer in 1877 as a solution for the Thames River bridge problem at the Tower. Another one was prepared and patented in 1876 by Mr. F. Barnett, and the idea was revived again in 1884 by Bell and Miller. None of these designs seem to offer any great advantage over two separate adjoining bridges connected at intervals by transverse roadways.

Retractile Bridges.—Moving bridges which retreat diagonally over land when opening, have been used for 70 years or more, one of the first reported being built prior to 1839 by Robert Stephenson over the canal at Weedon in Northamptonshire. It carried two tracks of the London & Birmingham Ry. over the canal on a single leaf only 8 ft. long, moving at an angle of 45° with the roadway. Three wheels supported the whole weight on two lines of rails, and there was enough of the platform beyond the side of the canal to keep the center of gravity within the area bounded by the wheels. The material was cast iron throughout, the deck being covered with flat plates. Another one, the work of Mr. F. W. Conrad, crossed the Warmonder & Leeds Canal on an angle of 50°, the platform moving diagonally on rollers. Its total cost was $18,580.

Several of this type were also used as opening spans on the Rotterdam & Amsterdam Ry. in Holland, one bridge of 1844 over a canal, with five spans of about 21 ft., had a central sliding timber draw, the platform of which was easily worked by one man. A double track railroad bridge over the Rhine near Vink beyond Leyden, had five timber arches, three of 10 meters and two of 6 meters, one of the side spans being a double retreating draw moving back at an angle of 82°, the two parts of which could be opened simultaneously by one man. The total cost of the bridge was $17,165.

Several others for both square and diagonal crossings appeared in Europe during the next 20 years, but the type has received its greatest development in America and chiefly at Boston and other Atlantic cities, the first one in the United States being the double opening spans of the Charles River highway bridge erected in 1870, and removed in 1899, when the new Charlestown Bridge was completed. Similar opening spans were in the Malden Bridge over the Mystic River completed in 1872, with a clear opening of about 45 ft., and another the following year over the same river at North Chelsea, with a clear opening of 60 ft. The Warren Bridge of 1884 over the Charles River at Boston had a clear span of 36 ft. when open, and double leaves, each of which had a 26-ft. roadway and a 10-ft. outerwalk, or a total width of 36 ft. Each leaf had a length of 75 ft. on the short side at the center, and 120 ft. on the long outer side. It was designed in the office of the city engineer of Boston according to usual custom, and contained:

Bridge steel, lbs	268,000
Rails, lbs	29,000
Rack, lbs	5,000
Lumber, ft. B. M	48,000

The girders were trussed from center gallows frames, and the floor and joists were timber. These four bridges at Boston were all for highway service, with double leaves retreating to the right and left at the same side of the channel.

A bridge on the Ulverston Canal which is 27 ft. wide, carries two lines of railway on a skew of about 45°. The bridge is 59½ ft. wide and 62 ft. long and is mounted on wheels, and to open it for boats, the leaf moves back at right angles to the channel into a recess on shore, and walled upon three sides. The platform is framed with eight plate girders 2½ ft. deep, and covered with 2-in. creosoted fir.

Two other retractile bridges have been completed in Brooklyn in recent years, one over the Gowanus Canal at Carroll St., in 1889, and another over the Wallabout Canal at Washington Ave., four years later. The Carroll Street Bridge is 104 ft. long, with a 17-ft. road and 4-ft. walks, the girders being trussed with gallows frames similar to the Warren Bridge in Boston. It had a single leaf with a clear opening of 44 ft. and was worked by steam.

A canal at Hambourg was crossed in 1891 by a bridge of this type, retreating diagonally away from the channel when it opened. The distance over the water is only 14½ meters, but the bridge with its two through trusses 8½ meters apart mounted on trucks, was 54 meters long on the center line. There were walks outside the trusses and the total width was 12 meters.

Two others with double leaves, at Boston, are at Federal St., over Fort Point Channel with a clear span of 41½ ft., and in South Boston over Reserve Channel with clear length of 39 ft. 9 ins. The Summer St. bridge over Fort Point Channel, finished in 1899, crosses a 50-ft. clear opening with two equal leaves, each one having a 30-ft. road and a 10-ft. walk, and weighing 156 tons, including 6 tons of counterweight. The leaves are mounted on trucks with ball bearings, and are moved by cables winding on drums connected with electric motors. The leaves move easily and will roll 20 to 30 ft. after the power has been shut off. The length of leaves on their short and long sides is 110 and 156 ft. respectively. The two leaves together contain 195 tons of steel and 84,000 ft. B. M. of lumber, including the wood joists.

The other bridge of this type in Brooklyn at Washington Ave., completed in 1893, has a single leaf 45 ft. wide. It has three longitudinal girders 5½ ft. deep, with gallows frames and outside walks on brackets, the whole being mounted on seven trucks. It carries two lines of car track and is paved with 3x6x2½ in. yellow pine blocks on 3-in. plank, the contract price for paving with five year guarantee being $2 per square yard. The old plank floor had previously been renewed every year. The total weight without tracks is 155 tons, and the cost $47,000. Plans were made by Mr. N. P. Lewis, who was then Assistant City Engineer. The bridge opens about 4,500 times per year.

The West Chester Avenue Bridge over Bronx River, like the two similar ones in Brooklyn, has only a single leaf spanning a 40-ft. channel. It is 60 ft. wide over all, including two walks. The leaf is 60 ft. long on one side and 150 ft. long on the other, and it is framed with three longitudinal plate girders 20 ft. 8 inches on centers, 74½, 105 and 135 ft. long, respectively. Upper bracing or gallows frames were not used. It is mounted on trucks with 24-in. wheels supported in ball bearings, and contains 176 tons of structural steel and 25 tons of machinery. The abutments are faced with ashlar, but other masonry is concrete.

Comparative Cost of Various Types.—In order to ascertain the comparative cost of traversing, retractile and swing bridges, an investigation was made in England in 1885 for one to carry two lines of railway on a skew of about 45° over a narrow canal 27 ft. wide. In this investigation four varieties were considered as follows: (1) Swing bridge, 112 long on the skew; (2) double track traversing bridge parallel to railway; (3) two, single track traversing bridges, parallel to railway; (4) wide retractile bridge moving back normal to the channel.

Owing to the skew, a double track swing bridge would have been 112 ft. long, weighing 140 tons. Two separate single track traversing bridges would have been 92 ft. long, weighing 38½ tons each, and the wide retractile span as built, weighed only 54½ tons. Comparative estimates for these four types are given by Table 1.

TABLE II.—COST OF RETRACTILE BRIDGE, 60 FT. WIDE AND 62 FT. LONG, FOR DOUBLE TRACK RAILWAY; SKEW OF 45°.

Foundations	$ 9,450
Fixed work in abutments, iron and timber	2,290
Bridge	4,375
Hydraulic machinery	2,580
	$ 9,245
Engine house	2,000
Engine and boiler	1,650
Tank	1,320
	$ 4,970
Watchings	200
Dolphins	2,125

The type selected and built was a retractile bridge (No. 4) 60 ft. wide and 62 ft. long, standing parallel with the canal and retreating back from it a distance of 27 ft. equal to the canal width. Over this span when closed, the two lines of railway cross on an angle of about 45°. It is framed with eight main girders 30 in. deep, and the whole area is covered over with 2-inch creosoted fir which adds 8 tons to its weight. The actual cost of the work as completed is given by Table II.

German Motor Truck Trade.—According to a report of the American consul at Berlin, motor trucks were exported from Germany in 1912 to the number of 694, valued at $1,849,000, as compared with 346 in 1911, valued at $980,000. As in 1911, Russia was the chief country of destination, shipments amounting to 502 tons, an increase of 298 tons over the previous year. Brazil was second, being credited with 394 tons, as compared with 149 in 1911. Consignments to Argentina about doubled, but were not large (56 tons in 1912). Trade with the United States decreased from 37 tons in 1911 to 31 in 1912, and with Great Britain from 92 to 48 tons. The importation of motor trucks increased from 134 to 201 in number and from $390,000 to $607,000 in value.

WATER WORKS

The Design of the Water Filtration Plant at Mt. Vernon, Ill.

Mt. Vernon is located in a part of Illinois which obtains its public water supplies either directly from a flowing stream or from impounding reservoirs. At present the city supply is taken from three reservoirs and a creek. Two small reservoirs, on the western boundary of the city, have a combined capacity of 50,000,000 gals. One large reservoir, four miles north of the city, has a capacity of 350,000,000 gals. When necessary, the large reservoir is allowed to discharge into an open creek which carries the water to a point on the northern boundary of the city, from which point it is pumped into the first mentioned reservoirs. The main pumping station and filter plant are located near the two reservoirs, and from this station the water is pumped to the city distribution system. Mr. S. B. Severson, General Manager of the Mt. Vernon Gas and Electric Company, described the new filtration plant in a paper before the Illinois Water Supply Association. The information here given is taken from Mr. Severson's paper, as published in the Proceedings of the Association.

While sewers do not discharge into the creek or the reservoirs, analysis shows a continuous presence of contamination in the raw water. It has always been unsafe for domestic purposes. It is strange that the city has never had a typhoid epidemic. It has been found that 19 out of every 20 typhoid cases can be traced to cisterns or out of town sources.

The following is the latest analysis of the water, made by the State Water Survey, Feb. 24, 1913:

Amounts are stated in parts per million.

Turbidity 20. Color 60. Odor 0.

Residue on evaporation	235		
Chlorine in chlorides	5		
Oxygen consumed	4.7	Bacteria—	
Nitrogen as—		Gelatine	190
Free ammonia	.016	Agar	40
Albuminoid ammonia	.154	Gas formers—	
Nitrites	.005	10 ccm.	1+
Nitrates	.40	1.0 ccm.	2+
Alkalinity	22	0.1 ccm.	1+1—
		Indol	+

The chemical and bacteriological examination indicates that this water is contaminated and is not satisfactory for drinking purposes unless treated.

Besides the ever existing possibility of an epidemic there is continual trouble with the mains and services on account of their being choked with silt and incrustation. Only last year the mains were thoroughly cleaned by the National Water Main Cleaning Company, but already the pressure is decreasing in various sections of the city. This is attributed mostly to the accumulation of silt which is being pumped continuously into the system.

The question of a filter plant has been brought up on various occasions, but until this last year nothing had been done. When the present company took charge of the several utilities in Mt. Vernon, it was with the intention of bringing up to standard for excellent service. We soon found need for a reconstruction of the water system. We felt under a moral obligation to install a filter plant, aside from the fact that it would be a good business proposition to overcome a great part of our expense of cleaning mains and renewing services, besides to increase our revenue by the general installation of meters and by connecting to our system a great number of customers who are at present using cistern water for domestic purposes.

The location of a filter plant was a problem for a time, as there were at least three feasible locations where gravity flow to the plant could be obtained. We finally decided on the location near the old water plant, because of the more favorable main connections and decreased initial cost. We have increased the capacity of our mains from this point to the city, and can now furnish water to the filters from the creek pumping station or the old pumping plant, in case the reservoir gets too low to give gravity flow. The old plant is also connected so that in case of an emergency raw water can be pumped into the distribution system. This emergency will arise only in case of serious trouble at our electric plant or on our electric line.

The filtration plant of 1,500,000 gals. capacity, is of the Pittsburg Filter Manufacturing Company design and is built of reinforced concrete with the exception of the building, which is brick. Excellent results were obtained in getting compact and practically water tight walls and floors by using concrete of the following mixture: Four parts coarse lead mine chats, one part sand and one part Portland cement, mixed very wet.

We were fortunate in having an open winter, until after all the concrete was poured. We started to break ground on Sept. 18 and finished the concrete work Dec. 24, 1912.

Beginning at the intake a 14-in. cast iron main runs to the mixing chamber, where a control valve regulates the water supply to the plant. The mixing chamber is 9 ft. by 17 ft. by 12 ft. deep, and is equipped with five sections of baffles which cause the water to have a longer travel and mixing period. These are so arranged that the water passes over and under alternate baffles until it has passed the last section where it passes out through a 16-in. perforated tile at the bottom of the chamber into the sedimentation basin. The chamber has an 8-in. sewer connection for the removal of sediment.

The sedimentation basin is 87 ft. long by 35 ft. wide by 12 ft. deep, having a four hours' supply for 1,500,000 gals. capacity.

As the water comes from the mixing chamber it has to pass around a baffle wall which extends lengthwise through the middle of the basin, thus causing the water to flow practically twice the length of the basin before passing over the skimming wall to the skimming trough. To this skimming trough we have an inlet direct from the mixing chamber so that the sedimentation basin can be emptied for cleaning out such deposit as does not pass through the 10-in. sewer.

From the skimming trough the water passes through a concrete flume to the sluice trough in front of the filters, the inlet to each filter being controlled by an 8-in. shear gate.

We have three filters 11 by 16 by 9 ft. deep and have installed in each a cast iron manifold system in which ⅜-in. strainers are placed 6 ins. apart. There are also two special form wash troughs, the tops being 5 ft. 5½ ins. over the center line of the manifold system. In each filter is placed first, 6 ins. of coarse gravel which will pass through screen having a clear mesh of 1 in.; then 6 ins. of finer gravel which will pass through a screen having a clear mesh of 3/16 ins., and then 32 ins. of sand having an effective size of not less than 0.36 m.m., nor more than 0.58 m.m., and having a uniformity coefficient of 1.70. Cape May sand and gravel were used.

The filtered water passes from each filter through a special form of balanced valve, which is guaranteed to control the flow within three per cent of any desired rate of filtration.

From the control valves the water passes into a clear well directly beneath the filters, which has a capacity of 75,000 gals. To this we also have a connection to our new 150,000 gal. water tower. So we have practically 20 per cent of our daily capacity in the clear well, giving us a fairly good reserve to draw on in case of fire.

We intend to use clear water from the tower for washing, having placed a 6-in. Mueller reducing valve in our wash line, which reduces the pressure to 10 lbs. per sq. in. No air will be used unless we find that it will be necessary and for this reason we had to increase the size of the wash line from 6 ins. to 8 ins., as a larger amount of water will be necessary for washing with water alone.

The wash water enters through the manifold system, passes upward through the filter bed and overflows from the wash troughs into a concrete sluice trough in front of the filters and from there out through a 10-in. sewer connection.

The pipe gallery of the plant was made larger than originally planned, to give room for three centrifugal motor driven pumps, two of these to be used for domestic purposes and one for fire service. The two domestic pumps are also connected so that they can be thrown in series to help out in case of a large fire. The motors installed are for 2,300 volts and are of the slip ring type. Lead covered cable is used for electrical connections. In order to prevent damage from condensation a large door was placed at one end of the gallery and a large ventilator was placed on the building, thus giving free circulation for the air.

The chemical tanks, which are placed on the operating floor, are of concrete and in duplicate sets for alum, lime and hypo. The lime tanks have a stirring paddle operated by a ½ H. P. motor. Through orifice boxes the chemicals are fed to the various points. Alum can be fed to either of three places, depending upon the condition of the water: first, the mixing chamber; second, the far end of the sedimentation tank, and third, the skimming trough. Lime, when necessary, is fed into the mixing chamber and the hypo into the flume before entering the filters.

The operating floor is neatly arranged with valve stands, loss of head gages, depth gage, etc., besides a switch board for controlling the motors.

Structural Features of the New Water Supply of Fort Worth, Texas.

About two years ago a commission was appointed by the city of Fort Worth, Texas, to make studies and recommendations leading to the installation of a new public water supply system. The procedure of this board of engineers and the chief structural features of the new works were described by the chairman of the Board, Mr. J. Trammel, City Engineer of Fort Worth, in an address to the Southwestern Water Works Association, from which the following abstract has been prepared.

The board of engineers examined all possible sites for a dam and reservoir. There were two streams available, namely, the Clear Fork and the West Fork of Trinity river. In the beginning, the board favored Clear Fork, but by reason of a larger stream in the West Fork they finally concluded, to utilize the flow of the West Fork. The Clear Fork afforded about 490 square miles of drainage basin above the proposed dam, and the West Fork approximately 1,875 square miles, giving a much larger area on the West Fork for collecting the water.

Investigation revealed the fact that there were no narrow places in the Clear Fork valley, though it is a smaller stream, and that while the West Fork valley is greater in average width, it has a number of quite narrow places, something not expected in the beginning of the investigation. It was found that a dam of given cost on the Clear Fork would only impound one-third the quantity of water as one of the same cost on the West Fork. Thus, it will be seen that the storage on the West Fork was much cheaper, and the chances for maintaining the full supply many times better than on the Clear Fork, by reason of the larger drainage basin above the dam.

The principal features of the work consist of a dam to impound the water, a reinforced concrete conduit to convey the water by gravity from the reservoir created by the dam to the city, a sedimentation basin for removing the heavier silt from the water, and a modern filter. The filter is located within the city limits adjacent to the main pumping plant.

The work was let under contract about 18 months ago, and has progressed with but little interruption. On the conduit there is a sedimentation basin, holding eleven days' supply. This is a long and narrow canal of 17 ft. depth. This is for the purpose of further taking out the heavier sediment from the waters before they reach the filter plant. The water surface in this canal is 5 ft. above the level of all adjacent land, and no adjacent surface water can enter to contaminate or make muddy the city supply.

The work is now about two-thirds complete. The dam at the reservoir consists of a masonry section which is 700 ft. long in the clear for the spillway, and an earth embankment which is 2,400 ft. long, approximately. The masonry dam contains about 55,000 cu. yds. of concrete, while the earth embankment contains approximately 550,000 cu. yds. of wetted and rolled selected clayey materials. The maximum known flood tide of the stream will give a depth on the crest of the dam of about 9 ft. The maximum height of the earth dam is approximately 72 ft., while the height of the masonry dam is 12 ft. lower. There was here one very fortunate condition in that one end of the dam joins on to a long flat ridge, and the earth dam is built a few feet higher than this flat ridge, so that if there should be an abnormal rainfall, such as must be provided for in such cases, there is an auxiliary spillway over this bridge 2,600 ft. in length, which would aid greatly in taking care of the abnormal flood.

The area of the lake when filled to the crest of the spillway, will be approximately 4,000 acres, and as now planned, the capacity of the lake is 28,000,000,000 gals., being four times larger than the Dallas reservoir which has just been completed. The larger part of the area is timbered land, and while the river valley is quite narrow at the dam site, the water line there being only about 2,000 ft. wide, two miles above the dam the lake is 2½ miles wide.

The filter plant which has been operated about twelve months, has a capacity of 5,000,000 gals. daily, and the city expects to add to it another 5,000,000 gal. capacity in the near future. Everything in the filter plant that could be added now has been installed for the 5,000,000 gal. extension.

The conduit line is of reinforced concrete, moulded vertically in sections 4 ft. in length and laid under the ground so that the top of the pipe is 4 ft. below the surface.

About 19,000 ft. of the length of the conduit is 3 ft. inside diameter, while the remaining 14,000 ft. is 4 ft. internal diameter, the difference being due to the fact that the first section of 14,000 ft., starting from the dam towards the city has relatively a very small gradient. These pipes will carry approximately 22,000,000 gals. daily to the filter plant. All of this pipe within and near the city will have an internal water pressure of nearly 20 lbs. per sq. in., thus enabling the works to supply any industry that can take water without filtering directly from the conduit. The water will be substantially clear before filtering, having the opportunity for the sediment to fall in the large lake of 4,000 acres, and still further clarify in passing through the sedimentation basin as it all does, after leaving the large lake, where the winds cannot keep it agitated.

The earth dam across the main portion of the valley crosses the river channel. The masonry dam begins nearly 300 ft. South of the channel and extends 700 ft. further South. This is due to the fact that there is a reasonably good level rock foundation at this place 20 ft. above the level of the bed of the stream, thus making it possible to build the masonry section of dam there at reasonably small cost, considering the total height of the dam above the bed of the stream.

The masonry dam with its massive apron, has a base width of 85 ft., while its total height above the base and curtain walls is approximately 36 ft.

A number of other conditions there favor this site. As explained, this rock on which the masonry dam is founded is almost perfectly level, measured along the axis of the dam, while at right angles to the dam it has a slope of approximately 1 per cent down stream from the dam, thus giving a natural apron sloping down 1 per cent to guide the water back to the stream level below the dam.

The masonry dam is known as the O. G. type: that type of dam over which the water passes and glides along the lower face of the dam in reverse curves, and is delivered below the dam in a horizontal direction to prevent erosion below the dam. The curve over the top of the dam is of 20 ft. radius, while the bottom curve is of 36 ft. radius with a good tangent between the two curves.

The earth dam is built 51 ft. wide on top, having a slope of 3 on 1 on the water side, and 2 on 1 on the down stream side. On the water side there is a berm at 31 ft. below the top level of the dam, varying from 50 to 150 ft. wide across the valley, and one 30 ft. wide on down stream side, while the river channel is filled 600 ft. above the dam, and 350 ft. below the dam. This filling of the river channel is to prevent the water reaching anywhere in the vicinity of the base of the dam at or near the river channel, below which there is known to exist more or less gravel and porous materials.

It is proposed to pave the water side of the earth dam with a slab of reinforced concrete, 6 ins. in thickness, or else to pave it with 1 ft. thickness of heavy boulders, either character of paving being laid upon a bed of gravel. The entire cost of the new works will approximate $1,260,000.

A Study of the Consumption of Water for Domestic Use in St. Louis, Mo.

Preparatory to making an estimate of the cost of installing and maintaining water meters in St. Louis, Water Commissioner Edward E. Wall collected accurate local information in regard to the domestic consumption of water. For this purpose there was selected, each as representative of its class, the following list of residences of various sizes, located in different parts of the city of St. Louis, upon whose services meters were placed, the number of rooms, occupants, faucets, baths, toilets, etc., being carefully noted:

(a)	8 residences	12 to 30 rooms
(b)	8 residences	8 to 12 rooms
(c)	11 residences	6 to 8 rooms
(d)	9 residences	6 to 12 rooms Boarding and rooming houses and residences without toilets or baths.
(e)	2 residences	4 to 5 rooms One story, with toilet and bath.
(f)	2 residences	4 to 5 rooms One story, without toilet and bath.
(g)	1 apartment house	18 apartments
(h)	1 tenement house	105 rooms

To this list others have been added and monthly readings of the meters made, and the per capita consumption calculated. The residents were not informed as to the purpose of metering their connections, the object being to have them continue in their ordinary use of water.

For the month of May, 1912, the average daily consumption in 37 residences containing 242 occupants, was 57 gals. per capita, the maximum being 202 gals. for a house of 30 rooms with 13 occupants, and the minimum 6.7 gals. at a boarding house with 10 rooms, 15 occupants, and without toilets or baths. Houses without toilets or baths showed a daily per capita consumption of 7 to 13 gals., while the other residences ran from 75 to 190 gals.

The same 37 houses containing 236 occupants during the month of June, 1912, showed an average daily consumption of 54 gals. per capita with a maximum of 212 gals. and a minimum of 5.6 gals. on houses taken individually. Table I gives the average daily per capita for each class by months.

It is evident that in classes (a), (b), (g) and (h) there is an excessive use of water which can only be due to carelessness and wastefulness.

The average daily pumping for the month of May, 1912, in the entire city was 83½ million gallons; for June, 84.6 millions; for July, 91.2 millions; for August, 92.4 millions; for September, 95.8 millions.

Reduced to per capita on the assumption that St. Louis has a population of 710,000, we have:

	Gals.
For May, daily consumption per capita	117.6
For June, daily consumption per capita	119.2
For July, daily consumption per capita	128.4
For August, daily consumption per capita	130.0
For Sept., daily consumption per capita	135.9

In estimating the domestic use of water from the data given above, it will be necessary to apportion the total number of residences in St. Louis among the several classes, and apply the per capita figures to each class, in order to arrive at the general average. There are 106,968 service connections to the mains smaller than 1 in., 4,973 of which are metered. Few residences are metered, and many stores and small establishments have connections smaller than 1 in. without meters, so that for all practical purposes it is fair to assume that there are approximately 100,000 residences in St. Louis supplied with water from the mains. These may be arbitrarily divided among the classes as follows:

TABLE I.—RESULTS OF MEASUREMENT OF WATER CONSUMPTION IN REPRESENTATIVE ST. LOUIS RESIDENCES.

Class.	Average No. of Occupants.	Average Daily Consumption per Capita, in Gals. May.	June.	July.	August.	Sept.
(a)	9	143	142	180	147.8	147.7
(b)	6	83	91	72	83.2	104.3
(c)	6	28	23	21	28.4	29.6
(d)	12	12	10	14	10.8	12.4
(e)	6	14	17	19	20.0	22.7
(f)	6½	9	17	17	12.6	13.4
(g)	20	145	180	133	119.0	98.5
(h)	60	109	156	60	96.0	51.9

(a)	10,000	(e)	10,000
(b)	25,000	(f)	4,450
(c)	40,000	(g)	300
(d)	10,000	(h)	250

This division of residences applied to the per capitas for May gives a general average of 52.2 gals. per capita; applied to June, figures 53.6 gals.; for July, 52.2 gals.; for August, 53 gals.; for September, 57.2 gals., as shown in Table II.

TABLE II.—GENERAL AVERAGE OF DOMESTIC USE OF WATER IN ST. LOUIS FOR THE WARM MONTHS.

Class.	Total No of Occupants.	Total Daily Consumption in Million Gallons. May.	June.	July.	Aug.	Sept.
(a)	90,000	12.87	12.78	16.20	13.30	13.29
(b)	150,000	12.45	13.65	10.80	12.48	15.64
(c)	240,000	6.72	5.52	5.04	6.82	7.10
(d)	120,000	1.44	1.20	1.68	1.30	1.49
(e)	60,000	0.84	1.02	1.14	1.20	1.36
(f)	29,000	0.261	0.493	0.493	0.36	0.39
(g)	6,000	0.87	1.080	0.798	0.71	0.59
(h)	15,000	1.635	2.340	0.900	1.44	0.78
T'ls	710,000	37.086	38.083	37.051	37.61	40.64
Av. per cap.		52.5	53.6	52.2	53.0	57.2

The Interpretation of a Water Analysis.

In their report on the filtration of the water from the Croton water shed, the Advisory Commission of Engineers of New York City included the following concise discussion of the significance and value of a water analysis:

The complete examination of water as conducted at the present time may be divided into four main divisions—physical, chemical, microscopical and bacterial. Such an analysis is intended to show whether or not the water is of a character to cause sickness; if it contains anything to render it distasteful or unpalatable; if it is suitable for laundry use and for general domestic and industrial purposes.

The physical examination includes temperature, turbidity, color and odor. The turbidity is a measure of the suspended matter. The figures represent the relative cloudiness of the water. The color of a water may be divided into true and apparent color. The apparent color may be affected by the turbidity. The true color represents matter dissolved in the water and is usually measured after the turbidity has been filtered out. The odor of water may be due to dissolved vegetable or mineral matter or to microscopic growths.

The chemical examination determines the amount of organic matter that a sample of water contains, but it does not necessarily determine the nature of it. It is not sufficiently delicate to distinguish always between a polluted water and an unpolluted water. It also shows the dissolved mineral matter which the water has taken up in passing over or through the soil, which includes hardness. It is particularly useful in determining the quality of the water so far as it relates to industrial uses and its corrosive action upon metals.

By far the most important service which the microscopical examination renders is that of explaining the cause of the taste and odor of a water and of its color, turbidity and sediment. It shows the number and kind of microscopic organisms in the water, certain of which produce strong tastes and odors due to the development of essential oils, while many others, even when occurring in large numbers, do not cause anything more than turbidity.

The bacterial examination is all-important in the sanitary analysis of water. The number of bacteria present is an evidence of the hygienic quality of the water. The character of the bacteria present is an indication of infection. In the bacterial counts no distinction is made between harmful and harmless bacteria, but experience has shown that the number of bacteria normally present in an unpolluted water is comparatively low.

The qualitative bacterial examination of water involves so many difficulties that it is not usually undertaken. The intestinal bacteria are usually indicated by the isolation of the bacillus colon.

The enormous numbers of B. coli which ordinarily occur in the fecal discharge of man and other warm blooded animals render the tests for B. coli instructive. This bacterium in itself is entirely harmless, but its recurrence shows the possibilty of the presence of any one of the many forms of intestinal diseases, the germs of which will of necessity be accompanied by large numbers of them. If the number is found to be large it indicates the presence to an undesirable extent of animal matter discharged from the intestines. It does not necessarily or even usually prove the presence of disease germs. It merely shows that if the animal, including man, that gave off the B. coli had typhoid fever or some other water-borne disease then the same water which conveys the B. coli will probably carry the dangerous germ, or putting it another way, it would show that the method of purification employed had not freed the water from intestinal products—that they had neither settled nor been destroyed in their progress towards the consumer.

When all is done and said, however, the value of an analysis is in its interpretation. Each part of the analysis must be interpreted by comparison with the other parts and in the light of an exact knowledge of the source of supply and the sanitary conditions on the watershed. In other words, it is necessary to have a knowledge of the environment of the source of supply before an intelligent interpretation of the mean results of that water can be made.

For the purpose of outlining some standard of purity for a public water supply, Professor W. H. Horrocks of the Army Medical School of Great Britain offers the following classification, which he says gives the mean results of a long series of examinations:

Very good waters contain from 0 to 50 bacteria per cc.

Good waters contain from 50 to 500 bacteria per cc.

Mediocre waters contain from 500 to 3,000 bacteria per cc.

Bad waters contain from 3,000 to 10,000 bacteria per cc.

Very bad waters contain from 10,000 to 100,000 bacteria per cc.

In the average filter plant, the object to be attained is to produce an affluent containing not over 100 bacteria per cubic centimeter. This figure may be exceeded at times when the filters are loaded with heavily polluted water, but the average results should fall within the figure stated.

Method and Cost of Making an 18-in. Tap on a 24-in. Water Main, Without Interrupting Service, at Columbia, South Carolina.

Contributed by F. C. Wyse, Engineer-Superintendent, Columbia, S. C.

For the purpose of supplying water to the new settling basins now being constructed at Columbia, S. C., in enlarging the water plant, it was found impractical to cut the 24-in. main leading from the raw water reservoir on account of the necessity of a continuous supply through this pipe to the coagulating basin and filters. In order to overcome the difficulty it was decided to make an 18-in. tap on the 24-in. pipe without disturbing the service.

The water department has in use a machine cutting up to 8 ins., made by the Water Works Equipment Co., and a proposition was made by the A. P. Smith Co., to demonstrate their style of machine in this territory, which was accepted by the city.

The pipe on which the tap was made is 24 ins. in internal diameter and 25.80 ins. externally, and carries a light pressure of about 20 lbs. per sq. in. The excavation was in earth bearing a large quantity of spring water and no record of cost of excavation was kept for the reason that the work was prosecuted intermittently and only at favorable times. A pump was necessary all the time, and the entire hole was close sheeted in order to preclude any accident to the machine by sliding mud. The excavation, however, was no larger than would have been necessary for the cutting in of a tee, and practically the same amount of sheeting would have been used, therefore in making a comparison of costs it would be very accurate to place the cost of excavation the same in both cases.

A 24-in. by 18-in. clamped sleeve, internal diameter 26¾ ins., and weighing 1,400 lbs., was adjusted on the pipe with lead wedges. Mud rolls were then placed at each end and in the neck of the sleeve and the lead was poured in the usual manner. This gave a sheet of lead approximately ½ in. thick between the sleeve and the pipe to be tapped. The ends were calked first then the lead in the neck, and the neck lead very carefully trimmed in order not to come in contact with the steel cutter. Onto the neck of the sleeve an 18-in. flanged valve weighing 1,600 lbs. was bolted, and to the valve the tapping machine, weighing 1,000 lbs., was bolted. A derrick supported the weight of the machine. The cutter was then started through the open valve and the cut was completed in 4½ hours, the cutter being turned by hand ratchets. After the cut was made the shaft was withdrawn, the valve closed, and machine removed.

The plug cut out remained tightly in the cutters, the center tapered drill helping in this. The plug was a clean cut, there being no break in the metal other than about 1/16 in. thickness of the inside shell. There were no leaks other than through the stuffing box of the machine which amounted to nothing.

The cost of the work was as follows:

Sleeve and valve	$210.00
Freight on sleeve, valve and machine coming, and machine returning	32.42
350 lbs. lead at 5 cts.	17.50
Drayage on material with department truck	1.50
Labor placing sleeve, valve and machine (5 hours)	4.80
Labor operating and removing machine (4½ hours)	5.55
Total cost without excavation	$271.77

The work was done by the water department forces, the men being paid as follows:

Foreman, $2.75; calkers, $1.50; and helpers, $1.25 per day of 10 hours. More men were used in operating the machine than in placing the sleeve, hence the higher cost for a shorter time.

Additional Statistics on Canadian Water Works Systems.

In Engineering & Contracting of April 23, 1913, a table was published which gave the estimated cost of water per 1,000 gals., the cost per capita per year, and the daily consumption of water per capita in the Canadian Provinces. The Canadian Commission of Conservation has recently issued the additional water works statistics given in the present article.

Table I classifies the water works systems according to the source of supply, system of operation, and ownership. The number of filtration plants, the kind of power used for pumping, and the basis of charges for service is also given. Assuming that all the filtration plants are used in conjunction with surface supplies, it will be noted that at present only 29 per cent of the surface supplies are filtered.

It is interesting to note, in addition to the data given in Table I, the number of systems installed at the end of five year intervals from 1850 to 1911, inclusive. The total figures are as follows for the five year periods: 4, 5, 10, 11, 13, 24, 43, 61, 112, 166, 214, 266 and 348.

American Road Roller for Guadeloupe, W. I.—A steam roller costing about $5,000 was recently imported from the United States by a merchant of Pointe a Pitre, on the island of Guadeloupe, French West Indies, and a successful demonstration given before a large crowd. The roller will be used for repairing the public roads, and is the first machine of its kind in the colony.

Street Preservation in Dalny.—The coat of coal tar put on the principal streets of Dalny, Manchuria, has proved too expensive. The busier streets must be coated at least twice a year. The difficulty comes with the great wear and tear from Chinese carts. Asphaltic cement is to be applied to one street and the experiment of paving with stone blocks will also be tried.

TABLE I.—CLASSIFICATION OF CANADIAN WATER WORKS SYSTEMS.

	Source of Supply.			No. of	System of Operation.		Power for Pumping.					Ownership.		Rates.		
Province.	Springs or Wells	Lake	River.	Plants Using Filters.	Gravity.	Pumped.	Water Power.	Steam.	Electricity.	Gas.	Gasoline.	Municipal.	Private.	Flat.	Meter.	Both F. and M.
Nova Scotia ...	13	12	4	1	19	10	1	9	..	..	..	25	4	18	..	10
New Brunswick	13	1	2	1	7	9	..	6	1	2	..	14	2	11	..	4
P. E. Island....	3	..	..	..	1	2	..	2	..	..	..	2	1	..	..	2
Quebec	42	11	41	15	48	46	8	24	11	1	2	57	37	31	..	3
Ontario	69	28	47	19	18	126	21	66	24	7	6	125	19	75	6	55
Manitoba	4	..	4	2	..	8	..	6	..	1	1	8	..	3	3	..
Saskatchewan..	12	..	3	3	4	11	..	4	2	..	4	15	..	7	5	2
Alberta	7	..	9	7	4	12	..	8	1	3	..	14	2	10	2	4
Brit. Columbia.	14	4	3	2	17	4	..	3	1	..	..	16	5	12	2	5
Canada	177	56	113	50	118	228	30	128	40	14	13	276	70	167	18	85

NEWS SECTION

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The Doings of the Week.

The railway construction field, as regards the letting of new contracts, has been unusually dull the past week. Few contracts of any size appear to have been let, and no new work of any considerable importance has made its appearance. Among the railway contracts let recently are the following: Winston Bros. Co., Minneapolis, Minn., for building an 8-mile coal road in Macoupin County, Illinois, for the Chicago & Northwestern Ry.; Chadwick & Devo, Tucson, Ariz., for 15 miles of line from Whitewater to Tyrone, N. Mex., for the El Paso & Southwestern R. R.; Meacham Contracting Co., Hopkinsville, Ky., for grading and concrete work for a tie-treating plant for the Louisville & Nashville R. R.; Grant Smith & Co., Henry Bldg., Seattle, Wash., for 8,900 ft. of snow sheds near Scenic, Wash, and a 1,200-ft. tunnel for the Great Northern Ry. Guthrie, McDougall & Co., Spokane, Wash., a $500,000 contract for snow sheds for the Great Northern Ry.; Jennings Construction Co., Joplin, Mo., for grading line from Randolph Springs to Moberly, Mo., for the Moberly, Huntsville & Randolph Springs Ry.; Morey-Faulhaber Construction Co., St. Louis, Mo., for grade revision work between Cleburne and Temple, Texas, for the Gulf, Colorado & Santa Fe Ry. Sub-contracts for constructing the Chartiers Southern Ry. in Pennsylvania, for which Brocklehurst-Potter Co. have the general contract, have been let as follows: Masonry work, Fogle Bros., Toronto, Ohio; H. J. Zevely, Morgantown, W. Va.; W. J. Torrington & Co., Philadelphia, Pa.; N. C. Hunter & Co., Washington, Pa. Sub-contract for tunnel work was let to Patton & Richardson, Newport News, Va.

The largest contracts in the earth-moving line on which bids have been asked the past week appear to be for work in connection with the construction of levees. Several good-sized contracts in this line are now open for bids. In Louisiana, Capt. C. O. Sherrill, U. S. Engineer, New Orleans, La., is calling for proposals for constructing 615,000 cu. yds. of earth work in the Lower Tensas Levee District; Maj. J. A. Woodruff, U. S. Engineer, Vicksburg, Miss., is asking bids on about 580,000 cu. yds. of earthwork to close the Shepwith crevasse, and the Board of Mississippi Levee Commissioners, Greenville, Miss., opens bids June 17 on about 2,300,000 cu. yds. of enlargement of old levees and new levee construction. A large ditch and levee contract in Henderson County, Ill., is being advertised for bids. This work includes 2,449,000 cu. yds. of ditch and levee work. Bids are to be opened June 16 at the office of the County Clerk, Oquawka, Ill.

State highway work is rather slow in getting started this spring, and only a few states appear to be making an active beginning on this year's program of construction work. The State Highway Commission of Ohio is asking bids on six fair-sized contracts, and has let contracts on a number of other pieces of work, as noted elsewhere in this issue. The California Highway Commission has awarded contracts for two good-sized highway jobs. Gillette, Montgomery & Tracy, Los Angeles, Cal., secured one of these at $101,998. The other was awarded to Lehigh Garnsey, Los Angeles, at $51,820.

The State Legislature of Massachusetts has passed a bill providing $5,000,000 for harbor development in the state. The money is to be expended under the direction of the State Harbor and Land Commission.

The Bowers Southern Dredging Co., Galveston, Texas, was the low bidder for dredging between Calcasiun and Sabine Rivers on the Inland Interstate Canal, Texas. The contract covers 22½ miles of work, involving 1,500,000 cu. yds. of dredging. The bid was 6.6 cts. per cu. yd.

PERSONAL

Mr. E. F. Harper has been appointed city engineer for East St. Louis, Ill.

Mr. C. M. Nye has been appointed principal assistant engineer of the Great Northern Ry.

Mr. W. J. Hazeltine of Bogota, N. J., has been appointed assistant city engineer of Mansfield, O.

Mr. William E. Sarver has been appointed city engineer of Canton, O., succeeding Mr. P. H. Weber.

Mr. Gaylord Cummins has resigned as city engineer of Dayton, O., and is succeeded by Mr. C. H. Kline.

Mr. G. W. Spencer, formerly of Glendale, Cal., has been appointed city engineer of Huntington Beach, Cal.

Mr. E. M. Smith has been appointed bridge engineer of the Wheeling & Lake Erie, with headquarters at Cleveland.

Mr. D. Mc. D. Campbell has resigned as city engineer for Sydney, N. S., because of ill health after a service of thirteen years.

Mr. L. J. Putnam, division engineer of the Chicago & Northwestern, becomes principal assistant engineer, with headquarters at Chicago.

Mr. C. L. Raymond of the city engineering department of Rochester, N. Y., has been appointed assistant engineer in charge of flood protection.

Mr. S. C. Hertz, Macon, Ga., has been appointed superintendent of the water and light plant at Quitman, Ga., succeeding Mr. J. M. Curtwright, resigned.

Mosher A. Sutherland, formerly city engineer of Passaic, N. J., and assistant engineer in the navy during the Civil war, died May 15 at his home in Passaic.

Mr. C. W. Highfill of Paragould, Ark., and Mr. A. S. Kilgore of Magnolia, Ark., have been appointed as members of the Arkansas State Highway Commission.

Mr. John F. Dull, formerly with Fisher and Barozza of Baltimore, has accepted a position wtih Kefauver & McLaren on their work on the B. & O. R. R, New Orleans Crossroads, W. Va.

Mr. C. W. Boynton will present a paper, illustrated with stereopticon views, on "Decorative Possibilities of Concrete" at the meeting of the Western Society of Engineers, Monday, June 16.

Prof. C. J. Tilden of the engineering department of the University of Michigan has resigned to become head of the new department of civil engineering at Johns Hopkins University, Baltimore.

Mr. Thomas McNally, formerly with the Thomas McNally Co., is president of the newly incorporated Monongahela Construction Co., organized for a general contracting business at 437 Oliver building, Pittsburgh.

Mr. Paul Shultz of Troy, N. Y., has been appointed third deputy state highway commissioner by the state superintendent of highways of New York. Mr. Shultz was formerly city engineer for Utica, N. Y., and later for Troy.

Mr. V. D. Simar, Chief Engineer for the Duluth, South Shore & Atlantic Railway Co., has resigned. Mr. E. R. Lewis, assistant to the general manager, office 904 Fidelity Bldg., Duluth, will take charge of all engineering, bridge and building matters.

Mr. M. E. Thomas has been appointed engineer of the Iowa and Minnesota divisions of the Chicago & Northwestern, and Mr. W. J. Jackson succeeds him, while Mr. Lee Julton, general bridge inspector at Chicago, has been appointed division engineer, with headquarters at Madison, Wis.

Mr. W. T. Curtis will present a paper on "Doubling the Load Capacity of an Old Iron Viaduct" at the meeting of the Bridge and Structural Section, Western Society of Engineers, Monday, June 9.

Mr. Samuel Hill, president of the American Road Builders' Association, on May 26th, delivered an illustrated lecture on "The Highways of the Northwest" at the residence of President George McAneny of the Borough of Manhattan, before an assemblage of over 50 municipal engineers who are in charge of the highways of Greater New York.

Mr. Frank W. Buffum of Louisiana, Mo., who has been actively identified with the good roads movement in Missouri, has been appointed state highway commissioner, and Col. W. S. Hawkins of Jefferson City, state highway engineer for Missouri. Colonel Hawkins has been employed for several years past in construction of highways in Oklahoma and Texas.

Mr. C. G. Elliott has resigned as chief of Drainage Investigations, U. S. Department of Agriculture, and will devote his time to private work as a consulting and supervising drainage engineer. The position of Consulting Drainage Engineer of the Agricultural Department has been offered to Mr. Elliott, but was declined. His office will be in the McLachlen building, Washington, D. C.

Mr. B. C. Collier has resigned his position with H. S. Kerbaugh, Inc., to become engineer and general superintendent for the Parker-Hassam Paving Co. of New York, with headquarters at 7 E. Forty-Second St., New York. Mr. Collier was resident engineer on the construction of the Kensico dam.

Mr. H. A. Mentz will be engineer in charge of the branch office opened in the Randolph building, Memphis, Tenn., by the Solomon-Norcross Co., consulting engineers of Atlanta, Ga.

Civil Service Examinations.

The United States Civil Service Commission announces examinations as follows:

Copyist ship draftsman; $2.40 per diem; June 18.

Clerk draftsman; $1,200 per annum; July 2-3.

INDUSTRIAL

The Raymond Concrete Pile Co. of New York and Chicago has been awarded the contract for placing standard Raymond concrete piles for the foundation of a power house for Armour & Co., Sioux City, Iowa. R. C. Clark, Architect.

The Laclede Steel Co. of St. Louis, Mo., manufacturer of rail carbon steel bars for reinforcing work, also angles and agricultural shapes, has appointed Theodore Geissmann & Company, Inc., 72 W. Adams St., Chicago, Ill., as authorized district sales agents in the central west, for the distribution of its products.

A contract has been awarded to the Raymond Concrete Pile Co. of New York and Chicago for placing standard Raymond concrete piles for the foundation of the train sheds for the new Union Passenger Station, Kansas City, Mo. Jarvis Hunt, Architect. George A. Fuller Construction Company, general contractors.

The contract for the concrete piling for the Farmers' Market to be located at Duquesne Way between 6th and 7th Sts., has been awarded by the city of Pittsburgh to the Cranford Construction Co., Cincinnati, O.; Simplex concrete piles to be used. The contract for Simplex concrete piles for Saint Columba's Church, Johnstown, Pa., has also been awarded to the Cranford Construction Co., by John T. Comes, Architect.

CATALOGUES

Antihydrine.—Paper, 6x9 ins., 4 pp. The Antihydrine Co., New Haven, Conn.

This bulletin describes Antihydrine for damp-proofing and stain-proofing.

Leschen's Wire Rope.—Paper, 8x10½ ins., 12 pp. A. Leschen & Sons' Rope Co., St. Louis, Mo.

The May issue of Leschen's Hercules contains illustrations and descriptions of work on Butler Brothers' new building in Chicago. Descriptions of logging operations and excavation work are given.

Uses for Gas.—Paper, 6¾x9½ ins., 8 pp. United Gas Improvement Company, 11th & Market Sts., Philadelphia, Pa.

This is a periodical issued by the Industrial Division of the United Gas Improvement Co., which is entitled "A Thousand Uses for Gas." The bulletin is devoted to explanations of the many ways in which gas will help in manufacturing goods economically.

Panama Pacific International Exposition.—Paper, Panama Pacific International Exposition, San Francisco, Cal.

Several catalogs and booklets have been issued by the officials of the Panama Pacific Exposition containing rules, regulations and information for exhibitors, with descriptions of the exposition and analysis of the plans and scope of the exhibit department.

Electrical Machinery. — Paper, 8x10½ ins., 28 pp. General Electric Co., Schenectady, N. Y.

Bulletin No. A4071 contains tables of sizes, stock numbers, as well as prices, etc., for ornamental lamp brackets and center span suspension fixtures for series and multiple incandescent street lighting. Bulletin No. A4097, 8 pp., illustrates and describes the General Electric Ventilated Railway Motors.

Clow Bulletin.—Paper, 6¾x10 ins., 70 pp. James B. Clow & Sons, Harrison St. Bridge, Chicago, Ill.

The Clow bulletin for May contains some interesting illustrations of the flood scenes at Coshocton and Newcomerstown, O., the homes of the Clow plants. There are also illustrated and described a large assortment of contractors' equipment and building and plumbers' supplies.

Interlocking Metal Hose.—Paper, 3½x6 ins., 24 pp. Pennsylvania Flexible Metallic Tubing Co., Abbot Bldg., Philadelphia, Pa.

This booklet describes an interlocking copper or galvanized steel spiral hose which is rolled so that the edges interlock, forming four metal thicknesses containing a prepared asbestos packing. The hose is made in all sizes from ⅛ in. to 12 ins.

Filtration Plant Equipment.—Paper, 6x9 ins., 48 pp. The New York Continental Jewell Filtration Co., 17 Broad St., New York City.

This catalog gives complete information about pressure filters with illustrations, descriptions, tables of sizes, capacities, weights, etc., of equipment. Plans and illustrations of filtration plants which have been built by the company are shown.

Pennsylvania Crushers.—Paper, 6x9 ins., 24 pp. Pennsylvania Crusher Co., Philadelphia, Pa.

Catalog No. 11 gives complete illustrations with tabular information showing dimensions, weight, speed, etc., of various sized machines. Another catalog issued by this company (4⅜x6½ ins.) deals with Pennsylvania Hammer Crushers.

Progressive Culverts.—Paper 6x9 ins., 16 pp. American Culvert Manufacturing Co., Buechel, Ky.

This catalog illustrates and describes a corrugated metal culvert with a cast iron bottom.

The Osborne Patented Machinery Co.—Paper 6½x9½ ins., 20 pp. The Osborne Patented Machinery Co., 122 Liberty St., New York City.

Bulletin No. 1 contains descriptions and illustrations of machinery for making ice, a standard vacuum air separator system, smoke consuming apparatus, etc.

Asphalt Block Pavement.—7x10 ins., 16 pp. The Hastings Pavement Co., 25 Broad St., New York City.

This catalog describes the advantages and shows illustrations of asphalt block pavement. Diagrams showing the methods of laying the block are shown.

The Jones Stoker.—Paper 6x9 ins., 16 pp. The Under-Feed Stoker Co. of America Harris Trust Bldg., Chicago.

This is the April number of the Publicity Magazine devoted to the interests of The Jones Stoker.

Canvas Belts.—Paper 6x7 ins., 12 pp. The Cling-Surface Company, 1066 Niagara St., Buffalo, N. Y.

This catalog describes and illustrates the use of painted canvas belts with Cling-Surface treatment. Another pamphlet issued by the same company gives proof that Cling-Surface contains no rosin or other harmful ingredients. Cling-Surface is described as the Life Preserver for belts.

The Photostat.—Paper 5¼x7½ ins., Commercial Camera Company, 349 State St., Rochester, N. Y.

This catalog describes and illustrates a labor saving office device for making facsimile photographic reproductions of letters, maps, drawings, etc.

Sand Blast and Paint Spray.—Paper 3½x6¼ ins. Niagara Devices, Inc., 618 Ellicott Square, Buffalo, N. Y.

This folder gives illustrations and specifications of this apparatus.

Waterproof Cement.—Loose leaves 3½x5½. The Hercules Waterproof Cement Mfg. Co., 700 Mutual Life Bldg., Buffalo, N. Y.

These leaves illustrate a large number of structures which have been waterproofed with Hercules compound.

Pocket Transit.—Paper 6x9 ins., 1 p. Keuffel & Esser Co., Hoboken, N. J.

This loose leaf illustrates and describes a universal instrument for preliminary surveys, combining the principal features of a Sighting Compass, Clinometer and Hand Level. Prices are given.

Brick.—Paper 12½x7½ ins., 8 pp. Hocking Valley Products Co., Harrison Bldg., Columbus, Ohio.

This catalog contains full page colored illustrations showing high grade impervious face brick of nearly every shade and texture.

Brick.—Paper 10x7½ ins., 9 pp. Twin City Brick Company, Capital Bank Bldg., St. Paul, Minn.

This catalog contains suggestions for prospective builders by showing illustrations in color of various kinds of high grade brick and terra cotta facing tile.

Brick Mantels.—Paper 6x9 ins., 32 pp. The Bradford Pressed Brick Co., Bradford, Pa.

This catalog shows diagrams of various shapes of brick for mantels and gives a number of illustrations of designs of mantels with specifications and costs.

The Cost of a House.—Paper 6x9 ins., 16 pp. The Building Brick Association of America, 1301 Flat Iron Bldg., New York City.

This is a paper by J. Parker B. Fiske, giving a comparison of brick, wood cement and hollow block construction.

Cellar Excavations.—Paper 4x9¼ ins., 4 pp. The Pneumelectric Machine Co., Syracuse, N. Y.

This pamphlet describes an excavation job in New York City where an electric truck and pneumelectric drill were used.

The Triumph Chronicle.—Paper 6¾x10 ins., 16 pp. Triumph Electric Co., Cincinnati, Ohio.

This is the same number which contains interesting information regarding electrical and refrigerating machinery.

Hydroelectric Plants.—Board 6x7½ ins., 70 pp. Stone & Webster Engineering Corporation, Boston, Mass.

This is a very interesting illustrated book which gives descriptions of a dozen hydroelectric plants of low, medium and high heads which have been constructed by the Stone & Webster Engineering Corporation.

Steam and Water Service Valves.—Paper 6x9 ins., 112 pp. Golden-Anderson Valve Specialty Co., Fulton Bldg., Pittsburgh, Pa.

Catalog No. 16 is a special catalog of steam and water specialties. Illustrates specifications, drawing, etc.

Ransome Machinery Co.—Paper 6x9 ins., 76 pp. Ransome Concrete Machinery Co., Dunellen, N. J.

Catalog No. 13 deals with a complete line of concrete machinery for handling concrete from the sand pile to the forms. Illustrations, descriptions, dimensions, sizes, weights, etc., are given for the mixers, towers, and all auxiliary equipment. The Ransome-Canniff Grout Mixer is also described.

Tackle Blocks.—Paper 4½x7 ins., 40 pp. W. W. Patterson Co., 54 Walnut St., Pittsburgh, Pa.

This catalog contains illustrations and specifications for extra heavy blocks for bridge erectors and general contractors.

Examinations and Reports.—Paper 6x9 ins., 4 pp. H. M. Byllesby & Co., Insurance Exchange Bldg., Chicago.

Bulletin No. 4 describes the facilities of the Byllesby Company in making examinations for giving expert assistance in cases before commissioners.

Independent Dynamite.—Paper 5¼x6⅝ ins., 62 pp. Independent Powder Co., Joplin, Mo.

This catalog contains a large amount of valuable information regarding the use of dynamite and shows the various brands of dynamite manufactured with a description of the uses to which each brand is especially adapted.

Industrial Locomotive Cranes.—Paper 6x9 ins., 8 pp. Industrial Works, Bay City, Michigan.

Bulletin No. 211 illustrates the uses of a number of locomotive cranes which have been supplied for work in the lumber industry.

Baird Machinery.—Paper 3½x6 ins., 28 pp. Baird Machine Co., Bridgeport, Conn.

This catalog illustrates and describes machines for wire cutting and straightening and for making clips, springs, chains, etc.

Manganese Steel Crusher Parts.—Paper, 6x9 ins., 28 pp. Edgar Allen American Manganese Steel Co., McCormick Bldg., Chicago, Ill.

Bulletin No. 56 contains illustrations and drawings of gyratory and jaw crusher wearing parts of "Stag" Brand Manganese Steel.

Electric Rock Drills.—Paper, 10¾x8¼ ins., 20 pp. Fort Wayne Electric Works, Madison, Wis.

Bulletin 1143, which supersedes Bulletin 1120, contains complete illustrations and descriptions of the construction of the Fort Wayne Electric Rock Drill.

Single Pumps.—Paper, 6x9 ins., 84 pp. Blake & Knowles Steam Pump Works, 115 Broadway, New York City.

This is a complete pump catalog of ammonia pumps; sinking pumps, automatic feed pumps, boiler feed and pressure pumps, condenser and vacuum pumps, direct acting air compressors and blowers of elevator pumps, filter press pumps, hydraulic pumps, light pressure service or tank pumps and magma pumps.

Webster Method.—Paper, 6x9 ins., 20 pp. The Webster Manufacturing Co., Tiffin, O.

The May number of "Webster Method" contains interesting articles describing conveyor installations of various types.

Four Wheel Drive Tractor.—Paper, 8½x11 ins., 32 pp. The Heer Engine Co., Portsmouth, O.

This catalog illustrates and describes the construction and operation of a four wheel drive gas tractor and gives views which illustrate the work of the machine.

D'Olier Centrifugal Machines.—Paper, 3½x6 ins., 16 pp. D'Olier Pump & Machine Co., Marice Bldg., Philadelphia, Pa.

This folder is entitled "Improved Oil and Washing Centrifugals." Illustrations and descriptions are given of machinery for separating and recovering oil and for freeing wash and acid liquors from various materials.

Pneumatic Tools.—Paper, 6x9 ins. Chicago Pneumatic Tool Co., Fisher Bldg., Chicago, Ill.

Bulletin No. 128, 12 pp., gives illustrations, specifications and tabular information regarding miscellaneous equipment for pneumatic drills.

Bulletin No. 132, 20 pp., gives complete information regarding pneumatic motors and pneumatic geared hoists.

Bulletin No. 133 gives complete information regarding Air Hoists and Jacks.

Unit Concrete Construction.—Paper, 6x9 ins., 32 pp. Unit Construction Co., St. Louis, Mo.

This book contains complete information regarding the methods of constructing buildings by the unit method. A number of illustrations show the various steps of the work and a number of completed buildings.

Negley Excavator.—Paper, 4x7 ins., 8 pp. Indianapolis Cable Excavator Co., 1128 W. New York St., Indianapolis, Ind.

This folder gives information and a complete description of the construction of the Negley Excavator. This is a slack cable excavator.

RAILWAYS

Alabama.

City Commission of Birmingham, Ala., has granted a franchise to I. C. Beatty and associates, representing the Birmingham Realty Co., for a street car line in Norwood. It is understood that the Norwood extension will be built and operated by the Kelley Street Ry. Co., which already has a street car franchise in the city.

Arizona.

⊙The El Paso & Southwestern R. R. Co. has let contract for the construction of 15 miles of road from Whitewater to Tyrone, N. Mex., to Chadwick & Devo, Tucson, Ariz. The work, which will not include the rock work, will cost about $50,000.

It is reported that engineers of the El Paso & Southwestern R. R. have surveys under way for the construction of a 10-mile cutoff on the line east of Douglas, Ariz., eliminating a number of curves.

Colorado.

On the budget of the Denver & Rio Grande R. R. for the fiscal year, according to reports, is an item providing for a new freight depot at Ogden, Utah, to cost about $100,000. The work will include new sidings, connecting lines, etc.

Further information in regard to the Montezuma & San Juan Southern R. R., mentioned in our last issue, is to the effect that already about one-half the necessary money is subscribed for the preliminary work. The officers and directors are G. O. Harrison, President; Wm. Guillet, Vice President; W. I. Myler, Treasurer; G. R. Lamb, Secretary and General Manager. Directors, John Fowler, H. McEwen, John Wilson, Emil Stein, F. M. Goodykoontz, G. R. Lamb, C. H. Avery, all of Cortez, Colo.

California.

Articles of incorporation of the Chowchilla Pacific Railway Co., capitalized at $200,000, have been filed at the office of the Secretary of State, Frank Jordan, Sacramento, Cal. The incorporators who have jointly subscribed for $10,000 of stock in the project are: J. A. McNeil and W. W. Wiard of Sacramento and M. E. Forbes of San Francisco. The corporation is organized with a view of building a railroad branch from Chowchilla in Madera County, 10 miles east, to a point on the Mount Diablo and Meridian base line.

Upon the completion of the electrification of the Tidewater Southern Ry., it has been announced, work will be started immediately extending the line to Turlock, Cal., a distance of 10 miles. Byron A. Bearce, 25 S. Sutter St., Stockton, Cal., is President and General Manager of the company.

Fresno Traction Co., F. W. Webster, General Manager, 1801 Tulare St., Fresno, will probably have work started in the near future on the construction of an 8½ mile line from Biola to Muscatel.

The Santa Fe System has been making surveys in the vicinity of Orosi for a spur along the foothills and through the Sand Creek Gap. The rights of way are being granted with the provisions that construction work be started within 6 months.

The Southern Pacific Co. is reported to have announced its intention of building an electric line from Redwood to San Jose. Particulars of the route have not been given out, though it is understood that the line will connect at Palo Alto with the interurban road, and thus the new extension will become part of the proposed electric railway system understood to be planned by the railroad company.

The State Railroad Commission has authorized the Stockton Terminal & Eastern R. R., G. W. Broadhurst, Chief Engineer, Stockton, Cal., to issue $345,000 of bonds for the completion of the road. The work includes the construction of 2.1 miles of line in Stockton.

The Minkler Southern Ry. Co. has been incorporated with a capital stock of $200,000, of which $42,000 is subscribed, and proposes a line from Minkler, in Fresno County, to Exeter, in Tulare County, a distance of 41½ miles. This is a Santa Fe project. The incorporators are officials of the Santa Fe System, of which G. W. Harris, Los Angeles, Cal., is Chief Engineer.

The Commercial Club of Blythe, Cal., is raising a $100,000 bonus to secure the construction of a railroad into the Palo Verde Valley.

The Pacific Coast Borax Co., Oakland, Cal., has surveys underway for a railroad from the Lilas Mine on the Tonopah & Tidewater R. R. to its borax deposits in Death Valley.

Florida.

Allen W. Jones, Augusta, Ga., is reported to have entered into a contract with the Miakka Land Co., which owns 193,000 acres of virgin pine land in eastern Manatee and western DeSoto counties, to build, equip and operate a standard gage railroad from Arcadia to Manatee, a distance of 53 miles. It is stated that the contract provides that construction work must actually begin not later than July 1 next, and the road be completed and in operation not later than July 1, 1915.

Illinois.

⊙Winston Bros. Co., Minneapolis, Minn., have been awarded the contract by the Chicago & Northwestern Ry. for constructing a coal road 8 miles long from Beuld, Ill., southward in Macoupin county. The work includes 200,000 cu. yds. of excavation.

The receivers of the Wabash R. R. have been given authority to purchase a strip of land, 400 ft. wide and 1½ mile long, located east of Granite City alongside the Wabash tracks, for the establishment of a large outer freight yard on the east side. It is stated the ground will be cleared at once and placed in order for the laying of tracks. This will be a freight assembling and distributing yard.

The Peoria, Galesburg & Western Ry. Co. has been incorporated and proposes the con-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

struction of an interurban line from Peoria to Galesburg, the route running through Kickapoo, the Jubilee territory and Brimfield. The directors include Howard Knowles of Galesburg, president of the Peoria Water Co.; Chas. L. Dungan of Brimfield, R. D. Clarke of Peoria and E. W. Wilson of Pekin.

The Pennsylvania R. R. will expend about $2,000,000 in elevating its tracks between W. 39th and W. 75th St., Chicago. Work is now underway on the 66 ft. wide, 650 ft. long subway at W. 59th St. H. C. Crowell, Pittsburgh, Pa., is the Engineer in charge.

Iowa.

The Chicago, Burlington & Quincy R. R. is reported to have surveys underway for the location of about 9 miles of new line between Indianola and Norwalk. The new line would connect the branch line extending north from the main line at Chariton through Oakley, Lacona, Milo and Ackworth, with the branch line extending into Des Moines from Osceola through New Virginia, St. Marys and Norwalk.

Kansas.

The Hutchinson Construction Co. has been chartered with a capital stock of $10,000 for the purpose of taking charge of building the Anthony & Northern Ry. As noted in our last issue, work is now underway on the 6-mile section from Quka to Pratt. Abernathy & Davis have the grading contract on this section. The incorporators of the construction company are O. P. Byers, Dr. J. H. Duvall, A. C. Malloy, F. B. Crooks, all of Hutchinson, and R. A. Cox of Pratt.

The Hutchinson & Northern Ry Co., organized some time ago to construct a steam railroad from Hutchinson to Burrton and possibly to McPherson, is reported to have changed its plans, and will, it is said, construct an interurban line instead. Informal application has been made to the State Utilities Commission for permission to increase the capital stock of the company from $100,000 to $250,000. Will S. Thompson, Hutchinson, Kan., is interested.

Kentucky.

⊙The Louisville & Nashville R. R. Co., W. H. Courtnay, Chief Engineer, has awarded a contract to the Meacham Contracting Co., Hopkinsville, Ky., for all grading and concrete work in connection with the establishment of a tie treating plant by the railroad. The work involves about 60,000 yds. of earth excavation and several thousand yards of concrete foundations, floors, retaining walls, etc. The entire contract amounts to about $35,000.

Louisiana.

⊙Henry J. Cox & Co., New Iberia, La., as noted in our last issue, have been awarded the contract for constructing the first section of the Alexandria & Western Ry. This section extends from Alexandria to Leesville, 14 miles. The survey for the remainder of the line has not yet been completed. The contract includes 70,000 cu. yds. earth excavation, 50,000 cu. yds. rock excavation, 3,300 lin. ft. wood trestle and 30,000 lin. ft. piling. Subcontracts for sections of the grading have been let to Irwin McGinnis, and A. E. Parker, both of whom have temporary addresses at Alexandria, La. No additional subcontracts are to be let at present. The temporary office of Cox & Co. for the contract is at 308 Murray St., Alexandria, La.

Maryland.

Officials of the Pennsylvania R. R. held a conference last week with the city officials of Baltimore, Md., on plans for increasing the railroad's terminal facilities. The Pennsylvania R. R. has recently purchased land in the vicinity of the Calvert St. station and is understood to have extensive improvements in view. These are believed to include a downtown terminal and elevated tracks. The company is also reported to have under consideration a caisson tunnel under the Patapsco River to shorten the route to the south.

Massachusetts.

The Bay State Street Ry. Co., J. T. Conway, General Superintendent, Brockton, Mass., has made an appropriation for extending its tracks in Ames and Grafton Sts., Brockton.

Michigan.

Plans are under consideration by the Grand Trunk R. R. to establish at Jackson, Mich., terminals of the new trunk line joining the main line at Bellevue, Eaton County, Mich.

Advices from Ludington, Mich., state that A. B. Ziegweld, formerly division engineer on the Toledo-Ludington branch of the Pere Marquette, is in that city with a crew of men preparing to start surveys for a new road from Ludington to Hart.

The Pere Marquette R. R. is now making a survey for a line 19 miles in length between Hart, Pentwater and Ludington.

The Michigan Central R. R., M. C. Coyle, Division Superintendent, Bay City, Mich., is to build a short extension to Portage Lake, where the permanent camp ground of the Michigan National Guards will be located.

Col. Eugene Zimmerman, Cincinnati, O., has submitted a proposition to the Board of Trade of Frankport to build and equip an electric road to Honor, to follow the old survey of the Alpena, Gaylord & Western. This survey runs through the fruit belt of western Michigan and will connect with the Empire & Southwestern, Manistee & Northeastern and the Pere Marquette. A committee of Benzie County's business men has been appointed to secure the necessary right of way.

St. Louis Items.

BY A. B. KOENIG.

⊙Thos. L. Rosser, Jr., has let 35,000 yds. of team work on the new Chicago & Northwestern R. R. extension near Staunton, Ill., to Joyce Bros. & Bagwell of Keokuk.

⊙Jas. Alexander Construction Co. of Memphis, Tenn., the lowest bidder for the new Illinois Central depot and office building at Memphis, Tenn. This particular bid is for a building 141 ft. on Calhoun, 242 ft. on Main St., 8 stories high. The depot part will occupy 2 stories, the offices to occupy 6 stories above these. The first 3 stories are to be of Bedford stone and the upper part of pressed brick and terra cotta. They expect to complete this job in about 18 months.

⊙Winston Bros. Co., of Minneapolis, secured the contract for building the Chicago & Northwestern extension in Illinois. Thos. L. Rosser, Jr., has taken quite a slice of this work.

List & Gifford Construction Co. have finished 25 miles of track laying and surfacing on the Louisiana & Arkansas R. R. in Louisiana. They beat the high water and had their outfit moved away before the flood got over the country.

M. L. Windham has two engines, two machines and a 15 team outfit idle at Centralia, Ill.

P. J. Murphy, Moberly, Mo., has quite a number of bridge filling jobs along the Wabash R. R.

Griffith & McMurray received word from the Frisco R. R. Co. to suspend work on the new line that they are building for this company near Morrisonville, Ill. We understand shortage of money is the cause.

Jas. Dowd & Son have their outfit idle at Morrisonville, Ill. They were on Griffith & McMurray's work on the new Frisco R. R. extension.

Jas. G. Hannahan, Secretary International Union of Steam-Shovel & Operative Engineers, spent a couple of days in town on business.

Mike Conroy expects to put his big team outfit on a couple of hundred thousand yards of grading in Illinois within the next week or ten days. Contract not signed, but Mike says it sure will be.

Dan Hannefin is in the market for some team work. Poag, Ill., will catch him.

Pat Hannon of Hannon & Hickey Bros. and the Universal Const. Co. was a caller the other day. All of their jobs are getting along fine and dandy.

Roberts Bros. are making rapid progress with their track laying on the new Northwestern extension near Pekin, Ill.

A quarter boat belonging to the Kinser Construction Co. and housing about 50 laborers on the East Side levee sprung a leak and sank one morning last week. The men who were sleeping at the time had a narrow escape from drowning. The boat was moored at the foot of Missouri Ave., East St. Louis, about 50 ft. from the shore. It is believed a log rammed the side. One side sank about 5 ft. to the river bed and the other side, where the water was deeper, sank down until the boat was overbalanced and turned over on its side. Two derricks were fitted up on tugs and worked all day lifting the boat out of the water and pushing it toward the shore. Three divers were obtained from the City Water Company to dive down and pass rope around the keel. The men sleeping on the boat at the time it sank all escaped in only their under clothing and took refuge in the office of the Kinser Constr. Co. until makeshift clothing could be prepared from East St. Louis stores. They, however, recovered their clothing when the boat was raised and landed on the shore.

T. J. Dolan, the hustling Secretary of Steam-Shovel & Dredge Union, was in St. Louis a couple of days last week. He left here for Kansas City. Dolan reports his organization in a flourishing and prosperous condition.

C. S. Dolman & Son, Topeka, Kan., can use 6 or 8 teams for cutting a channel near Chesterfield, Mo. There is about 6,000 yds. of earth to be moved in this job. Also some grubbing. In addition to this job they have 40,000 yds. of machine work on the Rock Island R. R. at Villa Ridge, Mo., to let. This work will be ready as soon as the culverts are in place about July 1.

The Chicago & Alton R. R. Co. is improving its Jefferson City branch, putting down new rails and new ties, also reballasting this line.

F. Ringer, Division Superintendent of the Missouri, Kansas & Texas R. R., moved his headquarters from McAlester to Muskogee, Okla., last week.

The Missouri, Kansas & Texas R. R. Co. is relaying its main line of track between St. Louis and Franklin Junction putting down 85 lb. steel.

Mississippi.

The following board of directors has been elected by stockholders of the recently incorporated Corinth & Northwestern Ry. Co., mentioned in our last issue: Abe Rubel, Russell Dance, G. A. Hazard, H. N. Young, J. A. McAmis, W. D. Conn, R. L. Young, W. E. Small and Clopton Thomas.

Missouri.

⊙Jennings Construction Co., Joplin, Mo., has been awarded the contract at an estimated cost of $13,080, for grading from Randolph Springs to Moberly, Mo., for the Moberly-Huntsville & Randolph Springs R. R. Co. Jno. J. Mundinger, Chief Engineer, Huntsville, Mo. The contract for the concrete work was let to Edwin Freed, Moberly, Mo., at $8.50 per cu. yd.

Montana.

It has been announced at Billings, Mont., that work will begin immediately on the construction of the branch of the Northern Pacific Ry. from Hasper, on the line of the Billings & Northern, to Melville, north of Livingston, and that grading will be completed to Summit, 75 miles, this year.

Nevada.

The Southern Pacific Ry. has established an engineering camp at Coaldale and it is believed that the company contemplates the construction of a line from that place into Tonopah, Nev., and thence to a connection with the Nevada & California.

New York.

A project is under consideration for the construction of an electric railway from Riverhead (L. I.) to Orient Point, a distance of 30 miles, the route passing through Riverhead, Aqueboque, Jamesport, Laurel, Mattituck, Cutchogue, Peconic, Southold, Greenport, East Marion and Orient. Edward B. Eaton and W. S. Davis of Hartford, Conn., are interested.

The Goodyear Lumber Co., 906 Ellicott Sq., Buffalo, N. Y., has made surveys for a railroad to extend to Newport and to be used for bringing out lumber.

The Public Service Commission for the First District has approved the plan of reorganization of the Pelham Park and City Island Railroad Companies as one company under the name of the Pelham Park & City Island Railway Co., Incor. It has also granted that company permission to issue its capital stock to the amount of $117,000, for the acquisition of the property of the two old companies and reconstruction as a standard gauge trolley railroad. This road runs from Bartow, or City Island, station on the Harlem River branch of the New York, New Haven & Hartford R. R. to Belden's Point, City Island.

The Interborough Rapid Transit Co. of New York City has been ordered by the Public Service Commission for the First District to build a new station on the 9th Ave. elevated railroad at 99th St. and Columbus Ave., Manhattan, and to have the same completed and ready for operation by Dec. 1, 1913. At present there is no station between 93d St. and 104th St., a distance of 11 blocks.

North Dakota.

Work is now being started for the completion of the Niobe North Line of the Great Northern Ry. A. Guthrie & Co., St. Paul, Minn., have the contract, and did the grading last season. The present contract covers the tracklaying and ballasting and construction of depots, section houses, etc. The line is to extend from Niobe north to make a connection with the Grand Trunk Pacific Ry.

Oklahoma.

Surveys are to be started shortly for the interurban line to be built to Nowata, Okla., by the Kansas-Oklahoma Traction Co. of Wert. D. H. Siggins, Coffeyville, Kan., is President.

Graders on the Mountain Valley & Plains R. R. in western Oklahoma have started work toward Guthrie, the eastern terminal, where connection will be made with the Santa Fe, Katy, Rock Island and Fort Smith & Western. The road was chartered in February, 1909, with $500,000 capital stock. During that summer the company secured bonuses from various towns along the proposed line, Guthrie giving $75,000, Taloga $25,000, Dalhart, Tex., $125,000 and other places in proportion. Other Texas towns on the proposed line are Higgins and Clarendon, and other Oklahoma towns are Arnett, Watonga and Kingfisher. H. S. Wannamaker of Amistad, N. Mex., is the head of the company.

Advices from Cheyenne state that active construction work has again commenced on the Cheyenne Short Line, which is being financed by Levy & Levy of Muskogee, Okla. The line was promoted by Cheyenne business men to build east from Cheyenne to a connection with the newly constructed Wichita Falls & Northwestern, which passes through the eastern part of Roger Mills county. Cheyenne is one of the old territorial county seats, but is still without railroad facilities.

Oregon.

Good progress is being made with the construction work on the Oregon & Eastern R. R., west of Vale. One of the most difficult pieces of work on the line, the 2,500 ft. tunnel at Milepost 39 in the Malheur Canyon, will probably be completed next month, and track laid through it by July 1. The Utah Construction Co., Ogden, Utah, has the contract for 200 miles of the line east of Coos Bay on the west coast of Oregon to the east slope of the Cascade Mountains.

Pennsylvania.

⊙Brocklehurst, Potter Co., Providence, R. I., who have the contract for constructing a railroad from Van Emaus to Marianna, Washington County, Pennsylvania, for the Chartier Southern Ry., as previously noted in these columns, has sublet the masonry work to the following: Fogle Bros., Toronto, O.; H. J. Zevely, Morgantown, W. Va.; W. J. Torrington & Co., Philadelphia, Pa.; N. C. Hunter & Co., Washington, Pa. Sub-contract for tunnel work was let to Patton & Richardson, Newport News, Va. All sub-contracts have now been let. The general contract includes 1,500,000 cu. yds. earth and rock excavation, 1,300 lin. ft. earth and rock tunnel, 40 concrete bridges and 40,000 cu. yds. concrete masonry.

The Wayne County Ry. Co. of Honesdale, Pa., has been incorporated with a capital stock of $100,000 and proposes to construct a 15-mile electric railway. Martin B. Allen, Honesdale, Pa., is President.

⊙Irwin & Leighton, 126 N. 12th St., Philadelphia, Pa., have been awarded the contract for extensive addition to the Arcade, Broad St. and South Penn, Philadelphia, for the Pennsylvania R. R. Co. at a price exceeding $300,000.

The Chambersburg & Shippensburg Ry. Co. (electric) rejected all bids received May 12 for the graduation, track-laying and ballasting, masonry and culverts for extension from Red Bridge Park, Franklin Co., Pa., to Shippensburg, Cumberland Co., Pa., approximately 8.4 miles, and is doing the work by its own forces. J. G. Schaff, Chambersburg, Pa., is Secretary.

Panama.

The Republic of Panama has entered into a contract with R. W. Hebard & Co., San Francisco, to make plans and surveys for proposed railroad lines in the interior. The contract calls for a thorough examination of the Province of Chiriqui, with a view of constructing a railroad from Pedregal, its chief port, to Boquete, the largest coffee-producing district on the isthmus, situated in the mountains, 35 miles inland. In addition, the Chiriqui surveys will include such other lines as it may be found advantageous to build. The other projects to be given attention are those in the provinces of Los Santos and Cocle. The work of the engineers will also include port works and a special investigation of available water-power sites. The engineers are to conclude their labors in six months from April 1 and submit a report to the president, with their recommendations as what lines it may have been found advisable to build, together with estimated construction cost, cost of operation and maintenance, what sources of revenue are available and what developments may be expected upon the termination of the projects.

Tennessee.

⊙The James Alexander Construction Co., Memphis, Tenn., will probably sublet the pile driving in connection with its contract for the Central depot of the Illinois Central R. R. at Memphis, Tenn. Practically all the excavating and masonry work will be done by the general contractors. The contract includes 7,000 cu. yds. earth excavation, earth tunnels, concrete, masonry and 42,000 lin. ft. pine pile, 9 in. point, 14 in. butt.

The Silica Construction Co., Tracy City, Tenn., has the grading contract for a railroad from Cape Springs to Johns Ridge, a coal hill, 4 miles from Tracy City.

Texas.

⊙Morey-Faulhaber Construction Co., St. Louis, Mo., has been awarded the contract for revising several grades between Temple and Cleburne, Tex., for the Gulf, Colorado & Santa Fe Ry.

The State Railroad Commission has granted the Aransas Harbor Terminal Ry. Co. a two-years extension of time in which to complete improvements on its principal survey on Harbor Island.

The Temple, Northwestern & Gulf R. R. Co., chartered recently with a capital stock of $100,000, has been organized to take over the property of the Temple & Northwestern R. R. and complete the line to Gatesville. In addition it is proposed to build the line on to Dublin. The capital for construction is reported to be assured and it is stated that construction work will be started this month. James F. Sadler, Jr., Houston, Tex., and W. S. McGregor, Temple, Tex., are interested.

Utah.

Hanson Bros. and Cowan & Loveless, Payson, Utah, have the contract for grading the Salt Lake & Utah Interurban R. R. from Lehi north to Jordan Narrows. The Utah Construction Co., Ogden, as previously noted, has the contract for construction work through the Narrows.

Washington.

⊙It has been announced that the Great Northern Ry. Co. has let contracts for constructing snow sheds near Scenic, Wash., to include 8,900 ft. of timber sheds, 4,000 ft. combination sheds with concrete and rubble back wall with timber posts and roof and a 1,200 ft. double track tunnel. Contracts have been awarded to Grant Smith & Co., Henry Bldg., Seattle, for tunnels and all timber sheds, at about $1,000,000, and for combination shed to Guthrie, McDougall & Co., Spokane, Wash., for about $500,000.

Citizens of Tacoma, Wash., have voted in favor of the proposition that the city construct and equip an electric street railway in S. 11th St. Estimated cost is about $87,000.

The Chicago, Milwaukee & St. Paul Ry. has been investigating the possibilities of constructing a line from Neppel, the new Milwaukee townsite on Moses Lake in southeastern Douglas County, north through the rich grain country lying south of the Colville Indian reservation to Foster Creek, thence along the creek to Bridgeport on the Columbia River and west to Bellingham.

West Virginia.

Stockholders of the Wheeling Traction Co., Geo. O. Nagle, General Manager, W. Va., have authorized a mortgage for $10,000,000, part of this amount to be used for improvements. The improvements contemplated include extensions of the Barton division to St. Clairsville, the Bellaire division to Neffs, O., the enlargement of the company's power house and the building of sub-stations at Warwood and McMechen. A portion of the bonds will be used for the purpose of retiring outstanding bonds of the Wheeling Traction Co. and subsidiaries.

Canada.

Bill has been approved by the Railway Committee of the House of Commons to incorporate a new western railway to be known as the Canadian Northwestern Ry. Co. The directors include Lord Howard De Walden, Lord Clinto and Lord Montague de Beaulieu, W. F. Morgan, Jr., of Paris and New York is another director; Frederick W. Baker and Harry E. Brittain of London, both described as directors of companies, are also named as directors. The capitalization of the company is $15,000,000. As proposed, the road is to run from Winnipeg to Manitou, thence through southern Manitoba and Saskatchewan to Lethbridge. The road then strikes northeast to North Battleford, across to Prince Albert to Le Pas, thence south through Dauphin to Brandon, across again to Manitou and to Dominion City. The line proposed thence goes northwesterly to Glencross and Altona and back to Winnipeg.

City of Toronto, Ont., has retained R. A. Ross, Montreal, Que., J. W. Moyes, Toronto, and J. C. Forman, Toronto, to report on the value of the properties of the Toronto Ry. Co. and the Toronto Electric Light Co. with a view to their purchase by the city.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ROADS AND STREETS

Alabama.

✣Bids will be received until June 25, by Butler County Commissioners, Greenville, Ala., for grading and surfacing with sand clay a portion of Milner Mill Road, estimated to cost $10,000. W. W. Keller is State Highway Engineer, Montgomery, Ala.

✣Bids will be received until June 24, by Marengo County Commissioners at the courthouse, Linden, Ala., for grading, draining and surfacing about 4 miles of road. W. S. Keller, Montgomery, Ala., is State Highway Engineer.

✣Bids will be received until June 16, by Board of Revenue Lowndes County, Hayneville, Ala., for the grading of about 7 miles of roads. W. S. Keller is State Highway Engineer, Montgomery, Ala.

The City Commissioners of Birmingham, Ala., have confirmed an ordinance to pave 12th Ave., from 24th St. to 32nd St., with bitulithic.

Arkansas.

A special road district has been organized in Poinsett County, Ark., to construct a 20-mile highway across the county at a cost of $80,000. The district will extend from Hydrick, on the line between Cross and Poinsett Counties, north through Harrisburg to the line between Craighead and Poinsett Counties. The road will cost about $4,000 per mile. Ben Cole, Harrisburg, is County Judge.

California.

⊙Bids were received May 19 by the State Highway Commission, Sacramento, Calif., for the construction of Section A, Route 2, Division 4, of the State highway in Santa Clara County. In the table shown below (1) stands for engineer's estimate, (2) bid of John Doyle, San Jose (awarded contract), and (3) A. Teichert & Son, Sacramento:

Without Classification—	(1)	(2)	(3)
Excavation, 3,000 cu. yds	$0.60	$0.50	$0.60
Paving and Monuments—			
Cement concrete, class "B," 1,500 cu. yds	2.50	2.70	3.21
Broken stone, 1,190 tons	0.72	0.69	1.45
Broken stone screenings, 115 tons	0.65	0.75	1.10
Sand, 95 cu. yds	0.80	1.00	1.50
Asphaltic oil (hauled and placed, 160 bbls	1.00	1.25	2.50
Guard rail, 3,200 lin. ft	0.25	0.35	0.30
Monuments (hauling and setting), 15, each	1.00	1.00	1.00
Totals	$8,835	$7,887	$9,984

⊙The Barber Asphalt Paving Co. has been awarded the contract by the City Council of Richmond, Calif., for the improvement of Chanslor Ave., from 10th to Espee St., for $37,360.

⊙Bids were received May 19 by the State Highway Commission, Sacramento, Calif., for the construction of a section of the State highway in Ventura County, Division 4, Route 2, Section A. In the table following (1) stands for engineer's estimate, (2) bid of Bent & Pennebaker, Los Angeles; (3) W. W. Atkinson, Los Angeles; (4) John D. Marsh, (5) Harry C. Mayer, Venice; (6) Roger Bros. Co., Los Angeles; (7) Leigh Garnsey, Los Angeles (awarded contract); (8) Gillette Montgomery & Tracy, and (9) Road & Street Improvement Co., Fresno:

Without Classification—	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Excavation (ordinary), 22,020 cu. yds	$ 0.50	$ 0.65	$ 0.75	$ 0.82	$ 0.60	$ 0.60	$ 0.685	$ 0.70	$ 0.70
Corrugated iron pipe, 12-in., 234 lin. ft	1.20	1.60	1.50	1.60	1.65	2.00	1.40	1.20	2.25
Corrugated iron pipe, 18-in., 88 lin. ft	1.65	2.10	2.00	1.80	2.04	2.35	1.75	1.40	2.50
Corrugated iron pipe, 24-in., 112 lin. ft	2.10	2.50	2.50	2.15	2.44	2.70	2.00	1.75	3.00
Culverts—									
Cement concrete, class "A," 45 cu. yds	11.00	11.50	12.00	10.00	10.00	10.00	10.00	11.00	11.90
Culverts and Monuments—									
Cement concrete, class "B," 36 cu. yds	10.50	12.50	12.00	10.00	10.00	10.00	9.00	9.00	10.50
Paving—									
Cement concrete, class "B," 7,189 cu. yds	4.50	4.75	5.75	4.50	5.75	5.50	4.26	4.95	5.90
Asphaltic oil (hauled and placed), 770 bbls	1.50	2.50	3.00	2.50	1.50	3.00	2.00	1.30	3.00
Broken stone screenings, 555 tons	2.20	3.00	2.50	5.00	2.25	2.50	2.50	2.50	2.50
Sand, 370 cu. yds	2.50	2.25	2.00	2.50	2.50	2.50	1.81	1.25	2.75
Guard rail, 2,744 lin. ft	0.40	0.45	0.15	0.60	0.50	0.50	0.31	0.40	0.45
Monuments (hauling and setting), 136, each	0.60	2.50	2.00	1.10	1.00	5.00	2.00	0.50	3.85
Totals	$56,735	$56,222	$65,523	$59,371	$60,983	$61,164	$51,870	$56,402	$66,282

⊙Henry L. Kuns, of Lordsburg, Calif., has commenced work on the $36,000 worth of street improvements in that city. The contract calls for the completion of the work by Oct. 15.

⊙Bids were received May 19 by the State Highway Commission, Sacramento, for the construction of that part of the State highway in Los Angeles County, Division 4, Route 2, Section 6. In the table below (1) stands for engineer's estimate, (2) bid of Bent & Pennebaker, Los Angeles; (3) W. W. Atkinson, Los Angeles; (4) T. T. Prendergast, Los Angeles; (5) John D. Marsh, Los Angeles; (6) Harry C. Mayer, Venice; (7) Leigh Garnsey, Los Angeles, and (8) Gillette Montgomery & Tracy, Los Angeles (awarded contract):

Without Classification—	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Excavation, 62,740 cu. yds	$ 0.35	$ 0.50	$ 0.60	$ 0.40	$ 0.90	$ 0.60	$ 0.43	$ 0.50
Corrugated iron pipe, 12-in., 362 lin. ft	1.15	1.60	1.50	1.65	1.60	1.45	1.40	1.00
Corrugated iron pipe, 18-in., 599 lin. ft	1.60	2.10	2.00	2.25	1.80	2.00	1.75	1.50
Corrugated iron pipe, 24-in., 665 lin. ft	2.10	2.50	2.50	2.75	2.15	2.50	2.00	2.90
Corrugated iron pipe, 30-in., 251 lin. ft	2.95	3.70	3.00	4.00	2.80	3.75	3.00	2.75
Culverts—								
Cement concrete, class "A," 236 cu. yds	10.00	11.50	10.00	13.00	10.00	10.00	10.00	11.50
Culverts and Monuments—								
Cement concrete, class "B," 178 cu. yds	9.50	12.50	12.00	13.00	10.00	10.00	9.00	9.00
Paving—								
Cement concrete, class "B," 11,030 cu. yds	4.50	4.75	5.25	6.92	5.45	5.50	7.50	4.80
Asphaltic oil (hauled and placed), 1,180 bbls	1.25	2.50	2.50	1.60	3.00	2.00	2.40	1.25
Broken stone screenings, 850 tons	3.00	3.00	2.50	4.00	4.00	2.25	2.75	3.00
Sand, 680 cu. yds	1.40	2.25	2.00	3.00	2.50	2.50	2.50	1.25
Guard rail, 12,680 lin. ft	0.40	0.45	0.40	0.53	0.60	0.50	0.39	0.40
Monuments (hauling and setting), 280, each	0.65	2.50	2.00	1.00	1.10	1.00	2.00	0.50
Totals	$102,796	$106,566	$116,271	$125,912	$141,065	$119,368	$129,678	$101,998

Connecticut.

✣Bids will be received until 11 a. m., June 9, by F. L. Ford, City Engineer, New Haven, Conn., for paving Atwater St., from Grand Ave. to Lombard St.; Canner St., from Whitney Ave. to Orange St.; Cold Spring St., from Whitney Ave. to Orange St.; Dewitte St.; Edgehill Road, from St. Francis Ave. to City Line; Edgewood Ave., from end of present pavement to Edgewood Ave. bridge over West River; Elm St., from Kensington St. to Pendleton St.; Greenwich Ave.; Mansfield St., from Prospect Place to Woodland St.; Orange St., from end of present pavement to Cold Spring St.; Prospect Place, from Prospect St. to Mansfield St.; South Front St. and Winchester Ave., from Division to Highland St., with sheet asphalt, asphaltic concrete, asfelto and Amiesite, on concrete and new macadam foundation. Total yards about 88,000. Certified check required, about 5 per cent of bid. Blank forms of proposal and any information concerning plans, specifications, bonds, etc., will be furnished upon application.

District of Columbia.

✣Bids will be received until 2:30 p. m., June 16, by Maj. F. C. Boggs, Purchasing Officer Northern Canal Commission, for finishing under Circular 778-B, paving and special brick.

Florida.

⊙The Bond Trustees of Pensacola, Fla., have awarded the contract for the laying of two additional miles of concrete street paving to W. P. Kennedy, of that city, for $31,392. The paving will cost $1.24 per sq. yd., straight concrete curb, $0.27 per lin. ft., reinforced concrete corner curb, $0.55.

Citizens of the eastern portion of Hillsborough County, Fla., at a recent mass meeting in Plant City, declared in favor of a bond issue of $1,000,000 for the construction of good roads. Tampa is the County Seat.

The Governor of Florida has approved an act permitting the Duval County Commissioners, Jacksonville, to pave with brick, macadam, concrete, granolithic, and to maintain one road or street through each incorporated city or town in the county, which has a population under 5,000.

The Board of Hillsborough County Commissioners, Tampa, Fla., has selected the roads that it is proposed to pave with brick out of the contemplated $1,000,000 bond issue. A total of 68½ miles is included in the list.

Georgia.

The City of Savannah, Ga., W. O'D. Rockwell, City Engineer, will let contracts soon for the paving of the following streets: Barnard, from State to Jones; Harris, from Barnard to Whitaker; Charlton, from Barnard to Whitaker; Perry, from Barnard to Whitaker; Hall, from Barnard to Whitaker, and York, from Barnard to Whitaker.

The City of West Point, Ga., has rejected all bids received recently for the construction of 10,000 sq. yds. of concrete sidewalks, being considered too high.

Idaho.

✣Following low bids were received at Lewiston, Ida., for paving about 371,000 sq. yds. in District No. 4: Empire Hassam Co., Spokane, $1.20 per yd. for Dolarway; Dole & Collins, Lewiston, $1.05 for 5-in. concrete; $1.20 for 6-in. coucrete; $2.45 for wood

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

blocks; Warren Construction Co., Portland, $2.04 and $1.75 for bitulithic.

Illinois.

⊙The Board of Local Improvements of East Moline, Ill., H. G. Paddock, City Engineer, has awarded the contract for the paving of High St., Eighth Pl., and Sixth Ave., to Abrahams-Porter Co., for $7,800.

The City Council of Moline, Ill., Lyle Payton, City Engineer, is considering ordinances for paving, as follows: Second Ave., from Ninth to 14th St., asphalt, estimated to cost $21,110; 12th Ave., from 12th to 22nd St., asphalt, estimated to cost $19,760; 16th Ave., from 12th to 15th St., asphalt, estimated to cost $5,749; 44th St., from the south line of Seventh Ave., to south line of Block 7, Edgewood Park Addition, brick, estimated to cost $15,018; 10th Ave., from 30 to 34th St., and 34th St., from 10th to 9½ Ave., asphalt, estimated to cost $10,763.

The Board of Local Improvements of East Moline, Ill., H. G. Paddock, City Engineer, is reported to have adopted the ordinance providing for the paving of 16th Ave., at an estimated cost of $80,000.

The City Council of Taylorville, Ill., has decided to lay about four miles of brick paving during the coming year. J. S. Michels is City Engineer.

The Board of Local Improvements of Rockford, Ill., has approved improvements which City Engineer Edwin Main estimates will cost about $90,000, including brick and macadam pavements and sewers for various streets of the city.

The Board of Local Improvements of Havana, Ill., has employed Capt. Hamilton of Springfield, Ill., to make a survey preliminary to commencing the paving of Havana streets. Fourteen blocks will be laid at this time.

Following are the lowest bids submitted to the Board of Local Improvements, Chicago, Ill., for the construction of pavements in the following streets and alleys: Aberdeen St., 77th St. to 79th St., 2,600 lin. ft., granite concrete combined curb and gutter, $.55, 4,220 sq. yds. asphalt pavement, $1.88, American Asphalt Paving Co., 133 W. Washington St. Albany Ave., Logan Blvd. to Belmont Ave., 7,300 lin. ft., granite concrete combined curb and gutter, 52c, 1,200 sq. yds. asphalt pavement, $1.70, American Asphalt Paving Co.; Aubert Ave. Robey St. to Lincoln Ave., 1,620 lin. ft., granite concrete combined curb and gutter, 55c, 2,550 sq. yds., asphalt pavement $1.63, American Asphalt Paving Co.; Central Ave., Thomas St. to Division St., 1.380 lin. ft., granite concrete combined curb and gutter. 55c, 2,180 sq. yds. asphalt pavement, $1.75, American Asphalt Paving Co.; Champlain Ave., 60th St. to 61st St., 1,260 lin. ft., granite concrete combined curb and gutter, 55c, 2,000 sq. yds., asphalt pavement $1.78, American Asphalt Paving Co.; 41st St., Lowe Ave. to Emerald Ave., 1,080 lin. ft., granite concrete combined curb and gutter, 55c, 2,190 sq. yds., asphalt pavement, $1.74, American Asphalt Paving Co., 49th Ave., Madison St. to Park Ave., 2,380 lin. ft., granite concrete combined curb and gutter, 55c, 3,820 sq. yds., asphalt pavement $1.69, American Asphalt Paving Co.; Hermitage Ave., 67th St. to 77th St., 6,690 lin. ft., granite concrete combined curb and gutter 55c, 10,930 sq. yds. asphalt pavement, $1.73, American Asphalt Paving Co.; Huron St., Western Ave. to Campbell Ave., 1,440 lin. ft., granite concrete combined curb and gutter 47c, 2,200 sq. yds., asphalt pavement $1.69, F. P. McCormick Co., 133 W. Washington St.; Lawrence Ave., Central Park Ave. to Ridgeway Ave., 1,950 lin. ft., concrete curbing 80c, 3,000 sq. yds., creosote of wood block pavement, $3.15, The Ryan Co., 10 S. La Salle St.; Mildred Ave., Oakdale Ave. to Wellington St., 580 lin. ft., granite concrete combined curb and gutter 55c, 920 sq. yds., asphalt pavement $1.89, American Asphalt Paving Co.; Ogden Ave., 40th Ave. to Belt Ry., 8,560 sq. yds. sandstone curbing 75c, 16,460 sq. yds. brick pavement $2.16, Ready & Callahan Coal Co., 133 W. Washington St.; Superior St., 46th Ave. to 48th Ave., 2,300 lin. ft., granite concrete combined curb and gutter, 3,630 sq. yds. asphalt pavement, $1.69, American Asphalt Paving Co.; Superior St., 48th Ave. to 51st Ave., 400 lin. ft., granite concrete combined curb and gutter 55c, 6,500 sq. yds. asphalt pavement, $1.68, American Asphalt Paving Co.; Windsor Ave., Milwaukee Ave. to 56th Ave., 5,900 lin. ft., granite concrete combined curb and gutter 55c, 7,700 sq. yds. asphaltic concrete pavement, $1.52, American Asphalt Paving Co.; alley, 30th St., 31st State St. and Dearborn St., 780 lin. ft., concrete curbing, 10c, 520 sq. yds. brick pavement, $2.52, J. A. McGarry & Co., 189 W. Madison St.; alleys, 46th, 47th Sts., St. Lawrence Ave., Champlain Ave., 1,390 lin. ft., concrete curbing 10c. 1,100 sq. yds. brick pavement, $2.36, J. A. McGarry & Co.; alleys, Harrison St., Oregon Ave., Center Ave., Lytle St., 1,000 lin. ft. concrete curbing, 10c, 790 sq. yds., brick pavement, $2.24, J. A. McGarry & Co.; alleys, Vernon Park Pl., Polk St., Sholto St., Aberdeen St., 1,080 lin. ft. concrete curbing 10c, 800 sq. yds. brick pavement, $2.24, J. A. McGarry & Co.; alleys, Vernon Park Pl., Polk St., Morgan St. and Miller St., 960 lin. ft. concrete curbing 10c, 500 sq. yds. brick pavement, $2.29, J. A. McGarry & Co.; alleys, Harrison St., Aberdeen St., Vernon Park Pl., May St., 1,260 lin. ft. concrete curbing 10c, 680 sq. yds. brick pavement, $2.24, J. A. McGarry & Co.; alleys, Harrison St., Vernon Park Pl., Blue Island Ave., Peoria St., 1,620 lin. ft. concrete curbing, 10c, 1,540 sq. yds. brick pavement, $2,24. J. A. McGarry & Co.; alleys Vernon Park Pl., Polk St., May St. Aberdeen St., 1,200 lin. ft., concrete curbing, 10c, 900 sq. yds. brick pavement, $2.24, J. A. McGarry & Co.; Vernon Park Pl., Blue Island Ave., Polk St. and Morgan St., 1,500 lin. ft. concrete curbing, 10c, 720 sq. yds. brick pavement, $2.29, J. A. McGarry & Co.; Vernon Park Pl., Polk St., Miller St. and Sholto St., 960 lin. ft., concrete curbing, 10c, 500 sq. yds. brick pavement $2.35, J. A. McGarry & Co., the work includes preparation of the sub-grade 6" Portland cement concrete foundation, sewer, manhole and catch basin construction and adjustment. The contracts have not been awarded. E. J. Glackin, Secretary of the Board.

Indiana.

✣Bids will be received until 10 a. m., June 6, by Board of Allen County Commissioners, Fort Wayne, Ind., for furnishing the labor and material for the construction of the Bohnke stone road in Madison Township 10,630 ft. long, and the Flackler stone road in Madison Township, 5,350 ft. long. C. H. Brown is County Auditor.

✣Bids will be received until 10 a. m., June 9, by Board of Public Works, Indianapolis, Ind., for the improvement of Olney St., e s, from s property line of Twenty-eighth St., to a point 225 ft. n of n property line of Twenty-eighth St., by curbing the outer edges of the roadway. Improvement of Olney St., e s, from s property line of Twenty-eighth St., to a point 225 ft. n of n property line of Twenty-eighth St., by grading and paving the sidewalks. Improvement of Adler St., from the w curb line of Union St., n s, and from e property line of Meridian St., s s, to the w curb line of Madison Ave., by grading and paving the sidewalks. Improvement of Adler St., from e property line of Meridian St., to the w property line of Madison Ave., by grading, graveling and rolling the roadway.

✣Bids will be received until 11 a. m., June 26, by Board of Randolph County Commissioners, Winchester, Ind., for the construction of a highway on line between Randolph and Wayne Counties. H. F. Wood is County Auditor.

⊙Harney & White have been awarded the contract by the Board of Park Commissioners, Indianapolis, Ind., for the construction of 1,600 lin. ft. of cement sidewalks, at $0.12½ per lin. ft. Bids were opened May 23.

⊙W. C. Dorsey, 1024 South Seventh St., Terre Haute, Ind., has been awarded the contract by the Board of Public Works of New Albany, Ind., for the paving of East Fifth St., from High to Elm Sts., with vitrified brick, for $4.49 per lin. ft. The work includes 26-ft. roadway, 6-ft. concrete sidewalks and 10-ft. grass plot. Bids were opened May 10.

⊙Wolfe & Clements, Richmond, Ind., have been awarded the contract by the Board of Public Works of that city, for the construction of 918 sq. ft. of cement sidewalks on the east side of Northwest First St., for $0.11 per sq. ft. Bids were opened May 22

⊙John Duke, 411 Lincoln St., Richmond, Ind., has been awarded the contract by the Wayne Township Trustees, Richmond, Ind., for the making of a fill on Cart Road, also for sewer turning channel, for $759. Bids were opened May 26.

⊙The Madison County Commissioners, Anderson, Ind., on May 21 awarded gravel road contracts as follows: Ed. Frank, et al., Pipe Creek Township, A. B. Huffman, $3,000; S. E. Clark, et al., Pipe Creek Township, Madison Contr. Co., $4,295; W. M. Leatherman, et al., Pipe Creek Township, Madison Contr. Co., $1,700; John Klumpp, et al., Pipe Creek Township, Madison Contr. Co., $1,675; Royal Knotts, et al., Pipe Creek Township, Madison Contr. Co., $2,530; F. M. Harbit, et al., Pipe Creek Township, Madison Contr. Co., $2,350; Thaddeus E. Shaw, et al., Monroe Township, Walker & Son Co., $2,240; No. 1 Eugene F. Haines, et al., Monroe Township, John E Mason Co., $800; No. 2 Eugene F. Haines, et al., Monroe Township, John T. Mason Co., $2,500; H. H. Shawhan, et al., Monroe Township. Walker & Son, $3,375; Wilfred Jeffrey, et al., Boone Township, I. W. Carr, $7,898; Nathan W. Hunt, et al., Boone Township, Underwood & Kirtpatrick, $6,900; Ellis Carey, et al., Boone Township, Chester Rogers, $6,031; Gentry, Jackson Township, A. B. Huffman, $1,050.

The Board of Public Works of Fort Wayne, Ind., has approved specifications and adopted resolutions for the paving of 18 streets. June 12 is the date set for a hearing on each of the improvements. F. M. Randall is City Engineer.

Iowa.

✣Bids will be received until 2:30 p. m., June 10, by M. G. McCreight, Town Clerk, Greenfield, Ia., for the construction of about 11,500 sq. yds. of cement concrete pavement with cement concrete curb. A certified check for $500 must be filed with each bid. The Iowa Engineering Co., Clinton, Ia., are Consulting Engineers.

⊙Geiger & Trompeter, of Sheldon, Ia., have been awarded the contract by the City of Sheldon, Ia., Scott Martin, City Clerk, for approximately 16,000 sq. yds. of brick block paving on a concrete base, for $1.98 per sq. yd. Keyes C. Gaynor, United Bank Bldg., Sioux City, Ia., is Engineer. Bids were opened May 26.

⊙The City Council of Independence, Ia., has awarded a contract for the asphaltic-concrete paving on East Main St., and Third Ave. S. E., to the Dearborn Construction Co., of Waterloo, Ia., for $1.58½ per sq. yd., $0.02 for overhauling, and $0.55 per lin. ft. for curb and gutter.

The City Council of Sac City, Ia., has decided to pave 13 blocks on Main and Fifth Sts. The contract will be let at once.

The City Council of Webster City, Ia., has laid out districts to be paved this summer. Des Moines St. will be paved south to Boone; Wilson Ave., from First St. to Ohio St., and Seneca, from First to Bank.

The Scott County Supervisors, Davenport, Ia., have selected the highways which are to receive the bulk of the $20,000 road improvement fund this season.

Louisiana.

⊙Geo. W. Garig Contracting Co., Baton Rouge, La., has been awarded the contract by the Highway Department of the Board of State Engineers, New Orleans, La., for the re-crowning and graveling of a public highway from the city of Baton Rouge to Hope Villa, East Baton Rouge Parish, a distance of

14 miles, for $52,090. Bids were opened May 26.

Maryland.

⊙The Board of Awards of Baltimore, Md., has awarded the J. H. Cranford Construction Co. Contract 112, 113, 114 and 116, calling for sheet asphalt and bituminous concrete. P. Flanagan & Sons secured Contract No. 106.

Plans are being made to build an improved road from Betterton, Kent County, Maryland, to Still Pond, a distance of 5 miles. The estimated cost is $26,000.

Massachusetts.

✣Bids will be received until noon, June 10, by Massachusetts Highway Commission, 15 Ashburton Place, Boston, Mass., for the construction of a section of state highway 4,000 ft. long. A certified check for $250 must accompany each bid.

✣Bids will be received by Public Works Department, Boston, Mass., until noon, June 9, for wood block pavement in Warren, Vernon and Ruggles Sts., Roxbury. Blank forms for proposals may be obtained at Room 49, City Hall. Bids to be filed at Room 62, City Hall.

✣Bids will be received by Public Works Department, Boston, Mass., until noon, June 9, for asphalt macadam roadway in Orient Ave., East Boston. Blank forms for proposals may be obtained at Room 49, City Hall. Bids to be filed at Room 62, City Hall.

⊙The Northern Construction Co., 99 W. Cedar St., Boston, Mass., has been awarded the contract by the Directors of the Port of Boston, Boston, Mass., for paving a portion of Northern Ave., and Commonwealth pier No. 6 on the South Boston flats, also sewers, drains and water pipes, for $104,597. Bids were opened May 28.

Michigan.

City Engineer William J. Fisher of Pontiac, Mich., has prepared estimates for paving, as follows: Orchard Lake Ave., from end of pavement to Franklin Blvd., $17,971; Franklin Blvd., from Huron to Orchard Lake Ave., $10,921; Huron St., from Williams St. to College St., $29,498; Auburn Ave., from Saginaw St. to Parke St., $5,741, and Franklin Road, from Saginaw St. to D. G. H. & M. tracks, $1,378. Estimates are being prepared for pavements on Rapid St., from Saginaw St. to Franklin Road, and for Mt. Clemens St., from Saginaw St. to Douglas St.

Minnesota.

✣Bids will be received until 2:30 p. m., June 5, by Board of Kandiyohi County Commissioners, Willmar, Minn., for grading State Road No. 6, running between Sections 5 and 8 and 6 and 7 in the Town of Gennessee. John Feig is County Auditor.

✣Bids will be received until 11 a. m., June 16, Board of Hennepin County Commissioners, Minneapolis, Minn., for Contract No. 20 for preparing and graveling 11,136 lin. ft. of roadbed on Road No. 7 in the Town of Minnetrista; also for Contract No. 23, for preparing and graveling 29,200 lin. ft. of roadbed on Road No. 10, in the Town of Corcoran; also for Contract No. 25, for preparing and graveling 12,611 lin. ft. of roadbed on Road No. 12 in the Town of Champlin; all according to plans and specifications on file in the office of the County Surveyor. A. P. Erickson is County Auditor.

✣The Board of Public Works of Duluth, Minn., has awarded the contract for the construction of 4 and 8-ft. walks in the First Ward to E. Howarden, for $0.49 and $0.95, and to Edward Johnson, for 5-ft. walks, at $0.61. Berg & Runsteen will construct 6-ft. walks for $0.64½. The Russell Construction Co. will lay 4-ft. walks at $0.55, and Edward Johnson 5 and 8-ft. walks for $0.64 and $1.03.

✣Bids will be received until 2 p. m., June 10, by Board of Beltrami County Commissioners, Bemidji, Minn., for grading, grubbing and turnpiking that part of the County Road, beginning at the sixteenth line between sections 17 and 20 in the Town of Bemidji, thence running south eighty rods, thence southeast across the Mississippi River, and ending at the School house on section line between sections 20 and 21, according to the specifications on file with the County Surveyor. J. L. George is County Auditor.

✣Bids will be received until 11 a. m., June 10, by Board of Beltrami County Commissioners, Bemidji, Minn., for clearing, grubbing and grading of one mile of County Road beginning at the quarter line between sections 32 and 33 in the Town of Turtle River, running thence west on the quarter line to the quarter corner between sections 31 and 32, and there ending, according to the specifications on file with the County Surveyor. J. L. George is County Auditor.

✣Bids will be received until 10:30 a. m., June 10, by Board of Beltrami County Commissioners, Bemidji, Minn., for clearing, grubbing and ditching County Roads Nos. 12 and 74, beginning at the southeast corner of the Southwest quarter of the Northwest quarter of Section 7 in the Town of Taylor, thence running south on the sixteenth line to the east and west quarter line of Section 18, thence west to the quarter corner or the Range line between the Towns of Port Hope and Taylor, thence south 80 rods according to the specifications on file with the County Surveyor. J. L. George is County Auditor.

✣Bids will be received until 10 a. m., June 10, by Board of Beltrami County Commissioners, Bemidji, Minn., for clearing, grubbing and grading one mile of the County Road between section 31 of the Town of Summit, and section 36 in the Town of Blackduck, also for grading and ditching two and one-half miles of that part of County Road No. 6, running from the Township line of the Towns of Summit and Birch, south on Range line to the quarter corner of Section 13, Town of Taylor, and Section 18 Town of Birch, according to plans and specifications on file with the County Surveyor. J. L. George is County Auditor.

Deputy State Engineer B. F. Umland, with a crew of surveyors have started work on the 48-mile State road that is to be built through the center of Clearwater County, running north and south.

New Jersey.

✣Bids will be received at 9 p. m., June 17, by Board of Village Commissioners, 232 Hackensack Road, Ridgefield Park, N. J., for improving Hazelton St. Approximate quantities of work to be done are as follows: 1,518 cu. yds. of excavation, 2,667 lin. ft. of bluestone curbing, 4,630 sq. yds. crushed stone foundation, 5-in. loose measure, 4,630 sq. yds. wearing surface, 3-in. loose measure, 2 catch basins, 2 catch basins rebuilt, 2 catch basins brought to grade, 10 manholes brought to grade, 1,000 lin. ft. sub-drains complete. Plans, profiles, specifications and instructions to bidders are on file in the office of Miller D. Starker, clerk of the Village of Ridgefield Park, and may be examined any day, except Saturday, between the hours of 10 a. m. and 4 p. m.

New York.

✣Bids will be received until 11 a. m., June 7, by Department of Public Works, Francis G. Ward, Commissioner, Buffalo, N. Y., for two street repaving contracts and three paving contracts. Plans and specifications are on file with the Bureau of Engineering.

✣Bids will be received until 8 p. m., June 11, by Village of Sidney, N. Y., W. Thorp, Clerk, for brick pavement on Bridge St., including about 3,620 sq. yds. and about 2,420 ft. of curb. Plans and specifications may be obtained of William Thorp or of E. E. Musson, Engineer, Norwich, N. Y.

✣Bids will be received until 3 p. m., June 12, by Park Board, 5th Ave. and 64th St., Borough of Manhattan, New York City, for constructing automobile roads in Forest Park, in the Borough of Queens, city of New York. The work consists of removing trees, stripping top soil along line of roads, grading roadways and slopes, laying sod gutters, building culverts, temporary bridges, retaining walls, fences all other work incidental thereto. The Engineer's estimate of the quantities is as follows: Earthwork (excavation and refill), 51,000 cu. yds.; top soil (stripping and relaying), 18,000 cu. yds.; sodding gutters, 13,760 sq. yds.; wrought iron picket fence, 400 lin. ft.; granite coping, 400 lin. ft.; rubble masonry, 350 cu. yds.; concrete footings, etc., 350 cu. yds.; 15-in. vitrified glazed clay pipe, 1,000 lin. ft.; 1 temporary bridge. The time allowed for the completion of the whole work will be 160 consecutive working days. The amount of security required is $20,000. A certified check or cash in the sum of $1,000 must accompany bid.

⊙The Board of Contract & Supply of Utica, N. Y., has awarded the contract for paving Elm and Albany Sts., and Capital and Seymour Aves., to John W. Davitt, of Troy, N. Y. Harry W. Roberts & Co. secured the contract to pave Catharine St., with bitulithic.

⊙The Board of Park Commissioners of Buffalo, N. Y., has awarded the contract for the paving of Niagara St., from Hertel Ave. to O'Neil St., to the German Rock Asphalt & Paving Co., of that city, for $86,740.

⊙The Board of Aldermen of Batavia, N. Y., has awarded a contract to pave Summit St., with Bessemer wire-cut brick to Louis Gipp, of Buffalo, N. Y., for $19,930.

The City Council of Hornell, N. Y., has instructed the Board of Public Works to advertise for bids for the paving of East Ave.

City Engineer Charles H. Snyder of Oswego, N. Y., has perfected plans for a new brick pavement to replace the present asphalt one in East Bridge St., between First and Sixth Sts. Bids will probably be advertised for early this month by the Department of Public Works.

Ohio.

✣Bids will be received until noon, June 16, by Ira Eisenbraun, Village Clerk, Struthers, O., for the construction of brick pavement on Bridge St., from the end of the present brick pavement on said street, southerly to its intersections with Poland Ave., according to plans and specifications on file in the office of the Clerk.

✣Bids will be received until noon, June 16, by Ira Eisenbraun, Village Clerk, Struthers, O., for furnishing the necessary labor and material for the construction of brick pavement on Poland Ave., from Bridge St. southerly to the end of the present macadam on said street, according to the plans and specifications on file in the office of the Clerk.

✣Bids will be received until 1 p. m., June 11, by C. E. Stonebaugh, County Auditor, Bowling Green, O., for the furnishing of labor and material for the repair of the Erven, Halsey-Elliott, Stearns, Metzger, Wooster, Frick Roads and Woodville Pike. E. F. Metzger is County Surveyor.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., June 13, 1913, for grading and paving with waterbound macadam, the Vinton County, State Highway D, Petition 417, Section No. 2 McArthur-Hamden Road, Inter-County No. 396, in Clinton Township. Length, 14,701 ft., or 2.78 miles. Width of pavement, 12 ft. Estimated cost of construction, $14,987. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, September 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., June 13, 1913, for grading and paving with waterbound macadam, the Richland County, State Highway H, Petition 657, Mansfield-Lexington Road, Inter-County No. 334, in Madison, Washington and Troy Townships. Length, 23,094.5 ft., or 4.37 miles. Width of pavement, 10 ft. Estimated cost of construction, $33,120. A draft or certified

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, September 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., June 13, 1913, for grading and paving with waterbound macadam, the Perry County, State Highway D, Petition 697, Zanesville-New Lexington Road, Inter-County No. 350, in Harrison Township. Length, 7,316 ft., or 1.38 miles. Width of pavement, 14 ft. Estimated cost of construction, $12,640. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, August 15, 1913. Plans and specifications are on file in the office of the County Commissioners, and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., June 13, 1913, for grading and paving with bituminous bonded macadam, the Lucas County, State Highway E, Petition 603, Central Ave. Extension Road, Inter-County No. 21, in Richfield Township. Length, 5,922 ft., or 1.12 miles. Width of pavement, 14 ft. Estimated cost of construction, $12,817. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, August 15, 1913. Plans and specifications are on file in the office of the County Commissioners, and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., June 13, 1913, for grading and paving with brick for heavy traffic, the Wayne County, State Highway G, Petition 458, Doylestown-Barberton Road, Inter-County No. 96, in Chippewa Township. Length, 5,634.9 ft., or 1.07 miles. Width of pavement, 10 ft. Estimated cost of construction, $16,157. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, August 15, 1913. Plans and specifications are on file in the office of the County Commissioners, and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., June 13, 1913, for grading and paving with brick for heavy traffic, the Ashland County, State Highway F, Petition 339, Ashland-New London Road, Inter-County No. 149, in Ruggles Township. Length, 13,265 ft., or 2.51 miles. Width of pavement, 10 ft. Estimated cost of construction, $36,000. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, October 1, 1913. Plans and specifications are on file in the office of the County Commissioners, and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker, State Highway Commissioner.

✣Bids will be received until noon, June 13, by W. J. Springborn, Director of Public Service, Cleveland, Ohio, for grading, draining, curbing, paving with paving brick and improving the following thoroughfares: Perkins Ave. N. E. from E. 35th St. to E. L. of E. 37th St.; W. 48th pl. from Lorain Ct. S. W. to Ravine Ct. S. W.; W. 49th Pl. from Lorain Ct. S. W. to Ravine Ct. S. W. Also for grading, draining, curbing, resurfacing with asphaltic cement, Lake Ave. N. W. from the L. S. & M. S. Ry. grade separation to about 300 ft. westerly. Each bid must be made in accordance with the plans and specifications, which may be seen at the office of City Engineer, Room 305 City Hall.

⊙The Snouffer Construction Co., of Columbus, O., has been awarded the contract by the Franklin County Commissioners, Columbus, for the improvement of Thresh, Livingston Ave., Scioto River Way, Park and Groveport Roads, for $165,737. Theodore Vogelsberg of London, O., will construct the Richardson Road, for $31,087, and E. C. Radebaugh, of Logan, O., will build the Atcheson Road, for $7,132.

⊙Wildes & Davidson and E. McShaffey & Son, Akron, O., have been awarded the contract for the paving of both sections of East Market St., in Akron, Ohio, for $171,299. Section No. 1 will be paved with No. 1 Medina stone, while Section No. 2 will be paved with three and one-half in. 6-lb. creosote block.

⊙E. N. Turner, Logan, O., has been awarded the contract by the State Highway Commission, Columbus, O., for the construction of section 2 of the Belmont-National road, Belmont County, for $12,800. The road is 4,424 long and 13 ft. wide. Bids were opened May 29.

⊙The Erie Stone Co., Van Wert, O., has been awarded the contract by the State Highway Commission, Columbus, O., for the construction of the Willshire-Fort Recovery road, Van Wert County, for $4,828. The road is 5,284 ft. long and 14 ft. wide. Bids were opened May 29.

⊙The Wilson Engineering & Construction Co., of Xenia, O., has been awarded the contract by the State Highway Commission, Columbus, O., for grading and paving with waterbound macadam the Champaign County highway in Westville Section, known as the Piqua-Urbana road, for $7,545. The road is 5,280 ft. long and 14 ft. wide. Bids were opened May 29.

⊙E. A. Freshwater & Sons, of Chester, W. Va., have been awarded the contract by the Department of Public Service of Painesville, O., F. N. Downer, City Engineer, for the paving of four streets, for $66,506. The work includes 33,000 sq. yds. of brick pavement, 2,100 ft. of storm sewer, and about 19,000 lin. ft. of curb and other items. Bids were opened May 24.

⊙C. W. Ryan, Maumee, O., has been awarded the contract by the State Highway Commission, Columbus, for the construction of the Bryan-Napoleon road in Henry County, for $14,590. The road is 13,200 ft. long and 16 ft. wide. Bids were opened May 29.

⊙Lunsford & Bro., of Pedro, O., have been awarded the contract by the State Highway Commission, Columbus, for the construction of the Kenton-Mt. Victory road in Hardin County, for $7,994. The road is 10,560 ft. long and 12 ft. wide. Bids were opened May 29.

⊙Lunsford & Bro., of Pedro, O., have been awarded the contract by the State Highway Commission, Columbus, for the construction of the Kenton-Forest road in Hardin County, for $6,000. The road is 10,550 ft. long and 12 ft. wide. Bids were opened May 29.

No bids were received on May 29 by the State Highway Commission, Columbus, O., for the construction of the Steubenville-Cambridge road in Guernsey County. The road is 5,280 ft. long and 14 ft. wide and is to be constructed of brick.

The Department of Public Service of Galion, O., rejected all bids received May 26 for paving and sewer work. The work included about 18,209 sq. yds. of paving.

No bids were received May 29 by the State Highway Commission, Columbus, O. for the construction of section 2 of the Kenton-Findlay road in Hardin County. The road is 7,860 ft. long and 12 ft. wide and is to be constructed of waterbound macadam.

No bids were received on May 29 by the State Highway Commission, Columbus, O., for the construction of section 1 of the Kenton-Findlay road in Hardin County. The road is 2,700 ft. long and 12 ft. wide and is to be constructed of waterbound macadam.

The City Council of Norwood, Ohio, is considering a resolution providing for a vote at the November election on a bond issue of $75,000 to widen Sherman Ave. from Allison to the Belt Line 10 ft. on the south side. The committee on streets and grades also has under consideration plans and estimates for the improvement of Lafayette with concrete, brick or bitulithic.

The Smith Township Trustees, Sebring, Ohio, will sell bonds June 25 to the amount of $30,000, the proceeds of which will be used in paving about three miles of the Johnston road, beginning at the state road and extending northward. Bids for construction work will be asked as soon as bonds have been sold.

City Engineer Geo. W. Tonson of Toledo, Ohio, is preparing plans for paving Canal St. along the Clover Leaf tracks.

Oklahoma.

✣Bids will be received until 7:30 p. m., June 11, by Town of Marietta, Okla., for the construction of approximately 26,000 yds. of asphaltic concrete pavement. Benham Engineering Co., 433 American National Bank Bldg., Oklahoma City, Okla., are Consulting and Supervising Engineers.

Pennsylvania.

⊙Director Joseph G. Armstrong, Pittsburgh, Pa., has awarded contracts for street repaving and other work for which bids were opened on May 16 as follows: Repaving with block stone, McCullough St., to M. O'Herron Co., $4,097; Webster Ave., to Thomas Cronin Co., $7,423; Fifth Ave., from Brenam to Gist Sts., to Booth & Flinn, $28,550; Liberty Ave., to Thomas Cronin Co., $2,829; Reed St., to Evans Jones Sons Co., $1,491; Greenfield Ave., to M. O'Herron Co., $8,473; Penn Ave., to Booth & Flinn, $26,450. Repaving with brick, Quince Alley, to W. J. Payne, Jr., Co., $1,310; Holley Alley, to Evan Jones Sons Co., $1,294; Breed St., bids rejected; Edwards Alley, to Thomas Cronin Co., $3,881; Mansfield Ave., to Booth & Flinn, $8,914. Repaving with asphalt, Sheffield St., bids rejected; Neville St., to Booth & Flinn, $2,450; Shady Ave., to Booth & Flinn, $19,548; Brighton Road, to Booth & Flinn, $10,366; 47th St., to Booth & Flinn, $7,771; Tioga St., to Booth & Flinn, $7,989.

⊙Joseph G. Armstrong, Director of Public Works, Pittsburgh, Pa., has awarded the following contracts for which bids were opened on May 16: Grading the University of Pittsburgh street, Evan Jones Sons Co., $8,274; reconstruction of retaining walls, Brownsville Ave., to J. B. Sheets Co., $11,017; Center Ave., to Evan Jones Sons Co., $1,895.

⊙John W. Hallam of Washington, Pa., has been awarded the contract by the borough of Masontown, Pa., W. E. Ward, Engineer, for grading, curbing and paving North Main St., South Main St. and Church St., for $34,743. Bids were opened May 19.

⊙R. M. Sutton, Franklin, Pa., has been awarded the contract by the Borough Council of St. Marys, Pa., for the construction of 11,000 sq. yds. of brick pavement, for $31,703. The work also includes grading and curbing. Bids were opened May 23.

⊙The Otto Construction Co., of Lancaster, Pa., has been awarded the contract to pave 24,000 sq. yds. of streets at Mt. Carmel, for about $64,000.

⊙The Fayette County Commissioners, Uniontown, Pa., have awarded the contract for two miles of road in Redstone Township to Hoblitzell & Price, of Myersdale, Pa., for $29,628, and a mile in Redstone Township to

Jack Austin, for $14,006. The United Fire Brick Co. has the contract for furnishing the brick for the South Union Township road.

⊙The Fayette County Commissioners, Uniontown, Pa., have awarded the contract for the construction of a mile of brick road in Bullskin Township to the Valley Construction Co., for $9,316. The road is to begin at Murphy Siding and extend to a point near the Marietta farm.

The Common Council of Franklin, Pa., has decided to repave Liberty St. from Moffett's Alley to 15th St. The improvement will cost about $10,000.

South Carolina.

All bids received May 23 by the Board of Richland County Commissioners, Columbia, S. C., for paving Divine St., Shandon, from Harden St. east, have been held up until June 1, at which time the contract will probably be awarded.

Texas.

✣Bids will be received until noon, June 12, by J. D. Kelley, City Secretary, Galveston, Texas, for the supply of 60 ornamental posts combination trolley and arc light design complete with lamps, etc., installed ready for operation. The contract will also include 13,000 lin. ft. of cable. Specifications may be seen at the office of W. D. Masterson, City Superintendent of Electricity.

⊙The Corpus Christi Street & Interurban Railway Co., Corpus Christi, Tex., has awarded a contract for the laying of two and one-half miles of paving between tracks of the company to the Texas Bitulithic Co., of El Paso, Tex.

⊙The City Council of Longview, Tex., has awarded the contract for 17 miles of paving and macadam to Roach & Manigan Co., of Fort Worth, Tex.

⊙The City Council of Bryan, Tex., has awarded the contract for the engineering work in the grading of the resident streets and the paving of Main St., to Carson & Adams, of Bryan.

Citizens of Jefferson County, Beaumont, Tex., on May 21 voted against the issuance of bonds to the amount of $500,000 for good roads.

An election will be held in Houston, Tex., on July 1 for the purpose of voting on the issuance of bonds in the sum of $1,200,000 for the paving of street intersections and the building of bridges.

Precinct No. 1, Kerr County, Tex., of which Kerrville is a part, at a recent election voted the issuance of bonds to the amount of $40,000 for the building of good roads.

The Commercial Club of Cisco, Tex., has authorized an expenditure of $6,000 for improvements of roads leading out of Cisco. It is proposed to work for 300 miles.

Utah.

⊙Featherstone & Whipple, of Lehi, Utah, have been awarded the contract by the City Council of that city for the construction of 5½ miles of street paving for $19,288.

Virginia.

⊙Perry W. Ruth has been awarded the contracts by the Board of Control of Norfolk, Va., for 600 ft. of combination curb and gutter, 800 sq. yds. of concrete base on North Windsor Ave., and 460 sq. yds. of brick paving on 28th St.

Washington.

✣Bids will be received until 2 p. m., June 24, by Board of King County Commissioners, Seattle, Wash., for clearing and grubbing right of way 60 ft. wide on Lake Ave., Kirkland.

⊙Holt & Jeffery, of Seattle, Wash., have been awarded the contract by the Board of Public Works of that city, for the grading of Shilshole Ave., for $186,477.

⊙Holt & Jeffery of Seattle, Wash., have been awarded the contract by the Board of Public Works of that city, for re-grading, etc., Ninth Ave. northwest, et al., for $87,526. Also for grading, curbing, etc., 24th Ave. S., et al., for $69,142.

⊙N. W. Ball of Wenatchee, Wash., has been awarded the contract for brick paving in Stanwood, Wash., for about $25,000.

⊙J. F. Costello, Hutton Bldg., Spokane, Wash., has been awarded the contract by the Board of Spokane County Commissioners, Spokane, Wash., for the completion of subgrade of the roadway of gravel macadam on the North Road, Permanent Highway No. 6, for $56,650. Bids were opened May 23.

⊙Alfred & James, of Centralia, Wash., have been awarded the contract for street paving in that city for $17,800.

⊙The Board of King County Commissioners, Seattle, Wash., on May 21 awarded the following road contracts: J. W. Johnson, Bailey Bldg., Seattle, No. 2 brick pavement on a 5-in. concrete base, 5-year maintenance, for Road No. 2 B, $84,450; D. A. Williams, Savage-Scofield Bldg., Tacoma, Wash., for No. 2 brick, 5-year guarantee, 5-in. concrete base, for Road No. 3 B, $85,289; the Barber Asphalt Paving Co., Northern Bank Bldg., Seattle, Road No. 4, two miles for brick block on a 5-in. base and four miles of Warrenite 5-in. concrete base, $310,916.

The City Council of Spokane, Wash., has ordered improvements on Trent Ave. The paving of Trent Ave., from Division to Grant St., will cost about $22,000, and the planking of the avenue from Grant St. to the west bridge, $6,600.

Sloane Bros. submitted the lowest bid to the Board of Public Works of Seattle, Wash., for the grading of Eighth Ave., northwest, at $39,105.

T. Ryan submitted the lowest bid to the Board of Public Works of Seattle, Wash., for the paving of Grand Ave., at $46,314 and $42,957.

Wisconsin.

⊙The City Commission of Superior, Wis., has awarded the contract for the paving of Grand Ave. with rock concrete to S. A. Riches, for $40,594.

The City Council of De Pere, Wis., has granted a petition asking for the paving of Broadway from the end of the present pavement to the city limits; also for the paving of Fourth and Fifth St., as far as Grant to the Northwestern station.

Canada.

✣Bids will be received until 5 p. m., June 12, by A. H. Millar, City Clerk, Berlin, Ont., for approximately 8,400 sq. yds. of asphalt or bitulithic pavement; approximately 6,400 sq. yds. of vitrified brick street car track allowance, and 6,800 lin. ft. of curb and gutter. Plans and specifications may be seen at the office of the City Engineer, Herbert Johnston.

✣Bids will be received until 6 p. m., June 16, by W. M. Treadgold, Town Engineer, Brampton, Ont., for the construction of the following: A—5,000 sq. yds. concrete roadway with concrete curb. B—Concrete arch bridge. C—Concrete retaining wall. Plans and specifications may be seen at office of Town Engineer, Municipal Buildings, Brampton, Ont. Marked check for 5 per cent of amount must accompany each tender. Separate tenders required for the different works.

✣Bids will be received until noon, June 7, by town of Oshawa, Ont., Frank Campbell, Town Engineer, for the construction of 15,000 sq. yds. of concrete highways. Plans can be seen and specifications obtained of the Town Engineer.

BRIDGES

Alabama.

⊙According to advices from Mobile, Ala., the contract for the construction of concrete bridge and culvert work on the 5-mile extension of Hall's Mill Road has been awarded to J. L. Henderson of Birmingham at $8,199.05. Other bidders were A. E. Perry of Mobile, $8,275; Gaboury & Son, of Jackson, Ala., $8,339; McClain & Farrangut, Birmingham, $8,584; Nuton Bridge Company, Birmingham, $9,086.

California.

⊙The contract for the bridge to replace the one over the Arroyo Seco to replace the one recently destroyed by a landslide, has been let by the Board of County Supervisors, Pasadena, Calif., to Munoz & Munoz, Los Angeles, Calif., at $8,160. The structure, which will be of reinforced concrete, will be 100 ft. long.

Plans are under way by J. G. McMillan, County Surveyor, San Jose, Calif., for the construction of a 140-ft. reinforced concrete bridge 30 ft. wide, over the Llagas at Morgan Hill. The cost of the structure is estimated at about $14,000.

Colorado.

Plans have been approved for the construction of the concrete bridge over Sand Creek on Colfax Ave. Road, between Adams and Arapahoe Counties, Colo. The structure will cost about $7,000. Brighton, Colo., is Adams County Seat.

Georgia.

⊙The contract for the construction of 210 ft. of timber approaches and 240 ft. of reinforced concrete and earth filled approaches to the proposed LaGrange St. viaduct, Newnan, Ga., has been let to R. D. Cole Mfg. Co., Newnan, at $7,603. Bids for the work were opened May 5.

Idaho.

✣Bids will be received until July 15 by Board of Lemhi County Commissioners, Salmon, Idaho, for the renewing of all timber members in two combination Pratt truss bridges over the Salmon River at Salmon. Fred Crandall is County Surveyor.

Illinois.

✣Bids will be received until 10 a. m., June 10, by Commissioners of Highways, Danville, Ill., Vermilion County, for improvements to consist of the following items: First, paving with brick a strip 14 ft. wide along said road, also a stone curb on each side of said strip; second, construction of a dirt road along the side of said strip; third, construction of a reinforced concrete bridge over Lick Creek, also the removal of the present bridge. Plans and specifications of the work to be done may be seen at the office of Oliver Morgan, Town Clerk, or William S. Dillon, Civil Engineer and County Surveyor at Danville, Ill.

⊙The contract for the construction of the Herman Schrader bridge in Waddams Township, Stephenson County, Ill., for which bids were taken May 14, has been awarded to W. H. Shons, Freeport, Ill., at $2,245. Other bids were as follows: Geo. A. Quinlan, Chicago, Ill., $2,880; C. A. Wever & Son, Clayton, Ill., $2,495; Parkinson & Fenton, Kent, Ill., $2,759.

⊙The contract for the construction of the Wiedenhoeft bridge in Munson Township, Henry County, Ill., for which bids were received May 16, has been let to C. H. Haman, Geneseo, Ill., at $1,297. Other bids received were as follows: G. A. Quinlan, Chicago, Ill., $1,360; H. S. Wetherell, Morgan Park, Ill., $1,310.

⊙The contract for the Ross bridge in Keene Township, Adams County, Ill., for which bids were taken until May 3, has been awarded to C. A. Wever & Son, Clayton, Ill., at $750.

⊙The contract for the construction of the Vandermoon bridge in Yorktown Township, Henry County, Ill., for which bids were received until May 6, has been awarded to G. A. Quinlan, Chicago, Ill., at $2,480. The work will be completed by August 15, 1913. Other bids received for work to be completed by Aug. 15, were as follows: M. E. Melloy, Chicago, Ill., $2,985; H. S. Wetherell, Morgan Park, Chicago, Ill., $2,675.

⊙The contract for the construction of three new bridges for which bids were opened May 26 at Okawville, Ill., has been awarded to Collins, Mannen & Wells, Mt. Vernon, Ill., at $1,495.

At a recent meeting of the City Council of Freeport, Ill., it was practically decided to repair the bridge instead of building a new structure. The work contemplated will require new girders and other reinforcements.

A special election was recently held in the Township of Aroma, Kankakee County, on the proposition to issue bonds to raise money for paying the township's portion of the expense of building the $15,000 reinforced concrete bridge over the Kankakee River at Waldron.

Indiana.

✣Bids will be received until 11 a. m., June 14, by James E. Elder, County Auditor, Rockville, Ind., for construction and repair of two bridges.

✣Bids will be received until 10 a. m., June 5, by Board of Bartholomew County Commissioners, Columbus, Ind., for the rebuilding and erecting in good shape, complete in every detail, the Pruitt bridge located on the south line of Section 1, Township 10, North Range 16 east, about three miles northeast of Taylorsville, German Township, Bartholomew County, Ind. The old bridge which was washed off the abutments shall be rebuilt and erected upon abutments complete in every detail. All cracked, kinked or lost pieces of steel shall be replaced with new steel of the same dimensions and all bent pieces shall be straightened, completed September 1, 1913. Plans and specifications are now on file in the office of the Auditor of said county. Philip J. Sater is County Auditor.

✣Bids will be received until 10 a. m., June 5, by Commissioners of Bartholomew County, Columbus, Ind., for the construction of a concrete bridge to be built across Horse Creek near Logan Chitty's, located on the south line of Section 19, Township 10, North Range 7 east, about 2 miles southwest of Hope, Hawcreek Township, Bartholomew County, Ind., completed by September 1, 1913. Plans and specifications are now on file in the office of the Auditor of said county. Philip J. Sater is County Auditor.

✣Bids will be received until 10 a. m., June 18, by Board of Grant County Commissioners, Marion, Ind., for the construction of the Fergus Falls bridge in Jefferson Township. E. H. Kimball is County Auditor.

✣Bids will be received until 11:30 a. m., June 16, by Board of Clay County Commissioners, Brazil, Ind., for the construction of two bridges. E. A. Staggs is County Auditor.

✣Bids will be received until 1 p. m., June 10, by Board of Huntington County Commissioners, Huntington, Ind., for the construction of five bridges. H. Guthrie is County Auditor.

⊙The Lafayette Engineer Co., Lafayette, Ind., has been awarded the contract for the repairing of the Main St. bridge at its bid of $11,564. A. E. Kemmer bid $13,900 for the work.

Iowa.

Floods during the month of May in Shelby and Carroll Counties are reported to have washed out 75 bridges and work will be started at once repairing the damage. Engineers of the State Commission at Ames, Ia., will direct the work.

Kansas.

⊙The contract for the construction of seven bridges in Wabaunsee County, Kan., for which bids were opened at Alma, Kan., May 23, has been let to the Massillon Bridge & Structural Co., 502 Orear Leslie Bldg., Kansas City, Mo., at $6,750.

Commissioners of Rush and Pawnee Counties have reached an agreement in regard to building the proposed inter-county bridge over the Dry Walnut. Larned, Kan., is seat of Pawnee County.

The following bids were received by the Board of Wyandotte County Commissioners, Kansas City, Kan., for the reconstruction of the old Southern bridge over the Kaw River on 18th St.: Masillon Bridge Co., $76,945; Kansas City Bridge Co., $79,700; Stupp Bridge & Iron Co., $93,634; Midland Bridge Co., $83,725; Blodgett Construction Co., $79,411; Leavenworth Bridge Co., $76,980; J. W. Murray Con. Co., $88,987.

Plans have been completed by G. L. McLane, City Engineer, Hutchinson, Kan., for the proposed West First Ave. bridge. The structure will be 120 ft. wide, including two 18-ft. sidewalks.

Kentucky.

✣Bids will be received until June 28 by Madison County Fiscal Court for building three steel bridges as follows: (1) At Silver Creek Station, 3 spans 43 ft. each, 1 span 27 ft. (2) At Red House, over Otter Creek, 1 span 100 ft. (3) At Berea, over Brushy Fork Creek, 1 span 50 ft. Specifications on file in the office of W. R. Shackelford, County Judge, Madison County, Richmond, Ky.

⊙Walton-McDowall Co., General Contractors on the Louisville & Nashville double track work, has awarded the contract for five bridges to Meacham Contracting Co., Hopkinsville, Ky.

Maine.

⊙Latly Bros., Stonginton, Me., has been awarded the contract for the stone work for the approach to the Manhattan bridge in New York City at $200,000.

Maryland.

⊙Stewart-Jones Co., Rock Hill, S. C., and Claiborne Johnston & Co., Baltimore, Md., at their joint bid of $190,693 have been awarded the contract for constructing the Fallaway viaduct for the city of Baltimore. Bids were opened May 21. The approximate quantities are: 14,000 cu. yds. concrete masonry; 48,000 sq. ft. hammer dressing; 1,591,000 lbs. reinforcing steel; 3,200 sq. yds. granolithic surfacing; 2,500 lin. ft. concrete curbing.

Massachusetts.

✣Bids will be received by Public Works Department, Room 62, City Hall, Boston, Mass., for building the steel and concrete extension of Pleasant St. bridge near subway.

⊙Advices from Springfield, Mass., state that the contract for the repairing of the West Springfield bridge to the United States Wood Preserving Co., New York City, at $8,652. The structure will be entirely overhauled, insuring a safe roadbed in place of the dangerous flooring now maintained. New underpining will be placed on the structure and the same will be covered with treated planking.

Minnesota.

✣Bids will be received until 11 a. m., June 16, by Board of Hennepin County Commissioners, Minneapolis, Minn., for Contract 22, for erecting a new floor system on Bridge No. 62 in the Town of Bloomington, according to specifications and plans on file in the office of the County Surveyor. Proposals must be made on blank forms furnished by the County Surveyor, and accompanied by a certified check, payable to the order of the County Treasurer, for 5 per cent of the amount of the bid, as a guaranty for the execution of a contract if awarded. A. P. Erickson is County Auditor.

William P. Parker, representative of the Concrete Steel Engineering Co., New York City, Engineers, retained by the City of Minneapolis, Minn., has announced that the river bottom at Third Ave. south is safe for the construction of the proposed new bridge.

Missouri.

✣Bids will be received until 3 p. m., June 9, by County Clerk, Sullivan County, Milan, Mo., for the construction of a 75-ft. steel span bridge over East Locust Creek on the Milan and Browning Road at Seaman Crossing, 10 miles south of Milan. The substructure will consist of steel tubes. E. L. Calfee is Highway Engineer.

The contract for the construction of two bridges over the Missouri Pacific Ry. tracks, one at Columbia Ave., and the other at Arsenal St., St. Louis, Mo., will probably be let to J. B. Turner, St. Louis, Mo. His bid for the work, opened May 23, was as follows: 260 cu. ft. of rock excavation at .30 per cu. ft.; 11,205 cu. ft. of earth excavation at .06 per cu. ft.; 15,000 cu. ft. Class A concrete at .33 per cu. ft.; 20,800 cu. ft. of Class B concrete at .35 per cu. ft.; 912 cu. ft. of Class C concrete at .90 per cu. ft.; 186,350 lbs. of steel reinforcement at .025 per lb.; 6,043 lbs. steel castings at .07 per lb. The total bid was $18,882.86.

New Jersey.

⊙The Board of Passaic County Freeholders, Paterson, N. J., has awarded the contract for the construction of the Long Hill Road bridge to George Cisco, at $7,758.

The Road and Bridge Committee of the Board of County Freeholders, Trenton, N. J., at a recent meeting authorized Engineer Tobish to prepare plans and specifications for the placing of the center pier beneath the East Clinton Ave. bridge over the Assanpink Creek and the substitution of a concrete floor for the present wooden one. Bids for the work will be advertised for shortly.

The Ocean City Bridge Construction Co. has filed articles of incorporation with the Secretary of State, Trenton, N. J. The company is capitalized at $10,000 and proposes to construct all kinds of bridges. The incorporators of the new company are Daniel W. Myers and Eiton Risley of Atlantic City and Edward M. Sutton and Everton A. Corson of Ocean City. The office of the corporation is in the Hotel Chelsea, Atlantic City, and the registered agent is Daniel W. Myers.

New York.

Advices from Southampton, L. I., state that plans have been prepared by County Superintendent of Highways Smith and State Engineers, for the repair of the Speonk bridge at a cost of $1,500.

The Corry Bridge & Supply Co., Corry, Pa., has been incorporated for the purpose of engaging in the construction of roads and bridges. A. Eugene Lane, 19 Hazel St., Corning, N. Y., is one of the incorporators.

The Board of Public Works, Elmira, N. Y., has under consideration plans for a bridge over Hoffman Creek at Second St. 100 ft. wide. T. A. Brown is City Engineer.

Plans and specifications have been completed by A. P. Smith, Engineer, North Tonawanda, N. Y., for the repairs to the center abutment under the Long Bridge over the Tonawanda Creek. The Board of Public Works will probably advertise for bids shortly.

The Town Board of Herkimer, N. Y., recently held a meeting at which it was decided to submit the matter of the proposed bridge over the West Canada Creek to the voters at a special election. Two questions will be submitted by the Board, one to raise $65,000 to build a concrete bridge over the stream in accordance with the offer of the State Highway Commission to construct and pay for the necessary approaches and also the road surface across the bridge; and another to raise $20,000 to erect a bridge, either of iron or concrete, over the west channel of the creek.

At a special town election held at Dansville, N. Y., both bridge propositions carried. The first proposition was to raise $3,500 for the construction of a joint town bridge between the Towns of West Sparta and Dansville on the Dansville-Mt. Morris Highway. The sec-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ond proposition was to raise $3,500 for the purpose of repairing the bridges along the Canaseraga Creek.

Ohio.

✣Bids will be received until 11 a. m., June 28, by Board of Cuyahoga County Commissioners, Cleveland, O., for the construction of bridge work per, Report No. 3078, concrete arch, station road over Chippewa Creek, Brecksville Township, in accordance with the form of contract and specifications to be furnished by Frank R. Lander, County Surveyor. Plans, descriptions, bills and specifications for the above work can be seen and are open to public inspection of persons interested therein, at the office of the County Engineer at the New Court House on Lakeside Ave., Cleveland, O. J. F. Goldenbogen is Clerk of the Board.

✣Bids will be received until 1 p. m., June 23, by Board of County Commissioners, Trumbull County, Ohio, for the construction of the sub-structure and superstructure of a two-span, through riveted truss bridge over the Mahoning River, at Harsh's, near Warren, Ohio. Bids must be made on printed forms which may be obtained at the office of the County Commissioners. Plans and specifications are on file at the offices of the County Commissioners, the County Surveyor, and at the office of Wilbur J. Watson & Co., Bridge Engineers, Leader Bldg., Cleveland, Ohio.

✣Bids will be received until 11 a. m., June 21, by Board of Hocking County Commissioners, Logan, Ohio, for the construction of an abutment of the river bridge at Haydenville, Ohio.

✣Bids will be received until noon, June 11, by Champaign County Auditor, Urbana, O., for the furnishing and erecting of a steel truss bridge. Each bidder will submit his own plan conforming to the following specifications. Width of roadway, 16 ft. Total length, 104 ft. Dead load on floor, 50 lbs. per sq. ft. Live load on floor, 200 lbs. per sq. ft., and a 16-ton steam roller. Steel open hearth. Floor 3 ins. white oak or a creosoted block. Factor of safety four. R. F. Darnell, County Engineer.

✣Bids will be received until 10 a. m., June 7, by Board of Darke County Commissioners, Greenville, O., for the construction of an abutment for Gettysburg bridge over Greenville Creek at Gettysburg corporation line, Adams Township. Plans and specifications are now on file with County Auditor. J. L. Morgan is Clerk of the Board.

✣Bids will be received until 11 a. m., July 2, by Board of Cuyahoga County Commissioners, Cleveland, O., for the construction of bridge work per, Report No. 3141, concrete bridge, Albion Road, Strongsville Township, in accordance with the form of contract and specifications to be furnished by Frank R. Lander, County Surveyor. J. F. Goldenbogen is Clerk.

✣Bids will be received until noon, June 10, by W. J. Springborn, Director of Public Service, Cleveland, O., for the erection of structural steel work for Lower West 3d St. bridge in accordance with plans and specifications on file with the Chief Engineer, Room 305, City Hall. W. H. Kirby is Secretary.

✣Bids will be received until noon, June 27, by Board of Hamilton County Commissioners, Albert Reinhardt, Clerk, Cincinnati, O., for constructing under specifications No. 464 superstructure over the Big Miami River at New Baltimore in Crosby and Coleraine Townships. A bond for $6,000 must accompany each bid.

✣Bids will be received until noon, June 27, by Board of Hamilton County Commissioners, Albert Reinhardt, Clerk, Cincinnati, O., for the construction under Specifications 455 of concrete culvert on Grove Ave., at Storey's Hill, west of Woodlawn, in Springfield Township.

✣Bids will be received until noon, June 27, by Board of Hamilton County Commissioners, Albert Reinhardt, Clerk, Cincinnati, O., for reconstruction under Specifications No. 468, of east abutment of bridge on Clark Road over East Branch of Mill Creek in Sycamore Township.

⊙The Board of Madison County Commissioners, London, O., has awarded the contracts for the construction of bridges and culverts as follows: Est. 344, concrete culvert on Lafayette-Mechanicsburg Road to Henry Smith, London, O., at $1,124; Est. 349, substructure Bradford Creek bridge to Jerry Neville, London, O., at $5,104; Est. 350, superstructure of Bradford Creek bridge, E. M. Scully, at $1,585; Est. 354, wings for Ganley bridge to John Stickley, Lilly Chapel, O., at $1,500. H. L. McCafferty is County Surveyor.

⊙The Capitol Construction Co., Columbus, O., has been awarded the contract for the erection of the North Fork bridge over Paint Creek, at a bid of $7,450. Bids were opened May 26. Robert D. Alexander, Chillicothe, O., is County Auditor.

A petition asking that the City Council of Youngstown, O., recommend the Lindsay plan for the construction of the proposed East End bridge has been filed with the City Clerk. The plan provides for a straight line bridge from Federal St. to Wilson Ave.

The Commissioners of Montgomery County, Dayton, O., have authorized the issuance of $300,000 of bonds for repairing and rebuilding bridges throughout the county damaged by the recent floods.

The Board of Wood County Commissioners, Bowling Green, O., has announced its intention to erect a new superstructure and one new abutment for the bridge over Portage River, in Freedom Township. C. E. Stonebaugh is County Auditor.

The City Council of Marietta, O., has decided to issue $120,000 of bonds for the construction of a new bridge to replace the old Putnam St. structure. E. Frank Gates is City Engineer.

Oklahoma.

✣Bids will be received until June 9, it is reported, by Board of Pittsburg County Commissioners, McAlester, Okla., for the construction of three steel bridges 50, 75 and 125 ft. long, estimated to cost $1,800, $2,500 and $4,500 respectively.

Arrangements are under way at Tulsa, Okla., for the construction of a combination wagon, pedestrian and interurban railroad bridge over the Arkansas River there. The bridge will be a double-decker, constructed of concrete and stone, and will cost about $250,000, according to plans under consideration.

Pennsylvania.

✣Bids will be received until 10 a. m., June 11, by Board of County Commissioners at the office of D. K. Hoch, County Controller, Reading, Pa., for the erection of a reinforced concrete girder bridge, to cross Mill Creek in Albany Township, Berks County, Pa., to be known as Stump's Bridge. Plans and specifications can be had at the County Commissioners' office, Reading, Pa., for which a deposit of $5 must be made, which will be refunded when the same are returned. All bids must be accompanied with a certified check equal to 10 per cent of the aggregate amount of the bid.

⊙The contract for rebuilding the Lippincott bridge in Pilesgrove Township, Salem County, Pa., has been awarded to Henry B. Richman, at $1,684.

The Luzerne County Commissioners, Wilkesbarre, Pa., and Edwin Troxell, Engineer, recently held a conference in regard to the proposed new bridge to replace the present Water St. bridge. A recent grand jury appropriated $100,000 for the improvement but the lowest bid submitted for the structure was $108,000. It is as yet undetermined whether to change the plans or seek a further appropriation.

⊙The Board of Bucks County Commissioners, Doylestown, Pa., has awarded the contract for removing the old bridge at Durham Furnace and building a new structure and for the construction of a reinforced concrete structure over Three-Mile Creek in East Rockhill to the Riegelsville Construction Co., at $1,474.

South Carolina.

The Atlantic Coast Line Engineering Department has filed with Maj. G. P. Howell, U. S. Engineer of the Charleston, S. C., district, plans for the construction of new bridges over the Ashepoo River and Rantowles Creek. The bridges will be larger with wider draws than now exist and in every way better and more substantial construction. The railroad company is taking the initiative in arranging for the new bridges on its own accord, but under the law, all bridges over navigable waterways can be constructed only with the approval of the Government Engineers and for this reason the plans and specifications are now submitted for approval before the work of construction is begun.

Tennessee.

✣Bids will be received until July 7, it is reported by City of Lebanon, Tenn., for the construction of a reinforced concrete bridge over Town Creek and West Main St. Plans are on file with the City Engineer.

⊙The Bridge Committee of Davidson County, Tenn., and the Chief Engineer of the N. C. & St. L. Ry., have awarded the contract for the construction of a reinforced concrete viaduct 560 ft. long connecting Harding Pike and Charlotte Road, near Nashville, over the main line of the N. C. & St. L., and Richland Creek to the Meacham Contracting Co., Hopkinsville, Ky., at $27,000. The work includes 10,000 yds. of earth fill approaches. The viaduct proper and the approaches will be macadamized.

Texas.

Mayor Campbell of Houston, Texas, has ordered an election to be held July 1 to vote on a bond issue of $1,200,000 to be used for paving of street intersections and to build more bridges.

The Texas Granitoid Co., San Antonio, Texas, has been incorporated with a capital stock of $10,000 and proposes to engage in the construction of roads and bridges. The incorporators are F. A. Johnson, W. T. Montgomery and W. W. Taylor.

Virginia.

✣Bids will be received until noon, July 1, by L. P. Slater, City Clerk, Portsmouth, Va., for furnishing the necessary labor and material for the construction of the following reinforced structures to be let in two separate contracts, viz.: 1st. 1 reinforced concrete bridge to be known as the "Gosport Bridge," on First St., about 65 ft. wide and 21-ft. span; also submit estimate for this bridge 65 ft. wide and 10-ft. span. 2d. 2 reinforced concrete culverts; one at north end of Dinwiddie St., about 105 ft. long and about 4 ft. diameter, and the other at south end of Dinwiddie St., about 310 ft. long and about 4 ft. diameter. Complete detail plans and specifications must be submitted with each bid, when same is filed. A certified check, cash or bidder's bond for $500 must accompany each bid. V. O. Cassell, Jr., is City Engineer.

✣Bids will be received until noon, June 9, by Circuit Court, Craig County, Newcastle, Va., for the construction of a 29-ft. 3-in. steel bridge on concrete substructure over Meadow Creek 3½ miles from Newcastle on the C. & O. Ry. Sand and gravel can be secured within three miles of the site. Gravel used is subject to inspection by the state. Plans and specifications are on file with the Clerk of the Court and with P. St. J. Wilson, State Highway Commissioner, Richmond, Va. Blue prints can be secured of Childrey-Sunday, Richmond, Va., at $.45 and postage.

✣Bids will be received until noon, June 9, by Circuit Court, Craig County, Newcastle, Va., for the construction of a 39-ft. 3-in. span bridge on concrete substructure over Sinking Creek, 16 miles from Newcastle on the C. & O. Ry. Stone and sand for the concrete can be secured within 1 mile of the site. Plans and specifications are on file with the Clerk of the Court, Newcastle, Va., and with P. St. J. Wilson, State Highway Commissioner, Richmond, Va. Blue prints, etc., can be secured of Childrey-Sunday, Richmond, Va., at a cost of $.45 and postage. A certified check for $250 must be filed with each bid.

✣Bids will be received until noon, June 9, by Circuit Court, Craig County, Newcastle, Va., for the construction of a bridge 81 ft. 9 ins. long over Barbour Creek 1 mile from Barbours Creek on the C. & O. Ry. The structure will include an 80-ft. span on concrete substructure. Stone gravel and sand can be secured within ½ mile of the site. Gravel used is subject to inspection by the State Commission. A certified check for $250 must be filed with each bid. Plans and specifications are on file with the Clerk of the Court or with P. St. J. Wilson, Richmond, Va., State Highway Commissioner. Blue prints, etc., can be secured of Childrey-Sunday, Richmond, Va., at a cost of $.45 and postage.

✣Bids will be received until noon, June 7, by Circuit Court, Allegheny County, Covington, Va., for the construction of a 50-ft. span with 12-ft. roadway over Dunlap Creek 3½ miles from Callaghan on the C. & O., in Allegheny County. The substructure will consist of one concrete abutment. Gravel which can be secured in the creek at the site may be used in the concrete, subject to inspection by the State Highway Commission. Plans and specifications are on file with the Clerk of the Court and with P. St. J. Wilson, State Highway Commissioner, Richmond, Va. Blue prints can be secured of Childrey-Sunday Co., Richmond, Va., at a cost of 42 cts. A certified check must accompany each bid.

✣Bids will be received until noon, June 7, by the Circuit Court, Allegheny County, Covington, Va., for the construction of a 140-ft. span bridge with 16-ft. roadway over Dunlap Creek, ½ mile from McDowell on the C. & O. Ry., in Allegheny County, Va. The proximity of stone, gravel and sand is 1½ miles from site. Sand and part of the stone is at the site. Gravel subject to state inspection will be allowed in the concrete. The substructure will include removing old abutments and any of old bridge at the site. Plans and specifications are on file with the Clerk of the Circuit Court. Blue prints of plans can be secured from Childrey-Sunday Co., Richmond, Va., at a cost of 42 cts. and postage. A certified check for $250 payable to P. St. J. Wilson is required with each bid.

Washington.

The International Contract Co., Central Bldg., Seattle, Wash., was low bidder at $30,921 for construction and at $30,921 for bascule type bridge over the Ebey Slough near Everett, Wash. Other bidders were: Everett Const. Co., $38,605 and $42,173; American Pile Driving Co., $39,220 and $40,709.

Wisconsin.

⊙W. C. Kiernan & Co., Whitewater, Wis., has been awarded a contract at $1,920 for the construction of a bridge in Holland.

⊙The contract for the construction of the substructure for the New Jersey Ave. bridge at Sheboygan, Wis., including concrete abutments and center pier, has been let to the Wisconsin Dredge & Dock Co., at $7,300. Pellett & McMullen, at $10,900, were awarded the contract for the superstructure, including two 210-ft. through truss spans. C. V. Boley is City Engineer.

Plans are nearing completion for the concrete bridges between Oak and Ash Sts., Baraboo, Wis., and at the Woolen Mill; also for the wall at the north end of the dam under high bridge. H. E. French is City Engineer.

The City Council of Manitowoc, Wis., at a meeting held recently, adopted the recommendation of the Bridge Committee for the new bascule bridge to be erected replacing the present Eighth St. superstructure. The cost of the structure is estimated at about $50,000.

Canada.

✣Bids will be received until 9 p. m., June 7, by C. R Wheelock, County Engineer, Orangeville, Ont., for the construction and erection of the following steel highway bridges in the Township of East Garafraxa: First, a 120-ft. single span through bridge; second, two 70-ft. spans, low truss, box chords. A form of tender and all information may be obtained from C. R. Wheelock, County Engineer.

DRAINAGE AND IRRIGATION

California.

Governor Johnson has signed the bill creating Reclamation District No. 1500. This project is to reclaim 64,000 acres of flood and overflowed land in the Sutter Basin. W. E. Gerber, Sacramento, Cal., is interested.

Puddingstone Water Co., San Dimas, Cal., has been incorporated, the incorporators being M. V. Helwick, G. M. Vermilyea and M. L. Hazzard.

The Big Springs Water Co. has been incorporated and proposes development work in Siskiyou County, near Montague. The company plans to develop 5,000 acres of alfalfa and dairy land and to furnish water from Big Springs, at the foot of Mount Shasta, to irrigate the land. The directors are George W. Peltier, William H. Devlin, Charles F. Silva, G. A. Starkweather and Dr. G. W. Dwinnell, all of Sacramento.

Georgia.

Citizens residing along Jack's Creek, near Monroe, Ga., are taking steps to organize a district for the drainage of the streams and the reclamation of bottom lands.

Idaho.

✣Bids will be received until 2 p. m., June 16, at the office of the U. S. Reclamation Service, Boise, Idaho, for furnishing sluice gates for the new Jackson Lake dam, Snake River storage project. Official advertisement will be found elsewhere in this issue.

The Glendale Canal Co., Ltd., of Bellevue, Idaho, has been incorporated with a capital stock of $10,000 for the purpose of building and operating irrigation systems. The directors are Henry J. Elliott, T. D. Perry, John Little, Matt. Jones and James Sharp, all of Bellevue.

Illinois.

✣Bids will be received until June 16, by Webber & Roth, Urbana, Ill., for the construction of drainage work in Union Drainage District of Ogden and Stanton Townships, near the Village of Royal, on the C. & E. I. R. R., five miles north of St. Joseph or Glover. The work consists of 200 ft. of open ditch, 2 concrete bulkheads containing 12 cu. yds. each, and the furnishing and laying of the following tile: North Branch, 3,000 ft. of 30-in., 3,000 ft. of 27-in., 1,800 ft. of 24-in., 1,800 ft. of 22-in., 1,000 ft. of 20-in., 1,000 ft. of 18-in., 1,200 ft. of 16-in. and 26 ft. of cast iron piping 16 ins. inside diameter under the C. & E. I. R. R. tracks. South Branch, 4,200 ft. of 22-in., 3,800 ft. of 20-in., 1,550 ft. of 18-in., maximum depth 3½ to 4 ft. Bids may be on well burned clay tile or well made concrete tile. Estimate for clay tile work and hauling, $17,000. G. F. Fisher, Danville, Ill., is Engineer.

✣Bids will be received until June 16, by Commissioners of Henderson County Drainage District No. 1, and Henderson County Drainage District No. 2, at the office of County Clerk, Oquawka, Ill., for the ditch and levee work aggregating 2,449,000 cu. yds. Harman Engineering Co., Peoria, Ill., are Engineers.

⊙Cazlett & Son, Assumption, Ill., have been awarded the contract for work in Drainage District No. 5, bids for which were opened May 24 by Row W. Johnson, Assumption, Ill. The contract includes 2,970 ft. 24-in. tile, 1,820 ft. 14-in., 1,800 ft. 12-in., 820 ft. 10-in., and 1,820 ft. 8-in.

Iowa.

⊙The Offerman Construction Co., of Omaha, Neb., has been awarded the contract by the Board of Mahaska County Supervisors, Oskaloosa, Iowa, for the proposed work in Drainage District No. 2, for $10,963. Bids were opened May 22.

Chambers & Dobson, of New Hampton, Iowa, have submitted the lowest bid to the City Council of Waverly, Iowa, R. B. Slippy, Waterloo, Engineer, for the construction of a bulkhead and flood gates at the west end of the present dam. The bid was $4,953. Bids were opened May 26.

Minnesota.

✣Bids will be received, it is reported, until 10 a. m., June 11, by Board of Polk County at the office of H. J. Welty, County Auditor, Crookston, Minn., for excavation work in Ditches Nos. 63 and 64.

New Mexico.

✣Bids will be received until 2 p. m., June 25, at the office of the U. S. Reclamation Service, Elephant Butte, N. Mex., for furnishing sluice at penstock gates and accessories for Elephant Butte Dam, Rio Grande project. Official advertisement will be found elsewhere in this issue.

Ohio.

✣Bids will be received until noon, June 27, by Board of Hamilton County Commissioners, Albert Reinhardt, Clerk, Cincinnati, O., for repair under Specifications 457 of the levee on the Newton Road south of the bridge over Little Miami River in Anderson Township. Plans and specifications are on file at the office of the Board.

Oregon.

Land owners of the East Side, according to advices from Hood River, Ore., voted May 27 on a bond issue of $175,000 to finance the recently established bonded irrigation district. Of the sum to be voted, $110,000 is to be used in paying the purchase price of the ditch bought from the East Fork Irrigation Co. The remainder will be used for improvements and extensions.

Virginia.

✣Bids will be received until June 11, it is reported, by Walter Sharp, Chairman, Drainage Commissioners, Norfolk, Va., for the construction of about 10 miles of drainage canal, including about 262,000 cu. yds. in Parksville Drainage District No. 1.

Canada.

✣Bids will be received until noon, June 16, by Adam Beck, Chairman, Hydro Electric Power Commission, Continental Life Bldg., Toronto, Ont., for the various classes of work in connection with construction and equipment of a hydro-electric power plant at Wasdell's Falls, on the Severn River. Separate tenders will be received under the following heads: Tender for dam and power house; tender for electrical equipment; tender for hydraulic equipment; tender for crane; tender for stop-log winch; tender for head-gate mechanism. Plans, specifications and instructions to bidders may be obtained at the offices of the Hydro-electric Power Commission, Continental Life Bldg., Toronto. W. W. Pope is Secretary.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

WATER WORKS

California.

•The Baker Iron Works of Los Angeles, Calif., has been awarded a contract to supply the Fontana Co. with iron pipe for the domestic water system at that city, for about $20,000.

Engineers Roberts & Denecke have submitted their report to the Trustees of Daly City, Calif., for the building of a municipal water works system. The estimated cost of the plant is $100,000.

The State Railroad Commission has granted the Lawndale Land & Water Co. permission to purchase the Lawndale Water Co., and to issue $75,000 in stock and $25,000 in bonds for the purpose of extending its system.

The citizens of Riverside, Calif., on May 19 voted bonds to the amount of $1,160,000 for purchase of three privately owned water works plants and $312,000 for improvements to the same. Bids will be received in about 60 days for material and construction. Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., are Engineers.

The Board of Trustees of Escondido, Calif., has ordered a bond election to be held to vote on an issue of $100,000 for a municipal water system. A reservoir to contain 5,000,000,000 gals. will be built on Park Hill.

Connecticut.

Chief Engineer Caleb M. Saville of the Water Board, Hartford, Conn., has advertised for bids for the construction of the remaining part of the Nepaug reservoir pipe line in the towns of Farmington, Avon and Burlington, known as Contract No. 4. The line to be laid is approximately 40,000 ft. in length, and the pipe will be of cast iron and steel, part 42-ins. in diameter.

Florida.

•The Bond Trustees of Sarasota, Fla., have let the contract for the 100,000-gal. reservoir of concrete to the Beard Construction Co., of Bradentown, Fla., for $1,735.

Georgia.

An election will be held in Colquitt, Ga., on June 5 to vote on the issuance of $5,000 in bonds for waterworks and school building.

Illinois.

The City Council of Bloomington, Ill., has granted the Chicago & Alton Railroad Co. permission to run a water main of 12 or not to exceed 16-in. in diameter from the pumping station on South Lee St., to the shops.

Indiana.

✣Bids will be received until 8 p. m., June 16, by West Terre Haute Water Co., H. L. Ensminger, Secy., West Terre Haute, Ind., for the installation of a complete Water Works system for the town of West Terre Haute. The installation will consist of a brick pumping station, with brick chimney; two 60 horsepower boilers; one compound double acting direct steam pump having a capacity of 500 G.B.M. against a maximum pressure of 150 lbs.; an elevated steel tank on steel tower having a capacity of 80,000 gals.; two 8-in. driven wells; five and six-tenth miles of mains 2 in. to 12 in. diameters; 62 hydrants, valves, etc.

✣Bids will be received until 8 p. m., June 6, by C. H. Clippinger, Secretary of Town Council, Greencastle, Ind., for the following work on Greencastle reservoir: 500 to 1,000 yds. of grading, which includes quarrying rock. Laying about 5,000 sq. yds. of 6-in. concrete slab. Plans and specifications may be seen at the office of C. H. Clippinger, Secretary of Town Council, Greencastle, Ind.

At Goshen, Ind., temporary restraining orders prevented the city from awarding contracts for material and construction for the new municipal lighting plant. Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., are Engineers.

Plans and specifications for this work may be examined at the office of J. W. Rateliffe, in West Terre Haute, or at the office of W. R. Paige, consulting engineer, 108 Rose Dispensary Building, Terre Haute, Ind.; or copies will be furnished to bidder on the receipt of $5.

Following bids were received by the Board of Works of Logansport, Ind., for the installation of the filtration plant: The Materne Mfg. Co., of St. Louis, Mo., $57,750 on the pressure type of filter; The New York Continental Filtration Co., New York City, $95,750 on the pressure type, and The Roberts Filter Mfg. Co., of Philadelphia, Pa., $87,633 on pressure type, and $59,364 on the gravity type.

Iowa.

⦿Work will be started at once on construction of two new wells and enlargement of the new engine rooms of the Sioux City, Ia., Service Co. The contract to sink the wells has been let to George Savage. C. R. Houx will supervise the construction of the engine rooms. The wells will cost about $9,000.

The City Council of Carson, Ia., has been authorized by a vote of the electors to construct a system of water works. The improvement will cost about $15,000.

Kentucky.

⦿George Osborne has been awarded the contract by the city of Fulton, Ky., for the laying of water mains at about $3,000.

Maryland.

The Montgomery County Commissioners, Rockville, Md., have decided to take charge of the construction of a water and sewerage system for Silver Spring Park. The improvements will cost about $20,000.

Massachusetts.

The special town meeting, East Longmeadow, Mass., has voted to ratify the contract made with the city of Springfield for water. Bids will probably be called for within a few days.

Michigan.

✣Bids will be received until 6 p. m., June 18, by Homer Fish, Village Clerk, Saline, Mich., for the construction of a system of water works for the village. Plans and specifications are on file at the office of the Clerk.

✣Bids will be received until June 10, by Village of Northville, Mich., at the office of Samuel Wilkinson, Supt. of Electric Light Plant, for the construction of a concrete spillway according to plans and specifications on file at the office of the Superintendent and at the office of L. L. Van Tuyl, Consulting Engineer, Detroit, Mich.

The Board of Water Commissioners of Saginaw, Mich., has instructed Supt. Robert F. Johnson to prepare specifications for a vertical tube boiler at the east side pumping station

Minnesota.

✣Bids will be received until 7:30 p. m., June 7, by E. Bruns, Recorder, Raymond, Minn., for the construction of an additional 4-in. water main about 350 ft. with one hydrant 7 ft. deep along Spicer Ave.

The City Council of Crookston, Minn., has passed a resolution providing for the laying of a water main in Sheridan Ave., D St., and Pine St.

Mississippi.

An election was held in Tutwiler, Miss., on June 2 to vote on the issuance of bonds in the sum of $7,500 for waterworks and sewer systems.

An election will be held in Richton, Miss., on June 10 for the purpose of voting on the issuance of bonds in the sum of $10,000 for a waterworks system.

Missouri.

The City Council of St. Charles, Mo., has passed an ordinance appropriating $3,162 for building a new bottom in the water basins recently added to the municipal water works plant.

The citizens of Hannibal, Mo., will vote July 1 on the question of purchasing the water works from the Hannibal Water Co., for $285,000, plus the betterments made from the time the offer was made to the time the transfer is made by the company.

Montana.

Plans and specifications for complete new water works plant are being prepared by Consulting Engineers Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., for Kalispell, Mont. The estimated cost is $200,000. An appraisement of the value of the present privately owned plant is being made.

•At Helena, Mont., an appraisement is being made by Consulting Engineers Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., of the property owned by the Helena Light & Street Railway Co., with a view of rate regulation before the Public Utility Commission of Montana.

Consulting Engineer H. J. Saunders, Valier, Mont, is preparing plans for a new water supply for that town. The estimated cost is $60,000.

Nebraska.

✣Bids will be received until 5 p. m., June 16, by City Clerk, Norfolk, Nebr., for the construction of extensions to the city water works system. The work will include the Edgewater Park extension estimated at $5,908 and the East Norfolk Ave. extension estimated to cost $9,811.

New Jersey.

The City Council of Milltown, N. J., have asked the citizens to vote upon the proposition to construct a water works plant at an estimated cost of $45,000. The work will include a stand pipe 98 ft. in height with a capacity of 90,000 gals.

New York.

⦿Bert Warren of Honeoye Falls, N. Y., has been awarded the contract by the Village Trustees of that village, for the construction of a municipal waterworks system. White & Getman, Mutual Life Bldg., Buffalo, N. Y., are Engineers. Bids were opened May 1.

⦿The H. P. Cummings Construction Co., Ware, Mass., has been awarded a contract for laying about two miles of water pipe in the Boston & Maine railroad yards, at Mechanicsville, N. Y.

The Water Commission of Glens Falls, N. Y., will repair the three reservoirs during the summer at an estimated cost of $1,200.

North Carolina.

✣Bids will be received until July 1, it is reported, by Mayor, Waltersboro, N. C., for waterworks construction, including erection of 20x32-ft. brick pumphouse, also brick and concrete reservoir 10x40 ft. in diameter; four miles 8, 6 and 4-in. castiron pipe, with hydrants, valves and boxes. 60,000-gal. steel tank. J. Newton Johnston, engineer, Florence, S. C.

The City Council of Raleigh, N. C., has ordered 5,000 ft. of 18-in. wood pipe from the Standard Wood Pipe Co., of Williamsport, Pa., to cost about $4,500. This pipe will replace about a mile of 14-in. clay pipe now extending from the sand pit No. 5 to the water works plant. The city will also install a temporary dam at a suitable point on Walnut Creek.

Bids as follows were received May 26 by Jas. H. Campbell, Constructing Q. M., Fort Caswell, N. C., for (1) construction of a 400,000 gal. concrete reservoir, and (2) a purification plant: Simon-Mayrant Co., Charleston, S. C., (1) $18,498; P. D. Hay, Charleston,

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

S. C., (2) $18,543; Robert B. Trifts, 702 East Lexington St., Baltimore, Md., (2) $14,975; alternate, $13,900; Newport Const. & Engineering Co., Newport News, Va., (1) $17,095; The Grascom-Nussel Co., 90 W. St., New York, (2) $56,750; Pure Water Apparatus Co., Philadelphia, Pa., (2) $48,340, $46,000, $43,500, $40,000. In addition bids as follows were received in water mains: Newport Construction & Engineering Co., $43,526 and $26,722, and Drew & Robbins, Southport, N. C., cost, plus 20 per cent.

Engineer W. C. Riddick, Raleigh, N. C., is preparing plans for the installation of a waterworks system in Weldon, N. C., at an estimated cost of $40,000.

North Dakota.

✣Bids will be received until 10 a. m., June 18, by C. O. Vangen, Auditor, Mayville, N. Dak., for furnishing material and equipment for a complete electric light plant and an addition to the waterworks system. Plans and specifications are on file and can be seen at the office of the City Auditor and at the offices of the Claussen Engineering Co., Consulting Engineer, Commercial Bldg., St. Paul, Minn., where copies can be obtained for $5. The work will include: Div. 1, brick power station; Div. 2, 2 A, 3 B Radial brick stack or concrete stack or self-supporting steel stack; Div. 3, 3 A, Boiler Room installation; Div. 4, Steam Engine installation; Div. 5, Electrical Equipment; Div. 6, Sewer and Water Mains; Div. 7, Pump and Pump Pit installation—remote control; Div. 8, Bids on the old equipment.

Ohio.

✣Bids will be received until noon, June 4, by V. T. Price, Director of Public Service, Cincinnati, O., for the construction, delivery and erection of one vertical triple-expansion crank and flywheel pumping engine for the high-service system at the Western Hills Pumping Station of the Water Works Department of the City of Cincinnati, O. The engine to have a capacity of 7,000,000 gals. per 24 hours. Plans, specifications and blank proposals can be obtained at the office of the General Superintendent of the Water Works Department.

✣Bids will be received until noon, June 11, by Charles W. Stage, Director of Public Safety, Cleveland, O., for approximately 10,000 ft. of 2½ in. cotton rubber lined tire hose, and approximately 4,000 ft. of 3-in. cotton rubber lined fire hose for the Department of Fire. Each bid must be in accordance with the specifications which may be obtained at the office of the Director of Public Safety, Room 109 City Hall.

✣Bids will be received by the Council of the Village of Pleasant City, O., until noon of June 13, for the construction of a municipal water works system for that village. Approximate requirements are 3,665 ft. 8-in. mains, 8,000 ft. 6-in. mains, deep well pumps and engines, reinforced concrete reservoir, brick pump houses, hydrants, valves, etc., etc. Plans and specifications are on file in the office of M. F. Devine, Clerk of said village. H. L. Maddock, Cons. Engr., Newark, O. Official advertisement will be found elsewhere in this issue.

✣Bids will be received by Director of Public Service, Painesville, O., until noon June 21, for the construction of water works intake and crib, being Contract No. 1 of the Improvements of Public Water Supply. The work to be done includes the construction of a wooden ballasted crib, to be located about 1,500 ft. from the shore of Lake Erie, and the furnishing and laying of 24-in. steel or cast iron pipe from the well on shore to the crib. Copies of the plans, proposal forms, specifications and form of bonds and contract can be seen at the office of the Director of Public Service, City Hall, Painesville, O., or at the office of the consulting engineer, R. Winthrop Pratt, 708 Hippodrome Bldg., Cleveland, O., or may be obtained by prospective bidders upon depositing $5, which sum will be refunded on return of plans and specifications in good condition, on or before the 23d day of June, 1913. Official advertisement will be found elsewhere in this issue.

Bids will be received until noon, June 21, by Director of Public Service, Painesville, O., for the construction of waterworks intake and crib being Contract No. I of the Improvement of Public Water Supply. The work to be done includes the construction of a wooden ballasted crib, to be located about 1,500 ft. from the shore of Lake Erie, and the furnishing and laying of 24-in. steel or cast iron pipe from the well on shore to the crib. Copies of the plans, proposal forms, specifications and forms of bonds and contract can be seen at the office of the Director of Public Service, City Hall, Painesville, Ohio, or at the office of the consulting engineer, R. Winthrop Pratt, 708 Hippodrome Bldg., Cleveland, Ohio, or may be obtained by prospective bidders upon depositing $5, which sum will be refunded on return of plans and specifications in good condition on or before the 23d day of June, 1913. S. A. Haskell is Director of Public Service.

Bids were received May 10 by the city of Willoughby, O., Burgess & Long, Consulting Engineers, Columbus, O., for two triplex pumps and for two centrifugal pumps. In the tables that follow the bidders are designated thus: No. 1, The Cleveland Pump & Supply Co.; No. 2, Fairbanks, Morse Co.; No. 3, Wilson-Snyder Centrifugal Pump Co.; No. 4, The John H. McGowan Co.; No. 5, The Platt Iron Works Co.; No. 6, The Goulds Mfg. Co.; No. 7, International Steam Pump Co.; No. 8, Epping-Carpenter Co.; No. 9, Dravo-Doyle Co.; No. 10, Buffalo Steam Pump Co.; No. 11, Rumsey & Co.

BIDS ON CENTRIFUGAL PUMPS.

No.	Price of Pumps.	Capacity.	Speed	Motor Manufacturer.	Motor H. P.	Combined Eff., Percent.	Wt. of Motor, Lbs.	Total Wt., Lbs.
1	$ 550	864,000	1,200	Croker-Wheeler Co.	10	54	875	3,500
2	891.40	864,000	1,130	Fairbanks, Morse & Co.	7½	60.2	600	1,750
3	900	864,000	1,130	Westinghouse or Croker-Wheeler	7½	57	640	1,400
4	920	1,080,000	1,200	Triumph Electric Co.	7½	62	375	1,375
5	570	864,000	680	Westinghouse Elec. & Mfg. Co.	10	51.24	1,050	2,150
5	589	972,000	1,720	Westinghouse Elec. & Mfg. Co.	10	57.6	650	1,450
5	901	864,000	680	Burke Electric Co.	10	53.07	1,130	2,230
5	602	972,000	1,720	Burke Electric Co.	10	56.3	900	1,700
6	875	864,000	1,130	Westinghouse	7½	54.6	630	2,050
7	807	864,000	1,200	General Electric Co.	7½	43.5	500	2,100
8	888	864,000	1,150	General Electric Co.	10	52.5	700	2,550
9	675	864,000	1,729	Westinghouse or Croker-Wilson	5	58	310	960
9	940	1,224,000	1,720	Westinghouse or Croker-Wilson	7½	54.5	710	1,700
10	726	1,080,000	1,740	General Electric Co.	10	52.5	700	2,100
11	1,320	1,140,000	.....		10	60		

TABULATION OF BIDS ON TRIPLEX PUMPS—WILLOUGHBY, OHIO.—TWO PUMPS.

No.	Price of Pumps.	Size of Cylinders, ins.	Length of Stroke, ins.	Rev. per min.	Cap. per min.	Mx. Working Press.	Mfg. of Motor.	Motor H. P.	Wt. of Pump & Motor, Lbs.	Comb. Efficiency, Percent.
1	$3,420	10	10	59	600	90	Croker-Wheeler Co.	50	18,000	71
1	3,220	10	10	59	600	90	Croker-Wheeler Co.	35	18,000	71
2	3,372	12	12	42	600	90	Fairbanks, Morse & Co.	40	18,675	63.4
4	3,480	12	10	42	600	80	Triumph Electric Co.	35	16,500	70
5	3,540	10	12	49	600	150	West'house El. & Mfg. Co.	40	18,900	61.6
5	4,589	12	12	35	600	150	West'house El. & Mfg. Co.	40	29,600	61.6
5	3,523	10	12	49	600	150	Burke Electric Co.	40	19,200	61.6
5	4,574	12	12	35	600	150	Burke Electric Co.	40	30,200	61.6
5	3,687	10	12	Motor 865	600	150	West'house El. & Mfg. Co.	50	19,100	61.6
5	3,629	10	12	Motor 855	600	150	Burke Electric Co.	50	19,400	61.6
5	4,763	12	12	Motor 865	600	150	West'house El. & Mfg. Co.	50	30,100	61.6
5	4,678	12	12	Motor 855	600	150	Burke Electric Co.	50	30,400	61.9
6	4,444	12	12	36	600	100	Westinghouse	35	22,000	68.8
7	3,706.25	9	12	62	600	100	General Electric Co.	35	34,500	66
7	3,151.85	11	12	42	600	95	General Electric Co.	35	36,300	62
10	3,488	12	10	42	600	100	General Electric Co.	35	16,000	62.5
11	3,140	10½	10	50	561			35		65

Oklahoma.

An election will shortly be held in Valiant, Okla., for the purpose of voting on a bond issue of $51,000 for a waterworks system and an electric light plant. E. W. Gantt, Sam Houston Life Bldg., Dallas, Tex., is engineer.

⊙Bids were received May 19 by the city of Hinton, Okla., for the construction of a water works and an electric light plant, for which The Benham Engineering Co., Am. Nat. Bank Bldg., Oklahoma City, Okla., are engineers. In the table shown below (1) stands for bid of T. C. Brooks & Son, Jackson, Mich.; (2) Don. A. Tolbert, Ada, Okla. (awarded contract); (3) Tochterman, Kerby & Richards, Lawton, Okla.; (4) Electric Supply Co., El Reno, Okla.; (5) Tulsa Electric & Construction Co., Tulsa, Okla.; (6) N. S. Sherman Machine & Iron Works, Oklahoma City, Okla., and (7) Connelley Construction Co., El Reno, Okla.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1-in. C. I. class "B" pipe, —— lin. ft......	$0.00	$0.20	$0.15	$0.00	$0.15	$0.17	$0.00
2-in. C. I. class "B" pipe, 5,905 lin. ft......	.22½	.25	.21	.293	.22	.242	.22
4-in. C. I. class "B" pipe, 14,604 lin. ft.....	.46½	.55	.48	.487	.48	.50	.49
6-in. C. I. class "B" pipe, 1,845 lin. ft......	.62	.70	.70	.633	.70	.67	.66
8-in. C. I. class "B" pipe, 210 lin. ft.......	.80½	.95	.95	.735	.95	.92	.89
Hydrants, 28, each..........................	24.75	30.00	27.00	31.90	31.00	25.00	27.75
4-in. valves, 27............................	10.00	12.00	11.50	15.95	12.00	13.00	10.55
6-in. valves, 9.............................	15.00	17.00	14.50	18.70	15.00	16.25	14.75
8-in. valves, 1.............................	20.00	25.00	21.00	27.50	22.00	20.00	20.60
Well, 1	.....	2.50	2.00	1.30	1.75	2.75	2.20
2-in. G. V. & B., 10........................	7.00	8.50	7.50	7.75	5.00	8.00	7.60
Concrete, per cu. yd........................	7.00	12.00	10.00	9.50	10.00	9.00	8.00
Start work, days............................	30	30	20	20	30	20	30
Finish work, days...........................	90	100	150	150	120	150	120
Totals	$27,000	$25,917	$27,000	$28,696	$30,390	$27,889	$29,858

J. E. Davis, Caddo, Okla., is consulting engineer for the proposed waterworks system for Broken Bow, Okla., to cost approximately $30,000.

The Benham Engineering Co., of Oklahoma City, Okla., have been retained by the city of Durant, Okla., as consulting engineers on the proposed extensions to the sewers and waterworks systems, for which bonds in the amount of $80,000 have been voted. W. P. Danford is City Engineer.

Oregon.

All bids for lowering the 24 and 28-in. submerged water mains across the Willamette have been rejected by the Water Board of Portland, Ore. It has been decided not to do this work this year.

Pennsylvania.

⊙The Girard Water Co., Girard, Pa., has awarded a contract for the construction of a new dam and piping at Ringtown to Bennett

& Randall of Reading and Lebanon, Pa. The contract provides for a dam in the Ringtown water shed and the piping to the towns in that vicinity together with a line to one of the Raven Run dams.

The Colver Water Co., Colver, Pa., has increased its capital stock from $5,900 to $25,000 for the purpose of constructing a small reservoir on one of the branches of the Blacklick, from which it now gets its water, and for pipes from the reservoir to the town.

The City Council of Allentown, Pa., has passed an ordinance providing for a 10-in. water main across the Eighth St. bridge.

A number of citizens of Morgantown, Pa., contemplate forming a company to supply water to the citizens from the springs 3,900 ft. from town.

The City Council of Homestead, Pa., has authorized the expenditure of $23,000 to improve the borough water plant. Chester & Fleming, Pittsburgh, Pa., are Consulting Engineers.

South Dakota.

⊙The Town Board of Carter, S. Dak., has let the contract for the installation of a new water works system to W. D. Lovell of Minneapolis, Minn., for $9,900. Bids were opened May 27. J. R. Martin is Town Clerk.

Texas.

Plans are on foot at Balmorhea, Tex., to construct a reservoir to store sufficient water to irrigate 23,000 acres of land. The water supply will be secured from Phantom Lake and the San Saloman Springs.

Utah.

Commissioner of Water Supply W. H. Korns, Salt Lake City, Utah, has recommended to the City Commission that the city appropriate $25,000 with which to continue the work on the proposed reservoir dams on Lake Phoebe and Twin Lakes at the head of Big Cottonwood Canyon.

Mayor A. G. Fell of Ogden, Utah, has recommended to the Board of Commissioners that the Mountain View Cemetery Co. be supplied with a 6-in. water main to its property and another 4-in. line be laid along the north line of the cemetery.

Virginia.

✣Bids will be received until 2 p. m., June 21, by Front Royal, Va., at the office of the Mayor, for the construction of a gravity mechanical filtration plant having a capacity of 1,000,000 gals. per day. A certified check for 10 per cent of the bid must accompany each proposal. Prospective bidders should apply to the Engineer, Edwin V. Dunstan, 204 Southern Building, Washington, D. C., for plans, specifications and blanks, enclosing $10 deposit for their return in satisfactory condition. W. W. Pettitt is Chairman Water Committee.

Washington.

✣Bids will be received until 11 a. m., June 9, by Capt. R. F. Woods, Constructing Quartermaster, Fort Worden, Wash., for furnishing and laying approximately 5,993 lin. ft. of 2 and 1½ in. galvanized water pipe at Fort Flagler, Wash.

⊙The Board of County Commissioners, Spokane, Wash., has let a contract for the drilling of a well on the site of the new county infirmary to James Burgrin.

The City Council of Seattle, Wash., has passed a resolution calling for the following water main extension: 12-in. cast iron main in South 56th St., Cedar to Puget Sound Ave.; 10-in. cast iron main in South 56th St., Puget Sound Ave., to Union Ave.; 6-in. cast iron mains in 10 different streets for a total lin. distance of about 50 blocks; 4-in. cast iron mains in three streets for a total lin. distance of 12 blocks.

Mayor Eugene France of Aberdeen, Wash., has recommended to the City Council that the water supply be augmented by extension of the Stewart Creek pipe line to the Wynoochee River, and that the construction of a concrete reservoir on high land back of the city be considered.

Following bids were received by the Board of Public Works of Seattle, Wash., on May 23, for the construction of water mains in North 82nd St.: Dickens & Rightmire, $26,400; T. Ryan, $26,322; Jahn Construction Co., $27,869; Krogh & Jessen, $26,516; Washington Construction Co., $27,336; Graff Construction Co., $29,106, and Ferguson-Coit Co., $26,478.

Following bids were received May 23 by the Board of Public Works of Seattle, Wash., for the construction of a water main in West 61st St.: J. Ruthe, $2,839; Frasca & Coluccio, $2,692; Ferguson-Coit Co., $2,780; M. Fiarito, $2,667; Nelson & Carlson, $2,829, and Washington Construction Co., $2,671.

Wisconsin.

⊙The City Commission of Appleton, Wis., has awarded a contract for the new Venturi meter to be installed at the filter plant to the Builders' Iron Foundry Co. of Providence, R. I., for $980.

Canada.

✣Bids will be received until noon, June 12, by C. O. Davidson, City Clerk, Prince Albert, Sask., for furnishing and delivering the following materials for sewer and water extensions in the City of Prince Albert: (A) Approximately—2,520 lin. ft. 10-in. cast iron pipe; 21,700 lin. ft. 8-in. cast iron water pipe; 26,300 lin. ft. 6-in. cast iron water pipe; 43,000 lbs. special castings. (B) 7—10-in. gate valves; 63—8-in. gate valves; 67—6-in. gate valves. (C) Approximately—754 lin. ft. 15-in. sewer pipe with junctions; 6,324 lin. ft. 12-in. sewer pipe with junctions; 6,568 lin. ft. 10-in. sewer pipe with junctions; 39,662 lin. ft. 8-in. sewer pipe with junctions. Specifications and full information may be obtained from M. H. Baker, City Engineer.

✣Bids will be received until 4 p. m., June 10, by John F. Groves, Town Clerk, Wingham, Ont., for laying 920 ft. of 8-in. water pipe.

✣Bids will be received until June 10, by R. M. Selkirk, Clerk, Leamington, Ont., for the construction of a reinforced concrete roofed reservoir.

⊙Following contracts have been awarded by the city of Port Arthur, Ont., L. M. Jones, City Engineer, for the installation of a water works system for which bids were opened on May 21: Sections 2, 3, 9 and 10, A. Cameron, $12,116, $11,342, $4,550 and $8,726, respectively; Sections 4, 6 and 7, T. McCallum, $5,504, $3,024 and $4,168, respectively; Section 5, K. Justin, $5,628; Section 8, R. Vigars, $19,088.

⊙The municipality of Le Pas, Man., H. H. Elliott, Secy.-Treas., has awarded the following contracts for the supply and delivery of the following machinery and materials, for which bids were opened May 20: Canadian Boring Co., oil engine, $16,985; Canada Foundry Co., two storage tanks, $2,380; Canadian Machinery Co., transformers, $490; Westinghouse Co., generators and exciters, $4,403; General Electric Co., electric apparatus, except meters and transformers, $16,757; Mannesman Tube Co., steel pipe, $17,469; John East Foundry Co., specials, $4.88 per cwt., and Drummond, McCare Co., hydrants and valves, $2,976.

The citizens of Kamloops, B. C., have voted three by-laws aggregating $480,000. Of this amount $100,000 will be used to extend and improve the water works, $120,000 to extend the electric lighting system and $260,000 for the hydro-electric power plant on the Barriere River, about 40 miles north of Kamloops.

An election was held in Amherst, N. S., on May 30 for the purpose of voting on a bylaw to appropriate $15,000 for the installation of a water works system. W. F. Donkin is City Clerk.

The Town Council of Beamsville, Ont., has under consideration extensions to the water works system. S. B. Bisbee is Town Clerk.

The Town Council of Kentville, N. S., plans extensions to the water works system at an estimated cost of $15,000. J. Carroll is Town Clerk.

SEWERAGE AND SANITATION

California.

✣Bids will be received until June 20, it is reported, by City of Los Angeles, Cal., for the construction of garbage plants. Lorin A. Handley is City Clerk.

⊙Chas. F. Walters, 714 Fulton Bldg., Pittsburgh, Pa., has been awarded the contract for the construction of a garbage crematory at Presidio of Monterey, Calif., for $4,390. Bids were opened March 5.

Connecticut.

✣Bids will be received until noon, June 6, by Sewer Commissioners, West Hartford, Conn., for the construction of 5 miles of sewers, including about 3 miles of 22 to 24-in. pipe. Plans, etc., can be obtained of Ford Buck & Sheldon, Inc., 60 Prospect St., Hartford, Conn.

Florida.

⊙The Board of Public Works of Pensacola, Fla., has awarded the contract for constructing 725 lin. ft. of 8-in. sanitary and 450 ft. of 15-in. storm sewer to Benson & Skipper, at $0.40 and $0.70 per lin. ft., respectively. Y-branch on 8-in. pipe will cost $0.70, manhole and casting, $30, and lamphole and casting, $10.

Georgia.

✣Bids will be received until 3 p. m., June 10, by R. M. Clayton, Chief of Construction, Atlanta, Ga., for the construction of two groups of sewers, each group approximately 5 miles in length. Specifications may be obtained of the Chief of Construction.

Idaho.

An election will be held in Boise, Ida., on June 3 to vote on bond issues, one for storm sewers to cost $185,000.

Illinois.

⊙The City Council of Princeton, Ill., has awarded the contracts for the construction of sewers Nos. 17, 18 and 19 to John Holmberg of that city, for $2,593, $952 and $375, respectively.

⊙A. M. Lanyon of Waukegan, Ill., has been awarded the contract by the City Commissioners of Hillsboro, Ill., for the installation of the new sewerage system, for $35,548. Other bidders were: Dunlap & Dippold, Edwardsville, Ill., $40,000; F. C. Kaminski, Watertown, Wis., $38,812; Hoeffken Bros., Belleville, Ill., $41,861; W. R. Holliday, Cairo, Ill., $37,369; Striplin & Co., Litchfield, Ill., $36,017, and Driscoll & McColman, Decatur, Ill., $41,551.

⊙Carl Wueff of Dolton, Ill., has been awarded the contract for the construction of a sewer at Tinley Park, Ill., for $8,900. Bids were opened May 24 by William Funk, Clerk.

⊙The General Engineering & Construction Co. of Rockford, Ill., has been awarded the contract for digging a sewer trench at Freeport, Ill., to be 15,000 ft. in length.

Judge Slater of Williamson County Court, Marion, Ill., has confirmed the assessment of $63,000 for sewer improvement in the City of Herrin, Ill. Work will be started soon.

The City Council of Farmington, Ill., has retained Consulting Engineers Fuller-Coult, Chemical Bldg., St. Louis, Mo., to prepare plans and specifications for the installation of a sewerage system.

Residents of the northwest part of Monmouth, Ill., have petitioned the City Council to construct sewers in that section of the city. The district asked for includes West Euclid

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Ave., from B to G Sts.; North and South D St.; North and South E St.; North F St., and North and South G St.

The City Council of Salem, Ill., has employed an engineer to prepare plans for the installation of the proposed sanitary sewer system.

Indiana.

⊙The Board of Public Works of South Bend, Ind., has awarded the following sewer contracts: Pipe sewer on Dunham St., to L. H. Webster, for about $14,458; trunk sewer on Indiana Ave., to Henry Debos, $7,075; trunk sewer on Mishawaka Ave., to Depape & Coussens, $46,591; Quimby St. pipe sewer to L. H. Webster, $729.

⊙The Board of Public Works of Gary, Ind., A. P. Melton, City Engineer, has awarded the contract for the construction of District No. 12 sewer to The Illinois Improvement & Ballast Co., of 72 West Adams St., Chicago, Ill., and Gary, Ind., for $72,963. The work includes 538 ft. of 42-in., 829 ft. of 36-in., 2,174 ft. of 30-in., 830 ft. of 24-in., 1,502 ft. of 20-in., 2,612 ft. of 18-in., 662 ft. of 15-in., 12,202 ft. of 12-in., 184 ft. of 10-in., pipe, and 135 manholes, 7 catchbasins. The contract for the construction of District No. 18 sewer was awarded to W. F. Brunt of Hammond, Ind., for $34,148. The work includes 822 ft. of 36-in., 659 ft. of 30-in., 1,158 ft. of 24-in., 330 ft. of 20-in., 330 ft. of 18-in., 297 ft. of 15-in., 6,710 ft. of 12-in., 760 ft. of 10-in., pipe, and 70 manholes and 8 catchbasins. Vitrified pipe, concrete, brick and vitrified tile will be used in the construction of both sewers. Bids were opened May 19.

⊙The Stewart, Sheets Co., of Vincennes, Ind., has been awarded the contract by the Board of Public Works of South Bend, Ind., for the completion of the Bowman sewer, for $148,930.

⊙The Board of Public Works of Kokomo, Ind., has awarded the contract for the construction of a sewer in Lordeman St., to O. O. Statford, for $583. Bids were opened May 26.

⊙Perry McKinsey, Frankfort, Ind., has been awarded the contract by the city of Danville, Ind., for the construction of a district sewer and disposal plant, for $19,285. Bids were opened May 26.

⊙Cronin & Meredith have been awarded the contract by the Board of Public Works of Richmond, Ind., for the construction of a sanitary sewer, including 400 lin. ft. of 12-in. pipe, for $0.98 per lin. ft. Bids were opened May 22.

John T. Gillig, Deputy Surveyor, has prepared plans and specifications for a complete sewer system for the Town of Geneva, Ind. About 1 mile of sewer will be constructed this year at an estimated cost of $7,000.

Iowa.

✣Bids will be received until June 9, it is reported, by City of Fort Dodge, Ia., for the construction of sanitary sewers in the northeastern part of the city on streets where paving is desired.

⊙The Dearborn Construction Co. of Waterloo, Ia., has been awarded the contract by the Cascaden Realty & Investment Co., for the laying of a new sewer in Prospect Place, for about $2,000.

⊙The Hubbell Construction Co. has been awarded the contract for the construction of a sewer 1,555 ft. long on Fourth St., and Ridgeway Ct., Bettendorf, Ia.

⊙The Blackhawk Construction Co. has been awarded the contract by the City Council of Waterloo, Ia., for the construction of sewers on Lafayette and other streets for $6,762.

The City Council of Nevada, Ia., has passed a resolution providing for the construction of about a mile additional sewers about the city.

The City Council of Des Moines, Ia., has been requested to plan for a $100,000 sewer system to extend west along the Des Moines Union tracks to Walnut Creek.

Property owners of LaPorte City, Ia., advocate the installation of a sewerage system. The Council will be asked to establish a sewer district.

City Engineer C. H. Young of Muscatine, Ia., is working on a plan for the disposal of the sewage in Mad Creek. It is planned to lay a 36-in. pipe from the Heinz factory to the river, a distance of over a mile.

The City Council of Council Bluffs, Ia., has established the boundary line of the west end sewer district. Resolutions will be passed for the laying of the sewer mains in accordance with plans as prepared by City Engineer E. F. Stimson and Consulting Engineer Wynkoop Keirstead of Kansas City, Mo.

The citizens of Schaller, Ia., on May 19 defeated the proposition to bond the town to the amount of $5,000 for a sewer outlet and disposal plant.

Kansas.

⊙Everitt & Burt, Hutchinson, Kan., have been awarded the contract for constructing 3,000 ft. of storm sewer and 5,000 ft. of sanitary sewer at Hutchinson. Contract amounts to about $4,500.

The City Commission of Hutchinson, Kans., has passed ordinances providing for the construction of the following sanitary and storm sewers: 8-in. sewer in alley between 15th and 16th, from Main to Madison; drainage sewer on North Washington; 10-in. from Ninth to Eighth; 12-in. from Eighth to Seventh; 18-in. from Seventh to Second Ave. Also 8-in. sewer from Ave. C and Elm, southeast to alley south of Ave. C, then east to Severence, 1,900 ft.; 8-in. sewer in alley between Sherman and Ave. A, running east from Severence St. 555 ft.

The City of Great Bend, Kan., has rejected all bids received recently for the construction of the outlet for the city sewer septic tank. The bids ranged from $18,173 to $23,065. The Engineer's estimate is $15,000. New bids will be asked.

According to advices from Topeka, Kan., the Atchison, Topeka & Santa Fe Railway proposes the construction of a sewer system at the company's shop at an estimated cost of $80,000.

City Engineer P. G. Wakenhut of Salina, Kan., has made preliminary surveys for the proposed new Ash St. sewer, which is intended to carry the sewage of the city across the Smoky River at Ash St. to the outlet of the East Side sewer.

The City Commission of Coffeyville, Kans., has passed a resolution for a new storm sewer district in the west part of the city. The district will drain practically all that section from First St. south to the Missouri Pacific tracks and bounded on the west by Cherokee and Harding Sts., and on the east by Grant, Spruce and Washita.

Louisiana.

✣Bids will be received until noon, July 28, by Sewerage & Water Board, 508 City Hall Annex, New Orleans, La., F. S. Shields, Secy., for work to be executed under the following contracts, viz.: Contract 53-D—Underground Conduit from Sewerage Station A to the Mississippi River. Contract 55-D—Extension to Drainage Pumping Station No. 1, including all foundations, section and discharge basins. Contract 56-D—Sluice gates for Drainage Pumping Station No. 1. Contract 57-D—Traveling Crane for Drainage Pumping Station No. 1. Plans, specifications and blank form of proposal may be obtained upon application at the office of the board. A deposit of $100 will be required of each applicant for a set of plans and specifications for Contract 55-D, which deposit will be refunded when the plans are returned in good condition. No deposit will be required of applicants for plans and specifications for Contracts 53-D, 56-D and 57-D.

⊙The Board of Directors of the First Sewerage District of Ruston, La., has awarded the contract for the construction of the proposed sewer in that district to Isaac C. Mishler of Chattanooga, Tenn., for $25,748. The Texarkana (Tex.) Pipe Co. secured the contract to furnish material, for $10,916. X. A. Kramer of Magnolia, Miss., is Engineer.

The citizens of Baton Rouge, La., on May 27 voted the issuance of bonds to the amount of $225,000 for needed improvements, including a sewerage system.

Maine.

✣Bids will be received until 8 p. m., June 9, by city of Biddeford, Me., for the construction of a trunk sewer. Plans, specifications and details will be open for inspection at the City Engineer's office. The approximate quantitatives, are: 1,300 lin. ft., 4 in. by 6 in., 1,650 lin. ft., 3 in. by 5 in. egg shape reinforced concrete; 800 lin. ft. 30-in., 550 lin. ft. 24-in. round reinforced concrete sewer. Each proposal must be accompanied by certified check for 2 per cent of such bid. W. C. Bigelow, City Engineer.

Maryland.

Following bids were received by the Board of Awards, Baltimore, Md., on Sanitary Contract No. 108, miscellaneous lateral sewers No. 4: W. H. Thompson Construction Co., Calvert & Read Sts., Baltimore, $17,006; Middleton-Thompson Co., Continental Bldg., Baltimore, $19,080; Gallagher, Boyle & Bryan, 147 W. Montgomery st., Baltimore, $19,564; Whiting-Turner Const. Co., Sexton Bldg., Baltimore, $22,768.

The citizens of Silver Spring, Md., have deposited with the Montgomery County Commissioners, Rockville, $500, to cover preliminary expenses. The Commissioners will construct water and sewer systems for Silver Spring Park. The plan is to connect the sewer with the District of Columbia sewer at Takoma Park. The cost is estimated at $20,000.

Following bids were received by the Board of Awards, Baltimore, Md., for Sanitary Contract No. 110, Sanitary District No. 16B: Bids for all sewers in open trench—Middleton-Thompson Co., Baltimore, $125,201; Ryan & Reilly, Union Trust Bldg., Baltimore, $132,780; McCarthy & O'Herron, 1518 Malster Ave., Baltimore, $141,184; Whiting-Turner Const. Co., Baltimore, $155,847; Gallagher, Boyle & Bryan, 147 W. Montgomery St., Baltimore, $158,502. Bids for all sewers under railway tracks in tunnel—McCarthy & O'Herron, 1518 Malster Ave., Baltimore, $146,833; Middleton-Thompson Co., Baltimore, $147,470; Whiting-Turner Const. Co., Baltimore, $163,464; Ryan & Reilly, Union Trust Bldg., Baltimore, $170,770; Gallagher, Boyle & Bryan, 147 W. Montgomery St., Baltimore, $183,897.

Following bids were received by the Board of Awards of Baltimore, Md., for Sanitary Contract No. 111, Sanitary District No. 16-A: Middleton-Thompson Co., $157,503 (Tunnel construction to be used for all sewers where alternative prices were asked); Whiting-Turner Const. Co., $164,826 (Trench construction to be used for all sewers where alternative prices were asked); Ryan & Reilly, $168,875 (Tunnel construction to be used for all sewers where alternative prices were asked, except open trench construction in Baltimore St., from Eutaw to Paca Sts., and in Charles St., from Lombard to Pratt Sts.); McCarthy & O'Herron, $186,865 (Trench construction to be used for all sewers where alternative prices were asked).

Following bids were received by the Board of Awards of Baltimore, Md., for Sanitary Contract No. 14, Section No. 8 of High Level Intercepting, and on Sanitary Contract No. 115, house connections across footways in District No. 20-B: Sanitary Contract No. 114—C. B. Clark & Co., 1507 W. Lombard St., Baltimore, $100,162; Whiting-Turner Const. Co., Sexton Bldg., Baltimore, $107,963; Ryan & Reilly, Union Trust Bldg., Baltimore, $110,104. Sanitary Contract No. 115—Carozza, Levezza & Carozza, 132 Delphin St., Baltimore, $23,870; Timothy, Bresnan & Sons, 2018 W. North Ave., Baltimore, $24,712; Wm. McCarthy & O'Herron, 1518 Malster Ave., Baltimore, $27,209; W. H. Thompson Const. Co., Calvert & Read Sts., Baltimore, $25,956; Gallagher, Boyle & Bryan, 147 Montgomery St., Baltimore, $25,105.

Following bids were received by the Board of Awards, Baltimore, Md., on Storm-water Contract No. 27: Ryan & Reilly, Union Trust Bldg., Baltimore, $29,025; Middleton-Thomp-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

son Co., Continental Bldg., Baltimore, $30,329; McCarthy & O'Herron, 1518 Malster Ave., Baltimore, $30,985; W. H. Thompson Construction Co., Calvert & Read Sts., Baltimore, $32,928.

Massachusetts.

✣Bids will be received until 10 a. m., June 13, by C. W. Ross, Street Commissioner, West Newton, Mass., for the construction of 3,278 lin. ft. of vit. pipe sewers in Boylston and Jackson Sts. A certified check for $500, payable to the city of Newton, must be filed with each bid.

The aldermanic committee on sewers, Fall River, Mass., has mapped out work requiring an outlay of $60,000 at the present time, and later in the year will probably arrange for an expenditure of at least an equal amount.

The City Council of New Bedford, Mass., plans the construction of a sewer in Durfee St., at an estimated cost of $19,500. The work would require 3,105 ft. of sewer at a depth varying from 6 to 14 ft.

E. S. Dorr, Chief Engineer of the Sewer Division of the Department of Public Works, Boston, Mass., has sent the Mayor a report wherein he states a need of $730,650 for sewer improvements in various parts of the city. The Mayor will recommend to the Council an appropriation of $400,000. The improvements recommended are as follows: Maywoods Brook conduit, etc., $50,000; Dorchester Brook sewer, from Massachusetts Ave. to Clifton St., $40,000; Dorchester Brook sewer, from Brook Ave. to Brookfield St., $50,000; Davenport Brook, $132,000; Mattapan Brook, $21,000; Readville District, Rugby District and district in vicinity of Thompson St., near Stony Brook Reservation, Hyde Park, $34,000; East Branch, Shepard Brook, Brighton, $153,000; Roslindale Brook conduit, $53,500; Temple St., outlet, West Roxbury, $80,000; Dent St. Brook, West Roxbury, $67,500; Charles, Friend, Kingston, Merrimac, Oswego, Portland and Sudbury Sts., rebuilding, $38,650. Total, $730,650.

Michigan.

✣Bids will be received until noon, June 11, by Homer Fish, Village Clerk, Saline, Mich., for the construction of a sanitary sewer system. Plans and specifications are on file with the clerk.

Preliminary steps were taken by the Village Council of Highland Park, Mich., May 19, for the construction of a new sewer system at a cost of $373,000. The plan contemplates the construction of a sewer main in Hamilton Blvd., at a cost of $61,000, a trunk line sewer in Oakland Ave., at a cost of $47,500, and intercepting sewer and sewage disposal plant at a cost of $226,500. L. D. Beckley is Village Engineer.

The City Council of Kalamazoo, Mich., has passed a resolution authorizing the expenditure of $25,000 for the construction of lateral sewers, and $111,000 for street paving. A. Lenderink is City Engineer.

The Board of Public Works of St. Johns, Mich., has recommended to the City Council that a 5-ft. sewer outlet be constructed at the junction of the sewer system on the Holton property and running a distance of 5,000 ft. The improvement will cost about $10,000.

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Minnesota.

✣Bids will be received until 8 p. m., June 16, by City Clerk C. J. Stark, Ortonville, Minn., for the construction of a sanitary sewer system and sewage disposal plant in accordance with plans and specifications on file with the clerk. Extra plans and specifications can be secured of J. A. Rowat, Willmar, Minn., for $2.50.

⊙Thornton Bros. have been awarded the contract at South St. Paul, Minn., for the construction of sewers on Fifth Ave., for $2,874.

The City Council of Virginia, Minn., has passed ordinances creating new sewer districts in Fairview Addition in the north part of the city and one in Anderson's Addition in the south part.

The Village Council of Rose Creek, Minn., will have the village surveyed with a view to putting in a sewer system.

No bids were received on May 6 by the city of New Ulm, Minn., Albert J. Meyer, City Clerk, for the construction of sewers on Broadway St. This work will be readvertised as well as six blocks of other sewers in the near future.

The committee on sewers has reported to the City Council of Stillwater, Minn., in favor of the construction of sanitary sewers on the South hill. City Engineer Lewis W. Clarke is preparing plans.

Missouri.

⊙Wm. H. Riley of St. Louis, Mo., has been awarded the contract by that city, for the construction of sewers in Rock Creek Sewer District No. 2, for $144,285.

The annual budget for the city of St. Louis, Mo., James Y. Player, Comptroller, includes an appropriation of $5,000 for the Chouteau Ave. relief sewer; $35,000 for the Gravois Ave. sewer (north); $52,000 for the improvement of Florissant Ave., and $11,000 for sundry street improvements.

The City Council of Springfield, Mo., C. E. Phillips, City Engineer, plans the construction of two new sewers in the Second and Eighth wards, respectively. These sewers will be six miles in length and will drain the district in the northeast and southwest parts of the city. The estimated cost is $20,000.

The citizens of Monroe City, Mo., at a recent election voted the issuance of bonds in the sum of $78 000 for the purpose of installing waterworks and sewerage.

The City Council of Trenton, Mo., has ordered the establishment of Sewer District No. 9, embracing a total area estimated at 120 acres, in the northwest part of the city. City Engineer H. O. Garst has prepared plans for the improvement and estimates the cost at $20,000.

New Hampshire.

⊙Bids were received May 15 by the Town of Charlestown, N. H., E. E. Davis, Northampton, Mass., Engineer, for the installation of the proposed sewer system. The 10 lowest bids received are shown in the following table, (1) standing for bid of Ricci Construction Co., Rutland, Vt. (awarded contract); (2) Petrossi Bros., Hartford, Conn.; (3) Tales & Simmons, Rockland, Me.; (4) Jos. Sacco & Co., Portsmouth, N. H.; (5) H. P. Cummings Construction Co., Ware, Mass.; (6) P. Baldasaro & Co., Bellows, Falls, Vt.; (7) Marcello Construction Co., Portsmouth, N. H.; (8) James & Kerr, Rumford, Me.; (9) F. B. Williams Co., Attelboro, Mass., and (10) The Henry Spinach Construction Co., Waterbury, Conn.:

Item.	Amount.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
6-in. pipe, 4-6 ft. deep	10,730 ft.	$ .27	$ .33	$ .365	$ .37	$ .295	$ .34	$ .425	$ .46	$ .44	$ .37
6-in. pipe, 6-8 ft. deep	3,055 ft.	.31	.42	.145	.4225	.385	.44	.50	.485	.56	.595
6-in. pipe, 8-10 ft. deep	2,175 ft.	.40	.565	.525	.5825	.725	.71	.60	.675	.74	.88
6-in. pipe, 10-12 ft. deep	400 ft.	.55	.775	.625	.80	1.35	1.085	.80	.875	.93	.99
8-in. pipe, 4-6 ft. deep	3,885 ft.	.325	.405	.43	42	.365	.40	.50	.545	.525	.53
8-in. pipe, 6-8 ft. deep	3,620 ft.	.375	.53	.52	.455	.48	.50	.60	.57	.635	.73
8-in. pipe, 8-10 ft. deep	830 ft.	.50	.665	61	.58	.78	.77	.70	.74	.79	.965
8-in. pipe, 10-12 ft. deep	555 ft.	.675	.875	.785	.82	1.225	1.145	1.00	.93	.98	1.10
8-in. pipe, 12-14 ft. deep	845 ft.	.825	1.00	.98	1.11	1.745	1.32	1.375	1.035	1.215	1.225
16-in. pipe, 4-6 ft. deep	2,820 ft.	.40	.495	.51	.54	.47	.525	.75	.68	.62	.58
12-in. pipe, 4-6 ft. deep	1,250 ft.	.475	.575	.57	.59	.66	.665	.825	.73	.70	.67
12-in. pipe, 6-8 ft. deep	270 ft.	.54	.71	.645	.67	.78	.765	.875	.74	.82	.77
Manholes, 4-6 ft. deep	50	25.00	12.50	21.125	23.00	27.50	27.625	30.00	24.00	27.00	23.25
Manholes, 6-8 ft. deep	18	27.50	20.00	24.25	26.50	40.00	42.50	37.50	30.00	33.50	26.50
Manholes, 8-10 ft. deep	8	30.00	26.50	27.375	33.50	65.00	56.00	42.50	36.00	41.00	30.00
Manholes, 10-12 ft. deep	2	35.00	30.00	31.50	39.00	85.00	66.00	50.00	44.00	49.50	35.00
Manholes, 12-14 ft. deep	2	40.00	35.00	37.75	46.00	95.00	77.50	67.50	49.00	56.50	41.50
Totals		$13,043	$15,370	$16,165	$16,507	$17,851	$18,124	$20,238	$19,665	$20,315	$19,959

The Board of Public Works of Portsmouth, N. H., plans the building of a new sewer along Newton Ave., and the reconstruction of the south sewer. James W. Barrett is Superintendent of Public Works.

New Jersey.

✣Bids will be received until 8 p. m., June 16, by Common Council, Plainfield, N. J., for the construction of sanitary sewers and appurtenances, including: 6,160 ft. 8 in. vit. pipe sewer, 6 to 12 ft. deep; 1,340 ft. 10 in. vit. pipe sewer, 6 to 8 ft. deep; 400 ft. 8 in. cast iron sewer, 6 to 10 ft. deep; 22 manholes; 4 flush tanks; branches, etc. Each proposal must be accompanied by a certified check for $250. The amount of bond required will be $5,000. Duplicate plans may be examined, and forms of proposal, specifications, contract and bond may be obtained at the office of James T. MacMurray, City Clerk, 151 North Ave., Plainfield, N. J.

✣Bids will be received until 2 p. m., July 1, by Passaic Valley Sewerage Commissioners, Essex Bldg., Clinton St., Newark, N. J., for furnishing and erecting pumping plant for the Newark Bay Pumping Station, Newark. Drawings, form or contract and specifications, etc., may be obtained at the office of the Commissioner from W. M. Brown, Chief Engineer. J. S. Gibson is Clerk of the Commission.

⊙The Borough Council of Roselle Park, N. J., has awarded the contract for the Sherman, Sheridan and Clay Ave. sewers to Albert Heitman of Roselle Park, for $1,610.

The Borough Council of North Plainfield, N. J., will call a special election for the purpose of authorizing a bond issue for the installation of a collecting system of sewers and a joint trunk line sewer to be constructed by the city, the borough and Dunellen with disposal plant on the Darling farm in Piscataway Township. The sewer will cost $270,000.

The Borough Council of Hammonton, N. J., has authorized $10,000 for the use of the Sewer Commissioners in order that work planned by that body may not be retarded.

The New Jersey State Board of Health has postponed further action upon the matter of the construction by the city of New Brunswick of a sewage disposal plant until June 17.

The Common Council of New Brunswick, N. J., has passed on ordinance to bond to the amount of $24,000 for the construction of storm sewers.

The citizens of Hammonton, N. J., at a recent election voted in favor of the construction of an up-to-date sewer system and disposal plant. The cost will be between $80,000 and $90,000.

New Mexico.

The New Mexico Legislature has appropriated $9,000 for the construction of a proper sewer system for the capitol building. The work will be done under the supervision of State Engineer James A. French.

New York.

✣Bids will be received until 2:30 p. m., June 11, by Board of Contract & Supply, Schenectady, N. Y., for the construction of a sanitary intercepting sewer, from Nott St. to the Sewage Disposal plant site. The approximate quantities to be used in the comparison of bids are: Rectangular sewer, Type A, 8,050 lin. ft.; rectangular sewer, Type B, 100 lin. ft.; manholes 25; Rock excavation 300 cu. yds; lumber for footings and sheathing 45,000 ft. b. m. and other items. Plans and specifications may be obtained from the office of the City Engineer and Architect, W. Thomas Wooley, No. 447 Franklin St., Schenectady, N. Y., by making a deposit of $25, which deposit will be refunded at such time as the plans and specifications shall be returned.

✣Bids will be received until 2:30 p. m., June 18, by Board of Contract & Supply, Shenectady, N. Y., for the construction of Sewage Disposal Works near the easterly boundary of the city, between the Erie Canal and the Mohawk River. Plans and specifications may be obtained from the office of the City Engineer and Architect, Mr. W. Thomas Wooley, No. 447 Franklin St., Schenectady, N. Y., by making a deposit of $25, which deposit will be refunded at such time as the plans and specifications shall be returned, and may be examined at the office of George W. Fuller, No. 170 Broadway, New York City.

⊙John M. Fahning, 25 Marigold St., Buffalo, N. Y., is the probable contractor for the construction of 12 and 10-in. tile sewer in Wende St., between 200 and 606 ft. north of Perry St., at $542. W. G. Smith, 1101 Elmwood Ave., Buffalo, will lay 12 and 10-in. tile sewer in Leslie St., between Ferry St., and 606 ft. north, at $845. Bids were opened May 26.

⊙The Pioneer Construction Co. has been awarded the contract by the Department of Public Works of New Rochelle, N. Y., for the construction of the Eastchester road sewer for $8,590.

⊙The Board of Contract & Supply of Troy, N. Y., has awarded the contract for the installation of the sewer in Marvin and Stow Aves., to Henry W. Golden & Son., for $1,853.

⊙James S. Campion has been awarded a contract at Albany, N. Y., for the laying of sewers in South Hawk and Chestnut Sts., for $6,915.

⊙The Board of Public Works of Fulton, N. Y., has awarded the contract for the construction of a new sewer to E. J. Schem.

The Board of Trustees of Herkimer, N. Y., has called an election for June 10 to vote on the proposition of raising $30,000 to extend the sewer system.

The State Department of Health has notified the Village of Canandaigua, N. Y., that it must build a sewage disposal plant in the near future. It is thought that such a plant would cost about $75,000.

The taxpayers of Phoenix, N. Y., on May 20 approved the proposed sewer work to be done during the next three years.

The Common Council of Syracuse, N. Y., has approved the bill authorizing the Intercepting Sewer Board to issue an additional $100,000 of bonds for a storm water sewer system in the First and Second Wards.

The Common Council of Schenectady, N. Y., has authorized a bond issue of $380,000 for sewage disposal and the construction of an intercepting sewer. Also an expenditure of $280,000 from the water bureau surplus, for the improvement of the water system.

The Village Board of White Plains, N. Y., E. H. P. Squire, President, plans to commence active work shortly on the construction of the proposed incinerator, estimated to cost $30,000 Joseph B. Rider, of South Norwalk, Conn., is Engineer.

The Board of Trustees of Herkimer, N. Y., has called an election for May 29, for the purpose of voting on the issuance of bonds to the amount of $30,000 for the extension of the sewer system in the village. John J. Toney is Engineer.

The Village Board of Trustees, Warsaw, N. Y., has appointed committees to prepare plans for new sewer pipes in various streets.

The citizens of Lawrence, N. Y., on May 10 voted on the issuance of bonds to the amount of $139,000 for the installation of a sewerage system.

Following bids were received by the Board of Contract and Supply of Yonkers, N. Y., for the construction of the double sewer in Yonkers Ave.: O'Rourke Contracting Co., New York City, $245,850; J. B. Bennell, $226,000; Michael Manigani, $248,000.

The Board of Public Works of Elmira, N. Y., has authorized the construction of the Roe Creek trunk sewer. This sewer will drain all of that basin which includes the major portion of the Seventh Ward.

The village of Watkins, N. Y., plans the construction of storm sewers on Franklin St., at a cost of $13,500.

All bids received on May 6 by the Common Council of Amsterdam, N. Y., for installing sanitary sewers and water mains on Genevieve St., from Guy Park Ave. to Stewart St., and on Stewart St. east of Genevieve St., have been referred to committee on public works. A report will be made May 20. James P. Wilson is City Clerk.

Following low bids were received May 2 by the City of Oswego, N. Y., Chas. H. Snyder, City Engineer, for the construction of sewers and a sewage disposal plant; R. M. Barnett, Contract "A," West Oswego sanitary trunk sewer, $40,541; Samuel Bond, Syracuse, N. Y., Contract "B," lateral storm and sanitary sewer, $6,825; R. M. Barnett, Contract "C," West Bridge St. storm sewer, $14,047; Gail-Wilson, Contract "D," $28,567; Leary & Morrison, Fairport, N. Y., Contract "H," East Oswego Creek storm sewer, $80,343.

The comprehensive sewer plan designed by Robert J. Harding of Poughkeepsie, N. Y., for that city has been approved by Consulting Engineers Hazen & Whipple of New York City. This plan provides a method of serving a city of 100,000 population and provides also a system of intercepting sewers for the present city system, with disposal plants for the purification of the sewage.

Plans for the system of storm water sewers in the First and Second Wards are being prepared by the Intercepting Sewer Board of Syracuse, N. Y. Governor Sulzer has been asked to sign the bill authorizing the board to issue $100,000 bonds for the improvement.

Ohio.

⊙The Griscom-Russell Co. of Massillon, O., has been awarded the contract for the construction of a garbage incinerator in that city, for $18,000.

⊙Bids were received May 1 at Bexley, O., for the construction of sanitary sewers, for which plans were prepared by Consulting Engineer A. Elliott Kimberly of Columbus, O. In the table shown below (1) stands for bid of Sieverling & Fairbairn, Springfield, O.; (2) F. R. Stone, Lima, O.; (3) Wm. Jones, Carnegie, Pa.; (4) S. T. Knight, Columbus, O.; (5) Barnewolt Construction Co., Peoria, Ill., and (6) Kohbarger & Hoyles, Marion, O. (awarded contract):

	(1)	(2)	(3)	(4)	(5)	(6)
Sewer pipe, per lin. ft.—						
With cement joints:						
8-in.	$ 0.24	$ 0.28	$ 0.22	$ 0.30	$ 0.29	$ 0.15
10-in.	.34	.37	.29	.40	.40	.21
12-in.	.44	.44	.35	.50	.51	.33
15-in.	.65	.61	.51	.70	.76	.40
18-in.	.85	.85	.72	.95	.99	.60
With asphaltic joints:						
8-in.	.22	.45	.42	.35	.36	.19
10-in.	.47	.52	.49	.45	.50	.28
12-in.	.52	.60	.55	.60	.65	.34
Excavation and back filling:						
Under 6 ft.	.30	.35	.48	.30	.23	.28
From 6 to 8 ft.	.40	.36	.64	.40	.32	.41
From 8 to 10 ft.	.60	.58	.72	.60	.65	.52
From 10 to 12 ft.	.73	.80	.88	.95	.78	.74
From 12 to 14 ft.	1.05	1.00	1.10	1.20	.92	1.30
From 14 to 16 ft.	1.40	1.40	1.26	1.65	1.44	1.80
From 16 to 18 ft.	1.60	2.00	1.42	2.25	1.61	2.75
6-in. house connections:						
With cement joints	.55	.28	.22	1.10	.22	.50
With asphaltic joints	.88	.45	.32	1.20	.28	.55
Y branches:						
8x6-in.	1.00	1.00	1.00	1.20	1.55	.90
10x6-in.	1.40	1.15	1.30	1.70	2.00	1.10
12x6-in.	1.80	1.50	2.00	2.00	2.38	1.40
15x6-in.	2.75	2.00	3.00	3.35	2.66	1.75
Manholes, concrete:						
8½ ft. and under	42.00	35.00	30.00	27.00	65.00	30.00
Over 8½ ft. and under 10 ft.	42.00	38.00	35.00	30.00	77.00	37.00
Over 10 ft. and under 12 ft.	42.00	41.00	45.00	34.00	90.00	44.00
Over 12 ft. and under 14 ft.	42.00	44.00	50.00	38.00	104.00	48.00
Over 14 ft. and under 16 ft.	42.00	47.00	55.00	40.00	119.00	60.00
Over 16 ft. and under 18½ ft.	42.00	50.00	60.00	45.00	135.00	70.00
Manholes, brick:						
8½ ft. and under	52.00	38.00	30.00	27.00	75.00	30.00
Over 8½ ft. and under 10 ft.	52.00	41.00	35.00	30.00	89.00	37.00
Over 10 ft. and under 12 ft.	52.00	44.00	45.00	34.00	104.00	44.00
Over 12 ft. and under 14 ft.	52.00	47.00	50.00	38.00	120.00	48.00
Over 14 ft. and under 16 ft.	52.00	50.00	55.00	40.00	137.00	60.00
Over 16 ft. and under 18½ ft.	52.00	53.00	60.00	45.00	155.00	70.00
Drop manholes:						
Concrete	52.50	45.00	60.00	45.00	100.00	70.00
Brick	60.00	50.00	60.00	45.00	115.00	70.00
Single flush manholes:						
Concrete	55.00	48.00	75.00	60.00	50.00	70.00
Brick	63.00	54.00	75.00	60.00	57.00	70.00
Double flush manholes:						
Concrete	110.00	55.00	100.00	100.00	55.00	80.00
Brick	122.00	60.00	100.00	100.00	63.00	80.00
Lampholes	10.00	9.00	10.00	10.00	15.00	10.00
Deep house connections	5.00	2.00	10.00	2.50	2.20	8.00
C. I. pipe, per ton:						
14-in.	40.00	45.00	60.00	50.00	45.00	30.00
18-in.	45.00	45.00	60.00	50.00	50.00	30.00
Concrete, per cu. yd:						
Class A	8.00	10.00	12.00	9.00	10.00	10.00
Class B	7.00	7.00	10.00	7.50	8.00	9.00
Class C	6.00	8.00	9.00	7.00	6.00	8.00
Y poles	.10	.25	10.00	.26	.10	.25
Rock excavation, per cu. yd.	6.00	4.50	5.00	5.50	5.00	3.00
Timber in foundation, per M ft.	38.00	35.00	50.00	50.00	30.00	30.00
Sheeting in trench, per M ft.	38.00	35.00	40.00	50.00	30.00	30.00
Common labor, per hour	.30	.30	.25	.26	.35	.22
Skilled labor, per hour	.50	.50	.35	.50	.50	.22½
Foreman, per hour	.60	.60	.60	.75	.65	.30
Teaming, per hour	.60	.65	.60	.55	.65	.45
Tile underdrains:						
6-in.	.30	.30	.20	.25	.12	.25
8-in.	.35	.33	.25	.30	.18	.40
10-in.	.45	.40	.30	.35	.25	.45
12-in.	.68	.50	.35	.40	.31	.50
Railroad crossing	400.00	100.00	200.00	250.00	500.00	100.00
Totals	$49,267	$53,722	$59,447	$55,284	$56,655	$43,257
Totals (alternate)	46,013	47,558	51,914	53,185	53,526	41,735

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

North Carolina.

The Board of Aldermen of Winston-Salem, N. C., has decided to construct a sewer line on White St. before the permanent paving is laid on that street.

The citizens of Elm City, N. C., have voted the issuance of bonds to the amount of $10,000 for water and sewerage for the town.

North Dakota.

Engineer S. F. Crabbe, of Fargo, N. D., has been retained to prepare plans and specifications and supervise the construction of a sewer system in New Rockford, N. D. The system will be put in this summer.
and docks, $5,000.

The Village of East Grand Forks, N. D., plan two extensions to the sewer system. A short extension will be made on South Second St., extending from the main sewer on DeMers Ave. to the intersection of the street with Kittson Ave. The other extension will be on Dovry Ave., where a main sewer will be constructed.

The City Council of Dickinson, N. Dak., has created Sewer Districts Nos. 4 and 5. City Engineer W. R. Veigel will prepare plans. Bids will shortly be asked.

The City Council of New Rockford, N. Dak., contemplates the installation of a sewerage and drainage system.

Ohio.

The City Council of Sandusky, O., has passed a resolution calling for the issuance of bonds in the sum of $125,000 for a sewer in the southern part of the city and for a sewage disposal plant. Robert L. Wager is City Engineer.

Director of Public Service H. P. Fribley of New Philadelphia, O., will ask for bids at once for the construction of the proposed sewage disposal plant, which will cost about $40,000. The plant will be located near Shane's Island, in Tuscarawas River, southeast of the city.

Following bids were received by the City Council of Marysville, O., for the construction and furnishing of material for a sanitary sewerage system and disposal plant: Sewer System—William Graham, Columbus, O., $58,264; Arthur Miller, Millersburg, O., $58,737; Frank R. Stone, Lima, O., $60,443. Disposal Plant—Frank Milligan, Bellefontaine, O., and William Epps, Marysville, $42,054; William Graham, $60,772; Frank Stone, $57,160.

The City Council of Canton, O., has adopted the sewage disposal plans of Consulting Engineer R. Winthrop Pratt, Hippodrome Bldg., Cleveland, O. The Moser tract will be used as the site of the new plant.

The City Council of Zanesville, O., has passed resolutions providing for new public improvements to cost $120,000. An entirely new sewer system will be installed in the old Seventh Ward to cost $81,762, and the installation of two separate sewers on Main St.

The City Council of Zenia, O., has approved the plans and specifications for the repair of the Main trunk sewer opposite the cemetery. The improvement will cost about $1,000.

The City Council of New Philadelphia, O., has passed an ordinance calling for the erection of a $45,000 sewage disposal plant in compliance with orders from the State Board of Health

The City Council of New Philadelphia, O., has passed an ordinance to revise plans for the city's sewerage disposal plant so as to conform with plans for the Dover disposal plant.

Jerry O'Shaughnessy, Superintendent of the Divisions of Water and Sewage Disposal, Columbus, O., has recommended the enlargement of the equipment at the main sewage pumping station, at an estimated cost $215,000.

Oregon.

✣Bids will be received until 10 a. m., June 11, by John B. Coffey, County Clerk, Portland, Ore., for furnishing Multnomah County with 1,750 ft. of 12-in. sewer pipe to be delivered at Multnomah Farm.

The City Council of Portland, Ore., will call for bids at once for the construction of the Lambert Ave. district sewer system on the East Side. This sewer will cost about $90,000. Tom Hurlburt is City Engineer.

Engineer J. W. Morris, Yeon Bldg., Portland, Ore., is preparing plans for the construction of a sewerage system at Arlington, Wash.

Pennsylvania.

⊙The Borough Council of Westchester, Pa., has awarded the contract tor constructing the Goose Creek sewer extending south from Market and Franklin Sts., to Linden, to M. & T. E. Farrell, for $13,500. At Linden St., the sewer will connect with the outfall main, which will carry sewage to the disposal plant at Eachus' dam or Point of Rocks.

⊙The Suburban Contracting Co. of Philadelphia, Pa., has been awarded the contract for the building of a sewage disposal plant at the County Home at Lima, Pa., for $5,975.

⊙W. K. Herbert has been awarded the contract by the Borough Council of Washington, Pa., for the erection of a 20-ton two-unit garbage incinerator on the borough farm at Arden, for $10,500.

South Carolina.

✣Bids will be received until July 1 by City of Walterboro, S. C., for sewer construction, including 4 miles of 8, 10 and 12 in. pipe, 14 5-in., F. T. siphons, manholes, covers, etc. J. Newton Johnston, Florence, S. C., is Engineer.

Texas.

✣Bids will be received until June 16 by Dan C. Smith, Jr., City Secretary, Houston, Tex., for storm sewer work. Contract A, labor and materials for construction of 1,000 lin. ft. 42-in., 1,780 ft. 84-in., 1,340 ft. 102-in. and 4,520 ft. 108-in. sewer, 23 manholes, 92 catch basins and 2,300 lin. ft. 15-in. catch basin connections. Specifications, etc., obtainable on application at office of City Engineer F. L. Dormant, City Hall.

The City Council of Hillsboro, Tex., has decided to submit the proposition of issuing bonds to the amount of $25,000 for water works and sewers to the citizens at an early date.

Vermont.

✣Bids will be received until 8 p. m., June 10, by H. C. Bacon, President, Board of Trustees, Bellows Falls, Vt., for building sewers. Plans and specifications may be seen and formal proposal obtained from E. A. W. Hammatt, Engineer, 15 Water St., Newton Centre, Mass., or at the office of the Trustees in Bellows Falls, Vt.

Washington.

An election will be held in North Yakima, Wash., on July 8, to vote on the question of issuing $240,000 worth of bonds for the construction of a trunk line sewer.

Preliminary plans are being made at Colville, Wash., for a trunk sewer which the City Council is planning to put in this summer. The proposed improvement will drain all of the east side of the city.

A survey has been made of the Town of Teko, Wash., and work will be begun soon on the new trunk sewer system.

West Virginia.

✣Bids will be received until June 13 by Board of Affairs, Bluefield, W. Va., for construction of sanitary sewer line from end of present sewer in west end of city of Bluefield west through the town of Graham and to a point on Bluestone River west thereof, distance of about 6,500 ft.; sewer to be 15 ins. in diameter; joints to be laid in cement, and work to be done according to plans and specifications and upon location of City Engineer of said city.

Wisconsin.

✣Bids will be received until noon, June 5, by Committee on Streets and Sidewalks, Monroe, Wis., for the construction of approximately 425 ft. of sewer on Emerson St., commencing at Summit St. and running north to the present sewer on said Emerson St., according to the plans and specifications and ordinances duly adopted by the said city of Monroe. William Dunwiddie is City Clerk.

✣Bids will be received until 8 p. m., June 10, by C. W. Jackson, City Clerk, Plymouth, Wis., for the laying of storm sewers approximately as follows: 100 ft. of 36-in. double strength vitrified pipe; 400 ft. of 30-in., double strength vitrified pipe; 100 ft. of 24-in., double strength vitrified pipe; 24 ft. of 36-in. cast iron pipe; 24 ft. 30-inch cast iron pipe; three manholes; three catchbasins. Plans and specifications covering this work are now on file at the office of C. W. Jackson, City Clerk.

✣Bids will be received until 7:30 p. m., June 10, by Village Clerk of Jackson, Wis., for furnishing all the materials and doing all the work necessary and required to construct and lay sewers with all necessary manholes, lampholes, connections, wyes, tees and other fittings in accordance with the plans and specifications on file. Bids for trenching, laying pipe, making all connections and construction of lampholes and for furnishing the necessary pipes, wyes, tees, lamphole pipes and covers, complete and filling trenches. Said bid to state the price per running foot of complete sewer as here specified: (2) Bid for rock excavation per cubic yard (if any) figured in trenches twenty-seven (27) inches wide. (3) Bids for manholes, including cover, steps and inverts complete. (4) Bids for two filtration tanks as shown on plans. Entire job to be completed by October 1, 1913, failing in which the contractor shall pay the Village of Jackson $3.50 per day for every day's delay in completing the entire job here outlined. A certified check or cash money must be deposited with each bid in an amount equal to 5 per cent of the bid which bidder will forfeit in case he does not abide by his bid.

The City Council of Horicon, Wis., has approved the plans and specifications of Consulting Engineer Arthur M. Morgan, 169 Jackson Blvd., Chicago, Ill., for the installation of a sanitary sewerage system. The estimated cost is $30,000.

The Common Council of Wauwatosa, Wis., has recommended bond issue aggregating $50,000, comprising street improvement work, school development and sewer extension.

Consulting Engineer John W. Alvord, Hartford Bldg., Chicago, Ill., has recommended to the city of Madison, Wis., the erection of a purification plant that would care for about 5,000,000 gals. of sewage per day in the year 1930, with the capacity to take for a short time a flow of 50 per cent in excess of this, or 7,500,000 gals. per day.

City Engineer P. H. Connolly of Racine, Wis., is preparing plans and specifications for the proposed trunk line sewers to be put in north, west and southwest of the city. The work will cost about $195,000.

Canada.

✣Bids will be received until 4 p. m., June 10, by John F. Groves, Town Clerk, Wingham, Ont., for the following works: (1) The construction of a storm sewer on Josephine St. in the Town of Wingham, according to the plans and specifications prepared by T. Harry Jones, C. E., of the city of Brantford. (2) The work of excavating, paving with concrete and curb stones on Josephine St. in the Town of Wingham, according to the plans and specifications prepared by T. Harry Jones, C. E., of the city of Brantford. The town will furnish road roller, stone crusher, screens and bins. Plans and specifications can be seen at the office of the Town Clerk in the Town Hall, Town of Wingham.

✣Bids will be received until 4 p. m., June 10, by John F. Groves, Clerk, Wingham, Ont., for the construction of a concrete reservoir 40x40x12 ft. Plans and specifications are on file with the Clerk.

✣Bids will be received until 7 p. m., June 9, by T. E. Simpson, Mayor, Sault Ste. Marie, Ont., for supplying and laying about 18,000 lin. ft. of tile sewer pipe with appurtenances. C. I. Pim is City Clerk.

⊙F. F. Fry, 744 Gladstone Ave., Toronto, Ont., has been awarded a contract at Weston, Ont., for the construction of a sewage dis-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

posal plant, for $14,548. T. Aird Murray, 303 Lumsden Bldg., Toronto, is Engineer.

⊙The Board of Control of Hamilton, Ont., John Allan, Chairman, has accepted the tender of the city engineer, for the construction of reinforced concrete sewage tanks, conduits, sludge drying beds, pipe foundations and other structures required for the complete erection of the west end disposal plant. The bid was $62,000. Bids were opened May 20.

⊙Jacob Yundt, Gadshill, Ont., has been awarded the contract by the city of Stratford, Ont., A. B. Manson, City Engineer, for the construction of one mile of sanitary sewer, for $12,270. Salt-glazed vitrified pipe and concrete manholes will be used. Bids were opened May 21.

The citizens of Medicine Hat, Alta., on May 15 voted a by-law appropriating $116,000 for the construction of sewers, and $67,000 for street grading.

BUILDINGS

Alabama.

The U. S. Steel Corporation has decided to proceed with the work on the new mills of the American Steel & Wire Co. at Birmingham, Ala., which has been halted since early in 1911. It is understood that about $800,000 will be required.

Arkansas.

✣Bids will be received until 3 p. m., July 8, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures, and approaches, of the United States postoffice at Searcy, Ark. The building is one store, basement, and mezzanine, and has a ground area of approximately 3,800 sq. ft.; nonfireproof construction except first floor, stucco and stone facing, and tile roof. Drawings and specifications may be obtained from the custodian at Searcy, Ark., or at the discretion of the Supervising Architect.

California.

✣Bids will be received until 11 a. m., June 10, by Capt. E. S. Walton, Constructing Quartermaster, Fort Mason, Cal., for constructing heating and plumbing addition to detention ward, nurses' dormitory, hydrotherapeutic ward and sterilizing and disinfecting building at Letterman General Hospital, Presidio of San Francisco, Cal.

⊙The Public Works Commissioners of San Francisco have awarded the contracts for general construction of academic building, Polytechnic High School, at Willard, Carl and Frederick Sts. and Arguello Blvd., to Newsom, Wold & Kohn Co. at $219,752.

Colorado.

The Colorado Fuel & Iron Co., Boston Bldg., Denver, Colo., contemplates the construction this year of three additional furnaces at its Pueblo plant, to cost about $500,000.

An expenditure of about $350,000 is proposed for improvements to the Denver Union Stock Yards, Denver, Colo. The extensions contemplate a new abattoir by Armour & Co., to cost between $150,000 and $200,000; an addition to the exchange building at a cost of $100,000; an extension of the stock pens to cost $50,000, and the construction of a poultry-feeding creamery and egg-handling plant by Swift & Co.

City of Venice, Cal., may hold another election to vote on issuing $250,000 in bonds for the construction of a high school. At a previous election 14 months ago a bond issue for this purpose was defeated by a small majority.

Connecticut.

✣Bids will be received until noon, June 12, by Yale Committee of Twenty-one Inc., 100 Crown St., New Haven, Conn., for the earthwork and building tunnels and retaining walls for the football amphitheater in Yale Field. Plans and specifications can be seen, and blank forms for proposals can be obtained at the office of Charles A. Ferry, Resident Engineer, Room No. 8, Benedict Building, No. 82 Church St., New Haven, Conn., or at the office of James B. French, Consulting Engineer, Room No. 1276 Hudson Terminal Bldg., No. 50 Church St., New York City. Proposals must be accompanied by a certified check for $5,000, and the contractor to whom the work is awarded will be required to furnish a bond in the sum of $10,000. The estimate of quantities by which the bids will be tested, is as follows: 40,000 cu. yds. of loam removed and deposited in piles; 170,000 cu. yds. of earth deposited in oval embankment; 60,000 cu. yds. of earth deposited on meadows or other low ground; 10,000 cu. yds. of concrete; 15,000 bbls. of Portland cement; 650,000 lbs. of steel for reinforcement; 80 piles; 780 ft. B. M. creosoted timber; 1,080 lin. ft. of 18-in. vitrified pipe sewer; 290 lin. ft. of 12-in. vitrified pipe sewer; 1,700 lin. ft. of 10-in. vitrified pipe sewer; 2,000 lin. ft. of 8-in. vitrified pipe sewer; 1,000 lin. ft. of 6-in. vitrified pipe drain; 60 cast iron drain inlets; 5 manholes; 1,800 lin. ft. of 4-in. cast iron water pipe; 6 hose connections with pipe, valve, gate box, etc., complete; 53,000 sq. ft. of 4-ply waterproofing; 80,000 sq. ft. of concrete surface coated with coal tar pitch. David Daggett is Secretary Yale Committee of Twenty-One, Inc.

District of Columbia.

✣Bids will be received until 2 p. m., June 24, by Lewis C. Laylin, Assistant Secretary Department of the Interior, Washington, D. C., for the installation of addition to coal and ash handling machinery in the Old Postoffice Building, 8th and E Sts. N. W., Washington, D. C., in accordance with specifications for the work, copies of which may be obtained on application to the chief clerk of the department.

✣Bids will be received until 2 p. m., June 20, by Lewis C. Laylin, Assistant Secretary Department of Interior, Washington, D. C., for the installation of two electric passenger elevators in the Patent and Old Postoffice Buildings, 7th and F Sts. N. W., Washington, D. C., for installation of inclosures therefor, and for excavating, cutting and brick and steel work for same; also for installation of suitable pent houses for elevator machinery, all in accordance with plans and specifications for the work, copies of which may be obtained on application to the Chief Clerk of the department.

✣Bids will be received by the Bureau of Yards and Docks, Navy Department, Washington, D. C., until 11 o'clock a. m., June 21, for wire fence and gates at the United States reservation, Radio, Va. Estimated cost, $2,000.

Georgia.

✣Bids will be received until 10 a. m., June 23, by R. V. La Dow, Superintendent of Prisons, Washington, D. C., for furnishing and delivering at the United States penitentiary, Atlanta, Ga., material for heating apparatus for the administration building, U. S. penitentiary, Atlanta, Ga.

✣Bids will be received until 10 a. m., June 23, by R. V. La Dow, Superintendent of Prisons, Washington, D. C., for furnishing and delivering at the United States penitentiary, Atlanta, Ga., plastering material to be used in the construction of the administration building, U. S. penitentiary, Atlanta, Ga.

✣Bids will be received until 10 a. m., June 27, by R. V. La Dow, Superintendent of Prisons, Washington, D. C., for furnishing and delivering at the United States penitentiary at Atlanta, Ga., mill work and flooring for administration, U. S. penitentiary, Atlanta, Ga.

Illinois.

✣Bids will be received until noon, June 14, by Board of Education, Ashley, Ill., for the erection of a ten-room brick High School Building, according to plans now on file with the secretary of said board. Plans may be obtained from Fred Brown, Acting Secretary, Ashley, Ill.

Indiana.

✣Bids will be received until 3 p. m., June 20, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for an electric vault protection system in the U. S. postoffice at Indianapolis. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 10 a. m., June 11, by H. R. Perry, Depot Quartermaster, Jeffersonville, Ind., for furnishing and installing two 75-H. P. tubular high-pressure boilers, with dutch ovens.

Kansas.

⊙Leeper & Smith, Topeka, Kan., have been awarded the contract at $6,200 for rebuilding the steam tunnel between the state heating plant and state house at Topeka.

Massachusetts.

✣Bids will be received until 2 p. m., June 10, by the Commanding Officer, Springfield Armory, Springfield, Mass., for furnishing under Schedule No. 50, miscellaneous quantity of steel for U. S. Armory Rifle, Model 1903; also quantity of wire for stock.

✣Bids will be received until 3 p. m., July 10, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction, except mechanical equipment, of the United States postoffice at New Bedford, Mass. The building is to be one story and basement, with a mezzanine, of approximately 21,730 sq. ft. ground area; fireproof construction; stone and terra-cotta facing; metal and composition roof. Drawings and specifications may be obtained from the custodian of site at New Bedford, Mass., or at the discretion of the Supervising Architect.

✣Bids will be received until 3 p. m., July 10, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the mechanical equipment of the United States postoffice at New Bedford, Mass., in accordance with drawings and specifications, copies of which may be obtained at the discretion of the Supervising Architect.

The Congress St. Associates of Boston, Mass., are contemplating the erection of a 10-story $500,000 office building adjoining the State Mutual Bldg., Congress St., Boston. Plans have been prepared by Andrews, Jacques & Rantoul, Architects, State Mutual Life Bldg., Boston.

Michigan.

✣Bids will be received until noon, June 10, by Charles A. Gadd, Secy., Board of Education, 50 Broadway, Detroit, Mich., for furnishing all labor and material under the "one bid" form for the entire job; also for furnishing all labor and material under the "four bid" form for the entire job—viz.: General mason, general carpenter, heating and ventilating and electric wiring specifications, respectively, necessary for the erection of the 16-room school building on the southeast corner of Garland Ave. and Charlevoix St.

Missouri.

✣Bids will be received until 3 p. m., June 16, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the remodeling, etc., except plumbing, gas piping, heating apparatus, electric conduits and wiring, and elevator, of the United States customhouse at St. Louis, Mo. Drawings and specifications may be obtained from the custodian of the building, St. Louis, Mo., or at the discretion of the Supervising Architect.

Nebraska.

✤Bids will be received until 3 p. m., June 18, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for wood sheet piling and approach work at the United States postoffice at Plattsmouth, Neb., in accordance with the drawings and specifications, copies of which may be had at the office of the custodian of the building or at the discretion of the supervising architect.

Plans have been submitted for the new Fontenelle Hotel, to be erected at 18th and Douglas St., Omaha. Building is to be 16 stories and is to cost about $700,000. T. R. Kimball, McCague Bldg., Omaha, Neb., is the Architect.

New Mexico.

All bids received May 8 by Capt. G. H. Scott, Quartermaster, Fort Bayard, N. Mex., for furnishing and installing one 10-h.p. engine in sawmill at Fort Bayard were considered excessive and rejected.

New York.

Plans are being prepared for a new building to be erected at Main and Swan Sts., Buffalo, N. Y., for the Manufacturers' & Traders' National Bank. Furness, Evans & Co., Provident Bldg., Philadelphia, Pa., are the Architects.

North Carolina.

✤Bids will be received until 3 p. m., July 11, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction, complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures and approaches, of the United States postoffice at Greenville, N. C. The building is to be one story high, with a mezzanine at each end and a basement, and will have a ground area of approximately 4,400 sq. ft.; fireproof construction except roof; stone and stucco facing, and tile and tin roof. Drawings and specifications may be obtained from the custodian of site at Greenville, N. C., or at the discretion of the supervising architect.

Ohio.

✤Bids will be received until noon, June 16, of Board of Trustees, Ohio State University, Columbus, O., for furnishing the materials and performing the labor for the construction of two underground tunnels, one 320 ft. long, the other 513 ft. long, in accordance with plans and specifications prepared by Joseph N. Bradford, University Architect, on file in the office of the Auditor of State. Plans and specifications for the above tunnels may also be seen at the office of the Architect and Secretary of the Board of Trustees, C. E. Steeb.

✤Bids will be received until noon, June 16, by Clerk of the Board of Education, East 6th St., Cleveland, O., for furnishing all the materials and for doing all the work necessary to complete a building on the Kennard property, on East 43d and East 16th Sts., and to be known as Kennard School, in accordance with plans and specifications on file on the office of the architect of said board, East 6th St.

✤Bids will be received until noon, June 11, by W. H. Kirby, Secretary to Director of Public Service, Cleveland, O., for coal chutes with air operated gates for the Municipal Electric Light Plant. Plans and specifications are on file with the Engineer of Construction, Room 319 City Hall.

✤Bids will be received until noon, June 16, by W. H. Kirby, Secretary to Director of Public Service, Cleveland, O., for cement and stone for the Municipal Electric Light Plant of the City of Cleveland, O. Each bid must be made in accordance with the plans and specifications which may be obtained in the office of the Engineer of Construction, Room 319, City Hall.

Special election will be held at Sandusky, O., on July 1 to vote on issuing $200,000 of bonds for erecting and equipping a municipal lighting plant. At an election 18 months ago the proposition had a majority vote but failed to receive the two-thirds vote required by statute. R. L. Wager is City Engineer.

Oklahoma.

Governor Cruce has approved the State Capitol building bill and it will become effective 90 days after the Legislature adjourns. It calls for a State House to cost $1,500,000 and appropriates $750,000 to begin the work.

Oregon.

Plans are being prepared by Doyle, Patterson & Beach, Architects, Worcester Bldg., Portland, Ore., for the construction of the 8-story Pittock Bldg., which will cover an entire block at Portland, Ore.

Plans for the municipal auditorium at Portland, Ore., are nearing completion and will be submitted to the Auditorium Commission in the near future. Freedlander & Seymour, New York City, are the Architects.

Pennsylvania.

✤Bids will be received until 4 p. m., June 5, at the office of A. J. Lathrop Co., Architects, People's Bank Bldg., Wilkesbarre, Pa., by the Newport Township School District for the erection and completion of an eight-room brick trimmed with stone school building, the same to be located at Glen Lyon, Pa., as per plans and specifications prepared by the A. J. Lathrop Co., Architects, 63-64 People's Bank Bldg., Wilkes-Barre, Pa. All bids must be accompanied by a $500 certified bank check, made payable to Constanty Tarnowski, Treasurer of board.

✤Bids will be received until 2 p. m., June 12, by Department of Fisheries, 507 Telegraph Bldg., Harrisburg, Pa., for the erection of a building to be used for a fish hatchery at Pleasant Mount, Wayne County, Pa., in accordance with plans and specifications on file with P. J. Morris, 23 Burr Bldg., Scranton, Pa., Architect.

⊙The Dravo Contracting Co., Diamond Bank Bldg., Pittsburgh, Pa., has been awarded a contract by the Jones & Laughlin Steel Co. for constructing near Woodlawn, Pa., a reinforced concrete ice breaker, 42 ft. long, 26 ft. wide and 50 ft. high, to cost $50,000.

⊙Architect Press C. Dowler, Arrott Bldg., Pittsburgh, awarded to Schutz, Schreiner & Clyde, May Bldg., Pittsburgh, the contract for constructing a 2-story brick and terra cotta fireproof school building at Noble and Ridge Aves. for the Board of Education. The building will contain class and several special rooms. The cost is to be $100,000.

⊙Samuel Larrivee, Williamsport, Pa., has been awarded the contract at $210 360 for constructing a new high school building for the City of Williamsport.

Architect Jarvis Hunt, 53 W. Jackson Blvd., Chicago, has preliminary plans in progress for a 12 or 15 story department store building to be erected in Sixth St., Pittsburgh, between Liberty and Penn Aves., for the Rosenbaum Co. department store, to cost about $1,000,000. It is believed the plans will be completed by Sept. 1.

West Virginia.

⊙Architect H. Rus Warne, Capital St., Charleston, W. Va., awarded to J. C. Jones & Co. the contract for constructing the 6-story concrete warehouse for Hubbard & Co., wholesale grocers, the price being $100,000.

The First Presbyterian Congregation, Charleston, W. Va., is having plans made by Architects Weber, Werner & Adkins, Cincinnati, O., for a brick and steel church building to cost about $100,000 and to contain an auditorium with a seating capacity of 1,500.

Canada.

⊙Snider & Brethour, 207 Hastings, W. Vancouver, B. C., have been awarded a contract for erecting a 6-story, 100x120 ft., reinforced concrete building on Beattie St., Vancouver, for the National Drug & Chemical Co. H. S. Griffith, Vancouver, is the Architect.

RIVERS AND HARBORS

Arkansas.

The St. Francis Levee Board has approved the recommendations for the construction of a 40 ft. banquette behind the Mississippi River levees in Crittenden, Mississippi and Lee Counties. The cost of the improvement will be about $4,185,000. Bids on a bond issue of $1,500,000 have already been received. D. G. Covington, Memphis, Tenn., is Chief Engineer of the St. Francis Levee Board.

The State Railroad Commission has granted the Garland Power & Development Co. the right to erect a dam on the Ouachita River, near Hot Springs. C. C. Kavanaugh of Little Rock, Ark., is President of the company.

California.

M. J. Desmond, City Clerk of Sacramento, will open bids on May 29 for the purchase of $887,000 of bonds voted for river improvements and levees.

The San Joaquin Light & Power Corp. has arranged with the J. G. White Engineering Corp., New York City for the engineering and construction of a 6,000 K. V. A. hydro-electric plant on the Tule River near Springville, Cal., installation of a 3,000 K. V. A. generator at San Joaquin, Power House No. 2, a 3,750 K. V. A. generator and water wheel at Kern River Canyon plant, installation of 6,250 K. W. steam turbine, boilers and auxiliaries and buildings at Bakersfield steam plant and installation of 4-666 K. V. A. transformer and necessary revision of switching arrangements for plant No. 3 of the San Joaquin Light & Power Corp.

District of Columbia.

✤Bids will be received until 2:30 p. m., June 17, by Maj. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under Circular 778-C, lumber.

✤Bids will be received until 2 p. m., June 10, by Maj. W. J. Barden, U. S. Engineer, Engineer Depot, U. S. Army, Washington Barracks, D. C., for furnishing filler caps and inner pipes.

Florida.

✤Bids will be received until noon, June 27, by Maj. J. R. Slattery, U. S. Engineer, Jacksonville, Fla., for dredging in channel between the St. John's River and Cumberland Sound, Fla.

Hawaii.

✤Bids will be received until 11 a. m., July 1, by Maj. W. P. Woten, U. S. Engineer Office, Honolulu, Hawaii, for dredging in Kahului, Hilo and Honolulu harbors, Hawaii. Information on application to Lieut.-Col. Thomas H. Rees, Custom House, San Francisco, Cal., or the office of W. P. Woten, maj., engineers.

Illinois.

The State Legislature will probably pass a bill to appropriate $250,000 to aid in strengthening the levee system of Cairo, Ill. Cairo has spent upon its levees up to the present time over $1,500,000 without outside assistance.

✤ indicates work now open for bids. ⊙ indicates a contract let recently.

To make sure of safety from future floods, it is proposed to raise the levee to 60 ft. For this purpose the Federal Government is asked to appropriate $500,000 and the State of Illinois $250,000, while $102,000 will be raised from local taxes.

Louisiana.

✣Bids will be received until noon, June 12, by Doullut & Williams, American National Bank Bldg., Shreveport, La., for supplying the following material (to be used in making and sinking subaqueous mattresses for bank protection on the Red River in Caddo Parish, La.) in carload lots, f. o. b. Shreveport, La. 3,500,000 ft. b. m. lumber in lengths of 12 ft. and up, 1x4 and 1x6 ins. wide. At least 30 per cent of which shall be not less than 16 ft. long. The lumber may be of any variety which will not break, split or warp before the mattress is sunk and whose strength or usefulness is not impaired by the presence of large knots, shakes and other defects which would cause breakage in weaving; 95,000 lbs. of No. 14 galvanized steel wire; 45,000,000 lbs. of stone weighing not less than 140 lbs. to the cubic foot. It shall be in pieces of not less than 20 pounds and not more than 100 lbs. in weight. It shall be tough, strong and not subject to material deterioration when exposed to weather or submerged in water; 30,000 lbs. of nails; 45,000 bbls. of Portland (hydraulic) cement. The cement shall meet the standard requirements for Portland cement adopted by the American Society of Civil Engineers; 8,000 cu. yds. of sand. The sand shall be sharp and clean and free from clay, earth, trash or vegetable matter of any kind; 12,000 cu. yds. of crushed rock or gravel. In either case it shall be strong, clean and durable and shall have a specific gravity of not less than 140 lbs. to the cubic foot (solid measurement). None of the stone shall pass through a sieve whose mesh is less than ¼ in., nor shall any stone fail to pass through a screen with 1 and ½ in. mesh.

✣Bids will be received until noon, June 10, by Capt. Ernest Graves, U. S. Engineer, Vicksburg, Miss., for furnishing and delivering about 8,000 bbls. of American Portland cement at Riverton, La.

✣Bids will be received until 11 a. m., June 26, by Maj. Ward H. Schulz, U. S. Engineer Office, Room 325, Custom House, New Orleans, La., for furnishing about 26,000 cords willows at South and Southwest Passes, Mississippi River.

✣Bids will be received until 11 a. m., June 9, by Capt. C. O. Sherrill, U. S. Engineer, Metropolitan Bank Bldg., New Orleans, La., for constructing 615,000 cu. yds. of earth work in Lower Tensas Levee District.

Massachusetts.

✣Bids will be received until 11 a. m., June 11, by Board of Harbor and Land Commissioners, 131 State House, Boston, Mass., for dredging a channel in Onset Bay and dredging a channel from Woods Hole, Great Harbor to Eel Pond at Woods Hole. The work to be done is the dredging of about 32,500 cu. yds. of material in Onset Bay and about 6,000 cu. yds. at Woods Hole. The dredging in Onset Bay is to be to a depth of 10 ft. at mean low water, and the dredging at Woods Hole is to be to a depth of 8 ft. at mean low water. Proposals must be made upon blank forms, which, together with information in regard to the work, may be obtained at the office of the Board, where plans and specifications may be seen. William F. Williams, Chief Engineer.

✣Bureau Yards and Docks, Navy Department, Washington, D. C., has extended the time for opening bids for coaling tower alterations and improvements to coaling plant at the navy yard, Boston, has been extended from May 31 to June 14.

The State Legislature has passed a bill providing $5,000,000 for harbor development in the state. The money is to be expended under the direction of the State Harbor and Land Commission, Capitol, Boston, Mass.

Michigan.

✣Bids will be received until noon, June 7, by Lt. Col. M. M. Patrick, U. S. Engineer, Federal Bldg., Detroit, Mich., for the sale of the U. S. Steamer Hancock.

✣Bids will be received until noon, June 23, by Lt.-Col., Mason M. Patrick, U. S. Engineer, 337 Federal Bldg., Detroit, Mich., for dredging Clinton River, Mich.

Mississippi.

✣Bids will be received until 11 a. m., June 14, by Maj. J. A. Woodruff, U. S. Engineer, Vicksburg, Miss., for the construction of about 580,000 cu. yds. of earth work to close Skipwith Crevasse. A description of the work is as follows: Section 1, Sta. No. 2661+10 to 2678, 140,000 yds.; Section 2, Sta. No. 2678 to 2694, 110,000 yds.; Section 3, Sta. No. 2694 to 2711, 110,000 yds.; Section 4, Sta. No. 2711 to 2731, 110,000 yds.; Section 5, Sta. No. 2731 to 2750+85, 110,000 yds. A blueprint of the work will be attached to and form a part of the contract. The work is to be completed on or before November 30, 1913. Section 1 of this levee will have 8-ft. crown, a 3 to 1 front slope, and 3 to 1 and 10 to 1 back slopes, as shown on blueprint. The other sections of this levee will have an 8-ft. crown, a 3 to 1 front slope, and 3 to 1, 10 to 1 and 5 to 1 back slopes, as shown on the blueprint. In addition, all of the work will have a light topping of the gross grade of the standard section, 1½ ft. high with 2-ft. crown and 2 to 1 slopes. Contractors will be required to first construct each section of the levee to a height sufficient to keep out any further rise of the river this year. The work can best be reached by local boats leaving Vicksburg on Mondays and Thursdays and Greenville Wednesday and Fridays, or by rail to Lake Providence, La., thence by launch to the work, which is about 16 miles up the river. The local boats land opposite the work, which is about 3,000 ft. from the landing.

✣Bids will be received by the Board of Mississippi Levee Commissioners, Greenville, Miss., until noon, June 17, for the construction of about 2,300,000 cu. yds. of enlargement of old levees and new levee construction. This will all be team work, with wagons or wheeled scrapers. Full information on application to W. J. Shackelford, Chief Engineer. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until noon, June 18, by Major Clarke S. Smith, Secretary, Mississippi River Commission, Liggett Bldg., St. Louis, Mo., for construction and delivery of a steel hull for floating derrick.

Missouri.

✣Bids will be received until noon, June 18, by Major Clarke S. Smith, Secretary, Mississippi River Commission, Liggett Bldg., St. Louis, Mo., for construction and delivery of steel derrick and machinery.

New York.

✣Bids will be received until noon, June 28, by Col. Wm. T. Rossell, U. S. Engineer, Room 802, Army Bldg., 39 Whitehall St., New York City, for dredging in Staten Island Sound, N. Y., and N. J.

⊙T. A. Gillespie Co., New York City, has been awarded the contract at $9,995 for constructing a pier at Durand-Eastman Park for the Park Board of Rochester, N. Y.

Ohio.

✣Bids will be received until 10 a. m., June 26, by Maj. C. S. Bromwell, U. S. Engineer, Cleveland, O., for breakwater construction at Conneaut Harbor, O.

⊙The Board of Madison County Commissioners, London, O., awarded the contract for the construction of the Post Road Levee to C. A. Huff, London, O., at $1,075; the contract for the cutting of a hill and building a levee at Spring Fork Bridge went to S. A. Willoughby, London, O., at $1,485. H. L. McCafferty is County Surveyor.

Oregon.

Bids were opened May 15 by the U. S. Engineer, Portland, Ore., for furnishing and delivering 400,000 tons of stone for jetty work. The Columbia Contract Co., East Water and Main Sts., Portland, Ore., at $1.10 per ton is the probable contractor for the stone delivered at Fort Canby, Wash., on board barges.

A bond issue of $800,000 will be voted on shortly at Astoria, Ore. The proceeds are to be used for the construction of docks and other water front improvements. L. C. Rogers is City Engineer.

Pennsylvania.

✣Bids will be received until noon, June 18, by Lt.-Col. Francis R. Shunk, U. S. Engineer Office, Pittsburgh, Pa., for furnishing and installing water-power-driven air compressor plants at dams Nos. 7 and 9, Ohio River.

✣The date of opening of sealed proposals for building a fireproof power house., etc., at dams Nos. 7 and 9, Ohio River, previously advertised as May 21, 1913, has been postponed and bids will be received at office of Lt.-Col. Francis R. Shunk, U. S. Engineer, Pittsburgh, Pa., until June 12, 1913.

A bill is before the State Senate for an amendment to the constitution to permit Philadelphia to borrow $25,000,000 for wharf and dock improvements, exclusive of any other debt. Under the proposed amendment Philadelphia could borrow this amount of money, even though the limit of the present borrowing capacity, 7 per cent of the real estate assessment, had been reached.

Tennessee.

An election will be held shortly by the city of Memphis, Tenn., to vote on issuing $1,250,000 of bonds for the construction of a levee and pumping system in North Memphis. J. H. Weatherford is City Engineer.

Texas.

✣Bids will be received until noon, June 27, by Lieut. Col. C. S. Riche, U. S. Engineer, Galveston, Tex., for constructing lock valves and operating gear, etc. Official advertisement will be found elsewhere in this issue.

⊙Bowers Southern Dredging Co., Galveston, Texas, has been awarded the contract by the U. S. Government for dredging between Calcasieu and Sabine Rivers on the Inland Interstate Canal. The contract covers 22½ miles of work, involving 1,500,000 cu. yds. of dredging. The contract price was 6.6 cts. per cu. yd.

Virginia.

The Administrative Board of Richmond, Va., has asked an appropriation of $1,000,000 for walling in Shockoe Creek. Charles E. Bolling is City Engineer.

Washington.

✣Bids will be received until 2 p. m., June 10, by Board of King County Commissioners, Seattle, Wash., for furnishing the necessary material and labor (Jap or Chinese labor not allowed) for the reconstruction of docks at Vashon Heights, Fernheath, Dockton, Burton, Cross, Lizabuella and Cove Docks. Byron Phelps is Clerk of the Board.

The Puget Sound Bridge & Dredging Co., Central Bldg., Seattle, Wash., at $252,308, was low bidder May 15 for work at Smith's Cove for the Port of Seattle, and will probably be awarded the contract. The work includes dredging two slips, on each side of a double wharf. Each slip is 1,800 ft. long by 250 ft. wide. Side slopes will be 2:1 protected with riprap. Depth of water will be 35 ft. at extreme low tide and 52 ft. high tide.

Wisconsin.

✣Bids will be received until 3 p. m., June 16, by Lt. Col. George A. Zinn, U. S. Engineer, Milwaukee, Wis., for furnishing 16,000 bbls. of Portland cement for use at Sheboygan, Wis. and Milwaukee, Wis.

⊙Arthur Vogel Dredging Co., Milwaukee, Wis., has been awarded the contract at 22 cts. per cu. yd. by the U. S. Government for dredging in Waukegan and Kenosha Harbor. About 20,000 cu. yds. are to be removed at Waukegan and 18,000 cu. yds. at Kenosha.

CALLS FOR BIDS

Rate, $2.40 an inch, single column. **Copy received until Monday noon.**

NOTICE TO ENGINE BUILDERS.

PASSAIC VALLEY SEWERAGE COMMISSIONERS.

Notice is hereby given that the Passaic Valley Sewerage Commissioners have designated Tuesday, the first day of July, 1913, at 2 o'clock in the afternoon, as the time when they will meet at their usual place of meeting, Essex Bldg., Clinton St., Newark, N. J., to receive proposals, in writing, for furnishing and erecting pumping plant for the Newark Bay Pumping Station in the City of Newark, N. J.

Particulars that may enable contractors to judge of the character of the plant to be furnished are given below:

Bids—

The contractor's bid must be for furnishing and erecting complete and ready to operate three (3) pumping engines (or sets of engines) directly connected with and so operate three (3) submerged centrifugal pumps, each capable of raising 100 million gallons of sewage per 24 hours to a maximum lift of 37 feet. Each pump and engine must also be capable of pumping at as low a rate as 50 million gallons per 24 hours against a lift of 20 ft., and at all rates between. The foregoing capacities must be demonstrated by suitable trials.

The contractor's bid must also include vertical internally fired, fire-tube boilers, sufficient in number and size to easily operate the three (3) engines when pumping at their maximum rate against their maximum lift, together with three additional boilers of the size offered for duplication and the general steam uses of the station; a fuel economizer; feed water heaters; a traveling crane; piping; feed pumps; condensers, and all necessary fittings and appliances found in pumping stations of the best class.

The engine and boiler houses and all foundations will be provided by the commissioners and in readiness within two years from the date of the execution of the contract.

The plant must be set up, complete in every detail, ready to run within two and one-half years from the date of the execution of the contract.

Drawings, form of contract and specifications and blank for proposal may be obtained at the Commissioners' office from William M. Brown, Chief Engineer.

The Commissioners reserve the right to reject any or all bids.

PASSAIC VALLEY SEWERAGE COMMISSIONERS.
JOHN S. GIBSON, Clerk.
April 22, 1913.

LEVEE WORK.

Sealed bids will be received at the office of the Board of Mississippi Levee Commissioners, Greenville, Mississippi, up to noon of June 17, 1913, for the construction of about 2,300,000 cubic yards of enlargement of old levees and new levee construction. This will all be team work, with wagons or wheeled scrapers.

Full information on application to the undersigned.

W. J. SHACKELFORD,
Chief Engineer.

DRAINAGE.

ORLANDO, FLORIDA.

Sealed bids for the construction of a drainage system for "Black Hammock Drainage District" will be received by the County Commissioners of Orange County, Florida, until ten o'clock, A. M. on Saturday, June 21st, 1913. The system comprises nineteen and 49/100 miles of canals and ditches, with approximately two hundred and forty thousand cubic yards of excavation. Payment will be made in cash as the work progresses. All bids must be accompanied by a certified check for $1,000.00, payable to B. M. Robinson, Clerk; as a guaranty that the bidder will within 15 days execute a proper contract and bond acceptable to the Board of County Commissioners, provided he be the successful bidder. The Board reserves the right to reject any or all bids. General information, plans and specifications may be obtained upon application to B. M. Robinson, Clerk, Board of County Commissioners, Orlando, Fla.

Ordered by the Board of County Commissioners of Orange County, Fla., this 14th day of May, 1913.

B. M. ROBINSON,
Clerk.

TO LET STEAM SHOVEL CONTRACT.

Suitable for revolving type shovel, six years' work stripping and loading coal, near Pittsburg, Kansas. Overburden consists of earth and shale, average depth 22 feet. Can all be handled without blasting. Coal vein 32 inches, averaging 4,000 tons per acre.

STERNBERG COAL & MINING COMPANY,
816-17 Reserve Bank Bldg.,
Kansas City, Missouri.

EARTH EXCAVATION.

Sealed bids will be received by the undersigned up to noon, June 4, for the excavation of about 12,000 cubic yards of earth, with an average haul of about 350 feet.

Right is reserved to reject any and all bids.

MATTHIESSEN & HEGELER ZINC CO.,
La Salle, Ill.

TREASURY DEPARTMENT, Office of the Supervising Architect, Washington, D. C., May 29, 1913.—Sealed proposals will be received in this office until 3 o'clock p. m., on the 10th day of July, 1913, and then opened, for the construction (except mechanical equipment) of the United States post office at New Bedford, Mass. The building is to be one story and basement, with a mezzanine, of approximately 21,730 sq. ft. ground area; fireproof construction; stone and terra cotta facing; metal and composition roof. Drawings and specifications may be obtained from the custodian of site at New Bedford, Mass., or at this office, at the discretion of the Supervising Architect. O. Wenderoth, Supervising Architect.

REINFORCED CONCRETE ARCH BRIDGE.

Sealed proposals will be received at the office of the Board of County Commissioners of Summit County, Akron, Ohio, until 12 o'clock noon, June 20, 1913, for the construction of a reinforced concrete arch bridge over the Cuyahoga River on North Howard Street Extension.

Proposals will also be received on the same date for the construction of a steel viaduct for the same site.

Plans and specifications for both concrete and steel structures are on file at the offices of the County Commissioners, the County Surveyor, and at the office of Wilbur J. Watson & Company, Consulting Engineers, Cleveland, Ohio.

Bids shall be made on printed forms which can be obtained at the office of the County Commissioners. Plans and specifications may also be obtained from the consulting engineers on the deposit of $25.00, which will be returned upon the return of said plans on or before the date of letting.

Proposals based upon alternate designs to be submitted with the proposal and in accordance with the specifications prepared by the consulting engineers, will be considered.

Proposals must be accompanied by a certified check for five thousand dollars ($5,000.00), and addressed to the Board of County Commissioners, Summit County, Ohio, and endorsed "Proposal for Bridge Over Cuyahoga River on North Howard Street Extension."

The Board of Commissioners reserves the right to accept or reject any bid should they deem it to the interest of the county so to do.

By order of the Board of Commissioners.

C. L. BOWER, Clerk.
Akron, Ohio, May 20, 1913.

CREOSOTED PILING.

Sealed proposals will be received at the offices of the Port of Seattle Commission, 843 Central Building, Seattle, Wash., until 2 p. m., June 18, 1913, and then publicly opened for furnishing 650,000 lineal feet of creosoted piling. Information furnished in application.

C. E. REMSBERG, Secretary.

DEPARTMENT OF THE INTERIOR, U. S. Reclamation Service, Washington, D. C., May 22, 1913.—Sealed proposals will be received at the office of the United States Reclamation Service, Elephant Butte, New Mexico, until 2 o'clock p. m., June 25, 1913, for furnishing sluice and penstock gates and accessories for Elephant Butte Dam, Rio Grande Project, New Mexico-Texas. For particulars address the U. S. Reclamation Service, Elephant Butte, New Mexico; 307 Wright & Calletnder Building, Los Angeles, Calif., or Washington, D. C. F. H. NEWELL, Director.

U. S. ENGINEER OFFICE, Wilmington, N. C., May 13, 1913. Sealed proposals for furnishing and delivering about 688,690 feet B. M. of lumber will be received at this office until 12 m., June 19, 1913, and then publicly opened. Information on application. H. W. Stickle, Maj., Engrs. 21-4t

ENGINEERING AND CONTRACTING

Devoted to the Economics of Civil Engineering Design
and to Methods and Cost of Construction

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Why Large Power Units Are More Economic Than Small Ones.

In many classes of production, large size of productive units is not always accompanied by low unit costs. But in the generation of power, whether by steam or by falling water, large generating units are more economic than small units wherever the demand for power is such as to give a high load factor.

The first cost per horsepower of power generating machinery decreases as the size of the units increase. Likewise the annual cost of attendance is less per horsepower the larger the generating unit.

In the case of electric power there is still another economic feature that favors large central stations, namely, the "diversity factor." "Diversity factor" is commonly defined as the quotient found by dividing the sum of the peak loads of the several power consumers by the station peak load. The greater the number of power consumers the more likely is it that there will be such diverse requirements for power that the peak load at the station will be far less than the sum of the individual peaks of the power consumers. Hence it may happen that 1 K. W. of central station capacity will take care of 3 K. W. (or more) of peak loads of individual power consumers—simply because the customers' peaks do not all come simultaneously, but at diverse times. The fewer the number of customers, the smaller is the "diversity factor"; and if there were only one customer with one power consuming device, the "diversity factor" would be unity, if no power were lost in transmission and transformation. The combination of the three elements above named—low unit first cost, low unit attendance cost, and high diversity factor—explain the rapid disappearance of small power stations in and about cities.

How Engineering Societies Can Educate the Public.

The possibilities for educational work by an engineering society naturally divide into two essentially different forms, namely, the education of the individual members of the organization by association with the other members and by participating in, listening to or reading the technical proceedings of the society, and, secondly, the influence of the society as a body in molding public opinion. The first function mentioned is well understood by many engineers at this time, but the opportunities for doing effective educational work of the second type mentioned, often of equal importance with the first, is very generally overlooked or neglected.

In this issue we publish a brief statement of the influence of the engineering society in educating its members. This statement is addressed primarily to young engineers, but it is equally applicable to the engineer of experience who has not become a member of an engineering society.

However, it is to the opportunities available to engineering societies for educating the public that we wish to call particular attention at this time. Anyone who reads the proceedings of our various societies year after year must be impressed by the fact that an unbridged gulf now exists between the educators and those whom they seek to educate. The foregoing statement does not relate to matters of interest to engineers only, such as the majority of the technical studies presented before the societies, but to the subjects from time to time discussed which are or ought to be of interest to the public. An example of the last mentioned type of subject will be given.

Within the past year or two practically every civil and municipal engineering society in the country has had presented before it and has published in its proceedings at least one paper calling attention to the neglect of sewage treatment plants by municipalities. This matter has been very clearly set forth in all of these papers. It has been well understood for several years by engineers. What good, then, has been accomplished by repeating the familiar story in the proceedings of technical societies? It is not likely that conditions have been bettered as yet as a result of the points brought out in the papers mentioned for the reason that the public does not know what the papers contained. The problem before the engineering society in educating the public through the medium of its proceedings is to bring those proceedings to the attention of the public. We believe that this can best be done through the medium of the daily newspapers.

Many of the best newspapers are now glad to publish matter of this kind. It is true that they do not seem to go very far in search of such matter, but it is equally true that they will give some space to it if it is sent to them in proper form for publication. The Cleveland Engineering Society and the Brooklyn Engineer's Club, and perhaps other similar organizations, now enjoy the co-operation of the daily papers in their cities in bringing to the attention of the public discussions of various questions upon which the members of the societies are especially well qualified to express opinions. The experience of the Cleveland society is of interest, and will be briefly stated.

In the fall of 1912 the society appointed a publicity committee. This committee prepared articles for the daily papers, written in popular style but dignified in tone and free from any suggestion of sensationalism. It soon became evident that the newspapers were glad to receive and publish such authoratative communications. The chairman of the committee concludes that both the public and the engineering profession would benefit from organized efforts, on the part of the engineering societies throughout the country, to get in touch with the public through the newspapers.

What has been done in Cleveland can be done in other cities by local engineering societies or clubs. If the big metropolitan dailies will make room for matter of this character it seems a certainty that the papers in the secondary cities and small towns will do the same, for the latter papers usually are less fortunate than the big dailies in the quantity of acceptable matter available for publication. Obviously many people can be reached in a day through the newspapers who could not be reached in a lifetime through the ordinary form of publishing the proceedings of technical societies. The present form of publishing the full proceedings is essential to the first form of educational work within reach of the society, that within its own membership and among engineers generally, but it is almost useless as a popular educational agency. To reach the public surely and quickly the newspapers must be used.

A Notable Series of Articles on the Design and Construction of a 39,000,000 Gal. Mechanical Filtration Plant, Giving Complete Construction Methods and Costs.

In this issue we begin the publication of a series of three articles which relate to the design, construction and operation of the mechanical water filtration plant at Minneapolis. We consider this series of articles superior to any heretofore published on water filtration plants from the standpoint of construction methods and costs. The articles will be of great interest and utility to all water works engineers, contractors and officials.

The article in the present issue describes the design and workings of the plant. This design has been described heretofore, though not in this journal, and not elsewhere in the degree of detail here shown. The history of the project is given insofar as it has a bearing upon the design ultimately adopted. The general drawings of the layout of the plant and its principal plans, sections, and major operating details, are shown and are accompanied by descriptive text. This article, while complete in itself, is published at this time as a preparatory step to the publication of the construction articles. The first construction article will be published in our issue of June 25.

The articles were written by the engineer who was in direct charge of the construction of the plant by the day labor system. Every condition which had a bearing upon the cost of the work is described. The methods employed in doing the work are given in detail and the corresponding cost data are presented. The method of keeping the cost data is fully described. The articles are fully illustrated with construction views. In a word, everything has gone into the making of these articles which is known to the man who lived with this job during two full construction seasons, with reference to all engineering and constructional features of the undertaking and to the spirit which pervaded the work from day to day.

Certain Deficiencies in Engineering School Training.

A praiseworthy feature of recent numbers of the Bulletin of the Society for the Promotion of Engineering Education is its articles from practicing engineers and citing flaws found by them in their own school training and in that of the younger graduates who are being employed by them. Sometimes in these articles the censure is hypercritical and frequently the remedies suggested are neither practical nor practicable, but generally the criticism is stimulating. We note, for example, in the May Bulletin, just delivered, two criticisms, each by a consulting engineer of experience, which are deserving of quotation, and this not because the deficiency indicated is confined to the men whose diplomas are new. The first quotation follows:

> Nowadays, the efficiency side of engineering is demanding more attention than perhaps has been the case in the earlier days. Many young engineers are employed in ascertaining the costs of work done, many older ones have to keep track of these costs in order to properly manage their work. Others are engaged in comparing costs, in planning for their reduction or in predicating the costs of work to be done. Few of the younger engineers seem to know anything at all of the principles of cost keeping, accounting or of financial matters generally. Many know so little that they are unable to properly record the daily expenditures of labor, material, etc., in such a way that the elementary costs of the items completed can be arrived at even approximately. And the writer has been unable to get hold of a sufficient number of engineers who seemed to understand the first principles of arriving at overhead charges, depreciation, sinking fund and interest charges, etc. Yet these insufficient men have been placed in responsible positions, such as that of county engineer, where not only were hundreds of thousands of dollars of expenditures to be accounted for annually by them, but also in many cases they were to be the guiding spirits in framing laws for the borrowing and expenditure of many more such sums.

The complete fairness of this statement of conditions is unquestionable. Also such conditions exist not because the juniors and seniors of our engineering schools are not taught the details of accounting, but because other things than accounting have been too much held to comprehend the doctrine of engineering. This point is demonstrated for us in the second quotation, which follows:

> Double tracking and bridge removals were being considered, and the railroad company was in doubt as to the proper type and length of bridges to specify. On visiting the bridge department of the road, the writer found the bridge engineer in charge fully qualified to make detail drawings of bridges when the type and general dimensions had been fully specified, but quite unable to determine the economic type or its proper length. Custom had governed the choice in these matters, and, as previously stated, the custom of different men differed by 400 to 500 per cent. The absurdity of the situation then loomed up strongly when it appeared that steel bridges had been installed where earth embankments should have been, and an amusing feature of the situation was that, after choosing improper types and general proportions costing three to four times more than needed, the engineering department was then calculating stresses to decimals and endeavoring to reduce the cost by saving in details.
>
> One of the most important duties of a bridge engineer is the selection of economic types and the determination of general dimensions and design, but too often this is fixed by custom, guess or judgment. The cost of a bridge is affected most of all by its form and proportions, and sizes which are too large and excessive are often specified when smaller ones with embankments at the ends would leave ample space for the highest floods. The difference in cost between a 500-ft. and a 300-ft. bridge might be $15,000 to $20,000, and if the greater length is specified where the shorter one would do, the figures given represent the loss which might have been saved by greater engineering knowledge. Whereas, after specifying a 500-ft. bridge, the greatest saving which an expert detailer could make would not exceed $4,000 to $5,000, or only one-quarter of the saving which would result from careful and competent preliminary investigations.

We do not for a moment believe that the circumstance described represents general conditions in railway engineering departments, but it does illustrate a tendency—one which is disappearing without doubt, but which still persists to a degree that is a hindrance to the most rapid development of the engineer. It is truly engineering to be able to calculate stresses in and to detail a specific structure with exactitude, but it is greater engineering to choose from all possible structures that one which will meet best the economic conditions, and it is still greater engineering to be able to tell certainly whether there is economic justification for construction at all.

GENERAL ARTICLES

A Concrete Mixing and Chuting Plant With a Folding Tower and Mounted on a Flat Car for Retaining Wall Construction.

(STAFF ARTICLE.)

A portable concrete mixing and chuting plant of unusual interest is being operated on track elevation work in Chicago by the Chicago, Milwaukee & St. Paul Ry. The plant will place the concrete for two parallel retaining walls on a stretch of 2.4 miles of double track which is being elevated. The elevated structure consists of an earth fill enclosed by the retaining and abutment walls and of overhead bridges at street crossings. Its cost is estimated at about $2,000,000.

The railway along the section being elevated occupies a right of way 32 ft. wide on one side of a city street. Between one side of the right of way and the property line there is a 6-ft. sidewalk and between the other side of the right of way and the adjacent property line are a 22-ft. roadway and a 6-ft. sidewalk. The retaining walls are within the railway right of way; that is, they are 32 ft. apart outside to outside faces, and are the full height of the grade elevation. They have battered rear faces. The abutment walls, similar in section, close the ends of the retaining walls at street crossings, which are about 275 ft. apart. Substantially, then, the concrete structure for the track elevation is a series of four walled enclosures each consisting of two side (retaining) walls and two end (abutment) walls. The crossing streets separate the ends of these enclosures. The construction tasks are the building of the concrete enclosing walls and the street crossing bridges and the placing of the earth filling inside the concrete walls.

The construction had to be done without blocking crossing streets. The plan adopted was as follows: One of the double tracks was swung out onto the 22-ft. roadway for the whole length of the section being elevated. This track was intended to carry the regular traffic. The second of the two tracks was shifted sidewise to the center of the right of way to serve wholly as a construction track. From the construction track the side or retaining walls are to be built first, then the track will be elevated on trestle and the abutment walls and bridges will be constructed and the earth fill placed. The first task of construction, according to the plan adopted, is the building of the parallel retaining walls.

The soil on which the retaining walls have to be built is solid and is considered good for a load of 2 tons per square foot. Foundation work consisted, therefore, of ordinary footings built in trench. These trenches are being excavated by an American Steam Ditcher built by the American Hoist & Derrick Co., of St. Paul, Minn. This machine is substantially a small steam shovel mounted on trucks and having a full circle revolution. The trucks have three gages, one standard and two wider gages. The track used consists of "sections" or frames composed of 8x16-in.x19-ft. timbers, on which as cross ties 6-ft. rails are bolted. Each track section is thus 6 ft. long and 19 ft. wide and spans the trench, resting on mud sills at the trench sides. These truck sections are picked up from behind by the dipper of the machine and set aboard as the ditcher advances.

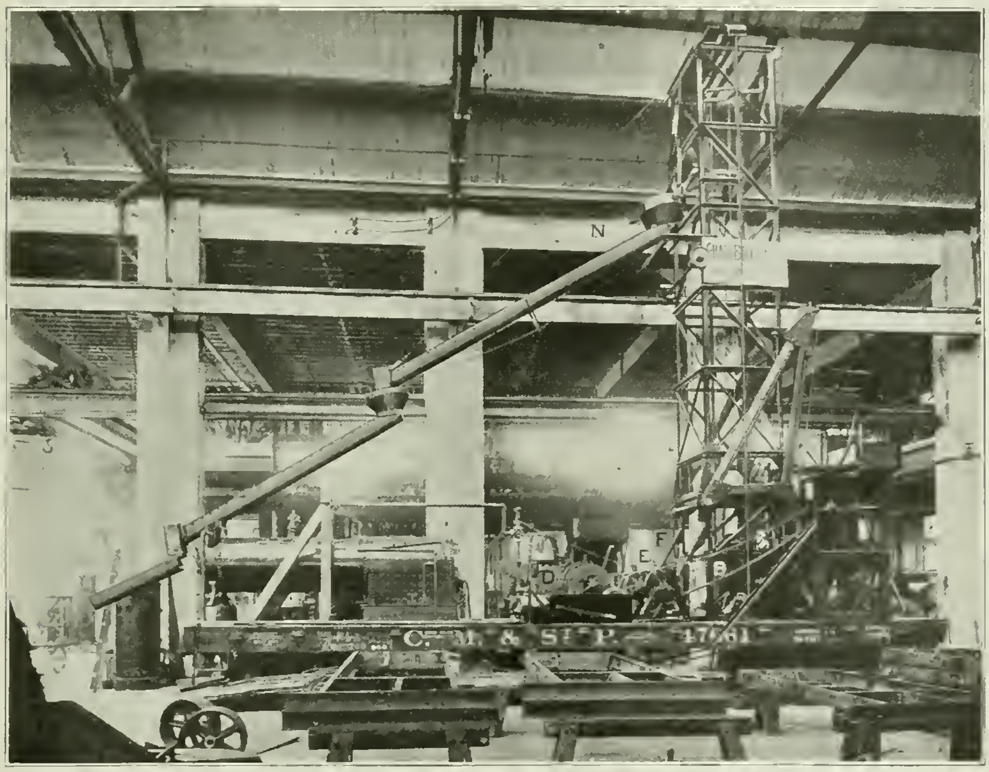


Fig. 1—Chuting Tower and Mixer Plant Erected Ready for Operation.

The trench required runs from 2 ft. to 4 ft. in depth, and the output of the ditcher is from 350 to 400 cu. yds. per 10-hour day. This spoil is loaded directly into flat cars standing on the construction track and is hauled away for filling. The force required to operate the ditcher is an engineer and a fireman and five or six laborers to attach the track sections to the dipper, to lay the 8x16-in. mud sills and to perform miscellaneous tasks about the ditching operations.

The concrete footings are built by two flat car mixing plants, one operating a Smith mixer and the other a Chain Belt mixer. The mixers are so located at the car ends that they discharge directly into swinging spouts which lead to the footing trenches. There is practically no shoveling of concrete. The stone and sand cars are in train with the mixer car. They are gondola cars and runways laid over the tops and over the mixer car enable the materials to be brought forward to the mixer in wheelbarrows. The concreting is done in sections of footing; each section contains about 30 cu. yds. and four sections constitute a regular day's work for one mixer car outfit working about 25 men.

The retaining walls proper are built independently of the footing construction and any time afterward with an entirely separate plant. The forms are constructed in a central yard and are shipped on flat cars to the work. They are built in panels which are assembled by means of bolts and present nothing exceptional in design. A locomotive crane on the construction track handles the form panels.

The concreting of the walls is performed by the car-mounted chuting tower and mixer, which is the special plant feature of the work. The outfit is illustrated by Figs. 1 and 2. It consists of a mixer and steel hoisting tower mounted at one end of a 40-ft. flat car on which, at the opposite end, is a boiler and between boiler and tower an engine. The tower is hinged 6½ ft. above the car floor and the upper part can be tipped down onto a support A above the boiler, so that its extension above the car floor is only 11½ ft. The mixer is arranged to discharge into a bucket B at the tower foot and this bucket is hoisted and empties into a hopper N, from which chutes lead to the wall forms. The total height above rail of the tower erect is 36 ft. and when the tower is lowered the clearance required above rail is 16 ft.

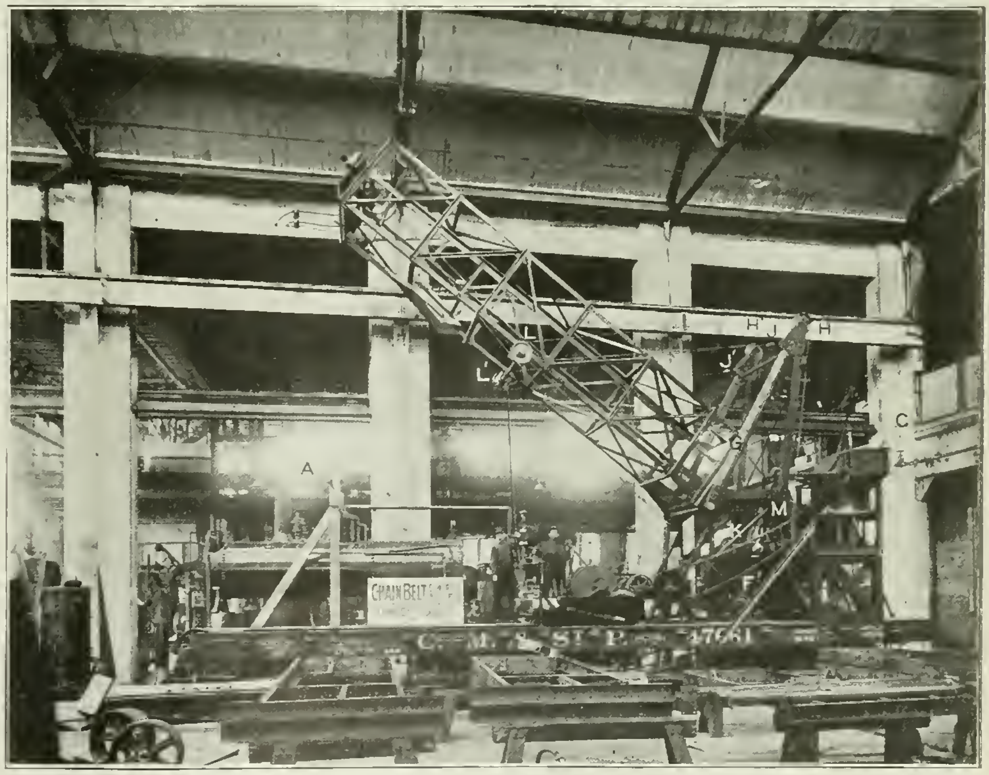


Fig. 2—Chuting Tower and Mixer Plant With Tower Being Lowered for Transportation.

The operation in detail of the tower and mixer is as follows: The engine shaft D carries a driver chain between bearings and extends beyond the far bearing and then carries a sprocket wheel and a nigger head. From the sprocket wheel a chain driver operates the jack shaft E. The jack shaft carries at the near end a sprocket wheel and at the far end a small drum. From the jack shaft sprocket a chain driver F operates the mixer by means of bevel and spur gears. The bucket B is operated by a wire rope winding onto the engine shaft drum. This rope passes from the drum under the jack shaft to the floor sheave F^1, thence up the tower and over two haul sheaves, thence down through the bucket sheave and finally up the tower to a fastening at the top. The bucket hangs, therefore, in the bight of the hoisting rope. It receives the discharge from the mixer, is hoisted and automatically discharges into the chute hopper, N.

The lowering and raising of the main tower is accomplished by means of two A-frames, G one on each side of the main tower. Each A-frame carries a vertical sheave at H, H^1 and a horizontal sheave at J, J^1. From the drum on the jack shaft a cable runs to and under the sheave K, thence up over sheave H^1, thence around sheave L^1, thence back to sheave J^1 and across to J, thence around sheave L, thence over sheave H and down to a fastening at M. A snub line from the nigger head on the engine shaft leads to the shaft L L^1.

To lower the tower its rear legs are unbutted at hinge level and a pull is given to the snub line, and the lowering cables from the A-frames are slacked off to let it tip slowly to rest on the frame A. A pull on the lowering cables hauls the tower upright when it is desired for use again. The A-frame, like the main tower, are hinged, and are lowered by hand after the tower is lowered; they are erected abreast of the main tower in the reverse operation. All operations are simple and the whole arrangement is well designed for its purpose.

The mixer car is operated in train with material cars coupled to its right-hand end. First there is a flat car covered entirely over with a platform which is at charging hopper C, level at the forward end and slopes toward the rear down to the level of the runways over the gondola material cars. The materials are wheeled to the mixer. The crew required consists of 20 men wheeling material, 1 man at charging hopper and to discharge the mixer, 1 man to discharge bucket and attend to water, 1 engineer, 1 fireman, 2 men in forms, 1 foreman and 1 strawboss. Assuming wages as follows. Laborers 30 cts. an hour, engineer $6 per day, foreman $5 per day, strawboss $4 per day, the fireman $3 per day, the pay roll per day will be $90. The plant concretes two 25-ft. sections of wall containing 200 cu. yds. in a day.

The brick elevation work is under the direction of the railway engineers, Mr. C. F. Loweth, Chief Engineer, and Mr. R. J. Middleton, engineer of track elevation. The concreting plant illustrated was built by the Chain Belt Co., Milwaukee, Wis., in conjunction with Mr. W. B. Lower of Chicago, and the mixer is the Chain Belt drum mixer.

The Engineering Society as an Influence in Education.

The engineering society as an educational agency among its membership was discussed by Mr. Albert Reichmann, president Western Society of Engineers, in an address delivered at the Railway Conference held in connection with the dedication of the Transportation Building, the Locomotive Laboratory, and the Mining Laboratory at the University of Illinois. The following discussion of the subject is abstracted from the text of Mr. Reichmann's address:

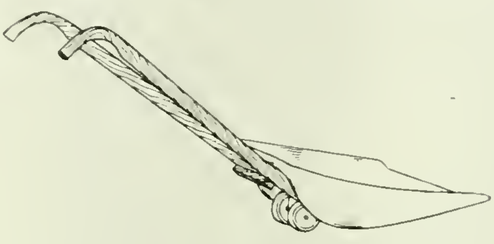
The training that an engineer receives at a university is so broad that to a limited degree it enables him to commence the practice of almost any branch of his profession. But so very broad is the field of engineering and so keen the competition in every line that in order to excel an engineer must choose a comparatively narrow field of activity in order that he may become thoroughly proficient therein. The progress of the world is so rapid, the field of human achievement so complicated that a man must be unusually able to anywhere near keep step with the onward march of events.

An engineer, therefore, must specialize along certain lines if he hopes to attain success; he must not only give the best that is in him to his immediate calling, but he must also study and observe the relation of his work to that of the other lines which have a bearing thereon. For instance: the expert in the construction and maintenance of railroad track should not only master the subject of track construction, but he must also watch the developments that are taking place in the motors and the rolling stock which pass over the road.

We have a notable example of this in connection with the development of the steam engine. After it was generally believed that this machine had attained its maximum efficiency it was found that it was not suitable for generating electricity, and as a result the steam turbine was evolved.

It is very evident, therefore, that an engineer in order to be successful cannot be a recluse. He must associate with his fellow engineers. Now he can best secure such association through the technical societies. The meeting of engineers under conditions where all are on a common footing fosters a spirit of kindly co-operation and helpfulness which binds them together and makes each of greater usefulness to the other. It is only by wide co-operation that the best advancement can be made in engineering science and achievement.

As in the legal profession the decisions of the judges are entered and published, thus forming a basis of precedent for future use, so also it is desirable that records of important engineering work should be published in order that we may benefit by the experience of others. Many of the larger engineering undertakings are the result of the co-operation of several engineers who are proficient in their respective fields. It is, of course, customary to have a chief engineer at the head of any important enterprise, nevertheless, the work which he supervises is usually the product not of himself alone but of those also who are associated with him. It frequently happens that on large undertakings experts in various lines of the work are employed and the duty of the chief then consists in determining the general scope of the work, the special features being developed by these experts in their respective lines. For instance: the building of a large steel plant requires expert metallurgical engineers, electrical engineers, mechanical engineers and structural engineers. It is manifest then that as the work becomes of great magnitude, it is most important that accurate records of the same should be made available. These records can best be promulgated through the proceedings of technical societies. Such published proceedings find their way around the world.



Scoop Truck for Broken Stone and Sand.

Technical societies also afford the younger engineers the opportunity of securing the experiences of older engineers, resulting from the fact that they are permitted to participate on an even footing in the discussion of the papers presented.

The older engineers should and generally do take great interest in the work of the student engineers, and the latter may be greatly profited thereby.

The influence of the technical society and its value to the professional engineer is probably even greater than to the student. The practicing engineer is no longer under the guidance of professors and instructors and his opinions and development of ideas must be largely molded by those with whom he associates.

To be well educated involves not merely the mastery of knowledge, statistics and current events, but also embodies the broadmindedness which can see the justice and good sense of the other fellow's opinions and beliefs. A comprehensive judgment of various views and solutions is only possible through the assimilation of ideas and associations such as an engineering society offers.

In the technical societies the various steps of mechanical development are depicted both from the practical and theoretical standpoint. They afford the engineer an opportunity to supplement his own knowledge by the experience of his fellow engineers. They afford him the opportunity to present to the world what he himself has accomplished and to receive criticisms and suggestions from his fellow men and resulting from the discussion of the various subjects which are presented the engineer learns to appreciate the benefits of co-operation; by means of which both the giver and receiver are greatly benefited.

A Scoop Truck for Handling Coal, Sand and Broken Stone.

(Staff Article.)

The scoop truck shown by the accompanying sketch should be a useful device for performing at times various tasks which are commonly performed with wheelbarrows and by shoveling in construction work. The device is comparatively light, weighing only 50 lbs., and its price, $10 f. o. b. factory, Lansing, Mich., is small. It has so far been chiefly used for unloading coal and grain from cars but is obviously capable of handling other fragmentary materials equally well.

The scoop bowl is 22 ins. wide at the front edge and 21 ins. long from front to rear and is pressed No. 10 gauge steel plates. The handles, 1¾x2-in. white oak, are 4 ft. 10 ins. long from back of bowl to tips. The wheels are of cast iron, with 1¼-in. treads, and are 5 ins. in diameter. The axle is forged steel.

The scoop truck is manufactured by the Detroit Scoop Truck Co., Detroit, Mich.

ROADS AND STREETS

The Repair and Maintenance of Macadam Roads.

Very little data of any value on the maintenance cost of highways are available. For this reason a bulletin issued last month by the U. S. Office of Public Roads is of particular interest. The bulletin was prepared by Lawrence I. Hewes, Chief of Economics and Maintenance, Office of Public Roads, and it contains a considerable amount of information as to the methods and costs of highway repair and maintenance. From this bulletin the matter that follows this was taken.

In his introduction Mr. Hewes draws the following distinctions between the terms maintenance, repair and reconstruction:

It is now recognized that there is a sharp distinction between the terms repair and maintenance, as applied to operations upon highways. When a road of any type is completed, the effect of travel and the elements tend to destroy it. Those operations required constantly to oppose the deterioration of the road constitute general maintenance. Without maintenance, the road after a time is partially destroyed, and operations then necessary to restore it constitute repair. It is true that both processes are often similar in kind and may overlap. They differ in quantity and in the order in which they are applied. A road properly maintained may not need repair for an indefinite interval, but a road properly repaired always needs maintenance. The term "strict maintenance" may be used to denote those operations that continuously keep a road true to its type, whether or not such operations restore the constant wear of the traveled way. When the hard surface of a road becomes worn so thin that resurfacing is necessary, such operations must at present be classed as repair, even though resurfacing operations may at times involve practically a reconstruction of the road surface. If a macadam road were paved with brick or rebuilt of concrete or other material and the result were decreased annual maintenance, such work would be essentially reconstruction. To indicate the kind of maintenance which constantly replaces a worn surface and so preserves the integrity of the road, the term "absolute maintenance" seems justified and is so used.

RESURFACING ORDINARY MACADAM.

Data on 54 pieces of resurfacing of ordinary macadam done by the Massachusetts Highway Commission in 1902, 1903, 1904, 1905 and 1907 show the following:

Average resurfacing period, years	6.27
Average amount of stone per mile per year for 15-ft. road, tons	207
Average amount broken stone per sq. yd. per year, tons	.0235
Average cost per sq. yd., cts	28.88
Average cost per sq. yd. per year, cts	4.59
Average cost broken stone in place, per ton	$1.96

In general this resurfacing was done by first loosening the old surface with picks in the roller, reshaping the crown without screening and then adding new stone in the form of a top course.

The following shows the average costs of 19 resurfacing jobs in New York State done in 1909 by the Department of Highways:

Average age when resurfaced, years	6.76
Average cost per mile	$3,167
Average cost per sq. yd., cts	39
Average cost per sq. yd. per year, cts	5.77

The data that follow relate to resurfacing work in the Duchy of Baden in Germany, during the period from 1900 to 1907. The results of general resurfacing of six roads in the Valley of the Black Forest show the following:

Average life of road, years	4.3
Average amount of stone per mile, tons	908
Average amount of stone per mile per year, tons	211
Average amount of stone per sq. yd. per year for 15-ft. road, tons	.024
Average cost per ton	$1.220
Average cost of laying stone, per ton	$0.41
Average cost per mile per year, stone and laying	$344

The averages for the general resurfacing of 204.6 miles of roads of Baden, Germany, were:

Average life of metal, years	4.66
Average amount of stone per mile, tons	912
Average amount of stone per mile per year, tons	202
Average amount of stone per sq. yd. per year for 15-ft. road, tons	.0222
Average cost per ton	$1.177
Average cost of laying stone, per ton	$0.429
Average cost per mile per year, stone and laying	$323

TABLE I.—BITUMINOUS SURFACING BY OFFICE OF PUBLIC ROADS.

Location of work.	Kind of material.	Year when built.	Freight and miscellaneous (per sq. yd.).	Length surfaced (ft.).	Area (sq. yds.).	Stone. Tons (per sq. yd.).	Cost of stone in place (per ton).	Gals. (per sq. yd.).	Bituminous material. Cost (per gal.).	Heating (per sq. yd.).	Hauling (per sq. yd.).	Applying and mixing (per sq. yd.).	Rolling (per sq. yd.).	Total cost (per sq. yd.).	Total cost of job
										Cts.	Cts.	Cts.	Cts.	Cts.	
Westminster, Md.	Water-gas tar and oil	1910	[1]$0.067	5,650	20,500	0.155	$1.64	2.3	$0.070	0.88	0.47	0.95	0.17	[1]56.6	$11,618.25
El Paso, Tex	Asphalt—penetration method	1909	.....	.....	23,470	.145	[2]1.45	1.8	.090	.....	[2]6.55	.....	.....	44.08	10,344.20
Bowling Green, Ky	Rock asphalt	1907	[3].057	385	770	.154	.94	[4]8.2	[5]5.82	.....	.....	1.44	2.18	[3]47.63	366.79
Newton, Mass. (mixing method):															
No. 1	Asphaltic preparation	1908	.....	222	567	.158	.69	.54	.13	(6)	20.23	7.87	(7)	46.92	266.04
No. 2	Asphaltic preparation	1908	.....	499	1,226	.158	.69	.54	.13	(6)	20.23	7.87	(7)	46.92	578.05
No. 3	Asphaltic preparation	1908	.....	479	1,064	.158	.69	.54	.13	(6)	20.23	7.87	(7)	46.92	499.23
No. 5	Asphaltic preparation with flush coat	1908	.....	98	223	.158	.69	1.12	.13	(6)	23.59	7.87	(7)	64.04	142.81
No. 7	Asphaltic preparation	1908	.....	232	618	.158	.69	.71	.13	(6)	20.23	7.87	(7)	48.16	298.11
No. 10	Water and coal-gas tar	1908	.....	326	869	.160	.69	.99	.08	(6)	23.10	12.18	(7)	46.55	183.70
Ithaca, N. Y. (penetration method):															
No. 1	Refined coal tar	1909	.050	300	620	.179	1.01	2.02	.065	2.02	2.84	(7)	.92	45.92	284.70
No. 5	Refined semiasphaltic oil	1909	.040	300	533	.179	1.01	1.50	.115	1.50	2.92	(7)	.92	49.32	262.88
No. 6	Semisolid refined semiasphaltic oil	1909	.034	300	533	.179	1.01	1.64	.07	1.64	3.19	(7)	.92	43.32	230.99
No. 7	Refined water-gas tar	1909	.046	300	533	.179	1.01	1.88	.07	1.88	3.65	(7)	.92	46.95	250.24
No. 8	Refined semiasphaltic oil	1909	.03	300	533	.179	1.01	2.06	.07	2.06	4.01	(7)	.92	52.30	278.76
Ithaca, N. Y. (mixing method):															
No. 2	Refined coal tar	1909	.074	300	622	.179	1.01	1.36	.08½	.44	2.65	10.32	.92	56.02	348.44
No. 4	Artificial oil asphalt	1909	.136	275	489	.179	1.01	.92	.10	.....	1.79	10.32	.92	56.62	286.65
No. 12	Artificial oil asphalt	1909	.072	260	463	.179	.89	1.90	.07½	.98	3.70	18.59	.92	60.89	281.92
Itsaca, N. Y. (penetration method):															
No. 15	Oil asphalt	1910	.037	300	533	.181	1.14	1.50	.07½	1.85	1.90	(7)	5.01	49.73	265.06
No. 16A	Refined asphaltic preparation	1910	.053	106	308	.242	1.17	1.60	.11½	6.76	1.01	(7)	5.01	69.36	213.63
No. 16B	Refined asphaltic preparation	1910	.035	146	260	.242	1.17	.80	.11½	3.38	.51	(7)	5.01	54.43	141.50
Ithaca, N. Y. (mixing method):															
No. 17	Oil asphalt	1910	.045	300	533	.189	.83	1.43	.11½	2.13	3.37	29.6	5.01	82.18	438.02
No. 18A	Refined semiasphaltic oil	1910	.036	206	366	.181	.83	1.38	.07	2.17	4.83	27.0	5.01	72.49	265.32
No. 19A	Refined water-gas tar	1910	.044	130	231	.189	.83	1.43	.07	1.17	3.83	17.3	5.01	62.84	145.16
No. 19B	Refined water-gas tar	1910	.036	170	302	.181	.33	1.01	.07	.....	4.38	19.8	5.01	60.34	182.23
No. 20	Oil asphalt	1910	.055	296	526	.206	.83	1.53	.10	1.47	3.43	18.4	5.01	72.26	380.09
Knoxville, Tenn. (penetration method):															
No. 1	Refined coal tar	1910	.023	217	482	.188	.85	1.99	.11	.....	.36	2.78	1.27	46.89	226.01
No. 2	Refined tar preparation	1910	.061	590	1,311	.188	.85	1.71	.06	.....	.19	3.24	.80	40.83	535.28
No. 3	Oil asphalt	1910	.023	173	405	.188	.85	2.19	.07⅓	.....	.....	2.96	.91	40.56	164.27
Averages					*53,890	.....	.....	.....	....	.....	.....	.....	.....	50.05	†$29,478.26

*Total area in sq. yds. †Total cost of all roads

[1] Cost of preparing subgrade, 6.7 cts. per sq. yd., included in final cost.

[2] Includes cost of heating, laying and rolling.

[3] Cost of preparing subgrade, 5.7 cts. per sq. yd., included in final cost.

[4] Pounds per sq. yd.

[5] Dollars per ton, including cost of hauling.

[6] Included in cost of mixing.

[7] Included in cost of hauling.

For general resurfacing with porphyry in Baden in 1906-7 for 128 miles of roads the averages were as follow:

Average life of surfacing, years	4.58
Average amount of stone per mile, tons	957
Average amount of stone per mile per year, tons	208
Average amount of stone per sq. yd. per year for 15-ft. road, tons	.0213
Average cost per ton	$1.23
Average cost of laying stone, per ton	$0.423
Average cost per mile per year, stone and laying	$343

The average cost of resurfacing 18 sections of Maryland roads, the total area being 37,110 sq. yds., was 29.9 cts. per square yard. Ordinary macadam resurfacing costs in Allegheny County, Pa., in 1911, averaged 38.4 cts. per square yard on 19.4 miles. On about 100 miles previous resurfaced with 4 ins. of broken stone the cost was 44 cts. per square yard.

MAINTENANCE OF ORDINARY MACADAM ROADS.

Under the system of periodical resurfacing at intervals of six years and more, the continuous maintenance of an ordinary or water-bound macadam road must take care of small patching and fill up ruts and hollows. Frequently a new macadam road shows some raveling, and it is necessary to remove the scattering, loose stones, which are stacked for future use. The primary object of macadam surface maintenance under the periodic repair system is, therefore, to prevent incipient ruts from becoming deeper, to fill up holes which hold water, to stop raveling, and to clean the road of organic matter, mud and dust. Where a road shows frost action in the spring, rolling with a steam roller produces excellent results. Sometimes there is a tendency for ordinary macadam roads which are exposed to wind action to ravel during the dry summer months. Such raveling occurs from loss of fine bonding material and has been combated with more or less success, particularly in Massachusetts, by the application of a coat of coarse sand. The application of sand is made along the center portion of the road and is soon spread by travel over the width of macadam. The coarse screenings which work toward the edges of a road are sometimes swept back to the center with push brooms. A supply of No. 2 stone or stone of the size in the wearing course should always be placed along the roadside.

It is necessary, in addition to the maintenance of the macadam surface itself, to clean the gutters, catch basins, and culverts which constitute the drainage features of the road. The road shoulders must be kept pared and free from weeds, and small gullies on the shoulders and embankments must be repaired before they become too large. Guard rails must be repaired and painted and the general neatness of the roadway preserved. In Allegheny County, Pa., the road petrolman also whitewashes culvert ends, sewer heads, etc., as a protection to travel. The cost of such maintenance for a number of years averaged approximately $100 per mile in the State of Massachusetts, where the macadam roadways are built 15 ft. wide and a large percentage of them are surfaced with trap rock which had been bonded with screenings of the same material. The Massachusetts authorities estimate that the expense was equally divided between work on the macadam surface itself and the care of the roadway. The cost of patrolling the ordinary macadam roads in New York State, where men are in charge of sections averaging 5 miles and supply hand tools and a horse with a cart, is expected to be about $125 per mile.* This cost does not, however, include material, which is furnished by the State. The use of some form of bituminous material in macadam road construction and in resurfacing operations upon old roads has now become so well established that the problem of macadam road maintenance has necessarily changed to a problem of maintenance of roads on which bituminous material has been used.

It is clear from the above analysis of the cost of general resurfacing and of continuous maintenance of ordinary or water-bound macadam roads that the annual charge for all repairs and maintenance of such roads has been about $525 per mile per year for a 15-ft. road, or about $35 per foot of width of macadam surface per mile. This charge allows from $100 to $125 for annual maintenance by a patrol and an annual charge of from 4.54 cts. to 4.83 cts. per square yard for resurfacing at necessary periods. The annual charge per mile is rated as a charge against the hardened way itself for purposes of uniformity. It is quite probable that in many instances the cost of maintaining the roadway or roadside outside of the macadamized portion will be less than $50 per mile, particularly as the continuation of good maintenance brings the whole road into better control from year to year. It must be understood that this figure is an average figure and varies with the intensity of travel, as well as with climate, the cost of road material, and the price of labor. It is furthermore a figure for standard maintenance and repair and insures the life of the road indefinitely for similar traffic without any additional cost. Future study should aim to determine in advance of construction the most economical width of macadam surfaces for maintenance under the expected increase of traffic which follows improved roads and increases from year to year.

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*During 1912 there were 735 patrolmen in charge of the maintenance of about 3,100 miles of road. The cost of the patrolmen's service was $137.12 per mile.

BITUMINOUS RESURFACING.

Although the repair or resurfacing of ordinary macadam roads with a bituminous binder is comparatively recent, certain important facts are now sufficiently well defined. There still exists some variation in the character of bituminous material used and in the application of such materials.

It has been found expedient in general, where roads are much worn, first to scarify or loosen the old macadam and then to add sufficient new stone to restore a true crown. Earth shoulders are carefully preserved along the edges of the foundation course. Either of two general methods of resurfacing may then be employed—the mixing method or the penetration method.

Data on 125.3 miles of resurfacing operations (bituminous macadam) on roads in New York State in 1909-10 give the following averages:

Average age when resurfaced, years	7.39
Average cost resurfacing per mile	$5,716
Average cost per sq. yd., cts	72.4
Average cost per sq. yd. per year, cts	9.83

The avove work was done under contracts let by the State Department of Highways.

The average costs on the bituminous resurfacing of eight sections of Maryland roads, the work being done in 1910, were as follows:

Average cost for resurfacing macadam, per sq. yd	$0.397
Average cost of pitching, including chipping, per sq. yd	.243
Total cost of road surface	$0.640

During 1911 the bituminous reconstruction of 32.55 miles in Allegheny County, Pa., cost on an average of 92.3 cts. per square yard. The subdivided cost per square yard of reconstructing 14,764 sq. yds. by the penetration method in Baltimore, Md., is reported as follows:

	Cost (cts.)
Labor	24.82
Stone	27.40
Rolling	4.84
Binder	13.74
Coal	.95
Hauling binder	.41
Incidentals, including supplies and repairs to plant	.79
Total	72.95

The quantity of bituminous material was 1.9 gals. per square yard.

The detailed cost of bituminous resurfacing at Chicopee, Mass., in 1912, with a 2-in. layer by the mixing method is reported by the State Highway Commission as follows:

Bitumen at the rate of 1.54 gals	$0.10
Trap rock, pea stone covering, at the rate of 0.027 per sq. yd	.07
Heating, mixing and applying	.20
Trap-rock broken stone, at the rate of 0.115 ton per sq. yd	.30
Total	$0.67

Considerable work, in the nature of bituminous resurfacing, has been done by the Office of Public Roads, with the co-operation of several localities. In general, the roads treated were not excessively worn and the cost of the work, which is given in Table I, does not include preparation of the foundation course except where specified. The weighted average cost of stone in place was $1.35 per ton, which is somewhat low, and no cost of supervision is included.

SURFACE TREATMENT.

The term "surface treatment" as used by Mr. Hewes in his bulletin designates primarily that treatment with bituminous material which is applied to a water-bound or ordinary macadam road, or which is subsequently applied to a macadam road constructed or resurfaced with bituminous material and which is intended to supply a wearing coat to the road and to prevent the formation of dust. Essential distinguishing features of surface treatment are, then, the application of a course of screenings or broken stone or equivalent "fines," such as clean small gravel or coarse sharp sand, and the use of heavier bituminous material.

The entire process of surface treatment has become fairly well defined. The principal operations are as follows:

(a) Cleaning the old macadam road surface thoroughly with a mechanical sweeper or hand brooms, so that no fine material or dust remains.

(b) Restoring an even smooth surface by placing No. 2 stone or clean screenings and bituminous material in hollows and ruts.

(c) Applying a uniform coat of bituminous material over the entire macadam surface.

(d) Covering the bituminous material with stone screenings from which the dust has been removed, or with equivalent material, such as clean fine gravel or sharp coarse sand.

(e) Rolling with a light roller or, after a sufficient interval, opening the road to travel without rolling.

There are a number of modifications and variations of the process of surface treatment, as outlined above. The object of such treatment is to supply a wearing coat more or less resilient, and to prevent the formation of dust, the loss of binding material, and the consequent disintegration of the road surface.

It has been observed that where a perfect surface is continuously maintained upon a road the harmful action of automobiles is almost completely stopped. The bituminous material incorporated with broken stone screenings forms a protective coating, "carpet," or "enamel" which prevents the beginning of ravel due to shear and the loss of binding material under the action of automobiles.

Even the smallest amount of dust remaining on an old macadam surface when the bituminous coat is applied may prevent the proper adhesion and cause subsequent flaking or peeling. Care must be used, however, in sweeping not to disturb the larger stones in the old surface, and for this reason soft brooms may be used to complete the sweeping. Machine sweepers are being used in increasing numbers and do their work more cheaply, but some hand sweeping is usually needed for a perfect job.

Ruts or depressions which occur in a road surface may be picked out clean, coated with bituminous material, and then filled with clean stone previously mixed with bituminous material, or the stone may be covered when it is in place. It is necessary that the road surface present an even, smooth condition before the bituminous material is spread upon it. All hollows become points of wear and collect water, which tends to disintegrate the bituminous material.

It is very desirable for a coat of bituminous material to penetrate the surface of the road to some extent, and for this reason the more perfectly the old road mosaic is exposed by sweeping without loosening the stone the better the results will be. The bituminous material may be applied hot or cold to a dry road, as described above. Push brooms are also used to work the bituminous material over the road surface.

A number of instances are on record where excellent results have followed the application of a bituminous coat to roads which have been previously soaked with water and allowed partially to dry over night. Apparently the resulting moisture induces capillarity and offers a better chance for the bituminous material to take hold or penetrate, notwithstanding the objections to the applications of bituminous material to a moist surface.

The presence of dust in the stone screenings is objectionable, as it prevents the intimate adhesion desired. The application of bituminous material should be sufficient to allow some absorption by the road and a sufficient residue to form a mat, "carpet," or "enamel," with the applied "fines" and thus secure a wearing surface thoroughly bonded with the road itself.

There seems sufficient evidence that the application of from 0.3 to 0.5 gal. per square yard of bituminous material is enough, although it may run as high as ¾ gal. Excellent results have been obtained where the bituminous material has been spread in two courses. The first course of about ¼ gal. to the square yard, followed by a coat of screenings, is allowed to stand for a few days and is followed by a second coating of about ¼ gal. to the square yard and a final coat of screenings. While it is not absolutely necessary to roll the road treated in this way, better results have followed where light rolling has been done. It usually requires from 75 to 120 cu. yds. of stone screenings or other "fines" per mile to build a surface coat thoroughly bonded with the road, and from ⅜ to ½ in. in thickness. It is desirable that the bituminous material be well covered by the "fines" and that there be some set or hardening upon cooling. It is necessary to have a sufficient surplus of screenings along the roadside at intervals to take care of all "bleeding" of the surface, as travel upon surface-treated roads tends to bring up the bituminous material from below.

Surface treatment, as above described, has proved an efficient method of maintenance of water-bound or plain macadam roads and is the logical method of maintaining macadam roads which have been built or resurfaced with a bituminous wearing course. The interval of wear of a surface treatment depends in part upon the nature and amount of travel. Indications at present are that the length of service is from one to three years, although longer intervals are on record.

Failures of surface treatment have resulted and are probably due to some of the following causes: Insufficient cleaning of the road surface, unsuitable bituminous material, nonuniform application, unsuitable covering material or "fines," excess of dust in the screenings, or unfavorable weather conditions. In all surface treatment operations it is necessary to give careful attention to details.

Table II gives a history of the cost on nine ordinary macadam roads in Massachusetts which were given the surface treatment in 1909 and were maintained by small patching during the years 1909, 1910 and 1911. The work was done by the Massachusetts State Highway Commission.

The cost of surface treatment varies with local conditions. The treatments, such as have been described above, should cost from 4 to 12 cts. per square yard. The following items are the subdivided cost figures per square yard for oiling a Massachusetts road in 1910. The conditions were those of an ordinary road in that state. The treatment required ½ gal. of oil per square yard in two applications of ¼ gal. each. The average haul for oil was 2 miles, and sand for covering was furnished and hauled an average of 2½ miles under contract:

Cleaning and sweeping	$0.0056
Patching old surface	.0016
Cost of oil	.0319
Heating oil	.0031
Delivering oil	.0033
Distributing oil	.0029
Furnishing sand beside road	.0165
Spreading sand	.0073
Watering	.0012
Rolling	.0002
Supervision	.0025
Total	$0.0766

The detailed cost of two jobs recently reported by the Massachusetts State Highway Commission for 1912 is given below. It will be seen that these costs covered more than is described by the typical resurfacing operations in the text:

Agawam (mixed method).—The road was scarified and the old surplus bitumen was removed, after which the road was reshaped and ¼ gal. per square yard of standard binder A was applied. This coat was given a light covering of trap pea stone, after which a second ¼ gal. of oil was applied and covered with pea stone.

	Per sq. yd.
Preparation of road surface, including scarifying, reshaping, etc.	$0.0474
Cost of oil distributed on road, including bitumen, heating, hauling, water and rolling	.0509
Cost of trap pea stone per sq. yd., at the rate of 0.035 ton per sq. yd.	.0852
Total per sq. yd.	$0.1835

Chicopee (penetration).—The old surface was heated with ½ gal. of tar per square yard, which was covered with sand and 0.04 ton of trap broken stone per square yard. A second application of ¼ gal. of tar per square yard was made and covered with 0.015 ton of trap pea stone per square yard. A third application of ¼ gal. of tar per square yard was then given and covered with 0.015 ton of trap pea stone per square yard.

	Per sq. yd.
Trap broken stone	$0.12
Heating, hauling and distributing bituminous material	.10
Bituminous material	.065
Trap rock pea stone	.081
Total per sq. yd.	$0.366

The cost of surface treatment of 1,000 miles of macadam road in the State of New York by the department of highways in 1910 was:

	Per mile.
Oil	$166.57
Labor, oiling, sweeping and applying cover	107.22
Material for cover	230.29
Total per mile	$504.08

The above cost per mile, assuming a 15-ft. road, is equivalent to 5.72 cts. per square yard. The bituminous material used was a heavy oil and the screenings were dustless.

In 1906, on the Metropolitan Park roads in Boston, 67,500 sq. yds. of surface were treated for 6.66 cts. per square yard. In the following year, 1907, the total cost of small repairs and re-treatments was 3.5 cts. In 1908, re-treatments cost 4.75 cts. on one-half the yardage already treated with refined tar; the remainder did not require treatment. The average cost of re-treatments in 1909 and 1910 was 6 cts. for each re-treatment, averaging once in two years. Figures on surface treatment by the State Commission of Highways of New York in 1912 show 99,314 sq. yds. treated with hot oil at a cost of 11.75 cts. per per square yard and 70,108 sq. yds. treated with cold oil at a cost of 6.83 cts. per square yard.

TABLE II.—COST OF MAINTENANCE ON ROADS OILED IN 1909 AND NOT RE-TREATED SINCE (MASSACHUSETTS STATE HIGHWAY COMMISSION).

No.	Year of original expenditure.	Area sq. yds.).	Length miles).	Original construction cost per mile.	Cost of oiling in 1909: Total cost.	Cost per sq. yd.	Cost per mile.
1	1909	7,750	0.880	$9,750.51	$ 637.50	$0.0823	$724
2	1900	3,090	.351	6,380.43	239.43	.0775	682
3	1897	8,530	.970	3,860.00	618.43	.0725	638
4	1901	10,505	1.000	5,857.51	660.51	.0628	661
5	1899-1904	30,000	3.409	6,551.01	1,745.56	.0581	512
6	1904-1905	12,655	1.438	6,032.84	1,256.07	.0992	872
7	1900-1906	51,641	5.868	7,076.01	4,066.17	.0787	693
8	1895-1896	25,873	2.940	8,862.60	1.875.79	.0725	638
9	1907-1908	10,333	1.174	7,807.04	809.99	.0784	690
Averages	....	[1] 160,337	[2] 18.03	$7,519.77	[3] $11,909.51	$0.0742	$660

No.	Cost of patching: 1909 Per sq. yd.	1909 Per mile.	1910 Per sq. yd.	1910 Per mile.	1911 Per sq. yd.	1911 Per mile.
1	$0.0027	$24 58	$0.0226	$199.21	$0.001	$ 8.17
2	......	.....	......	......	.....	......
3	.0009	8.14	.0104	92.11	.0187	165.03
4	.0020	21.20	......	......	.0073	82.63
5	......	.....	.0236	207.81	.0229	202.21
6	.0008	7.53	.0054	47.61	.0041	36.44
7	.0008	7.73	.0027	25.27	.0028	24.42
8	.0003	3.36	.0106	93.31	.0072	63.38
9	......	.....	.0055	48.89	.....	......
Averages	$0.0007	$ 6.48	$0.0094	$ 84.59	$0.0082	$ 73.55

No.	Cost of sanding: 1909 Per sq. yd.	1909 Per mile.	1910 Per sq. yd.	1910 Per mile.	1911 Per sq. yd.	1911 Per mile.	Total cost per sq. yd.	Total cost per mile.
1	....	.....	$0.0056	$ 49.72	....	......	$0.1142	$1,005.68
2	....	......	.0065	57.40	....	......	.0840	739.10
3	....	......	.0024	21.53	$0.6026	$23.50	.1075	948.31
4	....	.....	......	......	....	......	.0726	764.83
5	....	......	.0016	13.83	....	......	.1062	935.85
6	$0.0039	$34.45	.0243	214.24	....	......	.1377	1,212.27
7	....	......	.0040	35.36	....	......	.0890	785.78
8	....	......	.0062	55.12	.0012	10.61	.0980	864.28
9	....	......	.0025	22.57	.0048	42.53	.0912	803.99
Averages	$0.0003	$ 2.73	$0.0052	$ 46.52	$0.0006	$ 5.76	$0.0988	$ 879.63

[1] Total area in square yards. [2] Total length in miles. [3] Total cost of all roads oiled in 1909.

Surface treatment of a road subject to considerable motor traffic appears to be the logical and necessary form of repair. For the best results it must be accompanied by continuous strict maintenance. Such maintenance does the small work constantly necessary to keep the surface of the road free from occasional peeling or raveling and the consequent formation of depressions and ruts. Piecemeal bituminous patching involves considerable waste in heating tar and assembling material. It appears that a motor truck supplied with a sprinkling device to resurface with hot bituminous material would be capable not only of doing small patch repairs but of general resurfacing operations when necessary. Experience in Massachusetts and New York and in several counties of other states goes to show that a patrol system under which one man furnishes small tools and a cart with a single horse and spends his entire time upon the road cannot be put in effect at less than $125 per mile per year.

Perhaps the most significant fact in connection with surface treatment with bituminous material is the apparent increase of the life of the road. Theoretically, surface treatment supplies a wearing coat or "enamel," which prevents internal wear entirely and supplies an excellent waterproofing for the road. There should be, therefore, no deterioration of the road itself where the surface treatment is effective. This form of road repair has not, however, been practiced for a sufficient length of time to verify this theory. The life of the modern bituminous-bound macadam road is as yet unknown.

DUST PREVENTION.

There is a form of surface treatment which is largely for the purpose of dust prevention, but which may gradually accumulate a binding layer when material containing an asphaltic base is used. The theory of this treatment is to supply a liquid which binds sufficient dust to prevent it from being raised by air currents from the road surface. The simplest method is to sprinkle the road with water, but this means repeated applications during the summer season, and the expense upon country roads is prohibitive. Various hygroscopic salts have been used, particularly calcium chloride. These salts have the property of absorbing water from the air and they serve, when applied dry or when mixed with water, to hold moisture in the surface of the road and prolong the period of dustlessness. Dry granulated calcium chloride has been used on New York State roads, where it has been applied at the rate of about 1 lb. to the square yard, followed by two later applications of ¾ lb. each. The cost is expected to be about $125 per mile if the patrolman does the spreading. The width of application is 10 ft. Dust palliatives are, however, in no sense a structural benefit to the road, although they may serve in a measure to preserve it.

Another form of surface treatment for dust prevention is to sprinkle the road with some form of light oil. This method of road treatment has assumed a variety of forms, which range all the way from a thorough surface treatment intended to build up a road to the lightest spraying of the road surface without addition of any "fines" whatever. It has been found that for certain classes of roads where watering was necessary an annual surface treatment of oil with "fines" combines the results of dust laying and maintenance.

During the season of 1911 oiling in Rhode Island with a light semi-asphaltic oil cost $96 per mile for a 14-ft. road, or 1.17 cts. per square yard. The application was about ⅛ gal. per square yard and was made under pressure with an auto tank truck. The cost of filling holes with stone and top dressing is not included in the oiling price. The State spent $31,000 for oiling and $71,967 for filling holes with crushed stone and top dressing.

In Allegheny County, Pa., for five years (1907 to 1911), light asphalt-road oil has been used as a dust layer. Between 300,000 and 400,000 gals. have been used each year, and the distribution is made from tank wagons and distributors owned by the county. The county is subdivided into four sections, each in charge of an assistant superintendent, and the work of oiling is done with the county force. The mileage of completed roads was about 400 in 1911. The total cost of applying oil is about 2¼ cts. per square yard, and no screenings or other "fines" are used.

Maintenance of Sheet Asphalt Pavements.

The deterioration in an asphalt pavement which eventually makes repairs necessary may be broadly classified as (1) defects due to the wear and tear of traffic; (2) defects caused by the deterioration, through age and exposure of the bituminous cementing material used; and (3) defects in construction. An interesting discussion of these causes of deterioration was given by Mr. Francis P. Smith, consulting engineer, New York City, in a lecture delivered last January in the graduate course of Highway Engineering at Columbia University. An abstract of the lecture follows:

TRAFFIC DETERIORATION.

Under traffic the surface of the pavement is abraded and gradually wears off and the mineral particles exposed on the top are more or less crushed and broken. Where these particles are large, this crushing action is plainly noticeable, but with the smaller particles of sand it is hard to detect it. Under heavy traffic and unfavorable weather conditions, these crushed grains become active centers of disintegration. The crushed particles are not bound together by the asphalt cement and are soon swept away. The holes thus made in the pavement serve to retain the moisture and the edges of the holes are eventually more or less broken down, thus enlarging the hole. This condition reproduced all over the surface tends to make it wear away much more rapidly than would otherwise be the case. The effect of this action, which at first glance appears trivial, has been so well established by years of investigation and experience that it has become axiomatic in the paving industry that the heavier the traffic the finer must be the particles composing the mineral aggregate.

In hot weather, when the pavement is plastic, the abrasion of the surface is much less than in cold weather, when the pavement is hard and possesses practically no plasticity. In hot weather the caulks on horses' shoes sometimes mark up the pavement to a very considerable extent, but the subsequent action of vehicular traffic wears these marks out almost completely. Nevertheless, in a community unaccustomed to sheet asphalt pavements, the appearance of these caulk marks in a new pavement is always regarded as an ominous sign presaging its speedy destruction and failure. As a matter of fact, if the pavement, especially when newly laid, were not soft enough to show these marks it would be an almost infallible sign that the asphalt cement used in it was too hard and that the total life of the pavement would be less than if a softer asphalt cement had been used.

Traffic on a pavement always compresses it and increases its density, and for this reason a 2-year-old pavement will always mark up less than a new one. The pressure per square inch exerted by the comparatively narrow tire of a heavily loaded vehicle is much greater than that exerted by the heaviest steam roller used in the laying of sheet asphalt pavements. Even if this were not the case, the kneading action produced by narrow tires passing many times over the surface would always give greater compression than could be obtained by the action of the broad tires of a steam roller.

When the traffic is confined to a comparatively narrow space and is always in the same direction, a distinct pushing force is exerted on the pavement. Whenever the pavement lacks inherent stability, due to an improper mineral aggregate or bitumen which is lacking in cementing value from natural causes or the rotting action of gas or water, or a combination of these defects, very distinct waves or bumps will be produced by the action of heavy traffic. These waves sometimes occur in recently laid pavements in which the asphalt cement used was of the highest quality, but in such cases will usually be confined to a few places. Investigation will almost always show defective binder in these spots, or too soft an asphalt cement, or too great a thickness of pavement owing to an error in the grade of the concrete. A paving mixture, designed to have proper stability when laid 2 ins. thick, will often fail in this respect when laid 4 ins. thick, which is the explanation in the case last cited. Too soft an asphalt cement will also reduce the stability of a pavement. Once these waves appear, they are aggravated by traffic passing over them. The wheel of each vehicle rises to the crest of the wave and then drops down with considerable force into the adjacent depression. The plastic pavement in this way is continually displaced at the low spots and shoved up at the high spots until in many instances the concrete will be exposed at the bottom of the depression. Similar depressions are produced by setting manholes too high above the surrounding pavement. Vehicles drop off these high manhole covers onto the pavement and soon pound it out of place. It is better to set all manholes slightly below the grade established for the finished pavement.

Waves are much less liable to appear in those portions of the pavement which are subjected to cross traffic, i. e., in which the traffic does not always move in the same direction. This is usually the case at street intersections, and, if properly constructed, the pavement in these locations almost always lasts longer than in any other part of the street. It has been seriously suggested that in order to increase the effective life of pavements, the direction of the traffic in the afternoon should be the reverse of that in the morning, but the resulting confusion would probably more than offset the gain from such a procedure.

Car tracks in a street paved with sheet asphalt may cause the pavement to deteriorate very rapidly. Unless the rails are very heavy and laid on an adequate foundation, they will vibrate excessively when cars pass over them. This is especially the case where tracks designed for light city or town cars are subsequently called upon to carry heavier cars or cars of the interurban type. Not only will the vibration be excessive, but the rails will frequently sink below the level of the pavement and leave depressions where the water will collect. To prevent the vibration from being communicated directly to the sheet asphalt, rows of paving blocks or bricks are frequently placed along the rails, although in many cases the sheet asphalt is brought up directly to the rails. When the vibration is excessive, the sheet asphalt pavement crumbles or cracks in a very short time and leaves an opening for surface water to enter between the wearing surface and the concrete foundation, thus permitting the rotting action elsewhere described to take place.

EFFECT OF AGEING AND EXPOSURE.

All bituminous materials used in paving work deteriorate upon exposure to the elements and to the rotting action of escaping gas, water and street liquids. The lighter oils contained in them gradually volatilize, thus hardening the remaining bitumen. As the hardening process goes on the pavement loses its plasticity and wears away with increased rapidity. Eventually the bitumen loses its elasticity and the pavement cracks. The edges of these cracks crumble away and the cracks become sufficiently wide to be plainly felt by vehicles passing over them. The bumping action previously described in connection with waviness is produced and adds to the rapidity with which crumbling takes place. In order to guard against this and prolong the effective life of the pavement, the asphalt cement used in its construction is made as soft as possible without rendering the pavement too mushy when new. The extent to which this can be carried depends upon the grading and character of the sand employed. With a well-graded sharp sand and plenty of filler a much softer asphalt cement can be used than with a poorly graded or rounded sand. This is due to the greater inherent stability of the former type of sand. It is obvious that a mineral aggregate which when dry strongly resists displacement will permit the use of a comparatively soft asphalt cement. Modern traffic conditions have in this particular respect come to the aid of the pavement makers. Automobiles in their passage over the pavement are continually dropping a certain amount of oil on its surface, which is very evenly distributed by the large number of vehicles passing over it. This oil is gradually absorbed by the pavement and thus softens the bitumen and counteracts to a large extent the hardening action of time upon it. This is very clearly shown in a certain pavement in Chicago, which, prior to the passage of any considerable number of automobiles over it, some five years ago was so hard and badly cracked as to have practically reached its limit of usefulness. The street in question subsequently developed into an automobile center, with the result that the pavement was softened by the dropping of oil upon it to such a nextent that it is still giving satisfactory service. Fifth Ave., New York City, is a somewhat similar case.

Some asphalts are more easily rotted by water action than are others. With such asphalts it is more than ever necessary to make the pavement as dense as possible to prevent the water from getting into it. Generally speaking, with all asphalts the wetter the climatic or other conditions the closer and richer in bitumen should the mixture be.

The action of water upon a pavement may take place from the surface downward or from the bottom upward. The latter action is the more serious and the harder to guard against. The top surface is always compressed to its maximum density by the action of traffic, and if it has sufficient crown and grade to let the water run off and is kept clean so that it will not be covered by a layer of wet mud for long periods, but little deterioration will take place. Where water is allowed to remain in the gutters the rotting will frequently be very rapid, and this will be still more marked if, as in some towns, the dirty wash water from houses is discharged into the gutters.

Too frequent washing of a pavement with water at a high pressure is also bad, as the abrasive action of such a jet is very considerable and acts in the same way as the stream from a hydraulic nozzle. In a number of cases water finds its way between the wearing surface of the pavement and the concrete foundation. This may be due to the geological formation of the subsoil strata (and it must be remembered that concrete is not waterproof, especially the type used for foundation work) or the water works its way down between car tracks and the abutting pavement, or through faulty gutter construction, etc. Under such conditions it has little or no chance to evaporate or drain off, and attacks the pavement at its weakest point—i. e., where the compression is the least. It gradually destroys the life of the bitumen and renders it incapable of cementing the grains of sand together. This action progresses upward through the pavement and in some cases is not apparent until only a top shell of good pavement remains. Depending upon the conditions, this action usually manifests itself by a shoving and waviness of the pavement at the point where the rotting has taken place. Owing to the loss of the cementing power of the bitumen the stability of the pavement has been lowered so that it can no longer withstand the shoving action of traffic previously described. If the pavement is cut through at this point the white sand grains will be plainly apparent, and the whole mass can be readily disintegrated between the fingers. As soon as the rotting action reaches the surface the pavement is quickly worn away by traffic and a hole is produced.

Gas leaks produce a very similar result and the gas sometimes travels a long distance from the point of leakage before it actually comes in contact with the pavement.

Another cause for the deterioration of sheet asphalt pavement is lack of traffic. Pavements laid on outlying residence streets and culs-de-sac with little or no traffic, crack much more quickly than if they were subjected to a moderate traffic, which appears to be necessary to keep the life in the pavement. This is probably due to the fact that the surface is not in such cases kept at the maximum density by the action of traffic and gradually becomes porous, thus facilitating the evaporation of the lighter oils and also to the fact that the kneading action of traffic, like the continual use of a rubber band, tends to keep the life, so to speak, in the bitumen, and equalizes the stresses set up by contraction and expansion.

DEFECTS IN CONSTRUCTION.

These may perhaps be more clearly understood by a general discussion of the principles involved and the correct way of carrying them out and coincidentally calling attention to the particular defects arising from marked departures from standard practice.

Unless the foundation is rigid and of sufficient strength to carry the weight of the traffic passing over the finished pavement no sheet asphalt wearing surface will give satisfactory service. Being plastic at all normal temperatures, the wearing surface will not bridge over any depressions formed by the sinking or failure of the foundation, but will sink with it. The principles governing good foundation work and design need not be considered here except to say that the sub-grade must be well rolled and compacted in the first place and that good concrete of sufficient strength and thickness should then be put in place and allowed to set before any binder or wearing surface is put upon it. Assuming that the sub-grade has been properly rolled and that the concrete is of the proper thickness and quality, the first point of importance is to see that it is laid to grade. If it is too high in places the thickness of the binder and wearing surface must be reduced in order that the surface of the finished pavement may conform to the established grade. Any marked diminution in the thickness of the wearing surface will, under heavy traffic, considerably reduce the life of the pavement. On the other hand, if the concrete is laid too low, the thickness of the binder and wearing surface will have to be increased. Within limits this is not objectionable if the increased thickness is not carried to such an extent as to affect the stability of the pavement, otherwise it will tend to roll and push out of shape under traffic, as previously described.

It is usually considered better practice to leave the surface of the finished concrete somewhat rough in order that the binder may key into these depressions and still further resist the shoving action of traffic. After the concrete has been put in place ample time should be allowed for setting, and this will vary with the weather conditions. Concrete laid in freezing weather will apparently set up when in reality it has frozen. When the hot binder and surface mixture are placed on frozen concrete the latter is thawed by the action of the heat and becomes mushy and has not sufficient strength to support the weight of the steam roller. Under such circumstances it is impossible to properly compress the hot mixture. In addition to this, the water set free by the thawing of the concrete is forced into the mass of hot material and more or less of it remains entrained in the mass.

In most forms of construction a binder is laid directly on top of the concrete, although this is sometimes omitted and a paint consisting of asphalt dissolved in naphtha is applied directly to the dry surface of the concrete, and the wearing mixture laid directly on this. It goes without saying that the surface of the concrete should be dry and swept clean before the binder is laid upon it. The binder consists of a mixture of broken stone—preferably the run of the crusher with all particles smaller than 1-10 in. in diameter excluded and usually not exceeding 1½ in. in its largest dimension—mixed with sufficient asphalt cement to firmly bind the particles together. Sometimes sand or gravel is added to this mixture to increase its density. Where stone chiefly of the larger sizes is used without the addition of any sand or gravel it is termed an open binder. The denser mixture produced by the use of better graded stone and the addition of sand or gravel is called close binder.

The best modern practice calls for the use of the tight binder, as it gives a much firmer foundation for the wearing surface and will not be broken up and loosened from the concrete by the passage over it of teams hauling the hot surface mixture. The stone should be hard and clean—i. e., free from fine adhering particles of dust or dirt—in order that the asphalt cement may firmly adhere to it, and the mineral aggregate must be heated to the proper temperature before mixing it with the hot asphalt cement. Stone which is too cold or damp will not coat properly in the mixer, and binder which is too cold cannot be given sufficient compression upon the street. If the stone is too hot it will burn the asphalt cement and harden it so that the binder will be brittle and difficult to compress. Sufficient asphalt cement should be added to thoroughly coat each particle of the mineral aggregate and make a mass which, when rolled, will be sufficiently sticky to adhere to the concrete satisfactorily.

A close binder properly made and laid will be superior in many respects to the mixtures which have been laid on a large number of country highways and will carry a fair amount of traffic for a considerable time without suffering any serious damage. Poor binder will break up very easily—sometimes it can be kicked up—and the hauling of the hot surface mixture over it will damage it very seriously. Surface mixture laid on a binder of this kind which has been badly broken up might almost as well be laid on loose, broken stone, and will not give satisfactory service under heavy traffic. The binder should, of course, be thoroughly compressed with a steam roller before laying the wearing surface on it. Lack of compression will produce an unsatisfactory foundation for the wearing surface, and, as previously mentioned, binder which is too cold or made with too hard an asphalt cement or an insufficient quantity of asphalt cement, cannot be properly compressed into a dense, tough mass.

In hauling the binder to the street over long distances or in very cold weather it may become chilled below the danger point. During the hauling process a certain amount of surplus asphalt cement usually drains off the stone and accumulates on the bottom of the cart or wagon. If these excessively rich portions be laid on the street, what are called rich or fat spots in the binder course will be produced. As the name implies, these are places carrying an excess of asphalt cement. If these are permitted to remain the surplus asphalt cement will be absorbed by the hot surface mixture when it is placed over them. This will make a soft spot in the finished pavement, which will be displaced by traffic, and eventually produce a hole or depression in the pavement. They should, therefore, be cut out and replaced with normal binder.

Before laying the surface mixture on the finished binder course the latter should be dry and swept clean of dirt. Otherwise the layer of wearing surface will not adhere properly to it. The principles governing the manufacture of a suitable surface mixture are similar to those involved in the binder course, except that owing to the heavier duty which it is called upon to perform they are carried further. The particles of the mineral aggregate must be sufficiently hard and fine to carry the traffic without being fractured. They must be of such a character that the asphalt cement will firmly adhere to them and they must be so graded in size as to produce a pavement of sufficient stability and density for the purpose intended. The asphalt cement must be of the proper consistency and the heating and mixing must be so conducted as to produce the best possible mixture. When delivered upon the street the mixture should be of such a temperature that it can be properly compressed and should be evenly spread by means of hot iron rakes.

In many cases the loads of hot surface mixture are dumped directly upon the spot over which they are to be spread. This is bad practice, as the men trample upon it while shoveling and raking it and the rakes do not thoroughly loosen up this trampled material when passing over and through it. Although the mixture is raked into a uniform surface and apparently even thickness before it is rolled, those portions which have been trampled on before and during raking are really covered with a greater quantity of surface mixture than those portions which have not been trampled on and which are covered wholly with what might be termed loose or fluffy mixture. When the roller has completed its work there will, therefore, be a slight unevenness in the finished surface. Under light traffic this would make no appreciable difference, but under very heavy traffic the slight pounding action resulting from this condition would be detrimental and lead to uneven wear of the pavement.

Proper and thorough compression of the finished mixture is very essential as this produces a pavement which in its earliest stages is fit to sustain the heaviest traffic. It is always questionable whether portions which are very lacking in compression will be ground out or eventually consolidated. Under unfavorable conditions the chances are strongly in favor of their being ground out. In those portions of the pavement which are inaccessible to the roller, compression is effected by the use of hot smoothers or tampers, or both. If properly handled, the desired results will be obtained, but if used too hot they will burn the pavement and cause it to scale or grind out. Hot smoothers particularly are dangerous tools to put in the hands of incompetent or careless workmen.

Extreme care should be taken to insure a proper union between the surface laid on successive days. The first loads laid in the morning at a termination of the previous day's work should be a little hotter than normal, so that the hot maxture may soften the cold edge of the pavement and bond perfectly to it. The joint should be beveled and freshly cut away unless the rope joint or a similar method is employed.

The practice of painting the edge of the joint with hot asphalt cement is not to be recommended, as, unless extreme care is exercised, too much asphalt cement will be used and that portion of the pavement will be too rich in bitumen, and consequently softer than the rest, which will result in uneven wear and possibly shoving. Great care should be taken not to have any hump or depression when the joint is made.

A brief summary of the chief defects and failures met with in practice and the contributing causes is given below:

Cracking: Cracking of the concrete base. Hardening of the asphalt cement through age. Use of too hard an asphalt cement. Use of an unsuitable asphalt cement. Too little bitumen in the surface mixture. Insufficient compression. Lack of traffic. Improperly constructed joints. Extreme and sudden changes in temperature. Vibration of street car rails.

Disintegration of Surface: Defective base. Unsuitable mineral aggregate. Insufficient bitumen in mixture. Insufficient compression. Use of too hard an asphalt cement. Use of overheated mixture. Burning due to use of excessively hot smoothers. Action of water. Action of illuminating gas.

Waviness: Use of an unsuitable sand. Use of too soft an asphalt cement. Unstable binder. Lack of stability in mixing. Too great a thickness of mixture. Projecting manholes. Action of water. Action of illuminating gas. Uneven raking. Too much bitumen in mixture. Excessively heavy traffic in one direction over a limited area.

Scaling: Too coarse a mineral aggregate. Too hard an asphalt cement. Action of water. Accumulation of mud. Too little bitumen. Excessively heavy traffic.

REPAIRING.

This should be carried on within a reasonable time after defects first make their appearance. If this is neglected, deterioration proceeds much more rapidly than would otherwise be the case. Holes and depressions are increased in size by the passage of vehicles over them and water accumulates in them, accelerating disintegration.

Two distinct methods of repairing are in general use:

(1) The pavement is cut out and removed down to the concrete, and replaced with new binder and surface. (2) The upper portion of the surface is first heated by suitable appliances and a thin layer of it removed by rakes and shovels. Immediately thereafter and while the remaining pavement is still warm, a comparatively thin layer of new hot surface mixture is spread over it and raked and compressed in the usual manner followed in the construction of new pavements.

The first method is so simple that but little description of it would appear to be necessary. The defective pavement is cut up into pieces sufficiently small to facilitate its removal and pried up with crowbars if necessary. The adjacent edges of the old pavement are trimmed up with an asphalt cutter and sparingly painted with hot asphalt cement to insure a proper bond between the old and new portions. Under favorable conditions and when the pavement being repaired is not too old and hard this painting with asphalt cement may well be omitted. All loose debris is removed down to the concrete and a new binder course and wearing surface is then laid in exactly the same manner as when constructing a new pavement. This method should always be employed in filling up holes and depressions or wherever the defective pavement is in such shape as to necessitate its complete removal, as in the case of rotting from the bottom upward and waviness, defective binder or foundation, etc.

The second or surface-heater method of repair is conducted as follows: The surface heater is placed over the defective pavement and put in operation. Superheated steam, hot air or flame is then brought in contact with the surface and is allowed to remain there until the pavement has been softened to the required depth—usually from ¾ to 1 in. The heater is then withdrawn and placed on the next spot to be repaired, and the burned material completely removed. The space thus left is immediately filled with new hot surface mixture, which is spread, raked and finished in the usual manner. Care must be taken to completely remove all burnt material down to such a depth that the new surface after compression will not be less than ¾ in. in thickness, except in a very limited number of cases. Skin patching of less depth than this has not proven satisfactory. In order that repairs made by this method will give satisfactory service it is essential that the remainder of the old pavement which serves as a foundation should be sound and in good condition and free from water rotting. It is not applicable to the class of repairs rendered necessary by defective binder or foundation, or water or gas rotting.

When it becomes necessary to resurface, wholly or in part, a pavement which has become too hard through age to give satisfactory service, the surface-heater method gives very good results and is much cheaper than a complete removal of the old pavement down to the concrete. By applying the hot new surface mixture to the remaining portion of the old pavement while the latter is still hot from the action of the heater a satisfactory union between the old and new work can readily be obtained, provided that the hardening of the old pavement has not been allowed to proceed so far that it is impossible to soften it by the application of heat. Cracks may in most cases be more successfully repaired by this method than is possible in any other way. The repairing of cracks satisfactorily is a very difficult matter. If they are cut out and new material put in, this results in the formation of two joints approximately parallel to the original crack. If the pavement being repaired is old and hard it is difficult to establish a good bond between the old and new portions, and unless this is accomplished two cracks will shortly appear where only one existed before. This is especially the case where long cracks make their appearance at considerable intervals and in many instances these had better be left until they become sufficiently wide or numerous to render more or less extensive resurfacing necessary at these places where they occur.

Instructions of the Bureau of Highways, Queens Borough, New York City, to Inspectors of Highway Improvements.

In any city where a considerable amount of street improvement is carried on the advantages of having a code of instructions for the guidance of the inspectors employed on the work is apparent. Such a code not only makes for good discipline, but it also tends to unify procedure. A few cities have adopted systems of rules and regulations for their street paving inspectors, and in our issue of April 2, 1913, we reprinted those of the Bureau of Highways of Manhattan Borough, New York City. The Bureau of Highways of the Borough of Queens, of which Mr. J. H. Weinberger is Engineer of Highways, also has issued recently a set of instructions, which we are reprinting below.

The following instructions and suggestions are intended for your guidance in the discharge of your duties. They are to be considered as supplementing but in no case as taking the place of or modifying the specifications, and they must be strictly followed unless modified in any special case by instructions from the engineer to whom you report. In any case where compliance with these instructions appears to be impossible, impracticable or inadvisable, or in any case where you do not fully understand them, you are to ask special instruction from the Assistant Engineer and must await instructions from him. Ignorance or misunderstanding of the specifications or of these instructions will not be accepted as a sufficient excuse for your failure to comply with them.

The object and intent of these instructions is to secure full compliance with the contract and specifications and the performance of first-class work by the contractor.

GENERAL INSTRUCTIONS.

You shall report in person to and be under the control and direction of the Assistant Engineer to whom you are assigned. At the close of each day's work you shall report by mail, on forms furnished you, to the Engineer of Highways.

You shall obtain and keep with you on the street a copy of the contract and specifications and a print of the standard details and a general plan of the particular work you are inspecting.

You shall familiarize yourself with the requirements of the contract, specifications and plans. You shall be on and about the work at all times while construction is in progress. You shall give continuous personal attention to your duties and not allow yourself to be diverted by conversation or invitation to other matters or places. The inspector holds a most important position. You should realize and appreciate this. Defective material and work, not condemned, casts a reflection upon your ability and integrity. You will be held strictly responsible for the quality of the material used and the workmanship to the extent that they may be governed on the street and made to comply with the contract, specifications and plans.

In the event that the contractor, or his agents or his employes shall refuse or fail to comply with the requirements of the contract and specifications, or to perform the work in accordance with the instructions of the Assistant Engineer in charge, you shall direct him to suspend the particular work at fault and report the facts immediately to the Assistant Engineer. You shall inspect all material for such qualities, dimensions and defects as can be passed upon on the street; you shall mark distinctly all material for identification which in your opinion does not comply with the contract, specifications and plans. You shall have such material properly stored and held for the inspection of the Assistant Engineer. He will examine the material and instruct you. You shall see to it that all material condemned by the Assistant Engineer is removed forthwith from the street and entirely apart from any portion or section of the work. You shall not allow the use of any material in storage, subject to physical or chemical tests, until notified by the Assistant Engineer to do so.

You shall keep a diary of the important events and features affecting the work. Your daily report shall contain all the items and entries called for in legible writing. Your notebook shall contain the following entries:

(a) The title of contract and date of your assignment.

(b) A detailed force account for each day, the amount of material used, and the quantities of work performed, giving location by blocks.

(c) Condition of the weather each day.

(d) Delays, what caused by, and the duration.

(e) All railroad work, and subsurface construction, should be noted, located and reported: a copy of this should be reported on daily sheet, under remarks.

(f) You shall see if all persons and corporations doing work within the limits of the contract have secured a permit from the Bureau of Highways. As soon as discovered, you shall record the facts in your book and report on your daily sheet any incumbrance interfering with the work and requiring adjustment or relocation by private property owners or corporations. You shall give the name of owner, the house number, or number of pole, general location and sufficient detail to enable the Engineer of Highways to give the necessary orders to the owner. If electric light pole has a light attached, make special note of same on your report.

(g) Conditions of sidewalks and curbs within the limits of the work at the commencement of the work.

(h) Accidents; date of accident, names of persons concerned and witnesses of the circumstances and the conditions affecting the same.

(i) Careful memorandum of flagstones relaid and curbs reset if to be paid for and their location by station.

(j) Any neglect or refusal on the part of the contractor to comply with the specifications.

(k) Facts relating to material delivered, sampling for tests, forwarding samples, material condemned and its removal.

(l) Damages to private property by acts of the contractor.

(m) Memorandum of oral instructions received from the Assistant Engineer and all other matters worthy of note concerning the contract.

Unless an unusually lengthy report is necessary, your report should be made out and mailed immediately after the day's work is completed. In case of sickness you should have the main office notified at once by telephone. Absence due to sickness not immediately followed by a doctor's certificate will be considered as absence without leave. Leaves of absence can only be obtained upon written application. Absence without leave will be deducted from salary and repeated offences will be considered as sufficient grounds for charges tending toward removal.

The street must be kept open to travel until permission is given by the Assistant Engineer for the closing of the portions under construction. Material must be neatly and compactly piled and all driveways to business places provided with entrances at all times.

You shall see, when it is directed that material shall be stored or dumped on planking or platforms, that all of it is so stored or dumped.

Loose or excavated matter and old paving blocks, broken curbs or flagging, old asphalt, etc., shall be piled as loosened for removal from the street. You will be held accountable for the condition of the street during construction and you must insist upon having the street cleaned of all rubbish and unused material as the work is completed block by block.

You must see to it that proper barricades are placed both for the protection of the work and the traveling public and that sufficient lights, properly located, are placed each night for the protection of the public.

You shall see to it that the engineer's stakes are properly protected during construction and that City Monuments and Bench Marks are not disturbed by the contractor until referenced by the engineers and particular orders given for their removal.

You shall see to it that the mains and private service pipes and house connections are kept intact. When necessary to lower house connections, you shall notify the property owners to immediately do so, and if any fail to comply your daily report should so indicate, giving names, address, location, character of service, length exposed or to be lowered.

You shall notify the Assistant Engineer and the Engineer of Highways in your report on the day it occurs, if the contractor destroys or removes any public property not ordered destroyed or removed.

You shall notify the Engineer of Highways in your daily report on the day it occurs if the contractor violates the Labor Law. You must be on hand when the work commences and stay until it ceases.—Unless especially ordered otherwise the working hours for the contractor shall be 8 to 12 a. m. and 1 to 5 p. m.

You shall be careful to secure work true to line, grade and contour wherever called for. You shall report to the Assistant Engineer any negligence on the part of the contractor's men in the use or preservation of stakes. Grade lines shall be stretched over three or more stakes to see that the grade is a straight line.

You shall see to it that the contractor resets true to grade in cement mortar and on solid foundation all appurtenances belonging to the city of New York.

GRADING.

You shall read the specification and your particular attention is directed to—

(a) Excavation and embankment shall be carried to the widths, slopes, cross-sections and elevations directed and maintained there until the work is complete.

(b) Material for filling must be clean of garbage, vegetable matter, tin cans, spongy matter that will not pack, furniture and other unsuitable matter.

(c) Rock shall be excavated below the curb grade as required in the specifications.

(d) When there is an item for rock be careful to afford the engineers an opportunity for measurement before removal.

(e) Exercise care in properly protecting all blasts from flying rock. Allow no blasting nearer than 5 ft. to water and gas pipes.

(f) Filling upon which paving, curbing or flagging is to be laid directly after and under the same contract shall be rolled if ordered and the material shall be placed in layers not exceeding 12 ins., beginning at the end nearest the dirt supply so that the teams must pass over the fill and compact it evenly. End dumps shall be made only when specially permitted by the Assistant Engineer in charge.

(g) Special attention shall be paid to the compacting of cellar excavations, vaults, or depressions of any kind due to cuts, excavations, etc.

(h) In preparing subgrade for paving, great care shall be exercised to bring it true to subgrade and subcrown, and at the required depth below the finished surface. All cuts shall be specially compacted by rolling or tamping. The earth must not be ploughed below subgrade nor within 1 in. of it. In case only 6 ins. is to be removed, ploughing shall not be allowed. Obtain a solid dry subgrade for your foundation. No excavation shall be carried below subgrade except for the removal of unsuitable material.

CONCRETE.

You shall read the specification and your particular attention is called to—

The city lays different classes of pavements; be on your guard for the varying thicknesses of courses.

(a) Find the proportions specified for the various kinds of concrete and know that you obtain them in each batch. With the bag of cement as the unit find out how many are required to fill your measuring device and then work accordingly.

(b) You shall see to it that each consignment of cement is sampled and that it is reported upon as complying with the specifications before you allow it to be used. You should frequently make balls of cement and if they do not set up hard in 8 hours this should be reported.

(c) You shall see that the cement does not partly set and become granular while in storage. Rejected cement shall be removed from the work immediately after being rejected.

(d) Sand should be clean and sharp. You shall see to it that tests are made of any doubtful sand, before using, for clay and strength as compared with standard briquettes.

(e) Stone should be fairly cubical, clean, newly broken, free from rounded and weathered material and of proper size. You shall see to it that it is kept so until used and that it is properly wetted and cleaned of dust and dirt before using, if unavoidably coated with dust and dirt.

(f) You shall require all empty cement bags to be placed in a pile within your zone of observation, and count them yourself before leaving for lunch and for the day. Check your proportion of cement in this way in the finished work.

(g) You shall never allow the mixture of mortar or concrete directly on the ground. Nor shall cement and sand be mixed directly on the pile of sand unless the sand has been measured on a platform and sufficient cement is added for the whole pile.

(h) Obtain the proper consistency for the work in hand by the proper amount of water and mixing and then uniformly obtain that consistency.

(i) You shall see to it that the work is true to lines, grades and cross-section, carefully tamped, and moulded or worked into place; and that your concrete is protected from abuse or the weather until fully set up. You shall allow no driving directly on green concrete (6 days old or less). If driving is unavoidable the concrete must first be planked. You shall see to it that barricades are put up to protect the work. You shall require sprinkling with a sprinkling can of green concrete in hot drying weather.

(j) Concrete that shows voids is not proportioned properly. Such concrete should be taken out and replaced with concrete properly filled. Do not allow a contractor to try to remedy such a condition by grouting the surface.

CONCRETE CURB.

You shall read the specification and your particular attention is called to:

(a) Look under the heading "Cement Concrete Curb" for concrete and mortar proportions.

(b) The special size of stone to be used in the body and the mortar finish for face and top.

(c) You shall pay strict and uniform attention to the joints. After the curb sets up the joints must remain entirely open, completely separating the sections of curb.

(d) Examine the subgrade to make sure that it is not clay, loam or other unsuitable material and if unsuitable have such matter removed to a depth of 6 ins. and for a width of 12 ins. and filled in with cinders, gravel or broken stone.

(e) Take note of all private driveways, ask the owners whether they wish drop curbs, and provide the same accordingly. Just because a curb is dropped is no reason for continuing it if no longer needed. Carefully fit your curbs to the proper radii at corners and on curved streets. Don't allow a misfit form to be used or try to make curves out of tangents.

CEMENT SIDEWALK.

You shall read the specification and your special attention is called to:

(a) Grading for the full depth and width, leaving an even solid subgrade; on this place the steam ashes or broken stone and compact thoroughly, using water and tampers.

(b) Have forms properly and truly set to line and grade. Try the subgrade by using a gauge to make sure that you will obtain the full depth of concrete. Your failure to do this testing may result in obtaining walks thin in places, and likely to crack. You should have the cinders "struck" before laying concrete and the concrete should be "struck" so as to obtain the full 1 in. top coat.

(c) You shall carefully inspect the mixing of the concrete and mortar surface at all times. Observe that the ingredients are measured each time and that they are thoroughly mixed and properly placed. Use your gauge again to see that you obtain the full inch of mortar surface. Do not allow the concrete to set up hard before the mortar is placed. Do not allow concrete placed at night to be covered with mortar the following morning.

(d) Do not allow sand to be scattered over any portion of the concrete before placing the top layer. You shall try the joints after the mortar top is finished and if you do not find them open clear through the concrete, they are to be made so at once or the work condemned. This is most important.

(e) You shall not permit any incompetent mechanic or one inclined to be careless to finish the surface. You must insist upon the discharge of such employes and upon the correction of their work.

(f) You shall see to it that cement work is fully protected from the elements. Do not allow this class of work to dry out but see that it is kept moist so that it will set up hard. If necessary require it to be covered to protect it properly.

(g) Frequently make a ball of cement and if it does not set up hard in 8 hours report the fact.

(h) Observe the possible driveways, ask the property owners whether they are wanted and if so, place the additional concrete required by the specifications.

BLUE STONE CURB.

You shall read the specifications and your special attention is called to:

(a) The quality of stone specified. Each stone must be passed upon on its own merits.

(b) The dimensions of curbs specified.

(c) You shall carefully examine and test each stone for batter, wind and depressions. Do not try to make curves out of tangents.

(d) You shall see to it that the proper material is used for the subgrade. If it is not found to be there, see that it is placed there by the contractor.

(e) When curb is to be set in concrete be sure to obtain the full dimensions of concrete at all times.

(f) In redressing old curbstones do not allow the stonecutters to maliciously and wilfully destroy them.

FLAGSTONE SIDEWALK.

You shall read the specifications and your special attention is called to:

(a) The quality of stone specified. Each stone must be passed upon on its own merits.

(b) The dimensions specified. Be sure of your grades and slopes before laying any stones. When the sidewalk is laid for the full width it shall have a slope of 1-3 in. to the foot. When a 5 ft. strip only is laid, the slope from the curb to the near edge of the walk shall be ½ in. to the foot and the walk itself shall be laid at a slope of ¼ in. to the foot.

(c) You shall pay strict attention to obtaining stones out of wind and without depressions.

(d) You shall examine the subgrade and be sure that it is sand or sandy gravel; if not, sand or steam ashes must be provided for bedding the flag. Be insistent upon obtaining a joint completely filled with cement mortar of the required mixture.

(e) Before allowing a contractor to remove old flagstones, ordered removed by the engineer, find out whether the property owners wish to have them.

SHEET ASPHALT PAVEMENT.

You shall read the specifications, obtain the thickness of courses, and your special attention is called to the following:

Obtain a concrete true to grade and contour but rough in surface.

(a) If proper care has been taken at the mixing plant the mixture will not arrive on the street at too high a temperature. Your principal care will be to see that it is not laid at too low a temperature. The minimum temperature permitted by the specifications is 250° F. While the main or interior mass of a wagonload may be well above that temperature, the top and outer part of the load may be, particularly in cold weather, too cold to be safely used.

Some of this colder portion may be sufficiently reheated by mixing it with the hotter material if properly handled in unloading; but any material that is so cold as to be lumpy when unloaded or, more particularly, when being raked out, should be discarded. This applies to both surface and binder mixtures. The best practical guide is the manner in which the mixture behaves in raking. It must always be so hot that it will, under rake, break up into a uniform crumbling or powder mass. If it does not do this it is too cold whatever its temperature may be.

Preparation of Street Surfaces.—(b) Before the binder is laid all loose material, rubbish, street dirt and other matter foreign to the concrete surface shall be removed and the concrete surface swept, if necessary to properly clean it, with street brooms.

Neither binder nor surface mixture shall be laid upon wet surfaces. Before the spreading of the surface mixture on the binder, the latter must be cleaned of all foreign matter and, if necessary, swept. If the binder course already laid has become covered with mud from wagons or other travel, it must be swept clean. No loose fragments of binder material must remain on the surface. Any part of the binder course that may have become broken or loosened must be taken up and new material laid in its place with the same care as the original.

Laying Binder Course.—(c) The binder mixture must be carefully spread by hot shovels and rakes in a continuous layer, stretching from curb to curb, perpendicular to the center-line of the street, and rolled until all the voids are filled. It should then present a uniform layer whose thickness is not less than that specified, and whose upper surface is parallel with the finished surface of the pavement and not less than that specified, at any point, below the same. The tendency is to lay the binder course carelessly and to roll it insufficiencly.

Nearly the same care in raking and equally as careful rolling as for the surface course should be insisted upon. It the binder is not thoroughly compressed and becomes cold before the surface course is laid, and it is likely in future hot weather to soften and yield under heavy travel, and thus start small depressions in the pavement.

Laying the Surface Course.—(d) The requirements of the specifications should be rigidly enforced in the laying of the surface course. The joints against a cold edge of previously laid surface must be cut back until solid, fully-compressed material of full thickness is reached, and the raw edge completely but thinly painted with liquid bitumen. No masses or fragments of cold mixture must be allowed to remain on the surface of the binder in advance of the placing of the surface course to be covered up by the latter. Such cold masses will not be compressed by the roller but will later, under a hot sun and heavy travel, yield and start depressions in the pavement. The raking requires to be properly and skillfully done. The tines of the rake must penetrate to the binder, so that the raked material will be a uniform mass from top to bottom.

Rolling.—(e) You must insist upon the rollers being placed upon the freshly raked surface just as soon as the material will bear them without being squeezed out or displaced laterally. The tendency is to keep the roller off too long, thus permitting the chilling of the surface and preventing its proper compression. Do not take the contractor's word as to how soon the rolling may be begun, but have trials made until you are able yourself to judge. The rolling by the heavy roller should be very thorough; keep the roller at work constantly until the surface is too cold to be impressed. In operating the roller lengthwise of the street begin at the gutters and work toward the center of the street whenever practicable. Cross rolling and diagonal rolling must be insisted upon wherever the width of the street will permit it.

Proper Thickness and Surface.—(f) While the completed surface is still warm enough to permit it, measure the thickness of the surface course by forcing the graduated spatula through it to the binder. Also test the trueness of the finished surface with the straight edge, and if found defective in either thickness of pavement or trueness of surface, insist on heavier and more careful raking on the further work. Try the completed gutters with water to see that they are so truly laid that puddles of water will not stand in them.

Asphalt surface must not be laid when rain or snow is falling or so long as the surfaces are wet. Surface mixture raked out and caught in a shower before it is well enough rolled to exclude water must be taken up and discarded.

Measure and record each day the area of pavement laid and the quantity (number of batches) of surface mixture used, and note any lack of uniformity in the area laid per batch.

(g) You shall see to it that all the material is handled with the shovels clean to the bottom of the pile in every instance on both top and binder courses. The spreaders are inclined to leave some as dumped; this needs constant watching.

(h) You shall not allow any depressions or humps to be created so as to meet surface fixtures. Insist on the proper setting in cement mortar on concrete of all fixtures and lay your asphalt so as to meet it evenly when rolled.

(i) Examine the area under roller for spots that have an excess or deficiency of asphalt. Note what the specifications direct you to do.

(j) Note what the specifications say about following binder with surface mixture and carry out carefully.

(k) Note carefully how the specifications direct you to obtain a suitable gutter line.

(l) Require the contractor to clean up block by block and cause the least inconvenience to the public.

ASPHALTIC CONCRETE.

Look over the instructions for sheet asphalt. If laid on macadam use great care to have a solid, unyielding foundation true to your finished surface. Have the surface well covered with new stones, sufficiently rolled to have a grip on the macadam base.

ASPHALT BLOCK.

You shall read the specifications, note the thickness of courses and your special attention is called to the following:

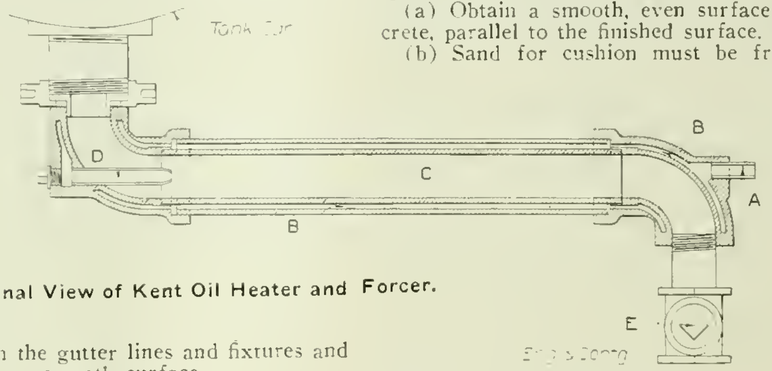
(a) Obtain even, smooth concrete for this pavement.

(b) Pay special attention to the striking of the moist mortar bed true to crown.

(c) Lay the courses straight and have about every fifth course driven back. Blocks that rock must be rebedded in mortar.

(d) Raise low blocks and lower high ones. You are cautioned that men are inclined to make matters worse in raising and lowering blocks.

(e) Give the Assistant Engineer an opportunity to inspect the blocks laid before covering them with sand. Use fine sand only as specified.



Sectional View of Kent Oil Heater and Forcer.

(f) Watch the gutter lines and fixtures and obtain an even, smooth surface.

WOOD BLOCK.

You shall read the specifications and your special attention is called to the following:

(a) Pay special attention to obtain a smooth concrete surface true to grade and crown. Have the moist mortar bed laid and struck truly parallel to the surface of the finished pavement.

(b) Discard all blocks with shakes and knotholes or otherwise contrary to specifications.

(c) Look carefully for blocks that do not have the grain vertical.

(d) Do not lay them with tight joints.

(e) Have all blocks rolled within one hour of laying of mortar bed. Do not allow blocks to be laid on mortar mixed more than a half hour. Make the time between the mixing of mortar and rolling as short as possible, but never let it exceed 1 hour and 30 mins.

(f) Have the blocks laid in straight courses, with open joints as specified and be especially careful to obtain the expansion joints regularly at intervals as required and continuously along the curb and headers.

(g) Raise low blocks and lower high ones truly to the proper plane. Take especial pains to obtain an even surface at fixtures and railroad tracks.

(h) Give the Assistant Engineer an opportunity to see all surface before covering the blocks with sand.

(i) Be sure that the joints to be filled with pitch are fully filled.

(j) Clean up refuse and waste material as you proceed block by block.

GRANITE BLOCK.

You shall read the specification and your special attention is called to the following:

(a) Obtain an even, smooth concrete base, truly parallel to finished surface.

(b) Examine all blocks for shape and quality. Blocks so shaped or undressed as not to lay close must be culled as well as those showing defective composition.

(c) Watch carefully for misfits in courses. Don't allow a narrow block to be laid next to a wide one.

(d) Have all blocks equally rammed and all low blocks raised and rerammed so as to get an even bearing for all. The number of rammers employed should be in the proportion of one rammer to two pavers.

(e) When filling the joints with paving pitch, be sure that your joints are open, that your gravel is clean and of the proper size, and hot and free of sand.

(f) When filling joints with cement grout filler, have pea gravel only for ramming purposes, use it sparsely and never dump it on the pavement in piles. Place it in the joints direct from the shovel by light scatterings.

(g) Keep the grout thoroughly mixed while using and fill all joints to full depth as specified.

(h) Protect the grout from the drying action of hot sun by keeping the sand covering wet for several days. Hand sprinkling only and at least twice a day.

(i) Don't allow any traffic on the finished work under any conditions. Provide drives by planking if absolutely necessary to pass over such work.

BRICK PAVEMENT.

You shall read the specifications and your special attention is called to the following:

(a) Obtain a smooth, even surface of concrete, parallel to the finished surface.

(b) Sand for cushion must be free from pebbles and the sand should be carefully struck.

(c) Lay the brick tight and in straight courses. Drive them back every five or six courses.

(d) Roll the surface to an even bearing. Raise low blocks and lower high ones to the true plane, newly bedded. Begin rolling at the curb, roll longitudinally and then at 45° and repeat again at 45° in the opposite direction.

(e) Agitate the cement grout filler continuously until used up.

(f) Provide carefully for expansion joints filled with filler.

(g) Keep off all traffic until the grouting has set and be sure that the sand coating is kept moist in dry weather.

(h) If bitumen is used as a filler be careful that the joints are clean and that they are thoroughly filled.

Read these instructions carefully, bear in mind that they are general and in no sense take the place of the specifications but supplement them only. You will be held strictly accountable for the compliance with the contract and specifications of improvements developed under your inspection.

Keep the street and sidewalk spaces in a safe and orderly condition and cause the least possible inconvenience to the public. Be courteous and civil to citizens and answer their questions respectfully and fully to the best of your knowledge.

Heater and Unloader for Road Oils and Tars.

A time and labor saving device for unloading road oils and tars from tank cars and storage tanks is shown in the accompanying illustration. This device is known as the Kent oil heater and forcer, and it is claimed that by its use a car can be drained completely without a drop of waste at the rate of 100 gals. per minute; in addition the oil is delivered to the sprinkler wagons at a high temperature. It will thus be seen that the device serves not only as an unloader, but also as a heater. Its application can be explained best by reference to the sectional view. The steam enters the heater through the pipe (A), passes through the jacket space (B) around the oil delivery pipe (C), maintaining a high temperature along its entire length. After traveling through the jacket space it passes out through the nozzle (D) into the oil delivery pipe. At the beginning the plug cock (E) in the delivery pipe is closed for a short time, forcing steam into the bottom of the tank car, and heating the oil so that it becomes very fluid. The plug cock is then opened and the oil flows by gravity around the nozzle (D) and is forced in a continuous stream through the delivery pipe into the tank wagons. A large boiler capacity is not required to operate the heater and forcer; a steam roller or donkey engine boiler is large enough. The device is simple in construction, has no moving parts, and but one man is required to operate it. It is sold by Wm. F. Irish (Engineers), 18 Battery Pl., New York City.

Annual Convention of the American Road Builders' Association.—The next annual convention of the American Road Builders' Association will be held in Philadelphia, Dec. 9 to 12th. The sessions of the convention will be held in the First Regiment Armory. As usual, the association will hold an exhibition of road and paving machinery, materials, etc. The main floor of the armory will be utilized for this purpose.

BUILDINGS

The Canadian Pacific Railway Shops at Calgary—A Record of Rapid Shop Construction.

(Contributed.)

The Canadian Pacific Ry. has recently put in operation near Calgary, Alberta Province, Canada, a large shop plant of more than ordinary interest by reason of its size, its complete and modern character, and the speed with which it was created. The work was designed and built in its entirety by Westinghouse, Church, Kerr & Co., consulting and constructing engineers, of Montreal, working under the direction of Mr. J. G. Sullivan, Chief Engineer of the western lines of the Canadian Pacific Ry., and Mr. N. E. Brooks, Division Engineer.

The shop location is at Ogden (named in honor of a vice-president of the railway) and is 4½ miles from Calgary and about 2,250 miles from Montreal. Its distance from those sections of the country where the greater part of the construction materials, machinery and equipment was produced constituted the first and one of the most important problems. A second important problem arose on account of the construction season being extremely short, owing to the high latitude frost remaining in the ground until about April 1 and returning with snow as early as Oct. 1. A third very important problem was the comparative scarcity of labor in the Canadian northwest, this condition being greatly aggravated during the late summer months when harvesting begins and all labor markets are practically drained of men.

Plans had, therefore, to be drawn, materials ordered, deliveries made and complete field organization perfected so that the shops could be closed in between April 1 and Dec. 1 and sufficiently heated so that inside work could be continued after cold weather had set in. How this was done will be seen by the progress diagram, Fig. 1.

The shops consist in general of (1) main locomotive shop (including erecting, machine, blacksmith and boiler shops); (2) tender and wheel shop; (3) pattern shop and pattern storage; (4) foundry; (5) storehouse and office building; (6) material platforms and scrap dock; (7) oil house; (8) coach repair and paint shop; (9) freight car repair shop; (10) planing mill; (11) boiler and compressor house; (12) 1260-ft. yard crane; (13) miscellaneous structures, including transfer table and pit for coach shop, mess hall, driven wells and water tower, all service systems, such as drainage, sewage, fire protection, water supply, etc.

MAIN LOCOMOTIVE SHOP.

This building is designed to contain the erecting shop, machine shop, blacksmith shop, and boiler shop.

The erecting shop is of the transverse liftover type, contains 35 bays, each 22 ft. between centers, and is 778 ft. long by 75 ft. wide. The entire area is served by two traveling electric cranes, carried on two levels. A 120-ton crane, furnished with two 60-ton trolleys is carried on the upper level and is used for transferring, wheeling and unwheeling locomotives and handling parts. One of the trolleys on this crane is equipped with a 10-ton auxiliary hoist for handling light material at a high hoisting speed.

Another 10-ton traveling electric crane operates at high speed and serves the entire area of the erecting shop, for handling material in that shop and transferring site to the blacksmith and machine shops. The machine shop and the boiler shop are located in adjacent bays on either side of the erecting shop.

Provision is made no the crane columns in the erecting shop for attaching portable jib cranes for use in dismantling and erecting material on the front ends of locomotives. These cranes are placed where desired by means of the overhead traveling electric cranes.

Entranc for locomotives to the erecting shop is provided through four doors, located in the west side of the shop, two of these doors being located at either end. For providing additional means for entrance of locomotives, six door openings are provided in the east wall of the machine shop, two of these being at the north end and four at the south end. All of these entrance tracks are connected up with the erecting pits of the several stalls where they enter the building, to permit of the locomotives moving into and out of the shop through these entrances should this movement become desirable or necessary.

The machine shop to contain heavy machine tools is located parallel with and adjoining the erecting shop on one side and is 60 ft. 9 ins. wide and the same length as the erecting shop. A high speed traveling crane of 10-ton capacity covers the entire area of this shop. Material can be brought into the shop through a door provided in the end of the building, the material being brought up to the end of the machine shop by the traveling electric yard crane which travels across the end and outside of the locomotive shop.

Space for the lighter machine tools is provided in a shop 60 ft. 9 ins. wide parallel with and alongside of the heavy machine shop and of the same length as that shop. An overhead trolley beam is provided on the bottom chord of the roof truss to permit of using a traveling electric trolley for handling material longitudinally in this shop. Provision has been made for a foreman's office elevated above the floor and having liberal glass surface in the walls so as to give the best possible view of the shop.

The blacksmith shop is located alongside of and parallel with the erecting shop on the opposite side from the machine shop. This building consists of two bays each 332 ft. long, 60 ft. 9 ins. and 50 ft. wide, respectively. Space is provided for heavy forging work, steam hammers, etc., in the building immediately adjoining the erecting shop. The blacksmith shop will not be served by a traveling crane but provision has been made for jib cranes to handle the material from steam hammers, forgings, etc. In a building of lower cross-section alongside, are located the furnaces, bolt headers and other blacksmith shop machinery. This portion of the shop is served by a trolley its full length to facilitate the longitudinal movement of material through the shop.

The space for the boiler shop is provided in a two-bay building, alongside of and parallel with the erecting shop at the end of the blacksmith shop, 352 ft. long and the same width as the latter shop. That part of the boiler shop immediately adjoining the erecting shop is provided with a 40-ton traveling electric crane equipped with two 20-ton trolleys serving the entire area of the boiler shop for handling the boilers and other material. The riveting tower is located between two of the roof trusses in the end of the boiler shop with a 25-ton crane for serving the hydraulic riveter. In the cuter of the two bays of the boiler shop, space is provided for a flue shop and boiler shop tools. The entire length of this space is served by a 3-ton overhead traveling trolley for handling material through the shop. Space for a flue rattler is provided immediately outside of and adjacent to the low bay of the boiler shop. An entrance track is provided through the outside wall of the boiler shop on which boilers or other equipment going to this department can be delivered on cars under the traveling crane, for unloading, or may be loaded out for shipment in the same way. This facilitates the handling of boilers from steam shovels, pile drivers, Lidgerwoods, etc. Jib cranes are provided for serving the individual machines in the boiler shop where such service may be necessary.

The heating throughout is done by indirect fan system. For distributing the heated air, underground concrete and tile ducts are used. The general illumination consists of Cooper-Hewitt lamps with circuit and plug boxes for extension loop cords. Provision has also been made for incandescent lighting circuits for individual lighting at machine tools where required, and for outlet boxes for connecting extension lamp cords to provide lighting for the interior of the locomotive boilers on the erecting floor. Toilets, lavatories, and metal lockers are provided in the various departments of this shop.

A suitable system of piping is provided for distributing live steam, compressed air, fuel oil and water for fire protection, drinking and hydraulic pressure. Outlets for compressed air are provided in duplicate in the sides of each of the engine pits to supply compressed air for operating pneumatic tools.

In the main locomotive shop the electrical feeders from the power companies' transmission lines are carried in underground ducts, bringing the current at the voltage delivered by the power company, namely, 2,200 volts, to a sub-station located adjacent to and immediately outside of the low machine bay, the transformers for stepping down to 440 volts being located in this sub-station. In this sub-station two motor generator sets for supplying direct current are also located. The switchboard is also located in this sub-station for controlling the power and lighting circuits in the machine shop and for the tender shop and foundry. As far as possible distributing feeders are carried in conduit beneath the shop floor, thereby minimizing the amount of exposed wiring in the shops.

The building containing all of the above departments of the locomotive shop is constructed with structural steel frame carried on concrete foundations. The exterior walls up to the window-sill line are of concrete, above the window sills of hollow-tile plastered. Ample window area is provided in the side walls and in roof monitors and skylights so as to give sufficient natural lighting. Good ventilation is obtained through ventilators in the monitors and skylights and by the use of swinging sash in the vertical walls.

With the exception of the blacksmith shop and a portion of the boiler shop the floor throughout is constructed with a 1½-in. asphalt mastic wearing surface which is underlaid with a rough concrete slab about 6 ins. thick. In the blacksmith shop and a portion of the boiler shop the floor is of cinders.

The roof sheathing is constructed of 2x4 in. pieces, surfaced on one side and one edge and spiked together on edge, thus affording good fire resistance qualities and materially reducing the heat losses. The roof water-proofing is four-ply tarred felt, pitch and gravel, with copper flashing. Suitable drain leaders are provided and connected into underground tiled drains to carry off the water from the roof. The large skylight on the erecting shop bay is of steel bars, lead covered with ribbed wired glass.

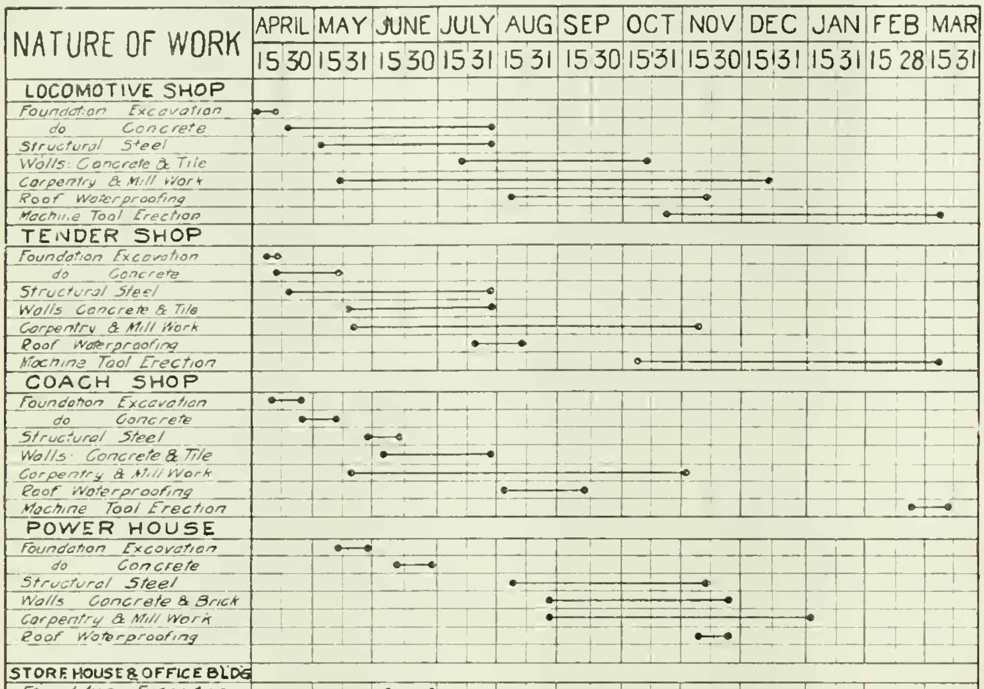


Fig. 1—Diagram Showing Progress of Construction of Canadian Pacific Ry. Shops, Calgary, Alberta.

TENDER AND WHEEL SHOP.

This building is constructed with structural steel frame and with steel roof trusses, otherwise the general construction of the building is similar to that described for the main locomotive shop. It is an L-shaped structure 263x80 ft. wide with L 180 ft. long by 80 ft. wide, and affords space for making repairs to locomotive tenders, steam shovels and other maintenance of way equipment. That portion of the shop intended to receive the equipment to be repaired is spanned over its entire area by a 20-ton high-sped traveling electric crane equipped with two 10-ton trolleys.

Longitudinal tracks on 20-ft. centers extend to the doors in the building wall. A car puller is installed for moving the equipment into and out of the shop. A sufficient number of tracks extend through the rear wall of the building to facilitate the movement of material into the shop.

In the L portion, of the building, of lower cross section,. space is provided for steel tire wheel lathes, wheel and axle machinery and such other tools as are required. A depressed track carried along the ends of the wheel storage tracks outside facilitates unloading and loading of wheels and axles. The heating, lighting, and service equipment is similar to that described for the main locomotive shop.

PATTERN SHOP AND PATTERN STORAGE.

Space for the pattern shop and pattern storage is provided in a separate building located adjacent to the foundry, a fire wall separating the pattern shop from the pattern storage.

The general construction of the building is the same as that of the other buildings—the roof of slow burning mill construction. The structure is 162 ft. long by 31 ft. wide, is heated by the direct system and lighted with keyless socket marine type incandescent lamps. A sprinkler system is provided for fire protection.

FOUNDRY.

The grey iron foundry building is 203 ft. long by 80 ft. wide, constructed with two bays. The frame is of structural steel carried on concrete footings. The general construction is the same as that described for the other buildings except that the floor is of the usual clay type used in foundries and the roof over the cupola room is of corrugated asbestos.

The bay of higher cross-section is served over its entire length by a 10-ton high-speed traveling electric crane. Jib cranes, attached to building columns are provided. These cranes are so arranged that they may be removed from one location to another if desired, being handled by the traveling electric crane. In the side bay of lower cross-section space is provided for core making and shop moulding floor. The charging floor for the cupola is located in the center of the lower bay.

Heating is by the indirect fan system with underground tile and concrete hot-air ducts. For general illumination flaming arcs are used in the high bay and ordinary arcs in the low bay, with outlet boxes for extension lamp cords.

Toilets, lavatories, and conveniences for the men are provided; also steam, air, and water service, for fire protection and drinking purposes.

The location of this building alongside of and parallel with the traveling electric yard crane enables the unloading of scrap and pig-iron to be taken care of by the yard crane. This close proximity of the foundry to the yard crane also reduces to a minimum the handling of the castings from the foundry to storage, to the main shop, or in loading for shipment.

STOREHOUSE AND OFFICE BUILDING.

This building is 252 ft. 6 ins. long by 60 ft. wide. One end of the building for a length of 40 ft. is carried up three stories and contains offices on the second and third floors and a fireproof vault. The remainder of the building, for storehouse purposes, is two stories high and contains electric elevator, platform scales, material bins, and shelving.

The walls are constructed of hollow tile blocks on concrete foundations. The framing is of heavy timbers, with 2x4-in. roof sheathing, surfaced on one side and one edge, and spiked together on edge. The foundations are carried up to bring the floor of the storeroom to car door height.

The necessary toilet and lavatory facilities are provided. The offices are heated by direct radiation, the remainder of the building being heated by the indirect system. The lighting is by incandescent lamps. Fire protection is by automatic sprinklers.

The ground floor of the storehouse has a 1½-in. asphalt mastic wearing surface. The other floors throughout the building are of wood.

The storehouse is located parallel with the main locomotive shop. The space between these two buildings is spanned by a high-speed traveling crane which can be utilized to handle all heavy material to and from the cars from the storage space that is provided between the storehouse and the erecting shop. The use of this crane practically eliminates manual handling of heavy material and permits of handling numerous small parts in quantities when contained in suitable receptacles.

MATERIAL PLATFORMS AND SCRAP DOCK.

A material platform 90 ft. wide and about 350 ft. long, abutts one end of the storehouse. This platform is also carried along either side of the storehouse where it is 15 ft. wide. It is constructed of concrete retaining walls filled in with earth and a top dressing of cinders covers the fill except alongside of storehouse where plank covering is laid. This platform extends to and along the side of the oil house.

OIL HOUSE.

For storing and distributing oil a separate building is provided convenient to, but located far enough away from the storehouse and other buildings to eliminate the fire risk. It is constructed with tile walls (plastered on the exterior) on concrete foundations, with a concrete basement at one end for the tanks which contain the oil, for local distribution. The roof is a reinforced concrete slab, as is also the floor of the pump room over the basement. That part of the building used for storing oil in barrels has a cinder floor. The pump room is partitioned off with a brick wall carried up to make a fire wall.

Ten oil tanks with measuring pumps are installed and provision is made for conveniently emptying the oil from barrels into the tanks in the basement.

The oil house basement is heated by the direct system to the high temperature necessary to render the oil fluid during extreme cold weather; the direct system being also used to heat the rest of the building. The lighting of the building is with keyless socket marine type incandescent lamps. Fire protection, including sprinklers, is installed.

COACH REPAIR AND PAINT SHOP.

The building containing these departments is 362 ft. long by 146 ft. wide, having fifteen tracks on 24-ft. centers. It is constructed with hollow building tile carried on concrete foundation. Heavy timber posts support the roof which is of slow burning mill construction. Otherwise, the construction is the same as that described for the main shop building. Space is provided along one side of the building for varnish room, upholstering, office, substore, paint storage, heating plant and air brake repairs.

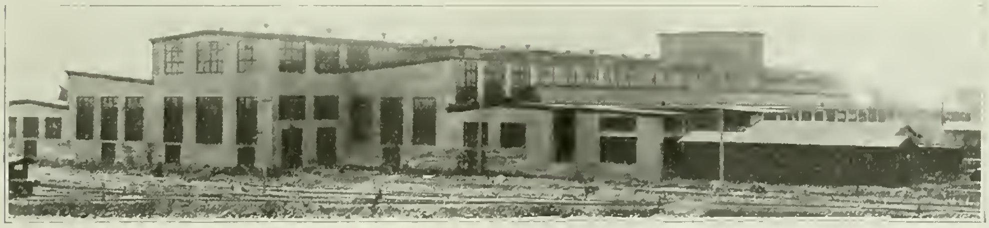


Fig. 2—View of Erecting and Machine Shops, Canadian Pacific Ry., Calgary, Alberta.

When necessity arises for increased shop capacity in this department it is proposed to obtain such increase by the erection of another shop on the opposite side of the transfer table.

Heating is by the indirect fan system with underground concrete and tile ducts. Lighting is by incandescent lamps. Compressed air, steam and water service, including fire protection and automatic sprinklers are provided. Toilets, lavatories, and conveniences for the men are also supplied in this shop.

FREIGHT CAR REPAIR SHOP.

This building is 231 ft. wide by 303 ft. long and contains eight repair tracks spaced in pairs with industrial track between each pair of repair tracks. A tile wall partitions off the shop, 50 ft. wide along one side, which will contain the blacksmith forges, tools, heating plant, foreman's office, toilets, and lavatories.

The building is of structural steel frame with tile walls, plastered on the outside, with saw-tooth roof construction. The general construction of the building otherwise is the same as that of the other shop buildings. An overhead trolley beam is provided to permit of handling timbers with a trolley into the shop.

Compressed air, steam and water service piping and fire protection, including automatic sprinklers, are supplied. Heating is with the indirect fan system with underground concrete and tile ducts. Lighting is by 100-watt tungsten lamps.

The location of this building alongside of the lumber yard permits of handling lumber so that it can be passed through into the shop without rehandling.

PLANING MILL.

This building is 303 ft. long by 80 ft. wide and contains the wood-working machinery. The frame is of structural steel carried on concrete footings. The general construction of the building is the same as that of the other shop buildings. A track extends through the building longitudinally to permit of movement of material in at one end to the various machines and out through the opposite end with the minimum amount of handling. The building is located so as to be convenient to the passenger car shop and the freight car shop. The lumber yard is located back of and at one end of the planing mill.

Suitable piping has been provided for distributing compressed air and water. The fire protection system includes automatic sprinklers. Provision is made for toilets, lavatories, and metal lockers for the men employed in this department. Heating is by the indirect fan system with galvanized iron heating ducts. Lighting is by mercury vapor lamps.

BOILER HOUSE.

This building contains sufficient space for 2,100 h. p. water tube boilers that are required to provide steam for heating the shops and for other purposes for which steam is required throughout the shops. The building is constructed with brick walls carried on concrete foundations with steel roof trusses and supports for coal bunkers. The chimney is of reinforced concrete, 200 ft. high with a minimum diameter of 9 ft.

The overhead coal bunker for each boiler is divided by a reinforced concrete partition into two compartments, to provide for storing and burning two kinds of coal. An overhead storage bin for ashes is provided, from which bin the cinders can be discharged by gravity into cars alongside of the building. A concrete dumping hopper is provided outside for dumping coal from cars. A pivot steel elevator raises and discharges the coal into the overhead bunker. A skip-bucket, with electric hoist, handles the ashes into the ash bin.

The boiler units are 350 h. p. rating and are set in three batteries of two each. Five of the boilers are equipped with chain grate stokers. The sixth boiler has the shaking grates to burn shavings and other planing mill refuse.

Space is also provided for three electrically driven air compressors, each of a capacity of 1,500 cu. ft. of free air per minute. Only two of these compressors are installed at this time.

Transformers and distributing panel are located in this building for transforming and distributing light and power current to the shop yard, freight car shop, planing mill, and coach repair shop. There is no direct current apparatus in this station.

Provision has been made for two incoming 2,200-volt lines, one of 2,000 k. w. and the second of 1,000 k. w. capacity for breakdown service.

The steam required for the steam hammers and other shop purposes during the summertime can be supplied by one boiler. The boiler capacity provided will afford one spare boiler during the extreme weather conditions when the maximum steam demand occurs.

YARD CRANE.

A yard crane runway, 1,260 ft. long, extends from the west line of the locomotive shop and carries a 10-ton high-speed traveling electric crane with 80-ft. span, serving the material yard and a portion of the storehouse platform and scrap dock. One of the storehouse tracks extends through under this crane, resulting in giving ample space for the storage of material alongside of the storehouse, foundry and locomotive shop. By this arrangement heavy material can be unloaded, stored, and rehandled to the shop or loaded out again by the crane for shipment, practically eliminating manual labor in the handling of all heavy material.

MISCELLANEOUS STRUCTURES.

The transfer table for serving the coach shop is 75 ft. long, of 150 tons capacity, equipped with electric motor, with concrete transfer table pit 400 ft. long, extending out far enough at either end of the building, for providing entrance and egress at both ends

The mess building is 269 ft. 6 ins. long by 31 ft. 10 ins. wide, of wooden frame construction, covered outside with sheathing, building paper and siding and sealed on the inside with metal sheathing. It has a concrete floor and contains a dining room and lunch room for the workmen and a dining room for the officials, together with kitchen and pantry; 60 ft. of the length of the building is carried up two stories to provide an apprentice school room and quarters for the help. Heating is by the direct system and lighting with incandescent lamps.

There are also two small buildings located near the freight repair tracks for blacksmith shops and workmen's tools, and in one of them is a small toilet and office. Dry kiln, material bins, plate and iron racks, coal and coke sheds, are also provided.

For obtaining water for shop purposes there have been put down two 8-in. wells equipped with electrically operated pumps. To supplement this supply and to provide a main source of supply for fire protection the city of Calgary has brought down into the shop site to a point midway the length of the main shop building on the west side a 10-in. cast iron water main. The shop service and fire lines are connected onto this main and into a steel tank of 125,000 gals. capacity, which is erected on a 70-ft. steel tower, principally for use in connection with automatic sprinklers in the various buildings where these are installed. A complete fire protection system has been put in with hydrants distributed about the shop yard.

The sewerage system in the shop yard may be divided into the sanitary and storm sewers. The city of Calgary is furnishing the main sanitary sewer, beginning at the east line of the freight car shop and extending to the eastern boundary of the shop property. All the sanitary sewerage lines from the various buildings are connected into this sewer. Storm sewers are provided where necessary to carry off the roof water from the buildings where the roof construction is such that this cannot be discharged onto the ground.

The location of the shops is practically on the open prairie and on the beginning of construction arrangements had to be made to house and board on the shop property a considerable quantity of labor. To this end, frame bunk houses were built with two tiers of bunks on each side of the building, eight bunks long, each house having a capacity of 32 men. Stoves were placed in the center aisle and benches along the sides of the lower tier of bunks. On the coming of summer and as the labor forces were increased some of the men were housed in standard 12x14 wall tents which accommodated four men each. A large mess room and kitchen and storeroom space was also fitted up with a capacity of feeding about 400 men at one time. Great care was exercised throughout the work in keeping the camp in a sanitary condition. This work was largely under the direction of doctors who visited the camp each day to take care of all sickness and an arrangement was also made whereby those who were employed on the work voluntarily contributed a small amount from their wages for the services of these doctors. This amount also included hospital service when necessary. Due to this care there was very little sickness on the job.

As there were no accommodations for men with families near the shops the railroad company put into temporary service a train to carry the men back and forth from Calgary, and several hundred men went back and forth on this train each day. This arrangement helped the situation considerably, especially as the season advanced and all kinds of skilled and unskilled labor became more difficult to obtain. A standing order was placed through several labor agencies in Calgary to send men daily to the job. As the work neared completion the bunk houses and mess house previously mentioned were turned over to the railroad to take care of their own men who were at that time living in cars on the property. This, of course, released the cars and permitted their use at other points.

The progress schedule, Fig. 1, will show the prosecution of the work, but it should be again pointed out that it was not possible to break ground until April 1,1912, and by March 17, 1913, the locomotive shop was in full operation. When the magnitude of the work is considered as also its distance from the larger centers, it will be appreciated that a record for prompt performance has been established.

SEWERAGE AND SANITATION

Further Discussion and Data on the Amount of Ground Water Infiltration Into Sewers.

In Engineering and Contracting of Jan. 15 and April 16, 1913, articles were published upon the subject of ground water infiltration into sewers, with special reference to the amount of such infiltration to be expected and usage of terms and units in recording it. The present article gives additional data and further discussion along the same lines and, as in the case of the preceding articles, the matter here presented is taken from Vol. xxxix of the Proceedings of the American Society of Civil Engineers. The present discussion of the original paper of John N. Brooks is from pp. 1135-1141 of the Proceedings. The discussion of Mr. E. G. Bradbury follows:

TABLE I.

Item.	Length of north section, in ft.	Length of south section, in ft.	Length of entire system, in ft.	Remarks
12-in. terra cotta sewer........	1,525	3,400	4,925	System built, 1909-1911. Pipe in 3-ft. lengths, with cement joints. Two laterals or Y's every 50 ft. Soil wet, sandy loam.
10-in. terra cotta sewer........	.....	1,000	1,000	
8-in. terra cotta sewer........	13,325	23,460	36,785	
4-in. laterals	2,300	5,140	7,440	
Total pipe	17,150	33,000	50,150	
Brick manholes	36	72	108	

A sewer which does not carry a much larger flow during heavy rains than in dry weather is an exception, and, as the maximum flow must be provided for in the design, it is important that information regarding leakage should state the weather conditions. Probably most of the data on systems in use are based on the difference between the storm flow and that of dry periods. There is danger, however, of obtaining misleading figures from observations of leakage in new sewers, or in sewers without connections, when the ground water is comparatively low, for they may show nothing more than the quantity of water which can make its way through the soil to the sewer. This should be borne in mind in comparing gagings of leakage in the same sewer at different dates.

Under average conditions, few sewers are built which fail to permit the entrance of ground water as fast as it can get to them, except during a heavy rain. This is demonstrated by the fact that water is seldom encountered in making connections to public sewers; it is also shown by the usual great increase of leakage coincident with storm conditions.

Unless the tightness of the work, rather than the imperviousness of the soil, is the controlling factor in the quantity of leakage, the size of the sewer evidently makes no difference. As this is seldom the case, it is not strange that there has been great difficulty in establishing any relation between diameter and leakage.

The writer has become convinced, much against his will, that, in the average location, with the ordinary method of making cement joints in pipe sewers, even with the most thorough supervision and careful inspection, the ground water level immediately along the line of the sewer is invariably lowered to the level of the pipe, sloping upward from it at a gradient depending on the porosity of the soil, the surface topography, and other conditions. Under these circumstances, the original height of the ground water enters into the problem of leakage only as it affects the flow toward the sewer.

It is seldom possible to determine without great effort the actual head on a sewer under working conditions. The writer believes that if data were limited to observations in time of heavy storm, when the tightness of the sewer is really put to test, something more remotely suggestive of a relation between size and leakage than has yet been produced, might result, although the surreptitious connection of roof drains, the inflow at manholes, and other possible means for the entrance of surface water, render this one of the most difficult subjects on which to obtain reliable information.

In the consideration of disposal plant design, it is necessary to have in mind both the ordinary infiltration, which is a function of soil and ground water conditions, and the leakage in time of storm, which is governed more directly by the tightness of the construction. The one will cause a continuous flow, usually of small consequence, and the other an occasional heavy discharge which may overtax the capacity of piping, weirs, etc., and perhaps derange seriously the operation of tanks and filters. If the writer's views are correct, it is of course entirely fruitless to attempt to reduce normal infiltration to terms of diameter of pipe; but it should be possible, as already suggested, to establish some general relation which would be of value in estimating the maximum leakage during storm periods.

TABLE II.—MONTHLY AVERAGES OF PRECIPITATION.

Month (1912).	Total, in ins.	Greatest in 24 hrs., in ins.	Total snowfall, unmelted, in ins.
April	4.41	1.06	...
May	6.47	3.21	...
June	1.12	0.70	...
July	4.33	2.53	...
August	3.04	1.46	...
September	3.46	1.42	...
October	6.95	3.12	...
November	3.82	2.27	...
December	5.49	1.94	11.2

TABLE III.—INFILTRATION IN ENTIRE SYSTEM BEFORE REPAIRS AND IN A DRY PERIOD.

Date, (1912).	Precipitation, in ins.	Hours of pumping.	Gallons pumped per day.	Approximate infiltration, in gals., per day.	Infiltration, in gals., per day per mile of sewer.	Infiltration, in gallons per day per inch diameter of pipe per mile of sewer.
July 20............	....	7	112,000	62,000	6,526	816
21............	1.21	8.30	136,000	86,000	9,052	1,131
22............	....	17	272,000	222,000	23,368	2,921
23............	....	14.40	235,000	185,000	19,473	2,434
24............	....	10.30	168,000	118,000	12,421	1,552
25............	....	7	112,000	62,000	6,526	816
26............	....	8	128,000	78,000	8,210	1,028
27............	....	8.30	136,000	86,000	9,052	1,131
28............	0.05	8.30	136,000	86,000	9,052	1,131
29............	0.01	8	128,000	78,000	8,210	1,028
30............	....	8	128,000	78,000	8,210	1,028
31............	Trace.	8.15	132,000	82,000	8,632	1,079

Mr. Marshall R. Pugh presented the following data:

The writer submits some observations made by him recently at Ocean Grove, N. J. South of Asbury Park is Neptune Township, the eastern part of which, known as Ocean Grove, is owned by the Camp Meeting Association. West of this are West Grove and Bradley Park, the greater part of which are included in what is known as "Sewer District No. 1." About a year after the construction of the sewerage system, the writer was retained to design sewage disposal works. The infiltration was so important a factor that a number of observations were made in the effort to determine it, and though the results are discordant in one or two particulars, it is thought that this is due chiefly to the impossibility of determining accurately the sewage flow as distinguished from the infiltration flow, other than by an estimate based on the houses sewered; there is also the great probability that one portion of the system is badly blocked up by sand, as will be noted later.

The system is divided into two parts, joining at a pumping station, which is being supplanted by a gravity outfall now under construction. The lengths and sizes of the sewers are shown in Table I.

It will be noted from Table I that the number of linear feet of joint in the total length of the 4, 10, and 12-in. pipes, in both the north and south sections of the system, corresponds so closely to the number of linear feet of joint in an equal length of 8-in. pipe, that, for all practical purposes, the system may be considered as consisting of the following:

North section	3.25 miles of 8-in. pipe
South section	6.25 miles of 8-in pipe
Entire system	9.50 miles of 8-in. pipe

The sewers are laid in a soil consisting partly of sandy loam and partly of sandy clay, or clayey sand, underlaid by gravel, and at times there may be a head of from 3 to 5 ft. of water in the pipes at the lower end of the system, and from 1 to 2 ft. at the upper end. The pipes are in 3-ft. lengths, with the ordinary cement joint, and have a slant or lateral on each side about every 50 ft. They were probably laid with only very ordinary care, and about 76 of the manholes were not brought quite up to street grade, being from 4 to 12 ins. too low, and 9 of them still have temporary wooden covers. Some of the manholes were very leaky, and two of them had powerful jets of water shooting through the sides.

As nearly as could be ascertained, the infiltration at times was approximately 900,000 gals. per day, and the house sewage, with the few connections as yet made to the system, amounts to about 50,000 gals. per day, divided fairly equally between the two sections. A sewage ejector which was placed at the pumping station has been discontinued, and, during construction, a temporary pumping plant has been erected. From the records of this plant the following details have been obtained. The rainfall data are given in Table II, and show what an all-important factor is the precipitation.

Table III shows the infiltration in the entire system, in a dry time, before any attempt had been made to diminish the ground water flow into the pipes.

TABLE IV.—INFILTRATION IN ENTIRE SYSTEM AFTER REPAIRS. AND IN A DRY PERIOD.

Date. (1912).	Precipitation, in ins.	Hours of pumping.	Gallons pumped per day.	Approximate infiltration, in gals., per day.	Infiltration, in gals., per day per mile of sewer.	Infiltration, in gallons per day per inch diameter of pipe per mile of sewer.
Sept. 20	0.01	4.35	73,300	23,300	2,452	306
21	....	5	80,000	30,000	3,158	395
22	....	5.20	85,300	35,000	3,684	460
23	Trace.	5.10	82,650	32,000	3,368	421
24	0.76	6.50	109,300	59,300	6,242	780
25	1.42	7.10	114,600	64,600	6,800	850
26	...	7.30	120,000	70,000	7,368	921
27	Trace.	6.20	101,300	51,300	5,400	675
Oct. 7	No rain in October prior to this.	5.55	94,700	44,700	4,705	558

Table IV shows the results after the tops of 76 manholes had been raised, and the leaky ones had been made tight.

At the time the repairs were made, the south section was disconnected, and Table V gives the infiltration in the north section alone.

The much higher infiltration per mile in the north section may be due to the fact that a large part of the south section is in territory which is not built up, and there is reason to believe that a great many stoppages are caused by sand which is washed in at the manholes (the tops of 50 being below the grade of the streets), thus blocking off the escape of the ground water through the sewers.

Then, too, the outlet of the north section is about 2 ft. lower than that of the south section, and is under a greater head of water. A part of the north section, also, runs through filled-in land which was formerly a swamp.

It will be noted that the infiltration shown in Table V was, for a somewhat drier time than that in Table IV.

It is obvious that there cannot be more infiltration in the north section than in the entire system; which shows that the estimated sewage flow is open to suspicion, and, in all likelihood, is not properly proportioned between the two sections. The fact that the total pumpage only fell off from 94,700 to 72,000 gals. when two-thirds of the system was cut out, showed, however, the general correctness of the higher infiltration figures in the north section.

The latter part of October was wet, and the flows shown in Table VI clearly demonstrate the effect of the rise in the ground water in winter.

At first sight it appears strange that the 0.86 in. of precipitation on Dec. 24 did not show in the sewer flow, but it is easily accounted for, as it consisted of a 10-in. fall of snow, on frozen ground, followed on the 27th by a cold rain, which increased the flow somewhat. On the 29th there was a thaw, and a heavy downpour on the 30th, the result being at once visible. The cause of the increase on Dec. 16 is difficult to explain.

The units of gallons per day per mile of sewer, and gallons per day per inch of diameter of pipe per mile of sewer appeal to the writer as the most convenient and satisfactory for general use, although the latter is open to the serious objection that manholes, slants, and laterals are frequently as numerous on the smaller sewers as on the larger ones, and they undoubtedly are responsible for much leakage.

TABLE V.—INFILTRATION IN NORTH SECTION AFTER REPAIRS, AND IN A DRY PERIOD.

Date, (1912).	Precipitation, in ins.	Hours of pumping.	Gallons pumped per day.	Approximate infiltration, in gals., per day.	Infiltration, in gals., per day per mile of sewer.	Infiltration, in gallons per day per inch diameter of pipe per mile of sewer.
Oct. 8	....	4.45	72,000	47,000	14,461	1,808
9	....	4.40	74,600	49,600	15,261	1,907
10	....	4.45	72,000	17,000	14,461	1,808
11	0.75	5.0	80,000	55,000	16,930	2,116
12	0.01	4.40	74,600	49,600	15,261	1,907
13	....	4.30	73,300	48,300	14,861	1,857
14	....	4.40	74,600	49,600	15,261	1,907
15	....	4.45	72,000	47,000	14,461	1,808

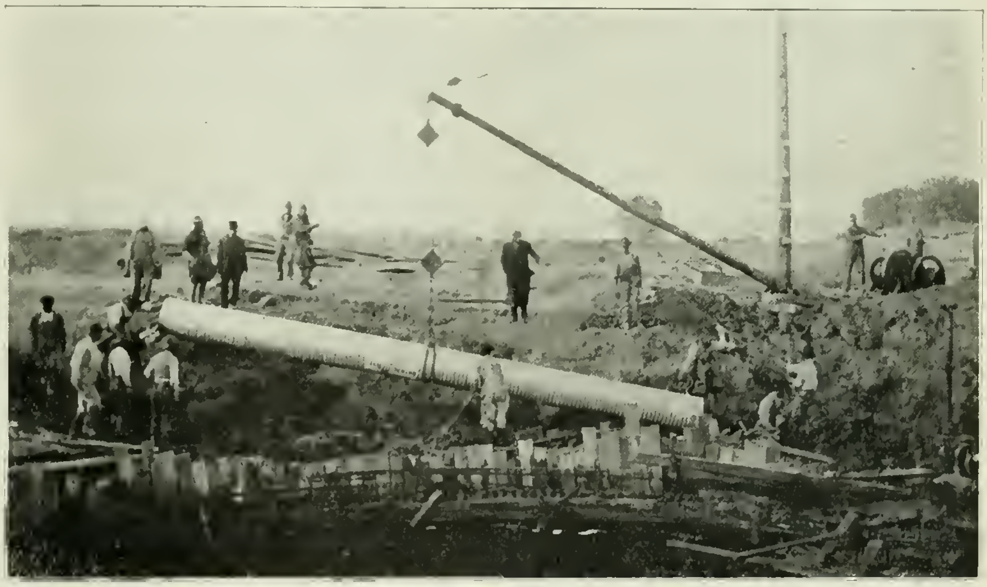
TABLE VI.—INFILTRATION IN NORTH SECTION AFTER REPAIRS. WINTER CONDITIONS.

Date. 1912.	Precipitation, in ins.	Hours of pumping.	Gallons pumped	Approximate infiltration, in gals., per day.	Infiltration, in gals., per day per mile of sewer.	Infiltration, in gallons per day per inch diameter of pipe per mile of sewer.
Dec. 15	....	6.30	104,000	79,000	24,308	3,038
16	....	11.	176,000	151,000	46,461	5,808
17	....	8.10	130,600	105,600	32,492	4,061
18	0.26	9	144,000	119,000	36,615	4,577
19	0.57	7.30	120,000	95,000	29,230	3,654
20	....	12,25	198,600	173,600	53,414	6,676
21	....	9.30	152,000	127,000	39,077	4,760
22	....	9.30	152,000	127,000	39,077	4,760
23	....	8.	128,000	103,000	31,600	3,950
24	0.86	8.40	138,600	113,600	34,900	4,362
25	....	8.45	140,000	115,000	35,300	4,412
26	Trace	9.25	150,600	125,600	38,600	4,825
27	1.05	11.35	185,300	160,300	49,300	6,162
28	....	11.	176,000	151,000	46,400	5,800
29	....	11.05	177,300	152,300	46,800	5,850
30	1.94	22.	352,000	327,000	100,615	12,577
31	....	16.	256,000	201,000	61,800	7,725

An Emergency Sewer Repair Made by Means of Corrugated Culvert Pipe.

(STAFF ARTICLE.)

A quick repair of a collapsed clay pipe sewer which ordinarily carried a heavy flow of sewage, was made recently at El Paso, Tex., by means of American Ingot Iron Corrugated Pipe. In connection with the construction of a new pipe sewer in deep cut, it became necessary to construct a sump 50 ft. in diameter and 26 ft. deep. The banks of the sump were held in place by steel sheet piling as shown in the accompanying view. The present main sewer, of 24-in. vitrified clay pipe, runs within 4 ft. of the sheet piling at one point. The soil traversed is such that in driving the piling the earth below the sewer was disturbed to such an extent that the pipe collapsed for a length of about 50 ft. The sewage then seeped under the piling until it filled the sump entirely and ran over the tops of the piling back onto the broken pipe line.



View Showing the Use of Corrugated Culvert Pipe in Making an Emergency Sewer Repair, El Paso, Tex.

It was necessary to find a quick and effective method of repairing the break and the choice of material to use for that purpose was a matter of first concern. In the summer of 1912 the city laid 3,800 ft. of 24-in. sewer and used American Ingot pipe for that purpose. The line worked satisfactorily and having in mind the ease with which it was installed and its comparative independence of a firm and even bearing, the City Engineer, Mr. Herbert Nunn, decided to employ this type of material in making the repair. The pipe was obtained from a local dealer.

When construction operations began pumps were started pumping the sewage out of the sump. At the same time a crew started excavating and removing the broken sections of clay pipe. A half hour before undertaking the actual replacement of the pipe the flow of sewage was practically cut off at a point upstream from the break. The accompanying view shows the method by which the first section of culvert pipe, 30 ft. long, was handled. The 20-ft. section was placed in the trench by hand without difficulty. An hour and a half after the replacement began the full flow of the main sewer was opened up and turned through the repaired section. The replacement began at 6:30 a. m. on a Sunday, at which time the sewage flow was comparatively small. The break occurred early in the morning of the preceding day.

The two sections of the culvert pipe were joined by means of a band connector. A reducer 2 ft. long was used at the upstream end of the corrugated pipe to join it at that point with the clay pipe. The reducer was of suitable size to slip over the outside of the clay pipe.

The downstream end of the corrugated pipe section was inserted in the bell end of the first length of clay pipe below the original break. This joint was calked full of oakum and was surrounded with a concrete collar. A concrete collar was also placed around the reducer previously mentioned.

The corrugated pipe employed was of the usual construction, not soldered. Previous experience with this pipe in sewer work in El Paso indicates that such slight leaks as may appear will soon silt up and make the pipe practically water tight. The job was considered a success by those who had it in charge. Although this corrugated pipe is not constructed with a view to its use for sewer purposes, instances like that here described serve to show the adaptability of the material.

Increasing Application of Refuse Destructors in America—Official Test of Plant at Halifax, N. S.

The first municipal refuse destructor installation in America was that at Westmount, Quebec, in May, 1906. Since that time this method of disposal has grown in favor. A statement of the number and capacity of plants now installed or contemplated, with their capacities, is given in Table I.

Of the plants listed in Table I two cities employ the surplus power for pumping water for the city supply or for fire protection, one furnishes auxiliary power for electric lighting, another develops power for pumping sewage. In one large industrial works the destructor boiler is an auxiliary to the steam power plant, and in another city the destructor furnishes steam for the operation of a reduction plant.

At four of the installations now operating, additional equipment is being installed for utilizing the power from destructor boilers for pumping water and municipal electric lighting. Of those under construction and pending award, seven places propose to use the power for several forms of municipal and private service.

Besides the list of cities where plants are and will be installed, there are a large number of places which are investigating, obtaining data and considering installations, that will utilize steam power to be developed for various municipal uses. It is apparent that the suitability of the modern destructor for use under American conditions is becoming well understood.

TABLE I.—DESTRUCTORS NOW INSTALLED OR PENDING AWARDS IN THE UNITED STATES AND CANADA.

United States—				
Installation in	10 cities with	12 sep. plants	72 grates, daily cap.	1,057 tons
Under construction	4 cities with	4 sep. plants	27 grates, daily cap.	440 tons
Pending awards	3 cities with	3 sep. plants	16 grates, daily cap.	270 tons
Canada—				
Installation in	7 cities with	8 sep. plants	24 grates, daily cap.	420 tons
Pending awards	3 cities with	3 sep. plants	9 grates, daily cap.	150 tons
Total	27	30	148	2,337

THE STERLING DESTRUCTOR AT HALIFAX.

The installation of a Sterling Refuse Destructor has just been completed at Halifax, Nova Scotia. The plans and specifications were prepared by the Griscom-Russell Co. of New York City. The essential features of the completed plant are as follows:

Destructor.—The rated capacity of the destructor is 50 tons in 24 hours. It is of the top container fed type and is built in one unit of three grates. The area of the grates aggregate 75 sq. ft. There is one Abendroth-Root water tube boiler of 2,034 sq. ft. heating surface. Rated horsepower is 200 at a steam pressure of 150 lbs. per square inch.

Building and Equipment.—The plant is housed in a concrete building. Steel storage hoppers of capacity sufficient to hold one day's supply are provided. There is a runway for the collection carts, and a special charging chute for night soil. The charging containers are mechanically operated. The bypass is directly connected with the radial brick chimney which is 6 ft. inside diameter and 115 ft. high. There is a rotary crusher screen and elevator for preparing the clinker for municipal uses. The draft through the regenerator is forced by means of a steam-driven fan. The ventilation system is connected with the fan. There are also the usual instruments for recording all the essential temperatures and pressures during tests.

LOG OF TEST OF THE HALIFAX DESTRUCTOR.

An official test of the destructor at Halifax was made on March 8, 1913. The log of the test follows:

Duration of test	4 hrs. 8 mins.
Number of grates	Three
Total grate area	75 sq. ft.
Abendroth-Root water tube boiler heating surface	2,034 sq. ft.
WEIGHTS—	
Total amount refuse consumed	24,072 lbs.
Composition, house ashes, 75 per cent	18,054 lbs.
Wet garbage, 16 per cent	3,852 lbs.
Rubbish, 9 per cent	2,166 lbs.
Lbs. burned per sq. ft. grate per hr. grate—	
No. 1	89 lbs.
No. 2	73 lbs.
No. 3	71.5 lbs.
Average	77.7 lbs.
WATER EVAPORATION—	
Temperature feed water	40° F.
Boiler pressure (gage)	145 lbs.
Factor of evaporation	1.227
Total water evaporated	29,992 lbs.
Evaporation from and at 212° F.	36,800 lbs.
Equivalent boiler horse power	258
Equivalent evaporation from and at 212° F. per lb. refuse consumed	1.52
TEMPERATURES AND PRESSURES—	
Temperature combustion chamber Fah.—	
Maximum	1,547° F.
Minimum	1,255° F.
Average	1,357° F.
Percentage CO_2—	
Average	9.44
Maximum	12.5
Minimum	7.25
Air pressure in ash pit	2.75 ins. water gage
From regenerator	3.75 ins. water gage
Into regenerator	4.25 ins. water gage
Temperature—	
Outside air	30° F.
Air from regenerator	180° F.
Gases into regenerator	475° F.
R. P. M. fan	375.
Duration clinkering periods	8 mins.
Interval between clinkering periods average	92 mins.
Labor cost per ton—city wages	28 cts.

The combustion of refuse at the test was at the rate of 70 tons in 24 hours. This is 40 per cent in excess of the guaranteed capacity. The calorific value of the Halifax refuse at the time of the test was very low, the analysis of the residues on one test showing 40 per cent of fine dust, 37 per cent of ash, and 23 per cent of clinker.

DRAINAGE AND IRRIGATION

Reinforced Concrete Embankment Protection, Prewitt Reservoir, Colorado.

The Prewitt Reservoir forms a portion of the irrigation system of the Great Western Sugar Co., operating beet sugar factories in South Platt River Valley in Colorado. It occupies a shallow, sandy depression on the plains bordering the river; it receives its water by canal from the river and delivers it to canal for distribution. The reservoir works comprise besides the canal inlet and outlet structures, an earthen embankment about 3½ miles long on about one-third the perimeter of the reservoir. This description is confined to the reservoir embankment construction, and is taken from "The Prewitt Reservoir Proposition" by J. C. Ulrich, Proceedings, American Society of Civil Engineers, Vol. xxxix, p. 989.

Figure 1 is a section of the embankment which has a maximum height of 36 ft. for about 100 ft., with a height not exceeding 25 ft. for the greater portion of its length and an average height of 20 ft. The water side slope is uniformly 1 on 2. The outside slope is uniformly 1 on 2 where the height does not exceed 20 ft. Above this height the 1 on 2 slope extends down to elevation 20 below the top and from there to the bottom the slope is 1 on 3. The top width throughout is 16 ft. and the top is 7 ft. above the highest proposed water level.

The material on which the embankment is founded, and of which it is constructed, consists essentially of very fine sand mixed with a small percentage of soil.

Prior to the construction of the embankment, a longitudinal trench was excavated along the entire site, its center line being coincident with that of the embankment. This trench was made 6 ft. deep and 6 ft. wide on the bottom, with side slopes of 1½ horizontal to 1 vertical.

Before depositing any earth for the embankment proper, this trench was partly filled with water, in which selected material was deposited in 2-ft. layers. This operation was repeated three times in the filling of the trench. The water for this purpose was pumped from a series of 16 wells, put down just outside of the lower toe of the embankment, at intervals of about 1,000 ft. Sufficient water was thus furnished and used, to effect, not merely the moistening, but the actual puddling, of the material deposited in the trench.

The purpose of this puddled trench was to break the continuity of any seam which there might be between the soil of the site and the material of the superimposed embankment. It was also designed to cut off and intercept the channels of any dog or gopher holes which might be in the material underlying the embankment.

After the trench had been filled, and the site had been cleared of all vegetable matter and plowed to a depth of 10 in., the construction of the embankment proper was begun.

The material was deposited in layers not exceeding 1 ft. in thickness. Each layer was then thoroughly wetted, before the deposition of the next, with water pumped from the wells. Then it was rolled with a corrugated roller weighing 125 lb. per in. of length. This operation was repeated successively until the full height of the embankment was reached. The wetting of this material prior to each rolling resulted in the actual wetting of the whole layer, not the mere moistening of the surface. The contractors claim to have kept records of their pumping operations, and these disclose the fact that the volume of water pumped into the material exceeded that of the embankment itself; in other words, the volume of water put into the embankment exceded that of the earth.

Protection of Embankment Against Wave Action.—The water side of the embankment is protected against wave action by a covering of concrete, 4 ins. thick, extending from its foot to within 2 ft. of its top, where it joins a vertical parapet wall of concrete. The latter is 3 ft. high, and extends 1 ft. above the crest of the embankment, and 8 ft. above the elevation of the highest proposed water in the reservoir. This parapet is 6 ins. thick, and is L-shaped, with a vertical leg of 3 ft. and a horizontal leg of 2½ ft. Both legs are reinforced in each direction with ⅜-in. square, twisted bars at intervals of 12 ins.

At the foot of the surface protection, and connected therewith by reinforcing rods of steel, there is a vertical "toe-wall," extending 5 ft. into the ground below the edge of the latter. This toe-wall is 6 ins. thick, and is reinforced horizontally and vertically with steel bars at intervals of 12 ins.

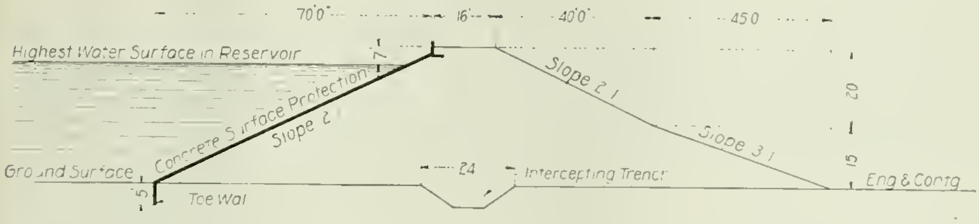


Fig. 1—Typical Section of Prewitt Reservoir Embankment Showing Concrete Paving.

The concrete sheathing which covers the surface of the embankment is in individual slabs, each 10 ft. wide, and continuous in length from the parapet wall at the top to the toe-wall at its foot.

These slabs were laid in two distinct sets, the first set being placed with intervening spaces of the same widths as the slabs themselves. After the first ones had become thoroughly set, the alternate slabs were placed. Side forms were placed for the first set of slabs, but their edges constituted the forms for the alternate set.

Under each line forming the junction of adjacent slabs, and designed for the purpose of breaking the joints between the latter, there are concrete stringers, extending from the top to the bottom of the inclined surface to be protected. These stringers are 6 ins. thick and 12 ins. wide, and each is reinforced with three bars of ⅜-in. square, twisted, steel placed midway between the upper and lower surfaces of the stringer. The edges of adjacent protection slabs are coincident with the center line of these stringers, each slab lapping over the stringer 6 ins. It was expected that this arrangement would break the joints between the edges of the slabs, and prevent the removal of sand and earth through seams which might be caused by the contraction of the slabs.

The slabs are reinforced in both directions with ⅜-in. square, twisted, steel rods at intervals of 12 ins. Great care was taken to insure that these rods would be midway between the two surfaces of the concrete. The longitudinal and cross-rods were secured to one another with wire fastenings at each alternate intersection.

The concrete in all this revetment was composed of 1 part of Ideal Portland cement and 4 parts clean, sharp river sand.

Test of New Paving Brick.—A new paving brick is being tested by the city of St. Petersburg, Fla., which, if found satisfactory, will greatly reduce the cost of paving for that city. The brick is mainufactured by the St. Petersburg Ornamental Stone & Brick Co., which is erecting a kiln of 40,000 acapcity at St. Petersburg, thus eliminating the cost of transportation to the city. The brick is made by a new process in which sand is used, and burned to make a harder and more durable article than the Georgia product now in use; and it is also cheaper. The company will pave one block with it for experimental purposes.

A Drag Line Excavator Bucket Which Eliminates Tension Between Drag and Hoist Lines.

(Staff Article.)

The drag line excavator bucket illustrated by the accompanying drawings can be hoisted from any position. It is also so "locked" that it can be hoisted with a slack drag line, thus eliminating all stresses which occur where a tension has to be kept on the drag line, and also, of course, decreasing the power required for hoisting. Absolute control of the bucket is had in any position; it can be hoisted, for example, from a position to which it has been "thrown" beyond the radius of the boom as well as from a position within the reach of the boom, and it can be dumped at any point of its travel and at any height of its lift. These properties are secured by special construction and appliances which are shown by the drawings and may be described as follows.

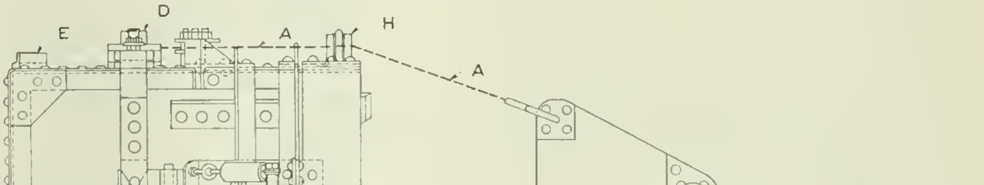


Fig. 1—Drawings of Iverson Drag Line Scraper Bucket.

The drawings show a top plan, a side elevation and a front elevation of the bucket which is built of steel plates and provided with rear skids and with digging teeth. It will be noticed that the two arches which support the tripping device also serve to brace the sides of the bucket against spreading or squeezing, together. Squeezing together is also prevented by leading the bucket lines *A* from which the drag line proper is fastened. The an unusually wide triangle *B* to the apex of special operating features of the bucket are the bail and the latching and tripping device.

Referring to the drawings, it is seen that the bail *C* is hinged freely at *D*, and can tilt back until checked by the stop *E*, or forward until it engages with the latching device. When hanging empty in dumping position the bail is against the stop *E*, and the bucket is mouth downward, in which position it strikes the ground when lowered and settles back on its bottom in doing which the bail tips forward until the latch pin *F* is engaged by the dog *G*. In this position the bucket is pulled ahead by the drag line and takes on its load. The routes of the bucket lines *A* indicate clearly the direction of the digging pull which it will be seen is such as to tip the bucket down and give it a good bite into the soil. By shifting the fair-leaders *H* the digging angle can be varied to suit the soil conditions. At *J* are stops which limit the forward swing of the bail. With the bail tilted forward and latched the bucket is hoisted with a slack drag line, and from the position of the bail it will be seen that the bucket, freed from the pull of the drag line, tilts up slightly in front and holds its load without spilling. The bucket is suspended in a bight of the hoisting rope. This rope from the engine passes along the top of the boom and down around the boom end sheave; its free end is then rove through a single block and fastened to the underside of the boom at a point a couple of feet back of the end sheave. The single block travels in the bight of the rope between the end sheave and the point where it is hitched to the boom.

To dump the bucket the trip lever *K* is operated by the trip line which runs to a reel so designed that it takes up or pays out line as the bucket moves in or out. The reel keeps the tip line just taut, so that when a brake is thrown on and the reel stopped the action places a pull on the trip lever which unlatches the dog *G* from the latch pin *F*. The bucket tips forward and discharges its load, and is left hanging front downward,

The bucket described is known as the Iver-ready to be lowered for a second load.

son bucket, and is made by the Dobbie Foundry & Machine Co., Niagara Falls, N. Y., in ¾, 1 1½, 2 2½ and 3 cu. yd. sizes, and of varying weights according to the class of material to be handled.

Steam Shovel Record at Patillas Dam Porto Rico Irrigation System.

Sirs: The Government of Porto Rico is building a hydraulic fill dam about one mile from Patillas, P. R., which will store 358,133,511 gals. of water and it will be used to irrigate about 16,000 acres of sugar cane lands.

Where the classes of materials are found, with which to build the dam, it is necessary to use steam shovels and train service to excavate and transport the materials about 6,000 ft. to either face of the dam, where the hydraulic monitors under a 200-ft. head, separate the classes of material.

On May 13, a 2 cu. yd. Marion steam shovel, Model 50, shop No. 2263, loaded 62 trains, which were comprised of four 8 cu. yd. Western air dump cars each; making a total of 1,984 cu. yds. in 7 hrs. 31 mins. of actual digging.

The shovel was moved ahead 14 times in 56 mins. and had a delay of 33 mins., due to breakdown, making a usual 9-hour shift.

The shovel engineers and their respective cranesmen, Walters and Eads, McLaughlin and Garrison, have each loaded 60 trains in one shift, but Peck and Giles now hold the record above stated at Patillas dam. About 49.90 per cent of the dam is now finished.

Respectfully yours,
G. C. Willson,
Division Engineer.

Patillas, P. R., May 22, 1913.

WATER WORKS

The Design and Operation of the Minneapolis Water Filtration Plant.

Contributed by W. N. Jones, Assoc. Mem. Am. Soc. C. E., Engineer in Charge of Filter Construction.

In the year 1868 the first work for supplying the city of Minneapolis with water taken from the Mississippi River was started, and since the completion of the same in the fall of that year the river has been the source of supply for all purposes, with the exception of a few isolated artesian wells for the supply of large office buildings.

During the early periods the supply of water obtained from the Mississippi River was found to be very good indeed, but as the watershed became more thickly peopled and sewerage systems were installed in the small towns upstream, a decided drop in the quality of the water took place and epidemics of typhoid fever followed. These epidemics led at various times to agitations for an improved and better water supply, but nothing ever came of them until the spring of 1904, when a commission consisting of Messrs. Rinker, Cappelen and Hazen were appointed by the city council to investigate and report on the best method of filtering the river water with the cost of the same. After an investigation of several months the commission reported in favor of slow sand filters located near the old existing reservoir.

The commission, however, investigated every possible source of supply in addition to the river and included in their report as sources of supply Lake Superior, Mille Lacs Lake and artesian wells, all of which were dismissed as impractical.

The Lake Superior project would have required a pipe line of 160 miles in length, and the reservoirs were situated at an elevation of over 400 ft. above the lake, with intervening ground at least 150 ft. higher, over which the water would have had to be pumped, making operating costs very high, besides incurring the great risk of depending upon a single pipe line.

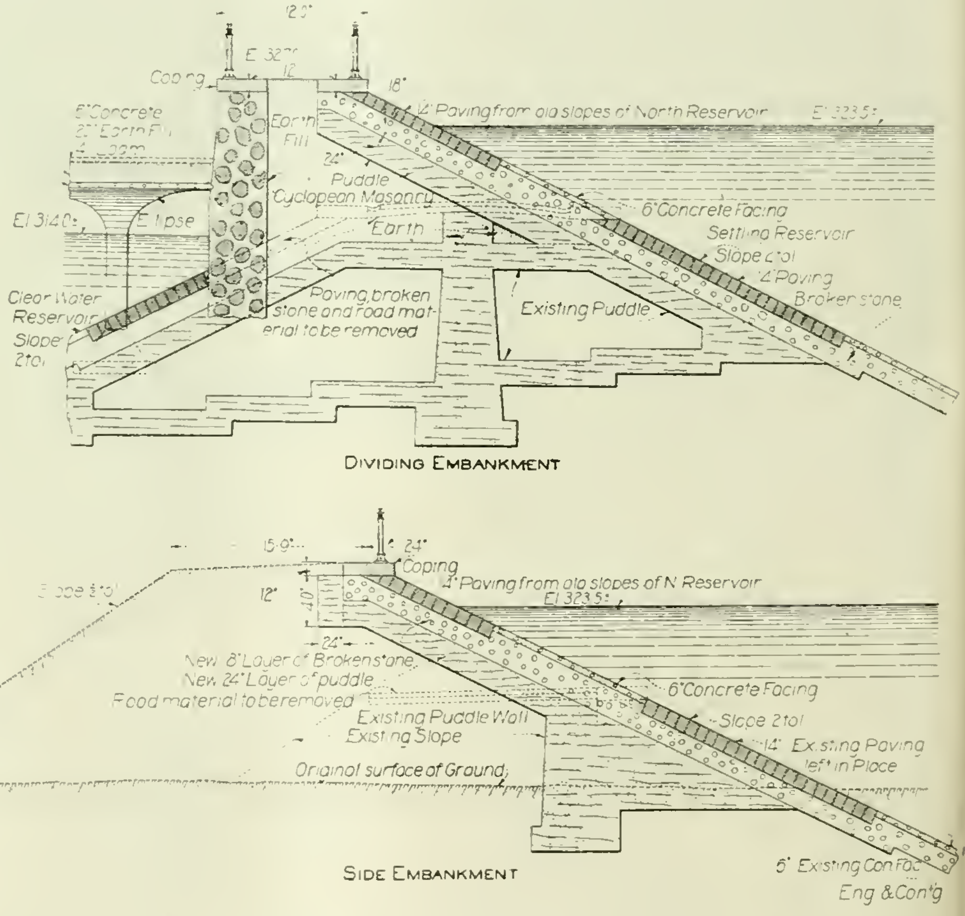
The artesian well supply was pure but hard, and it would have required a softening plant before fit for use, in addition to low lift pumping. Then, too, it was doubtful whether a sufficient quantity of water could be obtained from this source or not within a reasonable distance.

The Mille Lacs Lake project was very attractive, but was abandoned on account of its high cost in comparison with filtration. Later, however, a feeling arose that the city should obtain the best water supply available irrespective of its cost, and, at the instigation of the water committee, a second commission was appointed by the city council "to investigate and report upon the best method of securing a pure water supply for the city of Minneapolis."

After investigating various filter plants in different parts of the country, the Water Commission in June, 1909, brought in a majority and minority report. The majority report recommended the filtration of the Mississippi River water, but advised further study to ascertain the best method of doing so. The minority report advised further investigation of the Mille Lacs Lake project.

The report of the commission not being fully in favor of any definite project, the city council, wishing to move in this matter with caution, decided to investigate more fully both of the above sources of supply. With this end in view Mr. Rudolph Hering, of the firm of Hering & Fuller of New York City, was called in during the fall of 1909 and was given full power to make such investigations as he deemed necessary, and to report on the same as soon as possible.

Mr. Hering immediately made a very thorough examination of the existing pumping stations, reservoirs and general distribution system, relative to using the same in connection with a filter plant. Immediately upon the completion of this investigation a trip was made to Mille Lacs Lake for the purpose of examining the watershed as to topographical and geological features, the character of the water, the depth of the lake and the amount of its discharge. A resurvey of the proposed pipe line was made and it was found that the surface of the lake was 227 ft. higher than the old city reservoir and would give a gravity flow, but a pipe line would have to be constructed about 80 miles in length. The lake water was found to be similar to that of the Mississippi River, except for hardness and contamination, which were less. The average flow was estimated to be about 51,000,000 gals. per day, with not more than 60,000,000 gals. and not less than 43,000,000 gals. On account of no extended gage readings of the outlet being available, it was necessary to make the above estimates by the unusual method of rainfall and evaporation, and in view of certain topographical features of the lake, it was not certain that the city could be assured of more than 40,000,000 gals. flow at all times.



DIVIDING EMBANKMENT

SIDE EMBANKMENT

Fig. 1—Typical Sections of Dividing Embankment Between Clear Water and Settling Reservoirs and of Side Embankment.

The computations made by Prof. F. H. Bass of the University of Minnesota gave a less flow than was expected on account of the large evaporation from so large an extent of water surface, it being 6.5 ins. greater than the rainfall upon the same area.

It was estimated that the cost of building a pipe line 80 miles long and 64 ins. in diameter, the size necessary to carry 40,000,000 gals. per day would be $6,502,149, and that the annual cost to maintain the same, including interest and depreciation on pipe line and purification plant at 1½ per cent, repairs, care of lake shore and patrol, and hypochlorite treatment of 30,000,000 gals. of water daily, would be about $379,000.

The cost of treatment was based on 30,000,000 gals. daily for the reason that the capacity of the filter plant was based on this amount, which at this time was deemed sufficient.

From extended gage readings of the flow of the Mississippi River at Minneapolis, it was found that the river afforded a source of supply which would be abundant for all times, no matter how great should be the demand.

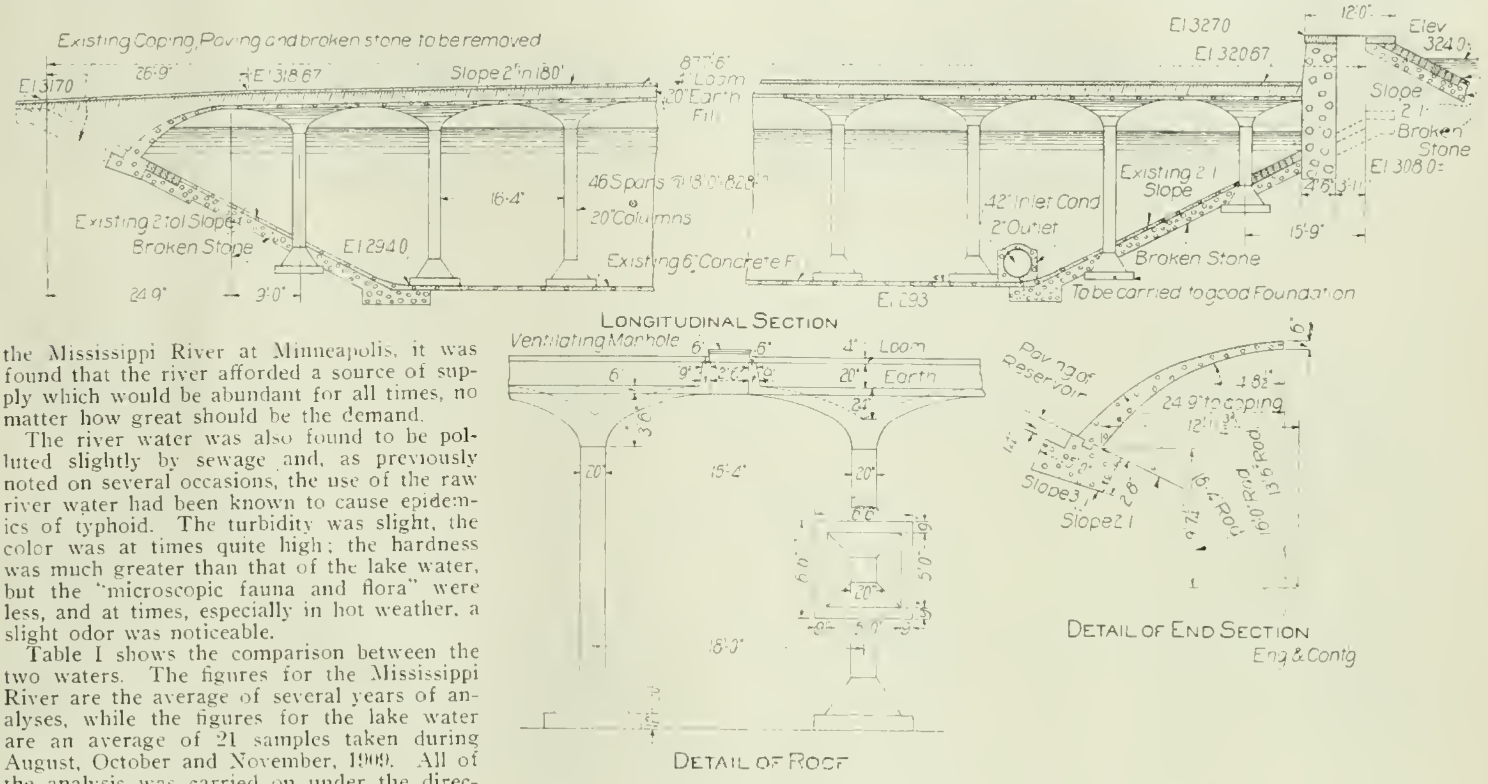


Fig. 2—Longitudinal Section and Details of Clear Water Reservoir.

The river water was also found to be polluted slightly by sewage and, as previously noted on several occasions, the use of the raw river water had been known to cause epidemics of typhoid. The turbidity was slight, the color was at times quite high; the hardness was much greater than that of the lake water, but the "microscopic fauna and flora" were less, and at times, especially in hot weather, a slight odor was noticeable.

Table I shows the comparison between the two waters. The figures for the Mississippi River are the average of several years of analyses, while the figures for the lake water are an average of 21 samples taken during August, October and November, 1909. All of the analysis was carried on under the direction of Dr. J. F. Corbett, City Bacteriologist.

In securing a satisfactory water supply for the city, it was required to accomplish two main objects. (1) To secure a water supply perfectly free from pathogenic bacteria, and (2) one free from turpidity, taste, odor and color.

It was decided that mechanical filtration and sterilization combined would accomplish this, and that no matter whether Mille Lacs Lake or the Mississippi River was used for the supply, filtration would be necessary as the lake water could not be made absolutely satisfactory without treatment. Thus, in addition to the cost of the pipe line, etc., there would be the cost of a filter plant to add to the cost of the Mille Lacs project.

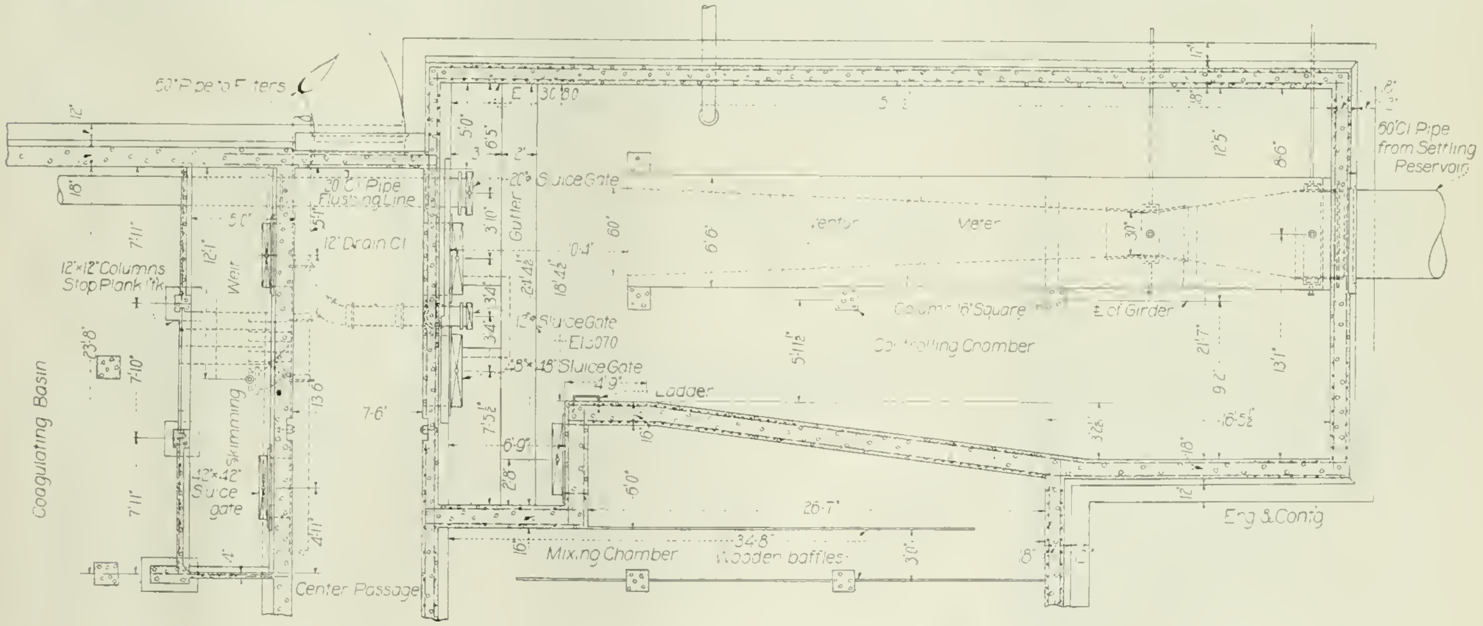


Fig. 3—Section Plan of Controlling Chamber and Parts of Mixing Chamber, Center Passage and Coagulating Basin.

The estimated cost of a mechanical filtration plant of 30,000,000 daily capacity, including a clear water basin and all other necessary appurtenances, was $522,500, and the annual cost for operation, including interest and depreciation, was estimated at $81,300. Thus a balance would be left of $5,979,649 in construction, and $298,051 per year for operation in favor of the mechanical filter plant over the Mille Lacs Lake project without filtration.

On account of the character of the water to be treated, only one other means was considered: that of double filtration, for which the initial cost would have been $964,100, and the annual cost for operation, etc., $90,265.

On March 17th, 1910, Mr. Rudolph Hering submitted a report favoring the purification of the river water by means of mechanical filtration and the use of hypochlorite of lime as a sterilizer, and recommended that a plant of 30,000,000 gals. daily capacity be built at Columbia Heights, near the old reservoirs. This recommendation was adopted by the Water Committee and City Council, and Messrs. Hering and Fuller were commissioned to draw the plans and specifications for the above work.

However, before a great deal of work had been done on the plans, a drought occurred and the daily consumption of water arose from an average of 22,000,000 gals. per day, to above the contemplated capacity of the plant, while the maximum reached 35,000,000 gals. daily for perhaps a week at a time. This made it imperative to increase the capacity of the plant to meet all demands, and with this end in view, the plans were changed to give a filtration plant that could filter 39,000,000 gals. day under a normal rating of 125,000,000 gals. per acre per day.

After careful study of the old works, which consisted of a first-class pumping station, three miles of 50-in. steel force mains, and two settling or service reservoirs of a capacity of 47,000,000 gals. each, it was decided to use the old reservoirs as a part of the new plant.

The new plant contemplated the covering of one of the old reservoirs with a groined arch roof to be used as a clear water basin, the raising of the embankments of the other reservoir 10 ft., in order to maintain the elevation of the water in the clear water basin at the old level and provide a working head for the operation of the filters, also a mixing chamber, two coagulation basins, a headhouse, 12 mechanical filter units, with an auxiliary clear water basin underneath, and a wash water tank of 135,000 gals. capacity.

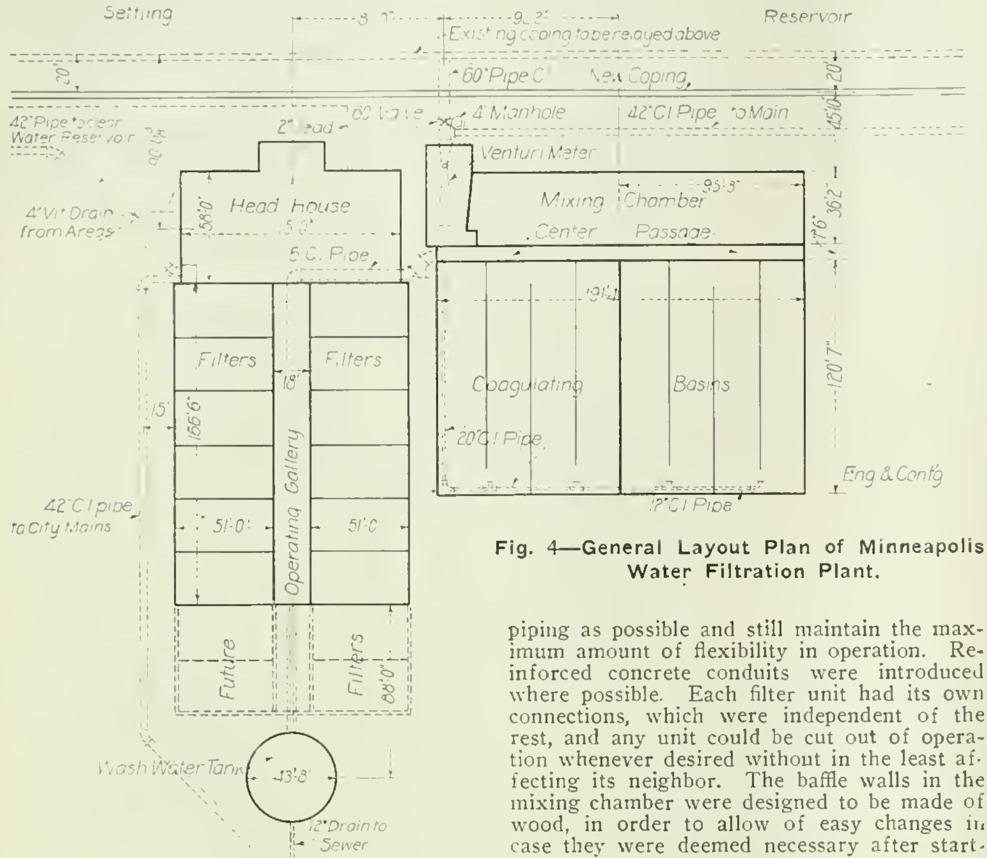


Fig. 4—General Layout Plan of Minneapolis Water Filtration Plant.

The old reservoirs, which were built in 1896, were rectangular in shape, each 877 ft. 6 ins. long by 413 ft. 6 ins. wide, c. to c. of curbing, with a 1 on 2 slope inside, the lower portion of which was lined with 18 ins. of crushed stone and a 6-in. layer of concrete in 10-ft. strips, and the upper portion of which was lined with sandstone blocks 14 ins. thick, resting on a bed of 18 ins. of crushed stone, as shown in Fig. 1.

TABLE I.—COMPARATIVE ANALYSES OF MISSISSIPPI RIVER AND MILLE LACS LAKE WATERS.

	Mississippi River water. Parts per million.	Mille Lacs Lake. Parts per million.
Chlorine	1.490	.86
Albuminoid ammonia	0.353	.416
Free ammonia	0.077	.085
Alkalinity	137.000	78.920
Total hardness	145.000	103.250
Fixed residue	129.000	54.210
Volatile residue	69.000	60.80
Color	56.630	9.00
Turbidity	4.700	9 43
Bacteria	1,622.000	177.00

In building up the embankments of the settling or south basin it was decided to follow the original design and make a portion of the slope of concrete resting on crushed stone, and the remaining, or upper portion, of sandstone paving blocks recovered from the clear water reservoir, or north basin, and which would be of no further use there. See Fig. 2 It was found, however, that in order to carry out this design it would be necessary to either move the north embankment of the south basin south a certain distance or to use some sort of a dividing wall between the two, and as it was deemed best to have as large a settling basin as possible, the dividing wall shown in Figs. 1 and 2 was decided upon after a consultation with the city authorities, and the plan was finally built as per this design.

FILTER PLANT.

In the design of the new works, an effort was made to cut out of the design as much piping as possible and still maintain the maximum amount of flexibility in operation. Reinforced concrete conduits were introduced where possible. Each filter unit had its own connections, which were independent of the rest, and any unit could be cut out of operation whenever desired without in the least affecting its neighbor. The baffle walls in the mixing chamber were designed to be made of wood, in order to allow of easy changes in case they were deemed necessary after starting up.

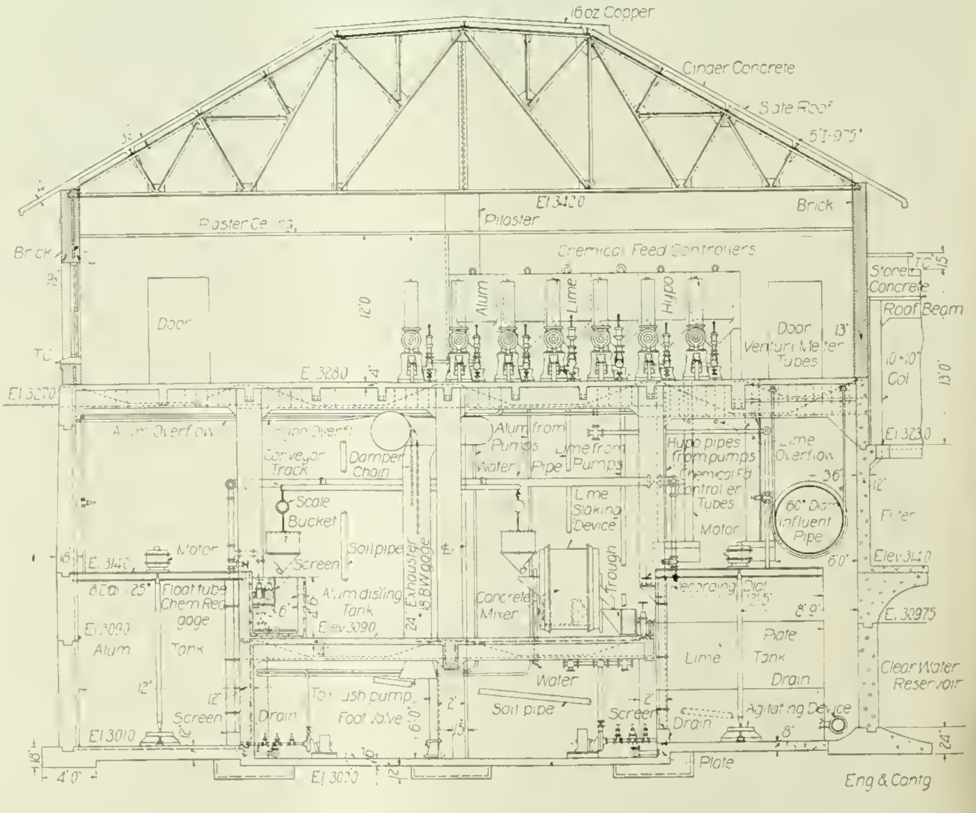


Fig. 5—Section A-A of Fig. 6

A large amount of study was put on the introduction of the chemicals into the water, and the handling, mixing and the storing of the same. A great deal of attention was also paid to the general layout and arrangement of the buildings. They were designed, not only to serve as shelters, but also to appear attractive to the eye from within and without, and to be as compact as possible.

CONTROLLING AND MIXING CHAMBERS.

The controlling and mixing chambers may be treated as one structure, although there is an irregular wall of concrete separating the two, as shown in Fig. 3. Together they form a covered chamber 34 ft. 8 ins. by 173 ft. inside measurements, having a flat slab of concrete for a roof, of the beam and girder type, supported by walls and columns of concrete and carrying a superimposed load of 24 ins. of earth for the greater part of the area, and one side of the gate house over the remaining portion. The slab is discontinued inside the gate house, leaving the waterways open to inspection.

The remaining portion of the gates house is carried in a like manner on the cover of the coagulation basins. The coagulation basins and mixing chamber are separated by a double decked reinforced concrete conduit known as the center passage. This method of design allowed of a very close grouping of the above basins and cheapened the cost materially, as some of the walls of the one could be used as walls for the other, by simply reinforcing in the proper manner.

Within the controlling chamber is located the 60x30-in. Venturi Meter for measuring the total flow to the plant. This meter is of reinforced concrete excepting its upstream end and throat, which are of cast iron lined with bronze, and is low enough to be submerged at all times during the operation of the plant. The meter is shown in plan in Fig. 3.

At 3-ft. intervals across the mixing chamber are placed wooden baffles, of "around the end" type, for mixing thoroughly the chemicals which are introduced in the desired quantities at several points along the passage. It is not necessary, however, that the full length of the mixing chamber be used, as provision is made whereby the treated water can be drawn into the center passage and then into the coagulation basin at a number of places in its travel.

For cleaning out, four sumps connected to the 12-in. drain, located below the center passage and closed by sluice gates, are provided.

and where the baffle walls occur to obstruct the full flow of the drainage wooden gates have been placed. All cleaning of the mixing chamber and coagulation basins is done by flushing and a pressure line has been installed for this purpose, although provision is also made to flush the coagulation basins by means of a 20-in. gravity line from the controlling chamber.

COAGULATION BASINS.

There are two coagulation basins, each 119 ft. 4 ins. by 95 ft. 8 ins. inside measurements, and their construction is similar to that of the mixing chamber, being of the beam and girder type with a dividing wall between them pierced by a 48-in. x 60-in. water way and controlled by the proper size sluice gate. Each basin is divided into four compartments by means of "round the end" baffle walls of reinforced concrete 4 ins. thick cast monolithic with the roof, girders and columns. Each basin has a capacity of 1,400,000 gals. and will allow a period of one hour of coagulation when used alone or about two hours when used together, running at a normal capacity of 39,000,000 gals. per day. Skimming weirs are provided about 23 ft. in length and are of reinforced concrete except for about 7 ft. of their length at the center, which is of wood stop planks 1 in. thick and weighted in place. The stop planks are introduced as a means of safety as well as to provide a method of varying the height at which the water can be skimmed off. In case any unforeseen cause, such as the breaking of a pipe, should occur and throw an undue pressure on one side or the other of the skimming weirs, the thin stop planks would immediately break and equalize the pressure before any serious damage could take place on the walls of the center passage or elsewhere.

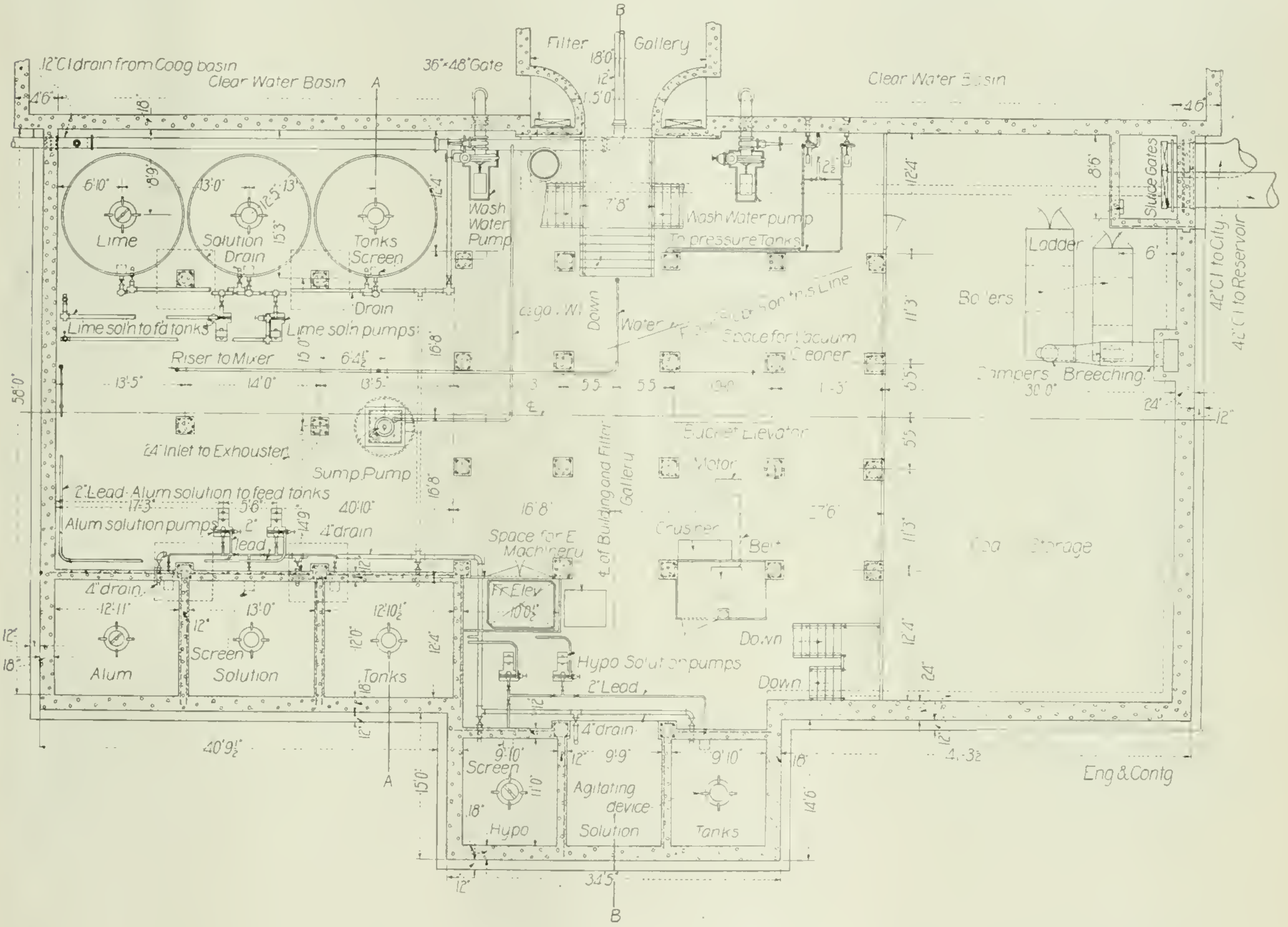


Fig. 6—Plan of Ground Floor of Head House.

Sumps connected to the 12-in. drain and controlled by 12-in. sluice gates are provided for cleaning out the sludge and sediment and are similar to those provided for the mixing chamber, but with the difference that no gates are placed in the baffle walls, but each section of the basins has its own sump, and the floor slopes toward it. A general plan of the plant is shown in Fig. 4.

CENTER PASSAGE.

The center passage is a double-decked conduit so arranged as to have the top of the lower forming the bottom of the upper. The lower conduit provides a means whereby the water can be drawn from various points in the mixing chamber and transferred to either of the coagulation basins, or both, or to the top conduit as desired. It also acts as the dividing wall between the mixing chamber and the coagulation basins. See Fig. 3. By means of sulice gates in the center passage the mixing chamber can be by-passed, and if desired the coagulation basins also.

HEAD HOUSE.

The head house is a reinforced concrete building throughout, except the facing of the upper portion, which is of brick laid in a mixture of cement and lime mortar. A plan of the ground floor of the head house is shown in Fig. 6.

In order to avoid as much plastering as possible it was decided to lay the interior with sand lime brick of a grayish-white color, and to use a white sand in the mortar. The outsids was built of a red sewer brick, and all backing was sand lime brick which cost $6.40 per M delivered at the plant, as against $11.40 per M for the red variety f. o. b. cars Minneapolis. Another thing in favor of the sand lime brick was its size, each brick being about 20 per cent larger than the red brick, and of a very uniform size and smooth surface. All outside joints were scraped out with a rounded tool, and all inside joints were struck straight with a trowel. The result of this treatment has been gratifying in the extreme, and the use of the white brick inside has added materially to the lighting effect of the buildings and to the general appearance of cleanliness.

All the rest of the buildings were built in like manner with no other expense for decorating excepting an acid wash to clean the brick of drippings from the concrete roofs when they were poured.

As shown by Figs. 6-8, the head house measures 115 ft. long and 58 ft. wide, with a 31-ft. 5-in. by 15-ft. extension in front which serves as an entrance, and also as a recess in which the hypochlorite of lime solution tanks are situated. It is three stories high, with a tower very near the center, and contains the chemical storage bins, chemical solution and mixing tanks, all machinery for handling and mixing the chemicals, pumps for pumping the chemicals to the various points of application, chemical feed controllers, wash water pumps, ventilating fans, vacuum cleaning system, boilers for heating purpose, offices and laboratories, and everything else necessary in the operation of the plant, except that which belongs to the filters themselves, and the gate house.

The handling and mixing of the chemicals is made as simple as possible and where the use of gravity or machinery could be employed this was done. Ordinarily the lime and alum is shipped in bulk, and as the nearest railroad is 1½ miles away it is necessary to haul everything for use in the plant by means of teams.

On each side of the front entrance are rolling steel doors and a receiving platform open at its far end and closed by wooden doors when not in use. The loaded wagons back up on the receiving platform and the load is shoveled or dumped out the back end down chutes, see Figs. 5 and 8, to a floor at elevation 319, from whence it is passed down galvanized iron spouts to a bucket elevator if alum, or to a rock crusher and thence into the bucket elevator if lime, and elevated to the top of the central tower from where it finds its way down another chute into the large storage bins at elevation 338. The hypochlorite which comes in suitable iron drums, is unloaded from the wagons through the main front entrance onto a 3-ton freight elevator, and is stored in a room at elevation 340.

Care was taken to make the operation of mixing the chemicals as simple as possible. The cans of hypochlorite are first opened under water in a small dissolving tank, see Fig. 8. The can is then removed and the hypochlorite is flushed by means of a hose into the middle solution tank and is agitated by a motor-driven impeller. When the agitation has been maintained long enough to thoroughly mix the solution it is drawn into either or both of the side tanks and sufficient water is added to give the proper strength, and the solution is agitated from time to time as used.

The alum, after being brought from its storage bins by means of a bucket traveling on a trolley track, is dumped into dissolving tanks containing a grid and is dissolved by means of an upward flow of water and is discharged into one of three solution tanks and diluted if so desired.

In mixing the lime two ordinary concrete mixers of 40 cu. ft. capacity each are employed to slack the lime and discharge it into a trough from whence the milk of lime can be drawn off into one or all of the three circular steel tanks, see Figs. 5 and 6, and diluted by means of water to form a lime water of proper strength for use in the operation of the plant. Motor-driven impellers are also placed on each of the alum and lime tanks, similar to those on the hypochlorite tanks, to agitate the solution and keep it of a uniform strength throughout as it is being used.

All chemicals are weighed before being mixed. The hypochlorite by ordinary platform scales and the alum and lime by means of scales attached to the buckets and trolley which carry them to the dissolving apparatus. See Fig. 5.

After the chemicals have been dissolved they are pumped by means of small centrifugal pumps into six chemical receiving tanks, two for each kind of chemical. The tanks are provided with overflows. The solutions are fed by means of Earl Controllers into the water to be treated at several different points as desired.

CHEMICAL FEED CONTROLLERS.

The chemical feed controllers are connected to a master controller, which in turn is connected by means of suitable piping directly to the large 60-in. x 30-in. Venturi meter in the controlling chamber which measures the total quantity of water entering the plant. By using the chemical feed controllers, connected in the above manner, the chemical solutions are automatically added to the water in a direct ratio to the flow through the meter. This is not true, however, for very large increases or decreases in the flow, as when these occur it is necessary to increase the sizes of the discharge orifice in the controllers themselves, and this must be done by hand. Such variations as do occur from time to time during the process of filtration, on account of clogging up or the washing of a filter, are taken care of automatically and it is only when new filters are thrown into operation, or some sudden demand is placed on the rate of filtration, that it is necessary to change the size of the discharging orifice of the controllers.

All the lime piping throughout the plant is of galvanized iron with tees or crosses containing clean-out plugs wherever a change in direction is made, in order that they may be rodded out upon becoming clogged. The hypochlorite of lime and the alum pipes are of lead 2 ins. in diameter and weighing 7 lbs. per ft., and wherever horizontal runs occur they are supported in ¼-in. x 3-in. x 3-in. angle irons.

All the pumps except the sump and fire pumps in the head house are in duplicate and are motor driven, being of the squirrel cage type induction motor and using a 440-volt, 3-phase, 60-cycle current furnished by the Minneapolis General Electric Co. over duplicate lines which enter the plant at 13,200 volts, and which is transformed down to 440 volts for power and 110 volts for lights. The list of pumps is as follows:

One 50-H. P., 2-stage fire pump pumping 500 gals. per minute against 100 lbs. pressure, 2 40-H. P. wash water pumps, each of which discharges 1,600 gals. per minute through an 8-in. pipe against a 50-ft. head, 1 sump pump discharging 200 gals. a minute against a 15-ft. head, 2 pressure pumps, for use in operating the hydraulic valves, which deliver 30 gals. each per minute against a head of 80 ft., 2 hypo and 2 alum pumps, the alum delivering 40 gals. a minute each, and the hypo 20 gals. a minute each against a head of 45 ft., 2 lime pumps delivering 40 gals. a minute against a 45-ft. head, and 12 sample pumps of ¼ H. P. each, which are located in the pipe gallery.

HEATING PLANT.

The heating boilers are located in the basement of the head house. They are of the locomotive type and were built with the Hawley down draught furnace. They are of different sizes, the larger having a capacity for supplying heat to 15,000 sq. ft. of radiating surface,

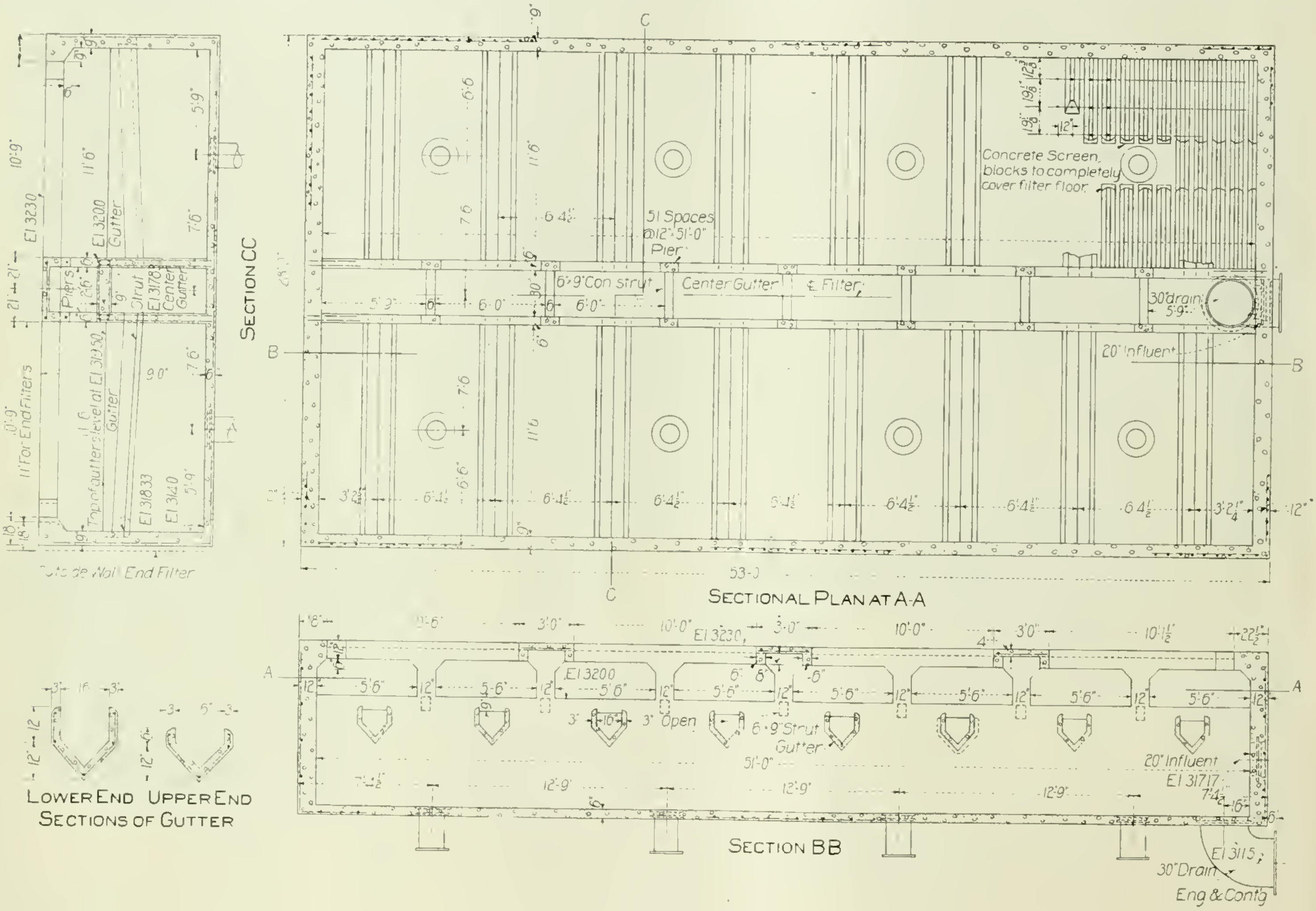


Fig. 7—Sections and Details of Typical Filter.

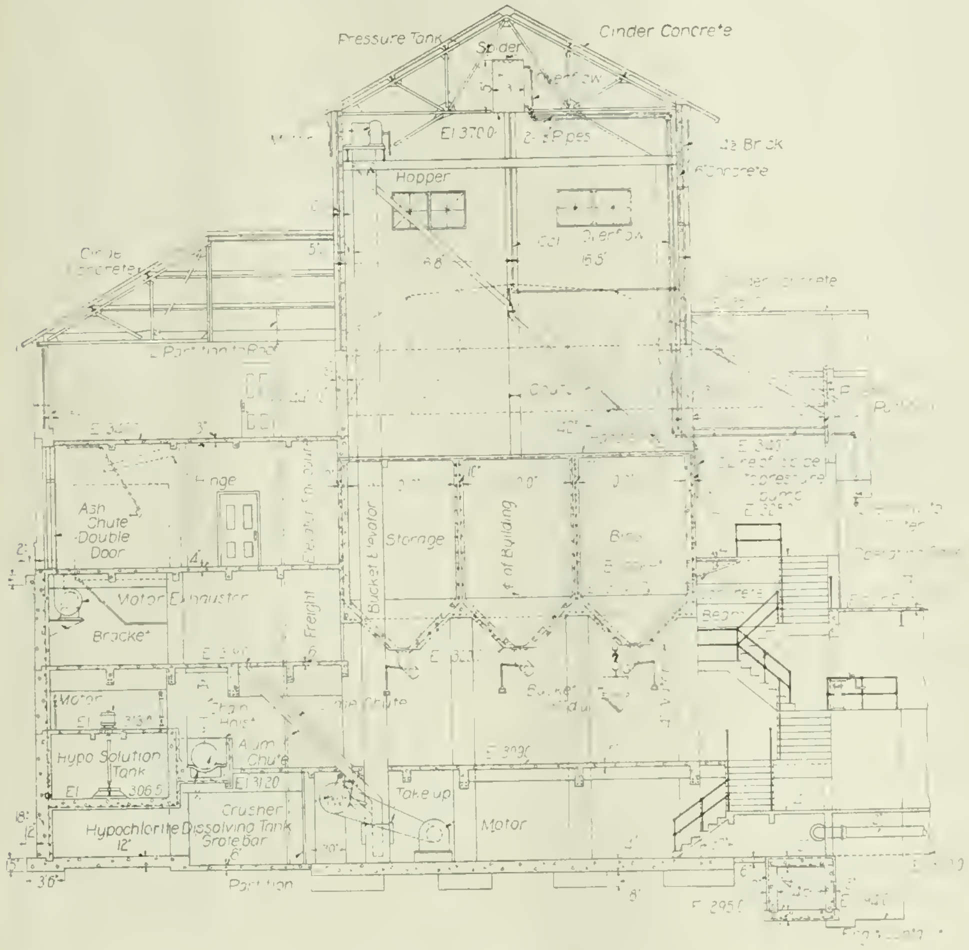


Fig. 8—Section B-B of Fig. 6.

and the smaller to but 5,000 sq. ft. It is the intention to use both in very severe weather, the larger at times of ordinary winter temperatures, and the smaller during the early fall and late spring when only a small amount of heat is required.

The heating system is both the direct and indirect type. The direct system, which is the one intended to be used most, is the Webster Vacuum System, with all the necessary apparatus pertaining to the same. All exposed steam mains and laterals are covered with an 85 per cent magnesian covering ¾ in. thick or thicker, bound at intervals by solid brass bands. All returns are left bare as it was considered of no value to cover them.

The indirect system, which was not contemplated in the original plans, comprises a 20-H. P. fan engine and a sirrocco blower which draws the cold air from the outside into a receiving room over the boilers, through 2,200 sq. ft. of vento coils and discharges the warmed air through ducts to the points desired.

For ventilating and removing the chemical dust from the head house two small exhaust fans are provided. These are only run at such times as the dust, caused by the handling of the chemicals, becomes troublesome or when the air becomes stagnant and foul.

FILTERS.

The filter units were designed to occupy the smallest possible space without in the least impairing the ease or efficiency of their operation. They are arranged so as to have six units on each side of an 18-ft. wide pipe gallery. They are rectangular in plan, 51 ft. x 26 ft. 6 ins. inside measurements, and have a filtering area of 1,173 sq. ft. each. Each unit is divided into two parts by a central wash water gutter 3 ft. wide to which are attached 16 lateral gutters on 6-ft. 4½-in. centers, and which are used to weir off the dirty wash water and carry it to the central gutter. See Fig. 7. At the normal rated capacity of 125,000,000 gals. per acre per day, each unit is designed to care for 3,250,000 gals. of water every 24 hours, but all connecting piping is large enough to carry as high as 50 per cent more water if it is found desirable or necessary to do so for short periods at a time.

All washing is accomplished by means of an upward flow of water under pressure at a comparatively high rate, necessitating as much as 15 gals. of wash water per square foot of area per minute. On account of the nature of the Mississippi River water it was deemed sufficient to use water alone to agitate the sand, and therefore no air was provided for this purpose.

In order to avoid as much piping as possible, the strainer system was designed as shown by sketches in Figs. 7 and 9. Here a series of waterways is shown made of parallel ridges and grooves of concrete spaced 12 ins. c. to c., and emptying into two longitudinal covered waterways made by the center strainer plates and ridge blocks, resting on the ends of the others. These waterways are connected by 8 14-in. outlets to the manifold of 18-in. to 24-in. cast iron effluent piping which also serves to carry the clear wash water. The spaces between the ridges, or grooves, are filled with four layers of gravel ranging in size from 1 in. in diameter on the bottom to 1/12 in. in diameter on top, and resting directly on the strainer plates. The filtering material which consists of a bed of sand 30 ins. deep is separated from the gravel by a layer of brass wire cloth of No. 20 wire with 10 meshes to the inch, and is used to hold the gravel in place when the back-wash water pressure is applied. The sand has an effective size of not less than 0.35 mm. nor more than 0.44 mm. and a uniformity coefficient of not more than 1.65. Not more than 10 per cent is finer than 0.25 mm. and 90 per cent is finer than 0.8 mm.

The filter boxes are built entirely of reinforced concrete braced across the top by means of walks about 3 ft. wide. The outside walls are 12 ins. thick, and the inside or abutting walls are 9 ins. thick. The bottom is of reinforced concrete 6 ins. thick and resting on a groined arch foundation, and is supported by square columns of plain concrete 26 ins. on a side.

Underneath each battery of six filters, on each side of the pipe gallery, is found an auxiliary clear water basin. This construction is made possible by the low ground at the site of the plant and the necessity of getting the filter units at the proper elevation to perform their duties. The effluent passes directly from the filters through 20-in. Simplex rate con-

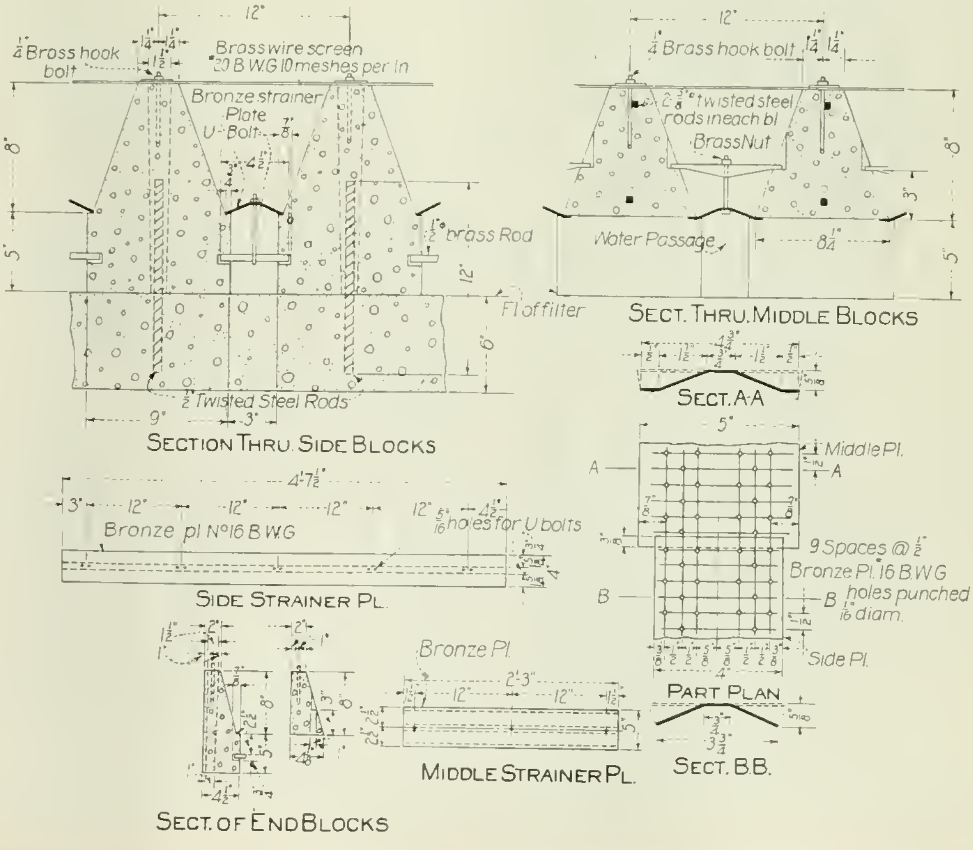


Fig. 9—Details of Blocks and Strainer Plates.

trollers into these clear water basins, and thus does away with piping.

The elevation of the north auxiliary clear water basin is about 18 ins. higher than the south basin. This was made so on account of the topography of the ground, it being necessary to go deeper on the south side to secure the proper foundation.

An interesting thing about the filters is the pipe gallery. This extends the full length between the filters, is 18 ft. wide and about 19 ft. high, with a floor sloping from the center to both sides, and the whole sloping towards the west end, where two 4-in. drains are placed.

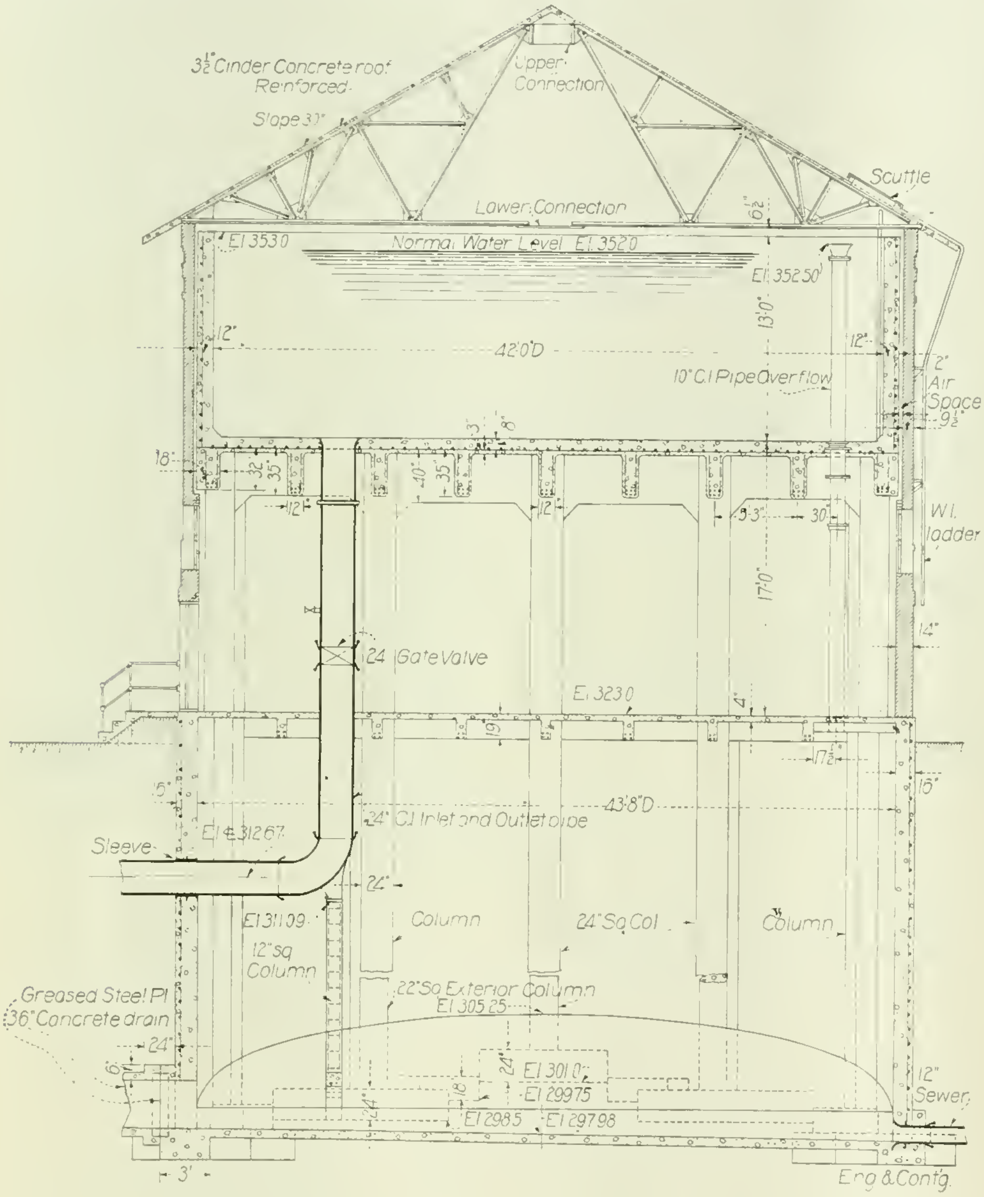


Fig. 10—Vertical Section Through Wash Water Tank.

Unlike most designs of this kind, an effort was made to have a clear passageway down the center, and with this end in view both the 60-in. influent and the 24-in. wash water lines were hung with steel rods from the 18-in. I beams which support the operating gallery floor above. The rest of the piping, valves, controllers, etc., were placed as near either side of the gallery as possible, and a passageway 9 ft. wide by 7 ft. high was obtained. The drain for carrying off the dirty wash water and sewage is built of reinforced concrete and was placed beneath the gallery floor.

The superstructure of the filters or the filter house was built in the same manner and of the same material as the head house, but for the purpose of properly lighting it was so designed as to have two arches or clear stories intercepting each other in the form of a Maltese cross. Concrete arches were used for cross supports with concrete purlins and cinder concrete roof slabs. No steel of any kind, except reinforcing rods, was used.

All the filter valves are hydraulically operated, and were furnished by the Eddy Valve Co., with a five-year guaranty to perform their duties without any repairs being necessary on account of the wear and tear which will come on them during that time.

WASH WATER TANK.

The wash water tank or tower, Fig. 10, is a three-story structure built of reinforced concrete and faced with red brick to conform to the rest of the design. It is circular in form, 42 ft. inside diameter. The tank proper will hold about 135,000 gals. of water. The lower part forms a large equalizing reservoir or sump, into which is discharged the dirty wash water from the filters, while the middle portion is used for storage purposes only. It was necessary to design the tank with a sump on account of already having a 12-in. drain laid from the river to the reservoir, and it was desirable to use this instead of going to the expense of laying a larger one. Therefore unless some form of storage was provided for the dirty wash water the 12-in. drain would have been overtaxed and it would have been impossible to remove the wash water fast enough to suit the operating conditions of the plant.

Another prime reason for using the wash water tank, instead of washing by direct pumpage, was the fact that in order to use direct pumpage very large wash water pumps would have to be used, and as all pumps are electrically driven, this would cause a sudden load to be thrown on the transmission lines. This would cause more or less trouble in addition to increasing the cost of installation and upkeep.

As originally designed, the rise and fall of water in the tank was intended to operate the wash water pumps by means of float switches, but on account of the extreme cold at Minneapolis and there having been no provision made for heating the tank, it was deemed best to run a small pressure line to the pumps and operate the pump switches by pressure instead, thus doing away with the possibility of having the ice tear away the floats and damage the apparatus. For recording the rise and fall in the tank a Winslow recording gage actuated by a float was installed with the recording apparatus in the head house. Unfortunately the very thing occurred that was guarded against in the case of the wash water pumps. Ice formed in the tank soon after the filter plant was put in operation and tore away the float, rendering the apparatus useless for the time being.

In conclusion it might be said that the Minneapolis filter plant was built only after very long and exhaustive studies on all the elements entering into an improved and better water supply for the city, and it is the consensus of opinion that the best method was finally adopted. The design was made with a constant effort towards the greatest economy, both in construction and operation. Whenever it was possible to use a portion of the old existing works as a part of the new this was done, but only where it was beyond a doubt that by doing so money could be saved without sacrificing anything in efficiency of operation.

The filter plant was designed by the former firm of Hering & Fuller, Consulting Engineers, in New York City, under the personal direction of J. W. Armstrong. But a great deal of credit is due Mr. Andrew Rinker, former City Engineer of Minneapolis, for valuable suggestions relative to various features throughout the plant.

The work was done under the day labor system, and all the material and tools were bought by the writer, except such as it was necessary to contract for. Mr. Rinker had general supervision of the work, and the writer was in direct charge of all the construction work, assisted by Mr. J. A. Jensen, Water Works Engineer, and Mr. A. W. E. Fawkes.

The filter apparatus was furnished by the Pittsburgh Filter Manufacturing Co. The strainer plates, screens, etc., by the American Water Softener Co., the valves by the Eddy Valve Co., the rate controllers by the Simplex Valve & Meter Co., the sluice gates by the Roe-Stephens Manufacturing Co., the cast iron specials by the United States Pipe & Foundry Co., the vacuum cleaner system by the McCrum-Howell Co., and the smaller apparatus by local bidders.

Expanded Metal Lath in India.—There is a steadily growing demand in southern India for expanded metal, a comparatively new importation in that country. The entire supply is obtained from England. The current selling price per square foot ranges from 4 cts. for size 1½ x 3/32 in. x 18 gauge to 14 cts. for size 1½ x 1¼ in. by 3/16 gauge. Expanded metal is used in India for various purposes, such as reinforced concrete construction work, in walls and ceilings; for protecting windows; as lattice work for inclosing open verandas, for gates, and for protecting trees growing in public places.

Paving Costs in Edinburgh.—Asphalt paving at Edinburgh, Scotland, costs $3.40 per square yard. The asphalt is largely of Sicilian origin. It is said that although only one mile is as yet paved with asphalt, compared with 89 paved with stone and 3½ with Australian jarrah blocks, the change will gradually be made to asphalt.

Improvements in the Georgetown Reservoir With Special Reference to Novel Form of Reinforced Concrete Baffle Wall.

The Georgetown reservoir is located in the District of Columbia. It was constructed as the distributing reservoir of the water supply system of the district. It is approximately rectangular in shape and is about 2,250 ft. by 850 ft. in plan. Its area is about 42 acres.

It was the designer's intention to divide the reservoir into two sections, the upper to contain about 24 acres and the lower about 18 acres. It was his plan that the cross embankment should be 2 ft. below the normal level of the water surface in the reservoir. By this design the upper section would have acted as a sedimentation basin and the lower section as a storage basin.

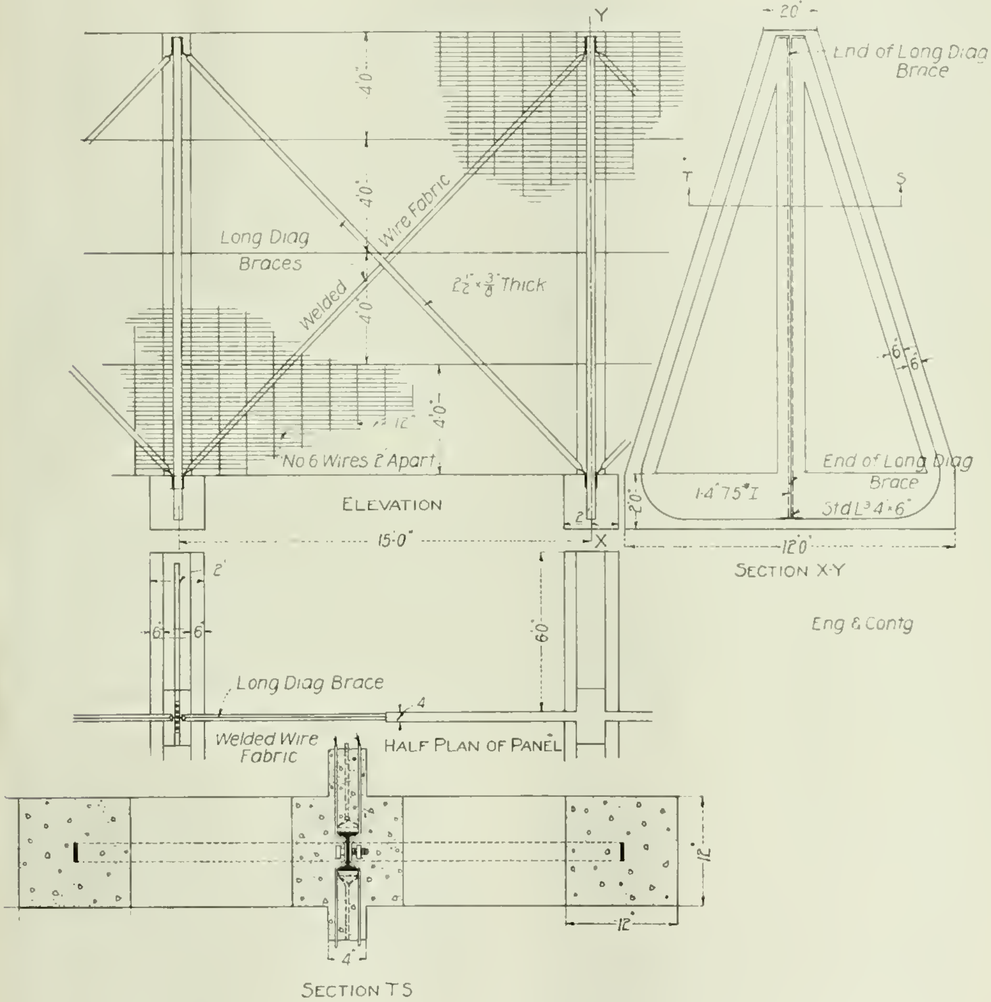


Fig. 1—Details of the Reinforced Concrete Baffle Wall in the Georgetown Reservoir.

The construction of the reservoir was began in 1862, but in one regard a radical departure was made from the plans of Capt. M. C. Meigs, the designer. The dividing embankment of the reservoir was built to the full height of the outside banks, a narrow cut in the middle of cross embankment was lined with masonry and fitted with stop flanks, and a 48-in. cast iron pipe line was laid under this opening and the lower section of the reservoir to the effluent gate house. By this arrangement water could be drawn from the lower section after having passed through both sections of the reservoir or it could be drawn directly from the upper section of the reservoir through the pipe line. The subsequent history of the reservoir, with special reference to improvements now being made, was described by Lieut. J. J. Bain in "Professional Memoirs" for March-April, 1913. The information here given is abstracted from Lieut. Bain's description.

For many years the reservoir served its double purpose as a storage and settling basin, but as the consumption of water increased it was noted that the sedimenation duties of the reservoir were not properly performed.

The draft through the middle opening of the dividing embankment and the cast iron pipe and through the effluent gate was so great that the greater part of the water which reached the city mains was drawn in a comparatively narrow stream straight from the influent to the middle gate, and thence straight to the effluent gate. In times of turbidity, the muddy water followed this stream and did not diffuse through the whole body of water in the reservoir, as it should have done in order to produce the greatest amount of settling.

When the filtration plant was put in operation in 1905, the Georgetown reservoir ceased to be the distributing reservoir of the system, but was continued in use as an intermediate storage basin. It was found that while the filtering reduced the turbidity to a great extent, it did not entirely remove it at all times, as some of the silt in the Potomac water is very fine and is not completely intercepted by the sand of the filter beds when the water is extremely turbid.

In 1910, Congress authorized the construction of a plant for the application of a coagulant at certain times in order to reduce the turbidity of the Washington water. This plant was constructed on the line of the conduit, just below the Dalecarlia reservoir. This made the remodeling of the Georgetown reservoir absolutely necessary, since, according to the theory of its action, conditions favorable to thorough sedimentation must exist in order to get the full benefit of the coagulant.

In the annual appropriation bills for 1912 and 1913, Congress appropriated $108,000 for the purpose, and the work of remodeling is now being done. The approved project for the expenditure of the above appropriations requires, in general, the following changes to be made in the reservoir; 1st, stopping up the old opening or cut in the middle of the cross dam; 2d, cutting a new opening near the extreme right hand end of this cross dam; 3d, the erection of an earthen dam, starting from the upper end of the reservoir near the influent gate and running in a general way parallel to the left-hand side of the reservoir until it intersects the cross dam; 4th, the construction of a gap or cut in the lower end of the new dam, containing eight sluice-gate openings; 5th, paving the top and sides of the earthen dam with concrete or riprap; 6th, the construction of two longitudinal concrete drains from the inlet to the outlet of the sedimentation basin; 7th, paving of the sedimentation basin with concrete; 8th, the construction of a reinforced concrete baffle parallel to the new dam in the portion of the upper section outside of the new sedimentation basin, and, 9th, laying a new section of 48-in. cast iron drain to connect that already laid with the lower ends of the concrete drain in the sedimentation basin. The work was begun in March, 1912, and will be completed, partly by contract and partly by hired labor, by June 30, 1913.

The most novel feature of the construction is the baffle, the details of which are shown in Fig. 1. It consists of open reinforced concrete triangular piers, spaced 15 ft. apart, and connected by a thin concrete wall, or web.

The piers were made by placing the steel reinforcement and concrete in forms in the usual way. The web between piers was built up by shooting mortar, by means of a cement gun, against wooden forming placed behind the outer layer of wire fabric reinforcement until the web had been built up to a thickness of about 4 ins.

After making the above named changes, the coagulated water will enter the sedimentation basin through the influent gate, and will remain there long enough for the coagulating action to become complete, thus depositing the greater part of the coagulated matter upon the concrete floor of the basin. By means of the sluice gates the water may be drawn into that part of the north half of the reservoir outside the sedimentation basin, either from near the surface or from near the bottom. Before reaching the effluent gate the water so drawn must travel in a tortuous path around the ends of the new baffle and the end of the old cross dam which originally divided the reservoir into two parts. It is believed that by this arrangement the water will be given more time to complete sedimentation and will diffuse itself more thoroughly over the reservoir, because, while its velocity is the same as before, it travels over a longer path.

For cleaning purposes, the sluice gates between the sedimentation basin and the remainder of the north basin will be closed and the one in the 48-in. drain opened. Such of the sediment which is not drawn out with the water then in the reservoir, will be loosened and carried out by flushing with fire hose. By a new connection at the effluent gatehouse, the sediment bearing water will be conducted back to the Potomac River by way of Foundry Branch.

Deep-Water Canal for Scotland.—A deep-water canal is proposed to connect the Firth of Forth and the Firth of Clyde, which will eliminate a 400-mile route around the dangerous north coast of Scotland. This canal which will cross the most thickly populated part of the country will cost about $150,000,000. The present barge canal has an average depth of 9 to 10 ft.

Gasoline-Electric Motor Car.—A motor car employing a novel combination of gasoline engine and electricity for propulsion and control has been introduced in England by the Thomas Transmission, Ltd. A car of this type has been running on the South African Railways, and very satisfactory results have been reported.

BOOK REVIEWS

Electric Crane Construction.—By Claude W. Hill. Philadelphia, J. B. Lippincott Co. Cloth, 6x9 ins.; pp. 313; illustrated; $8.

This is an English book based on English conditions and practices and it is a treatise for the practicing engineer and not particularly for the student. Its scope and contents and the expression of the author's purpose are best given in the author's own words, which follow:

The first seven chapters each deal with one of the principal types of crane. Each of these chapters commences with a description of the construction and duty of the crane, not with the idea of imparting elementary information, but as a recapitulation of the purpose for which the crane is intended. The stresses and other points peculiar to the type of crane are next dealt with, and then drawings and descriptions of typical cranes are given, test figures being also added in several cases. Points common to all forms of cranes are dealt with in the succeeding chapters, and in a final chapter crane installations are discussed and described.

In the chapter on Crane Structures, the design of struts and columns with lattice bracing has been dealt with somewhat fully, as compression members, such as jibs and towers, are an important feature in crane work, and it is hoped that Tables XX to XXIII, giving the breaking loads of British Standard Steel Sections, when employed as struts will be found of use. In dealing with girders the effect of rolling loads is emphasized with a view to showing that the maximum stress does not occur on all the members when the load is in the position which gives the maximum bending moment, and that it is, therefore, necessary to take out the stresses for different positions of the load.

In the chapter on Design of Machinery the question of deflection receives consideration, as the deflection of shafts or of the structure supporting them is liable to lead to excessive transmission losses and to noise and excessive wear in toothed gearing.

The question of deflection also requires to be borne in mind in cases where the use of high-strength steel is contemplated with a view to reduction of weight. Sheffield firms are now turning out steel having a tensile strength as high as 123 tons per square inch with an elastic limit of 116 tons per square inch. The modulus of elasticity of this steel is, however, about the same as that of mild steel. Consequently, in parts designed for a very small permissible deflection this steel offers no advantage over ordinary mild steel as it would require to be of the same dimensions.

In the chapter on Brakes the forms of brake mostly in use are described, together with calculations for their design. Some space has been given to showing in detail the method of ascertaining the pressure per square inch between the frictional surfaces of band brakes, as this is an important point affecting their design.

In dealing with Toothed Gearing the involute form of tooth only has been treated, the cycloidal form being of no practical interest at the present time. An analysis of the tangential and radial forces in involute gear, both when friction is neglected and when it is taken into account, is given and this leads up to a comparatively simple formula for the efficiency of involute gear.

In worn gear the length of the line of contact between the threads and teeth is a very important dimension, as it determines the load which the gear can transmit. Another point with which the author has dealt is a method of ascertaining the increased load which worm gear will safely carry when working intermittently, as compared with the load which it will carry when working continuously.

The subject of the stress set up in the outer wires of wire ropes when bent and the energy lost in running them round sheaves is one on which there seems to be considerable difference of opinion among engineers.

Mr. R. W. Chapman's paper, from which extracts are given, is a valuable contribution to the subject and will no doubt help to put the matter on a definite basis. Table XIV, which the author has worked out from Mr. Chapman's formulas, will save designers the trouble of making calculations for the more commonly used types and sizes of ropes.

The formulas for calculating magnet windings will prove useful to designers, as they obviate the necessity of reference to tables of resistance, etc.

The question of the correct method of testing crane motors is being much discussed at present. The author favors plain continuous test runs in preference to more complicated methods. As, however, the rate of rise of temperature of motors decreases as their size increases, a uniform length of test run for crane motors irrespective of their size cannot give satisfactory results in practice.

In the chapter on motors a method is shown for calculating approximately the length of continuous run at a given load which will give the same temperature rise as that attained ultimately by the motor when working intermittently on the same load with a given load factor, and this is sufficiently accurate for all practical purposes.

The formulas for the calculation of controller resistances have been used by the author for some years, and are of service not only for designing controllers, but for checking designs submitted by controller makers.

The planning of crane installations is a subject calling for broader treatment than the design of individual cranes. Before proceeding to design an installation it is necessary to make a careful study of the duty which the installation as a whole is to perform, and this point being settled the engineer can then proceed to determine the most suitable types of crane to be employed and their number, sizes and speeds, makers' standard designs being utilized as far as possible. The chapter on crane installations is therefore limited to dealing with the question of types of crane, employment of accumulators on crane circuits and so on, and in the descriptions which are given of installations of cranes only those points which appear to be of general interest are brought out, smaller details being omitted.

Electrical Engineers' Pocket Book. A Hand-Book of Useful Data for Electricians and Electrical Engineers. By Horatio A. Foster, New York, D. Van Nostrand Co. Leather, 4¼x7 ins.; pp. 1,599; illustrated; $5.

The present book is of the seventh edition of this well known hand book of electrical engineering, and while corrections and some substitutions have been made, it exhibits no radical changes from the sixth edition, which was completely revised in 1908. For those who are not acquainted with the book we give below a schedule of the section, titles and remark that the treatment is of recognized excellence in all particulars. The schedule of section titles follows: Symbols, Units, Instruments, 1; Measurements, 55; Magnetic Properties of Iron, 89; Electromagnets, 108; Properties of Wires and Cables, 131; Properties of Conductors carrying A. C. Current, 236; Dimensions of Conductors for Distribution Systems, 260; Standard Symbols for Wiring Plans, N. E. C. A., 299; Underground Conduits and Construction, 301; Cable Testing, 321; Direct-Current Dynamos and Motors, 334; Tests of Dynamos and Motors, 378; Alternating Current Machines, 404; Static Transformer, 443; Standardization Rules, A. I. E. E., 501; Electric Lighting, 528; Illuminating Engineering, 584; Electric Railways, 612; Deterioration of Metals by Electrolysis, 852; Transmission of Power, 864; Storage Batteries, 872; Switchboards, 906; Lightning Arresters, 980; Electricity Meters, 997; Telegraphy, 1,040; Wireless Telegraphy, 1,055; Telephony, 1,069; Use of Electricity in U. S. Army, 1,123; Electricity in U. S. Navy, 1,153; Resonance, 1,215; Electric Automobile, 1,224; Electro-Chemistry and Electro-Metallurgy, 1,229; X-Rays, 1,248; Electric Heating, Cooking and Welding, 1,256; Lightning Conductors, 1,277; Foundations and Structural Materials, 1,289; Steam, 1,327; Water Power, 1,460; Shafting, Pulleys, Belting, Rope Driving, 1,481; Miscellaneous Tables, 1,499; Power Required to Drive Machinery, 1,515; Index, 1,533.

Water: Its Purification and Use in the Industries.—By William Wallace Christie. D. Van Nostrand Co., New York. Cloth, 5½x8 ins.; 219 pp.; illustrated; $2.

This book describes the use of water by industrial works and very fully illustrates and describes the machinery and appliances commonly employed in such plants for the purpose of adapting raw or polluted waters to the requirements of the plant.

The text of the book is subdivided into ten chapters under the following headings: Sources of Water, Impurities, Uses, Reagents; Water Softening—Cold Process Systems; Water Softening—Hot Process Systems; Results Accomplished by Softening Systems; Pressure Filters; Aeration, Sterilization, Ozone, Ice; Drinking Water, Open Filters Alum, Chloride of Lime, Tannin; Measurement of Water; Oil Filters, Boiler Water; and, Miscellaneous Tables.

The chief feature of the book is the description of the machinery used in the preparation of water for use in industrial plants. The endeavor has been to emphasize the principal features of each piece of machinery or apparatus without giving detailed technical descriptions. These descriptions are very well prepared and are exceedingly well illustrated. The book will be highly useful to engineers and owners in working out the water supply problems of industrial plants.

Solution of Railroad Problems by the Slide Rule.—By E. R. Cary. D. Van Nostrand Co., New York. Cloth, 4x6 ins.; 136 pp.; illustrated; $1.50.

This book develops the possibilities in the use of the slide rule in solving the more frequently occurring railway civil engineering computations. There are chapters on the following subjects: The Slide Rule, Problems in Simple Curves, Problems in Compound Curves, The Vertical Curve, Turnouts, The Easement Curve, and Problems in Earthwork.

In each chapter there are the usual problems given in the railway location hand-books. The illustrations are line drawings of curve and track layouts and earthwork sections and prisms. Mathematical demonstrations of the relations of parts in these problems are given fully as in the railway hand-books. A numerical problem is stated following each such mathematical demonstration, and its solution by means of the slide rule is explained.

The book is intended for class room work and it will prove useful for that purpose.

Everyday Uses of Portland Cement.—The Associated Portland Cement Manufacturers (1900), Limited, London, England. Boards, 6x8½ ins.; 350 pp.; illustrated; 2½s net.

This is a trade publication of that sort that is so nearly a technical treatise that it has definite value to engineers. It summarizes from English practice the various uses of cement with illustrations of structures and descriptions of methods of work. The manufacture, testing and storing of cement and the materials for and methods of proportioning and mixing concrete, mortar, etc., are illustrated. As a simple guide to English practice the book will interest American cement users.

NEWS SECTION

Editorial Comment—Personals—Society Meetings—Trade Notes—Catalog Reviews—Contract News, Embracing Bids Asked, Work Projected, Contracts Let and Contract Prices on All Classes of Civil Engineering Construction Work.

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The Doings of the Week.

There has been a fair degree of activity during the past week in the railway construction field. While few contracts of any considerable size appear to have been let, developments indicate that several of the larger railroads in the near future will be in a position to offer some large pieces of construction work. The Southern Pacific Co. applied last week to the State Railroad Commission of California for permission to issue $30,000,000 in 5 per cent 2-year notes for improvement purposes. Of this sum about $10,000,000 will be expended in California and Nevada. The company in its statement to the Commission said it saw no need of segregating expenditures, "because of any underlying ownership." This was taken to indicate the intention of the company to proceed with improvements on the Central Pacific, held under lease, without fear of loss through the dissolution of the Southern Pacific-Union Pacific merger. The receivers of the St. Louis and San Francisco are now arranging a program for the rehabilitation of the property. It is understood that the first important step will be the issuance of receivership certificates to provide for the temporary financial needs of the company. The Baltimore & Ohio R. R. Co. has brought to conclusion the largest financial transaction of the year. It paid out $50,000,000 in cash for redemption of $50,000,000, 4½ per cent 3-year notes, maturing June 1. The transaction leaves unincumbered in the company's treasury released securities to the market value of between $75,000,000 and $80,000,000. Against this sum there is not a dollar of obligation or pledge. Among the railway construction contracts let recently are the following: C. U. Reynolds, New York City, for constructing second track from Jamesville to Syracuse, N. Y., 7 miles, for the Delaware, Lackawanna & Western Ry.; Callahan Construction Co., Knoxville, Tenn., for a 40½-mile extension into North Carolina for the Virginia & Carolina Ry.; J. J. Boxley & Son, Roanoke, Va., for a 14½-mile extension of the New River, Holston & Western R. R. in Virginia.

In the State Highway construction field the principal event of the past week was the signing by Governor Tener of the bill for the proposed constitutional amendment to allow Pennsylvania to borrow $50,000,000 for the construction of improved roads. The amendment will be voted on by the people of the state at the November election. State aid in Illinois is also provided by the Tice bill passed last week by the House of Representatives. This carries appropriations of $700,000 annually for the next two years. In the way of state highway work on which bids have been asked since our last issue, that of California is perhaps the largest. The highway commission of this state is calling for bids on six contracts of an aggregate length of 28¾ miles.

Two of the largest bridge contracts of the year have been let in the past few days. One of them calls for the substructure work for the bridge over the Mississippi River at Memphis, Tenn., for the Rock Island R. R. The Union Bridge & Construction Co., Kansas City, Mo., received the contract, which amounts to about $1,250,000. The other contract calls for the construction of the Plaza approach to the Manhattan bridge in New York City. The Northeastern Construction Co., 225 Fifth avenue, New York City, secured the contract at $596,400.

Levee construction in the Mississippi Delta aggregating nearly 4,000,000 cu. yds. is now open for bids. Of this work the Mississippi Levee Commission is calling for bids on 2,300,000 cu. yds. Maj. J. A. Woodruff, U. S. Engineer at Vicksburg, is taking proposals on 580,000 cu. yds., and Maj. E. M. Markham, U. S. Engineer, Memphis, is receiving bids on 1,900,000 cu. yds.

In the way of drainage construction one of the larger jobs that have come up for bids since our last issue is work for the Cow Lake Drainage District in Jackson County, Ark. This calls for about 33 miles of dredge work, some scraper work, 12 bridges and two small levees. It will cost $90,000.

One of the largest dredging contracts ever undertaken in Canada was awarded last week to the Canadian Stewart Co., Montreal, Que., by the Harbor Commissioners of Toronto, Ont. The work is to be done in connection with the water front development of the city. The contract calls for some 31,270,000 cu. yds. of dredging.

State Aid Roads in Illinois

A step toward securing much-needed improved roads in the State of Illinois was taken last week by the House of Representatives by the passage of the Tice good roads bill. This bill provides for a state aid system of roads, and carries an immediate appropriation of $700,000 annually for the next two years for hard road construction. It provides for a non-partisan state highway commission consisting of three members, the salaries of each to be $3,500; a chief engineer, with a term of six years and a salary of $4,000 and an assistant engineer with a six year term and a salary of $2,500. The members of the commission and the two engineers are to be appointed by the governor. Under the provisions of the bill, the state is to appropriate 50 per cent and the county 50 per cent of the total cost of constructing permanent roads in any county. In establishing the state aid roads the county, through its county board is to take the initiative. After a road has been selected by a county for improvement and its selection approved by the state highway commission, it is taken under control by the state and all contracts let in conjunction with the state board and the county board are carried out under the direction of the state highway commission, the county superintendent of highways acting as the representative of the state commission in each county. The county superintendent is to be appointed by the county board, but he must pass competitive examination at the hands of the state highway commission as to his qualifications for the place. His term of office is six years and his salary is to be paid from the county funds. Should the bill become a law, as now seems probable, Illinois, thanks to the excellent work already accomplished by its present state highway engineer and his assistants, will be in a position to begin the construction of improved roads in an intelligent manner, and in a way that will avoid the mistakes made by some of the states when they began the building of state aid roads.

Job Wanted.

The following verses appeared in the current number of Collier's. They were written by Berton Braley, the official poet of the construction field:

Here we are, gentlemen; here's the whole gang of us,
Pretty near through with the job we are on;
Size up our work—it will give you the hang of us—
South to Balboa and north to Colon.
Yes, the canal is our letter of reference;
Look at Culebra and glance at Gatun;
What can we do for you—got any preference,
Wireless to Saturn or bridge to the moon?

Don't send us back to a life that is flat again,
We who have shattered a continent's spine;
Office work—Lord, but we couldn't do that again!
Haven't you something that's more in our line?
Got any river they say isn't crossable?
Got any mountains that can't be cut through?
We specialize in the wholly impossible,
Doing things "nobody ever could do!"

Take a good look at the whole husky crew of us,
Engineers, doctors and steam-shovel men;
Taken together you'll find quite a few of us
Soon to be ready for trouble again.
Bronzed by the tropical sun that is blistery,
Chockful of energy, vigor and tang,
Trained by a task that's the biggest in history,
Who has a job for this Panama gang?

Commission Government in Pennsylvania

Small cities in Pennsylvania are to be given a chance to try out the commission form of government. The Clark bill, passed last week, provides for this form of government for the third class cities of the state. It provides for a commission of four commissioners or councilmen, who with the mayor shall conduct the city government. The mayor has no veto power and a majority of the commission rules. Some features of the bill are: Nominations and elections to be made by non-partisan ballots; all elective officers to be elected at large; the mayor to be ex-officio superintendent of public affairs. At the organization of the commission, one member shall be assigned to each city department as follows: Superintendent of accounts and finances, superintendent of public safety, superintendent of streets and public improvements, superintendent of parks and public property. Under the bill the initiative and referendum will become part of the charter in third class cities in the state.

PERSONAL

Mr. M. E. Bannon has been made county engineer for Lee county, Iowa.

Mr. Robert Tripp has resigned as city engineer of Petoskey, Mich., to take effect June 1.

Mr. Robert D. Hennan of the Monongahela Valley Engineering Co., Morgantown, W. Va., has been appointed city engineer for Morgantown.

Mr. William Geisheker has resigned as city engineer for Red Wing, Minn., to become district engineer for the Minnesota State Highway Commission.

Mr. J. C. Worrell has been appointed as superintendent of concrete construction for the Widell Co. of Mankato, Minn., on the Great Northern Railway work in Montana.

L. A. Bitterman, a pioneer railroad builder of Texas, died at his home in Neucestown, Tex., May 26, aged 80. Mr. Bitterman was the builder of several railway lines across Texas.

Mr. Burton Lowther, constructing engineer for the Kansas City, Mo., water works department, has been appointed chief engineer, succeeding Mr. C. N. Miller, who recently resigned.

Professor George F. Swain of Harvard University has been made chairman of the Boston Transit Commission, to fill the vacancy caused by the death of George G. Crocker.

Mr. N. P. Ramsey is made general manager for the Lorain, Ashland & Southern Railroad Co., a new line being built from Lorain to Ashland, Ohio. Mr. W. D. Holliday is traffic manager; Mr. J. Palmer Ramsey, chief engineer.

John M. Le Duke, a prominent railroad and bridge engineer of Ohio, died at his home in Lakewood, O., may 29. Mr. Le Duke built the Monon railroad into French Lick Springs, and the C. & O. bridge over the Ohio river at Cincinnati, and many other railroad bridges in that section.

Mr. W. L. Morse, who has held the position of terminal engineer of the Grand Central improvements, New York City, for a number of years, has been appointed terminal engineer at Jacksonville, Fla., and will be in charge of the Union Terminal which is to be constructed at that point.

Mr. Edwin Thacher of the Concrete-Steel Engineering Co., 21 Park Row, New York City, has withdrawn from that firm to engage in private consulting engineering practice, with offices in the same building. Mr. William Muesser will continue the business of the firm under the same name.

Mr. Henry W. Durham, chief engineer of highways, Borough of Manhattan, New York City, has been appointed by Mayor Gaynor to represent the city of New York as delegate to the International Road Congress to be held in London, England, this month. Mr. Durham will also visit a number of European cities to make a study of paving and street maintenance.

Mr. S. G. Porter, member of the American Society of Civil Engineers, who has for more than six years past been chief engineer of the Arkansas Valley Sugar Beet & Irrigated Land Co. at Holly, Colo., has resigned that position to accept the position of inspection engineer on the staff of the Commissioner of Irrigation, Department of the Interior, Canada, and will be located at Calgary, Alta.

CIVIL SERVICE EXAMINATIONS.

The United States Civil Service Commission announces examinations as follows:

Laboratory Assistant in Engineering; $900 to $1,200 per annum; July 2.

Laboratory Aid and Engineer; $800 to $900 per annum; July 2.

Hull Draftsman; $1,200 to $1,500 per annum; July 2-3.

INDUSTRIAL

The Orenstein-Arthur Koppel Co. has given the agency for its Canadian business to The Canadian Fairbanks-Morse Co., Ltd., having offices in Montreal, St. John, Ottawa, Toronto, Winnipeg, Saskatoon, Calgary, Vancouver, and Victoria.

The Raymond Concrete Pile Co. of New York and Chicago, has been awarded the contract for the excavation and concrete work in connection with the foundations for a coke plant for the Maryland Steel Co., Sparrows Point, Md. H. Koppers Co., General Contractors.

A contract has been awarded to the Raymond Concrete Pile Co. of New York and Chicago for standard Raymond concrete piles for the foundation of the Gayety Theater, Buffalo, New York. W. H. McElfatrick, Architect. George A. Fuller Co., General Contractors.

Some idea of the size and importance of the manufacturers who have recognized and acknowledged the merit of wire cut lug paving blocks is shown by the fact that of the total yardage of vitrified paving brick made in 1912 by the manufacturers affiliated with the National Paving Brick Manufacturing Association, 53 per cent was produced by licensed manufacturers of wire cut lug blocks (licensed under the Dunn patents). This showing is still more remarkable in view of the fact that a little less than one-third of the members of the association are licensed.

CATALOGUES

Air Compressors.—Paper, 6x9 ins., 32 pp. The Clayton Air Compressor Works, 115 Broadway, New York City.

Bulletin No. 6-210-S is printed in Spanish and illustrates and describes single and double cylinder steam and belt driven compressors. The book is well illustrated and contains tables of dimensions, capacities, etc.

Drawing Tables.—Paper, 7⅜x4⅜ ins., 8 pp. R. E. Kidder, 45 Hermon St., Worcester, Mass.

This catalog illustrates and describes artists' and library drawing tables. Prices are given.

Contractors' Machinery.—Paper, 6¾x10 ins., 32 pp. Harold L. Bond Co., 483 Atlantic Ave., Boston, Mass.

This catalog contains prices, specifications and illustrations of contractors' machinery, tools and supplies, including pumps, couplings, sewer cleaning tools, trench braces, concrete tools, etc.

High Explosives.—Paper, 6x9 ins., 108 pp. Atlas Powder Co., Wilmington, Del.

This book contains a considerable amount of information regarding the use, methods of loading, blasting, etc., of high explosives for various classes of work. Different brands of explosives required for various conditions are given.

Native Bitumens.—Paper 4x8 ins., 16 pp. McGraw-Hill Book Co., 239 West 39th St., New York City.

This is a reprint of the article by Clifford Richardson entitled "Characteristics and Differentiation of Native Bitumens and Their Residuals."

Venturi Meters.—Paper, 6x9 ins., 48 pp. Builders Iron Foundry, 39 Codding St., Providence, R. I.

This catalog gives a description of the principle of operation of Venturi meters, the various uses to which the meters are put and advantages arising from its use. It contains descriptions and illustrations of the various instruments and a reprint of a paper on the Venturi Water Meter by Clemens Herschel, Hydraulic Engineer, which gives a history of the 20 years of the existence of this meter. Several other catalogs are issued by the company. Bulletin No. 22 describes the largest meters in the world, which are used to measure water passing through the Catskill aqueduct.

Bulletin No. 75 describes meters for gravity mains, pump discharge lines, filtration plants, hydraulic turbines, sewage disposal systems, etc. Bulletin No. 76 describes the air and gas meter, and Bulletin No. 68 the hot water meter. Bulletin No. 71 describes the special Venturi Meters at the Washusett Dam.

The Nilo Meter.—Paper, 6x9 ins., 4 pp. Union Water Meter Co., 65 Hermon St., Worcester, Mass.

This pamphlet illustrates and describes and gives tables of sizes, capacities, etc., of the Nilo Water Meter.

Safety Railway Ties.—Paper 6¼x9¼ ins., 8 pp. J. F. Donahoo, 6th Floor, Woodward Bldg., Birmingham, Ala.

This catalog shows plans and specifications and gives complete descriptions of the International Safety Railway Tie.

Engineers' Surveying Instruments.—Paper, 6x9 ins., 138 pp. Heller & Brightly, 1126 Spring Garden St., Philadelphia, Pa.

This catalog contains a large amount of useful information regarding the instruments built by this company. A price list with descriptions of the various instruments is given.

Gravity Dumping Car.—Paper, 9x12 ins., 24 pp. Goodwin Car Company, 25 N. Dearborn St., Chicago, Ill.

Catalog No. 1 contains a number of full-page advertisements which set forth features of the Goodwin Pumping Car. The application of the cars for various classes of work is well illustrated.

Electrical Machinery.—Paper, 8x10½ ins. General Electric Co., Schenectady, N. Y.

Bulletin A-4035, 16 pp., describes Series Luminous Arc Lamps for operation on series direct current circuits of either 4 or 6.6 amperes.

Bulletin No. A-4122, 8 pp., is devoted to Carrier Bus Arc Panels and Brush Arc Generators.

Bulletin No. A-4109, 4 pp., describes Belt Driven Revolving Armature Alternators.

Bulletin No. A-4114, 12 pp., contains preliminary information regarding oil switches, known as Type F, Form K-21, which are used on systems of voltages up to 110,000. The construction of the switches is shown in detail, and the various operating mechanisms illustrated and described.

Continental Dump Cars.—Paper, 9x6 ins., 78 pp. Continental Car & Equipment Co., Inc., Highland Park, Louisville, Ky.

Catalog C. P. contains illustrations and specifications of dump cars 1¼ to 12 yard capacity, flat cars, spreader cars and side ballast cars. A number of illustrations showing views of these cars in operation on various undertakings are shown.

Steelcrete Products.—Paper, 3¼x3⅜ ins., 16 pp. Expanded Metal Engineering Co., Architects Bldg., Park Ave. & 40th St., New York City.

Steelcrete Mesh is the title of this pamphlet which illustrates and describes expanded metal lath and methods of construction of partitions and walls by its use. A number of other products are illustrated and described, including metal foundry molds, corner beads, steelcrete hollow studs, sockets, etc.

Weed Killer.—Paper, 3½x16 ins., 16 pp. Horticultural Chemical Co., Bullitt Bldg., Philadelphia, Pa.

This book describes a concentrated liquid chemical preparation for killing weeds in gravel walks, railway road beds, etc.

RAILWAYS

Alaska.

A bill was submitted last week to the Territories Committee of the U. S. Senate authorizing an issue of $40,000,000 in bonds for the building of a governmental Alaskan railroad. A committee of five under the direction of the President would have charge of the work. No route was decided upon and the question of government control was left open.

Arizona.

It is rumored on the Coast that the El Paso & Southern and the Rock Island Systems are preparing to build a line from Tucson, Ariz. to the Coast. It is said that valuable terminal facilities at San Diego have been secured. The route would lie through Phoenix, Yuma, the Imperial Valley and San Diego to Los Angeles.

Arkansas.

Plans and specifications have been completed for the Biddle car line to be built by the Little Rock Railway & Electric Co. of Little Rock. The city will take bids in the near future on the grading of the streets along which the line is to run.

The Fort Smith, Subiasco & Eastern R. R., Henry Stroup, President, Paris, Ark., is planning to begin construction work early next month on its extension to Dardanelle, where a connection will be made with the Rock Island.

California.

✣Board Public Works, San Francisco, Cal., will receive bids until 2 p. m., June 18, for furnishing and installing a motor generator set in the car barn of the Geary Street municipal railway.

The Watsonville Transportation Co., operating a short steam railway, is reported to have been purchased by capitalists of Milwaukee, represented by Edgar P. Stoltz, of San Francisco. It is stated that the new owner will start work in the near future on an extension from Watsonville to San Juan Bautista to furnish an outlet for the Old Mission Portland Cement Co. The extension will probably be completed by Jan. 1 next.

The Western Pacific Ry., according to a report from San Francisco, will be extended shortly to reach San Jose, the heart of the Santa Clara Valley; Twin Falls, Idaho, the heart of a rich mineral and timber belt, and to Boise City.

The Fresno Traction Co., Fresno, Cal., contemplates extending its line to the San Joaquin River, 10 miles. It is stated that the extension will be completed by Jan. 1.

W. Arnstein, 105 Montgomery St., San Francisco, President of the Oakland, Antioch & Eastern Ry. (electric), and S. L. Naphtaly, Vice-President, are reported to have acquired control of the Nevada County Narrow Gage R. R., a 21 mile steam line. It is stated that the O., A. & E. Ry. will now be extended from Marysville to Colfax, where it will connect with the newly purchased property.

The Southern Pacific Ry. has applied to the State Railroad Commission for permission to issue $30,000,000 in 5 per cent two-year notes for improvement purposes. Of this sum about $10,000,000 will be expended in California and Nevada.

The San Pedro, Los Angeles & Salt Lake R. R., E. G. Tilton, Chief Engineer, Los Angeles, Cal., has applied to the State Railroad Commission for authority to issue bonds to the amount of $1,119,000. The company desires to use the money for additional locomotives, passenger cars and other rolling stock, to cost $500,000; to enlarge its terminals and make shop improvements to the amount of $139,000; to construct and improve trestles and bridges and to reduce grades, at a cost of $161,000; to construct a branch line from Moapa, Nevada, to St. Thomas, Nevada, and to make general minor improvements over its system.

Colorado.

Grading work for the extension of the Denver, Northwestern & Pacific R. R. (Moffat Road) from Steamboat Springs to Craig will probably be completed this month, and it is hoped to have track laying machinery at Steamboat Springs by July 18. J. K. Skates of Denver, who had the contract for the rock work in the canon between Hayden and Steamboat, has finished his work and moved his outfit to the east, where he has another large contract.

Connecticut.

Bill has been passed by the State Legislature amending the charter of the Connecticut Co., Hartford, Conn., to allow new trolley line between New Britain and Hartford. The bill gives the Connecticut Company the power to build through the towns of New Britain, Newington, Farmington and West Hartford.

Idaho.

The Latour Creek Railroad Co., with general offices at Cataldo, Idaho, and a capital stock of $75,000, has been incorporated to build, maintain and operate a railroad in Kootenai County about nine miles long to connect with the Oregon-Washington Railroad and Navigation Company's line. The incorporators are: L. W. Buhler, Lane; A. E. Cole, Cataldo; F. B. Folz, Kellogg; George N. Butler, Spokane, Wash.; Wesley Hughes, Francis H. Whitman, Jesse M. Henneck, Cataldo; Walter R. Jaques, Pullman, Wash.; H. V. Moore, Pullman, Wash.; William H. Nellegan, Spokane, Wash.

Illinois.

It is reported that the Illinois Central, A. S. Baldwin Chief Engineer, Chicago, Ill., will commence work July 1 on the proposed new second track through Villa Ridge, New Cairo, Ill., 200 feet east of the present track, and reduce the grade fifty-two feet. For this work, which involves the building of two and a half miles of double track, $780,000 has been appropriated. The plan is to get around Villa Ridge hill.

J. Hill, President of the Kentucky & Illinois Railroad Co., which was organized with a capital stock of $1,000,000 to construct the proposed bridge over the Ohia River at Metropolis, has announced that work will be started about July 1.

Indiana.

The Chicago & Wabash Valley Ry., a 41 mile steam line, extending from Crown Point to McCoysburg, has been purchased by a Chicago syndicate, headed by Robert P. Ingalls, of Chicago. It is understood that the new owners will expend about $1,000,000 in connecting the line with Elgin, Joliet & Eastern Ry. on the route at Gary, thus securing an entrance to Chicago.

Iowa.

⊙E. A. Wickham, Council Bluffs, Ia., has started work on his contract for grading for the new shops of the Chicago, Rock Island & Pacific Ry. on the east side at Des Moines. The total cost of the shops, including the land, will be about $1,200,000. Of this sum about $600,000 will be expended the present season. The plans include a 52-stall round house, machine shop and other structures, and it is stated that contracts for these will be let in a week or so.

The Conn Construction Co., Boone, Ia., will complete its townsite work at Atlantic, Ia., in about a week and will then have two outfits idle. The work at Atlantic will be completed about a month ahead of time, although very wet weather has prevailed.

Kansas.

Track laying was started last week for the line of the Anthony & Northern Ry. between Iuka and Pratt, and the company expects to have the road ready to haul wheat on the six miles between the places named. O. P. Byers, Hutchinson, Kan., is President; G. L. McLane, Hutchinson, is Chief Engineer.

A committee of Wichita Business Association members is taking steps towards securing the construction of a Missouri, Kansas & Texas extension from Parsons to Wichita, Kan., a distance of 125 miles.

Kentucky.

The Baltimore & Ohio R. R. has acquired the charter of the Long Fork Ry. Co., which owns a location on the left fork of Beaver Creek. The line would be about 28 miles long, and would develop some 6,000 or 8,000 acres of coal land, owned by the Milwaukee Coke & Gas Co., and 100,000 acres owned by the Elkhorn Fuel Co. Nothing has been concluded as to the construction of the line.

Louisiana.

The St. Louis & San Francisco R. R. has acquired 18½ acres of land on the river front at Baton Rouge, adjoining its incline and connecting with the Anchorgo tracks. The road, it is said, plans the erection of docks and wharves for the handling of coal from barges to points in the west.

The New Orleans, Texas & Mexico Ry. contemplates extending its line from Mix to New Rounds, a distance of 4 miles.

Maine.

The State Railroad Commission has been considering petition of the Maine Central R. R., B. T. Wheeler, Chief Engineer, Portland, Me., for permission to begin work on improvements at Rumford Falls, Me., to cost about $350,000. This includes the erection of a new station. Town government of Rumford has approved the changes, and it is probable that work will be started in the near future.

Michigan.

The Grand Trunk Ry., according to advices from Battle Creek, contemplates the expenditure of $100,000 for improvements about the yards at Nichols. The work will include a new roundhouse and shops.

Minnesota.

Board of Regents of the University of Minnesota, Geo. E. Vincent, President, Minneapolis, Minn., has approved the route for an electric car line connecting the University with the Agricultural College. The legislature appropriated $60,000 for the construction of the line and it is probable that work will be started soon.

Montana.

The Eastern Montana Ry. Co. has filed on that part of a right of way which will lie in the public domain for a road from Billings to Cook City, where a number of copper and gold mines are located. As projected, the line will run from Billings by way of Clark's Fork to the mining town. William A. Logan, Billings, Mont., is President, and George Brenkenhoff, Billings, is Secretary.

It has been announced that work will begin immediately on the construction of the branch of the Northern Pacific Ry. from Hesper, on the line of the Billings & Northern, to Melville, Mont., north of Livingston, and that grading will be completed to Summit, 75 miles, this year. Melville is 24 miles west of Summit. The new road will traverse the rich Lake basin country.

Nebraska.

Banking and commercial interests of the Rosebud, S. D., district and those of Sioux City and intervening points have combined forces in efforts to procure the construction of an extension of the Omaha railroad between Wynot, Neb., and Niobrara, Neb. Joy M. Hacker, Gregory, S. Dak., is Chairman of the Committee.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

New Jersey.

A project is under consideration for the construction of an electric railway from Asbury Park to Freehold. Charles Leland, Asbury Park, N. J., is interested.

New Mexico.

The Santa Rosa, Palma & Albuquerque Railroad has been organized for the purpose of constructing a line between Albuquerque and Santa Rosa, a distance of 125 miles. The route is through Bernalillo, Torrance and Guadalupe counties. It will connect at Santa Rosa with the El Paso and Southwestern, and afford Albuquerque and the territory west and north a new and direct outlet to the East. The preliminary surveys for the proposed road are now being made, $25,000 having been appropriated for that purpose.

The Santa Fe System has filed with County Clerk A. E. Walker, Albuquerque, N. Mex., deeds for the greater part of the land required for the site of the proposed shops.

New York.

⦿C. U. Reynolds, New York City, has been awarded a contract for constructing a second track from Jamesville to Syracuse, 7 miles, for the Delaware, Lackawanna & Western R. R. It is probable that the work will cost about $1,000,000.

⦿The Northeastern Construction Co., 225 Fifth Ave., New York City, has been awarded the contract at $596,400, by the Department of Bridges, New York City, for the construction of the 400 ft. connection between the Manhattan Bridge and the 4th Ave. subway.

Officials of the New York Central Railroad and the city of Lockport, N. Y., recently discussed preliminary plans for the construction of the proposed new freight house and yards on the westerly limits of the city.

The Chamber of Commerce of Hornell, N. Y., is formulating plans for the construction of an electric railway from that city to Rochester. The plan as outlined is to place the proposition before the Erie R. R. Co., which would take over the Mt. Morris & Dansville road, now in the hands of receivers, build a spur from Dansville to Burns, electrify the entire route to Avon, and there connect with the company's line. Jay Stevens is Secretary Chamber of Commerce, Hornell, N. Y.

The Geneva, Seneca Falls & Auburn R. R. Co., of Seneca Falls, N. Y., has been incorporated with a capital stock of $450,000. This company was organized to take over the Geneva & Auburn R. R., a 17.7 mile electric line running from Geneva to Cuyaga Lake Park, passing through Waterloo and Seneca Falls. An extension to Auburn is projected. The directors are: Joseph Seep, Titusville, Pa.; John W. Hollenback, Lewis H. Taylor, H. H. Harvey, Wilkesbarre; Murray Wilson, Philadelphia; Richard Eastell, Richard R. Quay, Pittsburg; William B. Atwood, Seneca Falls; Lansing G. Hoskins, Geneva.

The Fonda, Johnstown & Gloversville R. R., Gloversville, N. Y., is reported to be considering an extension of its electric railway to the 5th Ward at Amsterdam.

The Public Service Commission for the First District, New York City, will ask the forthcoming special session of the Legislature for an appropriation to enable it to proceed with the work of eliminating grade crossings on the lines of the Long Island Railroad in Queens Borough. The Commission requested the last session of the Legislature to appropriate $1,500,000, but the appropriation bill carried only an item of $350,000 for New York City. This item, however, was vetoed by Governor Sulzer, and the Commission was left without any funds to prosecute grade crossing work. Under the law the State must pay one-quarter of the cost before the Commission can order a crossing eliminated. Since 1911 no money has been appropriated, and as a result elimination work, except as to that ordered prior to that time, is at a standstill. The Commission has held hearings on several groups of crossings which it desires to eliminate and only awaits an appropriation by the State to issue the necessary orders. Among these crossings are 21 on the Atlantic Avenue Division between the end of the elevated structure and the beginning of the Jamaica improvement. The elimination of these crossings will cost about $3,500,000, and the railroad company is willing to supply its half of the cost as soon as the State makes an appropriation. The other crossings for which the Commission has prepared elimination orders include several crossings on the Whitestone branch, the Main line, the Montauk and Rockaway divisions of the Long Island Railroad and a few crossings in Richmond Borough on the line of the Staten Island Ry.

North Carolina.

A company is being organized at Waynesville to build an electric street railway from Waynesville to Canton by way of the Southern Assembly Grounds to Lake Junaluska. While the plan tentatively evolved calls for the building of the road from Waynesville to Canton, it is quite probable that extensions will eventually be completed to Hazelwood, Dellwood, and even to Woodrow.

Surveys are now being made for the projected 35-mile line of the Hiawassee Valley Ry. The route is from Andrews, N. C., to Marble, Peachtree and up the Hiawassee River to Hayesville, N. C., via. Hiawassee, Ga. County and township bonds have been voted for the construction of a line. W. C. Sandlin, Andrews, N. C., is president, and J. Q. Barker, Andrews, N. C., is chief engineer.

North Dakota.

Meetings are soon to be held at Manning, Mandan and Center, N. Dak., county seats of Dunn, Morton and Oliver Counties, respectively, for the purpose of bringing before the people the plan for extending a branch railroad line up the Knife River to Manning.

Ohio.

Surveys have been started for the projected Charleston, Jefferson and Meadville electric railway. As proposed this line will be operated with storage battery cars. The Pease Engineering Co., 810 Marshall Bldg., Cleveland O., is the engineer.

Oklahoma.

⦿Rooney & Culp, Muskogee, Okla., have been awarded the contract for the foundation work for the main shops of the Missouri, Oklahoma & Gulf Ry. at Muskogee. Contract for the structural steel was let to the Central States Bridge Co., Indianapolis, Ind. The main building for machine shops, blacksmith, boiler and locomotive shops will be 148x200 ft. Other buildings will include car repair shed 46x180, carpenter shop 32x38, and storeroom, 80x52. Grading for the foundation has been completed and the material track to the site north of the city is finished.

It has been announced that the Frisco plans to rebuild its line, laying heavier steel, constructing new bridges and widening the roadbed between Lawton, Okla., and Quanah, Texas.

Officials of the Missouri, Oklahoma & Gulf R. R. are reported to have announced that construction work will be started within the next three months on the Henryetta, Shawnee and Oklahoma City line.

The Cushing R. R. Co. has been incorporated with a capital stock of $300,000 and proposes to contruct a 12-mile electric railway from the town of Cushing east to Drumright, the center of the Cushing oil field. The incorporators are Paul Arbon and C. R. Perry of Tulsa; T. J. Hughes, John H. Bellis and R. C. Jones, all of Cushing.

Negotiations are reported under way for the purchase of the property and franchises of the Lawton Ry. Co., by Samuel Insull, Chicago. It is stated that if the deal goes through street car service will be established at Lawton, and the line completed for four miles to Fort Sill.

Business men of Hartshorne are to ask the Choctaw Railway & Lighting Co., McAlester, Okla., to extend its interurban line from Hartshorne to Gowen by way of Cambria. Gowen is about 6 miles northeast of Hartshorne.

Oregon.

Officials of the Oregon Electric Ry. Co., Railway Exchange Bldg., Portland, have been inspecting a possible route from Forest Grove to Cherry Grove for an extension to the latter point.

Pennsylvania.

L. T. McFadden, Canton, Pa., chairman of the Bondholders Committee, has purchased the Pittsburg & Susquehanna R. R. at a receivers sale.

Stockholders of the East Berlin & York Electric Ry. Co. held a meeting last week to select a route for its projected line. The three routes under consideration and which have been surveyed, are: Direct from York to East Berlin, by way of Weiglestown; York to East Berlin, by way of Taxville and Admire. William Russell Smith of York is Engineer.

Tennessee.

⦿The Chicago, Rock Island & Pacific Ry. has awarded a contract to the Union Bridge & Construction Co., 902 Sharp Bldg., Kansas City, Mo., for the construction of the substructure of a bridge over the Mississippi River at Memphis, Tenn. The work will include the sinking of five pneumatic piers, several smaller piers for the approaches, and all shore protection, and will cost about $1,250,000. The finished structure, which will be located 200 feet above the Frisco Bridge at Memphis, Tenn., will be 6,000 feet long. The total cost of the structure will be $4,000,000. Ralph Modjeski, Chicago, Ill., is Consulting Engineer.

The Mingo Valley R. R. Co. of Washington County, has been incorporated with a capital stock of $70,000. M. H. Taylor, Erie, Pa., is one of the incorporators. The Pittsburg Coal Co., Pittsburg, Pa., is probably interested in this line.

The Middle Tennessee Traction Co. of Franklin, Tenn., has voted an amendment to its charter increasing its capital stock from $10,000 to $250,000. The company proposes an interurban line from Franklin to Shelbyville, 45 miles, and has already about completed the grading from the former place to Eaglenth. The Interurban Construction Co. has been organized to build the line. The officers are as follows: R. H. Crockett, President; P. E. Cox, Vice-President and General Manager; E. E. Green, Secretary and Treasurer; G. B. Howard, Chief Engineer.

Texas.

The Temple, Northwestern & Gulf Ry. has completed surveys and has secured the capital for the construction of its projected 100-mile line from Temple northwesterly to Dublin. The construction contract has been let but the company is not yet ready to announce the name of the contractor. W. E. Dozier, Temple, Tex., is Chief Engineer; W. S. McGregor, Temple, Tex., is Vice President and General Manager.

It is said that T. B. Meeks, President of the Texas Short Line Ry., is considering the advisability of extending the line south from Grand Saline to Canton, Athens, Houston and Galveston, Texas, and north from Grand Saline to Sulphur Springs and Paris or from Grand Saline to McAlester, Okla.

Virginia.

⦿The Callahan Construction Co., Empire Bldg., Knoxville, Tenn., has been awarded the contract by the Virginia-Carolina R. R., P. W. Early, Chief Engineer, Abingdon, Va., for a 40-mile extension. The Callahan Construction Co. has been working on an 8-mile extension running from the present general line near Konarock, Va., southeast to near the Virginia-Carolina line. The new contract joins on the present one and extends 40½ miles in a southeasterly direction into North Carolina running through Ashe county in that state. The contract comprises a large amount of cart and car and some nice team work, and the contractors are just now mak-

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

ing arrangements to offer a great part of the work to sub-contractors. Any contractors desiring to look over the work can make arrangements for an engagement ahead of time by writing or wiring to the home office at Knoxville. The excavation on the 40-mile will amount to about 500,000 cu. yds. There will be no trestle work or concrete masonry.

⊙The New River, Holston & Western R. R., P. W. Early, Chief Engineer, Abingdon, Va., has awarded a contract for a 14½ mile extension to J. J. Boxley & Son, P. O. Box 392, Roanoke, Va. The contract includes 300,000 cu. yds. of excavation of which 40 per cent is rock, and four timber trestles.

The Scranton & Wilkesbarre Traction Co., of Richmond, Va., has been chartered with a capital stock of $1,000 to $4,250,000. The corporation has been organized as a holding company. The officers are Thomas B. Gay, president; E. B. Flippen, treasurer, and H. H. Chalkley, secretary, all of Richmond.

Washington.

The Puget Sound & Williamsport Harbor Ry. is making surveys from Raymond, east. The ultimate termination of the east end of the line, however, has not been finally decided upon. This is a Chicago, Milwaukee & St. Paul project. C. A. Goodnow, Railway Exchange Bldg., Chicago, President.

West Virginia.

The Pittsburg & Lake Erie R. R. (New York Central Lines) is reported to have assumed the financing the extension of the Buckhannon & Northern R. R. to Fairmont, and it is probable that construction work on the seven miles of line will be started early next month. It is planned to continue the road from Rivesville by building a road over the Monongahela River at Catawba and go down the east bank of the Monongahela to Fairmont.

Wisconsin.

A project is under consideration for the construction of a 65-mile electric railway from Lancaster, Wis., to Stockton. Thomas McDonald, Lancaster, is interested.

Canada.

Citizens of Brandon, Man., have voted in favor of a by-law appropriating $150,000 for street railway construction and equipment. R. E. Speakman is City Engineer.

ROADS AND STREETS

Alabama.

⊙J. F. Giddens has been awarded the contract by the Board of Revenue, Montgomery, Ala., for grading and graveling seven miles of the Ramer-Grady road.

⊙J. W. Lawler & Co., Red Bay, Ala., have been awarded the contract by the Franklin County Commissioners, Red Bay, for grading, draining and surfacing gravel portion of Old Fulton and Russellville road, for $4,000. Bids were opened May 21.

⊙J. F. McCullough, Montgomery, Ala., has been awarded the contract by the Board of Revenue of Montgomery County, Montgomery, for the graveling of 5.4 miles of Snoudown-Chambers Road. Bids were opened June 2.

All bids received June 2 by the Board of Henry County Commissioners, Abbeville, Ala., for grading, draining and surfacing with sand-clay about four miles of Headland road and five miles of Eufaula road, have been postponed until June 12. The estimated cost is $8,000.

The City Council of Gadsden, Ala., has passed an ordinance for the paving of Walnut St., from Fifth to 12th, with Tarvia. The pavement is to have a 4-in. concrete base and a 2-in. wearing surface. The estimated cost is $32,312.

California.

✣Bids will be received at the office of the California Highway Commission, 515 Forum Bldg., Sacramento, Cal., until 2 p. m., June 23, 1913, at which time they will be publicly opened and read, for constructing a portion of a State highway in Santa Clara County between Morgan Hill and Gilroy (IV, S. Cl., 2, C); about 7½ miles in length, to be built of Portland cement concrete with bituminized surface, in accordance with the specifications therefor, to which special reference is made. Plans may be seen, and forms of proposal, bonds, contract, and specifications may be obtained, at the said office; and they may be seen at the office of the Division Engineer at San Francisco, Cal.

✣Bids will be received at the office of the California Highway Commission, 515 Forum Bldg., Sacramento, Cal., until 2 p. m., June 23, 1913, at which time they will be publicly opened and read, for constructing a portion of a State highway in San Mateo County between Cypress Lawn Cemetery and South San Francisco (IV, S. M., 2, A4); about 2 miles in length, to be graded in accordance with the specifications therefor, to which special reference is made. Plans may be seen, and forms of proposal, bonds, contract, and specifications may be obtained, at the said office; and they may be seen at the office of the Division Engineer at San Francisco, Cal.

✣Bids will be received at the office of the California Highway Commission, 515 Forum Bldg., Sacramento, Cal., until 2 p. m., June 23, 1913, at which time they will be publicly opened and read, for constructing a portion of a State highway in El Dorado County between Shingle Springs and El Dorado (III, E. D., 11, B); about 5 miles in length, to be built of water bound macadam in accordance with the specifications therefor, to which special reference is made. Plans may be seen, and forms of proposal, bonds, contract, and specifications may be obtained, at the said office; and they may be seen at the office of the Division Engineer at Sacramento, Cal.

✣Bids will be received at the office of the California Highway Commission, 515 Forum Bldg., Sacramento, Cal., until 2 p. m., June 23, 1913, at which time they will be publicly opened and read, for constructing a portion of a State highway in Santa Barbara County between Los Alamos and a point about 1¼ miles northerly from Bicknell Station (V, S. B., 2, B); about 12 miles in length, to be built of Portland cement concrete with bituminized surface, in accordance with the specifications therefor, to which special reference is made. Plans may be seen, and forms of proposal, bonds, contract and specifications may be obtained, at the said office; and they may be seen at the office of the Division Engineer at San Luis Obispo, Cal.

✣Bids will be received at the office of the California Highway Commission, 515 Forum Bldg., Sacramento, Cal., until 2 p. m., June 23, 1913, at which time they will be publicly opened and read, for constructiong a portion of a State highway in San Luis Obispo County between San Luis Obispo and Santa Margarita (V, S. L. O., 2, D); about 6½ miles in length, to be built of Portland cement concrete with bituminized surface, in accordance with the specifications therefor, to which special reference is made. Plans may be seen, and forms of proposal, bonds, contract, and specifications may be obtained, at the said office; and they may be seen at the office of the Division Engineer at San Luis Obispo, Cal.

✣Bids will be received at the office of the California Highway Commission, 515 Forum Bldg., Sacramento, Cal., until 2 p. m., June 23, 1913, at which time they will be publicly opened and read, for constructing a portion of a State highway in San Bernardino County between the westerly boundary and the southerly boundary via Ontario (VII, S. Bd., 19, A & B); about 6½ miles in length, to be built of Portland cement concrete with bituminized surface, in accordance with the specifications therefor, to which special reference is made. Plans may be seen, and forms of proposal, bonds, contract, and specifications may be obtained, at the said office; and they may be seen at the office of the Division Engineer at Los Angeles, Cal.

In regard to the California highway work mentioned above, a blue print of the title sheet of the plans will be furnished free with the specifications. Blue prints of the remaining sheets of the plans, and blue prints of the cross-sections, are furnished only at cost and become the property of the purchaser.

The City Council of Ontario, Calif., has taken steps to pave Euclid Ave., from A St. to 10th St., and G St., from Vine Ave. to Sultana Ave.

Checks for the above should be made payable to the Forrest Blue Print Company and should accompany the order.

The following table shows the cost of such blue prints for the work now advertised:

	Plans.		Cross-sections.	
	No. of sheets.	Cost.	No. of sheets.	Cost.
III E. D. 11 B........	12	$1.08	36	$3.24
IV S. M. 2 A4........	9	0.81	18	1.62
IV S. Cl. 2 C..........	17	1.53	47	4.23
V S. B. 2 B...........	26	2.34	83	7.47
V S. L. O. 2 D.......	14	1.26	71	6.39
VII S. Bd. 19 A & B..	15	1.35	45	4.05

The State Highway Commission, Sacramento, Calif., has directed State Highway Engineer A. B. Fletcher to make surveys and plans for a new route in San Joaquin, Stanislaus and Tuolumne Counties, to be designated route 13. The distance is 45 miles, extending from Farmington via Knight's Ferry, Keystone, Mountain Pass and Jamestown to Sonora.

Connecticut.

✣Bids will be received until 2 p. m., June 16, by F. L. Ford, City Engineer, New Haven, Conn. (readvertisement), for paving Congress Ave., from Howard Ave. to Davenport Ave.; College St., from Chapel St. to Grove St.; Sachem St., from Prospect St. to Winchester Ave.; Norton St., from Chapel St. to Derby Ave., and George St., from College St. to Broad St., with creosoted wood blocks, sheet asphalt, Sicilian Rock Asphalt block, or brick. Total yardage about 29,000.

Delaware.

⊙Joseph Anderson, of Delaware City, Del., has been awarded the contract by the City Council of that city, for the paving of Clinton St., for $1.16 per sq. yd., for concrete, the city to do the grading. The estimated cost of the improvement is $15,000.

District of Columbia.

✣Bids will be received until 2 p. m., June 12, by Commissioners of the District of Columbia, Washington, D. C., for laying concrete sidewalks in the District.

✣Bids will be received until 3 p. m., June 12, by Committee on Public Works of the Board of Bond Trustees, Jacksonville, Fla., for furnishing all materials and laying approximately 32,508 square yards of Asphaltic Concrete Pavement on a Concrete base, approximately 26,141 sq. yds. of Dolaway Pavement, approximately 27,743 sq. yds. of Vitrified Brick Pavement on a Concrete Base, approximately 3,758 sq. yds. of Vitrified Brick Pavement on a Sand Base, approximately 4,826 sq. yds. of Granitoid Pavement, approximately 1,190 sq. yds. of Asphalt Block Pavement on a concrete base.

✣Bids will be received until 2 p. m., June 17, by Board of Public Works, Tampa, Fla., for the paving of portions of a number of Aves. as follows: Nebraska Ave., from Michigan north to the city limits, 26 ft. wide, brick

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

to be laid on edge. Approximate area 7,600 sq. yds. Curb 5,300 lin. ft. Fifteenth Ave. from Fourteenth St. to Fifteenth St., 24 ft. wide, brick to be laid flat. Approximate area 950 sq. yds. Curb 810 lin. ft. Fifteenth Ave., from Tenth St. to Twelfth St., 21 ft. wide, brick to be laid flat. Approximate area 1,680 sq. yds. Curb 730 lin. ft. Eleventh Ave. from Nebraska Ave. to Fifteenth St., 28 ft. wide, brick to be laid flat. Approximate area 8,100 sq. yds. Curb 5,300 lin. ft.

⊙Seth Perkins, Jr., St. Augustine, has been awarded the contract by the City Council of St. Augustine, Fla., for the paving of Carrera St. with asphalt macadam, for $1.35½ per sq. yd.

The Commissioners of the District of Columbia contemplate the expenditure of $100,000 for alley improvement work.

Ordinances have been passed by the City Council of Jacksonville, Fla., providing for the repairing and repaving of four streets, as follows: Adams St., Broad to Main, vitrified brick, $2.94 per ft. front; Adams St., Broad to Stuart, vitrified brick, $2.88 per ft. front; Main St., from Hogans creek north to city limits, vitrified brick, $1.19 per ft. front, and Riverside Ave., from south side viaduct to Date St., $0.93 per ft. front.

Georgia.

✣Bids will be received until noon, June 25, by Committee on Streets and Lanes, at the office of E. R. Conant, Chief Engineer, Savannah, Ga., for furnishing approximately 17,000 sq. yds. of asphalt paving block or creosoted wood paving block.

Idaho.

✣Bids will be received until June 16, by City of Pocatello, Idaho, W. A. Sams, City Engineer, for 20,000 yds. of bitumen pavement; also for street cleaning machinery.

Illinois.

✣Bids will be received until June 28, by Commissioners of Highways town of Jamaica, Vermilion County, Ill., for the improvement of about 12 miles of rock road in Jamaica township. Plans and specifications may be seen at the office of Fred Gaines, Town Clerk or William S. Dillon, Engineer, Danville, Ill.

⊙H. C. Finley has been awarded a contract by the Board of Local Improvements of Hoopeston, Ill., for the paving of three blocks on West Main St., near Greer College, for $1.37 per sq. yd.

⊙Harry McMullen, of Kankakee, Ill., is reported to have been awarded a contract by the Board of Local Improvements of that city, for the paving of West Station St., and West Ave., with brick, for approximately $44,800.

⊙The Tri-City Construction Co., Davenport, Ia., has been awarded the contract by the Board of Local Improvements of Rock Island, Ill., for the paving of 25th St., from Ninth to 18th Aves., with brick, at the following prices: $2.05 per sq. yd., for paving, $0.60 per lin. ft. for curbing, $0.65 per lin. ft., for concrete curb and gutter, $0.35 for grading, $40 for catch basins and $50 for manholes.

⊙R. F. Conway, Chicago, Ill., has been awarded the contract by the city of Kewanee, Ill., for the grading, curbing, guttering and paving of Elliott St., Prospect St., and McKinley Ave., with asphaltic concrete on a 5-in. concrete base, for $34,035. Bids were opened May 31.

⊙The Western Improvement Co., Racine, Wis., has been awarded the contract by the city of Elgin, Ill., for the construction of 11,300 sq. yds. of asphaltic concrete pavement on Division St., for $22,690. Bids were opened May 28.

⊙Douglas A. Myers has been awarded the contract by the Board of Local Improvements of Peoria, Ill., for the paving of Peoria Ave., from Nebraska to Frye Ave., for $5,815.

The City Council of Taylorville, Ill., has voted to lay about four miles of brick paving during the coming year.

The City Council of Evanston, Ill., has passed ordinances providing for the paving of four streets.

Warden Ned Allen of the Penitentiary, Joliet, Ill., has asked the house committee of the Legislature to appropriate $25,000 for a new stone crusher.

County Surveyor W. S. Dillon, Danville, Ill., has been selected as engineer for the proposed 12½ miles of crushed stone roads in Jamaica Township, that county.

The Board of Local Improvements of Mt. Carmel, Ill., has passed a resolution providing for the improvement of Poplar St., from the south line of Ninth St. to the north corporation line. The estimate is as follows: 4,900 cu. yds. excavation at 25c., $1,225; 4,130 sq. yds. tar-macadam wearing surface at 44c., $1,949.20; 4,430 sq. yds. 4-in. concrete foundation at 35c., $1,550.50; 4,360 ft. concrete curb and gutter at 45c., $1,962; 216 ft. concrete edging at 30c., $64.80; 27 ft. 42-in. sewer at $5, $135; 35 ft. 18-in. sewer at 85c, $29.75; 74 ft. 12-in. sewer at 50c., $37; 6 inlets at $12, $72; 1 manhole at $20. $20; 2 head walls at $15, $30; 20 ft. 15-in. sewer at 65c, $13. Total $7,088.

The Board of Local Improvements of Mt. Carmel, Ill., Charles A. Martin, Pres., has passed a resolution providing for the improvement of Third St. from the west line of Chestnut St. to a point 5 ft. east of the center line of the main track of the Southern Railway Co. The estimate is as follows: 4,600 cu. yds. earth excavation at 25c., $1,150; 4,850 sq. yds. tar-macadam wearing surface at 44c., $2,134; 4,850 sq. yds. 4-in. concrete foundation at 35c., $1,697.50; 3,570 ft. curb and gutter at 45c., $1,606.50; 145 ft. edging at 30c., $43.50; 87 ft. 12-in. sewer pipe at 50c., $43.50; 57 ft. 15-in. sewer pipe at 65c., $37.05; 425 ft. 16-in. sewer pipe at 75c., $318.75; 23 ft. 20-in. sewer pipe at $1.00, $23; 73 ft. 24-in. sewer pipe at $1.80, $131.40; one catch basin, at $25, $25; one manhole at $20, $20; six inlets, at $12, $72. Total, $7,302.

Indiana.

✣Bids will be received until 7 p. m., June 23, by Town Board, Bloomfield, Ind., for the construction of about 14,240 sq. yds. of paving. The material considered is brick. C. C. Parker is City Engineer.

✣Bids will be received until 10 a. m., July 7, by Board of Clark County Commissioners, Jeffersonville, Ind., for the construction of highways in Jeffersonville and Charlestown townships. G. W. Stoner is County Auditor.

✣Bids will be received until 10 a. m., June 26, by Board of Marion County Commissioners, Indianapolis, Ind., for furnishing crushed stone and screenings for county highways. W. T. Patton is County Auditor.

✣Bids will be received until noon, July 9, by Board of Miami County Commissioners, Peru, Ind., for the construction of a road in Deer Creek township. F. K. McElheny is County Auditor.

✣Bids will be received until 2 p. m., July 8, by Board of Knox County Commissioners, Vincennes, Ind., for the construction of gravel roads in Winder, Johnson, Harrison, Busseron, Vigo and Vincennes townships. J. T. Scott is County Auditor.

✣Bids will be received until 1:30 p. m., July 8, by Board of Wabash County Commissioners, Wabash, Ind., for the construction of a gravel road in Chester township. Dan Showalter is County Auditor.

✣Bids will be received until 10 a. m., July 8, by Board of White County Commissioners, Monticello, Ind., for the construction of highways in Honey Creek, West Point, Prairie and Round Grove townships. A. G. Fisher is County Auditor.

⊙J. W. Thomas, Delphi, Ind., has been awarded the contract by the County Commissioners, Williamsport, Ind., for the construction of the Flint gravel road for $11,890. Bids were opened June 2.

⊙Reed & Thomson, Greensburg, Ind., have been awarded the contract by the County Commissioners, Greensburg, for the construction of a macadam road in Washington Township, for $12,548. Bids were opened June 2.

⊙William Avery, Waldron, Ind., has been awarded the contract by the County Commissioners, Greensburg, Ind., for the construction of a macadam road in Marion Township, for $7,440. Bids were opened June 2.

⊙Alva E. Harriman, Brook, Ind., has been awarded the contract by the County Commissioners, Kentland, Ind., for the construction of a highway in Washington Township, for $6,795. Bids were opened June 2.

⊙F. B. Warren of Crawfordsville, Ind., and Lawrence Jenkins of Frankfort, Ind., have been awarded the contracts by the County Commissioners, Crawfordsville, for the construction of four roads (two each) for which bids were opened June 3.

⊙Z. W. Dritt, Logansport, Ind., has been awarded the contract by the County Commissioners, Monticello, Ind., for the construction of the Bishop road in Jackson Township, for $4,239. Bids were opened June 3.

⊙Richard, Agnew & Martin have been awarded the contract by the Spencer County Commissioners, Rockport, Ind., for the construction of a gravel road.

⊙Robert Grayson, Jeffersonville, Ind., has been awarded the contract by the County Commissioners, Jeffersonville, for the construction of a macadam road, for $17,693. Maggart & Peacock, Scottsburg, Ind., secured the contract for a macadam road in Charlestown Township, for $5,787. Bids were opened June 2.

⊙O. L. Markle, Winamac, Ind., has been awarded the contract by the County Commissioners, Winamac, for the construction of the Marim and Markle gravel road, for $6,889. Bids were opened June 3.

⊙The Marion County Commissioners, Indianapolis, Ind., has awarded the contract for furnishing 36,000 gals. of road oil to the Barber Asphalt Paving Co., of that city, and for 114,000 gals. to the Standard Oil Co., of that city. Bids were opened May 31.

⊙J. L. Tugarden, Union City, Ind., has been awarded the contract by the Common Council of that city, for the paving of Pearl St., with vitrified brick on a concrete base, with stone curb, for $9,650. Bids were opened June 2.

⊙Following contracts have been awarded by the Board of County Commissioners, Lafayette, Ind., for the construction of gravel roads for which bids were opened on June 4: Vanderkleed road, Geo. E. Wolf, Lafayette, $3,490; Packard road, Geo. Vaughan, Lafayette, $7,100; Runkle road, John T. Sines, Delphi, $4,881; J. Crouch road, Benj. L. Oilor, Lafayette, $5,200, and the Misner road, $3,210.

⊙Jno. N. Murphy, Greenwood, Ind., has been awarded the contract by the Johnson County Commissioners, Franklin, Ind., for the construction of the Frank C. Tilson gravel road. Bids were opened June 2.

⊙Robt. Danner, R. R. 12, Madison, Ind., has been awarded the contract by the Ripley County Commissioners, Versailles, Ind., for the construction of a macadam road in Center Township, for $10,335. Bids were opened June 2.

⊙Homer Faust & Julius Haugh, Decatur, Ind., have been awarded the contract by the County Commissioners, Decatur, for the construction of gravel roads in French and Root Townships. Bids were opened June 3.

⊙Howard M. Cahpel, Knox, Ind., has been awarded the contract by the Starke County Commissioners, Knox, for the construction of a gravel road in Railroad Township. Bids were opened June 3.

⊙W. P. Thompson, Delphi, Ind., has been awarded the contract by the County Commissioners, Delphi, for the construction of a gravel road in Tippecanoe Township, for $7,283. Bids were opened June 3.

⊙The Board of County Commissioners, Wabash, Ind., awarded the contract for the construction of the Cassatt road to M. C. Greevey Bros., of Wabash, for $19,970. W. A. Graffis secured the Compton and Barnett roads, for $9,438 and $9,338 respectively. Huffman & Son, Warren, Ind., got the contract to construct the Rennaker road, for $10,500. Bids were opened June 3.

⊙Sawery & Mannex, Fort Recovery, O., have been awarded the contract by the Jay

County Commissioners, Portland, Ind., for the construction of the Bell gravel road, for $7,500. Bids were opened June 2.

No bids were received on June 2 by the Board of St. Joseph County Commissioners, South Bend, Ind., for the construction of a gravel or macadamized road in Lincoln Township.

Iowa.

✣Bids will be received until 5 p. m., June 16, by Charles J. Duff, City Clerk, Council Bluffs, Ia., for paving about 7,098 sq. yds.

✣Bids will be received until 8 p. m., June 16, by W. F. Weary, City Clerk, Sac City, Ia., for furnishing labor and material for paving and curbing streets. The following is an approximate estimate of work to be done: Paving, 17,175 sq. yds.; curbing, 5,270 lin. ft.; headers, 735 lin. ft.; grading, 5,300 cu. yds.

✣Bids will be received until 9 a. m., June 12, by City Clerk, Burlington, Ia., for grading, draining and paving a number of streets and alleys. H. G. Vollmer is City Engineer.

⊙Frank K. Hahn has been awarded the contract by the City Council of Cedar Rapids, Ia., for the concrete paving to be laid in West Highlands and other portions of the city, for $13,106. The work includes 9,800 sq. yds. of concrete paving and 2,300 cu. yds. of grading.

The City Council of Burlington, Ia., has adopted the final resolution ordering the paving of River and Denmark Sts.

The City Council of Keokuk, Ia., has passed an ordinance to pave Fifth St., from Blondeau to Orleans, with concrete, 7 ins. in thickness.

The City Council of Sac City, Ia., has decided to pave 13 blocks of Main and Fifth Sts. The contract will bet let at once.

Louisiana.

✣Bids will be received until noon, June 27, by Albert Bienvenu, Mayor, St. Martinsville, La., for furnishing the material for building cement sidewalks and curbings.

Property owners of Bossier Parish recently held a meeting in Shreveport, La., to discuss plans for the construction of 45 miles of hard surface roads, through wards one and two. An election will be held to vote a 10-mill tax for the improvements. Benton is the parish seat.

The good roads committee of Calcasieu Parish recently held a meeting in Lake Charles, La., the parish seat, for the purpose of reorganizing and formulating plans for the building of a system of highways throughout the parish. Dr. S. M. Lyons is president of the police jury.

Maryland.

✣Bids will be received until 11 a. m., June 18, by Board of Awards at the office of the City Register, Baltimore, Md., for grading, curbing and paving with granite block and vitrified block, all on a concrete base, the streets listed in the following contracts: Vitrified block contract No. 58, Fairmount Ave. from Central Ave. to Broadway; Watson St., from High St. to Central Ave.; Granby St., from Exeter St. to Central Ave.; Low St., from Front St. to East St.; Forrest St., from Fayette St. to Lexington St.; Customhouse Ave., from Lombard St. to Water St.; Hargrove Alley, from Saratoga St. to Pleasant St.; vitrified block, 14,400 sq. yds—certified check, $1,000. Vitrified Block Contract No. 59, McMochen St., from Park Ave. to North Ave.; Sherman Pla., from Lanvale St. to North Ave.; vitrified block, 5,050 sq. yds.—certified check, $400. Granite Block Contract No. 60, Ridgely st., from Stockholm St. to Fremont Ave.; President St., from Fawn St. to Pratt St.; granite block, 11,660 sq. yds.—certified check, $1,200. Granite Block or Hassam Granite Block and Vitrified Block Contract 61, Fayette St., from Gay St. to Central Ave.; Exeter St., from Fawn St. to Pratt St.; Exeter St., from Low St. to Gay St.; granite block or Hassam granite block, 9,510 sq. yds: vitrified block, 1,500 sq. yds.—certified check, $1,000. The figures above represent the approximate quantities of the principal items appearing in the contract. Specifications and proposal sheets can be obtained upon application to the office of the Paving Commission, City Hall. A deposit of $5 will be required for a specification covering each contract. This will not be refunded unless a bid is filed. Plans and profiles are on file for the information of bidders in the office of H. Kent McCay, Chief Engineer.

✣Bids will be received until noon, June 12, by State Roads Commission, 534 North Howard St., Baltimore, Md., W. L. Marcy, Secy., for building seven sections of state highway aggregating 16.58 miles, and including 1 bridge. The work is located as follows: Baltimore City—One section along the Reisterstown road, from Elgin lane to Pimlico gate, about 1 mile in length (grading); one section along the Frederick Road, from Bentalou St. to Tyson St. and from Vanbibber St. to Yale St., about 1.69 miles in length (vitrified brick); one 2,100-ft. span reinforced concrete arch bridge over Gwynn's Falls. Baltimore County—One section along the York Road, from Texas Road to Glencoe Road, a distance of about 5.60 miles (resurfacing macadam). Carroll County—One section along the Frederick Pike, from Ridgeville to south branch of Patapsco river, about 1.60 miles in length (resurfacing macadam). Frederick County—One section along the Frederick Pike, from Plane No. 4 to Ridgeville, about 2.50 miles in length (resurfacing macadam). Montgomery County—One section of road between Norbeck and Sandy Springs, about 1.25 miles in length (macadam or concrete). Talbot County—One section of road between Skipton and Wye Mills, about 2.94 miles in length (concrete, macadam).

⊙Frech & Allen have been awarded the contract by the Board of Awards of Baltimore, Md., for the paving of Hilton St., from Edmondson Ave. to the Frederick Road, with sheet asphalt, at $0.34 a cu. yd. for grading, $0.34 a cu. yd. for cutting through rock, and $1.74 for paving.

⊙P. F. Reddington has been awarded the contract by the Board of Awards of Baltimore, Md., for Paving Contract No. 53, vitrified brick, for $85,959.

Massachusetts.

✣Bids will be received until 2 p. m., June 20, by Chairman Board of Public Works, Holyoke, Mass., for laying approximately 28,000 sq. yds. of bituminous or asphalt or other form of pavement, but not brick, wooden block or Belgian block pavement; the yardage being divided approximately as follows, viz.: Contract A, 4,800 sq. yds.; Contract B, 2,100 sq. yds.; Contract C, 21,100 sq. yds., the Board reserving the right to award the contracts separately or as a whole. And for furnishing f. o. b. cars Holyoke, Mass., a sufficient quantity of wooden blocks to lay approximately 1,500 sq. yds. of pavement, the entire work to be performed in accordance with specifications to be prepared and submitted by the bidder under and in conformity with information and specifications issued by the Board. Proposals must be accompanied by a certified bank check in the sum of $500.

✣Bids will be received until noon, June 17, by Massachusetts Highway Commission, Boston, Mass., for constructing about 2,400 ft. of State Highway in the town of Revere. Further information can be secured of the Commission. A certified check for $250 must accompany each bid.

⊙The Hudson Construction Co., of Melrose, Mass., has been awarded the contract for the new roadbed between the iron bridge and the Athol, Mass., fair ground, for $44,490.

⊙The Selectmen of Greenfield, Mass., have awarded the contract for the construction of cement sidewalks for the town during the coming year to Michael Siano. C. L. Farnsworth, of Ayer, has been awarded the contract to construct a tar-bound macadam roadway on Main St., from Wells to Conway St.

⊙Antonio Pallotto, Lowell, Mass., has been awarded the contract by the Middlesex County Commissioners, Cambridge, Mass., for the construction of the Acton gravel road from Chelmsford Center through South Chelmsford to the Westford town line, for $5,800. Bids were opened May 31.

Michigan.

⊙Ancil Holmes has been awarded the contract by the County Commissioners, Charlotte, Mich., for the construction of 200 rods of the Hicks road in Hamlin Township, for $925. J. R. Briggs will construct a half-mile of the Dimondale road in Eaton Rapids Township, for $800.

⊙Robert Tripp of Petoskey, Mich., has been awarded contracts for the construction of three roads in Emmet County, of which Petoskey is the county seat.

⊙Lee Nowland, of Charlevoix, Mich., has been awarded the contract for the paving of the business section of Caro, Mich., for $16,062.

Jackson County, Mich., Jackson, county seat, proposes the construction of 12 miles of trunk line highway this year, and Calhoun County, Marshall, county seat, plans to construct 4½ miles of road.

Minnesota.

⊙The City Council of Bemidji, Minn., has awarded a contract for the construction of six additional blocks of concrete pavement to Goodman & Loitved, of Bemidji, for $1.05 per sq. yd.

⊙Ross K. Noble, Blackduck, Minn., has been awarded the contract by the Itasca County Commissioners, Grand Rapids, Minn., for the construction of Road No. 114, in the town of Arbo, for $6,900. Bids were opened May 27.

⊙J. J. Mergens, Deep Haven, Minn., has been awarded the contract by the Hennepin County Commissioners, Minneapolis, Minn., for the grading of Road 105 and graveling and repairing of the same, for $3,990. Bids were opened June 2.

The City Council of Northfield, Minn., has adopted new ordinances providing for the paving of the principal business streets of the city.

The paving committee of the City Council, Minneapolis, Minn., has recommended the immediate purchase of a city portable asphalt plant. The estimated cost is $12,500. E. R. Dutton is City Engineer.

The Ramsey County Commissioners, St. Paul, Minn., have pledged $10,000 for the St. Paul-Duluth highway.

The State Highway Commission, St. Paul, Minn., has approved 486 miles of new roadway in that state to cost $369,898, and apportioned among the counties as follows: $32,874 in Aitkin, $11,755 in Hubbard, $80,752 in Itasca and $244,517 in Koochiching. Geo. W. Cooley is State Engineer.

The Lyons County Commissioners, Marshall, Minn., have asked the State Highway Commission for an aprpopriation of $135,000 for the building of good roads.

Mississippi.

⊙The Healy Construction Co., Meridian, Miss., has been awarded the contract by the Board of State Engineers, New Orleans, La., for the construction of 5.8 miles of gravel roads in Caddo Parish, for $32,963. Bids were opened June 2.

Missouri.

✣Bids will be received until 7:30 p. m., June 30, by City Clerk, Popular Bluff, Mo., for 36,201 sq. yds. of brick pavement; 18,996 ft. of curb and gutter; 1,969 ft. of headers; 10,531 cu. yds. excavation; 16 basins; 120 ft. of 8-in. pipe; 770 ft. of 12-in. pipe. The cost is estimated at $88,093. Edward C. Thomes is City Engineer.

⊙Reinert Bros. Construction Co. has been awarded the contract by the Board of Public Works of St. Joseph, Mo., to macadamize the highway leading from Fourth and Cedar Ave. to Exchange Ave., for $1 per cu. yd. The improvement will cost about $16,000.

At a recent special election in Salem, Mo., a territory 7½ miles square, including Salem, was organized into a special road district.

The County Court, Kansas City, Mo., on June 2 rejected all bids received for the seven miles of macadam on the Blue Ridge Blvd., and the Red Bridge Road. New bids will be asked.

Nebraska.

⊙The City Council of Norfolk, Neb., has awarded the contract for paving 47,000 sq. yds. to the M. Ford Paving Co., of Omaha, for $88,330.

⊙The M. Ford Paving Co., of Omaha. Nebr., has been awarded the contract by the city of Norfolk, Nebr., for the construction of 17,000 sq. yds. of asphaltic concrete pavement at $1.58 and 25,000 ft. of combined curb and gutter, at $0.54. The entire contract amounts to $89,000. Bids were opened May 26.

New Hampshire.

No bids were received on June 4 by the Highway Department of New Hampshire, Concord, for the construction of a trap rock road in Bow, estimated to cost $3,400, and also for a similar road in Greenville, estimated to cost $3,000.

New Jersey.

✣Bids will be received until noon, June 17, by E. I. Edwards, Comptroller & Secretary, State House Commission, Trenton, N. J., for the construction of 100 lin. ft. of concrete retaining wall on the lands of the State in the rear of the Capitol. The work will include 240 yds. of concrete.

✣Bids will be received until noon, June 17, by E. I. Edwards, Comptroller & Secretary, State House Commission, Trenton, N. J., for approximately 11,000 cu. yds. of grading on lands in the rear of the Capitol Bldg.

⊙The City Commission of Trenton, N. J., Frank Thompson, City Clerk, has awarded the following contracts for the construction of approximately 31,000 sq. yds. of pavement for which bids were opened on June 4: Chas. A. Reid Co., Trenton, brick work; Newton Paving Co., Trenton, asphalt work; also to McGovern Construction Co., of Trenton. Chas. A. Reid Co., and Russell Klockner, Trenton, secured the concrete pavements.

New York.

✣Bids will be received until 5 p. m., June 23, by E. M. Hall, Village Clerk, Solvay, N. Y., for furnishing work and materials for paving Milton Ave. in said village, in accordance with the plans and specifications on file in the Clerk's office.

✣Bids will be received until 6:30 p. m., June 21, by Commissioners of Public Works, Olean, N. Y., at the office of the Superintendent of Streets, for the construction of a vitrified block pavement on concrete foundation on Sullivan St. from Second St. to Sixth or Seventh St., at the discretion of the Commissioners. The approximate quantities are: 1,100 cu. yds. excavation; 3,850 sq. yds. vitrified block pavement; 2,000 ft. of curb to be taken up and reset; 60 ft. 6-in. pipe house connections; 20 ft. 8-in. catch basin connections; 2 catch basins, 1 manhole. Plans and specifications may be examined, bid blanks secured and further information may be secured at the office of the City Engineer, City Building, Olean, N. Y.

✣Bids will be received until 6:30 p. m., June 21, by Board of Public Works, at the office of Supt. of Streets, Olean, N. Y., for the construction of a vitrified block pavement on North Clinton St. from East State St. to Jay St. The approximate quantities are: 1,000 cu. yds. excavation; 2,900 sq. yds. vitrified block pavement on a 5-in. concrete base or on a 6-in. rolled gravel base; 50 ft. depressed curb; 30 ft. curb to be taken up and reset; 100 ft. 6-in. house connections; 20 ft. 8-in. catch basin connections; 1 catch basin; 4 manholes, adjusted to grade. Plans and specifications may be examined, bid blanks secured and further information may be obtained at the office of the City Engineer, City Building, Olean, N. Y.

An ordinance has been introduced in the City Council of Schenectady, N. Y., authorizing a district assessment of $155,000 to extend Jay St. from State St. to Smith St., and to widen Dakota St., from the proposed juncture of Jay and Smith Sts. to South Centre St.

North Dakota.

✣Bids will be received until 8 p. m., June 11, by Lee Nichols, City Auditor, Mandan, N. Dak., for paving curbing and accessory work. The following estimate quantities are furnished for the guidance of bidders: 1,500 cu. yds. earth excavation, 4,600 cu. yds. earth fill, 14 manholes, 7 catch basins, 11 inlets, 1,200 lin. ft. of 8-in. sewer, 550 lin. ft. of 10-in. sewer, 23,100 sq. yds. pavement, 7,121 lin. ft. straight run concrete curb, 483 lin. ft. straight run sandstone concrete reset, 194 lin. ft. curved concrete curb, 25½ lin. ft. curved sandstone curb.

Ohio.

✣Bids will be received until noon, June 23, by Village Council, Lockland, Hamilton County, O., for the furnishing of the necessary labor and material for the improvement of William St., from the south line of Wyoming Ave. to the south line of Lock St., by grading, paving the roadway with vitrified brick on concrete foundation and constructing concrete curbs and gutters and the necessary drains, culverts and retaining walls, all in accordance with the plans, profiles and specifications now on file in the office of the Village Clerk of Lockland, Ohio. Frank Reed is Village Clerk.

✣Bids will be received until noon, June 14, by Board of Marion County Commissioners, Marion, O., for resurfacing Claridon pike from the intersection of the pike and the east, north and south quarter section line of section 30 in Claridon township, to a point 9,770 ft. east of the place of beginning. The estimated cost of the improvement is $8,501.52.

✣Bids will be received until 1 p. m., June 23, by Board of Ashtabula County Commissioners, Jefferson, O., for repairing improved roads in Conneaut, O., as per Report No. 169. Plans and specifications can be seen at the office of the county engineer. A. V. Hillyer is Clerk of the Board.

✣Bids will be received until noon, June 14, by Village Clerk, Wyoming, O., for furnishing the labor and material for the construction of combined concrete curbs and gutters on portions of Poplar Ave., Cooper Ave., Crescent Ave., Grove Ave., and Pendery Ave. Plans and specifications are on file with G. H. Eversman, Village Clerk.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., June 13, 1913, for grading and paving with waterbound macadam, the Hardin Co., State Highway C, Pet. 745, Sec. No. 1 Kenton-Findlay Road, Inter-County No. 221, in Blanchard Twp. Length 2,700 ft. or 0.51 miles. Width of paving, 12 ft. Estimated cost of construction, $1,788. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion August 15, 1913. Plans and specifications are on file in the office of the County Commissioners, and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., June 13, 1913, for grading and paving with waterbound macadam, the Hardin Co., State Highway D, Pet. 745, Sec. No. 2 Kenton-Findlay Road, Inter-County No. 221, in Blanchard Twp. Length, 7,860 ft. or 1.49 miles. Width of paving 12 ft. Estimated cost of construction $5,064. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, August 15, 1913. Plans and specifications are on file in the office of the County Commissioners, and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received until noon, June 13, by W. J. Springborn, Director of Public Service, Cleveland, O., for grading, draining, curbing, paving with paving brick and improving the following thoroughfares: Perkins Ave. N. E. from E. 35th St. to E. L. of E. 37th St. W. 48th Pl. from Lorain Ct. S. W. to Ravine Ct. S. W. W. 49th Pl. from Lorain Ct. S. W. to Ravine Ct. S. W. Also for grading, draining, curbing, resurfacing with asphalt Lake Ave. N. W., from the L. S. & M. S. Ry. grade separation to about 300 feet westerly. Each bid must be made in accordance with the plans and specifications, which may be seen at the office of city engineer, room 305, city hall. W. H. Kirby is Secretary.

✣Bids will be received until noon, June 30, by F. H. Shoaff, Clerk Village of Euclid, O., at the office in the town hall, for furnishing the material and labor necessary for the improvement of Church St. from the north line of Euclid Ave. to the south track of the N. Y., C. & St. L. R. R., by establishing a grade, grading, draining and paving the same with brick, according to the plans and specifications on file at the office of said clerk at the town hall, and at the office of the F. A. Pease Engineering Co., 810 Marshall Bldg., Cleveland, Ohio.

✣Bids will be received until noon, June 16, by Trustees of Poland Township, at the office of W. J. Maurice, Township Clerk, Lowellville, O., for the furnishing of material and performing labor necessary for the paving with brick of a portion of Section 1 of the Poland-Struthers Road in Poland Township, Mahoning County, Ohio, according to plans and specifications on file at the office of the clerk of said township and also at the office of George M. Montgomery, engineer, 816 Wilson Ave., Youngstown, Ohio.

✣Bids will be received until noon, June 27, by Board of Hamilton County Commissioners, Albert Reinhardt, Clerk, Cincinnati, O., for the following county work: Under Specification No. 465—For the west approach to Highway bridge over Great Miami River, near Venice, in Crosby Township, the work to be done according to the plans and specifications now on file in the office of the Board of County Commissioners.

✣Bids will be received until noon, June 27, by Board of Hamilton County Commissioners, Albert Reinhardt, Clerk, Cincinnati, O., for constructing under Specifications No. 456, concrete culvert on Van Zandt Road, one quarter mile east of Hamilton Pike, in Springfield Township, the work to be done according to the plans and specifications now on file in the office of the Board of County Commissioners.

⊙Wise, Smith & Krabill, of Canton, O., have been awarded the contract by the Stark County Commissioners, Canton, for the paving of the Canton-Cairo Road for a distance of seven miles from the Canton corporation limits, for $115,507. Haines & Miller, of Akron, O., secured the contract to pave the Alliance-Marboro Road for a distance of four miles, for $77,646.

⊙Lunsford Bros., Pedro O., have been awarded the contract by the State Highway Commission, Columbus, for grading and paving with waterbound macadam the Kenton-Mt. Victory road in Hall Township, Hardin County, for $7,994. The road is 10,560 ft. long and 12 ft. wide. Bids were opened May 28.

⊙Lunsford Bros., Pedro, O., have been awarded the contract by the State Highway Commission, Columbus, for grading and paving with waterbound macadam the Kenton-Forest road in Pleasant Township, Hardin County, for $6,000. The road is 10,560 ft. long and 12 ft. wide. Bids were opened May 28.

⊙Wilson Engineering & Construction Co., Xenia, O., has been awarded the contract by the State Highway Commission, Columbus, for grading and paving with water waterbound macadam the Piqua-Urbana road in Mad River Township, Champaign County, for $7,545. The road is 5,280 ft. long and 11 ft. wide. Bids were opened May 29.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

⊙C. W. Ryan, Maumee, O., has been awarded the contract by the State Highway Commission, Columbus, for grading and paving with waterbound macadam the Bryan-Napoleon road in Napoleon Township, Henry County, for $14,500. The road is 13,200 ft. long and 16 ft. wide. Bids were opened May 29.

⊙The Erie Stone Co., Van Wert, O., has been awarded the contract by the State Highway Commission, Columbus, for grading and paving with waterbound macadam the Willshire-Fort Recovery road in Willshire Township, Van Wert County, for $4,828. The road is 5,284 ft. long and 14 ft. wide. Bids were opened May 29.

⊙E. N. Turner, Logan, O., has been awarded the contract by the State Highway Commission, Columbus, for grading and paving with brick for heavy traffic the Belmont Co., highway, Union Township, known as the Belmont National road, for $12,800. The road is 4,424 ft. long and 13 ft. wide. Bids were opened May 29.

⊙The Modern Construction Co., Fremont, O., has been awarded the contract by the Department of Public Service, Fostoria, O., for the paving of E. Fremont St., with brick and curbing with stone, for $7,312. Bids were opened June 3.

City Council of St. Marys, O., has passed resolutions for paving three quarters of Main St., three of Indiana Ave., one of Ash and one of Clinton St.

The Board of Trade of Canal Dover, O., has mapped out a plan for paving the streets of the city. The plan includes about four miles of improved road.

Oklahoma.

✣Bids will be received until 7:30 p. m., June 30, by City of Okmulgee, Okla., for 33,000 sq. yds. of bituminous concrete paving, on a four inch cement concrete base in District 4; also 6,000 sq. yds. in District No. 5. James G. Lyons is Commissioner of Public Works.

The City Council of Shawnee, Okla., has voted to purchase a road making machine for use on the roads leading into the city.

Oregon.

⊙The Warren Construction Co., of Portland, Ore., has been awarded the contract at Sheridan, Ore., for the paving of Maria St., with bitulithic, for $35,132.

The City Recorder of Independence, Ore., has re-advertised for bids for paving 12 blocks of streets.

Following low bids were received by the City Council of Portland, Ore., for street improvements: Grand Ave., from Woodward to Karl — gravel bitulithic — Montague-O'Reilley Co., $23,393; Montgomery St., from Clifton to St. Helens Court—gravel bitulithic—Oregon Independent Paving Co., $20,823; Willamette Blvd., from Wabash to S. P. tracks—gravel bitulithic — Warren Construction Co., $76,949; Greeley St., from Killingsworth to Lombard—gravel bitulithic—Warren Asphalt Paving Co., $46,841; East 13th St., from Ochoco to Malden—asphaltic concrete—Barber Asphalt Paving Co., $43,661; Shaver St., from Capital to Commercial—bitulithic redress—Barber Asphalt Paving Co., $30,467; Pendleton Ave. district—Hassam—Oregon Hassam Paving Co., $20,570.

Pennsylvania.

⊙John K. Faust has been awarded the contract by the Board of Public Works of Reading, Pa., for the curbing and laying of cement sidewalks on the north and south sides of Penn St., from Front to Second, for $2,813. Also for resurfacing Second St., from Penn to Court and relaying sidewalks, at $872.

Tennessee.

The citizens of Halls, Tenn., have voted bonds amounting to $25,000 for improvements. Of the amount $20,000 will be used to grade streets and $5,000 for sidewalks.

Texas.

⊙The Bastrop County Commissioners, Bastrop, Tex., have awarded the contract for the construction of 40 miles of good roads in Smithville Precinct to Ray McDonald, of Austin, Tex., for approximately $65,000. This includes all bridging, draining and grubbing.

The City Commission of Port Arthur, Tex., plans considerable street paving during the year. Hearings were held June 4.

The citizens of Precinct No. 1 of Bell County, Tex., have voted the issuance of bonds to the amount of $150,000 for the construction of good roads. Belton is the county seat.

Sanger Precinct of Denton County, Tex., is preparing to vote on a road bond issue of $125,000. Denton is the county seat.

At a recent election in Lindalep Precinct, Smith County, Tex., it was voted to issue bonds amounting to $75,000 for the construction of good roads.

The City Council of Belton, Tex., has ordered an election to be held July 2 for the purpose of passing upon an issue of $74,000 in bonds, of which $50,000 is for permanent street improvements and $24,000 for waterworks improvements and extensions.

An election will be held in Timpson Precinct of Shelby County, Tex., for the purpose of voting on the issuance of bonds to the amount of $200,000 for the construction of good roads. Center is the county seat.

The City Council of Houston, Tex., has adopted a resolution ordering Main St., between Franklin Ave. and the south approach to the Main St. viaduct, paved with creosoted wood blocks. City Engineer F. L. Dormant has estimated the cost at $6,968.

The Commissioners' Court of Navarro County, Corsicana, Tex., has been petitioned by the voters of Barry community to order a good roads bond election on $80,000.

Moscow Precinct, Polk County, Tex., has voted to improve and construct roads in that precinct. Livingston is the county seat.

The Commissioners' Court of Denton County, Denton, Tex., has ordered an election held in Pilot Point precinct on June 21, to vote upon the issuance of $125,000 in good roads bonds.

Governor Colquitt of Texas has designated a highway extending from Fort Worth to Mineral Wells, through Tarrant, Parker and Palo Pinto Counties, a distance of about 50 miles, to be the first in the state to be improved with a pro rata portion of the Federal appropriation of $500,000 made available by the last Congress for the purpose of improving the public roads of the several states over which free rural delivery is had.

Virginia.

⊙The Tinsley Construction Co. has been awarded the contract by the City Council of Roanoke, Va., for street and sidewalk improvements aggregating $25,000, alley paving, street binding, curbing, macadamizing, etc.

No bids were received on May 23 by the Clerk of Cumberland Court, Cartersville, Va., for the construction of three miles of soil road between Cartersville and Muddy Creek Mills and Hamilton School House.

The town of Franklin, Va., contemplates paving a number of its streets with asphalt or some other smooth pavement.

Washington.

⊙Commissioner of Public Works Owen Woods, Tacoma, Wash., has awarded the contract for paving North L St., and South Yakima Ave., to George P. Wright, for $26,700. Asphaltic concrete will be laid on L St., and asphalt on Yakima.

West Virginia.

Plans are being prepared by City Engineer B. F. Stewart, Jr., Parkersburg, W. Va., for the construction of brick and concrete pavement, estimated to cost $200,000. The work will include concrete foundation, about 20,000 ft. of concrete curb, cement filler, etc. Contracts will be let about July 15.

Wisconsin.

⊙The Western Improvement Co., of Racine, Wis., at $22,690, submitted the lowest bid to the Board of Local Improvements of Elgin, Ill., for the paving of Division St. with asphaltic-concrete. Other bidders were: Logan & Giertz Construction Co., Elgin, $25,075; McCarthy Improvement Co., Davenport, Ia., $25,869; H. G. Goelitz, Oak Park, Ill., $26,097.

Canada.

The Wellington County Council, Guelph, Ont., has decided not to expend the proposed $400,000 for the construction of good roads.

BRIDGES

Georgia.

✣Bids will be received until noon, June 24, by Bridges Smith, Clerk of City Council, Macon, Ga., for repairs to the Spring St. bridge according to plans prepared by J. J. Gaillard, City Engineer.

Illinois.

✣All bids received June 2, 1913, for the construction of the Big Vermilion bridge, La Salle Township, La Salle County, were considered too high and were rejected. Proposals will again be received for this work up to 2 p. m., June 23, 1913, at the Court House, Ottawa, Illinois. Attention is called to the following changes in the conditions under which bids will be received. On plans for a steel channel span, 224 ft. in length, and reinforced concrete approaches, bidders may submit proposals for the steel channel span alone, or for the concrete foundations and approaches alone, or the entire work. The time for completing the work has been extended to December 1, 1914. Bidders unable to submit proposals on the basis of completing the work by December 1, 1914, are invited to submit proposals fixing a later date, which proposals will be given due consideration. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received up to 1 p. m., June 14, at the Town Hall in Hamel, Ill., for the construction of three reinforced concrete bridges to be built in Hamel Township, Madison County. L. F. Steinman, Town Clerk, R. R. No. 4, Alhambra, Ill. Daube, Davis and Ohms Bridges: Spans, 4, 8 and 10 ft.; roadways, 38, 21 ft. 3 in. and 20 ft.; height, 17, 9 and 12 ft. Estimated total concrete, 31.6, 32 and 47.6 cu. yds.; reinforcing steel, 2,190, 2,600 and 3,055 lbs. Nearest railroad station, Carpenter about ¾ mile; Carpenter about 1 mile and Hamel about 1¾ miles. No local concrete materials available. Present bridges wood, 4, 6 and 8 ft. spans. Low water flow dry. Excavation, clay and loam, averages about 5, 4 and 12 ft. Engineer's estimate, for the three bridges, $1,600. Work to be completed on or before October 15, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received up to 1 p. m., June 14, at the Town Hall, Sheldon, Illinois, for the construction of one steel bridge on reinforced concrete foundations to be built in Sheldon Township, Iroquois County. E. H. Luhring, Town Clerk, Sheldon, Ill. Crossland Bridge: 1 beam span, 30 ft.; roadway, 16 ft.; height, 14 ft. Estimated total concrete in abutments, 55 cu. yds.; reinforcing steel, 2,910 lbs. Nearest railroad station, Darrow, about ¾ mile. It is reported that gravel from Terre Haute can be had f. o. b. cars at Darrow at about $1.12½ per cu. yd. Present bridge steel, stone abutments, wrecked and in stream bed. Low water flow about 6 in. deep and 10 ft. wide; high water about 8 ft. deep. Average excavation about 6 ft. deep, through gravel and clay to about 4 ft. below stream bed. Engineer's estimate, $1,050. Work to be completed on or before October 28, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received up to 1 p. m., June 18, at the County Clerk's office, Ottawa, Ill., for the construction of one reinforced concrete bridge to be built in Serena Township, La Salle County. H. T. Marshall, Town Clerk, Serena, Ill. McKinley Ford Bridge: Two spans, each 50 ft. in the clear; roadway, 16 ft.; height, 18.5 ft. Estimated total concrete, 304.6 cu. yds.; reinforcing steel, 42,600 lbs. Nearest railroad station, Serena, about 4 miles. It is reported that gravel may be obtained from creek bed about 500 ft. from bridge site at 25 cts. per cu. yd., same will require screening and reproportioning to obtain most economical aggregate. No present bridge. Green timber for falsework may be cut near bridge site. Low water flow about 6 in. deep and 60 ft. wide; high water about 10½ ft deep. Excavation, gravel, will average about 5 ft. deep for north abutment and 14 ft. deep for south abutment. Engineer's estimate, $3,800. Work to be completed on or before October 1, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received up to 2:30 p. m., June 14, at the County Clerk's office, Pekin, Illinois, for the construction of one reinforced concrete bridge to be built in Elm Grove Township, Tazewell County. Geo. Young, Town Clerk, Pekin, Ill. Ripper Bridge: Span, 25 ft.; roadway, 18 ft.; height, 13 ft. Estimated total concrete, 81.8 cu. yds.; reinforcing steel, 9,045 lbs. Nearest railroad station, Leslie, about 3 miles. No local concrete materials available. Present bridge, steel leg, 25 ft. span. Green timber for false work can be cut near the bridge site. Low water flow dry. Excavation will average about 7 ft. deep through clay, to about 3½ ft. below stream bed. Engineer's estimate, $1,300. Work to be completed on or before September 15, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received up to 2 p. m., June 16, at the Town Clerk's office, Watseka, Ill., for the construction of one reinforced concrete bridge to be built in Belmont Township, Iroquois County. W. Rufus Kendall, Town Clerk, Watseka, Ill. Wheeler Bridge: Span, 25 ft.; roadway, 16 ft.; height, 15 ft. Estimated total concrete, 93.1 cu. yds.; reinforcing steel, 8,220 lbs. Nearest railroad station, Watseka, about 3½ miles. It is reported that gravel from Terre Haute may be delivered f. o. b. cars at Watseka, for about $1.15 per cu. yd. Old wood bridge washed out, except pile bents, which remain in place. Green timber for false work may be cut within 1½ miles. Low water flow dry; high water about 18 ft. Piles will probably be necessary. Excavation averages about 6 ft. deep through sand; to be carried about 3 ft. below stream bed. Engineer's estimate, $1,400. Work to be completed on or before October 1, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received up to 11 a. m., June 14, 1913, at the County Clerk's office, Pekin, Ill., for the construction of 2 bridges to be built in Cincinnati Township, Tazewell County. William Hays, Town Clerk, R. R. No. 4, Pekin, Ill. Bids will be received on 2 sets of plans for the Flick No. 2 bridge. First, an entirely new reinforced concrete bridge, span 30 ft.; roadway, 18 ft.; height, 20 ft. Estimated total concrete, 168.5 cu. yds.; reinforcing steel, 15,250 lbs. Second, new reinforced concrete abutments and replacement of old 30 ft. steel truss on same. Estimated total concrete in abutments, 135 cu. yds.; reinforcing steel, 6,500 lbs. Northwestern Bridge: Span, 10 ft.; height, 9 ft.; length of barrel, 25 ft. 3 in. Estimated total concrete, 44.8 cu. yds.; reinforcing steel, 3,330 lbs. Nearest railroad stations, Meyers, about 1½ miles; Pekin, 2½ miles. No local concrete materials available. Present bridges steel truss, 30 ft. span, steel leg bridge, 7 ft. span. Low water flow dry; high water about 11 and 4 ft. Excavation averages about 15 and 6 ft., through sandy clay to sand; to go about 4 ft. and 1 ft. below stream bed. Piles will probably be necessary for Flick No. 2 bridge. Engineer's estimate, for Flick bridge, 1st plan, $2,275; for the Northwestern, $625. Work to be completed on or before October 14, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

⊙The contracts for the construction of the Junghans and Trautwine bridges in Collinsville Township, Madison County, Ill., have been awarded to Collins, Mannen & Wells, Mount Vernon, Ill., at $2,700 and A. C. Gaun, Collinsville, Ill., at $1,700 respectively. Both structures will be of concrete. William Grenard, Collinsville, Ill., is Town Clerk.

⊙The contract for the construction of the Kingston Bridge for which bids were opened May 31 at the Town Hall, Troy, Ill., has been awarded to Miller & Borcherding, St. Louis, Mo., at $3,050. H. C. Dettmar, Troy, Ill., is Town Clerk.

At the recent election held at Wilmington, Ill., the township voted in favor of constructing a new concrete highway bridge over the Kankakee River. The matter will now be taken up by the Board of Will County Commissioners, Joliet, Ill.

⊙Luther Wallingford, Spring Hill, Ia., has been awarded the contract for replanking the bridge over the Rock River at Prophetstown, Ill., at $1,275. The other bidders were as follows: Clinton Iron & Bridge Co., $1,575; Rock River Bridge Co., of Oregon, $1,600; Houch & Sprinkle, of Prophetstown, $1,849. The contract calls for three inch yellow pine, and the contractors are given 60 days to complete the job.

⊙The contract for the construction of two reinforced concrete bridges in Ohio Township, Bureau County, Ill., known as the Hussy and Crannels bridges, have been awarded to Fletcher & Boes, Wyanet, Ill., at $1,785. Bids were opened June 4.

Indiana.

✣Bids will be received until 1 p. m., July 7, by Board of Switzerland County Commissioners, Vevay, Ind., for the construction of a highway in Pleasant township. J. W. Smith is County Auditor.

✣Bids will be received until 10 a. m., June 16, by Board of Vermillion County Commissioners, Newport, Ind., for the construction and repair of four bridges.

✣Bids will be received until 11 a. m., June 21, by Board of Wayne County Commissioners, Richmond, Ind., for the construction of a 75-ft. span steel bridge with concrete floor, several concrete arches and other bridge repairs. L. S. Bowman is County Auditor.

⊙The contract for the construction of repairs to the Blue River bridge on the National Road east of Knightstown has been awarded by the Board of Henry County Commissioners, Newcastle, Ind., to Burk Construction Co., New Castle, Ind. The work includes concrete abutments. Bids were opened May 26.

⊙J. M. Baird, Hartford City, Ind., has been awarded the contract for the construction of eight bridges in Blackford County, Ind. Bids for the work were opened June 2.

It is reported that the C. & E. I. (Frisco) Ry. has decided to construct a $75,000 bridge over the huge washout between Hadleton and Decker, Ind.

⊙B. D. McColly, Rensselaer, Ind., has been awarded a contract at $984 for the repair of two small bridges in Jasper County, Ind.

⊙The Board of Jefferson County Commissioners, Madison, Ind., awarded the contracts for the construction of two bridges to the East St. Louis Bridge Co., East St. Louis, Ill., at $4,180 and the contract for one bridge to the Vincennes Bridge Co., Vincennes, Ind., at $3,910. Bids were opened June 3.

⊙The Board of Spencer County Commissioners, Rockport, Ind., has awarded the contract for the construction of bridges to Vincennes Bridge Co., Vincennes, Ind.

Iowa.

The hearing on the proposed bridge and viaduct proposition has again been postponed by the city officials of Des Moines and the State Railroad Commission and will be held June 17.

Kansas.

✣Bids will be received until noon, June 17, by Gerald A. Otwell, County Clerk, Independence, Kan., for the construction of a concrete bridge 31 ft. long, between sections one and twelve, township 32, range 13 east; also repairing of bridges located as follows: Between sections 11 and 14, township 35, range 13 east; between sections 23 and 24, township 34, range 13 east; between sections 5 and 6, township 35, 34, township 34, range 14 east; between range 14 east; between sections 33 and sections 14 and 23, township 34, range 13 east; between sections 1 and 6, township 35, range 14; on south line of lot 1, section 1, township 35, range 15 east, and one four miles east and one mile south of Havana on North Cheyenne creek. Bidders are required to file a certified check for $50 as a guarantee for faithful bids. Plans and specifications for the above are on file at said county clerk's office.

⊙The Commissioners of Hodgeman County, Jetmore, Kan., have awarded the contract for the construction of a new concrete bridge 3 miles east of Jetmore to the Blodgett Construction Co., Kansas City, at $3,005.

⊙The contract for the construction of the Patton Bridge in Monroe Township, Anderson County, Kan., has been awarded to C. A. Alexander, Ottawa, Kan., at $4,138. The structure, which will be 75 ft. long, will be a concrete arch. Bids were opened June 4 by County Clerk, Garnett, Kan.

Kentucky.

✣Bids will be received until June 28, by Madison County Fiscal Court, Richmond, Ky., for building three steel bridges as follows: (1) At Silver Creek Station, 3 spans 43 ft. each, 1 span 27 ft.; (2) at Red House, over Otter Creek, 1 span 100 ft.; (3) at Berea, over Brushy Fork Creek, 1 span 50 ft. Specifications on file in the office of W. R. Shackelford, County Judge, Madison Co., Richmond, Ky.

⊙Harry Bros., Newport, Ky., have been awarded the contract for furnishing $3,500 worth of corrugated metal culverts for which bids were opened May 27 by S. A. Young,

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

County Judge, Henderson, Ky. S. H. Kimmel is County Road Engineer.

Louisiana.

⦿F. C. Barber, Echol, La., has been awarded the contract for the construction of the eastern approach to the new traffic bridge over the Red River at $0.26 per cu. yd. The work will cost about $10,500.

Maine.

✣Bids will be received until 2 p. m., June 17, by Selectmen of Harpswell, Me., for the construction of the sub-structure and super-structure for a bridge between Orr's Island and Bailey's Island, in the Town of Harpswell. Parties intending to figure on the work are advised to visit the site. Bids will be received for the sub-structure, the superstructure, or for both combined. Each bid must be accompanied by a certified check of $1,000 as a surety that if the bid is accepted a contract will be entered into. A surety bond for $15,000 will be required of the successful bidder. Plans and specifications can be seen at the Selectmen's Office, also at the office of George B. Merrill, Consulting Engineer, Portland, Maine.

✣Bids will be received until 2 p. m., June 14, by Selectmen, Falmouth, Me., for the construction of a reinforced concrete arch bridge of the open spandrel type. The structure will have a span of 160 ft. with an 18-ft. roadway. Further information may be obtained of Sanders Contracting Co., 102 Exchange St., Portland, Me.

Massachusetts.

The county of Barnstable, Mass., has awarded the contract for the construction of a reinforced concrete bridge to Taylor & Crosby, Hyannis, Mass., at $12,000. F. C. Wales, Tremont Bldg., Boston, Mass., is Civil Engineer.

Mayor Fitzgerald has instructed L. K. Rourke, Commissioner of the Department of Public Works, Boston, Mass., to advertise for bids for the construction of a temporary drawbridge to replace the present Chelsea south bridge.

Michigan.

A petition is being circulated asking that the City Council of Grand Haven, Mich., authorize another election to submit to the voters the proposition to issue $20,000 of bonds before repairs are made to the Spring Lake bridge.

The village authorities, Ford, Mich., are taking steps to securing the co-operation of the officials of the village of Ecorse in the construction of a new bridge over the Ecorse creek.

Minnesota.

W. A. McGonagle, of the D. M. & N. R. R. Co., has announced that immediate steps will be taken in regard to the building of a viaduct for the railroad tracks over Highland St. at Duluth, Minn.

The Railroad Committee of the City Council, Minneapolis, Minn., has approved the proposition to construct a concrete viaduct to carry Lyndale Ave. over the tracks of the Minneapolis, St. Paul & Sault Ste. Marie Ry. The matter will be referred to the engineers of the railway company, which will bear the expense.

Mississippi.

The Board of Harrison County Supervisors, Gulfport, Miss., is considering the advisability of constructing a bridge at Lamey's to do away with the old ferry. F. W. Elmer is a member of the Board.

Montana.

⦿The Montana Culvert Co., Missoula, Mont., has been awarded the contract by the Board of Choteau County Commissioners, Fort Benton, Mont., for furnishing one carload of galvanized corrugated culvert pipe, for $3,550. Bids were opened June 3.

Nebraska.

All bids received for building and repairing bridges in Gage County, Neb., have been rejected. J. C. Penrod, Beatrice, Neb., is County Clerk.

New Hampshire.

The City Council of Manchester, N. H., has passed a resolution appropriating $100,000 for the construction of a bridge over the Piscataquog River at Kelley St. S. J. Lord is City Engineer.

New York.

⦿The Town Board of Norfolk, N. Y., has awarded the contract for the construction of a concrete single arch bridge with steel girders to Thomas F. O'Brien, Watertown, N. Y. H. L. Whipple is Town Clerk.

⦿The Northeastern Construction Co., 225 5th Ave., New York, N. Y., has been awarded the contract for the improvement of the Brooklyn Plaza, Manhattan bridge, at its bid of $596,400. Arthur J. O'Keefe is Commissioner of Bridges, New York City. Bids for the work were opened May 22.

The Good Roads Committee of the Board of Supervisors, Rochester, N. Y., received the following bids for the reconstruction of the Ballantyne bridge over the Genesee River on June 1st: Lupfer & Remick, $12,435; Seneca Engineering Company, $45,000; Barrally & Ingersoll, $46,000; Frank M. Skene, $16,700; Owego Bridge Company, $47,600.

The Town Board of Herkimer, N. Y., at a recent meeting voted to submit to the voters the proposition to issue $65,000 for the construction of the bridge over the West Canada creek.

North Dakota.

✣Bids will be received until 9 a. m., June 23, by Board of County Commissioners, Williston, N. Dak., for the erection of the following bridges: 1. Steel bridge across Cow Creek between Secs. 35 and 36, Twp. 156, Rge. 101 W., 20-ft. span with concrete abutments. 2. Steel bridge across Stony Creek at the northwest corner of the N. W. ¼ Sec. 16, Twp. 155, Rge. 99 W., —— ft. span and concrete abutments. 3. Steel bridge on the section line between the N. E. ¼ N. W. ¼, Sec. 24, and the S. E. ¼ S. W. ¼, Sec. 13, Twp. 159, Rge. 95 W., 30-ft. span with concrete abutments. Plans and specifications on file in the office of the County Auditor or County Surveyor. All bids to be accompanied by a certified check in an amount equal to at least 20 per cent of the bid. M. H. Aaen is County Auditor.

⦿Board of Bottineau County Commissioners, Bottineau, N. Dak., has awarded the contract for the construction of the bridge over the Mouse River east of Westhope to the Hennepin Bridge Co., Minneapolis, Minn., at $18,200. The changes made in the specifications eliminated some of the concrete work by the use of tubular steel piers and reduced the item for buckle plates.

Ohio.

✣Bids will be received until 11 a. m., June 25, by Board of Mahoning County Commissioners, Youngstown, O., for furnishing the necessary labor and material to construct a reinforced concrete bridge on Town Line Road between Youngstown and Coitsville Townships. The Town Line Road is known as Bond St. and the structure is near Emma St. Plans and specifications may be seen at the office of the County Surveyor. I. M. Hogg is County Auditor.

✣Bids will be received until 10 a. m., June 24, by Board of Lucas County Commissioners, Toledo, O., for furnishing the necessary labor and material for the construction and building complete of the following described works, viz.: Res. No. 515, concrete abutments and creosoted wood block floor for bridge on county road No. 106½ over Blue Creek about 20 rods south of the east ¼ of Section 9, T. 6, N., R. 9 E., Providence Township. Res. No. 519, new abutment, center pier, repair and erection of bridges on Harroun road over Ten Mile Creek, just north of the center of section 10, T. 9 S., R. 6 E., in Sylvania village. Extension of culvert on Monroe turnpike (state highway No. 4), over Delaware Creek, Adams Township. The work will be done in accordance with plans and specifications now on file at the office of the County Auditor. Charles J. Sanzenbacher is County Auditor.

✣Bids will be received until 11 a. m., June 25, by Board of Mahoning County Commissioners, Youngstown, O., for furnishing the necessary labor and material for constructing a reinforced concrete facing on both abutments of bridge over Mahoning River on Canfield, Berlin and Deerfield Road, about two miles west of the center of Berlin. Plans and specifications may be seen at the office of the County Surveyor. I. M. Hogg is County Auditor.

✣Bids will be received until noon, June 20, by Board of Lake County Commissioners, Painesville, O., for furnishing the labor and material for the construction of retaining walls and wing walls for the bridge near Waite Hill in Willoughby Township. W. Albert Davis is County Auditor.

✣Bids will be received until 1 p. m., June 23, by Board of Trumbull County Commissioners, Warren, O., for the construction of the sub-structure and superstructure of a two-span, through riveted truss bridge over the Mahoning River at Harsh's, near Warren, O. Plans and specifications are on file at the office of the County Commissioners, the County Surveyor, and at the office of Wilbur J. Watson & Co., Bridge Engineers, Leader Bldg., Cleveland, O. Plans and specifications may be obtained from Wilbur J. Watson & Co. on deposit of $10, which will be refunded upon the return of the same on or before the date of receiving bids.

✣Bids will be received until noon, June 27, by Board of Summit County Commissioners, Akron, O., for the construction of the substructure for the steel bridge on Barnes Road over Pigeon Creek. Bids must be made on forms which may be obtained at the office of the County Commissioners. Plans and specifications are on file at the office of the County Commissioners and County Surveyor.

✣Bids will be received until 1 p. m., June 30, by Board of Lorain County Commissioners, Elyria, O., for furnishing the material and performing all necessary labor for constructing the superstructure of the West View Bridge No. 158, located on the County Line Road between Lorain and Cuyahoga Counties, West View village, in accordance with the plans and specifications to be furnished by T. L. Gibson, County Surveyor. F. L. Ellenberger is Clerk.

✣Bids will be received until 1 p. m., June 30, by Board of Lorain County Commissioners, Elyria, O., for furnishing the material and performing all necessary labor for constructing the superstructure of the West View Bridge No. 158, located on the County Line Road between Lorain and Cuyahoga Counties, West View village, in accordance with the plans and specifications to be furnished by T. L. Gibson, County Surveyor. F. L. Ellenberger is Clerk.

✣Bids will be received until noon, July 3, by Board of Hamilton County Commissioners, Cincinnati, O., for the contruction under specifications No. 466, of a bridge on the Baen road near Jacob Kniffert's place in Symmes Township. Plans and specifications are on file with the Board. A certified check for $500 must be filed with each bid. Albert Reinhardt is Clerk of the Board.

✣Bids will be received until 1 p. m., June 23, by Board of Ashtabula County Commissioners, Jefferson, O., for the construction of the superstructure for the Callender bridge at Callender's Grove, over Grand River, as per report No. 166 in accordance with form of contract, plans and specifications furnished by J. S. Matson, County Engineer. A. V. Hillyer is Clerk of the Board.

✣Bids will be received until noon, June 27, by Board of Hamilton County Commissioners, Albert Reinhardt, Clerk, Cincinnati, O., for the following work: Under specification No. 455—For concrete culvert on Grove Ave., at Storey's Hill, west of Woodlawn, in Spring-

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

field Township, the work to be done according to the plans and specifications now on file in the office of the Board of County Commissioners. All bids must be made on blank forms, to be had at the office of the Board of County Commissioners, and be accompanied by a bond in the sum of $500.

✣Bids will be received until noon, June 27, by Board of Hamilton County Commissioners, Cincinnati, O., for restoration, under specifications 463, of the east approach to the bridge on Harrison Ave. over the Great Miami River at Miamitown in Colerain Township. Plans and specifications are on file at the office of the Board. Albert Reinhardt is Clerk.

✣Bids will be received until 11 a. m., June 28, by Board of Cuyahoga County Commissioners, Cleveland, O., for the construction of bridge work per report 3078, concrete arch, Station Road over the Chippewa Creek in Brecksville Township. J. F. Goldenhogen is Clerk.

⊙The contracts for the construction of 14 steel and concrete bridges have been awarded by S. A. Young, County Judge, Henderson, Ky., to Champion Bridge Co., Wilmington, O.; Vincennes Bridge Co., Vincennes, Ind.; Attica Bridge Co., East St. Louis, Ill., and the Luten Bridge Co., York, Pa., at a total cost of $12,500. S. H. Kimmel is County Road Engineer. Bids were opened May 29.

⊙Contracts for the construction of bridges in Delaware County have been let by the Board of Commissioners, Delaware, O., as follows: Liberty substructure, A. B. Shaw, $5,726.70, superstructure to be readvertised; Mill Creek, S. C. Kissner, $4,150.20 on substructure, and Delaware Bridge & Iron Co., superstructure at $2,530; Fulton Creek substructure, J. T. Irwin, at $2,286.50, and superstructure to be readvertised; Bellpoint, T. P. Moore, substructure, at $4,927.60, and superstructure to be readvertised; and the Cole bridge, to the Hackedorn Concrete Construction Company of Indianapolis at $11,500.

⊙The Board of Jefferson County Commissioners, Steubenville, O., has awarded the contract for the construction of a steel bridge with creosote block floor to the Central Concrete & Construction Co., Canton, O., at $3,489. J. L. Means is County Auditor.

⊙The Board of Knox County Commissioners, Mt. Vernon, O., has awarded the contracts for constructing the west abutments to the Young and Banning bridges to Rabjohns, Bartlett & Hawk, Creer, O., and C. W. Hunter, Mt. Vernon, O., at $1,289 and $1,597 respectively. Bids were opened June 2.

The lowest bid received by the Board of Mahoning County Commissioners, Youngstown, O., for the construction of the bridge over the ravine in South Center St. was that of Wymer-Harris Construction Co., $6,480.

The Board of Licking County Commissioners, Newark, O., received the following bids for the Second St. bridge superstructure: G. W. Lane, Newark, $22,000; York Bridge Company, York, Pa., $27,700; Massillon Bridge and Construction Company, $22,000; Toledo Bridge Company, $26,100; King Bridge Company, Pittsburg, $23,600; substructure, H. L. Maddox, Newark, $3,531.18; A. R. Pitser, $4,352.53; B. C. Patterson, $3,394.10.

The following bids were submitted to the Board of Licking County Commissioners, Newark, O., for the construction of the Clay Lick bridge: Lane Bridge Co., $1,765; York Bridge Co., $1,990; Massillon Bridge Co., $2,000; Capital Construction Co., Columbus, $2,100; King Bridge Co., $2,200, and H. E. Williams, Chicago, $1,297.

The Board of Warren County Commissioners, Lebanon, O., has decided to erect one single span high truss steel bridge 300 ft. long with one 5-ft. sidewalk with creosoted plank and block floor over the Little Miami River at Foster, Ohio, at an estimated cost of $35,000. Also to construct a concrete roadway 250 ft. long by 24 ft. wide at Round Pond on Lower Carlisle and Franklin Road in Franklin Township, at an estimated cost of $2,700. T. C. Patterson, County Auditor.

Oregon.

At an election held June 2, Portland, Ore., a proposition to issue $850,000 of bonds for the construction of a bridge was voted upon.

Pennsylvania.

✣Bids will be received until noon, June 19, by Board of County Commissioners, Butler, Pa., for the construction of county bridges as follows: No. 2—In Connoquenessing township over Crab Run, superstructure to be deck beam with concrete roadway. No. 4—In Clinton Township over branch of Bull Creek on Lardin's Mill Road, superstructure to be deck beam with concrete and brick roadway; substructure, masonry. Each bid must be accompanied by a certified check for 10 per cent of the amount of the bid and a satisfactory bond for the full amount of the contract price must be filed by the successful bidder or bidders. These bridges must be completed for travel by Oct. 15, 1913. Plans and specifications are on file in the County Commissioner's office.

⊙At a recent meeting of the Board of County Commissioners, Hollidaysburg, Pa., contracts for bridges approximating $40,000 were let. The awards made as given below: Concrete arch bridge, 40-ft. span, over Dry run at East Freedom, awarded to the York Bridge Co., at price of $2,200. Other bids were: Edwin H. Brua, $2,574; Harley-Zeigler, of York, $2,608.65, and Curwensville Construction Co., $3,334. Concrete arch bridge over Fill run at C. Sharrar's farm, in Snyder Township, 40-ft. span, awarded to the York Bridge Co., $2,500. Other bids were: Hartley-Zeigler Co., $2,558.21; Fogel & Co., $3,310; Curwensville Construction Co., $3,336. Reinforced concrete girder bridge over Poplar run at Puzzletown, skew span 26 ft., awarded to Saupp & Herr, at $1,485. The other bid was that of Edwin H. Brua, $1,591. Reinforced concrete girder bridge over Roaring Spring run and a concrete culvert over the Tail race, both at Brooks Mills, span of bridge 35 ft.; span of culvert, 10 ft.; awarded to Edwin H. Brua, at $2,068. The other bid was by the York Bridge Co., $2,110. Reinforced concrete girder bridge over Halter Creek, near Rodman, Taylor Township, skew span 35 ft., awarded to Edwin H. Brua, at $2,151. Other bids were the York Bridge Co., $2,200; Saupp & Herr, $2,850. Reinforced concrete girder bridge over Riggle's run, at D. W. Irwin's farm, in Antis township, skew span 30 ft., awarded to D. E. Wentzel & Co., of Bellwood, at $1,511. Other bids were Saupp & Herr, $1,600; Fogel & Co., $1,992. Reinforced concrete girder bridge over Sink run, at Reservoir Park, near Tyrone, skew span 28 ft., awarded to Saupp & Herr, at $1,669. The other bid was by Lanners Brothers, of Tyrone, $1,900. Concrete abutments and wing walls for bridge over Halter Creek, at Chester Albright's farm, Taylor Township, awarded to Edwin H. Brua, at $2,743. The other bid was by Saupp & Herr, $3,250. Concrete abutments and wing walls for bridge over Bald Eagle Creek, at Bald Eagle Station, awarded to Saupp & Herr, at $1,280. The other bid was by Lanners Brothers, $1,675. For furnishing and laying creosote block floor on bridge over Tipton run at E. B. Dysart's mill, near Tipton, awarded to Saupp & Herr, for $549. Other bids were by the Standard Engineering Co. of Toledo, O., $576; York Bridge Co., $730. Furnishing and laying creosote floor, painting steel work of bridge over the Little Juniata River near Tipton, awarded to Saupp & Herr, at $1,100. Other bids were: Standard Engineering Co., $1,152; York Bridge Co., $1,350. Removing iron bridge at the Little Juniata River near Ironsville, Snyder Township, to Halter Creek, at Chester Albright's farm, erect on new location, furnishing oak joists and floor and painting steel work, awarded to the York Bridge Co., at $1,190; all worn out parts to be replaced at 15 per cent above cost. Remove truss bridge at present over Fill run at C. Sharrar's farm, haul to new location, erect over Bald Eagle Creek, at Bald Eagle station, furnish and lay creosote block floor, and paint steel work, awarded to Saupp & Herr, at $790. Other bids were: York Bridge Co., $830; Standard Engineering Co., $840.

⊙S. W. Newberry, Wilkesbarre, Pa., has been awarded the contract for the construction of the new bridge at East End at the approach to the boulevard. The contract price was $2,285.

The Grand Jury of Clearfield County, Clearfield, Pa., has recommended the construction of the proposed new bridge over Dubois St. at Dubois, Pa., and it is believed that the County Commissioners will shortly appropriate $8,000 for the improvement.

The Borough Council of Eddystone, Pa., has requested the Commissioners of Delaware County, Media, Pa., to construct a new bridge over Ridley Creek at Morton Ave. Joseph Griffith is Clerk of the Council.

The Dauphin County Court, Harrisburg, Pa., recently appointed a Board of Viewers to investigate the necessity of rebuilding the viaduct over the Shenango River between Union Township and New Castle known as Black Bridge. Cyrus E. Mill, Civil Engineer, Pittsburgh, Pa., is a member of the Board.

The State Board of Public Grounds and Buildings, Harrisburg, Pa., on June 5 received the following bids for the construction of the proposed bridge at Mack's Fording, Armstrong County: J. A. Lord, Hastings, $11,995; G. W. Ensign, Camp Hill, $15,253; Nelson Merydith Company, Chambersburg, $16,932; Ferro Concrete Company, Harrisburg, $18,795, and E. M. Wichert Company, Pittsburgh, $21,886.

Rhode Island.

⊙The Committee on Streets and Bridges, Woonsocket, R. I., has awarded the contract for the construction of the new Harrison Ave. bridge to S. Brien & Son and J. C. Bouvier at about $14,000. The structure, which will be of reinforced concrete, will span the cut through which the New Haven tracks run at Harrison Ave.

Tennessee.

⊙The Union Bridge & Construction Co., 902 Sharp Bldg., Kansas City, Mo., has been awarded the contract by the Chicago, Rock Island & Pacific R. R. for the construction of the substructure of a bridge over the Mississippi River at Memphis, Tenn. The work will include the sinking of five pneumatic piers, several smaller piers for the approaches and all shore protection, and will cost about $1,250,000. The finished structure, which will be located 200 ft. above the Frisco bridge at Memphis, Tenn., will be 6,000 ft. long. The total cost of the structure will be $1,000,000. Ralph Modjeski, Chicago, Ill., is Consulting Engineer.

Texas.

The City Council of Texarkana, Texas, has passed an ordinance calling for an election to be held June 30 to submit to the voters the proposition to issue bonds amounting to $225,000 for permanent bridge and road improvements. Charles E. Haydon is City Engineer.

Virginia.

✣Bids will be received until noon, June 19, by Board of Supervisors of York County, Yorktown, Va., for the construction of a 18-ft. concrete bridge with 16-ft. roadway over Harrods Mill Creek, 4½ miles from Oriana on the C. & O. Ry. A certified check for $100, payable to the Chairman of the Board, must accompany each bid. Sand can be secured within a fourth of a mile of the site. Plans and specifications can be seen at the office of the Clerk. Blue prints can be secured for $0.10 of Childrey-Sunday, Richmond, Va., P. St. J. Wilson, State Highway Commissioner, Richmond, Va.

✣Bids will be received until noon, June 19, by Board of York County Supervisors, Yorktown, Va., for the construction of a 14-ft. concrete bridge with 16-ft. roadway over Smith's Creek, 6 miles from Lee Hall on the C. & O. Ry. Sand may be secured near the

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

bridge. A certified check for $100, payable to the Chairman of the Board, must be filed with each bid. Plans and specifications may be seen at the office of the Clerk of the Circuit Court. Blue prints of plans can be secured for 10 cts. from Childrey-Sunday Co., Richmond, Va.

✣Bids will be received until noon, June 23, at King William, Va., for the construction of a 185-ft. steel bridge with 12-ft. roadway on concrete substructure over Pamunkey River between Hanover and King William, 3½ miles from Hanover on the C. & O. Ry. The superstructure will include one standard 119-ft. span, one 37-ft. span and one 29-ft. span. Gravel and sand may be secured within 2 miles of the site. Gravel in concrete will be allowed subject to State Inspection. The substructure will include tearing down the old bridge. Plans and specifications can be seen at the office of the Clerk of the Circuit Court, King William, Va., and at the office of P. St. J. Wilson, State Highway Commissioner, Richmond. Blueprints can be secured from Childrey-Sunday, Richmond, Va., at a cost of 36 cts. and postage.

✣Bids will be received until noon, June 20, at Tazewell, Va., for the construction of a 158-ft. steel bridge on concrete substructure and with a 12-ft. roadway over Clinch River 1 mile from Richlands on the N. & W. Ry. in Tazewell County. The superstructure will include one 37-ft. span and one 119-ft. span. Stone for concrete can be secured close to the site but sand must be transported 15 miles via railway. Gravel will be allowed in concrete subject to State Inspection. A certified check for $250 payable to P. St. J. Wilson must accompany each bid. Blueprints of plans can be secured for 36 cts. and postage of Childrey-Sunday, Richmond, Va. Plans, etc., can be seen at the office of the Circuit Court Clerk, Tazewell.

The Administrative Board in a series of resolutions adopted asked of the City Council of Richmond, Va., appropriations aggregating $1,795,000, $1,000,000 being desired to wall in Shockoe Creek, $600,000 for a concrete bridge to replace the Ninth St. Free bridge, $45,000 for smooth paving on Broad St., and $10,000 for grading and graveling streets. C. E. Bolling is City Engineer.

Washington.

⊙The International Bridge Co., Central Bldg., Seattle, Wash., has been awarded the contract by the Board of County Commissioners for the construction of the steel bridge over Ebey slough near Everett, Wash., mentioned in our last issue. The contract price was $30,568.

West Virginia.

The Jefferson County Court, Charleston, W. Va., has ordered a special election to be held on the proposition of building a bridge over Shenandoah River at Bloomery, about 3 miles from the county seat.

DRAINAGE AND IRRIGATION

Arizona.

The Hassayampa Canal, Irrigation & Power Co., Phoeniz, Ariz., has been incorporated with a capital stock of $120,000, the incorporators being J. R. Deal, Hot Springs Junction, Ariz.; R. A. Roberts, Sr., Wickenberg, Ariz., Perry H. Deal, Hot Springs Junction, Ariz., and R. A. Roberts, Wickenburg, Ariz.

Arkansas.

✣Bids will be received until July 7 by Cow Lake Drainage District of Jackson County, Ark., at Newport, Ark., for drainage work in the district embracing 23,909 acres. The contract will include 33 miles of dredge work, from 14 to 24 ft. wide, some scraper work, 12 bridges and two small levees. Bonds will be sold July 8, 25 yr. 6 per cent, first five years only interest paid. Interest payable semi-annually. The cost of the work is estimated at $90,000. Phillips, Hillhouse & Boyce, Newport, Ark., are Attorneys.

California.

The Imperial Valley Water Co., No. 3, Brawley, Cal., has been incorporated with a capital stock of $60,000. J. W. Yocum, Frank M. Salisbury, Earl C. Pound, Sydney McHarg and J. P. Weaver are the incorporators.

The Big Springs Water Co., of Sacramento, Cal., has been incorporated with a capital stock of $15,000, for irrigation purposes. The incorporators are: Geo. W. Pettier, W. H. Devlin, Charles F. Silva, G. A. Starkweather, all of Sacramento, and D. W. Dwinell, of Montague.

The Santa Anita Land & Water Co. has been incorporated at Los Angeles, Calif., with a capital stock of $100,000. The directors are: W. S. Collins, C. H. Johnson, F. L. Peairs, N. O. Johnson, H. A. Collins.

Colorado.

Bids were opened June 2 at the office of the U. S. Reclamation Service, Grand Junction, Colo., for the excavation of the Canyon Division Canal. Hewitt & Felch, Oakdale, Cal., bid only on Schedules 4 and 5, their bids totaling $58,960 and $9,820, respectively. The bidders and their bids on all of the schedules were as follows: (1) bid of Reynolds, Ely Construction Co., Springville, Utah, "all or none"; (2) W. O. & S. B. Morrison, Denver, Colo., "all or none, or 1st four"; (3) Kilpatrick Bros., Beatrice, Neb., "all or none"; (4) John J. Lumsden & Co., Grand Junction, Colo., "all or none":

Work or Material	(1)	(2)	(3)	(4)
Schedule 1:				
Excavation Cl. 1, 90,500 cu. yds	$ 0.18	$ 0.18½	$ 0.25	$ 0.37
Excavation Cl. 2, 1,500 cu. yds	0.48	0.55	0.45	0.65
Excavation Cl. 3, 1,000 cu. yds	0.98	0.98	0.90	1.00
Overhaul, 950,000 cu. yds	0.01½	0.016	0.01½	0.02
Riprap, 1,500 cu. yds	2.25	3.90	3.50	6.00
Totals	$35,615	$39,597	$43,700	$63,460
Schedule 2:				
Excavation Cl. 1, 54,500 cu. yds	$ 0.18	$ 0.189	$ 0.25	$ 0.37
Excavation Cl. 2, 1,600 cu. yds	0.48	0.58	0.45	0.65
Excavation Cl. 3, 1,000 cu. yds	0.98	1.10	0.90	1.00
Overhaul, 140,000 cu. yds	0.01½	0.018	0.01½	0.02
Riprap, 200 cu. yds	2.25	4.00	3.50	6.00
Totals	$14,108	$15,648	$18,045	$26,205
Schedule 3—Alt. A:				
Excavation Cl. 1, 41,000 cu. yds	$ 0.18	$ 0.189	$ 0.25	$ 0.37
Excavation Cl. 2, 500 cu. yds	0.48	0.58	0.45	0.65
Excavation Cl. 3, 500 cu. yds	0.98	1.15	0.90	1.00
Overhaul, 213,000 cu. yds	0.01½	0.016	0.01½	0.02
Totals	$11,305	$12,022	$14,120	$20,255
Schedule 3—Alt. B:				
Excavation Cl. 1, 41,000 cu. yds	$ 0.18	$ 0.189	$ 0.25	$ 0.37
Excavation Cl. 2, 500 cu. yds	0.48	0.58	0.45	0.65
Excavation Cl. 3, 500 cu. yds	0.98	1.15	0.90	1.00
Overhaul, 1,000 cu. yds	0.01½	0.016	0.01½	0.02
Material loaded into cars, 21,000 cu. yds	0.10	0.11	0.25	0.35
Totals	$10,225	$10,940	$16,190	$23,365
Schedule 4:				
Excavation Cl. 1, 137,000 cu. yds	$ 0.18	$ 0.186	$ 0.25	$ 0.37
Excavation Cl. 2, 3,000 cu. yds	0.48	0.55	0.45	0.65
Excavation Cl. 3, 2,400 cu. yds	0.98	1.15	0.90	1.00
Overhaul, 825,000 cu. yds	0.01½	0.015	0.01½	0.02
Riprap, 100 cu. yds	2.25	4.25	3.50	6.00
Totals	$41,052	$42,692	$50,485	$72,140
Schedule 5:				
Excavation Cl. 1, 27,000 cu. yds	$ 0.18	$ 0.18½	$ 0.25	$ 0.37
Excavation Cl. 2, 3,000 cu. yds	0.48	0.55	0.45	0.65
Excavation Cl. 3, 600 cu. yds	0.98	1.10	0.90	1.00
Overhaul, 25,000 cu. yds	0.01½	0.018	0.01½	0.02
Riprap, 100 cu. yds	2.25	4.00	3.50	6.00
Totals	$ 7,488	$ 8,155	$ 9,365	$13,640
Grand totals (incl. Alt. A, Sched. 3)	$109,568	$118,115	$135,715	$195,700

Illinois.

✣Bids will be received until noon, June 15, by Commissioners of Momence and Pembroke Union Drainage District No. 1, for about 942 cu. yds. of rock excavation. Plans were prepared by D. E. Rossetter and are on file with F. E. Lane, Town Clerk, Momence, Ill.

✣Bids will be received until 10 a. m., June 12, by Robert Fife, Clerk of the Frog Pond Drainage District, Palestine, Ill., for the construction of main ditch and 15 laterals. Specifications, etc. are on file with County Clerk, Robinson, Ill.

✣Bids will be received until 1 p. m., June 24 (readvertisement), by Commissioner of Drainage District No. 1, Oreana, Macon County, Ill., at the office of Charles Shastid, Oreana, Ill., for furnishing the necessary labor and material for the construction of a tile drainage system. Preston Hicks, Decatur, Ill., is Engineer.

Montana.

The Dearborn Canal Water Co., of Clemons, Mont., has been incorporated with a capital stock of $50,000, of which $8,000 has been subscribed, and will carry on a general irrigation business. The incorporators are Jacob C. Fey, John Barrett, Levi LaChappelle, C. E. LaChappelle, Edmand LaChappelle and W. J. Myles.

Ohio.

⊙County Commissioners at Defiance, O., have awarded the contract to D. W. Watson, at $13,975, for the North Gordon ditch. This will be 33,000 ft. long with an average width of 27 ft., and an average depth of 6 ft. It will run through Hicksville and Marks Townships.

Commissioners of Richland and Ashland Counties at a meeting at the Court House, Mansfield, O., decided to have the Blackfork dredged for a distance of 13 miles.

Texas.

The Peytons Creek Irrigation District, near Bay City, has voted to purchase the irrigating properties owned by John W. Gaines of Bay City, and to finish the system. The proposition to purchase the properties and to issue $125,000 in bonds and to levy a tax in payment therefor carried unanimously.

The Teutonic Land Co., which plans the reclamation of 17,000 acres of marsh lands on the east side of the Sabine River from Orange, Texas, has elected the following officers: Miss S. E. McKeon of Madison, Wis., president; A. M. H. Stark of Orange, vice president; E. S. Baldwin of Madison, Wis., secretary; W. H. Stark of Orange, treasurer. The first effort of the company will be to reclaim a unit of 4,000 acres or less just opposite Orange.

WATER WORKS

Alabama.

The City of Girard, Ala., is negotiating for the installation of a waterworks system. It is proposed to secure artesian water west of town and pump to a reservoir to be constructed on Bates Hill.

Arkansas.

The City Council of Booneville, Ark., plans the installation of a system of waterworks.

The Board of Commissioners of Heber Springs, Ark., has submitted its final report to the City Council relative to the construction of a waterworks and sewerage system. Contracts will be let shortly.

California.

✣Bids will be received until 8 p. m., June 30, by Board of Trustees, Burlingame, Calif., for furnishing labor and material for construction of a distributing water system in accordance with the plans and specifications now on file in the office of the City Clerk, consisting of the following approximate quantities subject to an increase or decrease at the option of the Board of Trustees. 3,700 lin. ft. of 8-in. Bell & Spigot Class B pipe, 27,300 lin. ft. of 6-in. Bell & Spigot Class B pipe, 68,800 lin. ft. of 4-in. Bell & Spigot Class B pipe, 35,900 lin. ft. of 3-in. full weight galvanized pipe, 54,800 lin. ft. of 2-in. full weight galvanized pipe. Necessary specials, fittings, valves, hydrants, valve boxes, service clamps, corporation cocks, service cocks, meters, meter boxes, cock boxes and other details shown on plans. Bids will be received under one or all of three classifications, namely, (a) materials only; (b) labor only; (c) both materials and labor. Plans and specifications may be obtained from the City Clerk or from the Consulting Engineers of the City of Burlingame, Shipman, Denny and Rhame, Holbrook Bldg., San Francisco, Cal., upon a deposit of $10, returnable upon the return of said plans and specifications.

The Supervisors of Alameda County, Oakland, Calif., have set July 29 as the date for the election on a metropolitan water district. If the proposal carries, Oakland, Berkeley, Alameda, Emeryville, Albany, San Leandro and Piedmont will be affected.

The Marin Municipal Water District, according to advices from San Rafael, Calif., is planning to build a reservoir in Liberty Gulch, in Alpine Valley, to gather and store water from the Bolinas and Tamalpais water sheds and to build a distributing system which will include the southern end of Marin County. Surveys have been made by A. R. Baker, and the estimated cost is $2,882,675.

Connecticut.

The Connecticut Legislature has passed a bill authorizing the New York, New Haven & Hartford Railroad Co., to build a dam at the Cos Cob power station.

Florida.

The Sanford Waterworks Co., Sanford, Fla., is preparing to make extensive improvements to its plant which will cost approximately $40,000. Artesian sulphur wells will be sunk and a standpipe erected and new motor driven pumps installed.

Georgia.

✣Bids will be received until 5 p. m., July 8, by J. D. Edmundson, Mayor and City Council, LaGrange, Ga., for the apparatus, materials and labor necessary to install a municipal water-gas plant, with requirements approximately as follows: One 4-ft. water-gas set; one 10,000-gal. capacity oil tank; two 8x10x5-ft. purifiers; one 5½-ft. station meter; one 8-in. governor; one 40,000-cu. ft. steel holder; the necessary station buildings and connections; 8½ miles of 4 to 8-ft. C. I. gas mains. Specifications may be procured and plans seen at the office of the City Clerk, James Nisbet Hazlehurst, Candler Bldg., Atlanta, Ga., is Engineer.

Illinois.

⊙P. F. McDonald has been awarded the contract by the Board of Local Improvements of Bloomington, Ill., for the 20-in. water main, for $31,139.

The Water Co., of East St. Louis, Ill., plans improvements to its plant amounting to $1,000,000. Two intake tunnels are under construction and an intake tower is to be built in the river above the high-water mark. Settling and filtering basins also will be erected. F. Rademacher will be in charge.

The City of Farmington, Ill., J. G. Findley, Clerk, did not let the contract on June 2 for the construction of the proposed pump house. Work will probably be let the latter part of the month.

Indiana.

✣Bids will be received until July 1, by City Council, Decatur, Ind., for the construction of a 230,000-gal. reinforced concrete reservoir. Plans for the work are on file with H. M. Devoss, City Clerk, and J. T. Gillig, Engineer, Decatur, Ind.

⊙Chas. H. Lipp, Union City, Ind., has been awarded the contract by that city, Ross C. Sutton, Clerk, for the construction of a waterworks building, for $2,998. Bids were opened June 2.

Iowa.

⊙The Keystone Driller Co., Monadnock Blk., Chicago, Ill., has been awarded the contract to furnish deep well pumping machinery to the Centerville, Ia., Gypsum Co.

Kansas.

The City of Herington, Kan., will call another special election in the near future to vote bonds for waterworks and electric light extensions, the principal object being to obtain a new and reliable source of water supply. The Benham Engineering Co., of Oklahoma City, Okla., have been retained as Consulting Engineers to investigate, make examinations, draw plans and specifications and supervise the work of construction. The probable cost will be approximately $50,000.

Kentucky.

⊙Mayor F. P. Strickler, of Elizabethtown, Ky., has signed a contract with Murphy Bros., of Bowling Green, O., to build a reservoir at the power house spring in order to obtain pure hydrant water for the city.

⊙Mason-Hanger Co., Lexington, Ky., has been awarded the contract by the Lexington Hydraulic & Mfg. Co., Lexington, for constructing an earthen reservoir dam and miscellaneous appurtenances thereto, the total work involving about 48,000 cu. yds. of earth work, for $49,043. Bids were opened June 2. Alvord & Burdick, Hartford Bldg., Chicago, are the Engineers.

Louisiana.

The City of Monroe, La., plans a number of municipal improvements, included in which will be the extension of water mains at an estimated cost of $75,000.

The City Council of Amite, La., plans the sinking of a well to supply the city with artesian water.

State Engineer Gervais Lombard has surveyed the Cross Lake lands, lying just west of the City of Shreveport, La., which the State will sell to the City of Shreveport for the exclusive use as a municipal water supply reservoir.

Maryland.

✣Bids will be received until 11 a. m., June 18, by Board of Awards at the office of the City Register, Baltimore, Md., for furnishing sluice gates for filtration plant, Water Department contract No. 12. The work consists of furnishing f. o. b. cars Baltimore, 49 rectangular gates, ranging in size from 84-in. x 84-in. to 24-in. x 24-in., inclusive; one circular gate, 60-in. diameter, and eight circular gates, 18-in. diameter. Ezra Whitman is Water Engineer.

✣Bids will be received until 11 a. m., June 18 by Board of Awards at the office of the City Register, Baltimore, Md., for furnishing valves for the filtration plant, Water Department contract No. 13. A certified check of the bidder on a clearing house bank, made payable to the Mayor and City Council of Baltimore, for the sum of $1,000 will be required with each bid. The work consists in furnishing f. o. b. cars Baltimore, 222 valves, ranging in size from 4-in. to 36-in. Ezra B. Whitman is Water Engineer.

✣Bids will be received until 11 a. m., June 18, by Board of Awards, at the office of the City Register, Baltimore, Md., for furnishing all the cast-iron pipe and specials as shown on plans on file in the office of the Water Engineer, City Hall, Baltimore, Md. Plans and specifications can be obtained at the office of Ezra B. Whitman, Water Engineer, City Hall, Baltimore, Md. A charge of $5 will be made for each set of plans and specifications; this amount will be refunded upon the return of these plans and specifications before June 21, 1913, in good condition. Specifications used in making a bid will be considered as returned. A certified check of the bidder on a clearing house bank, made payable to the Mayor and City Council of Baltimore for the sum of $1,000 will be required with each bid. The work consists in furnishing f. o. b. cars Baltimore, Md., about 360 tons B. & S. pipe; 190 tons B. & S. standard specials; 90 tons B. & S. special specials; 370 tons flange specials.

Massachusetts.

✣Bids will be received until 2 p. m., June 12, by Board of Water Commissioners, E. A. Kellogg, Chairman, Feeding Hills, Agawam, Mass., for furnishing 500 tons of 6 and 8-in. cast iron pipe and special castings. Specifications, etc., can be had upon application to J. L. Tighe, Engineer, 189 High St., Holyoke, Mass.

The Water Board of Springfield, Mass., has decided to relay the old cement-lined main running out State St. and Berkshire Ave. toward Indian Orchard. The work will require 1,300 tons of 24-in. pipe and will cost about $28,000. Construction expenses will bring the total up to $60,000.

Michigan.

✣Bids will be received until 7:30 .p. m., June 13, by the Board of Water Commissioners, Saginaw, Mich., for furnishing and installing one water tube boiler or two horizontal tubular boilers with necessary stoker or stokers for the East Side Water Works. W. H. Barton is Clerk of the Board.

⊙The City Council of Adrian, Mich., has let the contract for the laying of the water main from Third Ave. and First St. to Fourth Ave. and First St., to Arthur Colvin, for $0.11 per ft.

The Village Council of Hartford, Mich., is considering proposed extensions to the waterworks system to cost over $10,000.

The Board of Public Works and City Council of Holland, Mich., have accepted the terms of P. J. Zalsman and Klass Zuidewind in regard to furnishing a water supply for Holland.

The citizens of Benton Harbor, Mich., on June 5 voted to issue bonds to the amount of $100,000 for waterworks improvements.

The village of Olivet, Mich., plans the installation of a waterworks system at an estimated cost of $14,500. An election will be held June 14 to vote bonds for the improvement.

Minnesita.

✣Bids will be received until 7:30 p. m., June 20, by P. H. Buran, Clerk, Roseau, Minn., for

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

the erection of a brick or concrete power house, a system of water works and an electric light plant, including all labor and material. All bids must be in strict accordance with the plans and specifications, prepared by Leonard Peterson, of Thief River Falls, which may be seen at the office of the Clerk, and may also be seen on application to Mr. Peterson.

⊙The Pastoret Construction Co., of Duluth, Minn., has been awarded the contract for the construction of a water pipe line in Taylors Falls, Minn., for $6,589. All bids received on the 100,000-gal. reinforced concrete reservoir were rejected and will be readvertised. Bids were opened June 2.

⊙The Keystone Driller Co., Monadnock Blk., Chicago, Ill., has been awarded the contract to furnish a Downie double stroke deep well pumping outfit and equipment to the city of Pine City, Minn.

⊙The Keystone Driller Co., Monadnock Blk., Chicago, Ill., has been awarded the contract for furnishing a Downie double stroke deep well pumping outfit to the city of Hampton, Minn.

All bids received by the city of Eveleth, Minn., on June 3 for the installation of a pump have been rejected. The work will be readvertised when more complete specifications are available. D. P. McIntyre is City Clerk.

The Waterworks Committee of the City Council, Minneapolis, Minn., has asked for the immediate sale of an additional $100,000 of new bonds for filtration.

New York.

✣Bids will be received until 11 a. m., June 14 by Capt. A. H. Huguet, Quartermaster, Fort Niagara, N. Y., for constructing 60,000-gal. steel water tank and trestle.

⊙M. Furry, 340 N. Eighth St., Olean, N. Y., has been awarded the contract by that city for the laying and trenching of 1,400 ft. of 6-in. and 2,000 ft. of 4-in. water line and setting hydrants and valves, for $656. Bids were opened June 4.

⊙The Board of Village Trustees, Glens Falls, N. Y., has awarded the contract for the construction of a brick chimney at the pumping station to W. M. Kellogg Co., of New York City, for $810.

The Public Works Commissioners of Tonawanda, N. Y., have designated themselves a committee to confer with the North Tonawanda Public Works Board on the proposition to connect the water system of the two cities.

All bids received recently by the Common Council of Lockport, N. Y., for the building of the proposed force mains leading from the standpipe to the northerly and easterly portions of the city, have been rejected and the work ordered readvertised. The cost will be about $40,000.

North Carolina.

✣Bids will be received until 3 p. m., July 1, by Mayor and Board of Aldermen, Goldsboro, N. C., for building a pumping station and filter plant. The work will consist of a brick pumping and filter building with 1½ million gallon mechanical filter, resetting old pumps and about 6,000 ft. of 12-in. force main. Plans and specifications will be on file at the Mayor's Office in Goldsboro, and at the office of Gilbert C. White, engineer at Charlotte, N. C. Specifications and bidding form will be mailed on application to the engineer. No bid will be considered unless accompanied by a certified check for $1,000.00 as an evidence of good faith. J. R. Higgins is Mayor.

The citizens of Rocky Mount, N. C., have voted bonds in the sum of $235,000 for permanent improvements. Gas and electric plants will be installed, school building erected and extensions made to the water and sewer systems.

J. Newton Johnson, Consulting Engineer, Florence, S. C., is preparing plans and specifications and will supervise the construction of a waterworks system for Cherryville, N. C.

North Dakota.

✣Bids will be received until 8:30 p. m., June 14, by Director of the Mandan Commercial Club, Mandan, N. Dak., for building a dam across Heart River per plans and specifications. W. A. Lanterman is President.

✣Bids will be received until 3 p. m., June 17, by City Council, Dickinson, N. Dak., addressed to R. C. Hill, City Auditor, for the construction of sewer and water main extension as follows: 8,173 ft. of 8, 10 and 15-in. sewer pipe; 5 lampholes; 20 manholes; 1 flush tank; 5,136 ft. of cast-iron water pipe; 10 hydrants; 7 gate valves. All such work to be done in accordance with the plans and specifications now on file in the office of the City Auditor.

Ohio.

✣Bids will be received until noon, June 18, by W. H. Kirby, Secretary to Director of Public Works, Cleveland, O., for steel reinforcement bars for concrete foundations for the municipal electric light plant, of the City of Cleveland, O. Each bid must be made in accordance with the plans and specifications which may be obtained in the office of the Engineer of Construction, Room 319, City Hall.

✣Bids will be received until noon, June 13, by M. F. Devine, Village Clerk, Pleasant City, O., for the construction of a municipal water works system for that village. Approximate requirements are 3,665 ft. 8-in. mains, 8,000 ft. 6-in. mains, deep well pumps and engines, reinforced concrete reservoir, brick pump houses, hydrants, valves, etc., etc. Plans and specifications are on file in the office of M. F. Devine, Clerk of said village. All proposals will be accompanied by a certified check of 10 per cent of the amount bid. H. L. Maddock, Newark, O., is Consulting Engineer.

✣Bids will be received until noon, July 8, by S. A. Haskell, Director of Public Service, Painesville, O., for the construction of Water Purification Works of 3,000,000 gals. daily capacity, including pumping station. This work will be known as Contract 2, of the Improvement of Public Water Supply. R. Winthrop Pratt, 708 Hippodrome Bldg., Cleveland, O., is consulting engineer. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until noon, June 30, by Fred H. Shoaff, Village Clerk, Euclid, O., for constructing a 10-in. water main in Chardon Road, a 6-in. main in Perry St., and a 8-in. main in Roseland Ave., in accordance with plans and specifications on file at the office of the F. A. Pease Engineering Co., 810 Marshall Bldg., Cleveland, O.

✣Bids will be received until noon, June 21, by Fred Feuchter, Clerk of the Board of Public Affairs, West Park, O., for constructing water mains in Belmont St., Elmwood St. and part of Triskett Road in accordance with the form of contract, plans and specifications on file at the office of said Clerk, and at the office of The Wm. H. Evers Engineering Company, 332-334 The Arcade, Cleveland, Ohio.

Sanitary Engineer R. Winthrop Pratt, Hippodrome Bldg., Cleveland, O., is preparing plans for a 2,000,000-gal. filtration plant for that city on a site adjoining the Division St. pumping station. The cost of the plant is not to exceed $2,000,000.

The Village Council of New Straitsville, O., has called a special election for June 24 for the purpose of voting on the issuance of bonds to the amount of $25,733 for waterworks.

Consulting Engineer John H. Gregory, 170 Broadway, New York City, has been retained by the City of Ironton, O., to submit a preliminary report on the local water question.

The Public Improvements Committee of the City Council, Toledo, O., has approved the Lamb-Nearing site, beneath the west approach of the New Cherry St. bridge, as a site for the proposed high pressure pumping station.

Oregon.

The City Council of Eugene, Ore., on May 28 sold $100,000 worth of waterworks bonds. Contracts will shortly be let for the installation of three reservoirs, several miles of 10 and 12-in. mains, construction of a fireproof building over the pumping plant, and the location of a better intake.

Pennsylvania.

✣Bids will be received until 2:30 p. m., June 27, by Board of Public Works, 222 Market St., Harrisburg, Pa., for furnishing all materials and performing all labor for the construction of a protective wall and appurtenances, along the Susquehanna River in the City of Harrisburg, Pa. The work will consist of about 13,500 lin. ft. of stepped reinforced concrete retaining wall and appurtenances. The quantities involved are approximately 12,000 cu. yds. of concrete, 600 tons of steel reinforcement and 45,000 cu. yds. of excavation and fill. Each bid must be accompanied by a preliminary bond or certified check to the order of the City Treasurer, for 10 per cent of the amount of the bid. Specifications, plans and blank form of proposals can be obtained at the office of the Board of Public Works, and from James H. Fuertes, No. 140 Nassau St., New York City, upon making a deposit of $25. Edwin C. Thompson is Secretary Board of Public Works.

✣Bids will be received until 2:30 p. m., July 1, by Board of Public Works, 222 Market St., Harrisburg, Pa., for furnishing all material and performing all labor for the construction of a reinforced concrete dam across the Susquehanna River at the City of Harrisburg, Pa. The work will consist in the building of a reinforced concrete dam across the Susquehanna River about 3,000 ft. long and about 5 ft. high, consisting of a series of piers and slabs. The quantities involved are approximately 1,150 cu. yds. of concrete, 110 tons of steel reinforcement and 1,000 cu. yds. of stone filling. Each bid must be accompanied by a preliminary bond or certified check to the order of the City Treasurer for 10 per cent of the amount of the bid. Specifications, plans and blank form of proposals can be obtained after June 5, 1913, at the office of the Board of Public Works, and from James H. Fuertes, Consulting Engineer, 140 Nassau St., New York City, upon making a deposit of $25. Edwin C. Thompson is Secretary Board of Public Works.

The Borough Council of Homestead, Pa., has voted to expend $23,000 to improve the water plant. The artesian wells and pumping machinery will be put in better condition. Chester & Fleming, Pittsburgh, are Engineers.

South Carolina.

✣City Engineer John McNeal, Columbia, S. C., will receive bids until June 13 for furnishing 24-in. steel flange pipe.

The citizens of Lancaster, S. C., have voted bonds to the amount of $12,000 to extend the waterworks system to the suburbs or wherever needed.

The City Council of Columbia, S. C., nas authorized the removal at once of the pipe line across the canal. The work will be done under the direction of John McNeal, City Engineer, and F. C. Wyse, Engineer-Superintendent of the waterworks, subject to the inspection of any engineer the Columbia, Railway, Gas & Electric Co., may name.

South Dakota.

✣Bids will be received until 8:30 a. m., June 16, by W. L. Youngman, City Auditor, Mobridge, S. Dak., for the furnishing of 456 ft., more or less, of 4-in. cast iron water pipe, and 396 ft., more or less, of 6-in. cast iron water pipe, and all special castings required, according to plans on file in the office of the city engineer, and according to the Standard Specifications of the American Water Works Association. A certified check for $50 should accompany each bid.

✣Bids will be received until 8:30 a. m., June 16, by W. L. Youngman, City Auditor, Mobridge, S. Dak., for the furnishing of all 4-in. hydrants and 4-in. gate valves, according to plans and specifications on file with the city engineer. A certified check for $50 should accompany each bid.

Tennessee.

A special election was held in Nashville, Tenn., on June 5, to determine whether the municipality shall issue $2,500,000 of its bonds for the purpose of constructing a new reservoir and all incidentals in connection therewith.

The National Board of Fire Underwriters has recommended extensive improvements in the water system of Knoxville, Tenn.

Texas.

The City Council of Belton, Texas, has ordered an election to be held July 2 for the purpose of voting on the issuance of bonds to the amount of $24,000 for waterworks improvements and extensions.

The Board of Commissioners of Franklin, Texas, proposes to purchase the present waterworks system and issue bonds to improve the same.

The City of Madisonville, Texas, has sold bonds to the amount of $16,000 for a waterworks system. The work of putting in the tower and mains will begin shortly.

Virginia.

The Village Council of Shadyside, Va., is considering a water supply for the town. It is proposed to pipe water from Moundsville across the river.

Washington.

⊙T. Ryan, Lowman Bldg., Seattle, Wash., has been awarded the contract by the Board of Public Works of that city, for the construction of water mains in North 82 St., et al., for $26,322. N. Fiorito Bros. & Sanro, 616 26th Ave. N., secured the contract to lay water mains in W. 61st St., for $2,667.

The Town of Kittitas, Wash., will shortly install a waterworks system at an estimated cost of $20,000. Water will be piped from Warm Springs, a distance of three miles, to the town.

The citizens of Olympia, Wash., will shortly vote on the proposition to issue bonds in the sum of $150,000 for the construction of a municipal waterworks system.

Canada.

The citizens of Watrous, Sask., on June 2 voted a by-law for improvements to the waterworks and sewer system of the town, amounting to $70,000. Already $83,000 has been voted for these systems, making a total of $153,000.

The City of Edmonton, Alta., has passed a by-law providing for an issue of debentures in the sum of $137,240 for certain extensions to the waterworks plant.

The citizens of Brandon, Man., on June 4 passed by-laws authorizing the issuance of bonds to the amount of $548,000 for improvements, as follows: Waterworks extension and improvements, $100,000; water meters, $13,000; repairing and renewing bridges, $7,000; purchase of site for free library, $13,000; hospital extensions, $100,000.

The citizens of Wallaceburg, Ont., on June 2 voted a by-law to provide for the expenditure of $130,000 in the construction of a waterworks and sewerage system for the town.

The citizens of Kamsack, Sask., on May 31 voted by-laws providing for waterworks, sewerage and electric light systems. A complete waterworks system will cost $63,000, improvements to sewerage system $1,500 and the electric light plant $25,000.

SEWERAGE AND SANITATION

Arizona.

The City Council and Board of Health of Globe, Ariz., have declared in favor of a sewerage system. The citizens will be asked to vote on a bond issue of $150,000 for the improvement. City Engineer Stafford is preparing plans.

California.

The City Council of San Bernardino, Calif., has decided to create a sewer district extending from First to Third and from C to Waterman Ave.

Consulting Engineers Olmsted & Gillelen, Wright & Callender Bldg., Los Angeles, Calif., have submitted plans to the Board of Trustees of South Pasadena for the proposed sewer system. The estimated cost is $208,000.

The Board of Public Works of Los Angeles, Calif., has approved the plans of City Engineer Homer Hamlin to extend the main line of the Alameda St. storm sewer from the existing storm sewer through North Main to College St.

The Board of Public Works of Los Angeles, Calif., has rejected all bids received recently for the construction of the proposed San Pedro storm sewer system in Front St. and other streets.

The Chamber of Commerce of Biggs, Calif., plans the installation of a sewerage system in that city (population 403). Charles E. Sloan, Nevada Bank Bldg., San Francisco, Calif., is Engineer.

Connecticut.

⊙The B. D. Pierce Mfg. Co., Bridgeport, has been awarded the contract by the Paving & Sewer Commission of Bridgeport, Conn., for the construction of Whittier and the Frank St. sewers.

Delaware.

✣Bids will be received until noon, June 18, by Sewer Commission, S. J. Wright, Chairman, Newark, Del., for the construction of a sewage disposal plant and a system of sewers. The work to be done consists of a complete sewage disposal plant, about 25,594 ft. of terra cotta pipe sewers from 8 ins. to 12 ins. in diameter, and the necessary manholes, lampholes and flush tanks. Specifications and blank forms of proposals may be obtained at the office of T. Chalkley Hatton, Chief Engineer, at Wilmington, Del. Full sets of plans can be seen at the said office and a full set of blue prints may be obtained from the Chief Engineer upon the payment of $10, such sum to accompany the order.

The citizens of Newark, Del., on May 31 voted in favor of the installation of the new sewer system and sewage disposal plant at a cost of $51,000.

Florida.

⊙Benson & Skipper have been awarded the contract by the Board of Public Works of Pensacola, Fla., for the construction of 725 lin. ft. of 8-in. sanitary and 450 ft. of 15-in. storm sewer.

Idaho.

An election is to be held in Kellogg, Idaho, on June 16 for the purpose of voting on a $30,000 bond issue for a sewerage system.

The citizens of Boise, Ida., on June 3 defeated the proposition to issue bonds for paving, storm sewer and sand creek. The paving bonds were to have amounted to $45,000, storm sewer, $50,000, and sand creek, $30,00. C. C. Stevenson is City Engineer.

Illinois.

⊙Charles E. Hughes of Rockford, Ill., has been awarded the contract for the installation of a sewerage system in Evansville, Wis., for $7,889.

The village of Bradley, Ill., plans the installation of a sewerage system to cost about $238,000. A public hearing was held June 5. W. W. Marr of the Aetna Engineering Bureau, 17 N. La Salle St., Chicago, Ill., is Engineer.

Civil Engineer Charles H. Dunn of Peoria, Ill., is preparing plans and specifications for the installation of a sewerage system in Farmington, Ill.

City Engineer M. H. Brightman of Elgin, Ill., has recommended to the City Council the construction of a sewer system in the district including Bellevue Ave., at an estimated cost of $24,000.

The Board of Local Improvements of Joliet, Ill., Henry Odenthal, City Clerk, plans the construction of a Second Ward sewer system, preparatory to the proposed paving of North Chicago St. The system is estimated by City Engineer C. D. O'Callaghan to cost $25,254.

Indiana.

⊙McKinney & Co. of Frankfort have been awarded the contract for building the new sewer through the business district of Danville, Ind., for $19,284. Work is to be completed by Dec. 1.

⊙Adams Bros., Lebanon, Ind., have been awarded the contract by the Town Trustees of Kirklin, Ind., for the sewer work in connection with street paving, for $2,460. Wm. Coin, Frankfort, Ind., secured the contract to construct 16,940 sq. yds. of pavement and 6,570 lin. ft. of concrete curb, for $29,260. Bids were opened June 2.

⊙Clemens & Clemens have been awarded the contract by the Board of Public Improvements, Crawfordsville, Ind., for the construction of a 36-in. sewer in Lafayette Ave., for $2,540. Bids were opened June 2.

The Common Council of Milan, Ind., has passed a resolution to construct sewer system that will cost about $3,600.

Iowa.

The City Council of Waterloo, Ia., has passed a resolution directing City Engineer C. A. Robey to furnish plans and specifications for the extension of the Dry Run sewer from West Seventh St. to Byron Ave.

Citizens of Springfield, Ia., are agitating the installation of a municipal sewerage system.

At a recent mass meeting of citizens of Onawa, Ia., the proposition to install a sewerage system was favored. Ernest E. Carlson is Engineer.

The Town Council of Schaller, Ia. (population 646), has passed a resolution of necessity ordering the construction of a sanitary sewer system. The citizens recently voted down the issuance of bonds for a system.

City Engineer T. L. Blank of Grinnell, Ia., is preparing plans for the construction of a sewer in that city to be 12 miles in length.

Kansas.

⊙Everett & Burt have been awarded the contract by the City Commission of Hutchinson, Kan., for the construction of the new

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Washington St. storm drain and three small sanitary sewers, at $2,432 and $1,977, respectively.

Kentucky.

✣Bids will be received until 2 p. m., June 14, by J. M. Wallace, Danville, Ky., for furnishing material and constructing sanitary and storm sewers for said city. The work to be let consists, approximately, of: 430 ft. 39 in., 575 ft. 36 in., 450 ft. 30 in., 450 ft. 27 in., 104 ft. 24 in., 1,885 ft. 8 in. vitrified sewer pipe. All necessary inlets, manholes and flush tanks and alterations of and additions to two sewage-disposal plants. Plans and specifications can be seen at the office of the W. S. Shields Co., 1201 Hartford Bldg., Chicago, Ill., or at the Water Office, Danville, Ky.

⊙The Board of Public Works of Louisville, Ky., has awarded the contract for the construction of sewers in Shelby St., from Burnett Ave. to the city limits, and in Preston St., between Rawlings St. and the city limits, to J. H. Cahill, for $90,041. Other bidders were: Henry Bickel Co., Louisville, $90,178; Guild & Co., Chattanooga, $90,338; James Duff Construction Co., Cleveland, $104,749, and James Ferry Co., Pittsburgh, Pa., $115,995.

Louisiana.

The City Council of Lafayette, La., has retained Civil Engineer C. A. Reese of Shreveport, La., to prepare plans and specifications for a sewerage system and to superintend the work of laying the same. The estimated cost is $100,000.

The City of Monroe, La., plans extensions to the sewerage systems to make three new districts, one above the North Louisiana Shingle Mill, one south of Texas Ave. and one in the eastern section of the city to connect with the storm sewer being built out Calypso St.

Massachusetts.

⊙Louis Balboni, Brook St., Roslindale, Boston, Mass., has been awarded the contract by the Board of Sewer Commissioners, Milton, Mass., for the construction of 4,600 ft. of pipe sewers for $6,113. Bids were opened May 23.

The Committee on Sewers, Fall River, Mass., has approved three sewers, as follows: To construct the Lowell St. extension southerly, $10,000; for work in Raymond St., from Pleasant to Harriman St., $5,250, and for a sewer in Harriman St., from Raymond to Pitman, $1,600.

Michigan.

The Supreme Court, Lansing, Mich., has rendered a decision enjoining the City of Grand Rapids from dumping sewage into the Grand River. This will necessitate the reconstruction of all the outlet sewers and the construction of two septic tanks. The estimated cost of the change is $7,000.

The City of Cadillac, Mich., plans to make an extension to its sewer system. It has been found that the pumping station and sewage disposal plant are too small. An engineer will be employed to investigate.

Minnesota.

✣Bids will be received until 8 p. m., June 16, by George Stein, City Clerk, Bemidji, Minn., for laying storm sewers consisting approximately of 300 ft. of 15 in. pipe, 750 ft. of 12 in. pipe, 320 ft. of 10 in. pipe, four inlets and 1 manhole and accessories to make storm sewer complete. Plans and specifications are on file in the office of the city engineer, where full information can be obtained. Certified check in the sum of 10 per cent of amount bid, on some Bemidji bank, should accompany the same.

Mississippi.

All bids received June 1 by the City Commissioners, Laurel, Miss., for the construction of 4½ miles of 8 to 15 in. pipe sewers, 61 manholes and 17 flush tanks, were held up until June 5. Rank Reynolds, Iowa Engineering Co., Clinton, Ia., is Engineer.

Montana.

⊙The Butte Construction Co. has been awarded the contract by the City Council of Butte, Mont., for the construction of the extension of the second gulch sewer. The Council has decided to spend $10,000 on the sewer in Missoula Gulch, and $15,000 on the old gulch sewer south of Platinum St.

Nebraska.

✣Bids will be received until 10 a. m., June 17, by Board of Village Trustees, Ralston, Neb., at the office of the Towl Engineering Co., 1123 City National Bank Bldg., Omaha, Neb., for a sewerage system. A certified check for 5 per cent the amount bid must accompany each proposal. Bidding blanks and further information may be obtained of the Towl Engineering Co. The cost of the work will not exceed $8,000. C. M. Skinner is Chairman of the Village Board.

Mayor Haller of Blair, Neb., has recommended to the City Council that steps be taken to obtain a sewerage system.

City Engineer Watson Townsend of Omaha, Neb., is preparing to call for bids on the construction of a new sanitary and storm sewer just west of Fort Omaha Creek from 27th Ave. to Crown Point Ave. The sewer will be 12 ft. 6 ins. in diameter.

New Jersey.

Town Engineer Frank Shepherd of Belleville, N. J., has prepared plans for the proposed sanitary sewerage system. It is planned to commence work on the system as soon after June 18 as practicable.

New York.

✣Bids will be received until noon, June 17, by George Cromwell, President of the Borough of Richmond, New York City, for the construction of a temporary sewer in Sewerage District No. 3-C in Ward 2, also experimental sewage disposal plant at West New Brighton.

✣Bids will be received until 11 a. m., June 16, by Maurice E. Connolly, President of the Borough of Queens, New York City, for 17 sewer contracts, one of the largest being Contract No. 5, for constructing a combined sewer and appurtenances in Parsons Ave., from Queens Ave. to Oak Ave., 3d Ward. The Engineer's estimate of the quantities is as follows: 672 lin. ft. 3 ft. 3 in. concrete sewer, 839 lin. ft. 3 ft. concrete sewer; 110 lin. ft. 12 in. vitrified salt glazed culvert pipe; 40 lin. ft. 10 in vitrified salt glazed culvert pipe; 1,100 lin. ft. 6 in. vitrified salt glazed sewer pipe for house connections, 9 risers for house connections, 10 manholes, complete; 4 receiving basins, complete; 2 double receiving basins, complete; 15,000 ft., board measure, timber for bracing and sheet piling. The time allowed for completing the above work will be 75 working days. The amount of security required will be $6,000.

⊙Connors & Gallavan, Elmira, N. Y., have been awarded a contract by that city, Otis H. Gardner, City Clerk, for the construction of the Roe Creek trunk sewer, for $6,598. The work includes 1,652 lin. ft. of 24-in. double strength vitrified tile and 85 lin. ft. of 24-in. cast iron pipe, ¾-in. thick. Bids were opened May 29.

⊙The Board of Contract & Supply of Troy, N. Y., has awarded the contract for Marvin and Stow Aves. sewer to Henry W. Golden & Son for $1,853.

Bids were received on June 4 by Commissioner of Public Works John Smith and City Engineer Charles H. Snyder of Oswego, N. Y., for the construction of sewers on the East Side, the total cost of which will be upward of $140,000. The following contractors submitted estimates: R. M. Barnett and James Fennell, Oswego; Samuel Bonn and John Young, Syracuse; Leary & Morrison, Fairport, and Pratt, Reed & Phillips, Massena.

The New York Conservation Commission has approved the plans of City Engineer E. W. Sayles of Watertown, N. Y., for the Arlington St. sewer, for which there is a $12,000 bonding proposition to be voted upon June 11.

The City Council of Buffalo, N. Y., has agreed with the aldermen to authorize the Bureau of Streets to collect and dispose of ashes, garbage and refuse and clean the streets for the next five years, beginning July 1. The estimated cost is $300,000.

The Town of Scarsdale, N. Y., has authorized the sale of $180,000 bond issue for the purpose of constructing a trunk sewer.

The Board of Village Trustees, Waterloo, N. Y., has sold bonds to the amount of $100,000 for the proposed sewer system to Harris, Forbes & Co. The sewers are partly constructed.

North Carolina.

The officials of Bessemer City, N. C., R. F. Coble, Mayor, plans the installation of a sewer system at an estimated cost of $25,000. Plans have not been prepared.

Ohio.

✣Bids will be received until noon, June 30, by Village Council, Port Clinton, O., for furnishing the necessary labor and materials for the improvement of Jefferson St. from the south side of Sixth St. to the Portage River in Sewer District No. 5, by reconstructing a sewer therein according to the plans and specifications on file in the office of J. A. Singler, Clerk of the village.

✣Bids will be received until noon, June 20, by W. H. Kirby, Secretary to the Director of Public Service, Cleveland, O., for a rotary dryer for the Cleveland garbage disposal plant. Plans and specifications are on file with the Secretary.

✣Bids will be received until noon, June 17, by A. W. Burton, Director of Public Service, Piqua, O., for furnishing the necessary labor and materials for the construction of a sanitary sewer on Spring St. in said city, according to the plans and specifications on file in said office, being 900 lin. ft., with laterals to curb. Also for furnishing the necessary labor and materials for the construction of a sanitary sewer on Caldwell St., Gill St., River St. and Broadway, in said city, according to the plans and specifications on file in said office, being 4,700 lin. ft., with laterals to the curb. W. B. Mitchell is Clerk.

The City of Shelby, O., has been unable to secure bids for the construction of the proposed disposal plant, estimated to cost $12,000. Contractors claim the estimate is about $5,000 too low.

The Ohio Board of Health has approved the plans for sewerage at Westwood, a suburb of Cincinnati. Plans were prepared by City Engineer Henry M. Waite of Cincinnati, and embrace a sewage disposal plant.

An ordinance has been introduced in the City Council of Akron, O., providing for the issuing of bonds in the sum of $50,000 for the construction of a main trunk sewer from Bowery St. to the Kenmore Blvd.

The Department of Public Service, Galion, O., rejected all bids received May 26 for the construction of 24,868 lin. ft. of 8 to 120-in. pipe sewer, and 20,661 ft. of subdrains, including 85 manholes, 22,054 cu. yds. of excavation and 18,209 sq. yds. of street paving. A. O. Theobald is City Engineer.

Oklahoma.

✣Bids will be received until 8 p. m., June 25, by City of Henryetta, Okla., for the construction of a system of main sanitary sewers. A certified check for $2,500 must be filed with each bid. The Benham Engineering Co., 435 American National Bank Bldg., Oklahoma City, Okla., are Consulting and Supervising Engineers.

⊙W. F. Power has been awarded the contract by the City Commissioners of Guthrie, Okla., for the construction of a sanitary sewer on the West Side, for $2,055.

Pennsylvania.

⊙Following bids were received at Pottstown, Pa., for the construction of 12 miles of sewers, the first section of Pottstown's proposed new sewer system: Cantell Construction Co., Philadelphia, $142,307; Atlantic Construction Co., Philadelphia, $131,966; Willauer & Co., Pottstown, $128,358; Martin H. Miller, Passaic, N. J., $127,789.

⊙Frank Donatelli of Donora, Pa., has been awarded the contracts by the City Council of that borough for the construction of a sewer in Lawrence Alley for $3,280, a sewer in Meldon Ave. from Leven St. to Sixth St., $820, and a sewer in Cypress Alley for $976. Contracts let June 3.

No contract was awarded on June 4 by the Board of Public Works of Reading, Pa., L. S. Ramsey, City Clerk, for the construction of two concrete storm sewers, known as the West Elm St. Relief sewer and the North Sixth and Third St. sewer and branches. D. B. Ulrich is City Engineer.

The final work on the sewer plans for the Borough of Duquesne, Pa., is being done by the Engineering Department. R. D. Dell is Borough Engineer. Leo Hudson is Consulting Engineer.

A special election will be held in Brackenridge, Pa., on July 8 to vote on a bond issue of $56,000 for a sewerage system, a sewage disposal plant and for the improvement of many streets in the borough.

Tennessee.

L. E. Sparks on June 3 submitted the lowest bid to the City Commissioners of Memphis, Tenn., for the construction of the south crematory, at $21,925. Louis Kitchell bid $29,400 on the work.

South Carolina.

Civil Engineer J. Newton Johnson of Florence, S. C., has been retained to prepare plans and specifications and supervise the construction of a waterworks and sewerage plant at Cherryville, N. C. Mr. Johnson is also preparing plans and specifications for the waterworks and sewerage systems for Walterboro, S. C.

The citizens of Lancaster, S. C., have voted $70,000 in bonds for improvements, $45,000 to be applied to the installation of a sewerage system, $13,000 for street improvements and $12,000 for extensions to the waterworks system to the suburbs.

South Dakota.

⊙The City Commissioners of Watertown, S. D., have let the contract for the construction of a lateral sewer on First Ave. north between Oak and Maple Sts., to E. E. Little, for $1,072.

Texas.

The Attorney General at Austin, Tex., has approved the $75,000 bond issue by the City of Temple for the purchase and extension of the plant of the Temple Sanitary Sewer Co. As soon as the bonds are sold the city will take control of the system and contract for the necessary improvements.

The City Council of Texarkana, Tex., has ordered an election for June 30 to vote on two propositions for the issuance of bonds. One of these provides for a $60,000 bond issue to extend and improve the present city sewer system; the other provides for the issuance of $225,000 for the permanent street and bridge improvements.

Utah.

✣Bids will be received until 10 a. m., June 19, by Board of Commissioners, Salt Lake City, Utah, for constructing pipe sewers in sewer extensions Nos. 300, 309, 310, 311, 312, 313, 314, 316, 318, 320 and 322, according to plans on file in the City Engineer's office. Instructions to bidders, together with plans and specifications and forms for contract and bond are on file in the City Engineer's office, and copies will be furnished on receipt of $1. Noble Warrum is City Recorder.

✣Bids will be received until 10 a. m., June 17, by Board of Commissioners, Salt Lake City, Utah, for constructing pipe sewer on Fifth East St. from Twelfth South St. to Herbert Ave., thence northwesterly to the intersection of Fourth West and Eighth South Sts., sewer extension No. 321, according to plans on file in the City Engineer's office. Instructions to bidders, together with plans and specifications and forms for contract and bond, are on file in the City Engineer's office, and copies will be furnished on receipt of a deposit of $5. Noble Warrum is City Recorder.

West Virginia.

Plans are being prepared by City Engineer B. F. Stewart, Jr., for the construction of sewers in Parkersburg, W. Va., at an estimated cost of $25,000. The work will include small size sanitary sewers, mostly 8 in. Contracts will be let about July 15.

Wisconsin.

⊙The Board of Public Works of Racine, Wis., has let the contract for laying sewers in Kinzie, Grant, Hayes and Osborn Sts. to H. C. Hanson for $8,767.

⊙Ray Childs, Kaukauna, Wis., has been awarded the contract by that city for the construction of 334 ft. of 10-in. sewer in that city for $475. Bids were opened June 2.

⊙R. Nelson of Racine, Wis., has been awarded the contract by the City Council of Beloit, Wis., for the construction of sewers in Districts C and D for $6,869.

Civil Engineer Arthur M. Morgan, 111 W. Monroe St., Chicago, Ill., has submitted plans to the City Council of Horicon, Wis., for the proposed sewerage system. The plans call for the laying of 32,739 ft. of sewer pipe at an estimated cost of $30,000. Bids will be received about July 8.

Canada.

✣Bids will be received until 6 p. m., July 1, by H. H. Elliott, M. D., Secy.-Treas., The Pas, Man., for the supply and delivery of the following materials, and the performance of certain works: Tender A—Supply and delivery of 3,770 ft. of 24 in. vit. sewer pipe, 5,470 ft. of 20 in. vit. sewer pipe, 2,000 ft. of 18 in. vit. sewer pipe, 600 ft. of 15 in. vit. sewer pipe, 1,200 ft. of 6 in. vit. sewer pipe. Excavating and laying and construction of manholes, catch basins, flush tanks, etc. Tender B—Trenching and laying of approximately 4,400 ft. of 12 in. steel pipe, 3,500 ft. of 10 in. steel pipe, 4,400 ft. of 8 in. steel pipe, 2,000 ft. of 6 in. steel pipe. Setting valves, hydrants, etc., and back filling. Tender C—For the erection of power house. Tender D—For the erection of pole line. Tender E—For the supply, delivery and erection of motors, pumps, piping and air compressor. Tender F—For the supply and delivery of poles, wires, line material, etc. Murphy & Underwood, Consulting Engineers, Ross Block, Saskatoon.

✣Bids will be received until 5 p. m., June 16, by Municipal Clerk, Port Grey, B. C., for constructing outfall main sewers, laterals, manholes and other relative works in Kerrisdale, Eburne and West Point Grey Districts.

The citizens of Watrous, Sask., on June 2 passed four by-laws, comprising a sum of $89,800. Concrete sidewalks will be constructed throughout the town at a cost of $8,800. About $70,000 will be spent in the completion of the waterworks and sewerage system of the town.

The Municipal Council of Esquimault, B. C., will submit a by-law to the citizens for the borrowing of $400,000 for sewer construction. The plans of the Engineer call for 16.3 miles of sewers.

BUILDINGS

Alabama.

Earle Bros., Birmingham, Ala., will have work started in the near future on a 5-story reinforced concrete building to be erected on the site of their present store at 1918 First Ave., Birmingham. It will cost about $60,000.

California.

✣Bids will be received until 10:00 a. m., June 19, by Regents of the University of California, at the office of the Comptroller, Berkeley, Calif., for excavation and concrete, structural steel and steel erection, granite work, marble work, elevator and ornamental work for the Sather Campanile, on the grounds of the University of California, Berkeley.

Plans and specifications are on file in said office and may be obtained upon the payment of a deposit of $5.

No bids will be received unless accompanied by a certified check or bond equal to 10 per cent of the bid.

Plans are being prepared for a steel and concrete bank and office building to be erected at Fourth and Main Sts., Santa Ana, Cal., at a cost of about $125,000, for the Farmers & Merchants' National Bank of Santa Ana.

Illinois.

✣Bids will be received until 3 p. m., June 16, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for a new hoistway, a freight elevator, etc., in the U. S. Post Office, Court House, etc., Chicago, Ill. Official advertisement will be found elsewhere in this issue.

Iowa.

✣Bids will be received until 10 a. m., June 14, by Finance Committee of the State Board of Education, Iowa City, Ia., for the building of an underground tunnel for the State University of Iowa, at Iowa City, Iowa. The said tunnel will be approximately 2,000 ft. in length; part of which will be 4x5 ft. and part 4x6 ft. inside dimensions. Plans and specifications may be seen at the office of the Superintendent of Grounds and Buildings at Iowa City, Iowa.

Louisiana.

Plans are being prepared for a new courthouse and jail to be erected at De Ridder for Beauregard parish, at a cost of $175,000. Stevens & Nelson, New Orleans, La., are the architects.

Maine.

✣Bids will be received until 3 p. m., July 7, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction (except mechanical equipment and approaches), of the United States Post Office at Bangor, Me. The building is three stories and basement and has a ground area of approximately 15,600 sq. ft. Fireproof construction; stone and brick facing; composition roof. Drawings and specifications may be obtained from the custodian of site at Bangor, Me., or at the discretion of the Supervising Architect. Official advertisement will be found elsewhere in this issue.

Maryland.

⊙Irwin & Leighton, Keyser Bldg., Baltimore, Md., have been awarded the contract for the erection of a four-story, 275 by 350 ft. brick, steel and concrete factory building, at Boston, and Patunenk streets, Baltimore, for the American Tobacco Co.

Minnesota.

✣Bids will be received until 3 p. m., July 15, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the mechanical equipment (except elevators, lifts, interior lighting fixtures, engines, and generators), of the United States Post Office at Minneapolis, Minn., in accordance with drawings and specifications, copies of which may be obtained at the office of the Superintendent of Construction, Minneapolis, Minn., or at the discretion of the Supervising Architect.

Missouri.

✣Bids will be received until 3 p. m., July 15, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction (including mechanical equipment, interior lighting fixtures and approaches), of a one-story-and-basement, stone-faced building of 5,300 sq. ft. ground area, non-fireproof construction (except the first floor), for the United States Post Office at Poplar Bluff, Mo. Drawings and specifications may be obtained from the Custodian at Poplar Bluff or at the discretion of the Supervising Architect.

New Hampshire.

✣Bids will be received until 11 a. m., June 21, by Bureau of Yards & Docks, H. R. Stanford, Chief, U. S. Navy Department, Washington, D. C., for furnishing and installing electric hoisting machines and accessories for elevator at naval prison, Navy Yard, Portsmouth, N. H.

New York.

✣Bids will be received until 11 a. m, June 18, by Francis G. Ward, Commissioner of Public Works, Buffalo, N. Y., for furnishing the labor and material required in the erection of a new two-story brick fire-house to be known as Engine-house No. 35, and to be located on the north side of Clinton St., near Bailey Ave.

✣Bids will be received until 3 p. m., June 17, by the State Fair Commission, Syracuse, N. Y., Albert E. Brown, Sec'y-Treas., for the erection of a Poultry building on the State Fair grounds. Each bidder shall personally or through his agent present to the Commission at that time his sealed bid for the entire work and plumbing, for said new Poultry building, at which time they will be opened and read publicly. The proposals shall be accompanied by a certified check in an amount equal to 5 per cent of the bid, and the contractor to whom the award is made will be required to furnish a surety bond in an amount equal to 50 per cent of the contract within ten days from date of notice of award of contract. Failure to furnish bond within specified time will cancel the notice of award and cause forfeiture of said certified check. The contract will provide that the building shall be entirely completed on or before August 30th, 1913. Drawings, specifications and forms of proposal may be obtained of James A. Randall, Architect, 704 S. & A. K. Bldg., Syracuse, N. Y. Plans and specifications will be on file and may be examined by general contractors or sub-contractors at the office of the State Fair Commission, Post-Standard Bldg., Syracuse, N. Y., at the office of the State Architect, Capitol, Albany, N. Y., and at the office of the firm of Merrick & Randall, 704 S. A. & K. Bldg., Syracuse, N. Y. Plans and specifications must be returned to the State Fair Commission with proposal.

North Carolina.

✣Bids will be received until 3 p. m., June 27, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for a new heating boiler, breeching, stack, etc., for the Post Office and Court House at Asheville, N. C. Official advertisement will be found elsewhere in this issue.

Bids as follows were received May 19 by the Supervising Architect, Treasury Department, Washington, D. C., for construction of U. S. Post Office at Monroe, N. C., (1) bid on limestone, (2) on sandstone: W. J. Brent Construction Co., Norfolk, Va., (1) $49,000, (2) $54,000; Worrell & Waters, Llanerch, Pa., (1) $51,400, (2) $53,000; C. M. Leach, P. O. Box 2285, Boston, Mass., (1) $52,383, (2) $56,000; Newport Contracting & Engineering Co., Newport News, Va., (1) $53,470, (2) $54,000; Daniel T. McCarthy, 411 Walnut St., Philadelphia, Pa., (1) $53,822, (2) $54,822; Algernon Blair, Montgomery, Ala., (1) $54,749, (2) $56,500.

Bids as follows were received June 2 by the Supervising Architect, Treasury Department, Washington, D. C., for the construction of extension to the U. S. postoffice at Winston Salem, N. C.; (1) bid on limestone, (2) on sandstone: Boyle-Robertson Construction Co., Washington, D. C. (1) $169,980, (2) $175,000; John G. Unkefer & Co., Minerva, Ohio. (1) $182,210, (2) $187,210; J. E. & A. L. Pennock, Land Title Bldg., Philadelphia, Pa. (1) $185,400, (2) $193,200; Wm. H. Maxwell, Auburn, Ind. (1) $186,687; Wells Construction Co., Philadelphia, Pa. (1) $187,000, (2) $191,000; W. H. Fissell & Co., 1133 Broadway, New York city, (1) $187,835, (2) $194,900; Wise Granite Co., Richmond, Va., (1) $197,750, (2) $202,000; Hiram Lloyd Building & Construction Co., Odd Fellow's Bldg., St. Louis, Mo., (1) $197,500; Olin Gerlach, Frostburg, Md., (1) $197,750, (2) $204,000; Conners Bros. Co., Lowell, Mass., (1) $198,950; The Melton Construction Co., Washington, D. C., (1) $199,400; C. M. Leach, P. O. Box 2285, Boston, Mass., (1) $206,563, (2) $212,773; J. P. Cullen Construction Co., Janesville, Wis., (1) $221,350.

Ohio.

Plans have been completed by McNaughton & Raymond, Architect, Concord Bldg., Portland, Ore., for an 8-story building to be erected at 4th and Stark Sts., Portland, for the Title Trust Co.

Pennsylvania.

✣Bids will be received until 3 p. m., July 16, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete (including mechanical equipment, interior lighting fixtures, and approaches), of the United States Post Office at Corry, Pa. The building is to have two stories and basement, with a ground area of approximately 5,400 sq. ft.; fireproof construction; stone facing; tile and copper roof. Drawings and specifications may be obtained from the custodian of site at Corry, Pa., or at the discretion of the Supervising Architect.

C. A. Blanchard, Grant McCargo, James H. Park, William L. Abbott and Edward Hoopes, all identified with the Fort Pitt Hotel, Pittsburgh are projecting the erection of a new hotel not less than 20 stories high and containing 800 sleeping rooms each with bath, at 6th avenue and Smithfield street, Pittsburgh.

Architect A. H. Kropff, 709 Ranshaw Bldg., Pittsburgh, Pa., has completed plans for a 4-story brick and stone fireproof apartment building to be erected at Alber and Emerson Sts. for S. E. and Mary Bayard, to cost $100,000.

Plans and specifications are being prepared by John T. Windrim, Architect, Commonwealth Bldg., Philadelphia, Pa., for a new penitentiary to be built near Bellefonte, Pa., by the State of Pennsylvania. It will consist of a group of seven buildings as follows: Main cell house, isolation building, hospital building, power house, woman's prison, laundry and storage building and an administration building, the latter to contain an auditorium, chapel, dining rooms and kitchens and offices.

Lehigh University, Henry S. Drinker, President, South Bethlehem, Pa., is to erect a new $200,000 gymnasium and stadium.

Plans have been completed and bids will soon be asked for the proposed Mellon Institute of Industrial Research and School of Specific Industries of the University of Pittsburgh. James H. Geisey, of the Mellon Bank Bldg., Pittsburgh, is Architect. The new building carries the ancient Greek lines of architecture with an exterior of granite, terra cotta and colored brick. The main entrance to the structure will face Thackeray Ave. Instead of steps, the terrace will be cut away and the sidewalk extended to the front line of the building, level with the main floor. The plans provide for a main entrance hall ornamented with large columns and arched ceilings with a wide stairway leading to the upper floors. The basement will house electrical and other experimental furnaces and large scale apparatus, machine shops and boiler rooms. The building will be heated by steam and the most modern smoke devise will be used. Offices will be grouped on the first floor, as will a lecture room with a seating capacity of 400.

Rhode Island.

⊙George F. Payne & Co., 401 S. Juniper street, Philadelphia, Pa., has been awarded the contract for a residence to be built at Newport, R. I., for Mrs. George D. Widener. Approximate cost is $500,000.

Virginia.

✣Bids will be received until 11 a. m., June 21, by Bureau of Yards and Docks, H. R. Stanford, Chief, Navy Department, Washington, D. C., for wire fence and gates at the United States Reservation, Radio, Va. The cost is estimated at $2,000.

Washington.

Owing to an injunction of the Supreme court no bids were opened June 4 by the County Commissioners at Seattle, Wash., for construction of the $950,000 court house, and the matter has been indefinitely postponed.

Work will be started shortly on an 11-story steel and concrete office building to be erected at 4th Ave. and University St., Seattle, for the Metropolitan Bldg. Co., Henry Bldg., Seattle. It will cost about $500,000. Plans were made by Howell & Stokes, Architects, Henry Bldg.

West Virginia.

The Eagle Glass Co. is to build a 2-story office and 4-story factory building on an area of 65x179 ft. Plans are being prepared by M. F. Geisy, 414 Schmulbach Bldg., Wheeling, W. Va. The buildings are to be of fireproof construction.

Canada.

The Hudsons Bay Co., Herbert E. Burbridge, Stores Commission, Winnipeg, Man., is to call for bids shortly for the excavation work for a ten-story store building to be erected on Portage avenue, Winnipeg, at a cost of about $2,200,000. It will have a frontage of 300 ft., and will extend back in like distance. Erection of the steel work will be started next spring.

The Dominion Power & Transmission Co., Hamilton, Ont., will start work soon on the erection of an auxiliary steam plant at the foot of James street, Hamilton, to cost about $1,000,000.

Plans are being prepared by Thomas Hooper, Architect, Winch Bldg., Vancouver, B. C., for a 10-story 120x120 ft. reinforced concrete, tile and brick building to be erected on Granville St., Vancouver.

Plans have been completed for a 10-story hotel building to be erected at Hastings St., W., Vancouver, B. C. Building is to be of reinforced concrete construction and will cost about $200,000. Emil Guenther, North West Trust Bldg., Vancouver, B. C., is the Architect.

✣Bids will be received until noon, June 20, for the following departments in connection with the Hudson Bay Company's Departmental Store, Vancouver, B. C.: steam fitting, electric wiring, plumbing, refrigeration, vacuum cleaning, sprinklers, steam-driven generating units, turbine generating units, steel smoke stack, suction ash conveyor, pneumatic cash tubes. Burke, Horwood & White, Architects, 28 Toronto St., Toronto, Canada.

RIVERS AND HARBORS

California.

The Harbor Advisory Board of Los Angeles, Cal., has approved preliminary plans for the large steel transit shed to be erected on Municipal Dock No. 1 at the harbor. The building will be 100 ft. wide and 1,800 ft. long. The plans were prepared by Harbor Engineer Jubb.

The State Harbor Commissioners, San Francisco, have passed a resolution requesting the sale of bonds to the amount of $3,000,000 for harbor improvements in San Francisco, the money to be used for improvements along the city's water front. The request is made under the San Francisco harbor improvement act of 1909, which provided for a $9,000,000 bond issue for improvement of San Francisco harbor. Of this, $2,000,000 has now been used.

Connecticut.

✣Bids will be received until 2 p. m., June 23, by Maj. G. B. Pillsburry, U. S. Engineer, New London, Conn., for repairing inner arm of breakwater at mouth of Housatonic River, Conn.

Bids as follow were received May 31 by Maj. G. B. Pillsbury, U. S. Engineer, New London, Conn., for 34,000 cu. yds. of dredging in Mystic River, Conn.: Atlantic Dredging Co., 81 New St., New York, N. Y., 27.6 cts.; Charles M. Cole, Fall River, Mass., 24.9 cts. (recommended for acceptance); The T. A. Scott Co., Inc., New London, Conn., 28.25 cts.

District of Columbia.

✣Bids will be received until 2:30 p. m., June 13, by Maj. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under Circular 779—B, the following supplies; Black wrought iron or steel pipe, crosses, tees, Y's, bends, cleanouts, water-closet seats, rivets, carriage bolts, stools, drills, pipe, dies, augers, timber handles, wood blocks, boiler lagging, and ticking.

✣Bids will be received until 10:30 a. m., July 7, by Maj. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under Canal Circular 780, steel doors and gratings for batteries, locomotive tires, scrubbing brushes, fire clay, coal tar, lumber and piles.

Illinois.

✣Bids will be received until 10 a. m., July 2, by Lt. Col. G. A. Zinn, U. S. Engineer, Chicago, Ill., for furnishing fir timber for use in Chicago, Ill., District, f. o. b. mills. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 10 a. m., June 28, by Lieut. Col. G. A. Zinn, U. S. Engineer, Chicago, Ill., for constructing timber and concrete dock in North Branch Turning Basin, Chicago, Ill. Official advertisement will be found lesewhere in this issue.

⊙Bids were opened June 2 by the Cairo Drainage District, for about 562,000 cu. yds. of earth work enlargement in the Cairo Drainage District levees, for which the Miller Engineering Co., Little Rock, Ark., is the Engineer. The contract was awarded to the Walsh Construction Co., Davenport, Ia. Some of the quantities and unit prices are as follows: Mobile & Ohio R. R. levee, enlargement, Station 32 to Station 245, and including the short line and Station 32 and run-offs, 197,000 cu. yds. earth at 51½ cts.; Big Four R. R. levee, enlargement, Station 0 to Station 165, 309,400 cu. yds. (including muck ditch), at 48¼ cts.; raising four industrial tracks, 20,000 cu. yds. at 40 cts.; raising interchange track, 12,000 cu. yds. at 49½ cts.; paving new part of front slope with rip-rap 1 ft. thick, 19,000 sq. yds. at 47 cts.; new ballast, Station 0 to Station 165, 9,400 cu. yds., at $1; concrete in culverts, retaining walls, etc., 303 cu. yds., at $10. The Mobile & Ohio R. R. was awarded the contract for reballasting track, Station 32 to Station 332+70, 17,500 cu. yds., at $1, for raising and reballasting yard and Y track at Davis, at $7,980, and for raising interlocking plant at Davis at $2,070.

Indiana.

Town Board of Trustees of Broad Ripple, Ind., have adopted a resolution to build a levee to cost $15,000 to $18,000. It will be ½ mile long, 44 ft. base, 12 ft. top, and 10 ft. high.

The Greenfield Bayou Levee Association of Vigo County, Ind., has been incorporated and proposes to construct a levee. The incorporators include Sarah E. Stout, Nelson Sutliffe and Oliver Little.

Kansas.

Petition has been presented to the City Commission of Topeka, Kan., asking for a bond issue for a pumping station and flood gates for the South Side dike.

Kentucky.

City officials of Hickman, Ky., have asked the Nashville, Chattanooga & St. Louis Ry. to send an engineer to the city to make an estimate of the cost of building a levee to protect parts of Hickman now subject to the overflow.

Louisiana.

✣Bids will be received until 11 a. m., June 17, by Capt. C. O. Sherrill, U. S. Engineer, Metropolitan Bank Bldg., New Orleans, La., for furnishing and delivering 77,500 tons of rock on the Mississippi River between Greenville, Miss., and New Orleans, La.

✣Bids will be received until 11 a. m., June 20, by Capt. C. O. Sherrill, U. S. Engineer, Metropolitan Bank Bldg., New Orleans, La., for furnishing about 2,520,500 ft. B. M. rough pine lumber for mattress construction.

The Board of State Engineers, New Orleans, La., has completed plans and bids will be asked at once for the concrete work to be done on the east and west banks of the New Basin Canal at West End, New Orleans. The estimated cost is $30,000.

Bids as follow were received May 8 by Maj. E. H. Schulz, U. S. Engineer, New Orleans, La., for furnishing and delivering about 8,000 cu. yds. of stone at South Pass and Southwest Pass, Mississippi River; Oscar T. Barrett, Cincinnati, O., $3.38 (accepted); John Riess, New Orleans, $3.54.

The Board of State Engineers, New Orleans, La., has been making a profile and taking soundings for the purpose of having the canal dredged from Claiborne to Rampart St., New Orleans. Measurements have also been taken for the building of a concrete wall at the head of the New Basin.

Maine.

Bids as follows were received May 29 by the U. S. Engineer, Portland, Me., for dredging in Portland Harbor: (1) bid on 216,000 cu. yds. in Inner Harbor, (2) on 1,142,000 cu. yds. in Anchorage and (3) on 55,200 cu. yds. in Back Cove entrance: P. Sanford Ross, Inc., Jersey City, N. J., (1) 27½ cts., (2) 16.2 cts., (3) 27½ cts.; J. S. Packard Dredging Co., Providence, R. I., (1) 30 cts., (2) 15 cts., (3) 20 cts.; Jeremiah P. O'Riorden, Charlestown, Mass., (1) 27 1/82 cts., (2) 17¼ cts., (3) 28 cts.; Coastwise Dredging Co., Norfolk, Va., (1) 24 cts., (2) 14.6 cts., (3) 20 cts.; Morris & Cummings Dredging Co., New York City, (1) 10.6 cts., (2) 10.6 cts., (3) 10.6 cts; Eugene Breymann, Boston, Mass., (1) 25 cts., (2) 9.5 cts., (3) 25 cts.; John A. Seely, New York City, (1) 16½ cts., (2) 16½ cts., (3) 16½ cts.

Bids as follows were received June 7 by the U. S. Engineer, Portland, Me., for dredging in Carvers Harbor at Vinal Haven, Maine: Bay State Dredging Co., Ltd., Boston, Mass., 24¾ cts.; Eastern Dredging Co., Boston, Mass., 24.3 cts.; Jeremiah P. O'Riorden, Charlestown, Mass., 26 cts.; Charles M. Cole, Fall River, Mass., 22.9 cts.

Bids as follows were received June 7 by the U. S. Engineer, Portland, Me., for dredging in Medomak River, Maine: Bay State Dredging Co., Boston, Mass., 32.9 cts.; Eastern Dredging Co., Boston, Mass., 34.3 cts.

Bids as follows were received June 7 by the U. S. Engineer, Portland, Me., for dredging in Kennebec River, Maine: Bay State Dredging Co., Boston, Mass., 28¼ cts.; Eastern Dredging Co., Boston, Mass., 26.8 cts.; Jeremiah P. O'Riorden, Charlestown, Mass., 30 cts.; Charles M. Cole, Fall River, Mass., 27¼ cts.

Maryland.

Plans and specifications have been completed by M. A. Long, Assistant to Chief Engineer, Baltimore & Ohio R. R., Baltimore, Md., for a 54 by 800 ft. pier to be erected at Locust Point for the railroad.

Massachusetts.

✣Bids will be received until 11 a. m. July 12, by Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., for installing electrical distribution and street lighting at naval hospital, Chelsea, Mass. The cost is estimated at $4.000. H. R. Stanford is Chief of the Bureau.

Michigan.

✣Bids will be received until 5 p. m., June 16, by Gardiner S. Williams, Consulting Engineer, Ann Arbor, Mich., for the construction of a reinforced concrete spillway and waste gates, for the Argo Plant of the Eastern Michigan Edison Company, Ann Arbor, Michigan. The approximate quantities of the principal items are: 1500 cu. yds. excavation, 2600 sq. ft. sheet piling, 750 cu. yds. concrete, 19 tons reinforcing steel, 22 tons structural steel and mechanism. Plans and specifications may be seen at the office of the engineer, or may be obtained upon the deposit of a certified check for $10, $8 of which will be refunded upon the return of the plans and specifications.

✣Bids will be received until noon, June 30, by Capt. E. D. Peek, U. S. Engineer, Duluth, Minn., for furnishing and placing rubble stone foundation for breakwater extension, Marquette Harbor, Mich.

⊙Bids as follows were received May 8 by Lt. Col. Geo. A. Zinn, U. S. Engineer, Milwaukee, Wis., for building crib and pile pier with concrete superstructure on old breakwater at Manistique, Mich., (1) bid of Great

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Lakes Dredge & Dock Co., Chicago (awarded contract), (2) Robert Love & Co., Muskegon, Mich., (3) Greiling Bros. Co., Green Bay, Wis., (4) Burk, Smith & Nelson, Muskegon, Mich.:

Item.	(1)	(2)	(3)	(4)
305 cu. yds. concrete blocks on new cribs	$ 8.00	$15.00	$ 9.00	$13.00
601 cu. yds. concrete blocks on old breakwater	8.00	15.00	12.00	19.00
795 cu. yds. concrete superstructure on new cribs	8.00	14.00	12.00	9.00
1,165 cu. yds. concrete superstructure on old breakwater	8.00	14.00	8.50	7.00
562 cu. yds. concrete superstructure on pile pier	8.00	14.00	12.00	9.00
213 cu. yds. concrete slab walk	8.00	15.00	14.00	10.00
Furnishing and driving 6,100 lin. ft. round piles in pile pier, per lin. ft. in place	0.40	0.40	0.50	0.40
Making and driving 188,000 ft. B. M. sheet piles, timber furnished by the U. S., per M. ft. B. M	20.00	20.00	22.50	20.00
Framing 600,000 ft. B. M. timber, furnished by the U. S., for cribs, per M. ft. B. M. in place	15.00	13.00	12.00	10.00
Framing 62,000 ft. B. M. timber, furnished by U. S., for pile pier, per M. ft. B. M. in place	25.00	25.00	18.00	15.00
58,000 lbs. wrought iron or steel drift bolts and wrought iron or wire spikes, per lb	0.05	0.05	0.045	0.04
20.600 lbs. wrought iron or stel screw bolts and tie rods, per lb.	0.05	0.05	0.05	0.05
17,000 tons of stone, per ton of 2,000 lbs	1.75	1.75	1.50	1.75
Removing 423 lin. ft. old breakwater superstructure, per lin. ft.	9.00	3,00	8.00	5.00
Totals	$83.365	$102,592	$87,245.50	$86,227

Minnesota.

Bids were opened June 3 by Capt. E. D. Peek, U. S. Engineer, Duluth, Minn., for dredging at Superior Entry, Duluth-Superior Harbor. The amount available for the work is about $41,000: an amount proposed to be expended is about $30,000. The bids received were as follows: (1) bid per cu. yd. scow measurement for dredging 52,500 cu. yds. in entrance channel, (2) bid per cu. yd. scow measurement for dredging 208,000 cu. yds. in entrance channel, (3) bid per cu. yd. scow measurement for dredging 8,000 cu. yds. in Stilling basin, (4) bid per cu. yd. for dredging 500 cu. yds. bowlders exceeding 1 cu. yd., (5) total: Great Lakes Dredge & Dock Co., Chicago, Ill. (Duluth, Minn.) (1) 9¾ cts., (2) 9¾ cts., (3) 9¾ cts., (4) $1.50, (5) $26,929, (Recommended for acceptance); Zenith Dredge Co., Duluth, Minn., (1) 26 cts., (2) 26 cts., (3) 18 cts.. (4) $2.35, (5) $70,345; Northern Dredge & Dock Co., Duluth, Minn. (1) 12½ cts, (2) 14½ cts, (3) 14½ cts., (4) $1.00, (5) $38,382; Duluth-Superior Dredging Co., Duluth, Minn. (1) 10 cts., (2) 10 cts., (3) 10 cts., (4) $1.00, (5) $27,350.

Bids as follows were received June 3, by Captain E. D. Peck, U. S. Engineer, Duluth, Minn. For dredging in Portage River Harbor, for which work it is proposed to expend about $25,000: Great Lakes Dredge & Dock Co., Chicago, Ill., 9½ cts., (Recommended for acceptance); Zenith Dredge Co., Duluth, Minn., 14 cts.; Northern Dredge & Dock Co., Duluth, Minn., 11½ cents.

Mississippi.

✣The Mississippi Levee District, W. J. Shackelford, chief engineer, Greenville, Miss., as noted in our June 4 issue, is calling for bids until noon, June 17, in 2,300,000 cu. yds. of levee work. This work includes the following: Lake Vermillion enlargement, 250,000 cu. yds., to be completed Dec. 31, 1913; Bolivar enlargement, 170,000 cu. yds., to be completed Feb. 1, 1914; Catfish point enlargement, 110,000 cu. yds., to be completed Dec. 31, 1913; Entow enlargement, 90,000 cu. yds., to be completed Dec. 31, 1913; Stops Landing banquette, 16,000 cu. yds., to be completed March 14, 1914; Huntington Short Line dike, 60,000 cu. yds., to be completed Dec. 31, 1913; Biller's Bend banquette, 75,000 cu. yds., to be completed Mar. 1, 1914; Miller's Bend enlargement, 200,000 cu. yds., to be completed Dec. 31, 1913; Straight Stretch enlargement, 180,000 cu. yds., to be completed Dec. 31, 1913; Carson and Gooselake enlargement, 215,000 cu. yds., to be completed Dec. 31, 1913; Carson banquette, 30,000 cu. yds., to be completed Mar. 1, 1914; Barnes Landing enlargement, 100,000 cu. yds., to be completed Dec. 31, 1913. All of the foregoing work is locating above Greenville. The following work is located below Greenville: New Skinner levee, station 80 to 123, 173,000 cu. yds., Sta. 123 to 162, 257,000 cu. yds., Sta. 124 to 162, 98,000 cu. yds., to be completed Dec. 15, 1913; New Warfield levee, Sta. 292 to 325, 100,000 cu. yds., Sta. 325 to 355, 100,000 cu. yds., time of completion Dec. 15, 1913; Brunswich to Eagle Lake enlargement, 100,000 cu. yds., to be completed Feb. 1, 1914.

✣Bids will be received until 11 a. m., June 14, by Maj. J. A. Woodruff, U. S. Engineer, Vicksburg, Miss., for constructing about 580,000 cu. yds. of earthwork to close Skipwith Crevasse.

New Jersey.

✣Bids will be received until noon, July 5, by Col. Wm. T. Rossell, U. S. Engineer, 39 Whitehall St., New York City, for dredging in Hackensack River, N. J. The work consists in dredging for making a channel and completing same from Ridgefield Park to Hackensack, or as much of this distance as the available funds will admit, in order to provide a depth of 12 feet at mean low water from Little Ferry to Hackensack. The bottom width of the channel is to be 150 feet. The material is believed to be mud, sand, gravel and clay, and the estimated quantity is about 200,000 cu. yds., scow measurement. About $40,000 is available for payment of contractor's estimates.

New York.

✣Bids will be received until noon, June 28, by Col. Wm. T.. Rossell, U. S. Engineer, 39 Whitehall St., New York City, as noted in our June 4 issue, for dredging in Staten Island Sound, New York and New Jersey. The work to be done consists in dredging for making a channel from the deep water in the vicinity of the east end of Shooters Island to the vicinity of Buckwheat Island in Arthur Kill, a total distance of about 4 miles, in order to provide a channel depth of 25 ft. at mean low water, as far as the available funds will admit. The bottom width of the channel is to be 400 ft. The material to be removed is believed to be mainly mud, sand, gravel and clay; the estimated quantity is 1,400,000 cu. yds. The amount of money available for payment of contractors' estimate is about $250,000.

✣Bids will be received until 11 a. m., June 28, by Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., for the removal of cob dock at the navy yard, New York City. About $100,000 is available for the work.

Governor Sulzer has signed the bill appropriating $50,000 for the dredging and straightening of the Canisteo River from Hornell to Addison.

North Carolina.

It is expected to advertise for proposals for dredging in Wilmington, N. C., during the coming season at the localities mentioned below. The approximate date for opening bids is Aug. 1. General information of the work expected to be done may be obtained at the U. S. Engineer Office, P. O. Box 813, Wilmington, N. C. Specific information and specifications in each case can be obtained after the respective advertisement has been made. The locality, method of disposal of dredged material and probable consideration of contract are as follows: Scuppernong River, N. C., at prescribed dumping ground, $2,500; Neuse River, N. C., at prescribed dumping ground, $7,500; Inland Waterway from Pamlico Sound to Beaufort Inlet, on bank, or prescribed dumping ground, or both, $6,500; harbor at Beaufort, N. C., on bank and at prescribed dumping ground, $6,000; harbor at Morehead City, behind sea wall or at prescribed dumping ground, $2,000; New River, on adjacent marsh land or at prescribed dumping ground, $6,000; C. F. River at and below Wilmington, ocean bar and river channels, material from ocean bar at sea as prescribed, material from river channels at prescribed dumping grounds or on bank, $150,000; Shallotte River, at prescribed dumping grounds, $8,500.

Ohio.

✣Bids will be received until 2 p. m. July 8, by Lieut. Col. H. Jervey. U. S. Engineer, Cincinnati, O., for hire of five dredging plants, each consisting of one dredge, one towboat and two dump scows.

✣Bids will be received until noon, June 27, by Board of Hamilton County Commissioners, Albert Reinhardt, Clerk, Cincinnati, O., for repairing under Specifications 457, the levee on the Newton road south of the bridge over the Little Miami River in Anderson township. Plans and specifications for the work are on file at the office of the board. A certified check for $500 must be filed with each bid.

The River Improvement Commission of Lima, O., has selected Walter J. Sherman, of Toledo, as consulting engineer to prepare a comprehensive plan for the improvement of the Ottawa river bottoms. It is expected that the plant will be completed in about two months.

Pennsylvania.

The House Appropriations Committee of the State Legislature has reported a bill carrying $150,000 for a survey of the water resources of the state.

Tennessee.

✣Bids will be received until 11 a. m., June 20, by Maj. E. M. Markham, U. S. Engineer, Custom House, Memphis, Tenn., for about 1,900,000 cu. yds. of levee work in the First and Second Mississippi River Districts. Official advertisement will be found elsewhere in this issue.

Texas.

Bids as follows were received May 26, by Maj. E. H. Schulz, U. S. Engineer, New Orleans, La., for dredging a canal between Calcasieu River and Sabine River, La. and Tex. (1) bid per cu. yd., place measurement on eastern half of canal, 750,000 cu. yds., (2) bid on western half, 750,000 cu yds., (3) bid on entire canal, 1,500,000 cu. yds.: Hillsboro Dredging Co., Tampa, Fla., (1) 22 cts.; John Jacobson, Texas City, Tex., (3) 12.74 cts.; Gulf Dredging & Timber Co., Ltd., Fort Adams, Miss., (1) 9.5 cts.; The N. G. Huth Dredging Co., Ltd., Franklin, La., (1) 8.20 cts.; R. B. Gordon & Co. Carrollton, Mo., (1) 7 cts., (2) 7 cts., (3) 7 cts.; Home Dredging Co., Mobile, Ala., (3) 9.95 cts.; Canal Construction Co., Chicago, Ill., (3) 6.75 cts.; Bowers Southern Dredging Co., Galveston, Tex., (1) 6.7 cts., (2) 6.7 cts., (3) 6.6 cts.; R. H. & G. A. McWilliams, Chicago, Ill., (3) 7.98 cts.; John Anderson, Abbeville, La. (1)

8.99 cts., (2) 8.99 cts., (3) 8.99 cts.; Fred C. Morgan, Vincennes, Ind., (3) 6.94 cts.; E. W. Brown & W. H. Stark, Orange, Tex., (3) 7.125 cts.; Henry Goldthwaite, Mobile, Ala., (3) 8 cts.

Maine.

Bids as follows were received May 29, by the U. S. Engineers, Portland, Me., for dredging in Portland Harbor: (1) bid on 216,000 cu. yds., in inner harbor; (2) bid on 1,142,000 cu. yds. in anchorage, and (3) bid 55,200 cu. yds. in back cove entrance: Morris & Cummings Dredging Co., New York city, (1) 10.6 cts., (2) 10.6 cts., (3) 10.6 cts.: J. S. Packard Dredging Co., Providence, R. I., (1) 30 cts., (2) 15 cts., (3) 20 cts.; Jeremiah P. O'Riorden, Charlestown, Mass., (1) 27⅛ cts., (2) 17¼ cts., (3) 28 cts.; Coastwise Dredging Co., Norfolk, Va., (1) 24 cts., (2) 14.6 cts., (3) 20 cts.; Eugene Breymann, Boston, Mass., (1) 25 cts., (2) 9.5 cts., (3) 25 cts.; John A. Seely, New York city, (1) 16½ cts., (2) 16½ cts., (3) 16½ cts.; P. Sanford Ross., Inc., Jersey City, N. J., (1) 27½ cts. per cu. yd., (2) 16.2 cts. per cu. yd., (3) 27½ cts. per cu. yd.

Washington.

It is expected, according to advices from Puyallup, Wash., that the County Commissioners, Tacoma, Wash., will shortly advertise for bids for the construction of two jetties along the Stuck and Puyallup Rivers in Pierce County.

Bids were opened May 14 by the Port Commission of Seattle, Wash., for the construction of the superstructure for the East Waterway improvement. Harrington, Peters Co., Oriental Block, Seattle, Wash., at $97,200 was the low bidder and will probably be awarded the contract. The work includes two transfer sheds, each 90 ft. wide by 790 ft. long. The sheds will be fitted with ship towers and other freight handling machinery.

Harrington, Peters Co., Oriental Block, Seattle, Wash., at $230,316 was the low bidder May 15 for constructing substructures at Smith's Cove for the Port Commission of Seattle. This work includes 350,000 ft. creosoted piling, 458,000 ft. untreated piling, and 65,500 sq. ft. sheet piling.

Preliminary plans have been prepared for a sea wall and fill on Railroad Ave., Seattle, to cost $300,000. A. H. Dimock is City Engineer.

Wisconsin.

✣Bids will be received until noon, June 30, by Capt. E. D. Peek, U. S. Engineer, Duluth, Minn., for furnishing and placing rock on breakwater at Ashland, Wis.

⊙Greiling Bros., Green Bay, Wis., have been awarded a contract at 18 cts. per cu. yd., for 25,000 cu. yds. of dredging for the city of Racine, Wis.

Canada.

⊙The Canadian Stewart Co., Montreal, Que., is reported to have been awarded the contract by the Toronto Harbor Commissioners, E. L. Cousins, Harbor Engineer, 76 Adelaide St., W. Toronto, Ont., for dredging in connection with the water front development. The contract calls for about 31,270,000 cu. yds. of dredging. The estimated expenditure on the harbor front improvements is $19,142,088. Of this amount $6,462,344, will be expended in connection with the dredging operations, divided as follows: Eastern section, industrial area, $3,489,101; eastern entrance to Woodbine, $756,303; Island shores, 640,140; western section, Bathurst street to the Humber, $1,576,800.

New and Standard Books

Send for Complete Catalog of the Following Books:

Handbook of Cost Data. SECOND EDITION.
By Halbert P. Gillette, M. Am. Soc. C. E., Managing Editor of "Engineering-Contracting." The 1910 edition of this book contains nearly 1,900 pages. Postpaid, $5.00.

Diagrams for Designing Reinforced Concrete Structures.
Including Diagrams for Reactions and Strengths of Steel Beams, by G. F. Dodge, M. West. Soc. Engrs. 13 × 15½ inches; 104 pages. Postpaid, $4.00.

Cost of Electric Transmission Lines.
(Both Conduits and Pole Lines.)
The title of this book, by Clarence Mayer, is "Telephone Construction-Methods and Cost," which is somewhat a misnomer in that it does not indicate its wide scope. It is 6 × 9 ins.; 300 pages. Postpaid, $4.00.

Engineers' Pocketbook of Reinforced Concrete.
By E. Lee Heidenreich. "Mr. Heidenreich's pocketbook is nearer the ideal than any on the same subject heretofore published." —Engineerings' News, Jan. 14, 1909. Leather; 4½ ×6¾ ins.; 374 pages. Postpaid, $3.00.

The Reinforced Concrete Pocketbook.
By L. J. Mensch, M. Am. Soc. C. E. A book by an experienced engineer and successful contractor. Leather; 4¼ × 6¼ ins.; 216 pages. Postpaid, $4.00.

Concrete Bridges and Culverts.
(Both Railway and Highway.)
By H. Grattan Tyrrell. Leather; 4½ × 6¾ ins.; 272 pages. Postpaid, $3.00.

Tables for Structural Engineers.
By Edward Godfrey. Leather; 4 × 6½ ins.; 218 pages. Postpaid, $2.50.

Solid Bitumens.
Their Physical and Chemical Properties and Chemical Analysis, by S. F. Peckham. Cloth; 6 × 9 ins.; 330 pages. Postpaid, $5.00.

Graphic Statics.
By Charles W. Malcolm. This book has been adopted as a textbook by a large number of engineering colleges. Cloth; 6 × 9 ins.; 330 pages. Postpaid, $3.00.

Cost Keeping and Management Engineering.
By Halbert P. Gillette and Richard T. Dana. Cloth; 6 × 9 ins.; 360 pages. Postpaid, $3.50.

Theory and Design of Reinforced Concrete Arches.
By Arvid Reuterdahl, Chief of Bridge Dept., City of Spokane. Cloth; 6 × 9 ins.; 132 pages. Postpaid, $2.00.

Railroad Location Surveys and Estimates.
By F. Lavis, M. Am. Soc. C. E. Cloth; 6×9 ins.; 270 pages. Postpaid, $3.00.

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By F. A. Smith. Cloth; 5½ × 7¾ ins.; 600 pages. Postpaid, $1.50.

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Engineering Work in Towns and Cities.
By Ernest McCullough. Cloth; 6 × 9 ins.; 510 pages. Postpaid, $3.00.

A Treatise on the Design and Construction of Mill Buildings and Other Industrial Plants.
By Henry Grattan Tyrrell, C. E. (Toronto University). Author of Mill Building Construction (1900), Concrete Bridges and Culverts, History of Bridge Engineering, etc. Cloth; 6 × 9 ins.; 500 pages. 650 illustrations. Price, $4.00 net, postpaid.
"Affords by far the largest and best collection of practical information on Mill Buildings yet published." — Engineering News. August 17, 1911.

Practical Cement Testing.
By W. Purves Taylor. The most complete book on the subject. Cloth; 6 × 9 ins.; 330 pages. Postpaid, $3.00.

Concrete Construction—Methods and Cost.
By Halbert P. Gillette and Charles S. Hill, Editors of "Engineering-Contracting." Cloth; 6 × 9 ins.; 700 pages. Postpaid, $5.00.

Cements, Mortars and Concretes.
By Myron S. Falk. A summary of tests and conclusions derived therefrom. Cloth; 6 × 9 ins.; 184 pages. Postpaid, $2.50.

Surveyor's Handbook.
By T. U. Taylor, Professor of Civil Engineering, University of Texas. Leather; 4½ × 7 ins.; 328 pages. Postpaid, $2.00.

Concrete and Reinforced Concrete Construction.
By Homer A. Reid, Assoc. M. Am. Soc. C. E. The largest book on concrete. Cloth; 6 × 9 ins.; 906 pages; 715 illustrations. Postpaid, $5.00.

Bricklaying System.
By Frank B. Gilbreth, M. Am. Soc. M. E. Cloth; 6 × 9 ins.; 330 pages. Postpaid, $3.00.

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Rock Excavation—Methods and Cost.
By Halbert P. Gillette. Cloth; 5½ × 7 ins.; 384 pages. Postpaid, $3.00.

Backbone of Perspective.
By T. U. Taylor, Professor of Civil Engineering, University of Texas. Cloth; 4½ × 7 ins.; 56 pages. Postpaid, $1.00.

Engineering Law—The Law of Contract.
By Alexander Haring, LL.B., M. Am. Soc. C. E., Professor of Bridge and Railway Engineering, New York University. Cloth; 6 × 9 ins.; 510 pages. Postpaid, $4.00.

Concrete Inspection.
By Chas. S. Hill, C.E. Cloth; 3½ × 6 ins. 186 pages; Illustrated. Postpaid $1.00.

Reinforced Concrete—A Manual of Practice.
By Ernest McCullough, M. West. Soc. Engrs. Cloth; 5 × 7¾ ins.; 136 pages; illustrated. Postpaid $1.50.

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CHICAGO

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

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The Life of Paint and Its Bearing Upon Problems of Structural Design.

When we consider the aggregate annual cost of repainting existing structures it is surprising how meagre are printed statements as to the life of paint. None of the "engineer's pocketbooks" and none of the books on paint give information worthy of note as to the durability of paint.

In the journal of the New England Water Works Association for December, 1912, it is stated by Mr. Dexter Brackett that an unprotected standpipe at Arlington was painted in 1906 at a cost of $425, and again in 1911 in the same manner at a cost of $475. The standpipe is 40 ft. in diameter and 60 ft. high. After being cleaned the interior was given one coat of red lead and two coats of Gilsonite. The exterior and roof were given one coat of white lead. This indicates a cost of about $100 per annum for painting, the life of the paint being about five years.

On page 1643 of Gillette's "Handbook of Cost Data" the life of paint on a steel bridge is given at 5 years in one instance and 7 years in another. Probably the effective life of paint on exposed steelwork does not average more than about five years. But when protected from the direct action of rain, the life may be much longer. Thus, in the same water works "Journal" above mentioned, it is stated that the standpipe on Forbes Hill, Quincy, was painted inside and out, in 1902 at a cost of $427, and again in 1912 at a cost of $430. This standpipe is enclosed in a masonry tower, which protects it from the rain and from ice formation, which probably accounts for the 10-year life of the paint. The pipe is 30 ft. in diameter and 64 ft. high. The original cost of this Quincy standpipe is given in detail in Gillette's Handbook, page 725-727, where it will be seen that the steel work cost about $4,500 in place. On page 729, Mr. B. I. Cook is quoted as saying that the exterior of unprotected steel standpipes should be painted about once in five years and the interior every two years.

If it is necessary to spend $100 a year in repainting the steel work of a pipe whose first cost is about $5,000, then this item of maintenance alone is 2 per cent of the first cost. Capitalizing the $100 at 5 per cent, we have $2,000 (or 40 per cent of the first cost) which is the amount that could be economically spent in construction that would eliminate the necessity of painting.

The cost of scraping and repainting steel railway bridges with two coats is commonly about $2 per ton, or 40 cts. per ton per annum, which is 0.6 per cent of a first cost of $70 per ton of steel in place. While this is not a high percentage, it is sufficient to merit attention when comparisons are being made between steel and concrete bridges. In highway bridges the area of surface per ton of steel is about 60 per cent greater than in railway bridges (Gillette's Handbook, p. 1637). Hence the annual cost of maintaining the paint on a highway bridge approximates 1 per cent of the first cost of the steel superstructure. Capitalizing this 1 per cent at 5 per cent, we see that it would pay to increase the cost of the superstructure by 20 per cent if the cost of painting could be forever eliminated.

When looked at in this way, the question as to the life of paint becomes one of no slight importance.

Large Bucket Dredge.—A bucket dredge claimed to be the largest in the world was recently launched at Renfrew, Scotland. It is 309 ft. long, 47 ft. wide and 20 1/6 ft. deep. It is to work at the entrance of the Suez canal.

The Profits of a Great Manufacturing Company Contrasted With Those of Railways.

In our issue of May 25, 1910, we endeavored to show that the best way of expressing the profits of any business is as a percentage of the gross annual income. We also pointed out that "net earnings" should not be confused with "profits." From the "net earnings" should be deducted the interest on the actual cash invested in the plant, the balance then being the "profits." Failure to follow this method is responsible for much of the public misapprehension as to what the true profits of public service companies are. Furthermore, as we have previously shown also, the amount of fair profit should not be gaged solely by its ratio to the invested capital, but prefarably by its ratio to the gross annual income. The twenty-first annual report of the General Electric Co. contains statistics that serve admirably to illustrate these principles.

During the year 1912 the following were the gross sales and expenses of the General Electric Co.:

Sales billed	$89,132,185
Cost of sales	81,074,192
Net earnings	$ 8,107,993

It will be noted that the net earnings were nearly 9 per cent of the gross sales. This, it will be conceded, is not a large percentage. Let us now look at the net earnings from the point of view commonly taken by those who criticise railway rates.

The book value of all the manufacturing plants of the company, as of Dec. 31, 1912, was:

Machinery	$ 9,176,986
Real estate and buildings	15,379,122
Patents	1

Furniture and fixtures	1
Patterns	1
Total	$24,556,111

In passing it is of interest to note that the total factory floor space was 12,160,000 sq. ft., and that 60,000 persons were employed by the company.

For present purposes, let us call the plant investment $25,000,000. Then the net earnings of $8,107,993 amount to more than 32 per cent of the plant investment. In addition to the investment in the plant, there are investments in patents of an amount not stated, although it is said that $539,956 was expended during the year in the purchase of patents and in the payment of licenses, etc. Accounts and rates receivable amounted to nearly $27,000,000, Dec. 31, 1912, and at least part of this—the difference between accounts receivable and accounts payable—should be regarded as necessary working capital. However, the available data do not enable us to determine the amount of necessary working cash capital. If no working cash capital were required, still it would be necessary to pay interest on the $25,000,000 plant, which at 5 per cent is $1,250,000. Deducting this from the $8,100,000 net earnings, there remains $6,850,000. This would be the profit if no working cash capital were required, and this is less than 8 per cent of the gross income. We conclude, therefore, that, while the net earnings are 32 per cent of the plant investment, the profit is less than 8 per cent of the gross income.

For purposes of rough comparison with steam railway earnings, we have the following averages for American railways:

Gross earnings per mile	$11,500
Operating expenses and taxes	8,000
Net earnings	$3,500

Appraisals in different states indicate a plant value that will probably exceed $45,000 per mile. More than likely it will be found to average fully $50,000 per mile. In which case the railway net earnings will average about 7 per cent of the railway plant value. Assuming interest at 5 per cent, we have $2,500 interest on the $50,000 per mile, which deducted from the $3,500 net earnings leaves $1,000 profit per mile of line. This annual profit is about 9 per cent of the gross income, whereas the net earnings are 7 per cent of the plant value.

It will be seen that while the profits expressed as a percentage of gross income are not widely different in the two cases above considered, the net earnings expressed as a percentage of plant value are widely different. The average steam railway has nothing to fear which ever way net earnings and profits are viewed, so long as proper comparisons are made between the railways and large manufacturing industries, banks, etc. But the most rational basis of comparison is to express the profits as a percentage of gross income, always remembering that interest charges on the invesment should be deducted from net earnings to deduce the true profit.

Cost of Swiss Hydro-Electric Plants Showing Relation of K. W. Cost to Size of Plant.

Not a few editorials have advocated the more general utilization of small water power. But sight appears to have been lost of two very important facts: First, that the K. W. cost of small units is much greater than of large units; second, that the annual wages of attendance costs much more per K. W. for small units than for large units. Mr. H. A. McBride, in a recent consular report, gives some interesting general data relative to Swiss hydro-electric plants. About 160 hydro-electric plants having a combined capacity of 342,000 K. W. have reported their construction costs, showing the following results:

Size of Plant.	Cost per K.W.
100-k.w. or less	$467
100 to 500-k.w	281
5,000 to 6,000-k.w	177
20,000 to 30,000-k.w	161
Average of all	211

This average of $211 is divided thus:

	Per K.W.
Hydraulic plant	$116
Electric plant	95
Total plant	$211

The $95 of electric plant includes the transmission lines and probably it includes the distribution lines also.

The "Electrical World" of May 10 describes a Swedish hydro-electric plant of 15,000 K. W., and gives its construction cost in some detail. The plant is located at Mockfjord and was recently completed. Water from the river is diverted by a dam and through a discharge tunnel, 5,000 ft. long, giving a head of 78 ft. The water wheels and generators are located in subterranean chambers. There are four horizontal turbines of 5,100 H. P. each, at 225 r. p. m., direct connected to four generators, each of 4,500 K. V. A. (or 3,800 K. W. at 85 per cent power factor). It is not clear why the water wheels were not given about 25 per cent greater capacity than the rated capacity of the generators instead of being practically the same capacity; for generators are commonly designed to carry 25 per cent overload for a short time. Assuming the rated capacity of the generators to be 15,000 K. W., the following was the cost of the plant:

		Per K.W.
1.	Water rights and real estate	$14.91
2.	Dam, flume and tunnels	31.93
3.	Generating room and switch house	6.82
4.	Turbines and governors	2.11
5.	Generators	4.28
6.	Transformers	1.39
7.	Switching apparatus	2.82
	Total	$64.76
8.	Transmission lines	$ 7.87
9.	Substation	1.42
10.	Dwellings and engineering	1.15
11.	Overhead charges, interest, etc	7.57
	Grand total	$82.77

This entire plant is very inexpensive, but the low cost of the turbines is particularly noteworthy. In America the cost of the waterwheels is commonly about the same as the cost of the generators.

In subsequent issues we shall give in great detail the cost of a dozen or more American hydro-electric plants.

GENERAL ARTICLES

Cost and Construction of a Memorial Entrance at Columbia, Mo.

Contributed by W. C. Davidson, Columbia, Mo.

This entrance consists of two main columns approximately 16 ft. high, one on each side of the foot walk leading to the college grounds. On each side of this entrance, symetrically spaced, are two cinder drives leading into the campus, and on each side of these drives is placed a minor column about 11 ft. high. Connecting the small column on the inside of each drive with each of the large columns at the main entrance are masonry walls laid out on graceful curves.

The exterior of all the columns or shafts are composed of cut stone ashlar masonry, while the interior consists of brick work. The masonry wall connecting the large shaft with the smaller is composed of random ashlar with a rock facing. On the top of each of the large shafts is a lamp and on each of the smaller shafts is a cut stone vase. A bronze plate with a memorial inscription is to be placed on the front of each of the larger columns.

Concrete Footings.—The foundation of the columns and masonry walls consists of concrete mixed in the proportion of 1 part of cement, 2 parts of sand and 4 parts of broken stone. The aggregate specified was to consist of clean river gravel or broken stone, none being larger than 2½ ins. on the longest diameter.

The cement specified was Iola and the sand was to be clean and sharp. To prevent moisture from reaching the ashlar above, the top of the concrete footings were painted with a water-proof coating. A careful ramming of all concrete was also specified in order to insure the filling of voids. A lead conduit for the wiring to the lamps on top of the columns was placed on each main column footing before the concrete had set.

Brick Backing.—Hard burned common brick was used for backing up the stone work. This backing work was brought up at the same time as the masonry, each brick being laid with a shove joint in a full bed of mortar. Where the brick came in contact with the anchors, care was taken to form as firm a bond as possible. The mortar joints for the brick were ⅜ in. Each brick was thoroughly wet before using.

The mortar for the brick was composed of three parts of lime mortar having a large proportion of sand and six parts of Iola cement. The lime mortar was worked for at least two days before the cement was added, and then only small quantities of cement were added at a time. The stone work was plastered with lime mortar on the inside and care taken that the mortar of the brick was not pushed out in contact with the stone. This was to prevent the discoloration of the stone from the cement mortar. The specifications provided for a clear space of ¼ in. between the brick and the stone work.

Cut Stone Work.—The cut stone used in the shafts was first quality Bedford laid with 3/16 in. joints. This work was of regular coursed ashlar, 12 ins. for the large shafts and 8 ins. for the smaller ones. Each stone contained an anchor connecting it with the interior brick work. The stone used in the shafts was tooled and laid with carefully matched joints which were raked out to a depth of 1 in. and filled with non-staining cement. The anchors were made of galvanized iron and were dipped in tar before being laid in place.

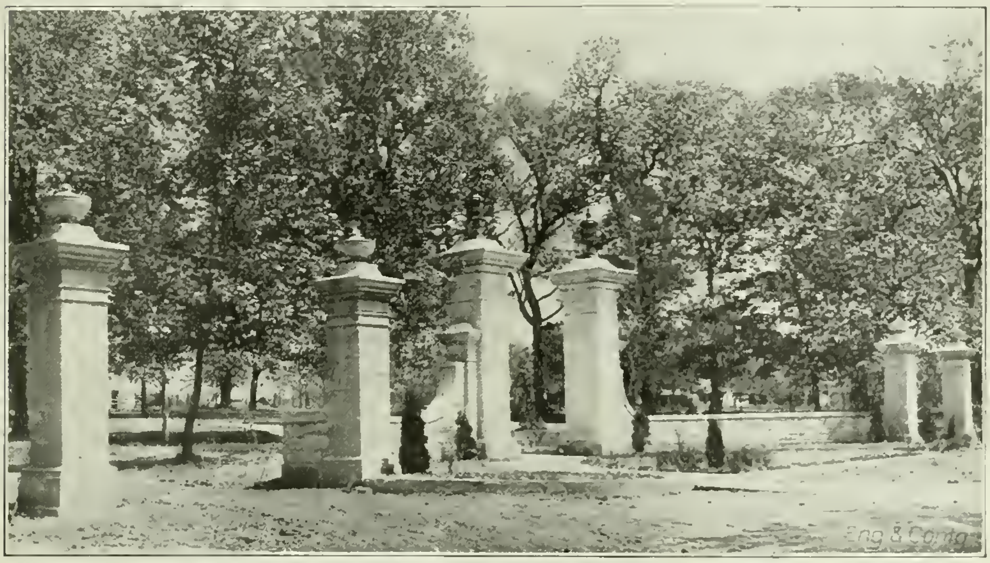
The bases of all the shafts were set with dowel pins projecting into the concrete footings, two pins being used for each stone. These pins projected 4 ins. into the stones. In each face of the large shafts a panel was cut to allow for the insertion of a memorial tablet which, when set, was to lie flush with the face of the stone. The mortar for this stone was a lime mortar composed of hydraulic lime and clean sharp sand.

Masonry Wall.—The curved masonry walls connecting the large and small shafts were constructed of a white crystalline limestone obtained from a local quarry. These walls are of random ashlar with a rock face and are capped with coping stones of Bedford stone as shown on drawing. The copings of these walls are held in place by anchors extending into the main walls. The stone of the main walls were laid with ½ in. tape joints. The base of these walls are of cut Bedford stone. Where the masonry wall joins the main shaft an engaged minor shaft extends out several inches to meet this wall. This engaged minor shaft or half-column is shown in detail on the drawing.

The mortar used in these walls was composed of Iola cement and sand mixed in the proportion of 1 part of cement to 2 parts of sand. The joints were raked out to a depth of 1 in. and pointed with a non-staining cement. The walls were built solid to a thickness of 14 ins. The base courses of these walls are 18 ins. wide having a 2-in. bevel on each side.

Cost.—A detailed statement of the cost is as follows:

Excavation, 27 cu. yds., at 40 cts.	$ 10.80
Concrete, 37 cu. yds., at $5.20	202.40
Forms, 836 B. M., at 10 cts.	83.60
Rubble masonry, 7 perch, at $5	35.00
Facing rubble, 284 sq. ft., at 30 cts.	85.20
Brick, 5,000, at $20	100.00
Anchors and clamps	10.00
Waterproofing, 10 gals., at $1	10.00
Bedford stone, 589 cu. ft., at $2, in place	1,178.00
Bronze memorial plates, 2, at $50	100.00
Lamps and wiring	175.00
Cap urns for small shafts, 4, at $20	80.00
Total cost	$1,985.00



Memorial Entrance to Christian College, Columbia, Mo.

Construction Expenditures on the Panama Canal for the Quarter Ending March 31, 1913.

The statement of the Isthmian Canal Commission of construction costs for the first quarter of 1913 contains interesting data on unit costs, which we have rearranged, and publish herewith. For comparison, previous quarterly reports, similarly arranged, may be found in ENGINEERING CONTRACTING, Dec. 7, 14 and 21, 1910; Feb. 22, Mar. 1, May 24 and Sept. 21, 1911; Feb. 28, May 29, Sept. 4 and Dec. 11, 1912.

Dams.—Gatun dam is 98 per cent completed. The last of the piers for the north approach have been brought to full height, and June 1 is set as the date for the completion of the sea gates. As soon as they are finished, the barrier of rock between the locks and the Atlantic entrance channel can be removed. This will require the operation of three pipeline suction dredges for about three months.

During the months of January, February and March, 1913, 334,502 cu. yds. of dry fill were placed at the dam. Excavation for rip rap rock amounted to 15,078 cu. yds. at a cost of $2.8094 per cubic yard. The costs of the dry filling per cubic yard were as follows:

Excavation	$0.0741
Tracks	0.0482
Transportation	0.0664
Filling	0.0765
Maintenance of equipment	0.0487
Division	0.0137
Total division cost	$0.1948
Administrative and general expense	0.0292
Total cost	$0.2240

At the Pedro Miguel dam there were placed during the quarter 22,198 cu. yds. of dry fill. The costs per cubic yard were as follows:

Tracks	$0.0951
Transportation	0.0324
Filling	0.0346
Maintenance of equipment	0.0184
Plant arbitrary	0.0027
Division	0.0100
Total division cost	$0.1929
Administrative and general expense	$0.0274
Total cost	$0.2203

There was also 304 cu. yds. of excavation in January at $1.4699 per cubic yard, and 630 cu. yds. of masonry work on the core walls, which averaged $4.8235 per cubic yard.

Costs of work per cubic yard on the Miraflores dam for the quarter were as follows:

Dry fill, cu. yds.	130,995
Tracks	$0.1000
Transportation	0.0670
Filling	0.0646
Maintenance of equipment	0.484
Plant arbitrary	0.700
Division	0.0135
Total division cost	$0.3635
Administrative and general expense	0.0251
Total cost	$0.3886
Excavation, cu. yds.	42,152
Drilling	$0.1609
Blasting	0.0633
Excavation by power	0.0651
Excavation by hand	0.8794
Transportation	0.1650
Tracks	0.1691
Trestles	0.2048
Pumps	0.1233
Maintenance of equipment	0.1465
Plant arbitrary	0.0300
Division expense	0.0843
Total division cost	$2.0917
Administrative and general expense	0.1357
Total cost	$2.2274
Excavation by power	$0.7038
*Excavation by Central Division, cu. yds.	58,171
Total excavation, cu. yds.	100,323
Unit cost	$1,7469
Masonry—core walls—cu. yds.	3,813
Concrete	$3.8008
Plant arbitrary	0.5300
Maintenance of equipment	0.0746
Division expense	0.0604
Total rivision cost	$4.4658
Administrative and general expense	0.4112
Total cost	$4.8770

Locks and Spillways.—Concrete work in the locks is nearly completed, the aggregate amount in place at the close of work on May 24 being 4,457,568 cu. yds. The unit costs of the work on locks and spillways are given in Table I.

Dry Excavation.—The total excavation for the quarter on the Central Division amounted to 3,316,280 cu. yds. On the Pacific Division 1,105,745 cu. yds. The unit costs of this work were as follows:

Items.	Central Division.	Pacific Division.
Dry excavation, cu. yds.	3,316,280	1,105,745
Clearing		$0.0010
Drilling	$0.0567	0.0390
Blasting	0.0488	0.0284
Loading	0.0541	0.0756
Tracks	0.1010	0.1530
Transportation	0.0902	0.0857
Dumps	0.0543	0.0217
Pumps	0.0049	0.0145
Maintenance of equipment	0.1149	0.0777

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*This excavation was accomplished during the months, October, 1912, to January, 1913, inclusive.

TABLE I.—LOCKS AND SPILLWAYS CONSTRUCTION COSTS, PANAMA CANAL.

	Gatun spillway.	Gatun locks.	Pedro Miguel locks.	Miraflores locks.
Dry excavation, cu. yds.		76,154		
Drilling		$0.0240		
Blasting		0.0060		
Loading by power		0.0500		
Tracks		0.1003		
Transportation		0.1539		
Pumps		0.0463		
Maintenance of equipment		0.0584		
Division expense		0.0204		
Total div'n cost		$0.4593		
Admn. and general expense		0.0340		
Total cost		$0.4933		
Preparing foundations, excavat'n, cu. yds.		14,162	2,496	13,087
Drilling			$0.1402	$0.0499
Blasting				0.1641
Loading by power		$0.2556	0.0382	
Loading by hand		0.7797	0.6887	1.3508
Transportation		0.1551	0.0510	0.0450
Tracks		0.6341	0.7456	0.1608
Pumps		0.0937	0.0191	0.0149
Maintenance of equipment		0.3686	0.3024	0.1241
Plant, arbitrary				0.0300
Division expense		0.1308	0.1775	0.1008
Total div'n cost		$2.4176	$2.1627	$2.0404
Admn. and general expense		0.2523	0.2572	0.1913
Total cost		$2.6699	$2.4199	$2.2317
Preparing foundations, dredging, cu. yds.		5,603		
Dredging		$1.0163		
Sluicing		0.8704		
Pipe lines		0.1108		
Maintenance of equipment		0.1304		
Division expense		0.0543		
Total div'n cost		$2.1822		
Admn. and general expense		0.1523		
Total cost		$2.3345		
Preparing foundations, wooden piling, lin. ft.		159,329		13,380
Wooden piles in place		$0.4371		$0.1711
Maintenance of equipment		0.0160		
Plant, arbitrary		0.0424		
Division expense		0.0151		0.0086
Total div'n cost		$0.5106		$0.1797
Admn. and general expense		0.0766		0.0119
Total cost		$0.5872		$0.1916
Masonry.				
Concrete, cu. yds.	9,504	92,793	7,435	92,935
Cement	$1.3552	$1.2864	$1.6062	$1.8863
Stone	1.0202	1.8067	0.5674	0.5933
Sand	0.4826	0.5299	0.3527	0.3689
Mixing	0.2951	0.1524	1.3412	0.1954
Wood forms	1.4120	0.6154	0.7123	0.5140
Steel forms		0.0006		0.0334
Placing	0.9163	0.3605	0.7035	0.4652
Reinforcements	0.0570	0.0104		
Pumps	0.0028	0.0553	0.0158	0.0148
Power		0.0515	0.0004	0.0434
Cofferdams	0.0050			
Maintenance of equipment	0.2640	0.1665	0.0838	0.1651
Plant, arbitrary	0.2540	0.9380	0.0331	0.5303
Division expense	0.1404	0.0699	0.1644	0.0783
Total div'n cost	$6.2046	$6.0423	$5.5146	$4.8884
Admn. and general expense	0.5103	0.2469	0.7273	0.4004
Total cost	$6.7149	$6.2892	$6.2419	$5.2888
Masonry, reinforced, cu. yds.	369	1,605	7,823	11,796
Cement	$1.3381	$1.3411	$1.9407	$2.2597
Stone	1.0906	1.3856	0.5418	0.5764
Sand	0.4716	0.4103	0.3689	0.3721
Mixing	0.3826	0.0168	1.0989	0.5383
Wood forms	3.9288	0.1533	1.5938	3.0718
Steel forms		0.0141		
Power		0.0297	0.0011	0.0271
Placing	0.9829	0.8823	1.0913	1.2891
Reinforcements		3.1484	1.3724	0.4515
Chipping to grade		6.2832		
Pumps			0.0183	0.0133
Maintenance of equipment	0.2364	0.6294	0.0924	0.0987
Plant, arbitrary	0.2540	0.9380		0.5289
Division expense	0.3464	0.3820	0.2431	0.3059
Total div'n cost	$9.0314	$15.2794	$8.3627	$9.5328
Admn. and general expense	0.9992	1.8119	0.6312	0.8706
Total cost	$10.0306	$17.0913	$8.9939	$10.4034
Total masonry, cu. yds.	9,873	94,398	15,258	104,730
Total cost	$6.8388	$6.4729	$7.6529	$5.8648

Plant arbitrary		......	0.0900
Division expense		0.0118	0.0179
Total division cost		$0.5367	$0.6045
Administrative and general expense		0.0365	0.0330
Total cost		$0.5732	$0.6375
Back filling, cu. yds.	108,881	56,825	279,779
Drilling	$0.0117	......	....
Blasting	0.0069	......	....
Loading	0.0129	......	....
Tracks	0.0531	$0.1081	$0.0922
Transportation	0.0820	0.0736	0.0527
Filling	0.1330	0.0941	0.0440
Maintenance of equipment	0.0360	0.0387	0.0291
Plant, arbitrary	....	0.1300	0.1100
Division expense	0.0159	0.0140	0.0098
Total div'n cost	$0.1875	$0.4585	$0.3378
Admn. and general expense	0.0326	0.0314	0.0503
Total cost	$0.2201	$0.4899	$0.3881
Filling center wall, cu. yds.	....	73,864	9,466
Loading	....	$0.0004	....
Tracks	....	0.0534	$0.0248
Transportation	....	......	0.0024
Filling	....	0.0844	0.5224
Power	....	......	0.0186
Maintenance of equipment	....	0.0334	0.0878
Plant, arbitrary	....	0.1300	0.1100
Division expense	....	0.0065	0.0335
Total div'n cost	....	$0.3081	$0.7995
Admn. and general expense	....	0.0158	0.0090
Total cost	....	$0.3239	$0.8085

Dredging.—Dredging excavation during the first quarter of 1913 on the Atlantic Division amounted to 1,047,288 cu. yds. of earth and 145,242 cu. yds. of rock. On the Pacific Division earth excavation for the quarter amounted to 577,884 cu. yds. and rock excavation to 256,018 cu. yds. Unit costs for dredging excavation are given in Table II.

TABLE II.—COST OF DREDGING EXCAVATION, PANAMA CANAL.

	Atlantic division		Pacific division	
Items.	Quantities, cu. yds.	Unit cost.	Quantities, cu. yds.	Unit cost.
Clearing	......	......	833,902	$0,0001
Operation, seagoing suction dredge	129,975	$0.0220	176,054	0.0752
Repairs, seagoing suction dredge	129,975	0.0325	176,054	0.8810
Operation, small ladder dredges	95,955	0.2175	247,930	0.1052
Repairs, small ladder dredges	95,955	0.1015	247,930	0.0636
Operation, 5-yard ladder dredge	......	......	352,895	0.0826
Repairs, 5-yard ladder dredge	......	......	352,895	0.0465
Operation, dipper dredges	148,074	0.1260	57,023	0.1532
Repairs, dipper dredges	148,074	0.0931	57,023	0.2246
Operation, pipe line dredges	818,526	0.0509	......	......
Repairs, pipe line dredges	818,526	0.0498	......	......
Pipe lines	818,526	0.0188	......	......
Dykes	818,526	0.0002	......	......
Operation, tugs, clapets and scows	244,029	0.1290	657,848	0.0815
Repairs, tugs, clapets and scows	244,029	0.0622	657,848	0.0201
Drilling	145,242	0.0489	256,018	0.1262
Blasting	145,242	0.1229	256,018	0.1673
Operation, drill barges	......	......	256,018	0.1059
Repairs, drill barges	......	......	256,018	0.0216
Operation, rock breakers	......	......	256,018	0.0388
Repairs, rock breakers	......	......	256,018	0.0157
Small boats	1,192,530	0.0024	833,902	0.0070
Repairs, miscellaneous equipment	1,192,530	0.0009	833,902	0.0135
Plant arbitrary	1,192,530	0.0510	833,902	0.0193
Division expense	1,192,530	0.0099	833,902	0.0117
Total division cost	1,192,530	$0.2587	833,902	$0.4903
Administrative and general expense	1,192,530	0.0319	833,902	0.0418
Total cost	1,192,530	$0.2906	833,902	$0.5321
Earth excavation—per cent	1,047,288	87.82	577,884	69.30
Rock excavation—per cent	145,242	12.18	256,018	30.70

Stone Production.—Costs of quarrying, crushing and transporting stone from the Ancon quarry during the quarter were as follows:

Quarrying, cu. yds.	197,475
Stripping	$0.0318
Drilling	0.0572
Blasting	0.0535
Loading	0.0470
Transportation	0.0553
Tracks	0.0338
Maintenance of equipment	0.0626
Plant, arbitrary	0.1000
Total	$0.4412
Crushing—	
Operation of crushers	$0.0235
Stone bins and conveyors	0.0043
Power	0.0186
Maintenance of equipment	0.0173
Plant, arbitrary	0.0220
Total	$0.0857
Rail transportation to storage—	
Operation of trains	$0.0353
Dumping in storage	0.0162
Maintenance of equipment	0.0181
Plant, arbitrary	0.0400
Total	$0.1096
Division expense	$0.0158
Total cost in storage	$0.6523

Sand Production.—The costs of dredging and transporting sand at Gatun and Chamé follow:

Items.	Gatun.	Chamé.
Dredging, cu. yds.	10,883	113,155
Operation, dredges	$0.2827	$0.0906
Maintenance of equipment	0.0791	0.0301
Total	$0.3618	$0.1207
Plant, arbitrary	......	0.0066
Total cost of production	$0.3618	$0.1273
Towing, cu. yds.	10,883	113,155
Operation, tugs and barges	$0.1102	$0.1134
Maintenance of equipment	0.0077	0.0301
Plant, arbitrary	......	0.0133
Total	$0.1179	$0.1568
Unloading, cu. yds.	10,883	109,155
Operation, cableways and cranes	$0.0625	$0.0724
Power	0.0142	0.0152
Maintenance of equipment	0.0426	0.0202
Plant, arbitrary	......	0.0110
Total	$0.1193	$0.1188
Rail transportation to storage, cu. yds.	......	109,155
Operation of trains	......	$0.0437
Repairs to tracks	......	0.1426
Dumping in storage	......	0.0319
Maintenance of equipment	......	0.0233
Plant, arbitrary	......	0.0200
Total	......	$0.2615
Division expense	$0.0129	$0.0219
Total cost in storage	$0.6119	$0.6863

Colon Breakwater.—Additional facilities at the Porto Bello quarry will result in an increased output of rock for the Colon breakwater. Track conditions are better, and more rolling stock is available at that point. A 70-ton steam shovel, equipped with a crane boom, has been stationed at the dock for loading barges. Three steam shovels are operated from 6:30 a. m. to 2:30 p. m., and two from 2:30 to 6:30 p. m. Costs of construction at the Colon breakwater include quarrying and transporting rock from the Porto Bello quarry.

Items.	
Porto Bello Large Rock.	
Quarrying, cu. yds.	55,337
Stripping	$0.3157
Drilling	0.1094
Blasting	0.2152
Loading	0.1223
Transportation	0.1425
Tracks	0.2808
Loading on barges	0.1440
Power	0.1106
Maintenance of equipment	0.6090
Plant arbitrary	0.3320
Total	$2.3815
Towing—	
Operation, tugs and barges	$0.2009
Maintenance and equipment	0.1229
Plant, arbitrary	0.3840
Total	$0.7078
Placing—	
Operation of floating derricks	$0.1254
Maintenance, floating derricks	0.0877
Operation, cranes	0.1561
Operation, trains	0.0784
Dumping	0.0075
Maintenance of equipment	0.1367
Plant, arbitrary	0.1500
Total	$0.7418
Trestles	$0.1059
Tug service, miscellaneous	0.0632
Maintenance of equipment	0.0350
Division expense	0.1253
Total division cost	$4.1605
Administrative and general expense	0.3942
Total cost	$4.5547

Permanent Power House, Gatun.—Costs of the work of preparing foundations and the masonry substructure for the permanent power house at Gatun were as follows:

Preparing foundations, cu. yds.	369
Drilling	$0.4443
Blasting	0.0260
Loading by power	1.4852
Loading by hand	4,9169
Tracks	1.1460
Transportation	0.2979
Maintenance of equipment	0.5860
Division expense	.0.4976
Total division cost	$8.8041
Administrative and general expenses	0.8843
Total cost	$9.6884
Masonry substructure, cu. yds.	1,149
Cement	$1.3882
Stone	0.9960
Sand	0.4531
Forms	1.6327
Mixing	0.5787
Reinforcement	0.0019
Placing	1.2830
Cofferdams	0.0248
Maintenance of equipment	0.4249
Plant, arbitrary	0.2540
Division expense	0.1425
Total division cost	$7.1798
Administrative and general expenses	0.4380
Total cost	$7.6178

Crushing Tests of Mortar Briquettes Made of Sand With Powdered Filler.

Dear Sir: In your issue of April 20, 1913, are data on the crushing strength of concrete cubes with filler added. The curve of crushing strength seems to show an increase up to a certain percentage. Enclosed is a tabulation of some briquettes which we recently broke, and which were made of one part cement and three parts sand, with varying percentage of filler.

The filler used is a sort of disintegrated sand stone which is obtained from the foot hills above Boise and adjoining the Boise River. It has been used for some time by the asphalt company as filler for the asphalt pavements. It is to be found in immense quantities and can be readily ground to powder under the blade of an ordinary pocket knife. Sixteen ounces by measure of this filler only weighed 10½ ozs., while 16 ozs. by measure of sand which was used, weighed 24½ ozs. The sand is what is known as Sand Creek sand and shows the following screen test:

Sieve No.	Per cent retained.
200	2.0
100	3.6
80	5.3
50	16.2
40	11.9
30	7.1
20	23.9
10	30.0
	100.0

The above sand when compared with standard Ottawa sand, using the same cement and under similar conditions, shows very little difference in tensile strength.

Briquettes made of filler only, after being kept in the molds under damp cloth for 24 hours, immediately disintegrated when placed in water. The tabulation, Table I,

TABLE I.—EXPERIMENT OF ADDING FILLER TO SAND, MADE AT BOISE, IDAHO, CITY ENGINEER'S OFFICE.

Experiment No.	Material used. Cement. Ozs.	Material used. Sand. Ozs.	Material used. Filler. Ozs.	Per cent of filler in sand.	Per cent of water.	No. of briquettes.	Kind.	Tensile strengths, 7 days.	Av'ge.	Remarks.
1	....	..	10	..	35	2	Neat	...	...	Disintegrated in water.
2	3.33	10	..	..	10	2	3:1	285 295	290	
3	3.66	10	1	10	14	2	3:1	260 270	265	
4	4.00	10	2	20	15	2	3:1	240 225	232½	
5	4.33	10	3	30	16	2	3:1	230 215	222½	
6	4.66	10	4	40	17.5	2	3:1	195 175	185	
7	5.00	10	5	50	19	2	3:1	170 160	165	
8	5.33	10	6	60	20	2	3:1	150 145	147½	

shows a very steady decrease in tensile strength as the perecentage of filler was increased.

Experiment No. 2 is straight Sand Creek sand with no addition of filler. The tensile strength of 290 lbs., as shown, is typical of 1:3 mixtures of sand and cement which we have been getting for Western cements. We had expected to find an increase in tensile strength up to, perhaps, 20 per cent addition of filler, but, as I stated before, the results show a very steady decrease.

Very truly yours,
J. B. Marcellus,
Assistant City Engineer.

Boise, Idaho, May 27, 1913.

ROADS AND STREETS

Sand-Clay Road Construction in Butler County, Alabama.

In a number of counties in Alabama where funds for the improvement of highways are limited the sand-clay type of road is constructed. The following description of the methods employed in Butler County, Alabama, is abstracted from a paper by Geo. C. Scales, County Engineer, in the recently issued Proceedings of the Alabama Association of Highway Engineers:

The sub-soil of Butler county is mainly a very stiff red clay which comes to the surface for long distances, particularly near Greenville and for a distance of several miles in every direction from the city; occasionally there is a sandy strip of several thousand feet where the clay is a number of feet beneath the surface.

It is proposed to begin at Greenville and build four or five miles on each of the four main roads leading into the city, therefore the first work will be mainly in a heavy clay soil. In many instances the clay is already about the proper mixture or sand can be obtained within ½ mile, so that the main expense will be for grading and hauling.

For greater ease of construction and cheapness of maintenance, I think the improved country roads should be as narrow as will accommodate the traffic; provided that the shoulders are sufficiently wide to allow any future widening to be easily done should future traffic conditions demand it. I have planned to have the main roads near the city 22 ft. between ditches and 20 and 18 ft. wide where there is less travel; the ditches will be about 3 ft. wide and the surfaced roadway will be 14, 12 or 10 ft. wide according to the travel, leaving a shoulder of 4 ft. on each side.

As the roads are almost impassible after a heavy rain, it will be necessary to have the sand hauled in while they are dry and deposit it in piles along the sides of the road, from which it can be spread when the mixing is to be done.

It will be cheaper to begin this mixing just after the grading is finished and before the clay is compacted by travel and not wait for a rain to soften it, though the surface must be finally mixed and puddled with water. This can be done after shaping the foundation to the proper crown by plowing and harrowing the desired width to a depth of about 4 ins., then cover with 6 ins. of sand and mix in the dry state with tooth or disk harrow.

The road should be shaped while still soft with a road machine and can then be left for the traffic to harden with the frequent use of the drag. I believe that it will also be wise to use a petrolithic roller to compact the road at once, as if left for the travel to do uneven places will develop and there will be much complaint from the average farmer who has to haul loads over soft roads. If this is done a roller and drag can easily complete the road after a rain and it will save much dragging later.

A sandy sub-soil is harder than a clay to build a good road upon, as in most instances the clay must be hauled a longer distance and it is harder to keep the road from disintegrating under the traffic and rains. In building over a sub-soil of sand, begin spreading the clay nearest the pit so as to haul each load over the preceding load, tapering from 6 to 8 ins. at the center and a thin edge at the sides. Break up the larger lumps of clay as much as possible and after a rain cover the surfaces with a few inches of sand and plow, harrow and shape with road machine and leave for the traffic to harden, using the drag frequently. In shaping the road with a road machine, stakes can be driven at the required distance from the center to the outer edge and a crown of ¾ in. to 1 in. to the foot should be given if with a clay sub-soil and slightly flatter if the sub-soil is sand. The object of the latter case is to let the water soak into the sand shoulders and retain the moisture under the road. After the central part has been smoothed with the harrow, shoulders should be back furrowed with the plow, raising them to protect the sides of clay when placed in the bed; it also makes it easy to get from the shoulders the sand necessary on the roadway.

Vegetation should be encouraged to grow on shoulders of sand roads. Six inches of sand worked into the ordinary clay should be sufficient and 8 to 12 ins. of clay on a sand base. Sometimes level stretches of sand on a sub-soil of clay only need to be ditched with a road machine and clay enough from the ditches added to make a fair road; this would be about the cheapest road that could be built with all conditions of grade, material, etc., being favorable and would cost about $400 per mile. From that it might go as high as $1,500 per mile where there is heavy grading and a long haul for the finishing material.

Assuming that clay can be procured within a mile of the road and that labor could be obtained for $1.25 per day and teams for $3 per day, a 12-ft. sand-clay road on a sand foundation covered with clay to an average depth of 6 ins. would cost about as follows for one mile:

Crowning and shaping with road machine using three teams at $3.50 per day and one operator at $1.25 per day	$ 12.25
Loosening 1,200 cu. yds. clay at pit with plow and shoveling into wagons, 15 cts. per cu. yd.	180.00
Hauling 1,200 cu. yds. one mile, 25 cts. per cu. yd.	300.00
Spreading clay with road machine using two teams at $3.50 and one operator at $1.75 for 3 days	20.25
Shoveling sand on clay at .01 cts. per sq. yd.	70.00
Plowing, using one team at $4 a day, 4 days	16.00
Harrowing, using one team at $4 a day, 2 days	8.00
Shaping and dressing with road machine, using two teams at $3.50 and one operator at $2 a day, 2 days	18.00
Foreman at $3 per day, 6 days	18.00
Rolling, using 4 teams at $3.50 per day, 4 days	56.00
	$704.50

In writing specifications for sand-clay roads so that the entire road may be built by contract, the finishing really becomes a haul proposition, the contractor being paid so much per cu. yd. for each ¼ mile for hauling, spreading, harrowing and dragging the same to the satisfaction of the engineer. The county would have to furnish such sand or clay pits as were necessary and the right of way from pits to road and I am of the opinion, where a county is obliged, by its poverty, to build sand-clay roads, whether by contract or with its own equipment, it would save money by finishing the roads itself if it has a good foreman. By so doing, the county could take advantage of weather conditions and they must keep an outfit and foreman anyway for the maintenance of roads already built.

Sand-clay roads must be cared for after construction until the proper condition is established. This is very important, as no sand-clay road is in proper condition when it is first completed.

I have proposed that Butler county build split-log or plank drags or buy steel drags and leave them with farmers along each road at intervals of five or ten miles, each man agreeing to thoroughly drag five miles after each rain for which he will be paid at the rate of $4 per day. After the first year it should not be necessary to drag the road as often if the mixture has been carefully proportioned and regulated during the first year. Maintenance would probably cost $5 per mile per year in this way.

Road Management.

The administrative side of highway construction and maintenance has of late attracted much attention. At nearly every road congress or convention held in the past two years papers dealing with questions of administration have occupied prominent positions on the programs. It is now commonly held that future advance in road betterment is largely dependent upon successful management. Where good business organization has been applied to highway work better results have always been obtained. The following interesting discussion of the question of road management is given by Mr. Laurence I. Hewes, Chief of Economics and Maintenance, Office of Public Roads, in a bulletin on the Repair and Maintenance of Highways, issued last month by the U. S. Office of Public Roads:

The repair and maintenance of public highways has suffered greatly from poor administrative systems. Such work is necessarily of a more routine character than the work of new construction, and the failure to recognize its importance has in the past led road officials to subordinate it to the execution of new work. It would seem that at just the point in road operations where stimulus of effective organization was most needed it has been absent. The only successful attempts at systematic repair and maintenance that are on record are those attempts which have been managed with skilled and strong central control. Almost without exception, those states which have undertaken state aid in any form for road building have, in the annual reports, reiterated the necessity of removing the responsibility of repair and maintenance of such roads from local authorities. In a number of states this change has been made, and the results have been an immediate improvement.

Viewing public roads as a whole, the defects of subdivided administrative units are conspicuous. The number of men who have more or less authority and personal direction over road matters in some sections of the country is extraordinary. There are at least 150,000 such road officials in this country. The term of office of these men is but a year or two, and rotation in the office tends to be the rule.

A fundamental difficulty with the organization of road systems which must handle repair and maintenance appears to be the failure to recognize that road work is a trade which requires training. Training for road work must necessarily be obtained at the expense of the community. As a rule, road officials, are not in office long enough to mature their experience, and there is a constant economic waste of road funds.

Repair and maintenance operations upon all public roads necessarily extend over a period of years. In order to secure effective execution of such operations, a comprehensive plan for several years is necessary. The work for each season must be carefully laid out in advance as far as possible. Where maintenance work has been seriously undertaken under such a system it has responded with gratifying results. Whatever the civil subdivision may be which constitutes the administrative road unit, a good road map showing all the various classes of roads is desirable.[1]

It has been found that the best results follow in an administrative district where the mileage of roads is sufficient to warrant the continuous employment of a man who is either a highway engineer or a competent road builder, whose interest is primarily in road work, and who has charge of road matters in his district. Where such a man is employed from year to year he can select competent men for road work, and he is able to plan with confidence systematic improvements which must wait for successive annual appropriations. Good business organization in road work demands an adequate bookkeeping system from which unit prices for various classes of work can be easily derived. Too frequently road accounting presents an accurate list of men to whom money has been paid for material or labor, but from which no estimate of the cost of future repair and maintenance work can be established.

It will be more and more necessary in the future to study the service of various roads by accurate traffic censuses. From the investigations that have already been made, it appears that for any civil subdivision a relatively small percentage of all the roads carry nearly all the travel. In France a traffic unit called the "collar" is used. The "collar" is a single horse harnessed to a vehicle, and all other traffic is reduced to "collars," including automobile traffic. The "collar" has not been adopted in the United States as a traffic unit. It is unfortunate, moreover, that no agreement exists among road men at present as to the detailed method of measuring traffic. Traffic censuses were taken in Illinois in 1906-7, in New York in 1909, and in Massachusetts in 1909 and 1912. These censuses counted the travel, but no common unit is yet available for reducing such traffic data; moreover, the useful tonnage is a most important item from an economic standpoint, and it is seldom counted.[2] It is well established that an improved road draws to itself increased traffic. To determine the future use of roads, it will be necessary not only to know the travel passing over the road before improvement, but also to know the increase of travel which is likely to be diverted to the road when it becomes improved. It is undeniable, moreover, that travel upon roads in general is rapidly increasing numerically in tonnage and in mileage of travel radius. Preliminary study is clearly necessary, therefore, to enable road men properly to relate the first construction costs to probable maintenance charges. There should be an ample "factor of safety" in road design to allow for increased service.

Under a competent and continuous administration there are many details which can be worked out for road betterment which are otherwise neglected. It is necessary for economy to have the location of deposits of all road material within a road district placed on the road map and the quality of each deposit carefully recorded. The care of all road machinery should be in competent hands, and it should be housed and ready for use when the season commences. A gradual improvement in the grades of more important roads can be undertaken with an established profile toward which some work is directed each year. It is quite probable that the prevailing lack of permanent culverts and bridges on highways is partly due to the unwillingness of short-term road officials to spend a considerable amount of money in one place. Under a continuous administration some permanent culvert or bridge work may be undertaken from time to time along a plan which contemplates the final improvement of all such structures. Concrete culverts and bridges require almost no maintenance charges, whereas wooden bridge floors and culvert bridge floors must be renewed every few years.

It is probable that the continuous employment of road patrols will be too expensive for a large part of our road mileage for some time to come. It is equally true, however, that on many miles of road the presence of a road patrol at a cost of from $60 to $75 per month will be economy.[3] It has been repeatedly observed that the work of such roadmen in preventing water breaks and wash from rain storms and thaws at the right time has in itself justified their salaries. Whatever system of road labor is adopted, the work should be organized early in the year and experienced men developed and retained as far as possible. The foreman of a repair gang on road work should have sufficient knowledge and experience to justify spending his entire time in supervising and planning the work without attempting to labor with his men. The element of thoroughness in details, such as complete cleaning of mud holes, sufficient material, swift repair of water-breaks, etc., can not be over emphasized. There is always enough necessary planning and supervision to keep a good road foreman occupied.

The supply of road material for repair and maintenance operations should be at frequent intervals along all roads—that is to say, for example, there should be sufficient broken stone of both sizes and screenings at hand on all macadam roads and the quantity should be known. With the increased use of bituminous materials, it is necessary also to supply at convenient intervals stores of such material, and men working on the roads must be furnished with necessary small tools, including tar kettles, heating apparatus, pouring pots, and stiff push brooms.

On the Continent of Europe and in England, where road repair and maintenance have been conspicuously successful, it has been the practice to issue printed instructions covering the smallest detail to all men engaged in the work. It is also the plan to require reports of work done and quantities of material used at frequent intervals, and sometimes daily. Roads are frequently inspected and accurate estimates of all quantities of work are made from year to year.

Larger jobs of repair are usually most advantageously handled by contract. Contract work must, however, be done under competent inspection and with proper plans, profile, and written specifications. Where road work is in continuous charge of one competent man, it is possible for him to gain information from time to time which fits him to draw up proper specifications, avoid the repetition of mistakes, and benefit by the experience of other highway engineers. With a rotation of road officials there is little incentive for a man to familiarize himself with the best practice. He is not interested primarily in road matters and can not be expected to educate himself by reading road journals or attending road gatherings.

Repair and maintenance have not been given sufficient consideration in planning road finances. It is becoming yearly more common for local authorities to issue bonds for road construction. During the year 1912 nearly $29,000,000 in bonds were issued by counties and road districts in various parts of this country for road construction. It is not uncommon to find such bond issues planned with no provision whatever for a repair and maintenance fund. No road can last 30 years without repairs, yet 30-year bonds are repeatedly issued for road improvement. Many such bonds are commonly issued and the proceeds are expended without adequate supervision and under weak administrative systems. Every bond issue should be accompanied by a direct tax, providing sufficient revenue for the upkeep of the roads with a good margin of safety, and the term of the bond should in most cases be shortened. Without doubt a serial bond is to be preferred to the form of retirement by a sinking fund. Serial bonds may be arranged so that the annual tax for interest and retirement is constant. With a serial bond there is a large percentage of the road actually paid for before it is worn out, even with long-term issues. There is apparent contradiction in the cost figures for repair and maintenance exhibited by expenditures on roads of a given class as a whole and the figures obtained by analysis of the cost of necessary operations on a given type of road. On a 15-ft. bituminous-macadam road an annual charge of $700 a mile is nearly 8 cts. per square yard. Although the cost of repair and maintenance in a number of states has recently averaged above $700 per mile, the annual cost of necessary operations for repair and maintenance by any given method is, on an average, considerably less than 8 cts. per square yard. The average cost of repair and maintenance for eight years in five states is shown in Table I.

TABLE I.—REPAIR AND MAINTENANCE EXPENDITURES IN CONNECTICUT, MASSACHUSETTS, NEW JERSEY, NEW YORK AND RHODE ISLAND.

Year.	Miles.	Appropriations and expenditures.[1]	Rate per mile.
1905	[2] 668	[2] $ 60,777	$100
1906	[3] 2,125	[3] 624,696	294
1907	3,303	1,024,096	310
1908	3,906	1,441,502	369
1909	5,161	2,880,272	558
1910	5,572	4,336,201	778
1911	6,183	4,491,718	[4] 726
1912	7,300	5,945,084	814
Av., 8 yrs.	.....	....	608

[1] Includes town and county expenditures and available automobile revenue.

[2] Connecticut, New Jersey and New York not included.

[3] Connecticut not included.

[4] New York appropriation late; repair and maintenance work not completed.

The apparent contradiction is partly due to the excessive accumulation of resurfacing charges. Resurfacing charges have recently risen because of the particular phase of average-life period reached by a large mileage of state-aid roads and because of the emeregency created by the new traffic, and especially because of the combination of the two causes. In so far as surface treatment is absolute maintenance, this present prevalent method of maintenance includes the former annual resurfacing charges which ordinary macadam roads required, but which for a number of years did not appear in the repair and maintenance figures. The present years are, therefore, bearing not only accumulated past resurfacing charges, but are now carrying an increment of annual cost directed toward the increased life of the new road surface.[4] It is possible, however, that considerable resurfacing of bituminous-bound macadam roads will ultimately be necessary, and in this case there will be a rise in repair costs when the life period is reached. Maintenance of roads subject to automobile traffic tends more and more to become absolute maintenance. Not only does automobile traffic become increasingly destructive to a road which is once allowed to ravel, but the reaction of road surfaces upon automobile tires is now a matter of much importance.

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[1] The State of New York has undertaken the preparation of a comprehensive atlas of all its roads; roads are drawn uniformly ¼ in. in width at a scale of 1 mile to 3 ins., which allows all culverts and bridges to be shown. The Ohio State Highway Department has issued Bulletin No. 11, giving maps of all roads in the State by counties. In this document also the scale is 1 mile to 3 ins.

[2] The Massachusetts census of 1909 and the census of 1912 determined the estimated gross daily tonnage as 344.8 and 647.3 at 247 and 156 stations, in the two respective years.

[3] A continuous maintenance gang of foreman and 8 or 10 men, with suitable equipment, is a practical and economical maintenance force for country road systems, aggregating 100 miles or more, where a patrol system can not be economically established.

TABLE II.—MASSACHUSETTS REPAIR AND MAINTENANCE EXPENDITURES.

Years.	Total miles maintained.	Total State aid.	Cost of maintenance per mile.
1896	62	$ 4,727	$ 76
1897	109	13,267	122
1898	160	20,661	129
1899	206	24,538	119
1900	250	33,562	134
1901	296	31,061	105
1902	358	59,943	167
1903	415	55,083	133
1904	482	51,896	107
1905	548	57,456	105
1906	610	68,382	112
1907	655	106,189	162
1908	702	229,666	327
1909	740	402,116	543
1910	784.63	504,061	642
1911	828.65	530,904	647
1912	879.6	594,574	676

Increased knowledge is needed of the actual relations between first cost and interest and of the life, service, and maintenance cost of the road. In future investigations for dtermining the type of road to be built it will be necessary to provide for large increases in traffic and carefully to balance the advantages of long-lived road surfaces, such as concrete and brick, with low maintenance costs, against the lower-cost road surface, with little or no factor of safety and immediate and high maintenance costs.

The discussion of the repair and maintenance of concrete roads is omitted because no sufficiently accurate or representative data yet exist either as to method or cost. The repair and maintenance cost of brick roads has repeatedly proved to be very low, and, in fact, nearly negligible, when the best modern construction is employed. There are not yet sufficient data from state authorities to warrant definite conclusions as to actual annual repair and maintenance figures.

MASSACHUSETTS.

The experience in the state of Massachusetts in the matter of repair and maintenance of state-aid roads is worthy of attention.

In the early years of construction in Massachusetts maintenance was carried out by the employment of local labor, under the direction of the division engineer of the state highway commission, and by contract on certain lengths of road where the consecutive mileage justified such contracts. The work consisted in repairing damage due to wash and freshets on the slopes and in the proper care of drainage features, such as cleaning gutters, culverts, and catch basins. The maintenance of the roadway itself included the removal of loose stones, the repair of wear in the center due to horses' feet, sanding the roads, and supplying binder in dry weather to prevent raveling. When this work was done with local labor the maintenance was not considered continuous, but on the contract sections the contractor was required to do whatever work was necessary at all times. The commission supplied stone along the road at proper intervals. When the roads were new a considerable part of the maintenance work was outside the roadway, but the expense appears to average about equally upon the roadway itself and on the roadside for a number of years.

By 1905, 63.19 miles were maintained by nine contracts and the remainder of the maintenance work was done by day labor under the supervision of a division engineer. In 1906 contracts were in effect in 28 cities and towns, and there were nearly 86 miles under this system. Many of the roads were considered of too short sections to be economically maintained under contract.

Under the contract system one man was employed, who furnished a horse, cart, and small tools. He was required to pick up stones, fill incipient ruts, supply new binder, pull weeds, fill any washouts, and, in general, to keep the road and roadside in good repair.

In 1908 the number of miles maintained by contract had decreased to 71, and the average cost was $52.18 per mile. There were 12 contracts in force with an average length of 5.88 miles. The maximum mileage was 10.47. Since that time there has been no disposition to extend maintenance by contract. Maintenance by surface treatment with bituminous material has been largely adopted and the work is done under the supervision of the engineers of the state highway commission. Table II shows the expenditure by the state for repair, including resurfacing, and maintenance of its roads for the years 1896-1912, inclusive:

Under the Massachusetts law of 1900 the state must be reimbursed for maintenance charges by the localities to an amount not exceeding $50 per mile. The amounts given in the column headed "state aid" include all money subsequently returned to the state under this act, and also the automobile revenues applicable to repair and maintenance. Previous to the year 1908 the motor-vehicle-fees fund was not available for highway purposes.

TABLE III.—MAINTENANCE AND REPAIR APPROPRIATIONS BY THE STATE OF NEW YORK.

Year.	Miles.	Amount available.	Rate per mile.
1907	667	$ 205,904	$ 309
1908	978	371,227	379
1909	1,987	1,350,000	679
1910	2,123	2,122,763	1,001
1911	2,623	1,015,253	[1] 387
1912	3,100	3,127,949	1,009

[1] Appropriation late; repair work not completed.

NEW YORK.

New York state made direct appropriations for repair and maintenance of state and state-aid roads beginning in 1907. In the year 1909 the repair and maintenance of state and county highways was put in charge of the first deputy highway commissioner. The work of the bureau of maintenance was organized with six assistant superintendents of repairs in charge of all maintenance, except resurfacing, in the respective subdivisions of the state. Each superintendent of repairs was assisted by a number of highway inspectors in charge of the roads in one or more counties, aggregating from 60 to 100 miles. The highway inspectors have direct oversight of road patrolmen. The maintenance system, then, is essentially, beginning with 1909, a system of continuous small repair by patrolmen, supplemented by resurfacing and surface treatment, directly supervised by the engineers of the commission.

TABLE V.—ANNUAL DUTY ASSESSED IN ENGLAND.

Items of taxation.	Amount in English currency. £	s.	d.	United States equivalent.
Motor bicycles and motor tricycles of whatever horsepower	1	0	0	$4.86
Motor cars:				
Not exceeding 6½ hp	2	2	0	10.21
Exceeding 6½, but not exceeding 12 hp	3	3	0	15.31
Exceeding 12, but not exceeding 16 hp	4	4	0	20.14
Exceeding 16, but not exceeding 26 hp	6	6	0	30.62
Exceeding 26, but not exceeding 33 hp	8	8	0	40.82
Exceeding 40, but not exceeding 60 hp	21	0	0	102.06
Exceeding 60 hp	42	0	0	204.12

The patrolman must furnish a horse, cart, and small tools. He is supplied with all road material by the state. His work is directed toward preventing unnecessary deterioration of the metal surface. He must clean all waterways and ditches, lower the shoulders of the road, fill ruts, and make other minor repairs, including repairs of guardrail, and prevent raveling by supplying binder from time to time. His hours are from 8 a. m. to 5 p. m., which allows him one hour for coming to work and one hour for leaving. Supplied with a small heating outfit for bituminous material, the patrolman can apply small patches of ¾-in. stone and fill ruts on bituminous-treated roads. As he becomes more efficient, it is possible to put him in charge of assistants and accomplish larger jobs of recapping the road. He must also spread fine stone to take up excess of bituminous material on the surface.

TABLE IV.—NEW YORK TOWN ROADS EXPENDITURES.

Years.	Miles money system roads.	State aid for maintenance.	County and town appropriation.	Cost per mile.
1899	3,696	$34,517	$138,070	$47
1900	6,497	54,057	222,767	43
1901	7,521	67,555	269,934	45
1902	11,681	102,509	419,491	45
1903	24,372	272,249	672,734	38
1904	30,952	393,493	917,873	42
1905	36,857	483,355	1,062,803	42
1906	38,857	594,591	1,206,462	46
1907	48,190	721,849	1,881,041	54
1908	54,745	1,062,674	1,757,583	52
1909	*79,632	1,441,751	2,526,612	50
1910	*79,646	1,591,911	4,673,962	78
1911	*77,000	2,000,000	6,800,000	112
1912	*67,451	1,665,500	6,938,694	103

*Town road system under bureau of town highways.

The patrolman is employed continuously and has charge of approximately 5 miles of water-bound macadam road, 8 miles of asphaltic macadam road, or from 12 to 15 miles of brick road on an average. Where road sections are too far apart, the length is necessarily reduced and the patrolman gives only a part of his time to the work. The work done by the patrolman is largely of a preventive nature and the results are regarded as successful. Bituminous material is supplied for the patrolman's use in barrels, and the screenings and stone or good gravel are stacked along the roadway. There are now 702 patrolmen, paid $78 per month, or $3 per day. The inspectors supply necessary instructions to the patrolman and supervise his work. They also see that he is supplied with material.

The patrolman is required to make a postcard report covering each day's repairs once a week to the highway inspector. The highway inspector in charge of the patrolmen on his mileage reports daily to the superintendent of repairs, who in turn reports to the first deputy highway commissioner.

In addition to the regular inspectors, a special inspector is employed, who is responsible directly to the commission. He is furnished with a list of all employes and their road sections. This special inspector at irregular times visits the patrolmen to see that they are properly performing their duties. A patrolman found off his work by his inspector is promptly discharged.

It is expected that the roads more recently constructed with bituminous binder and other roads with smaller top dressing can be maintained under the patrol system at a minimum expense. Much of the work of applying a top course of fine stone and oil can be accomplished by the regular patrolman, with outfits owned by the state and under the direction

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[4] Assuming the cost of bituminous resurfacing at 72 cts. per sq. yd., the annual maintenance, including necessary surface treatment, 4 cts., and the total annual charge for ordinary macadam resurfacing and maintenance, 5.9 cts.; then, if it is desired to find how long a road reconstructed with bituminous surface must wear, without resurfacing but with regular surface treatment, in order that the total annual cost shall be the same as for ordinary macadam, there results from the above figures (n=number of years)—

$$\frac{72+4n}{n} = 5.9,$$

whence n=37.9 years, nearly.

of the division superintendent of repairs. Repair work of considerable magnitude, such as resurfacing, is done by contract, under plans and specifications, and is handled by the division engineer. Repairs not let by contract may be handled by the county superintendent directly, when turned over to him by the state commission, and the work is done under the direction of the superintendent of repairs.

It is estimated by the department of highways that when the patrol system is well established the cost will be approximately $125 per mile per year.[5] Table III shows the maintenance and repair expenditures for all state and county roads in New York for the years 1907-1912, inclusive.

In 1909 the bureau of town highways was established for the purpose of organizing the management of all the town or earth roads which are not to be improved as state or county highways. The mileage of such roads is at present 77,000. This bureau controls the distribution of state-aid money for town roads, and its work supersedes the work done under the so-called Fuller-Plank Act of 1898. For purposes of administration the state is subdivided into 10 districts, each in charge of a district supervisor. There is one county superintendent in each of the 57 counties, and there are also 934 town superintendents in the various towns. Under the original law rules and regulations have been formulated for the guidance of county and town officials. Public meetings must be held once each year in each county for the purpose of instruction and information of the local officers and for the discussion of road problems. A uniform system of town accounts has been established, and all accounts are supervised and audited by the bureau. Money raised by the town and the state-aid fund is in the custody of town officials. The law requires an estimate from each town superintendent on or before Oct. 31 of each year, and all road funds are constantly under the supervision of the state highway commission. Expenditures of all moneys must be approved by the commission, and the supervision of the representatives of the commission is extended to actual field work in the different towns.

TABLE VI.—MAIN ROADS EXPENDITURES, COUNTY OF NOTTS, ENGLAND, FROM 1891-1892 TO 1910-1911.

Year.	Mileage.*	Average cost per mile of maintenance.	Average cost per square yard.
1891-92	303½	$270	$0.025
1892-93	305¼	278	.026
1893-94	305¼	284	.026
1894-95	312½	260	.024
1895-96	312½	253	.023
1896-97	312½	254	.023
1897-98	319	258	.024
1898-99	319	260	.024
1899-1900	326¾	255	.023
1900-1	326¾	265	.024
1901-2	326¾	270	.025
1902-3	326¾	278	.026
1903-4	326¾	304	.028
1904-5	326¾	325	.030
1905-6	326¾	316	.029
1906-7	326¾	315	.029
1907-8	326¾	380	.035
1908-9	326¾	382	.035
1909-10	326¾	405	.037
1910-11	326¾	433	.040

*3,568,000 square yards. In a road of average width (18.6+ft.)=10,912 sq. yds. per mile.

TABLE VII.—COST OF MAIN ROADS, LINDSEY, LINCOLNSHIRE.*

Year.	Cost per mile.	Year.	Cost per mile.
1881	$295	1896	$328
1882	292	1897	354
1883	286	1898	340
1884	298	1899	292
1885	256	1900	311
1886	318	1901	344
1887	276	1902	854
1888	271	1903	330
1889	278	1904	310
1890	293	1905	353
1891	260	1906	345
1892	296	1907	368
1893	366	1908	425
1894	314	1909	400
1895	309	1910	413

*From statement of cost of main roads for the year ended Mar. 31, 1910.

Widening and grading must be done systematically and thoroughly, and haphazard work in applying gravel or crushed stone is not allowed. Special mention is made in the reports of the commission of the excellent results which have been achieved in bridge and culvert work. Under the direction of the bureau, town superintendents have constructed reinforced concrete bridges with standard plans. There have been built, in fact, 10,000 permanent culverts and 900 bridges. Each district supervisor is required to keep in close touch with all town highway affairs in his district and systematically to inspect the work in the towns. He must also investigate complaints and examine the condition of highway accounts.

Table IV shows the county, town, and state appropriations under the Fuller-Plank Act and the bureau of town highways for the years 1899 to 1912, inclusive:

ROAD MANAGEMENT IN ENGLAND.

In 1888 the local government act placed all road work in charge of the county councils, district councils, and urban councils. These units may be combined in the county councils. The central government board exercises general supervision. The county councils have control of all main roads in the country, including the building and maintenance of bridges. The urban authorities may, however, retain the right to maintain roads within their boundaries, and counties may contract with districts to maintain all roads, which remain, however, under the supervision of the county surveyors. In each county the work is in charge of a county surveyor, with an assistant foreman and roadmen. The surveyors are appointed by the county council and are usually associate members or members of the Institute of Civil Engineers.

The English system under the law of 1888 is essentially a local system. In 1909, by the act known as "the development and road improvement funds act," the English road board was established. The board consists of five members and is a national body. It met for the first time in May, 1910, and issued an annual report in August, 1911. A consulting engineer and an advisory engineering committee of six members have been selected. Under the law the road board has the power to advance money to county councils and other highway authorities for the construction of new roads or for the improvement of existing roads, and also to construct and maintain any new roads which appear to be required. Improvement is construed to include the widening of the road, the improvement of the alignment, the reduction of the grades, the treatment of the road for mitigating dust, and certain other work beyond ordinary repairs. The authority of the board extends throughout the United Kingdom.

The road board administers the road improvement fund, which consists of the revenue obtained from motor-spirit (gasoline) duties and motor-car licenses. The total receipts of this fund, including interest, from May, 1910, to March 31, 1912, were £2,184,314. Of this amount £541,937 was granted and loaned for road improvement during the interval mentioned, and nearly all the remainder,[6] after deducting administrative expenses, was invested. Up to March 31, 1912, grants by the road board had been made as follows:

Improvement of road crusts	£421,949
Road widening and improvement of curves and corners	56,833
Road diversions	18,276
Reconstruction and improvement of bridges	15,128
New roads and bridges	4,928
	£517,114

In setting the amount of a grant the board attempts to pay 75 per cent of the net cost of the improvement contained in the work, after due allowance is made for the element of maintenance contained in improved surfacing. The policy of the board is to encourage the use of bituminous binding materials in improvement of road crusts.

The schedule of motor-vehicle taxation is shown in Table V.

TABLE VIII.—COST OF MAIN ROADS IN YORKSHIRE.

Year ended March 31—	Total cost, including grants toward improvement works on expenditure on burr[1] walls.	Approximate length (miles).	Average cost per mile.
1890	$461,581	1,006	$481.74
1891	523,639	1,006	520.51
1892	559,536	1,006	556.20
1893	664,084	1,073	618.90
1894	710,767	1,097	647.91
1895	714,669	1,122	636.96
1896	722,119	1,122	643.59
1897	766,759	1,122	683.38
1898	804,065	1,125	714.72
1899	791,150	1,128	701.38
1900	746,296	1,133	658.68
1901	768,223	1,111	691.47
1902	772,754	1,107	698.06
1903	775,715	1,104	702.64
1904	816,759	1,094	746.58
1905	836,377	1,094	764.51
1906	886,435	1,094	810.27
1907	872,917	1,094	798.92
1908	898,251	1,094	821.08
1909	953,007	1,094	871.10
1910	944,354	1,094	863.21
1911	1,029,909	1,094	941.42

[1] Foundation retaining wall, often out of sight.

A tax is levied on "motor spirits" or gasoline manufactured or imported at the rate of 3d. per gallon. Manufacturers of gasoline pay £1 annually for a license and dealers 5s.

Table VI shows the entire cost of main roads in the county of Notts, England, from 1891 to 1911:

Tables VII and VIII show the average cost of the main roads in the division of Lindsey, Lincolnshire, England, for 30 years and in Yorkshire for the past 22 years.

The cost of repair and maintenance of rural main roads in England and Wales by the county councils[7] for the years 1903 to 1910 throughout is shown by Table IX.

The above roads are strictly country main roads outside of cities, under the direct control of the county councils, and are about 12 per cent of the total road mileage of England and Wales.

In general English roads were formerly maintained by a patrol system by which a roadman with a donkey cart covered about 4 miles. This system is still used in some rural communities. The use of refined tar has now been largely adopted on main roads, and the above tables included resurfacing with such material by various methods. It is characteristic of recent bituminous work in England that no dust whatsoever is allowed in any material used. Sprinkling roads with water has been largely abolished, but the cost of washing and cleansing is a maintenance charge.

TABLE IX.—COST OF REPAIR AND MAINTENANCE IN ENGLAND AND WALES.

Year.	Total expenditure.	Miles.	Cost per mile.
1903-4	$5,887,127	16,768	$350
1904-5	5,964,863	16,970	350
1905-6	6,193,332	17,468	355
1906-7	6,204,680	17,480	355
1907-8	6,556,079	17,536	375
1908-9	6,914,205	17,687	388
1909-10	7,401,324	17,800	415

The latest figures obtainable present the mileage of roads in Great Britain as follows:

England and Wales	150,692
Scotland	24,771
Ireland	[8]55,562
Total	231,025

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[5] During the year 1912 there were 735 patrolmen in charge of the maintenance of about 3,100 miles. The cost of the patrolmen's service was $137.12 per mile.

[6] Indicated grants amounted to £534,534 additional.

[7] From the 39th and 40th annual reports of the local government board.

[8] Report of the Second Irish Road Congress, 1911.

There are about 27,802 miles of "main roads" in England and Wales, of which approximately 10,000 miles are urban "main roads," or roads in urban districts. The expenditure on the total mileage (27,802) of main roads for the year ending March 31, 1909, was £2,895,483 of which maintenance and repair amounted to £2,643,044 or about $475 per mile.

The increase of automobile traffic in the United Kingdom is shown in the following table of motor vehicles of all kinds:

1904	51,549	1907	125,320
1905	74,058	1910	218,680
1906	86,536	1911	266,258

The cost of maintenance in England and Wales in extra metropolitan county boroughs has risen 81 per cent from 1890 to 1909, but the rate of increase has not been greatest in the period of greatest development of motor traffic, as has been generally supposed. The average annual rate of increase in maintenance expenditures from 1890 to 1902 was 5.9 per cent and from 1902 to 1909, 1.4 per cent.

ROAD MANAGEMENT IN FRANCE.

The roads of France have a total length of about 360,000 miles, classified as follows:

(1) National roads, built and maintained by the National Government, 23,756 miles; (2) departmental roads, built and maintained by the departments traversed, now generally under supervision of the engineers of the Ponts et Chaussées, 8,161 miles; and (3) vicinal roads, including *(a)* principal communal roads, traversing two or more communes and maintained by them with government aid, 107,049 miles; *(b)* secondary communal roads maintained by the communes, 47,256 miles; and *(c)* ordinary vicinal roads, maintained by the communes under the supervision of government engineers, 177,550 miles

TABLE X.—ROAD MAINTENANCE IN FRANCE ON THE NATIONAL ROADS (23,756 MILES IN LENGTH).[1]

Items of expenditure.	1906 (francs[2]).	1907 (francs).	1908 (francs).	1909 (francs).
Ordinary repairs	29,512,809	29,325,074	30,072,663	30,157,643
Streets (Paris)	3,000,000	3,000,000	3,000,000	3,000,000
Extraordinary repairs	1,702,803	1,722,069	4,271,574	3,805,502
Pension fund (cantonniers)	450,793	450,822	450,743	445,377
Bureau du Service des Ponts et Chaussées	....	810,616	788,980	[4]785,067
Salaries, etc. (393 engineers[3] and "conducteurs")	3,798,409	3,442,096	3,406,847	[4]3,383,031
Salaries, etc. (2,113 under engineers and "conducteurs")	7,710,561	7,470,445	7,331,586	[4]7,770,802
General expenses of the service	1,370,222	1,363,340	1,398,574	[4]1,309,413
Total maintenance and general expenses	47,545,597	47,584,462	50,720,967	50,656,835
Cost of maintenance per year per mile	$315	$323	$349	$347

[1] From the reports of the minister of public works.

[2] United States equivalent is $0.193.

[3] The engineers of the Ponts et Chaussées perform a multitude of duties aside from the supervision of the "routes nationales."

[4] In deriving the cost per mile, 40 per cent of the above engineering and general expenses were assessed against the maintenance of the "routes nationales."

Rural roads and lanes of small importance, about 9 ft. wide on the average and maintained entirely by the communes, add about 155,376 miles.

The cost of the national roads was $303,975,000. They have a width of from 32.8 to 45.9 ft., with a metaled driveway from 16½ to 23 ft. wide. The depth of the road is about 8 ins. In exceptional cases and near large cities the width of the road is increased and the driveway paved instead of macadamized. The cost of constructing 316,900 miles of the roads classified under Nos. 2 and 3 is given as $308,800,000, of which the government's contribution was $81,060,000.

The superiority of the French road system is not due to any extraordinary natural conditions or advantages, but to the efficiency of the administrative organization. The basis of the administrative system is the publicly maintained Ecole des Ponts et Chaussées, where the road engineers and officials receive their technical training. A regularly recruited corps of trained and experienced men is thus constantly in charge of all the important roads. The department of the Ponts et Chaussées constitutes also a centralized source for information concerning the roads of the entire country.

For the purpose of road maintenance and construction the organization is as follows: (1) Inspectors general of bridges and highways; (2) chief engineers, charged with the work of a "département"; (3) ordinary engineers and under engineers, charged with an "arrondissement"; (4) principal and ordinary conductors, charged with a subdivision; and (5) cantonniers, each having from 4 to 7 kilometers (2.48 to 4.05 miles) of highway under his immediate supervision.

The cost of maintaining the roads in France is gradually increasing. In 1893 the cost of maintaining 22,009 miles of national roads was $225 per mile. In 1900 the cost of maintaining 23,660 miles of the same roads was $230 per mile. By 1906 the national roads had attained a length of 23,742 miles and the cost of maintenance was $315; in 1907, $323; in 1908, $349; and in 1909, $347. The cost of maintaining the departmental roads has remained more nearly stationery. From 1886 to 1888 the average cost of maintenance was $172 per mile, while from 1900 to 1905 the cost ranged from $180 to $182 per mile.

The roadmen who perform the manual labor on the roads to France are known as the "cantonniers" and number between 8,000 and 9,000. These men are nominated by the prefect and are required to be experienced in road work and to be not more than 35 years of age when appointed. They must have fulfilled their military duty and be sound workmen of good character. They have charge, on the average, of somewhat less than 3 miles of road each and give their whole time to the road work, with the exception of certain hours of leave during the summer. The "cantonniers" are paid about $174 per year, with certain perquisites as to lodges, etc., and it is common for them also to work small farms or gardens. Each "cantonnier" is supplied with a detailed list of instructions in his duties and with road materials, and his work is directed by the engineers.

The Land Tax Method of Raising Funds for the Park and Boulevard System of Kansas City, Mo.

The ordinary expenditures of the municipal government for absolutely essential functions in the safe guarding of life and property almost invariably absorb all general annual funds. The newer communities in the United States have, therefore, sought a further source of revenue for the establishment and maintenance of supposedly permanent improvements, such as betterment of streets, drainage work, and to some extent the purchase and improvement of parks and boulevards. In Kansas City, Mo., the funds for that city's excellent park and boulevard system were obtained by a land tax method, which was described as follows by Mr. George E. Kessler, Landscape Architect, St. Louis, Mo., in a paper presented last month at the fifth national conference on city planning:

All lands are, of course, assessable for general taxation for state, city and school purposes, these several items of general tax supplying the means of conducting the several general governments and providing for the ordinary functions of each. Out of general revenues only very little of street improvement is made, and out of general revenue or bond issues, based on general taxation, are constructed the principal trunk line sewers. All else is done in the form of special assessment against benefited land. In the case of special assessment for particular improvements, these assessments lie against the lands only, in no case taking the improvements thereon into account. When a street or any public highway, inclusive of the boulevards, is to be established, the administrative boards and the legislative body adopt the necessary resolutions or ordinances, and in as much as general funds are rarely available for this purpose, proceed in the local civil courts to appropriate or condemn the land necessary to establish, widen, or extend these highways. The cost of the lands entailed in such procedure is then, in the same court, by the same commissioners establishing the value of the lands taken, assessed against the private lands within a previously prescribed contiguous or abutting benefit district. In the case of streets, usually abutting lands; in the case of boulevards custom has established the frontage upon the adjoining parallel street on each side as properly within a district specifically benefited by the establishment of such highways. Later, after the properties have been acquired, sometimes at the time of acquisition, the grades upon which these highways are to be built are established, and should there be violent changes of ground surface, thereby producing possible injury to the abutting private property, opportunity is given to claim damages for this element, and the cost thereof is assessed in the form of special land assessment against the properties in the benefit district.

Subsequent to the disposition of the question of damages due to the street grade or changes in ground surface thereon, the highway is graded to its established grade and the cost of this work assessed in proportion to the value of the property assessed and against the lands forming the normal frontage on the highway so improved. After the street has been brought to the proper planes in accordance with the established grades, and all subsequent to the proper legislation by both the administrative and legislative bodies, the city proceeds to improve these highways by first establishing the necessary drains, discharging these into the established sewer system or creating new sewer districts. The cost of such drainage is assessed against the lands within the area to be drained, on the basis of cost in proportion to its area.

The city then further proceeds to build the curbs, the street pavements, the sidewalk pavements, and assess all of these elements against the abutting properties.

The city may, but does not as a rule, further assess the abutting properties with the cost of establishing the lawns on the sidewalk spaces, but does assess the cost of shade tree planting and care upon the abutting property in the case of the streets. In the case of the boulevards, the Park Commission, out of its funds, provides for the cost of tree planting and the lawns on the sidewalk spaces.

The city does not assess for the establishment of water mains, and the installation of lighting equipment is an incident to the general contract for lighting paid for out of the general revenue.

The Park and Boulevard System is administered by a Board of Park Commissioners, one of several administrative boards, and charged with the particular duty of creating and maintaining this system. It has the exclusive power of selection, no powers of legislation, but exclusive powers of administration.

Beginning 20 years ago to plan, under the writer's direction, for a comprehensive scheme of this class of improvement, actual acquisitions were not accomplished until approximately 1896. Since that time to the middle of April, 1913, the close of the fiscal year, the following general expenditures have been made on this system:

Special assessment:
Acquisition by condemnation (all purchases having been made through exercise of the power of eminent domain) $6,115,187

Boulevard improvements by tax bills	1,412,473	
Boulevard grading damages	24,723	
Park district maintenance	1,863,906	
Boulevard maintenance	78,730	
Miscellaneous collections (accruing through special assessments)	120,000	
		$9,615,019
General taxation:		
Bond issue	$ 500,000	
Apportionment for annual municipal revenue	1,353,000	
Vehicle tax	147,874	
Miscellaneous collections accruing through general taxation	64,009	
		$2,064,883
Aggregating		$11,679,902
Special assessment		82.3%
General tax		17.7%
		100 %

To understand perhaps more clearly the general scheme of administration and financing, it should be understood that Kansas City, Mo., now a community of some 275,000 people, is east of the line dividing Missouri from Kansas. In Kansas City on the Kansas side, known as Kansas City, Kan., there is a population of some 100,000 in addition. Kansas City, Mo., and the city of St. Louis, are the two constitutional cities of the state, each having its own charter and each having the exclusive power of charter amendment with reference to local affairs and the administration of local laws. Therefore, the city of Kansas City, Mo., is alone responsible, and through its consent alone, has the successful work there been accomplished. Among other administrative boards the Board of Park Commissioners has exclusive charge of its park and boulevard operations.

Like most other cities, the Park Department found itself faced with the question of waiting for years, perhaps never accomplishing anything, if it relied entirely upon the doling out of the current annual revenues or upon possible bond issues, which the public in that city does not generally favor. In this instance the Park Department had no hope of aid from current revenue and the debt making power had reached its limit for the purchase of water works. There remained only reliance upon private generosity or special land assessment. In applying, therefore, the principle of benefit assessments for the creation, improvement and maintenance of this park system, there were established certain assessment districts used as units of taxation, for this purpose, and within each of which the private lands were directly assessed, presumably in proportion to the benefits derived by these through the purchase of land required for the several public improvements.

If a park or parkway, defining the latter as a parked highway, was sought to be purchased, then, after the proper legislation has been adopted, the circuit courts and commissioners under the judges of the local civil courts, hearing claims for values for the properties sought to be taken, and also claims usually in resistance of assessment to pay for these properties, found the values in detail and in aggregate of the properties taken under such procedure, and distributed, in accordance with their judgment, the cost of this acquisition against the private lands within the park district in which the park was to be located. Such assessments become liens against the private lands, subject to sale in the event of failure to pay at given times. Where the assessments were likely to be large, opportunity was made to pay the individual assessments in installment periods, usually of 20 years. At no time has the community at large been required to pay any portion of these purchase costs.

In case of the boulevards there was practically the same procedure, and while under a different administrative board the streets were also established in the same manner, except that in the latter case no installment payment periods were permitted.

For the purpose of improving and maintaining these parks and boulevards, and in the absence of sufficient current revenue appropriated by the legislative body, there was established a power to assess annually within the limits of each park district and for the sole benefit of that park district every parcel of private land within that district, at the same time and to the same effect as the same lands were charged with the annual ordinary taxation, but in addition to and beyond the constitutional limit for general purposes. This created in each park district an annual fund for improving and maintaining the parks and boulevards within those districts. The real benefit of the division of the city into permanently established park districts is to create within those districts the annual revenue above described. Such park district maintenance funds are available for the improvement and maintenance of all the properties within their respective districts under the jurisdiction of the Board of Park Commissioners.

It was found desirable, in addition to the district maintenance funds, to assess annually, also in the form of special assessment, a low maximum charge against the abutting private properties upon boulevards and parkways for the exclusive purpose of maintenance work upon the boulevards or parkways along which these assessments were made. Inasmuch as a low limit was finally placed upon the powers of the city to make the annual maintenance levies, the Park Department was given, for the benefit of its park districts, all the vehicle licenses collected by the city. This in turn is apportioned in accordance with the annual revenues or the established valuation of the lands within the several districts.

One difficulty of the annual park district maintenance levy is that the actual revenue then depends upon the assessed valuation of the lands within these districts. In Kansas City this is approximately 50 per cent of the actual values of the properties. The older park districts naturally contain the high valued business areas, and, therefore, obtain ample revenues for improvement and maintenance within their limits. The outlying and intermediate districts, having comparatively low values, obtain insufficient funds to properly improve and maintain the lands and the highways within their limits. Therefore, there must each year be obtained from current general revenues a sufficient apportionment to the Park Department for the expenditures necessary in these districts beyond their local district revenues. This becomes particularly true of the great outlying park, the entire cost of improvement and maintenance of which must necessarily be borne out of the municipality's current revenues.

In effect this has placed the Park Department in Kansas City in a semi-independent condition with reference to its funds, and has made it possible to accomplish results that would have been entirely out of the question under any other financial system in that city.

In practice this entire procedure is an amplification of the theory of single land tax. It certainly was not accomplished as a matter of choice but as a matter of necessity, and inasmuch as no properties had been acquired under any other system, the tax-paying public finally acquiesced, and is constantly urging further and even more extensive development in order that the entire city may obtain commensurate benefits through improvement in every section. While it undoubtedly has become a serious burden upon the private lands of the entire community, yet these burdens have been equably distributed, and since all lands contribute there has been no reasonable objection. Its distinctive advantage in that city has been a resultant stability of land values reaching very far beyond the values for residential purposes alone, and has very strongly tended toward proper segregation of the several sections of the city for these several uses in their distribution for industrial, commercial and residential use, and made possible what otherwise would not have been accomplished.

RIVERS AND HARBORS

Structural Features and Construction Costs of Pile Piers With Reinforced Concrete Decks, New York Harbor.

A reinforced concrete deck supported on timber piles is the standard construction for piers in New York harbor. The development of this construction and its cost as compared with the standards which it replaced was given in "Modern Pier Construction in New York Harbor" by Charles W. Staniford, Proceedings American Society of Civil Engineers, Vol. XXXIX, p. 1089. We extract the following parts of Mr. Staniford's paper:

TYPES OF PIER CONSTRUCTION.

The United States Government, by virtue of its power to control all navigable waterways in the country, established along the entire waterfront or shore line of New York harbor two lines: one the bulkhead line, which limits the extent outshore of the solid filling or reclaimed land under water; the other, the pierhead line, which determines the limit to which piers may extend beyond the bulkhead line. These piers must be of such construction that the free flow of the tidal water shall remain uninterrupted by the supporting columns. This construction, being a condition wisely insisted on by the Government to preserve tidal conditions and currents, governs, to a great extent, the handling of vessels, particularly of large ones, and affects the sanitation of the city in that it prevents the accumulation of sewage and refuse which would occur in closed slips. With open slips, such matter is carried away by, and disseminated in, the tidal flow. All pier construction is limited to the area included between the bulkhead and pierhead lines.

The pier which meets these requirements, and was adopted by the city in its early history as the type of structure for berthing vessels (and also adopted by all private and corporate interests), is a wooden structure throughout, consisting of a deck resting on piles driven into the mud or hard bottom. The physical features of the harbor, the geological formation of the bottom, and the condition of the water, fortunately permit the adoption of this type of construction, which, in many other parts of the world, is not adaptable because the life of the timber itself in the water would not be permanent or fairly long. Wood-boring animals, the teredo, limnoria, etc., are very little in evidence, and, therefore, wooden piles are practically permanent below the water-line in almost all parts of New York harbor.

The prominent objectionable feature to wooden pier construction is the expense necessitated by the constant repairs of the deck sheathing and the continuous wear and tear of the fender system extending along the sides and outer ends of the piers. As to the remainder of the structure, piles, floor system, etc., its maintenance and repair is very economical and consists generally in the replacement, from time to time, here and there, of decayed portions of the timber above mean low water only, at inconsiderable expense.

Until seven or eight years ago, the piers were generally built with decks of yellow pine, 4 ins. thick, laid on a system of yellow pine floor structure of rangers and stringers. This deck plank in turn was covered with a second layer of either 3 or 4-in. plank sheathing, laid diagonally or at right angles to the deck proper, to form a wearing surface for the traffic.

Constant repairs and renewal of this deck sheathing, caused by the wear and tear of team traffic, is augmented in great measure by the moisture, horse urine, etc., which saturates the wood and eventually finds its way to the underlying deck and rangers. This forms the greatest item incident to the expense of pier maintenance, the average life of the sheathing for most busy piers being about six years, or requiring a 17 per cent renewal annually. As the cost of the deck sheathing is generally about 12 per cent of the total cost of a pier, it will be seen that these sheathing repairs would aggregate 2 per cent per annum of the cost of the entire structure.

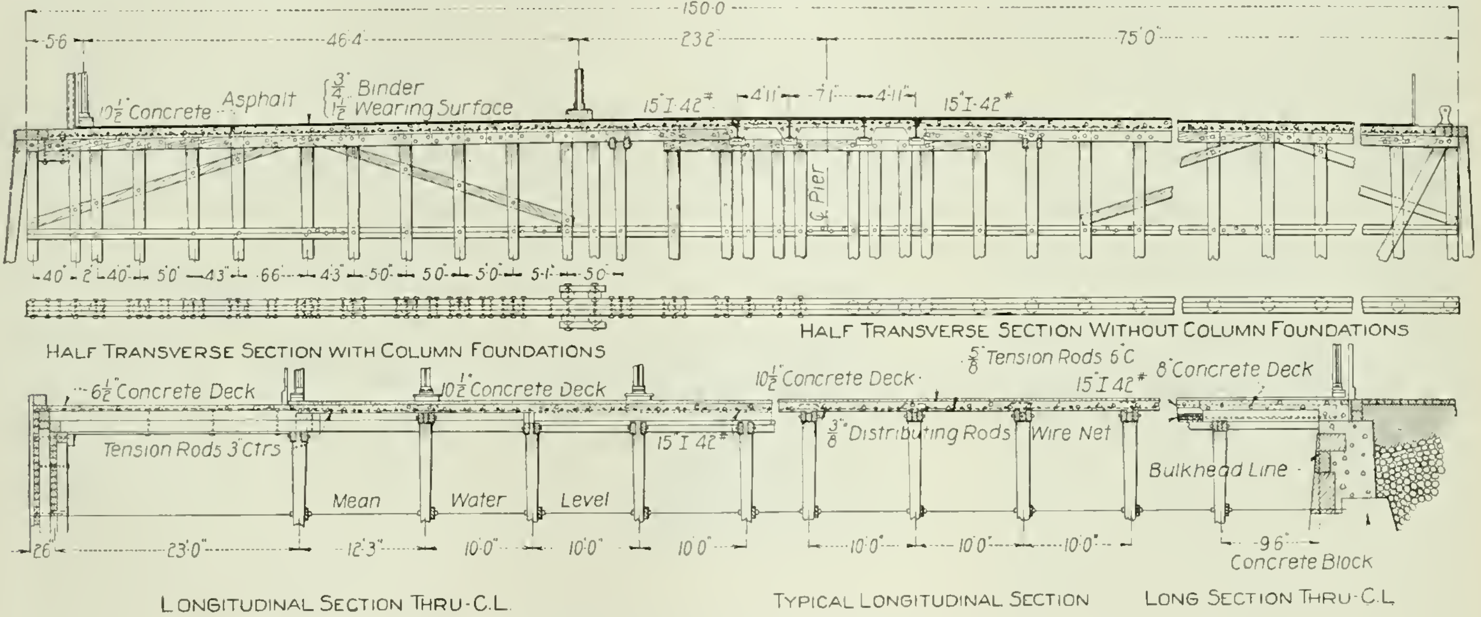


Fig. 1—Sections of Standard Reinforced Concrete Deck for Piers, New York Harbor.

NEW PIER CONSTRUCTION PRACTICE.

Notwithstanding the necessity for constant repairs to the deck sheathing of the wooden pier, the parts of the remainder of the structure—rangers, caps, stringers, piles, and bracing—give excellent service. Maintenance is economical, the average life of the structure above mean low water line being from 20 to 25 years, the repairs aggregating an entire renewal above low water in that period of time. As the life of the piles supporting the structure is practically permanent when submerged below the water, the entire structure can be rebuilt after this period and made practically new by "bench capping" such piles as may be decayed above the water line and renewing the stringers, caps, deck, and sheathing; in other words, the pier structure proper, after a life of 25 years, is readily susceptible of renewal above the water line, the supporting piles below that line being to all intents and purposes permanent.

It will be readily seen that the life of the wooden pier structure would be prolonged still further, and the cost of maintenance and repairs reduced, by the elimination of the objectionable wooden deck sheathing and its replacement by some form of deck impervious to moisture and resisting the wear and tear of traffic.

It was with the object of eliminating this large repair expense incidental to the maintenance of the sheathing, and reducing maintenance cost generally, that the Engineering Bureau of the Department of Docks and Ferries, under the direction of J. A. Bensel, M. Am. Soc. C. E., then Commissioner of Docks, about seven years ago, began a serious investigation and study of the problem of producing a permanent deck surface supported by timber piles, assumed as permanent below the water line.

This study has resulted in the entire elimination of the old style of wooden deck in new structures, and the production of a new type consisting of reinforced concrete laid directly on the transverse cap system of the wooden pier substructure. This concrete is laid in slabs, spanning the pile bents practically as simple beams.

This new type of deck eliminates not only the 4-in. deck sheathing, but also the 4-in. deck proper and the underlying 12x12-in. yellow pine ranger system longitudinally of the pier on top of the transverse cap system, further increasing the life of the sub-structure.

A structure was thus evolved which had a permanent deck practically impervious to the penetration of moisture to the substructure, readily renewable from low water to the under side of the concrete deck, and permanent below the water line, with a first cost about equal to that of the old wooden deck pier.

The first step in the elimination of the great cost factor, the renewal of the deck sheathing, was the replacing of this sheathing by a concrete wearing surface, from 4 to 6 ins. thick, laid directly on the old type of timber decking. This type was used by the North German Lloyd and Hamburg American Steamship companies in the reconstruction of their piers at Hoboken, and by the city of New York in the Chelsea section piers, the result being a deck surface which is impervious to moisture and urine, and, therefore, a protection to the substructure, as well as a saving in maintenance.

The unit of cost of construction of a pier depends in a large measure on the size of the pier. As the outer portions, the sides, and outer end of a large pier are more rigid and heavier than those of a smaller pier, and therefore, cost more in both labor and material, the relative cost per square foot of a short pier is considerably larger than that of a long one. The average cost of the old wooden deck pier of large dimensions is from $1.00 to $1.15 per square foot.

Further investigation and study resulted in the entire elimination of the wooden deck plank, deck sheathing, wooden floor rangers, etc., and the adoption of the present type of pier deck, as before mentioned, consisting of a reinforced concrete slab, 10½ ins. thick, extending from center to center of the transverse pile rows placed generally 10 ft. apart. This slab is designed to carry a live load of 500 lbs. per square foot for the 10-ft. span between pile rows, and is reinforced with ⅝-in. square steel rods. The latter run longitudinally of the pier, are 6 ins. apart, and are staggered so that only alternate rods terminate on the same pile row, with ⅜x⅜-in. separating rods. The slab is of 1:2:4 Portland cement concrete, with ¾-in. broken stone, the upper ½ in. of the slab being of Portland cement mortar finished smooth. This rod reinforcement is intended to be standard, but the substitution of trade sizes of equal strength and efficiency is permitted, subject to approval.

Definite illustrations of this type of pier construction are found in the two new piers recently completed by the Department of Docks and Ferries at the Gowanus section, South Brooklyn, one at the foot of 31st St., 1,475 ft. long, and the second at the foot of 33d St., 1,616 ft. long, each pier being 150 ft. wide. These piers are among the finest in the harbor, and are probably the largest of their type in the world. The unit cost is practically the same as that of the old wooden deck type. The decks have a crown of about 8 ins. in order to shed the water. The inshore end of the concrete deck rests on the bulkhead wall, but is not attached thereto, a horizontal plane joint allowing the deck to slide on the wall as it expands or contracts on account of changes of temperature.

Twenty-six piers with concrete decks have been built by the Department during the past seven years. The earlier type, as exemplified by the Chelsea section piers, consists of a 6-in. concrete deck surface reinforced with expanded metal and laid directly on the deck planking. The next type producer omitted the deck plank, and is represented by eight piers with decks consisting of a concrete slab, 6½ ins. thick, reinforced with expanded metal, the slab spanning yellow pine rangers running longitudinally of the piers and generally about 6 ft. apart.

The final type evolved, omitting the timber floor system entirely, and placing a concrete slab reinforced with longitudinal steel rods directly on the timber-capped transverse pile rows, is represented by eight piers, the most important examples being those at the foot of 31st and 33d streets, South Brooklyn, and the Municipal Pier at Stapleton, Staten Island.

All these piers have been built where the condition of the river bottom underlying them was such that no settlement could occur, and they have behaved admirably. No repairs have been necessary, except to the fender system, and none are anticipated for many years to come, excepting the renewal here and there of an imperfect pile, where rot may appear above the water line. Such renewals can be made at a minimum of cost—a few dollars per pile—by bench-capping, without any interference whatever with the integrity of the reinforced deck itself.

COLUMN FOUNDATIONS.

For single-story sheds, where additional bearing strength is required in the new concrete deck pier for shed column or superstructure support, the question has been treated in general in the same manner as in other parts of the structure, that is, by adding the necessary number of piles to carry the load concentrations, assuming the piles to be permanent below low water and easily renewable above that plane. Where heavier concentrations occur, as, for example, in double-deck or two-story sheds, the piles are cut off at or near low water and covered with a timber grillage; built on this grillage are reinforced concrete pedestals, extending to the deck level, to carry the shed columns.

Railroad tracks, being a requirement on the South Brooklyn piers previously described, are carried on four lines of 15-in. steel I-beams, placed on the transverse clamp system of the pile rows and extending from the inshore end of the pier sheds to within 60 ft. of the outshore shed wall. The beams rest on steel saddles placed on the clamps, and are entirely encased in concrete.

TABLE I.—COST OF CONSTRUCTION, MAINTENANCE AND REPAIRS.

(Average cost of construction of wooden deck piers, $1 to $1.15 per square foot.)

Repair costs of wooden deck pier:

Description.	Percentage of total original cost.	Renewal required.
Sheathing	12	Every 6 years.
Backing log	1.8	Every 8 years.
Fender chocks, including vertical sheathing	4	Every 10 years.
Fender piles......	4.7	Every 12 years.
Decking	11.3	Every 15 years.
Bracing	7.1	50% in every 20 yrs.
Rangers and caps	24.4	50% in every 20 yrs.
Piles	34.7	33⅓% every 20 yrs.

Concrete deck pier:

Cost of construction, 31st street pier, South Brooklyn, no asphalt surface, per sq. ft..$0.87

Cost of construction, 33d street pier, South Brooklyn, with asphalt surface, sq. ft.... 0.97

Economy being a prime factor in its construction, it was decided to try out the concrete deck surface for wear and tear of heavy team traffic, and the earlier decks, therefore, were finished with a smooth mortar surface to receive this traffic. Two years of experimenting on these lines determined the fact that though the concrete surface was admirably adapted to light traffic, cargo handling by hand or motor trucks, etc., it could not stand the concentration of heavy team traffic confined within narrow lanes located generally in the center of the pier. The grinding and turning of heavily laden trucks inside these narrow lanes or zones gradually caused surface rupture of the top coat of mortar. It was decided, therefore, to place an asphalt wearing surface on the deck, and this has proven very effective.

The piers at the foot of 31st and 33d streets, South Brooklyn, have been in service for about three years. No signs of cracking or other imperfections have appeared, and the piers, as a whole, are a complete success.

REPAIRS.

For the modern type of concrete deck pier, the cost of maintaining the fender system is about the same as that for the wooden pier; deck sheathing repairs are practically eliminated, except such minor asphalt patching as may be required, and can be considered negligible in a good asphalt deck under cover; the deck plank is eliminated; the life of the ranger and cap system is prolonged by the protection from moisture given by the impervious concrete deck, and the cost of maintenance and repairs, therefore is reduced to a minimum.

CONCLUSIONS.

From the foregoing it will be observed that the problem which confronted the Department was the elimination of the timber deck and deck-supporting structure of the wooden pier, by the substitution therefor of some permanent form of construction meeting the following requirements:

(*a*) Economy in cost of construction and maintenance, the unit cost to be such as to produce or make possible a remunerative return on the capital invested.

(*b*) The construction to be of such character as to be readily extended, reconstructed, re-modeled, or, if necessary, entirely removed, as more intensive development of the area occupied by the pier or system of piers might be made necessary by the growth of commerce and shipping.

From what has been stated the following conclusions may be deduced:

First. Admitting that timber piles and foundation work are generally permanent below the mean low water line in New York harbor, the Department of Docks and Ferries has met the requirements of the problem by producing piers having the following characteristics:

(*a*) The deck is absolutely permanent;

(*b*) The substructure, above mean low water, is easily and cheaply repaired and maintained;

(*c*) The supporting part, below the water line, is permanent; and

(*d*) The resulting structure is such that it can be readily extended, reconstructed, or, if necessary, entirely removed at a cost not prohibitive, as would be the case, for example, with most types of reinforced concrete deck-supporting structures.

Second. That the Department has produced permanent parts in the structures where these are essential. No attempt was made to obtain absolute permanency above low water, in the structure supporting the deck, for the reason that,

Third. This portion of the structure, the caps, piles, braces, etc., protected as they are from saturation by urine and other objectionable fluids by the concrete and asphalt deck forming a protecting roof, can be maintained in good condition at a very low cost.

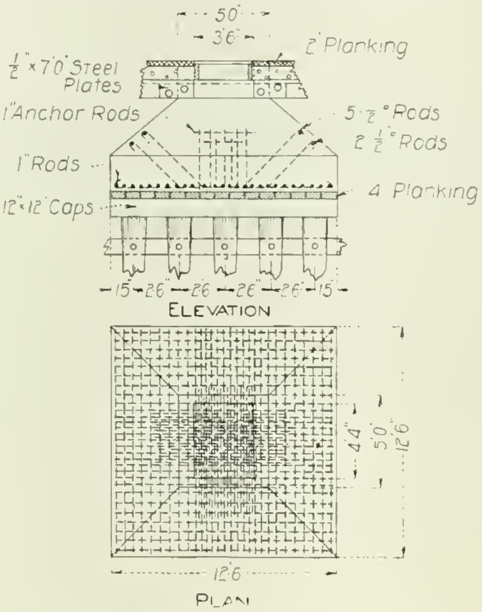


Fig. 2—Pedestal for Columns for Two-Story Pier Shed, New York Harbor.

Fourth. The type of structure produced, approximating permanency, is now being built by the Department at a first cost no greater than that of the former type of wooden pier throughout, and the cost of repairs and maintenance of the deck structure is almost entirely eliminated.

GENERAL REMARKS.

The phenomenal growth of commerce and shipping in New York harbor, producing constantly the need for additional wharfage room, has necessarily resulted in projects for dock and wharfage improvements, covering extensive portions of the water-front and involving enormous amounts of money.

As such development should be made revenue-producing, it follows that a cheap type of pier construction, low in first cost, long of life, and economical to maintain, is one of the fundamental factors in determining the extent of the improvements undertaken not only by the city of New York, but by private interests as well. This does not necessarily follow when smaller cities are considered.

Compared with the vast amount of money necessary for the comprehensive development of the port, the sums required for similar purposes by other ports on the Atlantic and Pacific seaboards of the United States are very small, in fact, in many cases, comparatively insignificant. Harbor improvements at these ports are generally confined to a limited area or extent of water-front, and consist usually of a few piers or bulkheads. Their aggregate cost is such that, even if not revenue-producing, the investment is often well within the financial capacity of the municipality and wisely undertaken by reason of its effect in stimulating existing trade and attracting new shipping business, producing what might be called "indirect revenue." This has often been the incentive in inaugurating harbor improvements at these minor ports, and it has resulted, in some instances, in absolutely permanent structures at such great expense that remunerative return on the capital invested is highly improbable, if not impossible; in other words, the benefits derived are being consummated at too great a cost, even when considered from the point of view of "indirect revenue."

Notwithstanding the many desirable features of this new type of pier construction, it has not been generally adopted, though many inquiries and requests for plans and descriptions of the type and method of construction have been received and replies made thereto, pointing out its proven economy in first cost, repairs and maintenance. New York harbor, however, presents a number of examples of similar types of concrete deck piers adopted by private interests, notable among which are: The reinforced concrete deck pier built by the Central Railroad of New Jersey at Communipaw, N. J., 892 ft. long and 131 ft. wide, used for railroad freight, tracks being laid on the pier deck; the pier under construction by the United States Lighthouse Board in the Reservation at St. George, Staten Island; and in two piers now under construction at the Brooklyn Navy Yard. The design of the latter, particularly, presents an admirable combination of reinforced concrete construction, surmounting the wooden pile and grillage supporting foundations near low water, resulting in a practically permanent pier at an economical first cost.

When reinforced concrete piers have been built at other ports along the coast, the attempt at absolute permanency, as stated above, has generally resulted in prohibitive first cost, when considered as a business proposition requiring interest on the capital invested.

Where the life of the wooden structure below the water is not endangered by wood-borers—in other words, where it can be considered as permanent—the difference in cost between an elaborate reinforced concrete pile and deck-supporting structure throughout, and a structure of the type herein described, represents practically that amount of money uselessly wasted.

Further, it is an open question whether the rigidity of a reinforced concrete structure throughout would not be a serious cause of deterioration in such structures, particularly below the water line. The shearing action of the impact of a large ocean-going steamship with a pier of this rigid type might cause a dangerous condition in the entire structure difficult to repair or overcome; even shocks tending to break the concrete surfaces of piles and substructure would admit sea water with its consequent destructive chemical action and freezing in cold weather.

On the other hand, the timber and pile substructure, with its flexibility and elasticity, acts, to a considerable extent, as a shock absorber, dissipating the effect on both the vessel and the pier, consequent on the impact of the collision or more or less violent contact with the pier, sometimes occurring when warping vessels into their berths.

The personnel of the Department of Docks and Ferries, as at present constituted, is as follows: Mr. R. A. C. Smith, Commissioner; Bureau of Engineering: The writer, Chief Engineer; S. W. Hoag, Jr., M. Am. Soc. C. E., Deputy Chief Engineer, and R. T. Betts, M. Am. Soc. C. E., Assistant Engineer, in charge of design.

A Report on the Practicability of a Reservoir System for Controlling Flood Waters from the Upper Tributaries of the Ohio River.

Included in the river and harbor act of July 25, 1912, was a section providing:

> That a preliminary investigation be made to determine whether a system of impounding reservoirs at the headwaters of the Allegheny, Monongahela and Ohio rivers and their tributaries is needed and practicable to provide sufficient water during dry seasons to operate the present and proposed system of locks and dams in these rivers, and to what extent the Federal Government, on the basis of their benefit to navigation, is justified in co-operating with local communities which may be interested in the construction of such reservoirs primarily for the purpose of flood prevention, and the feasibility of operating such reservoirs for the double purpose of flood prevention and improving navigation; and that this investigation be conducted by a board of three engineer officers, to be designated by the Chief of Engineers, United States Army; and that the results of this investigation be reported to Congress, with such additions as may be made thereto by the said Chief of Engineers, not later than December 7, 1912; and that for this purpose the sum of $5,000, or as much thereof as may be needed, be, and the same is hereby appropriated.

In pursuance of this act report was made Dec. 4, 1912, by a board of engineers consisting of Col. Curtis McD. Townsend, Lieut.-Col. Francis R. Shunk, and Lieut.-Col. Henry Jervey, Corps of Engineers, U. S. A. This report discloses material differences in estimates of work from those published by the Pittsburgh Flood Commission and we give it substantially in full as follows:

No detailed survey was possible. As the Pittsburgh Flood Commission has, during the past few years, made extensive investigations in this matter and has tentatively adopted a scheme for reservoir control of floods near Pittsburgh, it was deemed best to take this plan as a basis and make independent examinations as to its cost and feasibility. Accordingly two parties were sent into the field to make such examination as might be possible in the limited time.

The tentative plan of the Pittsburg Flood Commission comprises 17 reservoir sites on the headwaters of the Allegheny and Monongahela rivers, as in Table I.

TABLE I.

	Capacity, in million cubic feet.	Cost.
Allegheny:		
No. 1	2,876.3	$1,219,900
No. 2	4,877.9	3,057,000
No. 3	2,663.6	1,386,000
Tionesta Creek	3,629.6	1,362,609
North Branch French Creek	2,125.7	722,800
French Creek	3,323.1	2,388,100
Clarion:		
No. 1	5,067.0	1,309,900
No. 3	4,886.6	1,028,100
No. 4	1,537.9	451,800
Mahoning No. 2	2,367.8	1,089,400
Youghiogheny No. 2	1,547.1	999,300
Cheat:		
No. 1	5,737.4	1,287,900
No. 2	7,294.1	1,721,900
West Fork	2,724.3	811,200
Crooked Creek	3,255.7	893,700
Blacklick	1,454.7	720,500
Loyalhanna	4,112.5	1,222,000
Total	59,481.3	$21,672,100

The total capacity of the 17 reservoirs, as will be seen, is about 59,500,000,000 cu ft.

The examining parties visited the proposed sites and without referring to the data furnished by the Pittsburg Flood Commission obtained first-hand information as to cost of land per acre, damages to roads and railroads, nature of site, probability of finding coal, oil, and gas, etc. The two parties, one upon the Allegheny and one upon the Monongahela River, worked entirely independently of each other.

In cases where a railroad was affected the chief engineer of the road was requested to prepare an estimate of damages to his line. In each case the engineer of the road was furnished such information as to location and dimensions of the reservoir as could be obtained, and either went over the part of the line in question himself or had an assistant do it for him. The estimate was then prepared from the results of this examination and from the company's maps and other data.

Very valuable information was obtained from private companies who are forming projects for the industrial development of the streams in question. These companies are working entirely independently of the flood commission and also without reference to the railroad companies, and as their interests are not always identical with those of the other persons consulted, the check on estimates otherwise obtained was very useful. Most of the information given by these companies was confidential and can not be quoted in full, but was used in preparing the final estimates.

Table II will show the estimates of the flood commission and those of the board for 16 of the 17 proposed sites. A power development now under construction occupies the site of Cheat No. 1, and that reservoir is accordingly omitted from this discussion.

TABLE II.—SUMMARY OF LAND AND PROPERTY DAMAGES.

	Flood commission.	Board of Engineers.
Allegheny:		
No. 1	$ 658,100	$3,524,400
No. 2	1,851,400	4,006,800
No. 3	627,200	2,198,000
Tionesta Creek	675,200	1,203,200
North Branch French Creek	206,300	234,800
French Creek	1,323,900	2,984,700
Clarion:		
No. 1	97,000	204,800
No. 3	228,700	862,700
No. 4	66,900	77,900
Mahoning, No. 2	176,300	176,300
Total	$5,911,000	$15,473,600
Youghiogheny	249,900	$ 880,850
Cheat (upper reservoir only)	248,800	823,750
West Fork	580,000	1,590,450
Crooked Creek	183,400	283,110
Blacklick	203,800	250,025
Loyalhanna	279,500	778,725
Total	$1,745,400	$4,606,910
Grand total	$7,656,400	$20,080,510

The flood commission estimates, as given in the above table, do not include cost of dams. This is in order to make estimates comparable, as the board of engineers made no check on the cost of dams. Neither the flood commission nor the board estimates, as given in the above table, contain an allowance for engineering and contingencies, which explains some of the discrepancy between above figures and those in the report of the flood commission.

It will be observed that the board's estimate is, in round numbers, about three times that of the flood commission.

Although the board believes that the cost of a reservoir system would be much higher than has been supposed, it by no means follows that the plan is not feasible even at the board's figures, as the cost of reservoirs at a number of the sites appears to be quite within the bounds of reason, and doubtless other such locations could be found. The fact that private companies are seriously undertaking the building of reservoirs for power purposes, certainly at not less cost than the board's estimates, indicates that a system of reservoirs if desirable is quite feasible.

The total capacity of the reservoir system proposed by the Pittsburg Flood Commission is about 59,500,000,000 cu. ft., including Cheat No. 1. Merely to give a definite notion of what this figure means it may be well to mention that the system of reservoirs at the headwaters of the Mississippi River has a total capacity of 95,000,000,000 cu. ft., and this system is not adequate to give desirable control of the flow of the Mississippi river at St. Paul, the Ohio at Pittsburg and the Mississippi at St. Paul being comparable streams. It appears, therefore, that the capacity of the system now being considered by the board is not a large one and that it is certain that the total capacity will be needed in order to prevent floods at Pittsburg, which will be the primary purpose of the system, and that nothing can be counted upon as an aid to navigation. In order to be used for the benefit of navigation reservoirs must be kept at all times as full as possible in order to be ready for low stages when they occur.

In order to be useful in preventing floods reservoirs must be kept at all times as empty as possible, so as to be ready for the floods when they occur. These two uses are thus seen to be quite incompatible, and where reservoirs are actually used for both purposes it will be found that a certain amount of the total capacity is reserved for flood purposes and the remainder is all that is actually useful for navigation purposes, a state of affairs which does not differ in principle from having one system of reservoirs for flood control and another for navigation purposes. Dangerous floods at Pittsburg do not occur every year, and there might be a temptation to use the reservoirs in aid of navigation, in which case an unexpected flood would almost certainly find them partially full and perhaps completely full, with corresponding detriment to their value as preventers of floods. The board is therefore strongly of opinion that the system proposed by the Pittsburg Flood Commission, although probably feasible, would be of such limited capacity that it could not be used in aid to navigation as well as for preventing floods. While a more extensive system might be adopted, which would have sufficient capacity for both purposes, its cost would probably be very great, and it would remain to be determined whether the benefits to navigation would warrant any considerable co-operation on the part of the United States.

The Allegheny, Monongahela and Ohio rivers are all under improvement by the United States. In the Monongahela slackwater navigation is provided for 131 miles by a system of fixed dams with suitable locks. On the Allegheny there is one movable dam and two fixed, giving slackwater navigation for 24 miles. On the Ohio a project has been adopted for a system of movable dams from Pittsburg to the mouth of the river, which is intended to give a channel at least 9 ft. deep at all stages. Many of the locks and dams have been built. A system of reservoirs could be useful on these rivers only in one of the following ways: If there were a shortage of water in any of the pools during dry seasons, these reservoirs might be useful in providing the additional quantity needed; or if the necessary depth could be provided by reservoirs, then it is conceivable that some of the dams yet to be built might be omitted; or by use of the reservoirs the time of open-river navigation might be prolonged.

Examination fails to show that there has been serious shortage of water during any dry season on record. The lowest season in recent years was in 1908, and in this year there was a shortage of water in the pool above Dam No. 4 in the Monongahela river. No water ran over Dam No. 4 for 69 days, from Sept. 13 to Nov. 20, and at one time this pool was 1 ft. 3 ins. below its normal level. The shortage of water was remedied by drawing on the upper pools, thus distributing the deficit over a considerable reach of the upper river, and as the draft of boats did not tax the capacity of the channel to its utmost there was little or no interruption of traffic. During the six days of lowest water enough water was drawn from the upper pools to provide for an average of 17 lockages downstream daily, and there was no serious inconvenience even during the worst week of the drought. This is the most unfavorable state of affairs in any of the three rivers on record. It might be that a small reservoir containing, say, a billion cubic feet, might be useful somewhere on the headwaters of the Monongahela, but the shortage of water in dry seasons could be overcome by other means. For example, there is considerable leakage through the valves at the various locks. If tighter and somewhat more expensive valves were installed a great deal of water which now goes to waste could be saved, or if movable tops or flashboards were installed on all of the dams the pools might be held at higher levels than is now possible and there would be less likelihood of lack of water in any one pool and a greater store to draw from in the upper pools. At any rate the shortage of water heretofore has not been serious and can, in the opinion of the board, be remedied by less expensive methods than the building of reservoirs.

The amount of water which would have to be contributed by any system of reservoirs in order to hold the Ohio river at a 9-ft. stage would be so great as to put such system out of consideration. At Wheeling a 9-ft. stage implies a discharge of 40,000 cu. ft. per second. During a dry season, August to December, 1908, the average discharge at Wheeling for 121 days was 2,508 sec. ft. In order to keep up a 9-foot stage at this time reservoirs would have had to supply about 37,500 cu. ft. per second for 121 days, or 392,040,000,000 cu. ft. It seems certain that a system of reservoirs which is expected to provide this amount of water could not also be used for purposes of flood prevention.

The only benefit to navigation that could be expected from a feasible system of reservoirs would appear to be a slight prolongation of the season of open-water navigation. How long this would be, is difficult to determine, since for a given system of reservoirs the benefit would be different at different points of the river and accurate gaging curves would be required before a trustworthy estimate could be made. It seems evident, however, that the increase of time would not be great and would be confined to the upper reaches of the river. It would probably be better to subject boats and tows to the slight inconvenience of going through locks than to resort to reservoirs for assistance in so small a matter.

Furthermore, the board deems it needful to call attention to the fact that in rivers flowing over bottoms of easily movable material the effect upon available depths of increasing the flow of water is by no means certain. Experience in the lower Mississippi would seem to show that such rivers are apt to form a series of pools separated by bars, and that raising the water surface is accompanied perhaps by a deepening of the pools, but certainly by a building up of the bars, so that increased reading on the gage by no means implies greater available depths over the bars. For this reason it would appear unwise to adopt a system of reservoirs until it could be demonstrated that the effect would actually be what was desired.

Since the system actually adopted for improving the rivers in question appears to give better results at much less cost than could be expected from reservoirs, and since even in the driest seasons the benefit to be derived from any system of reservoirs would be small, the board is obliged to recommend that a system of impounding reservoirs at the headwaters of the Allegheny, Monongahela, and Ohio rivers and their tributaries, while probably feasible, would be of such small benefit to navigation that the Federal Government would not be justified in co-operating with local interests for their construction.

The board is, of course, not restricted to the consideration of merely the particular system proposed by the Pittsburg Flood Commission, but owing to the lack of time necessary for such survey as would make more precise recommendations possible, this system has been selected for purposes of discussion. By increasing the number of reservoirs so as to control other tributaries of the streams in question the amount of storage capacity could, of course, be greatly increased and the effect upon the flow of rivers at certain points made very much greater. But the investigations which it has been possible to make indicate that the cost of the reservoir system will be very high in comparison with the cost of the actual adopted lock and dam project. Also the plan of the Pittsburg Flood Commission is the only one so far as is known which has been seriously proposed for the purposes of flood prevention, and since the question to be determined is one of co-operation rather than of original construction, it does not seem advisable even were it possible to go into the subject more deeply.

The board invites attention to the activities of the water-power companies referred to. So far as could be learned the different projects are as follows: On the Cheat river near the state line the American Water Works Co. proposes to build a concrete dam 65 ft. high above low-water level. The crest will be about 1,060 ft. long and the capacity about 3,158,100,000 cu. ft. The contract for this work has already been let. The same company is considering the building of two other dams in the Cheat, the details of which have not yet been made public, but the reservoirs are expected to hold about 15,000,000,000 cu. ft. The proposed dams of the Pittsburg Flood Commission in this vicinity would hold somewhat over 13,310,500,000 cu. ft.

On the Clarion River it is proposed to build two dams, one near the mouth and the second about 35 miles upstream. Each of these dams will be about 250 ft. high. The capacity of the two is to be over five times that of the three reservoirs proposed on this river by the flood commission, 60,000,000,000 cu. ft., as compared with 11,491,500,000 cu. ft.

Dams are also proposed for power purposes on the Crooked Creek and the Cowanshannock, a small tributary of the Allegheny near Crooked Creek. These reservoirs will at least equal that proposed by the flood commission, 14,540,700,000 cu. ft.

Five dams for power purposes are proposed on the upper Youghiogheny River and its tributaries, which will be much more than the equal of the one proposed by the flood commission, about 8,000,000,000 as compared to 1,547,100,000 cu. ft..

Reservoirs are tentatively proposed on the Mahoning, Blacklick, Loyalhanna, Red Bank, and Two Lake Creeks, but no details are available. To sum up it seems probable that 7 of the 17 sites recommended by the flood commission will be occupied by private interests and that each reservoir will be at least equal to the one proposed by the flood commission. It appears to the board that future developments of the tributaries of the Allegheny, Monongahela and Ohio rivers in the interests of water power will go far toward solving the flood question and will provide all the additional water in dry seasons which could possibly be needed for purposes of navigation. Certainly reservoirs built for power purposes are managed neither in the interests of navigation nor flood control but would presumably be regulated so as to give as nearly as possible a uniform discharge at all seasons. Something would be left to be desired in the way of flood control but if eventually many capacious reservoirs were built in the area in question a considerable quantity of water would certainly be kept out of floods and the discharge at low water necessary in the interests of the power companies would add all that could be desired for the benefit of navigation in the streams as at present improved.

BRIDGES

Method of Strengthening an Iron Viaduct for 100 Per Cent Increase in Load.

The viaduct to be strengthened was a wrought iron structure built in 1888 to carry the single track of the Chicago & West Michigan Ry. over the Manistee River. As originally built the viaduct is shown by the broken lines of Figs. 1 and 2. The solid lines show the additions made in strengthening the structure and the following is a description of the new work abstracted from a paper by W. T. Curtis, Contracting Engineer, Wisconsin Bridge Co., before the Western Society of Engineers:

The original structure was designed for a loading about equal to Cooper's E-25. The rolling stock gradually became heavier and heavier, so that in later years the bridge was somewhat overloaded. In 1911 it was decided by the railway company to put still heavier loading (E-50) on the bridge, thus increasing it to an extent which would be unsafe for the old structure. It remained either to replace the structure or to reinforce it, and the latter method was elected as being much more economical.

Mr. J. F. Deimling, Chief Engineer of the Pere Marquette Railroad Co., asked for competitive propositions for both cost and design on the reinforcement, submitting, by way of suggestive information, a solution which had been used some years ago on their Mill Creek trestle. This consisted of adding a new line of deck plate girders the entire length of the viaduct on the center line of track, these girders being supported on new independent posts at the center of each bent, as shown on sketch for bents Nos. 24 to 28 in Fig. 1. (This scheme was used only on a very small portion of the plan finally adopted, for reasons given later.)

Some tenders were offered on this center girder scheme of reinforcement for the entire Manistee viaduct, but were discarded, partly on account of greater cost, but chiefly on account of uncertainty of distribution of load among the three girders, as the old girders on this Manistee viaduct are only 8 ft. centers, making the wood ties so short and stiff as to cause a marked degree of indeterminateness of the distribution of the load among the three girders. A further objection was the rocking or tipping effect over the new center girder as a fulcrum under imperfectly adjusted or worn ties, the shortness of the ties magnifying this difficulty. (The girders of the old Mill Creek trestle were spaced further apart, which made the new middle girder idea less objectionable in that piece of work.) A still further objection to this center girder scheme of reinforcement was the fact that the erection would seriously interfere with traffic during a long period of time.

Another scheme considered was to reinforce each of the old legs of the bents by adding another member parallel to it, surmounted with an additional new track girder placed closely along the side of the old girders, making a total of four girders with the old ones. This scheme was discarded as being prohibitively expensive, and somewhat unsightly as giving a pronounced appearance of being patched up.

The scheme finally adopted was proposed by the Wisconsin Bridge & Iron Co., being original with the writer, and is shown in Figs. 1 and 2. The latter shows, in dotted lines, the old or original structure, and in full lines the newly added members.

This design was adopted for its economy, its lesser degree of indefiniteness of distribution of loads, its far greater general stiffness, its minimum interference with traffic during construction, and incidentally on account of its having a less patched-up and made-over appearance than either of the other schemes offered.

The governing or fundamental idea of the adopted scheme was to convert the old deck plate girders into deep lattice trusses, of which the old girders would themselves constitute the top chords. This was done by adding a bottom chord about 12 ft. below the girders and introducing a Warren web system between the two chords thus formed. These old deck girders are, of course, stiff enough to resist the bending action of the load, and to deliver these local loads to the panel points of the newly formed truss. In calculation, for safety, the old girders were figured both as single spans between new panel points, and as continuous girders, the worst result being used in all cases. Additional stiffeners were added and cross frames installed.

To carry the excess load from these newly formed trusses to the ground, two new columns are added to each bent, starting at the bottom chord of the new trusses and running on an incline down to a new concrete pier built at the center of each old bent. The two new columns thus form a V and make the remodeled bent consist of two A-frames, as shown in the typical cross section sketch in Fig. 2.

This construction has the desired effect of virtually lessening the height of the trestle towers by about 12 ft., for the load is now delivered into the towers at the bottom chord of the newly formed trusses. Furthermore, this system braces the structure longitudinally by virtue of the depth of the new trusses. Also, the new A-frame form of the bents stiffens the structure transversely. The scheme has the further advantage of being capable of field construction with practically no interference with traffic, as the old girders were not disturbed, except for the drilling of holes, etc., in them.

In this manner we preserved for the main length of the viaduct the original two-point-bearing for the ties, which is undoubtedly the best, giving absolute definiteness of load delivery, and doing away with the tendency to tipping or teetering of the ties.

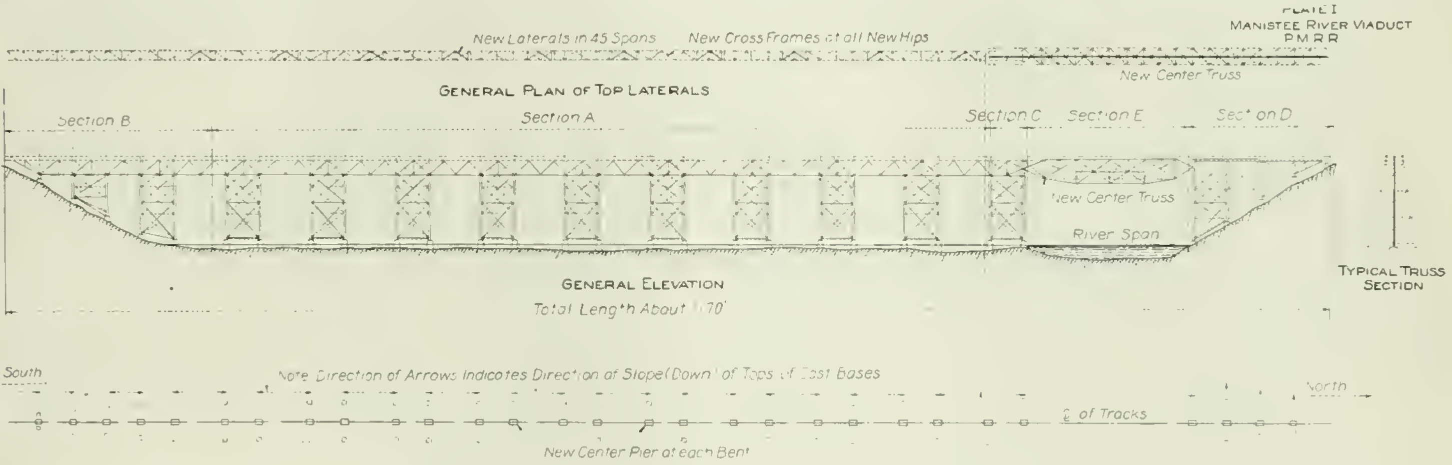


Fig. 1—General Elevation and Plan of Manistee River Viaduct.
(Broken lines show original structure and full lines show reinforcement added.)

At the river span the system just described could, of course, not be followed, and here a new deck truss 150 ft. long was placed midway between the old trusses. The distance between the old trusses is 14 ft., being thus sufficiently far to give longer and consequently more limber ties, permitting of more definite proportioning of loads as delivered from the ties into the two old and the one new truss, and also minimizing the tipping effect of the ties. In fact, this appeared to be the only reasonable solution of the river span problem, and was the one contemplated in all proposals offered.

The load from the new center river truss is carried to the ground by a new independent straight column as shown for bents Nos. 24 to 28 in Fig. 2.

The towers supporting the river span, and the three short spans of the north approach to the river span, were originally built with the deck girders spaced 14 ft. centers, the same as the river span trusses, and we therefore reinforced this small portion of the viaduct after the manner of the old Mill Creek trestle, *i. e.*, by the introduction of a new girder midway between the two old ones, in line with the new river truss and, like the latter, supported by a single new independent straight column at the middle of the old bents.

The developing and detailing of any scheme of reinforcement form fully as important a part as the conception of the general or fundamental idea itself. As other duties prevented the writer from taking any very active part in carrying out the execution of the work, that important part was turned over to other departments of the bridge company. The original idea was perfected, developed, and executed by the engineering staff of the Wisconsin Bridge & Iron Company under the direction of their Chief Engineer, Mr. V. Guillemin, with the bridge company's Assistant Engineer, C. M. Pearson, who had charge of the detailing of the work, and with Mr. F. A. Ross, Engineer of Erection for the bridge company.

The new steel was figured as closely as possible in accordance with the American Railway Engineering Association specifications. The old metal, which is of iron, was figured in general at 14,000 lbs. per square inch in tension, and at $16{,}000 - 70\frac{l}{r}$ in compression. Judgment had to be exercised at all times in the application of specifications, this particular piece of work being most highly susceptible for the practical adaptation of that familiar remark which appears on the front cover page of all of Mr. Theodore Cooper's specifications, reading as follows: "The most perfect system of rules to insure success must be interpreted upon the broad grounds of professional intelligence and common sense."

In a remodeling work of this kind it is impossible to escape entirely, indeterminate features, as the engineer is confronted and restricted by conditions as they exist. He necessarily lacks the freedom of ingenuity offered on new work. The problem before us was to double the capacity of the structure, and the general aim throughout was to arrange the new parts so that the old parts would still carry their full share of the old E-25 loading, and so that the new members would make up the difference to bring it up to E-50, with sufficient excess to insure taking care of uncertainties.

One source of indeterminateness which was true of both of the schemes seriously considered was the possibility of improper distribution of load between the two old and the one new pier of each bent. This is always true in the case of a continuous three-point-bearing, but there was no alternative in this problem, as there seemed to be no other way of getting sufficient bearing in the soil than to introduce the new middle pier. As a partial insurance to a proper distribution of loads on the three piers, the new middle pier was surmounted with an adjustable cast iron base, so simple in its adjustment that a bridge inspector on his annual inspection can, without any assistance whatever, and with no other tools than a good sized wrench, adjust this shoe to take care of any difference in shrinkage or settlement which may appear among the three piers. The sliding surfaces of these adjustable shoes were coated with a cheap and lasting form of lubricant known as "Velvet No. 2." The wedges provide for a vertical movement of ⅛ in. for a horizontal movement of 3 ins. and are controlled by ordinary machine bolts with double nuts. In erecting the wedges, they were set in pairs with the slopes in opposite directions so as to neutralize each other and prevent the entire structure from tending to drift or slide all in one direction.

A difficulty which presented itself was the difference in deflection between the old shallow river trusses and the new deeper one. This was studied carefully, and the difference in deflection was found to be sufficiently small so that it could be taken care of, to all practical purposes, by making the hangers from the old to the new trusses heavier than was theoretically required. This made the hangers act as equalizers, whereby if one truss should commence to be overstrained it would deflect enough more to deliver the load to the other truss before any actual harm would be done to the former. In this way, the load in any possibly overstrained member would still be so much below the elastic limit load that set deformation was out of the question. It was found that the percentage of overstrain necessary to demand equalization was very low, and that while perhaps this solution of the distribution of the loads would not be considered as the most desirable practice in new designing, it served as a safe and satisfactory solution of the problem at hand. The expansion of this new center river truss was taken care of by a link construction.

The structure being narrow and high, the matter of thoroughly bracing it was nearly as important as the direct loading feature, and while the general form of reinforcement provided for a marked general stiffening of the main run of the viaduct, additional bracing was added entirely independent of the old bracing system, the old system being allowed to remain intact so that both systems are now acting jointly to withstand wind and tractive forces.

For the transverse or wind strains in the 45 ft. spans, new laterals are introduced for the middle panel of the newly formed trusses. These rods terminate at new cross frames introduced at the panel points of the trusses carrying the wind load down to the bottom chord of the old deck girders, from which the load travels through a system of rod bracing in the plane of the inclined end posts of the new deep trusses to the tops of the newly formed A-frame columns. From this point to the ground the A-frames themselves constitute the additional wind or transverse bracing. The 30 ft. spans were similarly treated.

For the wind strain in the river and short approach spans which have the new independent straight center column instead of the V shaped columns, no additional stiffness was afforded by the new column, and the old system of rods was therefore doubled.

For tractive force or longitudinal bracing the newly formed Warren side trusses formed sufficient bracing down to the tops of the newly added V shaped columns, and the tractive forces are carried from this point to the ground by an entirely new system of bracing in the longitudinal plane of the legs of these new V columns.

While the solutions of the more general

problems were interesting, they incidentally led to problems of more minute detail, which were in themselves fully as interesting as the larger problems, and in fact some of them were fully as important. The detail drawings for the reinforcement of this bridge covered some 35 sheets, and the scope of this paper will permit of touching upon only a few of the more interesting details.

The new V shaped columns in the tower bents are designed to go half on either side of the old bents straddle fashion, and were shipper "knock down," each leg of the V being in two parts for each of its sections. The lacing bars were shipped riveted to one side of each section, the other side being connected in the field. It took careful drafting to insure no interference between the lacing bars of these new members and the old steel work. These new columns were connected to the old tower struts, where convenient, to form a general stiffening to the structure. In the erection of all these new columns the old steel was not disturbed, except for the necessary drilling. This in fact was considered as one of the commendable features of the design.

Connections for the rod bracing between the pairs of reinforcement trusses in the plane of the inclined end posts of these trusses presented a problem which was solved by the use of cast steel hitch brackets, which did away with what would otherwise have been clumsy and fussy detail. In order to avoid the uncertainty of rivets in tension on these hitch brackets, bolts instead of rivets were used in the outermost holes. These hitch brackets were cut with right and left threads, permitting of direct adjustment of the tension rods.

Much trouble was experienced in finding suitable connections of the new wind-bracing rods to the old bents, which were not converted into the double A-frame form, on account of the old bracing being pin connected. Whenever possible, a connection was made which did not make necessary the removal of the old pins, but this was impossible in some cases.

Particular care was exercised to see that the loads from the new intermediate river truss were delivered properly into the columns, and a somewhat complicated detail resulted.

Extra care was exercised in all the details to allow for inconsistencies in the old construction. This was done by providing numerous shims and doing a great deal of field drilling that would otherwise not have been necessary. The entire job abounded in painstaking work in order that the new member would fit the old parts to which it should connect, and at the same time clear the old parts with which it was desired not to interfere. The detail drafting alone on this job cost a little over $950 for wages paid direct to the draftsman, exclusive of any overhead expense of any kind.

As previously mentioned, the foundations required reinforcing by the introduction of a new or third pier midway between the old piers, at each bent for the entire length of the viaduct. These piers were of concrete construction resting on piles, there being 12 piles to each of the standard bents, and 20 piles for the special piers under the new river truss. The piles were driven 35 ft. The piles were so arranged that they could be driven on either side of the old bent without disturbing the old iron work.

Considerable difficulty was encountered on this foundation work, due to the fact that there existed, unknown to the railway company or to the bridge company, an old corduroy road on the center line of the viaduct for its entire length. This road was covered with several feet of sandy silt, which made it very difficult to remove the corduroy logs. In some cases the piles were driven right through the corduroy, in other cases the logs were removed, and in still other cases the logs were cut. One way seemed to be about as expensive as another. Unexpected difficulty was also encountered on account of the water rising some 2 ft. higher than had been previously known. This upset our calculations for cofferdams, causing much delay and expense.

The method of handling the pile driver was quite interesting. It had to be moved many times to drive the small cluster of piles at each of the bents, each cluster being split into two groups as divided by the old iron bents which stood on the center line of each pile cluster

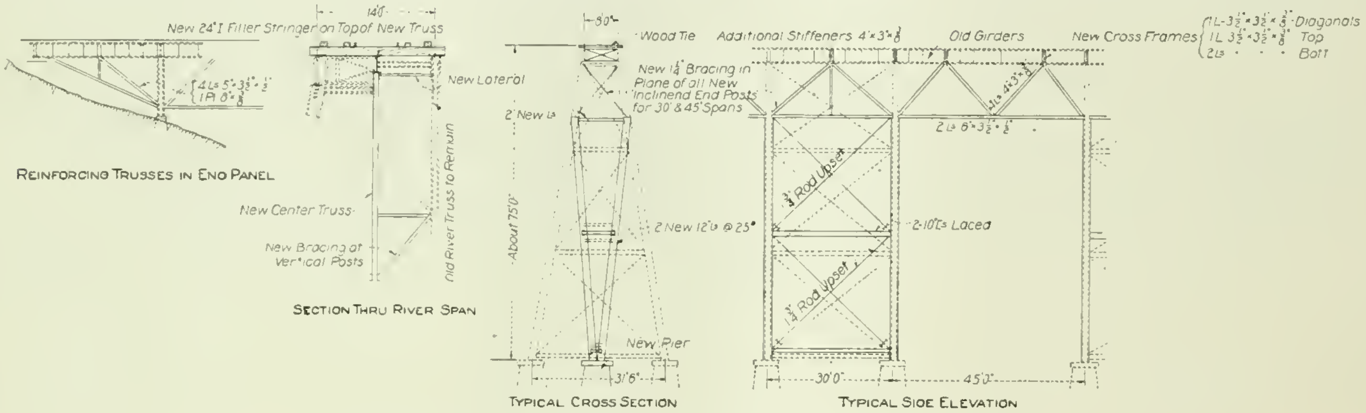


Fig. 2—Tower and Truss Details of Manistee River Viaduct.
(Broken lines show original structure and full lines show reinforcement added.)

The pile driver was handled from the deck of the structure 75 ft. above, and was placed at the various points of operation without removing any of the old bracing. This not only saved expense but was better for the structure. The driver was picked up near its center of gravity, tilted over with its legs uppermost and its nose or top thrust between the bracing rods of the structure to the desired point of setting up. In this way it was moved along from point to point. Very little timber bracing was used at the foot of the driver, which was guyed to the old iron columns of which there were plenty near each set-up. The engine was handled separately from the driver, not being mounted on it. This avoided the necessity of moving the engine as frequently as the driver.

The concrete was mixed and placed in the winter without any unusual expense, aside from the excavation and cofferdam annoyance previously mentioned. Gravel was brought to the site in hopper bottom cars and run out onto the viaduct to a desired point. A few track ties beneath the car were then spread and the contents dropped 75 ft. to the ice below. From the stock piles thus formed the gravel was conveyed over the ice to the final point of deposit, the mixing being done in each case right at the forms. The cofferdams were of the Wakefield type.

The weather was very cold most of the time, but we merely had to be sure that the frost was taken out of the dry material to begin with, for most of the concrete was placed under water and the small portion which protruded could be protected at slight expense with marsh grass and was kept slightly warm by the larger mass of concrete below the ice.

The erection of the steel work was somewhat unusual, and while at first appearing somewhat formidable, it worked out satisfactorily and with reasonable economy, barring delays due to foundation trouble.

The old work was mostly field bolted, which made the occasional temporary removing of old members less expensive. The field drilling and riveting was an expensive item, there being so much of it. There were about 7,000 holes to drill, about 2,000 old ¾-in. rivets to knock out and ream the old holes to 15/16 in., and about 28,700 rivets to drive on the job.

The new steel was handled by a derrick car at the beginning of the work, but this method did not prove entirely satisfactory, and was later replaced by a locomotive crane which gave better results.

The river span was erected with very little falsework. The new steel columns were first erected at the ends of this span. Then the top chord was raised and suspended from the old structure with steamboat ratchets, the turnbuckles being placed so as not to interfere with railroad traffic. All new top chord bracing was then placed, this being connected to the old trusses, and all bottom chord bracing removed. The balance of the new truss was then placed with falsework consisting of but a single wood post at either end, and the truss was kept suspended and controlled with 24 turnbuckles until completely riveted.

The work abounded in opportunities for interferences and misfits between old and new parts, but very little trouble in this direction was actually encountered—so little, in fact, that we were agreeably surprised, and considered this piece of work as a demonstration of the feasibility of doing this class of reconstruction at reasonable cost.

The cost of the reconstruction was, in round numbers, as follows; these figures including all extras on the work proper and a contractor's profit of 10 per cent, the work having been undertaken on a percentage basis with a fixed maximum limit:

Foundations in place (Ry. Co. furnished gravel free)	$10,200.00
New steel, 455 tons delivered at site (free freight)	22,400.00
Erection of steel (free transportation of men and equipment)	11,300.00
Total cost	$43,900.00

which, on a conservative guess, is only about half what a new structure would have cost. The old structure weighed 496 tons.

Measurement of Irrigation Water.—The U. S. Reclamation Service has issued a small book on this subject, for the use of ditch riders. It discusses briefly the general subject of irrigation water measurement, with particular reference to standard weirs in use. Discharge tables are given for standard contracted rectangular weirs and for standard suppressed rectangular and standard Cippoletti weirs. Coefficient tables for velocity of approach and for submergence, and a table of acre-foot equivalents for given second-foot discharges for given lengths of time are also included.

The Design and Erection of the Boucanne Viaduct of the National Transcontinental Railway.

Contributed by P. L. Pratley, Designing Engineer, Dominion Bridge Co. Ltd., Montreal, Canada, from a paper prepared for the Institution of Civil Engineers, Great Britain.

GENERAL DESCRIPTION.

The National Transcontinental Ry. crosses the Boucanne River at a point 167.2 miles east of the Quebec Bridge, which is the St. Lawrence River crossing of the same line. The crossing occurs just north of the peak of Maine where this state geographically juts into British territory. Although the river at this point is but a shallow stream with a depth varying with the seasons from a few inches to 5 ft., and a width of some hundred feet, the valley in which it flows is quite a considerable depression. This condition, together with the fact that the line follows generally the "height of land," necessitates a crossing of 790 ft. length with a maximum height of 127 ft. from base of rail to water level. The bridge is therefore of the trestle type with the general outline indicated in Fig. 1. The viaduct will there be seen to consist of five towers of 30 ft. spans and two of 40 ft., with intermediate spans of varying lengths. Beginning at the west end there is first a 60-ft. span from an embankment about 55 ft. high to tower bent No. 1. The succeeding three open spans are 56 ft. and then over the river between the 40-ft. towers is a 150-ft. truss span. Continuing up the east bank, there are three open spans of 60 ft., the easternmost resting on the embankment which here also is about 55 ft. high. The line is on tangent except for about 135 ft. at the west end where it lies on the approach spiral to a 6° curve (radius—977 ft.), which commences 165 ft. west of the bridge. The transition spiral is thus 300 ft. long and is laid out as a cubic parabola with equation $Y = KX^3$, Y being the offset from the tangent, X the distance from the beginning of the spiral measured along it, and K is a constant, in this case equal to .00000058232; so that at the end of the transition spiral when $X = 300$ ft., $Y = 15.722$ ft.

The viaduct is of the deck type, and the track is laid on ties placed with a 4-in. space between them. The ties are 10 ins. wide by 12 ins. deep and generally 14 ft. long, dapped ½ in. over the top flange of the girders and held from bunching by longitudinal timbers running along the ends of the ties and dapped over them. The girders are 9 ft. apart on centers and are uniformly 6 ft. deep. The transverse batter of the towers is 1 in 6 and this, together with the depth of the truss and its detail brings the width of the truss span to 17 ft. 2¼ ins. on centers. The viaduct is also on a grade of 1.10 per cent falling toward the east. The grade is, of course, affected by the vertical spiral at the west end whereby the super-elevation of the 6° curve is gradually attained, but not to any larger extent than can be adjusted by the size of the ties used on the end span. The necessary tilting of the track is also small enough on the bridge to be looked after in the ties.

The ground at the site is principally earth and boulders with solid rock about 10 ft. below, so that concrete pedestals and abutment walls were well founded on the bed rock.

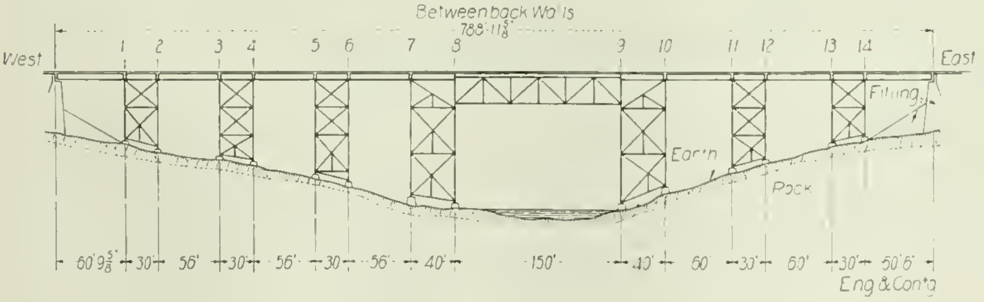


Fig. 1—Diagram Elevation of Boucanne River Viaduct, Canada.

SPECIFICATIONS FOR DESIGN.

The viaduct is designed in accordance with the specifications issued by the Dominion Government in 1908 with one or two further restrictions imposed by the Bridge Engineers of the National Transcontinental Ry., and which will be specifically alluded to later. The steel was proportioned for a live load known as class "heavy." This consists of two engines with tenders, the whole weighing 180 short tons, with a combined wheel base of 104 ft. followed by a uniform train load of 4,750 lbs. per foot of track.

The specification for impact calls for an extra allowance of load equal to the figure obtained by dividing the square of the live load by the sum of the dead and live loads. In addition to this again, for all spans under 80 ft., including the stringers and cross floor beams of the truss span, the live load itself is increased by a percentage depending upon the length of span, and having a maximum of 40 per cent at the theoretical span of zero, diminishing according to the formula $.40 - \frac{l}{200}$ where l is the length of span, vanishing at 80 ft. In the Transcontinental Ry. bridges this increment in live load is introduced into the live load figure used in the impact formula as well as the pure live load, so that for the girders of the Boucanne River Viaduct the impact load was obtained by dividing the square of the increased live load by the sum of the increased live load and the dead load. The sum of the dead load, the increased live load and the impact thus obtained is treated as the total load both for shears and bending moments. For this load a unit shear of 10,000 lbs. per square inch is allowed on the gross section of the webs of plate web girders, and on the net section of the tension flange a unit fibre stress of 16,000 lbs. per square inch is permitted.

The gross area of the compression flange is made equal to the gross area of the tension flange and 75 per cent of the gross bending value of the web plate is considered as effectively assisting the flanges to resist the induced bending moments.

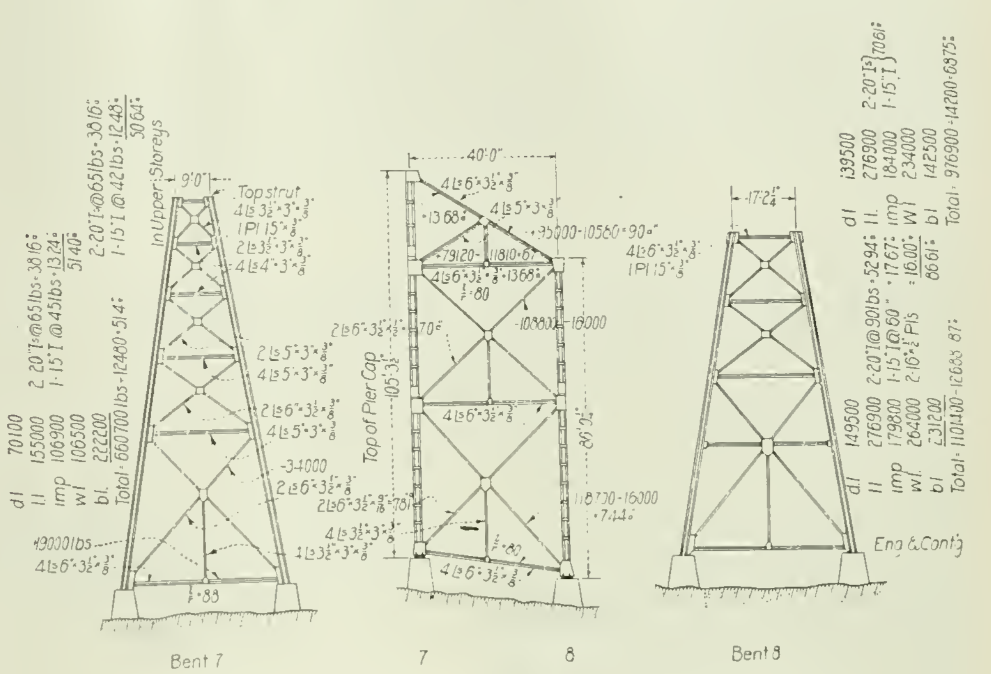


Fig. 2—Typical Compression Sections, Boucanne River Viaduct.

Under these specifications the weight of steel in the 60-ft. deck plate girder spans is 57,000 lbs. per span, including both girders and all wind and sway bracing. In the 56-ft. spans the corresponding weight was 51,000 lbs., in the 40-ft., 29,000 lbs. and in the 30-ft. spans 17,500 lbs. per span.

TOWERS AND TRUSS SPANS.

The trusses of the 150-ft. span, as will be seen from Fig. 1, have six panels of 25 ft., are in vertical planes, are 25 ft. deep between centers of gravity of chords, and are of the Warren type. The cross girders or floor beams at the intermediate panels are 4 ft. 4¼ ins. deep over flange angles and are riveted to the vertical members of the truss just under the top chord. The end floor beams which have to support the 40-ft. girder spans are 5 ft. ¼ in. deep over flange angles and are 1 ft. lower on the truss than the intermediate ones in order to accommodate the difference in depth between the 40-ft. girders mentioned, and the stringers of the truss span. These latter are also plate web girders, their depth thus being 5 ft. ¼ in. back to back of angles against the uniform 6 ft. ¼ in. of the girder spans. It will thus be seen that the stringer girders sit on top of the floor beams and are 9 ft. apart on centers, being in fact 25-ft. deck plate girder spans. The floor beams are similarly single-web plate girders with webs of 7/16-in. thickness and flange angles 6x6x9/16 ins. on the deeper and 6x6x⅝ ins. on the shallower. The truss itself has a top chord section composed of a cover plate, two web plates about 14¼ ins. between them and four angles 6x4 ins., all being ½ in. thick, the web plates 20 ins. deep, and the cover plate 23 ins. wide. Figure 2 will illustrate this make-up. The bot-

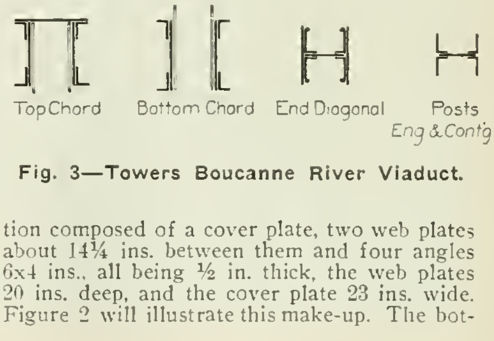


Fig. 3—Towers Boucanne River Viaduct.

tom chord consists of two web plates 22 ins. deep and four angles 6x4 ins., all 7/16 ins. thick in the first two panels at each end and all ¾ in. thick in the two central panels. The web system of vertical and diagonal members is consistently of H shape, the plate being uniformly 12¼ ins. wide with a thickness of ⅜ in. except in the compression diagonals where ½-in. plate is used. The angles are 9x3½x½-in. bulb angles, in all the diagonals and the end verticals, whilst in the verticals that are merely hangers they are 6x3½x⅜-in. angles, and in the intermediate compression verticals 7x3½x⅝-in. angles. The main or end compression diagonal is further reinforced by 19x¾-in. plates on the outside of each pair of bulb angles. These sections are also indicated by Fig. 2.

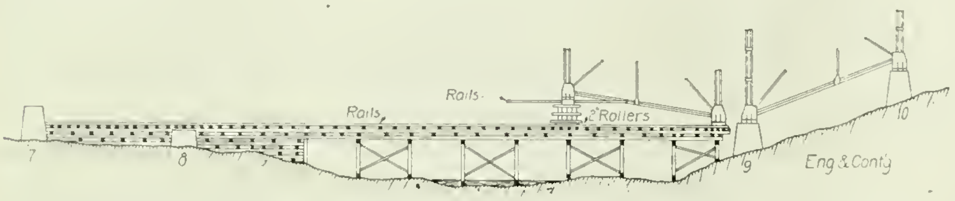


Fig. 4—Staging Track on Which Tower Was Moved, Boucanne River Viaduct.

The maximum top chord stress, composed of dead load, live load and impact load, amounts to 678,000 lbs., for which a section of 50.5 sq. ins. is provided, the maximum unit compression allowed by the Transcontinental Ry. engineers being 13,600 lbs. per square inch. The bottom chord receives a possible maximum stress of 768,000 lbs., which at 16,000 lbs. per square inch requires 48 sq. ins. of net sectional area. To meet this is supplied 48.76 sq. ins., being the effective net section obtained from the 60.760-sq. in. gross section provided. The Transcontinental Ry. prescribes that the Government formula for free ended compression members shall be used for their vertical struts, whilst for the compression diagonals the intermediate formula $16{,}000 \div \left(1 + \frac{l^2}{1{,}2000\ r^2}\right)$ is used, the constant before r^2 being 9,000 for free ends. By this means the units are obtained and by their aid the necessary cross section. The tension unit is 16,000 lbs. regularly.

The trusses are braced together horizontally by both top and bottom lateral systems, the top consisting of crossed single diagonal angles in each panel connected to the under side of the chord angles and to the bottom flange of the stringers. The bottom lateral bracing consists of transverse horizontal struts of four angles laced in pairs and of cross diagonals similarly constructed. They are made the full depth of the chord for the sake of simplicity and efficiency in connection. Under each floor beam is supplied a sway brace consisting of cross diagonals connected to the vertical members of the trusses and to the bottom struts.

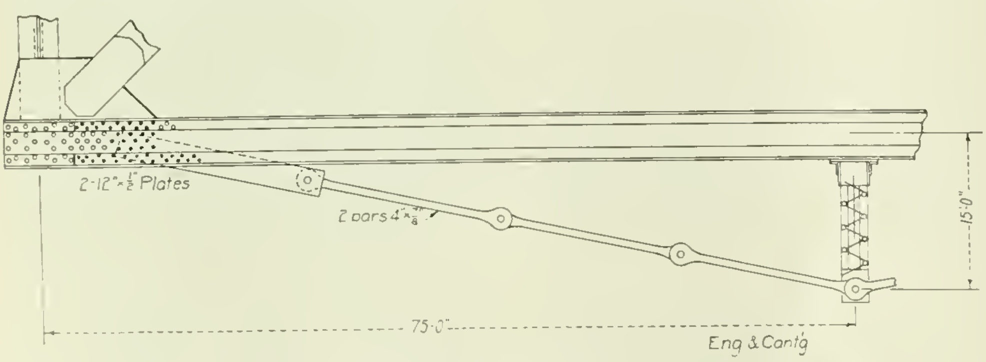


Fig. 6—Method of Trussing Bottom Chord for Erection in One Piece, Boucanne River Viaduct.

An interesting item, perhaps, is the size of the lattice bars and the clauses governing their dimensions. The lower side of the top chord is of course latticed between gusset plates, and here 5½x9/16-in. single lacing is used. The bottom chord is laced in both its upper and lower faces with 3x½-in. double lacing, whilst the lacing of all the lateral struts and diagonals is 2½x⅜-in. The clause in the specification that determines the thickness is that the bars should be at least 1/40 as thick as the distance between the rivets that connect their ends to the two leaves of the members which they lace, if singly laced, and 1/60 if doubly. On the upper chord the web plates being 14¼ ins. apart, the gage line on the angles are 20¼ ins., which with approximately 60° lacing gives 23 ins. between rivets and 23/40 in. or .575 in. as required thickness, for which 9/16 in. was used. The width is governed by the fact that two rivets were required at each end, and these could not be obtained with the necessary edge distances on the lattice bar, under 5½ ins. Similarly on the bottom chord the same 20½ ins. with 45° lacing gives 28½ ins. between end rivets and calls for $\frac{28.5\text{ ins.}}{60}$ or .48 ins. thickness in the bars. One rivet being sufficient connection, a 3-in. bar was adopted. The latticing in bracing members need only be made 75 per cent as heavy as the above specification, and so ⅜ in. is the usual dimension.

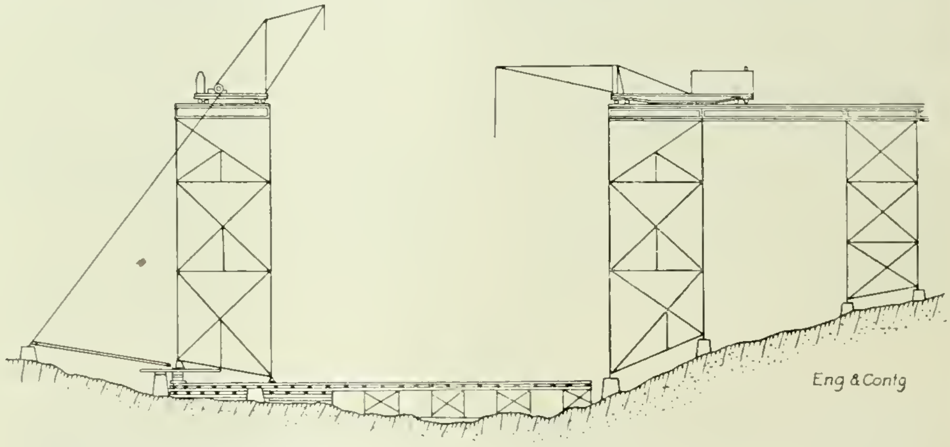


Fig. 5—Sketch Showing Method of Moving Tower, Boucanne River Viaduct.

The rivet values permitted are 10,000 lbs. per square inch single shear and 20,000 lbs. per square inch bearing. These figures are for shop-driven rivets, whilst for those driven by power in the field a reduction in value of 10 per cent is insisted on, and for hand-driven rivets a decrease of 25 per cent in value is prescribed. The gusset plates in the main truss were principally ⅝ in. and the minimum thickness of material allowed was ⅜ in. throughout the bridge.

The towers are of the usual viaduct construction, and consist of two "bents" braced longitudinally together. Each "bent" is made up of two battered posts with sway bracing between them. The sway bracing as indicated on Fig. 3 is composed of panels of crossed diagonals and horizontal struts. This is the most usually adopted type, although occasionally the struts are omitted except at the extreme top and bottom, and the diagonals made rigid enough to effectively resist compression. In the usual layout as typified by the Boucanne River Viaduct, the diagonals although made of stiff shapes are proportioned for tension with a limit of slenderness determined by making the maximum permissible ratio of unsupported length to radius of gyration equal to 200.

The horizontal struts are then figured as compression members and their stiffness is governed in turn by a clause limiting $\frac{l}{r}$ to 120. Under these conditions the stiffness more generally than the figured stress governs the choice of sections.

The longitudinal bracing between the bents is calculated to take any stress that might occur from suddenly applying or releasing the brakes on the train. Here, again, however, with the National Transcontinental Ry. the same stiffness clauses come in and in the smaller towers determine the dimensions of the diagonals and struts, whilst in the larger towers carrying the ends of long spans the figured stresses often call for increased thickness of metal. A typical diagram Fig. 3 is appended showing computed stresses and supplied material for the particular tower to be considered in this paper.

The posts are made up of three I-beams riveted together to form an H-section, reinforced by side plates where necessary. This form of post section provides the minimum of shop work and secures reasonable connections for all bracing. When the two I's are deep they may be connected at suitable intervals between bracing points by batten plates, or may be continuously latticed. In the case of the Boucanne Viaduct the bottom plate system was employed and 9x⅜-in plates 1 ft. 3 ins. long were provided on each face at about 5 ft. intervals. In the tower 7-8 under consideration the lowest story was built up of two 20-in. I-beams weighing 90 lbs. per foot each, with the diaphragm I-beam 15 ins. deep and weighing 60 lbs. per foot. In addition, there were two 16x½-in. side plates, one on the outside of the web of each 20-in. beam, giving a total gross section of 86.6 sq. ins. The beams are heavy American standards and were rolled by the Carnegie Steel Co. The loads on this post, No. 8, are computed to be as follows:

Dead load	149,500
Live load	276,900
Impact	179,800
	606,200
Wind load	264,000
Brake load	231,200
Total	1,101,400

These loads are the maximum that can coexist according to the specification and not necessarily the maximum amount of each and every class of load. Now the unit compressive stress allowed by the specification is that given by the formula $16,000 \div \left(1 + \frac{l^2}{9,000\, r^2}\right)$ This applies, however, to the combination of dead, live and impact loads which, as above detailed, amount to 606,200 lbs. In the story under inspection $\frac{l}{r} = 72$ and consequently $f = 10,150$ lbs. per square inch. But in consideration of the remoteness of the possibility of all the wind load and all the brake load occurring together and at the same time as such a large impact load, which the braking load either removes or replaces, the allowed unit for the full combination of live, dead, impact, wind and brake loads is increased above that already determined by 25 per cent. There are thus two cases to be considered in every post—first, the ordinary combination at the ordinary unit; and, second, the extraordinary combination at the increased unit. In the present case, as with most cases of high towers and long spans, the second case governs and so the unit of 12,688 is used, necessitating 87 sq. ins. of section.

The feet of the posts are shod with a steel shoe plate 2 ins. thick which rests upon a steel bed plate 1½ ins. thick, the latter being anchored to the pedestals. The anchor bolts for bent 8 were 1¾ ins. diameter and 6 ft. long, two to each post, whilst to bent 7 were given 2½-in. diameter bolts 13 ft. 3 ins. long, two to each post. A few inches of each bolt project above masonry to receive nuts and washers above shoe plates, and the rest is built into the pedestals. A space is left around the bolt to allow of slight adjustment and then after the towers are completed this space is filled with cement grout.

One post of each tower was rigidly fixed to its bed plate, but the other three were allowed freedom to move under expansion or contraction from temperature or loading. Each of the posts adjacent to the fixed one is permitted to move in the direction of the line adjoining to the fixed one; that is, the one transversely to the viaduct axis and the other longitudinally with the viaduct axis, while the diagonally opposite post can move in any direction. In other words, one shoe being fixed two had one degree of freedom and the other two degrees. Tongue and grooves in the bed and shoe plates, respectively, were used to accomplish this, and in the particular tower under notice the S. E. post was the fixed one. The tongues were 2½x5/16-in. flats and the grooves were planed out 7/16-in. depth.

ERECTION METHODS.

The viaduct was erected from the east end, and as the line itself was the only approach, the steel had to be forwarded from Montreal to the station on one of the existing railways nearest to the constructed track. This meant the carrying of all steel by the derrick cars from the east end storage to the actual site and over the erected portions. The process, therefore, was to erect bent 14 and place the 60-ft. girders from the east embankment. The derrick then moving into the 60-ft. girders erected bent 13 and the longitudinal bracing and the 30-ft. girders. This method, obvious and ordinary, was followed to bent 9. For the higher bents a horizontal temporary strut is employed to steady and support the first bent of a tower, being erected between it and the last completed tower. These temporary struts serve to stiffen the bent while the 60-ft. girders are placed and the derrick advanced to erect the rest of the tower. They were wooden in the case of the Boucanne River Viaduct, but are of steel for larger and higher towers.

When the tower 9-10 was completed, the next necessary undertaking was bent 8, which in its final position was to be 150 ft. west of bent 9. As this could not be erected from the west end, there being no line, it was essential to scheme out some method of building the complete tower 7-8 before the truss span which it was destined to carry. Although the river was but a foot or two in depth, falsework for the truss was considered too expensive and troublesome, and the plan now to be presented was selected as the most feasible and desirable means of erecting both the trusses and the tower. The outline of the scheme was the building of tower 7-8 on low staging close to 9-10 within reach of the derrick booms and approximately at its final level, and then rolling or sliding it westward into place. The company had before had experience with the moving of towers by this means and were satisfied from past successes that this was a possible and practicable scheme. Temporary wooden staging was built across the river upon which were laid the skidding or rolling track rails. These were laid at such a height that between their bases and the top of the pedestals of 8 there was just room for an ordinary railroad tie and an inch or two of blocking, Fig. 4. On top of these rails were then built the posts of bent 8. The base of bent 7 being 6 ft. higher than bent 8, this amount of timber blocking was built upon the rails 40 ft. west of bent 8 and upon this small timber tower bent 7 was erected. When the bracing and 40-ft. girders of this tower had been completed a stiff-leg derrick was built on top of the tower by the erection derrick on tower 9-10, Fig. 5.

Between the shoe plates of bent 7 and the blocking upon which they rested was placed another set of rails, so that when the tower had been rolled westward until the blocking under bent 7, having passed pedestal 8, was about 8 ft. from pedestal 7 they would project over pedestal 7 and when staged or blocked, would form a track upon which the shoes of bent 7 could slide the last few feet of their travel, the shoes of bent 8, of course, still rolling. Thus for the first 135 ft. or so the two bents of the tower rolled on the lower tiers of rails and afterwards the higher shoes slid on the upper tiers. The rollers were 2 ins. in diameter and about 4 ft. in length. In this manner the tower was rolled to position and then jacked down onto its anchor bolts which were already in place on the pedestals. The rolling was effected by the winding engine of the stiff-legged derrick on top of the tower rolled. Lines from its spools to a hitch west of pedestal 7 passed back to the tackles, which were placed around posts at gussets and around the blocking under 7. The derrick up above thus pulled the tower carrying it into place. The movement was very easily accomplished and without any trouble or hindrance.

The next problem was the erecting of the truss span. The two bottom chords were lowered piece by piece to the staging already referred to, a few feet only from the ground, and there they were bolted up and trussed as shown in Fig. 6, by temporary eye bars and short struts. By this means they were made strong enough to carry themselves and a part of their respective trusses as spans of 145 ft. 6 ins. length. The end vertical posts of the trusses had, of course, been already erected as part of the towers and the bottom chord and splices were arranged to permit of the trussed chord being hoisted vertically and immediately bolted to the short end sections, which were shop riveted to the gusset plates at the foot of the vertical posts incorporated into the towers. By this means the two bottom chords were hoisted into place and connected, the stiff-legged derrick on 7-8 taking hold of about 40′ out and the main traveler taking hold of about 50′ out. The bottom lateral bracing was then put in place and the chords thus stayed horizontally.

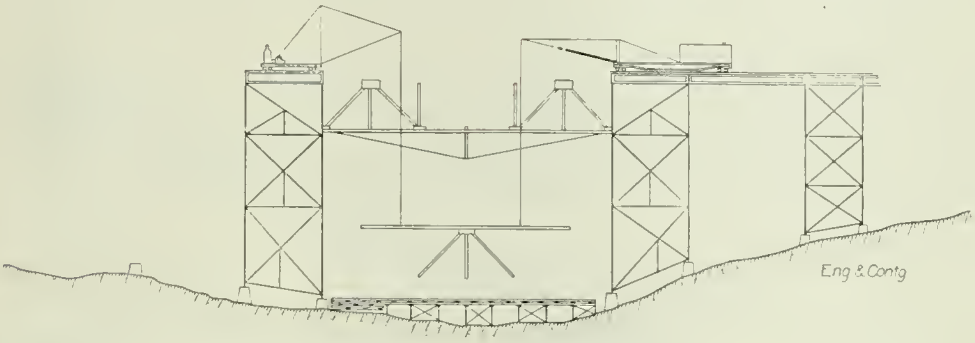


Fig. 7—Sketch Showing Method of Erecting Trusses, Boucanne River Viaduct.

The next process, Fig. 7, was the erecting on the low staging of the web members of the two panels at each end of each truss; that is, the main compression diagonal, the first vertical and the main tension diagonal. These were then hoisted into place and immediately braced by the placing of the first floor beam and sway bracing. The second verticals being added, the remaining central portion of each truss was assembled down below with the four panels of top chord and then similarly hoisted up to position and bolted on. The intermediate floor beams, sway bracing and top lateral bracing followed and the addition of end sections of top chords and stringer girders completed the span. When sufficient riveting had been done the temporary eye bar trussing was removed and everything was ready for the laying of track and the passage of the erection derrick. The stiff-legged derrick was dismantled and the erection of the remaining towers was proceeded with on the same plan as above described for the eastern shore. The photograph of the placing of the last girder is interesting in that it shows the device whereby a brace frame is hoisted above the second girder of a span, so that immediately both girders are correctly placed they can be braced together.

The main erection derrick had an interesting feature in its telescopic booms. They were built of steel sections in two lengths each, and so arranged that the outer half could enter the inner half and the effective boom thus shortened. Holes and pins were provided in the webs of each position of each boom whereby various lengths could be obtained and retained. The capacity of the booms was 15 tons per boom when shortened down to about 40 ft., and 10 tons each when acting at their full extension of 62 ft.

The greatest weight lifted in this viaduct was about 20 tons, divided between the derrick and the stiff-leg erected on tower 7-8. This weight comprised the center portion of the 150-ft. span, was 394,185 lbs., and the total in the viaduct 913 tons.

The steelwork was manufactured and erected by the Dominion Bridge Co., Ltd., of Montreal, under the supervision of R. F. Uniacke, Bridge Engineer to the N. T. C. R.

Mr. F. P. Shearwood is the Designing Engineer of the company, and Mr. J. Finley the

Erection Superintendent, while the author as Assistant Designing Engineer was in responsible charge of the designing of the work above described.

Method of Constructing a High Retaining Wall in Trench in a Narrow Side Hill Space.

Rather difficult conditions in respect to limited area and inaccessibility of working space prevailed in the construction of a high and thin retaining wall at Toronto, Canada. The accompanying sketch indicates fairly the construction required and the following description is condensed from an article by C. S. L. Hertzberg, Consulting Engineer, Toronto, in "Applied Science" for May, 1913:

Figure 1 shows a section of the Canadian Pacific Ry. reinforced concrete retaining wall on the south side of Front St., between Bathurst St. and Spadina Ave., Toronto. This wall protects the Canadian Pacific Ry. track which leads up to the company's new freight sheds on the old Government House property. The track parallels the wall on the south side of it, rising from an elevation of about 20 ft. below Front St. at Bathurst St. to the street level at Spadina Ave., where it crosses Front St. on the level. The wall is about 2,000 ft. long and varies in height from 22 ft. at the Bathurst St. end to 8 ft. at the Spadina Ave. end. The lack of space on which to carry on construction work made the execution of the contract considerably more difficult than would otherwise have been the case. The strip owned by the Canadian Pacific Ry. was about 14 ft. wide and was all on a steep slope from the elevation of Front St. on the immediate north to that of the Grand Trunk yard immediately south. The wall itself was built with the face on the south line of Front St. The base of the wall at the deepest part projects under the track of the Toronto Railway Co., which runs along the south side of Front St. From this it will be seen that there was no room to operate on the north of the wall excavation, while, to the south, the ground sloped sharply down to the Grand Trunk tracks.

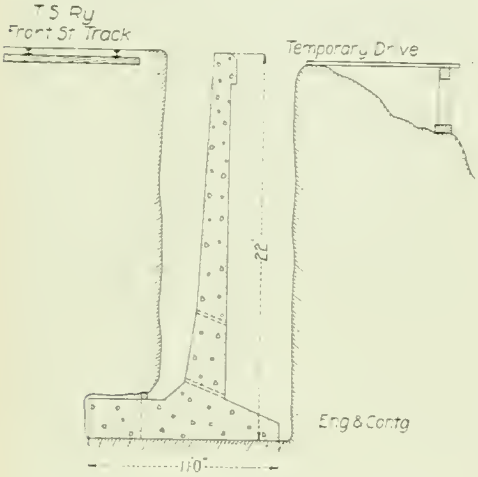


Fig. 1—Sketch of Retaining Wall Built in Trench, Canadian Pacific Ry., Toronto.

The material to be excavated was the very hard blue clay found in that locality. As there was in the neighborhood of 10,000 cu. yds. of excavation to be done, it was decided to use a steam excavator for the deepest sections while the shallower part of the trench was taken out by hand labor.

The Toronto Railway Co. was approached with a view to getting them to abandon their southerly track for certain hours of the day, in order to allow wagons to be placed on the track for the removal of the excavation. The railway company, however, would not consider any such plan, and a temporary plank roadway had to be built out over the bank to allow teams to approach the excavator. Here they were loaded from the Harris orange-peel machine which straddled the trench on a temporary track. The machine dug a trench about 10 ft. wide at the rate of about 120 cu. yds. per day of 10 hours, under the most favorable conditions.

The temporary roadway was so narrow that several teams fell down the bank to the Grand Trunk tracks and one horse slipped out of his harness and fell 20 ft. to the bottom of the excavation. This horse reported for duty next day after having walked out on a ramp built for the occasion.

Fortunately, the blue clay was very stiff and stood up well with comparatively little shoring, until the excavation was made for the toe of the wall, which projected under Front St. and under the south rail of the Toronto Ry. tracks. The bottom of the trench was prepared to receive the concrete before the undermining for the toe was commenced.

The undermining extended inwards about 5 ft. from the face of the trench at the deepest part. As this undermining left an unsupported overhang of earth about 20 ft. deep, along which street cars were continuously running, great care had to be taken in carrying on operations. This work was done in the early part of last summer during which we had an unusual amount of rain, increasing the danger from cave-ins. The undermining was done in sections about 12 ft. in length, after which the base was immediately poured and the concrete tamped in under the overhanging clay. A whaling piece of timber, 6 ins. square was also placed under the edge of the overhang and supported with uprights. No attempt was made to recover these timbers. The framework for the shaft of the wall was then erected to about 6 ft. above the top of the footing, and the cross braces were removed to this elevation. The wall was then poured to this height. After this had been allowed two days in which to set, and while the next 6 ft. of forms were being erected, the bottom 3 or 4 ft. of the north face was stripped and painted with tar and asphalt. Then a backing of 12 ins. of head size stone was placed against the wall and the excavation was filled to this level at the back of the wall.

This process was continued until the level of the underside of the coping was reached. For the coping, special forms were made in sections which were shifted for each section. By pouring the coping last it was possible to line it in independently of the face of the wall and thus any irregularities were overcome. It may be of interest to state that the average cost of this wall ran about $25 per lineal foot, including excavation, backfill and a pipe railing along the top.

Exhibition of Commercial Motor Vehicles.—There will be held in London, England, on July 15-30 an exhibition of commercial motor vehicles. This exhibition will be known as "The Heavy Motor-Vehicle Show."

Use Iron Ore on Roads.—The County Board of Ashland County, Wisconsin, has decided to use iron ore on the county roads hereafter, instead of crushed granite.

Results of Tests of Creosoted Bridge Timbers Which Had Been in Use 29 Years.

Tests of 6x16 in. x 30 ft. creosoted timbers which had been in use in a railway trestle for 29 years are described by W. B. Gregory in a paper entitled "Tests of Creosoted Timber," Proceedings American Society of Civil Engineers, Vol. xxxix, p. 943. The timbers were cut in two and were tested as beams 12 ft. between supports; the greater dimension was vertical. Table I is a summary of the results of the tests.

TABLE I.—SUMMARY OF TESTS OF CREOSOTED BRIDGE TIMBERS.

		b	h	I	Loads		$S = \frac{Plc}{4I}$		d, in inches.	E		
Number of beam.	Top of butt of log.	Width in inches.	Height in inches.	$I = \frac{bh^3}{12}$	Actual at elastic limit.	Maximum.	At elastic limit.	Maximum.	At elastic limit.	$E = \frac{Pl^3}{48dI}$	Weight, in lbs., per cu. ft.	Kind.
I	T	6.03	15.89	2,015	26,000	38,450	3,680	5,450	0.625	1,283,000	43.3	Coarse-grained loblolly.
I-A ...	B	6.22	16.00	2,125	24,000	29,800	3,252	4,038	0.565	1,243,000	42.6	
II	T	6.08	15.75	1,978	34,000	55,060	4,870	7,890	0.680	1,573,000	43.7	Long-leaf pine.
II-A ..	B	5.97	15.97	2,025	30,000	42,000	4,260	5,960	0.650	1,418,000	47.6	
III	T	5.86	15.50	1,818	22,000	25,700	3,380	3,945	0.615	1,224,000	39.4	Coarse-grained loblolly.
III-A ..	B	6.03	15.55	1,889	22,000	22,600	3,260	3,350	0.645	1,124,000	39.6	
IV	T	6.46	15.61	2,086	26,000	33,740	3,530	4,575	0.825	939,000	41.9	Long-leaf pine.
IV-A ..	B	6.50	16.12	2,271	24,000	40,130	3,065	5,120	0.600	1,095,000	45.5	
V	B	6.09	15.93	2,051	38,000	54,000	5,310	7,550	0.705	1,633,000	45.1	Coarse-grained loblolly.
V-A ...	T	6.25	15.94	2,109	22,000	41,275	2,990	5,620	0.480	1,350,000	42.5	

Reorganization of Reclamation Service.—Secretary Lane of the U. S. Reclamation Service on May 28 announced a reorganization of the service which is an adaptation of the commission plan of government to this work. The Commission will consist of five members: F. H. Newell, chairman; George Barton French, commissioner in charge of operation and maintenance; A. P. Davis, chief engineer; Judge Will R. King, of Oregon, chief counsel; and of one member whose name has not yet been announced and who will have charge of contracts and finances. George Barton French, the new commissioner in charge of operation and maintenance, has had an extensive western railroad experience, and was recently the president of the Seattle, Portland and Spokane Railroad, and from long residence in Arizona, California, Oregon and other western states, is familiar with irrigation matters. In the future all regulations affecting water users or proposed contracts for the construction of new works and the general policies of the service shall be considered with this board as a whole; that is to say, they shall collectively constitute an administrative regulating body, but each member thereof shall have distinctive administrative duties. Matters relating to the operation of constructed projects, the rights of water users and the relations between the water users and the Government are to be administered by Mr. French.

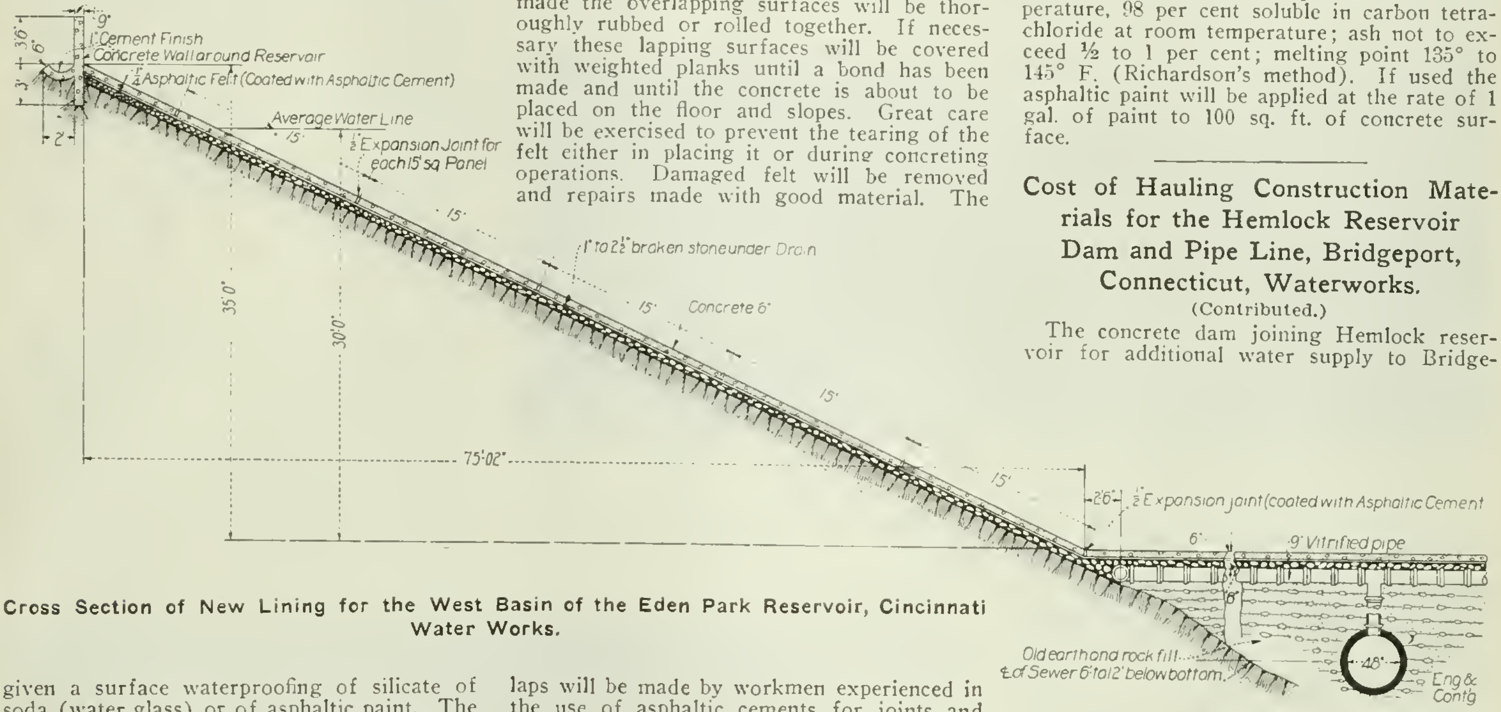
Panama Canal Excavation in April.—The grand total of canal excavation to May 1 was 198,243,402 cu. yds., leaving 19,894,897 cu. yds. to be excavated. The total for the month of April was 2,655,095 cu. yds., of which 1,676,000 cu. yds. was dry. The dredges removed 979,095 cu. yds. In the Atlantic division the total excavation was 469,677 cu. yds. Of this amount, 29,649 cu. yds. were dry excavation in the vicinity of the locks, and the remainder —440,028 cu. yds.—was principally wet excavation from the channel and harbor section. The total excavation in the Central Division was 1,179,100 cu. yds., which includes 1,100 cu. yds. charged to "plant excavation." In the Pacific division the total excavation was 1,006,318 cu. yds., 467,251 cu. yds. of which consisted of dry excavation, 23,875 at Miraflores spillway, 68,296 at the Balboa terminal and 375,080 from the prism between Pedro Miguel and Miraflores locks and immediately south of the latter. Of the 539,067 cu. yds. of wet excavation, 182,125 cu. yds. were taken from the terminal site and the remainder from the Pacific entrance.

WATER WORKS

A Concrete Lining with a Felt Waterproofing; Eden Park Reservoir, Cincinnati, O., Water Works.

(STAFF ARTICLE.)

A design of concrete lining, which is unusual in several particulars, has been adopted at Cincinnati, O., where the west basin of the Eden Park Reservoir is to be relined during the present season. The new lining will consist of a base course of compacted crushed stone and on this a layer of felt waterproofing covered with 6 ins. of concrete laid in 15-ft. squares with bituminous joints and given a surface waterproofing of silicate of soda (water glass) or of asphaltic paint. The particulars of the lining structure as planned are summarized below from information furnished to us by Bert L. Baldwin, General Superintendent of Water Works.


9"
1" Cement Finish
Concrete Wall around Reservoir
1/4" Asphaltic Felt (Coated with Asphaltic Cement)
3'6"
6"
3'
2'
Average Water Line
15'
1/2" Expansion Joint for each 15' sq Panel
15'
1" to 2 1/2" broken stone under Drain
35'0"
30'0"
15'
Concrete 6"
15'
75'02"
15'
2'6"
1/2" Expansion joint (coated with Asphaltic Cement
6"
9" Vitrified pipe
6"
6"
48"
Old earth and rock fill
℄ of Sewer 6' to 12' below bottom.
Eng & Cont'g

Cross Section of New Lining for the West Basin of the Eden Park Reservoir, Cincinnati Water Works.

The loose stone and concrete now in place will be removed, crushed, screened and graded. If necessary it will also be washed. Particles of the crushed or graded material larger than 1 in. in any dimension will be reserved for use in the layer of crushed stone which is to underlie the concrete on the slopes of the reservoir, and in the "French" drains constructed around the sewer pipe drains which are to be placed in the floor of the basin at the toe of the slopes. These "French" drains consist of vitrified clay pipe laid with open joints and surrounded by crushed stone. The remaining portion of crushed and graded material, down to 1/4 in., will be used in the new concrete work.

After the removal of the material now on the floor and slopes all soft places will be filled with waste material from the stone crusher and screen. The floor surface will be rolled with a roller weighing at least 3,000 lbs. per lineal foot and 4 ft. long. This rolling will precede the digging of trenches for the lateral drains.

A layer of 6 ins. of broken stone will be placed upon the slopes after the natural surface has been evened up to receive it. This stone will be rammed in place to furnish a firm foundation for the concrete lining. For this work stone from 1 in. to 2½ ins. in least dimension will be used. In placing this broken stone lining it will be worked up the slopes from the toe in sections about 7½ ft. wide. This lining will be continued around the toe of the slope on the floor of the basin to connect with the "French" drain around the sewer drain pipes.

A layer of waterproof felt 1/8 in. thick will be placed upon the floor of the reservoir after it has been properly leveled and upon the finished broken stone lining on the slopes. This felt will be in sheets 4 ft. wide and 15½ ft. long, lapped 6 ins. on all edges and joined with asphaltic cement used hot and thoroughly applied to the surfaces to be joined. On this surface a second thickness of waterproof felt will be laid with break joints in both directions, and with 6-in. side and end laps joined with hot asphaltic cement as in the case of the first layer. The felt specified is that made by the Philip Carey Mfg. Co., or equal.

After the asphalt cement joint has been made the overlapping surfaces will be thoroughly rubbed or rolled together. If necessary these lapping surfaces will be covered with weighted planks until a bond has been made and until the concrete is about to be placed on the floor and slopes. Great care will be exercised to prevent the tearing of the felt either in placing it or during concreting operations. Damaged felt will be removed and repairs made with good material. The laps will be made by workmen experienced in the use of asphaltic cements for joints and bonds.

The felt proposed for this use consists of wool and vegetable fibres in the ratio of one part of wool to three parts of vegetable fibres. The vegetable fibre is mainly cotton. The fibres are thoroughly felted together and compressed to a uniform thickness of about 1/8 in. The fibre is thoroughly impregnated with a residuum oil with asphaltic base. By weight about 6¼ parts of residuum will be used to impregnate 3¾ parts of felt.

The concrete lining on the floor and slopes of the basin will be placed in panels 15 ft. square. Alternate panels only will be placed at the first concreting. After the first set of panels has hardened sufficiently the forms will be taken down from around them. The expansion joints and the final alternate panels of concrete will then be placed. A 1:2:4 concrete, mixed in a batch mixer, is specified.

Smooth wooden strips 3/8 in. thick at the bottom, 5/8 in. at the top and 7 ins. wide, will be placed between the adjacent panels of concrete. Both surfaces of this strip will be oiled to facilitate its removal from this joint space after the concrete has hardened. The space left between the panels will be filled with an approved "Gilsonite" or asphalt. This joint material will be poured hot.

The specifications state that a suitable joint material should show at least 98 per cent solubility in carbon bi-sulphide, and at least 97 per cent solubility in carbon tetrachloride, and should show a penetration at 32° F. of not less than 5 mm. with a No. 2 cambric needle loaded with 100 grams during an interval of five seconds, and should show a penetration at 77° F. of not over 6 mm. for the same needle, load and time.

After the concrete lining and expansion joints have been placed, and the surface of the concrete washed and cleaned, a wash of silicate of soda will be applied to the surface of the concrete. Silicate weighing not less than 10 lbs. per gallon will be used. In applying the wash 1 gal. will be applied to 140 sq. ft. of concrete surface. The entire surface of the concrete lining on the floor and slopes of the reservoir will be given this wash, applied with white wash brushes.

Possibly an asphaltic paint will be substituted for the silicate of soda wash. In that case the asphaltic paint will consist of an approved asphaltic distillate, cut with about 25 per cent of benzine. The distillate will comply with the following requirements: 99 per cent soluble in carbon disulphide at room temperature, 98 per cent soluble in carbon tetrachloride at room temperature; ash not to exceed ½ to 1 per cent; melting point 135° to 145° F. (Richardson's method). If used the asphaltic paint will be applied at the rate of 1 gal. of paint to 100 sq. ft. of concrete surface.

Cost of Hauling Construction Materials for the Hemlock Reservoir Dam and Pipe Line, Bridgeport, Connecticut, Waterworks.

(Contributed.)

The concrete dam joining Hemlock reservoir for additional water supply to Bridgeport, Conn., is 92 ft. high and 1,350 ft. long and from it water will be taken to the city, about seven miles, through a 60-in. cast iron pipe line. All construction materials, including cement, crushed stone, structural steel, cast iron pipe, machinery and supplies, are being hauled to the work by motor trucks. Two of the trucks used are Locomobile 5-ton trucks, capable each of handling a 5-ton trailer in addition to its own burden. The operation of these two trucks for approximately nine months is recorded in this article from data collected by the Locomobile Company of America.

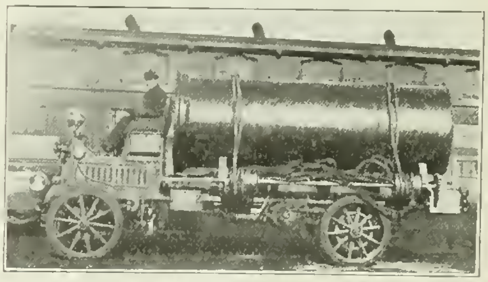


Fig. 1—Truck With Pipe Loaded Showing Side Shaft and Drums for Loading.

Both the standard 5-ton trucks and the trailers were especially constructed to carry pipe. The views, Figs. 1 to 3, show clearly the two vehicles. They are further described as follows: The truck was made special by mechanism and fittings provided for loading and unloading the 15-ft. lengths of 60-in. pipe. First, along one side of the truck there was fitted a horizontal shaft, with two drums, Fig.

TABLE I.—COST OF OPERATION OF TRUCK NO. 2.

	April 9-30.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan. 1-22.	Total.
Variable expenses	$ 70.99	$ 91.00	$ 42.65	$ 57.84	$118.94	$200.34	$304.03	$241.32	$ 81.15	$ 38.44	$1,236.70
Fixed charges:											
Garage	10.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	10.64	140.64
Driver	57.00	82.00	76.00	89.00	91.00	97.00	101.00	92.00	83.00	57.00	825.00
Interest	6.87	9.92	9.92	9.92	9.92	9.92	9.92	9.92	9.92	7.04	93.27
Insurance	5.60	8.12	8.12	8.12	8.12	8.12	8.12	8.12	8.12	5.76	76.32
Depreciation	60.69	88.00	88.00	88.00	88.00	88.00	88.00	88.00	88.00	62.40	827.09
Total	$211.15	$294.04	$239.69	$267.88	$330.98	$418.38	$526.07	$454.36	$285.19	$181.28	$3,199.02
Miles	606.7	1,135.8	1,095.7	1,438.8	1,348	1,667	1,541	1,342	920	376	11,471
Cost per mile (cts.)	34.8	25.9	21.8	18.6	24.5	25.1	34.1	33.8	30.9	48.0	....
Tons	245.2	340.4	344.5	473	459	582.4	524.4	464.5	326	332	4,091.4
Cost per ton (cts.)	86.1	86.4	69.5	56.4	71.9	71.5	100.0	97.5	87.4	54.6	....
Cost per ton mile (cts.)	11.5	10.6	9.1	7.8	9.8	9.8	13.4	13.2	12.1	18.8	....
Number of trips	52	70	73	96	91	114	102	91	66	16	771
Number of days	19	23	24	26	24	25	29	23	21	13	227
Bonus	....	$1.00	$1.00	$8.00	$10.00	$19.00	$11.00	$11.00	$2.00	......	$63.00

1. Across the truck platform just forward and behind the drums were fastened two bolsters fitted with wood chucks to form a seat for the loaded pipe. Two pressed steel channel skids, which, when use, are attached by reversible pins to the ends of the bolsters, and a jack complete the essential fittings. Figures 1, 2 and 3 show all the parts mentioned. The side shaft and drums by means of rope slings, as shown by the illustrations, rolled the pipe easily onto and off the truck. To take the weight of the pipe off the truck springs when loading and unloading the side over which the pipe rolled was jacked up as indicated by Fig. 2.

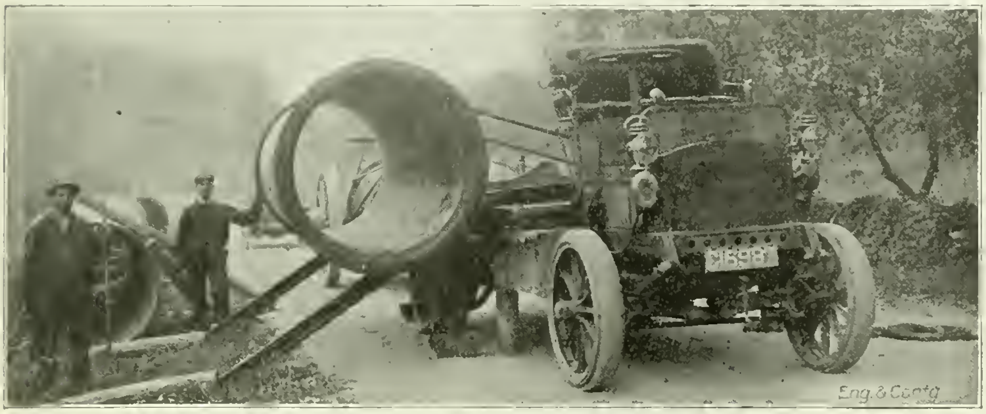


Fig. 2—View Showing Method of Unloading Pipe from Truck.

The trailer, Fig. 3, consists of a pair of wheels mounted on a steel axle curved overhead, to the middle of which a crane-neck beam is secured. The long end of this beam is trussed to the axle at four places so as to constitute a rigid system. At the short end of the beam, just above the axle, is a ratchet device with two pawls and a long lever. By working these a chain laid around the pipe is either wound around or off the ratchet wheel, thereby raising or lowering the pipe. One man controls the pawls, keeping one in and the other out of engagement with the ratchet, while two men control the end of the lever bar to which a cable is fastened.

All pipes are loaded at a dock where they are brought by a steamer. They are discharged along the roadside. Machinery and other loads are also loaded either by motor power or by means of cranes. Cement and similar material are placed on the truck in bags, being put on and off while the truck runs up against a platform which is on one level with that of the truck body.

Provided each truck is used in conjunction with a trailer, it can transport seven pipes per average day, making three trips and loading for another on the next day, and making four trips on that day. As the total daily average operation cost of one of the trucks is $12.26 and that of the other $14, the latter figure may be safely taken as an average daily cost, and figuring 14 pipes in two days at the cost of $28, or $2 a pipe, as above stated.

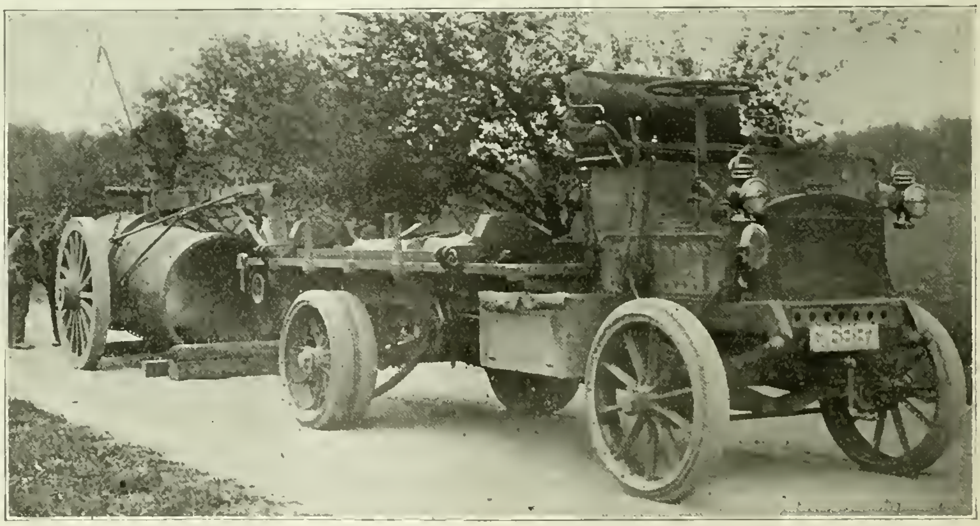


Fig. 3—View Showing Method of Unloading Pipe from Trailer.

Tables I and II give the costs by months for each truck. In computing these tables the investment is taken at $4,764, interest at 5 per cent and depreciation at 25 per cent per annum, less tires. A summary from the two tables gives the following:

Item.	Truck 2.	Truck 3.
Variable expenses	$1,237	$ 868
Fixed charges	1,962	1,598
Total	$3,199	$2,466
Miles run	11,471	10,425
Cost per mile	$0.278	$0.228
Tons carried	4,091	3,532
Cost per ton	$0.779	$0.673
Cost per ton mile	$0.106	$0.091
Trips made	771	704
Days worked	227	194

Break in Submerged Pipe Line.—It has been noted for several weeks past that the water pressure in the town of Marion, Mass., was falling off. It was noted that the level of water in the city standpipe fell as much as 7 or 8 ft. each night. Careful inspection of the standpipe failed to reveal any leakage in that structure. A submerged pipe line leading from the mainland to an island was believed to contain the leak, for pressure measurements showed a very low pressure on the island. This pipe is submerged to a depth of 25 ft. It was carefully examined and a hole 2 ft. long was found in it. It is being repaired by a diver.

TABLE II.—COST OF OPERATION OF TRUCK NO. 3.

	April 1-17.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	8 mo.
Variable expenses	$ 56.53	$ 83.06	$ 65.24	$ 70.86	$ 62.97	$218.91	$228.74	$ 69.59	$ 12.14	$ 868.04
Fixed charges:										
Garage	7.50	15.00	15.00	15.00	15.00	15.00	15.00	15.00	1.50	114.00
Driver	45.00	81.00	75.00	90.00	88.00	94.00	101.00	92.00	6.00	672.00
Interest	5.56	9.92	9.92	9.92	9.92	9.92	9.92	9.92	0.99	75.99
Insurance	4.54	8.12	8.12	8.12	8.12	8.12	8.12	8.12	0.81	62.19
Depreciation	49.13	88.00	88.00	88.00	88.00	88.00	88.00	88.00	8.80	673.93
Total	$168.26	$285.10	$261.28	$281.90	$272.01	$433.95	$450.78	$282.63	$ 30.24	$2,466.15
Miles	535	1,037	1,151	1,495.6	1,466	1,624	1,548	1,520	48	10,424.6
Cost per mile (cts.)	31.4	27.5	22.7	18.8	18.5	26.0	29.2	18.6	6.3	....
Tons	185.5	362	380	496	490	561.7	515.1	526	15.4	3,531.7
Cost per ton (cts.)	90.7	78.8	68.6	56.6	55.5	77.5	87.5	53.7	196.0	Av. 95.6
Cost per ton-mile (cts.)	13.3	10.9	9.1	7.6	7.4	10.4	9.3	7.3	24.6	....
Number of trips	39	73	76	101	97	110	102	103	3	704
Number of days	15	23	25	26	24	25	29	25	2	194

The Disinfection of Lake Michigan Water with Calcium Hypochlorite at Waukegan, Lake Forest, and Winnetka, Ill.

The experience of the cities of Waukegan, Lake Forest and Winnetka, Ill., in the disinfection with calcium hypochlorite of their water supplies, drawn from Lake Michigan, is interesting since it shows that disinfection of the sewage contaminated lake water is desirable and that the hypochlorite treatment is effective. The apparatus employed and the results obtained in disinfecting the water is here described from information obtained from three papers published in the 1913 Proceedings of the Illinois Water Supply Association. The information with reference to the practice at Waukegan was given by W. J. Allen, Chief Engineer of the Waukegan water works, substantially as follows:

One year ago Waukegan was said to have the highest typhoid fever death rate of any city in the world. Mr. C. A. Jennings of Chicago was employed by the city to install a hypochlorite treatment plant. The plant brought immediate results, and it has been operated successfully since the beginning. To avoid tastes and odors in the disinfected water the following precautions should be observed. In the treatment of water with any chemical a perfect admixture of the chemical and water is necessary. This is especially true in the case of hypochlorite. In Waukegan this has been brought about by the use of a suction tee in connection with a grid which is placed under the discharge of the intake into the suction well. Also, an accurate measuring device should be used. A small pump, which is operated by the plunger of the high service pump is used at Waukegan. The feed is directly proportioned to the quantity of water pumped and the ratio can be varied at will.

The Waukegan solution tanks are in duplicate, each 5 ft. in diameter and 7 ft. deep. They are made of wood, but are cement lined. The mixing box rests on top of the tanks and is also cement lined. Water enters the mixing box through a perforated pipe so arranged that thorough agitation is obtained. The solution passes off near the top of the box into pipes leading to either tank. The concentrated solution will fill the tank about ⅓ full (36 to 42-lb. charge). A second pipe, arranged so as to mix thoroughly the contents of the tank, feeds direct into the tank. No machinery for agitating is used. Every tank of hypo is tested for strength in parts per million of free chlorine. Only slight variations in strength are noted between top or bottom of a tank. Every four hours a record is taken of the gallons of water pumped and the amount of hypo used. The treated water is frequently tested for free chlorine.

The pump gave some trouble at first. An air device was attached to prevent water hammer and another to prevent syphoning of the solution. In this way the pump became regular and dependable.

The settling well has been cleaned out four times in the year. The last time I took out over 500 live fish and innumerable minnows. Thus you will see that the hypo, at least in the quantity used at Waukegan, is not severe on certain species.

We are troubled in winter with ice covering the mouth of the intake. The intake is an inverted cone and has no protection at the mouth. The pipe is 24 ins. in diameter and 4,000 ft. long. Unfortunately, it lies in the vortex of all currents at that part of the lake. The city sewage enters the lake in close proximity to the mouth of the intake. Every sea carries out the sewage and the bottom is badly contaminated. When the lake is rough the water is turbid, when calm the water is clearer. During the months of October and November and also during the spring months the bacteria increase. During these months the greatest amount of hypo must be used.

Our method of keeping records is a good check on the attendants. Knowing that each tank is tested for available chlorine, they are more careful in the preparation of the solution. A record is kept of the amount of hypochlorite used each day.

The strength of solution usually varies between 1,666. to 2.162. parts per million of chlorine, a difference of approximately 500 parts. The difference is due to various conditions. For instance, if a tank is not completely emptied before being recharged the resulting solution is stronger than it would be otherwise. An error in weighing is sometimes made by a careless attendant. I have also found an attendant running the new solution into the tank that is being used, instead of into the empty tank. All of these things are likely to occur even in a well regulated plant.

In conclusion, the thorough mixing of water and chemical solution is essential. An accurate proportional feed device is necessary. The over-dose test should be made frequently, at least every four hours. With these operating conditions one should meet with success.

Lake Forest is situated on Lake Michigan, eight miles south of Waukegan. The latter city pumps about 20,000,000 gals. of water a day from the lake and returns the same amount of untreated sewage. The Lake Forest septic tank, according to L. C. Trow, Superintendent of the Lake Forest Water Co., works on an average of eight hours per day with a vacation through the winter months. In September of 1908 the use of hypochlorite was begun at Lake Forest and there has not been a death from typhoid in that city since that time. Mr. Trow's description of the chlorination practice follows:

For about three years about 3 or 4 lbs. of hypo was mixed up in a pail of water and poured into a tank of 450 gals. capacity, which was being used for the alum coagulant; from this tank it passed into a hopper within which the height of solution was held to a constant level by a common closet float valve. From the hopper it passed into the suction pipes of the pumps. This amount of solution was used to treat 1,000,000 gals. of water. The test for any excess of chlorine was made by the potassium iodide starch test.

For the three years this arrangement was used the company did not expend a cent for any additional equipment, the only additional cost being for the powder, which amounted to but a few cents per day. A year ago some changes were made. The hypo is now mixed by being carried over and under a series of baffle boards in a small rectangular tank located above the main hypo solution tank; from this tank it is carried to the intake well and comes in contact with the water from the lake at the point where the intake discharges into the well.

The amount of hypo used has been slightly increased since the installation of a laboratory has enabled us to check up on the results more closely. There has never been any noticeable effect upon iron or other metals of the pumping equipment or service connections.

For a short period during the summers of 1911 and 1912 there was a very distinct taste in the water due to the growth of algae; upon this growth the hypo seemed to have no effect whatsoever, and a resort to other methods was necessary for its removal.

The amount of powder used has not varied because of any change in the temperature of the water. The rapid sterilizing effect seems to be the same whether the water is cooled by the floating ice of winter or warmed by the summer sun.

The hypo treatment was started and carried on without any previous advertising to the public in general so that no abnormal sense of taste or smell has developed in any of the consumers.

The efficiency of the plant has been increased owing to the fact that a great part of the time we are able to filter without use of alum, thus doing away with the necessity of pumping against any head which might be caused by the collection of a precipitate from the alum upon the filter beds. A bacteriological examination of the water is now made daily and sterile plates are not uncommon.

From the points of economy and efficiency to the company and of the health of the community, the treatment of water at Lake Forest has certainly been a success.

Mr. F. E. Herdman, manager and engineer of the Water and Light Properties of Winnetka, discussed the use of hypochlorite in that city, in part, as follows.

In Winnetka the water has never been really bad, it being much worse both to the north and south. At no time in past years could one point to the water as the real cause of sickness. While this is so, the conditions with which we are surrounded might at any time seriously affect us, and it is no more than consistent to take all needful precautions against such a possibility. The nearest approach that we have to polluted water is when a northeaster of long duration drives the sewage from Waukegan to the mouth of our intake.

Regular analyses were made beginning June 25, 1912. At first, the results did not warrant the use of the hypochlorite of lime. We did not commence to use it until the latter part of September when storms became more prevalent and the condition of the water correspondingly more suspicious. We commenced with a 3-lb. solution, which we afterward increased to 4 lbs. The anlyses at no time have indicated the advisability of using a stronger solution. In fact, the city chemist notified us at one time that it would be entirely consistent to cut down to 3 lbs., but as the use of 4 lbs. was working satisfactorily we have made no change. We have had little complaint from the use of the hypochlorite of lime. When we commenced its use, we did so without notifying the public, and consequently no one knew that there was anything occurring that he might have a chance to complain of. At this time, I do not believe that as many as 10 per cent of the people know that we are treating the water in any way.

Another reason in my judgment for not giving too much publicity to any attempt made toward making drinking water absolutely safe is that people immediately discontinue any personal precautions they may have been taking and place their entire dependence on what is being done at the pumping plant. Accidents can happen at that point as well as anywhere else, and if the whole dependence is placed there and any accident should happen where the treatment could not be applied for a fraction of time, the whole community would be in danger. This is a responsibility that all water plants should fully recognize and until they know that there is no opportunity for an accident to cause the discontinuance of the treatment, they should not allow consumers to place entire dependence upon the treatment.

Construction Methods Employed on the Shafts and Tunnel of the Under-City Section of the Catskill Aqueduct.

Features of the design of the under-city portion of the Catskill aqueduct were described in Engineering and Contracting of March 8, 1911, and Dec. 20, 1911. Some of the construction methods employed in sinking the shafts and driving the tunnels, with miscellaneous data, are here given as compiled from the annual reports of the Board of Water Supply of the City of New York for 1911 and 1912.

The under-city aqueduct comprises that portion of the Catskill aqueduct within New York City and extends from the city line through the boroughs of The Bronx, Manhattan and Brooklyn, to the proposed Silver Lake reservoir in Richmond borough and to Queens Blvd. and Fisk Ave. in Queens borough, a total distance of 34.2 miles.

In Shaft 4 at a depth of 150 ft. a flow of 120 gals. per minute was encountered in the drill holes which decreased in a few hours to 50 gals. The flow was successfully grouted through the drill holes. At a depth of 181 ft., water under a hydrostatic head of 70 lbs. per sq. in., was encountered by the drills. Each hole was plugged as soon as water was encountered and the possible rate of flow was therefore not determined. Grouting was again resorted to and the flow cut off.

A series of pilot holes again developed water at an average further depth of 14 ft., showing that the water bearing seam first encountered had been sealed off. After grouting off the flow through these pilot holes, a 5-ft. round was drilled and shot, developing practically no inflow. The small amount of grout taken through the pilot holes indicated that the lower water bearing stratum was not sealed off, and a series of 16-ft. rim holes, 18 ins. on centers, was put down and the flow sealed off by grouting, pressure up to 240 lbs. per sq. in. being used. Sinking was resumed and sound rock reached at a depth of 200 ft. The grouting through the rim holes formed a fairly impervious lining, the maximum inflow being 100 gals. per minute.

At Shaft 5, the close proximity of the Old Croton aqueduct, the invert of which was only slightly below the surface elevation at the shaft side, made it necessary to observe every precaution against runs of material from the ground beneath the aqueduct. Four-inch tongued-and-grooved piling was used with practically no loss of ground in excavating the chamber through 15 ft. of water bearing sand. For the remaining 14 ft. to rock through fine clay, sand, gravel and boulders, steel sheet-piling was driven 5 ft. ahead of the excavation and supported by timber sets. After placing the reinforced concrete lining inside the piling, the latter was pulled and the annular space left thereby was grouted.

After completing the chamber excavations at Shafts, 19, 20, 22, 23 and 24, a steel cutting edge was set up within the chamber. The reinforced concrete caisson was then built up between an inside form of the Blaw type and outside panels built by the Logan Iron Works. Sinking and concreting alternated until ground water was reached, when a deck 6 or 7 ft. above the cutting edge and from 3 to 6 ft. thick was placed, and the caisson built for a length which it was estimated would be needed to reach rock. Extending through the decks and rising somewhat above the top of the caisson, were steel risers carrying Mattsen air-locks, one at Shaft 19 and two at the other shafts. One was used as a manway and the other for the removal of muck, although at times both were so used. The first material excavated from the caisson was placed on top of the deck within to give weight in sinking. When the weight of the caisson itself and the sand within would not sink the structure, pig iron was loaded on the caisson top. To prevent excessive loss of air, the cutting edge was kept about 3 ft. in advance of the excavation except when rock was reached, sufficient air pressure being maintained to keep the bottom of the caisson dry. The contractors originated the following method for making the seal between the caisson and rock at Shaft 19. The caisson was supported on wooden posts; rock was excavated 3 ft. below the cutting edge; a concrete collar, ¼ in. greater diameter than the caisson, was placed below the shoe; the wooden supports were shot out and the caisson dropped to place. The seal was then made by concreting the cutting edge and grouting behind the shoe. While this method proved satisfactory for a shallow penetration, it seemed probable that some modification would be necessary for the deeper shafts. The engineers in the division suggested improvements which proved successful at the other shafts. Both collar and bench were built before the final dropping of

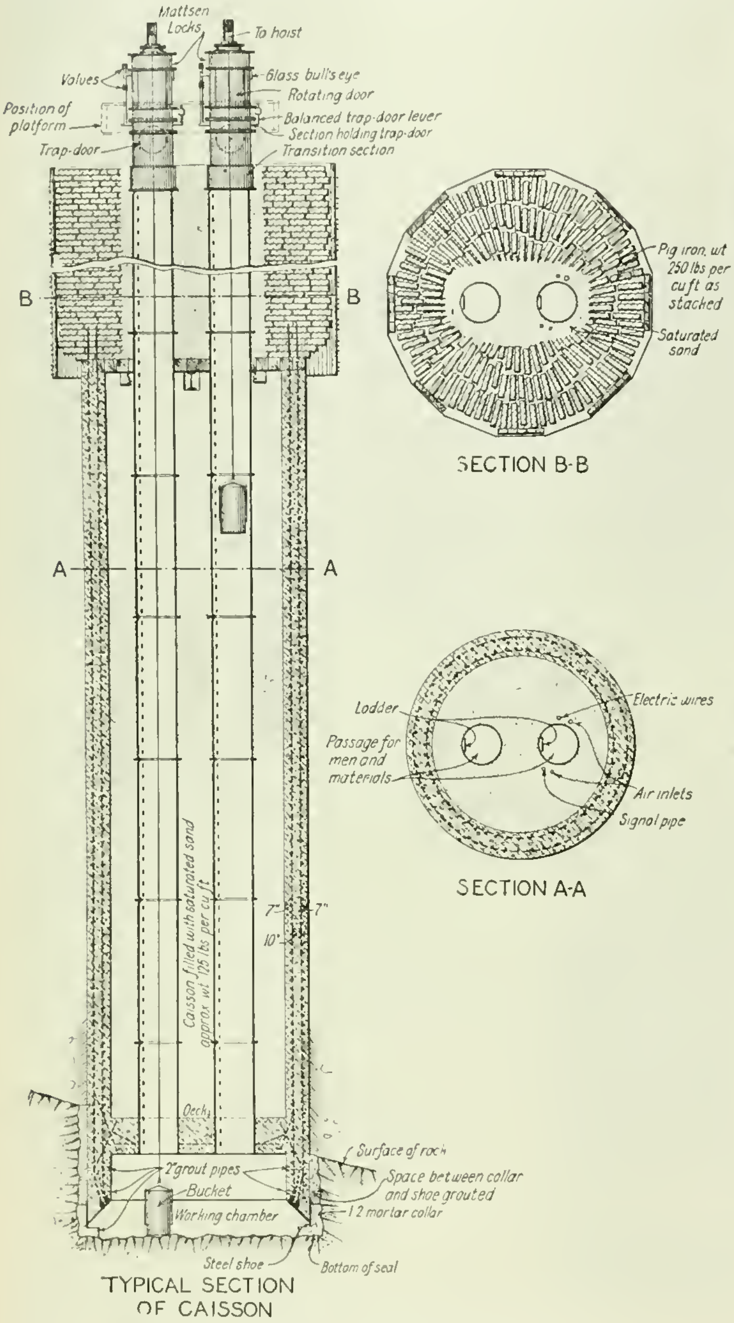
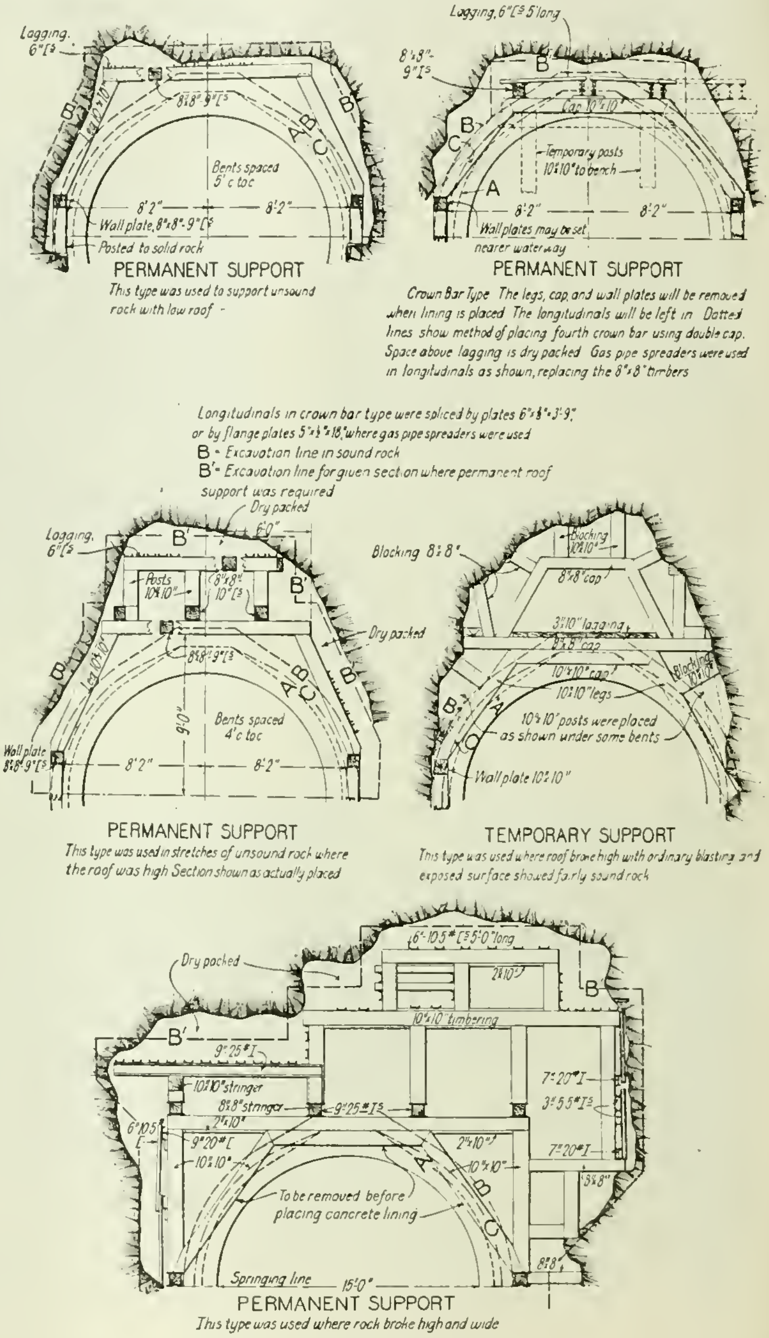


Fig. 1—Typical Pneumatic Caisson Employed to Sink Shaft Through Saturated Material Overlying Bed-rock, City Tunnel, Catskill Aqueduct.



This type was used to support unsound rock with low roof -

Crown Bar Type The legs, cap, and wall plates will be removed when lining is placed The longitudinals will be left in Dotted lines show method of placing fourth crown bar using double cap. Space above lagging is dry packed Gas pipe spreaders were used in longitudinals as shown, replacing the 8"x8" timbers

Longitudinals in crown bar type were spliced by plates 6"x½"x3'-9", or by flange plates 5"x½"x18", where gas pipe spreaders were used
B - Excavation line in sound rock
B' - Excavation line for given section where permanent roof support was required

This type was used in stretches of unsound rock where the roof was high Section shown as actually placed

This type was used where roof broke high with ordinary blasting and exposed surface showed fairly sound rock

This type was used where rock broke high and wide

Fig. 3—Types of Timber Roof Support, Under City Tunnel, Catskill Aqueduct.

the caisson; a thick layer of oakum was placed on the bench and compressed by the shoe in settling; grout was forced through pipes and the seal completed. Practically no loss of ground occurred in sinking. The typical pneumatic caisson used is shown in Fig. 1.

On Dec. 31, 1911, when the caisson at Shaft 23 had reached a depth of 86 ft. below the surface, the air pressure was temporarily removed from one of the access risers to lengthen the steel-pipe shafting. The pressure of the wet sand above the deck caused both steel shafts to collapse, allowing the caisson to fill with sand. Consequent delay in removing the sand and repairing the wrecked shafting will result. To sink Shaft 21 to rock, the contractor proposed to avoid the small foundation caissons and main shaft caisson, shown on the contract drawings, by using the alternate method permitted by the contract of enclosing the area by four large rectangular caissons. The caissons were of the usual timber construction, about 37 ft. high, from 40 to 48 ft. in length and about 5 ft. wide. The cutting edge was formed by a 6-in. by 12-in. bevelled yellow pine strip. The material passed through was troublesome, due to open gravel and the frequent occurrence of large boulders. To key the ends of the caissons together, half moons were formed in the caissons and later filled with concrete. After sealing off the caissons, excavation of the interior earth core was started. Satisfactory progress was made.

During caisson sinking, the contractor's plant at each shaft consisted approximately of one 150-HP. upright boiler, a low pressure compressor, a stiff-leg derrick and hoist, and the usual outfit of steel shafting, compressed-air-locks, concrete mixing plant, buckets, etc. After rock was reached, the following was installed: 2 Ingersoll-Rand compressors of 900 and 1,300 cu. ft. of free air per minute capacity; 2 General Electric synchronous 6,600-volt A. C. motors of 164 and 215 HP.; a 50-ft., steel head-frame; 6 to 8 drills, usually "japs" of Ingersoll-Rand, Sullivan or McKiernan types; 1 Cameron sinking pump, 100 gals. per minute capacity; 1 double-drum 20-HP. hoist, and a 1 cu. yd. Ransome mixer. The compressors, motors and head-frame form a part of the permanent construction plant.

The underground magazine for storing explosives, here illustrated as Fig. 2, consists of a chamber excavated in the rock 20 ft. by 32 ft. and 16 ft. high, which is reached from the tunnel by a winding drift 75 ft. long, 7 ft. by 6 ft. in cross-section. In the mouth of the drift, which is 100 ft. from the shaft, a concrete bulkhead was placed and a heavy steel and wood door hung on the inside of the bulkhead so that an explosion, however small, would close it, thus confining the gases from an explosion within the drift and chamber, and to a large extent reducing the rush of air and gases up the shaft. The underground magazines were designed for the installation of thawing apparatus, but such apparatus was not required. Before freezing weather the contractor adopted the new low-freezing gelatine dynamite which it is claimed will not freeze at temperatures above zero Fahrenheit. The introduction of the low-freezing dynamite during the past year was a very important advance in hard-rock tunnel driving as the use of this explosive removes one of the greatest hazards of such work, that of thawing the dynamite.

Shaft sinking and tunnel excavation were carried on continuously, except on Sundays. In shaft sinking, drilling, shooting and mucking reliever and rim holes were carried on in consecutive operations; drilling for the next shot was begun as soon as enough muck had been removed to allow the setting up of drills. In each advance from 27 to 43 holes, 6 to 10 ft. deep, were drilled, the number and depth of holes depending on local conditions. At each shaft, six to nine drill shifts, each having about five drillers with five helpers were employed each week, and six to nine shifts of muckers, each shift averaging eight laborers, were used. All shafts were concrete lined, excavation and lining alternating. Blaw collapsible steel forms, 5 ft. long, were used

TABLE I.—CONTRACTOR'S PLANT DURING TUNNEL DRIVING.

	Shaft					
	19	20	21	22	23	24
Compressor—						
Ingersoll-Rand, 900 cu. ft. per min., 164 HP., General Electric, 6,600 volts	1	1	1	1	1	1
Ingersoll-Rand, 1,300 cu. ft. per min., 215 HP., General Electric, 6,600 volts	1	1	1	1	..	..
Blower—						
Root No. 2, 1.500 cu. ft. per min., General Electric, 20 HP., 440 volts	..	..	..	1	1	1
Hoist—						
Exeter Machine Co., 112 HP., 230 volts, 400 ft. per min.	1	1	1	..	..	..
Exeter Machine Co., 75 HP., General Electric, 230 volts	..	..	..	1	..	..
Exeter Machine Co., 50 HP., General Electric, 230 volts	..	..	..	1	1	1
Lidgerwood Steam, 20 HP., 25 HP. and 30 HP.	1	1	1	..	1	..
Drills—						
Ingersoll - Rand, 3⅝-in., F94, and 3¼-in., E44	8	..	1	10	10	11
Ingersoll-Rand, non-rotating jap, BA No. 2	..	..	..	..	2	..
Ingersoll-Rand, non-rotating jap, Imperial MV2	.	..	..	..	1	..
Ingersoll-Rand, jigger jap	..	..	..	..	1	..
Ingersoll-Rand, butterfly 90-lb. rotating jap (BCR)	8	11	5	2	2	2
Wonder rock stope drill	1	..	..	..	..	..
Sullivan jap DB19 1¼-in.	2	..	..	..	..	..
McKiernan Terry 3⅝-in.	..	..	8	..	..	..
McKiernan Terry jap	..	..	..	..	..	2
Hardsocq jap drills Wonder No. 20	..	..	..	..	3	..
Pumps—						
Gould's Electric, 440 volts alternating current, 20 HP., 125 and 100 gals. per minute	..	1	..	..	..	1
Cameron Sinking, 9B, 100 gals. per minute	..	..	2	..	1	1
Concrete mixer—						
Ransome 1 yd., General Electric, 25 HP.	1	1	1	1	1	1
Drill sharpener—						
Pneumatic, Lake Shore Iron Works	1	..	..	1	..	..
Mucking machine—						
Whaley & Myers, 440 volts alternating current, 22 HP.	..	..	..	..	..	1
Locomotives—						
General Electric storage, pull 1,000 lbs. at 3½ miles per hour	..	..	..	..	1	1
Conveyor—						
Robbins, 25 yds. per hour, General Electric, 10-HP. motor, 230 volts	..	..	1	1	..	..
Muck cars—						
Koppel, 1.3 cu. yds.	..	..	..	..	11	20
Starting compensator	..	..	..	..	..	1
General Electric continuous-current motor, 125 volts	..	2	..	1	..	..
Boiler, Lambert, 15 HP.	..	..	..	..	..	1
Cages, Eagle Iron Works, fixed platform	2	2	..	2	2	2

TABLE II.—EXCAVATION OF SHAFT 21.

Drilling.

All regular drilling is done from midnight to 8 a. m. The main shaft is drilled by nine McKiernan-Terry slugger drills, 3⅝-in. cylinder and 7-in. stroke; an average of 44 ft. is drilled for an 8-hour shift. Trim holes and riser-shaft holes are drilled with two or three Ingersoll-Rand hammer drills weighing 96 lbs., and machine-rotated; an average of 64 ft. is drilled for an 8-hour shift.

Cu. yds. per foot of shaft.	Pumpage from bottom of shaft. Gals. per minute.	Average depth pulled per shot.	Total length of holes drilled per round.	Amount of drill hole per cu. yd.	60 per cent. Forcite dynamite pounds used per cu. yd.	Mucking.	
						Solid rock hoisted per hour.	1-cubic yard buckets hoisted per hour.
16.3	0 to 30	4.5 ft.	376 ft.	5.1 ft.	1.8	4.3 cu. yds.	11

Shooting Data.

Depth pulled 4.0 to 4.5 ft. for three 8-hour shifts.

8 or 9 cut holes shot about 7:15 a. m. and mucked nearly clean.

9 first and 18 second relief holes are loaded and shot about 12:30 p. m. and then mucked out. 18 rim holes are shot about 6 p. m. and mucked out.

The riser shaft is carried as a bench from 6 ft. to 60 ft. above the main shaft. When close, it is shot with the cut in one or two rounds.

ORGANIZATION.

Shift.	General.					Expedition.				Excavation.															
										At Surface.								In Shaft.							
	Superintendent.	Timekeeper.	Storekeeper.	General watchman.	Janitor.	Foreman.	Carpenter's helper.	Carpenter.	Laborers.	Pipeman.	Compressor engineman.	Hoist engineman.	Magazine watchman.	Topmen.	Blacksmith.	Blacksmiths' helpers.	Electricians.	Drillers.	Drillers' helpers.	Muckers.	Shift boss.	Nipper.	Signalman.	Trucks.	Totals.
Midnight to 8 a. m.	..	1	..	1	1	..	..	..	..	1	1	1	..	4	..	..	1	11	12	..	1	1	1	..	37
8 a. m. to 4 p. m.	1	1	1	1	1	2	4	1	4	2	1	1	1	4	1	1	1	2	..	18	1	..	1	2	52
4 p. m. to midnight	1	1	1	1	1	..	..	..	..	1	1	1	1	4	1	1	1	3	3	18	1	..	1	..	42

Plant.

One Lidgerwood hoist, 8 ins. by 10 ins., for derrick; one Exeter Iron Works hoist driven by General Electric induction motor, 112 hp., 440 volts, 133 amperes; 950 ft. of 1-in. non-rotating cable; head-frame, 72 ft. high, 15½ tons; sheave wheel 5-ft. diameter; one Ingersoll-Rand compressor, 18¼-in. and 11¼-in. cylinders, 16-in. stroke, 900 cu. ft. of free air per minute at 100 lbs., with direct-connected General Electric synchronous motor, 164 hp., 6,600 volts, with 6½-K. W., 125-volt exciter; one Ingersoll-Rand compressor, 21¼-in. and 12¼-in. cylinders, 18-in. stroke, 1,300 cu. ft. of free air per minute at 100 lbs., with direct-connected General Electric synchronous motor, 215 hp., 6,600 volts, with 9½-K.W., 125-volt exciter; high-pressure air-receiver, capacity of 235 cu. ft.; 6-in. air-line from air receiver to manifold, which has 14 1-in. connections.

METERED ELECTRIC POWER USED FOR 24 HOURS.

Kilowatt Hours.						
Drilling.		Blowing and miscellaneous.	Lighting and forge blower.	Hoisting.	Total for all purposes.	Kilowatts. Maximum demand.
Per cu. yd. excavated.	Used per day.					
18	1,300	1,100	100	260	2,760	295

TABLE III.—COMPARATIVE CAISSON DATA.

Design and construction	Shaft 19.			Shaft 20.			Shaft 22.			Shaft 23.			Shaft 24.		
Outside diameter	19.33 ft.			19.33 ft.			19.33 ft.			24.00 ft.			24.00 ft.		
Inside diameter	15.33 ft.			15.33 ft.			15.33 ft.			18.00 ft.			18.00 ft.		
Total length including shoe	45.00 ft.			105.30 ft.			100.00 ft.			123.00 ft.			105.60 ft.		
Total length excluding shoe	42.75 ft.			103.05 ft.			97.85 ft.			119.75 ft.			102.00 ft.		
Thickness of deck	3.00 ft.			5.50 ft.			5.00 ft.			8.00 ft.			6.00 ft.		
Height of working chamber—(cutting edge to bottom of deck)	6.25 ft.			7.25 ft.			6.00 ft.			7.00 ft.			6.25 ft.		
Length of shafting for men	54.00 ft.			120.00 ft.			120.00 ft.			144.00 ft.			120.00 ft.		
Length of shafting for muck	54.00 ft.			120.00 ft.			126.00 ft.			150.00 ft.			120.00 ft.		
Mattsen locks for men (weight)	6,000 lbs.			6,000 lbs.			6,000 lbs.			10,000 lbs.			6,000 lbs.		
Mattsen locks for men (diameter)	3.33 ft.			3.33 ft.			3.33 ft.			4.4 ft.			3.33 ft.		
Mattsen locks for muck (weight)	6,000 lbs.			6,000 lbs.			10,000 lbs.			10,000 lbs.			10,000 lbs.		
Mattsen locks for muck (diameter)	3.33 ft.			3.33 ft.			4.1 ft.			4.4 ft.			4.4 ft.		
Air inlet pipe	3-in.			3-in.			3-in.			3-in.			3-in.		
	*Distance, ft.	Size, ins.	Number.	*Distance, ft.	Size, ins	Number.	*Distance, ft.	Size, ins.	Number.	*Distance, ft.	Size, ins.	Number.	*Distance, ft.	Size, ins.	Number.
Vertical reinforcements (twisted rods)	1—26	1¾	108	1— 87	1¾	108	0 — 84.3	1¾	108	0— 97	1¾	132	0 — 83.3	1¾	132
Vertical reinforcements (twisted rods)	26—32	1½	108	87— 97	1½	108	84.3—100.1	1	108	97—109	1½	132	83.3—105.3	1	132
Vertical reinforcements (twisted rods)	29—48	1	108	97—108	1	108	....	...	...	109—123	1	132	....	...	...
			Spacing, ins., C.-C.			Spacing, ins., C.-C.			Spacing, ins., C.-C.			Spacing, ins., C.-C.			Spacing, ins., C.-C.
Horizontal reinforcements (twisted rods)	2— 8	1¼	12	2— 54	1	9	0— 48	1	9	0— 83	1	9	0— 63	1	9
Horizontal reinforcements (twisted rods)	8—25	1¼	9	54— 64	1¼	12	48— 58	1¼	12	83— 93	1¼	12	63— 73	1¼	12
Horizontal reinforcements (twisted rods)	25—31	1¼	12	64— 81	1¼	9	58— 75	1½	13	93—111	1½	13	73— 91	1¼	9
Horizontal reinforcements (twisted rods)	31—45	1	12	81— 87	1¼	12	75— 81	1¼	12	111—117	1¼	12	91— 97	1¼	12
Horizontal reinforcements (twisted rods)	......	...	..	87—104	1	12	81—100.1	1	12	117—123	1¼	19	97—105.3	1	12
Per cent of steel to concrete (volume)		3.3			3.3			3.4			2.2			2.25	
Grout pipes above shoe		16			16			24			18			18	
	*Distance, ft.	Proportions.		*Distance, ft.	Proportions.		*Distance, ft.	Proportions.		*Distance, ft.	Proportions.		*Distance, ft.	Proportions.	
Concrete proportions	....	**1⅓:2:4		....	**1⅓:2:4		0— 13	1⅓:2:4		0 — 73.5	1⅓:2:4		0— 21	1⅓:2:4	
Concrete proportions	....	....		....	....		13— 51	1 1/7:2:4		73.5— 94	1 1/7:2:4		21— 43	1 1/7:2:4	
Concrete proportions	....	....		....	....		51—100.1	1:2:4		94 —123	1:2:4		43—105.3	1:2:4	
Cement factor	1.91			1.97			1.70			1.86			1.72		
Time elapsed, setting shoe to first concrete	9 days			10 days			21 days			6 days			16 days		
Time of concreting	Sept. 15-27, 1911			Oct. 6-Nov. 12, 1911			Sept. 8-Oct. 5, 1911			Nov. 16-Dec. 23, 1911			Sept. 9-Oct. 12, 1911		
Number of 8-hour shifts	12			37			47			66			57		

*Distance taken from cutting edge.
**Same proportion for entire distance.

and the concrete was allowed to set at least 24 hours before striking the forms.

In tunnel excavation, the top-heading method was used, except for a short stretch after turning headings at Shaft 4, where a bottom heading was driven. When the contractor could shoot only between 7 a. m. and 11 p. m. four drilling and mucking shifts were employed, a drilling and a mucking shift working almost simultaneously in each heading, and the contractor tried to get two shots daily from each heading. Heavy auto trucks were used for the removal of tunnel spoil from Shafts 9, 10, 11 and 12 to the fill at West 129th St., which is being made along the North River by the Park Department; the small truck for the delivery and transfer of tools and supplies.

The contractor's plant which was used during the tunnel driving from Shafts 19 to 24 inclusive is listed in Table I.

The rock encountered near the bottom of Shaft 13 was crushed and seamy with much talcose material and carried much water. It was necessary at a depth of 197 ft. below the surface to grout the rock and shut off a flow of water estimated at 112 gals. per minute. The length of tunnel permanently supported north from Shaft 13 was 114 ft., the type used being a combination timber and steel. The caps of the bents were made up of an 8-in. by 8-in. timber between two 9-in. channels; the posts were 8-in. by 8-in. timber, and the lagging of 6-in. channels. South from Shaft 13, 1,400 ft. from the shaft, the rock broke high and wide and scaled badly, requiring 15 ft. of support. At a distance of about 1,000 ft. north of Shaft 17, two faults, nearly parallel to the tunnel, were encountered and it became necessary to carry roof support close to the face of the heading for a distance of 350 ft. About 90 ft. of the combined timber and steel roof support and 260 ft. of the

TABLE IV.—COMPARATIVE CAISSON DATA.

	Shaft 19.			Shaft 20.			Shaft 22.			Shaft 23.			Shaft 24.		
	Shifts		†Distance,	Shifts		†Distance,	Shifts		†Distance,	Shifts		†Distance,	Shifts		†Distance,
Sinking caisson:	Number.	Length. hrs.	ft.	Number.	Length. hrs.	ft.	Number.	Length, hrs.	ft.	Number.	Length. hrs.	ft.	Number.	Length, hrs.	ft.
Lowered while conc'ting (without air)			21.7±			11.2±	..	..	33.0	..	..	19.0	..	..	27.5
Lowered in sand (with air)	5	8	11.0	18	8	50.6	16	8	50.3	14	8	70.0	22	8	46.3
Lowered in sand (with air)	..	..	....	5	6	18.4	..	..	....	4	6	15.0	6	6	13.2
Lowered in sand (with air)	..	..	....	12	4	8.0	..	..	....	5	4	9.0	..	..	....
Lowered in sand (with air)	..	..	....	..	..	....	..	..	....	7	3	11.0	..	..	....
Lowered in rock (with air)	51	8	14.2	91	4	12.7	61	6	13.7	13	3	3.5	66	6	10.0
Lowered in rock (with air)	..	..	....	28	3	21.0	..	..	....	156	2	10.5	..	..	....
Maximum depth in rock	14.2 ft.			14.8 ft.			12.8 ft.			12.2 ft.			8.7 ft.		
Minimum depth in rock	5.0 ft.			5.9 ft.			1.1 ft.			2.1 ft.			2.4 ft.		
Maximum air-pressure used	17 lbs.			39 lbs.			28 lbs.			46 lbs.			29.5 lbs.		
Weight of caisson	460 tons.			1,050 tons.			978.3 tons			2,323 tons.			1,780 tons.		
Weight of caisson, maximum load	700 tons.			2,100 tons.			2,470.3 tons			4,612 tons.			4,046 tons.		
	Penetration, ft.	Resistance, lbs. per sq. ft.		Penetration, ft.	Resistance, lbs. per sq. ft.		Penetration, ft.	Resistance, lbs. per sq. ft.		Penetration, ft.	Resistance, lbs. per sq. ft.		Penetration, ft.	Resistance lbs. per sq. ft.	
Friction test 1	...	300-400		...	630		77	736		45	1,411		49	1,685	
Friction test 2	...	......		...	......		81	630		65	1,450		52	1,502	
Friction test 3	...	......		...	......		93	728		77	1,217		73	1,156	
Friction test 4	...	......		...	......		95	751		86	1,202		79	1,101	
Friction test 5	...	......					...	...		116	872			945	
Seal:															
Height of collar	1.5 ft.			2.0 ft.			2.0 ft.			1.5 ft.			2.0 ft.		
Height of bench	0.8 ft.			1.0 ft.			1.0 ft.			1.5 ft.			1.6 ft.		
Average thickness of collar	0.7 ft.			0.8 ft.			0.6 ft.			0.6 ft.			0.7 ft.		
Average thickness of bench	1.7 ft.			1.8 ft.			1.6 ft.			1.5 ft.			1.7 ft.		
Leakage after constructing seal and removing air	1.0 gals. per hr.			0.5 gal. per hr.			‡1.5 gals. per min.			7.2 gals. per min.			‡3.4 gals per min.		
Grout pipes in collar	6			6			10			8			11		
Time for constructing collar, lowering caisson and grouting	64 hrs.			35 hrs.			51 hrs.			51.5 hrs.			51 hrs.		
Time elapsed from placing shoe to removal of air	Sept. 6-Oct. 30, 1911			Sept. 26-Dec. 23, '11			Aug. 17-Nov. 4, 1911			Nv. 10, '11-Feb. 19, '12			Aug. 23-Nov. 16, 1911		
Elevations:															
Original surface	43.7			40.2			53.4			40.7			51.7		
Bottom of chamber	20.7			17.2			29.5			10.1			21.0		
Top of caisson	19.6			20.5			33.5			15.6			31.2		
Cutting edge	—25.4			—84.8			—66.5			—107.5			—74.4		
Ground-water	+ 4.0			+ 6.0			— 3.5			— 6.5			— 5.0		
Highest rock	—12.0			—71.0			—53.8			— 95.3			—66.0		
Lowest rock	—21.2			—79.9			—65.5 (pocket)			—105.4			—72.3		
Rock excavation under air (to)	—26.2			—85.8			—67.5			—109.0			—76.0		
Payment quantities:															
Concrete	173.5 yds.			406.6 yds.			408.8 yds.			900 yds.			773.4 yds.		
Cement	405.75 bbls.			952.75 bbls.			712.75 bbls.			1,734 bbls.			1,356 bbls.		
Reinforcement steel	76,542 lbs.			183,663 lbs.			183,914 lbs.			263,537 lbs.			231,245 lbs.		
Shaft in earth	46.9 ft.			103 ft.			97 ft.			119 ft.			97 ft.		
Grout connections	15			6			27			20			17		
Grout	8.2 yds.			16.8 yds.			3.4 yds.			11.8 yds.			3.3 yds.		
Steel pipe for grouting	72 lin. ft.			8.2 lin. ft.			128 lin. ft.			96 lin. ft.			145 lin. ft.		
Forms	42.8 lin. ft.			103.1 lin. ft.			97.8 lin. ft.			119.8 lin. ft.			102 lin. ft.		

†Distance in below chamber. ‡Seam in rock.

crown-bar type, were placed in this stretch. About 500 ft. south of Shaft 18 the lateral pressure from heavy slabs of rock distorted the temporary type of timber bents and it became necessary to strengthen the support. Types of timber roof support are shown in Fig. 3.

Drilling was entirely done by compressed air, but all other equipment, including the air-compressors, the hoists and pumps, were driven by electricity. The central power-plant at Shaft 14 continued to furnish compressed air to the Central Park shafts, Nos. 13, 14 and 15, and the individual compressor plants at the other shafts continued in service until excavation was completed. One of the novel features was the use of General Electric 85-volt storage battery tractors in the tunnel throughout the period of excavation. These tractors proved most satisfactory and their use avoided the overhead trolley wire required for the trolley tractors and also eliminated the bonding of the rails and other troublesome labor. Although the breakage of the cells in the storage batteries, due to rough handling of the tractors, was not infrequent, the ease with which they could be replaced prevent appreciable delays. About eight hours each day were necessary for charging the batteries, but as advantage was always taken of the shooting hours and every few minutes the motor was at rest, little time was lost thereby. All spoil was taken from the shafts in horse-drawn trucks. Eight-ton Knox and 5-ton Garford motor trucks were used for hauling concrete materials. The Knox trucks, having three wheels, are really tractors, since they replace the front wheels of ordinary trucks. The Garford trucks are of the ordinary self-dumping type.

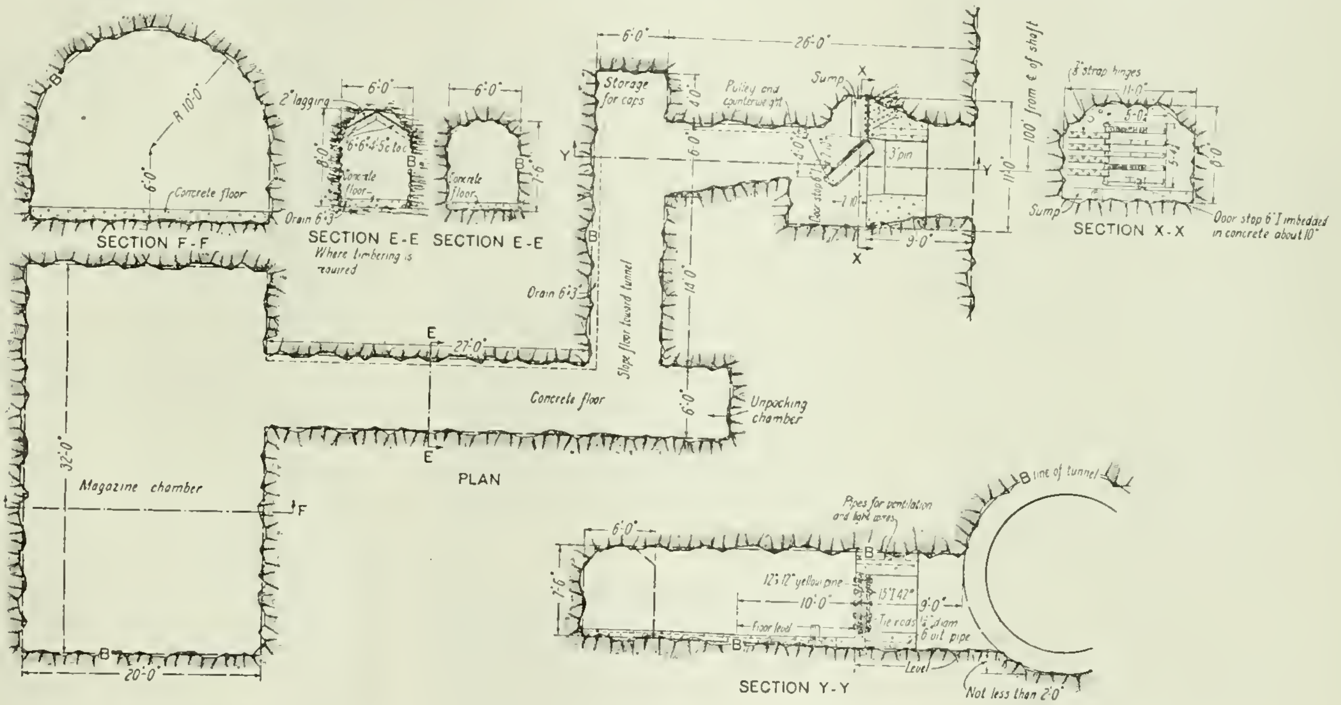


Fig. 2—Plan and Sections of Underground Magazine Chamber for Storing Explosives During Tunnel Excavation.

The bottom-heading method of tunnel excavation was used for about 100 ft. in each tunnel at Shafts 13 to 15, but was then given up in favor of the top-heading method, which was used throughout at the other shafts. Several different methods of handling the work were employed, of which the two following are typical. At Shaft 14, work was carried on simultaneously in both north and south headings. At midnight and noon, two hours after shooting and the smoke had cleared away somewhat, muckers started clearing out the face and setting up drill columns for the drilling gangs which came on at 2 a. m. and 2 p. m. At 8 a. m. and 8 p. m. the mucking gangs went off duty, allowing the drillers two hours in which to shoot. Where necessary, a small gang went on at 10 p. m. or 10 a. m. repairing track, mucking and setting up. Their services were seldom required, however. Two advances a day were obtained in each heading by this method. At Shaft 16 in each heading, drilling and mucking alternated, the muckers coming on duty an hour after shooting had been finished. In this way there was no interference by one set of men with the other, and no time lost by the drillers when the face could not be cleaned quickly. Three shots were obtained in each heading every two days, an average of 1½ advances per day. The average drilling shift consisted of six drillers and six helpers; a mucking shift of 12 to 15 laborers. In driving top heading, an average of 22 to 24 holes were drilled for each advance, consisting of 6 cut, 2 break-down, 10 trimming and 4 to 6 side round holes. Cut holes were usually 8 ft. deep, the others 2 ft. shorter. Bench was drilled with rows of 4 to 6 holes, the rows about 4 ft. on centers. Mucking was done by the usual hand methods at the face. From the foot of the bench to the shaft muck was carried in end-dumping cars, in trains of three, hauled by the storage-battery tractors.

Data on the excavation of Shaft No. 21 are given in Table 11.

Shafts 1 and 2 were excavated in the Yonkers gneiss and Shafts 3, 4 and 5 in the Fordham gneiss. About 922 ft. south from Shaft 1, however, the tunnel passed from the Yonkers series into Fordham gneiss, which appears to be a large inclusion in the Yonkers formation. For 166 ft., 586 ft. north of Shaft 3, the Fordham shows more or less evidence of Yonkers gneiss intrusions.

Steel roof support for a distance of 111 ft. was placed 500 ft. south from Shaft 2, where there was a crushed zone carrying 125 gals. per minute. North from Shaft 3, in the vicinity of the contact with the Yonkers gneiss, the Fordham gneiss contained frequent layers of black mica, requiring the use in several stretches of about 200 ft. of steel roof support. At a point 600 ft. from the shaft, several narrow crushed zones with layers of mica and some water were encountered. There the rock broke from 5 to 15 ft. outside of the excavation line and necessitated the placing of 25 ft. of combined timber and steel roof support, following which 214 ft. of temporary timber roof support were required. About 370 ft. north of Shaft 4 was encountered a disintegrated zone 70 ft. long through which the rock broke well outside the lines. This section was held for the next 68 ft. with steel roof support. A disintegrated zone 60 ft. long, which made about 400 gals. per minute was encountered 300 ft. south from Shaft 4. The roof broke high and was supported by temporary timber. The ground for the next 60 ft. beyond this zone was blocky and steel roof support was placed.

Comparative caisson data for shafts 19 to 24 inclusive are given in Tables III and IV.

Methods Employed by the Danville Water Company to Promote Pleasant Relations with the Public.

Public service corporations now fully appreciate the desirability and the importance of maintaining pleasant relations with the public they serve. The first step, and the longest step, in promoting such relations is to acquaint the public with the conditions and difficulties with which the corporation is confronted, which render ideal service at all times a practical impossibility. This point was well illustrated by Mr. H. M. Ely, Superintendent of the Danville Water Co., in a paper entitled "Some Features of the Danville Water Works," which he presented before the Illinois Water Supply Association. We here abstract the portion of Mr. Ely's paper which relates to the methods employed to create a public interest in the routine procedure of the Danville water works.

In the water works business, as in fact in all others, no matter how interesting it may be, there are some trials. Not the least of these is the preserving of amicable relations with all of the people, all of the time, as the public servant has many masters to please. It is his aim, however, to so serve that there may be no just complaints. Complaints are sometimes made and misunderstandings arise because of the lack of knowledge on the part of the consumer as to the care which is exercised in the endeavor to give the best of service at all times. Complaints of a taste or odor in the water may be expected for a short period at a certain season of some years; at least, it is so in our case and I do not believe that we are entirely in a class by ourselves in this matter. Criticism at such time would be withheld, to a great extent, if the situation were fully realized.

Our plant furnishes a safe water at all times, although in some years when the ice breaks up and melted snow is quickly washed into the river by heavy rains, there results a taste, odor and color which we are not able for a few days to entirely remove and does not give a palatable effluent from the filter. Many people do not realize at such time or at any time in fact that attention is being given to the treatment of the water, and that daily laboratory examinations are made. We do not believe in keeping secret our operations, but do believe that it is the best policy to show the public attention and courtesy and to obtain their confidence. To the end that we may interest the public in our filtration plant we invite inspection and attempt to get as many as possible to visit us.

One method of accomplishing this is by the display in our office window of a colored transparency, which is electrically illuminated, showing views of the station and grounds, together with an interior view of the laboratory.

It may be of interest to state how this transparency was made, as we might say the idea was developed step by step. The photos were first taken on film with a circuit or revolving camera by a local photographer. From the negatives he then made a positive on film which corresponds to the ordinary positive or print on paper. The positive films were then colored by water colors and framed at a picture store. In framing, tracing cloth is placed back of the films to give body to the picture, as otherwise we could look through the high lights of the photograph. The tinsmith and the electrician completed the work with the reflector and the lighting.

At the left in the transparency the concrete dam with fish ladder, taintor gates and hydraulic power house is shown. On beyond is shown the pumping and filtration plant and to the right of that the office, laboratory and shop building, together with the coal plant. At the extreme right is the residence of the Chief Engineer.

The transparency includes an interior view of the laboratory which while not so attractive a picture as the others is put there for a purpose. It was our idea that while passersby were attracted by the brightly illuminated landscape views they would note at the same time that we have a laboratory for the daily examination of water. We have on this transparency an invitation to the public which reads as follows: "The public is invited to visit the water works, where the operation of the plant will be shown to those interested." We have found that this sign has brought results, as many have visited us whose interest and curiosity was aroused by this display.

Steamshovel Excavation on the Panama Canal.—During the month of April the total amount of material excavated in the Central Division, Panama Canal, was 1,179,100 cu. yds., of which 353,646 cu. yds. were classified as earth and 825,454 cu. yds. as rock. Of the total, 1,178,000 cu. yds. were primary excavation in canal prism and 1,100 cu. yds. were from ditch for draining the old Culebra dump. The total—1,179,100 cu. yds.—was removed by steam shovels. The high record for the month was made by shovel No. 221, working 32½ days in the Empire district, which excavated 52,639 cu. yds. of earth. The second best record for the month was made by shovel No. 206, working 40 days in the Culebra district, which excavated 50,864 cu. yds., 35,604 cu. yds. of rock and 15,260 cu. yds. of earth. The best record for a shovel of the 70-ton class was made by shovel No. 109, working 26 days in the Cuelbra district, which excavated 39,720 cu. yds., 15,888 of which were earth and 23,832 rock. Shovel No. 230, working in the Culebra district, made a high record for one day by excavating 2,736 cu. yds. of rock on April 23. Shovel No. 232, working on 12-hour shift in the Empire district, made a high record of 3,173 cu. yds. of earth on April 28.

Corrected Cost Data on Laying Water Mains by Contract in Chicago in 1912.

In Engineering and Contracting of May 14, 1913, an article entitled "Cost of Constructing by Contract Water Pipe Extensions Aggregating 17.7 Miles in Chicago in 1912" was published. Attention has been called to several arithmetical errors which appeared in the tabular cost data. Since some of these errors have a bearing upon the average cost per foot of main for labor and material as published the incorrect items are here repeated with the proper corrections. The following corrections apply to the 6-in. mains:

On p. 550 under the material used on the Ellis Ave. extension between 91st and 92d Sts. the item which read: Pipe, 9.91 tons at $3.33 = $257.66, should read: Pipe, 9.91 tons at $26 = $257.66. Since the cost as published was correct there is in this case no correction to be applied to the unit costs.

On p. 550 under material used on 41st Place, Kedzie to Albany Ave., the item, Lead, 500 lbs. at 5 cts. = $250, should be $25. The total for material should be $402.60. The corrected average cost per foot for material is 63.4 cts., and for labor plus material 84 cts.

On p. 550, under material used on Lincoln St. from 71st to 72d Sts., the item, Coal and gasket, $210, should be $2.10. The total for material should be $443.17. The corrected average cost per foot for material is 60.4 cts., and for labor plus material 79.9 cts.

After the foregoing changes are made the actual costs of all 6-in. mains listed become: minimum, 72.2 cts.; maximum, $1.173; and average, 90.2 cts. per ft., respectively, for labor plus material.

The following corrections apply to the 8-in. mains: On p. 552, Carpenter St., 79th St. to 80th St., the material item, Coal and gasket, $250, appeared. This figure should be $2.50. Total for material should be $562.20. The corrected average cost per foot for material is 94 cts., and for material plus labor $1.216.

On p. 552, 58th St., Hamlin Ave. to Central Park Ave., the material item, Special castings, 5,299 lbs. at 3 cts. = $98.97, should read 3,299 lbs. at 3 cts. = $98.97. The total being correct as published there are no corrections to unit costs as given.

On p. 553, La Fayette Ave., 108th St. to 300 ft. S. of 107th St., the material item, Lead, 219 lbs. at 5 cts. = $15.95, should be $10.95. The total for material should be $191.54. The corrected average cost per ft. for material is 63.4 cts., and for labor plus material is $1.014.

On p. 553, MacFarlane Ave., 79th St. to So. Chicago Ave., the labor item, Laborers 25 days at $2.75 = $178.75 should be 65 days. The labor cost as published is correct.

On the same job the material item, Lead, 5,410 lbs. at 5 cts. = $270.50, should be 1,082 lbs. at 5 cts. = $54.10. Total material cost should be $960.15. Average per foot for material should be $93.8 cts., and for labor plus material $1.258.

After the foregoing changes are made the actual costs of all 8-in. mains listed become: minimum, 89.1 cts., maximum, $1.545, and average, $1.108 per ft., respectively, for labor plus material.

The following corrections apply to the 12-in. mains: On p. 556, Division St., 48th Ave. to 52d Ave., the material item, Special castings, 2,612 lbs. at 3 cts. = $130.60, should be $78.36. The total for material should be $3,484.47. The average per foot for material should be $1.322, and for material plus labor $1.492.

On p. 556, Irving Park Blvd., 66th Ave. to 72d Ave., the material item, Special castings, 14,268 lbs. at 3 cts. = $328.04, should be 10,935 lbs. at 3 cts. = $328.04. There are no changes here to cost items.

After the foregoing changes are made the actual costs of all 12-in. mains listed become: minimum, $1.188, maximum, $1.696, and average, $1.466 per ft., respectively, for labor plus material.

New Filtration Plant at Trenton, N. J.

The new filtration plant being erected at Trenton, N. J., will have a daily capacity of 30,000,000 gals. of water, which will provide for a future growth in population of about 60 per cent.

In general this plant consists of a low lift section, 16 filter beds, two covered sedimentation basins and a pure water basin. The four 10,000,000-gal. centrifugal pumps will raise the raw water from the Delaware river to the two sedimentation basins, each basin being 210 ft. by 62 ft. by 18½ ft., with a filtering area of 652 ft. and a capacity of 1,800,000 gals. The pumps are directly connected to an engine, which is automatically controlled by the amount of water in the sedimentation basins, so that the quantity of water pumped will be equal to that being drawn from the basins. The coagulant aluminum sulphate is added as the water enters these basins. The water is then allowed to stand in the basins for several hours, which allows the coagulated matter to settle. From here it is pumped into the filter beds, which will be placed between the two sedimentation basins. Under the filters will be the filtered water basin, from which the purified water will pass through a 5-ft. pipe to the high-lift pumps, which will raise it into the city reservoir.

As the water leaves the filtered water basin, it is treated with a small amount of hypochlorite of lime solution as a final step in its purification. This solution is only added when it is thought necessary. The excavation for one of the sedimentation basins has been practically completed, about 40 men and seven teams being engaged on the work. The plant is intended to remedy conditions which have for many years caused great concern to the citizens and to the local and state boards of health.

The plant was designed by Johnson & Fuller, consulting engineers, of New York City, who are also supervising the construction work, F. W. Daggett being their representative in immediate charge.

Lock Concrete Work on Panama Canal.—Less than 26,000 cu. yds. of concrete remains to be laid in the locks of the Panama Canal. This amount is divided as follows: Gatun Locks, 20,103 cu. yds.; Pedro Miguel, 723 cu. yds.; Miraflores, 4,431 cu. yds. All of the concrete at Gatun Locks is in place, with the exception of the north approach wall. The concrete work at Miraflores Locks will be finished by May 15, while the work at Pedro Miguel Lock is practically completed, with the exception of a gap in the northeast wing wall to allow Central Division construction trains to pass through, and a section at the north end where the caisson sill and the chain fender slot cross the drainage ditch. Concrete construction at Gatun Locks was begun on Aug. 24, 1909, and up to May 1, 2,023,627 cu. yds. had been laid out of a total of 2,043,730 cu. yds. The work at Pedro Miguel was begun on Sept. 1, 1909, and up to May 1, a total of 920,032 cu. yds. had been laid, out of a total of 920,755. Laying of concrete in Miraflores Locks was begun in Feb., 1910, and up to May 1, 1,497,562 cu. yds. had been placed out of a total of 1,501,993 cu. yds.

Philadelphia's Fight Against Water Waste.—Splendid results have already been otbained by Director Cooke in his fight to reduce the waste of filtered water in Philadelphia. Instead of being strained to their capacity, the filter plants, due to the lessened demand, are being operated under much more favorable conditions, both as to wear and tear and to coal consumption. In cutting down the waste, which was said to be the greatest in any city in the country, the Water Waste Exhibition, held last fall as an educational measure, is believed to have been a big factor. In West Philadelphia the consumption rate has been cut from 170 to 125 gals.

NEWS SECTION

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The Doings of the Week.

Few railroad construction contracts of any size appear to have been awarded since our last issue. This was to be expected under the conditions that prevail at present among the railroads. Aside from in the railroad field construction prospects are good at present. The June crop report of the U. S. Department of Agriculture issued last week forecasts a wheat harvest of 741,000,000 bushels, of which 492,000,000 bushels will be winter wheat, a record for this crop, and 252,000,000 bushels will be spring wheat. The third largest acreage ever planted and favorable growing conditions account for the prospect for an abundant yield. Among the railroad contracts let recently are the following: Grant Bros. Construction Co., Los Angeles, Cal., for grading for new electric railway of Pacific Electric Ry. Co. to Upland, Cal.; Kane & Smith, Youngstown, O., for grading for the line of the Poland Street Ry.; W. J. Kunkle, Ashtabula, O., for the excavation work for the new $1,000,000 shops of the Lake Shore & Michigan Southern Ry. at Ashtabula; Yale & Reagan, Fisher Bldg., Chicago, Ill., for constructing the Galva cutoff of the Chicago, Burlington & Quincy R. R.; Sharp-Fellows Construction Co., Los Angeles, Cal., for constructing the Minkler R. R. for the Santa Fe System.

Nothing of particular interest has developed in the state highway construction field. The State Highway Commissioner of Ohio is calling for bids on 13 new pieces of work. The California State Highway Commission has postponed the opening of bids until June 30 for the work mentioned in our last issue.

The principal earth grading work at the present time seems to be for levee construction. Bids on about 4,000,000 cu. yds. of this kind of work were opened this week. In addition, the St. Francis Levee Board, Marion, Ark., will open bids on July 1 on about 5,000,000 cu. yds. of levee work in this district.

A considerable amount of canal construction will be undertaken in Canada in the near future. The Department of Railways and Canals has begun advertising for bids for the first three miles of the new Welland Canal, starting from the Lake Ontario end. The total cost of the canal will be about $55,000,000. The Department also will ask for bids shortly for the beginning of work on the northern section of the Trent Valley Canal from Lake Sincoe to Georgian Bay via the Severn River.

Steps for a municipally owned terminal railroad have been taken by the Committee of Terminal Improvements of the Board of Estimate of New York City, which has reported on plans for a municipally owned terminal railroad, with yards and marginal facilities from the Brooklyn Bridge to 65th St., Brooklyn, to cost $11,236,516. The plan calls for the purchase of the Bush Terminal Railway Co., at a cost of $2,557,977, and of the New York Dock Co.'s railway, at a cost of $1,676,120.

Preliminary reports on the proposed Broad St. subway at Philadelphia, Pa., will probably be submitted this week or next. These reports will be an outline of the transportation plans. Construction work on the project probably will not be started before the spring of 1915. It will require a year and a half to complete the engineers' maps and other detail, while appeals to the courts on the enabling legislation loom up as probabilities in delaying the needed loans.

PERSONAL

Mr. Louis D. Kelsey has been appointed city engineer for Aberdeen, Wash.

Mr. John O'Neill has resigned as city engineer for Fredericton, New Brunswick.

Mr. R. J. Windrow has been appointed road superintendent for McLennan county, Texas.

Mr. W. S. Ruggles of Granite, Okla., has been appointed county engineer of Lyon county, Kansas.

Mr. J. Edgar Johnson has been appointed division engineer of the Pere Marquette railroad at Saginaw, Mich.

Mr. T. Kennard Thompson, consulting engineer, has been re-elected president of the Canadian Club of New York City.

Mr. Edwin F. Wendt has resigned as assistant engineer of the Pittsburgh & Lake Erie railroad in order to accept service at Washington.

Mr. J. H. Milburn, chief engineer of the drafting department of the Baltimore & Ohio railroad, was elected president of the Engineers' Club of Baltimore.

Mr. J. J. Rhoads has been appointed superintendent of the central division, Philadelphia, Baltimore and Washington railroad. Mr. C. I. Leiper is made principal assistant engineer.

Captain John D. Patterson of Atlanta, Ga., has been made general superintendent of the Panama railroad, vice Mr. J. A. Smith, resigned. Captain Patterson was recently superintendent of joint terminals in Atlanta.

Mr. E. B. Espenshade, civil engineer, formerly with the Pere Marquette Railway, has taken a position with the Boyne City, Gaylord & Alpena, a new railroad which is being built through the large timber tracts in Michigan.

Mr. James C. Harding, consulting engineer, has opened an office at 170 Broadway, New York City. Mr. Harding has been engaged in the practice of hydraulic and sanitary engineering for the past 21 years and has been a member of the firm of George W. Fuller for the last two years. He will retire from that firm July 1.

Arthur H. Blanchard, M. Am. Soc. C. E., professor of highway engineering in Columbia University, sailed on June 12 to attend the Third International Road Congress, London. Professor Blanchard is a United States reporter on Question 3, "Construction of Macadamized Roads Bound with Tarry, Bituminous or Asphaltic Materials," and Communication 10, "Terminology Adopted or to Be Adopted in Each Country Relating to Road Construction and Maintenance." He has been appointed a delegate to the congress by Columbia University, the American Society of Civil Engineers, the National Highways Association and the American Road Builders Association.

Mr. Charles B. Buerger has joined the staff of Mr. George W. Fuller, consulting engineer, 170 Broadway, New York City. Mr. Buerger entered the service of the Bureau of Filtration at Philadelphia in 1906 as a mechanical engineer and was engaged upon the design, construction, and testing of pumping stations and equipment. Later he was on the design of the preliminary filters at Torresdale and Belmont and had charge of the design of the Queen Lane filter plant. For the past two years he was senior assistant engineer in the Filtration Division of the Department of Water Supply in New York City on the design of the Jerome Park filter plant.

Mr. Joseph T. Richards, formerly chief engineer, maintenance of way, for the Pennsylvania railroad, has been made consulting engineer. Other appointments and changes on the road are: Mr. A. B. Clark, formerly assistant engineer at Wilmington, Del., is made assistant engineer, maintenance of way, in charge of roadway and track. Mr. George C. Koons, formerly engineer of the Cumberland Valley railroad is made assistant engineer in charge of bridges and structures. Mr. C. A. Preston, formerly division superintendent, middle division at Altoona, is made valuation engineer. Mr. Noel W. Smith is superintendent of the middle division. Mr. George R. Sinnickson is superintendent of the Schuylkill division.

INDUSTRIAL

I. Nhyre Hofstad, St. Petersburg, Alaska, has been appointed agent for that territory for the Blanchard Machine Co., Cambridge, Mass., manufacturers of Blanchard oil engines, marine and stationary, 8 to 100 h.p.

The Maryland Steel Co., Sparrows Point, Md., has awarded a contract to Raymond Concrete Pile Co., New York and Chicago, for the design and construction of reinforced concrete stock bins for blast furnace "C" at the Sparrows Point plant. Quincy Bent, assistant to president.

W. & L. E. Gurley of Troy, N. Y., will have a representative exhibit of the instruments which they manufacture, at the annual meeting of the Society for the Promotion of Engineering Education, which will be held in the Engineering Building of the University of Minnesota, Minneapolis, Minn., during the week beginning June 23. The exhibit will include engineers' and surveyors' field instruments, water stage registers and current meters, physical and electrical laboratory apparatus, standard weights and measures, accurate mercurial thermometers.

The MacArthur Concrete Pile & Foundation Co., 11 Pine St., New York City, has been awarded the contract for placing the foundation of the new twelve-story arcade building to be erected at New and Beaver Sts., New York City. Their foundation will be composed of about 150 steel-concrete piles. The method of placing the piles is as follows: A 12-in. steel pipe is driven to rock, the soil inside of the pipe blown out by compressed air, and the cavity filled with concrete and reinforced with 2-in. steel rods. Messrs. Rouse & Goldstone are the architects, and Robert E. Moss consulting engineer for this building. The MacArthur Concrete Pile & Foundation Co. also has been awarded the contract for placing the foundation of the core building for the Morgan & Wright Co., Detroit, Mich.

CATALOGUES

Tobin Bronze.—Paper, 4x7 ins., 32 pp. American Brass Co., Ansonia, Conn.

This book contains descriptions of the physical properties of Tobin Bronze and a number of testimonials from users. The various uses for which the material is suitable are listed.

Expanded Metal Construction.—Paper, 6x9 ins., 8 pp. Northwestern Expanded Metal Co., 37 W. Van Buren St., Chicago, Ill.

The June number of this bulletin contains illustrations and descriptions of the state capitol building in Idaho, the Medinah Temple in Chicago, and several other structures where expanded metal lath has been used.

Concentrated Galvanic Primer.—Paper, 6x11½ ins., 16 pp. Rinald Bros., 1160 N. Hancock St., Philadelphia, Pa.

This is a primer for galvanized iron which is applied like a paint and comes in small bottles. The contents of the bottle are stirred into a bucket of water and applied with a wide brush or a small clean mop and produces a surface upon which any paint will hold. It is claimed to prevent peeling and blistering. A number of testimonials are given.

Contractors' Equipment.—Paper, 3½x6 ins., 6 pp. Union Iron Works, Meadow Siding, Hoboken, N. J.

This pamphlet announces four catalogs which have been issued by the company as follows: No. 4, Pile Driving Machinery; No. 5, Derrick Excavators; No. 10, Buckets, Cars and Contractors' Equipment; No. 20, Road Builders' and Roofers' Equipment.

Lubrication.—Paper, 8½x5½ ins., 16 pp. The Texas Co., 17 Battery Place, New York City.

The May issue of Lubrication contains articles on the importance of good mechanical conditions for lubrication, the economic use of lubricating oils, the use of Texaco on railroads, etc.

General Pneumatic Engineering Information.—Paper, 6x9 ins., 48 pp. Chicago Pneumatic Tool Co., Fisher Bldg., Chicago, Ill.

Bulletin No. 34-L, which has just been issued, is one of the company's series covering the compressor line, and treats particularly of general engineering information of value to users of compressed air. It contains tables giving efficiencies of air compression at different altitudes, density of gases and vapors, mean effective pressures and horsepowers, loss of pressure due to friction in pipes, and many others, some rare and all important. Views of various types of compressors are shown in miniature, as well as illustrations showing the interior of the Pneumatic Tool Company's Compressor Plant at Franklin, Pa.

Bitu-Mortar Water Proofing.— Paper, 3½x6 ins., 6 pp. Bitu-Mortar Proofing Co., 250 E. 27th St., New York City.

This company has issued some pamphlets which illustrate the use of this waterproofing material which comes in a powder form and describes its uses and properties.

Air Compressor Outfits for Rock Excavation.—Paper, 6x9 ins., 16 pp. Abenaque Machine Works, 1879 Milk St., Boston, Mass.

Circular D illustrates and describes the Abenaque Portable Air Compressors for rock excavation such as quarry and trench work.

Raymond Concrete Piles.—Paper, 3½ x 6 ins., 8 pp. Raymond Concrete Pile Co., Chicago, Ill.

This gives illustrations showing large buildings, docks, etc., built with the use of concrete piles, and describes the method of driving this type of pile.

A Technical Test of Steel Coatings.—Paper, 9x5 ins., 20 pp. The Lowe Bros. Co., Dayton, O.

This book gives reports of experts on the six years of weather tests of paint for steel on the Pennsylvania Railroad bridge at Havre de Grace, Md.

Steel Bars, Plates, Shafting, Etc.—Paper, 4x9 ins., 32 pp. Faituoute Iron & Steel Co., Newark, N. J.

This is a stock list dated June, 1913, giving the sizes, weights, etc., of bars, tool steel, chain blocks, structural steel, etc.

Scriven Speed Regulators.—Paper, 6¼x 7 ins., 4 pp. S. & S. Variable Speed Gear Co., 52 Church St., New York City.

This circular illustrates and describes the variable speed jack shaft by which it is possible to feel for and maintain the exact operating speed required.

Scientific Road Construction.—Paper, 6x9 ins., 32 pp. Standard Oil Co., San Francisco, Cal.

The object of this bulletin is to call attention to the fundamental principles of road building and the necessity for the thorough examination of the material used in road construction. The bulletin gives a large amount of information regarding road construction, tests of materials, construction plant, methods, etc.

Air Washers.—Paper, 6x9 ins., 8 pp. Spray Engineering Co., 201 Devonshire St., Boston, Mass.

Bulletin No. 51 illustrates and describes in detail the nozzle used in the air washing plant built by this company. Layouts are shown for air washing plants.

Sprague Conduit Products.—Paper, 6x9 ins., 60 pp. Sprague Electric Co., 527 W. 34th St., New York City.

Catalog No. 439 gives an illustrated list of conduit products and fittings for electrical work. The book is divided into sections as follows: Stamped Steel Boxes and Covers, G.-E. Receptacles, Switches, Sockets and Rosettes, Flexible Steel Conduit, Galvanized Rigid Duct, Watertight Floor Outlet Boxes Adjustable, Non-Adjustable and Adjustable Gangs.

Air Washer.—Paper, 6¾x9½ ins., 8 pp. The Osborne Patented Machinery Co., 120 Liberty St., New York City.

This is Bulletin No. 2 which illustrates by drawings and describes the smoke consuming apparatus and air washer built by this company.

Pile Drivers, Steam Hammers, Etc.—Paper, 6x9 ins., 8 pp. Industrial Works, Bay City, Mich.

Bulletin No. 210 contains interesting illustrations of all steel self-propelling pile drivers with double acting steam hammers for railway work. Crane pile drivers are also illustrated.

The Hampton Hydrolytic Tank.—Paper, 4x8¼ ins., 6 pp. Sterilization Co., 802 Union Bldg., Newark, N. J.

This circular, with accompanying pamphlets, illustrates and describes the Hampton Sedimentation tank for the clarification of sewage.

Pneumatic Mixer and Conveying Machine.—Paper, 6x9 ins., 20 pp. The Pneumatic Concrete Placing Co., 1217 First National Bank Bldg., Chicago, Ill.

This book illustrates a concrete mixer which uses air pressure to mix and convey the batch which is carried from the mixer through a 6 or 8 in. pipe to place in the forms. Illustrations showing work upon which the machine has been engaged are given and letters from users of the machine are shown.

RAILWAYS

Alabama.

A plan is under consideration for the construction of a street railway at Dothan. As projected the line will run out West Main St. and through Houston Heights, a suburb. Hugh G. Smith, Dothan, Ala., is interested.

Arkansas.

Application has been made to the City Council of Little Rock, Ark., for a franchise to build an interurban between that city and Pine Bluff. Ed. Cornish, President Merchants' National Lighting Co., Little Rock, is interested.

California.

⊙Grant Bros. Construction Co., 620 Security Bldg., Los Angeles, Cal., has been awarded the grading contract for the new railway of the Pacific Electric Ry. Co. to Upland.

⊙Work has been started by Sharp-Fellows Construction Co. of Los Angeles, Calif., on the Redbanks branch of the Santa Fe system. The work will go both ways, south on the Minkler-Southern line and west on the Redbanks-Visalia line. It is announced that the line is to start from Redbanks and run to Peral, instead of to Cutler. This means that all the business from Redbanks will pass through the Visalia offices instead of the Cutler station. The construction crew now numbers 100 men and 200 head of stock. The agents of the company are soliciting bids from Visalia merchants for supplies that will cost about $2,000 a month. It is stated that the Sharp-Fellows Co. has 104 miles to build from Minkler south through Redbanks, Exeter and Porterville, as well as the Visalia branch. It will cost $40,000 a mile. A new $180,000 steel bridge is to be built over the St. John's River north of Visalia as a part of the work. This work will start as soon as the bridge crew is released from the Kern River job.

Surveys have been about completed for the new line of the Fresno Traction Co., F. W. Webster, General Manager, Fresno, from Wiston and McKinley Aves., Fresno, to the San Joaquin River. The line will be about 10 miles long and it is expected that construction work on it will be started about July 15.

The State Railroad Commission has granted the application of the Southern Pacific Ry. Co. for permission to issue $30,000,000 2-year notes at 5 per cent, for improvements and extensions to its lines. In addition the company plans to expend during the current fiscal year $10,000,000 from earnings.

The Exposition Terminal Ry. Co., formed to build a terminal railway and warehouses for the Panama Exposition, has completed its organization and will start construction work shortly. I. W. Hellman, Jr., San Francisco, is President, and Rudolph J. Taussig, San Francisco, is Secretary.

Finance committee of the Board of Supervisors of San Francisco has appropriated $5,000 for the preparation of plans by the City Engineering Bureau for the proposed extensions of the municipal railway system. Issuance of $3,500,000 of bonds for the construction of the extensions will be voted on Aug. 26.

The State Railroad Commission has granted authority to the Pacific Electric Ry. Co., Los Angeles, to construct the double track railroad along San Pedro St. at grade across intersecting streets and railroad tracks between Aliso and Ninth Sts., Los Angeles. With this permission the railway company now will be able to proceed with the work of construction, under the contract with the city, entered into some months ago, and which, when completed, will form the first link of the proposed municipal railroad to the harbor.

Advices from San Jose, Calif., state that offices have been opened at that city by the Southern Pacific Ry. and that preparations are being made to start on the proposed work at West San Jose. The cost of the improvement, which will reduce the distance from San Francisco to Los Angeles 1 mile, will amount to $2,000,000.

Surveys have been completed, it is reported, for the construction of a direct line of the Santa Fe System from Los Angeles to Imperial Valley, with a branch extending to San Diego. Surveyors are now running a line through San Felipe pass, and it is said the Santa Fe plans an extension of the Perris branch from Temecula by way of San Luis Rey Valley and Warner's hot springs through the San Felipe Valley to El Centro.

The Santa Fe System has asked the supervisors at San Bernardino for franchises to construct new industrial tracks at Rialto, Cucamonga and Upland. At Cucamonga the proposed track will be run quite a distance from the main line to connect with the rich Alta Loma section.

Announcement is reported to have been made by John D. Spreckels, President of the San Diego & Arizona Ry., that the line would be completed to Yuma, Ariz., by 1915 and that $1,000,000 would be expended for construction work within a year. E. J. Kallright, San Diego, is Chief Engineer.

Colorado.

⊙The Denver & Rio Grande Railroad has let the contract for the construction of the new roundhouse at Grand Junction, Colo., to Mortimus Nelson, Denver, Colo., at $65,000. Work will be started at once.

Plans are under consideration for the purchase of 30,000 acres of coal lands in Routt County and the construction of a railroad from Hayden to Casper, Wyo. It is understood that the project will be financed by a group of Belgian and Paris capitalists, who will have representatives look over the field in the near future. The railroad will be known as the Colorado & Northern and as projected it will connect with the Denver & Salt Lake R. R. at Hayden, the Union Pacific at Wolcott and the Chicago & Northwestern Ry. at Casper. Benjamin L. Dorsey and A. R. Bickerstaff of the Consolidated Securities Co., Toronto, Ont., are interested.

The Georgetown & Grays Peak Ry. Co., incorporated two weeks ago with a capital stock of $100,000, has been organized to acquire and extend the Argentine Central Ry., a 16-mile 3-ft. gage line, now constructed from Silver Plume to the summit of Mount McClellan in Clear Creek County. The incorporators are William Barth, Willis M. Marshall, William Rogers, F. W. Blankenbuhler and William S. Iliff. A. J. Woodruff, Denver, Colo., is Secretary of the Argentine Central Ry. Co.

Connecticut.

Steps are being taken to secure the construction of an electric railway from Stafford Springs to the Massachusetts state line via Orcuttville and Evergreen Park. Charter for such a line was granted this spring. The incorporators are Frederick Faulkner, Christopher Allen, Robert H. Fisk and M. D. O'Connell, all of Stafford.

Georgia.

City Council of Augusta, Ga., has granted application of the Augusta-Aiken Railway & Electric Co., 8th and Telfair Sts., Augusta, for permision to lay a track on Craig St. from their line on Central Ave. to the site of the new St. Joseph's College.

Illinois.

✣Bids will be received until 10 a. m., June 24, by the Chicago Rys. Co., Williston Fish, General Manager, 600 Borland Block, Chicago, Ill., for furnishing 100 steel underframes for use in connection with the 1913 closed motor car bodies. It is the desire of the company to obtain these underframes at the earliest date, and the question of time and rate of delivery is essential.

⊙Yale & Reagan, Fisher Bldg., Chicago, Ill., have been awarded the contract for constructing the Galva cutoff of the Chicago, Burlington & Quincy R. R. The contract includes about 350,000 cu. yds. of team work which will be done by Mike Conroy and 150,000 cu. yds. of steam shovel work which will be done by Yale & Reagan.

The stockholders of the Danville, Crescent City & Kankakee Traction Co., with general offices at Crescent City, Ill., have voted to increase the capital stock from $10,000 to $250,000. About 75 per cent of the right of way between Crescent City and Kankakee has been secured and it is proposed to begin construction work this summer.

Kansas.

Members of the Dodge City, Kan., Commercial Club recently conferred with Frank L. Yantis, Managing Receiver of the Scott City & Northern R. R., Scott City, Kan., in regard to the construction of a new line from Scott City to that place.

Right of way is being secured for the Newton, Kansas & Nebraska R. R., which proposes to build out of Newton, via Geneseo, Canton and Roxbury to Salina. Ex-Gov. C. M. Barnes, Guthrie, Okla., is right of way commissioner.

Kentucky.

Proposition has been submitted to citizens of Owingsville, Ky., by W. W. Hubbard, Indianapolis, Ind., Vice President of the Licking River R. R., for building a narrow gage line from that place to Preston, 5 miles.

Louisiana.

The Santa Fe System in order to secure an entrance to New Orleans is reported to have made an offer for the purchase of the New Orleans, Texas & Mexico R. R., which is part of the Frisco System and extends from New Orleans around the Gulf to Brownsville, Tex., on the Mexican border. The Santa Fe connects with this road at Houston and Beaumont.

The Progressive League of Rayville has taken up the matter of building a railroad from that place to Pioneer in West Carroll Parish. A meeting will be held at Pioneer on June 25 at which time the company will be formed and steps taken to start a preliminary survey.

The New Orleans, Mobile & Chicago R. R., B. V. Wright, Chief Engineer, Laurel, Miss., is reported to be planning to begin work in the near future on its extension from Beaumont, Miss., into New Orleans. It is also reported that the Chicago, Burlington & Quincy R. R. has about completed arrangements to acquire control of the New Orleans, Mobile & Chicago R. R. The Burlington tracks run as far south as Metropolis on the Ohio River, opposite Paducah, Ky., and the tracks of the New Orleans, Mobile & Chicago run northward as far as Middletown, Tenn., and the Burlington will have but a short distance to build its connecting line.

Maryland.

A preliminary survey for the proposed line of the Rock Castle Railroad has been completed to McKee via Annville, a distance of 28 miles, and it is expected that grading will be started by July 1. Officers of the company are as follows: N. U. Bond, General Manager, Oakland, Md.; Marvin I. Taylor, Engineer, Elkins, W. Va., and J. C. Pence, Construction Engineer, Westernport, Md.

Massachusetts.

The Senate and House have passed the New Haven trolley bill, which permits the New York, New Haven & Hartford R. R. to acquire trolleys in western Massachusetts. The bill is now before the governor for his approval.

The Berkshire Street Ry. Co., Pittsfield, Mass., is to improve its line between North Adams and Williamstown this summer. New rails will be laid and many curves eliminated.

The C. A. Dodge Co., Cambridge, Mass., has been awarded the contract for the construction of the union station at Pittsfield, Mass., at a cost of about $300,000. Work will be commenced at once and the station will be completed by the first of July, 1914. L. G. Morphy, Designing Engineer of the new station, and C. H. Shultz, assistant, obtained from Building Inspector John H. Flynn the required permit to erect the building. About $75,000 will be spent in grading and other improvements, and $35,000 will be spent on an addition to the freight station. The new passenger station will be located on practically the same site as the present station and will be an architectural ornament to the city.

Michigan.

The Muskegon, Ludington & Manistee Electric Ry. Co. has applied for incorporation. The capital stock is $1,500,000 and the company proposes a line to run from Muskegon and then to Manistee. This is the project promoted by Sidney M. Weil, Chicago, Ill. The other directors are Henry R. Baldwin, Chicago; Walter Hieston, Chicago; Thomas Jacobs, Chicago; Charles P. Williams, Washington, D. C.

Minnesota.

⊙Dennis Calnan and Edward Riley, Grading Contractors, have shipped their outfit from De Pere, Wis., to Crookston, Minn., where they have a 60,000-yd. contract.

Missouri.

Charles W. Grant, a railroad contractor of Joliet, Ill., has established a camp near Shelbyville, Mo., and will commence grading at once on the extension of the Shelby County Railway.

St. Louis Items.

BY A. B. KOENIG.

✣B. G. Covington, Chief Engineer of the St. Francis Levee District, Room 664 Randolph Bldg., Memphis, Tenn., will let 5,000,000 cu. yds. of levee work at the office of the St. Francis Levee Board, Marion, Ark., on July 1.

✣The Plum Bayou Levee District is asking for bids for the construction of about 6,000 ft. of new levee, containing approximately 100,000 cu. yds. Plans and specifications will be on file at the office of J. T. Lipscomb, Secy., England, Ark. Also at the office of Dickinson & Watkins, Engrs., State Bank Bldg., Little Rock, Ark. Bids will be opened noon July 7.

The Walsh Construction Co. of Davenport, Ia., were low bidders for enlarging the levees of the Cairo, Ill., drainage districts. Their bid was $286,498.50. The contract calls for raising the levees to the 57-foot mark on the Cairo gage with an 18-ft. crown on top and a two to one slope on the outside and a three to one slope on the inside. If additional funds are secured from the national government the levees will be raised to the 60-ft. grade. The work will start at once.

⊙Yale & Reagan, Fisher Bldg., Chicago, Ill., secured the contract for building the Galva cutoff of the Burlington R. R. There is 150,000 yds. of steam shovel work and about 350,000 yds. of team work in this job. Yale & Reagan are going to do the shovel work and the team work will be done by Mike Conroy.

⊙John Higgins secured the contract for digging a ditch near Chesterfield, Mo., from Dolman & Son.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

⦿The Callahan Construction Co. of Knoxville, Tenn., secured the contract for constructing a 40-mile extension of the Virginia & Carolina Ry.

Thomas Morris was in town looking for work for his outfit, which is about idle at Witt, Ill.

H. W. Houck has some team work to let on the Shelby County R. R. at Shelbina, Mo. Charles Grant has gone north to look over some work. Will report in next issue whether he landed any or not.

D. O. Sullivan has his 7-team outfit idle at Morrisonville, Ill. Sullivan was on Griffith & McMurray's work on the new Frisco extensions when orders were received to shut down the work on account of lack of money.

W. H. Thompson, 14 North 4th St., St. Louis, Mo., has a 6-team outfit idle.

James Dowd & Son at Morrisonville, Ill., have 25 teams, 2 machines, engine and a complete grader's outfit idle. Dowd is one of the contractors that was on the Frisco extension when orders were received to shut down.

Lane Bros. came in from Morrisonville, Ill., and left for Shelbina, Mo., to look over some of the Shelby R. R. work.

Joyce Bros. & Bagwell have made a start on their new Chicago & Northwestern R. R. work near Benld, Ill.

List & Gifford and the Winter Construction Co. are making rapid progress with their track laying on the Wabash R. R. between Bement and Ivesdale, Ill.

The Illinois Central R. R. Co. is going to raise its grade between Cairo and Mounds, Mounds, Ill., 5 ft. higher. Expect to start work July 1.

The Walsh Construction Co. is at work near Mound City, Ill., raising track and levee.

Montana.

⦿The Widell Company, according to advices from Mankato, Minn., has been awarded the contract by the Great Northern Ry. Co. for about $300,000 worth of tunnel and bridge work in Montana.

The Bear Creek & Western Ry. Co. has begun filing deeds for the right of way for its proposed line between Bridges and the Bear Creek coal fields with a terminus at Washoe. This is probably a subsidiary company of the Northern Pacific Ry.

New Jersey.

⦿Roydhouse-Arey Co. has been awarded the contract for the construction of a reinforced concrete machine shop 65x100 ft. and a reinforced concrete roundhouse 90x225 ft. at Morrisville, N. J., for the Pennsylvania R. R. The cost will amount to about $150,000.

New York.

Surveys are being made for an electric railway to be built from Fredonia to South Dayton, along the old Erie right of way. J. Herbert Digby, Dunkirk, N. Y., is interested.

The Committee of Terminal Improvements of the Board of Estimate of New York City has reported on plans for a municipally owned terminal railroad, with yards and marginal facilities from the Brooklyn Bridge to 65th St., Brooklyn, to cost $11,236,516. The plan calls for the purchase of the Bush Terminal Railway Co., at a cost of $2,557,977, and of the New York Dock Co.'s railway, at a cost of $1,676,120; the acquisition of yard space in Erie Basin district at a cost of $894,225; construction of yard and terminal facilities, at a cost of $1,500,000; acquisition of parcels for main line right of way and cutoffs, at a cost of $359,300; construction of a railway to connect the Bush and New York company lines, at a cost of $1,425,000; float bridge approaches at the foot of Conover St., $1,237,700, and purchase of land now used by the Bush company for yard spaces, to cost $1,586,200. There is $15,000,000 available for dock purposes. It is proposed to spend $8,498,816 of this for the main features of this plan, leaving an ample margin for other work, and to build the additional yards and terminals and the Conover St. float bridge next year, when the margin of credit will have been swelled by the increase in assessed values for the coming year. R. A. C. Smith, Pier A, Battery Place, New York City, is Commissioner of Docks.

The Public Service Commission for the First District, New York City, has written a letter to Governor Sulzer asking him to urge upon the special session of the Legislature, soon to be convened, to make an appropriation of $1,278,025 as the state's one-quarter of the estimated cost of eliminating grade crossings on the Atlantic Ave. division of the Long Island R. R., between the end of the present elevated structure and the westerly end of the Jamaica improvement. These crossings are 24 in number and extend from Norwood Ave. to Beech St. Ultimately there will be about 40 streets crossing between these points, but at present only 24 streets are opened across the tracks. The Commission recommends that the tracks be elevated on a structure having a solid concrete floor and resting on three columns, and the streets to be carried underneath the tracks so that there will be no longer any grade crossings at all. It is on this type of structure that the estimate of cost is based. The Commission says that hearings have been held and the required testimony taken in regard to these crossings; that the railroad company is willing to undertake the work immediately and bear one-half of the cost, as provided by law. Before the elimination order can be issued, however, it is necessary that the state make an appropriation for its share of the cost, and accordingly the governor is urged to present the matter to the Legislature.

Surveys have been made between Jamestown and South Dayton and rights of way secured for nearly half the distance for a proposed electric railway which is to ultimately extent to Buffalo. C. E. Bentley, Jamestown, N. Y., is the Engineer.

A meeting was recently held by officials of the New York Central & Hudson River Railroad, the Public Service Commissioners and members of the Citizens' Committee at Schodack Landing, N. Y., to consider the proposed line from that place to a connection with the Boston & Albany R. R. at a point near South Schodack.

North Carolina.

The Appalachian Electric Power & Trust Co., chartered for the purpose of promoting the construction of a railroad from Wilkesboro to Taylorsville, 20 miles, has elected the following officers: T. B. Finley, Wilkesboro, N. C., President; J. C. Smoot, Vice President; C. H. Cowles, Secretary, and R. W. Gwyn, Treasurer.

Ohio.

⦿The Poland Street Ry. Co., 2d floor, Stambaugh Bldg., Youngstown, O., has awarded contracts for its proposed street car line to Poland, a suburb of Youngstown, as follows: Grading, Kane & Smith, Youngstown; strengthening bridges, Hunter Construction Co., Youngstown; ties, poles and other lumber, Henderson Lumber Co., Pittsburgh; cars, Niles Car Co. George E. Rose is the promoter.

⦿W. J. Kunkle, Ashtabula, O., has been awarded the contract for the excavation work for the new $1,000,000 shops to be erected at Ashtabula for the Lake Shore & Michigan Southern Ry.

The Ohio River & Northern R. R., incorporated recently, is obtaining options on rights of way for its proposed road from Lisbon to Beaver, Pa., and Pittsburgh by the way of East Liverpool and the Ohio River. At Lisbon a connection will be made with the Erie for Niles, using the new line of the Lorain, Ashland & Southern which is now being constructed. The Erie R. R. and the Crucible Steel Co., Pittsburgh, are said to be backing the project.

The Southwestern Ohio Railway, Light & Power Co., 129 N. 4th St., Zanesville, O., is contemplating extending its line to Somerset and possibly to Lancaster. The officers of the Southwestern company are now surveying along the Maysville pike from Moxahala Park through White Cottage to Fultonham to ascertain if the pike is wide enough to allow their tracks to be laid along it and leave room for vehicle crossings.

Oklahoma.

The De Queen & Eastern R. R. has made surveys for a branch from Broken Bow, Okla., to De Queen, Ark. Construction contracts, however, will not be let until next year. E. Byington, Broken Bow, Okla., is Chief Engineer. Hans Dierks, Kansas City, Mo., is President.

It has been announced by officials of the Clinton & Oklahoma Western Railroad, which is projecting a line from Clinton to Chickasha, Okla., that the new road will pass through Anadarko. J. W. Maney, Oklahoma City, Okla., is President of the company.

Oregon.

The City Council of Portland, Ore., will shortly act on the request of the Clackamas Southern Ry. for permission to enter the city from the south. The road would come in from the south on East Seventeenth St. and finally connect with Hawthorne Ave. and cross to the west side over the Hawthorne bridge, and also will run to the Hill terminals on East Third St.

Pennsylvania.

Bill has been signed by Governor Tener which authorizes the city of Philadelphia to build subways for leasing purposes and gives Councils control over the leases and contracts. Under its provisions work on subway building must be started within 18 months. A. Merritt Taylor is Transit Director of the city.

Ordinance is before the Common Council of Harrisburg, Pa., for the vacation of several streets for a freight depot to be erected for the Pennsylvania. It is stated that the work of building the new freight station will be started as soon as Councils pass the necessary legislation. It will lie directly below Mulberry St. with entrance from Second.

C. P. Bower, Reading, Pa., has work under way on his contract on the low grade freight line of the Philadelphia & Reading Ry. at Wayne Junction, Philadelphia. The contract includes 153,000 cu. yds. unclassified excavation, 4,800 cu. yds. concrete masonry, 18,000 cu. yds. stone masonry and three bridges. These latter will consist of a 50-ft. span and a 60-ft. span I-beam, Jack arches, and an 80-ft. concrete arch.

South Carolina.

The Charleston-Isle of Palms Traction Co., W. W. Fuller, Chief Engineer, Charleston, S. C., will probably not undertake its proposed Mount Pleasant-McClellanville extension until late in the fall or early spring of next year. The distance from Mount Pleasant to McClellanville is 35 miles. The country is a farming district and practically level, high and dry the entire distance. The company now operates the above named property connecting Charleston with Mount Pleasant by ferry boats and Mount Pleasant, Sullivan's Island, Atlanticville and the Isle of Palms by electric line, approximately 10 miles in length. The proposed extension would be operated electrically and equipped with about six double truck cars, six freight cars and probably an electric locomotive, with some flat cars. The particular business of this railroad would be lumber and truck.

Good progress is being made in securing the right of way for the further extension of the South Carolina Western Ry. Grading work is now under way between Florence and Poston. W. R. Bonsal, President, Hamlet, N. C.

Tennessee.

The Yazoo & Mississippi Valley R. R. (Illinois Central line) is to lay a double track from Lake View, Miss., to Lake Cormorant, a distance of eight miles. The company will also construct a new roundhouse at the Nonconnah yards, Memphis.

Information received from Bristol, Tenn., is to the effect that surveys have been completed for the proposed steam belt line encirabout $10,000,000 for a line known as the St. Louis & Western Traction Co., 42 miles long, from St. Louis northwest, crossing the Missouri River at Weldon Springs and terminating at Wentzville, and another line, 125 miles long, including the St. Louis Belt and main line east through Pana to Mattoon, Ill. Both of these lines have been surveyed and 70 per cent of the right-of-way has been obtained for the Missouri line, 7 miles of the grade out of St. Louis from West End Heights having been completed. A considerable part of the right-of-way has been secured for the Illinois line and charters for bridges over the Mississippi and Missouri Rivers were granted by Congress 10 days ago. The Missouri River bridge at Weldon Springs will cost $900,000 and the one across the Mississippi, 14 miles north of Eads Bridge will cost $1,500,000.

Nebraska.

The Chicago, Rock Island & Pacific Ry. has appropriated $200,000 for improvements at Fairbury, Neb., one-half of which will be spent this year. The improvement will include the enlargement of the yard, work on which will be started at once. A change of main line is also included.

A meeting was recently held at Harrisburg, Neb., by citizens of Banner County and promoters of the railroad from Bridgeport, Neb., to Cheyenne, Wyo. It was stated that a sum of $250,000 must be raised by stock subscriptions and contributions along the line which, it is proposed, will run from Cheyenne, via Golden Prairie and Albin in Wyoming, and Long Canyon, Harrisburg, and Redington, to Bridgeport. An election will be held in Banner County to submit to the people a proposition to issue bonds amounting to about $55,000. The new company will file at the office of the County Clerk before Sept. 1, 1913, a survey of the proposed route.

New York.

⊙The contract for the construction of the new Union Station at Utica, N. Y., has been awarded to J. Henry Miller, Baltimore, Md., at $691,000 and work on the structure will be completed within 10 months.

The Pennsylvania R. R. opened bids on March 17 for changing the line on the Buffalo Division between Glynden and Corry, about 9 miles.

The Geneva & Auburn Ry., operating 17.7 miles of electric railway, has been purchased by R. R. Quay, Pittsburgh, Pa., representing the present trustees and bond holders. It is stated that the new owners will make plans for carrying out the contemplated extension to Auburn.

The Hudson River Connecting R. R. Co. has been incorporated with a capital stock of $250,000 and will build three short sections of railroads in Albany, Rensselaer and Columbia Counties. The new company is a subsidiary of the New York Central Lines, and the new sections will be built to connect the New York Central, West Shore and Boston & Albany. The plans of the company call for a $7,000,000 bridge over the Hudson River near Stuyvesant and the building of 22 miles of line to connect with the New York Central & Hudson River R. R. at or near Stuyvesant, Columbia County, and with the West Shore R. R. at or near Feura Bush, Albany County, with two branches, one 2½ miles south of Feura Bush running southerly 2 miles to another point of connection with the West Shore R. R., and the other from a point upon its line about ½-mile east of the Hudson and running thence easterly to a point of connection with the Boston & Albany R. R. at a place a short distance north of the dividing line between the counties of Rensselaer and Columbia. The directors and incorporators are: William C. Brown, William H. Newman, William K. Vanderbilt, Jr., John Carstensen, Charles F. Daly, Ira A. Place and 9 other New York Central stockholders.

North Dakota.

⊙Friederick & Barnard, 401 Globe Bldg., Minneapolis, Minn., have the contract for grading 50 miles of the Midland Continental R. R. from Jamestown, N. Dak., north. This is all team work and is ready to be started as soon as weather permits. A few good subcontractors are wanted.

The Great Northern Ry. is to extend its Sherwood branch this spring for a distance of about 10 miles.

The Commercial Club of Dickinson, N. Dak., is advocating the construction of an electric railway from that place to Mott.

A report from Veblen states that a total of $121,000 has been subscribed by farmers and business men of that place to promte the proposed "farmers'" road from Veblen to Fairmont, N. Dak.

The Chicago & Northwestern Ry. in the early spring will probably take up the extension of its line west from Winner, S. Dak.

The Great Northern Railroad Co., it is announced, will construct, this summer, shops at Fargo, N. D. The improvement is made necessary by the operating of trains over the Fargo-Minot cutoff and additional trains stopping at Fargo from the Devils Lake and Portal branches.

Contractors are shipping equipment into Dunn County, N. D., and preparations are being made for an immediate start on the Northern Pacific extension from Stanton, N. D., westerly up the Knife River to Spring Creek and thence to the south end of the Kildeer Mountains. The Cook Construction Co., St. Paul, Minn., as mentioned recently in ENGINEERING & CONTRACTING, has the general contract.

Ohio.

The Piqua & Bradford Traction Co. of Covington has been incorporated with a capital stock of $10,000, the incorporators including J. H. Marlin, Hugh C. Marlin and A. W. Minton. The proposed traction line will connect the town of Covington and Bradford. At Covington the line will connect with the Dayton, Covington & Piqua Line.

Steps are being taken to raise funds for making a preliminary survey for the proposed Middletown, Reading & Cincinnati Interurban Ry. Co., incorporated recently for the purpose of building a line through Monroe, Bethany, Reading and other smaller towns between Middletown and Cincinnati. The Business Men's Club of Middletown, O., is interested.

The Portsmouth Street Railroad & Light Co., R. D. York, General Manager, Portsmouth, O., will ask the council of Jackson for a franchise for an extension to that place.

It is believed that the increasing traffic over the Detroit & Toledo Shore Line Ry. will necessitate the double tracking of the road this summer. J. P. Main, Detroit, Mich., is General Manager.

Oklahoma.

M. Cassidy, Guthrie, Okla., has secured right of way from Newton to Abilene for the proposed Newton, Kansas & Nebraska R. R.

City of Cushing, Okla., has granted a franchise to the Cushing Electric Traction & Interurban Ry. Co. for the construction of a car line in the city and to the surrounding oil fields.

Oregon.

It is rumored that the Pacific & Eastern Ry. is making preparations for the extension of its line westward to Coos Bay, giving a direct outlet to the Pacific for Rogue River, Ore. William Gerig, Medford, Ore., is Chief Engineer and General Manager.

The Rogue River Valley Canal Co., according to advices from Central Point, Ore., is figuring on extending its ditch around the base of Roxie Anne to Ashland, thence crossing to the west side of the valley to Gold Hill.

Pennsylvania.

⊙Thomas Connor, Greensburg, Pa., has secured a sub-contract from John Marsch, Chicago, Ill., for driving a 620 ft. tunnel at McPherson on the 34-mile extension of the Montour R. R.

The Pennsylvania R. R. has acquired control of the Cornwall & Lebanon R. R., a 22-mile line running from Lebanon to Conewaga.

The Eastern Connecting Railroad Co. has been incorporated in Pennsylvania with a capital stock of $200,000. H. L. Mitchell, Pittsburgh, Pa., is one of the incorporators.

The Harrisburg Ry. Co., Harrisburg, is considering extending its line out Market St. to 21st St. Relaying of track in Race St. and along other points of the line is also contemplated.

Borough Council of Latrobe has granted permission to the West Penn Ry. Co., 345 Fourth Ave., Pittsburgh, Pa., to make improvements within this borough. The franchise enables the company to make a loop in its line by way of Walnut.

The Bloomsburg, Millville & Northern Ry. Co. has made surveys and 75 per cent of the construction capital has been paid in or secured for its projected 10-mile line from Bloomsburg to Millville. Contracts will be let as soon as the balance of the bonds is sold. D. O. Coughlin, Wilkesbarre, Pa., is President; Walter A. Hughes, West Berwick, Pa., is Treasurer.

South Dakota.

A new railroad to be known as the Clear Lake Southern, running from Clear Lake, S. D., to a junction with the St. Louis road at Wallace or Florence, is being promoted by H. F. Hart. An engineer from Chicago has been engaged to make a preliminary survey of the route.

Texas.

The Galveston, Harrisburg & San Antonio Ry., D. K. Colburn, Assistant General Manager, Houston, Tex., is planning to extend its Sylvan Beach spur at Houston in the direction of Morgans Point.

The Missouri, Kansas & Texas Ry. is reported to be planning to build a 4-mile extension from Reedville to Martindale.

Surveys are to be commenced shortly, it is now stated, by engineers of the Missouri, Kansas & Texas for the construction of a line from Newcastle to Cisco connecting the Wichita Falls & Southern with the Texas Central R. R.

It has been announced that Foster Crane, who has the contract for the construction of the Fredericksburg R. R. has decided to construct a tunnel through the "Big Hill." Mr. Crane has secured Ben Jones of Boise, Idaho, as chief engineer. The tunnel will be 900 ft. in length and will pierce solid rock 80 ft. beneath the apex of the hill. Dimensions of the hole are 16 by 20 ft. According to estimates, about 90 days will be required for completion of the tunnel. Work will be pushed from both sides of the hill.

Utah.

Officials of the Ogden Rapid Transit Co., Ogden, Utah, will shortly decide on the route for its interurban extension between Ogden and Logan.

The Logan Rapid Transit Co., Joseph A. West, Chief Engineer, Ogden, Utah, has voted to increase its capital stock from $100,000 to $500,000. The company proposes to build an extension out of Logan, Utah.

Virginia.

⊙W. W. Boxley & Co., Roanoke, Va., have the contract for 8 miles of work double tracking the main line of the Norfolk & Western Ry. from Disputanta to Estes, Va. About 400,000 cu. yds. of excavation is required. Boxley & Co. also have a contract from the Norfolk & Western Ry. for what is known as the High Bridge work, this consisting of building new abutments and pedestals for the bridge and filling in abutments. The work involves about 300,000 cu. yds. of excavation and about 10,000 cu. yds. of masonry. None of the work is to be sublet.

The Warrenton & Norlina R. R. Co., of Warrenton, Va., has been chartered with a capital stock of $50,000, of which $5,000 has been subscribed, and proposes to construct a 5-mile railroad from Warrenton to Norlina. The incorporators are J. H. Scoggin, W. H. Burroughs, W. E. Twitty, Warrenton; A. C. House, Weldon; J. K. Plummer, Jr., Raleigh, and J. E. Bowers, Scotland Neck.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Washington.

The Northern Pacific expects to commence construction soon on the new branch connecting with the main line at Olequa and running to Spirit Lake via Toledo. The new branch will form a feeder for the Tacoma-Portland main line.

The engineering' crew of the Spokane & British Columbia Ry. under Dennis P. Wood, Spokane, Wash., has completed surveys for changing the route of the line from Peach on the Columbia River to Detillion bridge on the Spokane River to comply with the Government's requirements regarding water rights.

Wisconsin.

Bids have been asked by William Cambier, Chief Engineer of the Wisconsin & Northern R. R., Oshkosh, Wis., for cutting out two miles of right of way for the proposed 8-mile line south of Crandon.

Wyoming.

The J. Fred Roberts Construction Co., Denver, Colo., has 15 miles of work near Casper, Wyo., on the Orin Junction-Powder River branch of the Burlington, for which Twohy Bros. are the general contractors. The Roberts work includes 750,000 cu. yds. of earth excavation and 20,000 cu. yds. rock excavation.

Canada.

✣Bids will be received until noon, March 29, by H. B. Walkem, Division Engineer, Vancouver, B. C., for clearing right-of-way on the Arrow Lake subdivision.

✣Bids will be received until noon, April 1, by A. L. Hertzberg, Division Engineer, Canadian Pacific Ry., Toronto, Ont., for the excavation, masonry and concrete work in connection with the double-tracking of Humber River bridge near Lambton, Ont. Plans and specifications may be seen at the office of the Resident Engineer, Room 605 Union Station, Toronto.

⊙Contracts for the completion of the Kootenay Central Ry. have been awarded by the Canadian Pacific Ry., as follows: Burns & Jordon, Spokane, Wash., 60 miles; Boomer & Hughes, Spokane, Wash., 20 miles. The first mentioned contract probably amounts to about $2,500,000; the other contract will probably aggregate about $830,000. Boomer & Hughes have the work from the Fort Steele end. Burns & Jordan will have about 20 camps and will employ something like 2,000 men; five or six steam shovels will also be used.

⊙Johnson Bros., Port Hope, Ont., expect to sublet a portion of its contract for constructing the Lake Erie & Northern Ry., mentioned in our last issue. This contract amounts to about $1,000,000 and calls for grading, bridging, track laying and ballasting 50 miles of lines from Galt to Port Dover, Ont., via Paris and Brantford. Johnson Bros. will at once open an office in Brantford, Ont., for the work.

⊙The Canadian Pacific Ry. has let contracts for 165 miles of double tracking on its Lake Superior Division and Ontario Division, as follows: Jones & Girouard, Ottawa, Ont., from Guelph Junction east to Islington, 30 miles; Cook Construction Co., Sudburg, Ont., 30 miles; Cartier subdivision of Lake Superior Division; Dominion Construction Co., Toronto, Ont., 84 miles; McQuaig, McCaffrey & Cochrane, 22 miles.

⊙The Canadian Pacific has awarded the contract for double track between Hammond Creek and Ruby, B. C., to Grant Smith & Co., Seattle, Wash., and a similar contract east of Hammond Creek to Patrick Welsh, Spokane and Seattle, Wash.

Work will be started in the spring by Burns & Jordan, Spokane, Wash., on the final 40 miles of the Grand Trunk Pacific connecting link for which they were recently awarded the contract. The work will cost about $1,500,000.

The Ottawa, Rideau Lakes & Kingston Ry. Co. has completed surveys for its proposed line from Ottawa to Kingston. At a recent meeting at Ottawa the following Board of Directors was elected: N. M. Clougher, of London, President; William Dennis, R. H. McElroy, M.P.P.; Dr. H. D. Ball, G. L. Dickinson. The company is being financed by English capital.

An election will probably be held at Halifax, N. S., to vote on the purchase by the city of the Halifax Electric Tramway Co.

The citizens of Vancouver, B. C., have ratified the agreement made by the City Council and the Canadian Northern Ry. for the giving of 120 acres of False Creek tide flats to the railway for its passenger terminals in the city. By this plan the 300 acres of the False Creek tide flats have practically been given over to railway terminals in agreements with the Great Northern and Canadian Northern, both companies being bound also to provide room for other railways to the full capacity of the property. The Canadian Northern will have a large freight and distributing terminal at Port Mann, which is 15 miles outside the city. From that place Vancouver passengers are to be handled into the city by electric locomotives. A tunnel much the same as the one at Mount Royal, Montreal, will provide entrance to False Creek. For freight and passengers destined for Victoria a branch is now being built by the C. N. Ry. from Port Mann to the mouth of the Fraser, where wharves will be erected.

BRIDGES

Arizona.

A bill has been introduced in the Arizona Legislature for the appropriation of $25,000 for the construction of a bridge over the Colorado River at Needles, Ariz., on the route of the National Highway.

Arkansas.

✣Bids will be received until 2 p. m., April 5, at Osceola, Ark., by Drainage District No. 11, for the construction of 11 steel bridges, Blue prints., etc., can be obtained from Willis E. Ayres, Consulting Engineer, Randolph Bldg., Memphis, Tenn. Official advertisement elsewhere in this issue.

California.

⊙The Chico Construction Co., Chico, Calif., has been awarded a contract at $25,557 for the construction of a steel and concrete bridge over Eel River in Humboldt County near Dyerville.

⊙The contract for the construction of the approaches to the Beale St. bridge at San Francisco, Calif., has been awarded by the Board of Public Works, Mercer-Fraser Co., at $2,057.

A bill is before the House at Sacramento, Calif., providing for the creation of a bridge district including Alameda, Contra Costa and Sonoma Counties to issue bonds for the construction of a bridge over Carquinez Straits from Benicia to Martinez, Calif. The cost of the improvement would be about $1,750,000.

M. M. O'Shaughnessy, City Engineer, San Francisco, Ca., has arranged a conference with the representatives of the Santa Fe and the Southern Pacific Systems in regard to the construction of the $100,000 drawbridge over Islais Creek at Kentucky and Q Sts.

Colorado.

⊙The Commissioners of Bent County, Las Animas, Colo., have awarded the contract for the construction of three bridges to the Bullen Bridge Co., Pueblo, Colo., at $2,093.

Connecticut.

✣Bids will be received until 1 p. m., March 28, by Board of Contract & Supply, Room 28, City Hall, Bridgeport, Conn., for the following: One reinforced concrete bridge across the Pequonnock River, at North Ave., city, carrying 70 ft. street, 2 spans, 22 ft. clear; one reinforced concrete bridge across the Rooster River, at North Ave., city, carrying 60 ft. street, one span, 22 ft. clear. Plans and specifications may be obtained from the City Engineer's Office, Room No. 20, City Hall.

⊙T. F. Foley and C. Chariott, South Norwalk, Conn., have been awarded the contract for the construction of the highway bridge at Whately, Mass. The work will require about four months' time for completion and will cost about $5,000.

Delaware.

The bill introduced by Senator Pierce authorizing the Levy Court of Sussex County, Delaware, to borrow $30,000 for the construction of two draw bridges over the proposed canal connecting Rehoboth and Delaware Bays, was passed by the House.

Illinois.

✣Notice is hereby given that the letting of the contract for reflooring the bridge across Rock River at Prophetstown has been postponed to noon, March 26, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office, or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received up to 2 p. m., March 24, 1913, at the Town Hall, St. Jacobs, Ill., for the construction of the Ritter and Radcliff as well as the Noll and Rule bridges. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received until March 27 by John F. Fisher, Civil Engineer, Danville, Ill., for the construction of two reinforced concrete bridges of 2 spans each, to wit: One of two 70 ft. spans and 16 ft. roadway over the North Fork of the Vermilion River at the Poke Mill Ford in Newell Township; the other of two 75 ft. spans and 16 ft. roadway over the Middle Fork of the Vermilion River at the Johnson Ford in Oakwood Township. The nearest railroad station is West Newell, 2 miles for the former, and Brothers Station, 4 miles for the latter bridge. The former is on the main line of the C. & E. I. R. R. and the latter is on the Rossville and Sidell branch of the same road.

✣Bids will be received up to 2 p. m., April 18, 1913, at the Council room, Pecatonica, Ill., for the construction of one reinforced concrete bridge to be built between the towns of Durand and Pecatonica, Winnebago County. J. S. Tarbert, Town Clerk, Pecatonica, Ill. Couse Bridge —Span, 30 ft.; roadway, 18 ft.; height, 13 ft.; estimated total concrete, 86.9 cu. yds.; reinforcing steel, 12,040 pounds. Nearest railroad station, Pecatonica, about 5½ miles. No local concrete materials available. Present bridge, 24 ft. span, King post truss, on stone abutments. Green timber may be cut about ½ mile from bridge site. Low water flow, about 6 ins. deep and 15 ft. wide; high water about 8 ft. deep. Excavation to be carried about 3½ ft. below stream bed, through clay and loam. Average excavation, east abutment about 12 ft.; west abutment, about 10 ft. Old stone abutments to be entirely removed. Engineer's estimate, $1,400. Work to be completed on or before June 18, 1913. More detailed information may be had by an examination of the plans and specifications

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

prepared by the Illinois Highway Commission which may be seen at the Town Clerk's office or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Ill.

⊙The City of Waukegan, Ill., on March 20, awarded to John Wheeler Construction Co., Geneva, Ill., the contract for constructing the Genesee St. reinforced concrete viaduct on their bid of $72,619; other bids as follows: Illinois Hydraulic Stone & Construction Co., Elgin, Ill., $72,931; C. W. Pence, Waukegan, Ill., $74,000; the Hackedorn Contracting Co., Indianapolis, Ind., $98,977. Engineer's estimate, $69,891.40. M. J. Douthitt, City Engineer.

⊙Geo. A. Quinlan, 1321 E. 53d St., Chicago, Ill., has been awarded the contract for the construction of a reinforced concrete bridge in Pleasant Valley Township, Jo Daviess County, Ill., for $3,110. Bids were opened March 20 at the Rindesbacher Bank, Stockton, Ill.

⊙C. A. Wever & Son, Clayton, Ill., have been awarded the contract by the Illinois Highway Commission, for the construction of a reinforced concrete bridge in Holland Township, Shelby County, Ill., for $1,347. Bids were opened March 20 by T. W. Carroll, Town Clerk, Fancher, Ill. Other bids received were as follows: John H. Fought, Shelbyville, $1,325; Koessler & Sons, Herrick, $1,800; Laws & Grantham, Irving, $1,472; Melloy Const. Co., Chicago, $1,574; J. G. Bergan, Ft. Brach, Ind., $1,324; Geo. A. Quinlan, Chicago, $1,540.

Following are the lowest bids submitted to the Department of Public Works, Chicago, Ill., on March 19, for furnishing the labor, materials, etc., necessary to design, construct and erect on the viaduct of the Washington St. bridge, 16 bracket fixtures each containing 2 lights, 8 light standards each containing 4 lights, 4 cluster light standards each containing 7 lights, complete with wires, lamps, globes, etc., Dearborn Manufacturing Co., 1525 Dearborn St., $1,760; Chicago Ornamental Iron Works, 37th St. & Stewart Ave., $2,286; the contract has not been awarded. L. E. McGann, Commissioner of Public Works.

Chicago City Council has ordered that plans and specifications and an estimate of cost for the construction of a bridge across the Chicago River at Franklin St. be prepared and submitted to them. L. E. McGann, Commissioner of Public Works.

The citizens of Wilmington, Ill., are advocating the construction of a new concrete highway bridge over the Kankakee River to replace the present structure at that place. It is believed that the improvement would cost not more than $50,000.

Indiana.

✣Bids will be received until 2 p. m., April 8, by Board of Noble County Commissioners, Albion, Ind., for the construction of eleven bridges and culverts. J. C. Kimmell is County Auditor.

✣Bids will be received until 10 a. m., April 8, by Board of Shelby County Commissioners, Shelbyville, Ind., for the construction of a creosoted wood block floor in Conn's Creek bridge near Waldron. F. W. Fagel is County Auditor.

✣Bids will be received until 10 a. m., April 7, by Board of Hancock County Commissioners, Greenfield, Ind., for the construction of the Hiday bridge on Buck Creek. Lawrence Wood is County Auditor.

✣Bids will be received until 10 a. m., April 7, by Board of Vermillion County Commissioners, Newport, Ind., for the construction of a bridge over Little Vermillion River at Newport. Roy Slater is County Auditor.

⊙The Board of Madison County Commissioners, Anderson, Ind., awarded the contracts for the construction of the following bridges March 14: Bronnenberg Ford Bridge, National Concrete Co., Indianapolis; Stony Creek Bridge, National Concrete Co., Indianapolis; South "J" St. Bridge, Elwood, Thos. P. Kelly, Anderson; South "M" St. Bridge, Elwood, Thos. P. Kelly, Anderson. Joel B. Benefixel is County Auditor.

⊙The contracts for the construction of the Armiesburg and Strong's Ford bridges in Parke County, Ind., have been let by the Board of Commissioners, Rockville, Ind., to J. P. Vanfossan at $7,730 and $2,875, respectively. Both structures are to be of concrete.

⊙The Board of County Commissioners, Richmond, Ind., has awarded the contracts for the construction of five bridges as follows: The Burke Construction Co., New Castle, Ind., four bridges; Isaac E. Smith, Richmond, Ind., one bridge. L. S. Bowman is County Auditor. Bids for the work were opened March 15.

⊙The Board of Spencer County Commissioners, Rockport, Ind., has awarded the contract for the construction of 52 bridges to the Vincennes Bridge Co., Vincennes, Ind., at $20,475.

Iowa.

⊙The City Council of Waterloo, Ia., on March 17, awarded the contract for the construction of two reinforced concrete bridges over Blackhawk Creek to Miller-Hey Construction Co., Waterloo, Ia., at $22,576. Other bids on this work were: Gould Construction Co., Davenport, $24,699.50; Waterloo Construction Co., Waterloo, Ia., $25,701.60; Blackhawk Construction Co., Waterloo, Ia., $27,473.50. C. A. Roby is City Engineer.

⊙The N. M. Stark Co., Des Moines, Ia., was awarded the contract March 17, by the City Council of Waterloo, Ia., for the construction of the reinforced concrete arch bridge over Cedar River at Mullan Ave. The structure will include 9 arches. The contract price was $99,777.80. Other bids were: Miller-Hey Construction Co., Waterloo, Ia., $103,034.89; Gould Construction Co., Davenport, Ia., $105,127.20; Blackhawk Construction Co., Waterloo, Ia., $101,073. C. A. Roby is City Engineer.

The City Council of Davenport, Ia., has awarded the contract for the repair of the Milan bridges to C. L. Ritchey.

Kansas.

Advices from Junction City, Kan., state that the bridge across the Kansas River, on the Fort Riley military reservation that was destroyed by a dynamite explosion two years ago, is to be replaced. The new bridge will be of steel and concrete.

At the election April 1, the voters of Hutchinson, Kan., will vote on two bridge propositions. One is for a bridge 120 ft. wide, the full width of the street, on First Ave. West, over Cow Creek, to be of concrete and costing, as estimated, $8,500. The other is for a bridge 64 ft. wide, of concrete, from curb to curb, on Avenue B East, to cost, as estimated, $7,000.

Louisiana.

The City Council of Lafayette, La., has authorized the Street Committee to get estimates on the cost of constructing three concrete bridges. W. A. Montgomery is in charge of streets.

Maine.

In his inaugural address, Maj. F. O. Beal of Bangor, Me., recommended the construction of a bridge over Kenduskeage Stream at the foot of Exchange St.

Maryland.

All bids received for the Gunpowder Bridge were rejected by the Board of Awards, Baltimore, Md., owing to an error of $10,000 in the bid of the Roanoke Bridge Co., which was low bidder. The work will be readvertised.

Massachusetts.

At a recent town election at Wareham, Mass., it was voted unanimously to authorize the construction of a new concrete bridge between Onset and Point Independence, the cost of the structure to be $40,000. The city will pay $15,000 of the expense.

It is planned to rebuild the Granite Ave. bridge over the Neponset River between Boston, Mass., and Milton, at a cost of $60,000.

Michigan.

⊙B. G. Cornell, Mt. Clemens, Mich., has been awarded contracts for the construction of four steel and concrete bridges in Macomb and Wayne Counties. The cost of the structures totalled about $5,000.

Minnesota.

⊙The Mahtowa Town Board, according to advices from Barnum, Minn., has let the contract for the construction of a steel and concrete bridge over Moose Horn River on the Park Lake Highway to A. C. Willcutts & Son at $1,490.

⊙C. W. Gove, Windom, Minn., has been awarded the contract for the construction of two bridges and three concrete culverts in Jackson County, Minn. Bids were opened March 14. P. D. McKeller, Jackson, Minn., is County Auditor.

Missouri.

⊙The Missouri Valley Bridge & Iron Co., Kansas City, Mo., according to advices from Jefferson City, Mo., has been awarded the contract for the construction of a bridge over the Knernschield branch near the Koehler Ford. The contract price was $1,074.

The Grundy County Court, Trenton, Mo., has authorized the construction of three new bridges over Grand River. Farmers interested in the improvements have raised $2,240 toward the expense.

An ordinance has been introduced into the City Council at St. Joseph, Mo., authorizing the Chicago, Burlington & Quincy Ry. Co. to erect a bridge across 26th St., between Messanie and Locust Sts.

Montana.

⊙O. E. Peppard, Missoula, Mont., has been awarded the contract for the construction of the proposed bridge over the east fork of the Bitter Root River in Ross' Hole, Ravalli County, at $1,482.

Nebraska.

✣Bids will be received until noon, April 8, by Gus E. Neumann, Hall County Clerk, Grand Island, Nebr., for the construction and repair of all wooden, steel, pile and truss bridges in the county for one year from April 8. The following is the number and location of bridges which may be built: One 24 ft. steel bridge between sections 20 and 29, South Platte Township; one 40 ft. steel bridge between sections 32 Prairie Creek and 5 Center townships; one 60 ft. between sections 17 and 18, Wood River Township; one 50 ft. steel between sections 10 and 11 Wood River Township; one 70 ft. steel between sections 22 and 23, Jackson Township; one 16 ft. steel between sections 15 and 22, Harrison Township; one 32 and one 16 ft. steel between sections 32 and 33 Wood River Township; one 20 ft. steel between sections 13, South Loup and 18 Mayfield Townships; one 20 ft. steel between sections 16 and 21, Harrison Township; one 50 ft. steel between sections 32 and 33, Mayfield Township; one 24 ft. steel between sections 22 and 23, Washington Township; one 40 ft. wood between sections 7 and 8, Alda Township; one bridge wood between sections 16 and 17, Lake Township; one 50 ft. wood across the south channel of the Platte River in Doniphan Township. Bids to be at a specific sum per lineal foot for all superstructure, approaches, sub-structure, piling and tubing and at a specified sum per foot, board measure, for all caps, sway braces and other wood materials used, and for lumber per thousand feet in place, and for all other metal (steel and iron) per pound in place. The board will make no allowance for removal of old lumber from old bridges.

✣Bids will be received until 10 a. m., April 22, 1913, at the County Clerk's Office of Dawson County, Lexington, Neb., for the construction of one bridge with earth approaches and fills across the Platte River, to be located at the approximate site of the present wagon bridge, about two miles south of the town of

Lexington, Neb. Bids will be received for the above bridge on alternate designs as follows: Lexington Bridge—First: One reinforced concrete girder bridge composed of 33-ft. spans, approximately 1,100 ft. in length, all as per plans and specifications. Second: One reinforced concrete arch bridge composed of 50-ft. spans, approximately 1,100 ft. in length, all as per plans and specifications. Fills to be made at the ends of the bridge containing approximately 30,000 cu. yds. of earth. Surfacing, six inches in depth, composed of gravel and clay mixture, will be made over the roadway of the bridge, and 16 ft. wide on all fills, about 1,000 cu. yds. Bids may be submitted separately on the bridge, earthwork and surfacing. All bids must be sealed and those on the bridge and entire project complete must be accompanied by cash deposit or certified check for $1,000. Bids on the earthwork and surfacing only to be accompanied by cash deposit or certified check for $200. All certified checks to be made payable to Mr. A. S. Gilland, County Clerk, of Dawson County. Bids will be publicly opened at the County Clerk's Office in Lexington, Neb., at 10:10 a. m., April 22, 1913. A copy of the plans and specifications will be on file in the County Clerk's office at Lexington and at the State Engineer's Office at Lincoln, and may be had upon application and payment of $5.00 at the office of the State Engineer, Lincoln, Neb.

⊙The Otoe County Commissioners, Nebraska City, Neb., have awarded the contract for the construction of bridges during the coming year to the Monarch Construction Co., Falls City, Neb.

New Hampshire.

Residents of South Manchester, Manchester, N. H., are advocating the construction of a viaduct over the Boston & Maine Railroad tracks at Mitchell St. Samuel J. Lord is City Engineer.

New Jersey.

⊙The Board of Freeholders, Middlesex County, New Brunswick, N. J., has awarded the contracts for the construction of the Lawrence Brook bridge at Deans and Manalapan Brook bridge near Half Acre to Morrell & Garrison and to John Storer, respectively. The bids on both jobs were as follows: For Lawrence Brook Bridge—The Ferro Concrete Co., $2,698; the Harry N. Scott Contracting Co., $1,875; Marcus S. Wright, $2,275; John F. McGovern, $1,800; Morrell & Garrison, $1,760.50; Abraham Jelin, $2,172; Conrad Sebolt, $2,089; Clarkson P. Steele, $2,325. Manalapan Brook Bridge—John Storer, $1,025; John C. Fowler, $1,070; Abraham Jelin, $1,335; William D. Dewhurst, $100.

Members of the Bridge Committees of the Atlantic and Cape May County Boards of Freeholders at a joint meeting, Atlantic City, N. J., March 11, awarded Phillips & Worthington a contract to make borings for the proposed intercounty bridge from Somers' Point to Beasley's Point. The project has been approved by State Road Commissioner Stevens. It is expected to involve an outlay of $350,000.

New York.

A bill has been introduced into the State Legislature providing for an appropriation of $100,000 for the erection of a state road and bridge over the Genesee River at Portage, N. Y., and 55 ft. below the Erie High Bridge.

Plans have been submitted to the Committee on Wharves and Harbors, Buffalo, N. Y., by the Delaware, Lackawanna & Western R. R. for the proposed new lift-bridge to replace the fixed bridge now spanning Buffalo River. A. E. Deal, Hoboken, N. J., is Engineer of Bridges.

It has been decided to build a bridge over Bronx River from Wakefield to 241st St., Yonkers, at an estimated cost of $252,000. The expense will be divided between New York City, Yonkers and the New York Central, New York & Harlem and the New York, New Haven & Hartford Railroads. Cyrus C. Miller is President of the oBrough of Bronx New York City.

North Carolina.

A petition has been filed with the Commissioners of Stanly County, Albemarle, N. C., for the construction of a bridge over Rocky River between Union and Stanly Counties.

North Dakota.

✣Bids will be received until 3 p. m., April 8, by Board of Traill County Commissioners, at the office of Nels O. Lindaas, County Auditor, Hillsboro, N. Dak., for furnishing the labor and material for the construction of all steel, wooden and concrete bridges and for repairing bridges in the county during 1913.

It is reported at Fargo, N. Dak., that the Great Northern contemplates the construction of a new bridge over the Red River to replace the present structure, which is considered too small to accommodate traffic.

Ohio.

✣Bids will be received until noon, March 28, by J. R. Cowell, Director of Public Service, Toledo, O., for furnishing the necessary labor and material for the construction of the revetment and fill for the east opproach and for the handrail for the bridge over the Maumee River from Ash St. to Consaul St. F. G. Stockton is Secretary.

⊙The Board of Columbiana County Commissioners, Lisbon, O., has awarded the contract for the construction of Bridge No. 1523 in Salineville to F. L. Cox, Kensington, O., at $1,086.

The contract for the construction of the proposed new Keowee St. bridge will probably be let by Director of Public Service Hoglen, Dayton, O., about April 1. It is thought that the improvement will necessitate an expenditure of $80,000.

The Board of Knox County Commissioners, Mt. Vernon, O., contemplates the construction of the following bridges: One over Johnson Run on the Pleasant Valley Road near the residence of Frank W. Lafever, and one over Center Run on East Vine St., near the residence of E. C. VanWicklen, both in Clinton Township in said county, the cost of each of which will exceed $1,000. Irvin Young is County Auditor.

Oklahoma.

⊙The Board of County Commissioners, Lawton, Okla., has awarded the contract for the construction of six bridges to the Massillon Bridge Co., Massillon, O., and to the Midland Bridge Co., Kansas City, Mo. Bids were opened March 15.

Oregon.

The Douglas County Court at a recent meeting, Roseburg, Ore., authorized the erection of two bridges. One of these will span Elk Creek, about six miles west of Drain, and the second will span the Calapooia River at a point about 1 mile east of Umpqua.

Pennsylvania.

⊙The Board of Delaware County Commissioners, Media, Pa., has awarded the contract for the construction of the reinforced concrete arch cantilever bridge over Chester River at 5th St., Chester, to Carl S. Camp, Montrose, Pa., at $33,800. Bids were opened March 17.

⊙The subcontract for the concrete piles reqired for the foundations of the Bloomfield bridge, Pittsburgh, Pa., has been awarded by the Dravo Contracting Co., general contractors, to the Cranford Construction Co., Pittsburgh and Cincinnati, O. The simplex system of concrete piling will be used.

⊙The contracts for the construction of four bridges in Philadelphia, Pa., were recently let by the Department of Public Works as follows: Montgomery St. bridge over Connecting Ry., to F. J. Boas, 201 N. Broad St., Philadelphia, Pa., at $49,224; 66th Ave., north over North Penn R. R., to Richard Walsh, 5922 Tacony St., Philadelphia, ·Pa., at $24,750; City Ave. bridge over Indian Run between Philadelphia County and Montgomery County, to P. J. Lawler, Bala, Pa., at $21,942; Chester Ave. bridge over the Philadelphia & Baltimore Central R. R., to M. & J. B. McHugh, 714 Arcade Bldg., Philadelphia, Pa., at $31,448. All bids received for this work on March 18, were as follows, (1) standing for the entire work complete as per plans and specifications, (2) for additional masonry in foundation, including excavation and all other appurtenances per cu. yd.; (3) additional masonry above neat lines, including all appurtenances per cu. yd.; (4) for additional structural steel work in place complete, including painting and all other appurtenances, per pound; (5) for additional steel rods for reinforced concrete in place complete, including all appurtenances per pound; (6) for additional grading, either excavation or filling, including appurtenances, per cu. yd.; (7) for additional 8-in. steelbound granolithic curb in place complete, including excavation and all appurtenances, per lin. ft.; (8) for additional granolithic sidewalk paving, including excavation and all appurtenances, per sq. yd.; (9) for additional asphalt paving on 6-in. concrete base, including excavation and all appurteances, per sq. yd.; (10) for vitrified brick or block paving, roadway or gutter on 6-in. concrete base, including excavation and all appurtenances:

Name of bidder.	Address.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Montgomery St. Bridge, over Connecting Ry.—											
F. J. Boas	201 N. Broad St., Philadelphia	$49,224	$ 7.50	$ 8.50	$0.05	$0.04	$0.50	$1.00	$1.50	$3.00	$3.00
M. & J. B. McHugh	714 Arcade Bldg., Philadelphia	54,948	10.00	12.00	.09	.06	1.50	1.25	2.00	2.50	3.00
Stier-Marsh Co	1011 Chestnut St., Philadelphia	51,430	7.00	12.00	.06	.03	.80	1.00	1.80	2.50	3.25
Richard Walsh	5922 Tacony St., Philadelphia	54,275	6.75	7.00	.06	.04	1.00	1.00	1.50	2.75	3.00
American Paving & Construction Co.	211 S. Ninth St., Philadelphia	54,750	7.00	7.00	.06	06	.50	1.00	1.50	3.50	3.50
Cramp & Co	Denckla Bldg., Philadelphia	49,960	9.00	8.00	.04½	.03	.50	.90	1.80	1.60	2.70
66th Ave., North, over North Penn Railroad—											
James Kelly	Bulletin Bldg., Philadelphia	26,500	8.50	9.00	.05	.04	1.50	.80	1.62	3.00	2.50
Stier-Marsh Co	1011 Chestnut St., Philadelphia	24,900	7.00	8.50	.05	.03	.80	1.00	1.80	2.50	3.25
Richard Walsh	5922 Tacony St., Philadelphia	24,750	5.00	7.00	.06	.04	.80	1.00	1.50	2.50	3.00
City Ave., over Indian Run, between Phila. and Montgomery Counties—											
Joseph Perna	334 N. 65th St., Philadelphia	26,500	7.00	8.00	....	.04	.55	1.00	1.80	....	3.00
Ferro-Concrete Co	Calder Bldg., Harrisburg, Pa	28,621	11.00	11.00	....	.05	1.00	.75	1.75	....	2.75
Stier-Marsh Co	1011 Chestnut St., Philadelphia	25,800	7.00	8.50	....	.03	.60	1.00	1.80	....	3.00
James Kelly	Bulletin Bldg., Philadelphia	24,100	8.50	9.50	....	.04	1.50	.80	1.62	....	2.50
M. & J. B. McHugh	714 Arcade Bldg., Philadelphia	34,980	12.00	12.00	....	.06	1.00	1.50	2.00	....	3.00
Nelson Merydith Co	Chambersburg, Pa	24,880	12.00	15.00	....	.03½	.50	1.00	1.35	....	2.50
P. J. Lawler	Bala, Pa	21,942	7.00	9.25	....	.05	.50	.60	1.80	....	3.00
Chester Ave., over Philadelphia & Baltimore Central Railroad—											
M. & J. B. McHugh	714 Arcade Bldg., Philadelphia	31,448	6.00	7.00	.09	.06	.75	1.25	2.00	2.50	2.75
F. J. Boas	201 N. Broad St., Philadelphia	31,943	6.00	7.00	.05	.04	.50	1.00	1.50	3.50	3.50

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Oklahoma.

✣Bids will be received at the office of County Clerk of Pittsburg County at McAlester, Okla., until 5 p. m.; on April 19, 1913, and opened at 10 a. m. on April 21, 1913, for furnishing and erecting: Bridge No. 39 over North Boggy Creek, 8 miles southwest of Kiowa, 50 ft. steel span and 47-ft. wood approach; one pier concrete with wing walls, other pier tubular. Also same bridge No. 39 at same location, 60-ft. span reinforced concrete spandrel, rib arch with wing walls. Also same bridge No. 39 at same location, 50-ft. wood span, concrete piers with 47 wood approach. Bridge No. 40 over Coal Creek on Katy Highway between McAlester and Reams, about 8 miles north of McAlester, 124-ft 3-in. steel span and 109 wood approach, one pier concrete with wing walls, the other tubular. Also same bridge No. 40, at same location, double 70-ft. span, reinforced concrete spandrel, rib arch with wing walls. Also same bridge No. 40 at same location, 124-ft. 3-in. span, concrete piers with 47-ft. wood approach. Bridge No. 41 over Long Town Creek near Bower, in Pittsburg County, Oklahoma, 75-ft. steel span and 125 ft. wood approaches. Piers tubular. Also same bridge No. 41 at same location, 70-ft. span, reinforced concrete spandrel, rib arch with wing walls. Also same bridge No. 41 at same location, 75-ft. wood span, concrete piers and 125-ft. wood approaches. All as per plans and specifications in said County Clerk's office. Each bid must be accompanied by certified check on a solvent bank, for 10 per cent of the amount bid as a guarantee that contract and bond will be executed within 10 days if awarded. P. S. Lester is Chairman of Board of County Commissioners; W. S. O'Neal, County Clerk.

Texas.

✣Bids will be received until noon, April 7, by Dan C. Smith, Jr., City Secretary, Houston, Texas, for the construction of a reinforced concrete viaduct connecting Capitol Ave. and Rusk with Moore and Young Sts. in Sixth Ward, Houston, Texas. Plans, specifications and bidders' blanks can be obtained on application at the office of the City Engineer, F. L. Dormant, City Hall, Houston, Texas. A certified check of the bidder on any bank in Houston, Texas, payable to H. B. Rice, Mayor, for $4,300, will be required to be deposited with each bid. Bidders are expected to examine the site of the bridge and acquaint themselves with local conditions.

✣Bids will be received until noon, April 7, by Dan C. Smith, Jr., City Secretary, Houston, Texas, for the construction of a reinforced concrete bridge on San Jacinto St., across the Ship Channel. Two kinds of bayou spans will be considered, one being a concrete arch and the other a Scherzer rolling lift bridge. Specifications and plans, bidding blanks, etc., can be obtained upon application at the office of F. L. Dormant, City Engineer, Houston, Texas. A certified check of the bidder on any bank in Houston, Texas, payable to the order of H. B. Rice, Mayor, for respectively $8,200 and $11,200 will be required to be deposited with each bid for the two types contemplated. Bidders are expected to examine the site of the bridge and acquaint themselves with local conditions.

⊙The County Commissioners Court, according to information received from Brenham, Texas, has awarded to the C. L. Horton Bridge Co., Austin, Texas, the contracts for the construction of two bridges, one over Indian Creek at Burton and the other at Crockett Crossing over New Year's Creek, at $1,100 and $1,900, respectively.

⊙The Board of Gonzales County Commissioners, Gonzales, Texas, has awarded the contract for the construction of 18 small bridges in Precinct No. 1, to A. A. Alsbury & Son, Houston, Texas.

Utah.

The Commissioners of Cache County, Logan, Utah, recently conferred with the officials of the Short Line Railroad in regard to the building of a viaduct over the county road near the Junction. The county bridge at that place must be replaced, and the Commissioners have selected a site for the new bridge some 80 rods above where the present one is. The railway track is elevated above the natural grade about 15 ft, and the plan is to have the wagon road pass under the railway track. It is argued that the viaduct will lessen the danger of collision with teams and will not interrupt the traffic on either road. The new bridge will cost $20,000.

Washington.

The Commissioners of Lewis County, Chehalis, Wash., have passed a resolution ordering the construction of a new wagon bridge over the Chehalis River near the Frances Mill and another over the river southwest of Chehalis. The cost of the structures will amount to about $27,000.

Wisconsin.

According to a bill introduced in the State Senate by J. M. True, Baraboo, Wis., the proposed bridge over the river at Merrimac will cost $95,000. The State will bear $55,000 and $40,000.

An election will be held April 1, at Green Bay, Wis., and a proposition voted upon to issue bonds amounting to $170,000 for the construction of a bridge over the Fox River.

Canada.

A preliminary design has been completed for the proposed $200,000 plate girder arch bridge at Gerrard St., Toronto, Ont. The total length of the structure will be 410 ft., consisting of five spans, two approach P. G. spans of 40 and 60 ft. each and one plate girder arch span of 130 ft. The roadway will be 50 ft. wide, paved with creosote block on concrete floor and a sidewalk 8 ft. wide will run along each side of the structure. The substructure will consist of four concrete piers resting on pile foundation. The piers will be 25 ft. wide, 80 ft. long and 38 ft. high above G. L. and about 55 ft. high above piles. C. W. Power is Asst. Engineer of Railways and Bridges, Dept. of Public Works; G. G. Powell is Deputy City Engineer and R. C. Harris is Commissioner of Works.

The ratepayers of the rural municipality of Portage la Prairie, Man., on March 10, voted to reject the by-law for the issuance of debentures to the amount of $35,000 for the construction of bridges over the Assiniboine River near High Bluff and the White Muddy River near Westbourne.

ROADS AND STREETS

Alabama.

⊙The City Commissioners of Birmingham, Ala., have let the contracts for about $80,000 worth of street paving on March 18 as follows: Southern Wood Block Paving Co.—19th St. and First Ave., $13,355; Second Ave., $18,544; Morris Ave., $4,177. Southen Bitulithic Co.—Eighth Ave., $17,043. Southern Asphalt & Construction Co.—24th St., $13,630; Beech St., $2,543; 14th Ave., $5,874, and Ash St., $1,440.

The citizens of Cullman County, Ala., on March 18 voted the issuance of good roads bonds. Cullman is the county seat.

Arkansas.

The Commissioners of Road Improvement District No. 1, of Woodruff County, Ark., have retained Engineer E. A. Kingsley, of Little Rock, Ark., to supervise the construction of 30 miles of road. Augusta is the county seat.

California.

⊙The Board of Public Works of Los Angeles, Calif., has awarded the contract for the construction of asphalt pavement and storm drains in Broadway at Wilmington to B. C. Nichols, for $25,219. Fairchild-Gilmore-Wilton Co. secured the contract to construct asphalt paving in Vermont Ave., between Sixth and Washington Sts., for $44,387.

The Orange County Commissioners, Santa Ana, Calif., have inaugurated work on the extensive county highway improvement project for which $1,270,000 in bonds were voted a few months ago. Chief Engineer Halladay has placed the first party of surveyors in the field. The first surveys will be made from the west boundaries of Santa Ana to the boundary line of Huntington Beach, a distance of 7.57 miles.

The Trustees of Roseville, Calif., have passed an ordinance calling an election for April 15 to vote on issuing bonds in the sum of $20,000 to build the link of the state highway through Roseville, a distance of 1.88 miles.

The Town Trustees of Red Bluff, Calif., have been petitioned for the paving of Walnut St., from Main St., west to Jackson St.

Colorado.

The City Council of Pueblo, Colo., has passed an ordinance creating the Court House and Dundee paving districts.

Connecticut.

✣Bids will be received until 8 p. m., March 31, by Paving and Sewer Commission, Bridgeport, Conn., at the office of Bernard Keating, Secy., Room 22, City Hall, for paving sundry streets in said city, about 13,270 sq. yds. of pavement in all. Proposals are requested for the following kinds of pavement, to-wit: Wood block, asphalt block, brick, bitulithic, stone block, hassam, and will be received as follows: (1) For completed pavement, including all labor and materials, of every description. (2) For wearing surface only. (3) For all labor and materials, except the wearing surface. A certified check or bank draft for five per cent of the amount of each bid must accompany each proposal. Standard forms of contract and specifications may be obtained from Alfred H. Terry, City Engineer, City Hall, said City.

Delaware.

The House of Representatives, Dover, Del., on March 12 passed Senator Walls' good roads bill for Kent County. This bill provides for a bond issue of $100,000, and the appointment of a county engineer at a salary of $1,500 a year. The roads are not to cost over $2,000 a mile.

District of Columbia.

✣Bids will be received until 10 a. m., May 3, by Bureau of Engraving and Printing, J. E. Ralph, Director, Treasury Department, Washington, D. C., for oils, etc.

Florida.

✣Bids will be received until noon, April 7, by J. A. Johnson, Clerk, Board of Polk County Commissioners, Bartow, Fla., for the construction of a macadamized road and highway from a point beginning at Eagle Lake in Polk County, Florida, and running thence in a northeasterly direction to the Osceola County line by way of Winter Haven, Florence Villa, Lucerne Park, Davenport and Loughman, profile, survey of route, plans and specifications of which are on file with said Clerk at his office in Bartow, where the same may be inspected. Each bidder shall accompany his bid with a certified check on some reliable bank for the sum of $1,000 drawn payable to the Chairman of the Board.

⊙Hand Bros., of Sanford, Fla., and The Wilson Construction Co., of Jacksonville, Fla., have been awarded the contract by the Board of Orange County Commissioners, Or-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

lando, Fla., B. M. Robinson, Clerk, for the construction of about 140,000 sq. yds. of vitrified brick pavement, with drainage and curbing, in Road & Bridge District No. 1. Bids were opened March 4. The H. S. Jaudon Engineering Co., Atlanta and Savannah, Ga., are Engineers.

The City Council of Orland, Fla., has ordered that Lucerne Circle be paved with brick, the work not to proceed, however, until the sewerage system is completed around the lake. North Orange Ave. is to be paved at once from Colonial Drive to Marks St.

Illinois.

✣Bids will be received until 2 p. m., April 19, by Commissioners of Highways of the Town of Lawrence, Lawrence County, Lawrenceville, Ill, for the grading, draining, graveling, macadamizing and building concrete culverts, retaining walls and otherwise improving what is known as the Kirkwood Road from Station 0 plus 00 to Station 188 plus 15, the Range Road from Station 0 plus 00 to Station 106, the Gillespie Road complete and Fifteenth St. in the City of Lawrenceville from Lexington Ave. to the B. & O. S-W. R. R., according to the plans and specifications now on file with the Town Clerk of said Town of Lawrence, at his office in the Court House at Lawrenceville, Illinois, and at the office of J. S. Spiker, Civil Engineer, at Vincennes, Indiana. The approximate length of said roads to be improved, as aforesaid, is 6.9 miles. Money or certified check for $1,000 or 10 per cent of the amount of each bid must accompany each proposal.

✣Bids will be received until 10 a. m., April 5, by S. Rose, Town Clerk, Crete, Ill., for the construction of approximately 10 miles of hard roads, in Crete Township, Will Co., Illinois. Separate bids will be received for sufficient crushed stone for the whole work; separate bids will be received for sufficient gravel for the whole work; separate bids will be received for concrete road for any part or all of the roads; separate bids will be received for grading the whole roads and a lump sum may be bid for the entire construction, including material, labor, grading and tools necessary to complete the entire work. Plans and specifications for the crushed stone work may be seen at the office of S. Rose, Town Clerk, and may be had on request from the Illinois highway commission, Springfield, Illinois, and the plans, profiles and specifications for the gravel or concrete road work can be seen at the office of S. Rose, Town Clerk, or can be obtained upon request.

✣Bids will be received until 7:30 p. m., March 31st, at the office of the Board of Local Improvements, Des Plaines, Ill., Wm. Wicke, City Clerk, for furnishing and delivering labor and materials necessary to construct the following pavement work on certain streets north of the C. & N. W. R. R., 2,400 sq. yds. asphaltic concrete pavement, including portland cement concrete foundation, 2,640 lin. ft. 6-in. concrete curb with 12-in. gutter, 12,530 lin. ft. 6-in. curb with 15-in. gutter, 2,420 lin. ft. 7-in. curb with 20-in. gutter, 2,500 lin. ft. 7-in. curb with 33-in. gutter, 310 lin. ft. 6x20-in. curb, 15,000 cu. yds. excavation, 98 cast iron inlets, 71 catchbasin adjustments, including new lids, 42 manhole adjustments, 6 new catchbasins without covers, 21 valve manholes without covers, 48 cast iron manhole covers, 1,170 lin. ft. of 6-in. sewer pipe inlet connections, 150 lin. ft. of 8-in. catchbasin connections, 100 lin. ft. 12-in. tile pipe sewer, 1,000 sq. ft. cement sidewalk to be adjusted to grade, 5,130 sq. ft. of new cement walks, 2,750 sq. ft. of alley pavement. Plans and specifications may be had upon application to R. L. Emerson, 1136 Chamber of Commerce Bldg., 133 W. Washington St., Chicago, or City Clerk.

✣Bids will be received until 11 a. m., April 4th, by the Board of Local Improvements, Chicago, Ill., E. J. Glackin, Secretary, for furnishing and delivering the labor, materials, etc., necessary to construct pavements in the following streets, details as follows: Belmont Ave., Rockwell St. to Milwaukee Ave., assessment available $106,219.55; 15,600 lin. ft. sandstone curbing, 7x18-in., 500 lin. ft. concrete curb wall, 1,050 sq. yds. brick pavement, 23,800 sq. yds. creosoted wood block pavement. Fifth Ave., S. Water St. to Van Buren St., creosoted wood block pavement; assessment available, $53,500. 42nd Ave., 22nd St. to Ogden Ave., assessment available, $7,000; 1,370 lin. ft. granite concrete combined curb and gutter, 2,200 sq. yds. asphalt pavement. 53rd St., S. Halsted St. to Union Ave., assessment available, $6,000; 1,270 lin. ft. granite concrete combined curb and gutter, 2,070 sq. yds. asphalt pavement. Loretta Court, Van Buren St. to Congress St., assessment available, $3,884; 600 li . ft. sandstone curb stone, 1,280 sq. yds. brick pavement. Lyndale Ave., Lawndale Ave. to Hamlin Ave., assessment available, $5,500; 1,280 lin. ft. granite concrete combined curb and gutter, 1,870 sq. yds. asphalt pavement. Montrose Ave., Elston Ave. to Avondale Ave., assessment available, $38,868.38; 7,500 lin. ft. sandstone curb stone, 7x18 ins., 11,900 sq. yds. brick pavement. Prairie Ave., Lake St. to Chicago Ave., assessment available, $16,971; 4,450 lin. ft. granite concrete combined curb and gutter, 6,050 sq. yds. asphalt pavement. 26th St., 40th Ave. to 46th Ave., assessment available, $66,364; 7,730 lin. ft. sandstone curb stone, 15,130 sq. yds. creosoted wood block pavement. 28th St., 43rd Ave. to 44th Ave., assessment available, $4,995; 1,140 lin. ft. granite concrete combined curb and gutter, 1,840 sq. yds. asphalt pavement. 30th St., 43rd Ave. to 44th Ave., assessment available, $4,995; 1,140 lin. ft. granite concrete combined curb and gutter, 1,840 sq. yds. asphalt pavement. 39th St., State St. to Cottage Grove Ave., assessment available, $66,556.61; 6,860 lin. ft. vertical concrete curbing, 15,530 sq. yds. creosoted wood block pavement. Wabash Ave., Washington to Congress St., assessment available, $46,907.45; creosoted wood block pavement. Washington St., La Salle St. to Franklin St., assessment available, $10,756.70. • Wilcox St., Oakley Ave. to Western Ave., assessment available, $4,842.10; 1,230 lin. ft. sandstone curb stone, 1,530 sq. yds. brick pavement. Haines St., Halsted St. to Hooker St.; Hooker So., Haines St. to Halsted St., assessment available, $15,150; 1,500 lin. ft. sandstone curb stone, 7x18 ins., 3,260 sq. yds. granite block pavement. The work includes preparation of the sub-grade, 6-in. portland cement foundation, except those streets in the business district where 8 ins. are specified; sandstone curb stones to be supported at each joint by 2 cu. ft. of concrete; sewer, manhole and catchbasin construction and adjustment, 2-in. sand cushion, except for asphalt pavement. Cash or certified check for 10 per cent of proposal must accompany bid.

✣Bids will be received until noon, March 31, by the Board of Local Improvements, George Parsons, President, Cairo, Ill., for the following street improvements: Holbrook Ave., from 21st to Charles Sts: 1523.0 cu. yds. earth excavation, 5962.0 cu. yds. earth filling in excess of excavation, 9468.0 sq. yds. pavement, including Portland cement concrete base 5 ins. thick, composed of one part Portland cement to eight parts washed river gravel, laid complete for foundation, sand cushion, spread 2 ins. thick on above foundation, vitrified brick pavement laid complete and Portland cement grout filler for filling above brick pavement, and including asphalt filler for expansion joints, as per plans and specifications; 4357.3 lin. ft. combination concrete curb and gutter, composed of one part of Portland cement to five parts of washed river gravel, 5 ins. high and 6 ins. thick, and the gutter flag 24 ins. wide and 6 ins. thick, the exposed surface of which curb and gutter flag to be finished, 1 in. thick, with a cement mortar, composed of one part Portland cement to one and one-half parts clean, sharp sand—the whole set on a bed or foundation of cinders, 8 ins. thick; 390.0 ft. (lin. ft.) of limestone marginal curb, 6 ins. thick and 12 ins. wide, set on a natural earth bed; 30 brick catchbasins 21 ins. by 24 ins. by 42 ins., fitted with cast iron traps and cast iron covers, as per plans and specifications; 7 brick manholes built up and repaired and supplied with cast iron rings and cast iron covers, set, of 300 lbs. minimum weight, per cover; 2216 lin. ft. of 12-in. tile pipe sewer, laid, main sewer; 5360 lin. ft. of 6-in. tile pipe sewer, laid, for house connections; 675 lin. ft. of 10-in. tile pipe sewer, laid, for catch-basin inlets. Total estimated cost of the whole of said improvement, $28,236.69. Fourth St.: 834 cu. yds. earth excavation and grading; 2512.7 sq. yds. pavement, as above described; 1247.9 lin. ft. comb. conc. curb and gutter, as above; 60 lin. ft. limestone marginal curb; 4 catch-basins complete; 32 lin. ft. 10-in. tile pipe sewer, laid complete, for catch-basin inlets; 2 manholes built up and furnished with cast iron tops. Total estimated cost of the whole of said improvement, $5,949.36. Sixth St.: 1101.3 cu. yds. earth excavating and grading; 2526.9 sq. yds. pavement, as above described; 1454.7 lin. ft. comb. conc. curb and gutter, as above described; 60 lin. ft. limestone marginal curb; 4 brick catch-basins, complete; 2 brick manholes built up and supplied with cast iron tops; 439.0 lin. ft. 12-in. vit. tile pipe sewer, laid; 386.0 lin. ft. 6-in. vit. tile pipe sewer, laid, for house connections; 52.0 lin. ft. 10-in. vit. tile pipe sewer, laid, for catch-basin inlets: 2 new manholes, complete, with cast iron covers. Total cost (estimated) of the whole of the said improvement, $6,967.46. Tenth St.: 1056.9 cu. yds. earth excavating and grading; 3062.6 sq. yds. pavement, as above described; 1578.0 lin. ft. comb. conc. curb and gutter, as above described; 60 lin. ft. limestone marginal curb; 4 brick catch-basins, complete; 1 brick manhole, built up and supplied with cast iron top; 32 lin. ft. 10-in. vit. tile pipe sewer, laid, for catch-basin inlets. Total estimated cost of the whole of said improvement, $7,356.79. Twelfth St.: Same as for Tenth St., except 975.6 cu. yds. earth excavating and grading. Total estimated cost of the whole of the said improvement, $7,332.40. The specifications for the above improvements can be found in the office of the Board of Local Improvements of the City of Cairo, Ill., or the City Engineer, George F. Dewey. (Official advertisement will be found elsewhere in this issue.)

✣Bids will be received until March 31, by Matt Berscheid, City Clerk, Joliet, Ill., for furnishing the city with one 40 h. p. 4-cylinder motor car.

✣Bids will be received until 8 p. m., March 31, by Board of Local Improvements, Waukegan, Ill., for the Grand Ave. paving. The work will include about 14,750 sq. yds. of brick on 6-in. concrete base. M. J. Douthitt is City Engineer.

⊙The following contracts have been awarded by the Board of Local Improvements, Chicago, Ill., Edward J. Glackin, Secretary: California Ave., Belmont Ave. to Diversey Ave., sandstone curbing, creosoted wood block pavement, $27,636.50, The Ryan Co., 10 S. La Salle St.; Center Ave., Blue Island Ave. to 14th St., brick pavement, $1,248, J. Dillon, 179 W. Washington St.; Colorado Ave., Independence Blvd. to 40th Ave., sandstone curbstones, brick pavement, $10,006.10, A. N. Todd, 179 W. Washington St.; Elston Ave., Fullerton Ave. to Belmont Ave., creosoted wood block pavement, The Ryan Co.; Erie St., Fairbanks Ct. to Lake Shore Drive, granite concrete combined curb and gutter, asphalt pavement, $11,257, F. P. McCormick, 133 W. Washington St.; 47th St., Paulina St. to 550 ft. west of Hoyne Ave., sandstone curbstones, granite block pavement, $49,910.80, F. P. McCormick; 54th St., 112 ft. east of La Salle St. to Wentworth Ave., granite concrete combined curb and gutter, asphalt pavement, $3,581, R. F. Conway Co., 133 W. Washington St.; Frankfort St., Oakley Ave. to Western Ave., granite concrete combined curb and gutter, asphalt pavement, $4,406, R. F. Conway Co.; Irving Park Blvd., East Ravenswood Park to Ashland Ave., sandstone curbstones, creosoted wood block and brick pavement, $18,547.90, The Ryan Co.; Keith St., Huron St.

to Chicago Ave., granite concrete combined curb and gutter, asphalt pavement, $4,227, F. P. McCormick; Lydia St., Halsted St. to 90 ft. cast, sandstone curbstones, granite block pavement, $1,397, J. Dillon, 179 W. Washington St.; May St., 21st St. to 22nd St., granite concrete combined curb and gutter, asphalt pavement, $3,897, American Asphalt Paving Co., 133 W. Washington St.; Spaulding Ave., Grand Ave. to Division St., granite concrete combined curb and gutter, asphalt pavement, $8,543, R. F. Conway Co.; Wellington St., Lincoln Ave. to Ashland Ave., granite concrete combined curb and gutter, asphalt pavement, $9,843, R. F. Conway Co.; Western Ave., Belmont Ave. to Roscoe St., sandstone curbstones, creosoted wood block pavement, $17,244.90, The Ryan Co.; Western Ave., Montrose Ave. to Lincoln Ave., sandstone curbstones, creosoted wood block pavement, $31,339, The Ryan Co.; La Salle St., Archer Ave. to 21st St.; 21st St., La Salle St. to Wentworth Ave., sandstone curbstone, brick pavement, $7,313.60. Ready & Callahan Coal Co., 133 W. Washington St.; Montana St., Western Ave. to Station St.; Oakley Ave., Fullerton Ave. to Station St., granite concrete combined curb and gutter, asphalt pavement, $10,465, R. F. Conway Co.; Roscoe St., Robey St. to Western Ave.; Robey St., Belmont Ave. to Roscoe St., granite concrete combined curb and gutter, asphalt pavement, $4,990.50; F. P. McCormick; Houston Ave., 82nd St. to 83rd Ct.; Commercial St., 82nd St. to 83rd St.; Coles Ave., 81st St. to 83rd St.; 82nd St., Exchange Ave. to Ontario St., granite concrete combined curb and gutter, asphaltic concrete pavement, slag base, $21,-887.60, F. P. McCormick. The work includes preparation of subgrade, sewer manhole and catchbasin construction or adjustment with a 6-in. Portland concrete cement foundation; also alleys, Flournoy St., Central Park Ave., concrete curbing, brick pavement, Central Paving Co., 179 W. Washington St.; alleys, De Koven St., Des Plaines St., etc., concrete curbing, brick pavement, etc., Central Paving Co.

⊙Ira D. Lain of Bloomington, Ill., has been awarded the contract by that city, for the paving of West Chestnut St., between Main and Center Sts., for $2,502.

A petition has been circulated in the vicinity of Murphysboro, Ill., asking that a special election be held April 22 for the purpose of voting on the proposition to build about nine miles of good roads in Murphysboro Township.

The City Council of Rock Island, Ill., has ordered the improvement of 14½ St., from Seventh to 18th Aves., with asphalt, and 14th St., from Ninth to 18th Aves., with asphalt, at an estimated cost of $19,878.

The Board of Local Improvements of Springfield, Ill., has passed a resolution providing for the paving with brick, on a concrete base, of Cook St., from Second to Fourth Sts. The pavement will have a width of 30 ft. throughout the two blocks.

The Board of Local Improvements of Champaign, Ill., has recommended to the City Council the paving of Hill St. and McKinley Ave.

A public hearing was held March 24 by the Board of Local Improvements of Prophetstown, Ill., to decide on the proposed street paving. The estimated cost is $17,437.

City Engineer Elmer Folsom of Bloomington, Ill., has submitted his estimate for a brick pavement on Union St., between Main and Roosevelt Ave., to the Board of Local Improvements. The estimated cost is placed at $4,397.

The City Council of Ottawa, Ill., has decided to call a special election for the purpose of voting on the West Side paving proposition.

The City Council of Peoria, Ill., has passed an ordinance providing for the paving of South Adams St., between Oak and Cedar Sts., with creosoted wood blocks.

Indiana.

✣Bids will be received until 10 a. m., April 2, by Board of Public Works, Indianapolis, Ind., for the construction of the following improvements: For paving Washington St., from White River to Belmont Ave.; for paving first alley southeast of Sutherland Ave., from 28th St. to Bellefontaine St.; for paving first alley east of College Ave., from 23rd to 24th St.

✣Bids will be received until 10 a. m., March 26, by Board of Public Works, Indianapolis, Ind., for the following street improvements: For the construction of cement sidewalks in Hoefgen St., from Shelby St. to Boyd Ave.; for the construction of cement sidewalks and curbing on west side Chadwick St., from Wilkins St. to Morris St.; for gravel roadway in Kealing Ave., from 10th St. to 16th St.; for gravel roadway in Tabor St., from Shelby St. to State Ave.; for gravel roadway and curbing in La Grange Ave., from Shelby St. to Mabel St.; for gravel roadway in Park Ave., from 34th St. to Fairgrounds Ave.; for gravel roadway in State Ave., from Minnesota St. to Naomi St.; for curbing in Ohio St., from State Ave. to Randolph St.; for graveling roadway of Hoefgen St., from Shelby St. to Boyd Ave.; for curbing in Hoefgen St., from Shelby St. to Boyd Ave.

✣Bids will be received until noon, April 9, by Board of Lake County Commissioners, Crown Point, Ind., for the construction of one gravel road in Calumet Township and three in North Township. Charles A. Johnson is County Auditor.

✣Bids will be received until noon, April 8, by Board of Sullivan County Commissioners, Sullivan, Ind., for the construction of a gravel road in Curry Township. W. S. Bicknell is County Auditor.

✣Bids will be received until 2 p. m., April 8, by Board of Orange County Commissioners, Paoli, Ind., for the construction of three gravel roads in Northwest and Stampers Creek Townships. Ed. A. Palmer is County Auditor.

✣Bids will be received until 10 a. m., April 8, by Board of Hamilton County Commissioners, Noblesville, Ind., for the construction of six gravel and macadam roads. George Griffin is County Auditor.

✣Bids will be received until 1 p. m., April 8, by Board of Boone County Commissioners, Lebanon, Ind., for the construction of a gravel road. D. M. Clark is County Auditor.

✣Bids will be received until 10 a. m., April 8, by Board of Randolph County Commissioners, Winchester, Ind., for the construction of a highway in White River Township. Henry F. Wood is County Auditor.

✣Bids will be received until noon, April 7, by Board of Starke County Commissioners, Knox, Ind., for the construction of a gravel road. C. W. Weninger is County Auditor.

✣Bids will be received until 1 p. m., April 7, by Board of Decatur County Commissioners, Greensburg, Ind., for the construction of bituminous macadam water bound and brick street in City of Greensburg. Linton Sands is County Auditor.

✣Bids will be received until 10 a. m., April 7, by Board of Clark County Commissioners, Jeffersonville, Ind., for the construction of a road by grading, draining and paving with crushed stone. George W. Stoner is County Auditor.

✣Bids will be received until 1 p. m., April 7, by Board of Benton County Commissioners, Fowler, Ind., for the construction of four crushed limestone roads. Warren Mankey is County Auditor.

✣Bids will be received until 2 p. m., April 6, by Board of Johnson County Commissioners, Franklin, Ind., for the construction of a gravel road in Hensley Township. H. L. Knox is County Auditor.

⊙Bennett Whitehead has been awarded the contract by the Board of Public Works, Evansville, Ind., for sidewalk improvements, for $0.98 per sq. yd., $0.10 per lin. ft. for a combination curb and gutter; $0.28 per lin. ft. for straight curb, and $0.30 per cu. yd. for extra excavation.

⊙James Garvey of New Castle, Ind., has been awarded the contract for the construction of brick pavement in Union City, Ind., for about $42,000. Approximately 800,000 brick will be used.

⊙The Board of Public Works of Richmond, Ind., has awarded the contract for paving Eighth St., from North E St., to South H St., to Sisk, Sprinkle & Level, of Portland and Winchester, Ind. Brick is to be laid at a cost of $1.72 per sq. yd., and the contract will aggregate about $30,000.

The Madison County Construction Co., submitted the lowest bid to the Commissioners of Madison and Tipton Counties, at Tipton, Ind., for the construction of the David Hutcherson gravel road, which is on the county line between Tipton and Madison County. The bid was $10,486.

The Board of Public Works of Evansville, Ind., has ordered Michigan St. paved, from First Ave. to Garvin St., a distance of one mile; also Grant Ave., from Powell Ave. to Green River Road and Chestnut St., from Fourth to Eighth Sts.

The Board of Public Works of Fort Wayne, Ind., has adopted resolutions and approved specifications for approximately eight miles of concrete sidewalks.

Iowa.

✣Bids will be received until 9 a. m., March 31, by City Clerk, Burlington, Ia., for the construction of the following improvements in accordance with plans and specifications on file with H. G. Vollmer, City Engineer, Burlington, Ia.: To grade, curb with artificial stone and pave with cement concrete, 6 ins. thick, Eighth St., from the north line of Oak St. to the west line of Eighth St. on Ash St., 30 ft. wide between curbs, and Ash St., from the west line of Eighth to 10 ft. west of the east line of Mark Lane, 30 ft. wide between curbs, and Ninth St., from the north line of alley north of Oak St. to 23 ft. 6 ins. north of the south line of Ash St., 27 ft. wide between curbs, said pavement to be west of viaduct approach wall in said street, and Mark Lane, from the north side of Oak St. to 10 ft. from the north line of Corse St., 30 ft. wide between curbs, and Corse St., 45 ft. wide between curbs from 10 ft. east of the west line of Mark Lane to the east line of Osborn St.

✣Bids will be received until 9 a. m., March 31, by City Clerk, Burlington, Ia., for the following work in accordance with plans and specifications on file with H. G. Vollmer, City Engineer: To grade, curb with artificial stone and pave with cement concrete, 6 ins. thick, 30 ft. wide between curbs, Gunnison St., from the south side of Smith St. to the north side of Division St., and from the south side of Division St. to the south side of Amelia St., and Amelia St., from the west side of Gunnison St. to the east side of Garfield Ave.

⊙F. W. Guenther, 1111 Och St., Burlington, Ia., has been awarded the contract by that city for the paving of four blocks of streets with one course concrete pavement, for $1 and $1.09 per sq. yd. The work includes 1,950 cu. yds. of excavation, 3,400 ft. of curb, and 9,500 sq. yds. of paving. Bids were opened March 20.

⊙The Dolarway Paving Co., of Marshalltown, Ia., has been awarded the contract for the construction of 27,800 sq. yds. of pavement at Clinton, Ia.

Kansas.

⊙J. W. Burton, 316 Bonds Bldg., Wichita, Kans., has been awarded the contract by the city of Anthony, Kans., Ena Kirkpatrick, City Clerk, for the construction of about 40,000 lin. ft. of curb and gutter, for $11,006. Bids were opened Mrach 15.

Kentucky.

✣Bids will be received until April 2 by Board of Public Works, Madisonville, Ky., for the construction of a new water works system. The work will include the construction of an earth dam involving 25,000 yds. cast iron pipe, steel tank, laying pipe, laying 1 miles of sanitary sewers. C. H. Jenks, Union City, Tenn., is Engineer. W. J. Dulin is Secy. of the Board.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Louisiana.

✣Bids will be received until 6 p. m., April 1, by Mayor, Natchitoches, La., for the paving with gravel of two blocks of Washington St., the whole of Jefferson St., from Touline St. to Texas and Pacific Depot; Pavie St., from Washington St. to Eighth St., aggregating approximately 20,000 sq. yds., in accordance with plans and specifications on file in the Mayor's office. Bids may be for the whole work, or any part thereof, not less than one block. The city owns a steam roller, which the contractor can rent on fair terms. Certified check for $600 to accompany each bid as a guarantee of good faith.

Maryland.

✣Bids will be received until noon, April 1, by Board of Kent County Commissioners, Chestertown, Md., for the construction of a section of State Aid Highway in Kent County upon or along the Still Pond Road between Betterton and Still Pond Station for a distance of 4.14 miles. Plans can be seen and forms of specifications and contract may be obtained at the office of the State Roads Commission, 534 N. Howard St., Baltimore, Md.

Massachusetts.

✣Bids will be received until 3:45 p. m., March 31, by Town Selectmen, Brookline, Mass., for the repair and construction of coal tar concrete sidewalks, driveways, street crossings, and gutters. Specifications may be seen at the office of the Superintendent of Streets. E. A. McEttrick is Secy. of the Board.

Town of Stow, Mass., has appropriated $1,500 for a stone crusher. Henry T. Smith is Town Clerk.

Town of Athol, Mass., has voted $4,000 for new sidewalks.

Town of North Attleboro, Mass., has voted the following appropriations: Paving Washington St., $7,000; sidewalks, $2,000; repairing old Post Road, $2,000; macadamizing Smith St., $2,100; macadamizing Mt. Hope St., $1,000. John A. Rose is Selectman.

Town of Revere, Mass., has voted $3,000 for granolithic walks. John D. Coughlan is Chairman of Board of Selectmen.

Michigan.

✣Bids will be received until 5 p. m., March 31, by C. L. Miller, City Clerk, Kalamazoo, Mich., for the construction of 4,000 sq. yds. of brick, and 30,000 sq. yds. asphaltic concrete machine mix. Specifications are on file with the City Engineer.

The citizens of St. Louis, Mich., on March 11 voted the issuance of bonds to the amount of $16,000 for the paving of the main street and three blocks to the depot.

Minnesota.

⊙The city of Ely, Minn., J. Wisted, City Clerk, has awarded the contract for the construction of sidewalks and curbs to D. H. Clough & Co., of Duluth, Minn., for $24,465. Bids were opened March 18. The work includes 3,400 cu. yds. of earth excavation; 120,056 sq. ft. of sidewalk; 6,048 sq. ft. of driveways; 8,400 sq. ft. of cross-walks, and 16,742 lin. ft. of curb.

At the annual meeting of the Town of Grant, Washington County, Minn., a resolution was adopted requesting the County Commissioners to take steps to bond the county in the sum of $500,000 for the construction and improvement of highways and bridges.

The Itasca County Board, Grand Rapids, Minn., has made a requisition upon the State Highway Commission for $8,000, to be used in equal proportion on state roads Nos. 1 and 4.

The Board of Public Works of Duluth, Minn., has estimated that $500,000 worth of street improvements will be finished in Duluth the coming season. Paving and sewer work to cost approximately $300,000 has already been ordered.

The Minnesota State Highway Commission, St. Paul, has a party of surveyors at work on the preliminary survey of the St. Paul to Faribault post road.

The City Council of Minneapolis, Minn., is reported to have adopted the recommendations of the Paving Committee to pave Washington Ave., between Third and 10th Aves., with creosoted wood blocks.

A petition has been circulated in Tower, Minn., for the laying of concrete sidewalks in the business district. An engineer will probably be secured to establish a grade for the walks.

Mississippi.

✣Bids will be received until noon, April 7, by Commissioners, Sanford, Miss., for the construction of about 26½ miles of earth and sand-clay roads, including all bridges and culverts, in District No. 2, Covington County, Miss. Plans and specifications are on file in the office of the Chancery Clerk, Collins, Miss., and in the office of Highway Engineer, A. L. Smith, Collins, Miss., and may be had upon application. Each bid must be accompanied by a certified check for $500.

The City Commissioners of Laurel, Miss., have decided to pave Fifth, Sixth and Seventh Aves., and Fifth St., including about 15 blocks in the residence section. Sheet asphalt will be used.

Missouri.

⊙E. M. Eby of Kansas City, Mo., has been awarded the contract by the City Commissioners of Abilene, Texas, to construct pavement to connect the business district with the good roads up to the city limits. The cost will be about $30,000.

Montana.

⊙James Kennedy of Fargo, N. Dak., has been awarded the contract by the town of Cascade, Mont., W. R. Call, Clerk, for the grading and constructing of concrete sidewalks on Central Ave., for $5,550. Bids were opened March 17.

Nebraska.

✣Bids will be received until April 14, it is reported, by the City Council of Hastings, Neb., for the repaving Second St., between St. Joe and Burlington Aves.

✣Bids will be received until 9 a. m., April 1, by Thomas Flinn, City Clerk, Omaha, Nebr., for following street improvements: Farnam St. from 44th St. to the east line of the Omaha Belt railway right-of-way in Street Improvement District No. 1230 by repaving, readjusting the old curbs and replacing all defective curbing, and that part of Farnam St. from the east line of the Omaha Belt railway right-of-way to 48th St. by paving and curbing in accordance with Ordinance No. 7843. 37th St. from Dodge St. to Davenport St. in Street Improvement District No. 1274, by paving and curbing, in accordance with Ordinance No. 7809. Pratt St. from Sherman Ave. to the west line of 19th St. south in Street Improvement District No. 1281, by paving and curbing, in accordance with Ordinance No. 7857. Walnut St. from 33rd St. to 35th St. in Street Improvement District No. 1299, by paving and curbing, in accordance with Ordinance No. 7898. Alley between Farnam St. and Harney St. from 14th St. to 15th St. in Street Improvement District No. 1325, by repaving in accordance with Ordinance No. 7997. 18th St. from Farnam St. to Harney St. in Street Improvement District No. 1328, by repaving, readjusting the old curbs and replacing defective curbing, in accordance with Ordinance No. 8018. Alley between Douglas St. and Farnam St. from 25th Ave. to 26th Ave., in Street Improvement District No. 1332, by paving, in accordance with Ordinance No. 8053. Bids for such improvements must be made upon asphalt, stone, vitrified brick, vitrified brick block, artificial stone, macadam and creosoted wood block, and must be made under and in accordance with plans and specifications for said work prepared by and on file in office of the City Engineer.

⊙Matzen Bros., Hooper, Nebr., have been awarded the contract by the Colfax County Commissioners, Schuyler, Nebr., Ed. F. Vrzak, County Clerk, for slip and elevator grader work on the county road for the remainder of the season of 1913, including four miles of road grade and several hills cut and fills made. Bids were opened March 10.

New Jersey.

✣Bids will be received until 8 p. m., April 7, by Mayor and Borough Council, Metuchen, N. J., for laying 10,000 ft., more or less, of concrete or bluestone flag sidewalks in accordance with the specifications. Details concerning the location where said sidewalks will be laid and the number of feet and other matters of interest to bidders may be obtained from Howard S. Wilson, Borough Clerk, or Charles B. Carman, Engineer.

✣Bids will be received until 8 p. m., April 7, by Raymond F. Davis, Secy., Joint Organization of the Council of the Town of Bloomfield and Borough Council of Glen Ridge at his office, Bloomfield National Bank Bldg., Bloomfield, N. J., for the grading and paving of Essex Ave., between Comley Place and Bay Ave., partly situated in the Borough of Glen Ridge and the Town of Bloomfield, 2,900 cu. yds. excavation, 900 sq. yds. cobble gutter, 3,300 sq. yds. Telford pavement, bound with asphalt. The above quantities are approximately correct, and are for the purpose of comparing bills only. Work must be completed within 65 working days. All bids must be submitted upon bidding sheets, which may be received and plan and specifications seen at the office of Ernest Baechlin, Civil Engineer, Bloomfield National Bank Bldg., Bloomfield, New Jersey.

✣Bids will be received until noon, April 7, by Board of Sussex County Freeholders, Newton, N. J., for the completion of the grading and macadamizing of a public road in the Township of Hardyston, known as the Franklin Furnace-Stockholm road. Each bidder must accompany his bid with a certified check for the sum of one thousand dollars payable to the order of the County Collector. Maps, profiles and specifications may be found at the office of A. H. Konkle, Engineer, Newton, N. J.

✣Bids will be received until 11 a. m., April 2, by Boulevard Commissioners of Hudson County, Jersey City, N. J., for furnishing and delivering about 100,000 gals. of asphalt road oil. For furnishing and delivering about 85,000 gals. of asphalt road binder. For furnishing and delivering about 100,000 gals. of tar road oil. For furnishing and delivering about 30,000 gals. of tar road binder. For furnishing and delivering about 3,000 cu. yds. of paving sand. For furnishing and delivering about 5,750 cu. yds. of broken trap rock and screenings. For hauling broken trap rock and screenings from Snake Hill to the Boulevard. All in accordance with the specifications on file in the office of the Boulevard Commissioners. Bids will be publicly received, opened and read at the place and time above stated, and the award of contract will be made as soon thereafter as practicable. Bids must be made on the form of proposal furnished by the Boulevard Commissioners. A certified check, drawn to the order of the Collector of Hudson County, N. J., or cash, to the amount of 10 per cent of the bid, must accompany each proposal. John C. Sweeney is Clerk of Boulevard Commissioners of Hudson County, N. J.

✣Bids will be received until noon, April 7, by Board of Chosen Freeholders, Sussex County, Newton, N. J., for the construction of a macadam road in Byran township and Andover Borough, known as the Whitehall Section of the Newton Stanhope, .673 mile. Plans and specifications may be seen at the office of The Board of Freeholders, at Newton, N. J., or at the office of Harvey Snook, County Engineer, Newton, N. J. Each bidder must accompany his bid with his check duly certified, for $1,000, payable to the order of the County Collector. R. Lee Slater is Clerk of the Board.

⊙The Hastings Pavement Co., 25 Broad St., New York City, N. Y., has been awarded the contract by the Common Council of Englewood, N. J., for paving with asphalt block, curbing and improving Palisade Ave., from Engle St. to James St., for $33,595. Other

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

bidders were: The Barber Asphalt Co., 30 Church St., New York City, $40,236, and P. F. Kenny, 2291 Broadway, New York City, $34,627. Bids were opened March 18.

New Mexico.

The New Mexico Legislature has passed a bill providing for some $13,000 worth of bricks for paving the streets of Santa Fe.

New York.

✣Bids will be received until 11 a. m., April 3, by Francis G. Ward, Commissioner of Public Works, Buffalo, N. Y., for the following improvements: A separate proposal must be made for the work and supplies included in each descriptive paragraph following: For paving Roma St., 26 ft. wide, from the north curb line of Delavan Ave. to the northerly end of Roma St., with each kind of pavement for laying, of which specifications have been filed by the Commissioner of Public Works. For repaving Balcom St., 30 ft. wide from the west curb line of Main St. to the east curb line of Linwood Ave., except the space occupied by the street railway tracks and two feet outside the same, with each kind of pavement for laying, of which specifications have been filed by the Commissioner of Public Works. For repaving Amherst St., 30 ft. wide from the east curb line of Delaware Ave. to the east curb line of Colvin St., with each kind of pavement for laying, of which specifications have been filed by the Commissioner of Public Works. For repaving Amherst St., 30 ft. wide, from the west curb line of Delaware Ave. to the east curb line of North Lincoln Boulevard, with each kind of pavement for laying, of which specifications have been filed by the Commissioner of Public Works. For repaving Delaware Ave., 36 ft. wide, from a point about 1,100 ft. south of Amherst St. to the south curb line of Hertel Ave., except the space occupied by the N. Y. C. R. R. subway with each kind of pavement for laying, of which specifications have been filed by the Commissioner of Public Works. Plans and specifications can be had upon application to the Bureau of Engineering.

✣Bids will be received until 11 a. m., April 2, by Francis G. Ward, Commissioner of Public Works, Buffalo, N. Y., for the repair of asphalt pavements maintained by the Department from Jan. 1, 1913, until Dec. 31, 1913. Specifications can be had upon application to the Bureau of Engineering.

Bids will be received until 11 a. m., April 14, by Capt. G. Robinson, Constructing Quartermaster Fort, H. G. Wright, N. Y., for concrete walks and steps around hospital.

An election is to be held in the Town of Manhasset, N. Y., on April 1 for the purpose of voting on the expenditure of $233,000 for public improvements in the Town of North Hempstead. The greater part of this amount will be used in macadamizing and paving the streets.

City Engineer E. C. Aldrich of Auburn, N. Y., has been directed to prepare plans and specifications for the paving of South Division St., between Genesee and Clark, and the extension of the pavement of Clark St., to Aurelius Ave.

Ohio.

✣Bids will be received until noon, April 8, by Charles L. Craig, Director of Public Service, Warren, O., for the repaving of North Park Ave., including about 8,400 sq. yds. of brick, asphalt or creosoted wood block. A certified check for $1,000 is required with each bid. Official advertisement will be found elsewhere in this issue.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio., until 2 p. m., March 31, 1913, for grading and paving with waterbound macadam, the Sec. 2 Maysville-Marion Road. State Highway "B" Pet. No. 625 in Clairbourne Twp., Union County. Length, 2,880 ft., or 0.53 miles. Width of pavement, 16 ft. Estimated cost of construction, $2,929.60. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the County Commissioners at Medina, Ohio, until 10 a. m., March 26, 1913, for the improving of two strips of road, namely, Wadsworth-Wooster Road, State Highway "C," Petition No. 548, in Wadsworth Township, Medina County. Length, 3891.2 ft. or .74 mile; width of pavement, 10 ft.; and in Sec. No. 1, Medina-Wooster Road, State Highway "D," Petition No. 546 in Montville Township, Medina County. Length, 5164 ft. or .98 mile, width of pavement 10 ft. James R. Marker, State Highway Commissioner. Clyde Harvey is County Surveyor.

✣Bids will be received until noon, April 15, it is reported, by Mayor and Village of Shreve, Wayne County, O., for furnishing necessary labor and material for grading, curbing and paving with vitrified paving block on concrete foundation Market St. Plans and specifications can be seen at the office of Clem Morgan, Clerk, or at the office of L. E. Chapin, Engineer, Canton, O. The cost of the improvement is estimated at $19,342.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., March 31, 1913, for grading and paving with bituminous concrete, the Columbus Road. State Highway "D," Petition No. 466, in Scioto Twp, Ross County. Length, 5,280 ft. or 1.00 miles. Width of pavement, 16 ft. Estimated cost of construction $10,391. Alternative bids will also be received for grading and paving the above road with brick for heavy traffic. Estimated cost of construction, $18,903. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., March 31, 1913, for grading and paving with waterbound macadam, the Cincinnati-Chillicothe Road. State Highway "C," Petition No. 588, in Miami Twp., Clermont County. Length, 24,200 ft., or 4.58 miles. Width of pavement, 14 ft. Estimated cost of construction, $21,013. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bills will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., March 31, 1913, for grading and paving with waterbound macadam, the New Market Road. State Highway "A," Petition No. 590, in Franklin & Washington Twps., Brown County. Length, 13,200 ft., or 2.50 miles. Width of pavement, 10 ft. Estimated cost of construction, $14,225. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m., March 31, 1913, for grading and paving with bituminous surface treated concrete, the Weeds Corner Ext. Road. State Highway "E," Petition No. 372, in LeRoy Twp., Lake County. Length, 11,686 ft., or 2.21 miles. Width of pavement, 12 ft. Estimated cost of construction, $25,012. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, Aug. 1, 1913. Plans and specifications are on file in the office of the County Commissioners and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received until noon, April 7, by Village Council, at the office of Village Clerk, Matamoras, Ohio, for furnishing the necessary labor and material for the improvement of Cougler St., from the northeasterly line of Fourth St. to the southwesterly line of Main St., by excavating, grading filling, preparing foundations, placing of drain pipes, constructing catch-basins, constructing a curb on each side of said roadway, and the paving of said roadway with brick paving block to the width of 16 ft., in accordance with the plans, grades, specifications, and profiles of the proposed improvement heretofore prepared by A. F. Cole, as Engineer of said village, and now on file in the aforesaid office of the aforesaid Clerk.

✣Bids will be received until noon, March 27, by Board of Park Commissioners, William Hodginson, Secy., Cincinnati, O., for the grading of Section No. 5 (between Woodburn Ave. and Hopkins Ave., now Asman Ave.) of the Bloody Run Parkway, approximately 16,500 cu. yds., according to plans and specifications on file in the office of the Board of Park Commissioners. Each bid must contain the full name of every person or company interested in the same, and be accompanied by a bond in the sum equal to 25 per cent of the amount of the bid.

⊙The Board of Control, Coshocton, O., has awarded the contract for the paving of North Eighth St., from Chestnut St. North, to T. J. Norman & Sons, for $7,680.

⊙J. T. Smith has been awarded the contract for the construction of one mile of brick paving on the Ellsworth Road north of Salem, O., for $15,825.

⊙Clayton & Hebb, 535 S. Main St., Canton, O., have been awarded the contract for hauling 3,000 tons of stone on the Collinsville-St. Louis Road in Nameoki Township, Madison County, Ill., for $40 per ton. Bids were opened at the office of the Town Clerk of Granite City, Ill., on March 20.

⊙Geo. S. Mellert of Medina, O., has been awarded the contract by the Trustees of Hinckley Township, Medina County, O., for the improvement of River Road No. 1, about 7,400 ft. in length, for $9,975. The road will be of gravel base and slag top, with a Bermuda asphalt binder. Bids were opened March 15.

⊙N. Ruebel of Cheviot, O., has been awarded the contract by that village, Jacob Krollmann, Jr., Clerk, for improving Center St., from Wardall St. to the corporation line in Walnut St., 50 ft. in width, 30 ft. between curb lines, by grading the same, setting cement combined curbs and gutters, macadamizing the roadway and rolling the same, and constructing basins and drains, for about $3,000. Bids were opened March 19.

⊙The Deshler Construction Co. has been awarded the contract by the Village Council of Waterville, O., for the paving of Fourth St. with Townsend block on a 5-in. concrete foundation, with Berea curb, for $11,434. Bids were opened March 20. Smith & Boulay, Toledo, O., are Engineers.

⊙C. A. Owens, of Owens, O., has been awarded the contract by the Pike Commissioners of Brooks Free Turnpike Road, at Marion, O., for the construction of the Brooks macadam road, for $12,467. The work includes four miles and 100 ft. of grading and macadamizing. Bids were opened March 15 by County Surveyor J. W. Scott.

⊙Daniels, Lyst & Douglas, Anderson, Ind., at $100,000, and G. H Heffner & Co., Celina, O., at $40,000, have been awarded the contracts by the Department of Public Works of Sidney, O., for the paving of streets with brick and alleys with concrete. The work includes approximately 35,190 cu. yds. of grading, 66,327 sq. yds. of paving, 27,476 lin. ft. of curbing, and 8,749 lin. ft. of sewers, 8-in. to 24-in. in diameter. Bids were opened March 11. Smith & Boulay, The Nasby, Toledo, O., are Engineers.

⊙Cisler & Morse of Mareitta, O., have been awarded the contract by the city of Cambridge, O., for the construction of 6,000 sq yds. of brick pavement on a concrete foundation, for $14,729. The work includes paving, stone curb, curb set in concrete, concrete base, 1:2:4 4 ins. thick, manholes, catchbasins, inlets, vitrified pipe, grading, grout filler, asphalt expansion, etc. Bids were opened March 20.

The Franklin County Commissioners, Columbus, O., will construct nearly 47 miles of water-bound macadam highways, costing $465,000, this year. Nine stretches of turnpike are included in the proposed improvements. Five roads for which bonds amounting to $220,000 have been authorized are: Groveport Pike in Madison Township, 2½ miles; pike from Groveport to Canal Winchester, 3½ miles; pike leading south from Groveport to the Pickaway County line, 4 miles; Jackson Pike, from Frank Road south to south county line, 7 miles; pike from Flint, east in Sharon Township, 3 miles. Hearings on the following proposed improvements will be held about April 4: Pike from Reynoldsburg through Black Lick and New Albany to Delaware County line, 12 miles; Boehn Road, east of Westerville, from Blendon into Plain Township, 2 miles east and 2 miles south; Kidwell & Taylor Road, from Central College east 2 miles and thence south 2 miles; Godown Road, south of Elmwood in Perry Township, 1 mile.

City Engineer E. A. Merkel, Mansfield, O., is preparing plans for the construction of 18,000 sq. yds. of brick and granite block pavement on a concrete foundation, with two miles of 5x18-in. and 6x20-in. curb; also 15,000 cu. yds. of excavation and tar and asphalt filler. Contracts will be let in May or June. E. A. Blecker, Department of Public Service, is official in charge.

The Clermont County Commissioners, Batavia, O., have decided to build a state road between Perintown and Milford.

The Hamilton County Commissioners, Cincinnati, O., have decided to improve River Road from the Blue Rock pile to the Colerain pike. Plans and specifications will be prepared by the County Surveyor. The estimated cost is $6,880.

Erie County Commissioners, Sandusky, O., have announced plans for road improvements involving an expenditure of nearly $500,000. The citizens will be asked to vote on the proposition soon.

The citizens of Middlefield, O., at a recent election, voted the issuance of bonds to the amount of $16,800 for street paving.

The Ashland County Commissioners, Ashland, O., have ordered the improvement of the Olivesburg Road with brick, a distance of 4½ miles, extending from the end of West Sandusky St., to the Olivesburg Pike.

Oregon.

⊙The City Council of Portland, Ore., has awarded the contract for the improvement of Weidler St., with asphalt pavement, to the Barber Asphalt Paving Co., for $18,835.

⊙The City Council of Portland, Ore., has awarded the contract for oiling 100 or more miles of gravel and macadam streets to the Acme Road Oiling Co., of Portland, at the rate of $29 a mile for a 6-ft. strip. Where a 12-ft. strip is oiled the cost will be doubled, and where an 18-ft. strip is oiled the cost will be trebled. Work will be started immediately.

Following bids were received by the City Council of Portland, Ore., on March 13 for street improvements: East 43rd St. district improvement: Hassam—Oregon Hassam Paving Co., $104,255. Asphaltic Concrete—Oregon Independent Paving, $119,270; Barber Asphalt Co., $102,749; Montague-O'Reilley Co., $105,009. Asphalt—Oregan Independent Paving Co., $122,039. Gravel bitulithic—Barber Asphalt Paving Co., $98,406; Warren Construction Co., $99,549. East 13th St. from Malden to Ochoco: Asphaltic concrete—Oregon Independent Paving Co., $47,534; Montague-O'Reilly Co., $41,109. Asphalt—Oregon Independent Paving Co., $48,084; Barber Asphalt Paving Co., $46,117. Hassam—Oregon Hassam Paving Co., $17,505. Bitulithic—Barber Asphalt Paving Co., $47,237; Warren Construction Co., $47,550. 29th Ave., S. E., from 41st St. to Richmond Addition; grading and concrete curbs and walks—Keenan Brothers, $477. 58th Ave., S. E., from 65th to 72nd Sts.: Grading and concrete curbs and walks—A. L. Kern, $4,577; Giebisch & Joplin, $4,781. 49th Ave., S. E., from 41st to Bevoir Sts.: Grading and concrete curbs and walks—Linden-Kibbe Construction Co., $1,908; Cochran, Nutting & Co., $1,824. Taggart St., from East 14th to East 26th: Asphalt—Oregon Independent Paving Co., $26,127; Barber Asphalt Paving Co., $25,905. Asphaltic concrete—Oregon Independent Paving Co., $25,715; Montague-O'Reilley Co., $22,875. Gravel bitulithic—Barber Asphalt Paving Co., $23,686; Warren Construction Co., $23,954. Hassam—Oregon Hassam Paving Co., $23,971. Patton Ave. from Jarrett to Portland Blvd.: Grading and concrete curbs and walks—M. Hansen, $2,997; A. D. Kern, $3,025; Giebisch & Joplin, $3,066; B. Kilkenny, $2,867; Miller & Bauer, $3,045; Keenan Brothers, $3,196; O. M. Patton, $2,878. 43rd St., S. E., from 55th to 64th Aves.: Grading and concrete curbs and walks—Stevens & White, $6,833; Bechill Brothers, $6,738; Manning & Co., $6,778. Lombard St. from the S. P. & S. Bridge to Westanna St.: Gravel bitulithic—Warren Construction Co., $10,023. Hassam—Oregon Hassam Paving Co., $9,940. Asphalt—Oregon Independent Paving Co., $10,898. Asphaltic concrete—Oregon Independent Paving Co., $10,572. Lombard St. from the S. P. & S. Bridge westerly to the city boundary line: Hassam—Oregon Hassam Paving Co., $7,280. Asphaltic concrete—Oregon Independent Paving Co., $7,833. Gravel bitulithic—Warren Construction Co., $7,341. Asphalt—Oregon Independent Paving Co., $8,102. East Eighth St. from Webster to Alberta: Grading and concrete curbs and walks—Bechill Brothers, $1,145; Peterson Brothers, $1,095. East Sherman St. district: Asphaltic concrete—Oregon Independent Paving Co., $29,191; Montague-O'Reilley Co., $25,644. Asphalt—Barber Asphalt Paving Co., $29,914; Oregon Independent Paving Co., $29,860. Gravel bitulithic—Warren Construction Co., $26,110; Barber Asphalt Paving Co., $26,935. Hassam—Oregon Hassam Paving Co., $26,924. Miller Ave. from East Seventh to East 16th: Gravel bitulithic—Oregon Independent Paving Co., $18,304; Barber Asphalt Paving Co., $18,318; Warren Construction Co., $18,301. Hassam—Oregon Hassam Paving Co., $16,287. Concrete—Jeffery & Bufton, $15,982; Linden-Kibbe Construction Co., $15,620. East Sixth St. from Hawthorne to Washington: Hassam—Oregon Hassam Paving Co., $19,304. Asphaltic concrete—Oregon Independent Paving Co., $18,073; Montague-O'Reilley Co., $16,855. Asphalt—Oregon Asphalt Paving Co., $19,027; Barber Asphalt Paving Co., $19,354 Bitulithic—Warren Construction Co., $20,009.

The City Council of Junction City, Ore., proposes to construct 25 blocks of street paving this year, to be of gravel bitulithic. The cost is estimated at $1.75 per sq. yd.

Pennsylvania.

✣Bids will be received until 8 p. m., April 2, by Street Committee, S. M. Morrison, Chairman, Dravosburgh, Pa., for improvement of Maple Ave., McClure St., South McClure St., Duquesne Ave., Raymond St. and Ravine St. Approximate quantities: Grading, 32,800 cu. yds. Combined curb and guter, 7,350 lin. ft. Paving, 6-in. concrete base Hillside block, 11,240 sq. yds. 15-in. 18-in., 24-in. T. C. storm sewer, 1,220 lin. ft.; concrete sidewalk, 53,600 sq. ft. Plans and specifications can be seen at the office of Courtney L. Wititaker, Borough Secretary, cor. Washington and First Sts. A certified check for $1,000 must accompany all proposals. R. C. Bayne is Engineer McKeesport, Pa.

✣Bids will be received until 10 a. m., April 2, by State Highway Department, Capitol Bldg., Harrisburg, Pa., for the purchase and delivery of machinery, implements and tools for maintenance and repair of state highways. Edward M. Bigelow is State Highway Commissioner.

✣Bids will be opened about April 14, by Oil City, Pa., for the construction of 9,340 sq. yds. brick wood block or bituminous pavement and for 3,200 ft. of 10-in. and 3,600 ft. of 6-in. sewers. G. F. Roess is City Engineer.

A special election is to be held in Meadville., Pa., to vote on a bond issue of $60,000 for paving and sewering 12 streets in the city. Washington, Grove, Race, Terrace, Spring, Prospect, Liberty, Arch, State, South Main, Market and Water Sts., are the ones included in the list

Improvements to Allegheny County, Pa., roads and bridges will consume the larger part of the $1,400,000 which the county will spend this summer on public improvements. New roads costing $800,000 will be the most costly item. Forty miles of new roads, and an equal stretch of repaired roads will be included. John S. Gillespie, Pittsburgh, is Road Commissioner.

South Dakota.

The City Council of Wagner, S. D., has taken steps to have the wooden sidewalks replaced by concrete walks.

Tennessee.

The City Council of Milan, Tenn., has presented a bill in the Legislature asking that the city be given authority to issue $10,000 worth of bonds for the purpose of graveling the streets.

Texas.

✣Bids will be received until 2:30 p. m., April 14, by Grimes County Commissioners Court, Anderson, Texas, for construction of a system of macadamized and sand-clay roads, to be built in the Navasota Road district of Grimes County; this work will comprise 30 miles of macadam work and 8 miles of sand-clay work and necessary culverts and bridges; detailed plans and specifications will be mailed from the Navasota office of Civil Engineer J. Gibbons Browne to any party upon receipt of a $5 deposit, the deposit to be returned when plans are returned to the Engineer.

✣Bids will be received until 10 a. m., March 28, by Calhoun County Clerk, Port Lavaca, Texas, for the construction of about 30 miles of graveled surfaced highway in Road District No. 2 of Calhoun County, Texas. Unconditioned certified checks on some bank in Port Lavaca payable to the County Treasurer of Calhoun County for the sum of $6,750 will be required conditioned upon the entrance into contract and furnishing of bond by the successful contractor. Plans and specifications may be seen at the office of the County Clerk of Calhoun County, Texas, at Port Lavaca. F. M. Dudgeon is County Judge.

✣The Calhoun County Commissioners, Port Lavaca, Texas, have sold bonds to the amount of $135,000 for the construction of good roads in Precinct Nos. 1 and 2 to N. H. Swain of Dallas, Texas Bids for the construction of the roads will be opened March 28. The roads are to be surfaced with gravel.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

⊙Isaac Heffron of Galveston, Texas, has been awarded the contract by the City Commissioners of that city, for the paving of Broadway with concrete, including the curbing and sidewalks, for approximately $70,000.

⊙The National Lumber & Creosoting Co., of Texarkana, Texas, has been awarded the contract by the City of Fort Worth, Texas, for furnishing creosoted wood blocks to be used in the paving of Houston St.

The Texas Motorway Co. has been organized for the purpose of constructing a motor highway between Dallas and De Rio, Texas, a distance of approximately 500 miles. The route of the proposed road has been tentatively decided upon. It will run through the counties of Dallas, Tarrant, Johnson, Somervell, Erath, Bosque, Comanche, Hamilton, Mills, Coryell, Lampasas, San Saba, Burnet Llano, Kimble, Edwards, Kinney and Val Verde. John D. Christenson of St. Louis, Mo., is principal stockholder.

Engineer G. R. Abney has completed all of the preliminary work on the 50 miles of good roads for Smithville Precinct of Bastrop County, Texas. The County Commissioners, Bastrop, will let contracts within a few weeks.

The city of Nacogdoches, Tex., has decided to spend about $70,000 for street paving. The Aetna Engineering Bureau, 17 North La Salle St., Chicago, Ill., are Engineers. Engineers would like to receive prices on gravel, crushed stone and cement.

Virginia.

✣Bids will be received until 4 p. m., April 5, by T. M. Pepper, Mayor, and Street Committee, Norton, Va., for street improvements; about two to three miles of macadam, with some grading. Town owns steam roller and stone crusher, which may be leased. Plans, profiles and specifications are on file at mayor's office and can be seen by applying to Mayor T. M. Pepper, Dr. T. M. Cherry, or H. E. Hyatt. Bids must be accompanied by certified check for $500 as evidence of good faith.

Lee District of Accomac County, Va., has voted the issuance of bonds to the amount of $10,000 for the betterment of the public roads. Accomac is the county seat.

Washington.

⊙The Board of Public Works of Seattle, Wash., has awarded the contract for the paving of 12th Ave. S., et al., to T. Ryan, Lowman Bldg., Seattle, for $26,962. P. J. McHugh, Third and Mercer Sts., Seattle, secured the contract to pave 27th Ave., for $12,259.

⊙The Dolarway Paving Co. of Oregon and Washington, Seattle, Wash., has been awarded the contract at Seattle for the construction of 30,000 sq. yds. of pavement on the Queen Anne Blvd.

⊙The County Commissioners at Everett, Wash., have awarded the contract for the construction of the Norton Ave. road to John F. Birney, former County Engineer, for about $6,000.

Following bids were received March 14 by the Board of Public Works, Seattle, Wash., for grading, etc., Franklin Ave.: R. M. Overstreet, $18,366; Henry Brice, Densmore Ave., Seattle, $14,310; H. L. Goerig, $14,486, and J. A. Inkan, $15,562.

Following bids were received March 14 by the Board of Public Works of Seattle, Wash., for grading, curbing and constructing concrete sidewalks on 18th Ave. S.: West Coast Construction Co., $44,063; A. J. Baumgartner, $44,060; S. Lamping, $41,545; Gillis & DeFlong, $43,248; T. Ryan, $42,790; Russell & Gallagher, $49,217, and D. H. Traphagen, $41,085.

The City of Centralia, Wash., will receive bids about April 1 for the paving of about 18,000 sq. yds. of streets. Stanley Macomber is City Engineer.

The city of Uniontown, Wash., contemplates paving about three business blocks this summer.

West Virginia.

✣Bids will be received until noon, April 7, by Marion County Court, Fairmont, W. Va., for the construction of 32.7 miles of road, including grading, etc., in Mannington District, Marion County, according to the plans and specifications prepared by J. Russell Wilson, Civil Engineer, Washington, Pa. Plans and specifications will be found in the office of the Engineer, National Bank of Mannington Bldg., Mannington, West Virginia, 163 South Main St., Washington, Pa., and the office of the County Clerk, Fairmont, West Virginia. No bid will be considered unless accompanied by a certified check of not less than 2 per cent of the bid. John F. Phillips is County Court Clerk.

Wisconsin.

✣Bids will be received until 2 p. m., April 8, by Board of Public Works, Morgan R. Butler, Chairman, Waukesha, Wis., for furnishing all material and doing all the work necessary and required to macadamize on Broadway from Hartwell Ave. to the east city limits, Oakland Ave. from Broadway to Main St., Lake St. from Broadway to Huron St., Huron St. from Lake St. to Hartwell Ave., Hartwell Ave. from Arcadian Ave. to Main St., Cutler St. from Grand Ave. to Center St., Center St. from Cutler St. to the C. & N. W. Railway, Ann St. from Madison St. to St. Paul Ave., St. Paul Ave. from a point 44½ ft. east of Wisconsin Ave. to a point 755 ft. west of State St., in the City of Waukesha, according to the respective plans, profiles and specifications on file in the office of the City Clerk.

✣Bids will be received until 2 p. m., April 8, by Board of Public Works, Waukesha, Wis., for furnishing all material and doing all the work necessary and required to macadamize on Randall St. from a point 564 ft. north of Chicago Ave. to Summit Ave. in the Second Ward of the City of Waukesha, according to the respective plans, profiles, and specifications on file in the office of the City Clerk of said city for the inspection of bidders. Said street to be graded to a sub-grade and surfaced with a bituminous macadam pavement, together with a combination cement curb and gutter or with hard limestone curbing and brick gutter, as designated on plans. Work will be commenced on said street on the first day of May and is to be completed within 20 days. Morgan R. Butler is Chairman of the Board.

⊙The Monroe County Highway Commissioners, Sparta, Wis., have awarded the following contracts for road-building machinery: Two road rollers, Kelly-Springfield Road Roller Co., Springfield, O.; rock crusher, bins, wheelers, plows, scrapers and rakes, The Good Roads Machinery Co., Fort Wayne, Ind.; three dump wagons, The Studebaker Corporation, Chicago, Ill.; three graders, Austin Western Co., Chicago. A cement mixer and tank will be purchased in the near future.

⊙Ed. L. Bartlett, Washington St., Watertown, Wis., has been awarded the contract by that city, Arnold Kraeft, City Engineer, for paving three streets and two alleys with reinforced concrete, as follows: 8,053 cu. yds. of excavation, $0.33; 15,675 lin. ft. of curb and gutter, $0.54; reinforced concrete pavement of 1-1½-2½ mixture, one course work, wire mesh reinforcement, elastite joint filler, at $1.41 per sq. yd., involving 23,028 sq. yds. Bids were opened March 15.

Canada.

⊙The City Commissioners of Edmonton, Alta., have let a contract for the construction of 75,000 sq. yds. of paving to the National Paving Co., for $2.65 per sq. yd. The Worswick Co. secured the contract to place 100,000 sq. yds. of paving. The entire work will cost approximately $230,074.

⊙Somerville & Reid, Merritt St., Welland, Ont., have been awarded the contract by that town, George R. Boyd, Clerk, for the construction of concrete sidewalks for the present year, for $0.12¾ per sq. ft. Bids were opened March 17.

The City Council of Montreal, Quebec, has approved the report of the Board of Control to widen St. Joseph Blvd., to 100 ft. The Council has voted the sum of $733,000 to purchase the needed land.

The Legislature of British Columbia has provided the sum of $150,000 for the purchase of improved road machinery. A total of almost $6,000,000 will be spent in the province this year for roads, bridges and wharves, of which the largest item is for roads. The Provincial Department of Works, Victoria, B. C., is in charge.

DRAINAGE AND IRRIGATION

Colorado.

✣Bids will be received until 4 p. m., April 17, by U. S. Reclamation Service, Montrose, Colo., for the construction of 6.2 miles of Selig extension canal and 3.4 miles of Peach Valley lateral Uncompahgre Valley project in the vicinity of Olathe, Colo. This work involves the excavation of about 171,500 cu. yds. of material in open cut and 930 lin. ft. of tunnel. For particulars address the United States Reclamation Service, Montrose, Colo., 519 Commonwealth Building, Denver, Colo., or Washington.

Illinois.

⊙Frank B. Stevens of Geneseo, Ill., has been awarded the contract for dredge boat work, including not less than 140,000 cu. yds. in Nodaway Drainage District No. 1, Oregon, Mo., at $0.113 per cu. yd. Bids were opened March 22 by William M. Morris, Secy.

Iowa.

✣Bids will be received until 2 p. m., March 27, by Board of Kossuth County Supervisors, Algona, Ia., for the construction of two Drainage Districts 78 and 79. Drain No. 78 to consist of 11,800 ft. of open ditch, 8-ft. base, av. depth 7 ft., estimated yardage 45,000 cu. yds., and 40,400 ft. of tile ranging in size from 8 to 26 ins. Drain No. 79 to consist of 12,200 ft. of open ditch, 6-ft. base, av. depth 6.6 ft., estimated yardage 45,000 cu. yds., and 54,620 ft. of tile ranging in size from 8 to 28 ins. Ten-per-cent check to accompany bids. B. E. Norton is County Auditor.

✣Bids will be received until 10 a. m., April 9, by Humboldt County Commissioners, Dakota City, Ia., for the construction of County Drain No. 54. The work will include the following tile drain: 3,260 ft. of 6-in., av. depth 5.3 ft.; 4,950 ft. of 8-in., av. depth 6.1 ft.; 1,800 ft. of 10-in., av. depth 6.5 ft.; 1,200 ft. of 14-in., av. depth 8.1 ft.; 1,500 ft. of 16-in., av. depth 9.3 ft.; 3,996 ft. of 18-in., av. depth 8.2 ft.; 4 ft. of 20-in., max. depth 9.3 ft. Estimated contract price, $5,315. Average haul from Hardy, 5 miles. Work to be started in 30 days and completed by Nov. 1, 1913. J. L. Parsons, Humboldt, Iowa, Engineer. Ten per-cent certified check required with bid. Bids will be received for either clay or cement tile

✣Bids will be received until 11 a. m., April 9, by Board of Humboldt County Commissioners, Dakota City, Ia., for the construction of Drain No. 45. The work will include the following tile drain: 339 ft. of 6-in., av. depth 4.5 ft.; 2,799 ft. of 7-in., av. depth 5 ft.; 3,200 ft. of 8-in., av. depth 5.1 ft.; 3,660 ft. of

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

10-in., av. depth 4.9 ft.; 5,328 ft. of 12-in., av. depth 5.7 ft.; 4,550 ft. of 14-in., av. depth 6.8 ft.; 1,600 ft. of 15-in., av. depth 8.5 ft.; 1,500 ft. of 16-in., av. depth 8.3 ft.; 500 ft. of 18-in., av. depth 6.5 ft.; 3,600 ft. of 20-in., av. depth 6.3 ft.; 1,350 ft. of 22-in., av. depth 7.5 ft.; 2,100 ft. of 24-in., av. depth 7.8 ft.: 2,000 ft. of 26-in., av. depth 7.2 ft.; 2,300 ft. of 27-in., av. depth 8.1 ft.; 2,500 ft. of 36-in., av. depth 5.6 ft.; 1,000 ft. of open ditch, 308 cu. yds. Estimated contract price is $21,497. Shortest haul is 4½ miles. J. L. Parsons. Humboldt, Iowa, Constr. Engr. Ten-per-cent certified check required with bid. Bids will be received for either clay or cement tile and for the tile and work separately.

Louisiana.

The Lafourche Drainage District has subscribed $10,000, and a preliminary survey for a drainage system will be started at once. At a meeting on March 17 the following officials of the district were elected: W. T. Couper, of Moorehouse, President; Wiley Roberts, of Richland, and N. M. Davis, of Caldwell, Vice-Presidents; G. A. Petrie, Secretary; H. D. Apgar, Treasurer, and Sandle & Clarke, Attorneys. About 428,000 acres of land will be drained by opening up the Lafourche Basin, as follows: Ouachita, 92,000 acres; Caldwell, 40,000; Richland, 76,000; Moorehouse, 220,000.

Michigan.

⊙Bids were opened March 19 by E. W. Redman, County Drainage Commissioner, Ithaca, Mich., for drainage work, contracts being let as follows: Laying 21,344 ft. tile, Henry Fuller, Ithaca, Mich., $1,851; open drain, George Kirby and Jay Borough, Ashley, Mich., $752; tile, American Sewer Pipe Co., $3,310.

Minnesota.

⊙Albrecht, Anderson & Isenberg, Glencoe, Minn., have been awarded the contract at $0.16 per cu. yd. for constructing Judicial Ditch No. 1 in Hennepin County, bids for which were opened March 17 by A. P. Erickson, County Auditor, Minneapolis, Minn.

⊙Contract for constructing Ditch No. 24 of Hennepin County has been let to Albrecht, Anderson & Isenberg, Glencoe, Minn., at $0.12½ per cu. yd. The work calls for about 68,000 cu. yds. of excavation. Bids were opened March 17 by A. P. Erickson, County Auditor, Minneapolis, Minn.

Missouri.

No decision has been reached as yet for calling for bids for ditches for Drainage District No. 10 in Beaver Dam Township. The plans of E. C. Nickey, Engineer, Poplar Bluff, Mo., call for about 35 miles of ditches.

Montana.

The U. S. Reclamation Service has rejected all bids received Jan. 22 for furnishing hydraulic and electric apparatus for the St. Mary's storage unit, Milk River project, Montana.

Nebraska.

The Culbertson irrigation ditch has been transferred to the Frenchman Valley Irrigation District, organized recently and bonded for $150,000. About $55,000 will be expended for building a dam and reservoir and for other improvements. R. D. Brown, Crete, Neb., and C. E. Eldred, McCook, Neb., are interested.

New Jersey.

⊙Jesse P. Manahan, Red Bank, N. J., has been awarded the contract at $0.02½ per lin. ft. for cutting 100,000 ft. of ditches on Newark Meadows for the Essex County Mosquito Extermination Commission. Bids were opened March 17.

New York.

✣Bids will be received until noon, April 15, by D. W. Peck, Superintendent of Public Works, Albany, N. Y., for the improvement of New York State Canals, as follows: Contract No. 112, Erie Canal, sections 9 and 10—For driving steel sheet piling in the embankment of the canal at certain localities within the limits of Contracts No. 60 and 66. Contract No. 113, Erie Canal, sections 9 and 10—For furnishing and delivering lumber and wooden piles at Bushnell's Basin, N. Y., and at Holley, N. Y. Detailed specifications, engineer's estimate of quantities, proposal blanks, form of contract and bonds required and other information for proposers may be had at the office of the Superintendent of Public Works at Albany, N. Y., at the office of the Assistant Superintendent of Public Works for the Middle Division at Syracuse, N. Y.; at the office of the Assistant Superintendent of Public Works for the Western Division at Rochester, N. Y.; and at the canal office, Spaulding's Exchange, Buffalo, N. Y. Copies of detailed plans or drawings may be obtained from the State Engineer and Surveyor at Albany, N. Y., upon payment to him of the cost of producing them.

Tennessee.

The Legislature has passed an act creating the following drainage districts in Catawba County: Lyle's Creek above the G. D. L. Yount Mill place; Pinch Gut Creek above the C. & N. W. R. R.; McLinn's Creek numbers 1 and 2 from the Catawba River to D. L. Witherspoon's farm.

Texas.

✣Bids will be received until noon, March 29, by A. and T. A. Munson, Civil Engineers, Angelton, Texas, for making and completing 8 miles of ditches for the purpose of draining lands in Brazoria County, Texas, situated about 8 miles south of Angleton, and owned by the Cochran & McCluer Land Company of Chicago, Ill. There will be approximately 38,875 cu. yds. of earth to excavate. Plans and specifications may be seen at the office of the engineers or the Cochran & McCluer Land Company. Said plans and specifications, together with bidding blanks, may be obtained for the sum of $1.50. All bids must be accompanied by a certified check for not less than 5 per cent of the amount bid.

Washington.

⊙Hans Pederson Construction Co., Madison Block, Seattle, Wash., has been awarded the contract at $20,800 for construction of a drainage system near Mabton, in Drainage District No. 12 of North Yakima County.

WATER WORKS

Alabama.

The citizens of Aliceville, Ala., on March 17 voted the issuance of bonds to the amount of $11,000 for a municipally owned waterworks plant.

California.

The City Trustees of Tehama, Calif., have been petitioned to adopt a resolution calling for an election on a bond issue to install a municipal water system.

The Chico Water & Supply Co., Chico, Calif., contemplates starting work soon on the new 150,000-gal. water tank. J. R. Robinson is President.

The citizens of Tulare, Calif., on March 12 voted to purchase the plant of the City Water Co., for $30,000. The plant will be made a part of the new $100,000 municipal water plant, bonds for which have already been voted and sold.

The Claremont Co-Operative Water Co., Claremont, Calif., has been incorporated with a capital stock of $60,000. The directors are: E. M. Pease, C. C. Johnson, E. O. Penfield, J. F. Wire and R. R. Wherry.

According to advices from Maricopa, Calif., the Western Water Co., is completing a survey for a 10-in. line from the lease of the Boston Pacific Oil Co., to a point within a mile of Maricopa.

Idaho.

The City Council of Priest River, Ida., is considering several propositions to put in a waterworks system.

F. O. Nelson, of Grace, Ida., has submitted a plan to W. H. Korns of the Water Department, Salt Lake City, Utah. to build a pipe line from Black Canyon Springs in Idaho to Salt Lake City, capable of carrying 45,000,000 gals. of water daily. The estimated cost of the project is placed at $5,000,000.

Illinois.

✣The City Commissioners of Moline, Ill., have approved plans for the remodeling of the waterworks building. This contemplates the remodeling of the engine room, extension of the boiler room at the west end of the structure 10 ft., and the raising of that portion 6 ft., making it over into a 20-ft. interior. The work calls for an outlav of $12,000. Bids are to be received on March 28 at 10 a. m. C. V. Johnson is City Clerk.

✣Bids will be received until 8 p. m., April 14. at the Town Hall, Riverside, Ill., for furnishing and delivering materials and labor necessary to construct a water works system. Details of specifications as follows: 3 700-G.P.M. motor driven centrifugal pumping units, cast iron piping, switchboard, wiring, appurtenances and machinery necessary in the insulation; 150,000-gal. steel water tank with gallery and appurtenances; pumping station building and masonry tower for water tank. Contracts to be let separate or together. Plans and specifications may be obtained at the office of D. H. Maury, Consulting Engineer, 1137 Monadnock Bldg., Chicago, or C. D. Sherman, City Clerk.

✣Bids will be received until 11 a. m., March 27, by L. E. McGann, Commissioner of Public Works, for furnishing and delivering to the water pipe extension plumbing shop. 14th St. & Indiana Ave., heavy bronze angle valves for cold water as follows: 1,000 1-in. valves, 100 1¼-in. valves, 300 1½-ins. valves, 400 2-in. valves, valves to be bronze of heavy design with iron hand wheel for opening and with renewable discs. Samples must accompany proposal. Cash or certified check for $100 must accompany bid.

✣Bids will be received until 11 a. m., March 27, by L. E. McGann, Commissioner of Public Works, for furnishing and delivering to the various pipelyards special castings for cast iron water pipe as follows: 360 tons from 4 ins. to 12 ins. in diameter; 40 tons, 16 ins. to 36 ins. in diameter; points of delivery as follows: Avers and Wabansia Ave., C. M. & St. P. switch track; 2,352 S. Ashland Ave., C. B. & Q. switch track; 49th St. and Union Ave., Pennsylvania team track; 68th St. and Yates Ave., I. C. switch track; 104th Pl. and Harvard Ave., C. & W. I. switch track. Cash or certified check for $500, must accompany proposal.

✣Bids will be received until 2 p. m., April 21, by the State Board of Administration, Springfield, Ill., for furnishing and delivering the labor, materials, etc., necessary to construct a water works for the Anna State Hospital located at Anna, Ill. The work is divided into five sections, 1, impounding reservoir and dam; 2, filter plant, buildings and grounds; 3, force main; 4, storage reservoir; 5, machinery and transmission line, section 1 consists of clearing and grubbing the basin, and grading, trimming the slopes, and constructing an earthen dam protected

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

by an 8-in. concrete core wall, approximately 350 ft. in length, with wing walls 130 ft. in length. spillway to be of concrete, 60 ft. in length. crest 22 ft. above creek bed, equipped with 2 24-in. cast iron blow off pipes; section 2 consists of sedimentation basin, clear water reservoir, filter tanks, building, etc., sedimentation tank to be constructed of reinforced concrete, approximate size, 26 ft. x 42 ft. x 11.6 ft., clear water basin reservoir to be approximately 15 ft. x 25 ft. x 10 ft., constructed of reinforced concrete, 3 filter tanks to be placed above the clear water reservoir, the same to be divided by concrete walls, with an estimated volume of concrete 22 cu. yds.; section 3 consists of furnishing and placing 3⅓ miles of force main, varying from 10 to 12 ins. in size, including valves, hydrants, fittings, etc., section 4 consists of a storage reservoir and appurtenances, the same to be a cylindrical tank, 120 ft. in diameter, greatest depth 24.83 ft. walls to be of reinforced concrete, 21.5 ft. high; section 5 consists of constructing an electrical transmission line, and telephone line. 3⅓ miles long, and the furnishing of the necessary pumping machinery, consisting of 2 50-H.P. 2,200 volt 3-phase 60-cycle 900-R.P.M. wound rotor motors, each motor to be connected to 1 triplex pump with capacity of 650,000 gallons per day, against a head of 300 ft. and 1 triplex or rotary pump, having a capacity of 300,000 gallons per day against a head of 22 ft., pumps to be Gould Mfg. Co. of Holyoke, Deane or Deming or their equal, and 1 20-H.P. 2,200 volt 3-phase, 60 cycle, 900-R.P.M. slip ring motor, direct connected to 1 1,920 gallon De Land American Well Works, Gould Mfg. Co. pump or equal; the transmission line conduit to consist of 2 duct vitrified pipe equal to that manufactured by the McRoy Clay Works, cable to be 3 conductor paper insulated, lead sheathed suitable for 2,300 volt current, poles to be of live cedar, 30 ft. in length. Estimated cost $100,000. Cash or certified check for $1,000 must accompany proposal. Plans and specifications may be secured upon deposit of $25.00 at the office of the State Board or the office of the Engineer, D. H. Maury, 1137 Monadnock Bldg., Chicago. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 2 p. m., April 21, for furnishing and erecting in the new pumping station to be erected at Anna, Ill., in conjunction with the Anna State Hospital water works, the necessary filter equipment, by the State Board of Administration, Springfield, Ill., the filter equipment includes the inlet regulating valve, in sedimentation basin, all supply pipes, valves and fittings, from the outlet pipe, effluent pipes, etc. From each filter tank, wash water drain pipes, etc., and the entire mechanical equipment of filters, including strainer system, filter beds, inlet and outlet, wash and rewash pipes, loss of head gauges, and regulating devices for the chemical plant for use in connection with alum or hpyo chlorite, as well as agitators for the chemical solution, and motors to drive the chemical apparatus, including piping, wiring and connections. Cash or certified check for $300 must accompany proposal. Plans and specifications may be had upon application to the State Board or the Engineer, D. H. Maury, 1137 Monadnock Bldg., Chicago. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 4 p. m. standard time, Apr. 14, 1913, by J. H. Moore, Commissioner of Public Works. Evanston, Ill., for furnishing and delivering such labor and materials which are necessary to construct a water filtration plant on a site already selected by the city. The work includes a mixing chamber, 96½ ft. x 14 ft. x 18 ft. deep, capacity 17,000 gals., constructed of reinforced concrete between two coagulating basins 39½ ft. x 96½ ft. x 15 ft. deep, a covered filter water reservoir about 154 x 161 ft., 6 mechanical filter units, each 23½ x 36 ft. All filter tanks floors and roofs to be of reinforced concrete, a two-story head house, 28 x 91 ft. with a wing 75 x 36 ft. of reinforced concrete. The low lift pumping machinery comprising two 8,000,000-gals. and one 5,000,000-gal. centrifugal pumps. The necessary cast iron pipe and tile pipe drains, wash water tank of steel construction, 100,000 gals. capacity with concrete foundation and a one-story low lift pump house with basement. Unit bids are required as follows; earth excavation, 22,000 cu. yds. B—rock excavation including disposal; C—mixing tanks, coagulating basins, filtered water reservoir and filter tanks complete; D—filter equipment; E—filter piping, connecting piping, chemical apparatus, piping head house and elevator; E—all outside piping including cast iron drain, head house including lighting, heating and plumbing, F—low lift pumps, valves, condensers, etc.; G—wash water tower complete; H—reinforcing steel, 18,000 lbs.; I—extra concrete, class A, 120 cu. yds. extra concrete, class B, 120 cu. yds. Plans and specifications may be had upon application to the Geo. W. Fuller Co., New York City; Langdon Pearse, 77 W. Monroe St., Chicago, Ill., or J. H. Moore, Commissioner of Public Works, Evanston, Ill., upon deposit of $25. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 7:30 p. m., March 31, by Matt Berscheid, City Clerk, Joliet, Ill., for the furnishing and erecting complete on foundations to be constructed by the said City of Joliet, a pumping plant of a capacity of 1,000,000 gals. of water per 24 hours at the site of the artesian well at the City lot on Van Buren street. The work to be embraced and covered by the proposal shall be based on the specifications now on file in the office of the City Engineer of the City of Joliet, which provide for the installation of a motor driven pump of vertical, triplex plunger type with a capacity of one million gals. per 24 hours against a domestic pressure of 55 pounds and a fire pressure of 100 pounds together with motor for operating same, also a two stage belt driven air compressor of a displacement of 700 cubic feet of free air per minute against a working pressure of 150 lbs.

✣Bids will be received until 11 a. m., April 4, by the Board of Local Improvements, Chicago, Ill., E. J. Glackin, Secretary, for furnishing labor and materials necessary to lay water service pipes in the following streets: Berenice Ave. to 48th Ave., Colfax Ave., 83rd St. to South Chicago Ave.; Drake Ave., Franklin Blvd., C. & N. W. R. R.,; Escanaba Ave., East 84th St. to East 87th St.; Exchange Ave., Baltimore Ave. to E. 87th St.; E. 84th St., Muskegon Ave. to Baltimore Ave.; N. 51st Ave., Irving Park Blvd. to Berteau Ave.; Grace St., 48th Ave. to C. & N. W. R. R.; Houston Ave., Baltimore Ave. to E. 87th St.; W. Jackson St., 46th Ave. to S. 52nd Ave.; Lawrence Ave., N. Lawndale Ave. to N. 40th Ave.; Manistee Ave., E. 86th St. to E. 82nd St.; Muskegon Ave., Baltimore Ave. to E. 91st St.; North Park Ave., South Blvd. to W. Madison St., Warwick Ave., N. 48th Ave. to C. & N. W. R. R.; Waveland Ave., 48th Ave. to C. & N. W. R. R. The contract includes the placing of Buffalo boxes, 1-in. lead pipe, etc. Cash or certified check for 10 per cent of bid must accompany proposal.

⊙Wm. Moran & Co., of Joliet, Ill., have been awarded the contract by the City Council of that city, Matt Berscheid, City Clerk, for the construction of a water main on Van Buren St., from Eastern Ave. to the new well, for $754. The main will be 8 ins. in diameter. Bids were opened March 17.

⊙L. E. McGann, Commissioner of Public Works, Chicago, Ill., has awarded to John Moore & Sons, 349 W. Illinois St., the contract for furnishing, delivering and erecting a steel shell for shaft excavation, contract price, $1,289.

⊙L. E. McGann, Commissioner of Public Works, Chicago, Ill., has awarded to Wm. Geartner, 5345 Lake Ave., the contract for furnishing and delivering to the various pumping stations 8 mercury columns; contract price, $1,600.

Following is the lowest bid submitted to L. E. McGann, Commissioner of Public Works, on March 19, for furnishing and delivering to the various pipe yards approximately 300 tons of pig lead on the switch tracks, 4.35 cts. per pound, Sleph, Sandrovitz & Goldblatt, 1108 Frank St.; the contract has not been awarded.

Following are the lowest bids submitted to L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering double gate valves of standard design with iron body, brass mountings, single stem and screw ends: 80 3-in. gate valves at $3.05 each; 100 4-in. gate valves at $4.20 each; 70 6-in. gate valves at $7.15 each; 20 8-in. gate valves at $11.90 each; total, $1,402.50. Kennedy Valve Mfg. Co., 111 W. Jackson Blvd., Chicago, Ill. The contract has not been awarded.

Following are the lowest bids submitted to L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering to the various pipe yards approximately 500 tons of round basin covers with lids, square vault covers with lids, tunnel shaft covers with lids, etc. T. A. Cummings Foundry Co., 1330 Clybourn Place.

The Southern States Engineering Co., First Nat. Bank Bldg., Chicago, Ill., will prepare plans for the construction of a new waterworks system in Corbin, Ky., at an estimated cost of $30,000. Water will probably be secured from wells.

Following are the lowest bids submitted on March 13, to the Sanitary District of Chicago, J. McGillen, Clerk, for furnishing and delivering to the store house, 31st St. and Wentworth Ave., apparatus and supplies necessary for street lighting, 18 to 30 single phase, oil insulated, self-cooled core type transformers with the required amount of oil, $735 each. Delta Star Electric Co., 637 W. Jackson Blvd., 30 to 100, 10 ampere, oil emersed constant current regulators with required amount of oil, $284 each; General electric Co., 53 W. Jackson Blvd., 100 hand operated automatic oil switches, $40.50 each; Delta Star Electric Co., 30 to 150 alternating current indicating switch board ammeters, $5.60 each; General Electric Co., 2,000 to 5,000 arc lamp hangers with lowering devices, etc., $1,275 each. Electric Service Supply Co., 417 S. Dearborn St., Chicago, 10,000 to 25,000 porcelain line insulators, $0.42 each; Electric Service Supply Co., 500 to 3,000 circuit breakers, $97.93 each; Western Electric Co., 500 S. Clinton St., 100 to 250 miles of No. 6 B. & S. gauge copper wire insulator, $20.00 per mile, guarantee delivery 20 miles per week; Western Electric Co., 500 S. Clinton St., 1,000 to 3,000 malleable iron lamp brackets, line Material Co., S. Milwaukee, Wis., $9.63 each; 1,000 to 5,000 malleable iron cross arms, $1.18 each; Line Material Co., 4 pin malleable cross arms, $1.62 each; 6 pin malleable cross arms, $1,96 each, Line Material Co. The contracts have not been awarded.

Indiana.

⊙The George J. Hoffman Construction Co., of South Bend, Ind., has been awarded the contract by the City Council of that city for furnishing the labor and material for the concrete work on the pumping station, for $9,868; also for the installation of two 300 H. P. boilers at the pumping station for $1,585. The Best Mfg. Co., of Pittsburgh, Pa., secured the contract for installing the piping system at the pumping station for $11,050.

⊙G. F. Stoeckinger, 109 W. Second St., Mishawaka, Ind., has been awarded the contract by that city for connecting six 10-in. wells and for laying a suction line, for $3,880. The wells are to be connected 25 ft. below ground level. The pipe, 200 ft., is to be laid in 25 ft.

trench, and 200 ft. in trench from 0 to 7 ft. Bids were opened March 10.

Iowa.

✣Bids will be received until April 1 (extension of date from March 25) by Town Council, Epworth, Ia., for the construction of a water works plant. J. J. Hamilton is Clerk.

⊙The Phee Construction & Engineering Co., Peoples Gas Bldg., Chicago, Ill., has been awarded the contract by the Citizens Water Co., Burlington, Ia., for the construction of a clear water basin, for $24,964. The work includes about 8,000 cu. yds. of rock excavation and 950 cu. yds. of reinforced concrete. Bids were opened March 18.

⊙The contract for the construction of the new reservoir on West Hill has been awarded by the Board of Trustees of the Muscatine Water Works, Muscatine, Ia., to W. E. Middleton of Kansas City, Mo., for $18,381. Other bidders were: J. H. Seldon, $26,000 and $27,000. Korneman & Co., $24,000; Davenport Construction Co.; Cedar Rapids Construction Co., and the Leyton Construction Co., Chicago, Ill., between $19,000 and $20,000. The reservoir will be 148 ft. square at the top with an average depth of 21 ft. 3 ins. The upper portion will be straight concrete wall 10 ft. 3 ins. high and 12 ft. at the top in thickness including the outside earth embankment. At the bottom of the straight wall will be a slope on a range of two to one to the bottom of the reservoir. The walls (vertical) will be of reinforced concrete and the slope inside will be "puddle" and brick and the floor will be finished in concrete. There will be a reinforced concrete valve house surrounded with earth on the East slope of the outside embankment.

The Citizens of Davenport, Ia., at a recent election voted against the municipal ownership of the waterworks system.

Kansas.

✣Bids will be received until 7:30 p. m., March 31, by City Clerk, Bennington, Kan., for furnishing of all material and labor required in the construction of a proposed water works system. The following is an approximate list of items required: Street mains 2,850 ft. of 6-in. standard weight cast iron pipe; 10,100 ft. of 4-in. standard weight cast iron pipe; 6,500 pounds of cast iron specials. Hydrants and valves—26 4-in. hydrants; 3 6-in. valves and boxes; 11 4-in. valves and boxes. Tower and tank—50,000-gal. tank on a 100-ft. tower. Pumping plant—One 100 g. p. m. motor-driven turbine pump; brick pumping house; 44-in. x 45-ft. well with casing. Plans and specifications will be on file at the office of the City Clerk at Bennington, Kansas, and at the office of the City's Consulting Engineers, Rollins & Wesotver, 420 Midland Bldg., Kansas City, Missouri.

An election will be held at Herington, Kans., about May 1, for the purpose of voting on the issuance of bonds amounting to approximately $50,000, to extend the waterworks system. It is proposed to obtain spring water from springs several miles distant. Karl Riddee is City Engineer.

Kentucky.

✣Bids will be received until 2 p. m., April 17, by Commissioner of Fisheries, Department of Commerce, Washington, D. C., for the construction of a pump house at Louisville, Ky., fisheries station

Louisiana.

⊙J. D. Brown, of Baton Rouge, La., has been awarded the contract by the Baton Rouge Water Works Co., W. P. Connell, President, for the construction of a concrete reservoir.

The City Council of Lafayette, La., has adopted plans prepared by Engineer Harold Raymond for a renovation of the water and light plant. Bids will shortly be asked.

Massachusetts.

The Water Commissioners of Springfield, Mass., have decided to extend the coming season the 24-in. water main from Federal St., Bay State, across the flat to the top of Brickyard hill, at the watering trough. The Commissioners also decided to replace the 6-in pipe in South St. with a 12-in. main.

The Massachusetts Legislature has been asked to allow the City of Lynn, Mass., to borrow $600,000 outside the debt limit, to extend the city's water system. Legislation permitting Lynn to tap Ipwich River at a point in Middleton has already been granted. It is planned to build 36-in. conduits all the way from Ipswich River to the city, a distance of about five miles.

Town of Millbury, Mass., has appropriated $5,500 for an auto fire truck. Ira N. Goddard is Town Clerk.

Town of North Attleboro, Mass., has appropriated $6,000 for an auto fire truck. Jas. D. Cheever is Town Clerk.

Michigan.

⊙The Waterworks & Electric Light Board, Lansing, Mich., has let a contract to E. E. Strope, Mason, Mich., for the sinking of four additional wells, each to a depth of 350 ft. The contract calls for 12-in. wells. Special machinery will be purchased by the contractor.

The citizens of Port Huron, Mich., will vote April 7 on the issuance of bonds totaling $46,000 for waterworks improvements and a sewer.

The citizens of Fenville, Mich., on March 12 voted the issuance of bonds to the amount of $11,600 to construct a waterworks system. Clifford L. Fosdick is Village Clerk.

Minnesota.

✣Bids will be received until 5 p. m., March 28, by A. J. Meyer, City Clerk, New Ulm, Minn., for furnishing all material and labor for placing gates and hydrants on 5th, North St., from Garden St. to the Loretta hospital, all according to plans and specifications on file in the City Clerk's office.

✣Bids will be received until March 31 by City Clerk, Albert Lea, Minn., for the construction of water main extensions. William Barneck is City Engineer.

Missouri.

The citizens of Lancaster, Mo., will vote at the regular election on April 1 on the issuance of bonds to the amount of $4,000 for the erection of a waterworks. C. W. Bunch is Mayor. John A. Roberts is City Clerk.

Montana.

✣Bids will be received until April 7 by City Clerk, Helena, Mont., for furnishing one auto fire wagon.

✣Bids will be received until April 7, it is reported, by the City Council of Helena, Mont., for the installation of an ornamental lighting system.

The City Council of Livingston, Mont., has accepted plans and specifications for the installation of a new waterworks system and pumping plant. An election is to be held on April 14 to vote on the issuance of bonds in the sum of $225,000.

New Jersey.

The Clementon Springs Water Co., Clementon, N. J., will construct a steel reservoir at the summit of Signal Hill, to supply water to Clementon and nearby boroughs, and a main will be extended to Berlin and other towns along the Pennsylvania railroad.

New York.

The Water Commissioners of Binghamton, N. Y., are considering the plans for the construction of a new filter plant which have been prepared by Engineer Frederick Beck.

City Engineer Edward A. Fisher of Rochester, N. Y., has asked the Common Council to authorize a note for $100,000 to provide funds for waterworks improvements.

The citizens of the Village of Madison, N. Y., have voted to expend about $14,600 for constructing a waterworks system. Fred Welch has been elected Village President.

The citizens of Manlius, N. Y., on March 18, voted to bond the village for $2,500 to change the water main in East Seneca St., from Fayette to Washington St., prior to the building of the state road. William Nightingale has been elected Village President.

Martin, Murray & Co., Troy, N. Y., on March 18 submitted the lowest bid to the Board of Water Supply of New York City, N. Y., on Contract No. 230, at $5,200. The contract calls for roofing with reinforced concrete tiles, five superstructures for Breakneck gaging chamber and Foundry Brook and Indian Brook siphon chambers, on the Catskill aqueduct

North Dakota.

The citizens of Hankinson, N. Dak., are to vote this spring on three bonding propositions, as follows: $5,000 for a city hall and fire station, $5,000 for refunding and $10,000 for a waterworks plant.

Ohio.

✣Bids will be received until noon, April 1, by W. J. Springborn, Director of Public Service, Cleveland, O., for special castings for the city water department. Specifications are on file with the Superintendent of the Water Department.

✣Bids will be received until noon, April 1, by W. J. Springborn, Director of Public Service, Cleveland, O., for automobile and auto trucks for the city water department. Specifications are on file with the Superintendent of the Department of Water Works.

✣Bids will be received until noon, April 8, by R. M. Pillmore, Director of Public Service, Akron, O., for the construction of the Cuyahoga River Dam under water works contract No. 24. The principal items as shown by the Engineers' estimate are: Earth excavation above elevation 252.0, 7,000 cu. yds.; earth excavation below elevation 252.0, 26,000 cu. yds.; rolled embankment, 15,000 cu. yds.; steel sheet piling, 15,000 sq. ft.; wooden sheet piling, 3,000 sq. ft.; riprap, 1,700 cu. yds.; cement, 12,000 bbls.; steel reinforcement, 350,000 lbs.; concrete masonry, 8,230 cu. yds.; power plant superstructure, sheet lead, 5,000 lbs.; sheet iron, 2,700 lbs.; chains, 4,000 lbs. Minor items are: seeding, sodding, road and paths, crib work, screened gravel or crushed stone, hauling and setting sluice gates, metal work, etc. Bidders may, if they so desire, submit substitute plans for the spillway section. Bidders submitting such plans will be required to indemnify the city against all patent rights or claims. Bids must be accompanied by a satisfactory bond or certified check in the sum of $10,000, payable to the City of Akron, as security for the execution of the contract. A satisfactory surety bond in the sum of $75,000 will be required from the successful bidder to guarantee proper performance of contract. All bids must be made on blank forms furnished by the city. Plans and specifications may be seen at the office of the Director of Public Service, Akron, O., or at the office of F. A. Barbour, Engineer, Boston, Mass. Official advertisement will be found elsewhere in this issue.

Oregon.

Bids are to be opened at Linnton, Ore., sometime during April for the construction of a $100,000 water system designed by Engineer Louis C. Kelsey, Selling Bldg., Portland, Ore.

The citizens of Milwaukie, Ore., have been asked to vote on the issuance of bonds to the amount of $20,000 for the construction of a waterworks system.

Pennsylvania.

✣Bids will be received until 7:45 p. m., March 28, by Dr. Thomas Monie, Secy., Special Committee, of Council, Archbald, Pa., for the purchase of 1 combination and chemical hose motor truck for the use of the fire department in the Borough of Archbold. Said truck must have a carrying capacity of from 1,000 to 1,200 ft. of 2½-in. fire hose, and be equipped with 1 40 to 50-gal. chemical tank and 150 ft. of ¾-in. chemical hose and other necessary fire fighting equipment or apparatus

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

and sufficient horse power to negotiate the hills on all the thoroughfares or streets of the borough.

The Mercersburg Water Co., Mercersburg, Pa., has decided to increase the capital stock of the company from $20,000 to $40,000 for the purpose of constructing a reservoir in the mountain above the present intake dam and for extensions and improvements to the plant.

South Dakota.

✣Bids will be received at once for the digging of about 35,000 ft. of trench for the new water works system at Yankton, S. Dak. Address Box 348, Yankton, S. Dak.

A special committee of the Commercial Club, White, S. Dak., (population 468) has presented the club with figures showing the cost of an electric light plant and waterworks system which it is planned to install for the town.

Tennessee.

Commissioner Geo. P. McTeer of Knoxville, Tenn., has asked for permission to make improvements at the water plant to increase the capacity of the filtration plant.

Texas.

⊙The Webb Co. has been awarded the contract by the City of Austin Tex., J. O. Johnson, City Clerk, for furnishing the city with a combination hose and chemical wagon for $4,802. Bids were opened March 17.

The citizens of Jacksonville, Tex., will vote April 14 on the issuance of bonds to the amount of $10,000 for water works extension and $25,000 for sanitary sewers. J. E. McFarland is Mayor.

The City of Fowlerton, Tex., plans to commence construction work within 30 days on the proposed waterworks system for which plans have been prepared.

The City Council of Mercedes, Tex., has granted a franchise to S. A. Robertson of San Benito, Tex., to operate an electric light and a waterworks plants. It is the intention of Mr. Robertson to purchase the local plants and later extend the water mains and the light system.

The citizens of New Boston, Tex., at a recent election voted the issuance of bonds to the amount of $15,000 for a waterworks system.

Washington.

⊙The City of Auburn, Wash., has let the contract for the construction of the 210,000-gal. capacity concrete reservoir for the waterworks to J. L. Playman of that city for about $5,000.

The citizens of Dayton, Wash., have voted the issuance of bonds to the amount of $12,000 for the construction of a waterworks system.

Wisconsin.

The Waterworks Committee of the City Council, Milwaukee, Wis., has recommended the adoption of a resolution appropriating $2,000 to purchase machinery for the new chlorination plant at the high service pumping station.

A system of waterworks is to be installed at Wittenberg, Wis., at an estimated cost of $33,600.

The Common Council of Beaver Dam, Wis., has asked the citizens to vote at the coming election on the matter of purchasing the local waterworks system.

Wyoming.

The citizens of Medicine Bow, Wyo., will vote April 1 on the proposition of issuing bonds to the amount of $30,000 for the installation of a waterworks system. Ed. Walter is Mayor. Emil Grooman is Town Clerk.

Canada.

✣Bids will be received until 8 p. m., April 14, by F. C. Wright, Secy-Treas., Watrous, Sask., for the following works: Contract "A"—Labor for laying water pipes and sewers. Contract "T"—Concrete sidewalks. Plans, specifications, etc., may be seen at the Town Hall, Watrous, or at the office of Chipman & Power, Engineers, Winnipeg and Toronto.

✣Bids will be received until 8 p. m., April 15, by H. W. Dixon, Secy-Treas., North Battleford, Sask., for the following works: Contract "A"—Pipe laying of waterworks and sewers. Contract "D"—Furnishing cast iron and steel water pipes and specials. Contract "E"—Fire hydrants and gate valves. Contract "S"—Furnishing vitrified tile sewer pipe and junctions. Contract "T"—Constructing concrete sidewalks and curbs. Plans and specifications may be seen at the offices of Chipman & Power, Engineers, Toronto and Winnipeg, and at the Town Hall, North Battleford, on and after March 17, 1913.

✣Bids will be received until 11 a. m., May 15, by Board of Control, Winnipeg, Man., at the office of M. Peterson, Secy., for the manufacture, delivery and erection in the generating station at Point du Bois of two 3-phase generators for direct connection to double reaction turbines and for spare parts for same. Instructions to bidders, specifications and form of tender may be obtained at the office of the City Light & Power Department, 54 King St.

✣Bids will be received until noon, April 15, by City Commissioners of Saskatoon, Sask., for one motor pumping engine of 500 gals. capacity and one motor pumping engine of 1,000 gals. capacity. A certified check for 5 per cent of the amount bid must accompany each tender. F. E. Harrison is Chairman of Commissioners.

✣Bids will be received until noon, April 9, by the City Commissioners, Regina, Sask., for the supply and delivery f. o. b., cars, Regina, of the following: Contract "B"—Approx., 77,637 lin. ft. of 6-in. cast iron pipe; approx. 7,180 lin. ft. of 8-in. cast iron pipe; approx., 2,983 lin. ft. of 10-in. cast iron pipe; approx. 1,140 lin. ft. of 12-in. cast iron pipe; approx. 9,958 lin. ft. of 16-in. cast iron pipe; approx. 10,941 lin. ft. of 18-in. cast iron pipe; approx. 16,712 lin. ft. of 24-in. cast iron pipe; approx. 96.02 tons specials. Contract "C"—Approx. 105 tons ¾-in. lead pipe; approx. 25 tons 1-in. lead pipe; approx. 4,500 lin. ft. 2-in. galvanized pipe and couplings; approx. 500 lin. ft. ¾-in. galvanized pipe and couplings; approx. 1,000 lin. ft. 1-in. black pipe; approx. 123½ tons pig lead; approx. 5 tons braided jute rope. Contract "D"—Approx. 150 2-in. brass gate valves; approx. 271 6-in. iron body gate valves; approx. 29 8-in. iron body gate valves; approx. 4 10-in. iron body gate valves; approx. 2 12-in. iron body gate valves; approx. 15 16-in. iron body gate valves; approx. 13 18-in. iron body gate valves; approx. 13 24-in. iron body gate valves; approx. 1 18-in. check valve; approx. 348 valve boxes; approx. 190 6-in. fire hydrants; approx. 10 8-in. fire hydrants. Contract "E"—Approx. 1,750 ¾-in. corporation cocks; approx. 800 lin. corporation cocks; approx. 1,750 ¾-in. curb cocks; approx. 800 1-in. curb cocks; approx. 300 ¾-in. lead to lead unions; approx. 200 1-in. lead to lead unions; approx. 150 1-in. four-way branches; approx. 1,500 No. 2 curb boxes; approx. 200 No. 4 curb boxes; approx. 200 curb box tops. Specifications and other information may be obtained at the office of J. M. Mackay, Superintendent of Waterworks. A marked cheque for five per cent of the bid must accompany each tender.

The ratepayers of Redcliff, Alta., have decided to purchase the waterworks in that town and will spend $20,000 in making improvements in the system.

SEWERAGE AND SANITATION

Alabama.

⊙The City Commission of Mobile, Ala., has awarded a contract for work on a new northern drain on Wilkinson and St. Louis Sts. to G. C. Chamberlain for $5,000. The sides and bottom of the drain are to be constructed of concrete. It is planned by the city to appropriate $5,000 annually until the drain shall have been completed to One Mile Creek.

Arkansas.

✣Bids will be received until 2 p. m., April 10, by Commissioners for Sewer District No. 16, Pine Bluff, Ark., for furnishing the necessary labor and material for the construction of sanitary sewers, including approximately 3,100 ft. of 8-in. and 8,300 ft. of 6-in. vit. pipe. Plans and specifications and bidding blanks will be furnished upon application to F. R. Allen, Civil Engineer, Pine Bluff, Ark.

California.

✣Bids will be received from 2 until 3 p. m., April 19, by Board of Public Works, San Francisco, Calif., for the completion of Contract No. 37 for the construction of sewers and appurtenances in Golden Gate Park and 48th Ave., from Lincoln Way to Cabrillo St.

⊙C. E. Chamberlain, Anaheim, Calif., has been awarded the contract by that city, Edward B. Merritt, City Clerk, for the construction of sewer connections, for 32 cts. per ft. The work includes 4 ft. vitrified pipe, 4 ins. in diameter. Bids were opened March 13.

The Board of Supervisors of San Francisco, Calif., has rejected all bids received for the purchase of the $5,248,000 bonds for city hall, school, sewer and hospital, and has ordered new bids received March 31.

The City Council of Hermosa Beach, Calif., has instructed the City Attorney to draw up papers preliminary to calling an election to vote on a bond issue of $100,000 for improvements. The proposed issue is to include $12,000 for a recreation park, with equipment, tennis courts, ball parks, etc.; $22,000 for a city hall and site; $36,000 for a sewerage system, and $10,000 for fire apparatus.

City Engineer Albert Givan of Sacramento, Calif., has submitted his report upon the work he has been engaged in securing data and making plans and estimates for the sewage system proposed for the city, for which the public will be asked to vote bonds next month.

City Engineer L. F. Warner of Auburn, Calif., has submitted complete data on sewers and sewer disposal to the Board of Trustees. It is proposed to call an election next month to vote on the proposition of issuing bonds for the improvement.

Connecticut.

The Blue Hills Improvement Association of Hartford, Conn., has requested the Common Council to construct an intercepting sewer in that section of the city at an estimated cost of $17,000

Georgia.

Mayor W. E. Watkins of Jackson, Ga., has appointed a committee to investigate the matter of taking over the private sewerage system now in operation in Jackson, with a view to calling a bond election to vote on the improvement.

Illinois.

✣Bids will be received until 2 p. m., March 27, by Board of Local Improvements, Bloomington, Ill., for performing all the labor and furnishing all the material in constructing the following improvements in accordance with the plans and specifications now on file in the office of the City Engineer at the City Hall in said city: A 12-in. vitrified brick sewer on Jackson, east of the west line of Woodland Ave., to a point 278 ft. west of the west line of Woodland Ave., in accordance with the ordinance therefor, approved November 30, 1912. A 6-in. cast iron water main on

Taylor St., between Gridley and McLean St., in accordance with the ordinance therefor, approved January 11, 1913. A brick pavement and stone curbing in the alley running east and west through the block bounded by East, Prairie, Front and Washington Sts., in accordance with the ordinance therefor, approved February 1, 1913. A certified check must accompany each proposal for an amount which shall not be less than 10 per cent of the aggregate proposal, to be forfeited as liquidated damages if the bidder fails to enter into contract, provided the same be awarded to him.

⊙The Merrifield Construction Co. of Monmouth, Ill., has been awarded the contract by the Board of Local Improvements of Galesburg, Ill., for the construction of the West Main St. sewer for $10,440, and for the sewer in Williams and Arnold Sts. for $1,255

⊙Bash & Gray of Joplin, Mo., have been awarded the contract by the N. O. Nelson Mfg. Co., at Edwardsville, Ill., for furnishing the labor for the laying of about 8,000 ft. of 8, 10 and 15-in. sewers, 4,600 ft. of 4-in. cast iron water main and hydrants and connections, for approximately $3,100. Bids were opened March 17.

⊙The following contracts for furnishing labor, materials, etc., for constructing house drains have been awarded by the Board of Local Improvements, Chicago, Ill., E. J. Glackin, Secretary: Ave. H, 107th St. to 108th St., C. Roberts, 1227 Gilpin Pl.; Coles Ave., 81st St. to 82d St., S. Ryan, 2927 Congress St.; Colfax Ave., 83d St. to South Chicago Ave., G. Barry, 4761 Shields Ave.; East End Ave., E. 82d St. to Anthony Ave., A. Mancini, 900 W. Taylor St.; 83d St., Stony Island Ave. to Anthony Ave., A. Scully, 4892 Our St.; 47th St., Leavitt St. to Western Ave., 50th Ave., Fulton St. to West End Ave., Green St., 83d St. to 84th St., Morgan St., 83d St. to 84th St., G. Barry; 73d St., Colfax Ave. to Jeffry Ave., 104th St., Perry Ave. to Indiana Ave., S. Ryan; 107th St., Wentworth Ave. to State St., M. Murphy, 5315 Wabash Ave.; Park Ave., 50th Ave. to 51st Ave., A. Muncini; Sangamon St., 83d St. to 84th St., Sherman Av., 83d St. to 87th St., Peoria St., 83d St. to 84th St., Wabash Ave., 103d St. to 107th St., 119th St., Michigan Av. to Calumet Ave., 119th Pl., Calumet Ave., 200 ft. E. Prairie Ave., 119th St. to 120th St., Calumet Ave., 119th St. to 120th St., G. Barry. Extent of work and prices published in previous issue.

Following are the lowest unit bids submitted on March 17, to the Board of Local Improvements, Chicago, Ill., for furnishing and delivering labor, materials, etc., necessary to construct brick and tile pipe sewers in the following streets. The contracts have not been awarded. E. J. Glackin, Secretary of the Board:

Street.	Length Ft.	Size In.	M. H.	C. B.	Price Bid.
Hayes Av	150	9	13	0	$2.00
Alley	1,150	9	..	..	1.35
Low bidder Geo. Pontorelli, 904 Forquer St.					
95th St	380	15	3	3	1.89
96th St	370	12	3	0	1.40
Low Bidder—Dominic Fosco, 812 S. Desplaines St.					
119th Pl	300	12	3	3	1.08
120th St	240	12	2	2	1.05
4 6-in. house drains 20 ft. long					5.00
Parkhurst Av	870	15	13	16	1.72
Parkhurst Av	730	12	..	..	1.20
Low Bidder—Geo. Pontorelli.					
LaSalle St	670	15	10	0	1.90
LaSalle St	630	12	..	..	1.75
72 6-in. house drains 20 ft. long					10.00
Low Bidder—M. Mancini, 900 W. Taylor St.					
39th St	750	15	12	3	1.90
39th St	750	12	..	..	1.60
31 6-in. house drains 20 ft. long					12.00
Low Bidder—M. Mancini.					
44th Av	360	20	26	24	1.85
44th Av	340	15	..	..	1.30
Nevada St	650	12	..	..	1.30
Wrightwood Av	670	15	..	..	1.30
Wrightwood Av	650	12	..	..	1.18
Nevada St	650	12	..	..	1.15
Low Bidder—S. Ryan, 2927 W. Congress St.					
63rd St	670	2.5*	100	135	3.55
63rd St	670	2†	..	..	2.55
67th St	670	2.5*	..	..	3.46
67th St	670	2†	..	..	2.46
Troy St	670	15	..	..	1.36
Troy St	1,340	12	..	..	1.24
Troy St	670	15		..	1.36
Albany Av	670	15	..	..	1.36
Albany Av	1,340	12	..	..	1.24
Albany Av	670	15	..	..	1.36
Whipple St	670	15	..	..	1.36
Whipple St	1,340	12	..	..	1.24
Whipple St	670	15	..	..	1.36
Sacramento Av	670	15	..	..	1.36
Sacramento Av	1,340	12	..	..	1.24
Sacramento Av	670	15	..	..	1.36
Low Bidder—P. J. McNulty, 4345 Prairie Av.					
Racine Av	1,990	4*†	36	0	8.25
Sunnyside Av	730	2**	..	..	2.55
Sunnyside Av	390	18**	..	..	2.60
Wilson Av	750	20**	..	..	2.50
Wilson Av	400	18**	..	..	2.30
Wilson Av	640	15	..	..	2.15
Leland Av	810	20**	..	..	2.35
Leland Av	410	18**	..	..	2.25
Leland Av	670	15	..	..	2.25
Alley	140	12	..	..	1.75
Alley	80	12	..	..	1.50
Alley	120	12	..	..	2.00
Alley	70	12	..	..	1.75
42 catch basins to be trapped and re-connected to new sewer					15.00
Low Bidder—M. Pontarelli, 4817 W. Dakin St.					

**Double strength tile pipe.
*†Double ring brick.
†Single ring brick.
*Double invert brick.

The City Council of Peoria, Ill., has offered to purchase the property of Smith Hancocks in the 200 block, South Washington St., for a consideration of $18,000. It is proposed to use this as a site for the new garbage plant.

The City Council of Freeport, Ill., has been petitioned to install a sewer in the southern part of the city, extending from Union to Locust Sts., on South St.

The city of Springfield, Ill., has appropriated $7,000 for the purchase of land and the erection of a garbage incinerator. J. E. Dusseldorfer, City Clerk.

The City Council of Belleville, Ill., Fred J. Kern, Mayor, has passed an ordinance providing for the construction of a sewer in Silver St., at an estimated cost of $2,854. William Ziehnert is City Engineer.

The City Council of East St. Louis, Ill., has passed an ordinance authorizing the building of the Winstanley sewer at a cost of $341,000. Work will begin within a few weeks. The sewer will drain a large territory in the residence district.

The City Council of Springfield, Ill., has passed an ordinance providing for an 18-in. sewer in Jefferson St., from 13th St., to East Grand Ave.

The City Council of Carlyle, Ill., will shortly ask for bids for the construction of a sewer in District No. 2, estimated to cost $19,000

The City of DeKalb, Ill., A. R. Russell, City Engineer, is reported to be asking for bids for the construction of a number of miles of vitrified pipe sanitary sewers.

Plans are being prepared by the Aetna Engineering Bureau, 17 N. La Salle St., Chicago, for a complete sewerage system at Bradley, Ill. Estimated cost, $80,000.

Indiana.

The Board of Public Works of South Bend, Ind., rejected all bids received March 11 for the construction of the Bowman St. sewer and has ordered the work re-advertised for April 2. William Moore is City Engineer.

Curtis Goss of Martinsville, Ind., and Thos. Harvey have been engaged by the Town Board of Danville, Ind., to make the survey and profiles for a sanitary sewer district embracing the business district, and the territory bounded by Clinton St. on the north, South St. on the south and Kentucky St. on the west.

Iowa.

⊙Dearborn & Jackson, Masonic Temple, Cedar Rapids, Ia., have been awarded the contract by that city for the laying of about two miles of sanitary sewer in the 11th precinct for $5,878. The work includes 4,810 ft. of 6-in. pipe, 2,460 ft. of 8-in. pipe, 2,480 ft. of 10-in. pipe, 36 manholes and 4 flush tanks.

⊙A. W. Merrick of Boone, Ia., has been awarded the contract at Toledo, Ia., for the building of the sewer outlet for $6,442. Work is to be completed by Aug. 1.

⊙Lytle Construction Co. of Sioux City, Ia., has been awarded the contract by that city, Paul J. Wells, City Clerk, for the construction of a sanitary sewer in South Alice St., from Dodge Ave. to Chicago Ave., for $1.43. Bids were opened March 8.

The City Council of Eldora, Ia., has set April 14 as the date for holding a special election to decide the question of extending the sewers and water drains. Bonds to the amount of $18,000 are proposed.

The City Council of Fort Dodge, Ia., has passed a resolution calling for the construction of a sanitary sewer on Eighth Ave. south, to be of 8-in. pipe with two manholes, six lampholes and two flush tanks.

Plans and specifications are now being drawn in the office of City Engineer Fred C. Smith of Sioux City, Ia., for the construction of a storm sewer for Leeds.

Kentucky.

Following low bids were received March 14 by the Board of Public Works, Louisville, Ky., for sewer work: Contract No. 12, W. H. Koppelman, New Albany, Ind., $10,841; Contract No. 13, W. H. Koppelman, $21,818; Contract No. 14, L. R. Figg Co., Louisville, $10,324; Contract No. 15, W. H. Koppelman, $21,630.

Maine.

Mayor J. G. C. Smith of Biddeford, Me., in his inaugural address advocated the building of an adequate sewer system.

Maryland.

✣Bids will be received until 11 a. m., April 2, by Board of Awards, at the office of the City Register, Baltimore, Md., for building Storm-Water Drain Contract No. 26, as shown on plans filed with Calvin W. Hendrick, Chief Engineer of Sewerage Commission, 904 American Bldg. A charge of $10 will be made for each set of specifications and blue prints, which charge will be refunded upon the return on or before March 26, 1913, of the unused specifications and plans in good condition, or of the plans and general specifications, in case a bid is submitted. A certified check of the bidder in the sum of $5,000, on a clearing house bank, made payable to the order of the Mayor and City Council of Baltimore, will be required to be deposited with each bid. Approximate quantities: 3,000 lin. ft. 78-in. x 36-in. to 54-in. x 36-in. rectangular masonry drains; 11,200 lin. ft. 48-in. to 30-in. circular masonry. drains; 365 lin. ft 30-in. to 20-in. cast-iron pipe drains; 26,500 lin. ft. 24-in. to 12-in. terra cotta pipe drains; 10,300 lin. ft. 18-in. to 12-in. inlet connections; 215 manholes; 420 inlets. The successful bidder on this contract will be required to give bond and comply with the City Charter respecting contracts.

Following bids were received by the Board of Awards, Baltimore, Md., Calvin W. Hendricks, Chief Engineer of the Sewerage Commission, for Sanitary Contract No. 109, Lateral Sewers in District 41: Carozza, Lavezza & Carozza, 2016 Pennsylvania Ave., Baltimore, $92,098; Gallagher, Boyle & Bryan, 147, W Montgomery St., Baltimore, $94,242; Wm. McCarthy & Co., Baltimore, $97,820.

Massachusetts.

The Aldermanic Committee on Finance of the City Council, Fall River, Mass., has recommended a loan of $60,000 for sewer construction work. The sum of $250,000 is now available for sewer work.

The Finance Committee of the City Council, Boston, Mass., has recommended a loan of $400,000 for sewerage works, Charles River Basin (separate system of drainage).

Town of Williamstown, Mass., has appropriated $3,500 for sewers. Geo. W. Grundy is Town Clerk.

Michigan.

The W. J. Sherman Co., The Nasby, Toledo, O., is preparing plans for the installation of a complete sewerage system and some street paving for the Village of Chesaning, Mich.

A special election is to be held in Port Huron, Mich., on April 7 for the purpose of voting on the issuance of bonds to the amount of $46,000 for improvements, as follows: An auxiliary water system, another sewer to alleviate flood conditions, and for the construction of a wall and wading pool at the intake pipe to prevent the contamination of drinking water.

The City of Iron Mountain, Mich., will let a contract early in the spring for an addition to the sewer system extending from a point on Kimberly Ave., from the alley between Hughitt and Ludington Sts., north to the latter street, thence east to the creek, near the Commercial Bank. The cost of the improvement is estimated at $9,881.

The City Council of Jackson, Mich., has decided to submit the question of issuing bonds to the amount of $68,000 for sewer, paving and water extensions to the people.

The City Council of Adrian, Mich., at the coming spring election will ask the voters of the city to decide whether or not to bond for $7,500 for sewer improvements.

The taxpayers of Flint, Mich., will vote March 20 on the expenditure of $260,000, divided as follows: $120,000 for paving, $90,000 for sewers, and $50,000 for parks.

The Common Council of Marshall, Mich., has voted to submit to the electors the question of bonding the city for $50,000 for surface sewer and paving.

The new City Council of Bellevue, Mich., has declared in favor of the installation of a sewerage system. W. E. Simon is President.

Minnesota.

⦿K. S. Johnson of Biwabik, Minn., has been awarded the contract by the city of Ely, Minn., J. Wisted, Jr., City Clerk, for the construction of storm sewers, for $33,483. The work includes 2,800 cu. yds. of earth excavation; 100 cu. yds. of rock excavation; 3,524 lin. ft. of 15-in. pipe in place; 996 lin. ft. of 12-in pipe in place; 900 lin. ft. of 8-in. pipe in place; 13 manholes and 36 catch basins. Bids were opened March 18.

⦿Lars Overn, St. Peter, Minn., has been awarded the contract by that city, M. E. Stone, City Clerk, for the construction of about 3,300 ft. of sewer, including manholes, catch basins, etc., for $6,150. Bids were opened March 17.

Missouri.

✣Bids will be received until noon, April 4, by Board of Public Improvements, Maxime Reber, President, St. Louis, Mo., for furnishing all necessary tools, labor, machinery and buildings for reduction of garbage for the city. Specifications are on file at the office of the Board.

✣Bids will be received until noon, April 4, by Board of Public Improvements, Maxime Reber President, St. Louis, Mo., for the necessary tools, labor, machinery and buildings for the reduction of garbage for the city.

Montana.

The Town Council of Eureka, Mont., has called an election for April 7 for the purpose of voting on the issuance of bonds in the sum of $7,000 for the installation of a sewerage system. A. L. Jaqueth, Kalispell, Mont., is Engineer.

The City Council of Great Falls, Mont., has created a special improvement district for the construction of a lateral sewer in 10th Av., south from the west line of 3rd St., to a point 250 ft. west of the west line of 2nd St.

Nebraska.

⦿The Katz Construction Co. of Omaha, Nebr., has been awarded the contract by the City Council of Madison, Nebr., for the construction of the sewerage system for $15,880. Other bidders were: C. F. Lytl . Sioux City, Ia., $16,700; William Lana, Council Bluffs, Ia., $17,104; A. A. Dobson Co., Lincoln, Nebr., $15,775; Park Laffler Co., South Omaha, $15,321; Bash & Gray, Joplin, Mo., $16,425; H. J. Cathrow, Omaha, $15,945; Elkhorn Construction Co., Fremont, Nebr., $16,330; Mathews Construction Co., Kansas City, $16,900; Public Service Co., Omaha. $15,980.

The business men of St. Paul, Nebr., (population 1,336) have recommended to the City Council that a special election be called to vote $10,000 in bonds for the installation of a sewerage system.

New Jersey.

✣Bids will be received until 8 p. m., April 21, by J. Y. Krout, Borough Clerk, Audubon, N. J., for the construction of sanitary sewers and sewage disposal plant for the Borough of Audubon, Camden County, N. J., and then opened before Council of the Borough of Audubon, for consideration. Approximately the work consists of the following: 66,000 lin. ft. of vitrified sewer pipe, with manholes and flush tanks; 15,000 ft. agricultural tile drain in sewer trench; sump and pumping outfit; sewage disposal works complete. Certified checks for $5,000 will be required from each bidder, and Council of the Borough of Audubon reserves the right to reject any or all bids. Plans and specifications can be had by addressing the Borough Clerk, Audubon, N. J., provided the request is accompanied by a certified check for $30, but of this amount $25 will be refunded if the copies of the plans and specifications are delivered to the Borough Clerk within five days after the opening of the bids, provided, however, that the same is in good condition. Said plans and specifications may be seen at the office of Messrs. Robinson & Wagner, Consulting Engineers, 37 E. 28th St., New York City, or at the office of John J. Albertson, Magnolia, N. J., Engineer of the Borough of Audubon.

Public hearing will be given by the Township Committee, Millburn, N. J., on April 14 on assessments made by a special commission for the construction of a sewer system in the Brantwood section.

According to advices from Atlantic City, N. J., City Engineer W. I. Risley and Mayor Bew, of Ventnor, N. J., have submitted plans for the disposition of the sewage in that city to the State Board of Health, Trenton. The plans call for the installation of a pumping station to carry the waste matter out into Beach Thoroughfare. A bond issue of $75,000 is now being acted upon by the Council.

The Board of Control of Secaucus, N. J., has ordered a special election held April 22 for the purpose of voting on the issuance of bonds in the sum of $29,000 for a sewerage system. Romeo T. Churchill is Mayor.

The following bids were received March 11 by the Passaic Valley Sewerage Commission, Newark, N. J., for constructing the southerly portion, Sta. 0-Sta. 26, of Section 6 of the main intercepting sewer. (1) standing for bid of Booth & Flinn; Ltd., Pittsburgh, Pa.; (2) bid of O'Gara & Maguire, Inc., Newark, N. J.; (3) Patrick McMeel, Passaic, N. J.; (4) Dock Contractor Co., Hoboken, N. J.; (5) Oscar Daniels Co., New York, N. Y.; (6) McCauley-Manton Co., Newark, N. J.; (7) Frawley-Kaufman Cont. Co., Inc., New York, N. Y.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Earth excavation and refilling, in trench, for 150-in. sewer	2,600 lin. ft.	$101.50	$79.77	$92.50	$77.50	$68.00	$70.00	$24.00
Concrete masonry, in trench	8,000 cu. yds.	9.00	10.50	9.00	7.83	8.00	9.00	7.50
Brick masonry, in manholes, and appurtenant work	100 cu. yds.	20.00	20.00	15.00	15.00	15.00	20.00	15.00
Rock excavation, in trench	10,000 cu. yds.	2.00	3.50	0.01	3.50	5.00	3.00	1.25
Totals		$357,900	$328,402	$311,100	$300,640	$292,300	$286,000	$136,400

New York.

✣Bids will be received until April 2 by Palisades Interstate Park Commission, 31 Nassau St., New York City, for the construction of a shelter building together with two separate buildings to be used respectively for laundry and kitchen building and toilet building, also a small sewerage disposal plant in connection with same, together with the necessary piping, appurtenances, etc. Charles W. Leavitt, Jr., 220 Broadway, New York City, is Engineer.

✣Bids will be received until 11 a. m., March 28, by Maurice E. Connolly, President of the Borough of Queens, New York City, for the construction of sewers under 11 separate contracts, the largest being No. 11, as follows: For constructing a sewer and appurtenances in Madison St., from Myrtle Ave. to Wyckoff Ave., in Wyckoff Ave., from Madison St. to Halsey St., and in Halsey St., from Wyckoff Ave. to Irving Ave., Second Ward. The Engineer's estimate of the quantities is as follows: 1,230 lin. ft. 5 ft. reinforced concrete sewer; 500 lin. ft. 4-ft. 6-in. reinforced concrete sewer; 386 lin. ft. 4 ft. concrete sewer; 700 lin. ft. 3-ft. 6-in. concrete sewer; 290 lin. ft. 12-in. vitrified salt glazed culvert pipe; 100 lin. ft. 10-in. vitrified salt glazed culvert pipe; 2,000 lin. ft. 6-in. vitrified salt glazed sewer pipe for house connections; 1 cleaning shaft, complete; 16 manholes complete; 11 receiving basins, complete; 5 double inlet basins, complete; 1 connection, complete, with existing 11-ft. 3-in. sewer; 75,000 ft. board measure, timber for bracing and sheet piling. The time allowed for completing the above work will be 150 working days. The amount of security required will be $15,000.

✣Bids will be received until 11 a. m., April 2, by Alfred E. Steers, President of the Borough of Brooklyn, New York City, for the construction of sewers under three contracts, the largest being No. 2, as follows: For furnishing all the labor and materials required for constructing sewers in Skillman St., from Park Ave. to Myrtle Ave.; in Myrtle Ave., from Skillman St. to Nostrand Ave.; in Nostrand Ave., from Myrtle Ave. to Vernon Ave.; in Vernon Ave., from Nostrand Ave. to Marcy Ave. The Engineer's estimate for the quantities is as follows: 1,141 lin. ft. 186-in. sewer, conduit section; 2,157 lin. ft. 180-in. sewer, conduit section; 1 storm water separator "A" complete; 1 storm water separator "B" complete; 1 storm water separator "C" complete; 1 inverted siphon; 346 lin. ft. 24-in. pipe sewer; 45 lin. ft. 18-in. pipe sewer; 1,090 lin. ft. 15-in. pipe sewer; 2,675 lin. ft. 12-in. pipe sewer; 100 barrels Portland cement; 5 manholes, class "A"; 46 manholes, class "D"; 5 manholes, class "F"; 235 house connection drains reconnected; 3 sewer basins rebu 14 sewer basins reconnected; 1,700,000 ft. (board measure), sheeting and bracing; 400,000 ft. (board measure) foundation planking; 200 cu. yds. class "B" concrete; 10 cu. yds. brick masonry. The time allowed for the completion of the work and full performance the contract is 350 working days. The amount of security required is $125,000.

✣Bids will be received until 5 p. m., March 29, by Board of Sewer Commission, Sharon Springs, N. Y., for sprinkling filters and settling tanks. Morrell Vrooman, Gloversville, N. Y., is Engineer.

Governor Sulzer of New York has been asked to sign the bill permitting the city of Oswego, N. Y., to construct the storm water sewer on the East Side. As soon as the bill has been signed bids will be asked. John Smith is Commissioner of Public Works.

Consulting Engineers Witmer & Brown, Buffalo, N. Y., have begun a field survey for the new sewer system which is to be established in the village of Fort Erie, N. Y. It is expected the survey will be completed within a month and plans will be prepared so that bids for the construction of the sewers may be called for early this spring. The estimated cost is $50,000.

A bill has been introduced in the New York Legislature which provides for the construction of sanitary trunk sewers and a sanitary outlet sewer in Westchester County. It is made the duty of the sewer commissioners appointed under this act to extend the sanitary trunk sewer from its northerly terminus in the town of Greenburgh, along the course of the Bronx River, to a point south of Valhalla Station, where Davis brook intersects the highway leading to Tarrytown; thence continuing through the town of Mount Pleasant in a generally northwesterly direction, and following generally the right of way of the N. Y. C. & H. R. Railway to the village of Pleasantville. The amount appropriated is $4,250,000.

The citizens of the Village of Scoita, N. Y., on March 18 voted on the proposition to expend $9,000 for the extension of sewers in the Harwell section.

North Carolina.

The Greenfield Sewerage & Development Co. of Wilmington, N. C., has been incorporated with a capital stock of $10,000. The incorporators are: R. C. Cantwell, Jr.; P. L. Cantwell, C. L. Myers, Washington Catlet, L. B. Orrell, R. O. Grant and C. K. Davis.

Ohio.

✣Bids will be received until Noon, March 27, by G. H. Lewis, Director of Public Service, Elyria, O., for the construction of a sewer in the City of Elyria, Ohio, along the following route: On Riverside Court from Lincoln Court to the north end of said Court. Said sewer shall be constructed in accordance with the plans, specifications, estimates and profiles therefor on file in the office of the Auditor of said City and in the office of the Department of Public Service of said City.

✣Bids will be received until Noon, April 7, by Director of Public Service, S. A. Kinnear, Columbus, O., for furnishing the labor and material for the design, construction, delivery and erection of incinerator plant for the disposal of rubbish, in the city of Columbus, in accordance with the plans and specifications on file in the office of Henry Maetzel, chief engineer, department of public service, City Hall, and from whom copies may be obtained.

✣Bids will be received until April 1, by B. M. French, City Engineer, Salem, O., for the construction of the Perry Township ditch, including 28,250 cu. yds. earth excavation, 24,926 cu. yds. earth and rock, 780 cu. yds. sewer excavation, 1,700 ft. of 24-in. vitrified pipe, etc. Bids must be accompanied by a certified check for $500.

⊙The Board of Control, Youngstown, O., has awarded the contract for the construction of the Westlake Ave. sewer to A. O'Horo, for $1,461, and for a sewer in Ridge Ave. to A. Serafgino, for $1,447.

The City Council of Springfield, O., has been petitioned to construct two sewers in Lowe and Florence Sts.

Bids were received on March 12 by Service Director McCarthy of Newark, O., for the construction of sewers in Union, Maholm, North sanitary and drainage, Granville, Columbia and Seventh, and Baker and South Third Sts., from the following firms: Geo. J. Bock & Sons, Coshocton, O.; Kohbarger & Hoils, Marion, O.; Adams Bros., Zanesville, O.; Shaffer & Dild, Dayton, O.; Henderson Bros., Coshocton; Pitzer & White, Newark; R. H. Nutter, Newark; D. E. Sullivan & Son, Columbus.

A. G. O'Donnell submitted the lowest bid to Service Director Bing of Sandusky, O., for the building of the new sewer in Hayes Ave., to replace the one which is now in use, extending from Taylor St., to a point beyond Fillmore St., at $7,745.

Engineer Geo. E. Arnold of New Philadelphia, O., has prepared plans for the construction of 6,000 ft. of 12-in. pipe, 4,600 ft. of 10-in. pipe, and 17,200 ft. of 8-in. pipe sewers and appurtenances for the city of Canal Dover, O., at an estimated cost of $24,000. Contracts will probably be awarded in July. Chas. H. Krantz, Director of Public Service, is official in charge.

Oklahoma.

The city of Bristow, Okla., will soon vote on the proposition of $20,000 worth of sewer bonds and $25,000 in park bonds.

Oregon.

•Calvert, Shaska & Walke, of Grants Pass, Ore., have been awarded the contract by the City Council of Corvallis, Ore., for the construction of 18 sewer laterals, at an estimated cost of $18,000. The James Kennedy Construction Co., of Portland, secured three of the laterals, and Geibish & Joplin, of Portland, secured five laterals.

⊙Barrott Bros. of Baker, Ore., have been awarded the contract at Idaho Falls, Ida., for the construction of lateral sewers in District No. 1, for $7,263, and for lateral sewers in District No. 2, for $18,482. Bids were opened March 20. Frank Beach is Engineer.

Pennsylvania.

✣Bids will be received until April 1, by Scranton Poor District, 624 Connell Bldg., Scranton, Pa., for the erection of a sewage, treatment or disposal plant at Hillside Home, near Clark's Summit, Pa. All to be done in accordance with plans and specifications now on file in the office of the Secretary, at the above address.

✣Bids will be opened April 14, at Oil City, Pa., for the construction of 3,200 ft. of 10-in. and 3,600 ft. of 6-in. sewers. G. F. Roess is City Engineer.

⊙The Department of Public Works, Pittsburgh, Pa., on March 14, awarded contracts for which bids were opened on March 7, as follows: Construction of Sewers—Liberty Ave. to M. O'Herron Co., at $5,431; Butler St., to same firm, $2,986; Melvin St., to Thomas Cronin Co., $5,689; Pattern St., to M. O'Herron Co., $861; Ridgway St., to same firm, $1,366; Liverpool St., to W. J. Payne, Jr., Co., $547; Amphere St., to M. O'Herron Co., $685; McClarren St., to same company, $649.36; Wyman alley, to same company, $4,732. Test borings for Corliss St. tunnel, to J. A. Brennan Drilling Co., $985. Grading, paving and Curbing—Craighead St., to Thomas Cronin Co., $13,171; Dyer St., to M. O'Herron Co., $903; Water St., to Booth and Flinn, Ltd., $14,609; Hoeveler St., to Booth and Flinn, Ltd., $4,768; Hoeveler St., to Booth and Flinn, Ltd., $2,879; Devonshire St., to Booth and Flinn, Ltd., $5,114; Devonshire St., to Booth and Flinn, Ltd., $5,888; Tuscarora St., to Booth and Flinn, Ltd., $6,601; Langtry St., to M. O'Herron Co., $6,197; Shelby St., to same firm, $1,267; Mary St., to same firm, $2,315; Mulford St., to W. J. Payne, Jr., Co., $1,539; Rockledge St., to M. O'Herron Co., $19,174; Merritt St., to Neelan and Daly, $4,814; Grandview Ave., to M. O'Herron Co., $9,624.

⊙The Department of Public Works, Pittsburgh, Pa., Joseph G. Armstrong, Director, awarded the following contracts for the construction of sewers and grading and paving streets: Thomas Cronin Co., Melvin St., $5,689; Craighead St., $13,171. Booth & Flinn, Water St., $14,610; Devonshire St., two sections, $5,115 and $5,888. M. O'Herron Co., Rockledge St., $19,174, and Grandview Ave., $9,624.

A special committee of the Council, York, Pa., has drafted an ordinance providing for a municipal loan to carry out certain proposed permanent improvements. The amount of the proposed loan is $300,000. The sum of $100,000 is to be expended for the completion of the sanitary sewerage system, $55,000 for street openings, and $50,000 for paving intersections.

State Commissioner of Health, Samuel G. Dixon, has issued a permit to the borough of Towanda, Pa., in which he approves the plans and specifications for the proposed $96,000 sewerage system and sewage disposal plant.

A sanitary sewerage system and sewage disposal plant are being installed by the Flannery Bolt Co., at Bridgeville, Pa., according to plans of Chester & Fleming, Hydraulic Engineers, Pittsburgh, Pa. The contract has been awarded to Pihl & Miller of Pittsburgh.

Texas.

Consulting Engineer Frank H. Todd for the city of El Paso, Tex., and Councilman recently visited the city of Albuquerque, N. Mex., for the purpose of inspecting the deep sewer system in that city. The city of El Paso plans expending $100,000 on sewer extensions. The specifications call for either vitrified pipe or reinforced concrete pipe.

Vermont.

The City Council of St. Albans, Vt., has voted down a resolution providing for the voting on the issuance of bonds to the amount of $45,000 for the construction of a sewage disposal plant. J. C. Renner is City Civil Engineer. S. C. Greene is Mayor.

Washington.

Following bids have been received by the Board of Public Works of Seattle, Wash., for the construction of sewers in West 55th St.; Ward & Scherer, $60,279; James Donofrio, $62,301; Dahlstrom & Rodal, $58,197; McGuire & Moon, $72,118, and Ferguson-Coit Co., $63,807.

The City Council of Leavenworth, Wash., plans the construction of a $30,000 sewer system.

Plans and specifications are being prepared by City Engineer Chas. W. Ewart of Aberdeen, Wash., for a trunk sewer, a system of storm sewers in tide fill district and ditches in the district west of Division St. The estimated cost of the trunk sewer is $26,970, of the storm sewers, $26,976, and of the ditches, $9,686.

The City Council of Sumner, Wash., has passed a resolution authorizing the construction of a sewer system throughout the most thickly settled district, at a cost of between $7,000 and $10,000. Contract will be let about April 15.

Wisconsin.

✣Bids will be received until 3 p. m., March 28 by Board of Public Works, Fond du Lac, Wis., for furnishing material, machinery and appliances, and constructing certain sewers with pumping station and sewage treatment plant. Said work being divided into three sections. Section 1 includes a pump pit with motor driven centrifugal pumps, settling tank, and hypochlorite treating plant, and shall be completed by Aug. 1, 1913. Section 2 includes 50 ft. of 36-in. pipe, 3,650 ft. of 30-in., 550 ft. of 24-in., 1,430 ft. of 20-in., 570 ft. of 18-in., 2,160 ft. of 15-in. tile pipe sewer, 23 manholes and one river crossing, and shall be completed Sept. 1, 1913. Section 3 includes 1,781 ft. of 18-in., 1,304 ft. of 15-in., 2,290 ft. of 12-in. sewer, with 17 manholes, one river crossing; shall be completed by Oct. 1, 1913. All proposals shall be submitted upon blank forms furnished by the board and shall be accompanied by a certified check on a National bank for an amount not less than 5 per cent of the aggregate of the enclosed proposal, made payable to the City Treasurer as a guarantee of good faith of the contractor, to enter into as agreed. Plans and specifications may be examined and blank proposals secured at the office of the City Clerk of Fond du Lac, Wis.

Plans are being prepared by Consulting Engineer Walter G. Kirchoffer, of Madison, Wis., for the construction of a new sewer system in Park Falls, Wis., at an estimated cost of $7,000. The work will include a sanitary sewer and storm sewer. Contract will be let about May 1. J. F. Blanchard is City Clerk.

Ed Johnson of Superior, Wis., submitted the lowest bid on March 18 to the City Council of Ely, Minn., for the construction of sewers, at $6,624.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

BUILDINGS

Alabama.

✣Bids will be received until April 1 by the Board of Revenue, Birmingham, Ala., for the construction of the new wing to the Jefferson County Court House.

California.

Supervisors of Tehama County held a meeting March 5 to discuss a proposition to call an election to vote on issuing bonds for $300,000 for building a court house and jail; or a bond issue of $50,000 for building a jail.

Delaware.

Bills providing for a joint county and city building in Wilmington, Del., have been signed by the Governor. The bills authorize a bond issue of $800,000 on behalf of the city and $600,000 on behalf of the county, also the appointment of a commission by the judges, with the approval of the Levy Court and City Council, which will buy the land selected, the block bounded by King, French, Tenth and 11th Sts.; the erection of the proposed building thereon and the conversion of the present Court House square into a public park.

District of Columbia.

Bids as follow were received by the Supervising Architect, Treasury Department, Washington, D. C., for the construction complete of the U. S. public building at Pueblo, Colo.; (1) bid on limestone, (2) bid on sandstone: John J. Lumstem, Grand Junction, Colo., (1), $125,670; (2), $125,670. Campbell Building Co., Salt Lake City, Utah, (2), $118,700. Hiram Lloyd Building & Construction Co., St. Louis, Mo., (1), $121,839; (2), $123,839. J. H. Wiese, Omaha, Neb., (1), $104,335. Dieter & Wenzell Construction Co., Wichita, Kan., (1), $135,350; (2), $134,800. Wm. H. Maxwell, Phoenix, Ariz., (1), $98,738.

Florida.

⊙McGucken & Hyer, Tampa, Fla., have been awarded the contract for erecting a 5-story fireproof hotel building at Lakeland, Fla., to cost $150,000.

Idaho.

Bids as follow were received Feb. 28 by the Supervising Architect, Treasury Department, Washington, D. C., for construction complete of U. S. public building at Pocatello, Idaho; (1) bid on limestone, (2) bid on sandstone: Palmberg & Mattson, Astoria, Ore., (1), $95,700; (2), $96,700. H. E. Doering, Portland, Ore., (1), $93,829; (2), $94,218. William O'Neill & Son Co., Faribault, Minn., (1), $109,389; (2), $111,849. W. D. Lovell, Minneapolis, Minn., (1), $99,450. Dieter & Wenzell Construction Co., Wichita, Kan., (1), $116,450; (2) $117,500. Northern Construction Co., Milwaukee, (1), $109,900; (2), $112,250. Sound Construction & Engineering Co., Seattle, Wash., (1), $169,638; (2), $109,638. George Curley, Salt Lake City, Utah, (1), $104,900. Campbell Building Co., Salt Lake City, Utah, (1), $105,300; (2), $104,700. Hiram Lloyd, St. Louis, Mo., (1), $109,254; (2), $112,254. J. E. Wiese, Omaha, Neb., (1), $101,180. William H. Maxwell, Phoenix, Ariz., (1), $108,818.

Indiana.

✣Bids will be received until 1:30 p. m., March 27, by N. R. Farlow, Trustee of Posey township, Rush County, Milroy, Ind., for the construction of an office building for trustee.

Iowa.

✣Bids will be received until noon, April 12, by Cress D. Mosier, Secy. of the Board, Derby, Ia., for the erection of a schoolhouse in Derby, Lucas County. Plans and specifications are on file at the bank at Derby.

Bids as follows were received March 17 by the Supervising Architect, Treasury Department, Washington, D. C., for the construction of the U. S. post office at Denison, Ia., (1) bid on limestone, (2) bid on sandstone: James Corse, Racine, Wis., (1) $48,500, (2) $50,000; Wm. O'Neil & Son Co., Faribault, Minn., (1) $48,931; W. D. Lovell, Minneapolis, Minn., (1) $51,780; Conners Bros. Co., Lowell, Mass., (1) $52,700; General Construction Co., Milwaukee, Wis., (1) $55,589, (2) $57,389; Northern Construction Co., Milwaukee, Wis., (1) $55,600, (2) $58,400; Joseph B. Betts, Massachusetts Bldg., Kansas City, Mo., (1) $59,500, (2) $59,500; C. E. Atkinson, Webster City, Ia., (1) $59,961, (2) $60,961.

Kansas.

Bids were opened Feb. 27 by the Quartermaster at Fort Riley, Kan., for an addition to the post bakery, the bid of C. C. Stevenson, Junction City, Kan., at $8,082, being recommended for acceptance.

Bids as follows were received Feb. 19 by the Supervising Architect, Treasury Department, Washington, D. C., for the construction of the U. S. Post Office and Court House at Topeka, Kan.: Mississippi Valley Construction Co., Fullerton Bldg., St. Louis, Mo., $84,791; Joseph B. Betts, Massachusetts Bldg., Kansas City, Mo., $87,230; George A. Shaul, Seneca, Kan., $89,297; Tom Lovell Sons, Enid, Okla., $90,991; Hiram Lloyd Building & Construction Co., Odd Fellows' Bldg., St. Louis, Mo., $91,347; General Construction Co., Milwaukee, Wis., $92,900; M. Yeager & Son, Danville, Ill., $91,793; Conners Bros. Co., Lowell, Mass., $91,800; Frank H. Latimer & Son, Massachusetts Bldg., Kansas City, Mo., $94,239; King Lumber Co., Charlottesville, Va., $96,800; James Corse, Racine, Wis., $95,200.

Minnesota.

✣Bids will be received until 10 a. m., April 1, by John P. Paulson, Lake County Auditor, Two Harbors, Minn., for the furnishing of all labor and all material (except the brick, sand and gravel) in the erection and construction of Lake Couny poorhouse to be erected on the building site on Lake County poor farm located on Southwest quarter (S. W. ¼) of Section 16, Township 53, Range 10 West, and certified check equal to the amount of 5 per cent of bid to accompany each bid. Plans and specifications are on file in the office of County Auditor at Two Harbors, Minn. and with John I. Wangenstein, Architect, Torrey Bldg., Duluth, Minn.

Missouri.

Bids as follows were received March 13 by the Supervising Architect, Treasury Department, Washington, D. C., for construction of an extension to the U. S. Post Office and Court House at Springfield, Mo.: General Construction Co., Milwaukee, Wis., $96,666; Wise Granite Co., Richmond, Va., $98,900; Hiram Lloyd Building & Construction Co., Saginaw, Mich., $103,313; L. W. Dumas, Jr., Construction Co., Columbia, Mo., $107,400; Springfield Plaining Mill, Lumber & Construction Co., Springfield, Mo., $115,900.

New Jersey.

⊙Contract for building an addition to bakery at Fort Hancock, N. J., bids for which were opened March 19, by the Constructing Quartermaster, has been let to R. C. Emmons, Brooklyn, N. Y., at $4,743.

New York.

✣Bids will be received until 11 a. m., April 4, by F. G. Ward, Commissioner of Public Works, Buffalo, N. Y., for furnishing the labor and material required in the installation of the heating, plumbing and power plant equipment in connection with the erection of a new fireproof high school building, to be known as the Masten Park High School, and to be located in Masten Park. Plans and specifications will be on file, and may be examined by contractors or sub-contractors, at the office of the Deputy Building Commissioner, Room 6, Municipal Building, where blank forms of proposals and any desired information may be obtained.

⊙Fuller & Robinson Co., Architects, 95 State St., Albany, N. Y., have awarded Barrows-Stewart Co., 17 Battery Pl., New York City, the general contract for the construction of the new Nurses' Home for the Albany Hospital, Albany, N. Y. Building is 192 ft. x 85 ft., 5 stories and basement, of brick, reinforced concrete and steel construction. Barrows-Stewart Co. are taking bids on all lines of subcontract work and will commence operations immediately.

A bill has been introduced in the State Legislature providing for a bond issue of $8,000,000 for the purpose of constructing and equipping state administration buildings in Albany, New York and Buffalo. The bill provides that $4,750,000 shall be used for a site and building in Albany. The law is not to take effect until it has been submitted to the people and voted for at the general election next fall.

Ohio.

✣Bids will be received until 11 a. m., April 18, by Capt. H. S. Brown, C. A. C. Signal Officer, Columbus Barracks, O., for concrete material and labor finishing and installing material for underground duct and trenched cable system at Columbus Barracks, Ohio.

The Reaugh Construction Co., 516 Garfield Bldg., Cleveland, O., at $144,000, was low bidder March 17 for the construction of a woman's building and hospital building at the State Correction Farm, Warrensville.

Bids have been taken by Hubbel & Benes, Architects, Citizens Bldg., Cleveland, O., for the erection of the Illuminating Co.'s substation and 12-story office building on the old Lyceum Theater site at Cleveland. The building will cost approximately $500,000.

Bids as follows were received March 19 by the Supervising Architect, Treasury Department, Washington, D. C., for the mechanical equipment, except elevators and lifts, of the U. S. Post Office and Court House at Dayton, O.: S. Faith & Co., 2433 Pennsylvania Ave., Philadelphia, Pa., $56,787; Fitzpatrick & Koepfner, Columbus, O., $57,877; W. G. Cornell & Co., Washington, D. C., $60,490; Thompson Starrett Co., 51 Wall St., New York City, $65,500; Mechanical Construction Co., Milwaukee, Wis., $88,850.

Pennsylvania.

⊙Walker & Curley, Bessemer Bldg., Pittsburgh, are to erect the brick and steel railroad shops and power house for the Pittsburgh & Lake Erie R. R. at Dickerson Run, to cost $75,000. The contract for the foundations was let to P. Sinnott & Sons, North Side, Pittsburgh.

The Hunting-Davis Co., architects, Farmers' Bank Building, Pittsburgh, Pa., is working on plans for private parties for the construction of a manufacturing plant to cost $150,000. It is proposed to erect a number of buildings of brick and reinforced concrete, one to be 60x128 ft., two stories; one 70x192 ft., two stories, and a third 60x353 ft. Plans will be completed by the end of April. Architects Kiehnel & Elliott, Publication Bldg., Pittsburgh, Pa., are preparing new plans for the erection of a 2-story brick tuberculosis hospital to be erected on the Leach farm, near Highland Park, to cost $150,000. The building will probably consist of two sleeping pavilions, administration building and service building. Architects Janssen & Abbott, Renshaw Bldg., Pittsburgh, Pa., are preparing plans for a 12-story brick and terra cotta fireproof department store addition for the Kaufman Department Stores, to be built at 5th Ave. and Cherry Way, Pittsburgh, to cost $1,500,000. Plans will be completed by April 5.

The American Iron & Steel Manufacturing Co., Lebanon, Pa., has adopted preliminary plans for a new steel plant to be constructed

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

in the next 12 months at an expenditure of about $500,000.

Texas.

A new County Court House is to be constructed at Palestine, Tex., at a cost of about $175,000. Structure is to be three stories and basement and fireproof. C. H. Page & Bros., Austin, Tex., are the Architects.

Wisconsin.

Bids as follows were received March 15 by the Supervising Architect, Treasury Department, Washington, D. C., for the construction of the U. S. Post Office at Waukesha, Wis., (1) bid on limestone, (2) bid on sandstone: General Construction Co., Milwaukee, Wis., (1) $68,780, (2) $72,400; James Corse, Racine, Wis., (1) $70,420, (2) $73,310; Northern Construction Co., Milwaukee, Wis., (1) $72,560, (2) $75,661; Thomas W. Cissel, Elwood, Ind., (1) $72,637, (2) $76,000; George W. Stiles Construction Co., Rookery Bldg., Chicago, Ill., (1) $73,825; American Construction Co., Milwaukee, Wis., (1) $74,200, (2) $78,200; R. S. Moore, Lafayette, Ind., $75,111, (2) $79,360; Fraser & Grumke, Appleton, Wis., (1) $88,333.

Canada.

⊙Peter Lyall & Sons Construction Co., Winnipeg, Man., has been awarded the contract at $114,700 for constructing a 12-room school room at Moose Jaw, Sask.

RIVERS AND HARBORS

Alabama.

The Board of Engineer Officers, charged with the consideration of the improvement of the Mussel Shoals section of the Tennessee River for the purpose of navigation combined with water power, has prepared plans and estimates for the cost of the structures necessary for securing both results, and is now prepared to receive proposals from any parties who may desire to co-operate in this combined water power and navigation development. The plans selected by the Board involve the construction of three dams, located between Florence and Decatur, Ala. The first has an available head varying from 64.5 ft. at low water to 45.5 ft. at extreme high water; the second has a head varying from 35 ft. to 29.5 ft., and the third has a head varying from 35 ft. to 28.5 ft. The plans provide for a power house at each dam and propose to utilize for primary power 10,000 second-feet; and for secondary power the next 10,000 second-feet of discharge. These plans provide locks necessary for 6-ft. navigation between Florence, Ala., and Decatur, Ala., with provision for ultimate deepening to 9 ft. The studies of the Board indicate that the three dams combined will develop at the switchboard of the power house approximately 105,000 h.p. electrical current for primary power, and about 95,000 h.p. for secondary power. The plans prepared by the Board and the details of the hydraulic studies for power are on file in the United States Engineer Office at Nashville, Tenn., and these may be examined by any company desiring to make an offer for the power. The proposals will be received at Nashville until 11 a. m., June 24.

California.

✣Bids will be received until 11 a. m., April 14, by Lieut. Col. Thomas H. Rees, U. S. Engineer, Custom House, San Francisco, Calif., for dredging in Oakland harbor, Calif.

✣Bids will be opened March 28 by the Board of Public Works, Los Angeles, Cal., for dredging slips 1 and 5 and filling lands adjoining. The amount of dredging from the two channels is 1,300,000 cu. yds. This is to be taken equally from the two channels—one being the south end of the Mormon Island channel and the other a channel in the Wilmington Basin. Homer Hamlin is City Engineer.

The Pacific Gas & Electric Co., San Francisco, proposes to expend $590,000 for enlarging the Bear River Canal. The canal will carry water to the Lake Spaulding reservoir.

The Great Western Power Co., Shreve Bldg., San Francisco, has been granted permission by the State Railroad Commission to raise $4,411,000 of bonds for improvements in Butte and Plumas Counties. Of the bond issue $1,607,635 is for the building of the gravity type dam at Nevis to form a reservoir in the Big Meadows in Plumas County. The other items are $709,975 for extension of the distribution system; $362,602, improvement in service, $639,627 for extensions to the Big Bend plant, 20 miles above Oroville on the Feather River, and $200,000 for additions to reservoir property in Big Meadows.

Connecticut.

✣Bids will be received until 2 p. m., April 21, by Maj. G. B. Pillsbury, New London, Conn., for removing riprap stone dike in Connecticut River above Hartford, Conn.

✣Bids will be received until 2 p. m., April 19, by Maj. G. B. Pillsbury, U. S. Engineer, New London, Conn., for the construction of timber and brush spur dikes at Press Barn Bar, Connecticut River, Conn.

✣Bids will be received until 2 p. m., April 12, by Maj. G. B. Pillsbury, New London, Conn., U. S. Engineer, for maintenance dredging in Connecticut River below Hartford, Conn.

Delaware.

✣Bids will be received until 11 a. m., April 15, by Maj. R. R. Raymond, U. S. Engineer, Wilmington, Del., for dredging Little River, Del.

All bids received by the U. S. Engineer for dredging harbor at Wilmington, Del., have been rejected on the ground that they did not conform to the specifications. New bids will be asked.

District of Columbia.

✣Bids will be received until 10:30 a. m., May 14, by Maj. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing and erecting coal-handling machinery and accessories for two coaling plants.

✣Bids will be received until noon, May 19, by Josephus Daniels, Secretary of the U. S. Navy, Washington, D. C., for constructing by contract one submarine tender, No. 2.

✣Bids will be received until 10:30 a. m., April 9, by Maj. F. C. Boggs, General Purchasing Officer Isthmian Canal Commission, Washington, D. C., for furnishing under Canal Circular 767 sand blast equipment, steel castings, wire, zinc plates, washers, bits, chisels, cable clips, track levels, journal jacks, vises, forges, files, wrench parts, paint brushes, scrubbing brushes, hose nozzles, hand oilers, tallow pots, grease cups, steam gages, buckets, metallic tapes, rules, hose, packing, railway flags, chalk line, twine, green enamel and chrome yellow.

Florida.

City Council of Kissimmee, Fla., has authorized City Engineer R. H. Ludlam to make surveys and estimates for reclaiming the water front and building a concrete dock.

Kentucky.

⊙The Levee Board at Hickman, Ky., has awarded the contract for closing breaks in the Big Lake Levee to Walter Lee at 17.7 cts. per cu. yd. About 35,000 cu. yds. of earthwork will be required.

Minnesota.

Plans have been prepared for a coal dock to be erected in West Duluth, east of the Grassy Point tracks of the Northern Pacific R. R. The dock will cost about $500,000 and will have a storage capacity of 500,000 tons. It is to be erected for the Berwind Coal Co.

New Jersey.

✣Bids will be received until noon, April 18, by Col. W. T. Rossell, U. S. Engineer, 802 Army Bldg., New York City, for dredging in Woodbridge Creek, Matawan Creek, Shoal Harbor and Compton Creek and Shrefsbury River, N. J.

New York.

Estimates have been prepared by Calvin Tomkins, Dock Commissioner, Pier A, Battery Pl., New York, for a 1,200-ft. pier at the foot of West 46th St., and for a half-pier of equal length at the foot of West 44th St. The estimated cost of the piers, which will provide berths for three ships, is $5,816,000. The estimate does not include the cost of acquiring land under water between street lines.

The Maryand Dredging Co., Baltimore, Md., at $1,000,098, was the low bidder for the construction of a concrete arch at Medina in connection with the barge canal. The bid was about $131,000 under the engineer's estimate.

Bids were opened last week by the State Superintendent of Public Works, Albany, N. Y., for the contract to excavate the Hudson River channel for a distance of 4 miles north of Waterford in connection with the barge canal. James Stewart & Co., of New York, bid $1,534,603, and P. McGovern & Co., of New York, bid $1,571,278. Proposals were asked for three times, and on the two former occasions only one bid was received, the amount being about the same as the Stewart Co.'s bid

North Carolina.

✣Bids will be received until 2 p. m., April 14, by Lieut. J. R. Campbell, Constructing Quartermaster, Fort Caswell, N. C., for dredging creek at Fort Caswell, N. C.

Ohio.

✣Bids will be received until noon, March 31, by Director of Public Service, Lorain, O., for furnishing the necessary labor and materials for improving Black River by the construction of a timber bulkhead dock and doing the necessary dredging in front of same, according to plans and specifications on file in said office. All bids must be accompanied by a certified check for 10 per cent of the proposal. The cost is estimated at $5,000. L. B. Johnston is Clerk.

Pennsylvania.

The Pennsylvania R. R. has appropriated $250,000 for preliminary work for an iron ore dock at Erie. An expenditure of about $1,000,000 is planned.

South Carolina.

✣Bids will be received until noon, April 10, by Maj. G. P. Howell, U. S. Engineer, Charleston, S. C., for dredging in Archer's Creek, S. C.

Texas.

✣Bids will be received until noon, April 14, by Maj. T. H. Jackson, U. S. Engineer, Dallas, Texas, for one-man stone and crushed rock delivered at Crockett, Texas, on the International & Great Northern Ry.

Virginia.

✣Bids will be received until noon, April 10, by Lieut.-Col. Eveleth Winslow, U. S. Engineer, Custom House, Norfolk, Va., for the removal of an iron barge "Florida," sunk in Hampton Roads, Va.

Wisconsin.

⊙The M. A. Hanna Dock Co. has awarded a contract to the Mead-Morrison Manufacturing Co. for a steel bridge, steel cable railway trestle and other equipment of the kind for improvement to its property on Connor's Point in Superior. It is stated that other contracts will be let within a few days for improvements to additional property at the same place.

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and to Methods and Cost of Construction

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Some Physical and Financial Aspects of the Mechanical Cleaning of Water Mains.

The mechanical cleaning of water mains is now so far beyond the experimental stage that it is coming to be looked upon as one of the well established procedures of water departments in maintaining their distribution systems. There are, however, a few physical and financial aspects of the process which are causing discussion among water works operators.

At the coming annual convention of the American Water Works Association, which will be held in Minneapolis next week, the first four topics scheduled for discussion in the "Question Box" relate to the mechanical cleaning of water mains. Since every water department in the country will probably find it expedient to resort to the mechanical cleaning of its mains at some time, it is desirable that this matter be discussed thoroughly at the convention.

The four questions cover the ground fairly well and are as follows: (1) Have you had any experience with mechanical cleaning of water mains? (2) If you have had experience has it been satisfactory and to what extent did it increase the capacity of the pipes cleaned? Did it obviate or delay the necessity of laying new mains? (3) Have you observed the effect of mechanical cleaning on the pipes and estimated the frequency with which they will have to be recleaned? That is, will tuberculation form more rapidly on cleaned pipes than on new or old uncleaned pipes? (4) In cleaning pipes have you closed the opening permanently or installed hatch boxes or other devices in manholes, with a view to future cleaning without tearing up streets and cutting pipes?

The foregoing questions are pertinent and, as previously stated, they cover the ground fairly well. There should he available, at this time, many data along the lines suggested by the questions here quoted. In 1912 alone 100 miles of cast and wrought iron mains, ranging in size from 4 to 30 ins. in diameter, were cleaned in 23 American cities by one cleaning company. In these cities the increased carrying capacity of the cleaned mains was not lower in any case than 14 per cent. The opinion has been expressed frequently that mechanically cleaned mains corrode more quickly after cleaning than before, and that the high initial improvement in carrying capacity is not long sustained. Data on these points are highly desirable. That hatch boxes should be installed in cleaning pipes to facilitate future cleaning seems to be the consensus of opinion of those who have discussed the subject heretofore. Data on the cost of opening the pavement, excavating to the pipe, cutting out a section of pipe and inserting the cleaning devices, compared to the cost of building, maintaining and using the permanent hatch boxes, are needed.

It is hoped that those who have the discussion in charge will amplify the questions somewhat so as to include more of the economic phase of the question. Data on the relative economy of having mains cleaned by contract and by the water department's field forces would be received with interest. Data on the actual cost of cleaning mains are greatly needed, as few have been published. It is customary to state that the cost of cleaning mains by contract ranges from, say, 10 to 20 per cent of the cost of laying new mains. That suggests at once that the mechanical cleaning of mains, even at such costs, is economically justifiable, but we are left somewhat in the dark as to the actual cost of cleaning mains. Contractors engaged in this kind of work are entitled to a legitimate profit, assuredly, but whether the charge is reasonable or exorbitant can best be ascertained by water works men generally from the officials of water departments of cities where mains have been cleaned. Due weight of course should be assigned to variations in local conditions. We hope that some data on costs will be brought out in the discussion.

We do not imply that contract prices for this work are exorbitant. However, there is an impression among some water works men that the usual prices are needlessly high for work of such a simple nature and of so little hazard. We believe that both officials and contractors would benefit from greater publicity of these cost data.

The economy of installing manholes and hatch boxes at the time mains are laid, in anticipation of future mechanical cleaning, is also worthy of some discussion. This is especially true of extensions to mains in cities where the local conditions are such that pipes become rapidly choked up from any cause.

As stated the subject is a very timely one and we trust that it will be thoroughly and authoritatively discussed at the convention. If any of our readers have actual data on the cost of cleaning mains which they care to make public we shall be pleased to aid in giving publicity to such data.

Construction Methods and Labor Costs on the Minneapolis Filtration Plant.

As announced in a previous issue the first of two articles on the construction methods and the corresponding labor costs on the Minneapolis water filtration plant is published in the present number of this journal. The second construction article will probably be published in July.

The present article discusses the day labor system of doing work in Minneapolis. All other conditions under which the work was done are described, particularly such conditions as had a bearing upon the cost of doing the work. The article is fully illustrated to show construction methods and arrangement of construction plant. It should be noted that unit labor costs only are given. These costs were kept primarily for the purpose of testing the economy of doing the work. From week to week comparisons of labor costs were made with those of preceding weeks and the need of different methods or the desirability of speeding up the construction gangs was thereby clearly indicated. The costs were kept, then, as a means of gauging the efficiency of conducting the work. The cost of material was not considered essential to this purpose so the cost data on materials were not computed. The cost data given are accompanied by notes and by descriptive matter in the text of the article to aid in their interpretation.

The article will be of interest to all water works superintendents and engineers. The author's description of construction methods is especially good and renders the article of great value even to those who are not interested in cost data. The unit cost figures given are the averages of the weekly costs of all the work of a certain character done throughout the year. They will prove very valuable in estimating on work of this character and as a measure of efficiency on other construction jobs on similar plants.

On Interesting the Public in Water Systems and Securing Popular Good Will.

In the preceding number of this journal a brief account was published of the methods employed by the Danville Water Co. to promote pleasant relations with the public served by the company. Realizing that acquaintance with the difficulties under which a water system must operate at times will tend towards a minimum of adverse criticism of the service rendered, many water companies and water departments are spending considerable time and money for the purpose of explaining to the public the features and occasional difficulties connected with the operation of local water systems. The work done in this connection by the Danville Water Co. illustrates one form of interesting and instructing the public along the lines here under consideration. Two additional examples will be given, based upon the practice of the Department of Water of San Diego, Cal., and of the Terre Haute Water Works Co., of Terre Haute, Ind.

The report of the San Diego Water Department for 1912 bears strong evidence of the desire of the Superintendent to interest the public in the water supply system. It also makes clear the desire of the officials of the department to establish and maintain the most friendly relations with the public. The report is a very readable document and, without dispensing with the publication of the essential technical data usually included in such reports, it gives much matter of popular interest presented in popular language. The difficulties encountered and overcome in the operation of the works during the year are enumerated and discussed in an interesting manner. The present extensive features of the water works and its proposed major extensions are described, the organization of the department is clearly described and diagrammed, and department methods and procedure are fully explained. A history of the growth and development of the city's water supply is also included. Incidentally, a view of the water department exhibit at the city's industrial fair is included. The slogan of the department: "The People Be Pleased," is printed in a conspicuous part of the report.

The annual report forms a convenient agency for interesting the public in its water works. Every water system, sufficiently important to issue an annual report, contains many features of design, construction, or operation of potential popular interest. All such departments contain at least one man who is capable of describing such features in a manner which would interest the public. Such descriptions should be published in the annual report as well as the data now commonly given which are devoid of popular interest.

A different, though equally interesting, water department publicity method is illustrated by a recent advertisement of the Terre Haute Water Works Co. This advertisement was published in one of the Terre Haute newspapers shortly after the great flood of this spring. It was published under the caption: "The Public Be Pleased." It sets forth the desire of the company to make the water works system as near perfect as it can be made. An idea of the training and experience of those in charge is given. The advertisement states that during the recent flood, while the usual pressure was maintained, the quality of the water was below the usual standard of purity for a period of three days. The plans of the company to avoid a repetition of this experience, even during a greater flood, are announced. It is further stated that during 1912 the bacterial reduction effected by the purification works averaged 98.4 per cent, "something a little nearer perfection than we poor mortals attain personally." Obviously other water departments and water companies will do well to adopt this form of publicity.

In almost every address delivered nowadays by railroad officials the belief that the railroads are being subjected to a form of persecution, through rate reduction and other adverse forms of legislation, is expressed. These officials now realize that the financial well-being of the railroads is coming more and more to rest in the hands of the people. For that reason popular favor is being more sought after by the railroads at this time than ever before. The railroads have been very slow to appreciate the money value of courtesy to and fair dealing with the public. The early railroad financier who expressed the sentiment so very like "The Public Be Pleased" in phraseology but so totally different in meaning, merely expressed the attitude toward the public of the railroad men of his and later times. The railroads are now experiencing and probably for some time in the future will continue to experience the results of setting the public at naught. The railroad ills brought about by adverse legislation are, in part, a direct result of the early policy of railroad operating employes, big and little, of riding rough-shod over everything and everybody. At this late date the railroads are fully appreciative of the value of popular good will. Water department officials, noting the predicament of the railroads, should insist that their employes be courteous in transacting business with the public.

In conclusion we wish to point out to the officials of privately owned water works systems that nothing so surely staves off or avoids rate and other disturbing agitations as popular confidence in and high regard for the officials of the company, and approval of the service rendered. Officials of municipally-owned water works properties who enjoy the water works business and wish to continue in it can best insure their futures in that business by adopting for their own the slogan: "The Public Be Pleased."

GENERAL ARTICLES

Allowable Heights and Areas for Factory Buildings.

In the design of factory buildings, one of the vital features tending to control the spread of fire is a judicious limitation of height and area. It is self-evident that whatever restricts a fire reduces the life hazard. Owing to the supreme importance of these two subjects, a person contemplating the erection of a building of this class should give careful consideration to the history of fires in such buildings, and the experience gained in fighting them. The question is more acute in this class of buildings than in any other because of the fire hazard which exists in them, and the economic advantages due to reduced costs in construction and supervision, when several large areas are housed under a single roof. Just where to draw the line so as to produce reasonable safety without prejudice to building investments is the problem.

TABLE I.—GENERAL AVERAGE OF 99 TO 111 REPLIES RECEIVED FROM ALL CLASSES OF CITIES.

Type of building.	Stories in height.	Area between fire walls in sq. ft.
Non-fireproof, not sprinklered	3.1	6,300
Fireproof, not sprinklered....	4.9	12,300
Non-fireproof, sprinklered....	4.6	12,800
Fireproof, sprinklered........	7.0	27,100

Average story height was 12 to 13 ft.

Factory buildings of excessive heights or areas have long been recognized by underwriting organizations as a grave danger to life and property, owing to the difficulty of controlling fires in them.

TABLE II.—GROUP 1—SUMMARY OF ANSWERS FROM 52 CITIES WITH A POPULATION OF 20,000 TO 50,000.

Type of building.	Stories in height: Average.	Max.	Min.	Answers above average.	Area in sq. ft.: Average.	Max.	Min.	Answers above average.
Non-fireproof, not sprinklered	2.8	6	1	13	6,000	20,000	1,150	15
Fireproof, not sprinklered...	4.4	10	2	24	12,600	60,000	1,150	15
Non-fireproof, sprinklered...	4.1	8	2	17	12,300	*60,000	3,000	17
Fireproof, sprinklered........	6.3	12	3	18	27,300	*180,000	5,000	20

*Four votes received in favor of "no limit to area" in this class.

It is logical to assume that the men best fitted to determine safe limits of heights and areas are the men who have made a life work of combating fires under all conditions of weather and hazard. With this idea in mind, Prof. Ira H. Woolson of New York City communicated with all the fire marshals and fire chiefs in the United States representing cities of over 20,000 population. A set of eight questions and a letter of explanation were sent to each. Replies were received from 117 representative cities well distributed as to size and geographical location. These have been summarized and form the basis of a paper before the American Society of Mechanical Engineers, which we reprint as follows:

A few of the replies indicated a misunderstanding of the questions, and these were discarded. The questions were as follows:

1. What should he the greatest height allowed for manufacturing or warehouse buildings without sprinkler equipment?

Brick and joist construction......................
Fireproof construction............................

2. Take the same question as No. 1, but assume the buildings to be fully equipped with automatic sprinklers. What height would you approve?

Brick and joist construction......................
Fireproof construction............................

3. What should be the greatest floor area allowed in the same class of buildings without sprinkler equipment?

Brick and joist construction......................
Fireproof construction............................

4. If the same buildings were fully equipped with automatic sprinklers, what area would you approve?

Brick and joist construction......................
Fireproof construction............................

Each building was assumed as a good one of its class, with enclosed stairways and elevator shafts; and the chiefs were requested to base their answers upon experience in fighting fires in the class of building described, and to assume restrictions which would afford a reasonable chance of controlling a fire on any floor.

TABLE III.—GROUP II—SUMMARY OF ANSWERS FROM 23 CITIES WITH A POPULATION OF 50,000 TO 100,000.

	Stories in height			Answers above	Area in sq. ft.			Answers above
Type of building.	Average.	Max.	Min.	average.	Average.	Max.	Min.	average.
Non-fireproof, not sprinklered	3.2	6	1	8	8,300	40,000	2,500	5
Fireproof, not sprinklered...	5.2	10	1	6	14,800	60,000	2,400	4
Non-fireproof, sprinklered...	4.8	10	3	5	16,300	75,000	1,500	5
Fireproof, sprinklered........	7.7	20	4	5	36,300	200,000	4,000	5

Naturally, and quite properly, the replies reflect the local conditions, such as the efficiency of the fire department, the water pressure, the combustibility of the goods being manufactured, the number of sprinkler equipments in service, and the degree of congestion among the buildings. However, all conditions were represented, and the summary of so large a number of opinions should indicate fairly well the average condition throughout the country. (See Table I.)

The answers regarding allowable heights were much more uniform than those relative to area. It is significant that 83 per cent of the replies would limit the height of a fireproof sprinklered factory building to less than ten stories. The opinions in reference to height of the other classes of buildings were exceedingly uniform, and consistently low.

Replies as to permissible areas in sprinklered buildings were widely divergent, but for the unsprinklered classes they were more uniform than would naturally be expected considering the great diversity of conditions under which they were prepared.

It is evident from the figures given that the fire chiefs have no settled policy among themselves as to the credit that should be given to an automatic sprinkler equipment as a fire extinguishing device. A few enthusiasts would permit unlimited area in a sprinklered building, while on the other hand a considerable number would give very little or no increase, when sprinklers are installed. Two chiefs stated that their unfortunate experiences with sprinklers had caused them to lose faith in their reliability. As a whole, however, they are strongly in favor of sprinklers and are inclined to permit over generous areas in buildings so equipped.

In order that the replies may be intelligently interpreted they have been separated into three groups, Tables II, III, IV, according to size of the city represented, and each group has been analyzed to show the character of the answers given to each question.

TABLE V.—ALLOWABLE HEIGHTS AND AREAS IN FACTORY BUILDINGS.

Type of building.	Stories in height.	Area between fire walls in sq. ft.
Brick and joist construction, not sprinklered	3	6,000
Fireproof construction, not sprinklered	5	10,000
Brick and joist construction, sprinklered	5	13,000
Fireproof construction, sprinklered	7	20,000

In the cases referred to by an asterisk, where no limits to area were given, they were not included in the averages, but were counted in the columns giving the number of answers above the average. In each group it will be noted that about the same number of men gave high answers to all questions, the proportion being one-quarter to one-half of the number in the group. The uniformity of height limits, and the lack of it in the area limits, is very apparent in all groups. It will be noted that the largest area values are given in Groups I and II, comprising the smaller cities.

The most rigid restrictions on area are found in Group III embracing the large cities. As fireproof construction and sprinkler equipments are common in most of our large cities, it is reasonable to assume that the fire chiefs of such cities would have had much more experience with such methods of protection, and be better able to decide what increase should be given in the size of a building when such protection is provided, than their less experienced fellow officers in smaller towns. It is thought quite proper to assume that their figures are more clearly correct and should be given the most weight.

Significant evidence in support of this argument is found in the fact that four chiefs who give no limit to areas in non-fireproof and fireproof sprinklered buildings are located in cities having a population of less than 50,000 in which there are few fireproof factory buildings or sprinkler equipments. On the other hand only two chiefs, in cities over 100,000 population, suggest a "no limit area" in a fireproof sprinklered building, and none approves such areas for non-fireprof buildings.

TABLE IV.—GROUP III—SUMMARY OF ANSWERS FROM 36 CITIES WITH A POPULATION OF 100,000 AND OVER.

	Stories in height			Answers above	Area in sq. ft.			Answers above
Type of building.	Average.	Max.	Min.	average.	Average.	Max.	Min.	average.
Non-fireproof, not sprinklered	3.5	7	1	17	5,400	10,000	900	75
Fireproof, not sprinklered...	5.3	9	2	18	9,800	22,500	2,400	10
Non-fireproof, sprinklered...	5.0	10	3	15	11,300	22,500	900	13
Fireproof, sprinklered........	7.5	12	4	16	19,400	*80,000	2,500	9

*Two votes received in favor of "no limit o area" in this class.

With these thoughts in view, Table I has been changed somewhat to be more in accord with the weight of evidence. It is believed, therefore, that Table V represents more correctly the consensus of opinion among the fire chiefs of the country best qualified to judge as to what should be the proper limits of height and area for factory buildings.

Results of Laboratory Tests of Concrete Disintegration by Alkaline Salts and Sea Water.

To determine the possible cause of failure of concrete through disintegration by salts present in sea water and alkaline soils, tests were begun some years ago in the Structural Materials Testing Laboratory of the U. S. Geological Survey and continued by the Bureau of Standards. The investigations included both laboratory and field tests and the results of both studies to Nov. 1, 1912, are given by Messrs. P. H. Bates, A. J. Phillips and Rudolph J. Wig in Technologic Paper No. 12, of the Bureau of Standards. We publish here a description and in brief the results of the laboratory physical tests:

This investigation, comprising three series of tests, consisted of making of cement mortar, hollow cylinders closed at one end, 3.5 ins. outside diameter, 10 ins. high, with walls and base 0.5 ins. thick, and permitting various solutions to percolate through.

FIRST SERIES.

The cylinders for this series were made of mortar in the proportion of 1 part Portland cement to 2 parts sand and mixed to a dry consistency, thus giving a very porous and rich mixture with good cause for disintegration, namely, a large percentage of voids in which the salts could crystallize and a large amount of cement to afford possible chemical action.

The test pieces were aged for one month in water, when the open end was closed with a two-hole rubber stopper and connected with an aspirator bottle in such a manner by a constant level apparatus that they were maintained about one-third full of the solution. The solution percolated through and the appearance of the cylinder was noted from time to time. This was continued until the pores of the cylinders were so clogged with precipitated and crystallized salts that the solution would no longer percolate. The constant level apparatus was then discontinued and the aspirator bottle raised until a head of 5 ft. was obtained. Until the end of the tests all the solutions containing magnesium, excepting the sea water, ran through these porous cylinders under this head. From this the relative disruptive force of the different salts could be noted.

From these tests it was seen that all the salts would break the cylinders (excepting the sodium carbonate and the iron sulphate); yet the action was so much more severe with some than with others that it was decided in later experiments to use sodium sulphate, and magnesium sulphate, alone, equal parts of sodium chloride-magnesium sulphate, sodium chloride-sodium sulphate, and sea water. It will be noted that two of these solutions did not contain magnesium salts, yet the results obtained by these, as shown later, are very striking. The use of sodium carbonate was discontinued, because it was not perceptibly affecting the mortar (though it was leaching out considerable quantities of silica and alumina) and the action was shown only by analysis, the cylinders remaining intact and in good condition. The iron sulphate was discontinued for the reason that the lime in the cement was rapidly replaced by iron, which, being colloidal, clogged up the pores and prevented all percolation. Although the head was raised to 8 ft., it was not possible to force enough solution into the cylinders to cause destruction. It was not feasible to hold the stopper in under a greater head.

At the end of 45 days, while all cylinders were badly stained and in the case of the magnesium solution covered with the precipitated hydrate, there was no other visible sign of disintegration. They were therefore removed and a current of warm air forced in one of the two holes of the stopper, and at the same time the air around the cylinder was raised to about 100° F. When dry, the percolation was continued until 1 liter of solution had passed through. They were then dried again. At the end of the second drying the cylinders which had been treated with the mixed solution of sodium sulphate-magnesium sulphate and sodium chloride-magnesium sulphate were so badly cracked that the solution ran through the cracks without appreciably wetting the rest of the cylinder. The same thing occurred in the case of the single salt solution of sodium sulphate and magnesium sulphate after the third drying; with the mixed solution of magnesium chloride-magnesium sulphate and magnesium chloride-sodium sulphate after the fourth drying; and with mixed salt of sodium chloride-sodium sulphate after the sixth drying. Following the seventh drying the percolation was discontinued. By this time the sea-water cylinder was so badly clogged that the water would not percolate through. While disconnecting it from the apparatus it was overthrown and broke horizontally in two parts. All the other cylinders, except the ones treated with sodium carbonate and ferrous sulphate, as noted above, were cracked.

The replacing of half of the sodium or magnesium sulphate present with sodium chloride does not decrease the apparent degree of destruction. It might be assumed that the amount of sodium or magnesium sulphate still left in the solution was sufficient for this purpose, but the destruction of sodium chloride-magnesium sulphate cylinders is greater than the magnesium sulphate alone.

While it seems to be the reverse with the sodium salts, yet the crack with the sodium sulphate-sodium chloride cylinders was wide enough to allow the solution to run through without causing the rest of the cylinder to become sufficiently wet to do much damage. The disintegration of the sodium sulphate-magnesium sulphate cylinders is characteristic of alkali disintegration in general—i. e., a blistering on the surface and on removing this blister a soft crumbling mass of concrete underneath.

SECOND SERIES.

In order to find, if possible, how much salt was necessary to cause disintegration, another series of six cylinders similar to the first series was made, but in the proportion of 1 part Portland cement to 3 parts of sand, which was mixed to a dry consistency.

These cylinders were placed in dishes in a room maintained at 100° F. during the day, and at night the temperature was allowed to drop to about 60° to 70°. Immediately after making, the forms were removed and the solutions were poured around the top of the cylinders and allowed to flow down to the bottom, without any previous aging in water or air, but never pouring on more than enough to wet them. After 500 cc. (containing 10 grams crystallized salt) of the solutions had been added the cylinder was thoroughly dried and examined for cracks, etc. In this manner it was hoped to determine how much salt was necessary for disintegration. After 50 grams of magnesium sulphate had been added to a cylinder two vertical cracks appeared, extending up 2.5 ins. from the base and then dividing into two more branches. The addition of successive amounts caused greater cracking, and finally, after having added 200 grams, the treatment was discontinued.

With the mixed salt sodium sulphate-magnesium sulphate 90 grams were required to cause any cracks, which were small and filled with hydrated magnesia; after 110 grams had been added the cracking was more pronounced; after 150 grams had been added a heavy horizontal crack appeared in the center; cracks continued to appear with the addition of more salt.

The mixed salt sodium chloride-magnesium sulphate did not show any disintegration until after 90 grams had been added, when a number of fine cracks appeared around the base; with the addition of more salts they disappeared, owing to the salts crystallizing over them. After washing off the salts the cracks are noticeable, but always filled with hydrated magnesia.

With the sodium sulphate there was nothing apparent until after 150 grams had been added, when there was a slight blistering about halfway up the cylinder, as though the salts were crystallizing under the outer cement film. With the addition of more sodium sulphate this was very pronounced.

With the sea water there was very little action; the lime of the cement seemed to have thrown out of the water a protecting coat of the colloidal hydrated magnesia, which being nearly imprevious, prevented the salts from penetrating. As a result there was no evidence of disintegration until after 265 grams had been added, when there was a very slight blistering. This has increased but little up to the present.

There was only a slight blistering caused on the cylinder to which the mixed salt sodium chloride-sodium sulphate had been added, even after the addition of 200 grams.

From this second series of tests it might be concluded, judging from the amounts of salts added when disintegration was first noticed, that the activity of the salts, in a descending scale, would be, first, magnesium sulphate alone; second, magnesium sulphate-sodium sulphate, and of equal activity with them, magnesium sulphate-sodium chloride; third, sea water and sodium sulphate alone, about equally active; fourth, sodium sulphate-sodium chloride. But while some cylinders started to disintegrate before others, yet when once started some showed greater destruction; and if the salts were to be arranged in the order of the amount of disintegration of the cylinders when 200 grams had been added to each cylinder, they would be in a descending scale, first, sodium sulphate; second, sodium sulphate-magnesium sulphate; third, magnesium sulphate; fourth, magnesium sulphate-sodium chloride; fifth, sea water; and last, sodium sulphate-sodium chloride. As mentioned above in this series there were used only the salts which showed a maximum disintegration in the first series. The hope that it would be possible to obtain some idea of the comparative amount of the various salts necessary to cause disintegration was not fulfilled. Had the same amount of sea water been actually forced into the cylinder as crystallized over it, due to its having been rendered impervious by the magnesium salts thrown out over it, it would have showed considerable disintegration. There seemed to be something which also prevented the other solutions containing sodium chloride from penetrating the cylinders. They appeared to have a glassy covering which did not allow the salts to penetrate and was not dissolved by the addition of more solution.

THIRD SERIES.

The cylinders for this series were made of mortar in the proportion of 1 part Portland cement to 4 parts sand and mixed to a very wet consistency, the cylinders being made by pouring the mortar in the molds and drying at an elevated temperature. It was necessary at intervals during the setting to give the removable core a number of twists in order to prevent the mortar adhering to it and promoting its ready removal, when the cylinder had acquired a preliminary set. Of course this brought some neat cement to the inner surface which tended to make the cylinders impervious. The purpose of this series was to use a very dense mortar. One of these cylinders was painted with a cement grout on the outside, another was painted similarly on the inside, the purpose of which was to see if it is possible to render them imprevious in this manner. To another pair, also, sufficient barium chloride was added, dissolved in the mixing water, to give an amount of this salt present, equal to about twice the amount necessary to precipitate all the plaster ($CaSO_4$) present in the cement. Another pair was treated similarly with barium carbonate, this being in an emulsion with the mixing water. The purpose of this addition of barium salts was to see if it was possible to protect the mortar by having the sulphuric anhydride radical combine with the barium to form the insoluble barium sulphate with consequent clogging and protecting of the cylinder.

The cylinders thus made, as soon as they had acquired sufficient strength to allow of handling, were connected with a constant level apparatus as in the first series, using here the solutions used in the second series. But these cylinders were placed in a long box, through which hot air (100° F.) could be forced. The cylinders stood in glass funnels, at the bottom of which valves were so arranged as to allow any solution which would percolate through the cylinders to drop out without allowing any air to be drawn in, as it was necessary on occasions to draw the warm air through instead of forcing it. In all other places the box was sealed, excepting one inlet and outlet. However, after using the constant level for two weeks it was found that there was no percolation, owing to the density of the mortar. Consequently, this was discontinued and the containers holding the solution were raised until a 5-ft. head was reached. This head was maintained for four months. At the end of this time it was found that all cylinders (excepting those containing the barium salts) had been rendered imprevious and were not allowing any solution to percolate through. The two cylinders which had been treated—the one on the inside and the other on the outside—with cement grout had never allowed any solution to run through. Those treated with the barium salts after several months gradually became porous and allowed the solution to come through in a number of minute pores. This result is rather difficult to explain; it was expected that there would be a precipitation of the insoluble barium sulphate in contact with the sulphates of the solution, which it was hoped might clog up any voids, though it was hardly expected that this means could be used in construction work, owing to the cost especially of chloride. But apparently the barium sulphate occupied a smaller volume than the other barium salts, so that it was washed completely through the cylinders, and instead of "silting" it up rather increased the number of voids.

Noting that the cylinders, after four months, were remaining in good condition, the funnels were sealed at the bottom and then filled with the solution which had been used with the cylinders; at the same time the head was increased to 12 ft. The amount of solution percolating through the cylinders was very small, and it was evaporated by warm air as fast as it came through. As this treatment was causing almost no action, the cylinders were removed from the box and placed in a room kept at about 75° C. in pans filled with sufficient solution to reach about one-third up the cylinder. At the same time the latter were kept filled with the solution. With three exceptions, after 15 months of this treatment there was practically no action. The cylinders were quite white on the exterior, but the salts did not seem to have penetrated or remained on the interior. Of the three exceptions mentioned above, two were those which had been placed in sodium sulphate solutions. At the end of three months they had been corroded or disintegrated to a depth of ⅛ to ½ in. at about 2 ins. above the water line. This action had progressed slowly, the first appearance being a blistering. The blister increased considerably in size and finally flaked off. Another blister then formed underneath this and the action was continued. The third of the exceptions mentioned was a cylinder treated with sea water, which was removed at the end of five months, the action being similar to that of sodium sulphate. All the other cylinders at the end of the 15-month period were in very good condition. The one immersed in the solution of sodium chloride-magnesium sulphate showed a very slight blistering. The one immersed in sodium sulphate-magnesium sulphate had a vertical crack extending about one-third of the distance down from the top of the cylinder. The cylinders grouted, both on the exterior and interior, were in first-class condition and, contrary to the usual opinion, the grouting had not separated from the remainder of the mass, but was as firmly bonded as ever. There was no corrosion of the specimens containing the barium salts, but they were badly stained with magnesium hydrate, showing that they had allowed the solution to percolate through them. This staining was almost entirely absent on all the other cylinders. It might be remarked that this blistering or corroding of the cylinders is very characteristic of the alkali action in the western arid regions. The cracking, as obtained in the other series, is not common in that district.

It is obvious from the above results of these physical tests that a pervious mortar (and almost of necessity a pervious concrete) can be destroyed by almost any salt if a sufficient amount of it is allowed to accumulate in the mortar and then a rapid formation of crystals is brought about by drying; and as larger crystals are formed by slow crystallization there would be obtained the same results on a larger scale, but in a greater time, if a slow-drying was used. Sodium carbonate is not excepted in this statement, as it must be remembered that these salts were allowed to percolate through the cylinders, and consequently products of chemical action were removed. This is also true in the case of the magnesium salts, where voluminous precipitates of the hydrate were obtained in the bottles placed under the cylinders to catch the dripping, though at the same time a heavy precipitate was obtained in the cylinder. This third series shows the value of a dense mortar. These tests were carried to a greater length and under severer conditions than the others, yet the results obtained were much better than in the previous ones. It also seems to be evident that a drying or an evaporation is necessary for disintegration to take place. This was particularly noticeable in the first series, where the cylinders remained intact until dried and where even the first drying in several instances produced large cracks and the second drying in two cases caused complete destruction. This action was very strikingly shown by applying Brard's tests to stone. This is a freezing test where the freezing (crystallizing) of a salt is used to produce disruption of the stone. Having in mind the disintegration of concrete under the influence of salt, there was included in the test three briquettes and three 2-in. compression cubes of an unknown proportion (they happened to be some test pieces lying in the laboratory—doubtlessly were 1:3). The test was usually carried out by immersing the specimens in a saturated solution of sodium sulphate and boiling for 1 hour, removing, allowing to dry 24 hours, washing off the crystallized salt, reimmersing in the solution, reboiling, etc., 10 times, then noting any loss in weight, the general appearance, and also obtaining the compressive strength. The cement specimens after having been treated 10 times in this manner were apparently unchanged, and were consequently returned and boiled 6 times more without replacing the water evaporated. At the end of this time they were still unchanged and were replaced in the solution and allowed to remain for a month, two briquettes and one cube projecting above the solution about ¼ in. They were then examined, and it was found that the surfaces out of the solution were badly cracked; that there was only about ½ in. of solution and the remainder was a sold mass of sodium sulphate. By heating this was dissolved, and it was found that the remainder of the partly immersed specimen was in good condition, the cracks uniting in a very remarkable manner just below the water line. It was also found that the totally immersed specimens were apparently unchanged. All were then left out of the solution, and at the end of another month, on trying to handle one, it crumbled to a mass of powder. All of the others also fell to pieces on handling, though they had retained their original form and appearance, except a whitening due to the effloresced sodium sulphate.

TABLE I.—ACTION OF VARIOUS SALTS ON CEMENT MORTARS.

Age in Solution.	Tensile strength, lb. per sq. in., after immersion in— Magnesium sulphate	Magnesium chloride.	Calcium sulphate.	Sodium sulphate.	Sodium chloride.	Sodium carbonate.
0 days[1]	219	219	219	219	219	219
7 days	268	245	227	257	236	225
28 days	272	300	300	334	268	277
3 months	287	315	334	354	299	324
6 months	196	202	314	378	287	320
1 year	Disintegrated	115	209	271	310	337
2 years	...	Disintegrated	Disintegrated	141	325	360

[1] The briquettes were aged 28 days in air before immersion.

TABLE II.

	Before immersion	Unaffected portion.	Affected portion.
Silica, pct	75.12	73.96	60.40
Oxide of iron, pct	0.52	0.60	0.30
Alumina, pct	1.15	1.30	0.64
Lime, pct	14.80	14.50	14.21
Magnesia, pct	0.70	1.66	3.64
Sulphur trioxide, pct	0.33	0.83	5.78
Loss on igniton, pct	7.02	7.14	14.97

It is possible that the production of efflorescence can play a prominent part in the destruction of a porous medium in which a crystallized efflorescible salt has separated. While there are no data on hand on the force which would be exerted by a crystal losing its water of crystallization and changing to a powder, yet there is some evidence that it is considerable. It must be mentioned, however, that this is not due to a true change in volume, but only to an apparent change, the effloresced material apparently occupying a much larger volume than the crystallized, although it really occupies a smaller volume.

Tests of Disintegration of Cement Mortars by Alkali Salts, Mine Water Acids and Lubricating Oils.

Results of tests extending over a period of five years and planned to throw light on the destruction of concrete by alkaline mortars, acid-bearing mine waters and lubricating oil drippings are given in a paper by Richard K. Meade before the American Society for Testing Materials. The cement used was a normal Lehigh Valley product and standard tests showed satisfactory results. We quote from the paper as follows:

All briquettes were made from a mixture of one part cement and three parts standard Ottawa sand. They were allowed to harden 28 days in air and then immersed in a solution of the salt. The briquettes were piled in such manner that the solution had access to almost their entire surface.

The solutions in all cases except that of the calcium sulphate, which was a saturated solution, were made up of one part of the salt to 100 parts of water, to form practically a 1 per cent solution. At first the solutions were changed every few days, but after the first month the solutions were changed weekly and after the first year less often. The results obtained are given in Table I.

First, it should be remembered that the 28-day strength of briquettes kept in air is much less than that of those kept in water. As will be seen from the results given in Table I, the sulphates have a marked action on concrete, which seems to be most apparent in the case of the magnesium salt. The action of magnesium sulphate on cement mortars has been discussed quite voluminously of late and I will not go into it to any length in this paper beyond stating that we carefully analyzed the affected portion and the unaffected portion of a sand briquette which had been stored in a solution of magnesium sulphate. These analyses are given in Table II.

The large increase in the magnesia and sulphur trioxide and the decrease on the oxides of iron and alumina indicate the elements which react with each other. The loss in silica may be due to chemical action also, but as the surface of the briquettes was very much attacked and the sand grains could be scraped away with the finger, I am inclined to think that the lower silica in the disintegrated portion was probably due to mechanical causes rather than chemical action. It will be noted that in almost all cases the first effect of the solution was to increase the strength of the briquettes and that signs of disintegration in no cases became evident until after a period of three months in the solution.

TABLE IV.—ACTION OF MAGNESIUM SULPHATE ON CEMENT MORTARS CONTAINING IRON OXIDES, ETC.

Age in 1% solution of magnesium sulphate.	Tensile strength, lb. per sq. in., of briquettes containing 5% of— Ferric oxide.	Magnetic oxide.	Venetian red.	Brick dust.
0 days[1]	218	225	165	170
7 days	275	280	225	220
28 days	310	340	300	275
3 months	355	340	345	310
6 months	310	280	215	205
1 year	125	105	Disintegrated	Disintegrated

[1] The briquettes were aged 14 days in air before immersion.

Some of the briquettes were even boiled in a 5 per cent solution of magnesium sulphate for several days, and in all cases the briquettes were much stronger after boiling than they were before and fully as strong as briquettes boiled in pure water, showing how slow the action of the sulphates is.

The briquettes which failed were considerably swollen and presented much the appearance of a baked potato which has burst its jacket.

Various authorities have proposed at different times the use of divers ingredients in concrete exposed to sea water, with a view to their reacting with the salts of the latter to form insoluble compounds which would protect the concrete. Most persistently suggested of these are the salts of barium, which form with soluble sulphates insoluble barium sulphate. I tried both barium chloride and barium carbonate. These were ground very finely and mixed with the cement. I employed 2 per cent of barium chloride with the cement, and also 2 per cent and 5 per cent of barium carbonate. Sand briquettes were made from these mixtures and the test pieces stored in a magnesium sulphate solution containing 10 grams of the salt to the liter. The results are given in Table III, and, as will be seen, none of these compounds arrest the destruction.

Some years ago an English chemist suggested the use of finely ground, burnt red brick as an admixture for concrete which was to be used in sea water. After reading this paper it occurred to me that the resistance to sea water claimed for high-iron cements might be due to the presence of oxide of iron in the cement. I therefore had sand briquettes made up containing oxide of iron in various forms and conditions, namely, red or ferric oxide, magnetic oxide of iron, venetian red (an impure oxide of iron made from low grade iron ores, so-called "paint ores" of the Lehigh district), and finely ground red brick, using of these 5 per cent of the weight of the cement in each case and placing the briquettes in a 1 per cent solution of the magnesium sulphate. The results are given in Table IV. As will be seen the additions of iron compounds are in no way beneficial to cements to be employed in sea water.

TABLE III.—ACTION OF MAGNESIUM SULPHATE ON CEMENT MORTARS CONTAINING BARIUM COMPOUNDS.

Age in 1% solution of magnesium sulphate.	Tensile strength, lb. per sq. in., of briquettes containing— 2% of barium chloride.	2% of barium carbonate.	5% of barium carbonate.
0 days[1]	181	115	166
7 days	...	221	257
28 days	213	246	346
3 months	306	311	346
6 months	265	204	274
1 year	146	Disintegrated	Disintegrated

[1] The briquettes were aged 14 days in air before immersion.

I next tried waterproofing the mortar on the theory that if the circulation of water through the pores of the mortar could be stopped no chemical action could take place. I employed for this purpose both a high-calcium and a magnesian-hydrated lime, road oil (as recommended by Page), a mixture of silicate of soda solution and fish oil (a well known waterproofing compound), and lime soap (the basis of many waterproofing compounds). I also tried dipping the briquettes first in a hot solution of soap and then in one of alum (Sylvester's Process). The results of the tests of sand briquettes made from these mixtures and stored in magnesium sulphate solution (10 grams to the liter) are given in Table V.

It will be noted that, while the disintegration is evidently taking place in these test pieces, all of these compounds seem to arrest it to some extent at any rate, and in the case of the lime soap and Sylvester Process this is quite marked.

I also investigated the action of magnesium-

TABLE V.—ACTION OF MAGNESIUM SULPHATE SOLUTION ON SO-CALLED WATER-PROOFED MORTARS.

Afe in 1% solution of magnesium sulphate.	Tensile strength, lb. per sq. in., of briquettes containing— 15% of hydrated lime (calcium).	15% of hydrated lime (magnesian).	10% of road oil.	2% of lime soap.	2% of oil-silicate soda.	Treated with alum and soap.
0 days[1]	215	215	165	185	160	220
7 days	215	225	200	210	200	235
28 days	315	320	210	250	245	275
3 months	245	260	260	275	260	265
6 months	200	245	210	230	225	215
1 year	120	105	140	180	165	185

[1] The briquettes were aged 14 days in air before immersion.

sulphate solution on cements high in silica. For this purpose, samples of commercial cement, one high in silica and low in alumina and one low in silica and high in alumina, were selected; sand briquettes were made of these and immersed in a solution of magnesium sulphate containing 20 grams to the liter, or practically a 2 per cent solution. The cements selected had the following analyses.

	Low-alumina cement.	High-alumina cement.
Silica, pct.	23.24	19.86
Iron oxide, pct.	2.25	2.56
Alumina, pct.	5.03	7.60
Lime, pct.	63.55	63.12
Magnesia, pct.	3.05	3.10
Sulphur trioxide, pct.	1.51	1.66

As will be seen from Table VI, the low-alumina cement resists the action of magnesium sulphate much better than the high-alumina one.

TABLE VI.—ACTION OF MAGNESIUM SULPHATE SOLUTION ON HIGH AND LOW-ALUMINA CEMENTS.

Age in 2% solution of magnesium sulphate.	Tensile strength, lb. per sq. in., of— High-alumina cement.	Low-alumina cement.
0 days[1]	242	225
7 days	318	307
28 days	404	430
3 months	402	476
6 months	230	472
1 year	Disintegrated	500
2 years	...	425

[1] The briquettes were aged 14 days in air before immersion.

In the above experiments, both cements were commercial cements; but the high-alumina cement when received was not quite so finely ground as the other one, so it was ground to practically the same degree of fineness in a small jar mill (or to 86.2 per cent passing the No. 200 sieve), so that the fineness of the two samples might in no way influence the results. Both these cements were made from cement rock and limestone.

In connection with the use of concrete for mine props, where it is often exposed to the action of dilute solutions of sulphuric acid, the following experiment was tried: Sand briquettes were allowed to harden 28 days and then were placed in a solution containing 250 grains of sulphuric acid (H_2SO_4) to the gallon. Te solution was changed frequently and the briquettes broken at regular intervals. The disintegration of concrete by such acid water is shown by the following:

Age in solution	0 days	7 days	28 days	3 mos.	6 mos.	1 year
Tensile strength, lbs.	226	299	300	280	176	disintegrated

Several years ago the question of the action of oil on concrete was brought up at one of the meetings of this society in connection with a paper by Professor Carpenter. In his experiments, oil was mixed with the concrete. In the discussion which followed the reading of the paper, a number of gentlemen suggested that what was needed most was information relative to the action of oil on concrete which had already hardened in view of the employment of concrete for machinery bearings, engine room and factory floors, etc., where it is subjected after being fully hardened to the oil which leaks from the bearings of the machinery. I went home from this meeting and had a number of sand briquettes made and allowed them to harden 2 weeks in air. These were stored in air, in engine oil, in cylinder oil, and in black oil, and broken at stated periods. The results are given in Table VII.

TABLE VII.—ACTION OF LUBRICATING OILS ON CONCRETE.

Age in oil.	Tensile strength, lb. per sq. in., of briquettes kept in— Air.	Engine oil.	Cylinder oil.	Black oil.
7 days[1]	248	252	235	234
28 days	233	240	273	222
3 months	287	251	221	181
6 months	303	232	209	131
1 year	293	231	203	Broke in clips

[1] The briquettes were aged 14 days in air before immersion.

It will be noted that the engine oil and the cylinder oil have practically no effect upon concrete. One would think that as the latter has a considerable proportion of animal oil in its composition it would be apt to appreciably affect concrete exposed to it. On the other hand, the action of the black oil seems strange in view of the fact that it is a straight mineral product. All of these briquettes had absorbed considerable oil, the actual gain in weight of each set at the end of the year being as follows:

In engine oil	10.6 per cent
In cylinder oil	10.0 per cent
In black oil	12.0 per cent

The briquettes in the black oil had not swollen perceptibly and seemed merely to be weak.

The experiments given above were all made upon very small test pieces and hence the action of the solutions upon them were much more rapid than they would be upon a large mass of concrete; and while in most of the above cases a year was sufficient to completely disintegrate the test pieces, in a large body of concrete such as a pier or wall, many years would be required, at least, to bring about this result. The experiments merely serve to show that even very dilute solutions of the salts of magnesium and the sulphates in general do have a destructive action on concrete and that the generally proposed remedies do not appreciably retard this. They indicate the desirability of employing low alumina cements in sea water construction. The experiments with the oils show that no destructive action is likely to take place where cement is used for floors in machine shops and engine rooms.

ROADS AND STREETS

Instructions of the Board of Local Improvements, Chicago, Ill., to Its Sub-Inspectors of Paving Work.

GENERAL.

All sub-paving inspectors shall report at the particular work to which they have been assigned, at the time work commences in the morning. They shall remain on same until day's work is completed in the evening excepting at the noon hour, unless otherwise ordered by their superiors.

Inspectors shall be in such proximity to the work as to carefully note the character of the work being done.

Inspectors must see that they are provided with a copy of the specifications and of the profile and must familiarize themselves with the conditions thereon. An unauthorized departure from the conditions of the same shall be considered an act of incompetency and neglect of duty.

Inspectors must insist that the foreman be provided with a profile, whether on subgrade, concreting, curbing or paving, and must himself be familiar with same and see that its provisions are carried out.

Any violations of the specifications must be promptly reported to the General Inspector.

It is also the duty of the Inspector to see that the work is properly barricaded and danger signals placed, and that all crossings are kept clear of obstructions. He shall see that all covers are brought to proper grade, shall note conditions of sidewalks, crossings, adjoining pavements, etc., and see that the work is finished in every detail.

Inspectors must know that all cement has been tested before being used.

Though an Inspector may be charged with the inspection of a particular part of the work, it is his duty to report to his superior officer and have corrected, if possible, any violations of the contract.

If an Inspector is replaced by another, he shall furnish the new Inspector all profiles, specifications or special instructions, together with all data pertaining to the work, in order that the incoming Inspector can give proper quantities of material previously laid and thus keep the daily reports continuous from the start to the completion of the work.

Inspectors are admonished that it is expected of them to be courteous and obliging to all persons making inquiries as to character of work. Profane, contemptuous, insolent and discourteous language must be avoided at all times.

Inspector must report on the 10th day of the month by separate postal card the work on which he has been engaged during the month, to be compared with a similar report submitted by the General Inspector.

After proper investigation, Inspectors must submit to the Chief Engineer in writing a complete detailed report of any accident on or about the work.

Inspectors when in doubt will confer with the General Inspector or Division Engineer.

Report location of all manholes, catchbasins and other covers not at proper grade.

Give nearest telephone so you may be reached by the office when on the work.

DAILY REPORTS.

Report postal cards must be carefully filled out in detail and *mailed at the close of the day.*

State at the top of the card the Street or Alley or System of Streets as given on the specifications.

If working on a system of streets, state under "Remarks" the name of the particular street of that system on which work is being done, giving location of work.

In giving location of work always give the limits between which work is being done, using house numbers where possible. On street car tracks give side of street on which work is done as well as limits.

Inspectors must promptly report any obstructions to the work, such as poles, lamp posts, catch basins, hydrants, manholes and electrical equipment, giving the name of the corporations to which they belong. Make every effort to obtain proper name of corporation.

Under "Remarks" state weather conditions, kind of cement, kind of filler, name of brick or granite block and any other information you may see fit.

Mention should be made of any delay in the work, giving cause of delay, such as weather, lack of materials or anything unusual happening about the work.

It is important that these report cards be properly filled out and mailed at the close of the day. Non-compliance with this rule will result in suspension for one day.

CURB AND GUTTER, CURBSTONE, CONCRETE CURB, GUTTER FLAG, ETC.

Inspectors must see that the concrete is mixed in the following manner:

Mix three times dry and twice wet. When cement and screenings are deposited on the mixing board, the same to be mixed twice by turning on the board, then after the coarse granite is deposited, the whole mass is to be turned again. When water is added the entire mixture must be turned again twice, making a turning of the entire mixture five times.

Where the cement sidewalks extend out to the curb line, inspectors must see that these walks are not undermined in removing the old curbs and that the new curbs are properly back filled after being set.

CEMENT AND TAR TICKETS.

Inspectors will be held responsible for all tickets of material used in the work.

When material such as cement or tar leaves the jurisdiction of an inspector and is transferred to another inspector, the inspector must so note in his report of material incorporated in the work. He must also send a note with the material stating the quantity and such marks which characterize its inspection for the guidance of the inspector on the work where material is to be used.

CONCRETE FOUNDATION.

Inspectors must see that all gutters, inlets, etc., are kept clean and free from debris during the progress of the work and while concrete is being laid.

See that top of concrete is such as to allow of slight overlapping of the asphalt at the gutters and iron covers.

Make test openings in the concrete at least every 200 ft. In report give location by block and house numbers of said openings as well as depth of openings. All test holes must be filled with new concrete.

ASPHALT PAVING.

Inspectors shall, each day, take a sample from one of the loads of wearing course being used, giving location and street number, also the number of the load from which sample was taken and time of day, together with name of plant from which same was taken. Give also location of plant.

Give sample to the General Inspector or the Division Engineer to be turned over to the Asphalt Chemist.

On report indicate material laid, whether binder or wearing surface. Measure depth of wearing surface every twenty feet after final rolling, and not after initial rolling, and report average of day's measurements, giving number of test measurements made.

If both binder and wearing surface are laid at different parts of the street, fill out separate cards for each.

Directions for Sampling Asphalt on the Street.—Use a wooden instrument about 2 ins. in width and sample the load immediately after it is dumped on the street, taking the sample midway between the top and bottom of the dump. Place all of sample on a clean piece of paper and press with another part of the paper and any heavy clean instrument to a thickness of from ¼ to ½ in. Trim to about 2¼x4 ins., and with a blunt instrument make a groove about one-half way through the sample about ¾ in. from the shorted edge. Place in envelope provided for the purpose and on the envelope write all information called for.

Never use a hot instrument in contact with the sample.

Guard against contamination with sand and dirt.

Do not allow paper to adhere to sample.

ASPHALTIC CONCRETE.

See general instructions under asphalt.

CREOSOTED WOOD BLOCK, GRANITE AND BRICK PAVING.

Inspectors shall state on daily report the car numbers from which the creosoted blocks laid today had previously been taken.

Special attention shall be paid to breaking joints properly when blocks are laid.

See that pitch filling is applied hot and enters joints between blocks, leaving as little as possible on the surface of the pavement.

Inspectors must know that paving brick has been tested and accepted before being used.

TARRING AND GROUTING.

State under "remarks" the location where tarring is done, giving the number of yards tarred today and the total number of yards tarred. Give the number of gallons of tar used today and total number of gallons of tar used.

In taking samples of tar give tank number, kind of pavement for which it is to be used, the improvement from and to, and the name of the contractor. Date samples the day they were taken.

MACADAM AND ASPHALTIC MACADAM.

See that street is graded to theoretical grade and properly rolled.

State on card which course is being built and give location of work.

When a course has been bonded, measure the depth of same at least every 200 ft.

Report locations of openings by block and house numbers, together with depth of openings.

Inspector's reports under these instructions will be considered as a certification on their part that the work has been carried out in accordance with the specifications, unless special mention is made to the contrary in the report.

On asphaltic macadam streets, inspectors shall each day take a sample of the asphaltic cement being used. Give sample to General Inspector or Division Engineer to be turned over to the Asphalt Chemist.

See that the stone is in a bone dry condition before the asphaltic cement is applied.

REPAIRS OF OPENINGS AND MAINTENANCE.

Report postal cards must be carefully filled out in detail and *mailed at the close of the day*.

State at the top of the card the street or alley on which repairs were made

Mention should be made of any delay in the work, giving cause of delay, such as weather, lack of materials or anything unusual happening about the work.

Inspectors shall, each day, take a sample of asphalt from one of the wagons, state on which street same was used, and from which plant the same was taken. Give sample to General Inspector in charge.

Make a report on each individual opening. Locate openings by house number, if possible, or by distance from nearest intersection.

Be careful to check with the foreman the exact size of openings which you report, also get the correct numbers of the permit and the name of the corporation making the openings

Before leaving the street, go over the entire contract and report any openings which have not been concreted or repaired, and if none appears, state on your card, street in "good condition" or "no openings on street"

Inspectors must enter on their report cards the total square yards of cuts repaired each day, also the total square yards of maintenance laid each day.

Specifications of the Board of Local Improvements, Chicago, Ill., for Concrete Pavements.

The Board of Local Improvements of Chicago, Ill., has prepared recently specifications for the concrete pavements to be laid under its jurisdiction. These specifications cover the 1-course type, the 2-course type and the bituminated surface type of pavements. They call for a ½-in. armored transverse expansion joint every 50 ft., the pavement for a distance of 6 ins. each way from the joints to consist of a mortar. They also provide that where the roadway is more than 20 ft. wide the pavement shall be reinforced. The clauses of these specifications relating to the pavement proper are given below:

PREPARATION OF THE SUB-GRADE.

Where filling is required it shall be of earth or cinders free from animal or vegetable matter, and shall be deposited in layers and thoroughly compacted.

In all cases where back-filling of curb is required, it shall have a berme of at least 4 ft. at the top thereof, with a slope of 1½ horizontal to 1 vertical.

Where the earth adjacent to the back of the curb is above grade, it shall be removed so as to form a slope of 1½ horizontal to 1 vertical, rising from the back of the curb to the surface of the ground.

Where cutting is required, the earth must be excavated to such a depth as may be necessary to bring the roadway to the proper sub-grade after being thoroughly compacted.

The contractor shall remove all spongy material or other inferior or vegetable matter that may be in the way of making this improvement.

All approaches connecting said street with other streets or alleys intersecting shall also be cut or filled so that the same will have a slope of not more than 1 vertical to 10 horizontal, and shall be secured from settlement adjoining the pavement.

The roadway shall be brought to the proper sub-grade by cutting or filling, and thoroughly compacted and secured from further settlement by flooding, ramming or rolling, or all, as may be deemed necessary by the Board of Local Improvements.

The contractor shall bid with the express understanding that all necessary precaution must be used in preparing the sub-grade so as to support the pavement permanently, and so that the pavement will not sink thereafter, and, at the expiration of 3 years after the first day of July next following the completion and acceptance of the work, will still be at the original grade.

This clause will not be waived on account of any trenches or holes made in the street by any corporation or private party prior to the laying of the pavement.

The price bid for cutting or filling, if in separate items, or the price per yard for paving, must include all cost of bringing the sub-grade to its proper position and compaction and securing the same from settlement.

FORMS.

Forms shall be free from warp and of sufficient strength to resist springing out of shape. They shall be well staked or otherwise securely held to line and grade. Their upper edges shall conform to the finished grade of the pavement.

All wood forms shall be thoroughly wetted and metal forms oiled before any material is deposited against them. All mortar and dirt shall be removed from forms that have been previously used.

EXPANSION JOINTS.

Expansion joints ½ in. in width shall be formed along the curbs and at intervals of 35 ft. across the roadway. These expansion joints shall extend through the entire thickness of the pavement and shall be filled with asphaltic filler of a quality as hereinafter specified.

All expansion joints shall be armored and the edges protected against abrasion by means of 3/16 in. soft steel plates 2½ in. wide. These plates shall be securely anchored to the concrete in such a manner as to leave the joints free to take up any expansion in the pavement.

The pavement for a distance of 6 in. each way from the transverse joints shall consist of a mortar composed of Portland cement, sand and broken granite. The sand used in making the mortar shall be of sizes ranging from ¼ in. down to the finest, and shall be free from dirt, dust or other impurities. No wind-drifted sand shall be used.

The broken granite used in making the mortar shall be of a size which will pass through a ring of ⅜ in. internal diameter. The mortar shall be mixed in a mortar box or by an approved machine mixer. The cement, sand and granite shall be mixed in the following proportions by volume: 2 parts of cement, 1½ parts of sand and 1½ parts of broken granite, with sufficient water to produce a mortar of a consistence which will not require tamping and which can be easily spread into position with a straight edge. The upper edge, at the expansion joints, shall be slightly rounded.

CONCRETE PAVEMENT.

Concrete Foundation.—On the sub-grade as above prepared shall be laid a foundation of Portland cement concrete to a uniform thickness of 5 in. The concrete shall be made of Portland cement and sand or limestone screenings in combination with stone, slag or gravel.

The sand used in making the concrete shall be of sizes ranging from ¼ in. down to the finest, and shall be free from dirt, dust and other impurities. No wind-drifted sand shall be used.

The limestone screenings used in making the concrete shall be of varying sizes, ranging from ¼ in. down to the finest, and shall be free from dirt, dust and other impurities. The screenings shall be made of the best quality of limestone; screenings made from quarry strippings or stone containing bituminous material will not be accepted.

The stone, slag or gravel used in making the concrete shall be of the best quality; clean, free from dust, and shall be of varying sizes. The maximum dimension of any piece of such stone, slag or gravel shall not exceed 1 in. nor shall the minimum be less than ½ in.

The concrete shall be mixed by approved batch machine mixers or on movable, tight, iron platforms of such size as to accommodate the manipulations herein specified. The cement, sand, or limestone screenings and stone, slag or gravel, shall be mixed in the following proportions by volume: 1 part of cement, 3 parts of sand or limestone screenings and 5 parts of stone, slag or gravel. The sand or limestone screenings and cement shall be thoroughly mixed dry, after which water shall be added and the mixture made into a stiff mortar. The stone, slag or gravel shall be immediately incorporated in the mortar and the mass thoroughly mixed, water being added if necessary as the mixing progresses, until each particle of stone, slag or gravel is covered with mortar.

The barrows or appliances used in measuring the parts of cement, sand, limestone screenings, stone, slag or gravel shall be of such size and shape as may be approved by the Board of Local Improvements.

The sand, limestone screenings, stone, slag or gravel, when delivered on the street, shall be kept clean until used.

The concrete shall be deposited in a layer on the sub-grade in such quantities that, after being thoroughly rammed in place it will be of the required thickness and the upper surface will be true and uniform and 2 in. below and parallel with the surface of the finished pavement. "Slushing" will not be permitted.

Reinforcement.—Where the roadway is more than 20 ft. in width, the pavement shall be reinforced with a mesh steel wire reinforcement, known as No. 29 American Steel & Wire Co.'s Standard weighing not less than 28 lbs. per 100 sq. ft., or other mesh steel reinforcement equal thereto. The cross sectional area of metal measured parallel to the axis of the roadway shall, approximately, equal the cross sectional area measured perpendicular to the axis of the roadway. The reinforcing metal shall be placed upon and slightly pressed into the concrete immediately after the base is laid. The reinforcement shall not cross expansion joints and shall be lapped sufficiently to develop the strength of the metal.

Top or Wearing Surface.—On the concrete foundation and reinforcement shall be laid a wearing surface of a thickness of 2 in., composed of Portland cement, sand, and broken granite.

The sand used in making the top or wearing surface shall be of sizes ranging from ¼ in. down to the finest, and shall be free from dirt, dust and other impurities. No wind-drifted sand shall be used.

The broken granite used in making the top or wearing surface shall be of a size which will pass through a ring of ⅝ in. internal diameter.

The mortar for the wearing surface shall be mixed in a mortar box or by an approved machine mixer. The cement, sand and broken granite shall be mixed in the following proportions by volume: 2 parts of cement, 1½ parts of sand, and 1½ parts of broken granite, with sufficient water to produce a mortar of a consistence which will not require tamping and which can be easily spread into position with a straight edge. The mortar for the top or wearing surface shall be spread on the foundation immediately after mixing. In no case shall more than 45 min. elapse between the mixing of the concrete for the base and the covering of same with the wearing surface.

After the wearing course has been brought to the finished grade with a template or straight edge, it shall be worked with a wood float in a manner to thoroughly compact it and produce a comparatively smooth surface, free from depressions or inequalities of any kind.

If desired, the surface may be troweled and corrugated. The corrugations shall not be more than ⅜ in. in depth.

The application of neat cement to hasten hardening and retempering of mortar will not be permitted.

The concrete pavement shall be kept moist so as to prevent checking. It shall be protected from injury and shall lie at least 7 days before being opened to traffic or a longer time if deemed necessary by the Board of Local Improvements.

CONCRETE PAVEMENT.

Concrete.—On the sub-grade as above prepared shall be laid Portland cement concrete to a uniform thickness of 7 in. The concrete shall be made of Portland cement and sand, in combination with gravel.

The sand used in making the concrete shall be of sizes ranging from ¼ in. down to the finest, and shall be free from dirt, dust and other impurities. No wind-drifted sand shall be used.

The gravel used in making the concrete shall be of the best quality, clean, free from dust and shall be of varying sizes. The maximum dimension of any piece of such gravel shall not exceed 1 in. nor shall the minimum be less than ½ in.

The concrete shall be mixed by approved batch machine mixers or on movable, tight, iron platforms of such size as to accommodate the manipulations herein specified. The cement, sand and gravel shall be mixed in the following proportions by volume: 1 part of cement, 2 parts of sand and 4 parts of gravel. The sand and cement shall be thoroughly mixed dry, after which water shall be added and the mixture made into a stiff mortar. The gravel shall be immediately incorporated in the mortar and the mass thoroughly mixed, water being added if necessary as the mixing progresses, until each particle of gravel is covered with mortar.

The barrows or appliances used in measuring the parts of cement, sand or gravel shall be of such size and shape as may be approved by the Board of Local Improvements.

The sand and gravel, when delivered on the street, shall be kept clean until used.

The concrete shall be deposited in a layer on the sub-grade in such quantities that, after being thoroughly rammed in place, it will be of the required thickness and the upper surface will be true and uniform and parallel with the surface of the finished pavement. "Slushing" will not be permitted.

Immediately after the concrete is laid and brought to the finished grade with a template or straight edge it shall be worked with a wood float in a manner to thoroughly compact it and produce a comparatively smooth surface, free from depressions or inequalities of any kind.

The concrete shall be kept moist so as to prevent checking. It shall be protected from injury and shall lie at least 7 days before being opened to traffic, or a longer time if deemed necessary by the Board of Local Improvements.

Reinforcement.—Where the roadway is more than 20 ft. in width the concrete shall be laid in two courses of 4 in. and 3 in. respectively and reinforced with a mesh steel wire reinforcement known as No. 29 American Steel & Wire Co.'s Standard weighing not less than 28 lbs. per 100 sq. ft. or other mesh steel reinforcement equal thereto. The cross sectional area of metal measured parallel to the axis of the roadway shall, approximately, equal the cross sectional area measured perpendicular to the axis of the roadway. The reinforcing metal shall be placed upon and slightly pressed in to the concrete immediately after the base is laid. The reinforcement shall not cross expansion joints and shall be lapped sufficiently to develop the strength of the metal.

BITUMINATED SURFACE.

The thoroughly cleaned, dry surface of the pavement shall be covered with hot bitumen at a temperature suitable to the material and in amount not less than ½ gal. to each sq. yd. of pavement. Before the bitumen shall cool a thin layer of dry torpedo sand shall be spread over it.

PORTLAND CEMENT.

The Portland cement used in this improvement shall be subject to the following inspection and tests, and must be approved by the Board of Local Improvements before it is incorporated in the work.

Fineness.—It shall be so ground that 92 per cent will pass through a standard No. 100 sieve, having 10,000 meshes per sq. in., made of wire cloth, No. 40 wire, Stubbs gauge.

Soundness.—It shall meet the requirements of the following boiling tests: A pat of neat cement, 3½ in. in diameter, ½ in. in thickness at the center and tapering to a feather edge, having been made on glass and having remained in air 24 hours protected by a damp cloth, together with broken briquettes of neat cement which have remained in air 1 day and been immersed in water 6 days, shall, after being subjected to the action of steam 4 hours and then immersed in boiling water 4 hours, show no checking, warping or swelling.

Setting.—The cement when mixed with 28 per cent of water, by weight, shall take initial set in not less than 45 min. as determined by the Gilmore needle.

Strength.—Briquettes shall develop the following ultimate tensile strengths per sq. in. of section: Neat, 1 day in air and 6 days in water, 500 lbs.; 1 part of cement to 3 parts of torpedo sand or limestone screenings, 1 day in air and 6 days in water, 200 lbs., and shall show a gradual increase in strength of 20 per cent at the end of 28 days.

Samples of cement which it is proposed to use in the work shall be submitted to the Board of Local Improvements in such quantities and at such time and place as will enable it to make all required tests.

The Board of Local Improvements reserves the right to reject any cement which is not satisfactory, whether the reasons mentioned in these specifications or for any good and sufficient cause.

All cement shall be delivered on the work in approved packages bearing the name, brand or stamp of the manufacturer, and shall be thoroughly protected until used.

ASPHALTIC FILLER.

The longitudinal and transverse expansion joints shall be filled with an asphaltic filler which shall be free from water, coal tar pitch or any product of coal or water gas tar. It shall adhere firmly to the concrete, be pliable at all climatic conditions to which it will be subjected, and conform to the following requirements:

It shall have a specific gravity of not less than 0.965 at 77° F.

It shall have a melting point of not lower than 110° and not more than 250° F.

It shall have a penetration of not less than 40 nor more than 100.

The bitumen of the asphaltic filler shall be soluble in carbon tetra chloride to the extent of at least 98½ per cent.

The asphaltic filler shall be heated to a temperature of not less than 280° nor more than 450° F., and shall be applied in such a manner that all spaces will be completely filled, the temperature of heating to be varied within these limits according to the nature of the asphaltic filler used and at the discretion of the Board of Local Improvement. . . .

ANGLE IRON PROTECTORS.

Unless otherwise directed by the Engineer there shall be placed at the end of each intersecting street and alley wing an iron protector.

These protectors shall be 2½ in. angles ¼ in. thick, and shall be securely anchored to the concrete. All protectors shall be constructed by the contractor and the cost thereof shall be included in the price bid per sq. yd. for the pavement.

Notes on Road and Street Work.

(STAFF ARTICLE.)

Cost of Repair and Maintenance of Gravel Roads in Bennington County, Vt.—Mr. L. D. Hewes in Bulletin 48 of the U. S. Office of Public Roads states that the actual expenditures on 175 miles of gravel roads in Bennington County, Vt., for repairs and maintenance during the season of 1912 were as follows:

Town.	Number of miles.	Total cost.	Cost per mile.
Arlington	13	$ 267.00	$20.53
Glastenbury	3	32.92	10.97
Landgrove	7	158.41	22.63
Manchester	17	361.48	21.26
Sandgate	15	301.87	20.12
Searsburg	6	90.45	15.07
Shaftsbury	13	269.30	20.71
Stamford	10	205.64	20.56
Winhall	9	291.00	32.33
Woodford	12	347.28	28.94
Pownal	17	315.75	18.57
Peru	14	282.92	20.21
Rupert	15	300.45	20.03
Readsboro	16	227.82	14.24
Sunderland	8	171.74	21.40
Totals	175	$3,624.03	*$20.71

*Average cost per mile.

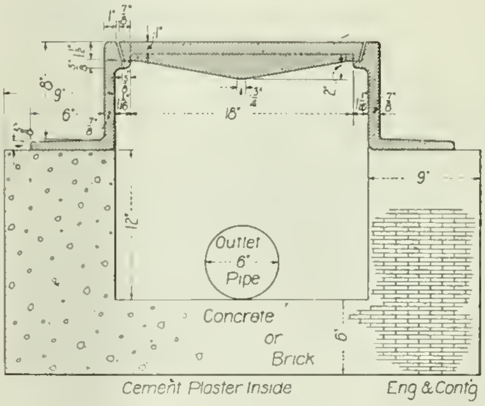
The average cost must be regarded as somewhat low as a general figure because of the unusual supply of native gravel and because the roads are protected from wear by snow for several months each year.

Specifying Amount of Cement for Concrete.—Mr. Stanley Macomber, City Engineer of Centralia, Wash., in an article in The Iowa Engineer, states that a number of engineers in Southwestern Washington are using clauses similar to the following in connection with their specifications for concrete work:

> Every cubic yard of concrete 1:3:6 mixture shall contain at least 4 sacks of cement.
>
> Every cubic yard of concrete 1:3:5 mixture shall contain at least 4½ sacks of cement.
>
> Every cubic yard of concrete 1:1:1 mixture shall contain at least 12 sacks of cement.
>
> Every 2 cu. ft. of top mixture 1:2 shall contain at least 1 sack of cement.
>
> For cement over this amount nothing will be paid the contractor.
>
> For every sack of cement under the above amount the regular price shall be deducted from the total sum due to the contractor.
>
> The contractor to figure on the above amounts rather than on the direct mixture.
>
> Arrangements must be made with the city engineer for the proper inspection of the amount of cement used.

During the day the inspector tries to keep the mix as near correct as possible and at night the empty cement sacks are counted and a material slip filled out, signed by the inspector and the contractor. A copy is given the contractor and a copy put on file in the office. When it comes to final settlement these slips are taken as receipts for the amount of cement used. The amount of cement hauled onto a job is also kept in this manner as a check.

Repair and Maintenance of Sand-Clay Roads.—The following notes are taken from a bulletin on the repair and maintenance of highways, issued May 16, by the U. S. Office of Public Roads. All the general features of maintenance, such as clearing waterways and dressing shoulders, apply as well to sand-clay roads as to metaled roads. In all cases the cross section should be carefully maintained to insure good surface drainage, and all ruts, hoof marks, and depressions likely to hold water should be smoothed away, so that there will be no standing water on the road. The special feature of sand-clay maintenance is the repeated smearing of the surface to close it against the penetration of moisture as far as practicable. The best method of effecting this is to use a simple drag, such as the split-log drag, as frequently as the surface seems to need it. In the first wet season following construction a sand-clay road will probably require dragging after every shower of much length. Later the need of dragging will probably be less, until finally about 10 thorough treatments each year will suffice to keep the surface in satisfactory condition. The dragging should always be done after a rain when the surface is plastic. There are two periods following rain when the soil is in suitable condition for dragging. The first period is almost immediately following the rain when the road is very wet and soft. Then follows a period when the soil is too sticky for dragging, and this is followed by a third state when there is a process in the soil analogous to setting, and at this time the dragging is of general benefit. The road surface is still plastic, but the mud does not adhere as badly to the drag. The surface can be smeared or plastered down, dressed free of all ruts, hoof marks, or minor depressions, and by careful use of the drag such small quantities of material as may be required can be shifted back and forth across the road. Dragging should be begun along the outside edge of the traveled way, and the first return trip should be along the opposite edge. It should advance toward the center, and the last trip should be made directly in the center with the drag linked up straight so as to spread the accumulated material evenly. A cutting edge on the drag should be avoided and, if a metal strip is used to reduce wear, it should be set flush with the edge and not projecting. If at any time the road becomes badly worn or out of shape, the entire section should be plowed, disk harrowed, reshaped with a drag or grading machine, and rolled. It is not uncommon when sand-clay roads are new to find that there is an excess of clay. In this case there may not have been sufficient sand used in construction or it may have been lost by wash into the gutters. There should be a sufficient supply provided on the roadside to restore the proper mixture, particularly for the first season or two after construction. In case the road hardens in a rough condition, owing to careless dragging or to neglect, a grading machine will re-dress it satisfactorily. Frequently by reversing the blade of the grader the effect of an excellent heavy drag is produced that will iron out hardened ruts and hoof marks. About 4 miles of road can be thoroughly dragged in one day for from five to six trips over the section. Ten treatments a year would therefore cost about $40 for 4 miles or $10 per mile per year for dragging.



Details of Inlet, Centralia, Wash.

Container for Bituminous Compound.—Much attention has been given in the laboratory of the Illinois Highway Commission to the selection of a suitable container in which to keep bituminous compounds for filing, and to the handling of samples. The most suitable devised at present, according to the last annual report of the commission, is as follows: Samples are sent to the laboratory in the usual 5 ct. tin pails, which can be readily obtained anywhere. Instructions are given to road engineers as to the method of selecting good representative samples. After analysis of the samples in the laboratory, enough material is left to fill a quart tin can, such as is used for canned fruit. The cans are labeled with the sample number, date received, car number, trade name, manufacturer, road on which they are used, township and county, and are filed for further reference. These quart tin cans are very satisfactory to handle and when the lid is kept tight the samples will keep for years without change. The ordinary glass fruit jars have been tried, but have been found to be too deep and to have too small an opening for convenient handling of bituminous material. These jars, however, are now in use for all samples of sand, gravel, rocks, slags, cement, etc., and are very convenient because they permit a general inspection of the sample without emptying the jar. A system of keeping a double record of all analyses has also been devised, and found to give very good results. Each analysis is entered on laboratory blanks; all data are then recorded in a book somewhat similar to a ledger, and the blanks filed. Three books with the record of all analyses have been in use; one for bituminous compounds, one for wood preservatives, paints and miscellaneous materials, the third for stone, sand and gravels.

Inlets for Handling Surface Drainage.—In Centralia, Wash., in connection with paving work, a considerable saving has been effected by the construction of simple inlets in place of catch basins. Details of these inlets are shown in the accompanying sketch. They consist of a regular manhole ring set in the gutter at the center of the curb return. A shallow concrete basin is placed under the ring. It is of the same diameter as the ring and deep enough to allow a 6-in. pipe to pass between the floor and the casting. The connecting pipe runs directly to the manhole. The casting complete cost $12. The cover for the ring is cast with slats and bars, the same as the regular inlet cover, to allow of the free passage of water. Mr. Stanley Macomber, City Engineer, states in The Iowa Engineer, from which this note has been taken, that over 50 of these inlets are in use in the city.

Cost of Hauling with a Tractor Outfit.—In the construction last year of bituminous macadam on the Western Ave. road, Mattoon, Ill., by the Illinois Highway Commission, part of the hauling was done by a tractor outfit, and part by teams. The average length of haul was one mile. Common labor was paid 20 cts. per hour; teams, 40 cts. per hour. In all, 674 cu. yds. were hauled by engine and 2,170 cu. yds. by teams The tractor outfit was on the job for 22 days, but was hauling only 13½ days, fractions being counted as full. The following data on the cost of the hauling are taken from the 4th annual report of the commission:

Cost to Illinois Highway Commission for engine operator (salary and expenses, straight time)	$ 66.00
Cost of fireman (actual days worked)	27.00
Coal, oil and supplies	51.00
Maintenance of outfit	26.00
Total	$170.00

Total cost per cu. yd. for hauling	$0.258
Actual cost of team hauling on same work and same haul	.435
Cost of hauling by engine per cu. yd. mile	.258
Cost of hauling by teams per cu. yd. mile	.435

The detailed costs of engine hauling per cubic yard mile were:

Operator	$0.098
Fireman	.042
Coal, oil, etc	.077
Maintenance	.041
Total	$0.258

Analyses of Mortar Constituent of Asphaltic Cement.—In a paper presented last April before the Civil Engineers' Society of St. Paul, Mr. Linn White, Chief Engineer South Park Commissioners, Chicago, Ill., gave the following analyses of the mortar constituent (that is, 10-mesh material or less) of several samples of asphaltic concrete, which had been under traffic in Chicago for long enough periods of time to demonstrate their good or bad qualities.

Mr. White states that the first four pavements proved to be very good, and the latter two indifferent in quality. As far as the coarse aggregate is concerned; that is, all material coarser than 10-mesh, there were considerable variations in the different samples, but the total quantity was approximately the same, and the variations seemed to have nothing to do with the success or failure of the sample. Samples 1 to 4 were successful, and they were rich in dust and reasonably well proportioned in other sizes up to 10-mesh. Samples 5 and 6 were practically failures, and they are seen to be lean in dust with an excess of 40-mesh material not well filled by the smaller sizes.

	No. 1. Jackson and La Salle.	No. 2. Jackson and Main.	No. 3. Michigan and Park.	No. 4. Grand and Oakwood.	No. 5. Jackson and Franklin.	No. 6. Jackson and Market.
	%	%	%	%	%	%
Bitumen ...	18.8	18.9	16.1	21.0	18.9	16.3
200-mesh ..	10.8	11.6	11.7	10.9	4.3	3.5
80-mesh ..	10.6	11.5	7.0	26.2	5.9	5.7
40-mesh ..	36.8	35.3	22.7	19.3	50.3	54.1
10-mesh ..	23.0	22.7	42.5	22.6	20.6	20.4
	100.0	100.0	100.0	100.0	100.0	100.0

WATER WORKS

Methods and Labor Cost of Constructing the 39,000,000 Gal. Mechanical Water Filtration Plant at Minneapolis, Minn.

Contributed by W. N. Jones, Assoc. Mem. Am. Soc. C. E., Special Engineer in Charge of Construction.

I. SETTLING BASIN, CLEAR WATER BASIN AND FILTERS.

In writing up any important work on construction in which the cost data are embodied, it is very important to state the exact conditions under which the work was done, the methods of carrying on the work, the difficulties encountered and how they were overcome, the organization, the wages and salaries paid, and all other matters pertaining to or affecting the final costs of the completed structure. Unless this is done, the unit costs are of small value in comparing with similar costs of like work at other places and under similar conditions.

It is the endeavor of this article to cover in as condensed a form as possible, each and every item entering into the construction of the filter plant for the City of Minneapolis, together with cost data on the same; numerous illustrations are offered showing the methods and equipment used and the manner of doing the work. Unit cost data for labor with notes covering the same are given, and a list of the different kinds of employes and wages or salaries paid each is incorporated in Table I.

The reader is referred to Engineering & Contracting of June 11, 1913, for general design and plans.

As is well known, Minneapolis has for a number of years been carrying on all its city improvements, excepting park and school improvements, by means of the "Day Labor System" or force account. Naturally then, when as large a project as a filter plant was considered, considerable agitation arose as to which was the better, the day labor system with an engineer in charge familiar with filter plant construction, or the contract system as generally practiced throughout the country. After considering all sides of the question, and upon the recommendation of the city engineer, the city council decided to do the work by force account and to engage an engineer familiar with mechanical filter construction to supervise and superintend the work.

On Aug. 8, 1910, the writer was retained in the above mentioned capacity with instructions to proceed with the work. However, as the plans were not available for the filter plant itself, but were ready for the improvement to the settling basin and clear water reservoir (see Engineering & Congracting of June 11, 1913, for contemplated work), it was deemed best to make a start on these, and to do as much work as possible during the remaining part of the season of 1910.

Prior to Aug. 8, 1910, a small crew had been started and some preparatory work had been done on raising the embankment of the old south reservoir, but the force was unorganized and no equipment was on hand except such as was fit for earth work alone. It was, therefore, necessary to immediately reorganize the working force and to secure suitable equipment for use in concreting, and it was not until a month and a half later that the work really began to move forward in a satisfactory manner. Even then, more or less friction was noticed between the foremen and sub-foremen, on account of the previous unorganized condition of the force, and only through drastic methods was this eliminated and a workable condition obtained.

For keeping the cost of the various items entering into the work it was decided to use a method very similar to that in use in the corps of engineers, U. S. Army, but with this difference: the material used was omitted from the cost data and only labor was considered as being vital to the job. For keeping these records, blank forms were prepared and strict instructions were given the timekeeper as to how to keep his units and how to enter them on the forms. Unfortunately, the timekeeper at this time was a man over 60 years of age and either would not or could not perform the duties required of him, but on account of his age and condition he was retained for perhaps two months when he took sick and died. The man who took his place was young, experienced and willing enough, but lacked the necessary education to perform satisfactorily such arduous duties as keeping cost data on a construction job of this magnitude. As the remaining season was filled out by this man, few data are available on the construction work done during 1910. A specimen weekly cost record form, as actually filled in, will be given in the succeeding article on this work.

Fig. 1—Mixer on Crib Work for Concretin Paving on Inside Slope of Settling Basin.

SETTLING BASIN.

The first work started on construction was the raising of the embankments of the old south reservoir and the building of a fill for the foundation of the coagulation basins and mixing chamber. Before this could be done, it was necessary, however, to tear up an old macadam roadway around the basin and to remove the existing iron railing and sandstone coping, and all bush loam, etc., from the site of the coagulation basin fill. It was deemed best to give the fill for the coagulation basin and mixing chamber as much time as possible to settle and become firm and hard, and for this reason this work was carried on simultaneously with the raising of the reservoir embankments.

In each case a selected clayey material was obtained from two borrow pits in the immediate vicinity and was hauled by means of common dump wagons of 1¼ cu. yds. capacity, or No. 2 wheel scrapers, as the length of haul demanded. This was spread in 6-in. layers, was well sprinkled and rolled by means of a 14-ton steam roller. At first the writer made an attempt to have a small steam shovel purchased for loading with automatic dump wagons for hauling, but this was frowned upon by the authorities, and even the suggestion of a trap, as used on railroads for earth work, was not received with favor. It was stated at the time that it was the desire to give work to as many men as possible, and the use of machinery would prevent this.

Perhaps a word of explanation is here necessary. Minneapolis has for a number of years occupied a unique position in the labor market; acting as it does as a clearing house for the northwest labor market. There are certain times when labor is very abundant and this generally happens during the construction period, or early spring and summer. On account of the extreme cold, most of the construction work is carried on during the spring, summer and fall. During the early winter a great many men are called to the northern woods for use in the lumber camps and later on, covering a period of about six to eight weeks, the ice harvest uses a great many more. The flour mills also take their extra quota of men during the winter (their busiest time) while the call for men to work in the harvest fields of the northwest is felt throughout the country. Therefore, the city authorities feel that these men should be taken care of as much as possible during their dull times, and for this reason provide as much work as possible on city construction jobs. This may not be good engineering practice, and adds nothing to the good temper of the man in charge of the work, but it probably returns as good a profit in the end to the merchant of the city and adds to the contentment of the citizens as much as a saving in construction costs would on any piece of city work.

On the side of the raised embankment of the settling basin next to the water a puddle wall of selected clayey material 4 ft. thick was built. This puddle was placed in horizontal layers from 1 in. to 2 ins. thick. It was well sprinkled with water and tamped with wooden tampers until the whole was of the proper consistency and was then allowed to dry. Embankments and puddle wall were kept as near the same elevation as possible at all times. After placing the puddle wall and the embankments were at or near their proper heights, a layer of crushed limestone 14 ins. thick measured normal to the slope was placed thereon. On top of this, for a part of the slope distance, a 6-in. layer of 1: 2: 4 concrete was laid in 10-ft. strips with an asphalt joint between them. The remaining portion of the embankments were covered with sandstone paving stones taken from the north basin which were of no further use there. All inside slopes have a slope of 1:2, and all outside slopes 1 to 1½.

In carrying on the concrete paving on the inside slopes, difficulty was experienced on account of the narrow embankments surrounding the reservoir, but this was finally overcome by placing the mixer on a cribwork built at the outer edge of the top of the slope, as shown in Fig. 1, and by extending the mixer's loading rails and hopper to the original flat surface of the surrounding ground, about 10 ft. below, where it was possible to store all the material used in concreting. The mixer was used to hoist the unmixed aggregate from the lower ground and thus the narrow top of the embankments were left free from all obstructions excepting the industrial track used for concreting.

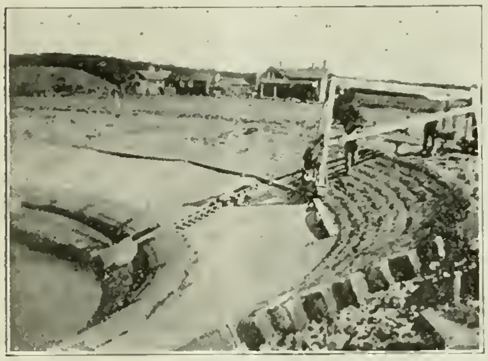


Fig. 2—View of Derrick for Handling Paving Stones.

The sandstone paving stones which varied in length from 2 ft. to 6 ft., and which were 14 ins. deep and 12 ins. wide, were generally laid by means of a small traveling derrick shown in Fig. 2. However, towards the end of the work it was found about as economical to roll the stones down the slope onto their bed of mortar and place them in the correct position by means of small crowbars in the hands of the common laborers, under the supervision of the stone mason.

All the coping stones were afterward laid by hand in a manner very similar to the paving stone. At first a derrick was tried out, but on account of the confined space available to work, about 12 ft. wide, it was found more economical to use the hand method, and thereby do away with the cost of moving the derrick four or five times a day. Another thing that tended to favor the handling of the stone by hand was the desire to have room to drive a team around the top of the basin for delivering the construction materials to their proper places.

After the coping had been all set the old iron fence was replaced. Care was taken, however, to avoid using any of the old anchor bolts, which were almost rusted in two after seventeen years of use. New holes were drilled and new bolts were set therein and run with hot sulphur. Cement grout was tried for anchoring the bolts, but was found unsatisfactory on account of the length of time it took to set and harden.

During the time of construction covering a period of about eighteen months, the reservoir was used continuously as a settling and storage basin for the entire supply of the city. It was necessary to prevent all contamination if possible and by strict and constant watch of the men employed, this was accomplished.

SUMMARY OF UNIT LABOR COSTS ON SETTLING BASIN IN 1911.

	Cts.
Earth fill, per cu. yd	48.5
Puddle wall, per cu. yd	89.2
Placing crushed stone, per cu. yd	29.3
Recovery of crushed stone, per cu. yd	75
Hauling crushed stone, per cu. yd	54
Screeds, per lin. ft	1.4
Concrete slabs, per cu. yd	$2.55
Laying paving stone, per sq. ft	5.8
Hauling paving stone, per sq. ft	4.4
Pouring asphalt joints, per lin. ft	2.3
Laying industrial track, per lin. ft	3.9
Stripping pit, per acre	$88

The items which are above summarized are given below in more detail:

LABOR COST DATA ON SETTLING BASIN FOR 1911.

Earth Fill.—The earth fill was well sprinkled with water and was rolled in 6-in. layers with a 14-ton steam roller. The average unit cost on 16,212 cu. yds. of fill was 48.5 cts. per cu. yd. The average haul was 1,200 ft. Amount hand-tamped, 1,100 cu. yds.

Puddle Wall.—Earth hand tamped in 1½ to 2-in. layers. Water pumped with hand pump. The average unit cost on 836 cu. yds. was 89.2 cts.

Placing Crushed Stone.—All crushed stone was shoveled and spread by hand. The average unit cost on 2,571 cu. yds. was 29.3 cts.

Recovery of Crushed Stone.—To remove dirt 71 cu. yds. of crushed stone were screened at an average cost of 75 cts. per cu. yd.

Hauling Crushed Stone.—Hauled 400 cu. yds. of stone in common dump wagons, loaded by hand, at an average cost of 54 cts. per cu. yd. The average haul was about 1,000 ft.

Screeds.—The average cost for setting and removing 5,578 lin. ft. of screeds was 1.4 cts. per lin. ft.

Concrete.—Slabs of concrete 10 ft. by 13 ft. 6 ins. by 6 ins. thick were laid on a 1:2 slope. These slabs contained 484 cu. yds. of concrete which was placed at an average cost of $2.55 per cu. yd. This cost also includes a 1:2 cement finish coat.

Laying Sandstone.—The sandstone paving blocks were 12x14 ins. in section and from 2 to 6 ft. long. An area of 9,826 sq. ft. was paved at an average cost of 5.8 cts. per sq. ft.

Hauling Sandstone.—Stone jigger used, loaded by hand. 11,975 sq. ft. of the paving stones were hauled at an average cost of 4.4 cts. per sq. ft. The average haul was 800 ft.

Pouring Asphalt Joints.—3,905 lin. ft. of asphalt joints were poured at an average cost of 2.3 cts. per lin. ft., including the heating of the asphalt.

Laying Track.—2,400 lin. ft. of 24-in. gage track was laid in 16-ft. sections at an average cost of 3.9 cts. per ft.

Stripping Pit.—1.37 acres were stripped at a cost of $88 per acre. This includes clearing and grubbing. 700 cu. yds. were moved 500 ft. by scrapers at 63 cts. per cu. yd. This includes plowing to depth of 8 ins.

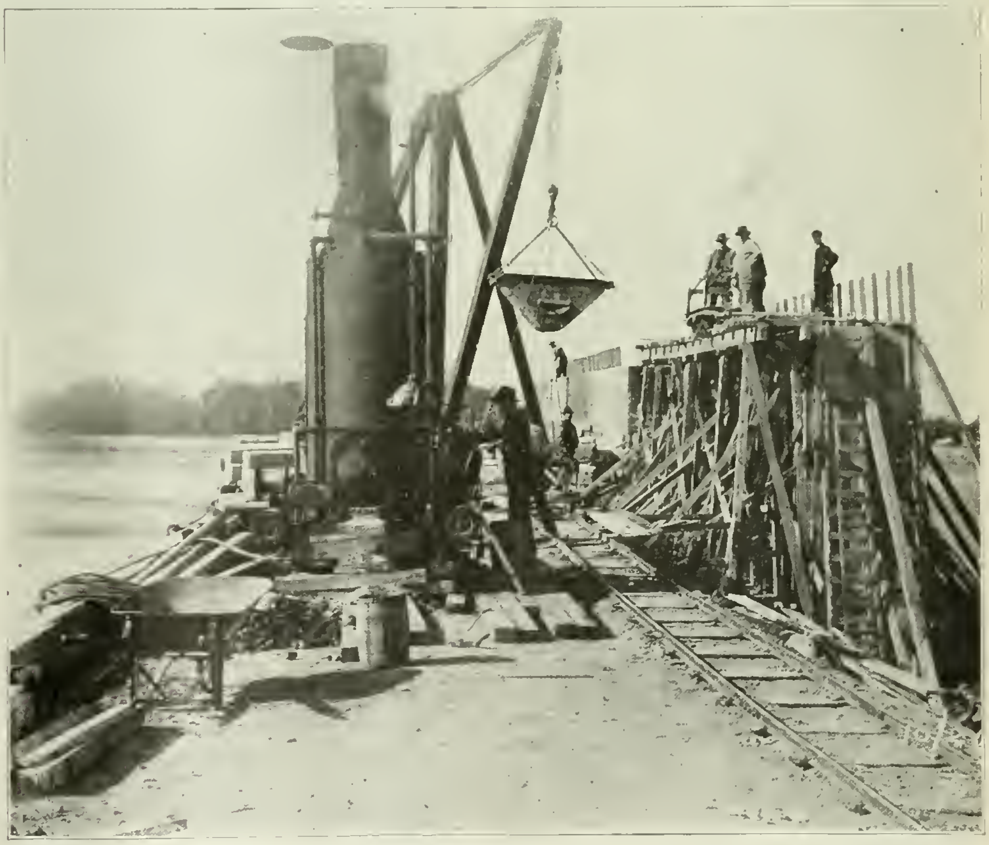


Fig. 3—Dividing Wall Between Basins Showing Method Used in Pouring Concrete and Bracing Forms.

Miscellaneous.—The portable derrick for laying the sandstone paving was built at a cost for labor of $23.88. The unclassified labor expense amounted to $111.86. Repairing damage done by storms cost $23.75.

SUMMARY OF UNIT LABOR COSTS ON SETTLING BASIN IN 1912.

	Cts.
Earth excavation, per cu. yd	78.4
Earth backfill, per cu. yd	34.7
Puddle wall, per cu. yd	75.7
Recovery of crushed stone and screening gravel, per cu. yd	$1.67
Hauling crushed stone and gravel, per cu. yd.	39.9
Concrete slabs, per cu. yd	$2.12
Laying crushed stone, per cu. yd	35.2
Laying track, per lin. ft	3.3
Laying paving stone, per sq. ft	4.9
Hauling paving stone, per sq. ft	4.4
Pouring asphalt joints, per lin. ft	7.1
Hoisting coping stone, per sq. ft	2.8
Hauling coping stone, per sq. ft	4
Setting coping stone, per sq. ft	5
Hauling fencing, per lin. ft	3
Setting fencing, per lin. ft	16.3
Painting fencing, per lin. ft	5.5
Setting 42-in. crossover pipe, per ton	$4.49
Cutting 42-in. crossover pipe, per cut	$1.50
Calking 42-in. crossover pipe, per joint	$2.41

The items which are above summarized are given below in more detail:

LABOR COST DATA ON SETTLING BASIN IN 1912.

Earthwork.—Excavation: 321 cu. yds. of earth were excavated from trenches by hand at an average cost of 78.4 cts. per cu. yd. This cost includes the sheeting and staging. Of the 321 cu. yds. excavated 236 cu. yds. was dry work, shoveled three times, 40 cu. yds. was wet clay handled four times, and 45 cu. yds. was wet clay handled twice, at average costs of 80 cts., $1, and 40 cts. per cu. yd., respectively. Backfill: 747 cu. yds. were backfilled by hand and scraper at an average cost of 34.7 cts. per cu. yd. The ground was wet and partly frozen. This figure includes the hauling of 93 cu. yds. 900 ft. Fill: The fill of 10,773 cu. yds. was well sprinkled and rolled in layers of 6 ins. with a 14-ton roller. Average cost, 49.8 cts. per cu. yd.

Puddle Wall.—The 1,529 cu. yds. of puddle were tamped by hand in 1½ to 2-in. layers at an average cost of 75.7 cts. per cu. yd. The water needed was pumped by hand.

Recovery of Crushed Stone and Screening Gravel.—All crushed stone was screened by hand to remove dirt. In all 77 cu. yds. of stone and gravel were screened at an average cost of $1.67 per cu. yd.

Hauling Crushed Stone and Gravel. — The crushed stone was handled by hand and hauled in common dump wagons. 172 cu. yds. were hauled an average of 330 ft. at an average cost of 39.9 cts.

Concrete.—Concrete was laid in slabs 13.5 ft. by 10 ft. by 6 ins. on 2 to 1 slope. 142 cu. yds. were laid at an average cost of $2.12 per cu. yd., including the 1:2 cement finish and the setting and removing of screeds.

Laying Crushed Stone.—Crushed stone shoveled down slopes and spread by hand. 1,134 cu yds. were placed at an average cost of 35.2 cts. per cu. yd.

Laying Tracks.—745 ft. of 24-in. gage track in 16-ft. lengths at an average cost of 3.3 cts. per ft.

Laying Sandstone. — The sandstone blocks were 12 by 14 ins. in section and from 2 to 6 ft. long. They were laid on edge. In all 11,690 sq. ft. were laid at an average cost of 4.9 cts. per sq. ft.

Hauling Sandstone.—11,795 sq. ft. of sandstone was loaded by hand and hauled on a stone jigger at an average cost of 4.4 cts. per sq. ft.

Pouring Asphalt Joints.—805 lin. ft. of asphalt joints were heated and poured at an average cost of 7.1 cts. per ft.

Coping Stone.—Hoisting: The coping stone were hoisted 12 ft. by an old pipe laying derrick operated by hand power. 10,548 sq. ft. of this stone was hoisted at an average cost of 2.8 cts. per sq. ft. The coping stones are 4x12 ins. in section and from 4 to 8 ft. long. Hauling: The stone was loaded by hand and hauled a distance of 750 ft. on a stone jigger. The average cost for 2,750 sq. ft. so hauled was 4 cts. per sq. ft. Setting: The average cost for setting 11,792 ft. of coping stone was 5 cts. per sq. ft.

Fencing.—Hauling: 2,207 lin. ft. of fencing was hauled 650 ft. on common dump wagons, which were not suitable for the purpose, at an average cost of 3 cts. per lin. ft. Placing: 2,534 lin. ft. of fencing was placed at an average cost of 16.3 cts. per lin. ft. This includes drilling five ⅝-in. x 3-in. holes in the sandstone coping for every 12 ft. length of fence, placing all bolts, etc. Painting: 2.324 ft. of fencing was painted at an average cost of 5.5 cts. per lin. ft. This is for one coat and includes cleaning off all rust. Fence consists of 3-in. pipe rail and 4-in. by 4-in. ornamental posts 12 feet apart. Bolted lug midway of each section.

Crossover Pipe.—Setting: 14.85 tons of 42-in. cast iron water pipe was set at an average cost of $4.49 per ton. This includes some sheeting and the use of a pipe derrick. Cutting: The 42-in. cast iron pipe was cut in two at three sections outside the trench, by two men using cold chisels at an average cost of $1.50 per cut. The pipe was cut at two sections after the main was in place, in soft ground, at an average cost of $11.50 per cut. Calking: 12 joints in the 42-in. cast iron water pipe were calked by the calkers of the water department at an average cost, including yarning, melting lead, pouring, etc., of $2.41 per joint. This pipe inclines 22½ degrees from the vertical.

Making Bolts.—136 bolts ⅝ x 4½ ins. were made at an average cost of 5 cts. each. 660 bolts ½ x 5 ins. were made at an average cost of 4.3 cts. each. These figures include welding on heads or upsetting, and threading bolts and nuts.

Miscellaneous.—During five weeks it was necessary to hand pump the seepage water on the bypass pipeline, day and night, for part of the time. The total cost for this purpose was $481.57. An amount of $191.15 was expended on labor on the settling basin for purposes which have not been classified.

CLEAR WATER BASIN.

On account of no equipment being on hand for concreting it was impossible to start construction work on the covering of the clear water basin until this arrived. It arrived on or about Sept. 20, 1910, when the construction really began and was pushed as fast as possible, under the then prevailing conditions.

Because of a desire of the Health Department to use the basin during the winter, and due to the great quantity of ice which forms on open reservoir in the vicinity of Minneapolis when subject to a rise and fall of water, as is the case with the city reservoirs, it was decided after careful consideration to start work only on that portion of the covering which would not be damaged by the frost and ice during the winter, and upon that part which would be entirely below the ice under all conditions to which the reservoir was subjected during that time. The only parts fulfilling these conditions were the large dividing wall between the two basins and the pedestals supporting the columns for the groined arch vaulting and with the object of doing as much of this work as possible, the work of 1910 was carried on.

In building the dividing wall between the two basins, all horizontal joints were avoided, as it was deemed better to use vertical joints only, and thus eliminate any upward lift due to the water pressure on the submerged portion.

The wall which is 450 ft. long, 18 ft. high and 4 ft. 3 ins. in average thickness was built of plain cyclopean concrete in alternate vertical sections, each about 32 ft. long with a double tongue and groove joint between adjoining sections to take care of all temperature stresses. To date the only cracks that appear in the wall are those at the joints.

The same difficulty was experienced here on account of the narrow embankment as was the case in lining the settling basin slopes. There being no room between the basins for setting up the concrete mixer, it was necessary to place it at one end of the wall, and to transport and hoist the mixed material to the desired place in the forms. A stiff leg derrick, hoisting engine, and a wooden trestle containing a 24-in. gage track were erected near the forms to be filled, and another 24-in. track was laid from the mixer along the top of the embankment to the trestle.

For hauling and placing the concrete 1¼ cu. yd. hopper side dump cars were used. One pair of car trucks were placed on the track which was on the trestle. As soon as a car of concrete was delivered to the derrick a man engaged a set of chains, attached to the falls of the derrick, into hooks at the four corners of the hopper. The hopper was then hoisted and placed on the trucks running on the track above. The car was then shoved into the desired position by hand, never more than 20 ft., and its contents were dumped into place. After this a quantity of rubble stone was thrown into the wet mass, but no stone was allowed to be nearer than 6 ins. to its neighbor.

The only difficulty experienced in this part of the work was in holding the forms to line on the north, or lower, side of the wall on account of the reservoir slope. However, this was finally accomplished by driving ⅝-in. round iron pins into the joints between the stones and adjoining strips of concrete on the slope, fastening a stringer thereto and in turn shoving the wall studs against this stringer. The manner of shoring, and method used to hoist the concrete is plainly shown in Fig. 3.

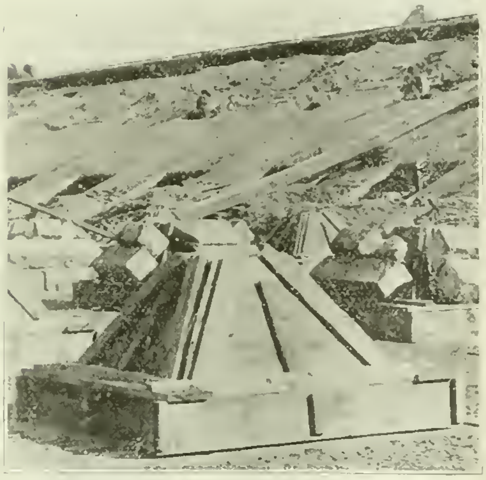


Fig. 4—Forms for Pedestals in Place Ready for Concrete, Weighted with Sandstone.

Pedestals.—The nature of the ground and conditions under which the work had to be done precluded the use of a cableway for handling the forms and concrete in the pedestals for supporting the columns of the groined arch roof, and it was therefore necessary to use some other method. After considering all phases of the work to be done, it was considered best to use a double system of cars for delivering and placing the concrete, and to handle all the forms by means of laborers alone. Each pedestal form was designed so as to be ridged. All sides, where shown vertical, were made with a slight batter, so that as soon as the contained concrete had set enough the form could be removed as a whole, carried to another place and reset ready for a new batch of concrete. All forms were well oiled with crude oil on the inside and but very little difficulty was experienced in removing them. At the conclusion of the work the forms were still almost as good as new, although they had been used 10 or 12 times. Fig. 4 shows pedestal forms before concreting.

In concreting the pedestals, the first cars took the concrete from the mixer and were hauled along the top of the reservoir by means of a horse to a point opposite the row of pedestals to be poured. The wet mix was then dumped down a chute into a car running on a trestle at the bottom. The track was high enough to allow the cars to run directly over the pedestal forms and dump their contents between the rails into the forms below.

The trestle was made of heavy wooden horses, with sets of 4 in. x 8 in. x 18 ft. stringers resting thereon, to which cross-ties were directly fastened. As the pedestals were spaced 18 ft. on centers, it was deemed best to place the trestle supports 9 ft. on centers, thus allowing two horses under each set of stringers with an even distance to each pedestal form. All rails and stringers were bolted securely together, excepting at certain predetermined places, where all joints were made to correspond. In no case were the stringers and horses fastened together in any way. Thus, wherever it became necessary to move to the next row of pedestals, half of the horses were moved first, then the stringers, ties and rails were broken at their predetermined joints and were carried in sections to their new positions on the horses. After this the remaining horses were put in place and the work of concreting was resumed.

The entire trestle work, 350 ft. long, was generally moved by the concrete crew of 24 men in about 20 minutes. On account of the general design of the forms and the shape of the pedestals, it was necessary to have the concrete mix quite wet in order to fill all the corners and make a good appearing job, and unless the forms were held down very rigidly they would rise vertically and allow the wet concrete to escape from below. At first sandstone paving blocks were tried for weighting down the forms, but this proved very expensive and failed to give the desired result if the concrete was poured with any degree of rapidity. It was finally decided to drill 1¼-in. holes in the old concrete floor of the reservoir near the four corners of the pedestal forms, then to drive a soft wooden plug into each of the holes and screw ¾ in. x 6 in. lag screws into the wooden plugs. Then 4 in. x 6 in. timbers of sufficient length were placed over the offsets and wired securely to the heads of the lag screws. At first, in order to secure the proper tension in the wires, wedges were used between the timbers and the offsets on the form, but this was finally abandoned in favor of twisting the wires together as it was found even more economical and answered the purpose just as well. This method proved very satisfactory indeed, and but very few pedestal forms broke loose. Those that did were generally at one corner only, and then on account of the old concrete giving away, or the wooden plug pulling out. After all the pedestals had been poured and the forms removed, the wooden plugs were driven down into the underlying clay of the reservoir bed and the holes were filled with a Portland cement mortar.

During the season of 1910 all the pedestals but 64 were poured, and although during the latter part of the work the temperature fell as low as 10° below zero, only ten pedestals showed any effects from the cold. Those that did show any effect of freezing were not damaged to a greater depth than ¼ in. and this was caused by a foreman getting drunk and not obeying orders. The only protection given the concrete was that afforded by the 2-in. form lumber and two layers of empty cement sacks, placed over the top of each form and allowed to remain about 48 hours.

The sand and water were heated as much as possible and sufficient salt was added to the warm water to float a potato. During the latter part of the work and while the temperature was at its lowest point, some of the concrete was hauled an average distance of 1,000 ft. in open cars but no effects of frost action have been noticed.

The remaining 64 pedestals were left out on account of being cut into slopes of the basin, and it was deemed inadvisable to expose the wet clay below during the cold weather. Soon after the last concrete was poured and the forms were removed, the reservoir was put back into service and used throughout the winter, thus the new concrete was well protected from frost action and was given ample time to harden before the work of placing the columns thereon was begun.

Groined Arches and Columns.—During the latter part of the winter and the early part of the spring of 1911 a great deal of discussion was carried on relative to making the

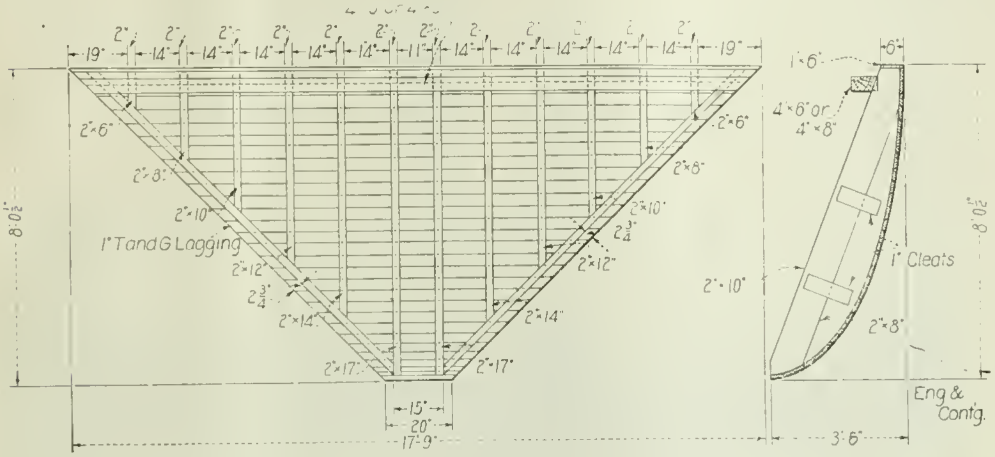


Fig. 5—Forms for Groined Arch Over Clear Water Basin.

groined arch forms and the column forms at the site of the plant, or to having them made up by some mill in the city and delivered at the reservoir. It was concluded, however, that a small mill and shop would be necessary at the plant any way, and that the cheaper and more satisfactory plan would be to build all forms of every description there. Accordingly, bids were asked for on the equipment, and a small mill containing a 26-in. band saw, a small circular saw table, a planer and matcher capable of planing and matching stock up to 2 ins. x 12 ins., a small drill press, an emory wheel, a hand punching machine, a hand power shears, a blacksmith forge and accessories, and a 10 h. p. Fairbanks-Morse gasoline engine were provided at a cost of less than $2,000, including equipment.

Soon after the mill was built, the form lumber arrived and active work was begun on the making of the groined arch and column forms for covering the clear water basin. This work was pushed vigorously until 80 column forms and 120 complete groined arch forms of the type shown in Fig. 5 had been built. The form for the end arch of the cover of the clear water basin is shown in Fig. 6. The building of the mill proved to be a very wise measure and it was in almost constant use from the time of its completion until the end of the work, late in 1912. The repairs to the mill equipment were slight and with few exceptions were made by the men engaged in the operation. The machinery is still in good condition, and can be used again on a similar job if the opportunity offers.

The use of a cableway for placing the groined arch forms and conveying the concrete to them was not practical on account of the nature of the ground, as before noted in respect to the pedestal. It was necessary to find some other means of accomplishing this. It was, therefore, decided to use the same cars for conveying the concrete as had been used on the pedestals, and to design a derrick capable of being easily and quickly moved from place to place as the work demanded. The result was the derrick shown in Fig. 7, which proved economical and very satisfactory in the extreme. The wheels shown in the picture were taken from the concrete mixers on the job and used throughout, as it was found that they were of no use on the mixers excepting in moving—and another set of trucks could be made to answer the purpose just as well as the originals.

Four inch by six inch stringers resting on 4 in. x 6 in. table posts at the ends, with a 4 in. x 6 in. strut at the middle were used for supporting the crown end of the arch forms, while the nose was supported by a collar made of 4 in. x 6 in. material resting on four 4 in. x 4 in. posts and the column form. The column forms in turn were supported on the old pedestal forms, which had been previously dropped over the pedestals and trued up. The bracing was in all cases made of 2 in. x 4 in. material, and of such a length as to need no splicing, although towards the end of the work these braces were spliced and answered very well. Twenty-penny wire nails were used in all cases for securing the bracing to the columns and posts, and all the heads of nails were allowed to protrude sufficiently to allow of their withdrawal by means of a small claw bar.

One of the difficulties encountered on this piece of work was the variable length of the columns, scarcely any two being of the same height. This was caused by the slope of the bottom of the reservoir on which rested the pedestals and the slope of the finished groined arch vaulting not corresponding in any way or manner. Thus it was necessary, after having used the column forms once, to vary their length before they could be used again. Careful thought and consideration was given this matter before any attempt was made to start operations, and it was decided to start at the south end, or where the columns were shortest, and work towards the north end, or where the columns were longest. In this way it became necessary to splice a short piece of column form on each time a column form was moved ahead. After using the column forms the first time, the forms were in two parts, a long part which was placed at the bottom, and a short part (never over 2 ft. long) at the top, and upon which rested the nose of the groined arch form supported by its collar and posts. After the concrete had set four or five days, it was very easy to remove the main part of the form from the column and allow the short part to remain without in any way disturbing the arch form or causing any stresses to come upon the newly poured arch. The short piece of form, collar and posts supporting the same, were allowed to remain in place until just before the time of dropping the arch forms when they were removed. In this way it was found that fewer column forms were required than would have been the case had the longer columns been poured first, as then it would have been necessary to have had as many column forms as there were groined arch forms in use.

In dropping the sections of groined arch forms four small blocks and tackle were used in a novel manner. A 4 in. x 8 in. scantling of sufficient length to reach across the arch at the nose, and another of sufficient length to span the crown were attached on edge at their ends to a set of falls, which were in turn fastened to the 4 in. x 6 in. stringers which rested on the table posts. The nose of the arch form was first pried loose and allowed to drop on its 4x8, and then one end of the crown of the arch form was worked carefully off its table post and lowered by hand by two men on to the other 4x8, after which the last corner was treated in a like manner, and then the whole section carefully but rapidly was lowered to the bottom of the basin by means of the four falls.

The arch sections were then placed on a timber dolly and transported into place ready to be reset by the traveling derrick. At first the men were very slow in dropping the forms, but finally by selecting the better men a fairly good crew was formed. After the crew had reached a point where no increase was noticed in their work, it still appeared as if more could be accomplished, so the amount of forms to be wrecked in a day was increased about 10 per cent, and the men were told that if they accomplished the amount of work laid out for them that they could go home. The scheme worked very nicely, with a saving in the cost to the city, and a saving of time to the men. No attempt was ever made to increase the amount of work, and all parties were satisfied. Furthermore, the need of a foreman was done away with, and his time could be put in on the transporting and setting to greater advantage.

All arch forms were used on an average of eight times and column forms about sixteen times. Nevertheless, at the end of the job, the main part of the arch and column forms remained very good and were afterwards broken up and used again on the filter work proper. In all, there were 940 columns, 940 groined arches, and 100 side arches poured and no collapsing of forms occurred throughout the work, showing conclusively that all forms were sufficiently strong for the work for which they were designed.

Crude oil was used to oil all surfaces that came in contact with the concrete, and the oiling was done but twice during the entire work.

Concreting.—For pouring the concrete in the arches and columns forming the roof of the clear water basin, the same cars and track were used as had been used for forming the pedestals, and the manner of their use was somewhat similar. The track was laid along the top of the reservoir embankment to a point opposite the arches and columns to be poured, and in order to allow the track to make a right angle turn a turn-table was installed. From this point the track was laid on 4 in. x 6 in. stringers, resting directly on the groined arch forms across the entire width of the basin to the opposite embankment, with a passing track about midway between embankments. On account of the track depending upon the forms and bracing for its support, it was found desirable to allow each car to contain not more than ¾ cu. yd. of mixed concrete. Therefore, the batch from the mixer was fixed at ⅔ cu. yd., although the mixer's capacity was about 1 cu. yd. of the mixed material, and this was the size of each batch throughout the work. The cars were used in pairs and were hauled from the mixer to the turntable by a horse, after which they were pushed out along the forms by hand to the proper place and their contents dumped directly on the lagging. The columns were always poured at least one day in advance of the arches which they were to support. This was accomplished by having the track laid over the crown of the arches midway between two rows of columns, and by pouring the columns on the north side before starting the groined arches on the south. The columns on the south side had been previously poured in a like manner. Thus when starting to pour

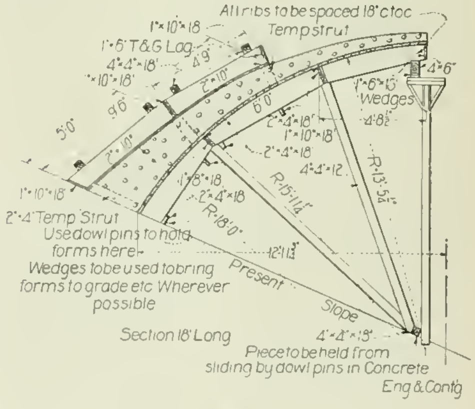


Fig. 6—Forms for End Arch of Covering Over Clear Water Basin.

a new set of arches, there were always two rows of columns in place to help the posts and bracing to take the thrust of the cars while dumping. A complete row of arches was poured before moving forward to the next. The alternate method of pouring was used; that is, one arche would be poured, then one jumped and the next poured, and so on until half the row was finished, when the remaining arches would be poured in a like manner.

The concrete, which was a 1:2:4 mix, was all mixed in an improved Chicago Cube Mixer and was poured wet in the columns and vigorously worked with steel rods to free all air and to give the outside a smooth and pleasing surface, after the forms were removed. While in the arches the mix was just wet enough not to run on the arch slopes with the depression in the top. All arch concrete was dumped directly on the forms and shoveled to place by hand. A screed in the form of a cross, with the desired outlines on its lower side, was used to give the general outline to the mass, and the whole was formed into shape by means of shovels in the hands of the laborers following the underside of the screed by eye alone, as shown in Fig. 8. Great care was taken, however, to secure the desired thickeness of material at all points, with the result that a little more concrete was used than would have been the case, had outside as well as inside forms been used instead of the screed. However, the ease with which the screed could be moved from place to place, together with its simplicity and low initial cost, more than compensated for the extra concrete and allowed one to observe his work at all times.

An effort was made to have all columns and side arch forms remain in place four days, and all groined arch forms nine days, but occasionally it was found desirable to remove the column and side arch forms in three days, and the groined arch forms in eight days. On one occasion a mistake was made and a half dozen groined arch forms were removed in five days, with no serious results. During freezing weather the forms were allowed to remain as long as possible, and were never removed in less than 14 days.

Earth Covering.—No attempt was made to start work in placing the 24-in earth covering over the arches until the concrete had set 30 days, and after this the time between pouring and loading increased of itself because of the fact that the concrete moved ahead very much faster than the earth work.

With the exception of some 2,000 cu. yds., handled by 1½-cu. yd. dump cars, all the earth was hauled from the borrow pits an average distance of 1,400 ft., by means of 1¼-cu. yd. common dump wagons, and dumped in the desired place. In no case, however, were the teams allowed to drive directly on the concrete. They drove as near as possible to the concrete and the earth was then spread by hand.

It was different, however, with the cars. They were hauled in trains of three by a team and were dumped over the side directly on the bare concrete. Then, as the work advanced, the track was removed sidewise, and run over the loaded arches. A series of measurements were taken to determine what effect the heavy loads running over the arches would have upon the concrete, but as far as could be determined by the method employed nothing whatsoever occurred different from the loading by teams. The deflection seemed to be about the same under the loaded wagons as under the cars.

All the earth covering except a part of the 4-in. layer of loam was finished early in December, 1911, and the remainder early in the spring of 1912.

During the winters of 1911 and 1912 the reservoir was in constant use, and although both winters were very severe, but ½ in. of ice was ever noticed to have formed on the water.

SUMMARY OF UNIT LABOR COSTS ON CLEAR WATER BASIN IN 1910.

	Cts.
Building pedestal forms, per sq. ft	6.6
Setting pedestal forms, per sq. ft	1.6
Removing pedestal forms, per sq. ft	1.2
Building wall forms, per sq. ft	4.3
Wrecking forms, per sq. ft	2.0
Setting and removing track and trestle, per lin. ft	9.9
Placing wall concrete, per cu. yd	72
Placing pedestal concrete, per cu. yd	$1.35
Sealing around pedestals, per cu. yd	$4.58
Excavating pedestal holes, per cu. yd	$1.07
Backfilling pedestal holes, per cu. yd	55
Hauling sand, per cu. yd	43.8
Hauling cement, per bbl	13.9

The items which are above summarized are given below in more detail:

LABOR COST DATA ON CLEAR WATER BASIN IN 1910.

Formwork.—Building Pedestal: 6,059 sq. ft. of pedestal forms were built at an average cost of 6.6 cts. per sq. ft. This includes oiling the forms. Setting Pedestal: 63,338 sq. ft. of pedestal forms were set at an average cost of 1.6 cts. per sq. ft. This also includes the drilling of the 1¼-in. holes in the bottom of the basin and bolting down, wiring, etc. Removing Pedestals: 53,793 sq. ft. of pedestal forms were removed at an average cost of 1.2 cts. per sq. ft. Building Wall Forms: 5,265 sq. ft. of wall forms were built at an average cost of 4.3 cts. per sq. ft. This includes all bracing. Wrecking: 3,456 sq. ft. of wall forms were wrecked at an average cost of 2 cts. per sq. ft.

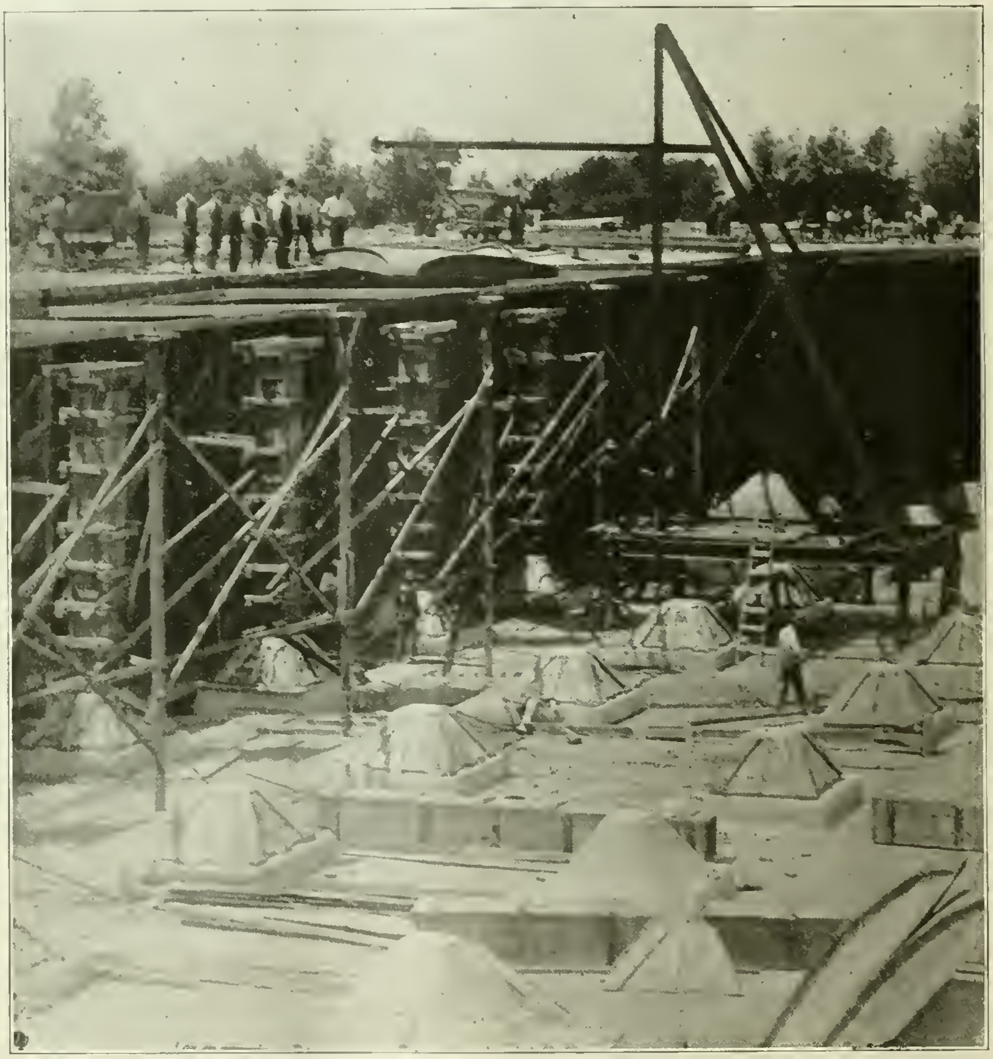


Fig. 7—View Showing Use of Derrick for Setting Groined Arch Forms.

Setting and Removing Track and Trestle.—800 ft. of track and trestle was set and removed at an average cost of 9.9 cts. per ft.

Placing Concrete.—Wall: 350 cu. yds. of wall concrete were hoisted 15 ft. and placed at an average cost of 72 cts. per cu. yd. Pedestals: 1,865 cu. yds. of pedestal concrete was placed at an average cost of $1.35 per cu. yd. The cost of moving the track is partially included. Sealing: 169 cu. yds. of sealing concrete were placed at an average cost per cu. yd. of $4.58. The cost of moving track is partially included.

Pedestal Holes.—Excavation: 920 cu. yds. of excavation was made at an average cost of $1.07 per cu. yd. This includes tearing out concrete, revetment, etc. Backfill: 519 cu. yds. of backfill was made at an average cost of 55 cts. This was hand tamped on the slope.

Hauling Sand and Cement.—1,853 cu. yds. of sand was hauled 2,000 ft. at an average cost of 48.8 cts. per cu. yd. 1,552 bbls. of cement were hauled 1½ miles at an average cost of 13.9 cts. per bbl.

Miscellaneous.—The cost of cleaning the basin for receiving water was $854.85. There were unclassified labor costs on the clear water basin in 1910 amounting to $438.85.

SUMMARY OF UNIT LABOR COSTS ON CLEAR WATER BASIN IN 1911.

	Cts.
Building arch forms, per sq. ft	5.2
Transporting arch forms, per sq. ft	0.6
Setting arch forms, per sq. ft	1.9
Wrecking arch forms, per sq. ft	1.7
Building supporting posts, each	18
Setting and wrecking supporting posts, each	46.7
Building column forms, per sq. ft	1.3
Transporting column forms, per 1,000 ft. B. M.	95
Setting column forms, per sq. ft	3
Placing column clamps, each	5.7
Wrecking column forms, per 1,000 ft. B. M.	$10.24
Making column clamps, each	1.2
Tearing up forms, per 1,000 ft. B. M.	$1.87
Sawing wedges, each	1
Recovery of lumber, per 1,000 ft. B. M.	$4.10
Making 42-in. conduit forms, per sq. ft	17.8
Setting 42-in. conduit forms, per sq. ft	2.5
Setting pedestal forms, each	68½
Concreting conduit, per cu. yd	$1.58
Concreting columns and arches, per cu. yd.	94
Backfilling pedestal holes, per cu. yd	59
Sealing up pedestal holes, per cu. yd	$3.22
Tearing up old revetment, per cu. yd	51
Filling on top of basin, per cu. yd	48.5
Transporting lumber, per 1,000 ft. B. M.	$4.00

The costs which are summarized above are given below in more detail:

LABOR COST DATA ON CLEAR WATER BASIN IN 1911.

Ground and Segmental Arch Forms.—Building: 25,964 sq. ft. of these forms were built at an average cost of 5.2 cts. per sq. ft., including oiling. Transporting: 367,832 sq. ft. of these forms were transported a distance averaging between 200 and 300 ft. at an average cost of 0.6 ct. per sq. ft. This cost includes hoisting 289,100 sq. ft. of the forms through a height of 22 ft Setting: 346,731 sq. ft. of these forms were set at an average cost of 1.9 cts. per sq. ft. This includes all bracing, repairs and reoiling. Wrecking: 334,214 sq. ft. of these forms were wrecked an average cost of 1.7 cts. per sq. ft. This includes the wrecking of all braces. In all the foregoing square feet of formwork refers only to the portion exposed to concrete.

Supporting Posts.—Building: 108 supporting posts for the arch forms were built at an average cost of 18 cts. each. This includes the cost of transporting the posts. Setting: 3,524 posts were set at an average cost of 46.7 cts. each. This includes wrecking the posts and hauling them. The cost of wrecking only on 174 posts averaged 2.9 cts. each.

Column Forms.—Building: 3,330 sq. ft. of forms were built at an average cost of 1.3 cts. per sq. ft. Transporting: 17,200 ft. B. M. of these forms was transported about 800 ft. at an average cost of 95 cts. per 1,000 ft. B. M. Setting: 123,243 sq. ft. of these forms were set at an average cost of 3 cts. per sq. ft., including transporting to place and reoiling. Placing Clamps: 16,029 clamps were placed at an average cost of 5.7 cts. each. Wrecking: 112,478 ft. B. M. of these forms were wrecked at an average cost of $10.24 per 1,000 ft. B. M. This includes removal of clamps.

Making Clamps.—4,807 clamps were made at an average cost of 1.2 cts. each.

Tearing Up Forms.—101,930 ft. B. M. of forms were torn up at an average cost of $1.87 per 1,000 ft. B. M.

Sawing Wedges.—1,880 wedges were sawed at an average cost of 1 ct. each.

Recovery of Lumber.—128,200 ft. B. M. of lumber was recovered from the torn down forms at an average cost of $4.10 per 1,000 ft. B. M. This work was the pulling of old nails, removing concrete from the boards, etc.

42-in. Conduit Forms.—Making: 111 sq. ft. of collapsible forms were built at a cost of 17.8 cts. per sq. ft. Setting: 7,779 sq. ft. of 42-in. conduit forms were set at an average price of 2½ cts. per sq. ft. This included oiling and bracing.

Setting Forms for Pedestals.—726 pedestal forms were set at an average cost of 68½ cts. These forms were dropped onto the pedestals and squared up for holding up the column forms.

Concreting.—Conduit: 158 cu. yds. of concrete were placed in the 42-in. conduit at an average cost of $1.58 per cu. yd. This included placing the reinforcing bars. Columns and Groined Arches: 10,933 cu. yds. of concrete were placed at an average cost of 94 cts. per cu. yd. The average haul was 650 ft.

Holes for Pedestals.—Backfilling: 269 cu. yds. were backfilled at an average cost of 59 cts. per cu. yd. Sealing Up: 64 cu. yds. of concrete were used in sealing up holes for pedestals at an average cost of $3.22 per cu. yd. This concrete floor was 6 ins. thick and the cost given covers the 1:2 cement mortar finishing coat.

Tearing Up Old Revetment.—1,589 cu. yds. of the old revetment wall were torn up and hauled away at an average cost of 51 cts. per cu. yd.

Filling on Top of Basin.—36,949 cu. yds. were filled at an average cost of 48.5 cts. per cu. yd. The average haul was 1,200 ft. Common dump wagons were used. All earth was shoveled by hand.

Transporting Lumber.—170,590 ft. B. M. of old form lumber was transported 1,000 ft. at an average cost of $4 per 1,000 ft. B. M.

Miscellaneous—During the year $1,316.50 was spent in cleaning out the basin. For painting up bad spots on the arches $236 was expended. The unclassified labor expense during the year was $742.

HEAD HOUSE AND FILTERS.

No work whatsoever was done on the head house and filters during the year of 1910, on account of the plans not being then available. In fact it was not until March 1, 1911, that the plans were turned over to the city of Minneapolis by Messrs. Hering & Fuller. As soon as the plans arrived everything possible was done to get out the estimates and contracts for construction materials at an early date, but it was the last of May before the reinforcing steel began to arrive and some delay was occasioned by this. However, the intervening time was utilized in making the necessary excavations for the foundations and the installation of the machinery with which to carry on the work. Whenever possible, wheel scrapers were used to transport the excavated material to the dumps, but on several occasions it was necessary to make use of the dump wagons instead on account of the confined quarters in which some of the work had to be done. At only one place was any difficulty experienced. At one corner of the headhouse a small spring was encountered and the ground in the immediate vicinity was very mushy and soft. The soft material was all excavated to solid clay and the footings of the head house walls were carried that much farther down.

All work in the head house and filters were carried on simultaneously and an effort was made to keep both parts at as near the same elevation as the nature of the design would permit.

All the inverted groined arches under the filters were poured monolithic, thus doing away with 50 per cent of the joints which would have occurred had the same method been used as was used at Cincinnati, and elsewhere. By reference to Fig. 9 the reader can see how this was accomplished, and the way in which the concrete was poured and formed into shape. For forming the inverted groined arch piers a wooden straight edge shod with iron was run over the concrete, using for its guide the two opposite sides of the form shown. Some difficulty was experienced at first on account of the inexperience of the men running the straight edge and the difficulty of getting the concrete mix of the right consistency, but after a few piers had been placed and the men had been shown the importance of getting everything right, no further difficulty was experienced in this line, nor on similar work on the coagulation basin.

All walls forming the outside of the auxiliary clear water basins, and foundations for the filters, were constructed in such a manner as to render them as impervious to water as possible. No wires for holding the forms together were used, bracing alone being depended upon to give the desired rigidity. The concrete was mixed very carefully and an oversupply of water was avoided, although sufficient water was used to make a wet mix. While pouring, and for some time after, the concrete was worked well by means of iron rods and spades in the hands of a number of men especially detailed for this purpose. In this way the wet concrete was made to fill all the voids and coat the steel, and any contained air was freed. After removing the forms no patching up was found necessary, and although no waterproofing material was used the walls have shown themselves to be waterproof under all conditions placed upon them during an operation period of four months.

Fig. 8—Method of Screening Concrete to Place on Covering of Clear Water Basin.

For handling the concrete a ¾-cu. yd. Polygon mixer was used to mix the concrete and an elevator was used to hoist the mix, and small cars or concrete carts were used to convey the material to the forms, as shown in Fig. 10. A hoist with chutes to convey the concrete was thought of, but on account of the uncertainty as to whether the stone would separate or not, and the consensus of opinion being that it would, the chuting of the wet concrete was abandoned in favor of the cars and carts.

Some difficulty was experienced in supporting the forms for the groined arch roof of the clear water basin on account of it being also necessary to support the bell mouth specials and to keep them exactly to line and grade while pouring. Had these specials come at the apex of the groins, the problem would have been very simple, but unfortunately some of them were as much as 16 ins. off center instead. The difficulty was finally overcome by making tables of sufficient width to not only support the arch form stringers, but also the bell mouth specials as well. The specials were then held to line by setting them over circles made of 2-in. wood of the right diameter and at the right elevation, and spiking the whole to the tables. In this way the correct position of the specials was maintained while pouring the arches.

All hangers for supporting the underdrain system were placed and held in the forms, while pouring, and when the piping was hung in place, no hanger or special was found to be out of place.

On account of the arches covering the auxiliary clear water basin being solid, a wet mix was used and the arches were poured in succession straight along the whole length, instead of alternately as was the case with those of the main clear water basin. No attempt was made to rod or work the arch concrete, although the columns were worked. The bracing and supports underneath were similar to those of the large basin, in fact there was but very little difference in the manner of doing the work on both jobs. It was not necessary, however, to lower the groined arch forms by means of a tackle, as the distance they had to fall was slight, and no very great damage was done them when they were allowed to drop free. Sufficient forms were provided for half the work at a time, and these forms were used but twice, after which time they were wrecked and the lumber was used again wherever it was possible to do so.

Filters.—With the exception of the walks across the top of the filters, the forms for the filter boxes were made up in sections and of such a size as to be easily moved from filter to filter as the work progressed. Enough forms for three complete filter boxes only were made, and these were used for pouring the twelve filter units. Of course, it was necessary to repair the forms somewhat during the work, but almost all the lumber was used again in building other forms after the filter boxes were finished. The use of oil on the concrete side of the forms was not resorted to and a smooth and pleasing surface was obtained nevertheless on all the filter boxes. Although oil had been used several times before this on the forms it was never again tried, excepting on collapsible forms, as there seemed to be no advantage in its use on straight walls, columns, beams, floors or other places where straight wooden forms were used.

Each filter box, which is 50 ft. x 26 ft. 6 ins. and 9 ft. in height, inside measurements, with a central gutter 3 ft wide running its full length, a 6-in. concrete floor and walks on top, was poured monlithic with but little trouble. The only difficulty experienced was in getting the concrete to completely fill all voids in the thin heavily reinforced walls of the central gutters. However, by thoroughly working the concrete as poured, this difficulty was overcome. For holding the lateral gutters, a hole with dimensions equal to the outside of the lateral gutters was left in the walls of the center passage at the location of each gutter for one end, and a recess was cut in the filter walls about 6 ins. deep, and at the right place for the other end.

Two sets of collapsible forms were then made and the gutters were poured as fast as possible. On account of the cold weather at the time the gutters were poured it was necessary to heat all the material, cover the work with a large canvas and keep salamanders burning all the time. This has been included in the cost data, and is one cause of the high cost of this work.

The lateral gutters were poured first only up to the curved or weir portion (see article on design for illustration) and were allowed to set for 24 hours or more, after which the inside part of the form was removed and a piece of 1-in. plank was put in place on the inside upon which the correct elevation of the crest was marked. Small screeds of the proper outline were then placed about 4 ft. center to center, and a 1:2 stiff cement mortar was used to form the weir, the same being formed to shape by means of a straight edge run carefully over the screeds. In order to tie the two parts of the gutters together, the cross reinforcing steel rods were run up as far as possible, and 20d. wire nails were embedded half their length in each part spaced 6 ins. on centers. The concrete was also left as rough as possible at the joints, and all joints were cleaned of laitance and dirt before placing on the finish. At first an attempt was made to finish the weir and main part of the gutter, at the same time using the inside form to form the weir against, but this was found to be impracticable, on account of the breaking off of the thin edges when the inside form was removed—either from the men stepping or dropping something on it, or from prying against it with a crowbar. Moreover, after a while, it was found better to remove all forms first and then put the weirs in place than it was to attempt to do anything while there were still forms to remove from the filter box.

Screen Blocks.—The screen blocks or ridges were all poured in collapsible forms outside the filters and were then put into place after having set sufficiently to bear being handled. All steel for anchoring the blocks to the bottom of the filter boxes was left out at the time of pouring, as it was impossible to obtain a smooth surface on the floor of the filters with all the bracing and steel anchor rods in place. Then, too, it would have been very difficult to have held the steel rods in place had the above method been used. All the anchor rods were thus left out until the time of setting the screen blocks, when holes 1¼ ins. in diameter and 9 ins. deep were drilled by means of an air drill, previously provided and set up for this purpose at the exact location. The hole was then filled with a thick grout, a bed of 1:2 cement mortar placed under the screen block, the block put in place and the anchor rods were driven through the inverted cone shaped hole in the block (see Fig. 9, p. 671, Engineering & Contracting, June 11, 1913) into the hole below and the remaining part of the holes was filled with thick grout.

It became necessary to remove one of the blocks on account of a defect, after the rods had been in place about two months, and out of curiosity an endeavor was made to pull three of the anchor rods out. A three-ton chain block was rigged up and six men were placed on the falls in each case, but the rods remained solid insofar as one could judge. Before deciding upon grouting the anchors, twelve test specimens were prepared and sent to the city testing machine, and although only embedded 6 ins. in the concrete it required a pull of from 5,000 lbs. to 9,000 lbs. to remove them.

Both steel and wooden forms were used for forming the blocks and crude oil was used on both. It was found that the wooden forms gave much better results as the edges seemed to hold better, and the oil mixed less with the concrete. The concrete was all mixed by machine, and the blocks were hauled about 200 ft. on a stone boat placed on a three-wheeled cart, hoisted about 20 ft. by a brick hoist, then carted about 100 ft. and lowered into the filter boxes by means of a block and tackle.

No reinforcement whatsoever was used at first in the side blocks, but it was found that it was almost impossible to handle them on account of their breaking in two wherever an anchor hole occurred, but by placing a piece of ⅜-in. square steel, when pouring, on each side of the hole near the bottom of the block this breakage was eliminated. In order to get the small offsets on each block it was necessary to use a fairly wet mix, but care was always taken to avoid using an excess of water.

Strainer Plates.—After a sufficient number of ridge blocks had been put in place and one could be assured that there would be no interference between the two parties a crew of men were put to work placing the strainer plates and bolting the same in position. The offsets on the side blocks were first coated with about ⅛-in. coat of neat cement and then the plates were put in position and partially bolted down by means of the "U" bolts and brass anchor rods shown in the previous article. In order to get the "U" bolts through the plate after the plate was set, linen thread was fastened to both ends of the "U" bolt and run through the proper holes. The brass anchor rod was then passed through the "U" bolt and set in the proper notches in the concrete ridge blocks. Then the plate was carefully lowered to place, care being taken to keep a tension in all the pieces of linen thread, and the "U" bolts were pulled through their respective holes, after which the nuts were put in place and partially tightened up. While the side plates were being set by some of the party another member was preparing the middle plate. A coating of cement mortar was first spread along both sides of the plate and about ⅛ in. thickness of red lead was placed on each end; then the bolts were passed through the plate and the whole was placed in position, after which the bolts were tightened up on the yokes and the side strainer plates were tightenel up until the red lead and cement mortar gave a proper bearing and oozed out from between the joints. All excess cement mortar and red lead were then wiped off.

In a good many cases it was necessary to chip out a small portion of the ridge block in order to increase the offsets on the same, as the clearance was not sufficient in all cases to allow the strainer plate to go easily between the blocks. It was also necessary to clean all the valleys between the ridge blocks first before the plates were set, as dirt, pieces of concrete, etc., were constantly falling down between the blocks no matter how hard one tried to keep them clean. All this is included in the cost data under the heading of "Setting Strainer Plates," as is also the replacing of a few of the ¼-in. brass bolts which holds the middle strainer plates up and which broke very easily when pressure was applied to tighten them up.

Gravel.—An attempt was made to secure the necessary gravel for the strainer system from local dealers in this material, but on account of the length of the haul over very poor roads, and the fact that no one possessed the proper screens for separating the gravel into the various sizes, the prices quoted (between $4 and $5 per cu. yd.) were considered too high, especially when it was noted it would have been necessary to give most of the material a wash anyway after its delivery. It was decided, therefore, to try and secure the gravel from a pit near the sight of the plant. The pit gravel, moreover, was of a much better quality for the purpose, and, as teams and men were very scarce at the time, the pit seemed to offer the better solution of the problem for a supply when wanted. It also furnished a place to work any excess men in when rains or lack of teams made the regular force too large to handle on the other work. Thus the men were kept busy at all times and the crews were more contented as they were always pretty sure to have work whenever they turned up, no matter what the weather was. As all the sand and gravel was more or less wet and mixed with clay in the pit, the material was first screened as it came from the pit over a coarse screen to remove the larger pieces. Then it was run over a fine screen and all the particles smaller than was wanted was washed through by means of a stream of water from a fire hose, and the remainder was put over hand rocked screens and separated into the proper sizes for use. Towards the last, difficulty was experienced in securing a certain size, and the cost of screening to obtain the same ran up enormously.

Fig. 9—Method of Forming Inverted Groined Arches Under Filters.

After screening and washing, the gravel was hauled from the screens to bins by means of the common dump wagons previously mentioned, it was placed in the bins and if there still remained any dirt of any kind it was again washed. It was then loaded into wheelbarrows, hoisted about 20 ft. by means of an elevator, wheeled to the filter and put in its proper place by means of 14-quart galvanized iron pails. Although wooden chutes were tried it was found that the use of pails instead worked a little better in placing the gravel, as the right quantity required for each layer could easily be placed without any mixing of those already in. The tops of each layer of gravel was rounded a little, the last rising about ¾ in. to 1 in. above the tops of the two ridge blocks containing it.

Brass Wire Mesh.—No special difficulty was experienced in placing the brass wire mesh over the gravel or in bolting it down, but the sewing of the sides was quite difficult. For this purpose No. 20 brass annealed wire was provided, and the adjacent edges where the strips of wire mesh overlayed were sewed double with stitches 1 in. on centers on both sides of the cloth.

It was found advisable to bolt one strip of wire mesh in place first, excepting the last row or row common to the two adjacent strips. The two strips were then made ready, forced down over the bolts to get their proper positions one with the other, then the edges were taken up again and small stove bolts were put in a few of the holes left by the bolts. The cloth was then raised on its edge with a man on each side, and the wire lacing was passed from one to the other until the whole length had received a double row of stitches, after which all displaced gravel (a little of the top layer only) was replaced and the cloth was bolted down to its last row of bolts when the operation was repeated, and so on until the whole side of the filter had been finished.

After all the wire screen had been placed in a filter box, holes were drilled in the concrete 12 ins. on centers entirely around the filter box about 1½ ins. above the wire mesh, and wooden plugs were driven in, after which an "L" shaped strip of 16-oz. copper was nailed by copper nails to the wooden plugs along the sides and soldered to the brass wire cloth. On the ends a "Z" shaped piece of copper was used instead of the "L" shaped piece and the upper leg was cut back into the concrete while the lower was soldered and held in place by the bolts and washers holding the wire screen. It was intended at first to use only the "L" strips on the sides to act as a stop and prevent the water from following along down the sides of the concrete, and to add to the strength of the wire screen, but soon after placing the plant in operation it was noticed on some of the filters that sand was getting into the under drains. Upon investigation a small opening, scarcely large enough to admit the point of a mason's trowel, was discovered between the wall and the middle screen block, which allowed a considerable quantity of sand to pass through. It was therefore decided to flash the end walls of all the filters as above described, and no further trouble has been experienced from this source since.

Sand.—It was found after a careful analysis that a bank of sand from a pit, located on the city's property very near the plant, would answer for the filter sand very well if the fine part, amounting to about 45 per cent of the whole, was screened or washed out, having first, of course, taken out all the particles above the maximum size that was allowed by the specifications. This sand was hard and durable, the majority of the grains being almost pure silica, resembling very much what is known as "The Red Wing Sand." A sand washer was installed and everything made ready for operations, but as the pumps were electric driven and no electricity had as yet been furnished the plant, it was necessary to hold matters in check for a while. Finally a temporary arrangement was installed whereby the current was furnished to the pumps and a start was made in washing the sand. At about this time the authorities were persuaded that the Red Wing sand was the only sand to use in a mechanical filter. Then, too, the season was getting pretty well advanced and fear was expressed as to whether the washer, which had a capacity of from 25 to 30 cu. yds. of washed sand per eight hour day, would be able to get enough sand washed to fill the twelve filter units before freezing weather set in. The Red Wing Filter Sand Company were then (on Aug. 22) called on and expressed their willingness to furnish the city with the necessary sand (filter sand) at $2.75 per ton f. o. b. cars, Red Wing, Minn., shipments to start immediately and all sand to be delivered by Jan. 1, 1913. Unfortunately, the Red Wing Filter Sand Company could not meet their agreement and there still remains one filter unit without sand.

All the filter sand, which weighs about 100 lbs. per cubic foot, was shipped in burlap sacks of 135 lbs. each, hauled from the sidetrack about 1½ miles away, 3½ tons to a load, unloaded and shot down a chute through one of the filter house windows onto the cement walks over the filters from whence it was loaded onto hand trucks and wheeled to the desired place. As soon as a load was unloaded, the sacks were opened and dumped into the filter box. When all the filters are filled with sand, there will be something over 1,800 tons of sand in the plant.

The local sand, it seems to the writer, would have answered the purpose almost as well as the Red Wing material and could have been washed, hauled and put in place for about ⅓ of the cost of the latter. It was also expected to get a part of the gravel for the filters from the sand in the process of screening and washing, but this could not be done with the final arrangements as entered into. Consequently the cost of the gravel, especially towards the last when only one grade was wanted, was pretty stiff and it is fair to say that some local concern would have received the contract for furnishing the gravel had anyone known at the time that the filter sand was to be bought by contract from the Red Wing Filter Sand Co.

SUMMARY OF UNIT LABOR COSTS ON FILTERS IN 1911.

	Cts.
Excavation and hauling earth, per cu. yd.	26 to 69
Concreting inverted arches, per cu. yd.	$1.21
Concreting foundation walls, per cu. yd.	$1.42
Concreting columns and groined arches, per cu. yd.	47
Concreting filter boxes, per cu. yd.	$1.47
Concreting sewer, per cu. yd.	$1.39
Concreting lateral gutters	$2.39
Making and setting inverted groined arch forms, per sq. ft.	3.7
Making and setting foundation wall, forms, per sq. ft.	4.2
Making and setting column forms, per sq. ft.	3.3
Making and setting groined and bbls. arch, forms, per sq. ft.	3.6
Making and setting filter box forms, per sq. ft.	5.9
Making and setting lateral gutter forms, per sq. ft.	7.4
Making and setting sewer forms, per sq ft.	8.8
Hand-tamped backfill, per cu. yd.	81
Bending reinforcing steel, per lb.	0.63
Setting reinforcing steel, per lb.	0.72
Transporting pipe and specials, per ton.	90.4
Setting pipe and specials, per ton	$8.25
Setting pipe hangers, each	8.5
Wrecking groined arch and conduit forms, per sq. ft.	1.4
Wrecking wall forms, per sq. ft.	1.5
Transporting form lumber, per 1,000 ft. B M.	$4.14
Cutting 18-in. pipe, per cut	50
Cutting 20-in. pipe, per cut	60
Cutting 24-in. pipe, per cut	75

The costs above summarized are given below in more detail.

COST DATA ON FILTERS IN 1911.

Excavation.—1,454 cu. yds. were excavated and hauled between 300 and 350 ft. with scrapers at an average cost of 26 cts. per cu. yd 600 cu. yds. were shoveled into dump wagons and hauled 450 ft. at an average cost of 38.7 cts. per cu. yd. 265 cu. yds. were excavated by pick and shovel for the 36-in. drain at an average cost of 69 cts. per cu. yd.

Mixing and Placing Concrete.—This includes all track, trestle and runway building, moving, and wrecking same. Track 24-in. gage, 16-ft. sections. Runways 10 ft. x 16 ft. of 2-in. material. Inverted Arches: 855 cu. yds. of concrete mixed and placed at average cost of $1.21 per cu. yd. Foundation Walls: 445 cu. yds. concrete, average cost of $1.42 per cu. yd. Columns and Groined Arches: 1,423 cu. yds. of concrete, average cost of 47 cts. per cu. yd. Filter Boxes: 1,312 cu. yds. of concrete, average cost of $1.47 per cu yd. Sewer and Lateral Gutters: 30 cu. yds. of concrete in the sewer cost on an average $1.39 per cu. yd. 55 cu. yds. of concrete in the lateral gutters cost an average of $2.39 per cu. yd.

Making and Setting Forms.—Areas given below are for contact with concrete. Costs given include all necessary supports, braces, scaffolds, etc. Inverted Groined Arches: 6,110 sq. ft. of forms at average cost of 3.7 cts. per sq. ft. Foundation Walls: 26,793 sq. ft. of forms at average cost of 4.2 cts. per sq. ft. Column Forms: 4,628 sq. ft. of column forms at average cost of 3⅓ cts. per sq. ft. 30 clamps were made and placed at an average cost of $1.19 each, and 458 column collars were made and set at an average cost of 12 cts. each. Groined and Barrel Arches: 40,355 sq. ft. of forms at an average cost of 3.6 cts. per sq. ft. Groined Arch Supports: The total cost of the groined arch supports was $151.94. Among other items 94 posts were set at 22 cts. each, 360 struts at 2 cts. each, and 118 intermediate posts at 13 cts. each. Filter Boxes: 75,174 sq. ft. of forms were set at an average cost of 5.9 cts. per sq. ft. Lateral Gutters: 3,328 sq. ft. of forms were oiled at 0.3 cts. per sq. ft. 2,113 sq. ft. of forms were built and set for 7.4 cts. per sq. ft., average. Sewer: 2,449 sq. ft. of sewer forms were built and set at an average cost of 8.8 cts. per sq. ft.

Wrecking Wall Forms.—63,905 sq. ft. of wall forms were wrecked at an average cost of 1½ cts. per sq. ft. This includes wrecking braces, supports, scaffolds, etc.

Transporting Form Lumber.—73,290 ft. B. M. were transported in common dump wagons, unsuited to purpose, at a cost of $4.14 per 1,000 ft. B. M.

Cutting Pipes.—Two men cut the pipe with cold chisels. 16 pieces of 18-in. pipe were cut at an average cost of 50 cts. per cut. 3 pieces of 20-in. pipe were cut at average cost of 60 cts. each. 3 pieces of 24-in. pipe were cut at average cost of 75 cts. each.

Setting I-Beams.—12.35 tons of I-beams were set at an average cost of $7 per ton. This includes the use of derricks, etc. 48 plates were set under the I-beams at an average cost of 82 cts. each.

Miscellaneous.—During 1911 $510 were spent for labor in cleaning up old form lumber. For repairing damages done by storms $325 was spent in 1911 for labor. There were also unclassified labor expenses in 1911 amounting to $723.

Calking Joints.—This includes yarning, heating lead, pouring, etc :

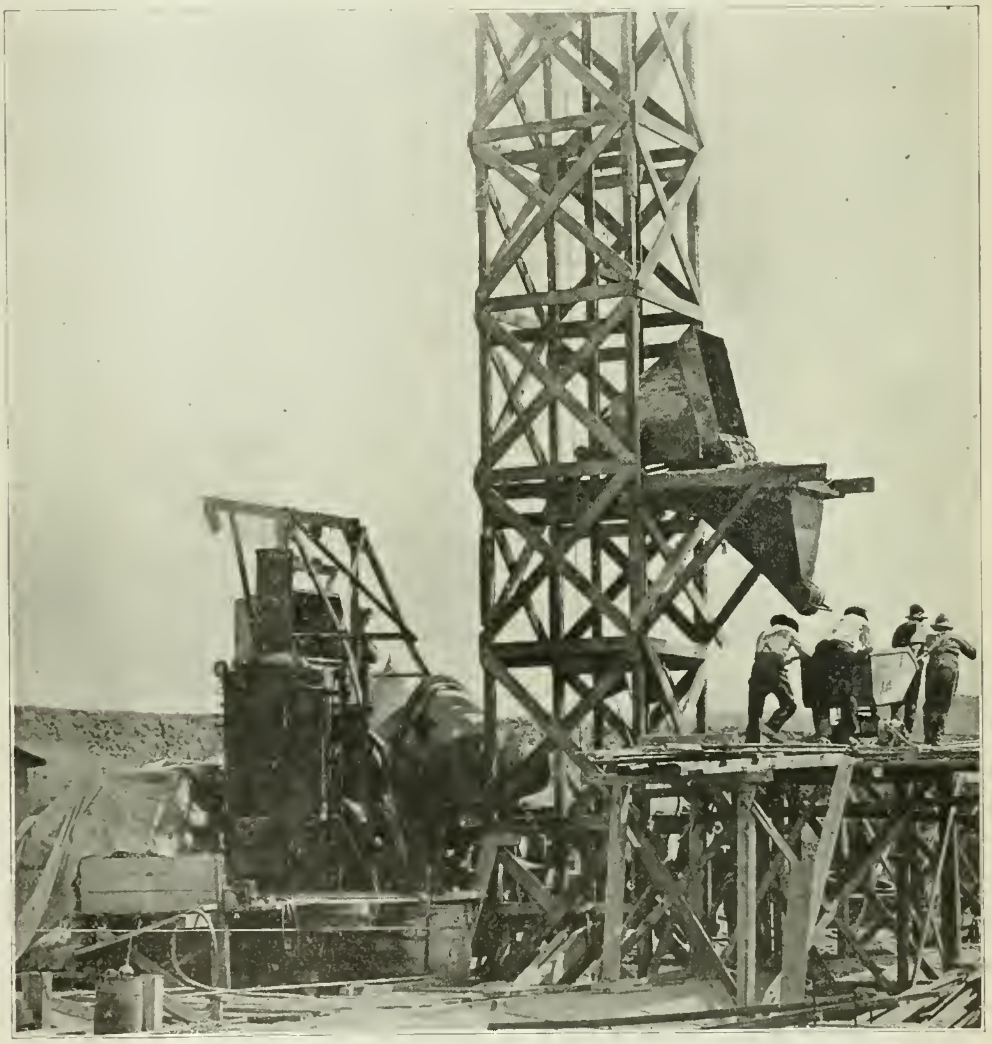


Fig. 10—View of Plant Used for Concreting on the Filters.

Backfill.—495 cu. yds. of backfill was hand-tamped at an average cost of 81 cts. per cu. yd. This was clay placed under all cast iron pipes

Bending Steel.—7,063 lbs. of reinforcing steel were bent at an average cost of 0.63 cts. per lb.

Setting Steel.—129,295 lbs. of reinforcing steel was set at an average cost of 0.72 ct. per lb. This steel was tied at all intersections with No. 16 wire. The cost given includes transporting the steel 350 ft. at approximately 0.1 ct. per lb.

Transporting Pipe and Specials.—216.7 tons of cast iron pipe and specials were rolled about 200 ft. by hand at an average cost of 90.4 cts. per ton.

Setting Pipe and Specials.—130 tons of pipe and specials were set at an average cost of $8.25 per ton. This includes the erection of derricks, scaffolds, etc., necessary for setting the material.

Setting Pipe Hangers.—144 short pipe hangers were set at average cost of 8½ cts. each. 46 long pipe hangers were set at 98½ cts. each.

Wrecking Groined Arches and Conduit Forms.—21,586 sq. ft. of these forms were wrecked at an average cost of 1.4 cts. per sq. ft. This includes wrecking of scaffolds, braces, supports, etc., also hoisting out the groined arch form sections.

27 18-in. joints were calked at average cost of	$1.01
35 18-in. joints were calked at average cost of	.90 cts.
90 20-in. joints were calked at average cost of	1.12
15 20-in. joints were calked at average cost of	1.00
10 24-in. joints were calked at average cost of	1.46
21 24-in. joints were calked at average cost of	1.19

Making Pipe Hangers.—120 1-in. x 18-in. pipe hangers were made at an average cost of 27 cts. each. One end of each hanger was upset to 1¼ in.

SUMMARY OF UNIT COSTS ON FILTERS AND FILTER HOUSE IN 1912.

	Cts.
Earth excavation, per cu. yd.	65.2
Earth fill, per cu. yd.	44.5
Making and setting ridge block and lateral gutter forms, per sq. ft.	1.7
Making and setting beam and column forms, per sq. ft.	9.7
Making and setting roof and floor slab forms, per sq. ft.	7.1
Wrecking forms, per sq. ft.	1.2

Transporting reinforcing steel, per lb......	0.2
Bending reinforcing steel, per lb............	0.4
Setting reinforcing steel, per lb............	0.4
Concreting lateral gutters, per cu. yd......	$6.10
Concreting floors and roof, per cu. yd......	$1.50
Concreting ridge blocks, per cu. yd........	$2.86
Placing lateral gutter weirs, per lin. ft....	7.3
Transporting ridge blocks, per cu. yd......	$1.39
Setting ridge blocks, per cu. yd............	$6.97
Setting strainer plates, each..............	32.8
Laying screen, per sq. ft..................	6.2
Screening gravel, per cu. yd................	$4.02
Hauling gravel, per cu. yd.................	$1.04
Placing gravel, per cu. yd.................	$3.62
Hauling filter sand, per cu. yd............	67
Placing filter sand, per cu. yd............	54½
Laying brick, per 1,000....................	$12.50
Placing roofing, per square................	$3.54
Transporting pipe, valves, specials and machinery, per ton..........................	$1.56
Setting pipe and specials, per ton..........	$2.00
Cleaning brick walls, per sq. ft............	2.1
Finish coat on roof, per sq. ft.............	3.7

TABLE I. — WAGES PAID ON CONSTRUCTION WORK AT THE MINNEAPOLIS FILTER PLANT.

Occupation.	1910.	1911.	1912.
		Per mo.	Per mo.
Assistant superintendent..	....	$125.00	$125.00
Chauffeur	....	65.00	65.00
	Per day.	Per day.	Per day.
Foreman	$4-5	$5.00	$4.50
Assistant foreman	3.00	3.50	3.75
Sub-foreman	....	3.00	3.00
Timekeeper	3.00	4.50	4.50
Clerk	3.00	3.00	3.00
Rodman	....	2.75	....
Brick foreman	....	....	7.00
Bricklayers	5.20	5.20	5.20
Structural steel foreman.	....	....	5.50
Structural steel workers..	....	....	4.50
Steamfitters' foreman.....	....	5.00	5.00
Steamfitters	....	4.50	4.50
Plumbers	....	....	4.50
Roofers	....	....	4.00
Plasterers	....	....	5.60
Mortar mixers	....	....	3-3.25
Stonemason	....	4.40	4.40
Machinist	....	....	4.00
Blacksmith	3.00	3.00	3.00
Electrician	....	....	4.00
Steam engineer..........	4.00	4.00	4.00
Gasoline engineer........	....	....	3.60
Concrete finishers........	....	....	2.60
Sheet metal workers......	....	....	4.80
Painters	....	....	3.60
Carpenters	....	4.00	4.00
Non-union carpenters.....	....	3.00	3.00
Erecting engineer, vacuum system	....	....	5.00
Bricklayer apprentice, 3rd year	....	....	3.60
Steamfitter helper........	....	....	2.40
Water boy	1.25	1.25	1.40
Handy man	2.40	2.40	2.55
Calkers	2.75	....	3.15
Single horse	3.00	3.00	....
Teams	4.72	4.72	5.00
Laborers	2.25	2.25	2.40

The costs above summarized are given in more detail below:

LABOR COST DATA ON FILTERS AND FILTER HOUSE IN 1912.

Earthwork.—Excavation: 2,409 cu. yds. of clay was excavated with pick and shovel at average cost of 65.2 cts. per cu. yd. Some of this clay was handled three times. The cost includes a small amount of sheeting. Fill: 6,494 cu. yds. of fill was made at an average cost of 44½ cts. per cu. yd. Sandy soil was used and was tamped by hand under pipes. The average haul of material was 800 ft.

Making and Setting Forms.—Ridge Blocks and Lateral Gutters: 60,110 sq. ft. of these forms were made and set at average cost of 1.7 cts. per sq. ft. These were collapsible forms bolted together. Cost includes oiling and cleaning after collapsing. Beams and Columns: 23,893 sq. ft. of these forms were built and set at average cost of 9.7 cts. per sq. ft. This includes clamping column and beveling all beams. Cost includes all supports, etc. Roof and Floor Slabs: 24,539 sq. ft. of these forms were set at an average cost of 7.1 cts. per sq. ft. These areas indicate only surface of form in contact with concrete. This cost includes all bracing, supports and wiring.

Wrecking Forms.—102,747 sq. ft. of forms were wrecked at an average cost of 1.2 cts. per sq. ft. This includes wrecking bracing and supports.

Reinforcing Steel.—Transporting: 86,481 lbs. of reinforcing steel was transported an average distance of 350 ft. at 0.2 ct. per lb. Bending: 23,481 lbs. of steel were bent at an average cost of 0.4 ct. per lb. Setting: 12,992 lbs. of reinforcing steel were set at an average cost of 0.4 ct. per lb. This includes wiring with No. 16 annealed wire at all intersections.

Electrical Work.—3,369 lin. ft. of ½ to 1-in. conduit was placed at a cost of 5.9 cts. per ft. 13,110 ft. of insulated wire was placed at 0.7 ct. per ft. 11 switch boxes were set at 25 cts. each. 10 arc lights were set at $1.50 each, and 8 arc lights were set at $1.00 each.

Concreting.—Lateral Gutters: 86 cu. yds. of concrete were placed at average cost of $6.10 per cu. yd. This includes firing of salamanders in each filter box for 72 hours continuously. Floors, Roof, etc.: 608 cu. yds. of concrete were placed at average cost of $1.50 per cu. yd. Ridge Blocks: 325 cu. yds. of concrete were placed at average cost of $2.86 per cu. yd. This includes placing screen bolts and all reinforcing steel in each block.

Placing Lateral Gutter Weirs.—5,800 lin. ft. of concrete were placed at an average cost of 7.3 cts. per ft.

Chipping Concrete.—The sum of $17 was spent for labor on chipping out concrete.

Cutting Recesses.—66 recesses were cut for the ends of the lateral gutters at an average cost of $1.03 each.

Ridge Blocks.—Transporting: 314.52 cu. yds. of ridge blocks were transported an average distance of 300 ft. and were hoisted from 20 to 23 ft. at an average cost of $1.39 per cu. yd. Setting: 305 cu. yds. of ridge blocks were set at an average cost of $6.97 per cu. yd. This includes all drilling for anchor rods, cutting and placing rods, grouting in rods, and chipping concrete.

Setting Strainer Plates.—3,736 strainer plates were set at an average cost of 32.8 cts. each. This includes cementing up, bolting, chipping concrete where necessary, etc., complete.

Laying Screen.—15,292 sq. ft. of screen was placed at an average cost of 6.2 cts. per sq. ft. This includes sewing with No. 20 wire, placing washers and bolting down.

Gravel.—Screening: 368.85 cu. yds. of gravel was screened at an average cost of $4.02 per cu. yd. Hauling: 265 cu. yds. of gravel was hauled at an average cost of $1.04 per cu. yd. Placing: 212 cu. yds. of gravel were placed at an average cost of $3.62 per cu. yd. This includes placing in wheelbarrows, hoisting 20 to 23 ft. and wheeling to place.

Filter Sand.—Hauling: 948 cu. yds. of filter sand was hauled 1½ miles at an average cost of 67 cts. per cu. yd. This includes loading from cars and wagons. Placing: 563 cu. yds. of sand was placed at an average cost of 54½ cts. per cu. yd.

Laying Brick.—221,700 brick were laid at an average cost of $12.50 per 1,000. This includes cost of mixing and coloring mortar, and all scaffold work.

Setting Terra Cotta.—14 terra cotta sills were set at an average cost of $2.14 each. Five were set at $1.20 each. 377 lin. ft. of terra cotta was set at an average cost of 14 cts. per ft.

Roofing.—82¾ squares of roofing were placed at an average cost of $3.54 per 100 ft. square. This includes placing tarred felt and shingles.

Setting Window Sashes and Frames. — 171 frames and sashes were set at an average cost of 73 cts. each. This includes setting the necessary hardware.

Transporting Pipe, Valves, Specials and Machinery.—418 tons were transported through distances ranging from 150 ft. to 350 ft. at an average cost of $1.56 per ton. This includes loading, hauling, unloading, picking loose from frozen ground, etc.

Setting Pipe and Specials.—476 tons were set at an average cost of $2.00 per ton. This includes scaffolds, derricks, belting, etc.

Pipe Hangers and Supports—

Making—

No. of hangers.	Size of hangers.	Av. cost per hanger.
31	¾ in. × 7 ft................	$1.24
7	⅞ in. × 29 ft..............	2.26
12	⅞ in. × 23 ft. 3 ins........	2.15
31	⅞ in. × 18 ft. 6 ins........	1.38
17	¾ in. × 6 ft. 4 ins.........	1.26
12	¾ in. × 6 ft................	0.37
18	1¼ ins. × 18 ins...........	0.81
11	1¼ ins. × 7 ft. 9 ins......	0.85

Placing—

No. of hangers.	Size of hangers.	Av. cost per hanger.
24	¾ in. × 7 ft................	$0.59
31	⅞ in. × 18 ft. 6 ins........	0.75
14	¾ in. × 21 ft. 6 ins........	1.17
3	¾ in. × 6 ft. 4 ins.........	0.75
24	¾ in. × 6 ft................	1.20
18	1¼ ins. × 18 ins...........	0.50
11	1¼ ins. × 7 ft. 9 ins......	0.14

Setting Hydraulic Gates—

Size, ins.	No. gates.	Av. cost setting.
12	14	$1.56
20	12	5.30
30	1	8.25
24	12	1.56

These costs include scaffolds, derricks, gaskets, etc.

Making Bolts—

Diam., ins.	No bolts.	Cost per bolt.
½	147	1.7 cts.
⅞	553	8.3 cts.
1	688	9.6 cts.
¾	106	8.4 cts.
⅝	50	3.4 cts.

Setting Rate Controllers.—The labor cost of setting the rate controllers was $175.

Ladder Rungs.—42 ¾-in. ladder rungs were made at an average cost of 33 cts. each. Sixty-four rungs were set at an average cost, including grouting, of 18 cts. each.

Transporting Lumber.—141,676 ft. B. M. of lumber was carried about 250 ft. at an average cost of $2.32 per 1,000 ft. B. M.

Cleaning Walls.—20,070 sq. ft. of brick wall was scraped free of cement and mortar and washed with a dilute solution of hydrochloric acid at an average cost of 2.1 cts. per sq. ft.

Drilling Holes in Concrete.—The following data shows the cost of drilling holes in concrete by hand:

Size of holes, ins.	No. of holes.	Av. cost per hole.
1⅜×9	3	$1.48
1¼×6	25	0.14
1⅛×8	8	0.63
1⅛×9	10	0.24
1⅜×9	18	0.15
1 ×4	30	0.09
⅝×2½	761	0.07

Painting.—27,500 sq. ft. of painting was done, one coat, at an average cost of 1 ct. per sq. ft.

Setting Small Pipe.—The following data relates to steam and vacuum pipe: 850 ft. of 1½-in. and 2-in. pipe was set at an average cost of 19 cts. per ft.

Setting Gate Stands.—Two stands for 36-in. × 48-in. sluice gates were set at an average cost of $2.87 each.

Placing Window Operating Device. — 391 ft. of window operating rods were placed at an average cost of 28 cts. per ft. This includes setting all gears, brackets, chains, etc., complete.

Sample Pumps.—11 sample pumps were set at an average cost of $1.73 each.

Finish Coat on Roof.—A 1:2 cement coat from ¼ to ¾-in. thick was placed on the cinder concrete roof. 9,736 sq. ft. were placed at average cost of 3.7 cts. per sq. ft.

Clearing Up.—Boards with nails in them were picked up periodically to prevent injury. The cost of this work on the filters in 1912 was $570.

Testing, valves, operating tables, etc., were tested at a cost of $49.

Repairs and Machinery Maintenance.—$530 was spent on the filters for this purpose in 1912. The greater part of this sum was for pointing up.

Storms.—For pumping water, removing snow, etc., $115 was spent on the filters in 1912.

Miscellaneous.—The miscellaneous and unclassified labor expense amounted to $881 on the filters in 1912.

Successful Application of the "Unit Well" System at Rockford, Ill.

(STAFF ARTICLE.)

For several years, at the time of peak load, it was noted that the momentary rate of water supply in the city of Rockford was insufficient to meet the demand. This condition was especially noticeable during hot, dry summers. In 1910 the city, therefore, employed a commission of engineers, composed of John W. Alvord, Dabney H. Maury and Daniel W. Mead, to make a study of the city's water supply needs, and to recommend enlargement and extension to the supply and system. The commission reported on several alternate projects and one proejct was adopted by the city for a trial.

The project adopted comprises the sinking of wells to the Potsdam sandstone at widely separated points in the city, usually near the outer ends of the large feeder mains. In each well a deep well centrifugal pump, of the direct connected type, will be operated by an electric motor in the well house at the top of the well. In this type of pump the water is lifted by the submerged turbines to the pump on the same vertical shaft, located at the surface, which pumps directly into the mains.

One such well has been sunk and equipped and is now in service. It is here described from information furnished by Mr. G. G. Crane, Superintendent of Water Works in Rockford, and by the American Well Works. It is referred to locally as a "unit well." The advantages of this system of supplying water are as follows: The wells are readily placed far enough apart to be mutually independent in lowering the ground water level. Also this system of supply largely obviates the necessity of laying the large mains and carrying the high pressures which are necessary when all the supply is introduced into the distribution system at one point.

DEEP WELL.

The new deep well is cased for the first 250 ft. with standard iron casing ½ in. thick and 18 ins. in outside diameter, with 12-in. casing for the next 150 ft., and the balance of the bore is 12 ins. in diameter to a total depth of 1,500 ft. The first 150 ft. was in fine sand and through this portion the 18-in. casing was driven. The next 100 ft. was in gravel and the casing could not be driven through it. It was put down successfully by means of a rotary drilling machine manufactured by the American Well Works. The St. Peter sandstone, first traversed, was cased and packed off. The Potsdam sandstone strata from which the water is drawn lies below the depth of 920 ft. to the bottom of the well.

TEST OF PUMP.

The pump is a 17-in. combination deep well and pressure pump. The turbines for lifting the water out of the well are in four stages and are located 108 ft. below the surface. At the top of the well there is a two-stage centrifugal pump. The entire installation is similar to that here shown in Fig. 1. An interior view of the well house is shown in Fig. 2.

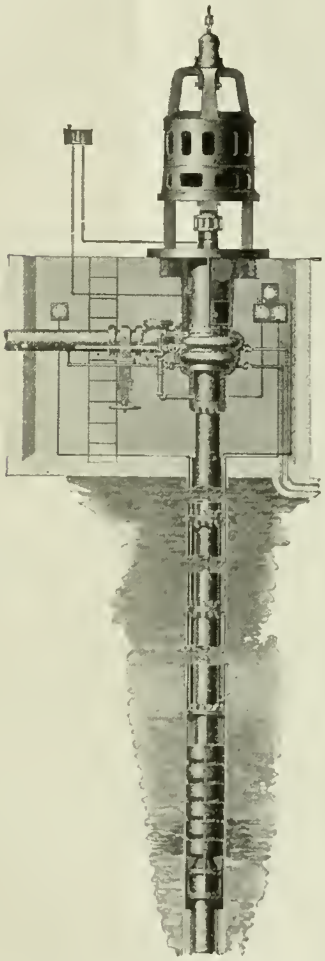


Fig. 1—View of Combination Deep Well and Pressure Centrifugal Pump Similar to the Rockford, Ill., Installation.

(The Rockford pump has 4 turbine stages instead of 6, as here illustrated.)

The pump was guaranteed to have an overall operating efficiency of 59½ per cent. Tests of the equipment as installed developed an overall operating efficiency of 65.5 per cent. The pump delivered 1,380 gals. per minute against a total head of 237½ ft. The theoretical horsepower is therefore 82.1. During the test the meter reading ahead of the transformers gave 116 K. W. The transformers have a 90 per cent efficiency, leaving 104.4 K. W. to enter the motor. Again allowing 10 per cent loss in the motor, 93.39 K. W. or 125 H. P. was delivered to the pump shaft. This gives a pump efficiency of 65½ per cent.

The following method of determining the exact water level in the well during pumping was used: A ¼-in. pipe was lowered into the well beside the supporting pipe of the turbine. The lower end of the pipe was a known distance below the floor line of the pump house. The upper end of this pipe was connected to a pressure gage and an air pump, provided with a necessary check valve, so a pressure in the pipe could be maintained equal to the submergence of this pipe in the water. After noting this pressure the depth to the water surface was computed in an obvious manner.

The cost of the ground, well, pump house, pumps, motors, and automatic controlling apparatus, amounted to about $20,000. The current is 60-cycle, 3-phase, alternating. It is stepped down from 4,000 volts to 440, at which it enters the motor. The automatic controlling apparatus was furnished by the Cutler-Hammer Co. It is actuated by variations of pressure in the water main.

The building is 19x14 ft. in plan and 18 ft. to the peak of the roof. It is built of paving blocks and has a slate roof. The interior is lined to a height of 7 ft. with white tile and the floor is of the same material. The balance of the interior is plastered. The building is equipped with a 5-ton trolley crane by means of which the entire pumping equipment can be removed from the well in about four hours.

The Application of Ozone to Water Purification, with Special Reference to European Practice.

The application of ozone to water purification was made the subject of a recent special report by Russell Spaulding, Consulting Ozone Engineer of the New York State Department of Health. The report was issued by the department and in tone it is very enthusiastic about the commercial feasibility of applying the ozone process to water purification in this country. The report describes several European installations. Only two American installations are mentioned, those at Ann Arbor, Mich., and Lindsay, Ontario. They are dismissed with the statement that they are failures, and that the failures resulted from faulty engineering in installation. Mr. Spaulding states that there is ample ozone generated in these plants but the water is not properly broken up and brought into contact with the ozone. The matter here given is quoted from the report.

Ozone is a form of oxygen in which the atoms of the molecule have a different arrangement from that of ordinary oxygen. It is very unstable and will revert to oxygen in a very short time if left to itself. When, therefore, it is put into water it will speedily assume the condition of oxygen and be quite beyond the possibility of polluting water. Consequently its use is beyond any criticism which may be directed at the chemical treatment which may remain as an impurity. Ozone could not be an impurity in water, for it changes instantaneously. It owes its efficiency in acting on bacteria to the fact that it cannot remain in the condition of ozone, but breaks up and forms free oxygen, which is an extremely powerful oxidizing agent. This oxidization destroys bacteria with great rapidity in the purification of water by ozone, which in turn leaves no trace of itself.

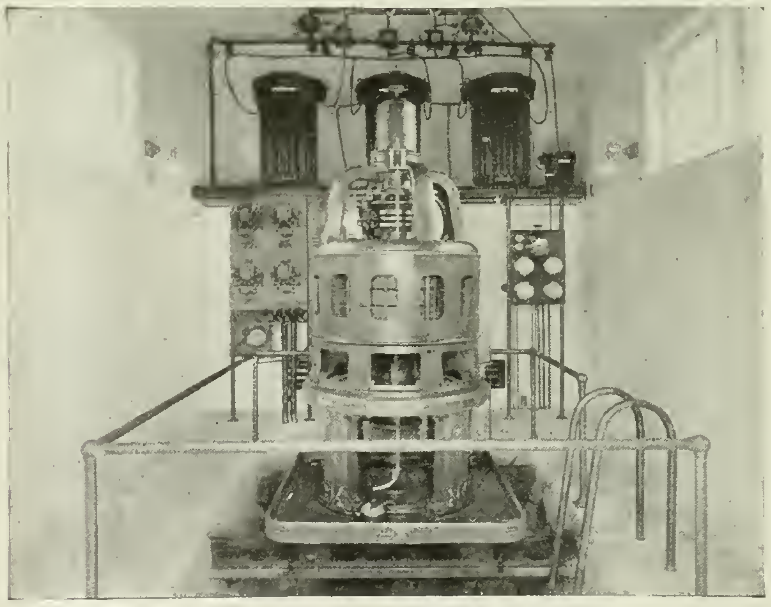


Fig. 2—Interior View of the "Unit Well" Pumping Station at Rockford, Ill.

Today there is little question of the efficacy of ozone as a commercial chemical and sterilizing agent but there are questions of practicability, related mostly to the cost of production and utilization, and to the ease of maintenance of generating apparatus. By the improvement and refinement of the generators, the cost of production has become a small part of the cost of any complete process for using ozone for purifying or bleaching. This condition arises largely through the expense of forcing contact between the ozonized air and the material to be treated.

The process about which most interest centers, naturally, is the purification of water. There are elements in the proposition to kill all bacteria and to get rid of organic contamination by introducing "electrified air" that appeal to the popular imagination as no proposal to filter or chemically sterilize water can. It has been demonstrated that ozone is a simple and effective sterilizing agent and leaves no residue in the water repugnant to the public mind as use of chemicals would. Whether or not an ozone plant is the best thing for a given location often reduces to a question of the costs, and these depend to a very large extent on local conditions, so that results obtained in one place are to be applied with caution to another place and only under the advice of competent engineers.

A partial list of European plants for the sterilization of drinking water by means of ozone is presented in the report. The list contains 26 plants in France, 4 in Roumania, 7 in Germany, 5 in Italy, 3 in Russia, and 1 in Spain. Three South American plants are also mentioned. These plants range in daily capacity from 32,400 gals. for the Ravenna, Italy, plant, to 24,300,000 gals. for the St. Maur, France, plant. A brief description of several plants follows:

Saint Maur (Paris), France.—This plant is the largest one in France. It was enlarged in 1910 to its present capacity of 24,300,000 gals. per 24 hours. This plant is situated near Paris on the River Marne. The water pumped from the river is first filtered through sand and then sterilized by means of ozone.

This ozone is drawn into the water by Otto aspirators. The water then trickles down through gravel contained in a sterilizing tower, meeting an ascending current of ozone which further sterilizes it. From this tower the sterilized water runs into a large reservoir, from which it is pumped into the city of Paris proper.

Nice, France.—Early in 1904 the muncipality of Nice, in southern France, entered into a contract with the French Ozone Company for the erection of an ozone sterilization plant near the reservoir of Bon-Voyage. This plant, with a capacity of 6,480,000 gals. daily, was completed in 1905.

Following are some of the requirements made by the city, translated from the official contract: 1. Capacity of sterilization, regular and continuous, 6,480,000 gals. per 24 hours. 2. Maximum allowance for upkeep $5,000 per annum. 3. The city will furnish free hydraulic power—13,157 kilogrammes on the axis of the turbines. 4. The Ozone Company guarantees that the treated water will not contain any pathogenic bacteria. 5. The maximum harmless bacteria not to exceed 10 per c. c., exception being made for B. Subtilis. 7. The Ozone Company guarantees that the chemical qualities of the water will not be altered except they be improved, that they will not introduce in the water any harmful foreign substance, and that no trace of ozone will remain in the treated water as it emits from the reservoir of Bon-Voyage. 8. The Ozone Company further guarantees the absolute inocuousness of the process. 9. The Ozone Company will be responsible for any abnormal corrosion of the conduits. 10. Price of entire installation to be $18,167.

The success of this installation is evidenced by the fact that in 1909 the municipality of Nice ordered installed a second plant at Rimiez with a capacity of 3,780,000 gals. per 24 hours.

Paderborn, Germany.—As a result of the experimental plants installed at Berlin in 1896 and at Martinikenfeld in 1898, it was decided to build an ozone water-purification plant on a large scale, in order to determine whether or not it would prove reliable, efficient and economical in a municipal plant.

The town of Paderborn in Germany was chosen for the initial plant. The plant was erected and officially turned over to the municipal authorities in the month of August, 1902.

The plant has a capacity of 500,000 gals. of sterilized water per 24 hours. It has been operating uninterruptedly since 1902, never once failing to perform its duties in an entirely satisfactory manner. Bacteriological examinations are made regularly and at frequent intervals each days. Since the day the plant started, in 1902, these examinations have shown an entire absence of pathogenic bacteria. A duplicate of the Paderborn plant was erected in 1903 to supply the town of Wiesbaden. The plant is located near the River Rhine at Schierstein, and the sterilized water is pumped over to Wiesbaden.

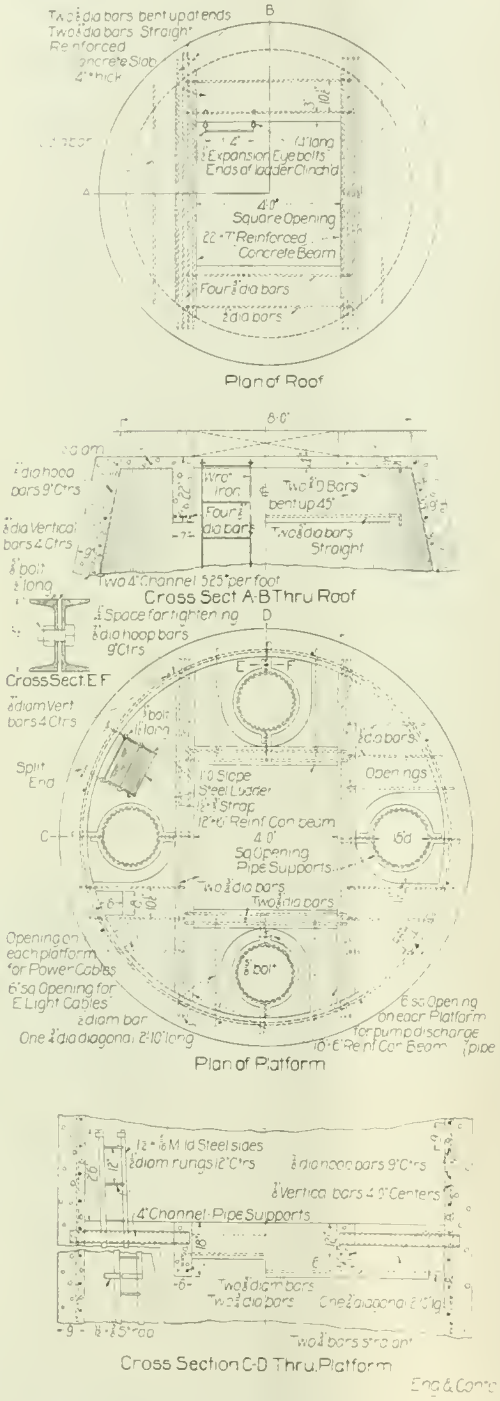
St. Petersburg, Russia.—The city of Saint Petersburg in Russia is dependent on the River Neva for the major portion of its municipal water supply. These waters were contaminated by typhoid and cholera bacteria.

After a thorough investigation of all available means for the purification of water, investigations which extended over a considerable period of time, the authorities of the city of Saint Petersburg decided that the most reliable and effective agent was ozone. Researches made at the Pasteur Institute in Paris were made the final basis of the Russian authorities.

Work on the plant was started in 1909 and was completed in November, 1910. The water after being pumped from the river is first treated with sulphate of alumina as a coagulant; it is then filtered through rapid filters. Careful bacteriological examinations show that both before and after filtration the water contains an abundance of typhoid and cholera bacteria, whereas after ozonization there is invariably a total absence of these and all other pathogenic bacteria. The gross cost of purification, including filtration, is $15 per 1,000,000 gals. The net cost of ozone sterilization is $7.50 per 1,000,000 gals.

In concluding his report Mr. Spaulding states that the most desirable mechanical factors to be used in connection with the generation of ozone are: 1. A supply of alternating electric current at low cost. 2. An efficient transformer to obtain high tension. 3. Ozone electrodes that do not generate enough heat to—(a) Disrupt the dielectrics; (b) Cause reversion of ozone to oxygen; (c) Require external means for cooling. 4. Ozone electrodes that will approach the theoretical efficiency much more closely than the various systems now in use.

The only failures in ozone water purification plants that have so far occurred have been due to a failure in breaking up the water in sufficiently fine particles and in properly contacting these small particles with ozone. This refers to failures in the technical sense, that is, failure to produce odorless, tasteless, colorless water, entirely free from pathogenic germs, by means of ozone. Failures might occur from a commercial point of view, because of excessive overhead charges or too high a cost of maintenance due to low efficiency or unreliability of apparatus.



Details of Tunnel Shaft for Pipe Line Crossing of Kaministiqula River, Fort William, Ont., Water Works.

An English syndicate, in which the Rothschilds are interested, is reported to be negitiating with the Turkish government for important oil concessions in Mesopotamia. The syndicate is stated to have offered $2,500,000, together with a royalty on the output.

Structural Features of Shaft and Tunnel River Crossings for Pipe Lines of Ft. William, Ont., Water Works.

(STAFF ARTICLE.)

Interesting designs have been prepared for the crossing of three rivers with water mains, by means of the shaft and tunnel system, at Fort William, Ont. The rivers crossed are the Kaministiquia, the Mission and the McKellar. The structural feature of special interest in connection with these crossings is the design adopted for the shafts. The typical shaft is lined with reinforced concrete and is provided with reinforced concrete platforms, at normal intervals of 20 ft. to serve as landings for the ladders and to provide support for the pipe lines. The shafts at the Kaministiquia River crossing are typical and since they are the largest one of them is here described and illustrated from information furnished by T. Aird Murray, Consulting Engineer, and Ray R. Knight, City Engineer.

At the Kaministiquia crossing there will be two reinforced concrete lined and rock cut shafts each 10 ft. in diameter. The length of the connecting tunnel is 1,285 ft. The tunnel is 7 ft. wide and 8 ft. high.

The accompanying figure shows the essential details of the design of the shafts at this crossing. The shafts are 121 ft. 9 ins. and 116 ft. deep. The tunnel lies wholly in the Hudson shale. The shafts at this crossing traverse sand, blue clay, dyke, broken rock and Hudson shale. The concrete shaft lining is carried into the shale for at least 6 ft. Below this point the shaft is rock cut and a lining is not necessary.

The reinforced lining is a 1:2:4 concrete, 9 ins. thick. The vertical reinforcement consists of ⅞-in. round rods spaced 4 ft. apart. The horizontal rods are also ⅞ in. round, and are spaced 9 ins. on center.

In case the contractor elects to build the concrete linings at or near the ground level and then sink them by gravity, it is specified that he shall provide special steel shoes to form the footing. Lowering of the lining in this manner will not be allowed until 48 hours after the initial set of the concrete. The use of a lubricant between the lining and excavation walls will be allowed to facilitate sinking. For this form of construction care will be exercised to excavate to a true circle of not more than ½ in. larger diameter than the outside of the concrete linings. If deemed necessary the linings will be slowly and evenly lowered by means of screw jacks. For this form of construction it is specified that three times the number of vertical reinforcing rods shown in the accompanying drawing be used. When the shoe reaches the rock an excavation will be made into the rock to a depth of 1 ft., so that the shoe will have an even bearing. The cavity left will be built up with brickwork and grouted in. Air and grout pipes at 2 ft. intervals will be provided for this purpose.

Only steel forms will be used on the concrete shaft linings. These forms will be well braced and stiffened to prevent deflection or twisting. Variations in line and level exceeding ¼ in. will not be permitted in placing the forms.

In case the reinforced concrete platforms are built after the shaft lining is completed, holes will be drilled for reinforcing bars, and cuts at least 1½ ins. deep will be made in the lining to receive the ends of the beams and slabs.

Where shale or loose rock is encountered in the roof of the tunnels this material will be removed and replaced with a brick arch. Permanent sumps and segmented drains will be cut in the rock at the bottoms of the shafts and along the floor of the tunnel. At intervals of 12 ft. along the tunnel floor, hardwood blocks 3 ft. long by 8 ins. wide by 3 ins. deep will be placed for pipe supports.

RAILWAYS

Method of Elevating Four-Track Railway on Embankment Between Retaining Walls, Philadelphia, Pa.

The work described forms a part of the grade crossing elimination being conducted by the Philadelphia & Reading Ry., in Philadelphia. The elevated structure consisted in part of viaduct and in part of embankment between retaining walls with bridges over crossing streets. In this article only the embankment and retaining wall work is described from a paper by S. T. Wagner in Proceedings, American Society of Civil Engineers, Vol. xxxix, p. 862.

METHOD OF CONSTRUCTION.

Work was begun in January, 1907, by diverting the temporary travel to two temporary tracks located as closely as possible to the west side of the 66-ft. right of way, Fig. 1. The retaining walls on the east side, with the eastern halves of the bridge abutments, were next built, and a temporary trestle for two tracks was constructed alongside of them; and approximately one-half of the permanent bridges were erected, so that two tracks on the new high level could be placed in operation. Crib work was placed along the western edge of the trestle to a height of about 8 ft., and as much fill as possible was made between the crib and the wall around the trestle before travel was placed on the trestle. On the completion of the temporary tracks on the high level, schedule travel was transferred to them and abandoned on the low level. The western retaining walls and the rest of the abutments were then completed with the fill and the remainder of the bridges. The fill was generally made by carting in from the cross streets before the abutments were finished, and completed after the abutments were built by raising it over them with a clamshell bucket and derrick. The permanent tracks were then laid on the new fill on the west side, and schedule travel was transferred to them; the temporary tracks on the trestle were removed; the ties, guard-rails, and stringers of the trestle were taken out for use at other points; the fill was completed, and the permanent tracks were laid in their final position. This same method was followed at all other points where masonry and fill construction was used, except that, in one district, the method was reversed, the work being started on the west side first.

RETAINING WALLS.

The part of the construction with masonry walls and fill consisted generally of retaining walls on each side of the 66-ft. right of way, with vertical faces on the lines. It was absolutely necessary to place these walls vertically on the right-of-way lines between Columbia avenue and Broad street, as the plans provided for five tracks with 13-ft. centers in this territory, and the same construction was used at other points. As private property adjoined the right of way, there was not room to erect forms for concrete work without trespassing, and large rubble masonry was indicated and used. Where retaining walls faced on streets, they were built of 1:3:6 concrete with granolithic washed faces and scored with horizontal lines. The same construction was used for bridge abutments.

The concrete used was of two kinds, 1:2:4 in bridge seats, pedestal blocks, etc., and 1:3:6 for main walls, foundations, copings, etc. The important and specially interesting points in the concrete specifications were as follows: Stone to be run of crusher, from ¼ in. to 1½ in. Sand graded from fine to coarse from ¼ in. down. Preference for machine mixing with cubical type. Consistency to be such that when dumped in place, concrete will not require much tamping, but not wet enough to cause the mortar to separate from the stone. Spaded down and tamped sufficiently to level off and quake freely like jelly. With special face exposed to the street, the specifications were as follows:

> Surface of concrete exposed to the street shall he composed of 1 part cement, 2 parts coarse sand or gravel, and 2 parts granolithic grit made into a stiff mortar. Granolithic grit shall be granite or trap rock crushed to pass a ¼-in. sieve and screened of dust. For vertical surfaces the mixture shall be deposited against the face forms to a least thickness of 1 in., by skilled workmen, as the placing of the concrete proceeds, and thus form a part of the body of the work. Care shall be taken to prevent the occurrence of air spaces or voids in the surface. The face forms shall be removed as soon as the concrete has sufficiently hardened, and any voids that may appear shall be filled up with the mixture.
>
> The surface shall then be immediately washed with water until the grit is exposed, and rinsed clean and protected from the sun and kept moist for 3 days. For horizontal surfaces, the granolithic mixture shall be deposited on the concrete to a least thickness of 1.5 in. immediately after the concrete has been tamped and before it has set, and shall be troweled to an even surface, and after it has set sufficiently hard, shall be washed untit the grit is exposed.
>
> All concrete surfaces exposed to the street shall be marked off into courses in such detailed manner as may be directed by the Chief Engineer.

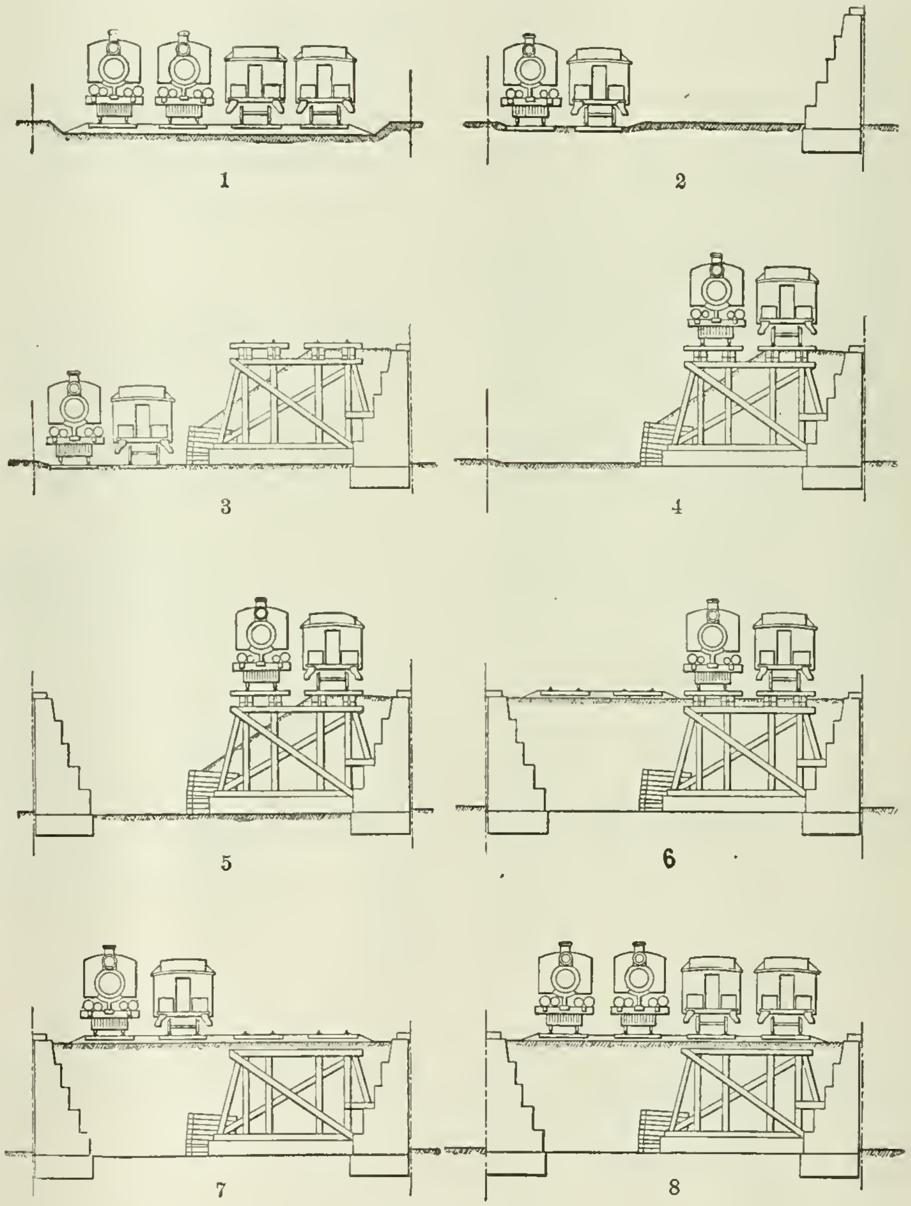


Fig. 1—Diagram Showing Sequence of Operations in Elevating Railway by Fill Between Retaining Walls.

The usual clauses regarding strength and finish of forms were used, and special fillets for the top edges of copings, pedestal blocks, and bridge seats were required. No reinforcement was placed in walls for temperature changes, but expansion joints were placed generally from 30 to 50 ft. apart. These were made with tongued and grooved joints on the faces of which there were corrugated asbestos boards. The use of embedded stone in the mass concrete was allowed, the stone not to exceed 6 to 8 cu. ft. in the foundations and 2 cu. ft. in the neat work. These were thoroughly cleaned, selected stone, embedded in the concrete immediately after it was placed. The stones were also used to form dowels bonding each day's work. The use of these stones was optional with the contractor, and though the quantity varied very much, they were generally put in. All copings were of concrete poured in place on top of the walls.

The contract prices obtained for the various kinds of rubble and concrete are shown in Table I.

On account of the walls facing immediately on private property, or on the streets, it was decided to carry the drainage back of them, a step farther than the usual practice, in order to guard as far as possible from leakage through them to adjoining property or to the street, and the entire back of each wall, up to the subgrade of the tracks, was filled with a minimum thickness of dry-stone packing, the stone being from ¾ to 2 cu. ft. in volume, and placed by hand after the walls were finished and before the embankment was placed. As the third-class masonry walls were built, their backs were thoroughly dashed with 1:3 cement mortar. At the bottom of the dry-stone packing, 6-in. vitrified clay pipes with open joints were laid, with grades of about 1 per cent leading to the cross streets and there connected to the sewers. This drainage has proved very effective.

TEMPORARY TRESTLE AND CRIB.

In the sections of the work constructed with masonry and fill, it was necessary to support two tracks between the bridges on trestle and then fill in as much as possible, using a crib about 8 ft. high with its face 5 ft. from the nearest running rail. The temporary trestle was built on concrete footings so as to reduce the settlement to a minimum and prevent wedging at the top in order to maintain proper track surface. It was constructed for two tracks in accordance with the general design shown by Fig. 2.

Long-leaf pine was used in the ties, guard-rails, and stringers, and these were all recovered when the fill was entirely completed and before the permanent track was laid. The caps, sills, posts and bracing were of short-leaf pine, and remained buried in the fill.

The prices paid for this work are shown in Table II, and included everything above the concrete footings ready to lay track.

The average height of the double-track trestle was about 17 ft., and its average cost per linear foot was about $18.50, exclusive of the concrete footings. The cribwork was covered by the following specifications:

> Where cribwork is required, it shall cover all temporary lumber work with the necessary filling and tamping required to retain slopes along partly made embankments or at other places, as may be directed.
>
> The lumber used in cribwork shall be placed as shown on the plans. It shall consist of second-hand lumber which is sufficiently sound to hold the drift-bolts.
>
> As the lumber is laid and drift-bolted, the embankment shall be filled in and thoroughly rammed. This work shall be paid for at the item price given in the proposal for cribwork per 1,000 ft. board measure, which price shall include all drift-bolts and the placing and ramming of the necssary embankment within the crib.

The prices obtained for the cribwork were as follows:

Contract numbers	1.	4.	5.	7.	9.	10.
Cribwork, per 1,000 ft. B. M.	$16.00	$15.00	$20.00	$24.00	$25.00	$20.00

EMBANKMENT.

Embankments were built as soon as the footings for the temporary trestle were begun, and all excavated material from the foundations of walls and abutments was placed around them and in the crib, payment being made for excavation only. On the completion of the sections of the trestle between streets, the crib was carried up to its full height, embankment material was delivered on the cross streets, raised over the abutments with derrick and clam-shell buckets, and the fill completed around the trestle to its finished lines.

In some cases where excavation was available from the depressed streets, the trestle was planked, and the street grading contractor hauled the excavated material over it, and dumped it as part of his cost of excavation. With the exception of this, all material going into embankments was furnished from outside the work and placed by the contractor at fixed prices, measurement being made on carts or wagons on delivery, each wagon load being measured by a representative of the contractor and an inspector who checked at the close of each day's work.

After schedule travel was placed on the temporary trestle, the remainder of the fill was made with teams hauling in from the adjoining streets, and after the abutments were completed the remaining material was raised over the abutment, as was done on the other side.

All material for embankment was inspected carefully and no ashes, cinders, or perishable material were allowed. Nearly all of it came from various building operations throughout the city.

The prices paid for embankment, delivered and placed by the contractor, were as follows:

Contract numbers	1	4	5	7	9	10	12	14	32
Embankment	$0.20	$0.14	$0.45	$0.52	$0.10	$0.15	$0.10	$0.45	$0.175

Assignment of Steam and Electric Locomotives, Passenger and Freight Train Cars and Work Equipment Cost to the Several States, and to Operating Divisions Within States.

The important subject indicated by the above title was discussed in a paper furnished June 6, 1913, to the Mississippi Valley States Conference by Mr. A. I. T. Thompson, Engineer Oklahoma Corporation Commission. The discussion follows:

In the apportionment of cost of steam railroads, one of the most important items is the equipment assignment to the several states. Actual railroad practice shows that some equipment is permanently assigned for a fiscal period, while other equipment is used promiscuously over the system when and where traffic demands its use. In orders to arrive at a reasonable assignment of the cost of rolling stock, it is, therefore, necessary to adopt some plan by which each state will be charged with the cost of equipment which is actually used therein. There are several theories, but only one true method.

The assignment of cost of equipment to the several states on the "road mile" theory contemplates that that portion of the total cost of all equipment be assigned to the states which is represented by the fraction of the "road mileage" within the given state over the total "road mileage" of the respondent. For example, if the road mileage of a carrier in a given state was 100 and the total road mileage of a system 1,000, then one-tenth of the total cost of equipment, regardless of kind, class, type, cost or where operated, would be assigned to that state, which is more clearly defined by the following tables I and II:

TABLE I.

Contract numbers	1.	4.	5.	7.	9.	10.	12.	14.	32.
Third class—neat	$6.00	$5.75	$6.50	$5.70	$5.25	$5.70	....	$6.50	....
Third class—foundations	6.00	5.00	5.00	5.25	5.50	5.00	....	5.00	....
1:3:6 concrete—neat work	5.80	6.25	6.45	5.55	6.25	6.25	$6.30	6.45	$6.50
1:3:6 concrete—foundations	5.50	5.60	6.00	5.25	5.63	5.50	6.30	6.00	5.75
1:3:6 concrete—copings	7.25	7.50	6.75	7.75	7.25	7.00	7.50	6.75	6.75
1:3:6 concrete—washed face	6.50	6.50	6.70	7.45	6.40	6.50	6.30	6.70	6.60
1:2:4 concrete	7.25	7.50	7.75	8.25	7.50	7.50	7.75	7.75	7.75
Dry stone packing	2.50	2.50	3.75	2.90	2.45	2.50	2.75	3.75	2.75
Arch concrete—1:2:4	....	....	7.50	....	....	....	....	....	....
Unclassified excavation	0.65	0.50	0.50	0.95	0.48	0.50	0.40	0.50	0.90

TABLE II.

Contract numbers	1.	4.	5.	7.	9.	10.
Long-leaf yellow pine, per 1,000 ft. B. M.	$43.00	$44.50	$40.00	$43.00	$44.50	$42.00
Short-leaf yellow pine, per 1,000 ft. B. M.	41.00	38.00	36.00	41.00	37.00	38.00
Wrought iron or steel, per lb.	0.03	0.03	0.04	0.03	0.03	0.00

The fallacies of this theory are that the cost of equipment is not assigned in accordance with the traffic demands or "use" of such equipment, and a state with a greater proportion of branch line mileage would be charged with cost of equipment which had never been used in that state.

Apply this theory, in assigning cost of the A., T. & S. F. equipment, to Oklahoma, with 843 miles of operated road, and Illinois, with 290 miles of operated road, practically all main lines. In Illinois trains are operated as frequently as time permits, and with higher and more expensive equipment than in Oklahoma, and one can readily see that this theory of assigning equipment would not be equitable and, therefore, would be radically wrong. In rate litigations the carrier would have cost of equipment assigned and included in a given state which had never been operated in that state.

At a recent conference in our state, the committee of the carriers brought forth a theory of assigning equipment which may be defined as the "total car and locomotive mile" theory, which contemplates that such portion of the total cost of all equipment be assigned to a given state as is represented by the fraction of the total passenger, freight, work or locomotive miles made in a state over the same factors for the system. Thus, if the total locomotive miles in the state were 100 and on the system 1,000, then one-tenth of the locomotives cost of the respondent would be assigned to such state, which is more clearly shown by Tables III.

The mistake is automatically made where this theory is used, that difference in traffic conditions which requires either heavy or

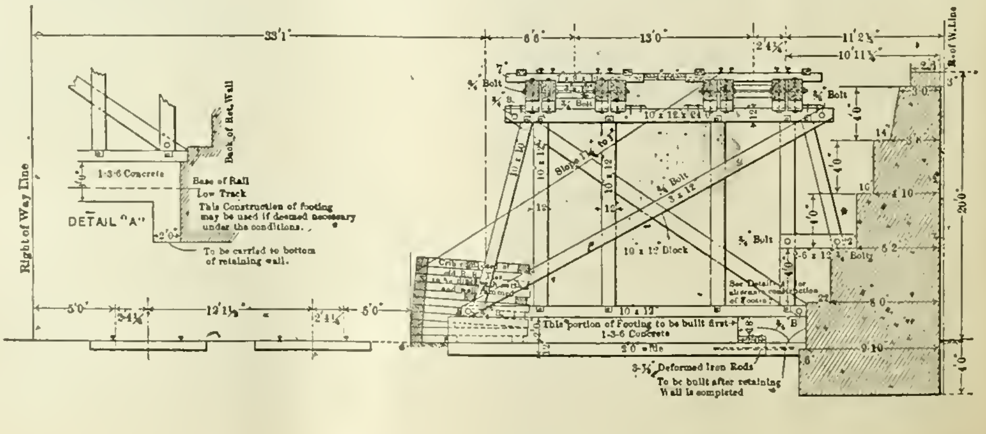


Fig. 2—Section of Retaining Wall Showing General Details of Trestle.

light locomotives, old or new passenger cars, is not accurately reflected. We do not believe the assignment of cost of expensive locomotives or passenger equipment to the state where such locomotives or passenger cars were never operated would be fair or just. For instance, the state of South Dakota, in which we understand there is not an expensive locomotive on the C. & N. W. R. R. or an electric lighted or steam heated passenger car, should not be charged with the cost of such equipment.

TABLE I.—M. K. & T. RY. ASSIGNMENT OF EQUIPMENT, IN SERVICE, IN OKLAHOMA ON THE "ROAD MILEAGE" THEORY, AS OF JULY 1, 1912.

Main track mileage on system	1,744.44
Main track mileage in Oklahoma	729.52
Steam locomotives, average cost per mile	$ 4,417.69
Passenger train cars, average cost per mile	1,886.00
Freight train cars, average cost per mile	10,204.22
Work equipment, average cost per mile	706.00
Average cost per mile, all classes	$17,213.91
Average cost per mile, all classes, less depreciation	12,450.29

I quote from the brief filed by the South Dakota Commission in its recent rate case:

> The next general point sought to be made by counsel for complainant is that the complainant company gives the same service in the state of South Dakota as it gives in the state of Minnesota and elsewhere on its system. The basis for this assertion is the testimony of A. C. Johnson. We are forced to take issue with this statement and we direct the attention of the Master to the timetable introduced in evidence from which it appears that in the states of Minnesota, Wisconsin, Illinois, Iowa and Nebraska the railway company not only has better equipped trains than in the state of South Dakota, but also that the schedule and running time is faster in all of those states than it is in the state of South Dakota.

TABLE III.—EQUIPMENT, IN SERVICE, JUNE 30, 1911, ASSIGNED TO OKLAHOMA ON A MILEAGE BASIS IN THE PROPORTION AS THE MILES MADE ON EACH CLASS OF EQUIPMENT IN THE STATE BEARS TO THE MILES MADE ON THE ENTIRE SYSTEM BY THE SAME CLASS OF EQUIPMENT, EXCEPT WORK EQUIPMENT, WHICH IS IN THE PROPORTION OF THE TOTAL MILES MADE ON THE ENTIRE SYSTEM:

Classes.	Mileage made on system.	Mileage made in Oklahoma.	Av. cost per mile assigned to Okla.
M. K. & T. Ry. Co.			
Steam locomotives	9,740,669	3,877,203	$ 4,194.69
Passenger train cars	15,334,810	6,875,966	2,017.12
Freight train cars	110,037,327	43,843,678	9,698.87
Work equipment	222,722,806	54,596,847	412.83
Average cost per mile, all classes			$16,323.51
Average cost per mile, all classes, less depreciation			11,838.27
C. R. I. & P. Ry. Co.			
Steam locomotives	41,972,762	5,308,092	$ 1,901.06
Passenger train cars	93,388,155	11,137,935	676.25
Freight train cars	446,437,398	62,022,767	3,609.18
Work equipment	100%	.075038%	116.09
Average cost per mile, all classes			$ 6,302.58
Average cost per mile, all classes, less depreciation			4,558.24

> We call attention particularly to trains numbers 501, 504, 505 and 506 between Chicago and the Twin Cities which carry cafe cars, observation cars and standard sleepers; to trains numbers 11 and 21 between Chicago and Omaha which carry dining cars and observation cars; to trains numbers 13 and 116 between Chicago and Milwaukee which carry observation and parlor cars; to trains numbers 209 and 210 from Chicago to Freeport which carry cafe and parlor cars, and to trains numbers 21, 6, 22, 25 and many others, all of which carry reclining chair cars. In contrast to this class of equipment we call attention to the fact that the Chicago & Northwestern Railway Company does not carry a parlor car in the state of South Dakota, nor a dining car or observation car on any of its 978 miles of track within the state of South Dakota. We would again call attention to the schedule time of trains between the Twin Cities and Chicago and between Chicago and Omaha and between Chicago and Milwaukee. On a few trains in South Dakota one sleeping car is carried, but not a single train in the state carries a chair car, observation car, parlor car, dining car or cafe car. In the state of Minnesota, Wisconsin, Illinois and Iowa the plaintiff company runs limited passenger trains, i. e., trains that are not local, equipped with high power engines and best of equipment, while in South Dakota every passenger train is a local train and the motive power and equipment is much inferior to many of the trains in the other states. In the face of these undisputed and uncontrovertible facts, how can it be said that the company is giving the same service to the people of South Dakota as it is giving elsewhere on its lines? Many of the passenger trains in Minnesota, Wisconsin, Iowa, and Illinois are lighted by electricity, and nearly all, if not all of the trains to which attention has been called in the other states are steam heated, while in the state of South Dakota no passenger trains are lighted with electricity, many of them are lighted with kerosene oil lamps and many of them heated by stoves.

If the plan for assigning equipment cost is unfair or unjust to one state, then the assignment of costs to all states on that system is relatively unfair. If the state of South Dakato or Oklahoma, or any other states, is charged with any other than the cost of the actual equipment used in that state, then the value of the assignment to all other states is also in error. So, if, by use of the foregoing theories, a state is charged with more than her pro rata of the cost, then, to be fair, we must produce a formula which will permit of the assignment to all states of such equipment as it actually used therein.

With the individual assignment of equipment on the "use" basis, the writer believes that the carriers should receive the benefits of the actual cost of equipment actually used for public service. If given states are benefited by the operation of heavy power, new, expensive and luxurious equipment, then the traffic of such given states should bear the burden. The writer further contends that heavy, new or expensive equipment will not be installed by the carriers, except where the traffic demands it, and that the unit cost will not, in his opinion, be greater than where the traffic and equipment are lighter.

Rates in the state of South Dakota, or any other state, should be based in part upon the cost of equipment actually operated there. If traffic in a state does not receive the benefit of electric lighted and steam heated cars, and up-to-date motive power, it would be manifestly unfair to charge such traffic with the cost of such equipment. If the total freight car valuation should be assigned upon a total mileage basis, i. e., the relation of the freight car miles in the state to the total freight car mileage of the system, then I would approve of the charging of increased cost of equipment to a state or division, when actually only a part, and in some instances not any of a particular kind or class of equipment had been used.

In order, therefore, to secure an impartial cost it is necessary to assign equipment upon an actual "use" basis. We will discuss each phase separately.

LOCOMOTIVES.

The cost of locomotive equipment should be assigned to a given state, and division, on the ratio that the miles made by that individual locomotive in that state or on that division, bears to the total mileage of that locomotive as made during the fiscal year for which the report is rendered.

The statement has heretofore been made that heavier and more expensive equipment was used in Illinois than is used in Oklahoma. During the fiscal year ended June 30, 1911, the average number of tons of freight per train mile in Illinois on the A., T. & S. F. was 357.99 and in Oklahoma was 280.32; the average number of cars per freight train mile in Illinois was 33.78 as compared with 26.80 in Oklahoma. On the C., R. I. & P. the average number of tons of freight per mile in Illinois was 437.62, compared with 246.18 in Oklahoma; and, the number of freight cars per train mile in Illinois was 34.39, compared with 26.30 in Oklahoma.

TABLE II.—C. R. I. & P. RY. ASSIGNMENT OF EQUIPMENT, IN SERVICE, TO OKLAHOMA ON THE "ROAD MILEAGE" THEORY, AS OF JUNE 30, 1911.

Main track mileage on system	7,551.16
Main track mileage in Oklahoma	1,346.57
Steam locomotives, average cost per mile	$ 2,680.85
Passenger train cars, average cost per mile	1,011.21
Freight train cars, average cost per mile	4,633.04
Work equipment, average cost per mile	153.61
Average cost per mile, all classes	$ 8,478.71
Average cost per mile, all classes, less depreciation	6,132.09

In view of these facts, it is reasonable to presume that in states like Illinois, where traffic is heavy and equipment used is more luxurious and expensive than in South Dakota, locomotives are larger and more expensive. If this fact is ignored, the public, through the regulative commissions, would certainly have reason to object, and the right to exercise control over supervision would become more essential. If the carriers, in states where traffic is light, should persist in operating power too expensive and heavy for traffic, the public through the legislative commissions would certainly have reason to object, and the right to exercise control over supervision of such carriers would become more essential. On the other hand, if traffic is heavy and carriers persist in attempting to operate and use light power, the necessity for public regulation is again emphasized.

I have the greatest consideration for the ability of the operating official, who, knowing that the traffic demands light or heavy power, can use locomotives adequate for the service without detriment to it, and when such changes are made the cost of equipment should reflect the true cost. I believe those conversant with railroad practice will agree that the large locomotives are located where there are excessive grades or where heavier trains are handled. There is no consistency in charging to South Dakota, for example, a part of the cost of the expensive locomotives used in pulling the immense trains between Chicago and Cedar Rapids, while the locomotives actually used in South Dakota (perhaps adequate for the service demanded of them), are in such condition that, from a tonnage standpoint, their operation on the main line would increase operating expenses. It must be admitted, of course, that the heavy through passenger trains, such as the Northern "Pioneer Limited" and the Santa Fe "De Luxe," consisting of heavy Pullman cars, require a heavier class of power than trains in South Dakota, with only a few coaches. Super-heater compound locomotives cost more than simple engines and if any other than an assignment on the "individual locomotive" basis is used, cost will be assigned which has no connection with the actual "use" or operation. With but little additional expense records of the operation of these locomotives can be kept. A great many carriers keep records of the performance of individual locomotives at this time.

PASSENGER CAR EQUIPMENT.

Passenger train equipment is generally permanently located for each fiscal year, and thus we find that on many lines the same cars are used from year to year, except when such cars are sent to shops for overhauling. The cost of passenger car equipment should be assigned to the several states in proportion that the individual car mileage in a given state is to the mileage of the individual car during the year. This assignment places the cost of equipment in the state at the time the car was actually operated—exactly the same as the result of the individual locomotive assignment. Citing again the example of the South Dakota car, the writer feels certain that that state should not bear the cost of expensive steel equipment, cafe and dining cars and the like, when it is shown that such equipment was not operated within that state. The passenger traffic in South Dakota should not be charged with reclining chair car cost unless traffic receives the benefits of chair car operation.

FREIGHT CAR EQUIPMENT.

Although at this time it may be impracticable, the proper method of charging the cost of freight car equipment would be the assignment to the states on the individual car mileage basis. A method which is more practical and one which should be used, is to assign to each state, and division, that portion of the cost of box car equipment as is represented by the fraction of the "box car mileage" made in the state or division during the period for which the report is made and the total box car mileage on the system. The use of the foreign car miles for the assignment of a respondent's equipment is on account of the operating practice of using, without discrimination, the foreign cars in lieu of system owned cars. Thus, if the foreign and system box car miles in a given state was 100 and the total foreign and system box car miles on the respondent's line during the fiscal year was 1,000, then one-tenth of the total box car cost should be assigned to the given state. Carrying out this principle again, that the use of the equipment should govern its assignment, if the same method is applied to cabooses, refrigerator, coal, stock, etc., cars individually, it will permit of an assignment of classes of equipment to the territory where those particular classes of equipment predominate. On a division or in state where coal traffic predominates, more coal car equipment should be assigned than in a state or on a division where the traffic demands furniture cars. By assigning freight car equipment cost, by individual classes, a very accurate assignment can be made and traffic involving the use of any particular class of cars will have to bear its proportion of the cost.

ASSIGNMENT OF COST OF (DEAD) TIME.

When units of equipment are not in service during a fiscal year the cost thereof should be apportioned to the several states in proportion to the respective states' car or locomotive mileage.

WORK EQUIPMENT.

Work equipment cost should be assigned to the several states. On the "use" basis, i. e., that part of the cost of each unit should be assigned to a given state in the proportion to the time in service in that state is to the total time such unit was in service during the period for which the report is rendered. It is understood that the dead time of each unit shall be apportioned on the basis of the car and locomotive mileage of states only which would be benefited by it if in use. For example, if a respondent owned a steam shovel that cost $2,000, and for the year in question it was in service six months in Oklahoma and six months in Kansas, then the cost should be apportioned equally to each state.

When units of work equipment are not in service, then the cost should be apportioned on the basis of the respectives states' car and locomotive mileage during the year for which the report is rendered, but again such apportionment shall be made to those states only which would, in ordinary practice, receive the benefit of such unit. This would prevent the assignment of cost of rotary and other snow plows to southern states, and other apparent inconsistencies.

In conclusion, in my opinion, unless the assignment is made upon the "unit basis" the efficiency of the various commissions' study upon operation and depreciation of car and locomotive equipment will be destroyed, and the value of results of compiling statistical work will be greatly impaired.

The Assignment of Valuation of Facilities to More Than One State.

During recent years the practice of establishing "general" or "system" repair shops at central and convenient operating locations for the general repair work of both cars and locomotives has come into prominence in American railroad practice and the gradual elimination of divisional repair shops has automatically followed. In a paper before the Mississippi Valley States Conference and read by Mr. Hugh H. Bryant, Assistant Engineer, Oklahoma Corporation Commission, a plan for apportioning the values of these general shops between states is suggested as follows:

For rate making purposes it would seem more equitable to all states to assign the cost of such general repair shops to the several states which are benefited by such costs. In other words if a general repair shop is located in Illinois, Missouri or Kansas it would be fair to all states to bear the burden of the cost in proportion to the benefits received therefrom. It would therefore appear that the proper manner in which the cost of general or system repair shops should be assigned to the several states is on the use basis. For example, if the locomotive repair shops at Parsons repaired three locomotives during a given fiscal period, one of which was used exclusively in Oklahoma, one in Texas and one in Kansas, and if these three locomotives all made the same mileage during the fiscal period for which the assignment is to be made, then the cost of the Parsons shop should be assigned equally to the three affected states. This, then, contemplates that the cost of such shops should be assigned according to the output and the benefit which each locomtive receives from each shop would naturally be reflected to the best advantage in the mileage which such locomotive made in the fiscal period after it had been repaired. To those familiar with shop operation and railroad practice, the mileage reflects the labor and material used, the supervision and use of machinery, and in fact all benefits of shop cost to a better advantage than any other factor.

Naturally the assignment of shop cost would fluctuate from year to year much the same as the assignment of locomotive cost fluctuates. If the state of Louisiana does not receive the benefit of shop investment of the Rock Island at Silvis, Ill., then the traffic of the state of Louisiana, both interstate and intrastate, should not be charged with a portion of the cost of the Illinois shop. On the other hand, if a locomotive which was repaired at Silvis did make mileage in Louisiana then Louisiana would have to bear the burden of its ratable portion of the shop cost.

In all of the foregoing it is intended that the shop machinery and tools be considered as part of the cost of shops. We would apply this method of assigning locomotive shop costs to passenger and work equipment shop costs as well.

Misunderstandings may arise as to why, in the opinion of the writer, the cost of shops should be assigned to the several states and why he does not believe that terminal cost should be divided between the several states. A terminal may be correctly defined as any place where a journey or shipment originates or is destined. Large terminals are constructed only for the economical handling of traffic. The division of cost of terminals between intra and interstate traffic, which is the ultimate use of all assignments, can be made on the primary basis since the factors on which the division is to be made are the units of actual use; that is, the number of passengers in and outbound and the number of tons in and outbound.

The proportion of use of terminals should always govern the division of cost between intra and interstate traffic. For example, if a passenger terminal cost $100,000 and the number of intra and interstate passengers using such terminal (in and outbound) are equal, then the cost of that terminal should be divided equally between intra and interstate traffic. For freight terminals the cost should be assigned on the basis of the number of tons handled of intra and interstate freight the same as the expense is now apportioned for operating expenses between the several carriers where a terminal is jointly owned or operated.

In the writer's opinion, if the facts were produced they would determine that the cost per unit would be less for the large city terminal than for the smaller terminal, but whatever they actually are should be charged against the classes of freight or passengers handled through such terminal.

For shops the equipment repaired does not, in itself, furnish the proper basis for the division of assignment of cost between intra and interstate traffic, but the purpose for which such equipment as is repaired therein is used furnishes the factors for assignment of cost between the two classes of traffic.

It is therefore necessary to first assign the cost of shops to the several states on an equitable basis and then divide that assigned cost for each state between intra and interstate traffic on the units of use, the tons one mile for freight traffic and the passengers one mile for passenger traffic.

The assignment of cost of shops for freight car repairs to the several states should be based upon the freight car mileage in the respective states for the particular fiscal year but the denominator of the fraction should be the total freight car miles made in the district or portion of the system upon which or for which the freight car shops are located.

It is the opinion of the writer that the mileage expresses the use of shops and shop machinery to a better degree of accuracy than any other unit of practical use.

Large Dredging Contract.—One of the largest contracts ever undertaken in Canada was recently awarded by the Toronto Board of Harbor Commissioners to a Canadian firm. About 31,000,000 cu. yds. will be removed from the harbor at Toronto, and the estimated cost is in the neighborhood of $6,500,000. Dredging operations will be carried on over the entire city water front, and the contractor is getting plant in readiness for the deepening of the harbor. The work of filling in the industrial area will be carried on simultaneously.

Concrete Block Machines at Panama.—It is probable that hollow concrete blocks will be used extensively in constructing the permanent buildings at the new Balboa town site. The blocks will be made on the Isthmus, and for that purpose 12 special machines have been ordered from the United States. These include two machines for foundation blocks 12 by 12 by 24 ins.; six for main wall blocks 8 by 12 by 12 ins.; two for corner blocks 8 by 8 by 16 ins.; one for partition blocks 4 by 12 by 12 ins.; and one for interior columns 3 by 12 by 12 ins. In addition, two agitators for agitating the concrete before going into the block machines are to be purchased.

Flood Mitigation on the River Seine.—A plan is under consideration in France for mitigating the floods on the River Seine and improving communication between Paris and the industrial districts of the Nord and the Pas de Calais. The plans call for the general improvement and enlargement of the Ourcq Canal (which is 50 miles long and puts the River Ourcq, a tributary of the Aisne, in communication with the Siene), and for lengthening it in order to connect it with the Oisne-Aisne Canal at Crecy au Mont. The total expenditure is estimated at $25,500,000, of which the state would contribute $4,000,000, and the municipality of Paris $20,00,000.

SEWERAGE AND SANITATION

Structural Features of the Sewage Treatment Works For Fitchburg, Mass.

(Staff Article.)

In Engineering and Contracting of Sept. 4, 1912, the studies made to determine the quantity of sewage to be handled by the new intercepting sewers were described, and in the issue of May 28, 1913, the siphon and grit chambers on the main intercepter were described. The present article relates to the principle novel features in the design of the sewage treatment works. Briefly summarized these features are: The use of a steel frame for supporting the side walls of the sewage tanks, the thin type of construction adopted for the troughs and gas vents in the sewage tanks, a special form of expansion joint at the end of the sides of the troughs, the vitrified clay floor blocks for the sprinkling filters, the thin wall between the stone of the filters and the natural soil, the avoidance of riser pipes in the distribution system of the filters, and the design of the secondary settling tanks. The main features are the five reinforced concrete Imhoff tanks, two acres of sprinkling filter beds, four vertical cylindrical reinforced concrete settling tanks, a two-story brick laboratory building and a small pump building, sludge beds, pipe lines, and appurtenant structures.

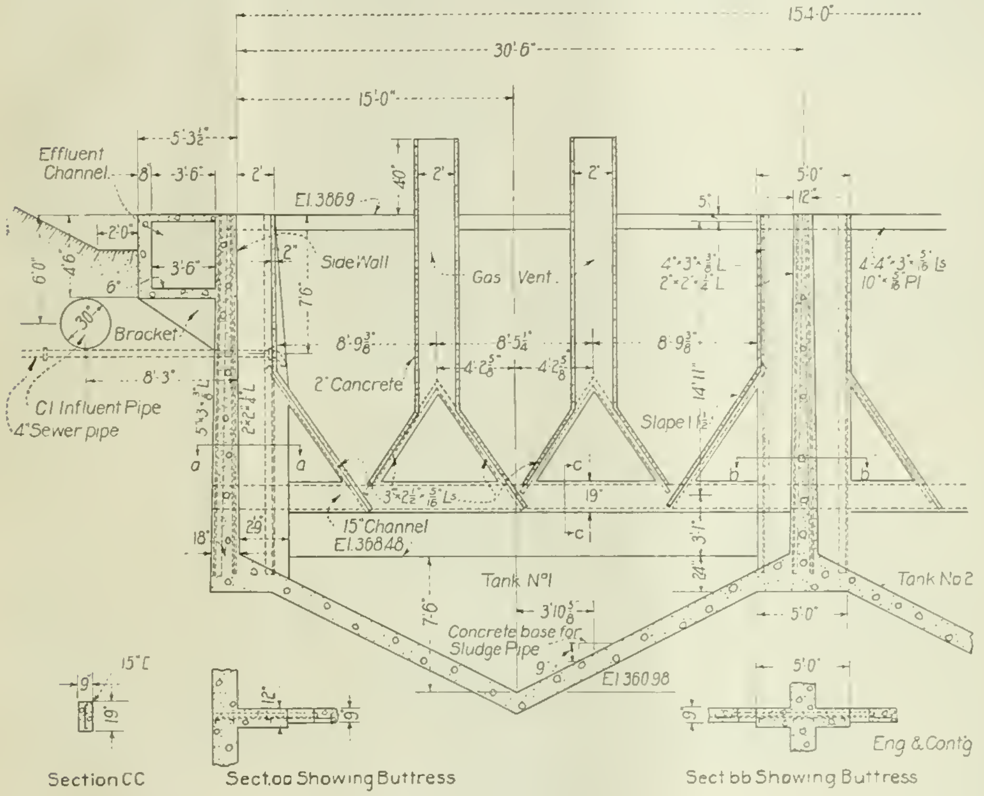


Fig. 1—Cross Section of One of a Battery of Five Imhoff Tanks at Fitchburg, Mass., Sewage Treatment Works.

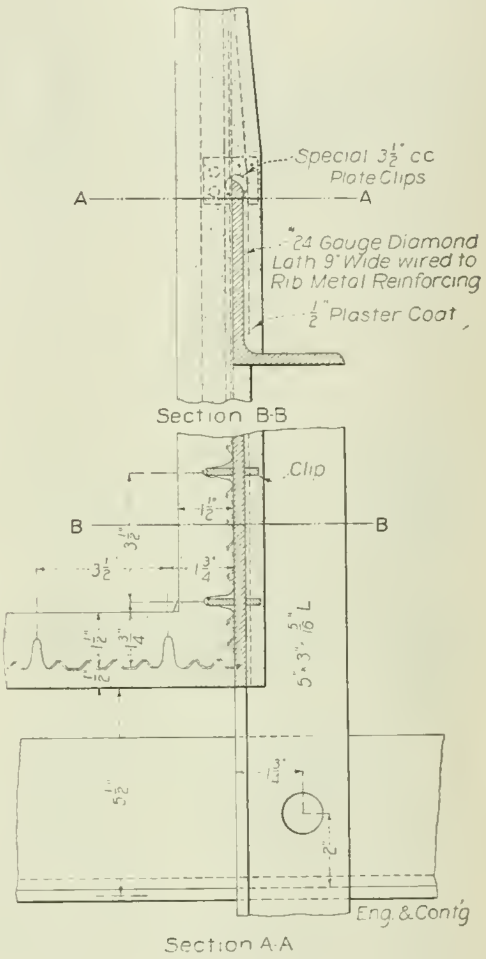


Fig. 2—Detail of Gas Vent.

The population of the City of Fitchburg, census of 1910, was 37,826. Fitchburg is a rapidly growing manufacturing town, situated on the north branch of the Nashua River. The industries consist of papermaking, textile works, wool scouring, the manufacture of woolen goods, all of which produce greater or less quantities of liquid wastes, and various manufacturing establishments which do not produce liquid industrial wastes. It is expected that local treatment plants will be provided at the several industrial plants so that relatively small quantities of industrial wastes will be discharged into the municipal sewerage system. There will be, however, small quantities of wastes which it may be advisable to admit to the city sewers. No special provision has been made at the sewage treatment works, on account of such industrial wastes, as it is expected that they will be so small and of such character as not to materially influence the character of the sewage.

With the exception of the trickling filters, the sewage treatment plant is designed for a population of 55,000 persons, estimated to be reached between 1925 and 1930. The trickling filters are designed with a view to providing a capacity for the treatment of sewage from 40,000 persons.

It is estimated that at the completion of the work the latter part of 1914 or early in 1915, the average quantity of sewage will be approximately 4,000,000 gals. daily, with a dry weather maximum rate of flow of perhaps 6,000,000 gals. and a minimum rate of 3,000,000 gals. per day. These estimates take little account of storm water, which will at times increase the flow to the maximum capacity of the intercepting sewer, 14,000,000 gals. daily, although the city is sewered at present largely by a system of combined sewers. It is contemplated, however, that separate sewers and storm drains will be provided in the future for a large portion of the city. New extensions have

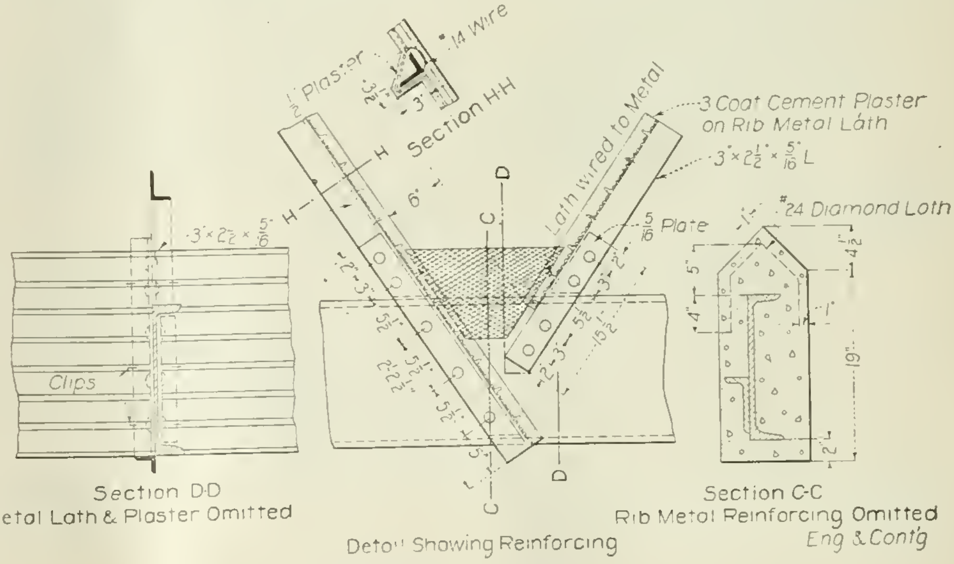


Fig. 3—Details of Trough.

for several years usually been built in accordance with this plan.

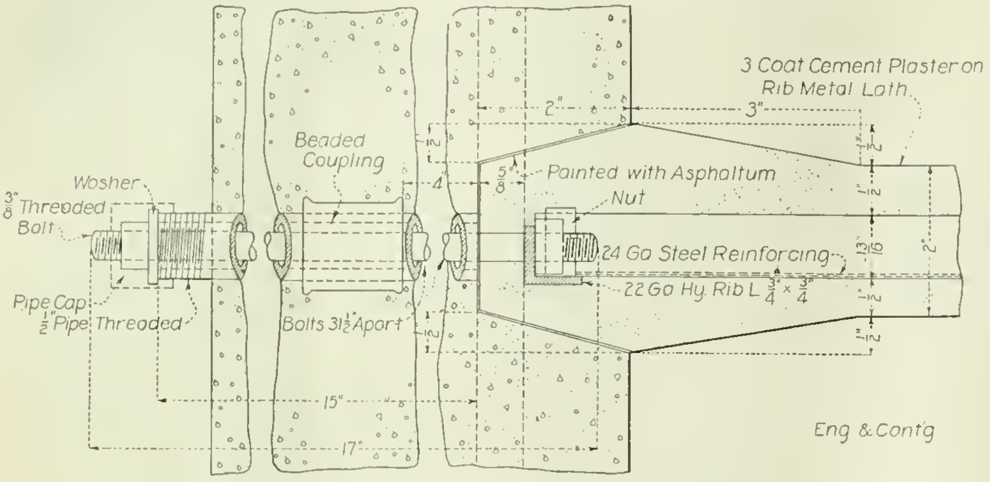


Fig. 4—Details of Joint Between Trough and Walls.

The sewage will be collected by an intercepting sewer terminating at a siphon chamber about a mile above the treatment works. From this chamber two cast iron siphons 30 and 36 ins. in diameter, respectively, will ultimately convey the sewage to the treatment plant. At present, however, only one line 30 ins. in diameter, respectively, will ultimately convey the sewage to the treatment plant. At the lower end of the cast iron siphon a Venturi meter will be installed, for accurately measuring the flow of sewage.

At a point somewhat more than a mile above the treatment plant and below the last sewer connection, a grit and screen chamber has been constructed on a line with the intercepting sewer. This chamber and the siphon chamber were illustrated and described in Engineering and Contracting of May 28, 1913.

Imhoff Tanks—From the Venturi meter the sewage will flow to a battery of five Imhoff tanks, each approximately 30 ft. wide by 90 ft. long by 26 ft. deep. These tanks are rectangular in shape and are built of reinforced concrete of relatively thin section. An interesting feature of the design of these tanks is the steel frame shown in Fig. 1, by which the side walls of the basins are held in place. Another feature of particular interest is the design of the thin partitions forming the troughs and gas vents, as shown in Figs. 2 and 3. These partitions are to be built of rib metal plastered on each side. Attention is particularly called to the method of providing an expansion joint at the end of each side of each trough, as shown in Fig. 4. During construction it will be necessary to hold the rib metal securely in place, which is provided for by a bolt carried through the end wall. Upon completion of the troughs these bolts are to be removed and the holes through the walls will be securely sealed.

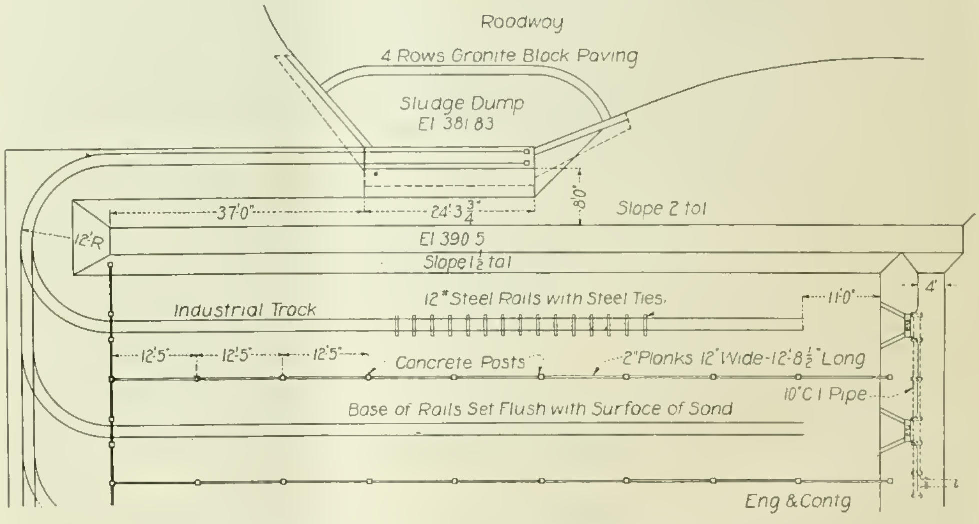
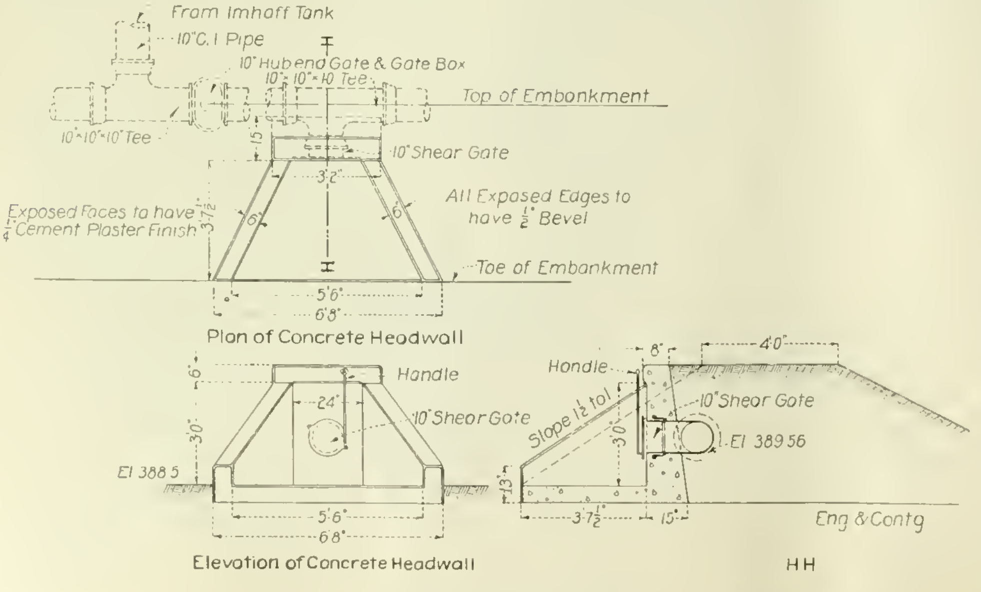


Fig. 5—Partial Plan of Sludge Beds and Sludge Dump.



Plan of Concrete Headwall

Elevation of Concrete Headwall

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Fig. 6—Details of Concrete Headwalls of Sludge Bed.

The thin trough partitions will then be free to move as required by expansion and contraction.

The Imhoff tanks were proportioned so as to give a storage period of three hours for a 25 per cent excess in addition to the normal flow of sewage for that length of time. In plan the tanks are rectangular. The greatest depth of a tank, as shown in Fig. 1, is 25 ft. 11 ins. The vertical walls are 18 ft. 5 ins. deep and the inverted pyramidal bottom portions of each tank are 7 ft. 6 ins. deep. There are three pyramids to a tank. Each tank is divided by means of three troughs into two compartments. The upper compartment provides a sedimentation basin and the lower compartment provides for the storage and digestion of sludge. The 6 in. opening along the bottom of each trough allows the settled-out solids to drop into the sludge compartment. It will be noted that the lower edges of the troughs overlap in vertical projection so that gas bubbles in rising will pass along the under surfaces of the trough sides to the gas vents and cannot rise through the sewage in the settling compartment.

The sludge storage capacity was proportioned for 0.007 cu. ft. of sludge per capita per day for a period of 6 months. When the volume of sewage flow is equal to the capacity designed for, three hours storage, the horizontal velocity of flow will be about 25 ft. per hour.

The structural steel frame work in the Imhoff tanks, with the exception of the upper cord of the frame, will be encased in concrete or surrounded with cement plaster on metal lath. The partition walls, vents and troughs will be constructed of three coats of cement plaster on metal lath. This metal reinforcing lath will be either "4-Rib-Hy-Rib" gage No. 24, or "Corr-Mesh" gage No. 24 or equivalent. The rib metal, unpainted, will be rigidly attached to the steel framing by means of special clips or by No. 14 galvanized wire. All adjoining sheets will be interlocked at the sides and ends, and will be fastened together every 24 ins. along the sides. Every rib at the ends will be wired with No. 14 galvanized wire or by clinching of the lapped ribs with special pincers. Where end splices occur between supports, splices in adjacent rows will be at least 2 ft. apart. In splices over supports a lap of at least 2 ins. will be provided. Where supports are over 5 ft. apart the rib metal sheets will be temporarily braced or supported before plastering and until the cement plaster on the rib side has become hard.

The plaster for each of the three coats will be a 1:3 Portland cement mortar. Long cowhair will be used in the motar for the scratch coat. The rib side will be plastered first with a scratch coat immediately after the plaster is mixed. This coat while still wet will be scratched to facilitate bonding with the finish coat. The finish coat will be applied as soon as it will adhere to the scratch coat. As soon as the plaster on the rib side has set the bracing will be removed and the lath side will be plastered. The finish and lath coats will be trowelled to a smooth finish. The total thickness of the wall will be approximately 2 ins.

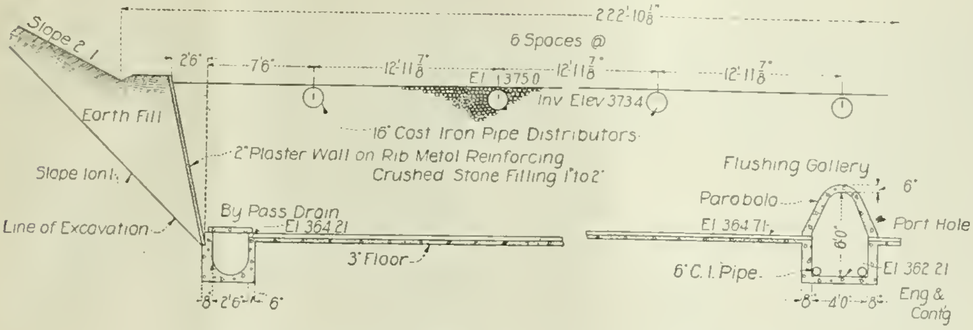


Fig. 7—Partial Cross Section of Sprinkling Filter Beds.

Sludge Beds.—From the Imhoff tanks the sludge will be pumped by "air lift" to 11 sludge beds of the usual type of construction. On account of the lay of the land at the site of the disposal works it was deemed wise to place the sludge beds at a higher elevation than the sewage tanks. This rendered pumping of the sludge necessary. The air lift was chosen in preference to other forms of pumping since, by that system, the sludge will not be broken up and its gas content unduly diminished. It is desirable to retain the gas since it facilitates the drying of the sludge. The sludge will be lifted to an elevation about 8½ ft. above the normal water surface of the tanks, and will flow by gravity from that point to the sludge beds through riveted steel pipes 10 ins. in diameter. The compressed air is delivered through a 2-in. pipe to the 8-in. cast-iron sludge discharge pipe which rises from the center of each pyramidal portion of the bottom of the tanks. The riveted steel pipes mentioned discharge into a 10-in. cast iron header along one end of the sludge beds.

The sludge beds are each to be 15 ft. wide and 111 ft. long. An industrial track will be laid in the center of each bed and will lead to a main track over which cars can be carried to the dumping platform, as shown in Fig. 5, where the sludge can be dumped either into wagons, or on to the concrete floor to be later shoveled into carts. The sludge beds are separated from each other by 2-in. creosoted wooden plank partition walls 12 ins. high. The planks are carried in grooves in concrete posts, set in gravel, 12 ft. 5 ins. on centers. The industrial track is made up of 12 lb. steel rails and steel ties. The top of the ties is set flush with the surface of the sand The gage of the track is such that it is 2½ ins. from outside to outside of rail heads. In proportioning the sludge bed the area was determined by allowing 1 sq. ft. of area of bed to every three people. That is, for a tributary population of 55,000 people the area adopted for sludge drying was 18,300 sq. ft. The sludge beds, it will be noted are not provided with under-drains. The soil affords good natural drainage. The concrete headwall through which the 10-in sludge header discharges the sludge upon the sludge beds is shown in Fig. 6. It will be noted that any bed can be filled by opening the 10-in. shear gate in the head wall.

Sprinkling Filters.—The settled sewage will flow from the two alternating dosing tanks to the broken stone sprinkling filter beds under variable heads. The sprinkling filters will have an average depth of 10 ft. of broken stone, varying in size from 1 to 2 ins., and will be about 228 ft. wide by 410 ft. long. The floor will be of concrete, with 12-in. by 3½-in. grooves, covered with 3-in. vitrified clay floor blocks, if type C floor block is used. These blocks will contain 5 slots and will be 12½ ins. wide by 15 ins. long. They are illustrated with Types A, B, and D, in Fig. 8. There will be two flushing galleries each 4 ft. by 6 ft. in section by means of which access may be had to the upper ends of the corrugations in the floor of the filters for inspection and flushing.

A novel feature in the design of these filters is the thin curtain wall between the natural earth on one side and the broken stone on the other, as shown in Fig. 7. This curtain wall is to be approximately 11 ft. high, and will be built of rib metal plastered on both sides to a thickness of approximately 2 inches.

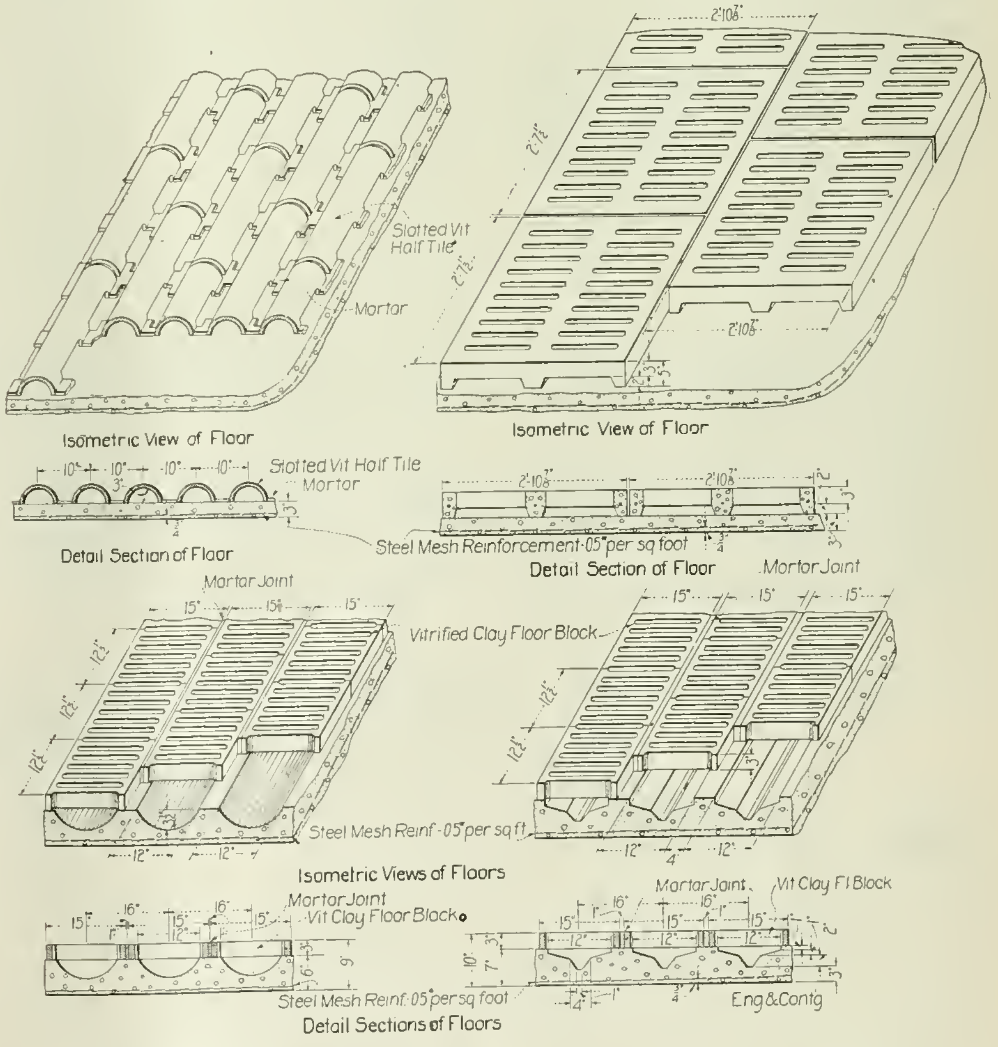


Fig. 8—Four Alternate Types of Floor Sys tem for Sprinkling Filter Beds.

Another feature of interest is the distribution system, which consists of cast iron pipes each connecting with the 36-in. and 30-in. cast iron header pipes. The laterals run lengthwise, being about 425 ft. in length and consisting of 16-in. and 12-in. cast iron pipe. Each lateral connects with a blow-off header at the lower end, by means of which it can be drained or blown-off to prevent freezing, for repairs, or for cleaning. A small sand filter is provided at the lower end of the trickling beds, to receive the sewage blown out of the distribution pipes.

Another novel feature is placing the cast iron lateral distributors just beneath the surface of the broken stone, bedding them in the stone without other support, and attaching the nozzles directly to the distributors, thus avoiding the use of risers. The area of the filters was determined by assuming that one acre of bed, 10 ft. in depth, is sufficient to handle the sewage from 20,000 people.

The sprinkling filters are constructed almost entirely in excavation. The surface of the stone is below the natural ground level. The outside partition walls will be constructed of three coats of cement plaster on rib metal reinforcing lath, in a manner similar to that previously described. The reinforcing sheets will be temporarily supported by wooden braces nailed to stakes driven into the ground at the back of the wall. When the earth backing and stone are being placed care will be taken to keep them at about the same level so as to avoid bringing an unbalanced pressure upon the thin wall. The finish coat on the rib side of the metal reinforcing will be trowelled sufficiently to form a wall of approximately uniform thickness, but a smooth finished surface will not be required. After the finish coat has hardened sufficiently a "slapdash" finish will be placed on the wall by throwing a thin coating of mortar from the trowel against the face so as to form a rough finish. If the cement gun method of applying the mortar is used the rib metal reinforcing lath known as "Rib-Trus," with ribs ¾-in. high, of No. 26 gage metal, or its equivalent, will be used. The two types of rib metal reinforcing lath previously mentioned will not be considered satisfactory for this purpose.

The cast iron pipe ilines in the sprinkling filters are to be laid in crushed stone. The stone will be leveled and a proper bed prepared on which to lay the pipe in order that as firm a bearing as possible may be provided for the pipe throughout its length. The 16-in. and 12-in. cast iron pipe lines in the sprinkling filters will be laid accurately to line and grade. This is necessary for the proper operation of the distribution system. After the pipe is laid and the joints yarned, crushed stone will be deposited around the pipe and will be rammed underneath the barrel of the pipe in such a manner as to prevent displacement of the pipe after the joints are poured with lead.

After the distributing pipe is laid and caulked it will be tapped and drilled for the nozzles. Great care will be taken even to the extent of providing special machinery if necessary, to so drill and tap the 2½-in. holes that the nozzles when inserted will have their vertical axes exactly plumb. The nozzles will be spaced at the apexes of equilateral triangles which are 15 ft. on a side.

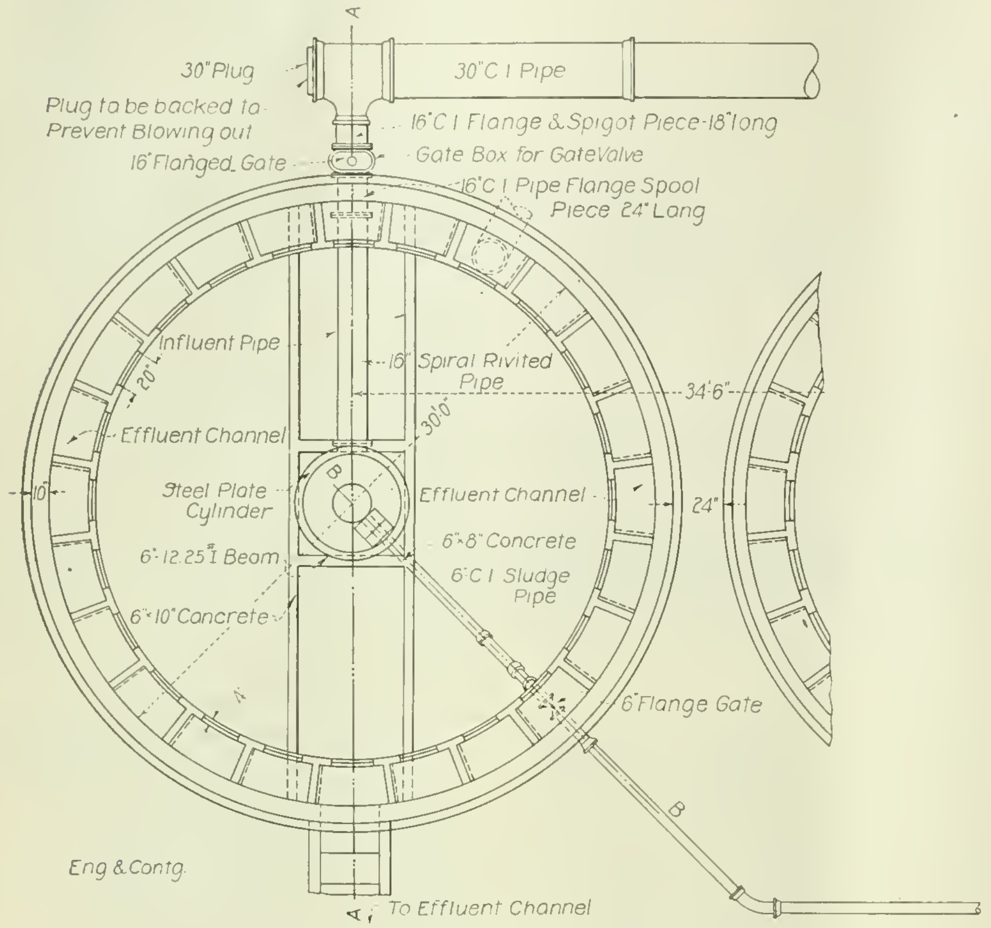


Fig. 9—Plan of One of the Secondary Settling Tanks.

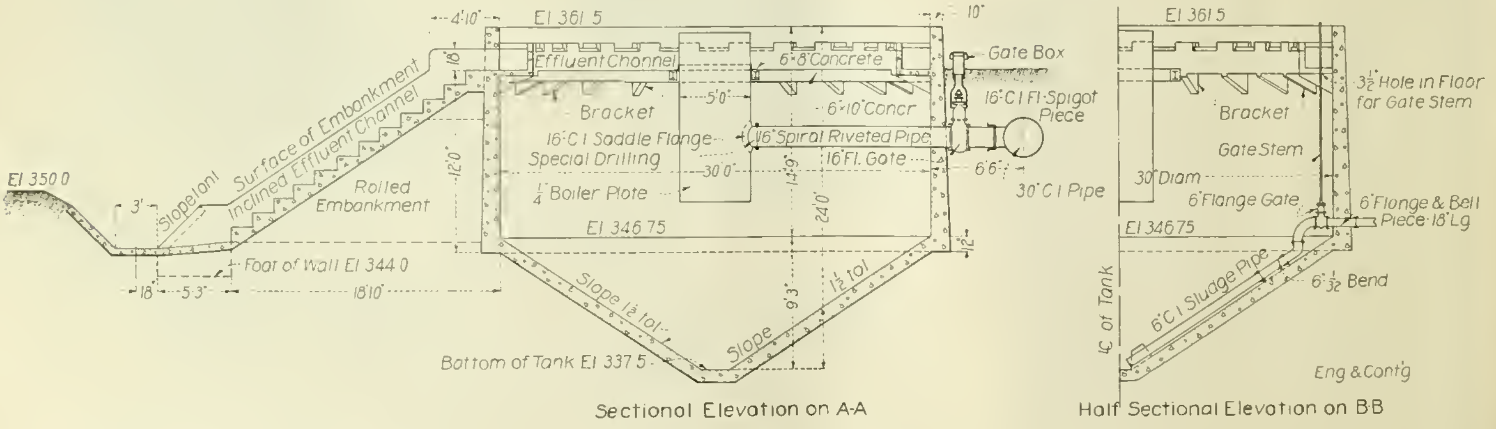
Secondary Settling Tanks.—The secondary settling tanks are cylindrical, with conical bottoms, and are 30 ft. in internal diameter by 24 ft. maximum depth. One of these tanks is shown in plan and sections in Figs. 9 and 10. The effluent from the trickling filters will be admitted to each tank through a vertical steel pipe 5 ft. in diameter, open at both ends and extending high enough above the surface of the water in the tanks to insure the discharge of the sewage through the bottom of the pipe. The effluent will be discharged over a large number of short weirs into a circumferential trough, from which it will flow direct to the north branch of the Nashua River. Provision is made, however, for tapping these troughs and conveying the effluent from the tanks to high rate sand filters, should it ultimately be found necessary to carry the treatment further.

The secondary settling tanks were proportioned so as to give one hour's sedimentation for 125% of the normal sewage flow from 55,000 people. The entire contents of these tanks will be pumped out frequently with a motor driven centrifugal pump into a force main, which in turn will discharge into the influent conduit of the Imhoff tanks. The sludge from the secondary settling tanks will thus be added to the sludge which is retained in the primary tanks from the raw sewage. This disposes of the troublesome sludge from the secondary tanks without the use of special sludge beds, and the disposal will be effected without the nuisance which usually attends the handling of this wormy sludge on beds.

The flow from the secondary settling tanks to the Nashua River will be through a concrete-lined trapezoidal channel. This channel will be 3 ft. deep and 3 ft. wide at the bottom, with side slopes of 1 to 1. The concrete lining will be 6 ins. thick. The invert slab will be placed in blocks 6 ft. long, cast in place. The sides of these blocks will be formed at an angle with their upper surfaces in order to provide a suitable thrust bearing for the slope blocks. After the alternate blocks have hardened sufficiently, the intermediate floor blocks will be placed. The paving for the side slopes will be cast in blocks 6 ft. long, with joints breaking with those between the bottom blocks. The side blocks will be cast in place or separately at the option of the contractor.

The plant will be provided with a laboratory building of rough-cut drab brick and red tile roof. This building will be fully equipped for such chemical and biological analyses as may be necessary for the intelligent operation of the plant.

The intercepting sewers and the disposal works have been designed and will be constructed under the general direction of the Fitchburg Sewage Disposal Commission, of which David A. Hartwell is Chief Engineer and Harrison P. Eddy is Consulting Engineer. The foregoing article has been prepared from information furnished by Mr. Eddy.



Sectional Elevation on A-A

Half Sectional Elevation on B-B

Fig. 10—Sectional Elevations of Fig. 9.

Isthmian Canal Commission Purchases Floating Cranes.

The Deutsche Maschinenfabrik A. G., Duisburg, Germany, was awarded a contract by the Isthmian Canal Commission April 21 for furnishing two revolving floating cranes of 250 tons capacity each. The contract price was $837,500 for delivery on the Isthmus. Only one American firm submitted a bid, the amount of which was $1,400,000, but several bids were received from firms in the Netherlands and England.

NEWS SECTION

Editorial Comment—Personals—Society Meetings—Trade Notes—Catalog Reviews—Contract News, Embracing Bids Asked, Work Projected, Contracts Let and Contract Prices on All Classes of Civil Engineering Construction Work.

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The Doings of the Week.

Railroad construction, as regards the letting of new contracts, has been particularly dull the past week. Few contracts of any importance appear to have been let, and no new work of any magnitude has made its appearance. In other lines of construction conditions have been better and bids on a number of large contracts have been opened. Building work in Chicago is tied up at present by the fight between the Building Construction Employers' Association and the members of 17 building trades unions. About 20,000 members of these unions were locked out last week, and work has been suspended on improvements aggregating $35,000,000. It is expected, however, that an early settlement of the difficulties will be effected. A great deal of building construction is projected in the Northwest at the present time. In the Builders' Exchange offices in Minneapolis, Minn., 24 new sets of plans were filed last week for large structures in Minneapolis and St. Paul.

Among the railway construction contracts let recently are the following: Foley, Welch & Stewart, St. Paul, Minn., and Winnipeg, Man., for constructing the 5-mile tunnel through the Selkirk Mountains for the Canadian Pacific Ry.; Allen Engineering & Contracting Co., Netcong, N. J., for the grading of about 3 miles of railway north of Quakertown, ½ mile at Sellersville, and about 3½ miles between Soudertown and Lansdale, all on the Philadelphia Division of the Lehigh Valley Transit Co.; J. N. Gillis & Son, Brewton, Ala., for grading and bridgeing for an extension of the Vredenburgh Saw Mill Co.'s railroad to Cay, Ala., 11 miles; Frank Shull, Toston, Mont., for constructing 20 miles of line for the Three Forks-Radersburg R. R.; J. C. Leathers, for six miles of construction at Vinton, La., for the Orange-Northeastern Ry. Co.

In the earth moving line the principal contracts let the past week are for levee work along the Mississippi. The Mississippi Levee District on June 17 awarded contracts amounting to about $700,000 for new work and enlargement. Bids have also been opened by the U. S. Engineers at Vicksburg and Memphis on good-sized levee contracts.

Bids on a number of good-sized government contracts have been opened the past week. Bids were opened June 16 for building reinforced concrete caisson, etc., at Sheboygan, Wis., Greiling Bros. Co., Green Bay, Wis., at $162,970 being the low bidder. For 1,438,700 cu. yds. of dredging at Fighting Island, Detroit, Mich., bids for which were openel June 14, the Great Lakes Dredge & Dock Co., Cleveland, O., at 7.5 cts., was the low bidder. Another large government job, on which bids were opened June 21, calls for dredging outer harbor and north entrance to Buffalo Harbor. Oliver E. Dunbar, Detroit, Mich., at $482,00 was the low bidder.

A considerable amount of highway improvement work has come up for bids in the past week. Most of the contracts are small, however, and are for county road work. Ohio also is calling for proposals on several sections of state line highway. In the way of contracts let one of the larger is for work for the State Road Commission of Maryland. This contract called for 1.09 miles of vitrified brick pavement on the Frederick Road. H. K. Faust, Belle Ave., Baltimore, Md., secured the work at $103,000.

In the way of bridge construction two of the larger contracts that have come up for bids in the last few days are those of New Castle County, Del., and Fayette County, Pa. The latter work calls for the construction of piers, foundations, etc., for a steel bridge viaduct and approaches over the Monongahela River between South Brownsville and West Brownsville, Pa. The Deleware work calls for the construction of the 3d St. bridge over the Christiana River at Wilmington. The substructure will require about 2,500 cu. yds. of concrete. The superstructure will consist of a movable bridge with a clear channel span of 150 ft. and two riveted truss approach spans, total length of superstructure being 416 ft. between the back walls of the abutment.

The citizens of Seattle, Wash., voted last week for a $3,000,000 bond issue for the development of terminals on the East waterway under direct public ownership and operation.

The city of Flint, Mich., has awarded the contract for a sewer system to A. H. Prange, Grand Rapids, Mich., at $374,269. The work consists principally of constructing lateral and main sewers.

The Department of Public Works of Canada, Ottawa, Ont., has engineers in the field preparing contract plans for the improvements to the French River in connection with which a vote of $500,000 was made at the last session. The river connects Georgian Bay and Lake Nipissing and would be one of the main sections of the Georgian Bay canal if that work were undertaken.

New Ingredient for Asphalt.

A guileless reporter on a small daily in an Eastern city, recently accompanied the city officials in an inspection of some asphalt pavement construction. He was much impressed with the 1-car asphalt plant, and described its workings as follows:

> Leading the way up a scaffolding the party stood in a regular sand storm while the mixer went through its antics for them. They saw how the sand, crushed stone and asphalt were poured into the big hopper where the eager jaws clutched the mixture with a gulp, churned the whole and dumped it, the finished article, into the wagon waiting below. So thoroughly does this mixer mix that once when a workman fell into it he was not missed until several days afterward. Then a fellow employe remembered having found a small piece of overall clinging to the mixer. The man himself had gone into the wearing surface of some street.

Imagine the surprise of the asphalt chemist if he had undertaken to analyze the batch of which the workman formed a part.

Mr. Flannagan.

The author of that famous report, "Off again, on again, gone again, Finnigin," is dead once more. This time he died at Tracy City, Tenn., aged 81. His name, according to a press dispatch, was John Flannagan, and he was formerly a locomotive engineer. While working on the Nashville & Chattanooga R. R. many years ago his engine got into the habit of running off the track pretty often. Mr. Flannagan was required to make reports on those occasions, and having lots of practice got to making lengthy reports, and as a consequence was jacked up by his superintendent and told to make them short. The laconic anecdote was the result. Many Finnigins and many Flannagans have died since "Off again" made its appearance, and such of them as had been employed on a railroad have been credited with the authorship. Funny thing about it, however, is that the anecdote was written by a professional jokesmith, who is still very much alive.

Highway Administration.

A significant indication of a recent development in the highway field is shown by the program of the Third International Road Congress, which is being held at London this week. At the previous Congresses in 1908 and 1910, the conferences were devoted entirely to the technical side of road improvement. At the present Congress questions of administration occupy a prominent place in the proceedings. Since the Brussels Congress in 1910, great advances have been made in highway construction The use of bituminous materials in road work has been advanced from the experimental to the practical stage. New types of construction have been developed successfully, and a better understanding has been attained of the proper use of the older types of road surfacings. The chief consideration in highway improvements now remaining seems to be mainly one of finance.

College Graduates.

Statistics collected by the officers of the class of 1903 of Northwestern University, show that the graduates in the above year are earning on the average, $660 a year more than the average salaried man in Chicago. On the other hand a press dispatch from San Francisco states that of the 700 members of the San Francisco Dishwashers' Union, 100 are college graduates. These figures, it is claimed, were compiled by two members of the union, one of whom was a former instructor in mathematics in an Eastern college. Of course, the San Francisco statistics should be taken with a grain of salt, for the days of romance are not past, and even a $10-a-week dish washer would like to appear to be a good old has been, rather than a never was.

PERSONAL

Colonel George W. Goethals sailed for New York on June 3.

Mr. L. W. Rundlett, city commissioner at Moose Jaw, Sask., has been appointed city engineer.

Mr. George T. Bacon has been appointed general manager of the Owego Bridge Company, Owego, N. Y.

Mr. F. W. Cappelen has been appointed city engineer for Minneapolis, Minn., succeeding Mr. Andrew Rinker.

Mr. G. A. Strand of the civil engineering and surveying firm of Lentell & Strand, has been elected city engineer for Eureka, Cal.

Mr. Hartwell Bishop, civil engineer, and son of Joseph Bucklin Bishop, secretary of the Isthmian Canal Commission, died at Boston, Mass., June 4, aged 33.

Mr. Andrew Rinker, for 25 years city engineer for Minneapolis, Minn., has opened an office in the Plymouth building, Minneapolis, as consulting municipal engineer.

Mr. E. D. Jackson has been appointed division engineer for the Baltimore & Ohio at Philadelphia, succeeding Mr. C. C. Cook, who has been transferred to the Pittsburgh division.

Mr. Norman K. Hay has been appointed city engineer of Sydney, N. S., succeeding Mr. Campbell, who recently resigned. Mr. Hay has been construction engineer with the Dominion Iron & Steel Co.

Mr. E. P. Goodrich, consulting engineer, New York City, has been retained by the city planning committee of the Chamber of Commerce and Board of Trade, Erie, Pa., to investigate Erie street car conditions.

Mr. J. C. Lord, formerly manager of the Fort Worth Power & Light Co., Fort Worth, Texas, has been appointed superintendent of construction on the West Fork reservoir, succeeding Mr. W. T. Smettem, resigned.

Mr. Thomas Taylor, minister of public works for British Columbia, has been appointed to represent that province at the International Good Roads Congress, which commences June 23, in London, England.

Mr. John Sproat has retired from the position of road superintendent at Delta, B. C., which he has held for the past 35 years. During that period he has built and located 800 miles of road, 300 miles of trails and 300 bridges.

Mr. Frederic M. Mann has resigned his position as head of the department of architecture at the University of Illinois to accept a half-time appointment at the University of Minnesota and to engage in professional work in Minneapolis, Minn.

Mr. F. O. Dufour, Assoc. M. Am. Soc. C. E., has resigned from the position of assistant professor of structural engineering, University of Illinois, to accept the position of construction engineer with Mr. D. A. Keefe, consulting engineer, of Athens, Pa.

Mr. Gale S. Strout, assistant hydraulic engineer with the California Railroad Commission, and formerly with Haviland & Tibbetts, San Francisco, has become assistant engineer to Mr. John S. Eastwood, consulting hydraulic engineer, of San Francisco.

Mr. G. N. Houston has been elected president of the Colorado Association of Members of the American Society of Civil Engineers; Mr. A. O. Ridgeway is vice-president and Mr. R. W. Toll, secretary-treasurer. The office of the association is at 700 Tramway building, Denver, Colo.

Mr. E. T. Corkill, chief inspector of mines for Ontario, has accepted the post of safety engineer with the Canadian Copper Co. at Copper Cliff, Ont. This office is the first of its kind at any mine in Ontario, but the greatly extended operations at Sudbury necessitated it. Mr. T. F. Sutherland, assistant inspector of mines, now resident at Cobalt, will proceed to Toronto on the first of next month to occupy the office vacated by Mr. Corkill. The position at Cobalt for Northern Ontario has not yet been filled.

Mr. C. M. Wetherill has severed his connection with the Chicago office of the Pratt Iron Works as salesman, to take charge of the water department at Chicago Heights, Ill Mr. Wetherill was at one time superintendent of water works at Rock Island, Ill., and was connected with the Denver Union Water Co., at Denver, Colo.

Mr. Charles F. Ffolliott and Mr. H. L. Mundy will carry on the business of the well-known railroad contracting firm of A. Guthrie & Co., St. Paul, Minn., under the same firm name as heretofore. The recent death of Mr. A. Guthrie, senior partner, has made no difference in the organization, as he had taken no active part during the past six years.

Civil Service Examinations.

The United States Civil Service Commission announces examinations as follows:

Hull Draftsman; $1,800 per annum; July 16-17.

Inspector of Motive Power; $1,200 to $1,500 per annum; July 23.

Senior Inspector of Motive Power; $1,800 to $3,600 per annum; July 21.

Mechanical Engineer; $1,080 to $1,500 per annum; July 23.

Senior Mechanical Engineer; $3,000 to $4,800 per annum; July 21.

Architect; $1,080 to $1,500 per annum; July 23.

Senior Architect; $3,000 to $4,800 per annum; July 21.

Railway Signal Engineer; $1,080 to $1,500 per annum; July 23.

Inspector of Car Equipment; $1,200 to $1,500 per annum; July 23.

Senior Railway Signal Engineer; $3,000 to $4,800 per annum; July 21.

Senior Inspector of Car Equipment; $1,800 to $3,600 per annum; July 21.

Civil Engineer; $720 to $1,080 per annum, second grade; $1,200 to $1,500 per annum, first grade; July 23.

Senior Civil Engineer; $3,000 to $4,800 per annum; July 21.

Electrical Engineer; $1,080 to $1,500 per annum; July 23.

Structural Engineer; $1,080 to $1,500 per annum; July 23.

Senior Electrical Engineer; $3,000 to $4,800 per annum; July 21.

Senior Structural Engineer; $3,000 to $4,800 per annum; July 21.

INDUSTRIAL

The Merritt Hydraulics Co., Philadelphia, Pa., has been appointed the sole distributor of "G.-K." sewer joint compound, manufactured by the Union Clay Products Co. of New Brunswick, N. J.

Paul Wever, Consulting Engineer, Düsseldorf, Germany, has opened a Technical Inquiry office. The main object of the office is to act as an agency through which any information, report or opinion on technical matters may be obtained from the competent source.

At a special meeting of the Board of Directors of the International Motor Co., on June 13, John Calder was elected President, in place of C. P. Coleman, resigned. Robert E. Fulton was elected Vice President, and Mr. F. R. Phillips has been appointed assistant to the President. Mr. Calder is an active member of the American Society of Mechanical Engineers. He has been Executive Engineer of the C. W. Hunt Co., Staten Island, Manager of Works and developer of the Remington Typewriter Industry at Ilion, N. Y., for nine years, and Associate Manager of the Cadillac Motor Car Co. at Detroit. Robert E. Fulton, the new Vice President, is also General Manager of Sales and Service. He was identified for some years with the Pope Manufacturing Co. in New York, and also with the Mercedes Co. in the same city. He has since been New York Sales Manager, and more recently General Sales Manager of International Motor Co. Mr. F. R. Phillips has been responsible for the Saurer and Mack Truck factories as General Manager of Works.

CATALOGUES

Locomotive Cranes.—Paper, 6x9 ins., 72 pp. Brownhoisting Machinery Co., Cleveland, O.

In this catalog is given a general description of the Brownhoist locomotive cranes, portal-pier cranes, traction cranes and work-car cranes, together with illustrations showing how the cranes are used by contractors, manufacturers, railroads and lumber men.

Pneumatic Tools.—Paper, 6x9 ins., 40 pp. Chicago Pneumatic Tool Co., Fisher Bldg., Chicago, Ill.

Bulletin 127 contains complete descriptions of the construction, with photographs and drawings, of pneumatic drills, reamers, wood borers, flue rolling and tapping machines and grinders.

Sprague Flexible Steel Armored Hose.—Paper, 5½x8 ins., 16 pp. Sprague Electric Works, 527 W. 34th St., New York City.

This catalog illustrates and describes Sprague armored air brake hose for railway service. Complete illustrations, lists of prices, etc., are given.

Gasoline Locomotives.—Paper, 6x9 ins., 24 pp. Baldwin Locomotive Works, Philadelphia, Pa.

Record No. 74 contains complete illustrations and descriptive matter showing the design and uses of this locomotive. Tables showing performances of the locomotives in tests are given.

Record No. 73, 6x9 ins., 56 pp., is entitled "Recent Development of the Locomotive" and contains descriptions of the later types of steam locomotives. This is a very interesting catalog.

Air Compressors and Drills.—Paper, 6x9 ins. Sullivan Machinery Co., Peoples' Gas Bldg., Chicago, Ill.

Bulletin No. 58-M describes air compressors, large power driven units, cross-compound belt-driven, motor-driven or water-wheel driven types, classes "WJ-2," "WN-2" and "WS-2." 20 pp.

No. 66-M describes hammer drills for quarries, including plug and foot-hole drills and stone dressing tools.

No. 112, air compressors, illustrates different types of Sullivan air compressors and gives tables of sizes, capacities, etc.

Fuel Oil Appliances.—Paper, 8½x12 ins., 12 pp. National Supply Co., 416 W. Indiana St., Chicago, Ill.

Bulletin No. 100, entitled "The Billow System, Fuel Oil, Pumping Units, Steam Actuated," gives illustrations and complete description of the various models, together with a table of dimensions, sizes, etc.

Bulletin 110 is entitled "Steel Storage Tanks and Accessories." Gives illustrations and descriptions with tables of prices, dimensions, etc.

Bulletin No. 120, entitled "Fuel Oil Atomizers and Accessories," illustrates by drawings and gives tabular matter showing dimensions, etc.

First Aid Cabinets for Contractors and Railways.—Paper, 6x9 ins., 12 pp. Johnson & Johnson, Kilmer St., New Brunswick, N. J.

This is a catalog of Red Cross medical cabinets which contain materials for use in rendering aid to injured persons. Illustrations, lists of contents of various cabinets, and prices are given. Another pamphlet accompanies this catalog which gives instructions for treating various injuries.

RAILWAYS

Alabama.

⊙The Vredenburgh Saw Mill Co. of Vredenburgh, Ala., has awarded contract to J. N. Gillis & Son of Brewton, Ala., for the grading and bridging on an extension of the railroad to Coy, Ala., a distance of about 11 miles.

City Commissioners of Birmingham, Ala., have approved the plans for the street railway to be constructed in that city by George C. Kelley & Sons, Birmingham. According to the terms of the franchise actual construction work on the Avenue F section of the railway must begin within the next few weeks.

Citizens of Leeds, Ala., are taking steps to organize a company to build an electric railway to connect that place with Irondale and thus get street car connections with Birmingham.

Arkansas.

City Council of Mount Pleasant, Ark., has granted a franchise to Dr. G. Haggard Rider to operate a street railway. It is stated that the line will be operated in connection with a sanitarium and amusement park which are to be constructed.

G. W. L. Brown, General Manager of the Cache Valley Railroad Co., Sedgwick, Ark., now operating a line from Sedgwick to Light, recently visited Paragould, Ark., and held a conference with the Chamber of Commerce relative to building a branch of the road into Paragould, a distance of about 20 miles. Mr. Brown said he had assurance of sufficient backing to build the road from Little Rock to Thebes, Ill., and if the citizens of Paragould would give a bonus of $25,000, secure the right of way and donate terminal grounds in Paragould, he would build the branch line into the city.

California.

The Pacific Electric Ry. Co., Los Angeles, is making final settlements for right-of-way for an extension from Santa Ana to Orange and plans to begin construction work at once.

The San Diego & Southeastern Ry., W. Clayton, General Manager, San Diego, Cal., has applied to the Railroad Commission for authority to issue $600,000 of bonds. The money is to be used for improving its road and for purchasing equipment, to pay off current obligations, for a new depot site and for new shop and yard sites in San Diego.

The Santa Fe System is reported to have practically decided upon the building of its own tracks from Bakersfield to Mojave and thereby eliminate its present necessity of using the Southern Pacific tracks for the distance of 65 miles between the two points. The decision reported to have been made is based upon the recently made surveys which will take the proposed connecting link in the Santa Fe System through Adobe, the Miller & Lux, Tejon and Los Alamos ranches and the Antelope Valley. The cost of the link is estimated at $3,500,000.

The Northern Electric Ry. Co., Alaska Commercial Bldg., San Francisco, is reported to have secured all right of way, and is believed to be preparing to begin construction in the near future on a 50-mile branch leaving the Yuba City-Colusa line at Meridian, on the Sacramento river and extending south through the Fair ranch to Woodland in Yolo county, forming a loop and giving direct connection for all points on the west side with Sacramento and San Francisco over the Vallejo & Northern.

Steps are being taken to organize the Humboldt, Siskiyou & Klamath Ry., for the purpose of building a line from Eureka to Klamath Falls, Ore. The line is to be about 350 miles long, and the route will follow the Klamath River. L. F. Pewter, Eureka, Cal., is President.

Colorado.

Engineers of the Denver & Rio Grande Railroad, according to advices from Salt Lake City, are working on a survey between Price and Huntington, and it is believed that rails will be laid before the summer is over. Huntington canyon contains rich coal deposits. The spur will also tap a rich agricultural and fruit country.

J. F. Springfield has been elected President and Walter Grundy, Hutchinson, Kan., Secretary, of the Colorado-Kansas Ry., of which they recently secured the controlling interest. This is a short steam line extending from Pueblo, Col., up the Arkansas valley toward Canon City. It is the intention later to build it down the valley, Garden City being the ultimate terminus.

Florida.

The Tampa & Gulf Coast R. R. Co. has begun grading and cutting right of way on its new line from Tampa to St. Petersburg. The company will be in the market for a few short bridges, drain pipes, grading outfits, and 8 or 9 miles of good first quality 60-lb. relaying rails together with splices. Chas. H. Brown, Tampa, Fla., is President.

Honduras.

Neil M. Gamble, C. E., is now at Truxillo, Honduras, with men and material and work on the Truxillo-Juticalpa R. R. will soon be under way. Several more corps of engineers, instruments and men will be required. Further information can be obtained from Mr. Gamble at Truxillo, Honduras, or Seely Dunn, C. E., St. Charles and Union St., New Orleans, La.

Illinois.

The Alton, Granite & St. Louis Traction Co., Alton, Ill., has applied to the Town Board of Wood River for a franchise on the county road east of Upper Alton. It is proposed to extend the line from Alton to Bethalto, passing the site of the new State Hospital for the Insane, east of Alton.

Mike Conroy has moved his outfit to Galva, Ill., where he has taken about 300,000 cu. yds. of machine work on the C. B. & Q. cut-off between Galva and Hewanee, Ill. He expects to put four grading machines at work, and will be glad to see all of his old hands, both skinners and dumpmen on the job. A nice slice of the work has been let to T. J. Morris and Thomas Vaughen.

A project is under consideration for the construction of an electric interurban line connecting Benton, Herrin, Christopher and Johnson City. As projected the line would be about 30 miles long. Steps are now being taken to raise the funds for making the surveys. Fred Pulliam, Benton, Ill., is interested.

The Danville, Crescent & Kankakee Traction Co. is projecting a 76 mile line from Kankakee to Danville. Preliminary surveys have been made and construction contracts will be let in August if possible. E. E. Meyer, Crescent City, Ill., is President; S. H. Clark, Crescent City, is Secretary.

Officials of the Elgin Terminal Railway Co., according to advices from Elgin, Ill., are to hold a meeting shortly to discuss the plan for building an outer belt line around the City of Chicago. It is said that the survey for the line from St. Joe, Mich., through South Bend, Ind., to La Porte, is complete. From that point the present intention is to connect with Gary, Ind., Joliet, Aurora, Elgin, Waukegan, Racine, Kenosha and Milwaukee.

Iowa.

The Iowa Railway & Light Co., Cedar Rapids, Ia., has been granted permission by the City Council of Mt. Vernon to build a line down Main street.

At the recent sale of the Atlantic Northern & Southern Ry., at Exira, Ia., under District Court proceedings the trustees for the bondholders offered $185,000. This was the highest bid and if the sale is confirmed by the Court the road will be turned over to the bondholders on Aug. 9. The Atlantic Northern & Southern Ry. is a 54-mile steam line with headquarters at Atlantic, Ia. This is the fourth time it has been offered for sale under court proceedings.

Kansas.

Grading work is under way for the 4-mile extension of the Arkansas Valley Interurban Ry. Co., Wichita, Kan., for Newton to Bethel Colleges.

The Kansas City, Kaw Valley & Western Ry. will probably let grading contract about July 1. This company purposes a line to run from Kansas City via Muncie, Kan., Edwardville, Bonner Springs, Lanape, Loring and Linwood to Lawrence. O. W. Williamson, Bonner Springs, Kan., is Chief Engineer.

The State Utilities Commission has granted authority to the Hutchinson & Northern Ry. Co. to issue $25,000 of stock to begin construction work. This company proposes the construction of a line from Hutchinson to Fairbury, Neb. It is proposed to build 14 miles of the line this summer from Hutchinson to Burrton to give the Frisco an entrance to Hutchinson. Will S. Thompson, Hutchinson, Kan., is interested.

Kentucky.

Surveys are under way for a branch of the Lexington & Eastern Ry., John H. Peyton, Chief Engineer Construction, Louisville, Ky., up Mace's Creek, near the Perry-Letcher line, to reach extensive coal and timber properties, most of which is owned by Eastern corporations.

The stockholders of the Kentucky Southwestern Electric Railway & Light Co., Paducah, have ratified the contract made by the executive committee for the sale of bonds to build the Paducah-Mayfield-Murray Division of the road. It is stated that actual construction work on the road will be started not later than August. The line will be standard gage, laid with 70 lb. rails, and the estimated cost of the first division is $1,300,000. The traction company is not ready at present to give out the name of the party who has contracted to take the bonds and build the road. This information will probably be available in about 30 days. Maj. W. A. Calhoun, Paducah, Ky., is Consulting Engineer for the line.

Louisiana.

⊙The Orange-Northeastern Ry. Co., projecting a 150-mile line from Natchitoches, La., to Orange, Tex., has awarded a contract for 6 miles of construction at Vinton, La., to J. C. Leathers. Bids on work at the Natchitoches end also are reported to have been opened. Arthur R. Carver, Natchitoches, La., is Chief Engineer.

The Mansfield Railway & Transportation Co., J. S. Miller, Secretary, Mansfield, La., now operating a 10-mile steam line from Mansfield to Hunter, has started surveys for an extension from Mansfield eastward through the De Soto oil field. It is expected to build the first section of 12 miles at once, and later continue the line to Campte on Red River.

Maryland.

The Central R. R. Co. has applied to the Public Service Commission for permission to issue $125,000 bonds. This company was formed to build a line from Keemar to Union Bridge. Options on right of way are being taken up. The line will tap the Tidewater Cement plant, near Union Bridge. Wm. J. O'Brien, Jr., Calvert Bldg., Baltimore, Md., is interested.

The United Railways & Electric Co., 1001 Continental Trust Bldg., Baltimore, Md., is to extend its Monmouth St. line to Orangeville.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Michigan.

A meeting is to be held shortly by the officials of the Michigan Central R. R., and the City of Kalamazoo, Mich., in regard to the elevation of the tracks through the city.

Minnesota.

Surveys are under way for the projected line of the Grand Marais & Northern Ry. The engineering crew had temporary offices in the Lundin Bldg., Grand Marais. A. Mitchell is President and T. R. Halsey is Engineer.

Resolution is before the City Council of Minneapolis, Minn., providing for new car lines and extensions for 1914 for the Twin City Rapid Transit Co. The resolution calls for about 15 miles of lines.

The Minneapolis, St. Paul & Sault Ste. Marie Ry. is reported to be planning to begin work in the immediate future on improving its line entering Duluth. The work will include the construction of a trestle connecting with the interstate bridge and carrying the line above all the other roads in the Duluth Yards. The work will cost something like $1,000,000.

The Red Lake Northern R. R. Co. has been organized and articles of incorporation filed. The company proposes to construct a line from Warroad to Akeley, Minn., and a preliminary survey of the route has already been made. The Board of Directors of the new company are: J. J. Opsahl, Bemidji; Bert Rodman, Akeley; D. Theriault, Akeley; Dr. A. Desmond, of Akeley, and Charles F. Shears, Akeley.

Missouri.

The Jefferson City Bridge & Transit Co., Jefferson City, Mo., has applied to the City Council for a new franchise with more extended powers. The company is stated to be planning a number of extensions and betterments.

Application for a final decree in the receivership of the Kansas City, Mexico & Orient Ry. to make possible the sale of the railway was filed last week before Judge Pollock in the federal court in Kansas City, Kan., by attorneys for the United States & Mexican Trust Co. and the bondholders of the road. About $24,000,000 of bonds are outstanding against the road. A new company to buy the Orient properties has been in the process of organization for several weeks.

Montana.

⊙The contract for the construction of 20 miles of line for the Three Forks-Radersburg R. R. has been awarded to Frank Shull, Toston, Mont.

New Jersey.

⊙J. E. & A. L. Pennock, Land Title Bldg., Philadelphia, Pa., have been awarded the contract for the car house and shops for the Atlantic City & Seashore R. R. Co., at Atlantic City. Buildings are to be brick, steel and concrete, 185 by 400 ft.

The Atlantic Coast Electric Ry. Co., Asbury Park, N. J., is contemplating extending its line to Brielle.

New York.

⊙C. W. Reynolds, 30 Church St., New York City, has been awarded the contract for double track from Janesville to Syracuse, about 7 miles for the D. L. & W. Ry. In our issue of June 11 the name of this contractor was given as C. U. Reynolds.

A project is under consideration for the construction of an electric railway for Falconer to Hamburg, N. Y. The projected length is about 55 miles. The company has not been organized as yet, and only a preliminary survey has been made. C. Eugene Bentley, Jamestown, N. Y., is the engineer.

Ambrose J. Murray, New York City, receiver of the Dansville & Mount Morris R. R., has announced that the company has under consideration the construction of an extension from Dansville to Burns, N. Y., where a connection with the Erie R. R. can be had.

North Carolina.

A delegation of citizens from Alexander, Eilkes and other counties recently conferred with the citizens of Charlotte, N. C., with reference to the building of a railroad from Taylorsville to Wilkesboro. Rights of way are being secured, a company having been organized and chartered by the recent Legislature to take up this work. R. Don Laws was one of the leaders of the delegation.

Ohio.

The Toledo, Ottawa Beach & Northern Ry. Co. (electric), Smith & Baker Bldg., Toledo, O., has secured the right of way for an extension of its line to Monroe, where connections will be made with the Detroit, Monroe & Toledo line. It is probable that the extension will not be build until next year.

The Springfield Ry. Co., 44 South Limestone St., Springfield, O., is making arrangements for a new issue of bonds to cover improvements proposed and insured under the new franchise granted by the city. The work includes car barns, machine shop and other improvements. It is understood the issue will be for about $300,000. The local lines are controlled by the American Railways Co., of Philadelphia.

Pennsylvania.

⊙The Lehigh Valley Transit Co., W. W. Wysor, Chief Engineer, Allentown, Pa., has awarded a contract to the Allen Engineering & Contracting Co. of Netcong, N. J., for the grading of about 3 miles of railway north of Quakertown, ½ mile at Sellersville, and about 3½ miles between Souderton and Lansdale, all on the Philadelphia Division. Right-of-way has been secured for double track but only one track will be laid this season. The new road is merely a revision of the existing line but the present line is along the edge of the highway and contains numerous sharp curves and heavy grades. The maximum curvature on the revised line will be 4° and the maximum grade 3 per cent. Some of the curves on the old line are as sharp as 100 ft. radius and the grades are as much as 6 per cent to 7 per cent. The grading on new line will be very light averaging about 8,000 cu. yds. per mile. There will be one steel viaduct 270 ft. long and 40 ft. high and several smaller bridges ranging in length from 20 to 50 feet. The overhead construction will be catenary suspension from poles and brackets. Track will be laid of 80 lb. A. S. C. E. Tee rail with stone ballast.

Tennessee.

The Southern Ry. Co., and the Aluminum Co. of America, Pittsburgh, Pa., are reported to have reached a tentative agreement whereby the former will elevate its tracks so that back waters from five dams to be constructed by the aluminum company will not overflow the tracks of the railway near Chilhowee on the Bushnell extension on the Tennessee & North Carolina division of the Southern railway, a large part of the right-of-way being in the gorge between the mountains.

The Middle Tennessee Traction Co., projecting a 70-mile line from Franklin through Shelbyville and Fayetteville, has made surveys and has secured the construction capital in part. John A. Pitts, Nashville, Tenn., is President; G. B. Howard, Franklin, Tenn., is Chief Engineer.

The Yazoo & Mississippi Valley R. R. (Illinois Central System) is reported to have plans for changes in its yards at Nonconnah, estimated to cost $600,000. The railroad will also construct two roundhouses and repair shops. A total expenditure of about $3,000,000 is proposed.

The Jackson Railway & Light Co., Jackson, Tenn., is considering extending its car line into West Jackson.

The Farmers' Phosphate & Fertilizer Co., Nashville, Tenn., will let a contract for removing with steam shovel 9 ft. of earth from 30 acres of land to lay bare phosphate deposits.

Texas.

The Paris & Mt. Pleasant R. R., R. F. Scott, President, Paris, Tex., has applied to the State Railroad Commission for permission to issue $600,000 of bonds.

The San Antonio, Uvalde & Gulf Ry., A. R. Ponder, General Manager, San Antonio, Tex., is reported to have sold its $3,000,000 bond issue to a New York syndicate headed by W. A. Bradford.

The Dallas, Fairfield & Gulf Ry. with principal offices at Fairfield, and a capital stock of $105,000, has been chartered and proposes to construct and operate a line of railway extending from Dallas by way of Ferris through Fairfield to Jewett, Leon County, a distance of 100 miles, passing through Dallas, Ellis, Navarro and a portion of Leon counties. The incorporators are: T. E. Alexander, Teague; W. H. Miller, R. N. Compton, W. F. Storey, Fairfield; R. L. Harper, W. J. Hall, Corsicana, and J. W. Wright, Ferris.

Utah.

It has been announced by J. G. Jacobs, Salt Lake City, Utah, that within the next 60 days a railroad will be in operation between the granite quarries in Little Cottonwood Canyon and Midvale for the transportation of Utah granite for the Utah capitol. J. G. Jacobs for several months has been working on a plan to build a road into Little Cottonwood Canyon.

An amendment to the articles of incorporation of the Bingham & Garfield R. R. Co., increasing the capital stock of the company from $2,500,000 to $6,000,000 has been filed with the County Clerk and Secretary of State, at Salt Lake City, Utah. D. C. Jackling, Salt Lake City, Utah, is General Manager.

Virginia.

The Virginia Railway & Power Co., 7th and Main Sts., Richmond, Va., is reported to be considering the construction of a branch electric railway from Petersburg to City Point.

West Virginia.

County Court of Wood County has granted right of way across the county roads to the Charleston & Northern R. R. Co., which plans to construct a line from Parkersburg to Charleston. Kenner B. Stephenson, Parkersburg, W. Va., is president of the company.

Wisconsin.

The Chicago Short Line Ry. Co. is projecting a 110-mile belt line in Western Grant County, the main line to run to Stockton, Ill. This is to be a heavy freight carrying road. Surveys have not been made. It is proposed to let construction contracts early in 1914. Joe T. Bennett, Lancaster, Wis., is President; Thos. McDonald, Lancaster, Wis., is the principal promoter.

At a meeting of the incorporators of the Minneapolis, Merrill & Marinette Ry. Co., which was recently incorporated as mentioned in ENGINEERING AND CONTRACTING, the following officers were elected: John O'Day, President; J. N. Cotter, Vice President; W. F. Kubasta; A. B. Nelson, Treasurer. The directors of the company are L. N. Anson, J. N. Cotter, John O'Day, W. F. Peterman, A. H. Wright, F. Kubasta, Chris Solum, H. Meyer, Geo. T. Harding, A. B. Nelson, E. S. King. The headquarters are located at Merrill, Wis.

Canada.

⊙Foley, Welch & Stewart, St. Paul, Minn., and Winnipeg, Man., have been awarded the contract for constructing the 5-mile tunnel through the Selkirk Mountains for the Canadian Pacific Ry. The tunnel will enter the Selkirks in the east end in the valley below Bear Creek station on the present line and will come out at the loop. Bids on this work were opened several weeks ago.

The Canadian Northern Ry. is stated to have made an agreement with the city of St. Catharine to carry the proposed line from

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Toronto to Buffalo through that city on consideration of the payment of a bonus of $100,000. It is stated that the entire line is promised complete and in operation in three years.

The Grand Trunk Ry. Co. will hold a special meeting at Montreal on July 16 for the purpose of passing a by-law authorizing the issue of debentures for $15,000,000 under the provisions of the act passed by Parliament recently, by which the Government is to loan that amount to the company. The debentures, when issued, will be delivered to the Dominion Government, and they will be guaranteed as to principal and interest by the Grand Trunk Railway.

Ratepayers of Morrisburg, Ont., have voted in favor of a by-law for the granting of right of way over certain streets to the Ottawa & St. Lawrence Electric Ry. Co. The franchise is for a period of 25 years, and to be effective the company must practically complete its road by fall of 1914. J. A. Morden, Toronto, and H. W. Pearson, Toronto, are interested.

Advices from Medicine Hat., Alta., state that it is proposed to electrify the spur, six miles long, running to Ainsley Mine and serving several industrial sites and arrange with the street railway company to operate motors thereon to do switching for industries.

Work will probably be started next month on the harbor improvements and building of grain elevators at Port Nelson, which is to be the terminus of the Hudson Bay Ry. About $5,000,000 will be expended for these improvements. Frank Cochrane, Ottawa, Ont., is Minister of Railways and Canals.

ROADS AND STREETS

Alabama.

✣Bids will be received until noon, July 14, by M. F. Brooks, Judge of Probate, Brewton, Ala., for the construction of approximately 11 miles of graded earth road. Specifications on file in the office of the Judge of Probate of said county. Successful bidder will be required to enter into bond in double the amount of his bid, conditioned for the proper performance of his contract.

⊙The City Commission of Montgomery, Ala., has let the contract for the paving of the Carter Hill Road from the bridge to Hall St., to James Hodgson, for $5,435.

⊙The Southern Asphalt Construction Co., Birmingham, Ala., has been awarded the contract by the city of New Decatur, Ala., Henry Hartung, City Clerk, for the construction of 85,000 sq. yds. of street paving. Bids were opened June 16 and contract awarded June 20.

⊙J. G. Brown, 116 Cramer avenue, Montgomery, Ala., has been awarded the contract by the State Highway Commission, Montgomery, for the construction of approximately 7 miles of graded earth roadbed at Hayneville, for $8,000. Bids were opened June 16.

Arkansas.

The Arkansas State Highway Commission has planned a permanent rock highway, to extend south from the Missouri state line, at St. Francis, through the county seat towns of Clay, Greene, Craighead, Poinsett, Cross and St. Francis Counties to Forest City, a distance of 125 miles. The estimated cost is $500,000. E. A. Kingsley, Little Rock, is State Highway Engineer.

California.

⊙The Board of Public Works of Los Angeles, Calif., has awarded the contract to the Fairchild-Gilmore-Wilton Co., of that city, for the paving of East First St., from Chicago St. to Evergreen Ave., for $57,214. The Rogers Bros. Co. secured the contract for the improvement of the Wilmington-San Pedro Road across Lot L of the Rancho Palos Verdes, for $4,672.

⊙The Standard American Dredging Co. has been awarded the contract by the Board of Public Works of Los Angeles, Calif., for the improvement of E St., Wilmington, from the inner bay exception line to West First St., for $18,399.

Colorado.

⊙The Board of Mesa County Commissioners, Grand Junction, Colo., has let a contract to C. L. Campbell for the construction of 2.4 miles of road between Big Creek reservoir southwest of Colibran on Grand Mesa and the Alexander Lakes. The forestry service will build the other 3.5 miles in Mesa County and Delta County Commissioners will construct the seven miles of road on their side to the Alexander Lakes.

Connecticut.

⊙The Hassam Paving Co., New Haven, Conn., has been awarded the contract by that city, F. L. Ford, City Engineer, for the construction of about 29,000 sq. yds. of pavement, for $3.16 per sq. yd. The contract calls for creosoted wood blocks. Bids were opened June 16.

Delaware.

✣Bids will be received until noon, July 8, by the Levy Court, New Castle County, at the office of the County Engineer, Wilmington, Del., for two 10-ton steam or gasoline road rollers. Benjamin A. Groves is President of the court.

An election will be held in Delaware City, Del., on June 24, for the purpose of voting on the question of borrowing $5,000 in addition to the $10,000 authorized by the Legislature, for street improvements.

Florida.

✣Bids will be received until 3 p. m., July 14, by Committee of Public Works of the Board of Bond Trustees, Jacksonville, Fla., for furnishing materials and laying approximately 2,600 sq. yds. of 2-in. asphaltic concrete on a 5-in. concrete base on Laura St., from south building line of Duval St. to north building line of Adams St., in the City of Jacksonville, Fla. Henry Gaillard is Chairman of the committee and L. D. Smoot is Chief Engineer.

Georgia.

⊙The Georgia Quincy Granite Co. has been awarded the contract for furnishing the City of Macon, Ga., with curbing material. The bid calls for curbing at $0.22 per lin. ft., and curved curbing at $0.30 per lin. ft.

Idaho.

A special election will be held in Ada County, Ida., on June 25, for the purpose of voting on the issuance of bonds to the amount of $200,000 for the construction of roads and bridges. Boise is the county seat.

Illinois.

✣Bids will be received until 7 p. m., July 7, by Village of Atkinson, Ill., for the construction of 10 (more or less) blocks of concrete sidewalk. Sidewalk complete is wanted, including 4 to 8 ins. of sand for foundation, 4-in. gravel concrete and ¾ in. finishing coat. Crossings to be 6 ins. of concrete and 1 in. finishing coat.

✣Bids will be received until 7:30 p. m., June 26, by Board of Local Improvements, Village of Glencoe, Ill., for the construction of approximately 5,575 sq. yds. of brick pavement on 2 ins. of cinders, a 5-in. concrete base and a 2-in. sand cushion, joints to be filled with an asphaltic filler; 4,015 lin. ft. of concrete curb, 3,000 cu. yds. of grading; 170 ft. of 15-in. drain tile, 1,350 lin. ft. of 12-in. drain tile; 465 ft. of 10-in. drain tile; 140 lin. ft. of plank end curb, and 9 brick masonry catch-basins. Plans and specifications on file in the Village Clerk's office and the Village Engineer's office. All bids must be made on blanks furnished by the Village Engineers and must be accompanied by cash or a certified check on a responsible bank for 10 per cent of the aggregate proposal. Windes & Marsh, 598 Birch St., Winnetka, Ill., are Village Engineers.

✣Bids will be received until 10 a. m., June 30, by Board of Local Improvements, Elgin, Ill., for paving with brick part of Riverside Ave., and Milwaukee St. The work will include about 5,493 sq. yds. Albert Fehrman is President of the Board.

⊙I. D. Lain of Bloomington, Ill., has been awarded the contracts for the paving of Taylor St., from Vale to Mercer; Beecher St., from Main to Fell Ave., and Union St., three blocks west from Main, for $1.97 per sq. yd.

⊙Robert L. Curdie, of Alton, Ill., has been awarded the contract by the Board of Local Improvements of Greenville, Ill., for the paving of First St. and Beaumont Ave., for $14,684. Brick will be used.

⊙The Board of Local Improvements of Spring Valley, Ill., has awarded the contract for the paving of Erie and Cleveland Sts., to T. W. Keys, of La Salle, Ill., for $39,501 and $20,315.

⊙The S. S. Saxton Co., of Chicago, Ill., has been awarded the contract by the City of Lorain, O., for the paving of Globe and E. 30th Sts. with sheet or stone filled asphalt, for $11,349 and $18,336, respectively.

⊙The Western Improvement Co. has been awarded the contract by the City Council of Elgin, Ill., for the paving of Division St., for $22,690.

The City Council of Rockford, Ill., proposes to pave Kishwaukee St., from State St. to 11th Ave., with brick. Edwin Main is City Engineer.

The Board of Local Improvements of Des Plaines, Ill., has adopted a resolution for paving Ashland Ave., Cora St., and several other streets and avenues with concrete. The estimated cost of the work is $89,703. The estimate includes the following: 24,000 cu. yds. of excavation at 35 cts. per cu. yd., 34,200 lin. ft. concrete curb, 9 in. by 24 ins., 1 2½ 5 mix at 45 cts. per lin. ft.; 41,500 sq. yds., 7 in. at center, 5 in. at side, 1 1½ 3 mix concrete pavement, reinforced and with steel protected joints, at $1.30 per sq. yd.; 30,000 lin. ft. 4-in. drain pipe at 9 cts. per lin. ft.; 10,600 sq. ft. cement walk at 16 cts. per sq. ft.; 600 lin. ft., 6 ft. high, 21 in. wide concrete retaining wall at $5 per lin. ft. W. M. Lawson, Des Plaines, Ill., is President Board Local Improvements.

Indiana.

✣Bids will be received until 1:30 p. m., July 8 by Board of Parke County Commissioners, Rockville, Ind., for the construction of seven gravel roads. J. E. Elder is County Auditor.

✣Bids will be received until 7:30 p. m., July 3, by Board of Public Works, Fort Wayne, Ind., for 15 street improvement contracts. Plans, profiles, etc., are on file at the office of the Board. H. W. Becker is Clerk.

✣Bids will be received until 2 p. m., July 7, by Board of Crawford County Commissioners, English, Ind., for the construction of a road in Union township. J. B. Enlow is County Auditor.

✣Bids will be received until 2 p. m., July 7, by Board of Posey County Commissioners, Mt. Vernon, Ind., for the construction of Heckman, Price No. 2 Fitzgerald, Weiss gravel roads. J. R. Haines is County Auditor.

✣Bids will be received until 2 p. m., July 11, by Board of Harrison County Commissioners, Corydon, Ind., for the construction of a highway in Heth township. J. L. O'Bannon is County Auditor.

✣Bids will be received until 2 p. m., July 7, by Board of Jasper County Commissioners, Rensselaer, Ind., for the construction of gravel roads in Gillam and Kankakee township. J. P. Hammon is County Auditor.

✣Bids will be received until 2 p. m., July 7, by Board of Johnson County Commissioners, Franklin, Ind., for the construction of gravel roads known as the W. B. Vandiver et al and the C. C. Featheringill et al. roads. H. L. Knox is County Auditor.

✣Bids will be received until 1 p. m., July 7, by Board of Benton County Commissioners. Fowler, Ind., for the construction of a crushed limestone road in Center township. Warren Mankey is County Auditor.

✣Bids will be received until 2 p. m., July 7, by Board of Hancock County Commissioners, Greenfield, Ind., for the construction of a highway in Sugar Creek township. Lawrence Wood is County Auditor.

✣Bids will be received until noon, July 10, by Board of Lake County Commissioners, Crown Point, Ind., for the construction of two gravel roads in Calumet township. Charles A. Johnson is County Auditor.

✣Bids will be received until 10 a. m., July 9, by Board of Bartholomew County Commissioners, Columbus, Ind., for the construction of gravel roads in Columbus township and Hancock and Clifty townships. Philip is County Auditor.

✣Bids will be received until noon, July 9, by Board of Lake County Commissioners, Crown Point, Ind., for the construction of six gravel roads. Charles A. Johnson is County Auditor.

✣Bids will be received until 10 a. m., July 8, by Board of Porter County Commissioners, Valparaiso, Ind., for the construction of a gravel road in Washington township. C. A. Blachly is County Auditor.

✣Bids will be received until 2 p. m., July 8, by Board of Pike County Commissioners, Rockville, Ind., for the construction of five highways. John D. Gray is County Auditor.

✣Bids will be received until 10 a. m., July 3, by Board of Wells County Commissioners, Bluffton, Ind., for the construction of five stone roads. L. A. Williamson is County Auditor.

✣Bids will be received until 10 a. m., June 26, by Board of Floyd County Commissioners, New Albany, Ind., for the construction of a gravel road in New Albany township. Julian T. Miller is County Auditor.

⊙Campbell & Crabb, Brazil, Ind., have been awarded the contract by the Clay County Commissioners, Brazil, for the construction of the Hendrie road in Van Buren Township. Bids were opened June 16.

The citizens of Reeve Township, Daviess County, Ind., have voted to construct 5 miles of rock roads. Washington is the county seat.

Iowa.

✣Bids will be received until noon, July 1, by F. J. Swanson, Secretary of the Road Committee, Akron, Ia., for grading the Akron-Spink Highway in accordance with plans and specifications on file at the Akron Savings Bank and in the office of G. Y. Skeels, Engineer, 401 Grain Exchange Bldg., Sioux City, Ia. It is estimated that the work will include 17,000 cu. yds.

⊙Young & Buescher, Burlington, Ia., have been awarded the contract by that city, for grading, draining and paving River and Denmark Sts., with one course concrete, for $1.17. Bids were opened June 12.

⊙F. K. Hahn, of Cedar Rapids, Ia., has been awarded the contract by the City Council of Vinton, Ia., for the paving of Jefferson St., at $1.27 per sq. yd., using reinforced concrete. The estimated cost of the work is $13,877.

According to advices from Nevada, Ia., the sum of $25,000 is to be expended in improving that portion of the transcontinental road which runs through Story County, going through Colo, Nevada and Ames, and passing the college grounds. The Government appropriation for the work on this piece of road is $6,000.

The City Council of Des Moines, Ia., has passed a resolution providing for the paving of Grand Ave., from the Des Moines River to the Fair Grounds. Asphalt, bitulithic or westrumite will be used.

All bids received June 16 at Sac City, Ia., by City Clerk W. F. Weary, were held under advisement until June 23. The bids were for constructing 17,175 sy. yds. of paving, 5,270 lin. ft. of curbing, 735 lin. ft. of headers, and 5.300 cu. yds. of grading.

Kansas.

⊙W. W. Gilmore, of Topeka, Kan., has been awarded the contract for paving the Santa Fe block on East Fifth Ave., in Arkansas City, with brick.

⊙The City Commission of Coffeyville, Kan., has awarded the contract to the McGuire & Stanton Construction Co. for the paving, curbing and guttering of Fourth, Fifth and Sixth Sts., between Walnut and Union, and Beech St., from Third to Fifth and 12th St., from Willow to Spruce, for $1.39 per sq. yd.

Maryland.

✣Bids will be received until noon, July 8, by the Wicomico County Commissioners, Salisbury, Md., for building a section of state aid highway in Wicomico County," upon or along the Spring Hill Church Road, between Hebron and Spring Hill Church, for a distance of about 1.27 miles. All bids must be made upon blank forms to be obtained of the State Roads Commission at its office, 534 North Howard street, Baltimore, Md. D. B. Cannon is Clerk and H. M. Clark is Roads Engineer.

✣Bids will be received until noon, July 10, by Highways Commission of Baltimore County, Towson, Md., for building a section of state aid highway in Baltimore County," upon or along Charles St. Ave., between Chesapeake Ave. and the Joppa Road, for a distance of about .76 mile. All bids must be made upon blank forms to be obtained of the State Roads Commission at its office, 534 North Howard street, Baltimore, Md. Each bid is to be accompanied by a certified check for $200, payable to the Highways Commission of Baltimore County, said check to be returned to the bidder unless he fails to execute the contract should it be awarded to him. Plans can be seen and forms of specifications and contract may be obtained at the office of the State Roads Commission, Baltimore, Md. E. Stanton Bosley is Secretary of the County Highway Commission.

✣Bids will be received until noon, July 10, by Baltimore County Highway Commission, Towson, Md., for the construction of a section of the State aid highway in Baltimore County along the Warren road between York turnpike and Franz's Store, a distance of 1.39 miles. Plans and specifications are on file at the office of the State Road Commission, 534 N. Howard St., Baltimore. E. Stanton Bosley is Secretary.

⊙T. C. Forsythe, Munsey Bldg., Baltimore, has been awarded the contract by the State Roads Commission, Baltimore, for one section of road along the York road, from Texas road to Glencoe road, a distance of 5.60 miles, resurfacing macadam, for $29,028.

⊙H. K. Faust, Belle Ave., Baltimore, Md., has been awarded the contract by the State Roads Commission, Baltimore, for one section of road along the Frederick road, 1.69 miles of vitrified brick, for $103,079. Bids opened June 12.

⊙P. Flannigan & Sons, 120 E. Lexington St., Baltimore, have been awarded the contract by the State Roads Commission, Baltimore, for the Roisterstown road, from Elgin Lane to Pimlico Gate, one mile in length, for $32,521.

⊙George B. Mullen, of Washington, D. C., has been awarded the contract for piking five miles of the Rockville-Georgetown Road, beginning at Rockville, Md.

Massachusetts.

⊙James Doherty, Boston, Mass., has been awarded the contract by the Department of Public Works, Boston, for an asphalt macadam roadway in Orient Ave., between Walley and Power Sts., East Boston, for $20,505. Bids were opened June 9.

Michigan.

✣Bids will be received until 7:30 p. m., June 26, by Board of Public Works, Saginaw, Mich., for the construction of the following improvements on the market site in said city: No. 1. Concrete paving, curb, concrete walks, building foundations, sewers, drains, etc. No. 2. Two market sheds. No. 3. Market building. Bids shall be made on blanks to be furnished by the City Engineer and in accordance to the contracts and specifications therefor, on file in the office of the Board of Public Works. W. H. Barton is Clerk of the Board.

⊙The City Council of Benton Harbor, Mich., has awarded a contract for the paving of Graham Ave. to Bean & Jones of that city.

The City Council of Benton Harbor, Mich., has voted to have East Main St., from First to Fourth Sts., paved to a width of 55 ft.

Civil Engineer E. H. Christ, Norris Bldg., Grand Rapids, Mich., is preparing plans for eight blocks of paving at Greenville, Mich. The town plans to repave the streets bearing the heavier traffic.

The Eaton County Road Commissioners, Charlotte, Mich., will construct 10 miles of state reward road, which has been officially adopted as the trunk line through Eaton County.

⊙J. A. Mercer has been awarded the contract at Detroit, Mich., for five paving jobs, amounting to $35,436, as follows: 11th St., from Leverette to Michigan Ave.; 18th St., from Rose to Michigan; Leverette St., from Brooklyn to 12th St.; Berry St., from Grand River to Trumbull, and Prentis Ave., from Cass to Second.

Minnesota.

✣Bids will be received until 10 a. m., June 27, by Town Board, Linden, Minn., and the Committee of the County Board at the office, New Ulm, Minn., for the construction of two steel, stone and concrete bridges over County Ditches No. 7 and 15. Plans and specifications are on file in the office of the County Auditor, which have been approved by the State Highway Commission.

The Washington County Commissioners, Stillwater, Minn., have approved the plan of building a model state highway from the Twin Cities to Duluth. The estimated cost of the work in Washington County is $11,000.

Mississippi.

✣Bids will be received until July 8, by L. B. James, City Recorder, Grenada, Miss., for the following approximate items: 14,000 sq. yds. street paving with vitrified brick, wood block, concrete and bitulithic. 4,000 lin. ft. concrete curb; all necessary grading, water and sewer connections. Proposals to be made on blanks furnished by the City Recorder and to be accompanied by certified check for $1,500. Specifications and forms may be obtained from City Recorder.

⊙The City Council of McComb, Miss., has awarded the contract for 2,000 sq. yds. of additional concrete sidewalks to C. G. Miller, of Natchez, Miss., for $0.84 per sq. yd.

The Board of Supervisors of Rankin County, Brandon, Miss., has given notice of its intention to issue $75,000 worth of bonds to be used in the construction of good roads.

The City Commissioners of Laurel, Miss., have approved ordinance providing for the paving of about 22 blocks of residence streets

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

adjacent to the business district. Sheet asphalt will be used. Bids are now being asked.

Missouri.

Petitions have been presented to the City Council of Chillicothe, Mo., for the paving of the following streets: Elm, from Calhoun to Ninth; Ninth, from Elm to Locust; Locust, from Bryan to the city limits; Walnut, from Jackson to Calhoun.

⊙J. M. Clack, of Nevada, Mo., has been awarded the contract for the construction of 12,000 sq. yds. of brick paving in Butler, Mo.

⊙J. A. Stewart, of Columbia, Mo., has been awarded the contract for paving two blocks of High St., and for paving Miller St., in Jefferson City, Mo., for $12,456 and $9,626, respectively.

⊙The City Council of Clinton, Mo., has let the contract for paving, curbing and parking of Franklin St. to C. Fielder, for $1.29 per sq. yd.

Montana.

⊙The Silver Bow County Commissioners, Butte, Mont., have awarded the contract for the construction of 41 miles of roads to the Butte Good Roads Association, Butte, for approximately $28,400.

Nebraska.

✣Bids will be received until 6 p. m., July 5, by Village Board, Barada, Neb., J. A. Martin, Clerk, for the construction of cement sidewalks and crossings.

✣Bids will be received until 8 p. m., July 16, by City Council, at the office of H. E. Clifford, Grand Island, Neb., for furnishing of all labor and material and paving Paving District No. 11 of said city embracing approximately 10,395 sq. yds. of paving and 1,000 lin. ft. of curbing, according to plans, specifications and estimates on file in the office of the City Clerk of said city.

A petition has been circulated in Beatrice, Neb., asking for the construction of 14 additional blocks of street paving.

New Jersey.

✣Bids will be received until 2 p. m., July 2, by M. J. Ford, Chairman, County Road Committee, Hackensack, N. J., for the improvement of Hackensack St., from Erie Ave., Rutherford, to the Hasbrouck Heights Borough line, Bergen County, N. J. Plans and specifications can be examined and all necessary information obtained at the office of the Clerk of the Board of Freeholders, Court House, Hackensack, N. J., or at the office of the County Engineer, Court House, Hackensack, N. J.

⊙Matthew J. Best, 2250 E. Allegheny Ave., Philadelphia, Pa., has been awarded the contract by the city of Trenton, N. J., for the construction of a concrete retaining wall, 160 lin. ft. in length. Bids were opened June 17.

⊙Chas. A. Reid & Co., Trenton, N. J., have been awarded the contract by that city, for 11,000 cu. yds. of grading. Bids were opened June 19.

New York.

✣Bids will be received until 11 a. m., July 12, by Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., for wood block paving at the navy yard, New York. The amount available for the work is $15,000. H. R. Stanford is Chief of the Bureau.

⊙The Evergreen Construction Co., 244 Jackson Ave., Long Island City, New York, has been awarded the contract by the Park Board, New York City, for the construction of an automobile road in Forest Park, Queens, for $36,510. Bids were opened June 12.

⊙C. N. Stainthorpe & Co. have been awarded the contract by the City Council of Lockport, N. Y., for paving Lock St., from the Pine St. bridge to Monroe St., with brick, for $21,485.

⊙P. W. Mulderry has been awarded the contract by the Board of Contract & Supply of Albany, N. Y., for the improvement of Whitehall St., from Second Ave. to Whitehall St., continued, for $13,073. Robert Dumary secured the contract to improve Myrtle Ave., from Allen St. to Pine Ave., for $4,104.

The Common Council of North Tonawanda, N. Y., has ordered the repaving of Webster St. John A. Rafter is Mayor.

The Common Council of Auburn, N. Y., has designated Franklin St., from the Five Points to the east line of Hunter Brook, and John St., to be paved, the former with brick and the latter with either brick or asphalt. City Engineer E. C. Aldrich will prepare specifications.

Following bids were received by the city of Buffalo, N. Y., on June 7 for street paving: Fourth St. Court to Carolina, German Rock Asphalt Co., asphalt, $7,720, brick, Erie Contracting Co.; Saybrook Pl., Delaware to Chapin, German Rock Asphalt Co., asphalt, $5,800; brick, $4,630; Woodbury alley, Virginia to north end, Constantine Construction Co., brick, $3,300; Chippewa St., Delaware to Niagara, German Rock Asphalt Co., asphalt, $17,190; Elmwood Ave., 1,085 ft. north of Herfel to 148 ft. north, H. P. Burgard Co., asphalt, $7,080, Erie Contracting Co., block stone, $8,700. The work includes base, surface, curb, drain tile and necessary connections.

North Carolina.

✣Bids will be received until 11 a. m., July 7, by Orange County Good Roads Commission, at the office of S. Strudwick, Hillsboro, N. C., for clearing, grading and draining 9⅔ miles of highway from Mebane to Hillsboro.

Ohio.

✣Bids will be received until noon, June 30, by John Lloyd, Director of Public Service, Middletown, O., for 6 jobs of street paving, etc., the estimated quantities of which are as follows: Extra excavation, 2,730 cu. yds.; 6-in. stone curbing, 1,775 lin. ft.; 6-in. stone curbing reset and redressed, 2,329 lin. ft.; combined curb and gutter, 8,580 lin. ft.; cement gutter, 26,940 sq. ft.; street paving, 50,160 sq. yds.; stone headers, 1,395 lin. ft.; cement sidewalks, 3,970 sq. ft. Plans, profiles and specifications are now on file in the office of the City Engineer. Official advertisement will be found elsewhere in this issue.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m. July 3, 1913, for grading and paving with concrete with a bituminous surface treatment The Geauga Co., State Highway E, Pet. 537, Scotland Station Easterly road, Inter-Co. No. 15, in Chester Twp Length 5,800 ft. or 1.10 miles. Width of pav. 14 ft. Estimated cost of construction $15,453. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion October 1, 1913. Plans and specifications are on file in the office of the County Commissioners, and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, Ohio, until 2 p. m. July 3, 1913, for grading and paving with concrete The Mahoning County State Highway K, Pet. 673, Akron-Youngstown road, Inter-Co. No. 18, in Milton Twp. Length 13,917.7 ft. or 2.64 miles. Width of pav. 14 ft. Estimated cost of construction $34,991. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion October 1, 1913. Plans and specifications are on file in the office of the County Commissioners, and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker, State Highway Commissioner.

✣Bids will be received until 10 a. m., July 12, by Commissioners of Shelby County, Sidney, O., for furnishing and hauling crushed stone and gravel, and performing all the labor necessary for the following road improvements. Bodey Pike at Loramie Creek bridge (crushed stone). Staley Pike south of Loramie Creek bridge (crushed stone). Luthman Pike north and south of Fosnight bridge (crushed stone). Stephenson Pike, east and west of Seigle bridge (crushed stone). Piqua and St. Marys Pike, north of Ft. Loramie (crushed stone). Piqua and St. Marys Pike, at Loramie Creek bridge, south of Newport (gravel.) Said work to be done according to instructions of Engineer and the County Commissioners. H. T. Ruese is County Auditor.

✣Bids will be received until noon, July 18, by Board of Hamilton County Commissioners, Cincinnati, O., for oiling Cleves and Bridgetown Pike under Specifications No. 507, from Harrison Pike to Miami Ave., in Cleves, in Green and Miami Townships. Plans and specifications are on file at the office of the Board. All bids must be accompanied by a bond for $500. Albert Reinhardt is Clerk of the Board.

✣Bids will be received until noon, July 18, by Board of Hamilton County Commissioners, Cincinnati, O., for oiling under specifications No. 513, Cincinnati Ave. through the villages of Addyston and North Bend and Miami Ave. through Cleves in Miami Township. Plans and specifications are on file with the board. A bond for $500 must be filed with each bid. Albert Reinhardt is Clerk.

✣Bids will be received until noon, July 18, by Board of Hamilton County Commissioners, Cincinnati, O., for oiling, under Specifications No. 505, Colerain Pike, from Blue Rock Pike to Great Miami River in Colerain Township. Plans and specifications are on file with the board. A bond for $500 must accompany each bid. Albert Reinhardt is Clerk.

✣Bids will be received until noon, July 18, by Board of Hamilton County Commissioners, Cincinnati, O., for oiling, under Specifications No. 491, Montgomery Pike, from east corporation line of Silverton to Warren County line, in Sycamore to Symmes Townships. The work to be done according to the plans and specifications now on file in the office of the Board of County Commissioners. All bids must be accompanied by a bond in the sum of $500. Albert Reinhardt is Clerk of the board.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, O., until 2 p. m., July 3, 1913, for grading and paving with waterbound macadam with a bituminous surface treatment the Perry County, State Highway C, Petition 693, Newark-New Lexington Road, Inter-County No. 356, in Thorn Township. Length, 9,775 ft. or 1.86 miles. Width of pavement, 16 ft. Estimated cost of construction, $18,726. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond for an amount equal to 150 per cent of the contract price. Date set for completion, October 1, 1913. Plans and specifications are on file in the office of the County Commissioners, and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received at the office of the State Highway Commissioner at Columbus, O., until 2 p. m., July 3, 1913, for grading and paving with waterbound macadam the Jefferson County, State Highway D, Petition 660, Section No. 1, Conton-Steubenville Road, Inter-County No. 75, in Springfield Township. Length, 12,700 ft. or 2.40 miles. Width of pavement, 14 ft. Estimated cost of construction, $31,096. A draft or certified check for $300 shall be deposited with each bid. The successful bidder will be required to give bond

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

for an amount equal to 150 per cent of the contract price. Date set for completion, October 1, 1913. Plans and specifications are on file in the office of the County Commissioners, and the State Highway Department. The State Highway Commissioner reserves the right to reject any and all bids. James R. Marker is State Highway Commissioner.

✣Bids will be received until noon, June 25, by W. J. Springborn, Director of Public Service, Cleveland, O., for paving the portion of Madison Ave. N. W. affected by the separation of grades of said street and tracks of the Lake Shore & Michigan Southern Ry. W. H. Kirby is Secretary to the Director.

✣Bids will be received until noon, June 27, by Trustees of Lyme Township at the Clerk's office, Bellevue, O., for the construction and improving of the following roads: The Prairie Road, between the Ridge Road and the Goodrich Roads, a distance of about 3,400 ft. The Sawyer Road, commencing at the Zieber bridge, running north a distance of about 2,600 ft. The Swaby Road, commencing at the Section Line Road, running east a distance of about 2,000 ft. The Swaby Road, commencing at the Sand Hill Road, running west a distance of about 2,000 ft.

✣Bids will be received until noon, July 7, by Village Council, Wauseon, O., for furnishing all labor and material for the improvement of Franklin St. in said village from its intersection with Oak St. south to the north line of Birch St., by paving the central portion thereof with slag or broken stone, finished with a wearing surface of tar, oil, asphalt, or other suitable material, doing all necessary grading, building curbs, retaining walls, and constructing all necessary crosswalks, gutters, sewers, drains, and culverts, and all in accordance with the plans, specifications and profiles on file in the office of the Clerk of said village. Each bid must contain the name of every person interested in the same, and must be accompanied with a certified check for the sum of $500. L. H. Deyo is Village Clerk.

✣Bids will be received until noon, June 28, by Township Trustees, Smith Township, at the office of the Clerk, Sebring, O., for the improvement of 3½ miles of the Johnson Road.

⊙The Ohio Engineering Co., Elyria, O., has been awarded the contract by the Department of Public Service of Lorain, O., for the paving of E. 30th and Globe Aves., for $17,995 and $10,860 respectively. Bids were opened June 5.

⊙The Andrews Asphalt Paving Co., Toledo, O., has been awarded the contract by the village of Wyoming, O., for the construction of concrete curbs and gutters, at $0.46 per lin. ft., and 30 driveways, at $18 each. About 1,300 lin. ft. of curbing and guttering is called for. Bids were opened June 14.

⊙W. G. Mustard, of Ada, O., has been awarded the contract by the State Highway Commission, Columbus, for the construction of section 2 of the Kenton-Finley road in Hardin County, for $5,060. Bids were opened June 13.

⊙W. G. Mustard, of Ada, O., has been awarded the contract by the State Highway Commission, Columbus, for the construction of section 1 of the Kenton-Finley road in Hardin County, for $1,785. Bids were opened June 13.

The City Council of Lima, O., has ordered street improvements to the amount of $60,000. The streets to be improved will be East North St., from Main to the west side of Scott St.; South Metcalf from the north side of the Spencerville Road to Kibby St., and North McDonald St., from McKibben to Grand Ave.

Will J. Campbell, Pultney Township Clerk, Bellaire, O., will sell bonds July 3, to the amount of $25,000, for the purpose of improving the Bellaire and Neff Road from the corporate limits of the City of Bellaire five miles westerly, by resurfacing with crushed slag or broken limestone and a binder

Oregon.

⊙The City Council of Portland, Ore., has awarded the following street improvement contracts: 60th Ave. southeast, from 41st St. southeast to 52nd St. southeast, for $16,255, to Joplin & Meeks, for macadam pavement; district improvement of East 28th St. near Sandy Blvd. to the Oregon Independent Paving Co., for $8,374, for concrete; East 23rd St. district, for Hassam, let to the Oregon Hassam Paving Co., for $14,677; Holgate St. and other streets as a district for Hassam, let to the Oregon Hassam Paving Co., for $64,962; Pendleton Ave. and other streets as a district, for Hassam, to the Oregon Hassam Paving Co., for $20,570; Shaver St., from Capitol Ave. to Commercial St., for bitulithic redress, let to the Barber Asphalt Paving Co., for $30,467; Grand Ave. as a district for asphaltic concrete, let to the Montague O'Reilly Co., for $23,393; Willamette Blvd., from Wabash Ave. to the North Bank bridge, for gravel bitulithic, let to the Warren Construction Co., for $76,949; East 11th St., from East Ankeny to East Glisan, for bitulithic redress, let to the Barber Asphalt Paving Co., for $10,489; East 13th St., from East Ochoco Ave., to East Malden Ave., to the Montague-O'Reilly Co., for $46,905; Summit Ave. as a district improvement, for concrete paving, let to Maginnis Bros., for $13,779; Greeley St., from Killingsworth Ave. to Lombard St., let to the Barber Asphalt Paving Co., for asphaltic concrete, for $46,841.

Following bids were received June 11 by the City Council of Portland, Ore., for the improvement of streets: Blandina St., from Vancouver to Patton Aves., gravel bitulithic, Barber Asphalt Paving Co., $23,176; Warren Construction Co., $24,077; asphaltic concrete, Oregon Independent Paving Co., $25,903; Hassam, Oregon Hassam Paving Co., $25,481. Blandina St., from Williams to Vancouver Aves., asphaltic concrete, Oregon Independent Paving Co., $2,282; gravel bitulithic, Warren Construction Co., $2,184; Hassam, Oregon Hassam Paving Co., $2,105. Lamson St., district, Hassam, Oregon Hassam Paving Co., $13,541; concrete, Linden-Kibbe Construction Co., $14,205; Jeffery & Bufton, $13,287; Giebisch & Joplin, $14,000; Montague-O'Reilly Co., $13,088. East 17th St., from Division to Powell, Hassam, Oregon Hassam Paving Co., $15,572; asphaltic concrete, Oregon Independent Paving Co., $14,417; bitulithic redress, Warren Construction Co., $13,012; Barber Asphalt Paving Co., $12,610; Oregon Independent Paving Co., $12,657. Commercial St., from Killingsworth to Ainsworth Aves., gravel bitulithic, Barber Asphalt Paving Co., $7,247; Warren Construction Co., $7,625; asphaltic concrete, Oregon Independent Paving Co., $7,894; Hassam, Oregon Hassam Paving Co., $7,619. 47th Ave. S. E., from 41st to 43rd Sts., grading and concrete curbs and walks, Bechill Bros., $1,526; Manning & Co., $1,800; Cochran-Nutting & Co., $1,655; A. D. Kern, $1,805; Joplin & Meeks, $1,688. 61st St. S. E., from 45th to 50th Aves., grading and concrete curbs and walks, Bechill Bros., $3,216; G. M. Battersby, $3,161; A. D. Kern, $3,103; Giebisch & Joplin, $3,235. 19th St. district improvement, concrete, Jefferey & Bufton, $6,894; Giebisch & Joplin, $8,000. Flint St., from Tillamook to Hancock, grading and concrete curbs and walks, Bechill Bros., $2,058; Peterson Bros., $1,895. East Pine St., from East 80th to East 82nd, grading and concrete curbs and walks, G. K. Howitt, $1,873; Bechill Bros., $1,731; G. M. Battersby, $1,791; A. D. Kern, $1,686. 65th St. S. E., from Foster road to 50th Ave., grading and concrete curbs and walks, G. M. Battersby, $2,163; Manning & Co., $2,078; Bechill Bros., $1,986; A. D. Kern, $2,061; Giebisch & Joplin, $2,121. 56th St. S. E., from Powell St. to 45th Ave., grading and concrete curbs and walks, Bechill Bros., $6,664; B. Kilkenney, $6,876; A. D. Kern, $6,772; Giebisch & Joplin, $6,779. 65th St. S. E., from 45th Ave. to Foster St., grading and concrete curbs and walks, Bechill Bros., $718; A. D. Kern, $700; Giebisch & Joplin, $721. 63rd St. S. E., from Powell to Foster, grading and concrete curbs and walks, Bechill Bros., $5,996; G. M. Battersby, $6,126; B. Kilkenney, $5,998; A. D. Kern, $6,025; Giebisch & Joplin, $6,168. 63rd St. S. E., from Foster St. to 50th Ave., grading and concrete curbs and walks, Bechill Bros. $2,644; G. M. Battersby, $2,710; Manning & Co., $2,785; A. D. Kern, $2,807; Giebisch & Joplin, $2,817. Reed St., from 21st to 22nd, grading and concrete curbs and walks, Bechill Bros., $1,437; A. D. Kern, $1,613.

Pennsylvania.

✣Bids will be received until 10 a. m., July 3, by Department of Supplies, H. B. Oursler, Director, at the office of the City Controller, Pittsburgh, Pa., for the furnishing of motor tractors for steam fire engines, combination chemical and hose wagons, motor driven; 75 and 85 ft. aerial truck motor drawn or motor propelled, one automobile for chief engineer, corporation cocks and corporation dead plugs, oat crushers, fire hose. Specifications and blanks for bidding may be obtained at the office of the Department of Supplies, 507 Oliver building.

✣Bids will be received until 10 a. m., July 11, by R. J. Cunningham, County Controller, Pittsburgh, Pa., for the improvement of Wildwood Road, Curray Hollow extension road and Natrona and Brackenridge Road. Plans, profiles, estimates, etc., of the above are on file in the office of John S. Gillespie, Road Commissioner, 306 Court House, Pittsburgh, Pa., and are open for the examination of all parties interested.

⊙Mayor W. A. Magee, of Pittsburgh, Pa., has awarded the contract for the repaving of Fifth Ave., from Penn Ave., to Hamilton Ave., with blockstone, to Booth & Flynn, of Pittsburgh, for $11,800.

⊙The Barber Asphalt Co. has been awarded the contract by the Borough Council of Allentown, Pa., for the construction of approximately four miles of street paving, for $110,000. The contract amounts to 62,000 sq. yds.

The citizens of Sharon, Pa., have defeated the proposition to issue $5,000 worth of bonds for street paving and sewering.

South Dakota.

⊙The County Commissioners, Deadwood, S. D., have let the contract for the building of a new road from Lead to the Spearfish Canyon crossing, a distance of nine miles, to W. H. Butler and W. J. Fogelsong, of Lead, S. D., for $27,700.

Texas.

⊙Witt, Fountain & Shaw, Dallas, Tex., have been awarded the contract by the Bell County Commissioners' Court, Belton, Tex., for the building of good roads in the Belton precinct, for which $150,000 in bonds were voted.

The Smith County Commissioners' Court, Tyler, Tex., has been petitioned to order an election in the Tyler precinct to submit the proposition of issuing $300,000 good roads bonds, the election to be held on July 8.

The County Commissioners, Dallas, Texas, have ordered the opening up and construction of about one mile of new road to connect the West Dallas Pike with Cement City.

The City Council of Bryan, Texas, has passed a resolution providing for the paving of Main St.

The City Council of San Antonio, Texas, has passed an ordinance setting July 18 as the date for the election on the bond issue providing for an issue of $3,450,000 for permanent public improvements. Of the total amount, $1,500,000 is to be for street paving, and the remainder for various other improvements, the chief item of which is $800,000 for sanitary sewers. For storm water sewers and drainage, $300,000 is provided.

An election was held in Hidalgo County, Texas, on June 18, for the purpose of voting on the issuance of bonds to the amount of $200,000 for the construction of good roads. Edinburg is the county seat.

An election will be held in Tyler, Texas, on July 8, for the purpose of voting on the issuance of bonds in the sum of $300,000 for the construction of good roads in a district embracing a territory in a radius of 10 miles of Tyler. W. H. Caldwell, Tyler, is interested.

The citizens of Cass County, Texas, have voted a 15-cent tax levy for road purposes. Linden is the county seat.

An election will be held in Waxahachie, Texas, July 7, for the purpose of voting on the issuance of bonds to the amount of $10,000 for permanent street improvements.

Virginia.

✣Bids will be received until noon, June 26, by W. L. Craft, City Clerk, Roanoke, Va., for the construction of 5-ft. granolithic sidewalks. F. L. Gibboney is City Engineer.

⊙L. Lawson has been awarded the contract for paving Bank St., between City Hall Ave. and Main St., in Norfolk, Va., with smooth material, for $5,573. The Board of Control has also awarded a contract for 75 yds. of broken stone for public works to the Water Works Supply Corporation, for $1.85 and $2 per cu. yd.

Washington.

✣Bids will be received until 2 p. m., June 30, by Board of Snohomish County Commissioners, Everett, Wash., for the construction of the Snoqualmie-Cathcart Road in accordance with plans on file with the County Engineer. P. T. Lee is County Auditor and Clerk of the Board.

✣Bids will be received until 2 p. m., June 30, by Commissioners of Snohomish County, Everett, Wash., for the construction of the Lunds Gulch Road as per plans and specifications on file with the County Engineer, which can be seen during the usual office hours. A certified check of 5 per cent must accompany each bid. P. T. Lee is County Auditor and Clerk of board.

⊙Albers & Son, of Chehalis, Wash., have been awarded the contract by the City Council of Centralia, Wash., for improving numerous streets in the south end of the city.

⊙The Board of Public Works of Seattle, Wash., has let the contract for the grading, curbing, etc., of E. 55th St., et al., to Russell & Gallagher, for $13,579. The West Coast Construction Co. secured the contract to pave Plum St., et al., for $34,387.

⊙The Harber Paving Co., of Aberdeen, Wash., has been awarded the contract for concrete sidewalks on Heron St., from K to M, estimated to cost $6,842.

The City Council of Aberdeen, Wash., Louis D. Kelsey, City Engineer, has passed ordinance for paving Second St. from K to M, two blocks, estimated to cost $4,800.

The City Council of Aberdeen, Wash., Louis D. Kelsey, City Engineer, has passed resolution for concrete walks on Second St., from K to M, two blocks.

Resolution has been ordered by the City Council of Aberdeen, Wash., Louis D. Kelsey, City Engineer, for the paving of East Heron, Kansas and East Wishkah Sts., 13 blocks of 48 ft. roadway.

Todd & Coates, of Coupeville, Wash., at $8,612 submitted the lowest bid for the construction of walks, curbs, gutters, etc., at Fort Casey, Wash., on June 11. R. F. Woods is Capt. C. A. C., Constructing Quartermaster.

J. Ruthe submitted the lowest bid on June 13 to the Board of Public Works of Seattle, Wash., for the planking of Brandon St., et al., at $20,457. J. H. Cullen & Co. were low bidders for the construction of concrete walks on West 59th St., at $1,495.

West Virginia

✣Bids will be received until noon, July 5, by Hancock County Court at the office of the Clerk, New Cumberland, W. Va., for paving the County Road from Brooke County line at Hollidays Cove to Ave. A. Weirton, a distance of 2.06 miles. James A. Bowers, Weirton, W. Va., is Engineer. Official advertisement will be found elsewhere in this issue.

Wisconsin.

✣Bids will be received until 10 a. m., July 5, by Board of Public Works at the office of the City Clerk, Racine, Wis., for furnishing all labor and material necessary for the following public work: Paving Forest St., from State St. to Liberty St., approximating the following quantities, viz.: 1,076 sq. yds. of paving, 866 lin. ft. of combined curb and gutter. Said work to be completed on or before the 15th day of August, 1913, all in accordance with the plans and specifications of the work on file in the office of said City Clerk.

✣Bids will be received until 2 p. m., July 1, by Board of Public Works, Burlington, Wis., for furnishing all the labor and materials necessary to make and fully complete the following curbing and brick paving, including all necessary grading on Geneva St., from end of present paving to east line of cemetery, according to the profiles, plans and specifications now on file for the inspection of bidders in the office of said board; said work to be begun within 15 days and completed within 60 days after the final execution of the contract by all parties interested: 3,441 sq. yds. of brick paving on a 5-in. concrete base, 1,625 lin. ft. of cement curbing, 200 lin. ft. of protection curbing, 1,184 cu. yds. of grading. In addition to the above the contractor may arrange with the Milwaukee Light, Heat & Traction Co. for the construction of 1,440 sq. yds. of brick paving which covers the area occupied by the tracks of said company. A blank form of contract, with bond, to be executed by the bidder and returned with his proposal and bond, will be furnished upon application. P. F. Hurtgen is City Engineer.

✣Bids will be received until July 13, by Board of Public Works, Racine, Wis., for the paving of Kinzie Ave. P. H. Connolly is City Engineer.

✣Bids will be received until 2 p. m., June 30, by Board of Public Works, Waukesha, Wis., for furnishing all labor and material for the construction of sewers in College Ave., from its intersection with Charles St., and running east on the center line of said College Ave. a distance of 660 ft. approximately, together with all the necessary Y connections, 1 manhole, 1 lamphole, as shown on the plans and specifications. Plans are on file at the office of the board.

✣Bids will be received until 2 p. m., July 8, by Board of Public Works, Janesville, Wis., for furnishing the labor and material for the construction of sewers in the following streets: In Sewerage District No. 3—On Galena St., from center line of Park Ave. to a point 250 ft. easterly, being 250 lin. ft. of 8-in. sewer and 1 manhole in said sewerage district. In Sewerage District No. 14—On Monroe St., from Glen St. to a point 725 ft. north, being 725 lin. ft. of 8-in. sewer and 2 manholes in said sewerage district. In Sewerage District No. 15—On Garfield Ave., from Racine St. to the center line of Home Park Ave. On Home Park Ave., from the center line of Division St. to the center line of Garfield Ave. On Clark St., from the end of the present sewer to the center line of Garfield Ave. to the south, being about 1,263 lin. ft. of 8-in. sewer, 3 manholes, and 3 lampholes in said sewerage district. All to be done according to the specifications and plans, which have been separately prepared for each of said sewerage districts.

The Board of Public Works of Madison, Wis., has let the following street improvement contracts: John F. Icke, Madison-South Brooks St., $14,924; West Lawn Ave., $11,900; Kendall Ave., $1,542; Brearly St., $14,594; North Dickinson St., $3,595. John R. Cullinane, Chadbourne Ave., $7,000; Hoyt St., $2,280; St. James Court, $2,796; Garfield St., $8,000.

Canada.

✣Bids will be received until 8 p. m., July 4, by D. J. C. Munro, Town Clerk, Thorold, Ont., for constructing permanent pavements on portions of the following streets: (a) Regent St. and Front St., brick pavement with concrete curb; (b) Pine St., Bitulithic or other pavement, with concrete curb and gutter, and brick on railway track allowance; (c) Vine St., Clairmont St. and Portland St., Bitulithic or other pavement, with concrete curb and gutter. No tender necessarily accepted. Plans, specifications, etc., may be seen at the Town Hall, Thorold. For further information address the Engineers, Chipman & Powers, Mail building, Toronto.

⊙The Warren Bituminous Paving Co., 103 Bay St., Toronto, Ont., has been awarded the contract by the city of Berlin, Ont., for the construction of street paving, for $51,628. Bids were opened June 12.

The special committee on good roads for the county of Essex, Ont., will meet in three months to consider the proposal to spend $1,000,000 on improved highways, and the County Council, Windsor, will meet in October to consider the report of the committee.

BRIDGES

Arkansas.

✣Bids will be received until 2 p. m., June 30, by Bridge Improvement District No. 1, W. D. McLain, Chairman, Newport, Ark., for the construction of one reinforced concrete bridge, 42 ft. wide and 200 ft. long, together with approaches thereto. Plans and specifications may be seen at the office of the Chairman of the Board, at Newport, Ark., or obtained from Wm. J. Parks, Engineer, at the Citizens' Bank Bldg., Pine Bluff, Ark., upon the deposit of ten dollars, which will be refunded upon the return of such plans and specification.

California.

⊙The contract for the construction of the bridge over Stoney Creek near Orland, Glenn County, Calif., has been let by the Board of County Supervisors, Willow, Calif., to the Ross Construction Co., at $115,642.

The committee appointed by the Board of Colusa County Supervisors, Colusa, Calif., to investigate the matter of necessary improvements estimates the cost at about $537,684. Among the items included in the report are the following: Bridge at Princeton to cost $57,000; bridge at Grimes to cost $45,000; improvement of roads, culverts and bridges of the county, $411,183.75; new hall of records to cost $60,000.

Delaware.

✣Bids will be received until noon, July 15, by B. A. Groves, President of the Levy Court, New Castle County, Wilmington, Del., for the construction of the Third St. bridge over the Christiana River at Wilmington. The substructure of the proposed bridge will embrace two concrete piers and two reinforced concrete abutments, section of new bulkhead and some alterations in the existing water main. Concrete work will amount to about 2,500 cu. yds. The superstructure will be composed of a movable bridge with a clear channel span of 150 ft. and two riveted truss approach spans, total length of superstructure being 416 ft. between the back walls of the abutment. Separate bids will be required for the sub and superstructures. Plans and complete data are on file in the office of the County Engineer, James Wilson, Church Bldg., Wilmington, Del., and in the office of the Consulting Engineer, J. E. Greiner, Fidelity Bldg., Balti-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

more, Md. Plans, specifications, forms for contracts and proposals will be furnished contractors by the Consulting Engineer upon receipt of a deposit of $10 for each set.

Georgia.

⊙The contract for the construction of a steel bridge over the Chickashay River near Desota, Clarke County, Miss., has been awarded to Austin Bros., Atlanta, Ga., at $5,232.

Idaho.

⊙The Idaho Bridge Co., Pocatello, Idaho, has been awarded the contract for the construction of a steel bridge over Red Rock River at Dillon, Mont.

Illinois.

✣Bids will be received until 10 a. m., June 26, at Smulls Hall, McConnell, Ill., for the construction of one reinforced concrete bridge to be built in Waddams Township, Stephenson County. J. C. Fisher, Town Clerk, McConnell, Ill. Henry Kleckler Bridge—Skew span, length out to out of superstructure, 24 ft. 7 ins.; roadway, 16 ft.; height, 13 ft. Estimated total concrete, 84.8 cu. yds.; reinforcing steel, 7,210 lbs. Nearest railroad station, McConnell, about 3½ miles. It is reported that gravel may be obtained at a bank about ½ mile from bridge site at 25 cts. per cu. yd. This material, if used, must be washed. Present bridge wood, 8 ft. span. Low water flow dry; high water about 8 ft. Excavation to be carried about 3 ft. below stream bed through loam to blue clay. Engineer's estimate, $950. Work to be completed on or before October 15, 1915. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission which may be seen at the Town Clerk's office or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received until 10 a. m., June 28, at the Town Clerk's office in Freeburg, Ill., for the construction of two reinforced concrete bridges to be built in Freeburg Township, St. Clair County. John Sintzel, Town Clerk, Freeburg, Ill. Eckert and Funk Bridges—Spans, 16 and 6 ft. box; roadways, 20 ft.; height, 9 and 8.5 ft. Estimated total concrete, 48.2 and 21.3 cu. yds; reinforcing steel, 4,820 and 1,760 lbs. Location, sections 6 and between 11 and 14. Nearest railroad station, Freeburg, about 6 miles each. No local concrete materials available. Present bridges wood. Low water trace; high water about 1 and 5 ft.; excavation clay and clay, to be carried about 4 and 1 ft. below stream bed. Engineer's estimate, $1,175. Work to be completed on or before Sept. 1, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received until 1 p. m., July 1, at the Court House, Winchester, Ill., for the construction of three reinforced concrete bridges to be built in Bluffs Township, and one reinforced concrete bridge to be built in Merritt Township, Scott County. J. R. King, County Clerk, Winchester, Ill. Bluffs Township, Sandman, Johnson and Nortrup Bridges; Merritt Township, Taylor Bridge—Spans for all four bridges, 8 ft.; roadways, pit about 2½ miles, quality reported fair. Per cent of sand not known; will cost about 20 cts. per cu. yd. at pit. Present bridges wood, 14, 12, 12 and 24 ft. spans. Green timber may be cut near all of the sites. Low water flow trace; high water flow about 6, 5, 6 and 5 ft. deep. Excavation clay and sand for all but Taylor bridge, to be carried about 1, 3 and 3 ft. below stream bed. Taylor bridge, stream bed shale, excavation about 6 ins. in shale and can be built without disturbing old bridge. Engineer's estimate, $3,900. Work to be completed on or before November 1, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received until 2 p. m., July 2, at the Town Hall, Marshall, Ill., for the construction of one reinforced concrete bridge to be built in Marshall Township, Clark County. Ernest Adams, Town Clerk, Marshall, Ill. East Mill Creek Bridge—Two spans, each 35.5 ft. clear; roadway, 20 ft.; height, 21.5 ft. Estimated total concrete, 168 cu. yds.; reinforcing steel, 26,260 lbs. The bridge is located on the Cumberland National road. about 2½ miles from Marshall. The present wood bridge will be removed by the commissioners. Old stone abutments to be capped with concrete, and pier built in center of stream to support new spans. Piles will be required for new pier. Green timber may be cut near bridge site. Low water flow about 6 ins. deep and 6 ft. wide; high water about 8 ft. deep. Excavation for pier, sand and gravelly clay, to be carried about 4 ft. below stream bed. Green Castle stone f. o. b. Marshall, about $1 per ton; Terre Haute gravel can be delivered at bridge site at about $1.75 per cu. yd. Engineer's estimate, $2,600. Work to be completed on or before October 15, 1913. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

✣Notice is hereby given that all bids received June 14, 1913, for the Crossland bridge, Sheldon Township, Iroquois County, were rejected on account of the fact that three of the four bids received were irregular, and the fourth was too high. Another letting will be held at noon, June 28. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be 20, 20, 20 and 72 ft.; height, 11, 14, 14 and 12 ft. Estimated total concrete, 291.4 cu. yds.; reinforcing steel, 20,290 lbs. Nearest railroad stations, Neeleys, about 1 mile; Bluffs, 1½ miles; Neeleys, 1½ miles on the road between Bluffs and Chapin, and Chapin, about 4 miles (section 15 Merritt Township). For Bluffs Township bridges gravel may be obtained from Rebby pit southeast of Bluffs at about 25 cts. per cu. yd. at pit, contains about 80 per cent sand, which would require about 9 sacks of cement per cubic yard unless stone is added; distance from each bridge, about 3 miles. For Merritt Township bridge, gravel seen at the Town Clerk's office or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Ill.

⊙The contract for the construction of the Tipton bridge in Woodland Township, Carroll County, Ill., for which bids were opened June 4, has been awarded to G. E. Hungerford, Mt. Carroll, Ill. The structure will be of reinforced concrete with 12 ft. span and 16 ft. roadway.

⊙The contract for the construction of a reinforced concrete bridge 25 ft. long with an 18 ft. roadway in Elm Grove Township, Tazewell County, Ill., for which bids were opened June 14 at the County Clerk's office, Pekin, Ill., has been awarded to Edward Cooney, Tremont, Ill., at $1,285.

⊙The contract for the construction of the Wheeler bridge in Belmont Township, Iroquois County, Ill., has been let to A. L. Greenbaum, Woodland, Ill., at $1,368. The structure will be of reinforced concrete 25 ft. long and 16 ft. wide. Bids were opened at the office of the Town Clerk, Watseka, Ill., June 16.

⊙The contract for the construction of the Crannels bridge in Ohio Township, Bureau County, Ill., for which bids were opened June 4, has been awarded to Fletcher & Boes, Wyanet, Ill., at $1,785.

⊙The City Council of Rockford, Ill., has decided to let the contract for the construction of the Race St. bridge to J. H. Sabin at $2,200.

It has been announced by Nicholas Engles, Supervisor, that the county aid petition filed by Highway Commissioners James Magner, James Craig and D. P. Hayes of Wilmington, Ill., has been accepted and the bridge authorized. The estimated cost of the structure, which will be of concrete, is estimated at $60,000.

The following unit bids were received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., for the construction of the superstructure of the Irving Park boulevard bridge over the north branch of the Chicago River, (1) standing for the Ketler-Elliott Erection Co., (2) FitzSimmons & Connell Dredge & Dock Co., (3) Walsh & Masterson, (4) Nash-Dowdle Co., (5) John O'Brien, (6) Great Lakes Dredge & Dock Co., (7) Joseph McGovern, (8) Byrne Bros. Dredging & Engineering Co.:

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Removal of old timber approaches, etc., and transferring present river span to new temp. location; also removing temp. bridge	$ 1,100	$ 1,642	$ 1,200	$ 1,250	$ 1,300	$ 3,500	$ 1,500	$ 1,100
Superstructure, complete	24,800	24,800	23,000	25,980	24,000	28,000	26,000	30,000
Building and removing cofferdams	2,064	4,000	3,800	4,500	2,800	3,000	4,500	6,200
Excavation for piers and abutments, 3,500 cu. yds.	0.50	0.75	1.00	0.75	0.80	0.75	0.90	1.00
Piles for temp. and perm. bridges, delivered, 16,500 lin. ft.	0.18	0.17	0.18	0.18	0.20	0.19	0.18	0.18
Driving piles for temp. and perm. bridges, 14,000 lin. ft.	0.14	0.12	0.14	0.12	0.10	0.16	0.12	0.13
Yellow pine, for approaches, temp. bridge, 70,000 ft. B. M.	0.50	0.55	0.60	0.50	0.48	0.55	0.50	0.66
Portland cement concrete, abut. and piers, 1,480 cu. yds.	6.50	6.00	7.50	7.00	7.80	6.25	7.50	7.00
Test piles, furnished and driven, 4 piles	0.30	0.35	0.30	0.30	0.30	0.25	0.50	0.40
Portland cement concrete, retaining walls, 870 cu. yds.	6.50	7.00	7.30	6.50	7.50	6.50	8.50	7.00
Filling, in approaches, 4,000 cu. yds.	0.50	0.50	0.40	0.50	0.65	0.50	0.50	0.50
Asphaltic macadam pavement, 3,000 sq. yds	1.25	1.50	1.35	1.25	2.00	1.20	1.45	2.00
Reinforcing steel bars and rods, in place, 125,000 lbs.	0.02½	0.02¾	0.03	0.03	0.02¾	0.03	0.02½	0.03¼
Concrete curb and gutter, in place, 1,030 lin. ft.	0.80	0.75	0.75	0.75	0.65	1.00	0.65	0.63
Concrete sidewalks, in place, 6,840 sq. ft.	0.14	0.18	0.14	0.17	0.15	0.15	0.15	0.11
Gas pipe railing, in place, 820 lin. ft.	1.60	2.00	2.00	2.50	2.00	2.00	2.50	2.20
Totals	$65,508	$70,093	$70,971	$72,135	$72,522	$74,401	$75,215	$82,137

Indiana.

✣Bids will be received until 2 p. m., July 1, by Board of Crawford County Commissioners, English, Ind., for the construction of a bridge in Union township. J. E. Enlow is County Auditor.

✣Bids will be received until 2 p. m., July 9, by Board of Warrick County Commissioners, Boonville, Ind., for the construction of 40 steel bridges. N. M. Spradley is County Auditor.

✣Bids will be received until 10 a. m., July 16, by Board of Marion County Commissioners, Indianapolis, Ind., for the construction

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

of bridges and repairs. W. T. Patten is County Auditor.

✣Bids will be received until 1:30 p. m., July 9, by Board of Wabash County Commissioners, Wabash, Ind., for flooring Carroll St. bridge, Wabash, Ind. Dan Showalter is County Auditor.

✣Bids will be received until 10 a. m., July 8, by Board of Hancock County Commissioners, Greenfield, Ind., for the construction of the Haney bridge in Jackson township. Lawrence Wood is County Auditor.

✣Bids will be received until 1:30 p. m., July 8, by Parke County Commissioners, Rockville, Ind., for the construction of repairs to the reinforced concrete arch in Greene township. J. E. Elder is County Auditor.

⊙The Board of Fulton County Commissioners, Rochester, Ind., has awarded the contracts for the construction of 6 bridges costing $3,700 to the Rochester Bridge Co., A. C. Gast & Son, Akron, Ind., and F. J. Williams, Macy, Ind.

⊙The Board of Clark County Commissioners, Jeffersonville, Ind., has awarded the contract for the bridge over Silver Creek at Samples Road in Monroe Township to the East St. Louis Bridge Co., at $2,750. G. W. Stoner is County Auditor.

⊙The contract for the construction of the Hog Creek and Croy's Creek bridge has been let by the Clay County Board of Commissioners, Brazil, Ind., to Charles O. Landine, Brazil, Ind.

⊙Rolla Cole, Perryville, Ind., has been awarded the contract for repairing four bridges with concrete, etc., at his bid of $3,730. Bids were opened June 16 by the Board of County Commissioners, Newport, Ind.

⊙The Board of Marion County Commissioners, Indianapolis, Ind., awarded the contracts for culvert and bridge repairs as follows: Lawrence Township culvert No. 554, Gilbert Robb, $1,574; Washington Township culvert No. 561, Charles Hoover, Indianapolis, Ind., $380; Washington Township culvert No. 562, Harding & Slattery, $1,730; Perry Township culvert No. 563, Volpp & Fritz, Indianapolis, Ind., at $2,375; Washington Township culvert No. 564, repairs, Central States Bridge Co., Indianapolis, Ind., at $14,500.

⊙The Central States Bridge Co., Indianapolis, Ind., has been awarded a contract by the Board of Marion County Commissioners, Indianapolis, Ind., for the construction of a concrete and steel superstructure bridge over the washout on the Westfield pike north of Broad Ripple at $14,500.

⊙The trustees of the State Tuberculosis Hospital, Rockville, Ind., have awarded the contract for the construction of abutments for the new bridge over Little Raccoon at west boundary of the hospital grounds to W. E. Ireland at $1,699.

⊙The Board of County Commissioners, Richmond, Ind., has awarded the contract for the construction of the Wasson Ford bridge to I. E. Smith, at his bid of $4,835.

The City Council of Peru, Ind., has appropriated $40,000 for the purpose of building a bridge over the Wabash River at Broadway, to replace the structure washed out by the spring flood.

Advices from South Bend, Ind., state that residents of Navarre Place have petitioned the County Commissioners to construct a new concrete bridge to replace the old Leeper single span truss bridge over the St. Joseph River at Navarre Place.

The Board of County Commissioners, Boonville, Ind., has rejected all bids for the construction of 40 new steel bridges. The bids received for the work were as follows: Vincennes Bridge Co., $38,884; Lafayette Engineering Co., $41,011; Montgomery-Parker Co., $39,050; Sullivan Bridge Co., $39,448. The County Auditor was ordered to readvertise for bids in the same way as before.

Iowa.

✣Bids will be received until 2 p. m., July 1, by Board of Winneshiek County Supervisors, at the office of W. R. Shea, County Auditor, Decorah, Ia., for the construction of the following described bridges: The Tom Rovang bridge, N. E. ¼, section 9, 97, 8, 26 ft. deck girder span, with concrete floor, 16 ft. roadway, reinforced concrete abutments and wings, estimated at 70 cu. yds., gravel haul 2 miles to railroad station. The Hildahl bridge, S. line, N. E. ¼, section 10, 97, 8, 24 ft. deck girder span, with concrete floor, 16 ft. roadway, reinforced in the abutment and wings, estimated 34 cu. yds., gravel haul ½ mile to railroad station. The Green bridge, S. line, S. E. ¼, section 12, 96, 7, 32 ft. deck girder span, with concrete floor, 16 ft. roadway, reinforced concrete and abutments and wings, estimated 62 cu. yds., gravel haul 5 miles to railroad station. The Riveland bridge, N. E. ¼, section 27, 96,, 8, 32 ft. deck girder span, with concrete floor, 16 ft. roadway, reinforced concrete in abutments and wings, estimated at 77 cu. yds., gravel haul 4 miles to railroad station. The Mullaney bridge, S. line, section 1, 99, 10, 32 ft. deck girder span, with concrete floor, 16 ft. roadway, reinforced concrete in abutments and wings, estimated at 58 cu. yds., gravel pit 1 mile, railroad station 10 miles. The Clark bridge, center section 21, 100, 10, 120 steel truss span to carry wood floor, with 30 ft. steel platform approach, reinforced concrete in abutments and wings, estimated at 172 cu. yds., gravel pit 4 miles, railroad station 12 miles. The Joe Whalen bridge, S. line, S. E. ¼, section 7, 100, 9, 32 ft. deck girder span, with concrete floor, 16 ft. roadway, reinforced concrete in abutments and wings, estimated at 68 cu. yds., gravel pit 6 miles, railroad station 4½ miles. The Myrah bridge, N. W. ¼, section 24, 99, 8, 32 ft. deck girder span with concrete floor, 16 ft. roadway, reinforced concrete in abutments and wings, estimated at 68 cu. yds., gravel pit 7 miles, railroad station 7 miles. The Thorsen bridge, S. E. ½, section 22, 99, 7, 20 ft. deck girder span with concrete floor, 16 ft. roadway, reinforced concrete in abutments and wings, estimated at 35 cu. yds., gravel pit 3 miles, railroad station 16 miles. The Ellingson bridge, S. line, N. E. ¼ section 24, 99, 7, 20 ft. deck girder span, concrete floor, 16 ft. roadway, reinforced concrete in abutments and wings, estimated at 35 cu. yds., gravel pit 1½ miles, railroad station 17 miles. The Frank Hoye bridge, N. E. ¼, section 30, 96, 10, 32 ft. deck girder span, concrete floor, reinforced concrete in abutments and wings, estimated at 72 cu. yds., gravel pit 1 mile, railroad station 2 miles.

⊙The contract for the construction of four new concrete bridges in Story County, Ia., has been let to George W. Koss, Des Moines, Ia., at his bid of $10,349. Other bids for the work were A. W. Merrick, Boone, Ia., $10,680; Capital City Construction Co., Marshalltown, Ia., $10,836.

The city of Des Moines, Ia., it is reported, contemplates the construction of a concrete bridge over the Des Moines River at Grand Ave. The commission has adopted a resolution asking the city to tear down the present iron structures. F. N. Carss is City Engineer.

Kansas.

⊙The City Commission of Hutchinson, Kan., has awarded the contract for the construction of two new bridges over the creek to the St. Joseph Construction Co., Hutchinson, Kan., at $14,700. The bids of the various companies were as follows: The St. Joseph Construction Co., Hutchinson: First Ave. bridge, slab type, $6,850, girder type, $7,250; Ave. B bridge, $7,900 and $8,000; combination, $14,700. Everett & Burt, Hutchinson, First Ave., slab, $8,160, girder, $8,000; Ave. B bridge, $10,200; combination, $17,760. Beebe Engineering & Construction Co., Hutchinson: First Ave., slab, $7,150, girder, $7,260; Ave. B bridge, $9,150; combined, $15,430; substitute plans optional bid, $13,500. Stauffer Construction Co., Wichita: First Ave., slab, $8,352, girder, no bid; Ave. B, $10,464; combined, $18,100. McLeod & Crandle, Hutchinson: First Ave., slab, $7,198, girder, $7,400; Ave. B, $8,959; combined, $16,057. Missouri Valley Bridge & Iron Co., Wichita: First Ave., slab, $8,900, girder, no bids; Ave. B, $11,280; combined, $19,680. Abbott & Wagner, Kansas City: First Ave., slab, $7,985, girder, no bid; Ave. B, $8,990; combined, $16,320. Kansas Construction Co., Wichita: Two bridges combined, $21,600; no separate bids.

Maryland.

⊙Elkan-Tuft Construction Co., 702 E. Lexington St., Baltimore, Md., has been awarded the contract by the Maryland State Roads Commission for the construction of the 200-ft. reinforced concrete bridge over Gwynne Falls. The contract price was $74,000. Bids were opened June 12.

⊙The contract for the construction of the abutments of Bridge No. 2 over Gunpowder River for the Water Department of Baltimore, Md., has been let to the Stewart-Jones Co., and Claiborne, Johnston & Co., at $26,435. Other bids received for the work were as follows: Whiting-Turner Construction Co., $26,667.10; W. H. Thompson Construction Co., $30,270; Mason, Hilton & Co., $31,210; Singer-Pentz Co., $31,661.70; Williams & Straus, $31,681.25; Concrete & Foundation Co., $33,335; King-Ganey Contracting Co., $44,915.

Massachusetts.

⊙The contract for the construction of the Lyman St. bridge at Pittsfield, Mass., has been awarded to E. B. Roberts, Boston, Mass., at $5,090. Other bidders for the bridge were George W. Van Vranken of Schenecteday, N. Y., $5,476, and Fred T. Ley Co. of Springfield, $6,500.

⊙W. A. & H. A. Root, Inc., have been awarded the contract by the Department of Public Works, Boston, Mass., for widening Pleasant St. bridge, for $6,437. Bids were opened June 12.

⊙The Board of Public Works, Pittsfield, Mass., has let the contract for the construction of the Lyman St. bridge to E. B. Roberts. His bid was $5,090. Other bidders and their bids were: George W. Van Vranken, Schenectady, N. Y., $5,476; Fred T. Ley Co., Springfield, $6,500.

Michigan.

⊙The Bay County Bridge Commission has let the contract for the construction of a new sidewalk on the north side of the west approach to the Third St. bridge, Bay City, Mich., to the Standard Engineering Co., Chicago, Ill., at $3,780. The sidewalk will be 700 ft. long.

Minnesota.

✣Bids will be received until 1 p. m., June 30, by H. C. Nolte, Martin County Auditor, Fairmont, Minn., for building State Bridge No. 797, over outlet of East Chain Lake, Sec. 7, Twp. 101, Range 29. The superstructure will be 74 ft. span between faces of abutments and 16 ft. roadway. Plans and specifications may be seen at the above named office, or at the office of the State Highway Commission at St. Paul.

⊙The Security Bridge Co., Minneapolis, Minn., has been awarded the contract for the construction of all steel and concrete bridges during the year commencing May 6, 1913, and ending May 6, 1914. Bids for the work were opened by W. R. Hall, Faulk County Auditor, Faulkton, S. Dak., May 6.

The Minneapolis, St. Paul, Rochester & Dubuque Railroad, D. S. Smith, International Bldg., General Manager, has filed a petition with the Minnesota State Railroad and Warehouse Commission for permission to construct a steel bridge over the Minneapolis and St. Louis and the Great Northern Railroad tracks at Holden St., Minneapolis, Minn.

The Special Council Committee on New Bridges, Minneapolis, Minn., has instructed City Engineer F. W. Cappelen to prepare new plans for an 80-ft. steel bridge over the Mississippi River at Third Ave. S. Mr. Cappelen estimates that a concrete bridge at that point would cost about $706,308.

Missouri.

⊙The City Council, Jefferson City, Mo., has awarded the contracts for the construction of

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

the bridges on West McCarty St. over Wear's Creek and on East Dunklin St., between Marshall and Lafayette St. The McCarty St. bridge will cost $4,400 and will have a roadway of 30 ft. and 42 ft. in the clear between the rails. The Dunklin St. bridge will be built at a cost of $1,400.

Montana.

⊙The Commissioners of Yellowstone County, Billings, Mont., have awarded the contract for the construction of 13 new bridges and rebuilding eight old ones to the Security Bridge Co., Minneapolis. Minn. The contract price was $19,874. Gagnon & Co. bid $20,206 for the work.

Nebraska.

✣Bids will be received until noon, July 14, by Board of Webster County Commissioners, Red Cloud, Nebr., for the furnishing of all material required in the erection and completion of bridges and culverts required by Webster County for one year, to-wit, 1913, according to plans and specifications on file in the County Clerk's office; also a separate bid for all iron, metal, I-beams, bolts, rods, etc., required both in carload lots and by local freight; also a separate bid for cement per sack of 95 lbs. per sack and in carload lots; also a separate bid for performing all labor in the erection of cement bridges and culverts per cubic foot, the county to furnish all material excepting only forms; also a separate bid for the building and erection of each class of bridge and culvert, as per plans and specifications now on file in the County Clerk's office, the county to furnish all material excepting only forms; also a separate bid for all lumber, including piling. Each bid must be made according to the law and accompanied by a certified check for the sum of $500.

⊙The contract for the construction of a 70-ft. concrete arch bridge at Sutton in Clay County, Nebr., has been awarded to the Lincoln Construction Co., Lincoln, Nebr., at $3,-890. Bids for the work were opened May 20 by the County Clerk at Clay Center, Nebr.

⊙The contract for the construction of all wood, steel and concrete bridges in Kearney County for which bids were taken until June 8 by J. H Jensen, County Clerk, Minden, Nebr., has been let to H. T. Ward & Co., Tecumseh, Nebr.

⊙The Lincoln Construction Co., Lincoln, Nebr., has been awarded the contract for the construction of concrete bridges and culverts in Lancaster county for one year. Bids for the work were opened June 10 by H. E. Wells, County Clerk, Lincoln, Nebr.

The Board of Supervisors, Omaha, Nebr., has passed a resolution of necessity for the construction of a 120-ft. steel span bridge across the Nishnabotna at Carson. The cost of the structure is estimated at $5,000. A hearing will be held on the matter July 1.

New Jersey.

✣Bids will be received until noon, June 30, by Board of Freeholders, Newton, N. J., for the reconstruction of River Styx bridge, Lake Hopatcong, Sussex County. Harvey Snook is County Engineer.

⊙The contract for furnishing all labor and material for the construction of a highway bridge across Barnegat Bay, including two timber trestles a total length of 7,212 ft. and a 3,150 ft. earth fill, has been let to Edward Fay & Son, 2 Mole St., Philadelphia, Pa., at $95,-000. Bids for the work were opened by Arthur C. King, Engineer in Charge, Toms River, N. J., May 17.

New Hampshire.

Mayor Hayes, Manchester, N. H., has approved the resolution making an appropriation of $100,000 for the construction of a bridge over the Piscataquog River at Kelley St. S. J. Lord is City Engineer.

New York.

⊙The Town Board of Sanford, Me., has awarded the contract for the construction of a 50-ft. steel truss bridge over Mousam River on Winter St., to the United Construction Co., Albany, N. Y., at $2,500.

At an election held June 11 at Watertown, N. Y., the proposition to build a bridge at Court St. to eliminate a dangerous grade crossing at that place, was voted upon.

The Eddy St. merchants, Ithaca, N. Y., have succeeded in raising among themselves $5,000 toward the construction of the proposed $14,000 bridge over Cascadilla Creek near the White Arch. W. O. Kerr is City Clerk.

North Dakota.

✣Bids will be received until 1:30 p. m., July 8, as mentioned in our last issue, by W. W. Felson, Pembina County Auditor, Cavalier, N. Dak., for the construction of 10 bridges. The following is a general idea of the bridges to be constructed: Bridge No. 1—Steel beam bridge; 12-ft. span, height of 9 ft. each end; no approaches; no wings; location between sections 31-163-55 and sections 36-163-56, nearest railway station at Leyden on Great Northern and haul about 2½ miles. Bridge No. 2—Steel beam bridge; 16-ft. span; height of foundation 9 ft. each end; no approaches; four 8-ft. wings; location between sections 7 and 8-100-56; nearest railway station at Mountain on Northern Dakota Railway, haul about three miles. Bridge No. 3—Steel beam bridge; 15-ft. span; height of foundation 6 ft.; no approaches; four 8-ft. wings; location between sections 6 and 7-163-53; nearest railway station at Neche on Great Northern; haul about 2 miles. Bridge No. 4—Steel beam bridge; 20-ft. span; height of foundation 7 ft. each end; no approaches; four 8-ft. wings; location between sections 33 and 34-163-52; nearest railway station at Bathgate on Great Northern railway; haul about 7 miles. Bridge No. 5—Steel low truss bridge; 44-ft. span; height of foundation 14 ft. each end; no approaches; three 8-ft. wings and one 12-ft. wing; location between sections 7 and 8-162-52 over Tongue River; nearest railway station at Bathgate on Great Northern; haul about four miles. Bridge No. 6—Steel beam bridge; 12-ft. span; height of foundation 6 ft. each end; no approaches; two 6-ft. wings; location between sections 2-160-53 and section 36-161-53, nearest railway station at Glasston on Great Northern; haul about two miles. Bridge No. 7—Steel beam bridge; 14-ft. span; height of foundation 5 ft. at each end; no approaches; two 6-ft. wings; location between Northern Pacific; haul about seven miles. Bridge No. 8—Steel beam bridge; 16-ft. span; height of foundation 10 ft. each; no approaches; one 10-ft. wing and one 8-ft. wing; two 6-ft. wings; location between sections 23 and 24-160-56; nearest railway station at Mountain on the Northern Dakota Railway; haul about four miles. Bridge No. 9—Steel beam bridge; 20-ft. span; height of foundation 10 ft. each end; no approaches; four 8-ft. wings; location between sections 4 and 5-159-55; nearest railway station at Crystal on Great Northern; haul about seven miles. Bridge No. 10—Steel beam bridge; 14-ft. span; height of foundation 7 ft. each end; no approaches; four 8-ft. wings; location between sections 28 and 29-159-55; nearest railway station at Crystal on Great Northern; haul about six miles. Prices to be submitted on each of the above bridges and to show the price of each bridge if constructed with (a) wood substructure, (b) reinforced concrete substructure or (c) reinforced concrete, with steel piling, substructure. All spans 12 ft. 0 ins. to 16 ft. 0 ins. to have needle beam 4 ins. at 7 lbs., U bolt over each beam; joist six lines 7 ins., I's at 15 lbs., and six lines 7-in. channels at 12½ lbs.; rail post, three on each side, 2x2x3/16-in. angle iron. All spans 18 ft. 0 ins. to 24 ft. 0 ins., to have needle beams 6-in. I at 12¼ lbs.; joist six lines of 12-in. I's at 31½ lbs., and six lines of 12-in. channels at 20½ lbs.; U bolt over each beam connecting with needle beam; five-rail posts on each side, 2x2x3/16-in. angle iron. All beam bridges to have 4x6-in. wheel guards laid flat with ⅝-in. hook bolts; 2-in. nailing plank and 4-in. western pine decking; 18-ft. roadway. Truss bridge to be 4 panels 44 ft. center to center of end pins; riveted truss span; height 6 ft. center to center of chords; joist 6 lines 7-in. I's and 6 lines 7-in. channels; 18 ft. road way between trusses. Floor beams for roadway, 15-in. I's 50 lbs. Joists, 6 lines 7-in. I's and 6 lines 7-in. channels. Ends of joists to run to outer edge of beam joists and all joists to have 2⅝-in. bolts at each and every bearing. (a) Substructure of wood. Five piles each abutment, with channel cap 12-in. channel, 20½ lbs., 19 ft. long, ¾x20-in. drift bolts; ends and wing backing 3-in. pine or fir; 3x12-in. sway bracing on all foundations 6 ft. or over; no sway bracing on back walls of 5 ft. or less. Sway bracing to be fastened with ½x9-in. boat spikes. All backing to be put on with 2-60-lb. spikes to each bearing through each and every plank, channel cap to be neatly fitted and to have solid bearings. (b) Substructure of reinforced concrete; 8-in. channel embedded in concrete for cap, 4 ¾x28-in. anchor bolts thoroughly embedded concrete, each joist fastened to cap at each end with 2 ⅝-in. bolts, reinforced bars ½-in. bars horizontal spaced 2 ft. c. to c. 2 ins. from front and back faces. Vertical spaced 1 ft. c. to c. 2½ ins. from front face and spaced 2 ft. c. to c. from back face. Batter, abutments 12 ft. or less in height 1 to 6, 12 ft. or over in height 1 to 12. Pier without wings, front face at top 21 ft., with wings from face at top 20 ft. Three cedar piles in footing for pier and two additional cedar piles for each wing. Top of abutment 12-in. slope 1-in. to foot. (c) Substructure of concrete with steel piling. Cap 21 8-in. channels 20 ft. long. All beam bridges to have 5 piles in each abutment, size 7-in. I's and each wing to have steel piling of same dimensions, number as required, but in no case shall piling in wing be over 3 ft. 6-in. between piling. Concrete to run flush with piling. Concrete to be reinforced with ⅝-in. round rods 12-in. center to center, full depth of concrete. Footing to all foundations and wings to be 6-in. wider each side at bottom, 12 ins. high, see plans. Rods to run through end of steel piles and rods to be of one piece and to extend from end to end of foundation; 2⅝-in. rods in footings. Truss bridge to have six steel 7-in. I's each end. In bridge number 1, 18-ft. piles will be necessary; bridge No. 2, 20 piles for foundation and 12 16-ft. piles for wings; bridge No. 3, 10 16-ft. piles for foundation and 12 14-ft. piles for wings; bridge No. 4, 10 16-ft. piles for foundation and 12 14-ft. piles for wings; No. 5, 12 26-ft. piles for foundation, 12 20-ft piles and 1 16-ft. pile for wings; bridge No. 6, 10 14-ft. piles for foundation and 4 12-ft. piles for wings; bridge No. 7, 10 14-ft. piles for foundation and 4 12-ft. piles for wings; bridge No. 8, 10 18-ft. piles for foundation and 10 16-ft. piles for wings; bridge No. 9, 10 20-ft. piles for foundation and 12 18-ft. piles for wings; bridge No. 10, 10·16-ft. piles for foundation and 12 14-ft. piles for wings. Plans and specifications on file in Auditor's office.

Ohio.

✣Bids will be received until 11 a. m., July 7, by Board of Muskingum County Commissioners, Zanesville, O., for furnishing the material and labor for the reconstruction and rebuilding of the superstructure of the Sixth Street bridge across the Muskingum River in said city of Zanesville; said bridge to consist of four spans each 150 ft. in length, one span 76 ft. long and one lift span 75 ft. long. All bidders shall submit bids under two separate plans, as follows: 1. Said bridge to have a roadway of 32 ft. in the clear to provide for a single street car track and to have a sidewalk on each side 6 ft. in width, and roadway to be provided with treated block floor, sidewalks to be of concrete. Said bridge to have a capacity to carry a 50-ton car and to withstand 250 lbs. to the sq. ft. in addition thereto; said bridge to have a continuous chamber of two per cent. 2. Said bidder shall submit bids for said bridge, same dimensions as above, except said roadway to be 40 ft. in width in the clear, to provide for a double car track and of sufficient strength to carry two 50-ton cars, and to withstand 250 lbs. to the sq. ft. in adidtion thereto. Bidders shall assume all responsibility for measurements. All bids shall be in accordance with plans and specifications to be submitted by the bidder.

✣Bids will be received until 1 p. m., July 12, by Charles A. Morelock, Union County Auditor, Marysville, O., for all the labor and material necessary to construct and complete the following substructure and superstructure: The superstructure for the Kennedy bridge over Mill Creek, in Taylor township, 150 ft. span, 16-ft. roadway. The substructure for the Kennedy bridge over Mill Creek, in Taylor township. he superstructure for the Essex bridge over Rush creek in Jackson township, 160 ft. span, 16-ft. roadway. The substructure for the Essex bridge, Jackson township. The superstructure of the Shields bridge over Mill Creek, Millcreek township, 2 spans, of 96 ft. each, 16-ft. roadway. The substructure for the Shields bridge, Millcreek township. The superstructure for the Thompson bridge over Mill Creek, Millcreek township, 112 ft. span, 16-ft. roadway. Plans, drawing representations, bills of material and specifications of work and estimates of the cost thereof in detail and in the aggregate are on file in the office of the county auditor.

✣Bids will be received until noon, June 27, by Board of Summitt County Commissioners, Akron, O., for the construction of the substructure for Hopkins Bridge over Yellow Creek, West of Ghent, O. Bids must be made on forms which may be obtained at the office of the County Commissioners. Plans and specifications are on file at the office of the County Commissioners and County Surveyor. Proposals must be accompanied by a certified check for $200. C. L. Bower is Clerk of the Board.

✣Bids will be received until 11 a. m., July 19, by Board of Cuyahoga County Commissioners, Cleveland, O., for the construction of bridge work per report No. 3149, concrete bridge, Wooster pike, Strongsville township, report No. 3150, concrete bridge, Wooster pike, Strongsville township, in accordance with the form of contract and specifications to be furnished by Frank R. Lander, County Surveyor. Plans and specifications are on file with the county engineer, Courthouse, Lakeside Ave., Cleveland. J. F. Goldenbogen is Clerk.

✣Bids will be received until noon, July 11, by Thomas C. Patterson, Scioto County Auditor, Portsmouth, O., for furnishing the labor and material for the following work: One iron concrete floored bridge and masonry over each of the following creeks: Little Bear Creek in Union Township; Bull Run in Clay Township; Hales Creek in Bloom Township; Long Run in Madison Township; Parks Run in Harrison Township. All work to be done in accordance with the approved plans and specifications on file in the office of the County Auditor.

✣Bids will be received until noon, July 18, by Board of Hamilton County Commissioners, Cincinnati, O., for new steel superstructure under specifications No. 484-B, for the bridge on Elliott St. over West Fork Mill Creek in Springfield Township. Each bid must be accompanied by a bond for $1,000. Albert Reinhardt is Clerk of the Board.

✣Bids will be received until noon, July 18, by Board of Hamilton County Commissioners, Cincinnati, O., for new steel superstructure under Specifications No. 482-B for bridge over Clark and Davis St. over East Fork of Mill Creek in Sycamore Township. Plans and specifications are on file with the Board. Albert Reinhardt is Clerk.

✣Bids will be received until noon (Standard time), July 2, by S. A. Kinnear, Director of Public Service, Columbus, O., for furnishing the labor and material for constructing the masonry approaches to and substructure of a viaduct over the tracks of the Baltimore & Ohio, the P. C. C. & St. L., and the C. C. C. & St. L. Rys. on North Fourth St. All bids will be compared on the basis of the engineer's estimate of the quantities of work to be done, as follows: Contract No. 2—Item No. 1, excavating 7,000 cu. yds.; item No. 2, embankment, 4,000 cu. yds.; item No. 3, concrete, Class A, (Parapet Wall), 1,800 lin. ft.; item No. 4, concrete, Class B (piers), 1,450 cu. yds.; item No. 5, concrete, Class C (footings), 5,100 cu. yds.; item No. 6, masonry, Class A (coping), 1,800 lin. ft.; item No. 7, masonry, Class B (concrete, with sandstone facing), 4,450 cu. yds.; item No. 8, limestone wheel course, 160 lin. ft.; item No. 9, twisted steel rods, 32,000 lbs.; item No. 10, expanded metal, 8,800 sq. ft.

✣Bids will be received until 1 p. m., July 15, by Board of Miami County Commissioners, Troy, O., for eight bridges as follows: 1 bridge, 2 spans, 135 ft. pin centers; 1 bridge, 1 span, 74 ft. pin centers; 1 bridge, 2 spans, 112 ft. pin centers; 1 bridge, 2 spans, 135 ft. pin centers; 1 bridge, 2 spans, 108 ft. pin centers; 1 bridge, 3 spans, 112 ft. pin centers; 1 bridge, 2 spans, 112 ft. pin centers; 1 bridge, 3 spans, 75 ft. clear opening, concrete. Plans and specifications are now on file in the office of the County Auditor at Troy, Ohio, a complete set of which will be furnished upon application to the County Surveyor, on receipt of $5 for each set furnished, which sum will be returned on return of plans and specifications in good condition. H. E. Whitlock, County Surveyor, Troy, Ohio.

⊙The Board of Hamilton County Commissioners, Cincinnati, O., has awarded the contract for alterations for lift bridge over the Miami and Erie canal at Section Ave., Hartwell, to O. D. Curry, 2525 Ashland Ave., Cincinnati, O., at $21,000. Albert Reinhardt is Clerk of the Board. Bids were opened June 13.

⊙The Massillon Bridge & Structural Co., Massillon, O., has been awarded the contract for erecting a viaduct 536 ft. long and 60 ft. wide over a railroad track on North Fourth St., Columbus, O.

⊙The contract for the construction of a steel truss bridge 104 ft. long over Mad River to be known as the Arrowsmith bridge has been let by Champaign County, O., to the Home Engineering Co., Canton, O., at $2,987. Bids for the work were opened June 11. R. F. Darnell is County Engineer, Urbana, O.

⊙The Commissioners of Muskingham County, Zanesville, O., have awarded the contract for the construction of the Gaysport bridge to G. W. Lane, Newark, O., at $21,000. The bid for the structure with plank floor on draw span was $815 less.

The Board of Commissioners of Muskingum County, Zanesville, O., has received the following bids for the construction of the Fultonham and White Cottage bridges: Fultonham bridge—R. J. Flautt, Fultonham, $4,960; E. J. Lander, Canton (a)—$4,265, (b)—$4,775; E. M. Scully, concrete, $3,930, block, $3,985; Capitol Construction Co., Columbus, $4,075; G. W. Lane, $5,250; York Bridge Co. $3,900; H. L. Hastings (a)—$5,294, (b)—$4,938; substructure, W. R. Bolin, $815. White Cottage bridge—E. M. Scully, $3,793; York Bridge Co. (a)—$3,450; (b)—$3,750; Columbus Structural Co., $3,150; Massilon Bridge Co., (a)—$3,100, (b)—$3,400; E. J. Lander, $3,970, $4,200 and $3,890 (different plans); Capitol Construction Co., $4,026; H. L. Hastings, (a)—$5,887, (b)—$5,445.

The McClintic-Marshall Co., New York City, at $90,000, was low bidder for the substructure of the new Fourth St. viaduct, Columbus, O.

The Board of Cuhahoga County Commissioners, Cleveland, O. J. F. Goldenbogen, Clerk, has announced its intention to shortly construct a bridge on Breckville Road over Chippewa Creek in Breckville township. A public hearing will be held on the proposition July 14.

Oklahoma.

⊙The contract for the construction of three steel bridges 50, 75 and 100 ft. long has been awarded by the Board of Pittsburgh County Commissioners, McAlester, Okla., to the Missouri Bridge & Iron Co., St. Louis, Mo., $8,148. Bids for the work were opened June 9.

Oregon.

The suburb of Sellwood, Portland, Ore., is to agitate shortly the construction of a bridge over the Willamette River at the foot of Spokane Ave. to replace the ferry. The cost of the structure would amount to not more than $200,000. T. M. Hurlburt is City Engineer of Portland, Ore.

Pennsylvania.

✣Bids will be received until 11 a. m., July 2, by Board of Montgomery County Commissioners, Norristown, Pa., for the construction of a 2-span steel structure over West Branch of Perkiomen Creek, Douglass township. The shipping point is Bartox, Colebrookdale R. R., a distance of 3 miles. J. N. Jacobs is Controller.

✣Bids will be received until July 5, by Snowden Township Road Supervisors, H. L. Snyder, Secy., Broughton, Pa., for the construction of a road and filling in approaches of new bridge in said township with slag. The work will include about 2,200 cu. yds.

✣Bids will be received until 11 a. m., July 2, by Board of Montgomery County Commissioners, Norristown, Pa., for the construction of the stone retaining wall at the Toll House Lot, DeKalb St. bridge, Norristown end, Montgomery County, Pa. J. N. Jacobs is Controller.

✣Bids will be received until July 2, by Commissioners of Butler and Armstrong Counties at Butler and Kittanning, Pa., for the construction of a joint county bridge as follows: In Parker Township, Butler County, Pa., over Bear Creek. Superstructure to be steel truss with concrete and brick roadway. Substructure, masonry. Each bid must be accompanied by a certified check for 10 per cent of the amount of the bid.

✣Bids will be received until noon, July 2, by Board of Dauphin County Commissioners, Harrisburg, Pa., for the repair and building additional wing walls at a bridge over Fishing Creek, Fort Hunter Highway, at J. W. Reily's Residence, Susequehanna Township. Plans and specifications are on file in the Commissioners' office. D. F. Lebo, Clerk.

✣Bids will be received until noon, July 9, by Harry Kisinger, Controller of Fayette County, Uniontown, Pa., for the construction of piers, foundations, etc., necessary in the building of a steel bridge, viaduct and approaches, over the Monongahela River, between South Brownsville and West Brownsville, Pa. Plans, specifications and other information are on file at the offices of the Controllers and the Commissioners of Fayette County and Washington County, where they may be seen by all parties interested. The same can be obtained from George Porter, Engineer for Fayette Co., Uniontown, Pa.; Chaney & Armstrong, Engineers for Washington Co., Pa., or Hermann Laub, Consulting Engineer, Pittsburgh, Pa., upon application from a bona fide bidder accompanied by a deposit of $20. Official advertisement will be found elsewhere in this issue.

⊙The contract for the construction of a reinforced concrete girder bridge over Mill Creek in Albany township, Berks County, Pa., to be known as Stump's bridge has been awarded by Board of County Commissioners to the Ferro Concrete Co., Harrisburg, Pa., at $6,566. D. K. Hoch is County Controller. Bids were opened June 10.

The City Council of Scranton, Pa., has granted permission to the Delaware, Lackawanna & Western Ry., to build a viaduct over their Keyser Valley branch on Washburn St.

D. A. Keefe, Athens, Pa., has been appointed by the Commissioners of Luzerne County, Wilkesbarre, Pa., to prepare plans and specifications for a new bridge at Nanticoke and for remodeling the foot path of the bridge near the Oneonta Hotel.

South Dakota.

State Engineer Derr, Pierre, S. Dak., has completed plans for the construction of the bridge and dam to be constructed jointly by the city and the state on Capitol Ave. The bridge will be of concrete 18 ft. wide with 32-ft. roadway and two 8-ft. sidewalks. Work will probably be started in July.

Texas.

Advices from Corpus Christi, Texas, state that The Nueces County Commisisoners Court is expected to call an election for the purpose of voting on the proposition to issue $200,000 for the erection of a causeway across Nueces Bay connecting the main lands of Nueces and San Patricio Counties.

The Board of Trade and the Young Men's Business League held a joint meeting at Cleburne, Texas, recently to formulate plans for getting the proposed steel bridge over the Brazos River, which Bosque County has agreed to aid in building.

Virginia.

⊙The contract for the construction of two steel bridges over Dunlap Creek in Alleghany County, Va., has been awarded to the Roanoke Bridge Co., Roanoke, Va., at $8,375. Bids for the work were opened at Covington, Va., June 7. P. St. J. Wilson, Richmond, Va., is State Highway Commissioner.

A public hearing is to be held 11:30 June 26, by Lieut. Col. W. C. Langfitt, U. S. Engineer, Southern bldg., Washington, D. C., at the Post Office of Newcastle, Va., on the question of constructing a railroad bridge across the Pamunkey River at Newcastle.

Washington.

⊙Hunley & Henry have been awarded the contract for reinforcing the piers of the Heron St. bridge, Aberdene, Wash., which is estimated to cost $2,350. Louis D. Kelsey is City Engineer.

An election is to be held in July to submit to the voters of Clarke County, Wash., the proposition to issue $500,000 of bonds for paying a portion of the cost of building the proposed bridge over the Columbia River, at Vancouver, Wash.

Wisconsin.

An election will be held July 2 at Janesville, Wis., to submit to the voters the proposition to issue bonds to rebuild the Milwaukee St. bridge destroyed by fire. A concrete structure is under consideration. C. V. Kerch is City Engineer.

The Wisconsin State Senate has passed the True Bill, which provides for a $50,000 appropriation for the construction of a free wagon bridge over the Wisconsin River at Merrimac. The cost of the structure is estimated at about $90,000.

Bids will be received until July 15 by Board of Public Works, Janesville, Wis., for the construction of two reinforced concrete bridges as follows: One over Rock River on Milwaukee St., consisting of four 52-ft arch spans, 54 ft. wide, and one over Spring Brook on Main St., consisting of three 22-ft. girder spans, 26 ft. wide in accordance with the specifications, plans and details on file in this office. A certified check for 10 per cent of the bid required. A copy of official notice, specifications, contract and bond will be furnished on application. James A. Fathers, Chairman of the Board, C. V. Kerch, City Engineer.

DRAINAGE AND IRRIGATION

California.

Richgrove Citrus Water Co., Los Angeles, Cal., and Bakersfield, Cal., has been incorporated with a capital stock of $10,000; John Stein, O. B. Morgan, William Holt, Anton Gross, Frank Liebritz, Frank W. Curtin, Pete B. Finch, W. F. Herzog and William Willinger are the incorporators. The company will engage in an irrigation business.

Imperial West Side Water Co., El Centro, Cal., has been incorporated with a capital stock of $25,000 and will carry on an irrigation business. W. G. Darce, J. W. Rhyne, Nat B. Morse, Jerome McBride and J. G. Dailey are the incorporators.

Advices from Stockton state that West Side land owners have voted to organize the Tracy irrigation district at Tracy. The district is to contain approximately 63,000 acres. Petitions will be circulated throughout the proposed district immediately. A system of pumps will be installed and the water lifted from the river to three different levels. Four pumps will be installed at each of these three points and the water turned into the ditches for distribution over the irrigated sections of the district. The district will extend from Bethany on the north, through San Joaquin county and as far as Grayson on the south, in Stanislaus county. This will practically bring the Patterson district and the proposed Tracy district together at Grayson.

A company with a capitalization of $3,000,000, organized in Los Angeles and Douglas, Ariz., has secured rights in Rucker canyon in the Chariccuhua Mountains, and proposes to build a concrete dam. This water is to be used in the development of several thousand acres of farming land in Sulphur Springs Valley. H. W. Ackland, of Los Angeles, Cal., is interested.

Colorado.

✣Bids will be received until 4 p. m., July 14, by U. S. Reclamation Service, Montrose, Colo., for furnishing f. o. b. shipping point, 7,000 pieces round reinforcement bars. Further information may be obtained of C. T. Pease, Project Engineer.

Illinois.

✣Bids will be received until 2 p. m., July 8, by Commissioners of the Joe Benes Drainage District, at the office of the clerk of Kankakee County Court, Kankakee, Ill., for the construction of the entire proposed work. The kind of work to let is principally as follows: Main Open Ditch—2,641 cu. yds. earth excavation; 680 cu. yds. rock excavation. Tile Main—7,060 ft. of 27-in. tile; 4,900 ft. of 24-in. tile; 2,700 ft. of 22-in. tile; 1,800 ft. of 20-in. tile; 2,600 ft. of 18-in. tile; 1,139 ft. of 14-in. tile; 460 ft. of 12-in. tile. Giroux Branch—1,120 ft. of 10-in. tile. Peterson Branch—150 ft. of 8-in. tile. Bevan Branch—1,250 ft. of 10-in. tile; 786 ft. of 8-in. tile. Ossman Branch—1,500 ft. of 10-in. tile. Walker Branch—800 ft. of 10-in. tile. Reiniche Branch—1,200 ft. of 10-in. tile; 2,700 ft. of 8-in. tile. Gladu Branch—1,800 ft. of 8-in. tile. James Bevan Branch—700 ft. of 8-in. tile. Ullum Branch—2,070 ft. of 8-in. tile. Healy Branch—1,070 ft. of 8-in. tile. Cast Iron Pipe Through Railroad Bed—23 ft. of cast iron pipe of 18-in. Work to be begun at once and completed by January 1st, 1914. For full particulars and greater certainty see said map, plans, profiles and specifications. Consult L. C. Looker, Engineer for said district.

✣Bids will be received until 10 a. m., July 3, by Robert Fife, Clerk of the Frog Pond Drainage District, Palestine, Ill., for the construction of main ditch and 15 laterals. Specifications are on file with the County Clerk, Robinson, Ill. All bids received for this work June 12 were rejected.

⊙J. M. Egan, Jr., Amboy, Ill., has been awarded the contract at $27,000 for excavating trenches for about 12,000 ft. of drain tile for the Northville, Sandwich and Little Rock Drainage District. W. S. Shields Co., 1201 Hartford Bldg., Chicago, Ill., are the Engineers.

Bids were opened June 19 by the Trustees of the Sanitary District of Chicago, Chicago, Ill., for the construction of Contract Sections 7 and 8 of the Calumet-Sag Channel. The bids received were as follows: (1) bid of Green & Sons Co., Chicago, Ill., (2) Byrne Bros. Dredging & Engineering Co., Chicago, Ill., (3) Great Lakes Dredge & Dock Co., Chicago, Ill., (4) T. W. Keys, La Salle, Ill.:

	(1)	(2)	(3)	(4)
Section 7:				
Excavation, glacial drift, 1,150,000 cu. yds.	....	$0.43¾	....	$0.62
Excavation, solid rock, 10,000 cu. yds.	....	.90	....	3.00
Roadway construction, 1,800 lin. ft.	....	2.50	....	3.00
Concrete, 650 cu. yds.	....	7.50	....	12.00
Reinforcing metal, 10,000 lbs.	....	.06½	....	.04½
Erection of Worth road bridge	....	7,000	....	9,500
Totals for section 7	....	$529,150	....	$766,150
Section 8:				
Excavation, glacial drift, 1,200,000 cu. yds.	....	$0.43¼	....	$0.62
Excavation, solid rock, 5,000 cu. yds.	....	.90	....	3.00
Roadway construction, 1,275 lin. ft.	....	2.50	....	3.00
Concrete, 550 cu. yds.	....	7.50	....	12.00
Reinforcing metal, 9,000 lbs.	....	.06½	....	.04½
Erection of Piper road bridge	....	11,000	....	11,500
Totals for section 8	....	$550,197	....	$781,330
Sections 7 and 8 as entirety:				
Excavation, glacial drift, 2,350,000 cu. yds.	$0.42½	$0.43½	$0.51½	$0.62
Excavation, solid rock, 15,000 cu. yds.	1.90	.90	2.80	3.00
Roadway construction, 3,075 lin. ft.	2.25	2.50	2.75	3.00
Concrete, 1,200 cu. yds.	10.00	7.50	14.00	12.00
Reinforcing metal, 19,000 lbs.	.06	.06½	.05½	.04½
Erection of Worth road bridge	7,230	7,000	7,500	9,500
Erection of Piper road bridge	10,500	11,000	10,500	11,500
Totals for sections 7 and 8	$1,065,039	$1,071,672	$1,296,551	$1,547,480

Among the legislation passed at the session of the Illinois Legislature, which closed June 20, is a bill authorizing the construction of pumping plants in special drainage districts. Another bill permits the joining of drainage districts for the construction and operation of a joint pumping plant.

Bids as follow were received June 19 by the Trustees Sanitary District of Chicago, Chicago, Ill., at Jackson St., Chicago, (1) bid for removal of superstructure, all material to become property of the contractor, (2) bid for removal of superstructure, all girders and cast pedestals to remain property of Sanitary District, (3) bid for removal of substructure, (4) dredging 9,000 cu. yds. scow measurement: Great Lakes Dredge & Dock Co., Chicago, Ill., (1) $7,200, (2) $8,200, (3) $8,000, (4) $0.30; Byrne Bros. Dredging & Engineering Co., Chicago, Ill., (1) $17,161, (2) $20,549, (3) $11,462, (4) $0.30.

Indiana.

✣Bids will be received until 2 p. m., July 11, by Board of Drainage Commissioners, Pike County, at Petersburg, Ind., for the construction of several drains. J. A. Carr is Drainage Commissioner.

⊙Lowell P. Grissell has been awarded the contract at $7,846 for constructing the Grissell Ditch, bids for which were opened June 7 at the office of the County Surveyor, Portland, Ind.

Minnesota.

✣Bids will be received until 2 p. m., June 28, by J. C. Jensen, Watonwan County Auditor, St. James, Minn., for the construction of a public ditch in Watonwan and Blue Earth Counties known as Judicial Ditch No. 7. The cost of the work is estimated at $40,722.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Final hearing was held June 21 at St. Cloud, Minn., on Ditch 32. This will be 23 miles long and will affect the towns of Raymond, Getty, North Fork and Lake George. Sam Chute, St. Cloud, Minn., is County Surveyor.

Plans and specifications have been completed for the construction of a 6-mile ditch across the town of Melrose. Samuel Chute, St. Cloud, Minn., is County Surveyor.

North Carolina.

A $500,000 bond issue for the drainage of the Mattamuskeet Lake, Hyde County, has been sold. Col. J. P. Kerr, Raleigh, N. C., is Secretary of the Commission.

H. M. Lynde, of the Drainage Bureau, U. S. Department of Agriculture, is making surveys for the drainage of Third Creek in Rowan County, North Carolina. As soon as the surveys are completed a drainage district will be formed.

Wisconsin.

✣Bids will be received at 2 p. m., July 10, at Racine, Wis., for the following work in the Yorkville Raymond Drainage District, consisting of cleaning and deepening the present ditch and a short extension of main ditch with open lateral ditch and several lateral drains. The estimate of P. J. Hurtgen, Engineer, Burlington, Wis., is as follows: Extension to Main Ditch—Station 0 to 15, 4 ft. wide base, 6.5 ft deep. Main Ditch, Sta. 15 to 40, 4 ft. wide at base, av. cut, 6 ft.: Sta. 40 to 245, 7 ft. base, av. cut, 5 ft. Sta. 245 to 430, 10 ft. wide at base, av. cut, 4 ft. Sta. 430 to 460, 12 ft. wide at base, av. cut, 4 ft. Sta. 460 to 505, 24 ft. wide at base, av. cut, 2 ft. 9 ins. Branch 3, Sta. 0 to 20, 2 ft. wide at base, av. cut, 8 ft. The open ditches will include a total of approximately 117,642 cu. yds. The Tile drains are as follows: Branch 1, 500 ft. of 18-in. tile drain, 6½ ft. cut. Branch 2, 500 ft. of 12-in. tile drain, 6½ ft. av. cut. Branch 2 North, 1,300 ft. of 4-in. tile drain, av. cut, 4½ ft. Branch 2 South, 1,200 ft. of 4-in. drain tile, av. cut, 4½ ft. Branch 4, 1,950 lin. ft. of 16-in. tile drain, 2,250 ft. of 12-in. tile drain, av. cut 7 ft. Branch 5, 3,120 lin. ft. of 12-in. tile drain, av. cut, 5 ft. Branch 6, 1,470 ft. of 12-in. drain tile, 745 lin. ft. of 10-in. tile drain, av. cut, 5 ft. Plans and specifications are on file with P. J. Myers, Attorney for District, Racine, Wis.

WATER WORKS

Alabama.

Plans are being prepared by J. E. Baskerville, Birmingham, Ala., for the installation of a new waterworks system in Louisville, Miss., to cost approximately $30,000. The work will also include sewerage. W. J. Newson is Mayor.

Arkansas.

The city of Rector, Ark., will install water works and sewerage at an estimated cost of $60,000. Frank L. Wilcox, Chemical Bldg., St. Louis, Mo., is Consulting Engineer.

California.

✣Bids will be received until 8 p. m., July 21, by Board of Trustees, Burlingame, Calif. (readvertisement), for the furnishing of materials for and the construction of a distributing water system in accordance with the plans and specifications now on file in the office of the City Clerk, consisting of the following approximate quantities subject to an increase or decrease at the option of the Board of Trustees: 3,700 lin. ft. of 8-in. Bell & Spigot Class B pipe, 27,300 lin. ft. of 6-in. Bell & Spigot Class B pipe, 68,800 lin. ft. of 4-in. Bell & Spigot Class B pipe, 35,900 lin. ft. of 3-in. Full Weight galvanized pipe, 54,800 lin. ft. of 2-in. Full Weight galvanized pipe. Necessary specials, fittings, valves, hydrants, valve boxes, service clamps, corporation cocks, service cocks, meters, meter boxes, cock boxes and other details shown on plans. Bids will be received under one or all of three classifications, namely, (a) materials only; (b) labor only; (c) both materials and labor. Plans and specifications may be obtained from the City Clerk or from the Consulting Engineers of the City of Burlingame, Shipman, Denny and Rhame, Holbrook Bldg., San Francisco, Cal., upon a deposit of $10, returnable upon the return of said plans and specifications.

✣Bids will be received between the hours of 10:30 and 11:30 a. m., July 15, by City Commission, Sacramento, Calif., for furnishing and installing a 450 h. p. turbine pumping unit for the city. Plans and specifications are on file with the City Engineer. M. J. Desmond is City Clerk. Specifications are also on file at the office of ENGINEERING AND CONTRACTING, 608 S. Dearborn St., Chicago. Ill.

The Schmeiser Mfg. Co., of Davis, has made application to the California Railroad Commission in San Francisco to sell its water plant in that place to the Davis Water Co., for $6,300. At the same time the Davis Water Co., applied for a permit to make extensions and improvements in the system to the extent of $28,000.

The City Commission of Sacramento, Calif., has accepted specifications for a pumping engine for the city water works as prepared by City Engineer Givan. The proposed engine will have a capacity of from 10 to 14 million gallons of water daily, and will cost from $6,000 to $12,000.

The City of San Fernando, Calif., has been offered the privately-owned water plant in that city for $50,000. The city plans to take over the plant and make improvements and extensions at an estimated cost of from $25,000 to $50,000.

The City Trustees of Redlands, Calif., have decided to extend the municipal water system at a cost of $16,000.

The Trustees of Reedley, Calif., are considering the proposition of purchasing the waterworks which, at the present time, are owned by G. H. Blowers. Engineer Chris. P. Jensen, of Fresno, is determining the value of the plant.

Delaware.

The citizens of Clayton, Del., have voted in favor of the installation of a waterworks system and sewer.

Georgia.

Plans have been prepared for the installation of a waterworks system in Royston, Ga., at an estimated cost of $45,000. It is also planned to install sewerage. Contracts will be let soon. C. B. Welborn is official in charge.

Illinois.

The water department of Chicago Heights, Ill., will soon ask for bids on a circular brick smokestack, 125 ft. high, with an inside area of 28 sq. ft.

The Cairo Water Co., Cairo, Ill., has purchased a site for its new tower and tank. Preliminary reports have been received from Engineers.

Indiana.

✣Bids will be received until July 1, by Common Council, Decatur, Ind., for the construction of a concrete reservoir in the city. Plans and specifications are on file with H. M. DeVoss, City Clerk, and John Gillig, Engineer.

No bids were received on June 16 by the West Terre Haute Water Co., H. L. Ensminger, Secy., West Terre Haute, Ind., for the installation of a complete waterworks system for the town.

Iowa.

⊙The Des Moines Bridge & Iron Works, Des Moines, Ia., has been awarded the contract for the construction of a 60,000-gal. steel water tank and steel trestle at Fort Niagar, N. Y., for $9,175. The work also includes the tearing down of the old tank. Bids were opened June 14.

The citizens of Woodbine, Ia., will vote July 7 on the proposition of issuing bonds to the amount of $8,000 for improvements to the water works plant.

The citizens of Miles, Ia., will vote July 8 on the question of installing a waterworks system and the granting of a franchise to J. H. Maher for an electric light and power plant.

Voters of Mt. Ayr, Ia., have signed a petition asking the Town Council to submit the proposition of issuing bonds for a waterworks and sewerage system to the citizens.

Kansas.

The City of Long Island, Kan. is figuring on putting in a waterworks system and would be pleased to receive catalogs and prices of storage tanks, standpipes, pumps, pipes and fittings, hydrants, fire hose, kerosene or gasoline pumping engines, corrugated iron culverts and proposals of Engineers and Contractors of waterworks systems not exceeding $10,000 in value. These prices are wanted to make a preliminary estimate of the cost of a system and if the cost is not too great the matter will be taken up farther and a bond election will be called. Prices of an electric light and power outfit to be used in connection with the waterworks system are also asked. Ira C. Young is Acting City Clerk.

Maine.

The Belfast Water Co., Belfast, Me., will construct a second dam this season on Little River above the bridge on the back road for a supplemental reservoir, and is also to install a filter plant at an estimated cost of $30,000.

Massachusetts.

✣Bids will be received until 2 p. m., June 27, by Board of Water Commissioners, Chester, Mass., for the furnishing of all material and the construction of a pipeline consisting of 4,000 ft. of 6-in. and 11,500 ft. of 4-in. cast iron water pipes. Each bid will be accompanied by a certified check of $500, drawn upon a national bank and payable to the Town of Chester. A bond in the amount of $5,000 with a surety company satisfactory to the Board will be required of the successful bidder for the faithful performance of the contract. Plans and specifications are on file and can be seen at the office of the Engineer, James L. Tighe, 189 High St., Holyoke, Mass. J. J. Harrington is Chairman of the board.

Michigan.

✣Bids will be received until 5 p. m, July 7, by Board of Public Works, Big Rapids, Mich., at the office of Barney Laser, City Clerk, for delivering, trenching, laying with gates, hydrants and specials appurtenant thereto and backfilling of approximately: 4,750 lin. ft. 12-in., 1,425 lin. ft. 10-in., cast iron water mains, all in the city of Big Rapids, Mich. Plans and specifications may be seen at the office of the City Clerk at Big Rapids, or at the office of Gardner S. Williams, Consulting Engineer, Ann Arbor, Mich. Official advertisement will be found elsewhere in this issue.

⊙The Wickes Boiler Co., Saginaw, Mich., has been awarded the contract by the Board of Water Commissioners, Saginaw, for furnishing and installing one water tube boiler or two horizontal tubular boilers with necessary stoker or stokers for the East Side Water Works, for $4,808. Bids were opened June 13.

⊙The City Council of Kalamazoo, Mich., has awarded the contract for the installation of a private waterworks system at the tuber-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

culosis hospital to L. S. Deal. The contract calls for the sinking of a 3-in. well, installation of pump, motor and all equipment, erection of well house and a pressure tank with capacity of 865 gals. in the basement, piping from well to house, etc.

The citizens of Olivet, Mich., at a recent special election voted the issuance of bonds for the installation of a waterworks system to cost approximately $14,500. The contract will be let as soon as specifications are drawn.

Residents of East Main St., between Summit and East Sts., have petitioned the Village Council of Morenci, Mich., for an extension of the water mains.

Minnesota.

✣Bids will be received until 11 a. m., July 1, by W. F. Roche, Village Clerk, Lakeville, Minn., for the construction of a complete waterworks system. Plans and specifications are on file with the Village Clerk and with Oscar Claussen Engineering Co., Consulting Engineers, 312 Commercial Bldg., St. Paul, Minn., and additional copies may be secured of the Engineers at $3.50 per set. The work to consist of the following approximate quantities: Division I being a distribution pipeline and accessories, including the following approximate quantities: 276 ft. of 8-in. C. I. B. & S. pipe, 2,100 ft. of 6-in. C. I. B. & S. pipe, 2,208 ft. of 4-in. C. I. B. & S. pipe Ten by 4-in. hydrants together with valves, specials, etc., installed complete, including trenching and back-filling, etc. Division II being a 50,000-gal. steel tank on a 100-ft. steel tower together with all accessories installed complete, including foundations. Division III being the pumping plant and accessories consisting of a 7½ h. p. geared base gasoline engine with all accessories, or a power working head geared to a gasoline engine together with all accessories. Division IV being a building 12 ft. by 14 ins. inside dimensions and accessories. The above divisions are all to be installed complete and ready for continuous use and successful operation, including all labor and material, excavation and back-fill. A certified check for $150 made payable unconditionally to the Village Clerk must accompany proposals for each section of the work, or certified check for $600 to cover the entire work.

✣Bids will be received until 11 a. m., June 28, by J. O. Hage, Village Clerk, Deerwood, Crow Wing County, Minn., for the construction of a complete waterworks system. Plans and specifications are on file with the Clerk, and may be obtained of the Oscar Claussen Engineering Co., 314 Commercial Bldg., St. Paul, Minn., Consulting Engineers.

Mississippi.

The citizens of Richton, Miss., at a recent election voted the issuance of bonds for the installation of a waterworks system.

The electors of Jackson, Miss., have authorized a bond issue of $250,000, the proceeds to be used in the construction of a filtration plant and other public improvement purposes.

Missouri.

✣Bids will be received until 1 p. m., July 8, by G. W. Tompkins, City Clerk, Monroe City, Mo., for the necessary labor and material for the construction of a water works and sewer system. Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., are Engineers. Official advertisement will be found elsewhere in this issue.

The citizens of Maitland, Mo., on June 24 voted on the proposition of issuing bonds to the amount of $14,800 to construct a waterworks system.

Nebraska.

⊙The Genung Plumbing & Heating Co., Norfolk, Nebr., has been awarded the contract by that city, for making extensions to the waterworks system to Edgewater Park and East Norfolk. Bids were opened June 16.

⊙The Alamo Engine & Supply Co., of Omaha, Neb., has been awarded a contract by the City of Ralston, Neb., for the installation of a waterworks system, for about $25,000.

New Jersey.

The Borough Council of Haledon, N. J., is considering the question of extending the water mains to the vicinity of Squaw Brook Road, north of Haledon Ave., and in that section of the borough on the Pompton Turnpike lying west of Belmont Ave.

New York.

✣Bids will be received until 2:30 p. m., July 2, by Board of Contract & Supply, Schenectady, N. Y., for the construction of a sewage pumping station, force main, and for the installation of pumping machinery appurtenances, in North Ferry street. Plans and specifications may be obtained from the office of the City Engineer and Architect, Mr. W. Thomas Wooley, No. 447 Franklin St., Schenectady, New York, by making a deposit of $10, which deposit will be refunded at such time as the plans and specifications shall be returned, and may be examined at the office of George W. Fuller, No. 170 Broadway, New York City.

A special election was held in Hempstead, L. I., on June 24, for the purpose of voting on the proposition to raise $18,000 for repairs to the village waterworks and also for the purchase of a new boiler.

An ordinance has been presented in the Common Council of Rochester, N. Y., providing for raising fund for $100,000, the proceeds to be used in the construction of the dike at the foot of Hemlock and Canadice lakes and other general improvement work.

Superintendent Diven of the waterworks, Troy, N. Y., has recommended the laying of two miles of 12-in. pipe from Lake Ave., in Sycaway, across the Poestenkill creek, into Ford Ave., Albia, at an estimated cost of $25,000.

Village Clerk J. A. Striker, Mt. Morris, N. Y., will sell bonds June 23 to the amount of $100,000 for a waterworks system.

McWhirk Construction Co., Niagara Falls, N. Y., and John W. Danforth Co., Buffalo, submitted the lowest bids to the quartermaster at Fort Porter, N. Y., on June 14, for filtration plant and remodeling water distributing system. It is probable the bids will be rejected.

North Carolina.

The Board of Aldermen of Winston-Salem, N. C., has authorized the water committee to purchase a new pump for the Salem pumping station and also to build a clear water basin at that plant. The improvements will cost between $12,000 and $15,000.

North Dakota.

⊙James Kennedy, of Fargo, N. Dak., has been awarded the contract at Hillyard, Wash., for the laying of cast iron water mains, for $30,973.

The Mandan Commercial Club, Mandan, N. Dak., rejected all bids received June 14, for building a dam across Heart River. James Kennedy, of Fargo, submitted the lowest bid.

The City Council of Fargo, N. Dak., has created water improvement district No. 1 and instructed Engineer Crabbe to prepare plans and specifications for waterworks.

Citizens of New Rockford, N. Dak., contemplate installing a municipal waterworks system and electric light plant. A bond issue will be voted upon.

Ohio.

✣Bids will be received until noon (central time), July 8, by H. H. Canfield, Clerk of the Village of Cleveland Heights, 309 Beckman Bldg., Cleveland, O., for the furnishing of one complete motor hose and ladder truck for said village, according to plans and specifications on file at the office of said Clerk at the Town Hall, and at the office of F. A. Pease, 8th floor, Marshall Building, Cleveland, O.

⊙F. R. Stern, of Lima, O., has been awarded the contract at Pleasant City, O., for the installation of a waterworks system, for $14,350. The work includes cast iron mains, pumps, engines, concrete reservoir, hydrants, valves, etc. Bids were opened June 13.

⊙D. W. McGrath, New First Nat. Bank Bldg., Columbus, O., has been awarded the contract by the Board of Trustees, Ohio State University, Columbus, for the construction of two underground tunnels, one 320 ft. long, the other 513 ft. long, for $8,090. Bids were opened June 16.

Oregon.

All bids received by the city of Ashland, Ore., for the construction of a dam and intake for the city plant have been rejected as too high.

The City Council of Milwaukie, Ore., has instructed City Auditor Mathews to advertise the $20,000 water bonds authorized by the voters at a recent special election. The funds are to be used to construct a municipal water plant.

Pennsylvania.

⊙Samuel P. Angle, of Hagerstown, Pa., has been awarded the contract by the Borough Council of Greencastle, Pa., to finish concreting the bottom of the new reservoir. The work will be done under two sets of specifications prepared by Engineer Mason D. Pratt, of Harrisburg, who made the plans for the reservoir. The concreting will be done on practically solid rock and will be laid in blocks about 10 ft. square and six inches thick, with the joints filled with asphaltum.

Consulting Engineer R. Winthrop Pratt, 708 Hippodrome Bldg., Cleveland, O., has been retained as consulting engineer during the construction of a waterworks dam for the Pennsylvania Training School, at Morganza, Pa. This dam was designed by Mr. Pratt several years ago but the construction work has been delayed until the present time. Wm. F. Penn is superintendent of the school.

The citizens of Benscreek, Pa., plan the installation of a waterworks system.

The Borough Council of Barnesboro, Pa., has ordered an election held July 28 for the purpose of voting on the proposition of issuing bonds in the sum of $35,000 for the construction of a municipal water plant.

South Carolina.

⊙The Columbia Supply Co., Columbia, S. C., and the U. S. Cast Iron Pipe & Foundry Co., Chattanooga, Tenn., have been awarded the contract by the city of Columbia, S. C., for furnishing spiral riveted steel 24-in. pipe and specials, also cast iron pipe specials, for $4,225 and $924 respectively. Bids were opened June 13.

A waterworks system to cost approximately $20,000 is planned by Mount Pleasant, S. C. The proposition will be submitted to the citizens for a vote.

A petition has been circulated throughout the town of Ridgeland, S. C., by the freeholders asking the Town Council to order a special election for the purpose of voting on the issuance of bonds for waterworks and electric lights.

The town of McColl, S. C., has sold bonds to the amount of $60,000 for the complete construction of a waterworks system, sewer system and electric light plant. J. Newton Johnston, of Florence, S. C., is Engineer.

J. Newton Johnston, of Florence, S. C., has been engaged by the Mayor and Town Commissioners of Cherryville, N. C., to design and supervise the construction of a water works system costing approximately $25,000. There will be about five miles of 8, 6 and 4-in. cast iron pipe with necessary hydrants and valves and an electric motor pump, 50,000 gallon brick reservoir, several deep wells and a 100,000 gal. steel tank on a 100-ft. trestle. J. B. Houser is Mayor.

J. Newton Johnson, of Florence, S. C., has been engaged by the Mayor and commissioners of Walterboro, S. C., to prepare plans and supervise the construction of a water works and sewer system to cost approximately $30,000. There will be four miles of eight and ten in. terra cotta sewer pipe with necessary manholes and flush tanks, and for the water works, there will be about four miles of 8, 6 and 4-in. cast iron pipe with forty hydrants, valves, boxes, etc. A deep well, a 100,000 gal.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

reservoir and a 60,000 gal. steel tank on an 85-ft. trestle, and general service pump operated by a gasoline engine. D. B. Ackerman is Mayor.

South Dakota.

✣Bids will be received until 8 p. m., July 7, by N. H. Jensen, City Auditor, Mitchell, S. Dak., for furnishing the material for and laying approximately 950 ft. of 6-in. water main with appurtenances including valves and fire hydrants. All work to be done in accordance with the plans and specifications now on file in the office of the City Engineer of said city.

Tennessee.

According to advices from Alamo, Tenn., a privately-owned waterworks system will be installed in that town.

The citizens of Greeneville, Tenn., at the recent election voted the issuance of bonds for the installation of a waterworks and a sewerage system.

The Board of Public Works of Nashville, Tenn., has introduced a bill in the City Council to provide $105,000 out of the reservoir emergency fund for the repair of the east basin of the reservoir.

Texas.

⊙The O. E. Fisher Building Co., Galveston, Tex., has been awarded the contract for the installation of fresh and salt water mains at the federal quarantine station, Galveston, for $3,284.

A company capitalized at $15,000 has been organized at Rogers, Tex., to develop and exploit the hot water wells recently discovered at that place while boring for natural water supply. The organizers of the company are Messrs. Burns, Odom. Ater Bros., J. M. Sampson and F. E. Zeelner.

The Attorney General at Austin, Tex., has approved the bond issue recently voted by the citizens of Haskell, Tex., for the extension of the city waterworks. It is planned to commence construction work by July 1.

Engineer A. Humpries has prepared plans for extensions to the waterworks system of Hillsboro, Tex., estimated to cost $10,000. Water will be secured from shallow wells and artesian wells. M. W. Lovell is Mayor.

The Wootan Wells Water Co., Wootan Wells, Tex., has been incorporated with a capital stock of $100,000. The officers are: I. A. Goldstein, president; George Robinson, vice president; C. L. Glover, Sr., secretary-manager, and Ed. McCullough, treasurer.

Utah.

The citizens of Castle Dale, Utah, have voted a bond issue amounting to $14,000 for the installation of a waterworks system.

Virginia.

Civil Engineer F. W. Scarborough has submitted his report to the officials of Ashland, Va., relative to the water and sewerage system, now operated by Receiver Diggs, of the Ashland Gas, Sewerage and Water Co. The value of the plant is estimated at $32,000, while it would require an outlay of $39,000 to complete an adequate system to cover the town.

Washington.

⊙The Washington Construction Co. has been awarded the contract by the Board of Public Works of Seattle, Wash., for the construction of a water tank for tuberculosis hospital, for $9,920.

⊙James H. Coyne, Port Townsend, Wash., has been awarded the contract for the laying of approximately 5,993 lin. ft. of water pipe at Fort Flagler, Wash., for $1,700. Bids were opened June 9.

Following bids were received on June 13 by the Board of Public Works of Seattle, Wash., for the construction of the Cedar River dam: Graff Construction Co., $778,882; Hans Pederson, $866,578; Nettleton, Bruce Eachbach Co., $687,110; P. E. McHugh, $976,071. The engineer's estimate was $825,000.

West Virginia.

✣Bids will be received until 10 a. m., July 2, by City Council, Parkersburg, W. Va., for the following second-hand machinery: Two vertical duplex pumps, 12x12-in. water ends. 18x24-in. steam ends. Rated capacity, one million gallons each. One horizontal compound duplex plunger pump, rated capacity two million gallons, 12-in. suction, 12-in. discharge. One horizontal duplex compound pump, size 19x24x15x24-in., rated capacity, two million gallons, 13-in. suction, 12-in. discharge. Two 80 horsepower return tubular Titusville boilers. One 80 horsepower return tubular Erie boiler. One 250 horsepower Atlas water tube boiler. Three metal boiler stacks. Two boiler feed pumps. One water heater. A certified check for the full amount offered must accompany each bid. The Council reserves the right to reject any or all bids. For further information address E. G. Stephenson, Superintendent of the Department of Waterworks and Sewers.

The residents of Mount de Chantal, W. Va., contemplate the installation of a waterworks system in that village.

Canada.

✣Bids will be received until noon, July 15, by C. H. Rust, Water Commissioner, Victoria, B. C., for the fabrication and laying of about 27½ miles of reinforced concrete pipe and appurtenances on the line of the Sooke Water Supply gravity conduit, and in accordance with the requirements of the general specifications prepared by Wynn Meredith, Consulting Engineer, for such construction, pursuant to the provisions of By-law No. 814, and adopted by the Council. Plans and specifications can be seen and Forms of Tender obtained, at the Sooke Water Supply Office, 1414 Douglas St., Victoria, B. C.

SEWERAGE AND SANITATION

Alabama.

Following bids were received by the city of Birmingham, Ala., Walter G. Kirkpatrick, City Engineer, for the storm sewers recently awarded by that city: Section No. 1—Southern Asphalt & Construction Co., $70,940; Sullivan, Long & Haggerty, $73,039; J. W. Gurley & Co., $74,705; Thomas Worthington, $75,825; Dunn & Lallande Bros., $82,596. Section No. 2—Southern Asphalt & Construction Co., $26,945; Sullivan, Long & Haggerty, $31,276; J. W. Gurley & Co., $31,759; Dunn & Lallande Bros., $32,131; Thomas Worthington, $34,027; F. H. Patterson, $37,433. Section No. 3—Southern Asphalt & Construction Co., $70,052; Thomas Worthington, $77,982; Sullivan, Long & Haggerty, $82,944; J. W. Gurley & Co., $87,188; Dunn & Lallande Bros., $104,052. Section No. 4—A. C. Brooks & Co., $27,844; Southern Asphalt & Construction Co., $28,689; Sullivan, Long & Haggerty, $33,212; J. W. Gurley & Co., $34,533; F. H. Patterson, $41,021; Dunn & Lallande Bros., $44,612.

Arkansas.

⊙Joseph McCoppin, of Little Rock, Ark., has been awarded the contract for the installation of a sewerage system in District No. 1, of Conway, Ark., for $35,125.

⊙A. B. Dowell, Carbondale, Ill., has been awarded the contract for the installation of sewers and sewage works at Brinkley, Ark., for $30,000. Frank L. Wilcox, Chemical Bldg., St. Louis, Mo., is Consulting Engineer. Bids were opened June 12.

California.

Civil Engineer Carl Ewald Grunsky, 515 Mechanics' Inst. Bldg., San Francisco, Calif., has completed plans and specifications for the new sanitary sewer proposed for Stockton, Calif. W. G Hunter is City Engineer.

Plans have been submitted to the Stege Sanitary Commission, Stege, Calif., for the proposed sewer system in the section between Stege Junction and the county line. George Scott, of Stege, is sanitary assessor.

The Board of Public Works of San Francisco, Calif., will advertise for bids at once for the construction of the so-called Mile Rock sewer, which will drain the Richmond and Sunset districts. The estimated cost is $235,000.

Connecticut.

The City of Willimantic, Conn., has asked for bids for the extension of the Mansfield Ave. sewer, estimated to cost $5,464. The city also plans to extend the sewer through Valley St. from Watson to Mansfield Ave., at an estimated cost of $1,292.

Delaware.

The United States Sewage Disposal Corporation has been incorporated at Dover, Del., with a capital stock of $3,000,000. The incorporators are: H. H. Poole, L. W. Baggage, Newark, N. J.; J. T. McGovern, New York City.

Georgia.

An election will be held in Jackson, Ga., on July 3 for the purpose of voting on the issuance of bonds to the amount of $23,000 for sewerage.

Illinois.

✣Bids will be received until 8 p. m., July 1, by Board of Local Improvements, Morton Grove, Ill., for the construction of a sewer in accordance with plans and specifications prepared by E. H. Rossiter, Village Engineer, Reaper Block, Chicago, Ill. Official advertisement will be found elsewhere in this issue.

Indiana.

✣Bids will be received until 9 a. m., July 9, by Board of Trustees, Geneva, Ind., for the construction of 7,218 ft. of pipe sewers as follows: 400 ft. of 36-in. pipe; 1,283 ft. of 33-in. pipe; 790 ft. of 27-in. pipe; 362 ft. of 24-in. pipe; 640 ft. of 20-in. pipe; 2,200 ft. of 18-in. pipe; 252 ft. of 15-in. pipe; 639 ft. of 12-in. pipe; 652 ft. of 10-in. pipe; 30 manholes; concrete headwall. Proposals must be accompanied by a certified check or bidder's bond for the sum of $525. Copies of the plans and specifications may be had from the Town Clerk or the Engineer upon deposit of $5 to guarantee their return, or may be seen at the offices of said Clerk or Engineer. W. A. Wells is Clerk of the Town of Geneva, Ind., and John T. Gillig is Engineer, Decatur, Ind.

Iowa.

✣Bids will be received shortly by R. A. Davis, City Clerk, Nevada, Ia., for about 15,000 lin. ft. of 3 and 4 ft. combined curb and gutter, 2,500 sq. yds. of 5-in. sidewalk and 4,300 ft. of sanitary sewers. Sam Steigerwalt is City Engineer.

⊙Potts Bros., Des Moines, Ia., have been awarded the contract by that city for the construction of 16,000 ft. of walk and 960 ft. of storm sewer, at $0.09 per sq. ft., and $3.25 per lin. ft. respectively. Bids were opened June 11.

⊙The City Council of Fort Dodge, Ia., has let contracts for two sanitary sewer districts. No. 1 going to C. A. Peterson and No. 2 to Joseph Benson for $1.59 per ft. for 8-in. pipe and $1.46, respectively.

⊙The City Council of Eldora, Ia., has let the contract for the construction of new sewer and new water mains to the Dearborn Construction Co., of Cedar Rapids, Ia., for $17,050 for the sewer, and $1,925 for the water mains.

A special election will be held in Woodbine, Ia., on July 7 for the purpose of voting on

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

the issuance of bonds to the amount of $20,000 for sewerage and $8,000 for improvements to the water works plant.

City Engineer Charles Roby of Waterloo, Ia., has submitted his report to the City Council on the feasibility of extending the Dry Run sewer through Greenfield addition. The estimates provide for the laying of a sewer 2,600 ft., at an approximate expenditure of $28,000.

Kentucky.

⊙The Dillehan Brick Co., Danville, Ky., has been awarded the contract by that city, J. M. Wallace, Mayor, for the construction of storm and sanitary sewers. W. S. Shields Co., 1201 Hartford Bldg., Chicago, Ill., are Engineers. Bids were opened June 14.

Mayor J. T. Hinton of Paris, Ky., has had engineers surveying the east side of the city with a view of supplying sewer service to the residents of that section.

Maine.

✣Bids will be received until noon, July 14, by Department of Public Works, Portland, Me., for building Sec. 2 of the East Side Intercepting Sewer and for building Sections 1 and 2 of the Fall Brook Branch of the East Side Intercepting System. Bion Bradbury, Jr., is Commissioner of Public Works.

⊙Otto Nelson Co., 194 Exchange St., Bangor, Me., has been awarded the contract by the city Biddeford, Me., W. C. Bigelow, City Engineer, for the construction of trunk sewers, for $47,442. The work includes 3,000 ft. of reinforced concrete sewer, 4 ft. x 6 ft., and 2,000 ft. of reinforced concrete sewer, 30-in. in diameter. Bids were opened June 9.

Massachusetts.

✣Bids will be received until 2:30 p. m., June 25, by Metropolitan Water and Sewerage Board, W. N. Davenport, Secy., 1 Ashburton Place, Boston, Mass., for constructing in earth trench a 15-in. vitrified pipe sewer, Section 48A, North Metropolitan System, in Somerville and Medford, from a point at the existing Metropolitan sewer in Mystic Valley Parkway southerly through Boston Ave. to near the boundary line between the cities of Somerville and Medford, in accordance with the forms of contract and specifications to be furnished by the Board. Some particulars are estimated to be as follows: Length of 15-in. vitrified pipe sewer in trench, 561 ft.; 20 cu. yds. of Portland brick masonry; 90 cu. yds. of concrete masonry in trench. F. D. Smith is Engineer of Sewerage Works.

✣Bids will be received until June 30, by Sewage Disposal Commission, Fitchburg, Mass., for furnishing cast iron pipe, special castings, gate valves and sluice gates for the Sewage Disposal Works. David A. Hartwell is Chief Engineer of the work and Harrison P. Eddy, 14 Beacon St., Boston, Mass., is Consulting Engineer. Plans and specifications are availiable at the office of Metcalf & Eddy, 14 Beacon St., Boston, Mass. Bids will also be asked within a short time for a small centrifugal pump and air compressor for the same work.

⊙The Board of Public Works of Pittsfield, Mass., has contracted with George D. Van Vranken, of Schenectady, N. Y., to drive piles for a new sewer which will be placed to the south of East St. across the swamp connecting the new east trunk laid last year.

The city of Pittsfield, Mass., will construct a new branch sewer which will care for the sewerage and surface water of many of proposed G. E. buildings and also for a section of Morningside will be constructed during the year at an estimated cost of $25,000.

Michigan.

⊙The city of Flint, Mich., H. E. Terry, City Engineer, has awarded the contract for the construction of sewers in that city to Albert H. Prange, of Grand Rapids, Mich., for $374,269. The work includes the following approximate quantities: 8-in. sewer, 43,387 ft.; 10-in. sewer, 12,101 ft.; 12-in. sewer, 22,403 ft.; 15-in. sewer, 16,214 ft.; 18-in. sewer, 11,690 ft.; 20-in. sewer, 7,419 ft.; 22-in. sewer, 11,145 ft.; 24-in. sewer, 11,266 ft.; 27-in. sewer, 8,004 ft.; 30-in. sewer, 5,968 ft.; 33-in. sewer, 6,893 ft.; 36-in. sewer, 5,994 ft.; 39-in. sewer, 2,526 ft.; 42-in. sewer, 420 ft.; 45-in. sewer, 1,270 ft.; 48-in. sewer, 2,096 ft.; 51-in. sewer, 540 ft.; 54-in. sewer, 160 ft.; 60-in. sewer, 825 ft.; 66-in. sewer, 882 ft. Bids were opened June 3.

General Manager L. D. McCutcheon and City Engineer Stevens are preparing an approximate cost of building a sewage purification plant in Grand Rapids, Mich., in accordance with the recent decision of the Supreme Court

Plans and specifications for storm water sewerage systems and paving at Marshall, Ithaca and St. Louis, Mich., have been prepared by the Smith & Boulay Co., Consulting Engineers, 322 Nasby Bldg., Toledo, O. Bids for the three municipal contracts, to amount to between $30,000 and $50,000 each, will be received about July 1. In addition to the above plans and specifications are being prepared for a storm sewer system to be built at Pemberville, O.

Minnesota.

⊙L. S. Eckstrum, of Bemidji Minn., has been awarded the contract by that city, George Stein, City Clerk, for the laying of storm sewers consisting approximately of 300 ft. of 15-in. pipe, 750 ft. of 12-in. pipe, 320 ft. of 10-in. pipe, four inlets and one manhole and accessories. Bids were opened June 16.

Montana.

The city of Helena, Mont., plans to expend $363,680 this year for improvements on its streets, sewers and water works system. William Jordan, Jr., is City Engineer

New Jersey.

✣Bids will be received until 2 p. m. July 29, by Passaic Valley Sewerage Commissioners, Essex Bldg., Newark, N. J., for the construction of the Northerly Portion of Section 6 of the Main Intercepting Sewer, in the city of Newark. Particulars that may enable contractors to judge of the character of the work are given below: Approximate Quantities, Northerly Portion of Section 6, Station 40+00 to Station 56+00: Item 1—Earth excavation and refilling, in trench, for 150-in. sewer, 1,600 lin. ft. Item 2—Concrete masonry, in trench, Portland cement mortar, 4,600 cu. yds. Item 3—Brick masonry, in manholes, laid with Portland cement mortar, and appurtenant work, 50 cu. yds. Item 4—Rock excavation, in trench, 300 cu. yds. Item 5—Furnishing, placing and maintaining steel and timber sheeting, etc., between Station 26+75 and 28+75, lump sum. Drawings, form of contract and specifications, and blank form for proposal may be obtained at the Commissioners' office from William M. Brown, Chief Engineer. John S. Gibson, Clerk.

✣Bids will be received until 2 p. m., July 29, by Passaic Valley Sewerage Commissioners, Essex Bldg., Newark, N. J., for the construction of the Central Portion of Section 6, of the main intercepting sewer: Approximate Quantities, Central Portion of Section 6, Station 26+00 to Station 40+00: Item 1—Earth excavation and refilling, in trench, for 150-in. sewer, 1,400 lin. ft. Item 2—Concrete masonry, in trench, Portland cement mortar, 4,500 cu. yds. Item 3—Brick masonry, in manholes, laid with Portland cement mortar, and appurtenant work, 50 cu. yds. Item 4—Rock excavation, in trench, 300 cu. yds. Drawings, form of contract and specifications, and blank form for proposal may be obtained at the Commissioners' office from William M. Brown, Chief Engineer. John S. Gibson, Clerk.

✣Bids will be received until 2 p. m., July 29, by Passaic Valley Sewerage Commissioners, Essex Bldg., Newark, N. J., for the construction of a part of Section 19 of the Acquackanonk-Garfield-Passaic Branch Intercepting Sewer, in the Borough of Garfield, New Jersey. Particulars that may enable contractors to judge of the character of the work are given below: Approximate Quantities for a Part of Section 19: Item 1—Earth excavation and refilling, in trench, for 33-in. concrete sewer, 2,600 lin. ft. Item 2—Earth excavation and refilling, in trench, for 30-in. concrete sewer, 2,800 lin. ft. Item 3—Earth excavation and refilling in trench, for 27-in. concrete sewer, 900 lin. ft. Item 4—Earth excavation and refilling, in trench, for 18-in. pipe and concrete sewer, including vitrified pipe, etc., 500 lin. ft. Item 5—Concrete masonry, in trench, Portland cement mortar, 13,000 cu. yds. Item 6—Brick masonry, in manholes, laid with Portland cement mortar, and appurtenant work, 100 cu. yds. Item 7—Rock excavation, in trench, 100 cu. yds. Drawings, form of contract and specifications, and blank form for proposal may be obtained at the Commissioners' office from William M. Brown, Chief Engineer. John S. Gibson, Clerk.

✣Bids will be received until 2 p. m., July 29, by Passaic Valley Sewerage Commissioners, Essex Bldg., Newark, N. J., for the construction of the Southerly Portion of Section 6 of the Main Intercepting Sewer, in the city of Newark. Particulars that may enable contractors to judge of the character of the work are given below: Approximate Quantities, Southerly Portion of Section 6, Station 9+00 to Station 26+00: Item 1—Earth excavation and refilling, in trench, for 150-in. sewer, 1,700 lin. ft. Item 2—Concrete masonry, in trench, Portland cement mortar, 5,500 cu. yds. Item 3—Brick masonry, in manholes, laid with Portland cement mortar, and appurtenant work, 100 cu. yds. Item 4—Rock excavation, in trench, 7,000 cu. yds. Drawings, form of contract and specifications, and blank form for proposal may be obtained at the Commissioners' office from William M. Brown, Chief Engineer. John S. Gibson, Clerk.

⊙Peter J. Kennelly, of Secaucus, has been awarded the contract to construct a sewer in the Paterson Plank Road near Hoboken, N. J., at 69 per cent.

⊙Michael Garafaro, of Summit, N. J., has been awarded the contract by the Common Council of Plainfield, N. J., for the construction of sanitary sewers for $7,283. Bids were opened June 16.

New York.

⊙Kellam & Shafer Co., of Schenectady, N. Y., has been awarded the contract at Oneonta, N. Y., for the construction of the trunk sewer.

⊙E. Lifschitz has been awarded the contract by the Village Board of Scotia, N. Y., for the construction of the sewer in Halcyon St., for $6,443.

⊙Leary & Morrison, of Fairport, have been awarded the contract by the Storm Sewer Commission, Watervliet, N. Y., for the completion of the outlet storm drain, for approximately $100,000.

⊙Jas. Johnson & Sons, West New Brighton, N. Y., have been awarded the contract by the president of the borough of Richmond, New York City, for the construction of temporary sewer in Sewerage District No. 3-C in Ward 2. Jos. Wisner Co., Inc., New York City, secured the contract to construct an experimental sewage disposal plant at West New Brighton for $2,974. Bids were opened June 17.

Village Clerk J. A. Striker, Mt. Morris, N. Y., will sell bonds June 23 to the amount of $45,000 for sewerage improvements.

State Chief Sanitary Engineer Theodore Horton, Albany, N. Y., has recommended that the village of Clyde employ an engineer to prepare plans for a complete sewer system and a disposal plant.

The citizens of Herkimer, N. Y., have voted an appropriation to extend the sewerage system of the village.

An ordinance for the employment of an engineering expert to supervise the construction of the sewage disposal plant and interception sewers for Schenectady, N. Y., has been introduced in the City Council.

North Carolina.

City Clerk L. R. Terry of Hamlet, N. C., will sell bonds July 5 to the amount of $30,000

✣ **indicates work now open for bids.** ⊙ **indicates a contract let recently.**

for improvements, as follows: $15,000 for sewerage, $10,000 for graded schools, and $5,000 for streets.

The Board of Aldermen of Charlotte, N. C., has voted an appropriation of $30,000 for additional sewer lines and $1,000 for incidental expenses thereto.

North Dakota.

⊙L. W. Schruth, of Fargo, N. Dak., has been awarded the contract by the City Council of Dickinson, N. Dak., for sewer and water main extensions, for $18,363. Bids were opened June 17 by R. C. Hill, City Auditor.

⊙James Kennedy, of Fargo, N. Dak., has been awarded the contract by the City Commissioners of Minot, N. Dak., to complete the sewer construction on Park Ave. and Roach Ave.

⊙The Northern Construction Co., of Grand Forks, N. Dak., has been awarded the contract by the City Council of that city for about 11 blocks of sewer on Dover and Division Aves., for $7,150.

Ohio.

✣Bids will be received until noon, June 30, by Village Board, Port Clinton, Ohio, for furnishing the necessary labor and materials for the improvement of Jefferson St. from the south side of Sixth St. to the Portage River in Sewer District No. 5 by reconstructing a sewer therein according to the plans and specifications on file in the office of the Clerk of said Village. J. A. Singler is Clerk.

✣Bids will be received until noon, June 27, by Director of Public Service, Marion, O., for the necessary labor and material for constructing a sanitary sewer and cellar drain on Scioto St. from Center to York St. Constructing a combined sanitary sewer and cellar drain beginning in Garfield Park, thence west to Madison Ave., thence south in Madison Ave. to Center St. Also for constructing two public comfort stations, to be located in Garfield Park. Also a sandstone sidewalk on Hane Ave., according to plans and specifications on file in said office.

⊙The J. B. Sheets Co., of Pittsburgh, Pa., has been awarded the contract by the Department of Public Service, Columbus, O., for the construction of the southern relief sewer, for $160,000.

R. Winthrop Pratt, 708 Hippodrome Bldg., Cleveland, O., has been retained by the city of Mt. Vernon, O., to secure data to determine the degree of treatment necessary in connection with the construction of proposed additional sewerage and an intercepting sewer to carry all of the sewage of the city into the Kokosing River. Following action upon the proposition by the State Board of Health, Mr. Pratt will proceed with general plans.

Consulting Engineer R. Winthrop Pratt, Cleveland, O., has been retained by the C. P. & E. Ry. Co. to prepare detailed plans for a sewage treatment plant for Willoughbeach Park, a resort owned by that company on the lake near Cleveland.

General plans for the Duck Creek intercepter have been submitted by V. T. Price, Director of Public Service, Cincinnati, O. The cost is estimated at $300,000. This is the first work on the new sewer system, which will cost approximately $3,000,000.

The City Council of Sandusky, O., has passed a resolution of necessity to construct the South End sewer together with a sewage disposal plant. The city's portion of the expense will be $125,000.

Oklahoma.

No bids were received on June 14 by the city of Enid, Okla., B. F. Lewis, City Engineer, for the construction of a small sanitary sewer system in District No. 57.

The city of Tulsa, Okla., T. C. Hughes, City Engineer, rejected all bids received June 16, for the construction of sanitary sewers in Districts Nos. 86 and 87 of Mitchell-Crosbie addition. The work will be readvertised.

Pennsylvania.

⊙The City Council of Reading, Pa., has awarded the contract for the construction of the storm water sewer on North Sixth St. to Fehr & O'Rourke, for $71,853.

⊙Michael Yashinis has been awarded the contract by the City Council of Hazelton, Pa., for the construction of the proposed sewer on West Broad St., for $3,301.

Citizens of the 10th Ward in Reading, Pa., have petitioned the City Council to construct a sewer in the bed of the Rose Valley Creek.

R. Winthrop, 708 Hippodrome Bldg., Cleveland, O., has been retained to prepare general plans and estimate of cost for a sewage treatment plant for the community of Point View, at Mine No. 5, of the Vesta Coal Co., near Centerville, Pa., where sewage improvements have been ordered by the Pennsylvania State Department of Health. This plant will be of sufficient capacity to provide for 5,000 persons.

The borough of Troy, Pa., plans the installation of a sewerage system at an estimated cost of $15,000. Everett Vandine is interested.

The citizens of Fairview Hill, East Mauch Chunk, Pa., has perfected plans for the construction of a sewer at an estimated cost of from $7,000 to $8,000.

The City Council of Brackenridge, Pa., has called an election July 8 for the purpose of voting on the issuance of bonds to the amount of $56,800 for the installation of a sewerage system and a sewage disposal plant.

The Borough Council of Clifton Heights, Pa., has passed an ordinance for a $50,000 sewer loan, to be voted on by the people.

The Commissioners of Upper Darby Township, Darby, Pa., have adopted an ordinance to increase the bonded indebtedness of the township $25,000. The money is to be used for sewers in Fernwood, Drexel Hill and Highland Park.

The City Council of Quakertown, Pa., plans the installation of a sewerage system.

Texas.

✣Bids will be received until 8 p. m., June 26, by W. H. Brown, City Secretary, Polytechnic, Texas, for furnishing all material and labor and installing complete sewer system of approximately 6,250 ft. 6-in. V. S. P., 6,000 ft. 8-in. V. S. P., 4,350 ft. 10-in. V. S. P., 1,000 12-in. V. S. P., and appurtenances. Each bidder must inclose $1,000 certified check on a Fort Werth bank, payable to city of Polytechnic without condition. Plans and specifications on file at City Hall and at office of Nagel & Peterson, Engineers, Muskogee, Okla.

An election is to be held in San Antonio, Tex., on July 18 for the purpose of voting on the issuance of bonds for municipal improvements, including an issue of $800,000 for sanitary sewers and $300,000 for storm water sewers and drainage.

The City Council of San Antonio, Tex., will submit the proposition to issue bonds in the sum of $3,450,000 for municipal improvements to the citizens next month. Of the amount $800,000 will be used to construct sanitary sewers, $300,000 of storm sewers, $1,500,000 for paving, $25,000 for concrete sidewalks and $375,000 for opening and widening of streets.

The City Council of Texarkana, Tex., has called an election for June 30 to vote on the proposition of issuing bonds to the amount of $60,000 to extend and improve the present city sewer system.

The Board of Municipal Commissioners, Dallas, Tex., has ordered the construction of a 6-in. sanitary sewer in Hubert St. from the block between San Jacinto and Ross to the block between Ross and Lewis, thence west in the center of the block to the Greenville Road.

The City Council of Temple, Tex., has readvertised for new bids for the purchase of $75,000 worth of sewer bonds, to be opened July 8.

Virginia.

The citizens of Vinton, Va., have voted a bond issue of $50,000 for improvements. Of the total amount $17,000 will be expended for sewers, $25,000 for water service and $8,000 for street and sidewalk improvement.

The Administration Board, Richmond, Va., has requested the City Council to appropriate $27,000 for a southside sewer. This sewer, the plans for which have already been prepared, is to run down 14th St. from Maury to McDonough Sts.

Washington.

⊙N. Fiorito Bros. & Sanro have been awarded the contract by the Board of Public Works, of Seattle, Wash., for the construction of sewers in Ashworth Ave. et al., for $5,368.

City Engineer Louis D. Kelsey, of Aberdeen, Wash., has been instructed to make survey, plans and estimates for proposed sewer system for South Aberdeen. This area covers approximately 1,000 acres.

West Virginia.

The Board of Affairs, Bluefield, W. Va., rejected all bids received June 13 for construction of sanitary sewer line from end of present sewer in west end of city west through the town of Graham and to a point on Bluestone River west thereof, a distance of about 6,500 ft.; sewer to be 15 ins. in diameter. The work will be re-advertised.

Wisconsin.

✣Bids will be received until 4 p. m., June 27, by Board of Public Works, Racine, Wis., for furnishing all the material and doing all the work in and about the construction and completion of a pipe sewer in North 19th St., from the center line of Superior Ave. to the center line of Sheridan Ave., in the First Sewer District of the city of Sheboygan, Wis. Approximate quantities, 565 lin. ft. of 10-in. pipe sewer, 3 manholes, according to plans and specifications on file in this office, work to be completed on or before August 15, 1913.

⊙Fred Schultz, Jr., West Bend, Wis., has been awarded the contract by the village of Jackson, Wis., for the construction of sewerage and septic tanks. Bids were opened June 10.

The City Council of Horicon, Wis., has taken steps looking toward the installation of a sewerage system. Arthur M. Morgan, of Chicago, Ill., is Engineer.

The City Council of Tomah, Wis., has passed a resolution providing for the extension of the sewer system from Woodward Ave. along Washington St. to Monroe St., and along Glendale St. to Monroe St. Bids will be asked immediately upon the completion of plans and specifications.

Plans have been prepared for the construction of a sewerage system in South Kaukauna, Wis. Objections will be heard July 7. G. E. Haas is Commissioner.

The city of Lake Geneva, Wis., is to have a sewer system. An ordinance granting the city permission to construct a system has been drawn.

The Wisconsin Senate, Madison, has passed the Weigle bill creating a sewerage commission to construct a disposal plant in Milwaukee at an estimated cost of over $15,000,000.

The Common Council of Beaver Dam, Wis., has instructed the city engineer to prepare specifications for the construction of a sewer on portions of Beaver, Norris and North Center Sts.

No bids were received on June 5 by the Committee on Streets and Sidewalks, Monroe, Wis., for the construction of approximately 435 ft. of sewer on Emerson St. William Dunwiddie is City Clerk.

Canada.

⊙The city of Sault Ste. Marie, Ont., T. E. Simpson, Mayor, has awarded the contracts for furnishing and laying about 18,000 lin. ft. of tile sewer pipe to McNamara & Son, city, for $16,025, and Toney De Pietro, city, for $14,284. Bids were opened June 9.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

BUILDINGS

Arizona.

⊙J. T. Dalton & Sons, Junction City, Kans., has been awarded the contract by John A. Wagner, Constructing Quartermaster, Fort Huachuca, Ariz., for the construction complete, including plumbing, heating, electric wiring, where required, of three double captains' quarters, one troop barrack, one double lavatory, additions to buildings Nos. 19, 20 and 30 installation of sewer extension, for $103,766. Bids were opened May 23.

California.

The congregation of Temple Emanu-El, Rev. Martin A. Meyer, San Francisco, will soon be asked to pass upon tentative plans for a new tabernacle to be built on Van Ness Ave., at a cost of between $750,000 and $1,000,000.

Plans are being prepared for a 10-story reinforced concrete hotel to be erected at Ocean and Pine Aves., Long Beach, by the Oxford Investment Co., at a cost of about $700,000. Kysor & Bigger, Los Angeles, are the Architects.

The U. S. Steel Products Co., New York City, at $476,283, was low bidder for furnishing 7,000 tons of structural steel for a new City Hall for San Francisco. Bids were opened June 13.

District of Columbia.

✣Bids will be received until 2 p. m., June 30, by Secretary of the Interior, Washington, D. C., for furnishing labor and material for the erection of an ash conveyor for the central heating plant for Fredemen's Hospital, Washington, D. C.

Illinois.

Bids as follow were received June 16 by the Supervising Architect, Treasury Department, Washington, D. C., for the construction of the U. S. Postoffice at Rochelle, Ill.; (1) bid on limestone, (2) bid on sandstone: James Corse, Racine, Wis., (1) $52,020, (2) $54,095; George W. Stiles Construction Co., Chicago, Ill., (1) $52,195, (2) $55,600; Barnes Bros., (1) $54,000, (2) $55,900; Geo. W. McAlpine, (1) $54,104, (2) $54,960; Alexander & Dinnie, (1) $56,485, (2) $58,235; Dan Hart, (1) $60,700; Israel Doan & Sons Co., (1) $73,627, (2) $76,267; Skoglund & Wedberg, (1) $74,000, (2) $74,542.

Maine.

✣Bids will be received until 3 p. m., July 31, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for the mechanical equipment (except lighting fixtures, elevator, and lift) of the United States post office, Bangor, Me., in accordance with drawings and specifications, copies of which may be obtaned at the office of the superintendent of construction, Bangor, Me., or at the discretion of the Supervising Architect.

Massachusetts.

✣Bids will be received until 11 a. m., July 12, by H. R. Stanford, Chief of Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., for magazines for smokeless powder at the naval magazine, Hingham, Mass.

Bids as follow were received June 14 by the Bureau Yards and Docks, Navy Department, Washington, D. C., for reconstructing Building 24 at the Navy Yard, Boston, Mass.: C. M. Leach, P. O. Box 2285, Boston, Mass., $61,873; Penn Bridge Co., Washington, D. C., $64,843; Simpson Bros. Corporation, 166 Devonshire St., Boston, Mass., $72,355; Guernsey-O'Meara Co., North American Bldg., Philadelphia, Pa., $72,687; Conners Bros. Co., 157 Plain St., Lowell, Mass., $86,600; Marr Bros. & Stewart Co., 319 Washington St., Boston, Mass., $72,434; Whitton & Haynes Co., 35 Federal St., Boston, Mass., $76,600; Darling-Slade Construction Co., 52 Bridge St., Newport, R. I., $77,000.

Missouri.

✣Bids will be received until 3 p. m., July 18, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for additions and alterations to the mechanical system of mail-handling apparatus in the United States post office, St. Louis, Mo., in accordance with the specifications and drawings enumerated therein, copies of which may be obtained at the office of the custodian at the post office, St. Louis, Mo., at the discretion of the Supervising Architect.

⊙John Costello & Son, 2519 St. Louis Ave., St. Louis, Mo., have been awarded the contract at $62,800 for erecting the new church of the Holy Name Parish at Grand Ave. and Emily St., St. Louis.

Bids as follow were received June 16 by the Supervising Architect, Treasury Department, Washington, D. C., for remodeling U. S. Custom House at St. Louis, Mo.: Daniel Evans Construction Co., 816 Olive St., St. Louis, $70,900; Hiram Lloyd Building & Construction Co., 816 Olive St., St. Louis, $72,317; Mississippi Valley Construction Co., $74,994.

New Jersey.

The Atlantic Construction & Supply Co., of Atlantic City, N. J., at $413,900, was low bidder for the erection of the new municipal electric plant at Camden, N. J. Runyon & Carey, Newark, N. J., are the Architects and Engineers.

A petition is being circulated at Ocean City, N. J., asking the City Commissioners to submit to a vote of the people the proposition to erect a new city hall with furnishings, cost not to exceed $75,000.

The Board of Education of Vineland, N. J., has voted to call a special election June 24 for the purpose of submitting to the voters the proposition of erecting a new high school building for $60,000 and $16,000 for remodeling the present building, or building a $45,000 structure and remodeling the old building.

The Board of Education of Newark, N. J., in its annual budget asks the Board of Estimates to provide $976,000. Of this amount it is proposed to expend $826,000 for buildings during the year and $150,000 for realty.

The Public Service Corp., Thos. N. McCarten, President, Broad and Bank Sts., Newark, N. J., operating street railways and electric companies, is stated to be planning the erection of a $1,000,000 power plant on the Delaware near Burlington.

New York.

✣Bids will be received until 3 p. m., July 11, by Oscar Wenderoth, Supervising Architect, Treasury Department, Washington, D. C., for an electric dumb-waiter in the south wing of the United States Marine Hospital (reconstruction), New York, N. Y. (Stapleton, S. I.), in accordance with the specification, copies of which may be obtained at the discretion of the Supervising Architect.

The Knickerbocker Club, Frank E. Polk, Secretary, 5th Ave. and 32nd St., New York City, has purchased a site at 5th Ave. and 62nd St., on which to erect a new 6-story club house.

North Carolina.

✣Bids will be received until 2 p. m., July 11, by Commissioner of Indian Affairs, Washington, D. C., for labor and material for the construction of a frame quarters and brick laundry at the Cherokee Indian School, N. C.

⊙J. A. Jones, Charlotte, N. C., has been awarded a contract at about $90,000 for the erection of a city hospital for the City Hospital Commission of Winston, N. C.

Ohio.

⊙James Black Construction Co., Wright Bldg., St. Louis, Mo., has been awarded the general contract for constructing department store building at Cleveland for the May Co. About 9,000 tons of steel will be required.

⊙The National Concrete Fireproofing Co., Cleveland, O., has been awarded the general contract for machine shop, equipment and tools at the Lima State Hospital, Lima, O.

Oregon.

Plans are being prepared for several buildings for the Oregon Agricultural College at Corvallis, Ore. One of these will be a 3-story brick and mill construction to cost $50,000. The art, science and administration buildings will be constructed later at a cost of $175,000. A 261-159 gymnasium will be erected at a cost of $160,000, but only one wing of which will be built at this time at a cost of $60,000. Bennet & Hendricks, Henry Bldg., Portland, Ore., are the Architects.

Pennsylvania.

✣Bids will be received until 10:30 a. m., June 26 by Department of Charities, Dr. E. R. Walters, Director, at the office of the City Controller, Pittsburgh, Pa., for the erection of an additional wing to the present Male Hospital, plumbing, steam heating and electric wiring of same, for the erection of a bakery building, plumbing, steam heating and electric wiring of same, for the remodeling of the plumbing system in the Male Asylum building; all at the City Home and Hospital, Marshalsea Station, on P. C. C. & St. L. Ry.

Bids will soon be asked by the officials of the University of Pittsburgh, through Architect James H. Geisey of the Mellen National Bank Bldg., Pittsburgh, Pa., for the construction of the Mellen Institute of Industrial Research of the university at Pittsburgh. Ancient Greek lines of architecture are carried by the proposed structure, with an exterior of granite, terra cotta and colored brick. The main entrance to the Institute will be in Thackeray avenue, Schenley Farms district, where the present group of buildings for the University are located. The terrace is to be cut away and the sidewalk extended to the front door of the building, thereby doing away with steps. The main entrance is to be ornamented with huge columns and arched ceilings, with wide stairways leading to the upper floors. In the basement of the building will be electrical furnaces, machine shops, boiler rooms and scale apparatus. The most up-to-date smoke consuming devices will be installed. All of the offices are to be on the ground floor, as will be the lecture room, which will have a seating capacity of about 400.

Common Council of Reading, Pa., has passed an ordinance giving the citizens the right to vote at November election on a proposed loan of $500,000 for the erection of a new city hall.

Utah.

⊙The Consolidated Stone Co.'s of Utah, Salt Lake City, has been awarded a $600,000 contract for furnishing granite for the exterior of the new State Capitol building. The stone will be obtained from quarries in Little Cottonwood Canyon.

Virginia.

Sketches for the proposed city hall for Roanoke, Va., will be received until noon, June 28, by F. L. Gibboney, City Engineer, from whom further information can be obtained. All sketches must be submitted without cost to city. The estimated cost of the building is $250,000.

Canada.

⊙Luney Bros., Victoria, B. C., have been awarded the contract at about $307,000 for constructing a Normal School building for the Department of Public Works of British Columbia.

Plans have been completed for a theater building to be erected on Douglas Ct., Victoria, B. C., at a cost of about $125,000. Building is to be of steel, brick and concrete, 60x 120 ft. in size. J. J. Donnellen, 319 Pender St. W., Vancouver, B. C., is the Architect.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

RIVERS AND HARBORS

California.

✣Bids will be received until 11 a. m., July 26, by Bureau of Yards & Docks, U. S. Navy Department, Washington, D. C., for dredging channel and basin in Mare Island Strait and removing rocks at Vallejo, Calif. H. R. Stanford is Chief of the Bureau.

Connecticut.

✣Bids will be received until 2 p. m., June 30, by Maj. G. B. Pillsbury, U. S. Engineer, New London, Conn., for dredging in Greenwich Harbor, Conn.

✣Bids will be received until 2 p. m., July 5, by Maj. G. B. Pillsbury, U. S. Engineer, New London, Conn., for dredging in Housatonic River, Conn.

District of Columbia.

✣Bids will be received until 10:30 a. m., July 19, by Maj. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for the purchase of scrap copper screens.

✣Bids will be received until 2 p. m., July 11, by Maj. W. J. Barden, U. S. Engineer, Washington Barracks, D. C., for furnishing 3 motor driven two-stage air compressors.

✣Bids will be received until 10:30 a. m., July 9, by Maj. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under Canal Circular 781, electric lamps, motor boats, switch stands, tin plates, track bolts, track spikes, galvanized roofing, horseshoes, washers, stovepipe, iron and steel pipe, pipe fittings, lead pipe, bibbs, cleanouts, valves, chisels, cable clips, cotters, wrenches, twist drills, hammers, tacks, files, tallow pots, hand oilers, padlocks, galvanized buckets, water coolers, coal baskets, brooms, scrub brushes, paint brushes, steel tapes, hose, packing, gaskets, canvas tarpaulins, railway flags emery cloth, mop heads, oakum, twine, lime, calcium carbide, sulphate of copper, muriatic acid, drop black paint, sienna, spar varnish, aluminum paint and mahogany lumber.

The Lincoln Memorial Commission has approved the detailed plans of the architect for the building to be erected at Washington and certified them to the Secretary of War, for the latter to have specifications drawn and to advertise for bids for construction. Henry Bacon, 160 Fifth Ave., New York City, is the Architect.

Louisiana.

Bids as follows were received June 11 by the U. S. Engineer, Vicksburg, Miss., for furnishing and delivering about 8,000 bbls. in sacks, of American Portland cement at Riverton, La., (1) brand, (2) price per barrel in sacks, (3) deduction for empty sacks returned, (4) total: F. R. Bissell, trustee for bondholders of the Iola Portland Cement Co., 815 Commerce Bldg., Kansas City, Mo., (1) Iola; (2) $2.24; (3) 9½ cts.; (4) $14,880. The Kansas Cement & Material Co., Waldheim Bldg., Kansas City, Mo., (1) Sunflower; (2) $2.32; (3) 10 cts.; (4) $15,360. The Atlas Portland Cement Co., Chicago, Ill., (1) Atlas; (2) $2.34, a. $2.40; (3) not stated. Perry Grain & Cement Co., Vicksburg, Miss., (1) Coosa; (2) $2.40; (3) 10 cts.; (4) $16,000. The Atlas Portland Cement Co., 30 Broad St., New York, N. Y., (1) Atlas; (2) $2.40; (3) 10 cts.; (4) $16,000.

Maryland.

The Ellicott Machine Corporation, Baltimore, Md., was the only bidder for the construction of a dredge to be named Monguas, bids for which were opened at Wilmington, Del., by Major Raymond, U. S. Engineer. The Ellicott Co.'s bid was $149,700, delivered at Wilmington, Del. The dredge is for Delaware River use by the United States Engineers.

Massachusetts.

Bids as follows were received June 7 by Col. Frederick V. Abbot, U. S. Engineer, Boston, Mass., for rock excavation in Mystic River, Mass.: Great Lakes Dredge & Dock Co., Boston, Mass., $28.70 per cu. yd. place measurement; Eastern Dredging Co., Boston, Mass., $17.80; Johnston & Virden, Lewes, Del., $22.50.

The Directors of the Port of Boston, Boston, Mass., are planning to acquire the old Eastern R. R. property at East Boston for the construction of a modern dock and railway terminal. If the plans go through the Port Directors intend to demolish the old pier and sheds and replace them with two modern piers of 900 or 1,000 ft. in length inclosing a dock capable of accommodating two large steamers. The railroads will have direct connection with the piers and there will be all the facilities for a modern terminal.

Minnesota.

Bids as follows were received June 13 by Capt. E. D. Peek, U. S. Engineer, Duluth, Minn., for dredging in Duluth-Superior Harbor, (1) bid per cu. yd. on 925,000 cu. yds., new measurement, (2) totals: Northern Dredge & Dock Co., Duluth, Minn., (1) 8½ cts., (2) $78,625; Duluth-Superior Dredging Co., Duluth, Minn., (1) 7.9 cts., (2) $73,075; Great Lakes Dredge & Dock Co., Chicago, Ill., (1) 9 cts.; (2) $83,250; Byrne Bros. Dredging & Engineering Co., Chicago, (1) 15½ cts., (2) $143,375; Zenith Dredge Co., Duluth, Minn., (1) 8½ cts., (2) $78,625. Recommended for acceptance.

Mississippi.

⊙The Mississippi Levee District, W. J. Shackleford, Chief Engineer, Greenville, Miss., has awarded contracts as follows for the levee work, bids on which were opened June 17: Lake Vermillion enlargement—100,000 yds. at lower end, to C. C. Aderholdt, Benoit, Miss., at 35 cts. per cu. yd.; Bolivar enlargement, stations 2550 to 2670—to W. T. and E. M. Lowrance & Co., Luna Landing, Ark., at 40 cts., estimated 170,000 yds.; Catfish Point enlargement, stations 2913 to 2992—estimate 110,000 yds., to S. R. Hughes & Co., Vicksburg, Miss., at 36 cts. per cu. yd.; Miller's Bend enlargement, stations 3680 to 3810—estimated 200,000 yds., to John R. Scott, St. Louis, at 40 cts. per cu. yd.; Straight Stretch enlargement, stations 3810 to 3916—estimated 180,000 yds., to John R. Scott, at 40 cts. per cu. yd.; Carson and Goose Lake enlargement, stations 3916 to 4030—estimated 145,000 yds., to John R. Scott, at 36 cts. per cu. yd.; Stations 4030 to 4100—estimated 70,000 yds., to John R. Scott, at 33 cts. per cu. yd.; Carson banquette, stations 3916 to 3972—to John R. Scott, estimated 30,000 yds., at 24 cts. per cu. yds.; Barnes' Landing enlargement, stations 4100 to 4170—to John R. Scott, at 29 cts. per cu. yd.; New Skinner levee, sections 1 and 2, and moving sand, stations 80 to 162—to Leonard, Jennings & Clark, Memphis, Tenn., estimated 528,000 yds., at 30 cts. per cu. yd.; New Warfield levee, sections 1 and 2, stations 292 to 355—estimated 160,000 yds., to Swain & Richards, at 24½ cts. per cu. yd.; Miller's Bend banquette—75,000 yds., to John R. Scott. All the work advertised except the Huntington short line dike, part of Vermilion Lake enlargement, the Eutaw enlargement and the small levee from Brunswick to Eagle Bend, was let.

New Jersey.

✣Bids will be received until noon, July 19, by Col. Frederic V. Abbot, U. S. Engineer, 39 Whitehall st., New York City, for dredging in Raritan River, N. J. The work consists of making a couth channel between the Stakes and Crabs Island in order to provide a depth of 5½ ft. at mean low water. The estimated quantity is 60,000 cu. yds. of mud and sand. The amount available for payment of contractor's estimate is about $9,000.

Ohio.

Great Lakes Dredge & Dock Co., Monroe Bldg., Chicago, Ill., at 8.95 cts. per cu. yd. was low bidder June 12 for dredging in Toledo Harbor, bids for which were opened June 12 by Maj. Chas. S. Brownwell, U. S. Engineer. About $94,500 will be expended for contractor's estimates.

Oregon.

The Port Commission of Portland, G. B. Hegardt, Engineer, Portland, Ore., will probably be ready about June 30 to call for bids for the construction of Dock No. 1.

Pennsylvania.

✣Bids will be received until noon, July 14, by Lieut. Col. Joseph E. Kuhn, U. S. Engineer, Philadelphia, Pa., for furnishing and placing about 15,000 tons of riprap stone in dike and revetment at Reedy Island, Delaware River, about 40 miles below Philadelphia.

✣Bids will be received until 11 a. m., July 12, by Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., for dredging at the U. S. Navy Yard, Philadelphia, Pa. About $40,000 is available for the work. H. R. Stanford is Chief of the Bureau.

Rhode Island.

✣Bids will be received until 11 a. m., June 28, by Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., for ferry landing and dredging at the naval training station, Newport, R. I. The cost of dredging will amount to about $1,800, while the ferry landing will be about $4,300. H. R. Stanford is Chief of the Bureau.

South Carolina.

✣Bids will be received until 11 a. m., July 31, by Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., for reinforced concrete wharves, etc., at the Charleston, S. C., navy yard. About $290,000 is available for the work. H. R. Stanford is Chief of the Bureau.

Tennessee.

✣Bids will be received until noon, July 10, by Maj. E. M. Markham, U. S. Engineer, Custom House, Memphis, Tenn., for furnishing about 623,000 ft. b. m. of yellow pine lumber, etc.

Texas.

✣Bids will be received until noon, July 16, by Maj. T. H. Jackson, U. S. Engineer, Dallas, Tex., for jetty work at Sabine Pass, Texas.

Washington.

✣Bids will be received until 11 a. m., July 12, by Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., for furnishing and installing one air compressor having at least 5,300 cu. ft. of free air per minute displacement, complete, with accessories at the navy yard, Puget Sound. The estimated cost is $35,000. H. R. Stanford is Chief of the Bureau.

West Virginia.

✣Bids will be received until 11 a. m. (eastern time), July 23, by Maj. F. W. Altstaetter, U. S. Engineer, Wheeling, W. Va., for constructing lock and dam No. 17. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 11 a. m. (eastern time), July 23, by Maj. F. W. Altstaetter, U. S. Engineer, Wheeling, W. Va., for the construction of Lock and Dam No. 16, Ohio River. Official advertisement will be found elsewhere in this issue.

Canada.

Bids will be asked shortly by the Department of Railways and Canals, L. K. Jones, Secretary, Ottawa, Ont., for the beginning of work on the northern section of the Trent Valley Canal from Lake Sincoe to Georgian Bay, via the Severn River.

CALLS FOR BIDS

Rate, $2.40 an inch, single column. **Copy received until Monday noon.**

REINFORCED CONCRETE BRIDGE.

Sealed proposals will be received by the Board of Improvement, Bridge Improvement District No. 1, Newport, Ark., at their office, until 2 o'clock p. m., Monday, June 30, 1913, for the construction of one reinforced concrete bridge 42 feet wide and 200 feet long, together with approaches thereto.

Plans and specifications may be seen at the office of the Chairman of the Board at Newport, Ark., or obtained from Wm. J. Parks, Engineer, at the Citizens' Bank Bldg., Pine Bluff, Ark., upon the deposit of $10, which will be refunded upon the return of such plans and specifications.

The right is reserved to reject any or all bids or to let the bridge and the approaches separately or the entire contract to one party.

All proposals must be accompanied by a certified check for $1,000.

W. D. McLAIN,
Chairman, Bridge Improvement District No. 1, Newport, Ark.

WATER MAINS.

Proposals will be received by the Board of Public Works of the City of Big Rapids, Michigan, at the office of the City Clerk, Barney Laser, Esq., until 5:00 p. m., Monday, July 7th, 1913, for delivering, trenching, laying with gates, hydrants and specials appurtenant thereto and backfilling of approximately:

4,750 linear feet 12-inch,
1,425 linear feet 10-inch,

cast iron water mains, all in the City of Big Rapids, Michigan.

The right is especially reserved by the city to reject any or all proposals, and accept only such as appears to the best interest of the city.

Plans and specifications may be seen at the office of the City Clerk at Big Rapids, or at the office of Gardner S. Williams, Consulting Engineer, Ann Arbor, Michigan, and will be furnished upon the deposit of a certified check in the amount of $2.00, which will be refunded upon the return of the plans and specifications in good condition.

BOARD OF PUBLIC WORKS,
By H. J. Ward, President.

PAVING, CURBING, ETC.

Grenada, Miss.

Sealed proposals will be received by the City of Grenada, Miss., at the City Recorder's office until July 8, 1913, for the following approximate items:

14,000 sq. yds. street paving with vitrified brick, wood block, concrete and bitulithic.

4,000 lin. ft. concrete curb.

All necessary grading, water and sewer connections.

Proposals to be made on blanks furnished by the City Recorder and to be accompanied by certified check for $1,500. Specifications and forms may be obtained from City Recorder. The Board of Mayor and Aldermen reserve the right to reject any or all bids.

L. B. JAMES,
City Recorder.

WATER PURIFICATION WORKS.

Sealed proposals will be received at the office of the Director of Public Service, Painesville, Ohio, until 12 o'clock noon of the 8th day of July, 1913, and then publicly opened and read, for the construction of Water Purification Works of three million gallons daily capacity, together with Pumping Station, this being Contract No. 2 of the Improvement of Public Water Supply.

The work to be done includes the construction of concrete basins, buildings, piping, pumps, boilers, stack, tanks and filter appurtenances.

Bids are to be based upon the plans prepared under the direction of the Department of Public Service; bids will be made upon the work as a whole as well as upon the several different classes of work, it being understood that the concrete building work, the piping, the filter appurtenances, and the pumps and mechanical equipment may be let separately.

Payment will be made as stipulated in the form of contract for the performance of the above work, which form of contract is on file in the office of the Director of Public Service.

Copies of the Plans, Proposal forms, Specifications and form of Bonds and Contract, can be seen at the office of the Director of Public Service, City Hall, Painesvile, Ohio, or at the office of the consulting engineer, R. Winthrop Pratt, 708 Hippodrome Bldg., Cleveland, Ohio, or may be obtained by prospective bidders upon depositing Fifty Dollars ($50.00), which sum will be refunded on return of plans and specifications on or before the 10th day of July, 1913. Copies of the specifications will be furnished by the Consulting Engineer on payment of Two Dollars, ($2.00) for each copy. The cost of the Specifications used in bidding will be returned to the bidders.

Each proposal shall contain the full name of every person, firm or corporation interested in the same, and shall be accompanied by a certified check for ten per cent (10%) of the amount of proposal or by a bond with surety or sureties satisfactory to the Director of Public Service, for the same amount.

Said Bond or Certified Check is required as a guarantee that if the bid is accepted a contract will be entered into and the performance of it properly secured.

The contract bond will be fifty per cent (50%) of the amount of the contract.

Labor and material must be separately stated in bid with the price thereof.

Bidders must furnish satisfactory evidence of their experience and ability to construct work of the character required.

Bidders must use prepared formal proposal forms, as none other will be received.

The right to reject any or all bids is reserved. Informalities may be waived at the option of the Director of Public Service.

Department of Public Service,
By the Director,
S. A. Haskel.

NOTICE TO DREDGING AND DIVING CONTRACTORS.

PASSAIC VALLEY SEWERAGE COMMISSIONERS.

Notice is hereby given that the Passaic Valley Sewerage Commissioners have designated Tuesday, the 15th day of July, 1913, at 2 o'clock in the afternoon, as the time when they will meet at their usual place of meeting, Essex Building, Clinton street, Newark, N. J., to receive proposals, in writing, for constructing Section 1 of the Passaic Valley Sewer in New York Bay, off Robbins Reef, in New Jersey.

Particulars that may enable contractors to judge of the character of the work are given below:

QUANTITIES.

All bids will be compared on the basis of the engineer's estimate quantities of work to be done.

Item 1—	
Furnishing and placing, in trenches dredged below the bed of New York Bay, two lines of 96-inch reinforced concrete pipes...lin. ft.	3,000
Item 2—	
Furnishing and placing, in trenches dredged below the bed of New York Bay, reinforced concrete pipes, with horizontal and vertical branches, having dimeters ranging from 24 to 96 inches.... ....lin. ft.	1,500
Item 3—	
Furnishing and placing rip-rap of ½ to 3-ton stones, in trenches for 24 to 96-inch reinforced concrete pipes and branches.....tons	30,000
Item 4—	
Rock excavation, in dredged trenches..................cu. yds.	100

Drawings, form of contract and specifications, and blank form for proposal may be obtained at the Commissioners' Office from William M. Brown, Chief Engineer.

The Commissioners reserve the right to reject any or all bids.

PASSAIC VALLEY SEWERAGE COMMISSIONERS.
JOHN S. GIBSON, Clerk.
May 6, 1913.

TILE BRANCHES.

Sealed bids for labor and material necessary for the construction of tile branches known as Sections 8, 9, 16, 17, 18, 19, 20, 21 and 22 of Drain 96 will be received at the office of the Auditor of Webster County at Ft. Dodge, Ia., up to the hour of 10 a. m., June 28, 1913. All tile and labor must comply with standard specifications on file in the County Auditor's office at Ft. Dodge, Ia. Total estimated cost of labor and material, $38,143.20.

Dated June 12, 1913.

J. L. HANRAHAN,
County Auditor.

U. S. ENGINEER OFFICE, CHICAGO, ILL., May 28, 1913.—Sealed proposals for constructing timber-concrete dock in North Branch Turning Basin, Chicago River, Ill., will be received here until 10 a. m., June 28, 1913. Information on application. Geo. A. Zinn, Lieut.-Colonel Engineers.

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